IUPAP Report 41

Research Facilities in Nuclear Physics

A worldwide overview of research facilities in nuclear physics
prepared by Working Group WG.9 of the
International Union of Pure and Applied Physics (IUPAP)

Preface

At its 2003 Annual General Meeting, Commission C12 of the International Union of Pure and Applied Physics (IUPAP) made a formal decision to establish an ad-hoc Committee on International Cooperation in Nuclear Physics (CICNP). The membership of CICNP included the Chair and Vice-Chair of C12, as well as the Chairs of NSAC and NuPECC and representatives of key laboratories world-wide. Considerable care was also paid to the geographic distribution of members, in order to ensure appropriate representation from the whole nuclear physics community.

The formation of this committee had been a topic of discussion within C12 since 1995 and perhaps even earlier. It was created to facilitate international cooperation within the nuclear physics community following the recommendations of the various committees that preceded it. The objectives of CICNP were:

- To promote international cooperation in the broadest sense with the construction and exploitation of the large nuclear physics facilities - those which are intended for use by a worldwide nuclear physics community.
- To organize meetings on a regular basis, which are open to all wishing to attend, for the exchange of information on future plans for new nuclear physics facilities, be it very large multi-disciplinary facilities or facilities intended to more regional use.
- To stimulate the organization of workshops and/or symposia to discuss the future of nuclear physics and the need for facilities for the various subfields: high energy heavy-ion beam facilities, radioactive-ion beam facilities, multipurpose hadron beam facilities, high energy electron beam facilities.
- It was also recognized that there was a need to discuss facilities which are clearly cross-disciplinary, like underground laboratories for particle, nuclear, and nuclear-astrophysics.

In accomplishing these objectives the committee was to document facilities under construction or being planned in terms of their anticipated performance parameters; to assess these anticipated performance parameters with regard to the requirements of the field; to evaluate the different facilities in terms of their complementarities and to indicate the areas of the field not covered but identified in the current science planning documents, like the NSAC Long Range Plan, the NuPECC Long Range Plan, and similar documents; and to recommend on the need for additional new facilities and for the expeditious use of the current facilities. The first Chair of CICNP, appointed by C12, was Anthony W. Thomas.

The creation of this ad-hoc committee was also presented at the IUPAP Council and Chairs Meeting in October, 2003. The IUPAP headquarters welcomed this proposal and suggested that it might become an official Working Group of IUPAP. This led to a formal proposal to that effect, which was approved at the October 2005 General Assembly in South Africa. The new IUPAP Working Group, WG.9, has the following Mandate (**http://www.iupap.org/wg/):**

1) provide a description of the landscape of key issues in Nuclear Physics research for the next 10 to 20 years
2) produce (maintain) a compendium of facilities existing or under development worldwide
3) establish a mapping of these facilities onto the scientific questions identified above
4) identify missing components that would have to be developed to provide an optimized, comprehensive network of international facilities
5) explore mechanisms and opportunities for enhancing international collaboration in nuclear science
6) identify R/D projects that could benefit from international joint effort
7) serve as a source of expert advice for governmental or inter-governmental organizations in connection with efforts to coordinate and promote nuclear science at the international level
8) serve as a forum for the discussion of future directions of nuclear science in the broadest sense
9) document the cross disciplinary impact of Nuclear Physics and of nuclear facilities and identify mechanisms for expanding (fostering) cross disciplinary research

This booklet is the result of the first task which WG.9 has set itself. It is a compendium of those basic nuclear physics facilities world-wide which are considered genuine user facilities by management. As far as it has been possible the information is complete and accurate. However, the very nature of IUPAP means that participation is purely voluntary and in the case of a very small number of countries we have been unable to obtain information. In addition, apart from personal knowledge of the members of the committee it has been necessary to rely on the information provided by the facilities themselves.

In spite of the obvious difficulties this is probably the most comprehensive summary of the research facilities available to the international nuclear physics community that has been compiled. It has been supplemented by a brief outline of how these facilities relate to what the committee feels are the major questions facing us in key areas of nuclear science. We very much hope that the nuclear community will find this a useful resource and it will be widely distributed as well as made available on the world-wide web.

Anthony W. Thomas
Chair WG.9

IUPAP Working Group on International Cooperation in Nuclear Physics – Current Membership

- A. W. Thomas (Jefferson Lab, USA) Chair
- W. T. H. van Oers (Manitoba, Canada) Secretary
- S. H. Aronson (BNL, USA)
- R. F. Casten (Yale, USA) NSAC Past-Chair
- B. Fulton (York, Great Britain) NuPECC Chair
- S. Gales (GANIL, France)
- M. N. Harakeh (Groningen, The Netherlands) NuPECC Past-Chair
- W. F. Henning (GSI, Germany) Chair of C12
- A. Lepine-Szily (Universidade de Sao Paulo, Brazil)
- V. A. Matveev (Institute for Nuclear Research of Russian Academy of Sciences, Moscow, Russia)
- T. Motobayashi (RIKEN, Japan)
- S. Nagamiya (J-PARC, Japan) Past-Chair of C12
- J.-M. Poutissou (TRIUMF, Canada)
- R. Tribble (Texas A&M, USA) NSAC Chair
- Wenlong Zhan (Lanzhou, China)

Acknowledgement

This report is the culmination of an enormous amount of work by many people. I would like to thank all of the laboratory representatives who responded to us and helped to ensure the accuracy of the entries. It is also appropriate to acknowledge the efforts of all those members of WG.9 and C12 who worked hard to solicit information, contribute to the overview sections and provide quality assurance on the final document.

I would like to particularly thank Walter Henning and Wim van Oers for their tireless efforts to produce a high quality report on schedule. I also would like to thank Gabriele-Elisabeth Körner for her help with obtaining some of the laboratory information in this report. It is a pleasure to acknowledge the enormous amount of work that Susan Brown devoted to the preparation and the presentation of this document.

On behalf of the community I would also like to express appreciation to IUPAP for their support (including a financial contribution to printing costs) of this project.

Anthony W. Thomas
Chair WG.9
Jefferson Lab

Table of Contents

Executive Summary

Nuclear physics is driven by fundamental investigations of the origin, evolution, structure and phases of strongly interacting nuclear matter. This is a challenging mandate that requires a balanced program of experimental and theoretical effort to address a series of key questions which carry to the larger scientific community. There is broad international consensus on these more important questions as these are given in nearly identical formulations in both the Nuclear Science Advisory Committee (NSAC) report in 2002 and in the Nuclear Physics European Collaboration Committee (NuPECC) report in 2004. The five key questions and the major facilities where these questions can be answered are:

1) Can the structure and interactions of hadrons be understood in terms of QCD?

Nucleons are composite particles made up of quarks and gluons. There exists to date partial answers on how the quarks are distributed and move within the nucleon and the 2004 Nobel Prize in Physics was awarded for the discovery of asymptotic freedom within the context of perturbative Quantum Chromodynamics (QCD). However, QCD is unsolved in the confinement regime where the quark coupling strength is too large to permit perturbative methods to be used. One of the central problems in nuclear physics remains the connection of the observed properties of the hadrons to the underlying theoretical framework of QCD. The solution requires advances both in theory and experiment. In a few specific cases, where chiral coefficients are well known, recent advances in lattice QCD, in combination with chiral perturbation theory, have allowed one to extrapolate full lattice simulations to physical quark masses, thus enabling a direct comparison with experimental observables. The objectives are:

- a tomographic view of the quarks and gluons and their motion within the nucleon.
- a detailed understanding of how QCD gives rise to the properties of the lighter hadrons; and how these properties are modified when they are placed in a nuclear environment.
- Experiments designed to make detailed comparisons with QCD predictions are high-priority endeavors for research at facilities across the USA, Japan, and Europe. In particular, J-PARC of KEK and JAEA, FAIR at GSI and the 12 GeV upgrade at Jefferson Lab, which will operate in the near term, were all designed (to varying degrees) to address this question in detail.

In addition one should mention the important program of study using colliding polarized protons on polarized protons at RHIC, the current program at Jefferson Lab and the plans under development at Jefferson Lab and RHIC to extend the earlier work at DESY, namely the study of the structure of the sea of the nucleon. Jefferson Lab and RHIC, as well as possibly CERN, are developing plans to extend these studies to the structure of the sea of atomic nuclei.

2) What is the structure of nuclear matter?

The original and central role of nuclear physics is to understand the properties of nuclei and nuclear matter. This is a formidable task, which, at least at the present time, seems better approached in steps: from the basic equations of QCD through effective field theories to nucleon-nucleon interactions, few-body systems and very-light nuclei; and further on to the many approaches used to describe nuclear structure, ranging from methods such as Green's Function Monte Carlo (GFMC) to the shell model and density functional theory. While calculations based on "realistic" nucleon-nucleon interactions, supplemented with three-body forces, have achieved quantitative success in reproducing the features of light nuclei, detailed agreement is still lacking for heavier nuclei. This is a problem not restricted to the description of heavy nuclei but is common to the description of other complex systems, such as proteins.

The development of a comprehensive, predictive theory of complex nuclei is a key goal for nuclear physics. Worldwide this has driven the development of high-quality and multi-faceted radioactive beams, as these allow one to move from a one-dimensional picture, where the mass of the nucleus varies, to a two-dimensional picture where both proton and neutron numbers vary over a wide range. Rare isotope beams are obtained either through the well known ISOL process or through in flight fragmentation. There exists at present a plethora of small and large facilities of both kinds, the larger ones being NSCL at Michigan State University, ISOLDE at CERN, ISAC (I and II) at TRIUMF, and SPIRAL1@GANIL in Caen, France. The near-future facilities are RIKEN in Japan, SPES in Italy, GSI-FAIR in Germany and SPIRAL2@GANIL in France. Still in the planning stage are EURISOL in Europe and the Rare Isotope Beam Facility in the USA. These facilities are also engaged in studying current nuclear structure problems. The quest for the super-heavy elements is an ongoing effort at JINR in Dubna, GSI in Darmstadt, and RIKEN in Saitama.

3) What are the phases of nuclear matter?

Nuclei are an important manifestation of nuclear matter, since they make up 99.9% of the visible matter in the universe. But it is somewhat humbling to realize the preponderance in the universe of dark matter and dark energy. At the highest densities, yet at still rather low temperatures, the quarks making up the nucleons of nuclear matter may form a new state of nuclear matter, which is color superconducting. As the density rises (but before quark matter of any kind can form) one may also find a large fraction of the matter present is strange and one cannot yet exclude the possibility of kaon condensation. Nuclear matter can also be heated by absorbing energy in a relativistic collision. In this case 'nuclear temperatures' can reach values that represent the state of matter that existed during the first moments after the big bang. The quest for the so-called quark-gluon plasma (or phase transitions in hadronic matter) is an active field of study at international facilities such as GSI in Germany, the LHC at CERN (ALICE experiment), and RHIC in the USA.

4) What is the role of nuclei in shaping the evolution of the universe?

Primordial nucleosynthesis, nucleosynthesis that occurred during the cooling immediately following the big bang, gave rise to the primordial abundances of H, He, and Li. All other chemical elements in the universe were produced as a result of the nuclear reactions occurring in stars, during supernovae explosions, novae, neutron star mergers, etc. It is another central objective of nuclear physics to explain the origin and abundances of matter in the universe, while nuclear astrophysics must address the many fundamental questions involving nuclear physics issues that remain. The latter include: the origin of the elements; the mechanism of core-collapse in supernovae; the structure and cooling of neutron stars and the presence of strange matter; the origin, acceleration, and interactions of the highest energy cosmic rays; and the nature of galactic and extragalactic gamma-ray sources. Nuclear astrophysics has benefited enormously from progress in astronomical observation and modeling. A new era in nuclear astrophysics has opened up with the advent of rare ion beam facilities dedicated to the measurement of nuclear reactions involving short-lived nuclides of particular relevance to astrophysics. These include measurements of the various nuclear capture processes and the determination of masses, half-lives, and structures of rare nuclei that occur in cataclysmic stellar environments. Most of the rare isotope facilities (mentioned above) have or will have extensive research programs in nuclear astrophysics.

5) What physics is there beyond the Standard Model?

The forces and interactions that were in play in the early stages of the universe have shaped the cosmos as it is known today. Nuclear physicists have long studied the fundamental symmetries of the weak interaction, and probed the Standard Model with precision, low- and intermediate-energy experiments. While the Standard Model has proven remarkably resilient to these tests, there are a few indications of physics beyond the Standard Model. If the breakdown of the Standard Model is confirmed, this could constitute the first indication of super-symmetry, which offers a possible explanation of the dark matter of the universe. A new generation of experiments, designed to push the limits of discovery and precision, can be grouped as follows:

i. The universe has an obvious imbalance between matter and antimatter which the Standard Model is unable to explain. An essential ingredient in the possible solution of this enigma is the presence of new interactions which violate time-reversal-invariance (TRI) and charge conjugation/parity inversion (CP) (if one assumes CPT invariance). There is today a great deal of activity probing for a signal of TRI violation in the properties of mesons, neutrons, and atoms.

ii. Another key question is the nature of the "superweak" forces which disappeared from view when the universe cooled. The Standard Model, as stated above, is one of the better tested theories in physics, but still it is considered to be incomplete. Both nuclear and particle physics experiments are continually searching for indications of additional forces that were present in the initial moments after the big bang. High-energy experiments will probe the TeV scale directly, but high precision experiments at lower energies probe mass scales and parameter spaces not accessible at the high-energy accelerator facilities. Any deviation from the Standard Model discovered at the LHC, for instance, must be reflected in a corresponding rare interaction at lower energy. Jefferson Lab is a prime laboratory for such studies of probing the limits of validity of the Standard Model and of the physics beyond. Other approaches followed are atomic parity violation measurements for which trapping experiments at the rare isotope facilities are essential.

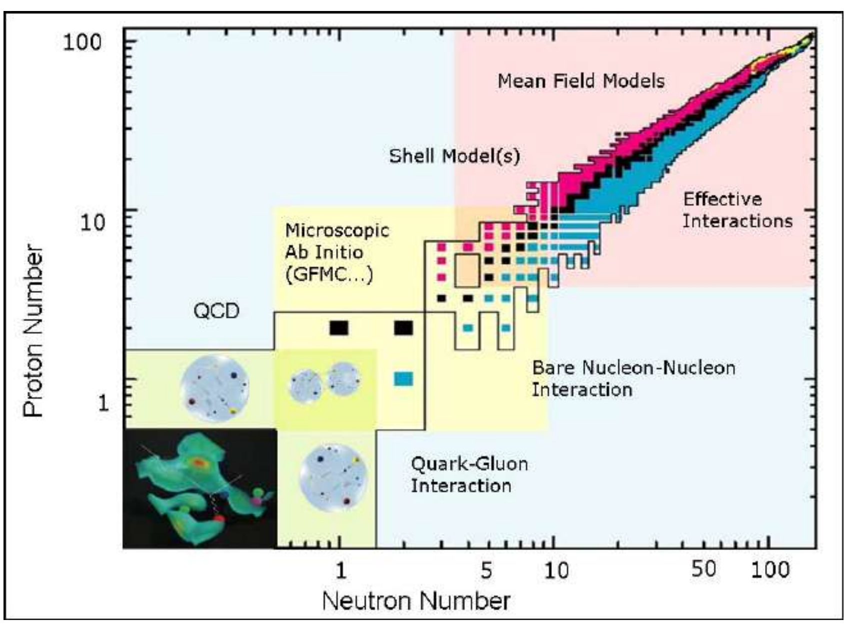
iii. Finally, the resolution of the solar and atmospheric neutrino puzzles by SNO and Super-Kamiokande has opened up the possibilities for exciting discoveries in the neutrino sector, like CP violation. A key question is the nature of the identified neutrino oscillations (long baseline neutrino experiments, e.g. T2K). In this context one can contemplate the possibility of a neutrino factory. The observation of neutrinoless double beta decay would revolutionize the understanding of lepton number in the Standard Model and would determine the mass scale of the neutrino. Clearly, existing and future underground laboratories have an all-important role to play, searching for the decay of the proton, neutrinoless double beta-decay, and not to be forgotten dark matter!

Low Energy Nuclear Structure and Astrophysics

With its links to both the nano-scale world and to the cosmos, and with its origins in QCD, the study of the femto-region of atomic nuclei is central to modern physical science, with effects spanning over 42 orders of magnitude in distance scale from 10^{-15} m to 10^{27} m or more.

Research in nuclear structure aims to understand the nature of atomic nuclei, in particular, their dependence on the number and interactions of their constituents. These are usually taken to be free nucleons—protons and neutrons—although a QCD-based interpretation in terms of quarks and gluons is a long term goal. The ultimate aim of nuclear structure is to develop a simple, coherent, comprehensive theory and understanding of nuclei and of nuclear reactions in all their manifestations in which our present, often ad hoc, models will likely be seen as projections applicable to particular subsets of nuclei near stability. Nuclear astrophysics focuses on the study of the reactions and decay properties of nuclei involved in stellar phenomena, in particular energy generation in stars and the various processes associated with nucleosynthesis. With the advent of advanced facilities for the production and study of exotic nuclei far from stability, both fields are enjoying a resurgence of activity and discovery, with prospects for a future brighter than ever.

For over a century, the study of nuclei and nuclear techniques has also produced many innovative applications, to areas as diverse as medicine, security, industrial manufacturing, and energy. Examples are the development of new concepts of fission and fusion reactors, the search for solutions to the problem of long-lived nuclear waste, the development of myriad diagnostic and therapeutic techniques in medicine and control apparatae for industrial manufacturing. In addition, research in low energy nuclear physics is a prime training ground for those interested in working in applied areas.



The Nuclear Chart

Two themes and challenges run through much of the quest to understand nuclear structure: complexity and simplicity. The first is to understand how these complex many-body objects can be constructed from simple ingredients (nucleons, their interactions, quantum numbers, and conservation laws). This is the microscopic approach and has intimate links to techniques and research in nano-scale systems. The second is to understand how these complex objects can display such astonishing simplicity. This approach is more macroscopic, focusing on geometry and descriptions in terms of dynamical symmetries. Both approaches seek to understand not merely the properties of individual nuclei but the evolution of those properties with N, Z, and A, including sudden changes (similar to phase transitions) in structure with the addition of only a couple of nucleons.

The emerging accessibility of vast numbers of unstable nuclei far from the valley of stability is revitalizing the field by giving access to the limits of bound nuclei and to long iso-chains within these boundaries where structural evolution can be mapped. Exotic nuclei present new nuclear physics, such as found in the properties of weakly bound quantal systems, the dependence of nucleonic interactions on the in-medium density, the presence of the continuum of positive energy states, exotic topologies such as halo nuclei, changes in shell structure and the traditional magic numbers, properties of the heavy and super heavy nuclei as well as collective modes unlike anything found near stability. Investigations of the properties of the nuclear equation-of-state (EOS) and the associated phase diagram allow study of static properties of asymmetric matter, the thermodynamics of exotic nuclei, and the density and momentum dependence of the isovector interaction.

In addition to new, next-generation accelerator facilities, significant advances in experimental techniques are key to this research. Advanced facilities for exotic beams will provide stopped nuclides and beams ranging from keV to hundreds of GeV and provide thousands of nuclei far from stability with orders of magnitude greater intensities than at present. Examples of current facilities central to this work include Louvain la Neuve, TRIUMF ISAC-I, MSU-NSCL, HRIBF, SPIRAL1@GANIL, GSI, REX ISOLDE, and RIKEN. Next generation facilities, under construction or proposed, include RIKEN RIBF, TRIUMF ISAC-II, SPIRAL2@GANIL, GSI-FAIR, EURISOL, and a proposed new Rare Isotope Beam Facility in the United States. The aim, of course, is not to study all nuclides available but to choose from the expanded "gene pool" to select those that isolate and amplify particular physics issues. New experimental developments involve the concept of inverse kinematics in which the traditional roles of target and projectile are reversed. This approach is necessary with reactions involving unstable exotic nuclei but its many inherent advantages mean that it is now also being used with stable beams. Advances such as the use of large γ-ray tracking arrays, powerful fragment separators, advanced optical and magnetic traps, storage rings, and laser spectroscopy, along with the exploitation of new types of reactions, such as knock out reactions and intermediate energy Coulomb excitation, are revitalizing experimental capabilities. Where, once, beams of 10^9 particles/sec were standard, experiments can now be done with orders of magnitude lower beam intensity, and, in selected cases, at rates well under 1 particle/sec.

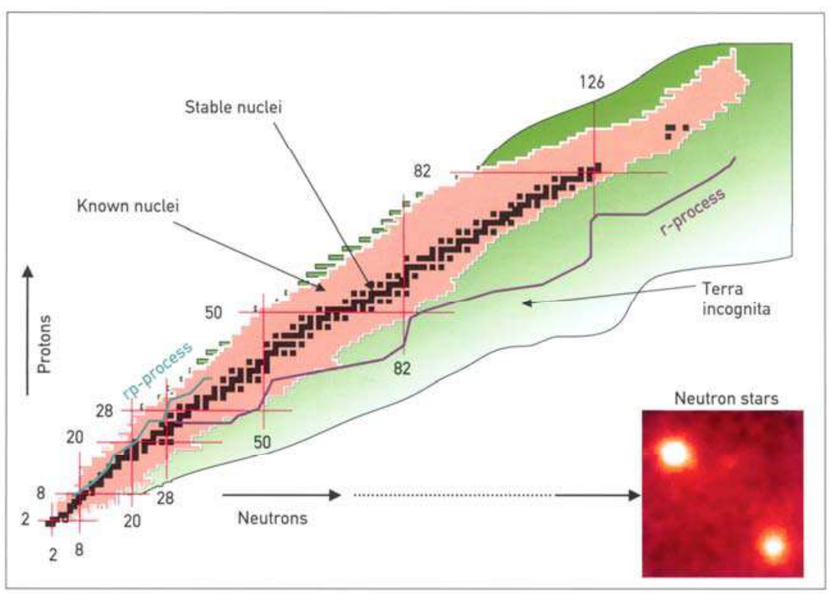
Of course, research at the fringes of stability does not preclude the need for stable beam capability to help answer the new questions raised by those studies. Likewise, complementary experiments with neutron beams (thermal, cold, and ultracold) at both accelerators and reactors will complement research with charged particle reactions.

Theoretical descriptions have also made significant progress. *Ab initio* calculations of nuclei now extend to A~12 and no-core and Monte Carlo shell model techniques go much further. For heavier nuclei, density functional theory and the shell model embedded in the continuum promise paths towards a coherent theoretical treatment. Complementary to this, the development of dynamical symmetries and the new critical point descriptions for nuclei in the region of phase transitions are providing new paradigms and benchmarks of structure.

Key areas of nuclear astrophysics are: understanding energy generation in steady burning processes such as the pp chain, CNO cycle, and helium burning, and explosive burning processes, like the hot pp chain, hot CNO cycle, and rp process which ignite by breaking out from steady burning and form nuclei in the Ne to S range or even heavier nuclides; understanding the cosmic origin of radiations currently being observed with a variety of satellite orbiters; understanding the nucleosynthesis of the heavier elements through the rp, p, s, r, and other processes and the stellar sites where many nuclides beyond Fe are produced in cataclysmic stellar explosions such as supernova. Primordial nucleosynthesis just after the Big Bang is another area where a deeper understanding of nuclear processes is much needed.

Energy generation in stars is caused by low-energy charged particle reactions. Their low cross section due to the Coulomb repulsion hinders measurements that are carried out with high backgrounds. Experiments in an underground laboratory succeeded in measuring cross sections of the solar fusion reaction $^{3}He(^{3}He,2p)^{4}He$ at its Gamow-window energies around 20 keV. Another way to overcome the difficulty is to employ a method to “amplify” the small cross sections. Coulomb dissociation uses high-intensity virtual photons during a heavy-ion collision. The ANC (Asymptotic Normalization Coefficient) determines the amplitude of a wave function in its asymptotic region by an appropriate nuclear reaction with a larger cross section. The “Trojan Horse” method employs a three body quasi-free process that simulates a rearrangement reaction. These indirect methods help to access difficult-to-measure reactions.

The recent development of radioactive nuclear beam techniques has opened new possibilities to measure reactions in explosive burning involving short-lived nuclei. Several reactions in the hot CNO cycle and the rp process have already been directly studied. The Coulomb dissociation and ANC methods are also applied to various reactions with unstable nuclei. Further developments will be made by the next generation facilities with radio-active nuclear beams.

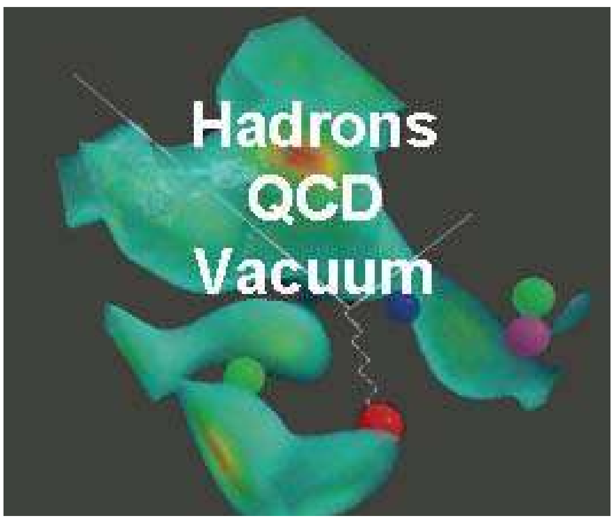


The Nuclear Landscape

Heavy element synthesis is by neutron or proton capture, their inverse processes, and β decays. In the majority of cases, basic nuclear properties such as the mass, half-life, level density, *etc*., are important. Recent developments of experimental and theoretical techniques have advanced our understanding of heavy element synthesis through slow or rapid capture processes. However, most of the nuclei involved in the explosive r- and rp-process are very far from the stability valley, and their study is just beginning. In addition, the neutrino-nucleus interaction may be important in understanding the explosive mechanisms of supernova. To fully understand explosive nucleosynthesis is a major challenge that can be attacked only by the above-mentioned, new radioactive-beam facilities, where the expected pathway of the r-process might be covered. Several new techniques for mass measurements, β decay studies and the like are being developed. Together with the rapid expansion of astronomical observations, which is clarifying details of the heavy element abundance in specific astrophysical objects, and experimental and theoretical studies on stellar explosion mechanisms, the origin of heavy elements is expected to be significantly clarified in the next two decades.

Hadronic Nuclear Physics

This is an exciting time for hadronic nuclear physics. There is a candidate for a fundamental theory of the strong interaction, namely Quantum Chromodynamics (QCD). In the high energy or short distance regime it has been thoroughly tested but the confinement regime remains a challenge. The next decade will see a concerted effort to explore the consequences of non-perturbative QCD (the form of QCD applicable for strong binding), primarily using the technique of lattice QCD, while at the same time exploiting new experimental facilities and techniques to test those predictions. Three major new facilities, J-PARC in Japan, FAIR in Germany, as well as the 12 GeV upgrade at Jefferson Lab, have been designed to answer this challenge.

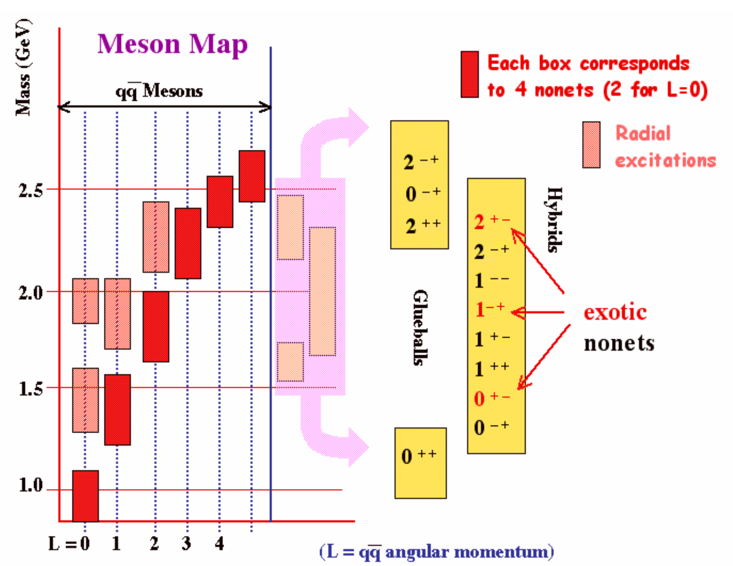


The first great question to be addressed is the origin of confinement, that is, why free quarks have never been observed. This is connected in a fundamental way with the nature of the QCD vacuum, a complex medium of quark and gluon condensates and non-trivial topological structure. A key to unraveling this mystery experimentally is the prediction that within QCD one should find so-called exotic mesons, in which gluons play more than a binding role, actually contributing to the observed quantum numbers in a characteristic way. The experimental search for these exotic mesons will be focused on two major new experimental facilities over the next decade – the Gluex experiment at Jefferson Lab, upgraded to 12 GeV in order to have the necessary energy reach, and the antiproton storage ring at the new FAIR facility at GSI, which will allow the high resolution exploration of charmed, exotic mesons. These two new facilities complement each other in that the latter will explore the nature of confinement in a heavy quark system, where a model invoking a flux-tube picture is perhaps a reasonable starting point, while the former will focus on light, relativistic quarks, for which it is much more difficult to construct a simple physical picture at present.

Next one faces important and fundamental questions regarding the structure of the proton and neutron. In more than 30 years since the discovery of scaling, in deep inelastic scattering at SLAC, it has not been possible to determine experimentally how the proton's momentum is distributed onto its valence quarks. The behavior of the ratio of down to up quarks in the nucleon, as the quark momentum changes (as a quantity called Bjorken x approaches 1), is a crucial test of the role of correlations in the motions of pairs of quarks versus processes involving independent hard scattering in the proton. Another key question relates to the "spin crisis" which first emerged in the 1980s and has never been resolved. One would think that the spins of the quarks in the nucleon would simply add to yield the net nucleon spin. But this is not the case and the resolution of this mystery is one of the most intriguing and important questions in the study of hadron structure. The question is how the proton spin is distributed amongst the valence quarks, and/or if some of the net spin of the nucleon comes from excitations of the “sea” of anti-quark-quark pairs required by QCD. Two complementary techniques, semi-inclusive deep inelastic scattering studied at Jefferson Lab and the Drell-Yan process studied at RHIC will enable a complete characterization over the next decade. Finally, a related question, which remains a mystery, is whether the gluons in the proton carry a significant fraction of its spin. The COMPASS experiment at CERN and the high energy Drell-Yan studies at RHIC are expected to yield answers to this question.

New experimental facilities offer novel ways to explore familiar problems – sometimes with surprising results. The ability at Jefferson Lab to separate electric and magnetic form factors of the nucleon, by studying recoil polarization (rather than the traditional Rosenbluth separation method), has led to a dramatic change in our picture of the proton charge distribution. With the 12 GeV upgrade at Jefferson Lab, accurate and reliable measurements of both the electric and magnetic form factors of the proton and neutron can be extended to distance scales a factor of two smaller than currently possible. That is, measurements can be done of structure in the nucleon on distance scales much smaller than the nucleon itself, thereby probing its inner structure. By adding precision measurements of parity violation one can also isolate the individual contributions of the u, d and s quarks to these form factors – following pioneering work at MIT-Bates, Mainz and JLab. Data of nucleon form factors in the time-like region are largely incomplete. In particular, measurements of the phases have never been made, despite their fundamental implications for understanding of the connections between space-like and time-like form factors. With the proposed energy upgrade of the DAΦNE e^+e^- storage ring at Frascati, complete and accurate measurements of both the proton and neutron form factors in the time-like region will be possible. This will strongly constrain models that fit well space-like data and make very different predictions once extrapolated into the time-like region.

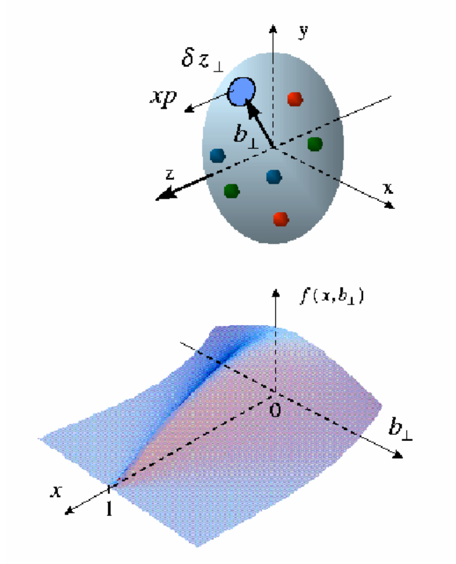
Recently there has been tremendous interest in a new set of physical observables, the so-called Generalized Parton Distributions (GPDs), which offer a three-dimensional (or tomographic) view of the internal structure of hadrons and, eventually, nuclei. The CLAS 12 detector at Jefferson Lab has been designed to explore the proton GPDs across the entire valence region, while allowing sufficient overlap with the excellent work already done at smaller x at SLAC, and reaffirmed in HERA at DESY and Hermes. A particularly important milestone will be the determination of the orbital angular momentum carried by the u



Anticipated spectrum of mesons in the mass range 1.5 to 2.7 GeV, with exotic nonets highlighted in red

and d valence quarks. One may also hope to investigate the GPDs by applying them to the analysis of exclusive proton-antiproton annihilation into two photons at large energy and momentum transfer. It is proposed to measure crossed-channel Compton scattering and the related exclusive annihilation process with various final states (scalar meson, vector meson, or lepton pair) at FAIR.

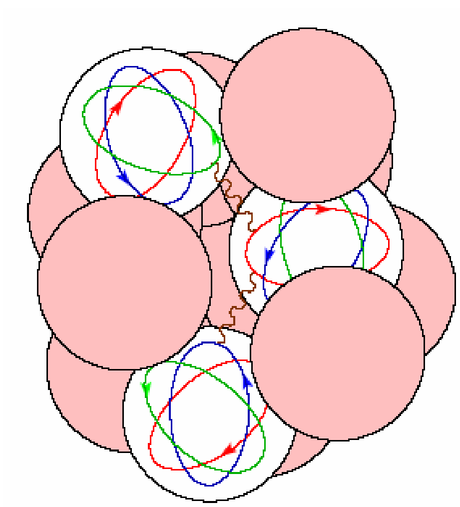
There are further plans at FAIR to obtain polarized antiproton beams in the future. It is argued that the quark transverse polarization is most accessible via Drell-Yan lepton pair production in proton-antiproton collisions, with the transverse distribution of valence quarks appearing at leading twist level and the cross section containing no unknown quantities besides the transversity distributions themselves.



The Generalized Parton Distributions are expected to yield a true three-dimensional picture of hadron structure for the first time

A common theme across modern nuclear physics is the effect of a change of energy or baryon density on the QCD vacuum and the hadrons which may live in it. Studies at GSI have already yielded important information on the change of pion properties with baryon density. There are many theoretical predictions of changes of baryon and vector meson masses and other properties with density and temperature which must be tested experimentally. An array of techniques ranging from hadronic atom formation to anti-proton annihilation in nuclei to the spin correlation parameters in quasi-elastic electron scattering will be applied to these issues over the next decade. Again, the three new hadronic flag-ship facilities, FAIR, J-PARC and Jefferson Lab with its 12 GeV upgrade will carry the prime responsibility.

A particularly fundamental question of interest to both the nuclear structure and astrophysics communities is the origin of phenomena such as the observed "saturation" of nuclear binding within QCD itself: That is, the total binding energy of nuclei does not simply increase linearly with the number of nucleons, suggesting some kind of screening, or a reduction in nucleon interactions over the extended size of nuclei. Great progress has been made in understanding normal nuclei in terms of effective two- and three-body forces, derived either phenomenologically or through modern effective field theory based on the symmetries of QCD. A truly microscopic understanding of the origins of these effective descriptions at the quark and gluon level would allow one rather more confidence in extending such theories to regimes of density or neutron-



Hadron substructure may be intimately connected with the many-body forces needed to understand nuclear structure.

proton asymmetry for which data is not yet available – for example at the densities found in the core of neutron stars or in nuclei with highly asymmetric numbers of protons and neutrons. Some progress has been made in relating the widely used Skyrme force to a quark-gluon level description of nuclei and this work needs to be continued. However, most importantly, this consideration makes the experimental challenge of measuring the changes of hadron properties immersed in a nuclear medium, discussed above, especially important.

QCD and Quark Matter

The fundamental interactions of nature are described by theoretical approaches called gauge theories. Quantum Chromodynamics (QCD), the theory of strong interactions, is such a theory and it is a special one – it is a complete theory, with just a small number of parameters to be determined from experiment. It is, however, difficult to compute the manifestations of QCD in nature except in the high energy (i.e., the weak coupling) limit, where the perturbative approach is extremely successful. The structure of strongly interacting particles is not amenable to this approach. Tools for understanding this structure include experiment and computer simulations of QCD. The important questions about QCD that can be accessed with these tools may be formulated as follows:

1. ***What are the phases of QCD matter?***

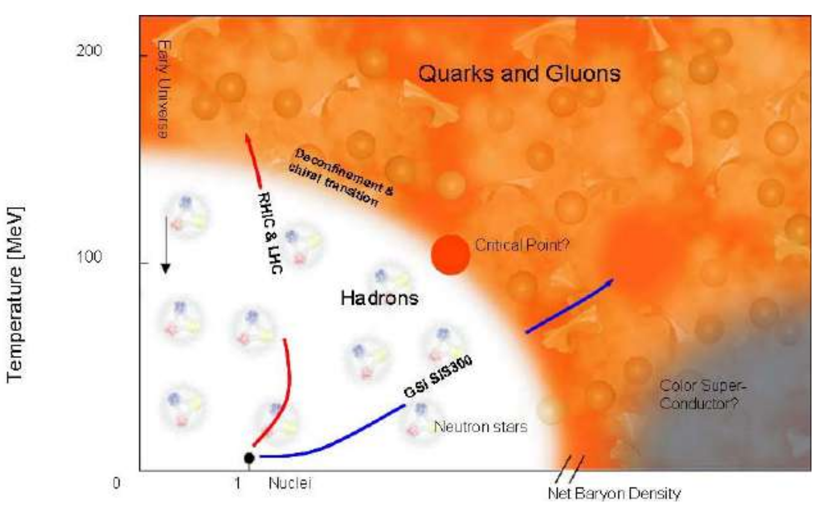
   Is there a phase transition to a state of matter in which more elementary entities (called partons) than hadrons are the relevant degrees of freedom?

2. ***What is the wave function of a heavy nucleus?***

   How does the growth of gluon density in hadrons reach a saturation limit in certain situations? How does the wave function of a proton in a nucleus differ from that of a free proton?

3. ***What is the nature of non-equilibrium processes in a fundamental theory?***

   How is entropy produced in processes involving quantum states of strongly interacting matter?



Anticipated phase structure of hadronic matter.

Gauge theories describing other fundamental interactions have similar questions and presumably the phase structure of each played its role in the very early development of the Universe. Again, the case of QCD is especially interesting. Based on the results of lattice gauge simulations, the expected phase transition from hadrons to quarks and gluons occurs at T ~ 170 MeV and can be studied *in the laboratory.* (This is not the case for the Electroweak phase transition, where T ~ 100 GeV, beyond the reach of any foreseeable collider.)

The experimental approach to the study of strongly interacting matter at very high temperatures involves the interaction of hadrons at very high energy. The study of the bulk properties of strongly interacting matter – implicit in most of the questions above – requires as large a volume of high energy density matter as practical. Thus, the fundamental questions about QCD and the physical states of strongly interacting matter are addressed in the laboratory by studying heavy ion collisions at relativistic energies.

In order to gain new understanding of QCD from the interaction of relativistic heavy ions, one needs directly comparable data sets with smaller system size, different energies and different experimental probes. These ancillary data sets provide "baselines" against which the largest volume, highest temperature, reactions can be compared. Thus a fundamental and systematic study of QCD requires data on A + A, A + B, p + A and p + p collisions, all at comparable nucleon-nucleon center of mass energies, preferably in the same detector systems. Hard processes, which can be accurately calculated in p + p collisions using perturbative QCD, can then serve as calibrated probes of the medium created in collisions involving nuclear beams. Addressing many of the questions above also requires data from high energy interactions of hadrons with non-hadronic probes, e.g., deep inelastic scattering (DIS) of leptons from nuclear targets ranging from protons to heavy ions. Question 2 requires the use of spin-polarized beams and/or targets at the highest energies.

Fixed target and collider experiments have contributed to the experimental attack on these questions over time. Taking beam energies of 1 GeV or greater, one has:

- fixed target heavy ion experiments (in the future at SIS200 - GSI);
- fixed target proton nucleus studies (currently at COSY and in the near term future at J-PARC);
- heavy ion collider experiments (in the future at the LHC - CERN and FAIR - GSI);
- fixed target lepton DIS experiments (at Jefferson Lab, currently at 6 GeV and in the near term future at 12 GeV);
- DIS collider experiments at DESY (HERA) – in the longer term: possibilities at BNL (eRHIC), CERN (LHeC) and JLab (ELIC);
- polarized beams/targets - in the longer term: possibilities at eRHIC and ELIC.

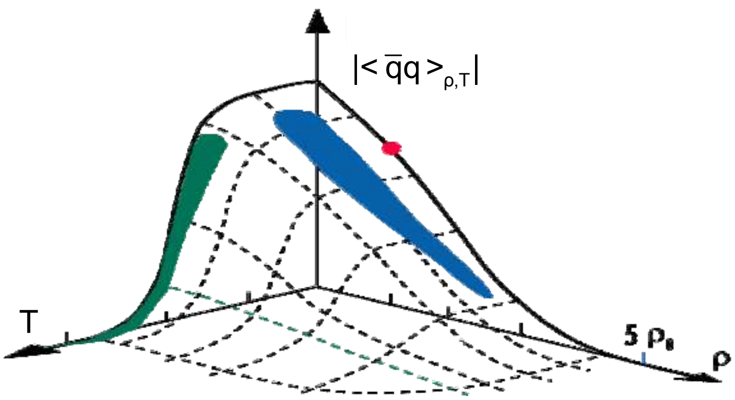
Recent results in this field have primarily come from RHIC at BNL and for electron-proton collisions at DESY. The four experiments at RHIC have produced new results in the first 5 years of operations. These results can be summarized briefly as follows:

At center of mass energy $\sqrt{s_{NN}}$ = 200 GeV, a new state of matter has been produced, with the following properties:

- Opaqueness to strongly interacting particles (deduced from "jet quenching" measurements)
- Transparency to photons and leptons (from direct photon measurements)
- Appearance of a nearly perfect liquid of quarks and gluons, i.e., a strongly-coupled Quark-Gluon Plasma (sQGP) (from the systematics of elliptical flow)

- Consistency with the picture that it has its origin in a universal hadronic state called the Color Glass Condensate (CGC) (from particle production spectra measured at forward angles)

New questions and some experimental puzzles have resulted from these data. For example, results on source size from quantum interference measurements (called HBT), the large amount of baryon production at intermediate values of p_T and the extremely rapid thermalization of the produced matter ($\tau \sim 0.6$ fm/c) is not understood.



Hadrons in the nuclear medium: The restoration of the chiral symmetry of QCD as both temperature (T) and density (ρ) rise is expected to have dramatic effects on hadron structure in-medium.

These and many other experimental questions are open to ongoing and future investigation. These include: the flow of heavy quarks, the spectrum of thermal radiation from the produced matter, the suppression and/or enhancement of the production of entities involving charmed quarks, the evidence for CGC and the contributions to the spin of the proton of the gluon and the orbital motion of the partons. A planned luminosity upgrade at RHIC will extend and expand the reach of that facility in this direction.

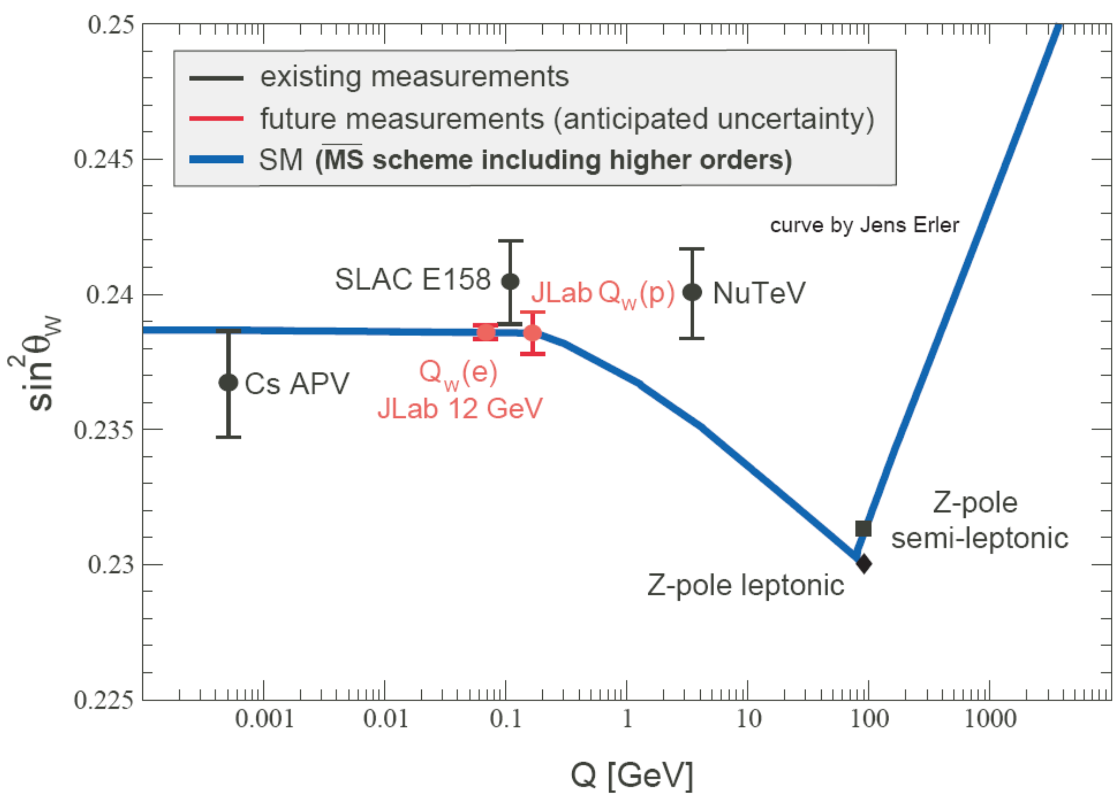
In the next few years the CERN LHC heavy ion program will contribute greatly to this body of knowledge. With a nucleus-nucleus center-of-mass energy nearly 30 times larger than the one reached at RHIC, the LHC will provide the biggest step in energy in the history of heavy ion collisions and will open a new era for studying the properties of strongly interacting matter under extreme thermodynamical conditions. This new energy regime will lead to a much higher density, to a faster equilibration and to a bigger deconfined system with a longer lifetime, resulting in an enhanced role of the QGP over interactions involving hadrons. The higher temperature and close to vanishing baryonic potential of the system will make it closer to the conditions of the primordial universe. In addition, heavy ion collisions at the LHC access exceedingly small Bjorken-x values, where low momentum gluons are expected to be close to saturation and lead to a significant shadowing effect (CGC). Another exciting aspect of this new energy regime is the copious production rate of hard processes. These processes, which are produced at the early stages of the collision, are sensitive probes of the collision dynamics at both short and long time scales. They represent, at the LHC, an ideal high statistics tool for a detailed characterization of the deconfined medium.

In the next decade complementary studies of the structure of strongly interaction matter are planned for GSI's Facility for Antiproton and Ion Research (FAIR), where ion-ion collisions at lower energies can create nucleus-sized volumes of low temperature, high baryon density samples of nuclear matter.

In the longer term there are plans at BNL and Jefferson Lab to open up a new window on deep inelastic lepton-hadron experiments using electron-ion collisions. At BNL this would involve the addition of an electron ring and new detectors to the existing ion/proton rings and experiments at RHIC. At Jefferson Lab there are plans to build an electron light ion collider, building on the laboratory's expertise in superconducting RF and energy recovery technology. Both of these proposals would make available electron-ion and polarized electron-polarized proton collisions and enable new studies of the low-x structure of strongly interacting states of matter using precision (lepton) probes. Finally we note that consideration is also being given to adding an electron ring at CERN in order to study electron-nucleus collisions at extremely small values of Bjorken x and at a significantly high luminosity of $10^{33}cm^{2}$-s^{-1}. All these experiments will need critical data from the 12 GeV CEBAF as an anchor that will calibrate and set the scale for interpreting high energy data.

Fundamental Symmetries

The understanding of the physics of the Universe is derived primarily from conservation laws and fundamental forces which are related to symmetries (global or local). It is very critical to test these symmetries to the best of our ability and more specifically test the domain (energy scale) of their applicability. Three of the four fundamental forces which govern the Universe are embodied into the so-called Standard Model (SM) which has been constructed over the last forty years. It is based on the very general assumption of Lorentz invariance (independence of physics from space rotation and boost transformations) and assumes that the product of C(charge), P(parity) and T(time) symmetries (CPT) is invariant. The experimental observation that the P symmetry is maximally violated in weak interactions at energy scales below the weak symmetry breaking scale (100 GeV) is accounted for by restricting the possible interactions to a specific combination of Vector – Axial vector couplings. The small observed CP violation in the B and K mesons is accounted for via a rotation of the weak and mass quark eigenstates through phases in their mixing matrix (and possibly similarly for the neutrinos) - hence T also is violated if CPT is to be a good symmetry.



The curve shows the predicted running of $\sin^2\theta_W$ within the Standard Model as a function of Q^2. Plotted are experimental results from APV, NuTeV, SLAC E158 and the leptonic and semi-leptonic measurements at the Z-pole. Also shown are the anticipated precision of the JLab Qweak proton measurement currently under construction and a future 4th generation measurement of the weak charge of the electron using the 12 GeV upgrade at JLab. As a purely leptonic measurement this would be the cleanest and most precise of the low Q^2 measurements in sensitivity to physics beyond the Standard Model.

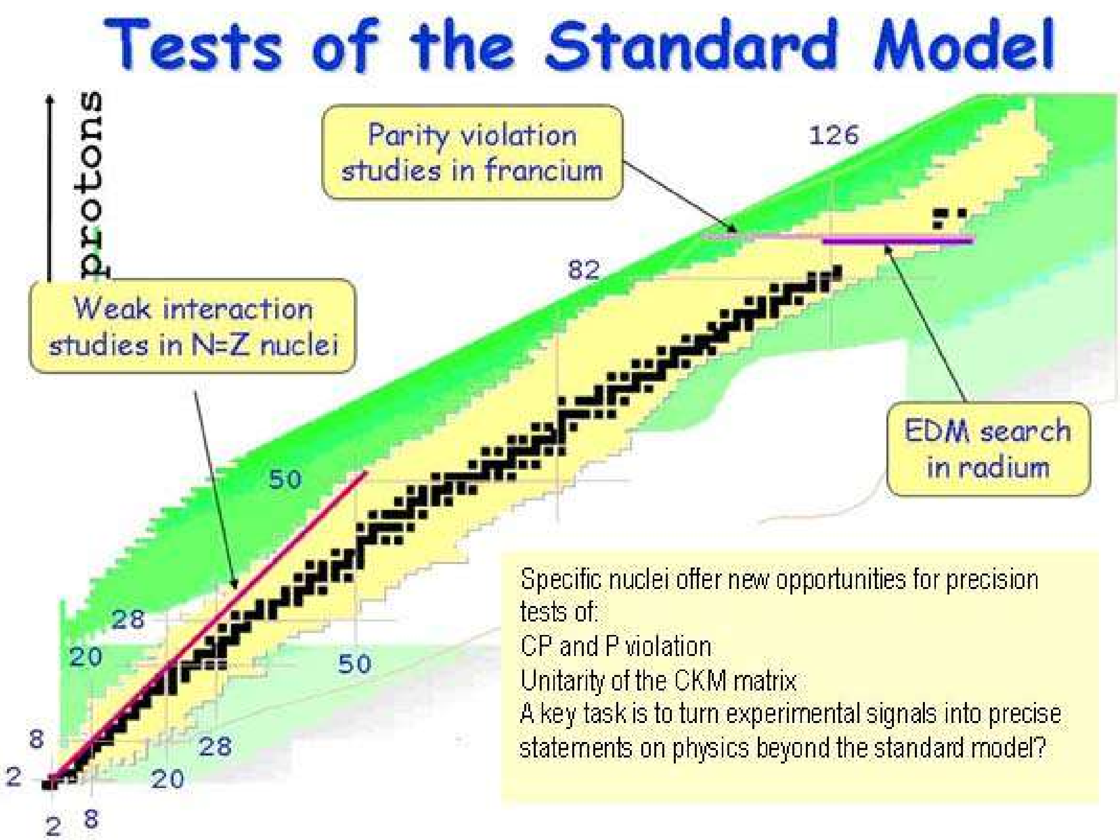
Tests of these assumptions have been and are still the focus of a large part of the research program in particle physics and in nuclear physics. Moreover, since the observed violations have been incorporated in an ad-hoc fashion, and since the model includes many arbitrary parameters, it is believed that the SM is only an effective approximation which has been extremely successful at the energy scale that one has been able to probe. It is also conjectured that a more encompassing theory should be developed which would be valid up to the Planck scale and would also incorporate quantum gravity (a force which is not yet included in the SM).

Many extensions to the Standard Model have been proposed which predict small but measurable deviations from SM predictions in terms of symmetry violations. While particle physics experiments at the energy frontier search for deviations that would be made more apparent with increased energy scales, nuclear physics has a complementary role to play in providing a special quantum laboratory where selection rules can be used to extract specific components of the interactions or enhance the violation effect in nuclei. The searches involve very high precision measurements of SM observables, or of phenomena forbidden or suppressed in the standard model. These "indirect" signatures of new physics can probe very large energy scales. For example, a 4% measurement of the proton weak charge tests new physics at the 3 TeV scale and beyond, while rare decays of the muon can probe multi-TeV scales not accessible in accelerators. Similarly a high precision measurement of the weak charge of the electron with an upgraded CEBAF has great potential.

The main questions that are the focus of the field are:

1. What is the Lorentz structure of the fundamental interaction?

In a model-independent way one can write the basic fundamental interactions in terms of Lorentz invariant terms that transform like scalars, pseudo-scalars, vectors, axial vectors, and tensors. In



its minimal form, the SM includes only the specific combination of vector and axial vector (V-A) terms and hence exhibits maximal parity violation and CP and T invariance. The present set of experimental data cannot exclude the presence of a substantial amount of non V-A terms at the level of 10%. One goal of the nuclear physics symmetry program is to tighten these constraints in order to provide a set of discriminatory tests of possible extensions of the SM. As an example, high precision experiments are testing the Lorentz structure of the weak interaction in semi-leptonic decay (beta-decay correlations), purely leptonic decays (muons, tau) and hadronic systems.

2. Where does the present Matter-Antimatter asymmetry in our Universe come from?

Many extensions to the SM include time reversal violations (CP violation). To explain the small CP violation observed in K decays 40 years ago, one introduced the concept that the fermion weak eigenstates were mixtures of the mass eigenstates (expressed in terms of the CKM matrix for the three generations of quarks and the PMNS matrix for the neutral leptons). The presence of the CP violation term introduced by an extra phase in the mixing matrix of the quarks has been confirmed by experiments in both the K-meson system and the B-meson system. However, the level of CP violation produced by the so-called SM phase is too small to explain the present matter-antimatter asymmetry in our universe. The CP violating phase in the neutrino mixing matrix is associated with the θ_{13} mixing angle which is very small and for which we have only upper limits (its measurement is the main goal of the worldwide neutrino physics program). In any event, many extensions to the SM induce larger CP violations, and the second focus of the low-energy symmetry tests is to search for evidence of such CP violation effects using the quantum numbers of nuclei to isolate specific contributions. This is addressed for example in the search for electric dipole moments (EDMs) of leptons, nucleons, atoms or molecules.

3. Is the fundamental assumption of CPT invariance valid?

One of the most sensitive test comes from the mass difference of neutral kaon and anti-kaon mesons but such comparisons must be extended to all other possible systems (l^+/l^-, m^+/m^-, $H/\bar{H}$, i.e., leptons, mesons, and hadrons and their anti-particles).

4. Can one resolve the remaining pieces of the neutrino puzzle?

There is a sense of neutrino mass splittings and mixings from the results of SNO for solar neutrinos, Kamiokande for atmospheric neutrinos, and the long-baseline neutrino oscillation experiments Kamland and K2K. However, one does not yet have a determination of the absolute scale for the mass of neutrinos. Zero neutrino double beta decay could shed some light on the Majorana nature of the neutrino and on their mass scale provided that the transition nuclear matrix elements can be determined (this is a challenge for both experiments and theory).

Experimentally, recent advances in both beam and target polarization and in polarization control have benefited from powerful and precise atomic techniques. The opportunities offered by ion and atom traps to study beta-decay in vacuum, advances in ultra cold neutron sources intensities, availability of high duty cycle polarized electron beams, and major developments in the production of exotic radioactive beams have led to a renaissance of this field which complement nicely the search for physics beyond the SM at the energy frontier.

Nuclear Physics: Basic Research Serving Society

Curiosity is the driving force behind research. Basic research does not aim specifically to create new inventions; instead, its purpose is to expand knowledge. This, in turn, serves as the basis for applied science, which strives to solve practical problems relevant to society.

In the early stages of discovery, it can be difficult to appreciate how useful basic research may become. As the 2006 Physics Nobel Laureate, Dr. George Smoot, once said, "People cannot foresee the future well enough to predict what's going to develop from basic research. If we *only* did applied research, we would still be making better spears." Throughout history, one has seen numerous cases illustrating the vital role of basic research in the advancement of scientific knowledge and of humankind as a whole. This could be elaborated in just a few important examples.

Nuclear techniques have transformed medical imaging, as illustrated here by the Dilon Gamma Camera, used in the scanning for breast cancer.

The current understanding of genetics and heredity is largely derived from Gregor Mendel's experiments with pea plants in the 1860's, and on the fruit fly experiments of T.H. Morgan roughly half a century later. Michael Faraday's experiments with magnets and coils of wires allowed him to discover the principle of magnetic induction in 1831, and eventually led to the creation of many modern electrical devices, including radios, alternators, and power generators. Likewise, Wilhelm Röntgen's late 19^{th} century experiments with electric discharges in vacuum tubes led to his discovery of X-rays and its many applications in modern medicine. Similarly, in 1947, William Shockley, John Bardeen and Walter Brattain's studies of the surface states of germanium led to their invention of the transistor, which is considered by many to be one of the greatest inventions in modern history. Transistors now serve as the foundation of all modern electronics and communication systems, including such necessities as computers, cellular phones, digital appliances, and even the Internet.

Like many other forms of basic research, research in the area of nuclear physics has yielded considerable benefits to society. Nuclear physics studies the structure of matter, its properties and interactions at the sub-atomic level. There are many applications and related techniques derived from nuclear physics which serve to address many of the challenges faced by society today. Still, the influence of nuclear physics in daily life is often overlooked.

Up to slightly over hundred years ago, most people thought that the atom was the most fundamental unit of matter, and that it was therefore indivisible. In 1897, Sir Joseph John Thomson, experimenting with currents of electricity inside empty glass tubes, discovered that the cathode rays produced were in fact streams of particles much smaller than atoms. He found that the rays were made up of *electrons:* the very small, negatively charged particles that are indeed the fundamental parts of every atom. J. J. Thomson's discovery of the electron led to the invention of the television and almost all modern electronic devices used today.

In 1931, Ernest Lawrence invented the cyclotron, which became a powerful particle accelerator. Its offshoots are the synchrocyclotron and the synchrotron. Already shortly after its invention, the cyclotron was used to produce a plethora of radioactive isotopes. Many of these isotopes have been used by scientists in a diverse range of disciplines, including chemistry and biology, archaeology and paleontology. Of the various applications of nuclear physics and radioactive isotopes, perhaps the most important are the advancements in the life sciences, in particular the use of radioactive isotopes for medical diagnostics. Another well-recognized example is medical imaging. Technologies used to survey the human body include nuclear magnetic resonance (NMR or as it is known today MRI), computer-assisted tomography (CAT), and positron emission tomography (PET). Additionally, nuclear physics research has been used to develop techniques for the treatment of disease, including gamma-ray and neutron radiation, proton and ion-beam therapy. Together, these tools aid in the diagnosis of various physiological conditions and can contribute to an improved quality of life for affected patients.

An MRI image of the lungs of a firefighter who was a first responder following the attacks of September 11th in New York, imaged at UVa by inhaling polarized ^3He

The global issues of greenhouse gas emissions, high demand for electricity, and the increasing price of fossil fuels present a challenge not only to policy makers but also to nuclear physics researchers. Climate change is being described as an immediate threat to the welfare of current and future generations. Consequently, nuclear energy is being considered as an alternative to traditional sources. Initiatives in nuclear safety have begun to address such critical issues as the disposal of nuclear waste, and have thus alleviated concerns over the viability of nuclear energy. Whichever strategy society ultimately adopts to solve the energy problem, research leading to fusion reactors and towards the transmutation of nuclear waste will be of importance for future technical developments.

As researchers continue to develop new and exciting applications, nuclear physics will inevitably become increasingly far-reaching and inter-disciplinary in nature. Foremost ranks nuclear-astrophysics to explain the development of the universe after its first instant, the so-called "big bang", and the abundances of the chemical elements. Nuclear physics has also made important contributions to a variety of fields beyond those listed above, including geology and oceanography, astronomy and forensic studies, and materials science. Examples for the latter are the use of stable energetic ions from accelerators which serve as versatile tools for structural analyses as well as modifications of solids. The analytical methods include channeling, elastic recoil detection analysis (ERDA), particle induced X-ray emission (PIXE), Rutherford back scattering spectroscopy (RBS), and focused beam scanning transmission ion microscopy (STIM). Ion beam analysis methods have reached high spatial resolution studying ultra thin layers of thickness a few nano-meters or less. Significant advancements in nuclear technology have been made in recent years, and it appears that research in nuclear physics will continue to have profound effects on humankind in the future.

Today, intense competition in the business world forces industry to focus on applied research. The onus is therefore on government and universities to perform the basic research necessary for the advancement of science and the creation of the foundation on which applied research can build.

Introduction

INDIVIDUAL LABORATORY ENTRIES BY GEOGRAPHICAL REGION

Nuclear Physics Institutes and Laboratories worldwide which possess an accelerator with an external users group for research in nuclear physics are indicated on the following map and listed in the following two Tables. Table I gives the names of the Nuclear Physics Laboratories, their location, and the chief performance characteristics of the laboratory's accelerator(s). Table II gives the staffing levels of the Nuclear Physics Laboratories as well as the total number of users and how these divide into internal users, national users and international users.

There are a very large number of medium size and smaller size facilities. It must be recognized that these facilities have a very important role in the education and training of nuclear physicists. In addition these facilities in general serve society at large through various applied nuclear physics programs and in quite a few cases have important programs within nuclear medicine.

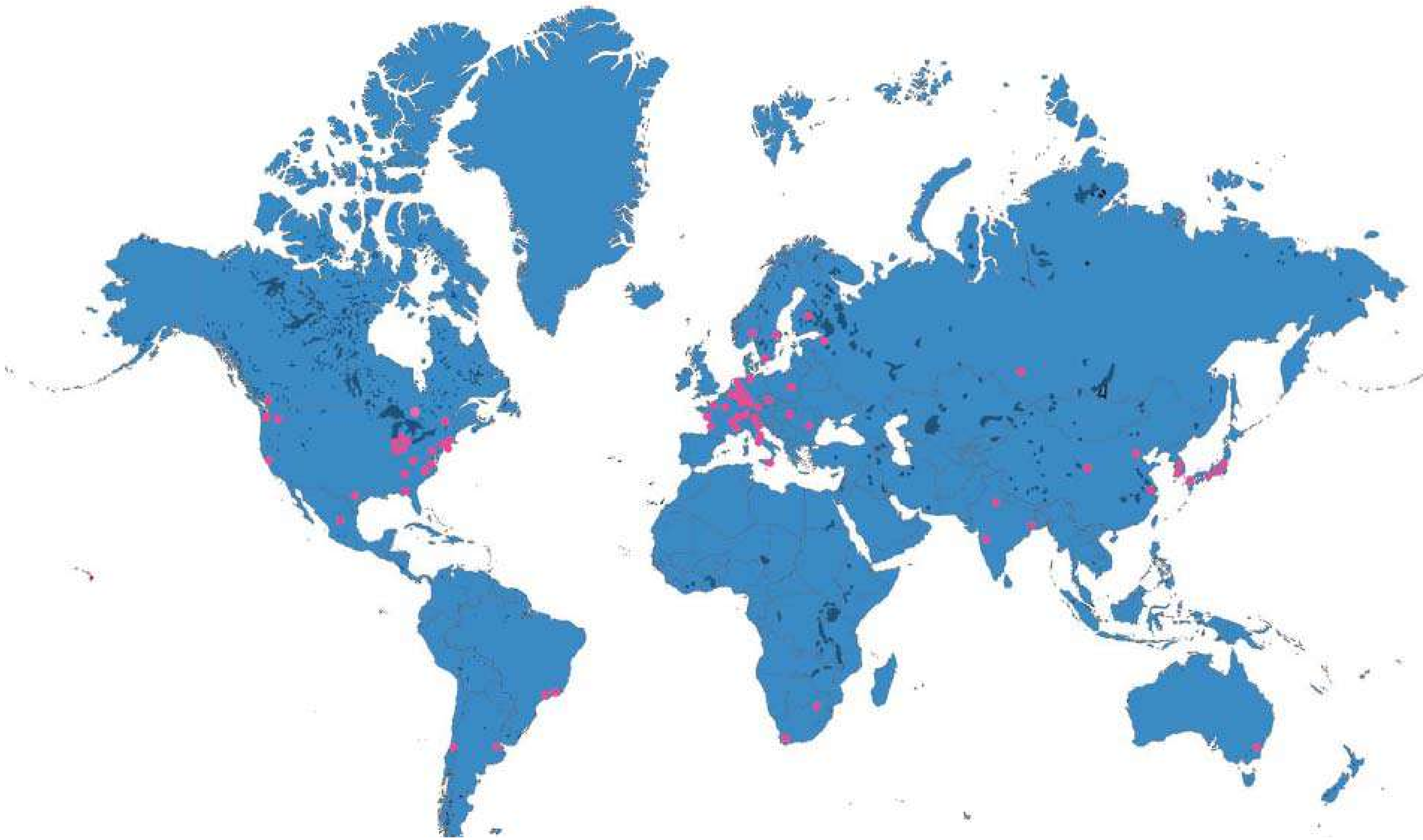
If one were to make the arbitrary choice to define truly international user facilities in nuclear physics as those which have a users group of national and international users combined in excess of 300 scientists, one would identify: in Japan J-PARC, RCNP, and RIKEN, in France GANIL, in Germany DESY-HERA, GSI, and COSY, in Italy Laboratori Nazionale di Legnaro, in Switzerland CERN and PSI, in Canada TRIUMF, and in the USA, ANL, BNL and JLAB. Other choices are possible and in some contexts perhaps more desirable, but this small group of large facilities would appear in almost any such collection.

The individual entries on the Nuclear Physics Laboratories are primarily the responses obtained through a questionnaire that was widely circulated. In a few cases in Europe, entries were taken from the NuPECC Handbook on International Access to Nuclear Physics Facilities. As the information was provided on a purely voluntary basis, there are some unavoidable gaps. For example, we had few responses from India. In that case we list below the web pages of several key institutions from which we did not receive information. Additional information on laboratories as defined above and not yet listed would be appreciated.

Centre for Advanced Technology (Department of Atomic Energy), Indore [Synchrotron Radiation Facility, 450 MeV] www.cat.ernet.in

Bhabha Atomic Research Centre (Department of Atomic Energy), Mumbai [Research Reactors] www.barc.ernet.in

Tata Institute for Fundamental Research, Mumbai [Pelletron] www.tifr.res.in



Region	Country	Institution / Location	Facility Name	Facility Characteristics
AFRICA				
	South Africa	ITHEMBA Laboratory, Faure / Cape Town	Cyclotron and Accelerator Facility	Cyclotron / p (227 MeV) / HI (A<136, 50-6 MeV/u) Accelerators (3-6 MeV)
		NECSA, Pretoria	SAFARI-1/Van de Graaff	Research Reactor / n(3-10Å, 10^{7} s^{-1} cm^{-2}) / 4 MV VdG: p, d, ^{4}He, N
ASIA				
	China	China Institute of Atomic Energy, DNP, Beijing	Beijing Tandem Acc. Lab.	Cyclotron/p(100 MeV) under construction Tandem (15 MV)/p (30 MeV) / HI (15 MeV/q)
		Chinese Academy of Sciences, IMP, Lanzhou	HIRFL	Cycl.-Synchr.-Storage-R./ p (3.7 GeV) / HI (^{12}C 1.1 GeV/u, ^{238}U 520 MeV/u)
		Chinese Academy of Sciences, SIAP, Shanghai	SLEGS (in planning)	Gamma rays / 1-25 MeV 10^{8}-10^{10} s^{-1}
	India	New Delhi University Grants Commission of India, New Delhi	Inter-University Accelerator Center	Tandem - S.C.Linac HI (9-1 MeV/u)
		Variable Energy Cylotron Centre, Kolkata	VECC	AVF Cyclotron A<40, 20-7 MeV/u SC-Cyclotron, K=500, 10-80 MeV/u
	Japan	Japan Atomic Energy Agency, Tokai	JAEA Tandem Facility	Tandem-ISOL-S.C-Linac / p(20 MeV) / HI(A=15/200 20/5 MeV/u)
		KEK and JAEA, Tokai	J-PARC (under construction)	Synchrotron / p (30 /50) GeV >10^{14} s^{-1}
		Kyushu University, Fukuoka	KUTL	Tandem (9 MV) / p (18 MeV) / HI (A<60, 9 MeVq)
		National Institute of Radiological Sciences, Anagawa	HIMAC	Synchrotron / 6 MeV/u inj.-linac / HI (A<60 100-800 MeV/u) / medical
		Osaka University, Osaka	Van de Graaff Laboratory	Van de Graaff (5MV) / p-He (5 MeV/10 MeV)
		RCNP, Osaka University, Osaka	Cyclotron complex/back scattered photon facility	Cyclotrons (K140 + K400) / p (400 MeV) / HI (A<20, 100 MeV/u)
		RIKEN, Wako	Nishina Center for Accelerator-Based Science	Cyclotrons / RARF (<135 MeV/u) / RIBF (d-U / 350 MeV/u)
		Tohoku University, Sendai	CYRIC	Electron-Linac-SBRing (1.2GeV) / tagged photons (30-1150 MeV)
		Tohoku University, Sendai	LNS Sendai	Cyclotrons (K=10&110) / p(12/90 MeV) / HI (C 33 MeV/u, Kr 9 MeV/u)
		University of Tsukuba, Tsukuba	Tandem Accelerator Complex	Tandems 4MV (22 MeV) Bi (<1 MeV/u)
	Korea	Korea Institute of Geoscience and Mineral Resources, Daejeon	Ion Beam Application Group	Tandem (1.7 MV) / p-Au
		National Cancer Centre, Goyang	Center for Proton Therapy	Cyclotron / p (50-230 MeV)
		National Centre for Inter-Universities Research Facility, Seoul	Electrost. Ion Acc./ AMS Fac.	Tandem (3 MV) / p(6 Mev) / HI (^{14}C 10 MeV)
AUSTRALIA				
		Australia National University, Canberra	Heavy Ion Accelerator Facility	Tandem (15 MV)–SC-Linac / HI (Li 14 MeV/u Au ≤2 MeV/u)

Region	Country	Institution / Location	Facility Name	Facility Characteristics
EUROPE				
	Belgium	Université Catholique de Louvain, Louvain-la-Neuve	Centre de Recherche du Cyclotron	Cyclotrons (K=30 & K=110) / p (30/70 MeV) / HI(A≤130 25-0.56 MeV/u / RIB (A < 20: 10 - 0.56 MeV/u)
	Czech Republic	Academy of Sciences of the Czech Republic, Řež	Nuclear Physics Institute	Cyclotron (K=40) / p He
	Finland	University of Jyväskylä, Jyväskylä	Accelerator Laboratory	Cyclotron (K=130) / p (130 MeV) / HI (A≤130 30 MeV/u – 5 MeV/u)
	France	Centre d'Etudes Nucléaires Bordeaux Gradignan (CENBG), Gradignan	AIFIRA	Singletron(3.5 MV) / p (3.5 MeV) / n (7 MeV)
		CNRS, Université de Nantes, École des Mines de Nantes, Nantes	ARRONAX	Cyclotron (K=70) planned; radioisotope production and nuclear medicine
		European Synchrotron Radiation Facility, Grenoble	ESRF GRAAL	Gamma Rays (Compton back-scattered polarized) (550-1500 MeV)
		GANIL Laboratory, Caen	GANIL	Cyclotrons (3 compact, 2 sep.sector) / SPIRAL ISOL / HI (95MeV/u)
		Institut de Physique Nucléaire de Lyon, Lyon	IPNL Van de Graaffs	Van de Graaffs (2.5/4 MV) / p (3.5MeV) / Au-clusters (2 MeV) / HI
		Institut Laue-Langevin, Grenoble	ILL	Research Reactor / n ($10^{15}s^{-1}$ cm^{-2})
		Institut Physique Nucléaire d'Orsay, Orsay	Tandem / ALTO	Tandem (15 MV) / 50 MeV e^- linac / ISOL / p (25 Mev) HI (8-1 MeV/u)
	Germany	Deutsches Elektronen-Synchrotron (DESY), Hamburg	HERA	Electron (30GeV)-Proton (920 GeV) Collider, pol. e^-
		Forschungsneutronenquelle Heinz Maier-Leibnitz, Garching	FRM II	Research Reactor / n ($8x10^{14}s^{-1}cm^{-2}$)
		Forschungszentrum Juelich (FZJ), Juelich	COSY	Synchrotron (acc.-cooler) / pl. p,d/0.27 - 3.7 GeV/c
		Gesellschaft fuer Schwerionenforschung (GSI), Darmstadt	UNILAC, SIS, ESR NP	Linac-Synchrotron-Storage Ring / p (4.7 GeV) / HI/RIBs (2 GeV/u)
		Technical University of Darmstadt, Darmstadt	S-DALINAC	Electron-Linac (S.C. / recirculating) / 2-130 MeV
		University of & Technical University of Munich, Garching	Maier-Leibnitz Laboratory	Tandem (14MV) / p (28 MeV) / HI (9-1.1 MeV/u)
		University of Bonn, Bonn	ELSA	Electron-Synchrotron/Storage-Stretcher Ring/0.5 - 3.5 GeV
		University of Cologne, Cologne	Tandem Accelerator	Tandem (10MV) / p (20 MeV) / HI (A≤80, 6-1.5 MeV/u)
		University of Mainz, Mainz	MAMI Accelerator	Microtron (e^- cw-race track) / 180-1500 MeV
	Hungary	Inst. of Nucl. Res. of the Hungarian Acadamy of Sciences, Debrecen	ATOMKI	Cyclotron (K=20) / p(20 MeV) / ^{3}He(27 MeV)
	Italy	European Centre for Theoretical Studies in Nuclear Physics, Trento	ECT*	Theory Institute
		National Institute of Nuclear Physics (INFN), Assergi	Laboratori Nazionali del Gran Sasso	Electrostatic Acc. 50 kV & 400 kV / deep underground facilities
		National Institute of Nuclear Physics (INFN), Catania	Laboratori Nazionali del Sud	Tandem (15 MV) p (28 MeV)/HI (14-1 MeV/u) SC-Cyclotron / p (80 MeV) / HI (80-20 MeV/u)

Region	Country	Institution / Location	Facility Name	Facility Characteristics
		National Institute of Nuclear Physics (INFN), Frascati	Laboratori Nazionali di Frascati	Synchrotron-Storage-Collider-Ring (e^+e^-) / 1020 MeV cm energy
		National Institute of Nuclear Physics (INFN), Legnaro	Laboratori Nazionali di Legnaro	Tandem (15 MV) & S.C. Linac / p (30 MeV) / HI (20-6 MeV/u)
	Norway	University of Oslo, Oslo	Cyclotron Laboratory	Cyclotron (K=35) / p (35 MeV) / ^{4}He (35 MeV)
	Poland	Warsaw University, Warsaw	Heavy Ion Laboratory	Cyclotrons (K=16.5 & K=160) / p (16 MeV) / HI (11≤A≤40 5-2 MeV/u)
	Romania	National Institute of Physics and Nuclear Engineering (IFIN-HH), Bucharest-Magurele	FN Tandem Van de Graaff	(9 MV) /p (18 MeV) /HI (5-0.5 MeV/u)
	Russia	Budker Institute of Nuclear Physics, Novosibirsk	VEPP-4M / ROKK-1M	Collider (e^+e^-) / 5.5 GeV beam) / Gamma rays (tagged 30 – 3500 MeV)
		Budker Institute of Nuclear Physics, Novosibirsk	VEPP-3	Electron (positron) storage ring / (350 MeV-2 GeV) / internal target
		Petersburg Nuclear Physics Institute, Russ. Acad. Sciences, Gatchina	PNPI Synchro-Cyclotron	Synchro-cyclotron / p (1000 MeV) / n (<200 MeV) / pions / muons
	Sweden	Lund University, Lund	MAX-LAB	Electron Linac (250 MeV) / stretcher / tagged photons (20–225 MeV)
		Uppsala University, Uppsala	The Svedberg Laboratory	Cyclotron (K= 180) / p (180 MeV) / HI (45 MeV/u)
	Switzerland	CERN, Geneva	LHC – ALICE	Pb Pb collisions at 5.5 ATeV
		CERN, Geneva	ISOLDE	Radioactive beams
		Paul Scherrer Institute, Villigen	Isochronous Cyclotron	Cyclotron / p (590 MeV, ≤12 MW) / low-energy pions / muons
	The Netherlands	Kernfysisch Versneller Institut (KVI), Groningen	AGOR	SC-Cyclotrton (K=600) / p (190 MeV) / HI (6≤A≤208 5-95 MeV/u)
NORTH AMERICA				
	Canada	Snolab (Under construction), Sudbury, ON	SNOLAB	Underground solar neutrino laboratory / SNO heavy-water detector
		TRIUMF, Vancouver, BC	TRIUMF / ISAC-I / ISAC-II	Cyclotrons (K= 13 - 500) & ISOL Linac / p (500 MeV) / RIBs (6 MeV/u)
	Mexico	Universidad Nacional Autonoma de Mexico UNAM, Mexico City	Van de Graaff Laboratory	Van de Graaffs (0.7 MV & 5.5 MV) / p–Ar (<700 KeV) / p-He (1-5.5 MeV)
		Universidad Nacional Autonoma de Mexico UNAM, Mexico City	Pelletron Accelerator Laboratory	Tandem (3 MV) / p-HI (A≤109 1-18 MeV)
	USA	Argonne National Laboratory (ANL), Chicago, IL	ATLAS	SC-Linac & tandem injector / p (18 MeV) / HI (6≤A≤238 16-8 MeV/u)
		Brookhaven National Laboratory (BNL), Upton, NY	RHIC	Collider / p (250 GeV+250 GeV) / HI (A=d-Au 100 GeV/u + 100 GeV/u)
		Florida State University, Tallahassee, FL	Superconducting Accelerator Laboratory	Tandem(9 MV) - SCLlinac (11 MV)

Region	Country	Institution / Location	Facility Name	Facility Characteristics
		Hope College, Holland, MI	HIBAL	Tandem (1.7 MV) / p (3.4 MeV) / ^{4}He (5.1 MeV)
		Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA	88-inch Cyclotron	Cyclotron (K=55) / p (55 MeV) / HI (6≤A≤209 32-4.5 MeV/u)
		Michigan State University, East Lansing, MI	NSCL	SC-Cyclotrons (coupled, K500, K1200) / HI RIBS (16≤A≤238 E=160-80 MeV/u)
		National Institute of Standards & Technology (NIST), Gaithersburg, MD	NCNR	Research Reactor / cold neutrons ($2x10^9 s^{-1} cm^{-2}$)
		Nuclear Structure Laboratory, SUNY , Stony Brook, NY	Nuclear Structure Laboratory	FN Tandem (9 MV) & SCLlinac (12MVxq) / p(20 MeV) / HI (A<60 12-7 Mev/u)
		Oak Ridge National Laboratory (ORNL), Oak Ridge, TN	HIRBF	Cyclotron-Tandem(25 MV) ISOL system / RIB (1≤A≤136 15-3 MeV/u)
		Pacific Northwest National Laboratory, Richland, WA	IGEX Detector	Enriched isotope double beta decay
		Texas A&M University, College Station, TX	Cyclotron Institute	Cyclotrons (K=150 K=500) / d – U (70 MeV/u – 15 MeV/u) / RIBs
		Thomas Jefferson National Accelerator Facility, Newport News, VA	CEBAF	Electron Facility (6 GeV CW SC-Linac recirculator) / 10 kW FEL
		Triangle Universities Nuclear Laboratory, Durham, NC	TUNL	Tandem (10 MV) & LEBAF/LENA (0.2 -1 MV) / p,d,He
		University of Kentucky, Lexington, KY	Accelerator Laboratory	Single-ended dc accelerator (7 MV) / ^{3}He (7-12 MeV)
		University of Notre Dame, Notre Dame, IN	Nuclear Structure Lab. (NSL)	Tandem (10.5 MV) & KN Van de Graaff (4 MV) / p(21 MeV) / HI (<100 MeV)
		University of Washington, Seattle, WA	CENPA	Tandem (9 MV)
		Western Michigan University, Kalamazoo, MI	Tandem Accelerator Laboratory	Tandem (6 MV) / p(12 MeV) / HI (A<60 3-0.7 MeV/u)
		Yale University, New Haven, CT	Wright Nuclear Structure Laboratory, (WNSL)	Tandem (20 MV) / p(28 Mev) HI (A=6-200 , 7-1.4 MeV/u)
SOUTH AMERICA				
	Argentina	CNEA Physics Department, Buenos Aires	TANDAR Laboratory	Tandem (20 MV) / p(28 MeV) / HI (A=6-200, 7-1.4 MeV/u
	Brazil	Catholic University, Rio de Janeiro	Van de Graaff Laboratory	Van de Graaff (4 MV, single-ended) / p (4 MeV) / HI (A≤40, 1 MeV/u)
		University of São Paulo, São Paulo	LAFN	Tandem (8 MV) (SC Linac u. constr.) / p(16 MeV) HI (A<30, 5-3 MeV/u)
	Chile	Comision Chilean de Energia Nuclear, Santiago	Centro Nuclear La Reina	Cyclotron (K=18) / p (18 MeV) / d (9 MeV)
		University of Chile, Santiago	Van de Graaff Accelerator Laboratory	Van de Graaff (3.75 MV) / p-Xe (3.5 MeV)

Region / Country	Institution	Facility Name	Staff							Users			
			Total	Theory (total)	Permanent	Temporary	Postdocs	PhD Students Onsite / Other Graduate Students	Undergraduates	Total user number	Internal (%)	National (%)	International (%)
AFRICA													
South Africa	ITHEMBA Laboratory, Faure / Cape Town	Cyclotron & Accelerator Facility	300	12	283	17	13	30/160	yes	445	0%	35%	65%
	NESCA, Pretoria	SAFARI-1/Van de Graaff	17		15		2	0/3	4	25	30%	95%	5%
ASIA													
China	China Institute of Atomic Energy, DNP, Beijing	Beijing Tandem Acc. Lab.	250	20	200	50	2	50/10	50	200	65%	90%	10%
	Chinese Academy of Sciences, IMP, Lanzhou	HIRFL	500	26	400	100	10	200/20	40	200	50%	90%	10%
	Chinese Academy of Sciences, SIAP, Shanghai	SLEGS (in planning)											
India	New Delhi University Grants Commission of India, New Delhi	Inter-University Accelerator Center	110	0	100	10	4	12/80	0	100	15%	95%	5%
	Variable Energy Cyclotron Centre, Kolkata	VECC	470	13			3	14/2		30	20%	80%	20%
Japan	Japan Atomic Energy Agency, Tokai	JAEA Tandem Facility	17	6	14	3	4	2/5	0	280	90%	80%	20%
	KEK and JAEA, Tokai	J-PARC (under construction)								480	10%	40%	60%
	Kyushu University, Fukuoka	KUTL	4	2	2	0	1	4/3	8	35	70%	100%	0%
	National Institute of Radiological Sciences, Anagawa	HIMAC	31		20	11	6	5/20	10	704	20%	90%	10%
	Osaka University, Osaka	Van de Graaff Laboratory	9		6	3	0	3/1	2	3	40%	90%	10%
	RCNP, Osaka University, Osaka	Cyclotron complex/back scattered photon facility	58	8	17	41	8	33/135	0	700	5%	90%	10%
	RIKEN, Wako	Nishina Center for Accelerator-Based Science	157	6	59	98	50	25/112	12	500	50%	81%	19%
	Tohoku University, Aoba	CYRIC	39		13	26	3	25/2	10	20	20%	95%	5%
	Tohoku University, Sendai	LNS Sendai	32		14	18	3	15/3	0	100	40%	100%	0%
	University of Tsukuba, Tsukuba	Tandem Accelerator Complex	21	0	13	8	1	7/3	0	60	90%	99%	1%
Korea	Korea Institute of Geoscience and Mineral Resources, Daejeon	Ion Beam Application Group	6	0	6	0	0	0	0	256	0%	100%	0%
	National Cancer Center, Goyang	Center for Proton Therapy	15	0	8	7	4	0/2	0	-	-	-	-
	National Centre for Inter-Universities Research Facility, Seoul	Electrost. Ion Acc./ AMS Fac.	11	0	8	3	1	1	0	500	75%	100%	0%
AUSTRALIA													
	Australia National University, Canberra	Heavy Ion Accelerator Facility	42	2	23	19	6	10/10	8	97	31%	52%	48%
EUROPE													
Belgium	Université Catholique de Louvain, Louvain-la-Neuve	Centre de Recherche du Cyclotron	19	0	19	0	2	0	1	145	7%	20%	80%

Region / Country	Institution	Facility Name	Staff							Users			
			Total	Theory (total)	Permanent	Temporary	Postdocs	PhD Students Onsite / Other Graduate Students	Undergraduates	Total user number	Internal (%)	National (%)	International (%)
Czech Republic	Academy of Sciences of the Czech Republic, Řež	Nuclear Physics Institute	46	15	21	25	4	15	6	50	70%	10%	30%
Finland	University of Jyväskylä, Jyväskylä	Accelerator Laboratory	68	9	26	42	9	32	10	270	15%	25%	75%
France	Centre d'Etudes Nucléaires Bordeaux Gradignan (CENBG), Gradignan	AIFIRA	17	0	10	7	3	4/0	0	60	65%	95%	5%
	CNRS, Université de Nantes, École des Mines de Nantes, Nantes	ARRONAX											
	European Synchrotron Radiation Facility, Grenoble	ESRF GRAAL	35	0	25	10	2	0/15	3	30	40%	50%	50%
	GANIL Laboratory, Caen	GANIL	267	8	242	25	4	9/8	20	370	9%	64%	36%
	Institut de Physique Nucléaire de Lyon, Lyon	IPNL Van de Graaffs	29	0	20	9	0	6/1	0	30	95%	95%	5%
	Institut Laue-Langevin, Grenoble	ILL	452	5	382	70	18	28	5	1220	7%	26%	74%
	Institut Physique Nucléaire d'Orsay, Orsay	Tandem / ALTO	38	28	28	10	10	5	10	130	22%	64%	36%
Germany	Deutsches Elektronen-Synchrotron (DESY), Hamburg	HERA Note: Nuclear Physics about 10% of figures given	1695	50	1114	581	92	100/100	45	3000	5%	53%	47%
	Forschungsneutronenquelle Heinz Maier-Leibnitz, Garching	FRM II	220	0	140	20	40	15	5	814	0%	62%	38%
	Forschungszentrum Juelich (FZJ), Juelich	COSY	148	12	125	23	7	16/6	8	391	21%	44%	56%
	Gesellschaft fuer Schwerionenforschung (GSI), Darmstadt	UNILAC, SIS, ESR NP	1003	50	543	460	90	115/80	40	1300	20%	60%	40%
	Technical University of Darmstadt, Darmstadt	S-DALINAC	22	7	17	5	5	23	13	39	84%	25%	75%
	University of & Technical University of Munich, Garching	Maier-Leibnitz Laboratory	58	0	26	32	10	17/5		122	31%	75%	25%
	University of Bonn, Bonn	ELSA											
	University of Cologne, Cologne	Tandem Accelerator	35	0	6	29	5	12	0	75	40%	66%	34%
	University of Mainz, Mainz	MAMI Accelerator	216	20	103	113	36	93/10	0	150	50%	80%	20%
Hungary	Inst. of Nucl. Res. of the Hungarian Acadamy of Sciences, Debrecen	ATOMKI											
Italy	European Centre for Theoretical Studies in Nuclear Physics, Trento	ECT*											
	National Institute of Nuclear Physics (INFN), Assergi	Laboratori Nazionali del Gran Sasso											
	National Institute of Nuclear Physics (INFN), Catania	Laboratori Nazionali del Sud	141	9	101	40	12	10/-	6	280		60%	40%

Region / Country	Institution	Facility Name	Staff							Users			
			Total	Theory (total)	Permanent	Temporary	Postdocs	PhD Students Onsite / Other Graduate Students	Undergraduates	Total user number	Internal (%)	National (%)	International (%)
	National Institute of Nuclear Physics (INFN), Frascati	Laboratori Nazionali di Frascati											
	National Institute of Nuclear Physics (INFN), Legnaro	Laboratori Nazionali di Legnaro	170	0	120	50	10	25/20	0	400	10%	50%	50%
Norway	University of Oslo, Oslo	Cyclotron Laboratory	25	0	10	15	3	8/0	0	30	50%	70%	30%
Poland	Warsaw University, Warsaw	Heavy Ion Laboratory	53	0	46	7	2	2/13	16	100	10%	80%	20%
Romania	National Institute of Physics and Nuclear Engineering (IFIN-HH), Bucharest-Magurele	FN Tandem Van de Graaff	54	4	49	5	11	10/3	7	60	90%	97%	3%
Russia	Budker Institute of Nuclear Physics, Novosibirsk	VEPP-4M / ROKK-1M	5	0	2	3	1	1/0	0	3	100%	100%	0%
	Budker Institute of Nuclear Physics, Novosibirsk	VEPP-3	11	2	7	4	1	2/0	2	20	70%	85%	15%
	Petersburg Nuclear Physics Institute, Russ. Acad. Sciences, Gatchina	PNPI Synchro-Cyclotron											
Sweden	Lund University, Lund	MAX-LAB	80		50	30	20	10/50	5	40	5%	15%	85%
	Uppsala University, Uppsala	The Svedberg Laboratory	29	0	24	5	0	0	0	150	2	25%	75%
Switzerland	CERN, Geneva	LHC – ALICE	85	1	33	8	14	-	22	761	-	-	100%
	CERN, Geneva	ISOLDE	26	0	12	14	4	7/50	15	350	2%	2%	98%
	Paul Scherrer Institute, Villigen	Isochronous Cyclotron											
The Netherlands	Kernfysisch Versneller Institut (KVI), Groningen	AGOR	50	5	22	28	3	24/0	10	108	39%	50%	50%
NORTH AMERICA													
Canada	Snolab (Under construction), Sudbury, ON	SNOLAB	-	-	-	-	-	0/25	10	150	-	50%	50%
	TRIUMF, Vancouver, BC	TRIUMF / ISAC-I / ISAC-II	384	14	384		41	29/21	60	603	7%	34%	66%
Mexico	Universidad Nacional Autonoma de Mexico, UNAM, Mexico City	Van de Graaff Laboratory	18	0	8	10	0	0/0	1	24	25%	85%	15%
	Universidad Nacional Autonoma de Mexico, UNAM, Mexico City	Pelletron Accelerator Laboratory	11	0	7	4	0	6/12	15	14	85%	98%	2%
USA	Argonne National Laboratory, Argonne (ANL), IL	ATLAS	92	6	74	18	14	9/32	35	411	12%	54%	46%
	Brookhaven National Laboratory (BNL), Upton, NY	RHIC	523	8	473	50	20	10/60	20	1100	13%	50%	50%
	Florida State University, Tallahassee, FL	Superconducting Accelerator Laboratory	36	12	17	19	5	19/1	8	25	80%	90%	10%
	Hope College, Holland, MI	HIBAL	2	0	1	1	0	0	12	18	95%	95%	5%
	Lawrence Berkeley National Laboratory (LBNL), Berkeley, CA	88-inch Cyclotron	57	0	35	22	9	8/1	9	147	29%	95%	5%

Region / Country	Institution	Facility Name	Staff							Users				
			Total	Theory (total)	Permanent	Temporary	Postdocs	PhD Students Onsite / Other Graduate Students	Undergraduates	Total user number	Internal (%)	National (%)	International (%)
	Michigan State University, East Lansing, MI	NSCL	280	14	155	125	23	55/10	30	170	27%	69%	31%
	National Institute of Standards & Technology (NIST), Gaithersburg, MD	NCNR	16	0	8	8	4	3/4	3	30	50%	80%	20%
	Nuclear Structure Laboratory, SUNY , Stony Brook, NY	Nuclear Structure Laboratory	13	-	5	8	1	7	4	20	80%	100%	-
	Oak Ridge National Laboratory (ORNL), Oak Ridge, TN	HIRBF	59	17	34	25	11	14/14	3	228	22%	90%	10%
	Pacific Northwest National Laboratory, Richland, WA	IGEX Detector	35	5	30	0	2	0	0	0			
	Texas A&M University, College Station, TX	Cyclotron Institute	82	11	50	32	13	22/0	10	140	60%	90%	10%
	Thomas Jefferson National Accelerator Facility, Newport News, VA	CEBAF	638	19	604	34	11	75/80	70	1206	5%	61%	39%
	Triangle Universities Nuclear Laboratory, Durham, NC	TUNL	65	0	25	40	10	30/0	15	60	90%	98%	2%
	University of Kentucky, Lexington, KY	Accelerator Laboratory	4	0	3	1	5	3/0	1	?	80%	95%	5%
	University of Notre Dame, Notre Dame, IN	Nuclear Structure Lab. (NSL)	32	-	4	28	6	22/11	7	40	25%	50%	50%
	University of Washington, Seattle, WA	CENPA	47		26	21	6	15/0	5	33	100%	-	-
	Western Michigan University, Kalamazoo, MI	Tandem Accelerator Laboratory	5	0	5	-	0	4/0	4	10	100%	100%	-
	Yale University, New Haven, CT	Wright Nuclear Structure Laboratory, (WNSL)	30	0	15	15	4	12/10	3	60	15%	65%	35%
SOUTH AMERICA													
Argentina	CNEA Physics Department, Buenos Aires	TANDAR Laboratory	52	15	44	8	3	5/0	10	25	90%	90%	10%
Brazil	Catholic University, Rio de Janeiro	Van de Graaff Laboratory	10	0	7	3	4	10/2	3	30	80%	100%	0
	University of São Paulo, São Paulo	LAFN	47	13	47	-	8	34/6	20	100	90%	100%	0
Chile	Comision Chilena de Energia Nuclear, Santiago	Centro Nuclear La Reina	6	9	5	1	1	0/1	2	15	100%	100%	_
	University of Chile, Santiago	Van de Graaff Accelerator Laboratory	8	-	7	1	1	1/2	20	8	90%	100%	-

ITHEMBA LABORATORY FOR ACCELERATOR BASED SCIENCES (ITHEMBA LABS)

Old Faure Road, Faure, near Cape Town, South Africa

P O Box 722
Somerset West 7129
Telephone: +27 21 843 1000
Facsimile: +27 21 843 3525
Internet: www.tlabs.ac.za
E-mail: director@tlabs.ac.za

National facility operated by the National Research Foundation (NRF) which is governed by the NRF Act of 1998.

The South African Government

Prof. Krish Bharuth-Ram, Managing Director

Scientific Mission and Research Programs:

(a) Vision

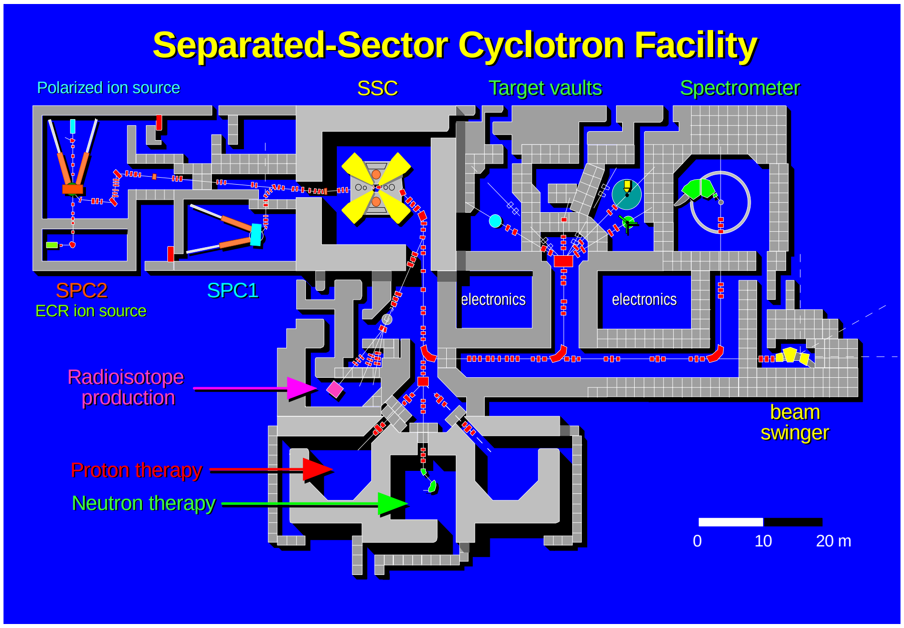
To be the primary centre of research, training and service expertise in radiation medicine and accelerator based science and technologies to advance the knowledge and health of the people of Africa.

(b) Mission

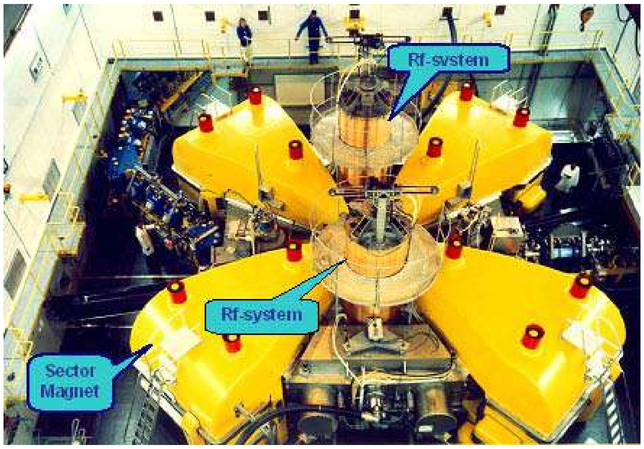
To provide advanced, viable, multidisciplinary facilities for training, research and services in the fields of nuclear science and radiation medicine for the pride and benefit of all the people of Africa.

Research programmes include Nuclear and Accelerator Physics, Materials Research, Medical Physics and development of Radionuclides.

Layout of the iThemba LABS cyclotron facility



Characterization of the facility:



200 MeV Separated Sector Cyclotron

Two 8 MeV injector cyclotrons

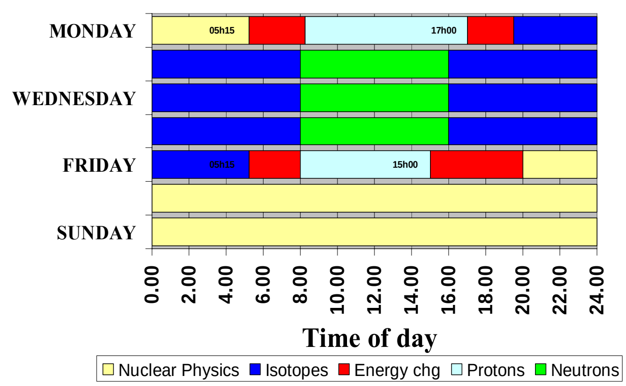
Beams delivered at iThemba LABS

Some beams at iThemba LABS			
Element	Mass	Energy range MeV	
		from	to
H	1	11.5	227
He	4	25	200
B	11	55	60
C	12	58	400
C	13	75	82
N	14	140	400
O	16	73	400
O	18	70	110
Ne	20	110	125
Ne	22	125	125
Al	27	150	349
Si	28	141	141
Cl	37	205	250
Ar	40	280	280
Zn	64	165	280
Kr	84	450	530
Kr	86	396	462
I	127	730	730
Xe	129	750	790
Xe	136	750	750

for 66 MeV Protons

- **Beam current on target: 100 μA**
- **Transmission efficiency: 99.9%**

CYCLOTRON OPERATING SCHEDULE



Brief and compact table with the facility's major experimental instrumentation and its capabilities:

1. Magnetic spectrometer:
   K=600 QDD with kinematic correction
   Angular acceptance 50msr, momentum byte 9%
   x and y vertical drift chambers and plastic scintillators in focal plane
   Energy resolution 1/9000 at 200 MeV
2. Afrodite gamma detector array
   9 clover detectors (EurogamII type) with BGO escape suppression
   8 4-fold segmented planar Ge detectors
   efficiency 1.6% at 1.33 MeV and 11% at 100 keV

3. A collimated fast neutron beam facility Neutrons from p + ^{7}Li or ^{9}Be at E_p up to 200 MeV
4. A large multi-purpose scattering chamber (1.2 m diameter)

Nature of user facility:

Yes, by the NRF.

Program Advisory Committee/experiment proposals:

Yes

Number of active users and their origin:

Number is based on actual use of facilities and collaborations with partners.

212 International
225 National

437 Total

Note: These are external users.

Percentage of users, and percentage of facility use (these numbers may differ) that come from inside the institution:

% Users: 20%
% Facility: 20%

Percentage of users and percentage of facility use from national users:

% Users: 51,5%
% Facility: 60,0%

Percentage of users and percentage of facility use from outside the country where facility is located:

% Users: 48.5%
% Facility: 40.0%

Fraction of the international users outside of geographical region:

48.5%

User Group:

Cape Town (Cyclotron Physics Group): 58

Cape Town (Materials Research Group): 108 users who are automatically part of the users group.

There is an official Users Advisory Committee comprising of eight members, chosen from disciplines to represent all users.

iThemba LABS (Gauteng): Yes, established recently. No records available. Currently rebuilding user base.

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

a) Permanent: 283
b) Temporary: 17
c) Postgraduates: 120

Number of theoretical staff employed at the facility: permanent, postdoctoral, students:

12 (twelve)

Number of postdoctoral researchers:

13 (thirteen)

Number of graduate students resident at the facility:

30 (thirty)

Number of non-resident graduate students with thesis work primarily done at the facility:

90 (ninety)

Special student programs:

Under-graduate and graduate vacation work during mid-year break (± one month).

Future Plans:

- New ECR Ion Source - components on order
- AFM acquisition: evaluating suppliers
- Major Radiation Medicine Centre: Seeking external funds (US$100m)
- Refurbishment of Tandem Accelerator (6 MeV) - completion end 2006.

SOUTH AFRICAN NUCLEAR ENERGY CORPORATION LIMITED (NECSA)

Beam line facilities at the SAFARI-1 research reactor
Beam line facilities at the Van de Graaff accelerator

30 km west of Pretoria, North West Province, South Africa

PO Box 582
Pretoria 0001
South Africa
Dr Van Zyl de Villiers, Acting Executive General Manager
Telephone: +27 12 305-5630
Facsimile: +27 12 305-5925
E-mail: vzdevill@necsa.co.za

Limited liability company under South African law

South African Government, through the Department of Minerals and Energy

Mr L.D.S. Thobejane, Chief Executive Officer

Heads of the facilities:

SAFARI-1 Research Reactor: Dr C.S.B. Piani
Beam Line Facilities of SAFARI-1 Research Reactor: Dr C.B. Franklyn
Van de Graaff Accelerator: Dr C.B. Franklyn

Scientific Mission and Research Programs:

Scientific mission:

To maintain, develop and exploit beam line instrumentation based at the SAFARI-1 research reactor and the Van de Graaff accelerator, for the benefit of the research community and industry such that world-class research, development and advanced training can be undertaken

Current research programs:

Application of non-destructive neutron and X-ray radiography and tomography imaging methods in materials investigations/characterisation such as, two-phase flow in porous media, distribution of minerals/elements in rocks and reverse engineering applications.

Analytical investigations of crystalline systems with neutron diffraction methods in the fields of crystallography, chemical composition, magnetism and residual stress applications.

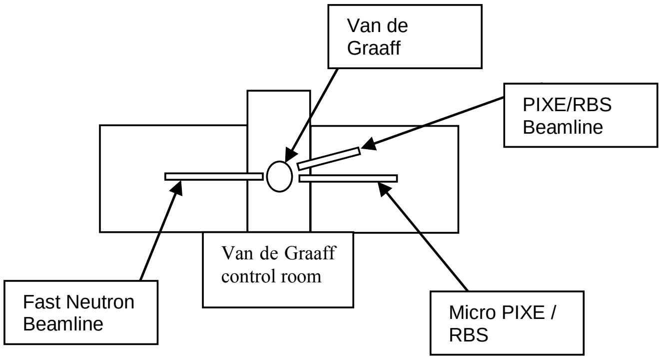
Materials analysis using the Van de Graaff beam lines. Techniques such as RBS and PIXE are used to determine elemental compositions and thin film thickness on a variety of geological and other samples.

Development of a plasma window that will be used to separate regions of high pressure from regions of low pressure. This research is targeted towards use of gas targets to generate fast neutrons as well as to bring a particle beam into atmosphere with minimal energy loss.

Generation of fast neutron beams using a variety of solid targets. Beams can be used to perform research in the field of neutron detection as well as to study fast neutron activation analysis. Specific project currently under way involves the detection and identification of contaminants within a bale of wool.

Future research programs:

Analytical investigations of polymers and nanomaterials with small angle neutron scattering.



Magnetic ordering investigations of thin films deposited on single crystal substrates using neutron diffraction methods.

Quantifying fluid flow phenomena within the trickle bed flow regime with radiography/tomography methods.

Mono-energetic fast neutron production using gas targets and plasma window technology.

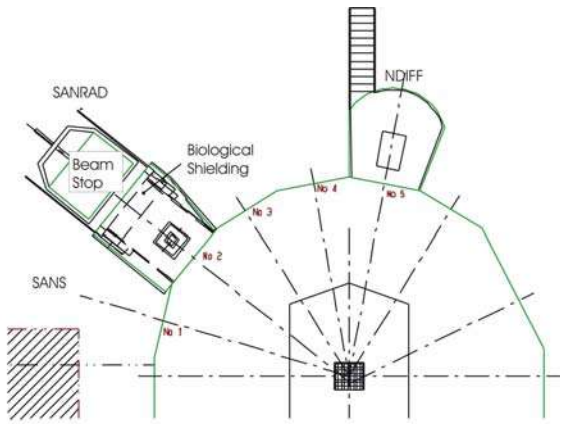
Using materials analysis techniques (such as RBS and PIXE) in atmosphere without restriction to the sample size. Also using plasma window technology.

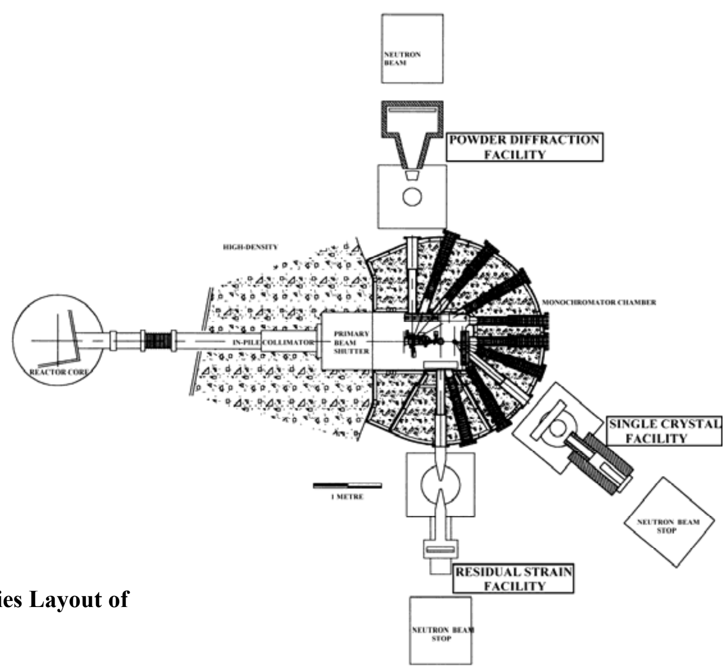
Technical facilities:

SAFARI-1: Present beam line facilities encompass radiography/tomography with the availability of thermal neutron or x-ray beams (SANRAD), and neutron diffraction used in neutron single crystal diffraction, neutron powder diffraction, magnetism and residual stress (NDIFF).

A small angle neutron scattering (SANS) facility is under development.

Layout of SAFARI-1 beam line facilities





Schematic of the SAFARI-1 beam line facilities Layout of neutron diffraction (NDIFF) facility

Van de Graaff accelerator: Facilities exist for fast neutron science, ion beam analysis and micro PIXE (particle induced x-ray emission) investigations.

Layout of Van de Graaff accelerator beam line facilities

Characterization of the facility:

SAFARI-1 research reactor: 20 MW pool-type light water cooled and moderated reactor Van de Graaff accelerator: 4MV; used for ion beam analysis and fast neutron scattering studies.

Facility Parameters:

SAFARI-1 beam line facilities	
Description	Parameters
SANS	Beam species: Thermal to slow neutrons within wavelength range: 3 – 10 Å selectable by velocity selector.
Radiography	Beam species: Thermal neutron beam (300mm in diameter) or tungsten X-rays. Usable in radiography or tomography configurations. Thermal neutron flux 10^7 $n.cm^{-2}.s^{-1}$ at a collimation ratio of 125. Continuous x-ray energies at 100kV.
Diffraction	Beam species: Thermal neutrons with wavelength and resolution selectable in the wavelength range 1 - 2 Å by single crystal monochromators. Three independent instruments setup exist in single crystal, powder diffraction and residual stress configurations. Thermal neutron flux 10^6 $n.cm^{-2}.s^{-1}$.

Van de Graaff beam line characteristics	
Parameter	Characteristics
Energy	0.6 – 4.0 MV
Beam species	H^+, D^+, $He^{+(+)}$, $^3He^{+(+)}$, N^{3-5+}
Beam current	nA to 200 µA
Beam type	Mass analysed, DC beam and 1.3 or 6MHz pulsed beam

Major experimental instrumentation and its capabilities:

SAFARI-1 beam line facilities

Neutron diffraction	
Experimental instrumentation	Capabilities
Single crystal diffractometer	Investigation of medium sized unit cells. Four circle diffractometer.
Powder diffractometer	Equipped with two-dimensional position sensitive detector array covering 20º in diffraction angle in high-resolution setting and 30º in medium-resolution setting for fast data acquisition. Diffraction pattern recording range 5º to 135º.
Residual stress diffractometer	Equipped with Si-multiwafer monochromator that enables intensity / resolution optimisation at specific detector angle. Coupled with position sensitive detector gives resolution of $\Delta d/d < 10^{-4}$.

Radiography	
Experimental instrumentation	Capabilities
Neutron radiography	Variable collimation ratio (L/D) for resolution and image sharpness: L/D (125 → 500) up to 50µm resolution for film and 0.1mm for CCD imaging.
X-ray radiography	Variable L/D for resolution and image sharpness.
Tomography	Peltier cooled CCD camera, Pentax lenses to improve field of view and full 3D image reconstruction.

Van de Graaff beam line facilities

Experimental instrumentation	Capabilities
Rutherford Backscatter (RBS)	Materials and thin film analysis
Particle Induced X-ray Emission (PIXE)	Determination of elemental composition of materials
Fast Neutron Science	Generation and detection of fast neutrons for application to activation analysis and radiography.
Isotopic sources	Various characterisation and analytical techniques for evaluation of materials non-destructively and for training purposes.

Nature of user facility:

Yes, officially by Necsa. Facilities are freely available to users from academia and on a proprietary base to industry.

Program Advisory Committee/Experiment Proposals:

In principle, but not yet formalised.
Number of actual, active users of the facility in a given year:

SAFARI-1

SANS:	1
Radiography:	7
Diffraction:	10

Van de Graaff accelerator

IBA:	5
FNS:	2

Users are defined as institutions for which investigations are performed within various formats of collaboration such as Necsa personnel performing the investigations with student/client participation based on project proposals/contracts, as well as in-house facility development and capability/technology establishment.

Percentage of users, and percentage of facility use that come from inside the institution:

SAFARI-1

SANS:	Users:	100%
	Facility use:	100%
Radiography:	Users:	10%
	Facility use:	20%
Diffraction:	Users:	5%
	Facility use:	30%

Van de Graaff accelerator

Users:	50%
Facility use:	80%

Percentage of users and percentage of facility use from national users:

SAFARI-1

SANS:	Users:	0%
	Facility use:	0%
Radiography:	Users:	80%
	Facility use:	75%
Diffraction:	Users:	95%
	Facility use:	70%

Van de Graaff accelerator

Users:	50%
Facility use:	20%

Percentage of users and percentage of facility use from outside the country where your facility is located:

SAFARI-1

Radiography:	10%
Diffraction:	0%

Van de Graaff Accelerator

Users:	0%
Facility use:	0%

Various potential collaboration opportunities are being discussed with Africa, Europe and North-America.

Fraction of international users outside of geographical region:

Australia & New Zealand (50%); Europe (50%).

Does a formal users group exist for your facility(s) and what is the number of registered members:

Not yet convened

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) 15 b) 3

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

None

Number of postdoctoral researchers:

2

Number of graduate students resident at the facility:

None

Number of non-resident graduate students with thesis work primarily done at the facility:

3

Involvement of undergraduate students in research (approximate average number per year):

4

Special student programs:

Undergraduate and graduate student labs
Graduate student practicals and projects

Future Plans:

SANS: Facility development in implementation stage for commissioning within the next year.

Radiography: Upgrade of beam line to optimise neutron spectrum and reduce neutron scattering within SANRAD and beam hall to start in 2007.

Establish a national radiography center for research and development over the next five years.

Diffraction: Substantially upgraded neutron powder diffraction facility is being developed in-house; scheduled for commissioning by the third quarter of 2005.

Establishment of a second-generation residual stress facility to be done in collaboration with the Hahn Meitner Institute in Germany. Formation of an international consortium of neutron residual stress instruments for collaborative research programs, backup and future development.

Further beam line facilities may be developed as the need arises.

OVERVIEW OF SCIENCE

A. SAFARI-1 beam line facilities

Neutron beams not only provide supplementary probes to X-rays in material characteristic investigations, but in many cases provide unique analytical and diagnostic capabilities. This emanates from their distinct interaction mechanisms with matter that are fundamentally different to X-rays. With neutrons the interaction with matter is a nuclear interaction with the atomic nuclei, compared to x-rays where the interaction is an electromagnetic interaction with the orbital electrons.

The properties of neutrons are listed together with their subsequent advantages:

Wave properties: Wavelengths selectable to the magnitude of various phenomena in matter, e.g. from those comparable with the interatomic spacing in crystalline materials (1 – 5 Å), through ordering phenomena in polymers and micro defects such as precipitates (sizes 1000 Å), up to macro defects micrometer to millimeter in dimension.

No charge combined with nuclear interaction mechanism: Dense matter is substantially less dense due to the interaction range being in the order of femtometers. This enables deep penetration into solid matter that is at least 1000 times larger than x-rays.

This superior penetrating capability enables easy manipulation of the sample environment such as high and low temperatures, externally applied magnetic fields, high pressures, inducing liquids such as water (deuterated water), etc. to facilitate parametric studies of material properties and responses.

Nuclear interaction: Interaction probabilities are independent of the atomic number and do not only vary from element to element, but even from isotope to isotope. This provides enhanced sensitivity to materials containing high neutron absorbing elements such as hydrogen, lithium, boron, cadmium, gadolinium, etc., contrast between the transition metal series and the rare-earths that are chemically very similar.

Intrinsic spin: This enables a direct probe of magnetic phenomena in matter that originating from unpaired electrons.

This suite of properties provide excellent probes for the investigation of crystalline materials at the microstructural level, 10^{-10} m, using diffraction methods, micro defects of dimension 10^{-6} m using small angle neutron scattering, and macro defects and phenomena of dimension 10^{-3} m and larger using radiography/tomography imaging methods.

B. Van de Graaff accelerator

Various particle beams can be generated and applied in the investigation of surface material properties using ionised beams, or internal properties using fast neutrons. Ion beam analysis techniques such as PIXE and RBS enable high elemental sensitivity in the parts per billion range as well as the determination of layer compositions and thicknesses in thin film systems.

Fast neutron beams are generated by accelerating ions into a selected target (gas or solid). This induces a nuclear reaction that results in the emission of the neutrons, which can then be used to perform analytical tasks such as activation analysis and radiography. Both the production and detection of fast neutrons form vast fields of research. On the side of production we are currently developing a system that would be able to produce mono-energetic fast neutrons, which could be used in applications ranging from the mining industry to airport security to the textile industry. On the detection side we intend to establish a fast neutron radiography and tomography system using the VDG in collaboration with the SAFARI-1 beam line facilities.

BEIJING TANDEM ACCELERATOR NUCLEAR PHYSICS NATIONAL LABORATORY (BTANPNL ATTACHED TO DNP) CHINA INSTITUTE OF ATOMIC ENERGY(CIAE), DEPARTMENT OF NUCLEAR PHYSICS (DNP BELONGS TO CIAE)

Beijing

P. O. Box 275(80)
Beijing 102413, China
Telephone: (0086)-10-69358015
Facsimile: (0086)-10-69357787
E-mail: wpliu@iris.ciae.ac.cn

DNP belongs to CIAE, and BTANPNL is attached to DNP.

Construction: National Committee for Development and Reform
Operation: Ministry of Finance
Funding applicable: National Science Foundation of China (NSFC) and Ministry of Science and Technology

Zhixiang Zhao

Head of the facility:

Weiping Liu

Scientific Mission and Research Programs:

The present research areas of CIAE-DNP are heavy ion physics, nuclear astrophysics, nuclear theory, measurement of nuclear data, application of nuclear physics such as accelerator mass spectroscopy, atomic physics, radiation physics, accelerator technology in the energy range from 2 to 10 A MeV. The BRIF(Beijing Radioactive Ion Beam Facility) project is under construction and includes a 100 MeV, 200 micro A compact proton cyclotron (as a driving machine of unstable nuclei), isotope separator on line and a 2 MeV/q super conducting energy booster after existing 15 MV tandem accelerator (for acceleration of stable and unstable nuclei).

Characterization of the facility:

150 kV neutron generator

15 MV tandem accelerator

100 MeV proton cyclotron (under construction)

Table of facility parameters:

Tandem accelerator

Ion species of Stable nuclei: p to U

Max. Energy: 15 MeV*q

Intensity: up to 2 p micro A

Momentum spread: 30 keV

RIB (A<180): neutron-rich, proton-rich (under construction)

10**(7-12) pps (RIB)

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

The major experimental instrumentation includes: radioactive beam line (GIRAFFE), neutron time of flight spectrometer, Q3D heavy ion spectrometer, accelerator mass spectroscopy, in-beam g experimental terminal, ECR platform, irradiative terminal for materials science research, atomic physics terminal, ion source laboratory and public electronic pool.

Nature of user facility:

BTANPNL is a National Laboratory of China.

Program Advisory Committee/experiment proposals:

BTANPNL has a Science Advisory Committee to evaluate experiment proposals and to advise the research activities.

Number of active users and their origin:

There are more than 200 formal users in the last five years.

Percentage of users, and percentage of facility use that come from inside the institution:

About 30~40% of users come from outside the institute.

Percentage of users and percentage of facility use from national users:

About 90% of users are national users, and they use 90% beam-time of the facility.

Percentage of users and percentage of facility use from outside the country where your facility is located:

About 10% of users come from outside of China and 10% of facility use from outside of China.

Fraction of the international users outside of geographical region:

Up to now the international users are from Asia and North America.

User Group:

Most of the users are members of a formal user group and they have had very close collaboration with the institute for a long time.

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

There are roughly 200 permanent staff and 50 temporary staff.

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

There are 10 permanent theoretical staff and 10 temporary staff (including post-doctoral fellows, graduate students and long term visiting scientists)

Number of postdoctoral researchers:

About 2.

Number of graduate students resident at the facility:

About 50.

Number of non-resident graduate students with thesis work primarily done at the facility:

About 10.

Involvement of undergraduate students in research (approximate average number at a given time):

About 50/year.

Special student programs:

Joint summer school every two years together with universities. Student lectures in universities.

Future Plans:

The BRIF project (mainly 100 MeV proton cyclotron) is under construction, and will be commissioned in 2009; and BRIFII project (mainly RFQ-DTL-SC LINAC and experimental facilities) is planned. Together in the near future they will provide normal and unstable beams up to 10 MeV/u or 34 MeV/q, with a full spectrum of instruments like a versatile magnet spectrometer, Gamma array, decay measurement, large area and micro beam radiation stations, etc.

HEAVY ION RESEARCH FACILITY IN LANZHOU (HIRFL) INSTITUTE OF MODERN PHYSICS (IMP) CHINESE ACADEMY OF SCIENCES (CAS) /

Lanzhou, China

509 Nanchang Road
730000 Lanzhou China

Telephone: (0086)-931-4969500
Telephone: (086)931-4969226
Facsimile: (0086)-931-8272100
Email: mingxie@impcas.ac.cn
Email caixh@impcas.ac.cn

National Laboratory of China

Funding for construction comes from the National Committee for Development and Reformation of China.
Funding for operation comes from the Ministry of Finance of China.
Funding from CAS and the National Science Foundation of China (NSFC) are applicable.

Wenlong Zhan

Head of the facility:

Baowen Wei

Scientific Mission and Research Programs:

The present research missions of IMP are heavy ion physics, atomic physics, irradiative material science, biology physics, accelerator physics and technology in the energy range from few eV to 100 AMeV. The

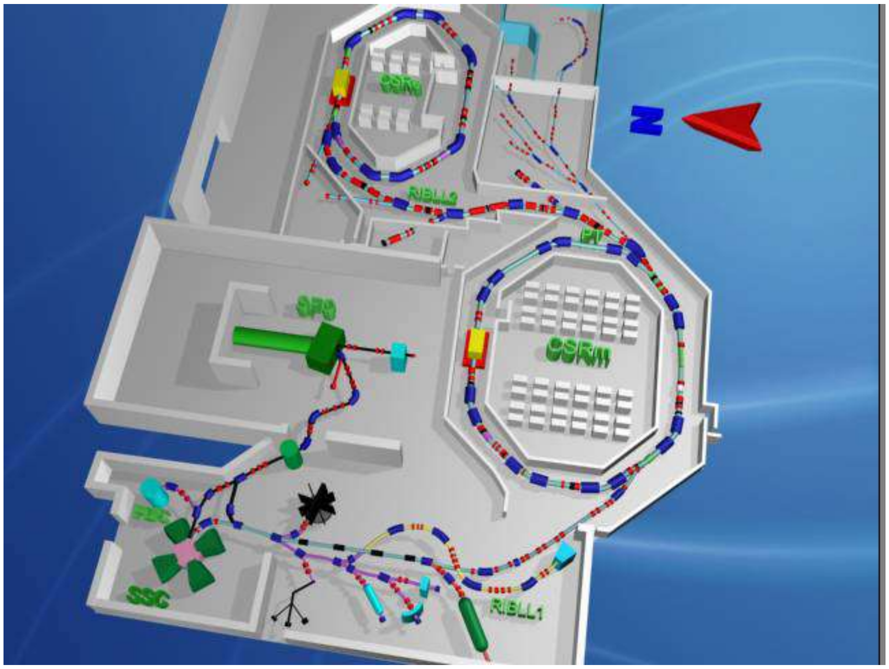
project of heavy ion cooling storage is under construction which may extend the maximum beam energy to 1000AMeV. The hadron physics, cancer therapy and high energy density physics will be the missions in near future.

Characterization of the facility:

320 kV ECR ion high voltage platform

SFC cyclotron: K=69 and full ion accelerator
SSC cyclotron: K=450 and full ion accelerator
CSRm cooler synchrotron 12.2 Tm
CSRe cooler storage ring 9.4 Tm

Technical facilities:



Facility Parameters:

CSRm	
Ion species	Stable nuclei: P — U
Max. Energy	3.7GeV/c(p),1.1GeV/u($^{12}C^{6+}$), 520MeV/u($^{238}U^{72+}$)
Intensity	10^5—10^{11} ppp (Stable nuclei)
Momentum spread	$\frac{\Delta p}{p} \sim 10^{-4}$ (Stable nuclei)
Experiment mode	External-target, Internal-target
CSRe	
Ion species	Fully stripped heavy ions: P — Ta H-like, He-like heavy ions: Ta — U RIB (A<180): neutron-rich, proton-rich
Max. Energy	2.2GeV(p), 750 MeV/u ($^{12}C^{6+}$), 500 MeV/u ($^{238}U^{92+}$)
Intensity	10^{11-16} pps (Stable nuclei, internal target) 10^{7-12} pps (RIB, internal target)
Momentum spread	$\frac{\Delta p}{p} < 10^{-5}$
Experiment mode	Internal-target

Major experimental instrumentation and its capabilities:

The major experimental instrumentation includes: radioactive beam line (RIBLL, RIBLL-II), CSRe internal experimental setup with mass, livetime measurement and laser instruments, SHE spectrometer, mini 4π charged detector-MUDAL, in-beam γ experimental terminal, ECR platform, 320kV ECR platform, irradiative terminal for materials science research, irradiative terminal for biology research, cancer therapy terminal, atomic physics terminal, laser laboratory and public NIM pool. The general and some special instruments, detectors and electronics for nuclear physics, atomic physics, materials sciences and biology physics are available.

Nature of user facility:

HIRFL is officially a National Laboratory of China.

Program Advisory Committee/experiment proposals:

HIRFL has a Science Advisory Committee to adjudicate experiment proposals.

Number of actual, active users of the facility in a given year:

There are more than 200 formal users in the last five years.

Percentage of users, and percentage of facility use that come from inside the institution:

About 30~40% of users come from outside the institute.

Percentage of users and percentage of facility use from national users:

About 90% of the users are national users, and they use 90% of the beam-time of the facility.

Percentage of users and percentage of facility use from outside the country where your facility is located:

About 10% of the users come from outside of China and less than 5% of the facility use is from outside of China.

Fraction of international users outside of geographical region:

Up to now the international users are from Asia, Europe. And Africa.

User Group:

The most of users are formal user group and they have had very close collaboration with the institute for a long time.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

There are roughly 400 permanent staff and 100 temporary staff.

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

There are less than 6 permanent theoretical staff and 40 temporary staff (including post-doctoral fellows, students and the temporary staff of the theoretical centre of the National Lab)

Number of postdoctoral researchers:

About 10.

Number of graduate students resident at the facility:

About 110.

Number of non-resident graduate students with thesis work primarily done at the facility:

About 110.

Involvement of undergraduate students in research (approximate average number per year):

About 50/year.

Future Plans:

Facilities for cancer therapy including a booster, high current linear injector and molecular injector for the experimental ring are in planning in the near future. A big facility for high energy density physics is under consideration.

SHANGHAI LASER ELECTRON GAMMA SOURCE (IN THE PLANNING) SHANGHAI INSTITUTE OF APPLIED PHYSICS, CAS, CHINA

Pudong New District, Shanghai, China

P.O. Box 800-204
No. 2019, Rd. Jialuo
Shanghai, 201800, China
Telephone: 86+21-59553998
Facsimile: 86+21-59553021
Email: ygma@sinap.ac.cn

National Lab of China

Chinese Academy of Science
National Natural Science Foundation of China

Prof. Hong-Jie Xu

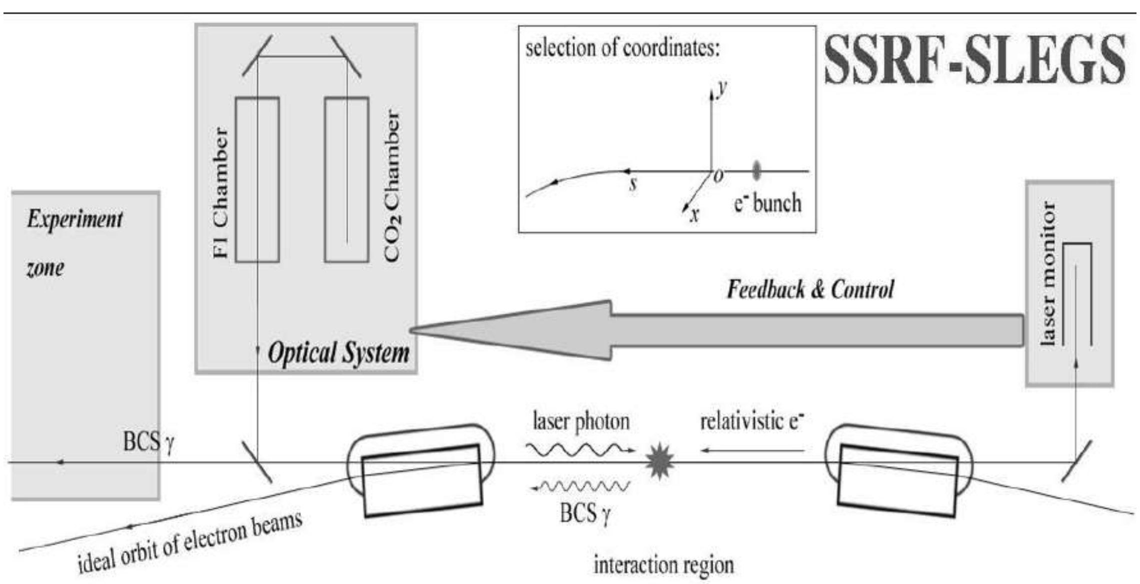
Head of the facility:

Prof. Yu-Gang Ma

Scientific Mission and Research Programs:

We plan to build a low-energy γ-ray beam line (SLEGS) at the under constructed Shanghai Synchrotron Radiation Facility (SSRF). By Compton back-scattering (BCS) of infrared or far-infrared laser lights from 3.5 GeV electrons circulating in the storage ring of SSRF, high intense quasi-monochromatic BCS γ-rays with high linear or circular polarization ranging 1~25MeV will be produced. It can be widely applied to fundamental researching fields of nuclear physics and nuclear astrophysics, such as accurate measurement of cross sections of photon reaction in nuclei, nuclear resonance fluorescence experiments, nuclear giant resonances, accurate measurement of the inverse capture cross sections important for astrophysics.

Technical facilities:



Characterization of the facility:

MeV BCS γ-ray source based on Synchrotron Radiation Facility

Facility Parameters:

beam species: γ-ray

intensities: 10^{8}~10^{10} s^{-1}

range of energies: 1~25MeV

linear or circular polarization: >80%

Nature of user facility:

unofficially

Program Advisory Committee/experiment proposals:

Not yet

Number of actual, active users of the facility in a given year:

No

Percentage of users, and percentage of facility use that come from inside the institution:

No

Percentage of users and percentage of facility use from national users:

No

Percentage of users and percentage of facility use from outside the country where your facility is located:

No

Fraction of international users outside of geographical region

No

User Group:

No

INTER-UNIVERSITY ACCELERATOR CENTRE (FORMERLY KNOWN AS NUCLEAR SCIENCE CENTRE)

New Delhi, India

Inter-University Accelerator Centre
Aruna Asaf Ali Marg
P.O.Box 10502
New Delhi-110067

Telephone: +91-11-26893955
Facsimile: +91-11-26893666
E-mail: root@iuac.ernet.in

Autonomous Inter-University Research Institute of University Grants Commission of India
University Grants Commission, Department of Science & Technology, Govt of India

Dr. Amit Roy, Director

Heads of the facilities:

Dr. R.K.Bhowmik, Programme Leader, Nuclear Physics; ranjan@iuac.ernet.in
Dr. D. Kanjilal, Programme Leader, Accelerator; dk@iuac.ernet.in
Dr. D.K. Avasthi, Programme Leader, Materials Sciences; dka@iuac.ernet.in

Scientific Mission and Research Programs:

Inter-University Accelerator Centre (IUAC), an inter-university research institution, was set up by the University Grants commission of India as an autonomous body in the year 1988 with a primary objective of providing a front ranking accelerator-based research facility for undertaking internationally competitive research by university personnel and promoting both basic and applied research in multi-disciplines. Research activities by the user community are in the areas of Nuclear Physics, Materials Science, Atomic Physics and Radiation Biology.

Technical facilities:

Figure 1. Arrangement of the QWR cavities in the first Linac module.

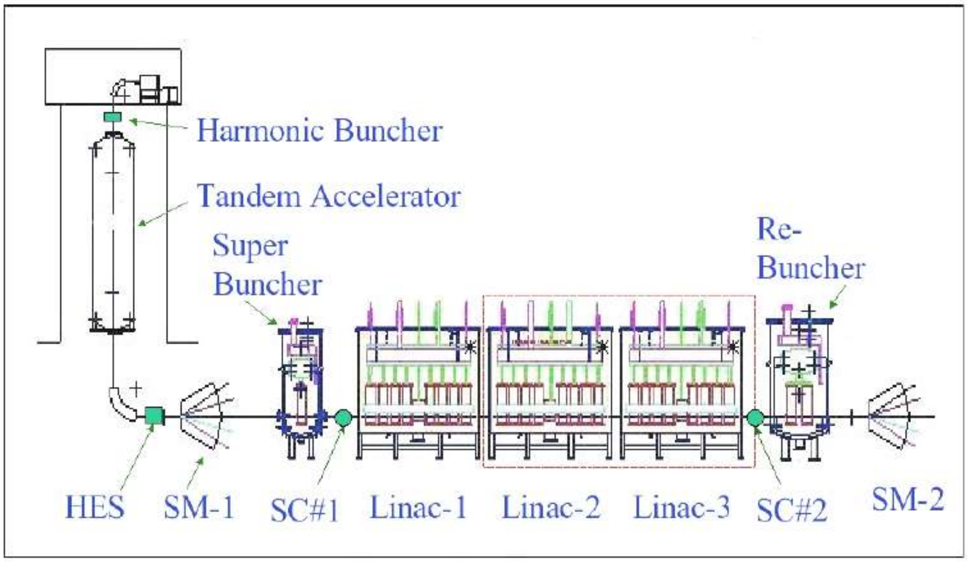
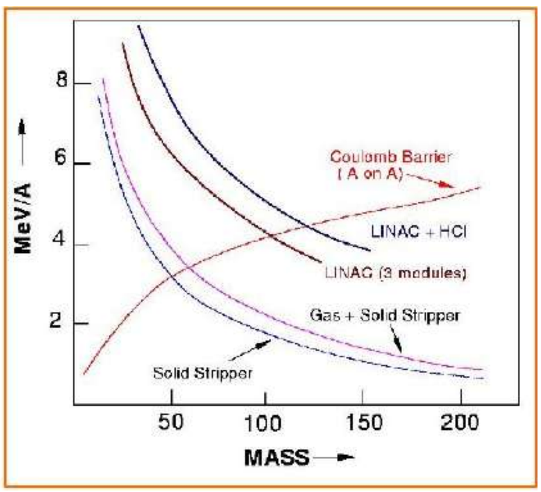


Figure 2. Layout of the 15 UD Pelletron(Tandem) Accelerator and the Superconducting Linac Booster. Linac Booster consists of 3 modules, each having 8 Quarter Wave Resonators. First module is in operation currently.

Characterization of the facility:

Heavy ion tandem + superconducting linac



Facility Parameters:

Beam Current is in the range of 1-10 pnA for most species Pulsed beams with time width in the range 1ns(for protons) to 2 ns(for heavier ions) at 12 MHz repetition rate are delivered

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Instrument	Capability
Gamma Detector Array,	For high-spin spectroscopy. It consists of 12 Compton suppressed HPGe detectors with a 14 element BGO multiplicity detector. It can be augmented with Recoil-distance device, Mini-orange spectrometer and a Charged-particle array.
Neutron Array,	For neutron multiplicity and energy measurements through time-of-flight. It is a 22 element array of 5" x5" liquid scintillator detectors.
Heavy Ion Reaction Analyser,	Mass spectrometer for reaction products, Mass resolution ~1/300, Beam rejection $\sim 10^{-12}$. has been used for measurement of sub-barrier fusion ans transfer reactions. Used for production of ^{7}Be beam .
Hybrid Recoil Analyser	A mass spectrometer for reaction products. Can be operated in either vacuum mode or gas-filled mode. In vacuum mode mass resolution ~1/300 and good efficiency for inverse kinematic reactions. In gas-filled mode good efficiencey (~20-30%) for recoils in the mass region ~200.
Indian National Gamma Array,	A 24 clover Ge detector array is being set-up for high spin spectroscopy. It would have accessories like, plunger for lifetime measurements, a few planar Ge detectors for low energy gamma detection, a compact charged particle ball. Two-thirds of the array can be coupled to the spectrometer HYRA for recoil tagging.
UHV Scanning Tunnelling	For materials science studies

Microscope, Atomic Force Microscope,Low Temp Cryostat with 8T magnet.	
Elastic Recoil Detection Analysis, Three-axis Goniometer, In-situ X-ray reflectivity, In-situ photoluminescence, In-situ X-ray Diffractometer.	For on-line materials science interaction studies with swift heavy ions.
Single & Two foil Beam-foil spectroscopy	Lifetime measurement of electronic states highly charged ions.
Low Energy Multiply charged ion beams	Multiply charged ion beams in the energy range : a few keV to few MeV. Equipped with two beam lines. Facility for ion implantation , Atomic and Molecular collissions with multiply charged ions, Time of Flight spectrometer, Liquid droplet targets.
Low-flux irradiation facility, Irradiation in air & Vacuum	The heavy ions from the Pelletron are scattered and diffused to give uniform irradiation over an area with diameter ~3 cm at flux of 10^3 - 10^7 /cm2/sec.

Nature of user facility:

Yes, it is a user facility of UGC

Program Advisory Committee/experiment proposals:

There is an Accelerator Users Committee which adjudicates the experimental proposals.

Percentage of users and percentage of facility use from national users:

95% of users and 100% facility users are from within the country.

Percentage of users and percentage of facility use from outside the country where your facility is located:

About 5% of users are from outside India.

Fraction of international users outside of geographical region:

100% of the international users are from outside region, viz, Europe and North America

Does a formal users group exist for your facility(s) and what is the number of registered members:

No, there is no registered users group. However, the total number of users is ~ 300 currently.

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

a) 100 scientists and technicians

b) 10 graduate students and post doctoral researchers

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

None

Number of postdoctoral researchers:

4

Number of graduate students resident at the facility:

12

Number of non-resident graduate students with thesis work primarily done at the facility:

80 currently

Involvement of undergraduate students in research (approximate average number per year):

None

Special student programs:

Two weeks programmes are held for students at the Masters level, Graduate courses are given for Ph.D. students

Future Plans:

A High Current alternate Injector based on ECR source, Radio-frequency Quadrupole and drift-tube linac is planned.

Also planned are a neutron array and upgrade of the Indian National Gamma Array.

KOLAKATA SUPERCONDUCTING CYCLOTRON (VARIABLE ENERGY CYCLOTRON CENTRE)

Kolkata, West Bengal, India

1/AF, Bidhan Nagar
Kolkata – 700064, India
Telephone: +91 33 2337-1230
Facsimile: +91 33 2334-6871
E-mail : bhandari@veccal .ernet.in

Funding for the construction & operation comes from Department of Atomic Energy, Government of India.

Dr. Bikash Sinha, Director

Head of the facility:

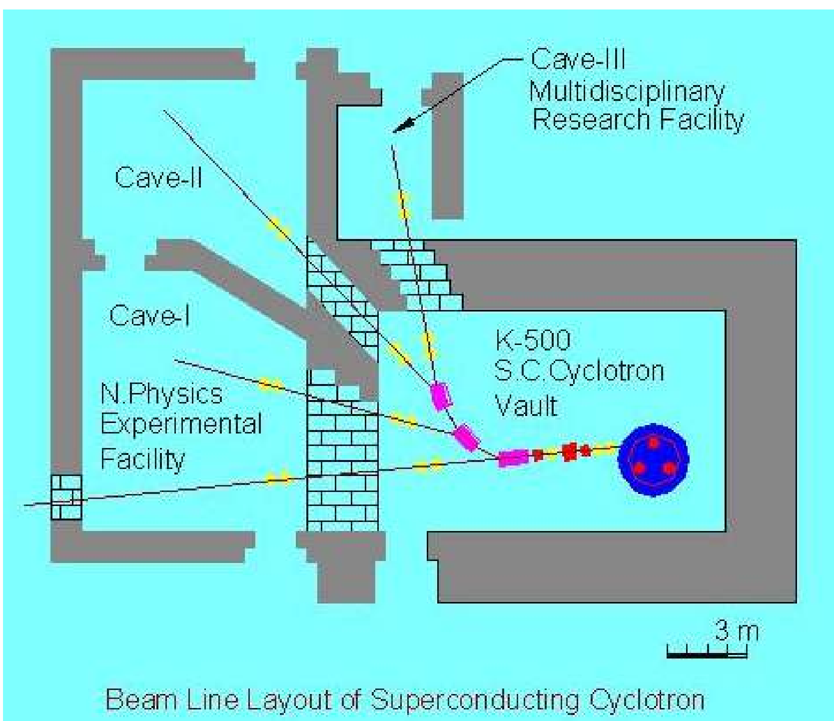
Dr. R. K. Bhandari, Associate Director

Scientific Mission & Research Program:

The overall mission of the K-500 Superconducting Cyclotron is to provide fore front research opportunities for the scientific community. This cyclotron will deliver heavy ion beams up to 80MeV/nucleon. It will be a national facility for universities and research institutions for undertaking research in nuclear physics, material science, nuclear chemistry, biology etc. Another mission of this project is to gain expertise in development of superconducting magnet and cryogenic technology. The facility will become operational in 2007.

Technical Facilities:

Electron Cyclotron Resonance (ECR) ion sources will be used to produce ions for acceleration. The ion beam will be injected axially through top of the cyclotron magnet and accelerated by the cyclotron to ~80MeV/A for light ions and ~10MeV/A for heavy ions. There will be four beam lines in the first phase – three for nuclear physics and one for the other experiments.



Beam Line Layout of Superconducting Cyclotron

Facility parameters:

Following table shows the range of beams with expected energy & intensities

Beam	Energy (MeV/A)	Maximum intensity (pnA)
d	80	500
α	70	500
Li	70	100
B,C, N, O, Ne	70	100
S, Ar	55	100
Kr	40	50
Xe	30	50
Ta	10	30

User facilities *(currently under development)*:
Main instrumentation for nuclear physics experiments & other experimental programs:

1. Scattering chamber (90cm diameter & 50 cm long, vertical type).
2. 50 detector BaF2 array.
3. CsI charge particle array for gamma ray spectroscopic studies.
4. HPGe detectors
5. Segmented LEPS detector.
6. X-ray diffractometer
7. Target laboratory.
8. Si-detector laboratory.
9. Electronics laboratory.
10. HPLC System,
11. Low background counting laboratory.

Program Advisory Committee /Experimental proposals:

At present the VEC Users' Committee reviews the experimental proposals.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) 470 (VECC)
b) 29 (VECC)

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

Permanent: 11 (VECC)
Postdoctoral: 1 (VECC)
Student: 1 (VECC)

Number of postdoctoral researchers:

3 (VECC)

Number of graduate students resident at the facility (>80% of their time):

14 (VECC)

Number of non-resident graduate students with thesis work primarily done at the facility:

2 (VECC)

Special student programs:

Vacation programs/projects for undergraduate students (Science & Engineering), are organized of durations ~1-2 months.

Future Plans:

1. Scattering chamber (100cm diameter & 200cm long, horizontal type).
2. Charged particle detector array: Each detector in the forward part of the array (covering angular range ~ 5° - 40°) has been planned to be made up of 3 detector elements in telescope configuration. Each detector telescope will consist of (i) thin Si-strip ΔE detector (Size: 5cm x 5cm, thickness: 30 – 50 μm, 16 strips, one-sided), followed by (ii) thick Si-strip ΔE/E detector (Size: 5cm x 5cm, thickness: 500 μm – 1mm, 16 strips, double-sided, X-Y directions), and (iii) 4 CsI(Tl) crystals (Size: 2.5cm x 2.5cm, thickness: 4 – 6cm). Backward part of the array will be consist of ~250 Si+CsI telescopes.
3. Neutron multiplicity detector: Neutron multiplicity detector is a large tank of Gd-loaded liquid scintillator, read out using PMTs. The neutron detector is planned to be designed in such a way that the charged particle array can be placed within the neutron detector, rendering it possible to measure simultaneously the neutrons as well as charged particles.
4. High energy gamma detector array: The array will consist of 162 BaF2 detectors (each of size: 3.5cm x 3.5cm x 35cm).
5. Ion trap: It is used for trapping low energy ions in magnetic field. Typical field required is ~5T, which is planned to be provided by a superconducting solenoid.
6. Multidisciplinary research facility: Low temperature irradiation setup. Acoustic emission setup etc.

VARIABLE ENERGY CYCLOTRON CENTRE

Calcutta, India

Sector 1, Block AF
Bidhan Nagar
Calcutta 700 064
India
Telephone: +91 33 23371230 to 33
Facsimile: +91 33 23346871
E-mail: vectldsc@veccal.ernet.in

Under the Department of Atomic Energy (DAE),
Government of India
Funded by DAE

Dr. Bikash Sinha

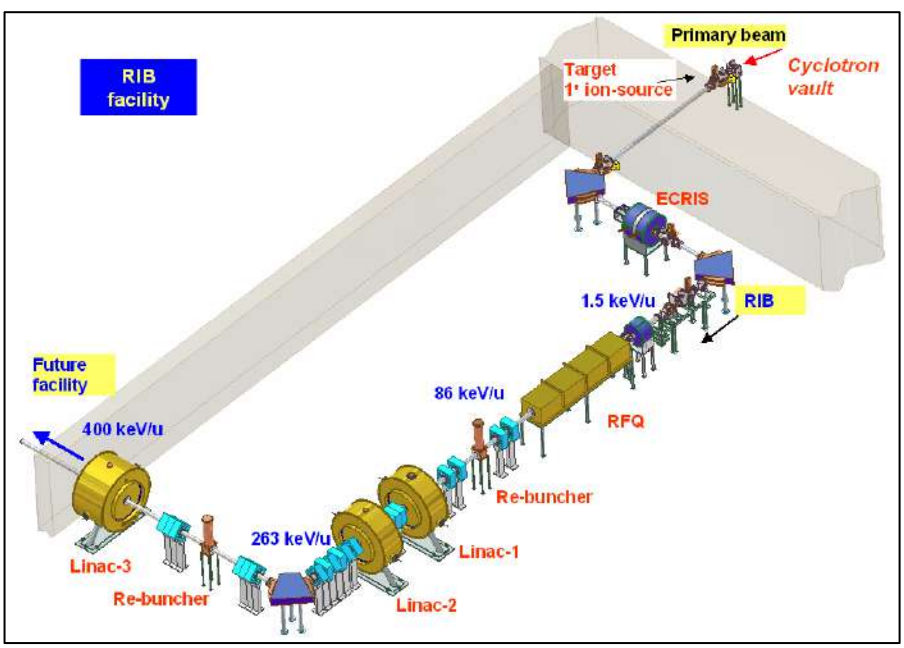
Head of the facility:

Radioactive Ion Beam Facility at VECC**:** Alok Chakrabarti

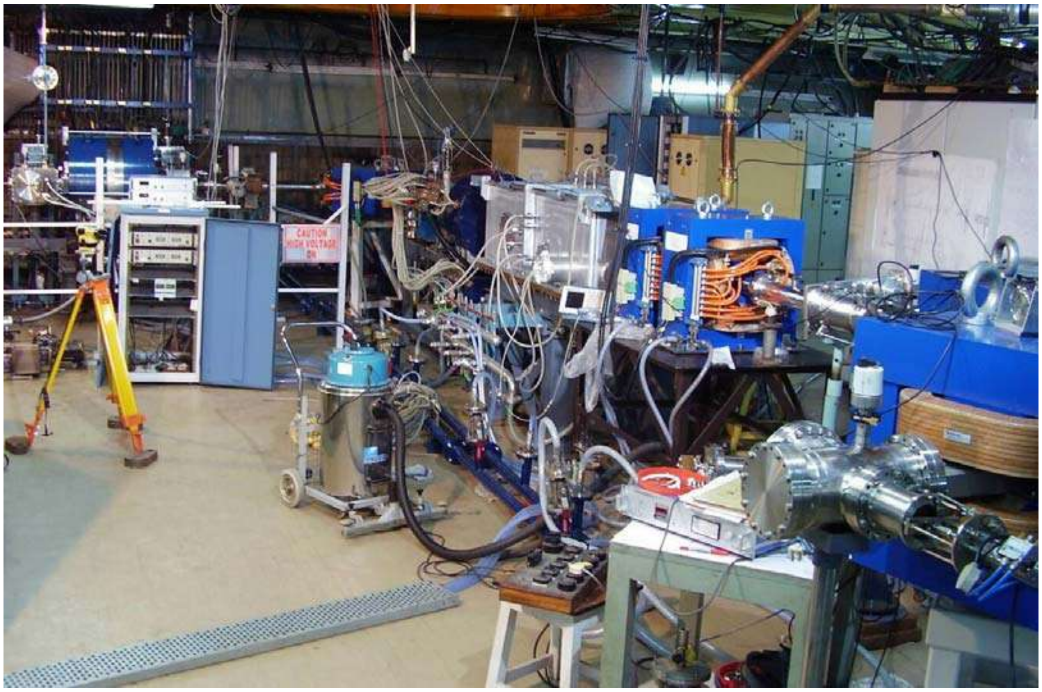
Technical facilities:

VECC RIB Facility

- ISOL type facility; RIB acceleration to 400 keV/u is funded
- Primary accelerator: VEC K130 cyclotron (p, α) ; 50 MeV Electron-Linac (proposed)
- Present status: stable beams accelerated to 30 keV/u at the end of RFQ; new RFQ for acceleration to 86 keV/u & three IH-Linac tanks to achieve 400 keV/u under construction; thick target and charge breeder R&D continuing
- Group strength 20 – Physicists (7); Engineers (8); Technicians (3); Post-Docs (2)



VECC RIB facility layout



Program Advisory Committee/ experiment proposals:

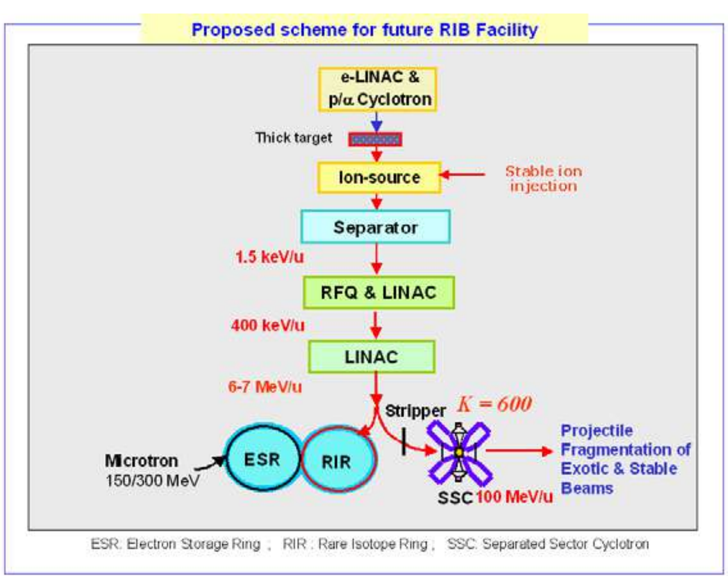
International Advisory Committee for SCC and RIB project & Project Implementation Committees have been over-viewing the projects

Special student programs:

Summer Internship programmes for graduate students from Universities, Indian Institutes of Technology and other colleges are conducted

Future Plans

- Acceleration of up to 400 keV/u is expected to be complete by middle of 2008
- In the second phase (year 2008 and beyond), the option of using electron linac for production of neutron-rich RIB through photo-fission route and acceleration of RIB using linacs up to about 6-7 MeV/u is under consideration. Finally, it is proposed to inject the 6-7 MeV/u RI as well as stable beams into a Separated Sector Cyclotron for further acceleration to about 100 MeV/u.



224 CM VARIABLE ENERGY CYCLOTRON (VEC)
VARIABLE ENERGY CYCLOTRON CENTRE (VECC)

Kolkata, India

1/AF, Bidhan Nagar
Kolkata-700 064
India
Telephone: +91 33 2337-1230
Facsimile: +91 33 2334-6871 & 2334 1110
E-mail: bhandari@veccal.ernet.in

VECC is a unit of the Department of Atomic Energy, Government of India
Government of India

Dr. Bikash Sinha, Director

Head of the facility:

Dr. R. K. Bhandari, Associate Director

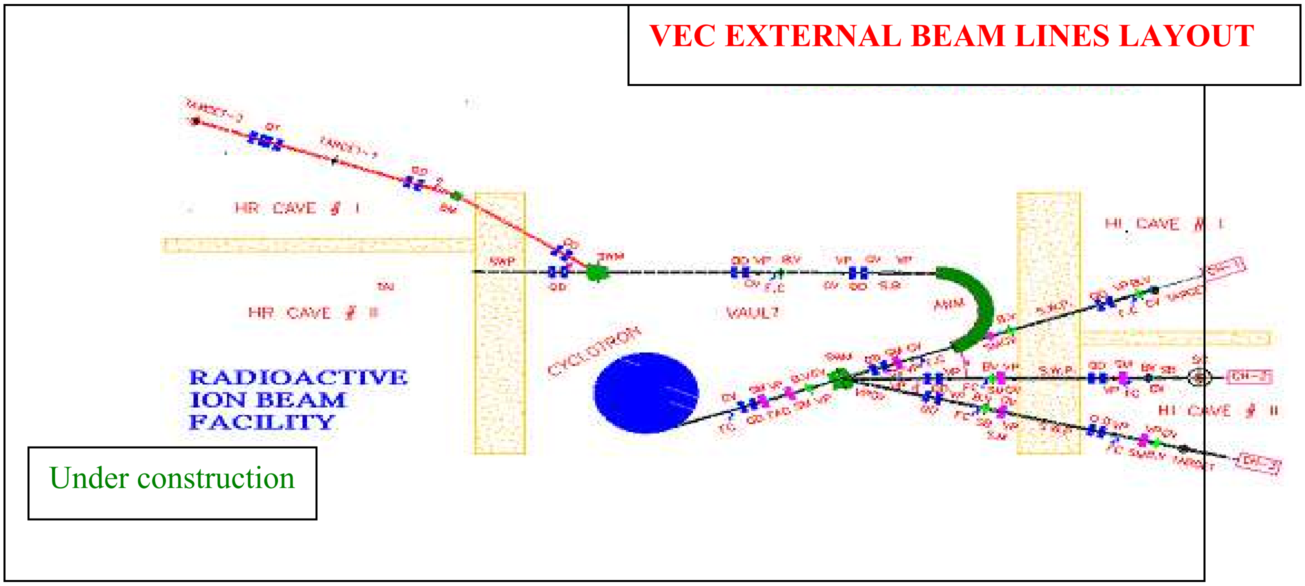
Scientific Mission and Research Programs:

The 224 cm cyclotron commissioned in 1978 was built to demonstrate indigenous capabilities in the country for constructing a large accelerator. And eventually the cyclotron provided a unique experimental facility for nuclear physics community. During the past several years it has not only provided beams for nuclear physicists but for nuclear chemistry, condensed matter physics, isotope production etc. Presently the cyclotron is mostly used as a heavy ion facility where the ion production is done by Electron Cyclotron Resonance (ECR) ion source. VEC will soon become the primary beam source for the Radioactive Ion Beam (RIB) facility that is currently under construction at VECC.

Technical facilities:

There are four experimental caves. Three beam lines transporting beams to two high intensity caves are generally used for experiments. A 160^{o} magnet will be used to bend the beam for transport to a large cave where the RIB facility is coming up.

224 cm VARIABLE ENERGY CYCLOTRON - CALCUTTA - INDIA



Characterization the facility:

The accelerator is an AVF cyclotron with K=130. It accelerates light ion beams and till date has provided beams up to mass no. 40. The beam energy currently ranges from 7*A MeV to 20*A MeV in the first harmonic mode.

Facility Parameters:

In the past PIG ion source was used for producing alpha, proton and deuteron beams. Presently, two external ECR ion sources are used for producing multiply charged ions for injection into the cyclotron using an axial injection line.The two ECR sources have operating frequencies of 6.4 GHz and 14 GHz.

Beams Available:

Ion	Energy (MeV)	Beam Current (nA)
Proton	7-10	400
Alpha	30-65	2500
Nitrogen	98	120
Oxygen	110-160	1000
Neon	140-200	300
Sulphur	230	60
Argon	280-340	85

Major experimental instrumentation and its capabilities:

1. Irradiation chambers – a variety of them
2. 90 cm scattering Chamber for charged particle spectroscopy
3. Detector (array)systems for gamma spectrocopy

Nature of user facility:

It is a national facility available to all research institutions and universities

Program Advisory Committee/experiment proposals:

The VEC Users' Committee screens the experimental proposals and advises on matters related to utilization of the cyclotron.

Number of actual, active users of the facility in a given year:

Till date about 50 institutions including universities have used the facility. In a typical year 25-30 experimental groups have been given the beam time.

Percentage of users, and percentage of facility use that come from inside the institution:

An average estimate for percentage of inside users= 20%

Percentage of facility use by the inside users =35%

Percentage of users and percentage of facility use from national users:

Percentage of national users =80%

Percentage of facility use by the national users =65%

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) 470 (VECC)
b) 29 (VECC)

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

a) Permanent: 11 (VECC)
b) Postdoctoral: 1 (VECC)
c) Student: 1 (VECC)

Number of postdoctoral researchers:

3 (VECC)

Number of graduate students resident at the facility (>80% of their time):

14 (VECC)

Number of non-resident graduate students with thesis work primarily done at the facility:

2 (VECC)

Special student programs:

Summer training programs for undergraduate students, both engineering as well as science, for a duration of 1 or 2 months are organized

Future Plans:

The cyclotron is 28 years old. Presently different subsystems of the cyclotron are being upgraded and modernised. The objective is to use the cyclotron as feeder of primary beam to the Radioactive Ion Beam Facility that is under currently construction.

HEAVY ION MEDICAL ACCELERATOR (HIMAC) CHIBA
NATIONAL INSTITUTE OF RADIOLOGICAL SCIENCES

30km east of Tokyo, Japan

4-9-1, Anagawa, Inage-ku, Chiba
263-8555 JAPAN
National Institute of Radiological Sciences

Dr. Takeshi Murakami
Department of Accelerator and Medical Physics
National Institute of Radiological Sciences
4-9-1, Anagawa, Inage-ku, Chiba
263-8555 JAPAN

Telephone: +81-43-206-3205
Facsimile: +81-43-251-1840
E-mail: muraka_t@nirs.go.jp

Independent Administrative Institution

Government funding

Yoshiharu Yonekura, M.D., Ph.D.

Head of the facility:

Hirohiko Tsujii, M.D.

Scientific Mission and Research Programs:

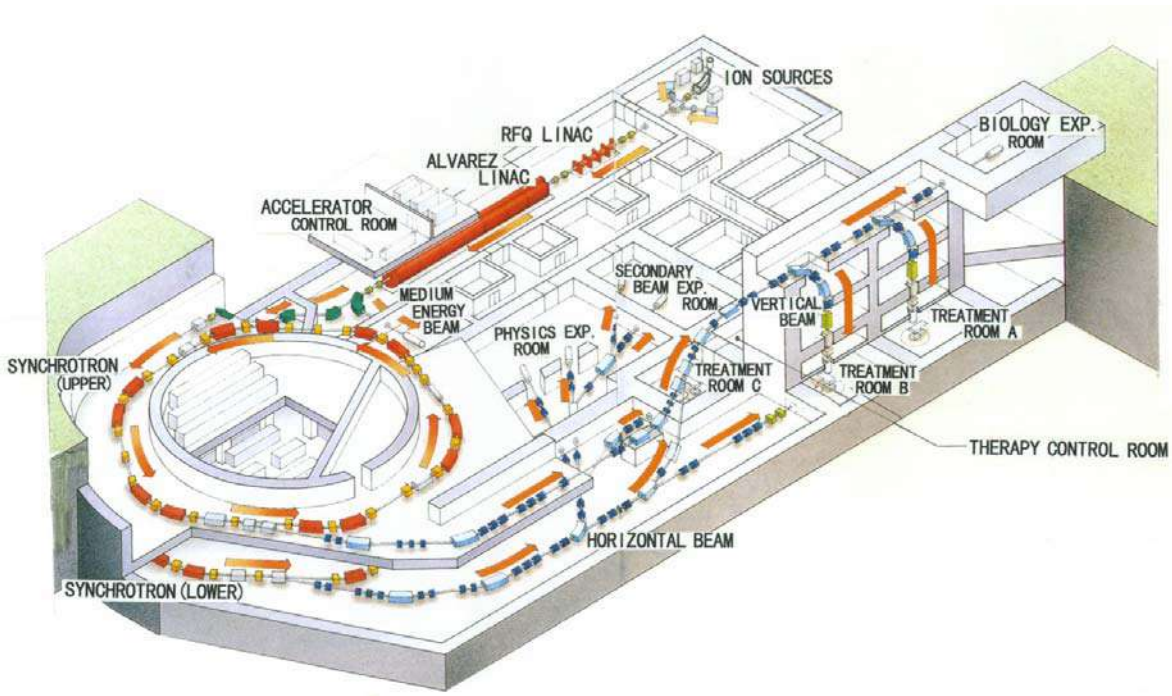
National Institute of Radiological Sciences (NIRS) is the institution in Japan dedicated to comprehensive scientific research for radiation and health. The primary purpose of HIMAC is a clinical trial of cancer treatment by heavy ion beams.

During 11 years, 2600 or more patients were treated, being as a leading facility of heavy ion beam therapy in the world. Although the primary purpose is the clinical trial, HIMAC supplies the various beams to experiments of basic research beyond the medical science, during the night and weekend.

Characterization of the facility:

High energy heavy ion beams, up to 800 MeV/u, supplied by linear accelerators and two synchrotron rings.

Technical facilities:



Facility Parameters:

The typical parameters from the synchrotron rings.

Ion species	Energy (MeV/u)	Intensity (particles / second)
He	100 - 230	<1.2 x 10^10
C	100 - 430	<1.8 x 10^9
N	100 - 430	<1.5 x 10^9
O	100 - 430	<1.1 x 10^9
Ne	100 - 600	<7.8 x 10^8
Si	100 - 800	<4.0 x 10^8
Ar	290 - 650	<2.4 x 10^8
Fe	400, 500	<2.2 x 10^8

Beams from an injector linac, 6 MeV/u, are also available.

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

(Caution) In this, and the following descriptions, the clinical treatment part will not be included.

Course name	Beam characteristics
General Purpose	Thin beams, a few mm in diameter
Secondary Beam Course	Projectile fragmentations
Biology Course	Large uniform field, 10cm in diameter
Medium Energy Course	Beams from an injector, 6 MeV/u

Nature of user facility:

Yes, it is. The facility announces the call for proposal periodically.

Program Advisory Committee/experiment proposals:

Yes, it has. The PAC is composed of scientists outside of NIRS, nominated by scientific societies, institutions, and some on request by NIRS.

Number of actual, active users of the facility in a given year:

Users outside of NIRS are around 570, an average value of the last three years. Once proposals are accepted, each participant must be registered as a collaborative researcher of NIRS. The cited number is a total of registered researchers.

Users inside NIRS are around 134, 3 years average. These are statistics based on a participant list of each proposal.

Thus the total is 704.

Percentage of users, and percentage of facility use that come from inside the institution:

See the previous answer about the number of users. About 20% (134/704) comes from inside the institution. Facility Use] is difficult to answer. As a tip, 30% of spokespersons of total 129 proposals in 2005 were researchers inside the institution.

Percentage of users and percentage of facility use from national users:

See the previous and the next one. About 70 % of the users and 60% of the spokespersons come from other institute in Japan.

Percentage of users and percentage of facility use from outside the country where your facility is located:

Foreigners are 67 in 704 registered researchers. Thus 10 % of users and spokespersons are from outside Japan.

Fraction of the international users is from outside your geographical region:

Mainly U.S., Canada, and Europe. Small numbers come from China, Russia.

Users Group:

No formal users group exists.

Number of a) permanent staff and b) temporary staff:

(Caution) Answers to this question or questions hereafter strongly depend on how we estimate them, such as the way staff of the hospital, etc.

a) Around 13, including medical physicists, but medical staff are excluded. b) Around 11,

Number of postdoctoral researchers:

Around 6.

Number of graduate students resident at the facility:

Around 5

Number of non-resident graduate students with thesis work primarily done at the facility:

Around 20.

Involvement of undergraduate students in research:

Around 10.

Special student programs:

None.

Future Plans:

A building housing new treatment rooms will be constructed in 5 or 6 years. The first phase of the three phase plan was funded. When it is completed, the arrangement of experiment halls and old treatment rooms might be reconsidered.

J-PARC (NUCLEAR AND PARTICLE PHYSICS FACILITY)

Tokai, Ibaraki, Japan

Shirakata-Shirane 2-4, Tokai
Naka-gun, Ibaraki 319-1195
Japan

Under a construction agreement between KEK and
Japan Atomic Energy Research Institute (JAERI)

The J-PARC organization at the operational stage is still in discussion

KEK and JAERI
(probably) KEK and JAERI

Yoji Totsuka, Director General of KEK
and Toshio Okazaki, President of JAERI

Head of the facility:

Shoji Nagamiya, Project Director of J-PARC

Scientific Mission and Research Programs:

J-PARC covers a broad range of sciences; not only nuclear and particle physics, but also material and life sciences with pulsed neutron and muon beams, and R&D's for nuclear transmutation. The current main subjects in nuclear and particle physics at J-PARC are 1) strangeness nuclear physics, 2) hadron physics, 3) neutrino physics, 4) kaon decay physics, etc.

Characterization of the facility:

High-intensity proton accelerators providing high-intensity kaon, neutrino, muon, neutron beams, etc.

Nature of user facility:

KEK intends to have J-PARC as a user facility for its mission as an inter-university research institute corporation. The nuclear and particle physics facility, which is mainly taken care of by KEK, is, therefore, going to be a user facility. The official decision will be made by the Ministry of Education, Culture, Sports, and Science when they decide the J-PARC organization at the operational stage.

Program Advisory Committee/experiment proposals:

The call for letters of intent (LOI) for nuclear and particle physics experiments at J-PARC was officially announced by the Project Director in 2002. The accepted LOI's (30 LOI's in total) were considered by the Nuclear and Particle Physics Facility Committee under the Project Director. We expect to have a Program Advisory Committee in the near future, after the J-PARC organization at the operational stage is established.

Number of actual, active users of the facility in a given year:

About 480 people are listed in the 30 LOI's.

Percentage of users, and percentage of facility use that come from inside the institution:

Less than 10% of the LOI authors are from KEK.

Percentage of users and percentage of facility use from national users:

About 40% of the LOI authors are Japanese.

Percentage of users and percentage of facility use from outside the country where your facility is located:

About 60% of the LOI authors are from outside Japan.

Fraction of the international users is from outside your geographical region:

Asia: North-America: Europe = 4%: 30%: 26%

User Group:

No formal user group exists.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

Not available.

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

Not available.

Number of postdoctoral researchers:

Not available.

Number of graduate students resident at the facility:

Not available.

Number of non-resident graduate students with thesis work primarily done at the facility:

Not available.

Involvement of undergraduate students in research (approximate average number per year):

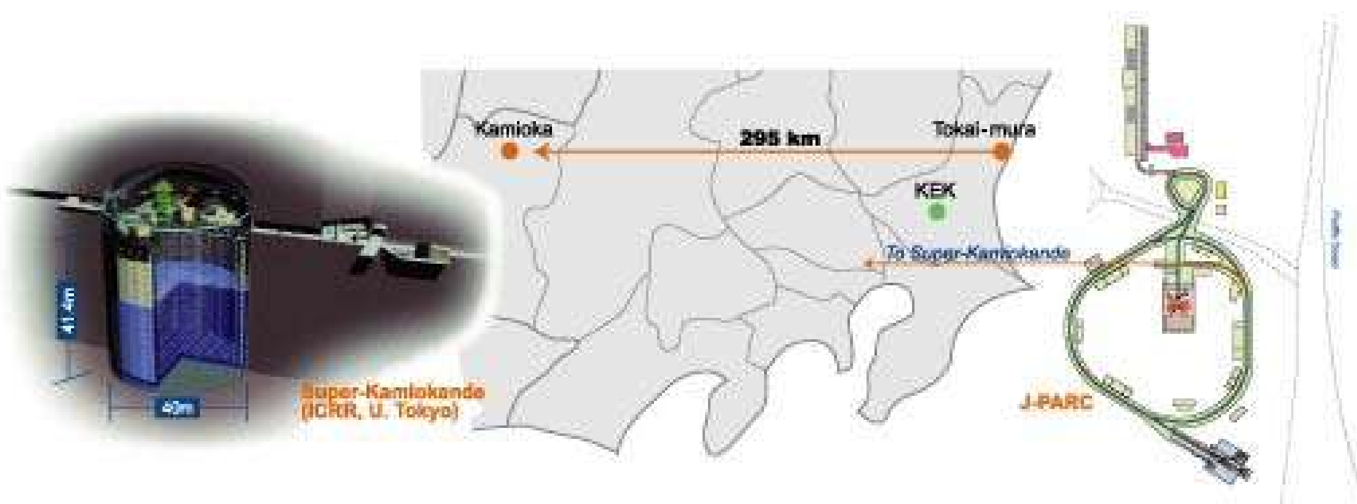
Not available.

Special student programs:

Not available.

Future Plans:

The facilities in construction are in the Phase 1 of the J-PARC project. The construction will be completed in March, 2008. After that, we anticipate to proceed to the Phase 2 construction which includes the extensions of the experimental area and secondary beam lines, and the energy up-grade of the accelerators.



RESEARCH CENTER FOR NUCLEAR PHYSICS, OSAKA UNIVERSITY

Osaka, Japan

10-1 Mihogaoka, Ibaraki
Osaka 567-0047
Japan

Telephone: 6-6879-8900
Facsimile: 6-6879-8899
E-mail: director@rcnp.osaka-u.ac.jp

University Institute

Ministry of Education, Culture, Sports, Science and Technology

Hiroshi Toki

Head of the facility:

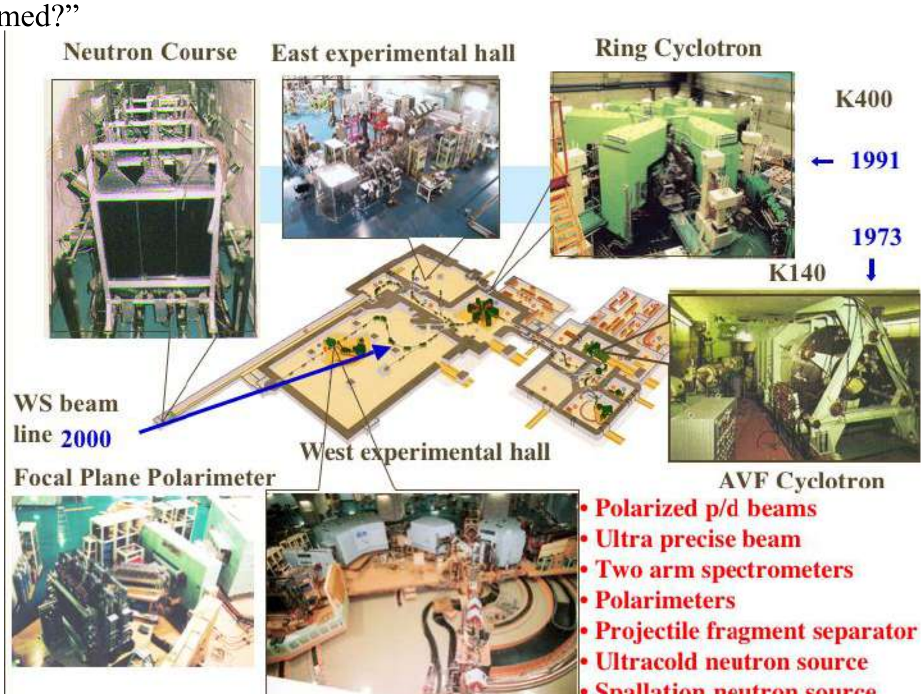
Hiroshi Toki

Scientific Mission and Research Programs:

RCNP is a national research center for nuclear physics research both from the experimental and theoretical sides. The aim is to promote and perform world-level research in nuclear and particle physics using advanced accelerators and related facilities to answer basic questions such as “Why are quarks permanently confined in a nucleon?" and "what is the role of pion in nucleus" and "How was the universe born and formed?”

The current major experimental activities are: (1) studies of the properties of nuclear forces and mesons in nuclear matter by using a high resolution proton beam from the Ring Cyclotron, (2) studies of the quark and gluon properties in a nucleon by using a high-energy polarized photon beam at the Laser-Electron Photon facility at SPring-8, and (3) studies on neutrinos and the dark matter of the universe at Oto Cosmo Observatory

Technical facilities:



Characterization of the facility:

Cyclotron complex (K140 AVF + K400 ring) with relatively light-ions

back-scattered photon facility (2.4 GeV)

Table of facility parameters:

1.

particle	max. energy (MeV)	intensity (eμA)
p	400	1
d	200	1
3He	510	1
4He	400	1
Light-ions	100/A	1

High energy resolution with a dispersion matching method between the cyclotron and the magnetic spectrometer, $\Delta E/E$ is as good as 4×10^{-5}.

2. polarized γ, 2.4 GeV, 2.5×10^{6} cps
polarized γ, 3.0 GeV, 2.0×10^{5} cps

Major experimental instrumentation and its capabilities:

Magnetic spectrometer "Grand Ralden"
5.6 msr, $\delta p/p = 5\%$, $p/\Delta p = 37000$
Large Acceptance Spectrometer $B\rho = 3.2$ Tm,
20 msr, $\delta p/p = 20\%$, $p/\Delta p = 5000$
Neutron TOF flight length = 100 m, $\Delta t = 0.6$ ns
Projectile fragment separator $B\rho = 3.2$ Tm,
1.1 msr, $\delta p/p = 8\%$, $A/\Delta A = 326$

Nature of user facility:

National user facility (officially)

Number of actual, active users of the facility in a given year:

700 (last year)

Percentage of users, and percentage of facility use that come from inside the institution:

users 5%, facility use 20 %

Percentage of users and percentage of facility use from national users:

users 85%, facility use 73 %

Percentage of users and percentage of facility use from outside the country where your facility is located:

users 10 %, facility use 7%

Fraction of international users outside of geographical region

Asia, North-America, Africa, Europe

User Group:

There is a formal users group. The number registered is 300 this year. Not all of users are registered.

Number of a) permanent staff and b) temporary staff (including graduate students and postdocs):

Experimental scientists: permanent 15, temporary: 25

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

Permanent: 2, temporary: 16

Number of postdoctoral researchers:

8

Number of graduate students resident at the facility:

33

Number of non-resident graduate students with thesis work primarily done at the facility:

135

Involvement of undergraduate students in research (approximate average number per year):

0

Special student programs:

Educational experiments for undergraduate students

Future Plans:

Upgrade project of the injector AVF cyclotron is under way.

Photon energy will be upgraded to 3 GeV soon.

NEW SUBARU

SPring-8 site, Hyogo, Japan

New SUBARU
SPring-8
Kouto, Kamigori
Hyogo 678-1205
Telephone: +81-791-58-0249
Facsimile: +81-79-58-0242

Institute operated by University of Hyogo

Ministry of Education, Culture, Sports, Science and Technology

Takayasu Mochizuki

Scientific Mission and Research Programs:

The aim of the facility of the low-energy γ–ray beam line is to contribute the nuclear science by means of photon nuclear reactions. We call this scientific development as “Photon Nuclear Science”. Photon beam is produced by backward Compton-scattering (BCS) of laser light from the 1.0 GeV-1.5 GeV electron beam in the storage ring of New SUBARU. A high intensity BCS photon beam is produced in the energy range of 2 MeV to 30 MeV. This photon beam is used for developing various nuclear physics technologies including the studies of nuclear structure, astrophysics, and fundamental science via the observation of the symmetry violation effect, and materials science.

Technical facilities:

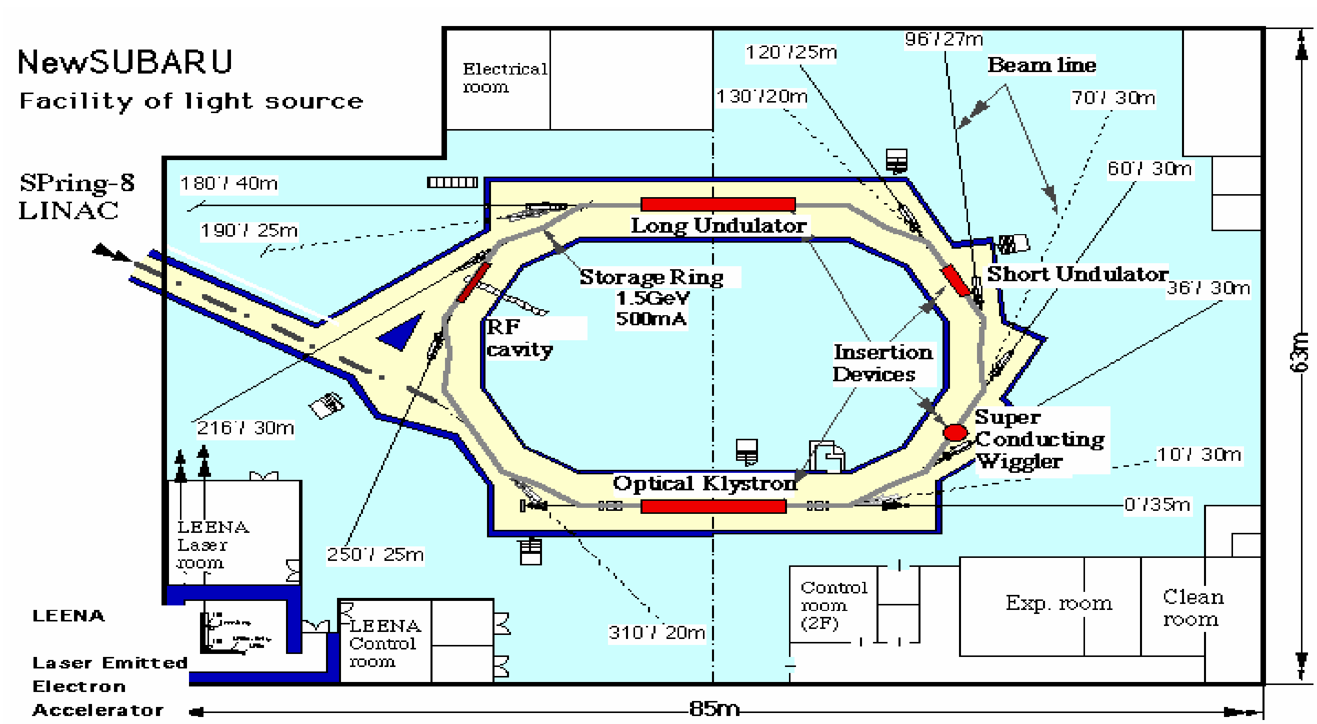


Fig. 1 New SUBARU storage ring. A electron beam at 1.0 GeV is injected into the storage ring with a top-up mode. The energy of a 1.0 GeV electron beam is boosted up to 1.5 GeV on base of the experimental requirement.

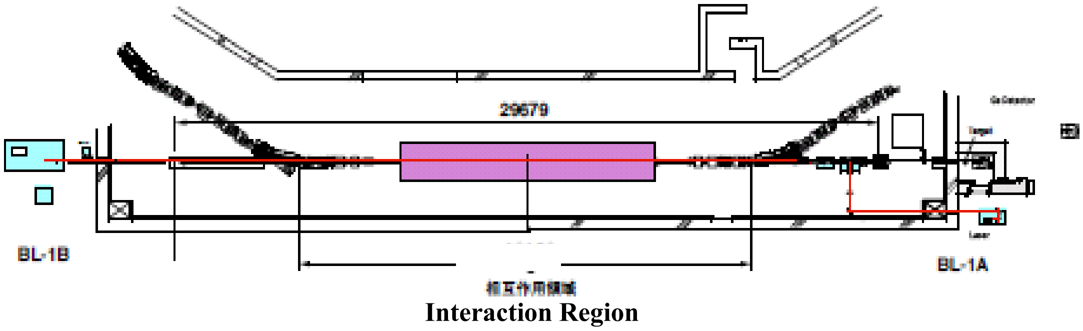


Fig. 2 Laser injection line and the collision part for the BCS process.

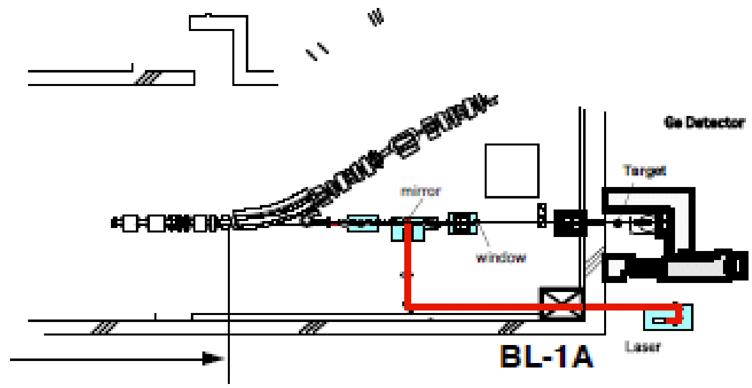


Fig.3 Laser injection part and the experimental room.

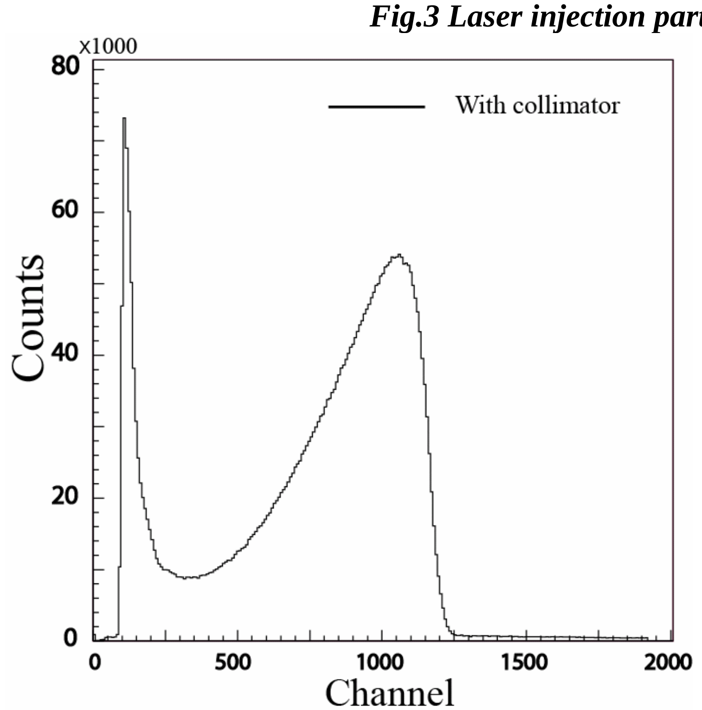


Fig. 4 BCS photon spectrum observed by a LYSO detector with a size of 50 mm$^{\phi}$ in diameter and 90 mm in length. The photon beam is generated in the BCS process of YVO 1 Watt laser light with a wave length of 1064 nm from the 200 mA 1GeV electron beam. The maximum energy is 16.7 MeV. The photon intensity is 2x10^{6} /second.

Brief characterization of the facility:

MeV BCS γ-ray source in Synchrotron Radiation Facility

Table of facility parameters:

Beam: γ–ray
Intensity: 10^{6}-10^{9} /sec. This intensity will be increased in future.
Energy range: 2-30 MeV
Linear and circular polarization: > 80%

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

High resolution Ge detectors, neutron detectors

Nature of user facility:

Unofficially

Program Advisory Committee/experiment proposals?

Yes

Number of, active users and their origin:

10 user groups

User group:

No user group exists.

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

Permanent staff is 4, and there is no temporary staff.

Number of theoretical staff employed at the facility:

No

Number of postdoctoral researchers:

No

Number of graduate students resident at the facility (>80% of their time):

No

Number of non-resident graduate students with thesis work primarily done at the facility:

No

Special student programs:

No

Future plans:

In the SR facility of SPring-8, There are two plans to install the photon facilities. One is from the BCS collision between 8 GeV electron beam and the far-infra-red laser to generate 10 MeV photon beam with a good emmitance. Another is the photon beam production from the superconducting Wigger system. The former plan is now on going. The test of the latter Wigger system has been tested once at Spring-8.

JAEA also considers to have a BCS facility for MeV γ-ray with an intensity of around 10^{13} photon/sec in the energy range of < 10 MeV in combination with the energy recovery linac (ERL) system.

RIKEN ACCELERATOR RESEARCH FACILITY (RARF)

Asia (Saitama, Japan; North latitude: 35 46' 37", East Longitude:139 37' 11")

2-1, Hirosawa
Wako, Saitama
351-0198, Japan
Telephone: +81-48-462-1111(operator)
Facsimile: +81 48 461 5301
E-mail: yyano@riken.jp(.Yasushige Yano)
E-mail: motobaya@riken.jp(Tohru Motobayashi)

RIKEN Independent Administrative Institution under the
Ministry of Education, Culture, Sports, Science and Technology

Dr. Ryoji Noyori (President)

Head of the facility:

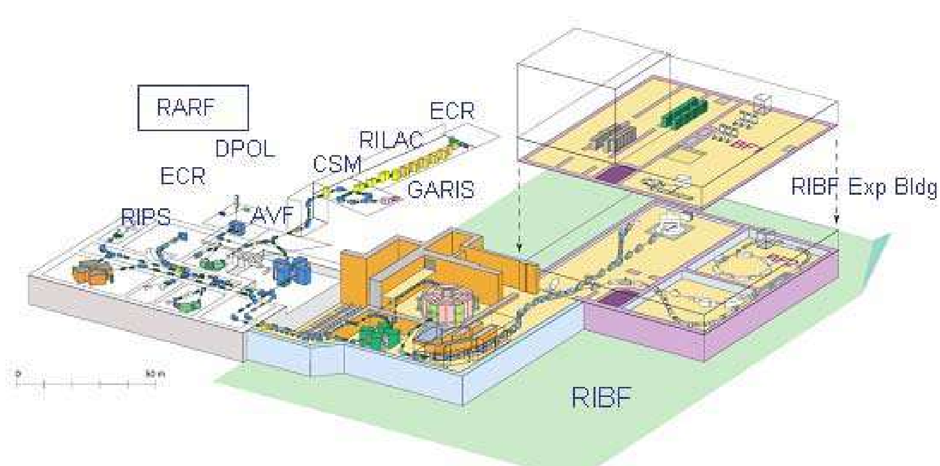
Dr. Yasushige Yano (Director)

Scientific Mission and Research Programs:

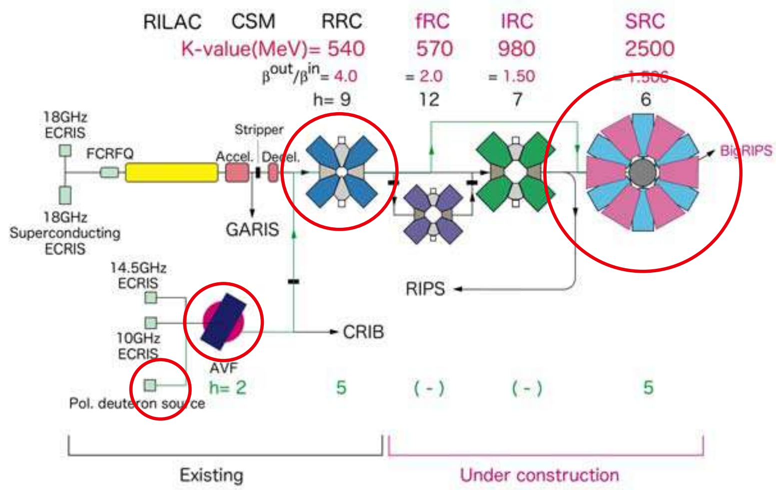
Current facility provides heavy-ion beams with energies up to 135 MeV/nucleon. Various studies are performed in nuclear physics, atomic physics, applied nuclear physics, nuclear chemistry, heavy-ion assisted breedings, animal irradiation, biology, and medicine. For nuclear physics, major emphases are put on studies of unstable nuclei with radioactive ion beams produced by the fragmentation scheme, precision studies of few-body nuclear system using polarized deuteron beams, and super-heavy element search with intense heavy-ion primary beams.

RIKEN RI Beam Factory will be completed in 2006 in its first phase. The first beam will be provided in the end of year 2006. It will be the leading RI beam facility in the world. Intense primary beams with 350 MeV/nucleon will be available for all elements up to uranium, which will provide beams of a wide range of unstable nuclei through projectile fragmentation or in-flight fission. Properties of nuclei very far from stability will be studied for developing our understanding of nuclear structure and nuclear synthesis in the universe.

Technical facilities:



RIBF Heavy-ion accelerator system



Layout of the present facility and RI Beam Facility and acceleration scheme

Characterization of the facility:

Intermediate-energy cyclotron complex with heavy-ion involved science, including RI beam production

Table of facility parameters:

RIKEN RI Beam factory

Beam spices: from deuteron to ^{238}U

Intensities: 1pμA (goal). 1pnA for ^{238}U at 350 MeV/u at the early stage of operation.

Range of energies: typically 350MeV/u using fRC at the new facility

Special properties: A large acceptance fragment separator, Big RIPS, for secondary beam production.

Lower energy heavy-ion beams from 0.66MeV/u to 135MeV/u are also available.

Details of available beam condition at the current facility can be found at the URL of http://www.rarf.riken.jp/application/e-user/beamtype.html

Major experimental instrumentation and its capabilities:

RIPS (RIKEN Projectile Fragment Separator)
GARIS (Gas-filled recoil Separator for search for a super-heavy element)
CRIB (Low energy secondary beam separator)

Big-RIPS (Big RIKEN Projectile Fragment Separater)
Zero Degree spectrometer
Planned
SAMURAI (Large Acceptance Spectrograph)
SCRIT(Self Confining RI Target for electron scattering)
SLOWRI (RF Ion-Guided for slow and trapped RNB from a Projectile Fragmentation Separator)

Nature of user facility:

Both RARF and RIBF are officially user facilities.

Program Advisory Committee/experiment proposals:

PAC for nuclear physics
PAC for material physics

Number of actual, active users of the facility in a given year:

500 (taken from personnel data for four major research laboratories in RIKEN)

Percentage of users, and percentage of facility use that come from inside the institution:

~50%

Percentage of users and percentage of facility use from national users:

81 %

Percentage of users and percentage of facility use from outside the country where your facility is located:

19 %

Fraction of the international users is from outside your geographical region:

Asia 30%, Europe 51%, North-America 18%, Africa 1%

User group:

RIBF user's group exists.
Number of the registerd members is 247. (taken from members of ribf-ml mailing list)

Number of a) permanent staff and b) temporary staff (including graduate students and postdocs):

a) (permanent) 59

b) (temporary) 98

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

6

Number of postdoctoral researchers:

50

Number of graduate students resident at the facility:

25

Number of non-resident graduate students with thesis work primarily done at the facility:

112

Involvement of undergraduate students in research (approximate average number per year):

12

Special student programs:

Graduate student by Asia Program Associate program (2)

Future Plans:

RIKEN Nishina Center for Accelerator-Based Science is established in April 1, 2006.

RIKEN RI Beam Factory (RIBF) is nearly completed, and the commissioning is scheduled in the end of 2006. The first PAC meeting will be held in the beginning of 2007.

KYUSHU UNIVERSITY TANDEM ACCELERATOR LABORATORY (KUTL) FUKUOKA

Fukuoka, Western Japan

Tandem Laboratory
Department of Physics, Kyushu University
Hakozaki, Fukuoka, Japan 812-8581

Telephone: & fax +81-642-2546
E-mail: sagara@nucl.phys.kyushu-u.ac.jp

Institute of Kyushu University

Japanese Government

S. Miyahara (Dean of Faculty of Science, Kyushu University)

Head of the facility:

Kenshi Sagara (Director of KUTL)

Scientific Mission and Research Programs:

a) Direct measurement of $^{12}C+^{4}He \rightarrow ^{16}O+\gamma$ reaction cross section near the stellar energy. Many instruments and methods have been developed since 1994; such as a blow-in windowless gas target (cooled), a recoil mass separator, a chopper for recoils, transform of a large tandem accelerator to a small one, etc. The experiment will be completed in a few years.

b) Three-nucleon force effects and NN off-shell effects

Discrepancy between experiment and calculation in pd breakup at 10-20 MeV has been precisely studied to investigate 3NF effects and NN off-shell interactions.

c) Development of accelerator mass spectrometry (AMS) technique

The tandem accelerator is being modified for AMS. AMS will be started in 2006.

Characterization of the facility:

A tandem accelerator with pulsed beam

Facility parameters:

Beam	Intensity	Energy	
p,d	a few μA	2-18 MeV	
C, O	5-0.1 particle μA	3-60 MeV	pulsed
Si, Ni	50 particle nA	10-70 MeV	

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Recoil mass separator	$\Delta\Omega = \pm 40$mr, E/q= 4MeV, $\Delta m/m = 200$
Windowless gas target	He10 Torrx3cm, N_2 30 Torrx3cm
Pulsed beam	3-6 MHz, width = 5-10 ns
Accel-decel operation	transform the 10 MV tandem to a 1 MV tandem

Technical facilities:

A recoil mass separator consisting of QQEMDDQQ (upper part) and a windowless gas target (lower part) for astro-nuclear experiments.

Nature of user facility:

Users can use the facility. Consult to Director.

Program Advisory Committee/experiment proposals:

Yes. Experiment proposals are discussed and scheduled in the weekly meeting.

Number of active users and their origin:

10 staffs and 25 graduate students, 7 experimental groups

Percentage of users, and percentage of facility use that come from inside the institution:

Inside user 70%,

Inside use 85%

Percentage of users and percentage of facility use from national users:

100 %

Percentage of users and percentage of facility use from outside the country where your facility is located:

0% (foreign users are welcome)

Fraction of the international users is from outside your geographical region:

None

User group:

Yes. 7 staffs and 20 graduate students

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

a) 2, b) 0

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

2

Number of postdoctoral researchers:

1

Number of graduate students resident at the facility:

4

Number of non-resident graduate students with thesis work primarily done at the facility:

3

Involvement of undergraduate students in research:

8

Special student programs:

Lecture and experiment for undergraduates

Graduation thesis experiment for undergraduates

Learning experiment for high school students (3 days in a year)

Future plans:

New upgrade facility is planned in a new campus. A FFAG synchrotron and a small tandem accelerator will be installed. The present tandem accelerator will be shut down in 8 years.

TOKAI RESEARCH AND DEVELOPMENT CENTER, TANDEM FACILITY
JAPAN ATOMIC ENERGY AGENCY

Japan

Shirakata Shirane 2-4
Tokai, Ibaraki, 319-1195
JAPAN
Telephone: +81-29-282-5439
Facsimile:+81-29-282-6321
E-mail : Takeuchi.Suehiro@jaea.go.jp

National Institute

Ministry of Education, Culture, Sports
Science and Technology

Yuichi Tonozuka

Head of the facility:

Suehiro Takeuchi

Scientific Mission and Research Programs:

Basic research in fields of nuclear physics, nuclear chemistry, and material science using accelerated heavy-ions as well as radioactive ions.

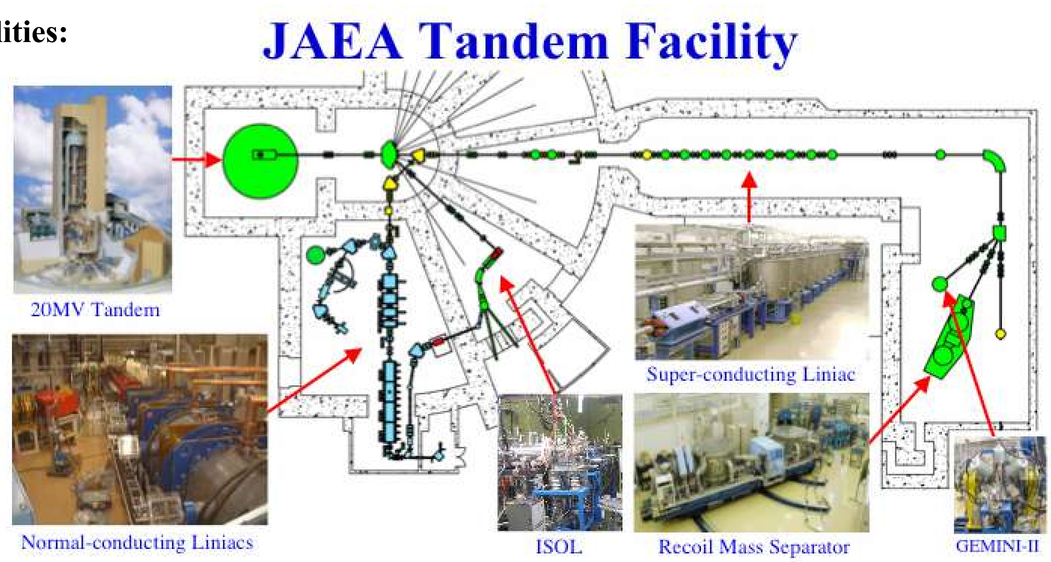
(1) study of heavy-ion nuclear physics

(2) study of heavy-ion chemistry

(3) study of nuclear fuels and materials

(4) research and development of radioactive nuclear science

Technical facilities:



Characterization of the facility:

(1) tandem accelerator and superconducting linac with heavy-ion beams

(2) tandem accelerator, ISOL, and normal conducting linacs with radioactive-ion beams

Table of facility parameters:

(1) tandem + superconducting linac

beam species	proton to uranium
intensities	3 micro A (for proton), 0.5 particle micro A (others)
range of energies	20A MeV (A=15) to 5A MeV (A=200)

(2) tandem + ISOL + normal conducting linacs

beam species	radioactive ions (mainly fission fragments of uranium)
Intensities	< 20 particle pico A
range of energies	0.174A to 1.1A MeV
special properties	ISOL-based radioactive ion beams

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Recoil mass separator	Ion-optical configuration: Q-Q-E-D-E-Q-Q Mass resolving power: variable less than 1500 Solid angle acceptance: 10 pi mm•mr
Isotope Separator On-Line (ISOL)	Ion-optical configuration: Q-Q-D Mass resolving power: 1200 Available ion-sources: surface and hot-plasma
Gamma-ray detector array (GEMINI-II)	Configuration: 20 Ge-detectors + Compton active shields

Nature of user facility:

This facility is an official user facility by Japan Atomic Energy Agency (JAEA), but some part of the facility is maintained by a cooperation of JAEA and High Energy Accelerator Research Organization (KEK).

Program Advisory Committee/experiment proposals:

JAEA-PAC is for the proposals using heavy-ion beams and KEK-PAC is for the ones using radioactive ion beams.

Number of actual, active users:

280

Percentage of users, and percentage of facility use that come from inside the institution:

users: 90 %, facility: 10 %

Percentage of users and percentage of facility use from national users:

users: 80 %, facility: 95 %

Percentage of users and percentage of facility use from outside the country where your facility is located:

users: 20%, facility: 5%

Fraction of the international users is from outside your geographical region:

Asia: 72 %, North-America: 14%, Europe: 14%

User Group:

No

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

(a) permanent staff: 14, (b) temporary staff: 3

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

permanent: 4, postdoctoral: 2, student: 1

Number of postdoctoral researchers:

4

Number of graduate students resident at the facility:

2

Number of non-resident graduate students with thesis work primarily done at the facility:

5

Involvement of undergraduate students in research (approximate average number at a given time):

0

Special student programs:

There exist a summer program for under graduate student.

Future Plans:

Existing normal conducting linacs will be connected to the superconducting linac to accelerate radioactive ion beams up to 5 to 8 MeV/A as well as to supply an intense heavy-ion beams independent from the tandem beams.

UNIVERSITY OF TSUKUBA
TANDEM ACCELERATOR COMPLEX

Tsukuba, Japan

Tennoudai 1-1-1
Tsukuba
Ibaraki, 305-8577
Japan

Telephone: +81-29-853-2490
Fascimile: +81-29-853-2565
Email: nagashima@tac.tsukuba.ac.jp

University Facility

Government

Head of the facility:

Yasuo Nagashima

Scientific Mission Research Programs:

Technical facilities:

Characterization of the facility:

Electrostatic accelerator facility with two tandems

Facility Parameters:

H,D,Polarized H,Polarized D,He,B,C,O,Cl,Au,Bi (Many species)

0.5MeV----150MeV(Depend on the species)

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Accelerator Mass Spectrometry System (AMS), Micro Beam Hydrogen Analysis System (ERCS), Micro Beam PIXE (μ-PIXE), Recoil Back Scattering Particle Analysis System (RBS), Momentum Analyzer (ESP-90), Polarized Ion Source

Nature of user facility:

Yes

Program Advisory Committee/experiment proposals:

Yes

Number of actual, active users of the facility in a given year:

60

Percentage of users, and percentage of facility use that come from inside the institution:

Percentage of users; 90%

Percentage of facility use; 70%

Percentage of users and percentage of facility use from national users:

Percentage of users; 99%

Percentage of facility use; 98%

Percentage of users and percentage of facility use from outside the country where your facility is located:

Percentage of users; 1%

Percentage of facility use; 2%

Fraction of the international users is from outside your geographical region:

Asia; 100%

User Group:

Yes, total number of registered members are 120.

Number of a) permanent staff and b) temporary staff:

a) permanent staff; 13

b) temporary staff; 8

Number of postdoctoral researchers:

1

Number of graduate students resident at the facility:

7

Number of non-resident graduate students with thesis work primarily done at the facility:

3

Involvement of undergraduate students in research:

Special student programs:

Student labs for high school students

Experiments with the accelerator for under graduate students

TOHOKU UNIVERSITY
CYCLOTRON AND RADIOISOTOPE CENTER(CYRIC)

320 km north-northeast from Tokyo

6-3 Aoba, Aramaki, Aoba-ku, Sendai, Miyagi, 980-8578, Japan
Telephone: +81 (0)22 795 7800
Facsimile: +81 (0)22 795 7997
E-mail: www-admin@cyric.tohoku.ac.jp
or shino@cyric.tohoku.ac.jp

University Institute

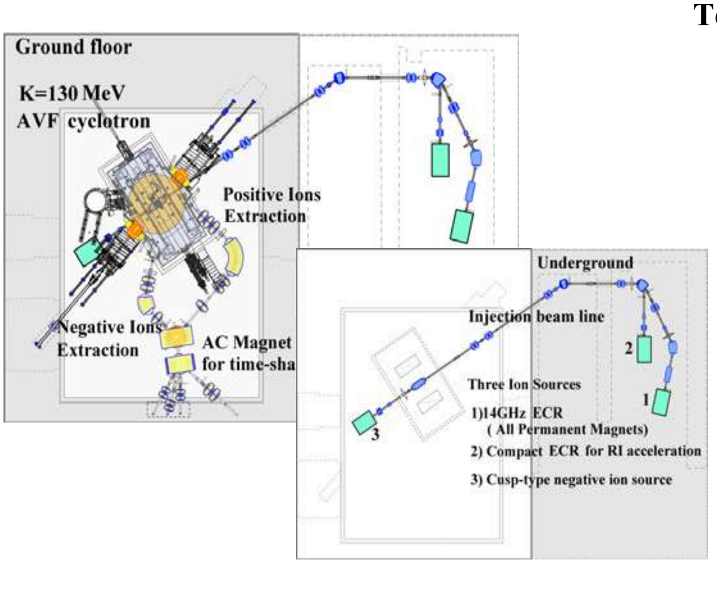
Japanese Government

Keizo Ishii

Scientific Mission and Research Programs:

CYRIC was established in 1977 as an institution for carrying out research studies in various fields with the cyclotron and radioisotopes, and for training reseachers of Tohoku University for safe treatment of radioisotopes and radiations.

In conformity with the aim of establishment of CYRIC, the cyclotron has been used for studies in various fields of research, such as nuclear physics, nuclear chemistry, solid-state physics and element analysis by PIXE and activation, and for radioisotope production for use in engineering, biology and medicine.



Technical facilities:

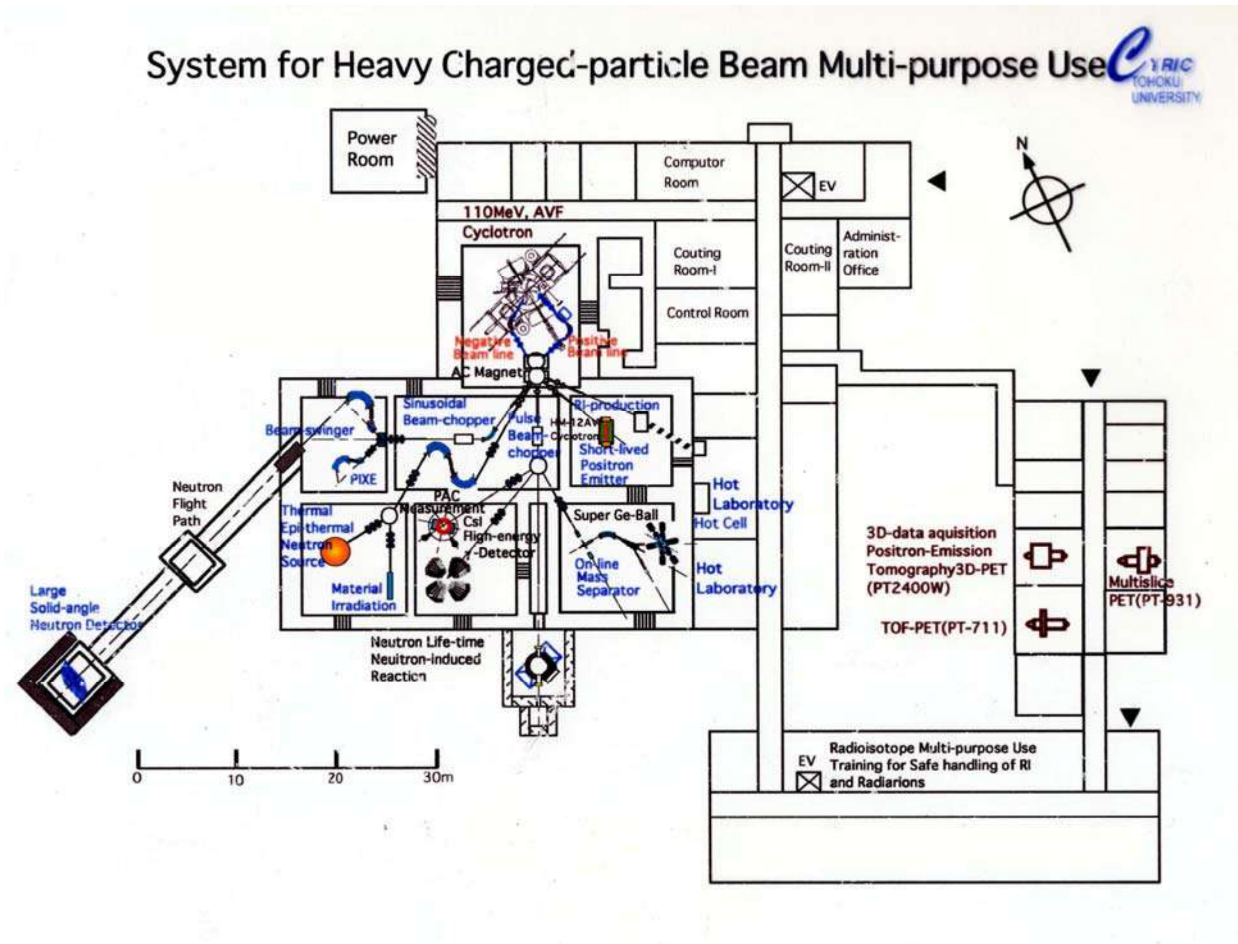
From 2001, two cyclotrons are working; the first is the new cyclotron (K=110 MeV) which is replaced from the old one (K=50 MeV) for ligh ion beam and the second is the small cyclotron (12 MeV proton) for the production of positoron emitters of PET study.

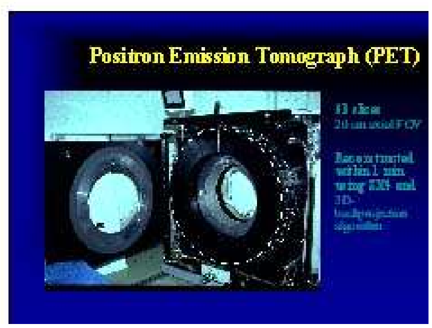
Overview of facility (two cyclotrons and 6 experimental halls)

Characterization of the facility:

Low-energy cyclotron with light-ion beams

Technical facilities:





Facility Parameters:

Beam energies of the new AVF cyclotron(K=110 MeV) and small cyclotron for PET.

a) Positive ion acceleration by K=110 cyclotron

Accelerated Particle	Energy (MeV)	Beam intensity(uA)
p	10- 90	5
d	10- 65	5
He3	20- 170	5
He4	20- 130	5
C12	20- 397	1p
N14	20- 463	1p
O16	20- 530	1p
Ne 20	20- 662	0.5p
S32	20- 698	0.3p
Ar40	20- 744	0.3p
Kr86	20- 695	0.1p

b) Negative ion acceleration by K=110 MeV cyclotron.

Accelerated	Particle Energy (MeV)	Beam intensity(uA)
p	10 - 50	40(present),300(goal)
d	10 – 25	20(present),300(goal)

c) Negative ion acceleration by small cyclotron for PET

Accelerated	Particle Energy (MeV)	Beam intensity(uA)
p	12	30
D	6	20

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Beam Swinger and Large Solid-angle Neutron Detection system for Time-of-Flight Experiments
On-line Electric and Magnetic Isotope-separator
High-energy g-ray Detection System
Neutron-life and Neutron-induced Reaction Analyzing Facility
High Intensity Thermal and Epi-thermal Neutron Source
Medical developments of new PET medicines and canser therapy by proton beam

Nature of user facility:

The facility is officially opened for inside-users of university, but is not closed for outside-users' proposals.

Program Advisory Committee/experiment proposals:

Yes.

Percentage of users, and percentage of facility use that come from inside the institution:

20%: users from institute

50%: users from Tohoku University

30%: users from outside university

Percentage of users and percentage of facility use from national users:

95 %

Percentage of users and percentage of facility use from outside the country where your facility is located:

5%

Fraction of the international users is from outside your geographical region:

Asia and Europe

User group:

20 groups

Number of a) permanent staff and b) temporary staff:

a) permanent : 9 researchers and 4 technical members

b) temporary : 26 including graduate students

Number of postdoctoral researchers:

Three

Number of graduate students resident at the facility:

25 students in this year (physics, engineering and medical course)

Number of non-resident graduate students with thesis work primarily done at the facility:

1-3 students in every year

Involvement of undergraduate students in research:

10 students at last year

Special student programs:

Lectures and site-seeing for high school students and citizens at every summer time (2 days)

Future Plans:

a) Nuclear structure study by intense unstable nuclei and beams

b) Development of intense high energy neutron beams by negative ion acceleration with K=110 MeV cyclotron and the engineering and medical applications by the neutron beam

c) Fundamental researches for cancer therapy by proton beam

TOHOKU UNIVERSITY
LABORATORY OF NUCLEAR SCIENCE, SENDAI

Sendai, Japan

Laboratory of Nuclear Science (LNS)
Tohoku University
Mikamine 1-2-1, Taihaku, Sendai, Japan
Telephone: +81-22-743-3400
Facsimile: +81-22-743-3401
E-mail: koho@lns.tohoku.ac.jp

A university-based research center affiliated to Graduate School of Science, Tohoku University

Government (Ministry of Education)

Professor Jirohta Kasagi, Director

Scientific Mission and Research Programs:

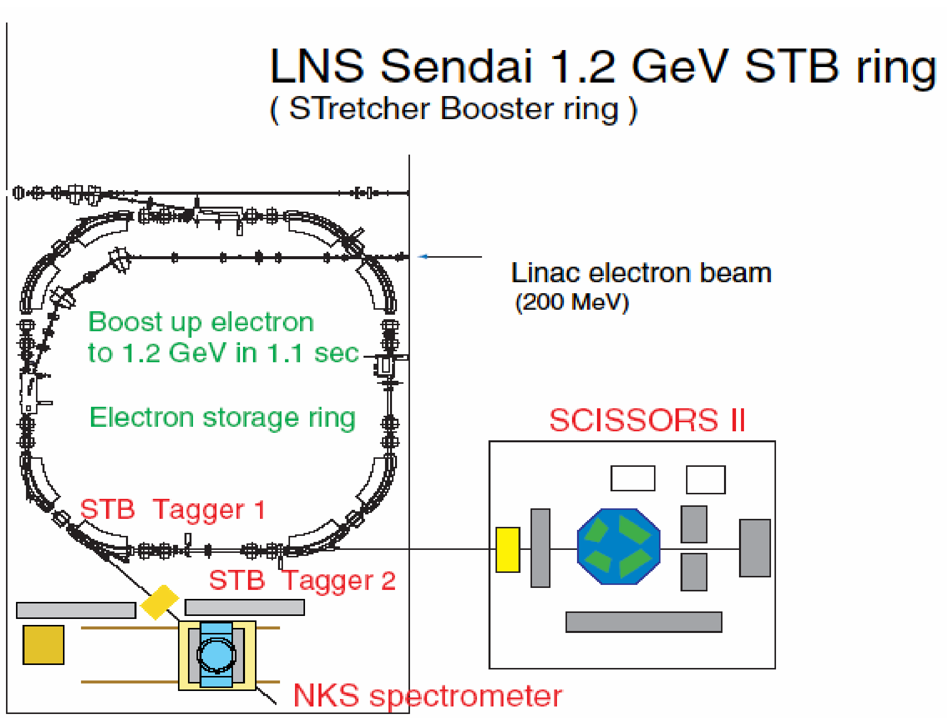
The Laboratory of Nuclear Science was founded to aim at carrying out fundamental researches and applications in nuclear science as well as at educating students and researchers. The research programs in three main fields are follows.

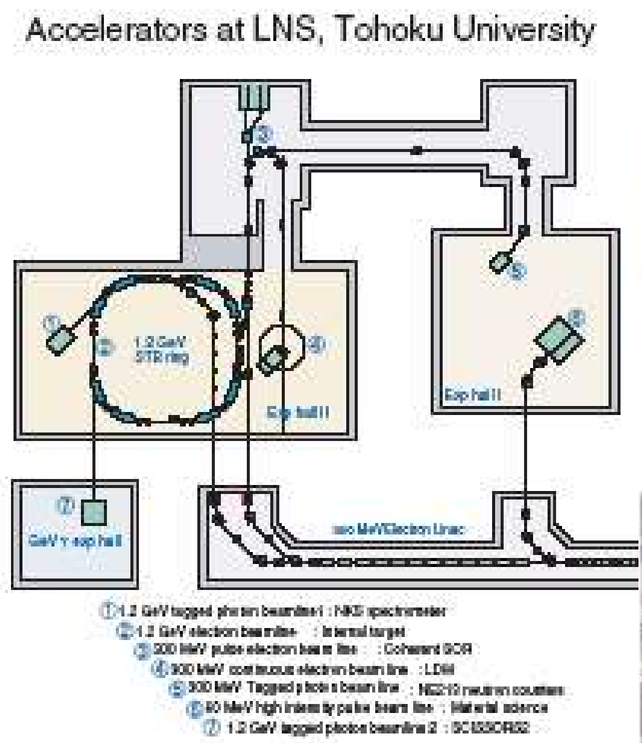
Quark Nuclear Physics: hadrons in nuclei, nucleon excitations via (γ,η) and (γ,π^0), strangeness production in (γ,K^0), pentaquark states, relativistic effects and meson exchange currents in electro- and photo-reactions.

Low-Energy Nuclear Science: production of radioactive fullerene, change of nuclear lifetime, dynamics of alpha-decay, ultra-low energy nuclear reactions.

Beam Physics/Accelerator Science: non-linear beam dynamics in circular accelerators, development of an RF electron gun, isochronous bending magnet for supercoherent terahertz photon ring.

Technical facilities:





300 MeV electron linac

Characterization of the facility:
300 MeV electron linear accelerator (LINAC)
1.2 GeV electron synchrotron ring (STB ring).

Facility Parameters: **Brief and compact table with the facility's major**

Electron and gamma beams at LNS

Linac pulse beam

Beam Line	Linac Energy	Modulator Repetition Rate	Macropulse Peak Current	Macropulse Width @ Gun	Remarks
I	30 MeV	300 Hz	~ 130 mA	~ 3.5 µs	Average current ~ 120 µA @ 300 Hz
I	50 MeV	300 Hz	~ 130 mA	~ 3.5 µs	Average current ~ 120 µA @ 300 Hz
II	150 MeV	50 Hz	~ 60 mA	~ 2 µs	Average current ~ 1.5 µA @ 50/3 Hz

STB ring continuous beam: Stretcher mode operation

Beam Line	Linac Energy	Modulator Repetition Rate	Ring Energy	Ring Current (DCCT@Injection)	Remarks
III - LDM	200 MeV	300 Hz	200 MeV[1)]	~ 40 mA	Extracted average current ~ 1 µA
III - V	150 MeV	100 Hz	150 MeV	~ 40 mA	Extracted average current ~ 300 nA

1) 現在可能なエネルギーは150 MeVです

STB ring storage beam: Booster mode operation

Beam Line	Linac Energy	Booster Repetition Rate	Ring Top Energy	Ring Current (DCCT@1.2 GeV)	Remarks
III	200 (or 150) MeV	0.04 Hz	1.2 GeV	~ 30 mA	Lifetime ~ 20 min @ 1.2 GeV – 10 mA
III	200 (or 150) MeV	0.04 Hz	0.92 GeV	~ 10 mA	

Tagged photons

Beam Line	STB operation	Energy range	Energy bin	Intensity	Remarks
III – V	Strecher	120 ~ 30 MeV	64 Bin	2×10^6 /sec	Duty ~ 70 % (^{4}He photo-disintegration)
STB ring (BM4)	Booster	1.1 ~ 0.8 GeV	50 Bin	5×10^6 /sec	Duty ~ 75 % (γη) , ~ 65 % (K0)
STB ring (BM5)	Booster	1.15 ~ 0.75 GeV	116 Bin	30×10^6 /sec	Duty ~ 75 % (γη)

experimental instrumentation and its capabilities:

4π gamma-ray detector system FOREST

Neutral Kaon Spectrometer NKS II

Nature of user facility:

Yes.

Program Advisory Committee/experiment proposals:

Yes. Twice a year, we have PAC meetings.

Number of actual, active users of the facility in a given year:

Average over these five years:

Quark Nuclear Physics (including R&D instrument), about 50

Low-Energy Nuclear Science, about 35

Beam Physics (including Coherent Radiation), about 15

Percentage of users, and percentage of facility use that come from inside the institution:

	users			facility use		
	Lab.	Tohoku U.	national	Lab.	Tohoku U.	national
Quark Nuclear Physics	45	45	10	45	45	10
LE Nuclear Science	10	30	60	20	40	40
Beam Physics	70	30	0	70	30	0

Percentage of users and percentage of facility use from national users:

Percentage of users and percentage of facility use from outside the country where your facility is located:

0%

User group:

Yes. About 150.

Number of a) permanent staff and b) temporary staff:

a) 10 scientists and 4 technical staffs, b) 3 postdocs, 15 graduate students

Number of postdoctoral researchers:

3

Number of graduate students resident at the facility:

15

Number of non-resident graduate students with thesis work primarily done at the facility:

3

Special student programs:

nothing

Future Plans:

Accelerator: construct Supercoherent Terahertz Photon Ring

Quark Nuclear Physics: construct a new photon beam line at SPring8 (joint work with RCNP and SPring8)

OSAKA UNIVERSITY, VAN DE GRAAFF LABORATORY

Osaka

1-1 Machikaneyama
Toyonaka, Osaka
560-0043, Japan
Telephone: +81-6-6850-5520
Facsimile: +81-6-6850-5535
E-mail: matsuta@vg.phys.sci.osaka-u.ac.jp

Faculty driven facility

Construction: Government
Operation: Government

Tadafumi Kishimoto

Head of the facility:

Kensaku Matsuta

Scientific Mission and Research Programs:

Scientific mission of the facility is to study nuclear physics and related fields, including nuclear structure, beta decay, and also solid state physics by use of nuclear technique. Main programs are the study of unstable nuclei through its nuclear moments, of the symmetry in the beta decay and of hyperfine interactions of beta emitting nuclei inside various kinds of materials. Any kinds of researches on nuclear physics and material sciences are welcome.

Characterization the facility:

Low energy electrostatic accelerator with light-ion beams (single-end Van de Graaff)

Facility Parameters:

beam species: p, d, ^{3}He, ^{4}He

Intensities: 30 μA

range of energies: 5 MeV (single charge) 10 MeV (double charge)

beam course: 4 (analyze d) 1 (strait)

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

β-NMR apparatus

^{15}N circulation target system for beta decay studies

Precision beta-ray correlation apparatus

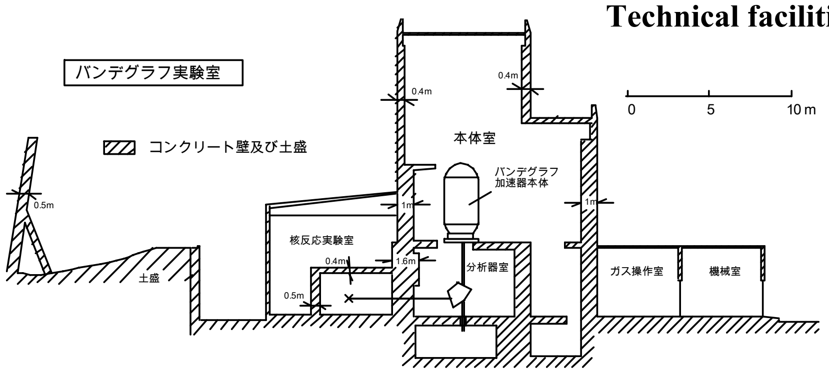
Nature of user facility:

unofficially

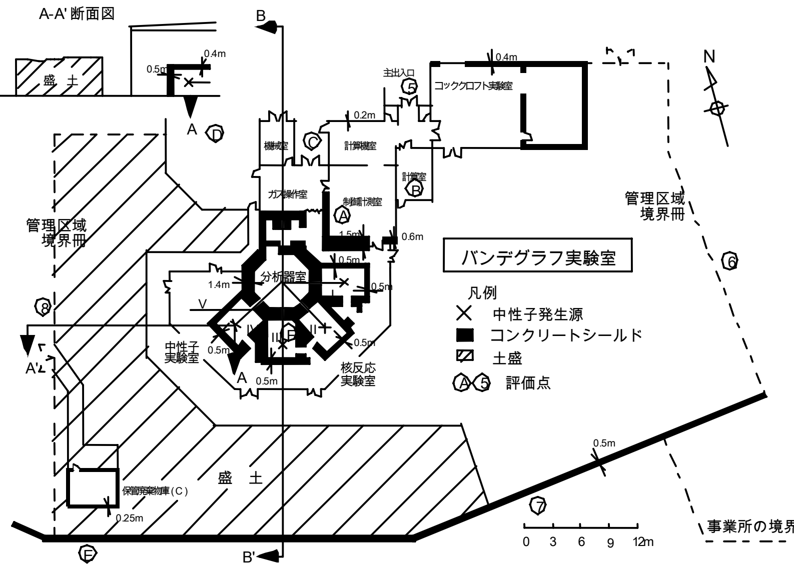
Program Advisory Committee/experiment proposals

No

Technical facilities:



添付書類４－４　放射線発生装置使用室のしゃへいの能力を示す断面図（B-B'断面）



添付書類４－４　放射線発生装置使用室のしゃへいの能力と評価点を示す平面図

Number of actual, active users of the facility in a given year:

3 user groups (1 group from inside facility, 2 groups from outside)(average over about 20 years)

Percentage of users, and percentage of facility use:

Inside user is 40%, but the facility use is 80% from inside

Percentage of users and percentage of facility use from national users:

National user is 50%, but the facility use is only 10 % from national users

Percentage of users and percentage of facility use from outside the country where your facility is located:

International user is 10%, but the facility use is only 5 % from outside the country

Fraction of the international users is from outside your geographical region:

Almost zero

User Group:

No

Number of a) permanent staff and b) temporary staff:

a) presently, 3 faculty staff and 2 technician and 0.5 secretary

b) presently, 3 temporary staff (graduate students)

Number of postdoctoral researchers:

Presently none

Number of graduate students resident at the facility:

None

Number of non-resident graduate students with thesis work primarily done at the facility:

Presently 1

Involvement of undergraduate students in research:

Average is approximately 2

Special student programs:

1 student lab in summer for high school students

several times of open houses for high school students and public

Future Plans:

In the past, there was an upgrade plan to have small cyclotron, but presently none.

CENTER FOR PROTON THERAPY, NATIONAL CANCER CENTER

Korea

Center for Proton Therapy
National Cancer Center
809 Madu-dong, Ilsan
Goyang, Kyonggi
411-764, Korea
Telephone: +82-31-920-1727
Fascimile: +82-31-920-0149
Email jwkim@ncc.re.kr

Government supported under the law
Ministry of Health and Welfare

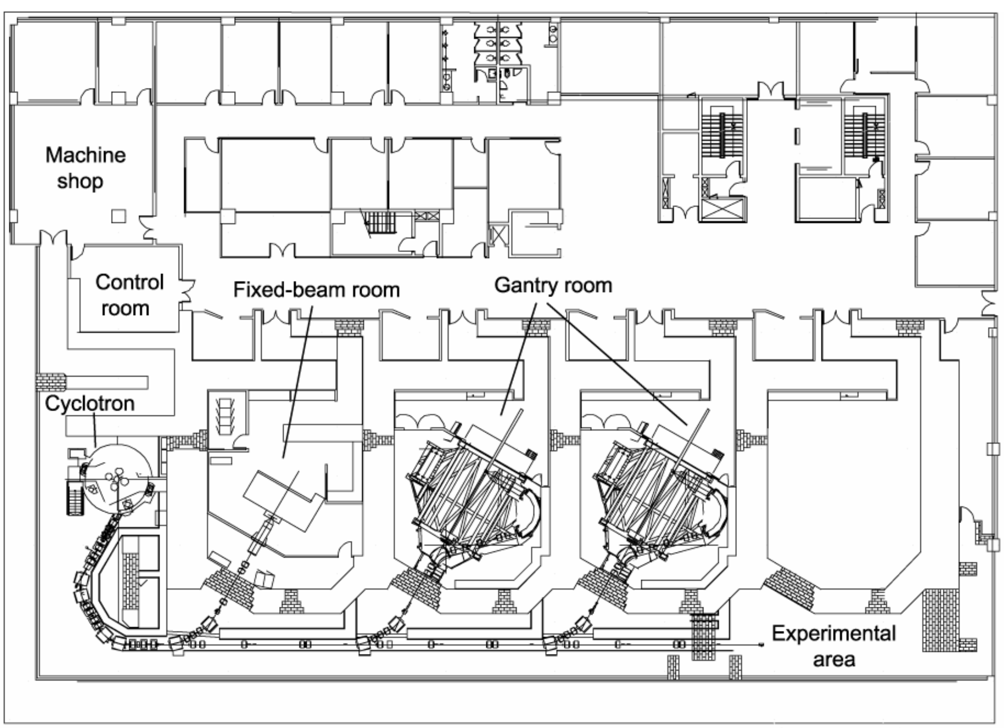
Heads of the facilities:

Jae-Gahb Park, M.D., Ph.D
Kwan-Ho Cho, MD

Scientific Mission and Research Programs:

The experimental area of the proton therapy facility will be used to perform radiation damage measurements such as for semiconductor and biological objects. The area will also be used to develop the devices for advanced radiation treatments and to test the detector parts to ensure their expected performances. The Research Institute of National Cancer Center will have around 140 staff members composed of mainly biologist and medical doctors for the developments of diagnostics, prevention and treatments of cancer.

Technical facilities:



Characterization of the facility:

Intermediate energy cyclotron, low-energy electron linacs for therapy

Facility Parameters:

Proton, 0.1-300 nA, 50-230 MeV

Major experimental instrumentation and its capabilities:

Nozzles to form large-area uniform beams.

Nature of user facility:

Therapy facility,

Expected users: nuclear, medical physicists and radiation biologists

Program Advisory Committee/ experiment proposals:

Not formed yet.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) 3 PhD and 5 MD, b) 4 PhD and 3 MD

Number of postdoctoral researchers:

four

Number of non-resident graduate students with thesis work primarily done at the facility:

two

Future Plans:

Facility will have beams in the end of 2005, and plan to begin treating patients in 2006.

The experimental area is expected to be prepared in 2006.

KOREA INSTITUTE OF GEOSCIENCE AND MINERAL RESOURCES (WWW.KIGAM.RE.KR)
ION BEAM APPLICATION GROUP (IONBEAM.KIGAM.RE.KR) WITH A MULTI-PURPOSE ION BEAM ACCELERATOR

Daejeon, Republic of Korea (South Korea)

30 Kajeong-dong
Yuseong-ku
Daejeon, Korea
Telephone: +82-42-868-3666
Facsimile: +82-42-868-3393
E-mail: whong@rock25t.kigam.re.kr

An institute base on national funding

Government
Government, Companies

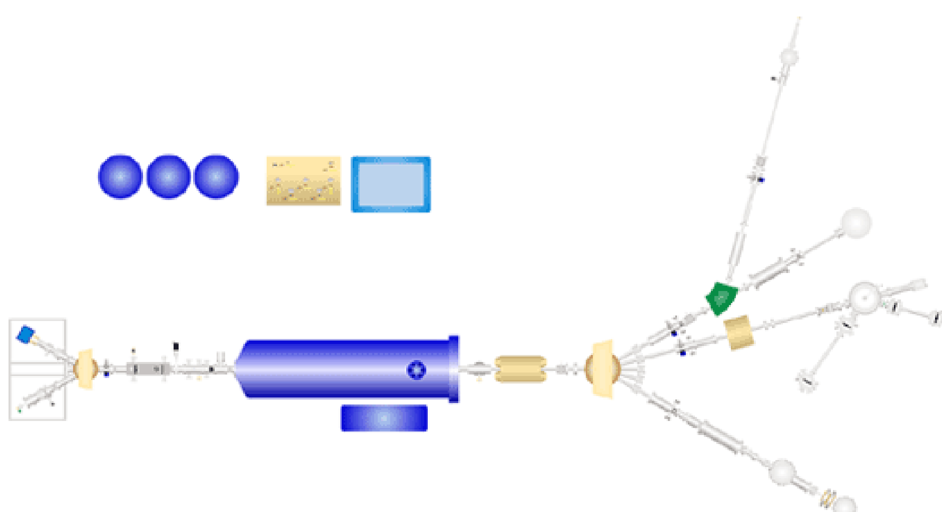
Head of the facility:

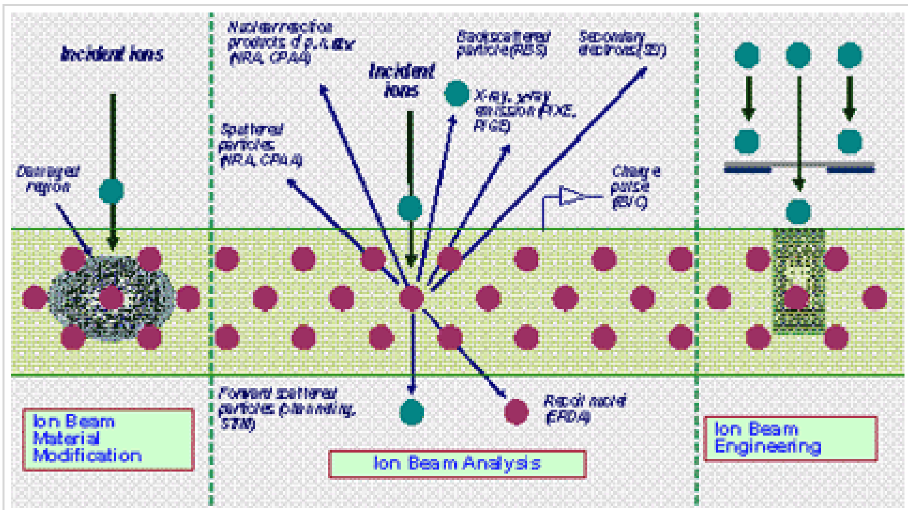
Dr. Tae Sup Lee
Dr. Hyung Joo Woo

Scientific Mission and Research Programs:

Most applications of middle size (1.7 MV tandem) ion beam accelerator have been performed at this facility. Main application is ion beam analyses such as ERD-TOF, RBS/channeling, PIXE/PIGE, and NRA. The other apllication is high energy ion beam implantation for surface modification of semiconductor devices. Studies on ion beam engineering such as ion beam lithography, ion beam MEMS, nano-crystal forming, and SOI (Si on Insulator) wafer fabrication are also done. And this facility is used for neutron capture cross-section measurement of nuclear physics field. An AMS system will be introduced next year (2006), of which main purpose will be global environmental change study.

Technical facilities:





Characterization of the facility:

medium-energy(TV=1.7 MV) tandem accelerator with heavy-ion sources

Facility Parameters:

Negative Ion	Beam Current	
	Injector Faraday Cup	Post Faraday Cup (Terminal Voltage*: kV)
H	-13.0 ~ -15.0 μA	~ 3.0 μA (136) ~ 5.7 μA (236) ~ 5.7 μA (486)
D	-6.5 ~ -12.5 μA	~ 2.3 μA (136) ~ 4.0 μA (161)
B	~ -1.4 μA	~ 0.45 μA (151)
C	-14.0 ~ -20.8 μA	~ 6.5 μA (136) ~ 20.0 μA (1000)
O(ZnO)	-24.5 ~ -35.0 μA	~ 6.7 μA (136) ~ 8.1 μA (236) ~ 10.4 μA (667)
F	-11.1 ~ -20.6 μA	~ 4.13 μA (136)
Si	-20.0 ~ -33.0 μA	~ 8.3 μA (136)
		~ 17.5 μA (186) ~ 12.5 μA (261) ~ 2.34 μA (500)
P	-8.3 ~ -10.18 μA	~ 3.11 μA (161) ~ 3.25 μA (236)
Cl	-15.7 ~ -17.5 μA	~ 6.7 μA (333) ~ 20.9 μA (1000) ~ 30 μA (1700)
V	-1.2 ~ -2.2 μA	~ 0.6 μA (443)
Fe	-0.85 ~ -1.31 μA	~ 2.93 μA (1600)
Ag	-2.7 μA	~ 2.0 μA (136)
Au	-5.0 ~ -7.2 μA	~ 2.9 μA (104) ~ 4.4 μA (150)

* Total acceleration = 28 kV(pre-acceleration) + terminal voltage×(charge state+1)

Major experimental instrumentation and its capabilities:

Cesium sputtering source (NEC)

RF source (NEC)

Analysis chamber with 6-axis goniometer sample stage

Implantation chamber with temperature controller and precise beam current monitor

Mono-energetic neutron beam generation facility

Particle detectors (charged particles and neutrons)

photon detectors (gamma-ray and X-ray)

Electronics for measurement

Nature of user facility:

Yes (officially)

Program Advisory Committee/experiment proposals:

Yes

Number of actual, active users of the facility in a given year:

Simple analysis service: 256 users in 2004 (more than 1,000 samples)

Visiting users for experiment: 2 users in 2004

Percentage of users, and percentage of facility use that come from inside the institution:

All users came from outside of our institute

Percentage of users and percentage of facility use from national users:

See the answer of next question

Percentage of users and percentage of facility use from outside the country where your facility is located:

One user came from outside Korea

Fraction of the international users outside of geographical region:

None

User Group:

None

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

5 staffs (plan to hire one more staff in this year)

1 staffs (plan to hire 3 more staffs in this year)

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

None

Number of postdoctoral researchers:

None

Number of graduate students resident at the facility:

None

Number of non-resident graduate students with thesis work primarily done at the facility:

None now

Involvement of undergraduate students in research (approximate average number per year):

None now

Future Plans:

The project to introduce an AMS system started this year

NATIONAL CENTER FOR INTER-UNIVERSITIES RESEARCH FACILITY / ELECTROSTATIC ION ACCELERATOR ACCELERATOR MASS SPECTROSCOPY DIVISION

Seoul, Korea

NCIRF Bldg. 139
Seoul National University
Seoul 151-742, Korea
Administration Telephone: +82-2-880-5431
Administration Facsimile: +82-2-884-6661
Lab. Telephone: +82-2-880-5774
Lab. Facsimile: +82-2-880-5781
Corresponding E-mail: myoun63@snu.ac.kr

National Institute established under Korean law, maintained as a part of University organization

Construction: Ministry of Education, ROK (100%)
Operation: Ministry of Education, ROK (~40%)
University Budget (~60%)

Heads of the facility:

Prof. SeungWhan Hong
Prof. Jong Chan Kim

Scientific Mission and Research Programs:

The institution technically supports for researches concerning natural science, engineering, and literature providing user facilities and highly reliable analysis services. The electrostatic accelerator facility provides ion beam based upon user request, and services AMS analysis as well as radiocarbon dating. The scientific staffs and technical staffs also pursue the facility's own research program.

Technical facilities:

Characterization of the facility:

Low energy tandetron with light-ion beams(heavy-ion beam will be provided based upon R&D).

Facility Parameters:

Beam species	intensity	Range of Energy	Special feature
1H, 2H	200nA MAX	1~6 MeV	
B	100nA MAX	1~10MeV	
C	Typically 150nA	2~10MeV	12C, 13C, 14C recombinator

Major experimental instrumentation and its capabilities:

1 duoplasmatron ion source

2 Cs-sputtering ion source(1 dedicated for C-beam)

beam recombinator

Spectrometer

Gamma detectors, charged particle detectors

PIXE beamline

heavy-isotopes AMS beamline(under construction)

Nature of user facility:

Officially a user facility (by law). No other unofficial, practical aspects.

Program Advisory Committee/experiment proposals:

Yes.

Number of actual, active users of the facility in a given year:

As an ion-beam user facility; Seoul National University

For the analysis service; Over 500 users per year

Percentage of users, and percentage of facility use that come from inside the institution:

	Inside SNU	**Outside SNU**
Ion beam	**75%**	**25%**
AMS analysis	**12%**	**88%**

Percentage of users and percentage of facility use from national users:

	Domestic	**International**
Ion beam	**100%**	**0%**
AMS analysis	**45%**	**55%**

Percentage of users and percentage of facility use from outside the country where your facility is located:

See above

Fraction of international users outside of geographical region

No statistics available

User Group:

None

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

4 scientific staff, 4 technical staff

2 graduate students, 1 post-doc.

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

None

Number of postdoctoral researchers:

One

Number of graduate students resident at the facility:

One

Number of non-resident graduate students with thesis work primarily done at the facility:

One

Involvement of undergraduate students in research (approximate average number per year):

None

Special student programs:

None

Future Plans:

beamlines construction: to extend the experiments that use ion beam

AMS development

Theoretical nuclear physics

HEAVY ION ACCELERATOR FACILITY

Australian National University Campus
Canberra, Australia

Department of Nuclear Physics
R.S.Phys.S.E.
Australian National University
Canberra, A.C.T. 0200
Australia

Telephone: +61-2-6125 2090
Fascimile: +61-2-6125 0748
E-mail: nuclear@rsphysse.anu.edu.au
Facility Head: George.Dracoulis@anu.edu.au
Web address: www.rsphysse.anu.edu.au/nuclear

University Institute

Various sources of funding:
Initial Establishment: University Funds and Direct Commonwealth Government Grant
Staffing and Operation: Internal University Funds
Instrumentation and development: Internal University Funds and Competitive External Grants, including the Australian Research Council

Heads of the facility:

Facility is operated by the Department of Nuclear Physics
Head Professor George Dracoulis
Facility Operations Manager: Dr David Weisser

Scientific Mission and Research Programs:

The mission of the Facility is to carry out internationally competitive research in both basic areas of Nuclear Physics and selected applications, to maintain and develop accelerator capabilities for the research community, and to provide a training ground for postgraduate and postdoctoral research in nuclear physics and related areas.

The current research programme encompasses

Fusion and Fission Dynamics with Heavy Ions

Nuclear Spectroscopy and Nuclear Structure

Nuclear Reaction Studies

Nuclear Moments and Hyperfine Fields

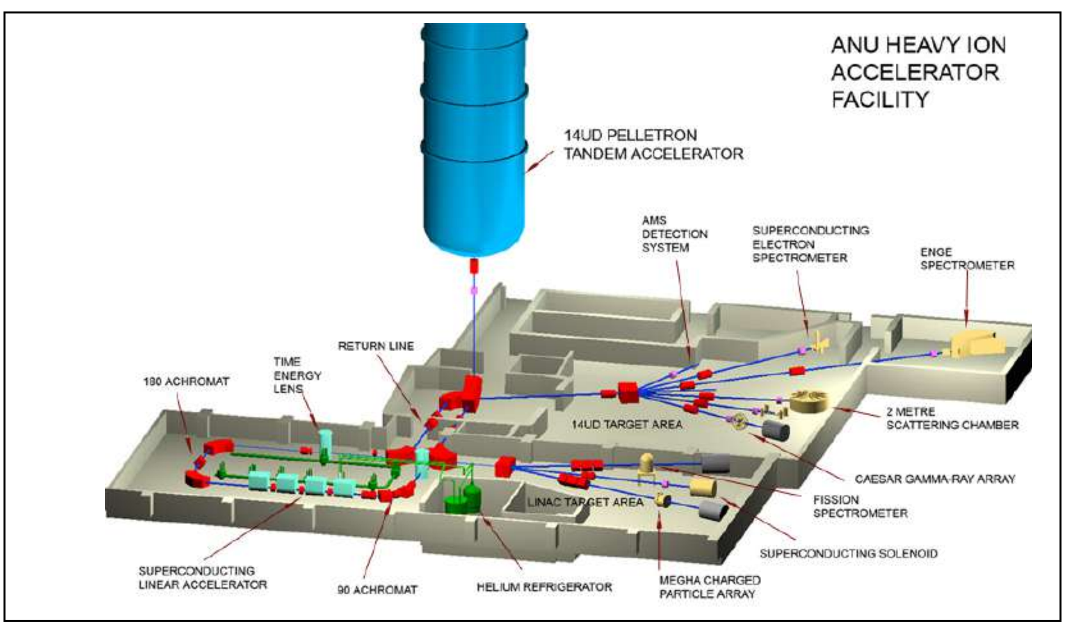
Perturbed Angular Correlations and Hyperfine Interactions Applied to Materials

Heavy Ion Techniques for Materials Stochiometry

Accelerator Mass Spectrometry – Development and application

Technical facilities:

Aerial view of the Heavy Ion Accelerator Facility within the laboratories of the Research School of Physical Sciences and Engineering



ANU Heavy Ion Accelerator Facilty: General Layout

Characterization of the facility:

Electrostatic Tandem accelerator operating in the 15MV region with the ability to inject into a modular superconducting Linear Accelerator. Producing a broad range of heavy ion beams delivered to ten experimental stations, instrumented for a range of national and international users. Pulsed and chopped beams; Gas and foil stripping and double-stripping operation for heavy beams.

Facility Parameters:

A broad range of beam species is available, with LINAC beams under development. Beam intensities vary with beam species, from a few particle-nanoamps of the heaviest beams to 100 particle-nanoamps for lighter beams such as ^{12}C and ^{16}O. Flexible pulsed beam conditions ranging from nanosecond pulsing to macroscopic chopping in the millisecond region.

Beam Species	Max Energy Single Stripping	Max Energy Double Stripping	Max Energy LINAC
	(MeV)	(MeV)	(MeV)
$^{6,7}Li$	60		84
^{9}Be	75		107
$^{10,11}B$	90		130
$^{12,13}C$	105		140
$^{16,17,18}O$	120		165
$^{24,25,26}Mg$	150	170	211
^{27}Al	150	180	230
$^{28,29,30}Si$	165	185	235
^{31}P	165	195	267
$^{32,34}S$	165	195	278
$^{35,37}Cl$	180	204	294
^{40}Ca	180	229	320
$^{58,64}Ni$	195	259	360
^{74}Ge	195	259	409
^{81}Br	195	269	427
^{127}I	210	304	
^{197}Au	210	323	

Major experimental instrumentation and its capabilities:

Current instrumentation includes

General purpose scattering chamber

Enge split-pole spectrograph instrumented with position-sensitive multiwire focal plane detector systems. Gas-filled operation of required AMS beamlines instrumented with Wien Filters and purpose-built gas-hybrid detector systems for particle identification.

Superconducting Solenoid instrumented for high-resolution in-beam electron measurements.

Compact Ge detector array for time-correlated gamma-ray spectroscopy including ten Compton-suppressed detectors and various ancillary detectors

Fission-fusion spectrometer incorporating large-area position-sensitive multiwire proportional counters.

Superconducting solenoid for transport of fusion products with active focal plane system.

Various ion sources

Nature of user facility:

The facility is informally advertised as a User facility and is available for bona-fide scientific users, either through collaborative programs or as independent groups, at the discretion of the Head. A proportion of the operating time (20%) falls under a formal agreement between the Australian National University and the Engineering and Physical Sciences Research Council of the U.K (the ANU-EPSRC Agreement). UK Users are formally (publically) notified about access.

Although operating as a *de-Facto* National Facility, at this stage, that status is not formally recognised and no direct Facility funding is provided.

Program Advisory Committee/Experiment Proposals:

Allocation of the majority of Accelerator time is through an internal committee for on-going experimental programs. The proportion of accelerator time allocated through the ANU-EPSRC agreement is approved through a peer-review process, managed by the EPSRC in the UK with involvement of the Facility Director.

A Program Advisory Committee would be a mandatory requirement if designation as a National Facility eventuated.

Number of actual, active users of the facility in a given year:

The five-year average for the period 2000-2004 inclusive is 97 per year.

This does not include numerous collaborators who do not participate in the on-site running of experiments.

Percentage of users, and percentage of facility use that come from inside the institution:

(2000-2004 Period): 31%

Percentage of users and percentage of facility use from national users:

(2000-2004 Period): 21%

Percentage of users and percentage of facility use from outside the country where your facility is located:

(2000-2004 Period): 48%

Fraction of international users outside of geographical region

(2000-2004 Period): 47%

User Group:

No. A Web registration system is shortly to be implemented.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

Permanent Staff; Total of 23, composed of 7 Academic staff, 5 Scientific Staff at PhD level and 11 General/Technical Staff.
b) Temporary Staff: Total currently 19 (Postdoctoral/
student/Visiting Fellows).

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

Permanent-none

Temporary- on average two (predominantly medium-term Visiting Fellows).

Number of postdoctoral researchers:

Currently 6; varies between 5 and 10.

Number of graduate students resident at the facility:

Currently 10

Number of non-resident graduate students with thesis work primarily done at the facility:

Approximately 10

Involvement of undergraduate students in research (approximate average number per year):

Approximately 8

Special student programs:

Annual workshops in Radiation Physics, Applications of Accelerators – duration approximately 1 week each with involvement of about 20-30 undergraduate students, mainly from other Universities.

Annual involvement in summer scholar programs (10-week projects), Industry youth schemes (CSIRO etc.) and Honours undergraduate programs (6-month projects) and various National Youth summer schools.

Future Plans:

Mainly incremental upgrades of detector instrumentation (recoil spectrometer for spectroscopy studies; cryogenic system for Hyperfine Interaction Studies).

Accelerator Improvements funded through the Australian Research Council for general accelerator improvements including additional Computer Control, improved beam intensities (ion source and pusling efficiencies) and upgrading of LINAC resonator RF systems and control. Extension of AMS facilities with a dedicated Radio Carbon accelerator system (commissioning in 2006)

CENTRE DE RECHERCHES DU CYCLOTRON

Louvain-La-Neuve (Belgium)

Chemin du Cyclotron, 2
B-1348 Louvain-la-Neuve
Facsimile: +32 10 45 21 83
WWW: http://www.cyc.ucl.ac.be/

Guido Ryckewaert, Director
Telephone: +32 10 47 32 37
E-mail: ryckewaert@cyc.ucl.ac.be

Contact Person for Foreign Users
Carmen Angulo
Telephone: +32 10 47 32 31
E-mail: angulo@cyc.ucl.ac.be
Carine Baras
Telephone: +32 10 47 29 98
E-mail: baras@cyc.ucl.ac.be

Facility:

Cyclotron CYCLONE110 for ions from H (25 µA, 10–90 MeV) to Xe (few nA, 400 MeV), including 5– 25 MeV/µ ^{12}C to ^{40}Ar ions and 0.65–10 MeV/µ radioactive ions.

Cyclotron CYCLONE30 for H beams up to 30 MeV, 500 µA.

Procedure to Apply for Beamtime:

Send a written proposal to the secretary of the PAC (C. Angulo). Present it orally (twice per year, beginning of January and beginning of July).

Programme Advisory Committee (current membership):

1 in-house, 3 national, 5 international members.

Main Instrumentation for Nuclear Physics Experiments:

Radioactive ion beam facility for ^{6}He, ^{7}Be, ^{10}C, ^{11}C, ^{13}N, ^{15}O, ^{18}Ne, ^{19}Ne,
^{35}Ar (other radioactive beams under development) using CYCLONE110 with CYCLONE30.
Leuven Isotope Separator On-Line (LISOL) with FEBIAD, ion guide (LIGISOL) and laser ion sources.
Monoenergetic fast neutron facility (20-75 MeV).
Electron cyclotron resonance ion sources.
Neutron multidetector array (DEMON).
Multistrip charged particle detectors (LEDA).

Main Fields of Nuclear Research:

Nuclear astrophysics in explosive environments.
Exotic light nuclei and nuclei far from stability.
Heavy ion reaction mechanisms.
Fast neutron interactions of interest for biology and energy generation.

Main Fields of Other Research:

Radiobiology, neutron dosimetry.
Nuclear chemistry.
Radiation damage by light, heavy and fast neutrons.
Detector calibration for space missions.

Accommodation:

2 apartments in the immediate neighborhood, 2 hotels within walking distance.

Transportation:

Public transportation from the center of Brussels and from Brussels National Airport by fast connection.

NUCLEAR PHYSICS INSTITUTE

Řež near Prague (Czech Republic)

Academy of Sciences
of the Czech Republic
CZ-25068 Řež near Prague
Czech Republic
Facsimile: +420 220941130
WWW: http://www.ujf.cas.cz/

J. Dobeš, Director
Telephone: +420 220941147
Facsimile: +420 220941130
E-mail: dobes@ujf.cas.cz

Contact Person for Foreign Users
J. Štursa
Telephone: +420 266173613
Facsimile: +420 220941130
E-mail: stursa@ujf.cas.cz

Facility:

Cyclotron U-120M: Isochronous cyclotron (K=40) for light ions operated in both positive (p, D, $^{3}He^{2+}$, $^{4}He^{2+}$) and negative (H^{-}, D^{-}) regimes.

Procedure to Apply for Beamtime:

Call for proposals on June 15th and December 15th every year. Submit proposals to contact person for foreign users.

Programme Advisory Committee (current membership):

8 in-house, 4 national, 0 international members

Main Instrumentation for Nuclear Physics Experiments:

Achromatic magneto-optical system for spectroscopy of nuclear reaction products.

High-power-wide spectrum fast neutron sources (10^{11} n/s/cm^2 up to 32MeV).
Scintillator detector based fast neutron spectrometer.

Main Fields of Nuclear Research:

Nuclear Astrophysics.
Fast neutron benchmark tests of activation cross sections.

Main Fields of Other Research:

Neutronic tests of fusion related materials.
Cross section measurements and preparation of new radionuclides for nuclear medicine purposes.

Accommodation:

Institute guest rooms on the site.
Hotel within walking distance from the Institute.

Transportation:

The Institute is located 20km from Prague.
Trains and buses go from and to Prague every 1 hour from 5 am to 12 pm.

Future Developments (under construction):

New beam lines dedicated to particular projects.
Increase of external beam intensity up to 50mA.

ACCELERATOR LABORATORY
UNIVERSITY OF JYVÄSKYLÄ

Department of Physics
University of Jyväskylä
Jyväskylä, Finland

Department of Physics
P.O. Box 35 (YFL)
FI-40014 UNIVERSITY OF JYVÄSKYLÄ
Finland

Telephone: +358 14 260 2355
Facsimile: +358 14 260 2351
E-mail: rauno.julin@phys.jya.fi
Home Page: http://www.phys.jyu.fi/

University Institute
Various sources of funding:
University of Jyväskylä, Academy of Finland, European Union Programmes

Professor Rauno Julin

Scientific Mission and Research Programs:

The Accelerator Laboratory at the University of Jyväskylä (JYFL) is a national facility with an extensive international programme in education and research on atomic nuclei under extreme conditions as well as related applications.

The current research activities include:

Decay and ground-state properties of exotic nuclei

Weak interaction physics

Structure and spectroscopy of superheavy elements

Structure and spectroscopy of proton-drip line nuclei

Nuclear clustering phenomena

Physics at CERN-ALICE

Accelerator-based materials physics

Radiation testing for the space industry

Neutrino physics and cold dark matter

Technical facilities:

Figure 2: View of the Department of Physics at the Ylistö campus area.

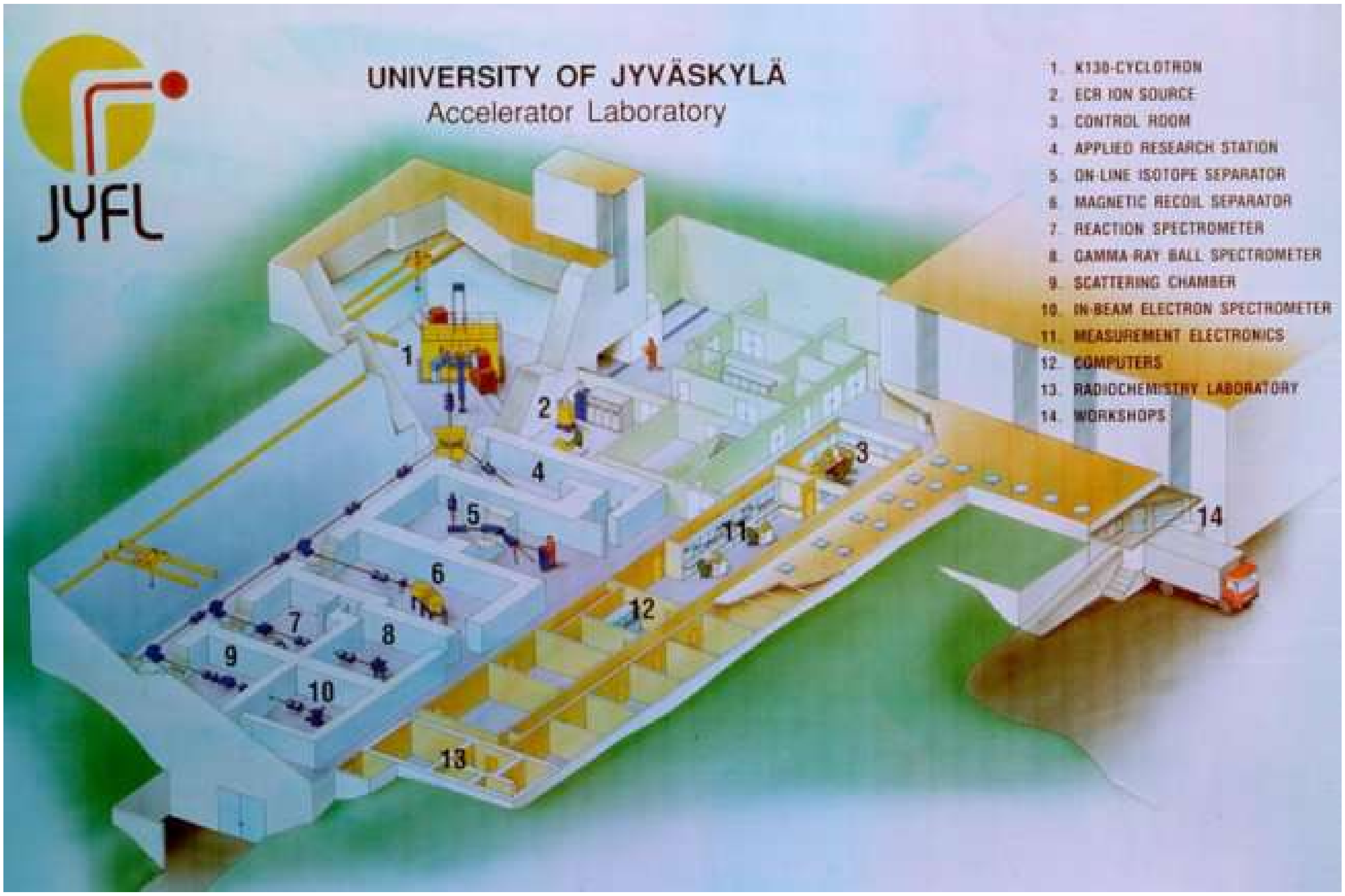


Figure 1: Layout of the JYFL Accelerator Laboratory.

Characterization of the facility:

The facility consists of a K=130 AVF cyclotron equipped with two ECR ion sources (6.4 and 14 GHz) for heavy ions and a multi-cusp ion source for protons. It is a relatively new facility used for nuclear physics experiments since 1994. Its reliability is reflected in the annual operation time, which during the last years has been close to 7000 hours.

As the maximum energy for the ion beam from the JYFL cyclotron is $E/A = 130(q/A)^2$ MeV/A, the availability of various beams strongly depend on the performance of the ion sources. Heavy ions are delivered by a 6.4 GHz or a 14 GHz ECR ion source.

Facility parameters:

Available beams and intensities from the cyclotron for ions with energies above 5 MeV per nucleon are as follows:

> 1pµA

p, He, B, C, N, O, Ar

> 100 pnA

F, Ne, Mg, Al, Si, S, Cl, Ca, Fe, Cr, Ni, Cu, Zn, Kr

> 10 pnA

Ti, Mn, Ge, Sr, Zr, Ru, Xe

Intensities for various isotopes depend on the isotopic enrichment of the available material. Metallic beams are extracted from a furnace or a MIVOC chamber. The MIVOC method (based on the use of volatile compound) was developed at JYFL. Negative H ions for high-intensity proton beams up to 50 µA from the cyclotron are extracted from the multi-cusp source.

Major experimental instrumentation and its capabilities:

The major experimental instrumentation available is:

Online isotope separator IGISOL

IGISOL can separate nuclei far from stability, especially those of refractory elements not available elsewhere.

Penning Trap JYFLTRAP

JYFLTRAP consists of a Radiofrequency Quadrupole (RFQ) beam-cooler device and a high-precision Penning trap.

Laser Ion Source FURIOUS

Currently under development to provide enhanced beam intensity and purity for exotic nuclei from IGISOL

Collinear Laser Spectroscopy Line

Allows high-sensitivity laser spectroscopy measurements of all elements, using cooled and bunched beams from IGISOL

Gas-filled Recoil Separator RITU

RITU is one of the leading instruments in the world for studies of neutron-deficient heavy nuclei.

Focal Plane Spectrometer GREAT

Developed by a group of U.K. institutes and located at the focal plane of RITU. Allows detailed measurement of the decay properties of implanted ions.

Germanium Detector Array JUROGAM

Consists of 43 HPGe detectors (efficiency 4.3% @ 1.3 MeV) and is used in conjunction with RITU in Recoil-Decay Tagging studies.

Internal Conversion Electron Spectrometer SACRED

Developed in collaboration with the University of Liverpool. Used in Nuclear Structure studies of heavy elements when combined with RITU.

Large Scattering Chamber LSC

Used in Nuclear Reaction studies and Stopping Power measurements.

Radiation Effects Facility RADEF

Used to study radiation effects in materials and electronics components (mainly for the space industry)

Neutron and Charged Particle Detector Array HENDES

Used in Nuclear Reaction and Fission studies

Facility for Radioisotope Production

Mainly used for the production of ^{123}I

Nature of facility:

The JYFL Accelerator Laboratory is considered a user facility, a fact which is reflected in the JYFL status as an EU Research Infrastructure.

Program Advisory Committee/experiment proposals:

The research program at JYFL is overseen by the Program Advisory Committee, consisting of six external members, three local members and a scientific secretary. There are two calls for proposals each year with deadlines of March 15th and September 15th.

Percentage of users and percentage of facility use from outside the country where your facility is located:

The number of foreign users of the laboratory during the last 7 years has been on the average 200 per year. Of these 35 - 40 % are new users.

Percentage of users, and percentage of facility use that come from inside the institution:

Approximately 15% of the users and 30% of the facility use are from within the institution.

Percentage of users and percentage of facility use from national users:

Approximately 10% of the users and 15% of the facility use are from national users not belonging to the institution.

Fraction of international users outside of geographical region:

The remaining users and facility use are from outside the country where the facility is located. Of these, around 10% are from outside the geographical region.

User Group:

The JYFL Accelerator Laboratory does not have a formal users group, but regularly organizes users meetings and workshops to discuss the status and future of research in the laboratory.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

The Accelerator Laboratory employs 26 permanent staff, and 42 temporary staff including graduate students and postdoctoral researchers.

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

There are 7 theoretical staff employed at the facility, of which 1 is permanent, 2 are postdoctoral and 4 are graduate students.

Number of postdoctoral researchers:

There are 15 postdoctoral staff employed at the facility, including senior researchers.

Number of graduate students resident at the facility:

There are 26 graduate students resident at the facility and a similar if not larger number of non-resident graduate students whose thesis work is done primarily at the facility.

Number of non-resident graduate students with thesis work primarily done at the facility:

At any given time, there are approximately 10 undergraduate students working in research at the facility.

Involvement of undergraduate students in research (approximate average number per year):

The facility regularly runs a Summer School for postgraduate students, and has a program of Summer Student Training aimed at undergraduates. Students from the facility often participate in overseas schools and conferences.

Future Plans:

In the future, it is hoped that the facility will be upgraded with the addition of a small cyclotron to provide intense light-ion beams to IGISOL and for isotope production. This will allow the K=130 cyclotron to provide more beam time for heavy-ion users. A new vacuum mode recoil mass spectrometer will be built to allow Nuclear Structure studies in the A=100 region. A new combined gamma ray and conversion electron spectrometer known as SAGE will be built by the University of Liverpool and Daresbury Laboratory in collaboration with JYFL. A new facility for Accelerator-Based Materials Physics will be constructed.

2.5 MV VAN DE GRAAF
INSTITUT DE PHYSIQUE NUCLEAIRE DE LYON (IPNL)

Lyon (France)
Institut de Physique Nucléaire de Lyon (in2p3-CNRS/Université Claude Bernard Lyon)

4, rue Enrico Fermi
69622 Villeurbanne- France
Telephone: +33 (0)4 72 43 19 19 or 4 72 43 13 54
Facsimile: +33 (0)4 72 43 13 54
E-mail: peaucelle@ipnl.in2p3.fr

French mix Unity of research University of Lyon/ CNRS (National Centre for Scientific Research)

Construction: IPNL (in2p3-CNRS/ University of Lyon)
Operation: IPNL (in2p3-CNRS/ University of Lyon)

Heads of the facility:

Mr Bernard ILLE
Mr Christophe Peaucelle (head of accelerator division)

Scientific Mission and Research Programs:

The main program research made on such facility concerns sputtering and emission from solids under impact of MeV-energy heavy ions and gold clusters. Indeed, under impact of 2 MeV-gold clusters on gold targets, the formation of surface craters is related to very large sputtering yields. The ionised component of such ejected matter consists mainly of large size clusters as shown in time-of-flight experiments.

Technical facilities:

Van de Graaf 2.5 MV accelerator tube

Characterization of the facility:

Electrostatic van de graaf 2.5 MV accelerator with gold cluster source

Facility Parameters:

Accelerated Particles	Au_1	Au_5	Au_{13}
Charges	1+	1+	1+
Max Energies:	2.2 MeV	1.5 MeV	1 MeV
Max Intensities:	300 nA	100 nA	few pA

Major experimental instrumentation and its capabilities:

Nature of user facility:

No

Program Advisory Committee/experiment proposals:

No

Number of actual, active users of the facility in a given year:

2 + national collaboration (in2p3-CNRS labs)

Percentage of users, and percentage of facility use that come from inside the institution:

100%

Percentage of users and percentage of facility use from national users:

2/3

Percentage of users and percentage of facility use from outside the country where your facility is located:

1/3

Fraction of the international users is outside of geographical region:

0

User Group:

Yes (3)

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

permanent technical staff: 2

permanent user staff: 1

temporary staff: 1

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

0

Number of postdoctoral researchers:

0

Number of graduate students resident at the facility:

0

Number of non-resident graduate students with thesis work primarily done at the facility:

1

Involvement of undergraduate students in research (approximate average number per year):

0

Special student programs:

None

4 MV VAN DE GRAAF ACCELERATOR
INSTITUTION: INSTITUT DE PHYSIQUE NUCLEAIRE DE LYON (IPNL)

Lyon (France)

Institut de Physique Nucléaire de Lyon
(in2p3-CNRS/Université Claude Bernard Lyon)

4, rue Enrico Fermi
69622 Villeurbanne- France

Telephone: +33 (0)4 72 43 19 19 or 4 72 43 13 54
Facsimile: +33 (0)4 72 43 13 54
E-mail peaucelle@ipnl.in2p3.fr

French mix Unity of Research: University of Lyon/ CNRS
(National Centre for Scientific Research)

Construction: PACE program+ IPNL (in2p3-CNRS/ University of Lyon)
Operation: PACE program+ IPNL (in2p3-CNRS/ University of Lyon) + business service

Heads of the facility:

Mr Bernard ILLE
Mr Christophe Peaucelle (head of accelerator division)

Scientific Mission and Research Programs:

There are mostly two main researches on the 4 MV accelerator:

On one hand, the 4 MV van de Graaf accelerator is used for research about nuclear waste management: first one, as a particles source for study on effects and damages on matrices after irradiation;

Secondly, different ion-beam-analysis methods (such as RBS, PIXE, ERDA and NRA) are powered in order to follow and determine migration of several isotopes which simulate long life radio element inside nuclear waste matrices.

On the other hand, argon ions are used for application of Time-of-Flight Mass Spectrometry to the analysis of environmental samples such as pesticides adsorbed on soils.

Besides, facility is uses for ionic implantation and practical for undergraduate and graduate students

Finally, our laboratory develops business implantation and analysis services for others labs or firms.

Characterization of the facility:

4 MV Electrostatic accelerator Van de Graaff used for ionic implantations and ion beam analysis: Nuclear Reaction Analysis, Rutherford Backscattering Spectroscopy, Particles

Induced X-ray Emission, Elastic Recoil Detection Analysis)

3 beams lines dedicated to TOF, RBS+ERDA+PIXE, Ionic Implantations, Extract beam line

Facility Parameters:

Accelerated ions:	**Protons**	**Deutons**	**He_3**	**He_4**	**N_{15}**	**Ar**
Enable Charges:	1+	1+	1+/2+	1+/2+	1+/2+	1+/2+/3+
Enable Energies:	3.5 MeV	3.5 MeV	3.5/7 MeV	3.5/7 MeV	3.5/7 MeV	3.5/7/9
Enable Intensities:	400 nA	400 nA	400/50 nA	400/50 nA	400/50 nA	100/30/10

Technical facilities:

Bending magnet of the 4MV Van de Graaf accelerator

Major experimental instrumentation and its capabilities:

Instrumentation for ion beam analysis: Nuclear Reaction Analysis, Rutherford Backscattering Spectroscopy, Particles Induced X-ray Emission, Elastic Recoil Detection Analysis)

Nature of user facility:

Yes

Program Advisory Committee/experiment proposals:

Yes, an internal one

Number of actual, active users of the facility in a given year:

In 2004, there were about 20 active users divided in 2 subjects of research

Percentage of users, and percentage of facility use that come from inside the institution:

95%

Percentage of users and percentage of facility use from national users:

95%

Percentage of users and percentage of facility use from outside the country where your facility is located:

5%

Fraction of the international users outside geographical region:

100% (Lebanon)

User Group:

Yes, two formal users group (14 p. and 6 p.)

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

permanent staff: technical staff: 5

permanent user staff: 12

temporary staff: 8

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

0

Number of postdoctoral researchers:

0

Number of graduate students resident at the facility:

6

Special student programs:

Practical for under graduate and graduate students

Future Plans:

Renovation (40-year-old accelerator) and upgrades of the facility and the 3 beam lines

ARRONAX: ACCELERATEUR POUR LA RECHERCHE EN RADIOCHIMIE ET EN ONCOLOGIE A NANTES ATLANTIQUE

Nantes/Saint-Herblain (France)

No address yet (start of operation: 2008)

Groupement d'intérêt public (CNRS, INSERM, Université de Nantes, École des Mines de Nantes, Centre Hospitalier Universitaire de Nantes, Centre de Lutte Contre le Cancer René Gauducheau)

Local authorities, French State, European Union
CNRS, INSERM, Université de Nantes, École des Mines de Nantes
Centre hospitalier universitaire de Nantes
Centre de lutte contre le cancer René Gauducheau

Project Manager: François GAUCHÉ
francois.gauche@subatech.in2p3.fr

Scientific Mission and Research Programs:

The government of France and the political authorities of the Région des Pays de la Loire have initiated plans for a high-energy cyclotron to be located in Nantes and dedicated to nuclear medicine, radiochemistry, and education. The main purpose of this equipment will be to produce innovative electron-, positron-, and alpha-emitting radionuclides for diagnostic and therapeutic applications developed in research laboratories and hospital-based nuclear medicine departments and to advance knowledge about radiation and matter interactions.

The project was approved in 2004. The facility is expected to go into operation in 2008.

Technical facilities:

not available yet (available in 2006)

Characterization of the facility:

high-energy cyclotron with light-ion beams

Facility Parameters:

protons: 25-70 MeV, up to 350μA

alpha particles: 25-70 MeV, up to 35μA

The possibility of a vertical beam is being evaluated.

Major experimental instrumentation and its capabilities:

not available yet

Nature of user facility:

The facility is intended to be partly a user facility (CNRS, INSERM, University of Nantes, but also other interested laboratories).

Program Advisory Committee/experiment proposals:

It will.

Number of actual, active users of the facility in a given year:

not known yet

Percentage of users, and percentage of facility use that come from inside the institution:

not known yet

Percentage of users and percentage of facility use from national users:

not known yet

Percentage of users and percentage of facility use from outside the country where your facility is located:

not known yet

Fraction of international users outside of geographical region:

not known yet

User Group:

not yet

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

estimated permanent staff: 15

EUROPEAN SYNCHROTRON RADIATION FACILITY
ESRF GRAAL – GRENOBLE ANNEAU ACCÉLERATEUR LASER

Grenoble (France)

6, rue Jules Horowitz BP220 38043
Grenoble CEDEX9, France
Telephone: +33 (0) 4 76 88 20 00
Facsimile: +33 (0) 4 76 88 20 20
web address: http://www.lnf.infn.it/nuclear

ESRF: W.G. Stirling
INFN: R. Petronzio

Limited liability company under French law

For Graal: Government funds via the Italian agency for
nuclear physics INFN – Istituto Nazionale di Fisica Nucleare

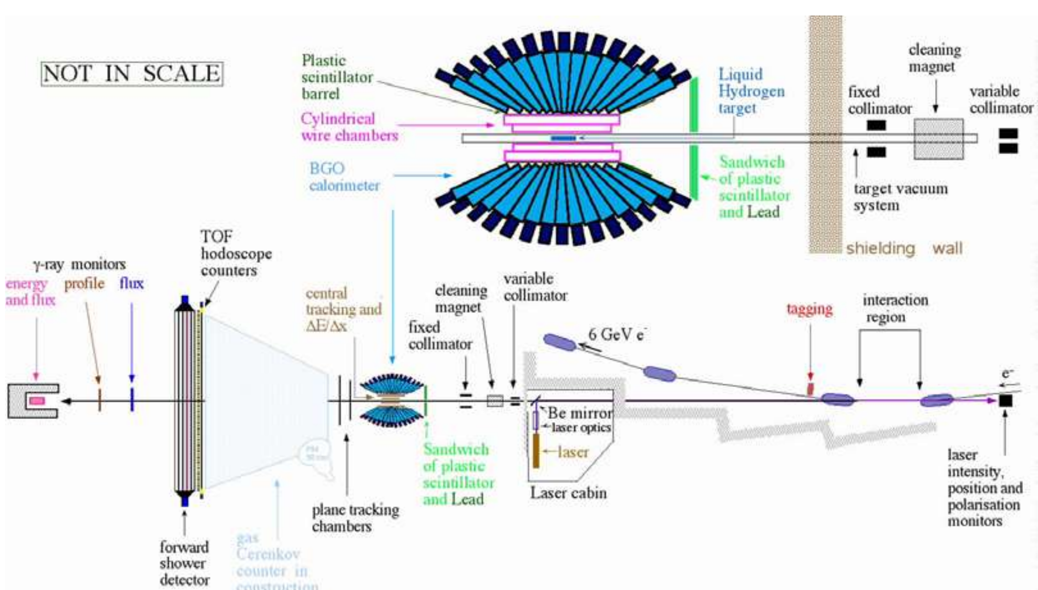
Contact Person for Foreign Users

C. Schaerf Telephone: +39 06 72 59 45 61
E-mail: Carlo.Schaerf@roma2.infn.it

Scientific Mission and Research Programs:

The scientific goal of the Graal Beam Facility is the study of the barion spectrum through the measurement of polarisation degrees of freedom in photonucleon reactions with monochromatic and polarised (circular or linear polarisation) γ rays in the second and third resonance region. Current research include meson photoproduction on the proton and on the neutron, strangeness photoproduction, Compton scattering. Future programs are focused on the same topics with the introduction of a polarised HD target.

Technical facilities:



Brief characterization of the facility:

Compton back-scattered polarised photon beam

Table of facility parameters:

Laser line (nm)	γ energy (MeV)	Intensity (s^{-1})
514 (green)	550-1100	5×10^{6}
351 (UV)	950-1500	2×10^{6}

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Lagrange a 4π detector for charged and neutral particles with excellent energy resolution to 1-1000 MeV photons (BGO calorimeter with 480 elements), high neutron detection efficiency (20-50%), no magnetic field.

Nature of user facility:

The facility is advertised as user facility only informally and is available for scientific users through collaborative programs at the discretion of the Graal collaboration.

Program Advisory Committee/experiment proposals:

The beam time is allocated through an internal committee.

Number of actual, active users of the facility in a given year (average over the last few years, or just the last year if the facility is new, for example; please indicate how the number is derived):

We have in average 30 users, not including collaborators not belonging to the Graal collaboration.

Percentage of users, and percentage of facility use that come from inside the institution:

65% 80%

Percentage of users and percentage of facility use from national users:

50% 90% from Italy.

Percentage of users and percentage of facility use from outside the country where your facility is located:

50%

Fraction of international users outside of geographical region:

10%

User Group:

There is no users group.

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

25 permanent, 5-10 temporary.

Number of theoretical staff employed at the facility: permanent, postdoctoral, students:

No direct theoretical staff is directly involved in running the experiment.

Number of postdoctoral researchers:

Presently 2

Number of graduate students resident at the facility:

Presently none.

Number of non-resident graduate students with thesis work primarily done at the facility:

15

Involvement of undergraduate students in research (approximate average number at a given time):

3

Special student programs:

No particular programs specific for Graal. More general INFN programs include schools and stages of different duration.

Future Plans:

Main development for the future will be the installation of a polarised HD target.

FACILITY AIFIRA (APPLICATIONS INTERDISCIPLINAIRES DES FAISCEAUX D'IONS EN REGION AQUITAINE) AT THE LABORATORY CENBG

Centre d'Etudes Nucléaires Bordeaux Gradignan (CENBG)
Chemin du Solarium
Le Haut Vigneau, BP 120, 33175 GRADIGNAN, FRANCE

Telephone: +33557120804
Facsimile: +33557120802
E-mail: haas@cenbg.in2p3.fr
http://www.cenbg.in2p3.fr

The laboratory is a mixed unit of research (UMR) CNRS/IN2P3-University (of Sciences and Technology) Bordeaux 1

Region Aquitaine, the ministery of Research and Education, the French National Research Council (CNRS) and the University Bordeaux 1 for the construction
CNRS and University Bordeaux 1 for the operation

Heads of the facility:

Dr. Michel SPIRO (CNRS/IN2P3**)**
Prof. Francis HARDOUIN (University Bordeaux 1)
Dr. Bernard Haas, Head of the laboratory
e-mail: haas@cenbg.in2p3.fr
Pr. Philippe. Moretto, scientific coordinator of the project
e-mail:moretto@cenbg.in2p3.fr

Since September 2004 the facility has been under construction (total cost 2.7 MEuros) and the first beams for experiments are expected in autumn 2005

Scientific Mission and Research Programs:

Activities of the laboratory extend from nuclear to astroparticle physics, and beyond to applications of subatomic physics to different multidisciplinary fields like for example the AIFIRA project. The main research topics are:

Study of exotic nuclei far from the valley of beta stability, and rare decays modes

Neutrino physics (type and mass) and double beta decay

High energy gamma ray astronomy

Laser induced nuclear excitations

Theoretical study of nuclear and hadronic matter

AIFIRA: the addressed topics cover different fields of research including life sciences, environment, archaeology, solid state physics, microelectronics, neutron physics, waste transmutation, nuclear fuel cycles and industrial applications.

Characterization of the facility:

The accelerator chosen for the AIFIRA project is a single stage 3.5 MV electrostatic Singletron type machine (HVEE The Netherlands) which will provide light ion beams with spacial resolutions ranging from a few mm down to 50 nm (nanometer).

Facility Parameters:

Ion energy range from 0.3-3.5 MeV, energy stability better than 2.10^{-5}

protons $^1H^+$, max current 80 µA

deuterons $^2H^+$, max current 50 µA

helium $^4He^+$, max current 50 µA

mono energetic neutron beams from 0.1 to 7 MeV, flux ~10^6neutrons / cm^2.sec

Major experimental instrumentation and its capabilities:

Five beam lines each dedicated to a special application: 2 lines with mm size beams for material characterization and quantitative chemical analysis, 2 lines with µm and nm size beams for local irradiations as well as two-and three-dimensional imaging, 1 line for the production of intense mono energetic neutrons produced via nuclear reactions of protons on ^3H and ^7Li targets or deuterons on ^2H.

Nature of user facility:

The forthcoming facility is considered to be a user facility by CNRS and by the University of Bordeaux 1.

Program Advisory Committee/experiment proposals:

The facility will have a program advisory committee with external members

Number of actual, active users of the facility in a given year:

We expect about 60 different users of the facility in a given year (some of them might come a few times)

Percentage of users, and percentage of facility use that come from inside the institution:

We expect about 65% users and facility use from local Bordeaux CNRS and University laboratories.

Percentage of users and percentage of facility use from national users:

We expect about 30% users and facility use from national users

Percentage of users and percentage of facility use from outside the country where your facility is located:

We expect about 5%

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

In October 2005 there will be 10 permanent staff and 7 temporary staff

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

0

Number of postdoctoral researchers:

In October 2005: 3

Number of graduate students resident at the facility:

In October 2005: 4

Special student programs:

We plan to organise student labs for university students in physics from second and third year.

GRAND ACCELERATEUR NATIONAL D'IONS LOURDS (GANIL)

Caen (France)

Boulevard Henri Becquerel
– BP 55027 –
14076 Caen cedex 5
Telephone: 33 (0)2 31 45 46 47

Facsimile: 33(0)2 31 45 46 65
E-mail: gales@ganil.fr

Groupement d'Intérêt Economique (Economic Interest Group) - GIE

CEA-DSM (Commissariat à l'Energie Atomique/Direction des Sciences de la Matière)
CNRS-IN2P3 (Centre National de la Recherche Scientifique – Institut National de Physique Nucléaire et de Physique des Particules)
Région Basse-Normandie
Union Européenne

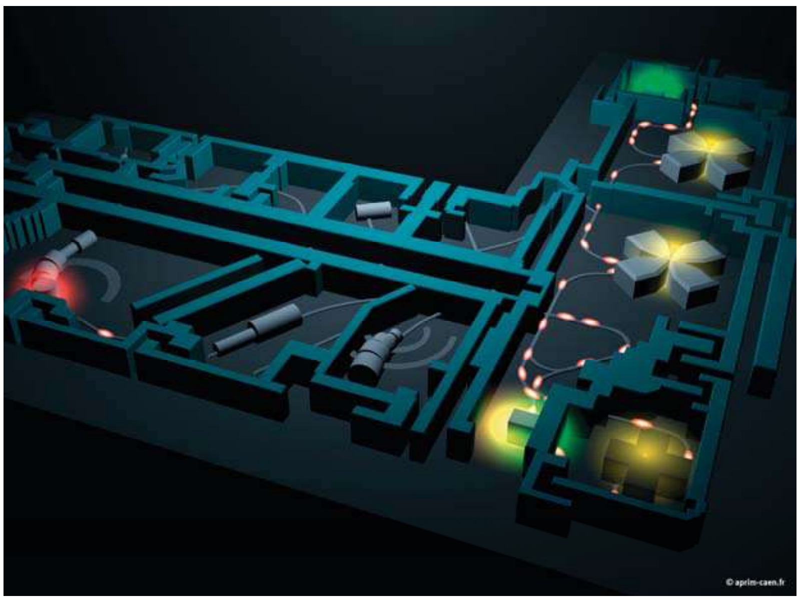
Head of the facility:

Director: Sydney GALES
Deputy Director & SPIRAL2 Project Leader: Marcel JACQUEMET
Scientific Deputy Director: Philippe CHOMAZ
SPIRAL2 Scientific Coordinator: Marek LEWITOWICZ

Scientific Mission and Research Programs:

GANIL is a large-scale European facility providing beams of heavy ion from Carbon to Uranium with energies ranging from very slow (few hundreds meters per second) to high energies up to 95 MeV per nucleons. The scientific program is developing along 2 lines: (i) the study of the atomic nucleus, its structure and reactions and its mechanical, chemical and thermal properties (ii) the use of the various beams to investigate matter at larger scale from atoms to DNA. GANIL is producing beams of exotic nuclei using the fragmentation method in LISE and SiSSi and the ISOL technique with the recently open facility SPIRAL (1). Exotic nuclei are a key point in our understanding of nuclear structure and isospin dependence of the nuclear interaction and matter. They are also important in astrophysics. GANIL is now building a second generation exotic beam facility SPIRAL2.

Technical facilities:



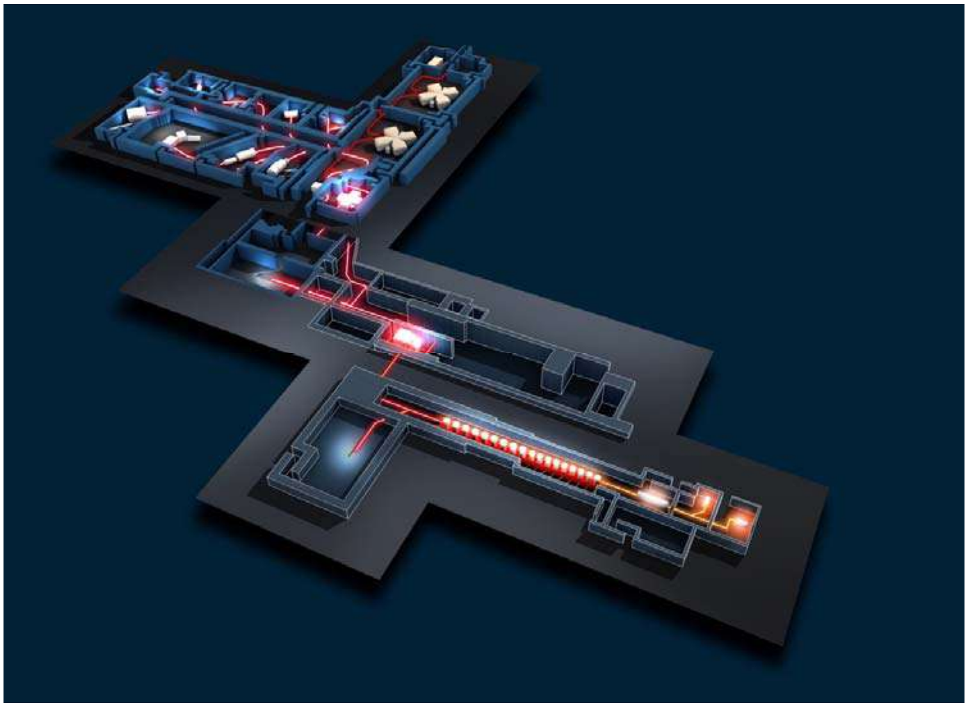
Cf annexe 1

Characterization of facility:

2 separated sector cyclotrons and 3 compact cyclotrons

Technical facilities:

Acceleration of light and heavy ion beams (carbon to uranium) from few MeV/nucleon to 95 MeV/nucleon. Exotic beams can be produced by Isotope Separation On Line method with the SPIRAL facility (up to 25 MeV/nucleon) or In-Flight Separation techniques



GANIL in the future with SPIRAL2

Nature of user facility

GANIL has been considered as a user facility (since 95) by the European Commission through the Integrated Infrastructure Initiative Contract "EURONS"

Program Advisory Committee/experiment proposals:

2 PACs one for Nuclear Physics (7 foreign,5 national) and one for interdisciplinary research (atomic, condense matter, biology) Industrial applications do no go through the PAC's. Both PAC's are run twice a year.

Number of actual, active users of the facility in a given year (average over the last few years; for example; please indicate how the number is derived)

The five-year average for the period 2001-2005 inclusive is 370 per year. This doesn't include numerous collaborators who do not participate in the on-site running of experiments. (active users is interpreted as physicists coming on site to run experiments)

Percentage of users, and percentage of the facility users that come from inside the institution:

2001-2005 period: 9 % of users come from inside GANIL

Percentage of users and percentage of facility use from national users:

For the period 2001-2005, national users represent 55% of the users for the nuclear physics

Percentage of users and percentage of facility use from outside where your facility is located:

Period 2001-2005: 36%

Fraction of the international users outside geographical region:

8% (outside EU)

Users group:

No, it does not, only a board of representatives from each lab using the facility is formally defined. A formal user group, GANIL-SPIRAL2, is being discussed with the users.

Number of a)permanent staff and b)temporary staff (including graduate students and postdoctoral researchers):

Permanent staff: 242

Temporary Staff: 25

Number of theoretical staff employed at the facility: permanent; postdoctoral; students:

4, permanents, 1 post-doc,3 PhD students

Number of postdoctoral researchers:

Currently 4; varies between 3 and 6

Number of graduate students resident at the facility:

Currently 9

Number of non-resident graduate students with thesis work primarily done at the facility:

7/8 non resident-graduate students

Involvement of undergraduate students in research (approximate average number at a given time):

About 20 per year (estimate for Ganil only)

Special student programs:

a summer school for high school, undergraduate an graduate students

Trainings for undergraduate, high school students

Thesis presentation day for undergraduate

Open doors for high school students

Future Plans:

The major development at GANIL in the next 5 years is the construction of the new radioactive beam facility SPIRAL2 which is on the road map toward EURISOL. At the same time the associated instrumentation is underdevelopment with for example a new spectrometer for the search for super-heavies or a new low energy cave for the study of radioactive elements.

IMPLANTEUR 400 KV INSTITUTION: INSTITUT DE PHYSIQUE NUCLEAIRE DE LYON (IPNL)

Lyon - France

Institut de Physique Nucléaire de Lyon
(in2p3-CNRS/Université Claude Bernard Lyon)

4, rue Enrico Fermi
69622 Villeurbanne- France
Telephone: +33 (0)4 72 43 19 19 or 4 72 43 13 54
Facsimile: +33 (0)4 72 43 13 54
E-mail peaucelle@ipnl.in2p3.fr

French mix Unity of research University of Lyon/ CNRS
(National Centre for Scientific Research)

Construction: PACE program+ IPNL (in2p3-CNRS/ University of Lyon)
Operation: PACE program+ IPNL (in2p3-CNRS/ University of Lyon) + business service

Heads of the facility:

Mr Bernard ILLE
Mr Christophe Peaucelle (head of accelerator division)

Scientific Mission and Research Programs:

This accelerator is exclusively used for ionic implantation. Nuclear waste management is the main research program: indeed, this field of research needs to simulate several radio elements by mean of implanted ions in nuclear waste matrices.

Besides, our laboratory develops business implantation service for other labs or firms

400 kV Implanteur

Technical facilities:

Characterization of the facility:

Ion implanter (energy from 60 keV to 800 keV)

Facility Parameters:

Produced ions: He, N, C, Cs, Mg, Al, Cl, Ar, Fe, Pb, Ag, Au, Ti, Cr, Kr, I, Xe, Eu, Er, Ne, Li, O, Ni, Se, Zr, Lu, Nd…

Max. high voltage: 400 kV

Max source intensity: 4 mA

Max selected ion intensity: several hundred of µA

Max implanted area: 80 cm2

Major experimental instrumentation and its capabilities:

Nature of user facility:

No

Program Advisory Committee/experiment proposals:

No

Number of actual, active users of the facility in a given year:

Over 100 uses per a year

Percentage of users, and percentage of facility use that come from inside the institution:

80 % from inside the institution

Percentage of users and percentage of facility use from national users:

99 % from national users

Percentage of users and percentage of facility use from outside the country where your facility is located:

1 %

Fraction of international users outside of geographical region:

0 %

User Group:

No

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

Technical staff: 2

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

0

Number of postdoctoral researchers:

0

Number of graduate students resident at the facility:

0

Number of non-resident graduate students with thesis work primarily done at the facility:

0

Involvement of undergraduate students in research (approximate average number per year):

0

Special student programs:

0

Future Plans:

New construction in 2006: low energy ion implanter (10 to 50 keV)

INSTITUT LAUE-LANGEVIN

Grenoble ILL (France)

6 rue Jules Horowitz
BP 156
Grenoble Cedex 9
F-38042
Facsimile: +33 4 76 48 39 06
WWW: http://www.ill.fr/

Dr. Richard Wagner, Director
Telephone: +33 4 76 20 71 74
E-mail: carlile@ill.fr

Contact Person for Foreign Users
G. Cicognani
Telephone: +33 4 76 20 70 82
Facsimile: +33 4 76 48 39 06
E-mail: sco@ill.fr

Facility:

High-Flux 58.4 MW Reactor: The most powerful source of neutrons in the world for research, operating some 40 instruments. Maximum unperturbed thermal neutron flux in reactor: 1.0×10^{15} n /cm^2/s. Maximum perturbed thermal-neutron flux at beam tubes: 0.8×10^{15} n /cm^2/s.

Hot source at 2400 K. Vertical and horizontal cold sources at 25 K.

Procedure to Apply for Beamtime:

Proposals for experiments at the ILL are submitted from the "visitor's club" on the ILL's website (www.ill.fr). Two proposal rounds per year, whose dates are announced on the ILL's website.

Programme Advisory Committee (current membership):

8 different PAC subcommittees each specialised in a particular scientific field (one subcommittee for nuclear and fundamental physics). Each PAC has 8 external members.

Main Instrumentation for Nuclear Physics Experiments:

Four main intruments: Lohengrin (PN1), GAMS (PN3), PF1 and PF2. The Lohengrin online mass spectrometer for unslowed fission products, which produces and separates neutron-rich nuclei far from stability. The focal point of the spectrometer can be equipped with, ionistation chambers for particle identification, an efficient array of "Clover" detectors for γray spectroscopy, BaF_2 detectors for fast-timing measurements and Si(Li) detectors for conversion-electron spectroscopy. These detectors are used mostly for the studying decays from microsecond isomers. A tape transport is also available for beta-decay studies. Studies of the fission process and applied physics experiments related to reactor applications can also be performed with this instrument. The GAMS 4 and 5 ultra-high resolution crystal gamma-ray spectrometers have eV resolution and can be used for ultra-high resolution gamma-ray spectroscopy, measurements of nuclear lifetimes on the femtosecond scale, the determination of fundamental constants and the low-energy slowing down processes of ions in matter. The PF1 cold-neutron beam, with a thermal-equivalent flux of 1.4×10^{10} n/cm^2/s delivers the most intense cold polarised neutron beam in the world. It can be used for experiments such as the study of asymmetries in neutron decay, nuclear structure (through fission or neutron-capture reactions) and studies of the fission mechanism.

PF2 ultra-cold neutron facility provides beams of ultra-cold neutrons. Examples of experiments include studies of the electric dipole moment of the neutron and measurements of the neutron lifetime.

Main Fields of Nuclear Research:

Nuclear structure of neutron-rich nuclei far from stability. Nuclear structure from neutron-capture reactions.

Main Fields of Other Research:

Research at the ILL covers nearly all areas of physics, chemistry, biology, materials science and engineering.

Accommodation:

Joint guest house (with the ESRF) with 114 single rooms and 20 twin rooms located at the laboratory.

Transportation:

Train station Grenoble (2 km from the laboratory). Grenoble, Lyon and Geneva airports all within easy reach by road (all have regular coach services).

TANDEM FACILITY INSTITUT DE PHYSIQUE NUCLEAIRE D'ORSAY
ALTO FACILITY (ELECTRON ACCELERATOR)
(ELECTROSTATIC HEAVY ION ACCELERATOR)

25 km away from Paris, on the RERB line (Orsay station)

Institut de Physique Nucléaire d'Orsay
UMR 8608 – CNRS IN2P3
15 rue Georges Clémenceau
Université Paris Sud
91406 ORSAY
Telephone: 01 69 15
Facsimile: 01 69 15 64 70
E-mail: ibrahim@ipno.in2p3.fr

The institution is under the responsibility of the Centre National de la Recherche Scientifique (CNRS)
The University Paris XI Institute under French administrative law,
under the responsibility of the French Ministry of Education and Science Research.
The Tandem/ALTO facility, it is under the responsibility of the Institute.
It therefore has the same status.

Heads of the facility:

Pr Dominique GUILLEMAUD-MUELLER
Dr Fadi IBRAHIM, Head of the Tandem and ALTO facilities (scientific matters);
Dr Saïd ESSABAA, Head of the Tandem and ALTO facilities (technical matters).

Scientific Mission and Research Programs:

The physics fields are:

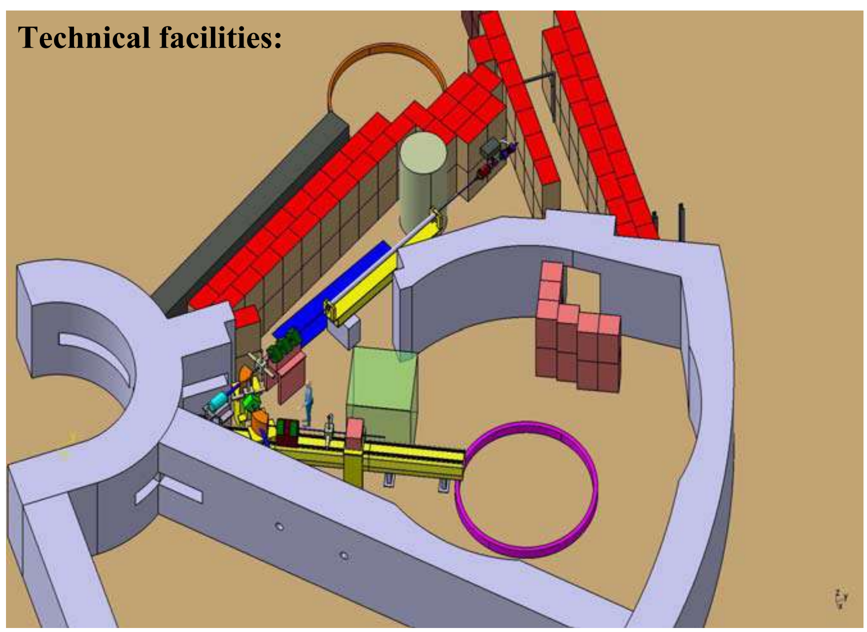
fundamental nuclear physics, nuclear structure, exotic nuclei;

nuclear astrophysics;

solid physics;

atomic physics.

Technical facilities:



Characterization of the facility:

The Tandem is an electrostatic machine (maximum voltage 15 MV). It can speed up an important range of ions, from the protons to the mass agregates, ALTO is a 50 MeV pulsed electron linac, dedicated to the production of neutron rich radioactive beams with a production up to 4.10" fissions per second, on line with a mass separator.

Table of facility parameters:

Tandem:

Injected ion species	Injected intensity (µA)	Energy (MeV)	Intensity analysed (pps x 10^{10})
^{1}H	2.5	25	600
^{2}H	1.6	29	113
^{4}He	1.9	36	900
^{6}Li	0.07	50	1.8
^{7}Li	0.09	56	13
^{9}Be	0.0025	62	0.56
^{11}B	0.0042	77	4.3
^{12}C	0.92	69	94
^{13}C	1.8	70	2.6
^{14}C	0.11	72	15
^{16}O	4	90	100
^{19}F	0.2	104	3.3
^{24}Mg	0.06	130	6
^{27}Al	0.18	120	8
^{28}Si	0.14	150	0.063
^{31}P	0.07	155	0.95
^{32}S	0.75	154	29
^{34}S	0.09	130	5.6
^{35}Cl	0.2	154	10
^{40}Ga	0.12	168	37
^{48}Ti	0.014	210	1.2
^{56}Fe	0.0025	99	0.032
^{58}Ni	0.18	182	6.8
^{81}Br	1.5	217	2.2
^{127}I	0.5	297	0.5
^{197}Au	0.2	172	0.045

ALTO: neutron rich radioactive beams with production up to 4.10^{11} fissions/sec.

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Split pole spectrometer

Parrne separator

Bacchus spectrometer

Orsay Segmented Clover Array (OSCAR)

Nature of user facility:

YES

Program Advisory Committee/experiment proposals:

YES

The ALTO Programme Advisory Committee adjudicates experiment proposals twice a year.

Number of active users and their origin:

Just with the Tandem facility: 130 active users of the facility. This number will increase with ALTO (end of 2005).

Percentage of users, and percentage of facility use that come from inside the institution:

22 %

Percentage of users and percentage of facility use from national users:

42 %

Percentage of users and percentage of facility use from outside the country where your facility is located:

34 %

Fraction of the international users outside of geographical region:

2 %

User Group:

Not for the moment, in progress.

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

a) 28, b) 10

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

20 permanent theoretical staff, 2 post-doc theoretical staff, 6 students at IPN.

Number of postdoctoral researchers:

10 at IPN

Number of graduate students resident at the facility:

42 at IPN

Number of non-resident graduate students with thesis work primarily done at the facility:

5

Involvement of undergraduate students in research (approximate average number at a given time):

10

Special student programs:

Master experiments: once a year, schools visits (under graduates).

Future Plans:

Construction of 4 low energy lines, in addition with the one already existing. Laser Ion source, high resolution spectrometer,

DARMSTADT S-DALINAC (GERMANY)

Institut für Kernphysik
Technische Universität Darmstadt
Schlossgartenstrasse 9
D-64289 Darmstadt

http://linac.ikp.physik.tu-darmstadt.de/
Telephone: +49 61 51 16 21 16
Facsimile: +49 61 51 16 43 21
E-mail: Richter@ikp.tu-darmstadt.de

A. Richter

Scientific Mission and Research Programs:

Main Fields of Nuclear Research:

Photon and electron scattering for the study of elementary nuclear excitations with low multipolarity.

Electric and magnetic giant resonances.

Mean square charge radius of the proton.

Few-body systems.

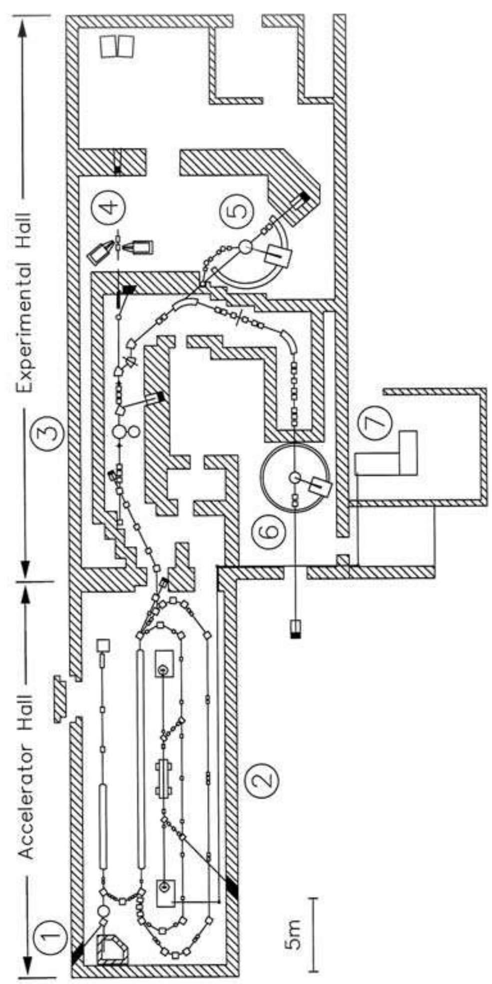
Nuclear astrophysics.

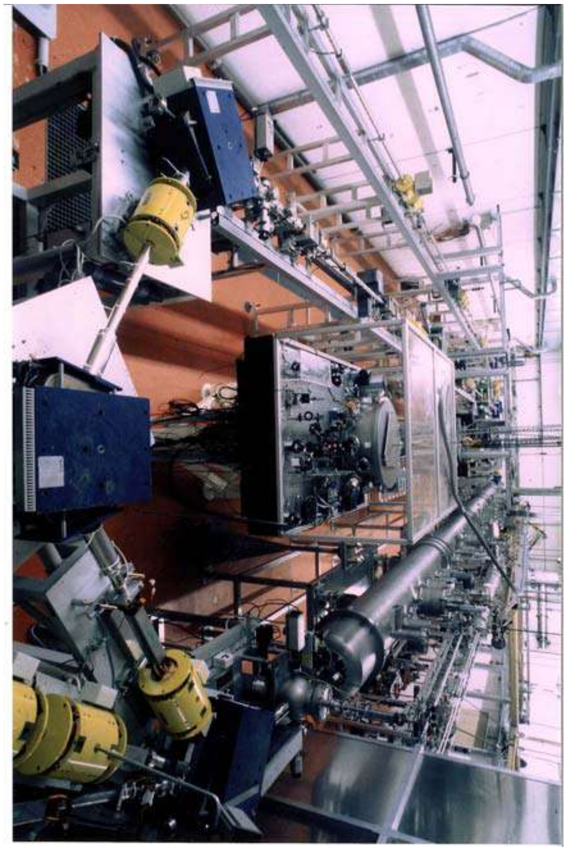
Electric and magnetic polarizabilities of the nucleon determined through Compton scattering at low photon energies.

Technical facilities:

Layout: S-DALINAC + Exp. Facilities
Fig caption

1. channelling radiation and (gamma,gamma') – experiments.
2. Free-electron-laser
3. high energy radiation physics
4. Compton scattering off the nucleon
5. (e,e'x) – experiments & 180º spectrometer
6. (e,e') – experiments
7. optics experiments





Characterization of the facility:

Superconducting recirculating electron beam accelerator.

Table of facility parameters:

beam: electrons
energy: 2-130 MeV
current: 50 μA (10 MeV), 20 μA (130 MeV)

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Main Instrumentation for Nuclear Physics Experiments:

Nuclear resonance fluorescence facility with three 100% efficient Germanium dectors

Large solid angle magnetic spectrometer of the QCLAM type for single arm (e,e') and coincidence experiments of the form (e,e'x) with x = n,p, …

Solid state and neutron counter arrays

Energy loss spectrometer for (e,e') at high resolution

Facility for inelastic electron scattering under 180º

Nature of user facilty:

no; mainly inside users

Program Advisory Committee/experiment proposals:

no

Number of active users and their origin:

diploma/masters+doctoral students+scientific staff: 11+19+9 = 39

Percentage of users, and percentage of facility use that comes from inside the institution:

mainly inside users (~90%)

Percentage of users and percentage of facility use from national users:

≤ 5%

Percentage of users and percentage of facility use from outside the country where your facility is located:

≤ 5%

Fraction of international users outside of geographical region:

2% 2% 50%

User Group:

no

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

4; 3; 5

Number of postdoctoral researchers:

9

Number of graduate students resident at the facility:

21

Number of non-resident graduate students with thesis work primarily done at the facility:

1

Involvement of undergraduate students in research:

21

Special student programs:

Bachelor theses

Future Plans:

Future Developments (under construction):

- Polarized electron source
- Low energy photon tagger
- Neutron ball
- Solid state counter ball
- Cryogenic targets

DEUTSCHES ELEKTRONEN-SYNCHROTRON, DESY

Hamburg and Zeuthen

DESY in Hamburg
Notkestraße 85
22607 Hamburg, Germany
Telephone: +49 40/8998-0
Facsimile: +49 40/8994-3282
E-mail: desyinfo@desy.de

DESY in Zeuthen
Platanenallee 6
15738 Zeuthen, Germany
Telephone: +49 33762/77-0
Facsimile: +49 33762/77-413
E-mail: desyinfo.zeuthen@desy.de

DESY is organized as a foundation under civic law. It is member of the Helmholtz Association of German research centres.

DESY is publicly financed by the federal ministry BMBF (Bundesministerium für Bildung und Forschung) and by federal states *Freie und Hansestadt Hamburg* (DESY in Hamburg) and *Brandenburg* (DESY in Zeuthen).

The research centre is headed by a board of six directors.

Heads of the facility:

Prof. Dr. R.-D. Heuer - Director in charge of High Energy Physics and Astroparticle Physics
C. Scherf - Director in charge of Administration
Prof. Dr. J. R. Schneider - Director in charge of Research with Photons
Dr. D. Trines - Director in charge of Accelerator Physics
Prof. Dr. A. Wagner - Chairman of the DESY Directorate
Dr. U. Gensch - Representative of the DESY Directorate in Zeuthen

Scientific Mission and Research Programs:

DESY conducts basic research in the natural sciences with special emphasis upon

- the development, construction and operation of accelerator facilities

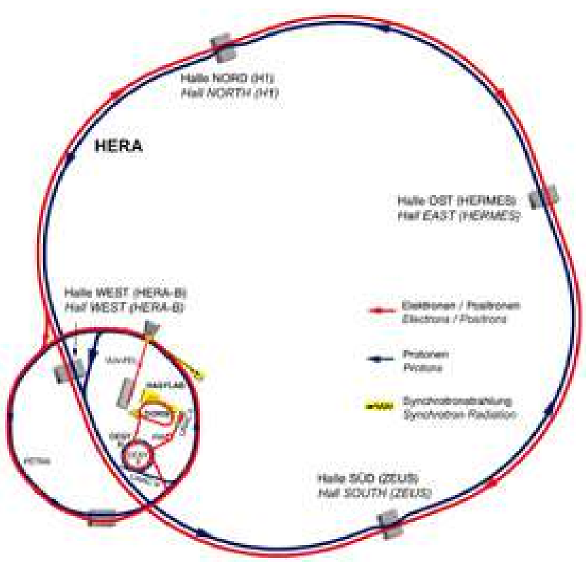
- particle physics (investigation of the fundamental properties of matter and forces)

- research with photons (investigations in all fields of natural sciences using a special light generated at accelerators).

About 3000 scientists from 34 countries visit DESY every year for research at the DESY facilities.

Technical facilities:

Aerial view of DESY in Hamburg



Sketch of the accelerator complex of DESY

Brief characterization of facility:

Presently DESY has three main facilities providing beams for experimental physics:

HERA is a storage ring to scatter 27.7 GeV electrons / positrons off 920 GeV protons. These collisions are detected by the experiments H1 and ZEUS. The lepton beam is employed for the fixed target experiment HERMES.

HERA consists of several pre-accelerators. For general use an electron test beam up to 7 GeV is provided by one of them, the pre-accelerator DESY, in parallel.

The storage ring DORIS is a dedicated synchrotron radiation source with wiggler/undulator insertion devices and several dipole beamlines.

The VUV-FEL is a superconducting linear accelerator with free-electron laser which generates radiation according to the SASE principle. Beside that DESY is developing and operating a photo injector test stand at Zeuthen (PITZ) used also for studies in relation with the VUV-FEL and the XFEL (see below).

HERA operation will come to an end by mid of 2007. DESY will then convert the storage ring PETRA (presently used as a pre-accelerator) into a new high-brilliance synchrotron radiation source PETRA III.

In cooperation with international partners, the European XFEL facility will be realized in Hamburg. It will provide extremely intensive, ultrashort X-ray flashes with laser light properties.

Table of facility parameters:

Facility	Beam Species	Max Energy (GeV)	Circumference or Length (m)	Usage
HERA	e^- or e^+ and p	30 and 920	6336	$e^{-/+}$p-scattering
DESY	e^-	7	293	Pre-accelerator, Test Beam
DORIS	e^+	4.45	289	Synchrotron radiation
VUV-FEL	e^-	0.380	260	Synchrotron radiation
PITZ	e^-	0.015	~5	Test Beam
PETRA*	e^-	12	2304	Synchrotron radiation
XFEL*	e^-	17.5	~3000	Synchrotron radiation

* Planned for the near future.

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

HERA has two collider experiments, H1 and ZEUS, which are complex 4π detectors with weight of several hundred tons consisting of tracking devices and calorimeter components. The goal is to study $e^{-/+}$p-scattering in order to investigate the structure of the proton and properties of fundamental forces, in particular strong and electroweak forces. HERMES is a fixed target experiment using the HERA electron beam to examine the intrinsic angular momentum – or spin – of protons and neutrons.

The synchrotron radiation at DESY is used in many different ways in fundamental and applied research in the fields of physics, biology, chemistry and crystallography, in materials and geological sciences as well as in medical applications. The wide spectrum of electromagnetic radiation ranges from the visible to the hard X-ray regime and covers an energy domain from about 1 eV to 300 keV. The experimental instrumentation is mainly based on small or wide angle scattering experiments using general purpose detectors.

Nature of user facility:

DESY is a user facility visited by about 3000 scientists from 34 countries every year.

Program Advisory Committee/experiment proposals:

The research programmes at DESY are reviewed by a Scientific Council, a Physics Research Committee (PRC), a Machine Advisory Committee (MAC) and a Photon Science Committee (PSC), each consisting of external members. Beside this DESY is reviewed every five years within the Helmholtz Association.

Number of active users and their origin:

On average DESY facilities are used by 3000 user per year; about half of them from abroad. ***(Although it is difficult to precisely determine, we estimate that of these users approximately 10% are in the field of nuclear physics.)***

Percentage of users, and percentage of facility use that come from within the institution:

In 2004 the composition of users was as following: About 5 % came from inside DESY. 53 % of all users came from outside Germany (23 % of them were working in High Energy Physics with an average length of stay of five months per year, 30 % of them in the field of synchrotron radiation with an average length of stay of one month per year).

Percentage of users and percentage of facility use from national users:

42 % of facility use from national users plus 5 % DESY staff.

Percentage of users and percentage of facility use from outside the country where your facility is located:

53 % of all users came from outside Germany.

Fraction of international users outside of geographical region:

DESY is associated scientifically with institutes from Europe (25 countries), Asia (5), North America (2) and South America (2).

User Group:

Formal user groups exist for all major instruments in high energy physics and also start to be established in the research field of synchrotron radiation.

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

In 2004 the total number of employees was 1695. 1114 of them were permanent staff. The temporary staff consists of 581 people, 163 of them were graduate students and postdoctoral researchers.

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

In 2004 together 14 permanent and 36 postdoctoral and students worked at DESY in theoretical physics.

Number of postdoctoral researchers:

92 postdoctoral researchers were employed by DESY in 2004.

Number of graduate students resident at the facility (> 80 % of their time):

More than 100 graduate students were resident at DESY in 2004.

Number of non-resident graduate students with thesis work primarily done at the facility:

More than 100 non-resident graduate students worked on a thesis primarily related to DESY research in 2004.

Involvement of undergraduate students in research (approximate average number at a given time):

45 undergraduate students have been involved in research at DESY in 2004.

Special student programs:

A yearly summer student programme attracts approximately 100 students from all over the world (typically selected from about 250 applicants) to DESY for 8 weeks during the summer season. The programme consists of lectures on Particle Physics, accelerators and research with synchrotron radiation. The main attraction of the school, however, is the opportunity to work in one of the research groups at DESY. Independent of the summer student programme DESY is hosting several DAAD students from abroad, like for example from Mexico. Every year, the Association of the Friends and Sponsors of DESY awards a prize to the best PhD thesis produced at one of the DESY experiments.

Future plans:

The success of DESY lies in its synergy between development, construction and operation of accelerators, elementary particle physics (from high energy physics, nuclear physics to Astroparticle Physics) and research with synchrotron radiation. Innovative accelerators, like DORIS, PETRA, HERA and the VUV-FEL have been successfully built and operated for researchers in both these fields. These unique scientific tools have resulted in a wealth of important results in many areas of scientific endeavour. They also attract a large national and international user community to the DESY campus and engender a creative and exciting scientific culture. DESY's aim is to maintain and further develop this interdisciplinary culture. In support of the construction of the PETRA III storage ring and the European X-ray Laser Project XFEL, the accelerator department of DESY will largely concentrate its activities on the development and construction of accelerator based light sources. As a further consequence DESY decided to build up a strong in-house research activity for preparation of the scientific programme at the XFEL as well as the related instrumentation. DESY participates in the preparatory work of the International Linear Collider (ILC) which will be based on superconducting TESLA technology developed by DESY and its partners in the frame work of the TESLA Collaboration. Besides this a strong theory group at DESY is an important asset. DESY is also providing competitive computing resources for the user groups on campus and for the community (e. g. HERA, LHC, Grid) and for the German Lattice Community.

ELSA, UNIVERSITY OF BONN (GERMANY)

Physikalisches Institut
der Universität Bonn
Nußallee 12
D-53115 Bonn

WWW: http://pi.physik.uni-bonn.de/

Prof. Dr. F. Klein, Director
Telephone: +49 228 73 2340
Facsimile: +49 228 73 3518
E-mail: klein@physik.uni-bonn.de

Contact Person for Foreign Users
Director

Facility:

Storage and stretcher ring ELSA with two pulsed linear accelerators and booster synchrotron producing polarised (1 nA) and unpolarised (up to 10 nA) electron beams from 0.5 to 3.5 GeV with high duty factor. Linearly and circularly polarised photons for hadron physics experiments. Storage of electrons (up to 200 mA) for Synchrotron Radiation experiments.

Procedure to Apply for Beamtime:

Contact the director.

Programme Advisory Committee (current membership):

3 national, 6 international members, common for MAMI and ELSA.

Main Instrumentation for Nuclear Physics Experiments:

ELSA accelerator with polarised electron source,

Photon taggers with goniometers,

Polarised solid state proton and neutron targets,

Large solid angle spectrometer with Crystal Barrel.

16

Main Fields of Nuclear Research:

Electron- and photon-induced reactions,

Photoproduction of Mesons,

Baryon Spectroscopy,

In-Medium Properties of Hadrons.

Main Fields of Other Research:

Application of Synchrotron Radiation:

X-Ray Absorption and Flourescence Spectroscopy, Microfabrication.

Accommodation:

Hotels in Bonn, guest rooms.

Transportation:

Public transport.

FORSCHUNGSZENTRUM (RESEARCH CENTRE) JÜLICH (FZJ)
INSTITUT FÜR KERNPHYSIK/INSTITUTE FOR NUCLEAR PHYSICS (IKP)

North Rhine Westphalia, Germany

Wilhelm-Johnen-Str
52425 Jülich
Germany

Helmholtz Center (HGF e.V.)
GmbH (Ltd)

Federal Republic of Germany (90%)
State of North Rhine Westphalia (10%)

Prof. Dr. Achim Bachem

Telephone: + 02461 61-0
Facsimile: +49 2461 61-8100
E-mail: info@fz-juelich.de

Head of facility (IKP):

Prof. Dr. James Ritman (IKP 1)
Prof. Dr. Hans Ströher (IKP 2)
Prof. Dr. Ulf-G. Meißner (Theory)
Prof. Dr. Rudolf Maier (Accelerator)

Scientific Mission and Research Programs:

FZJ is a multi-disciplinary laboratory within the framework of the Helmholtz Association. The IKP operates and further develops the Cooler Synchrotron COSY, and makes its beams available to a national and international community - in combination with dedicated detector systems, which have been built and which are operated by international collaborations.

The hadron physics program at COSY, conducted jointly in cooperation of the COSY users and the IKP, focusses on the following key topics:

Investigation of symmetries and symmetry breaking

Hadron spectroscopy and reactions

Spin physics

IKP is committed to research and development for the FAIR project, to be realized at GSI (Darmstadt) as an international facility, as its major future activity; several key issues will be investigated and tested at COSY:

High energy electron cooling

Beam-target interactions using a pellet target and cooling techniques

Spin filter method to produce polarized beams

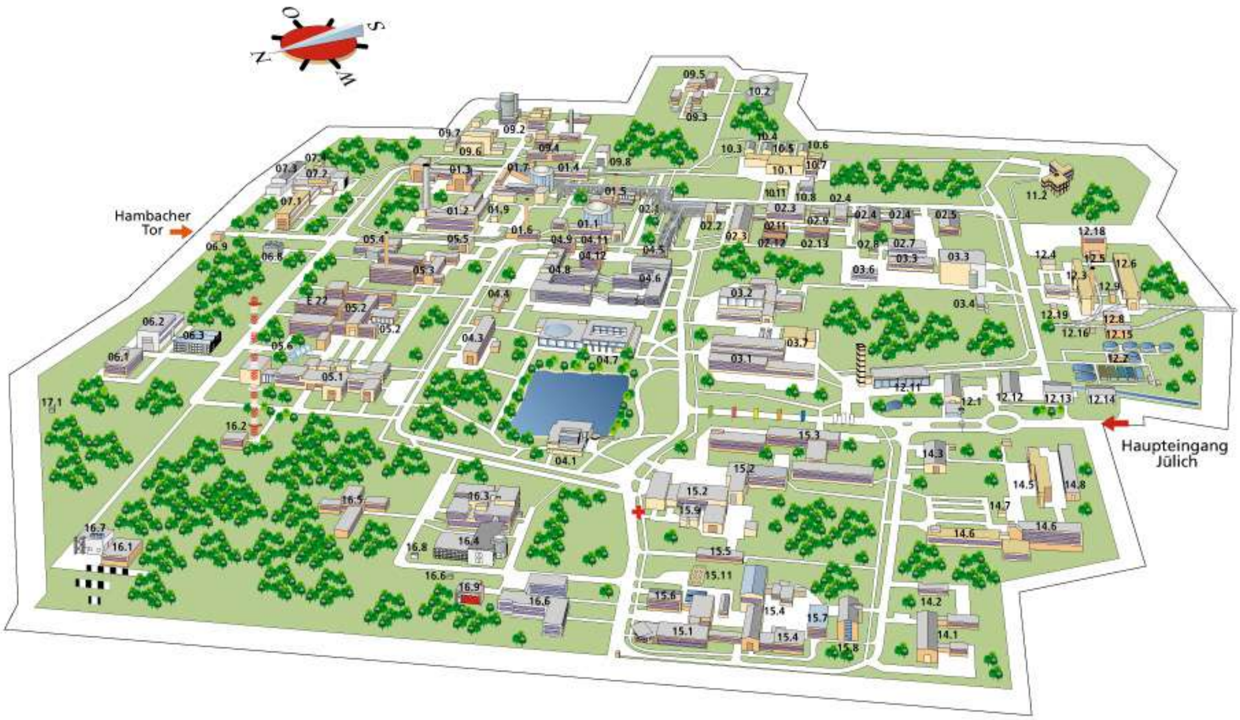
In addition, substantial contributions of IKP towards the realization of FAIR are agreed upon:

Leading laboratory for design, construction and operation of the High Energy Storage Ring (HESR) for antiprotons

Collaborating institution for development and installation of the PANDA detector at HESR

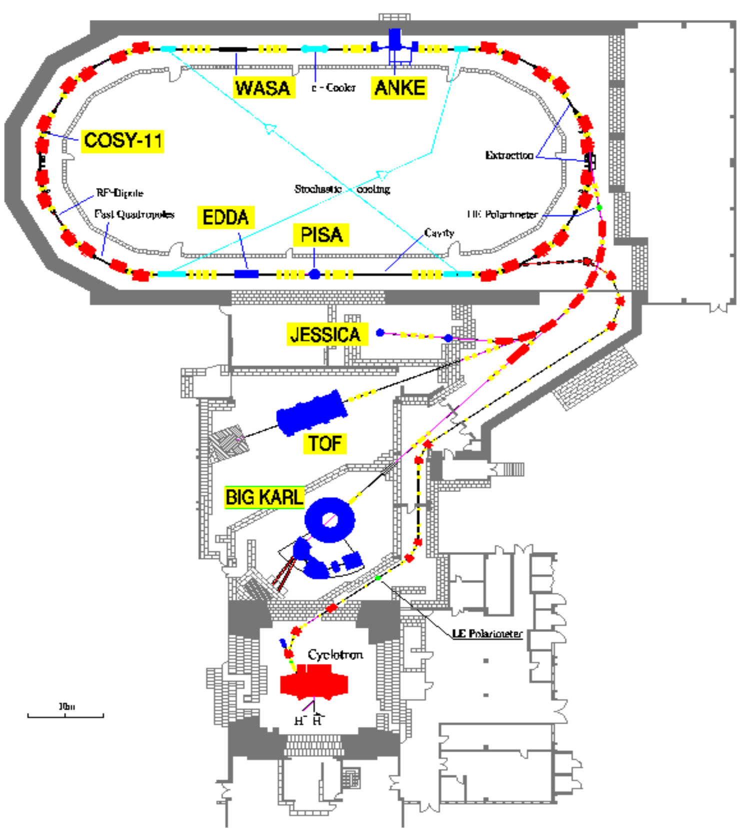
Precursor for the future upgrade option of polarized antiprotons (PAX collaboration).

Technical facilities:



Characterization of the facility:

Few-GeV synchrotron for phase-space cooled and polarized proton and deuteron beams



Facility parameters:

Ring length	184 m
Momentum range	0.27 – 3.7 GeV/c
Particle species	p, d (vector and tensor polarized)
Maximum beam intensity	~10^{11}
Cooling methods	electron, stochastic
Internal experiments	ANKE, WASA COSY-11, PISA (both up to 2006)
External experiments	COSY-TOF BIG KARL, JESSICA (both up to 2006)

Brief and compact table with the facility's major instrumentation and its capabilites:

Name of experiment	
ANKE	*"Apparatus for the detection of Nuclear and Kaon Ejectiles"* Dipole spectrometer with acceptance in forward direction Special range telescopes optimized for K^+ meson detection
COSY-11	Forward spectrometer using ring dipole for threshold meson-production studies
PISA	*"Proton Induced Spallation"* Detection of light fragments from proton-induced spallation
WASA	*"Wide Angle Shower apparatus"* Spectrometer for charged and neutral particles comprising a superconducting solenoid and a CsI(Na) calorimeter
COSY-TOF	Large acceptance, non-magnetic spectrometer
BIG-KARL (with GEM, HIRES)	High resolution magnetic spectrometer
JESSICA	Test experiment for the target region of a spallation neutron source

User facility:

Yes.

Program Advisory Committee/Experiment Proposals:

Yes.

Number of actual, active users of the facility in a given year:

391 (users listed on collaboration lists or proposals in 2005)

Percentage of users, and percentage of facility use that come from inside the institution:

21% from FZJ

Percentage of national users:

44% (including FZJ users)

Percentage of users from outside the country where your facility is located:

56%

Fraction of international users outside of geographical region:

10% (non European)

User group:

CANU (COSY Acossiation of Networking Universities), 121 members

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

a) 125, b) 23

Number of theoretical staff employed at the facility (permanent, postdoctoral, students):

8 permanent, 1 postdoctoral, 3 graduate students, 2 undergraduate

Number of postdoctoral researchers:

7

Number of graduate students resident at the facility:

16

Number of non-resident graduate students with thesis work primarily done at the facility:

6

Involvement of undergraduate students in research (approximate average number at a given time):

8

Special student programs:

COSY summer school (biennial)

Lectures and seminars at universities (Basel, Bochum, Bonn, Cologne, Dortmund, Erlangen, Esssen, Münster, Tübingen, Wuppertal)

Future Plans:

WASA detector (commissioning in 2006)

High-energy electron cooler

FORSCHUNGSNEUTRONENQUELLE HEINZ MAIER-LEIBNITZ FRM II (GERMANY)

FRM II
Lichtenbergstraße 1 D-85748 Garching
Telephone: +49 89 289 149 65
http://www.frm2.tum.de

Prof. Dr. Winfried Petry, Director
Telephone: +49 89 289 14704
Facsimile: +49 89 289 14995
E-mail: winfried.petry@frm2.tum.de

Contact Person for Foreign Users
User Office
Telephone: +49 89 289 14313
Facsimile: +49 89 289 12162
E-mail: useroffice@frm2.tum.de

Facility:

20 MW research reactor with a maximal thermal neutron flux density of 8 x 10^{14} cm^{-2} s^{-1}, 10 horizontal, 2 inclined and 1 vertical beam tubes. Cold neutron source, hot neutron source, fission neutrons, positron source.

The Neutron Research Source Heinz Maier-Leibnitz (FRM II) and its predecessor FRM I (from left or right)

Procedure to Apply for Beamtime:

Proposals are submitted following a call for proposals, twice a year, http://user.frm2.tum.de.

Programme Advisory Committee/Experiment Proposals:

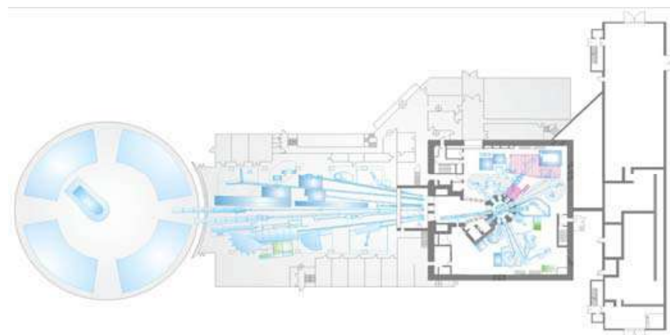
Currently 6 PAC for different scientific topics. One PAC related to nuclear and particle physics.

Main Instrumentation for Nuclear Physics Experiments:

MEPHISTO, high intense beam of cold neutrons for particle physics experiments.

PGAA, prompt gamma activation analysis, nuclear spectroscopy.

NEPOMUC, high intensity monochromatic positron beam, special open beam port for nuclear physics.



Interior Layout: Reactor building and experimental hall (darkgrey frame) and neutron guide hall (left)

Main Fields of Nuclear Research:

Production of long-lived superheavy nuclei.

Structure of exotic neutron-rich nuclei.

Gamma-ray spectroscopy of nuclei at high temperature.

Order-to-chaos transition in nuclei.

Fission fragment spectroscopy.

Main Fields of Other Research:

Neutron scattering for material science, biology, physics, chemistory.

Precision tests of the standard model of particle physics.

Measurement of the weak coupling constants of the neutron.

Test of T-symmetry.

Search for the electric dipole moment of the neutron.

High accuracy measurement of the neutron lifetime.

Production of medical isotopes.

Tumor therapy.

Accommodation:

A few guest rooms, near-by hotels.

Transportation:

Motorway A9 (München-Nürnberg) to Garching-Nord.

U-Bahn U6 to Garching, terminal stop.

or S-Bahn S8 to Ismaning, and bus No. 230, stop "Forschungsreaktor".

Future Plans:

Munich Accelerator for Fission Fragments (MAFF).

Mini-D2 Source for Ultra-Cold Neutrons.

GESELLSCHAFT FÜR SCHWERIONENFORSCHUNG MBH – GSI

Darmstadt, Germany

Planckstr. 1
64291 Darmstadt
Germany

Facsimile: +49 (0)6159-71 2991
Email: K.D.Gross@gsi.de
Email: K.Fuessel@gsi.de
http://www.gsi.de

Government Institution, legal form: GmbH under German law
Member of Helmholtz-Association of German Research Centres
Funds: 90% German Federal Government, 10% State of Hessen

Walter F. Henning – Chair, Board of Directors

Scientific Mission and Research Programs:

GSI's mission is the development, construction and operation of ion beam accelerators for a broad national and international science community. GSI operates a large accelerator complex consisting of the linear accelerator UNILAC, the heavy ion synchrotron SIS-18 and the experiment storage-cooler ring ESR. Ions of all elements, from hydrogen to uranium, can be accelerated up to energies of 2 AGeV. Moreover, secondary beams of unstable nuclei are available for the research program, as well as beams of highly ionized atoms up to bare uranium and beams of secondary pions. The accelerators are complemented by technically advanced experimental facilities as well as a high-energy (kJ), high power (PW) laser system Phelix, which altogether offer outstanding opportunities for current and future research in the fields of hadron and nuclear physics, atomic physics, dense plasma research, material science, biophysics and radiation medicine.

Technical facilities:

Figure 1: GSI is located in the outskirts of Darmstadt (aerial view).

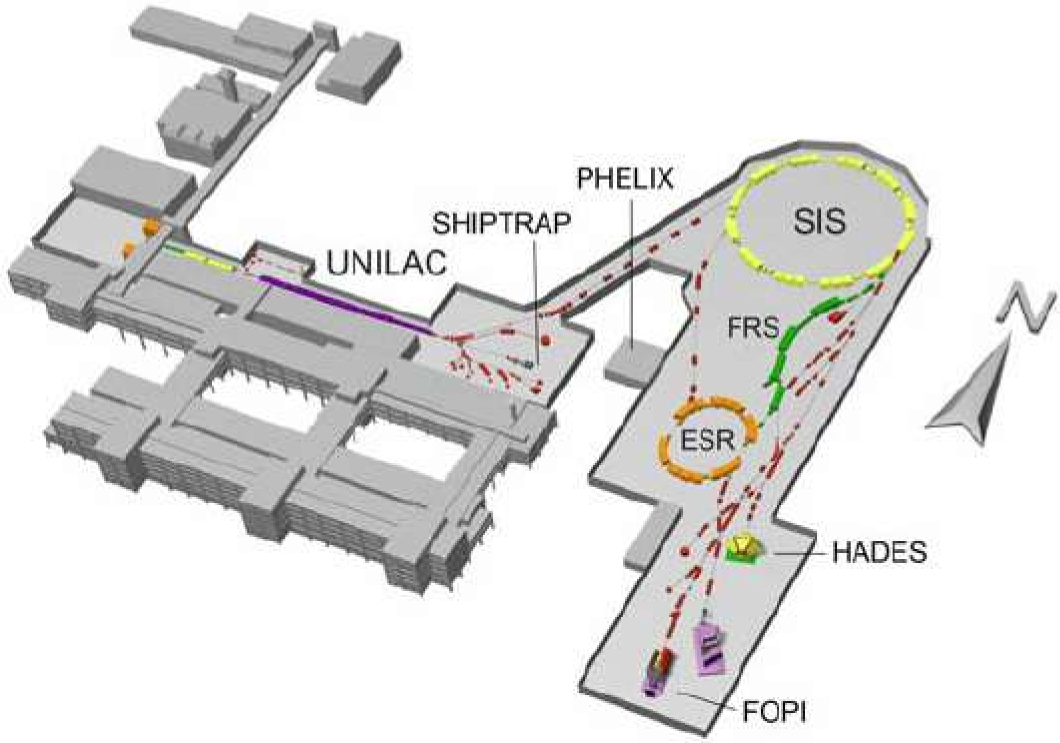


Figure 2: GSI Accelerator Facilities:
UNILAC, SIS and ESR with FRS and experimental stations

Characterization of the facility:

The GSI accelerator complex provides ion beams of all stable elements up to uranium with energies from the Coulomb barrier up to 2 AGeV. In addition, secondary beams of unstable nuclei are available as well as beams of highly ionized atoms up to bare uranium and beams of secondary pions. As a further option, secondary pion beams can be delivered at momenta of 0.5 GeV/c to 2.5 GeV/c.

UNILAC, a 120m linear accelerator, provides intense ion beams (p to U) at energies up to 11.4 AMeV. The UNILAC serves as an injector to the synchrotron SIS.

SIS, the heavy-ion synchrotron with 216m circumference and a maximum bending power of 18 Tm accelerates particles of p to U up to 2 AGeV.

FRS, a 75m projectile fragment separator, provides unstable isotopes of all elements up to uranium.

In the ESR (experimental storage ring), stable or radioactive ion beams can be stored and cooled at energies up to 0.56 AGeV (for U).

The pion-beam facility provides pion-beams in the momentum range of 0.5 to 2.5 AGeV.

Table of facility parameters:

Facility	Particle	Energy Range	Charge (expl.)	Description
UNILAC - heavy ion linear accelerator	p to U	11.4 AMeV	Ar10+ Kr17+ U28+	10 mA 6 mA 5 mA
SIS 18 - heavy ion synchrotron, magnetic rigidity 18 Tm, cycle rate 1Hz	p to U	10 – 4500 AMeV	Ne10+ Ar10+ U73+	2 AGeV, 1e11 ions/cycle 0.7 AGeV, 8e10 ions/cycle 1 AGeV, 3e9 ions/cycle
ESR - heavy ion storage ring, magnetic rigidity 12 Tm	p to U	for U up to 0.56 AGeV		Electron-, fast stochastic and laser cooled ions; interaction with internal gas targets
Pion-beam facility	pion-beam	momentum range: 0.5-2.5 AGeV		
Phelix laser	laser beam	high-energy (kJ), high power (PW) laser system (fully operational in 2007/8)		

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Name	Instrument	Description
HADES	High Acceptance Di-Electron-Spectrometer	for studying the properties of vector mesons in high density hadronic matter
FOPI	4π-detector for high-energy nucleus-nucleus reactions	allowing a complete momentum analysis of all charged particles emerging from the reaction zone
FRS – fragment separator	large projectile fragment separator	allowing the production and in-beam separation of nuclei far off stability
ALADIN	magnetic spectrometer	to study nuclear (multi-) fragmentation, high-lying collective states and complete kinematics break-up reactions of exotic nuclei
LAND	large neutron detector	
SHIP spectrometer	velocity filter	separation and detection of super-heavy elements
SHIPTRAP	Penning trap	for nuclear structure and atomic physics studies on very heavy nuclei/atoms
ESR	cooler storage ring	equipped with: Schottky mass spectroscopy; time-of-flight mass spectroscopy using the isochronous operation mode of the ring; internal gas-jet target and detector system; various X-ray and position sensitive particle detectors; collinear laser spectroscopy system,
RISING Ge detector array (former EUROBALL)		for in-beam γ-spectroscopy of exotic nuclei
162-element NaI-crystal ball		for in-beam γ-spectroscopy of exotic nuclei
Two experimental stations for dense plasma research		allowing the combined application of intense ion and Phelix laser beams for plasma generation and diagnosis
Ion micro-probe (up to UNILAC energies)		allowing precision irradiation experiments with a pre-defined number of ions and a spatial resolution of ~1 micro-meter
Several multi-purpose experiment stations for atomic physics, material science and radiation biology research		equipped with, e.g., a charge-state separator/analyser for atomic reaction products, a raster scanner for vertical and horizontal beam deflection facilitating the controlled irradiation of large areas of 20x20 cm^2, etc.
Medical irradiation facility		for tumour therapy with ion beams
Detector test facility		for detector tests, beams of protons, ions, pions and electrons can be provided.

Nature of user facility:

With about 260 internal and 1040 external users per year (about 500 from abroad), GSI is *de facto* a user facility for the international science community. Since the 3rd Framework Program of the European Union, GSI has been recognized as a large scale *European* research infrastructure and has received EC funding for supporting travel and subsistence of European user groups doing research at GSI. Under the present 6th Framework Program, GSI has acquired this classification of being a *European user research infrastructure* within the following three *Integrated Infrastructure Initiatives (I3 projects)* focussing on the following research areas:

(i) EURONS (European Nuclear Structure Physics); (ii) I3HP (Hadron Physics); (iii) LaserLab Europe.

Program Advisory Committee/experiment proposals:

To cover the broad spectrum of research pursued at GSI, three program advisory committees have been established:

(i) The General Program Advisory Committee (G-PAC) with 12 members (see website www.gsi.de/informationen/users/EAC/g-pac).

(ii) (see website www.gsi.de/informationen/users/EAC/ppac).

(iii)(see website www.gsi.de/informationen/users/EAC/biopac).

All PAC members are external scientists.

Percentage of users from national users, from outside of geographical region:

From an analysis of the number of users contributing to the GSI Annual Report over the recent years, one finds:

Total number of users:		***ca. 1300***
internal users	ca. 260	(ca. 20%)
other national users	ca. 540	(ca. 40%)
international users	ca. 500	(ca. 40%)
European (w/o German users)	ca. 240	(ca. 20%)
outside Europe	ca. 260	(ca. 20%)

User group:

The GSI User Group has 2,229 registered subscribers (as of January 2006).

For more detailed information check the GSI Users Group website at http://www.gsi.de/forschung/usersgroup/

Number of a) permanent staff and b) temporary staff (incl. graduate students and postdoctoral researchers):

Permanent staff:	539
Temporary staff:	464

Number of theoretical staff employed at the facility:

Number of theoretical staff:	30
Permanent:	5
Temporary	15

Number of postdoctoral researchers:

In 2005, there were about 90 scientists on postdoc positions at GSI.

Number of graduate students resident at the facility (> 80% of their time):

In 2005, there were 115 PhD students performing their thesis work directly at GSI and about 40 undergraduate students.

Number of non-resident graduate students with thesis work primarily done at the facility:

In addition, there were around 80 PhD students at the neighbouring universities performing their thesis work primarily at GSI.

Special student programs:

International Summer Student Program (8 weeks in late summer): about 40 undergraduate students from all over the world.

School Laboratory 'Radioactivity and Radiation' for high school students: last year, about 800 high school students attended the school laboratory.

Saturday Morning Physics (every fall): series of lectures on modern physics for high school students including a tour of the GSI facilities (together with the Technical University Darmstadt).

Lectures on and guided tours of GSI: last year about 40 university groups and 50 high school classes with a total of 4340 visitors paid a visit to GSI.

Girl's-day (one-day visitor program for girls): in 2005, about 40 girls participated in the Girl's day.

Two-week to four-week internships for high school and undergraduate students: ca. 120 students in 2005.

Future plans:

GSI, together with national and international partner institutions, is planning the construction of a new large accelerator complex – the Facility for Antiproton and Ion Research (FAIR). A superconducting double-synchrotron SIS100/300 with a circumference of about 1,100 meters and with magnetic rigidities of 100 and 300 Tm, respectively, is at the heart of the FAIR accelerator facility. Following an upgrade for high intensities, the existing GSI accelerators UNILAC and SIS18 will serve as an injector. Attached to the large double-synchrotron SIS100/300 is a complex system of storage-cooler rings and experiment stations including a superconducting nuclear fragment separator (Super FRS) and an antiproton production target. FAIR will supply radioactive ion beams and antiproton beams with unprecedented intensity and quality. Moreover, the facility is designed to provide particle energies 20-fold higher compared to those achieved so far at GSI (up to 35AGeV for U92+). A further important feature of the FAIR accelerator facility is that, due to the intrinsic cycle times of the accelerator and storage-cooler rings, up to four research programs can be run in a truly parallel mode. This allows, in a very efficient and cost-effective way, a rich and multidisciplinary research program to be conducted covering a broad spectrum of research fields such as: QCD studies with cooled beams of antiprotons; QCD-Matter and QCD-Phase Diagram at highest baryon density; nuclear structure and nuclear astrophysics investigations with nuclei far off stability; precision studies on fundamental interactions and symmetries; high density plasma physics; atomic and material science studies; radio-biological investigations and other application oriented studies. Full operation of the FAIR facility is scheduled for 2014/15.

MAIER-LEIBNITZ-LABORATORY FOR NUCLEAR AND PARTICLE PHYSICS OF THE TU MÜNCHEN AND THE LMU MÜNCHEN

GARCHING-MLL (Germany)

Science and Technology Campus
TU München
Am Coulombwall 6
D-85748 Garching
Germany

3 Am Coulombwall 6
D-8748 Garching
Germany
Telephone: +49 89 289 144 33
http://www.bl.physik.tu-muenchen.de/

Joint University Institute
of the Technische Universität München and Ludwig Maximilians Universität München

Operation and investment funds by the State of Bavaria
Various research grants from federal ministry (BMBF), German Research Association (DFG), European Union (EU), Bavarian Research Foundation

Acting Director: Prof. Dr. Reiner Krücken
E-mail: Reiner.Krueckenqph.tum.de
Telephone: +49-89-289-12433
Facsimile: +49-89-289-12435

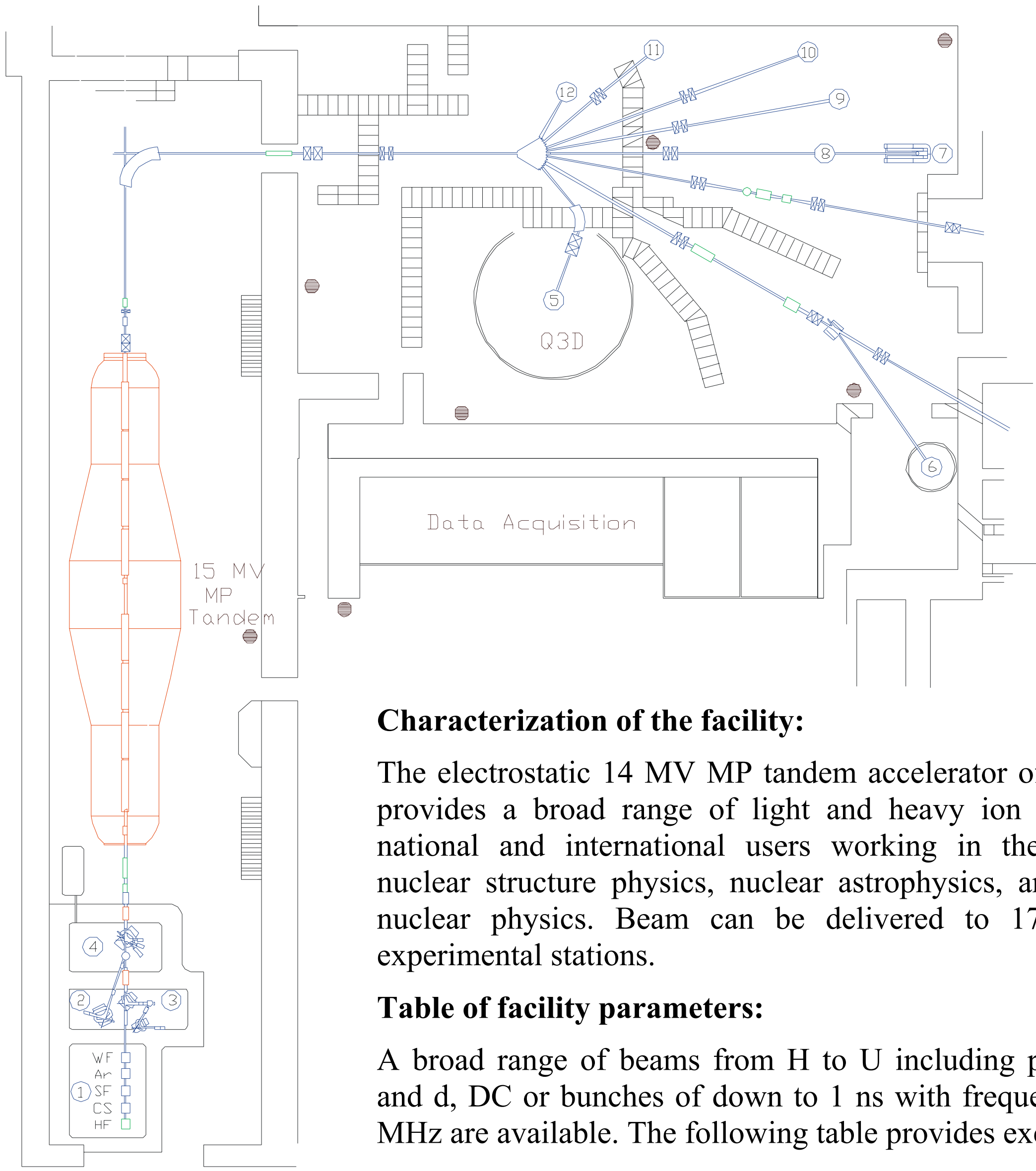
Head of facility:

Dr. Ludwig Beck
E-mail: Ludwig.Beck@physik.uni-muenchen.de
Telephone: +49-89-289-14271
Fascimile: +49-89-289-14280

Scientific Mission and Research Programs:

The Maier-Leibnitz-Laboratory (MLL) for Particle and Nuclear Physics of both Munich universities supports activities over a broad range of experimental and theoretical research subjects from Elementary Particle Physics, Particle Astrophysics, Nuclear and Hadron Physics, as well as Applied Nuclear Physics. MLL researchers carry out experimental work at the local facilities (MLL tandem accelerator and the Munich research reactor FRM II) as well as at major international facilities, such as CERN, GSI Darmstadt, Gran Sasso, and Fermilab as well as a number of smaller facilities. The laboratory infrastructure of workshops and technological laboratories is used for detector developments for the local and external experiments. The MLL operates a large cosmic ray test stand for ATLAS muon chambers and a small underground laboratory for the development of cryogenic detectors.

Technical facilities:



Characterization of the facility:

The electrostatic 14 MV MP tandem accelerator of the MLL provides a broad range of light and heavy ion beams for national and international users working in the areas of nuclear structure physics, nuclear astrophysics, and applied nuclear physics. Beam can be delivered to 17 different experimental stations.

Table of facility parameters:

A broad range of beams from H to U including polarised p and d, DC or bunches of down to 1 ns with frequencies of 5 MHz are available. The following table provides exemplary energies information, where the intensity relates to the highest

Element	Max. Intensity	Energy
p,d (polarized)	2 μA	28 MeV
^{6,7}Li	270 nA	56 MeV
^{12,13}C, $^{16-18}$O	3 μA	98,126 MeV
$^{40-48}$Ca	720 nA	196 MeV
$^{58-64}$Ni	230 nA	224 MeV
^{107}Ag	10 nA	266 MeV
$^{112-124}$Sn	10 nA	266 MeV
^{197}Au	70 nA	266 MeV

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

- Q3D magnetic spectrograph with various light and heavy ion detectors.
- SNAKE (Superconducting Nanoscope for Applied nuclear (Kern-)physics Experiments
- Ge gamma-ray detectors and conversion electron spectrometer
- Gas filled magnet for AMS
- High resolution Penning Trap
- Neutron time-of-flight experiment
- Shielded laboratory for low-background experiments.

Nature of user facility:

The MLL tandem laboratory is an unofficial user facility for national and international users.

Program Advisory Committee/experiment proposals:

Beam time for proposed experiments is distributed by an in house user committee.

Number of active users and their origin:

122

Percentage of users, and percentage of facility use that come from inside the institution:

inside users: 31%,
inside usage: 100%, because always inside users are involved

Percentage of users and percentage of facility use from national users:

national users: 75%
national usage: also 100%

Percentage of users and percentage of facility use from outside the country where your facility is located:

international users: 25%,
international usage: approximately 50%

Fraction of international users outside of geographical region:

about 4% non-European users

User Group:

no formal users group

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

a) permanent staff: 14 in the facility itself, 6 each in the physics departments of TUM and LMU
b) temporary staff: 32

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

no theoretical staff directly at the facility but part of the MLL

Number of postdoctoral researchers:

10

Number of graduate students resident at the facility:

17

Number of non-resident graduate students with thesis work primarily done at the facility:

5

Involvement of undergraduate students in research:

Undergraduate students in research 5

Special student programs:

An experiment at the tandem accelerator is performed every semester as part of the advanced laboratory courses of both participating universities

Future plans:

Two major experiments are in the planning phase for installation at the FRM II:
- UCN: intense source for ultra-cold neutrons for EDM and neutron half-life measurement
- Munich accelerator for fission fragments (MAFF): an intense source for accelerated radioactive beams of neutron-rich fission fragments

MAINZ MICROTRON (MAMI)

Mainz, Germany

Institut f¨ur Kernphysik
Johannes Gutenberg-Universit¨at Mainz
Becherweg 45
D-55099 Mainz

http://www.kph.uni-mainz.de
Telephone: +49 6131 39-25802
Facsimile: +49 6131 39-22964
E-mail: arends@kph.uni-mainz.de

Main sources of funding: Collaborative Research Centre (SFB443) of the German Research Foundation (DFG), University of Mainz, and Federal State of Rhineland-Palatinate

Head of the facility:

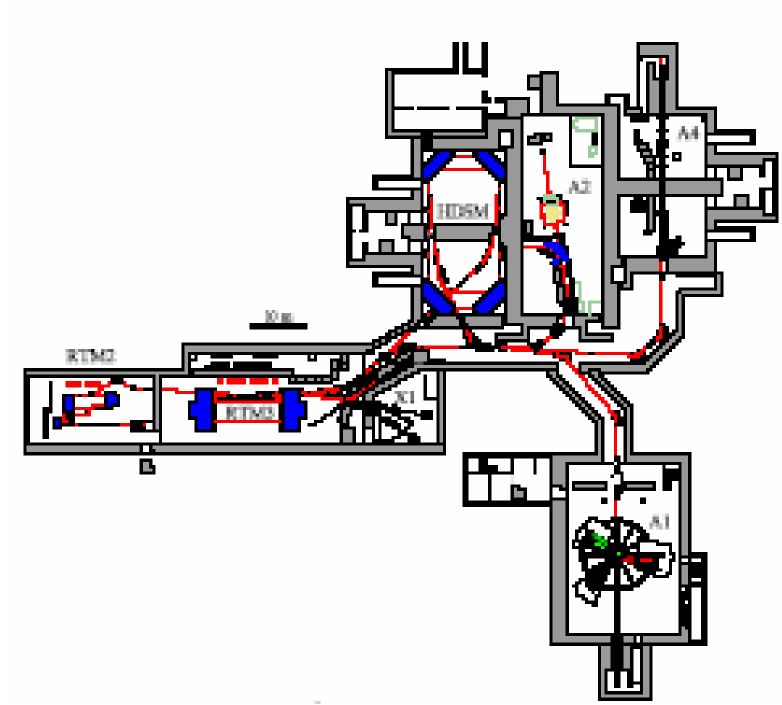
Acting Director: Prof. Dr. H.-J. Arends

Scientific Mission and Research Programs:

Study of the structure of hadrons with electromagnetic probes at low energies and momentum transfers. Precision studies of light nuclei and hypernuclei.

Technical facilities:

Picture of the Institut für Kernphysik (on the left) and the MAMI accelerator (on the right, control room in front, spectrometer building in the back).



Floor plan of the MAMI accelerator.

Characterization of the facility:

Cascade of three race track microtrons with c.w. polarized electron beam. A fourth stage is under construction. Secondary real photon beam.

Table of facility parameters:

Beam species	e^-
Energy range	180 – 880MeV (1500MeV after upgrade)
Maximum current	100 µA
Beam Polarization	80%
Horizontal Emittance	$12 \times 10^{-6} \pi \cdot$ m · rad (1σ)
Vertical Emittance	1.7×10^{-6} π m · rad (1σ)
Secondary Beam	tagged photon beam

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

A1 (electron scattering): Setup of three high resolution magnetic spectrometers, one is equipped with a proton polarimeter. Short orbit spectrometer for pion detection. Calorimetric detector for nucleons, time-of-flight walls for neutron detection. A short orbit, high magnetic field kaon spectrometer is under construction. Liquid hydrogen/deuterium/helium target, polarized ^{3}He target.

A2 (real photon scattering): Tagged photon beam with unpolarized and polarized photons. Large solid angle detector Crystal Ball. Liquid H_2, D^2, ^{3}He targets, a polarized frozen-spin target is under construction.

A4 (parity violating electron scattering): Setup of fast PbF_2 crystal detectors with high count rate readout electronics and high power liquid hydrogen/deuterium target.

X1 (X-ray generation): Coherent X-ray generation using transition and undulator radiation and the Smith-Purcell effect.

Nature of user facility:

No. All access is through collaborative programs. For access, external scientist should contact the collaborations directly (see instrumentation).

Program Advisory Committee/experiment proposals:

Yes. Submission of written proposals, followed by oral presentation to a Program Advisory Committee. 1 inhouse, 3 national and 6 international members.

Number of active users and their origin:

Average 150 users.

Percentage of users, and percentage of facility use that come from inside the institution:

50% (estimate)

Percentage of users and percentage of facility use from national users:

50% (estimate)

Percentage of users and percentage of facility use from outside the country where your facility is located:

30% (estimate)

Fraction of international users outside of geographical region:

20%

User Group:

No.

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

a) permanent: 5 Prof., 18 scient., 80 tech./administr.

b) temporary: 113

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

5 (permanent), 5 (postdoctoral), 10 (students)

Number of postdoctoral researchers:

36 (2003)

Number of graduate students resident at the facility:

93 (2003)

Number of non-resident graduate students with thesis work primarily done at the facility:

10 (estimate)

Involvement of undergraduate students in research (approximate average number at a given time):

20 (estimate)

Special student programs:

Several student programs are organized by the University of Mainz. The facility is integrated in the physics education of the University, e.g. in the context of advanced laboratory courses. High school internships are possible at all stages. One Research Training Group (Graduiertenkolleg) of the DFG. Annual Student Workshop at Bosen/Saar.

TANDEM ACCELERATOR
UNIVERSITY OF COLOGNE

Institute for Nuclear Physics
University of Cologne
Zülpicher Straße 77
D-50937 Köln
Germany

Telephone: +49 221 470 3456
Facsimile: +49 221 470 5168
E-mail: dewald@ikp.uni-koeln.de
Web Address: www.ikp.uni-koeln.de

University Institute

Various sources of funding:
Initial funding: Land Nordrhein Westfalen, Bundesministerium für Bildung und Forschung
Staffing and Operation: Internal University funds
Instruments and development: Internal University funds,
Deutsche Forschungsgemeinschaft (DFG), Hochschulbau Förderungs Gesetz (HBFG),
Bundesministerium für Bildung und Forschung (BMBF)

Heads of the facility:

The facility is operated by the Institut für Kernphysik.
Director: Prof. Dr. J. Jolie
Facility operation Manager: Dr. A. Dewald

The FN Tandem Accelerator is one of the largest instruments of the University of Cologne. This accelerator was installed in 1969 and has, over the decades, been continuously innovated and improved and is still a state-of-the-art facility for university based research. While the Tandem Accelerator has been pushed to its limits with the terminal voltage reaching 10 MV, one of the cornerstones of the Institute is the development of new experimental methods and the increased sophistication of detectors, ion sources and data analysis. The facility is mainly used for the study of low-spin excited states at high excitation energy. It forms the core of the Institute's education and research.

The current research program uses:

- sub Coulomb barrier reactions,
- Coulomb excitation,
- light-ion induced fusion evaporation reactions,
- proton induced X-ray emission,
- ion implantation

for the study of:

- symmetries in nuclear structure
- (isospin, F- spin, dynamical symmetries and supersymmetries,
- collective and chaotic behaviour of yrare states,
- shape phase transitions and shape coexistence,
- shell effects,
- applied physics.

Three ion sources (Lamb shift, duoplasmatron and sputter source) produce a variety of different ions (see Table 1). The beam can be bunched down to ns short pulses. The eight beamlines are equipped with different instruments. The most important ones are:

The HORUS spectrometer which is a compact cube Ge array with 14 60-80% Ge detectors. It is equipped with a beta-slider and ideally suited for DCO measurements;

The MINIBALL beamline which is equipped for particle gamma coincidences and often hosts the MINIBALL array.

The ORANGE spectrometer for conversion electron spectroscopy which can be used for e^--e^- and e^--γ coincidences;

The COLOGNE PLUNGER set-up for lifetime measurements;

The PIXE set-up with a sweeped beam.

Figure 1 shows an overview of the accelerator and its beamlines. As well as the accelerator, a well equipped target laboratory is available. The facility is informally run as a user facility without a PAC; requests for beam time can be sent to the director or the responsible. Beamtime is distributed about every six weeks. The accelerator has about 30 in-house users, mainly students (12), PhD students (12), post-docs (5) and permanent staff (6). The number of external national users is 20 and of international users 25, of which about 5 from the USA. Most of the time, experiments are performed in collaborations with the different users. The accelerator is operated with a dedicated technical staff of three persons and the in-house students, PhD students and post-docs. Students are taught how to run the machine as part of their education. The facility runs 24 hours a day and also over the weekends, typically 5000-6000 hours a year.

Beam Species	Max. Energy Single Stripping	Beam Species	Max. Energy
	MeV		MeV
p	20	^{24,25,26}Mg	110
d	20	^{27}Al	120
^{3,4}He	30	^{28,29,30}Si	120
^{6,7}Li	40	^{31}P	120
^{10,11}B	50	^{32,34}S	120
^{12,13}C	70	^{46,47,48,49}Ti	120
^{14,15}N	80	^{50,52,54}Cr	120
^{16,18}O	90	^{58,60}Ni	130
^{19}F	90	^{63,64}Cu	130
^{23}Na	90	^{81}Br	130

Table 1: Examples of available beams.

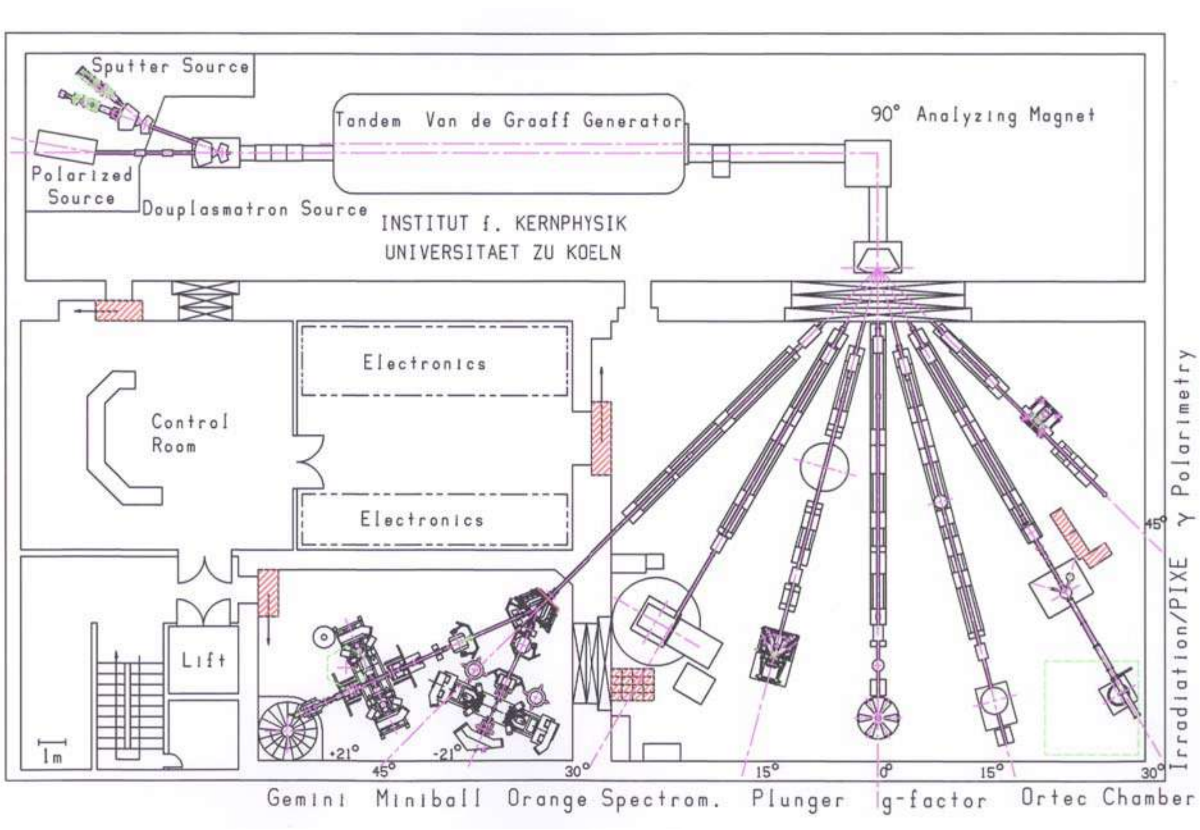


Figure 1: The Tandem accelerator and experimental facilities (see text).

INSTITUTE OF NUCLEAR RESEARCH OF THE HUNGARIAN ACADEMY OF SCIENCES (ATOMKI)

H-4026 Debrecen
Bem tér 18/c Hugary

Telephone: + 36 52 509261
Facsimile: + 36 52 416181
WWW: http://www.atomki.hu

R.G. Lovas, Director
Telephone: + 36 52 509261
E-mail: rgl@atomki.hu

Contact Person for Foreign Users
F. Tárkányi
Telephone: + 36 52 509223
E-mail: tarkanyi@atomki.hu

Facility:

Isocronous cyclotron (K=20) for light ions, p,d, 3He, α and intensities of maximum 50 mA. Energies from 3 MeV (p) to 27 MeV for 3He particles.

Procedure to Apply for Beamtime:

Informal.

Programme Advisory Committee (current membership):

There is no PAC.

Main Instrumentation for Nuclear Physics Experiments:

Split pole magnetic spectrograph.

CLOVER type HPGe detector with BGO shield and other HPGe detectors.

Superconducting solenoid, and mini orange magnetic electron spectrometers.

Ionization chambers and PPAC detectors for fission fragments.

Scattering chamber with Si particle telescopes.

Multi-detector array for high energy nuclear e+e− pair spectroscopy.

Main Fields of Nuclear Research:

Spectroscopy of super- and hyperdeformed states in the actinide region.

Study of fission barriers and the fission process.

Study of α-optical model potential for nuclear astrophysics.

Study of γ-decay of giant resonances.

Main Fields of Other Research:

Production of radioactive isotopes for a PET camera.

Production of long lived radioactive isotopes for radioactive beams used abroad.

Thin layer activation. Nuclear data measurements. Neutron and gamma induced mutations.

Radiation hardness tests of electronic units.

Accommodation:

Visitors' apartments at the institute and hotels in town

Transportation:

Public transportation. The institute is located in the town. Connection: Railway, local airport.

EUROPEAN CENTRE FOR THEORETICAL STUDIES IN NUCLEAR PHYSICS AND RELATED AREAS (ECT*)

TRENTO ECT* (Italy)

Strada delle Tabarelle, 286
I-38050 Villazzano (Trento)

Telephone: +39 0461 314 722
Facsimile: +39 0461 314 747
E-mail: susan@ect.it
www: http://www.ect.it

Jean-Paul Blaizot, Director
Renzo Leonardi, Scientific Secretary
Telephone: +39 0461 314 760
E-mail: blaizot@ect.it
Telephone: +39 0461 314 753
E-mail: renzo@ect.it

Contact Person for Foreign Users
Jean-Paul Blaizot, Director

Facility:

ECT* hosts a variety of activities in theoretical nuclear physics and related areas: workshops and collaboration meetings, doctoral training programs, innovative research. It offers positions for postdoctoral fellows and visiting scientists. It has two dedicated clusters for parallel computing. ECT* is an institutional member of the ESF Committee NuPECC.

Procedure to Apply for Beamtime:

Applications for a stay at ECT* and proposals for a workshop or a collaboration meeting should be sent to the Director. Details are given on ECT* Web page.

Programme Advisory Committee (current membership):

The Programme Advisory Committee is the Board of Directors. Current members:

W. Alberico, B. Friman, B. Fulton, H.-Å. Gustafsson, W. Haxton, P. Hoyer, F. Karsch, F.-K. Thielemann and P. Van Isacker

Main Instrumentation for Nuclear Physics Experiments:

Workshops and collaboration meetings

Doctoral Training Programme

Positions for postdocs and visiting scientists

In-house library and access to the Physics Department library

Supercomputer allowing parallel computing thanks to a cluster architecture with maximum capacity of 1TeraFlop/s

Offices in two buildings: Villa Tambosi and the Rustico; two conference rooms (capacities of 40 and 80)

Main Fields of Nuclear Research:

Nuclear structure and low energy nuclear physics, QCD and hadron physics, high energy heavy ion reactions, nuclear matter under extreme conditions, nuclear astrophysics.

Main Fields of Other Research:

Related Areas: Particle physics, astrophysics, condensed matter physics and quantal physics of small systems, quantum information.

Accommodation:

The ECT* staff finds accommodation for visiting scientists and postdoc researchers in local hotels, apartments and university residences.

Transportation:

Nearest airport: Verona (80 km). Trento is on the Innsbruck-Brenner-Verona railwayline (Munich-Trento ca. 5 hours). Trento is on the motorway connecting Munich-Innsbruck-Verona-Modena (A 22).

LABORATORI NAZIONALI DEL GRAN SASSO
ASSERGI LNGS (ITALY)

Istituto Nazionale di Fisica Nucleare
S.S. 17 bis, km.18+910
67010 Assergi (L'Aquila)

Telephone: +39 08 62 43 71
Facsimile: +39 08 62 43 72 18
WWW: http://www.lngs.infn.it

Eugenio Coccia, Director
Telephone: +39 08 62 43 72 31

Contact Person for Foreign Users

M. Junker (LUNA)
E-mail: matthias.junker@lngs.infn.it
M. Laubenstein (Low Level Laboratory)
E-mail: matthias.laubenstein@lngs.infn.it
F. Chiarizia (Research Division Secretary)
E-mail: fausto.chiarizia@lngs.infn.it

Facility:

50 kV and 400 kV accelerators (LUNA) with very small energy spread, excellent long term stability and high beam current even at low energy. Ultra low radioactivity levels laboratory.

Procedure to Apply for Beamtime:

All proposals are screened on the basis of scientific merit by the LNGS Scientific Committee.

Programme Advisory Committee (current membership):

0 in-house, 4 national, 5 international members.

Main Instrumentation for Nuclear Physics Experiments:

LUNA: 50kV and 400 kV electrostatic accelerators, windowless gas target, BGO summing detector and High Purity Germanium detector with low intrinsic background.

Main Fields of Nuclear Research:

Nuclear reactions of astrophysics interest.

Main Fields of Other Research:

Neutrino Physics.
Dark Matter Search.
Rare Decays.

Accommodation:

7 double rooms (14 beds).

Transportation:

Public Bus Service from and to L'Aquila every hour.

Future Developments (under construction):

Enlargement of the low background levels laboratory.

INSTITUTO NAZIONALE DI FISICA NUCLEARE
LABORATORI NAZIONALI DEL SUD

Via S. Sofia 62
95123 Catania, Italy
director@lns.infn.it

Telephone: +39 095 542111
Fascimile: +39 095 7141815

Government Institution
Government funds

Prof. Roberto Petronzio

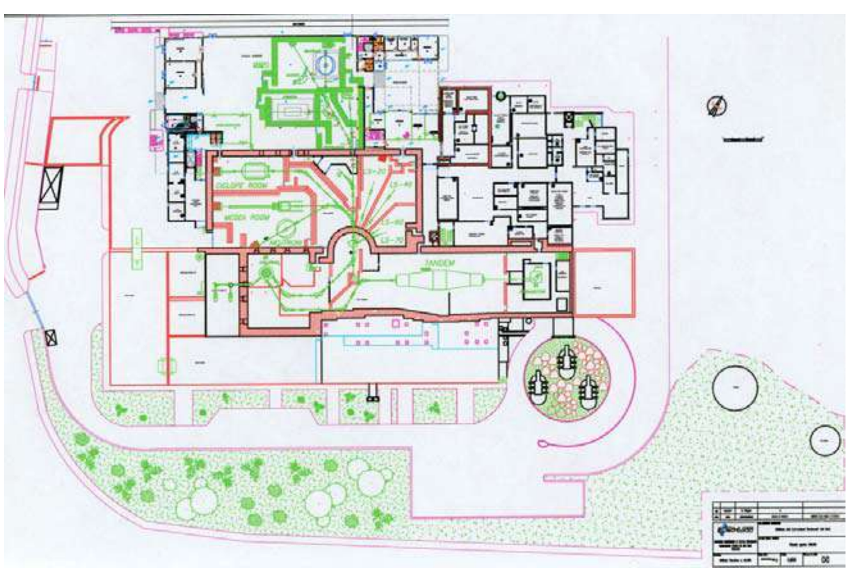
Head of the facility:
Prof. Emilio Migneco

Scientific Mission and Research Programs:

The scientific mission of LNS is mainly the study of nuclear structure and nuclear collisions at intermediate and low energy. Research activity in several multi-disciplinary fields using nuclear techniques is also performed. The current research program in nuclear physics is carried out with large detector systems (4π multi-detector systems for the intermediate energy case, large acceptance spectrometer for low energy experiments). The current interdisciplinary research program concerns studies on Atomic Physics, Solid State Physics, Single Event Effects, Biology and Medicine, Dosimetry. The latter is to be related to the proton therapy program, which started in 2002 as a clinical activity.

There are two future research programs: a short-range one (in operation since 2006) concerns the production and acceleration of radioactive ion beams, based on the use of the two existing accelerators. A long-range research program, in the field of astroparticle physics, concerns the detection of astrophysical neutrinos by means of an under sea neutrino telescope (NEMO project).

Technical facilities:



Characterization of the facility:

Intermediate energy Superconducting Cyclotron with light and heavy-ion beams;

Low energy 15 MV Tandem Van De Graff with light and medium mass ion beams;

Facility Parameters:

Beam	Energy Range (AMeV) Tandem	Cyclotron	Intensity
Protons	6-28	45-80	5 nA – 1 μA
Deuterons	3-14	45-80	5 nA –1 μA
^{12}C, ^{14}N, ^{16}O	1-8	20-80	5-300 nA
^{13}C		45	700 nA
^{20}Ne		45-62	5-700 nA
$^{36,40}Ar$		10-45	1-40 nA
$^{40,48}Ca$	1-4	10-40	1-5 nA
$^{58,62}Ni$	0.5-3	15-45	1-5 nA
^{93}Nb	0.5-1.5	15-40	1-5 nA
$^{112,116,120,124}Sn$	0.3-1.5	15-43.5	1-3 nA
^{197}Au	0.3-1	10-23	1-3 nA

Cyclotron beams can be delivered with timing characteristics: peak width 1 ns FWHM and inter-burst distance 120-150 ns.

Major experimental instrumentation and its capabilities:

Main Instrumentation for Nuclear Physics Experiments

CHIMERA: a 4π charged particle detector, consisting of 1200 (Si + CsI) telescopes.

MEDEA + MULTICS: a BaF_2 crystall ball of 180 elements for γ and light particle detection, coupled to a forward wall of 64 (gas chamber + Si + CsI) telescopes for fragment detection.

TRASMA: a multidetector suitable for simultaneous detection of particles and gamma rays.

CICLOPE: a cylindrical (4 m diameter, 6 m long) scattering chamber designed for intermediate energy experiments.

CT 2000: a 2m diameter multipurpose scattering chamber specially suitable for low energy experiments.

Nature of user facility:

Yes, by INFN.

Program Advisory Committee/experiment proposals:

The facility has a Program Advisory Committee which meets at least one time per year.

The PAC is composed of 1 national and 6 foreign members.

Number of actual, active users of the facility in a given year:

280 is the number of users averaged over the last two years

This is the number of people who participate at each experiment with LNS accelerators, evaluated according to the number of access cards.

Percentage of users and percentage of facility use from national users:

National users 60%, facility used by national users 75%

Percentage of users and percentage of facility use from outside the country where your facility is located:

Foreign users 40%, facility use 25%

Fraction of international users outside of geographical region

6% of the total number of users are from extra-European countries (North and South America).

User Group:

About 300

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) Permanent staff: 22 INFN researchers + 23 associated researchers (permanent position at University or other research institutions) + 79 Technical/administrative staff

b) Temporary staff: 22 researchers +18 technical/administrative staff

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

Permanent staff: 4

Postdoc: 2

Students: 3

Number of postdoctoral researchers:

12 postdoctoral researchers (contracts or fellowships, average over the last three years)

Number of graduate students resident at the facility:

On average10 graduate students (PhD students after four year degree) are studying and working, more than 80% of their time, at LNS. This number is an average over the last three years.

Number of non-resident graduate students with thesis work primarily done at the facility:

Not available

Involvement of undergraduate students in research (approximate average number per year):

6 per year, average on the last two years

Special student programs:

Experimental Nuclear Astrophysics summer school for graduate students

Future Plans:

EXCYT: a radioactive beam facility (ISOL-type) based on the Superconducting Cyclotron as primary accelerator and the Tandem as post-accelerator (first beams of ^{8}Li at the beginning of 2006).

MAGNEX: a large angle and momentum acceptance magnetic spectrometer commissioned in 2005. First experiments at the beginning of 2006.

FRIBS: a facility producing tagged secondary ion beams by in-flight fragmentation of cyclotron primary beams. Intensity and transport improvements are expected in 2006-2007.

LABORATORI NAZIONALI DI FRASCATI
FRASCATI LNF (ITALY)

Istituto Nazionale di
Fisica Nucleare (INFN)
Laboratori Nazionali di Frascati
CP 13
Via E. Fermi, 40
I-00044 Frascati

Facsimile: +39 06 94 03 25 82
WWW: http://www.lnf.infn.it/

Mario Calvetti, Director
Telephone: +39 06 94 03 22 23
E-mail: dirlnf@lnf.infn.it

Contact Person for Foreign Users

Carlo Guaraldo
Telephone: +39 06 94 03 23 18/23 17
Facsimile: +39 06 94 03 25 59
E-mail: Carlo.Guaraldo@lnf.infn.it

Facility:

DAΦNE: storage ring, e^+e^-, 1020 MeV c.m. energy, luminosity $5 \times 10^{32}cm^{-2}s^{-1}$, circumference 97.69 m, maximum total average current 5 A, bunch length σ_z 3 cm, number of bunches 1 − 120, $2.2 \times 10^2{}_s{}^{-1}$ K^- K^+ pairs at L=1.2×10^{32} $cm^{-2}{}_s{}^{-1}$, from Φ decay.

Procedure to Apply for Beamtime:

Send a proposal to the contact person.

Programme Advisory Committee (current membership):

LNF Scientific Committee: 1 in-house, 6 international members.

Main Instrumentation for Nuclear Physics Experiments:

FINUDA spectrometer.

SIDDHARTA setup.

Main Fields of Nuclear Research:

Hypernuclear spectroscopy with stopped K^-.

Low energy K−-nucleus interaction.

Kaonic atoms research.

Main Fields of Other Research:

Elementary particle physics.
Research with synchrotron light.
Hadron Physics
Gravitational waves research.
Theoretical physics.
Accelerator physics.
FEL research.
Detector development.

Accommodation:

8 Guest rooms (20 Beds).

Transportation:

Railway station “Tor Vergata” at walking distance (line Rome−Cassino). Frascati main railway station (3km from the laboratory) INFN buses at fixed times connect the laboratory to the station “Anagnina” of Rome Metro line A.

Special Student programs:

Post doctoral LNF spring-school, held every year in May

Master on Physical and Technical Bases of Hadrotherapy and Precision Radiotherapy, held every year.

Future Plans:

A major upgrade of DAΦNE is planned aiming at a machine able to deliver more than 50 fb^{-1} at the Φ-resonance in 4-5 years of data taking, and to operate with a center-of-mass energy in the interval 1-2.5 GeV.

LEGNARO NATIONAL LABORATORIES (LNL)

Laboratori Nazionali di Legnaro
Istituto Nazionale di Fisica Nucleare
Viale dell'Università, 2
I-35020 Legnaro (Padova)
Italy

Telephone: +39 049 80 68 311
Fascmile +39 049 64 19 25
Web site: http://www.lnl.infn.it/
Email: puglierin@lnl.infn.it.

Government Institution

Construction – INFN
Operation – INFN and EU
Instrumentation – INFN and EU

Prof. Roberto Petronzio

Head of the facility:

Dr. Gabriele Puglierin

Scientific Mission and Research Programs:

The Laboratori Nazionali di Legnaro (LNL) is a Nuclear Physics (NP) based, user-oriented Research Centre with a leading position in Nuclear Structure and Nuclear Dynamics Studies. The impact of such activities on other research fields using ion beams, nuclear methods and techniques, such as Material, Earth and Life Sciences is getting every year stronger since the foundation of the Laboratories in 1968. Research activities have been continuously supported by intense R&D programmes covering proton and ion linacs, radiation and particle detector forefront technology.

The current main research programs for nuclear physics are:

– Structure of neutron–rich nuclei populated by binary reactions.
– Nuclear structure at high spins, proton rich nuclei and superdeformation.
– Fusion and grazing collisions around and below the Coulomb barrier.
– Fission and quasi–fission dynamics with heavy–ion beams.
– Nuclear structure at high excitation energy (giant resonances).
– Nuclear reactions induced by light ions and neutrons.

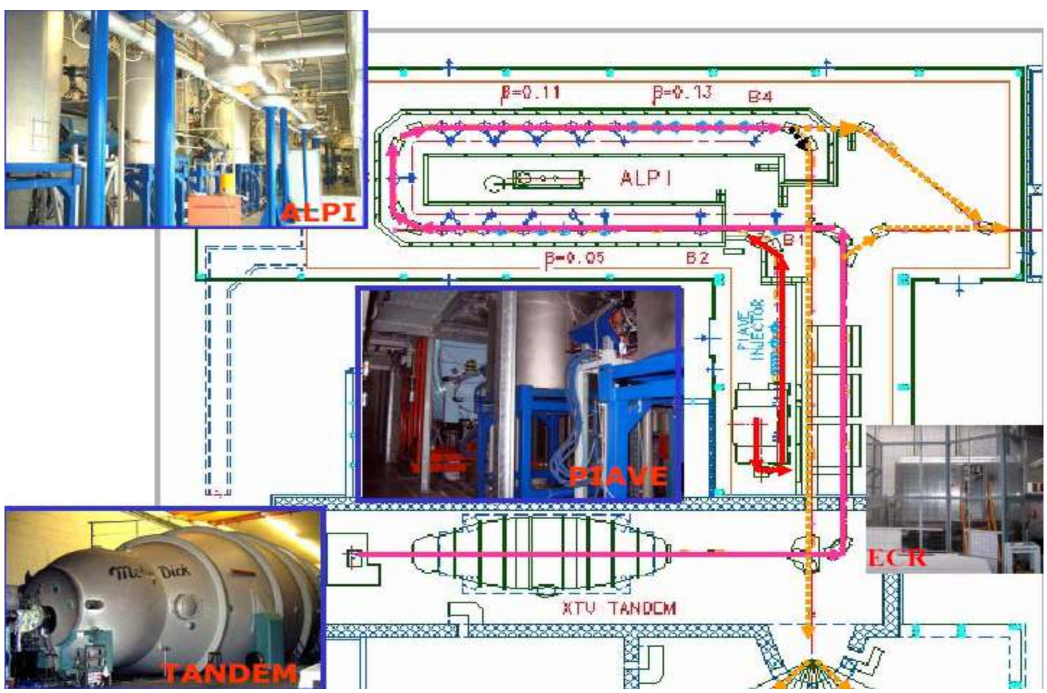
The main interdisciplinary research programs concern:

– Biophysics, medical physics, microdosimetry.
– Environmental physics.
– Solid state physics, material physics.
– Accelerator physics, superconductivity, RNB developments.

Within the EC-contract EURONS, LNL has been included among the eight large scale facilities providing access to their research infrastructures to European research teams eligible for EC financial support.

Future programs for nuclear physics instrumentation concern the development of a new gamma-array detector based on gamma-ray tracking (within the AGATA collaboration) to be associated, in a first phase, with the PRISMA spectrometer. Ongoing developments concern new generation gas and solid state detectors with related read-out electronics. Future programs for the accelerators (medium term) are based on the upgrade in energy, beam intensity and ion species of the present accelerator complex and (long term) on the development of a radioactive ion beam facility for neutron rich beams based on ISOL technique (SPES project).

Photos of the facility and layout of the Tandem-ALPI accelerator complex



Characterization of the Facility:

The present research basic facilities operating at LNL are:

Tandem-ALPI Accelerator Complex, hosting the 15 MV XTU-Tandem accelerator (1982), and the ALPI superconducting linac post-accelerator (1995), with equivalent voltage 40 MeV/q, with 3 Experimental Halls (1982, 1996) mainly for Nuclear Physics research.

PIAVE: ECR source + superconductive positive ion injector into ALPI.

7.0 MV CN Van de Graaff (V.d.G) accelerator (1961) mainly for Applied Physics and Interdisciplinary and Biomedical Physics (see in detail below)

2.5 MV AN2000 V. d. G. accelerator (1971) with 2.5 MeV Proton Microbeam (1994) for Applied physics and Interdisciplinary and Biomedical physics

Accelerators Physics and Related Technology Division, Material Science Laboratory including 200 keV Ion implanter (1998), Scanning Electron Microscope (1992), 6 Sputtering apparatus (1993-98) for Solid State and Applied Physics

Radiobiology Laboratory (1987) and Biomedical Laboratory for Interdisciplinary and Biomedical physics

AURIGA Gravitational Wave Observatory (1995)

Table of maximum energy and current for some representative beams available at the Tandem-ALPI-PIAVE accelerator complex

Beam species	Tandem *		Tandem+ALPI** PIAVE+ALPI	
	Energy [MeV]	Current [pnA]	Energy [MeV]	Current [pnA]
^{1}H	30	500		
^{7}Li	60	95		
^{12}C	90	450	252	2
^{22}Ne			172 #	20
^{16}O	105	370	305	2
^{32}S	150	170	465	30
^{40}Ar			391 #	30
^{40}Ca	165	13	518	3
^{58}Ni	180	40	562	10
^{84}Kr			549 #	18
^{80}Se	180	20	509	6
^{90}Zr	195	20	542	6
^{120}Sn			654	8.6
^{132}Xe			741 #	5.4
^{197}Au	210	5		

* estimated using 1 stripper foil (good for max. tandem transmission) and max ionization probability
** estimated for the state of charge of maximum probability obtained using a single foil stripper; using a double stripper the reachable energy substantially increases, but the available current reduces.
# beams presently available using PIAVE+ALPI only

Facility's major experimental instrumentation for nuclear physics (Tandem-ALPI-PIAVE accelerator):

PRISMA: large solid angle magnetic spectrometer for heavy ions with ion tracking capabilities, for binary reaction studies and possible upgrade for gas-filled operation.

CLARA: array of 25 CLOVER γ-ray Ge detectors of the EUROBALL spectrometer, placed at the PRISMA target location.

GASP: array of 40 γ-ray Ge detectors with anti-Compton shields and 80 BGO inner ball, 4π Si ball for light particles.

CAMEL: Recoil Mass Spectrometer for evaporation residue detection.

GARFIELD: high granularity 4π array for light particles and heavy fragments

8πLP: high granularity 4π array for light particles, evaporation residues and fission fragments

EXOTIC: set-up for reaction mechanism studies with radioactive beams produced in-flight

PISOLO: time-of-flight spectrometer for transfer reactions and electrostatic deflector for evaporation residues.

N2P: neutron detector array for fission reaction studies

GAMIPE: set-up for g-factor measurements

SERPE: set-up for coincidences between particles and high energy gamma-rays

TRAPRAD: magneto-optical trap (MOT) for atomic trapping of exotic nuclei

Facility's major experimental instrumentation for interdisciplinary and biomedical physics (CN and Tandem accelerators):

- Radiobiology, to study the molecular and cellular biological effects induced by accelerated charged particles and neutrons in cultured cells
- Single-ion\single cell microbeam facility with an automated cell recognition, positioning and revisiting system
- Microdosimetry
- Trace element analysis of environmental, biomedical, geological and archeological samples using PIXE, PIGE and NRA techniques.
- Multi-elemental surface analysis using the Microbeam facility at AN2000 accelerator

Facility's major experimental instrumentation for applied physics (AN2000 accelerator):

- Synthesis and characterization of advanced thin film materials and their treatment by chemical, thermal and ion beam methods
- Elemental analysis performed by means of the nuclear techniques - RBS, ERD, NRA, PIXE and PIGE

- Radiation damage and material modification studies using low energy light and heavy ions (1-14 MeV) as well as mono energetic neutrons (100 keV ÷ 8 MeV) and gamma rays

Gravitational Wave Observatory

AURIGA is an ultra-cryogenic detector for gravitational waves generated by impulsive sources in the Local Group of Galaxies. The 2.3-ton resonant bar cooled at 100 mK has a burst sensitivity of $4*10^{-19}$ at 1kHz. Available research and development facilities include: another resonant bar antenna of 2.3 tons with mechanic suspensions in a vacuum container at room temperature for testing transducers, data acquisition and calibration methods development system, cryogenic system for testing superconducting electronics such as SQUID amplifiers and LC resonators with high Q factor ($>10^6$) and a new world level facility for the complete test of very high Q factor ($>10^7$) electromechanical oscillators for thermal noise measurement at T<100 mK. An optical for Fabry-Perot cavity study, both at room and cryogenic temperature.

User facility

Yes

Program Advisory Committee/experiment proposals:

All proposals are screened on the basis of scientific merit by the LNL Program Advisory Committee (PAC) for the Tandem-ALPI accelerator complex and by the User Selection Panel (USP) for the smaller accelerators.

Program Advisory Committee/PAC (current membership): 0 in-house, 3 national, 4 international. User Selection Panel/USP (current membership): 1 in-house, 1 national, 3 international.

Number of actual, active users of the facility in a given year:

400 average number of individual users per year (including permanent staff).

Percentage of users and percentage of facility use from inside the institution:

10%, 10%

Percentage of users and percentage of facility use from national users:

>50% estimated percentage of external individual users per year

Percentage of users and percentage of facility use from outside the country where your facility is located:

50%

Fraction of international users outside of geographical region:

5%

Users group:

Not applicable

Number of:

permanent staff: 120
temporary staff (incl. graduate students and postdoc researchers)
50 on average

Number of theoretical staff:

permanent: 0
postdoc: 0
students: 0

Number of postdoc researcher:

10 on average

Number of graduate students resident at the facility:

25 on average

Number of non-resident graduate students with thesis work done at the facility:

20 on average

Involvement of undergr. students in research:

20 on average

Special student programs:

- Summer student AURIGA (May – September 2004): 2 students
- Stage for Secondary School and University students (yearly held from May to September): 40 students
- Master on "*Surface Treatments applied to Innovative Technologies for Industry*":10 students
- Exhibition "*Sperimentando*", held every year: interactive scientific exhibition to learn and enjoy oneself: 500 high school students

Future plans:

SPES is a mid-term ISOL type facility for producing and accelerating radioactive ion beams of neutron rich species. This facility is part of the European Road Map prepared by NuPECC in view of the construction of the next generation ISOL facility (EURISOL).

OSLO CYCLOTRON LABORATORY (OCL)

Centre for Accelerator Based Research and Energy Physics (SAFE)
Faculty of Mathematics and Natural Sciences, University of Oslo

Oslo, Norway

SAFE, University of Oslo
P.O. Box 1038 - Blindern
N0316 Oslo, Norway
http://www.safe.uio.no/

Telephone: +47 2285 5439
Facsimile: +47 2285 5441
E-mail: j.p.omtvedt@kjemi.uio.no

Establishment: Norwegian research council and University funds
Operation: University funds
Instrumentation: Norwegian research council and University funds

Prof. Jon Petter Omtvedt

Head of the facility:

Prof. Jon Petter Omtvedt

Scientific Mission and Research Programs:

The Oslo Cyclotron Laboratory is the only particle accelerator in Norway dedicated to fundamental research within the fields of nuclear physics and chemistry. The local group focus on thermodynamic and electrodynamic studies of atomic nuclei. Research in nuclear chemistry is divided between two main research areas. The properties of super-heavy elements are studied by the SISAK group which use OCL for tests and development of equipment and systems to be used in heavy-ion experiments at other facilities. PET research, in particular development of new compounds suitable for PET studies, is the other focus area. OCL is part of the SAFE center (http://www.safe.uio.no) which supports and promotes basic and applied nuclear research in Norway.

Technical facilities:

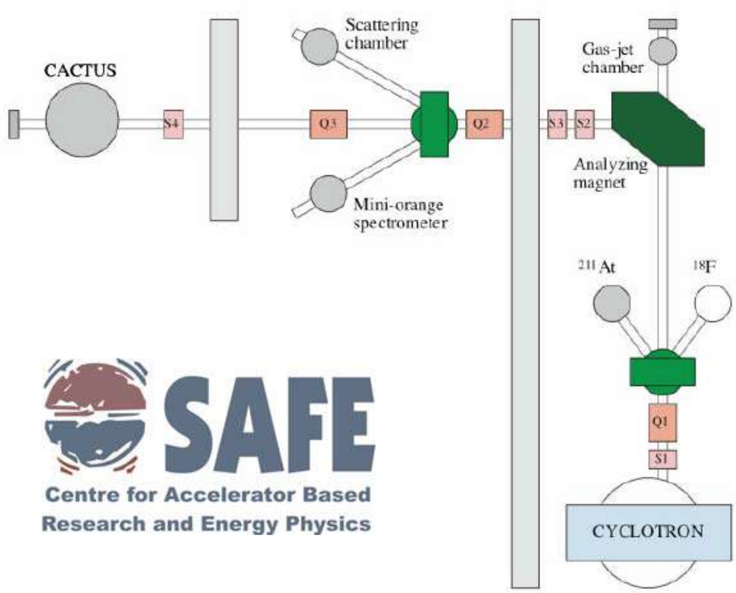


Fig. 1: The Cactus detector array

Characterization of the facility:

Low-energy MC-35 cyclotron with light ion beams

Facility parameters:

Available beams from the MC-35 cyclotron:

Particle type	Energy (MeV)	Beam intensity (uA)
Proton	2-35	100
Deuteron	4-18	100
^{3}He	6-47	50
^{4}He	8-35	50

Major experimental instrumentation and its capabilities:

The main experimental facility is:

- The CACTUS detector array with 28 NaI 5"x5" detectors and silicon particle telescopes.
- Target chamber with gas-jet (activity is transported with aerosols) transport to on-site chemistry lab.
- Type-A classified radiochemistry lab with hot-cells for e.g. PET-research is under construction.

Is the facility a user facility:

The OCL is a part of the SAFE center that is open for external and internal research groups.

Program Advisory Committee/experiment proposals:

The operation of the cyclotron is conducted by an operational group, which also schedules beam time for various projects.

Number of actual, active users of the facility in a given year:

OCL has an active user community of about 30 people, 70% in basic research, 15% in industrial application and 15% in medicine.

Percentage of users, and percentage of facility use that come from inside the institution:

Users from inside the institution 50% and facility users from inside the institution 50%

Percentage of users and percentage of facility use from national users:

National users 70% and facility used by national users 70%

Percentage of users and percentage of facility use from outside the country where your facility is located:

Foreign users 30% and facility used by foreign users 70%

Fraction of international users outside of geographical region:

10%

User Group:

No

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

Permanent staff 10, temporal staff 15

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

None

Number of postdoctoral researchers:

2-4

Number of graduate students resident at the facility:

8

Number of non-resident graduate students with thesis work primarily done at the facility:

None

Involvement of undergraduate students in research (approximate average number per year):

None

Special student programs:

Various student labs

Future Plans:

Siri III, a new silicon particle detector system with 64 telescopes. Upgrade and expansion of chemistry lab for on-line experiments.

Total amount of funding available for nuclear physics nationally and which is the total amount of high energy physics:

OCL became a part of the SAFE center summer 2005. Thereby the funding for operation is established for at least five new years.

HEAVY ION LABORATORY

Warsaw University
Ochota Science Campus
Warsaw, Poland
PL 02 094 Warszawa, ul. Pasteura 5a

E-mail: slcj@slcj.uw.edu.pl
Web address: www.slcj.uw.edu.pl

University Unit

Governmental funds

Head (Institution and facility):

Jerzy Jastrzębski, Laboratory Director

Scientific Mission and Research Programs:

The Heavy Ion Laboratory is a "User Facility" with around 100 national and foreign users per year. The isochronous K_{max}=160 cyclotron delivers around 3000 h of heavy ion beams yearly ranging from B to Ar with energies between 2 and 10 MeV/nucleon. The current research program comprises nuclear physics, atomic physics, material sciences, solid state physics, biology, particle detectors development and testing.

Actually the Heavy Ion Laboratory is in its transformation phase to become the Warsaw University accelerator centre, operating two cyclotrons. Shortly (2006/7) a second commercial proton – deuteron cyclotron

(E_p = 16.5 MeV) will be installed in the Laboratory building for the production of – and research on the radiopharmaceuticals for the Positron Emission Tomography (PET). Production of long – lived radiopharmaceuti-cals for other medical and life – science applications is also foreseen.

Characterization of the facility:

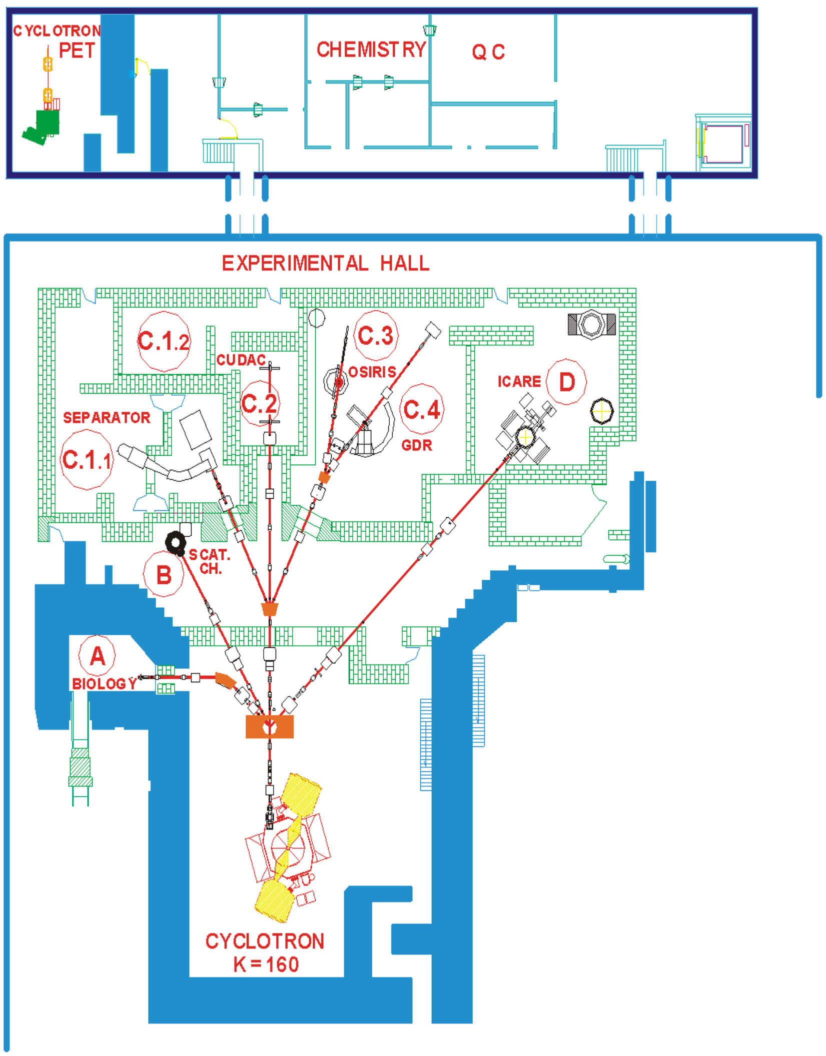
Medium – energy (2 -10 MeV/nucleon) cyclotron with heavy ion beams;

Low – energy, high current proton – deuteron cyclotron.

Table of facility parameters:

Cyclotron	Ion	Energy [MeV]	Extracted current [pnA]
K= 90 - 160	$^{10}B^{+2}$	50	4
	$^{11}B^{+2}$	38 - 55	3 - 4
	$^{12}C^{+2}$	22 - 50	2 - 20
	$^{12}C^{+3}$	89.6- 112	0.8 - 12
	$^{14}N^{+2}$	28 - 50	13 - 143
	$^{14}N^{+3}$	57 - 110	80
	$^{16}O^{+2}$	32	5.7
	$^{16}O^{+3}$	46 - 80	5.7 - 138
	$^{16}O^{+4}$	90	6.5
	$^{19}F^{+3}$	38 - 66	1.3
	$^{20}Ne^{+3}$	50 - 65	11 - 35
	$^{20}Ne^{+4}$	70 - 120	11 - 35
	$^{20}Ne^{+5}$	140 - 190	24 - 40
	$^{22}Ne^{+3}$	44	10
	$^{22}Ne^{+4}$	132	8
	$^{32}S^{+5}$	64- 121.6	0.5 – 1.4
	$^{40}Ar^{+6}$	80 - 132	2.5
	$^{40}Ar^{+7}$	120 - 172	0.9 – 2.3
	$^{40}Ar^{+8}$	195	0.9 – 2
K=16.5	$^{1}H^{+1}$	16.5	> 75 μA
	$^{2}D^{+1}$	8.4	> 60 μA

Technical facilities:



Brief and compact table with the facility's major experimental instrumentation and its capabilities:

GDR multidetector system JANOSIK;
Gamma - ray, 12HPGe multidetector system OSIRIS II;
Two universal scattering chambers CUDAC and SYRENA;
Charged particle multidetector system ICARE;
Scandinavian type on - line mass separator IGISOL;
I rradiation chambers with target water cooling;
Low background lead shielded HPGe counters;
Radiochemistry and Quality Control equipment for the radiopharmaceuticals production;
For details see: www.slcj.uw.edu.pl/en/96.html

Nature of user facility:

Heavy Ion Laboratory (HIL) was founded jointly by the Ministry of Education and Sciences, Polish Academy of Sciences and Polish Atomic Energy Agency. In the founding agreement the above three authorities enacted HIL to become, from the very beginning a national "User Facility".

Program Advisory Committee/ Experiment Proposals:

The K=160 cyclotron beam time is allocated by the Laboratory director on the recommendation of the Program Advisory Committee. The proposals are received twice a year (www.slcj.uw.edu.pl/pac) in a written form and publicly presented. In their ranking PAC considers the scientific value of the proposal, its expected international impact, its contribution to the teaching process and the previous achievements of the proposers.

Number of actual, active users of the facility in a given year:

About 100 real users per year as indicated by the access record plus about 15 virtual users, participating in data interpretation (co-authors of publications).

Percentage of users, and percentage of facility use:

About 10% of K=160 cyclotron users come from inside HIL. Less than 5% of the beam time is used by the HIL staff alone.

Percentage of users and percentage of facility use from national users:

About 80% of users come from Polish institutions.

Percentage of users and percentage of facility use from outside the country where your facility is located:

About 20% of users come from abroad.

Fraction of the international users outside of geographical region:

During last 5 years cooperation with HIL involved groups from India, Japan, USA as well as European Countries (80% of users from abroad come from Europe).

Users group:

The users group has an elected chair – person, who reports to the Laboratory Scientific Council. The facility users meet 3 times per year on a voluntary basis. No official record of people participating to the users group exists.

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

a) 46

b) 7.25

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

No theoretical staff is employed at HIL.

Number of postdoctoral researchers:

2

Number of graduate students resident at the facility (>80% of their time):

2

Number of non-resident graduate students with thesis work primarily done at the facility:

13

Involvement of undergraduate students in research (approximate average number at a given time):

16 per year (quoted nb. is for 2005)

Special student programs:

An undergraduate Student's Workshop of one week duration is organized in March each year for about 15 participants coming from Physics Faculties located outside Warsaw. Students, supervised by the Laboratory staff are performing various nuclear physics experiments, including the cyclotron operation.

During Summer up to 7 students from various Physics Faculties take part in one month duration training, participating in experiments, conducted by the Laboratory staff.

Future Plans:

Heavy Ion Laboratory is conveniently placed in the heart of the Warsaw University, Polish Academy of Sciences and Academy of Medicine Scientific Campus Ochota. Shortly the intense proton and deuteron beams from a medical cyclotron, equipped with an external beam line will be also available. These beams will be used for the production of PET radioisotopes, subsequently transformed to radiopharmaceuticals using the commercially available chemistry and quality control modules. This 4 Million Euro project is currently financed by the Polish Ministry of Education and Sciences and International Atomic Energy Agency. The Polish Health Ministry will finance the PET scanner, to be located in the neighboring Academy of Medicine Clinical Hospital. Leading the Warsaw PET Consortium, the Laboratory foresees the development of a large interdisciplinary research program including medicine and life sciences, unique at least in this part of Europe.

For the K=160 cyclotron, a purchase of a new ECR ion source allowing a substantial increase of the accelerated ion species and masses is planned within coming two years if the funding is available.

NATIONAL INSTITUTE FOR PHYSICS AND NUCLEAR ENGINEERING (NIPNE)

FN Tandem Van de Graaff (FN-15)
Standalone ECR ion source (RECRIS)

Bucharest, Romania

407 Atomistilor St.
Bucharest-Magurele, Romania
P.O. Box: MG-6, 76900

Telephone: (401) 404.23.00
Facsimile: (401) 423.17.01
http://tandem.nipne.ro
E-mail: dirgen@ifin.nipne.ro

National Institute for Research and Development

Initial Establishment: Romanian Government Investment Funds
Staffing and Operation: Special Funds from the National Agency for Scientific Research
Instrumentation and Development: Grants from the National Agency for Scientific Research and EU Programs

Prof. dr. Nicolae Victor ZAMFIR, Director General of NIPNE

Heads of the facility:

Administrative Head: Dr. Constantin Ciortea
Technical Coordinator: Dr. Serban Dobrescu
Scientific Coordinator: Dr. Gh. Cata-Danil

Scientific Mission and Research Programs:

The mission of the facility is to carry out competitive basic and applied scientific research accelerated ion beams and to provide training opportunities for undergraduate and PhD students, in collaboration with Romanian Universities. The current research program encompasses Nuclear

Structure Physics, Atomic Physics, Interdisciplinary research on Material Sciences, Biology, Medicine and Ecology. In the future, a large fraction of the research Programs will be allocated also to the studies based on Accelerator Mass Spectrometry (AMS) techniques and those required in Nuclear Astrophysics

Technical facilities:

Figure 1: General view of the Main Vault of the Tandem accelerator, built in 1973 by the HIGH VOLTAGE ENGINEERING CORPORATION (BURLINGTON, MASS.)

Figure 2: Accelerator Building of the Nuclear Physics Department –NIPNE Bucharest

Characterization of the facility:

Electrostatic Tandem Accelerator operating at voltages up to 8MV with light and heavy ions. Continuous and chopped beams; 3 ion sources (one Duoplasmatron and two Sputtering); Gas and foil stripping; 7 experimental beamlines.

Electronic Cyclotron Resonance Ion Source, Microwave frequency: 14.5 GHz; Mirror field strength, injection/middle/extraction: 1.2 / 0.34 / 1 T; Hexapole permanent magnet: Halbach structure, 24 radial segments; plasma chamber: 5-cm diameter 15-25 cm length (variable) platform voltage: 2 – 50 kV.

Facility parameters:

Tandem Accelerator: currently accelerated Beams

Beam Species	Max Energy [MeV]	Intensity on target [nA]	Source
Protons	16	700	Duoplasmatron
Deuterons	16	500	Duoplasmatron
^{4}He	24	20	Dedicated source
^{7}Li	32	10	Sputtering
^{9}Be	32	7	Sputtering
^{10}B	48	5	Sputtering
^{11}B	48	9	Sputtering
^{12}C	56	100	Duoplasmatron
^{14}N	64	30	Duoplasmatron
^{16}O	56	400	Duoplasmatron
^{19}F	72	15	Duoplasmatron
^{24}Mg	56	50	Sputtering
^{28}Si	48	30	Sputtering
^{32}S	82	100	Sputtering
^{35}Cl	42	25	Sputtering
^{48}Ti	64	1	Sputtering
^{52}Cr	96	1.1	Sputtering
^{56}Fe	84	1.5	Sputtering
^{58}Ni	88	2.7	Sputtering
^{59}Co	96	0.8	Sputtering
^{63}Cu	88	1.6	Sputtering
^{79}Br	91	0.9	Sputtering
^{81}Br	84	1.1	Sputtering
^{127}I	88	0.7	Sputtering
^{198}Au	96	1	Sputtering

ECR Ion Source: Beams under development; tested: H, N, O, Ar.

Major experimental instrumentation and its capabilities:

Gamma rays detectors (5 GeHP and 7 NaI(Tl) scintillators); neutron liquid scintillators, X-rays detectors (Si(Li)), charged particles detectors (Si), several reaction chambers. Electronic modules in NIM and CAMMAC standards. Data Acquisition System based on CAMMAC modules. Local Area Computer Network with fast INTERNET access.

Nature of facility:

It is an User Facility – recognized officially by the National Agency for Scientific Research and an appropriate Funding for maintenance and operation is provided.

Program Advisory Committee/experiment proposals:

The Facility has no official PAC. Allocation of he Accelerator time is through an internal committee.

Number of actual, active users of the facility in a given year:

Approx. 50 users per year.

Percentage of users, and percentage of facility use that come from inside the institution:

90%

Percentage of users and percentage of facility use from national users:

7%

Percentage of users and percentage of facility use from outside the country where your facility is located:

3%

Fraction of international users outside of geographical region:

1%

User Group:

Beamtime requests can be formulated by accessing the web page:

http://tandem.nipne.ro/resources_index.html

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) Permanent Staff: 27 scientific + 22 technical

b).Temporary Staff: 5 scientific

Number of postdoctoral researchers:

10 – 12

Number of graduate students resident at the facility:

9 – 10

Number of non-resident graduate students with thesis work primarily done at the facility:

3 – 4

Involvement of undergraduate students in research (approximate average number per year):

7 per year

Special student programs:

Romanian Summer Schools and Workshops in Nuclear Structure and Related Topics (http://www.nipne.ro) - yearly

Future Plans:

(i) Technical developments

(ii) New instrumentation

(iii) New nuclear analytical techniques

BUDKER INSTITUTE OF NUCLEAR PHYSICS / ROKK-1M

Novosibirsk, Russian Federation

Prospect akademika Lavrentieva 11, 630090
Novosibirsk, Russian Federation

Telephone: +7 (3832) 394337
E-mail: muchnoi@inp.nsk.su

Member of Russian Academy of Sciences (Siberian Branch)

Academy of Sciences, Russian Foundation of Fundamental Research, BINP budget.

Alexander N. Skrinsky

Head of the facility:

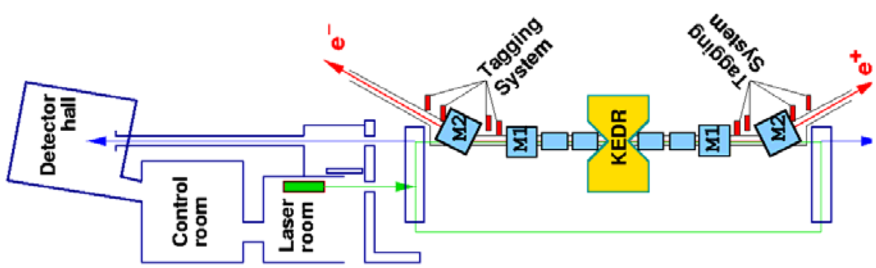
Nickolai Yu. Muchnoi

Scientific Mission and Research Programs:

The ROKK-1M facility at Budker Institute of Nuclear Physics generates high energy polarized gamma-ray beams by backscattering of laser light against the high energy electron and positron beams of the VEPP-4M collider. The facility design allows to obtain backscattering of laser light on electron and positron beams separately or simultaneously. Tagging and/or collimation is applied to select a narrow energy band from the gamma ray beam energy spectrum.

Current research program is concentrated on precise measurement of the τ lepton mass with the KEDR detector. The $\tau^+\tau^-$ pairs are produced at the threshold of $e^+e^- \rightarrow \tau^+\tau^-$ reaction. Precise on-line beam energy monitoring is performed by laser backscattered gamma rays. It allows to check the stability of the beam energy with approx. 60 keV accuracy obtained within 10 minuits calibration cycles.

Technical facilities:



Brief characterization of facility:

back-scattered photon facility

Facility Parameters:

Parameter	Symbol	Value
VEPP-4M beam energy	E_0	1.5 - 5.5 GeV
VEPP-4M beam current upto	I_e	20mA
Tagging range for gamma rays	W_{tag}	$(0.02 – 0.64)*E_0$
Tagging accuracy	ΔW/W	0.2% – 1.2%
Maximum Compton gamma ray energy	W_{max}	$(0.003 – 0.2)*E_0$ 4 – 1000 MeV
Tagged gamma ray flux upto	R_{tagged}	$1.6*10^6$ s^{-1}
Compton gamma ray flux upto	$R_{compton}$	10^7 s^{-1}

Nature of user facility:

No

Program Advisory Committee/experiment proposals:

No

Number of actual, active users of the facility in a given year:

2-3

Percentage of users, and percentage of facility use that come from inside the institution:

100%

Percentage of users and percentage of facility use from national users:

0/0

Percentage of users and percentage of facility use from outside the country where your facility is located:

0/0

Fraction of international users outside of geographical region

0

User Group:

No

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) 2 b) 3

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

0

Number of postdoctoral researchers:

1

Number of graduate students resident at the facility:

0

Number of non-resident graduate students with thesis work primarily done at the facility:

1

Involvement of undergraduate students in research (approximate average number per year):

0

Special student programs:

No

Future Plans:

In the nearest time we plan experiments with the measurements of photo-fission cross-section of heavy nuclei at threshold. The existent configuration of the facility provides the energy of the Compton spectra edge from 4.5 MeV up to 8 MeV with intensivity of gamma-quanta beams up to 10^5 Hz. Experiments in this region of energy will have interest due to the some discrepancies in available data.

BUDKER INSTITUTE FOR NUCLEAR PHYSICS/VEPP-3 STORAGE RING/DEUTERON FACILITY

Novosibirsk, Russian Federation

Budker Institute for Nuclear Physics
11 Lavrentiev Prospect
Novosibirsk 630090, Russia

Telephone: +7 3832 394026
Facsimile: +7 3833 307163
E-mail: nikolenko@inp.nsk.su

Member of Russian Academy of Sciences (Siberian Branch)

Academy of Sciences, Russian Foundation of Fundamental Research, BINP budget.

Alexander N. Skrinsky

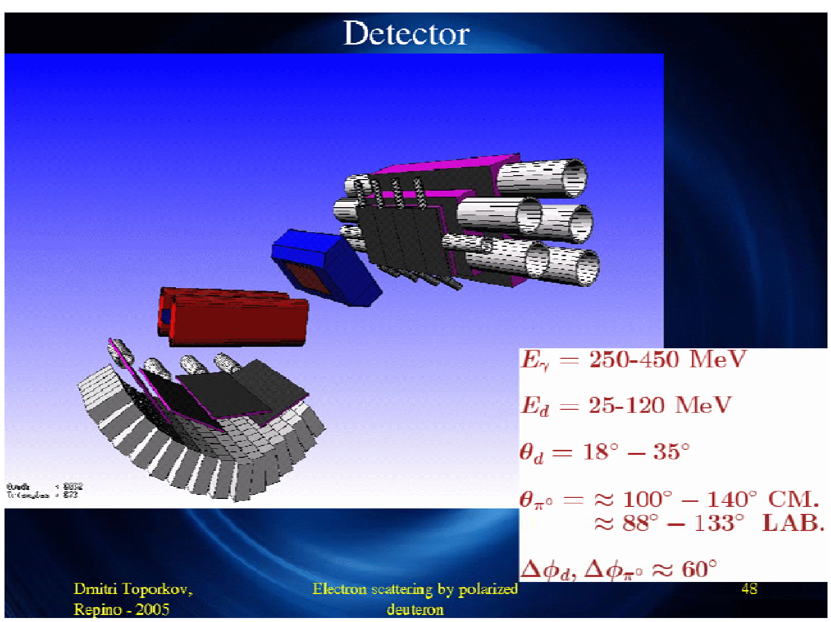
Head of the facility:

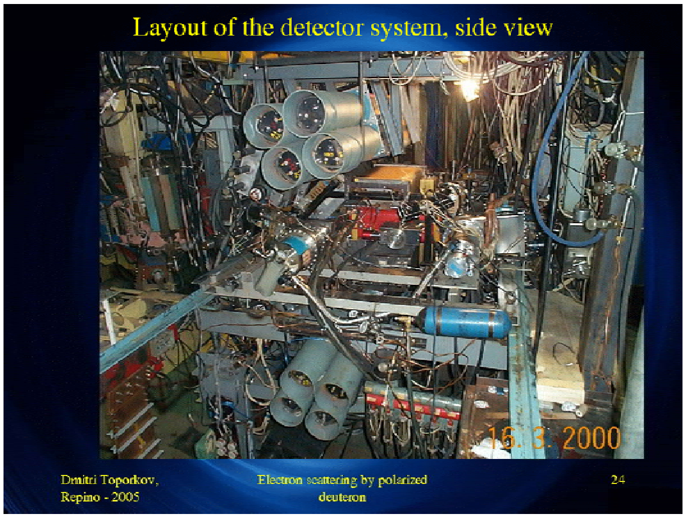
Dmitry Nikolenko

Scientific Mission and Research Programs:

The main direction is study of the electromagnetic structure of the lightest nuclei in experiments with polarized internal targets. The current program: Measurement tensor analyzing power in coherent and incoherent pion production on the deuteron. Measurement of two-photon exchange contribution in elastic scattering of electrons/positrons on the proton. This experiment will use the advantage of VEPP-3 storage ring, where high enough luminosity in (e^+p) and (e^-p) scattering can be achieved. Future research program: measurement of tensor analyzing power in deuteron photodisintegration, pion and vector mesons photoproduction by tagged photons with energy 500 -1500 MeV.

Technical facilities:





Characterization of facility:

Electron/positron storage ring VEPP-3

Facility parameters:

Electron/positron beam energy from 350 MeV to 2 GeV

Electron/positron beam current 150/50 mA

Beam lifetime 30000 s

Beam lifetime with polarized internal target 8000 s

Beam cross section 0.3 x 0.7 mm

Bunch repetition 4 MHz

Brief and compact table with the facility's major experimental instrumentation:

Atomic Beam Source with strong superconducting magnets provides polarized deuterium atoms flux 8×10^{16} at/s for target with thickness 8×10^{13} at/cm^2. Non-magnetic particle detector covers the solid angle ~1 str. It consists from tracking system, electromagnetic calorimeter 200 CsI and NaI crystals, proton and neutron scintillator counters.

User facility:

The facility can be used 20% time of VEPP-3 (other 80% time is devoted to the high energy physics experiments)

Program Advisory Committee/Experiment Proposals:

Scientific Council of BINP plays the role of Program Advisory Committee

Number of actual, active users of the facility in a given year:

About 15 persons (plus several students).

Percentage of users, and percentage of facility use that come from inside the institution:

70% come from inside the institution.

Percentage of users and percentage of facility use from national users:

85%

Percentage of users and percentage of facility use from outside the Russia:

30%

Fraction of the international users from outside geographical region:

North-America and Europe: 1/1

User Group:

No.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) permanent staff - 7; b) temporary staff - 4

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

Permanent - 1; postdoctoral - 0; students -1;

Number of postdoctoral researchers:

1

Number of graduate students resident at the facility:

2

Number of non-resident graduate students with thesis work primarily done at the facility:

0

Involvement of undergraduate students in research:

2

Special student programs

No.

Future Plans:

New Injection Complex of BINP will provide more intensive (up to 200 mA) electron/positron beam in VEPP-3. System of tagged photons, which is under development, will provide new advantage in photodisintegration and photoproduction experiments.

PETERSBURG NUCLEAR PHYSICS INSTITUTE RUSSIAN ACADEMY OF SCIENCE (PNPI).

Gatchina, Leningrad District, Russia

188350, Gatchina
Leningrad District
Russia

Telephone: 7-813-7146047
Facsimile: 7-813-71-3-1347
E-mail: pnpi@lnpi.spb.su

Institute belongs to Russian Academy of Science (RAS)

Main source of funding: Budget of RAS
of Science and Education Russian Federation

V. A. Nazarenko

Heads of the facilities:

High Energy Physics - RAS, Alexey Vorobyev
Theoretical Division - Lev N. Lipatov
Neutron Research Dept – Prof. Valery Fedorov

Scientific Mission and Research Programs:

Main research program of HEPD.

- Elementary particle physics (experiments on LHC, Tevatron-USA, Desy-Germany),
- Nuclear Physics (experiments at PNPI, JINR-Dubna, ISOLDE-CERN, GSI- Germany, Cosi-Germany, PSI-Switzerland, K-130-Jyvaskyla, Finland)
- Solid state physics (MSR-experiments at PNPI and PSI); Radiation physics and Proton therapy at PNPI synchrocyclotron.

All above shown experiments cover as current as well future ones.

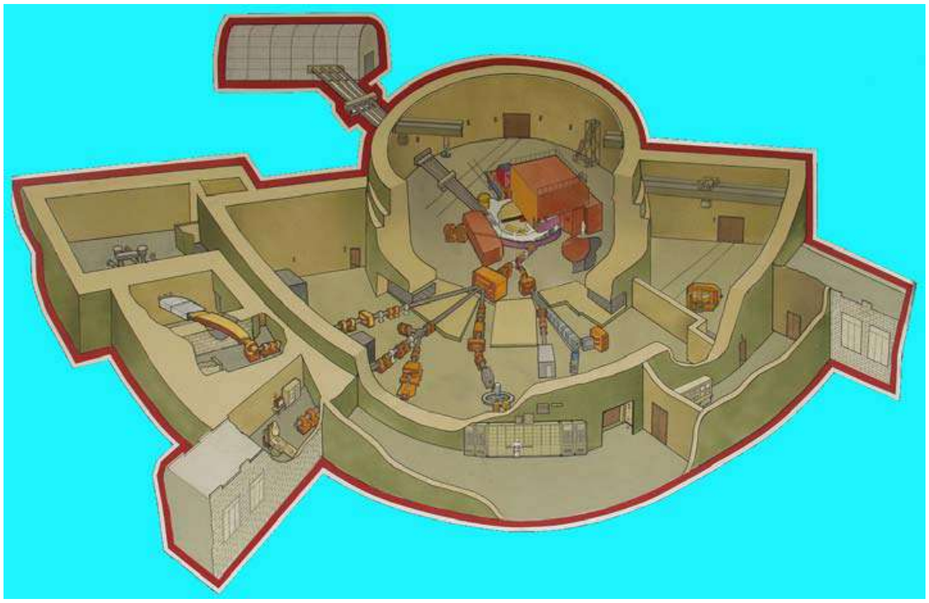
Technical facilities:

1. Synchrocyclotron on proton energy of 1000 MeV
1. Acting atomic reactor
2. Building atomic reactor ”PIK”

Characterization of the facility:

The biggest synchrocyclotron in the world with proton energy of 1000 MeV.

Total view of synchrocyclotronSchematic view of accelerator complex



Schematic view of accelerator complex.

Table of facility parameters:

- Technical parameters of HEPD facility-synchrocyclotron:
- Energy of extracted protons-1000 MeV,
- Intensity of inner beam-3 mkA,
- Intensity of extracted beam-1 mkA
- Energy spread of beam 0.1%.
- Intensities and energies of second beams:
- Pions +/-(3-10)E5 for P=450 MeV/c,
- Muons +/(9-30)E4 for P=170 MeV/c,
- Neutrons of E=0.01 eV-200 MeV
- Total intensity-3E14/sec
- Total area-20000 m^2

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Table of the major experimental instrumentation

	NAME OF SETUP AND DIRECTION OF ACTIVITY
1	Mass-separator IRIS for the study of short-lived nuclei far from the beta stability region (analogue of ISOLDE, CERN).
	Measurements of electromagnetic moments and charge radii of radioactive nuclei by resonancelaser spectroscopy.
2	Time-of flight neutron spectrometer (GNEIS). Energy of neutrons
	E=0.01 Ev-200 MeV. Full intensity is 3E14/sec. $3{\cdot}10^{14}$ n/sec.
	Measurements of fission cross sections.
3	MSR facility on muon beam. Investigations on solid state physics using muon spin rotation method
4	Two shoulder magnetic spectrometers system (MAP) for measurement of incident and recoil protons with energy 100-1000 MeV.
	Study of nuclear matter density distributions by the method of proton elastic scattering, investigation of nuclear structure by quasielastic proton scattering
5	Electromagnetic calorimeter on the basis of CeI crystals.
	Investigation of η-meson formation.
6	Experimental variable proton energy facility in the range 200-800 MeV.
	Intensity of 200 MeV proton beam is 3E8 proton/sec. $3{\cdot}10^5$ sec^{-1}.
	Measurements of fission cross sections for a number of heavy targets as a function of proton energy.
7	Complex of stereotaxic radiation therapy on 1000 MeV proton beam.
	Treatment of different diseases of head brain. Since 1975 till 2005 1280 patients were treated by this method.

Nature of user facility:

PNPI synchrocyclotron is considered as a user facility

foreign members of it are:
ISOLDE Collaboration, GANIL (France),----(Japan), INFI (Italy), Argonne Lab. (USA), GSI (Germany), LHC (CMS, ATLAS, ALICE,

LHCb)/RUSSIAN MEMBERS: JINR (Dubna), IETP (Moscow), IHEP (Protvino), NC Kurchatov Institute (Moscow) Minsk State University (Belarussia), St.Petersburg State Technical University, CRIRR (St.Petersburg)

Program Advisory Committee/experiment proposals:

Our facility has a Program Advisory Committee with the goal of adjudicating experiment proposals.

Percentage of users and percentage of facility user from national users:

The estimated number of national users is 15% of the total number.

Percentage of users and percentage of facility use from outside the country where your facility is located:

We estimate a number of users outside the country as 10-15%.

Fraction of the international users outside of geographical region:

The main fraction of international users is from Europe and Japan (Asia).

This number is equal to above shown number 10-15%.

The formal user group is organized now in HEPD facility.

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

Permanent scientific stuff of HEPD consists of 200 physicists and engineers.

Number of graduate students resident at the facility:

A number of graduated students in HEPD is in average 12.

MAX-LAB

Lund, Sweden

Ole Römers väg 1
Box 118, SE-221 00
Lund, Sweden

Telephone: +46 46 222 9872
Facsimile: +46 46 222 4710
E-mail: forestandare@maxlab.lu.se
web address: www.maxlab.lu.se

National facility

Construction: Government funds (The Swedish Research Council and the Lund University) and private foundations such as the Knut and Alice Wallenberg Foundation,
Operation Government funds (The Swedish Research Council and the Lund University).

Prof. Nils Mårtensson

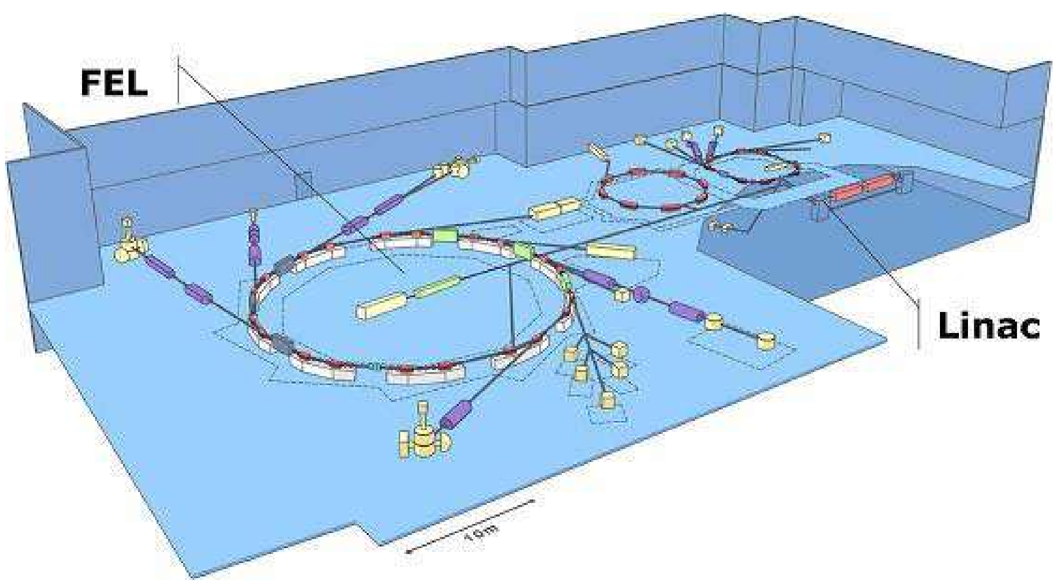
Head of the facility:

Prof. Nils Mårtensson

Scientific Mission and Research Programs:

MAX-lab is a multi-program National Facility with: Accelerator physics research; Synchrotron light research (Physics, Chemistry, Life sciences, Applied subjects); and Nuclear physics research. A guide to the scientific program can be found at www.maxlab.lu.se. The current research in Nuclear physics is based on the access to monochromatic photons in the energy range 20 to 225 MeV. The research program includes studies of Compton scattering, pion production, knockout reactions and total absorption cross sections. The future plans include a synchrotron light facility, MAX IV, with a 3 GeV linear accelerator serving two storage rings at 1.5 and 3 GeV, respectively, and Free Electron Lasers.

Technical facilities:



Characterization of the facility:

The nuclear physics part of MAX-lab consists of a linear accelerator with a nominal maximum energy 250 MeV (in 2005 190 MeV was obtained) and a stretcher ring, MAX I. The electron beam is used to produce bremsstrahlung with high duty factor. A monochromatic beam is achieved via the tagging method.

Facility parameters:

Facility parameters	Design value	In 2005
Maximum electron energy (MeV)	250	190
Duty factor	0,5-0,8	0,8
Operating current (nA)	≈ 40	< 10
Tagged photon energy range (MeV)	20-200	
with Main Tagger (MeV)		33 – 124
with the End Point Tagger (MeV)		110 – 180
Energy resolution (MeV)	< 0,150	< 0,150

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Major experimental instrumentation

2 Tagging spectrometers

4 25 cm x 25 cm NaI(Tl) spectrometers

3 ≈ 50 cm x 50 cm NaI(Tl) spectrometers

Si-Si and Si-HPGe telescopes for charged particles

3 large Si-Si-HPGe telescopes

Liquid scintillation neutron detectors

Time of flight neutron detector wall 6 m x m

Targets for LHe and LH

User facility:

MAX-lab is an official user facility and part of the I3HP project HadronPhysics within the 6th EU program.

Program Advisory Committee/Experiment Proposals:

The facility has a Program Advisory Committee that allocates beam time to projects based on the scientific merits of these projects.

Number of actual, active users of the facility in a given year:

For the total facility the number of active users during a year amounts to approximately 600. The average number of nuclear physics users is about 40 during a year.

Percentage of users that come from inside the institution:

Less than 5 per cent of the nuclear physics users come from inside MAX-lab.

Percentage of users and percentage of facility use from national users:

Less than 10 per cent of the nuclear physics users come from Sweden.

Percentage of users and percentage of facility use from outside the country where the facility is located:

85 per cent of the users come from outside Sweden and about 70 per cent of the facility use comes from outside Sweden.

Fraction of the international users from outside Europe:

About 50 per cent of the nuclear physics users come from outside Europe.

Users group:

There exists a user group with about 50 members.

Number of permanent staff and temporary staff:

The total number of permanent staff at MAX-lab as a total is about 50 and the number of temporary staff including graduate students and postdoctoral researchers are about 30.

Number of theoretical staff employed at the facility:

There is no theoretical staff employed at MAX-lab.

Number of postdoctoral researchers:

The number of postdoctoral researchers is about 20.

Number of graduate students resident at the facility:

The number of graduate students resident at the facility (>80% of their time is 10.

Number of non-resident graduate students with thesis work primarily done at the facility:

The number of non-resident graduate students with thesis work primarily done at the facility is about 50.

Involvement of undergraduate students in research:

The involvement of undergraduate students in research is about 5 at any given time.

Special students programs:

For the synchrotron light oriented students there are Nordic summer schools organized every second year. For undergraduates there is a course about "Nuclear physics at MAX-lab" (7.5 ECT points). A more general course, also 7.5 ECT, is "The Frontiers of Science". This course extends over a full year, and the students meet regularly with a given research group at MAX-lab in order to learn what it means to do research. Other parts of the course is seminars every second week in some topic in natural science.

Future Plans:

For the MAX-lab the plans for the future include a new facility consisting of a 3 GeV linear accelerator which will be used to provide electrons to two storage rings, one with energy 1.5 GeV and one with 3 GeV. The Linac system will also be used for Free Electron Lasers. This project is called MAX IV. For the nuclear physics part the plans for the near future are related to new detection systems for neutrons, charged particles and fission fragments. Also the production of polarized photons via coherent bremsstrahlung will soon be available. On the target side, a liquid He-3 cell is under development in order to study the effects of 3 nucleon forces.

THE SVEDBERG LABORATORY

UPPSALA (Sweden)

Uppsala University
Box 533
SE - 751 21 Uppsala, Sweden

C. Ekström, Director
Telephone: +46 18 471 31 12
Facsimile: +46 18 471 38 33
E-mail: curt.ekstrom@tsl.uu.se
WWW: http://www.tsl.uu.se/

Contact Person for Foreign Users
C. Ekström
Telephone: +46 18 471 3112
E-mail: curt.ekstrom@tsl.uu.se

Facility:

Cyclotron for protons up to 180 MeV and heavy ions up to 45 MeV/u.

Procedure to Apply for Beamtime:

Proposals should be sent to the Director.

Proposal forms available at the TSL home page.

Programme Advisory Committee (current membership):

1 national and 3 international members.

Main Instrumentation for Nuclear Physics Experiments:

Monoenergetic neutron beam facility.

Main Fields of Nuclear Research:

Intermediate energy nuclear reactions.

Neutron induced reactions.

Cross-section measurements for application-oriented projects.

Main Fields of Other Research:

Biomedical research with ion beams.

Proton beam therapy.

Application of nuclear techniques to material science.

SEU studies using neutron and proton beams.

Transportation:

Airport bus or train (35 km) from Stockholm Arlanda Airport to central Uppsala.

Walking distance from city centre.

Future Developments (under construction):

Accelerator developments for HESR of FAIR, GSI, Darmstadt.

Pellet target developments for the PANDA experiment at HESR.

CERN/ALICE

CH-1211 Geneve 23
Switzerland

Telephone: +41 22 767 58 28
Facsimile: +41 22 767 89 90
WWW: http://www.cern.ch

International Organization

R. Aymar, Director
Telephone: +41 22 767 23 00
E-mail: Robert.Aymar@cern.ch

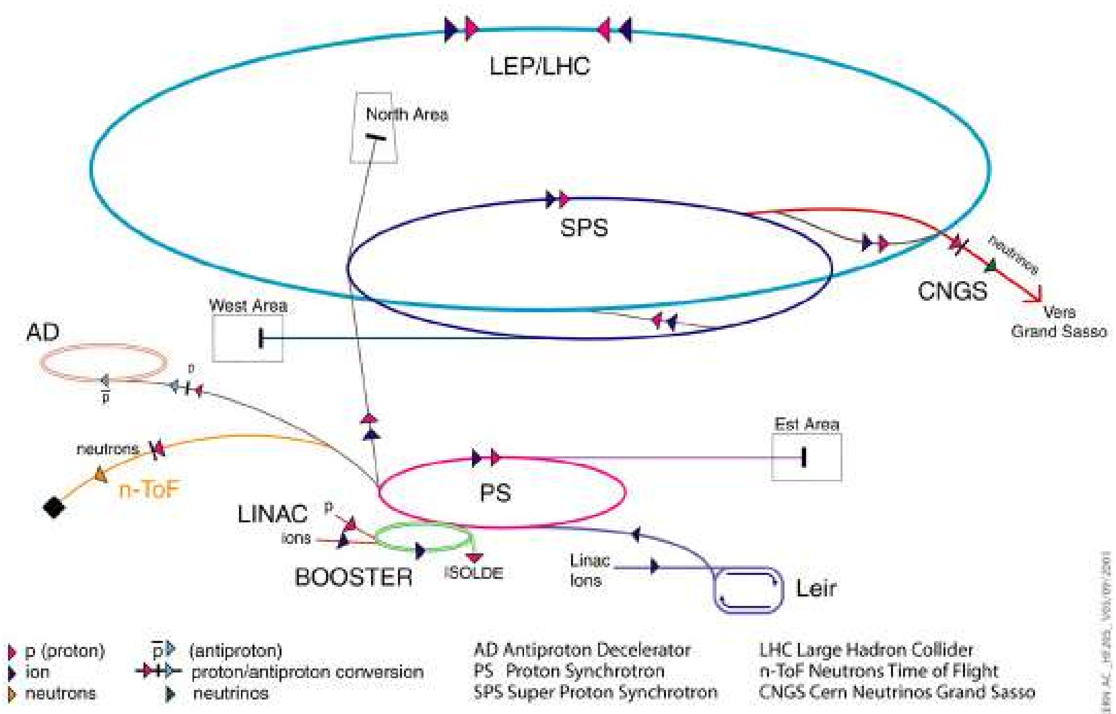
Head of the facility:

Chief Scientific Officer: J. Engelen
LHC project leader: L. Evans

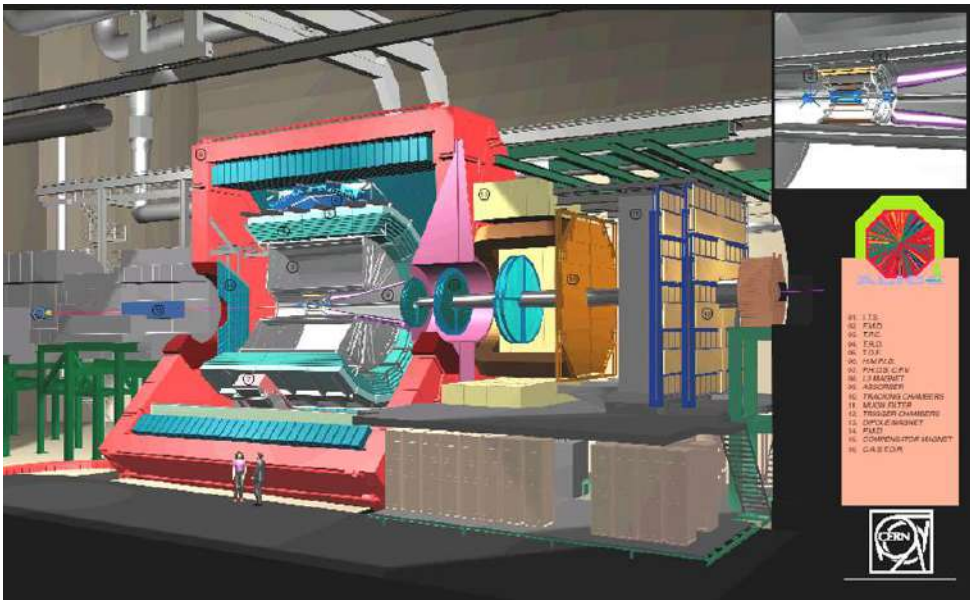
Scientific Mission and Research Programs:

The Large Hadron Collider (LHC) currently under construction at CERN will come into operation in 2007. Besides proton-proton collisions, aimed at exploring particle physics at the TeV scale, both proton-nucleus and nucleus-nucleus collisions are foreseen as a significant part of the experimental program. With heavy ions at a center-of-mass energy of 5.5 TeV/nucleon, the LHC will carry the study of nuclear matter under extreme conditions and of the quark-gluon plasma into a new and unexplored energy domain.

Technical facilities:



Accelerator chain of CERN (operating or approved projects)



Characterization of the facility:

High energy proton-proton collider, relativistic heavy ion collider.

Table of facility parameters:

Peak luminosities and center-of-mass energy for a number of possible ion beam combinations in the LHC. All numbers are estimates only.

Beams	c.m.s. energy [TeV/A]	Luminosity [$cm^{-2}s^{-1}$]
Pb-Pb	5.5	10^{27}
Ar-Ar	6.3	10^{30}
O-O	7.0	$3x10^{31}$
p-Pb	8.8	> 1.5×10^{29}
p-Ar	9.4	> 5×10^{30}

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Three of the four major LHC experiments will make use of heavy ion beams: the dedicated general purpose heavy ion experiment ALICE and the two general purpose proton-proton experiments ATLAS and CMS.

Nature of user facility:

User facility

Program Advisory Committee/experiment proposals:

LHCC committee (12 CERN + 15 international members)

Number of active users and their origin:

ca 1000 users working primarily with heavy ions, ca 4000 working primarily in particle physics

Percentage of users, and percentage of facility use that come from inside the institution:

n/a

Percentage of users and percentage of facility use from national users:

n/a

Percentage of users and percentage of facility use from outside the country where your facility is located:

n/a

Fraction of the international users from outside geographical region:

ca 30%

User Group:

This and the remaining questions are probably not applicable to LHC as a specific facility.

CERN/ISOLDE

Geneva

CH-1211 Geneve 23
Switzerland

Telephone: +41 22 767 61 11
Facsimile: +41 22 767 65 55
E-mail: Karsten.Riisager@cern.ch

International Laboratory

For all three cases: contributions from member states (directly and through CERN budget). ISOLDE also receives funding through various EU funded programmes, presently the Integrated Infrastructure Initiative EURONS and the EURISOL Design Study.

R. Aymar, Director

Head of the facility:

K. Riisager

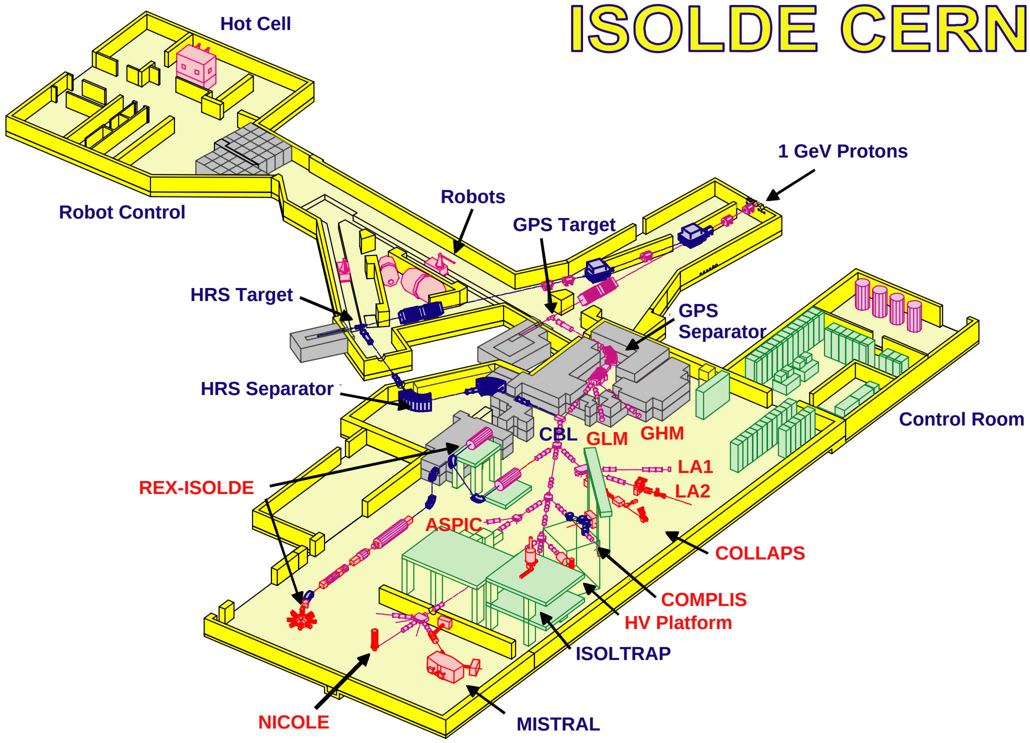
Scientific Mission and Research Programs:

The aim of ISOLDE, as of CERN, is to carry out fundamental research of the highest quality. ISOLDE provides radioactive beams of more than 850 isotopes at low energy (10-60 keV). These beams can be postaccelerated to 0.3-3 MeV/u (presently, up to 5.5 MeV/u and 10 MeV/u in the future). The main research topic is nuclear structure of nuclei far from stability, but there are significant activities also in solid state physics, biophysics and medicine, nuclear astrophysics and fundamental physics. Experiments include measurements of ground state properties (masses, moments, radii) and decay properties, Coulomb excitation reactions and transfer reactions.

Technical facilities:

©CERN photo

ISOLDE CERN



Characterization of the facility:

Isotope separator on-line to a high-energy proton synchrotron (1-1.4 GeV, 2 microAmps)

Table of facility parameters:

ISOLDE delivers more than 850 isotopes as low energy beams (10-60 keV), though REX-ISOLDE beams can be postaccelerated to 0.3-3.0 MeV/u. The intensity of the radioactive beams can reach more than 10^{11} ions/s, detailed yield information for ISOLDE and REX-ISOLDE is available through http://isolde.web.cern.ch/ISOLDE/

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

- Tape station to transport radioactivity for nuclear spectroscopy studies
- Several state-of-the-art germanium detectors for nuclear spectroscopy
- MINIBALL, a highly efficient germanium array placed at target station after REX-ISOLDE
- UHV experimental chambers for surface and interface studies
- High-resolution laser spectroscopy set-ups and laboratories
- High-precision mass spectrometers (Penning trap, transmission spectrometer)
- Electron-photon spectrometer
- Experimental platform at 200 kV
- Several angular correlation spectrometers
- Low-temperature dilution refrigerator
- Emission-channelling apparatus

Nature of user facility:

Yes, all CERN infrastructures are open to users

Program Advisory Committee/experiment proposals:

Yes, the INTC (ISOLDE and neutron Time-of-Flight Experiments Committee)

Number of active users and their origin:

About 350, counting users showing up for experiments (30-35 different experiments/year)

Percentage of users, and percentage of facility use that come from inside the institution:

About 1 % and 2 %, respectively

Percentage of users and percentage of facility use from national users:

0 %

Percentage of users and percentage of facility use from outside the country where your facility is located:

About 99 % and 98 %, respectively

Fraction of the international users outside of geographical region:

Roughly 10 %

User Group:

There is no formal users group, but the users are organized through the ISOLDE Collaboration (9 member countries + CERN) and yearly users meetings are held

Number of a) permanent staff and b) temporary staff:

a) No physicists, 12 technical staff

b) 8 physicists (and 1 secretary) paid by CERN and EU grants, 5 technical staff paid by CERN

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

None at ISOLDE (occasional long-term visitors), CERN has a theory department

Number of postdoctoral researchers:

2 physicists and 2 technical postdocs

Number of graduate students resident at the facility:

Typically at least 5 physics students and 2 technical students

Number of non-resident graduate students with thesis work primarily done at the facility:

At a given time more than 50 graduate students, roughly 15-20 theses/year

Involvement of undergraduate students in research (approximate average number at a given time):

Significantly fewer undergraduate students, except for the summer student programme

Special student programs:

CERN has a summer student program for under graduate students in which ISOLDE participates actively (10-15 students/year)

Future Plans:

HIE-ISOLDE, an upgrade of intensity and energy of post accelerated radioactive ions at ISOLDE with additional benefits for low energy nuclear physics (<kV) in beak purity, transverse and longitudinal beam emittance and intensity.

PAUL SCHERRER INSTITUT

VILLIGEN (Switzerland)

CH-5232 Villigen PSI
Telephone: +41 56 310 21 11
Facsimile: +41 56 310 21 99
WWW: http://www.psi.ch/

R. Eichler, Director
Telephone: +41 56 310 32 16
Facsimile: +41 56 310 27 17

Contact Person for Foreign Users
C. Petitjean
Telephone: +41 56 310 32 60
E-mail: claude.petitjean@psi.ch

Facility:

Isochronous cyclotron running at 50.6 MHz frequency and delivering 2 mA proton current at 590 MeV.

Secondary beams of $\pi^{\pm}$, $\mu^{\pm}$, cold polarized n.

Procedure to Apply for Beamtime:

Submission of proposals.

Information on procedures available from http://ltp.web.psi.ch

Presentation in an open users meeting.

PAC meets once per year.

Programme Advisory Committee (current membership):

1 in-house, 3 national, 5 international members.

Main Instrumentation for Nuclear Physics Experiments:

Several highest intensity _π and μ-beams.

Special high purity μ-facility for measuring ultra-rare decays.

High intensity, highly polarized cold neutron beam.

Main Fields of Nuclear Research:

Low energy pion and muon physics.

Experiments with cold polarized neutrons.

Main Fields of Other Research:

Muon Spin Resonance experiments at several μSR facilities.

Radiation hardness tests of materials and electronic components and circuits with high intensity proton, neutron, pion and photon beams.

OPTIS: cancer therapy on human eyes with 72 MeV protons.

Human cancer therapy with 250 MeV protons, using a new dedicated cyclotron and a large gantry.

Neutron scattering at spallation neutron source SINQ.

X-ray experiments at the 2.4 GeV electron storage ring (Swiss Light Source SLS).

Accommodation:

Guest house (72 rooms) on site.

Transportation:

Bus connection to Brugg railway station (approx. 10 km).

Future Developments (under construction):

Source of ultra-cold neutrons derived from proton-induced spallation neutrons (high storage densities, low background). Commissioning 2006.

KERNFYSISCH VERSNELLER INSTITUUT (KVI) / AGOR

Groningen, The Netherlands

Zernikelaan 25
NL-9747 AA Groningen
The Netherlands:

Telephone: +31 50 363 3600
Facsimile: +31 50 363 4003
E-mail: info@kvi.nl
Website: http://www.kvi.nl/

University Institute

Construction; large additional constructions have generally been obtained through investment schemes operated by the *Nederlandse Organisatie voor Wetenschappelijk Onderzoek" (NWO)*; smaller investments are paid from the running budget

Operation; the institute is jointly operated from base funding from the *Rijksuniversiteit Groningen* and mission and programmatic funding from the *Stichting voor Fundamental Onderzoek der Materie (FOM)* and *Gesellschaft für SchwerIonenforschung* in Darmstadt, Germany. The latter funding is earmarked for research and development at FAIR/GSI.

Prof.dr. M.N. Harakeh

Head of the facility:

Head of AGOR Accelerator Group: Dr. S. Brandenburg

Scientific Mission and Research Programs:

KVI pursues high-quality, innovative, front-line scientific research in the fields of fundamental and applied subatomic and atomic physics in a broad sense and educates and trains (graduate) students and post-docs in an international environment preparing them for future careers in industry and academia. KVI actively stimulates and participates in interdisciplinary fields of research, both within and outside KVI, as well as undertakes application-oriented research together with industries, businesses and the public sector.

The main current and future research programmes are:

– Fundamental interactions and symmetries (performed at KVI)

– Nuclear structure and nuclear astrophysics (performed at GSI)

– QCD at low energies; exotic states of quarks and gluons and charmonium spectrum

(performed with PANDA at FAIR/GSI)

– Astroparticle physics (performed at Auger, ANTARES/KM3NeT)

Technical facilities:

Figure 1: Aerial view of the KVI

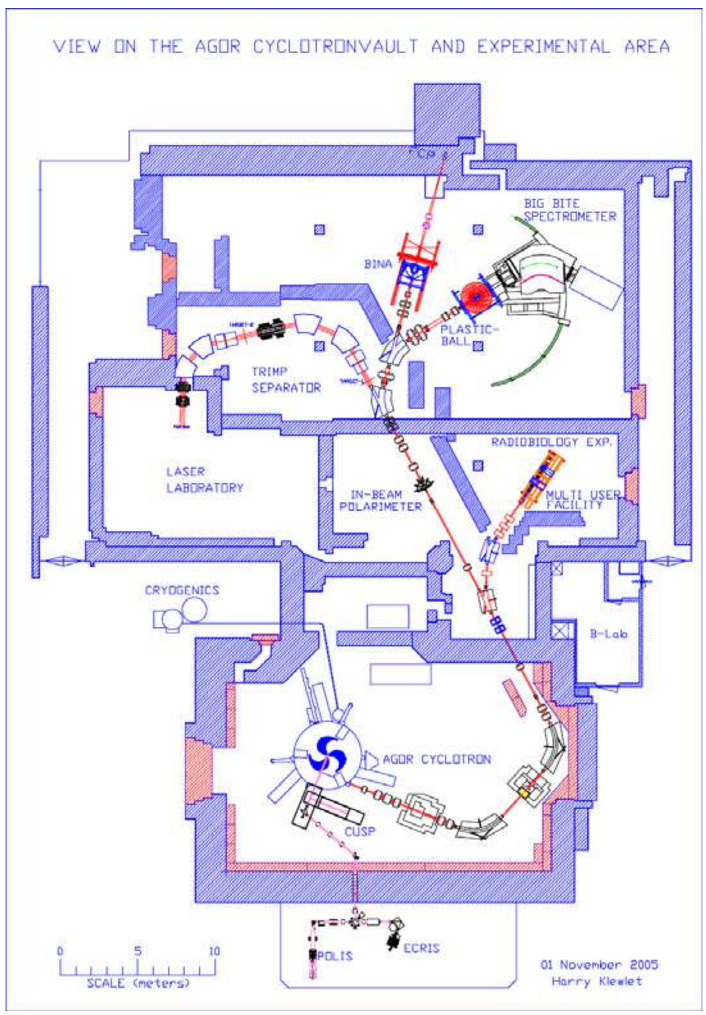


Figure 2: Top view of the cyclotron vault and the experimental areas

Characterization of the facility:

Intermediate-energy superconducting cyclotron with (polarised) proton and deuteron beams as well as heavy-ion beams up to Pb.

The central facility of KVI is AGOR, a superconducting K=600 MeV cyclotron for the acceleration of light and heavy ions. The cyclotron is equipped with three external ion sources. Presently, there are three major experimental detection systems for nuclear research at KVI, which all three can be used in conjunction with ancillary equipment. A new facility called TRIμP, meant for trapping radioactive ions produced with AGOR, will be in full operation around end of 2007.

Facility Parameters:

AGOR facility parameters:
maximum energy from bending limit E/A = 600 $(Q/A)^2$ MeV per nucleon;
maximum energy from focussing limit E/A = 190 Q/A MeV per nucleon;
minimum energy 5 MeV per nucleon at Q/A < 0.2,
35 MeV per nucleon at Q/A = 0.5,
120 MeV per nucleon at Q/A = 1
maximum intensity ≤ 10^{13} particles per second (pps) for light ions,

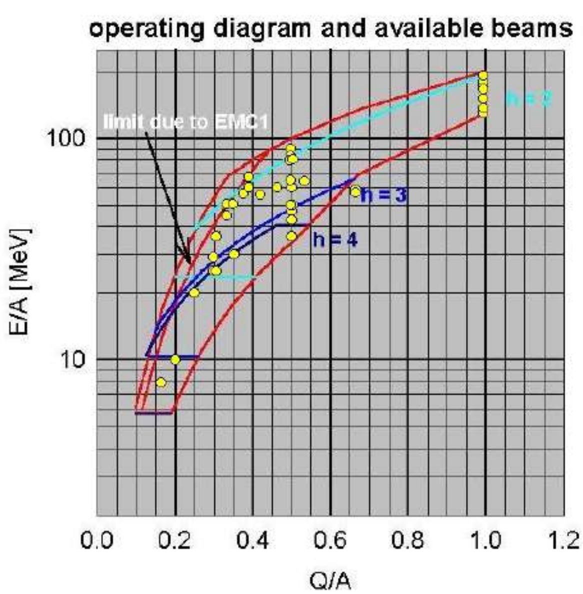


Figure 3: Operating diagram and available beams from the AGOR cyclotron

≤ 10^{12} pps for heavy ions, strongly dependent on ion species;
proton polarisation 75 %;
deuteron polarisation 70 %.

A broad range of isotopes (light ions as protons, but also heavy ions up to lead) is available (see Figure 3). In the coming years high-intensity beams will be developed (in particular for the TRIμP research programme).

Major experimental instrumentation and its capabilities:

Big-Bite magnetic Spectrometer (BBS)

Dual-mode magnetic separator TRIμP

Magneto-optical traps

Big Instrument for Nuclear-polarisation Analysis (BINA)

Plastic Ball: a 4π detector system consisting of 815 phoswich detectors.

SiLi Ball consisting of 20 solid-state detectors.

EDEN: a neutron-detection array consisting of 48 liquid scintillator detectors.

Clover detectors: a pair of high-purity Ge detectors.

Presently, the TRIμP facility is being built. Its purpose is to perform high-precision measurements to investigate physics beyond the Standard Model. The TRIμP magnetic dual separator has been installed and was successfully tested during 2004. Concurrently, a laser laboratory is being set up. The facility is expected to be ready for physics in 2006.

A special beam line has been set up with which radiobiology experiments pertinent to proton therapy can be performed. Another beam line is available for irradiation experiments.

Nature of user facility:

KVI is a user facility for the international scientific community. Under the EURONS collaboration of the EU, KVI offers support for transnational access of outside users to the AGOR facility. The AGOR facility is also available for commercial use by industries, businesses and the public sector.

Program Advisory Committee/experiment proposals:

Yes. Proposals from users will be evaluated on basis of their scientific merit, by the AGOR Programme Advisory Committee (PAC).

Number of actual, active users of the facility in a given year:

We list here the number of Principal Investigators (PI) for the last 3 years (2003-2005); if an experiment has more than 1 PI, it is being counted

as 1 only. On the average every PI represents 5-7 (active) users.
2003: 13
2004: 9
2005: 18

Percentage of users, and percentage of facility use that come from inside the institution:

Almost all users from outside collaborate with in-house users; here we list the number of PI's from inside the institution (as with the previous item, in case of more than 1 PI per experiment, we count just 1).

2003: 1 (15%)
2004: 4 (44%)
2005: 7 (39%)

The used beam time of the inside users is as follows:

2003: 37%
2004: 57%
2005: 35%

Percentage of users and percentage of facility use from national users:

Here we exclude the inside users
2003: 2 PI's (15%), using 11% of the time
2004: 2 PI's (22%), using 20% of the time
2005 2 PI's (11%), using 8% of the time

Percentage of users and percentage of facility use from outside the country where your facility is located:

2003: 9 PI's (70%), using 51% of the time
2004: 3 PI's (34%), using 23% of the time
2005: 9 PI's (50%), using 58% of the time

Fraction of the international users from outside geographical region:

0%

User Group:

Yes, 70

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) Permanent scientific staff: 22
b) Temporary scientific staff: 28

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

Permanent: 2
Postdoctoral: 1
Graduate students: 2

Number of postdoctoral researchers:

Post-docs: 3

Number of graduate students resident at the facility:

Graduate students: 24

Number of non-resident graduate students with thesis work primarily done at the facility:

0

Involvement of undergraduate students in research (approximate average number per year):

10

Special student programs:

Biannual FANTOM study weeks; FANTOM is an international research school with partner institutes at the universities of Groningen (KVI), Gent, Leuven, Münster, Orsay (Paris) and Uppsala.

KVI is setting up a research master programme *Atomic and SubAtomic Physics* together with the Department of Theoretical Physics of the University of Groningen and the University of Uppsala.

KVI together with the Astronomy department of the University of Groningen is setting up a joint European master programme *Advanced Instrumentation and Informatics in Astronomy and Physics*, for which an application will be submitted in the Erasmus Mundus programme. Anticipated partner universities are the universities of Leuven, Paris-Sud, Uppsala, Bonn/Bochum/Köln (through FZ Jülich) and Krakow.

Future Plans:

Presently, the TRIμP facility is being set up. With this facility, high-precision measurements will be performed to investigate physics beyond the Standard Model. The TRIμP magnetic dual separator has been installed and was successfully tested during the summer of 2004. Concurrently, a laser laboratory is being set up. In the coming years high-intensity beams will be developed with AGOR, in particular for the TRIμP programme.

SNOLAB

Sudbury, Canada

P.O Box 146
Lively, ON
P3Y 1M3 Canada

Telephone: (705) 692 7000
Facsimile: (705) 692 7001
E-mail: david_sinclair@carleton.ca

University Institute

Construction – Canada Foundation for Innovation, Province of Ontario
Operation – Under discussion

Dr. A. Noble, Director, SNOI

Head of the facility:

Dr. D. Sinclair, Director, SNOLAB

Scientific Mission and Research Programs:

SNOLAB is an International Facility for Underground Science. Its primary focus is those areas of nuclear and particle astrophysics that can be addressed using a very deep laboratory. Specific areas include solar neutrinos, supernova neutrinos, neutrino-less double beta decay, dark matter searches. Other areas of science that can take advantage of this unique site are being explored.

Technical facilities::

The underground facilities are located at the 6800 foot level of the Creighton Mine and will include the present SNO cavern.

The surface building provides clean room space, change facilities, meeting rooms and office space for the underground experiments.

Table of facility parameters:

The main facility is clean, serviced space at 6000 metres water equivalent and the infrastructure to develop experiments at this space.

Program Advisory Committee/experiment proposals:

Yes

Number of active users and their origin:

The facility is under construction. The figures in the following sections apply to SNO. Several additional international groups are interested in SNOLAB but it is too early to define numbers and percentages.

Currently about 150 people use the SNO facility (includes faculty, RA's, students and engineers)

Percentage of users, and percentage of facility use that come from inside the institution:

Almost all users are from outside

Percentage of users and percentage of facility use from national users:

About 50% of the users are from Canada

Percentage of users and percentage of facility use from outside the country where your facility is located:

About 50% of the users are from outside Canada

Fraction of the international users outside of geographical region:

90% of users are from North America

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

There are no theoreticians employed at the facility.

Number of non-resident graduate students with thesis work primarily done at the facility:

~25

Involvement of undergraduate students in research (approximate average number at a given time):

~10

TRIUMF (TRI UNIVERSITY MESON FACILITY), CANADA

Vancouver, Canada

TRIUMF
4004 Wesbrook Mall
Vancouver, BC
V6T 2A3, Canada

Telephone: 604 222 1047
Facsimile: 604 222 3791
E-mail: sciencediv@triumf.ca

Joint Venture of Canadian Universities
Currently 6 full members and 7 associate members

Funded by the Canadian Federal Government under a contribution administered by the National Research Council of Canada (NRC). Buildings provided by the province of British Columbia
Federal Government contribution
Experimental program by the relevant Science Research Councils (Peer reviewed) (Natural Science and Engineering Council, Canadian Institute for Health Research, etc)

Dr. F. Hamdullahpur, Chairman of the TRIUMF Board of Management

Head of the facility:

Dr. N. Lockyer, Director

Scientific Mission and Research Programs:

The Scientific mission of the laboratory is defined by the statement of works attached to the Five Year Contribution agreement with NRC as follows:

-Maintain a national facility for sub-atomic physics and provide support for an on-going experimental program at TRIUMF, including auxiliary programs in materials science, life sciences and medical therapy.

-Construct and operate an expanded radioactive beam facility (ISAC-II)

-Act as Canada's main connection to CERN, supplying contributions to the LHC accelerator and the ATLAS experiment.

-Provide infrastructure support to the whole of the Canadian sub-atomic program in collaboration with NSERC

-Maximize the economic benefits of the Federal Government's investment in TRIUMF to Canadian companies.

Characterization of the facility:

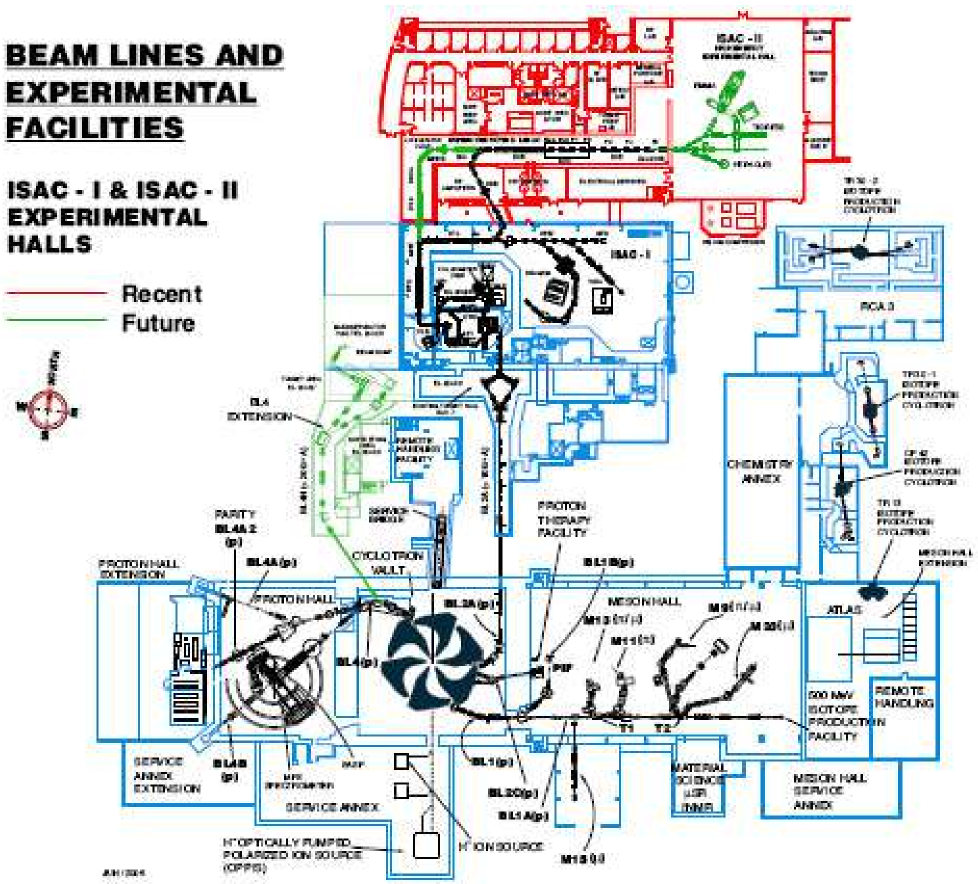
-Intermediate energy proton(H-) Cyclotron (500MeV), 4 independent extracted beams: 150 µamps,100 µamps,60 µamps and 10 µamps.

-RFQ linac, Drift Tube Linac for Radioactive beams up to 1.8 MeVu (ISAC-I)

-Superconducting Drift Tube Linac for RIB to 6 MeV/u (ISAC-II)

-4 Low energy H- cyclotrons: two high intensity machines(1 to 2 milliamp)30 MeV and two 50µamp at 42 MeV and 13MeV dedicated to isotope production for life sciences and medical applications

Technical facilities:



Facility Parameters:

Proton: 60-100MeV and 200 -500MeV 150 µamp

Pion: up to 300 MeV/c 10**7/sec

Muon: up to 150MeV/c 10**7/sec

Radioactive beams from ISOL facility ISAC: up to 6.0 MeV/u, mainly A<150, up to 10**8/sec (isotope dependant)

Major experimental instrumentation and its capabilities:

at ISAC:

8π: 25 Compton suppressed Germanium Detectors, plastic and thin silicon detector arrays.

TIGRESS (under construction): a 12 Large volume segmented Germanium Clover detector array.

DRAGON: low energy recoil spectrometer and windowless gas target for radiative capture reactions.

TUDA: Segmented silicon detector array for low energy reaction studies

Polarizer: polarized low energy ion beams (currently 8Li,11Li, Na)

TRINAT: Neutral atom trap.

TITAN: Penning trap for mass measurement (under construction)

EMMA: Electromagnetic recoil spectrometer for ISAC II (planned)

b) TWIST: High resolution low mass spectrometer for muon decay studies.

RMC: large acceptance pair spectrometer for muon and pion radiative studies

c) µSR spectrometers

d) Large Clean rooms for detector development and construction

Nature of user facility:

YES, by the funding agency.

Program Advisory Committee/ experiment proposals:

Yes in fact three: Sub-atomic Physics, Molecular and Materials Sciences, Life Sciences

The first two meet twice a year, the last one once a year.

Number of actual, active users of the facility in a given year:

603 users used the TRIUMF facilities in the last five years. (repeat customers counted only once)

Percentage of users, and percentage of facility use that come from inside the institution:

40 internal scientists have programs relying on TRIUMF (7%) using all facilities as collaborators for external users.

Percentage of users and percentage of facility use from national users:

33% users, 80% use of facilities

Percentage of users and percentage of facility use from outside the country where your facility is located:

66% users with only 20% not relying on local collaborators.

Fraction of the international users is from outside your geographical region:

Out of 603 Users

Asia: 97, Aus- New Zel: 2, North-America: 357, South –America:5 Africa:0, Europe: 120

Russia: 22

User Group:

The TRIUMF User group has 328 registered participants.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

384

101

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

4 permanent (+1 new position being searched for) 7 postdoctoral and R.A fellows (2 year term) 2 students

Number of postdoctoral researchers:

41

Number of graduate students resident at the facility:

29

Number of non-resident graduate students with thesis work primarily done at the facility:

21

Involvement of undergraduate students in research (approximate average number per year):

60 per year

Special student programs:

Summer research awards,

Coop term,

Summer Nuclear Institute: (40 students each summer)

Lake Louise Institute (Particle Physics)

Future Plans:

ISAC-II completion to 6.5 MeV/u

New ISAC production beamline for target development at 100μamp and second independent RIB source

ISAC Detectors: TITAN, TIGRESS, EMMA (see above)

Tier -1 computing centre for ATLAS physics at LHC

Detector contributions: T2K (Japan), Kopio(BNL)

0.7 MV VAN DE GRAAFF ACCELERATOR
INSTITUTO DE FÍSICA, UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO

Mexico City. Mexico

Instituto de Física, UNAM.
Circuito de la Investigación Científica s/n
Ciudad Universitaria
Coyoacán, México DF
C.P. 04510
México

Telephone: 00 52 55 56225029 / 52 55 56225005
Facsimile: 00 52 55 56225009 / 52 55 56161535
E-mail: luisrf@fisica.unam.mx
E-mail: miranda@ fisica.unam.mx

Research Laboratory at the Physics Institute of the National University of Mexico

University grant
University and/or Federal Grants by short term research projects
Budget from the institute

Dr. Arturo Menchaca Rocha, Director
Instituto de Física, UNAM

Heads of the facility:

Dr. Luis Rodríguez Fernández
Dr. Javier Miranda Martín del Campo

Scientific Mission and Research Programs:

The main activity of the laboratory is research focused on three subjects:

i) Fundamental physics on phenomena related to interaction of low energy ion beams with matter.

ii) Low energy Ion beam analysis of materials using: Rutherford Backscattering Spectrometry, RBS, Nuclear Reaction Analysis, NRA, and Particle induced X-Ray Emission, PIXE.

iii) Ion irradiation of materials.

iv) Teaching modern physics.

Technical facility:

The main instrument of the laboratory is a High Voltage Inc. 0.7 MV Van de Graaff Accelerator model AN700 with three fully operational ion beam lines each with an analysis vacuum chamber. It is possible to produce H^+, He^+, N^+, Ar^+ ions by a RF ion source located in the high voltage terminal.

Characterization of the facility:

Low energy ion accelerator for material analysis and atomic physics.

Facility parameters:

Beam species	Maximum Intensities	Range of energies
H^+	2 µA	100-700 keV
He^+	500 nA	100-700 keV
N^+	500 nA	100-700 keV
Ne^+	500 nA	100-700 keV
O^+	500 nA	100-700 keV
Ar^+	1 µA	100-700 keV

Major experimental instrumentation and its capabilities:

Three vacuum chambers for RBS, NRA and PIXE analysis.

User facility:

Scientifics and research people from other institutes of the UNAM or other universities of the country may use the facility if they are associated with a member of the staff of the facility, mainly by a research project approved by the scientific committee of the laboratory. They may be considered also as external users when they have access to the laboratory by an external service, by short term contracts for a specific use (analysis or irradiation). Non-university institutions and industry are always considered as external users.

Program Advisory Committee/ experiment proposals:

The facility has a scientific committee which determines the feasibility of a research project in this laboratory. Any experimental proposal has to be sent to Dr. Luis Rodriguez Fernández or Dr. Javier Miranda.

Number of actual, active users of the facility in a given year:

During the last three years the facility has got 10 research scientists as regular users.

Percentage of users:

Users from the same institution: 85%
Users from other institutes and Mexican universities: 15%
Users from other countries: 0%

Formal groups in the facility:

There is one: the group GAMMAI (Group of Analysis and Modification of Materials by Ion Beams) is in charge of the management of the Van de Graaff Accelerator Laboratory. That group is composed by 8 research scientists and 4 technicians.

Permanent staff:

4 research scientists
2 technicians

Temporary staff:

4 undergraduate students
2 graduated students

Theoretical Staff employed at the facility:

No theoretical staff is employed at the facility.
Number of postdoctoral researchers:
None

Number of graduate students resident at the facility:

None

Number of non-resident graduate students with thesis work primarily done at the facility:

None

Involvement of undergraduate students in research:

4 undergraduate averaged during the last two years.

Special student programs:

Open laboratory days (One full day for university students, one for high school and secondary students). Guided visits for students (around 15 per year).

5.5 MV ACCELERATOR, INSTITUTO DE FISICA, UNAM

North America, Mexico, South of Mexico City, Main University Campus of UNAM

5.5 Accelerator
Instituto de Fisica, UNAM
Circuito de la Investigación Científica s/n
Ciudad Universitaria
Mexico DF 04510
Mexico

Laboratory of Pelletron Accelerator
Instituto de Fisica, UNAM
Apdo. postal 20-364
Mexico DF 01000
Mexico

Telephone: 00 52 55 56225043 / 56225055
Facsimile: 00 52 55 56225009 /56225046
E-mail: sil@fisica.unam.mx
E-mail: andrade@ fisica.unam.mx

Research laboratory of an institute of the national university

Mainly three sources of funding:
i) Federal grants for research projects (CONACyT-Mexico)
ii) University grants for short term research projects (UNAM)
iii) Budget from the institute.

Dr. Arturo Menchaca Rocha, Director
Instituto de Fisica, UNAM

Head of the facility:

Dr. Eduardo Andrade

Scientific Mission and Research Programs:

Scientific mission and main current and future research programs of the facility:

Interdisciplinary research projects mainly in material science that requires material analysis, the most important: Ion Beam. Analysis techniques have been established in this accelerator.

Technical facilities:

Van de Graaff 5.5 MeV accelerator for positive ions. Description in E. Andrade et al. NIM B A287(1990)135.

Characterization of the facility:

Single ended Van de Graaff electrostatic. The accelerator ion source is RF.

Facility Parameters

Beams H1, H2, He3, and He4, energy beam 1 to 5.5 MeV.

Facility major experimental instrumentation and capabilities:

Surface barrier detectors and associated nuclear electronics; also Si(Li) X'ray detector

User facility:

Yes

Program Advisory Committee/ experiment proposals:

Yes

Number of users:

10 users, mainly from the materials science related, to produce thin films using plasma methods

Percentage of users and percentage of the facility use (last year):

20% inside.

Percentage of users and percentage of the facility use from national users (average last years):

60% outside

Percentage of users and percentage of the facility use from foreign users (average last two years):

20% outside

Percentage of international users from outside of the geographical region (average last two years):

10% euope, 10% USA.

Formal groups in the facility:

None

Permanent and temporary staff:

Permanent staff: 2

Temporary staff: 4 PhD students.

15 under-graduated students.

Theoretical staff:

No theoretical staff

Number of postdoctoral researches:

None

Number of graduated students resident at the facility

None

Number of non-resident graduate students with thesis work primarily done at the facility:

None

Involvement of the undergraduate student in research:

1 student

Special students programs:

This facility is used for teaching, basic experiments in nuclear physics by students from Science Faculty from National University.

Describe the future developments at the facility:

We will replace the 90 degrees analyzing magnet.

LABORATORY OF PELLETRON ACCELERATOR, INSTITUTO DE FISICA, UNAM

North America, Mexico, South of Mexico City
Main University Campus of UNAM

Laboratory of Pelletron Accelerator
Instituto de Fisica, UNAM
Circuito de la Investigación Científica s/n
Ciudad Universitaria
Mexico DF 04510
Mexico

Laboratory of Pelletron Accelerator
Instituto de Fisica, UNAM
Apdo. postal 20-364
Mexico DF 01000
Mexico

Telephone: 00 52 55 56225043 / 56225005
Facsimile: 00 52 55 56225009 /56161535
E-mail: sil@fisica.unam.mx
E-mail: karim@ fisica.unam.mx

Research laboratory of an institute of the national university

Three main sources of funding:
i) Federal grants for research projects (CONACyT-Mexico).
ii) University grants for short term research projects (UNAM).
iii) Budget from the institute.

Dr. Arturo Menchaca Rocha, Director
Instituto de Fisica, UNAM

Head of the facility:

Dr. José Luis Ruvalcaba Sil

Scientific Mission and Research Programs:

The Pelletron laboratory is one of the most important laboratories of the National University of Mexico (UNAM), Mexico and of the Latin American countries. The main activity of the laboratory is research focused on three subjects:

i) Fundamental physics on phenomena related to interaction between ion beams and matter.

ii) Ion beam analysis of materials and its applications.

iii) Ion beam modifications of materials.

There is no other laboratory in Mexico with these three features. The research topics are determined and described in detail in the development program of the institute (IFUNAM, http://www.fisica.unam.mx/plan2003.pdf). The main research topics are:

1. Nuclear Reactions in Astrophysics
2. Thermoluminiscence properties of irradiated materials.

3. Atomic and molecular physics.
4. Development of analytical methods based on ion beam accelerators
5. Interdisciplinary applications of ion beam analysis (materials science, archaeology and arts, geology and soils, food, odontological materials, biomaterials, etc.).
6. Pollution and environmental studies.
7. Biological and medical tissues studies by ion beam analysis
8. Applications of ion beam dosimetry.
9. New materials and modification of surface properties by ion beam implantation and ion beam mixing.

Future research projects must fit the research frame of the institute. The revision of the program of research is carried out every three years or less, if necessary.

Under the actual research program it is considered the development of the following devices in the next future to complete and improve the researches.

a) A microbeam facility for materials characterization (biological, medical, nanomaterials, national heritage).

b) A WDX spectrometer for the study of ionization processes and X-ray emission by heavy ions and for analytical purposes.

Technical facilities:

The main instrument of the laboratory is a 3 MV Tandem Pelletron Accelerator with four fully operational ion beam lines. It is possible to produce ions from H to Au or even heavier (except noble gas from Ar). The maximum energy of the beam depends on ion charge and ion production cross sections. Two kinds of ion sources are available: A ion sputtering source for solids (SNICS) and a plasma radiofrequency (RF) source for gases (Alphatross).

One beam line is used mainly for measurements of astrophysical reactions and light isotopes separation while two beam lines may be used for ion beam analysis in vacuum or for non-vacuum measurements by an external beam set-up at the air atmosphere. The main analytical techniques are PIXE, RBS (including channeling) and PIGE but ERDA, PESA, XRF and NRA may also be carried out. Finally, one line is used for ion beam implantation and the modification of the surface properties of materials. Measurements on basics processes of interaction of heavy and light ion beams with materials may be done on most of the ion beam lines (e.g. ionization cross sections by heavy ions).

Low, medium and high vacuum equipment, high performance electronics devices, detectors of radiation (X-rays, Gamma rays, particles, UV and visible light), computers for the accelerator control and data acquisition are associated with the accelerator and represent a valuable part of the laboratory.

Characterization of the facility:

Low-Medium Energy Tandem Pelletron Accelerator (3 MV) for ion beam analysis and ion beam implantation.

Facility Parameters

The parameter for the most used ions:

* Intensity depends on ion charge.

Beam species	Ion source	Ion charges	Intensities*	Range of energies	Remarks
H	SNICS	1^+	1nA-1mA	1-6 MeV	No radioactive beams are used; it is not allowed to produce neutrons and deuterons by nuclear reactions.
He	Alphatross	1^+, 2^+	1nA-300 nA	1-12 MeV	
C, Si	SNICS	2^+, 3^+, 4^+	1nA-5mA	1-18 MeV	
N, O	SNICS	2^+, 3^+	1nA-500 nA	1-12 MeV	
Cu, Au	SNICS	2^+, 3^+, 4^+	1nA-3mA	1-18 MeV	
Ag	SNICS	2^+, 3^+	1nA-0.5mA	1-18 MeV	

Facility major experimental instrumentation and capabilities:

3 MV Tandem Pelletron Accelerator, Instituto de Fisica, UNAM, Mexico							
	Main Purpose	Fully Oper.	Most used ion beams	Remarks	Type and number of detectors	Most used methods of analysis	Main topics of research
Beam lines	Ion beam interaction's phenomena	3*	H, He, C, N, O, F				Ionizations, Scattering and nuclear reactions cross sections, mainly
	Ion beam analysis	2	H, He, C, Si	+ one external beam	X-rays (4) Gamma-rays (2), Particles (8)	PIXE, RBS, RBS-channeling PIGE, PESA, ERDA.	Atmospheric pollution, odontological and biological studies, food analysis, national heritage studies (Archaeology and arts), soils and geology samples.
	Ion beam implantation	1	H, He, Si, C, Ti, Cu, Ag, Au	Max. area of irradiation: 10x10 cm			Nanomaterials, New surface properties (metals, polymers, semiconductors, biomaterials).

* Fundamental physics measurements are carried out also in the analytical beam lines

User facility:

Since the use of the laboratory require a high degree of specialization on ion beam accelerators, radiation production and management and its detection, the research staff of the Experimental Physics Department of the Instituto de Fisica represents the main official user of the facility. All the experiments are approved or rejected by a scientific committee who determine the research feasibility and if the experiments keep under the radiological security regulations for this laboratory.

Scientifics and research people from other institutes of the UNAM or other universities of the country may use the facility if they are associated to a member of the staff of the facility, mainly by a research project approved by the scientific committee of the laboratory. They may be considered also as external users when they have access to the laboratory by an external service, by short terms contracts for a specific use (analysis or irradiation). Non-university institutions and industry are always considered as external users.

Program Advisory Committee/ experiment proposals:

The facility has a scientific committee who determine the feasibility of a research and if the experiments accomplish the radiological security regulations for this laboratory. The research topics and scientific applications are mainly determined by the frame-program of development and research of the institute.

Number of users:

Regular users from the research departments of the institute per month (average of the last three years): 14 research scientists.

Percentage of users and percentage of the facility use (last year): Institute regular users:

85%. Facility use:

85% Users from other institutes and universities: 10%. Facility use: 10% External users: 5%. Facility use: 5%

Percentage of users and percentage of the facility use from national users:

Institute regular users: 85%. Facility use: 85% Users from other national institutes and universities: 15%. Facility use: 15%

Percentage of users and percentage of the facility use from foreign users:

National users: 98%. Facility use: 95% Foreign users: 2%. Facility use: 5%

Percentage of international users from outside of the geographical region:

One. The group GAMMAI (Group of Analysis and Modification of Materials by Ion Beams) is in charge of the management of the Pelletron accelerator laboratory. It is composed by 8 research scientists and 4 technicians.

Permanent and temporary staff:

Permanent staff: 5 research scientists. 2 technicians. Temporary staff: 4 PhD students. 15 under-graduated students.

Theoretical staff:

No theoretical staff is employed at the facility but some theoretical groups have a close collaboration with the scientists of this facility.

Number of postdoctoral researches:

None during the last year.

Number of graduated students resident at the facility:

6 students (average last two years).

Number of non-resident graduate students with thesis work primarily done at the facility:

12 students (average last two years).

Involvement of the undergraduate student in research:

15 students (average last two years). Four or five students may participate in one experiment at the same time in the laboratory for some topics of research.

Special students programs:

Summer programs (between one and two months) organized by the Mexican Academy of Science and the UNAM program of science for young students (high school and university).

Open laboratory days (One full day for university students, one for high school and secondary students).

Guided visits for students (around 15 per year).

Future plans:

Under the actual research program it is considered the development of the following developments in the next future:

a) A micro-beam facility for materials characterization (biological and medical tissues, studies on nanomaterials, samples related to national heritage). The expected spatial resolution of the experimental set-up is 1µm.

b) A WDX spectrometer for the study of ionization processes and X-ray emission by heavy ions and for analytical purposes.

c) A new chamber for ion beam implantation. The main new features of this device concern to in situ characterization and the control of the sample temperature.

7 MV ACCELERATOR, UNIVERSITY OF KENTUCKY

North America

Chemistry-Physics Building
University of Kentucky
Lexington, KY USA

Department of Physics & Astronomy
University of Kentucky
Lexington, KY 40506-0055
USA

Telephone: (859) 257-7085
(859) 257-3403
(859) 257-8624
Facsimile: (859) 323-2846
E-mails: marcus@uky.edu or yates@uky.edu

Construction: Commonwealth of Kentucky
Operation: University of Kentucky
Nuclear Resarch Program: National Science Foundation
(Sponsored by the U. S. National Science Foundation)

Prof. Joseph W. Brill, Chair
Department of Physics and Astronomy

Heads of the facility:

Prof. Joseph W. Brill
Prof. Steven W. Yates

Scientific Mission and Research Programs:

The main mission is to carry out basic research in nuclear sciences, with a special emphasis on neutron-induced reactions.

An associated mission is graduate education for candidates for MS and PhD degrees in physics and chemistry.

A secondary mission has been applications of nuclear research to diagnosis of explosives and narcotics in airplane luggage, and other non-destructive assays of materials using neutrons.

Current research: is focused primarily on nuclear structure of complex nuclei, and also isospin symmetry tests in even-A nuclei. Some work on topics in nuclear astrophysics is also ongoing.

Future research: will probably focus more strongly on fundamental symmetries and nuclear astrophysics, but a strong emphasis on nuclear structure will continue.

Technical facilities:

please see: http://www.pa.uky.edu/~marcus/nukes.html and associated links.

Characterization of the facility:

This is a single-ended electrostatic accelerator in a cylinder tower near the Chemistry-Physics

Building. Only light ions are accelerated, mostly with nanosecond pulsed beams.

Pulse width: protons – 0.8 ns; deuterons – 1.3 ns; He ions – same as deuterons.

Subnanosecond pulsing is available through post-acceleration bunching.

Facility Parameters:

Accelerated: protons – 0.4 MeV to 7.0 MeV
deuterons – 0.4 MeV to 7.0 MeV

3He+ ions – 1 MeV to 7.0 MeV
3He++ ions – 6 MeV to 12 MeV

All beams can be nanosecond pulsed beams or continuous beams.
Nanosecond-pulsed beams have average intensities of 1 – 3 microamps.
Continuous beams can be up to 30 microamps.

Major experimental instrumentation and its capabilities:

Shielded Neutron and Gamma-ray detectors for neutron scattering or neutron-producing reactions, such as (d,n) or (He,n).
A four HPGe detector array and collimated neutron fluences are used for gamma-ray coincidence experiments (KEGS) in neutron-induced reactions.

Nature of user facility:

Unofficially many groups come to collaborate with us on experiments each year, because of our special capabilities in neutron-induced and neutron-producing reaction studies.

Program Advisory Committee/Experiment Proposals:

Very unofficial arrangements are made to accommodate users, by contacting Prof. Steven W. Yates.

Number of actual, active users of the facility in a given year:

Over the last few years, research teams carrying out experiments of their own design:

University of Cologne, a couple of collaborators.

University of Dallas, Prof. S. F. Hicks and one or two undergraduate students

U. S. Naval Academy, Prof. J. Vanhoy and undergraduate students

University of Guelph and Lawrence Livermore National Nuclear Lab., Prof. P. E. Garrett

Georgia Institute of Technology, Prof. J. L. Wood and Dr. David Kulp, research associate

Institute of Isotopes, Budapest, Hungary, Prof. Jesse L. Weil (emeritus)

Percentage of users, and percentage of facility use that come from inside the institution:

Inside users: 80% outside U. S. 5%

Percentage of users and percentage of facility use from national users:

national users (including Canada) 15%;

Percentage of users and percentage of facility use from outside the country where your facility is located:

5% outside the U. S.

Fraction of the international users outside geographical region:

All from Europe (and Canada)

User Group:

No formal users group.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) Two senior professors full time, equivalent of one faculty member from intermediate energy nuclear groups.
b) About 1.5 postdoctoral fellows, 3 to 4 graduate Phd candidates.

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

Three nuclear theorists in the Physics Department, one experienced in low energy phenomena; the others are intermediate energy theorists.

Number of postdoctoral researchers:

no postdoctoral fellows in nuclear theory.

Number of graduate students resident at the facility:

three to four graduate students

3

Number of non-resident graduate students with thesis work primarily done at the facility:

All thesis and dissertation students become resident at the facility.

Involvement of undergraduate students in research (approximate average number per year):

typically one student, plus those outside collaborators bring with them.

Special student programs:

none

Future Plans:

No expansion plans; last major upgrade was in 1989-90.

88-INCH CYCLOTRON AT LAWRENCE BERKELEY NATIONAL LABORATORY

Berkeley, CA USA

MS88R0192, LBNL
1 Cyclotron Rd
Berkeley, CA 94720

Telephone: (510)-486-5088
Facsimile: (510)-486-7983
E-mail: p_mcmahan@lbl.gov (Research Coordinator)

Department of Energy Office of Science for Nuclear Physics and National Reconnaissance Office
Operating funds: 60% DOE, 20% USAF-SMC, 20% National Reconnaissance Office

Dr. Steven Chu

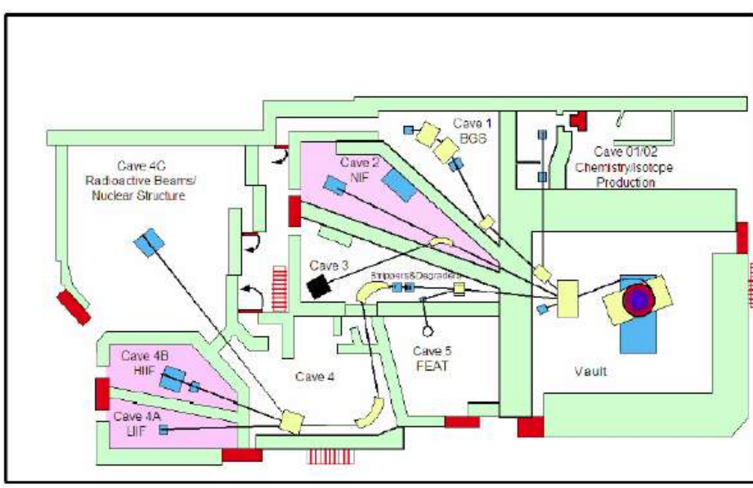
Head of the facility:

Dr. Claude Lyneis

Scientific Mission and Research Programs:

The 88-Inch Cyclotron, which is operated by the Nuclear Science Division at LBNL, is the home of the Berkeley Accelerator Space Effects (BASE) facility and supports a local research program in nuclear science. The National Security Space (NSS) community and researchers from other government, university, commercial and international institutions use the BASE facility to understand the effect of radiation on microelectronics, optics and materials for spacecraft. Research programs in nuclear structure and astrophysics, fundamental interactions and symmetries, technology research and development and radiation biology by local LBNL and UC Berkeley scientists and students are supported. Major instrumentation under development at the Cyclotron includes GRETINA, the next generation Gamma Ray Energy Tracking Array, and VENUS, a 3rd generation superconducting ECR ion source which is the prototype for the Rare Isotype Beam Facility driver ion source.

Technical facilities:



Characterization of the facility:

The 88-Inch Cyclotron accelerates both light and heavy ions to medium energies.

Facility Parameters:

Ion	Energy range (AMeV)	Max intensity (nA)	Primary uses
protons	1-55	20000	BASE, nuclear science
Deuterons	1-32.5	20000	Neutron production, nuclear science
^{3}He	1-45	20000	Nuclear science
^{4}He	1-32.5	20000	Nuclear science, isotope production, BASE
Medium Ions (A=7=40)	1-32.5 for q/A=1/2	10000	Nuclear science, radiation biology
Heavy Ions (A=40-180)	Maximum energy depends on q/A (> Coulomb barrier)	3000	Nuclear science
Heavy Ion	4.5 (A=8-209), 10(A=8-	100	BASE
cocktails	136), 16 (A=8-86) AMeV cocktails		

Major experimental instrumentation and its capabilities:

Instrument	Use/capability
Berkeley Gas-Filled Separator (BGS) + Recoil Transfer Chamber (for chemistry the heaviest elements)	A He-filled separator which has high efficiency for normal kinematic expts for heavy element physics and chemistry
Livermore/Berkeley Array for CollaborativeExperiments (LIBERACE)	A particle/gamma detector array consisting of DSSD particle detectors and six Ge clovers for gammas for nuclear structure and transfer reactions with light ions
Facility for Exotic Atom Trapping (FEAT)	A magneto-optical trap for neutron radioactive atoms; for beta-neutrino correlation studies of the weak interaction

Nature of user facility:

The Cyclotron is supported to run a local program in nuclear science and a national program for radiation effects testing using the BASE facility. (Status was changed from a DOE National User Facility for Nuclear Science in FY04).

Program Advisory Committee/experiment proposals:

No.

Number of actual, active users of the facility in a given year:

147 (FY04 numbers, since it was the first year of our new mode of operation)

Percentage of users, and percentage of facility use that come from inside the institution:

29% of users; 40% of facility use (FY04 numbers)

Percentage of users and percentage of facility use from national users:

66% of users; 58.5% of facility use (FY04 numbers)

Percentage of users and percentage of facility use from outside the country where your facility is located:

5% of users; 1.5% of facility use (FY04 numbers)

Fraction of international users outside of geographical region

100%

User Group:

No

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

35 permanent

22 temporary

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

0

Number of postdoctoral researchers:

9

Number of graduate students resident at the facility:

8

Number of non-resident graduate students with thesis work primarily done at the facility:

1

Involvement of undergraduate students in research (approximate average number per year):

6 during school year; 9 during summer

Special student programs:

1) We provide research experiences to undergraduate students

a. through DOE programs such as SULI and CCI,

b. the NSF FAST program

c. we are collaborating with the UCB Physics Department on ways to get their undergraduates more hands-on research experience

2) We provide research experiences to high school students through the LBNL summer high school program

3) We are organizing and hosting the Rare Isotype Beam Facility Summer School (graduate and early postdoctoral) in 2005 (rotates between four facilities)

Future Plans:

1) The VENUS ion source will be coupled to the Cyclotron, providing higher energies and intensities of heavy ion beams

2) A neutron beam line is under development which will provide quasi-monoenergetic and white spectrum neutrons up to 30 MeV

ATLAS (THE ARGONNE TANDEM LINAC ACCELERATOR SYSTEM) ARGONNE NATIONAL LABORATORY (ANL)

Darien, Illinois (Chicago Metropolitan Area)

Physics Division,
Argonne National Laboratory
9700 S. Cass Ave.
Building 203
Argonne, Illinois 60439

Telephone: 630-252-4004
Fascimile: 630-252-3903
Email: Geesaman@anl.gov

Department of Energy Office of Science for Nuclear Physics

Department of Energy Office of Nuclear Physics SC-26
Dr. Robert Rosner, Director, Argonne National laboratory

Heads of the facility:

Dr. Donald F. Geesaman, Director, Physics Division
Dr. Jerry A. Nolen Jr., Director, ATLAS
Dr. Robert V. F. Janssens, Scientific Director, ATLAS

Scientific Mission and Research Programs:

The mission for the ATLAS facility at Argonne is to enable research of the highest quality by its users and staff, especially probing the properties of atomic nuclei, through utilizing the capabilities of the accelerator and research equipment in a safe and efficient manner, with the associated responsibility of research and development in accelerator science and in the techniques that are required to accomplish its scientific goals.

The major scientific goals of the ATLAS research program are: (a) understanding of the stability and structure of nuclei as many-body systems built of protons and neutrons bound by the strong force, (b) exploring the origin of the chemical elements and their role in shaping the reactions that occur in the cataclysmic events of the cosmos, (c) understanding of the dynamics governing interactions between nuclei at energies in the vicinity of the Coulomb barrier, and (d) testing with high accuracy the fundamental symmetries of nature by taking advantage of nuclei with specific properties.

To reach these goals, major research topics included:

(1) The development of beams of short-lived isotopes and their subsequent use for measurements of astrophysics interest and for nuclear structure and reaction studies;

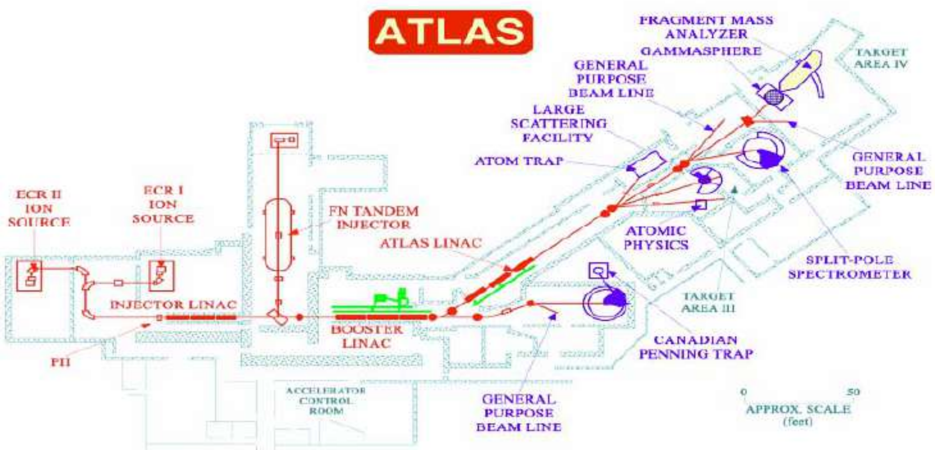
(2) The production and characterization of nuclear structure away from the valley of stability including nuclei at the very limits of stability, i.e., nuclei at and beyond the proton drip-line, on the neutron-rich side of the valley of stability, and in the region with $Z > 100$;

(3) The study of the nature of nuclear excitations as a function of mass, proton or neutron excess, spin and temperature; with emphasis on characteristics such as nuclear shapes, the interplay between degrees of freedom, changes in shell structure;

(4) The use of traps for high precision mass measurements for astrophysics and for searches of physics beyond the standard description of the weak interaction.

Smaller scale, complementary efforts exploit the exceptional and often unique capabilities of ATLAS: for example, the irradiation of samples for materials research, developing accelerator mass spectrometry techniques for applications in environmental studies, oceanography, astrophysics, fundamental interactions, and any other area of basic science where they apply, and accelerator research experiments.

Technical facilities:



Characterization of the facility:

Superconducting Heavy-ion Linac

Facility Parameters:

Stable Beams Provided by ATLAS (through 2004)

Ion	Maximum Beam Current Provided (pnA)	Max. Energy Possible (MeV)
p	20	18
3He	2	54
4He	0.1	72
6Li	17	94
7Li	200	110
10B	130	175
12C	1000	200
14N	1000	225
16O	1000	265
17O	300	281
18O	94	298
19F	50	300
20Ne	1000	320
21Ne	2.5	320
22Ne	30	320
24Mg	10	390
26Mg	2	390
28Si	1000	430
29Si	6	430
32S	1000	470
34S	3	470
35Cl	35	480
36Ar	5	490
40Ar	1000	540
40Ca	1000	540
48Ca	120	540
46Ti	3	520
48Ti	100	540
51V	2	570
50Cr	40	600
54Fe	50	680
59Co	50	680
58Ni	100	680
60Ni	21	680
64Zn	2	680
74Ge	10	760
76Ge	20	780
80Se	10	760
79Br	10	875

78Kr	12	875
82Kr	3	875
84Kr	200	875
86Kr	400	875
84Sr	5	875
90Zr	5	875
98Mo	7	975
124Sn	2	1300
124Xe	2.5	1300
128Xe	26	1300
129Xe	7	1300
132Xe	4	1300
136Xe	1	1300
133Cs	50	1300
152Sm	1	1420
197Au	50	1750
207Pb	1	1800
208Pb	100	1800
209Bi	50	1800
238U	20	1925

Remarks:

1. The table lists typical stable beams that have been used in experiments at ATLAS over the last five years. The beam intensities indicated are those used in the actual experiments. The maximum energy (assuming intensities ≥ 1 pnA) are given in the third column.

2. Intensities for ions lighter than ^{12}C are restricted by administrative constraints based on radiation safety considerations.

3. When needed, isotopically enriched material is used at no direct cost to the user. The consumption rate varies with the element. For ^{48}Ca, for example, for a beam of 15 pnA on target (typical in the ^{254}No experiments) the consumption rate is typically 0.05 mg/h.

Maximum Currents Available at ATLAS

Type of Material	I pnA	Examples
Gases	2000 – 3000	Ne, Ar, Kr, Xe, O, N, …
Non-refractory Metals and Non-metals Tboil< 1500ºC	50 – 200 some up to 1500	Si, S, Ni, Fe, Ce, Ca, U…
Refractory Metals Tboil > 1500ºC	15-50	Mo, Ti, Zr, V, Pt, Ir …
Low Boiling Point Heavy Metals	300	Au, Pb, Bi, …

ATLAS: Exotic Beam Production - Yields

Beams produced using the "In-flight" method.
Beams produced using the "Two-accelerator" or "Batch" method.
Allowed maximum radiation may limit beam current.

Ion	Half-Life	Reaction	Intensity (ions/sec/pnA)	Opening Angle (degrees)	Production Energy (MeV)	Max. Rate (ions/sec)
$^{6}He^{a,c}$	0.807 sec	d(^{7}Li,^{6}He)^{3}He	150	19	75	1×10^{4}
$^{8}Li^{a,c}$	0.838 sec	d(^{7}Li,^{8}Li)p	2000	11	71	1.5×10^{5}
$^{8}B^{a,c}$	0.770 sec	^{3}He(^{6}Li,^{8}B)n	10	13	27	
$^{11}C^{a,c}$	20.385 min	p(^{11}B,^{11}C)n	2300	4.5	105	2×10^{5}
$^{14}O^{a}$	70.606 sec	p(^{14}N,^{14}O)n	1200	2.9	170	
$^{16}N^{a}$	7.13 sec	d(^{15}N,^{16}N)p	30000	5.4	70	3×10^{6}
$^{17}F^{a}$	64.49 sec	d(^{16}O,^{17}F)n p(^{17}O,^{17}F)n	20000 20000	4.5 1.7	~90	2×10^{6}
$^{20}Na^{a}$	0.448 sec	^{3}He(^{19}F,^{20}Na)2n	~1		148	
$^{21}Na^{a}$	22.48 sec	d(^{20}Ne,^{21}Na)n p(^{21}Ne,^{21}Ne)n	4000 8000	4.0 2.6	113	2×10^{6}
$^{25}Al^{a}$	7.183 sec	d(^{24}Mg,^{25}Al)n p(^{25}Mg,^{25}Al)n	1000 2000	3.7 2.2	204 180	4×10^{5}
$^{37}K^{a}$	1.226 sec	d(^{36}Ar,^{37}K)n	1200	2.2	280	1×10^{5}
$^{18}F^{b}$	109.77 min	Two-accel.				6×10^{6}
$^{44}Ti^{b}$	59 yr	Two-accel.				2×10^{6}
$^{56}Ni^{b}$ $^{56}Co^{b}$	6.10 day 77.12 day	Two-accel.				5×10^{4} 2×10^{5}

Major experimental instrumentation and its capabilities:

Major Equipment:

Fragment Mass Analyzer (FMA)	**Recoil separator for reaction products. The focal plane instrumentation includes a large variety of detectors (Si DSSD, PPAC, Ionization chamber, tape transport, etc**
Gammasphere	**The national gamma-ray facility of 110 Compton-suppressed Ge detectors. The facility can be operated in conjunction with the FMA as well as on a separate beam line**
Split pole spectrograph	**Dedicated for use with the Penning trap below (see**
Split pole spectrograph	**Used primarily in astrophysics, AMS measurements**
Gas target system	**System of cooled gas cells combined with a large bore superconducting resonator and a resonator, used for the production of rare isotope beams for astrophysics and nuclear structure research.**
Canadian Penning Trap (CPT)	**An instrument for high-precision mass measurement that includes a gas catcher system to slow down reaction products and transform them into slow moving 1+ ions, an RFQ-based transport system, a storage trap and a high-precision Penning trap**
Advanced Penning Trap (APT) system	**High-field isobar separator system with very high mass resolution based on a linear Penning trap, injecting either a RF quadrupole trap for weak interaction studies or a general purpose station for beta-decay investigations**
Atom Trap	**Laser based atom trap systems at present dedicated to measurements of charge radii of various He atoms**
General purpose scattering chamber	
BGO array	**Array of 64 BGO hexagonal crystals for multiplicity and total-energy measurements**
LEPPEX	**A stack of 16 BaF2 scintillators for the detection of high-energy gamma rays.**
Large array of double-sided Si strip detectors	**Includes annular and rectangular counters and associated electronics**
X-array	**An array of detectors for decay spectroscopy including Ge "clover" detectors, and Si detectors for electron spectroscopy. The array will ultimately also include planar, double-sided Ge strip detectors currently under development.**
General-purpose beam lines	**Two fully instrumented beam lines for equipment brought in by outside users.**

Nature of user facility:

DOE Designated National User Facility

Program Advisory Committee/experiment proposals:

Yes

Number of actual, active users of the facility in a given year:

Typically 180 users per year are present at ATLAS for an experiment each year. Including users on approved proposals, the number of users is typically 380 each year.

Percentage of users, and percentage of facility use that come from inside the institution:

30% of the users are internal, 43% of beam time (FY 04 numbers)

Percentage of users and percentage of facility use from national users:

40% of Users, 40% of beam time (FY 04 numbers)

Percentage of users and percentage of facility use from outside the country where your facility is located:

30% of Users, 17% of beam time (FY 04 numbers)

Fraction of the international users outside geographical region:

50/54 = 92.6%

User Group:

Yes, 468 Active user appointments

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

Physics Div Permanent Staff = 76

Temporary Staff = 15 Postdocs, 5 Visiting Scientists, 14 resident grad students, 24 active emeritus staff

As subsets of the above:

Operations & Accelerator Dev. Perm. Staff = 27

Operations & Accelerator Dev. Temp. Staff = 1 Postdoc, 2 Vis. Sci, 1

resident grad student

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

Physics Div. Permanent Staff = 6; Postdoctoral = 4

Number of postdoctoral researchers:

Operations & Accelerator Development = 1

Low Energy Research = 6

Medium Energy Research = 4

Number of graduate students resident at the facility:

9

Number of non-resident graduate students with thesis work primarily done at the facility:

32

Involvement of undergraduate students in research:

30-40/year. The number varies considerably through the year peaking during the summer months.

Special student programs:

Graduate Programs
Laboratory-Graduate Research Appointments
Guest Graduate Appointments
Thesis-Parts Appointments
Research Aide Appointments
International Student Exchange Program
Cooperative Education
Undergraduate Programs
Fall Science Undergraduate Laboratory Internships
Spring Science Undergraduate Laboratory Internships
Summer Science Undergraduate Laboratory Internships
Community College Student Internships
Pre-college Program
Pre-Service Teacher (PST) Program
Research Aide Appointments
Cooperative Education
Symposium for Undergraduates in Science, Engineering, & Mathematics
Faculty and Student Team (FAST) Fellowships

Future Plans:

New initiatives:

Californium Rare Isotope Breeder Upgrade (CARIBU)**:**

A new project to increase the radioactive beam capabilities at the ATLAS accelerator facility by one installation at a new ion source to provide beams of short-lived neutron-rich isotopes is under construction. The neutron-rich isotopes will be obtained from a 1 Ci 252Cf fission source located in a large gas catcher from which the radioactive ions will be extracted and transferred to an ECR ion source for charge breeding before acceleration in the ATLAS superconducting linac. The technique is universal, highly effective and based of technologies already demonstrated at the laboratory. It will provide accelerated neutron-rich beam intensities of up to 10^6 ions per second on target and will greatly enhance the physics capabilities currently available worldwide to study neutron-rich nuclei. Status: First beams expected early in 2009.

Solenoid for transfer reactions:

We have begun to construct a new type of spectrometer for the study of reactions in inverse kinematics. The concept is based on a superconducting solenoidal spectrometer with uniform field. The target and detector are both on the solenoid axis in the field with the reaction products bent back to the axis. The target-todetector distance and the energy of the particles translate into the desired information of excitation energy and center-of-mass angle. Such a device has a number of attractive features: greatly improved effective resolution, large solid angle, compact detectors and electronics, and easy particle identification. It is well suited to experiments that probe the structure of the exotic nuclei that are currently of high interest: single-nucleon transfer reactions, pair transfer, inelastic scattering, or even knockout reactions.

Note: The laboratory is currently involved in the design activities associated with the Rare Isotope Beam Facility (RIBF). If RIBF were to be sited at Argonne, the ATLAS accelerator complex would become an integral part of the facility.

CENTER FOR EXPERIMENTAL NUCLEAR PHYSICS AND ASTROPHYSICS (CENPA) UNIVERSITY OF WASHINGTON,

Seattle Washington USA

CENPA
Box 354290
Seattle, WA 98195

Telephone: 206 543 4080
Facsimile: 206 685 4634
Email: storm@npl.washington.edu
URL: http://www.npl.washington.edu

University Facility
Department of Energy Office of Science for Nuclear Physics

Mark A. Emmert, President

Heads of the facility:

R.G. Hamish Robertson, Scientific Director
Derek W.Storm, Executive Director

Scientific Mission and Research Programs:

Experimental research in nuclear physics, nuclear astrophysics, fundamental forces, neutrino physics. Main efforts include solar neutrinos (SNO), neutrino mass measurement (KATRIN, next generation double beta decay experiments, studies of nuclear reactions related to astrophysics and related to weak interactions.

Technical facilities: FN Tandem van de Graaff accelerator. Precision machine shop and modern electronics shop for preparation of major components of collaborative off-site experiments. See website for pictures. This facility is not simply an accelerator facility, it is a facility for putting together complicated experiments that operate in a variety of venues.

The accelerator part of the facility is the FN tandem which can also be operated with a terminal ion source for low energy helium or hydrogen isotope beams. Energies from 100 keV to 5 MeV, with currents of 10s of micro amps are available for those isotopes. Operating as a tandem, the usual range of ion beams with terminal voltage up to 9 MV are available. A ^{8}B radioactive beam of 10 ions/second has been developed. A table is available on the website.

Not an official user facility, but outsiders can run experiments collaboratively and/or by various arrangements.

No separate PAC. Experiments are evaluated and scheduled by the local community.

Percentages of users and so on are appropriate to a simple accelerator facility. Our facility serves our group which consists of 12 faculty, 6 postdocs and 15 graduate students.

Besides the students and postdocs, we have technical staff (engineers and techs) of 11.5 and administrative staff of 2.

Numbers of students and postdocs given above. Students are all resident

Typically 5 undergraduates involved in research at any one time

In summer we have 3 or 4 REU students here out of the 12 or so in the UW Physics Department program.

CYCLOTRON INSTITUTE
TEXAS A&M UNIVERSITY

Southwest United States

Cyclotron Institute
Texas A&M University
College Station, TX 77843

Telephone: 979 845-1411
Facsimile: 979 845-1899
E-mail: tribble@comp.tamu.edu

University Facility (Department of Energy University Laboratory)
Construction: Department of Energy Office of Science for Nuclear Physics
Operations: Department of Energy Office of Science for Nuclear Physics

Dr. Robert Gates, President Texas A&M University

Head of the facility:

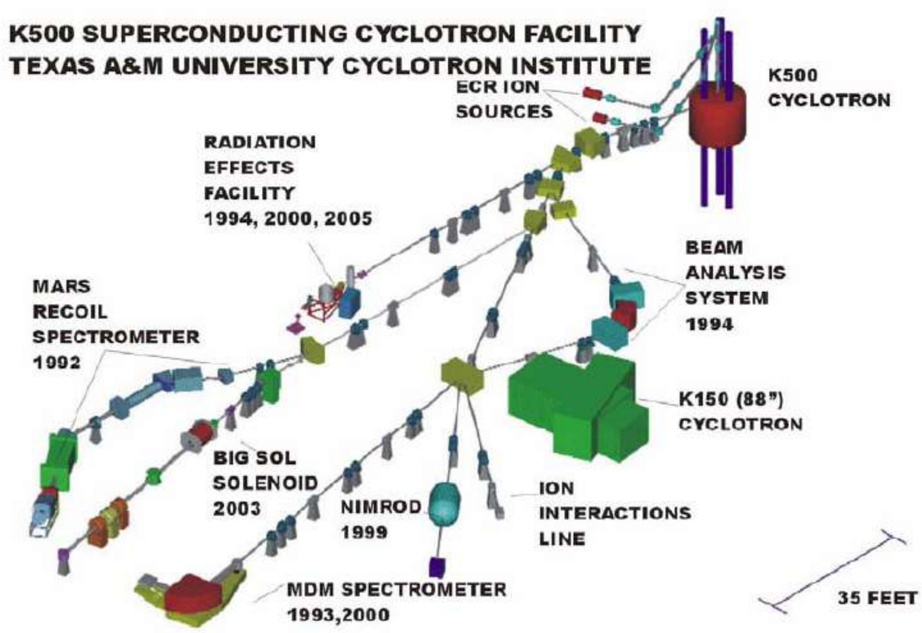
Robert E. Tribble

Scientific Mission and Research Programs:

The Cyclotron Institute is jointly operated by the U.S. Department of Energy and the State of Texas to carry out a program of basic research in nuclear science. Institute programs include measurements of reaction rates for nuclear astrophysics, studies of heavy-ion reactions at low and intermediate energies, determination of the properties of giant resonances in nuclei and β-decay studies of fundamental weak interaction parameters. In addition, the Institute provides beam time for government and industrial laboratories to test electronics components for space satellites.

Technical facilities:

The centerpiece of the Institute is a K500 superconducting cyclotron, from which first beams were extracted in 1988. The first figure below shows the layout of the lab.



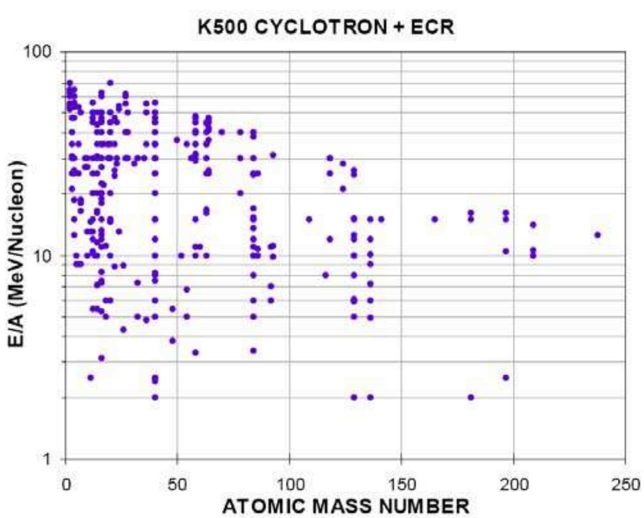
Facility:

The Cyclotron Institute operates a low to medium energy superconducting cyclotron. Two electron-cyclotron-resonance (ECR) ion sources provide beams for acceleration from H to U.

Facility parameters:

The figure below (attached as figure 2) shows the range of beams and beam energies which have been extracted from the cyclotron. Over 55 different beam species have been run at varying energies. The maximum energy run to date is 70 MeV/u for light ions. U beams have been run at 12 MeV/u. Intensities up to 1 particle μamp have been achieved for extracted heavy-ion beams. In the table below, I summarize the beams by groups.

Beams	Energy range (MeV/u)	Max. Intensities (pnA)
d	53 – 70	1000
α	12 – 30, 53 – 70	1000
Li	4 – 70	400
Be, B, C, N, O, F, Ne, Na, Mg	2 – 70	700
Si, P, S, Ar	2 – 55	300
Ca, Cr	2 – 50	200
Fe, Ni, Cu, Zn	2 – 47	100
Kr, Ag	2 – 40	80
Sn, Xe, Pr	2 – 30	50
Ta, Au, U	2 – 15	30



Major experimental equipment:

Device	Description	Parameters	Primary Uses
MARS	Recoil Spectrometer	ΔΩ = 9msr; K* = 160; Δm/m = 300	Secondary beam production
BigSol	Superconducting Solenoid	ΔΩ = 10-100msr; Bρup to 3 T-m	Secondary beam production; heavy-element studies
MDM	Magnetic spectrometer	ΔΩ = 8msr; K* = 400; ΔE/E = 1/4500	Elastic, inelastic and transfer reaction studies
NIMROD	Neutron and charged Particle detector	4πdetector for neutron and charged particle multiplicities	Heavy-ion reaction mechanism and equation of state studies

User facility

No

Program Advisory Committee/experiment proposals:

No

Average number of users:

Over past couple of years, in-house users average approximately 40, external users (non SEE line) average approximately 25 and SEE-line users average approximately 75. Of the 25 external users, about 60% are from outside the US in a typical year.

Percentage of users and facility use:

Approximately 6500 hours of beam time are provided each year. About 25% of this is used for SEE-line testing and the remaining 75% is used for basic research.

Outside users

(nearly always) collaborate with Institute faculty and staff. Fraction of international users outside of geographical region: In a typical year, nearly all of the users outside of the US come from Europe.

User Group:

No

Staff numbers:

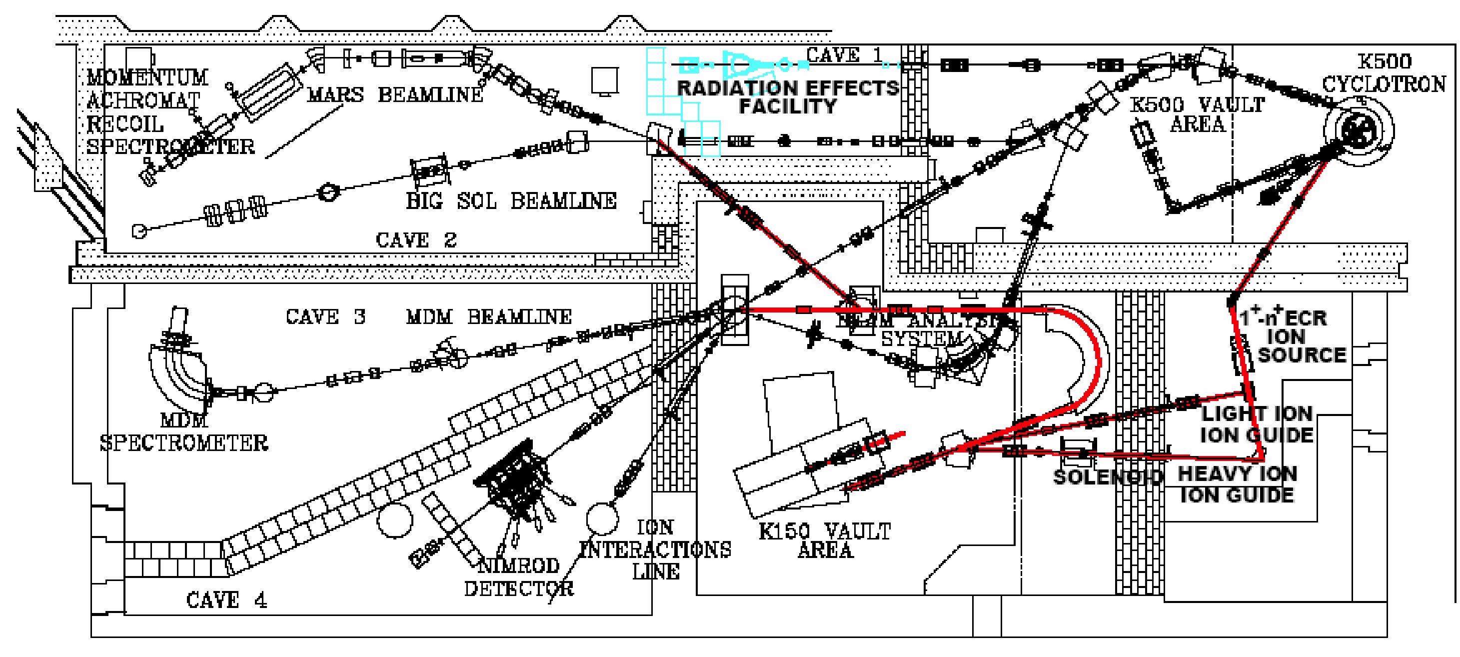
(a) permanent staff – 50 (b) temporary staff – 32 Number of theoretical staff: (a) permanent – 4 (two faculty) (b) postdoctoral – 13 (c) graduate students – 4

Number of postdoctoral researchers:

Number of graduate students: 22
Number of non-resident graduate students: 0
Special student programs:

We operate a summer program for 10 undergraduate students as a National Science Foundation REU site for nuclear science. Development plans: We have just begun an upgrade of the Institute to produce and re-accelerate radioactive beams. We are re-activating our K150 (88”) cyclotron and will use it to produce secondary beams. The secondaries will be stopped in ion-guide gas stoppers and transferred to a charge-breeding ECR source where highly-charged ions will be produced. Following the charge-breeding ECR source, the ions will be injected into the K500 cyclotron and accelerated. The figure above for stable beams gives the operating range for unstable beams.

The upgrade project has been funded by the Department of Energy, Texas A&M University and the R.A. Welch Foundation. Total funding available for the upgrade is $5 M. The Management Plan for the upgrade was approved in December, 2004 by the Department of Energy. The layout of the laboratory following the upgrade is shown in the figure below.



HOLIFIELD RADIOACTIVE ION BEAM FACILITY AT OAK RIDGE NATIONAL LABORATORY

Oak Ridge, TN, USA

Oak Ridge National Laboratory
P.O. Box 2008
Bldg. 6000
Oak Ridge, TN 37831-6368

Telephone: 865 574 4114
Fascimile: 865 574 1268
E-mail: beenejr@ornl.gov

Department of Energy Office of Science for Nuclear Physics

Dr. Jeffery Wadsworth, Director of Oak Ridge National User Facility (ORNL)

Heads of the facility:

Glenn R. Young, Director, Physics Division
James R. Beene, Director, Holifield Radioactive Ion Beam Facility (HRIBF)

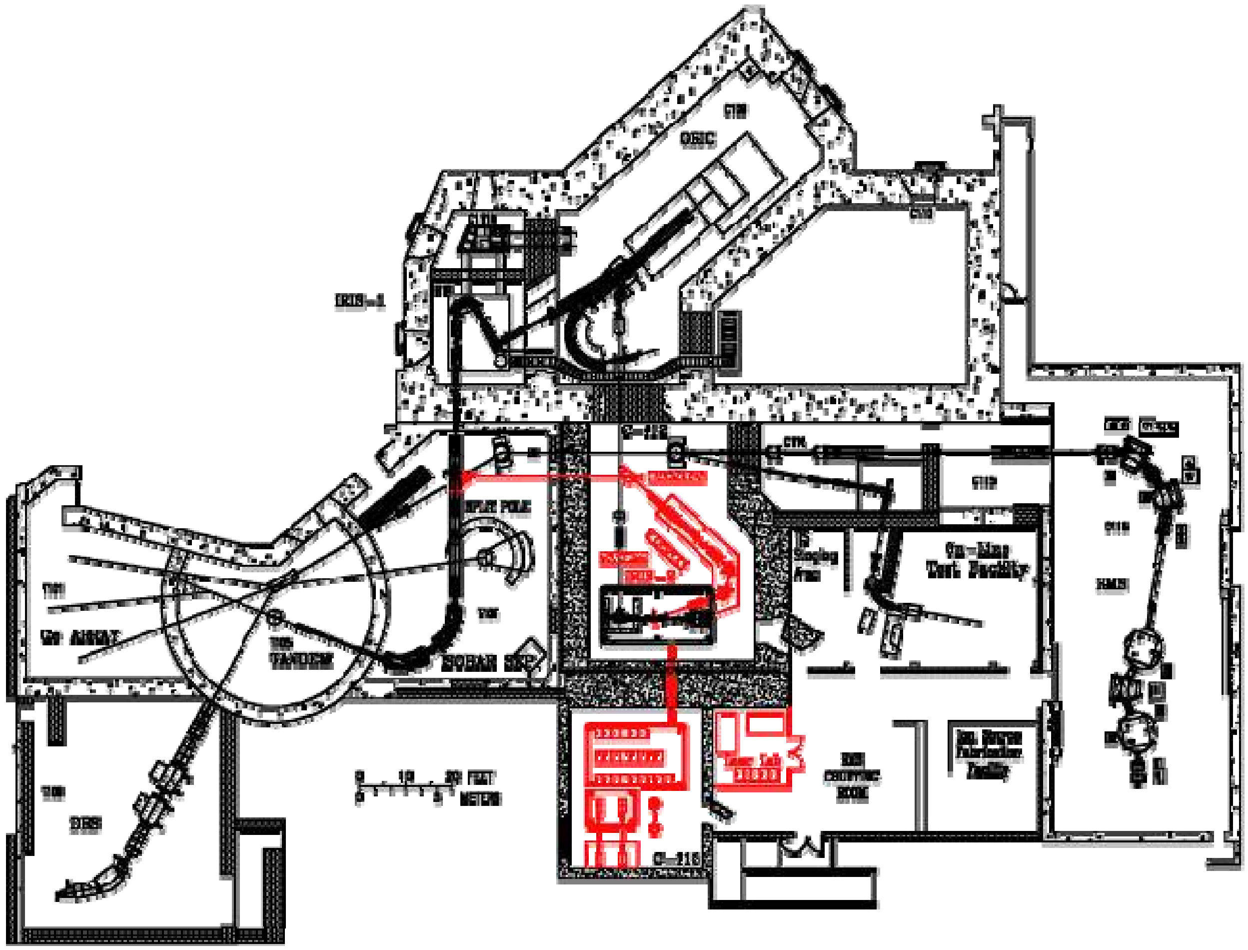
Scientific Mission and Research Programs:

The primary mission of HRIBF is to provide high quality post-accelerated beams of short-lived radioactive species to support research in nuclear physics. Our principal research programs are the study of the structure of nuclei at the limits of stability and the investigation of nuclear reactions relevant to nucleosynthesis and energy generation in stellar explosions. In addition, we help to advance the science and technology of radioactive beam production and manipulation and help to train the scientists who will work at the next-generation radioactive ion beam facility, which is a high-priority element of the DOE Office of Science 20-year plan for facilities.

Characterization of the facility:

The HRIBF produces post-accelerated radioactive ion beams by the Isotope Separator On Line (ISOL) method. Radioactive species are produced in a hot, thick target by an intense light-ion (H or He isotopes) beam from a low-energy cyclotron. The radioactive ions are thermally transported out of the target (at ~2000˚ C), ionized, passed through a first-stage mass separator (M/ΔM~1000), converted to negative ions by charge exchange if necessary, accelerated to ~200 keV, mass analyzed again (M/ΔM~20000) and injected into a 25-MV tandem electrostatic accelerator to be post-accelerated to energies sufficient for experiments.

Technical facilities:



Facility Parameters:

A complete list of HRIBF beam species, intensities, range of energies and special properties can be found at http://www.phy.ornl.gov/hribf/users/beams/

Beam species at HRIBF can be categorized as (1) stable ion beams, (2) proton-rich radioactive ion beams, and (3) neutron-rich radioactive ion beams. Since 1982, the HRIBF has delivered stable beams of more than 40 elements and can in principle deliver beams of any element that can form a negative ion or negative molecule. Maximum beam energy, which depends on mass and desired intensity, ranges from ~12 MeV/amu at A~12 to ~4 MeV/amu at A~150. More than 100 radioactive beams are available, ranging from ^{7}Be up to the heaviest fission fragments. Almost 40 different radioactive beams have been delivered to experiments. The following table shows characteristics of a few selected radioactive beams.

Beam	Energy (MeV)	Intensity (pps)
^{7}Be	100	$4x10^{6}$
^{17}F	155	$1x10^{7}$
^{78}Cu	370	0.15
^{82}Ge	375	$3\ x10^{4}$
^{118}Ag	400	$2x10^{6}$
^{132}Sn	400	$9x10^{5}$
^{132}Sn	615	$1x10^{5}$
^{136}Te	400	$5x10^{5}$

Major experimental instrumentation and its capabilities:

Experimental endstation/typical uses

Recoil Mass Spectrometer (RMS). An electric-magnetic-electric split dipole mass separator to detect heavy ions primarily from fusion-evaporation reactions for nuclear structure measurements.

In-beam gamma-ray spectroscopy; beta, gamma, and charged-particle radioactivity; light-ion single-particle transfer; Coulomb excitation.

Daresbury Recoil Separator (DRS). A mass separator based on velocity filters and optimized for proton-capture reactions in inverse kinematics for nuclear astrophysics measurements.

Proton capture measurements, (d,p) reactions in inverse kinematics.

Enge Spectrograph. A magnetic spectrometer for measuring reaction products.

Vacuum or gas-filled Mode.

Scattering Chamber. A general purpose 1-meter chamber for reaction measurements.

Scattering, fusion-fission, Coulomb excitation, g factor measurements

On-line Test Facility (OLTF). An Isotope-Separator On-Line magnetic separator.

Low-intensity development of radioactive ion beams (RIB) and ion sources.

Time-of-Flight Beamline. A fast (nanosecond) time-of-flight separator.

Fusion cross-section and fusion-fission measurements.

Low-energy beamline. Under construction; radioactivity measurements not requiring post-acceleration.

Detectors - Most can be used on different endstations

Ge array (CLARION - 2.2% photopeak eff. - upgrade to 4.5% planned; CARDS - subset of Ge-detectors when used at RMS focal plane)

CsI array (HyBall - 2 versions: nearly 2π and 4π solid angle)

Si detectors (Forward Array - E-ΔE annular array; SIDAR - E-ΔE annular array; DSSD - charged-particle radioactivity; ORRUBA – Oak Ridge-Rutgers University Barrel Array - under construction)

Neutron detectors (19 element liquid scintillator; ^{3}He gas ionization counters - under construction)

Micro-channel plate detectors (heavy ion detection)

Tape system (MTC - radioactivity transport)

Pair Spectrometer (BESCA - conversion electrons)

Ionization Chamber (heavy ion detection identification)

Barium Fluoride Array (150+ 6.5 cm x 6.5 cm x 20 cm elements)

Nature of user facility:

DOE Designated National User Facility

Program Advisory Committee/experiment proposals:

Yes

Number of actual, active users of the facility in a given year:

90 users (average over 2002-2004)

Percentage of users, and percentage of facility use that come from inside the institution:

~22% users come from ORNL.

Percentage of users and percentage of facility use from national users:

78% users are from outside ORNL.

Percentage of users and percentage of facility use from outside the country where your facility is located:

10%

Fraction of the international users from outside your geographical region:

86%

User Group:

The HRIBF users group consists of over 370 members.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

(a) Facility Operations – 20, Research - 14

(b) 25

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

7 permanent: 4.625 FTE; 7 post-doctoral (various funding sources); 5 students (various funding sources).

Number of postdoctoral researchers:

11

Number of graduate students resident at the facility:

14

Number of non-resident graduate students with thesis work primarily done at the facility:

14

Involvement of undergraduate students in research (approximate average number per year):

3 students

Special student programs:

First Rare Isotype Beam Facility Summer School in 2002, will host again in 2006; National Nuclear Physics Summer School in 2003; summer students from Science Alliance High School tours; Summer School and Workshop on Radioactive Ion Beam Production Targets and Ion Sources in 2005.

Future Plans:

The HRIBF is currently in the midst of an upgrade project. By the end of fiscal 2005, we will have added a High Power Target Test Facility that will greatly improve our capability of developing new radioactive beams. By fiscal 2008, we plan to bring on line a fully instrumented new radioactive ion production station with substantially greater capability than our existing facility. We are preparing a proposal for an upgrade to the accelerator systems used for RIB production.

Experimental equipment is also being upgraded. A significant upgrade of our high-resolution γ-ray detection array is the next major enhancement planned.

We are also planning the development of a RIB Theory Center.

HOPE COLLEGE ION BEAM ANALYSIS LABORATORY (HIBAL)

Hope College, Holland, MI

c/o Graham Peaslee
Chemistry Department
Hope College
Holland, MI 49423

Telephone: 616-395-7117
Facsimile: 616-395-7118
Accelerator lab: 616-395-7519
E-mail: peaslee@hope.edu

University Laboratory

Construction: National Science Foundation – MRI#0319523
Operation: Hope College and individual PI grants

James Bultman, President

Head of the facility:

Graham F. Peaslee (PI)

Scientific Mission and Research Programs:

The Hope College Ion Beam Analysis Laboratory is a low-energy light ion facility that provides routine PIXE, μPIXE, and RBS measurements for a variety of research projects. Current research projects include PIXE analysis of metals in lake sediments, μPIXE analysis of sand grains for provenance studies, μPIXE and PIXE analysis of dinosaur bones and surrounding strata from a Wyoming dig site, RBS characterization of organometallic electrochemical films, RBS characterization of vapor deposited amorphous GaN and ScN films, and energy-loss measurements and coincident x-ray detection of protein electrophoresis gels. In addition to basic research, HIBAL serves as a training facility for the next generation of interdisciplinary scientists as our undergraduate researcher are taught the routine operation, maintenance, sample preparation, data acquisition and analysis skills required to perform the basic research described above. Occasionally some applied research for local companies is performed as well.

Technical facilities:

Characterization of the facility:

The accelerator is a 1.7 MV NEC tandem Pelletron with an Alphatross external ion source.

Provide a compact table of facility parameters:

Beam type	*Energy range Intensity on target*
$^{1}H^{+}$	0.5 – 3.4 MeV <500 nA
$^{4}He^{+}$ and $^{4}He^{2+}$	0.5 – 5.1 MeV <500 nA

Provide a compact table of facility's major experimental instrumentation:

Qty	*Description*
3	Analysis beamlines with scattering chambers
2	Si(Li) detectors
1	Electrostatic microprobe end-station (10 micron)
1	CAMAC-based FPGA acquisition system
Assorted	Surface barrier Si detectors and electronics

Nature of user facility:

No

Program Advisory Committee/ experiment proposals:

No

Number of users of the facility:

(The facility was installed less than 6 months ago)

To date we have had 6 faculty members as users and 11 undergraduates as users and 1 external user.

Percentage of users and percentage of facility use from inside the institution:

95% and 98%

Percentage of users of facility from national users:

0%

Percentage of users of facility from outside the country:

0%

Does a formal users group exist for your facility:

No

Number of (a) permanent staff and (b) temporary staff:

(a) 0.5 FTE technician

(b) 1.0 undergraduate student

Number of theoretical staff:

0

Number of post-doctoral researchers:

0

Number of graduate students:

0

Number of undergraduate students:

Approximately 8 users in any given semester. Approximately 12-16 users during the summer.

Special student programs:

Most of our research (>80%) involves undergraduate students directly. We do lots of local tours.

Future Plans:

The third beamline is still under construction.

We will add a new x-ray detector soon.

We will upgrade acquisition system for the microprobe

NATIONAL SUPERCONDUCTING CYCLOTRON LABORATORY

East Lansing, Michigan, USA

National Superconducting Cyclotron Laboratory
Michigan State University
1 Cyclotron Laboratory
East Lansing, MI 48823-1321 USA

Telephone: 517-355-9671
Facsimile: 517-353-5967
E-mail: Gelbke@nscl.msu.edu

Higher Education Institution (State University)
National Science Foundation

Lou Anna Simon, President, Michigan State University

Head of the facility:

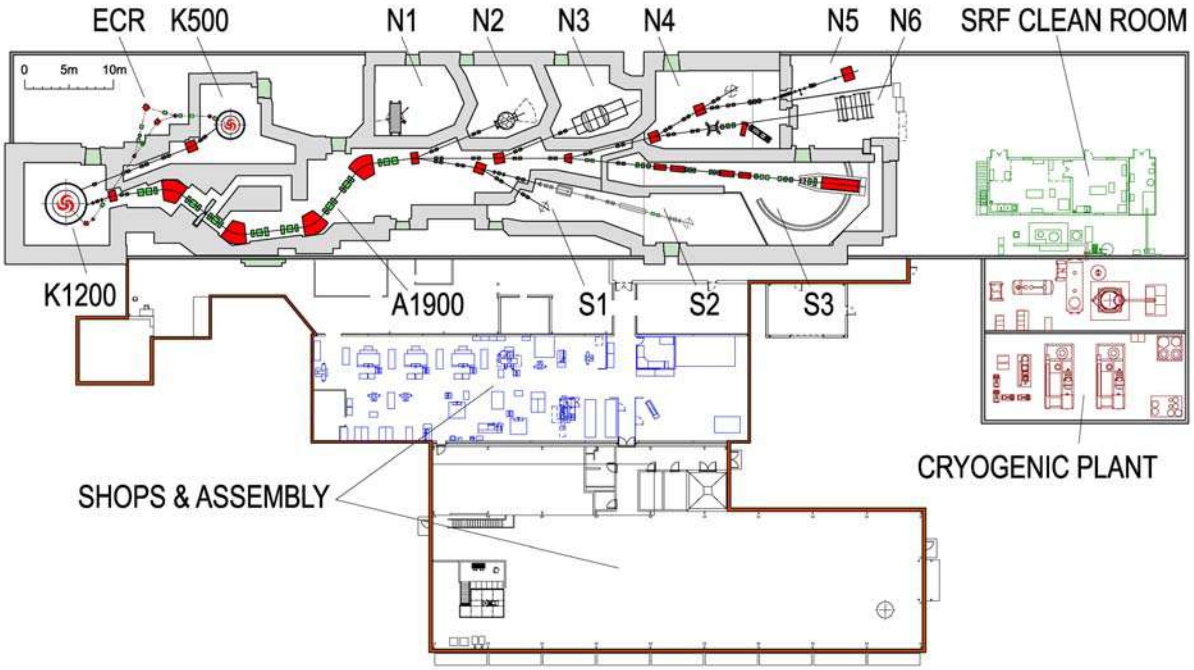
C. Konrad Gelbke, Director, NSCL

Scientific Mission and Research Programs:

The overall mission of the National Superconducting Cyclotron Laboratory (NSCL) is to provide forefront research opportunities with stable and rare isotope beams. A broad research program is made possible by the large range of primary and secondary (radioactive) beams provided by the facility: from hydrogen to uranium, and from 4 to 200 MeV/nucleon. The major research thrust is to determine the nature and properties of nuclei, especially those near the limits of nuclear stability. Other major activities are related to nuclear properties that influence stellar evoution, explosive phenomena (e.g. supernovae and x-ray bursters), and the synthesis of the heavy elements; and research and development in accelerator and instrumention physics, including the development of superconducting radiofrequency cavities and design concepts for future accelerators for basic research and societal applications. Another important part of the NSCL mission is the training of the next generation of scientists.

Technical facilities:

The floor plan of the NSCL Technical facilities: shows the two superconducting cyclotrons (K500 and K1200 on the left), the superconducting A1900 fragment separator and subsequent beam lines, the various experimental vaults, the SRF (superconducting RF) R&D area, the cryoplant, and the shops and assembly areas.



Floor plan of the NSCL Technical facilities:

Characterization of the facility:

Coupled superconducting cyclotrons, all stable ions, intense radioactive beams separated by physical means.

Facility Parameters:

Primary Beams

See: http://www.nscl.msu.edu/aud/exp/propexp/beamlist.php

Particle	Energy [MeV/u]	Intensity [pnA]
^{16}O	150	125
^{18}O	120	125
^{36}Ar	150	50
^{40}Ar	140	50
^{40}Ca	140	22
^{48}Ca	140	40
^{58}Ni	160	5
^{64}Ni	140	7
^{76}Ge	130	20
^{78}Kr	150	25
^{86}Kr	140	200
^{124}Xe	140	2
^{124}Sn	120	1.5
^{136}Xe	120	2
^{209}Bi	80	1.0

Over 250 rare isotope beams produced by fragmentation of the primary beams and characterized for user experiments have been used in experiments at the NSCL during 2001-2006.

Major experimental instrumentation and its capabilities:

1. For production of radioactive ion beams: A1900 fragment separator.

2. For charged-particle spectroscopy: S800 spectrograph, Sweeper Magnet.

3 For charged particle detection over large solid angle: 4pi Array; High Resolution silicon strip detector Array.

4. For neutron detection: Modular Neutron Array; Neutron Walls.

5. For gamma-ray detection: Segmented Germanium Array; NaI Array

6. For beta-decay studies: Beta Counting System.

Nature of user facility:

Yes. National Science Foundation.

Program Advisory Committee/experiment proposals:

Yes

Number of actual, active users of the facility in a given year:

170

Percentage of users, and percentage of facility use that come from inside the institution:

27% of users come from inside the institution. Most of the facility usage (80.6% in 2005) is for mixed (inside *and* outside) user experiments. 19.4% of the facility usage in 2005 was for inside-only experiments.

Percentage of users and percentage of facility use from national users:

69% and 92%. [Note: Since most experiments involve international collaborations, we define facility use as the percentage of experiments with US spokespersons.]

Percentage of users and percentage of facility use from outside the country where your facility is located:

31% and 8%. [Note: Since most experiments involve international collaborations, we define facility use as the percentage of experiments with non-US spokespersons.]

Fraction of the international users from outside geographical region:

97%.

User Group:

718.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) 155 permanent staff

b) 125 temporary staff (incl. postdocs, graduate and undergraduate student employees)

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

14

Number of postdoctoral researchers:

23

Number of graduate students resident at the facility:

55

Number of non-resident graduate students with thesis work primarily done at the facility:

10

Involvement of undergraduate students in research (approximate average number per year):

Approximately 30

Special student programs:

Undergrads:

REU: Research Experience for Undergraduates

Professorial Assistant Program

High school and others:

HSHSP: High School Honors Science Program

PAN: Physics of the Atomic Nuclei

Future Plans:

The laboratory emphasizes construction of state-of-the-art instrumentation in nuclear and accelerator physics. Projects in progress include a digital electronics system for gamma ray tracking; an RF fragment separator to provide additional purification of radioactive beams from the A1900 fragment separator; an improved gas stopper based on stopping in a magnet (cyc-gas stopper) to reduce losses for short-lived isotopes and for high-intensity operation; a high-performance charge breeder to improve reacceleration efficiency with variable duty cycle; and a reaccelerator facility, based on cryomodules with low-beta superconducting RF cavities and superconducting focusing magnets, for accelerating stopped fragments to energies of up to 3.2 MeV/nucleon.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)
Neutron Interactions and Dosimetry Laboratories

Gaithersburg, Maryland, USA

Stop 8461
NIST
100 Bureau Drive
Gaithersburg, MD 20899

Telephone: 301-975-6303
Facsimile: 301-926-1604
E-mail: muhammad.arif@nist.gov

US government, Dept. of Commerce, National Institute of Standards and Technology,
Ionizing Radiation Division, Neutron Interactions and Dosimetry group

NIST

Head of the facility:

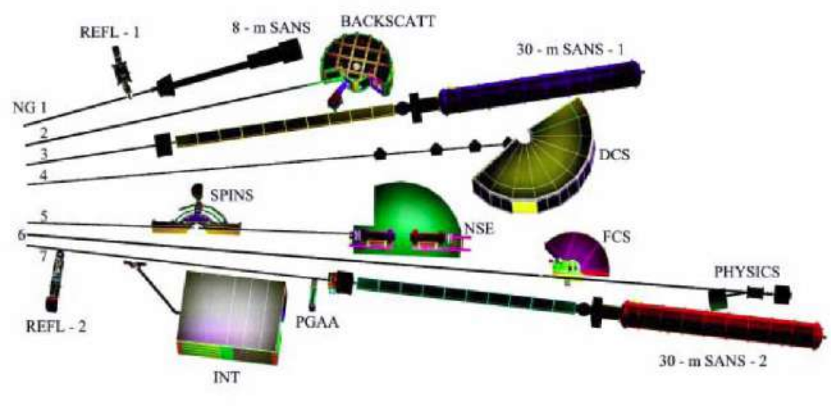
Dr. Muhammad Arif

Scientific Mission and Research Programs:

The NIST Fundamental Physics Neutron Facility provides a location for internal and external users to conduct both fundamental and applied physics experiments with thermal, cold, and ultracold neutrons. The research program includes studies of the weak interaction, neutron instrumentation, neutron interferometry, neutron imaging, neutron fluence measurements and dosimetry, and applications to homeland security. Past and current experiments in weak interaction physics includes measurements of the neutron lifetime, a search for time reversal violation in polarized neutron decay, study of nucleon-nucleon interactions via parity-violating spin-rotation of polarized neutrons, a search for the radiative decay mode of the neutron, and precision measurements of neutron scattering lengths. Instrumentation development is focused on the polarized ^{3}He-based neutron spin filters for neutron scattering and fundamental neutron physics. The neutron imaging program includes studies of fuel cells.

Technical facilities:

A diagram and photo of the NIST Center for Neutron Research (NCNR) cold neutron guide hall is included. The NCNR is operated by the Materials Science and Engineering Laboratory of NIS. The Neutron Interactions and Dosimetry group operates the NG-6 Fundamental Physics Beam Line, along with the NG-6M and NG-6U monochromatic beam lines that split off of NG-6, the NG-7 Neutron Interferometer and Optics Facility, and two thermal neutron stations (not shown).



Characterization of the facility:

Thermal and cold neutron beam lines at a research reactor

Facility Parameters:

NG-6 cold, polycromatic neam line: neutron fluence rate (no filters): 2.3×10^9 cm^{-2} s^{-1}

6 cm diameter beam

NG-6M monochromatic beam line: wavelength = 0.496 nm

typical available fluence rate = 6.5×10^5 cm^{-2} s^{-1}

pyrolytic graphite crystal size = 5.1 cm by 5.1 cm

NG-6U monochromatic beam line: wavelength = 0.89 nm

capture fluence rate = 4.7×10^6 cm^{-2} s^{-1}

potassium-interclated graphite monochromator

beam size = 6 cm by 6 cm

NG-7 Neutron Interferometer and Optics Facility: wavelengths - 0.2 nm - 0.48 nm

fluence rate - 2×10^5 cm^{-2} s^{-1}

beam size = 2 mm by 8 mm

phase stability - 0.25 degrees/day

contrast - 90%

Major experimental instrumentation and its capabilities:

In addition to the neutron beam lines, the facility has apparatus for spin-exchange and metastability-exchange optical pumping of ^{3}He neutron spin filters. There is also a thermal beam for neutron imaging.

Nature of user facility:

The neutron beam lines are considered to be a user facility by the NIST Center for Neutron Research as well as the Neutron Interactions and Dosimetry group.

Program Advisory Committee/experiment proposals:

Yes, for the neutron beam lines.

Number of actual, active users of the facility in a given year:

We estimate that about 30 people per year have made use of our facilities in the last year.

Percentage of users, and percentage of facility use that come from inside the institution:

Percentage of users from inside the institution - zero (we define "users" to be from the outside)

Percentage of facility use from inside the institution - 50%

Percentage of users and percentage of facility use from national users:

80% (users); 40% (facility use)

Percentage of users and percentage of facility use from outside the country where your facility is located:

20% (users); 10% (facility use)

Fraction of international users outside of geographical region:

100%

User Group:

No

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

Permanent staff = 8; Temporary staff = 8

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

0

Number of postdoctoral researchers:

4

Number of graduate students resident at the facility:

3

Number of non-resident graduate students with thesis work primarily done at the facility:

4

Involvement of undergraduate students in research (approximate average number per year):

2 (summer); 1 (academic year)

Special student programs:

Summer Undergraduate Research Program, sponsored by NIST, the NSF and the students' institutions

NUCLEAR STRUCTURE LABORATORY (NSL)

UNIVERSITY OF NOTRE DAME

Institute for Structure and Nuclear Astrophysics (ISNAP)

North America

ISNAP or Nuclear Structure Laboratory
Department of Physics
124 Nieuwland Science Hall
University of Notre Dame
Notre Dame, IN 46556

Telephone: 574-631-8120
Facsimile: 574-631-5952
E-mail: aprahamian.1@nd.edu

University Institute

Construction: University of Notre Dame
Operation: National Science Foundation

Rev. Edward A. Malloy, CSC, President until June 30, 2005
Rev. John Jenkins, CSC, President-elect

Head of the facility:

Prof. Ani Aprahamian

Scientific Mission and Research Programs:

Research in nuclear structure is focused on studies of dynamics, deformations, and bulk nuclear properties. **Dynamics of nuclei** include studies of behavior as wide ranging as vibrational motion associated with tidal waves on the surface of the nucleus to giant resonances and rotational motion including chiral rotations as well as superdeformations. Understanding nuclear dynamics has many implications from the most fundamental issues related to nuclear forces to probing incompressibility of nuclear matter and therefore the properties of neutron stars. Theoretical approaches of many body quantum systems can also be applied more generally to mesoscopic systems or clusters of atoms, and quantum dots.

A pioneering focus in the Nuclear Structure Laboratory has been the development and application of short-lived radioactive beams, and the associated study of the structure and reactions of nuclei at the very limits of particle stability. This includes investigations of the recently discovered "neutron halo" nuclei, exotic systems in which a cloud of nearly pure neutron matter at very low density surrounds a normal nuclear core. These nuclei can be a key for the onset of explosive nucleosynthesis mechanisms such as the r-process.

Measurements of nuclear reaction rates and decay processes at stellar temperatures and densities comprise a strong part of the experimental effort in nuclear astrophysics. The goal is to understand the origin and distribution of the elements in the universe. Research is directed towards simulating stellar nucleosynthesis in the laboratory, understanding late stellar evolution and explosive nucleosynthesis in novae and supernovae, and explaining the origin of the very high luminosity observed in stellar x-ray bursts.

Developing Accelerator Mass Spectrometry techniques for a range of applications from oceanography to astrophysics is a new research focus of our laboratory. Accelerator Mass

Spectrometry has traditionally been used to detect environment tracers at or below their natural abundance level with extremely high sensitivity. We seek to advance and exploit this technique at the local facilities for identifying new radioactive noble gas probes of oceanography and for the study of low cross-section nuclear reactions which are important in stellar evolution.

Technical facilities:

The centerpiece of the Nuclear Structure Laboratory is the model FN Tandem Van de Graaff Accelerator, which is capable of reaching acceleration voltages in excess of 10.5 MegaVolts. The FN Tandem is used to accelerate a wide variety of ion beams to energies that range from a few MeV to 100 MeV. Most of these ion beams are produced by a standard Sputter Ion Source (SNICS), with helium beams being produced using a separate Helium Ion Source (HIS). In addition to the continuous, or DC, beams available from these sources, experimenters may elect to bunch and pulse the beams. The buncher/pulser system is capable of producing beam pulses of about 1.5 nsec width, separated by 100 nsec (or by some multiple of 100 nsec using the pulse selector).

In addition to the FN Tandem Van de Graaff accelerator, the laboratory also operates a KN Van de Graaff accelerator. This accelerator has a maximum accelerating voltage of 4 MegaVolts and provides high intensity positively charged low-mass beams used for experimental nuclear astrophysics applications. The KN accelerator facility is, at present, completely separate from the FN Tanden facility with a separate target room and dedicated target stations.

Characterization of the facility:

Low-energy accelerators with light to medium ions with high intensity.

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

Listed above

Nature of user facility:

Officially we are not a user facility but we have a large number of users from all over the world.

Program Advisory Committee/experiment proposals

The laboratory personnel meet once a week and make decisions on proposed experiments. The proposers typically give a brief 10-15 presentation to discuss why the experiment needs to be done and the associated technical requirements. The group then decides if there are competitive proposals, if the experiment is doable, and if the experiment is interesting. Then we attempt to find the best solution with regards to the schedule and competing resources.

Number of actual, active users of the facility in a given year:

40 approximately in a given year

(foreign countries, US Universities/Colleges, US National Laboratories, and some industrial Laboratories)

Percentage of users, and percentage of facility use that come from inside the institution:

There are two major inside users;

Radiation Laboratory Personnel (DOE funded laboratory on the campus of Notre Dame) and individual scientists from the Physics Dept. here at Notre Dame.

Percentage of users and percentage of facility use from national users:

50%

Percentage of users and percentage of facility use from outside the country where your facility is located:

50%

Fraction of the international users from outside geographical region:

Middle East (Jordan, Israel)

Asia (Turkey, Armenia, India, Japan)

Europe (Hungary, Bulgaria, Germany, UK, France, Italy)

South America (Mexico, Brazil)

North America (Canada)

User Group:

No

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) permanent staff - 4

b) temporary staff - 28

Number of postdoctoral researchers:

6

Number of graduate students resident at the facility

22

Number of non-resident graduate students with thesis work primarily done at the facility:

11

Involvement of undergraduate students in research (approximate average number per year):

7

Special student programs:

Research Experiences for Undergraduates (REU – summer program)

Research Experiences for Teachers (RET – summer program for High School Teachers)

Local High School students doing projects with faculty (academic year)

Quarknet network of High School Teachers (year round + special programs in the summer)

Future Plans:

Design and Building of a recoil mass separator: presently in final stages of design

NUCLEAR STRUCTURE LABORATORY

Stony Brook NY

State University of New York
Stony Brook NY 11794-3800

Telephone: 631-632-8118, 8115(secretary)
Facsimile: 631-632-8573
E-mail: Gene.Sprouse@sunysb.edu

University Institute

construction: SUNY and NSF
operation: NSF and SUNY

Shirley Strum Kenny, President of Stony Brook University

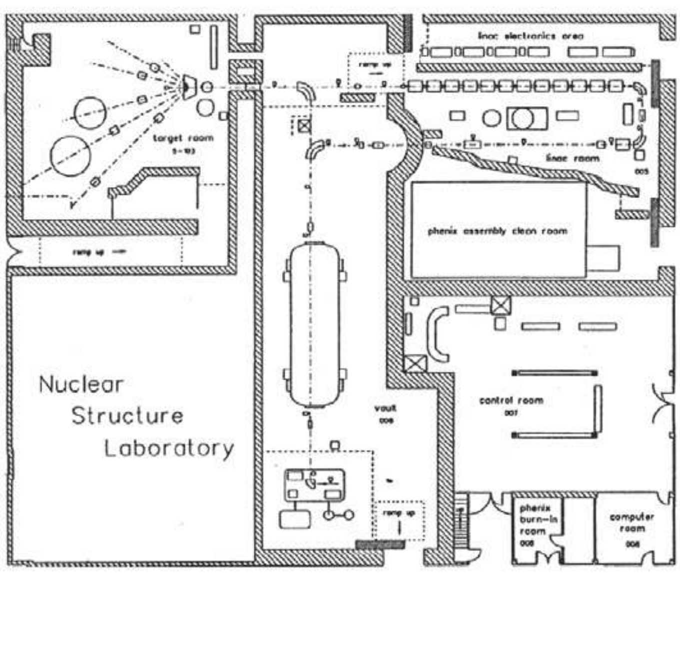
Head of the facility:

Gene Sprouse, Director, Nuclear Structure Laboratory

Scientific Mission and Research Programs:

The Stony Brook Superconducting Linear Accelerator provides heavy ion beams for basic research in nuclear and atomic physics, and an infrastructure for the recruitment, development and training of students in the areas of radiation detection, hardware development and experimental analysis. The research program includes gamma ray spectroscopy of low spin nuclei that reveals special symmetries in nuclear structure. Another research project uses the unique capability of our LINAC to provide intense Fr beams of 10^7 particles/sec. These Fr beams are used to develop weak interaction measurements in atoms. The Stony Brook Nuclear Structure Laboratory also serves as a focus of many educational activities. Students at the high school, undergraduate, graduate, and postdoctoral levels participate in the research program with various intensities, from beam line construction to running actual experiments. In addition to these students, high school students, incoming students, and various classes tour the laboratory as an example of an accelerator research facility.

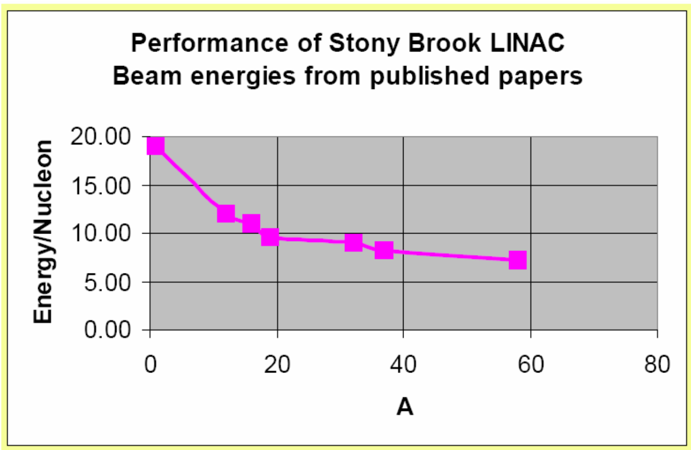
Technical facilities:



Characterization of the facility:

The facility consists of an FN Van de Graaff generator capable of 9MV that can be used stand-alone or injected into a superconducting heavy ion linac. The linac is capable of 12 MV/charge up to A=60 nuclei.

Facility Parameters:



Major experimental instrumentation and its capabilities:

A major facility exists for producing secondary beams of radioactive alkali atoms, in particular, $^{208-212}$Fr. These beams can be sent into three separate beam lines for atom trapping, ion trapping and atomic polarization studies.

Nature of user facility:

The system does not have the infrastructure to be a user facility, but occasionally outside users take advantage of some our unique beams.

Program Advisory Committee/experiment proposals:

No.

Number of actual, active users of the facility in a given year:

The facility is in active use by 4 groups in the last year, each with an average of a faculty member, 3 students and a postdoctoral fellow.

Percentage of users, and percentage of facility use that come from inside the institution:

80% of facility use is from inside the institution.

Percentage of users and percentage of facility use from national users:

20% of facility use is from national users.

Percentage of users and percentage of facility use from outside the country where your facility is located:

There is occasional use by collaborators from outside the country.

Fraction of the international users from outside geographical region:

Does not apply.

User Group:

Does not apply.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

There are 2 permanent faculty, 3 permanent operations staff, 1 postdoc and 7 graduate students.

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

There are no theoretical staff at the Nuclear Structure Laboratory, but the Nuclear Theory group at Stony Brook has 6 faculty, 3 postdocs, and 5 graduate students, and the Nuclear and Particle Astrophysics group has 3 faculty, 1 postdoc and 3 graduate students.

Number of postdoctoral researchers:

1.

Number of graduate students resident at the facility:

7.

Involvement of undergraduate students in research (approximate average number per year): 4

Special student programs:

We participate annually in the Stony Brook physics REU program, and occasionally mentor high school students interested in Intel research projects.

Future Plans:

We intend to upgrade various components of the accelerator to further improve reliability, but we have no major expansion planned at the present time.

PACIFIC NORTHWEST NATIONAL LABORATORY

Pacific Northwest National Laboratory
902 Battelle Boulevard
P.O. Box 999
Richland, Washington 99352
Physics Point of Contact: Dr. Harry S. Miley

509-376-9481, harry.miley@pnl.gov
Switchboard: (509) 375-2121
Toll Free: 1-888-375-7665
Web: http://www.pnl.gov/
E-mail: inquiry@pnl.gov

U.S. Department of Energy (DOE)

Mr. Michael Kluse, Interim Laboratory Director

Submittal Contact: Steve Slate, 509-375-3903, steve.slate@pnl.gov

The Pacific Northwest National Laboratory (PNNL) is a U.S. Department of Energy (DOE) multi-program national laboratory that creates new knowledge and solutions that address national challenges in science, national security, environmental quality, and energy resources. PNNL's 4200 staff conduct a broad research agenda (approximately $760M in 2005) in 180,000 square meters of facilities, most of which are located in Richland, Washington. PNNL has staff expertise and selected capabilities that have direct application to nuclear and high-energy physics programs. For example, in the area of ^{76}Ge double-beta decay, starting in the 1980s, PNNL researchers produced the technology for one of the two worldwide ^{76}Ge experiments, which led to publishing the half-life of the two-neutrino mode of decay in 1990. Since that time, PNNL-led developments in the chemistry of ultra-pure materials, development and testing of signal analysis methods, and deployment of ultra-low-level, radiopurity screening technology via radiometric analysis and mass spectrometry have resulted in the successful operation of one of the world's two isotopically enriched germanium double-beta decay experiments, the International Germanium Experiment (IGEX). These developments have also aided several ongoing dark matter experiments.

PNNL staff have organized a collaboration of scientists to pursue the challenge of determining the mass and character of the neutrino, qualities indicated by the measurement of the oscillation of neutrinos in solar, atmospheric, and reactor experiments. This Majorana experiment (http://majorana.pnl.gov) is envisioned ultimately to be an approximately 1-ton-scale, double-beta decay experiment in ^{76}Ge, with sensitivity to an effective Majorana mass of the electron neutrino below 45 meV. Majorana will require the use and extension of the capabilities of PNNL and other labs in materials science, analytical chemistry, and surface science (for the exploration of more germanium-efficient electrical contacts).

PNNL's Environmental Molecular Science Laboratory (http://emsl.pnl.gov) is a national DOE user facility, with state-of-the-art equipment for advanced materials and surface science, such as that needed for new detector development for the Majorana experiment and potentially for other physics research. PNNL's Category II Radiochemcial Processing Facility includes capabilities in trace and high-level radioactive chemical separations and analyses, which are needed to perform extremely hot chemical separations needed for neutrino sources and neutrino, magnetic-moment experiments.

PNNL's rapidly growing pool of about 30 nuclear and high-energy physicists work with a much larger team of nuclear and materials scientists on large national security research as well as pure physics experiments such as the Majorana experiment.

RELATIVISTIC HEAVY ION COLLIDER (RHIC)
BROOKHAVEN NATIONAL LABORATORY

Upton, New York, U.S.A.

P.O. Box 5000
Upton, NY 11973, U.S.A.

http://www.bnl.gov
BNL is operated by Brookhaven Science Associates for
Department of Energy Office of Science for Nuclear Physics

Telephone: (631)344-8000
E-mail: mgrdichian@bnl.gov

Department of Energy Office of Science for Nuclear Physics

Dr. Samuel Aronson, Director

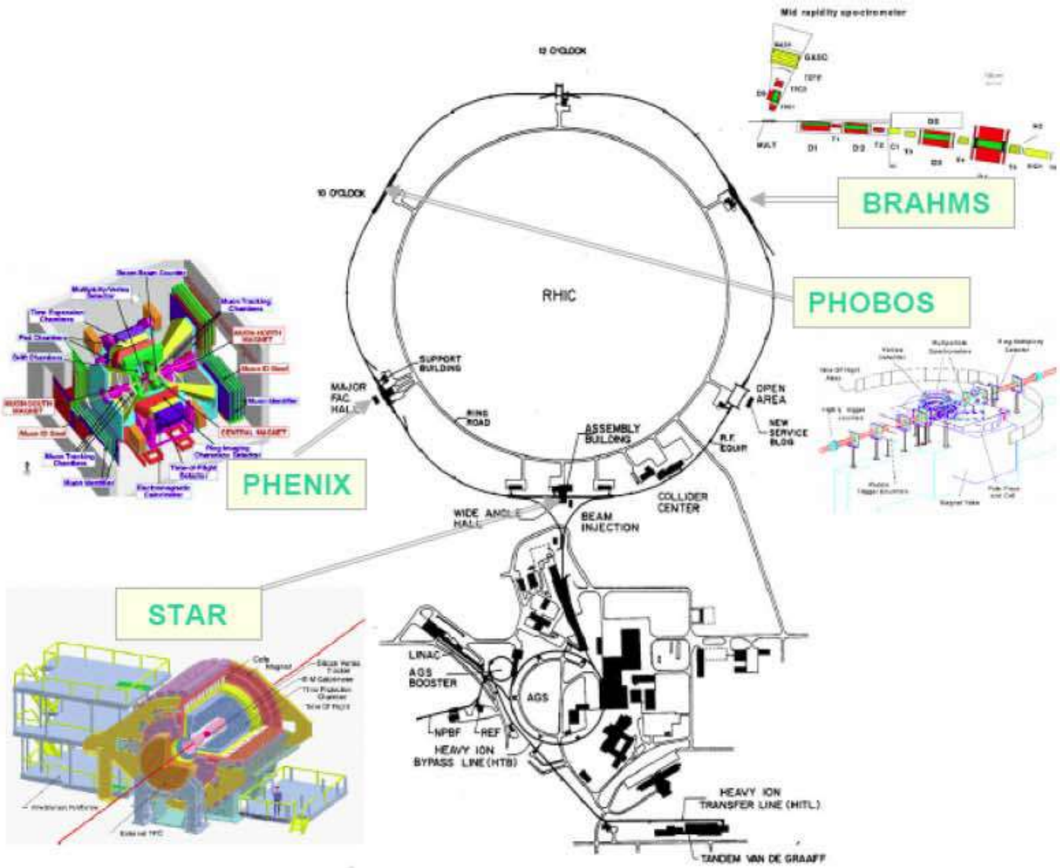
Heads of the facilities:

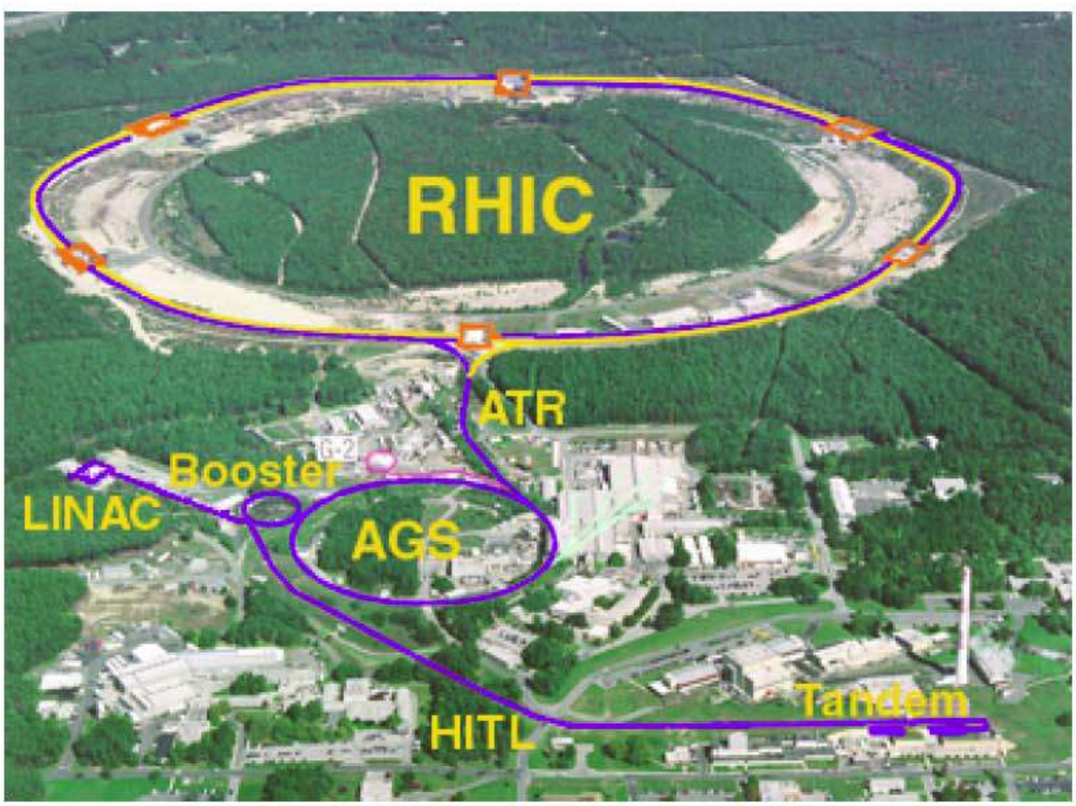
Interim Associate Laboratory Director for HENP – Dr. Peter Bond
Collider-Accelerator Department Chair [RHIC] – Dr. Derek Lowenstein
Physics Department Chair [ATF] – Dr. Sarah Dawson
Superconducting Magnet Division – Dr. Michael Harrison
Instrumentation Division – Dr. Veljko Radeka

Scientific Mission and Research Programs:

BNL is a Multi-Program National Laboratory with scientific programs in: Nuclear Physics; High Energy Physics; Basic Energy Sciences; Life Sciences; and Applied Sciences. BNL has a wide variety of current programs in all these fields. A guide to the scientific program can be found via the BNL website at http://www.bnl.gov. The future Nuclear and High Energy and Nuclear programs are available in brief form as the "BNL Strategic Plan for Nuclear Physics" and the "BNL Strategic Plan for High Energy Physics", http://www.bnl.gov/henp. Preeminent among the future BNL facilities plans are the scientific evolution of the present Relativistic Heavy Ion Collider (RHIC) complex, including the planned RHIC II and eRHIC facilities that will continue and extend the nuclear physics mission of the current RHIC heavy ion and proton spin programs, adding electron-ion collider capability.

Technical facilities:





Characterization of the facility:

relativistic heavy ion collider; polarized proton collider

Facility Parameters:

RHIC Facility:

Exemplary tables on RHIC performance:

Table 1. Integrated luminosities delivered to the four RHIC experiments during Run - 4.

Mode		Au-Au at 100 GeV/n	Au-Au at 31.2 GeV/n		Pol. p – pol. p at 100 GeV	
Mode	β* [m]	Integrated Luminosity [μb^{-1}]	β*[m]	Integrated Luminosity [μb^{-1}]	β* [m]	Integrated Luminosity [pb^{-1}]
PHENIX	1	1370	3	22	1	3.0
STAR	1	1270	3	21	1	3.2
BRAHMS	3	560	5	12	3	0.3
PHOBOS	3	540	5	12	3	0.6

Table 2. Peak luminosities and best week performance for RHIC.

Mode	# bunches	Ions/bunch [10^9]	β* [m]	Emittance [μm]	L_{peak} [$cm^{-2} s^{-1}$]	$L_{storeave}$[$cm^{-2}s^{-1}$]	L_{week}
Au-Au	45	1.1	1	15-40	15×10^{26}	4×10^{26}	160 μb^{-1}
p↑-p↑*	56	70	1	20	6×10^{30}	4×10^{30}	0.9 pb^{-1}
d-Au	55	110d / 0.7Au	2	15	7×10^{28}	2×10^{28}	4.5 nb^{-1}

Brief and compact table with the facility's major experimental instrumentation and its capabilities:

RHIC Facility:

The instrumentation at RHIC consists of four collider detectors designed to provide complementary capabilities form measurements of high energy collisions of heavy nuclei and of spin-polarized protons. Each detector occupies one of the six beam-crossing regions in the RHIC ring.

BRAHMS Detector – two instrumented particle spectrometers

PHOBOS Detector – full solid angle Si detector spectrometer with magnet

PHENIX Detector – magnetic spectrometer with many detector systems for measurement of hadrons, electrons, muons, and photons

STAR Detector – Large solid-angle tracking with time projection chamber, followed by electromagnetic calorimetry, in a solenoidal magnetic field.

Nature of user facility:

DOE Designated National User Facility

Number of actual, active users of the facility in a given year:

RHIC has an active user community of about 1000 users registered with the Users Office

13% BNL users; 37% other U.S. users; 50% international users

[The numbers are based on active guests appointments as of 10/1/04.]

User Group:

A formal users group exists. Its membership includes all guests involved in research at the RHIC complex including AGS, ATF, Tandem, and NSRL accelerators. Current membership is 1498.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) Total staff 473

b) Staff with doctoral degrees:

i) Permanent 75
ii) Temporary and postdoctoral 50

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

a. Permanent Staff: 3

b. Temporary and Postdoctoral: 5

Number of postdoctoral researchers:

~ 20

Number of graduate students resident at the facility:

5-10

Number of non-resident graduate students with thesis work primarily done at the facility:

> 60

Involvement of undergraduate students in research (approximate average number per year): ~ 20 **Special student programs:**

Undergraduate and summer students (physics & engineering): ~ 20

High school students and teachers: ~ 40

Future Plans:

At its inception, in 2001, the RHIC collider and detectors were configured to search for new forms of strongly interacting matter, e.g. the Quark Gluon Plasma, in high-energy nuclear collisions, and to provide unique capability to measure the spin structure of the nucleon in terms of the contributions from its constituent partons. The early discoveries at the facility have opened the way for a new field of research exploring fundamental properties of condensed strongly interacting matter in high-density states described by the theory of quantum chromodynamics (QCD). To pursue this extended program Brookhaven is proposing a facility upgrade project called RHIC II. This will increase the luminosity of the present colliding ion beams by an order of magnitude, using techniques of electron beam cooling that are presently under development. RHIC II will also upgrade the detector capability of the facility, to provide high-rate sensitivity to the radiation of quarks, photons, and leptons created during the earliest stages of the collisions, thus sampling the phase boundary between quark matter and nuclear matter. The construction of RHIC II is proposed to begin in 2009.

BNL also proposes to add a 10 GeV polarized electron beam to the facility, providing high-energy, high-luminosity electron nucleus and polarized electron-proton collisions, with a new detector in a dedicated collision region. The eRHIC project will provide a new scale of precision measurements for quark and gluon structure of the nucleon, including spin-dependent structure functions at smaller distance scales (Feynman-x) than any previous experiment. It will also provide, in electron-nucleus collisions, a unique means for studying partonic matter under extreme conditions – exploring the postulated universal form of hadronic matter, the Color Glass Condensate, a condensed state of gluons that may be the initial state from which the Quark Gluon Plasma evolves in heavy ion collisions. Construction of eRHIC is planned to begin in 2012.

SUPERCONDUCTING ACCELERATOR LABORATORY AT FLORIDA STATE UNIVERSITY

Tallahassee, Florida 32306 USA

Prof. S. L. Tabor
Physics Department
Florida State University
Tallahassee, Fl 32306-4350

Telephone: (850) 644-5528
Fascimile: (850) 644-4478
Email: tabor@nucmar.physics.fsu.edu

University Institute

U.S. National Science Foundation
Florida State University

University President T.K. Wetherall

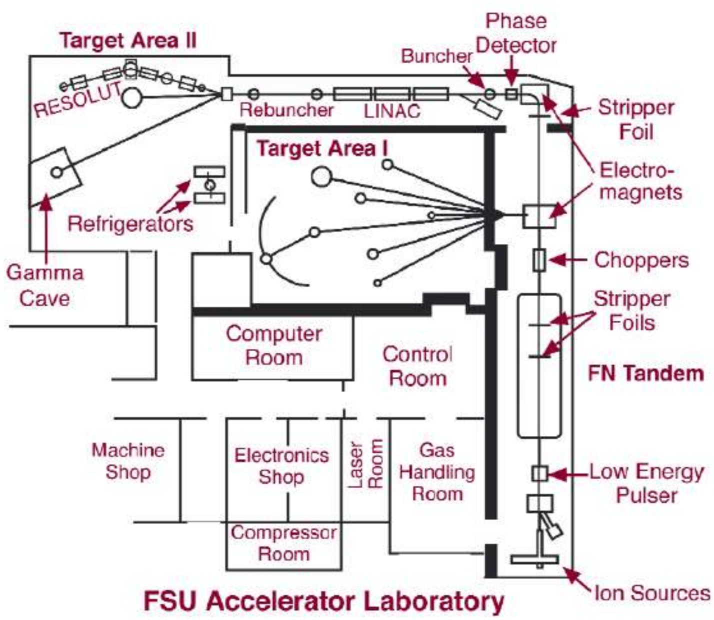
Head of the facility:

Prof. Samuel L. Tabor

Scientific Mission and Research Programs:

The mission of the laboratory is forefront research in nuclear physics and the education of graduate students. The major research programs are the study of nuclear reactions induced by polarized Li beams and unpolarized radioactive beams, the structure of nuclei at high angular momentum, the structure of nuclei far from stability using both stable and radioactive beams, and reactions of importance in astrophysics.

Technical facilities:



Characterization of the facility:

9 MV tandem Van de Graaff accelerator injecting into a superconducting LINAC

Facility Parameters:

Particle	enA	Max Energy (MeV)	Properties
^{1}H	1000	20	
^{4}He	500	40	
$^{6,7}Li$	300	50	highly polarized
^{12}C	1000	100	
^{14}C	200	100	radioactive
^{16}O	2000	150	
^{28}Si	1000	180	
^{32}S	1000	200	
^{35}Cl	800	220	

Major experimental instrumentation and its capabilities:

1)Polarized Lithium ion source
2)Dedicated 14C ion source
3)Gamma detection array
4)In-flight radioactive beam line RESOLUT
5)Scattering chambers, charged particle detectors
6)Neutron detector array

Nature of user facility:

Not a user facility

Program Advisory Committee/experiment proposals:

No PAC

Number of actual, active users of the facility in a given year:

Number of active users averaged over the last 5 years is 25 per year, including faculty, postdocs, and graduate students

Percentage of users, and percentage of facility use that come from inside the institution:

Estimated at 80% averaged over last 5 years

Percentage of users and percentage of facility use from national users:

10%

Percentage of users and percentage of facility use from outside the country where your facility is located:

10%

Fraction of the international users from outside geographical region:

100%

User Group:

No formal users' group

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) 9 faculty and 8 technical staff

b) 3 postdocs and 16 graduate students

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

a) 4 faculty

b) 1 postdoc and 7 graduate students

Number of postdoctoral researchers:

5

Number of graduate students resident at the facility:

19

Number of non-resident graduate students with thesis work primarily done at the facility:

1

Involvement of undergraduate students in research (approximate average number per year):

~8 per year

Special student programs:

Research Experience for Undergraduates, Summer Junior Fellows program for high school students

Future Plans:

Acquiring a new 210 W He liquifier and a new liquid He transfer system.

Planning to add superconducting resonators to increase the maximum energy and mass of beams.

THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY (JEFFERSON LAB)

Newport News, Virginia; USA

12000 Jefferson Avenue,
Newport News, VA 23606
http://www.jlab.org

Telephone:757-269-7100
Facsimile: 757-269-7398
E-mail: awthomas@jlab.org

Jefferson Lab is a user facility managed and operated by Jefferson Science Associates, LLC (JSA) for the U.S. Department of Energy.

Department of Energy Office of Science for Nuclear Physics
Work for Others funded by the U.S. Department of Energy and the U.S. Department of Defense

Christoph W. Leemann, Director

Heads of the facility:

Anthony Thomas, Chief Scientist
Lawrence Cardman, Experimental Nuclear Physics
Andrew Hutton, Accelerator
George Neil, Free-Electron Laser

Scientific Mission and Research Programs:

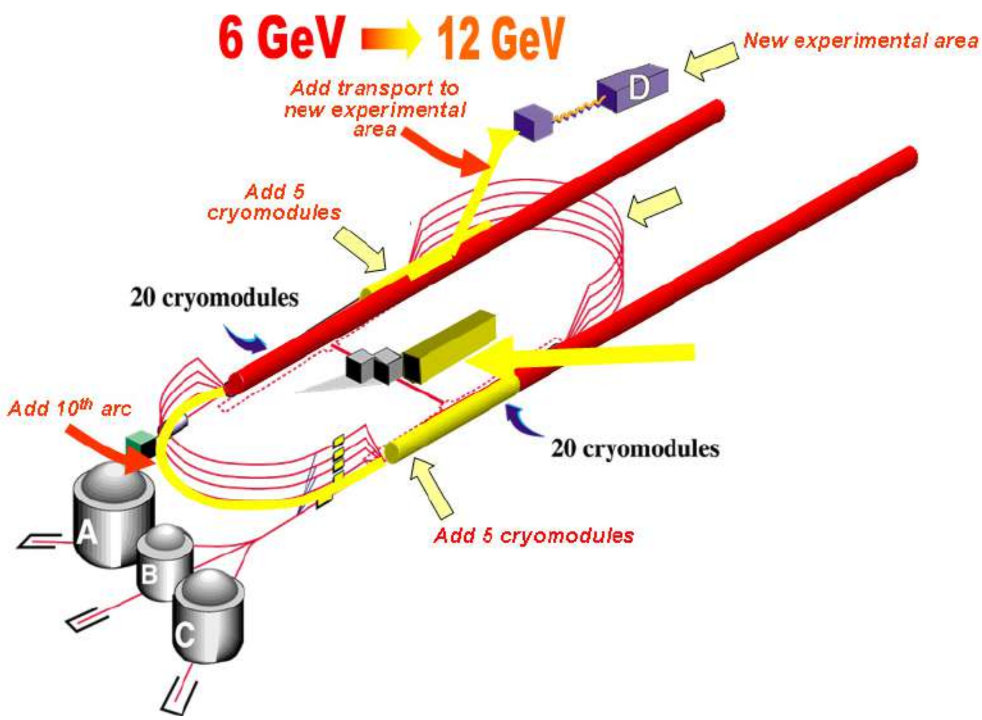
The Department of Energy's Thomas Jefferson National Accelerator Facility, or Jefferson Lab (JLab), is a basic nuclear physics research laboratory built to probe the nucleus of the atom to learn more about the quark structure of matter. Its high energy (6 GeV), high current (up to 200 μA) cw electron beams and associated experimental equipment offer unique research capabilities to its international user community. Jefferson Lab is also a leader in Superconducting Radiofrequency (SRF) accelerator technology, an enabling technology for the main research accelerator as well as the record-breaking Jefferson Lab Free-Electron Laser (FEL) that has delivered 10 kW of infrared light for basic and applied science.

Characterization of the facility:

Jefferson Lab features a continuous wave recirculating electron accelerator providing beams from 0.05 to 6 GeV at 100 picoamps to 200 microamps. The Continuous Electron Beam Accelerator Facility (CEBAF) can provide beams simultaneously to three experimental halls with complementary experimental equipment. Jefferson Lab also houses the Free Electron Laser (FEL) designed to provide 10 kW of laser light with picosecond pulse length, transform-limited bandwidth and diffraction-limited emittance.

Technical facilities:

Aerial photo of the Jefferson Lab accelerator site



CEBAF Schematic

One of the Jefferson Lab's two superconducting linear accelerators

Facility Parameters:

Continuous Electron Beam Accelerator Facility (CEBAF) parameters:

– Energy: up to 6 GeV
– Current: nA to 200 μA
– Polarization: > 75%
– Relative Energy Spread and Stability: ~10^{-5}
– Pulse Structure: 31.5 MHz to 1500 MHz
– Beam Power: up to 800 kW
– Controlled Helicity Correlated Properties: <10^{-6} level

Free-Electron Laser parameters:
– Average Power: > 10,000 W
– Wavelength range: 1-14 microns
– Micropulse energy: up to 300 mJ
– Pulse length: ~0.1-2 ps FWHM nominal
– PRF: 74.85 MHz ÷ 2x down to 4.68 MHz
– Bandwidth: ~ 0.2–3 %
– Timing jitter: < 0.2 ps
– Amplitude jitter: < 10% p-p
– Wavelength jitter: 0.02% RMS
– Position/Angle jitter: < 100 um, 10 μrad
– Polarization: linear, > 100:1
– Transverse mode: < 2x diffraction limit
– Beam diameter at lab: 2 - 6 cm

Major experimental instrumentation and its capabilities:

CEBAF (Superconducting Radio Frequency Accelerator):

From 0.05 to (currently) 6 GeV, 100 picoamps to 200 microamps, continuous-wave electron accelerator, upgradeable to ~25 GeV. Simultaneous beams to three experimental Halls with polarization exceeding 75%.

Hall A: Two high-resolution magnetic spectrometers

Hall B: Large acceptance superconducting toroidal magnet system for detecting multiparticle final states (capable of handling 1 Tbyte/day)

Hall C: Two general-purpose spectrometers (one high resolution and one for short-lived final states) and experiment-specific equipment

Superconducting Radio Frequency Technology Facility:

Superconducting accelerator cavity fabrication, surface treatment, cryomodule assembly and test, and research facilities

FEL User Facility: IR/UV upgrade free-electron laser designed to provide 10 kW of laser light with picosecond pulse length, transform-limited bandwidth, and diffraction-limited emittance

LQCD Aggregate Computer: A one Tflop/s commodity-PC-based system to be upgraded to mutli-Tflop/s system in 2005

Applied Research Center: In collaboration with local colleges/universities and the City of Newport News, share cooperative R&D laboratories in lasers, plasmas and materials

Nature of user facility:

DOE Designated National User Facility

Program Advisory Committee/experiment proposals:

Yes

Number of actual, active users of the facility in a given year:

Jefferson Lab has over 2200 registered users with over 1200 actively involved in experiments.

Percentage of users, and percentage of facility use that come from inside the institution:

As a user facility, very little of the research at Jefferson Lab is conducted by scientists in-house, we would estimate JLab staff to be ~4% of our user community (1285 total active users, including 55 JLab staff and 1230 non-JLab scientists).

Percentage of users and percentage of facility use from national users:

61%

Percentage of users and percentage of facility use from outside the country where your facility is located:

39%

Fraction of international users outside of geographical region:

36% are from outside North America

User Group:

The Jefferson Lab Users Group has over 2200 members and its work is coordinated by the Use Group Board of Directors (UGBOD). The Chair of the UGBOD represents the users with the Program Advisory Committee and JSA and with the Laboratory Director.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) 638 b) 106

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

13 Permanent; (5 Laboratory scientists plus 8 in joint positions with local universities); 6 Postdocs; 12 Graduate Students

Number of postdoctoral researchers:

11 employed by laboratory directly; others employed by user community

Number of graduate students resident at the facility:

75-80 (depends on the time of year)

Number of non-resident graduate students with thesis work primarily done at the facility:

80-90 (there are 153 PhDs in progress that include a significant component of JLab-research; 60-75 are "resident" and 80-90 are "non-resident")

Involvement of undergraduate students in research (approximate average number per year):

70/year

Special student programs:

- Laboratory programs involve more than 10,000 students each year; they include:
- Hampton University Graduate Student Program (HUGS)
- Becoming Enthusiastic About Math and Science (BEAMS)
- Science Lectures for High School and Middle School Students (Science Series Lectures)
- Physics Fest
- The Department of Energy's Science Undergraduate Laboratory Internships (SULI)
- Pre-Service Teacher Program – for undergraduate students having decided on a teaching career in math or science
- Jefferson Lab High School Summer Honors Program
- Graduate Student Seminar Series
- SURA Fellowship at JLab Program (for Graduate Students)
- Summer Detector and Computer Lecture Program
- SURA/JLAB Thesis Prize Program

Future Plans:

Jefferson Lab has received second-stage approval (Critical Decision 1) for an upgrade of the CEBAF accelerator to 12 GeV in order to provide new insights into the structure of the nucleon, the transition between hadronic and quark/gluon descriptions of matter, and the nature of quark confinement. This facility will have unique capabilities world-wide for exploring non-pertubative QCD and hadron and nuclear structure in the valence region. The Free-Electron Laser UV upgrade to cover the range down to 250 nm at 1 kW average power levels is underway. Further plans include 100kW operation in the IR. Long-range plans for a second upgrade of CEBAF under consideration include both higher energy (~25 GeV) high luminosity fixed target capability and a high luminosity electron light-ion collider (ELIC) with a center of mass energy of order 65 GeV

TRIANGLE UNIVERSITIES NUCLEAR LABORATORY (TUNL)

Durham, NC, U.S.A.

Department of Physics
PO Box 90308
Duke University
Science Drive
Durham, NC 27708-0308

Three-University Facility
http://fds.duke.edu/
Telephone: 919-660-2637
Email: howell@tunl.duke.edu

Duke, State of North Carolina
Department of Energy Office of Science for Nuclear Physics

Director Prof. Calvin Howell

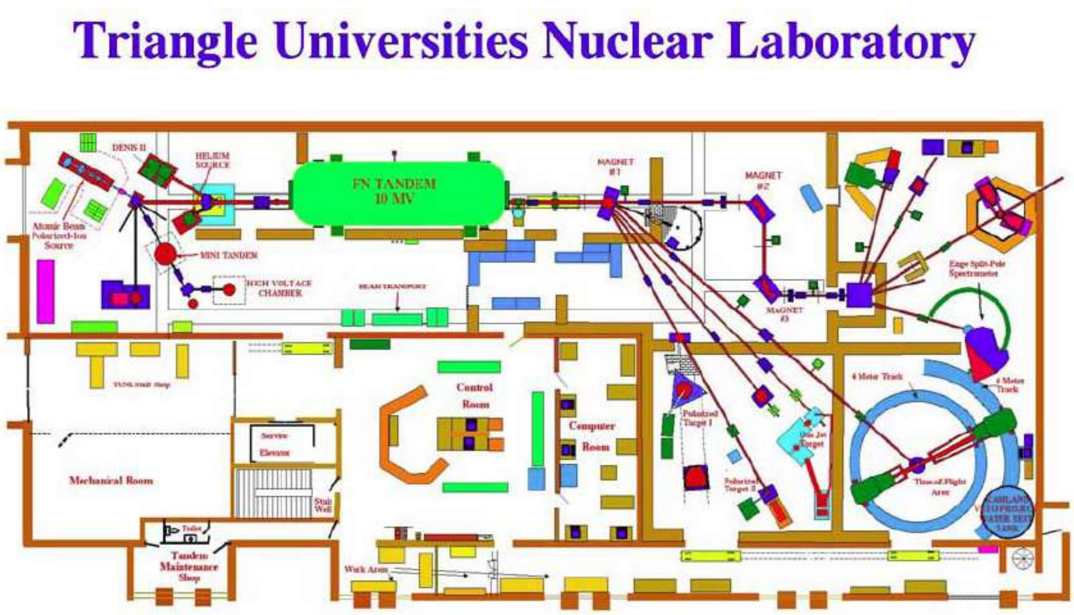
Head of the facility:

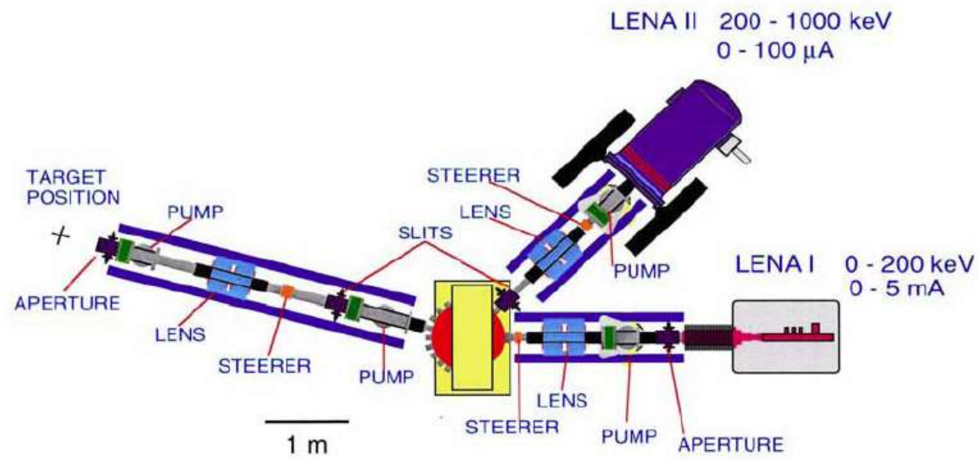
Director Prof. Calvin Howell

Scientific Mission and Research Programs:

- Studies of fundamental interactions and symmetries.
- Subnucleonic degrees of freedom, nucleon-nucleon interactions, and few-nucleon systems, with the aim of testing and refining our description of nucleons and the nuclear force and its currents.
- Nuclear astrophysics, with emphasis on measurements which are important for solar physics, neutrino physics, and stellar evolution and nucleosynthesis
- Nuclear many-body problems

Technical facilities:





Briefly characterized the facility:

Tandem Van de Graaff,

light unpolarized and polarized ions and MeV neutron beams, CW or pulsed,

low-energy accelerators, light ions

Compact (exemplary) table of facility parameters:

Parameters	FN – Tandem Van de Graaff	LEBAF	LENA
E_{max} (p, d)	20 MeV	680 keV	200 keV/1 MeV
Pulse width	DC to 1 ns	DC	DC
I_{max} on target:			
Unpolarized	5 μA	400 μA	1 mA / 100 μA
Polarized	3 μA	50 μA (+), 3 μA (-)	
Beams	p, d, ^{3}He, ^{4}He, and heavier ions	p, d, ^{3}He, ^{4}He	p
ΔE	<500 eV	<200 eV	~100 eV/ ~250 eV

Brief and compact table of the facility's major experimental instrumentation and its capabilities:

Polarized Ion Source
Polarized Targets
Enge Split-pole Spectrograph
Neutron-time-of-flight spectrometer
Shielded neutron source

User facility:

No

Program Advisory Committee/experiment proposals:

Yes

Number of actual, active users of the facility in a given year:

60

Percentage of users and percentage of facility use that come from inside the institution:

90/90

Percentage of users and percentage of facility use from national users:

98/98

Percentage of users and percentage of facility use from outside the country where your facility is located:

2/2

Fraction of international users outside of geographical region:

100% Europe

Users group:

No

Number of a) permanent staff and b) temporary staff:

a) 25 b) 40

Number of theoretical staff employed at the facility:

None

Number of postdoctoral researchers:

10

Number of graduate students resident at the facility:

30

Number of non-resident graduate students with thesis work primarily done at the facility:

0

Involvement of undergraduate students in research:

3 during semester, 15 during summer

Special student programs:

NSF-REU

Future Plans:

see High-Intensity Gamma-ray Source (HIGS)

TANDEM ACCELERATOR LABORATORY
WESTERN MICHIGAN UNIVERSITY

Kalamazoo, Michigan

Physics Department
Western Michigan University
MS 5252,
Kalamazoo MI 49008

Telephone: 269-387-4941
Fascimile: 269-387-4939
Email: lori.krum@wmich.edu
(Department administrative assistant)

University Institute
University funds for operation
NSF MRI grant for recent facility upgrade

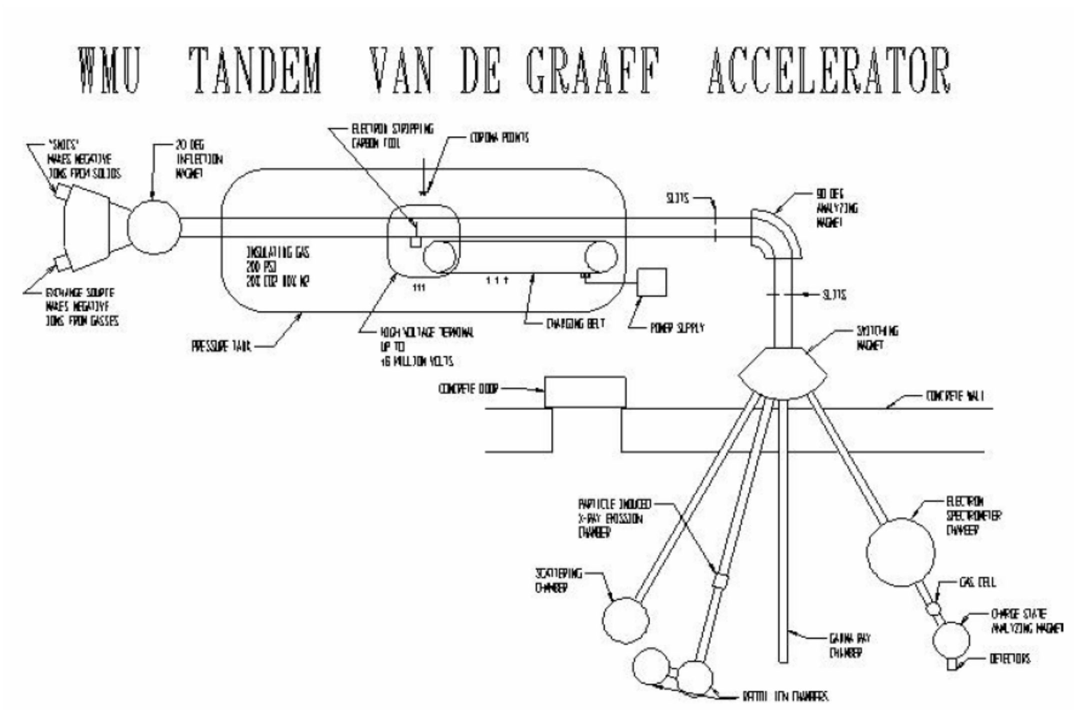
Judith Bailey, President

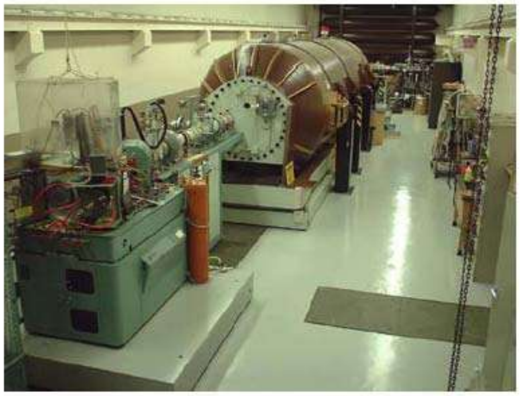
Scientific Mission and Research Programs:

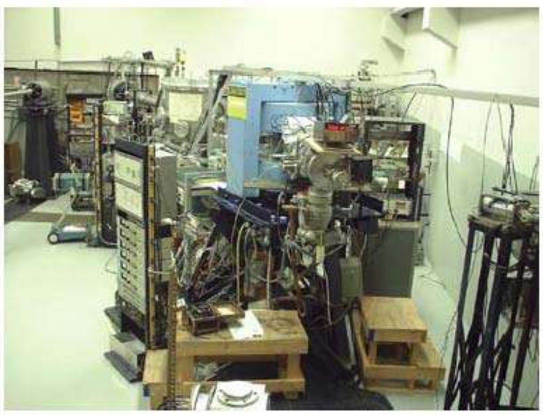
The tandem accelerator facility serves a broad spectrum of research activities including atomic, nuclear, condensed matter, and applied physics.

Also, the laboratory serves educational goals by providing undergraduate and graduate student laboratory experience, is used in PhD thesis research of graduate students, and supports outreach programs to local secondary-school students.

Technical facilities:







Tandem schematic layout and photographs of the tandem and the beam line.

Characterization of the facility:

6 MV EN Tandem accelerator, light ion beams (H to Cu)

Facility Parameters:

Typical beams (not all-inclusive list):
^{1}H 2-12 MeV 1pμA
^{4}He 2-20 MeV 100pnA
^{12}C 4-30 MeV 1pμA
^{37}Cl 4-40 MeV 1pμA
^{63}Cu 4-40 MeV 1pμA

Major experimental instrumentation and its capabilities:

Electron and Ion spectrometer for energy and angular analysis
General purpose scattering chamber (usable for Rutherford Backscattering Analysis)
PIXE apparatus

X-ray and γ-ray spectroscopy instrumentation

Nature of user facility:

No

Program Advisory Committee/experiment proposals:

No

Number of actual, active users of the facility in a given year:

8-10 (faculty, staff, graduate students)

Percentage of users, and percentage of facility use that come from inside the institution:

Nearly all

Percentage of users and percentage of facility use from national users:

Occasional

Percentage of users and percentage of facility use from outside the country where your facility is located:

Occasional

Fraction of the international users from outside geographical region:

All

User Group:

No

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) 4-5
b) 4-5

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

0

Number of postdoctoral researchers:

Presently 0

Number of graduate students resident at the facility:

3-4

Number of non-resident graduate students with thesis work primarily done at the facility:

0

Involvement of undergraduate students in research (approximate average number per year):

3-4

Special student programs:

Modern physics laboratory, Advanced laboratory for graduate students, Kalamazoo Area Math and Science Center Mentorship projects

Future Plans:

New Pelletron charging system recently installed, new data acquisition system.

WRIGHT NUCLEAR STRUCTURE LABORATORY

Yale University, New Haven, CT, USA

Wright Nuclear Structure Laboratory
Yale University
P.O.Box 208124
New Haven, CT USA 06520-8124

Telephone: 203-432-3090
Facsimile: 203-432-3522
http://wnsl.physics.yale.edu/

University

U.S. Department of Energy

Richard Levin, President, Yale University

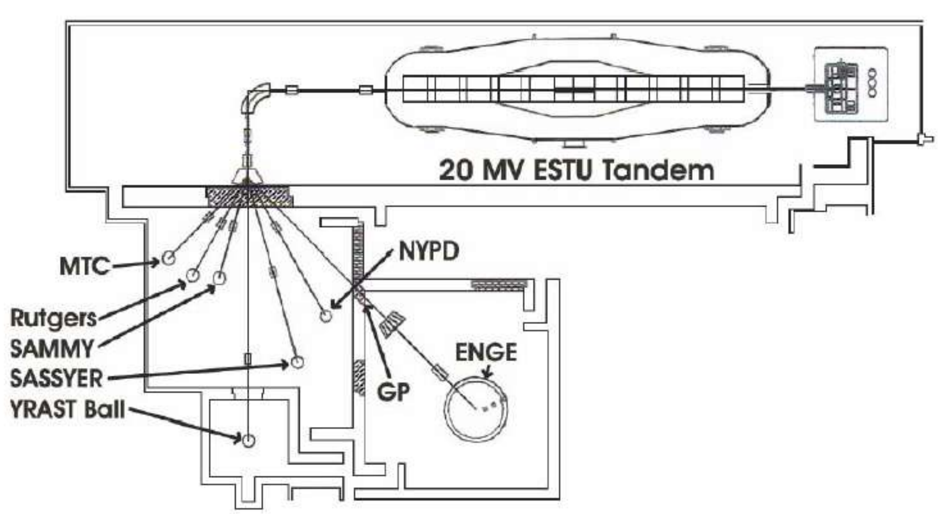
Head of the facility:

Prof. Richard Casten, Director WNSL

Scientific Mission and Research Programs:

The overall scientific mission of this Laboratory is the study of nuclear structure and nuclear astrophysics, and the education and mentoring of graduate students and post-docs. The principal research themes in nuclear structure are the study of structural evolution, phase transitional behavior, collective modes in heavy nuclei, proton-neutron interactions and excitation modes, the spectroscopy of heavy nuclei, and the study of exotic nuclei. In astrophysics the primary emphasis is on the study of reactions important for stellar evolution and explosive nucleosynthesis. Both these programs involve measurements using stable beams at the Yale tandem facility and complementary stable and radioactive beam experiments at other laboratories, primarily in North America and Europe.

Technical facilities:



Characterization of the facility:

20-MV Tandem Van de Graaff accelerator

Technical facilities:

Examples (a much broader range of beams is available)

Beams and Energies [MeV]		
Species	**Lowest Run**	**Highest Run**
H-1	16	28
H-2	30	30
He-4	30	30
Li-6	42	42
Li-7	22	54
B-10	20	35
B-11	35	90
C-12	35	116
N-14	40	130
N-15	70	71
O-16	31	140
F-19	25	108
Si-28	40	85
S-32	60	125
Cl-35	65	135
Cl-37	120	170
Ca-40	165	165
Cr-50	150	160
Ni-58	210	325
Ni-60	103	103
Ni-62	100	100
Se-74	230	230
Se-76	230	230
Se-78	230	230
Se-80	230	230
Se-82	230	230
Br-79	240	290
Br-81	290	290
Te-120	220	220
Te-124	220	220
Nd-142	190	190
Nd-145	190	190
Yb-170	200	200
Os-188	267	270
Os-189	268	268
Os-190	200	250
Os-192	270	270

Major experimental instrumentation and its capabilities:

1. YRAST-Ball – an array of 30 Ge detectors (including 11 clover detectors)

2. SASSYER – gas-filled magnetic spectrometer

3. NYPD – plunger device for picosecond range lifetime measurements

4. MTC – moving tape collector for β-decay and angular correlation studies

5. SAMMY – superconducting magnet for g-factor studies

6. ICEY Ball for conversion electron studies

7. Rutgers g-factor beam line

8. Enge Split-Pole Magnetic Spectrometer – Charged Particle Spectroscopy

9. Beam lines for irradiation testing of semiconductor components

Nature of user facility:

Unofficially (many users annually – no PAC)

Program Advisory Committee/experiment proposals:

No

Number of actual, active users of the facility in a given year:

60 (count of users)

Percentage of users, and percentage of facility use that come from inside the institution:

The answer depends a little on the definition. If we consider users who come in for an experiment the numbers for inside use are 70% and 70%. However, we have a number of foreign resident students who spend 6 months to a year at WNSL. If they are considered outside users, the numbers are about 50% and 50%.

Percentage of users and percentage of facility use from national users:

15% of users

15% of users

Percentage of users and percentage of facility use from outside the country where your facility is located:

See above. Either 15% /15% or 35% / 35%.

Fraction of international users outside of geographical region:

95%

User Group:

No

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) 30

b) 6

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

0

Number of postdoctoral researchers:

3-4

Number of graduate students resident at the facility:

~12

Number of non-resident graduate students with thesis work primarily done at the facility:

~5-10

Involvement of undergraduate students in research (approximate average number per year):

3

Special student programs:

Perspectives in Science Program for sophmores

Senior Thesis projects, miscellaneous smaller projects

TANDAR LABORATORY
COMISIÓN NACIONAL DE ENERGÍA ATÓMICA
PHYSICS DEPARTMENT

Buenos Aires, Argentina

Av. General Paz 1499
San Martín
Pcia. de Buenos Aires
B1650KNA
Argentina

Telephone: (54-11) 67 72 71 16
Facsimile: (54-11)67 72 71 21
Email: duran@tandar.cnea.gov.ar
www.tandar.cnea.gov.ar/

Governmental agency
Government budget (CNEA)
Funding agencies (mainly CONICET and ANPCYT)

Dr. José Abriata (President of CNEA)

Head of the facility:

Dr. Daniel Abriola

Scientific Mission and Research Programs:

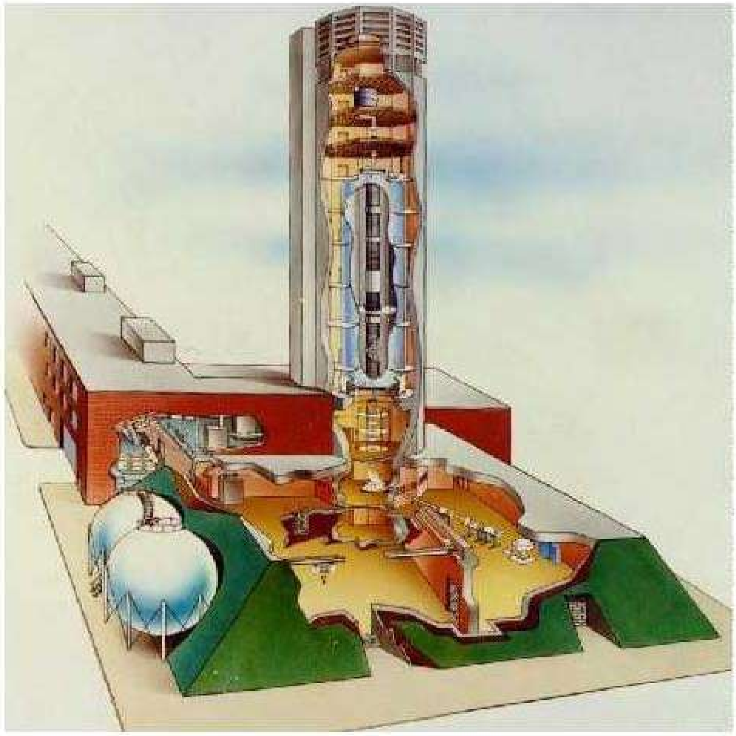
The main experimental and theoretical research lines related to Nuclear Physics and its applications are the following:

Low-energy nuclear physics: Nuclear structure, nuclear reactions, collective nuclear excitations and giant resonances. Search for chaotic phenomena in nuclear scattering; break-up reactions and their influence on fusion reactions involving weakly bound nuclei; fusion barrier distributions.

High-energy nuclear physics: Hadronic models based on QCD. Phase structure of strong interactions.

A result of basic research activities has been the application of various experimental nuclear physics techniques to other fields of knowledge: biomedicine, environment, material science, nuclear astrophysics. In the biomedical area it is worth mentioning a project related to accelerator-based Boron Neutron Capture Therapy (BNCT), including aspects related to the development of a high-intensity low-energy proton accelerator. A heavy-ion microbeam facility for the study of biological and physical problems with high spatial resolution has recently started to operate.

Technical facilities:



Characterization of the facility:

20 MV electrostatic tandem accelerator

Facility Parameters:

An example of frequently used beams are: protons, lithium, beryllium, carbon, oxygen, fluorine, sulphur, nickel, iodine, gold, with typical on-target intensities in the range of 1 to 100 particle-nanoamperes and energies of a few MeV/nucleon.

Major experimental instrumentation and its capabilities:

Microbeam facility (beam spots of about 1□m^2) with high resolution X-ray detection.

QDD magnetic spectrometer.

External beam facility with on-line dose determination.

Heavy-ion identification based on a time-of-flight facility (start and stop signals derived from micro-channel plates) followed by a Bragg spectrometer.

30-inch diameter multipurpose scattering chamber.

Nature of user facility:

Unofficially, user facility

Program Advisory Committee/ experiment proposals:

No

Number of actual, active users of the facility in a given year:

Approximately 25 active users

Percentage of users, and percentage of facility use that come from inside the institution:

An estimated 90% of the users come from inside the institution.

An estimated 90% of the facility use comes from inside the institution.

Percentage of users and percentage of facility use from national users:

An estimated 90% of the users come from national users.

An estimated 90% of the facility use comes from national users.

Percentage of users and percentage of facility use from outside the country where your facility is located:

An estimated 10% of the users come from outside the country.

An estimated 10% of the facility use comes from outside the country.

Fraction of the international users from outside of geographical region:

Less than 10%

User Group:

40 registered members in the users group:

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) Total laboratory staff (all categories): 52

b) Scientists staff with doctoral degree: 22

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

15

Number of postdoctoral researchers:

3

Number of graduate students resident at the facility:

5

Number of non-resident graduate students with thesis work primarily done at the facility:

None

Involvement of undergraduate students in research (approximate average number per year):

10

Special student programs:

An extension course for senior high-school students is carried out yearly (once a week; from April to November)

LABORATÓRIO ABERTO DE FÍSICA NUCLEAR – LAFN
UNIVERSIDADE DE SÃO PAULO
INSTITUTO DE FÍSICA

Departamento de Física Nuclear
LAFN – Laboratório Aberto de Física Nuclear

Campus of USP –
City of São Paulo, Brazil

Laboratório Aberto de Física Nuclear – LAFN
Departamento de Física Nuclear - IFUSP
C. P. 66318
05314-970 São Paulo, SP
BRAZIL

Telephone: 55-11-3091-6939/ 55-11-3091-7100
Facsimile:55-11-3031-2742
Email: seclinac@dfn.if.usp.br
http://www.dfn.if.usp.br/
www.dfn.if.usp.br/pagina-lafn/index.html

The LAFN is part of the Nuclear Physics Department of the Institute of Physics, University of São Paulo, a public university funded by the Government of the State of São Paulo.

Operation (including salaries), is funded by the University. Maintenance, upgrades, etc. are funded by several state agencies like FAPESP (State of São Paulo), CNPq and Finep (federal).

Dmitri M. Guitman – Head of the Nuclear Physics Department

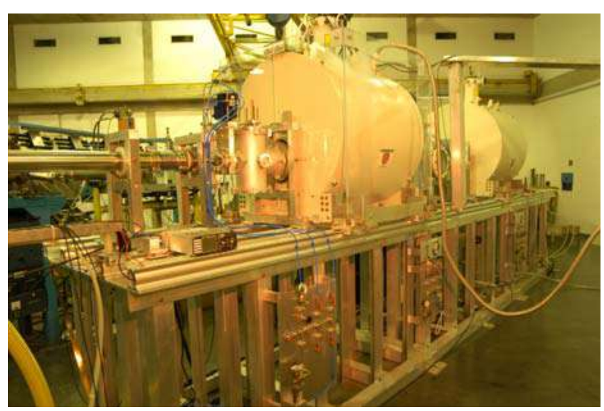
Head of the facility:

Dirceu Pereira - Director of LAFN (until March 2005)
Roberto Vicençotto Ribas – Director of LAFN (from March 2005-March 2007)

Scientific Mission and Research Programs:

The LAFN is a low energy nuclear physics laboratory, devoted both to basic and applied nuclear physics. Research is mainly in Nuclear Reactions (light and heavy ions), Nuclear Structure and Material Analysis. Recently a device to produce a secondary radioactive beam has been installed and research with Radioactive Beams is also underway. A large part of the research programs involve graduate students from USP.

Technical facilities:



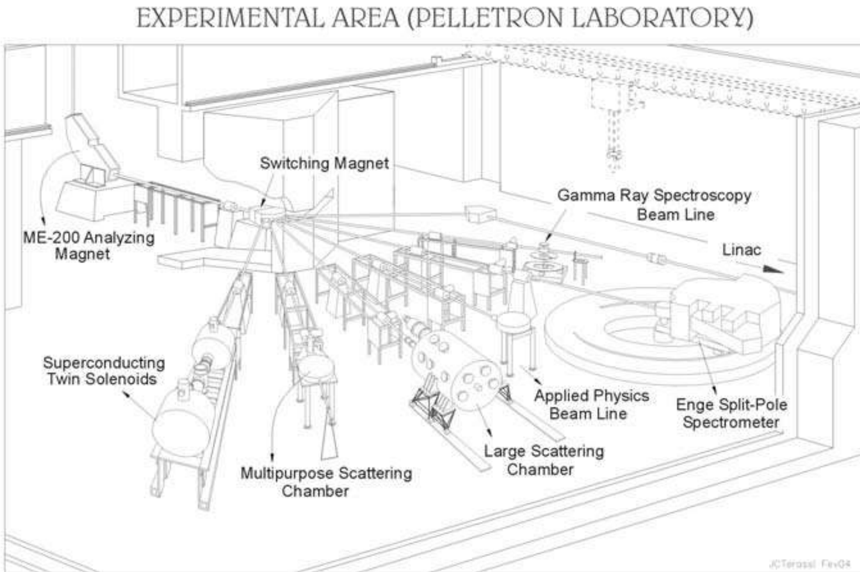


Fig. 1: RIBRAS (Radioactive Ion Beams Brasil) facility consisting of double superconducting solenoids of 6.5 T, installed in the LAFN(Laboratorio Aberto de Fisica Nuclear)

Characterization of the facility:

NEC 8UD (8 MV) Tandem electrostatic accelerator. A superconducting linear accelerator for heavy- ions is under construction.

Facility Parameters:

Stable Beams: p, d, ^{6,7}Li, ^{10,11}B, ^{12,13}C, ^{16,17,18}O, ^{19}F, ^{28,29,30}Si, ^{35,37}Cl

Intensities: from ~0.3 to ~2 microAe

Energies: 16 MeV (p) to 80 MeV (Si)

Radioactive ion beams delivered by RIBRAS (Radioactive Ion beams Brasil) facility:

^{8}Li (10^{6} pps/microAe, E< 32 MeV)

^{6}He (10^{5} pps/microAe, E<28 MeV)

^{7}Be (10^{5} pps/microAe, E<31 MeV)

Major experimental instrumentation and its capabilities:

RIBRAS: 2 Superconducting solenoids (for secondary radioactive beam)

General purpose scattering chamber (about 50 cm radius)

Large volume scattering chamber (about 80 cm radius, ~2 m long)

Gamma-ray spectrometer (4 HPGe with AC shield + particle ball)

Nature of user facility:

Yes, unofficially. Even if owned by the University, the facility is operated like a National Lab. and is open to users from all Institutions.

Program Advisory Committee/experiment proposals:

Yes. The PAC consists of five members, one from outside Brazil and meets once in the year. 200 days/year are distributed, 5days /week, 24h/day. Last PAC meeting had 440 days requested and 200 approved.

Number of actual, active users of the facility in a given year:

Average from last two years: about 100 (researchers and graduate students) were involved in experiments approved by the PAC and effectively realized.

Percentage of users, and percentage of facility use that come from inside the institution:

About 90% of the users are from the home institution. Nonetheless, the number of outside users is increasing and from the experiments proposed at the last PAC, we expect about 20% of outside users for the current year.

Percentage of users and percentage of facility use from national users:

All users are, with rare exceptions, from Brazilian institutions.

Percentage of users and percentage of facility use from outside the country where your facility is located:

Until recently very little, except for eventual collaborators of the local groups.

However recently the RIBRAS facility is attracting international collaborators (Argentina, Cuba, Japan, Spain, France)

Fraction of the international users from outside of geographical region:

Recently the RIBRAS facility is attracting international collaborators (Japan, Spain, France)

User Group:

Yes, the formal user's group has 100 members. Every year the users group leader is elected by the users.

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) 17 faculty staff and 30 technical staff

b) 17 faculty staff

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

3 staff members and 10 pos-docs and students.

Number of postdoctoral researchers:

8

Number of graduate students resident at the facility:

34

Number of non-resident graduate students with thesis work primarily done at the facility:

6

Involvement of undergraduate students in research (approximate average number per year):

20

Special student programs:

Yes. Every two years there is a training program (about 3 month duration) four undergraduate students join the lab and four fresh graduate students coming from other institutions.

The staff members of the facility also participate actively in the organization of Biennal Nuclear Physics Summer Schools (theoretical and experimental) with participation of many students from over all Brazil and South America.

In Feb 2004 we held the XII Jorge Andre Swieca Experimental Nuclear Physics Summer School a 2 week of duration involving, 50 students from all South America using the RIBRAS facility that has just begun its operation.

In Feb 2005 we held the XII Jorge Andre Swieca Theoretical Nuclear Physics Summer School, a 1 week of duration and 70 students from all South America, where Prof. Shiguero Kubono from Tokyo, Prof. Jeff Tostevin from Surrey, Prof. Brian Serot from Indiana, and Dr R. Clark from LBL were some of the lecturers.

Future Plans:

The main goal for the near future is to finish the installation of the LInac post-accelerator, that has been delayed for many years due to financial difficulties. The new Radioactive Beam facility (RIBRAS) that became operational in January 2004 brought new research possibilities and several groups have many new experiments approved that will use this device.

VAN DE GRAAFF LABORATORY
CATHOLIC UNIVERSITY

Rio de Janeiro, Brazil

Rua Marquês de São Vicente,225 CP 38071
22452-970 Rio de Janeiro, Brazil

www.vdg.fis.puc-rio.br
Telephoe: (55-21) 3114.1272
Fascimile: (55-21) 3141.1271

University Laboratory - Department of Physics

Private

Pe. Jesus Hortal, S.J.

Head of the facility:

Prof. Rodrigo Prioli

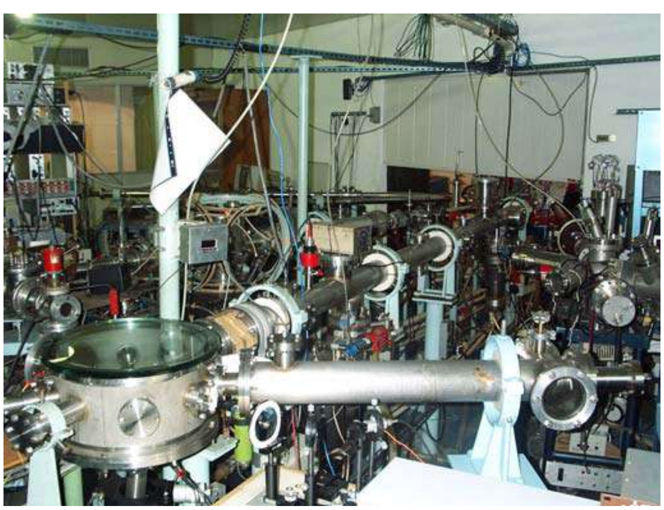
Scientific Mission and Research Programs:

The Laboratory started in the 70´s, as a Nuclear Physics Lab.

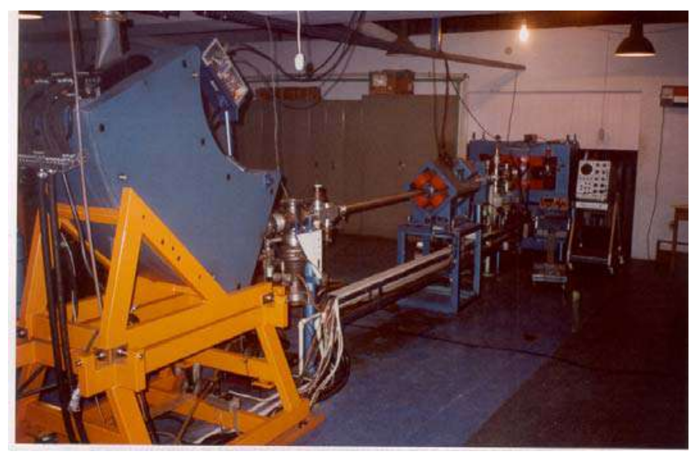
In the 80´s the activities were directed towards applications such as Material Science (RBS, PIXE), Environment Analysis and Atomic Physics research. In the 90´s, the lines on Atomic Collisions in gases and Surface Physics & Analysis were included.

Nowadays, Nanotechnology and Biological Material Analysis are also included.

Technical facilities:



Experiment Room



90^o magnet

Characterization of the facility:

The accelerator is a 4 MeV single end Van de Graaff.

Facility Parameters:

Proton to argon beams.

Radiofrequency ion source.

Analyzing magnet: ME = 40

Major experimental instrumentation and its capabilities:

Several TOF systems for ion detection. (identification, angular and energy distributions)

RBS and PIXE systems

Nature of user facility:

It is operated by the staff members, very often with external cooperation.

Program Advisory Committee/experiment proposals:

No.

Number of actual, active users of the facility in a given year:

About 10 groups a year. Each group has typically 3 persons and has the beam for 5 days per week. Nevertheless it is possible to operate by night and week ends, the accelerator is used only during the day.

Percentage of users, and percentage of facility use that come from inside the institution:

80%

Percentage of users and percentage of facility use from national users:

100%. Of course, foreign professors come as visiting researchers.

Percentage of users and percentage of facility use from outside the country where your facility is located:

-

Fraction of international users outside of geographical region

Visiting professors come from US or Europe.

User Group:

4 groups of 3 permanent persons

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

a) 7 professors b) 10 persons

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

None

Number of postdoctoral researchers:

4

Number of graduate students resident at the facility:

10

Number of non-resident graduate students with thesis work primarily done at the facility:

1 or 2

Involvement of undergraduate students in research (approximate average number per year):

3

Special student programs:

None

LABORATORIO CICLOTRON
CENTRO NUCLEAR LA REINA
COMISIÓN CHILENA DE ENERGÍA NUCLEAR

Amunátegui 95
Santiago, Chile

Telephone: +(56) 2 470 2500

Government Owned Facility

Loreto Villanueva, Executive Director

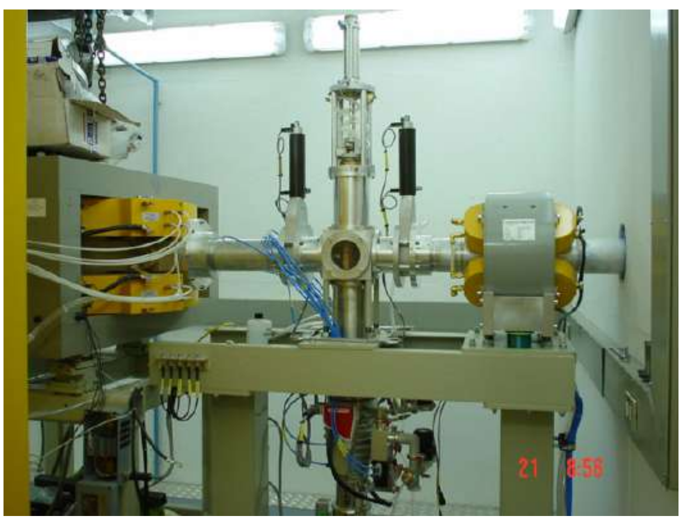
Head of the facility:

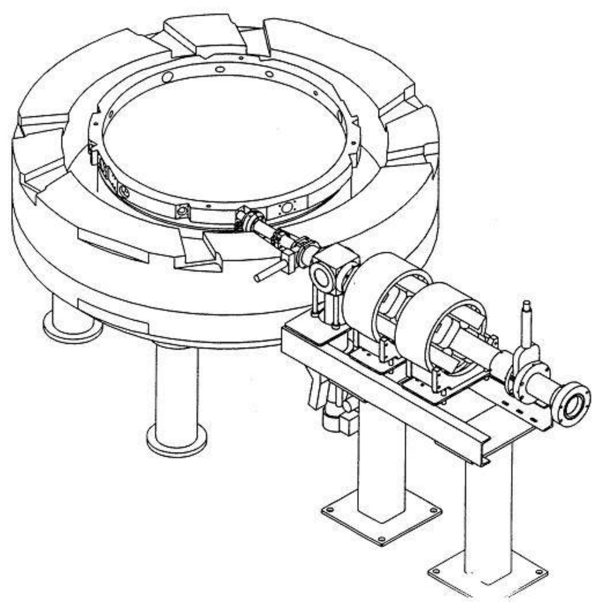
Mario Avila-Sobarzo

Scientific Mission and Research Programs:

Neutron-deficient Radioisotope Production for PET applications, Basic Research on targets for radioisotope production

Technical facilities:





Not available but should be possible to obtain from the institutional web site (www.cchen.cl)

Characterization of the facility:

Accelerator cyclotron, Cyclone 18/9 Manufacture by IBA Belgium. Eight targets, and one external Beam Line Transport with Switching Magnet.

Facility Parameters:

18 MeV Proton and 9 MeV Deuteron fixed energy beams. Proton beam intensity 60 uA. Deuteron beam intensity 30 uA.

Major experimental instrumentation and its capabilities:

8 targets positions at the maximum radius of extraction with liquid, solid and gas targets plus one external beam line with a 5 position switching magnet.

Program Advisory Committee/experiment proposals:

100% from inside users

Number of actual, active users of the facility in a given year:

Two groups from the institution, one for PET RI RF production another for accelerator development. At least 3 groups from University: a) nuclear astrophysics, b) solid state physics and c) elementary analysis.

Percentage of users, and percentage of facility use that come from inside the institution:

100% from inside users.

100% from inside

Percentage of users and percentage of facility use from national users:

None

Percentage of users and percentage of facility use from outside the country where your facility is located:

None

Fraction of international users outside of geographical region:

None

Number of a) total laboratory staff (all categories) b) Scientists on staff with doctoral degree:

5

1

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

5, 0, 1

3, 2, from 3 up

Number of postdoctoral researchers:

1

Number of graduate students resident at the facility:

0

Number of non-resident graduate students with thesis work primarily done at the facility:

1

Involvement of undergraduate students in research (approximate average number per year):

2

Special student programs:

None

Future Plans:

I.- GMP facility for PET RF Production.

II.- Extended Beam Line Transport (from SM) for:

a) Neutron dosimetry.
b) 18 MeV PIXE analytical facility for elemental NDA analysis.

VAN DE GRAAFF ACCELERATOR LABORATORY
UNIVERSITY OF CHILE

Faculty of Sciences
Las Palmeras 3425
Nunca, Santiago 6850240
Chile

Telephone: + (56) 22 978 7276/7281
Facsimile: + (56) 2 271 2973
http://www.fisica.ciencias.uchile.cl/nuclear

University Owned Facility

Prof. Raul G. E. Morales-Segura, Dean Faculty of Sciences.

Head of the facility:

Dr. Jose Roberto Morales

Scientific Mission and Research Programs:

This is the only charged particle accelerator operating in the Chilean university system. The principal features of its scientific mission are: a) to perform research in basic and applied nuclear physics; b) to provide training to undergraduate and graduate students in experimental nuclear physics and related areas.

The current research programs are:

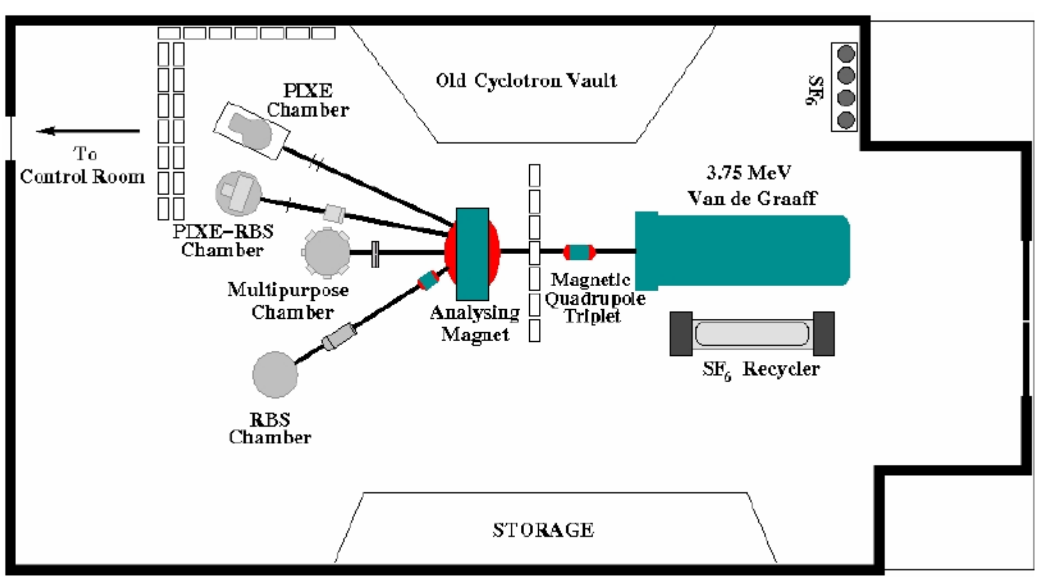
a) Applications of accelerator-based IBA methods to multidisciplinary studies like elemental characterization of airborne particulate matter from urban and remote sites, elemental composition of archaeological materials, bioaccumulation of metals in tissues, and others.

b) Measurement of nuclear reaction cross sections of medical and astrophysical interest.

c) Measurement of stopping power in a variety of metallic foils.

Technical facilities:

Layout of the facility



Beam lines of the facility
NIM B 248 (2006) 150-154
http://fisica.ciencias.uchile.cl/nuclear/

Characterization of the facility:

Single-end Van de Graaff accelerator, High Voltage Engineering KN3750. 3.75 MV maximum. RF ion source. Operates at 30 psi SF6. Beam switching magnet with nine exits.

Facility Parameters:

Single charge ions of protons, deuterons, alpha, Xe, Ne. Variable energy in the range from 300 keV to 3500 keV. Beam intensities from less than one nanoamp. to tens of microamps.

Major experimental instrumentation and its capabilities:

Four dedicated irradiation chambers:
1.- PIXE chamber. Manual and remote control of target position. Thin and thick targets.
2.- ORTEC scattering chamber for RBS and stopping power measurements.
3.- CINEL-Strumenti Scientifici chamber for simultaneous PIXE and RBS. Remote controlled target positions.
4.- Multipurpose chamber for ion implantation and nuclear reaction measurements
X-ray and gamma spectroscopic systems.
HPGe, HPSi, Si(Li), Na(Tl), and surface barriers detectors.
CAMAC multiparametric data acquisition system.

Nature of user facility:

From the university system.

Program Advisory Committee/experiment proposals:

There is a Users Advisory Committee

Number of actual, active users of the facility in a given year:

6 in nuclear physics and applications
2 (plus students) in thin films and material science.

Percentage of users, and percentage of facility use that come from inside the institution:

90 % users from the institution
100 % use from inside

Percentage of users and percentage of facility use from national users:

10 % users from other national institution
5 % use by users from other national institution

Percentage of users and percentage of facility use from outside the country where your facility is located:

None at present

Fraction of international users outside of geographical region:

None at present

User groups:

Nuclear and IBA applications: 6
Material Science and thin films: 2 (plus students)
Technical developments: 2 (one from other national institution)

Number of a) permanent staff (all categories) and b) Scientists on staff:

a) 7 permanent (plus one part time)
b) 3 Ph.D., 3 M.Sc.

Number of postdoctoral researchers:

1

Number of graduate students resident at the facility (>80 % of their time):

1 (>80% of their time)

Number of non-resident graduate students with thesis work primarily done at the facility:

2 (<80% of their time)

Involvement of undergraduate students in research:

20

Special student programs:

2 internships during one month in summer student vacation period

Future Plans:

Development of oxygen, nitrogen, argon and krypton beams

Get a new ion source

Appendix

Questionnaire
C12 Commission of IUPAP

Dear Colleagues,

Commission C12, the standing committee representing nuclear physics within the International Union of Pure and Applied Physics (IUPAP), decided in one of its recent meetings to initiate activities that would help promote closer interaction and collaboration between the nuclear physics laboratories worldwide including, in particular, the facilities of our field. For this purpose a Working Group was formed with Anthony W. Thomas as chair.

The first charge to the Working Group is to collect information on all facilities currently operating, under construction and/or in the planning and to prepare a report containing this information. This report is intended to serve the community itself in its efforts to interact and to promote the scientific goals of our field. It will also serve to generate a reliable and forward-looking data base for science managers, agencies, governments, students at all levels and, last but not least, the interested general public (press).

Towards this goal, we would like to ask for your assistance. Initially we need two pieces of information:

i) the name and address (in particular the e-mail address!!) of a designated contact from your institution/facility with whom we can interact and ask for direct help (for example in proof-reading the information pertaining to your institution in the draft report, etc.), and

ii) we would like you to fill in the information asked for in the enclosed questionnaire.

Thank you in advance for your cooperation. If you have any question, please do not hesitate to contact us.

With best regards,

Anthony Thomas (Chair Working Group)	Shoji Nagamiya (Chair C12)	Walter Henning (Vice-chair C12)	Wim van Oers (Secretary General C12)

<u>Questionnaire</u>

Name of institution and/or facility(s):

Geographic location:

Full address (regular and e-mail; telephone, facsimile, etc.):

(Legal) form/status of the institution/facility (e.g. university institute; DOE lab; limited liability company under, for example, French/British/German/Japanese.... law)

Main source of funding for a) construction, b) operation and c) other (if applicable):

Head of the institution:

Head(s) of the facility(s):

In a brief abstract (5 – 10 lines) describe the scientific mission and, broadly, the main current and future research programs of the institution/facility:

Technical facilities: please provide one (for smaller facilities) or two (for larger facilities) figures and/or photos providing a technical layout of the facility and its instrumentation, and a visual overview :

Briefly characterize the facility (e.g. low-energy cyclotron with light-ion beams; relativistic heavy ion collider; pulsed electron linac; heavy-ion linac/synchrotron; cw electron beam facility; back-scattered photon facility etc.):

Provide a compact (exemplary) table of facility parameters (e.g. beam species, intensities, range of energies, special properties):

If appropriate, provide a brief and compact table with the facility's major experimental instrumentation and its capabilities:

Is the facility considered to be a user facility (officially and by whom; unofficially?):

Does the facility have a Program Advisory Committee or the equivalent, adjudicating experiment proposals?

Number of actual, active users of the facility in a given year (average over the last few years, or just the last year if the facility is new; for example; please indicate how the number is derived):

Percentage of users, and percentage of facility use (these numbers may differ) that come from inside the institution (if no statistics exist, please give an estimate but indicate this as such):

Percentage of users and percentage of facility use from national users:

Percentage of users and percentage of facility use from outside the country where your facility is located:

What fraction of the international users is from outside your geographical region (i.e. Asia; Australia & New Zealand; North-America; South-America; Africa; Europe):

Does a formal users group exist for your facility(s) and what is the number of registered members (in general this may be quite different from the number of actual users in a given year):

Number of a) permanent staff and b) temporary staff (including graduate students and postdoctoral researchers):

Number of theoretical staff employed at the facility: permanent; postdoctoral, students:

Number of postdoctoral researchers employed at the facility:

Number of graduate students resident at the facility (>80% of their time):

Number of non-resident graduate students with thesis work primarily done at the facility:

Involvement of undergraduate students in research (approximate average number at a given time):

Special student programs, e.g. summer programs, student labs etc (high school, under graduates, graduate students?):

Describe any plans you might have and their status for future developments at the facility (major instrumentation; facility upgrades; expansions and new construction etc.:

Please provide in brief abstract form any other information you might want included in the report: