ENLIGHT

HIGHLIGHTS

June 2013

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MEDAUSTRON
CNAO FOUNDATION
ONCORAY
ROMANIAN SOCIETY OF HADRONTHERAPY

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For more information and contact details please visit the ENLIGHT website - enlight.web.cern.ch/

Join the ENLIGHT network. Register to become a member here.
https://indico.cern.ch/confRegistrationFormDisplay.py/display?confId=180036

FROM THE ENLIGHT COORDINATOR

Credit: Nathalie Hospital for ENLIGHT

EXCELLENCE IN RESEARCH AND TRAINING

The second decade of ENLIGHT begins with the welcome recognition from the European Commission of the quality of the R&D and training programmes launched by our network.

It is with great pleasure and pride that I see ENTERVISION following in the footsteps of the successful PARTNER project. Thanks to the ENLIGHT platform and collaborating institutes, it provides high-quality multidisciplinary training and supports bright young researchers in the early stage of their careers. In the past 6 months, ENTERVISION successfully passed the Mid Term Review exercise and was the only Marie Curie Initial Training Network to be selected by the European Commission (EC) as a so-called "gold project" in the advertising campaign for Horizon2020. In addition, it was the only project featured in an EC press release about the CERN visit of the Commissioner for Education, Culture, Multilingualism and Youth.

A further encouragement from the European Commission came only a few weeks ago, with the announcement that the CORDIS science editors will showcase ENVISION and ULICE in the section "Results in brief", aimed at a broader public and meant to promote dissemination and exploitation of the project results.

The challenge ahead is to keep up with the high standards which we have set for ourselves in terms of research, training, funding and positive feedback from the European Commission. We will discuss future strategies at the annual ENLIGHT meeting in Wiener Neustadt, and I am looking forward to seeing many of you there.

M Dosanjh

Manjit Dosanjh

ENTERVISION MTR

ENTERVISION, the Research Training Network in 3D Digital Imaging for Cancer Radiation Therapy, successfully passed its mid-term review (MTR) held at CERN on 11 January. This multidisciplinary project aims at training experts in medical imaging techniques for improved hadron therapy and radiotherapy in general. The project, coordinated by CERN, brings together ten academic institutes and research centres of excellence and the one leading European company in particle therapy. It provides training for 12 Early-Stage Researchers (ESR) and 4 Experienced Researchers (ER) of different backgrounds and nationalities.

The training covers physics, medicine, electronics, informatics, radiobiology and engineering, as well as a wide range of soft skills e.g. the communication, leadership and teamwork course which was featured in the last issue of Highlights. The network is funded by the European Commission within the Marie Curie Initial Training Network, and relies on the EU-funded research project ENVISION to provide a research and training scientific platform for the Marie Curie researchers.

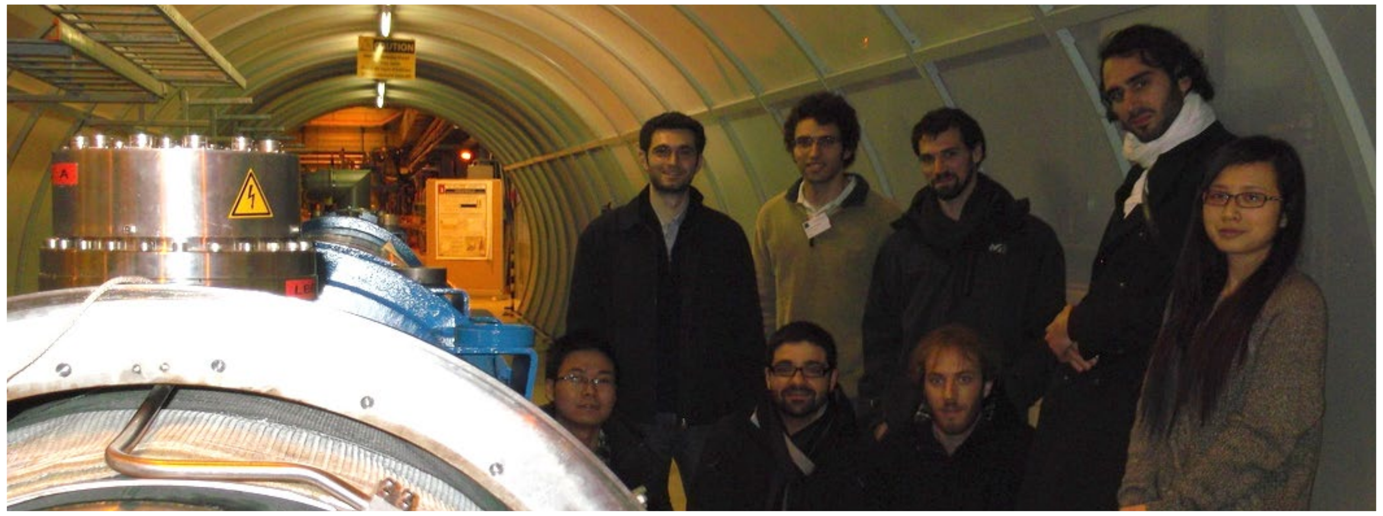
The two projects hold their annual meetings jointly, allowing the young researchers to meet senior scientists and to have a full picture of the latest developments in the field beyond their individual research project. This is an important aspect of the project as it is unusual for researchers so early on in their career to establish professional relationships with the leading experts in their field. A video about the MTR was produced, you can see it here: **http://cds.cern.ch/record/1512628**

According to the Mid-Term review, the project is excelling in the scientific work and training carried out so far. The fact that this ITN is connected to an FP7 Cooperation project, and that the ENTERVISION ERs and ESRs are carrying out their research together with their ENVISION colleagues ensures that they will deliver concrete results which will be published in due course.

The EU project officer Dr Marcela GROHOLOVA was present at the MTR and commented "From my side, the project is running very well, fellows get very professional and high level scientific training. It seems that this project will contribute a lot to their career development. Also the collaboration with your partners seems to work very well, they are fully integrated into the project tasks.

Fellows are happy in the network, they certainly gain a lot scientifically, professionally as well as in terms of a multicultural experience. It seems that they all are very happy to be Marie Curie fellows."

As with the PARTNER project, the researchers are actively encouraged to socialise together after the meetings and friendship bonds as well as a professional network are being created. During their visit to CERN they were able to visit the magnet testing facility, taste the Swiss speciality cheese fondue and some even ventured up the nearby Jura mountains for a ski and snow-shoeing trip. The eclectic menu and musical selection at their social soirée demonstrated the multicultural diversity of the group (Chinese dumplings with Zorba the Greek)!



The next major outreach opportunity will be the European Researchers night on Friday September 27th. This is a Europe-wide event which aims to bring researchers closer to the public at large with direct exchange during fun and interactive activities. The ENTERVISION Researchers will take part in the event taking place at CERN where there will be a special focus on Marie Curie researchers and medical applications. Hopefully they will highlight the appeal of pursuing a career in research and inspire budding young scientists!

ENTERVISION is funded by the European Commission under the FP7 Grant Agreement 264552.

ENTERVISION NEWS

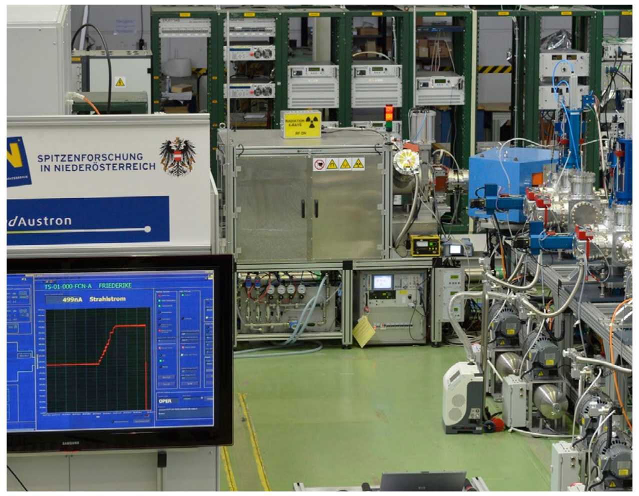
In addition to the positive feedback from the project officer, ENTERVISION has been chosen as 'a success story illustrating the good use of EU funds for research' and 'as a flagship project for Marie Curie Actions for the promotion of H2020, as a so-called "gold project"'. 37 projects in total from FP7 have been selected by RTD and ENTERVISION is the only project representing the Marie Curie Actions.

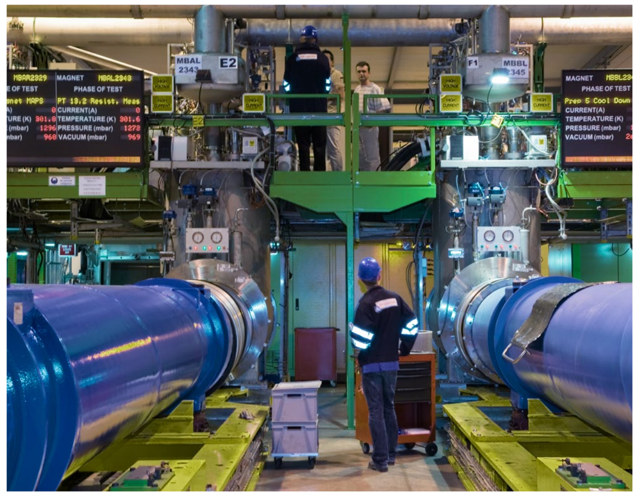
In April Androulla Vassiliou, Commissioner for Education, Culture, Multilingualism and Youth visited CERN to meet young researchers supported by the EU Marie-Curie Actions fellowship programme. An EC press release on the ENTERVISION project was published and a video released to mark the occasion. See:

http://entervision.web.cern.ch/ENTERVISION/news.html

2 of the ENTERVISION researchers hosted by CERN presented a poster to describe their project work and other activities including outreach.

VISIT TO MEDAUSTRON AND LHC MAGNETS





The ENVISION and ENTERVISION researchers had the opportunity to visit some of CERN's surface installations, and to discover the characteristics of the magnets for the LHC and for the MedAustron hadron therapy facility.

The visitors first headed for the vast SM18 hall, just across the French border from CERN's main campus in Meyrin (Switzerland), where all LHC magnet have been tested prior to the installation underground. The test facility is equipped with 12 test benches, as well as all the necessary cryogenic infrastructure.

The visitors could see the 15 metres long dipole magnets, which steer the beam around the LHC ring, learn about the challenges of operating superconductors, and take pictures in the full-size mock-up of the LHC tunnel.

The second half of the tour brought the visitors to the second CERN campus, in Prevessin (France). Here they could see some of the 300 magnets for MedAustron, which were all designed at CERN but produced at different sites in Europe and Russia.

The most critical magnetic measurements are performed at CERN, exploiting the experience and know-how acquired with the CNAO magnets.

Many thanks to Marco Buzio, senior magnets engineer at CERN, who accompanied the visitors throughout this voyage at the frontier of technology, from particle physics to particle therapy.

ENVISION

COMES TO CERN FOR ITS THIRD ANNUAL MEETING

On January 10, 2013, the ENVISION community gathered at CERN for its third annual meeting. ENVISION is a collaboration of fifteen leading European research centres and one industrial partner, and it tackles a key issue in particle therapy: the need for an ever higher level of quality assurance during treatment. In order to meet this challenge, ENVISION is implementing advanced and innovative medical imaging techniques, integrated into the treatment planning.

At the meeting, the leaders of the five R&D work packages reported on the progress in the respective activities: Time Of Flight in-beam PET, in-beam single particle tomography, organ motion monitoring techniques, simulation, and treatment planning. All work packages are releasing promising preliminary results, as demonstrated by the number of publications on peer-reviewed journals and of presentations at international conferences.

ENVISION also serves as a training platform for the Marie Curie Initial Training Network ENTERVISION, and the annual meetings of the two projects are held jointly, allowing young and senior researchers to exchange opinions and to get together also socially.
ENVISION has entered into its final year, and everyone is hard at work on the last deliverables. As agreed at CERN, the final meeting will take place in Milano and will be hosted by the Politecnico.

The ENVISION project is co-funded by the European Commission under FP7 Grant Agreement 241851.

ENVISION SELECTED BY THE EC CORDIS SCIENCE EDITORS

As part of the annual reporting to the European Commission, ENVISION submits a publishable summary, whose scope is to disseminate the outcomes of the project through CORDIS, the Community Research and Development Information Service of the EC.

This year, the CORDIS science editors have selected the ENVISION summary to draft a "Result in Brief", a short text written in a language more easily understandable by a broader public. The text will be made available by the EC in 5 languages (English, French, German, Spanish and Italian).

ULICE NEWS

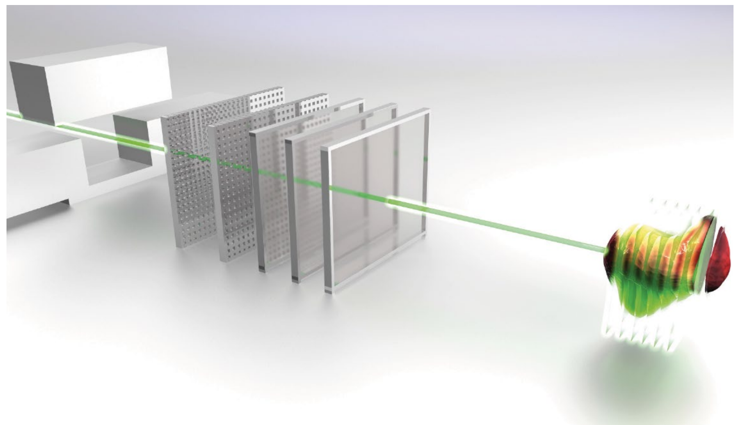
AN EXTRA YEAR TO APPLY FOR BEAMTIME!

ULICE project extended by 12 months to end of August 2014

WATCH OUR VIDEO

Following up from the last issue of Highlights, a video on transnational access has been produced.

WATCH OUR VIDEO OVER AT :
HTTP://CDS.CERN.CH/RECORD/1475404



ULICE is co-funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, under Grant Agreement 228436

THE ICTR-PHE CONFERENCE

CONNECTING PHYSICS, BIOLOGY AND CLINICAL ONCOLOGY

Jacques Bernier MD, PD

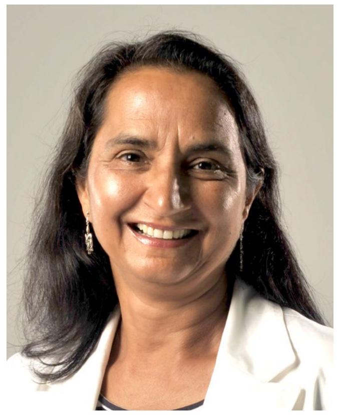
Genolier Swiss Medical Network and University of Geneva, Switzerland

First held in Geneva in 2012, the ICTR-PHE Conference now has the spotlights turned towards its 2014 edition, which will take place at the International Conference Centre of Geneva (CICG), on February 10 – 14, 2014. Those who attended the first edition recognise the value of such a new reality in oncology, which brings together two major events in the interdisciplinary field at the intersection of medicine, biology and physics: the International Conference on Translational Research in Radiation Oncology (ICTR) and CERN's Physics for Health (PHE) workshop.

The ICTR conference started in 2000, with the objective to update the radiation oncology community on the most recent advances in translational research, and reinforce the synergies among clinicians, biologists and medical physicists. The first edition of the Physics for Health workshop was organised at CERN in February 2010, with the aim of reviewing the progress in the domain of physics applications in life sciences, stimulating the exchange between different teams and indicating the subjects most suitable for further studies in diagnosis and therapy.

In 2012, the time had come to merge ICTR and PHE, as it was obvious that this synergy would boost the development of new strategies in oncology. Optimizing biologically and physically the ways we attack cancer is the key issue in the search for better treatment precision and specificity, achievable by both increasing the tumour cell killing and augmenting normal tissue sparing. These novel research developments require a closer integration between the cutting-edge technologies developed for particle detectors and therapeutic devices, and all the bio-molecular vectors that the post-genomic era is now offering.

UNITING PHYSICS, BIOLOGY AND MEDICINE FOR BETTER HEALTHCARE will be the red thread that ICTR-PHE 2014 will follow during the 5-day conference. As in the past years, the meeting will continue to pay tribute to those institutions and individuals who significantly contribute to the development of translational research in oncology. Last but not least, this conference will further expand the partnerships with industry, with concerted efforts in Research & Development, and will trigger institutional contacts favouring a more efficient collaboration among laboratories worldwide.



THE ICTR-PHE 2014 CHAIRS ARE LOOKING FORWARD TO WELCOMING YOU ONCE AGAIN TO GENEVA, SO SAVE THE DATE: FEBRUARY 10 - 14, 2014!

MEDAUSTRON IN WIENER NEUSTADT

by Ramona Mayer on behalf of the MedAustron Team

MedAustron is a dual-beam ion therapy and research centre which is presently under construction in Wiener Neustadt, Austria. The facility is based on a synchrotron which will deliver proton beams with kinetic energies up to 250 MeV and carbon ion beams up to 400 MeV/nucleon for clinical applications. In addition to the clinical applications, the accelerator will provide beams for nonclinical research in the fields of medical radiation physics, radiation biology and experimental physics with a proton energy range extended beyond medical requirements to 800 MeV.

Initially when starting the facility, proton beams will be used for patient treatment. In the first years of operation about 60-70% of the patients will be treated with proton beams, preferably with two or more fields and 30-40% of patients will be irradiated with carbon ions. Intensive clinical studies will be performed at MedAustron to increase knowledge about the treatment with carbon ions. In the following years the percentage of protons and carbon ions will be changed to 50% vs. 50% and maybe even to 30% vs. 70% in the long run.

The planning and realisation of the particle accelerator facility is being made in cooperation with the European Organisation for Nuclear Research (CERN). The MedAustron accelerator complex consists of an injector, a synchrotron as main accelerator and the extraction line, that brings the beam towards the treatment rooms. The accelerator complex is designed to allow fully active beam delivery which is presently the most advanced technique in the field of hadron therapy. The complex will cycle with a typical repetition rate of 0.5 Hz and beam energy, size and intensity can be changed on a cycle-to-cycle basis. A change of the ion type, i. e. protons or carbon ions will also be possible on the sub-minute level.

The centre is realised within the industrial zone "Civitas Nova" located in the northern periphery of Wiener Neustadt. This is a small city with 40 000 inhabitants, located about 60 kilometres away from Vienna.
The building is characterised by a clear zoning of the various functional parts of the project: The ground floor houses the medical part, the research part and the accelerator part. The basement accommodates the technical infrastructure for the building services and for the accelerator. The administrative area is situated on the upper floor.
Large glass windows establish a visual link between inside and outside areas. Patios create an agreeable atmosphere for patients and personnel and will enable the illumination of internal rooms with natural daylight.
The utilisation of natural daylight together with intelligent sun protection devices minimises the energy consumption for electric lighting and air-conditioning.

The number of patients to be treated and the envisaged modus operandi defined the layout of the medical part of the facility. In the fully operational phase, up to 1400 patients per year will be treated at MedAustron; for the medical operation of the facility two shifts on normal working days will be foreseen. Consequently three treatment rooms are needed in this scenario to efficiently use the accelerator and to achieve the desired patient numbers. The choice was made for two fixed beam rooms for proton and carbon ion treatments and one gantry room for proton treatment only. One of the fixed-beam rooms is equipped with a horizontal beam line and the other with a horizontal and a vertical beam line with a common iso-centre. All rooms will be equipped with a robotic couch which will be ceiling mounted and a state of the art patient positioning verification system.
Patient treatment will be performed on week days from 6:00 to 22:00 and the remaining time and weekends can be used for non-clinical research corresponding to about 50% of the total available beam time.
Dynamic treatment is foreseen for all treatment rooms, by active pencil-beam scanning. The tumour volume is subdivided in layers of typically 2-5 mm thickness each at a constant penetration depth, corresponding to a specific particle energy. Every voxel of an iso-energy layer is then irradiated by a particle beam with a 4 - 10 mm cross-section. When the required dose for the voxel is reached, the beam is moved (without being switched off) to the next voxel.

The MedAustron facility will be equipped with adequate imaging tools to meet the future requirements for precise radiotherapy planning and delivery:

- computed tomography (CT)
- 3 T magnetic resonance imaging (MRI);
- 3D ultrasound;
- positron emission tomography (PET)-CT for offline verification;

KEY MILESTONES

2013

INSTALLATION AND INTEGRATION OF THE PARTICLE ACCELERATOR.

2014

MEDICAL COMMISSIONING AND CERTIFICATION OF THE PROJECT.

END OF 2015

FIRST PATIENT TREATMENT.

Ramona Mayer

THE STATUS OF CNAO AT THE BEGINNING OF 2013

by Roberto Orecchia and Sandro Rossi on behalf of the CNAO Foundation

CNAO (Italian acronym that stands for National Centre for Oncological Hadrontherapy) began its clinical activity in September 2011 with the first experimental treatments with proton beams and the very first patient was treated with carbon in November 2012. Both events represented an absolute novelty on the landscape of Italian healthcare. The end of construction phase of the centre was marked with the inauguration of CNAO, on February 15th 2010, and the second phase, of clinical trials began. This phase takes place over 2010-2013, and will allow to scientifically validate hadrontherapy applied to the cure of tumours with a range of many clinical protocols. It will also lay the foundation for the subsequent phase of optimising the number of patients treated as outpatients, a few thousands patients per year and gradually expanding the clinical indications and introducing clinical, radiobiological and translational research.

The treatment of patients with carbon ions was approved in July 2012 by the Italian Ministry of Healthcare, following a detailed review of the data presented by CNAO on dosimetry and radiobiology with carbon ions, both in-vitro and in-vivo. These experimental activities were performed in the first part of 2012 also thanks to the collaboration of the Italian Institute of Nuclear Physics (INFN) and the Japanese National Institute of Radiological Sciences (NIRS). The data presented at the National Health Council confirmed the expected beam parameters specifications and also demonstrated the high standards of safety and quality achieved at CNAO.

The first months of 2012 were also important to adopt a quality management of the CNAO procedures, and in July the certifications ISO9001 and ISO13485 were obtained. This represented a fundamental step in view of the CE marking of CNAO. In fact, the CE marking of the different clinical protocols is mandatory to begin routine hadrontherapy treatments.

Table 1 shows the situation of treatments updated to April 2013. In addition to the number of patients treated, clinical protocols already approved by the Ethical Committee and by the Ministry of Healthcare are shown. At the end of April, 89 patients completed their treatment, 75 within clinical trials, 14 within the framework of solidarity treatment approved on a case-by-case basis by the Ethical Committee and by the Ministry. Among them, 59 patients have been treated with protons and 30 with carbon ions.

Patients were referred to CNAO by around thirty hospitals from throughout the country, which demonstrates that an oncological network for patient referral is beginning to take shape and operate effectively. This aspect is crucial to establish CNAO as a national structure, and represents one of the key elements to ensure an efficient recruitment of patients who are eligible for this type of treatment..

In February 2013, clinical results of the first protocol (CNAO 01/2011 v. 2.0), concerning treatments with protons of 30 patients with chordomas and chondrosarcomas of the skull base, were submitted for approval to the National Health Council. These clinical results are very positive, and they reach the target goals of the protocol. A peer review commission will examine these results and will deliver the CE marking of CNAO as a medical device for these protocols. The CE procedure foresees to complete other protocols, and to obtain each authorisation on a one by one basis by the health authorities.

STATUS OF FACILITIES

The facility is located in an area of Pavia that hosts other hospitals and the University campus. The realization of CNAO is based on a close collaborative network, which links CNAO with the most important institutions in Italy and abroad. In particular, for the cutting-edge technologies, fundamental contributions came from INFN, that shared the management of the realisation, and also from CERN and GSI. This network has ensured collaboration of experts at CNAO in the past, and it will continue to do so in the future.

In 2013, a study programme for the design of a dedicated experimental beam line has been launched. Within three years a dedicated research facility for radiobiology, detector developments, clinical research and translational research will become operational at CNAO.

CNAO's main objective of 2013 will be the increase of the patients' throughput and the approval of most of the on-going clinical trials. At the beginning of the year, the third treatment room became operational and it added one horizontal and one vertical beam lines to the already active treatment rooms (two rooms with one horizontal beam each). Figure 2 shows a treatment room, with the systems used for patient positioning and verification of the correct alignment with the beam port.

				Clinical Trial				
Protocol	**Protocol Description**	Proton or Carbon	Fractions	Enrolled patients for certification	Missing patients for certification	Treated	On treatment	TOTAL
CNAO 01/2011 V.2.0	Proton therapy of skull-base chordoma and chondrosarcoma	Proton	35-37	30	0	30	0	30
CNAO 02/2011 V.1.0	Proton therapy of spine chordoma and chondrosarcoma	Proton	35-37	20	8	12	0	12
CNAO 03/2011 V.2.0	Proton therapy of intracranial meningioma	Proton	30-33	30	29	1	0	1
CNAO S4/2011/P	Proton therapy of brain tumors	Proton	22-30	40	40	0	0	0
CNAO 05/2011 V.1.0	Proton therapy of of head and neck relapses	Proton	n.a. (1)	40	39	1	0	1
CNAO 06/2011 V.2.0	Proton boost in advanced head and neck cancer	Proton	8-15	20	13	7	0	7
CNAO S7/2012/P	Proton therapy of brain glioblastoma	Proton	37	20	20	0	0	0
CNAO S8/2012/P	Proton re-irradiation of spine relapses cordhoma and chondrosarcoma	Proton	n.a. (1)	20	19	1	0	1
CNAO S9/2012/C	Carbon ions theraphy of adenoid cystic carcinoma of salivary glands	Carbon	16	20	14	4	2	6
CNAO S10/2012/C	Carbon ions re-irradiation of pleomorphic adenoma relapses	Carbon	16	30	28	2	0	2
CNAO S11/2012/C	Carbon ions re-irradiation of ricurrent rectal cancer	Carbon	dose escalation (2)	20	20	0	0	0
CNAO S12/2012/C	Carbon ions theraphy of head and neck sarcoma	Carbon	16	15	9	6	0	6
CNAO S13/2012/C	Carbon ions theraphy of trunk sarcoma	Carbon	16	15	9	4	2	6
CNAO S14/2012/C	Carbon ions re-irradiation of head and neck relapses	Carbon	10-30	15	12	1	2	3
CNAO S15/2012/C	Carbon ions theraphy of malignant mucosals melanoma of head and neck	Carbon	16	15	15	0	0	0
CNAO S16/2012/C	Carbon ions theraphy of high risck prostate carcinoma	Carbon	16	20	20	0	0	0
CNAO S17/2012/C	Carbon ions theraphy of primary and secondary orbital tumors	Carbon	16	15	15	0	0	0
CNAO S18/2013/C	Pancreas tumors	Carbon	12	15	15	0	0	0
CNAO S19/2013/C	Malignant liver tumors	Carbon	12	15	15	0	0	0
Patients within Clinical Trials						69	6	75
Eligible Patients for Clinical Trials								32
Patients under Eligibility Evaluation								23
Patients out of Clinical Trials								14

Figure 2.

Figure 1- Top view of the area occupied by CNAO. At the front the hospital building and the entrance, in the back the power station and the roof of the synchrotron vault.


Figure 1.

THE DRESDEN PROTON THERAPY FACILITY

by Wolfgang Enghardt ,Technische Universität Dresden,
OncoRay – National Center for Radiation Research in Oncology

A new proton therapy facility is under construction on the campus of the University Hospital Carl Gustav Carus in Dresden, Germany. The conceptual work for the proton therapy facility started in autumn 2005. Thomas Herrmann (at that time the director of the Radiotherapy Department of the University Hospital), Michael Baumann (present director of the Radiotherapy Department) and I analysed the situation in particle therapy, i.e. radiation therapy with either proton or light ion beams. From the well known facts that particle therapy (i) is clinically challenging, technologically complex and cost intensive, and (ii) has to be scientifically supervised and accompanied by research in medicine, radiobiology and medical physics, in particular for extending its application to new tumour species, we concluded that a particle therapy facility has to be fully integrated into the clinical, scientific, technological and staff infrastructure of an existing radiotherapy department of a university hospital.

Under these conditions, and considering the state-of-the-art accelerator and beam delivery technology as well as the available building site, the installation of a proton cyclotron (but not an ion synchrotron) was feasible in Dresden. After an initial learning curve the clinical capacity should be around 500 patients per year, leading to the conclusion that the facility should start with one treatment room and one horizontal beam line for physics and radiobiology research. There is still space available for two additional treatment rooms to increase patient capacity in the future.

In 2008, OncoRay – National Center for Radiation Research in Oncology, a consortium of Technische Universität Dresden, University Hospital Carl Gustav Carus Dresden and Helmholtz-Zentrum Dresden Rossendorf (HZDR), was successful in financing the proton therapy facility building (Figure 1) in the framework of the excellence initiative of the Free State of Saxony via the European Regional Development Fund (ERDF) of the European Union. Following this large contribution, the University Hospital Carl Gustav Carus decided to finance the basic clinical components of the proton therapy machine. In addition, the scientific equipment of the facility has been supported by the Federal Ministry of Education and Research of Germany. In April 2010 we started the tendering procedure for the machine which resulted in Ion Beam Application (IBA), Louvain-la-Neuve, Belgium winning the contract in January 2011. Ground breaking started in May and the building construction began in November 2011. The accelerator and beam delivery equipment were brought into the building in January and February 2013 (Figure 2) and the installation started immediately, leading to the first internal cyclotron beam on April 16, 2013. Therefore, we expect first patient treatments in spring 2014, and the fully functioning facility by the end of 2014.


Figure 2.

Figure 1 gives an overview of the facility. Since it is situated in a rather densely populated area of Dresden (about 3 km linear distance to the famous Church of Our Lady), logistics as well as radioprotection issues led to establishing the facility 5 m below ground level. This decision resulted in a challenge to the architects, since the Elbe river flows about half a kilometre north of the building, and we will never forget when, in August 2002, the Elbe flooded the cellar of the Radiotherapy Department and, therefore, also the area where the new facility is now being constructed.

The IBA Proteus 235 cyclotron delivers a proton beam of 230 MeV maximum energy to the therapy room, equipped with an isocentric gantry bearing a universal nozzle for treatment field formation via single and double scattering, as well as pencil beam scanning. The experimental irradiation room has a horizontal beam line for radiobiology and physics research mainly conducted in the fields of in-beam PET and prompt γ-ray imaging. As a future basis for the research on laser particle acceleration for therapy, a major activity in Dresden since 2007, a laser driven proton beam will also be installed in the experimental room. This will offer the unique possibility to exploit, in one and the same room, a conventionally accelerated (and, therefore, well characterized) as well as a laser driven proton beam for developing new beam delivery components and for performing experiments for physical and radiobiological characterization of the ultra-short pulsed laser accelerated particle beams. For this reason, a hall has already been constructed on top of the experimental room to host a dedicated Petawatt (PW) laser, which is at present developed by the Institute of Radiation Physics of the HZDR.

Figure 1: Top view onto the new proton therapy facility in Dresden, Germany, on February 6, 2013. The red crane on the left side is lifting the cyclotron into the building. Since the treatment level is 5 m below ground, the top of the cyclotron and the beam transfer line (foreground) only slightly exceeds the ground level. The highest part (centre) of the proton irradiation facility building is the experiment bunker with the PW-laser laboratory on top. The right part of the building hosts the treatment room with the isocentric gantry. The preliminary cover of the roof opening, which will be used for craning in parts of the gantry, is visible. Behind the proton therapy facility and attached to it, stands the second part of the new building, housing staff offices, auxiliary rooms, research laboratories as well as lecture and seminar rooms. In the background, on the right, the existing Radiotherapy Department can be seen, which has been already connected to the new building.

Figure 2: Lifting the lower half of the Proteus 235 cyclotron into the new building on February 6, 2013.

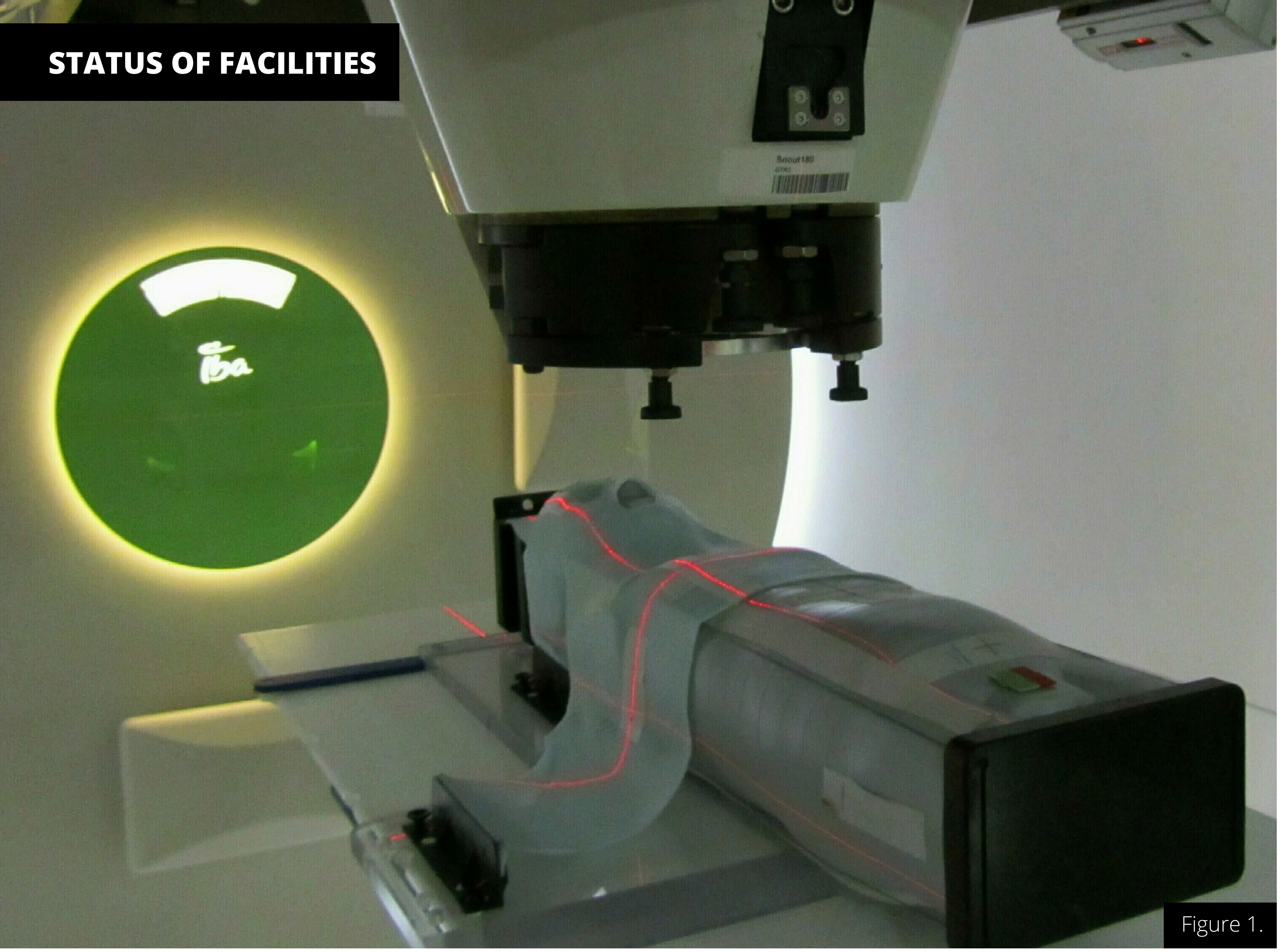


Figure 1.

ACCELERATOR HEALTH PHYSICS AND RADIATION RESEARCH AT WEST GERMAN PROTON THERAPY CENTRE ESSEN (WPE)

by Xiaoning Ding , Bhaskar Mukherjee

The West German Proton Therapy Centre Essen (WPE), a daughter institution of the University Hospital Essen currently operates a 230 MeV room temperature proton therapy cyclotron (Model: PROTEUS 235, Supplier: IBA). The commissioning and acceptance testing of the cyclotron, the beam lines, and the treatment rooms are completed and the first patient treatment has already been started on 23 May 2013. In the past years, during the testing phase of the facility we have accomplished several important research projects, vindicated by numerous publications in peer-reviewed journals, granted patents, and collaboration with other departments within the University Hospital Essen. Our research activities are outlined as follow:

(a) Radiological shielding verification of the treatment rooms using neutron and gamma dose measurements and Monte Carlo simulations. The parameterised neutron attenuation data from our studies could be used to design optimised shielding containment for future proton therapy faculties.

(b) Development of radiation detector for fast neutrons, protons and gamma rays based on novel-scintillator materials, Si and GaAs diodes, superheated emulsion (bubble) detectors, radiochromic films, thermoluminescence (TL), and optically stimulated luminescence (OSL) lumophors. An ultra-sensitive OSL-based neutron area monitor has been developed by our group for surveillance of high-energy particle accelerator environment is currently being implemented at WPE.

(c) Explicit assessment of organ specific out-of-field neutron and gamma equivalent doses during proton therapy, in particular for paediatric patients using a TLD-based micro-dosimeter developed at our laboratory. The data can be used to predict the risk of late incidence of secondary cancer. Our research was done using an anthropomorphic phantom.

(d) Microdosimetry and LET spectrometry of secondary particles produced during proton therapy using tissue equivalent proportional counter (TEPC) and solid-state (TLD-based) microdosimeter. The solid-state microdosimeter based on multiple TLD chips developed by our researches can be implemented to estimate aircrew dose equivalent during long haul flights.

Selected snapshots related to our research projects at WPE are depicted in figures 1 and 2. Within the framework of ULICE and ENLIGHT we envisage collaborations with European and international particle therapy centres in the research areas highlighted above.

In particular, we would like to focus on the role of RBE in heavy, as well as, light particle therapy. At present, an ad hoc RBE value of 1.1 is universally used in all commercially available treatment planning systems. In fact, RBE depends on a myriad of factors including dose, LET distributions of primary as well as recoiled secondary particles, crucial biological conditions like the cell-cycle phase, the pH value, and the oxygen content in the target volume (tumour). Hence, the lack of accuracy in the RBE (1.1) may escalate the “golden rule” of ± 2% uncertainty in delivered dose in the tumour volume. We aim to conduct well-planned radiobiological experiments, using TEPC and solid-state microdosimeters and Monte-Carlo simulations to overcome any ambiguities.

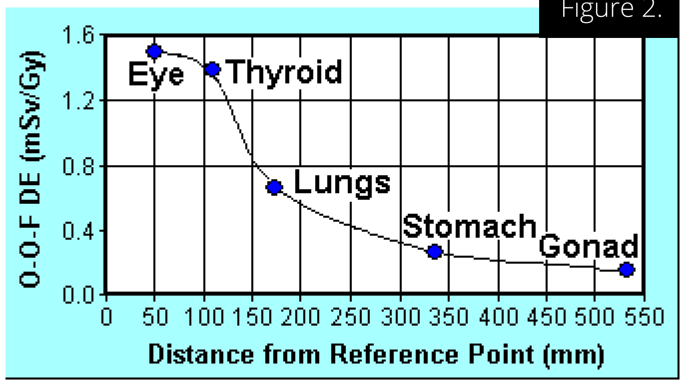
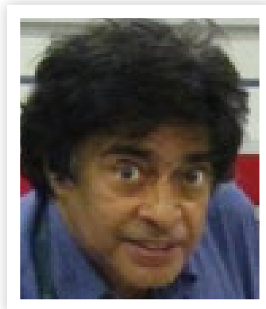


Figure 2.

Figure 1
The irradiation of an anthropomorphic (paediatric) phantom with therapeutic proton beam.

Figure 2
The out of field dose equivalent (O-O-F DE) at selected locations on the paediatric phantom normalised to delivered therapeutic proton dose evaluated using twin-chip TL dosimeters. This data can be used to predict the incidence of second cancer.

Dr. Xiaoning Ding



Dr. Bhaskar Mukherjee

THE INTERNATIONAL CONFERENCE OF THE ROMANIAN SOCIETY OF HADRONTHERAPY - ICRSH 2013

by Nicolae Verga

THE ROMANIAN SOCIETY OF HADRONTHERAPY [RSH] WAS FOUNDED IN 2005 BY A MEDICAL DOCTOR AND A PHYSICIST, LATER TWO MORE PHYSICISTS WERE CO-OPTED AND A STRATEGY WAS ESTABLISHED.

In the years that followed, the RSH pursued the fulfilment of its proposed goals, the most important one being the study and evaluation of the methods used for tumour destruction in order to integrate hadron therapy in the therapeutic regime currently used in cancer treatment.

Another objective was to inform the public and the interested specialists about this method of benign and malign tumour treatment.

Along this line, besides the use of mass media and the establishment of postgraduate courses, RSH also organized annual international meetings (2010, 2011, 2012, 2013), where oral presentations were held in the following topics:

- the scientific, technological and medical history of the biggest centres from Europe, Africa and Asia;
- recent research in hadronbiology, accelerator technology, dosimetry, treatment planning and various problems in computational planning
- recent hadrontherapeutic achievements in the treatment of various cancerous tumours;
- hadrontherapy quality assurance;
- training the specialists needed;
- economic issues.

ICRSH 2013 and previous meetings (2010-2012) gathered scientists from different cultural and ethnical environments, promoted international collaboration for the use of the community, open communication between scientists and their mutual knowledge.

An example of such cooperation is the activity of the ENLIGHT Network, and the ULICE & PARTNER projects, which provide a model for the RSH, and its members are trying to adapt their activities according to the specific needs of the Romanian community.

We would like to acknowledge the roles of Prof. Nicolae Victor Zamfir and phys. Ioan I Ursu who are providing scientific and administrative support in hadrontherapy development activities, Prof. Gheorghe Cata-Danil, Prof. Florin Scarlat and Prof. Dan Dumitras representing the team that currently perform experiments in the hadrontherapy fields, phys. Radu Vasilache that handles the dosimetric problems and the computational aspects. We have named only a few of our active specialists. We must not forget the constant support from our sponsors; the most popular presence is the one of Chem. Eng. Iulian Popa.

Step by step, hadrontherapy becomes well known in Romania, groups of scientists, patients, journalists and politicians accept it and believe in its development in our country.

Tomorrow we will improve it even further and possibly find other applications useful for humanity.
We are looking forward to ICRSH 2014 already!

QUOTES FROM ICRSH 2013

"ICRSH 2013 was very important for the future of hadrontherapy in general (and in Romania in particular), because it brought together a group of professionals (physicians, physicists, engineers) that are very dedicated towards the development of this specific type of radiotherapy" - Ionut Busca M.D.

"The meetings organized by the RSH (the former two workshops and the ICRSH 2013) are the only instances where the radiotherapy with hadron beams was discussed in Romania. From the presentations and discussions we got a lot of valuable conclusions regarding the advantages, disadvantages, applicability to the Romanian context, project management necessities etc. of a Romanian hadrontherapy centre." – phys. Radu Vasilache

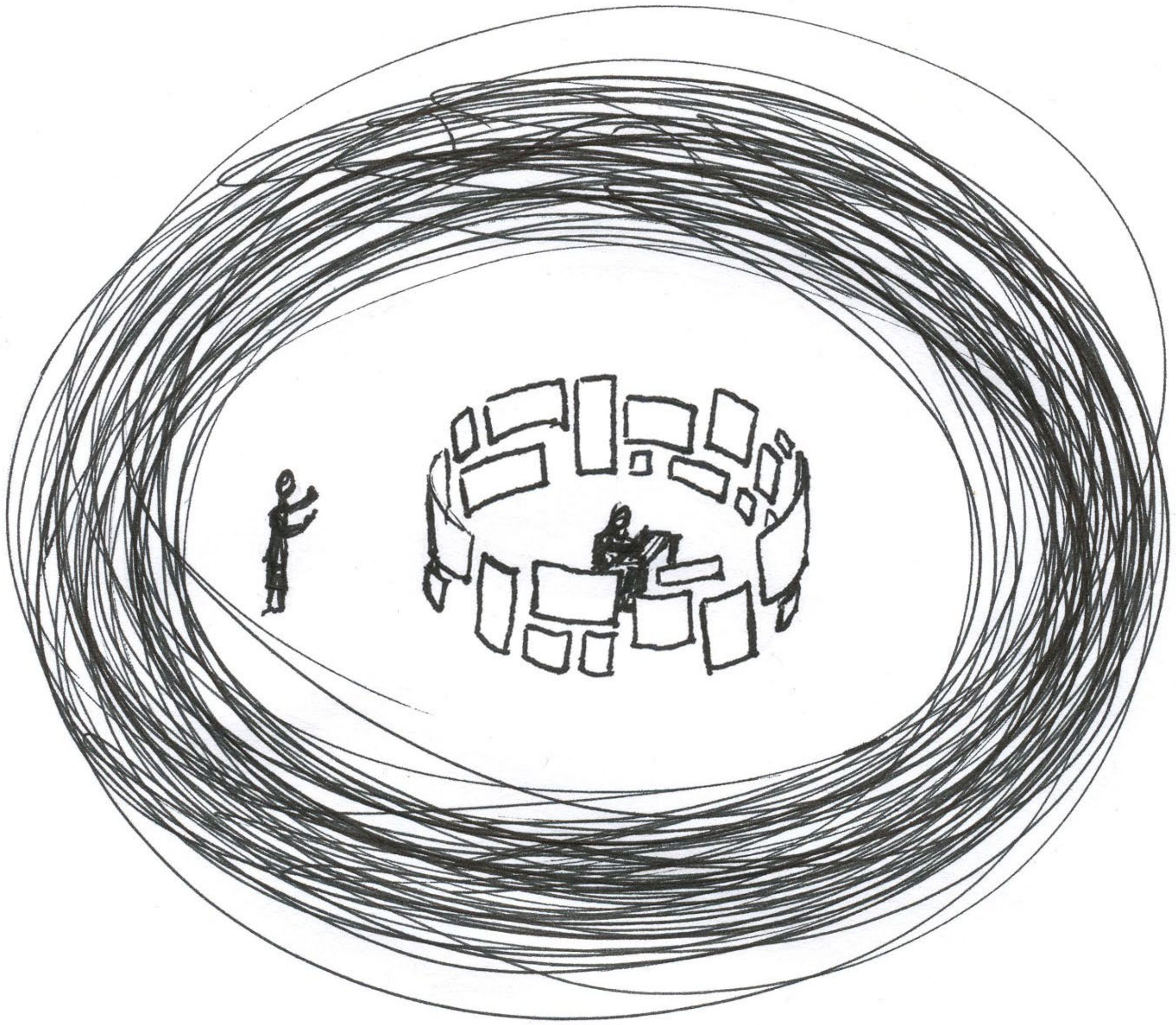
"ICRSH 2013 was an excellent opportunity to meet people involved in radiotherapy and hadrontherapy all around the world. Medical doctors, medical physicists and physicists from Romania and abroad had very interesting presentations, followed by stimulating discussions. "
- Prof. Dan Mihailescu

"ICRSH 2013 brought together the latest news in hadron therapy from medicine and physics, and establish a relation between education and research in the view of preparing specialists for the next hadron therapy facilities" - phys. Roxana Rata

"The conference offered the opportunity to discuss about new methods in radiotherapy education and design of the new curricula for different academic levels in order to improve the student and adult training in the field. "
- Prof. Gabriela Iacobescu

"ICRSH 2013 (was) an important channel for information exchange between high-educated specialists who are working in domains regarding the use of hadrons in diagnostic and medical treatment."
- Chirvase Cezarina-Isabela

"ICRSH 2013 determined Romania to cooperate with other medical and academic societies from abroad."
- Chirvase Cezarina-Isabela



IMPRESSIONS

im·pres·sion (ĭm-prĕsh′ən)

n.- An effect, a feeling, or an image retained as a consequence of experience.

'I SING A PARTICLE'

by Adrian Hornsby, Arnoud Noordegraaf

A NEW PIECE OF MUSIC THEATRE FEATURING HADRON THERAPY IS BEING DEVELOPED THROUGH THE COLLIDE@CERN ARTIST PROGRAMME

Artists are essentially interested in two things: ideas, and how people feel about them. Given such concerns, physics is a rather curious field in that it exhibits terrific idea-density, but is mostly silent as to what these ideas mean to the people who develop or use them. Over the last decade artists have increasingly come to notice this quirk, and started saying to themselves, 'Aha! There's maybe something I can do here.'

A few years ago I started reading particle physics books with a mind to making a piece. One thing I was struck by in particular was how moving an experience much of the reading was. What did it really mean for a particle to sniff out all possible paths, I kept asking myself. Should I be worried about the possibility that the universe was losing information? These were profound and emotive questions. At some point I caught myself standing in front of the fridge with the door open, feeling lost, and thinking, 'The idea of gravity — that bodies in space simply attract one other — is so beautiful. But that it's so hard to find at the small scale is upsetting. But perhaps also a little wonderful ....' I closed the fridge door without an answer to quantum gravity, but what was emerging, it was clear, was the possibility for a human story.

I started to see a character — a non-physicist, but who nevertheless felt bombarded by physics-related questions. In obsessing over them, he was partially obsessing over the fundamentals of matter, and partially using these questions as proxies for the real issues in his life. The story-making mind is so suggestive that it's very easy for a peculiar aspect of, for example, antimatter, to somehow have something to say about your relationship with your daughter, or your dog. But to put this character in a dramatic situation required more. There needed to be something at stake for the character, to generate a crisis of some kind, and he needed to be brought into contact with particles, such that he had a tangible reason to be bombarding himself with these questions.

The narrative solution we found was to give him a tumour, and a mixture of radio- and hadron therapy. The tumour, and the sense of mortality it necessarily provokes, leads him to thinking about his life. What kind of a story does his life make, and what is the story telling him? At the same time, the particle beams he is subjected to are at once either healing him, or making him sicker. The behaviour of these particles is governed by the laws of particle physics, and matter more generally, which in itself is the story of the unfolding of the universe. Such a story must in some way include the unfolding of his life. But is this universe, and its particles, flowing against him? The tumour is on his throat, and as a result of tissue damage from radiotherapy, he has lost the ability to sing. Consequently he feels the particle beam to be a hostile force, taking pieces of his life away from him, and this plays into his anxieties over a broken relationship with his daughter, and his fear of dying with this piece of his story unresolved.

As the treatment progresses, and his condition and prognosis fluctuate, he remembers things in different ways. Through a series of letters written out loud, he reveals to the audience various parts of his life, suggesting first one and then another version of the past.

His observations and feelings about the beam seem to be writing and rewriting his own personal history, as though tracing out different possible paths ...

This concept for the scenario came at the same time as a vision for a song cycle, which we saw playing on the same stage and almost in parallel. The idea was to create a libretto composed of pure descriptions of particle physics — filled with all the suggestive and emotive potential I had found while reading — and for this text to be sung by a soprano alongside the story of the man, as he sits writing his letters. The two worlds would naturally start to resonate, with the physics of the songs taking on meaning in relation to an individual human life. What was emerging between these two for us was a full-length piece of music theatre.

Over the course of the piece, the man gradually moves through the anger he initially feels about his disease, and the universe and how its particles are treating him, and increasingly is able to hear the soprano's song cycle, and to think of it all as a form of music. Though he has lost the ability to sing himself, he comes ultimately to understand living as a form of singing. It is singing the song of the particles, or the universe, or letting the song sing through him. And within the story of his life, this translates to being able to heal the relationship with his daughter (the soprano), and so to find love.

We wrote these ideas up as a proposal and sent them to Collide@CERN, CERN's artist residency programme. We were then lucky enough to be invited for a research visit to start honing the content and language for the song cycle, and to develop our understanding of hadron therapy. On this front, Manjit Dosanjh and Robert Kieffer were both very generous with their time and knowledge, and we look forward to working with them further as the piece takes shape.

Arnoud Noordegraaf

Adrian Hornsby

COLLIDE @ CERN

The British writer Adrian Hornsby and Dutch composer Arnoud Noordegraaf won an honorary mention in the first Prix Ars Electronica Collide@CERN competition in 2011. As a result, they were awarded a special in-depth curated research visit CERN to develop their music theatre piece, 'I sing a Particle.' Collide@CERN will continue to support them in its development to production as part of the programme's emerging portfolio of supporting imaginative and innovative contemporary work in the arts.

Collide@CERN is the annual competition held by CERN for two artists each year to win a fully funded residency at the Geneva based particle physics laboratory. There are two strands - Prix Ars Electronica Collide@CERN, where artists working with the digital as the means of production or creation compete to win a fully funded 3 month residency at CERN and at Ars Electronica, Linz. The second strand is Collide@CERN Geneva, and changes art forms every year. The first year it was in performance and choreography, the second in film. All the residencies are funded by external donors who support making these creative collisions between the arts and science which happen at a high level of selected excellence.

The winners of the first competitions in 2011, the german visual artist Julius von Bismarck and the swiss choreographer Gilles Jobin, have just been awarded the prestigious Hermes Foundation New Settings Award for their Collide@CERN collaboration called 'Quantum'. Their art-dance piece, will now go on an international tour which includes New York and Paris, after having its world premiere at CMS detector hall at CERN this September 2013. So watch out for new Collide@CERN productions.

FOR FURTHER INFORMATION ABOUT COLLIDE@CERN SEE HTTP://ARTS.WEB.CERN.CH

ARTSATCERN.

JULY

11-13 — **ULICE & ENLIGHT ANNUAL MEETINGS**
MEDAUSTRON, WIENER NEUSTADT, AUSTRIA
HTTP://INDICO.CERN.CH/CONFERENCEDISPLAY.PY?CONFID=239829

26 — **COST ACTIONS –FULL PROPOSAL SUBMISSION DEADLINE DATE**

AUGUST

25-29 — **PARTICLE RADIOSURGERY : A NEW FRONTIER OF PHYSICS IN MEDICINE**
UNIVERSITÄTSZENTRUM OBERGURGL, 6456 OBERGURGL, AUSTRIA

SEPTEMBER

9-13 — **ENTERVISION COURSE "SENSORS & READOUT ELECTRONICS"**
IFIC, VALENCIA, SPAIN

27 — **EUROPEAN RESEARCHERS' NIGHT AT CERN, THE ENTERVISION RESEARCHERS WILL EXPLAIN THEIR PROJECTS TO THE PUBLIC**

28-29 — **CERN OPEN DAYS**
GENEVA, SWITZERLAND - HTTP://OPENDAYS2013.WEB.CERN.CH/
HADRON THERAPY SHOWCASED TOGETHER WITH OTHER APPLICATIONS OF PARTICLE PHYSICS.

NOVEMBER

25-29 — **INTERNATIONAL DAY OF MEDICAL PHYSICS**
HTTP://WWW.IOMP.ORG/?Q=CONTENT/INTERNATIONAL-DAY-MEDICAL-PHYSICS

JANUARY 2014

1 — **HORIZON 2020 STARTS**

TBC — **ENVISION FINAL MEETING AND ENTERVISION ANNUAL MEETING**

FEBRUARY 2014

10-14 — **ICTR-PHE 2014**
GENEVA, SWITZERLAND
HTTP://CERN.CH/ICTR-PHE14
REGISTRATION NOW OPEN!

PARTNER project

2008-2012

- 4 years
- 26 researchers
- 12 European institutions
- More than 12 courses

There are the facts. Here come some personal impressions...

VIEW THE PARTNER PROJECT BOOK
HTTP://TINYURL.COM/L2ZDKMW

The PARTNER project was funded by the European Commission under Grant Agreement 215840 from 2008 - 2012

Post-doctoral proposal – IPNL-CREATIS-CAL

Development of a prompt-gamma monitoring system for hadrontherapy

Scientific background

Real-time *in vivo* control of the dose deposited in a patient during ion therapy is a major challenge for Quality Assurance (QA) of treatments. A few years ago, prompt gamma-rays have been investigated for beam range verification with proton (Min et al. 2006) and carbon ion beams (Testa et al. 2008). In the latter case, time-of-flight measurement (TOF) was mandatory to be able to select prompt gamma-rays from the neutron background, which is uncorrelated to the ion range. Since then, several teams in the world have been progressing toward the construction of the first clinical prototype (Smeets et al. 2012; Roellinghoff et al. 2011; Min et al. 2012).

We propose to extend this technique of prompt-gamma detection with TOF to the measurement of the integrated prompt-radiation yield produced in the patient body. A first step toward on-line dosimetry by secondary prompt neutral particles has been developed by the group of the Centre Antoine Lacassagne), using neutron (BF3 scintillator) and gamma (ionization chamber) monitors at large distance from the treatment beamline (Carnicer et al. 2012). The device to be designed during the project should be able to discriminate gamma-rays issued from the patient versus radiations from the environment allowing for the real-time measurement of the energy delivered in the patient.

Objectives

The main purposes of this post-doctoral position is to:

- Design and develop a detection device and its dedicated portable acquisition system.
- Characterize the device during experiments with homogeneous and heterogeneous phantoms as well as real treatments, to be compared to the corresponding Monte Carlo simulations.

Method

The purpose of this post-doctoral position is to:

- Study the TOF information to discriminate gamma-rays issued from the patient versus radiations from the environment in particular from beam tailoring in the case of passive delivery.
- Simulate the radiation field according to the treatment room geometry and the beam delivery mode, for a given treatment plan, and optimize the detection geometry for prompt-gamma issued from the patient.
- Design an optimized detection setup with a single detector according to the previous simulations.
- Carry out preliminary tests with existing data acquisition systems (standard NIM+VME) for both homogeneous targets and realistic phantoms to validate the design of the detection device.
- Develop a readout and data acquisition board for a prompt-gamma scintillator (counting, ADC, TDC for energy and TOF selections) and a dedicated portable acquisition system (with user-friendly interface on laptop computer). TOF measurement can be achieved either by using the cyclotron HF signal or a beam hodoscope inserted in the beamline in front of the patient.
- Acquire data during experiments with homogeneous and heterogeneous phantoms as well as real treatments, and compare to the corresponding simulations. Special attention will be paid to the influence of the treatment plan on the dose monitoring.

Miscellaneous

- **Skills:** medical physics, instrumentation and Monte Carlo simulations.
- **Location**: IPNL (Campus de la Doua, Lyon, France), CREATIS laboratory (Centre de lutte contre le cancer Léon Bérard, Lyon, France) and Centre Antoine Lacassagne (Nice, France)
- **Duration**: 1 year from Fall 2013, extendable with 1 additional year (the recruited fellow will have to spend time with each partner).
- **Contact**: send CV and letters by email to
  Etienne Testa e.testa@ipnl.in2p3.fr
- **Team members:**

  IPNL: D. Dauvergne (DR CNRS, HDR), C. Ray (MCF, HDR), E. Testa (MCF), Y. Zoccarato (IR), H. Mathez (IR)

  CREATIS: N. Freud (MCF, HDR), J. M. Létang (MCF, HDR)

  CAL: J. Hérault (Medical Physicist, HDR)

Context

This post-doctoral position is open within the project "GammaDosi" funded by the "Plan Physique Cancer" (INCa/INSERM). It is a collaboration between the laboratories IPNL, CREATIS and the Centre Antoine Lacassagne.

References

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Roellinghoff, F. et al., 2011. Design of a Compton camera for 3D prompt-gamma imaging during ion beam therapy. *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, 648(Supplement 1), p.S20-S23.

Smeets, J. et al., 2012. Prompt gamma imaging with a slit camera for real-time range control in proton therapy. *Physics in medicine and biology*, 57(11), p.3371-3405.