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Demonstration of production and conceptualization of a continuous beam of X-Rays electromagnetic radiation, from Nikola Tesla's single node tube, with subsequent characterization of the pulsating occult sound frequency, of the inner tube discharge gas, using Artificial Intelligence software, and elaboration of a plan of virtual energy

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ABSTRACT

The life work of Serbian scientist and inventor Nikola Tesla has produced important innovations not only in the field of telecommunications and wireless transmission but also in the fields of electrical distribution systems, fluid propulsion and signaling systems. Such is the amount of his work, especially from the point of view of scientific weight, that his resonance will be felt for many decades in the future, having himself been a precursor. One of the experiences of the Serbian inventor, not well known to most people, is his work on X-rays. His experiments led to the definition, at the same time as German physicist Wilhelm Conrad Roentgen published his discovery on "particularly penetrating rays", in 1895, a form of radiation that could pass through soft tissue, highlighting electron-dense structures such as bones. Of great importance is his work which included not only the production of X-rays through the then known Crookes tubes, with anti-cathode, but also on a new version of the X-ray tubes, the one on which this single node study will be focused. of reduced size and even simpler constitution, compared to the aforementioned Crookes tubes with red-hot cathode rays where, X-rays were produced thanks to the impact of fast electrons (cathode rays) on a heavy metal structure, such as Tungsten, Palladium, or Platinum. Beyond the demonstration of the production of X-Rays, through the Tesla Tube, we have demonstrated the possibility of producing audio frequencies, having the same frequency as the X-Rays, thus defining them, Virtual Energy.

Keywords: Cathode rays; Bremsstrahlung; Anticathode; X-Rays; Crookes's Tube; Coolidge Tubes; Nikola Tesla; Wilhelm Conrad Roentgen; Artificial Intelligence; Virtual Energy.

Introduction

Nikola Tesla's life story can be said to have been marked by numerous births, not only the day he was born on July 10, 1856 but also the day he gave birth to the first induction motor, devoid of a component. defined commutator, for the production of Alternating Current (AC). Many believe that the determination of AC can be counted as his greatest discovery as it truly made the world smaller, through the possibility of breaking down distances, connecting distant places, through a form of electric current that did not require large cables, as instead required the Continuous Current (CC). A further and no less important innovation was that the AC did not show dispersion during transmission. It is important to underline that, in parallel with the studies that Tesla was conducting, on Alternating Current, developing his induction motor, in Italy, and, more precisely in Turin, a physicist and engineer named Galileo Ferraris, was conducting similar research, always on the concept of alternating current, arriving at the realization of an induction motor with many characteristics of similarity with that of Tesla [1-16]. His Second Birth was, probably, when he practically demonstrated the possibility of wireless power transmission, with the operation of a small remote-controlled boat. The places and dates are currently not relevant as we want to focus on the scientific weight of discovery according to the historical moment in which it occurred. Among the spectators of this demonstration were some who asked where the wires were and if they were hidden. Few and almost no one understood the scientific-historical-social significance of that event, in which actually, there was a

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double birth: a further birth of Tesla and of Wi-Fi, which now connects the world and is used by more than six billion individuals around the world. The fundamental paradox is that few today remember the name of the Serbian inventor. His Third Birth lies, probably again, when he laid the foundations, thanks to his patents, of wireless radio transmission, the period in which, financed by the banker J. J. Astor, was in Colorado Springs. The Fourth Birth probably lies when he conceived the Induction Coil, which now bears his name is that represents a pillar for the study of the high potential current, namely the Tesla Coil, an instrument widely used during the experiments in Colorado Springs and, thanks to which, he managed to light a series of light bulbs placed at a distance of several kilometers. Other births could be traced back to the invention of the Mechanical Oscillator or the first example of a direct energy device that would have been renamed, for some, improperly, as the Death's Ray. Without a shadow of a doubt, one of Tesla's most important works, which contributed to enrich cultural background on Applied Electromagnetism, is the one on X-rays. From a physical point of view, X-rays consist of a type of electromagnetic radiation, with a wavelength between 10 nm (nanometers) and 1 pc (picometer), defined as ionizing radiation due to the high energy content they carry. The three physical quantities that best define radiation, whether it be of a corpuscular or electromagnetic nature, although the Belgian physicist Louis De Broglie has developed the equation that allows you to connect the concept of electromagnetic with corpuscle, are: Energy, Frequency, and Wavelength. Energy and frequency are directly proportional to each other, which means that as one increases, the other increases as well. Energy and Wavelength are inversely proportional to each other, as are Frequency and Wavelength. The shorter the wavelength of specific radiation, the greater its energy and, consequently, its frequency. X-rays are that form of radiation that is found, at the level of the electromagnetic spectrum, between ultraviolet radiation and gamma rays, which derive from nuclear transformations, at the level of the atom, such as Beta Decay, in which, a neutron, isolated from the atom, after about 15 minutes, decays into a proton and an electron, with the emission of a neutrino/antineutrino, depending on whether it is positive beta or negative beta decay, and a gamma photon or gamma rays. This, according to the Principle of Conservation of Mass and Energy. Depending on whether the X-rays have a wavelength that brings them closer to the terminal portion of the ultraviolet spectrum or to the initial portion of the gamma spectrum, they are defined as Soft X-rays (closer to the ultraviolet spectrum) and Hard X-rays (closer to the gamma spectrum). The latter, as it is logical to guess, are more energetic than the soft X-rays. The energy associated with a radiation depends on its ability to penetrate biological and non-biological tissues. As regards electromagnetic radiations, their penetration is a direct function of their energy, since, as photons, they do not have a mass, consequently they can interact with matter producing different ionization effects, depending on the energy they carry, or intrinsic energy, and the nature of the material against which they impact. A different rule applies to corpuscular radiations as their penetrating and, therefore, ionizing capacity also depends on their mass and electric charge. In this second case, the Coulomb Repulsion rule applies, in which two point charges, having the same sign (+, + or -, -), repel each other and, if of opposite sign (+, - or -, +), they attract. The greater their mass, the more difficult their ability to penetrate, however, the greater their ionizing power. Mass and ionizing power/capacity are directly proportional. The situation is different for the neutron, a particle with neutral electric charge and, therefore, not being subjected to the forces of electric repulsion, it is able to penetrate matter, although its mass is almost equivalent to that of the proton, i.e. $6{,}67 \times 10^{-27}$ Kg. What is important to underline, in order to differentiate X-rays from gamma rays, is that the former are produced through a process of modification of the kinetics of the electrons, ie the outer part of the atom, while gamma rays are produced as a result of nuclear transformations, as mentioned initially, which concerns the internal part of the atom [17-34]. The history of X-rays is as controversial as their name since, as early as 1887, Nikola Tesla was conducting experiments on single-node tubes, of his own invention, connected to an apparatus, such as a high voltage power supply such as a coil of Tesla, as it is able to supply the energy necessary for their emission [150-153]. In the following years, between 1892 and 1895, internationally renowned scientists such as Hermann von Helmholtz, Heinrich Hertz, William Crookes and Phillip von Lenard, were carrying out experiments on cathode ray discharges within an atmosphere in which high vacuum was practiced. ie a high vacuum tube. Helmholtz provided a first mathematical description of x-rays, Hertz came to demonstrate that cathode rays, produced within a high vacuum tube, where there was therefore the inconvenience of air molecules that could have slowed down the cathode rays and / or produce a scattering phenomenon, i.e. angular deviation following contact of the radiation with a body, thin metal thicknesses could penetrate. William Crookes came to develop a version of a high vacuum tube, called the Crookes tube, in which there were two poles, a cathode and an anode, interspersed with a metal structure called an anticathode. Crookes tubes could contain either a low pressure noble gas, such as Argon, or high vacuum. One of the versions of the Crookes tubes involves the use of an external glass button which contains a particle of carbon. Before using the tube, the operators tend to brush it with the flame of a lighter, thus contributing to the release of CO_2, by combustion, within the tube itself, thus further decreasing the oxygen content. This is a way to maintain and preserve, especially during experiments, the microaerophilic atmosphere inside the tube itself. The heating must not last for more than 2-3 seconds and with a discontinuous flame, in order to avoid deformations or cracks in the glass that could pressurize the tube, making it lose its function. When a beam of cathode rays, or electrons, passed through this gas at low pressure, it produced a luminescence, due to the ionization effect of the gas, just as the radiation, emitted by a radioactive isotope, produces a luminescence around it, called Cherenkov Effect [156-157]. Phillip von Lenard, then a student of Heinrich Hertz, developed a new version of the Crookes tubes, in which he actually produced X-rays, however without realizing it. One of the Crookes tube models that, at that time, was most used in university laboratories, was the Maltese Cross Crookes tube, used as an anti-cathode. The beam of cathode rays, accelerated by the intense electric field produced by the high voltage power supply outside the tube, impact on the anticathode producing a shading phenomenon in the fluorescence produced. This metal screen therefore appears opaque to these rays, since the cathode ray beam has a high kinetic energy, deriving, as mentioned, from the high electric field used to accelerate them, they also have a high temperature, therefore, if the impact time of the same, on a metal screen, it lasts for a long time, it can go against red-hot and, the beam, can make a hole. The greater the energy produced by the electric field, therefore, the greater the ddp, or voltage, the greater the speed of the electrons in the beam. This principle is also applied today in modern linear or circular particle accelerators and in large accumulation rings such as the LHC at CERN in Geneva [35-49]. Phenomena which carry out inside of one high vacuum tube is the same, in reduced scale, that happen inside of one particle accelerator, where, a beam of particle is accelerated by toroidal magnetic fields, put around of one high vacuum metal tube (linear or circular). Moreover, the same process is used inside of an other instrument,

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as Transmission (TEM) and/or Scansion Electron Microscope (SEM), in which, one source of electrons, generated by one high voltage power supply, send a beam of particle inside of one vacuum tube, and, later, is focused and collimated by magnetic lens, as for particles accelerator, and directed on sample, put on a base of same instrument, always in a vacuum space [158-161]. Usually, as an external high voltage power supply for these tubes, a Tesla Coil or a Continuous Current Ruhmkorff Coil is used. Both consist of a primary and a secondary circuit, consisting of numerous windings of turns of conductive material, such as copper, having a specific and mathematically determined so-called "winding pitch". The value of the differentiation of electric potential, in these generators, increases due to the induction effect and, after passing through all the turns of the secondary circuit, the electric current coming out of it, will have a ddp of about 25,000 or 50,000 volts, depending on the number of windings present in the secondary circuit. Normally, these devices are equipped, especially the old Ruhmkorff spools, with a hammer circuit, which allows to strike a discontinuous spark, between two ends of the conductors, defined as spark gaps. The length of the spark is a function of the ddp and is linked by the following relationship: for every centimeter of spark, there are 10,000 volts of ddp [50-80]. The production of X-rays occurs, for most of the cases, through a phenomenon called Friction Radiation or Bremsstrahlung, a phenomenon which, as mentioned before, involves the electronic shells outside the atomic nucleus. Everything comes from the beam of cathode rays or electrons, at high energy, which come to life from the cathode (the pole with negative valence) and are projected linearly inside the environment of the X-ray tube, in a microaerophilic atmosphere or in the presence of a high vacuum. The greater the ddp, delivered by the external generator, with which the tube is powered, the greater the energy of the electron beam directed from the cathode to the anode. At the same time, it means that the higher the kinetic energy of the electrons themselves. When a screen is placed between the cathode and the anode, that is a target of material with a high atomic weight, such as Tungsten, already expressed initially, the high energy beam of cathode rays hits it and causes modifications to the outer part of the atom, inducing the ejection of electrons from the outermost energy levels, according to Bohr's Atomic Model, in which the positions of the electrons are determined thanks to a simplified model, at energy levels, which does not include orbitals or Schrodinger's Statistics. When a high-energy electron from the beam hits the outside of the atom, it interacts with the electrons of the energy levels and this can cause an electron to scatter and eject from the target atom. The electrons of the beam have higher energy than those of the energy levels, for this reason it will be the electrons of the levels to be expelled. Furthermore, the electrons of the beam (cathode rays) are accelerated by the high ddp of the generator and reach a speed close to that of light, which will not be reached, as an ideal value, due to the non-absolute vacuum present inside. of the tube. When at least one electron is expelled, a vacuum is generated, a lack, in an energy level, which is replaced by an electron present on an outermost level, which therefore decays. The more electrons are on external levels, the more energy they possess and the less they are subjected to the forces of attraction by the atomic nucleus. This ejection, followed by decay, generates the emission of an X-ray photon (X-rays), by the Principle of Conservation of Energy. The reason why an atom with a high atomic number is chosen as the target / anti-cathode is the long time before the occurrence of wear. If it were an atom with a low atomic number, such as Carbon, which has only 6 electrons in the two energy levels in the outer part of the atom (2 electrons in the first level and 4 electrons in the second level), wear would occur quickly as you have fewer electrons to expel. Theoretically, the more the atomic number of the element used as an anti-cathode increases, the longer the time of use, before the occurrence of wear that makes the anti-cathode unusable; this assuming a constant energy of the cathode ray beam [81-97]. A more advanced version of the Crookes tubes, whose internal geometry has been mathematically calculated to ensure efficiency of x-ray production and a high wear time, requires; a glass structure, cylindrical, where the two poles are located, on opposite sides, which culminate in a central area, spherical in shape where there is the anticathode in a heavy element, which, if it is fixed, has a truncated conical shape, for prevent a 90° cross section of the beam, thereby reducing the wear time. The cutting angle of the truncated cone anticathode is very important to ensure a ratio between efficiency and wear, in favor of efficiency. The x-rays are therefore emitted, at an angle of 90° with respect to the cathode ray beam and in the direction of the cut of the anticathode itself. The x-ray emission is continuous and regular until a limit temperature value is reached. The second reason for choosing a heavy metal, usually part of the Transition Elements, as an anti-cathode, is the high melting temperature. Therefore, one of the best is undoubtedly Tungsten / Wolframio. The high melting temperature, combined with the high number of electrons in the outer shell, makes it an ideal element. When the high energy cathode ray beam hits the anticathode for a long time, it overheats and reaches the melting temperature. The electrons of the outer shell increase their kinetic energy, reaching that of the beam and undergo spontaneous expulsions, without occurring due to Bremsstrahlung and, therefore, the production efficiency of X-rays decreases and production becomes discontinuous. For this reason, the efficiency and regularity of x-ray production is inversely proportional at the temperature of the anticathode. For this reason, the ignition of a generator, on a Crookes tube, cannot last long as it would cause wear of the anticathode. An even more advanced version of X-ray tubes, called Coolidge Tubes, has a mobile, rotating anti-cathode and a shorter distance between cathode and anti-cathode, another fundamental factor in determining the efficiency of an X-ray tube. The rotating anticathode ensures that the cathode ray beam hits different portions, over time, of the anticathode itself, made of tungsten alloy and of concave morphology, to avoid, as mentioned before, a contact, with a cross section direct, between the beam and the target. Also in this case, the rotation speed of the anticathode must be such as to maintain the ratio between efficiency and wear, always in favor of efficiency. These tubes, Coolidge Tubes, have a very complex constitution and are also expensive, however, they guarantee a long-lasting operating efficiency (Fig. 2.1-2.20). A Tesla tube is very simple in constitution; it is generally cylindrical in shape, with an ampullary enlargement of the diameter, towards the terminal portion, again, as for the Crookes tubes, to ensure greater heat dispersion. The single node, i.e. the cathode, appears in the internal projection as a filament in cardanic suspension, i.e. with free orientation in the three dimensions and fixed only at the point of contact with the cathode itself. The theory that I propose here, for the production of X-rays, by Tesla tubes, is the fact that the cathode acts as a cathode and an anti-cathode at the same time. When the high-energy electron beam crosses the internal filamentous cathode, it determines the Bremsstrahlung effect, and hence the production of x-rays. Therefore, the electrons do not have to cross an empty space before impacting the anticathode but are directly involved in the internal filament (internal cathode) and this could lead to an increase in the efficiency of the tube itself. Also, since it is a filamentous structure, it could reach critical temperature sooner, however, the heat would be dispersed faster than from a thick, heavy anticathode, which has more mass. The dispersion of heat would also be guaranteed by the

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ampullary expansion of the diameter of the tube itself, in the terminal portion. A second theory, now partially set aside, developed by the author of this work himself, proposed that the glass in the tube functioned as an anticathode since, normally, the glass forged in Central Europe of that period contained salts of heavy metals, whose atoms could function as an anticathode for the cathode ray beam. This would require that the atoms, included in the internal thickness of the glass of the tube (in any case not greater than 1 or 1.5 mm), those in contact with the internal vacuum, could produce the Bremsstrahlung phenomenon. According to the theory exposed and the results obtained, subsequently exposed, the author therefore inclines towards the first theory, in which the filamentous cathode also acts as an anti-cathode, at the same time [98-112]. We preferred to deal, first, with the technical-scientific section, on the production of x-rays, so that readers could have a more complete view on the physical mechanisms, before tackling the way in which the discovery of the same took place. Historically, the discovery of X-rays is attributed to Wilhelm Conrad Roentgen, during 1895, at his laboratory in the Würzburg Physical Institute of the University of Würzburg. During his experiments on Crookes tubes at Maltese Cross, fed with a Ruhmkorff spool, in addition to the fluorescence of the gases inside the tube, produced by the ionization caused by the cathode ray beam, he noticed that a screen of fluorescent material, in Platinocyanide of Barium, placed near the table on which the tube was placed, but far from it, was illuminated, emitting a characteristic green fluorescence. In order to avoid that the fluorescence of the tube could somehow induce the development of fluorescence from the screen, he took care to carefully wrap the tube in a thick layer of black cardboard and repeat the experiment. Likewise, the fluorescent screen lit up. His conclusion is that it was a unknown form of radiation that excited the atoms of the fluorescent material on the screen. Without knowing it, Roentgen had paved the way for Fluoroscopy. Subsequent experiments showed completely unexpected effects, such as the impression of photographic plates, enclosed in layers of black cardboard, placed at a distance from a Crookes tube and the appearance of the internal structure of the bones of the hand, on a fluorescent screen, in which the hand was placed between the tube and the fluorescent screen. This "unknown" form of radiation passed through the soft tissues, giving the image of electrondense tissues, such as bones. Roentgen also obtained the first radiographic image of his wife's hand, in 1895, in which the bones of the phalanges of the fingers and the position of the ring of the same clearly appeared. Having learned of Roentgen's discovery, through the publication he made in succession, of a "new type of penetrating radiation", Nikola Tesla wrote a letter to the German physicist, congratulating him on the brilliant achievement and informing him that, too, had obtained similar results with a new type of single-node tube. Roentgen's response was not long in coming and he too expressed total admiration for the work of his Serbian colleague. Furthermore, between 1896 and 1897, Nikola Tesla published a series of ten articles on the biological effects of x-rays, defining the risk of prolonged exposure to this form of radiation. Roentgen's discovery of this new form of radiation, as well as arousing the discontent of the German physicist Phillip von Lenard, who claimed the discovery as his, opened the door to a completely new world in medicine. Roentgen, never gave a real name to this radiation, due to their mysterious nature, and, for this reason, the criterion of simply defining them as X, or X rays, prevailed. Since then, with the development of the first fluoroscopes, X-ray studies have multiplied, both in terms of number and advancement. Numerous other scientists devoted themselves to the study of this form of radiation, both in terms of basic and applied research, especially at the medical-clinical level, where x-rays

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experienced their most flourishing development [113-129]. Nikola Tesla's compatriots, such as Mihajlo Pupin, who also gained support from Thomas Edison, thanks to the fact that he provided him with fluorescent screens based on Calcium Tungstate [130-132], and the German physicist Max Von Laue, Nobel Prize in Physics, are just two of them. the most eminent authorities, in the scientific field, who devoted part of their life to the study of x-rays. In particular, Max von Laue demonstrated that x-rays can undergo diffraction when they come into contact with atomic and / or molecular structures, and that the angle of diffraction of the same is a function of the bond angle that is established between atoms, in a particular compound [133-140]. This provided the basis for the development of a technique that would revolutionize Experimental Science, in particular, in the fields of Molecular Biology, Biochemistry and Genetics, that is X-Ray Crystallography. All the molecular structures, three-dimensional, that we possess today, in the online libraries of proteins and / or nucleic acids, they arose precisely from X-ray diffraction and crystallography studies. James D. Watson and Francis Crick arrived at the determination of the three-dimensional structure of DNA, thanks to X-ray crystallography studies, performed by colleague, who passed away prematurely, Rosalind Franklin [141-145]. Over time, centers for X-ray crystallography grew up around the world, such as the Grenoble Synchrotron, used for the three-dimensional determination of the structure of proteins for the most part. It consists of a circular particle accelerator, in the shape of a ring, from which linear structures depart and are used for the production of pure high-energy x-ray beams. To obtain a three-dimensional structure of a molecule it is important that the beam incident on the protein crystal (obtained previously in the laboratory thanks to a salt deposition procedure), is as pure as possible and does not contain spurious components of other forms of electromagnetic radiation, such as gamma rays, or some residues of corpuscular radiation that derive from the acceleration of the same particles within the Synchrotron. The parallel area in which x-rays developed was the clinical one, which appeared from the very beginning of their discovery, since their potential in experiencing electrondensic structures, such as bones, was immediately understood, highlighting the nature of traumas and / or fractures of different nature. From here, modern radiology was born, now applied all over the world, and its variants, such as CAT or Computerized Axial Tomography, which allows to obtain three-dimensional images of the internal structure of bodies, not necessarily living, thanks to the use x-ray. Forensic Science, Archeology, Paleontology, Metallurgy, Electrotechnics, Robotics, have known a flourishing development thanks to the development of x-rays. As we can see, from those simple initial experiments, carried out in university laboratories with high voltage generators and high vacuum tubes, the results have had an echo of worldwide resonance, touching every area of scientific knowledge. X-rays, before the development of more modern techniques, such as the use of particle beams such as Hadrons (Protons), Deutons and Heavy Ions, also had a use in Antiblastic Radiotherapy. Finally, their application has touched areas such as Astronomy and Astrophysics, in fact, a very developed branch of the same is X-ray Astronomy. The Italian physicist Riccardo Giacconi, received the Nobel Prize in Physics for discovery of sources of x-rays, natural, in the cosmos. Among the natural sources, there are black holes, as it was found that they emit a beam of radiation, identifiable as a specific signal. This allowed for the identification of one of the first black holes, in the constellation of Cygnus, which would be called Cignus X-1 [147, 148]. Precisely because of their nature, x-rays are considered an electromagnetic radiation, of an ionizing nature, particularly dangerous for living organisms, due to the biological effects they are able to produce. The more the energy increases, the greater the ionizing effect will be, due to the production of oxygen and nitrogen radicals, also called free radicals, responsible for oxidative stress, at a cellular and molecular level, and, therefore, potentially carcinogenic, depending on the dose and time of exposure and the more radiosensitive tissues [163].

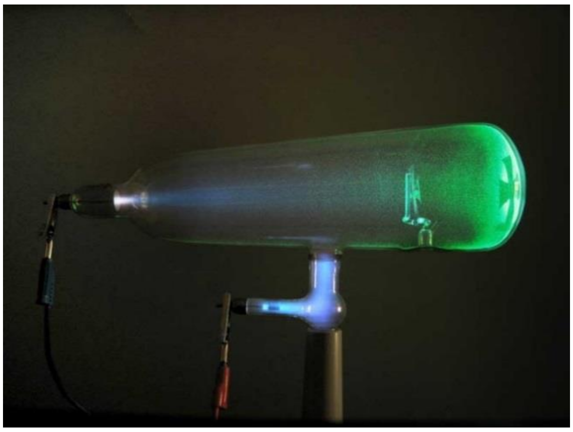

Figure 1. Example of a Crookes tube, with a Maltese cross anti-cathode, used for the first experiments on x-rays. There is a linear structure, blue in color and on the left, corresponding to the beam of high-energy cathode rays (electrons), which impacts the anticathode. On the right of the anticathode, a green fluorescence and the shadow of the Maltese Cross. At the ends of the two nodes are connected two electrodes, with "crocodile clips", in turn connected to a high voltage generator, such as Ruhmkorff's coil or Tesla's coil (Copyright: https://ecografieroma.it/tubo-di-crookes/)

Figure 2.1

Figure 2.2

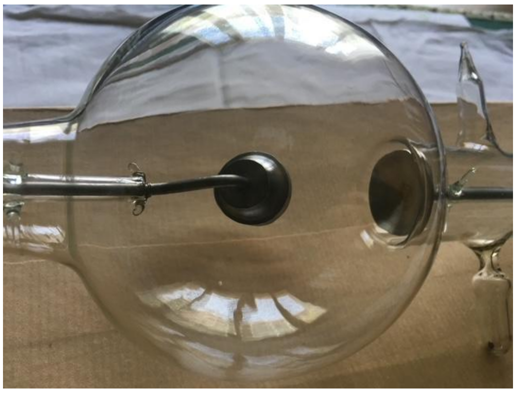

Figure 2.3

Figure 2.4

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Figure 2.5

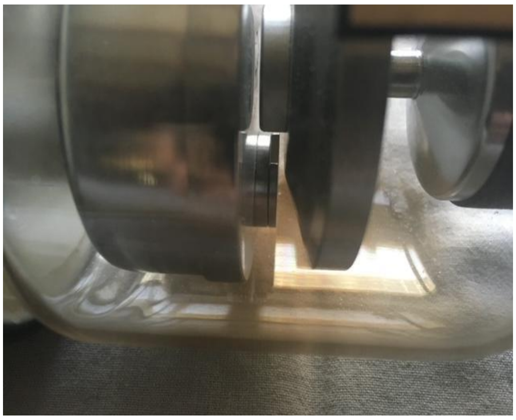
Figure 2.6


Figure 2.7

Figure 2.8

Figure 2.9


Figure 2.10

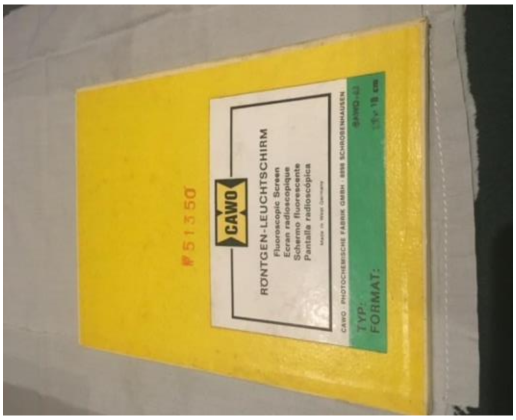

Figure 2.11


Figure 2.12

Figure 2.13

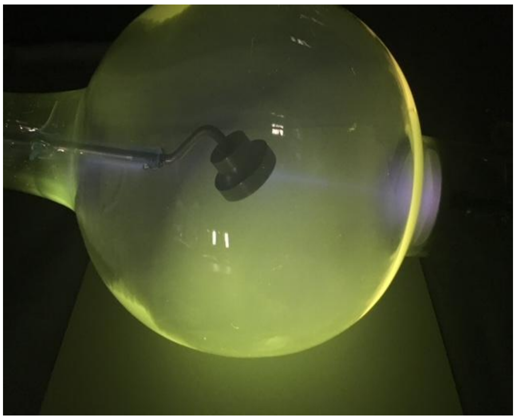

Figure 2.14

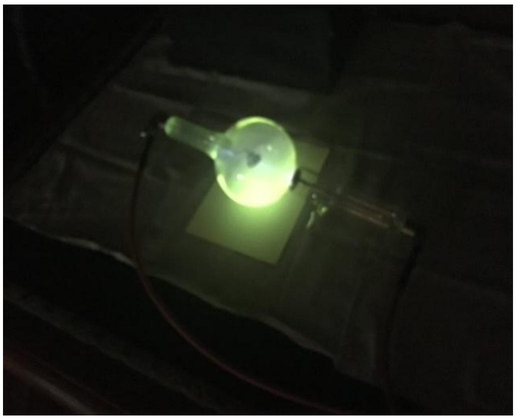

Figure 2.15

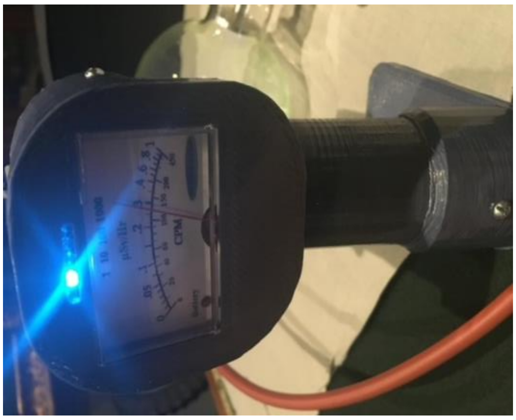

Figure 2.16

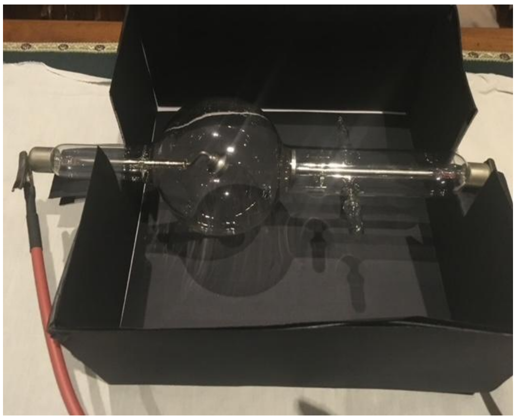

Figure 2.17

Figure 2.18

Figure 2.19

Figure 2.20

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Courtesy of Stefano Turini's Private Collection

These images define the summary of what is defined in the Introduction;

Figure 2.1. The Crookes tube, with an angled central anti-cathode, in its packaging.

Figure 2.2. Portion/detail of the cathode of the Crookes tube.

Figure 2.3. Detail of the central Ampullary Dilatation in which the angled anticathode and the concave plate of the cathode are clearly visible.

Figure 2.4. Detail of the button/External protrusion, with carbon particle, for the maintenance of the low oxygen content, inside the tube, during use.

Figure 2.5. X-ray tube, used in Orthodontics, with rotating anticathode.

Figure 2.6. Detail of the X-ray tube, used in Orthodontics, which highlights the rotating anticathode and the reduced distance between anticathode and cathode.

Figure 2.7. Crookes tube placed inside a black cardboard box, to shield the spurious light radiation.

Figure 2.8. Detail of the outgoing cables, with rubber insulation, with relative crocodile clips, of the high voltage power supply, with 50,000 volts in output from the secondary, used to ignite the Crookes tube.

Figure 2.9. On/off key and potentiometer of the high voltage power supply (Ciano Industries, Turin, Italy).

Figure 2.10. Portable Tesla Coil containment box, with secondary output ddp of about 45,000 Volts.

Figure 2.11. Containment box of the fluorescent screen, with Barium Platinocyanide, used for the identification of x-rays in Fluoroscopy.

Figure 2.12. Detail of the Barium Platinocyanide fluorescent screen, supported by protective tissue paper.

Figure 2.13. Luminescence of gases at low pressure, within the ampullary enlargement of the Crookes tube.

Figure 2.14. Detail of the Crookes tube in which the high energy cathode ray beam is visible, as a faint blue line, which impacts on the angled anticathode.

Figure 2.15. Overview of the active Crookes tube placed on a fluorescent screen.

Figure 2.16. Detail of the x-ray emission detection, by Geiger counter (Heliognosis, Canada).

Figure 2.17. Crookes tube, connected at both ends, with the high voltage power supply and placed in a black cardboard box, shielding the luminous impurities.

Figure 2.18. Containers for three fluids used for radiographic development (Development, Washing and Fixing).

Figure 2.19. Detail of maximum detection, in CPM (Counts Per Minutes), of the Geiger counter (Heliognosis, Canada).

Figure 2.20. Radiography of the right hand of the author of the experiments, Stefano Turini. As you can see, the production of x-rays took place (through confirmation with the Geiger counter), however, soft x-rays were produced, not sufficiently energetic to highlight the internal bone structure.

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Objectives

The objective of this work is to demonstrate the actual production of X-rays by a single node Tesla tube, by means of a verification performed with a military-type Geiger-Mueller counter equipped with a window for x-ray detection. To the primary objective, just outlined, a second one is added, in which, the use of Tesla tubes, for modern diagnostics, would decrease the costs of the industry for the production of X-ray tubes and would allow the development of simpler and more simple devices. portable, with the same resolution of modern equipment, also considerably reducing production and / or maintenance costs. The further purpose, secondary, however, no less important, compared to the previous ones listed, was to try to record the audio emission frequency of the discharge tube and to compare this spectrum, after the analysis, with the emission frequency of X-Rays. This experiment was needed as a basis for the creation of an audio frequency, corresponding to the emission frequency of the X-Rays, and to observe the effects of this audio emission, if they could be compared with the actual X-ray radiation, in view of the possibility of realizing a sort of form of virtual energy.

Materials and Methods

All the material used for the experimentation was provided by the author of the work himself, Stefano Turini, from his private collection of scientific instruments, who also personally carried out the experiments. A single node Tesla tube by Industrie Italiane Galileo was used, dating back 62 years (Fig.2.21), a Geiger Mueller military counter, model RAD-MONITOR™ 9000, Radiation/Contamination Survey Meter, RPI (Raspberry Pi, USA) equipped with a window for X-ray detection (Fig.2.22), a portable Tesla Coil, of the H.F. TESTER, MODEL T.2, EDWARDS HIGH VACUUM LTD. CRAWLEY, SUSSEX, with ddp, output from the secondary of 45,000 volts, with the potentiometer set to maximum (Figs. 2.23-2.24).

Figure 2.21. Single node Tesla Tube, from Industrie Italiane Galileo, used in experiment, with basal support and single node localized in upper part of tube, near of ampullary enlargement

Courtesy of Stefano Turini's Private Collection

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Figure 2.22. Geiger Counter detector, with external probe, used for detection of X-rays from Tesla Tube

Courtesy of Stefano Turini's Private Collection

Figures 2.23 and 2.24. Portable Tesla Coil used in experiment for X-rays production from Tesla Tube with single node - ***Courtesy of Stefano Turini's Private Collection***

Figures 2.25 and 2.26. Detail of the proximity of the external probe of the Mueller Geiger Counter, to the ampullary enlargement of the Tesla tube, where it is assumed, thanks to the internal protusion of the cathode, that X-rays are produced - ***Courtesy of Stefano Turini's Private Collection***

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Figures 2.27 and 2.28. The image on the left shows the luminescence of the low pressure gas, inside the tube, excited by the high ddp discharge, provided by the Tesla Coil, where we see the spark exiting the secondary, at the upper apex of the tube, which activates the cathode. The image on the right, unfortunately grainy, shows the level of X radiation detected by the Geiger counter. The detector needle is over half of the reading index. (The image is grainy as it was taken from a still image of a video, shot by the author himself, during the execution of the experiments) - ***Courtesy of Stefano Turini's Private Collection***

Figures 2.29 and 2.30. The images show a comparison between the grainy image, of the detection, with a more defined one, of the reading index of the Geiger Mueller counter. By comparing the position of the hand in the upper frame, with the visible index of the lower frame, we mean that, with the Tesla Coil, having the potentiometer set to maximum power, there is a constant emission at the output. of X-rays, of at least 800 mR/hr (Milli Roentgen/ Hour), also identified by the red line, specially inserted, which helps to understand the radiogenic emission value, not visible in the grainy frame

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The experiment was conducted taking care to bring the external probe close to the ampullary enlargement of the Tesla tube and to block it, by means of supports (Fig. 2.25 and Fig. 2.26), at the right distance. The ignition of the tube took place manually, holding the external probe of the Tesla Coil, separated from the main generator of the same (Fig. 2.23 and 2.24). As the coil power was varied, by acting on the external potentiometer, the spark and luminescence gradually appeared inside the tube (Fig 2.27). Next to it, the Geiger Mueller counter began to signal, both through the calibrated needle and through external sound emission, the production of x-rays. During the whole time of the experimentation, the operator was equipped with a thoracic and dorsal vest, with extension to the neck, in order to protect himself against the X-ray emission, deriving from the tube. A peculiar feature of the experiment was the possibility of visualizing not only the discharge gas inside the tube, but also the beam of cathode rays which came out of the pole and came into contact with the glass portion of the discharge tube. This beam of particles, made visible thanks to the ionization of the air, had a certain pulsation frequency, probably connected to two phenomena: the instability of the external electrons of the gas atoms within the ampullary expansion of the tube and the stimulation current of the tube that had an inhomogeneous voltage. The instability of the electrons could derive from the fact that, in the more distant portions of the central beam, the electrons tended to lose energy and tended to decay on more internal and lower energy levels and orbitals. As they decayed, they emitted energy in the form of photons at a specific wavelength, including X-rays. It is no coincidence that the Bremsstrahlung effect is precisely due to the decay of one or more electrons, on levels and/or at lower energy and, as it decays, a Photon is emitted, having the wavelength of X-rays. In all likelihood, the pulsation frequency of the discharge gas was a visualization of the Bremsstrahlung effect. By means of a recording instrument, and by placing the Tesla tube within an anechoic chamber, the sound frequency of the tube was recorded and amplified during the emission of the X-ray beam. Within this frequency, after its analysis, using the software Audacity (Copyright © 2023 by Audacity), the aim was to determine if there was the presence of a harmonic, understood as a submultiple of the X-ray frequency, which corresponds to approximately 10^{16}-10^{19} Hz. This would have demonstrated whether the discharge frequency was directly related to the production of X-rays. To ensure accurate recording of the signal, an anechoic chamber, cubic in shape and 70 cm per side, was created using an Olympus three-dimensional sound capture voice recorder, model LS-P4. Thus, it was a structure having an area of 29,400 cm^2 ($A = 6L^2$) and an internal volume of 343,000 cm^3 ($V = L^3$). The chamber was made with an external coating in Mu metal sheets, with a dimension of 70 cm per corner, and a thickness of 0.5 mm and an internal coating in sound-absorbing material, i.e. in Chrysotile, also known as White Asbestos. The Chrysotile thickness, about 5 cm, was made from Asbestos yarn. The tube was kept lit, inside the anechoic chamber, powered by the Tesla Transformer, for 30 seconds, during which the specific frequency was recorded. The application of the Asbestos thickness in the internal portion of the chamber, made, from the outside towards the inside of: Mu Metal (0.5 cm), Multilayer Wood (2.5 cm), Chrysotile Asbestos yarn (5 cm) , further reduced the useful volume, however, sufficient to be able to produce a form of packing of the internal instrumentation, in order to avoid contamination with other forms of sound emissions that could have altered the recording. In all, each side was reduced by 10 cm, of which 5 cm for each end. In all, the side, intended as useful space, was 60 cm, therefore, a useful area of 21,600 cm^2 and a useful volume of 216,000 cm^3. The cleaning of the signal, once recorded, was performed using a software for algorithmic

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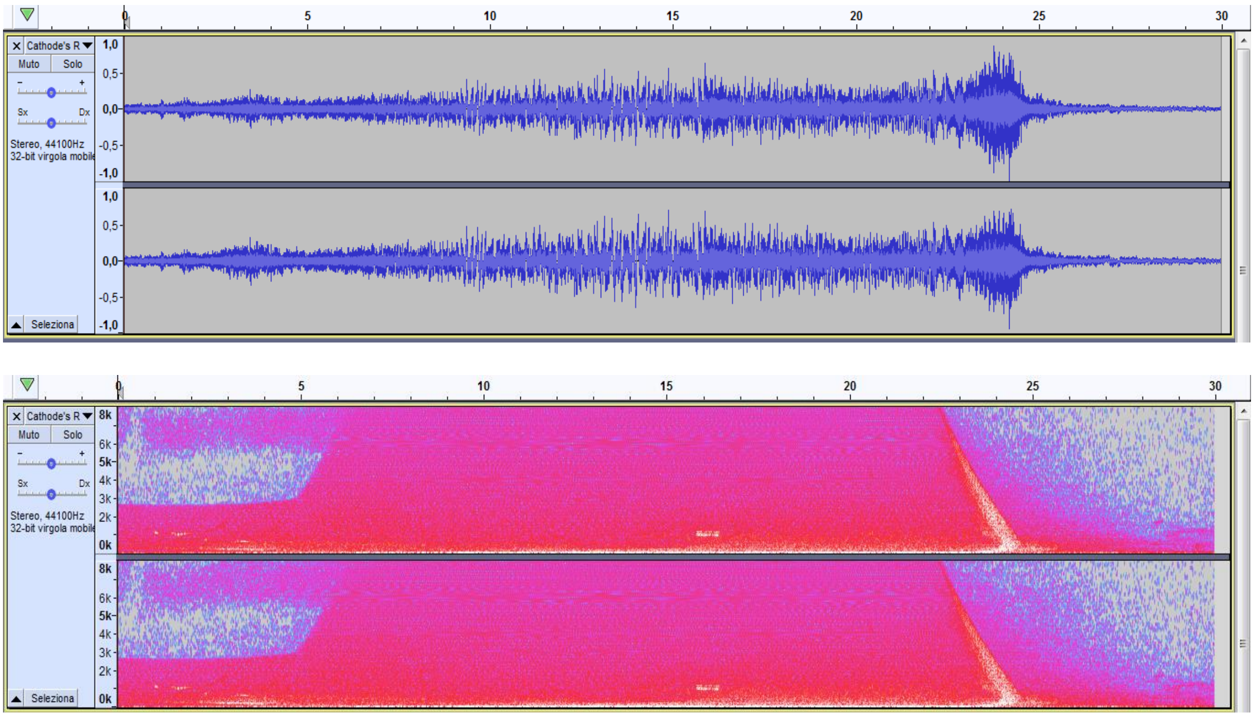
reprocessing of the signals, created using the Oracle Java platform (© 2022 Oracle) [164]. In succession, thanks to the frequency generation software GNaural [165], a sound model of the X-Ray frequency was recreated using a frequency of 10^{18} Hz. The output signal was cleaned of the other frequencies, using the program created with Java , and was examined, from the point of view of the sound spectrum, with the AudaCity program (Fig. 2.31 and Fig. 2.32).

Results

The experiment, repeated three times, under the same conditions, resulted in an X-Ray emission value of 800 mR/hr (milli Roentgen/hour), which, making the appropriate conversions, correspond to: 91.2201 Grays (Gy) and 0.0074637309324999 Sievert (Sv). In addition, conversion factor was also applied to determine how many chest radiographs, performed per hour, correspond to the emission value of 800 mR / hr or 0.8 R / hr. Considering that the emission value of 3.6 R / hr, the maximum detected by low-scale detectors, during the Chernobyl accident, corresponds to about 400 chest radiographs, as stated by Prof. Valery Legasov, superintendent of the commission of the investigation into the accident at the Chernobyl nuclear power plant in 1986 [162], the emission of 0.8 R / hr, making the appropriate proportion, corresponds to about 89 chest X-rays, taken in the time interval of one hour. The production of x-rays was continuous, and this was determined by listening to the sound emitted by the Geiger Mueller counter, for three experiences, each lasting at least 20 seconds. Subsequently, there was a decrease in the intensity of the emission, accompanied by the appearance of discontinuities and / or solutions of continuity in the sound emission of the radiation detector. It is assumed that the temperature increase of the filament inside the ampullary expansion of the tube may have influenced, as initially explained in the Introduction section, the efficiency of the tube itself.



Figures 2.31 and 2.32. Reprocessing of the sound signal, recorded by the device, within the anechoic chamber, of which the waveform (top image) and spectrum (bottom image) are appreciated

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Therefore, the increase in temperature reduces the efficiency of the Bremsstrahlung effect. The analysis performed on the sound sample, extrapolated from the recording inside the anechoic chamber, revealed the presence, even if only at the beginning of the audio track, of the frequency of 10^6 Hz, corresponding to a harmonic of the frequency of 10^{16}-10^{19} Hz, corresponding to the X-ray range (Figure 2.33).

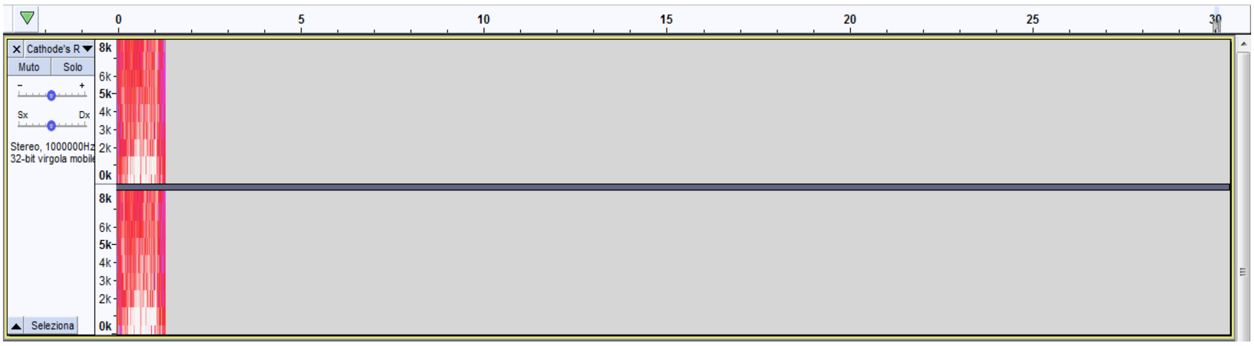

Figure 2.33. Examination of the sound frequencies, with cleaning of the signal and identification of the 10^6 Hz frequency, harmonic, in submultiple, of the X-Ray frequency

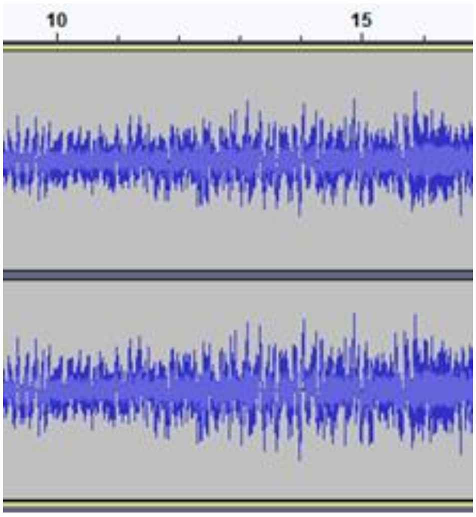

Figure 2.34. Central portion of the sound spectrum recorded within the anechoic chamber

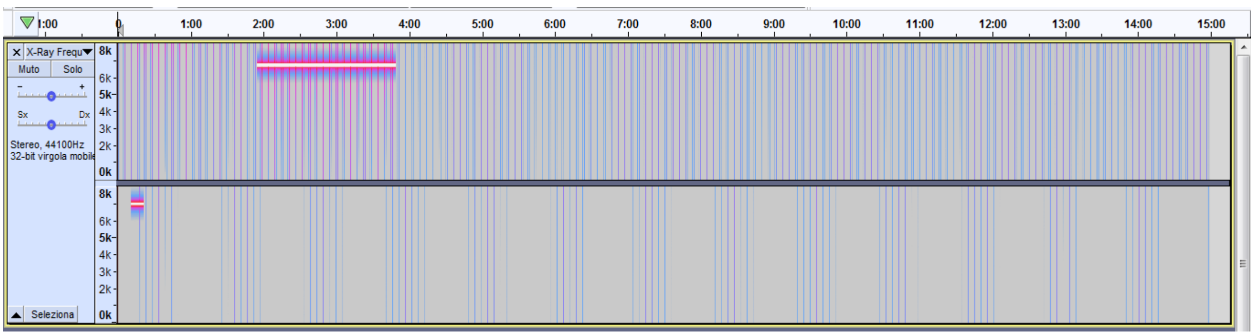

Figure 2.35. AudaCity elaboration of sound spectra of frequency of 10^{18}Hz, which relate frequency of X-Rays

In the central portion of the spectrum (Figures 2.31 and Figure 2.34) it is possible to note a greater inhomogeneity, understood as a greater distance between the individual peaks, perhaps corresponding to the time distances in which the Bremsstrahlung events would have occurred, one for each peak. The processing of the sound spectrum, of the frequency carried out using the GNaural software (Fig. 2.35, Fig. 2.36, Fig 2.37), and the consequent selection of the frequency, corresponding to 10^6 Hz, the submultiple of the harmonic of the X-Ray frequency, gave, as a result, the presence of this frequency in the initial portion of the sound spectrum (Figure 2.36).

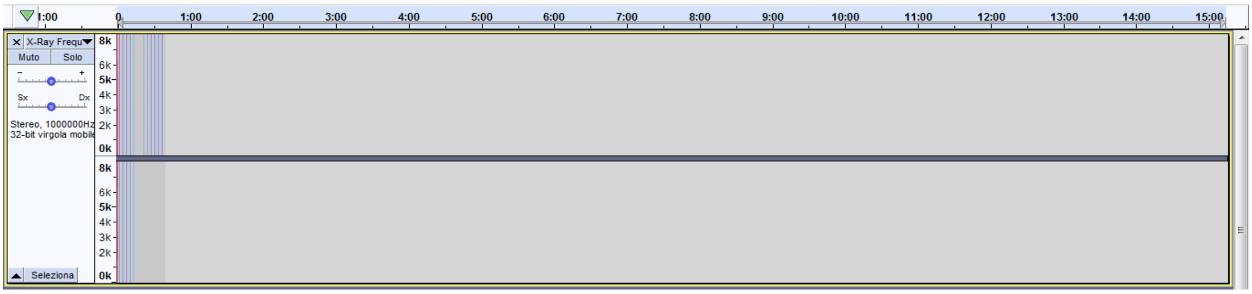

Figure 2.36. AudaCity elaboration of sound spectra of frequency of 10^{18}Hz, which correspond of frequency of X-Rays, with a selection of a frequency of 10^6 Hz

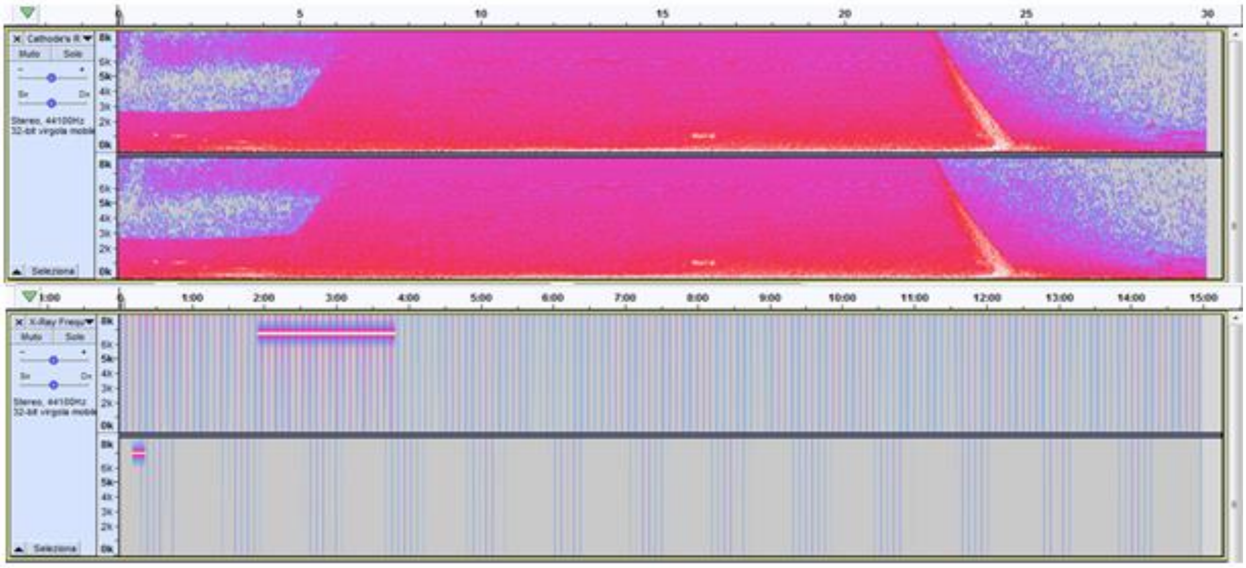

Figure 2.37. Comparison of sound spectra of emission of Tesla's Tube (top image) and signal created with Gnaural software (bottom image)

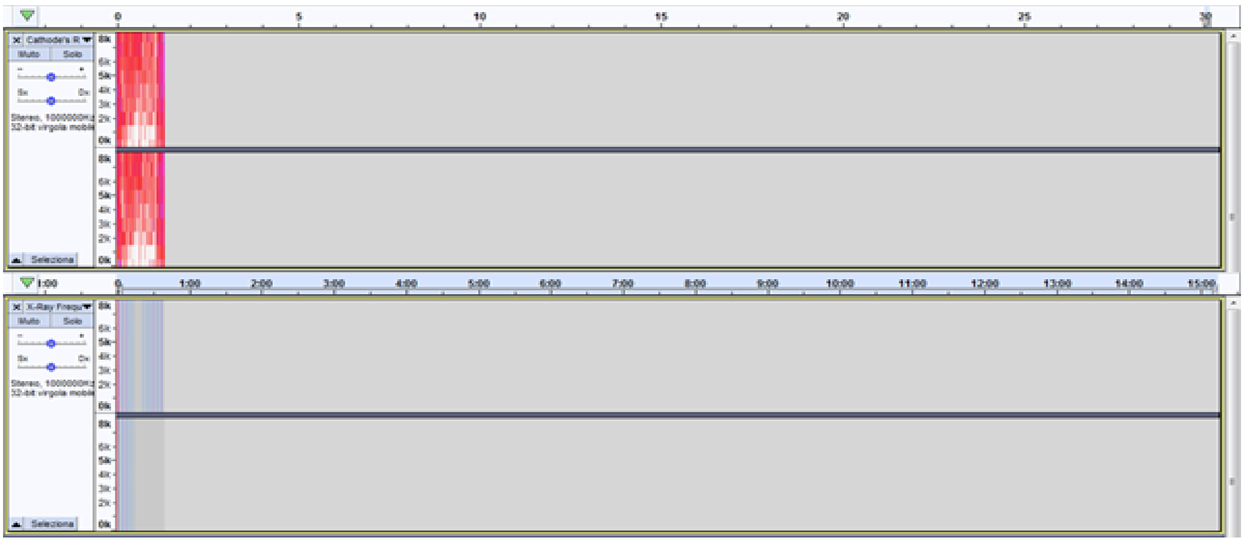

Figure 2.38. Comparison of the sound spectra, with only the selected frequency of 10^6 Hz, of the sound signal emitted by the discharge tube (top image), and of the frequency created with the Gnaural software (bottom image)

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Although the spectra of the two frequencies examined, i.e., the sound recording of the discharge tube and the frequency created with GNaural, are completely different (Figure 2.37), both present, in the same portion of the spectrum, the same submultiple of the harmonic, i.e. 10^6 Hz (Figures 2.38).

Discussion

The theory developed by the author of this work is that, in the case of Tesla tubes, with a single node, the production of x-rays always occurs through the Bremsstrahlung effect, however, while in more complex X-ray tubes, such as Crookes tubes or modern Coolidge tubes, in which there is a rotating anti-cathode, in Tesla tubes, the external cathode is directly connected to an internal filamentous portion, constituting the extension of the cathode itself. This filamentous structure acts as a cathode and an anticathode at the same time, and is made up of a transition element, such as Tungsten. A better definition could be "improper anticathode" as it does not function exactly as a target for the cathode ray beam, but rather as a sort of conveyor for the beam itself. If the energy supplied to the cathode is sufficient, it is transmitted to the internal filamentous portion, which, having a very thin section of at least 2 tenths of a millimeter, has a minimum value of electrical resistance and, consequently, allows the charges (cathode rays) to flow more freely. Therefore, if the energy supplied by the external power supply is sufficient, then more electrons of the atoms making up the filament will be expelled from its energy level and the Bremsstrahlung effect will occur, with the consequent production of x-rays. As with other types of X-ray tubes, the problem is the overheating of the cathode and anticathode. The efficiency in the production of x-rays decreases with increasing temperature (already called initially), however, it decreases with a regular and/or pseudolinear trend, until reaching a limit temperature value, in which, especially for the anticathode, the electrons of its atoms vibrate, due to accumulated kinetic energy, which becomes thermal energy, making the Bremsstrahlung effect practically impossible. It is when this limit temperature value is reached that the efficiency in the production of x-rays, up to before decaying with a regular trend, undergoes a rapid peak decay. In some Crookes tubes, used for the study of the arching of the anticathode, caused by cathode rays, they can even drill a hole in the anticathode itself as the collimated beam hits a point of the anticathode with precision and, the electrons of the beam, endowed with very high kinetic energy, produce a melting spot of the anticathode itself. It is possible to calculate the kinetic energy, associated with the electrons of the beam, through the knowledge of the fact that, normally, free electrons travel at the same speed as light, in a medium such as air, ie about 100,000 Km / s. When they are accelerated by an electric field with a high ddp, then their speed is close to 290,000 Km / s, especially if they move within the environment of the X-ray tube, where there is a very low air content, therefore, the beam does not it undergoes friction, deriving from air molecules, and / or deflections of any kind.

The calculation of the kinetic energy of each of the electrons of the beam can be performed as follows:

$Ec = ½ m * v^2$

The mass of the electron is $9.107 * 10^{-31}$ Kg

Their speed, within the high vacuum tube, is about 290,000 km / s. The term "about" is used, since, at speeds close to those of light, the concept of the Uncertainty Principle, formulated by the German physicist Werner Heisenberg, prevails, in which it is not possible to establish, with the same precision, position and speed of a electron, therefore, the calculation that follows is of a purely probabilistic nature.

So:

Initially, the value of Km/s is converted to m/s:

290,000 Km/s = 290,000,000 m/s

$Ec = 1/2\ m * v^2$

$Ec = (9.107 * 10^{-31} /2) * (290{,}000{,}000\ m/s)^2$

Ec = (0.0000000000000000000000000000009107 / 2) * 84.100.000.000

$Ec = 7.658987 * 10^{-20}\ Kg * m^2s^2$

$Ec = 0.00000000000000000007658987\ Kg * m^2s^2$

The Tesla tube has characteristics that, physically, make it more efficient than modern X-ray tubes, in which there is a separation between cathode and anti-cathode, although some have a rotating cathode and, the distance between cathode and anti-cathode is reduced. The strengths of the Tesla tube, compared to other X-ray tubes can be summarized as follows:

(1) The cathode is identified with the anticathode (according to the theory developed by the author of this work);

(2) The cathode/anti-cathode is of a filamentous nature and, therefore, guarantees a better dispersion of heat and a greater fluence of the cathode ray beam, on a structure that functions as a conveyor, thanks to the reduction of the electrical resistance;

(3) The anticathode, identified in the cathode itself, does not behave as a target, but as a conveyor of the cathode ray beam.

Obviously, all the points outlined are a direct consequence of each other and possess a logic only if the theory of the identification of the cathode with the anticathode is confirmed.

The analysis of the sound emission, by the discharge tube, inside the anechoic chamber, revealed the presence of a harmonic, in submultiple, of the frequency of the X-Rays, i.e. at 10^6 Hz. This constitutes the demonstration that, a part of the emission spectrum is not made up only of hard X-rays, but also of soft X-rays, ie with a lower energy than the previous ones, above all, as the spectrum has shown, at the beginning of the emission. This must be correlated with the temperature of the internal filament itself since, it is presumable that, the more the tube is kept lit, the higher the temperature of the internal filament, therefore, the greater the possibility of Bremsstrahlung events occurring and with emission energy higher, until a limit temperature peak is reached, whereby, arriving close to the melting point of the filament itself, there would be a decrease in Bremsstrahlung events and, therefore, the emission of X-rays with lower energy. This technique has also demonstrated that the audio emission of the discharge tube is directly connected to the emission of X-rays by the same tube. The further presence, in the same portion of the spectrum, of two completely different vocal prints, of the same frequency, corresponding to a harmonic, in submultiple, demonstrates that it is possible to reproduce the X-Ray frequency not only through an electromagnetic pulse, but also through sound waves. The conversion of X-Ray to sound waves would allow us to understand how to produce energy from a sound wave at a specific frequency.

Conclusions and Future Proposals

The experiments outlined here have allowed us to conclude that single-node Tesla tubes can emit X-rays through regular emission and that, like other X-ray tubes, they have problems with internal overheating, which affects efficiency. of operation of the tube, in the form of x-ray emission. The same work has allowed the development of a theory that would see Tesla tubes, with a single node, with a greater operating efficiency, compared to other X-ray tubes, due to a higher simplicity of realization, which would involve a reduction in maintenance costs and possible replacement. The final theory, elaborated by the same author of the work and, for the moment not yet supported by any type of scientific proof, is the following: Tesla tubes have such a simplicity of realization that they can be compared to a normal light bulb or incandescent lamp (Fig. 3.1 and 3.2). The comparison between the two devices sees many similarities, including:

- The morphology of the bulb, or ampullary expansion, where the internal filament is present.

- A single pole or node, i.e. a cathode.

Figures 3.1 and 3.2. Comparison and highlighting of similarity between an incandescent lamp, with a Tungsten filament, and the Tesla tube

(Copyright: https://sg.electgo.com/products/Chiyoda%20lamp)

Given the high similarity, one wonders, what could be the result if one tried to power an incandescent lamp with a source such as a Tesla transformer / coil and not with the canonical current at 220/230 V, at the frequency of 50 / 60 Hz. The Tungsten filament, inside the bulb, assumes the same role as the linear filament inside the Tesla tube. If it were stimulated with a Tesla coil, like the one described in this work, could the Bremsstrahlung effect occur in the

Tungsten filament of the light bulb? So, could a common incandescent lamp become a new X-ray tube? Even then, the costs associated with the X-ray equipment would be significantly reduced. The author proposes to perform a second series of experiments, having as their objective the ignition of common incandescent lamps, thanks to a Tesla coil, using a Geiger Mueller counter (the same used in such experiments), to determine if, such bulb lamps can emit X-Rays, under appropriate stimulation. Furthermore, since the main problem of X-ray tubes is internal overheating, as already explained, it would be necessary to develop a metal alloy, highly resistant to heat, having at least one transition element in the composition, including Tungsten. An efficient combination could be: Tungsten-Niobium-Tantalum. Niobium-Tantalum, known industrially as Coltan, has a high melting point of 3017°C. Tungsten, for its part, has a melting point of 3422°C. Thanks to the creation of a similar alloy, with a different percentage of the two/three elements, the efficiency and duration of operation of the tubes would be increased, especially if it were decided to develop a bulb lamp or a Tesla tube, having a filament made of Tungsten-Niobium-Tantalum alloy, there would be a very high efficiency increase. It must be considered, however, that Tungsten is the known element, having the highest melting point. The determination that the emission audio frequency contains harmonics in submultiples of the frequency of the X-rays themselves is a demonstration that, using advanced investigation tools, it is possible to record the emission sound of such radiations. The demonstration of the possibility of creating an audio frequency, corresponding to X-rays, has the potential to open completely different application scenarios and to a new level of technological advancement.

Declarations

Source of Funding

The aforementioned research did not require funds as it was carried out with tools and software owned by the same author.

Conflict of Interests

The author declares the total absence of conflicts of interest, both during the conduct of the experiments and during the written drafting of this work.

Consent for Publication

The author declares that he/she consented to the publication of this research work.

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