ISASINDIA Newsletter

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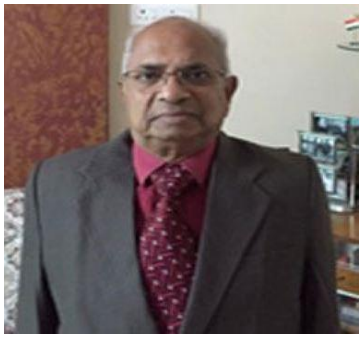
Message from President ISAS



It gives me immense pleasure to have April-June issue, 2023 of e- version of ISAS Newsletter.

Newsletter plays a prime role in keeping us abreast with the latest research, scientific activities in offing, under process and completed by ISAS and its different chapters to meet the basic objective of the society besides knowledge sharing.

The Newsletter, thus acts as a link between ISAS and its Members.

The long cherished desire of the news letter realised in June, 2019 has completed almost four years of its continuity.

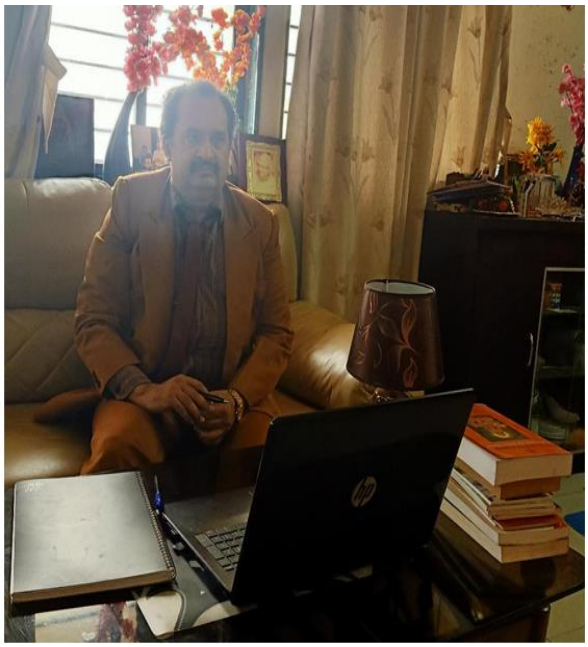
I am positive that it would continue its voyage in the days ahead. The credit goes solely to the Editor, who almost does it single handedly.

I wish the Newsletter a bright future and its rupture-free continuance.

Dr. Raghav Saran

President ISAS

From Editor's Desk



Namastay to all Dear ISAS members

Here is the second issue of the year. New executive committee has started functioning. ISAS will touch new heights under the dynamic leadership of President of ISAS, Dr. Raghvan Saran. Personally he is always motivating me. All other committee members are extremely nice and experts in their fields.

Variety of articles are included in the issue. This is matter of pride that India is contributing towards Fermi lab projects in America. Newsletter is remembering our great Indian scientist Jagdish Chandra Bose, who proved that plants have also life. Physicist Saw Wai Hla and his colleagues were able to X -ray scan a single iron atom hidden amid a complex molecule, for the first time. The Government has given green signal for the installation of 10 nuclear reactors in five states across India expecting increase from 6780 MW to 22480 MW. It looks like science fiction movie, but it is reality now, 3D-Patterned Sensors allow robots to be controlled by thought. I request ISAS members to contribute articles for ISAS newsletter.

Dr. Pradeep Kumar
Chief Editor
ISAS newsletter.

Modi, Biden Hail Indian Contribution to Fermi Lab Upgrade Project

Source website link: https://www.business-standard.com/world-news/modi-biden-hail-indian-contribution-to-fermilab-upgrade-project-123062300574_1.html

Prime Minister Narendra Modi and US President Joe Biden on Thursday hailed the deepening bilateral cooperation between the two countries on cutting edge scientific infrastructure

India is supplying components worth $140 million to the US Department of Energy's ambitious plans to upgrade the Fermi lab accelerator complex to create the most intense high-energy neutrino beams which would help unravel understanding of the evolution of the universe.

India and the US signed an agreement in 2018 to expand collaboration for jointly advancing cutting-edge neutrino science projects such as the Long-Baseline Neutrino Facility (LBNF) with the international Deep Underground Neutrino Experiment (DUNE) hosted at Fermilab, and the India-based Neutrino Observatory (INO). Prime Minister Narendra Modi and US President Joe Biden on Thursday hailed the deepening bilateral cooperation between the two countries on cutting-edge scientific infrastructure.

This includes a $140 million in-kind contribution from the Indian Department of Atomic Energy (DAE) to the US Department of Energy's (DOE's) Fermi National Laboratory toward collaborative development of the Proton Improvement Plan-II (PIP-II) Accelerator, for the Long-Baseline Neutrino Facility the first and largest international research facility on US soil.

Biden and Modi also welcomed the commencement of construction of a Laser Interferometer Gravitational-Wave Observatory (LIGO) in India, according to a joint statement issued after the bilateral talksbetween the two sides.

Prime Minister Modi is visiting the US from June 21-24 at the invitation of US President Biden and First Lady Jill Biden. The leaders called on their administrations to extend these partnerships to advanced biotechnology and bio-manufacturing, and enhance biosafety and biosecurity innovation, practices, and norms,the statement said. The PIP-II project includes the construction of a 600-foot-long superconducting linear accelerator at Fermi lab. It will be the first-ever particle accelerator built in the United States with significant contributions from international partners, including the

United Kingdom and Italy.

Scientists from four institutions *Bhabha Atomic Research Centre in Mumbai; Inter-University Accelerator Centre in New Delhi; Raja Ramanna Centre for Advanced Technology in Indore; and Variable Electron and Cyclotron Centre in Kolkata* are contributing to the design and construction of magnets and superconducting particle accelerator components for PIP-II at Fermi lab.

Jagadish Chandra Bose

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Introductory (1858-1885)

Some decades ago I chanced upon a copy of - 'Collected Physical Papers' of Jagadish Chandra Bose in my father's library wherein lay a newspaper clipping written by him & titled J.C.Bose, 'Gifted Experimenter', Deccan Herald, Nov 30, 1988. That article made me a fan of J.C.B. My appreciation went on increasing with passage of time as I read his Collected Physical Papers [1], about the controversy regarding the real inventor of Marconi's 'coherer with telephone' [2], about his being ahead of his time by half a century [3], regarding his attitude towards patents [4] and his views on life and purpose of life. Let me quote from the article in Deccan Herald.

"At the time when Jagadish was getting excited about the great Karna and other heroes of Mahabharatha, a Scottish Professor put into Mathematical language the ideas that were then known (1864) about electricity …… into one unified

single theory …… Nine years later, he published it in his book of two volumes in the last chapter ……. Fifteen years after (1888) …. Heinrich Hertz actually produced the sort of light which Maxwell predicted. ….. Jagadish Chandra must have known of Maxwell's work when he was a tripos student at Cambridge from 1879 to 1884. Now at the time of Hertz's epoch making publication he was a junior professor in the Presidency College at Calcutta and that too obtained with great difficulty. Some years later, in 1894, a review of Hertz's work by Sir Oliver Lodge fired the imagination of Jagadish Chandra and he resolved on repeating Hertz's experiments for himself in his Calcutta Presidency College Laboratory. It was at this time, on his 35th birthday that he took his famous vow, 'I shall henceforth dedicate myself not to professional survival or family honour, but to the pursuit of scientific truth.' As everyone knows he kept his vow, all his life-time." He became a pioneer of modern experimental science in India, his first work having been reported in Asiatic Society of Bengal in May 1895, followed by papers in Proceedings of Royal Society in October and The Electrician in December.

What was the mind behind this person who vowed to dedicate himself to scientific truth? We need to know a little bit about the state of intellectual fervor at that time in Bengal to understand him. The second half of 19th Century was a period of renaissance. Calcutta was the capital of British rule. Western influence and English based education had made inroads and a number of social changes were taking place. Three universities were established in 1857, just a year before J C Bose's birth (30 Nov. 1858). They were merely teaching and examining centers with no research component. Indian Association for the Cultivation of Science (IACS) was established in 1876 by Dr. Mahendra Lal Sircar with the aim of providing research opportunities to Indians. However, research activity started

there only much later when C V Raman joined in 1907. In 1875, Rev.Fr. Lafont started a small astronomical observatory at St Xavier's (School and) College, founded by Belgian Jesuits in 1860; this provided an impetus to science education in Calcutta. Lafont was a remarkable person who would teach physics with the help of demonstrative experiments which made deep impression on the students. In science, Lafont was the first influence on Bose who joined St. Xavier's School and College at the age of 11 and graduated from there at 21, with a BA of Calcutta University. Thus one finds that there was no scientific research in spite of a great social awakening which threw up giants like Ram Mohan Roy, Vivekananda, Rabindranath Tagore, Bankim Chandra Chatterjee and many others. Indeed, Bose was greatly supported emotionally by Vivekananda and Rabindranath Tagore with whom he was in communication.

Bose's father, Bhagaban Chandra Bose was another, indeed the first, influence on him. Senior Bose was a Deputy Magistrate at the time of his birth and rose to become an Assistant Commissioner by the time J.C.B. was sent away to Calcutta for studies. So, one would naturally assume that Jagadish's upbringing was in affluent surroundings. This was not entirely true as Bhagaban Chandra was a person with a high sense of social responsibility towards the general populace and took up many educational, agricultural and technical projects quite beyond the call of his official duties, investing his own earnings. He started an Exhibition and Mela when he was Deputy Magistrate at Faridpur and opened workshops in carpentry, metal work etc as Assistant Commissioner in Burdwan. These and other such activities resulted in his being often short of money. Much later, at the fiftieth anniversary of the Faridpur Exhibition and Mela, Bose said this of his father __ 'A failure! Yes, but not ignoble nor altogether futile. And through witnessing this struggle, the son learned to look on success or failure as one, and to realise that

some defeat may be greater than victory. To me his life has been one of blessing and daily thanksgiving. Nevertheless everyone has said that he had wrecked his life, which was meant for greater things. Few realise that out of the skeletons of myriad lives have been built vast continents. And it is on the wreck of a life like his, and of many such lives, that will be built the greater India yet to be." He followed his father in every respect, struggling against discrimination and injustice and never bending from his pursuit of scientific truth. "Like that of my boyhood's hero Karna, my life has been ever one of combat and must be to the last. It is not for man to complain of circumstances, but bravely to accept, to confront and to dominate them" he wrote and followed tenaciously both in his scientific pursuits and dealings with people.

After his graduation from St Xavier's College with a B.A degree of Calcutta University he was sent to London in 1981 for medical education which he could not continue due to indifferent health. After a year he joined Cambridge for doing tripos in natural sciences. Among his teachers at Cambridge were Sidney Vines, Lord Rayleigh, Michael Foster and Francis Darwin who were later responsible also for proposing his name for the Fellowship of the Royal Society. He obtained B.A. from Cambridge and B.Sc. from London University in 1884.

So, from his father he inherited and imbibed compassion, sharing, perseverance and tenacity born out of a broad vision, from Fr. Lafont he got his love of experimentation and in Cambridge he saw and learnt about the conduct of experimental science at its highest portal.

Presidency College (1885-1900)

After returning to India, he joined Presidency College as the first Indian Professor of Physics. The saga of his getting his rightful place as a professor (box

2) is a glowing example of his ability "to accept, to confront and to dominate" the circumstance. He was a brilliant lecturer and between 1885 and 1894 he seems to have done his duty as a Professor of Physics, mainly lecturing to students but also indulging himself seriously in many scientific hobbies including sound recording and photography. However, on his 35th birthday in 1894 he took his now famous vow of pursuing scientific research, presumably after reading Sir Oliver Lodge's book entitled 'Heinrich Hertz and his Successors'. Though he started late in life as a researcher he brought enormous energy into his activity, publishing his first paper by mid 1895 and three more papers before the end of that year. His article 'On the determination of the Index of Refraction of Sulphur for Electric Ray' communicated to the Royal Society by Lord Rayleigh in October 1895 and two other papers published in 'The Electrician' of December [1] had a major impact on the peers in England. Impressed by the high class work the Royal Society offered him a special Parliamentary grant for his researches at Calcutta. "That day the closed gate opened and for five years this progress was uninterrupted" as Bose himself expressed. Many papers followed during the next four years.

The University of London awarded him a D.Sc. without any examination. People like Kelvin and Cornu, former President of French Academy were superlative in praising Bose's work. This resulted in Bose getting recognised in Bengal and he was deputed by the Education Department to go to England . He sailed for England on 24th July 1896. He gave a lecture demonstration of his researches on radio waves at a meeting of British Association for Advancement of Science at Liverpool in the presence of front line scientists of the time, including Sir Oliver Lodge (whose writing had inspired Bose), Sir J J Thomson (who later wrote a Foreward to his 'Collected Physical Papers) and Lord Kelvin [5] (who congratulated Smt Abala Bose on her husband's brilliant work). He was invited by

the Royal Institution to give the prestigious Friday Evening Discourses. So in January 1897, he spoke on the 'Electro-magnetic radiation and polarisation of the electric ray'. This, like his lecture at Liverpool was highly appreciated and he got invitations to visit France and Germany for presenting his results. By this time he had already perfected a complete apparatus for the study of the properties of Electric Waves producing millimetre waves (5 to 25 mm), a waveguide radiator, a collecting funnel , a reliable special detector whose sensitivity could be accurately controlled and a complete set of optical elements for waves of millimeter range. Optical properties, namely, reflection, refraction, selective absorption, interference, double refraction, polarisation, and total reflection were studied. One of the things which I found particularly interesting was his measurement of the depth of evanescent waves at reflection. To my knowledge this was the first direct measurement of penetration of any wave into the 'rarer' medium, near a totally reflecting surface. This was a gigantic effort. Let me again quote from Deccan Herald to emphasise the size and difficulty of the task: "In repeating Hertz's experiment he had first to produce the Vajra of Indra, the electric spark. He found that though the spark need not be big, it should be steady and to get it he made several ingenious modifications of the existing methods. It came to this, that he must use a ball and two beads of platinum, a costly metal and very difficult to work with as its melting temperature was 1773 deg. C. But Jagadish Chandra got these cast, presumably in his laboratory. With these improvements J.C.B. found that he could produce invisible light whose waves were ten times shorter than those got by Hertz. While Hertz required big halls to arrange and demonstrate his experiments, J.C.B. could show the same in almost any room or hall. This was a great triumph, achieved by none before. Furthur, his ingenious method of detecting the invisible waves, formed of wire twisted like those in our electric bulbs, occupy no more

space than that required by a quarter-anna coin. Just by rotation of a screw, the sensitiveness of this electric eye, could be changed at will."

"The electric eye is so simple and its performance so elegant, still it was difficult to explain how it worked. J.C.B. undertook a whole series of experiments using every kind of metal known to science… *(some of which like lithium, calcium etc had to be extracted in his lab)…*If he were not a gifted experimenter, confident of his ability he would not have gone to the extent of extracting these metals for himself. He used altoghether no less than 25 metals."

In April 1899 issue of Proceedings of Royal Society his article on 'On a Self Recovering Coherer and the Study of Cohering Action of Different Metals' appeared. This work described the details of the 'millimetre wave detector which, with some minor modification, was used in Trans-Atlantic transmission of electric waves by Marconi. That Marconi did not mention Bose in any of lectures or papers has been extensively discussed [2] in recent times and it is now established without doubt that indeed a trivially modified version of Bose's detector – coherer with telephone – was used and this was a critical component for the success of Marconi's experiment, since no other detector was sensitive enough to detect the weak signals reaching Newfoundland, Canada from Cornwall, England. Indeed Bose in this short span of five years devised 'wave guides, horn antennas, dielectric lenses, various polarisers and even semiconductors at frequencies as high as 60 GHz'[3]. The proceedings of IEEE (January 1998) had a special section devoted to 'Centennial of Semiconductor Diode Detector, J.C.Bose's Diode Detector and its Application in Marconi's First Trans-Atlantic Signal' on the 50th Anniversary of the Transistor !'

In the course of this work he noticed time dependence of his detectors with incidence of radiation and decided to examine this in depth. He was struck by the similarity of behaviour of inorganic and living matter . He started increasingly examining time dependence of plants reacting to external stimuli. This was to lead him away from study applications of radio waves to study of plants using accurate instrumental methods – a watershed in his research career. Essentially he left Physics and became a biophysicist (and a bioengineer) as he entered the twentieth century.

In 1900, Bose attended International Conference of Physics in Paris and presented a paper on the 'Similarity of Effect of Electrical Stimulus on Inorganic and Living Substances' which was well appreciated and published in the Proceeding of the Congress. This talk was attended by Swami Vivekananda (1863-1902) and his disciples Mrs. Sara Bull. Vivekananda wrote in glowing terms about a lone Indian holding forth among international peers.

Bose proceeded to England, giving his 2nd Friday Evening Discourse in May 1901. The lecture was so highly appreciated by the audience that Sister Nivedita (another follower of Vivekananda), after attending the lecture wrote to Tagore, " I fail to express what a thrill I felt, when the traditional Indian message of grand cosmic unity was restated in the language of modern times . Later, in 1903, Tagore welcomed Bose back to India by composing a poem in his honour. However, such emotional adulation was not going to be helpful in his scientific pursuits, rather it probably did lead to some criticism .At the presentation of the Royal Society of London he faced, presumably for the first time, an opposition to his theory relating to plants. Before going into this phase of Bose's activities let us take an aside relating to the first period. This relates to the issue of patents about which much has been written in excellent investigative work of Bandopadhyay[4] .

Bose and Patent

In the exposition of his research at the Calcutta Town Hall in 1895 Bose demonstrated the passage of electric waves generated by him through two concrete walls [and through Lieutenant Governor Sir Alexander Mackenzie of Bengal] over a distance of 75 feet by producing the electric wave in one room and letting it ring a bell and explode a mini-mine in the second nearest room from the source. Without doubt he was aware of its commercial potential but was not interested in exploiting the same. In a letter to Rabindranath Tagore, written on November 23 1900, from London, he mentions about a telegraph company having assembled an apparatus based on his description and having achieved results beyond their expectations. In his diary (Nov 13, 1900)he noted that--- "the head of a great firm working on wireless telegraphy told me the advantage he derived from suggestions contained in that paper was beyond anything he could have dreamt of. About my further ideas on the subject he begged me not to make things public but allow him to take out patents…… He told me he could make great things out of my ideas. But I cannot find heart to give any part of my life for money making purposes.

The head of this great company was Alexander Muirhead D.Sc (London), FRS and partner in a firm making telegraphic equipment and syndicated with Sir Oliver Lodge. In a letter in January 1901 to Tagore he mentions about his new paper which 'will greatly facilitate the development of practical wireless telegraphy. Dr. Muirhead has asked me not to reveal my new discoveries". And yet Bose revealed everything in his second public lecture at the Royal Institution on 10th May 1901. 'The Electric Engineer' expressed surprise that 'no secret was at any time made as to its (Coherer's) construction, so that it has been open to all the world to adopt it for practical and possibly money making purposes'. He even wrote to Tagore about his aversion to 'hankering after money in this country' and

why he declined to oblige Muirhead. And yet, it is a fact that five patent applications were filed in the names of J.C.Bose and Sara Chapman Bull between 9th May 1901 and 18th Sept. 1901. An application was also filed in London for a patent in USA in Sept.1901. This has been recently discussed at length by Bandopadhyay who concludes that 'Prof Bose was not against patenting his own research products. He was actually against any interference or obstruction in his current research……" However it does not gel with Bose's declaration while inaugurating his Institute on 30th Nov 1917 that "the new discoveries made here will be demonstrated before the public and through regular publication of the Transactions of the Institute these Indian contributions will reach the whole world. The discoveries will thus become public property : no patents will ever be taken. The sprit of our national culture demands that we should ever be free from desecration utilising knowledge for personal gain." My conjecture is that all the patent applications, which were filed between 9th May and 18th Sept 1901, five in England and one in USA were more to oblige his friend Vivekananda's disciple Sara Bull: it was an aberration and he never patented anything thereafter. He was in the mould of Benjamin Franklin (1706 – 1730) and Louis Pasteur (1822 – 1895) who had similarly refused to derive financial benefit from their scientific work. "In France, a scientist would be lowering himself if he worked for personal profit" according to Pasteur.

The biophysicist and bioengineer (1900 onwards)

Getting back to work after 1901, I have already mentioned that Bose was crossing borders of physics and getting into investigation of living substances. His presentation at the Royal Society had run into rough weather at the hands of Sir John Burdon Sanderson, a senior physiologist, who was opposed to Bose's interpretation. Burdon had himself (and others) found electric response to occur

only in sensitive plants. Bose showed it to be a universal phenomena characteristic of all plants and of all their different organs. Consequently, his communication was not published in the Proceedings, though it was archived. However, support came from other leading Botanists who had witnessed the experiments and who were office bearers of the Linnaen Society. This included Vines, one time teacher of Bose at Cambridge and his staunch supporter.The paper was read and published in the journal of the Linnaen Society in 1902.

In view of the comments by botanists and in order to be able to form a firmer experimental basis for his views about plants, Bose decided to make highly sensitive measurements for which he had to design and build a number of instruments. They include Resonant Recorder and Cardiograph, the Oscillating Recorder, the High Magnification Crescograph (or plant growth recreder), the balanced Crescograph, Magnetic Crescograph and Radiometer, Photosyntheic Recorder, Diametric Contraction Apparatus, and Self Recording Radiograph. These permitted him to make measurements which others found difficult to do. The Resonant Recorder, for example, could automatically record velocity of excitatory impulse (nerve impulse) such that measurement down to an interval of $1/1000^{th}$ of a second could be made. This was used to measure responses in Mimosa pudica under different conditions of temperature, poisoning etc. The cardiographic version was used for measuring cardiograms of Tortoise, Frog and Fish under different influences and compared with response of Desmodium plant and found to be similar. High magnification Crescograph devised for measuring linear growth in plants (magnification 5000) was further improved in Magnetic Crescograph to achieve a magnification of a million times. This was doubted by some but eleven Fellows of the Royal Society testified to Bose's claims in a communication to London *Times* in 1920. (Newspaper diplomacy worked even

then!). He was elected to the Fellowship of the Royal Society at this time, having been made Commander of the Order of Indian Empire (CIE) in 1903, Commander of the Star of India (CSI) in 1912 and Knighted in 1916.

Lest it be thought that he was only a developer of instruments (a view sometimes expressed) and not a first rate scientist I shall let Bose speak for himself. He said, "The first (condition for advancement of knowledge) is great imaginative faculty, for the true laboratory is one's own mind where every experiment has first to be visualised in all details and where behind all illusions one catches glimpses of truth. Aimless experimentation without clear vision is futile… The researcher has next to compare his thoughts with facts to be discovered by following surer paths of demonstration. Unrestrained imagination inevitably leads to widest speculation which is subversive of intellectual sanity. Thus, methods of introspection and experimentation must equally balance , one supplementing the other." Further, "Two other conditions for successful prosecution of research are the facilities of a well equipped laboratory and the invention and construction of new equipments of extreme delicacy and precision." (Alas! many in India have forgotten these simple truths.) In this connection it is enlightening to quote Gerta von Ubish from University of Heidelberg, Germany. She was highly critical of Bose's theory of ascent of sap and growth of plants; she said, "One is unable to re-examine Bose's results because one cannot make the apparatus; firstly they are very expensive, and secondly, everyone who something from apparatus knows, one must say that they will not function differently than in the case of Bose…. Inexpediently one needs to make other apparatus to test the result. (translated from German; see Rajinder Singh, Current Science, 96 ,419,2009) She made the apparatus but could not match it. What better compliment than this! And where are we today!

Each apparatus was utilised for a specific purpose (see P C Ghosh). Bose made bold postulates and tested them with his unsurpassed instruments. One finds that in this phase Bose changed his mode of publication of papers on life sciences. He started bringing out books on his specific areas of work; he brought out eleven books between 1902 and 1927 on investigations on plants, all published by Longmans, Green and& Co. While he was criticised in his time by physiologists many of his postulates, including the theory of ascent of sap and idea of pulsating growth have come to be accepted. Again he was decades ahead of his time.

Bose built a new Institute after his retirement in 1915 with his own money and from personal contributions. He described his concept of this Institute in lofty terms at its inauguration in 1917. Prof . Moellish from Vienna, after spendind six months in the Bose Institute wrote in a letter to Nature (1930), ‘ I saw the plant writing down the rate of assimilation of its gaseous food. I also observed the speed of the impulse of excitation in the plant being recorded …..All these are more wonderful than fairytales; nevertheless, those who have the opportunity of seeing the experiments become fully convinced that they are laboratory miracles revealing the hitherto invisible reactions underlying life.’ Bose worked in this wonderland till his death on 23rd November 1937

Scientific Recognition

One may ask whether Bose, who was ahead of his time in almost every area of work that he undertook, was given his rightful place among scientists. A fair answer, in my view, is that the recognition has been very slow in coming. One of the main reasons, I feel, for the delay in recognition of his work on radio waves was that he changed his field after 1901.

Let me recall some other cases. Marshall W. Nirenberg was awarded the Nobel Prize in Physiology or Medicine with Robert W. Holley and Har Gobind Khorana for " their interpretation of the genetic code and its function in protein synthesis" in 1968 and yet a book was published in 2006 with the title "Francis Crick; Discoverer of Genetic Code". Why was Nirenberg's credit taken away? Nirenberg told Ed Regis, a science writer for Scientific American, " I am shy, retiring. I like to work and I have never gone out of my way to publicise myself. Crick told me I was stupid because I never was after limelight." After cracking the genetic code Nirenberg turned his attention to brain. He published more than 70 papers in neurobiology and he was forgotten as father of genetic code (because he changed his field) ! (Ed Regis, Scientific American, pp26, Nov.2007).

Hugh Everett III invented Quantum Theory of Multiple Universe in 1950s (see Peter Byrne, Scientific American, Dec 2007, pp 72) which turned the well accepted Copenhagen interpretation on its head. It was strongly opposed by Copenhagen School including Bohr. Everett had to cut his doctoral thesis to one fourth its size; the truncated and modified version was published in a Rev. Mod. Phys. with complimentary note by his guide John Wheeler. However waiting for his doctorate from Princeton, frustrated Everett joined Pentagon and forgot all about interpretation of Quantum Mechanics. He too was forgotten. He did some excellent work of lasting value for the Pentagon. He introduced the Generalised Lagrangian Multiplier (the Everett algorithm) and application of Bayes' theorem which correlates the prbabilties of future events with past experience. In recent times, his interpretation seems to have found much greater respect. Would he have been better recognised if he had not changed his field? Probably! Let's recall S.Chandrashekhar's tenacity to continue in Astrophysics after the summary dismissal by Eddington. Among the three Bose seems nearer to Nirenberg.

Bose is the *Pitamaha* of modern experimental physics, biophysics and bioengineering. He deserves one of the most exalted places in the pantheon of Indian scientists.

References;

[1] J. C.Bose, Collected Physical Papers, Longmans, Green & Co., London (1927)

[2] P. K. Bandopadhyay, Proc. IEEE ,16, 259 (1998)

[3] D.T. Emerson, IEEE Trans. 45 , 2267(1997)

[4] P. K. Bandopadhyay and Suchanda Banerjee, Ind. J. Hist. Sc., 43 , 57 (2008)

In addition, papers by A. Bhattacharya & D. Sen, XVIII Int. Cong. Hist. Sc 1989., S. Dasgupta, Newcomen Soc. Trans.,67, 207 (1995-96) and S. Mahanty, DREAM 2047, 5 , 34 (2002) were extensively referred to.

"From his (Karna's) low caste came rejection, came every disadvantage; but he always played fair! So his life, though a series of disappointments and defeats to the very end – his slaying by Arjuna – appealed to me as the greater of the triumphs. I still think of the tournament where Arjuna had been victor, and then of Karna coming as a stranger to challenge him. Questioned of name and birth, he replies, I am my own ancestor! You do not ask the mighty Ganges from which of its many springs it comes: its own flow justifies itself, so shall my deeds me!'

……

J.C.Bose

from Subodh Mahanty in DREAM 2047

"With Fawcett's letter of introduction Bose met Lord Ripon at Shimla. … he promised to nominate him for the Imperial Educational Service. But after coming to Kolkata when Bose met Croft he was not at all welcomed. Croft said: "I am usually approached from below, not from above. There is no higher class

appointment at present available in the Impreial Educational Service, I can only offer you a place in the Provincial Service, from which you may be promoted." Bose did not accept the offer. The Viceroy again wrote to the Government of Bengal asking explanation for the delay in appointing Bose. Finally Croft was forced to appoint Bose."…..

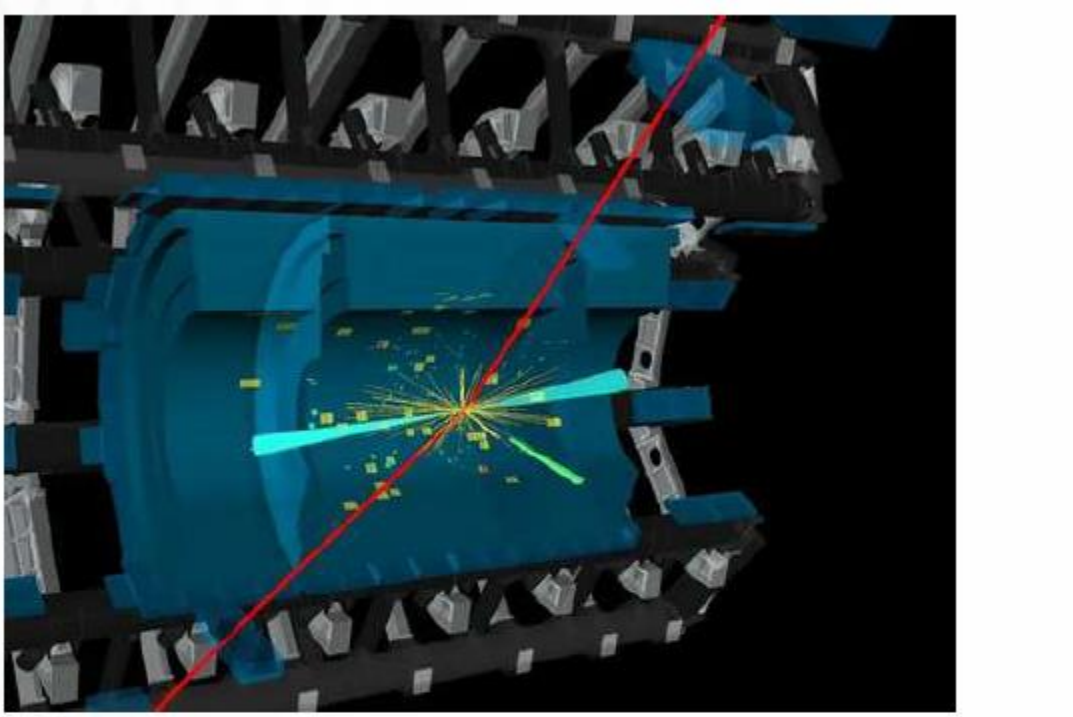
"Though Bose, because of Lord Ripon's personal intervention, was given an appointment in the higher service he was taken on temporary basis with one-half of the pay attached to such an appointment. Bose protested and he asked for the same salary as an European was entitled to get. When his protest was not entertained he refused to accept his salary. He continued is teaching assignment for three years without any salary. Finally both the Director of Public Instruction and the Principal of the Presidency College fully realized the value of Bose's skill in teaching and also his lofty character. As a result his appointment was made permanent with retrospective effect. He was given the full salary for the last three years in lump sum, which he used for paying off his father's debt".

From Subodh Mahanty in DREAM 2047

Higgs Boson Unveils New Secrets: Rare Decay Detected at Large Hadron Collider

28 May, 2023 | by CERN

Source website link: https://scitechdaily.com/higgs-boson-unveils-new-secrets-rare-decay-detected-at-large-hadron-collider/



CERN's ATLAS and CMS teams have found initial evidence of a rare Higgs boson decay into a Z boson and photon. The discovery, while not meeting conventional statistical significance, provides valuable insights and potential indirect evidence of undiscovered particles and physics beyond the Standard Model. Credit: CERN

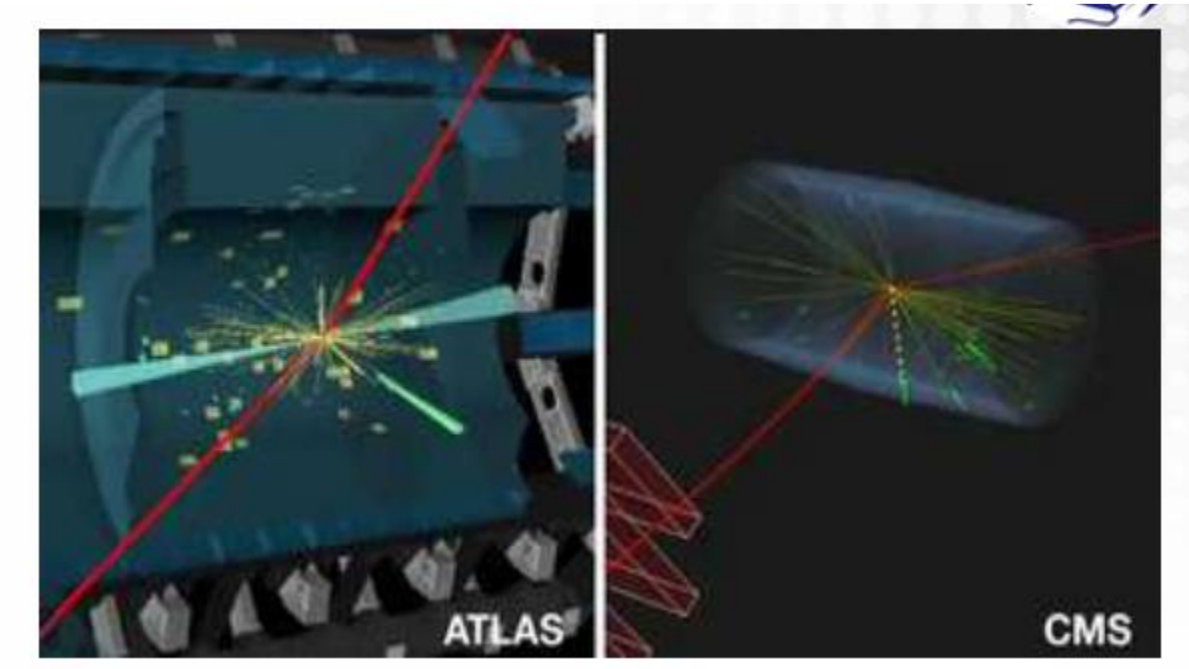
The ATLAS and CMS collaborations have joined forces to establish the first evidence of the rare decay of the Higgs boson into a Z boson and a photon. The ATLAS and CMS collaborations at CERN's Large Hadron Collider (LHC) have

uncovered the first evidence of the Higgs boson decaying into a Z boson and a photon, a rare process that could provide indirect evidence of particles beyond those predicted by the Standard Model of particle physics. The discovery of the Higgs boson at CERN's Large Hadron Collider (LHC) in 2012 marked a significant milestone in particle physics. Since then, the ATLAS and CMS collaborations have been diligently investigating the properties of this unique particle and searching to establish the different ways in which it is produced and decays into other particles. At the Large Hadron Collider Physics (LHCP) conference last week, ATLAS and CMS report how they teamed up to find the first evidence of the rare process in which the Higgs boson decays into a Z boson, the electrically neutral carrier of the weak force, and a photon, the carrier of the electromagnetic force.

This Higgs boson decay could provide indirect evidence of the existence of particles beyond those predicted by the Standard Model of particle physics. The decay of the Higgs boson into a Z boson and a photon is similar to that of a decay into two photons. In these processes, the Higgs boson does not decay directly into these pairs of particles. Instead, the decays proceed via an intermediate "loop" of "virtual" particles that pop in and out of existence and cannot be directly detected. These virtual particles could include new, as yet undiscovered particles that interact with the Higgs boson. The Standard Model predicts that, if the Higgs boson has a mass of around 125 billion electronvolts, approximately 0.15% of Higgs bosons will decay into a Z boson and a photon. But some theories that extend the Standard Model predict a different decay rate. Measuring the decay rate, therefore, provides valuable insights into both physics beyond the Standard Model and the nature of the Higgs boson.

Previously, using data from proton–proton collisions at the LHC, ATLAS, and CMS independently conducted extensive searches for the decay of the Higgs boson

into a Z boson and a photon. Both searches used similar strategies, identifying the Z boson through its decays into pairs of electrons or muons – heavier versions of electrons. These Z boson decays occur in about 6.6% of the cases



In these searches, collision events associated with this Higgs boson decay (the signal) would be identified as a narrow peak, over a smooth background of events, in the distribution of the combined mass of the decay products. To enhance the sensitivity to the decay, ATLAS and CMS exploited the most frequent modes in which the Higgs boson is produced and categorised events based on the characteristics of these production processes. They also used advanced machine-learning techniques to further distinguish between signal and background events.

In a new study, ATLAS and CMS have now joined forces to maximize the outcome of their search. By combining the data sets collected by both experiments

during the second run of the LHC, which took place between 2015 and 2018, the collaborations have significantly increased the statistical precision and reach of their searches. This collaborative effort resulted in the first evidence of the Higgs boson decay into a Z boson and a photon. The result has a statistical significance of 3.4 standard deviations, which is below the conventional requirement of 5 standard deviations to claim an observation. The measured signal rate is 1.9 standard deviations above the Standard Model prediction.

“Each particle has a special relationship with the Higgs boson, making the search for rare Higgs decays a high priority,” says ATLAS physics coordinator Pamela Ferrari. “Through a meticulous combination of the individual results of ATLAS and CMS, we have made a step forward towards unravelling yet another riddle of the Higgs boson.” “The existence of new particles could have very significant effects on rare Higgs decay modes,” says CMS physics coordinator Florencia Canelli. “This study is a powerful test of the Standard Model. With the ongoing third run of the LHC and the future High-Luminosity LHC, we will be able to improve the precision of this test and probe ever rarer Higgs decays.”

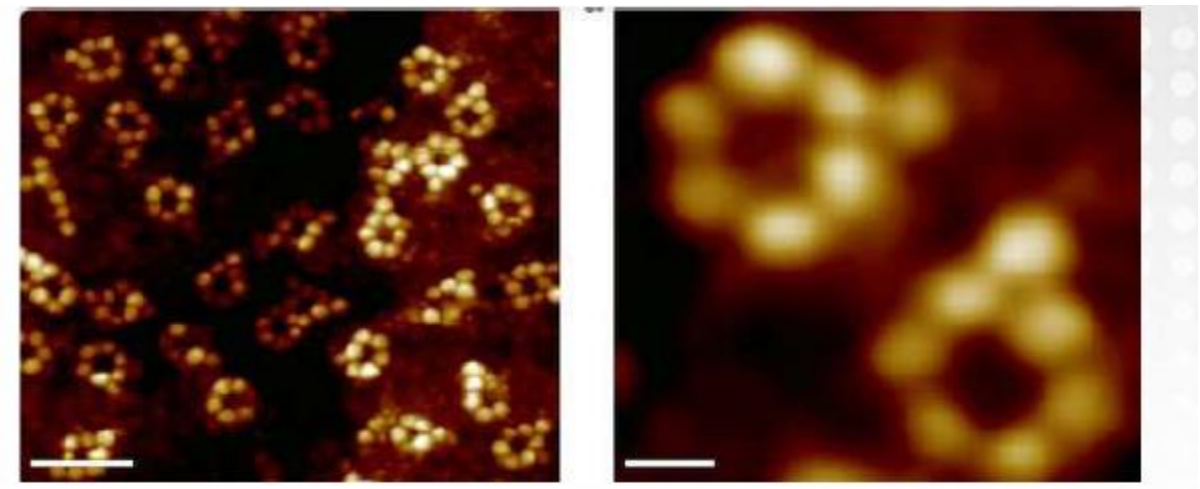
Scientists X-ray a Single Atom for the First Time

31 May, 2023 | by Kiona Smith

Source website link: https://www.inverse.com/science/scientists-x-ray-a-single-atom-for-the-first-time

I took quantum tunneling and a particle accelerator to get the job done Ohio University physicist Saw Wai Hla and his colleagues were able to scan a single iron atom hidden amid a complex molecule, something that's never been done with an X-ray before. Extremely powerful microscopes can take images of individual atoms, and in fact they do it pretty much all the time, because we live in the future. But without X-rays and spectroscopy (a way of taking the "chemical fingerprint" of an object based on which wavelengths of light it absorbs or emits), images alone can't tell scientists what element they're looking at.

In recent experiments, Hla and his colleagues identified individual atoms and measured a few of their key properties. To do it, the researchers combined powerful, focused X-rays from a particle accelerator called a synchrotron with a technique called scanning tunneling microscopy, which uses a conductive tip to scan the surface of a sample. Their goal, Hla tells Inverse, was "to use X-ray spectroscopy at the ultimate limit of atomic scale. X-rays were discovered in 1895, almost 130 years ago, but have never been able to detect just one atom." They published their results in the journal Nature.



There's a single iron atom tucked into all of these interlocking molecular rings. Hla et al. 2023

Fast Electrons and Bright Lights

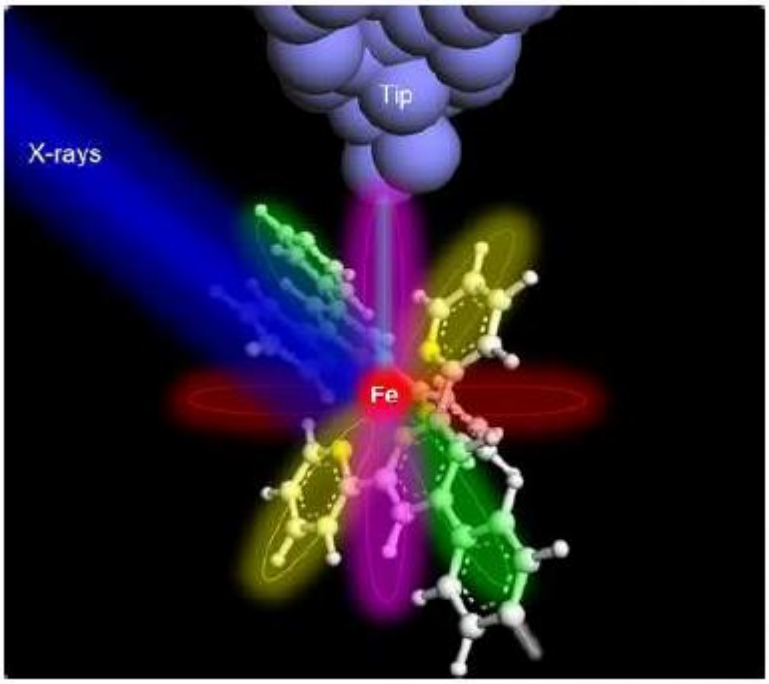
A synchrotron, like the one at Argonne National Laboratory in Illinois, accelerates electrons to nearly the speed of light, then sends them zipping around a curved track. As the racing electrons take each curve of the track, they flash bright light — picture a tiny version of Tron. Equipment attached to the synchrotron splits the light into different wavelengths, sending the infrared light down one beamline and the X-ray light down another, for instance.

X-rays produced this way are brighter and more focused than the ones a normal X-ray machine can offer. Physicists can watch how light interacts with the molecules in a material to learn about really tiny details of its structure and makeup. But how tiny is tiny? If you want to know whether there's iron in a particular material, for example, you'd better hope your sample contains at least a few thousand iron atoms, or the synchrotron X-ray will probably miss it. But there's good reason for materials scientists to want to detect individual atoms in much smaller samples. "If

one can detect the elemental and chemical state of an atom, then there will be a huge impact in many research areas," says Hla.

The Quantum Realm

That's where quantum tunneling comes in handy. When the synchrotron X-rays hit a sample, they pump energy into the atoms. That new burst of energy riles up some of the electrons orbiting closest to the center of the atom, and they manage to break free. Hla and his colleagues held the sharp metal tip of a scanning tunneling microscope instrument just half a nanometer away from the sample — close enough for a quantum tunnel to form, letting the newly-freed electrons travel from the sample into the instrument.



When X-rays from the synchrotron hit the iron atom in a complex structure of ring-shaped molecules, electrons from the iron atom quantum-tunnel to the tip of an instrument just half a nanometer away. Hla et al. 2023

The electrons that arrive at the detector tip carry information about the atom they came from — such as which wavelengths of X-ray light the atom absorbed. Since each chemical element absorbs, reflects, and emits a specific set of light wavelengths, knowing which wavelengths the sample absorbed can reveal exactly which element an electron came from.

And in this case, Hla and his colleagues had just scanned the only iron atom in a large, complicated ring-shaped molecule. The scan also revealed how many electrons the iron atom was missing: two, in this case. That impacts how an atom can react with other atoms to form new chemical bonds, so it's an important thing to know.

What's Next

Hla and his colleagues repeated the experiment with a different big, complicated molecule, this time with a single atom of a rare-earth element called terbium hidden inside it. And once again, the detector identified the terbium atom and its chemical state. Being able to combine detailed images with X-ray scans of a single atom of such a valuable element could be a huge help to engineers and materials scientists in the future. "It might also be useful in medical research," says Hla. "It will also have an impact on quantum information science, to name a few." Next, Hla says he and his colleagues hope to measure the magnetic properties of a single atom, which will be useful for solid-state electronics.

LIGO Begins Fourth Run to Catch Gravitational Waves, Unravel Secrets of Universe

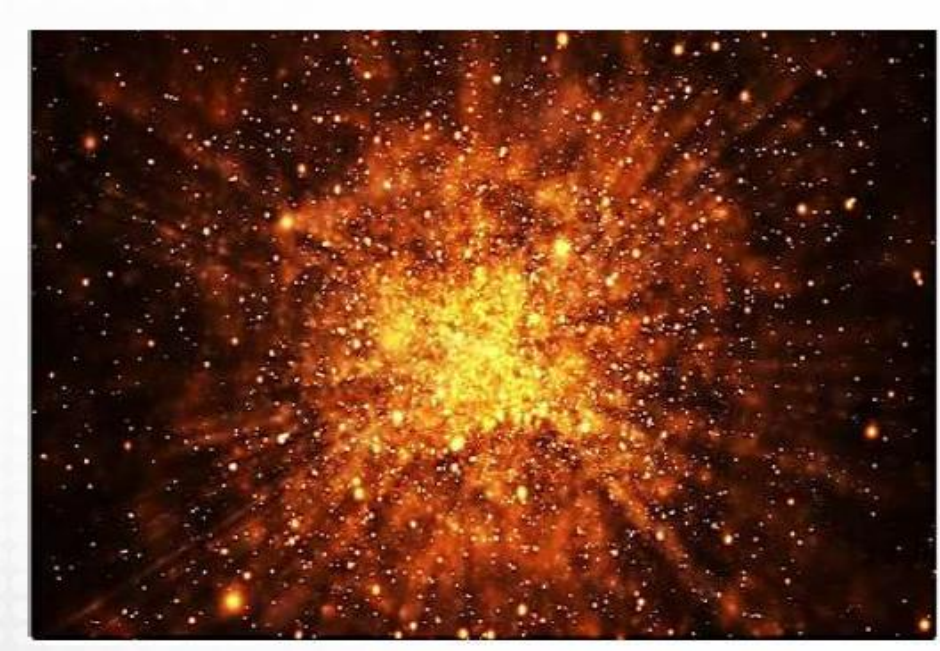
26 May, 2023 | by India Today Science Desk

Source website links: https://www.indiatoday.in/science/story/ligo-begins-fourth-run-to-catch-gravitational-waves-unravel-secrets-of-universe-2384934-2023-05-26

The fourth run, since the observatory picked up the first gravitational waves in 2015, is the most sensitive one and will last 20 months.

In Short

- The increase in sensitivity will help the teams extract more physical information
- Work is underway to build India's first gravitational wave detector
- At the moment there are two such observatories he global network of gravitational-wave detectors that have their ears pierced to the faintest rumblings happening in the far end of the vast universe has commenced their latest run. The Laser Interferometer Gravitational-Wave Observatory (LIGO) began a new observing run to explore the secrets of the universe after going through a major upgradation with further sensitive instruments and other improvements to boost the search for gravitational waves.



Gravitational waves are ripples in the fabric of space time. (Photo: Getty)

The fourth run, since the observatory picked up the first gravitational waves in 2015, is the most sensitive one and will last 20 months, including up to two months of commissioning breaks.

LIGO

The site of LIGO. (Photo: LIGO)

What are gravitational waves?

The ripples in the fabric of space time caused by the acceleration of massive objects, gravitational waves, were first conceptualised by Albert Einstein as part of his theory of relativity. The gravitational waves are generated by colliding black holes and other extreme cosmic events. Gravitational waves can be detected through their effect on the measurement of space and time. The most common method used to detect them is through the use of interferometers, which measure the ripples in space and time by measuring the change in length of two perpendicular arms of the interferometers.

New run begins

The new run will see an increase in sensitivity of approximately 30 percent. The team said that the detectors will observe a larger fraction of the universe than before and will pick up gravitational wave signals at a higher rate, detecting a merger every two or three days.

Black hole

The increase in sensitivity will help the teams extract more physical information from the data, allowing them to better test Albert Einstein's general theory of relativity and infer the true population of dead stars in the local universe. By observing gravitational waves, we can gain insights into the nature of these astrophysical objects and the fundamental laws of physics. "Our LIGO teams have worked through hardship during the past two-plus years to be ready for this moment, and we are indeed ready," Caltech's Albert Lazzarini, the deputy director of LIGO, said systems and even neutron stars.

Work underway to build India's LIGO

Work is underway to build India's first gravitational wave detector in Maharashtra. The centre had in April allocated Rs 2,600 crore to construct the observatory by 2030. It will observe the gravitational waves traveling in the vastness of space from some of the mostviolent and energetic processes in the Universe and hitting Earth.At the moment, there are two such observatories that are separated by a distance of 3000 kilometres that work in tandem to pick up these gravitational waves.

India Approves Installation of 10 New Nuclear Reactors in Five States

05 April, 2023 | by India Today Science Desk

Source website link: https://www.indiatoday.in/science/story/india-approves-installation-of-10-new-nuclear-reactors-in-five-states-2356115-

Two nuclear reactors will each be installed in Kaiga, Chutka, and Gorakhpur nuclear power plants.

During 2021-22 nuclear power reactors generated 47,112 million units of electricity. (Photo: Getty)

In Short

*The 10 reactors will come up in Karnataka, Haryana MadhyaPradesh, and Rajasthan

*These reactors will be developed at a cost of Rs 1,05,000 crores

*Installed nuclear power capacity is set to increase from 6780 MW to 22480 MW

The Centre has approved the installation of 10 nuclear reactors in five states across India. The information was given by Atomic Energy Minister Dr. Jitendra Singh in Parliament on Wednesday. The minister said that the government has roped in

public sector undertaking for the installation of the reactors. "The Government has roped in PSUs for the installation of the nuclear reactors or the exercise would be done exclusively by the specialized government agencies," the minister said in a written reply in Lok Sabha. He added that the Center has accorded administrative approval and financial sanction for 10 indigenous Pressurized Heavy Water Reactors of 700 MW each in fleet mode. The 10 reactors will come up in Karnataka, Haryana, Madhya Pradesh, and Rajasthan.

Two nuclear reactors will each be installed in Kaiga, Chutka, and Gorakhpur nuclear power plants, while the Mahi Banswara nuclear power plant in Rajasthan will get four nuclear reactors. "The Government has amended the Atomic Energy Act in 2015 to enable the Joint Ventures of NPCIL with Public Sector Enterprises to set up nuclear power projects. These reactors are planned to be set up in fleet mode‘ progressively by the year 2031 at a cost of Rs. 1,05,000 crores," the Department of Atomic Energy said in a statement. The minister further informed that during 2021-22 the nuclear power reactors generated 47,112 million units of electricity, which comprises about 3.15 per cent of the total electricity generated in the country. "The present installed nuclear power capacity is set to increase from 6780 MW to 22480 MW by 2031 on progressive completion of projects under construction and accorded sanction. The Government has also accorded ‗in principle‘ approval for new sites to set up nuclear reactors in the future," Dr. Jitendra Singh said in his written reply.

Talking about India's space missions, he said that the American space agency Nasa and the Indian Space Research Organization (ISRO) have jointly manufactured an earth science satellite named, NISAR, the NASA-ISRO Synthetic Aperture Radar. It is to be noted that the spacecraft arrived in India last month for integration and final tests before it is launched next year from Sriharikota.

Exploring the Dark Matters of Physics: Large Hadron Collider Enters Uncharted Territory

02 April, 2023 | by CERN

The FASER collaboration has made its first observation of neutrinos produced at the Large Hadron Collider (LHC) during its measurement campaign, with statistical significance exceeding the threshold for a discovery in particle physics. The observation includes muon neutrinos and candidate events of electron neutrinos. Additionally, the collaboration presented results on searches for dark photons, which enabled the exclusion of regions motivated by dark matter.

FASER aims to collect more data to allow more searches and neutrino measurements. The detection of neutrinos produced in proton collisions at the LHC can contribute to the study of highenergy neutrinos from astrophysical sources and test the universality of the interaction mechanism of different neutrino species. The

first observation of collider neutrinos at the LHC paves the way for exploring new physics scenarios.

Although neutrinos are produced abundantly in collisions at the Large Hadron Collider (LHC), until now no neutrinos produced in such a way had been detected. Within just nine months of the start of LHC Run 3 and the beginning of its measurement campaign, the FASER collaboration changed this picture by announcing its first observation of collider neutrinos at this year‘s electroweak session of the Rencontres de Moriond.

In particular, FASER observed muon neutrinos and candidate events of electron neutrinos. ―Our statistical significance is roughly 16 sigma, far exceeding 5 sigma, the threshold for a discovery in particle physics,‖ explains FASER‘s co-spokesperson Jamie Boyd. In addition to its observation of neutrinos at a particle collider, FASER presented results on searches for dark photons. With a null result, the collaboration was able to set limits on previously unexplored parameter space and began to exclude regions motivated by dark matter. FASER aims to collect up to ten times more data over the coming years, allowing more searches and neutrino measurements.

FASER is one of two new experiments situated at either side of the ATLAS cavern to detect neutrinos produced in proton collisions in ATLAS. The complementary experiment, SND@LHC, also reported its first results at Moriond, showing eight muon neutrino candidate events. ―We are still working on the assessment of the systematic uncertainties to the background. As a very preliminary result, our observation can be claimed at the level of 5 sigma, adds SND@LHC spokesperson Giovanni De Lellis. The SND@LHC detector wasinstalled in the LHC tunnel just in time for the start of LHC Run 3.

FASER (top) and SND@LHC (bottom) detectors. Credit: CERN

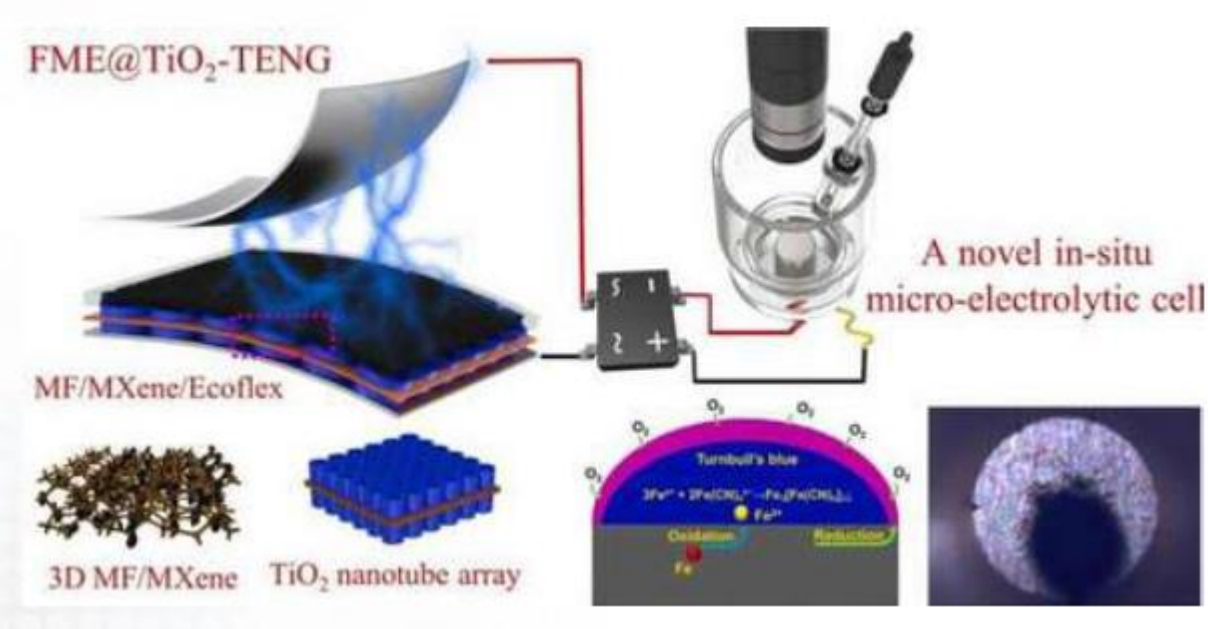
Until now, neutrino experiments have only studied neutrinos coming from space, Earth, nuclear reactors or fixed-target experiments. While astrophysical neutrinos are highly energetic, such as those that can be detected by the IceCube experiment at the South Pole, solar and reactor neutrinos generally have lower energies. Neutrinos at fixed-target experiments, such as those from the CERN North and former West Areas, are in the energy region of up to a few hundred gigaelectronvolts (GeV). FASER and SND@LHC will narrow the gap between fixed-target neutrinos and astrophysical neutrinos, covering a much higher energy range –between a few hundred GeV and several TeV.

One of the unexplored physics topics to which they will contribute is the study of high-energy neutrinos from astrophysical sources. Indeed, the production mechanism of the neutrinos at the LHC, as well as their center-of-mass energy, is the same as for the very-highenergy neutrinos produced in cosmic-ray collisions with the atmosphere.

Using Green Energy for Electrochemical Corrosion Protection

03 April, 2023 | by Li Yuan (Chinese Academy of Sciences)

Metal corrosion seriously affects the service life of marine steel structures. The traditional cathodic protection needs great consumption of energy and metal resources. Therefore, it's imperative to develop green and cost-effective energy sources for corrosion protection.



Graphical abstract. Credit: Nano Energy (2023).
DOI:10.1016/j.nanoen.2023.108345

Recently, a research team led by Prof. Wang Xiutong from the Institute of Oceanology of the Chinese Academy of Sciences (IOCAS) focused on triboelectric nanogenerators (TENGs) as a new energy conversion system, and designed

melamine foam (MF) /MXene/Ecoflex@TiO2-TENG (FME@TiO2-TENG) for green electrochemical corrosion protection. The study was published in Nano Energy on March 13.

The researchers explored the effects of MXene and TiO2 nanotubes on the charge transfer mechanism of the friction layer. They found that the conductive properties and strong electronegativity of MXene played a positive role in the charge transfer of Ecoflex. At the same time, TiO2 nanotubes could capture the image charge. The combined action of the above two points improved the electrical output performance of TENG, which is conducive to the formation of better cathodic protection effect. In addition, the researchers evaluated FME@TiO2-TENG cathodic protection effect with the help of micro-electrolytic cell system.

TENGs technology has the advantages of wide availability of materials, light weight, low cost and high efficiency of low-frequency energy conversion. "There are abundant mechanical energies available in the marine environment, such as wind energy, wave energy, tidal energy, etc., which provides a convenient energy source for corrosion protection using TENG," said Nan Youbo, first author of the study.

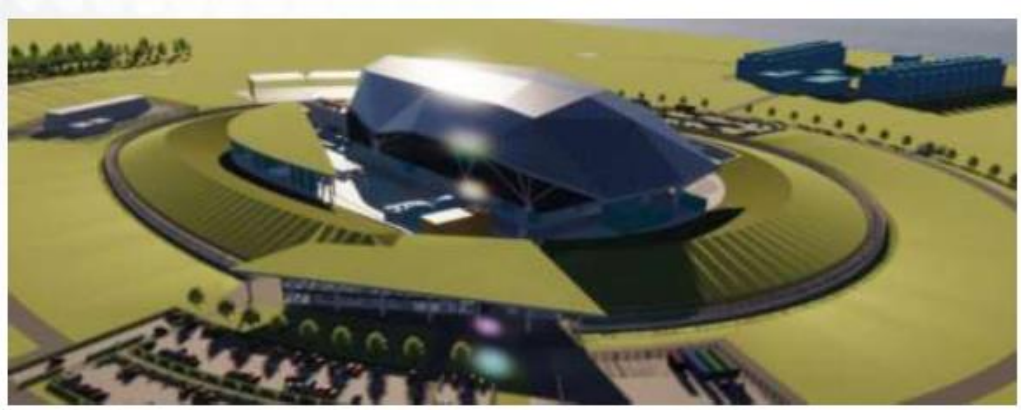
"This study demonstrates the potential of TENG as a green energy source for electrochemical cathodic protection, which would provide safety guarantee for the structures and equipment in marine environment," said Prof. Wang. More information: Youbo Nan et al, Synergistic effects of charge transport and trapping in tribomaterials for boosted triboelectricnanogenerators, Nano Energy (2023).

DOI: 10.1016/j.nanoen.2023.108345

Source website link: https://phys.org/news/2023-04-green-energy-electrochemicalcorrosion.html?utm_source=nwletter&utm_medium=email&utm_campaign=daily-nwletter

Rolls-Royce Small Modular Reactor Design Passes First Assessment Hurdle

04 April, 2023 | by Rob Hakimian



The Environment Agency, the Office for Nuclear Regulation (ONR) and Natural Resources Wales (NRW) have announced that they are progressing to the next phase of their assessment of Rolls-Royce SMR‘s 470MW small modular reactor (SMR) design.The assessment process for nuclear power plants is known as generic design assessment (GDA) and allows regulators to assess the safety, security, safeguards and environmental aspects of new reactor designs before site-specific proposals are brought forward. Step 1 of the GDA for Rolls-Royce‘s SMRs started in April last year and has now been completed following preparatory work by Rolls-Royce SMR and the regulators.

This has seen those involved agree the scope of the GDA based on the information supplied by Rolls-Royce SMR to the other parties so that the regulators could undertake a meaningful assessment of the design. Rolls-Royce SMR has completed all the requirements for Step 1 from the regulators‘ guidance

with good progress made in developing its organisation and arrangements to support GDA.

Step 2 of the GDA process has now commenced and will see fundamental technical assessment take place. It is expected to last for 16 months. A comments process has also been launched by Rolls-Royce SMR on its website, enabling anyone to submit comments and questions on the design. The company will then respond to the questions and any relevant issues that arise during the process will help inform the regulators‘ assessments throughout the rest of the GDA process.

In December 2022, Rolls-Royce SMR announced three potential locations for its SMR factory. These are the International Advanced Manufacturing Park on Sunderland and South Tyneside, Teesworks on Teesside and Gateway on Deeside. A final decision is expected shortly.

As for the location of the SMRs themselves, Rolls-Royce has prioritised Wylfa Newydd, Trawsfynydd, Oldbury and Sellafield as potential sites. In January, representatives visited potential locations around Oldbury and Berkeley in the South West of England and had constructive meetings with stakeholders there.

Meanwhile another SMR startup, Newcleo, has raised £900M to kickstart its entry into the market. Environment Agency strategy and policy lead for Rolls-Royce SMR GDA Andrew Pynn said: ―We‘re assessing the environmental acceptability of a new reactor design from Rolls-Royce SMR. Our team of specialist assessors will identify any issues or concerns we have with the design and will work with the company to make sure it understands our expectations to ensure the protection of communities and the environment. GDA is an enabling and efficient approach, helping to ensure that new nuclear power stations will meet high standards of safety, security, environmental protection and waste management. During Step 1 we‘ve studied the company‘s arrangements, plans and readiness for Step 2 and learnt more about the reactor design.

In our Step 1 statement we‘ve summarised what we have looked at and concluded that we can progress to Step 2 of GDA where we will begin our fundamental assessment. Public and stakeholder engagement is important to us. We‘re encouraging people to get involved in the comments process, which begins today, by reviewing the information on the company‘s website and providing your comments which are viewed by the regulators. We‘ll be engaging continually with stakeholders and public and we will carry out a consultation as we step through the regulatory process.

ONR head of GDA Rob Exley said: The purpose of GDA is to determine whether the design meets our robust safety, security,safeguards and environmental protection standards in Great Britain. "We are working together with the Environment Agency and NRW to ensure Rolls-Royce SMR understand and meet our regulatory expectations for its proposed reactor design. As nuclear regulators, we recognise that we are acting in the interests of the public and, as such, this period of scrutiny will be open, transparent and provide regular opportunities for meaningful engagement with interested parties throughout the GDA process.

"ONR is satisfied that Rolls-Royce SMR has adequate arrangements to support GDA. We have agreed an appropriate scope for GDA, for which the company has provided an appropriate submission schedule and a resourced organisation to deliver it. As regulators, we can now begin our technical assessment phase.

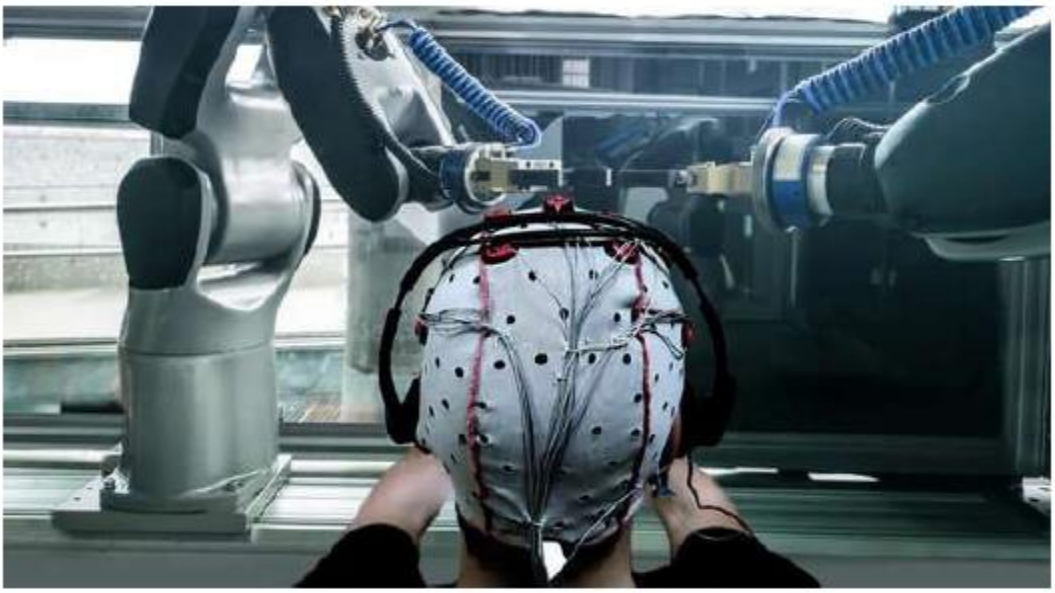
Based on our work during Step 1, the generic Rolls-Royce SMR design can proceed to Step 2 of the GDA. Natural Resources Wales radioactivity and industry policy team leader Paul Gibson said: We are working closely with the Environment Agency and the Office for Nuclear Regulation as part of the process to determine the acceptability of the Rolls-Royce SMR design which potentially could be sited in Wales.

Source website link: https://www.newcivilengineer.com/latest/rollys-royce-small-modular-reactor-design-passes-first-assessment-hurdle-04-04-2023/?tkn=1

Mind Control: 3D-Patterned Sensors Allow Robots to Be Controlled By Thought

04 April, 2023 | by Can Emir

This novel technology looks like a sci-fi device. But it's real.



Mind-controlled robots concept image

It seems like something from a science fiction movie: a specialized, electronic headband and using your mind to control a robot. A new study published in the journal ACS Applied Nano Materials took a step toward making this a reality. The team produced "dry" sensors that can record the brain's electrical activity despite the hair and the bumps and curves of the head by constructing a specific, 3D-patterned structure that does not rely on sticky conductive gels. University of Technology Sydney (UTS) researchers have developed biosensor technology that will allow you to operate robots and machines entirely by thought control. The enhanced brain-computer interface was created with the Australian Army and the Defence Innovation Hub by Distinguished Professor Chin-Teng Lin and Professor Francesca Iacopi of the UTS School of Engineering and IT. In addition to military

applications, the technology has tremendous potential in industries such as sophisticated manufacturing, aerospace, and healthcare, such as allowing persons with disabilities to control wheelchairs or operate prosthetics.

Electroencephalography (EEG) is a technique doctors use to monitor electrical signals from the brain by implanting or placing specialized electrodes on the surface of the head. EEG not only aids in diagnosing neurological problems but may also be used in "brainmachine interfaces," which use brain waves to operate an external object such as a prosthetic limb, robot, or even a video game.

Most non-invasive versions employ "wet" sensors that adhere to the scalp using a gloopy gel that can irritate the scalp and occasionally cause allergic responses.

A new sensor design used to control a robot using brain waves

Researchers have been working on "dry" sensors that do not require gels as an alternative, but none have performed as well as the goldstandard wet kind. Although nanomaterials such as graphene may be a viable choice, their flat and often flaky nature makes them incompatible with the uneven curves of the human skull, especially over long periods.

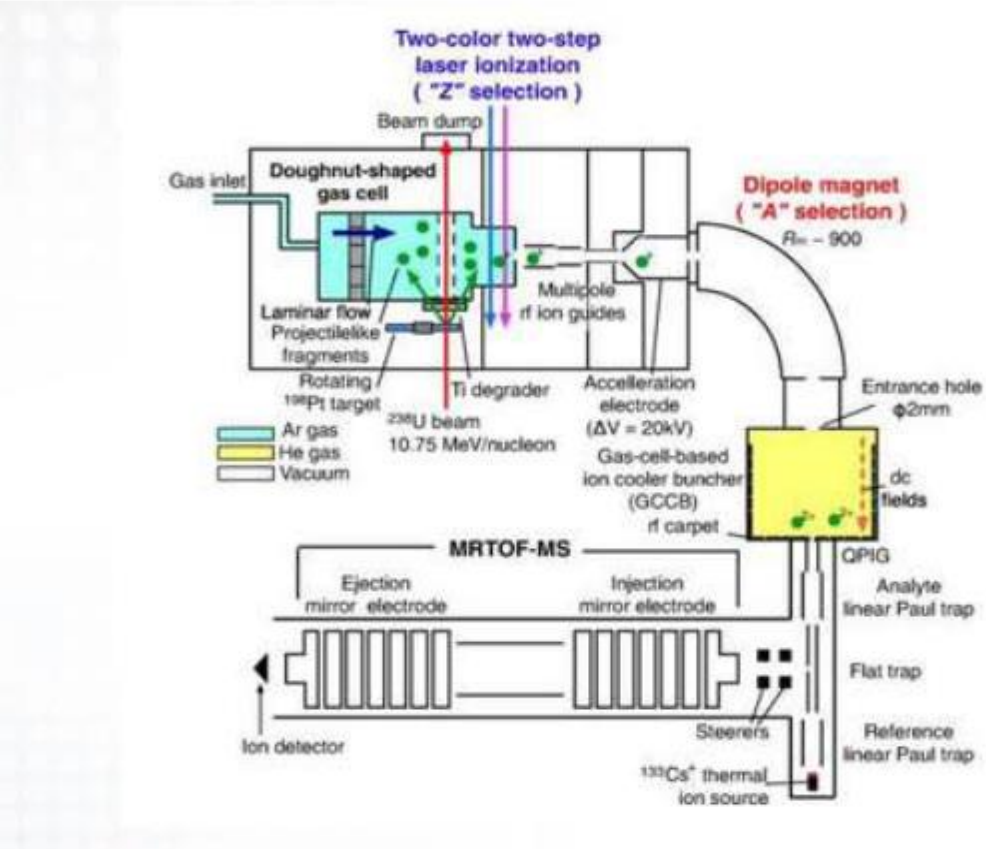
As a result, Francesca Iacopi and colleagues set out to develop a 3D graphene-based sensor based on polycrystalline graphene that could accurately monitor brain activity while being stick-free. The researchers produced numerous 3D graphene-coated structures with varying shapes and patterns, each approximately 10 m thick. A hexagonal pattern performed the best of the designs examined on the curved, hairy surface of the occipital region — the location at the base of the head where the brain's visual cortex is located. Eight of these sensors were combined into an elastic headband that kept them against the back of the head. When used with an augmented reality headset that displayed visual cues, the electrodes could recognize which line was being observed and then work with a computer to translate the signals into commands that controlled the mobility of a four-legged robot – fully hands-free.

However, the new electrodes did not perform as well as the wet sensors; the researchers believe their study is a first step toward building robust, easily deployed dry sensors that will help expand the applications of brain-machine interfaces. The complete study was published in ACS Applied Nano Materials and can be found at

Source website link: https://interestingengineering.com/science/mind-control-3d-patterned-sensors

Previously Unknown Isotope of Uranium Discovered

05 April, 2023 | by Bob Yirka



A team of nuclear physicists affiliated with multiple institutions in Japan, working with a colleague from Korea, has discovered a previously unknown uranium isotope with atomic number 92 and mass 241. In their study, reported in the journal Physical ReviewLetters, the group forced the isotope to reveal itself and tested the results of their efforts to show that what they had found was indeed uranium-241.

Over the past several decades, physicists have found that determining the properties of neutron-rich isotopes is difficult due to problems caused in creating

them. For that reason, ongoing research has been looking for new ways to synthesize them under lab conditions.

In this new effort, the research team tried a new approach—they fired a sample of unranium-238 nuclei at a sample of platinum-198 nuclei using an isotope separation system. Such interactions are known to result in multinucleon transfer, in which isotopes swap neutrons and protons. The collision resulted in the creation of a large number of fragments, which the researchers studied to determine their makeup.

They found evidence of 19 heavy isotopes holding from 143 to 150 neutrons. Each was measured using time-of-flight mass spectrometry, a technique that involves determining the mass of a traveling ion by tracking the time it takes to travel a given distance when its initial acceleration is known. The research team noted that most of the isotopes they measured had never been measured before. They also noted that one of them, uranium-241, had never been observed before and that it marks the For the first time since 1979 that a neutron-rich uranium isotope has been discovered. The researchers also calculated that uranium-241 likely has a half-life of just 40 minutes. The technique used by the team represents a pathway to better understanding the shapes of large nuclei associated with the heavy elements, which could yield changes to models used to build nuclear power plants and weapons and to theories describing the behavior of exploding stars. The research team notes that that their method of discovery could be used to learn more about other heavy isotopes and also, perhaps, to discover new ones.

More information: T. Niwase et al, Discovery of New Isotope U241and Systematic High-Precision Atomic Mass Measurements of Neutron-Rich Pa-Pu Nuclei Produced via Multinucleon Transfer Reactions, Physical Review Letters (2023). DOI: 10.1103/PhysRevLett.130.132502

Source website link: https://phys.org/news/2023-04-previously-unknown-isotopeuranium.html?utm_source=nwletter&utm_medium=email&utm_campaign=daily-nwletter

NALCO-BARC Releases India‘s 1st Bauxite CRM

25 March, 2023 | by PSU Watch Bureau

NALCO has successfully developed a Bauxite Certified Reference Material (CRM) naming as BARC B1201 in joint collaboration with Bhabha Atomic Research Centre (BARC).

NALCO-BARC releases India’s 1st Bauxite CRM

National Aluminium Company Limited (NALCO) under Ministry of Mines and country‘s leading manufacturer and exporter of alumina and aluminium, has successfully developed a Bauxite Certified Reference Material (CRM) naming as BARC B1201 in joint collaboration with Bhabha Atomic Research Centre (BARC). This is the first of its kind CRM in India and 5th in the World. BARC B1201 was formally launched by NALCO's Director (P&T) MP Mishra and National Centre for Compositional Characterisation of Materials Head of Division Dr AC Sahayam in the presence of senior officials of NALCO and BARC at NALCO Research & Technology Centre, Bhubaneswar on March 24.

Expressing pride and congratulating the entire team involved in development of this product, NALCO CMD Sridhar Patra said ―The collaboration with BARC

has resulted in developing this uniqueproduct required by our research laboratories. This achievement will inspire the researchers for further innovation and will also add value to the cherished vision of Atmanirbhar Bharat and Make in India Initiative. Worth mentioning that this new product will act as an import substitution for use by Industries, Research Laboratories and Academic Institutions as a calibration standard in evaluating analytical methods, performance of Instruments, and data quality control in routine analysis of bauxite.

Source website link: https://psuwatch.com/psuevents/nalco-barc-releases-indias-1st-bauxite-crm

India's Nuclear Submarine Secrecy: Boosting Naval Firepower

01 March, 2023 | by Manish Kumar Jha

India's top secret nuclear submarine project achieved another milestone with the launch of a second ballistic missile submarine, the Arighat What is the full spectrum of India's nuclearsubmarine architecture?

Nuclear Submarine INS Chakra- IN

India’s top secret nuclear submarine project achieved another milestone with the launch of a second ballistic missile submarine, the Arighat. India’s quest for the indigenous nuclear submarine started when the Indian government approved the construction of six nuclear-powered attack submarines in 2015. Nuclear submarines form the strategic part of India’s ‘no first use’ policy for nuclear weapons. It works as a guarantee of an ‘assured retaliation’ or a second strike, preventing any surprise first strike by a nuclear-armed adversary.

So, what is the full spectrum of India’s nuclear-submarine architecture? India’s submarine fleet is based on the east coast of Visakhapatnam and on the west coast of Mumbai. Also, the submarines in the nuclear class have not been documented in photographs. So, it is largely based on the experts’ analysis through the structural similarities and technical expertise. Primarily, India’s nuclear-powered submarine program is managed by the Defence Research and Development Organisation (DRDO), the Department of Atomic Energy (DAE), and the Indian Navy at Visakhapatnam.

Nuclear submarine: SSN and SSBN

The common factor between these two types of the submarine is nuclear reactors which power the entire submarine. While the major difference lies in the design and the types of weapons. In terms of firepower, the SSBN is designed to carry long-distance missiles while the SSN is designed for short-range assailant attacks. The SSN is also designed for carrying out surveillance and intelligence missions.

Arihant-class submarines

The Arihant-class is named after the country’s first nuclear-powered submarine — INS Arihant. The Arihant-class is defined as a nuclear powered ballistic missile submarine for the Indian Navy.

INS Arihant (reuters) The first of these SSBNs, the INS Arihant (S2), was launched in July 2009. The INS Arihant was commissioned into the Indian Navy in August 2016. The second in the series, S3 (INS Arighat), is in the final stage of sea trials. The last in the series is the S-4 submarine. The S-4 remains highly classified. The construction of these two remaining two Arihant-class submarines is undergoing at the shipbuilding center in Vadodara in Gujarat.

Also Read German submarine offer for joint manufacturing resurrects Project-75(India) The Arihant-class submarines are being developed and built indigenously under the Advanced Technology Vessel (ATV). India took steps to operationalize its nuclear triad by commissioning its first ATV submarine, the INS Arihant, in 2016 at a cost of $12 billion. The four SSBNs carry shorter-range K-15 and larger K-4 ballistic missiles. The K-15 has a range below 1000 km. The naval arm of the nuclear triad is significant for India given its nofirst-use (NFU) nuclear posture.

The SSN-Chakra

India operated one SSN — the INS Chakra-2. Basically, the INS Chakra

was an Akula-class attack boat, which was on a 10-year lease from Russia.

India leased two SSN-class nuclear-powered submarines from Russia. In March 2019, India signed for a second nuclear-powered attack submarine, named —Chakra-3—which is under modification in Russia. The Chakra-III is expected to be delivered to the Indian Navyby 2025.

The biggest advantage of the nuclear-powered submarine is the ability to remain submerged indefinitely. For example, an 80MW pressurized water reactor (PWR) submarine can stay submerged for many months without the risk of detection. While conventional diesel-electric submarines can only stay for a limited period. Such conventional submarines need to come up to the surface to release carbon dioxide produced by the generator.

In the prevailing scenarios in the Indian Ocean and beyond, India is perusing the prospect of leasing another SSN from Russia. The submarine deployment in the Indian Ocean has been proven as an effective deterrence against Chinese warships. However, the Indian navy is phasing out its conventional submarines. And, India currently has only one Akula class SSN on lease while one more is expected to come on the lease, not before 2025.

Source website links: https://www.financialexpress.com/defence/indias-nuclear-submarine-secrecy-boosting-naval-firepower/2996559/

We Just Mapped Out Dark Matter with Radiation from the Big Bang

17 April, 2023 | by Jackie Appel

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We can‘t see dark matter, but we can map it. And according to a recent series of preprint papers, we can map it pretty well. It might seem a bit counterintuitive, but

it‘s true. Dark matter got its name because we aren‘t able to see it. It doesn‘t interact directly with electromagnetic radiation, so the detectors on our telescopes just can‘t spot it. But it does interact with gravity, and by using gravity, we can spot where it‘s hiding and, potentially, what influence it has on our universe.

To see the effects of the gravity generated by dark matter throughout the universe, cosmologists turned to another elusive area of interest—cosmic microwave background radiation (CMB). The CMB is radiation that permeates the universe, originating from just after the Big Bang.

It‘s diffuse, it‘s everywhere, and it can be moved around by gravity—a perfect candidate for showing off the power and distribution of dark matter. So, a team of researchers decided to use the Atacama Cosmology Telescope to map the CMB over about a fourth of the sky and see how it‘s affected by sources of gravity like dark matter.―We‘ve made a new mass map using distortions of light left over from the Big Bang,‖ Mathew Madhavacheril, one of the researchers who worked on the project, said in a press release. ―Remarkably, it provides measurements that show that both the ‗lumpiness‘ of the universe, and the rate at which it is growing after 14 billion years of evolution, are just what you‘d expect from our standard model of cosmology based on Einstein‘s theory of gravity. A confirmation of ―lumpiness‖ doesn‘t necessarily sound like a big deal, but it‘s actually a significant point in favor of one side of a major cosmological debate. Sometimes called ―The Crisis in Cosmology,‖ it‘s a disagreement about how ―lumpy‖—or unevenly distributed—dark matter should be. According to measurements of dark matter‘s distribution taken from starlight instead of CMB, the mystery substance isn‘t ―lumpy‖ enough to agree with the standard model of cosmology (ΛCDM). That disagreement would imply that ΛCDM is wrong, and would throw a serious wrench in our understanding of the deep universe.

But according to this most recent CMB-dark matter map, ΛCDM is doing just fine.

―While earlier studies pointed to cracks in the standard cosmological model, our findings provide new reassurance that our fundamental theory of the universe holds true,‖ Frank Qu, a Ph.D. student and one of the researchers on the project, said in a news release. Suzanne Staggs, another researcher on the project, added in the release that she believes combining the starlight-based calculations with the new map will provide ―an extraordinary opportunity to use these different data sets together. Our map includes all of the dark matter, going back to the Big Bang, and the other maps are looking back about 9 billion years, giving us a layer that is much closer to us. We can compare the two to learn about the growth of structures in the universe. I think is going to turn out to be really interesting. That the two approaches are getting different measurements is fascinating. In any case, the map is a huge success, marking the beginning of the end of a project about 20 years in the making. The team is now looking forward to seeing what other groups do with their data, and anticipates being able to make even more efficient maps with the upcoming Simons Observatory.

―When we proposed this experiment in 2003, we had no idea the full extent of information that could be extracted from our telescope, Mark Devlin, another of the researchers on the project, said in a press release. ―We owe this to the cleverness of the theorists, the many people who built new instruments to make our telescope more sensitive, and the new analysis techniques our team came up with.