SATYENDRA NATH BOSE NATIONAL CENTRE FOR BASIC SCIENCES

Newsletter

Vol. 7, Issue 1

Celebrating 125th Birth Anniversary of Satyendra Nath Bose

Editorial

We are happy to publish the first edition of Newsletter 2018 on the occasion of 125th birth anniversary of Satyendra Nath Bose. This special four-page edition pays tribute to Bose and his path-breaking discovery of Bose statistics, which ultimately led to the quantum revolution of 20th century physics. This edition gives a flavour of activities, namely the ***BOSE-125***, which is being celebrated throughout this year at the S. N. Bose National Centre for Basic Sciences.

Professor Satyendra Nath Bose

Tribute to Professor Satyendra Nath Bose (January 1, 1894 - February 4, 1974)

Professor Satyendra Nath Bose was born on 1st January 1894 in Calcutta (presently Kolkata). In 1924, Bose did a path-breaking fundamental work on the quantum statistics of particles (i.e., how particles would behave in extremely small atomic scales), which laid the foundation of quantum theory of matter. In the words of Albert Einstein, "*Bose's derivation signifies an important advance*". Bose wrote the celebrated paper, "*Planck's Law and the Light-Quantum Hypothesis*" and after receiving no response from Phil. Mag., sent his work to Einstein, with an accompanying letter, asking him for his opinion and to arrange for its publication in Zeitschrift für Physik. Einstein wrote back to Bose that he had translated and communicated the paper to Zeitschrift für Physik for publication. He said that "*I liked it (Bose's work) very much. ... It is a beautiful step forward."!*

S. N. Bose has been immortalized in the history of science for Bose statistics and Bose-Einstein condensation. Half of the fundamental particles in the universe, called *boson*, are named after Bose. According to Einstein's biographer Abraham Pais, the work by Bose is regarded as one among the last four revolutionary papers on old quantum theory (the other three by Max Planck, Albert Einstein and Niels Bohr). After Bose's paper, there was a flood of important developments: extension of Bose's theory by Einstein to ideal gases, the Fermi-Dirac statistics for electrons, quantization of the electromagnetic field by Heisenberg and Pauli, and quantum electrodynamics by Dirac.

S. N. Bose studied at the Presidency College, Calcutta and there met Meghnad Saha, another towering personality in Indian science. This began a lifelong scientific collaboration and friendship with Saha. At the Presidency College, he had luminaries like Acharya Prafulla Chandra Ray and Acharya Jagadish Chandra Bose as his teachers. In 1917, Bose became a lecturer in Physics and Applied Mathematics at the University College of Science, Calcutta University. After four years, he moved to the University of Dhaka as a Reader in the Department of Physics. There he started teaching quantum theory and acutely felt the lack of a logically satisfactory derivation of Planck's black-body radiation law. He then attempted to provide one in his own way, leading to the above-mentioned famous work.

A self-taught scholar and polymath, S. N. Bose's range of interests spanned not only the subjects of physics, mathematics, chemistry, but also included philosophy, arts, literature and music. He was also an accomplished player of the musical instrument, *Esraj*. As a tribute to his legacy, a few years after S. N. Bose's death on February 4, 1974, the Government of India established the *Satyendra Nath Bose National Centre for Basic Sciences* in Kolkata in 1986.

Curtain Raiser Ceremony of 125th Birth Anniversary of Professor S. N. Bose

The Curtain Raiser Ceremony on January 1, 2018, was inaugurated by Hon'ble Prime Minister of India, Shri Narendra Modi, through video conferencing. On the occasion, Prime Minister delivered a special speech to the scientific community of India and especially urged the scientists to use vernacular languages for promoting science and technology so that youths develop love for science through their mother tongue (which was the dream of Bose). He also appealed to the scientists to work for the benefit of the people and to directly reach out to the students. He also stressed that the innovations should be directed, apart from its academic interest, towards the social issues of our country, such as addressing health issues of tribal people and how diseases like malaria and Japanese encephalitis could be checked, etc. Dr. Harsh Vardhan, Hon'ble Minister, Ministry of Science & Technology, Earth Sciences and Environment, Forests and Climate Change, Government of India; Shri Y. S. Chowdary, Hon'ble Minister of State, Ministry of Science & Technology and Earth Sciences, Government of India; Prof. Ashutosh Sharma, Secretary to the Government of India, DST, and other honorable delegates were also present at the ceremony. On the same day, a colourful procession was

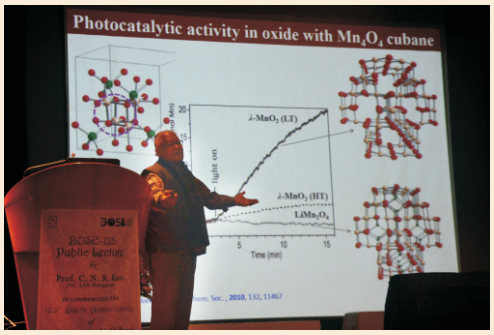
jointly organized by the S. N. Bose Centre and Bangiya Bijnan Parishad. A Special Cover on S. N. Bose was released by Ms. A. Ghosh, Chief Postmaster General, West Bengal Circle, Kolkata. Also there were screening of documentary on *Life and Works of Bose - "An Iconic Genius"* and inauguration of new Bose Archive and Museum.

BOSE-125 Distinguished Lecture by Professor Ajay K. Sood

A BOSE-125 Distinguished Lecture was delivered by Prof. Ajay K. Sood on 1st January, 2018. Prof. Ajay K. Sood, a Fellow of Royal Society, is an Honorary Professor at Department of Physics at IISc Bangalore. He received the civilian honor, Padma Shri by Government of India, S. S. Bhatnagar Prize, G. D. Birla Award, TWAS Prize in Physics, FICCI Prize, Goyal Prize and many more. He is currently the President of the Indian National Science Academy and the Secretary General of the World Academy of Sciences. Prof. Sood's research interests include Physics of Nano systems, such as graphene and other two dimensional materials and soft condensed matter, with a strong focus on innovative experiments. The latter includes the flow behavior such as rheo-chaos, nonequilibrium phase transitions, deconstruction of glass physics using experiments on colloids, active matter and stochastic thermodynamics, etc. In this lecture, he talked about "*Nature inspired physics: Flocking and bacterial heat engine*". His talk brought out how nature inspires one to explore fascinating emergent phenomena like flocking - a coherent macroscopic motion of a huge number of birds or animals in a particular direction. Remarkably, this beautiful phenomenon has also been realized in the laboratory in systems of inanimate granular objects, placed on a rapidly vibrating surface.

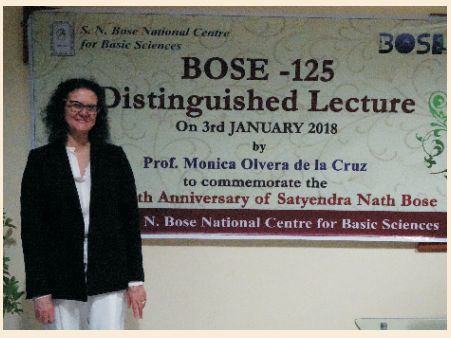
BOSE-125 Public Lecture by Professor C. N. R. Rao

A BOSE-125 Public Lecture was delivered on 1st January, 2018 by eminent scientist, Prof. C. N. R. Rao, who is the Fellow of Royal Society, recipient of Bharat Ratna and who has been a colossus figure in the scientific landscape of the country, especially in the area of solid state and materials chemistry, worldwide. He gave lecture on "Photochemical, Thermo-chemical and Electro-chemical Splitting of Water". Artificial photosynthesis is a promising method for harvesting renewable energy by use of sun-light. He discussed the ways of splitting water, followed by recent results obtained on the photochemical generation of hydrogen by different strategies especially those involving semiconductor hetero-structures of the type ZnO/Pt/CdS or nano-sheets of chalcogenides such as MoS_2 and $MoSe_2$. He has also explored all other novel strategies for hydrogen generation.



BOSE-125 Distinguished Lecture by Professor Monica Olvera de la Cruz

A BOSE-125 Distinguished Lecture was delivered by Professor Monica Olvera de la Cruz on 3rd January, 2018. Prof. Monica Olvera de la Cruz is a Lawyer Taylor Professor of Materials Science and Engineering, Northwestern University. She has developed theoretical models to determine the thermodynamics, statistics and dynamics of macromolecules in complex environment including mani component solutions of heterogeneous synthetic and biological molecules and molecular electrolytes. She is a member of National Academy of Sciences (NAS) and a fellow of American Physical Society (APS). In her lecture, she talked about directed crystallization using DNA hybridization, which has been used to design materials with a broad range of crystal symmetries. Spherical nucleic acid (SNA) nano-structures assemble into a large variety of well-defined crystalline super lattices via DNA-directed hybridization. The model also provides surface energy values to determine the shape of defect-free single crystals with macroscopic anisotropic properties, which are suitable for the fabrication of materials with specific optical and mechanical properties. A large-scale coarse-grained model has been analyzed to capture the relevant contributions to the kinetics of the DNA hybridization process.



BOSE-125 Distinguished Lecture by Professor Charles H. Bennett

Professor Charles H. Bennett gave a BOSE-125 Distinguished Lecture on February 2, 2018 at the S. N. Bose National Centre for Basic Sciences, Kolkata. Prof. Bennett (b. 1943) is a physicist and information theorist; he is an IBM Fellow at the IBM Research, a Fellow of the American Physical Society, and a member of the National Academy of Sciences, USA. Prof. Bennett discovered, with Gilles Brassard, the concept of quantum cryptography and is one of the founding fathers of modern quantum information theory. In 1993, Bennett and Brassard, in collaboration with Claude Crepeau, Richard Jozsa, Asher Peres, and William Wootters, discovered "quantum teleportation". In collaboration with Smolin, Wootters, IBM's David Di Vincenzo, and others, he formulated the quantitative theory of entanglement. In the Lecture, he elucidated the interconnections between physics and information, particularly in the realm of quantum computation, but also in cellular automata and reversible computing. He particularly emphasized the exchange of ideas, which happened over past several decades among physicists, mathematicians and engineers. The ideas developed in their respective fields have invigorated the theory of communication and computation, enabling it to outgrow its brash beginnings with Turing, Shannon and von Neumann. The development of quantum theory of information has thus provided a coherent scientific taste of its own, adopting and domesticating ideas from thermodynamics and quantum mechanics that physicists had mistakenly thought belonged solely to their field, to better formalize the core concepts of communication and computation.

Young Bose

Bose in Dhaka

Bose in Kolkata

Bose with P. A. M. Dirac

Bose with Abdus Salam

Published by:

Satyendra Nath Bose National Centre for Basic Sciences
Block-JD, Sector-III, Salt Lake,
Kolkata - 700 106