

N.9: Talk on breast cancer awareness

Awareness is the key to timely detect and treat cancer. In order to spread awareness about breast cancer amongst RRCAT community, RRCAT Women's Welfare Committee (WWC) organized a talk in co-ordination with Medical Centre on breast cancer awareness on 14th Nov 2018. The speaker was Dr. S. P. Shrivastava, HoD, Oncology Dept., Shalby Hospital, Indore. The program was attended by over 200 people, which included employees, spouses, colony residents, CISF family members and students.



Ms. Sujata Joshi welcoming Dr. S.P. Shrivastava (top) and the attendees of the lecture (bottom).

The programme was conducted by Ms. Swati Chaudhary. Dr. Bhavani gave a brief introduction of the speaker to the audience. Ms. Sujata Joshi, Chairperson, WWC welcomed the guest with a plant. This was followed by the talk by Dr. S. P. Shrivastava on the subject. Initially, he made the audience aware about different types of prevalent cancers and emphasized that breast cancer was the second most prevalent form of cancer. He pointed out the difference between malignant and benign tumours. He also mentioned about the risk factors and probable causes of cancer amongst females. He emphasized on the need of periodic self examination and also regular clinical examination after age of 45 for early detection of breast cancer. He informed that HPV vaccines can be given to females of age group 9 to 16 years for prevention of cervix cancer. Dr. Shrivastava discussed treatment options available for various stages of cancer. His easy to understand slides were appreciated by everyone present. The vote of thanks was proposed by Ms. Shradha Tiwari.

*Reported by:
Shradha Tiwari (shradha@rrcat.gov.in)*

N.10: RRCAT Seminars during July-December 2018

Understanding the high temperature thermoelectric properties of some oxide materials : *Dr Sudhir Kumar Pandey, Associate Professor, School of Engineering, IIT, Mandi, July 06, 2018.*

In the past few decades, need of energy resources has highly been increased. Most of the non-renewable natural resources (coal, petroleum and natural gases) have limited stock may be sufficient for next fifty years. Therefore, the need of alternate resources of energy are in high demand. Thermoelectric materials are one of the best sources of clean energy, which is efficient in conversion of heat energy into electrical energy. Due to this, a lot of efforts are being put to search new thermoelectric electric materials. Using DFT based tools many researchers are predicting new thermoelectric materials. However, due to lack of proper bench marking in high temperature region, most of the predicted materials are very difficult to realize experimentally. In this talk, the applicability of DFT+U method in studying the high temperature thermoelectric behaviour of some oxide materials viz. ZnV_2O_4 , $LaCoO_3$ and $La_{0.75}Ba_{0.25}CoO_3$ compounds were shown. The ground state electronic structure is found to reasonably explain the high temperature thermoelectric behaviour of these compounds if temperature dependent band gap and scattering time are properly considered.



Soft x-ray reflectivity- a tool for structural and compositional analysis in thin films: *Dr. M. H. Modi, Head, Soft x-ray Applications Lab, October 10, 2018.*

Determination of optical constants and refractive index in soft x-ray/vacuum ultra violet region is very useful as absorption edges of most of the elements lie in this photon energy region, enabling one to perform spectroscopic analysis of complex samples using refractive index measurements. Angle dependent reflectivity technique for getting information of optical constants has an advantage over transmission measurements as both δ and β can be deduced simultaneously and measurements are carried out on bulk thin film samples. In the soft x-ray region, the contrast in optical constants is sufficiently high for thin films of low atomic number elements. Near the absorption edges the energy-dependent atomic scattering factor gives a resonant behaviour and offers an opportunity to enhance the



optical index contrast further. At Indus synchrotron facility, the soft x-ray reflectivity beamline is used to measure optical constants and analyze compositional details of various thin films of low atomic number elements. Details of such studies carried out on thin films of different compound materials were presented in the seminar.

Structure and dynamics of Au nanoclusters using artificial neural network based interatomic potentials: *Dr. Satya Bulusu, Assistant Professor, Dept. of Chemistry, IIT, Indore, October 12, 2018.*

This seminar discussed that the artificial neural network (ANN) based interatomic potentials are accurate in describing interatomic interactions in metal nanoclusters and also make the calculations affordable. In terms of computational speed, ANNs are very fast and hence it allows us to run molecular dynamic simulations up to time scales of 3 ns on a single CPU for a medium sized nanocluster. ANN potentials are explored for bare, doped ((AgAu)₅₅) and thio protected Au nanoclusters to study the effect of size, composition on structure and dynamical properties. For bare Au nanoclusters, molecular dynamics simulations were performed on Au₁₇, Au₃₄, Au₅₈, Au₁₄₇ and Au₃₀₉. The study shows that there is a dynamical coexistence of solidlike and liquidlike phases near melting transition. For (AgAu)₅₅, using c-T phase diagram, surface area, surface charge, probability of isomers and Landau free energies, speaker talked about enhancement of catalytic property of Ag-Au nanoalloys by incorporation of Ag up to 24% by composition in Au nanoparticles. It was shown that using ANN, the effect of composition of SH for different sizes of thio protected nanoclusters. UV-visible spectra were utilized to probe the structure of nanoclusters.



Dynamics of Open Quantum Systems: *Dr. S. V. M. Satyanarayana, Assistant Professor, Dept. of Physics, Pondicherry University and National Coordinator, Physics Training and Talent Search, October 15, 2018.*

The most debated measurement postulate in quantum mechanics states that when an observable A of a system is measured, the state of the system collapses to that eigenstate of the corresponding self adjoint operator whose eigenvalue was seen in the measurement. While the evolution of state in quantum mechanics is unitary,



the wavefunction collapse is non-unitary and irreversible. The mechanism of wavefunction collapse is central to understanding foundation of quantum mechanics. The interaction between a quantum system and classical apparatus is similar in formulation to open quantum systems, where a quantum system is interacting with a statistical bath. The composite system of quantum system and bath can be considered as a closed system. In this seminar, light was thrown on that how non-unitary evolution for system is formulated by averaging over bath degrees of freedom from the unitary evolution of the composite system. It was discussed by means of some concrete example systems how coherence leaks out of the system into the bath generating correlations between the system and bath, i.e. decoherence. Towards end of the talk, intriguing phenomena such as entanglement sudden death, revival of entanglement when two or more quantum systems are considered in contact with a bath was presented.

Laser, butterfly effect and secure communication: *Dr. D. J. Biswas, Raja Ramanna Fellow, BARC and former Head, LPTD, BARC, Mumbai, November 12, 2018.*

The talk was on basics of a laser, how does it work, and what is so special about the light that it gives out to impact our day to day life so profoundly. The talk also introduced the manifestation of butterfly effect in the operation of a laser and its exploitation to make optical communication that has been revolutionized by laser, absolutely secure. The butterfly effect in a literary sense means that the mere flapping of a butterfly can turn an otherwise bright and sunny day into a dull and gloomy one. No wonder, a tiny long ago act can create ripple far into the future.



Nuclear Fuel Complex – Vision 2028 (Challenges, expertise, innovations and technologies): *Dr. Dinesh Srivastava, Chairman, Nuclear Fuel Complex, December 10, 2018.*

The talk provided an overall view on Nuclear Fuel Complex and its future vision. The talk covered the details of requirement, capacity and production of nuclear fuel in India by the department, including a comprehensive view on future projects.



Superconductivity of cobalt in nanoscale cobalt thin films:

Dr. B. N. Dev, Visiting Professor, Dept. of Physics and School of Nanoscience and Technology, IIT, Kharagpur, December 10, 2018.

The phenomenon of superconductivity was discovered over a century ago. So far more than half of the number of elements in the periodic table have shown superconductivity. Usually metals possessing strong long-range magnetic order do not exhibit superconductivity. This includes cobalt – a ferromagnetic transition metal. After discovery of high density nonmagnetic (HDNM) fcc phase of Co in thin films by the speaker and team. They explored superconductivity in this Co thin films. Seminar described about the discovered superconductivity in these HDNM Co films with a superconducting transition temperature (T_c) of ~ 5 K using four-probe measurements. Point-contact spectroscopy provided a T_c value of ~ 9.5 K. The higher value of T_c obtained in point contact spectroscopy is apparently due to unavoidable pressure at the contact point. First-principles density functional theory calculations for this dense fcc phase of Co show that the phase is nonmagnetic, characterized by zero elementary moment, and the estimated T_c using BCS theory is 0.30 K. A volume preserving strain in fcc Co is shown to result in anomalous softening of zone boundary phonons which couple strongly with electrons, and stabilize superconductivity at a relatively high temperature (> 5 K). The value of T_c can indeed be higher for other strain conditions. The superconducting Co layer (~ 4 nm) in contact with a ferromagnetic Co layer (18 nm) indicates its potential application in the area of quantum information. It was mentioned that the role of scattering techniques like x-ray and neutron reflectivity were vital in the discovery of the HDNM phase of Co in Co thin films.



Towards a compact 10-GeV self-guided laser plasma accelerator and its applications, *Dr. Bobbili Sanyasi Rao, Scientific Officer - F, Laser Plasma Division, RRCAT, Indore, Dec. 21, 2018.*

Since inception of the idea of the Laser Plasma Acceleration (LPA) in 1979, active research has been pursued and progressed tremendously, particularly in the last two decades. Thanks to the 2018 Nobel Prize winning invention of “Chirped Pulse Amplification” technique (by Gérard Mourou and Donna Strickland) and subsequent development of table-top femtosecond lasers with ever increasing peak powers. Currently, to push the energy frontier of laser plasma



accelerators to 10-GeV and beyond, Quantum Beam Facility at Center for Relativistic Laser Science (CoReLS), Institute for Basic Science in Gwangju, South Korea has recently developed 4 PW, 20 fs laser which is probably the most powerful femtosecond laser operating in the world currently. Dr. Rao told about its development and use in LPA experiments and also for discovering hitherto unknown processes at extremely intense laser matter interaction conditions. It was described that recently, in the initial experiments at CoReLS employing 2.5 PW laser power, a 4.5 GeV electron beam has been produced from only 7 cm long self-guided laser plasma acceleration. Seminar discussed the simulations about the electron beams to drive short-pulsed bright source of GeV muon pairs from a compact set up, with wide-ranging applications in in-land security to compact future colliders.

*Reported by:
Arup Banerjee (banerjee@rrcat.gov.in)*

N.11: Awards and Honours

The Department of Atomic Energy has instituted the Excellence in Science, Engineering and Technology Awards Scheme from the year 2006 to recognize outstanding accomplishments and exceptional achievements of the DAE staff, who are engaged in scientific research, technology development, engineering/project implementation, teaching, healthcare and supporting services. There are ten categories of awards under the scheme and one Meritorious Service Award for auxiliary, administration, account services etc. These awards are given annually. The awards for the year 2017 were given on the Founder's Day on October 30, 2018 in BARC. The following scientists, engineers and staff members bagged the DAE awards for the year 2017.

N.11.1: DAE Excellence in Science, Engineering and Technology Awards 2017

N.11.1.1: Homi Bhabha Science and Technology Award

Dr. Christ Prakash Paul, SO/G and Head, Head, Laser Additive Manufacturing Lab., Laser Development & Industrial Applications Division, Laser Group, has been conferred with "Homi Bhabha Science and Technology Award" for his contribution to the "Laser based metal additive manufacturing". The award carried a cash prize of ₹ 5 Lakh, a citation and a medal.

