MEETING REPORT

Exploring radiation in many splendors*

Diverse applications of ionizing radiation in different fields have made it important to study the underlying physics and related safety as well as to develop the human resources in this area. New modes of detection and related new-generation detectors are evolving continuously for the identification and quantification of radiation. In the search for dark matter of the universe as well, precise tools are needed to isolate the rare event from the known radiations. Biomedical and materials science research and applications have used radiation sources as tool and have significantly improved the quality of life. Ion beam therapy has given a new dimension to the conventional radio therapeutic techniques. The RAD2013 workshop was aimed at providing a platform to discuss the above topics, thereby creating awareness among young students about the scope of work in the related areas and motivating them towards research in these areas with resources in the country as well as at the international level.

The workshop began with the introductory remarks by Milan K. Sanyal, Director, Saha Institute of Nuclear Physics (SINP), Kolkata followed by the inaugural address by Dinesh K. Srivastava, Director, Variable Energy Cyclotron Centre (VECC), Kolkata. Lectures were delivered by scientists and professionals of international acclaim in diverse areas of application of ionizing radiation. A. Goswami (SINP) gave a detailed analysis of the principle of various modes of detection of nuclear radiation emitted in different types of nuclear scattering and nuclear reaction processes. Working principle and application of nuclear radiation detectors, viz. gas detectors, scintillator and solid-state detectors along with their important characteristics like resolution, efficiency and counting speed were discussed. Usefulness of Multi-Wire Proportional Chamber (MWPC), Parallel Plate Avalanche Counter (PPAC), Gas Electron Multiplier (GEM) and Resistive Plate Chamber (RPC) was mentioned. Application of composite detectors like particle identifier, time-of-flight set-up, Compton suppressor using Bismuth Germanate (BGO) scintillator, etc. were also discussed. Different special detector systems, viz. TACTIC, INDRA, TESSA, EUROBALL, GAMMASPHERE, TIGRESS, EXOGAM, INGA and Microball were discussed in the light of new physics discovered through these composite systems.

Photons and particulate radiation play an important role in probing composition, structure, bonding and dynamics of matter. A large amount of information has been gathered by analysing response characteristics of materials to specific radiations, where structural symmetry plays an important role. A. Datta (SINP) discussed the general ideas and principles behind X-ray scattering techniques in the determination of structural correlations in condensed matter. Determination of structures evolving in fatty acid monomolecular layers (Langmuir monolayer) at the air–water interface due to interaction with metal ions like Cd, Pb, Cu^{2+}, Ni^{2+}, Co^{2+}, Ba^{2+}, Mn^{2+} and Mg^{2+} in the water, through the use of grazing incidence X-ray diffraction and the effect of pH variation were presented in detail.

A. J. Noble (Queen's University, Canada) explained the motivation for experimental search for the evidence of dark matter. Till date, dark matter is studied through astronomical observations of its gravitational interactions with the cosmos. Direct detection experiments hope to observe them directly by measuring the tiny energy imparted to recoiling nuclei in occasional dark matter interactions with normal matter. With event rates predicted to be as low as a few events per year for a tonne of material, the detectors must be very large, operate for many years, and be free of background events. The DEAP-3600 experiment was described to analyse the physics care that must be taken to understand and eliminate potential radioactive background sources, and to ensure that the signal can be distinguished from any residual activity.

Sunanda Banerjee (SINP) discussed the revolution in the field of particle detection which has led to all the discoveries over the past 100 years. Detection principles from emulsion experiments to cloud chambers and finally the modern-day experiments where one probes very short distances using very high energy particles were explained. The experimental search for Higgs boson at the Large Hadron Collider was discussed in detail. Such complex detectors were commissioned and validated by detecting and observing all the particles which have been discovered in the past 80 years. The well-understood detector has now established a new particle, the Higgs boson, at a mass of 125 GeV. The particle detection technique has helped broaden our knowledge in understanding the basic constituents of matter.

Application of ionizing radiation in medicine was discussed in the context of hadron therapy and nuclear imaging. Marco Durante (GSI, Germany) elaborated on the role of proton and carbon ions for the treatment of different solid cancers. The technique of raster scanning is being successfully utilized for the treatment of tumours at the base of the skull and brain. In the past years, the Biophysics Group at GSI had an intense activity in a pilot project on ^{12}C-ion therapy which paved the way to hadron therapy in Europe. There are around 40 hadron therapy centres all over the world and several new centres with large accelerators are under construction. In India, there are proposals to have such a centre in the near future.

S. Ray (Tata Medical Centre, Kolkata) explained the application of radionuclides in the diagnosis of diseases and in radioisotope therapy. Efficacy of functional imaging, both in the case of disease progression and during recovery through detection of gene expression, gene regulation, gene function, gene transfer, protein–protein interaction, cell proliferation, metabolism, apoptosis, receptors, angiogenesis, peptides, neurochemicals and antibodies was described. Use of some radioisotopes like ^{131}I in treating thyroid cancer, pheochromocytoma, of ^{177}Lu, ^{90}Yt for octreotide,

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carcinoid, neuroblastoma and painful bone metastases was discussed in detail.

There was a session on 'Detector demonstration'. Different detectors were demonstrated along with a poster explaining their working principle and applications. The following detectors were demonstrated under the leadership of S. Saha (SINP): thick GEM, superheated droplet detector, multi wire proportional counter (MWPC), Ge-crystal, dosimeter, scintillation detector, charged particle detector, photon multiplicity detector, plastic scintillator, muon detector and MANAS and track projection chamber.

The workshop ended with a panel discussion involving panelist from different fields: S. C. Roy (Science & Culture), G. Ganguly (University of Calcutta, Kolkata), B. K. Chatterjee (Bose Institute, Kolkata), S. Chattopadhyay (VECC), S. Basu Roy (Institute of Post Graduate Medical Education & Research/SSKM Hospital, Kolkata), and S. Chattopadhyay (SINP). The topic of the discussion was 'Enthusing experimental research – present problems and possible solutions'. The aim of this panel discussion was to make the experimental programme more interesting to students by explaining the importance of experimental work to the global scenario and to motivate them in experimental research.

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MEETING REPORT

Growing interest in doubled haploidy for improvement of horticultural crops in India*

Sexually producing diploid plants carrying a set of chromosomes from each parent are the rule in nature. For crop breeders, haploid plants represent a more useful resource. Though haploidy was first reported by Bergner in 1921, the first attempt to use it in breeding was done in 1952 by Chase in maize. Ever since, several techniques for induction of haploidy, including pollen irradiation prior to pollination, alien cytoplasm, ultra wide hybridization, inducer lines, micro/megaspore culture and more recently, the Cenh3 histone-based haploidy have been reported in several crops with varying success. Since such plants have only one version of each gene, they are of special interest for geneticists. Further, these plants can be used to develop doubled haploid (DH) populations which are of great value in crop improvement.

Incorporating DH in breeding programmes has the advantage of accelerating inbred line development by achieving homozygosity instantly within a generation. DH technique can be used to transfer sterile cytoplasm of CMS lines into a desirable background in a single step avoiding many generations of backcrossing. Further, DH can also be employed for studying inheritance of quantitative traits, QTL mapping, genomics, gene identification, as base material for Targeting Induced Local Lesions in Ganome (TILLING) populations, production of stable transgenic plants and reverse breeding. With these advantages, haploidy is emerging as a powerful tool to enhance genetic gain per cycle, which is of more relevance in horticultural crops that are either perennial in nature or outcrossing with inbreeding depression or with great commercial value where breeding duration is critical.

Recognizing the growing interest in this area, a one-day interactive meeting on 'Doubled haploids: scope and future in horticultural crops' was organized. Over 200 participants across the country representing various research institutions, state universities and private seed companies participated in the event chaired by N. K. Krishna Kumar (ICAR, New Delhi).

The programme included invited lectures by eminent scientists from CIMMYT, IISER-Trivandrum, UAS-Bengaluru, Monsanto, Syngenta, Namdhari Seeds and *In Vitro* International, who shared their experience in the field. Anand (Namdhari Seeds, Bengaluru) analysed the current status of expertise and achievements in India and the problems associated with this technology for vegetable crop improvement.

Unlike the gamete culture-based techniques that are commonly being used in horticultural crops, the technique of using haploid inducing lines in maize added a new dimension to the experience in horticultural crops. Karthikeya (CIMMYT Regional Station, Hyderabad) gave a brief account of the work on genotypes inducing haploids both in temperate and tropical backgrounds of maize at CIMMYT and its scope in other crops.

More recently, Cenh3 histone-based haploidy has been reported, which has the potential to replace all existing techniques of haploidy induction considering its recovery efficiency and handling ease. M. Ravi (IISER-Trivandrum), the inventor of this patented technique, presented the prospects of developing doubled haploids through centromere-mediated uniparental genome elimination in horticultural crops.

The meeting helped create awareness, deliberate and debate on strategies and prospects of using doubled haploidy in horticultural breeding programmes. It also brought to light that several vegetable seed companies like Monsanto, Syngenta, Nunhems (Now Bayer), Namdhari, HyVeg, etc. have already made significant progress in this regard, especially in crops like cauliflower, cucumber, pepper, melons, etc. while

*A report on the one-day interactive meeting on 'Doubled Haploids: Scope and Future in Horticultural Crops' held on 4 October 2013 at the Indian Institute of Horticultural Research, Bangalore, in association with the Society for the Promotion of Horticulture, Bangalore.