TIFR Centre for Interdisciplinary Sciences
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# Seminar

## Recent advances in laser driven ion and neutron sources – current research activities at QUB

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In the context of developing a compact, high current ion accelerator, the study of intense laser driven acceleration mechanisms and optimisation of the ion beams produced, have been, over the past decade, very active areas of research. An appealing beam of ions will not only be useful for their direct application in science, industry, healthcare; it can be beneficial towards development of secondary radiation sources, such as neutrons. An ultra-short, directional burst of fast neutrons, produced by high power laser driven compact ion accelerators, would have a wide ranging applications, including material testing for fusion energy research, fast neutron radiography, neutron resonance spectroscopy etc.

Several aspects of this area have been the research focus of our group at the Queen's university Belfast. While we sought out exploring the possibility of ion acceleration from ultra-thin targets at the onset of radiation pressure effects, significant efforts were made to control and optimize ion beam parameters produced by the well-known Target Normal Sheath Acceleration mechanism. A recently developed concept of a versatile, miniature linear accelerating module to achieve simultaneous focusing, energy selection and post-acceleration of the proton beams will be discussed. After a proof-of-principle demonstration of the technique at university-scale laser, achieving post-acceleration of ~10^8 protons by ~5 MeV over less than a cm of propagation – i.e. an accelerating gradient of ~ 0.5 GeV/m, already beyond what can be sustained by conventional accelerator technologies, the technique was recently employed at the Vulcan Petawatt, UK and Titan laser, LLNL, USA, which produced narrow band pencil beams of up to 50 MeV. Where preliminary analysis indicates a fast scaling of the post-acceleration gradient with laser power, deploying this modular device in a multi-stage scenario will open up new opportunities for the development of extremely compact and cost-effective ion accelerators for both established and innovative applications. Recent progress in the development of laser-driven neutron source will also be presented, which not only paved the way towards increasing neutron flux by improving its anisotropicity, measuring neutrons itself proved to be an extremely useful diagnostic to characterize and optimize the acceleration mechanism of their parent ions.

***Wednesday, Dec 7th 2016***

***4:00 PM (Tea/Coffee at 3:45 PM)***

***Seminar Hall, TCIS***