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Ultra high intense laser matter interaction and their applications

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A major impetus to the field of laser plasma interaction was provided by the proposals of initiating fusion reactions for viable energy production using extremely powerful laser beams. This quest still continues in the form of inertial confinement based fusion techniques, and more recently with the fast ignition scheme. In a broad perspective this talk can be described as a detailed experimental study of interconnected issues relating to the production and transport of fast particles thus generated. We demonstrate experimentally that relativistic electron flow in dense plasma can be efficiently confined and guided in targets exhibiting a core/cladding structure analogous to optical wave-guides. Collimation of electron beams of radius 50μm is achieved successfully by self-generated magnetic fields (of MGauss magnitude) at the boundary of a high resistivity core with a low resistivity cladding. This focused beam has potential to enhance the coupling efficiency of electrons to the compressed fuel in the fast ignitor fusion approach.

We also illustrate the efficient production of laser driven energetic ion beams and protons using novel targets. These high brightness, collimated, laminar beams with high-energy cutoff are useful for the development of compact ion accelerators with possible medical applications. This talk will also emphasize on the results obtained towards the application of laser driven proton beams on the areas related to proton probing of electric and magnetic fields in a plasma, cancer therapy and future experimental techniques to improve the ion beam quality and energy.