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MLL-KOLLOQUIUM für KERN- und TEILCHENPHYSIK

Donnerstag, 11.02.2010, 16^{15} Uhr

Hörsaal der LMU in Garching, Am Coulombwall 1
Treffen zum gemeinsamen Kaffee 16 Uhr

Dr. Jörg Schreiber
(Max-Planck-Institut f. Quantenoptik)

Radiation Pressure Acceleration with VULCAN-PetaWatt: Rayleigh-Taylor-Instability and Fast Plasma Shutters

The last thing one worries about on a sunny day is being driven back by the force of the sunshine. However, the radiation pressure at the surface of some exotic astrophysical objects can be sufficient to shape material flow. Similarly, the radiation pressure exerted by the most intense Petawatt (10^{15} W) laser pulses now found in the laboratory, which can now be focused to intensities I$\sim 10^{21}$ W/cm^2, can exceed 10^{12} atmospheres. However, these enormous forces are typically only exerted over the smallest dimensions ($\sim$ microns) and for the shortest of durations ($\sim$ femtoseconds). So that even at these astronomical pressures, only the very smallest targets can be driven to high energies over the short duration of the pulse. Nevertheless, because of the efficiency of this acceleration process, nanometre thickness targets are being developed, which when irradiated at such intensities may be accelerated to near relativistic velocities in fractions of a micron. A particularly attractive target material is diamond-like carbon (DLC) foils, due to its mechanical strength, and insensitivity to laser pre-pulses. In this paper, we report on the acceleration of nanometre scale DLC foils at $I > 10^{20}$ W/cm^2 for a picosecond laser pulse. We demonstrate that the acceleration of the thinnest nanometre scale foils shows bunching of ions at high energy, and evidence for a radiation driven Rayleigh-Taylor like instability. These measurements have important consequences for the radiation driven acceleration of low-mass targets.

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