Contribution ID: **2** Type: **talk**

Radiation pressure assisted acceleration of ions using multi-component foils in high-intensity laser-matter interactions

Tuesday, 4 June 2013 16:00 (25 minutes)

We report on the observation of mono-energetic features for different charge states of carbon and modulations in the proton spectra by accelerating ions out of an ultra-thin 15 nm polymer foil. For a rather low intensity of 6x10^19 W/cm2, and a very high contrast, detailed studies based on high statistics were done. Careful comparison with numerical results indicates a two-step acceleration model based on radiation-pressure acceleration (RPA) as long as the laser is interacting with the foil and a target-normal-sheath like acceleration (TNSA) of the system afterwards.
Scans on the dependence of the incident laser polarisation, the pre-plasma conditions and the target thickness were done. By varying the polarization we were able to tune the energy of the modulation. Inducing a pre-plasma by a second, counter-propagating pulse, made it feasible to decrease the thermal background spectrum and to trigger the mono-energetic features at the same time.
This experiment, at the origin of the intensity range for which RPA is predicted, gives evidence for scheduled experiments of our collaboration at other laser-systems, enabling intensities in the range of 10^21..22 W/cm2.

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Session Classification: WG2 - Ion beams from plasmas

Track Classification: WG2 Ions - Ion beams from plasmas