Laser plasma experiments featuring levitating mass limited targets

T. Ostermayr$^{1,2}$, P. Hilz$^1$, D. Haffa$^1$, J. Schreiber$^{1,2}$

$^1$ Ludwig-Maximilians-Universität, Munich, Germany
$^2$ Max-Planck-Institute of Quantum Optics, Garching, Germany

A large community investigates the interaction of relativistically intense lasers ($I > 10^{18} \text{ W/cm}^2$) with overcritical plasmas. Most experiments to date rely on foil targets of few nm to several µm thickness and large transverse dimensions compared to the laser focal spot size. In theory it is well established that laser driven ion acceleration could potentially benefit from isolated, so-called mass limited targets in a variety of scenarios [1, 2, 3]. However, since isolated targets are challenging to provide, experimental attempts are rare. We present an experimental setup which provides isolated spherical levitating mass limited targets for laser plasma experiments by means of a Paul trap. Recent experiments using our setup together with the lasers at Max-Born-Institute (MBI, Berlin) and GSI (PHELIX, Darmstadt) confirm the great potential of this target system. Especially we obtain convincing hit rates well above fifty percent, even for targets in the size range of the laser focus (few µm) or smaller.

In a follow up experiment which will take place from March-April 2014 at the Texas Petawatt facility (TPW, UT Austin) we will for the first time conduct a complete size scan of isolated spherical polymer targets with diameters ranging from 500 nm to 40 µm, aiming to identify optimum conditions for laser ion acceleration using isolated targets and boost the energies obtained at GSI even further.

References

