Ion acceleration with on-shot monitored ultra-high contrast using the DRACO Petawatt laser facility

T. Ziegler[1,2], C. Bernert[1,2], F.-E. Brack[1,2], S. Kraft[1], F. Kroll[1], J. Metzkes-Ng[1], L. Obst[1,2], M. Rehwald[1,2], H.-P. Schlenvoigt[1], U. Schramm[1,2], K. Zeil[1]

[1] *Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany*

[2] *TU Dresden, Dresden, Germany*

Laser-driven ion acceleration promises to provide a compact solution for demanding applications like particle therapy, proton radiography or inertial confinement research. Controlling the beam parameters to achieve these goals is currently pushing the frontier of laser driven particle accelerators.

We present an overview of recent achievements at the high power ultra-short pulse laser source DRACO at the HZDR in Dresden (Germany). The laser system was recently upgraded by new front end components and an additional Petawatt (PW) amplifier stage, finally providing high contrast pulses of 30J within 30fs at 1 Hz pulse repetition rate.

The performance of the plasma acceleration is strongly dependent on the complex pre-plasma formation process at the target front surface which is determined by the temporal intensity contrast. Plasma mirror setups have proven to be a valuable tool to significantly improve the temporal contrast by reducing pre-pulse intensity and steepening the rising edge of the main laser pulse. Re-collimating single plasma mirror devices have therefore been implemented into the Draco laser beam lines, enabling investigation of laser proton acceleration and proton energy scaling within the TNSA regime using ultra-thin foil targets.

The results of the simultaneously measured proton emission energies in laser forward direction, laser backward direction and the temporal contrast, measured on a single-shot base by means of self-referenced spectral interferometry with extended time excursion (SRSI-ETE) at unprecedented dynamic and temporal range, will be presented.