Investigating the influence of the picosecond leading pulse edge on ultra-intense laser heating of solids with 3D PIC simulations

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With recent improvements in plasma mirror techniques [1] achieving a reproducibly high laser contrast, systematic studies of short-pulse, ultra-high intensity laser-ion acceleration from thin foil targets (~10nm) become experimentally available [2][3]. A deeper understanding of the influence of the pre-pulse phase and ps leading pulse edge of the drive laser could lead to better control and reproducibility of ion cut-off energies which are crucial for using laser-accelerated ions in medical applications. Plasma dynamics accompanying the acceleration are highly non-linear and require precise knowledge about the influence of both ab-initio electromagnetic and atomic evolution of the plasma. Consequently, modelling these processes requires a fully kinetic high resolution treatment and extensive 2D surveys, while comparisons to experiments have shown that a quantitative prediction of proton cut-off energies and evolution of plasma instabilities demand a full 3D approach [4]. We present first results from a 3D PIC simulation campaign, modelling ultra-intense (a_0 = 20-60) laser interaction with up to micrometer thick foils covering the pico-second time span prior to the arrival of the main pulse. Simulations have been performed at the Piz Daint supercomputer at CSCS, Switzerland, using the fully-relativistic 3D3V open-source particle-in-cell code PIConGPU [5] developed at HZDR.

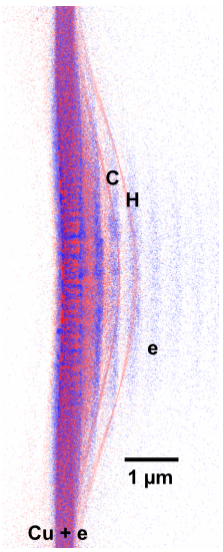

Figure 1: *Longitudinal current density component of a 300nm Cu target with organic contamination layer.*

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