Superintense laser-microplasma interactions and possible applications

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We have realized a micro-particle trap which can be operated under conditions that are relevant for studying the physics of laser-plasma interactions at highest intensities. Providing single, fully isolated, well-defined, microscopic targets represents an experimental approach which can foster understanding and help benchmarking theoretical models for the complex physics that is involved when laser pulses with intensities ranging from the ionization threshold up to peak intensities of around 10^{21} W/cm² interact with plasmas.

By investigating the proton emission from microscopic spherical targets irradiated by laser pulses at the Texas-Petawatt laser, we observe in the recorded energy distributions the transition from ambipolar plasma expansion to coulomb explosion [1]. Reproducing the experimental results by simulation requires three-dimensional treatment and fails when reducing the geometry to 2D [2], rendering the value and potential of our novel experimental tool. In addition, the isotropic emission characteristics of radiation that is typically associated with micro-targets brings forward unique features and new opportunities for their practical applicability, for example in multi-modal radiographic imaging applications with large magnification.

Near term activities of our Munich-based group comprise developing our target-technology further, which is currently in a proof-of-principle-state, to simplify implementation in collaborative experiments at large scale laser facilities and to implement it in the Petawatt-laser infrastructure at Munich's Center for Advanced Laser Applications (CALA, [3]) that will start operation in 2018.

References

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