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Relativistic laser interaction with isolated micro-plasma

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We present results of experiments with high-intensity, ultrashort laser pulses with isolated, levitating microscopic plasmas. By means of a vacuum-compatible Paul trap, polymer spheres with diameters ranging from 100 nm to 50 µm can be positioned fully isolated and with micrometer precision into the focal spot of a high power laser pulse [1].
The primary interest of experimental campaigns at the Texas-PW laser in Austin and the Phelix-PW laser at the GSI, Darmstadt concerned the angular and spectral characteristics of emitted proton bunches. Employing plasma-mirror enhanced temporal contrast enabled the first clear observation of the transition from ambi-polar plasma expansion to Coulomb explosion [2].
Pre-expansion in the low contrast case resulted in a sub-critical density plasma with micrometer dimensions, resembling target parameter conditions not accessible by other means. The PW-laser pulse in this case accelerates a dense proton bunch with small energy spread and high directionality [3].
The talk will explain the target technology and illuminate the underlying physics based on experimental evidence in concert with simulation results. Our observations encourage optimism to exploit this new technology within the Centre for Advanced Laser Applications at the research campus in Garching (Munich), which accommodates the Advanced Titanium-Sapphire LASer ATLAS3000 enabling experiments with up to 3 PW peak power.

References

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