Ultra-bright laser-driven sources of MeV particles and radiation using low density foams

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Experiments on the interaction of relativistic laser pulse with pre-ionized foam targets were carried out at the PHELIX-facility at GSI, Darmstadt. Experiments and simulations showed a strongly enhanced conversion of laser energy into energy of MeV-particles and radiation. In interaction of ~ 10^{19} W/cm^2 sub-ps laser pulses with pre-ionized foams, high-current beams of direct laser accelerated (DLA) electrons with an effective temperature up to 10× higher than the ponderomotive potential and a charge of 50-100 nC (> 7.5 MeV) were measured [1, 2]. Using foams combined with μm-thin foils or mm-thick high-Z convertors, we successfully demonstrated the generation of ultra-bright bremsstrahlung with photon energies of up to 50-60 MeV and a record-breaking conversion efficiency of 1.4% for photons > 7.5 MeV (giant dipole resonance) [2, 3]; record efficiency of neutron production in gamma-driven nuclear reactions [3]; superintense betatron radiation [4, 5], and strongly enhanced proton acceleration.

The DLA process proves to be very robust and can be used to generate ultra-bright laser-driven sources of particles and photons with energies of tens of MeV already at moderate relativistic laser intensity, which is typical for large kJ-class PW laser facilities, used in ICF research.

References:

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