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Boosted MeV-gamma and particle generation in short pulsed laser interaction with long-scaled NCD plasma of aerogel foam targets

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Ultra-high intense gamma and secondary particle beams are indispensable tools in many research fields like nuclear, atomic and material science as well as in biophysical and medical applications.
Providing ultra-high intense and ultra-short pulsed beams, laser-driven relativistic electron beams are excellent tools for the generation of MeV gammas, protons and neutrons.
We report on enhanced laser-driven electron beam generation in the multi-MeV energy range that promises a tremendous increase of applicability.
Here, it is presented a novel concept for the efficient generation of gamma and neutron beams based on relativistic laser interactions with a long-scale near critical density plasma at moderate relativistic laser intensities.
The basis is a target system with CH aerogel foam of sub-mm thickness and a volume density of 2 mg/cm^3.
New experimental insights in laser-driven generation of ultra-intense well-directed multi-MeV beams of photons with fluences of >10^{12} ph/sr above 10 MeV and an ultra-high intense neutron source with 6×10^{10} neutrons per shot are presented. We observed high conversion efficiencies of laser energy to MeV-gammas (1.4%—2% above 10MeV) and neutrons (0.05% at 0.5—1MeV) already at moderate relativistic laser intensities.
These new insights of laser-driven ultra-intense gamma and neutron sources show a high capability for providing applicable beams in nuclear astrophysical research as well as in nuclear photonics applications. In addition, it promises a strong boost of the diagnostic potential of existing kJ PW laser systems used for ICF research.

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