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Experimental results on all optical Compton source with GeV photon at ELI-NP

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The Compton scattering between a GeV electron beam and a relativistic laser pulse is a promising scheme for studies including radiation reaction in strong-field quantum electrodynamics (QED), in-suit laser intensity measurement, and brilliant gamma-ray generation. Instead of using the routine method with an individual scattering laser, we applied the self-aligned single-laser Compton scattering setup at the ELI-NP and Apollon multi-PW laser facilities. GeV photons were measured after the Compton scattering of a 2- to 5-GeV electron beam and a laser pulse reflected by a plasma mirror with a_0 of the order of 5, corresponding to a quantum nonlinearity parameter of $\chi \approx 0.3$. Benefiting from the automatic alignment and synchronization provided by the plasma mirror, nonlinear Compton scattering was probed with a collision success rate of approximately 100%, free from the misalignment errors and fluctuations of usual multibeam approaches. The distance between the gas nozzle and the plasma mirror was scanned to investigate the dependence of photon energy, photon divergence, and change of electron divergence during scattering on the laser intensity. The dynamics of electrons passing through the overlapped region of the forward and the reflected laser pulses were also explored with the help of PIC simulations.

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