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We have demonstrated the amplification and subsequent recompression of optical chirped pulses [1]. We report here a demonstration of laser intensity exceeding $10^{29} W/cm^{2}$. We obtained nearly diffraction-limited focusing with a spot size of $1.1 μm$ (FWHM). From the measurement of 1000 consecutive laser shots, a peak intensity of $\left(1.1\pm 0.2\right)×10^{29} W/cm^{2}$ was achieved [2]. Generation of strong gamma rays via nonlinear Compton scattering has been a fascinating topic in ultra-intense laser physics both as a manifestation of strong-field quantum electrodynamic processes and as a potential mechanism for intense gamma ray sources. In this regard, we propose a scheme based on double-layer targets for efficiently realizing nonlinear Compton scattering and thus generating strong gamma rays [1]. In this scheme, an ultra-intense laser pulse propagates through a near-critical-density layer, becoming stronger by relativistic self-focusing and accelerating copious ambient electrons by direct laser acceleration mechanism [2], as shown in Fig. 1. Then the laser pulse is reflected by a solid-density layer and collides with the accelerated electrons, resulting in a strong nonlinear Compton scattering. From 3D simulations with a particle-in-cell code including strong-field quantum electrodynamics modules [3], we found that 2.6×1012 gamma-ray photons (energy > 1 MeV) can be generated with a 28-fs laser pulse with a peak intensity of 5.3×1021 W/cm2, achieving a conversion efficiency of 10-2. Furthermore, using high-energy particle simulations with a standard code [4], we present an analysis of the pair creation by such strong gamma rays via Bethe-Heitler process.



Figure 1: Schematic diagram.

References

[1] D. Strickland and G. Mourou, Opt. Comm. 55, 447 (1985). "Apply PP\_Bold in Style to the volume number to make it bold".

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[3] <http://geant4.web.cern.ch/>