High-quality gamma-rays driven by petawatt laser pulse in near-critical density plasmas

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The nonlinear synchrotron radiation of direct laser-accelerated electrons in near-critical density (NCD) plasmas recently has been proposed as a very efficient scheme to produce multi-MeV gamma-rays [1]. In this presentation, we demonstrate that by employing a plasma density channel, the divergence angle and transverse size of the gamma-rays can be much reduced [2]. In addition, we propose a highly efficient gamma photon emitter obtained by irradiating a not-so-intense laser pulse on a miniature plasma device consisting of a plasma lens and a plasma mirror [3]. In this novel scheme, brilliant gamma-rays with very high conversion efficiency (higher than 1%) and spectral intensity (higher than 10^9 photons/0.1%BW/s) can be achieved by employing currently available lasers with intensity of 10^{21} W/cm^2. The practical effects of different nanostructures in the plasma lens and the oblique laser incidence are also discussed in this scheme [4]. At last, a novel scheme by exploiting an intense Laguerre Gaussian laser pulse interacting with under-dense plasmas is also proposed to produce helical gamma-rays with very small divergence angle (less than 5^o) and ultra-high brilliance (~10^{24} photons/s/mm^2/mrad^2/0.1%BW) at a laser intensity of 10^{22} W/cm^2 [5]. Such high-quality gamma-rays generated in these schemes would find applications in wide-ranging areas.

References

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