Giant collimated gamma-ray flashes

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Powerful gamma-ray emissions are ubiquitous in astrophysics, from active galactic nuclei [1] to pulsars [2] and neutron star mergers [3]. One of the key mechanisms leading to powerful gamma-ray emissions is thought to be the interaction of ultrarelativistic particle beams with a surrounding plasma environment, which was experimentally shown to lead to the formation of filaments [4] with the self-generation of $\sim 10^4$ gauss and long-lived magnetic fields [5]. Here we show that the filamentation of a high-density and ultrarelativistic electron beam in a high-density plasma background leads to the generation of 10^7-10^8 gauss magnetic fields with the emission of a very bright and collimated gamma-ray flash [6]. In addition to their intrinsic interest, these findings pave the way to new routes for reproducing astrophysical phenomena in the laboratory [7], and to novel investigations in strong-field QED and nuclear physics such as the interaction between real photons in vacuum [8].

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