Numerical simulation of cascading in super-intense laser fields

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In the focus of ultra-strong laser fields cascades of electrons, positrons, and photons can be triggered from a few seeding electrons, positrons, or photons. The process is called cascading when the number of newly generated particles exceeds the number of seed particles the laser is interacting with. The strength of quantum effects is essentially controlled by the two quantum efficiency parameters χ_e and χ_γ. Depending on the magnitude of the latter for the external radiation field and seed particle energy substantial pair production and radiation can be expected.

Under certain conditions the newly produced pairs cannot escape from the focus of the laser field. They are trapped by a process of repetitive energy gain from the laser field and energy loss due to photon emission thus providing a path for the conversion of laser field energy into radiation. Hence, depending on the parameters cascading can lead to substantial energy loss of the driving laser field [1].

We present a number of 3D simulations of cascading from a nano foil irradiated from its front and back sides by ultra-intense ($a \approx 10^4$) circular laser beams in a regime of strong nonlinear feedback between the created plasma and the laser field. The large number of initial seed electrons in the foil leads to efficient pair production and hard radial photon emission while the laser is depleted at the same time. In addition we investigate the relaxation of the pair plasma after the laser has been turned of on the basis of our model [1].

Due to the complexity of the interaction a new simulation code has been employed. Details of the simulation code are given by Kai Germaschewski.

[1] N. Elkina, H. Ruhl *et al.*, Phys. Rev. ST Accel. Beams 14, 054401 (2011)