Relativistic positron beam generation by laser-plasma interaction

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High power laser facilities have been developed greatly in decades and the intensities are approaching $10^{23-24}$ W/cm\textsuperscript{2} nowadays. In the laser-plasma interaction with such a high intensity, the radiation reaction and gamma photon emission must be considered. The effects of quantum electrodynamics (QED) are significant when the emitted photon momentum becomes comparable to the momentum of the emitting electron. In this work, we propose a regime of ultra-short relativistic positron beam generation by the ultra-high intensity laser-plasma interaction\textsuperscript{1}. A bunch of electrons are self-injected into the laser pulse in longitudinal direction due to the balance between electrostatic force and the laser ponderomotive force. These electrons can be confined in the laser pulse for a long time while emitting high energy gamma photons. The corresponding photons are counter-propagating through the strong laser field which provide a high probability for pair creation. Relativistic and well collimated positron beams are obtained. This regime may be beneficial for the potential experiments carried on the large laser facilities such as ELI-beamlines\textsuperscript{2}.

References
