TRANSPORT OF LASER-DRIVEN GAMMA-RAYS IN ULTRA-INTENSE LASER-MATTER INTERACTIONS

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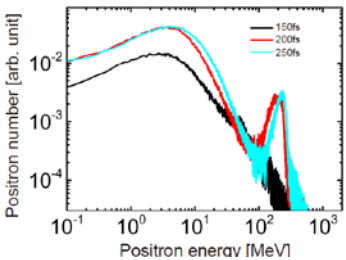
Increasing of the focused laser intensity has opened new research areas such as high energy density physics. In the regime where the radiation reaction effect plays an important role, the electron motion in the laser field becomes dissipative. This results in the decrease of the maximum energy of electrons [1]. By paying attention to the energy dissipation, it is proposed that high energy photons can be effectively generated when the laser and plasma parameters are properly chosen, which shows the possibility of high power gamma-ray source [2, 3]. When the laser energy is effectively converted to the high energy photons, it is important to understand the energy transport inside of the target by these photons. For this purpose, we have developed a Particle-in-Cell (PIC) code which includes the transport processes of gamma-rays.

In the present simulation code, we treated the photons as macro-particles same as charged particles in PIC codes. Photons are generated by sampling the photon energy spectrum evaluated from the Synchrotron radiation spectrum. Here, low energy photons with energies less than tens of keV are neglected in photon generation processes, since we are interested in energy transports of high energy photons. The generated photons propagate inside of the target interacting with atoms and nucleus. We included interaction processes such as Compton scattering, electron-positron pair creation via nucleus electric field, and photo-nuclear reactions. The code is checked with the particle transport code PHITS [4]

We investigated the ultra-intense laser-matter interaction using the developed code. The figure shows the energy spectra of positrons generated via electron-positron pair creation by gamma-ray interaction with nuclear electric field. The black line shows the energy spectrum at the timing of pair-creation is occurring. After their generation, high energy component are further accelerated by the sheath field and quasi mono-energetic positions are emitted from the rear surface (shown in red and blue lines). The detail of simulations condition and characteristics of positions will be discussed at the presentation.



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