# On the synergic approach toward experimental realization of interesting fundamental science through the laser plasma interaction

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Over the last two decades, tremendous advances have been made in the femtosecond (fs) high-power laser development, experimental and theoretical studies in the relativistic laser-plasma interaction [1-3]. A next step to a higher power laser (ranging 10 – 100 PW) is under way [4] for the study on fundamental science including photonuclear physics [5], laboratory astrophysics [6], strong-field quantum electrodynamics (SF-QED) [7], and so on. Apparently, the field strength itself formed by such a high-power laser is not yet strong enough compared to the critical field strength (~$1.3\times10^{16}$ V/cm) [8] for the quantum electrodynamics study. However, the secondary sources, energetic charged particles and high energy photons produced by the high-power laser, can plays a key role in the study of fundamental science through the quantum nonlinearity parameter [9].

Interesting ideas and schemes have been proposed in [5,10] and references therein to realize the experimental approach to the fundamental science via all optical approach. Among them is the γ-photon generation with a high conversion efficiency. According to recent theoretical research [11], the fs high-power laser can produce γ-photons with a very high conversion efficiency (~ 50%) from solid target material. The radioactive nuclei production and electron-positron pair production by irradiating γ-photons and following energetic particles to high-Z material has been discussed in [5]. In this presentation, we discuss the laser parameters for the efficient generation of γ-photons, spectral characteristics of the γ-photon with angular distribution. The high energy γ-photons generated collide another high-power laser pulse for electron-positron pair production from vacuum through the multi-photon Breit-Wheeler process.

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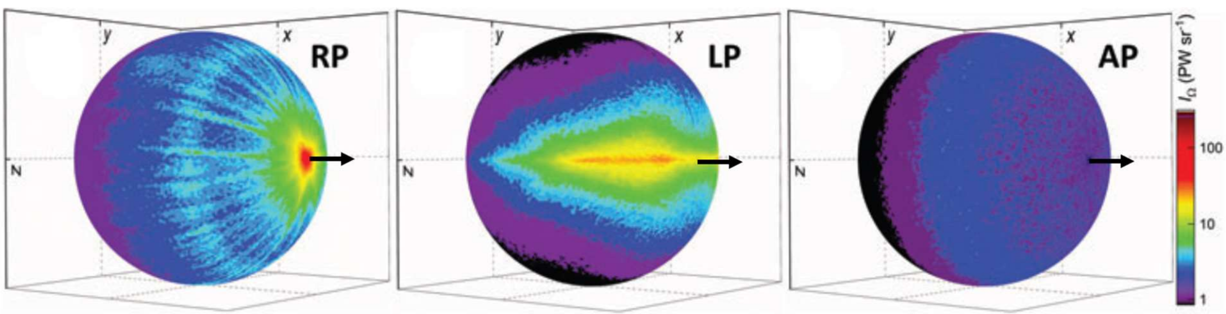


Figure 1. Intensity map of γ-photons from a solid target irradiated by a 80 PW single-cycle laser pulse in the $\lambda^3$ regime. RP: radially-polarized laser pulse, LP: linearly-polarized laser pulse, and AP: azimuthally-polarized laser pulse. Black arrows in the figure denote the laser propagation direction.