Structured Extreme Field Driven Compton Scattering and QED Exploration

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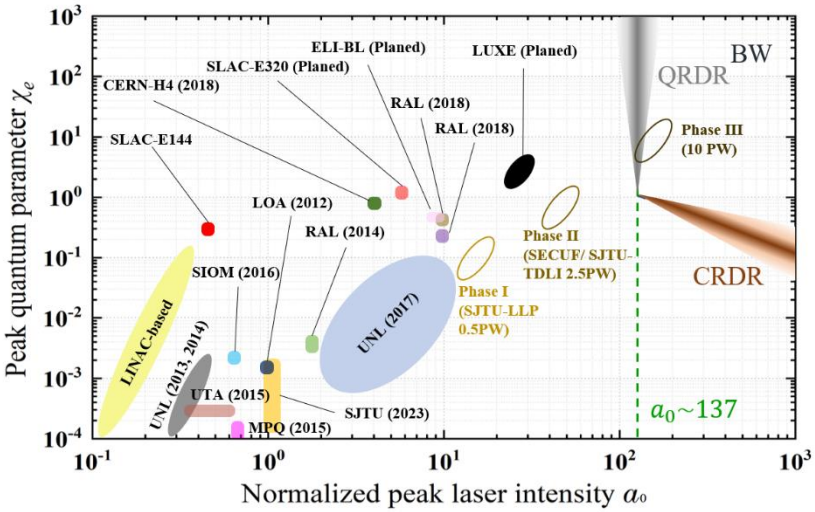
The theory of Quantum electrodynamics (QED) is considered to be the most precise theory for electromagnet field. With the development of high-power laser technology, the experimental verification of strong field QED is possible. All-optical Compton scattering with dual-beam high-power femtosecond laser is one of the best testbed to study SFQED.

A dual-beam platform for all-optical electron-photon scattering, or Thomson/Compton scattering, with adjustable collision-angle and parameter tuning ability has been developed. In principle, it can be used for the verification of strong-field quantum electrodynamics (SFQED) effects via nonlinear Compton scattering. Combining this platform with a PW Ti:Sapphire laser system, we demonstrated the generation of inverse Compton scattering X/gamma-rays with tunable energies from tens of keV to tens of MeV. The polarization of X/gamma radiation was shown to be controlled by manipulating the polarization of scattering beam. In the near future, by combining this experimental platform with multi-PW laser facilities, it is proposed to experimentally generate X/gamma radiation with orbital angular momentum for the nuclear isomer excitation, more importantly, to explore the regime transition from nonlinear Thomson scattering to nonlinear Compton scattering and eventually verification of theories at extremely strong field quantum electrodynamics effects. Also, preliminary plan of SFQED study in two high-power laser facilities, 0.5PW in SJTU and 2.5PW in TDLI will be presented, both of the lasers include two independently compressed two beam lines.



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