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Laser-electron colliding at extreme light intensities

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Ultra-intense laser pulses colliding with high energy electrons is not only an important source for high-brightness gamma-rays but also a powerful approach to exploit new physics in the exotic strong-field QED regime. In the cross-colliding geometry, we found that when radiation-reaction (RR) force is interpreted by the classical Landau-Lifschitz equation, an energetic electron transmitting through the laser beam can be reflected due to the radiation in the laser field. There is an intensity threshold beyond which the classical RR barrier cannot be overcome for electrons of arbitrarily high initial momenta. This barrier, however, can be tunnelled when the process is described by QED approach. The quantum nature of gamma-photon emission during colliding allows for electron penetration by a certain amount of possibility. This effect becomes significant for laser intensities at 10^{23} W/cm^2 and electron energies of 150 MeV; thus could be measured in 10-100 PW laser facilities. By detecting the transmitting rate of the energetic electron beam after colliding, the results are capable of identifying the boundaries between classical and QED approaches in the strong field regime and testifying the various models describing the fundamental process. In addition, a novel set-up that can realize the colliding between high energy electrons and intense lasers based on one single multi-PW laser is proposed. It utilizes a micro-structure target to accelerate electrons and a reflecting mirror to enable automatic collision. The idea will allow the verification of the radiation-reaction effect and serve as an efficient source of bright gamma-rays. The proof-of-principle experiment on enhancing electron acceleration at relativistic intensities was accomplished, which would set the basis for up-coming experiments at higher laser intensities.

References

1. "Quantum tunneling of the classical radiation-reaction barrier in the QED regime", submitted.
2. "Towards manipulating relativistic laser pulses with micro-tube plasma lenses", Sci. Rep. 6, 23256 (2016).
3. "Microengineering Laser Plasma Interactions at Relativistic Intensities", Phys. Rev. Lett. 116, 085002 (2016)
4. "Radiation-Reaction Trapping of Electrons in Extreme Laser Fields", Phys.Rev.Lett. 112, 145003 (2014).

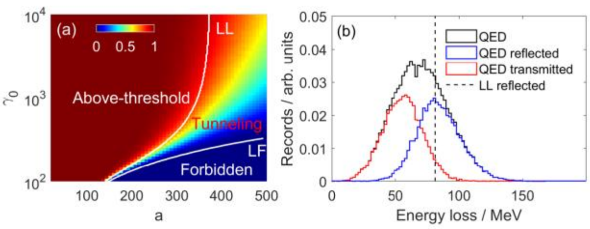

Figure 1. The tunneling region is bounded by the threshold calculated from the classical picture denoted by LL and LF a) and the radiated energy in the QED calculation b)

Note: Abstract should be in 1 page.