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Testing Quantum Electrodynamics at critical background electromagnetic fields

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Quantum Electrodynamics (QED) is a well established theory and its predictions have been successfully confirmed experimentally in different regimes. However, there are still areas of QED that deserve theoretical and experimental investigation, especially when processes occur in the presence of electromagnetic background fields of the order of the so-called critical fields of QED [1]. Highly-charged ions, like lead or uranium, already provide electric fields of the order of the critical electric field of QED ($\sim 10^{16}$ V/cm) at distances from the ion of the order of the Compton wavelength ($\sim 10^{-11}$ cm). On the other hand, in view of the increasingly stronger available laser fields it is becoming feasible also to employ them to test QED under the extreme conditions supplied by ultra-intense fields [1]. In the presence of incoming particles (like electrons, positrons or photons) with energies much larger than the electron rest energy, the laser field amplitude can be effectively boosted to the critical value. Thus, the interplay between the strong field provided by a highlycharged ion and by an ultra-intense laser beam has been investigated in the process of electron-positron photo-production (Bethe-Heitler process) [2]. It has been shown that, unexpectedly, the presence of the laser field strongly suppresses the Bethe-Heitler cross section, an effect analogous to the well-known Landau-Pomeranchuk-Migdal effect.

[1] A. Di Piazza, C. Müller, K. Z. Hatsagortsyan, and C. H. Keitel, *Rev. Mod. Phys.* 84, 1177 (2012).

[2] A. Di Piazza and A. I. Milstein, *Phys. Lett. B* 717, 224 (2012); *ibid.*, *Phys. Rev. A* 89, 062114 (2014).

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