

# Production of QED bound states in photon induced processes

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One interesting subject of the QED are the lepton –antilepton bound states, which are atom –like systems. These systems are ideal to test the ground of QED, once they allow us to test the CPT invariance of the theory, as demonstrated by several authors. Besides that, recent studies point out that these QED bound states can be sensitive to Beyond Standard Model Physics. Currently, we can study the QED bound states in photon induced processes present in heavy ion collisions at the Large Hadron Collider (LHC) and Relativistic Heavy Ion Collider (RHIC). The advantage of these collisions is the strong electromagnetic field produced by heavy ions, which are associated with photon fluxes proportional to  $Z^2$ , leading to large production rates for bound states. In this work we investigate the photoproduction of QED bound states in proton –proton, proton – nucleus and nucleus –nucleus ultraperipheral collisions at RHIC, LHC and FCC energies. We estimate the total cross sections and rapidity distributions for the production of singlet states  $(l^+l^-)_S$  with  $l = e, \mu, \tau$ , considering different form factors for heavy nucleus. The impact of the Coulomb corrections on the  $(e^+e^-)_S$  production in heavy ion collisions is estimated. We predict a large number of events associated to the production of the parapositronium and paramuonium states, which indicate that a future experimental analysis of these states is, in principle, feasible in hadronic collisions.

**Auteurs principaux:** FRANCENER, Reinaldo (Universidade do Estado de Santa Catarina); Dr MOREIRA, Bruno Duarte (Universidade do Estado de Santa Catarina); GONCALVES, Victor (Universidade Federal de Pelotas)

**Orateur:** FRANCENER, Reinaldo (Universidade do Estado de Santa Catarina)

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