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Testing Bound State QED in Strong Fields with Kaonic Atoms

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Quantum Electrodynamics (QED) is the most accurate theory describing the interaction between photons and charged particles. Despite its predictive success, such as the 2p–1s transition in hydrogen, further tests in bound atomic systems are required because the perturbative expansion in (⊠Z) fails to converge for intermediate and high atomic numbers. Exotic atoms offer a clean system for testing bound-state QED (BSQED) under these conditions, as demonstrated recently with muons at J-PARC and proposed with the PAX experiment at CERN. Here, we present how such tests can be performed with kaonic atoms through experiments conducted at the National Laboratories of Frascati (INFN) within the SIDDHARTA-2 experiment. Starting from the case of kaonic neon, where QED contributions exceed the overall experimental uncertainty, we examine how this result is affected by model uncertainties such as electron screening effects and the uncertainty in the kaon mass. Finally, we consider the case of kaonic fluorine, which allows the study of QED under strong field transitions, and discuss how these studies can be extended to other elements. These results show that kaonic atoms provide a robust platform to investigate both Quantum Chromodynamics and QED.

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