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LeRoy Apker Award Talk: Applying the Standard-Model Extension to hydrogen

THEODORE YODER, Franklin and Marshall College

Theoretical generalizations of the standard model serve to guide experiments toward potential observations of non-standard phenomena. The standard model extension (SME), for instance, generalizes the standard model to incorporate Lorentz and CPT violation through additional terms in the SME Lagrangian, each controlled in strength by an SME parameter. I will discuss the corrections that the SME makes to the spectrum of free hydrogen, calculated completely to order SME$\cdot\alpha^2$ for the first time. This reveals exactly what combinations of SME parameters may be detected through measurement of hydrogen transitions. Of particular interest is the 2S–1S transition, whose first nonzero correction appears at order SME$\cdot\alpha^2$. The calculation is motivated by the extensive study, both theoretical and experimental, of hydrogen as an exemplary quantum system. Additionally, precision experiments on hydrogen provide some of the best chances of detecting any minute violations of the Lorentz and CPT symmetries in the universe.