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Precision physics with few electron atoms and molecules

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In the light of the proton charge radius discrepancy [1] and possible existence of extra forces between leptons and hadrons, we search for discrepancies in the spectra of few electron atoms and molecules by comparison of the experimental values with the high accuracy calculations. As a result we observed several unexplained discrepancies, such as in the determination of ^{3}He charge radius from different atomic transitions [2], anomalies in the magnetization distribution of ^{6}Li nuclei [3], and set bounds on existence of the fifth force from the vibrational spectra of the H_2 molecule [4]. Further development of precision tests is currently limited by difficulties in the incorporation of higher order quantum electrodynamics effects in few electron systems. I will describe the recent progress in high precision calculations of atomic energy levels and point out limitations in the current theoretical approaches to the bound state quantum electrodynamics.

[1] R. Pohl, R. Gilman, G.A. Miller and K. Pachucki, Annu. Rev. Nucl. Part. Sci. **63**, 175 (2013).
[2] P. Cancio Pastor, L. Consolino,P. De Natale, M. Inguscio, V. A. Yerokhin, and K. Pachucki, Phys. Rev. Lett. **108**, 143001 (2012).
[3] M. Puchalski and K. Pachucki, Phys. Rev. Lett. **111**, 243001 (2013).
[4] E.J. Salumbides, J.C.J. Koelemeij, J. Komasa, K. Pachucki, K.S.E. Eikema, and W. Ubachs, Phys. Rev. D **87**, 112008 (2013).