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The hyperfine anomaly and precision atomic searches for new physics

I will discuss the hyperfine anomaly, and its relevance to tests of the standard model and searches for new physics in precision atomic experiments. I will focus on several of our recent works on the topic [1,2,3]. The hyperfine anomaly gives the finite-nuclear-size contribution to the hyperfine structure, and is difficult to quantify at the required level of accuracy from nuclear structure theory. I will describe how —through a combination of atomic theory and atomic and nuclear experiments —the hyperfine anomaly may be determined. An accurate understanding of this effect is needed for reliable tests of atomic structure theory in the nuclear region, and for the development of precision atomic many-body methods. This is important for the error analysis of atomic parity violation stud- ies, and for maximising the impact on particle physics discovery.

References
[1] J. S. M. Ginges and V. A. Volotka, "Testing atomic wave functions in the nuclear vicinity: The hyperfine structure with empirically deduced nuclear and quantum electrodynamic effects,"Phys. Rev. A, vol. 98, 032504, 2018.
[2] B. M. Roberts and J. S. M. Ginges, "Nuclear magnetic moments of francium-207-213 from precision hyperfine com- parisons,"Phys. Rev. Lett, vol. 125, 063002, 2020.
[3] G. Sanamyan, B. M. Roberts, and J. S. M. Ginges, "Empirical determination of the Bohr-Weisskopf effect in cesium and improved tests of precision atomic theory in searches for new physics,"Phys. Rev. Lett., vol. 130, 053001, 2023.

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