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Magnetic Dipole and Electric Quadrupole Moments of the ^{229}Th Nucleus M.S. SAFRONOVA, University of Delaware, U.I. SAFRONOVA, University of Nevada, Reno, A.G. RADNAEV, C.J. CAMPBELL, KLA-Tencor, A. KUZMICH, University of Michigan, Ann Arbor — The electromagnetic nuclear moments are fundamental quantities that play an important role in many atomic, nuclear, and solid state processes. While nuclear magnetic moments are known well for many nuclei, many quadrupole moments are known poorly, due to lack of either direct measurements or accurate theoretical values of hyperfine constants B/Q for atomic spectroscopy methods. We report a new method for determining the accuracy of theoretical hyperfine constants B/Q and demonstrate that it can be used to extract the electric quadrupole moment Q with 1-2% uncertainty for a large number of nuclei. We determine the magnetic dipole $\mu = 0.360(7)\ \mu_N$ and the electric quadrupole $Q = 3.11(6)\ e$b moments of the ^{229}Th nucleus by combining our high-precision calculations of the hyperfine constants with measurements reported in C. J. Campbell *et al.*, Phys. Rev. Lett. **106**, 223001 (2011). We find that the previous value $\mu = 0.46(4)\ \mu_N$ [S. Gerstenkorn *et al.*, J. Phys. 35, 483 (1974)] is incorrect by 25%. The prospects for further accuracy improvements of ^{229}Th nuclear moment and possible extraction of the $^{229}Th^{3+}$ nuclear magnetic octupole moment are discussed.

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