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Atomic laser spectroscopic determination of lithium nuclear charge radii

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High resolution laser spectroscopic measurements of transition frequencies, isotope shifts etc. are now at a level that they are sensitive to the charge radius of the nucleus. Hence, the recent interest in the discrepancies in the determination of the proton charge radius. A number of experiments have employed novel spectroscopic techniques to measure isotope shifts for several transitions at optical frequencies for the stable and radioactive lithium isotopes. These data offer an important test of theoretical techniques developed by several groups to accurately calculate QED effects and the finite nuclear size in 2 and 3 electron atoms. Theory and experiment have studied several transitions in both Li^+ and neutral lithium. The work by multiple groups permits a critical examination of the consistency of separately, the experimental work as well as theory. Combining measured isotope shifts with calculated energy shifts passing these consistency tests, permits the determination of the relative nuclear charge radius with an uncertainty approaching $1x10^{-18}$ meter. These results are about two orders of magnitude more accurate than those obtained by electron scattering experiments and give insight into the mass and charge distributions of the nuclear constituents.

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