ATOMIC PROBES OF ELECTROMAGNETIC AND WEAK INTERACTIONS WITH TRAPPED RADIOACTIVE ATOMS*

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The alkali element francium has a simple electronic structure, and copious amounts of a wide range of isotopes can be produced in present and future rare isotope facilities. Atomic trapping methods now offer new ways to study these atoms with precision, and we will discuss some of our recent measurements with trapped Fr atoms. Future measurements of the spin independent weak interaction can be used to test the Standard Model, but advances in atomic theory and improved understanding of the neutron distribution in nuclei are needed to make progress. We have made precise hyperfine anomaly measurements in Fr and have shown that they have some sensitivity to the radial distribution of the neutron magnetization. Measurements of this type can help to constrain the neutron distributions.

The anapole moment of a nucleus is a parity non-conserving (PNC), time reversal conserving moment that arises from weak interactions between the nucleons. It can only be detected in a PNC electron-nucleus interaction. We are studying the earlier suggestion[1] of directly measuring the probability of E1 transitions between the ground hyperfine states of an atom, allowed only through the anapole moment, with the present possibilities of atom manipulation. The light Fr isotopes, five of them available at the Stony Brook superconducting LINAC, form a suitable system in which to study nuclear anapole moments since the shell model provides a good description of the nuclear structure. Future measurements of the nuclear anapole moments for a sequence of isotopes should allow separation of the neutron and proton weak interaction between hadrons.

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[1] C.E. Loving, and P.G.H. Sandars, J. Phys. B**10**, 2755 (1977); V.G. Gorshkov, V.F. Ezhov,M.G. Kozlov, and A.I. Mikhailov, Sov. J. Nucl. Phys **48**, 867 (1988)