

A Precision Measurement of the Neutron Radius in ^{208}Pb

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October 2009

Abstract

The upcoming ^{208}Pb Radius Experiment (PREx) at Jefferson Lab's Hall A will determine the neutron radius R_n of Lead with $\pm 1\%$ projected precision. The experiment will measure the parity-violating electroweak asymmetry in the elastic scattering of polarized electrons from ^{208}Pb at an energy of 1.05 GeV and scattering angle of 5° . In this way, the neutrons are isolated by the weak charge probe and thus allow for a model independent measurement of R_n analogous to the classic measurements of the proton radius R_p . The theoretical corrections to the measured asymmetry are either small or well understood providing a clean extraction of the neutron form factor and charge density. In addition to being a fundamental test of nuclear theory, a precise measurement of R_n pins down the density dependence of the symmetry energy of neutron rich nuclear matter which has impacts on neutron star structure, heavy ion collisions, and atomic parity violation experiments.