ABSTRACT

The difference between the neutron radius $R_n$ of a heavy nucleus and the proton radius $R_p$ is believed to be on the order of several percent. This qualitative feature of nuclei, which is essentially a neutron skin, has proven to be elusive to pin down experimentally in a rigorous fashion. We propose to measure the parity-violating electroweak asymmetry in the elastic scattering of polarized electrons from $^{208}$Pb at an energy of 850 MeV and a scattering angle of 6°. Since the $Z_0$ boson couples mainly to neutrons, this asymmetry provides a measure of the size of $R_n$ with respect to $R_p$ that can be interpreted with as much confidence as traditional electron scattering data. The projected experimental precision corresponds to a ±1% determination of $R_n$, sufficient to establish the existence of the neutron skin if it is of the expected size.