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Electron-Proton Parity Violation & the Qweak Experiment

LARRY LEE, University of Manitoba/TRIUMF

The "weak charge" of the proton (Q^P_{weak}) is the neutral current (weak interaction) analog of the proton's electric charge. It is both precisely predicted and suppressed in the Standard Model, making this an ideal observable to use in searches for "new physics," beyond the Standard Model. By measuring parity violation in the scattering of longitudinally polarized electrons from liquid hydrogen, the Qweak experiment can measure the weak charge of the proton, as "seen" by the Z-boson. This measured weak charge is "screened" by clouds of virtual particles in the vacuum, so by taking into account all "known" particles, Standard Model calculations attempt to make firm predictions for what our result should be. Nature, on the other hand, will use all particles, including ones not yet discovered, so a discrepancy between our measurement and the Standard Model prediction would be a sign of new physics. At our predicted accuracy, a $\pm$ 4% measurement of Q^P_{weak}, we could see the effects of new physics at the TeV scale. The Qweak experiment, which was carried out in Hall C at the Thomas Jefferson National Accelerator Facility, has completed data-taking and is currently in the analysis phase.