A Search for New Physics via the Proton Weak-Charge Measurement

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Recent and proposed precision experiments to study the running of the weak mixing angle with energy scale have sensitivity to new physics beyond the Standard Model of electroweak interactions. Two fundamental observables are the weak charge of the proton and the weak charge of the electron measured in the scattering of polarized electrons from protons and electrons, respectively. Depending on the accuracy reached in these measurements, the discovery potential is for new particles well in the TeV range. Any new particles will be reflected indirectly in the deviation of the experimental result from the 'running' of the weak coupling in the Standard Model. The low energy measurements can establish detail about any new particles which are observed in high energy collisions at the Large Hadron Collider .

The "Qweak Experiment", currently under construction, is Jefferson Laboratory's contribution to this program. The experiment will provide the first precision measurement of the proton's weak charge, $Q^{p}_{Weak} = 1 - 4\sin^2\theta_W$ and will constitute one of the most rigorous tests of the Standard Model at low Q^2. The Standard Model makes a firm prediction of the proton's weak charge, based on the running of the weak mixing angle from the Z^0 pole down to low energies, corresponding to a 10 sigma effect in our experiment. The required hadronic corrections have now been precisely determined from recently completed strange quark search parity violation measurements. Prospects for a future ultra precise Moeller parity violation Q^{e}_{Weak} measurement at 12 GeV will be discussed in addition to the recent results from the SLAC E158 Moeller parity measurement. Anticipated results from these next generation experiments will be compared to the existing measurements of lower precision.