APR08-2008-001196

Abstract for an Invited Paper
for the APR08 Meeting of
the American Physical Society

Precision measurement of the weak charges of quarks

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The Standard Model has been enormously successful at predicting the outcomes of experiments in nuclear and particle physics. The search for new physical phenomena and a fundamental description of nature which goes beyond the Standard Model is driven by two complementary experimental strategies. The first is to build increasingly energetic colliders, such as the Large Hadron Collider (LHC) at CERN, which aim to excite matter into a new form. The second, more subtle approach is to perform precision measurements at moderate energies, where an observed discrepancy with the Standard Model will reveal the signature of these new forms of matter. Here we use precision parity-violating electron scattering measurements on nuclear targets to extract the weak charges of the quarks. The result is found to be in excellent agreement with the predictions of the Standard Model. Combining this result with earlier measurements of the low-energy weak force, most notably data on parity violation in atomic cesium, lifts the relevant energy scale for physics beyond the Standard Model to almost 1 TeV.