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The results from the Q-weak experiment measurement of the parity-violating electron-proton scattering

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The results of the Q-weak experiment at the Thomas Jefferson National Accelerator Facility are presented. The experiment performed the most precise measurement of the parity-violating electron-proton scattering asymmetry at low momentum transfer, resulting in the first direct determination of the weak charge of the proton (a weak force analog to the electric charge for the electromagnetic force) and the most precise value of the weak mixing (Weinberg) angle, for the first time measured in a semi-leptonic reaction. Since the weak mixing angle is precisely predicted by the Standard model, these results provide new constraints on classes of physics beyond the Standard Model and are complementary to direct searches in the high energy measurements. The requirements of this precise measurement posed technical challenges resulting in the design of a custom apparatus consisting of a triple collimator system, a resistive copper-coil toroidal magnet and eight fused silica Cherenkov detectors, the world's highest power liquid hydrogen target, precision control of helicity-correlated beam properties and beam polarimetry. The detector array absorbed a scattered electron rate of about 7 GHz read out in integrating mode by custom-built modules. Dedicated low-current measurements were undertaken to determine the momentum transfer using sets of drift chambers before and after the toroidal magnet. The technical aspect of the Q-weak experiment will also be presented.

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