

Measurement of the weak charge of the proton: Qweak at Jefferson Lab

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The Standard Model makes a definite prediction for the neutral weak charge of the proton; deviation from this value would be a signature of physics beyond the Standard Model.

The Qweak experiment has determined the weak charge of the proton by measuring the parity-violating asymmetry in elastic e-p scattering at $Q^2 = 0.03 \text{ (GeV/c)}^2$ with a total precision of less than 10 ppb.

The experiment was carried out in Hall C of Jefferson Laboratory in the period 2010-2012, using longitudinally-polarized electrons of energy 1.16 GeV, a 35 cm long liquid hydrogen target, and custom detector apparatus.

This determination of the proton's weak charge may be used to determine the running of the weak mixing angle, $\sin^2 \theta_W$, to low Q^2 with a relative error of about a half percent.

Further, in combination with measurements from atomic parity violation, this measurement imposes a strong constraint on the values of the vector weak charges of the u and d quarks, C_{1u} and C_{1d} .

The final results of Qweak will be presented, along with a discussion of the new constraints imposed by these results on additional parity-violating physics beyond the Standard Model.

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