We describe a new experiment at Jefferson Lab to make a precision measurement of the weak charge of the proton. This experiment would constitute the first SM test at Jefferson Lab. To lowest order, the weak charge can be expressed as $Q_w = 1/2 - \theta_w^2$, where $\theta_w$ is a well defined experimental observable weak mixing angle. The goal of the $Q$weak experiment is a $4\%$ measurement of $Q_w$, to an accuracy of $0.3\%$.

The experiment would require $2200$ hours of running at an electron beam energy $\gamma E = 1.8$ GeV with a total intensity of $0.4$ pb$^{-1}$. The experiment will provide the first measure of the weak charge of the proton, and the dilution factor of background events. The theoretical systematic errors, which contribute to the total error budget, are less than $1\%$.

The experiment would constitute the first SM test at Jefferson Lab. To lowest order, the weak charge can be expressed as $Q_w = 1/2 - \theta_w^2$, where $\theta_w$ is a well defined experimental observable weak mixing angle. The goal of the $Q$weak experiment is a $4\%$ measurement of $Q_w$, to an accuracy of $0.3\%$. With these kinematics the systematic uncertainties from hadronic processes are strongly suppressed. To obtain the necessary statistics this $2200$ hours experiment must run at an event counting mode to determine the average.

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The Qweak experiment at Jefferson Lab (JLab) will provide a precision measurement of the proton's weak charge, a term that is expected to be only 31% of the axial charge. On the other hand, the expected deviation of the axial charge is about 3 ppm at Q^2 = 0, the first term in \(1\).

\[ Q_{weak} = Q_p \] (1)

The expected measured asymmetry \(A_{meas}^{Q_{weak}}\), which is a measure of the weak charge of the proton, is related to the weak mixing angle by the formula:

\[ \sin^2 \theta_w = \frac{A_{meas}^{Q_{weak}}}{2G_F} \] (2)

where \(G_F\) is the Fermi constant and \(\lambda\) is the weak vector coupling to the proton. At tree level the value of \(\sin^2 \theta_w\) is given by:

\[ \sin^2 \theta_w = 1 - \frac{\lambda^2}{\alpha} - \frac{\lambda^2}{4\pi} \] (3)

where \(\alpha\) is the fine-structure constant. This term is expected to be about 3% at Q^2 = 0, when added in quadrature, the two background terms can be accounted for solely with the results of precision experiments like Qweak. Should the result of this experiment disagree with the prediction of the SM, then the result would provide important consistency checks of the SM, and can be essential to determine the charges, coupling constants, etc. of nature. Neutral current experiments like Qweak will dramatically constrain possible extensions to the SM. The discovery potential of weak charge measurements will be well constrained by the precise measurements of A_{meas}^{Q_{weak}}.

The expected measured asymmetry A_{meas}^{Q_{weak}}, the first term in $1$, has been chosen as the most ideal complement of nature. Neutral current experiments like Qweak will provide important consistency checks of the SM, and can be essential to determine the charges, coupling constants, etc. of nature. Neutral current experiments like Qweak will dramatically constrain possible extensions to the SM. The discovery potential of weak charge measurements will be well constrained by the precise measurements of A_{meas}^{Q_{weak}}.