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Progress on Constraining the Strange Quark Contribution to the Nucleon Spin

We report on a global fit of neutral-current elastic (NCE) neutrino-scattering data and parity-violating electron-scattering (PVES) data with the goal of determining the strange quark contribution to the vector and axial form factors of the proton. Knowledge of the strangeness contribution to the axial form factor, $G_A^s(Q^2)$, at low Q^2 will reveal the strange quark contribution to the nucleon spin, as $G_A^s(Q^2 = 0) = \Delta s$. Previous fits [1,2] of this form included data from a variety of PVES experiments (PVA4, HAPPEx, G0, SAMPLE) and the NCE neutrino and anti-neutrino data from BNL E734. These fits did not constrain $G_A^s(Q^2)$ at low Q^2 very well because there was no NCE data for $Q^2 < 0.45$ GeV^2. Our new fit includes for the first time MiniBooNE NCE data from both neutrino and anti-neutrino scattering; this experiment used a hydrocarbon target and so a model of the neutrino interaction with the carbon nucleus was required. Three different nuclear models have been employed; a relativistic Fermi gas (RFG) model, the SuperScaling Approximation (SuSA) model, and a spectral function (SF) model [3]. We find a tremendous improvement in the constraint of $G_A^s(Q^2)$ at low Q^2 compared to previous work, although more data is needed from NCE measurements that focus on exclusive single-proton final states, for example from MicroBooNE [4]. This work has been published in Physical Review D [5].

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