



Contribution ID: 35

Type: parallel talk

Model-independent determination of the axial mass parameter in quasielastic antineutrino-nucleon scattering

Monday 9 May 2016 17:00 (15 minutes)

Understanding the charged current quasielastic (CCQE) neutrino-nucleus interaction is important for precision studies of neutrino oscillations. The theoretical description of the interaction depends on the combination of a nuclear model with the knowledge of form factors. While the former has received considerable attention, the latter, in particular the axial form factor, is implemented using the historical dipole model. Instead, we use a model-independent approach, presented in a previous study, to analyze the muon antineutrino CCQE mineral oil data published by the MiniBooNE collaboration. We combine the cross section for scattering of antineutrinos off protons in carbon and hydrogen, using the same axial form factor for both. The extracted value of the axial mass parameter $m_A = 0.84^{+0.12}_{-0.04} \pm 0.11$ GeV is in very good agreement with the model-independent value extracted from MiniBooNE's neutrino data. Going beyond a one-parameter description of the axial form factor, we extract values of the axial form factor in the range of $Q^2 = 0.1 \dots 1.0$ GeV², finding a very good agreement with the analogous extraction from the neutrino data. We discuss the implications of these results.

Summary

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Session Classification: Neutrinos