Contribution ID: **241** Type: **Oral**

Reexamination of the Reactor Antineutrino Anomaly

Thursday, 12 September 2013 15:00 (20 minutes)

The reactor neutrino anomaly [1] refers to a greater than 3σ deficit between the number of neutrinos detected relative to the number that are predicted in short baseline reactor neutrino oscillation experiments. The prediction for the expected number of detected neutrinos has evolved upward over time, largely as a consequence of a predicted increased in the neutrino flux and an increased cross section associated with smaller values for the neutron lifetime. The changes in the predicted neutrino flux are mostly associated with improved knowledge of the beta decays of the isotopes created in fission reactors. If not an artifact, such an anomaly is potentially extremely significant, as a shortfall in the detected neutrino flux could be ascribed to oscillation into a light sterile neutrino with a mass ~ 1ev.

An analysis [2] that sought to improve the earlier flux estimations based on the ILL on-line measurements [3-6] of the integral beta spectrum of the reactor fission products resulted in a systematic increase in the antineutrino flux. Because the beta spectra from reactor fission products involve about six thousand beta transitions, ~1500 of which forbidden transitions, some assumptions are required to deduce the antineutrino flux from a measured beta spectrum. A second independent analysis [7], that used similar assumptions to [2], confirmed the predicted increase in reactor antineutrino fluxes.

The present contribution questions whether the previous analyses properly accounted for the forbidden nature of many (~30%) decays present in the aggregate fission spectra. We find that the uncertainty in how to treat these forbidden transitions is large, and our analysis indicates that the resulting uncertainty in the aggregate antineutrino spectra is larger than the size of the original anomaly. This suggests that earlier conclusions on the reactor neutrino anomaly need to be revisited. In addition, analyses of medium and long baseline reactor experiments, that placed small uncertainties on fission antineutrino spectra may also need to be revisited.

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Session Classification: Low Energy Neutrinos IV

Track Classification: Low-Energy Neutrinos (solar, reactor, supernova, and geo neutrinos and also nuclear astrophysics associated with these sources)