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Implications of new theoretical calculations on reactor antineutrino and gallium anomalies

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The reactor antineutrino and gallium anomalies have been long unexplained. Possible explanations for both of these anomalies include new physics, such as the existence of one or more eV-scale sterile neutrino [Ga15]. However, the previous theoretical calculations, which do not replicate the experimental results, rely on many simplifying approximations [Ba97,Ha19].

In the reactor-antineutrino analysis the beta decays contributing to the cumulative electron spectrum are usually assumed to have allowed spectral shapes. However, many of these decays are actually first-forbidden. Moreover, these decays dominate the experimentally observable region. In some cases, like in the case of the ground-state-to-ground-state decay of ^{140}Cs (see figure), this is found to be a rather poor approximation. Based on the recent results, the use of this allowed approximation can at least partially explain the so called reactor antineurtino anomaly.

Our new large-scale shell model calculations regarding the neutrino-nucleus scattering cross section off ^{71}Ga shows no statistical difference to the experimental results of GALLEX and SAGE experiments. Conflict between charge-exchange BGTs and the neutrino-nucleus cross sections can to some extent be explained by destructive interference between Gamow-Teller and tensor contributions. A Bayesian approach to estimating the significance of the gallium anomaly is discussed.

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