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New calculation of the geo-neutrino energy spectrum and its implication

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The precise calculation of geo-neutrino energy spectra is critical for particle physics and Earth science. This study introduces a novel geo-neutrino flux model by systematically incorporating forbidden transitions and beta-decay corrections in uranium-238 and thorium-232 decay chains, supported by updated nuclear database inputs. Compared to the widely adopted Enomoto model, our approach reveals distinct spectral features: inverse beta decay (IBD) detection shows 4% and 9% yield deviations for uranium-238 and thorium-232 chains, respectively. These discrepancies could induce 10% to 20% variations in geo-neutrino measurements at KamLAND and Borexino experiments. The work establishes a new precision benchmark in geo-neutrino research, significantly advancing detection accuracy.

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