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Project 8: Waveguide CRES Measurements of Tritium Spectrum and 83mKr Conversion Electrons

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The unknown absolute scale of the neutrino mass remains an outstanding problem in astro and particle physics. Project 8 experiment seeks to measure the effective $anti-$neutrino mass m_β with a sensitivity of 40 meV/c^2 with the tritium endpoint method. To achieve this goal, Project 8 has pioneered the Cyclotron Radiation Emission Spectroscopy (CRES) technique. Adopting a four-phased approach, in Phase II Project 8 has recorded the first CRES tritium spectrum in a waveguide apparatus and extracted the first frequency-based neutrino mass limit. This milestone has established CRES as a promising method for direct neutrino mass measurement. In Phase II, Project 8 also performed high-resolution CRES spectroscopy on 83mKr conversion electrons. This source is widely used for low-energy particle detector calibration, with the K-32 conversion line at 17.8-keV being close to the tritium endpoint at 18.6-keV. Measurements of the 32-keV gamma energy and the Kr shell electron binding energies were conducted based on the high-resolution CRES frequency spectra of the 83mKr conversion electrons generated in the 32-keV isomeric transitions. Improved precision was achieved for the binding energies of the L1, L2, L3, M1, M2, M3 shell electrons in our measurements compared to the literature values. Those measurements pave the way for the high-resolution spectroscopy studies in Phase III.

Poster prize

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