



Poster session 4 – Friday 8 July

P4.047 Project 8 phase III design concept

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The Project 8 Collaboration is taking a four-phase approach to implement a next-generation tritium endpoint experiment based on the technique of Cyclotron Radiation Emission Spectroscopy (CRES). CRES constructs an energy spectrum from the spectrum of the cyclotron frequencies of magnetically trapped electrons. Phase I is successfully complete and Phase II is underway. This poster presents a design concept for the third phase of Project 8. The goal of Phase III is a neutrino mass sensitivity comparable to current limits from the Mainz and Troitsk experiments: $m_\nu \lesssim 2 \text{ eV}/c^2$. Such sensitivity requires a departure from earlier Project 8 phases where CRES was done inside the confined volumes of microwave waveguides. The increased volume on the order of 100 cm^3 required to accommodate the more intense tritium source will need an antenna array that collects cyclotron radiation emitted to free space by trapped tritium beta decay electrons. We review m_ν sensitivity estimates for Phase III, and present a quantitative design concept for a phased array receiver. We will also look forward to the design challenges required by the ultimate fourth phase of the experiment, whose goal is to be sensitive to the range of neutrino masses permitted by the inverted hierarchy.