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Project 8: A Neutrino Mass Experiment using Cyclotron Radiation Emission Spectroscopy¹

LUIZ DE VIVEIROS, Pennsylvania State University

Project 8 is an experiment that seeks to determine the electron-weighted neutrino mass via the precise measurement of the electron energy in beta decays, with a sensitivity goal of $40 \text{ meV}/c^2$. We have developed a novel technique called Cyclotron Radiation Emission Spectroscopy (CRES), which allows single electron detection and characterization through the measurement of cyclotron radiation emitted by magnetically-trapped electrons produced by a gaseous radioactive source. The technique has been successfully demonstrated on a small scale in waveguides to detect radiation from single electrons, and to measure the continuous spectrum from tritium. The next phase of the experiment will move to larger volumes to increase sensitivity, requiring implementation of CRES in a free-space radiation environment instrumented with a phased antenna array. We present a brief overview of the Project 8 experimental program, highlighting the preliminary measurement of the tritium beta spectrum using CRES in a small scale prototype, and the development of the techniques needed to deploy CRES at large scales.

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