

The PTOLEMY experiment: Direct Detection of the Cosmic Neutrino Background

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The PTOLEMY collaboration's ultimate goal is the first direct observation of the Cosmic Neutrino Background (CNB). As an essential milestone, we present the status and physics reach of the PTOLEMY-LNGS demonstrator now under construction at the Gran Sasso. The experiment utilizes a solid-state atomic tritium target, CRES-based background reduction, a new type of compact and scalable EM spectrometer, and transition edge sensor (TES) microcalorimetry to deliver 50 meV resolution in a room-sized space. A three-year demonstrator run will reach a neutrino-mass sensitivity of 150 meV (90% CL), more than a factor of two beyond current limits, and will establish the technique needed to scale to a 100g CNB target. We outline the project timeline, the strategy for sub-eV systematic control, and the complementarity of PTOLEMY's approach with KATRIN's MAC-E filter. By uniting novel materials, cryogenic calorimetry, and magnetic-drift optics, PTOLEMY opens a realistic path from precision beta-decay spectroscopy to the first glimpse of relic neutrinos from the Big Bang.

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