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Cryogenic Bolometer Experiments for Neutrinoless Double Beta Decay: CUORE and CUPID

The search for neutrinoless double beta decay ($0\nu\beta\beta$) is crucial for testing lepton-number violation, probing physics beyond the Standard Model, and determining whether neutrinos are Majorana particles. CUORE, a tonne-scale cryogenic experiment at LNGS, studies $0\nu\beta\beta$ in ^{130}Te using 988 TeO_2 bolometers operated below 15 mK.

Since 2017, CUORE has collected over 2.5 tonne-years of exposure, setting strong limits on ^{130}Te $0\nu\beta\beta$ and obtaining one of the most precise $2\nu\beta\beta$ half-life measurements, along with a reliable background model. These results provide essential benchmarks in nuclear physics for $0\nu\beta\beta$ searches.

CUPID, CUORE's successor, aims to greatly enhance its $0\nu\beta\beta$ discovery sensitivity in ^{100}Mo , covering the inverted mass hierarchy. It will deploy 1596 enriched Li_2MoO_4 crystals and 1710 light detectors to enable simultaneous heat and light readout, thus improving the background rejection. Reusing the CUORE cryostat and infrastructure, CUPID is finalising detector performance validation, sensitivity studies, and the experimental design.

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