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Using a cryogenic Li2MOO4 detector prototype to study qubit charge responses

We present a prototype Li2MoO4 calorimetric detector with a low-impedance TES readout designed and assembled to search for neutrinoless double beta decay. We analyze the results of the operation of the detector at the NEXUS underground facility located at the MINOS hall at Fermilab, which has a rock overburden of 107m. The prototype's fast rise time of ~0.5 ms improves its ability to resolve the background from so-called "pileup events": two independent neutrino decay events that may occur close enough in time to mimic a neutrinoless double beta decay in the energy window of interest. This same device was used to measure the ambient background in a study measuring the response of a four-qubit device to ambient radiation. With a baseline resolution of 1.95 FWHM and calibrated up to the MeV region, we characterize the radiation incident upon the detector, in two configurations: with and without the surrounding low radioactivity lead shield with coverage of 4π. The rates obtained are compared with the correlated jump rates of the superconducting qubits, and we observe the qubit jump rates don't scale with the incident ionizing radiation, indicating a new as-yet-unknown source of qubit jumps.

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