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HeRALD: direct detection with superfluid 4He

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We present the HeRALD detector concept, a staged path to meV nuclear recoil thresholds. The proposal centers on a 4He target at mK temperatures, which allows long-range ballistic propagation of the superfluid' s phonon and roton excitions. On reaching a liquid-vacuum interface, such kinetic excitations liberate 4He atoms via a one-to-one process, and this signal channel of liberated atoms is then sensed via its adsorption energy onto large-area low-threshold calorimetery. We describe past R&D on this technique, along with sensitivity projections assuming various levels of technical advancement.

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