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BULLKID-DM: phonon mediated Kinetic Inductance Detectors for light WIMP direct detection

BULLKID-DM is a new experiment aimed at searching for hypothetical WIMP-like Dark-Matter particles with mass around 1 GeV or below and cross-section with nucleons smaller than 10^{-41} cm^2 . The target detector consists of a stack of diced silicon phonon collectors, acting as an array of particle absorbers sensed by multiplexed Kinetic Inductance Detectors (KIDs). The target will amount to 800~g subdivided in more than 2000 silicon dice. The aim is to control the backgrounds by creating a fully active structure and by applying fiducialization techniques. A first 20~g prototype of the detector was built with 60 cubic voxels (of dimensions $5.4 \times 5.4 \times 5 \text{ mm}^3$) that are carved out of a single 5 mm thick 3" silicon wafer. The carvings leave intact a 0.5-mm thick common disk acting as a holder for the dices and as a substrate to host the KID structures.

Following the encouraging results from the 20~g prototype detector, here we present the first operation of 3-wafer demonstrator array (for a total of 60~g and 180 silicon dice), operated on surface with a mild shield. The recorded background is here compared with Geant4 simulations conducted by the collaboration.

Finally, we present the plan for the deployment of the experiment at the shielded underground site of Gran Sasso laboratories in Italy. The commissioning will happen in two stages: first, the demonstrator array will be deployed at the beginning of 2026 in the cryo-platform. Once the success of the demonstrator stage is ensured and the setup is fully characterized, the full experimental setup will follow and is expected to be commissioned at Gran Sasso in the beginning of 2027.

Title

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Topic

Solid state sensors

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