

BULLKID is a R&D project aiming to pair an array of Kinetic Inductance Detectors with a diced silicon absorber, achieving mass scalability up to the Kg scale and high segmentation.

An average baseline resolution of $27 \pm 6 \, eV$ makes it a suitable detector for low-energy processes such as direct interactions of dark matter and coherent elastic neutrino-nucleus scattering.

The above ground unshielded operation of this prototype has led to the characterization of a background level of 2-10^6 counts/(kev-kg-day) flat down to an energy threshold of 160 eV.

We present the status of the project and its future development towards an improvement in

terms of threshold and active volume of the detector.

BULLKID: Kinetic Inductance Detectors coupled to silicon absorbers [1]





Cluster cuts for low energy data selection To select only events interacting with a chosen voxel:

Acquire simultaneously a central voxel and 8 surrounding neighbours

3x 3-inch Demonstrator

- Intermediate step before moving to a full scale array
- 3x 3-inch silicon wafers for a total of 180 units and 61g of active silicon





4-inch design



- **Characterize the expected phonon** x-talk ratio $m_r =$ $\langle A_m/A_n \rangle$
- Reject events not compatible with the expected geometry





Surface background acquired by a 0.34 die over 40h [2]



- Upgraded pixel count from 60 to 145 per wafer
- Easier scalability towards the Kg range with less wafers

Sensitivity plots

	BULLKID prototype	BULLKID-DM demonstrator		BULLKID-DM
mass	20 g	60 g		600 g
# of sensors	60	180		~2500
threshold	160 eV	200 eV		200 eV or lower
bkg (c/keV kg d)	2x10 ⁶	~104		10 - 0.01
laboratory	Sapienza U.	Sapienza	LNGS?	LNGS
installation	2023	2024	2025	2027?



Threshold (ongoing R&Ds):

. Replace AI with AI-Ti-AI KIDs: 5x inductance 2. Deeper carvings for higher phonon focussing



Next shielded measurements



2) D. Delicato et al., "Low-energy spectrum of the BULLKID detector array operated on surface", EPJC, 84,353 (2024)

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