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Energy calibration of bulk events in the BULLKID detector

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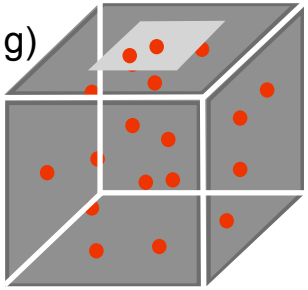
BULLKID: Kinetic Inductance Detectors coupled to silicon absorbers

Phonon mediation:
detection of phonons created by the energy release of particles in a **silicon** die

KID (~ 2x2 mm^2 x 60 nm, 0.5 μg)

Silicon die (0.34 g)
at < 80 mK

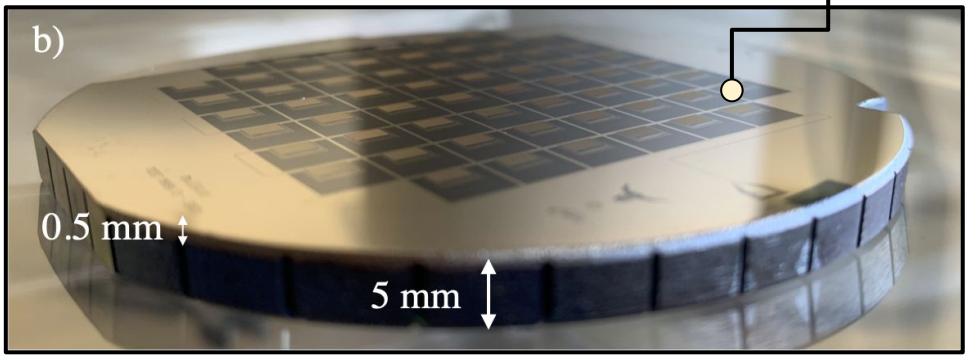


5 mm

Monolithic structure
with
60 detectors in 1
Fully multiplexed
(single readout line)

Carving of dice in a thick silicon wafer

Lithography of KID sensors



60 nm thick aluminum film

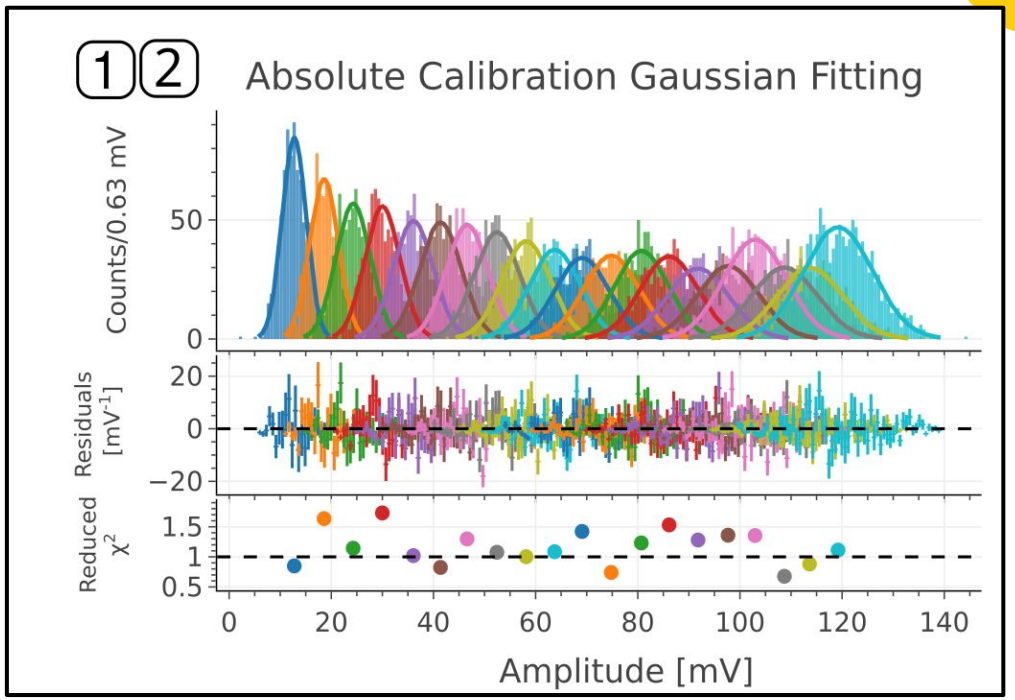
Optical calibration concept

1. Shine on detector with monochromatic LED changing the mean number of photons

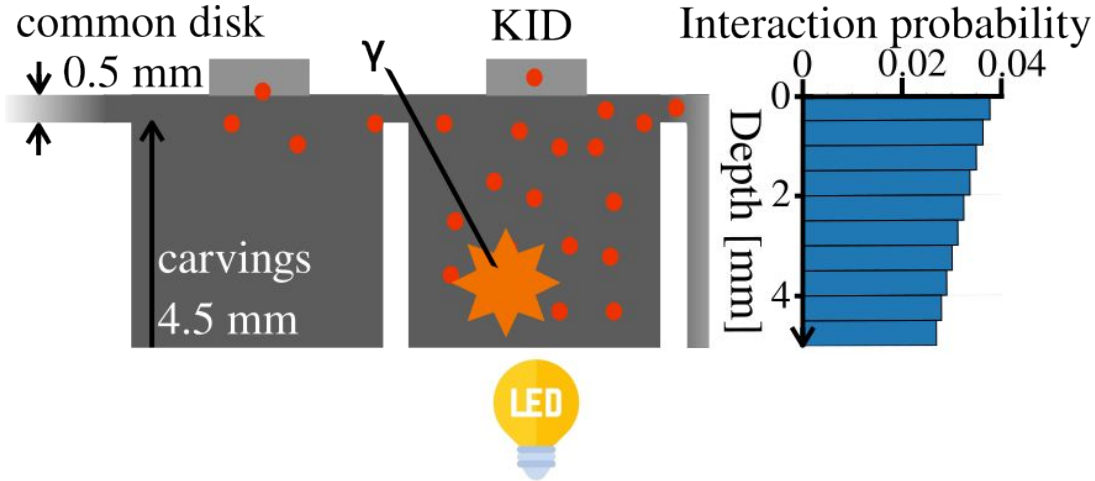
2. Fit the energy distributions

3. Fit the photon-statistics (Poissonian) hypothesis to measure the calibration constant

4. Correct for the non-linearities of the detector



Energy calibration with the 59.5 keV X-rays of ^{241}Am



Validation of the standard optical calibration through the monochromatic peak of a particle interaction

The 59.5 keV X-rays interact quite uniformly within the depth of BULLKID, allowing the investigation of possible positional effects

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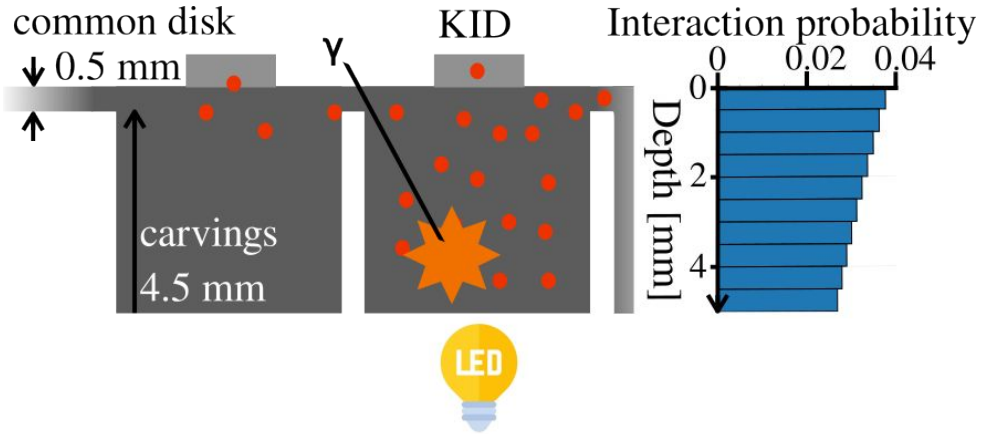

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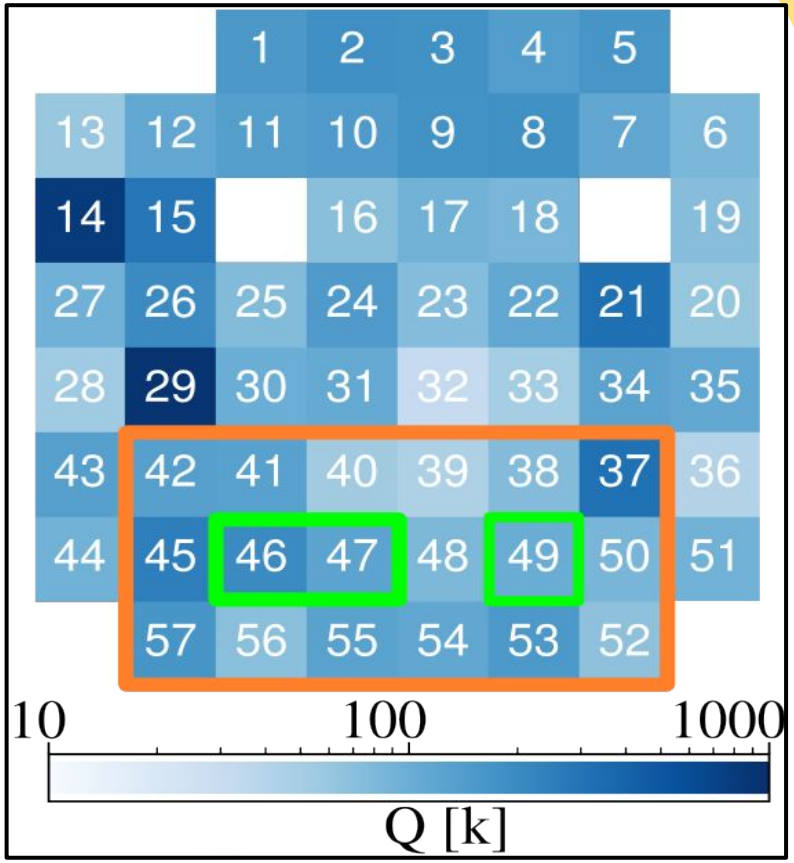
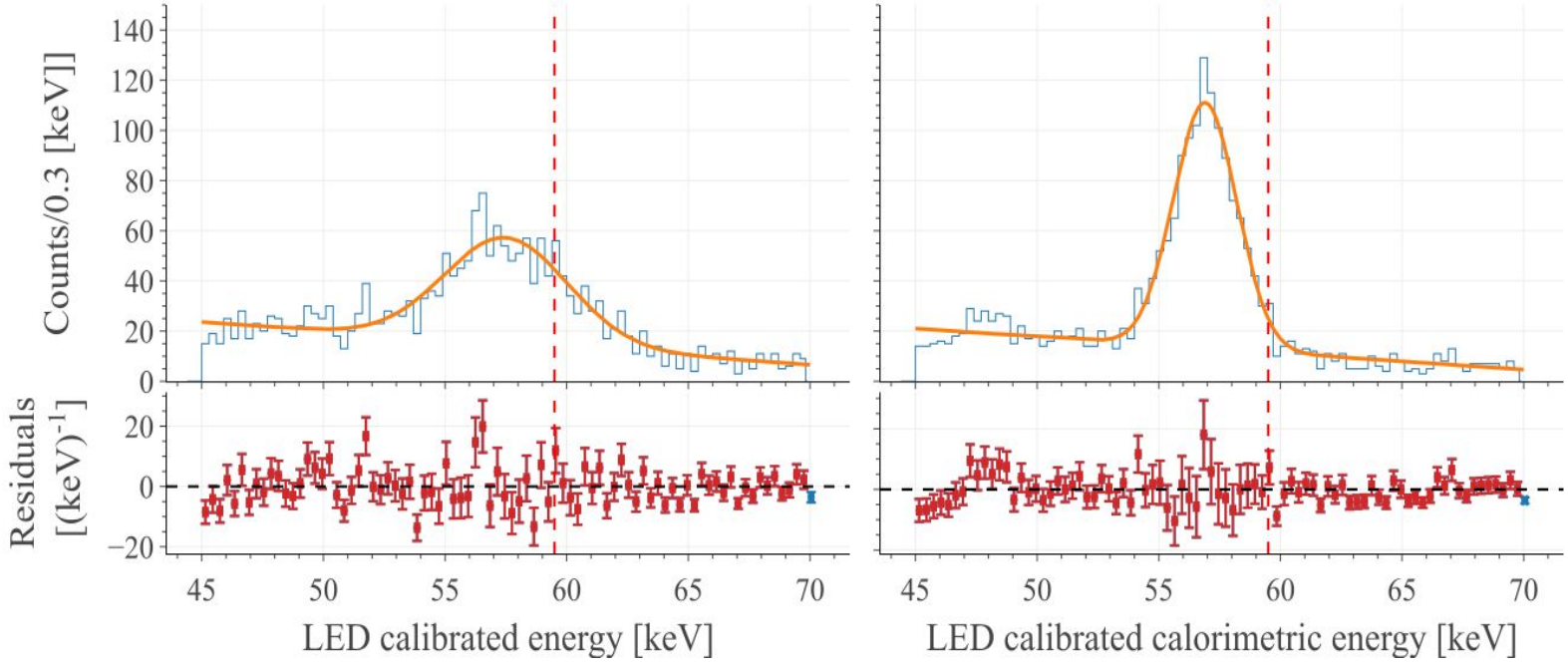
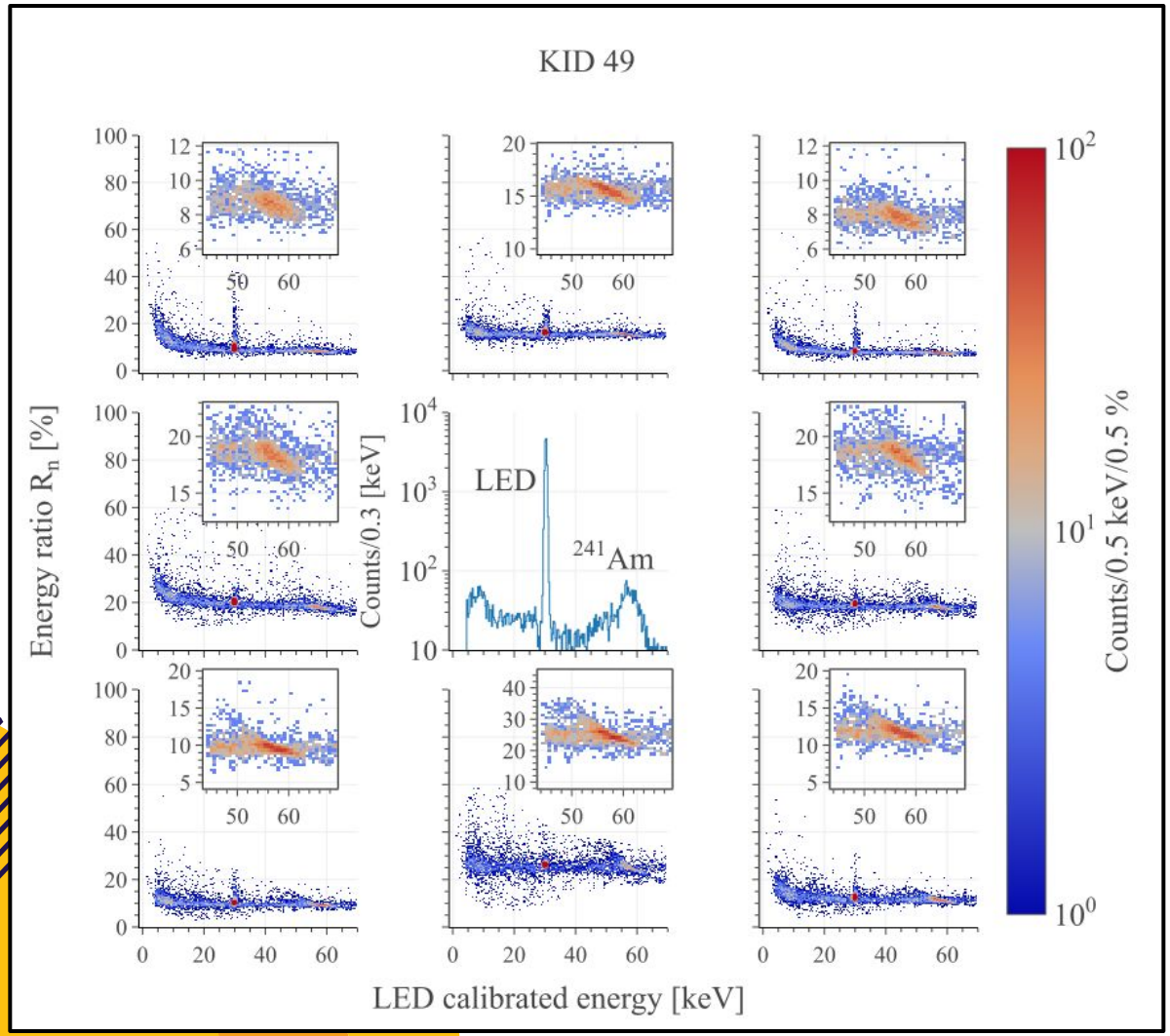


Energy spectrum

The ^{241}Am peak is reconstructed with a deficit below 10%. Resolution is 5% σ and can be improved by a factor 2 considering phono leakage



Phonon leakage



In the plot the ratio between the energy released in the neighbouring dice and the energy release in the central die

We observe the same leakage for LEDs and ^{241}Am but an anti-correlation for the latter case

Thank you for the attention

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