









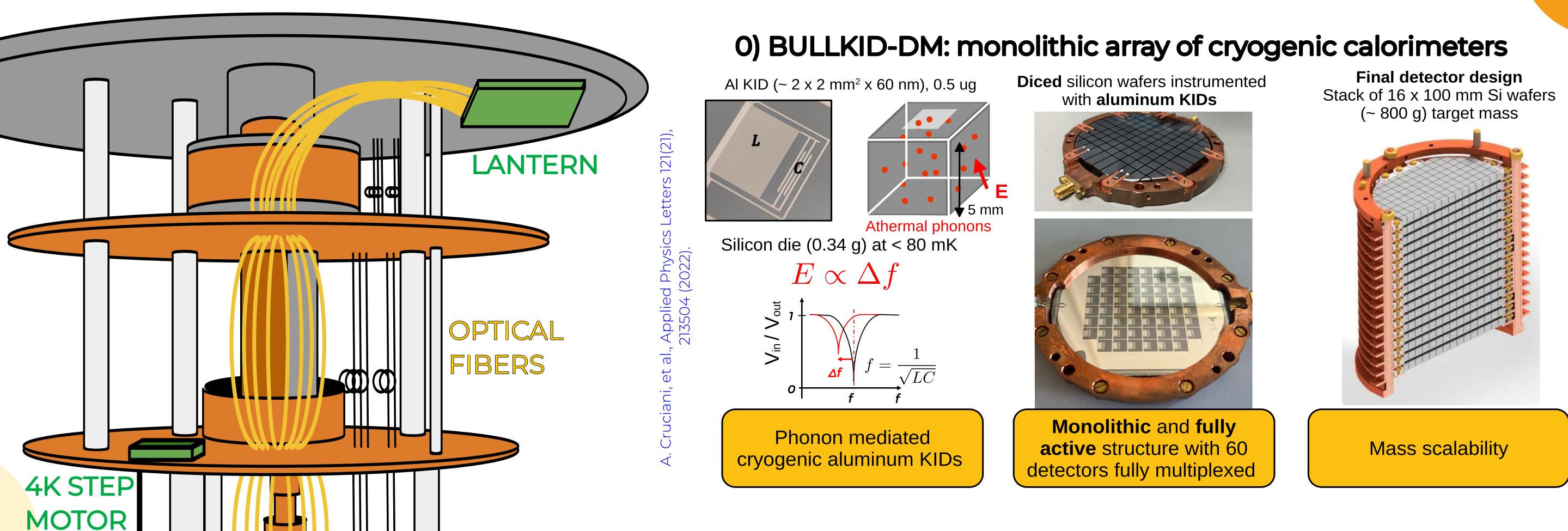
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Energy calibration of the BULLKID-DM experiment

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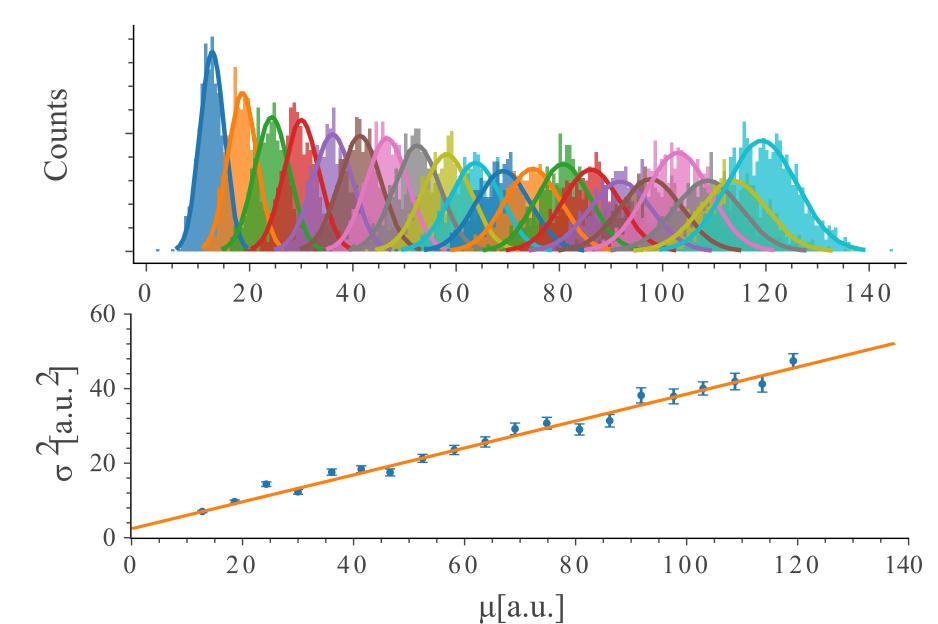
BULLKID-DM is a direct dark matter experiment searching for light WIMP-like particles with **monolithic** arrays of cryogenic calorimeters. It is based on silicon wafers carved in 5 mm thick dice sensed by phonon mediated Kinetic Inductance Detectors to form a fully active structure. The collaboration is working on 3 complementary strategies to overcome the **energy calibration** of the future detector:

- 1) Injecting controlled IR-Vis LED pulses, generated at room temperature, directly to the detector
- 2) Autocalibrating the detector from the response function of KIDs
- 3) Shining the detector with the 59.5 keV gammas emitted by 241 Am moved through a 4K step motor

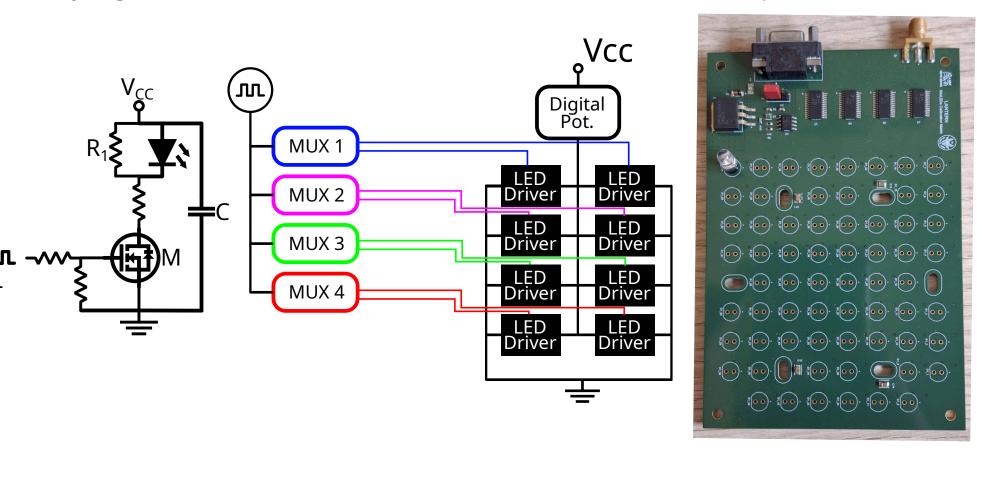


1) Optical calibration and LANTERN

The amplitude of the LED induced pulse is Poisson distributed. From the linear relation between the mean and the variance we can infer the calibration constant

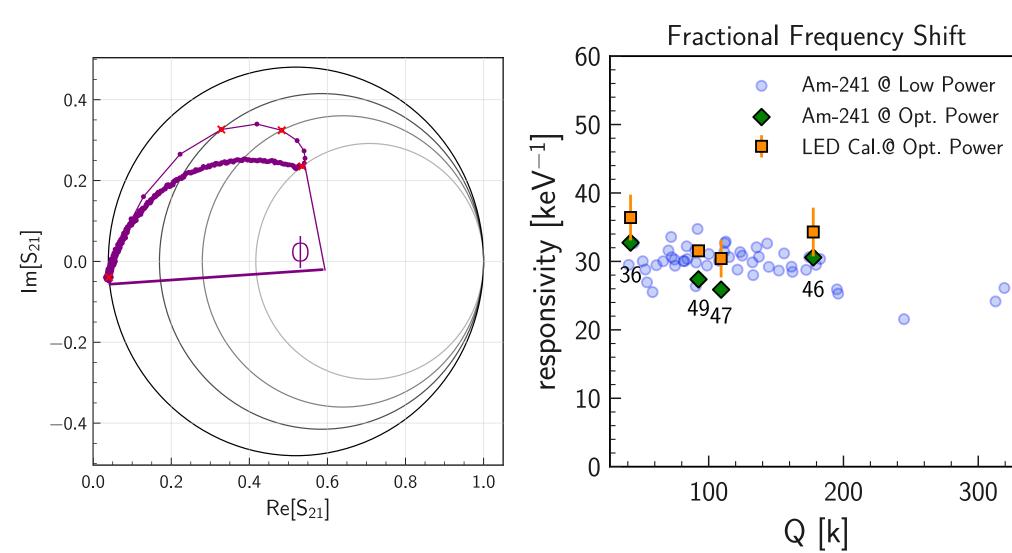


LANTERN is an electronic and optical setup that is easily upscaled and targeted at the low-energy calibration of cryogenic calorimeters via the use of IR-Vis photons



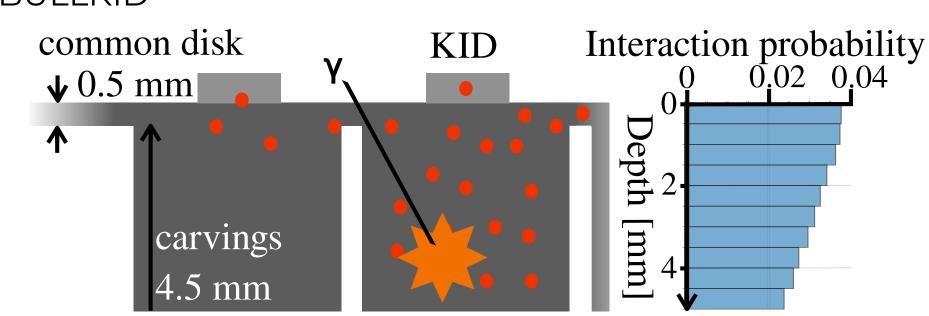
2) Autocalibration from the response function

From BCS theory we can build a variable which has equal responsivity among KIDs. Test with ²⁴¹Am validates the response equalization with an agreement better than 10%

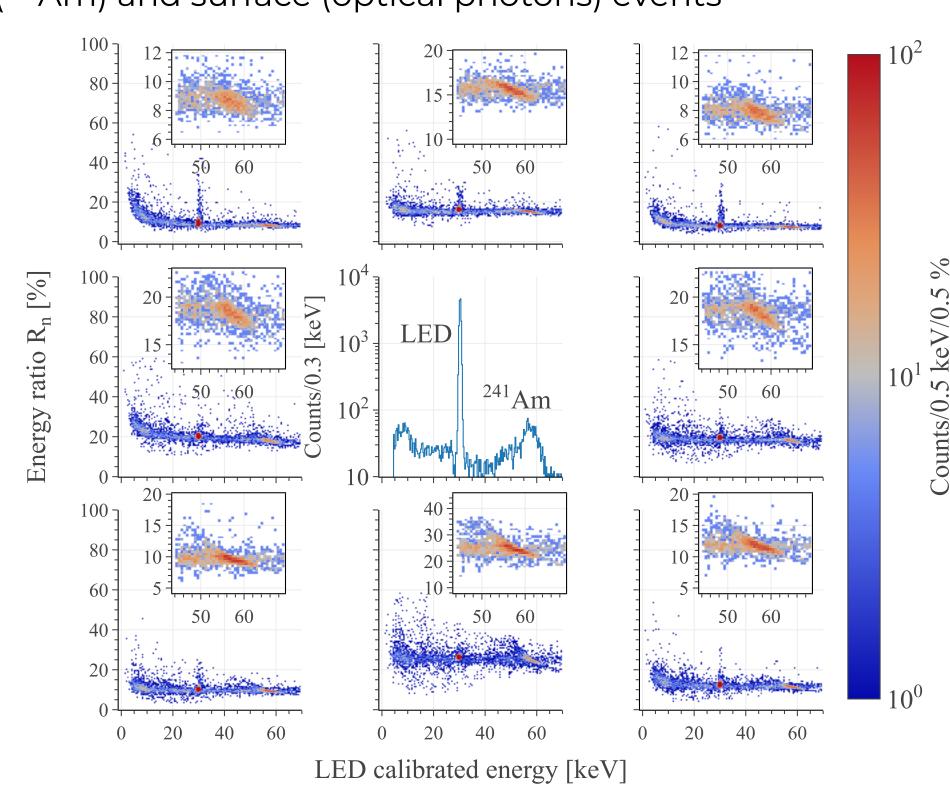


3) Energy calibration with ²⁴¹Am

²⁴¹Am decays spontaneously to ²³⁷Np by emitting a 59.5 keV γ -ray that interacts quite uniformly within the depth of BULLKID

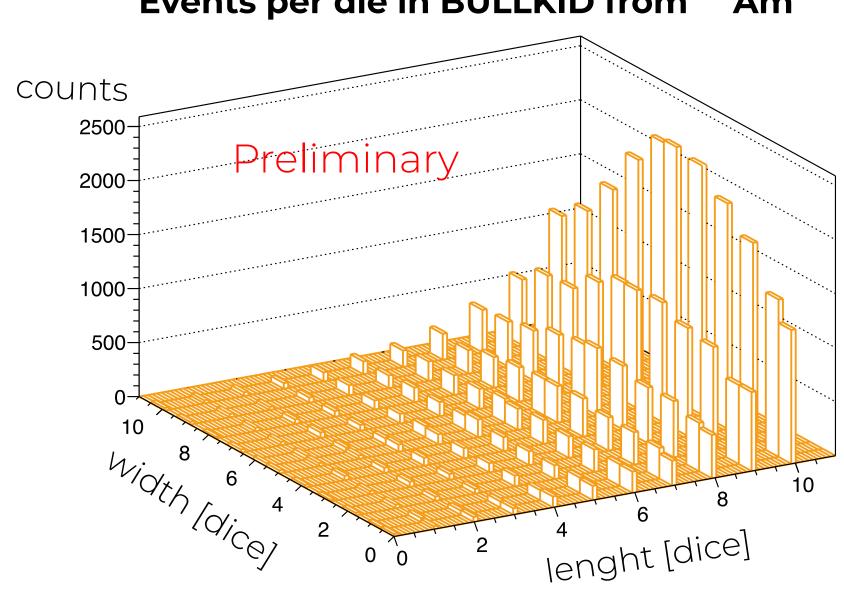


The same phonon leakage is observed between bulk (²⁴¹Am) and surface (optical photons) events



A possibility is to calibrate the final experiment with an internal Americium sorce moved by a 4K step motor

Events per die in BULLKID from ²⁴¹Am



Activity (kBq)	Pile-up (%)	Calibration Run duration (h)
3	0.39	4.7
10	1.3	1.4
100	12.3	0.14

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²⁴¹Am SOURCE

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