Data analysis and characterization of the KID-based light detectors of CALDER

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The aim of the CALDER (Cryogenic wide-Area Light Detectors with Excellent Resolution) project is the development of light detectors with active area of 5x5 cm^2 and noise energy resolution smaller than 20 eV RMS, implementing phonon-mediated Kinetic Inductance Detectors (KIDs).
The detectors are developed to improve the background suppression in large-mass bolometric experiments such as CUORE, via the double read-out of the light and the heat released by particles interacting in the bolometers.

In this work we present the characterization of the first light detectors developed by CALDER, consisting of a 2x2 cm^2, 275 μm thick high resistivity Si(100) substrate sampled by 40 nm thick Al film lumped-element resonators.
We describe the analysis tools that we developed to evaluate the resonator parameters (resonant frequency and quality factors) taking into account simultaneously all the resonance distortions introduced by the read out chain (as the feed-line
impedance and its mismatch with the resonator one) and by the power stored in the resonator itself.
We study the dependency of the quasiparticle life-time and of the resonator response on the detector temperature and on the absorbed power, and compare the results with theoretical predictions.
We detail the method for the absolute energy calibration of the detectors and the comparison with a calibrated photon source.
Finally, we present the efficiency and the energy resolution obtained exposing the detectors to optical pulses and to a low-energy X-ray sources.