Progress of Kinetic Inductance Detectors on CaF2 for astroparticle physics

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Introduction

- Search for low-mass DM (WIMP-like particles) 10 - 100 GeV WIMP
- Approach:
  - Light nucleus target: CaF2
  - Electron target: Superconductor
  - Low energy detector: Kinetic Inductance Detector (KID)

Why CaF2?
- Scintillation crystal: strong fake reduction
- 19F: sensitive to spin-dependent DM scattering
- 48Ca: 2β decay nucleus

Why Kinetic Inductance Detector (KID)?
- Natural multiplexable
- Easy producible
- Suitable for large detector(s)

Objective

Feasibility study to fabricate superconducting detector on CaF2

Fabrication

KID design
- LC resonator circuit
- Kinetic Inductance Detector

Fabrication process
- Lithography
- Resist coating
- Al sputtering
- Resist coating
- Development
- Etching

Setup

Balanced mixer (MLIQ-0218L)
- AT1
- SG
- KID

KIDs on CaF2

Measurements and results

1. Resonance frequency

Resonance frequency by VNA

2. Temp sweep

Temp Sweep 15mK – 320mK

3. Power Sweep

The Q factor changed due to the power sweep

4. Particle detection

Detection of α ray events using Am241

Conclusions

KIDs on CaF2 substrate work properly at temperature 15 mK to 320 mK with high Q factor, more than 500k and responsive to the particle detection about 1 mrad/keV.

Future work

- New KID design for more sensitivity on the CaF2

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