**Abstract:** For high-energy particle detection, we investigated two materials: niobium (Nb) and a high-temperature superconductor, YBa$_2$Cu$_3$O$_{7-δ}$ (YBCO). Lumped element kinetic inductance detectors are fabricated with both superconducting films. The alpha line (5.49 MeV emitted by Am-241) is irradiated from the top side of the devices. When we submitted the abstract, we thought that YBCO-KIDs detected the alpha line, but after further investigation, we found that the signal was fake. Although the quality factor and the noise level of the YBCO-based device were comparable with that of the Nb-base KID, the signal suppressed due to the large gap energy and short quasiparticle lifetime. The performance of the Nb-KIDs was an excellent agreement with the expectations; the energy resolution was 25, and the decay time was approximately 1 µs. We distinguished the direct absorption events and the phonon mediated events. By decreasing the filling factor of the inductance line, the phonon originated events suppressed, and the energy resolution improved.

**LeKID as α-line detector**

(top) Schematic drawing of Lumped element Kinetic Inductance Detector (LeKID) and Equivalent circuit of LeKID. (bottom) Alpha particles emitted from Am241 enter the top side of the device.

**Measurements in 1 K cryostat**

For fast sampling (>15 MHz), we also used the oscilloscope whose maximum rate is 1.25 GHz.

YBCO
- 200-nm thick film covered by in-situ Au deposited on MgO.
- $T_c$ was degraded by processes, but still above 75 K.
- Device was patterned by wet etching in twice. First is for removing the Au coat and second is for patterning YBCO.
- Width of Inductance is 5 μm.
- Good Quality factors (>15000) below 6 K.

Nb
- 100-nm thick film sputtered on high-R Si.
- $T_c$ was 8.7 K.
- Device was patterned by dry etching.
- Inductance width is 3 μm.
- Readout power is applied as high as possible to improve energy resolution, although high power cause the slope of the amplitude noise at low frequency range.
- Two types of the signal were found. Higher pulses correspond to the direct absorption of α-line in niobium film. Lower pulses respond to the phonons created the absorption of α-line in the silicon substrate.
- Decay time of the pulse is around 1 μs and good agreement with the ringing time calculated by the quality factor and the resonant frequency.

**Energy resolution from theory**

$$\sigma = \frac{\Delta E}{E} \approx 0.05 \text{ (assumed } \eta = 0.57)$$

where $E$ & energy gap=1eV, $N_0$, single spin density $\times 10^{25} \text{ spin}^{-1} \text{ μm}^{-3}$, $V$: volume of LeKID $3 \times 5000 \times 0.3 \text{ in μm}$, $\kappa_0$ : almost unit in amp. readout $Q$: loaded $Q = 10^7$, $Q_c$ coupling $Q=10^9$ $\alpha$: bolzmann constant, $T_r$ : noise temp. of HEMT=7 K $P_{in}$ : read out power $\sim 60 \text{ dBm}$, $\tau_{QPS}$: QPS life time $=10^{-6}$ $\alpha$: kinetic fraction=0.08

**Energy resolution from experiments**

- Linear stopping power @ 5.5 MeV in Niobium
  - $\Delta E / E = 0.1 - 0.2 $keV
  - $\Delta E / E = 0.48 \text{ eV}$

**Conclusion:** Alpha lines (5.49 MeV) were irradiated to YBCO-LeKID and Nb-LeKID. Both detectors made pulse responses, but it turned out that the signal with YBCO LeKID was fake. Energy deposited to the 100-nm thick niobium film is 12 keV, and the energy resolution of the Nb-LeKIDs corresponded to 480 eV. This value was close to the prediction. The count rate calculated with the pulse decay time is approximately 500 kHz.