1. COBAND experiment

- Difference between mass-square of different generation neutrino has been measured by various experiments of neutrino oscillation.
- Neutrino mass itself has not been measured.
- COBAND (Cosmic BBackground Neutrino Decay search) experiment aims at measuring the neutrino mass by observing the neutrino decay of the cosmic background neutrinos (CBN).
- In the COBAND experiment, we measure the cosmic infrared photon energy spectrum continuously to find the energy cutoff from the CBN decay against the zodiacial emission which is the dominant background.

We adopted Hf-STJ as a detector for the COBAND satellite experiment.

2. STJ detector

- STJ = Superconductor / Insulator / Superconductor.
- Characteristics:
  - Single photon counting
  - Broad response from the ultraviolet to the far infrared
  - Arrival time information to <1μs
- High energy resolution
- Must be operated at low temperature for best performance. ( T < 0.1 × Tc )

Working principle
1. Incident photon is absorbed in the superconductor and excites cooper pairs.
2. Exit cooper pairs become quasi particles.
3. Quasi-particles go through tunnel barrier by tunnel effect.
4. We can measure the energy of incident photon by measuring the tunnel current.

Energy resolution

$$\sigma_E = \sqrt{(1.78) E_F}$$

3. Hf-STJ development

- Our old Hi-STJ has large leakage current. 20μA@20μV, 50mK.
- We newly made two types of Hi-STJ.
- Hi-STJ w/ thin Al layer
- Hi-STJ using smooth Hf film
- These two samples work as STJ detector and leakage current improved.

IV characteristics of new Hi-STJ

4. Summary

- COBAND experiment aims at measuring the neutrino mass by observing the CBN decay.
- We are developing Hi-STJ for the COBAND satellite experiment.
- The leakage current density of new type of Hi-STJ became 16 times smaller than old Hi-STJ.
- Also, Hi-STJ response to the visible laser light pulse was observed.
- However, our Hi-STJ sample has large leakage current of 6μA@20μV and need more improvement to function as a far-infrared photon detector.