P3 (GEP=4)

Superconducting detector

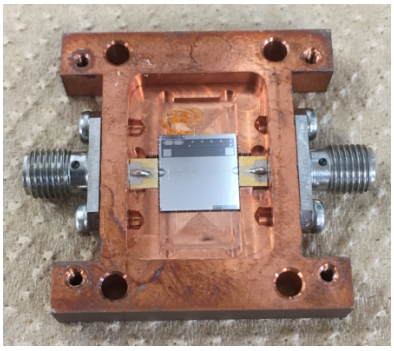
Instructor: Koji Ishidoshiro (koji@awa.tohoku.ac.jp, RCNS Annex 221)
GPPU Experimental Point (GEP): 4

Goal of Study

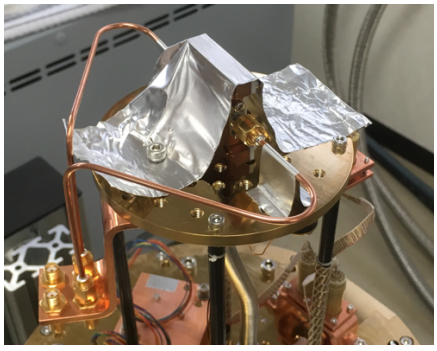
The students will understand superconducting detectors and their wide application to particle and nuclear physics and astrophysics. The students will also learn basics of superconductor, electronics, cryocooler, digital signal processing, data acquisition system and data analysis from detector characterization and response measurements of cosmic rays and/or gamma rays.

Contents

Superconducting detectors are extremely sensitive and have a wide variety of application from particle and nuclear physics to quantum measurement and biology. However, it is difficult to integrate into large arrays like a CCD camera. Kinitic Inductance Detectors (KIDs) provide a promising solution to produce the large array. Several KID arrays have been constructed for astronomical observations and TeraHertz imaging. Research Center for Neutrino Science in Tohoku University is developing KID arrays for next generation dark matter and double-beta decay experiments. Using that facility, students will learn superconducting detectors, especially KID detectors, and their wide application. We hope that the students will propose in future the new experiments using superconducting detectors based on this experience.



KID detector used in the course



KID detector and 3He cryocooler

Textbook and References

[1] KID detector: P. K. Day *et al.*, *Nature* 425, 817 (2003)

[2] KID detector: S. Doyle *et al.*, *J. Low Temp. Phys.*, **155**, 530 (2008).

[3] Application example for elementary particle experiment: E. S. Battistelli *et al.*, *Eur. Phys. J. C* **75** 53 (2015).

[4] Application example for space observation: S. Oguri *et al.*, *J. Low Temp. Phys.* **184**, 786 (2016).

Progress Schedule

- ✧ Day 1
  Lecture on superconducting detector, microwave, and cryoclooler.
  Fabrication of superconducting detectors
- ✧ Day 2
  Fabrication of superconducting detectors
  Preparation of cooling.
- ✧ Day 3
  Lecture on application of superconducting detector to particle physics.
  Detector characterization at 0.3 K.
- ✧ Days 4
  Measurement of detector response with cosmic-ray and/or gamma-ray source.

Other Details

Course Period	Feb 2020
Place	Research Center for Neutrino Science Annex, 125
Number of Students	1—2
Evaluation method	The evaluation method will be based on report (100 %).

In Addition

Language used in this course is only Japanese since the fabrication require helps from technical staffs.