

# Session 2: Future Space Programs

# DEVELOPMENT OF STJ AS A NEW X-RAY DETECTOR

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## 1. Introduction

STJs are promising X-ray detectors as high energy resolution spectrometers due to the small excitation energy to break the Cooper pairs to product detectable electrons. The expected energy resolution is about 5 eV for a 6 keV incident X-rays (see review by Kraus et al. and Esposito et al.). We have developed a large area ( $178 \times 178 \mu\text{m}^2$ ) Nb/Al/AlO<sub>x</sub>/Al/Nb STJs (Kurakado et al. 1993) and series-connected STJs with a position resolution of  $35 \mu\text{m}$  for  $\alpha$  particles (Kurakado 1997) at Nippon Steel Corporation. As a focal plane detector in future X-ray missions, we are developing STJs whose target characteristics are ; an energy resolution of 20 eV at 6keV, an effective area of  $1 \text{ cm}^2$ , and position resolution of  $100 \mu\text{m}$ .

## 2. Experiment at TMU

A measurement system for STJs with an X-ray generator attached to a <sup>3</sup>He cryostat to be cooled to 0.35 K is fabricated at Tokyo Metropolitan University. Using this system, we succeed to detect X-ray signals from both single and series-connected STJs.

From a single STJ detector of  $178 \times 178 \mu\text{m}^2$ , an energy resolution of 112 eV at 5.9 keV including 95 eV electrical noise is obtained (see Fig.1). Utilizing the X-ray generator, we measure the X-ray energy vs. pulse height relation for 6 incident X-ray energy at the same condition. We found that

the energy scale is well represented by a parabolic function(see Fig.2), because the recombination rate of quasi-particles in the superconductor is proportional to the power of the density of the pseudo particles, i.e. the square of the incident energy.

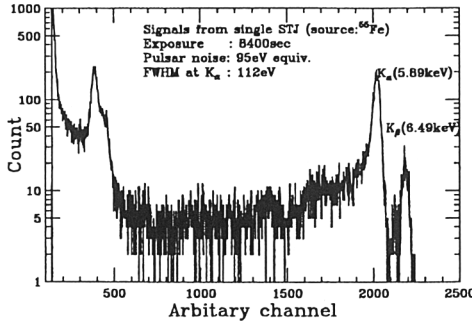


Figure 1. The energy spectrum obtained by a STJ

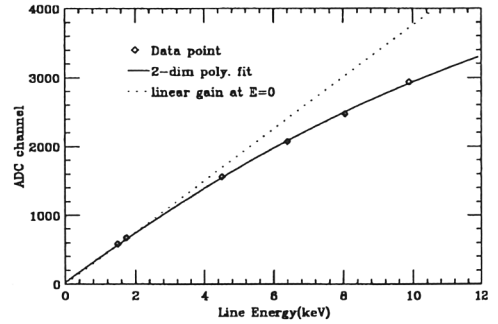


Figure 2. The X-ray line energy vs pulse height

### 3. Future developments

To obtain the good energy resolution, it is necessary to reduce the readout noise. Frank et al. obtained a good energy resolution (29 eV at 5.9keV) with a SQUID readout. Recombination loss of the pseudo particles in the superconducting layer drops the signal current. Multi-trap structure (for example, Nb/Ta/al/AIO<sub>x</sub>/Al/Ta/Nb) to gain the efficient tunneling of the quasi-particles is proposed (Kurakado 1997). And we are starting the position sensing of X-rays with series-connected STJs analyzing the rise-time and pulse height of each events.

### References

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