

## A COMPACT SIS RECEIVER COOLED BY 4 K GM REFRIGERATOR

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### INTRODUCTION

SIS receivers have higher sensitivity than Schottky diode receivers. The SIS mixer, however, must be cooled at 4 K level, and either a GM (Gifford-McMahon) + JT (Joule-Thomson) refrigerator or liquid helium is used. Therefore, SIS receivers are usually much larger and heavier than Schottky diode receivers which are usually cooled by a GM refrigerator only.

Kuriyama et al. <sup>(1)</sup> developed a GM refrigerator using  $\text{Er}_3\text{Ni}$  as a regenerator material which achieved to cool at 4 K level.

In this work, the SIS receiver was constructed and investigated, which was cooled below 4 K by the GM refrigerator with  $\text{Er}_3\text{Ni}$ . It resulted in the SIS receiver which was about the same size and weight as a usual Schottky diode receiver.

### CONSTRUCTION

Figure 1 shows a photograph of the SIS receiver. It is 720 mm in height, 260 mm in length, and 260 mm in width, and the total weight is 35 kg. The cryogenic part of the SIS receiver consists of a two-stage GM refrigerator with  $\text{Er}_3\text{Ni}$  and a 4 K stage mounted on the second stage of the GM refrigerator. The 4 K stage consists of a corrugated feed horn, a crossguide coupler, an SIS mixer, an isolator and an IF amplifier.

The calculated heat load was about 220 mW for the second stage, where the first and second temperatures were assumed 35 K and 4.2 K, respectively.

## EXPERIMENTAL RESULT

The refrigeration capacity of the GM refrigerator with  $\text{Er}_3\text{Ni}$  was investigated. The refrigeration capacity at 4.2 K was 580 mW without the first stage heat load, and 430 mW with the first stage heat load of 5 W.

The cooling performance of the SIS receiver was also investigated. The cool down time from the room temperature to 4 K level was about 4.5 hours. The lowest temperature of 3.4 K was achieved at the SIS mixer.

This SIS receiver was installed on the 45 meter antenna at Nobeyama Radio Observatory and has been used for radio astronomical observations. During more than 3000 hours operation, the SIS mixer temperature was always less than 4 K.

## CONCLUSION

A compact SIS receiver, 720 mm in height, 260 mm in length, 260 mm in width and 35 kg in weight, was developed by using the GM refrigerator with  $\text{Er}_3\text{Ni}$ . This SIS receiver was installed on the 45 meter antenna at NRO and has been used for radio astronomical observations more than 3000 hours.

## REFERENCE

(1) T. Kuriyama et al., Jpn. J. Appl. Phys. **31** (1989), p.1206.

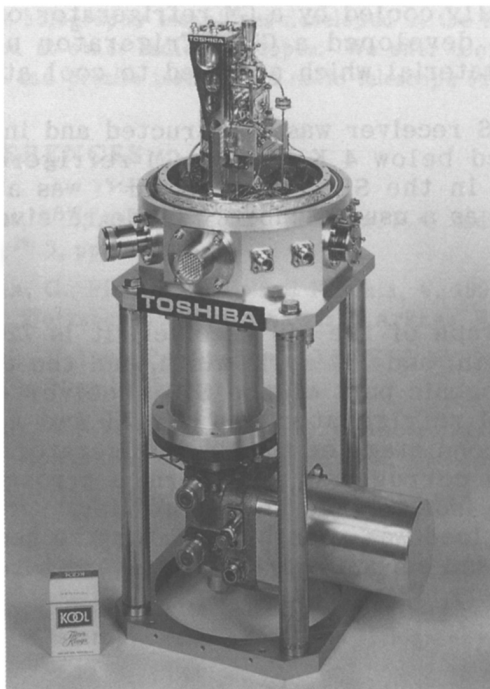


Figure 1  
Photograph of  
the SIS receiver