

## Space-qualified 4 K Cooler for 640 GHz SIS Receiver of SMILES

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We have built and tested a proto-flight model (PFM) of the 4 K cooler and its cryostat for SMILES 640 GHz SIS receiver. Tests have been conducted for the cooler and cryostat in mechanical, thermal and electric aspects, and also for the RF performance of SIS receiver accommodated in the cooler. Those tests have shown the cooler system meets all the specifications of the SMILES receiver.

The cooler system is composed of a two-stage 20 K Stirling cooler and a Joule-Thomson 4 K cooler. Narasaki et al. reported the design of those components and the cryostat in detail as well as the results of space-qualification tests at the CEC/ICMC conference, Anchorage, Sept. 21-26, 2003. Since then we have accumulated experience of running the cooler system while conducting the submillimeter receiver performance tests over the noise temperature, gain stability, quasi-optical characteristics and others. We are now confident on the cooling performance and its repeatability. Two SIS mixers are kept at a physical temperature that is adjustable below 4.5 K as shown in Fig.1. Its stability is better than 7 mK (peak-to-peak), which is limited by the variation of the room temperature that is not expected in orbit. We have also investigated the effects of mechanical vibrations and magnetic fluxes due to the compressors: the Stirling compressor is working at 15 Hz and the JT at 30 Hz. Although we find significant oscillations at these frequencies in DC bias lines of the SIS mixer, they are too small to affect the mixer performance. From the viewpoint of optical alignment, we measured the movement of the 4 K stage during the cool-down and warming-up periods. It is found repeatable and has been put into the whole mechanical alignment process of the cryostat. Those measured characteristics of the SMILES 4 K cooler will be reported with an emphasis on the effects to the SIS receiver performance.

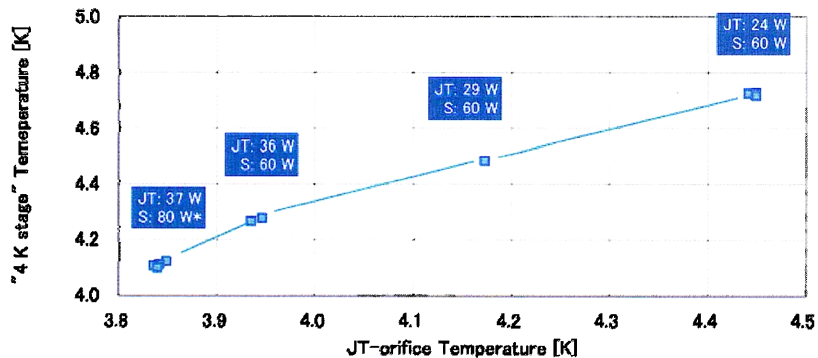


Fig.1 Temperatures of the cryostat "4 K" stage and JT orifice are adjustable by means of the AC power put into the JT and Stirling compressors (given in each box).

