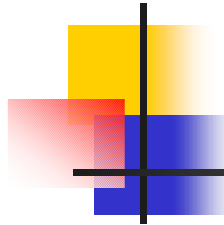




Collaboration on SMA & Development of Submm SIS Mixers*

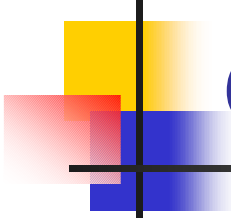
*Sheng-Cai Shi, Ji Yang & PMOSMA Team
Purple Mountain Observatory/NAOC
CAS, Nanjing*

**PMO/IAA*



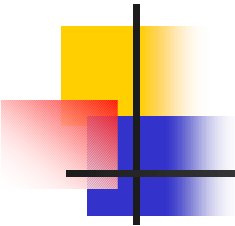
OUTLINE

- Collaboration on SMA
- On-site Assembly & Testing
- Development of Submm SIS Mixers
- Future Work



Collaboration on SMA

- What to Do in Submm at PMO
 - *discussion about CSA around 1998*
 - *site testing at QingHai at 492GHz (1999-)*
 - ✍ limited resources (manpower, site, budget, etc.?) ✍ to start from 1-2 10-m telescopes?*
- Why Collaborate with ASIAA
 - *2000.2-4, Yang & Shi invited to visit ASIAA*
 - *extensive discussion with Prof. Fred Lo*
 - ✍ consensus reached on the importance & feasibility of such a collaboration!*



MOU on Collaboration in Mm/Submm Astronomy between PMO and ASIAA (2000.6)

Memorandum of Understanding
on
Collaboration in Millimeter- and Submillimeter-wave Astronomy
between
the Academia Sinica Institute of Astronomy & Astrophysics
and
the Purple Mountain Observatory

The Academia Sinica Institute of Astronomy & Astrophysics (ASIAA) and the Purple Mountain Observatory (PMO) have reached a consensus on the importance and feasibility of a collaboration in millimeter- and submillimeter-wave astronomy.

The PMO will participate in the ASIAA efforts on the Sub-Millimeter-wave Array (SMA), which is a unique 8-element interferometer array operating between 176 GHz and 900 GHz, sited on Mauna Kea in Hawaii, being jointly constructed by the Smithsonian Astrophysical Observatory (SAO) and the ASIAA. The PMO participation in the ASIAA efforts on the SMA will include the joint R&D of submillimeter SIS receivers (450-, 660- and 850-GHz bands) with the ASIAA, the contribution of two 345-GHz SIS receiver modules to the specifications of the SMA, involvement in the system assembling of the two antennas being constructed by the ASIAA, in both Taipei and on Mouna Kea, and in the ASIAA share of the SMA operation in Hawaii. The PMO will also participate in the science use of the SMA via collaborative projects with the ASIAA, up to the equivalent of 15% of the ASIAA share of the SMA observing time.

The collaboration between the ASIAA and the PMO will also include exchange of personnel such as students, postdocs, technical and research staff. The local expenses will be paid by the host institute. The two institutes will exchange general information on millimeter-wave and submillimeter-wave astronomical research and development.

Through this collaboration, the two institutes will endeavor to participate jointly in the international project of the Atacama Large Millimeter-wave Array (ALMA.) The two institutes have recognized that the strengthening of the mm and submm scientific efforts and the joint R&D of submillimeter SIS receivers, and other related technical areas, at both institutes will be important to their future participation in ALMA.

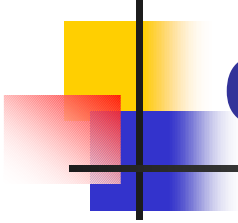
The ASIAA is building the Array for Microwave Background Anisotropy (AMiBA) project in collaboration with the National Taiwan University. The PMO will explore the possibility to collaborate on the AMiBA project.

Prof. K.Y. Lo, Director
Institute of Astronomy & Astrophysics
Academia Sinica, Taipei

2000 June 8

Prof. B.K. Lu, Director
Purple Mountain Observatory
Chinese Academy of Sciences, Nanjing

2000 June 8



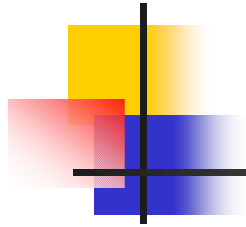
Collaboration on SMA (contd)

- Major Tasks

- *joint R&D of submm SIS receivers*
- *contribution of two 345-GHz SIS receivers*
- *joint on-site testing & operation*
- *joint science use of SMA (~15% of ASIAA share)*

- Team structure

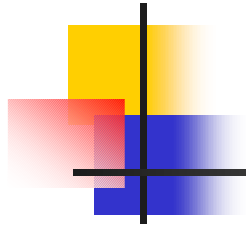
- *J. Yang & S.C. Shi, R.Q. Mao, Y.X. Zuo, Q.J. Yao, C.H. Sun, S.P. Huang, W.L. Shan, W. Zhang*
- *astronomers from other institutions*



On-Site Assembly

(ASIAA Team + Yingxi, Qijun)

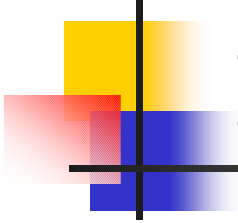
- Sub-ref & Chopper Assembly of Ant #8
- Debug PMAC Software



On-Site Tesing (Ant#7)

(ASIAA, SMA Team+Ruiqing & JY)

- Single-dish Pointing (Optical & Radio)
- Focusing, Tilt
- Radio Interferometric Pointing (iPoint)
- Beam Pattern, Antenna Efficiencies
- Holographic Measurement



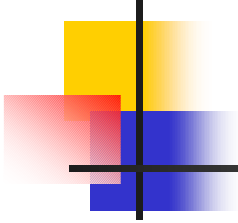
Development of Submm SIS Rxs

- Team

*SC, WenLei, Wen (PMO) &
ChiChung, MingJye, HongWen (IAA)*

- Frequency Bands

- *660-GHz band (600-720GHz)*
- *850-GHz band (787-950GHz), & 345-GHz band*

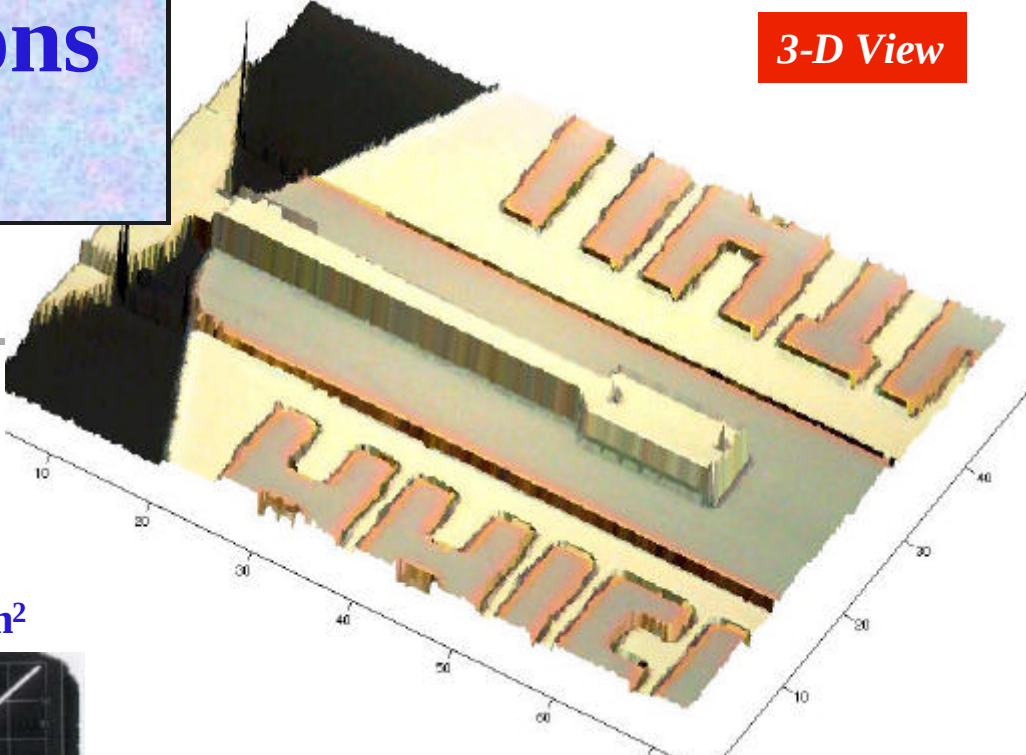


A 600-720 GHz SIS Mixer

- Mixer mount: *WG type (SAO design)*
 - feed-point imped.: $\sim 35 \text{ ?}$
- SIS Junction: *twin-junction design*
 - J_c : 10 kA/cm^2
 - Junction area: $1.2 \times 1.2 \text{ mm}^2$
 - $? R_n C_j$ product: $\sim 6.9 \text{ @ } 660 \text{ GHz}$
 - R_n : 13.6 ohm

ons

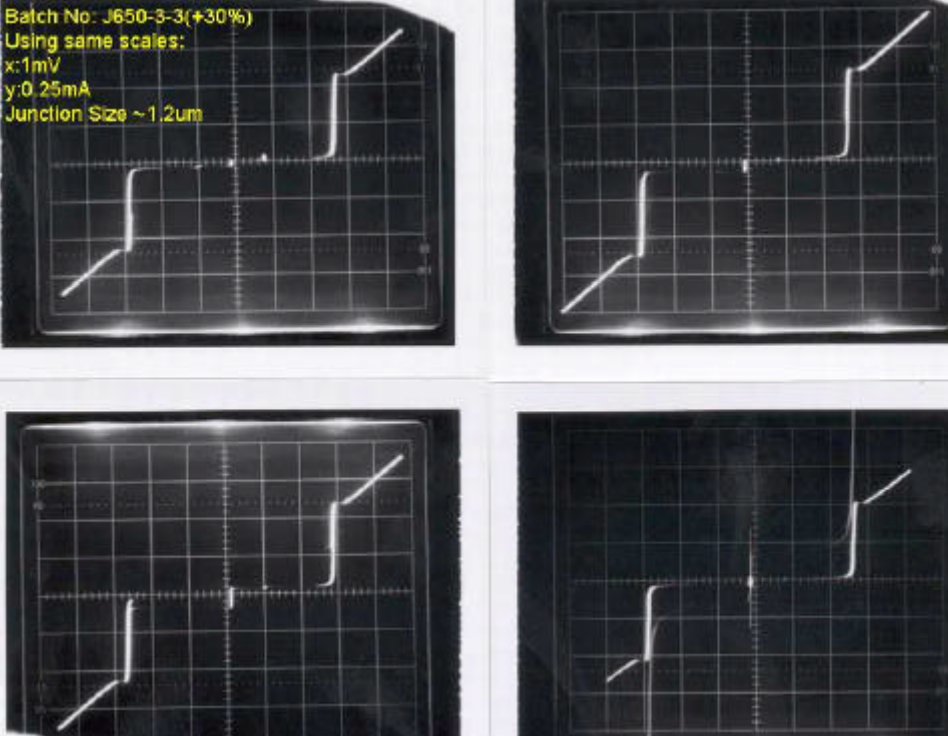
3-D View



m²

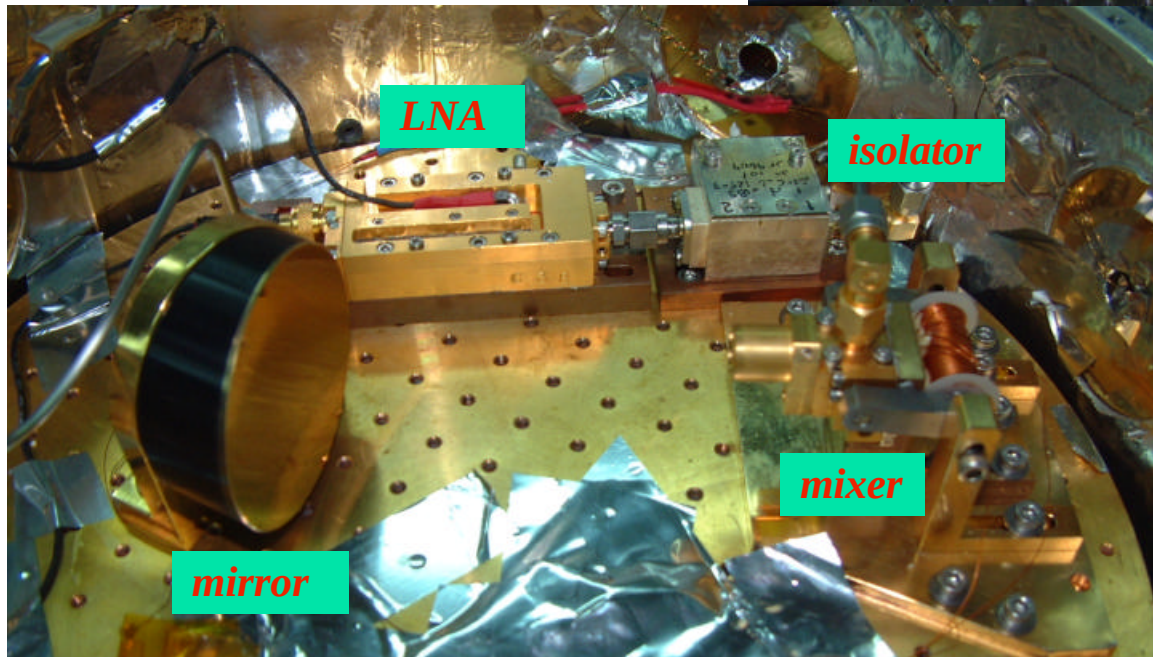
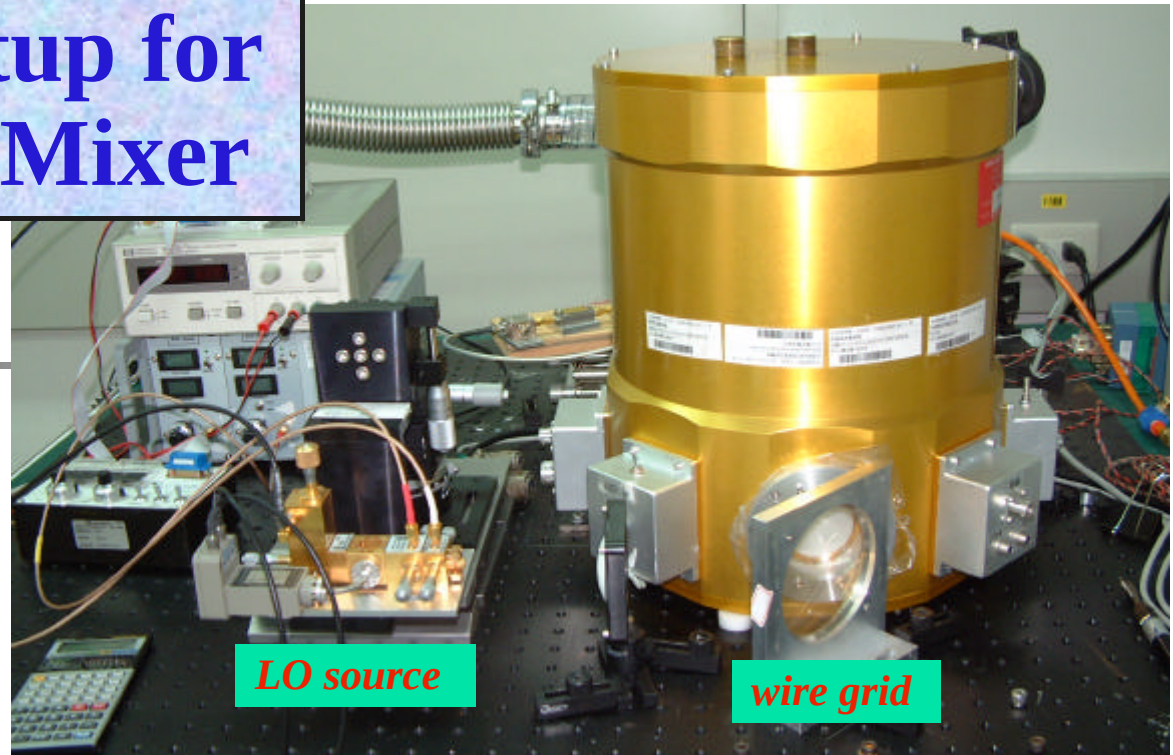
A 3D perspective view of a building layout. The layout is shown on a grid with axes labeled 10, 20, 30, 40, 50, and 60. The building is composed of several rectangular blocks, some of which are colored red and others yellow. A central area is colored green. The building is surrounded by a black area, possibly representing a road or a boundary. The text '3-D View' is written in red on a black background in the top right corner. The text 'ons' is written in blue in the top left corner. The text 'm²' is written in blue in the bottom left corner.

Batch No: J650-3-3(+30%)
Using same scales:
x:1mV
y:0.25mA
Junction Size ~1.2 μ m

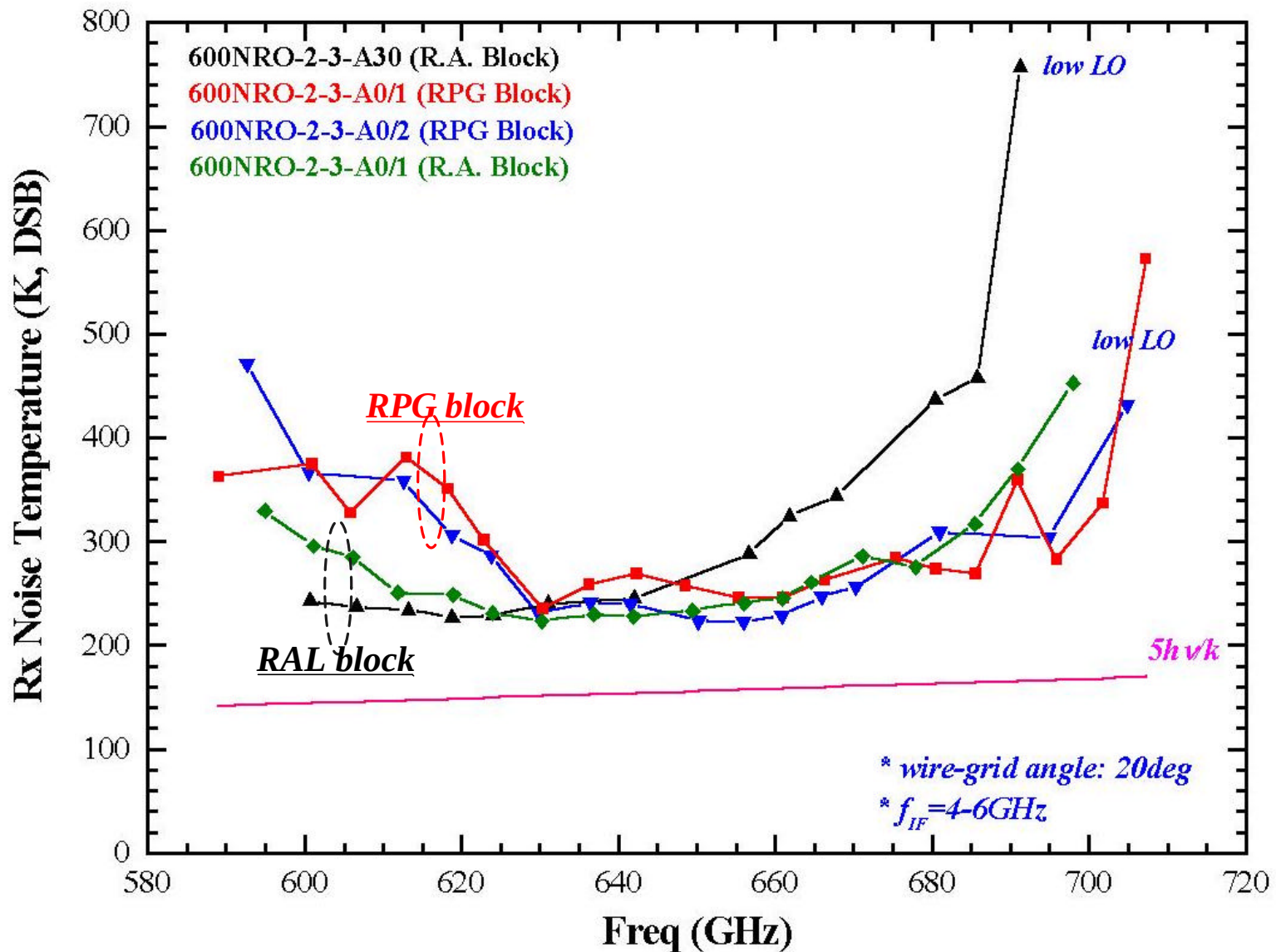


A micrograph showing the SIS junction and transformer region. Labels include: *feed* (red arrow pointing to the input), *Nb* (red text for niobium), *SiO2* (red text for silicon dioxide), *SIS* (blue text for the superconductor-insulator-superconductor junction), *transformer* (blue text for the transformer region), and *tuning L* (blue text for the tuning inductor). Blue arrows point to the junction and the tuning inductor.

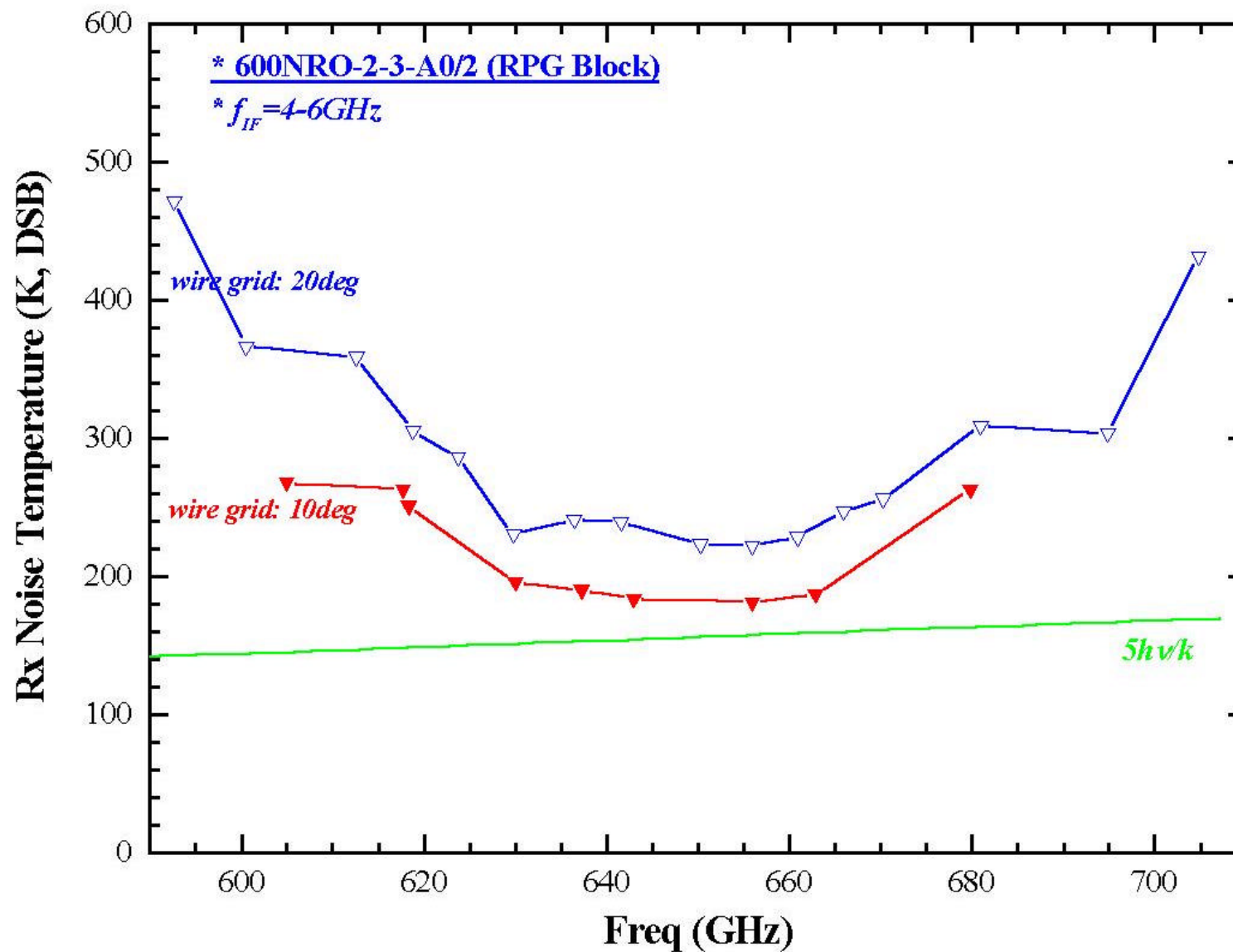
Measurement Setup for 600-720GHz SIS Mixer

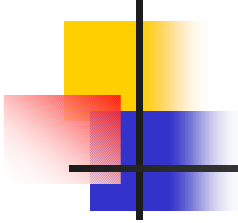


Measured Results for Twin Junctions-I



Measured Results for Twin Junctions-II





Future Work

- To continue to take part in on-site testing;
- Joint astronomical research with SMA;
- To improve the 660-GHz SIS receiver;
- To start the R&D for the 800-GHz band rx;
- ...