The Institute of Applied Astronomy of the Russian Academy of Sciences

The S/X/Ka receiver system for radio telescope RT-13 of Quazar VLBI Network


IAA RAS has already established two-element radio interferometer which consists of two radio telescopes with dish diameter of 13.2 m. Each radio telescope is equipped with a specially designed receiver system. The main feature of this system is the cryogenic receiver unit that includes cooled tri-band feed and LNAs. Such design makes possible to achieve high sensitivity to receive weak noise signals of cosmic origin. As well, feed design allows to receive signals in three frequency bands S (2.2-2.6 GHz), X (7.0-9.5 GHz) and Ka (28-34 GHz) both in LCP and RCP simultaneously.

The parameters of the RT-13 radio telescopes of the “Quasar” VLBI network of the IAA RAS in S/X/Ka bands

Vekshin Y. (Institute of Applied Astronomy, Russia)

For calibration and measurement operation, noise temperature of our receiver unit is used two points method, which requires two noise sources with different RF brightness temperatures. For example ambient temperature “hot” load and liquid nitrogen temperature (“cold” load). This plot illustrates typical calibration process for the start using the hot load, in the next step, using the cold load and then finally using the sky. If we inject some noise into the feed, that we can calibrate this signal too.

The main features of FCUs such as gain and noise figures are presented in table 1 for each channel. Gain plots of the FCUs are given in fig. 10-11. There are only one plot for each FCU are presented.

The main features of the RT-13 radio telescopes of the “Quasar” VLBI network of the IAA RAS in S/X/Ka bands

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For injection of calibration signals we use coaxial connectorized modules for electrical injection and radiocontact. For the selected receiver design with the feed placed inside the cryogenic receiver, it is possible to measure the injection noise signal with standard methods using traditional matched loads. This objective is based on the use of complex calibration systems of the telescope noise figure. The main element of this calibration system is a low-noise preamplifier unit. It is a low-temperature wide-aperture radiator (LTW AR) designed by Russian Institute of Federal agency on Technical regulating and metrology. Special broadband matched load was applied for measuring the noise temperature of cryostat. It is a low-temperature wide-aperture load, which is placed in a chamber where it is kept at liquid nitrogen. The load is mounted on a mobile base, allowing to match it with the device under test during the movement. The difference between the load and coolant is very low to reduce the influence of moisture in the air. This equipment provides scalable load. For a given load the ambient material plate with the room temperature is applied.

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