

Development of Wideband Antennas

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Abstract Wideband antennas are developing a next generation radiometer and wideband feed horns for upgrading of conventional Cassegrain antennas. This next generation radiometer uses a 16–64 GHz feed horn for observing water vapor spectra (22-GHz band), water drops in clouds (30-GHz band), oxygen (50-GHz band), and VLBI. Wideband feed horns for upgrading radio telescopes are designed for 1.5–15.5 GHz with a narrow beam of 15 degrees in the subtended angle of the sub-reflector.

Keywords Wideband, VLBI, radiometer

1 Introduction

Wideband feeds and OMTs developed for Gala-V have simple structure that can be easily arranged for higher frequency. Thus, the next generation radiometer has been developed with 16–64-GHz wideband feeds. The feed can be used with parabola or Cassegrain optics, because the beam width of the feed is easily changed to fit the optics. Further, it has been explored to extend the bandwidth with a narrower beam to other Cassegrain antennas in a simulation study. These activities are reported here.

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2 Next Generation Radiometer

Water vapor measurement experiments were done by the BBM of the K-Band multimode horn for the VSOP-2 satellite set on the 3.7-m antenna of NICT Okinawa in 2019. But the development was slowed down by COVID-19. The OMT and feed horns for 16–64 GHz were developed in 2020 and tested at Kyoto University in 2021. And now, 900 mm Cassegrain for a portable radiometer with high resolution is being developed at Kyoto University. The main mirror is a spun aluminum parabola dish, that is the same technique to make MARBLE dishes, but the surface is more accurate for higher frequency. The mirror is supported by CFRP pipes and is easy to assemble and disassemble for the transportation through the stairs and doors of buildings. This system can be also used for VLBI in K/Q band or receiving satellite signals. In 2022, water vapor measurement experiments will be done at NICT Kashima, and VLBI experiments will be done with the Mizusawa 10-m dish at NAOJ.

3 Wideband Feed

Wideband feed horns for 1.5–15.5 GHz with a narrow beam have been developed in simulations. Based on the original designs of the IGUANA feed, it will be the coaxial feed. Using the third model of the IGUANA feed for Kashima 34-m, a 2.2–22 GHz test feed will be made.

4 Wideband OMT

The OMT of the radiometer delivers one linear polarization to the LNA for 16–34 GHz, and the other to the LNA for 26–62 GHz. They were tested at room temperature with wideband horns at Kyoto University. The LNA will be cooled by a stirling cooler; thus their bandwidth cannot cover the whole band. The first design of the OMT used TSA in the waveguide to make a thin ridge. The second design will be a quad-ridged waveguide, because factories in Japan are now in normal operation. These quad-ridged waveguide OMTs can have a sharp cut-off frequency to suppress RFIs in the same way as the Gala-V system.

5 Conclusions

Development schedules were delayed by COVID-19, but various wideband feeds and OMTs have been developed (Figure 1) and are waiting for experiments. Results will be presented at the next General Meeting.

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Fig. 1 Developed wideband feed and OMT for next generation radiometer at NICT Kashima.

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