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Development of Wideband Antennas

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Development of various wideband antennas will be presented. After the development of 3.2-16 GHz feed for the Cassegrain focus of NICT(National Institute of Information and Communications) Kashima 34 m antenna and two 2.4 m portable VLBI stations, named MARBLE-1 and 2, for the VLBI experiment Gala-V[1,2], 16-64 GHz wideband radiometer, 1.5-15.5 GHz narrow beam wideband feed and their OMTs are now under development.

This wideband radiometer is developed to observe water vaper distribution in the atmosphere. That also observe water drop in clouds and oxygen spectrum by wideband feed simultaneously and can correct observed water vapor spectrum to improve the estimation by subtraction of fitted spectra without assumptions on derivation from the pressure measured at the antenna position. Observed spectrum is a integrated spectra of water vapor or oxygen along the line of sight altitude, they are deformed by pressure and temperature distribution from the surface of the earth to the top of atmosphere. Portable 900 mm dish with wideband feed can decompose the elements and enables fine spatial resolution nearby horizon. Or, the wideband receiver and feed systems can be used for VLBI observations with simultaneous water vaper observation to estimate the delay time caused by it. This system was tested at NICT Okinawa 3.7m antenna and at the roof top of Kyoto University. Now the receiver system are reassembled for easy operation. This study is supported by JSPS KAKENHI Grant Number 21H04524.

The wideband feed for 1.5-15.5GHz is designed for an upgrade device of large radio telescopes. It will be set on the secondary focus of Cassegrain optics, thus its beam width should be fit for small subtended angle of the sub reflector. Several derivations from the initial designs of coaxial feed for Gala-V were tested in numerical simulations to make narrower beam width and wider bandwidth than Gala-V.

Each wideband feed is used with a suitable OMT(Orthogonal Mode Transducer) to handle both of two linear polarizations. RFI(Radio Frequency Interference) in lower frequency than observation band can be suppressed by the OMT. For an example, a wideband feed for 6.7-43GHz do not have to observe 7-8GHz for radio astronomy use, thus ripples in return loss can be accepted to cut RFI sharply under 6.5 GHz nearby 6.7 GHz methanol maser. Several designs of wideband quad ridged waveguide OMT with or without sharp cut-off, and also another type of OMT with grounded coplanar line design for 16-64GHz were designed for the radiometer and wideband VLBI[3].

References

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