Development of wideband circular polarizer in 70-118 GHz band

Sho Masui[1], Yutaka Hasegawa[2], Toshikazu Onishi[1], Hideo Ogawa[1], Satoshi Ochiai[3], Issei Watanabe[3]

VLBI (Very Long Baseline Interferometer) observations generally require circular polarized detection. Since these radio signals are extremely weak, radio-astronomical receivers are usually operated at cryogenic temperatures to have very low noise performance. Septum type polarizers or a combination of an OMT (Orthogonal mode Transducer) and a 90-deg differential PS (Phase Shifter) can be employed in millimeter-wave receivers for dual-circular polarization observations. Septum type polarizer is usually used to observe circular polarization in satellite communications or low frequency VLBI receivers, because of its low insertion loss and compact structure. However, the fractional bandwidth of septum type polarizer is limited less than 25 %. On the other hand, a combination of an OMT and a 90-deg differential phase shifter has a potential for realizing much wider-bandwidth circular polarizer. Since OMTs have wideband performance generally [1], it is important to develop a broadband 90-deg phase shifter for wideband circular polarization observations in VLBI.

A reported fractional bandwidth of wideband PS is so far up to 30 % [2]. The fractional bandwidth of PS is limited by the frequency dependence of the phase shift. To decrease the frequency dependence of the phases, we examined whether a wideband phase shifter could be developed by combining PSs with different phase shift characteristics. Then we have discovered that ridge type PS and corrugated type PS have different characteristics. We have designed and fabricated wider band PS by combining the corrugated and ridge structures, and obtained a good performance with the fractional bandwidth of ~50% at 70-118 GHz (Fig. 1). We also designed and fabricated a wideband OMT with the fractional bandwidth of ~50% at 67-116 GHz. We are currently assembling to its wide band PS and OMT, and measuring the characteristics of wideband circular polarizer.

At the conference, we will present the measurement performance of wideband circular polarizer.

[1] Osaka Prefecture University, Sakai, 599-8531, Japan.
[2] Institute of Space and Astronautical Science, Sagamihara, 252-5210, Japan.
[3] National Institute of Information and Communications Technology, Koganei, 184-8795, Japan.

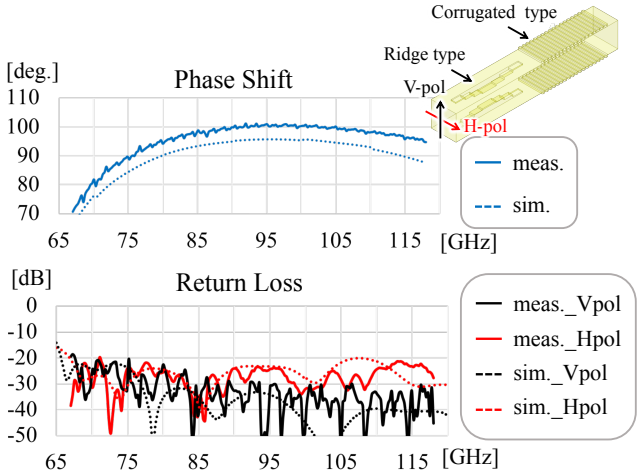

Fig. 1. Simulation and measurement performances of the broadband PS composed of ridge type and corrugated type PS. Upper graph shows the phase differences between each polarization. Lower graph shows the return loss.

References

[1] Alvaro Gonzalez, "Double-Ridged Waveguide Orthomode Transducer (OMT) for the 67–116-GHz Band," *J Infrared Milli Terahz Waves,* vol. 39, pp 723–737, Aug. 2018

[2] Moon-Hee Chung, "Development of 85-115 GHz 90-deg Phase Shifter using Corrugated Square Waveguide," *Proceedings of the 44th European Microwave Conference*, pp. 1146-1149, Oct. 2014

NOTES: