

Contribution ID: 9

Type: **Oral Contribution**

Development of Octave-band Planar Ortho-Mode Transducer with MKID for LiteBIRD

Friday, 24 June 2016 10:20 (25 minutes)

LiteBIRD is a next-generation satellite mission for measuring the primordial B-modes polarization signals of CMB. We describe a design of octave-band corrugated horn coupled planar ortho-mode transducer (OMT) with Microwave Kinetic Inductance Detector (MKID) as a candidate detection technology for LiteBIRD.

In our design, each single pixel contains 90 and 150 GHz two frequency bands, covering the maximum power part of CMB polarization signal. Through a 2.4 mm diameter circular waveguide, polarization signal are coupled to the 4-probe planar OMT structure silicon membrane, below which a backshort structure with quarter wavelength is fabricated by deep reaction-ion etching from the backside of silicon on insulator wafer.

After planar OMT, a broadband coplanar waveguide (CPW) 180-degree hybrid is used to cancel higher modes from circular waveguide. An Al/Ti center strip acts as absorber to absorb higher modes signal and TE₁₁ signal is transmitted to a CPW-to-microstrip (MS) transition structure for connecting MS 5-element Chebyshev diplexer and following MKID. For coupling signal to MKID, the center strip of MKID acts as ground of MS and absorber to generate quasi-particle. For testing, a 4-pixel model is designed, containing 16 MKIDs and 4 dark MKIDs. MKIDs are designed with Nb ground plane and Al/Ti bilayer center strip line to achieve low frequency response and high sensitivity.

The 4-pixel broadband corrugated horn array is fabricated with high accuracy direct machining. Measurement shows that S₁₁ parameter is lower than -10 dB from 80 GHz to 170 GHz and agree well with simulation. After calibration and testing, this prototype will be installed on Nobeyama 45-m telescope.

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Session Classification: Session 6: MKIDs for optical, infrared, and millimeter wave telescopes

Track Classification: MKIDs for optical, infrared, and millimeter wave telescopes