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A New Mulitband Receiver for the ALMA Prototype 12 m Telescope of the Arizona Radio Observatory

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A new receiver has been designed, constructed, tested, and now is in full operation at the 12 m telescope of the Arizona Radio Observatory (ARO). The receiver package consists of four separate, dual polarization, frequency bands in a modular cryostat with rapid band selection through a simple mirror assembly. The four bands cover the astronomically important atmospheric windows at 1.2, 2, 3, and 4 mm. In the 3 mm and 1.2 mm wavelength regions, the receiver employs ALMA Band 3 (84 -116 GHz) and ALMA Band 6 (211-275 GHz) sideband-separating (SBS) SIS mixers, while at 4 mm (67-90 GHz), cryogenic HFET amplifiers obtained from the National Radio Astronomy Observatory (NRAO) Central Development Laboratory (CDL) are used. Sideband separation for the 4 mm band is achieved through a room temperature E-band down-converter developed at ARO. The 2 mm band (125-180 GHz) consists of SBS mixers developed from the device level by Arizona in collaboration with NRAO CDL and the University of Virginia Microfabrication Lab (UVML). The 2 mm window is consequently accessible by a single broadband mixer, which covers all of ALMA Band-4 (125-157 GHz) and 40% of ALMA Band-5 (157-211 GHz). The mixer chip has a series array of four SIS junctions, similar to that of ALMA Band 6. The new 2 mm mixers have typical noise temperatures < 45 K across the 125-180 GHz range (Figure 1), with image rejection > 15 dB at most frequencies. The 2 mm mixers have proven to be exceptionally robust, with system temperatures ~ 100 K on the sky at moderate elevations and in good weather conditions, and with excellent baseline stability, even when position-switching by 1 degree. For polarization separation, all four bands utilize a waveguide orthomode transducer (OMT) based on designs from the NRAO CDL for the 1.2 mm and 4 mm bands, and from the National Research Council of Canada (NRC) for the 2 mm and 3 mm bands. Scientific measurements are currently underway in all four frequency regions. New astronomical results will be presented.

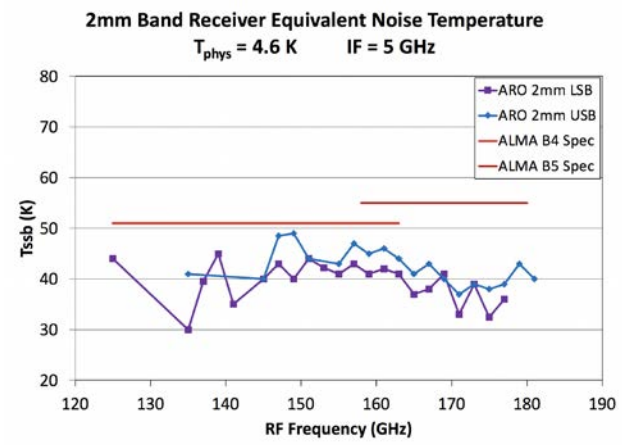

Figure 1. Noise performance of the 2 mm band mixers for the new receiver. These 125-180 GHz mixers are significantly better than the ALMA specifications for Bands 4 and 5 and cover a wider frequency range than ALMA Band 4.