

V102a ALMA band 2 (67-116 GHz) and 7+8 (275-500 GHz) receiver optics

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At NAOJ, we are working on the development of wideband receivers for radio astronomy, with a focus on high-current-density SIS mixers and on receiver optics. In particular, we are collaborating on the development of two receivers to cover two ALMA bands simultaneously: the ALMA band 2 receiver (to cover ALMA band 2 and 3, 67-116 GHz) led by ESO; and the ASTE band 7+8 receiver (275-500 GHz) in collaboration with KASI. The fractional bandwidth of these target bands is around 55-60%. From the point of view of receiver optics, the band 2 design uses a dielectric lens to focus the radiation coming from the Cassegrain antenna onto the corrugated horn in the receiver; whereas in the case of band 7+8, it uses a pair of cold ellipsoidal mirrors (at 4K). However, in both cases, behind the lens or mirrors, the design uses a corrugated horn followed by a waveguide OMT to separate orthogonal linear polarizations. Since the bandwidth is approximately the same, band 2+3 components have been fabricated firstly, to demonstrate the validity of electromagnetic designs, and then, upon successful measurements, band 7+8 prototypes have been fabricated and tested. This approach allows to divide the validation of sub-mm wave components (whose fabrication is very challenging) in two steps: validation of the design, and validation of the fabrication methods. In this paper, we will present the design and measurement results of corrugated horns and waveguide OMTs for the 67-116 GHz and 275-500 GHz bands, to be used for prototype receivers for ALMA and ASTE, respectively.