Installation and testing of the wSMA prototype receiver system

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***Abstract*—For the past several years, the Submillimeter Array has been developing the wideband Submillimeter Array (wSMA) upgrade. This upgrade includes the complete replacement of the aging SMA receiver systems with new receiver systems consisting of a new cryostat, receiver cartridges, SIS receiver front ends, receiver optics, local oscillators and IF processor. Following extensive laboratory testing, the prototype receiver has recently been installed in an SMA antenna for on-sky testing. We describe the prototype receiver, the deployment and commissioning process and the results of on-sky testing.**

***Keywords*—Heterodyne receivers, astronomical instrumentation.**

I. Introduction

The Submillimeter Array[2] has operated with its current receiver systems since its commissioning in 2003. In 2015, we began the design of the wideband Submillimeter Array upgrade, a complete redesign of the receiver and other systems with the aim of improving the sensitivity, and increasing the throughput, of the SMA, while also replacing the aging cryogenic systems.

The wSMA upgrade consists of new cryostats for each of the SMA antennas, containing cooled receiver selection optics and two receiver cartridges, each of which house new integrated dual polarization receivers based on DSB SIS mixers optimized for wide IF bandwidth. New receiver control electronics and local oscillator modules and an IF processor complete the wSMA receiver system.

The wSMA receivers will provide two frequency bands for the SMA, with LO frequencies from 210-270 GHz and 280-360 GHz, and IF bandwidths from 4-20 GHz. By using wire grid polarizers and optical diplexers [1] in the cooled receiver optics, dual frequency observing in either single or dual polarization modes will be possible. The two polarization channels of each receiver band can be independently tuned, allowing for "split" LO tunings that provide greater on-sky instantaneous bandwidth.

The first prototypes of the new cryostats and receiver cartridges were delivered during the pandemic in 2020 and 2021. After extensive laboratory testing of the cryostats, integration of receiver frontends to the cartridges, testing of new receiver electronics and local oscillator modules, and performance testing of the full receiver system, one prototype receiver was delivered to the SMA site in early 2023.

Fig. 1. Photo of the prototype wSMA receiver installed in SMA Antenna 7.

We are currently installing this prototype receiver into an SMA antenna, for commissioning checks and on-sky testing. In this paper we will describe the design of the prototype receiver, discuss the results of laboratory performance testing, the receiver commissioning, and early results of on-sky testing.

[1] Carter et al, "A Low Loss Optical Diplexing Scheme for Millimeter to Terahertz Waves," to be presented at ISSTT2024.

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