

wSMA Receiver Cartridges

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Abstract—The wideband Submillimeter Array (wSMA) is an ongoing upgrade project for the SMA to replace the aging original receiver cryostats and receiver cartridges with all new cryostats and wideband 230 and 345 GHz receivers. In this report, we will describe the design, fabrication, assembly, and the measurements of the wSMA receiver cartridges. The receiver elements are installed on a floating 4 K stage, which maintains alignment of the receiver in the cold.

Keywords— Coherent detectors, SIS, submillimeter wave technology, radio astronomy, receivers.

I. INTRODUCTION

The Submillimeter Array (SMA) is an array of eight antennas operating at millimeter and submillimeter frequencies on Mauna Kea, Hawaii. First commissioned in 2003, the SMA has been operating for over 20 years. At present, the frequency coverage of the SMA is from 180 to 420 GHz. The wideband Submillimeter Array (wSMA) is an ongoing upgrade project to replace the SMA cryostats and receiver cartridges with all new cryostats and wideband 230 and 345 GHz receiver cartridges.

Each wSMA cryostat consists of one 230 GHz (low band) and one 345 GHz (high band) receiver cartridge. As shown in Figure 1, both low band and high band cartridges share identical receiver optics. The low band receiver has a Local Oscillator (LO) covering 210 – 270 GHz and the high band receiver has a LO range from 280 GHz to 360 GHz. The output Intermediate Frequency (IF) bandwidth is 4 – 16 GHz in the current operation. It will be expanded to 4 – 20 GHz in future upgrades.

The wSMA receiver cartridge bears two major mechanical features. One is a pair of Automatic Thermal Links (ATL), through which the 50 K plate and a fixed 4 K plate are thermally connected to the cryostat in operation. The other feature is the introduction of a separate floating-4K stage, which carries the receiver optics, frontend assembly, and mixers. It is designed to be able to be mechanically registered to the top 50 K plate of the cryostat so that the receiver beams may achieve the required optical alignment accuracy. There are thermal links connecting the floating-4K and fixed-4K plates.

Both low band and high band receivers are dual polarization receivers. The frontend assemblies consist of a profiled-

corrugated horn, an Orthomode Transducer (OMT), two couplers based on silicon chip technology and a 90 deg waveguide twist for compact integration.

We will present the design, fabrication, and measurements of each component of the wSMA receiver cartridges, along with the measurement results assessing the overall receiver performance.



Fig. 1. Photo of a wSMA receiver cartridge. The upper section comprises the receiver optics, coupling the signals from the cryostat optics to the frontend assembly located inside the base of the receiver optics. The 4K plate is divided into a floating-4K and a fixed-4K stage for optical alignment purposes. The image also shows the 50K plate, the lower 300K plate, and the G10 shells providing support between the stages.

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