DESERT STAR AND SUPERCAM: HETERODNE ARRAY RECEIVERS FOR THE 870 MICRON ATMOSPHERIC WINDOW ON THE HEINRICH HERTZ TELESCOPE

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We present two heterodyne array receivers built for the Heinrich Hertz Telescope and the 870 μm atmospheric window. These instruments have been optimized for wide-field spectroscopic imaging, in particular molecular Galactic plane surveys. DesertStar is a 7 pixel system based on discrete, tunerless mixer technology. This system saw first light in 2003, and is entering routine operation in fall, 2005. The instrument offers ∼55K DSB receiver noise temperatures, a 2 GHz instantaneous bandwidth, and is tunable from 315-375 GHz. The LO source is a Virginia Diodes synthesizer driven planar diode multiplier chain that delivers at least 1 mW across the band. The array is flood illuminated with a large LO beam, making complicated LO diplexing unnecessary. The initial backend is a filterbank spectrometer that offers 8, 256 MHz channels and 1 MHz resolution. DesertStar will increase imaging efficiency at the HHT by more than an order of magnitude over the existing dual polarization receiver system. SuperCam is a 64 pixel array receiver, which will use integrated mixer technology. This receiver, begun in fall, 2004, has a focal plane based on 1x8 mixer modules, with integrated MMIC low noise amplifiers. Each waveguide mixer is based on the proven DesertStar design, but eight are integrated into a single block. Eight MMIC LNA modules are also mounted in the block, with an integrated bias tee and input matching network. These LNA modules offer ∼30 dB of gain, a 2-9 GHz IF, and ∼5K noise temperature, while dissipating only ∼5 mW of heat. The mixer module is designed to use blind-mate connectors to allow easy assembly and service. Cryogenics are provided by a Sumitomo closed cycle 4K cryocooler augmented with a CTI 15K cryocooler for dedicated cooling of the IF semirigid cable. The local oscillator is a Virginia Diodes system similar to the DesertStar source, but designed for higher power and moderate-bandwidth. A waveguide LO diplexer will divide the LO into 64 beams with precisely defined optical properties and power balance. For a wide field of view, the instrument will be mounted at the cassegrain focus of the telescope. A new f/7 composite secondary will be fabricated to replace the existing f/13.8 secondary during SuperCam operation. A two-lens AR-coated reimaging system will then reduce the f/7 telescope beam to f/5 to match the focal plane. The backend will be either a 64 channel × 1 GHz/512 MHz correlator with 1024 lags per channel, or a 64 channel × 512 MHz realtime FFT system based on high speed digitizers and FPGAs. We hope to have the system ready for first light with one 1x8 mixer module in fall, 2006, with the full array completed by fall, 2007.

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