

## Receiver Optics and 1.9 THz HEB Mixers for STO

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*Abstract*—We present results of our work on the receiver optics and the 1.9 THz waveguide hot electron bolometer (HEB) mixers for the Stratospheric Terahertz Observatory (STO). The balloon-borne STO is a 0.8 m telescope using 4-pixel HEB mixer focal plane arrays to survey selected regions of the Galactic Plane in the [NII] and [CII] spectral lines at 1.461 THz and 1.901 THz, respectively. The receiver optics and the 4 HEB mixers at 1.9 THz are the KOSMA hardware contribution to the STO project.

The cold optics unit provides the mounting point of the two focal plane units (FPU), each with four HEB mixers, to the integrated imaging optics and employs a cryogenic polarizer grid for overlay of both array beams.

The warm receiver optics unit includes the LO mounts and the Fourier grating mirrors, which split the LO beam into an array of four beams. Instead of a more common Martin-Puplett Interferometer (MPI), we use a multi-beam Fabry-Perot Interferometer (FPI) with polarizer grids as diplexer for each frequency. Compared to the MPI, the FPI, centered at 1.5 GHz, provides a larger IF bandwidth for the receiver. Both optical units including the mirrors are machined from one piece or assembled from as few parts as possible. This monolithic approach ensures sufficient alignment accuracy of the optics.

The FPU and a single pixel prototype FPI are characterized at 1.9 THz with waveguide mixers developed at KOSMA for STO. These mixers utilize a NbTiN HEB on a 2  $\mu$ m SiN membrane. The design is similar to the KOSMA 2.5 THz mixer, presented in a separate contribution to this conference, and uses beam leads for electrical contacts and registration to the waveguide environment. The waveguides have been made exclusively by stamping with different specially made carbon steel tools in CuTe blocks.