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Development of a HEB mixer for the observation of molecular hydrogen on SOFIA

Based on the successful development of superconducting THz Hot Electron Bolometer (HEB) mixers for the Stratospheric Observatory for Infrared Astronomy (SOFIA) [1], we are currently developing a HEB mixer for the high resolution observation of molecular hydrogen at 10.7 THz.

As Local Oscillator we will use a Quantum Cascade Laser [2], similar to that at 4.7 THz that has been implemented successfully by our group in the upGREAT receiver [1].

Contrary to our 4.7 THz mixer which is a waveguide mixer, we use an open structure mixer including a planar antenna and a dielectric lens. This type of mixer is successfully used up to a frequency of 5.3 THz [3].

The RF design of the mixer cannot completely be done with simulation solvers using spatial discretization into cells, as the cell dimensions are directly related to the wavelength of interest. As such, our computational resources prohibit the use of our commercial software CST design studio for the spatial discretization of the dielectric lens of the mixer design at 10.7 THz. We therefore use a hybrid approach calculating the planar antenna field in CST design studio and using an additional, in house developed, software to simulate the propagation of this field through a lens of arbitrary form to the focus. The software combines two techniques. It uses a plane wave decomposition of the initial field, which is propagated as rays based on the spectral theory of diffraction (STD).

We will present the current status of the RF design in detail, including our newly developed software.

References

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