Measurement Results of the Caltech Submillimeter Observatory 230 GHz and 460 GHz Balanced Receivers

J. W. Kooi*, R. R. Monje *, B. L. Force*, F. Rice*, D. Miller*, and T. G. Phillips*.

*Dept. of Physics
California Institute of Technology
Email: kooi@caltech.edu

Abstract

The Caltech Submillimeter observatory (CSO) is located on top of Mauna Kea, Hawaii, at an altitude of 4.2km. The existing suite of heterodyne receivers covering the submillimeter band is rapidly aging, and in need of replacement. To this extend we have developed a family of balanced receivers covering the astrophysical important 180-720 GHz atmospheric windows.

For the CSO, wide IF bandwidth receivers are implemented in a balanced receiver configuration with dual frequency observation capability1, 2. This arrangement was opted to be an optimal compromise between scientific merit and finite funding.

In principle, the balanced receiver configuration has the advantage that common mode amplitude noise in the LO system is canceled, while at the same time utilizing all available LO power. Both of these features facilitate the use of commercially available synthesized LO system. In combination with a 4 GHz IF bandwidth†, the described receiver layout allows for rapid high resolution spectral line surveys.

Dual frequency observation is another important mode of operation offered by the new facility instrumentation. Two band observations are accomplished by separating the H and V polarizations of the incoming signal and routing them via folded optics to the appropriate polarization sensitive balanced mixer.

Scientifically this observation mode facilitates pointing for the higher receiver band under mediocre weather conditions and a doubling of scientific throughput (2 x 4 GHz) under good weather conditions.

Not only do these changes greatly enhance the spectroscopic capabilities of the CSO, they also enable the observatory to be integrated into the Harvard-Smithsonian Submillimeter Array (eSMA) as an additional baseline.

The upgrade of the 345 GHz/650 GHz dual band balanced receivers is not far behind. All the needed hardware has been procured, and commissioning is expected the summer of 2010.

†The SIS junctions are capable of a 2-12 GHz bandwidth.

References

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