Introduction

The CO N Deuterium Observations Receiver (CONDOR) is a heterodyne receiver that operates at THz frequencies. Its primary goal is to observe star-forming regions in CO, N, and HD emission. CONDOR is a modular receiver that we anticipate deploying at several telescopes, including the Atacama Pathfinder EXperiment (APEX), a 12 m telescope in Chile, and the Stratospheric Observatory For Infrared Astronomy (SOFIA), a 2.7 m telescope mounted in a high-altitude aircraft.

To meet its scientific goals, CONDOR will cover a frequency range from 1250 to 1500 GHz. For Galactic observations, an intermediate frequency (IF) bandwidth of 1 GHz (~200 km/s) will be sufficient; for extragalactic observations, we anticipate upgrading the IF to up to 4 GHz. The greatest technical challenges are achieving a low receiver temperature and maintaining good system stability. It is particularly important to meet these challenges for ground-based observations, as both poor atmospheric transmission and imperfections in the dish surface lead to high system temperatures.

Design

The design follows that of a standard heterodyne receiver (see Fig. 1). The sky and local oscillator (LO) signals are combined and directed to the mixer, where the difference between the signals is produced. The IF signal is subsequently amplified and sent to the telescope’s spectrometer.

The mixer and the first amplifier of CONDOR need to be cooled to about 4 K. For APEX, where liquid helium is not readily available, a closed-cycle system with a pulse tube cooler is used. On board SOFIA, the components are cooled in a wet helium Dewar.

First Results

Currently, CONDOR has an IF of 1 – 2 GHz (214 km/s at 1400 GHz), which is sufficient for Galactic observations. In order to match the backend spectrometers of APEX and SOFIA, the IF is upconverted to 5-6 GHz. A wider IF of up to 4GHz is anticipated with the new generation of HEBs.

In the summer of 2005, tests of CONDOR and (in particular) of the HEB were performed in a helium Dewar. Receiver temperatures increase above 1.8 GHz due to a dysfunctional isolator that cuts off at that frequency. Stability measurements suggest a minimum in the spectral Allan variance times around 20 sec for the entire system (see Fig. 8). Although further efforts will be made to reduce the receiver temperature, the current system fulfills the requirements for astronomical observations.

Conclusion

We have built CONDOR, a 1.25 - 1.5 THz receiver, and successfully tested it in the lab. In November 2005, CONDOR successfully detected several sources in Orion during its “first light” observations on APEX (see poster by Volgenau et al. and Wiedner et al. 2006). We expect CONDOR to fly on SOFIA as the low-frequency extension of the 1.9 THz channel on the German REceiver for Astronomy at Terahertz frequencies (GREAT) in 2008. CONDOR is the only modular THz receiver worldwide, which puts us in a unique position to benefit from the new generation of submm telescopes.

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