CONDOR - AN ASTRONOMICAL HETERODYNE RECEIVER AT 1.25 - 1.5 THZ

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The CO N^+ Deuterium Observations Receiver (CONDOR) is a heterodyne receiver that operates between 1250 - 1530 GHz. Its primary goal is to observe star-forming regions in CO, N^+, and H_2D^+ emission.

The instrument follows the standard heterodyne design. It uses a solid state local oscillator (LO) fabricated by Radiometer Physics GmbH. This LO consists of a high frequency Gunn followed by a tripler and quadrupler and produces 1370 - 1500 GHz. Alternatively, a multiplier chain from Virginia Diodes allows us to extend the frequency range to 1250 - 1530 GHz. Since the power of the LO is only a few W, the LO and sky signal are overlaid with a Martin-Puplett interferometer. The heart of the receiver is a superconducting NbTiN hot electron bolometer (HEB) (see contribution by Muñoz et al.). The bolometer has an area of 0.25 x 2.8 m and is mounted on a SiN membrane in a waveguide mixer block. To facilitate operation at remote sites, CONDOR is the first receiver that cools the HEB with a closed-cycle system. Since HEBs are particularly sensitive to temperature fluctuations as well as modulations in LO power, we use a Pulse Tube Cooler, which has less vibration than, e.g., a Gifford McMahon cooler. In order to further minimize vibrations and temperature fluctuations, the mixer and first amplifier are mounted on a separate plate connected via flexible heat straps to the 4 K stage. To improve the matching at the intermediate frequency (IF) we inserted an isolator between the mixer and the cryogenic, high electron mobility transistor (HEMT) amplifier. This reduced the receiver temperature by about 25%, but unfortunately, also decreased the IF bandwidth from the intended 1.0 - 2.0 GHz to about 1.0 -1.8 GHz.

We consistently obtain receiver noise temperatures below 1800 K using hot (ambient temperature) and cold (liquid nitrogen) calibration loads. However, reliable noise temperatures as low as 1400 K were seen on dry days and with optimal tuning. Receiver temperatures are flat over the entire 800 MHz band. We measured spectral Allan variances by computing the variance of the calibrated differences of consecutive spectra. These variances are important for spectral line observations because they indicate baseline ripples caused by temporal deformations of the passband. We obtain minimum Allan variances at 25 - 35 s, which is approximately the optimum individual on-source integration time (see Schieder & Kramer 2001). As expected, the Allan variance is dominated by the mixer and the LO and not the IF. (The minimum time of the total power Allan variance is about 10s over a 1 MHz bandwidth. This variance is important for continuum observations.)

In November 2005, CONDOR was successfully commissioned on the 12-m Atacama Pathfinder Experiment (APEX) telescope, which is located at an elevation of 5100 m in the Atacama desert in Chile. Pointing observations were preformed on the Moon and Mars. The first spectral line observations were obtained of CO J=13-12 emission at 1497 GHz from several sources in Orion. (For details on the first light observations see Wiedner et al. (2006).)

References:
Schieder, R. & Kramer, C. 2001, 373, 746
Wiedner, M. C., et al. 2006, A&A submitted