THE SUBMILLIMETER ARRAY: RECENT SCIENTIFIC RESULTS

Moran James
Harvard-Smithsonian Center for Astrophysics, 60 Garden St., MS 42, MA, Cambridge, USA 2138

The Submillimeter Array (SMA), a joint project of the Smithsonian Astrophysical Observatory and the Astronomy Sinica, Institute of Astronomy and Astrophysics, was dedicated in November 2003 and is now in full operation in three bands (230, 345, and 690 GHz). At this time, 345 GHz is the primary band, and 230 GHz is used during less favorable weather conditions. Observations at 690 GHz are still at a preliminary stage because conditions in the band are more difficult than at lower frequencies (e.g., higher opacity and phase noise, fewer calibration sources, less sensitivity, etc.).

About 200 proposals for projects were received in 2004, and time is available for users not affiliated with the principal sponsors, SAO, ASIAA, and the University of Hawaii. The Array has been applied to a broad range of astrophysical problems. Some of these applications are described here and some have been reported in a special issue of the Astrophysical Journal Letters (2004 November 20).

In the solar system, the CO (3-2) distribution in the atmosphere of Mars has been imaged and the distribution of nitrogen bearing molecules in Titan explored. The bipolar outflows and disks in numerous galactic star formation regions such as TW Hydrae, L1551, IRAS 18089-1732, IRAS16293-2422, and G5.89-0.39 have been imaged in a variety of molecular tracers such as CO, CS, SO, SiO, H2S, HCN, DCN, CH3OH, HC3N and HCOOOCH3. In addition, the Orion KL region has been also been imaged in many molecular transitions including the 325 GHz maser transition of water vapor. Measurement of the spectral energy distributions of key continuum sources in Orion, such as Source I, have helped define their radiation mechanisms. The atmospheres of molecules in late type stars have been explored and a particularly interesting outflow pattern has been discovered in V Hydrae. The properties of the CS(14-13) emission at 685 GHz from IRC10216 have been measured. The linear polarization properties of the SiO maser at 215 GHz in the envelope of VYCMa have been determined. The polarization of Sgr A* and its rotation measure have been measured at 345 GHz, which limits the possible mass accretion rate onto the Galactic Center's black hole. Imaging of the CO(3-2) transition in nearby galaxies such as M51, M83, NGC6090, NGC253, and VV114 has revealed structure not seen in emission from CO in lower rotational transitions.