The Submillimeter Array

Ken Young, Smithsonian Astrophysical Observatory, USA

The Submillimeter Array (SMA) is a collaborative project of the Smithsonian Astrophysical Observatory and the Academia Sinica Institute of Astronomy and Astrophysics. When completed the array will be comprised of eight 6-meter antennas which will be deployed among 24 pads arranged in four rings approximating Reuleaux triangles. The antennas will contain cryostats capable of cooling up to eight receiver inserts. The initial suite of receivers will cover three frequency bands: 177 to 240 GHz, 230 to 350 GHz and 600 to 700 GHz. Eventually receivers will be installed to cover all usable atmospheric windows from 177 to 950 GHz. Full polarization measurements will be possible in the 345 GHz band. The IF system and correlator will allow simultaneous observations with two receivers, each with a bandwidth of two GHz.

Because submillimeter observations can only take place in locations were the atmospheric transmission is highest, the array is being constructed at the high, dry site of Mauna Kea in Hawaii. On Mauna Kea, observations in the 230 GHz band are possible 80% of the time, 345 GHz observations may be done 50% of the time, and the atmospheric windows above 400 GHz may be used about 20% of the time. The array is scheduled to be completed in November of 2003. Two neighboring submillimeter telescopes, the JCMT (15-meter) and CSO (10.4-meter) are expected to periodically join the array starting in 2005.

By the beginning of 2003, £ve antennas were deployed in the array at the Hawaii site. Holographic measurements using a 232 GHz beacon at low elevation have allowed the antenna surfaces to be adjusted to an rms accuracy of ~ 15 microns. Monitoring of the surface of one antenna over a period of two years has shown that the surface degrades very slowly and the panels will need to be adjusted only once every few years.

Astronomical observations in the 230 and 345 GHz band have been made with up to £ve antennas, producing maps of star-formation regions, evolved stars and galaxies. As of late 2002, three antennas are working in the 650 GHz band. Observations of a beacon at 682 GHz show that the phase closure error is less than one degree. Molecular emission at 691 GHz (CO(6-5)), 685 GHz (CS(14-13) and 658 GHz (H_2O: $\nu_2 = 1$, $1_{10} \rightarrow 1_{01}$) from celestial sources has been detected and in some cases mapped with the array, as have 690 GHz continuum sources as weak as 5 Jy.