Observations of Solar System Bodies with the VLA and ALMA

Bryan J. Butler[(1)]
(1) NRAO, Socorro, NM, USA

Observations of solar system bodies at wavelengths from submm to meter wavelengths provide important and unique information about those bodies. Such observations probe to depths unreachable at other wavelengths – typically of order 10-20 wavelengths for bodies with solid surfaces, and as deep as tens of bars for those with thick atmospheres (the giant planets). Broad-bandwidth observations (bandwidths as wide as ~10^{10} Hz) are the most sensitive and used to map continuum emission, while narrow-bandwidth observations (resolving powers as high as 10^8 or even higher) are used to measure emission from spectral lines in atmospheres where they are not pressure-broadened into continuum. Single dishes are useful for larger bodies, but for finer resolution, interferometers must be utilized. Resolutions as fine as tens of masec can routinely be achieved for connected-element interferometers. In the past five years, two instruments have been commissioned which have revolutionized the ability to make these very sensitive observations: the Karl G. Jansky Very Large Array (VLA) and the Atacama Large Millimeter/Submillimeter Array (ALMA).

The VLA is situated on the plains of San Agustin in New Mexico. It consists of 27 25-m diameter antennas, which cycle through four fixed configurations, with maximum baselines of 1, 3, 11, and 36 km. The feed and receiver system covers wavelengths from several meters down to 6 mm. A recent upgrade has improved the sensitivity of VLA observations substantially, mostly via expanded bandwidth in the data transmission system and the correlator. Noise of a few microJy is typically achieved over several hours of observing, in all of the frequency bands from ~1 GHz to ~48 GHz. The VLA has a long history of observing solar system bodies, but the upgrade has made these observations much more powerful.

ALMA is situated in the high Andes of northern Chile. It consists of 40 (currently, 50 eventually) 12-m diameter antennas in the main array, and cycles through nine fixed configurations with maximum baselines ranging from 0.2 to 12.6 km. The feed and receiver system covers wavelengths from ~100 to ~900 GHz. Noise of a few tens of microJy is typically achieved over an hour of observing, in the lower frequency bands (<400 GHz). ALMA has already undertaken a number of important and interesting observations of solar system bodies.

I will present a discussion of results over the past five years from observations from both the VLA and ALMA.