

## **Planetary Atmospheric Science with ALMA**

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The Atacama Large Millimeter Array will be the finest earth-based observatory for studying planetary atmospheres ever conceived. ALMA will have very superior sensitivity and imaging capabilities, coupled with a extremely broad spectrometer passband, allowing unprecedented exploration of the atmospheres of all the planets. ALMA will be able to spatially resolve nearly all planetary bodies (and many of their moons) save perhaps Pluto and Triton, allowing us to probe the three-dimensional structure of temperature and species abundances. In addition, the high sensitivity and rapid imaging ability of ALMA will allow direct detection of atmospheric winds through measurement of minute ( $\geq 5$  m/s) Doppler shifts of line cores.

We will present state-of-the-art interferometer observations of Titan and Mars and use these bodies as test cases of what ALMA will be able to help us learn about their atmospheres. We will also consider the cases for observing all planetary atmospheres, including: tenuous atmospheres (such as Mercury, Io, Pluto, and Triton, where linewidths are thermal), moderate atmospheres (Mars, Titan, Venus, with moderate pressure broadening out to at most a few GHz), and giant planet atmospheres (where observable pressure broadened lineshapes of  $\text{NH}_3$  exceed 100 GHz or more).

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Abstract submitted for Science with the Atacama Large Millimeter Array, 6 – 8 October 1999, Washington, D. C.