VLBA Observations of Cassini to Improve the Saturn Ephemeris

Dayton L. Jones* [(1)], Ed Fomalont [(2)], Vivek Dhawan [(3)], Jon Romney [(3)], Gabor Lanyi [(1)], and James Border [(1)]
(1) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109
(2) National Radio Astronomy Observatory, Charlottesville, VA 22903
(3) National Radio Astronomy Observatory, Socorro, NM 87801

We have carried out a series of six phase-referenced VLBA observations of the Cassini spacecraft during the past two years. By combining the VLBA position measurements with a model of Cassini's orbit around Saturn, we determined the ICRF position of Saturn at each epoch to about 0.3 mas, or about 2 km at the average distance of Saturn. Further calibration of tropospheric delay effects is expected to reduce the position uncertainties. Over time this will improve all three components (longitude, latitude, and range) of the Saturn ephemeris by a factor of 2-3 compared with pre-VLBA accuracies. In particular, the error in latitude (the plane of Saturn's orbit) will decrease dramatically as the total time span of VLBA data approaches six years (1/4 of Saturn's orbital period) by 2011-2012. The planetary ephemeris is an essential tool for studies of solar system dynamics, interplanetary spacecraft navigation, and test of general relativity. It requires continuous maintenance and improvement.

This presentation will describe the experiment design, our current results, and plans for continuing the observations until the end of the Cassini mission. We will also discuss the dominant error sources and our efforts to improve the final astrometric accuracy. Finally, we will describe the scientific value of similar VLBA astrometric observations of future spacecraft planned to orbit Jupiter and one or more of the major outer planet moons.

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