Radiometric observations from the Mars Orbiter Laser Altimeter (MOLA) can be used to improve the ephemeris of Phobos, with particular interest in refining estimates of the secular acceleration due to tidal dissipation within Mars. We have searched the Mars Orbiter Laser Altimeter (MOLA) radiometry data for shadows cast by the moon Phobos, finding 7 such profiles during the Mapping and Extended Mission phases, and 5 during the last two years of radiometry operations. Preliminary data suggest that the motion of Phobos has advanced by one or more seconds beyond that predicted by the current UTC, the center of Phobos's shadow passed through the MOLA detector field-of-view (Figure 1). The ephemeris of Phobos has previously been estimated at 0.001247 km/s, leading to an advance in their synodic periods is roughly 3.905, so that opportunities arise every 39th orbit of MGS, or every 10th orbit of Phobos. Shadows detected by MOLA are potentially better spatial constraints than astronomical observations, but will need to be carefully modeled. The ground shadow of Phobos in MOLA observations currently puts Phobos more than 2 seconds ahead of Jacobson's model.

MGS is in a nearly polar orbit, and Phobos in a nearly equatorial orbit. The ephemeris of the Mars Global Surveyor is known to high precision and the timing of the MOLA instrument can be determined to the 10-ms level. The ratio of their synodic periods is roughly 3.905, so that opportunities arise every 39th orbit of MGS, or every 10th orbit of Phobos. Shadows detected by MOLA are potentially better spatial constraints than astronomical observations, but will need to be carefully modeled. The ground shadow of Phobos in MOLA observations currently puts Phobos more than 2 seconds ahead of Jacobson’s model.

The secular acceleration of Phobos [3, 4] has previously been estimated at 0.001247 km/s, leading to an advance in Phobos’ orbit relative to a Keplerian model. The advance appears to have increased slightly over the years up to the present. There are also long period terms in the ephemeris (mainly associated with a near resonance between the Martian year and the nodal regression period), and some of them have large enough amplitudes that they could be contributing to the observed discrepancy. The Mars Observer Wide Angle Camera has imaged the Phobos shadow more than a hundred times. Those observations, if analysed, might help sort out periodic versus secular effects.

MOLA observations will continue for the lifetime of MGS. Another possibility for future measurements is a radio occultation by Phobos of the Mars Exploration Rovers. There are also plans for the PanCam on MER to observe Phobos eclipses.

REFINEMENT OF PHOBOS EPHEMERIS USING MARS ORBITER LASER ALTIMETER RADIOMETRY. G. A. Neumann$^{1,2}$, B. G. Bills$^{2,3}$, D. E. Smith$^2$, M. T. Zuber$^{1,2}$, 1 Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Building 54, 77 Massachusetts Avenue, Cambridge, MA 02139-4307, (neumann@tharsis.gsfc.nasa.gov), 2 Laboratory for Terrestrial Physics, Code 920, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, 3 Institute for Geophysics and Planetary Physics, Scripps Institution of Oceanography, University of California, San Diego, La Jolla, CA 92093.
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