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**Observations of Phobos' Orbit and Rotation Using Images of SRC on Mars Express** K. Willner[1], J. Oberst[1], K-D. Matz[1], M. Wählisch[1], B. Giese[1], T. Roatsch[1], H. Hoffmann[1], G. Neukum[2]. [1]German Aerospace Center, Institute of Planetary Research, Rutherfordstrasse 2, 12489 Berlin, Germany. [2]Institute of Geosciences, FU Berlin, 12249 Berlin, Germany. konrad.willner@dlr.de

**Introduction:** With the large number of Mars Express flyby observations available (compared to the analysis in 2006 [4] the number has quadrupled) we validate the orbit models of Phobos by astrometric measurements. Furthermore a refinement of the control point network is under way with the goal to study the complex librational motion of Phobos.

**Astrometric Measurements:** During one SRC flyby a sequence of 8 images is obtained. The first and last image is usually dedicated to long-time exposure to observe background stars for the verification of the nominal camera pointing. Overall, nominal pointing information was in good agreement with our observations. Nevertheless, occasional large offsets between star catalog data and observed star positions were found, and pointing data had to be corrected. Pointing during one image sequence was observed to be stable to within ±3 pixels.

We used surface features to determine Phobos' orbital position. Image coordinates were measured for surface features identified as control points from the Duxbury and Callahan catalog. By definition those points are the center of a local plain defined by the crater rim [1]. Under oblique view, craters appear as ellipses. Sample and line coordinates of the centers of the ellipses were extracted using an ellipse-fit method.

Two orbit models are currently available one released by the Jet Propulsion Laboratory [2] and one by the Royal Observatory of Belgium [3]. To verify the orbit models we calculated the predicted image coordinates of the observed control points using the orbit models and corrected camera pointing. For determination of the positional differences of the two coordinate sets a similarity transformation was used as functional model in an iterative least-squares analysis. With the assumption that the derived transformation parameters are the same for all points of one image, the position of the Center of Mass of Phobos can be determined.

The least-squares analysis converged rapidly after only 3 to 4 iterations. The translation vectors showed no significant offsets to the orbit models in the across-track direction (towards Mars or out of the orbit plane). However, the along-track component of the observed vectors shows magnitudes between 1.5 km and 2.6 km with estimated accuracies of ±0.1 km to ±0.5 km, depending on the distance from the target. We anticipate that our results will be the basis for further improvement of the orbit models.

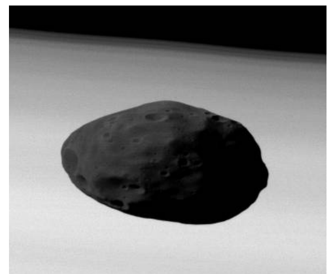

**Figure 1.** Phobos in front of the limb of Mars observed during Mars Express orbit 3909.

**Control Point Network:** At this time a set of 60 SRC images is used to refine and to densify the control point network of Phobos. The resolutions of the images range from 6m to app. 50 m per pixel. Most selected points are small craters were as control points are defined to be at the center of the crater floor. Our network currently includes 470 control points in SRC images.

Multiple stereo coverage with SRC images is available for approximately two thirds of Phobos' surface. First runs of a least-squares adjustment resulted in mean object point accuracies of ±30 m. We currently assume the rotation of Phobos to be as modeled in the available SPICE-Kernels for planetary constants. Tests will be made to search for improved parameters of libration amplitude and phase. As for the area without SRC stereo coverage we are about to incorporate Viking Orbiter images in the analysis. The goal is to use the control points as a framework for a new global shape model. Preliminary results will be presented at the meeting.

**References:** [1] Duxbury, T. C. and Callahan, J. D. , Feb (1989), *Icarus*, 77:275–286. [2] Jacobson, R.A. , pers. communication. [3] Lainey, V. et al., Apr (2007). *A&A*, 465:1075–1084. [4] Oberst, J. et al., Mar (2006), *A&A*, 447:1145–1151, March 2006.