[EJ] Evening Poster | P (Space and Planetary Sciences) | P-PS Planetary Sciences

[P-PS07]Mars and Mars system: results from a broad spectrum of Mars studies and aspects for future missions

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Unprecedented progress in being made in our understanding of the planet Mars, especially because of new data from the US, European, Russian, and Asian missions to Mars. Eight spacecraft are currently operating at Mars, with six in orbit (Odyssey, MRO, MAVEN, Mars Express, Mangalyaan and TGO) and two on the surface (MSL-Curiosity and MER-Opportunity), the largest number ever at any given time. In addition InSight Lander is on track for launch in 2018, and Mars 2020, ExoMars and the Emirates Mars Mission in 2020. All this is a clear demonstration of public's strong fascination with and commitment to Mars exploration and the resulting scientific bonanza. Synergistic investigations with ongoing or already completed missions along with modeling studies and earth-based observations are gradually revealing the nature of Earth's most closely resembling planet that took on a different evolutionary track. Morphology and variable phenomena seen on the surface (RSLs, for example) indicate the red planet may possibly be still active, and require a clear understanding of its current geologic and atmospheric state, climate evolution and habitability. Thus, this session is planned to discuss recent results from a broad spectrum of Mars studies encompassing the interior, surface, atmosphere, plasma environment, and the Mars system including its two satellites. Abstracts on instrumentation and future mission plans are also encouraged for this session, as both the presenters and the audience would greatly benefit from ensuing discussions and feedbacks.

[PPS07-P09]The gravity field and geological features on the surface of Phobos

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Through spacecraft exploration, we realized that there are small bodies with volumes that extend outside their Roche lobe such as Saturnian satellites, Pan, Atlas, and Prometheus [1]. Unconstrained particles outside of the lobe are not gravitationally bound to the primary body, and are influenced by the third-body effect from the Sun or other planetary bodies. Thus, understanding these small bodies is important, not only for their own evolution, but also their environment. The martian moon, Phobos is one of the ideal celestial bodies to understand this effect, because the mass is well observed by Mars Express [2], a lot of image data have been obtained, and one of the volume of Phobos is certainly outside of the lobe [3]. However, which region of Phobos is outside of the Roche lobe is not well known because of many parameters. For instance, the gravitational field would change depending on the shape model, the method by which the self-gravity of Phobos is calculated, the internal structure of Phobos, and the orbital distance. Therefore, in this study, we examine the gravitational field in the vicinity of Phobos by varying these influential parameters in detail. Using Phobos-fixed frame, Jacobi integral for the restricted three-body problem is calculated. We develop self-gravity field of Phobos according to Newton's law of universal gravitation. Because this method regards the whole body as an aggregation of small mass elements, we can change the mass density of each element. We test three different structural models of Phobos. Model A is homogeneous – using a uniform density. Model B uses a dense sphere inside Phobos surrounded by a less-dense regolith layer. Model C uses a lower density regolith layer of a specified, constant thickness above a denser core. In Models

B and C, the density outer layer is a variable ranging from 1.5 to 1.8 g/cm^3 in 0.1 g/cm^3 increments. In these models, the density of the core is determined based on the measured mass of Phobos. Depending on the value of the orbital eccentricity [4], the gravitational field is calculated in the case of periapsis, apoapsis, and mean orbital distance.

As a result, we confirmed that some parts of the latest shape model are outside of the Roche lobe in every case. Comparing the shape of the Roche lobe to the Phobos shape model, the major axis of Phobos is always inside the Roche lobe. A small part of both ends of the intermediate axis is outside while, on the minor axis, the north side is outside, and the south side is inside the lobe. In Model B, the value of the calculated the forced libration amplitude sometimes falls outside of the range of error in the observational value. Moreover, it was found that the Jacobi constant changes ˜1% between periapsis and apoapsis.

This survey was also conducted for the first time in this study on the global distribution of geological features (boulders and ray craters) that is thought to be affected by the gravitational field of Phobos. In the presentation, we compare the gravity fields in various cases and report on the relation between gravity field and these geological features.

[1] Porco, C.C., et al., *Saturn's Small Inner Satellites: Clues to Their Origins.* Science, 2007. **318** (5856): p. 1602-1607. [2] Pätzold, M., et al., *Phobos mass determination from the very close flyby of Mars Express in 2010.* Icarus, 2014. **229**: p. 92-98. [3] Dobrovolskis, A.R. and J.A. Burns, *Life near the Roche limit: Behavior of ejecta from satellites close to planets.* Icarus, 1980. **42**(3): p. 422-441. [4] Burns, J.A., *Contradictory clues as to the origin of the Martian moons.* Mars, 1992. **1**: p. 1283-1301.