# Lighting Condition Analysis for Mars′ Moon Phobos

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**A manned mission to Phobos may be an important precursor and catalyst for the human exploration of Mars, as it will fully demonstrate the technologies for a successful Mars mission. A comprehensive understanding of Phobos' environment such as lighting condition and gravitational acceleration are essential to the mission success. The lighting condition is one of many critical factors for landing zone selection, vehicle power subsystem design, and surface mobility vehicle path planning. Due to the orbital characteristic of Phobos, the lighting condition will change dramatically from one Martian season to another.**

**This study uses high fidelity computer simulation to investigate the lighting conditions, specifically the solar radiation flux over the surface, on Phobos. Ephemeris data from the Jet Propulsion Laboratory (JPL) DE405 model was used to model the state of the Sun, the Earth, and Mars. An occultation model was developed to simulate Phobos' self-shadowing and its solar eclipses by Mars. The propagated Phobos' state was compared with data from JPL's Horizon system to ensure the accuracy of the result.**

**Results for Phobos lighting condition over one Martian year are presented in this paper, which include length of solar eclipse, average solar radiation intensity, surface exposure time, total maximum solar energy, and total surface solar energy (constrained by incident angle). The results show that Phobos' solar eclipse time changes throughout the Martian year with the maximum eclipse time occurring during the Martian spring and fall equinox and no solar eclipse during the Martian summer and winter solstice. Solar radiation intensity is close to minimum at the summer solstice and close to maximum at the winter solstice. Total surface exposure time is longer near the north pole and around the anti-Mars point. Total maximum solar energy is larger around the anti-Mars point. Total surface solar energy is higher around the anti-Mars point near the equator.**

**The results from this study and others like it will be important in determining landing site selection, vehicle system design and mission operations for the human exploration of Phobos and subsequently Mars.**