Illumination conditions within permanently shadowed regions at the lunar poles

Jacob L. Kloos,[1] John E. Moores,[1] Paul J. Godin,[1] Ed Cloutis[2]

[1] *Centre for Research in Earth and Space Science, York University, Toronto, Ontario*
[2] *Department of Geography, University of Winnipeg, Winnipeg, Manitoba*
jlkloos@yorku.ca

Abstract. Permanently shadowed regions (PSRs) at the lunar poles are of unique interest for science and exploration due to their low surface temperature and potential for volatile sequestration. While not directly illuminated by the Sun, PSRs are exposed to faint sources of radiation such as starlight, Ly-α photons from the interplanetary medium, Earthshine and sunlight scattered from the surrounding topography. These illumination sources are significant as they contribute to the thermal energy budget of PSRs and also provide a photon source with which to observe areas otherwise concealed by shadow. In this work, we survey the illumination conditions from the aforementioned sources within northern and southern hemisphere PSRs at far ultraviolet (FUV), visible (vis) and infrared (IR) wavelengths. With respect to magnitude, it is shown that scattered sunlight is the brightest radiation source to illuminate PSRs in the visible and IR spectral regimes. As well, we show that scattered sunlight contributes an appreciable supply of FUV photons and may exceed the interplanetary medium/starlight brightness in many PSR craters due to the temporal and spatial variance of scattered sunlight. This finding implies higher rates of photodesorption and lower adsorption residence times for water molecules than previously suggested, and, furthermore, indicates that this rate fluctuates diurnally, seasonally and geographically owing to variation in the incoming solar flux. Large differences in the received solar energy are found between craters, with crater latitude and size being among the modulating influences. Within individual craters, strong spatial heterogeneities in scattered solar flux are found, with equator-facing PSR slopes receiving 40%–60% less energy relative to slopes oriented toward the pole.