On the role of dust in the lunar ionosphere

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Abstract. Evidence suggests that electron concentrations above the dayside lunar surface can be significantly higher than expected from either the photo-ionization of exospheric neutrals or any other well-known process. The Luna 19 mission performed dual-frequency radio occultation experiments in order to determine electron column concentrations above the lunar limb as a function of tangent height1 (shown in the figure below). The resulting electron concentration profiles surprisingly indicated a peak of ~500–1000 cm−3 and scale heights of ~10–30 km. It has been suggested that electrically charged exospheric dust could contribute to these electron enhancements2. Here we describe how to estimate the electrons produced by photo-charged dust, which is then used to predict electron concentrations from exospheric dust distribution models that are based on the “excess brightness” observed in Apollo 15 coronal photographs3. The results indicate that radio occultation measurements likely provide a valuable perspective on the role of dust in the lunar environment.

Electron column concentrations measured above the lunar limb by Luna 191.

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2 Imamura, T., et al., The possibility of studying the lunar ionosphere with the SELENE radio science experiment, Earth Planets Space, 60, 387–390 (2008).