LUNAR SOILS ON SWIRLS: THEIR PHOTOMETRIC PROPERTIES AND POSSIBLE MIGRATION IN A NON-UNIFORM MAGNETIC FIELD. Jiang Zhang[1], Zongcheng Ling[1] and Bo Li[2], [1]Institute of Space Sciences and Shandong Provincial Key Laboratory of Optical Astronomy & Solar-Terrestrial Environment, Shandong University (Weihai), Weihai 264209, China (zhang_jiang@sdu.edu.cn).

Introduction: Lunar swirls, known as magnetic and albedo anomalies [1], are unique geologic features on the surface of the Moon, for whose formation three primary hypotheses have been proposed, i.e., cometary impact [2-3], solar wind shielding [4-5], and electrostatic dust lofting and redistribution [6]. The two hypotheses other than solar wind shielding could result in dust migration and/or regolith structure alteration, which both involve photometric studies of lunar soils on swirls [7-8].

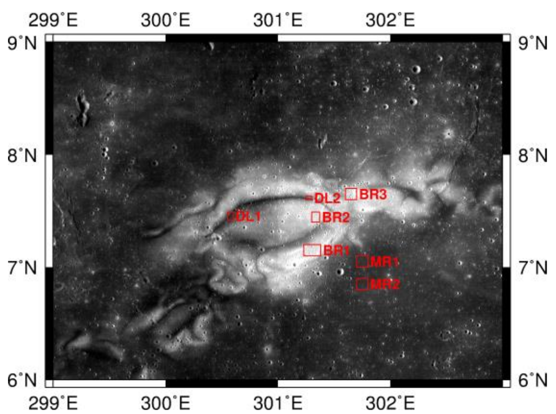

Fig. 1: LROC WAC 643 nm image for Reiner Gamma region and the 7 study areas.

In the following, we will study the photometric properties of the three geologic units in the Reiner Gamma swirl region (Fig. 1), i.e., bright ribbons (BR1-BR3), dark lanes (DL1-DL2), and surrounding maria (MR1-MR2), using Lunar Reconnassance Orbiter Camera (LROC) Wide Angle Camera (WAC) observations. Then we will propose a refreshing mechanism for lunar soils on swirls to interpret their albedo patterns.

Photometric Properties: We used a simplified Hapke model without macroscopic roughness term [9], whose parameter values were derived with LROC WAC observations from Febrary 2010 to October 2011 and covering Reiner Gamma (6.7-8.0°N, 300.0-300.5°E) at small solar phase angles (< 6°).

The bright ribbons on the Reiner Gamma swirl show distinctive photometric properties from the dark lanes and the surrounding maria (Fig. 2a), and their unusual photometric behavior (phase function parameters) might be correlated with strong horizontal component of the magnetic field anomalies [6]. The spectral properties of the dark lanes are similar to those of the surrounding maria [10], while their phase function parameters are quite different (Fig. 2 and Fig. 3). The phase curves for the dark lanes lie between those for the bright ribbons and the surrounding maria (Fig. 2b), indicating that the dark lane soils have different physical properties from those in bright ribbons and maria.

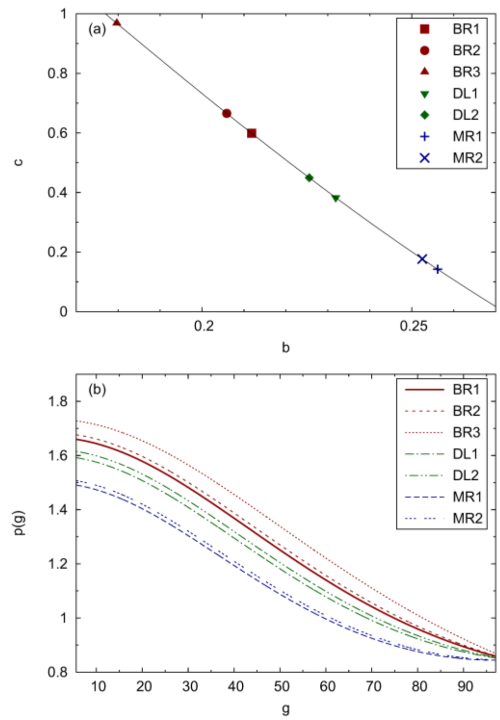

Fig. 2: Henyey-Greenstein phase function parameters (a) and phase curves (b).

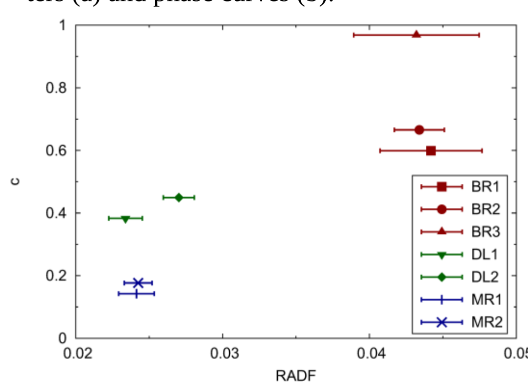

Fig. 3: RADF vs. c scatter plot for 7 study areas.

Dust Migration: The fine-grained portion (dust) of lunar soils within Reiner Gamma swirl can be lofted by electrostatic field [6]. These dust particles, mostly elongated [11] and containing more $npFe^0$ with decreasing grain size [12], are strongly ferromagnetic. The magnetic force on these dust is given by:

$$F = -\nabla(m \bullet B)$$

Where *m* is the magnetic moment and *B* the magnetic field. Therefore non-uniform magnetic field could cause fine-grained lunar dust to move [13].

Conclusions: Photometric studies of Reiner Gamma awirl and magnetic measurements of lunar soils indicated that dust could be transported from bright ribbons to dark lanes in a non-uniform magnetic field, which provide a refreshing mechanism for lunar soils on swirls, no matther maturation of soils are caused by solar wind or micrometeorite impact.

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