THE REINER GAMMA SWIRL AS CHARACTERIZED WITH EARTH-BASED CCD PHOTOMETRY.

N. Opanasenko[1], Yu. Shkuratov[1], I. Nikolenko[2], and V. Psarev[1], [1]Astronomical Institute of Kharkov National University. 35 Sumskaya St. Kharkov, 61022, Ukraine, [2]Astronomical Institute "KRAO", Crimea, Ukraine. opanasenko@astron.kharkov.uaT

Introduction: The Reiner-γ Formation (RGF) is the best example of swirls on the lunar surface. Swirls are albedo structures that are not manifested themselves in topography. The RGF is located in the western portion of the nearside. Swirls are considered to be results of cometary or meteoroid swarm encounters. Infrared data showed that the RGF has somewhat lower thermal inertia, indicating presence of fine-grain regolith. Radar measurements reveal no significant anomaly, exhibiting that the near-surface population of stones in the area resembles that for the average mare regolith layer. The RGF shows a polarimetric anomaly at large phase angles, which indicates either presence of coarse-grained regolith or that the regolith is comparatively dense. The formation is generally considered to have strong forward scatter, as it shows up at large phase angles near terminator, whereas craters with bright halos disappear. Thus the RGF material is characterized by lower slope of the phase function as compared to surrounding mare regions. The purpose of this study is advancing CCD-imaging photometry of the RGF at phase angles when the shadow-hiding effect is the main contributor to the phase angle behavior of lunar surface brightness [1].

Source data: New observations of the Moon were carried out with the telescope Zeiss-600 of Crimean Observatory (Simeiz). A CCD LineScan Camera SONY ILX707 was exploited. The western portion of the lunar disk was scanned with the 2048 pixels line at the wide spectral bands with λ_{eff} = 0.65 μm and 0.45 μm. Several scans of the Moon were done at the phase angles near 18°, 39°, 90°, 122°, and 134°. Note that the phase angle 134° is almost the highest one that can be reached in Earth-based observations. The scan data were brought to images using complicated geometric transformations. Then for each image we compensate the brightness trends from the limb to terminator and from the poles to equator. All images were coregistered with an original heuristic algorithm and transformed to the direct orthographic projection. Finally we mapped phase-angle ratios (39°/18°), (90°/39°), (122°/90°), and (134°/122°) that are presented in Figure 1.

Results: The mapped area includes the RGF that is clearly seen as a bright diffuse spot near the frame center. The crater Reiner is located on the right hand. As one can see the RGF (or its portions) shows up almost in all the phase ratio images. The brighter the details on the phase ratio images, the smaller the slope of the phase angle curve of lunar surface brightness. The phase ratio patterns differ from the albedo one. The phase ratio patterns are similar to each other in red and blue light. Different portions of the RGF are characterized with slightly prominent forward scattering in the phase angle range 18° – 90°, which consists with results obtained earlier [1]. This feature result from higher albedo of the RGF material, as high albedo implies multiple scattering that decreases the slope. On the other hand the phase ratios (122°/90°) and (134°/122°) demonstrate higher slopes of phase curves of the RGF than those of surrounding regions. In particular, the external bright area of the RGF demonstrates steeper slope of phase angle curve (and hence more rough surface) than mare vicinity (the same effect is observed for highlands). The described slope differences are relatively small, < 5 – 10 %, but they are reliably detected. Unlike the phase ratios (39°/18°) and (90°/39°), the ratio (122°/90°) and especially the ratio (134°/122°) can be significantly effected by meso-topography on the scale ~ 1 m, that is relatively low surface slopes.

Conclusion: Our results clearly show that on average the RGF in the phase angle range 90° - 134° reveals smaller forward scattering than surroundings. The found effect is due to surface roughness, and it does not compensated with the albedo influence. This indicates that the RGF surface is perhaps more rough on the scale ~ 1 m, than the surrounding mare surface. This conclusion is in agreement with model of meteoroid swarm encounters [2,3].

Acknowledgments: This work was partially supported by CRDF grant.

References: [1] Opanasenko N. and Shkuratov Yu. (2004) LPSC-35, # 1493. [2] Pinet P. et al. (2000) *JGR. 105*, 9457-9475. [3] Starukhina L. and Shkuratov Yu. (2004) *Icarus* 167, 136-147.

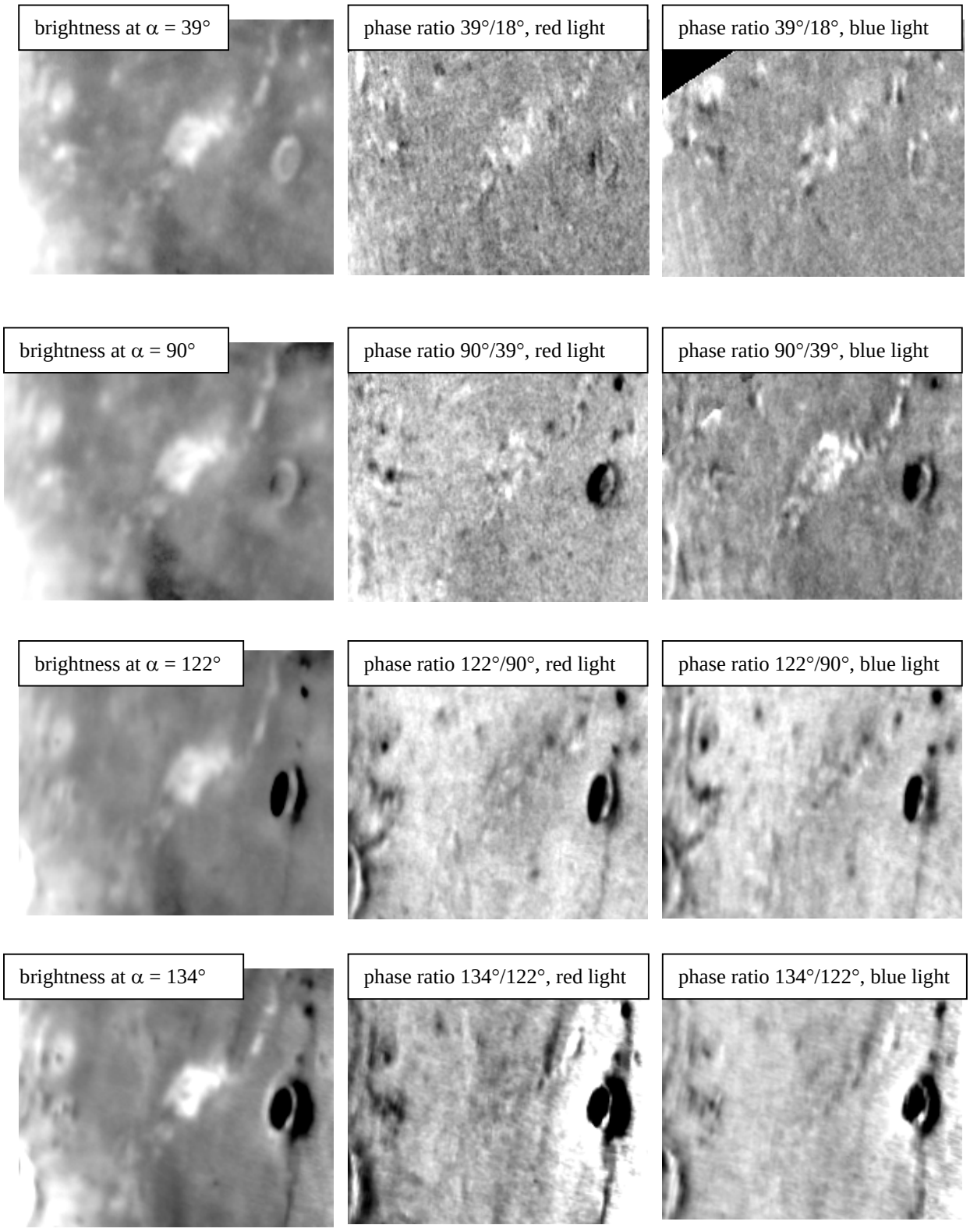

Figure 1. Brightness and phase-angle ratios images.