THE PHOTOMETRIC RESEARCHS OF THE MERCURY'S SURFACE BY MEANS OF DIGITAL MODELS. S.G. Pugacheva. Sternberg State Astronomical Institute, Moscow University, 13 Universitetsky pr., 119992 Moscow, Russia, pugach@sai.msu.ru.

Introduction. This work presents the new results of photometric studies of the surface of Mercury. The basic material for investigations is the cosmic images of the Marcurian surface from KA Mariner-10. The photometric properties and structure of the relief of the Mercury's surface were determined. The article is devoted to research of the regolith of the Mercurian surface by methods ground and space photometry. The purpose of researches is the estimation of the structure of the surface layer of the Mercurian regolith.

Photometric properties of the surface of Mercury. Mercury is the innermost planet and the least known of the terrestrial planets. The first visual observations of the planet of Mercury have been made Zollner (1865) and Muller (1893) in the 19th century. The surface brightness of Mercury was measured Danjon (1933, 1949, 1953) and Harris (1961) in phase angle 3^o-123^o.

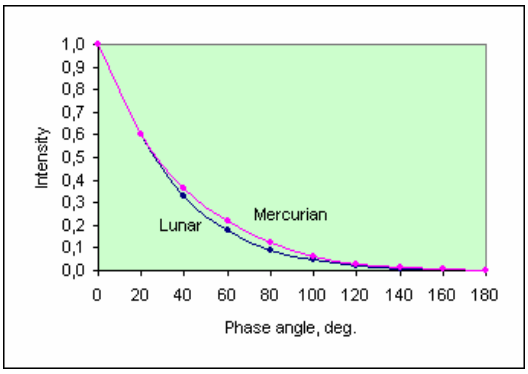

Figure 1.

The phase curve can be calculated by a cubic equation

$\Delta m(\alpha)=3.80(\alpha/100^o)-2.73(\alpha/100^o)^2+2.00(\alpha/100^o)^3$,

$m(\alpha = 0^o) = -0.21$, $V(1,0) = -0.42$,

where α is the phase angle expressed in degree, V(1,0) is the conventional absolute magnitude reduced to $\alpha = 0^o$ and planet-Sun and planet-Earth distances of 1 Astronomical Unit. Figure 1 shows the phase function of Mercury and Moon in relative units.

The analysis of the various data of the integral photometric gives the results of determination of the main photometric constants for Mercury. The values of the main photometric constants were obtained by Dollfus and Auriere (1974), Veverka et. al. (1988–1, 1988-II). They calculated the photometric parameters the geometrical альбедо (p_v), the phase integral (q_v), the spherical альбедо (A_v). The results of the calculations of the basic photometric parameters are tabulated.

Modeling of the photometric characteristics of the reflected radiation of Mercury. The model of Hapke of the bi-directional reflectance was applied to disk-integrated observations of Mercury. The model enables to be determined the structure parameters of the relief from experimental results. The Hapke's formula is well known model for the estimation of the surface roughness [1].

The Hapke's theoretical integral phase function involves six parameters: w, B_o, h, θ, and two parameters to describe P(g): b, c. The parameter h characterizes compaction of the regolith and size of the particle. The parameter B_o defines amplitude of the opposition effect. The function P(g) includes two parameters b and c, which determines the phase function form and the nature of scattering ($c<0.5$ corresponds to forward scattering and $c>0.5$ to backward scattering). The equation $S(\theta)$ allows to calculate the effects of macroscopic roughness on light scattered by a surface having an arbitrary diffuse-reflectance function. The parameter θ is a mean topographic slope angle of the surface.

Values of the photometric parameters (w, h, B_o, b, c, θ) were definition from Mariner-10 images. The method calculation of the Hapke's parameters is described in the previous article [2, 3, 4].

The surface brightness of the Mercurian images was established on the geologic map Mercury. The different types of morphological formations of the surface are allocated. Designations of the morphological types: 1 – heavily cratered terrain, 2 – planes between craters, 3 – hilly terrain, 4 – lineated terrain.

Fig.2. Image of the region of the Mercury of number 435.

Fig.3. Image of the region of the Mercurian surface of number 375.

The images (fig.2, 3) show a several of morphological types: hilly and lineated terrain, plains materials on the crater floors and the surrounding terrain.

The most detailed study of the planet shows that the brightness across Mercury images could be fitted using a photometric method. Results of the photometric estimation of the surface brightness are shown on the diagram (fig. 3). The brightness of the Mercury surface may vary in the rages 10 –200 relative units.

The average integrated lunar indicatrix was used for calibration values of the surface brightness [5, 6]. The photometric function was calculated for 4 morphological types. The average values of the some parameters of the photometric function are given in Table. The Table of the Lunar and Mercurian photometric parameters will be submitted in the report.

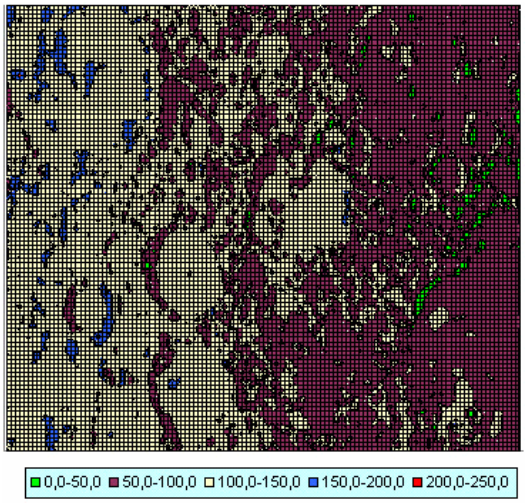

Figure 3. Colouring indicates surface brightness with resolution 50 relative units.

Conclusion and Future Work.

Studying of the photometric characteristics of Mercury is an actual problem, because about 70 % of surface of planet remains unexplored. Mercury remains the most difficult object for ground supervision. KA "Mariner 10" is the space spacecraft most full investigating this planet. Studying of photometric characteristics of the surface of Mercury is also an actual problem in connection with the prospective project the ESA BepiColombo (ESA, JAXA) and the project space station MESSENGER (NASA). The information about structure and composition of the Marcurian ejecta can be useful to scientific planning and realization of the future space projects.

References:

[1] Hapke B. (1993) Cambridge Univ. Press, New York. [2] Pugacheva S.G. et. al. (2001) Astron. Vestn., v.35, n.3, pp.199-207. [3] Pugacheva S.G. et al. (2005) LPSXXXIV, Abstract #1112. [4] Pugacheva S.G. et al. (2005) 42-Microsymposium of comparative planetology, Vernadsky Institute of Geochemistry and Analytical Chemistry, Moscow, Abstract m42-60. [5] Shevchenko V.V. (1980) The modern selenography. "Nauka Press" (In Russian). [6] Shevchenko V.V. (2004) Astron. Vestn., v.38, n.6, pp.504-512.