ANALYSIS OF THE ASTEROID PHASE DEPENDENCES OF BRIGHTNESS. V. G. Shevchenko, Astronomical Observatory of Kharkiv University, Kharkiv 31022, Ukraine.

Since we cannot obtain distribution of brightness over the asteroid disk, an integral phase dependence of brightness contains a fundamental information about the optical properties of surface, its structure and a probable formation mechanism of the optical appearances on the surface. There are some empirical and theoretical functions with few parameters which characterize physical properties of the surface regolith [1, 2, 4, 5 and etc.]. At present Hapke, Lumme-Bowell and HG functions are applied for describing the magnitude-phase relations for the asteroids and other atmosphereless bodies [2]. However, Hapke and Lumme-Bowell functions have a lot of parameters which do not allow unambiguously to determine their values from the observation data, i.e. it is always possible to find a new set of the parameter values when the approximation function is contented with the observation data. HG-function is ill fitted to the magnitude-phase relations in the spike-effect region ($\alpha\leq 2$ deg.).

In present work a new three-parameter empirical function is proposed. It approximates well the asteroid phase relations of brightness in range of phase angles 0-40 deg. This new function has the following form in the magnitude scale:

$$V(1, \alpha) = V(1,0) - \frac{a}{1+\alpha} + b \cdot \alpha;$$ \hspace{1cm} (1)

when $a$ characterizes an amplitude of the opposition effect; $b$ is a parameter describing the linear part of the magnitude-phase relations; $\alpha$ - solar phase angle ($\alpha \geq 0$); $V(1,0)$ - absolute magnitude. The second item of the equation (1) describes only the opposition effect and its contribution into the linear part is no more several percents.

The correlation for the parameters $a$ and $b$ with IRAS-albedo [6] was investigated using the phase dependences of brightness for 32 asteroids of the different types. There is a linear dependence for parameter $b$ and logarithmic albedo $p$ (Fig. 1) with coefficient correlation equal to 0.86:

$$b = 0.0125(\pm0.0016)-0.01054(\pm0.00076)\ln(p)$$ \hspace{1cm} (2)

![Fig.1](image_url)
PHASE DEPENDENCES OF BRIGHTNESS: Shevchenko V.G.

For comparison, the correlation coefficient of the linear phase coefficient $\beta$, which be used early for describing of the linear part of the phase curve (as for instance [3]), and logarithmic albedo is only 0.68. For $a$ and logarithmic albedo $p$ the correlation is more complicated but the main C, M, S, and E composition types of asteroids are well separated (Fig.2). The amplitude of the opposition effect $a$ is maximal for S-type asteroids, and minimal for C-type.

The function (1) can be used for the determination of the asteroid albedo and diameters, the calculations of the asteroid brightness for ephemerides, the determination of the asteroid pole coordinates, etc. Since the linear part of the magnitude-phase relation is formed with both shadow-hiding [1,4] and multiple-scattering of light, the high linear correlation $b$ and logarithmic albedo (see equation (2)) shows that the roughness of a regolith layer is similar for the using set of asteroids.

![Fig.2](image_url)