POLARIZED LIGHT SCATTERED FROM ASTEROID SURFACES. I. POLARIMETRIC AND PHOTOMETRIC DATA ANALYSIS. P. N. Shustarev, L. F. Golubeva, D. I. Shestopalov, Shemakha Astrophysical Observatory, Shemakha AZ-3243 Azerbaijan, (petersh50@mail.ru), (shestopalov_d@mail.ru), (lara_golubeva@mail.ru).

Since a theory of polarization of light scattered from rough surface at small phase angles is still in progress, the question "What surface features are responsible for asteroid polarimetric properties?" continues to hold valid as, say, ten or more years ago. As a first step, we decided to search for any relations between polarimetric and photometric properties of asteroids. With that end in view, the Asteroid Polarimetric Database [1] and precise photometric observations of asteroids with well-measured magnitude-phase curves [2] were utilized. In order to calculate as accurately as possible the phase-dependent polarimetric curves of asteroids we used the five-parameter empirical formula introduced in [3]:

$$P(\alpha)=\frac{h(1-e^{-m\alpha})(1-e^{-n(\alpha-\alpha_i)})(1-e^{-l(\alpha-\pi)})}{n(1-e^{-m\alpha_i})(1-e^{-l(\alpha_i-\pi)})},$$

where h is the slope of polarization curve at an inversion angle α_i and parameters m, n, and l are equal to or larger than null. In addition to h and α_i, the minimal polarization, P_{min} , and its angular position, α_{min} , are also determined by the above approximation formula.

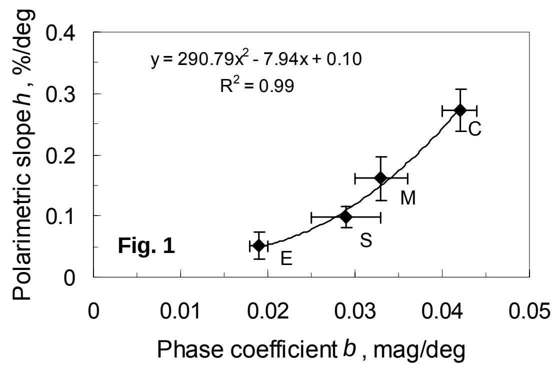
The photometric functions of asteroids (magnitudes in V bandpass) are well approximated with the simple expression [2, 4]:

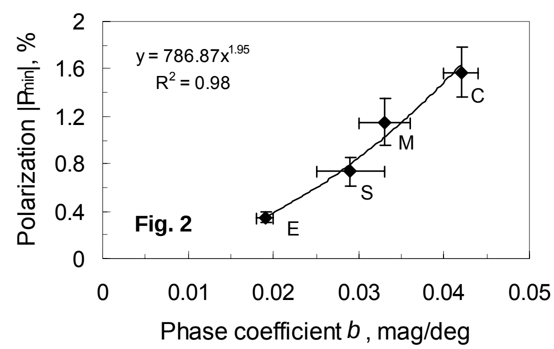
$$\Delta V(\alpha)=-a/(1+\alpha)+b\times\alpha,$$

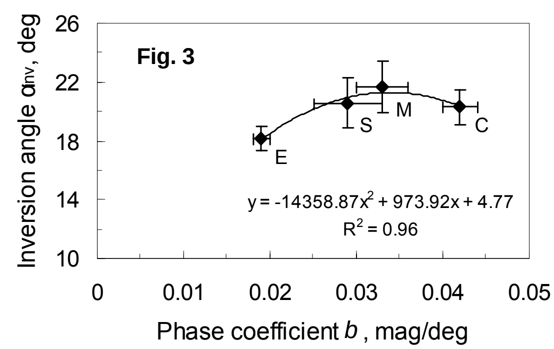
where the a parameter characterizes the amplitude of opposition effect (i.e., the surplus of magnitude relative to the extrapolation of the linear part of phase curve to the null phase angle) and the b parameter is the phase coefficient (i.e., the slope of the nearly linear part of the magnitude-phase dependence). Other attributes of the photometric curve as the angle of the opposition effect beginning, α_{OE} , and the width of the opposition surge at half of its maximum, FWHM, can also be determined using this formula.

The phase polarization functions were constructed and the characteristics of negative polarization branch were estimated for 67 asteroids, for which polarimetric data of a good quality were obtained in the V and G bandpasses [1]. Precise photometric functions in the V bandpass have been obtained for 33 asteroids [2]. But the intersection of these polarimetric and photometric sets forms only several objects. Under the circumstances our analysis was carried out for average data characterizing asteroids of E, S, M, and C optical types. For asteroids belonging to these optical types, the average data set (h, P_{min} , α_i , α_{min}) was compared with the average data set (a, b, α_{OE}, FWHM).

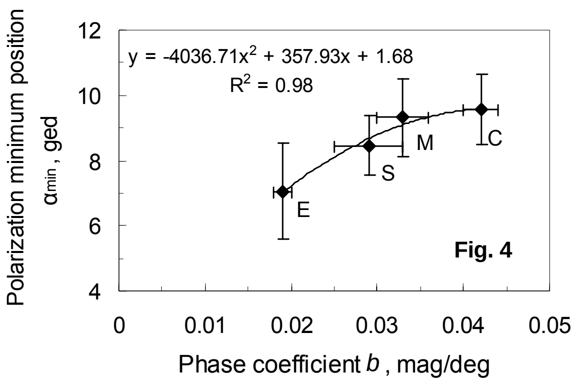
The following results were obtained. There are statistically significant correlations between the phase coefficient b and the characteristics of negative polarization branch, i.e., h, P_{min} , α_i , and α_{min} (Figs.1 – 4).

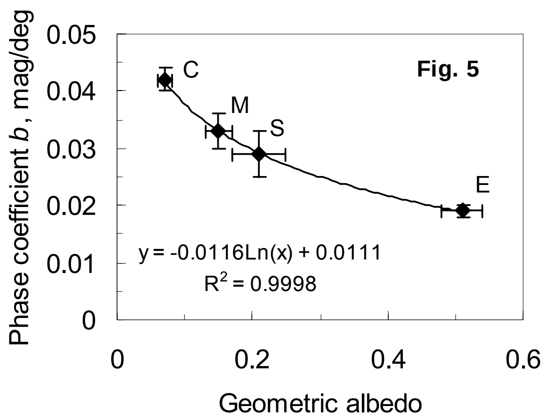






No other statistically significant correlations were found between other pairs of polarimetric and photometric characteristics. Besides, the phase coefficient b strongly correlates with geometric albedo (Fig. 5). Such a dependence between b and A have been discussed in [2] and was reasonably believed to be caused by a shadow-hiding effect. This implies the correlations shown in Figs. 1 – 4 are mainly caused by the shadow effect and consequently a surface roughness. This fact is examined in Part II, this volume.





References:

[1] Lupishko D.F. and Vasilyev S.V. (2008) *NASA PDS,* Asteroid Polarimetric Database V6.0. EAR-A-3-RDR-APD-POLARIMETRY-V6.0.
[2] Belskaya I.N. and Shevchenko V.G. (2000) *Icarus 147,* 94–105. [3] Shestopalov D. (2004) *JQSRT 88,* 351–356. [4] Shevchenko V. G., and Lupishko, D. F. (1998) *Solar System Res.32*, 220–233.