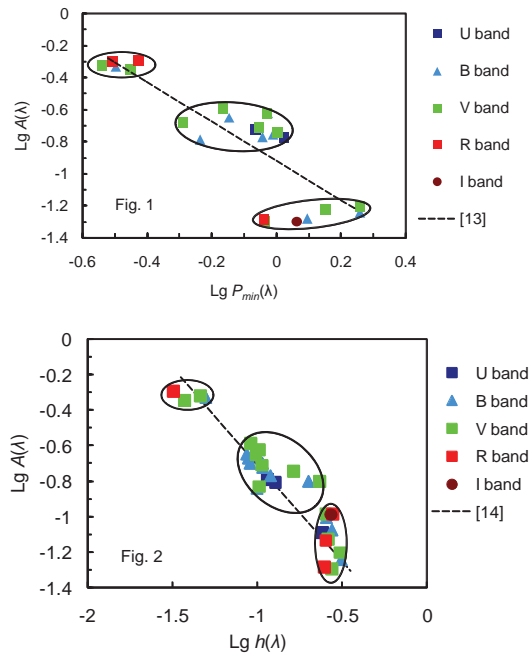


POLARIZED LIGHT SCATTERED FROM ASTEROID SURFACES. VI. POLARIMETRIC AND PHOTOMETRIC INTERRELATIONS FROM MULTISPECTRAL DATA. D. I. Shestopalov, L. F. Golubeva, Shemakha Astrophysical Observatory, Shemakha AZ-3243 Azerbaijan, (shestopalov_d@mail.ru, la-ra_golubeva@mail.ru).

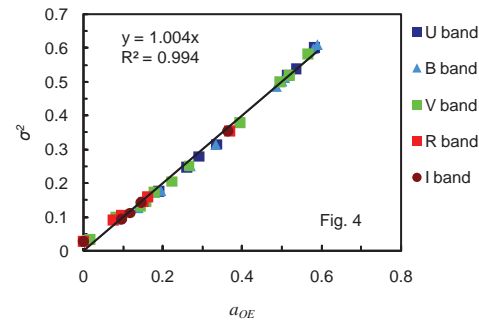
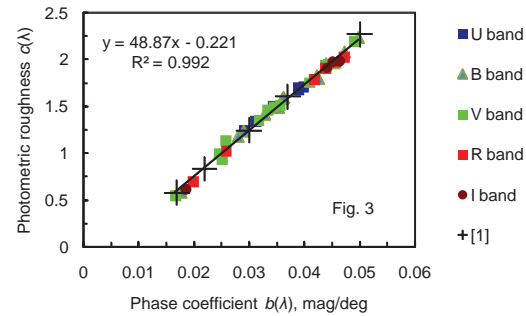
Analysis of the polarimetric and photometric properties of asteroids in a visible spectral range is usually restricted to the data obtained in the V band [e.g. 1, 2, 3, 4], since most of the data have been accumulated by observations in this bandpass. It is clear the parameters of asteroid polarimetric and photometric functions vary depending on the wavelength of light diffusely reflected by an asteroid surface. However, the following question remains open: will correlations between asteroid polarimetric and photometric parameters be different at different wavelengths? To investigate this topic we used the polarimetric and photometric databases available now at PDS [5, 6]. These catalogs contain the high-accuracy polarimetric and photometric measurements of asteroids in the UBVRI bandpasses against the phase angle, α , at the time of observations.



We calculated the attributes of asteroid negative polarization branch (i.e., its depth $P_{\min}(\lambda)$, at α_{\min} , and slope $h(\lambda)$ at α_{inv}) in the above bandpasses using the approximating formula introduced in [7]. In the case of asteroid photometric functions observed in the same bandpasses, we used the empiric formula [8] to calculate the amplitude of opposition effect $a_{OE}(\lambda)$ and the phase coefficient $b(\lambda)$. We also utilized the theoretic phase function [9, 10] to estimate certain physical characteristics of asteroid surfaces such as the surface photometric roughness $c(\lambda)$ as well as the $a(\lambda)$ and $\sigma^2(\lambda)$ parameters that were entered in practice [10] to specify

the lensing effect of relatively large semitransparent surface particles.

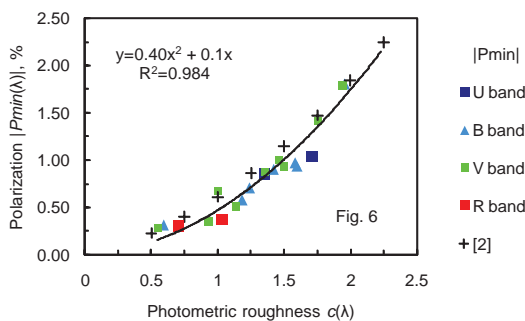
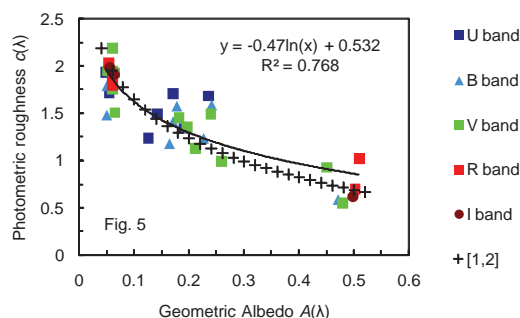
To calculate a spectral albedo $A(\lambda)$ we used the mid-infrared asteroid survey [11] and the eight-color spectra of asteroids [12]. So that $A(\lambda) = A_V \times R(\lambda)$, where the visual geometric albedo A_V and spectral reflectance $R(\lambda)$ normalized to unity at the visual wavelength were taken from [11] and [12], respectively.



The interrelations between various optical characteristics of asteroids are shown in Figs. 1 – 7. The data measured in the different bandpasses are marked by colors, whereas crossers and dashed lines denote interrelations, which have been already known [1, 2, 13, 14] owing to observations in the V band. On the plots, solid lines demonstrate the regression relationships calculated on the base of multispectral data.

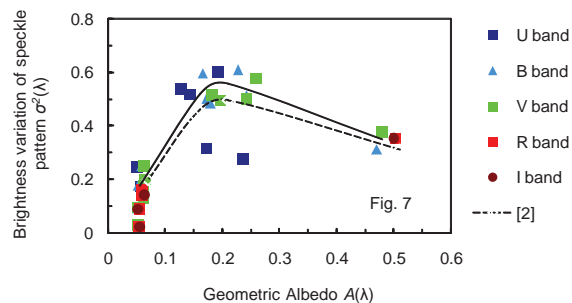
Figures 1 and 2 demonstrate interdependences between $A(\lambda)$ and $P_{\min}(\lambda)$, $h(\lambda)$ parameters in logarithmic coordinates. Despite the scatter of the points on these plots, the linear correlations, found previously for the V-band data [13, 14], more or less specifies the multispectral data. However, there are no specific correlations between parameters in question for the low-, moderate-, and high-albedo asteroids. This, in particular, implies that the inverse ratio between spectral albedo $A(\lambda)$ and $P_{\min}(\lambda)$, $h(\lambda)$ parameters may be absent for certain asteroids.

A very close correlation between phase coefficient $b(\lambda)$ and surface photometric roughness $c(\lambda)$ is shown in Fig. 3. Moreover, the regression lines for multispectral data and those for the V band actually coincide. The physical meaning of the phase coefficient becomes more transparent: in the visible spectral range, variations in the slope of the linear part of the asteroid magnitude-phase dependences are caused by variations in the photometric roughness of asteroid surfaces. In turn other parameter of the empiric photometric function [6], $a_{OE}(\lambda)$, is closely related to $\sigma^2(\lambda)$ parameter. As follows from Fig.4 the amplitude of brightness opposition spike at different wavelength is induced by a brightness contrast of a patchy pattern that could be generated by surface semitransparent particles with different refractive index $m(\lambda)$ [10].



Interrelations between the surface photometric roughness $c(\lambda)$ on the one hand and $A(\lambda)$, $P_{min}(\lambda)$ parameters on the other hand are presented in Figs. 5 and 6. The roughness $c(\lambda)$ stands in closer relation to $P_{min}(\lambda)$ than to $A(\lambda)$. For the present, we cannot explain why this occurs. As before, regression lines obtained for multispectral data prove to be close to those obtained only for the V band (shown by the crosses).

Figure 7 shows the unusual \cap -like dependence of $\sigma^2(\lambda)$ parameter on albedo $A(\lambda)$. We have become accustomed to the fact that dependences between multispectral parameters and those obtained in the V band are similar, and the last case is no exception. This implies that the interpretation of this dependence found previously in [2] for the parameters at the visual wavelength are also valid for the given set of these multispectral characteristics.



Returning to the question raised above, we can argue in favor of the following statistical regularity. Every one of the interrelations under study remains statistically invariable with respect to different wavelengths in the visible spectral range. This may be a consequence of the facts that (i) the V and B data predominant in Figs. 1 – 7, and (ii) all the multispectral data have approximately the same random spread relative to the regression lines shown on these plots.

We use the results obtained here to interpret the multispectral polarimetric observations of asteroids (part VII, this volume).

References:

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