ALBEDO DEPENDENCE OF ASTEROID OPPOSITION EFFECT. I. N. Belskaya and V. G. Shevchenko, Astronomical Observatory of Kharkiv State University, 35 Sumska str., 310022 Kharkiv, Ukraine, e-mail address: irina@astron.kharkov.ua.

Introduction: Asteroids with their diversities in albedos, compositions, surface structure, geometry of observations can be a very useful tool for checking and improving theoretical models of light backscattering, which is actively developed (e.g. [1,2]). In particular, the dependence of opposition effect (OE) amplitude on albedo is of a great importance. According to [3,4] the coherent backscatter effect can be distinguished observationally from the shadow hiding effect since the OE amplitude should decrease with increasing albedo for shadow hiding while for coherent backscatter the OE amplitude increase with increasing albedo.

Observational data: For analysis the magnitude-phase dependencies of 33 asteroids were chosen which have a good phase coverage with small scatter of observational data. Although the number of asteroids under consideration has not changed considerably as compared to previous analysis [5], the quality of the considered data set has essentially improved. More than half of asteroids under consideration were observed down to phase angle of 0.3 deg. To describe the OE phenomena we avoid to use model dependent parameters. The OE amplitude was calculated in two ways as a total increase in asteroid brightness at small phase angles and as the relative increase compared to the extrapolation of the linear part of magnitude phase curve. An approximated function is used only to determine asteroid magnitude at chosen phase angles

Results: Table summarized the mean values of opposition effect parameters and their standard deviation (in parentheses) calculated for different asteroid types. It gives the number of asteroids of each type, mean albedo, the OE amplitude measured at phase angle 0.3 deg. relatively to the extrapolation of the linear part of phase curve, ratio of intensities I(0.3)/I(5) - the absolute increase in intensity of scattered light measured at 0.3 deg. to that at 5 deg., and the angle of OE beginning - the angle at which non-linear increase in a magnitude-phase dependence begins. The differences in the ratio of intensities I(0.3)/I(5) determined by using different approximations (Hapke [2], Akimov [6], Shevchenko [7]) are less than 3%. Nevertheless to avoid any dependence on a kind of approximating function used, average values of the OE amplitude are given in the Table. The differences in magnitude-phase dependences are clearly seen for the main asteroid classes. The OE amplitude differs in both definition as absolute and relative increasing in brightness.

Table: Mean values of opposition effect parameters for different asteroid types

Type	N	Albedo	OE amplitude (mag)	Ratio of intensities I(0.3)/I(5)	Angle of OE beginning
P	4	0.04 (0.01)	0.11 (0.04)	1.30 (0.03)	4.1 (2.8)
C	6	0.07 (0.01)	0.16 (0.05)	1.34 (0.05)	4.2 (2.3)
M	6	0.15 (0.02)	0.34 (0.04)	1.44 (0.04)	6.8 (1.1)
S	10	0.21 (0.04)	0.35 (0.04)	1.44 (0.04)	6.3 (1.3)
E	4	0.51 (0.03)	0.23 (0.03)	1.28 (0.03)	3.4 (1.2)

Fig.1 shows dependence of the OE amplitude on albedo of asteroids. It is clearly seen that the amplitude of OE depends on asteroid albedo in a non-monotonic way. The amplitude of the OE decreases both for dark and high albedo asteroids. The largest amplitude occurs with moderate albedo asteroids (about 20% of albedo). A non-monotonic dependence of the OE amplitude on albedo observed for asteroids is impossible to explain within a single mechanism. A maximum for moderate albedo asteroids may give an evidence of almost equal contribution of coherent backscattering and shadow hiding effects. The same conclusion was made for the OE of the Moon [4]. Obviously, the contribution of coherent backscatter dominates for the high albedo E type asteroids. However, the coherent backscattering mechanism may be also important for low albedo asteroids since the darkest P type asteroids show smaller OE amplitude as compared to other low albedo objects. The angle of OE beginning also varies from type to type (see Table). The mean value of the angle is about 5 deg increasing for M and S types and decreasing for both high and low albedo asteroids. For some of them the magnitude-phase dependence remains linear down to 2-3 deg. (Fig.2). It is rather unexpected result since previously it was considered that the OE of asteroids begins at phase angles of 7-9 deg.[5].

Conclusions: The amplitude and width of OE depend on asteroid albedo in a non-monotonic way with maximum for the moderate albedo asteroids which is impossible to explain neither by coherent backscatter effect nor shadow hiding effect alone.

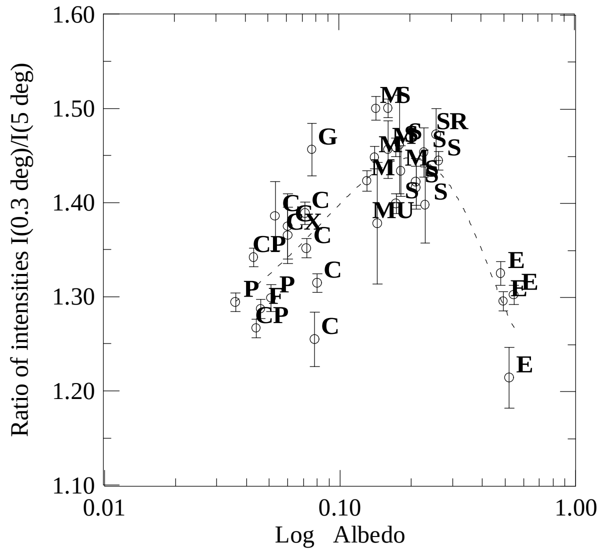

Fig.1. Amplitude of the opposition effect calculated as ratio of intensities at 0.3 deg to that at 5 deg. of phase angle versus albedo for asteroids of various compositional types.

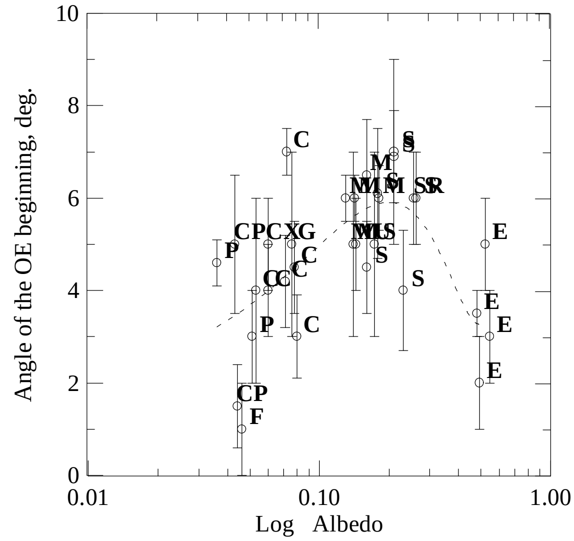

Fig.2. Angle of the opposition effect beginning versus albedo for asteroids of various compositional types.

References: [1] Shkuratov Yu. G. and Ovcharenko A. A. (1998) *Astron.Vestn, 32,* N4, 1. [2] Hapke B. (1998) *BAAS, 30,* 1080. [3] Hapke B. (1993) *Theory of Reflectance and Emittance Spectroscopy*, Cambridge Univ.Press. [4] Nelson R. M. et al. (1998) *Icarus., 131*, 223. [5] Scaltriti F. and Zappala V. (1980) *Astron. Astrophys., 83*, 249. [6] Akimov L.A. (1988) *Kinematika Fiz. Nebesnykh Tel,4*, 3. [7] Shevchenko V.G. (1996) *LPS XXVII*,1193.