The Opposition Effect of the Asteroid 4 Vesta

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We present the results of photometric observations carried out for the asteroid 4 Vesta in the B, R_c, and z' bands at a minimum phase angle of 0.1 degrees with four small telescopes: the 0.064 m refracting telescope at ISAS, JAXA in Sagamihara, the 0.36 m Ritchey–Chrétien telescope at the Miyasaka Observatory, the 0.076 m refracting telescopeat the Nishiharima Astronomical Observatory, and the 0.6 m Zeiss reflecting telescope at the Maidanak Astronomical Observatory.

The magnitudes reduced to unit distance and phase angle were $M_B(1, 1, 0) = 3.83$, $M_{R_c} = 2.67$, and $M_{z'}(1, 1, 0) = 3.03$ mag. The absolute magnitude obtained from the IAU *H–G* function [1] is ~0.1 mag darker than the magnitude at a phase angle of 0 degrees determined from the Shevchenko function [2] and Hapke models with the coherent backscattering effect term [3] (see Fig. 1, 2). Our photometric measurement allowed us to derive geometric albedos of 0.35 in the B band, 0.41 in the R_c band, and 0.31 in the z' bands through the Hapke model with the coherent backscattering effect term [4]. The porosity of the optically active regolith on the asteroid 4 Vesta was estimated from the Hapke model to be $\rho = 0.4$–0.7 yielding the bluk density of 0.9–2.0×10^3 kg m^{-3} [4].

It is evident that the opposition effect for the asteroid 4 Vesta makes a contribution to not only the shadow-hiding effect, but also the coherent backscattering effect that appears from about 1 degrees. The amplitude of the coherent backscatter opposition effect for Vesta increases with a brightening of reflectance. By comparison with other solar system bodies, we suggest that multiple-scattering on an optically active scale may contribute to the amplitude of the coherent backscatter opposition effect (B_{C0}) [4].

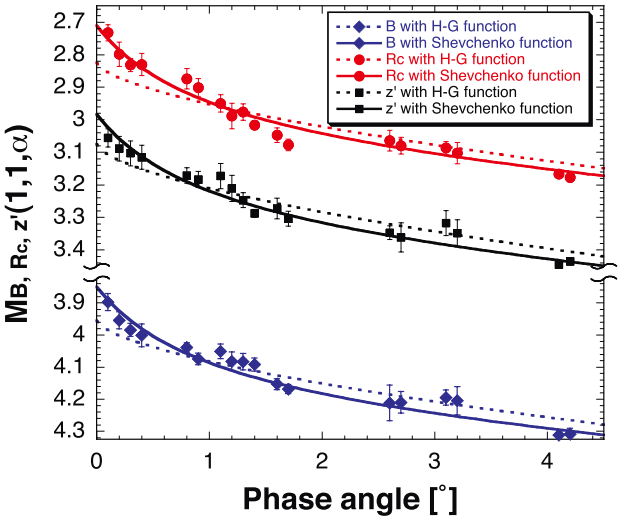

Figure 1: Fitted phase curves for asteroid Vesta using the IAU H–G phase function [1] and the Shevchenko function [2].

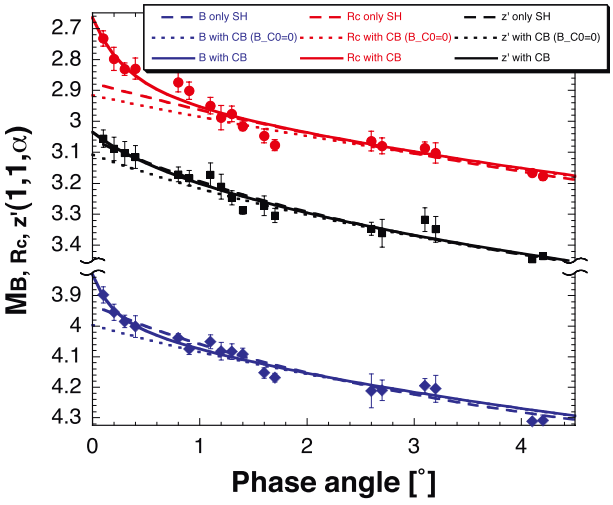

Figure 2: Fitted phase curves for asteroid Vesta obtained with the Hapke model [3].

References

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