SPECKLE INTERFEROMETRIC AND POLARIMETRIC ESTIMATES OF VESTA'S SHAPE AND SIZE

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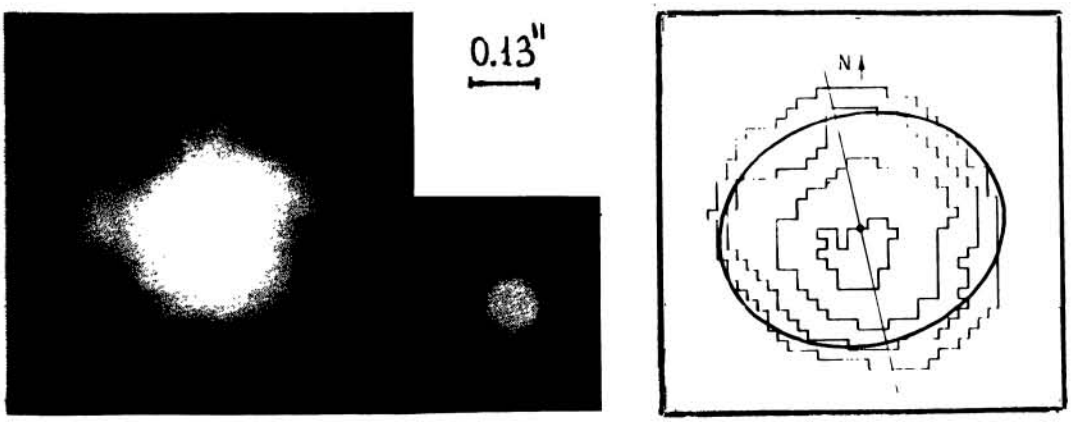
Speckle interferometric measurements of asteroid 4 Vesta effective size were made, and diffraction limited images of Vesta's disk were synthesized for three moments of observations. From the polarimetric data[1] a contribution of Vesta's albedo features in its lightcurve was estimated, and the "shape-born" component of the lightcurve was derived, due to Vesta's figure only. Analysing all this results, together with the results of simulation of Vesta's speckle interferometry, we concluded that Vesta is most probably a spherical body, with noticeable albedo features and possible shape irregularities. The triaxial ellipsoid model[2], with axes ratio 0.91 x 1.00 x 0.88 is evidently an artifact, resulted from using a model of a uniformly bright disk.

OBSERVATIONS AND PROCESSING. On January 21, 1988, speckle series of Vesta were obtained at Mount Maidanak (Middle Asia) with the 1-m telescope and the speckle camera, analogous to that described by Dudinov et al[3]. Power spectra measurements were carried out with the coherent optical processor of Kharkov Astronomical Observatory[3]. The images of Vesta were synthesized from speckle interferograms by the "shift-and-add"[4] method using the simple device for optical superposition, which operates on the principle of blinking.



a b

Fig. 1

RESULTS OF SPECKLE INTERFEROMETRY. As it is known, speckle interferometric measurements need a model of an object. A discrepancy between the accepted model and the true appearance of an object may cause a bias of speckle interferometric estimates for complex objects. Speckle interferometry followed by image reconstruction with the minimum of arbitrary suggestions is thus of particular interest for asteroids. In Fig. 1a the reconstructed diffraction limited image of Vesta is shown together with the image of a reference star, synthesized by the same method. Fig. 1b - contours for the same Vesta's image, with the step 0.2 in a logarithmic scale. The contour with the maximal value of gradient is accepted as an edge. The ellipse in this figure is the result of a standard speckle interferometric estimate with the model of a uniformly bright disk. Speckle interferometric results for three moments of observations are presented in Table 1. Here a

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and b are the axes of the projected ellipse, θ is the positional angle of the semiminor axis, measured eastward from North. All three moments are close to the lightcurve maximum.

Table 1

Date	UT	a(km)	b(km)	θ
21.01.88	$20^h\ 50^m$	543 ± 16	436 ± 13	-12° ± 3°
21.01.88	$21^h\ 38^m$	636 ± 19	534 ± 16	-27° ± 3°
21.01.88	$22^h\ 21^m$	561 ± 17	445 ± 13	+ 4° ± 3°

SIMULATION OF SPECKLE INTERFEROMETRY. To estimate the validity of speckle interferometric results and to illustrate their characteristic errors a simulation has been carried out. Experiments have shown, in particular, noticeable overestimation of an asteroid size and the effect of false ellipticity in the case of a round disk with albedo features.

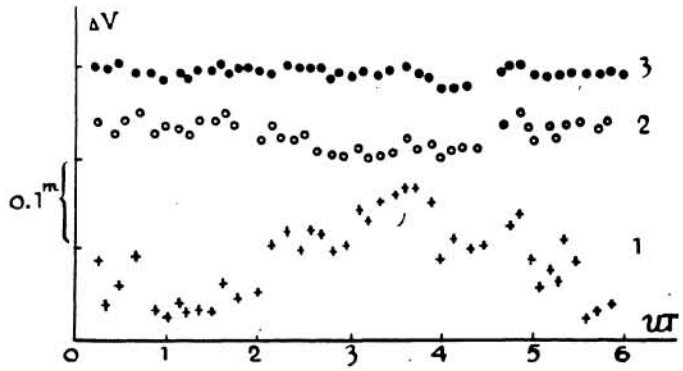

Fig. 2

POLARIMETRY OF VESTA: A NEW APPROACH TO SHAPE ESTIMATES. To elucidate the question of Vesta's shape an attempt was made to use polarimetric measurements[1]. Two lightcurves were reconstructed from polarimetric data, one of them with the empirical equation $|P_{min}|A = 0.16$, which has been obtained for asteroids[5], and another with the equation $A = -15.3|P_{min}|+30.6$, obtained for lunar features[6] (A is albedo and $|P_{min}|$ is polarization in percent near the minimum). Subtraction of the reconstructed lightcurve from the genuine one must separate the component, which is due to Vesta's shape only. The results of this subtraction is shown in Fig.2 (curves 1 and 2). In both cases only one maximum and one minimum occur over 5-hr 20.5-min period. It contradicts the conception of the short period of Vesta's rotation. The only way out is to regard Vesta as a spherical body, (curve 3). The connection between A and $|P_{min}|$ in this case is $A = -24|P_{min}|+36$, the average over a period albedo of Vesta being accepted 0.25.

References.
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