THE ALBEDO MAP OF 4 VESTA AS DERIVED FROM UV TO NEAR-IR REFLECTANCE SPECTRA. M. C. Festou, Southwest Research Institute, PO Drawer 28 510, San Antonio, Texas, TX 78228 and Observatoire Midi-Pyrenees, Toulouse, France, S.A. Stern, University of Colorado - Boulder, CO 80309 and G.P. Tozzi, Osservatorio Astrofisico di Arcetri, Firenze, Italy.

The derivation of surface morphology and composition information from a single monochromatic asteroid light curve is in most cases ambiguous, since the effects of shape and albedo variegation are not distinguishable [1, 2]. This ambiguity can be overcome in the case of asteroids with light curves controlled by large albedo spots [3]. Rotationally resolved spectrophotometry, in the UV, far-UV and in near-IR regions where strong laboratory absorptions features have already been observed, and polarimetric observations are powerful tools to further progress in the interpretation of photometric light curves and derive surface physical and/or compositional characteristics

The rotationally resolved UV and near-B light curves of asteroid 4 Vesta were obtained on 6-7 October 1990 with the two spectrographs and the Fine Error Sensor of the *International Ultraviolet Explorer* (IUE). The FES data, recorded with temporal resolution of about 2% of the 5.324 h rotation period, was used to determine an accurate value of the rotation period, 0.222 588 40 $\pm$ 8 x 10^{-8} day. In 13 hours, a total of 16 short LWP spectra and one deep LWP spectrum were recorded. The temporal resolution of those UV observations is 5% of the rotation period. A very deep SWP spectrum was obtained by adding 16 x 28 minute segments into a single exposure as the object rotated about 3 times about its axis. The reflectivity curve was obtained in the $\lambda\lambda$2000-3000 Å interval. The observed UV and optical light curves have one single minimum and one single maximum, and are nearly in phase. The UV light curve structure indicates the presence of spots. No absorption feature is seen below λ3000 Å (in particular, there is no trace of the iron-bearing minerals absorptions indicated in laboratory works [4]). The shape of the UV reflectivity curve is constant with rotational phase at the 3-5 % absorption level between λ2600 Å and λ3000 Å. The asteroid albedo varies in the λ2300 Å to λ3000 Å interval according to the law $p_V(\lambda) = 0.075 + 5.1 \times 10^{-5} (\lambda - 2700)$, and this linear dependency is likely to hold over the entire λ2000 Å to λ3500 Å interval.

The intrinsic light curve amplitude of Vesta is of the order of 10% and does not vary with wavelength from UV to near-IR. Whatever the actual shape of Vesta is, this implies a hemispheric-wide albedo asymmetry. Two quantitative models are found that attempt to explain the near spherical shape of Vesta: that of Cellino *et al.* [3], who proposed an equilibrium shape showing a hemispheric-wide albedo asymmetry (by $\approx$ 10%, which origin is very uncertain) plus an entirely dark polar cap, and that of Drummond *et al.* [5] who found that Vesta was a true tri-axial elipsoid covered by a series of small scale very bright and very dark spots. This last model presents many difficulties, the most serious being the necessity to compensate the shape of the asteroid by finely placed highly contrasted albedo spots that lead to the observed light curve.

The amplitudes of the UV, optical and near-IR light curves are identical and no obvious color changes are correlated with rotational phase in the wide $\lambda\lambda$2000 Å - 2.5 μm wavelength range explored so far. This certainly indicates that the size of the grains is significantly larger than that of the wavelength of the incident light.

Concerning the nature of the spots on Vesta, the small scale albedo variations cannot explain alone the 10% amplitude variation of the light curve. Using all available observations, we argue that Vesta has two hemispheric-wide dark spots, one that covers a large fraction of the southern hemisphere and one that is nearly equatorial. Assuming the rotation axis of Drummond and Hege [6], we find that the first hemispheric asymmetry corresponds to a seasonal-like effect that can be described as an hemisphere centered at about 30° N latitude being brighter than its opposite situated at about 30° S latitude.

The large scale properties of Vesta's regolith could be due to (i) either a variation of the geometrical arrangement of the particles that compose it, ot (ii) a surface chemical composition variation. In the first case, since the albedo of the individual grains is large, very small changes in the arrangement of the grains may suffice to induce the observed light curve amplitude. In the second case, the average grain albedo does not change by more than about 10%, which suggests a small change in the relative populations of the various grains that compose Vesta's regolith. Small bright spots may indicate true chemical surface variegation, although their visibility at specific phase angles suggests geometrical effects such as a modification of the arrangements of the grains, their compaction state, or togographical features.

Vesta is certainly a fascinating object. Three ways exist to further extend our knowledge of its surface. (i) radar observations that could reveal the shape of Vesta, hence facilitate the spectrophotometric data interpretation. (ii) ground-based *differential* spectrophotometric observations performed at very high photometric accuracy (milli-magnitude level). (iii) high spatial resolution imaging of Vesta with the Hubble Space Telescope.

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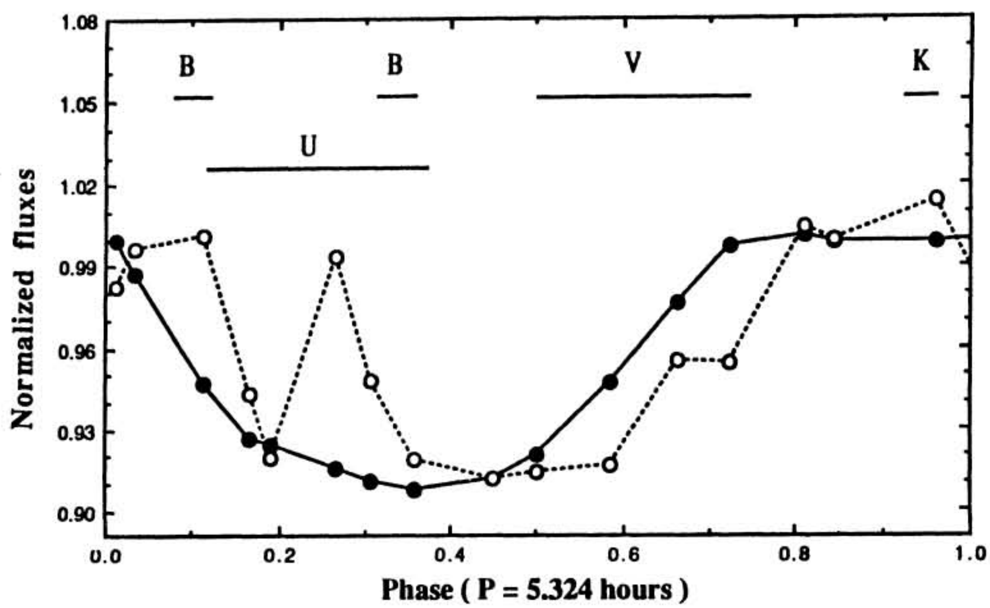

Figure 1: Normalized optical (full line) and ultraviolet (dotted line) light curves of Vesta. The two curves are nearly in phase if features near phases 0.20 and 0.70 are due to localized spots. Above the curves are mentioned by their color and probable extension the spots that have been clearly identified in previous optical observations.