First Disk-Resolved Spectroscopy of 4 Vesta

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Introduction: Asteroid (4) Vesta, target of NASA's Dawn mission, is the only known asteroid with a possibly differentiated internal structure [1]. Geological diversity across Vesta's surface has been first reported from Earth-based disk-integrated spectrophotometry [2,3]; and HST imagery [4] revealed strong albedo variations across its surface, whose origin has not yet been determined.

Ion irradiation experiments on Eucrite meteorite [5] have shown that, if solar wind ions do reach the surface of Vesta, its reflectance spectrum should be much redder and its albedo lower. Thus, the similar albedo and NIR reflectance spectrum displayed by Vesta and the HED meteorites reveals Vesta's surface to be either (a) free from heavy space weathering [6], or (b) continuously refreshed. Both processes have been discussed: the action of local magnetic field (with a required strength at the surface of only $\sim$0.2 μT) has been proposed to explain Vesta shielding from solar wind ions (space weathering) [5], and regolith activity will bring fresh material on surface. Regolith processes can be triggered by global seismic activities (from the giant crater relaxation), or the fall of small-sized debris ($\sim$1m) launched from the impact basin and remained in Vesta's gravitational influence [7].

Observations: We observed Vesta over the 1.1-2.4 μm range during the Science Verification program of SINFONI, the ESO integral-field spectrograph [8] mounted on Cassegrain focus of UT4 at VLT. The observations were obtained in August and October 2004, under good atmospherical conditions, while the asteroid was fully resolved by the system (Fig. 1): SINFONI provides a spectral resolution of $\sim$1500 over the range and the AO correction provided a resolution element of about 80 milli-arcsec at 2 micron, corresponding to $\sim$95 km on Vesta.

Surface Analysis: We will present the results inferred from near-infrared wavelength: **1.** We compared Vesta's spectra to those of laboratory measured HED meteorites and Augite minerals (clinopyroxene) catalogued in the RELAB database in order to investigate Vesta's pyroxene composition: no clinopyroxene-rich area was detected, and Vesta's overall spectrum is consistent with howardite meteorites. **2.** We mapped the distribution of spectral slope and compared it to the albedo distribution obtained from HST [4] to test the magnetic field hypothesis [5], although the definitive answer will come from

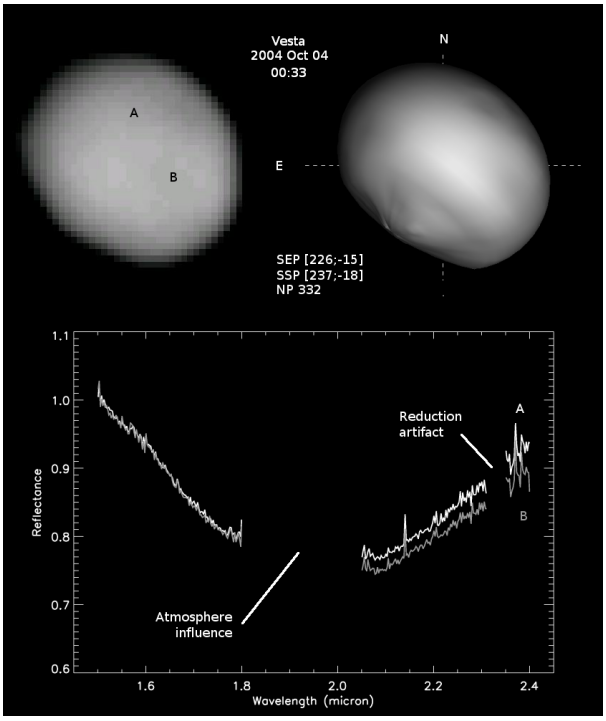

Figure 1: Vesta spectro cube, compared to Vesta's shape model [9] obtained with IMCCE Eproc ephemeris generator. Each pixel (12.5x12.5 milli-arcsec) in the image is a spectrum, as illustrated in the lower panel (here *H+K* grating). We improved the SNR of all the spectra by smoothing them with a 8 pixel median filter. A and B spectra illustrate Vesta's pyroxene heterogeneity, with the characteristic 2-micron band shape varying accross the surface.

NASA Dawn mission.

References

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