THE UNIQUE PHOTOMETRIC PROPERTIES OF V-TYPE ASTEROIDS AND 4 VESTA . B. J. Buratti[1], M. D. Hicks[1], J.-Y. Li[2], D. Blackburn[1], J. K. Hillier[3], V. Reddy[4], M. V. Sykes[2], C. A. Raymond[1], C. T. Russell[5], S. Mottola[6], [1]Jet Propulsion Laboratory Calif. Inst. of Technology, Pasadena, CA 91109, Bonnie.J.Buratti@jpl.nasa.gov, [2]Planetary Sci. Inst., [3]Grays Harbor College, [4]Max Planck Inst.for Solar System Research, 5. U. Calif. Los Angles, [6]DLR, Berlin.

Introduction: 4 Vesta is the first V-type asteroid to be studied in detail by a spacecraft. *Dawn* arrived at Vesta in July 2011 and after approach and survey orbits began to execute a year-long study of the asteroid. Fig. 1 shows a global image from the Framing Camera. *Dawn's* range in observed viewing geometries, especially large solar phase angles not attainable from Earth, and its instruments that cover spectral ranges blocked by the Earth's atmosphere, enabled a detailed study of the physical photometric properties, including roughness, albedo corrected for viewing effects, and the directional scattering properties. Physical properties that can be derived from small phase angles, such as the compaction state of the surface, are still best derived from ground-based observations, as small angles were never attained during the *Dawn* mission. Preliminary results from *Dawn* on the albedo of Vesta and its roughness, when combined with observations and modeling of V-type asteroids, show that these bodies are different from other classes of asteroids.

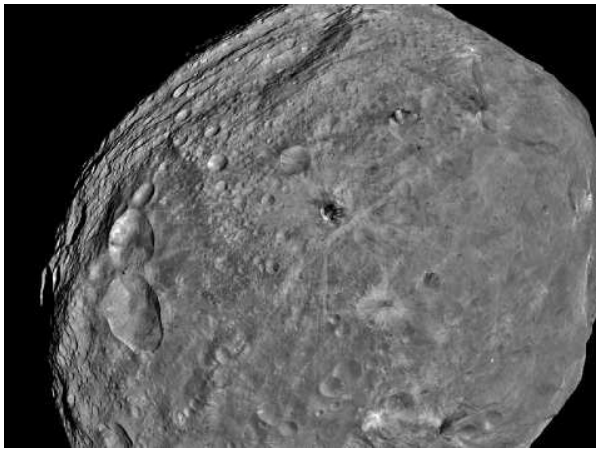

Figure 1. This image of 4 Vesta from *Dawn* shows that the macroscopic surface roughness of the asteroid varies widely across the body. For example, there is a smooth terrain adjacent to the three touching craters near the left limb and a much rougher region near the dark crater in the center of the body. Also evident is the wide range in albedos on the surface.

Roughness: Macroscopic surface roughness includes features such as craters, mountains, ridges, and clumps of particles. Photometric modeling of these features is especially powerful, as the effects of features below the resolution limit of the camera are included. Preliminary modeling of a phase curve including V-type asteroids and Vesta shows that their roughness is higher than that of S-types and C-types, which suggests a more violent collisional history [1]. Fig. 2 shows a comparison of IAU model fits to the main classes of asteroids.

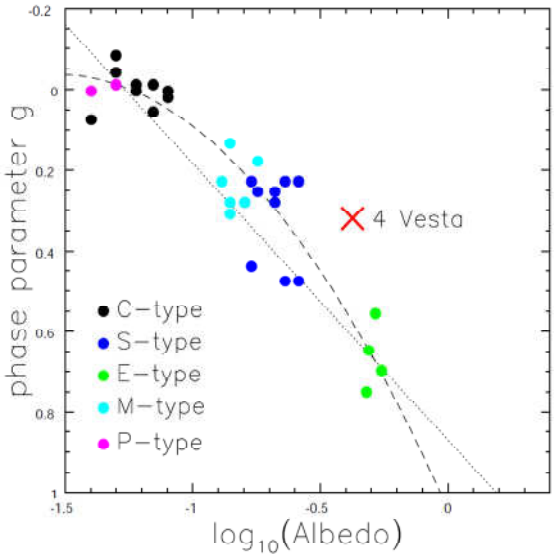

Figure 2. The position of 4 Vesta in albedo and IAU phase curve parameter g, where a smaller g corresponds to a steeper solar phase curve characteristic of low-albedo bodies. Vesta is closest to S-type asteroids, although its albedo is higher. Adapted from [2].

Albedo: Previous spacecraft missions to asteroids revealed that albedo variegations on these bodies tended to be minor. For example, 951 Gaspra had variegations of about 20% [3], while Eros had larger variegations of up to a factor of two [4]. Variegations on Vesta are at least a factor of five.

References: [1] Hicks, M. D. et al., 2012, submitted to *Icarus*. [2] Belskaya, I. N. and Shevchenko, V. G. 2000. *Kinematika i Fizika Nebesnykh Tel*, Suppl, no. 3, p. 219. [3] Helfenstein, P. et al. 1994. *Icarus* **107**, 37. [4] Murchie, S. et al. 2002. *Icarus* 1**55**, 145.

Acknowledgements: This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology under contract to the National Aeronautics and Space Administration. We acknowledge support from the Dawn Participating Scientist program.