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510 – Asteroid Physical Characteristics: Surfaces II

510.01 – 3-µm Spectroscopy of Asteroid 16 Psyche

Asteroid 16 Psyche, an M-type asteroid, is thought to be one of the most massive exposed iron metal object in the asteroid belt. The high radar albedos of Psyche suggest that this differentiated asteroid is dominantly composed of metal. Psyche was previously found to be featureless in the 3-µm spectral region. However, in our study we found that this asteroid exhibits a 3-µm absorption feature, possibly indicating the presence of hydrated silicates.
We have observed Psyche in the 3-µm spectral region, using the long-wavelength cross-dispersed (LXD:1.9-4.2 µm) mode of the SpeX spectrograph/imager at the NASA Infrared Telescope Facility (IRTF). For data reduction, we used the IDL (Interactive Data Language)-based spectral reduction tool Spextool (v4.1). Psyche was observed over the course of three nights with an apparent visual magnitude of ~9.50: 8 December 2015 (3 sets), 9 December 2015 (1 set), and 10 March 2016 (1 set). These observations have revealed that Psyche may exhibit a 3-µm absorption feature, similar to the sharp group in the 2.9-3.3-µm spectral range. Psyche also exhibits an absorption feature similar to the one in Ceres and Ceres-like group in the spectral 3.3-4.0-µm range. These 3-µm observational results revealed that Psyche may not be as featureless as once thought in the 3-µm spectral region.
Evidence for the 3-µm band was found on the surfaces of many M-type asteroids and a number of plausible alternative interpretations for the presence of this 3-µm band were previously suggested. These interpretations include the presence of anhydrous silicates containing structural OH, the presence of fluid inclusions, the presence of xenolithic hydrous meteorite components on asteroid surfaces from impacts, solar wind-implanted H, or the presence of troilite. The detection of the Ceres-like feature in the 3.3-4.0-µm spectral range, however, would rule out some of these alternative interpretations, especially the solar wind-implanted H.
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510.02 – Asteroid 16 Psyche: Radar Observations and Shape Model

We observed 16 Psyche, the largest M-class asteroid in the main belt, using the S-band radar at Arecibo Observatory. We obtained 18 radar imaging and 6 continuous wave runs in November and December 2015, and combined these with 16 continuous wave runs from 2005 and 6 recent adaptive-optics (AO) images to generate a three-dimensional shape model of Psyche. Our model is consistent with a previously published AO image [Hanus et al. Icarus 226, 1045-1057, 2013] and three multi-chord occultations. Our shape model has dimensions 279 x 232 x 189 km (±10%), D_{eff} = 226 ± 23 km, and is 6% larger than, but within the uncertainties of, the most recently published size and shape model generated from the inversion of lightcurves [Hanus et al., 2013]. Psyche is roughly ellipsoidal but displays a mass-deficit over a region spanning 90° of longitude. There is also evidence for two ~50-70 km wide depressions near its south pole. Our size and published masses lead to an overall bulk density estimate of 4500 ± 1400 kg m^{-3}. Psyche's mean radar albedo of 0.37 ± 0.09 is consistent with a near-surface regolith composed largely of iron-nickel and ~40% porosity. Its radar reflectivity varies by a factor of 1.6 as the asteroid rotates, suggesting global variations in metal abundance or bulk density in the near surface. The variations in radar albedo appear to correlate with large and small-scale shape features. Our size and Psyche's published absolute magnitude lead to an optical albedo of p_v = 0.15 ± 0.03, and there is evidence for albedo variegations that correlate with shape features.
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510.03 – VLT/SPHERE observations and shape reconstruction of asteroid (6) Hebe

(6) Hebe is a large main-belt asteroid, accounting for about half a percent of the mass of the asteroid belt. Its spectral characteristics and close proximity to dynamical resonances within the main-belt (the 3:1 Kirkwood gap and the nu6 resonance) make it a probable parent body of the H-chondrites and IIE iron meteorites found on Earth.
We present new AO images of Hebe obtained with the high-contrast imager SPHERE (Beuzit et al. 2008) as part of the science verification of the instrument. Hebe was observed close to its opposition date and throughout its rotation in order to derive its 3-D shape, and to allow a study of its surface craters. Our observations reveal impact zones that witness a severe collisional disruption for this asteroid. When combined to previous AO images and available lightcurves (both from the literature and from recent optical observations by our team), these new observations allow us to derive a reliable shape model using our KOALA algorithm (Carry et al. 2010). We further derive an estimate of Hebe's density based on its known astrometric mass.
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510.04 – A search for differentiated fragments within asteroid families

The existence of iron meteorite samples suggest that a number of planetesimals differentiated fully and were subsequently disrupted. Within the current asteroid belt, there is little evidence of bodies that fully differentiated into core, mantle and crust layers (Moskovitz et al. 2008). However, because it has been suggested that differentiation can occur within the interior of a body while the primitive exterior remains intact (Elkins-Tanton et al. 2011), an understanding of the diversity of compositions from differentiated parent bodies is critical. Asteroid families, as constituents of a