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Ceres and Vesta: Two Protoplanets in the Main Asteroid Belt

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The Dawn mission will characterize the conditions and processes of the solar system's early epoch by investigating in detail two of the largest protoplanets Ceres and Vesta. The mission is motivating renewed study of these asteroids. Years of ground-based observations have given us a baseline for their rotation period, size, shape, polarization, photometric and spectral reflectance, which will be summarized. With images from the Hubble Space Telescope's Advanced Camera for Surveys, Thomas et al.2005 have determined Ceres' shape, of 487.3 +/- 1.8 and 454.7 +/- 1.6 km, and pole orientation of RA 291° and dec 59°. The difference between these principal axes is smaller than predicted for a homogeneous body of Ceres' density (2, 077 kg/m3). The conclusion is that Ceres is a differentiated object. Li et al. (2006) derived the first albedo maps of Ceres showing albedo variations and spectral differences for 11 different spatially resolved regions on Ceres. Recent spectral reflectance (Li et al.2006, Rivkin et al.2005, 2006), to be presented elsewhere at this meeting, shows absorption bands that should provide us with clues to the surface composition of Ceres. The absorption bands do not yet give a clear picture of Ceres' composition. In the past, we thought Ceres was similar to carbonaceous chondrite meteorites. But with evidence of ammoniated saponite, water bound in a silicate structure, suggestion of a sulfate related band in the UV, the picture is not clear. Vesta has a well-characterized rotation period, size, and shape and has been mapped with visible and near-IR filters by Binzel et al.1997 using Hubble Space Telescope. Ground-based near-IR observations with the IRTF of the Mauna Kea Observatories, have been acquired at different sub-earth latitudes enabling latitudinal mapping of Vesta. Longitudinal variations with rotation have been interpreted in the past as mineralogical variations consistent with the range in composition of the basaltic achondrites. The evidence for small amounts of water ice on Vesta is disconcerting. Will latitudinal mapping help us understand the reported presence of weak water bands on Vesta? Vesta makes a close approach to Earth in May/June, 2007 and should be a target for observations supporting the Dawn mission at that time. An improved pole position of Vesta will help planning orbital observations for the Dawn mission. The Dawn mission will extend our knowledge of these asteroids by providing images from the two framing cameras to reveal surface morphology and photometric properties, spectra from the Visible and Infrared (VIR) mapping spectrometer, and elemental abundances from the Gamma Ray and Neutron Spectrometer (GRaND).