The Gravity Field and Uniformity of Eros

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The NEAR spacecraft was inserted into a 320x360 km orbit about Eros on Feb. 14, 2000. After systematically reducing the orbit size, the best gravity data from radiometric Doppler tracking was obtained July 14 to July 24 in a polar circular orbit 35 km from the asteroid center. A 68 day polar 50-km orbit also provided excellent data. With all the Doppler and range tracking since orbit insertion, a spherical harmonic gravity model has been developed and compared to a gravity field determined from the lidar shape model of Eros and assuming constant density. Other studies also include the development of ellipsoidal harmonic models which can be used much closer to the asteroid's surface. The center-of-figure offset from the center-of-mass is on the order of 10 meters and indicates a very uniform density (< 1% variation) on a large scale (35 km). Spatial variations to harmonic degree 6 or 7 (~6 km size) between the observed gravity and topographic based constant density model (i.e. Bouguer gravity) are now greater than the noise in the observed gravity. The differences may indicate a mass excess near the asteroid ends of about 1% of the gravity amplitude (not including the central GM term) or may be partially caused by uncertainties in the shape model. Spectrally, the gravity coefficients between the observed gravity and constant density models also match to about the 1% level. Studies are underway to characterize modifications to the constant density model with constant density layers and variable density polyhedra to match the observed gravity. Linear programming methods are also planned to bound density variations for equally sized blocks.