Estimating the Mass of Asteroid 433 Eros During the NEAR Spacecraft Flyby

D.K. Yeomans (JPL/Caltech), P.G. Antreasian (JPL/Caltech), A. Cheng (JHU/APL), D.W. Dunham (JHU/APL), R.W. Farquhar (JHU/APL), J.D. Giorgini (JPL/Caltech), A.S. Konopliv (JPL/Caltech), J.K. Miller (JPL/Caltech), W.M. Owen, Jr. (JPL/Caltech), P.C. Thomas (Cornell University), J. Veverka (Cornell University), B.G. Williams (JPL/Caltech)

The terminal navigation of the Near-Earth Asteroid Rendezvous (NEAR) spacecraft during its flyby of asteroid 433 Eros on December 23, 1998 relied upon coordinated efforts to first determine the heliocentric orbits of the spacecraft and Eros using ground-based data and then to determine the relative trajectory of the spacecraft with respect to Eros. Although the gravitational perturbation on the NEAR spacecraft from nearby Eros was not nearly as obvious as that seen during the asteroid Mathilde flyby in June 1997, this perturbation was evident in the spacecraft tracking data. Using ground-based Doppler and range tracking of the spacecraft as well as spacecraft images of the asteroid's center and surface features, the mass and rotation pole of Eros were determined. The mass value for Eros was estimated to be (7.2 +/- 1.8) x 10**18 grams and coupled with a volume estimate provided by the NEAR imaging team, this mass suggests a bulk density of 2.5 +/- 0.8 g/cm**3. The rotation pole position determined for the asteroid is compatible with ground-based results as well as those determined by the NEAR imaging team.