



NEAR Radio Science

Critical Mission Statement

The Near-Earth Asteroid Rendezvous (NEAR) Radio Science Team, in cooperation with the NEAR Spacecraft Navigation Team, determined the mass of asteroid 253 Mathilde in June 1997. During the 1999 rendezvous with asteroid 433 Eros, the mass and mass distribution of Eros will be determined in addition to its rotation characteristics and dynamical history. The investigation will exploit tracking data, optical images, and laser altimetry data taken by NEAR's on-board instrumentation.

Specifications

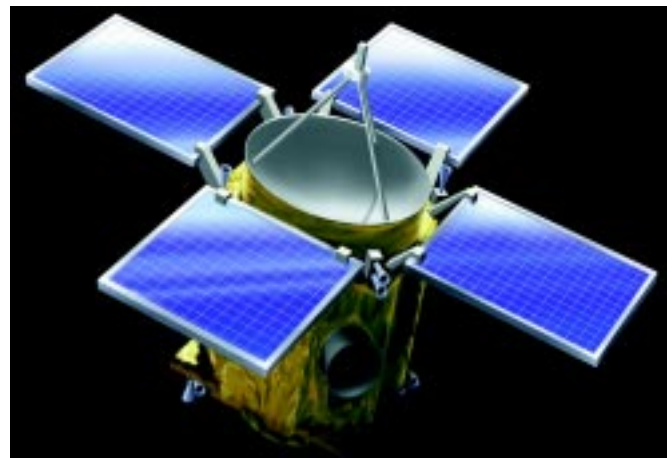
NEAR carries a radio transponder that will enable us to establish its position and velocity in inertial space. This X-band transponder operates at 8438 MHz and can pinpoint the spacecraft's radial velocity to better than 0.1 mm/s when the data are properly calibrated.

Radio Science Objective

By using ground-based tracking data along with spacecraft observations of the nearby asteroid, we can assess several fundamental properties of the asteroid. While the NEAR spacecraft is in close proximity to the asteroid, the spacecraft's trajectory is modified by the asteroid's gravity. These spacecraft trajectory changes, which are monitored using the tracking data, depend upon the relative distance and velocity of the spacecraft as well as the mass of the asteroid.

Working closely with the NEAR Spacecraft Navigation Team, the Radio Science Team successfully determined the mass of asteroid Mathilde during the NEAR spacecraft flyby on 27 June 1997. From a Mathilde volume estimate provided by the Multispectral Imager (MSI) Team, the asteroid's bulk density was estimated as 1.3 g/cm³, suggesting that the asteroid may have a high degree of porosity. For the asteroid Eros rendezvous in early 1999, the asteroid's mass and density will be determined along with its mass distribution, its rotational characteristics, and its dynamical history. The MSI Team and the NEAR Laser Rangefinder Team will determine a shape model for Eros. This shape model will allow the volume of the asteroid to be estimated and the volume, together with the mass estimate, will allow Eros's bulk density to be determined.

As the NEAR spacecraft orbits the asteroid Eros, the spacecraft's ground-based tracking data will be used to determine the asteroid's gravity field, or the distribution of mass throughout the asteroid's interior. This true



gravity field will then be matched against one where the gravity field is determined using only the shape model and an assumed constant interior density. The extent to which the two gravity fields agree is an indication of how well the surface topography is correlated with the interior field, thus providing an indication of the asteroid's homogeneity.

In addition to its gravity field, Eros's rotational characteristics will have to be ascertained to successfully navigate NEAR in orbit around the asteroid. Thus, the objectives of the NEAR Radio Science Team and NEAR Navigation Team are intimately linked, and both teams will work closely to accomplish their mutual goals

Furthermore, by using spacecraft data and over 100 years of ground-based observations, the orbital history of Eros will be investigated with an eye toward placing upper limits on any comet-like outgassing activity that may have occurred during the last century.

Instrument Management

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