NEAR Multispectral Imager

The NEAR Multispectral Imager (MSI) will determine the overall size, shape, and spin characteristics of the asteroid 433 Eros and will map the morphology and color properties of the surface. The imager will also be used for optical navigation and to search for satellites of Eros. Images taken during approach and orbit of Eros will detect surface features as small as 3 meters. The 7-color capability of the instrument will complement the near-infrared and X-ray/gamma-ray spectrometers in extrapolating variations in surface composition down to smaller spatial scales. During the cruise to Eros, MSI acquired the first images of the asteroid 253 Mathilde.

Specifications

Mass:	Camera head, 3.7 kg Electronics, 4.0 kg
Power:	Camera head, 1.43 W Electronics, 5.49 W
Detector:	Si CCD; Thomson-CSF TH7866
Field of view:	2.26° × 2.95°, in 244 × 537 pixels = 3.9 × 5.1 km from 100-km distance
Resolution:	9.6 × 16.2 m from 100-km distance
Exposure time:	1–999 ms manual or automatic
Wavelength range:	1 broadband filter, 7 spectral filters at 450, 550, 760, 900, 950, 1000, 1050 nm
Data character:	12-bit data, with three-tiered compression menu

MSI Description

MSI consists of a five-element refractive telescope with passively cooled Si CCD and electronics, a filter wheel, and a computer (digital processing unit, or DPU). The telescope is $f/3.4$ with a 168-mm focal length. The imager provides a field of view of 2.26° × 2.95°, divided into an array of 244 × 537 pixels on the CCD. Pixel angular resolution is 96 × 162 μrad, corresponding to 9.6 × 16.2 m from a distance of 100 km. Brightnesses are encoded to 12 bits. The Si CCD is sensitive to the wavelength range of 400–1100 nm (visible and short-wavelength near-infrared light). A filter wheel has seven spectral filters designed primarily to discriminate iron-containing silicate minerals, and one broadband filter for low-light imaging and optical navigation. The DPU contains software that controls the instrument and supports automatic exposure time control, acquisition of image sequences, and a three-tiered compression system offering several modes of lossless compression and seven lookup tables for converting the data from 12 to 8 bits.

MSI Imaging Science

433 Eros is a member of the "S" class of asteroids, which are composed of iron-containing silicates and metal. At 40 × 14 × 14 km, it is the largest asteroid that approaches close to Earth. The main science objectives for NEAR are to determine Eros's surface morphology and the processes that affect its surface, its internal structure, and its composition and relationship to meteorites. MSI is critical to accomplishing each of these goals. MSI will image the surface at spatial resolutions as high as 3–5 meters. These high-resolution images will reveal the distribution and thickness of the asteroid's fragmental surface layer or "regolith," the history of impacts by fragments of other asteroids and comets that is recorded in craters, the character and locations of fractures of the asteroid's body, and the processes that affect the surface layer.

MSI images will also be used to determine the size, shape, and volume of Eros. Unlike previous targets of orbiting spacecraft, Eros's mass and density are unknown. The mass will be measured by radio tracking of the spacecraft as it approaches Eros; shape will be measured from MSI imagery during approach and flyby of the asteroid, as well as by NEAR's laser

rangefinder (NLR). The mass and shape measurements will provide the asteroid's density and density structure, which are necessary both for conducting the later orbital phase of the mission and for evaluating Eros's internal structure.

MSI's seven spectral filters are specifically chosen to distinguish between the spectra of sunlight reflected by the major iron-containing mineral constituents of Eros's surface. MSI has 70 times the spatial resolution of the near-infrared spectrograph, so color imagery from MSI will be used to extrapolate compositional information down to smaller spatial scales. Correlation of the compositional variations with specific surface features such as fractures or craters will allow discrete rock units to be mapped, and will provide a window into the internal geologic structure exposed by craters.

En route to Eros, MSI acquired the first close-up images of the main-belt asteroid 253 Mathilde. These revealed the most heavily cratered body yet observed in the solar system, with a size of 66 × 48 × 46 km. Mathilde is a member of the "C" class of asteroids, believed to be composed of primitive, organic-rich materials. Mathilde's low density (1.3 ± 0.2 g/cm^3), inferred from MSI's volume estimate and from measurement of the deflection of NEAR's trajectory by the asteroid's weak gravity, suggests that its interior is loose and porous.

to align its flight path with the orbit of Eros. Insertion into orbit around Eros occurs on 10 January 1999, after which the spacecraft will be inserted into orbits of progressively lower radii, culminating in a 35-km low orbit. On approach to Eros and from the higher orbits MSI will search for satellites and determine the global shape, spin, and color properties of the asteroid. Most of the mission will be devoted to high-resolution mapping from low orbits. MSI will provide the first detailed global geologic map of any asteroid, which will reveal important clues to Eros's evolution and history.

MSI Team

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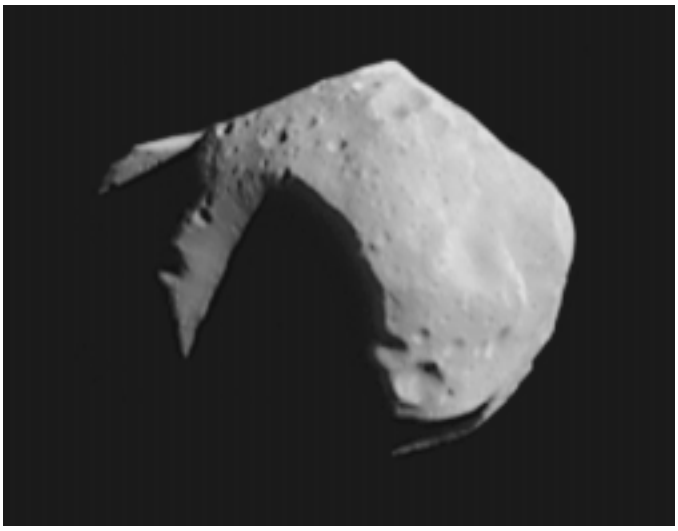

Mathilde global mosaic, acquired June 27, 1997, from a range of 1500 miles (2400 kilometers).

Image of Antarctica, South America, and Earth's Southern Ocean, acquired January 23, 1998, from a range of 135,000 miles (220,000 kilometers).

Experiment Profile

The NEAR spacecraft is following a 2-year DVEGA trajectory, beginning with launch on 17 February 1996. The flyby of Mathilde occurred on 27 June 1997, and on 23 January 1998 NEAR made a close swingby of Earth

For more information,
access the NEAR home page
on the World Wide Web at
http://near.jhuapl.edu

NEAR is a NASA Discovery Program mission

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