

## NEAT: Near Earth Asteroid Trailblazer Characterization Mission

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Asteroid characterization is an essential part of a broad-based NEO program. In parallel with advanced searches, we need to investigate a representative set of NEAs. The Near Earth Asteroid Trailblazer Mission is a low-cost lander that will dramatically improve our understanding of the physical properties and orbital dynamics of small NEAs.

NEAT provides global reconnaissance (shape, mass, density, dynamical state), *in situ* surface characterization, and long-term precision tracking. While discussed here as a single mission, with multiple launches NEAT spacecraft could sample the diversity of the NEA population, and make the critical measurements required for future defense/mitigation mission planning.

The most likely threat to Earth is from small NEAs (of order 100-500 m diameter), and these are the asteroids that we most need to understand from a defense perspective. Orbiting small asteroids requires active thrusting and control due to their low gravity. In addition, small asteroids are more subject to orbital perturbations by non-gravitational forces such as the Yarkovsky effect.

A rendezvous and lander mission is the most practical way to obtain the required data for characterization and orbital tracking of most of these objects. The primary NEAT objectives involve characterization of the physical nature and dynamical state of the object, and long-term evaluation of the Yarkovsky effect. Physical characterization covers measurements of the asteroid's size, shape, thermal inertia, mass and density in the rendezvous and approach phases, together with *in situ* investigation by a small suite of landed instruments measuring the mechanical properties and micro-structure of the undisturbed surface. A surface transponder permits precision tracking for multiple orbits.

NEAT utilizes a low-cost spacecraft bus and may be launched with a Minotaur or Falcon-class rocket. The nominal target, NEA Apophis, can be reached with a single EGA; other NEA targets are accessible with direct flight. The final target selection will take advantage of new discoveries of sub-km NEAs from the Pan-STARRS survey. The concept is being studied at NASA Ames in collaboration with JPL and industry and academic partners. It is a candidate mission for the characterization phase of the proposed new NASA NEO Program.