DEEP INTERIOR: COMPREHENSIVE GEOPHYSICAL EXPLORATION OF AN ASTEROID

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Near-Earth Objects (NEOs) come closer to Earth than any other celestial body, and their compositions are represented on Earth by thousands of well-studied meteorites. Yet we understand neither their origin, evolution, nor their geophysical behavior. These secrets are locked up in their **unexplored interiors**.

Goal 1 of the NASA Strategic Plan emphasizes the requirement to catalogue and understand NEOs down to 1 km diameter. Goal 4 urges us to understand natural processes at work in the low gravity environment. Goal 5 expresses the need to explore the solar system and to learn how planets originated and evolved. In response to the NASA Strategic Plan we are proposing a NASA Discovery mission whose primary science objective is to greatly advance the realization of these Goals by conducting the first investigation of the global geophysics of an asteroid.

Radio reflection data from 5 km orbit about a 1 km NEO will provide a tomographic 3D image of electromagnetic properties. Mechanical properties will be examined in the simplest possible way, using explosions to initiate seismic cratering events and to expose diverse interior units for spectroscopic analysis.

Deep Interior is the lowest-risk, lowest cost path towards attaining the required characterization of NEOs. It breaks new ground for future missions to asteroids and comets and facilitates the design of reliable NEO technologies.

Our science goals are as follows, and the techniques (radio science, imaging, IR spectroscopy, active surface science) will be described at this meeting:

Asteroid Interiors. Radio, gravity, and seismology experiments give a complete first picture of an asteroid's deep interior, resolving inclusions, voids and unit boundaries at $\sim$30 m scales, and determining global and regional mechanical properties.

Surface Geophysics. Blast experiments explore the structure and mechanics of the upper meters, demonstrate microgravity cratering, trigger natural geomorphic events, and expose subsurface units for near-IR investigation.

Relation to Meteorites. Ejecta movies at $<$30 cm/px at varying phase angle show how meteorites are launched. Color imaging and spectroscopy of final craters determine the stratigraphy, from weathered to pristine.

Asteroid Diversity. Radar flyby experiment of another near-Earth asteroid, en route. Ground support extends NIR range to $\sim$5.6 μm. Aims to leverage and validate terrestrial remote sensing.