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The Main-belt Asteroid and NEO Tour with Imaging and Spectroscopy (MANTIS)

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The asteroids preserve information from the earliest times in solar system history, with compositions in the population reflecting the material in the solar nebula and experiencing a wide range of temperatures. Today they experience ongoing processes, some of which are shared with larger bodies but some of which are unique to their size regime. They are critical to humanity's future as potential threats, resource sites, and targets for human visitation. However, over twenty years since the first spacecraft encounters with asteroids, they remain poorly understood. The mission we propose here, the Main-belt Asteroid and NEO Tour with Imaging and Spectroscopy (MANTIS), explores the diversity of asteroids to understand our solar system's past history, its present processes, and future opportunities and hazards.

MANTIS addresses many of NASA's highest priorities as laid out in its 2014 Science Plan and provides additional benefit to the Planetary Defense and Human Exploration communities via a low-risk, cost-effective tour of the near-Earth and inner asteroid belt. MANTIS visits the materials that witnessed solar system formation and its earliest history, addressing the NASA goal of exploring and observing the objects in the solar system to understand how they formed and evolve. MANTIS measures OH, water, and organic materials via several complementary techniques, visiting and sampling objects known to have hydrated minerals and addressing the NASA goal of improving our understanding of the origin and evolution of life on Earth. MANTIS studies the geology and geophysics of nine diverse asteroids, with compositions ranging from water-rich to metallic, representatives of both binary and non-binary asteroids, and sizes covering over two orders of magnitude, providing unique information about the chemical and physical processes shaping the asteroids, addressing the NASA goal of advancing the understanding of how the chemical and physical processes in our solar system operate, interact, and evolve. Finally, the set of measurements carried out by MANTIS at near-Earth and main-belt asteroids will by definition characterize objects in the solar system that pose threats to Earth or offer resources for human exploration, a final goal in the NASA Science Plan.

MANTIS revolutionizes our understanding of asteroids through its state of the art payload of complementary instruments: A powerful infrared imaging spectrometer and narrow angle camera, both with recent flight heritage and both being used at small bodies for the first time, an innovative dust analyzer with the potential for paradigm-shifting discoveries during and between asteroid encounters, and the first-ever mid-IR imager brought to a small body. MANTIS obtains datasets at each target with a common instrument suite that can be readily intercompared with oneanother, effectively doubling the sample of asteroids visited by spacecraft.

The MANTIS team is composed of leading international experts in asteroid science, led by PI Andrew Rivkin (APL) and Deputy PI Barbara Cohen (NASA MSFC). Spacecraft and payload construction and mission management are conducted at APL, with payload elements also constructed at the University of Colorado and contributed by DLR.