The New Horizons mission: A first reconnaissance of the Sun's third zone

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Introduction. The New Horizons spacecraft, launched on January 19, 2006 as the first of NASA's New Frontiers line of medium-class, PI-led missions, will be the first spacecraft to encounter the Pluto system and explore the Kuiper belt. The close encounter with Pluto, its large moon Charon, and Pluto's two recently discovered small satellites will take place in July 2015. En route to Pluto, the New Horizons spacecraft will encounter Jupiter on February 28, 2007 at a distance of 32.2 Jupiter radii, receiving a gravity assist and shortening what would otherwise be a substantially longer flight time. After the Pluto system encounter, and pending NASA approval, the New Horizons spacecraft may encounter one or two small (50 km-class) Kuiper belt objects.

Science Rationale. The New Horizons mission is the first designed to visit bodies in the Kuiper belt, the "third zone" of the solar system, outside both the inner realm of the terrestrial planets and that of the gas and water giants. Of all the accessible bodies in the Kuiper belt, Pluto is the largest, and the Pluto system is the most complex. Pluto represents a new class of planet, an "ice dwarf" composed of subequal amounts of rock, metal, ices, and in all likelihood, carbonaceous matter. Pluto-Charon itself is a binary planet, one whose formation bears directly on that of the Earth-Moon system. New Horizon's science goals reflect the consensus of the scientific community as articulated in the 2002 U.S. National Research Council study, "New Frontiers in the Solar System: An Integrated Exploration Strategy."

The craft will map the surfaces of Pluto and Charon with an average resolution of 1 kilometer in order to characterize global geology and morphology. It will map the surface composition across the various geological provinces of the two bodies at an average resolution of 7 km. And it will determine the composition, structure and escape rate of Pluto's neutral atmosphere. Other important measurements include characterizing Pluto's ionosphere and solar wind interaction and mapping surface temperatures across Pluto and Charon.

Science Payload. Fully fueled, the New Horizons probe weighed 478 kg at launch, and operates on the power provided by a single radioisotope thermoelectric generator. Its 30-kg science payload consists of 7 instruments – three optical, two plasma,

a dust sensor and a radio science receiver/radiometer. These instruments are: Alice, a extreme to far-ultraviolet (50-180 nm) imaging spectrometer; Ralph, a combination of a) three panchromatic and four color imagers inside MVIC (Multispectral Visible Imaging Camera) and b) a short-wavelength infrared (1.25-2.50 micron) composition mapping spectrometer, called LEISA (Linear Etalon Imaging Spectral Array); REX (Radio science EXperiment), in which signal-processing electronics are integrated into the telecommunications system; LORRI (LOng Range Reconnaissance Imager), a panchromatic long focal length imager; SWAP (Solar Wind at Pluto), which will make energy (up to 6.5 keV) measurements of both the solar wind interaction with Pluto's atmosphere and of low energy pickup ions from Pluto; PEPSSI (Pluto Energetic Particle Spectrometer Science Investigation), which will determine the density, composition and nature of energetic (up to 1 MeV) particles escaping from Pluto's atmosphere; and the Student Dust Counter (SDC), which will trace the concentration, mass, and speed of dust particles with masses as small as 10^{-12} gm in the outer solar system.

Status. In the spring and summer of 2006 the New Horizons spacecraft will be undergoing system and instrument commissioning. The Jupiter gravity assist in early 2007 not only reduces the flight time to Pluto, thus reducing mission risk; it also presents a unique opportunity to flight-test the instruments and the spacecraft operational procedures on an exciting scientific target: Jupiter, its satellites and ring.