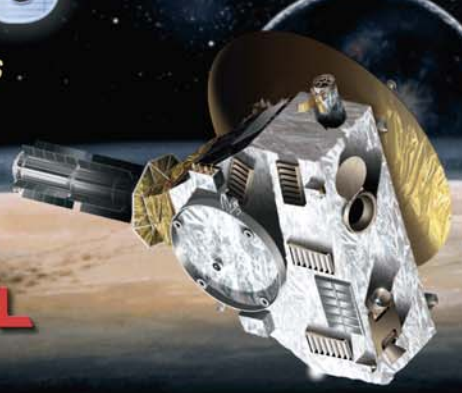
NEW HORIZONS

Shedding Light on Frontier Worlds

A Pluto-Kuiper Belt Mission

http://pluto.jhuapl.edu



Project Team

Team Leaders

Southwest Research Institute (SwRI)
- Institution of Principal Investigator Dr. Alan Stern
- Science Team
- Payload

Johns Hopkins University Applied Physics Laboratory (APL)
- Mission Management and Development
- Spacecraft Operations

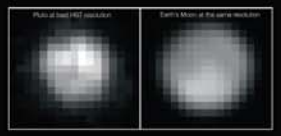
Major Partners
- NASA's Goddard Space Flight Center: LEISA infrared focal plane
- Stanford University: REX radio science investigation
- Lockheed-Martin: Atlas V launch vehicle
- Boeing: STAR 48B upper stage
- Department of Energy: Power Supply
- NASA Jet Propulsion Laboratory: Technical Analysis and Co-I support

New Horizons is the first mission to the last planet—the initial reconnaissance of Pluto-Charon and the Kuiper Belt—sent out to explore the mysterious worlds at the edge of our solar system.

To Pluto & Beyond

- Flyby mission to Pluto and its moon, Charon
  - Destination deemed "Highest Priority" for a new mission by the National Research Council's Planetary Decadal Survey (2002)
  - Mission "proposed" until final reviews completed
- Flyby mission to the Kuiper Belt
  - Pending NASA approval of Extended Mission
- Serendipitous flyby mission to Jupiter if primary launch window is used

Destination: Pluto



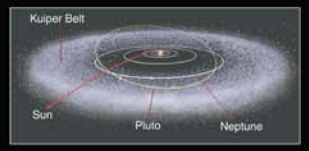
- Pluto is neither a terrestrial nor a gas giant planet—it is a new type, an ice dwarf
  - Pluto's diameter is about 2× that of its moon, Charon

- Pluto's surface has regions of very high contrast and is among the most variegated in the solar system; the Hubble image below shows both sides of the planet.

- Pluto–Charon is the solar system's only known binary planet
  - Distance between Pluto and Charon is <1/20 the distance between Earth and Moon
  - Implications for atmospheric transfer
  - Better understanding of the origin of the Earth–Moon system
- Pluto's atmosphere is transitional between a cometary and a classical planetary atmosphere—the only expected site of planetary hydrodynamic escape
- Pluto's and Charon's surfaces record the details of outer solar system object bombardment
- Comparison of Pluto's cratering record with Charon's should yield a direct comparison of present-day and historical impacts from the Kuiper Belt

Destination: Kuiper Belt

- The Kuiper Belt is the best "archeological site" to explore mid-stage accretion in the outer solar system
- The Kuiper Belt is a thick band around the ecliptic outside of Neptune's orbit that contains small bodies orbiting the Sun
  - Source of many short-period (<200 yrs) comets



Mission Objectives

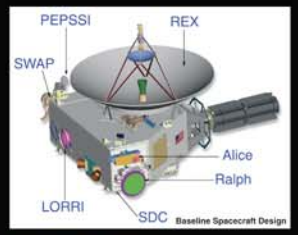
- Map surface composition of Pluto and Charon
- Characterize the global geology and morphology ("look") of Pluto and Charon
- Characterize the neutral atmosphere of Pluto and escape rate
- Search for an atmosphere around Charon
- Map surface temperatures of Pluto and Charon
- Search for rings and additional satellites around Pluto
- Search for magnetic fields of Pluto and Charon
- PLUS... Similar investigations of one or more Kuiper Belt Objects (KBOs)

Pluto Encounter Highlights

- 6 months of encounter science
- Exceed HST resolution for 150 days
- Map Pluto's "far-side" 3.2 days out (40-km resolution)
- Map Pluto's night-side frost in Charon-light
- Create global composition maps of Pluto and Charon
- Obtain radio and UV data from occultations of Pluto and Charon
- Map surface temperatures at high resolution

KBO Encounter Highlights

- Geologic, photometric, and color mapping of KBOs
- Mapping the surface in stereo
- Mapping the surface composition of KBOs
- Mapping the variation in temperature of the surface
  - Sensitivity of 2 K variance on scales of ~10 km
- Searching for an atmosphere
  - Sensitivity of <1 nanobar (10^{-9} Pluto's atmospheric pressure)
- Searching for material ejected from the surface due to particle impacts
- Measuring mass, density, and shape of the KBO
- Counting craters created by impactors with diameters larger than ~20 m
- Searching for satellites of diameters down to <1 km



Instrument Payload

Core Instruments
- **REX**—Radio science and passive radiometer
- **Ralph**—Visible and Infrared imager and spectrometer
- **Alice**—UV imaging spectrometer

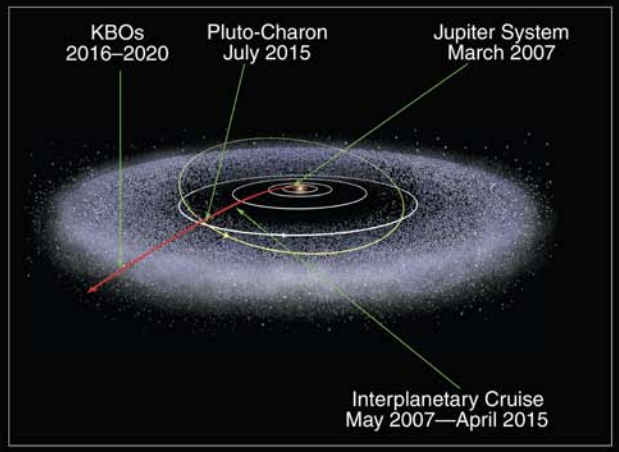
Supplemental Instruments
- **LORRI**—Long-range and high-resolution visible imager
- **SWAP**—Plasma/solar wind spectrometer
- **PEPSSI**—Pluto Energetic Particle Spectrometer Investigation
- **SDC**—Student-built Dust Counter

Instrument	Instrument Type	Primary Uses
Ralph	Visible imager IR imaging spectrometer	➢ Color mapping (1- to 3-km resolution) ➢ Composition mapping (7-km resolution) ➢ Thermal mapping (5- to 20-km resolution)
Alice	UV imaging spectrometer	➢ Analyze composition and structure of Pluto's atmosphere ➢ Search for evidence of an atmosphere around Charon and KBOs
REX	Radio science, radiometry	➢ Measure the composition and temperature of atmospheres

Instrument	Instrument Type	Primary Uses
LORRI	High-resolution imager (optical telescope)	➢ Map the far side of Pluto (35- to 40-km resolution) ➢ High-resolution geology (up to 50-m resolution) ➢ Obtain encounter data at a farther distance (5× farther than Ralph)
SWAP	In situ plasma spectrometer	➢ Measure atmospheric escape rate, solar wind at Pluto, presence of a magnetosphere around Pluto
PEPSSI	In situ particle spectrometer	➢ Measure plasma (ions) escaping from Pluto's atmosphere
SDC	In situ dust counter	➢ First solar system dust density profile beyond 18 AU ➢ Measure dust impacts on spacecraft throughout the voyage

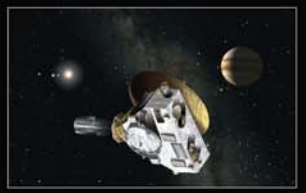
Launch Information

- Primary Launch Window: Jan. 11 – Feb. 14, 2006
- Launch Vehicle: Atlas V 551 first stage; Centaur second stage; Star 48B solid rocket third stage
- Location: Cape Canaveral Air Force Station, Florida
- Trajectory
  - To Pluto via Jupiter Gravity Assist (first 23 days of window)
    - Spacecraft mass: 1,205 pounds (465 kilograms)
  - Direct to Pluto (last 12 days of window)
    - Spacecraft mass: 981 pounds (445 kilograms)



The Voyage

- Assuming a launch during the primary launch window in Jan. 2006, the first 13 months include
  - Spacecraft checkout
  - Instrument checkouts
  - Trajectory correction(s)
  - Instrument calibrations
  - Jupiter encounter rehearsal



- Pluto Arrival Depends on Exact Launch Date
  - Arrival via Jupiter: 2015-2017; flight duration is 9.5 – 11.5 years
    - At the earliest, current 1st graders will see New Horizons arrive at Pluto during the summer before 12th grade!
  - Direct to Pluto: 2018-2020; flight duration is 12 – 14 years
- Secondary Launch Window: Feb. 2 – 15, 2007
  - Trajectory: Direct to Pluto
    - Spacecraft mass: 981 pounds (445 kilograms)
    - Arrival at Pluto: 2019-2020, depending on exact launch date
      - Duration of flight to Pluto: 12.5 – 13.5 years

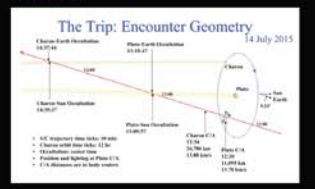
Jupiter Encounter

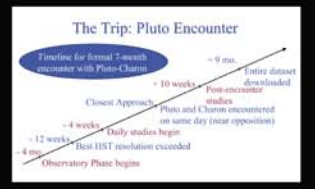
- New Horizons will fly past Jupiter 3–4× closer than Cassini
  - Closest approach range: 31.7–32.4 R_J
  - Closest approach date: Feb. 25–March 2, 2007
  - Speed: 21 km/s
- Science opportunities at the Jupiter system
  - Jupiter
    - Meteorology
    - Auroral studies
    - Magnetospheric sampling and dust sampling
    - Io torus UV mapping
  - Jupiter's moons
    - Surface mapping
    - Compositional mapping
    - Atmospheric studies
    - Possible close encounter with a small Jovian satellite

Interplanetary Cruise

- Activities during the approximately 8-year cruise to Pluto include
  - Annual spacecraft and instrument checkouts
  - Trajectory correction(s)
  - Instrument calibrations
  - Pluto encounter rehearsals

Pluto Encounter





KBO Encounters

- One to two encounters of KBOs are likely
  - Size of accessible KBOs: probably 40–90 km in diameter
- Identical data acquisition objectives to Pluto–Charon encounter, where applicable
- Encounter timeline and operations for KBO encounters will mimic Pluto–Charon encounter
  - Closest Approach – 4 weeks: Observatory phase
  - Closest Approach + 2 weeks: Post-encounter studies
  - Closest Approach + 2 months: All data returned to Earth