Extreme Navigation

NASA’s Discovery Missions: Stardust-NExT and EPOXI Missions

NASA’s Discovery Missions:
Stardust-NExT
http://stardustnext.jpl.nasa.gov

EPOXI
http://epoxi.umd.edu
What Are Comets?

• They contain a high percentage of rocky organic materials and ices
  – Ices include: water (H$_2$O), carbon dioxide (CO$_2$), methane (CH$_4$)
• Solid nuclei are generally smaller than asteroids
  – On average a few km in diameter
• They are left over “bits” or remnants from the formation of the Solar System
  – Thought to originate in either the
    • Oort Cloud (long period)
    • Kuiper Belt (short period)
Comet Anatomy

- **Nucleus**: “dirty ice ball” (ice, dust, and rocky debris)
  - The nucleus is relatively small, usually only 1-50 km across

- **Coma**: a cloud of dust, water vapor, carbon dioxide, and other gases which sublimed off the nucleus and contain very little mass.
  - The coma and tail can be as large as Jupiter (about 10x Earth’s diameter).

- **Tails**:
  - **Dust tail**: composed of small (smoke-sized) dust particles driven off the nucleus by escaping gases, making it the easiest to see.
  - **Ion Tail**: composed of plasma (ionized gases) and created by interaction with solar winds.
    - A comet’s tails can be as long as 1-2 AU (150-300 million km) when the comet is near the Sun.
  - **Sodium Tail**: composed of sodium ions, yellowish
    - Only recently discovered, the sodium tail requires special filters to perceive.
At 6 AU the comet nucleus is inactive and the comet has no tail.

By 4 AU the comet nucleus is starting to become active.

The comet now has a well-defined tail.

The tail may now be 1–2 AU long.

The comet is at perihelion.

Jupiter’s Orbit

Once again, beyond 6 AU the comet nucleus is inactive.

Earth’s Orbit
The orbital paths of the comets EPOXI and SD-NExT are visiting in 2010 and 2011.
NASA Comet Explorations:
Two Spacecraft, Three Comets, Four Missions, Oh My!

**Stardust Spacecraft**
First mission to comet Wild 2 ("vilt 2")
second mission to comet Tempel 1

**Deep Impact Spacecraft**
First mission to Tempel 1,
second mission to comet Hartley 2
EPOXI’s trajectory to comet Hartley 2

Earth Gravity Assist
Dec 28, 2009

Earth at Encounter

Nov 4, 2010
Hartley 2 Encounter

Earth Gravity Assist
Jun 27, 2010
EPOXI Deep Impact Extended Investigation Objectives

- Understand the impact of Hartley 2’s gas jets by
  - Searching for and map outbursts of gas from the comet's surface
  - Tracking the outburst as the comet rotates
  - Matching outbursts with surface feature
  - Looking for frozen volatiles on the surface of the comet
- Produce broad band images of the comet and a model of its shape
- Map the brightness and color variations of the surface; locate topographical features that reveal what processes formed the comet; compare the distribution of various crater sizes with craters on other comets, asteroids and moons
- Map the temperature of the surface to assess the thermal conductivity of the interior and the migration of subsurface volatiles
Stardust-NExT
Mission Objectives

Stardust-NExT will flyby comet Tempel 1 on February 14, 2011, to complete the exploration initiated by Deep Impact by:

– obtaining images of the coma, nucleus, and jet at resolutions as high as 12 m/pixel
– measuring the composition, size, distribution, and flux of dust emitted into the coma

The mission plan offers high probabilities of viewing significant portions of the hemisphere studied by Deep Impact in 2005 and imaging the crater made by its impactor.
Discover More!

Stardust-NExT
http://stardustnext.jpl.nasa.gov

EPOXI
http://epoxi.umd.edu

NASA’s Discovery and New Frontiers
http://discoverynewfrontiers.nasa.gov