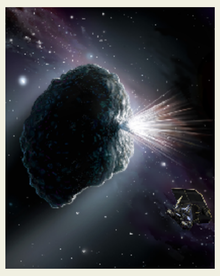
DEEP IMPACT *First Look Inside A Comet*



http://deepimpact.umd.edu, http://deepimpact.jpl.nasa.gov

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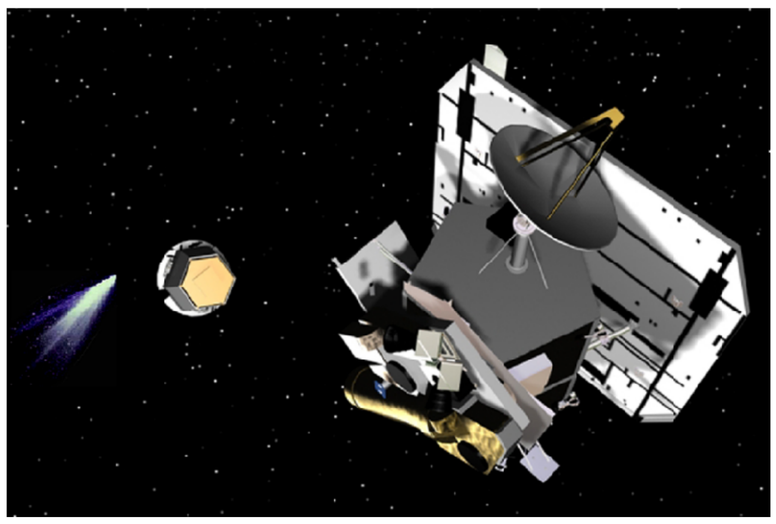
Deep Impact's Scientific Questions:

1. What are the basic properties of a cometary nucleus and interior?
2. How do comets evolve?
3. What is the composition of primordial ices in comets?
4. How would one mitigate a cometary impact on Earth?

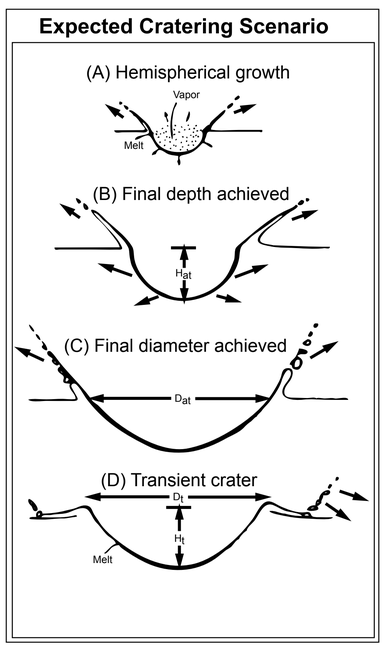
Wilhelm Tempel

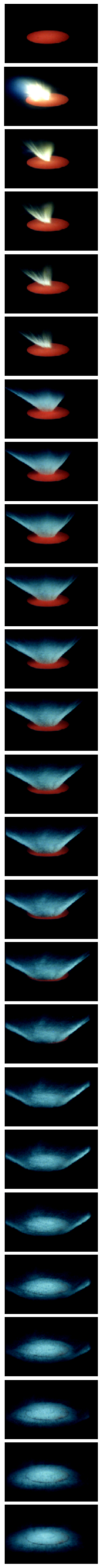
A Unique Experiment



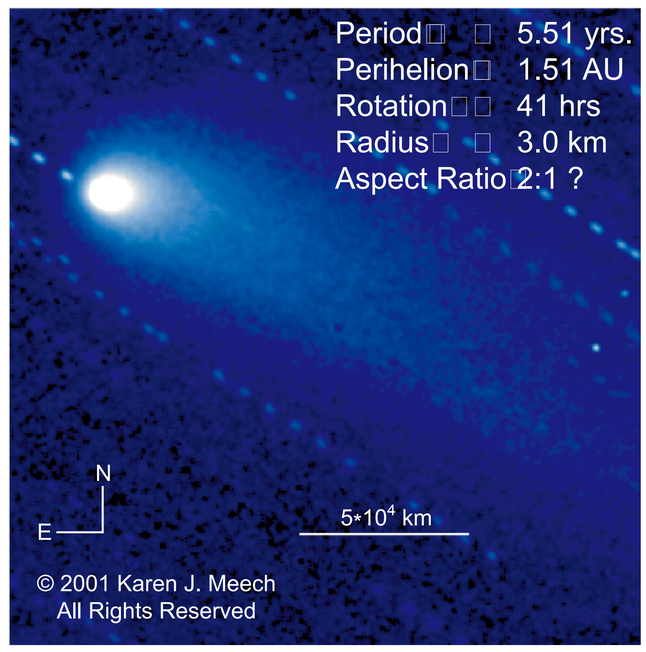
A 370 kg impactor will hit Tempel 1 at 10.2 km/s with a variety of possible outcomes:

- If impact energy goes into breaking the surface (**strength dominated**), then the crater will be small with a 3:1 diameter to depth ratio. The ejecta cone will detach.
- If impact energy goes into compressing porous material (**compression dominated**), then the crater will be small and deep with a weak ejecta cone.
- If impact energy excavates weak material (**gravity dominated**), then the crater will be large, ~60-240m in diameter, with a 4:1 diameter to depth ratio. The ejecta cone will remain attached.
- Since we know so little about comets, it is not clear which regime will dominate. The Deep Impact science team pre-launch expectation is that **the newly formed crater will be gravity dominated**.

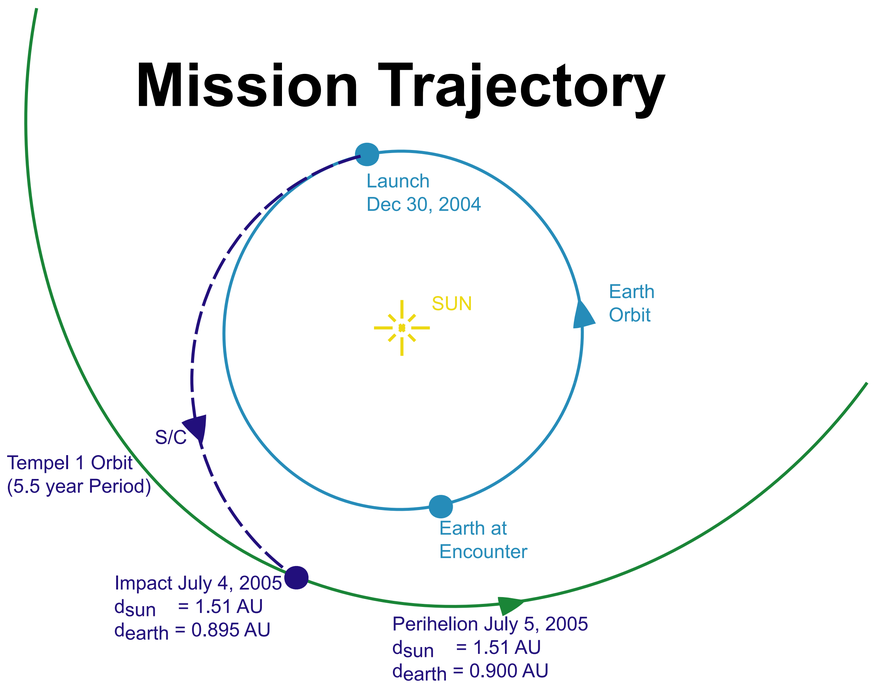




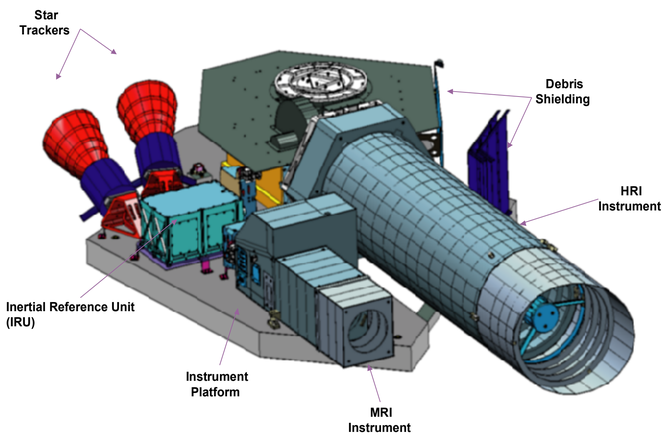
Target: 9P/Tempel 1

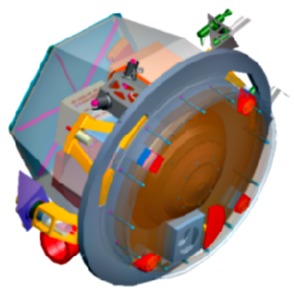


Mission Trajectory



Tools of the Experiment





Flyby Spacecraft

HRI-Vis	HRI-IR	MRI-Vis
0.34 - 1.0 μm fov=2 mradians 1.4m/pixel @ 700 km range 9 filters 1024 x 1024 CCD	1.1 - 4.8 μm fov=2.6 mradians 7m/superpixel @ 700 km range 2 prisms 512 x 256 HgCdTe	0.3 - 1.0 μm fov=10 mradians 7m/pixel @ 700 km range 9 filters 1024 x 1024 CCD

Impactor
ITS=MRI-Vis w/ no filters 1024x1024 CCD

Total Mass	Copper Deadmass
370 kg 47% Cu 24% Al 29% other	140 kg Density 3.0-5.5 g/cc Diameter 0.65 m Diam:Ht 4:1 99% Cu, 1% other

Observing Sequence

Approach: E-2 mo to E-24 hr (E = impact event)
- Images and spectra of coma to study rotation

Impactor release: E-24 hr to E
- Color images of coma and nucleus
- Spectra of coma and nucleus

Impact: E to E+800 sec
- High speed white light imaging of crater formation and ejecta cone
- High speed IR spectra of ejecta vs. time
- White light and color images of ejecta cone and crater formation
- IR spectral map of nucleus and crater
- Spectra of coma near limb
- Color images of final crater
- White light images with resolution < 2m/pixel of final crater

Lookback: TCA+30 min to TCA+1 day (TCA = time of closest approach)
- Images and spectra of evolving ejecta
- Data playback up to 3 days after TCA

From long before to long after impact
- Continuous world-wide telescopic observations
- at multiple wavelengths

Scientific Measurements

- Map surface for shape and morphology
- Analyze albedo map in terms of surface and jetting processes
- Compare surface to interior, radially and laterally, to define mantle boundaries and interior heterogeneity
- Compare outgassing before and after for composition and evolution of gases
- Measure ejecta cone's half-angle for bulk density and porosity
- Determine process controlling shape of crater from debris cone structure
- Determine elemental, molecular, and mineralogical components of surface and interior from IR spectra

Encounter Sequence