Dawn - Overview, Science Objectives, Mission Progress

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For PI Chris Russell

Presentation to Decadal Survey
Primitive Bodies Panel,
Washington, DC, Sep 2009

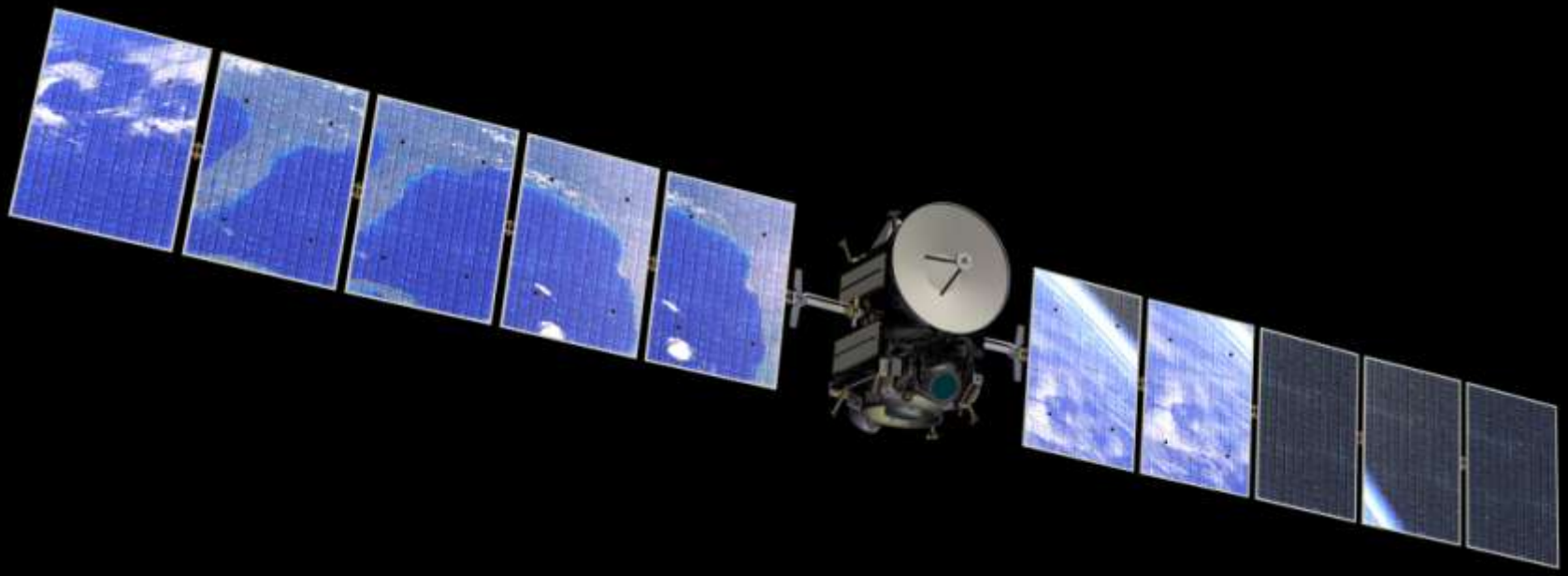
Spacecraft configuration, assembly for launch

Size and mass
~1/2 minivan

Dawn spacecraft being lifted to the top of its Delta II launch vehicle

Dawn launch
September 2007

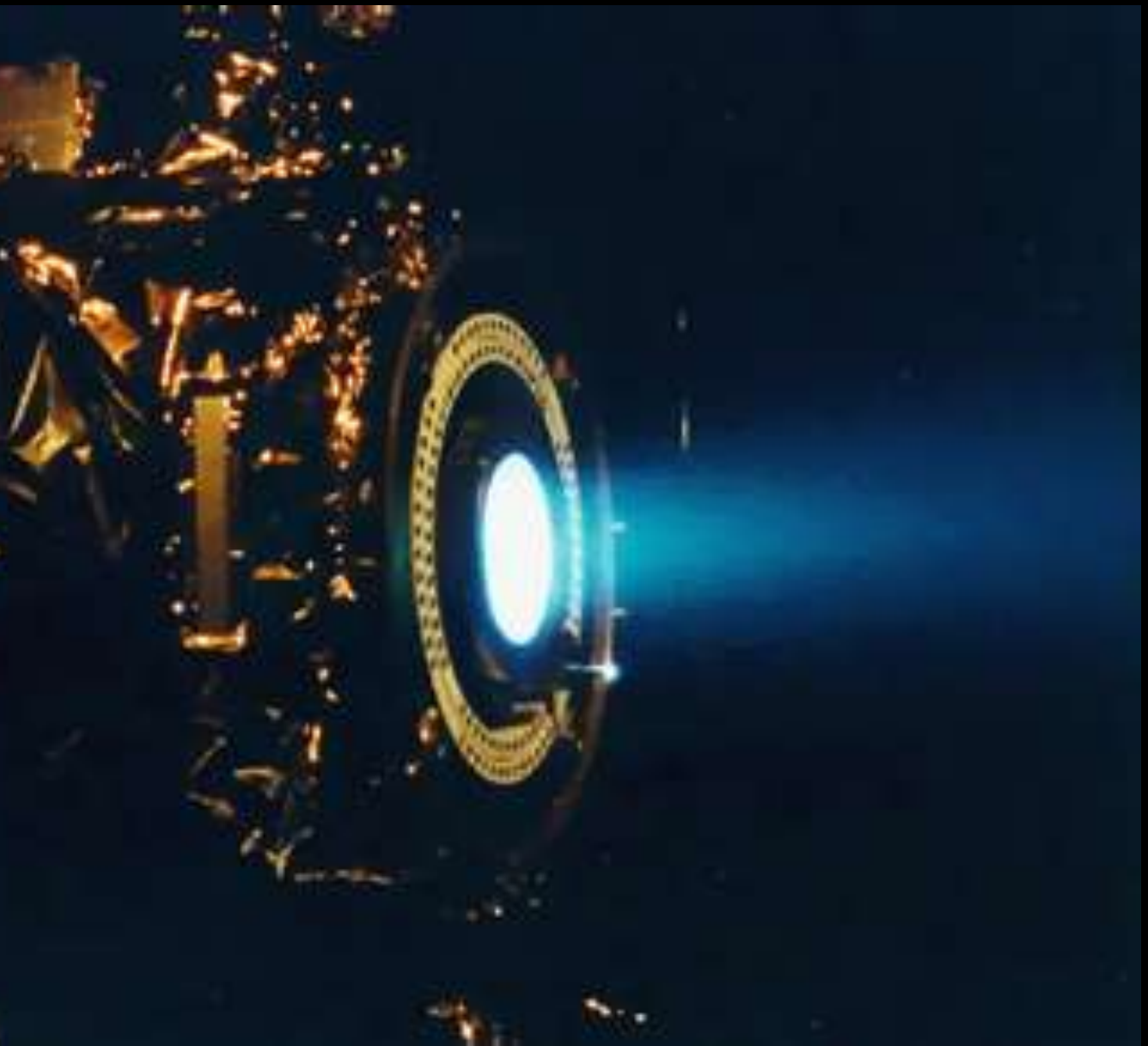
Artist's view of Dawn spacecraft



Solar arrays deployed

19.7 meter wingspan

Ion propulsion system



Dawn mission is only possible within Discovery cost cap using IPS

Dawn will have 2.5X ΔV ever obtained by a apacecraft with its propulsion system

Dawn will thrust for >5 years in its 8-year mission, 3X the longest powered flight

Dawn objectives at Vesta

- Map the surface of Vesta in eight filters with 100-m spatial resolution to examine its geology and cratering history

Framing Camera (FC), contributed by Germany (Max-Planck Institute and German Aerospace Center)

Dawn objectives at Vesta

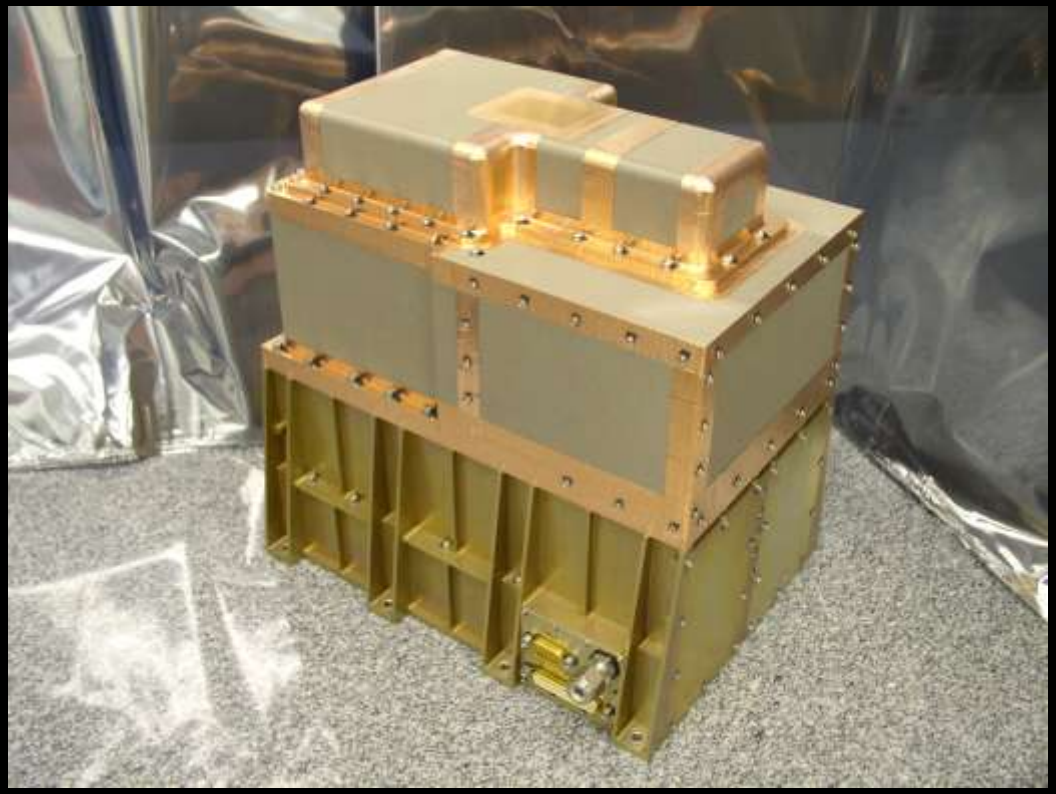
- Determine the mineral composition of the surface at ~800-m resolution, and selected areas at 200-m or better
- Perform detailed photometric and spectroscopic examination of areas of interest, such as the walls of the southern crater

Visible and Infrared Spectrometer (VIR), contributed by Italy (Angenzia Spaziale Italiana)

Dawn objectives at Vesta

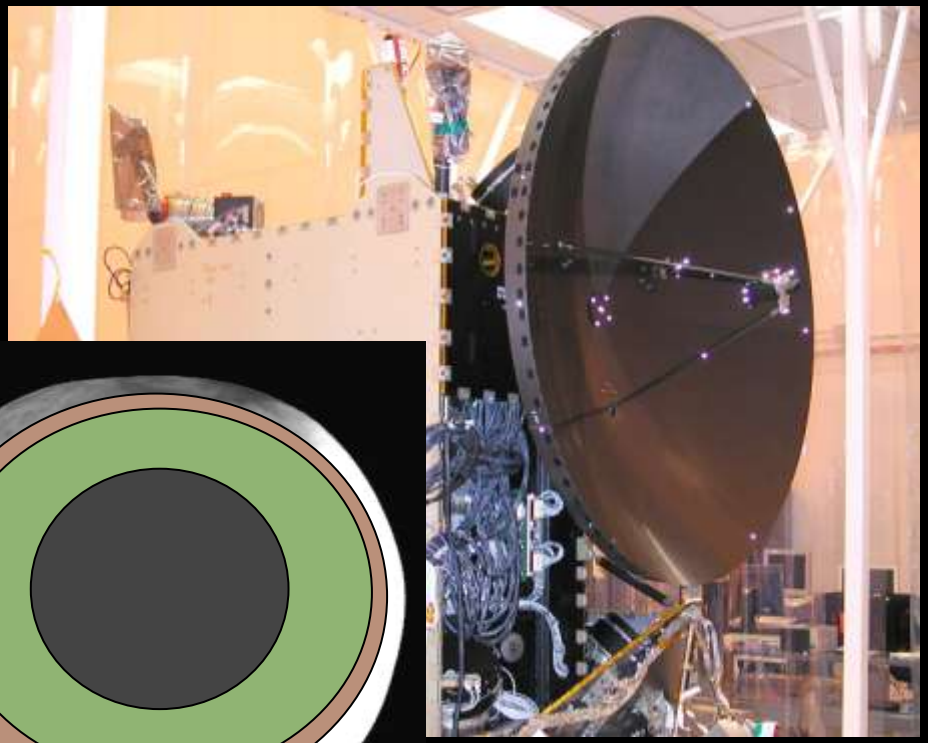
- Map elemental abundances to ~ 300-km resolution or better

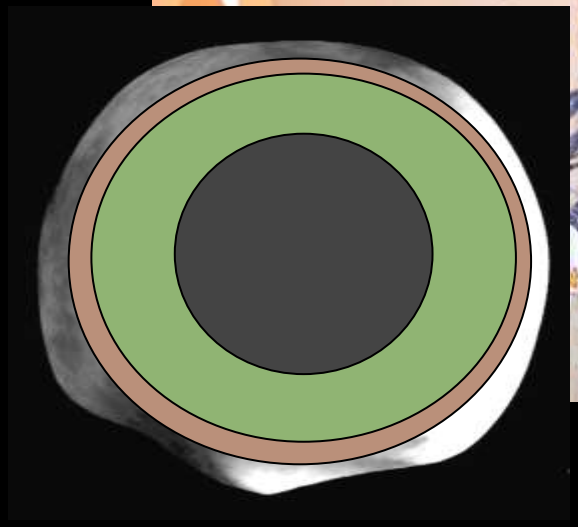
Gamma Ray and Neutron Detector (GRaND), provided by USA (Los Alamos National Laboratory)



Dawn objectives at Vesta

- Map the gravity field to 90-km half-wavelength resolution, to characterize crust and mantle density variations, and possibly detect a core

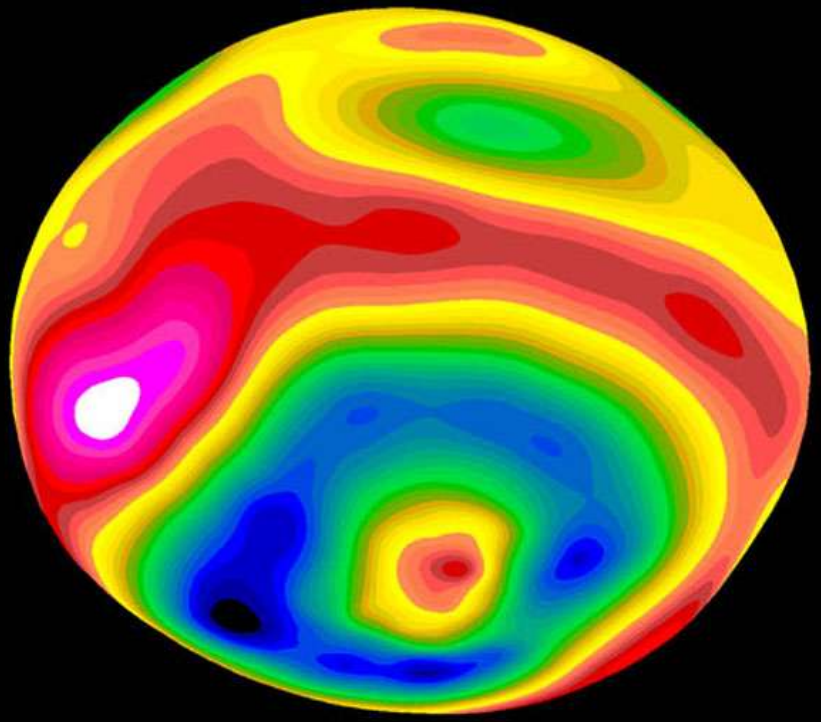




Gravity science using spacecraft orbit tracking via radiometric navigation, provided by USA (Orbital Sciences Corporation and JPL)

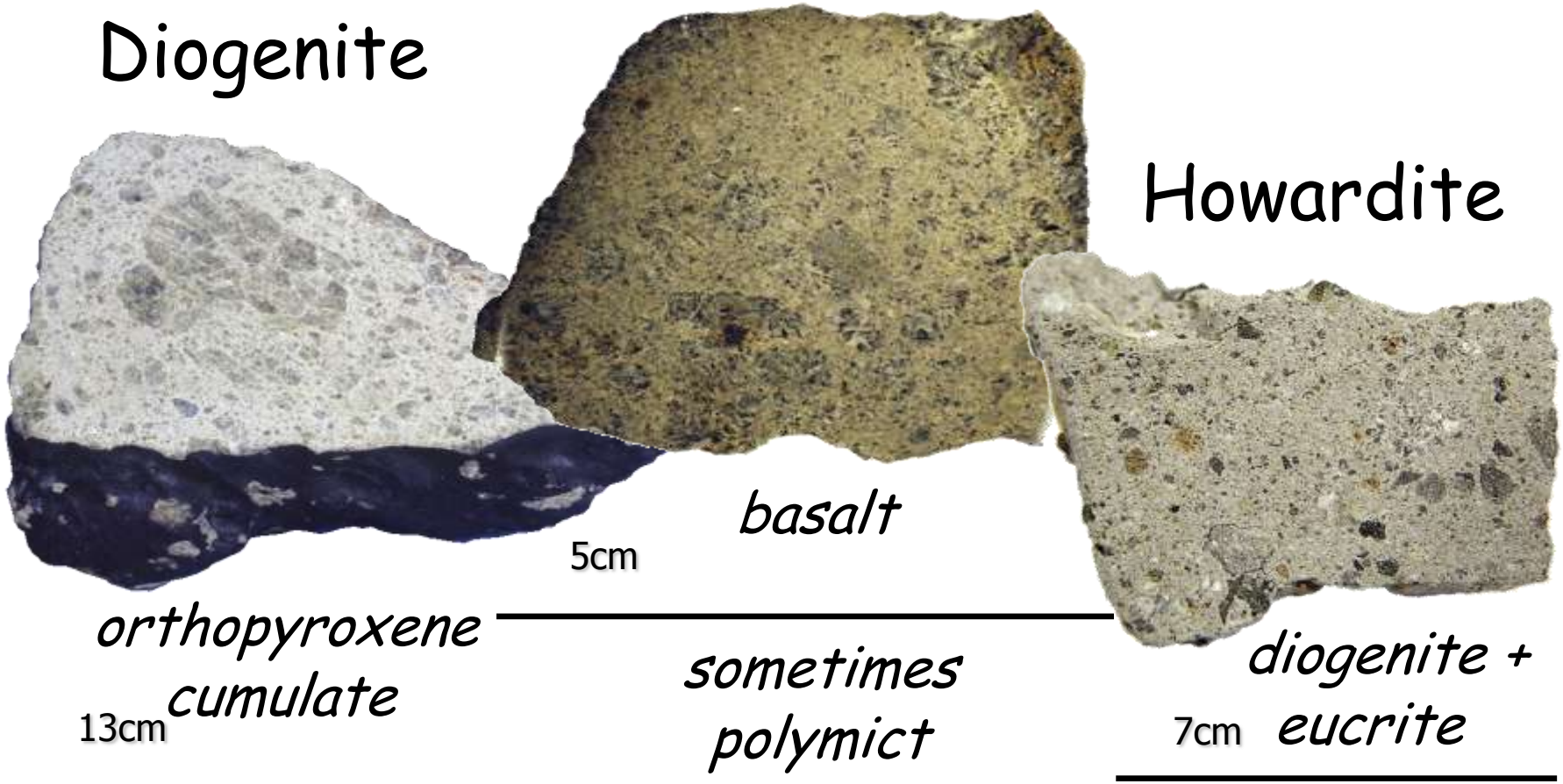
Dawn objectives at Vesta

- Resolve the topography of Vesta to 10-m height at 100-m spatial resolution



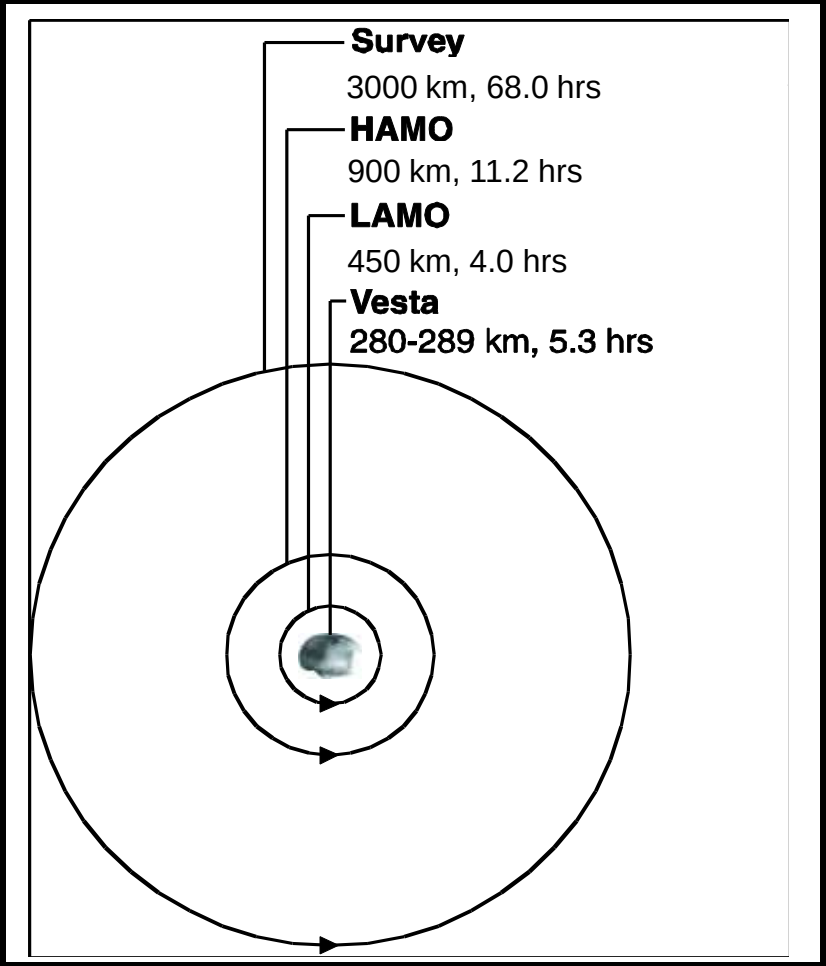
FC imaging to map surface elevations (laser altimeter was descoped for mission); topography needed to define size and shape, identify tectonic processes, and remove elevation effects from gravity signals

HED meteorites - used for instrument calibration and groundtruth for data

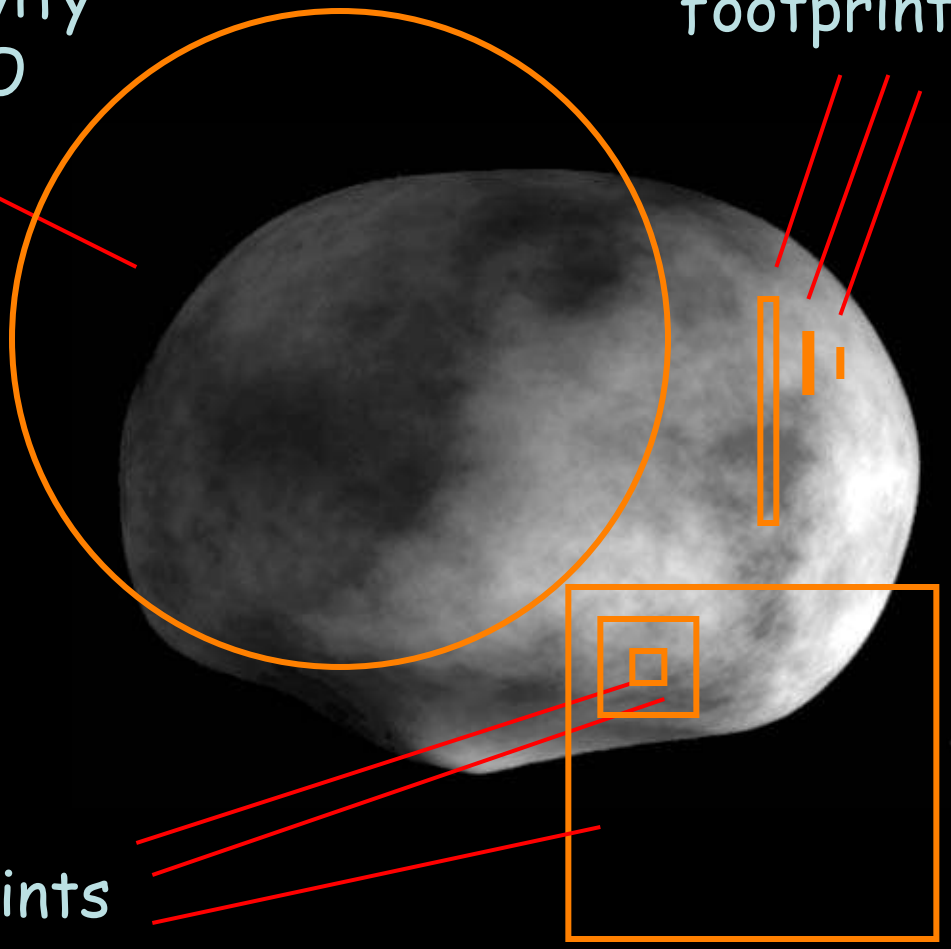


Vesta operations overview

- **Approach** phase:
  - Nav ops begin 1.4M km out, 86 days before orbit insertion
- **Survey Orbit:**
  - Duration 4 orbits (11 days)
  - VIR is prime, some FC
- **High Altitude Mapping Orbit:**
  - Duration 60 orbits (28 days)
  - FC is prime, VIR "rides along"
- **Low Altitude Mapping Orbit:**
  - Duration 420 orbits (70 days)
  - GRaND is prime, FC and VIR collect data opportunistically
  - Dedicated gravity tracking



DAWN instrument footprints



Vesta operations

orbits - altitudes

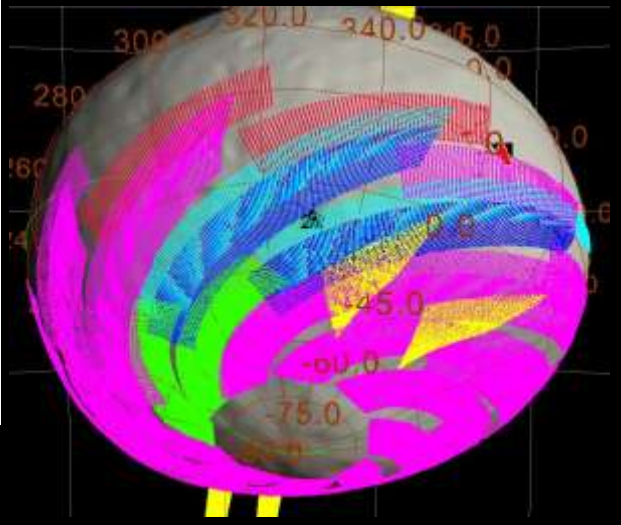
Survey - 2720 km
HAMO - 620 km
LAMO - 170 km

Vesta coverage

Sunlit coverage in the funded baseline mission stops at ~80° north, allowing ~65% topographic and spectral coverage.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

FC at HAMO



VIR at HAMO

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Orbital coverage at LAMO

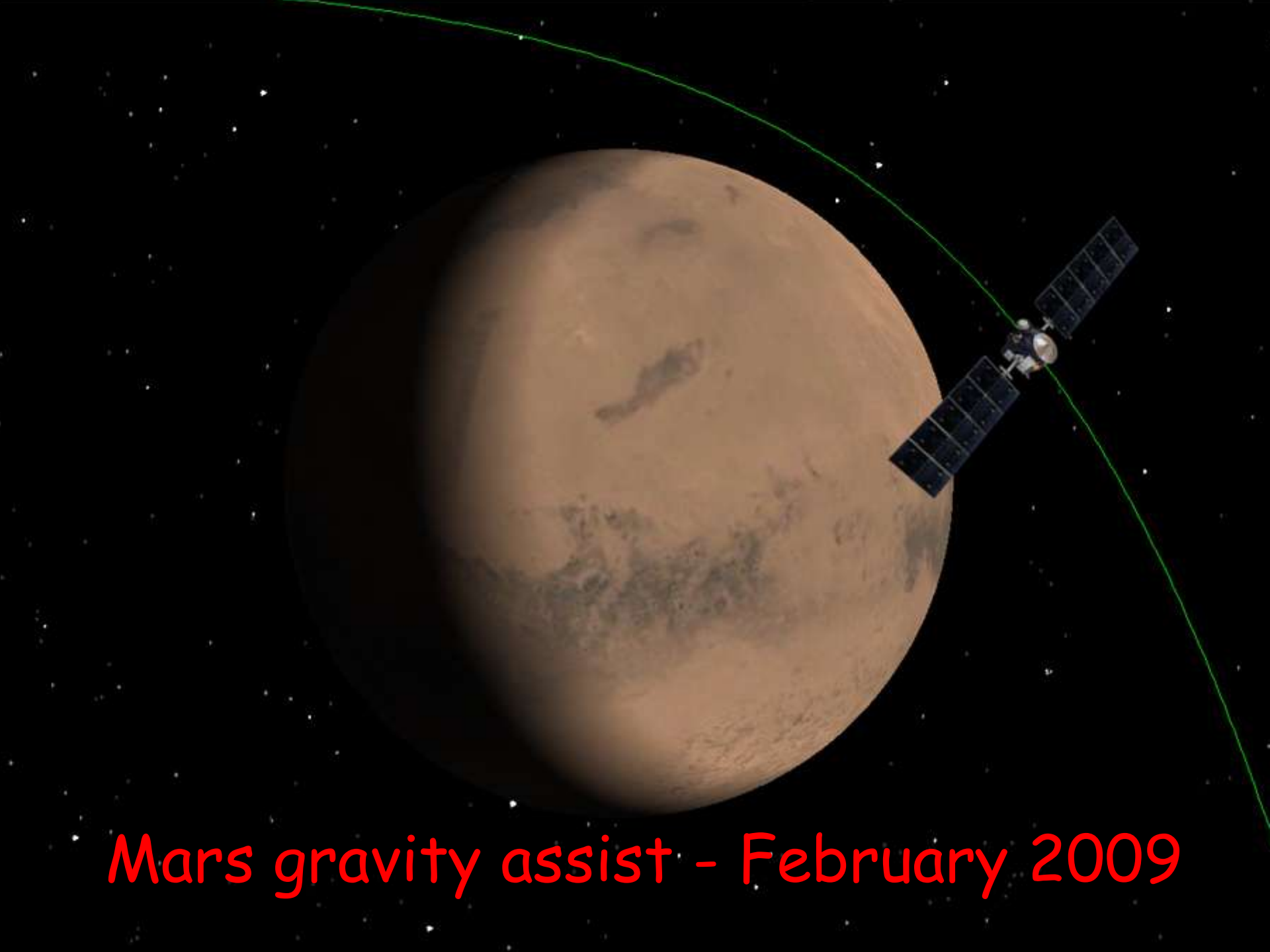
Vesta science operations

- Baseline Mission: Prelaunch approved and funded operations at Vesta from Sep 2011 to May 2012.

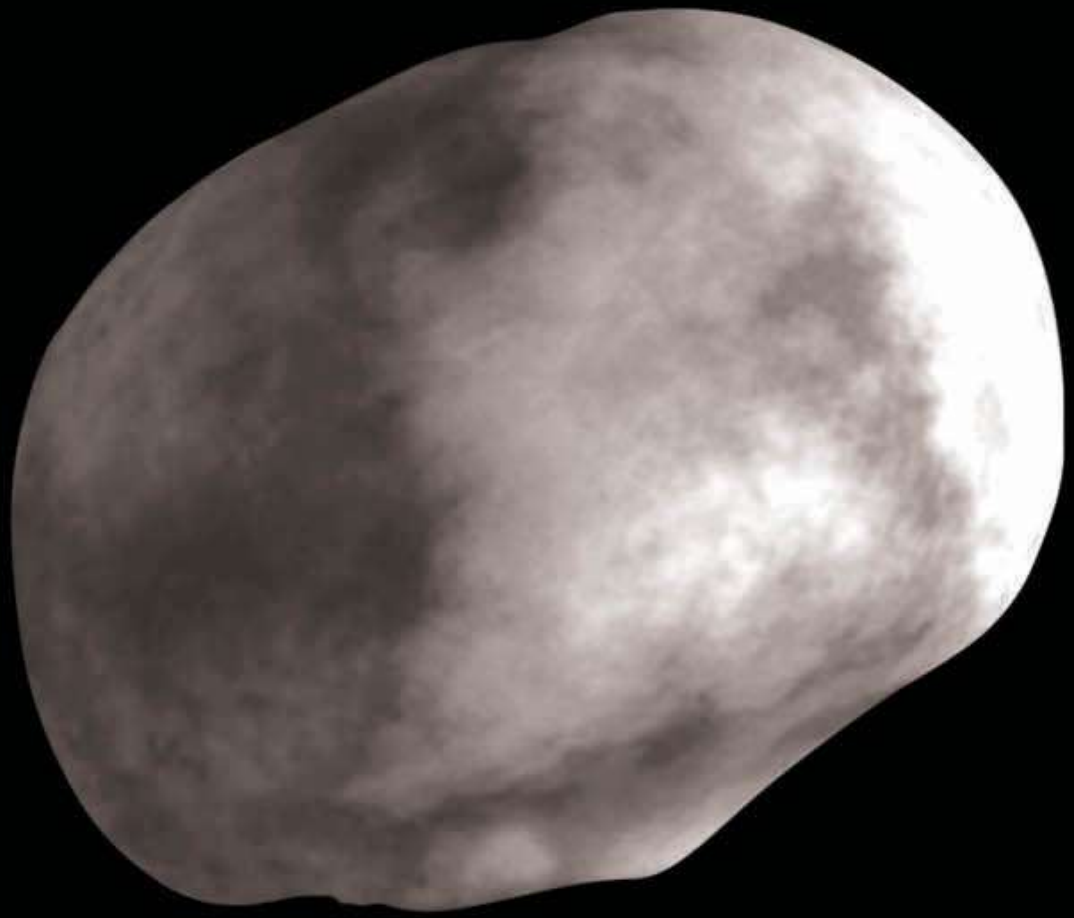
- Technical Baseline Mission: Inflight calibration of solar array revealed more power (increased IPS efficiency) than conservative project allotment. Thus spacecraft can travel faster, arrive at Vesta early (Aug 2011), leave late (Aug 2012), and still arrive at Ceres as planned. This mission would allow greater reserve, more low-altitude data collection, more coverage of the northern hemisphere.

- Extended Mission: By delaying arrival at Ceres by 3 to 6 months, Dawn could complete coverage of the northern hemisphere. The spacecraft was designed to operate longer than the extended mission.

NASA would need to approve additional funds if either the Technical Baseline or Extended Mission were undertaken. Community support for these options is welcome.


Mars gravity assist - February 2009

Vesta operations - September (?) 2011-May 2012 (?)

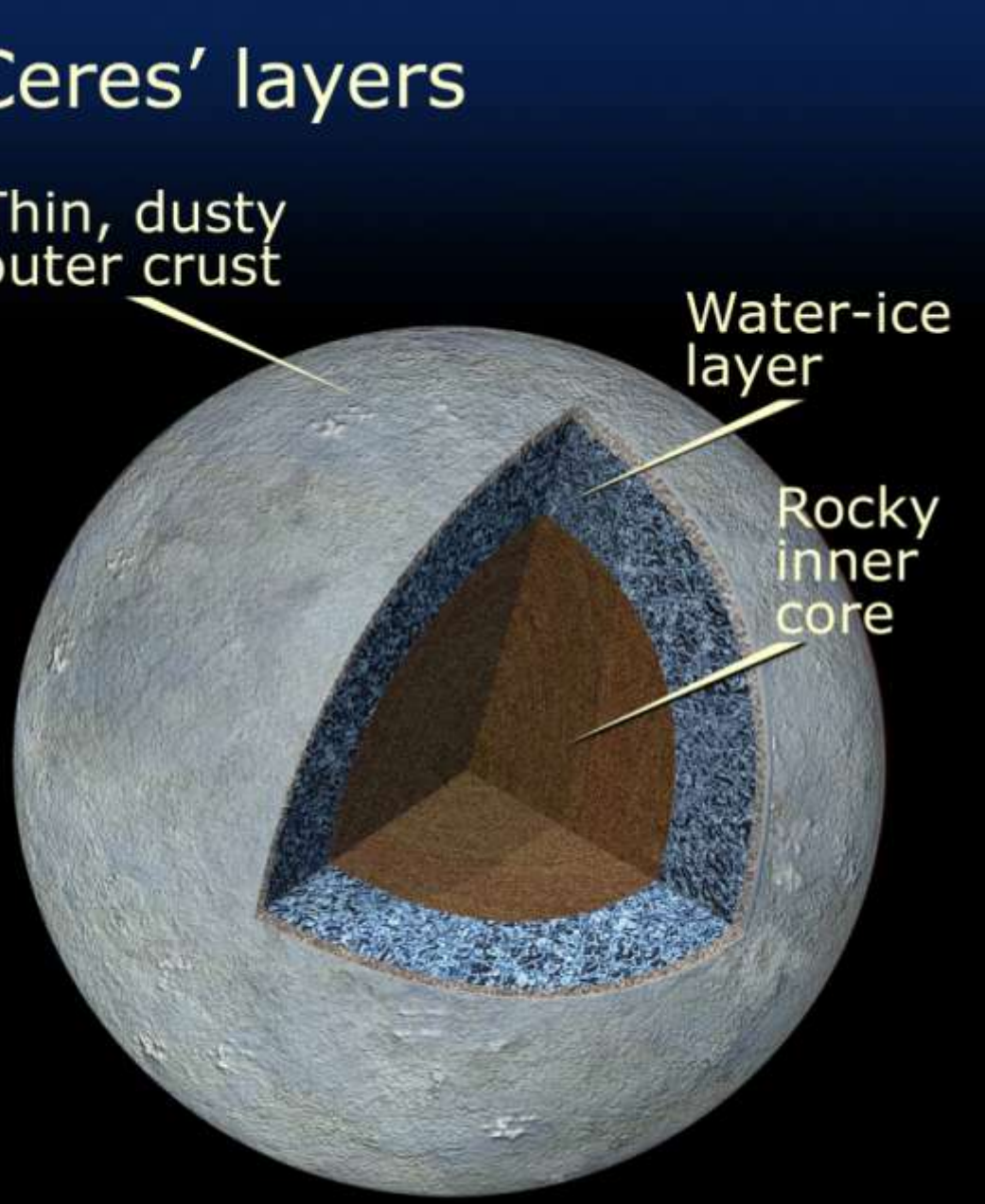


Then on to Ceres

Hubble images of Ceres' rotation

Science objectives are similar to those at Vesta, but Ceres is very different

Nominal mission Ceres operations commence Aug 2014



Density suggests 75% rock / 25% ice