To Uranus on Solar Power and Batteries

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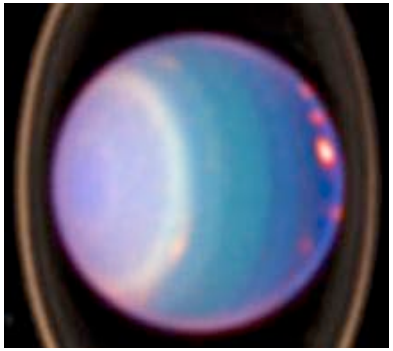
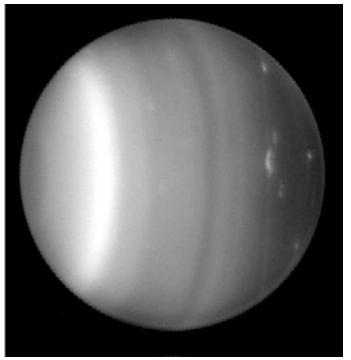
Report to OPAG, 9 March 2009
Bethesda, Maryland

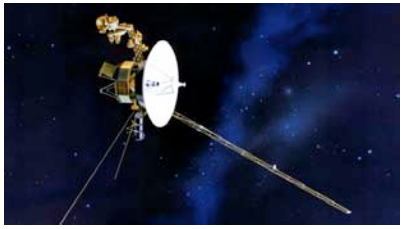
Voyager 1986



Hubble 1998
(Karkoschka)



Keck 2003
(Hammel et al.)

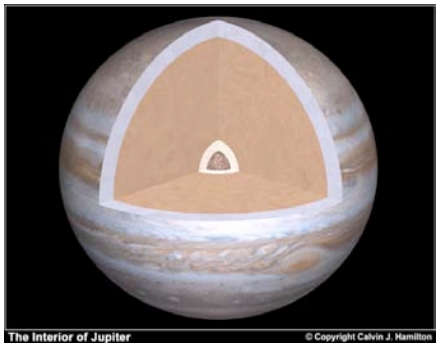


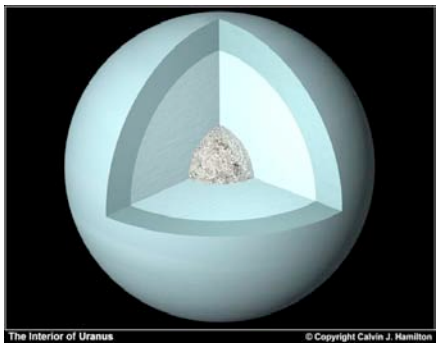
Why Am I Here?

Recently, a small study was done at JPL to explore the feasibility of non-nuclear powered missions to Uranus.

Eleven mission architectures were reviewed, including flybys and orbiters, with options for probes and multi-spacecraft configurations.

I will report some general results, as well as details of a potential New Frontiers mission.





We Were Somewhat Surprised to Find.....

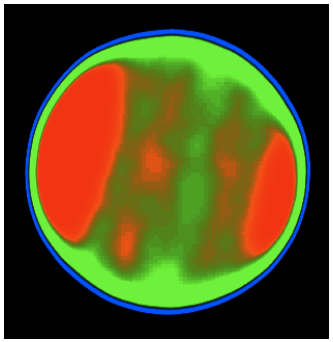
- Large masses could be placed into orbit around Uranus.

  For example, using an Atlas 521 and only chemical propulsion, a **dry mass** in excess of 1500 kg (~100 kg for science instruments) could be inserted after a 12-year flight.

  There are many trade-offs possible among cost, flight time, and delivered mass. Electric propulsion is also an attractive option.

- Solar powered missions are feasible. Power is a significant constraint, but batteries, radioisotope heating units, and phasing of instrument on/off times would allow the needed science return with solar panels producing only 100 W.

- Missions **may** be possible under the current New Frontiers (NF) cost cap.



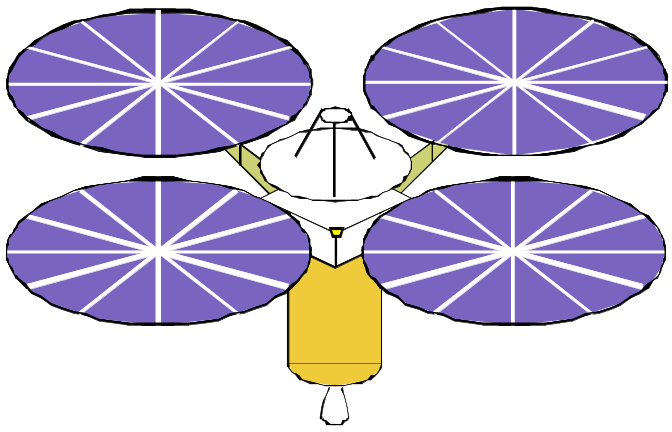
A Possible New Frontiers Mission (1 of 2)

• We found the most cost-effective, scientifically compelling mission would be an orbiter for high resolution mapping of the gravity and magnetic fields as a probe of interior structure.

• Our rough cost estimate (±30%), including all reserves, would be 10% over the current NF guideline ($650 million not counting the launch vehicle).

• Mass is not a limiting factor, so foreign contributions of instruments or a probe could be a way to increase science return while minimizing cost.

• Mission would be possible with no new technology, though we would need to optimize Ultraflex arrays for low light and temperatures.
Advances in low-power electronics, improved downlink rates, low-temperature propellants, or aero-capture would significantly improve capabilities.

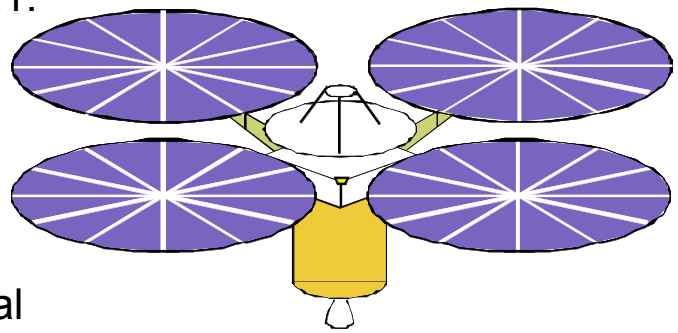


Conceptual Design

A Possible New Frontiers Mission (2 of 2)

We found this mission scenario to be a good starting point for future studies:

- Potential launch September 2018 on an Atlas 521.
- Planned flybys of Venus (2), Earth, and Jupiter.
- Predicted arrival at Uranus in September 2030.
- Insertion into a polar orbit (~70˚ inclination).
- 1.2 year mission consisting of 10, 44-day elliptical orbits. Periapse 1.1 Uranus radii, apoapse 100 radii.



Conceptual Design

Science floor instrument package would consist of

- X/Ka radio transmitters (Doppler tracking used for mapping the gravity field).
- Scalar and vector magnetometers (plus boom with star tracker).
- PEPPSI-type instrument for particles measurements.

Total science mass ~22 kg, not counting radio transmitters. 12 Gb of data generated during Uranus operations.

Subject to power and data volume constraints, ~100 kg of additional science payload could be accommodated.

Our Study Team

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Acknowledgement

This work was carried out at the Jet Propulsion Laboratory/California Institute of Technology, under contract with the National Aeronautics and Space Administration.