OCEANUS: A Concept Study for a Uranus Orbiter Mission from the 2016 NASA/JPL Planetary Science Summer School

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Synopsis

- Origins and Composition of the Exoplanet Analog Uranus System – a mission concept for an orbiter reaching Uranus in 2041
- Measure both the gravity (J6) and magnetic fields during 13 orbits – a significant improvement over the single Voyager flyby
- Small instrument suite: a radio antenna and a magnetometer
- Not achievable within the New Frontiers budget suggested by the Decadal Survey due to high cost of reaching Uranus and powering the spacecraft while in orbit (Jupiter gravity assist not available until a 2040s launch)

Motivation

- Voyager 2 is the only spacecraft that has visited an ice giant
- The structure and composition of the interiors of ice giants and gas giants differ significantly
- Ice giant sized planets are the most common type of planet according to Kepler data
- Interior models and solar system formation models do not agree on the size of Uranus’ rocky core
- The single Voyager flyby did not fully characterize the high-order structure and temporal evolution of Uranus’ dynamo

Key trades

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<thead>
<tr>
<th>Orbiter</th>
<th>Flyby</th>
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<tr>
<td>2000 kg constrained</td>
<td>500 kg delivered</td>
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<td>Single reliable instrument</td>
<td>Low TRL instrument</td>
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<td>$13.5 million instrument cost</td>
<td>$70 million instrument cost</td>
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Mission Type:

- More compelling science at lower cost
- Solar power is not feasible due to mass and surface area, cannot deliver spacecraft
- Sacrifice cost for manageable mass and power

Cost

- Mission cost cap of $1B, with cost credit of $213.2M for eMMRTGs. Total $1213.2M (FY2015). Our cost: $1180.8 M
- Quasi-grassroots approach using JPL institutional cost model (ICM)
- ICM based on historical missions
- Assumes class B mission, in-house development, donated probe, protection category II
- Payload costs calculated using NICM CERs

Mission Schedule

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<thead>
<tr>
<th>Phase</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
<th>2028</th>
<th>2029</th>
<th>2030-40</th>
<th>2041</th>
<th>2042</th>
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Why Oceanus?

Oceanus, son of the Greek god Uranus, was the divine ocean encircling the Earth in which floated the habitable world. The planet Uranus is thought to be enfolded by an ocean that generates a dynamic magnetic field; this puts the significance and complexity of our solar system’s ocean worlds in a new and exciting scientific context.

This poster was created by students as an educational activity at the Jet Propulsion Laboratory, California Institute of Technology, and does not represent an actual mission.