Outer Planets Program Overview

- The Outer Planets Program is a new administrative/budget grouping consisting of three elements: Cassini, R&A, OPF
- Cassini Mission to Saturn
  - Recently began first extended mission (Cassini Equinox Mission)
  - Planning underway for XXM mission
    - Strategy to transition Cassini to extended lifetime at reduced operations budget
    - HQ has asked the Project to assess the feasibility and impact of this reduced operations budget for XXM
    - Project XXM plan will undergo Senior Review in February
    - Results of analysis and Senior Review will play a significant role in budget decisions yet to be made
  - Program Scientist Denis Bogan is retiring

Research, Analysis, and Support

- Cassini Data Analysis Program
  - Max Bernstein has replaced Denis Bogan as Discipline Scientist
  - ~$8M budget in FY09
  - 2006: 72 submitted, 27 selected (38%)
  - 2007: 77 submitted, 41 selected (53%)
  - 2008: 61 submitted, expect ~33% selection rate (selections expected to be finalized around Thanksgiving)
- Jupiter Data Analysis Program
  - First time program in ROSES 2008; ~42 proposals submitted
  - ~$2M budget in FY09
  - Next year (ROSES 2009) we are considering merging JDAP into OPR
- Outer Planets Research Program
  - ~$9M budget in FY09 (~$2.5M available for new selections)
  - Budget not within OPP but will be managed along with other OPP elements
  - 2004: 142 submitted, 53 selected (37%)
  - 2005: 80 submitted, 26 selected (33%)
  - 2006: 53 submitted, 12 selected (23%)
  - 2007: 117 submitted, 44 selected (38%)
  - 2008: proposals due next week!
- Cassini Data Availability/Usability
  - Joint Community/Cassini effort to assess usability of Cassini data to non-team members
- Expanding the Cassini Team
  - Expectation on all sides that Cassini would periodically expand its science base
  - Effort needs to provide benefit to both the Cassini team as well as the Community – What are the goals? What are the challenges?
Outer Planets Flagship

- NASA is currently finishing a nine month long Outer Planet Flagship mission study which is being conducted jointly with ESA. Two missions are being studied:
  - Europa Jupiter System Mission (EJSM)
  - Titan Saturn System Mission (TSSM)
- NASA plans to select a single Outer Planet Flagship mission in February 2009 which will be pursued jointly with ESA and other international partners.
- The community owes a

Initial Ground Rules – Feb 2008

- **Cost Cap**: $2.1B ($FY07) with 33% reserves
- **Power System**: only MMRTG’s or solar allowed
- **Launch Vehicle**: Atlas 5, Delta IV-H, Ares 5
- **Launch and Cruise**: Launch nlt 2017 and cruise ngt 7 years
- **DSN**: utilize 34 m stations only
- **Technology**: “Rule of One” and missions own necessary technology development
- **International Contributions**: Partnerships are expected and are being pursued, but international contributions must provide capability above the mission science floor and cannot impinge on the ability of NASA to fly a complete mission for $2.1B

“Sweet Spot” Mission – June 2008

- In June 2008 NASA changed its strategy
  - Strict cost cap strategy with science as the only free variable was dropped since the $2.1B cost capped mission was not compelling
  - A new strategy to seek the “sweet spot” was adopted: optimize balance between science and cost to better respond to the Decadal Survey
- The study teams were directed to identify a “sweet spot” mission consistent with this new strategy
- An assessment of science value vs. cost was developed based on science goals set down by the Decadal Survey
- Following the second interim briefing to HQ management in June 2008 the study teams were directed to:
  - Focus the remaining study efforts on the “sweet spot” mission
  - Defer the nominal launch date from nlt 2017 to 2020 (with evaluation of launch options from 2018-2022)
  - Assess the impact of ASRG and MMRTG power sources and select the preferred system
- This slipped the original schedule and increased study costs
### JEO Plus Up Process

- JJSDT identified and prioritized instrument and mission capabilities
- Mass, power and data estimated to determine when additional MMRTGs or LV capability was required
- Costs were obtained from estimated raw costs and obtaining fully integrated costs from Project cost estimate

<table>
<thead>
<tr>
<th>Priority</th>
<th>Add-backs</th>
<th>Science Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>Detailed local geology; System Satellites, Ring &amp; Jupiter Science</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Hybrid IR</td>
<td>Europa Surface Composition &amp; System science</td>
</tr>
<tr>
<td>2</td>
<td>Hybrid IR</td>
<td>System science—increased data volume return</td>
</tr>
<tr>
<td>3</td>
<td>Augmented IR</td>
<td>Added satellite surface coverage, discovery follow-up</td>
</tr>
<tr>
<td>4</td>
<td>Attract Target</td>
<td>Europa Surface Composition &amp; System science; Satellite atmosphere</td>
</tr>
<tr>
<td>5</td>
<td>Augmented IR</td>
<td>Improved, Latitudinal resolution—quantitative morphology</td>
</tr>
<tr>
<td>6</td>
<td>Simple Thermal Imagers</td>
<td>Europa &amp; Satellite Thermal Anomalies; Space physics—sublimation and Sputtering</td>
</tr>
<tr>
<td>7</td>
<td>Interdisciplinary scientists</td>
<td>Multi-focused/multi-disciplinary science investigations</td>
</tr>
<tr>
<td>8</td>
<td>Particle Instrument</td>
<td>Space Physics—system integrations</td>
</tr>
<tr>
<td>9</td>
<td>On-Orbit functionality</td>
<td>Interior science flyby</td>
</tr>
<tr>
<td>10</td>
<td>IR Radiometer</td>
<td>Atmospheres Science—Regression</td>
</tr>
<tr>
<td>11</td>
<td>Mars Lander: Laser Altimeter</td>
<td>Improved, Latitudinal resolution—quantitative morphology</td>
</tr>
<tr>
<td>12</td>
<td>ISSA to MAC</td>
<td>Improved, Latitudinal resolution—quantitative morphology</td>
</tr>
<tr>
<td>13</td>
<td>INIR</td>
<td>Composition of spotter material</td>
</tr>
</tbody>
</table>

Add MMRTG and go to Delta IV

- Dust Detector: Composition of spotter material
- Augmented UV: Enhanced Europa Surface Composition studies & System science
- Richard Upland: High-Res Imaging data
- Penetrator Demonstration: In situ assessment of organics
- New: Europa science phase: Greater ability to follow-up on discoveries
- CIRS: Jupiter Atmospheric Structure

### JEO Sweet Spot Determination

- Stay on Atlas launch vehicle and within capability of 5 MMRTGs including 33% margin
- Increase resiliency to future changes in direction

### STO Sweet Spot Determination

- Prioritization driven by decadal science
- Includes ESA full complement in situ payload
- In situ elements add considerable science value at limited accommodation cost to NASA
- Sweet Spot and enhanced decadal for NASA-only mission not shown in these charts

### Rating JEO to the Decadal Survey’s Steering Group Recommendations

<table>
<thead>
<tr>
<th>DECADAL SURVEY STEERING GROUP “EUROPA GEOPHYSICAL EXPLORER” SCIENCE</th>
<th>Core JEO</th>
<th>Sweet Spot</th>
<th>Decadal JEO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine the presence or absence of an ocean.</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Characterize the three-dimensional distribution of any sub-surface liquid water and its overlying ice layer.</td>
<td>4</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Understand the formation of surface features, including sites of recent or current activity, and identify candidate landing sites for future lander missions.</td>
<td>3</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Characterize the surface composition, especially compounds of interest to prebiotic chemistry.</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Map the distribution of important constituents on the surface.</td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Characterize the radiation environment in order to reduce the uncertainty for future missions, especially landers.</td>
<td>2</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

5: Definitely addresses full science.  
4: May address full science.  
3: Definitely addresses partial science.  
2: May address partial science.  
1: Touches on science.  
0: Does not address science.
Rating JEO to the Decadal Survey’s Large Satellites Panel Recommendations

Rating TSSM to the DS Large Satellite Panel Recommendations

NOTE: Illustrative purposes only; ratings have changed slightly since this slide was created and are updated in the final report

Reporting Requirements and Review Process

- For each mission concept, the NASA-ESA study teams will produce three reports:
  - NASA Study Report: a technical report prepared by the NASA study team and JSDT and focused on the NASA contribution
  - ESA Assessment Report: a technical report prepared by ESTEC and the JSDT and focused on the ESA contribution
  - NASA-ESA Joint Summary Report: a less technical summary report describing the joint mission and linkages between NASA and ESA contributions
- NASA and ESA will each conduct independent reviews of the results of their own studies
  - NASA will conduct a standard independent STMC review of the NASA Study Reports for EJSM and TSSM
    - Site visits are scheduled for Dec. 9-12 and results will be briefed to HQ in Jan. 2009
  - NASA will conduct review of the ESA Assessment reports tailored to the level of technical detail that is available on the ESA contributions
    - Science will be reviewed by ESA’s Solar System Working Group
    - Technical feasibility, cost and risk will be independently reviewed by a team of ESA project managers
- NASA and ESA management will meet in early 2009 to discuss study results of studies and reviews and select a mission

The Road Ahead

- NASA and ESA have made tremendous progress but many hurdles remain (budgetary, technical, political)
- Keep in mind that OPF is a complex international mission that is currently in pre-phase A
  - We should expect some changes as we move toward and through Phase A (programmatics, schedules, unforeseen technical issues)
  - But the important things will not change (Europa radiation environment, Titan surface conditions, key science objectives)