Instruments as Part of the JEO Mission Systems Engineering Process

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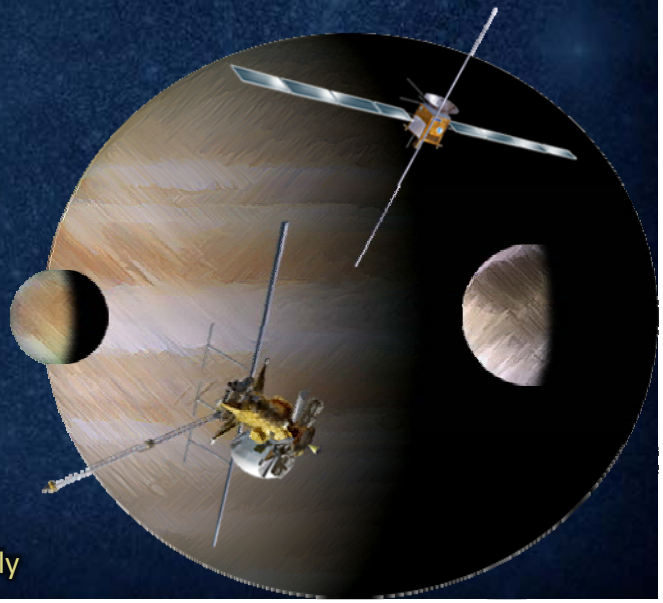
JEO Pre-Project

EJSM Instrument Workshop

July 27 – 29, 2010



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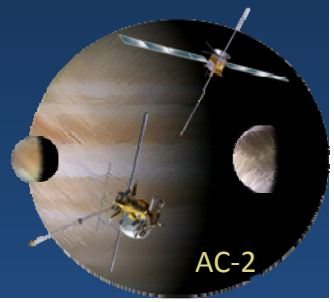
Pre-Decisional - For Planning & Discussion Only

Instruments as Part of JEO

- The reality of JEO is that this is a tough job due to the duration and to technical, environmental challenges
- Why do it? **Fantastic Science**
- To be successful this needs to be a team effort!
  - The project needs the contributions, expertise and unique skills of the science & instrument community
  - The project will help wherever appropriate to facilitate success
  - Instruments and associated scientists, engineers and collaborators are part of one JEO team
    - Symbiotic relationship as neither can do it alone

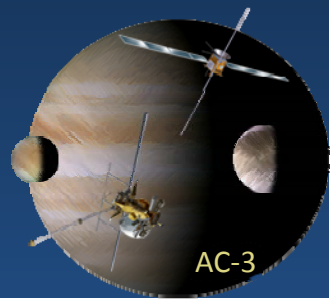


Science Influence within JEO

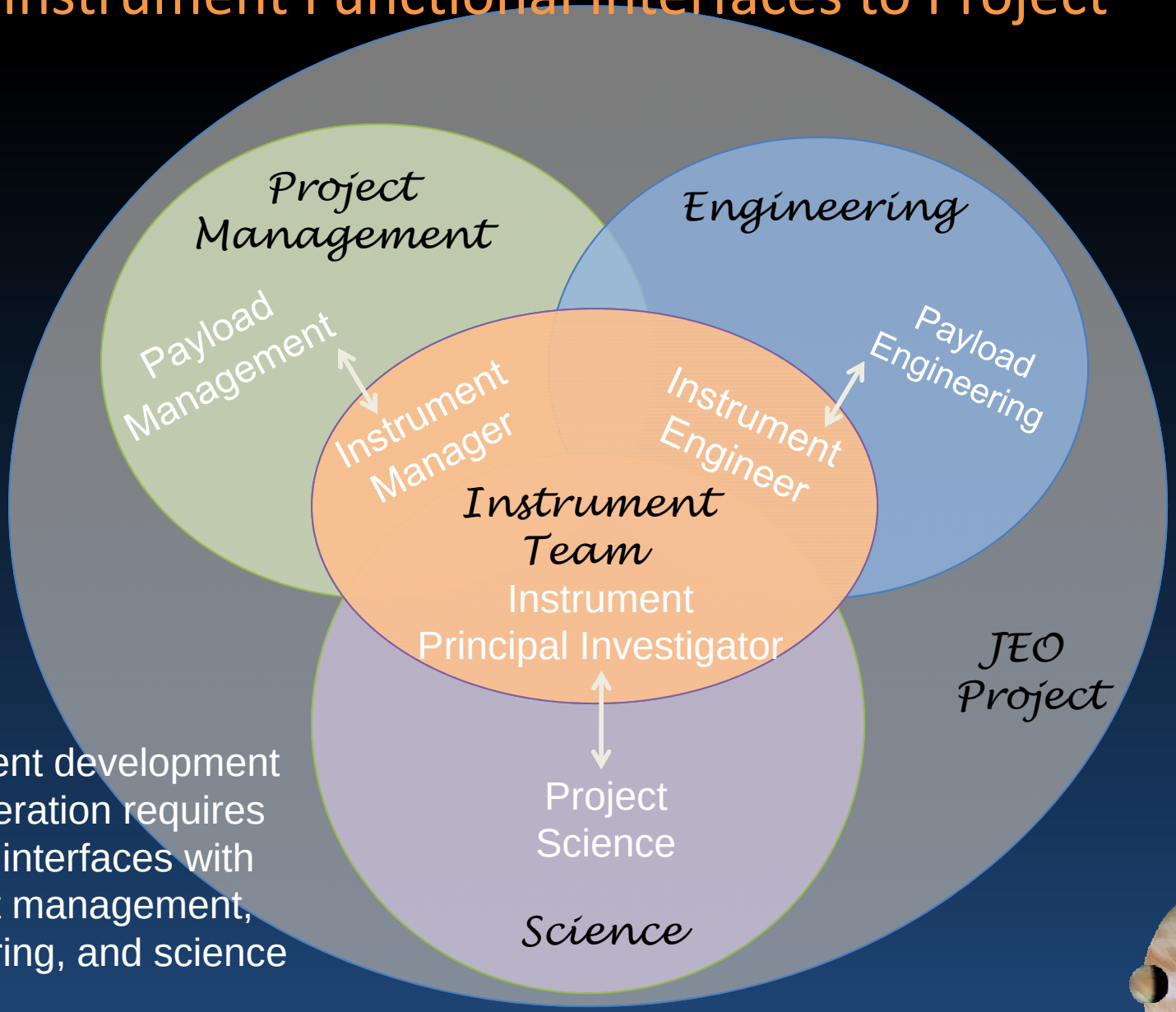
Project Science

- **NASA** (Review Boards)
- **External Stakeholders**
- **Control & Administration**
  - Documentation
  - Configuration Control
- **Management**
  - Contracts
  - Conflicts of Interest
  - Schedule
  - Finance
- **Science & Mission Design Engineering**
  - Payload
  - Mission Design & Navigation
  - Science Scenarios
  - EPO
- **Project & Flight System Engineering**
  - Payload Integration
  - Resource Management
  - Accommodation
  - System Modeling
- **Operations**
  - Mission Operations
  - Science Operations
  - Ground Data System

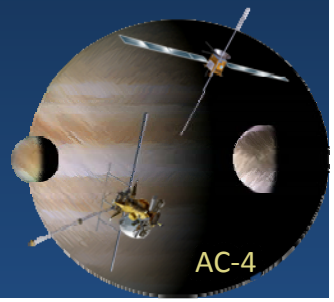
Science touches most aspects of mission planning, development and execution



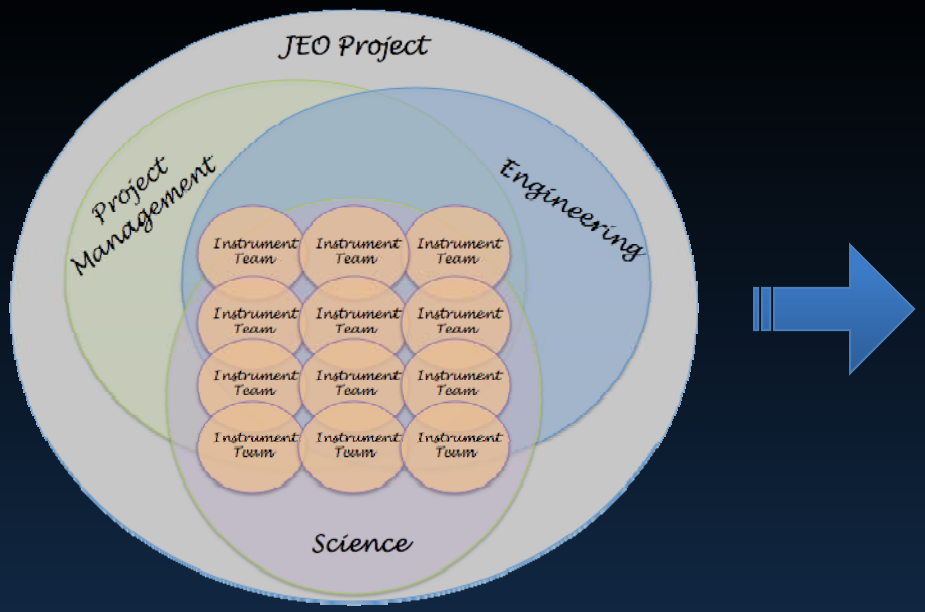
Instrument Functional Interfaces to Project

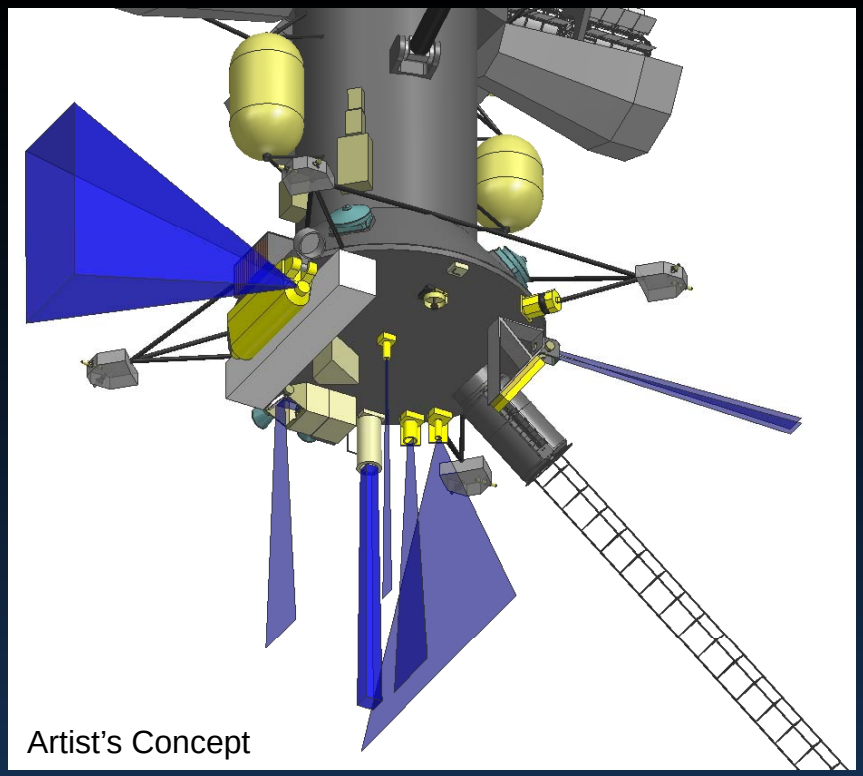


Instrument development and operation requires strong interfaces with project management, engineering, and science

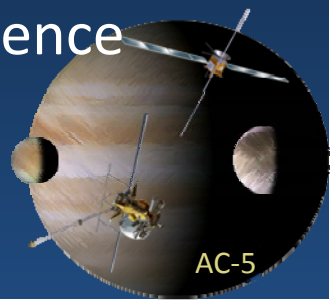


Notional Instrument Interfaces to Project

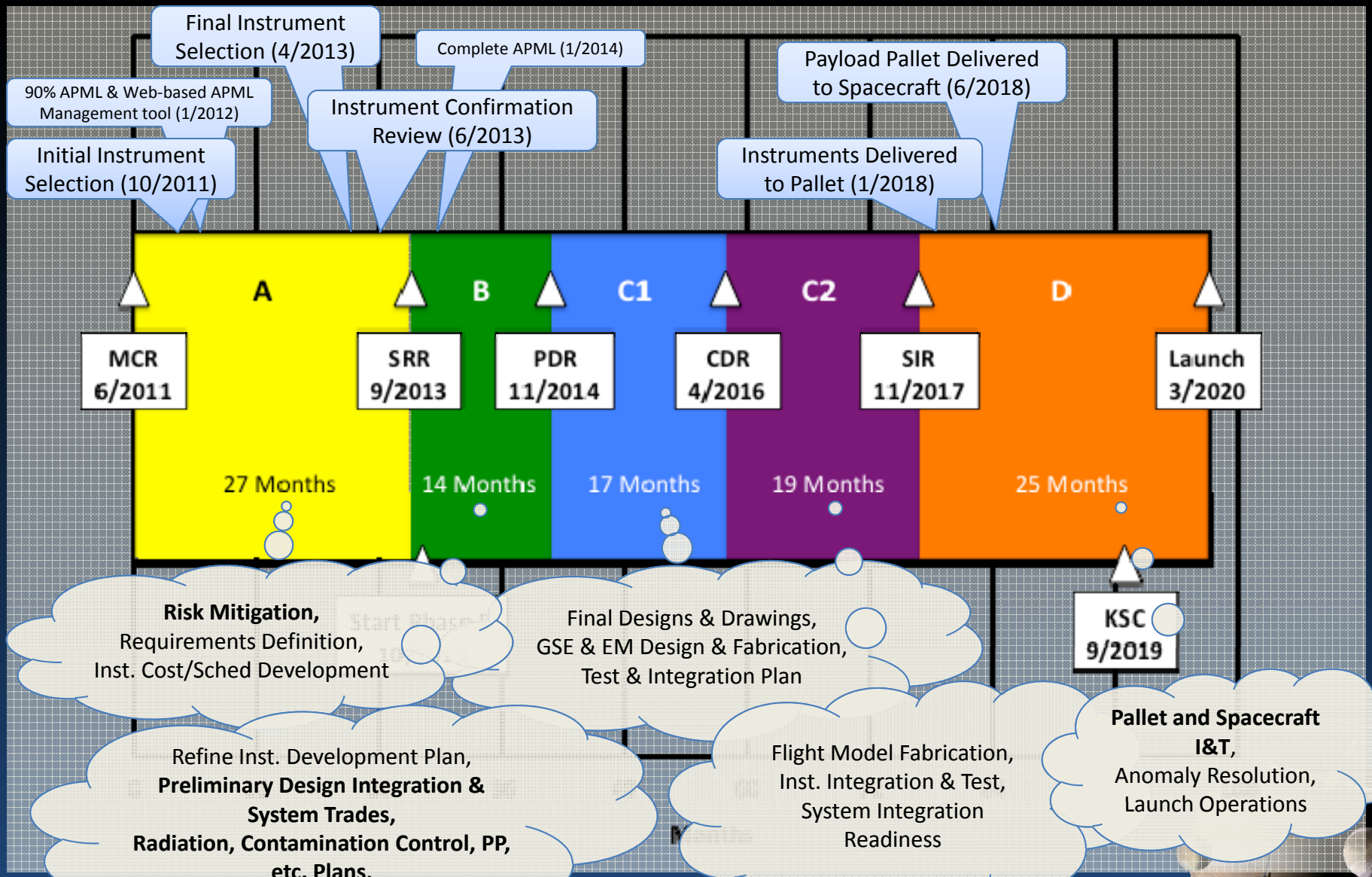




- Single integrated payload
- Focus on operability and synergy
- ~12 instruments working harmoniously in a unified operations and science plan in order to answer the fundamental science questions



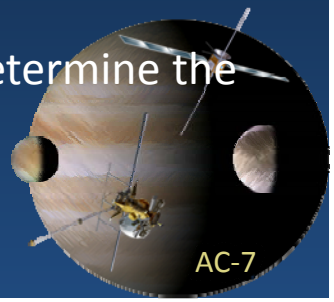
Phase A-D Baseline Schedule



Instruments as Part of the System Design

An integrated system model allows the project to make trades & decisions within a constrained schedule

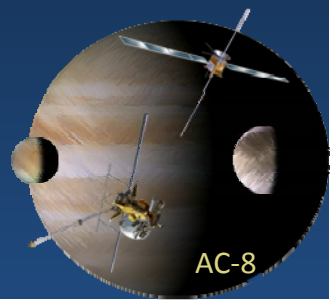
- Model centric engineering approach - model the entire system and all of the various components to demonstrate system can achieve "good' science
- Initial science inputs derived from the Joint Jupiter Science Definition Team (JSDT)
  - Post selection, contributing scientists will influence science merit evaluation
- System model developed in parallel with Instrument AO process
  - Instruments must be modeled with actual details "plugged-in" once selected
  - Project needs input and feedback from instruments for this to be effective
  - Instrument specifics will need to be integrated quickly post-selection to achieve SRR
- The model
  - is a means to have science influences trades and decisions, rather than simple technical/cost/schedule
  - must objectively evaluate science impacts to various choices to help determine the preferred compromise, resolution, or trade option



Instrument Requirements – Getting to SRR/MDR

There are only 5 months between final instrument selection and SRR; everyone needs to start thinking today about what is required to achieve this milestone.

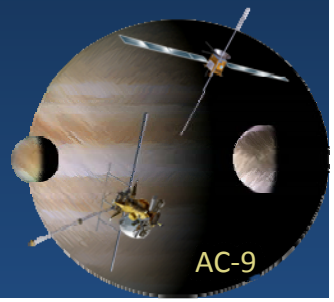
- Programmatic Issues
  - Reconcile selected instruments to the project's system design and constraints, coordinate mitigating of any remaining risks, and fully integrate instruments as part of the JEO team
- Technical Issues
  - Defining deliverable items, allocation of resources and spacecraft services, functional descriptions, identification of key performance characteristics, accommodation of supplied standard elements, environment considerations, and interface descriptions
  - Planetary protection and radiation accommodations
- SRR entry requires capture all of the above in Level 2 (science) and Level 3/4 (instrument) requirements, along with ICDs and related documents
  - Must include analysis indicating all requirements are achievable
  - Some of this information is sufficient to be in draft format



Instrument Requirements – Getting to SRR/MDR

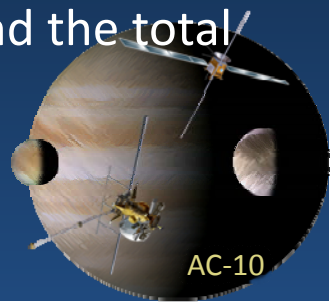
Given the limited time between instrument selection and SRR, and the breadth of JEO's anticipated payload our success depends upon…

- An effective mechanism for listening to instrument needs, concerns, issues, etc.
- Open, accessible lines of communication that facilitate talking between instrument providers and the project early and often
- Prepared teams at selection that have thought through the issues and project needs leading into SRR
- Instrument concepts that embrace the standards, policies, guidelines, and processes put forth by the project

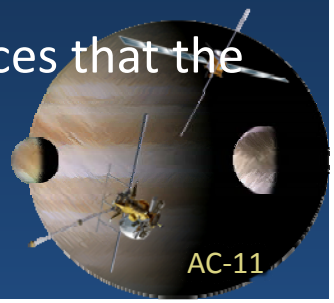


Instrument Development – Things to Keep in Mind

- Because of the nature of radiation, planetary protection, and new instrument development, V&V activities must be given more consideration than usual
  - Provide convincing evidence that the delivered instruments meet the defined objectives and constraints
  - Continual, comprehensive effort from the start (requirements development) and evolves throughout development lifecycle (localized impacts to V&V activities)
  - The JEO V&V program would use intermediate levels of integration and test
  - JEO plans extensive use of models, prototypes, EMs, simulations, etc. as design pathfinders
- There are numerous risk items in addition radiation, planetary protection, etc. that can significantly impact instrument development
- Don't lose sight of the complexity and challenges of the mission and the total system, and remember schedule constraints (especially early on)



Instrument Development – Things to Keep in Mind

- To facilitate the integration of selected instruments into one project team, we would like to encourage your feedback
  - Please let the project know of any concerns/constraints with the radiation, planetary protection, parts/materials approaches presented?
  - Are there any specific or unique concerns associated with the instrument accommodations or interfaces (mechanical, thermal, electrical, services, operability, etc.)?
  - Are there any additional models, resources, or inputs desired from the project?
  - Other?

- Your success is JEO's success
  - Please use the tools, guidance, models, information, and services that the project is providing