The Argus mission will observe Io by investigating Jupiter’s innermost Galilean moon, Io, as outlined in the 2008 National Academies Report on choices for the new New Frontiers Announcement of Opportunity. Io has the greatest amount of volcanic activity of any planetary body in the solar system and provides a great location for studying this fundamental planetary process. The surface of Io is rich in sulfur and sulfur dioxide frost, however not as icy as other moons of the outer planets. The orbit of Io has a 2:1 orbital resonance with Jupiter’s next Galilean moon, Europa, and a 4:1 resonance with the next moon Ganymed. This resonance causes Io to maintain a 4:1 resonance with the next moon Ganymede. This resonance causes Io to maintain a 0.0041 orbital eccentricity that causes tidal heating of the interior. In addition to the interior perturbations, Io is greatly affected by Jupiter’s magnetosphere that surrounds it and in high radiation levels around the equatorial plane, and causes mass loss from the atmosphere. The Argus mission will consider these characteristics and study the moon in detail to achieve great advances in planetary science.

WHAT CAN WE LEARN FROM STUDYING IO?

1. Internal Processes
   - Early Earth
   - Europa likely had a more active thermal past similar to present-day Io
   - C.Possible water on Io, possible molten core, possible history of a magma ocean?
   - Surface temperature anomalies and internal heating (tidal)
2. Atmospheric Properties/Composition
   - Plume emissions
   - B.Ice
   - C.Loss to Jupiter’s magnetosphere?

BREATHSCIENCE

1. Geologic/Variclude processes
   - A. Topography and other surface processes
   - B. Plumes
2. Geochemical
   - A. Composition
   - B. Thermal Structure
3. Atmosphere
   - A. Composition
   - B. Temperature
   - C. Volcanoes
4. Geophysics and Tidal Heating
   - A. Interior structure
   - B. Variability of internal heating

Argus: A New Frontiers mission proposal to observe Io


MEASUREMENT OBJECTIVES

1. Monitoring of the surface: global @ ~1 km/pix, regional @ ~100 m/pix.
2. Local high-resolution imaging @ ~10m/pix Stereo imaging Thermal measurements.

RADIATION

A significant consideration in the design of instruments is the high-level of radiation Argus would be exposed to during fly-bys. All instruments are designed for a radiation level of 1.5 Mrad. Heritage from the Europa 2015 mission for high radiation level instrument design, designed for 3 Mrad, was assumed for all instruments except TIRIMISU. This allows significant savings in instrument development for the Argus mission.

ORBITAL MECHANICS

Nominal 5:1 resonance (10.62 day period) Io’s high velocity leads to short time at low altitude during flyby. Coverage of Io achieved by small orbit perturbations (inclination, resonance) End of mission: Possible orbit burn into Io

ORBITAL MECHANICS

- 4041 kg wet mass
- 83.7 kg planned payload
- 3 ASRG’s provide power
- Single fixed HGA
- Two-way doppler at both X-/Ka-bands for data, communications, and telemetry
- 50 kb/s to 34mb from 6 AU at Ka-band
- Up to 720 Mb/day during main science phase
- Dual mode propulsion system; 2030 m/s
- Fully redundant subsystems
- 1.5 Mrad radiation design point

SCIENCE DATA RETURN

1. Global and regional imaging down to 10 m resolution, with stereo coverage
2. Surface Mineralogical Composition at resolutions down to 300 m
3. UV images of 4 targeted plumes and majority of the Io torus
4. Global heat flow map with down to 10 km resolution
5. Total: 280 Gb data over 2-year science mission

This mission concept study was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration. NASA’s 20th Annual Planetary Science Summer Meeting.

CONCLUSIONS

- Low cost, high science return
- Global, high-resolution imaging down to 10 m resolution
- Robust propulsion system
- Autonomous navigation and attitude control
- Dual mode thermal regime and a variety of thermal behaviors
- Safety and risk mitigation
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- Robust propulsion system
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Total Mission Cost SFY08: BASELINE PI-MANAGED Best Estimate: $642.8 M Range: $578.5 - 771.4 M