Argus: A New Frontiers Mission Proposal to Observe Io

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The Argus mission will obtain breakthrough level science advances by investigating Jupiter’s innermost Galilean moon, Io, as outlined in the 2008 National Academies Report on choices for the new Next 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, is 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 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 Io in high radiation levels around the equatorial plane, and causes mass loss from the atmosphere. The Argus mission is proposed to 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
   A. Early Earth
   B. Europa likely had a more active thermal past similar to present-day Io

2. Atmospheric Properties/Composition
   A. Plume emissions
   B. Ice
   C. Loss to Jupiter’s magnetosphere?

BREATHTHROUGH SCIENCE

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

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.

ORBITAL MECHANICS

Nominal 6:1 resonance (10.62 day period) Heliocentric orbit leads to short time at low altitude during flyby. Coverage of Io achieved by small orbit perturbations (inclination, resonance) End of mission: Possible de-biased orbit into Io

SCIENCE DATA RETURN

1. Global and regional imaging down to 10 m resolution, with stereoscopic 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

Mission Concept:
- Total Mission Cost: $642.8 M
- Best Estimate: $642.8 M Range: $578.5 - $711.4 M

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, and NASA’s 20th Annual Planetary Science Summer School.