Planetary Exploration Possibilities Enabled by the Ares V Launch Vehicle

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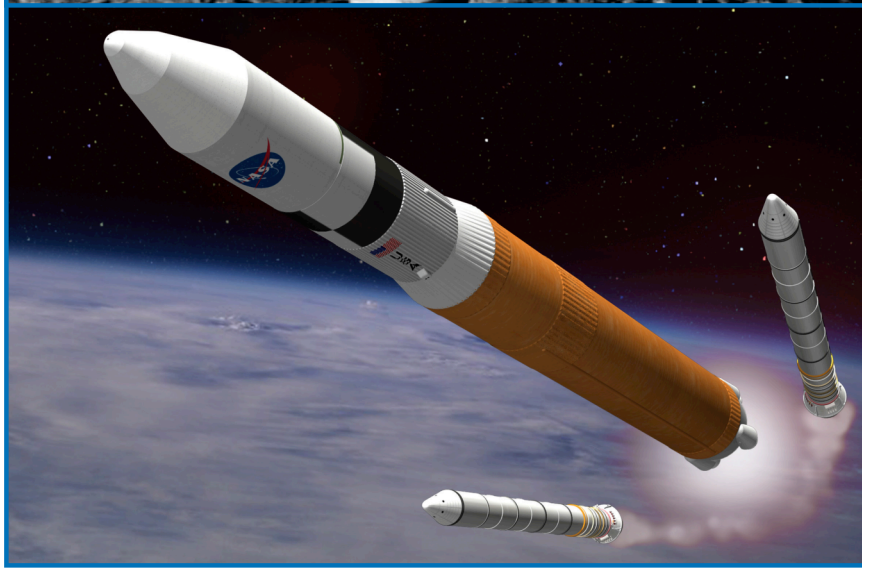
Agenda

- Potential Science Capabilities Made Possible by Ares V
  - Enhancements of previous missions
  - New mission opportunities
- Examples of Potential Future Mission Capabilities
- New 'Operational' level Atmospheric Observers
- Mercury Polar Lander
- Titan Sample Return



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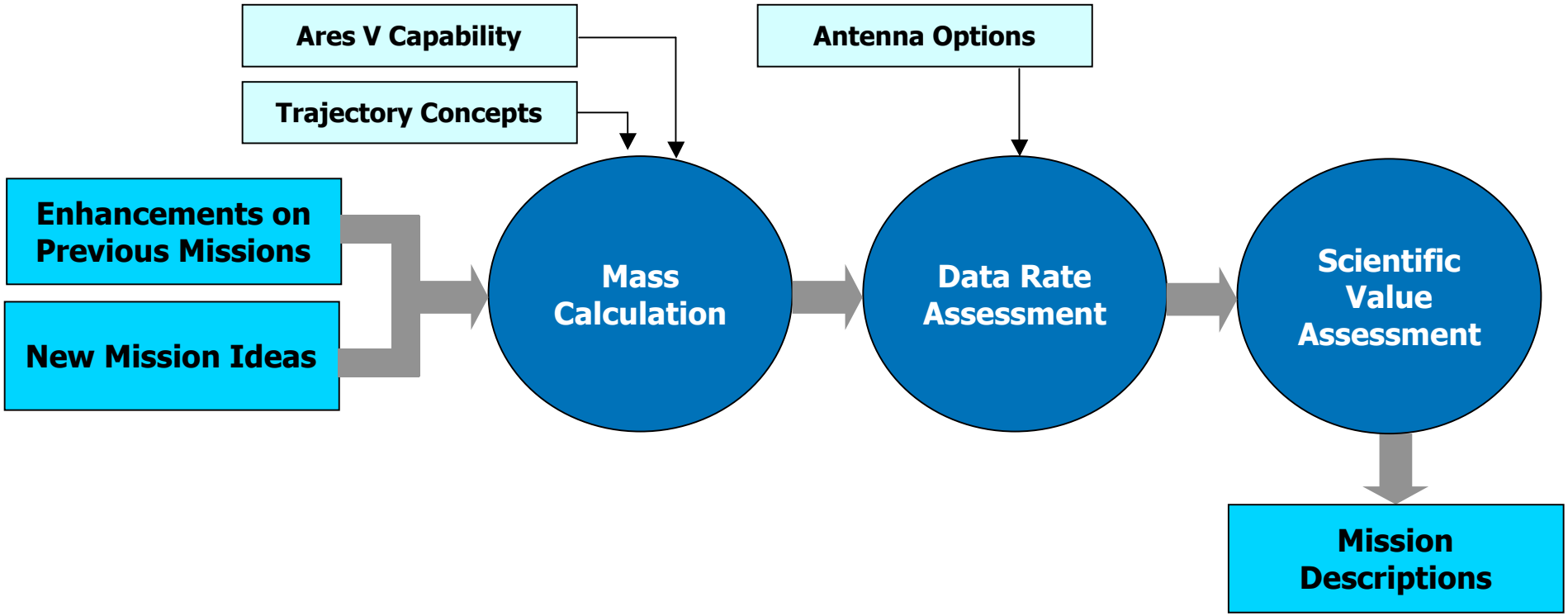
NGST Space Science and Exploration Team Assessed 18 Mission Candidates



Enhancements of Previous Missions

Mission	Objective
Venus, Mars, Jupiter, Saturn, Titan Observing Systems	Provide terrestrial quality 'operational' remote sensing (large-scale, long-term data products) at another solar system body
Long-Lived Venus Lander	Determine/study/characterize surface composition, internal structure variations and evolution
Lunar Circumnavigator Prospector	Prospect Lunar minerals and geology

- Large scale high fidelity data products for all planetary atmospheres
  - 'EOS-class' observations of other planets
  - Comparative planetary atmospheric studies increases our understanding of Earth's atmospheric trends
- MER quality science at Venus with extended life rover/lander
- Lunar In-Situ Prospector
  - Solar powered rover "chases" the Sun at 18 kph
  - Nuclear powered surface explorer

New Mission Opportunities

Mission	Potential Science Objective
Europa Lander/Penetrator	Characterize/study Europa's ice shell and ocean, look for life
Mercury Polar Lander/Rover	Confirm water ice at Mercury's pole
Titan Sample Return	Characterize/study Titan's organic compounds
Triton Orbiter/Lander	Understand Triton's atmosphere, cryovolcanism, composition
Neptune Orbiter	Study/characterize Neptune's composition, gravity field, magnetic field, magnetosphere
C-M Class Asteroid Lander/Orbiter	Characterize surface and internal properties for these less-studied types
Main Belt Comet Lander/Orbiter	Study evolution of primitive objects, characterize internal structure
Comet Surface Sample Return	Study nature of volatiles and organic compounds in primitive bodie
Io Orbiter/Lander	Understand/characterize tidal heating and internal processes of Io
Pluto/Charon Orbiter	Understand/study volatile endowment
Zodiacal Light Imager	'Ground Truth' for extra-solar zodiacal cloud studies

- Intensive follow-on investigations of previous flyby targets
- Investigation of zodiacal dust clouds supports exo-planet search missions

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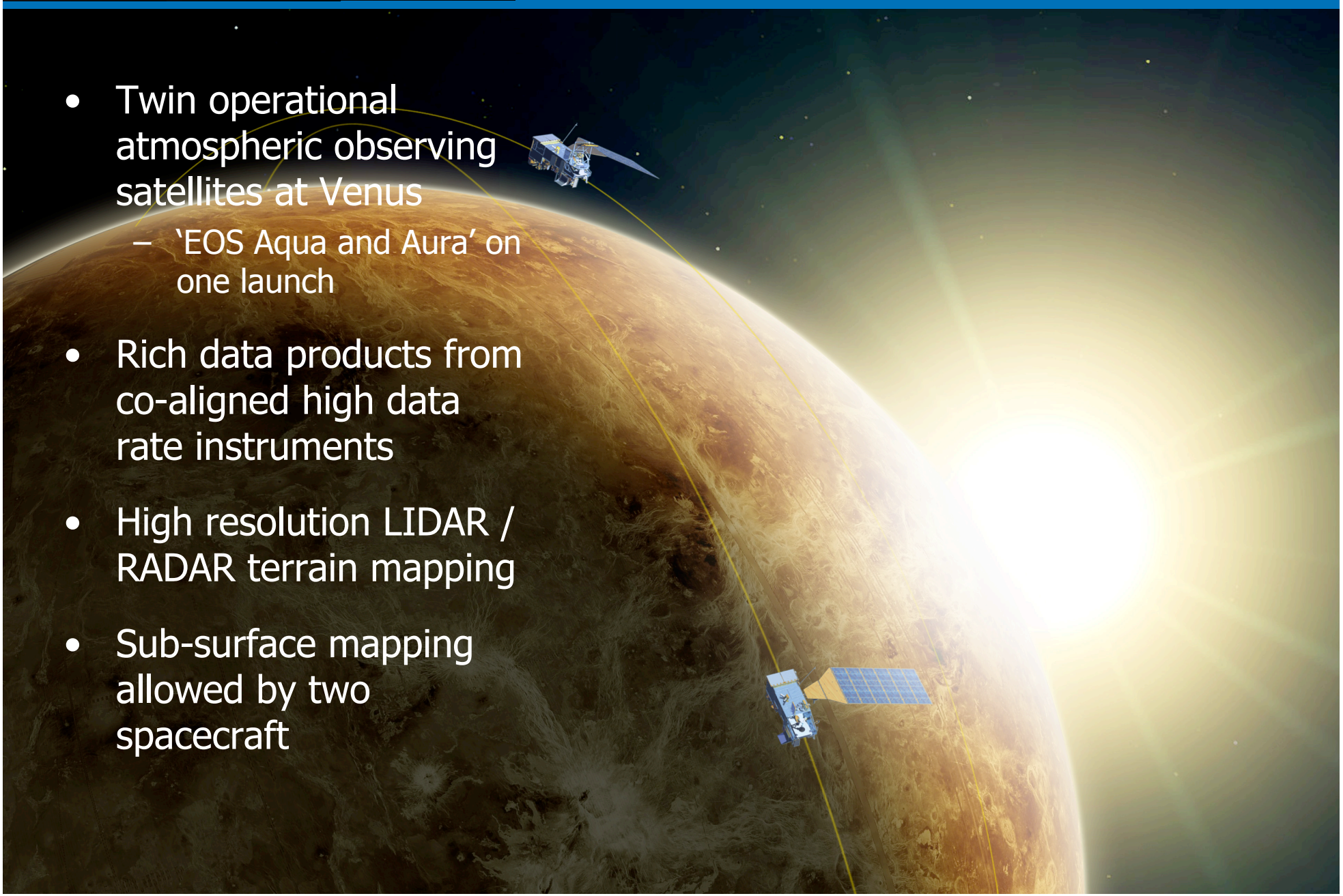
Examples of Potential Future Mission Capabilities

	Mission	Max Earth Distance (AU)	Destination	Deliverable Mass (kg) *	Downlink Data Rate** (Mbps)	
					3m S/C Ant., 250W P.A., 34m DSN	6m S/C Ant., 250W P.A., 100m DSN***
Improved Science to Past Targets	Venus Orbiter	1.7	400km Orbit	14000	8.75	280
	Mars Orbiter	2.6	250x400km Orbit	26800	3.75	120
	Jupiter/Saturn/Titan Orbiter	6.4	Altitude varies by target	14600 / 12000 / 8200	0.625	20
	Long-Lived Venus Lander	1.7	Surface	14500	8.75	280
	Lunar Circumnavigator	0.003	Surface	71000	16.8	600
New Science Targets	Europa Lander/Penetrator	6.4	Surface	10600	0.625	20
	Mercury Polar Lander/Rover	1.4	Surface	9400	13	416
	Titan Sample Return	11	Surface	8200	0.2	6
	Triton Lander	31.2	Surface	2000	0.025	0.8
	Neptune Orbiter	31.2	2500 km Orbit	2300	0.025	0.8
	C-M Class Asteroid Lander/Orbiter	4	Surface	4200	1.6	51
	Main Belt Comet Lander/Orbiter	4	Surface	11600	1.6	51
	Comet Surface Sample Return	5	Surface	9300	1	32
	Io Orbiter	6.4	200 km Orbit	10600	0.625	20
	Pluto/Charon Orbiter	50.4	400 km Orbit	2352	0.01	0.3
	Zodiacal Light Imager	11	15 – 20 AU	600	0.2	6

Downlink Data based upon Existing Earth orbiting Ka quality large scale antennas.
* Variable. Numerous gravity assist options or solar electric propulsion could increase these numbers
**Ka-band assumed
***Planned Phased Array DSN equivalent to100m

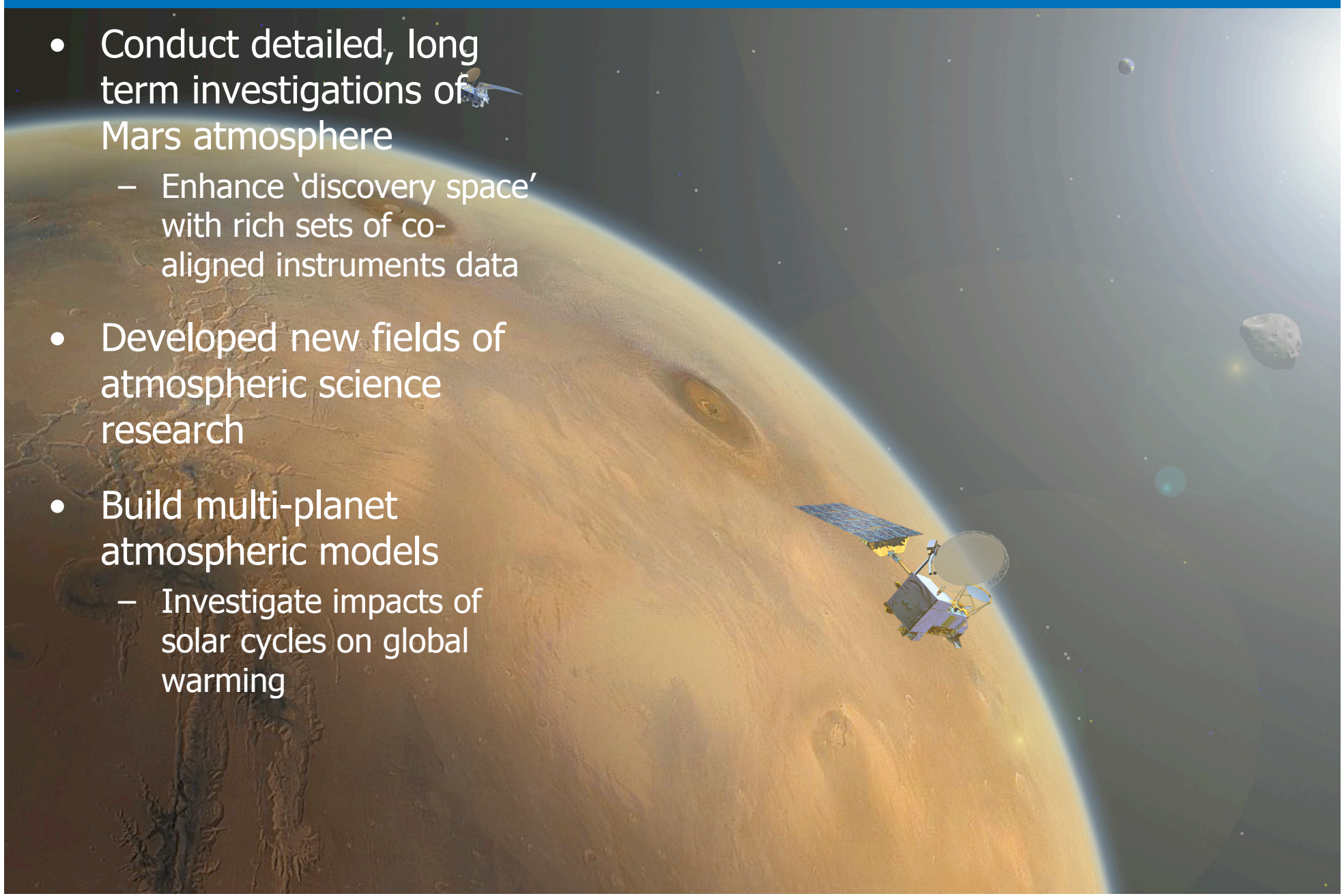
Venus Operational Orbiting System



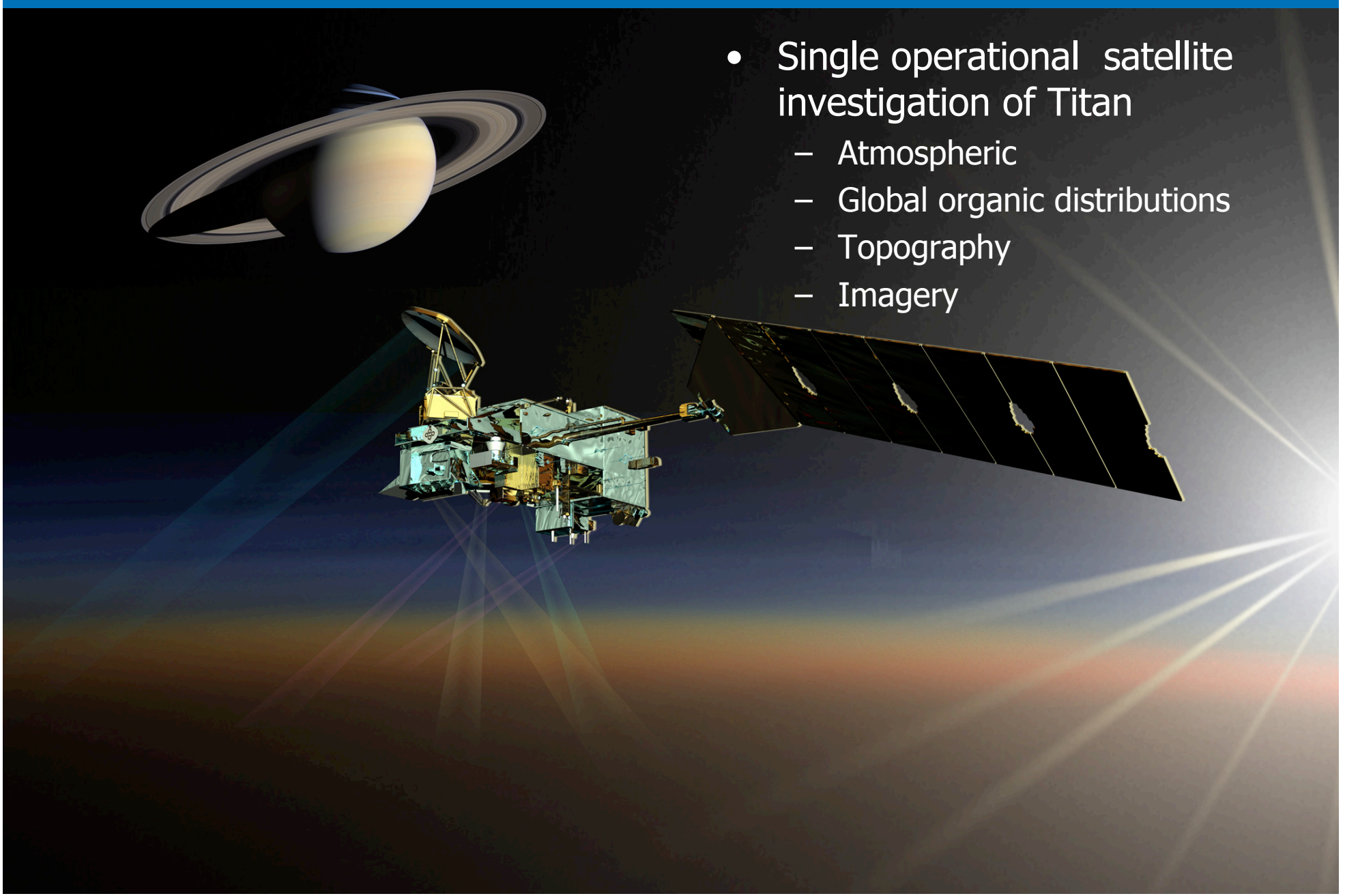
- Twin operational atmospheric observing satellites at Venus
  - 'EOS Aqua and Aura' on one launch
- Rich data products from co-aligned high data rate instruments
- High resolution LIDAR / RADAR terrain mapping
- Sub-surface mapping allowed by two spacecraft

Mars Operational Orbiting System

- Conduct detailed, long term investigations of Mars atmosphere
  - Enhance 'discovery space' with rich sets of co-aligned instruments data
- Developed new fields of atmospheric science research
- Build multi-planet atmospheric models
  - Investigate impacts of solar cycles on global warming



Titan Operational Observing System



- Single operational satellite investigation of Titan
  - Atmospheric
  - Global organic distributions
  - Topography
  - Imagery

Mercury Polar Lander Mission

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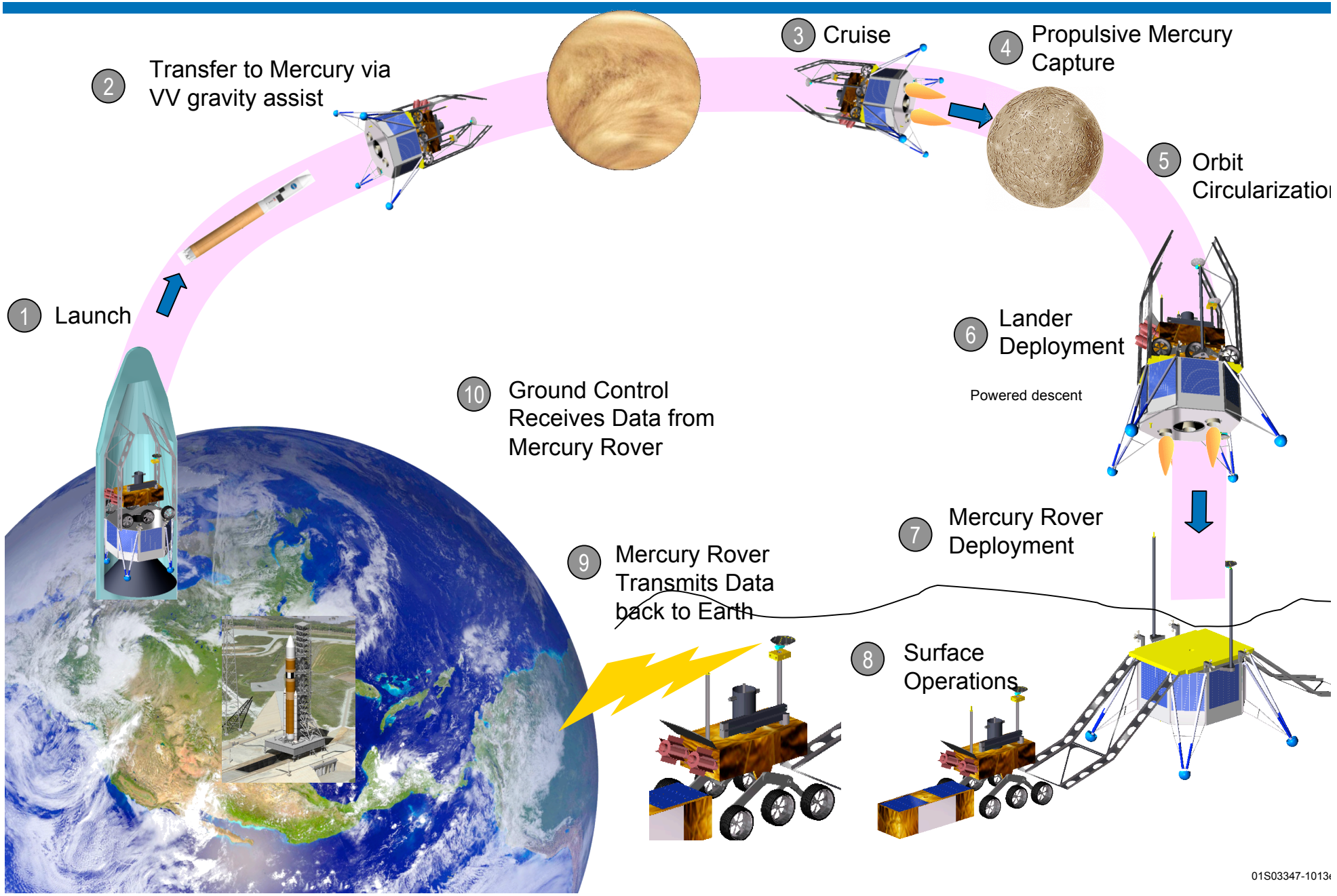
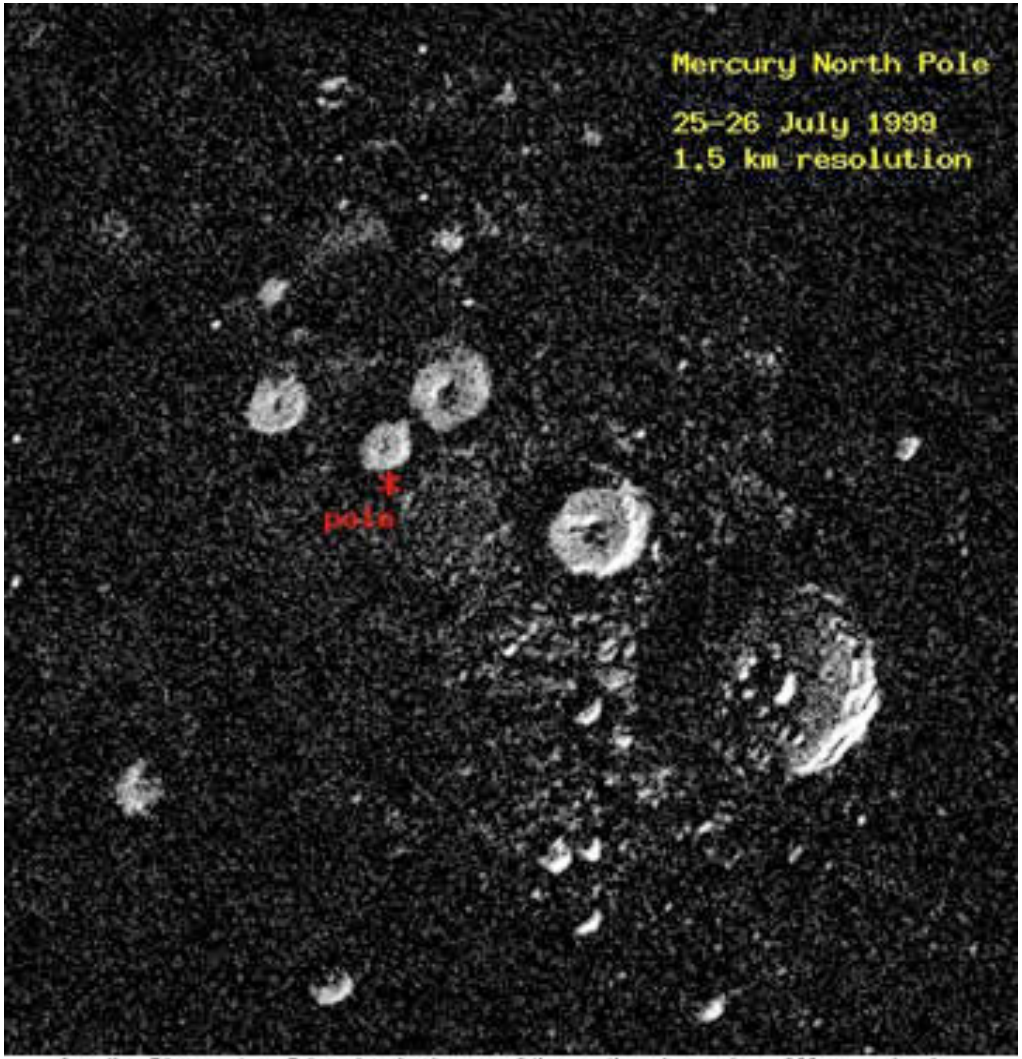


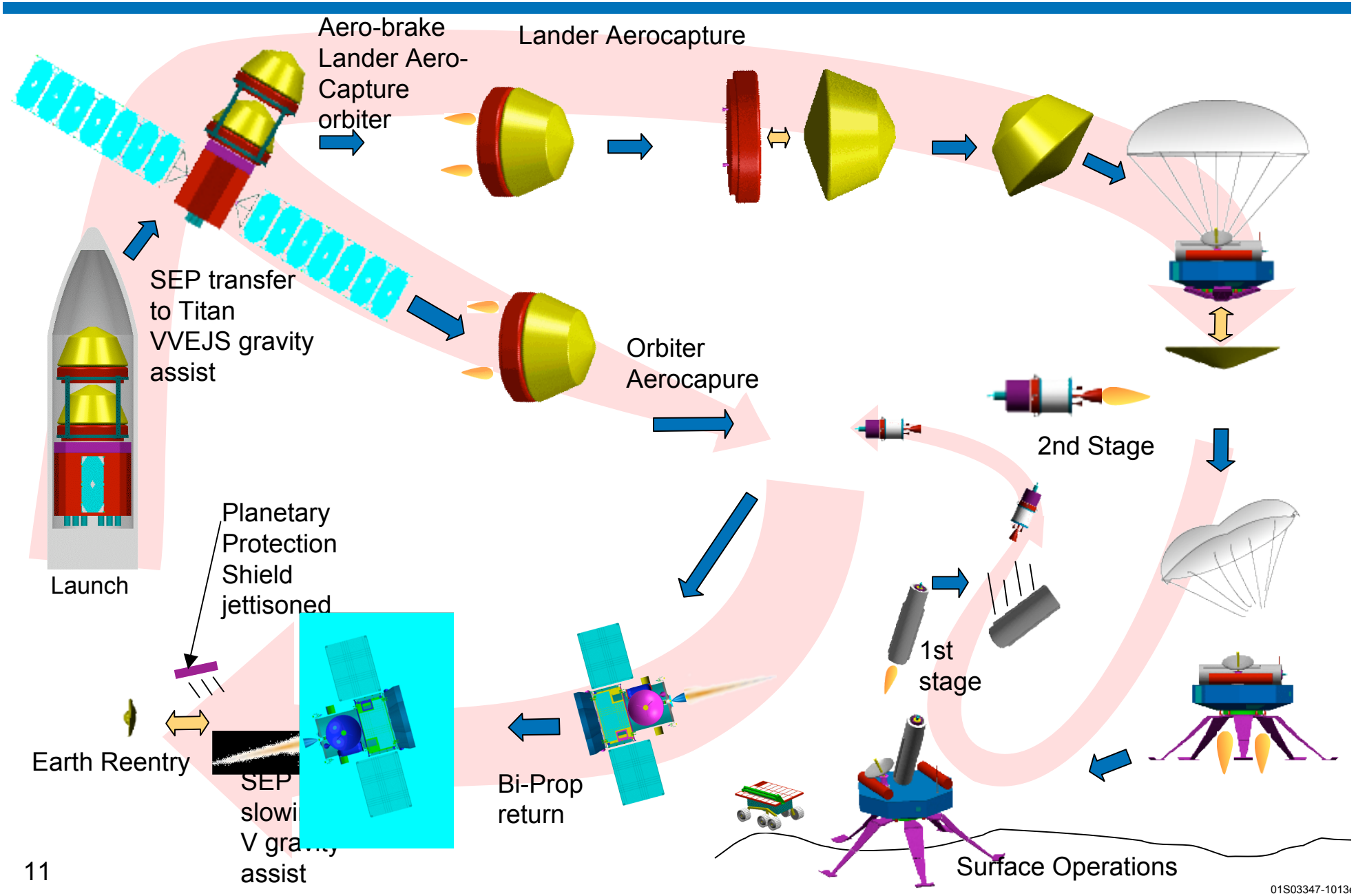
Mercury Polar Lander/Rover Enables *In Situ* Study of Water Ice and Geologic Composition



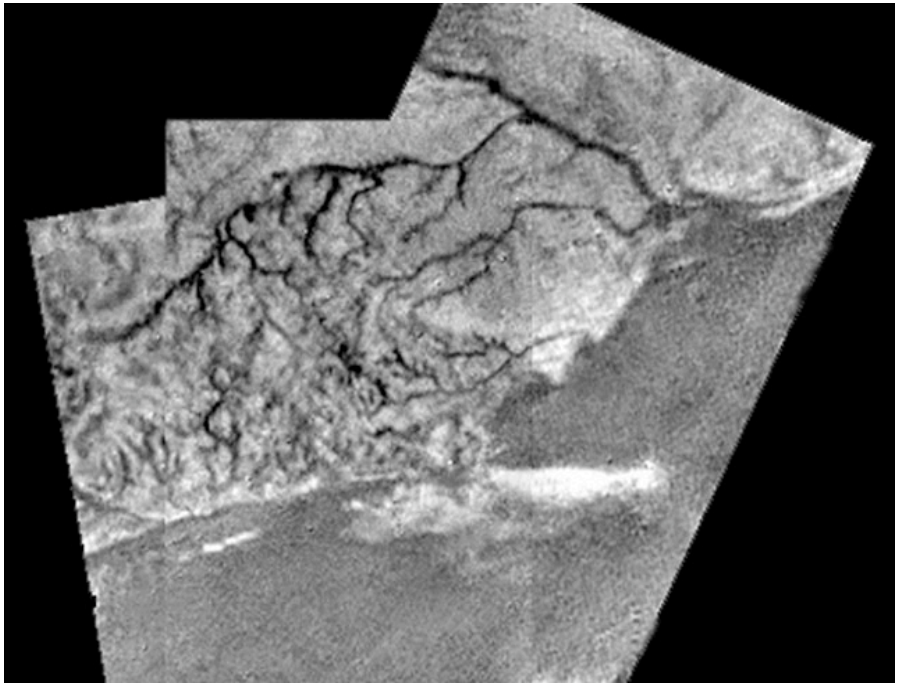
Arecibo Observatory S-band radar image of the north polar region of Mercury by J. Harmon, P. Perrilat, and M. Slade. The resolution is 1.5 kilometers (about 1 mile) and the image measures 450 kilometers on a side. The bright features are thought to be ice deposits on permanently shadowed crater floors.

- Very bright radar returns from Arecibo suggest water ice (Slade et al, 1992, Butler et al, 1993, Harmon et al, 1994)
  - Data for water is much stronger and more conclusive than for the Moon
- Confirmation of water ice has astrobiological significance
- Long-term ice accumulation could occur in permanently shadowed craters
  - A potential test for models of solar system formation
- Bright returns from lower latitude craters (72˚) indicate either a recent cometary impact or sulfur deposited by asteroids

Titan Sample Return



Pre-biotic Chemistry at Titan?



Riverbeds and lakebeds discovered on Titan's Surface
(ESA, NASA, Descent Imager/Spectral Radiometer Team-LPL)

- Atmosphere predominantly composed of Nitrogen and Methane, similar to early Earth
- Existence of organic compounds in atmosphere known since Voyager 1 encounter
- Compounds detected on the surface that were not previously detected in the atmosphere indicate complex chemistry on Titan's surface (Lebreton et al., 2005)
- Measurements from the Huygens probe indicate the possible presence of geologic activity (Niemann et al., 2005)
- Cassini radar measurements suggest existence of hydrocarbon lakes

Ares V Provides Nearly Unlimited Possibilities for Solar System Exploration

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- The NGST Space Science and Exploration Team
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  - Keith Kroening
  - Ron Polidan
  - Teresa Segura
  - Luke Sollitt
  - Connie Spittler
  - Tom Guilmette
  - Mike Ciffone

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