JPL

Current and Future Activities in Solar System Exploration

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Strategy for Solar System Exploration

- **Foundations of planetary exploration rooted in the key themes of the NRC Solar System Decadal Survey:**

  -The First Billion Years of Solar System History

  -Volatiles and Organics, the Stuff of Life

  -The Origin and Evolution of Habitable Worlds

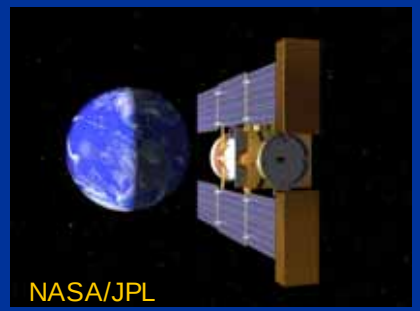
  -Processes, How Planets Work

Missions to Asteroids & Primitive Bodies

Stardust

Science Objectives:
Understand solar system building blocks by collecting cometary material

Extended Mission:
StardustNEXT, New Exploration of Temple 1; return to the Deep Impact Target



Deep Impact

Science Objectives:
Understand the composition and structure of Comets

Extended Mission:
EPOXI, Explore Comet Boethin and make extra-solar planet observations

Dawn

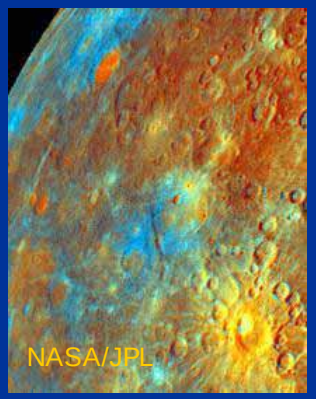
Science Objectives:
Understand structure and composition of the two largest asteroids, Vesta & Ceres

Missions to the Terrestrial Planets

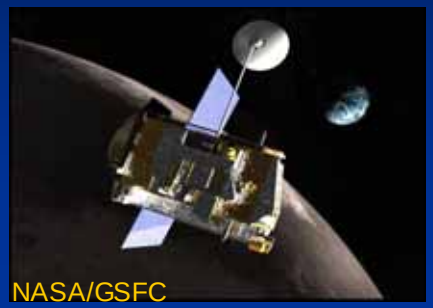
Messenger

Science Objectives:

1. Why is Mercury so dense?
2. What is the geologic history of Mercury?
3. What is the structure of Mercury's core?
4. What is the nature of Mercury's magnetic field?
5. What are the unusual materials at Mercury's poles?
6. What volatiles are important at Mercury?



LRO



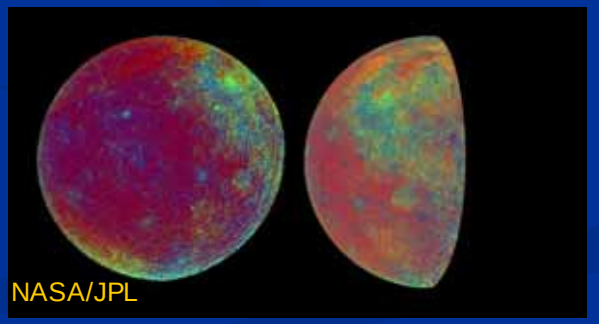
Objectives:

1. Study the Lunar radiation environment
2. Provide the first highly accurate 3D lunar cartographic maps
3. Map mineralogy across the whole moon
4. Search for polar volatiles (especially water ice)
5. Provide sub-meter resolution imaging
6. Provide an assessment of features for landing sites

Moon Mineralogical Mapper

Science Objectives:

Address questions about the Moon's origin and development and the evolution of terrestrial planets in the early solar system by generating the first map of the entire lunar surface at high spatial and spectral resolution

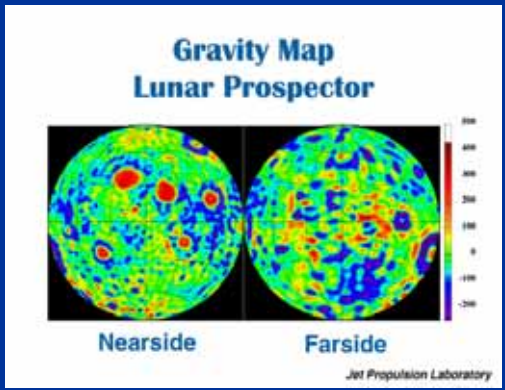


Prospects for the Future

GRAIL

Gravity Recovery and Interior Laboratory

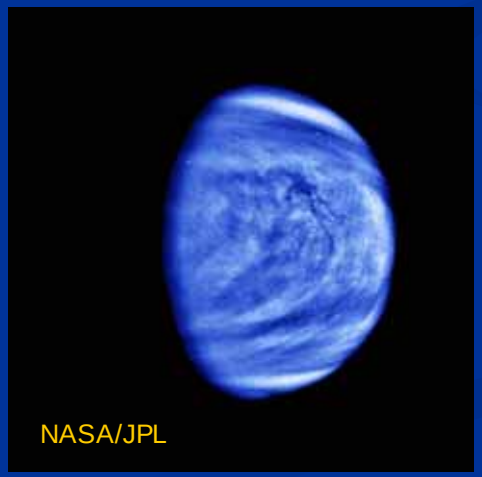
Science Objectives:
High resolution gravity Mapping to understand the lunar interior structure



VESPER

Venus Sounder for Planetary Exploration

Science Objectives:
Study the chemistry and dynamics of Venus' atmosphere



OSIRIS

Origins Spectral Interpretation, Resource Identification, and Security

Science Objectives:
Survey an asteroid and attempt to return a sample from the asteroid to Earth

The Outer Planets

Drivers For Outer Solar System Exploration

- **Study of Bodies of the outer solar system (from the asteroid belt to the Kuiper belt) provide a means to gain information about the early solar system and how it has evolved**

  --Origins: Presence of primitive materials and dynamic processes provide insight into how the solar system formed

  --Volatiles: Bodies rich in water ice and evidence for the presence of subsurface oceans

  --Organics: Abundant organic materials which when combined with an environment providing heat and containing liquid water may be suitable for life to arise

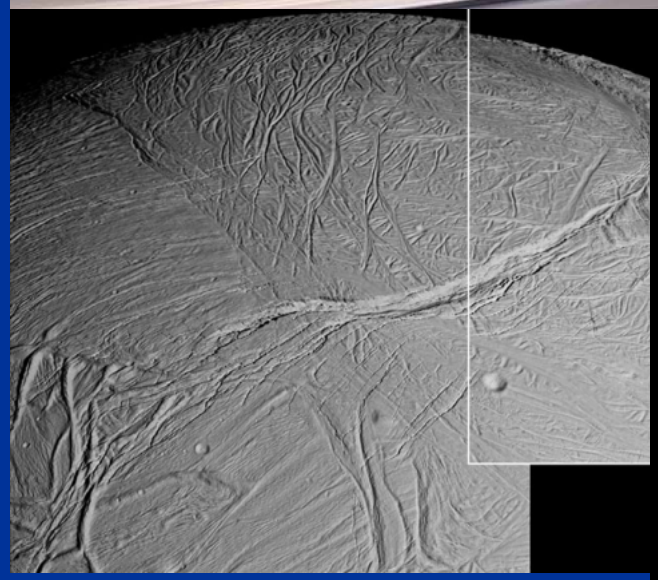
Cassini-Huygens

Saturn: Understand the composition and structure of the atmosphere

Rings: Understand the compositional and dynamic properties; insight into accretionary disks

Icy Satellites: Geologic history, crustal properties & composition, especially related to orgranic rich materials

Magnetosphere: Characterize the structure of the magnetosphere and its interations with Saturn's moons and rings



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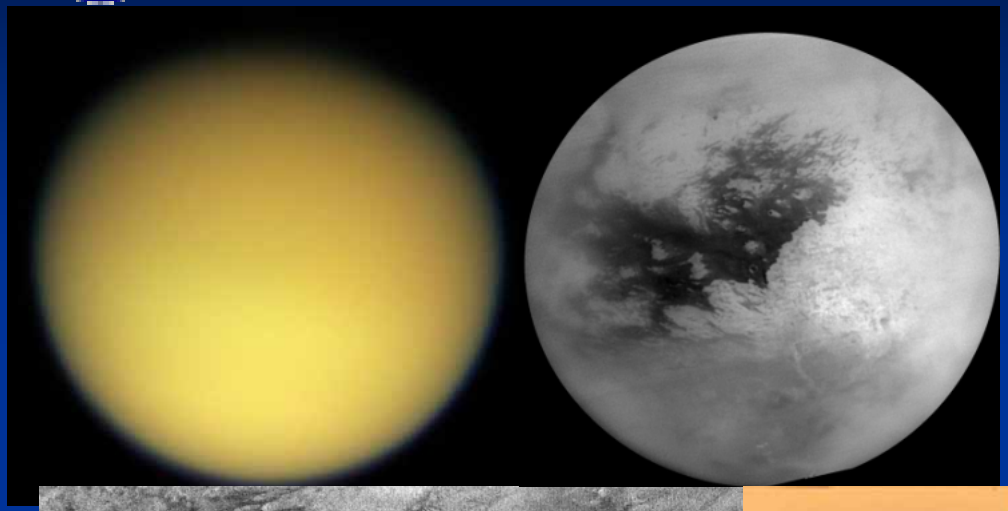
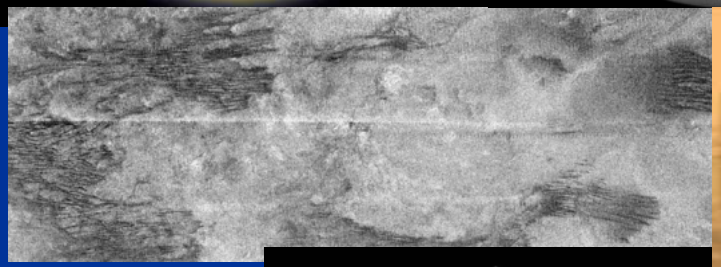
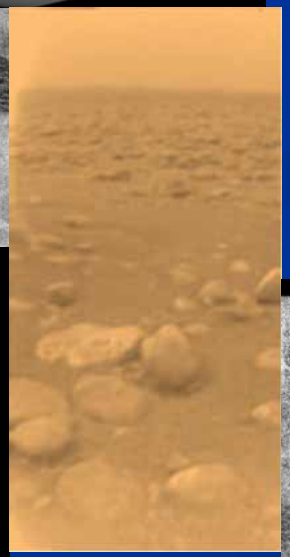
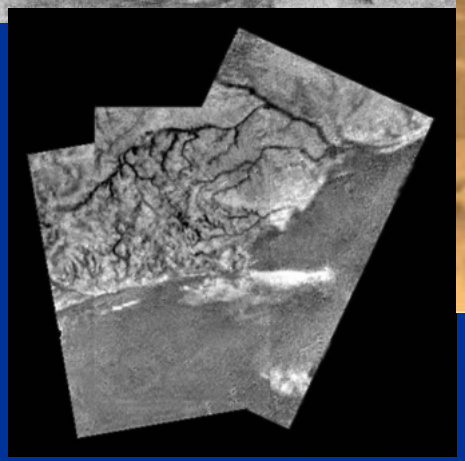
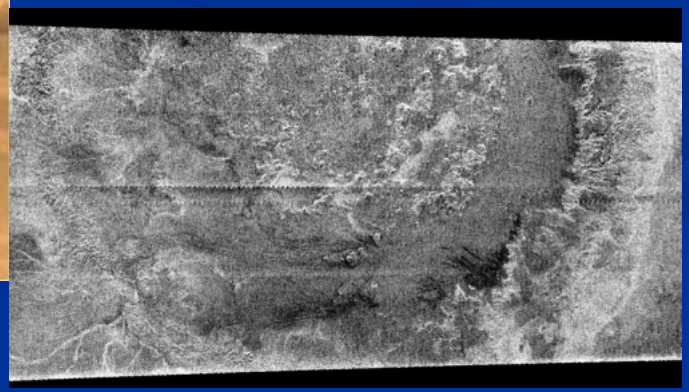
Cassini-Huygens











Titan:

--Determine the most abundant elements and and most likely scenarios for the formation and evolution of Titan and its atmosphere

--Determine the physical state, topography and composition of Titan's surface; characterize its internal structure.

--Determine if liquids are present on the surface of Titan

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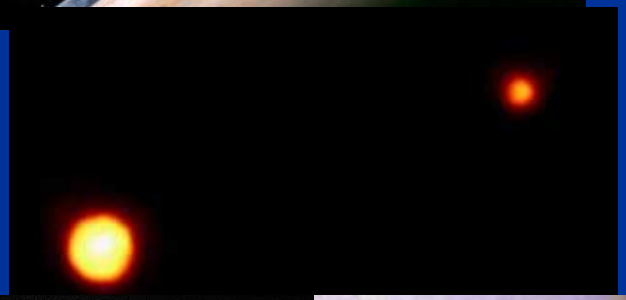
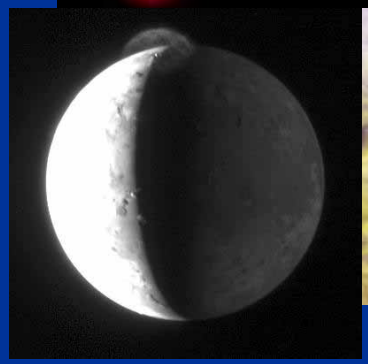
Missions--New Horizons





- A science payload of seven instruments will:
  - Characterize the global geology and morphology of Pluto and Charon
  - Map surface composition of Pluto and Charon
  - Characterize the neutral atmosphere of Pluto and its escape rate
- *"NASA desires, if at all possible, …to have a reasonable plan for visiting one or more Kuiper Belt Objects…during and extended mission."*
  - This is currently part of the New Horizons Mission plan

The mission timeline:
- Launch January 2006
- Jupiter flyby March 2007
- Pluto-Charon flyby July 2015
- Kuiper Belt Object flybys 2016-2020

NASA/APL/JHU

Missions--Juno

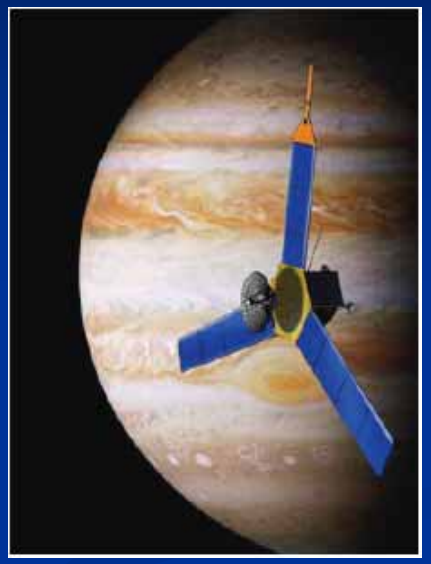
Juno: Jupiter Polar Orbiter

-- Mission goal to understand the origin and Evolution of Jupiter

-- Collect data to produce global maps of the gravity & magnetic fields and atmospheric composition

--Instruments: Radiometers, magnetometers, gravity science system

-- Jupiter arrival, October 2016; Planned mission of 32 Jupiter orbits; Perijove ~5000 km



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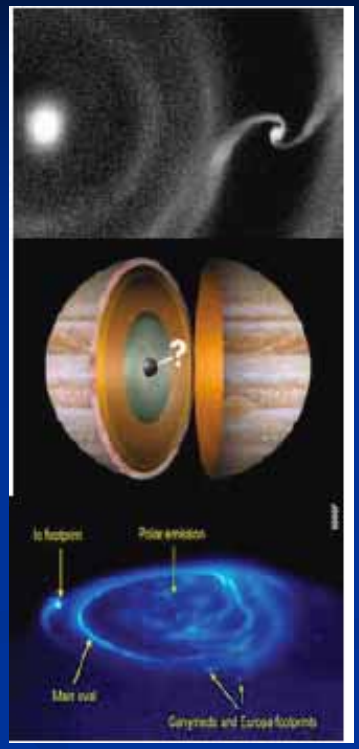
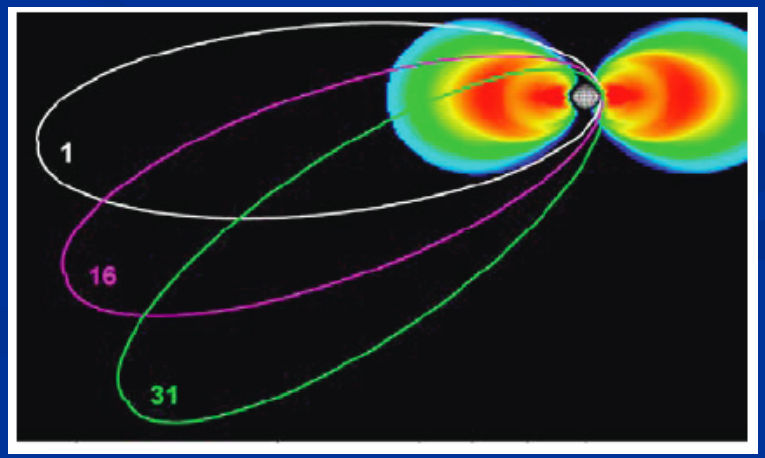




Opportunities for the Future

- **NASA Science Mission Directorate chartered four outer planet flagship mission studies**
  - **-- Establish Goals, Objectives, Investigations and Measurements to drive a coherent outer planets exporations**
  - **-- Science targets of high priority**
    - **- *Europa*, Oceans, Organics & Habitability**
    - **- *Jupiter System*, Comprehensive study of the system; probing the foundations of planetary systems**
    - **- *Titan*, Exploration of the surface & atmosphere of a earth-like world**
    - **- *Enceladus*, a unique world of cryovolcanic activity**

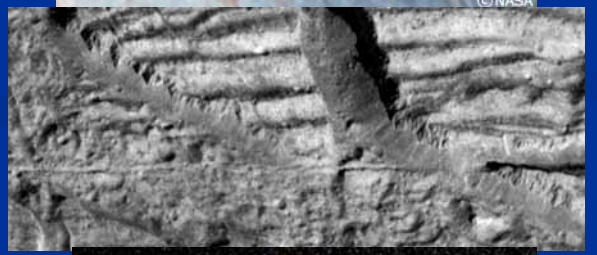
Europa Explorer

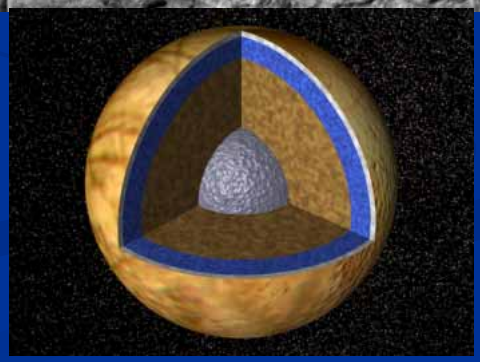
- **Highest Priority Flagship class mission identified by the Decadal Survey**

Goal: Explore Europa and Investigate its habitability

- **Science Objectives:**

-Characterize the Ocean and Deep interior
-Characterize the Ice shell & any subsurface water and the nature of surface-ice-ocean exchange
-Determine global surface composition and chemistry especially as related to habitability
-Understand the formation of surface features including sites of recent or current activity and identify and characterize candidate sites for future in situ exploration
-Characterize the magnetic environment and moon-particle interactions
-Determine how the components of the Jovian system operate and interact, leading to potentially habitable environments in icy moons





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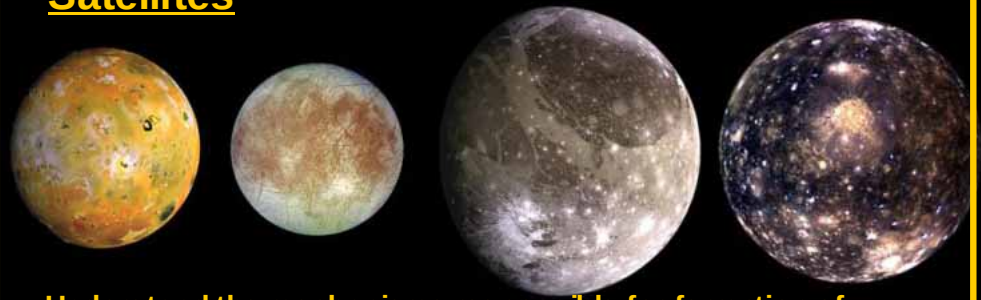
Jupiter System Observer

Satellites



-- Understand the mechanisms responsible for formation of surface features and implications for geological history, evolution, and levels of current activity

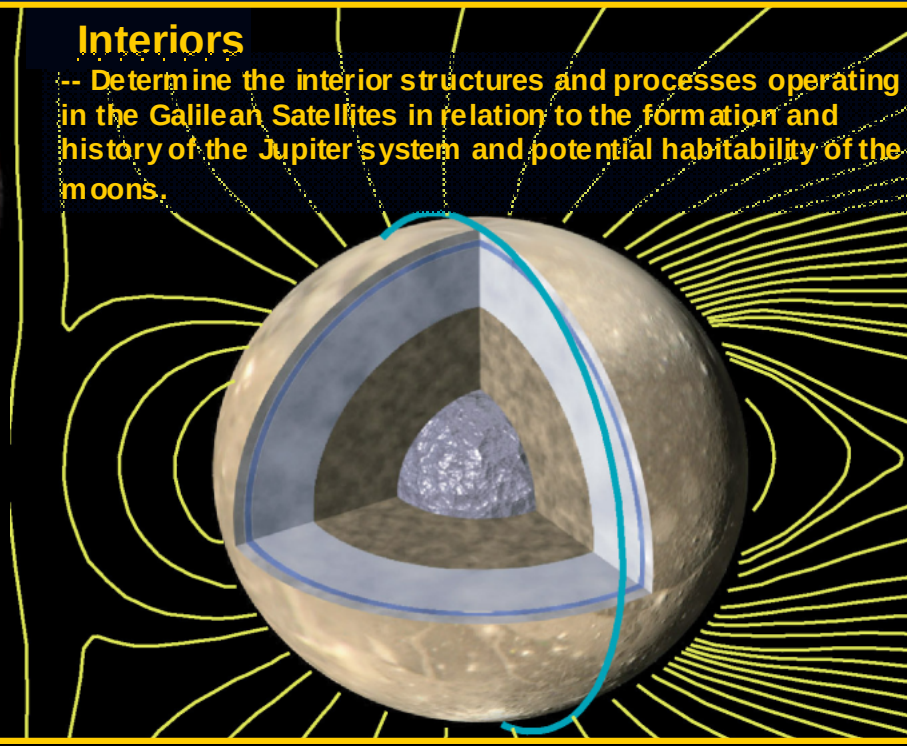
--Determine the surface compositions and implications for the origin, evolution and transport of surface materials

--Determine the compositions, origins, and evolution of the atmosphere, including transport of material throughout the Jovian system

--Determine how the components of the Jovian system operate & interact

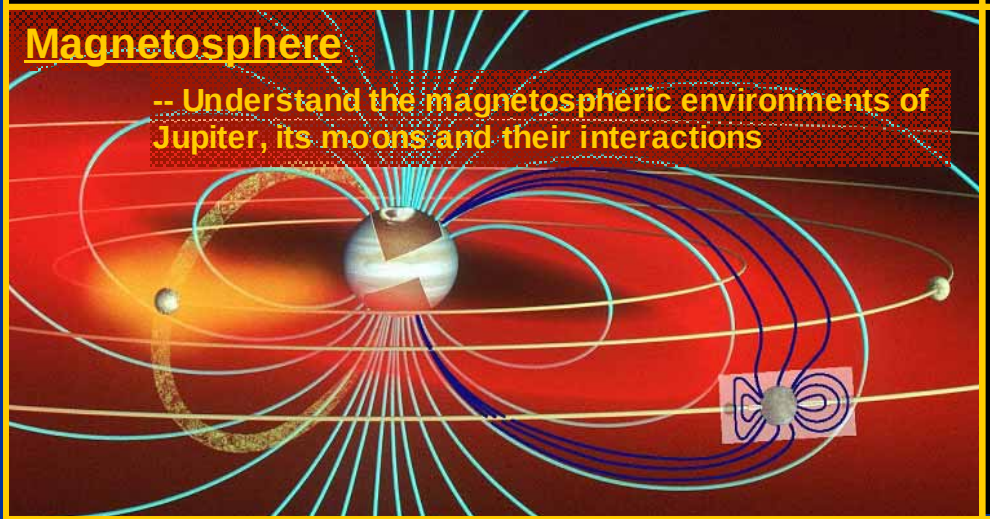
Interiors

-- Determine the interior structures and processes operating in the Galilean Satellites in relation to the formation and history of the Jupiter system and potential habitability of the moons.



Magnetosphere

-- Understand the magnetospheric environments of Jupiter, its moons and their interactions



Jupiter Atmosphere

-- Understand the processes that maintain the composition, structure and dynamics of the Jovian atmosphere as a type example of a gas giant planet

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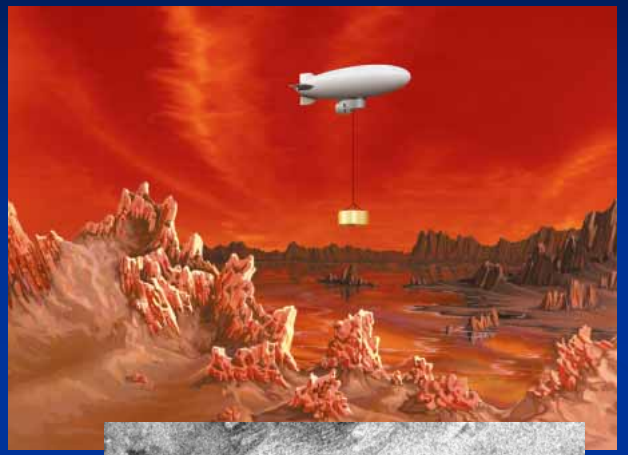
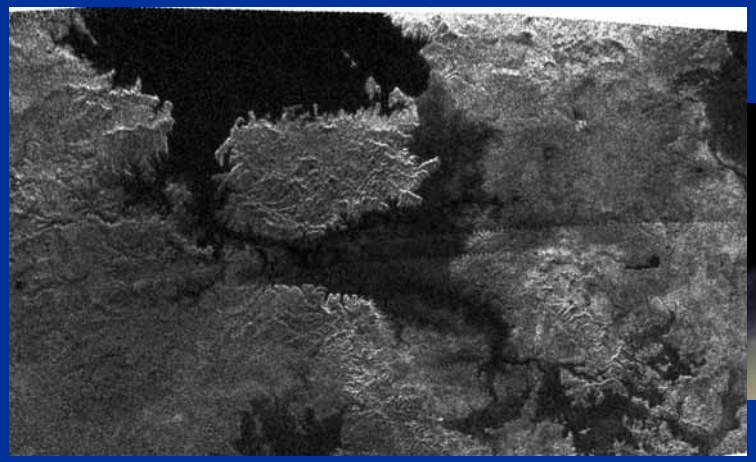
Titan Explorer

Exploration using orbiter, aerial platform and lander

Science Objectives:

-Titans origin and Evolution (Origininal composition of surface rocks & ices)
-Titan as a system (geology, hydrology, atmospheric science)
-Organics and Life's Origins (Titans complex organic chemistry)





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Enceladus Explorer

- A Unique cryovolcanically active world

- Science Questions:

-Understand the source of tidal heating
-What is the internal structure?
-What is the composition of the interior?
-What drives the extensive tectonic activity?
-Why does the intensity of tectonic activity vary so widely across the surface?
-Cryovolcanism:
  -What is the nature of the plume source?
  -What are the resurfacing rates?
  -What are the escape rates?
-Understand Surface Processes
-What is the Biological potential