NASA UPDATES AND MORE

NASA after the Space Shuttle

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END OF THE SPACE SHUTTLE ERA…

THE SPACE SHUTTLE

- 135 missions from 1981 – 2011
- “Reusable” design
- 5 orbiters
  - Enterprise (prototype)
  - Columbia (1981) – 28 missions
  - Challenger (1983) – 10 missions
  - Discovery (1984) – 39 missions
  - Atlantis (1985) – 33 missions
  - Endeavor (1992) – 25 missions

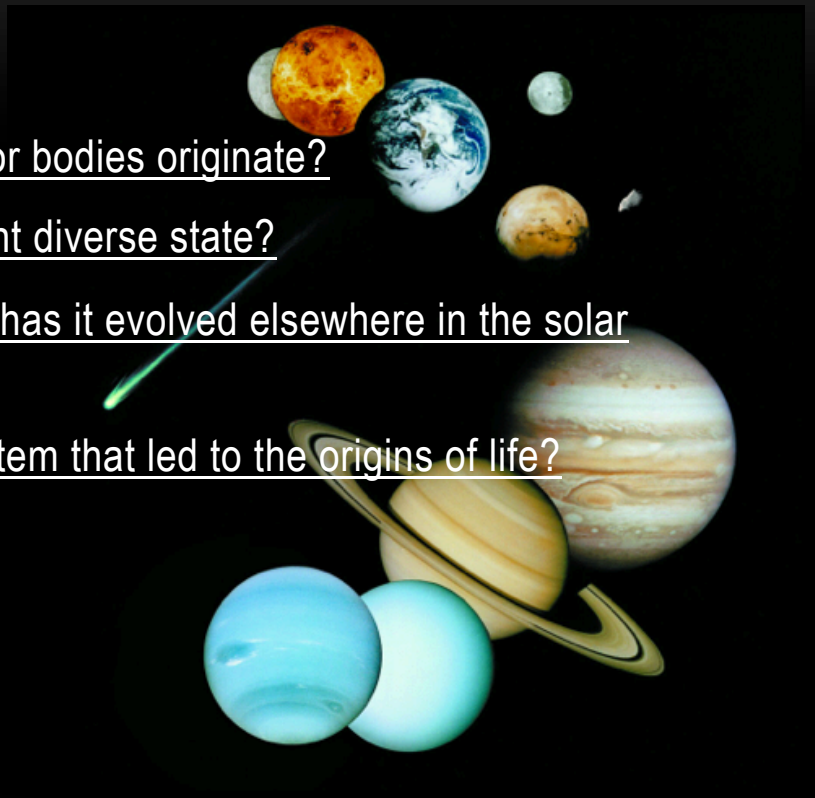
NASA – AREAS OF ONGOING RESEARCH

THE BIG QUESTIONS - 1

- Earth:
  - How is the global earth system changing?
  - How will the Earth system change in the future?
- Heliophysics:
  - What causes the sun to vary?
  - How do the Earth and heliosphere respond?
  - What are the impacts on humanity?

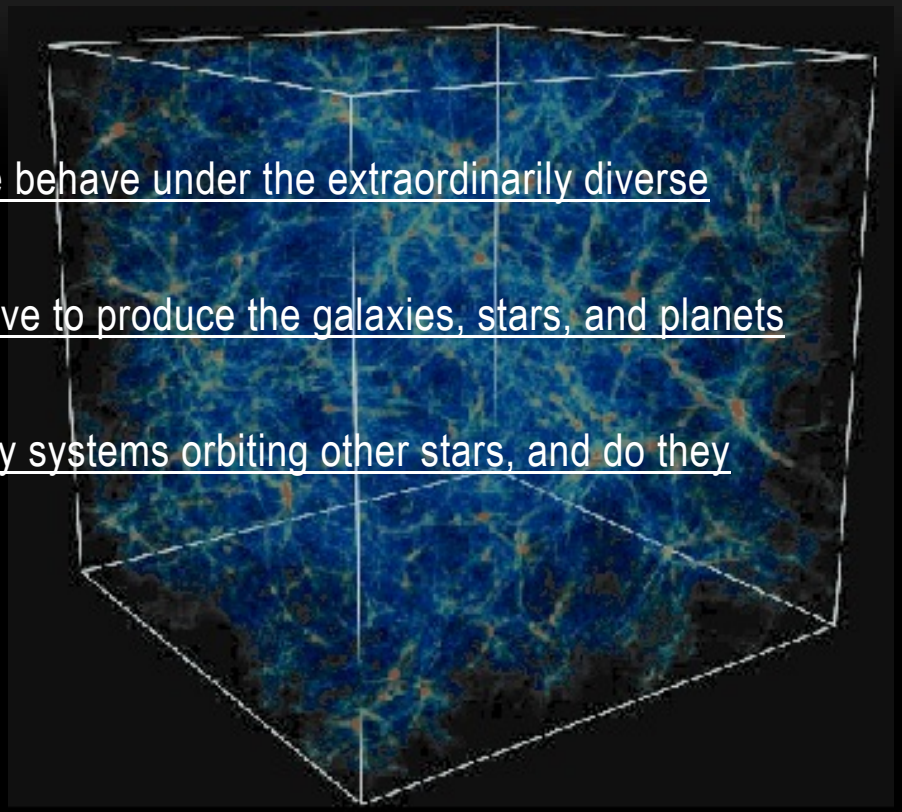
THE BIG QUESTIONS - 2

- Planets:
  - How did the sun's family of planets and minor bodies originate?
  - How did the solar system evolve to its current diverse state?
  - How did life begin and evolve on Earth, and has it evolved elsewhere in the solar system?
  - What are the characteristics of the solar system that led to the origins of life?

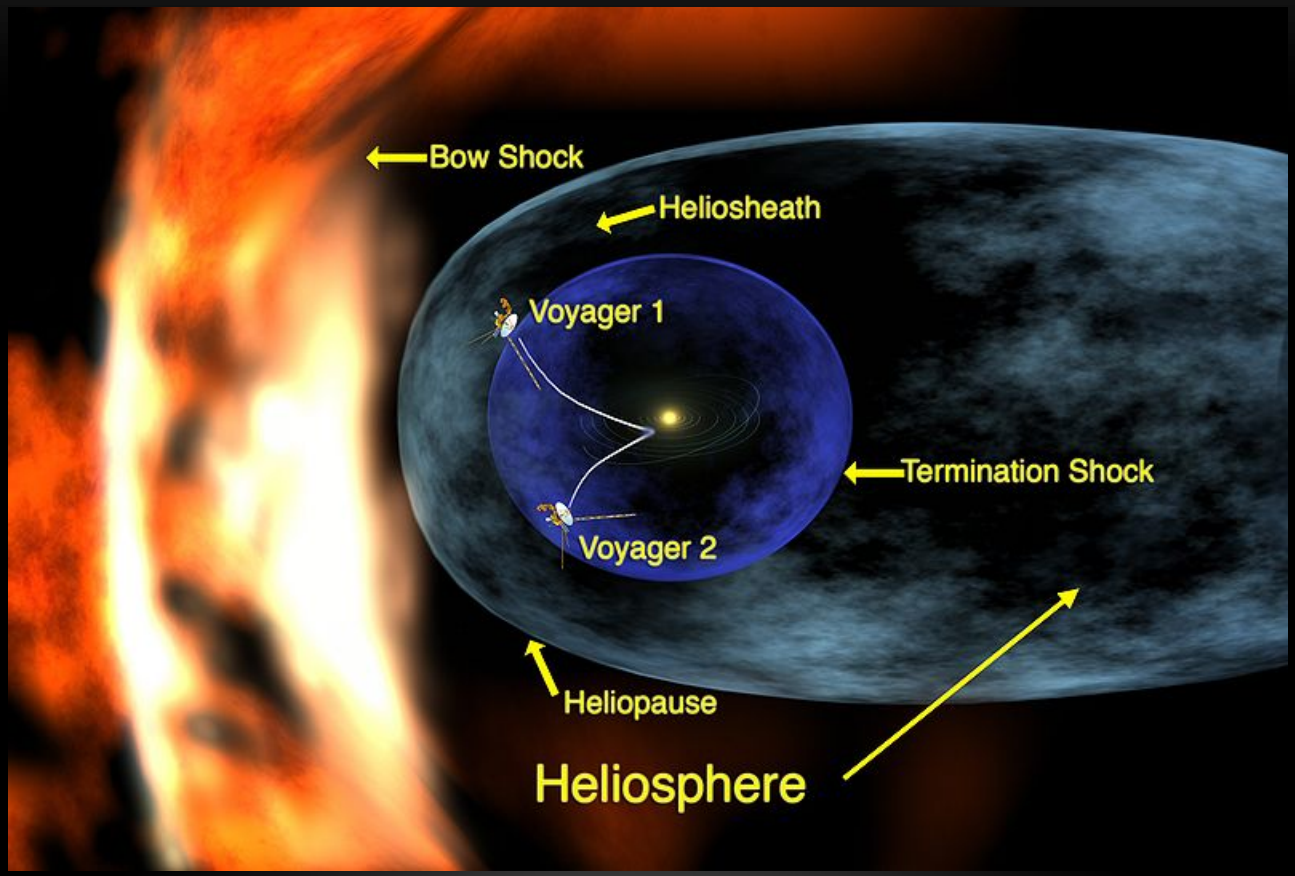


THE BIG QUESTIONS - 3

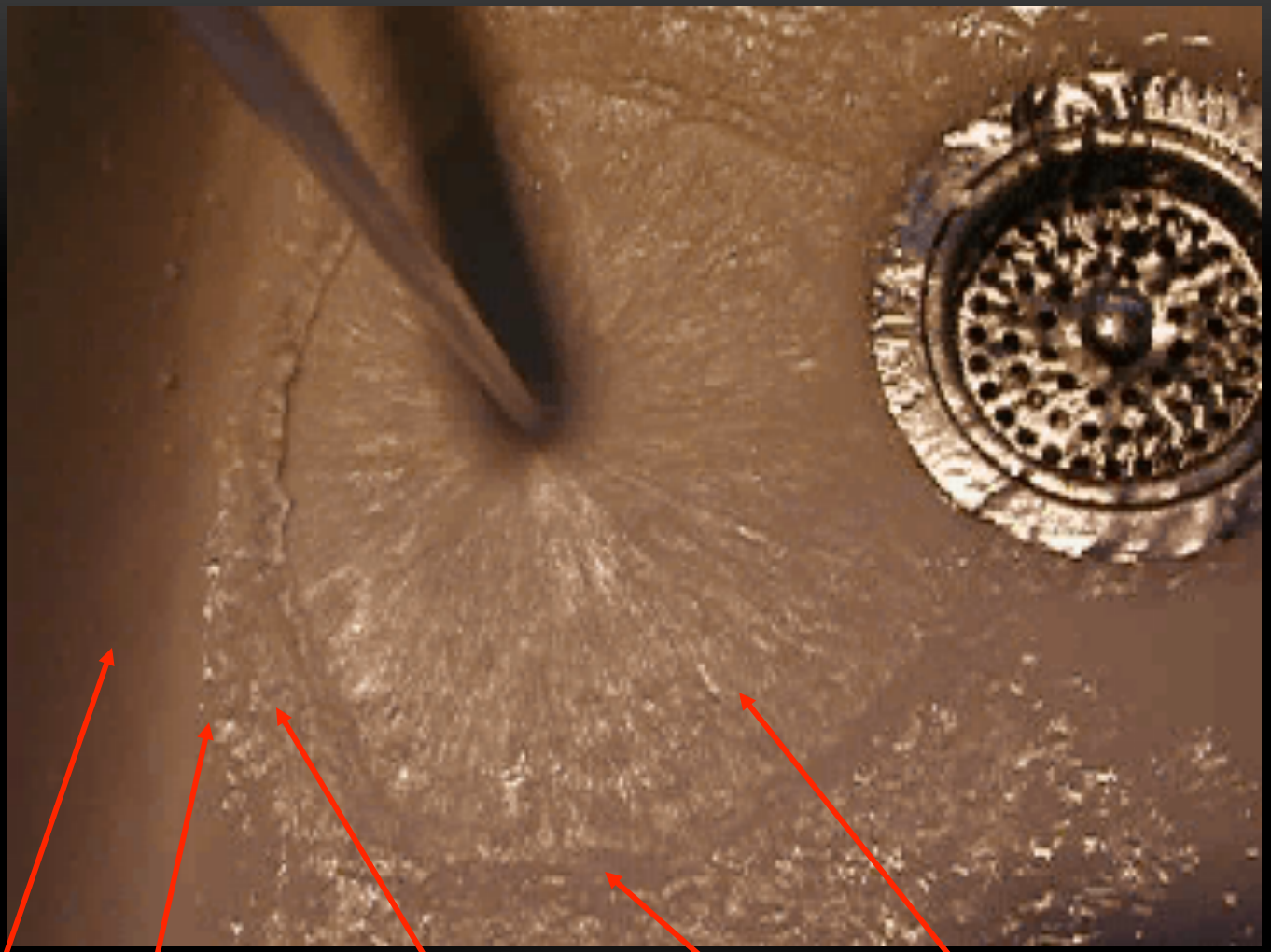
- Astrophysics:
  - How do matter, energy, space, and time behave under the extraordinarily diverse conditions of the cosmos?
  - How did the universe originate and evolve to produce the galaxies, stars, and planets we see today?
  - What are the characteristics of planetary systems orbiting other stars, and do they harbor life?



HELIOSPHERE



The Heliosphere in a Kitchen Sink



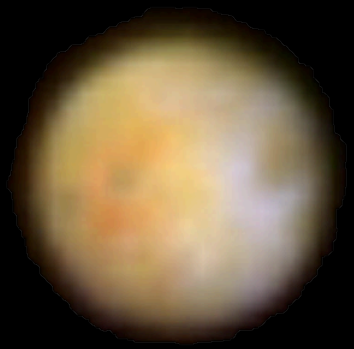
HELIOPHYSICS MISSIONS

- AIM – Ice composition in upper atmosphere.
- CINDI – Dynamics of the ionosphere
- SOHO – First Solar observatory
- Solar Dynamics Observatory – Latest observatory to monitor heliosphere.
- STEREO – Monitor and understand Coronal Mass Ejections
- THEMIS – Study Earth's magnetic field interaction with solar storms
- IBEX / Voyager – Explore the Boundaries of the Solar System.

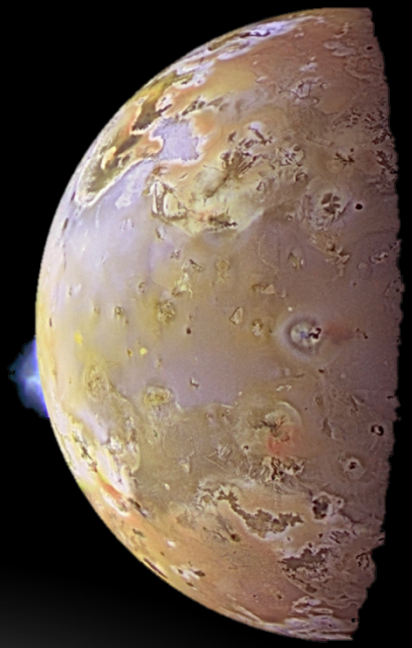
EXPLORING THE PLANETS

DO WE HAVE TO GO THERE?

View of Io from Hubble



View of Io from Galileo



EXPLORING THE PLANETS

- Types of Missions
  - Fly by – Voyagers, New Horizons
  - Orbiter – Galileo, Magellan, Cassini, MESSENGER, MRO, LRO, Dawn
  - Probe – Huygens, Galileo, Deep Impact
  - Lander – Viking, Phoenix
  - Rover – Pathfinder, Spirit/Opportunity, Curiosity
  - Sample Return - StarDust

EXPLORING THE PLANETS

	Sun	Mercury	Venus	EarthÕs moon	Mars	Asteroids	Comets	Jupiter	Jupiter 6 moons	Saturn	SaturnÕs moons	Uranus	Neptune	Pluto & Kuiper belt
Flyby	NA	o	o	o	o	o	o	o	o	o	o	o	o	>
Orbiter	o	>	o	o	o	o	>	o		o				
Probe			o	o			o	o			o			
Lander			o	o	o	o	>	NA		NA	o	NA	NA	
Rover				o	o									
Sample return	o			o		>	o							
Human				o										

o Done > En route **NA** Not applicable

CURRENT AND UPCOMING MISSIONS

- Lunar Reconnaissance Orbiter – launched June 18, 2009
- Grail Lunar Orbiters – launched September 8, 2011
- Mercury MESSENGER Orbiter – in orbit since March 2011
- Juno Orbiter to Jupiter – launched August 5, 2011
- Curiosity Rover (Mars Science Laboratory) – November 25, 2011

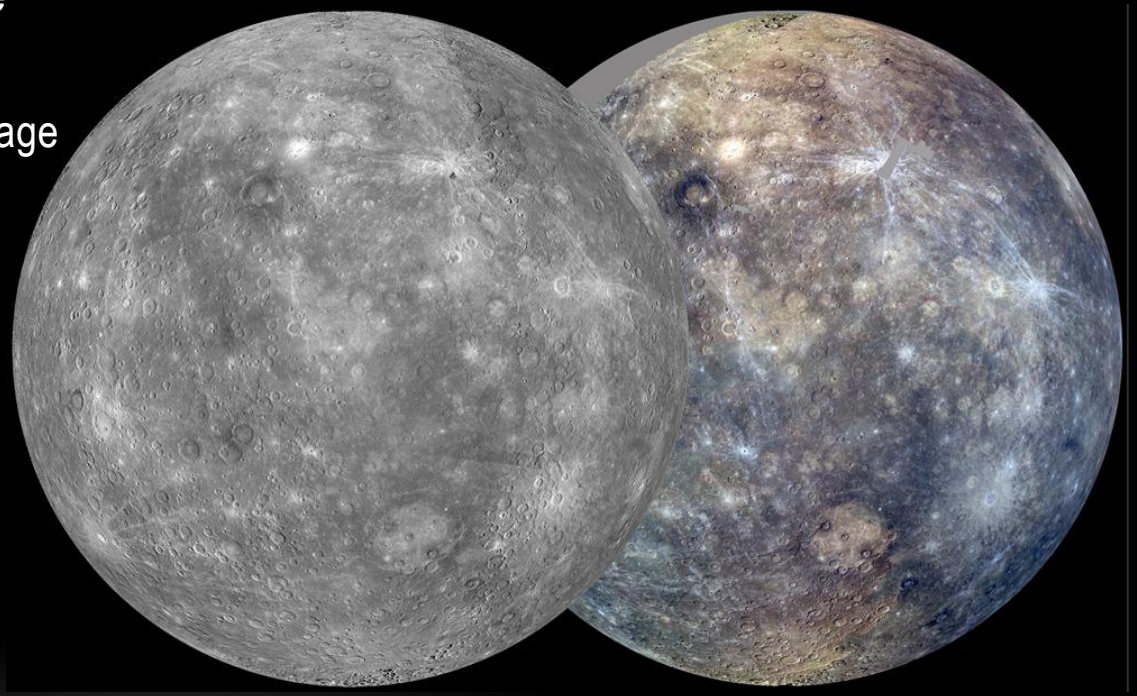
MANNED MISSIONS TO THE MOON

- Lunar Reconnaissance Orbiter
  - Launched 2009
  - Orbiting at 24 km.
- GRAIL
  - Twin orbiters to map Gravity
  - Launched Sept. 10, 2011

Apollo 12 landing site. Image by LRO

MESSENGER TO MERCURY

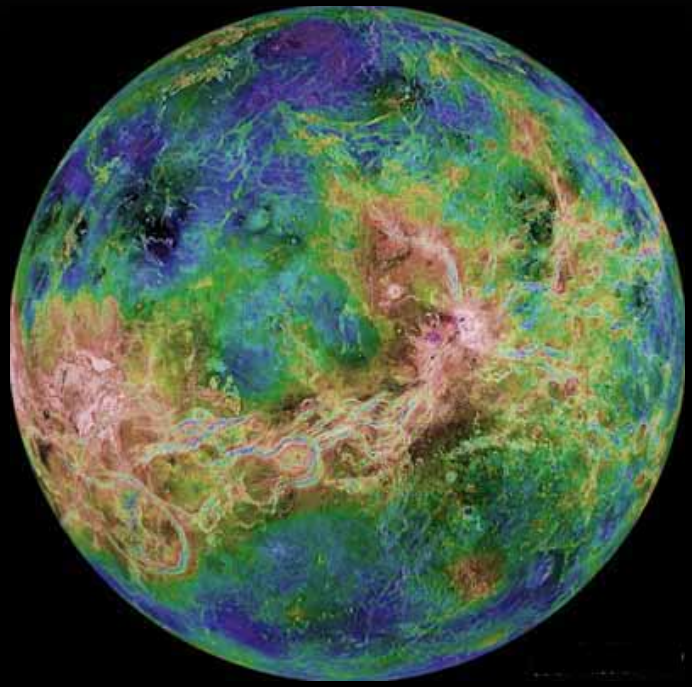
- In orbit around Mercury since March 2011
- Measuring magnetosphere, surface composition and environment.
- Recent image shows composite image from first Solar Day



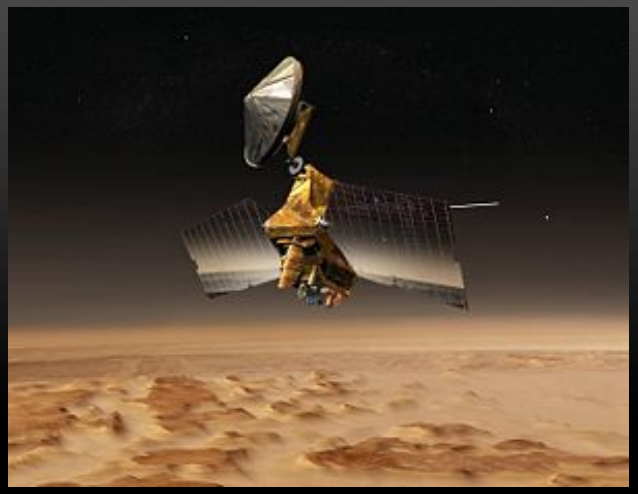
MESSENGER images

VENUS

- Magellan
- Launch: May 4, 1989
- This orbiter used imaging radar to map 99 percent of the surface of Venus over four years. After concluding its radar mapping, Magellan made global maps of Venus's gravity field. Flight controllers also tested a new maneuvering technique called aerobraking, which uses a planet's atmosphere to slow or steer a spacecraft.



MARS



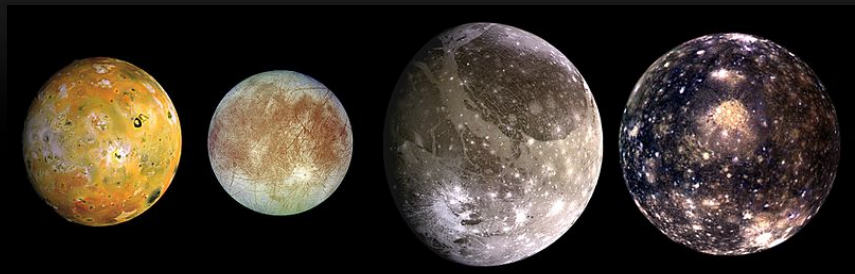
- Mars Reconnaissance Orbiter
- Launch: August 12, 2005
- NASA's Mars Reconnaissance Orbiter has the most powerful telescopic camera ever sent to another planet, plus five other scientific instruments.

- Phoenix
- Launch: August 4, 2007
- In the continuing pursuit of water on Mars, the poles are a good place to probe, as water ice is found there. This mission sent a high-latitude lander to Mars where it is using its robotic arm to dig trenches up to half a meter (1.6 feet) into layers of soil and water ice.

- Curiosity Rover will launch in November 2011.

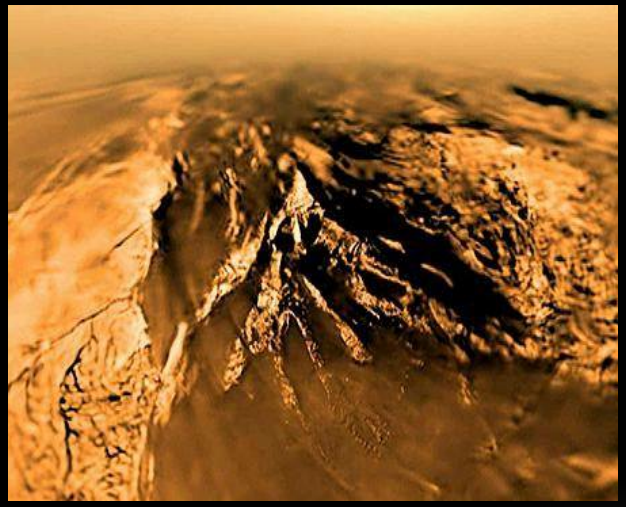
JUPITER

- Galileo orbited from 1989 – 2003
- Juno – launched August 5, 2011
  - Arrival at Jupiter in July 2016.
  - To study Jupiter's origins and interior
  - Orbit to avoid intense radiation belts.



SATURN

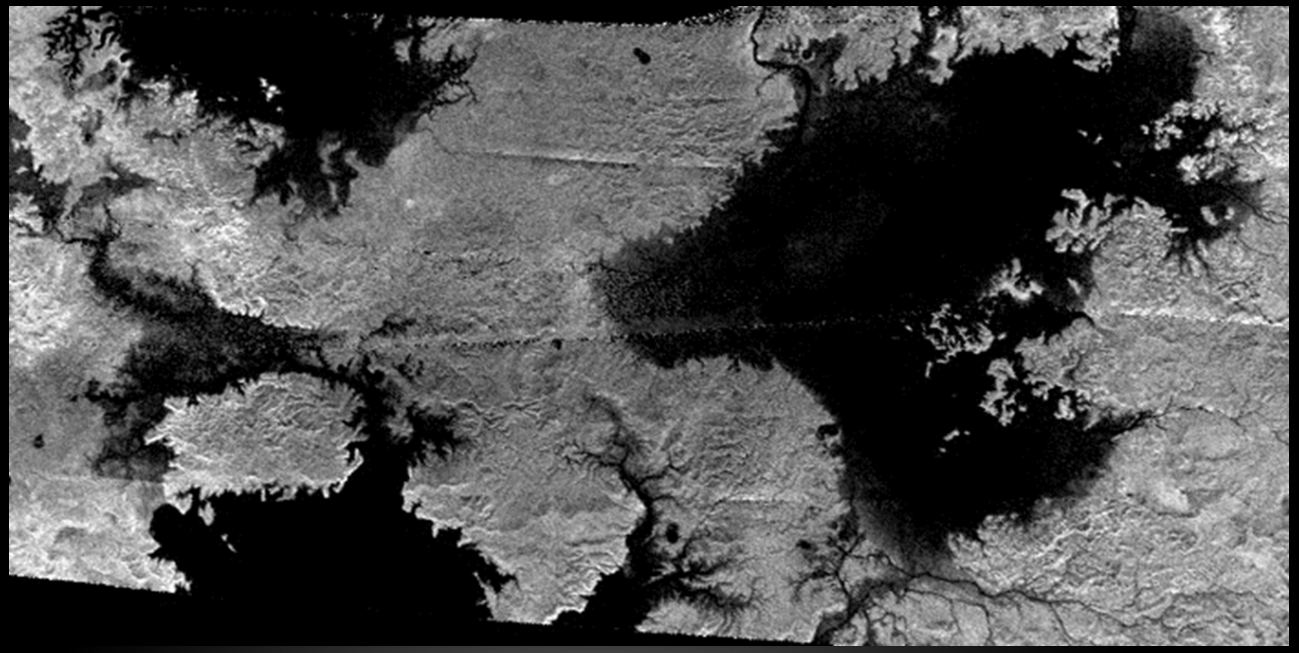
- Cassini launched October 1997.
- Arrived at Saturn in July 2004.
- Huygens probe lands on Titan in 2005.



Saturn storm imaged by Cassini in 2010

TITAN

- Titan found to have liquid methane which forms lakes and seas.
- Methane weather cycle confirmed



PLUTO

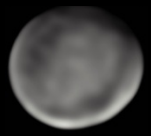
- New Horizon mission launched in 2005
- Arrival at Pluto: July 14, 2015
- Launched directly in solar system escape trajectory!

ASTEROIDS

- Dawn Spacecraft
  - Ion Propulsion
  - Orbiting Vesta until 2012
  - Travelling on to Ceres

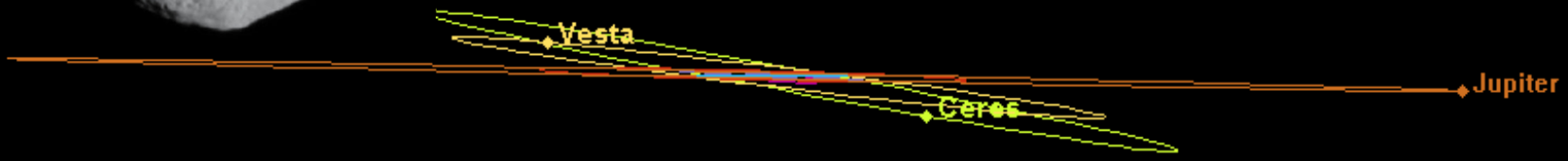
Vesta

Earth's moon

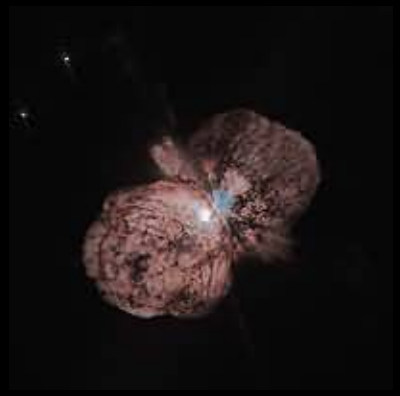


Ceres

California



HUBBLE SPACE TELESCOPE



SPACE EXPLORATION
TELESCOPES IN SPACE

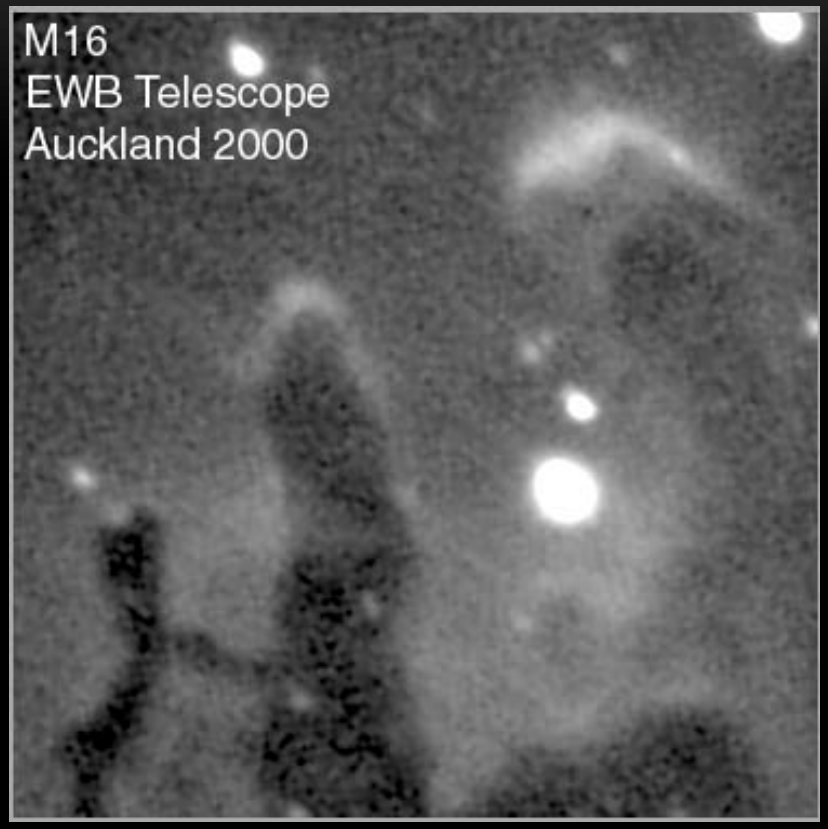


PHOTO FROM
AUCKLAND OBSERVATORY
IN NEW ZEALAND

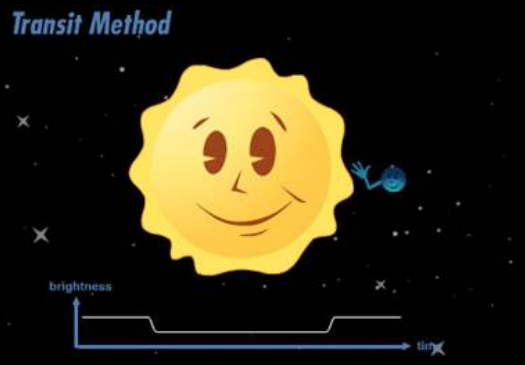
Photo from
Hubble Space Telescope

SENSING THE UNIVERSE - MISSIONS

- Compton - Great Gamma-ray Observatory – 1991 - 2000
- Chandra – Great X-Ray Observatory – 1999
- Fermi – Latest Gamma-ray observatory - 2008
- GALEX – Origin and evolution of Galaxies - 2003
- Herschel – far infrared telescope - 2009
- Hubble Space Telescope – Great Optical Observatory – 1990 (+ 4 service missions)
- Kepler – Looking for nearby planets – 2009
- Planke – Cosmic Background Radiation observatory – 2009
- Spitzer – Great Infrared Observatory – 2003
- SWIFT – Gamma-ray burst explorer - 2004

LOOKING FOR OTHER EARTHS

- Kepler - Launched March 6, 2009 to look for stars with planets.
- Stare at stars and follow the light curves.
- Over 1500 candidates found to date.



Twin City Amateur Astronomers

Sharing our love of astronomy for over 50 years!

http://tcaa.us

Sugar Grove Observatory

Ground floor – storage and resting accommodations

Second floor – observing deck

Third floor – telescope dome

OUR TELESCOPE AND CAMERA SYSTEMS

MESSIER 101 AND SUPERNOVA, MAY/AUG

NORTH AMERICAN NEBULA, AUGUST 3

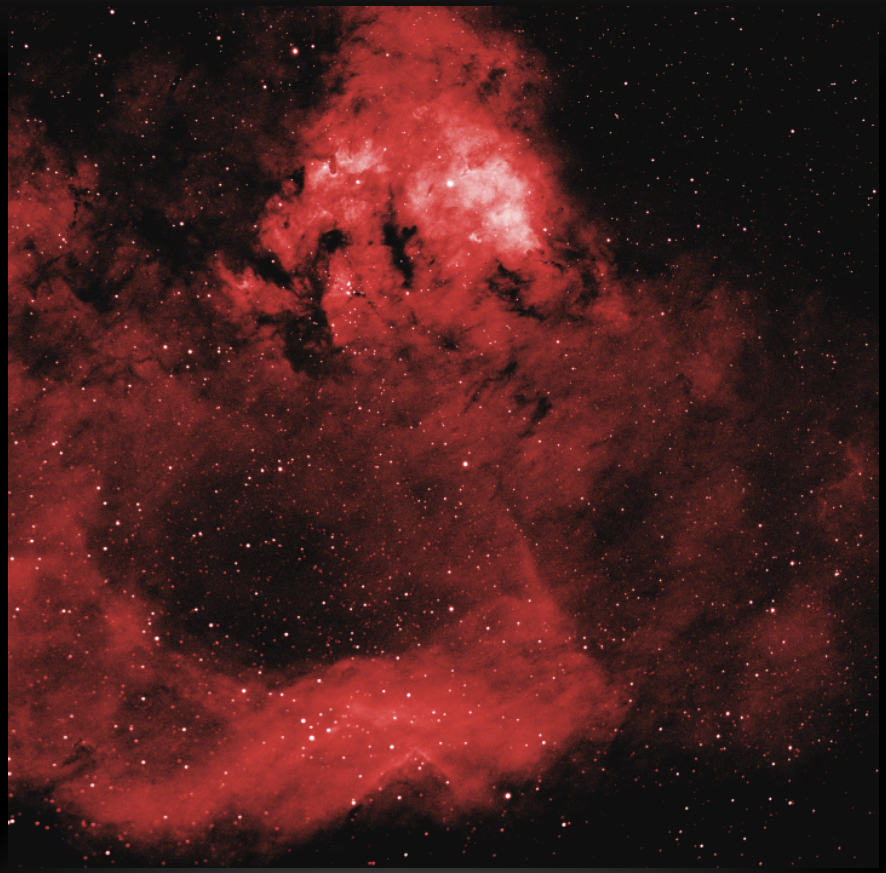
WIZARD NEBULA, AUGUST 17

COMET GARRADD AND MESSIER 71, AUGUST 27

PACMAN NEBULA, AUGUST 27-31

TULIP NEBULA, SEPTEMBER 2

SHARPLESS 171, SEPTEMBER 14



M31 – ANDROMEDA GALAXY, OCTOBER 2

M33 – TRIANGULUM GALAXY, OCTOBER 2