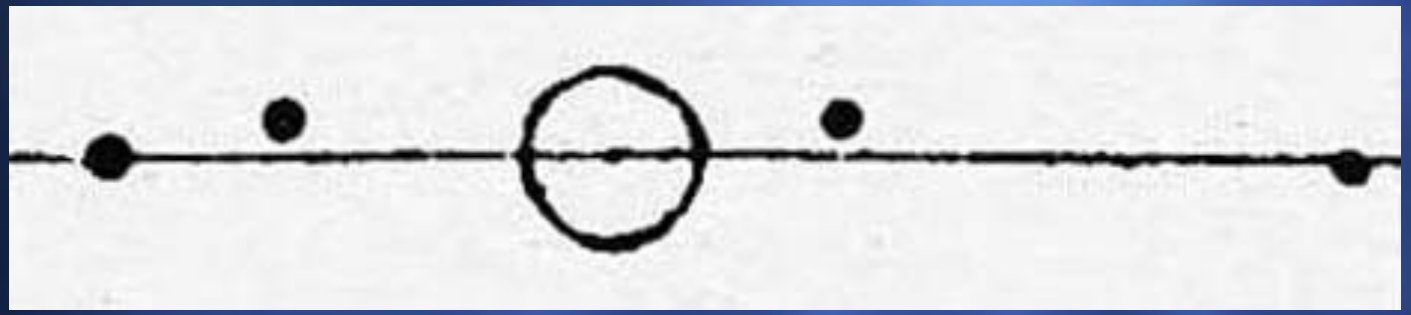
Welcome
to
The Challenge of Discovery
Presented by NASA's Discovery and New Frontiers Programs
April 6, 2013

# Galileo and His Telescope

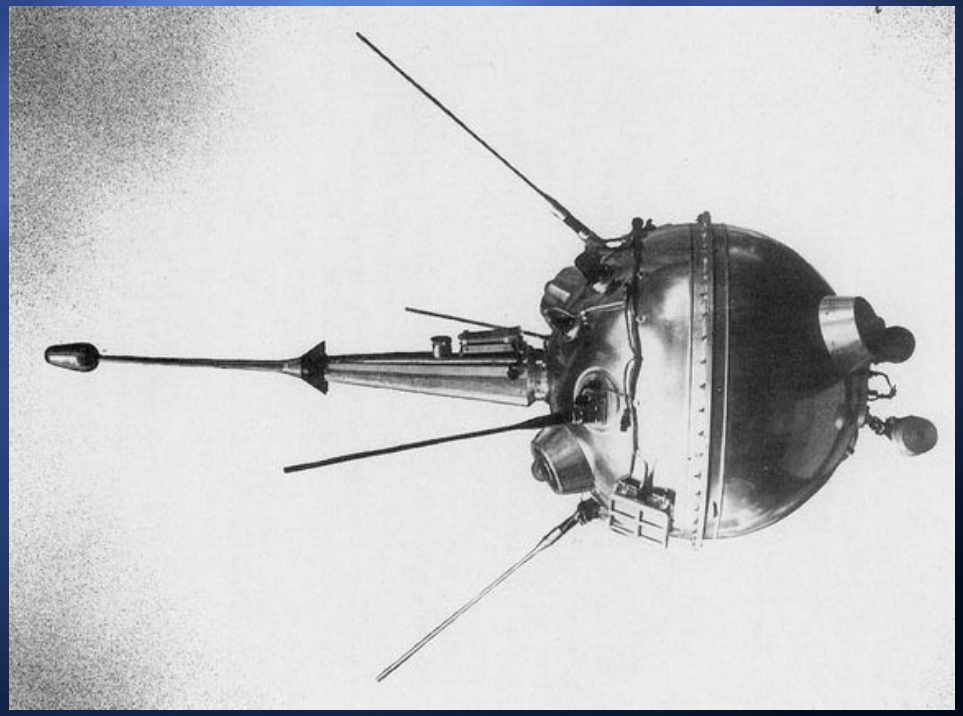
# Galileo Discovers Jupiter Moons



*Changes History!*

# *Fast Forward 400 Years*

- New and better telescopes
- Discoveries of planets and moons, asteroids and comets, but from very far away
- First spacecraft to reach another celestial object, Luna 2 impacted the Moon in 1959



# *1962 – Planetary Exploration Begins*

NASA Goes to Venus!

Mariner 2, the first successful interplanetary flyby

1965 – Mariner 4 flyby of Mars

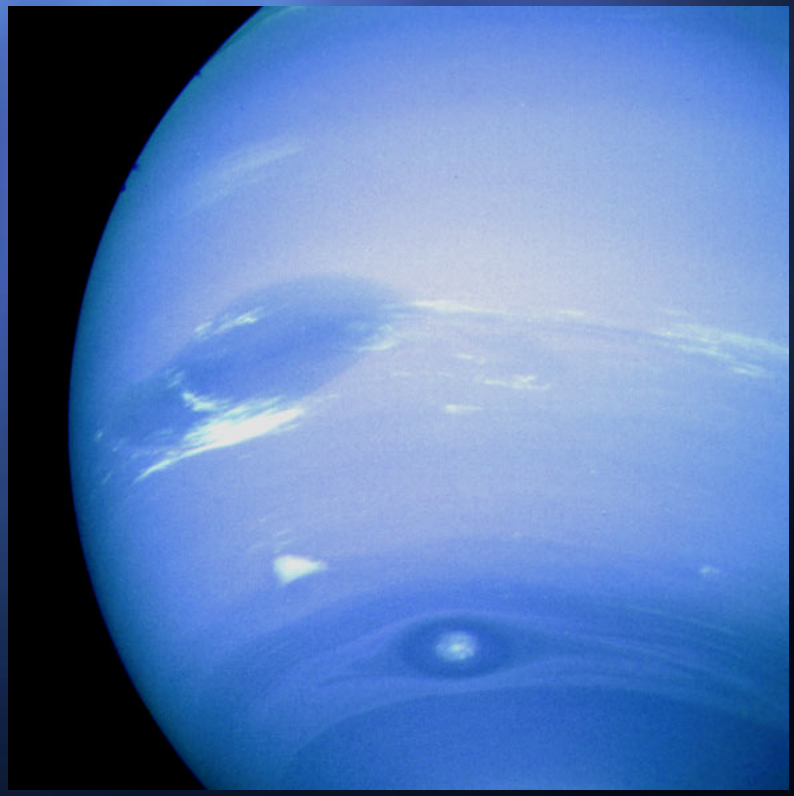
1973 – Pioneer 10 flies by Jupiter

1974 – Mariner 10 to Mercury

1979 – Pioneer 11 to Saturn

1986 – Voyager 2 to Uranus

1989 – Voyager 2 to Neptune



# *Magnificent Moon Montage*

Io, Europa, Ganymede and Callisto

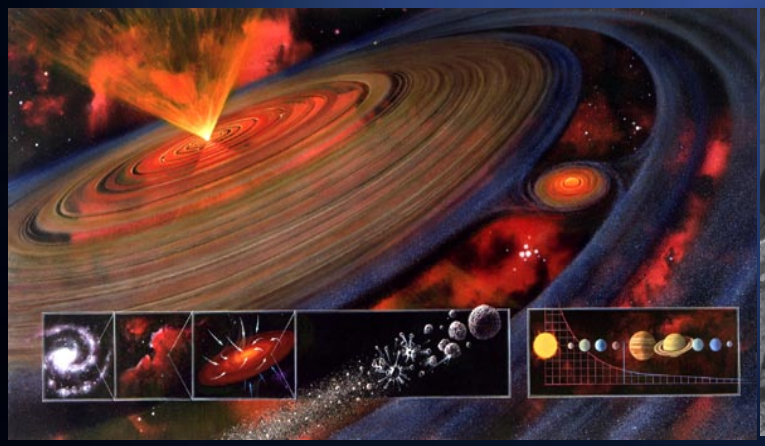
Credit: NASA/JPL

# *Planetary Science – It's About the Questions*

Where do we come from?

Where are we going?

Are we alone?



# *NASA's Discovery and New Frontiers Programs*

- Lower-cost planetary science missions searching for answers
- Revolutionizing perceptions and challenging long-held theories with amazing new images, data and samples

- Proposed by a "Principal Investigator" along with a large team of scientists and engineers
- People with lots of questions, on a quest for new knowledge

"To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science."

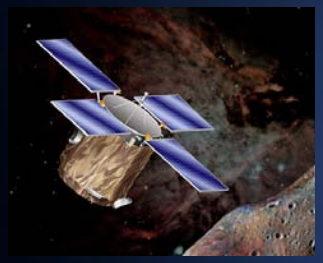
Albert Einstein

# *Opportunities to Participate*

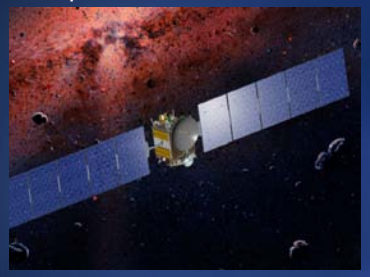
- Each mission requires hundreds of people to formulate the sciences questions, build the machines, design the flight path, develop the software, program the computers, create graphics and animations, and get the mission launched into space

# Discovery Missions

**NEAR**
***Asteroid Orbiter***
Investigate Eros

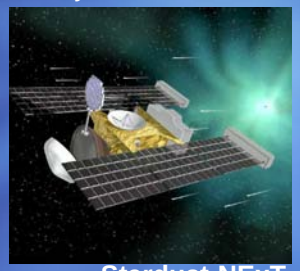


**Dawn**
***Asteroid Orbiter***
Compare Vesta and Ceres



**CONTOUR**
***Comet Flyby***
Compare two comets

**Stardust**
***Comet Sample Return***
Analyze comet dust



**Deep Impact**
***Comet Flyby/Impactor***
Probe under the surface

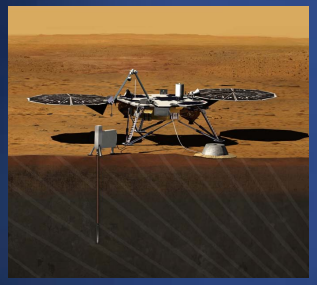
**Kepler**
***Orbiter***
Search for exoplanets

**Stardust-NExT**
***Comet Flyby***

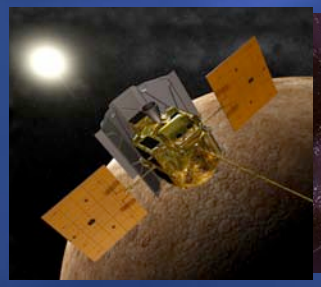
**EPOXI**
***Comet Flyby***

**Mars Pathfinder**
***Lander/Rover***
Study the Martian surface

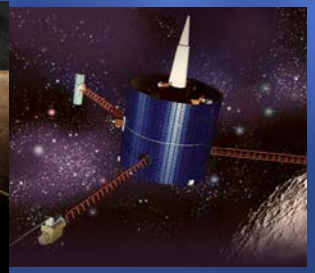
**InSight**
***Lander***
Dig below Mars' surface



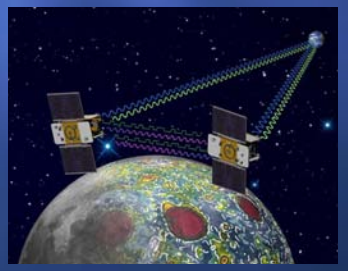
**MESSENGER**
***Orbiter***
Survey Mercury



**Lunar Prospector**
***Orbiter***
Examine the Moon



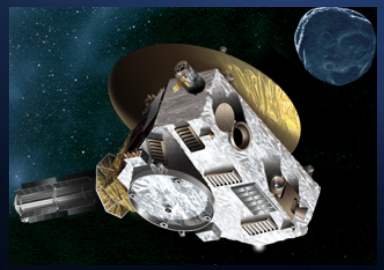
**GRAIL**
***Orbiter***
Measure lunar gravity



**Genesis**
***Orbiter/Sample return***
Collect solar wind

# New Frontiers Missions

**New Horizons**
***Flyby***
Study the Pluto and Kuiper Belt Objects



**Juno**
***Orbiter***
Investigate Jupiter

**OSIRIS-REx**
***Asteroid Sample Return***
Explore 1999 RQ36

# *Breakthrough Science By People in Shower Caps*

GRAIL spacecraft assembly at Kennedy Space Center

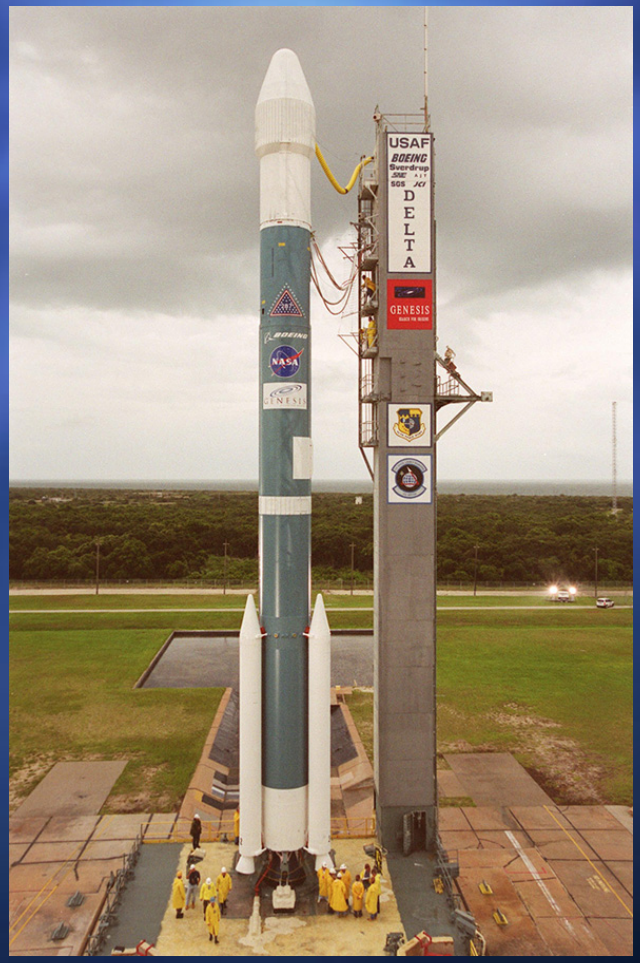
Deep Impact Instrument Team

MESSENGER Vibration Testing

New Horizons before and after encapsulation within the fairing sections at the Kennedy Space Center Payload Hazardous Servicing Facility.

# NASA's First Sample Return Missions Since Apollo Brought Back Moon Rocks

Stardust
Collected and Returned
Dust from Comet Wild 2




Genesis
Captured and Returned
Ions of Solar Wind

Genesis during assembly

Genesis fragments
after return
to Earth

Closing the Lid
on Stardust

Stardust Ground Recovery Team at the Utah Test and Training Range

Stardust sample return capsule in a temporary cleanroom in Utah.

Stardust “V” for Victory

First View of Comet Dust in the Aerogel Collectors

# *Measuring the Moon's Gravity*

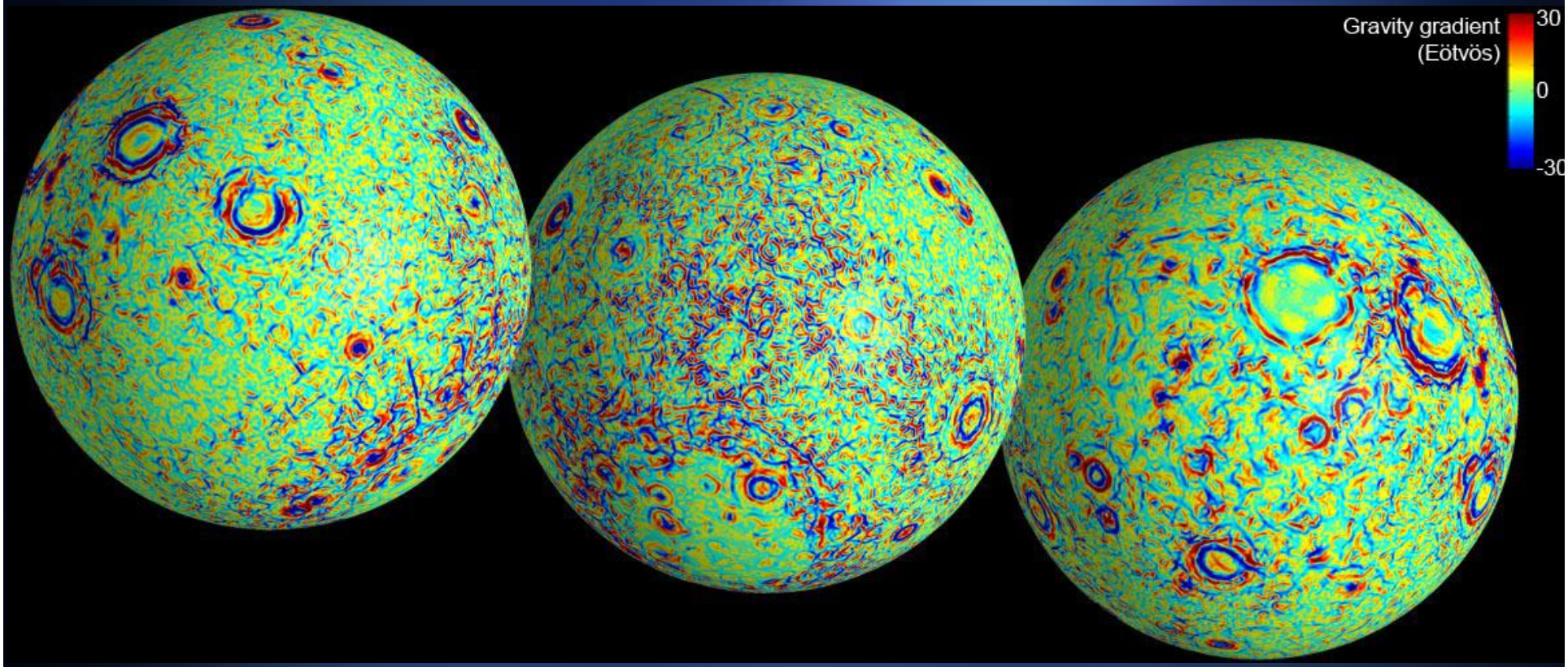
## GRAIL

- Twin spacecraft - Ebb and Flow - generated the highest-resolution gravity field map of any celestial body
- Provide a better understanding of how Earth and other rocky planets in the solar system formed and evolved
- Both probes were directed into the lunar surface in December 2012

GRAIL Twins Being Prepared to Ship to Kennedy Space Center

NASA Deputy Administrator Lori Garver (left) tours Astrotech's payload processing facility in Titusville, Florida, as GRAIL is prepared for launch.

Fourth-graders at Emily Dickinson Elementary School in Bozeman, Montana, submitted the winning names, Ebb and Flow.




Maps of the Moon's near and far side show gravity gradients measured by GRAIL.

Red and blue areas indicate stronger gradients due to underlying mass anomalies.

# *InSight into Mars Quakes!*

*Interior Exploration using Seismic Investigations, Geodesy and Heat Transport*

- Will place a geophysical lander on Mars to study its deep interior
- **InSight** into the processes that shaped the formation of the rocky planets of the inner solar system
- Launch March 2016
- Arrival at Mars 6 months later
- Two years of science operations

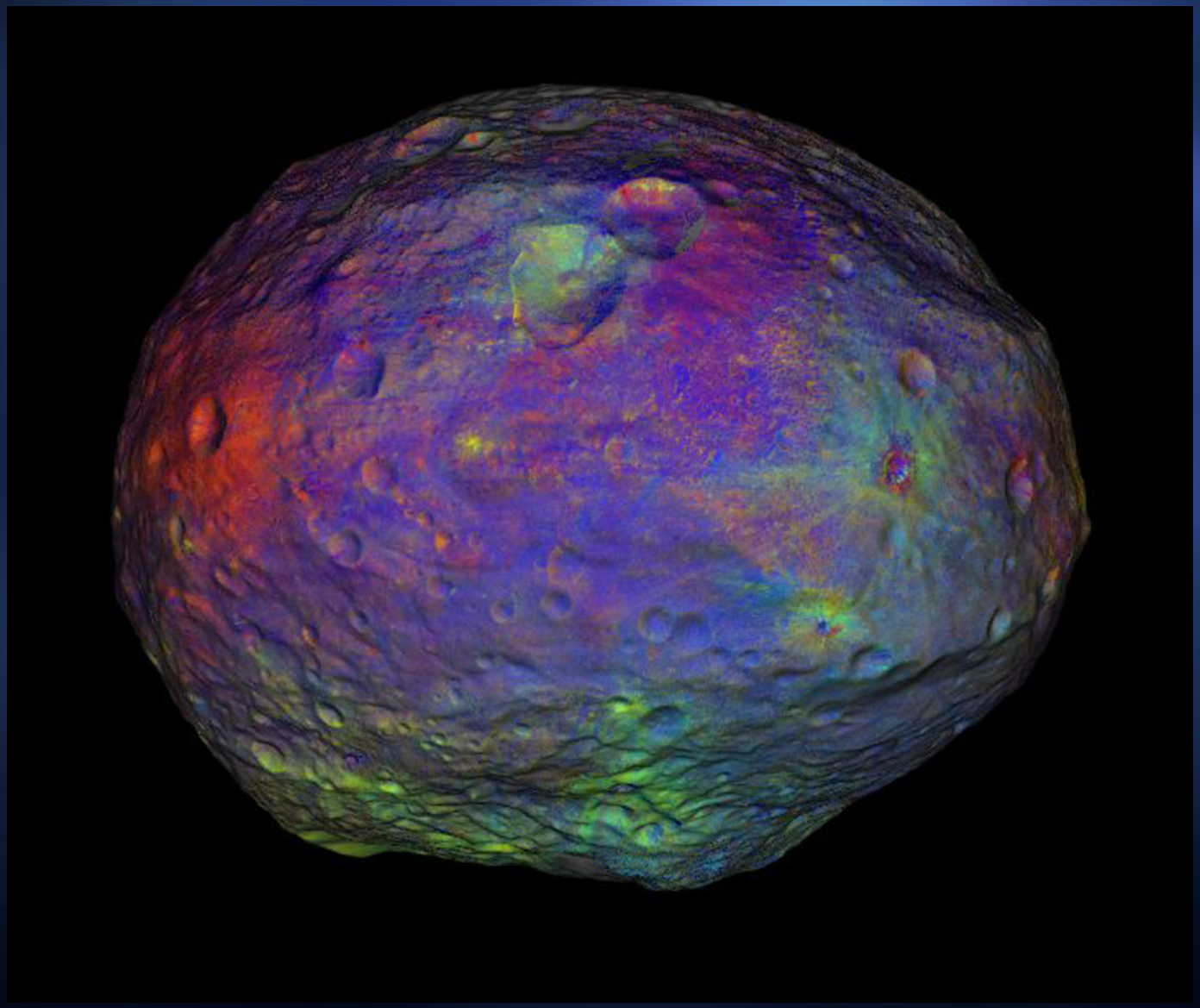
# Comparing Asteroids

## Dawn

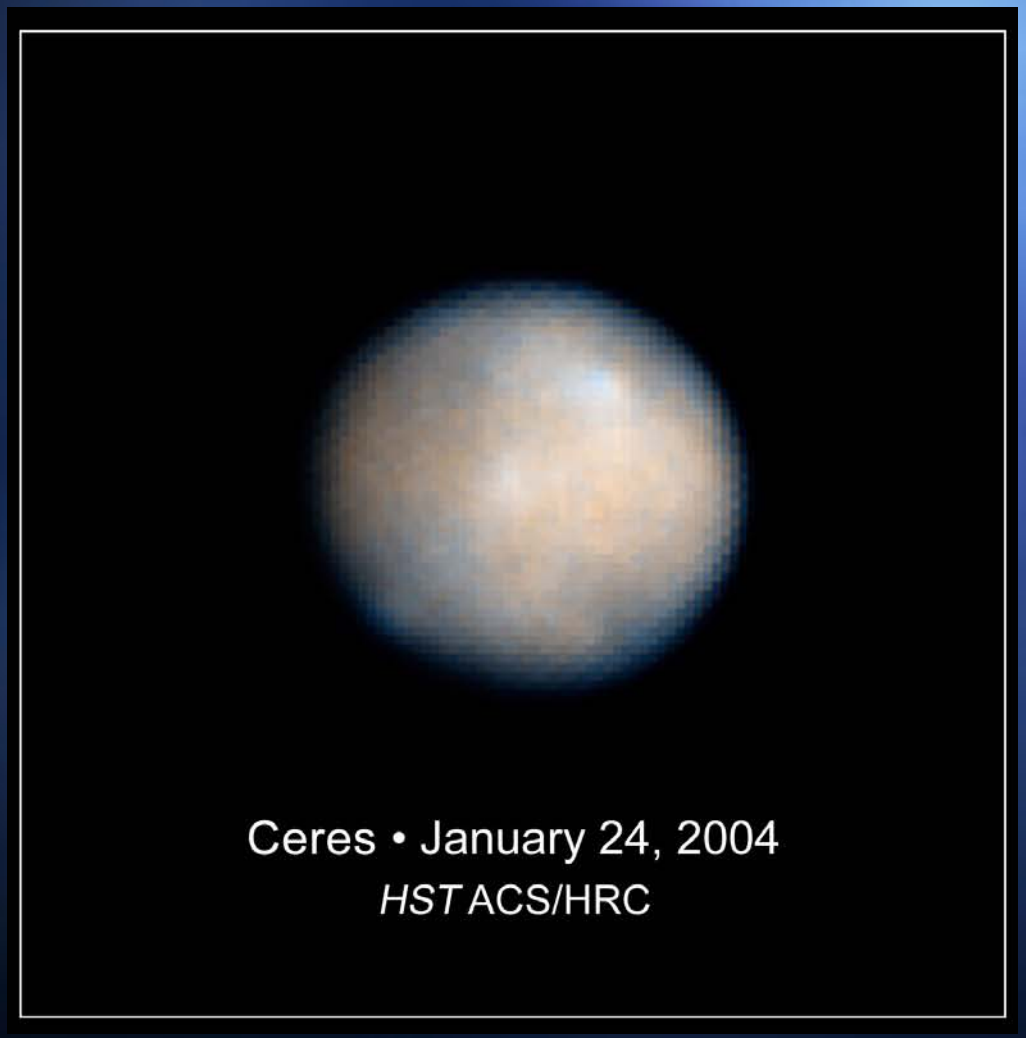
Orbited Vesta for 12 months, now onward to Ceres for a close-up comparison of these two very large and very different asteroid belt objects

# *Hubble Space Telescope*
# *Best View of Vesta*

# Vesta from Dawn - 2012



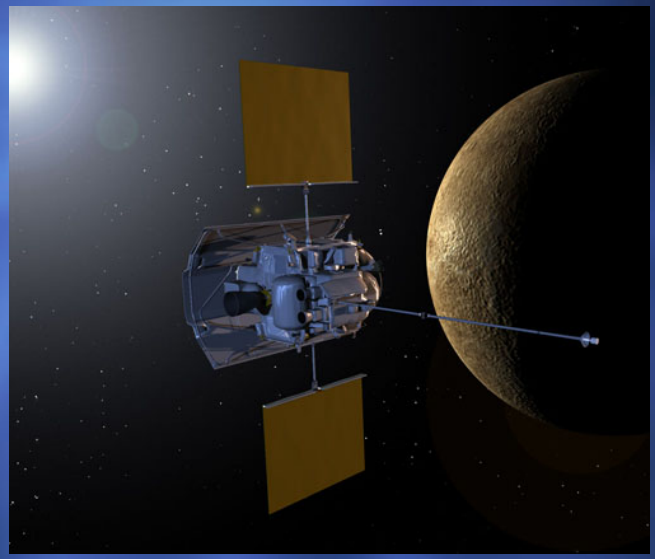
# *Hubble Space Telescope Best View of Ceres*

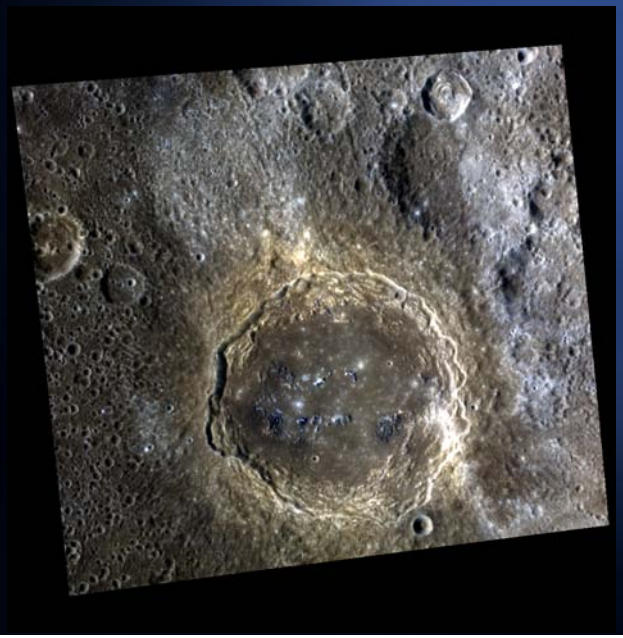


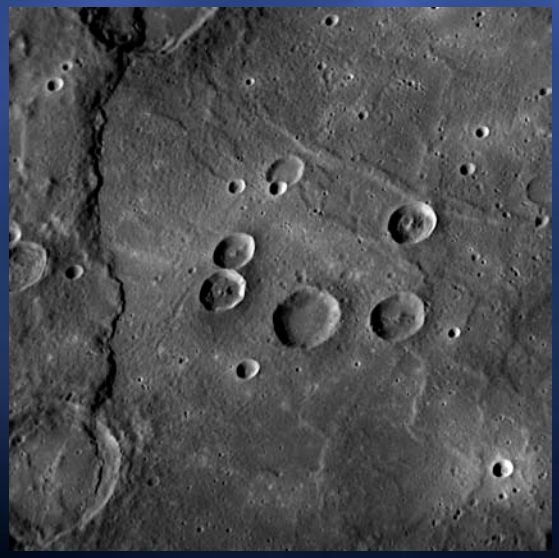
# *Mercury Revealed!*

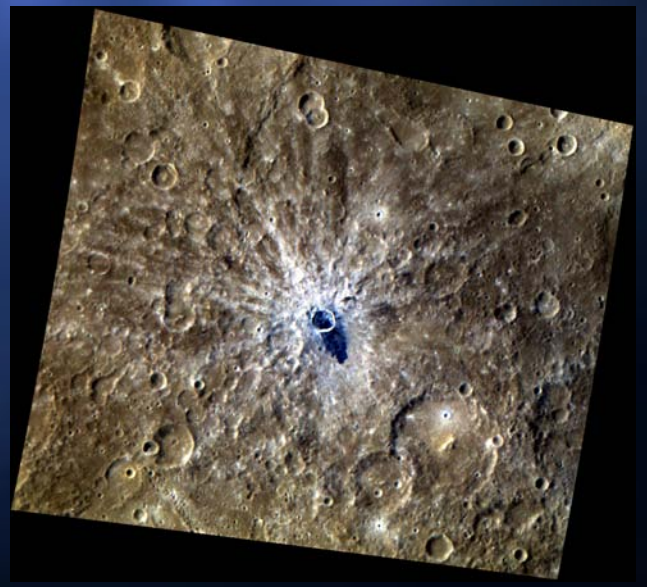
**MESSENGER**

First spacecraft to orbit the planet closest to the Sun, beginning in March 2011. Continues to return fantastic close-up images that are generating new questions,









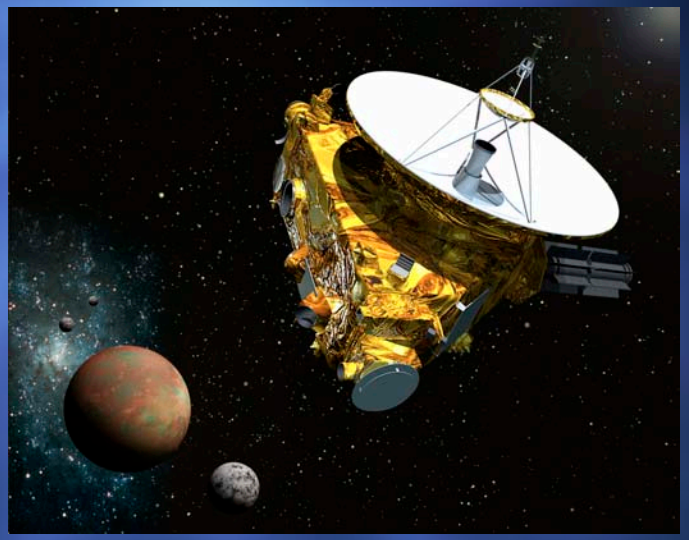
# MESSENGER Sun Shade

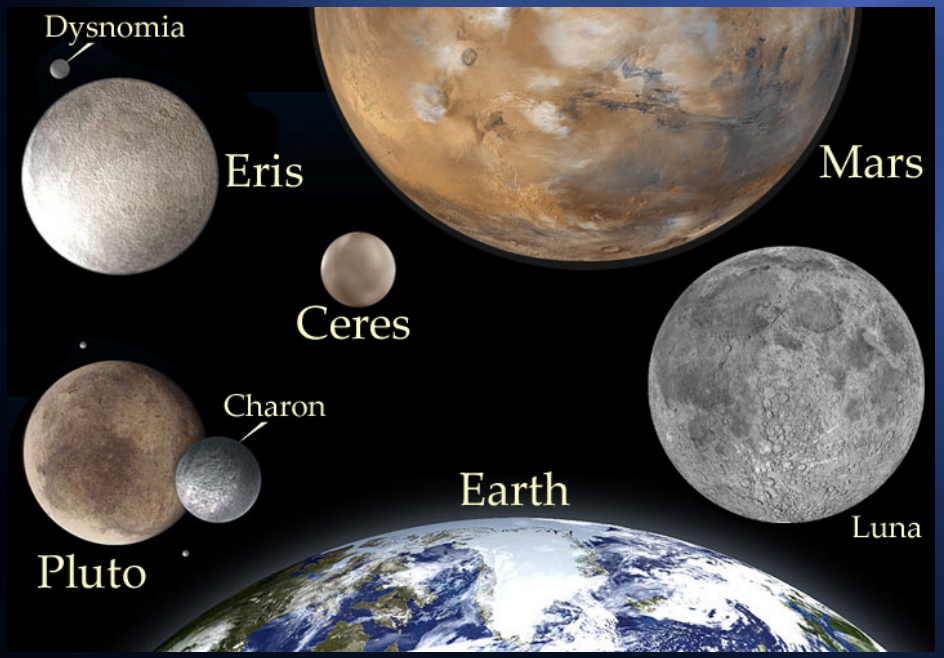
This ceramic-fabric sun shade, 8 feet tall and 6 feet wide, keeps the instruments at room temperature while the spacecraft orbits the planet closest to the Sun.

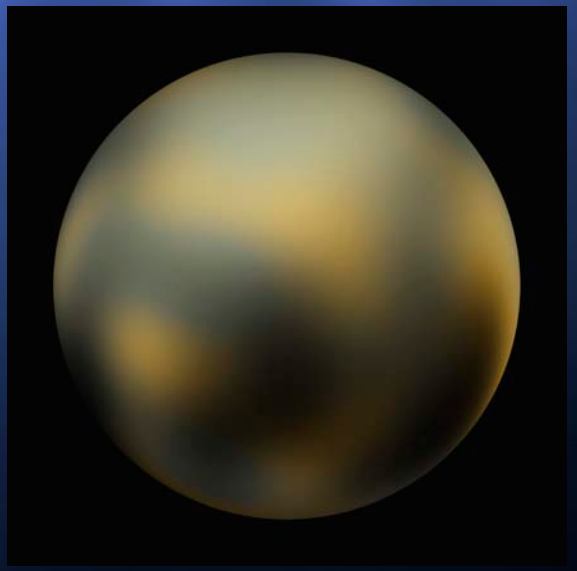
# *Pluto – Two Years from First Peek !*

## New Horizons

First mission to study Pluto, its moons and Kuiper Belt objects, to reveal how ice dwarf planets formed and have evolved over time and where they fit in with other solar system objects



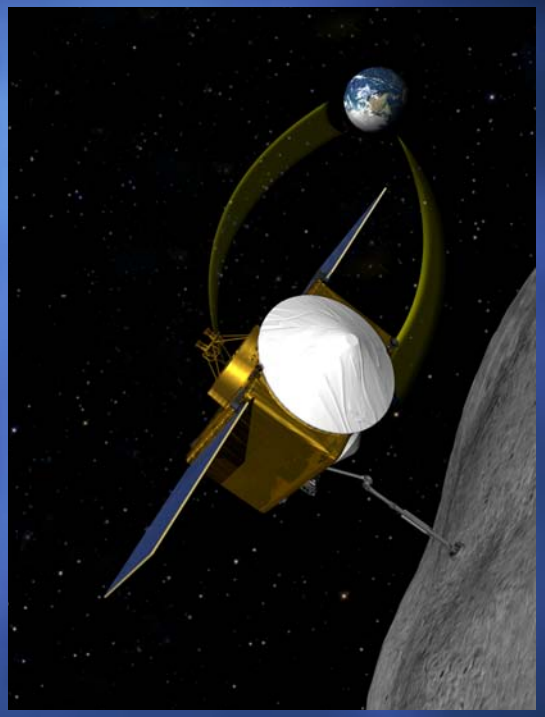


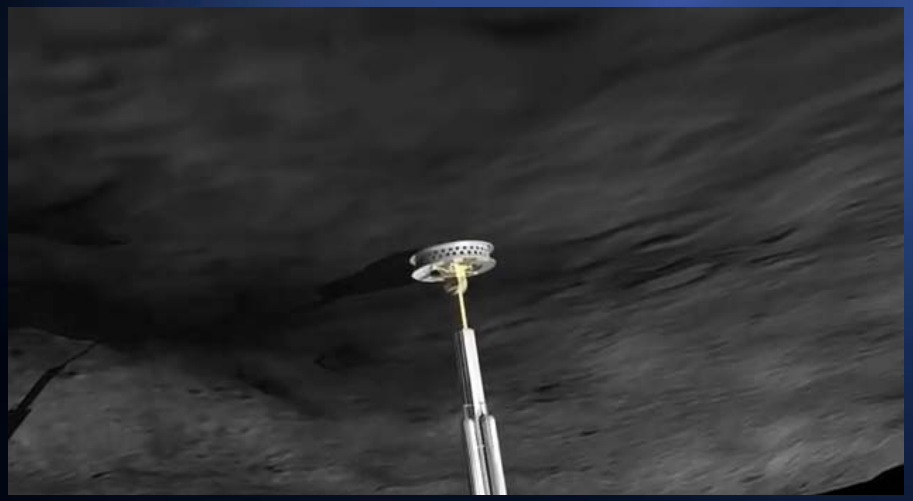



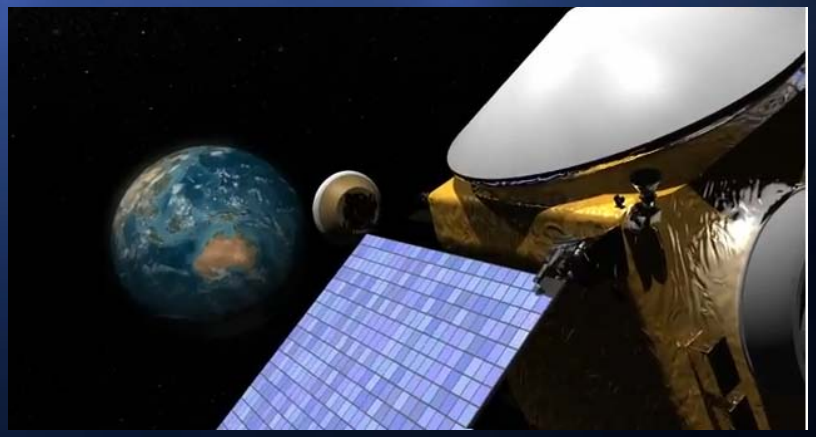
# *Returning Asteroid Dirt*

## OSIRIS-REx

NASA's first asteroid sample return
- 2016 launch
- 2019 arrival at 1999 RQ36 to map, measure, then grab a soil sample
- 2023 return to Earth after a journey of 823 million miles

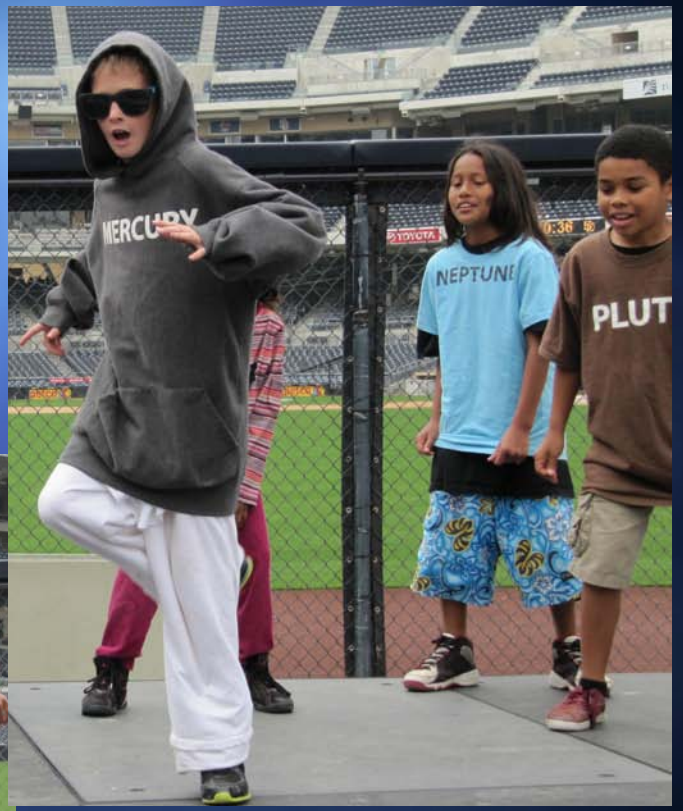






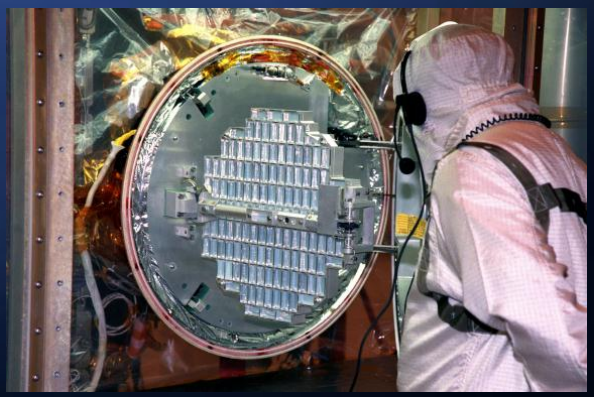
# “Space School Musical”

*Introduce your students to our solar system*



# Learn More

Find out much more about all these missions that are visiting **New Worlds** and making **New Discoveries**

discovery.nasa.gov
newfrontiers.nasa.gov

YOUR STUDENTS can be part of NASA's exciting work!