

BIBLIOTHECA ALEXANDRINA

# COSMIC HORIZONS

مكتبة الإسكندرية  
BIBLIOTHECA ALEXANDRINA

AN ASTRONOMY AND SPACE NEWSLETTER

AUTUMN 2006 ISSUE



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## o n t h e c o v e r



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Editorial



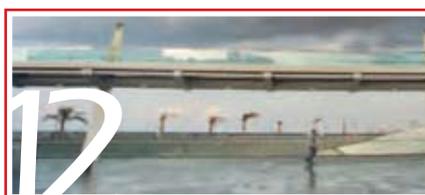
The Universe Now



Hot Topic



Fun Fact



Picture Gallery

يعرض الآن بمركز القبة السماوية العلمي  
Now showing at the BA Planetarium Science Center

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## IN SPACE

## في الفضاء



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# Hubble Explores Negative Gravity



Credit: NASA, ESA and A. Riess

Scientists observing with the Hubble Space Telescope (HST) have discovered evidence that dark energy, a hypothetical form of energy that pervades the entire Universe and counteracts gravity, is not a new characteristic of space, but rather has been acting for most of the Universe's history.

Dark energy is believed to accelerate the rate of cosmic expansion, discovered by Edwin Hubble in the 1920s. In his theory of General Relativity, Albert Einstein introduced a cosmological constant to achieve a model of a static Universe. Einstein, however, abandoned this constant after Hubble's discovery of the expansion of the Universe, calling it "greatest blunder".

In 1998, researchers used HST and ground-based telescopes to detect the acceleration of the expansion of space from observations of distant supernovae. Astrophysicists realized that Einstein may have been correct after all, as there appeared to be a negative gravity in space that was subsequently dubbed "dark energy".

The researchers used Hubble to find that dark energy was already increasing the expansion rate of the Universe as long as nine billion years ago (The Universe is believed to be about 14 billion years old). Hubble's data would allow cosmologists

to rule out competing explanations that predict that the influence of dark energy changes over time.

The researchers also arrived at an interesting conclusion that the type of exploding stars, or supernovae, used to determine cosmic distances today look remarkably similar to those that exploded nine billion years ago and are just now being detected by Hubble. This important finding provides additional support to the use of these supernovae for tracking the cosmic expansion through most of the evolution of the Universe.

Supernovae provide reliable distance measurements because their brightness variation and intrinsic brightness are well studied. They are therefore reliable distance indicators, enabling astronomers to determine their vast distances from Earth.

These Hubble images reveal five supernovae in distant galaxies. The arrows in the top row of images point to the supernovae. The bottom row shows the host galaxies, before or after, the stars exploded. The supernovae exploded between 3.5 billion and 10 billion years ago.

#### Further reading

Hubble Finds Evidence for Dark Energy in the Young Universe  
<http://hubblesite.org/newscenter/archive/releases/2006/52/full/>

# A Close Encounter with a .. Tornado

By Aymen Ibrahim  
Senior Astronomy Specialist, PSC

On Monday, 4 December 2006, showers occurred in Alexandria in the evening. I observed the rain hoping to photograph a rainbow. No rainbows appeared, instead, I encountered my first tornado!

Tornadoes are among the most dangerous natural disasters. They are rare in Egypt; the country witnessed its last tornado, which occurred in Upper Egypt, in 1981. On the other hand, tornadoes occur frequently in a region in the mid-section of the United States, known as the Tornado Alley. This is due to that region's climate that features frequent powerful thunderstorms.

I recorded all the stages of the tornado, from its birth, through its development, and finally its dissipation. Some of the photos show the twister approaching the Library, others are close-ups acquired just under the tornado.

At about 15:45 EET, expecting to observe a rainbow, I was waiting for sunlight to shine through breaks in the drifting rainy clouds. There were beautiful garden snails feeding on nearby plants. Garden snails are nocturnal animals, but they are active in the day during rains, or in humid weather. They

are fascinating creatures. I always enjoy observing them. I sought to take some photos of the snails.

Shortly, after I photographed the snails, I noticed a little funnel-shaped cloud, developing amid the clouds. It was an interesting feature. I began to photograph it. While I was taking the photos, it grew rapidly in size. It was swirling, and approaching the ground. I soon realized I was experiencing a close encounter with a twister.

Fortunately, the tornado was not powerful. It lasted about 10 minutes, but it was a spectacular phenomenon. I did not fear the terrible hazard. I was very thrilled, and monitored it closely. I have always dreamed to travel to Tornado Alley, to observe the meteorological wonders.

My pictures were published by several international publishers, and stimulated worldwide interest. I found online texts in English, Spanish, Italian, Japanese, Korean and several other languages reporting and discussing my twister observation.

I present my photos of the tornado in this issue's Picture Gallery, "Tornado over Bibliotheca Alexandrina".

# NASA Launches STEREO Mission

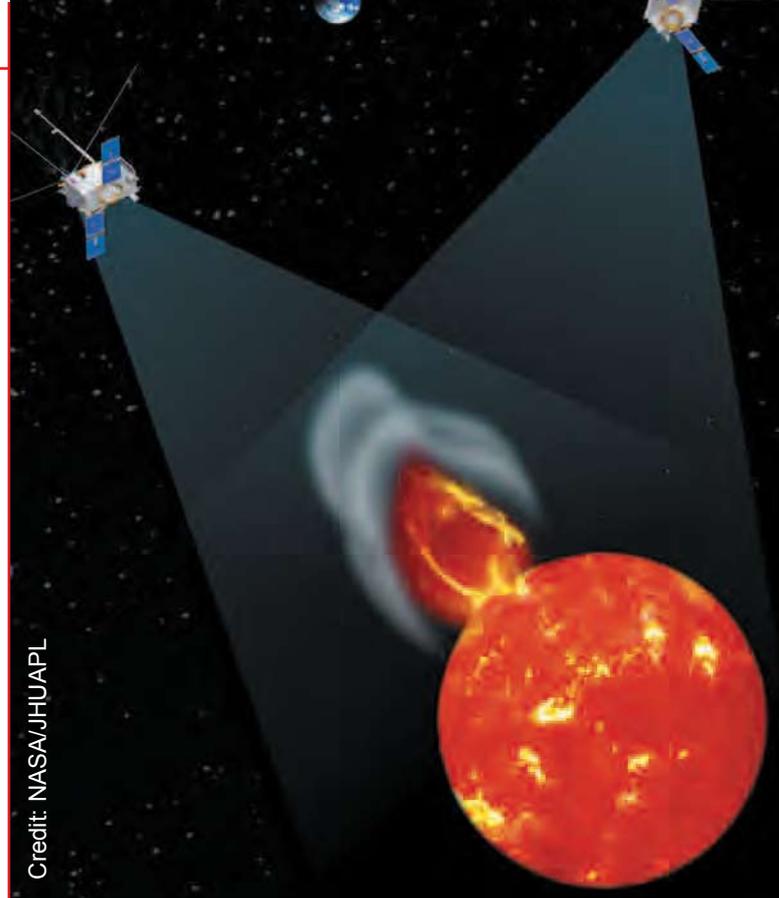
On Thursday, 26 October 2006, NASA launched the Solar Terrestrial Relations Observatory (STEREO) mission aboard a Delta II rocket. The mission comprises two almost identical spacecrafts that will study the Sun from solar orbits. The twin space observatories will create the first 3D images of the Sun and observe violent solar eruptions known as Coronal Mass Ejections (CMEs).

CMEs are capable of damaging artificial satellites and disrupting power networks and telecommunications. The two solar observatories will also study the interplanetary space near Earth and in the inner Solar System.

The two observatories were launched in a stacked configuration and separated from the rocket approximately 25 minutes after lift-off. About 63 minutes after launch, mission controllers at the Johns Hopkins University Applied Physics Laboratory (APL), confirmed each observatory's solar arrays successfully deployed and were operating well. NASA's Deep Space Network antennas in Canberra, Australia, received the initial radio signals.

In a few weeks, mission controllers at APL will examine all systems aboard the observatories. For the next three months, the observatories will fly from a point near Earth to one that lies just beyond the lunar orbit.

After about two months, STEREO observatories will encounter the Moon. Observatory A will use the lunar gravity to place it in an orbit "ahead" of Earth. Observatory B will encounter the Moon again for a second swing-by about one month later to adjust its position "behind" Earth.



Credit: NASA/JHU/APL

STEREO spacecrafts in space, an artist's impression

STEREO is the first NASA mission to use separate lunar swing-bys to place two observatories into different orbits around the Sun. The observatories will be so precisely positioned to provide depth perception, in a manner similar to that due to the slight offset between human eyes. The placement also allows the two spacecrafts to take local particle and magnetic field measurements of the solar wind as it flows by.

The STEREO mission is expected to last two years. During the mission, the observatories will explore the origin, evolution and effects of CMEs.

CMEs pervade the entire Solar System, and interact with Earth's magnetic field. They give rise to the fascinating aurora, the bright colorful lights observed in the night sky, usually in the polar regions.

Scientists hope that STEREO's measurements will improve our understanding of CMEs and methods of predicting them.

#### Further reading

STEREO

<http://www.nasa.gov/stereo>

# 1000 Days on Mars



An artist's impression of the Rover Spirit

On 26 October 2006, NASA celebrated the 1000<sup>th</sup> sol of its highly successful robotic Mars Exploration Rover Spirit. A sol is the length of the day on Mars, which lasts 24 hours, 39 minutes, 35 seconds.

Spirit landed on Mars on 4 January 2004. Its voyage in interplanetary space lasted over 6 months. Among the mission's primary goals was to search for and characterize rocks and soils that hold clues to past water activity on Mars. Spirit has a twin, the Mars Exploration Rover Opportunity, which landed on the opposite side of Mars on 24 January 2004.

Originally, Spirit's mission was scheduled to be only 90 sols long. Thus, Spirit has been operating successfully for over one Martian year, or two Earth years (Mars orbits the Sun every 687 Earth days).

Spirit is a six-wheeled robot. Scientists regard it as a robotic geologist. Spirit is powered by solar energy. It has 9 cameras that enable it to explore our red, small planetary neighbor and roam its surface.

On 6 February 2004, Spirit achieved history when it performed the first grinding of a rock on Mars, applying its Rock Abrasion Tool.

Occasionally, Spirit points its cameras to the Martian skies to perform astronomical observations. Spirit observed a solar eclipse by Mars's moon Deimos, and obtained the only picture of Earth from the surface of another planet. Spirit also recorded the eclipse of Mars's larger moon, Phobos, when it plunged in Mars' shadow, on 27 November 2005.

Spirit has endured the most challenging part of its second Martian winter. It is gaining solar power, and spring in the Martian southern hemisphere is due in early 2007.

#### Further reading

Mars Exploration rover Mission

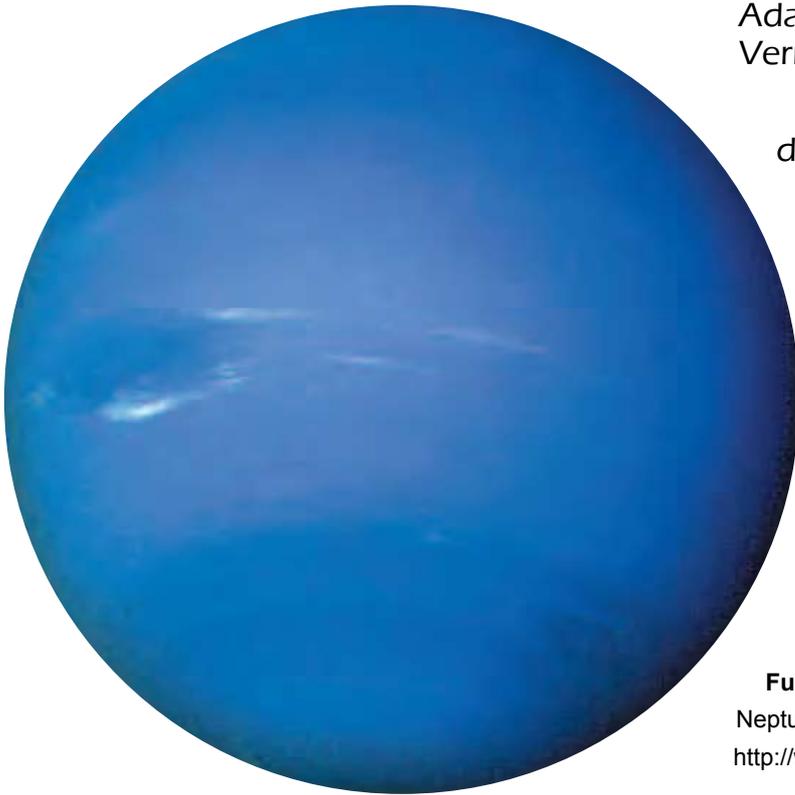
<http://marsrovers.nasa.gov/home/index.html>



Earth from Mars, pictured by the Spirit rover



# Neptune at 160



Neptune, the eighth planet from the Sun, was discovered on 23 September 1846. Its discovery, based on calculations made independently by the British astronomer John Adams and the French astronomer Urbain Le Verrier, was a scientific glory.

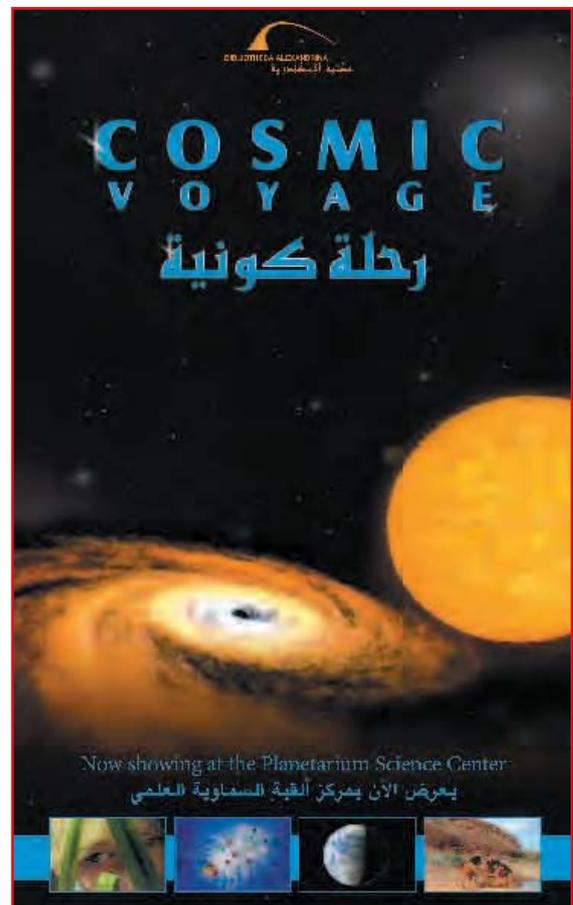
Celebrating the 160th anniversary of the discovery of Neptune, Aymen Ibrahem, Senior Astronomy Specialist, gave a public lecture at the Bibliotheca Alexandrina's Auditorium, on 25 September 2006. The lecture, entitled "Neptune, the Blue Giant", was a virtual space exploration of Neptune. Ibrahem also presented the story of the discovery of Neptune.

Due to its vast distance from the Sun of approximately 4,500 million km, Neptune orbits the Sun every 164.8 years. The planet has not yet completed one orbital revolution since its discovery!

#### Further reading

Neptune

<http://www.nineplanets.org/neptune.html>



# An Image of Jupiter



Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute

On 4 September 2006, the New Horizons spacecraft, en route to the dwarf planet Pluto, obtained an interesting image of Jupiter. New Horizons was still 290 million km from the giant planet. The image was acquired by an imaging device aboard New Horizons, the Long Range Reconnaissance Imager (LORRI).

The image shows the shadows of two of the major four Jovian moons, transiting the disc of the planet, and prominent features in the planet's atmosphere.

New Horizons is hurtling in space toward Jupiter at 45,000 miles per hour. It will reach the closest approach distance on 28 February 2007. New Horizons is expected to acquire the most detailed images of Jupiter since the Cassini spacecraft flyby in 2000, and the final images of the Galileo spacecraft, which was in orbit around Jupiter, in 2003.

New Horizons will observe Jupiter again in January 2007. The spacecraft will continue to study the gigantic magnetosphere of Jupiter after the closest approach.

New Horizons was launched toward Pluto on 19 January 2006. It is expected to arrive at Pluto in 2015. After studying Pluto and its system of moons, it will probably explore one or more of the Kuiper Belt Objects.

## Further reading

New Horizons

<http://pluto.jhuapl.edu/Jupiter>

<http://www.nineplanets.org/jupiter.html>

Pluto

<http://www.nineplanets.org/pluto.html>

The Kuiper Belt

<http://www.nineplanets.org/kboc.html>

# Fourth Space Tourist Returns to Earth

On 29 September 2006, the first female space tourist, Anousheh Ansari, landed safely in the steppes of Kazakhstan, after a 10-day mission aboard the International Space Station (ISS). The Soyuz space capsule also carried Russian cosmonaut Pavel Vinogradov and American astronaut Jeff Williams.

The landing occurred, according to plan, in the Kazakh steppe. The descent lasted over three hours.

Airborne search and rescue teams retrieved the spacefarers.

Ansari is the fourth space tourist to visit the ISS, after Dennis Tito, Mark Shuttleworth and Greg Olsen. She is also the first Iranian in space. She was standby of Japanese businessman Daisuke Enomoto who had been in astronaut training, but eventually unqualified for space travel for unspecified medical reasons.

## Further reading

ISS

[http://www.nasa.gov/mission\\_pages/station/main/index.html](http://www.nasa.gov/mission_pages/station/main/index.html)

# The Lightest Planet!



Credit: Hubble Heritage Team (AURA/STScI/NASA/ESA)

Saturn is the second largest planet. With an equatorial diameter of over 120,000 km; its volume is approximately 650 times that of Earth. With a mass of approximately  $600 \times 10^{24}$  kg, Saturn is nearly 100 times more massive than Earth!

Saturn's mean density of  $0.7 \text{ g/cm}^3$ , is less than that of water ( $1 \text{ g/cm}^3$ ). This means that, if there were a hypothetical ocean, large enough to fill the space of the Solar System (about 30 billion km across), Saturn would float on the surface of this ocean!

The Earth, Moon, Sun and all the other planets are denser than water. To avoid sinking, they will need a buoy, or a lifejacket.

# A Critical Decision: NASA to Save the Hubble Space Telescope

Image credit:  
NASA, ESA, J. Hester and A. Loll



Images acquired by the Hubble Space Telescope were used to create this magnificent mosaic of the Crab Nebula, the remnant of a dead massive star whose explosion was observed in 1054 CE.

On Tuesday, 31 October 2006, NASA Administrator, Dr. Michael Griffin, decided to reinstate a space shuttle mission to maintain and upgrade the Hubble Space Telescope (HST). Without this mission, HST, one of the greatest scientific projects in history, will be operational only for 2-3 years. The new servicing mission would extend Hubble's mission till 2013.

NASA earlier considered this mission risky, after the Space Shuttle Columbia disaster in 2003, and deorbiting HST was deemed necessary. Some scientists disagreed with the decision, urging NASA to send robots to repair Hubble. The issue also stimulated public concern.

The final Hubble Servicing Mission 4 is scheduled for launch in May 2008. Veteran astronaut Scott Altman will command the Space Shuttle Discovery to Hubble. Discovery's astronauts will install two new instruments, the Cosmic Origins Spectrograph, and the Wide Field Camera 3. They will also repair Hubble's gyroscopes, crucial for the telescope's pointing accuracy.

In 16 years of operation, HST has captured more than 750,000 images of the cosmos, and made many startling discoveries.

Hubble's first images, however, were blurry, due to a flaw in the telescope's main

mirror. Space shuttle astronauts repaired the optical defect during the first Hubble servicing mission in 1993. Ever since, Hubble has captured hundreds of thousands of images of the cosmos and made many startling discoveries.

Actually, Hubble acquired some of the most famous images in the history of science, including an iconic image of the Eagle Nebula, known as "Pillars of Creation", and the "Hubble Ultra Deep Field", the deepest ever image of the Universe in the visible light, showing galaxies over 13 billion light years away.

Hubble is one of the largest artificial satellites ever flown into space. It is 13.2 m long and weighs over 11 tons. Its primary mirror is about 2.5 m across. Hubble is one of NASA's four Great Observatories, with the Compton Gamma Ray Observatory (CGRO), Chandra X-ray Observatory (CXO) and the Spitzer Space Telescope (SST).

From its Earth orbit, at an altitude of about 600 km, above the clouds and hazes of our atmosphere, Hubble conducts images with unprecedented detail. Hubble's powerful light grasp enables astronomers to detect faint, distant galaxies at the edge of the visible Universe. Hubble orbits Earth every 97 minutes.

Hubble can also observe the Universe in the near infrared wavelengths, enabling astronomers to explore star birth regions in our Galaxy and other galaxies. Hubble can point to, and track any celestial object with an amazing accuracy.

Thousands of published research articles have been based on Hubble's data. The HST budget is over \$2.5 billion.

#### Further reading

Hubble Websites

<http://hubblesite.org/>

<http://www.spacetelescope.org/>

CGRO

<http://coss.gsfc.nasa.gov/docs/cgro/index.html>

CXO

<http://chandra.harvard.edu/>

SST

<http://www.spitzer.caltech.edu/>



***Tornado over BA***

The tornado is nearly fully-grown.



***Tornado Declines***

The tornado started to decline in about 10 minutes.



***Dissipation***

The tornado dissipated. All what remained was a rotating oval cloud (just above center).



**Formation**

This is the first photo Ibrahim obtained. It is a close-up showing the formation of the tornado. Actually, the twister grew rapidly!



**Tornado Develops**

The tornado develops. Few passers were on the Plaza.



**Tornado Close-up**

This is a close-up photo showing the swirling winds of the tornado. The tornado grew considerably in size.

Cassini was approximately 2.2 million km from Saturn when the images in this mosaic were acquired. Image scale on Saturn is about 260 km per pixel.

## Superb Janus

The above image shows Janus, Saturn's curious small moon, visible against the cloud-streaked backdrop of the giant planet.

Unlike our moon, Janus (181 km across) is irregular in shape, i.e., it resembles a gigantic potato! Many minor planets and planetary moons are too small to attain a round shape.

There are many craters on the surface of Janus, but some areas seem to have been smoothed by some geological process. Like Pandora and Telesto, Janus is believed to be covered with a mantle of fine dust-sized icy material.

The image was taken using a spectral filter sensitive to wavelengths of infrared light centered at 930 nanometers. The view was acquired with the Cassini spacecraft narrow-angle camera on 25 September 2006, at a distance of approximately 145,000 km from Janus and at a Sun-Janus-spacecraft, or phase, angle of 62 degrees. North on Saturn is up. Image scale is 871 meters per pixel.

## Helene's Close-up

The images show Saturn's small, peculiar moon Helene. The images were obtained by the Saturn-bound Cassini spacecraft, and they show the bizarre, rugged terrain of Helene.



It is believed that large portions of Helene have been blasted away by meteoritic impacts.

Cassini flew by Helene on 17 August 2006, when these images were acquired, at a distance of about 50,000 km. The series of images were recorded over the course of one hour.

Helene (32 km across) is co-orbital with Dione (1,120 km across), the second densest of Saturn's moons. Dione is believed to be composed of rock and ice.

In 2004, Cassini discovered another small co-orbital moon, Ploydeuces.

### Further reading

The Janus/Epimetheus Ring

[http://www.nasa.gov/mission\\_pages/cassini/multimedia/pia08322.html](http://www.nasa.gov/mission_pages/cassini/multimedia/pia08322.html)

Moon-Made Rings

[http://www.nasa.gov/mission\\_pages/cassini/multimedia/pia08328.html](http://www.nasa.gov/mission_pages/cassini/multimedia/pia08328.html)

The Cassini-Huygens Mission

<http://saturn.jpl.nasa.gov/home/index.cfm>

Helene.jpg

162056main\_PIA08329.jpg

Janus.jpg

PIA08329.jpg



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# New Images from the Cassini Spacecraft



NASA recently published the following superb images of Saturn and its moons, acquired by the Saturn-bound Cassini spacecraft.

## In Saturn's Shadow

This is a unique image of Saturn. The Cassini spacecraft was flying in the shadow of Saturn, viewing the planet's glorious rings as never seen before.

The picture reveals previously unknown faint rings, and even shows our home planet from afar. It is a composite of 165 images obtained by Cassini on 15 September 2006, when it flew beyond Saturn for 12 hours.

Cassini detected two new rings; one coincident with the shared orbit of the moons Janus and Epimetheus, and another along the orbit of the tiny moon Pallene.

The rings were discovered by Galileo in 1610, but he failed to perceive their shape with his small telescope. In 1655, observing with a more powerful telescope, Christian

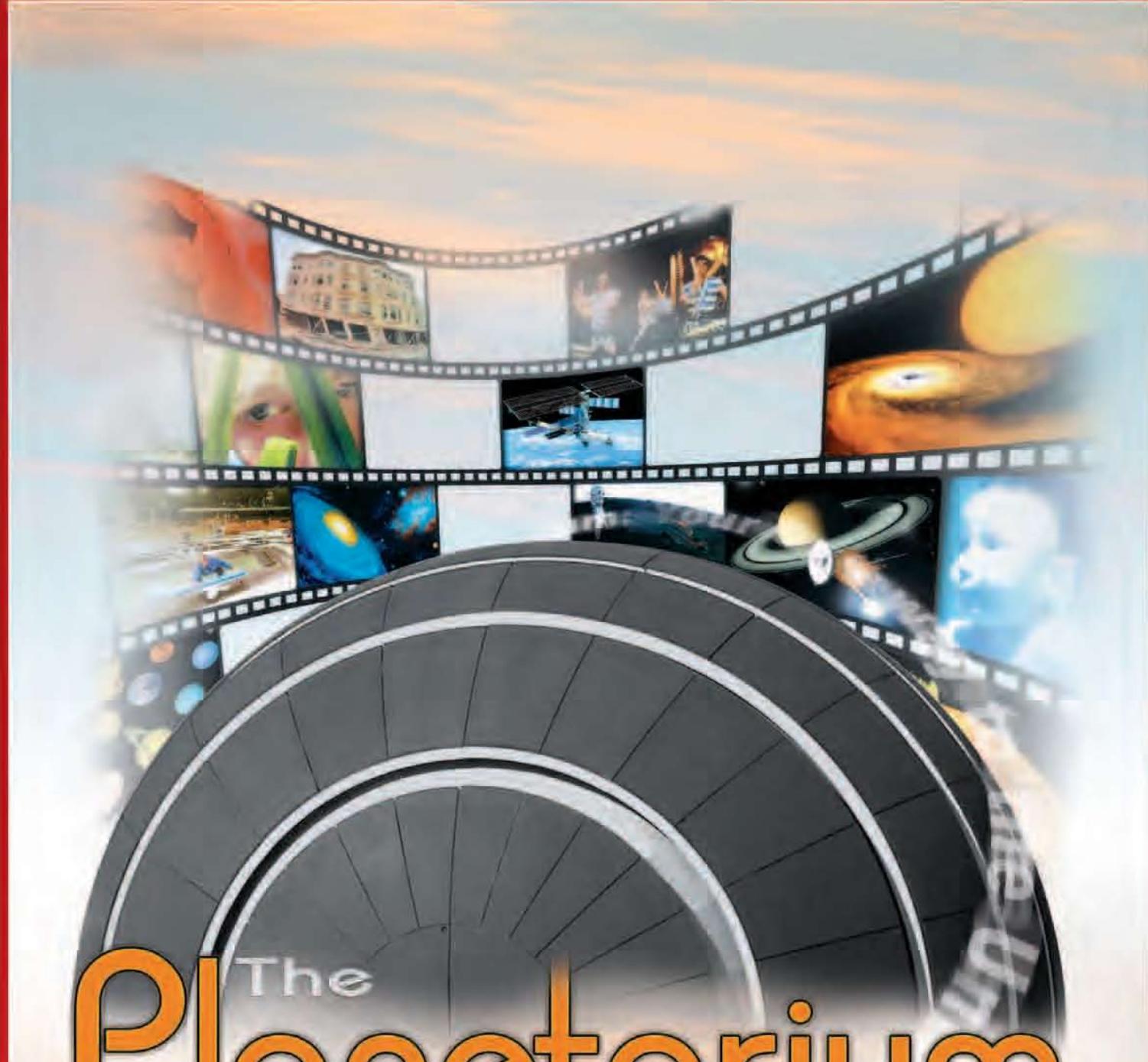
Huygens announced that there are rings surrounding Saturn.

Seven major rings have been named A through G, in order of discovery. They contain several gaps, due to the gravitational influence of some of Saturn's moons.

Saturn's rings are composed of ice and dust. They contain fine microscopic dust particles, best viewed when the Sun is directly behind Saturn. The distribution of these particles provides information about the space environment of the planet.

The outermost ring, the E ring, is encircling the entire ring system. The narrow G ring is visible between the E ring and the main bright rings. The E ring is believed to have originated due to volcanic eruptions on the surface of the icy, geologically active moon Enceladus.

Earth was over a billion km from Saturn during the observation. It is visible as a pale dot, interior to the G ring, and above the bright main rings.



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