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Carolyn Porco Captain's Log July 2015

by *Erik Ruvalcaba*

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University of Arizona

Carolyn Porco, Imaging Team Leader for the Cassini-Huygens mission, has gained a reputation as an authority on belt formations and satellites of extraterrestrial bodies.

Push Carolyn Porco's birthday a few centuries into the future, she would probably be leading expeditions to uncharted planets. Since she was actually born in 1953, she chose a career that seems like the next best thing—she became a planetary scientist, a job that allows her to travel vicariously all over the [Solar System](#). Her passion to explore is matched only by her desire to spread the news

**NATIONAL
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about the unearthly beauty she sees in images radioed back from the Solar System's distant reaches. Porco is an artist as well as a scientist, finding not only science but poetry in the data streams sent back to Earth by NASA's robot probes.

Born to Italian immigrant parents, Porco is the only daughter among five children. She grew up with her four brothers in the East Bronx neighborhood of Pelham Bay in New York City while her father drove a bread-delivery truck and her mother kept house. She attended a local Catholic high school in the Bronx and found herself drawn to astronomy through interests in eastern philosophy, religion and existentialism. "I was really kind of seeking answers to the big questions of wonder," she told the *Anchorage Daily News*. "You know: What are we doing here? What's out there? What's the purpose of it all?" Growing up in the 1960s, when the U.S. space program got a lot of money and public attention, helped fuel Porco's interest in outer space.

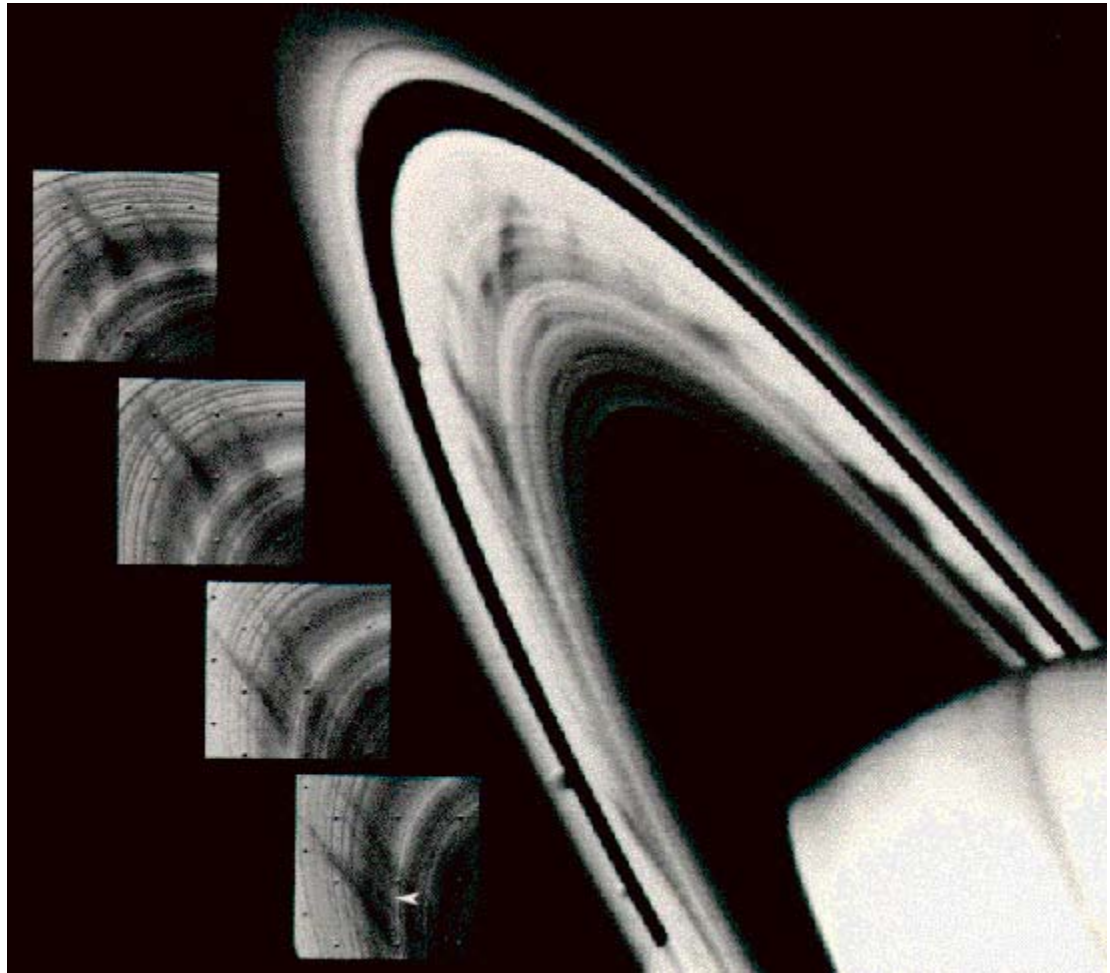
Porco was a girl of 13 when she first encountered Saturn on a Bronx rooftop while looking through a friend's telescope. The second-largest planet to orbit the Sun has been called the "Jewel of the Solar System" thanks to its striking appearance and complex ring structure. From then on, she knew what she wanted to do with her life: explore space.

Caltech and the Voyager Mission: A 'Eureka Moment'

In 1974 Porco completed her undergraduate studies with a double degree in physics and astronomy from the State University of New York at Stony Brook. Later that year she began graduate work at the California Institute of Technology (Caltech) in Pasadena, Calif. Caltech oversees the Jet Propulsion Laboratory (JPL), one of NASA's space exploration facilities, which oversees many of NASA's missions to the planets.

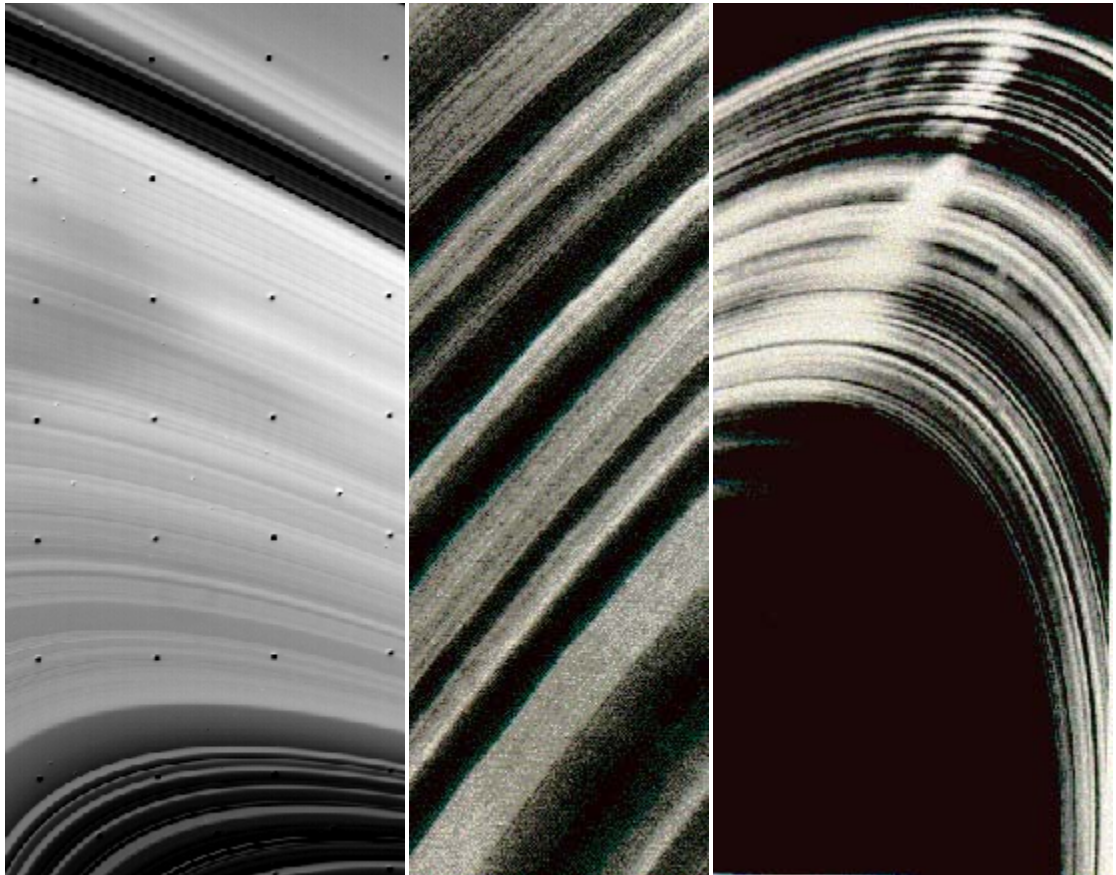
Porco was fortunate enough to be at Caltech when the two spacecraft of NASA's famous Voyager mission (Voyager 1 and 2) made their closest approaches to Saturn. Voyager 1 passed Saturn in November 1980, while Voyager 2 did so in August 1981. [See Voyager 2 Flies by Saturn, August 1981; Voyager 1 Files by Saturn, November 1980]. Porco was invited by members of the Voyager Imaging Team, to assist in analyzing the vast quantity of images and data sent back to Earth. She jumped at the chance to help, and her youthful fascination with the planet was rekindled.

Her job involved examining the behavior and dynamics of the handful of Saturn's eccentric ringlets. She also paid attention in particular to the B-ring, where strange and shadowy formations (which have been compared to spokes on a wheel) appeared and then disappeared. [See The "Dirt" On Saturn's Rings, July 2004].



NASA

Saturn's B-ring, where strange and shadowy formations (which have been compared to spokes on a wheel) appeared and then disappeared. TOP: Clear images of the B-ring spokes. BOTTOM: The B-ring without the shadowy shapes (left and center) and the underside of the B-ring with light-reflected spokes (right).



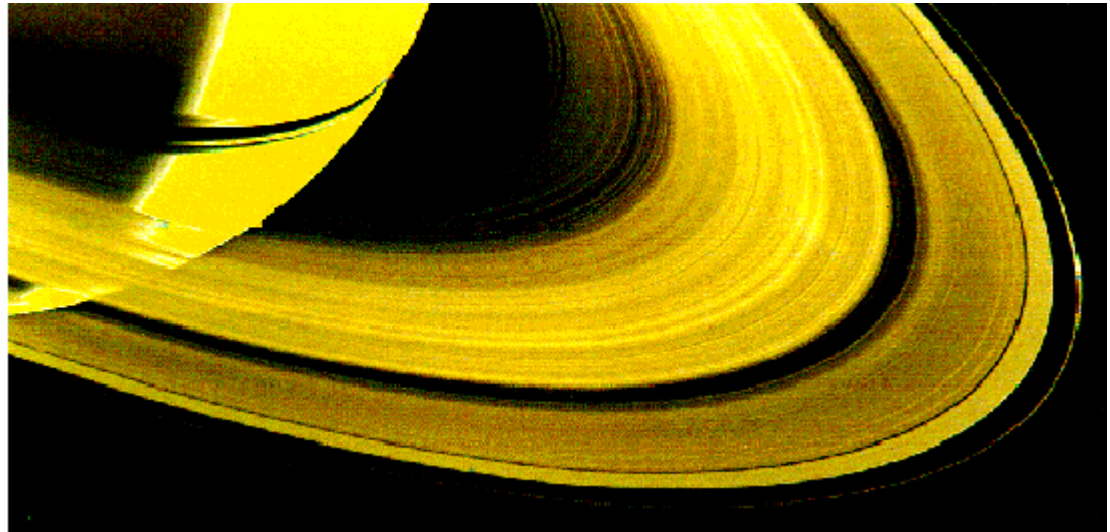
NASA

First, she was able to pinpoint the cause of the motion and shape of several of Saturn's ringlets and the outer edges of the A and B rings. Second, she was the first to notice something strange about the spoke-like patterns which had been baffling the imaging team. She noticed a correlation between certain regions of Saturn's magnetic field and the formation of the spokes. The appearance of these ghostly features (now believed to be made up of tiny dust particles less than a micron wide—or about 1/50 the width of a human hair) were being modulated by the rotation of the planet's magnetic field, she proposed. "It was a 'eureka' moment," she told *SPACE.com* about her discovery at Caltech. She was exhilarated by the thought that she was the only person on Earth at that moment who understood the phenomena.

She wrote her doctoral thesis on these discoveries and earned her Ph.D. in 1983. That year, she joined the faculty of the Department of Planetary Sciences at the [University of Arizona](#) in Tucson, as a research associate. She also received and accepted an invitation that year to become an official member of the Voyager imaging team.

In 1986, Porco helped plan and analyze images of the [Uranian](#) ring system that were collected as Voyager 2 passed by the planet in 1986. [See [Voyager 2 Flies by Uranus](#), January 1986]. By 1989, Porco had gained a reputation as a leader and an authority on rings and satellite-ring interactions. That year, when Voyager 2 was passing the planet [Neptune](#) (also found to have a ring system), an official unit of the Voyager imaging team called the Rings Working Group was placed under Porco's supervision. [See [Voyager 2 Spacecraft Flies by Neptune](#), August 1989].

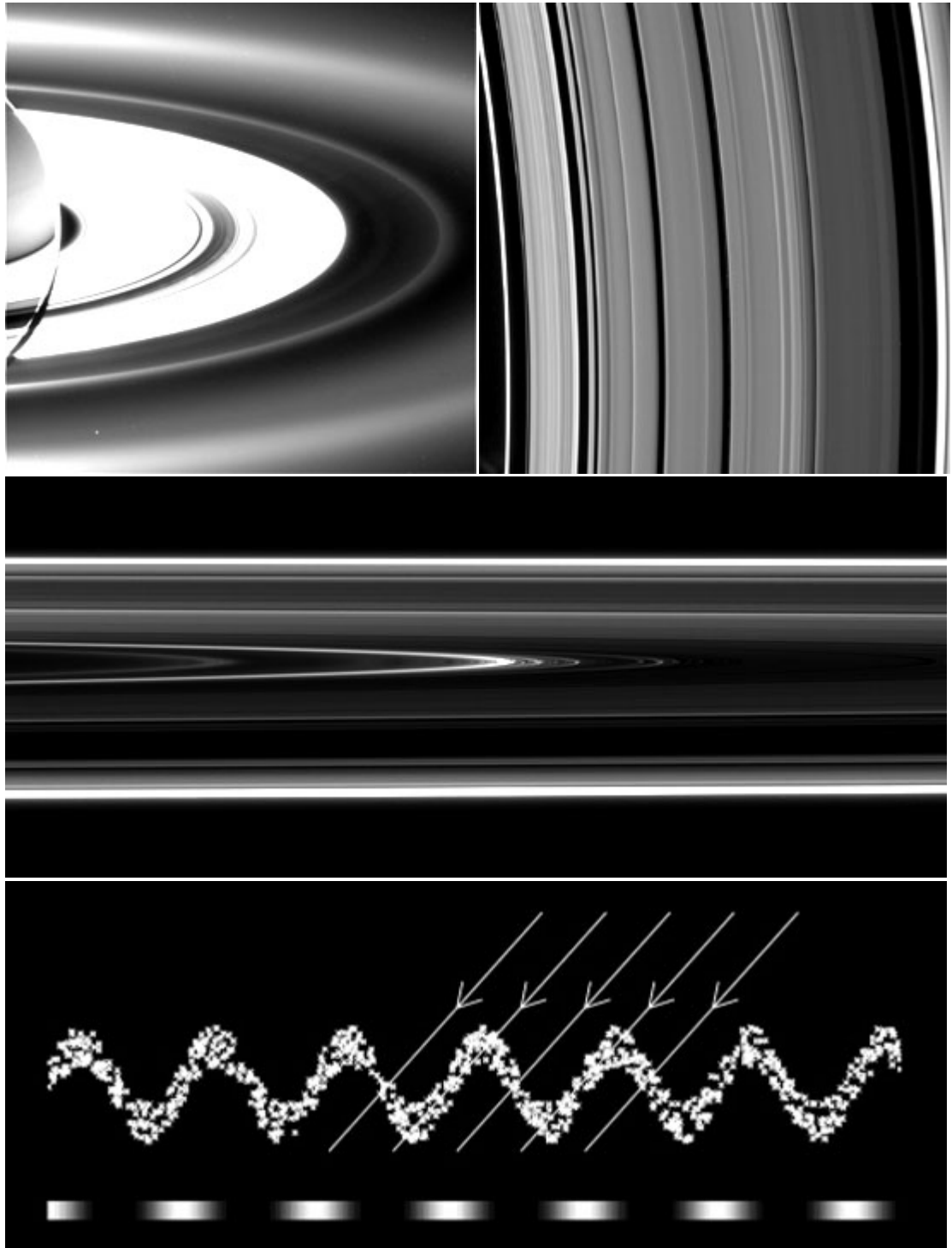
Cassini-Huygens: A Passion to Return to Saturn



NASA

The Voyager mission to explore the Solar System officially ended in 1989 after the Neptune flyby despite the fact that both spacecraft are still technically active. ABOVE and BELOW: Images of Saturn through the "eyes" of Voyager and Cassini as "poetry and beauty and science all mixed together." BELOW: Top Row: With giant Saturn hanging in the blackness and sheltering Cassini from the Sun's blinding glare, the spacecraft viewed the rings in a new light, revealing previously unknown rings. Second Row: With the Sun almost directly behind Saturn (left), Cassini reveals a faint ring of material coincident with the orbit of the small moon Pallene. High resolution Cassini images (right) show an astonishing level of structure in the Cassini Division, including two ringlets that were not seen in Voyager spacecraft images 25 years ago. Third Row: Saturn's D ring—the innermost of the planet's rings—sports a structure that appears to be a wavy, or "vertically corrugated," spiral. Bottom Row: This vertical corrugation in a diaphanous ring can give rise to brightness variations.





All photos courtesy of Carolyn Porco/Ciclops

The Voyager mission to explore the Solar System officially ended in 1989 after the Neptune flyby. (Both Voyager spacecraft are still technically active, and are following trajectories that will take them out of the Solar System. The mission is now known as the Voyager Interstellar Mission.) [See [Voyager I Is Leaving Home](#), July 2005]. That same year, Congress approved funding for the Cassini (pronounced kah-SEE-nee) mission, whose objective was to examine more closely entire Saturn system, including its famous rings. [See [\\$67 Billion Spending Bill Cleared](#), October 1989].


Although no longer involved with the Voyager mission, Porco was not done with Saturn. "That was exhilarating, I can tell you, and left me with a passion to return [to Saturn]," she told the *Guardian* in 2004 about her experience with the Voyager mission. "There's an aspect of being a planetary explorer that is terrifically romantic and even spiritually gratifying. Essentially, I was hooked on the

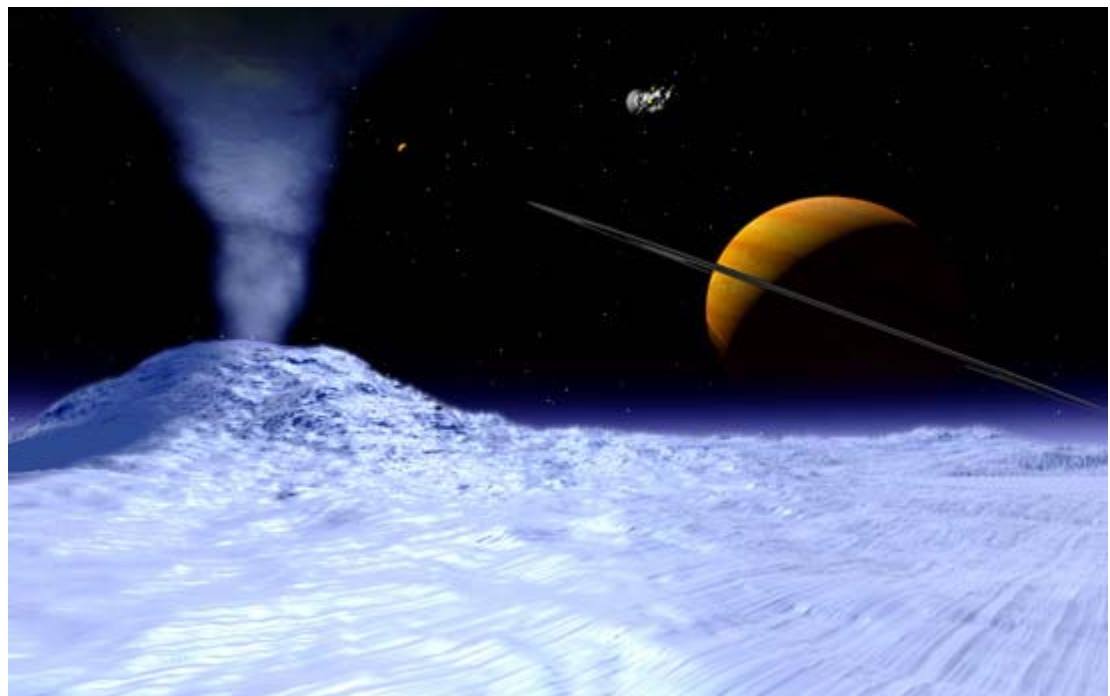
thrill of exploration and needed another fix." Porco applied for the position of Imaging Team Leader of the fledgling Cassini mission. Her dedication, enthusiasm and recognized expertise on ring systems paid off. In November 1990, she was selected for the position, beating out more experienced candidates.

The Cassini mission would turn out to be a commitment lasting more than 15 years for Porco. Seven years of planning and building were necessary before the craft's launch in October 1997. [See [Saturn Probe Successfully Launched](#), November 1997]. By that time, the Cassini mission had morphed into the internationally sponsored Cassini-Huygens mission. In addition to sending the Cassini orbiter to Saturn for imaging purposes, the Huygens (pronounced HOY-gins) probe would be deployed to explore the atmosphere and surface of Titan, the largest of Saturn's many moons (well over 40 have been identified so far). [See [Scenic Titan: Orange Haze, Hydrocarbon Seas](#), January 2004].

After the launch, another seven years passed before Cassini entered Saturn's system in July 2004. Since then, Porco and her team have been busy analyzing the data and images sent back to the Cassini Imaging Central Laboratory for Operations—or CICLOPS (pronounced SYE-klops, like the one-eyed creature of Greek mythology). CICLOPS is located at the Space Science Institute in [Boulder, Colorado](#), where Porco is Senior Research Scientist. The center of uplink and downlink operations for the Cassini imaging experiment, as well as the place where images are both prepared for archive and processed for release to the public. [See [ciclops.org](#)]. In addition to Image Team Leader, Porco is also the Director of CICLOPS.

Enceladus: The Holy Grail of Planetary Exploration

Most recently, in March 2006, Porco and her Cassini team reported in *Science* magazine on images from 2005 flybys that may indicate evidence of liquid water very close to the surface of one of Saturn's small moons, Enceladus (pronounced en-SELL-a-dus). The imaging team observed geyser-like eruptions of ice particles on the south pole of the tiny moon. The most plausible interpretation, put forth by Porco and her team, is that the eruptions derive from heat and pressure below the surface pushing up liquid water and vapor, which freezes immediately when it shoots out of the cracks on the surface of Enceladus. While Titan was supposed to be the centerpiece for the Cassini-Huygens mission, the discoveries of Porco's imaging team and from the other Cassini experiments have made Enceladus a focus of intense scientific curiosity. Scientists expected to find water ice on Enceladus. (The term "water ice" is used by planetary scientists to distinguish it from other kinds of ice, like methane  ice.) Saturn's rings are essentially made up of water ice and it is often found on other moons. However, no one expected to find geological activity that suggested highly accessible liquid water—particularly on the south pole of a moon only 318 miles (512 km) in diameter, just big enough to cover the state of Colorado. [See [Enceladus: A Weird and Wonderful Place](#), March 2006].



NASA/JPL/David Seal

An artist's impression of the surface of the small moon Enceladus, showing a geyser-like vent at the moon's south pole emitting ice.

The Enceladus discovery is important because many scientists have long believed that the search for extraterrestrial life should begin where there is liquid water. Other moons in the Solar System appear to have liquid water, but the water is buried under icy crusts several kilometers thick, making it difficult to reach. Titan is of interest because scientists believe it to be a "frozen vault," preserving many of the same chemical compounds that helped shape life on Earth 3.8 billion years ago. Mars has also been considered a strong candidate in the search for life, since many scientists believe that Mars once had accessible liquid water—and may still have some below the surface. [See Signs of a Frozen Martian Sea, March 2005].

According to Porco, however, Enceladus may be the best candidate in the search for life beyond Earth. First of all, if the theories she and her Cassini imaging team have developed are correct, liquid water exists in pockets very close to the surface of Enceladus, possibly "only a few tens of meters" down, she told the *PBS* program "Nova." Moreover, forming life as we know it on Earth required liquid water, but it also needed two other important elements: an energy source (heat) and carbon-based molecules (organic materials). Enceladus apparently has all the requisite ingredients, and in addition may have been active long enough for life to have formed at some point along the way.

"We may have just stumbled upon the Holy Grail of modern day planetary exploration," she wrote in her Captain's Log on the CICLOPS Web site. "It doesn't get any more exciting than this." The images are still being studied, but if Porco and her team are right, they have found an extraterrestrial environment that might be suitable for the evolution of life.

Beyond the Stars: Porco in the Spotlight

Porco's accomplishments reach beyond the austere world of scientific research. Unlike many of her peers, she can deliver straightforward and entertaining commentary on scientific issues. Consequently, she has made many appearances on radio and television.

She has appeared in documentaries like "Cosmic Journey: The Voyager Interstellar Mission and Message" on the A&E cable television network and "The Planets" on the Discovery Channel. News programs, including the "MacNeil/Lehrer Newshour" on PBS and "60 Minutes" on CBS, have also featured her. Porco served as an adviser for the 1997 film *Contact*, which was based on a novel by the well-known astronomer Carl Sagan. The actress Jodie Foster portrayed the heroine in the movie; Sagan asked Porco to consult because he considered her, out of all the women scientists he knew, to be most like the character he wanted the movie to portray.



Getty Images

Porco served as an adviser for the 1997 film *Contact*, which was based on a novel by the well-known astronomer Carl Sagan. The actress Jodie Foster portrayed the heroine in the movie, and Sagan reportedly suggested that she use Porco as a real-life model to guide her performance.

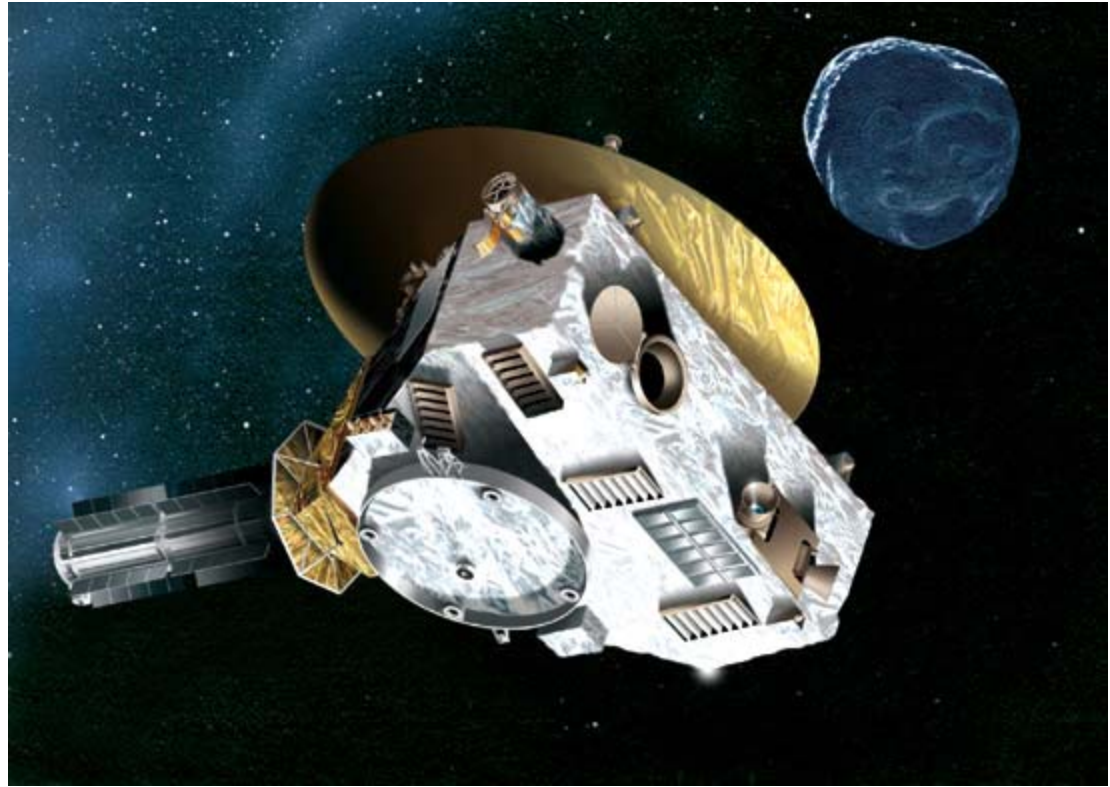
Porco has written for or been featured in such periodicals as the *Guardian*, *Astronomy* and *Science*. The *Sunday Times* of London in 1999 identified her as one of 18 budding scientific leaders of the 21st century. That same year, *Industrial Weekly* designated her as one of "50 R&D Stars to Watch." She has held positions on several NASA advisory committees and was the vice chairperson of the Steering Group for the Solar System Decadal Survey, a committee sponsored by the National Academy of Sciences and NASA to identify priorities, themes and missions in future planetary exploration.

Porco endeavors to bring the poetic imagery of her work to the general public. She is the chief executive officer of Diamond Sky Productions, a company dedicated to artfully presenting the science of planetary imaging to the general public. "It's about poetry and beauty and science all mixed together," she told *SPACE.com*.

When pioneer planetary geologist Eugene M. Shoemaker died in 1997, Porco came up with the idea of sending his ashes to the moon aboard the Lunar Prospector, an unmanned spacecraft designed to orbit the moon. The spacecraft was launched in January 1998, taking Shoemaker's remains with it and symbolically fulfilling his lifelong desire to travel to the moon. (The craft crashed on command into the Lunar south polar region in July 1999.)

In recognition of her dedication and achievements, astronomer Edward L.G. (Ted) Bowell, of the Lowell Observatory in Flagstaff, Arizona, honored Porco in 1998 by naming an asteroid after her: Asteroid (7231) Porco, "Named in honor of Carolyn C. Porco, a pioneer in the study of planetary ring systems . . . and a leader in spacecraft exploration of the outer solar system." (Bowell discovered the asteroid in 1985. Discoverers of asteroids are allowed to name them with the approval of the Small Bodies Names Committee, under the authority of the International Astronomical Union.)

Boldly Going Where No One Has Gone Before



NASA

An artist's conception of the New Horizons spacecraft launched in January 2006. For Porco, this mission has special significance: it means that she will have (vicariously) visited every planet in the Solar System.

Up next, Porco will be one of a number of scientist examining images from NASA's New Horizons Mission to Pluto and the Kuiper (pronounced ki-per) Belt. NASA launched the mission in January 2006, in partnership with Johns Hopkins Applied Physics Laboratory. The first mission to visit the "last" planet in our solar system, it is also the first to go to the Kuiper Belt. Scientist think the Kuiper Belt may contain material relatively unchanged from the earliest days of the Solar System, and thus exploring this distant region could give vital insights into the Solar System's origins.

For Porco, a mission to Pluto has special significance: it means that she will have (vicariously) visited every planet in the outer Solar System. As with Cassini, being a scientific space traveler requires patience. The New Horizons spacecraft will travel at a velocity of 27,000 miles per hour to get to Pluto, which is about 3 billion miles away from Earth. Even at that remarkable speed, the spacecraft is not scheduled to arrive at Pluto until July 2015. [See To Pluto and Beyond, February 2006; Student Project Is Headed for the Kuiper Belt, February 2003].

A thirst for knowledge inspires Porco. "It is a singular privilege to be standing on the threshold separating ignorance from knowing," she wrote in her Captain's Log on May 6, 2004, when Cassini was nearing Saturn. She closed the same log entry with a reference to the iconic science fiction TV series "Star Trek": "Step aside, Captain Kirk. This one belongs to us."

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Keywords

Carolyn Porco, Saturn, Voyager, Cassini-Huygens, New Horizons, Jet Propulsion Laboratory, CICLOPS, Enceladus