Circling Saturn: Carolyn Porco on her Celestial Trip

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Photograph by Tony Rinaldo (c) 2010

(PhysOrg.com) -- Carolyn Porco is on a mission. As she explained to an audience of several hundred gathered at the Radcliffe Gymnasium earlier this month, in a lecture titled “At Saturn: Tripping the Light Fantastic,” this mission is nothing less than “to understand how our small planet came to be.”

Porco is the leader of the imaging team for NASA’s Cassini spacecraft, which has been orbiting Saturn since July 2004. The giant ringed planet

is so large that it could swallow about 1,000 Earths, and its magnificent rings would span almost the entire space between Earth and the Moon.

But it's not just Saturn and its rings that fascinate Porco, a planetary scientist based at the Space Science Institute and the University of Colorado in Boulder. Saturn is the lord of 61 known moons, making it the centerpiece, she says, of "a rich, complex planetary system." Two of them, Titan and Enceladus, hold special interest for Porco and her NASA colleagues, who believe these moons may help to answer questions about the origins of life. The researchers have identified several additional small moons, including one that orbits within the rings themselves.

Porco made her mark in the 1980s as a member of the Voyager imaging team, which used data from NASA's Voyager 1 and 2 to study Saturn's rings. In particular, she calculated how the gravitational influence of several small moons has sculpted the sharp edges of Saturn's rings and narrow ringlets

Unlike the Voyagers, which flew past Saturn and will never return, the $3.4 billion Cassini has settled into orbit around the planet. Cassini is providing far superior images, which reveal new levels of detail and structure in the rings. As Porco explained to her audience during the last installment in the 2009-2010 Dean's Lecture Series, the same physics and mathematics that govern the giant spiral arms in galaxies like our Milky Way can explain waves in Saturn's rings that were created by sizable moons. Some of the rings' features give us a glimpse into the solar system's distant past, when the planets were forming within a huge disk of gas and dust surrounding the Sun.

Saturn's largest moon, Titan, is slightly larger than the planet Mercury, and the only moon to harbor a thick atmosphere. That atmosphere is dominated by nitrogen, just like Earth's, but it also contains small

amounts of methane. The methane plays the same role on Titan that water plays on Earth: It forms clouds, rains out of the atmosphere, and collects on the surface to create lakes oozing with organic compounds. Porco sounded choked with emotion when she described the brilliantly successful January 2005 landing on Titan of the European-built Huygens probe, which piggybacked its way to Saturn on Cassini. “This was an event that in my mind was so significant that it should have been celebrated with ticker-tape parades in every major city across the US and Europe,” she said.

But for Porco, the star of the Cassini show has been Enceladus, an ice ball about the size of Great Britain. “We knew it was intriguing from Voyager,” she said, “but what we found is startling.” Cassini images reveal jets of icy particles spraying hundreds of miles into space from the moon’s south pole. Cassini has flown through these plumes several times, and shows that they contain organic molecules such as carbon dioxide, methane, propane, and perhaps benzene. Not only do the plumes contain the stuff of life, but they seem to originate from salty water very near the moon’s surface. “We are more confident than we were five years ago that Enceladus presents an environment where prebiotic chemistry—and perhaps even life itself—might be stirring,” said Porco.

Cassini has already fulfilled all its mission objectives, but because the spacecraft remains in excellent health, NASA has extended its Saturn sojourn to 2017. Porco hopes that someday NASA will fly a follow-up mission to explore Enceladus in more detail, to see if life has taken root. “Should we ever discover that a second genesis had occurred in our solar system, independently outside the Earth,” she said, “then I think at that point the spell is broken, the existence theorem has been proven, and we could safely infer from that that life was not a bug but a feature of the universe in which we live—that it’s commonplace and has occurred a staggering number of times.”

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