Astronomers discover evidence of football-field sized moonlets in Saturn's A ring

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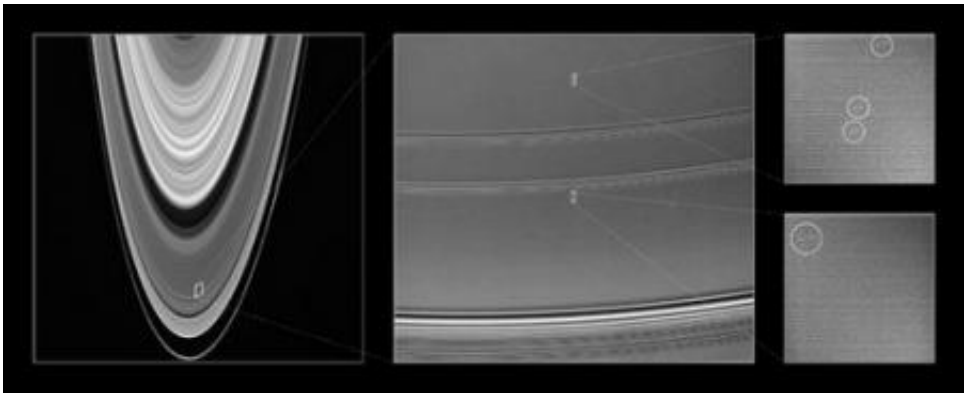

The left image shows the B ring, Cassini Division, A ring and F ring, with the location of the propeller-shaped disturbances indicated. The center image is a closer view of the A ring, showing the radial locations where propeller features were spotted. In the right-hand image, the propellers appear as double dashes in the two close-up images. The unseen moonlets, each roughly the size of a football field, lie in the center of each structure. (The horizontal lines in the image represent electronic noise and do not correspond to ring features.)

New observations of propeller-shaped disturbances in Saturn's A ring indicate the presence of four small, embedded moons -- and most likely millions more, Cornell University astronomers report.

This is the first evidence of the existence of moonlets bridging the gap in size between the larger ring moons Pan and Daphnis (several miles each in diameter) and the much smaller ice particles that comprise the bulk of

the rings. The discovery could lead to a better understanding of the origin and formation of Saturn's rings and the solar system as a whole.

Matthew Tiscareno, a Cornell research associate, is lead author of a paper describing the discovery in the March 30 issue of the journal *Nature*.

The four disturbances, which appear as pairs of slightly offset bright horizontal streaks in an otherwise bland region of the ring, were captured in two images taken in 2004 by NASA's Cassini spacecraft. Astronomers say the streaks are indicators of orbiting moons about 100 meters (328 feet) in diameter: about the length of a football field, but still too small for even Cassini's highly sensitive Imaging Science Subsystem (ISS) to see directly, but large enough to exert an observable gravitational pull on the particles around them.

"The discovery of these intermediate-sized particles tells us that Pan and Daphnis are probably just the largest members of the ring population, rather than interlopers from somewhere else," said Tiscareno.

A continuum of particle sizes lends strong support to the theory that Saturn's rings were formed when another object fragmented close to the planet, breaking into pieces which were then captured by Saturn's gravitational pull.

"There has always been the question about whether the rings were primordial material that was unable to grow into a moon or debris left over from a breakup event," said Joseph Burns, Cornell professor of astronomy and of theoretical and applied mechanics and paper co-author, along with Cornell research associate Matthew Hedman and researchers at other institutions. The discovery doesn't rule out the accretion model, but "it's a step in that direction," said Tiscareno. "It's hard for direct accretion to produce particles this large. It's much easier

if you start with a solid icy core, like a shard from a breakup."

The discovery also helps explain fully cleared openings such as the Encke and Keeler gaps within the rings. The gravitational influence of a larger moon like Pan or Daphnis wraps around the circumference of the rings, creating a gap. The smaller moonlets begin to create this effect, the researchers say, but their influence is not strong enough to prevent particles from falling into the rings ahead of and behind them.

Like a motorboat's wake on a smooth lake, the four observed disturbances are particularly visible since the area they inhabit is otherwise smooth. But the fact that four were found in just two images covering only a tiny fraction of the ring makes it likely that millions more exist. By studying them further, researchers hope to gain a better understanding of how Saturn's rings formed -- and even about how solar systems form around stars.

"The structures we observe with Cassini are strikingly similar to those seen in many numerical models of the early stages of planetary formation, even though the scales are vastly different," said Carl Murray, a co-author and astronomer at Queen Mary College, University of London. "In this way, Cassini is giving us unique insight into the origin of planets."

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. The Jet Propulsion Laboratory, a division of the California Institute of Technology, manages the mission for NASA.

During its Saturn tour, as currently planned, Cassini will complete 74 orbits of the ringed planet, 44 close flybys of the moon Titan and numerous flybys of Saturn's other icy moons.

Source: Cornell University