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Saturn's Shiny Rings May Be Pretty Young

Saturn's rings gild the jewel of our solar system, and their shininess has helped astronomers pin down their age. Data from NASA's Cassini mission show how fast dust has been pelting the Saturnian system, revealing that for the rings to have remained as shiny and dust-free as they are, they can be no more than 400 million years old, much younger than the planet itself.

The age of Saturn's rings "is an old question," said Sascha Kempf, lead author of the research and a physicist at the University of Colorado Boulder who studies cosmic dust. Astronomers' fascination with this problem "is not so much about the age itself, even not so much about Saturn," he said. "It's that this provides us with another puzzle piece about planet formation."

The Age of the Ring

The Sun and its planets formed around 4.5 billion years ago, and many of the planets' moons, including ours, followed not long afterward.

Astronomers initially thought that Saturn's rings formed during that early dynamical period, when large collisions were common. That would seem to be a natural outcome, Kempf said. The rings' orbits and compositions support the idea that they are old.

"But there was an uneasy feeling about all of that," Kempf added. For almost 200 years, scientists have understood that rings don't stick around for long. Collisions between the icy particles that make up Saturn's rings generate a "ring rain" that pours down into the planet's atmosphere.

Measurements of the rainfall rate and the total mass of the rings from NASA's Cassini spacecraft, which orbited Saturn for 13 years, suggested that the rings must be far younger than the planet; otherwise, they would have disappeared already.

It was a real needle in a haystack problem.

Cassini also revealed that the rings are fairly shiny, having accumulated only a small amount of cosmic dust—tiny silicate particles that come from the far reaches of the solar system or beyond.

Dust particles are constantly flowing. "You can't shut them off," Kempf said. Most Saturnian dust comes from within—Enceladus produces a lot, as do the rings themselves. But that "dust" is mostly water ice, whereas dust that comes from beyond Saturn contains more silicates, which darken the rings over time like dirt on fresh snow.

Because the rings don't have a lot of silicate dust on them, they likely haven't had a lot of time to collect it. Knowing the speed at which dust streams into the Saturnian system is therefore key to determining just how long the rings have been around.

Cassini's Cosmic Dust Analyzer did just that. Over 13 years, it detected more than 2 million dust particles. The research team analyzed the trajectory of each particle and found only 163 dust particles that likely came from beyond Saturn.

"It was a real needle in a haystack problem," Kempf said.

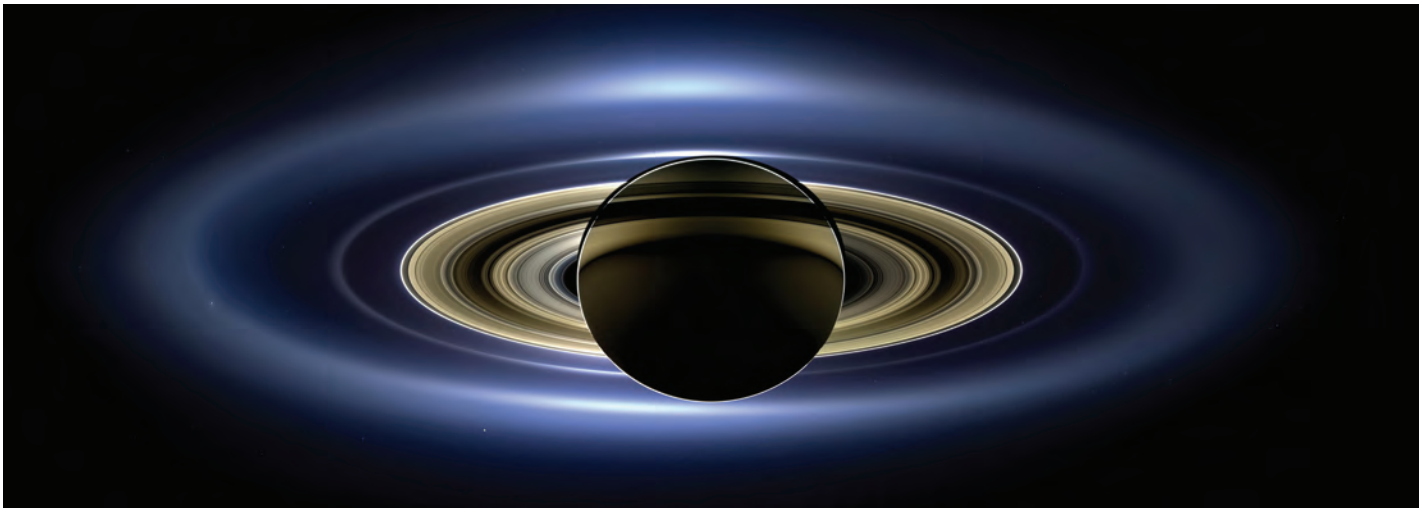
Considering how small an area of the rings Cassini sampled, 163 dust particles over 13 years extrapolates to a lot of dust moving through the rings. The team found that at that rate, the barely dusty rings have likely been around for just 100–400 million years. These results were published in *Science Advances* (bit.ly/Saturn-rings-age).

Shiny Snapshots

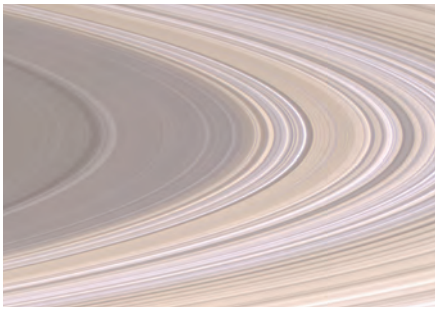
Even before the new finding, planetary scientist Philip Nicholson of Cornell University, who was not involved with the research, had been in the "young rings" camp. The new result built on some of his previous Cassini research on the mass and dustiness of the rings.

"Although the age of Saturn's rings has been hotly debated for many years, we have only really had good data bearing on this question since the Cassini mission," Nicholson said.

He added that the new age estimate is also consistent with past research that pins the



This mosaic of the Saturnian system was constructed from images taken by NASA's Cassini spacecraft while the Sun was hidden behind the planet. Credit: NASA/JPL-Caltech/Space Science Institute, Public Domain



Saturn's rings are dominated by water ice and naturally vary in color. Dust pollution creates more color variation. Credit: NASA/JPL/Space Science Institute, Public Domain

age of some of Saturn's small moons at 10–100 million years.

Despite the agreement with past results, forming a ring system "would require breaking up an icy body the size of the satellite Mimas—about 200 kilometers [125 miles] in radius—which is not easy to arrange so late in the history of the solar system," Nicholson cautioned.

The recent revelations about Saturn have certainly opened our eyes to the possibility that all of these ring systems may be relatively young.

"A prudent person would probably say that the case is still open, despite many groups' strenuous efforts to provide the key data with which to resolve it," he said.

Saturn isn't the only object in the solar system with rings. Jupiter, Uranus, Neptune, and several dwarf planets all sport them. Scientists lack the detailed information on those systems that Cassini provided for Saturn. Nevertheless, "the recent revelations about Saturn have certainly opened our eyes to the possibility that all of these ring systems may be relatively young," Nicholson said.

By **Kimberly M. S. Cartier** (@AstroKimCartier), Staff Writer

Supersized Potholes Discovered off South African Coast

South Africa's coast is renowned for mighty waves and world-class surfing. Those same breaks might have carved the world's largest marine potholes.

Researchers recently discovered a cluster of large depressions on the seafloor 90 meters (300 feet) below the ocean surface off the coast of Eastern Cape Province. That's far deeper than similar features elsewhere, said Andrew Green, a marine geologist at the University of KwaZulu-Natal in South Africa and lead author of a new study published in *Geomorphology* (bit.ly/marine-potholes).

Green and his colleagues believe the formations are marine potholes, circular depressions drilled into bedrock by grinding sediments. Potholes can form anywhere water swirls stones against bedrock, from river eddies to rainy hillsides.

In intertidal zones, constant waves send sediments corkscrewing. That phenomenon can result in a landscape pocked by small, grooved bowls. Most observed marine potholes are found no deeper than 50 meters below the surface—shallow enough for a scuba diver to visit, Green said. The Eastern Cape potholes sit on a seafloor almost twice as deep.

Once a site of crashing waves, the location would have been submerged as rising sea levels shifted the intertidal zone inland. The potholes may therefore reveal the location of an ancient seashore.

That is, if the pits are even potholes at all. Their depth is just one of the cluster's curiosities. Marine potholes rarely exceed 2 meters in diameter, but these depressions stretch up to 60 meters (200 feet) across. Compared with marine potholes in China, Hawaii, and Japan, Green said, "these things are orders of magnitude bigger." They are also unusually shallow: Their diameter-to-depth ratio is

Waves near Durban, South Africa, are known for surfing. They also may have created the largest marine potholes on Earth. Credit: Lynn Greyling/Pixabay