

Cassini may be dead, but a new era of Saturn science has just begun

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Saturn as seen by the Cassini spacecraft. Credit: NASA/JPL/Space Science Institute

NASA's Cassini mission to Saturn may have come to a fiery end in September, but observations made by the spacecraft in its final months still have plenty to teach us about the mysteries of the ringed planet.

Case in point: A new study finds that the electrically charged region of Saturn's atmosphere, known as the ionosphere, is significantly more complex and variable than scientists thought.

Cassini's instruments also found evidence that the ionosphere is strongly

affected by shadows cast by the rings. In addition, it might also interact with microscopic ice particles from the rings themselves in a phenomenon known as "[ring](#) rain."

The work was presented Monday at the American Geophysical Union conference in New Orleans, and will be published this week in the journal *Science*.

"Consider this a prelude of things to come from Cassini," said Hunter Waite, director of planetary mass spectrometry at the South West Research Institute, who was not involved in the study. "Saturn's ionosphere is much more complicated than anyone could imagine."

After traveling in the Saturn system for nearly 13 years, Cassini launched on a new trajectory in April that took the two-story-high spacecraft into the previously unexplored territory between Saturn and its rings—including through the top of the planet's atmosphere.

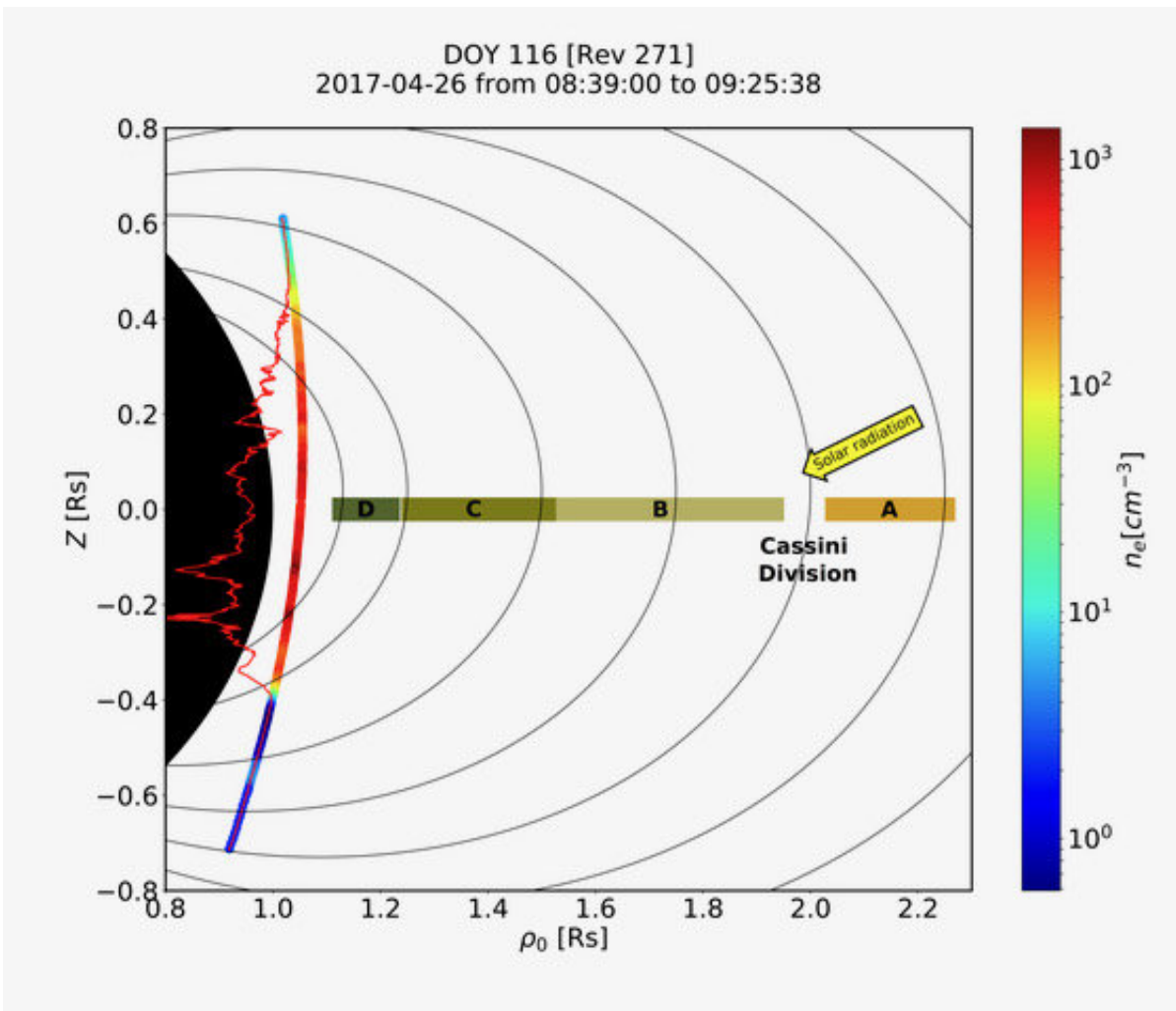
This allowed instruments on board the spacecraft to make in-situ observations of Saturn's ionosphere for the first time. Researchers had been able to study this region of Saturn's atmosphere using other methods such as radio occultation, but actually being there allowed them to take much more precise measurements.

"There is absolutely no substitute for being in-situ," Waite said. "It changed our whole perspective."

The new work is based on data collected by Cassini's Radio and Plasma Wave Science instrument (RPWS), which measures electron density in the planet's atmosphere.

The study is the first of what experts say could be dozens of papers describing this region of the planet.

William Kurth, the principal investigator for RPWS and a co-author of the study, said the new work is based on Cassini's first 11 passes through the space between the planet and the rings. The spacecraft would eventually make a total of 22.



Credit: Swedish Institute of Space Physics

"We thought we had gathered enough information to write a paper about Saturn's ionosphere that would be groundbreaking and set the stage for what would come," he said.

The researchers report large variations in the density of electrons as a function of latitude and altitude and also from one orbit to the next.

Some of these variations can be attributed to interactions with the rings, but not all of them, the authors said.

For example, the A and B rings cast shadows on the planet that are opaque enough to block the sun's ultraviolet radiation from hitting the atmosphere. Ultraviolet radiation can knock an electron off an atom and allow it to be free floating. Therefore, these shadowy regions have less [electron density](#) than other parts of the planet.

But that's only part of the story.

"We see other types of effects that appear to be relative to the rings, but we don't fully understand them yet," Kurth said. "Further analysis is due on that point."

The researchers also report that ring rain does not have a significant effect on the ionosphere at the equatorial regions of the planet, where the measurements in the new study were made.

However, they added that it is still possible that the water particles from the rings interact with Saturn's atmosphere at higher latitudes.

Kurth said much more about the structure of the ionosphere will become clear in the coming months as data from Cassini's other instruments are published. He said that already, behind the scenes, scientists are beginning to compare observations and work out what they all mean.

Waite agreed.

"We were wrong about the [ionosphere](#), but that's OK," he said. "Mother

Nature is always more imaginative than scientists."

More information: J.-E. Wahlund et al. In situ measurements of Saturn's ionosphere show that it is dynamic and interacts with the rings, *Science* (2017). [DOI: 10.1126/science.aao4134](https://doi.org/10.1126/science.aao4134)

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