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Saturn's Atmosphere Proves Deep, Its Rings Young

As Cassini reached its final act, Weizmann Institute of Science researchers took part in the last phase of the 20-year mission

Grand Finale was the official name of Cassini's last act: a risky orbit between the rings and the planet's atmosphere in a daring attempt to probe the planet from up close, right before the craft went up in flames. Prof. Yohai Kaspi and Dr. Eli Galanti of the Weizmann Institute's Earth and Planetary Sciences Department led one of the studies on Cassini's final mission, revealing the depth of Saturn's jet streams – the strongest measured in the Solar System with winds of up to 1,500 km per hour – and found them to reach a depth of around 9,000 km. Teaming up with research partners in Italy and the USA, their study also helped reveal the age of the planet's iconic rings. The findings of these studies were published today in Science.

Cassini was one of the more successful planetary missions, orbiting and returning information on Saturn and its moons for the last 20 years. But as the mission was approaching its end, it was decided to end its life with a non-circular orbit swinging in very close to the planet, followed by a final plunge into the gaseous mass. Kaspi and Galanti joined the Cassini team following their work as part of NASA's Juno science team, which had employed a similar orbit to produce the most reliable measurements yet of Jupiter's atmospheric depth. The Cassini scientists thought it would be possible to do the same for Saturn; the Weizmann scientists were called in to apply their methodology to the Saturn measurements. Kaspi describes the challenge: "We detect small variations in the gravity field as the craft orbits Saturn, and translate these into the atmospheric wind that produces them. There was no guaranty it would work for Saturn, as the gravity signal on Saturn is more difficult to interpret than what we had on Jupiter. We discovered that not only did it work for both planets, but that same physical processes control the depth of the flows on these two planets."

To calculate the depth of the winds, the gravity measurements undertaken by Cassini were analyzed with the theoretical model developed by the Weizmann researchers. Galanti says: "We also teamed up with a second group investigating the internal structure of the planet. Together, we calculated that the depth of the atmosphere is up to around 9,000 km. That is three times

deeper than that of Jupiter. We also found that, just as on Jupiter, a strong internal magnetic field is what limits the depth of this layer of the atmosphere. Our theory ‘worked’ twice, which is provides strong support for its validity.”

In the same study, the researchers analyzed the Grand Finale data from Saturn’s rings, finding they are a mere 10-100 million years old. That is quite recent in the 4.5-billion-year history of the Solar System: The planet in the night sky at the time of the first dinosaurs was, apparently, without the rings we know today.

Prof. Yohai Kaspi’s research is supported by the André Deloro Institute for Space and Optics Research; and the Schwartz/Reisman Institute for Theoretical Physics.

The Weizmann Institute of Science in Rehovot, Israel, is one of the world's top-ranking multidisciplinary research institutions. Noted for its wide-ranging exploration of the natural and exact sciences, the Institute is home to scientists, students, technicians and supporting staff. Institute research efforts include the search for new ways of fighting disease and hunger, examining leading questions in mathematics and computer science, probing the physics of matter and the universe, creating novel materials and developing new strategies for protecting the environment.

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