

Planetary scientists close in on Saturn's elusive rotation

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Radio waves produced near the poles of Saturn have been monitored by Cassini's Radio and Plasma Wave Science instrument (RPWS) since 2003. A team of European scientists have analysed several years of Cassini RPWS data to study the variations of Saturn's radio clock, or its large fluctuations, at a 1-2% level, over weeks to months. They have found that the variation in the solar wind speed near Saturn is probably responsible for the poor stability of the planet's radio clock. Interestingly, the solar wind speed does not vary randomly, but instead, follows a saw-tooth pattern, first building up in speed and then suddenly slowing down, and causing thus apparent rotation period fluctuations. Credits: Inset - NASA/ESA/JPL/University of Iowa/ Obs. de Paris Lesia (P. Zarka), Background - Magnetosphere: NASA, the Sun: ESA/NASA SOHO

Somewhere deep below Saturn's cloud tops, the planet rotates at a constant speed. Determining this interior period of rotation has proven extremely complicated. Now, with new Cassini results, a team of European scientists have taken an important step forward.

The results, published in *Nature*, are based on data from the Radio and Plasma Wave Science instrument on Cassini.

Determining the length of a day on one of the gas giant planets, has been difficult. The interior of the planet is masked completely by the clouds in the upper atmosphere. So to measure the internal rotation of the planet, scientists need a property that is associated with the interior and yet is observable from space. It proves to be radio emission.

Electrically charged particles trapped in the planet's magnetic field release radio waves with frequencies around 100 kilo Hertz. The magnetic field itself is generated deep inside the planet, so watching the variation of the radio emission as the magnetic field sweeps around can reveal the planet's rotation rate.

Using data, first from NASA's Voyager spacecraft, and over 15 years later, from Ulysses, scientists found that Saturn's period of radio emission varied. It was inconceivable that a planet could have slowed down by 6 minutes in a few decades. Cassini's near-continuous observations have also shown that Saturn's rotation rate seemed to vary by as much as one percent in a week.

Scientists concluded that something must be affecting the emission of radio waves from Saturn, rather than the rotation of the planet itself.

Now, after further careful analysis, Cassini's data strongly implicates the solar wind as the source of at least some of the radio period variation. It shows that there is a characteristic variation in the behaviour of the short-

period radio emission every 25 days. “This immediately points to the Sun because it is the rotation rate of the Sun as seen from Saturn,” says Philippe Zarka, CNRS, Observatoire de Paris, France, who led the research.

Zarka and colleagues analysed the properties of the solar wind and found that the speed variation of the wind is probably responsible. It does not vary completely randomly but instead follows a saw-tooth pattern, first building up in speed and then suddenly slowing down. Their analysis of this behaviour showed that it could induce the observed short period variation in the radio data period.

The work is not finished yet because the long-period variation must still be explained. This may be down to Enceladus. “The two phenomena could be superimposed upon each other,” says Zarka.

The team is now looking to remove the effects of the solar wind and deduce the true rotation rate of Saturn, a key to understand Saturn’s atmosphere and interior. Knowledge of the planet’s true rotation rate will allow planetary scientists to compare observations taken years apart and calculate the true wind speeds on the planet. Ultimately, the speed of rotation of the planet is linked to the way material is distributed inside the vast globe and so is a clue to the formation of the planet.

“If we can find the true value for Saturn’s rotation then we have it for once and for all,” says Zarka.

The results appear in, ‘Modulation of Saturn's radio clock by solar wind speed’ by P. Zarka, L. Lamy, B. Cecconi, R. Prangé and H. Rucker, published in *Nature*, on 8 November 2007. The results are also being presented today at the fall meeting of the American Geophysical Union, in San Francisco, USA.

Source: ESA

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