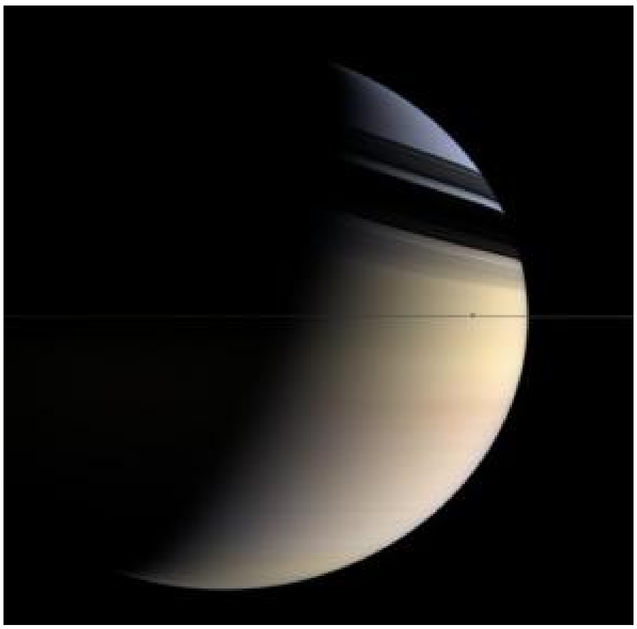
How long is a day on Saturn?

May 3 2006



Dreamy colors ranging from pale rose to butterscotch to sapphire give this utterly inhospitable gas planet a romantic appeal. Shadows of the rings caress the northern latitudes whose blue color is presumed to be a seasonal effect. Enceladus (505 kilometers, or 314 miles across) hugs the ringplane right of center. Credit: NASA/JPL/Space Science Institute

Measuring the rotation period of a rocky planet like the Earth is easy, but similar measurements for planets made of gas, such as Saturn, pose problems. Researchers from JPL, Imperial College London and UCLA present new results in this week's *Nature* (4th May 2006) that may solve the mystery. Using the magnetometer instrument on Cassini, they have found a clear period in the magnetic field of the planet that they believe indicates a day of 10 hours and 47 minutes.

This is a whole 8 minutes slower than NASA Voyager results from the early 1980s, and slower than previous estimates from another Cassini instrument. The magnetometer results provide the best estimate of the Saturn day to date, because it can see deep inside Saturn.

Planets rotate around their "spin" axes as they orbit about the Sun. Rocky planets like the Earth and Mars have rotation periods that remain quite constant and are easy to measure because we can see the surfaces rotate.

Gaseous planets do not have a solid surface to track and are not as rigid as rocky planets. Thus, their periods may change more than those of rocky planets while being less easy to measure. Scientists have sought to use proxy measures such as the repetition rate of radio signals or the period of the rotation of the direction of the magnetic axis of the planet. However for Saturn this has proved difficult because previous missions could not detect a period in the magnetic field measurements and whilst radio data have shown a period - it has changed in the time between previous missions and Cassini.

Since the Voyager days scientists have been seeing changes in the period of radio observations. They knew that it was virtually impossible to slow down or speed up a mass as large as Saturn. As Cassini's measurements of the rhythms of natural radio signals from the planet continued to vary, scientists began to realize these signals were probably not a direct measurement of the internal rotation rate. Suddenly the length of Saturn's day became uncertain. Measurements of the magnetic field help scientists "see" deep inside Saturn and may have finally solved this puzzle.

Professor Michele Dougherty of Imperial College London, says "Making this measurement has been one of team's most important science goals. Finding a period in the magnetic field rotation helps us to understand the internal structure of Saturn's magnetic fields and from that, of Saturn itself, which will help us understand how the planet formed. After almost two years of collecting data, we are starting to get fascinating insights in Saturn, but we still have more questions than we do answers."

According to Dr Giacomo Giampieri, a researcher at the Jet Propulsion Laboratory (NASA) and lead author of the paper, Saturn's rotation posed a great challenge to scientists in the past. In fact, Saturn's internal magnetic field is almost perfectly aligned with the rotation axis. To explain the consequences of this alignment, Giampieri says to consider a Compact Disc in a CD player.

"Imagine you want to check whether the CD is playing" Giampieri says "If your CD has a label it is easy to see at a glance that it is spinning very fast in the CD player. But if the CD has no label, you would not be able to tell whether the CD is moving or not because it would look static". Giampieri explains that "Saturn's magnetic field is similar to a blank CD: if you just look at it, it seems that it is not rotating at all."

In the past, Pioneer 11 and two Voyager spacecraft encountered Saturn during brief fly-bys and collected data, but no clear periodic signals were found in their magnetic field data. In July 2004 the Cassini spacecraft was inserted into orbit about Saturn and it now has completed many orbits around the gaseous planet. Thanks to the extent of data collected over this extended period of time and the use of appropriate algorithms, a small but regular periodic signature in the magnetic field close to the planet has been detected, with a period of 10 hours 47 minutes and 6 seconds (plus or minus 40seconds). This discovery is like finding a small spot on a CD that allows you to measure how fast it is spinning.

The result is somewhat surprising. Giampieri explains "the period we found from the magnetic field measurements has remained constant since Cassini entered orbit almost 2 years ago, while radio measurements since the Voyager era have shown large variability. By monitoring the magnetic field over the rest of the mission, we will be able to solve this puzzle".

The periodic signal of Saturn's magnetic field does not fit simple models for planetary magnetic fields. Giampieri explains "Saturn's periodic magnetic field differs from that found at Jupiter, which can be modelled as a dipole field tilted with respect to the rotation axis." This study opens a new perspective on the internal structure and dynamics of Saturn, and how it affects the source of the magnetic field. "We now know that the internal rotation of Saturn and its connection to the external magnetic field is very complex. Our study is the first step in breaking the code" Giampieri says.

Source: PPARC

Citation: How long is a day on Saturn? (2006, May 3) retrieved 3 May 2024 from https://phys.org/news/2006-05-day-saturn.html