Saturn’s aurora – not as we thought! Comment from UK scientists

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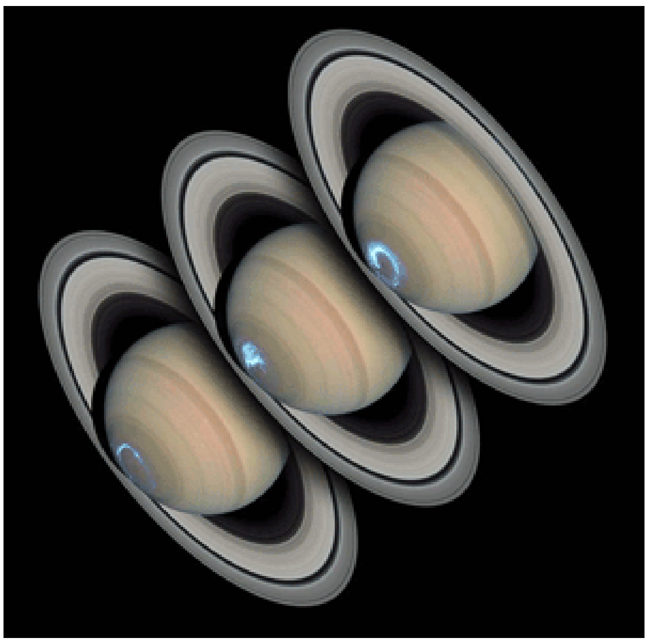

Results which combine data from the joint NASA/ESA/ASI Cassini Huygens space mission and the Hubble Space Telescope, published in Nature today (17th February 2005), reveal that Saturn’s auroras, long thought to be a cross between those of Earth and Jupiter, are in fact different and may even be unique to Saturn.

Over several weeks Hubble snapped ultraviolet images of Saturn’s aurora, whilst Cassini’s radio and plasma wave science instrument

(RPWS) recorded radio emissions from the same regions and the Cassini Plasma Spectrometer (CAPS) and Magnetometer (MAG) instruments measured the solar wind. All measurements were combined to reveal the most accurate glimpse yet of Saturn's auroras and the role of the solar wind in generating them.

The observations show that Saturn's auroras vary from day to day, as they do on Earth, moving around on some days and remaining stationary on others. But compared to Earth, where dramatic brightening of the auroras lasts only 10 minutes, Saturn's can last for days.

Professor Michele Dougherty from Imperial College is Principal Investigator for the Magnetometer instrument on Cassini and co-author on all three papers.

She explains more,

"These latest findings show that the Sun's magnetic field and the solar wind play a much greater role in Saturn's auroras than previously thought. Cassini measurements show that the auroras sometimes move along with Saturn as it spins on its axis whilst the Hubble images show that some displays remain still while the planet rotates beneath. This difference indicates that Saturn's auroras are driven in an unexpected manner by the Sun's magnetic field and the solar wind and in particular one big surprise is the fact that the magnetic field embedded in the solar wind plays a much smaller role at driving the aurora than we expected it to."

Dr Andrew Coates from the Mullard Space Science Laboratory, who heads up the team responsible for the electron spectrometer (part of CAPS) on Cassini, is a co-author on one of the papers along with his colleague, Dr Abigail Rymer.

He says, ""With our new results we are re-writing the textbooks on how the solar wind controls Saturn's beautiful aurora. Unlike the Earth the solar wind pressure dominates in driving Saturn's dynamic magnetosphere. It's like pushing a balloon on one side and the balloon distorts. This seems to be the dominant effect on Saturn."

Seen from space, an aurora appears as a ring of energy circling a planet's polar region. Auroral displays are spurred when charged particles in space interact with a planet's magnetosphere and stream into the upper atmosphere. Collisions with atoms and molecules produce flashes of radiant energy in the form of light. Radio waves are generated by electrons as they fall toward the atmosphere.

The team observed that even though Saturn's auroras do share characteristics with other planets, they are fundamentally unlike those on either Earth or Jupiter. When Saturn's auroras become brighter and thus more powerful, the ring of energy encircling the pole shrinks in diameter. Saturn's auroras become brighter on the sector of the planet where night turns to day as the storms increase in intensity, unlike either of the other two planets. At certain times, Saturn's auroral ring is more like a spiral, its ends not connected as the energy storm circles the pole.

Professor Stan Cowley from University of Leicester is a Co-Investigator on the Magnetometer instrument on Cassini. His team is involved in considering the theoretical consequences of these results.

"We are particularly interested in how the plasma dynamics in Saturn's magnetosphere associated with the compression produces an auroral spiral. This work has clear implications for the interpretation of future Cassini data and will centrally inform our thinking on plasma dynamics at Saturn for some considerable time to come."

The new results do show an aspect of Saturn's aurora that matches

Earth's however. Radio waves appear to be tied to the brightest auroral spots. Dr William Kurth from the University of Iowa explains, "We know that at Earth, similar radio waves come from bright auroral arcs, and the same appears to be true at Saturn. This similarity tells us that on the smallest scales, the physics, which generates these radio waves is just like what goes on at Earth, in spite of the differences in the location and behaviour of the aurora."

These findings appear in three papers published in the February 17th issue of Nature.

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