Beams of electrons link Saturn with its moon Enceladus

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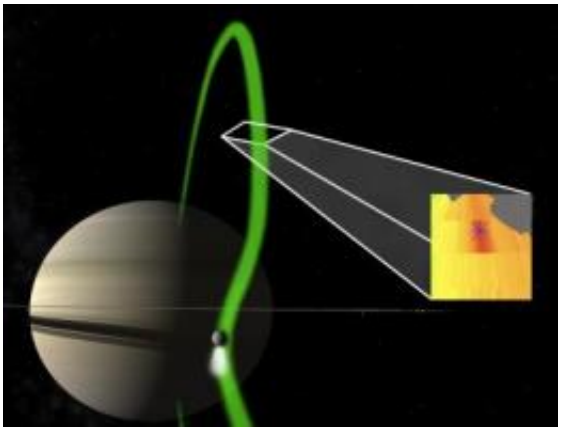


The green line provides an approximate trace of the magnetic field lines connecting Saturn's ionosphere with Enceladus and its south polar plume of gas and icy grains. The inset shows the electron beam viewed by CAPS-ELS during Cassini's encounter with Enceladus on Oct. 31, 2008. The centering of the electron beam on the position of the magnetic field (asterix) indicates that the electrons are flowing parallel to the local magnetic field. Credit: Geraint Jones, UCL

(PhysOrg.com) -- Data from NASA's Cassini spacecraft have revealed that Enceladus, one of Saturn's diminutive moons, is linked to Saturn by powerful electrical currents - beams of electrons that flow back and forth between the planet and moon. The finding is part of a paper published in *Nature* today.

CAPS, one of the instruments on board Cassini which made the electron beam discovery, includes a electron sensor called CAPS-ELS – led by UCL (University College London).

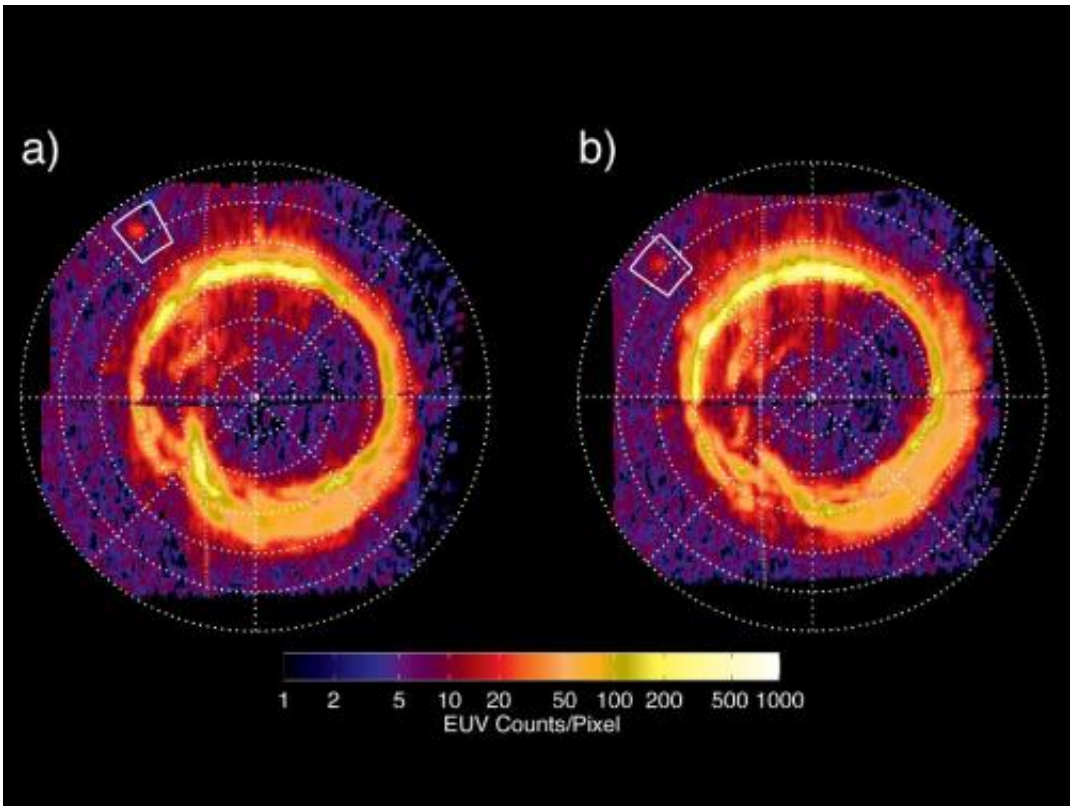
Since Cassini's arrival at Saturn in 2004 it has passed 500km-wide Enceladus 14 times, gradually discovering more of its secrets on each visit. Research has found that jets of gas and icy grains emanate from the south pole of Enceladus, which become electrically charged and form an ionosphere. The motion of Enceladus and its ionosphere through the magnetic bubble that surrounds Saturn acts like a dynamo, setting up the newly-discovered current system.

NASA's Cassini spacecraft has spotted a glowing patch of ultraviolet light near Saturn's north pole that marks the presence of an electrical circuit that connects Saturn with its moon Enceladus. Image credit: NASA/JPL/University of Colorado/Central Arizona College

Scientists already knew that the giant planet Jupiter is linked to three of its moons by charged current systems set up by the satellites orbiting inside its giant magnetic bubble, the magnetosphere, and that these current systems form glowing spots in the planet's upper atmosphere. The latest discovery at Enceladus shows that similar processes take place at the Saturnian system too.

The detection of the beams was made by the Cassini Plasma Spectrometer's electron spectrometer, CAPS-ELS, the design and building of which was led at UCL's Mullard Space Science Laboratory. UCL co-authors of the Nature paper, Dr Geraint Jones and Professor Andrew Coates, are delighted with this new finding.

Dr Jones said: "Onboard Cassini, only CAPS-ELS has the capability of directly detecting the electron beams at the energies they're seen; this finding marks a great leap forward in our understanding of what exactly is going on at mysterious Enceladus."



NASA's Cassini spacecraft has spotted a glowing patch of ultraviolet light near Saturn's north pole that marks the presence of an electrical circuit that connects Saturn with its moon Enceladus. This newly discovered patch occurs at the "footprint" of the magnetic connection between Saturn and Enceladus and indicates electrons and ions accelerating along magnetic field lines. White boxes indicate the location of this footprint, which scientists have long predicted but never before seen. The patch glows because of the same phenomenon that makes Saturn's well-known north and south polar auroras glow: energetic electrons diving into the planet's atmosphere. However, the footprint is not connected to the rings of auroras around Saturn's poles. The two images shown here were obtained by Cassini's ultraviolet imaging spectrograph on Aug. 26, 2008, separated by 80 minutes. The footprint moved according to changes in the position of Enceladus. In the image, the colors represent how bright the extreme ultraviolet emissions are. The lowest emission areas (one to two extreme ultraviolet counts per pixel) are in black/blue. The brightest emission areas (500 to 1,000 extreme ultraviolet counts per pixel) are in yellow/white. The footprint appeared at about 65 degrees north latitude. It measured about 1,200 kilometers (750 miles) in the longitude direction and less than 400 kilometers (250 miles) in latitude, covering an area comparable to that of California or Sweden. In the

brightest image the footprint shone with an ultraviolet light intensity of about 1.6 kilorayleighs, far less than the Saturnian polar auroral rings. This is comparable to the faintest aurora visible at Earth without a telescope in the visible light spectrum. The sun was illuminating Saturn's north pole from the left and the footprint is on the day side of the planet. The night side of the planet was to the right of the hashed line. Credit: NASA/JPL/JHUAPL/University of Colorado/Central Arizona College/SSI

Lead co-investigator of CAPS-ELS, Professor Coates, added: "This now looks like a universal process – Jupiter's moon Io is the most volcanic object in the solar system, and produces a bright spot in Jupiter's aurora. Now, we see the same thing at Saturn – the variable and majestic water-rich Enceladus plumes, probably driven by cryovolcanism, cause electron beams which create a significant spot in Saturn's aurora too."

The *Nature* paper in which the discovery is reported is co-led by Dr Wayne Pryor of Central Arizona College and Dr Abigail Rymer of the Johns Hopkins University Applied Physics Laboratory. The work also reports the presence of an ultraviolet auroral spot in Saturn's upper atmosphere, and of energetic ions flowing towards Enceladus: discoveries made using other Cassini instruments.

More information: 'The Enceladus Auroral Footprint at Saturn' is published in the April 21st issue of *Nature*.

Provided by University College London