CPS Plasma Page

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Newman Enlivens Third CPS Congressional Luncheon

On January 28, 2003, the Coalition for Plasma Science hosted its third in a series of luncheons designed to introduce Members of Congress and their staffs to the many facets of plasma science. The occasion marked the return of popular speaker Prof. David Newman from University of Alaska Fairbanks, who inaugurated this series of luncheons in March 2000 with a discussion of plasma as an educational tool. This time Newman focused on "Understanding Plasmas: From the Milky Way to Silicon Valley."

Following words of introduction from Lee Berry, Chair of CPS, Newman observed that because his talk was falling on the day of the State of the Union Address, and because plasma is the state of matter that makes up most of the visible universe, it might appropriately be titled "The State of the Universe Address." Questioning why we are – or should be – interested in plasma, he noted its role in fusion, manufacture of computer chips, and toxic waste clean-up. Newman included in this list the beauty of plasmas, such as those often observed as the *aurora borealis* in the sky above Fairbanks.

Two staffers from Alaskan Senator Murkowsky's office thank David Newman (left) and Lee Berry for the discussion.

Citing the Hubble space telescope's revolutionary ability to reveal the rich structures of space plasmas, Newman explained that it will take a great effort to understand such structures, through modeling and analytic theory.

He concluded that understanding plasmas has great potential benefits for society. Plasma in solar flares can bring down power grids and interfere with satellite signals. Understanding how plasmas respond to magnetic configurations could help provide a potentially endless source of energy, from fusion. Plasma thrusters may provide a lightweight source of propulsion for long-term space travel. Plasmas, already an important part of our lives in plasma TV displays, spark plugs and lighting, should be an even more vital part of our future.

Sounds of Space Plasma Inspire Work of Art

In a case of art imitating science, a musical composition involving the sounds of space plasmas has received its world premier and is touring the world.

Commissioned by the National Aeronautics and Space Administration (NASA), "Sun Rings" is a multimedia work for string quartet based upon the sounds of space collected on various spacecraft over the last 35 years by internationally known researcher Donald Gurnett. Written by renowned minimalist composer Terry Riley, it was premiered in the fall of 2002 by the world famous Kronos Quartet at the University of Iowa, where Gurnett is a space physicist. The accompanying visual production was designed by Willie Williams using numerous NASA space images. The production has since visited Houston and London, and will travel to Seattle and California.

Although a human being floating through space would hear nothing but silence, space plasmas can be noisy for a radio equipped with sensitive antennas. For one thing, "chorus emissions," or rising tones similar to the sound of chirping birds, result from the solar wind of electrically charged particles flowing outward from the sun and colliding with Jupiter's magnetosphere. Another sound is the "whistler," a rapidly descending tone caused by lightning discharges. Scientists have detected chorus and whistlers at Earth, Jupiter, Saturn, Uranus and Neptune.

For Gurnett, the interest shown by NASA's Art Program is an honor that adds to an already distinguished career. A member of the National Academy of Sciences, he is a veteran of more than 25 major spacecraft projects, including the Voyager 1 and Voyager 2 flights to the outer planets, the Galileo mission to Jupiter, and the Cassini mission to Saturn. Many of his space sounds were recorded as he made the first observations of plasma waves and low-frequency radio emissions in the magnetospheres of Jupiter, Saturn, Uranus and Neptune and discovered lightning in the atmospheres of Jupiter and Neptune.

The Cassini spacecraft is scheduled to begin a four-year exploration of Saturn, its rings, atmosphere and moons on July 1, 2004. Under a $9.6 million NASA contract, Gurnett and an international team of 18 co-investigators will use the craft's Radio and Plasma Wave Science Instrument to measure Saturn's powerful radio emissions, as well as its lightning discharges. Although it is impossible to predict all that Cassini will provide scientists, one thing is certain: Donald Gurnett will be adding to his collection of space sounds.

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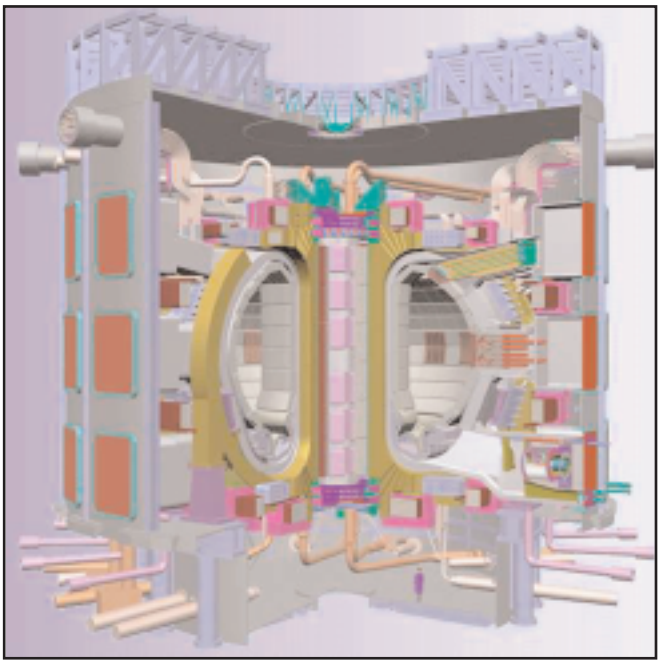
U.S. to Join Negotiations on Major International Fusion Project

In January, U.S. Secretary of Energy Spencer Abraham announced that the U.S. would join negotiations for the construction and operation of a major international magnetic fusion research project. Known as ITER, the project's mission is to demonstrate the scientific and technological feasibility of fusion energy.

"This international fusion project is a major step towards a fusion demonstration power plant that could usher in commercial fusion energy," Secretary Abraham said.

Fusion is the energy source that powers the sun and stars. In fusion, the nuclei of light elements, such as hydrogen, fuse together to make heavier elements, such as helium, giving off tremendous amounts of energy. ITER will use a "tokamak" concept — a toroidal (doughnut-shaped) magnetic configuration — to create and maintain the conditions for controlled fusion reactions on Earth. In ITER, superconducting magnet coils around a toroidal vessel will confine and control a plasma, and induce an electrical current through it. Fusion reactions will take place when the plasma is hot enough, dense enough and contained long enough for the atomic nuclei in the plasma to start fusing together.

ITER is expected to provide 500 megawatts of fusion power for 500 seconds or longer during each individual fusion experiment. ITER will demonstrate essential fusion energy technologies in a system that integrates physics and technology and will test key elements required to use fusion as a practical energy source. ITER will be the first fusion device to produce a burning plasma and to operate at a high power level for such long duration experiments. The fusion power produced in the ITER plasma is expected to be 10 times greater than the external power added to the plasma.



A cross-sectional view of ITER as presented on the ITER web site: http://www.iter.org/

Canada, the European Union, Japan and the Russian Federation have been negotiating ITER construction and operation since last year, recently joined by China. Candidate sites in Canada, the European Union and Japan have been proposed.

The U.S. proposes to provide a number of hardware components for ITER construction, to be involved in the project construction management and to participate in the ITER scientific research and technology development.

The construction cost for ITER, including buildings, hardware, installation and personnel, is estimated to be about $5 billion in constant 2002 dollars. However, since the cost will be shared among all of the parties, who will provide most of the components "in kind," the actual construction cost will be a combination of different amounts in different currencies. The U.S. share of the construction cost is expected to be about 10 percent of the total. ITER could begin construction in 2006 and be operational in 2014. Fusion research would last for up to 20 years.

For more information:
http://www.ofes.fusion.doe.gov/iter.html.
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Imaging the Invisible

Observations led by Southwest Research Institute (SwRI) using NASA's Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) spacecraft have provided the first images of Earth's plasma sheet using a medium-energy neutral atom (MENA) instrument. The observations revealed that the solar wind fills the sheet with high-density plasma that is later squeezed toward the Earth when the interplanetary magnetic field orientation points southward. These conditions correlate with the occurrence of geomagnetic storms that create aurorae and have the potential to disrupt ground-based electronic communications and harm orbiting satellites.

These findings may lead to a new, critical technique for monitoring and predicting space weather.

For more information:
http://www.gsfc.nasa.gov/news-release/releases/2002/h02-169.htm
NASA News, Release 02-169, Dec. 4, 2002
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These brief summaries are drawn from several sources and are issued throughout the year. For more information please contact the source given at the end of each article or the editor: rivenberg@psfc.mit.edu; 617/253-8101