CPS Plasma Page

Published by the Coalition for Plasma Science, Vol.4, No.2 June, 2001

Astronaut Chang-Diaz Speaks at CPS Congressional Luncheon

On March 29, 2001, the Coalition for Plasma Science hosted the second in its series of educational luncheon presentations on Capitol Hill for Members of Congress and Congressional staff. NASA Astronaut Franklin Chang-Diaz, Director of the Advanced Space Propulsion Laboratory at the Johnson Space Center in Houston, addressed the limitations of chemical rockets for space travel, and the necessity of turning to plasma propulsion to increase both payload and speed.

CPS Chairman Gerald Rogoff acted as MC for the event, opening with comments that included an introduction to plasmas and to CPS. For Franklin's introduction, he gave the podium to Representative Gene Green (D-Texas), a good friend of Franklin.

The Congressional sponsors of the event were Representatives Sherwood Boehlert (R-New York), Chairman of the House Science Committee, and Ralph Hall (D-Texas), the Ranking Member of the House Science Committee. The event was well attended, to a great extent by Congressional staff members from both the House and the Senate sides.

Plasma-science related topics for future Capitol Hill luncheons may include industrial applications of plasmas, plasmas and the environment, energy production, and space plasmas.

Franklin Chang-Diaz discussed plasmas and their importance to future space travel in his educational presentation.

For further information about plasma propulsion: http://spaceflight.nasa.gov/mars/technology/propulsion/aspl/

CPS Evaluates Plasma Education Web Sites for Teachers

Teachers need all the help they can get these days. Not only do they have the usual demands of planning a curriculum, but, increasingly, they have to ensure it meets state and/or national standards. In response, the Coalition for Plasma Science has created a web site that not only directs teachers to the best plasma education sites, but also analyses those sites against the national science standards.

Science teachers have been involved in this project from the beginning. Three educators from around the country were chosen to find and evaluate plasma-related education materials on the Web. With their input, CPS divided the site into five sections: Basic Information; Plasmas in Nature (e.g., space plasmas, lightning); Man-Made Plasmas (e.g., Fluorescent lamps, Fusion, Plasma Displays, Space Propulsion); Resources for Students; Resources for Teachers; and Local Plasma-related Outreach Programs.

Each web site listed comes with a brief evaluative paragraph. In most cases a teacher browsing the site can click on a round button next to a listing to discover exactly which of the national science standards the site satisfies.

CPS hopes that teachers will find the site useful, and that they will suggest other sites that should be included, or other plasma outreach programs that have proven valuable to their local areas. To access the education page, go to the CPS web site (http://www.plasmacoalition.org/) and choose "Educational Materials" from the side bar.

Please send comments to Paul Rivenberg, rivenberg@psfc.mit.edu

General Atomics Releases Free Fusion Education CD

The year is 2020 and the inhabitants of Fusion City are expecting at least 1000 Megawatts of electricity from their new, state-of-the-art tokamak reactor. You have been selected to start up the reactor, but first you must learn enough physics and engineering to sustain a burning plasma in the STAR2020 reactor and produce the needed energy.

No, this is not the recurring dream of someone in California who has suffered one too many brown outs. It is a fusion science adventure CD, Star Power, produced by General Atomics in San Diego.

Awarded a five-star rating from *Physics Education Journal* (March, 2001), this interactive CD educates the would-be operator about a variety of issues, including power generation, charged particles in magnetic or electric fields, isotopes and energy production. Once would-be operators prove competent in the basics, they are allowed into the control room, where they must shape the plasma and control its confining magnetic field, auxiliary heating and fueling.

The CD is most appropriate for high school, though science-minded middle school students would also find it stimulating. Copies are free of charge,

For more information contact: Carol Danielson, danielso@fusion.gat.com

Earth's Invisible Magnetic Tail

The first large-scale pictures of the hidden workings of the Earth's magnetic field confirm a suspected but previously invisible "tail" of plasma.

The tail, which streams from Earth towards the Sun, was spotted by NASA's Imager for Magnetopause to Aurora Global Exploration (IMAGE) spacecraft. It is featured on the cover of the Jan. 26. issue of the journal Science. IMAGE is offering researchers an unprecedented view of the transparent electrified gas trapped within Earth's magnetic field, providing the first visual, global perspective on magnetic storms.

The region laced by Earth's magnetic field, called the magnetosphere, dominates the behavior of electrically charged particles in space near Earth and shields our planet from the solar wind. Explosive events on the Sun can charge the magnetosphere with energy, generating magnetic storms that occasionally affect satellites, communications and power systems.

It is difficult for any one spacecraft, or even a small fleet, to obtain a coherent, large-scale view of activity in this vast region because the magnetosphere extends even beyond the Moon on the night side of the Earth.

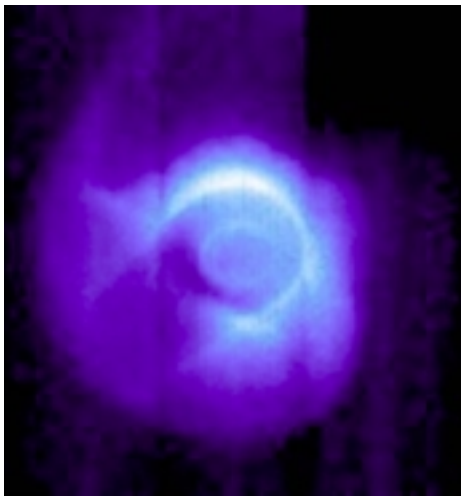
"Imagine trying to track and understand the formation of hurricanes without the view from weather satellites," said Dr. Thomas Moore, IMAGE Project Scientist at NASA's Goddard Space Flight Center. "Like the first meteorologists with a small number of measuring stations, we had an incomplete and at times misleading view of the magnetosphere before IMAGE, because we couldn't see the big picture."

"IMAGE is providing for the first time global views of the Earth's charged-particle populations at multiple wavelengths and energies on time scales of a few minutes, which is sufficient to track the dynamics of the magnetosphere," said Dr. James Burch, IMAGE Principal Investigator and lead author of the Science paper at Southwest Research Institute.

The Earth's magnetosphere traps plasma. The new IMAGE pictures show a tail-like structure in the Earth's own plasma cloud that forms as some of the gas streams toward the Sun. The structure was predicted 30 years ago, but previous spacecraft were unable to confirm its existence.

Although the Sun-pointing plasma tail was expected, IMAGE uncovered some surprises too. For one thing, the spacecraft discovered areas in Earth's plasma cloud that are nearly empty of plasma. The IMAGE team calls these unexpected structures "troughs" and is trying to determine how they form.

IMAGE, launched March 25, 2000, also revealed some surprising activity during magnetic storms, which occur when the solar wind pummels the Earth's magnetosphere. The nightside region of the magnetosphere, which is stretched out by the solar wind, sometimes snaps back and shoots plasma violently toward Earth. The plasma becomes heated to several hundred million degrees and whirls around Earth in multi-million-amp currents. IMAGE discovered that such plasma occasionally is most dense on the Earth's day side, which was unexpected. Researchers are currently studying the phenomenon.



The Extreme Ultraviolet imager (EUV) instrument on board IMAGE captured this picture of the ultraviolet glow from relatively cold plasma surrounding the Earth. A hook-shaped "tail" of plasma, near the top-left, streams toward the Sun. The small, faint circle near the center of the image traces ultraviolet radiation from aurora borealis.

For further information and images: http://science.nasa.gov/headlines/y2001/ast25jan_1.htm?list112104

Natural History Tells the Story of Plasma

Those in the plasma science community who have ever tried to write a general explanation about plasma - what it is, where it can be found, when it occurs, why it acts the way it does, how it affects our daily lives - know how difficult it is to put into words. Often the complexity of the topic overwhelms what is fascinating about plasmas.

In an article for *Natural History* (p. 46, May, 2001) Neil de Grasse Tyson finds an engaging way to present this information in an article entitled "Cosmic Plasma." Tyson, the Frederick P. Rose Director of New York City's Hayden Planetarium, is obviously in touch with how the general public appreciates science. After explaining how a plasma differs from a gas, and illustrating the strength of electric and magnetic fields, Tyson grounds his readers in "Earth's most conspicuous plasmas": lightning, the trail of a shooting star, and the spark you make when you've been walking on a carpet.

From there he leads the reader through the sun cycle, solar flares, solar wind, auroras, the magnetosphere and the ionosphere (a "plasma blanket") to fusion reactors and quark-gluon plasmas, finally ending with the beginning of the universe - all in three pages. Tyson never writes for long without including an interesting observation or grounding his audience in the familiar. This approach makes a sometimes difficult topic come alive and leaves the reader with a greater appreciation of the pervasive plasma state.

For further information contact: Natural History Magazine, http://www.amnh.org/naturalhistory/

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