

Utah Team Sparks CPS Enthusiasm at INTEL Science and Engineering Fair

Reno, Nevada – When high school students Walter Preston Hansen and Riley Densley set out to replicate a published air spark experiment, they were expecting to confirm the results. In the article, “The electric air arc is an MHD generator,” [see Proceedings of the 36th Intersociety Energy Conversion Engineering Conference, Savannah, GA, July 29 – August 2, 2001, p. 401] researchers N. Graneau, P. Graneau and G. Hathaway reported that electrical discharges in air could produce extra energy. In 2002, R. Antanasijevic et al. confirmed these results in the journal Physics Letters A, their simple air spark experiment showing more energy coming out than going in.

But after replicating the experiment, making what they determined were more precise measurements, and analyzing the data, Hansen and Densley concluded that in fact no excess energy was produced. The study brought these two students from Bingham High School in South Jordan, Utah, to the 2009 INTEL International Science and Engineering Fair (ISEF) in Reno, Nevada, where CPS judges found their investigation worthy of the CPS Award for Excellence in Plasma Physics, a \$1500 prize. The project, entitled “Energy from Spark Discharges – Amazing Overunity or Experimental Error?” also won the second prize for team projects (\$1500), presented by Science News.

CPS judges were impressed with the team’s careful measurements. Steve Allen noted, “Care was taken to provide the needed experimental precision and to analyze the errors. These guys even rented a high-voltage oscilloscope probe with a traceable calibration. This probe was, in turn, used to calibrate an identical probe that came with the oscilloscope.” CPS Chair, Lee Berry, was pleased that the students relentlessly pursued their results, despite the fact that they “went against

what they were hoping for.” Berry revealed that the students contacted the original researchers, who indicated that they “guessed the ISEF team had done a more careful experiment.”

Berry observed that the quality and quantity of plasma-oriented presentations had risen this year, many of the projects winning awards. Finalists for the CPS prize are listed below.



Walter Preston Hansen (left) and Riley Densley evaluated energy produced (or not produced) by a spark, correcting published research and winning the admiration of CPS judges. Photo/Lee Berry

A Relativistic Generalization of the Navier-Stokes Equations to Quark-Gluon Plasmas: Nilesh Tripuaneni, Clovis West High School, Fresno, CA. Intel Physics and Astronomy Best of Category Award (\$5000) and First Award (\$3000); U.S. Army Award (three \$1000 U.S. savings bonds, a gold medallion); American Mathematical Society Award – Honorable Mention.

Star in a Jar: Operating Parameter Relationships in an Inertial Electrostatic Confinement Fusion Reactor: Eric A. Foss, Kentwood High School, Covington, WA. Intel Physics and Astronomy Second Award (\$1500); Vacuum Technology Division of the American Vacuum Society First Award (\$1250).

CD Photo-spectroscopy: Construction of a Spectroscope Using a Compact Disk, a Digital Camera and Python Image Processing: Sayuri Sepulveda, Laval Liberty High School, Laval, Canada. American Association of Physics Teachers and American Physical Society Second Award (\$800).

The Dependence of GPS Accuracy on Ionospheric Electron Density: Cayley Erin Dymond, North Point High School for Science, Technology and Industry, Waldorf, MD. U.S. Coast Guard Fourth Award (\$500).

Optimization of a Machine for the Production of Carbon Nanotubes through an Arc Discharge at a Low Frequency: Fabiola Bogantes-Jimenez, Mabellin Fallas-Quesada, Yaoska Hernandez-Duarte, Colegio Tecnico Profesional de San Sebastian, San Jose, Costa Rica. Team Projects Second Award (\$1500).

The Effect of Switching on Lifetime and Life Cycle Cost of Compact Fluorescent Lamps and Incandescent Bulbs: Elizabeth Mari Mako, W.T. Woodson High School, Fairfax, VA. Intel Electrical and Mechanical Engineering Second Award (\$1500).

Plasma Projector: Blake Alan Birmingham, Leesville High School, Leesville, LA.

The State of the Universe is (mostly) Plasma

On March 30, Prof. David Newman of the University of Alaska, Fairbanks, presented a “State of the Universe” address to congressional representatives and their staffs, among others. Subtitled “Understanding Plasmas – In Nature and Application,” the talk revealed that the state of the “known and visible” universe is 99% plasma. CPS Vice Chair Gerald Rogoff introduced Newman, who had inaugurated the program in March 2000.

As in the past, Newman presented a brief but broad introduction to plasma - what it is, why studying it is important, where it appears in the universe and how

it is used on earth in various applications. Newman moved from magnetic arcs on the sun, to the solar wind, interstellar space, lightning, blue jets and sprites before dwelling on fusion and the high temperatures and densities the process requires.

The topic of fusion led to a discussion of potential future plasma applications, including the transmutation of nuclear waste. Newman also suggested that the study of turbulence in plasmas could provide insights that could be applied to other complex systems, like the ash plume from the recent eruptions of Alaska’s

Redoubt Volcano, which had nearly caused Newman’s flight to Washington to be cancelled.

Newman ended his talk with a demonstration of how a spark plug works, using a corked bottle containing air and a little bit of alcohol, with two closely spaced electrodes extending to the outside. Applying a hand-held tesla coil to the bottle created a plasma “spark” between the electrodes, which explosively vaulted the cork to the ceiling. Newman suggested that the plasma physics of spark plugs would make an interesting topic for a future CPS event or publication.

Danielson Honored for Years of Outreach Success

Former CPS Steering Committee Member Carol Danielson was honored at the 50th annual meeting of the American Physical Society – Division of Plasma Physics (APS-DPP), November 2008, for her outstanding contributions to the DPP education and outreach activities. Having retired in June 2008 from General Atomics, where she was Manager of Energy Publications and Presentations, Danielson attended the meeting not in her familiar role as organizer of the popular “Plasma Sciences Expo,” but as a special guest of the DPP. The award was presented to her at a luncheon during Science Teachers Day, a day of workshops and hands-on demonstrations that Carol had helped shape over a decade ago.

Carol has been honored for her education work throughout her thirty-year career at General Atomics. Originally a graphic artist in the Energy Group, she became involved with fusion outreach in 1994 when she was asked to organize exhibitors from around the U.S. for the first “Fusion Forum” in Washington, DC – an event tailored to communicate the importance of plasma science and fusion research to members of Congress and their staffs in a language they could understand. As Danielson puts it, “That meant trying to entertain them with toys.”

Danielson’s talent for graphics and down-to-earth facility with science education made her a natural for helping with GA’s increasing K-12 outreach efforts. Some of the graphic materials and publica-

tions she helped create at that time are still being used to engage students with plasma science.

In 1996 she became involved in planning outreach events for the APS-DPP meeting in Denver – including a Science Teachers Day and a Plasma Sciences Expo (for students). The stunning success of this effort created a model for organizing future APS-DPP outreach, and solidified Carol’s reputation as a fusion education leader. She was instrumental in establishing the DPP education outreach committee that continues to plan these events.

Danielson’s CV includes numerous local and national awards. California’s 51st district even recognized her professional accomplishments by declaring May 27, 1999 “Carol Danielson Appreciation Day.” Carol’s impact on national science education has also been recognized by the U.S. Department of Energy. Their Distinguished Associate Award, presented in March 2000 and signed by then Secretary of Energy Bill Richardson, applauded her “critical role in organizing and sustaining national and international education outreach activities as a part of the U.S. fusion program,” including organizing the first U.S./Russian Olympiad on Physics, which was conducted via the internet. That same year Fusion Power Associates recognized her with their “Special Award for Education and Outreach.”



Carol Danielson stands before the Pegasus Ballroom at the Hyatt Regency Dallas, where she was honored for her outstanding service to the plasma science education community. Photo/Paul Rivenberg

CPS has been fortunate to have Carol on their Steering Committee for the past decade, where she guided the “Plasmas Are Everywhere” materials through design and publication. Her contributions to CPS monthly conference calls, her expertise with publications and her sense of humor will be missed. Reflecting on her years involved with science education, Carol realized, “I really accomplished much more than I had ever envisioned doing,” and gave credit to her friends and coworkers in the fusion outreach community. “Thanks to all of the outreach people for their support and encouragement; without all of them I would not have accomplished very much.”