Nuclear security, deep water drilling, black hole signal flares and more at 2011 APS annual meeting

EurekAlert

The physics of deep water drilling, new energy technologies, science at the LHC, tests of gravity at both very large and small scales, and much more cutting edge science will be featured in talks at this year's April meeting of the American Physical Society (APS). The meeting runs from April 30 to May 3 at the Hyatt Hotel Orange County in Anaheim, CA.

Journalists are invited to attend the meeting free of charge. Registration information can be found at the end of this release.

MEETING HIGHLIGHTS

The items below highlight some of the interesting talks and sessions at the meeting.

WATCHING NUCLEAR REACTORS WITH NEUTRINOS

Under the Nuclear Non-Proliferation Treaty, the International Atomic Energy Agency (IAEA) has installed nuclear safeguard systems to monitor nuclear reactors. These systems, while effective, lack certain attractive features: they cannot provide real-time monitoring of reactor activities and some of them interfere with reactor operations. Antineutrino detectors can provide a continuous, real-time, and less intrusive method for monitoring reactors, according to Fangfei Shen of the Massachusetts Institute of Technology. This proposed safeguards system, tested at reactors in Russia and the United States, is a spin off from antineutrino experiments, many of which use reactors to produce antineutrinos. Monitoring antineutrino flux can detect illicit activities in reactors, such as the diversion of plutonium. Sensitivity to changes in fissile content in a few months using only antineutrino data has been demonstrated with greater than 99 percent confidence. In the last few years, the IAEA has begun to consider the potential of this technology for its reactor safeguards regime, said Gregory Keefer of Lawrence Livermore National Laboratory (LLNL). An upcoming experiment, to be described by Timothy Classen of LLNL will monitor antineutrinos at a nuclear reactor in Canada through its construction to operation.

Q13.00001 — http://meetings.aps.org/Meeting/APR11/Event/146368 [1]
Q13.00002 — http://meetings.aps.org/Meeting/APR11/Event/146369 [2]
Q13.00003 — http://meetings.aps.org/Meeting/APR11/Event/146370 [3]

DEEP WATER DRILLING

Kenneth Gray, of the University of Texas at Austin, will talk about his recently-

patented Dynamic Density Control (DDC) system that might soon make drilling deepwater wells safer, faster and more economical. He will also introduce some of the technical terms surrounding deepwater drilling and describe the challenges posed by extreme depths and high pressures. Jonathan Katz, of Washington University in St. Louis, will talk about the failure of mineral slurries — or mud — to kill out-of-control wells from above, as in the case of the Macondo/Deepwater Horizon oil well. Adding a new polymer to the slurry mix could enable the mix to successfully kill a well. Brian Clark, of Schlumberger, an oilfield services provider, will give an overview of the role of physics in drilling, for example in locating hydrocarbons. Hydrocarbons are found largely in crude oil, where decomposing organic material produces large amounts of carbon and hydrogen that bond to form hydrocarbons.

Q5 —
http://meetings.aps.org/Meeting/APR11/SessionIndex2/?SessionEventID=146308 [4]

SIGNAL FLARES FROM THE CENTER OF THE GALAXY

The recently-identified black hole at the center of our galaxy, likely part of the Sagittarius A* ("Sagittarius A-Star") radio source, appears to be producing flares similar to those given off by our Sun. The black hole's flares, which are emitted at radio, millimeter, infrared and X-ray wavelengths, are much more energetic than flares coming from the Sun. Farhad Yusef-Zadeh, of Northwestern University, will talk about the discovery of these flares and his attempts to learn how they are physically related to one another. "We don't know exactly where [the flares are] being produced, but we think it is very close to the event horizon of a black hole," Yusef-Zadeh said. The event horizon is the turning point at the edge of a black hole where material wandering by is sucked in with no hope of return and where space and time are distorted. The team has also noticed that there is a time delay between the observation of infrared flares and X-ray flares. They hypothesize that the X-ray flares are echoes of the infrared flares. If they are correct, it would confirm a theoretical model about black hole flaring called inverse Compton scattering.

L3.00002 -
http://meetings.aps.org/Meeting/APR11/SessionIndex2/?SessionEventID=146203 [5]

A NEW WAY TO CREATE ELECTRICITY FROM CHEMISTRY

When atoms and molecules interact at a surface, a lot of chemistry goes on, some of it still surprising. One idea that had been understood as possible for decades is now being shown to actually work at a practical level: the chemovoltaic (CV) effect. The CV effect happens when a chemical reaction taking place at the surface of a material also creates high-energy electrons in the material that can be used as a source of electrical current. This is in contrast to a fuel cell or battery that requires separate anodes and cathodes with materials to separate positive and negative charges between them, making them bulky. New studies by Eduard Karpov, of the University of Illinois at Chicago, have shown that through the CV effect hydrogen-to-water oxidation can occur next to platinum-based surfaces just nanometers thick. In

this way, the CV effect can exceed other electronic effects that have been well known for some time, leading to the possibility of novel energy transport devices to compete with fuel cells and batteries.

E13.00007 — http://meetings.aps.org/Meeting/APR11/Event/145841 [6]

TESTING GRAVITY WITH LEVITATED MICROSPHERES

Gravity is the least understood among the forces of nature. According to some theories, the gravitational interaction between objects will show an anomalous increase at distances under a millimeter. Andrew Geraci of the University of Nevada and colleagues at the National Institute of Standards and Technology are developing a supersensitive gravitational test that relies on levitating tiny glass spheres. The spheres are suspended and cooled in a virtual container made from lasers. Slight displacements of the beads that occur when heavy objects are placed nearby should reveal any exotic forces beyond those produced by gravity at larger scales. The researchers propose that the new method could be over 100,000 times more sensitive than previous gravitational experiments at micrometer distances.

T13.00002 — http://meetings.aps.org/Meeting/APR11/Event/146546 [7]

SCREENING NUCLEAR MATERIALS WITH GAMMA RAYS

Researchers at Duke University's High Intensity Gamma-Ray Source (HIGS) are investigating a new method for distinguishing enriched uranium, which could be developed into nuclear weapons, from the more benign, depleted form of the heavy metal. To accomplish the feat, the researchers irradiated uranium samples with a high-energy polarized gamma-ray and measured the pattern of neutrons the samples emitted. Eventually, the technique may lead to a novel method of detecting enriched uranium in cargo containers. Jonathan Mueller, of Triangle Universities Nuclear Laboratory, will describe the progress in developing the screening method as well as their efforts in developing a model to explain the unexpected differences in neutron patterns the two types of uranium emit under gamma-ray exposure.

Q10.00007 — http://meetings.aps.org/Meeting/APR11/Event/146350 [8]

FASTER THAN LIGHT PARTICLES ILLUMINATE BIOLOGY

Cerenkov radiation is emitted by particles that move faster than the speed of light in a given material. Although the radiation has been helpful for gathering data in particle detectors for years, biologists working with radioactive isotopes have just begun to make use of it in living organisms. Cerenkov Light Imaging (CLI) can be done with charge-coupled devices (CCDs) typically used for fluorescence or bioluminescence imaging. Nicole Ackerman, of Stanford University, will present simulation results in comparison to data collected from living creatures and tissue samples at the Stanford Small Animal Imaging Core Facility in an attempt to get a handle on the limitations of the imaging technique.

L7.00003 — http://meetings.aps.org/Meeting/APR11/Event/146223 [9]

EXPLORING THE DIGITAL DIVIDE

In the first decade of the 21st century, huge progress was made in bridging the digital divide between developed and developing nations. This was largely due to the explosive growth of mobile technologies, which saw mobile cellular subscriptions rise from under 500 million to over five billion in just ten years. With household mobile phone penetration rates of over 50 percent even in rural areas of developing countries, the dream of bringing all the world's people within reach of communications technology has been achieved, Hamadoun Tourè, Secretary-General of the International Telecommunications Union, said. In his talk, Tourè will argue that we must now replicate the mobile miracle for the Internet, and especially broadband. Meanwhile there has been progress in South America, where a network of optical cables has been laid. The network is enhancing advanced computing applications and collaboration there, Michael Stanton, of the Brazilian National Research and Education Network, said. The African continent, however, is falling further behind the developed world, Roger Cottrell of the SLAC National Accelerator Laboratory said, but potential can be seen through the huge boost in optical fiber connectivity improvements ahead of soccer's 2010 World Cup held in South Africa.

J6.00001 — http://meetings.aps.org/Meeting/APR11/Event/146754 [10]
J6.00002 — http://meetings.aps.org/Meeting/APR11/Event/146755 [11]
J6.00003 — http://meetings.aps.org/Meeting/APR11/Event/146097 [12]

LHC MEDIA AVAILABILITY

A large suite of talks will discuss the latest results from the Large Hadron Collider (LHC) at CERN, the European Organization for Nuclear Research. Earth-shattering results are not expected at this meeting but there will be many scientists available to discuss what has been achieved so far, including the replication of the discovery of the standard model of particle physics and what is expected to come in the next year's running. LHC representatives will be available to speak with the media about the latest results.

Various sessions including overviews in Session R2 — http://meetings.aps.org/Meeting/APR11/SessionIndex2/?SessionEventID=148085 [13]

PHYSICS FUN FOR EVERYONE

Session C13, devoted to educating and exciting the public about physics, will answer questions like: Is it possible for a TV program to be both funny and scientifically accurate? Bill Prady, the executive producer and co-creator of The Big Bang Theory, will talk about the first TV comedy to employ a physicist consultant and how the show brings together science and entertainment. Or, why do humans place artificial barriers between fields of study, like art and science, when people from different disciplines could benefit from one another, like a neuroscientist learning new problem-solving methods from a filmmaker? K.C. Cole, of the

University of Southern California's Annenberg School for Communication & Journalism, will talk about overcoming the tendency to force subjects into confining categories. Linda Shore, from the Exploratorium science museum in San Francisco, will talk about the museum's goal of encouraging children and adults to do science both at the museum and at home.

C13 —
http://meetings.aps.org/Meeting/APR11/SessionIndex2/?SessionEventID=146921 [14]

SUPERCONDUCTIVITY CENTENNIAL

Session J2 celebrates the centennial of the discovery of superconductivity. Peter Pesic, of St. John's College, will talk about Heike Kamerlingh Onnes and his colleagues who discovered superconductivity in 1911. David Larbalestier, of Florida State University's National High Magnetic Field Laboratory and Department of Physics, will talk about the superconducting materials developed over the last century as well as about strategies for creating new superconducting materials over the next century. Anthony Zee, of the University of California, Santa Barbara, will talk about "superconductivity beyond superconductors," discussing superconductivity's role in particle physics and quantum field theory.

J2 —
http://meetings.aps.org/Meeting/APR11/SessionIndex2/?SessionEventID=146809 [15]

ATOMIC NUCLEUS DISCOVERY CENTENNIAL

This year marks the centennial of the discovery of the nuclear structure of the atom. Session C1 will celebrate Ernest Rutherford's nuclear model for the atom. Before Rutherford's discovery, scientists thought that electrons were scattered in atoms like raisins in a plum pudding (Thomson model). Rutherford discovered that electrons were in orbit around an atomic nucleus, a discovery he called the "most incredible event" in his life. "It was almost as incredible as if you had fired a 15-inch shell at a piece of tissue paper and it came back to hit you," Rutherford said of his experimental results. John Heibron, of the University of California, Berkeley, will talk about Rutherford and his colleagues, including Niels Bohr and Charles Darwin (grandson of the famous naturalist). Suman Seth, of Cornell University, will discuss several early atomic models that followed the Rutherford discovery. Nobel laureate Jerome I. Friedman, of the Massachusetts Institute of Technology, will talk about the Rutherford model's continuing influence on modern work in sub-atomic physics.

C1 -
http://meetings.aps.org/Meeting/APR11/SessionIndex2/?SessionEventID=146807 [16]

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