Ames Lab's Victor S.-Y. Lin

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DOE Pulse

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Research Highlights . . .

Catching the sun's rays with wire

Traditional solar cells are expensive to manufacture and convert only a small fraction of the light that hits them. At DOE's Idaho National Laboratory, researchers are designing an alternative – nanoscale antennas that capture infrared energy from the sun. The antennas are made by stamping tiny square spirals of conducting metal onto a sheet of plastic. The flexible, inexpensive circuitry resonates when infrared light hits it. The more efficient technology, developed by Dale Kotter and Steven Novack of INL and Patrick Pinhero of the University of Missouri-Columbia, was awarded two Nano50 awards in June. Next research steps include battery storage and conversion to usable current frequencies.

[Rachel Courtland, 208/526-4595, Rachel.Courtland@inl.gov]

A benign way to nanowire living cells

One day it may be possible for physicians to use electrical stimulation to guide the development of embryonic stem cells into neurons, heart cells, lung cells, breast cells, muscles, and other specific cell types. Researchers at DOE's Berkeley Lab and their collaborators have taken a critical first step toward that goal. They've developed a technique by which silicon nanowires can be embedded in a living cell, with no apparent harm to the cell. The technique can be used to connect individual cells to one another and to wire the cells to external sensors and other electronic devices. It may also have the potential to deliver genetic material to specific organelles within a cell. "This is the first example of nanowires interfacing with biological cells without the use of external force," says chemist Peidong Yang, who led the research.

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Spare parts turn into potential discovery tools

A borrowed high-power laser, a spare superconducting magnet and $30,000: for ten scientists at DOE's Fermi National Accelerator Laboratory, this was all it took to assemble a cutting-edge particle physics experiment. The resulting Gamma-to-milli-electron volt experiment will either confirm or refute the evidence for a new type of particle reaction observed by the PVLAS experiment at the Legnaro National Laboratory in Italy. The GammeV experimenters send laser light through a strong magnetic field, looking for the production of a new type of particle that is a billion times lighter than an electron. If the PVLAS result is confirmed, it will mark the surprising discovery of a new subatomic force.

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Los Alamos tracks "killer electrons"

Using data from satellites, Los Alamos scientists have developed models that show how interactions between electromagnetic waves and electrons are responsible for accelerating radiation-belt particles in the Van Allen belts to the point where they become "killer electrons—energetic particles that are hazardous to satellites, spacecraft, and astronauts. The Van Allen radiation belts are doughnut-shaped magnetic fields encircling Earth comprised of high-energy electrons and ions. The new empirical models will be used by engineers to design radiation-hardened spacecraft, while the physics-based models will be used by forecasters to predict geomagnetic storms and alert both astronauts and spacecraft operators to potential hazards.

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DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. *DOE Pulse* (www.ornl.gov/news/pulse/) is distributed every two weeks. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

Nuclear physicists reach for the stars

Jefferson Lab's Excited Baryon Analysis Center is helping nuclear physicists make the stuff of stars out of ordinary matter. Probing the properties of this "stuff" could provide key insights for understanding the evolution of real stars in the early universe.

"The research we're doing has consequences, not only in nuclear physics, but also in astrophysics and other fields," says Harry Lee, EBAC leader and joint Jefferson Lab and Argonne National Lab senior scientist. Established in January 2006, EBAC is the first of the Department of Energy Topical Theory Centers.

It resides within Jefferson Lab's Theory Center and provides theoretical support to worldwide experiments probing the structure of excited baryons. Baryons, such as protons and neutrons, are building blocks of ordinary matter. However, the baryons inside stars are thought to be more than just protons and neutrons.

"In a star, the density and temperature could be very, very high, so the matter there has not only regular protons and neutrons, but also their excited states, what we call the N-star (N*) states," Lee explains. To really understand our universe, he says, it's important to understand all the forms matter can take, including these excited states.

One could liken the normal and excited states of a baryon to a vibrating telephone cord. During a phone call, the cord often moves up and down —slowly and evenly. This gently swaying cord is like a regular baryon. Now twang the cord, giving it more energy. The cord now has more ripples in it, and that's like an excited baryon.

To find out how the properties of excited baryons differ from their regular counterparts, scientists are using accelerators to produce these particles. For instance, the N* program in Jefferson Lab's Hall B aims to make excited baryons that have never before been seen.

One goal of EBAC is to further develop and apply theories to existing data. These theories may help scientists squeeze more information about the properties of the excited baryon from the data, allowing experimentalists to get more information from their data and to design better future experiments.

These new theories may serve as tools for eventually tackling one of the most difficult problems in nuclear physics: Linking the description of matter's building blocks to quantum chromodynamics, or QCD, the most fundamental theory yet for describing how these building blocks make up matter. If that can be established, the potential benefit is enormous, according to Lee.

Submitted by DOE's Jefferson Lab

AMES LAB'S VICTOR LIN
A BUSY MAN

Victor S.-Y. Lin

Take on two major directorships within a month's time and your life goes up a level or two on the hectic scale. Ames Laboratory chemist Victor S.-Y. Lin can attest to that. But he'd also tell you that he thrives on the challenge and demand of those positions and finds the work extremely satisfying.

Lin, who is also an Iowa State University chemistry professor, specializes in the synthesis of functional nanomaterials as catalysts for various reactions, such as biodiesel production and other biorenewable applications. Considered one of the world's experts in the basic science of catalysis and the application of catalysts in agriculture, industry and even medicine, Lin was appointed director of the ISU Center for Catalysis in July.

"Although catalysts are widely used in industry, I believe we have only started to tap their potential to make all kinds of processes more efficient and environmentally friendly," said Lin. "Catalysts are also the key to making biorenewable energy a viable alternative to fossil fuels."

In August, Lin took on his second directorship when he was selected to head up Ames Laboratory's Chemical and Biological Sciences Program. "I'm excited by the opportunity to lead the program at this time," Lin said.

"The Department of Energy's Office of Basic Energy Sciences is refocusing its efforts in four chemistry-related research areas—bioenergy, hydrogen, solar and nuclear—and I feel we have all the key components to match up nicely with this new emphasis."

According to Lin, catalysis is a vital step in producing energy, whether it's converting biomass into ethanol or biodiesel, turning solar energy into electricity or chemical energy, or producing hydrogen for use as a fuel or to generate electricity. As Chemical and Biological Sciences program director, Lin plans to create more interdisciplinary teams to tackle problems in the areas of synthesis, characterization, spectroscopy and computation to better leverage Ames Laboratory's strengths in catalysis and materials.

Submitted by DOE's Ames Laboratory