



SRNL's Joe Cordaro



Science and Technology Highlights from the DOE National Laboratories

Research Highlights . . .

Sandia researchers predict worldwide water shortage By 2025 more than half the nations in the world will face freshwater stress or shortages. By 2050 up to 75 percent of the world's population could face freshwater scarcity, according to Sandia National Laboratories water experts Mike Hightower and Suzanne Pierce in an article published in Nature. Freshwater withdrawals already exceed precipitation in many parts of the U.S., frequently in areas with the greatest population growth, such as the Southwest. Solutions will involve all water sources — more than just freshwater supplies — and require innovative treatments, such as those using advanced membrane separation technologies, applied to nontraditional water sources such as wastewater and seawater.

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New software HUSTLES to identify proteins

As the mass of proteomics data continues to grow, the challenge of discovering what job a specific protein does also increases. Scientists have effective tools for identifying proteins that are similar in function and composition, or sequence. But it is far more difficult to detect remote homologs, proteins with similar function but largely dissimilar sequence. Researchers at Pacific Northwest National Laboratory have developed software that outperforms current methods for remote homolog identification. SVM-HUSTLE was created under the laboratory's Data-Intensive Computing Initiative and DOE's Office of Advanced Scientific Computing Research Bio-Pilot project. It can be downloaded without charge. The research was published in the March issue of *Bioinformatics*.

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Brains in the beamline

From X-rays to MRIs, advances in physics have been instrumental in improving human health. A new imaging technique developed at the Stanford Linear Accelerator Center (SLAC) may represent the next big advance for biological imaging. The new method, called biological rapid scanning or X-ray fluorescence (XRF) imaging, uses the intense X-rays to reveal the identities of trace elements in a scanned sample. Currently being used to study neurodegenerative diseases, the technique is an advance over earlier microprobe X-ray analysis because it's very fast, scanning in one hour what used to take nearly 12 days to scan. XRF imaging provides lower resolution than microprobe analysis, but its speed makes it practical for the first time large samples—such as the human brain—are scanned.

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Microbes may hold biofuel secret

Last October a team of researchers from DOE's Oak Ridge National Laboratory went to Yellowstone National Park in search of "superbugs." Now a batch of microbes is stockpiled in dozens of bottles of silt, rocks and soils, collected from the same hot springs that draw throngs of summertime visitors. Yellowstone's warm waters offer the promise of microbes that can rapidly and efficiently degrade cellulose—the woody, leafy matter that makes up plants. Scientists hope to tap the power of these microbes for industrial-scale consolidated bioprocessing of plants, including trees and switchgrass, the species central to research efforts at ORNL's BioEnergy Science Center.

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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).

Biochip can spot earliest cancers

In their fight against cancer, doctors have just gained an impressive new weapon to add to their arsenal. Researchers at DOE's Argonne National Laboratory have developed a chip that can save lives by diagnosing certain cancers even before patients become symptomatic.

The new technology, known as a biochip, consists of a one-centimeter by one centimeter array that comprises anywhere between several dozen and several hundred "dots," or small drops. Each of these drops contains a unique protein, antibody or nucleic acid that will attach to a particular DNA sequence or antigen.

A tumor, even in its earliest asymptomatic phases, can slough off proteins that find their way into a patient's circulatory system. These proteins trigger the immune system to kick into gear, producing antibodies that regulate which proteins belong and which do not.

"Antibodies are the guardians of what goes on in the body," said Tim Barder, president of Eprogen, Inc., which has licensed Argonne's biochip technology to search for new biomarkers that indicate cancer. "If a cancer cell produces aberrant proteins, then it's very likely that the patient will have an antibody profile that differs from that of a healthy person. You can look for similarities and differences in autoantibody profiles to look for clues and markers that provide early indicators of disease."

In their hunt for cancer indicators, Eprogen uses a process called 2-dimensional protein fractionation, which sorts thousands of different proteins from cancer cells by both their electrical charge and their hydrophobicity or "stickiness."

The 2-D fractionation process creates 960 separate protein fractions, which are then arranged in a single biochip containing 96-well grids. Eprogen scientists then probe the microarrays with known serum or plasma "auto-antibodies" produced by the immune systems of cancer patients.

By using cancer patients' own auto-antibodies as a diagnostic tool, doctors could potentially tailor treatments based on their personal autoantibody profile. "This technology is really designed to take advantage of the information contained within the patient's own biology," Barder said. "What makes this technique unique is that scientists can use the actual expression of the patient's disease as a means of obtaining new and better diagnostic information that doctors could use to understand and fight cancer better."

"We're starting to see a way of treating developing tests and therapies for cancer by bringing the bedside to the laboratory, rather than the other way around," he added.

Submitted by DOE's Argonne National Laboratory

SRNL's JOE CORDARO: COULOMETRY ON THE GO

A staple in the NNSA complex is precision gas analysis, and a key tool in that work is the high-resolution mass spectrometer. Enter the Network of Senior Scientists and Engineers, whose current chairman is Joe Cordaro of DOE's Savannah River National Laboratory.



Joe Cordaro

Joe is no stranger to this machinery. He's recognized across the DOE complex and internationally as an expert in nuclear instrumentation, process control and high speed data acquisition.

NSSE work plus his regular assignments keep him on the go. "Seventy percent of my work this year is outside of Savannah River," he says. "The NSSE spearheaded a collaboration in mass spectrometry, SRNL is now upgrading equipment at Pantex and SRS. There's going to be more work in upgrading the electronics in similar legacy equipment that the vendors don't support any more."

Another focus for Joe is coulometry, not only for SRS, but also in Japan and the IAEA. He and a colleague developed an automated controlled potential coulometer for the measurement of plutonium, independent of certified reference material.

"A major NSSE initiative now is a collaboration on short-range wireless sensors for new facilities, which may save taxpayers millions of dollars," he says.

Joe joined SRS after graduating from State University of New York in Buffalo in both electrical and computer engineering and is now an advisory engineer at SRNL. He has numerous publications and nine inventions, including one patent and one pending. The pending one is for an electrometer that can accurately measure 1 femto-amp.

"The most rewarding aspect for me in coulometry and mass spectrometry is the ability to blend electrical engineering with physics and chemistry," he says. "It's even more exciting to help tie together common needs and solutions for NNSA sites."

Submitted by DOE's Savannah River National Laboratory