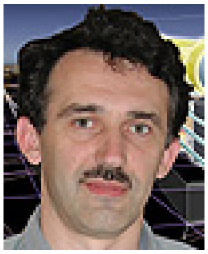

SLAC's Andrei Seryi

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Research Highlights . . .

DOE Pulse

Science and Technology Highlights from the DOE National Laboratories

Number 187 July 5, 2005

World's most powerful diode pumped solid state laser

A revolutionary new laser under development at DOE's Lawrence Livermore National Laboratory could drastically reduce casualties by U.S. forces. The Solid State Heat Capacity Laser program has already successfully achieved world-record energy output. The system will eventually allow infantry units to use a beam of invisible light to destroy incoming mortars, artillery shells and anti-tank missiles, as well as defusing buried landmines. The Army's Space and Missile Defense Command is sponsoring the program, which uses a unique pulsed beam that fires 200 times per second, and can already easily burn a hole through an inch of carbon steel in approximately seven seconds.

[Bob Hirschfeld, 925/423-2379, hirschfeld2@llnl.gov]

Lighting solution for the developing world

An energy-efficiency expert with DOE's Lawrence Berkeley National Laboratory (Berkeley Lab) has calculated that replacing kerosene and other fuel-based lighting systems in developing nations with highly-efficient, cost-effective white light-emitting diode lighting systems could save tens of billions of dollars per year worldwide in energy costs, and also dramatically reduce carbon dioxide emissions. In a paper published in Science, Berkeley Lab's Evan Mills showed that fuel-based lighting now consumes the energy equivalent to 1.3 million barrels of oil per day, and gives off about 190 million metric tons of CO2 emissions per year, equivalent to one-third the total emissions from the United Kingdom.

Lynn Yarris, 510/486-5375, lcyarris@lbl.gov]

INL tests advanced fuel cell technology for industry

Scientists and engineers at DOE's Idaho National Laboratory have tested and successfully demonstrated, for the first time, the technical feasibility of directly connecting a catalytic partial oxidation diesel reformer to a 5-kilowatt solid oxide fuel cell system – converting the diesel fuel into a hydrogen-rich synthesis gas and passing the gas through a fuel cell to generate electricity. The purpose of this unique three-day test was to gather data to design and integrate a new and revolutionary diesel-powered solid oxide fuel cell system. Ultimately, scientists say, by designing a heat recovery unit into the next-generation system, an efficiency rating of 80 percent can be achieved.

[Reuel Smith, 208/526-3733, Reuel.Smith@inl.gov]

Spotting spins in a cryogenic vise

Scientists at DOE's Los Alamos National Laboratory have developed a novel method for controlling electron spins in gallium arsenide semiconductor crystals. By mounting the crystals in an optical cryostat and using a miniature "cryogenic vise" to apply gentle pressure, researchers were able to watch the electron spins rotate as they flow through the crystal. The cryogenic vise operates at only a few degrees above absolute zero and can be used to intentionally tip, rotate, and flip the electron spins without applying magnetic fields. The work suggests an alternative method of spin manipulation for use in future generations of "spintronic" devices.

[Todd A. Hanson, 505/665-2085, tahanson@lanl.gov]

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).

Theory meets experiment as Fermilab scientists team up for ILC

Together with four experimenters from DOE's Fermilab, from Lancaster University in the UK and from DESY-Zeuthen in Germany, Fermilab theorists Marcela Carena and Ayres Freitas are studying a possible "benchmarking" process for detectors at the proposed International Linear Collider.

Fermilab theorists Marcela Carena (pictured) and Ayres Freitas are working with experimenters from the Fermilab, from Lancaster University in the UK, and from DESY-Zeuthen in Germany to develop a "benchmarking" process for detectors at the proposed International Linear Collider

The six scientists are investigating whether an ILC detector could measure the properties of "stop" quarks, hypothetical particles predicted by Supersymmetry. An ideal detector would be able to distinguish all interesting particles and processes from the collisions' background. But in the real world, experimenters must make compromises in building detectors. Theorists and experimenters work together and carry out computer simulations to test the capabilities of various detector designs.

" 'Stops' are of great theoretical interest," says Freitas. "If they exist and if they are light enough, they must have played an important role in the formation of matter in the early universe. They would have an effect on the total amount of dark matter."

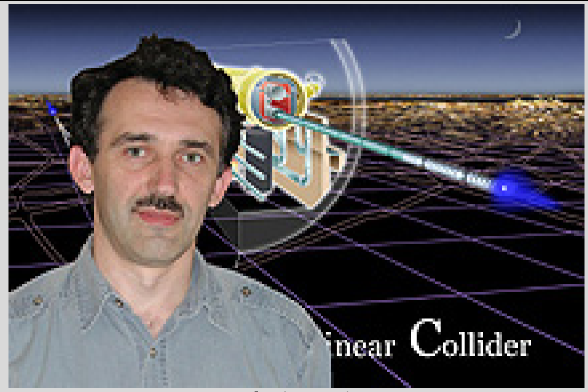
Electron-positron collisions at the ILC would produce pairs of stop quarks, which would yield a signal of two charm quark jets and missing energy. Detecting these decays and concluding the existence of stop quarks is an experimental challenge.

"Anything else that creates two jets and large missing energy is a severe background," said Caroline Milstene, one of the four experimenters working on the project, during her presentation of the study at Fermilab in May. "We have to get rid of background that is a few orders of magnitude bigger than the signal."

The team showed that the ILC detector could determine the mass of a potential 122.6 GeV "stop" quark with a precision of +/- 0.4 GeV. Combined with other precision measurements, they found that the ILC can test whether supersymmetric particles are the source of dark matter. The study will be published later this year.

Submitted by DOE's Fermilab

Science 'detective story' sparked Seryi's career



Andrei Seryi

It was a book about element 104, known as Rutherfordium, which led a 12-year-old Andrei Seryi to pursue a career in physics. “It read like a detective story,” said Seryi, who now leads a group of over one hundred people on the International Linear Collider (ILC) beam delivery design team from the DOE’s Stanford Linear Accelerator Center (SLAC).

Seryi obtained his Ph.D. from the Budker Institute for Nuclear Physics, where he helped design VLEPP, an electron-positron linear collider. His role was to devise the final focus system.

Now, 17 years later, he’s doing the same thing. Currently, Seryi, Tomoyuki Sanuki from the University of Tokyo, and Grahame Blair from the Royal Holloway University of London are leading an international group of particle physicists working on the design of a final focus for the ILC, a future polarized electron-positron linear collider that will create collisions with energies from 500 GeV to 1 TeV. This time, however, the challenge is much more difficult.

After electron and positron beams collide, the particles disperse and may stream back toward the beams. In order to prevent such a scenario, which damages beam quality, Seryi and his group is designing a unique configuration for the two twenty-kilometer linear accelerators at the ILC. The two accelerators won’t be arranged in a straight line; instead, the angle the separating them will be less than 180 degrees. Deciding exactly what the separation will be, however, is the team’s main task. “The group is very active and able to work quite productively,” says Seryi, who is excited about SLAC’s role in the ILC.

“I think SLAC has a lot of expertise in a wide variety of areas and will play a central role in the ILC,” he said. “Certainly SLAC will play a large role in the beam delivery and final focus design.”

Submitted by DOE's Stanford Linear Accelerator Center