

NewsLetter

Week of July 18, 2005

Vol. 6, No. 15



Q: The Laboratory recently received four R&D 100 Magazine awards representing top scientific and technological advances with significant commercial potential. What do you think the awards say about the importance of scientific research being done at Los Alamos and its importance to the nation?



Alex Baker of Communication Arts and Services (IM-1)

These awards show that Los Alamos is esteemed as a high-quality research facility. As the Lab continues to produce high-quality products, it will be able to maintain this esteem that we have earned.



Natalia Perez of Technical Support, Staffing, R&D (SUP-10)

This confirms the fact that we are working at one of the most important labs in the country. It also makes me proud of the work I do, knowing that these programs are of such importance.



Bradley Hyde of Biological and Quantum Physics (P-21)

As always, a nation is built by the hard working men and women with the courage, drive and ability to see past the problems of today to the solutions of tomorrow.



Sandra Scher of Occupational Medicine (HSR-2)

I'm proud to be working with and a part of the scientific community here at the Laboratory. It's important that Los Alamos is involved with scientific research, and the awards reflect its effort.



Scott Dick of the Supply Chain Management Division (SUP-DO)

Very important. These awards are one of the reasons that the Laboratory is known as the premier lab in the Department of Energy complex.



Laboratory captures four R&D 100 Awards

Scientists at the Laboratory have captured four of R&D Magazine's 2005 R&D 100 Awards. The latest winners bring the Laboratory's total to 87 awards over the past 18 years. The projects recognized this year have implications in a wide range of industries from aerospace engineering and automotive design to drug development and personalized medicine.

In acknowledging the achievement, Laboratory Director Robert Kuckuck said, "The teams that received 2005 R&D 100 awards once again showed that, when put to the test, the scientific talent and the research and development excellence at this Laboratory really shine through. I am extremely proud of the award recipients and all the Los Alamos teams that submitted entries to this year's competition."

The four Los Alamos National Laboratory technologies receiving R&D 100 awards are

- CartaBlanca: A High-Efficiency, Object-Oriented, General-Purpose Computer Simulation Environment;
- MESA: Measuring Enzyme-Substrate Affinities;
- nanoFOAM: A Metal-Nanofoam Fabrication Technique; and
- NESSUS: Probabilistic and Uncertainty Analysis for Large Scale Complex Systems.

The R&D 100 awards program is designed to honor significant commercial promise in products, materials or processes developed by the international research and development community. Each year, R&D Magazine recognizes the world's top 100 scientific and technological advances with awards for innovations showing the most significant commercial potential.

Over the past 18 years, the R&D 100 awards have become just one measure of Los Alamos' technical contributions to society. Technologies from the Laboratory are nominated in open competition and judged by technical experts selected by the Illinois-based R&D Magazine. The awards are officially made in October.


NewsLetter

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Lightning safety

July typically signals the beginning of New Mexico's rainy season. With the showers and thunderstorms, however, come lightning. When the threat of thunderstorms develops, the following precautions should be taken, according to the National Weather Service:

- If your hair stands on end or you feel a tingling sensation, lightning may be about to strike. If no shelter is available, squat down with feet together and place hands over ears to minimize hearing damage from thunder. This also reduces your chances of being struck or becoming a conductor for nearby lightning strikes.

- Remember the "30/30" rule. If lightning is sighted and its accompanying thunder arrives in less than 30 seconds, the lightning is within six miles and shelter should be taken. Remain in that shelter for 30 minutes after the last clap of thunder.

- Avoid projecting above the surrounding terrain, as you would if standing in an open field or on a mountain top.

- Stay away from open water.
- If indoors, avoid water and stay away from doors and windows. Don't use telephones with cords and take off headsets. If possible, turn off appliances, such as computers, power tools and televisions, because an exterior lightning strike of electric or telephone lines can induce shocks to indoor equipment.

- Stay off motorcycles and bicycles, tractors and other metal farm or construction equipment.

- Put down golf clubs and take shelter. Metal-spiked golf shoes increase the probability of being struck.

- Don't stand under natural lightning rods such as tall, isolated trees.

- Avoid taking shelter in small structures that are isolated in an open area.

- If in a forest, seek shelter in a low area under a thick growth of small trees; if in an open area, seek a low place, such as a ravine or valley, but stay alert for possible flash flooding.

KUDOS AND CONGRATULATIONS

"These [R&D 100] awards demonstrate that DOE scientists and researchers are hard at work developing the technologies of the future. In the past, breakthroughs like these have played an important role in both our economic and national security."

—Samuel W. Bodman,
Department of Energy secretary



"The fact that our labs routinely win so many of the R&D 100 awards is confirmation that they engage in some of the best scientific work and have staffs composed of some of the brightest scientific minds in the world. While we pursue our mission of national security, we also are producing technologies that can serve society in many ways."

—Linton F. Brooks, National Nuclear
Security Administration administrator



"The University of California's research capabilities and the innovative work being done at the national laboratories has been a winning combination for decades. These awards recognize once again the remarkable scientific and technological work being conducted at the UC-managed national laboratories, exemplify successful collaboration with other public and private institutions and reaffirm the great benefit UC research provides for the nation."

—Robert C. Dynes, UC president



"The teams that received 2005 R&D 100 awards once again showed that, when put to the test, the scientific talent and the research and development excellence at this Laboratory really shine through. I am extremely proud of the award recipients and all the Los Alamos teams that submitted entries to this year's competition."

—Robert Kuckuck, Laboratory director



Los Alamos National Laboratory NewsLetter

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Los Alamos National Laboratory is operated by the University of California for the National Nuclear Security Administration (NNSA) of the U.S. Department of Energy and works in partnership with NNSA's Sandia and Lawrence Livermore national laboratories to support NNSA in its mission.

Los Alamos enhances global security by ensuring safety and confidence in the U.S. nuclear stockpile, developing technologies to reduce threats from weapons of mass destruction and improving the environmental and nuclear materials legacy of the Cold War. Los Alamos' capabilities assist the nation in addressing energy, environment, infrastructure and biological security problems.



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Update on Appendix F:

Research and development in ADWP

by Susan Seestrom, associate Laboratory director for Weapons Physics

The Weapons Physics Directorate has a diverse portfolio of capabilities and facilities that contribute both to world-class basic research and nuclear weapons science. A crucial component of scientific excellence is rigorous peer review; one such review mechanism is the process outlined in Appendix F of the current University of California contract.

ADWP is a key contributor to three of the 10 Appendix F objectives:

- certification of the nation's stockpile
- long-term integrated stewardship
- science and technology base

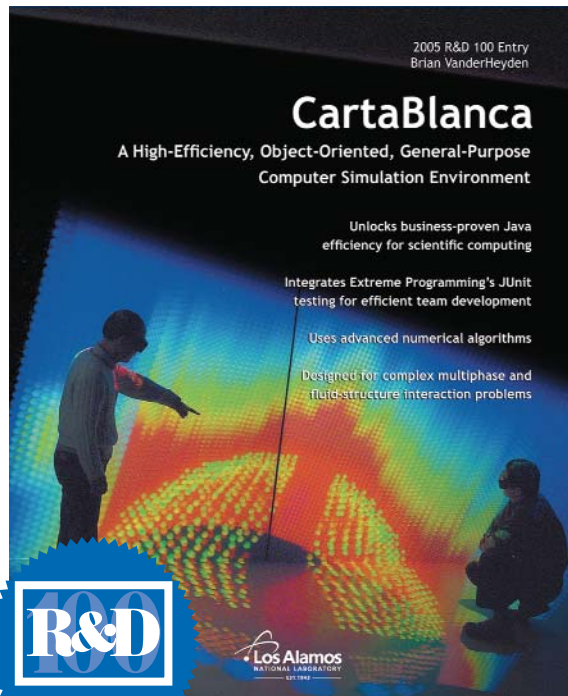
We strive to maintain a balance between basic and applied research and to remain leaders in the scientific fields critical to current and future national security missions. Creative and innovative research serves as the engine of new ideas for nuclear weapons science, that underpins our understanding of the current stockpile. The R&D 100 Awards are one measure of success in how well we nurture and support the connection between our basic and applied research interface.

Recently, senior scientists in Material Dynamics (DX-2) received an R&D 100 Award for their research and development of A Metal-Nanofoam Fabrication Technique. This is the third R&D 100 Award earned by this team of high-explosives researchers. This exemplary research has broad application in national security and industry.

As I reviewed the R&D 100 Award winners over the last decade, I was pleased to note that the divisions now in ADWP have earned many of these awards and comprise about one-third of the Laboratory's R&D 100 winners. In addition to those won by the DX team, Computer and Computational Sciences (CCS) and Physics (P) divisions have earned the majority of ADWP's R&D 100 Awards for research ranging from the 10-Gigabit Ethernet Adapter to Free Space Quantum Cryptography.

The common denominator for all our research is how we perform the work — integrating safety, security, quality and productivity; focusing on results; promoting innovation; seeking rigorous peer review; and acknowledging each individual's contribution.

100 R&D Winners ...



CartaBlanca: A High-Efficiency, Object-Oriented, General-Purpose Computer Simulation Environment

CartaBlanca brings the tremendous efficiency of the Java programming language to the world of scientific computing. CartaBlanca is a state-of-the-art, object-oriented simulation software package poised to offer next-generation modeling and simulation capabilities to scientists in a number of disciplines. Written in the “developer friendly” Java language, it enables computer code developers to simulate complex nonlinear effects such as airflow through a turbo booster, blast effects on buildings, or heat transfer along a semiconductor. Because it is a Java-based software package, the code is much easier to use, manipulate, and modify than codes based on programming languages such as FORTRAN or C++.

CartaBlanca takes advantage of the improved execution speed offered by the HotSpot™ compiler and opens up the field of physical modeling to a much broader set of programmers. CartaBlanca is modular and allows for rapid software application or simulation code prototyping; strong, extensive compiler checking; plug-and-play module insertion for modeling physical systems; solutions with consistent results; and integrated unit and regression testing.

Applications

- Aerospace engineering
- Animation and special effects
- Computational fluid dynamics
- Fluid/solid interactions
- Automotive design
- Weapon/target interactions
- Pharmaceutical processing
- Homeland defense

Team members: Nely Padial-Collins, Brian VanderHeyden, Duan Zhang and Qisu Zou of Fluid Dynamics (T-3), Giovanni Lapentam of Plasma Theory (T-15) and Stefano Markidis, former Lab employee.

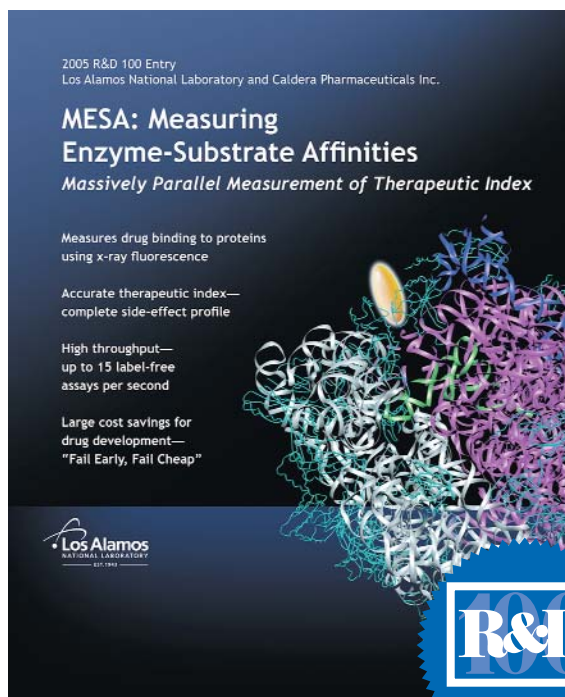
MESA: Measuring Enzyme-Substrate Affinities

MESA is a low-cost assay for detecting the binding of drugs to proteins (and other biomolecules and cell structures) without the biasing influence of added fluorescent molecular labels. The assay images drug-protein binding using atoms intrinsic to drug molecules themselves. Because of this label-free detection, MESA captures and quantitates all drug-protein binding, including potentially therapeutic and potentially toxic bindings. This allows MESA measurements to generate a complete therapeutic index early in the drug-development process. Today's high drug-development failure rate — the primary cause of the high cost of new drugs — is driven by the inability to measure more than an infinitesimal number of protein-drug interactions. MESA's ability to measure a very large number of these interactions and its resulting early detection of toxicity could save hundreds of millions of dollars in drug-development costs.

Applications

- Drug development: Screens label-free drugs against all body proteins in 24–72 hours, compared with extant technologies that test drug effects on less than 0.5 percent of body proteins.
- Personalized medicine: Allows screening of individual patients for potential drug responses, enhancing drug prescribing and reducing adverse reactions.
- Target validation: Facilitates identification of new protein targets for drug therapies, a necessity for treating currently intractable or incurable diseases.
- Label-free accuracy: Provides far more accurate data than that obtained with fluorescently labeled molecules.

Team members: George Havrilla of Chemical Sciences and Engineering (C-CSE), Edel Minogue of Actinide, Catalysis and Separations Chemistry (C-SIC) and Benjamin Warner of Caldera Pharmaceuticals Inc.



Working with industry

by Tom Bowles,
chief science officer



The largest part of my scientific career has been involved in studying the properties of neutrinos. A number of my relatives ask

me “What good is that?” While the primary motivation is to learn about the unification of the forces of nature, the ultra-low background counting capabilities developed for our neutrino detectors is also a critical capability for the electronics industry.

As the size of individual elements in large-scale integrated circuits gets smaller, they become more sensitive to the alpha particles emitted in the decay of uranium and thorium (which are present in very low levels in virtually all materials). The alphas can cause single-event effects (SEE) in which the state of a memory bit is flipped by the alpha particle. Industry has not had the ability to assay the materials they use with enough sensitivity to ensure this will not occur. Thus, the work being done in neutrino physics turns out to be directly relevant to industry.

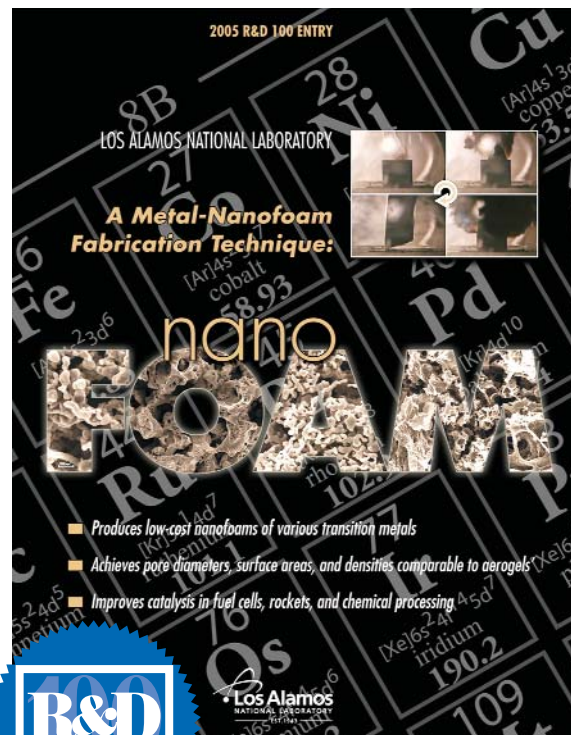
The Laboratory is working to increase its connections with industry. In some cases, we provide unique capabilities to industry: the fast neutron beams at the Los Alamos Neutron Science Center (LANSCE) are used to study the effects of SEE — the flight electronics for the Boeing 777 were in part qualified at LANSCE. In other cases, we have collaborative research and development (R&D) with a number of companies, such as ChevronTexaco and Procter & Gamble. In such cases, we have found that it is the breadth of R&D capabilities at the Laboratory that are most important in being able to solve problems for industry. The Laboratory benefits from these interactions — the R&D required to address a specific problem is funded directly by the company. In turn, some of the advances [the Lab] makes for industry can be transferred to address problems we face in meeting the Laboratory's mission.

This is clearly a win-win situation for both industry and Los Alamos. I urge you to get involved in these connections with industry. It is a means in which we can carry out R&D that is challenging and relevant and [that] provides direct benefit to the public.

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100 R&D Winners

nanoFOAM: A Metal-Nanofoam Fabrication Technique



The nanoFOAM technique produces self-supporting, nanoporous metal foams by igniting a pressed pellet of a special compound in an inert atmosphere. The compounds are high-nitrogen transition-metal complexes synthesized with a low-cost, high-volume method developed at Los Alamos. Nanofoams produced to date include iron, cobalt, copper and silver. The nanofoams have pore diameters of 20 nanometers to 1 micrometer, surface areas as high as 258

meters-squared per gram, and densities as low as 0.01 gram per cubic centimeter. These values compare favorably with those of silica aerogels, the lightest known solids.

Applications

Nanofoams could be used to improve the efficiencies of

- the catalytic production of ammonia, sulfuric acid, fuels, plastics and other chemicals and products;
- oil-refining processes and electrical generation from fuel cells that run on hydrocarbons; and
- silver biocidal filters that destroy liquid or airborne germs on contact.

Nanofoams also could be used to

- improve the strength and heat-transfer properties of jet-turbine blades while decreasing their weight;
- reduce emissions of nitrogen oxides from internal combustion engines and coal-fired power plants;
- remediate chlorohydrocarbons in the environment; and
- enhance the sensitivity of biomedical detectors.

Team members: David Chavez, Michael Hiskey, My Hang Huynh, David M. Oswald, Steven Son and Bryce Tappan of Materials Dynamics (DX-2).

NESSUS: Probabilistic and Uncertainty Analysis for Large-Scale Complex Systems

NESSUS is a general-purpose tool for computing the reliability of engineered systems. It was originally developed by a team led by Southwest Research Institute (SwRI) as part of a 10-year NASA project to develop a probabilistic design tool for the space shuttle main engine. Recently, a team from Los Alamos and SwRI enhanced and applied NESSUS to the Laboratory's weapon reliability assessments for the Stockpile Stewardship Program.

New features include support for extremely large multi-physics models, a sophisticated Java-based graphical user interface, three-dimensional probability contouring and results visualization, advanced design of experiment and sensitivity analysis, probabilistic input database and interfaces to ABAQUS, ANSYS, LS-DYNA, MSC.NASTRAN and ParaDyn.

Team members: Edward Rodriguez and Jason Pepin of Weapon Response (ESA-WR) and a team from the Southwest Research Institute.

Those also nominated ...

Editor's note: The following technologies were nominated this year for an R&D 100 Award.



BeFinder: Rapid Assay for Beryllium Detection

A 45-minute assay for the presence of beryllium, BeFinder provides an inexpensive and unambiguous method for assessing the health and safety risks to beryllium-industry workers and for protecting the public from exposure to this toxic metal. With chronic, degenerative lung disease

the potential consequence of even a small exposure to beryllium particles, a fast, accurate detection assay is now available for industries that use beryllium in manufacturing — for example, electronics, sporting goods, tools, jewelry and dental crowns — as well as for companies or agencies that perform environmental testing of potentially contaminated sites. BeFinder provides a convenient, inexpensive, and highly portable method for frequent and reliable testing, promoting prompt remediation and preventive measures. BeFinder is being considered as a NIOSH and ASTM standard for beryllium screening.

Applications

Beryllium detection in the following situations:

- sites contaminated by prior industrial use of beryllium or by illegal or inadvertent disposal of beryllium-containing waste;
- manufacturing environments, such as, electronics, sporting goods, tools, jewelry and dental apparatus;
- aerospace industry and other R&D environments in which beryllium and its alloys are used in development of new electrical and mechanical components; and
- DOE complex, where beryllium is widely used in weapons manufacture and maintenance.

Team members: Anthony Burrell, Gavin Collis, Deborah Ehler, Kevin John, Mark McCleskey and Edel Minogue of Actinide, Catalysis and Separations Chemistry (C-SIC); and Anoop Agrawal of Berylliant Inc.

Los Alamos National Laboratory R&D 100 Award winners 1978–2004

1978

- Diamond Machining of Optics
- Electronic Identification System
- Electronic Device for Treating Tumors — Hyper Thermic Cancer Treatment

1980

- Wee Pocket Radiation Detector
- Portable Multichannel Analyzer

1981

- Radio Frequency Quadrupole Linac

1982

- WC Field Computer System

1983

- Transuranic Waste Assay System

1984

- Superconducting Magnetic Energy System

1985

- BHTP — A Unique Scintillation Compound

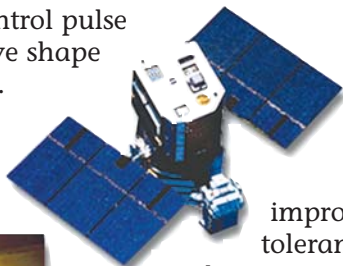
1986

- Aurora Laser Beam Alignment System

R&D Nominations ...

Diode-Directed Marx Modulator: A Pulsed-Power Source with GroundBreaking Architecture

A team of engineers at Los Alamos developed a new type of solid-state Marx modulator with the demonstrated ability to control pulse width, duty factor and wave shape from one pulse to the next. The team attained this result with a circuit architecture that significantly



improves the fault tolerance, efficiency, and compactness of Marx-style modulators and combines it with precise process control. A Marx modulator with these capabilities opens the door to advanced applications ranging from health care to space vehicles to homeland defense, all in a package roughly 100 times

lighter and smaller than a comparable device costing 10 times as much.

Applications

The modulator will make possible smaller, lighter, less expensive and more capable versions of products and devices and enable other, entirely new applications. Some examples:

- Defense — electronic warfare, nuclear stockpile maintenance
- Homeland security — portable inspection and decontamination machines
- Health and medicine —



low-cost X-ray machines and water-treatment systems

- Aerospace — plasma generators to manage air flow or reduce radar reflectivity

- Industry — discharge reactors to improve energy efficiency and control pollution
- Micro power — essential power conditioning for advanced micro power sources

Team members: Greg Dale and Thomas Lopez of Applied Electromagnetics (ISR-5), Hugh Kirbie of William Haynes, Cynthia Heath, Frank Romero and Robert Wheat of High Power Electrodynamics (ISR-6).

Hands-Off Sampler Gun: An Investigator's Best Friend

In recent years, high-visibility courtroom trials and television shows such as CSI (Crime Scene Investigation) have heightened public attention to sample collection and record-



keeping. Unfortunately, devices used to collect samples are often highly specialized, require separate procedures to use, and could expose an investigator to hazardous substances. Moreover, recordkeeping is usually done by hand, a time-consuming, error-prone

process. The Hands-Off Sampler Gun overcomes these shortcomings. It comes with a universal adapter that can use virtually any type of sampling media, a hands-off loading/unloading mechanism that eliminates direct contact with a sample, and a built-in electronic data-acquisition system that eliminates manual record-

keeping. These features make the Sampler Gun an investigator's best friend.

Applications

- Environment/Ecology: Enables investigators and scientists to examine containers and drums; inspect food products; collect solid, liquid and gas samples; map vegetation and track wildlife; and scrutinize archaeological and cultural sites.
- Forensics: Collects evidence for all types of suspected crimes, ranging from burglaries and narcotics trafficking to murders and arson.
- Homeland Security: Helps first responders assess threats involving radioactive, chemical or biological agents.
- Inspections: Other potential users include healthcare providers, supply-chain safety assessors, pharmaceutical inspectors and doping testers at sporting events.

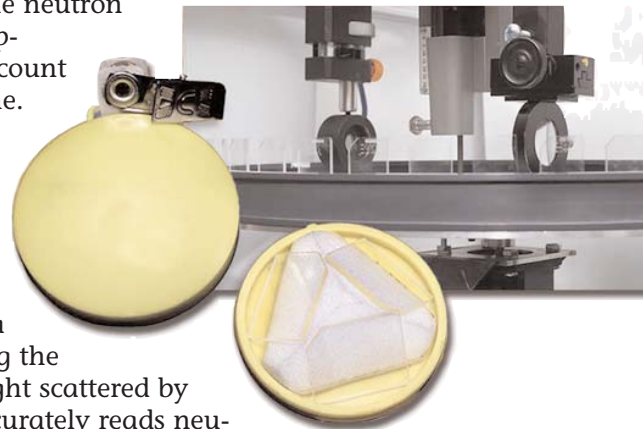
Team members: Torsten Staab, Gus Takala and John Jensen (deceased) of Applied Engineering Technologies (ESA-AET); Larry Bronisz of Applied Electromagnetics (ISR-5); Toshiyuki Shiina of Materials and Explosives Engineering (ESA-MEE); and Corey Grimes of Polytechnic University.

LITES: A Laser Reader for Personal Neutron Dosimeters

LITES measures the surface densities of microscopic "pits" chemically etched on the surfaces of clear-plastic dosimeter chips. During etching, a pit forms at the intersection of a neutron-produced "damage track" and a chip surface; the pit density is

proportional to the neutron dose. Existing chip-reading methods count the pits one by one.

In contrast, LITES measures the simultaneous, collective effect of the pits on a laser beam passing through a chip by measuring the intensity of the light scattered by the pits. LITES accurately reads neutron doses up to 5 rem for a 15-hour etch, meeting the Department of Energy's requirement for neutron dosimetry, while conforming to the Los Alamos standard etch time. For a 6-hour



continued on Page 6

R&D 100 Award winners ...

1988

- Optical Microrobot Single-Cell Manipulator/Analysis System
 - Nuclear Material Solution Assay System
 - 32-Stepper Motor Position Controller
 - Mobile Beryllium Monitor
- HTMS Reference Electrode Oriented, Highly Anisotropic Conducting Polymer
 - Photoinjector for RF Linac Accelerators
 - Lattice Gas Algorithm

1989

- Fourier Transform Flow Cytometer
- Noncontact Superconductor Screening
 - Conductive Lattices

1990

- Coolahoop
- Universal Process for Fingerprint Detection
- Fast Agarose Gel Electrophoresis (FAGE)
 - Solid-State NO₂ Sensor
 - Upconversion Solid-State Laser
- A Broadband (ABB) Mw Absorption Spectrometer for Liquid Media
 - Mds2/SC Composites (Molybdenum Disilicide/Silicon Carbide)

1991

- Semi-Insulator Detector
- Optical High-Acidity Detector
- Resonant Ultrasonic Inspection (RUI)
 - Single Molecule Detector

R&D 100 Nominations ...

continued from Page 5

etch, LITES accurately reads neutron doses up to 50 rem, making LITES useful for accident dosimetry as well as routine dosimetry. In addition to the applications cited below, LITES can be used to measure the amount of radon gas in a home from radon's alpha-particle emissions.

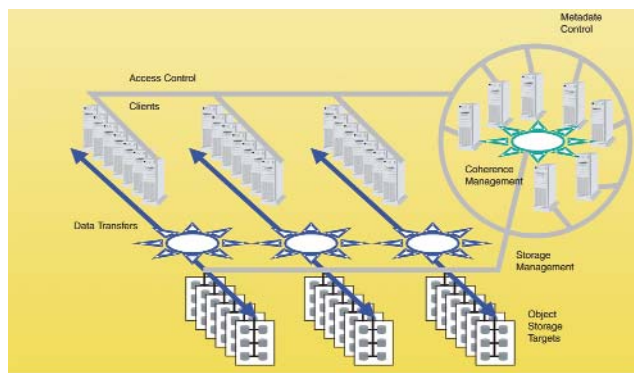
Applications

LITES can be used to measure the neutron exposure of

- workers at accelerator facilities;
- workers at facilities where weapons-grade plutonium is handled; and
- airline flight crews.

Team members: Robert Devine, Richard McKeever and Murray Moore of Health Physics Measurements (HSR-4); Robert E. Hermes of the Technology Transfer (TT) Division; Jeffrey Hoffman of Radiation Protection Services (HSR-12); Heather Gepford of Missouri University at Rolla; and Nolan Hertel of Georgia Institute of Technology.

The Lustre File System Technology



The Lustre project started three years ago as an exploration of object storage on the Linux platform. Lustre introduced an innovative object storage software stack that enables modular development of

client/target networking, storage management, and file system modules to address High Performance Computing (HPC) requirements for scalable file management for the terascale Advanced Strategic Computing Initiative computing environment. The file management solution scales to tens of gigabytes/sec, tens of thousands of file operations/sec, management of tens of thousands of clients and thousands of storage devices, and dozens of metadata servers. Lustre is targeted for the extremely large-scale Linux Cluster Supercomputing environment. It has a networked environment with three types of systems: clients with access to the file system, object storage targets that control persistent storage but have extensive capabilities for "on-controller-processing" and cluster-control nodes that handle metadata updates and arbitrate file system security.

Applications

HP and Cray offer products that use this technology. An open source version is available from Cluster File Systems, a file systems technology company. The object file systems technology is applicable for

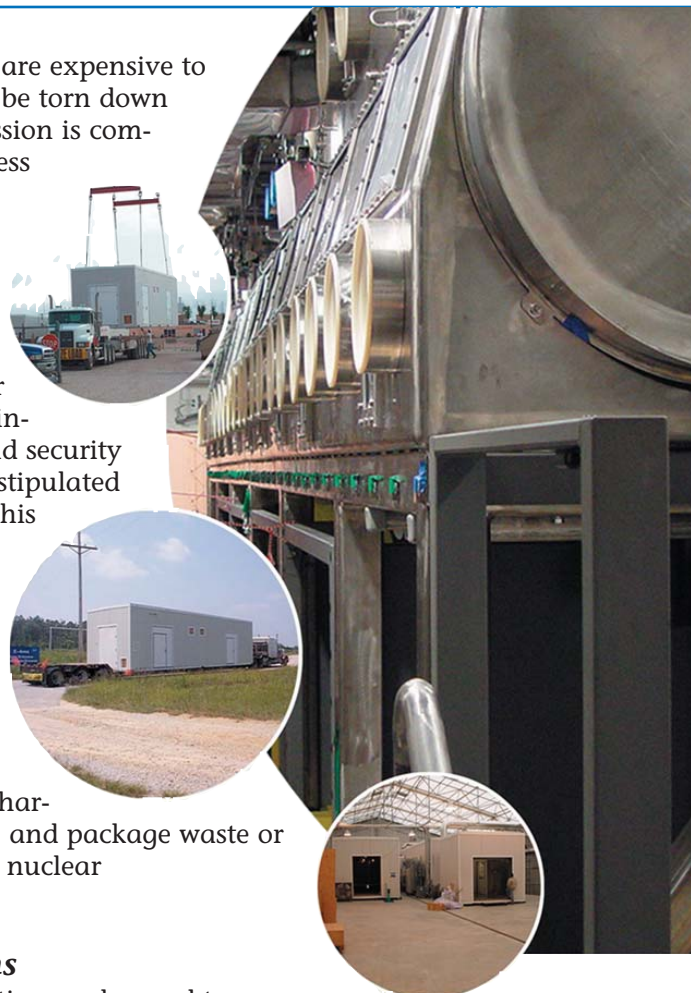
- high performance simulation,
- seismic,
- financial,
- genomic,
- intelligence,
- data warehousing,
- Web indexing and
- other extremely large-scale computing applications.

Team members: Hsing-Bung Chen, Gary Grider and James Nunez of HPC Systems Integration (CCN-9); Julianne Stidham of HPC Systems (CCN-7); Bill Boas of Lawrence Livermore National Laboratory; and Lee Ward of Sandia National Laboratories.

Mobile and Modular Nuclear Facilities

In the United States, there are more than 100 nuclear facilities whose combined acreage is equivalent to the size of Rhode Island and Delaware combined. Many facilities have thousands of metric tons and millions of liters of various nuclear material wastes, as well as contaminated tools and clothing, metal scrap, solvents and other waste. Unfortunately, no infrastructure exists for characterizing, treating, and packaging these wastes. The traditional solution to this problem has been to construct waste-handling facilities on site, but

such facilities are expensive to build, only to be torn down once their mission is complete. To address this problem, Los Alamos has developed a mobile and modular transportainer that meets stringent safety and security requirements stipulated by the DOE. This portable and self-contained "trailer" can be customized to carry the equipment and resources necessary to characterize, treat, and package waste or perform other nuclear operations.



Applications

These facilities can be used to

- House operations related to nuclear processes, waste characterization, treatment and packaging.
- Protect the public and the environment by containing hazardous cleanup operations.
- Serve as command and operation centers for nuclear, chemical, biological and forensics investigations related to natural disasters, accidents or terrorist acts.

Team members: Kurt Anast, Scott Hickman and Dave Melton of Hydrodynamics (DX-3); Johnny Harper of the Earth and Environmental Sciences (EES-DO) Division; Mel Burnett Stephen Diamond, Deidre Witherell of Design Engineering and Construction Services (ENG-DECS); Dave Yeamans of Actinide and Fuel Cycle Technologies (NMT-11); Howard Granzow of Deployed Services (PM-DS); Dave Munger of PIT Disassembly and Nuclear Fuels Technologies (NMT-15); Guy Lussiez, Lab retiree; Bill Oliver and John Englick of Merrick and Co.; Chuck Conway, Lincoln Griswold, Brian Hammond and Roy Byrd of Washington TRU Solutions LLC; Michael Brennan of Washington Group International; and Keith Barras of Mosaic Architectural Solutions.

R&D 100 Award winners ...

1992

- Thermal Neutron Multiplicity Counter
 - Plastic Laser Dye Rods
 - Cryogenic Diamond Turning
- Portable Laser Spark Surface Mass Analyzer (PLASSMA)
 - Zeeman Refractive Index Detector
- Animated Display of Inferred Tongue, Lip and Jaw Movements During Speech

1993

- Selenium-Based Reagents for the Evaluation of Chiral Molecules
 - Phase-Sensitive Flow Cytometry
 - Ultrafast Infrared Spectrometer
 - Mini Elastic Backscatter Lidar

1994

- Ultrasensitive Ultrasonic Transducer
 - Telemetric Heat Stress Monitor
 - Optical Biopsy System
 - Lattice Boltzmann Permeameter
 - Directed Light Fabrication of Complex Metal Parts
 - Bartas Iris Identification

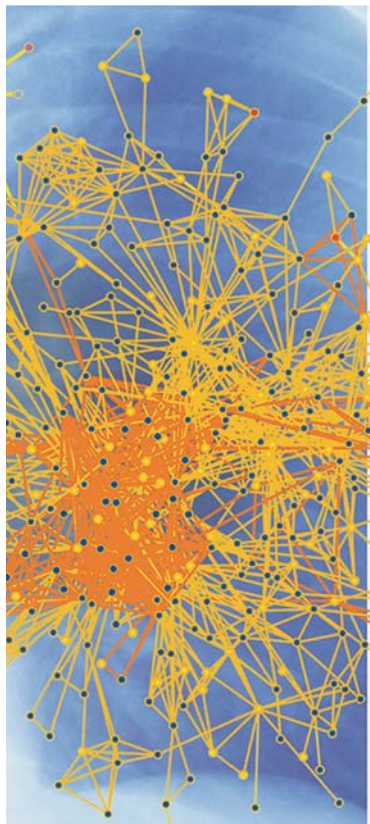
1995

- The Indigo-830
 - ARS Chemical Fill Detector
- Hydride-Dehydride Recycle Process
 - HIPPI-SONET Gateway
 - Microsensor for VOCs
 - Polymer Filtration System

R&D Nominations ...

Network Express: Software for Modeling Systems Properties of Biological Response Networks

Network Express models the interdependent genetic, metabolic and signaling processes of biological response networks for systems-level analyses of cellular responses to external stimuli. Representative stimuli include drugs, radiation, allergens, toxins, microorganisms and other agents involved in inflammation. Both experimental data and metabolic/genetic information are used to generate the networks, which are refined through computational optimization. This predictive tool provides graphical output for precise description of network responses. It has demonstrated the capability for subtle discrimination among responses to apparently similar drugs and has been used to model human signaling networks as well as ecological and agricultural networks.



Applications

- **Biological target identification:** Identifies key network genes and proteins in a biological response, accurately targeting them for therapeutic intervention.
- **Drug discovery:** yields precise drug comparisons and guides drug development by identifying "copycat" drugs and unanticipated side effects.
- **Personalized health care:** Evaluates the most beneficial therapeutic regimen on a patient-specific basis.
- **Environmental remediation:** Accurately models ecological networks involved in fundamental ecosystem processes.

R&D 100 Award winners ...

1996

- TRACER (Transportable Remote Analyzer for Characterization and Environmental Remediation)
- PLASMAX (Plasma Mechanical Cleaner for Silicon Wafers)

1997

- Falcon: Breakthrough Software for Simulating Oil Reservoirs
 - Rapid Size Analysis of Individual DNA Fragments
- ASR Detect — Diagnostic Method for Analyzing Degrading Concrete
 - Dry Wash
- Plasma Source Ion Implantation for Enhancing Materials Surfaces
 - High Performance Storage

1998

- Cyrax™ — Portable, 3D Laser-Mapping and Imaging System
 - Low-Smoke Pyrotechnics
- SOLVE — Creating 3D Pictures of Protein Molecules from X-Ray Diffraction Spots
 - Underground Radio

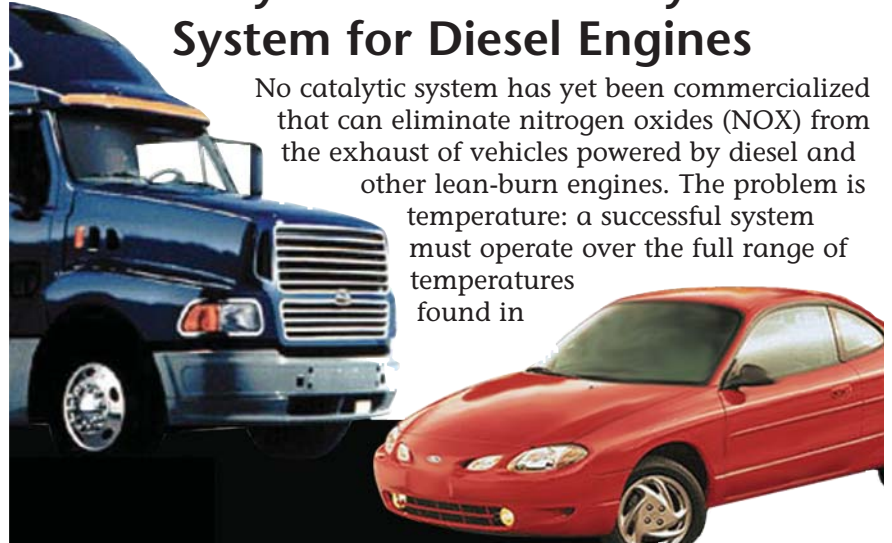
1999

- Acoustic Stirling Heat Engine
- Atmospheric Pressure Plasma Jet
- CHEMIN: A Miniaturized X-ray Diffraction and X-ray Fluorescence Instrument
 - PREDICT — A New Approach to Process Development
 - Real-Time, Puncture-Detecting, Self-Healing Materials
- REED-MD: A Computer Code for Predicting Dopant Density Profiles in Semiconductor Materials
 - The Sulfur Resistant Oxymitter 4000™

- Agricultural pest management: Models interactions between plants and plant pests, identifying the most-effective points for intervention.

Team members: Lawrence Cabusora and Christian Forst of Genomic Sequencing and Computational Biology (B-5) and Electra Sutton of Systems Engineering and Integration (D-3).

NOX HyCat: A New Catalytic System for Diesel Engines



No catalytic system has yet been commercialized that can eliminate nitrogen oxides (NOX) from the exhaust of vehicles powered by diesel and other lean-burn engines. The problem is temperature: a successful system must operate over the full range of temperatures found in

vehicle exhaust: 150°C to more than 500°C, the low temperatures being the most problematic. Our NOX HyCat is the first catalytic system to span that temperature range. The system includes a brand-new, iron-containing, zeolite catalyst that is augmented with cerium-manganese oxide, an oxidizer that produces a near-optimum ratio of NOX components to speed up the catalytic reaction and enable the zeolite to operate efficiently as a low-temperature catalyst. We combine this new low-temperature catalyst with a conventional high-temperature catalyst in a "dual-bed" configuration that provides high rates of NOX conversion over the broadest temperature range ever achieved. It operates efficiently from 113°C to as high as 600°C, includes no expensive precious metals, requires no complex engine controls, and is compatible with existing manufacturing techniques.

Applications

The NOX HyCat is the first NOX-reduction system for diesel engines that can be used in vehicles such as

- sedans,
- vans,
- SUVs,
- light and heavy trucks, and even
- locomotives.

Team member: Kevin Ott of Actinide, Catalysis and Separations Chemistry (C-SIC).

Reversible Electrotint Windows

Most office buildings are literally made up of windows — for example, the Sears Tower in Chicago has 16,000. During spring and summer, the heat from sunlight, coupled with the heat from people, lights, computers and other equipment, often means that buildings must run air conditioning until the outside temperature falls to freezing. Permanently tinting the windows presents a different problem during the fall and winter when sunlight helps keep buildings warm.

To address these problems, researchers developed windows that can quickly go from a colorless to a deeply colored — or mirrored — state and back again. The windows let in 75 percent of visible light during fall and winter and block 90 percent of light during spring and summer.



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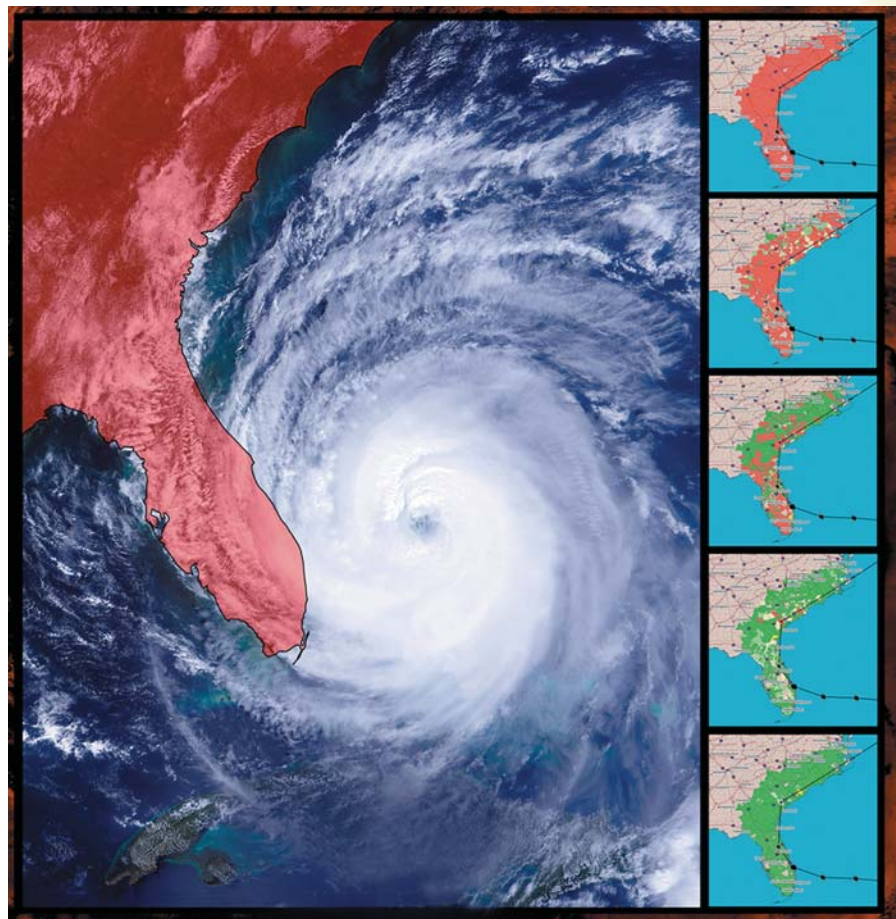
R&D Nominations ...

continued from Page 7

Applications

- Energy-efficient building windows — DOE estimates that optimizing heat gains and losses through architectural windows and enhancing the use of daylight can save the United States 5 percent in energy consumption annually.
- Rear- and side-view automotive mirrors — For this market, the technology eliminates headlight glare, thereby reducing automotive accidents. Unlike conventional electrochromic mirrors, the Electrotint mirrors are more stable in sunlight. The present market for rear- and side-view mirrors is estimated to be worth \$550 million and growing at 20 percent per year.

Team members: Benjamin Warner of Actinide, Catalysis and Separations Chemistry (C-SIC) and Gordon Goodyear of ElectroChromiX Inc.



Scenario Library Visualizer: The Calm during the Storm

On Sept. 24, 2004, Hurricane Jeanne struck the Florida coast, knocking out electricity to more than 1.7 million homes, businesses and institutions. In just eight days, first responders restored power, thanks in part to the Scenario Library Visualizer (SLV). SLV is a software package that consists of a catalog of presolved scenarios that a user can modify electronically to analyze and visualize electrical blackouts during an unfolding natural disaster, such as a hurricane or tsunami, or a manmade catastrophe, such as an industrial accident or terrorist attack. Based on such predictions, first responders can restore power quickly to the neediest areas. SLV generates results within four hours. Moreover, SLV provides decision makers and concerned citizens detailed information about power availability and schedule restoration. SLV runs on medium-performance laptops preferred by first responders and requires minimal training to use.

Applications

- Predicts damage to electrical infrastructures, thus enabling first responders to restore power quickly.
- Helps planners, such as the Federal Emergency Management Agency and the Department of Homeland Security, create and evaluate emergency response plans and contingency action plans.
- Can be used to assist in the training of first responders, as well as local, state and national decision makers.

Team members: Steve Linger, Mihaela Quirk, Loren Toole and Fred Roach (D-4); and Thomas Riggs, Lab retiree.

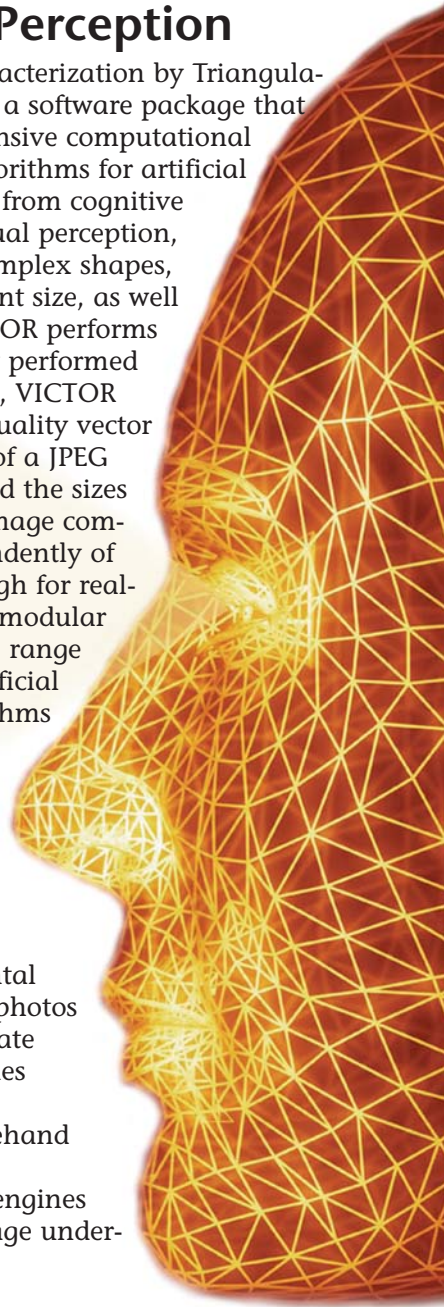
VICTOR: A New Paradigm for Artificial Visual Perception

VICTOR (Vectorized Image Characterization by Triangulation, and Object Reconstruction) is a software package that provides a versatile and comprehensive computational framework for developing new algorithms for artificial visual perception. Using principles from cognitive psychology to emulate human visual perception, VICTOR recognizes objects with complex shapes, regardless of orientation or apparent size, as well as objects with moving parts. VICTOR performs many object-recognition tasks now performed by humans. To recognize an object, VICTOR converts a pixel image to a high-quality vector image, typically reducing the size of a JPEG image by a factor of about four and the sizes of other image types even more. Image compression can be performed independently of object recognition and is fast enough for real-time video applications. VICTOR's modular structure can accommodate a wide range of existing algorithms used for artificial visual perception as well as algorithms to be developed in the future.

Applications

- Reducing digital-image storage requirements
- Analyzing X- or gamma-ray images of cargo containers
- Analyzing medical X-rays, dental photos or satellite-reconnaissance photos
- Helping robotic vehicles navigate
- Helping military robotic vehicles identify targets
- Rendering 3D objects from freehand 2D sketches
- Enabling visual-object search engines
- Developing algorithms for image understanding and machine vision

Team members: Lakshman Prasad and Alexei Skourikhine of Space and Remote Sensing Sciences (ISR-2); and Ramana Rao, former Lab employee.



R&D 100 Award winners ...

2000

- ANDE: Advanced Nondestructive Evaluation System
 - Electroexploded Metal Nanoparticles

2001

- Free-Space Quantum Cryptography
- SCORR — Supercritical CO₂ Resist Remover
- Tandem-Configured Solid-State Optical Limiter

2002

- GENIE: Evolving Feature-Extraction Algorithms for Image Analysis
 - HDF5 — Hierarchical Data Format

2003

- CARISS: Integrated Elemental and Compositional Analysis
- BASIS: High-Confidence Biothreat Detection and Characterization
 - FIRETEC: A Physics-Based Wildfire Model
 - Flexible Superconducting Tape
 - FlashCT™
 - Green Destiny
- PowerFactoRE: A Suite of Reliability Engineering Tools for Optimizing the Manufacturing Process
 - Super-Thermite Electric Matches

2004

- Clustermatic
 - Confocal X-ray Fluorescence Microscope
- mpiBLAST: A High-Speed Software Catalyst for Genetic Research
 - Plasma-Torch Production of Spherical Boron Nitride Particles
 - 10-Gigabit Ethernet Adapter: Speed Really Changes Everything