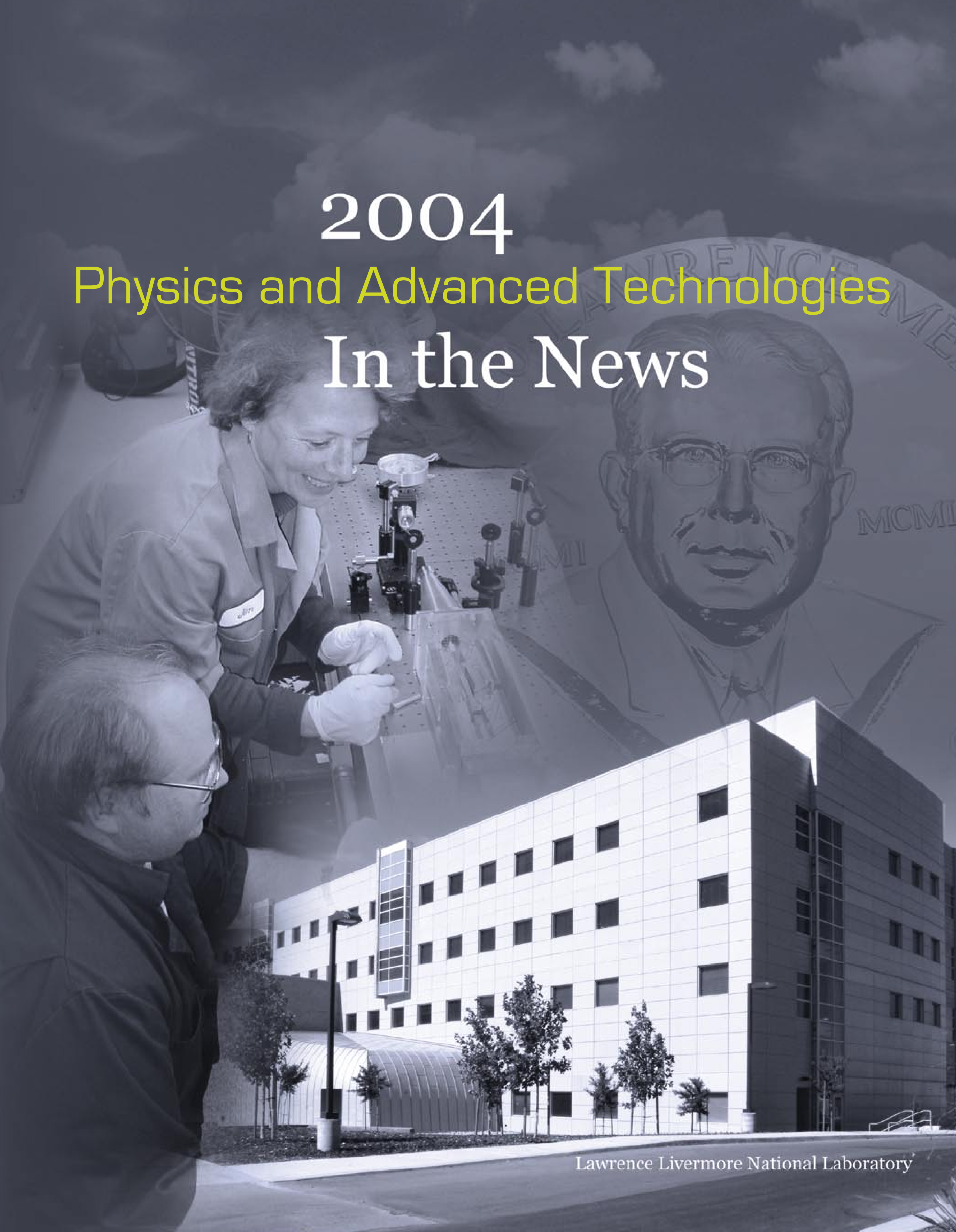
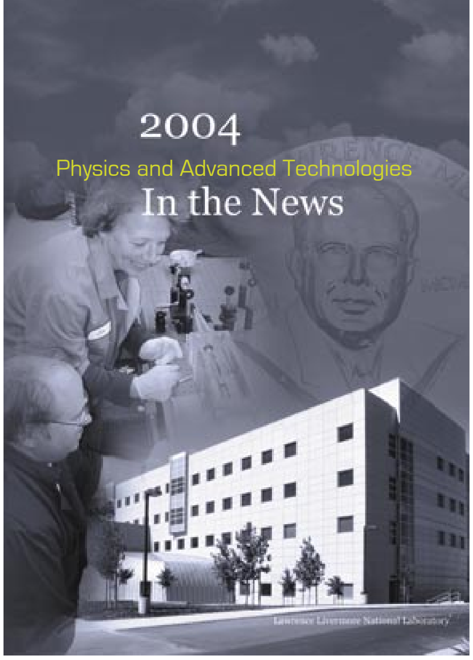
2004 Physics and Advanced Technologies In the News



Lawrence Livermore National Laboratory



About the Cover

Physicists Marilyn Schneider and Joe Holder working with part of a soft x-ray imager in the laboratory. This instrument, mounted on a framing camera at the target chamber of the National Ignition Facility, provided key information about the hot plasma formed inside hohlraums in experiments that were part of the NIF Early Light campaign in 2004 (see pp. 6 and 7).

The Ernest O. Lawrence Award Medal. Established in 1959, the Lawrence Award is presented by the Department of Energy each year to scientists and engineers for their exceptional contributions to the development, use, or control of nuclear energy. Nuclear energy is broadly defined to include the science and technology of nuclear, atomic, molecular, and particle interactions and their effects. In 2004, astrophysicist Claire Max was one of seven award winners nationwide (see p. 12).

The newly constructed Terascale Simulation Facility at Livermore. This facility, opened in July 2004, will house some of the world's fastest supercomputers, such as BlueGene/L and ASC Purple, both made by IBM. PAT researchers are using Livermore's wide array of supercomputers to perform unprecedented simulations, which are advancing our understanding of states of matter and phenomena ranging in size from subatomic to cosmological (see pp. 2 and 6).

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About this Report

Several outstanding research activities in the Physics and Advanced Technology Directorate in 2004 were featured in *Science & Technology Review*, the monthly publication of the Lawrence Livermore National Laboratory. Reprints of those articles accompany this report. Here we summarize other science and technology highlights, as well as the awards and recognition received by members of the Directorate in 2004.

About Physics and Advanced Technologies

The Physics and Advanced Technologies Directorate was established in July 2000 through the merger of the former Physics Directorate and elements of the former Laser Programs. The Directorate has a budget of approximately $160 million and a staff of approximately 380 employees. We are highly integrated and multidisciplinary, with substantive collaborations with the rest of Lawrence Livermore National Laboratory and with other national laboratories, universities, and industries. Our mission is to be a leader in frontier physics and technology for 21st-century national security missions: stockpile stewardship, homeland security, global stability, and scientific preeminence.

Find Out More About Us

Visit our Web site at http://www-pat.llnl.gov/ for more information on Physics and Advanced Technologies research, facilities, publications, staff, organizations, events, and awards.

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National Nuclear Security Administration

Physics & Advanced Technologies

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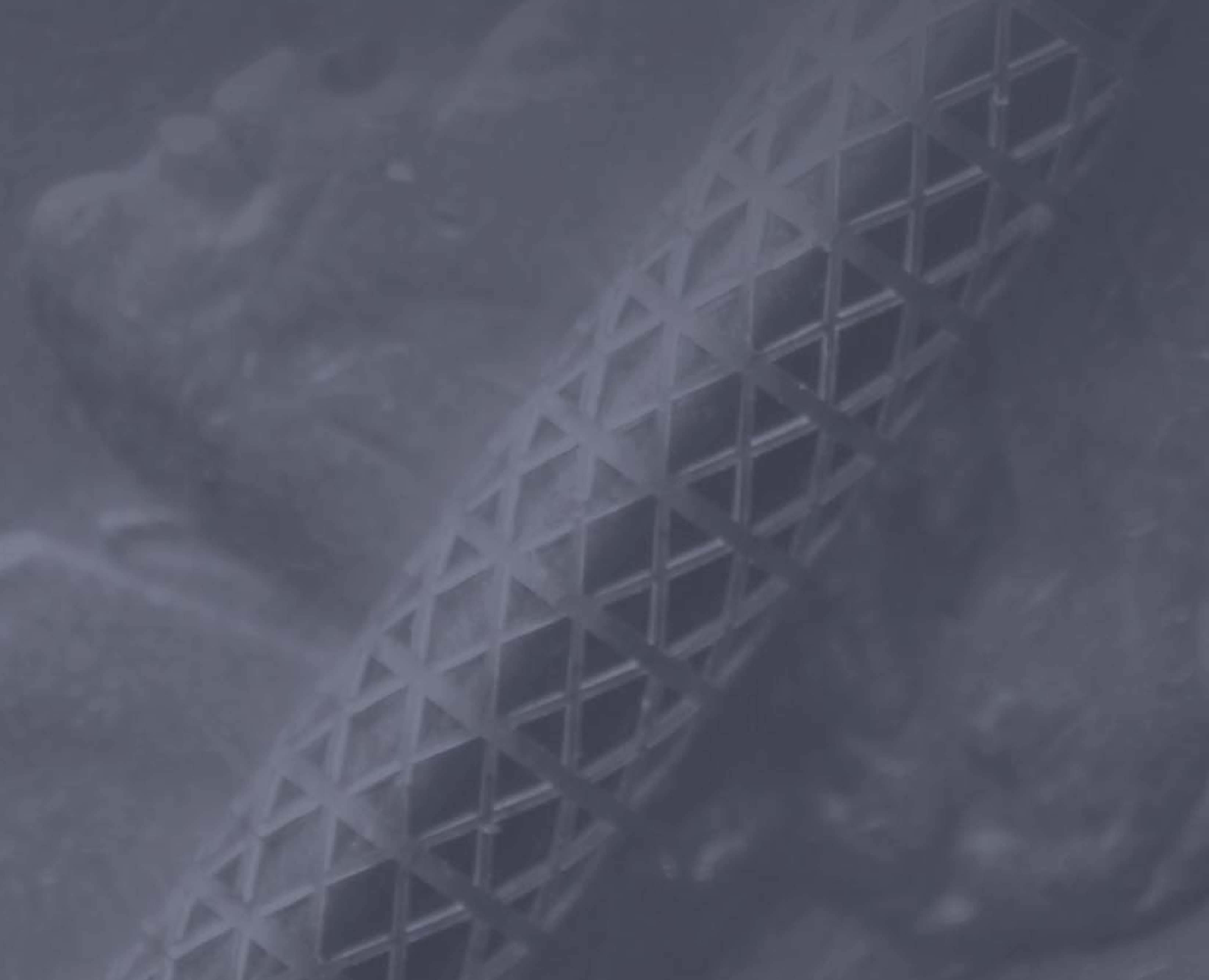
Research in the News

Advancing science and technology in the national interest



Scientists unveil melting point of iron at Earth's core

Livermore physicists Jeffrey Nguyen and Neil Holmes have discovered that iron at conditions comparable to Earth's core melts at a pressure of 225 gigapascals and a temperature of about 5,100 kelvins. Determining the melting point of iron is essential to determining the temperatures at core boundaries and the crystal structure of Earth's solid inner core. To date, the properties of iron at high pressure have been investigated experimentally through both laser-heated, diamond-anvil cell experiments and shock-compression techniques as well as through theoretical calculations.

However, those techniques have not produced a consensus on the melt line or the high-pressure, high-temperature phase of iron in the inner core. Using the Laboratory's two-stage gas gun, the researchers demonstrated that a shocked sample of iron crosses the melt line at a pressure between that of the core–mantle boundary and the pressure of the inner–outer core boundary.

"By determining the melting point of iron, we can estimate the temperature at the core boundaries," Nguyen said. "These data provide us with more information to study the temperature of Earth's core." Nguyen and Holmes's results appeared in the January 22, 2004, issue of *Nature*.

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Reprinted from April 2004 issue of Science & Technology Review of the Lawrence Livermore National Laboratory.

Gamma-ray bursts expel common elements

In the February 20, 2004, issue of *Astrophysical Journal Letters*, Jason Pruet, a Livermore astrophysicist, and Rebecca Surman and Gail McLaughlin of North Carolina State University report on their discovery that gamma-ray bursts are important sources of several common elements. Their findings are based on recent observations indicating that each gamma-ray burst expels about half a solar mass of readily visible radioactive nickel. After a few months, this radioactive nickel, which is moving at 40,000 kilometers per second, decays to iron. Their modeling calculations show that gamma-ray bursts also produce enormous quantities of such everyday elements as zinc, titanium, calcium, and scandium.

Gamma-ray bursts are rare—only a small percentage of dying stars produce them. But, says Pruet, these events may account for as much of some elements as all other stellar explosions combined.

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Reprinted from May 2004 issue of Science & Technology Review of the Lawrence Livermore National Laboratory.

Guide star sheds light on stellar origins

In a university–laboratory collaboration, a team of astrophysicists has observed for the first time that distant larger stars formed in flattened accretion disks just as the Sun was formed. Less massive stars, including the Sun, are believed to be formed in a swirling spherical cloud that collapses into a disk. Using the laser guide star adaptive-optics system created by Livermore scientists, the astronomers observed a strongly polarized, biconical nebula 10 arcseconds in diameter around the star LkHa 198 and a polarized jetlike feature in LkHa 198-IR. The star LkHa 233 featured a narrow, unpolarized dark lane similar to an optically thick circumstellar disk. The team included scientists from Lawrence Livermore, the University of California (UC) at Berkeley, UC Santa Cruz, California Institute of Technology, the National Science Foundation's Center for Adaptive Optics, and UC's Lick Observatory. Results from this research were published in the February 27, 2004, issue of *Science*.

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Reprinted from May 2004 issue of Science & Technology Review of the Lawrence Livermore National Laboratory.

Experiments to understand plutonium

Plutonium is an extremely complex material, and it is critically important to the functioning of nuclear weapons. Understanding the metal and alloys is one of the major scientific challenges in the Stockpile Stewardship Program. Through precise laboratory measurements using diamond anvil cells, Livermore researchers have been able to determine some of the structural and thermodynamic properties of plutonium at high pressures.

A diamond anvil cell is a small mechanical press that squeezes a microgram of material between two small flat-tipped diamonds, attaining pressures on the order of 100 gigapascals. In experiments fielded at the Advanced Photon Source at Argonne National Laboratory, the scientists found the first evidence of a new high-pressure structure of plutonium that had been predicted years ago. The experiments were conducted at a special beam line for high-pressure material studies. The beam line was developed by a consortium of researchers from Lawrence Livermore, Argonne, the University of Nevada, and the Carnegie Institute of Washington. In February 2004, Livermore scientists performed the first experiments in which new and aged samples of plutonium were measured in the same diamond anvil cell to provide side-by-side comparisons.

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Estimate of photon mass is listed in 2004 compendium

A paper written by Livermore physicist Dmitri Ryutov titled, "The Role of Finite Photon Mass in Magnetohydrodynamics of Space Plasmas," has piqued the interest of particle physicists and astrophysicists worldwide. In the paper, which appeared in a plasma physics journal in 1997, Ryutov proposed an upper estimate of a finite photon mass. Eight years after his published findings, Ryutov's estimate was selected to appear in the 2004 edition of the *Review of Particle Physics*, a compendium of elementary particle data, as the best estimate of photon mass to date.

Although in calculations photon mass is assumed to be zero, physicists have been trying for years to determine how small the mass actually is. Ryutov suggested an upper limit based on observations of the solar wind: The photon mass is less than the electron mass divided by 10 billion of trillions. Ryutov says that even this tiny mass would have a strong effect on large-scale astrophysical phenomena.

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Efficient multi-kilovolt x-ray sources

Livermore scientists and collaborators from the Naval Research Laboratory demonstrated an efficient five-kilovolt x-ray source using laser-irradiation of titanium-doped aerogel targets. Bright laser-produced x-ray sources are needed for radiography of targets in inertial-confinement fusion and other high-energy-density experiments. As the targets get larger and denser, the backlighter x-ray sources need to be brighter and have higher photon energies.

In experiments at the OMEGA laser at the University of Rochester, the researchers used 40 beams to irradiate the two flat faces of the cylindrical target using nanosecond laser pulses. The irradiation fully ionizes and heats the entire volume of the low-density aerogel target and a supersonic wave excites the titanium atoms resulting in the emission of K-shell x-rays. The scientists measured x-ray output between 40 and 260 joules in the 4.6 to 5.0 kilovolt band, corresponding to a maximum conversion efficiency of nearly 2 percent. This a factor of 3 better than that obtained in previous experiments with titanium targets. These results were published in an article, which was highlighted on the cover of the April 23, 2004 issue of *Physical Review Letters*.

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Livermore is partner in new Fusion Science Center

In May 2004, DOE's Office of Fusion Energy Sciences announced the formation of the Fusion Science Center for Extreme States of Matter, which will be hosted at the University of Rochester. Livermore's Institute of Laser Science and Applications (ILSA) is a partner in the new Center. Other participants include Massachusetts Institute of Technology, General Atomics, University of California at San Diego, University of California at Los Angeles, Ohio State University, University of Texas at Austin, and University of Nevada at Reno.

DOE funding for the Center will total $5.5M over five years. Participants will be investigating the physics of creating matter using a combination of high-energy drivers (compression) and high-intensity lasers (heating). Integrated experiments will be conducted at the major national high-energy-density science facilities at Rochester, Livermore, and Sandia, in a synergistic relationship with the National Nuclear Security Administration. A major long-term goal is to study fast ignition as a potential future energy source.

The Center will bring academic scientists from around the country into a collaboration that will foster rapid progress in this field. As part of the Center's activities, ILSA will co-host a summer school on high-energy-density physics in August 2005 at the University of California at Berkeley.

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New medical device for treating stroke

In collaboration with clinicians from the University of California at Davis, Livermore researchers are developing a unique neurovascular device for the treatment of stroke. The device consists of an optical fiber with a tip made of a novel material called shape memory polymer (SMP). This material has the ability to rapidly change its shape into a pre-programmed form when heated. During treatment, the device is inserted into the patient's vascular system through a catheter and pushed beyond the stroke-causing blood clot. Laser light transmitted through the optical fiber is absorbed by the SMP tip, causing it to transform into a corkscrew shape to capture the clot and restore blood flow. This mechanical clot retrieval procedure has the potential to overcome both the narrow treatment window and hemorrhage risk associated with conventional clot-dissolving drug treatment. The short timeframe and risk currently leave the majority of stroke victims ineligible for treatment. Preliminary in vitro experiments in anatomical vascular models have demonstrated the feasibility of the SMP device. Results were presented at the June 2004 Topical Meeting of the IEEE Lasers and Electro-optics Society, and later at the International Conference on Advances in Optics for Biotechnology, Medicine, and Surgery.

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Gamma-ray detector on Mercury voyage

Scientists and engineers from Lawrence Livermore, the Space Sciences Laboratory at the University of California at Berkeley, and the Applied Physics Laboratory at Johns Hopkins University designed a high-resolution gamma-ray detector for use on the Mercury MESSENGER spacecraft. MESSENGER (short for Mercury Surface, Space Environment, Geochemistry, and Ranging) was launched on August 3, 2004, and will conduct an in-depth study of Mercury, the planet closest to the Sun. Its voyage will include three flybys of Mercury in 2008 and 2009 and a yearlong orbit of the planet starting in March 2011. As it orbits the planet, MESSENGER will use the detector to measure characteristic gamma-ray emissions from Mercury's crust as well as solar winds and cosmic rays.

The Livermore team's role in the project was to ensure that the spacecraft's gamma-ray spectrometer could withstand the Sun's heat reflected from the surface of Mercury. To do that, the team combined a rugged, encapsulated germanium gamma-ray detector with a miniature cryocooler and a multilayered thermal shield. The cryocooler and shield maintain the detector at a temperature of less than 90 kelvins, ensuring that the spectrometer operates correctly.

The detector is based on technology originally developed by Lawrence Livermore and Lawrence Berkeley national laboratories for CryoFree/25—a handheld, mechanically cooled detector that can detect gamma rays from radioactive material. (See *S&TR*, September 2003, "Portable Radiation Detector Provides Laboratory-Scale Precision in the Field.") The detector onboard MESSENGER is cooled by a low-power, compact cryocooler, which eliminates the need for liquid nitrogen yet allows the detector to attain the high-level energy resolution needed for accurate measurements.

More information on the MESSENGER voyage is available online at messenger.jhuapl.edu.

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Simulations point to unexpected physics in hydrogen

Livermore scientists have used quantum simulations to compute the melting temperature of hydrogen as a function of pressure. Their results indicate that the melting curve of hydrogen has a maximum, which opens up the interesting possibility of finding a low-temperature metallic fluid at about 4 million atmospheres of pressure (400 gigapascals). Such a fluid is expected to have unusual properties and would likely represent an entirely new state of matter.

In addition to predicting the melting curve, the simulations provide a microscopic model showing the physical origin of the maximum melting temperature in hydrogen. Contrary to previous expectations, the researchers have discovered that the hydrogen melting temperature is strongly influenced by subtle changes in intermolecular interactions that occur in the fluid phase at ultrahigh pressure.

Numerous experiments have attempted to measure the high-pressure phases of hydrogen. However, until now, the phase boundary that separates the solid and liquid phases has remained relatively unknown. With this new understanding of the physical process involved in the melting of hydrogen, the Livermore researchers have proposed experiments to measure the solid–liquid phase boundary. Results from the team's research appeared in the October 7, 2004, issue of *Nature*.

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Initial experiments at the National Ignition Facility

In 2004, researchers completed a series of experimental campaigns using the first four laser beams of the National Ignition Facility (NIF), as part of a program called NIF Early Light. With just 4 of its 192 beams in operation, NIF is already the highest energy infrared laser in the world and has also set world records for green and ultraviolet laser energy produced by a single beam.

Future weapons physics experiments at NIF will require hohlraums (hollow cylindrical enclosures) producing higher radiation temperatures than those needed for ignition. To achieve these temperatures will require smaller hohlraums, higher laser power, and shorter duration for measurements. One of the experimental teams conducted five shots at NIF to test laser beam smoothing techniques and study laser-plasma interactions in subscale hohlraums open on one end (called halfraums). The researchers characterized the temporal evolution of plasma formation and found that the plasma did not fill the halfraum as fast as predicted by simulations. Energy coupling to the target was excellent with smoothed laser beams, resulting in temperatures of over 300 electronvolts in 0.6-millimeter diameter halfraums. These results verify that NIF's laser beams can be precisely pointed to deliver energy into subscale hohlraums and set the requirements for beam conditioning for experiments on targets driven by hot radiation. The United Kingdom's Atomic Weapons Establishment provided a key diagnostic for measuring the production of energetic electrons, and researchers from Sandia National Laboratory also contributed to these experiments.

This work was the subject of an invited talk, given by Livermore scientist Denise Hinkel, at the 2004 Annual Meeting of the American Physical Society's Division of Plasma Physics.

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Advanced diagnostics for the National Ignition Facility

Development of advanced diagnostics is an important component of the overall effort at NIF. Scientists from the Physics and Advanced Technologies Directorate have made important contributions to this effort. Bruce Young is the Responsible Individual for the Full Aperture Backscatter (FABS) instrument, which measures the laser light scattered from the target back through the final focusing lens. FABS is important in understanding laser-plasma instabilities in NIF targets and was used in the aforementioned hot hohlraum experiments. It was also a key diagnostic on another series of experiments, which met the first milestone of the Inertial Confinement Fusion Program on NIF.

A team lead by Peter Celliers installed and commissioned the velocity interferometer system for any reflector (VISAR) in May 2004. Developed by scientists and engineers from Livermore, Los Alamos, and Bechtel Nevada, VISAR measures the reflection from a shock front generated in a laser-irradiated target. It will be used to perform equation-of-state experiments and to optimize the performance of fusion targets on NIF.

Joe Holder is the Responsible Individual for the Framed X-ray Instrument (FXI), which was a key instrument for the joint Livermore–Los Alamos hydrodynamics experiments on NIF that met a high-level milestone for the Stockpile Stewardship Program. Subsequently, the FXI was modified for imaging in the soft x-ray band and was fielded during the extensive experimental campaign on hohlraum physics that ended in October 2004.

Franz Weber supported the development, installation, and operation of the Dante soft–ray power diagnostic system on NIF during the 2004 campaigns. This instrument provided particularly important information during the aforementioned hohlraum physics campaign. Additionally, he directed the x-ray calibration work for NIF at the NSLS synchrotron at Brookhaven National Laboratory.

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Understanding the physics of tokamaks

Livermore researchers are advancing the science underlying the tokamak concept for magnetically confined fusion through collaborations on experiments at the DIII-D Tokamak at General Atomics in San Diego. The research will have important implications for the performance of the International Thermonuclear Experimental Reactor (ITER), a major international project with significant U.S. participation.

The Livermore team at DIII-D led several experiments aimed at understanding the edge plasma and the transport of impurities. In one case, carbon-13 was injected into the plasma and used as a tracer to determine the location of carbon deposition on the plasma facing surfaces. Most of the carbon-13 was found in the diverted plasma region. The transport of carbon impurities is particularly important because, in future deuterium/tritium burning devices such as ITER, the tritium will be co-deposited with carbon and thus impurity transport will be a major factor in determining the in-vessel inventory of tritium.

In another experiment, new, two-dimensional measurements of plasma fueling and impurity transport in DIII-D have shown that most of the recycling occurs in the divertor region, in agreement with the predictions of fluid simulations.

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Alternative concept for magnetic fusion energy

Researchers are examining an alternative to the tokamak concept at the Sustained Spheromak Physics Experiment at Livermore, which may lead to lower-cost fusion reactors because of the spheromak's compact size and reduced complexity. Because of the difficulty of diagnosing experiments without disturbing the plasma, three-dimensional magneto-hydrodynamic simulations are aiding the quest to understand what is happening inside the spheromak's hot plasma. Laboratory scientists and collaborators at the University of Wisconsin are using supercomputers at DOE's National Energy Research Scientific Computing Center at Berkeley to simulate the results from the spheromak experiments. In one experiment, the researchers use multiple current pulses to increase the magnetic field energy in the spheromak in a stepwise manner, nearly doubling the confining magnetic field for a given gun current. Electron temperature measurements showed plasma heating after each current pulse. These results, published in the November 12, 2004 issue of *Physical Review Letters*, suggest a possible route to spheromaks with high magnetic fields and low gun currents.

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Rapid detection of biological agents in aerosols

An interdisciplinary team of Livermore researchers has developed a new analytical tool for the rapid detection of biological agents in aerosols. The Bio-aerosol Mass Spectrometer (BAMS) analyzes the biochemical composition of single, micrometer-size particles, such as bacterial cells or spores, which can be directly sampled from air or a suspension. Incoming individual particles are irradiated with a laser pulse that desorbs and ionizes characteristic molecules from a particle. Subsequent time-of-flight measurement determines the molecular masses of those molecules and reveals characteristic mass spectral fingerprints that are used to identify the particles. The whole process takes only a fraction of a second per particle. Applications of BAMS include rapid detection and identification of biological weapons particles and "white powder hoax" materials, studies of cell cycles and cell viability, and rapid screening of human effluents for pathogens.

In 2004, an advanced BAMS prototype demonstrated excellent performance in challenge tests sponsored by the Defense Advanced Research Projects Agency. The tests involved detecting small concentrations of various biological agent simulants dispersed in air. At the end of 2004, a BAMS was used at the San Francisco International Airport to study aerosol backgrounds in a field test sponsored by the Department of Homeland Security. BAMS provided valuable insights into potential sources of false alarms reported by other biosensors. The results will lead to better and less expensive biosensors for facility protection.

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Laser-irradiation of foils produces energetic proton beams

The recent discovery that ultra-intense laser pulses can produce well-collimated, high-energy proton beams has generated considerable interest in using such beams for fast-ignition in inertial confinement fusion, production of medical isotopes, and high-resolution radiography of opaque materials and plasmas. Livermore scientists and collaborators from the University of California at Berkeley have elucidated the fundamental mechanisms responsible for proton acceleration from laser-solid interactions. In experiments conducted at the Jupiter Laser Facility at Livermore, the researchers irradiated thin gold foils with 100-terawatt, 100-femtosecond laser pulses producing proton beams with a total yield of 100 billion and maximum proton energy exceeding 9 million electronvolts. Removing contamination from the back surface of the foils reduced the total yield of accelerated protons to less than 1 percent of that measured without removing contamination. No similar reduction was observed when only the front surface was cleaned. These results, published in the December 31, 2004 issue of *Physical Review Letters*, confirm the theory that the collimated, high-energy protons are produced from a thin (less than 1 nanometer) layer of contaminants (such as water or hydrocarbons) on the back surface of the laser-irradiated foils. This work will allow optimization of laser-produced proton beams for heating and probing warm, dense matter.

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Rapid detection of respiratory diseases in public health facilities

Livermore researchers are collaborating with physicians at the University of California Davis Medical Center to develop a new diagnostic tool for use in public health laboratories and hospital emergency rooms. This tool will simultaneously test for six of the most commonly seen respiratory infections, such as influenza and parainfluenza, and produce a diagnosis in less than an hour. Multiplexed assays of nucleic acid sequences are used to detect and identify the respiratory pathogens. The instrument will be simple to operate, requiring only the introduction of a nasal swab sample from the patient. All fluid handling, chemical reactions, and analysis of the results will be automated.

Wait times in hospital emergency rooms now average between 4 and 6 hours, and the threat of spreading infection during this time is great, especially for highly contagious pathogens. In addition, patients with undiagnosed infections often demand treatment leading to the over-prescribing of antibiotics. Because the new tool is automated and will test for the six pathogens simultaneously, the cost per test will be low, and the rapidity of results will reduce wait times and subsequent cross-infections in hospital waiting rooms.

The biological assays and instrumentation used for the public health application are similar to those developed previously at Livermore for environmental monitoring and early warning systems designed to protect against bioterrorist attacks.

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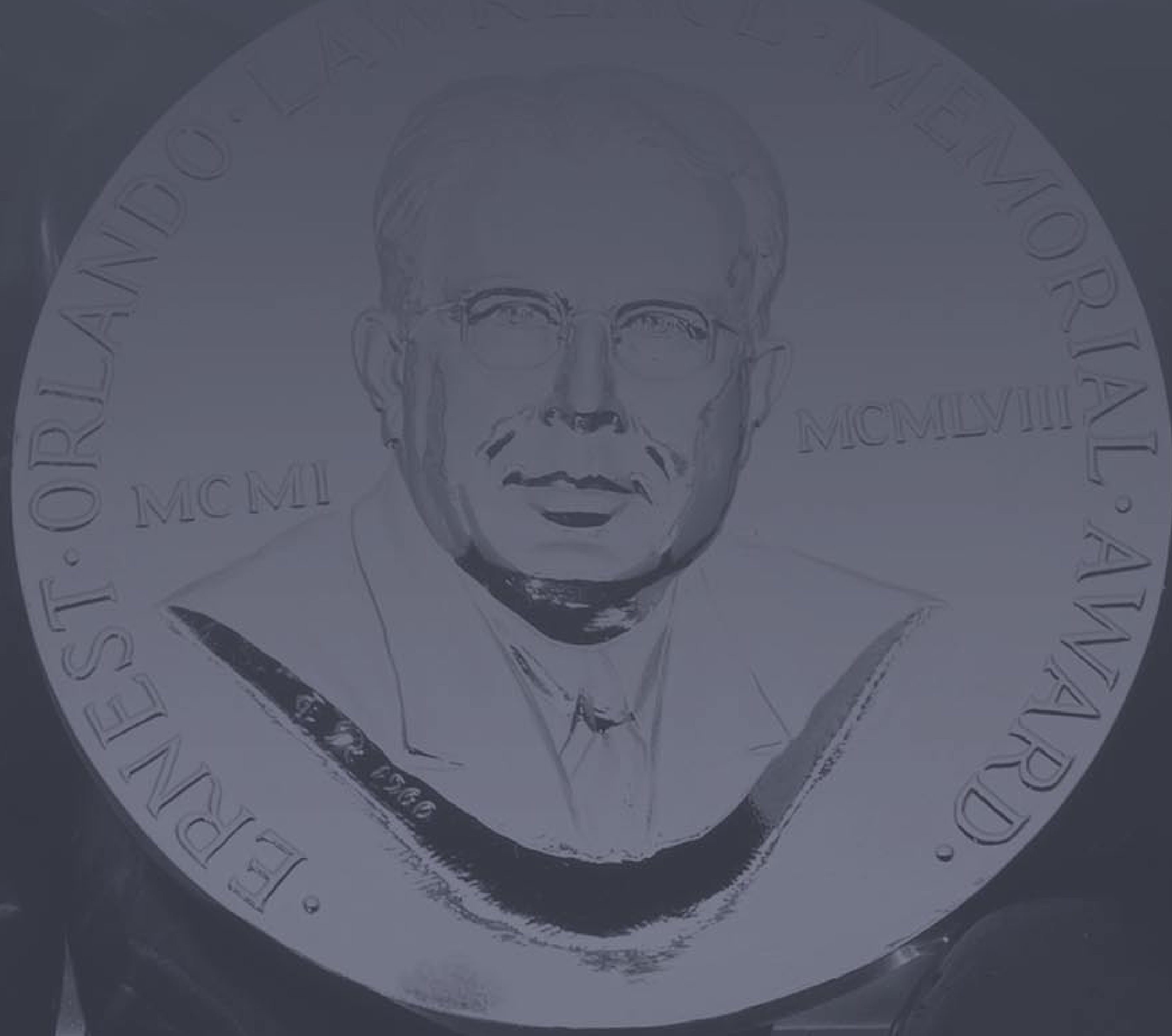
People in the News

Valuing scientific excellence,

leadership, and visibility



The scientific and technological accomplishments of the staff in the Physics and Advanced Technologies Directorate are recognized outside the Laboratory through prizes, awards, and front-page publicity. Highlights in 2004 include:

Claire Max, an astrophysicist at the Laboratory's Institute for Geophysics and Planetary Physics and a professor at the University of California at Santa Cruz, was one of seven winners of the **Department of Energy's E. O. Lawrence Award** for 2004. Max received the award in the physics category for her contributions to the theory of laser guide star adaptive optics and its application in ground-based astronomy. Then-Secretary of Energy Spencer Abraham presented the award at a ceremony in Washington, D.C. on November 8, 2004. Adaptive optics correct telescopic images for the blurring caused by atmospheric effects. Laser guide stars enhance the clarity of ground-based observations by a factor of 50 or more, making them comparable to observations with space-based telescopes.

Tom Rognlien, a physicist in the Fusion Energy Program, was elected **Fellow of the American Physical Society** (APS) in 2004 for seminal contributions to the modeling of tokamak edge plasmas and their interaction with bounding surfaces, and to the understanding of heating and transport in collisional and radio-frequency-excited plasmas. The APS Fellowship recognizes those members who have made significant advances in knowledge through original research or who have made significant, innovative contributions in the application of physics to science and technology. Each year, no more than one-half of one percent of the current APS membership is elected to the status of Fellow.

Dmitri Ryutov, a physicist in the Fusion Energy Program, was selected **Fellow of the Institute of Physics** in the United Kingdom in 2004. Ryutov was recognized for his status in the international physics community and his contributions to the Institute as a member of an Editorial Board.

Five teams of Laboratory scientists won **R&D 100 awards**, known as the "Oscars of Invention." Each year, R&D Magazine selects the 100 most technologically significant new products and processes, ones that are likely to produce the most benefits for the world at large. Two of the awards involved significant contributions by scientists in the Physics and Advanced Technologies (PAT) Directorate:

• *Autonomous Pathogen Detection System* (APDS) is an automated, lectern-size instrument that can monitor the air for all three types of biological agents—bacteria, viruses, and toxins. Because it operates continuously, APDS can detect low concentrations of bioagents that might go undetected by other systems. It employs two independent detection methods which increases system reliability and minimizes the possibility of false positives. PAT members of the award-winning team were **Mary McBride, Anthony Makarewicz, Bill Colston, Fred Milanovich, Kodumudi Venkateswaran, Benjamin Hindson,** and **Ujwal Sathyam Setlur**.

• *Inductrack* is a magnetic levitation system for transportation. Inductrack uses new arrangements of permanent magnets to produce the magnetic fields that levitate the train and provides economic and operational advantages over other maglev systems. It can be adapted to both high-speed and urban-speed environments. This maglev concept was originally conceived by Laboratory physicist Richard Post and licensed in 2003 to General Atomics in San Diego for transportation systems. The award-winning team included Fusion Energy Program physicist **Dmitri Ryutov**.

Two teams of PAT scientists received **DOE Weapons Excellence Awards**:

• **John Becker**, **Lee Bernstein**, **Paul Garrett**, **Erich Ormand**, and **Walid Younes** in N Division were recognized for experiments at the Los Alamos Neutron Science Center leading to precise yttrium cross sections for fusion yield radiochemistry.

• **Neil Holmes** and **Robert Thoe** in H Division were recognized for plutonium experiments at JASPER providing highly precise measurements of the equation-of-state.

John Lindl in the Fusion Energy Program and **Doug Wright** in N Division were among the three scientists who were awarded **Teller Fellowships** by the Laboratory to pursue self-directed research. Lindl is a recognized leader in fusion energy and the physics of inertial fusion targets. Wright has been instrumental in the discovery of an asymmetry in the temporal distribution of the decay of B and anti-B mesons.

H Division scientists **Giulia Galli**, **Andrew Williamson** and **Jeff Grossman**, and their collaborators from the Chemistry & Materials Science and Computation directorates, received one of the two 2004 **LLNL Science and Technology Awards** for their discovery of Bucky-diamond and unraveling the atomic structure of silicon and germanium nano-particles.

Christian Marois in the Institute of Geophysics and Planetary Physics won the **Canadian Plaskett Medal** for the best Ph.D. thesis in astronomy for the past two years.

The Alameda County Women's Hall of Fame named physicist and former Astronaut **Tammy Jernigan** its 2004 **Outstanding Woman of the Year** in the science category.

Michael Bogan in M Division received the 2004 Douglas Ryan **Graduate Student Award** from the Analytical Chemistry Division of the **Canadian Society of Chemistry**. The Ryan Award, presented every two years, recognizes the outstanding graduate student in the field of analytical chemistry enrolled in a Canadian University.

Robert Heeter in V Division and **Don Correll** in the Fusion Energy Program received the **Infography Web Site Honor** for one of the most excellent sources of information about the topic of plasma science and technology.

Undraa Agvaanluvsan in N Division received a **Recognition of Excellence** from National Nuclear Security Administration's Stewardship Sciences Academic Alliances Program for the best poster presentation.

Steve Allen, a physicist in the Fusion Energy Program, was elected **Treasurer–Secretary** of the Division of Plasma Physics of the American Physical Society.

PAT scientist **Bill Colston** was selected as the first **Director** of the **Biodefense Knowledge Center** sponsored by the Department of Homeland Security at Livermore. The Center's mission is to provide in-depth analysis of biodefense issues by integrating existing knowledge and information from disparate sources. It is also developing new capabilities to enable real-time assessment of biothreat data. The Center, which opened in September 2004, is a collaboration of the Lawrence Livermore, Sandia, Oak Ridge, and Pacific Northwest national laboratories and Science Applications International.