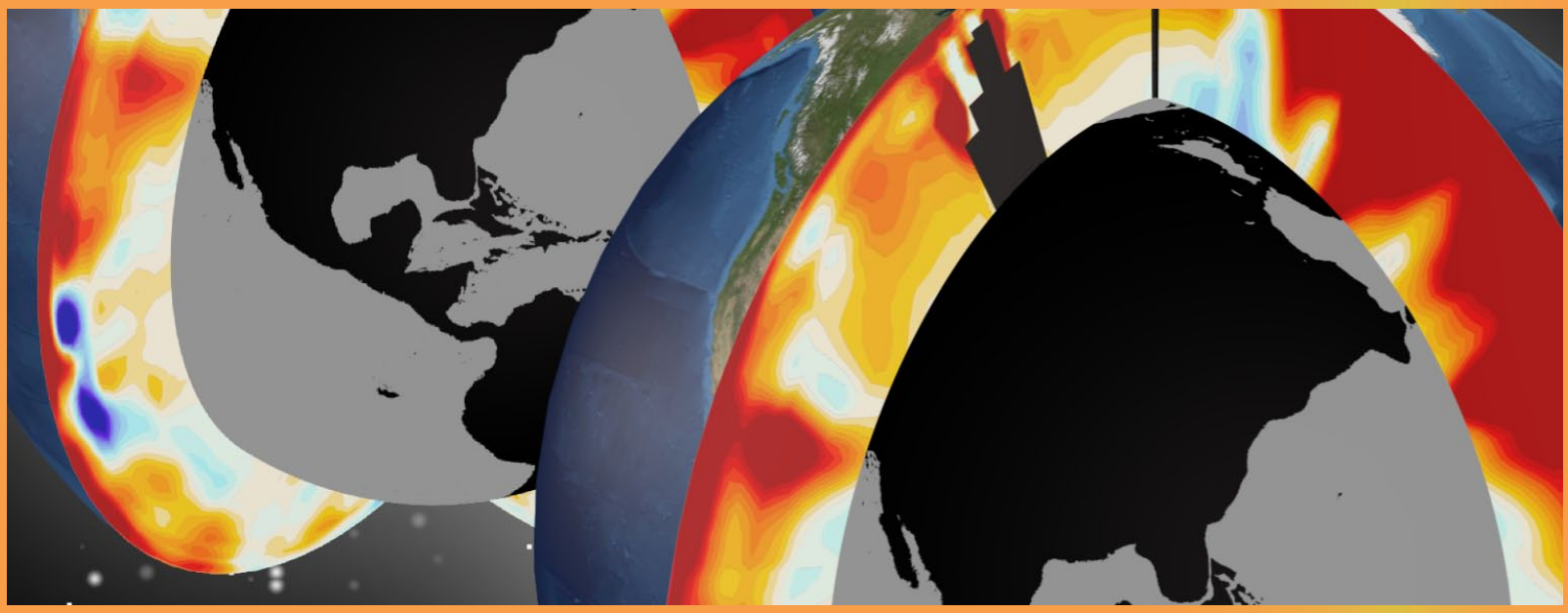
Science and Technology UPDATE

June/July 2012



A bulletin of achievements
at Lawrence Livermore National Laboratory

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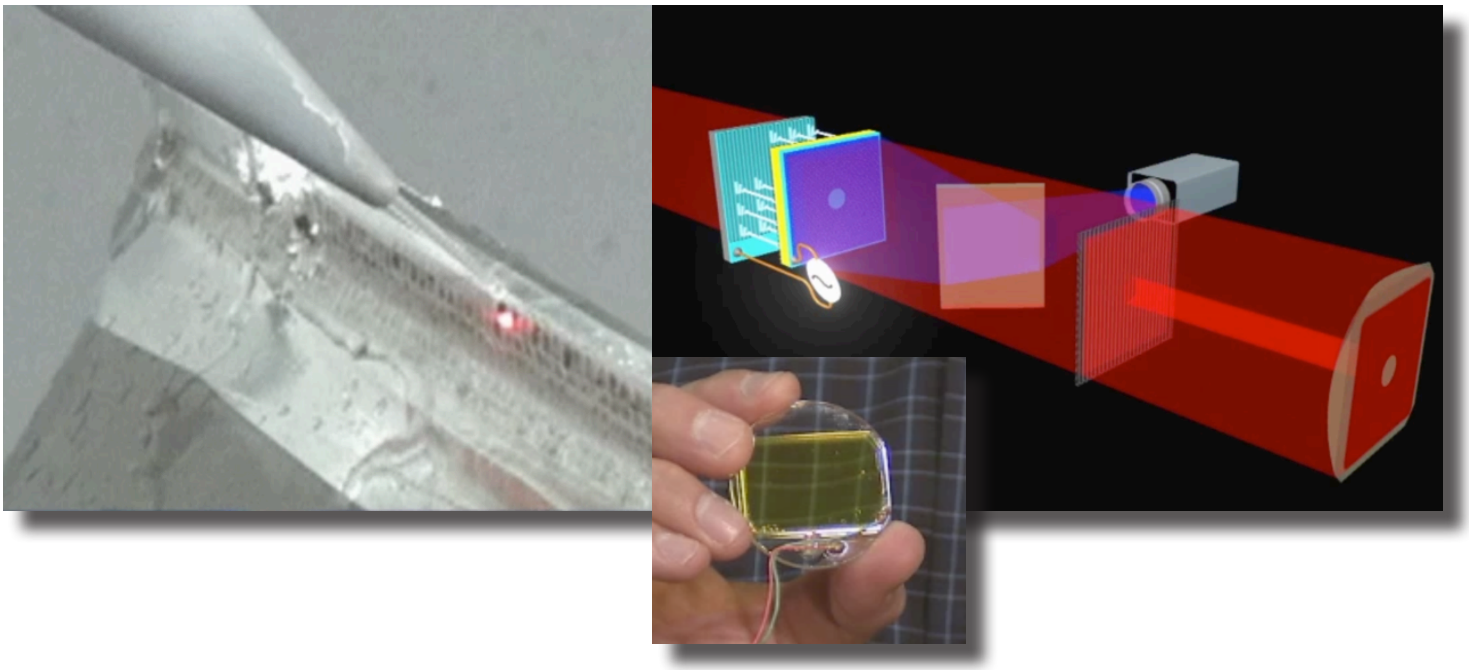
LLNL WINS FIVE R&D 100 AWARDS

Lawrence Livermore researchers have won **five awards** in the latest R&D 100 competition, which recognizes breakthrough technologies with commercial potential. The Laboratory was principal developer of four of the award-winning technologies, while the fifth was a joint submission. "Congratulations to this year's R&D 100 award winners," said Energy Secretary Steven Chu. "The research and development at the Department of Energy's laboratories continues to help the nation meet our energy challenges, strengthen our national security, and improve our economic competitiveness." Livermore's winning technologies are **high-velocity laser accelerated deposition** (HVLAD), a new photonic method for producing protective coatings with ultrahigh-strength, explosively bonded interfaces that prevent corrosion, wear, and other modes of degradation in extreme environments; **laser energy optimization by precision adjustments to the radiant distribution** (LEOPARD), which precisely adjusts the intensity profile of a NIF laser beam, enabling the beam to extract the maximum amount of energy from the laser amplifiers while preserving a high degree of reliability among the optical components; **plastic scintillators for neutron and gamma ray detection**, the world's first plastic material capable of efficiently distinguishing neutrons from gamma rays; the **snowflake power divertor**, an enabling technology for toroidal tokamaks that generates a magnetic field with a snowflake-shaped configuration to spread the hot plasma exhaust over a larger wall area and reduce the exhaust heat flux to manageable levels; and the **multiplexed photonic doppler velocimeter**, a portable optical velocimetry system that simultaneously measures up to 32 discrete surface velocities onto a single digitizer by multiplexing signals in frequency and time. The figures are a close-up of the HVLAD (left) process and an animation of the LEOPARD system (right), with a key component (inset).



About the Cover

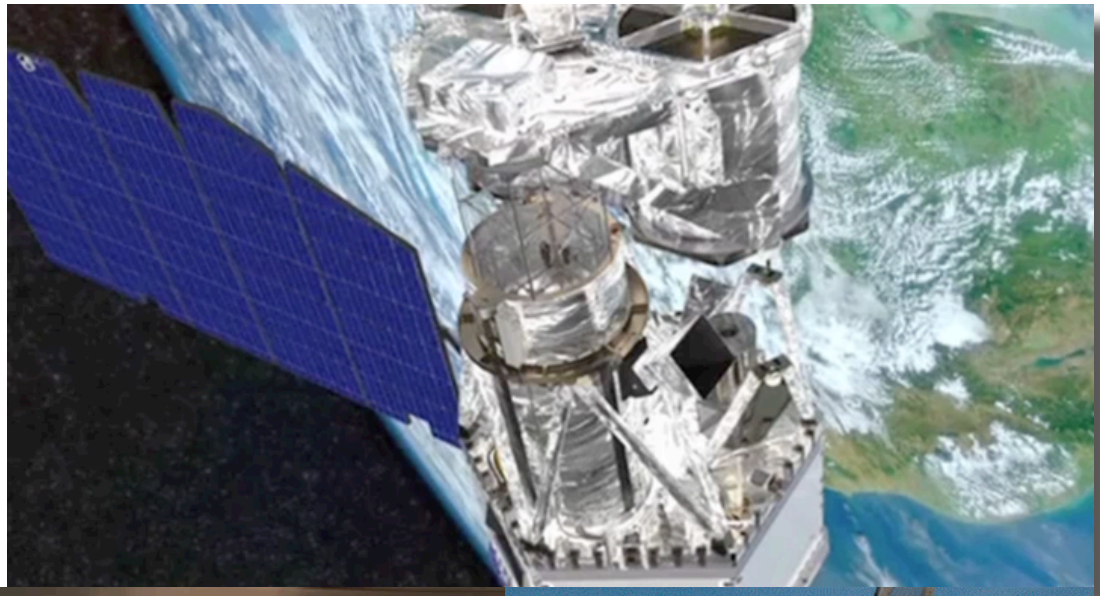
Decadal changes in ocean surface temperatures, here graphically presented, are found to be consistent with climate models only when the effects of anthropomorphically increased greenhouse gases are incorporated. (See "Paper shows human hand in ocean warming," on pg. 11.)

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-7NA27344.

LAB OPTICS ACHIEVE ORBIT ON NASA'S NUSTAR

On July 13, NASA successfully launched its Nuclear Spectroscopic Telescope Array (**NuSTAR**) satellite to observe the most energetic objects in the universe, including black holes and relativistic jets. NuSTAR is the first-ever satellite to focus high-energy x-rays, and it is these special optics that make possible a 100-fold increase in sensitivity over any previous hard x-ray device. This sensitivity will enable scientists to see objects such as supernovae in great enough detail to test current theories, as well as the black holes believed to be at the center of all galaxies and "extreme objects" that have never been directly seen before, such as relativistic jets.

Important optics design and testing work for NuSTAR were done at LLNL, where this x-ray-focusing technology dates back to the LDRD-supported High Energy Focusing Telescope (HEFT) instrument. (The success of HEFT—in the bottom right photo—allowed Livermore to propose NuSTAR to NASA.) Livermore's crucial involvement in this optics work was directed by physicist Bill Craig (photo), who served as payload manager. Bill—who explains how NuSTAR works in **this video**—led a team that included lead optics engineer Todd Decker, who took leave from LLNL to work on NuSTAR. Researchers Mike Pivovaroff and Julia Vogel and others played key roles in optics calibration and will also be involved in using the data that NuSTAR will deliver.



POSTDOC'S THESIS WINS APS AWARD

LLNL postdoc Yu-hsin Chen has been chosen by the American Physical Society Division of Plasma Physics to receive the 2012 Marshall N. Rosenbluth Outstanding Doctoral Thesis Award. The award, sponsored by General Atomics, was established to recognize "exceptional young scientists who have performed original thesis work of outstanding scientific quality and achievement in the area of plasma physics." The award certificate, which will be formally presented at the Fall Division of Plasma Physics Annual Meeting, reads: "For measurements and theory of the ultrafast, high-field, nonlinear response of gases near the ionization threshold; characterization of femtosecond plasma filaments; and demonstration that femtosecond filamentation requires plasma stabilization."

PLASMA PHYSICS AWARD WON

The Executive Board of the American Physical Society has selected Debbie Callahan, Ed Williams, Nathan Meezan, Laurent Divol, Robert Kirkwood, and Pierre Michel as recipients of the 2012 John Dawson Award for Excellence in Plasma Physics Research. The award was established to recognize a particular recent outstanding achievement in plasma physics research. The LLNL team's citation reads: "For predicting and demonstrating the technique of laser scatter on self-generated plasma-optics gratings that enables generation and redirection of high-energy laser beams important for indirect drive inertial confinement fusion and high-power laser–matter interactions."

E. O. LAWRENCE AWARD WINNERS RECOGNIZED

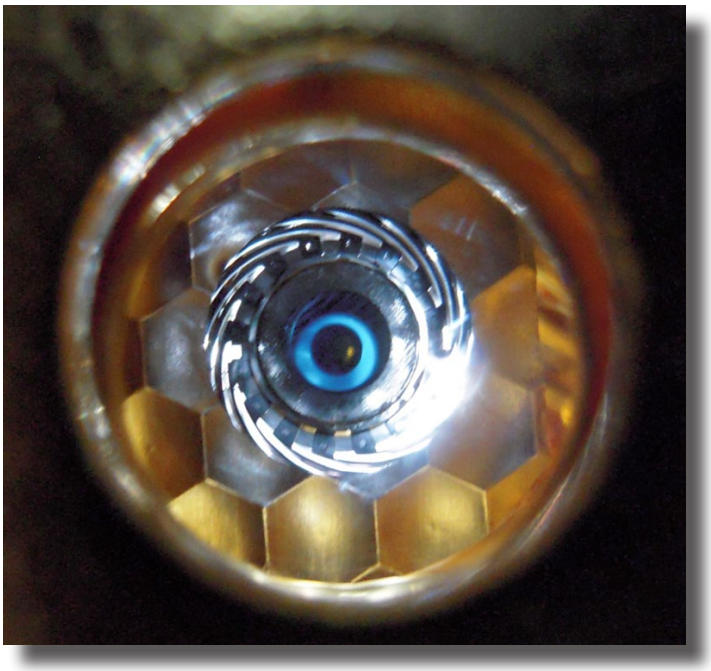
Secretary of Energy Steven Chu recently awarded the nine recipients of the 2011 Ernest Orlando Lawrence Awards—**announced** last November—for outstanding contributions in research and development supporting DOE and its missions. Among the nine winners was LLNL's Tom Guilderson (far right in the photo), who won in the Biological and Environmental Sciences category. Recipients in each category received a gold medal, a citation, and $20,000.

SEQUOIA CLOCKED AS WORLD'S FASTEST SUPERCOMPUTER

Clocking in at 16.32 sustained petaflops (quadrillion floating-point operations per second), Sequoia earned the **No. 1 ranking** on the industry standard Top500 list of the world's fastest supercomputers. Sequoia's number 1 status was announced at the International Supercomputing Conference (**ISC12**) in Hamburg, Germany. A 96-rack IBM Blue Gene/Q system, Sequoia will enable simulations that explore phenomena at a level of detail never before possible. "Computing platforms like Sequoia help the United States keep its nuclear stockpile safe, secure, and effective without the need for underground testing," said NNSA Administrator Thomas D'Agostino. "Sequoia also represents continued American leadership in high-performance computing, key to the technology innovation that drives high-quality jobs and economic prosperity." The screen captures are from KTVU science editor John Fowler's **story** about the record-breaking supercomputer.

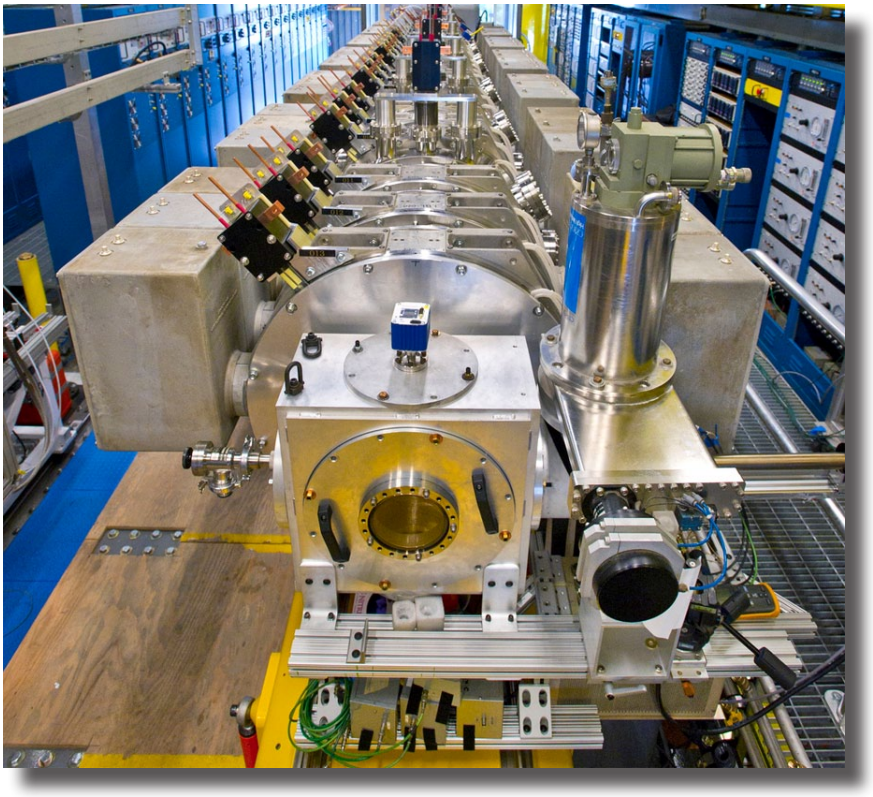
ANOTHER RECORD-BREAKING SHOT AT NIF

On July 5, NIF's 192 beams delivered more than 1.85 megajoules of ultraviolet laser light with 500 terawatts of peak power and to its target, reaffirming NIF's status as the most powerful laser of its kind. The shot achieved challenging performance targets first defined in the late 1990s, in the facility's planning stages. "NIF is becoming everything scientists planned when it was conceived over two decades ago," NIF Director Edward Moses said. Simultaneously delivering extreme levels of energy and peak power to a target is a critical requirement for achieving ignition of the hydrogen fusion fuel and producing more energy than is supplied. "The 500-terawatt shot is an extraordinary accomplishment by the NIF team, creating unprecedented conditions in the laboratory that hitherto only existed deep in stellar interiors," said Dr. Richard Petrasso, senior research scientist and division head of high-energy-density physics at the Massachusetts Institute of Technology. The photo is a view of a NIF target through the hohlraum's laser entrance hole.



NEW ACCELERATOR TO STUDY ALTERNATE APPROACH TO INERTIAL FUSION ENERGY

The Heavy Ion Fusion Science Virtual National Laboratory, whose members include LLNL and Lawrence Berkeley National Laboratory (LBNL), has recently completed a new accelerator designed to study an alternate approach to inertial fusion energy. The 2nd Neutralized Drift Compression Experiment (**NDCX-II**), housed at LBNL, incorporates advances in the acceleration, compression, and focusing of intense ion beams that can guide the design of major components for heavy-ion fusion energy production.



NDCX-II's design was established through simulations at the National Energy Research Scientific Computing Center using the Warp-3D ion-beam optics code developed primarily by LLNL's David Grote and Alex Friedman and LBNL's Jean-Luc Vay.

PRESENTER CHOSEN FOR YOUNG SCIENTISTS WORKSHOP

Eric Duoss has been selected as a presenter at the 3rd International Workshop for Young Scientists, organized by the World Materials Research Institutes Forum. In a talk titled "Additive Micro-Manufacturing of Designer Materials," **Eric** will discuss his cutting-edge fabrication work, which is supported by the LDRD Strategic Initiative "Disruptive Fabrication Technologies Initiative" (11-SI-005). The **workshop**, which will be held August 28–31 in Pathumthani, Thailand, will focus on reliable manufacturing with advanced materials and on material challenges for biomedical applications, mobility systems, and the mitigation of and adaptation to climate change.

POSTDOC INVITED TO SANDIA Z FACILITY WORKSHOP

Matt Terry, a postdoctoral researcher in the Fusion Energy Sciences Program, has been selected by the meeting organizers to receive financial support for his participation in the upcoming Fundamental Science with Pulsed Power: Research Opportunities and User Meeting, which takes place August 5–8 in Albuquerque, NM. Matt has been working on targets for heavy-ion-beam-driven inertial fusion energy and on other advanced target concepts. He plans to explore possible applications of pulse power machines to the study of targets for ion- and laser-driven fusion. **Workshop** attendees will discuss future research directions in the dynamic compression of matter using the current Z machine and a future 1-Mbar facility and ways to assure that collaborative user experiments undertaken on the machine are of the highest quality and impact.

NEUTRINO RESEARCH PRESENTED AT INTERNATIONAL CONFERENCE

PLS researchers Adam Bernstein and Nathaniel Bowden, postdocs Greg Keefer and Samuele Sangiorgio, and graduate student Michael Foxe all presented posters at the Neutrino 2012 **conference**, which was held in Kyoto, Japan, June 3–9. The conference, held every two years, is the most influential neutrino physics conference in the world. At the past two conferences, Adam and Nathaniel gave plenary overviews of applied antineutrino physics activities worldwide. Thanks in large part to LLNL's influence, applied antineutrino physics has become a regular feature at these conferences, including this year's plenary talk given by Fumihiko Suekane of Japan's Tohoku University, in which Livermore's technological leadership featured prominently. Nathaniel presented a well-received proposal for a U.S.-based sterile neutrino search experiment; Samuele and Michael presented progress towards first-ever measurement of coherent neutrino–nuclear scattering; and Greg described an improved model for the emitted antineutrino flux from nuclear reactors. Adam described ongoing activities related to the standoff monitoring of a nuclear reactor in the U.S. using a kiloton-scale water Cherenkov detector—a step towards the much larger detectors required for the remote discovery of small clandestine reactors.

TEAM WINS DNDO SUPERIOR PERFORMANCE AWARD

The Transformational and Applied Research Directorate of the Domestic Nuclear Detection Office (DNDO) presented its 2012 Award for Superior Performance in Support of the Mission to Livermore's Nerine Cherepy, Steve Payne, and the rest of the Scintillator Discovery Team along with their DNDO colleagues in recognition of their achievements in developing new high-performance scintillators. The honor was presented at the Symposium on Radiation Measurements and Applications (**SORMA**). Pictured from left to right are Alan Janos (DNDO), Nerine, Namdoo Moon (DNDO), Marissa Giles (DNDO), Steve, Owen Drury (LLNL), Joel Rynes (DNDO), and Ben Stur (LLNL).

COUNTERTERRORISM ARTICLE WINS "PAPER OF THE YEAR" AWARD

An **article** written by LLNL's Ellen Raber and five other researchers about remediating an American airport after a chemical warfare attack has been named "Risk Management Paper of the Year" for 2011 by the journal *Human and Ecological Risk Assessment*. The journal's editors state, "This paper gives salient management actions should airports experience terrorists' release of toxic substances into airport environments." Ellen, who is Deputy Program Manager for Counterterrorism in the Lab's Office of Strategic Outcomes, wrote the paper with two former LLNL employees and three other researchers. As a part of the research, a conceptual site model and human health-based guidelines were developed to expedite the recovery of airports to full operational status in the absence of U.S. state or federal values designated as compound-specific remediation or re-entry concentrations. "I'm very happy that all of the work by our team has been appreciated and has been able to contribute to this important problem," said Ellen.

NANOLIPOPROTEIN TECHNOLOGY OPTIONED

The Laboratory executed an option agreement with Nzyme2HC, LLC for a technology titled "Nanolipoprotein Particles for Hydrogen Production for Energy Applications." The agreement provides the company an exclusive, time-limited right to negotiate and execute a license agreement. Nzyme2HC, LLC, is a small, San Clemente, CA-based startup formed around previous LLNL technology.

EDITORIAL DESCRIBES CHALLENGES OF IMPROVISED EXPLOSIVES

Jon Maienschein, Director of the Energetic Materials Center (EMC) and the National Explosives Engineering Sciences Security Center (NEESSC) wrote an **invited editorial** on the challenge of countering improvised explosives in the journal *Propellants, Explosives and Pyrotechnics*. The article describes how improvised explosives differ from traditional explosives and display behaviors outside the bounds of standard detonation theories that were developed for military and commercial explosives. Various research opportunities arise from the challenges posed by these new materials, including studying handling safety and response to thermal and physical stimuli, extending classical detonation theory to account for slow reactions, determining the equivalence for a wide range of improvised explosives, and devising new detection methods and devices. The EMC and NEESSC are already tackling these scientific challenges and are focusing on the development of a predictive understanding of performance and detection to ultimately enable rapid response to the ever-evolving suite of improvised explosives.

NIC TEAM MEMBERS TO RECEIVE APS JOHN DAWSON AWARD

Seven members of the National Ignition Campaign (NIC) team have been selected to receive the John Dawson Award for Excellence in Plasma Physics Research from the American Physical Society's Division of Plasma Physics. The award recognizes the team's success in employing power transfer between crossing laser beams in the NIF hohlraum, a technique that led to the use of two different laser wavelengths to improve implosion symmetry in NIF ignition targets. Receiving the award are LLNL researchers Debra Callahan, Laurent Divol, Bob Kirkwood, Nathan Meezan, Pierre Michel, and Edward Williams, along with George Kyrala of LANL. The citation accompanying the $5,000 award reads, "For predicting and demonstrating the technique of laser scatter on self-generated plasmaoptics gratings that

enables generation and redirection of high-energy laser beams important for indirect drive inertial confinement fusion and high-power laser–matter interactions." The award will be presented at the annual meeting of the Division of Plasma Physics, to be held October 29–November 2. "It's great to receive this recognition for all the efforts of the team at this point in the development of ICF and especially for this critical technological development," Bob said.

BIODEFENSE KNOWLEDGE CENTER RECOGNIZED

The Laboratory's Biodefense Knowledge Center (BKC) was recognized on May 24 for efforts to improve the methodology used by U.S. Customs and Border Protection (CBP) to intercept suspicious biological material or equipment that could support bioterrorism. This new capability has been integrated into CBP's Automated Targeting System for routine use at the National Targeting Center and will be accessible to all 22,000 CBP officers at the nation's ports of entry. This successful partnership between CBP and Livermore's BKC was acknowledged with a plaque and a commendation letter from Acting Deputy Commissioner for Custom and Border Protection Thomas Winkowski to the Science and Technology Directorate of the Department of Homeland Security (DHS). Pictured (left to right) are DHS Under Secretary Dr. Tara O'Toole, DHS project manager Dave Shepherd, LLNL's Matt Dombroski, LLNL's Brent Segelke, LLNL's Kristi Swope, and CBP project manager Mike Oraze.

DTRA TO FUND CARBON NANOTUBES FOR CHEMICAL THREAT RESPONSE

Francesco Fornasiero and coinvestigators Sangil Kim and Kuang Jen Wu have received notification that their Phase II Defense Threat Reduction Agency (DRTA) proposal entitled "Chemical Threat Responsive Carbon Nanotube Membranes" has been chosen for funding—$13M over 5 years, with $6.5M going to LLNL as the lead institution. The project will focus on developing breathable fabrics that switch to a protective state in response to a chemical threat. Collaborating institutions include MIT, the University of Massachusetts-Amherst, Rutgers University, Natick Soldier Research Development and Engineering Center, and Chasm Technologies, Inc.

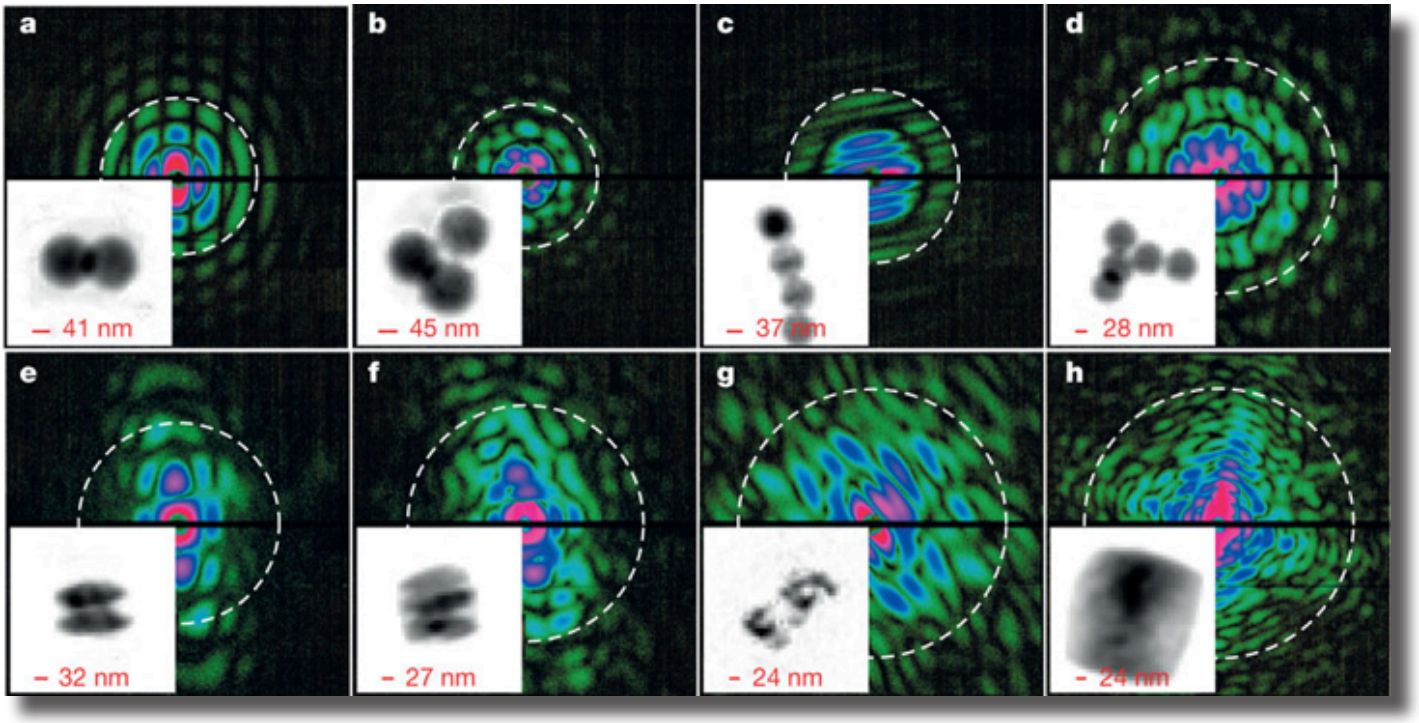
ENGINEER NAMED INAUGURAL CHAIRMAN OF SCHOLARSHIP PROGRAM

Souheil Ezzedine has been selected as the first-ever chairman of the Scholarship Program for the Society of Petroleum Engineering (SPE). As chairman of an SPE committee, Souheil will also become a member of the SPE Board of Directors. The newly established committee is charged with establishing and selecting the recipients of four scholarships, one each for high school, bachelors, masters, and Ph.D. students.

COLLABORATION WINS SMALL BUSINESS AWARD

One of the Phase II winners in DOE's 2012 Small Business Innovation Research Awards is a collaboration between LLNL and Lodestar Research Corporation to develop and apply the kinetic eigenvalue code ArbiTER, which is primarily used for tokamak edge plasma applications. LLNL participants include researchers Maxim Umansky and Mikhail Dorf. The Laboratory will receive $125K per year for 2 years, beginning in late FY12.

NATURE PAPER ON IMAGING SINGLE PARTICLES OF SOOT



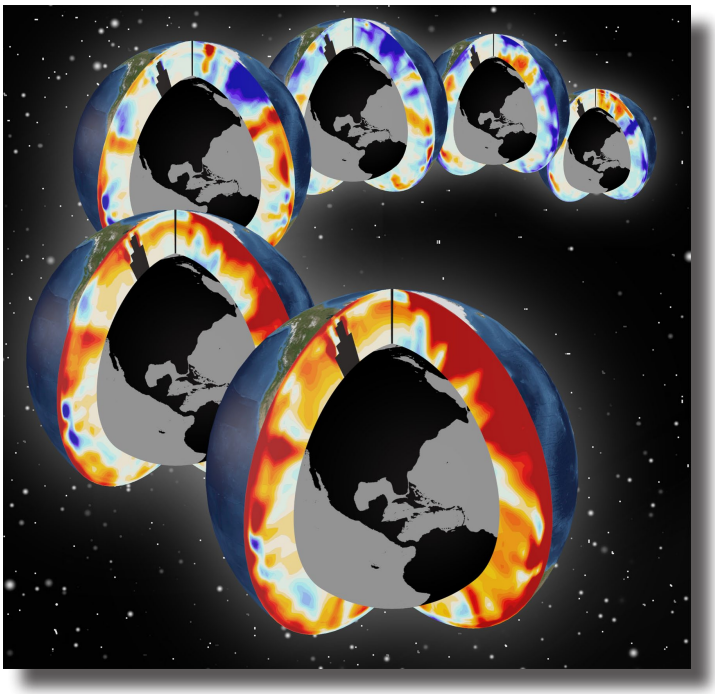
Lawrence Livermore researchers and international collaborators, using intense coherent x-ray pulses from the free-electron laser at the Linac Coherent Light Source, **describe** in the journal *Nature* a new in situ fractal method with which they have imaged, for the first time, individual submicron particles of soot in their native environment. Previous techniques were able to image only collections of such particles, but determining such particles' structure—which directly affects toxicity and other properties—requires the ability to image individual particles. The researchers did this by shooting x-ray beams into a jet of aerosolized particles. The beam is small enough to hit individual particles and powerful enough to produce a diffraction pattern from which the structure of an individual particle could be determined. The technique has potential applications in a wide range of fields, from toxicology to climate science. The photo shows diffraction patterns of various particles along with resultant electron-density maps revealing each particle's structure.

PHYSICS OF PLASMAS HIGHLIGHTS PAPER ON MAGNETIZED-LINER INERTIAL FUSION

A **paper** by Dmitri Ryutov and colleagues from Sandia National Laboratories has been **featured** as a Research Highlight in *Physics of Plasmas*. The paper presents an analysis of the scalability of key physical processes that determine plasma confinement in a recently proposed approach to inertial confinement fusion that uses a magnetically driven (Z pinch) approach. The paper identifies the relevant dimensionless scaling parameters and concludes that the plasma behavior in scaled-down experiments can correctly represent the full-scale plasma, provided the dimensionless scaling parameters are approximately the same in two systems. This conclusion is important because smaller-scale experiments typically have better diagnostic access and can conduct more experiments per year than larger-scale systems.

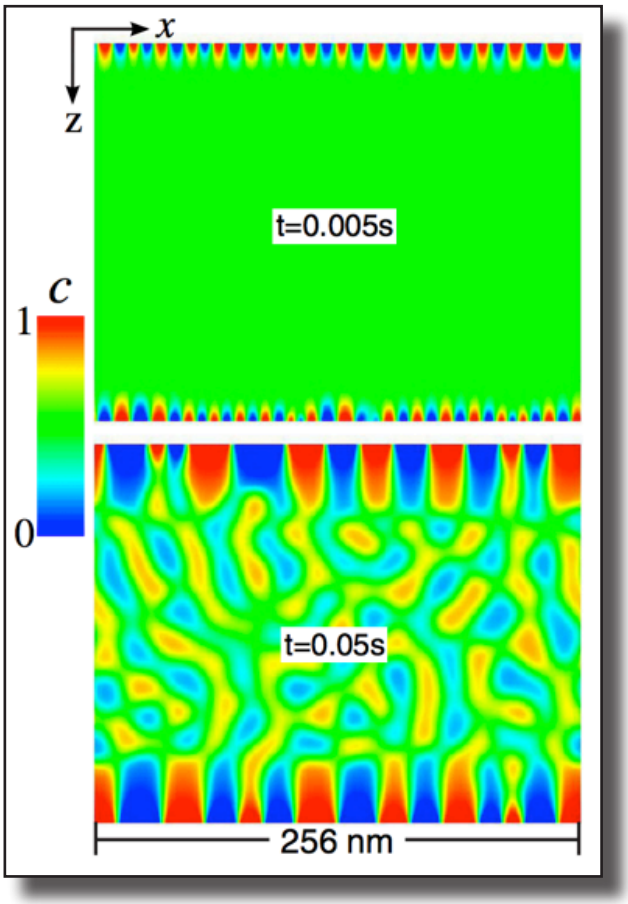
PAPER SHOWS HUMAN HAND IN OCEAN WARMING

Research **published** in *Nature Climate Change* concludes that observed ocean warming over the last 50 years is consistent with climate models that incorporate the effect of increases in greenhouse gases. The international team used a multimodel ensemble in which the simulations were compared with control simulations that do not include the effects of humans but do include natural variability. Says lead author Peter Gleckler, of LLNL, "[W]e found no evidence that simultaneous warming of the upper layers of all seven seas can be explained by natural climate variability alone. Humans have played a dominant role." The figure, by LLNL's Timo Bremer, graphically presents decadal change in average ocean surface temperature in the Pacific and Atlantic Oceans from 1955 to 2011.



PLS PAPER REVEALS SURPRISE ABOUT SPINODAL DECOMPOSITION

An LLNL researcher recently upended established theory about spinodal decomposition, a phase separation phenomenon that has important influence on material behavior. For decades it had been accepted

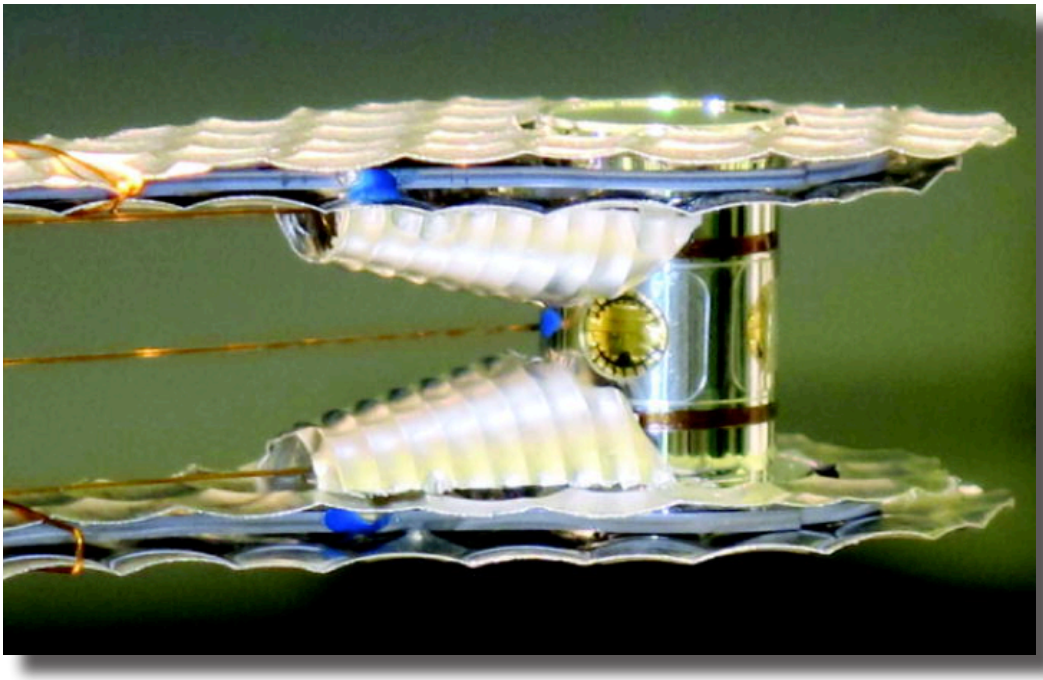


that spinodal temperature—the temperature below which the decomposition can occur—can be significantly suppressed in bulk crystalline systems by internal stress arising from the misfit between the different lattices of the phases in the spinoidal mixture. Livermore's Ming Tang recently discovered from numerical simulations that spinodal decomposition can begin near the free surfaces of a material and then propagate into the interior of a crystal even at temperatures above the bulk spinodal temperature. In a **paper** published in *Physical Review Letters*, Ming and Alain Karma at Northeastern University explain this surprising finding in terms of general linear stability theory and show that unlike the bulk-mode decomposition, misfit stress has no effect on the onset temperature of surface-mode spinodal decomposition because of stress relaxation near the free surface. This finding sheds light on existing experimental observations and has farreaching implications for predicting and manipulating the stability of many technologically important materials, such as nanostructured lithium-ion battery electrodes and semi-

conductor thin films. The figure shows two snapshots of spinodal decomposition proceeding in a solid with free surfaces from an initial state of a temperature (T) of 298 K and a composition (c) of 0.5.

PROGRESS TOWARD IGNITION ANNOUNCED

Two invited papers in *Physics of Plasmas* by LLNL researchers and their collaborators trace the progress of the National Ignition Campaign (NIC) in achieving the target capsule implosion conditions needed for ignition. A **paper** by Brian Spears and colleagues from LLNL and LANL describes recent experiments using non-igniting tritium–hydrogen–deuterium capsules to reduce neutron yield while maintaining hydrodynamic similarity with deuterium–tritium ignition capsules. The **second paper**, by Siegfried Glenzer and colleagues, describes the first inertial confinement fusion implosion experiments with equimolar (50–50) DT fuel—experiments that have resulted in "the highest areal densities and neutron yields achieved on laser facilities to date." Four other NIC-related papers were also published in the same issue of the journal. The image shows a cryogenic ignition target before it is fully enclosed by a shroud. Visible on the side of the hohlraum is a cutout covered with a 10-nm-thick gold coating that allows characterization of the ice fuel layer during the layering process.



LIGHT SHED ON LIMITS TO SINGLE-MOLECULE IMAGING

In a **paper** published in *Physical Review Letters*, LLNL researcher Stefan Hau-Riege reports on the development and use of a new hybrid continuum–particle approach for modeling the damage induced in carbonaceous materials exposed to x-rays with the characteristics of an x-ray free-electron laser (XFEL). He found that the dynamics of the photoelectrons and their electrostatic "confinement" strongly affect the time scale of the damage processes. Although positive charging of the sample causes the photoelectrons to be "trapped" near the sample, the energy transfer characteristics and the charge distribution in the sample are altered, with the energy transfer depending nonlinearly on the x-ray fluence and pulse length. The hydrodynamic models typically used today do not capture the dynamics of the photoelectrons and are inadequate to describe the damage induced by energetic XFEL pulses. X-ray free electron lasers hold the promise of enabling atomic-resolution diffractive imaging of single biological molecules, but their inherently low signal-to-noise ratio requires large x-ray fluences to achieve acceptable signals, and so x-ray radiation damage is expected to limit the achievable image resolution. This paper sheds further light on the issue.

LEMUR STUDY REVEALS RISK OF "EXTINCTION CASCADE"

In contrast to the belief that the extinction of a species opens that species's now-empty ecological niche to its close competitors, a paper published in *Proceedings of the Royal Society B* suggests than the event can result in new selective pressures that decrease the survival prospects for those competitors, potentially leading to an "extinction cascade." The study, which used the radiocarbon dating capabilities of LLNL's Center for Accelerator Mass Spectrometry, examined lemurs in Madagascar, where at least 17 species of the primate have gone extinct since humans arrived on the island roughly 2,000 years ago. The survivors of extinctions seem to have been forced—perhaps by the same factors contributing to extinction—into ecological niches that no lemurs had previously occupied. The photograph below shows lemur skulls collected by the team.

X-RAY BANG TIME MEASURED AT NIF USING DIAMOND DETECTOR

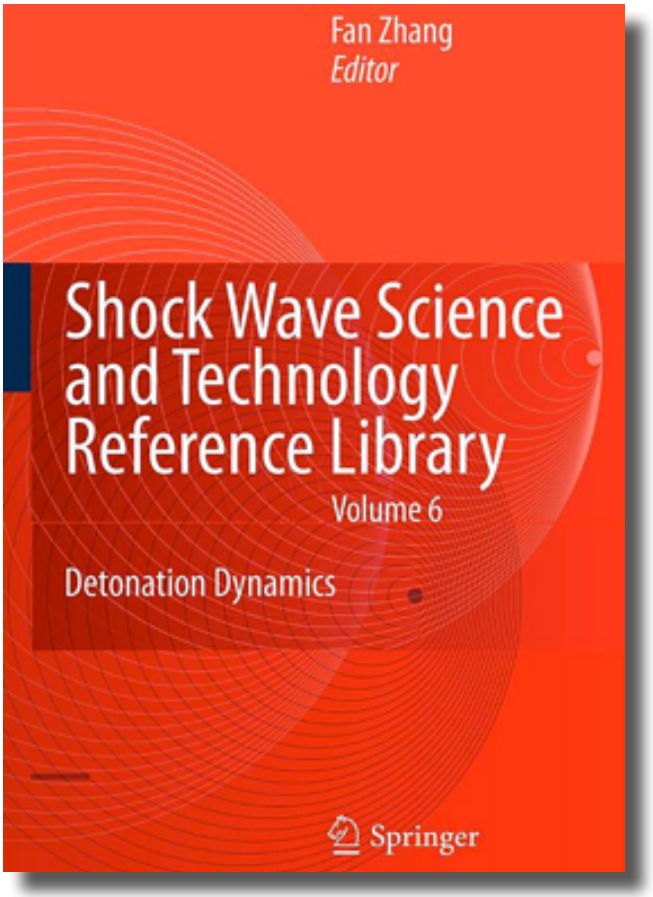
X-ray bang time, corresponding to peak x-ray emission of an inertial confinement fusion (ICF) implosion, is used in NIF experiments to measure the energy coupling to the target and is therefore an important diagnostic for tuning implosion velocity. In a *Review of Scientific Instruments* **paper**, LLNL lead author Maria Barrios and colleagues report that a photoconductive diamond detector using a chemical vapor deposition polycrystalline diamond was fielded at NIF to successfully measure x-ray bang time for imploding capsules to within 41 to 46 ps. Its collimated view along a line of sight within a few degrees of the hohlraum axis provides a temporal history of the capsule emission that is not contaminated by hohlraum x-ray emission.

FIBER LASER ARTICLE IS AMONG MOST-DOWNLOADED

A 2008 paper by NIF researchers describing the scaling limitations of diffraction-limited fiber lasers and amplifiers was among the most-downloaded articles from *Optics* Express in recent years, according to Optics InfoBase. The **article**, "Analysis of the scalability of diffraction-limited fiber lasers and amplifiers to high average power," reported on studies to derive the average power limit of a single diffraction-limited fiber-based laser system. Joining lead author Jay Dawson on the paper were Mike Miserly, Ray Beach, Miroslav Shverdin, and others.

SCIENTISTS AUTHOR CHAPTERS OF SHOCK WAVE TEXT

Energetic Materials Center scientists have contributed two chapters on detonation dynamic to **volume 6** of *Shock Wave Science and Technology Reference Library*. Sorin Bastea and Larry Fried provided a chapter on chemical equilibrium detonation, and Craig Tarver provided a chapter on condensed matter detonation. This book is primarily concerned with the fundamental theory of detonation physics in gaseous and condensed-phase reactive media. The detonation process involves complex chemical reaction and fluid dynamics, accompanied by intricate effects of heat, light, electricity, and magnetism—a contemporary research field that has found wide applications in propulsion and power, hazard prevention, and military engineering. The book offers a timely reference of theoretical detonation physics for graduate students, as well as professional scientists and engineers.



STUDY SHOWS WATER IS DEEPLY EMBEDDED IN TATB FORMULATIONS

In *Journal of Physical Chemistry A*, Libby Glascoe, Long Dinh, Ward Small, and George Overturf **published** an experimental study and corresponding kinetics model of water desorption rates from 1,3,5-triamino-2,4,6-trinitrobenzene (TATB) formulations. The results of their study show two stages of moisture release: at lower temperatures, the release is likely assisted by thermal expansion of the TATB and melting of the binder, while at higher temperatures, a considerable amount of water is released by sublimation of the TATB, which exposes new surfaces for water desorption. This study—the first to investigate water release in TATB via nondecomposition mechanisms and to quantify the rates of release—indicate that water is deeply embedded in the TATB formulations and that its presence in TATB decomposition products does not necessarily imply formation by decomposition.

RECENT PAPERS BY LLNL AUTHORS

B. Abelev, et al., "Multi-strange baryon production in pp collisions at $\sqrt{s}$ = 7 TeV with ALICE." *Physics Letters B* **712**, 309 (June 2012).

B. Abelev, et al., "J/psi production as a function of charged particle multiplicity in pp collisions at $\sqrt{s}$ = 7 TeV." *Physics Letters B* **712**, 165 (June 2012).

A. Adare, et al., "Deviation from quark number scaling of the anisotropy parameter v(2) of pions, kaons, and protons in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV." *Physical Review C* **85** (June 2012).

J. R. Angus, M. Umansky, and S. I. Krasheninnikov, "3D blob modelling with BOUT++." *Contributions to Plasma Physics* **52**, 348 (June 2012).

A. Arsenlis, et al., "A dislocation dynamics study of the transition from homogeneous to heterogeneous deformation in irradiated body-centered cubic iron." *Acta Materialia* **60**, 3748 (May 2012).

A. B. Artyukhin and Y. H. Woo, "DNA extraction method with improved efficiency and specificity using DNA methyltransferase and 'click' chemistry." *Analytical Biochemistry* **425**, 169 (June 2012).

C. G. Bathke, et al., "The attractiveness of materials in advanced nuclear fuel cycles for various proliferation and theft scenarios." *Nuclear Technology* **179**, 5 (July 2012).

J. Biener, et al., "A new approach to foam-lined indirect-drive NIF ignition targets." *Nuclear Fusion* **52** (June 2012).

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Questions? Comments?

Please contact Paul Kotta at **kotta1@llnl.gov** or (925) 424-4018.