LDRD Quarterly Highlights

Mission Agility | Technical Vitality | Workforce Development

FY23 Q2

FEATURED HIGHLIGHTS FOR Q2

Sandia National Laboratories

Sandia computer scientists Casey Doyle, left, and Kevin Stamber helped develop a computer model to determine the optimal order to restore power to the substations and infrastructure of a grid after a total disruption, a process called a black start. (Photo by Craig Fritz)

Restoring power to the grid

Sandia scientists have been working on an innovative computer model to help grid operators quickly restore power to the electric grid after a complete disruption, a process called a black start. Their model combines a restoration-optimization model with a computer model of how grid operators would make decisions when they don't have complete knowledge of every generator and distribution line. The model also includes a physics-based understanding of how the individual power generators, distribution substations and power lines would react during the process of restoring power to the grid. Read more…

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Sandia technologist Levi Van Bastian works to print material on the Laser Engineered Net Shaping machine, which allows scientists to 3D print new superalloys. (Photo by Craig Fritz)

New superalloy could cut carbon emissions from power plants

As the world looks for ways to cut greenhouse gas emissions, researchers from Sandia have shown that a new 3D-printed superalloy could help power plants generate more electricity while producing less carbon. Sandia scientists, collaborating with researchers at Ames National Laboratory, Iowa State University and Bruker Corp., used a 3D printer to create a high-performance metal alloy, or superalloy, with an unusual composition that makes it stronger and lighter than state-of-the-art materials currently used in gas turbine machinery. The findings could have broad impacts across the energy sector as well as the aerospace and automotive industries. Read more…

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Lawrence Livermore National Laboratory

Reactive molecular dynamics simulations predict that a complicated distribution of molecular states is generated in explosive hotspots formed under shock conditions.

National Ignition Facility achieves fusion ignition

The U.S. Department of Energy (DOE) and DOE's National Nuclear Security Administration (NNSA) announced on Dec. 13 the achievement of fusion ignition at Lawrence Livermore National Laboratory (LLNL) — a major scientific breakthrough decades in the making that will pave the way for advancements in national defense and the future of clean power. On Dec. 5, a team at LLNL's National Ignition Facility (NIF) conducted the first controlled thermonuclear fusion experiment in history to reach this milestone, also known as scientific energy breakeven, meaning it produced more energy from fusion

than the laser energy used to drive it. This first-of-its-kind feat will provide unprecedented capability to support NNSA's Stockpile Stewardship Program and will provide invaluable insights into the prospects of clean fusion energy, which could be a game-changer for long-term energy and climate security.
Read more in these two articles: 1 2.

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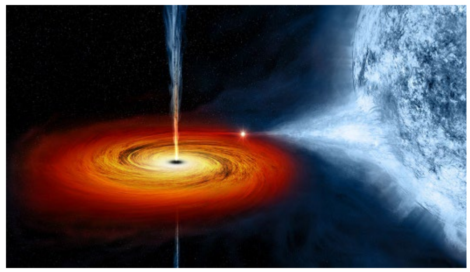

An LLNL researcher and collaborator have reviewed how lasers can create energetic electron-positron pairs that are common in extreme astrophysical environments associated with the rapid collapse of stars and formation of black holes. (Image courtesy of NASA/CXC/M.Weiss)

Illuminating the science of black holes and gamma-ray bursts using high-power lasers

High-power lasers now create record-high numbers of electron-positron pairs, opening exciting opportunities to study extreme astrophysical processes, such as black holes and gamma-ray bursts. A new review of the current breakthroughs in the creation of electron-positron pair plasma, its main challenges and the future of the field, authored by LLNL physicist Hui Chen and SLAC National Accelerator Laboratory scientist Frederico Fiuza, appears in *Physics of Plasmas*. Read more…

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Los Alamos NATIONAL LABORATORY

Los Alamos technologist Andrew Hatch prepares a sample of wastewater for genomic sequencing. (Image courtesy of LANL)

Predictably unpredictable

Scientists at Los Alamos are studying disease behavior and pathogen identity, as well as their interconnectedness, to better understand pandemics. Through multiple projects, LANL scientists are assessing epidemiological and genomic clues, as well as developing models and detection schemes, to help better predict and prepare for future pandemics. Understanding how disease spreads and what gives some viruses an advantage over others when it comes to infecting human cells will improve government and public health systems' ability to have critical infrastructure in place in the event of a future pandemic. Read more….

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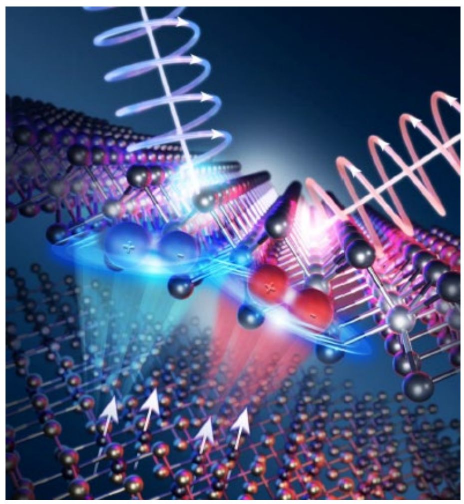

Depiction of magnetic proximity interactions in a hybrid two dimensional (2D) heterostructure
(Image courtesy of LANL, artwork by Sarah Tasseff)

Searching for frost at Jezero Crater

The ability to impart magnetic functionality into otherwise non-magnetic materials has exciting prospects for hybrid devices that combine, for example, the optical and electrical properties of semiconductors with additional tuning parameters that couple to magnetic and spin degrees of freedom. Los Alamos researchers recently demonstrated that magnetic proximity interactions (MPI) can be achieved; furthermore, they found that the influence of MPIs is quite asymmetric (i.e., spin-up and-down are affected unequally), and that asymmetric MPIs are likely a general feature of all magnetic/nonmagnetic hybrid van der Waals structures. An important implication of this work is the possibility to selectively control specific spin degrees of freedom in 2D semiconductors through rational design of component materials and their stacking arrangement. Such combinations open up new possibilities for combining functionality such as information processing and nonvolatile storage. Read more…

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AMAZING LDRD HIGHLIGHTS

USING CLAY TO CAPTURE CARBON DIOXIDE: Sandia researchers attempt to design artificial trees to capture carbon dioxide directly from the air
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SECURING SUPPLY CHAINS WITH QUANTUM COMPUTING: Research at Sandia moves science closer to overcoming global supply-chain challenges
> Mission Agility, Technical Vitality

ADVANCING TREATMENTS FOR AUTOIMMUNE DISEASES: LLNL is now helping companies develop therapies
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DOUBLING DOWN ON BREAKTHROUGH METHOD TO STUDY RADIOACTIVE MATERIALS: LLNL chemists develop new approach to the study of radioactive and/or precious elements more efficiently
> Mission Agility, Technical Vitality

IMPROVING SUBSURFACE GEOLOGY MODELING: LANL researchers use machine learning to better understand subsurface geology
> Technical Vitality, Workforce Development

USING REPURPOSED DETECTOR TO SEARCH FOR DECAY: 'Tantalizing' decay of nature's rarest isotope may finally be within reach of LANL researchers
>Technical Vitality, Workforce Development

This newsletter, published quarterly, features LDRD and SDRD work done by Lawrence Livermore, Los Alamos, Nevada National Security Site and Sandia. To see a PDF with all articles referenced in this newsletter or review past issues, visit NNSA-LDRD.lanl.gov and click on the Quarterly Highlights tab. (SAND2023-01666O)

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NNSA
National Nuclear Security Administration