LDRD

Quarterly Highlights

Mission Agility | Technical Vitality | Workforce Development

FY23 Q3

FEATURED HIGHLIGHTS FOR Q3

Los Alamos NATIONAL LABORATORY

Inside the newly constructed CCM200 detector, showing the 200 photo-multiplier tube light sensors (circles) and the interior walls coated with a special material to convert the argon scintillation light into visible light that can be detected by the photo-multiplier tubes and then recorded by the data acquisition system.
(Photo courtesy of LANL)

Designing the right tools to hunt for elusive axion particles

Since axions were first predicted by theory nearly half a century ago, researchers have hunted for proof of the elusive particle, which may exist outside the visible universe, in the dark sector. But how does one find particles that can't be seen? The first physics results from the Coherent CAPTAIN-Mills experiment at Los Alamos suggest that liquid-argon, accelerator-based experimentation, designed initially to look for similarly hypothetical particles such as sterile neutrinos, may also be an ideal set-up for seeking out stealthy axions. Read more…

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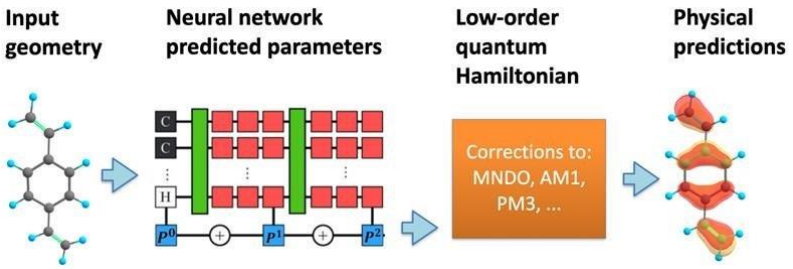

Image is of the model's structure. A neural network processes a molecular geometry to predict a semi-empirical quantum Hamiltonian, which is then solved self-consistently to predict a variety of chemical properties. (Image courtesy of LANL)

New research from creates a predictive model for drug design by combining quantum physics, chemistry, and machine learning

Many equations within quantum physics can be helpful for guiding researchers that are looking at chemical interactions. As both quantum physics and chemistry work on the same atomic levels, they are often used in tandem with each other to achieve new results. Recently, researchers at the Los Alamos National Laboratory took this pairing one step further by adding machine learning processes to help predict biochemical interaction in molecular simulations. This in turn could help accelerate steps in drug design and other industry scenarios, making drugs safer and quicker in the long term. Read more…

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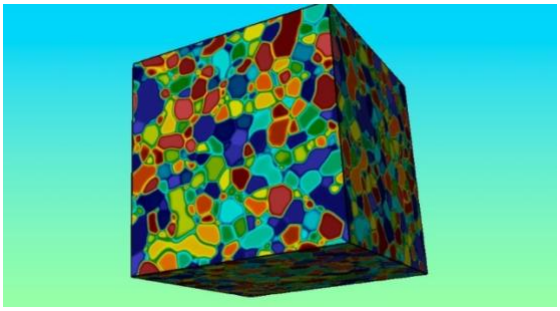
Lawrence Livermore National Laboratory



Digital representation of a titanium oxide microstructure simulated using phase-fielding modeling. (Image courtesy of LLNL)

Understanding material degradation in titanium alloys

Titanium and its alloys are attractive for a wide variety of structural and functional applications due to the metal's excellent strength, toughness and stiffness, and corrosion resistance. Specific applications include lightweight structural materials, bioimplants, and energy storage materials. However, if exposed to hydrogen sources,

these alloys are susceptible to hydrogen incorporation and hydride formation, leading to crack initiation and mechanical failure resulting from lattice deformation and stress accumulation. When it comes to understanding hydrogenation and hydride formation in titanium alloys, many unanswered questions and challenges remain. Read more…

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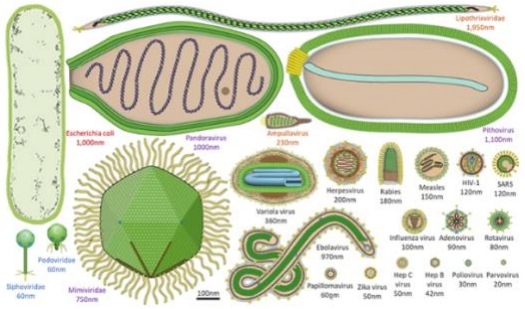

Example viruses illustrate the diversity of viral structure and size, ranging from a few to thousands of nanometers. Here, an example bacterium, Escherichia coli (top left, red text), is contrasted with the example viruses. (Image courtesy of LLNL)

Researchers explore how viruses enhance our understanding of life in the universe

On Earth, viruses are abundant and an integral part of life. However, very little is known about them outside human health contexts, especially in areas related to space. Understanding the role viruses play on Earth and how they interact with their hosts in extreme environments can better inform human spaceflight missions (environmental control, life support systems, and microbiomes) and the search for life elsewhere. To this end, Lawrence Livermore researchers and collaborators reviewed previous research in this area and identified specific knowledge and technical gaps that should be addressed in future research. Read more…

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Tristan Richmond piloting a UAS quadcopter for detection testing. (Image courtesy SDRD)

Ian McKenna's UAS feasibility study flies high to become SDRD project

Principal investigator Ian McKenna successfully transitioned a Site-Directed Research and Development (SDRD) Feasibility Study into a full, two-year SDRD project. Read more…

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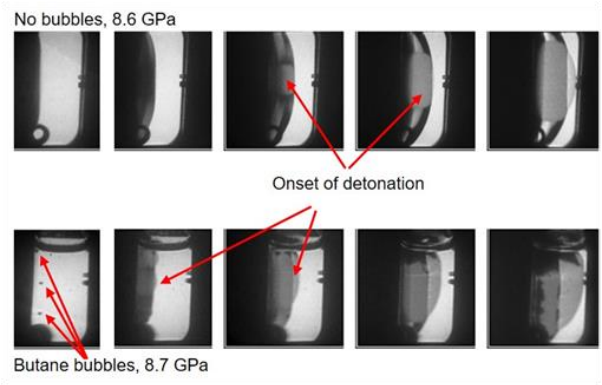

Comparison of images captured for shocked and detonating NM without (top row) and with butane bubbles (bottom row). (Image courtesy SDRD)

Dale Turley wins MVPI with bubble collapse project

The Special Technologies Laboratory's Dale Turley is the winner of this year's Most Valuable Principal Investigator (MVPI) award for his SDRD project. Read more…

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Sandia National Laboratories

Steve Bauer, a recently retired Sandia Labs geoscientist, is preparing his sensitive mass spectrometer to detect the gases released by crushing a piece of granite. (Photo by Craig Fritz)

Real-time detection of noble gases could improve monitoring of underground explosions

Sandia geoscientists have detected specific gases being released from fractured rocks in real time after a series of small chemical explosions using different explosive compounds was set underground at the Energetics Materials Research and Testing Center outside of Socorro, New Mexido. This fundamental research could one day improve the prediction of earthquakes or detection of underground explosions. The improved understanding of how and why rocks fracture could also be valuable for enhanced geothermal systems and strain detection in unconventional oil and gas production. Read more…

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Part of the Sandia team working on a moving target defense that makes computer networks commonly used on space and aircraft less vulnerable to cyberattack stand aboard a C-130 transport aircraft. (Photo by Craig Fritz)

Employing a cyber shuffle to stop hackers from taking over military aircraft

A cybersecurity technique that shuffles network addresses like a blackjack dealer shuffles playing cards could effectively befuddle hackers gambling for control of a military jet, commercial airline or spacecraft. Many aircraft, spacecraft and weapons systems use an onboard computer network, the military standard 1553 (MIL-STD-1553), to let systems like radar, flight controls and the heads-up display talk to each other. Sandia partnered with researchers at Purdue to show that a moving target defense that utilizes randomness can effectively protect MIL-STD-1553 networks against a machine-learning algorithm. Read more…

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AMAZING LDRD HIGHLIGHTS

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QUANTUM ANNEALING AND NOISY GIBBS: Using QA harware for Ising-model sampling **> Mission Agility, Technical Vitality**

RE-EXAMINING CARBON MINERALIZATION: A rock hard technique to harvest atmospheric CO2 at LLNL **> Mission Agility, Technical Vitality**

ADVANCES FOR ENERGY STORAGE AND ELECTRONICS: LLNL is charging up with carbon nanotubes **> Mission Agility, Technical Vitality**

STUDYING SHIP TRACKS: Sandia researchers develop computer tools to study, inform climate intervention **> Mission Agility, Technical Vitality**

ANTICIPATING HUMAN INTERACTIONS: Researchers at Sandia use math to predict group behaviors **> Mission Agility, Technical Vitality**

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 Highlight tab. Publication approved for release: LA-UR-23-26993.

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