



## Quarterly Highlights

Mission  
Agility



Technical  
Vitality

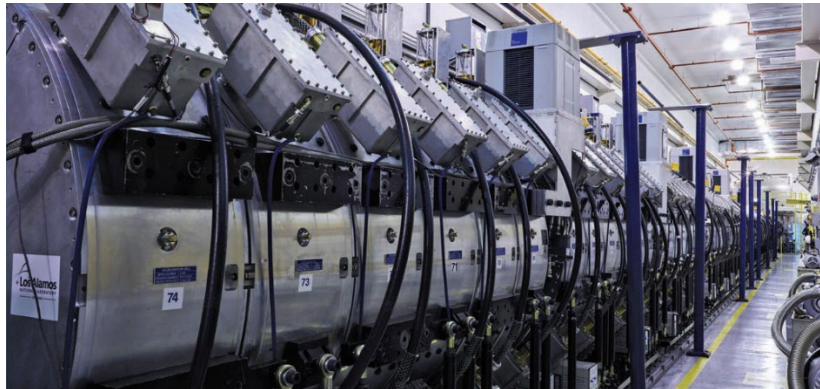


Workforce  
Development



FY24 Q1

## FEATURED HIGHLIGHTS FOR Q1



DARHT Axis-II Accelerator Hall where NNSS and LANL scientists collaborate on accelerator science research.

### [Feasibility Study becomes Strategic Initiative to improve critical skills for Scorpius](#)

A new project put forth by Accelerator Beam Science and Target Interactions Science and Technology Thrust Area Lead, Trevor Burris, is helping to identify and pre-fill skillsets necessary to operate and maintain the Nevada National Security Sites' first large-scale linear accelerator, Scorpius. [Read more...](#)

- **Technical Vitality, Workforce Development**

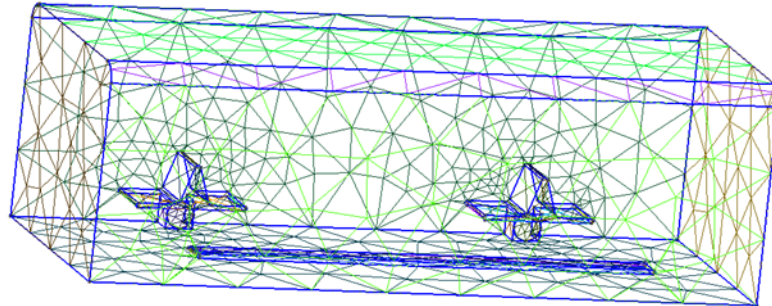
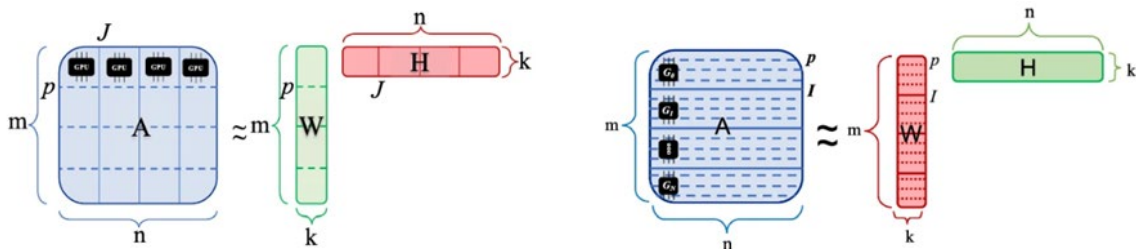


Diagram created to simulate Computational Fluid Dynamics in a ventilation system inside of a train car.

### Computational Fluid Dynamic simulations for critical infrastructure

Scientists at the Nevada National Security Sites are developing novel tools to simulate computational fluid dynamics (CFD) in incompressible regimes common to heating, ventilation, and air cooling (HVAC) systems located in office workspaces, public transit, and other critical infrastructures. [Read More...](#)

➤ **Mission Agility, Technical Vitality**



Column partition with orthogonal batching (*left*). Row partition with co-linear batching (*right*).

An Illustration of non-negative observational matrix ( $A$ ) with two co-factor matrices ( $W, H$ ) in consensus non-negative matrix factorization and robust non-negative matrix factorization distributed partitions. Solid lines show distributed partition boundaries and dashed lines show local partition segmentation in batch for Out-of-Memory decomposition.

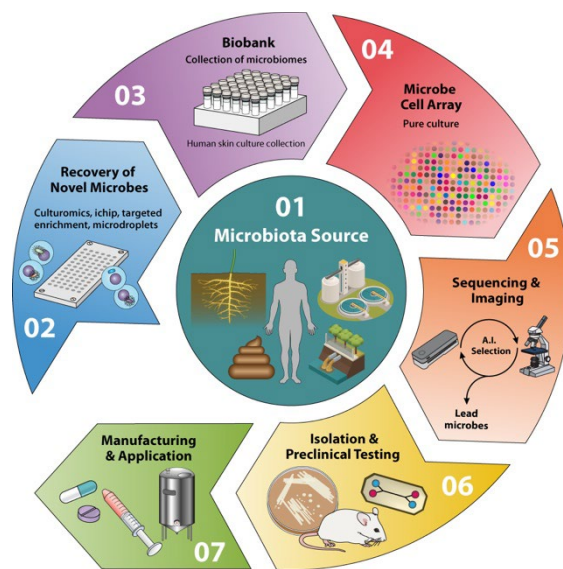
(Image source: I. Boureima, et. al. 2023, *Distributed out-of-memory NMF on CPU/GPU architectures*. Journal of Supercomputing. <https://doi.org/10.1007/s11227-023-05587-4>)

### Machine learning tames huge datasets

A machine-learning algorithm that was developed at Los Alamos National Laboratory has set a world record for factorizing huge datasets. This record was set during a test run on Oak Ridge National Laboratory's *Summit*, the world's fifth-

fastest supercomputer. The highly scalable algorithm solves hardware bottlenecks that prevent processing information from large data-rich applications that include cancer research, satellite imagery, social media networks, and national security science and earthquake research. [Read more...](#)

➤ **Technical Vitality, Mission Agility**



Circular flow diagram highlighting the critical steps needed for therapeutic-microbe discovery. (Image source: N. Cruz, et. al. 2022. *The Age of Next-Generation Therapeutic-Microbe Discovery: Exploiting Microbe-Microbe and Host-Microbe Interactions for Disease Prevention*. ASM Journals. <https://doi.org/10.1128/iai.00589-21>)

### Biologically inspired reinforcement using polydopamine of polymer bound composites

Humans are considered ‘superorganisms,’ harboring a diverse microbial collective that outnumbers human cells. Host- and microbe-microbe interactions govern the superorganism in almost every aspect of life function and overall well-being. However, these interactions are complex and presently understudied. Los Alamos researchers are helping to lead an immense effort that focuses on dissecting host- and microbe-microbe relationships to characterize if a ‘positive’ or ‘negative’ interaction are at play and to gauge the usefulness of microbes for therapeutic and diagnostic application. [Read more...](#)

➤ **Mission Agility, Technical Vitality, Workforce Development**



Eric Nagel showing the latest batch of material developed by his team as they work to reproduce a molecule that changes the traditional behavior of polymers. (Photo by Craig Fritz)

### Making materials more durable through science

Sandia materials scientist Erica Redline and her team have developed a molecule that helps change the way polymers react to temperature fluctuations, which would make them more durable. This application could be used in everything from plastic phone cases to missiles. Polymers, which include various forms of plastics, are made up of many smaller molecules, bonded together. [Read more...](#)

➤ **Mission Agility, Technical Vitality**

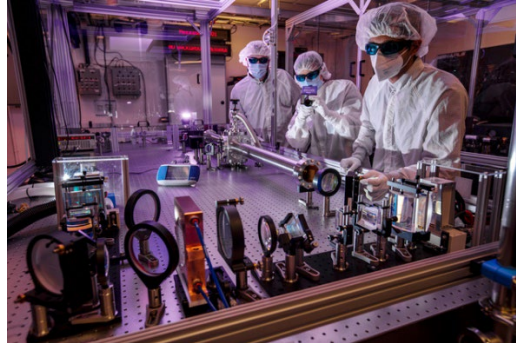


A microneedle-based sensor puck designed by Sandia National Laboratories researchers to continuously monitor the levels of a 'last line of defense' antibiotic with less pain than a blood draw. (Photo by Craig Fritz)

### Wearable sensor to monitor 'last line of defense' antibiotic

Researchers at Sandia have combined earlier work on painless microneedles with nanoscale sensors to create a wearable sensor patch capable of continuously monitoring the levels of antibiotics. For certain antibiotics, continuous monitoring is crucial because there is a narrow range within which it effectively kills bacteria without harming the patient. "This is a great application because it requires tight control." [Read more...](#)

➤ **Technical Vitality**



ICMuS2 LLNL team members Drew Willard, Brendan Reagan, and Issa Tamer work on a prototype laser system that will be developed through this effort. Credit: Jason Laurea.

### LLNL leads initiative to advance muon-based imaging

Today we can see inside seemingly impossible places — nuclear reactors, volcanoes, tsunamis, hurricanes and Egypt’s Great Pyramid of Giza — thanks to muon imaging. This technique uses naturally occurring subatomic particles called muons, which can penetrate far deeper than what is possible with X-rays through material as thick and dense as 30-meter concrete walls.

But this process is also slow. Due to the low flux of naturally occurring muons, these images require exposure times on the order of months. Scientists at [Lawrence Livermore National Laboratory](https://www.llnl.gov) are working to change that with a new initiative called Intense and Compact Muon Sources for Science and Security (ICMuS2). [Read more...](#)

➤ **Mission Agility, Technical Vitality**



A schematic illustration of the salt foam fabrication process that a Lawrence Livermore research team used to transform sodium chloride (table salt) and potassium chloride into foams that could then be packed into a panel and used to provide 24-hour, electricity-free cooling.

### Just add salt: Researchers explore a new electricity-free cooling method

Rising global temperatures are creating an increased demand for cooling as the number of air-conditioning units used worldwide is expected to triple by 2050.

However, with 13% of the global population without access to electricity, solutions that can provide cooling without electricity are needed.

In a study published in [Materials Horizon](#), a [Lawrence Livermore National Laboratory](#) research team explores a passive daytime radiative cooling method using sodium chloride (table salt) and potassium chloride to fabricate a panel that can provide 24-hour, electricity-free cooling. PDRC is an environmentally friendly supplement to air-conditioning that can reduce buildings' energy usage, increase power plant efficiency, collect water from the air and even desalinate water. [Read more...](#)

➤ **Mission Agility, Technical Vitality**



## AMAZING LDRD HIGHLIGHTS

**FOUR 2023 R&D 100 AWARDS TIED TO SANDIA LDRD PROJECTS:** [Electro3D](#), [Materials Learning Algorithms](#), [META Optics Studio](#), and [Pre-Symptomatic Volatile Organic Compounds Detector of Seizure Events](#)

> Mission Agility, Technical Vitality

**QUANTUM SENSING AND DARK MATTER** [Could quantum sensors solve one of the universe's biggest mysteries?](#) > Mission Agility, Technical Vitality

**CLIMATE CHANGE IMPACTS TO VECTOR-BORNE DISEASES:** [Modelling to forecast the impact of climate change on infectious disease outbreaks.](#) > Mission Agility, Technical Vitality

**THE KEY TO NUCLEAR DEBRIS MODELING:** [Unlocking gas phase uranium oxidation](#) > Mission Agility, Technical Vitality

**PHENOMENON IN TITANIUM ALLOYS WHEN UNDER STRESS:** [LLNL physicist probes causes of life-shortening 'dwell fatigue' in titanium](#) > 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](https://www.llnl.gov/newsroom/quarterly-highlights) and click on the Quarterly Highlights tab. Approved for Public Release: NNS eDC/RO ID: 20197.

**For more information:**

**NNSA LDRD**

Anthony Lewis

[anthony.lewis@nnsa.doe.gov](mailto:anthony.lewis@nnsa.doe.gov)

**LANL LDRD**

Laura Stonehill

[lauracs@lanl.gov](mailto:lauracs@lanl.gov)

**LLNL LDRD**

Doug Rotman

[rotman1@llnl.gov](mailto:rotman1@llnl.gov)

**Sandia LDRD**

Wahid Hermina

[wlhermi@sandia.gov](mailto:wlhermi@sandia.gov)

**NNS SDRD**

Paul P. Guss

[gusspp@nv.doe.gov](mailto:gusspp@nv.doe.gov)

