Sandia National Laboratories

Exceptional service in the national interest

QUANTUM AT SANDIA NATIONAL LABORATORIES

PRESENTED BY

SUSAN SEESTROM, ASSOCIATE LABORATORIES DIRECTOR AND CHIEF RESEARCH OFFICER, ADVANCED SCIENCE & TECHNOLOGY

QNM | QUANTUM NEW MEXICO

New Mexico is a Quantum State

QUANTUM NEW MEXICO (QNM) SYMPOSIUM | MARCH 31, 2022

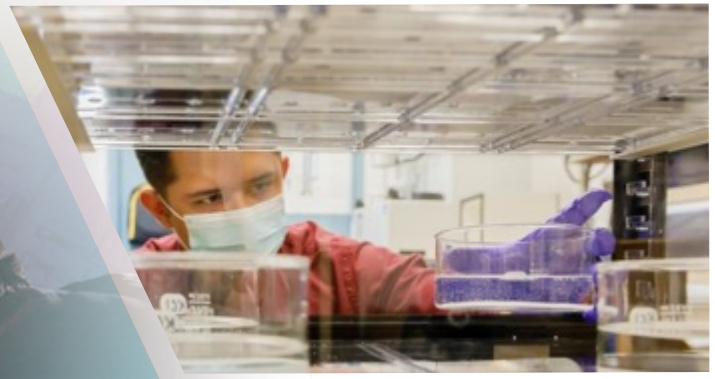
Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia LLC, a wholly owned subsidiary of Honeywell International Inc. for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525. SAND20XX-XXXXX P

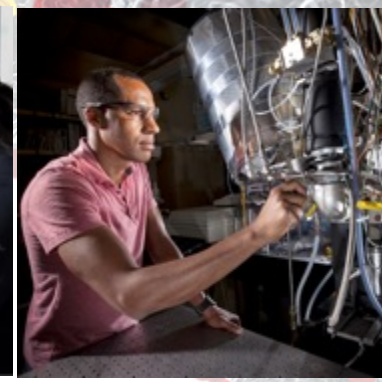
U.S. DEPARTMENT OF ENERGY

NNSA

NATIONAL SECURITY IS OUR BUSINESS

For more than 70 years, Sandia has delivered essential science and technology to address the nation's most challenging security issues





PURPOSE

Render exceptional service in the national interest

VISION

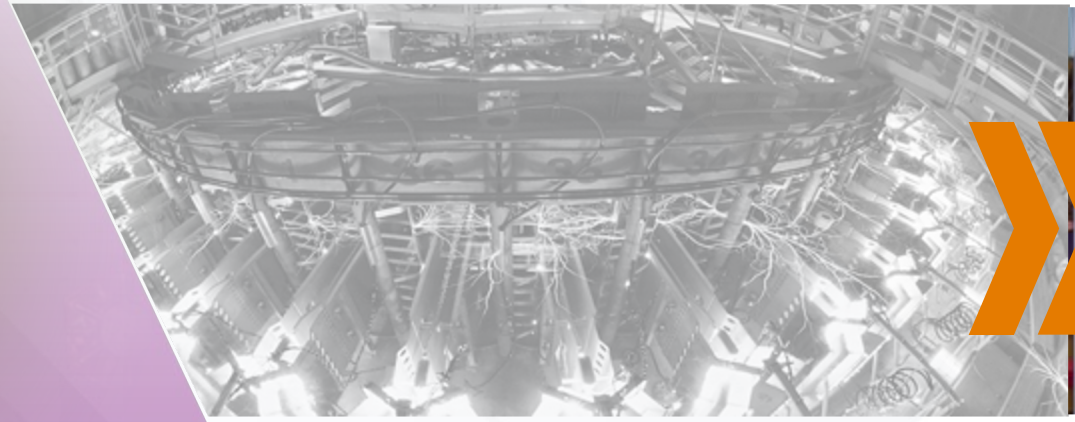
On behalf of our nation, we anticipate and solve the most challenging problems that threaten security in the 21st century

MISSION

Our unique mission responsibilities in nuclear weapons create a foundation from which we leverage capabilities, enabling us to solve complex national security problems

RESEARCH FOUNDATIONS ENABLE QUANTUM R&D

Sandia is accelerating quantum R&D for the economic and national security of the United States

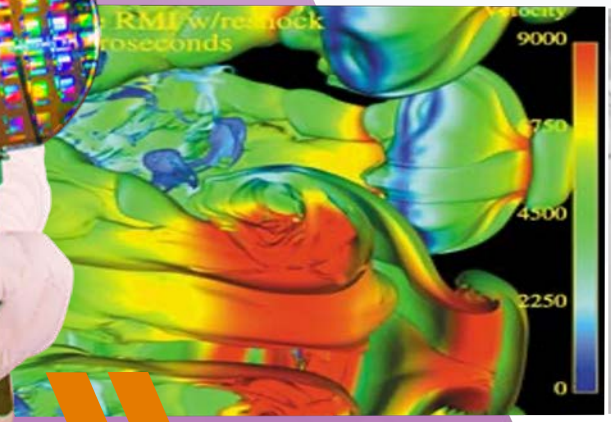


Radiation, Electrical & High Energy Density Science

MATERIALS SCIENCE

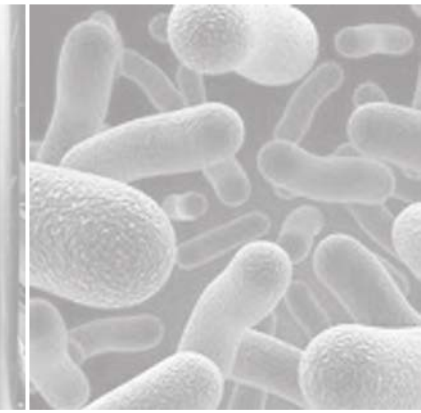
NANODEVICES & MICROSYSTEMS

COMPUTING & INFORMATION SCIENCE



ENGINEERING SCIENCE

Earth Science



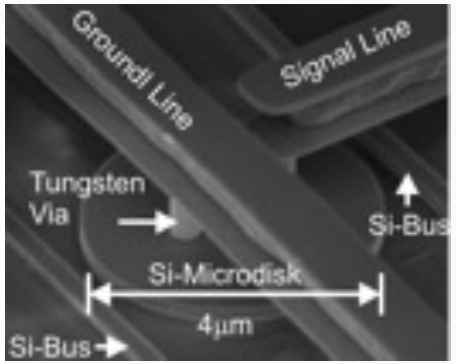
Bioscience

SANDIA'S DIFFERENTIATING QUANTUM CAPABILITIES

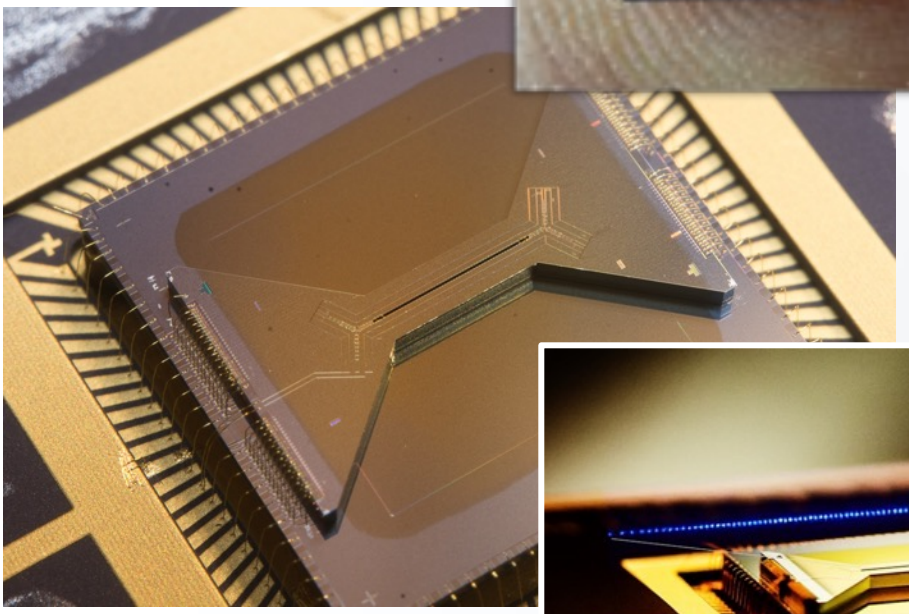
- **MESA Silicon Fab and Micro Fab** is a world-wide supplier of ion traps and silicon-based dot devices.
- **Center for Integrated Nanotechnologies (CINT)** a DOE Office of Science user facility managed jointly with LANL, focused on device testing, materials/devices characterizations, and fabrication.
- **High Performance Computing** is a critical enabler for qubit design, simulation, testing, analysis, and data analyses.
- **Materials Science** program focuses on the creation and synthesis, prototyping processes, measurements, characterization, and modeling.
- **Deep, broad technical base** and a foundation from significant LDRD investments.
- **Multidisciplinary, integrated cross-laboratory team** with broad domain expertise ranging from basic science to engineering to systems integration, outreach, and partnerships.

SANDIA RESEARCHERS ARE AT THE FOREFRONT OF INNOVATION

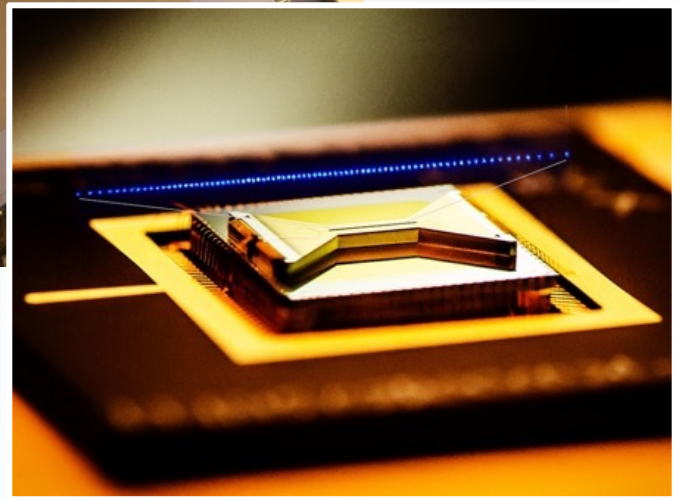
QUANTUM TRANSCEIVER

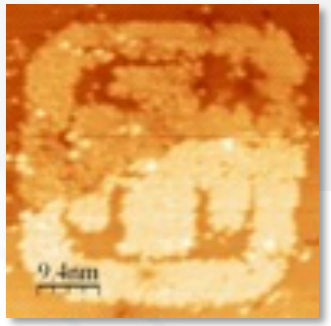


SI PHOTONICS RESONANT OPTICAL MODULATOR/FILTER



HIGH OPTICAL ACCESS (HOA) ION TRAP



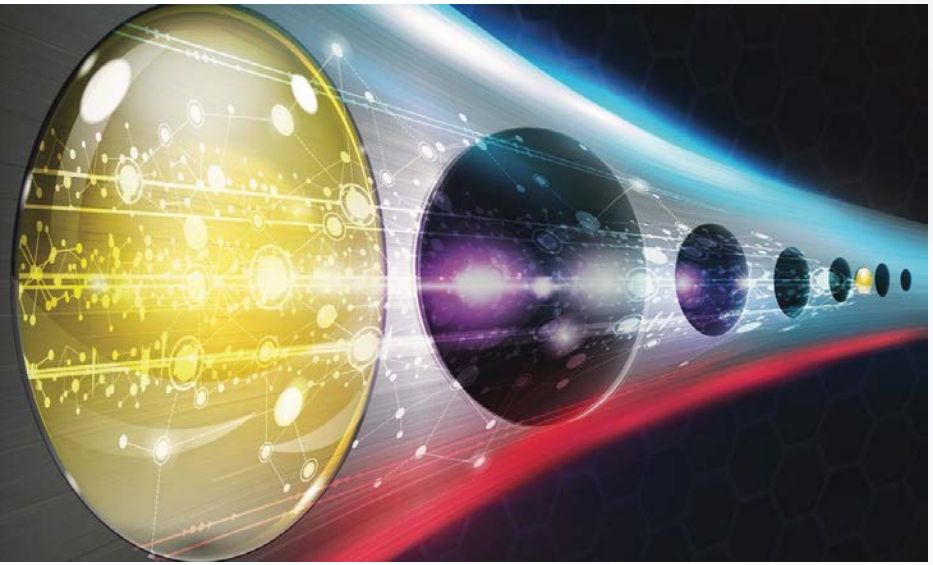


NANO-LOGO

- **Best characteristics** of any microfabricated surface trap at room temperature
- **World-first chip** scale Si photonics quantum transceiver
- Developed the Si Photonics **resonant optical modulator**/filter for high-bandwidth I/O
- **Reduced footprint** atom interferometer for positional sensing in GPS-denied environments
- World-smallest Sandia "**nano-logo**," at 0.7 nm precision
- **Deep understanding of how device architecture** impacts quantum applications and algorithms

QUANTUM INFORMATION SCIENCE (QIS) IS A NATIONAL STRATEGIC PRIORITY & IMPACTS NM'S ECONOMY

- Information sciences and quantum mechanics leading to novel physics and new capabilities with implications for national security.
- Quantum Science & Technology is a top research priority for the DOE Office of Science and Sandia.
- Investments come from a variety of sources and are managed to nurture our foundational science and engineering base.
- New Mexico has made pivotal contributions to the establishment of the QIS field, and we have a unique opportunity to develop and expand our strong, established QIS programs.



"At DOE, we're investing in the fundamental research, led by universities and our National Labs, that will enhance our resiliency in the face of growing cyber threats and climate disasters, paving the path to a cleaner, more secure future."

SECRETARY OF ENERGY JENNIFER M. GRANHOLM

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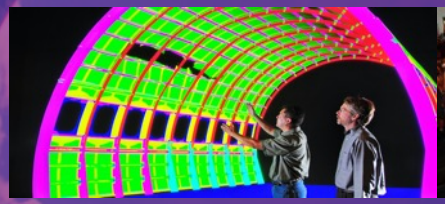



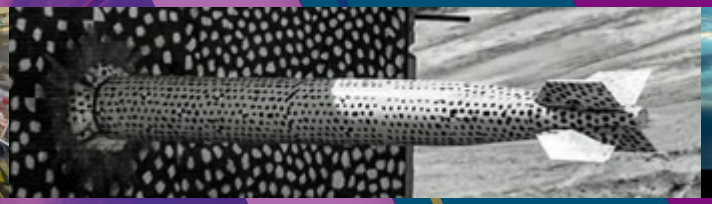


SCIENCE AS A MISSION

ADVANCED SCIENCE & TECHNOLOGY integrates multidisciplinary efforts to advance the science of the possible for Sandia's missions

- ✓ We identify solutions to the nation's most challenging current and future security problems and help address them through investment in and operation of key foundational science and engineering capabilities.
- ✓ We maintain advanced research capabilities in computational simulation, environmental testing, high energy density and inertial confinement fusion science, high performance computing, materials science and engineering, and radiation effects science. The division uses these capabilities to provide services and products that directly support all of Sandia's missions.
- ✓ Our people are national leaders in science and technology as well as in their professional communities.

LDRD PROGRAMS BALANCE FOUNDATIONAL AND APPLIED INVESTMENTS

~400 LDRD PROJECTS

40% NEW PROJECTS

60% SECOND/THIRD-YEAR PROJECTS

RESEARCH FOUNDATIONS (RF)

Conduct **fundamental/discovery and use-inspired research** in disciplines germane to national security mission needs.

MISSION FOUNDATIONS (MF)

Conduct **applied research** in areas directly relevant to current and anticipated missions.

STRATEGIC INITIATIVES (SI)

Bridge or advance science, technology, and engineering to meet mission demands. The research is strategic, involves cross-collaboration, and is directed by the CRO Fellows, or Labs-directed.