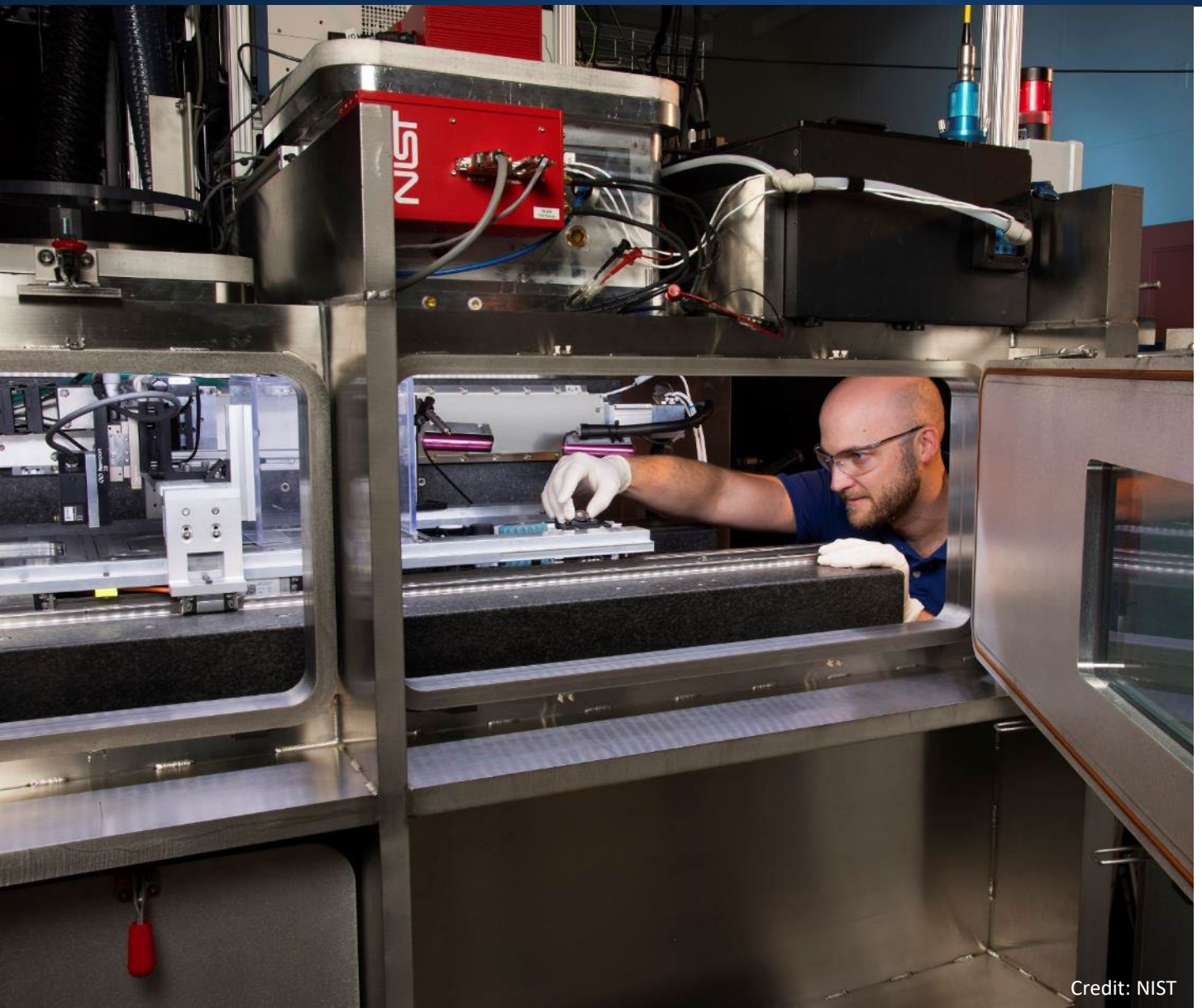
NIST Laboratory Programs

Dr. Jim Olthoff

National Institute of Standards and Technology
U.S. Department of Commerce

NIST Metrology for Industry



Credit: NIST

NIST provides technical support to industry through research, metrology, and standards

Unique NIST Products and Services

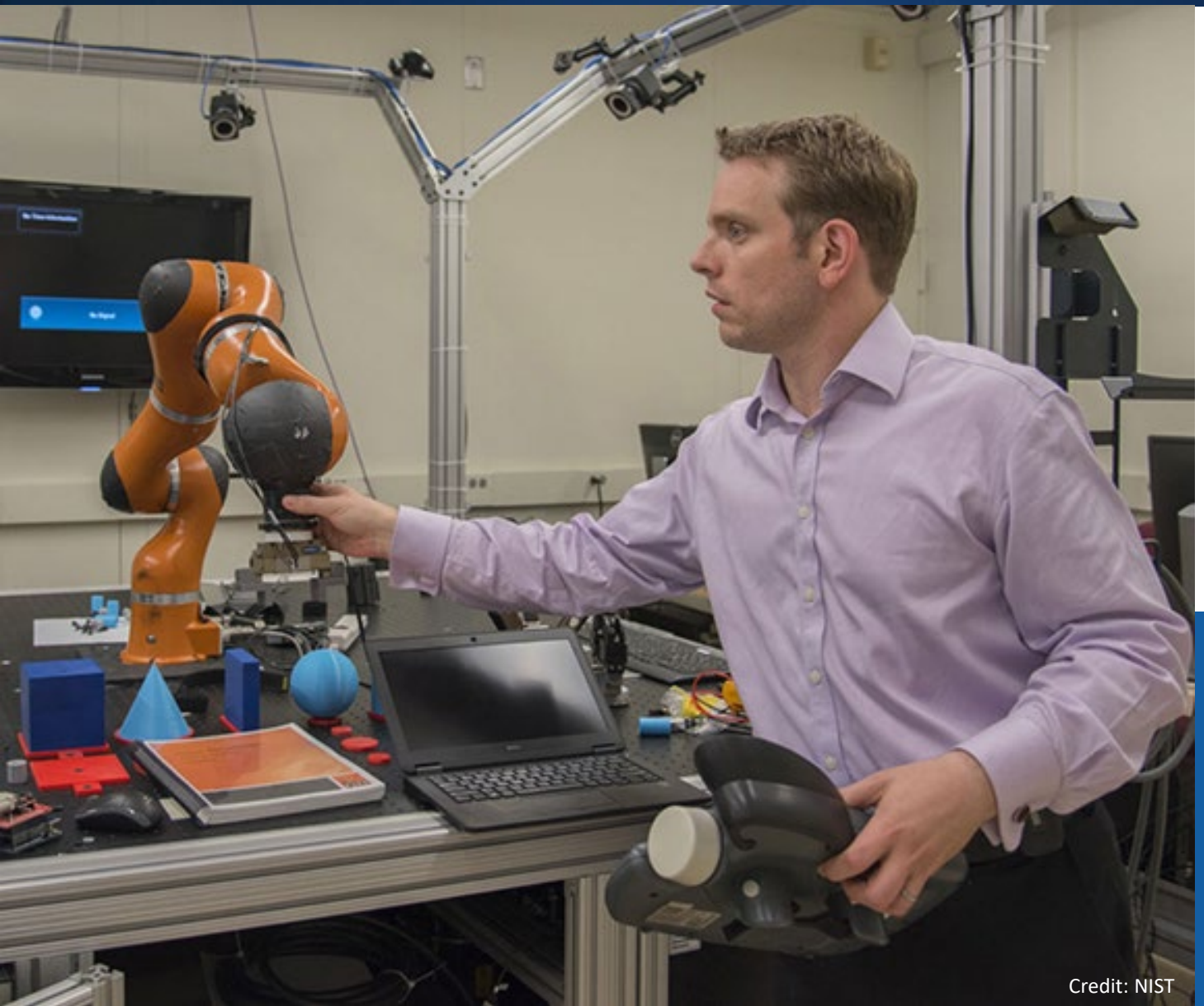
Million-Pound Deadweight Machine

- **1,200** Standard Reference Material (SRM) products
- **100** Standard Reference Data (SRD) products
- **700** measurement services

Every year:

- **32,000 SRM units sold**
- **13,000 calibrations and tests**
- **800 accreditations of testing and calibrations laboratories**

Documentary Standards


Credit: NIST

Important Role

- **400+** NIST technical staff in **100+** standard committees
- Leadership in **international standards** bodies

NIST's technical expertise results in improved standards and U.S. competitiveness

Ensuring U.S. Leadership in Critical Technologies

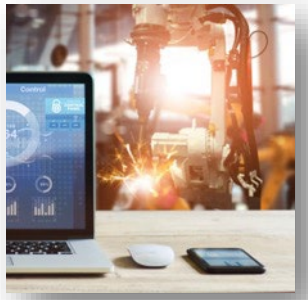
NIST continues to expand research efforts in the industries of the future and to strengthen U.S. standards leadership

Advanced Communications/5G

AI-enabled measurement systems to support wide deployment of 5G wireless technologies, Participating and leading in 5G standards development

Quantum Science

New quantum networking grand challenge will build on NIST world-leading science, while NIST expands industry partnerships in the Quantum Economic Development Consortium



Advanced Manufacturing

Providing technical support and key infrastructure to the nation's manufacturing industries as they strive to out-innovate global competitors

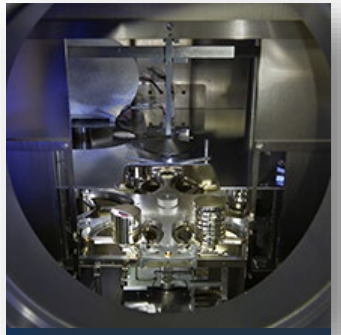
Artificial Intelligence

Leading efforts to prioritize and address key AI standards needs while developing training and testing tools for research domains from materials science to robotics

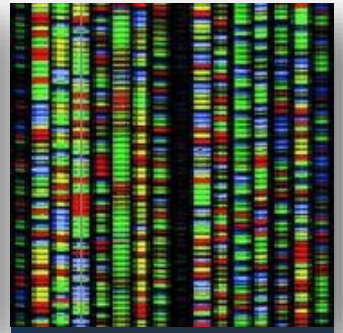
Engineering Biology

Living Systems Foundry for safe, predictable design and control of biological systems

NIST Laboratory Programs



Physical Measurement Laboratory



Material Measurement Laboratory

Information Technology Laboratory

Communication Technology Laboratory

Engineering Laboratory

NIST Center for Neutron Research

Driving innovation through measurement science

Accelerating the adoption of advanced technology solutions

Providing world class, unique facilities

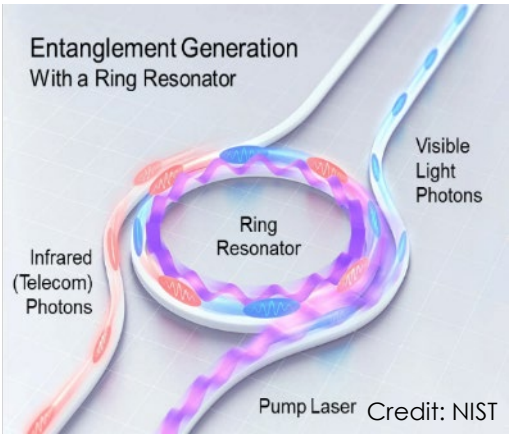
https://www.nist.gov/labs-major-programs

Physical Measurement Laboratory (PML) NIST

Provide U.S. science, industry, and trade with the **most advanced SI-traceable physical metrology**, through **world-class measurement services** and **research** at the **frontiers of measurement science**

- U.S. standard time dissemination
- 700 kinds of calibration services
- Special testing services
- Over 100 standard reference materials

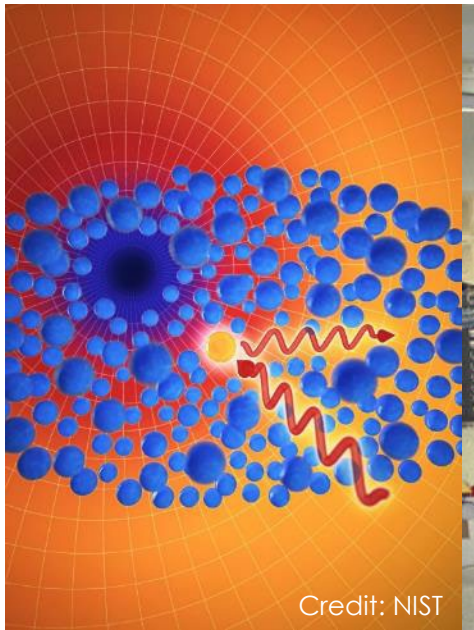
Credit: NIST



Credit: NIST

Activities include:

- Artificial Intelligence Hardware
- Advanced Microelectronics
- Climate Metrology
- Integrated Photonics and Opto-mechanics
- Nanofabrication research
- Quantum Science, Metrology & Information Science
- Weights and Measures dissemination

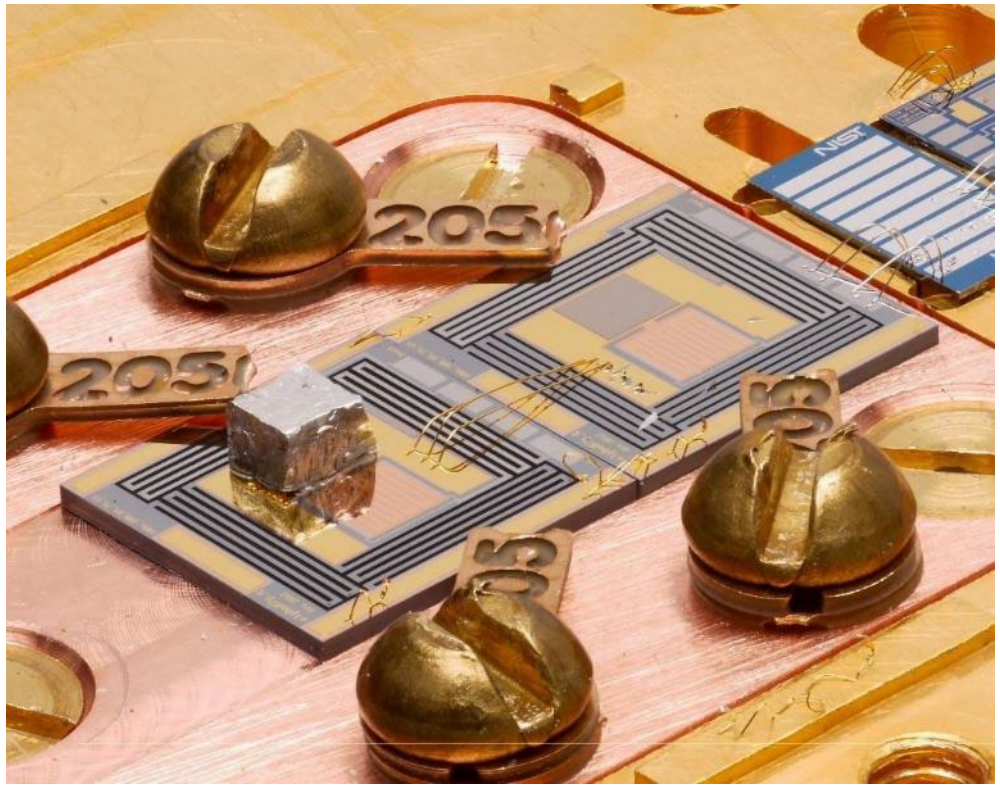

Credit: NIST


Credit: NIST

PML Highlight: Radiation Physics

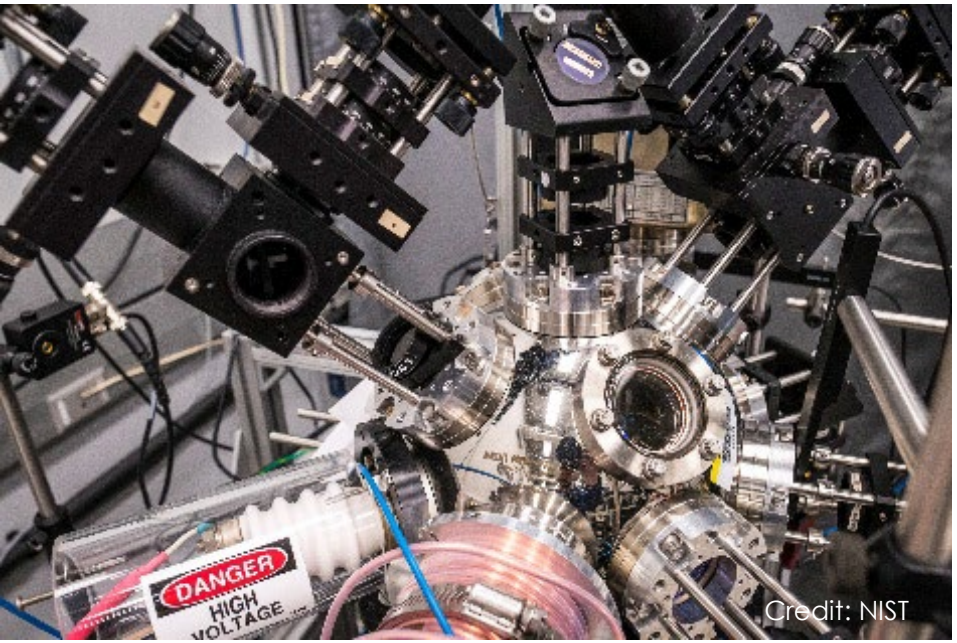
- Realize the Système International (SI) units for absorbed dose (the gray) and activity (the becquerel)
- Maintain an active research programs in terahertz spectroscopy, neutron physics, radiation dosimetry, and radionuclide metrology
- Medical physics to support medical imaging and therapeutics
- Standards and test procedures for chemical/ biological/ radiation/nuclear/explosives countermeasures in homeland security, measurement assurance and
- Promote the accurate and meaningful measurements of dosimetric quantities pertaining to ionizing radiation
- Provide measurement services, standards, and fundamental research

True Becquerel - A New Paradigm for 21st Century Radioactivity Measurements



Multidisciplinary project to develop a new capability for primary standardization of radionuclides

Material Measurement Laboratory (MML)



Credit: NIST

Credit: NIST

MML conducts measurement science research and develops standards in the **chemical**, **biological**, and **material** sciences to assure quality measurement results.

Providing research, measurement services, measurement quality assurance tools, and technology in:

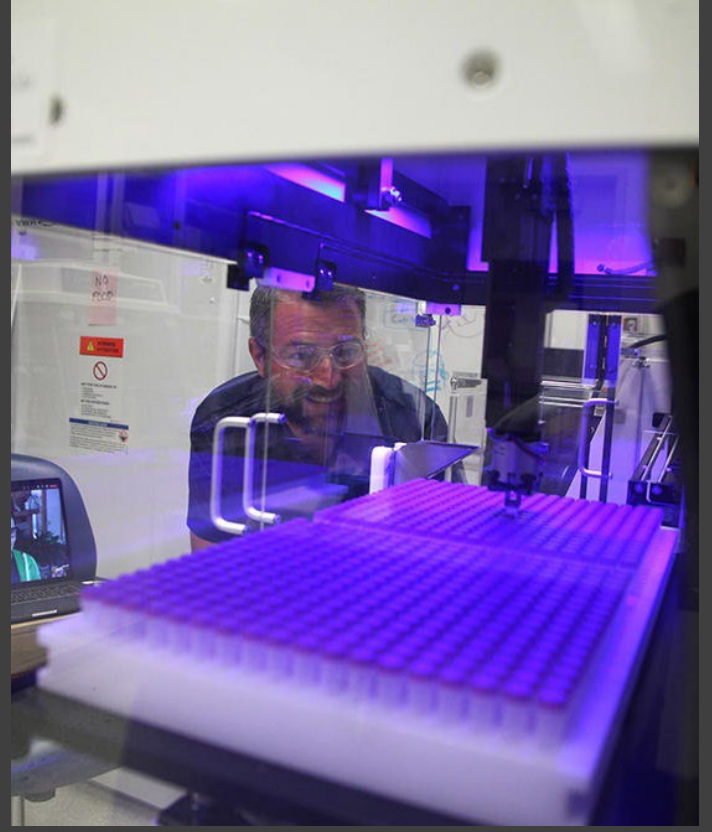
- Biotechnology
- Biomanufacturing
- Healthcare
- Advanced Materials
- Food Safety and Nutrition
- Renewable Energy
- Advanced Manufacturing
- Forensics
- Circular Economy
- Climate and Decarbonization
- Environmental Contaminants
- Biobanking and Cryopreservation
- Reference Material Production

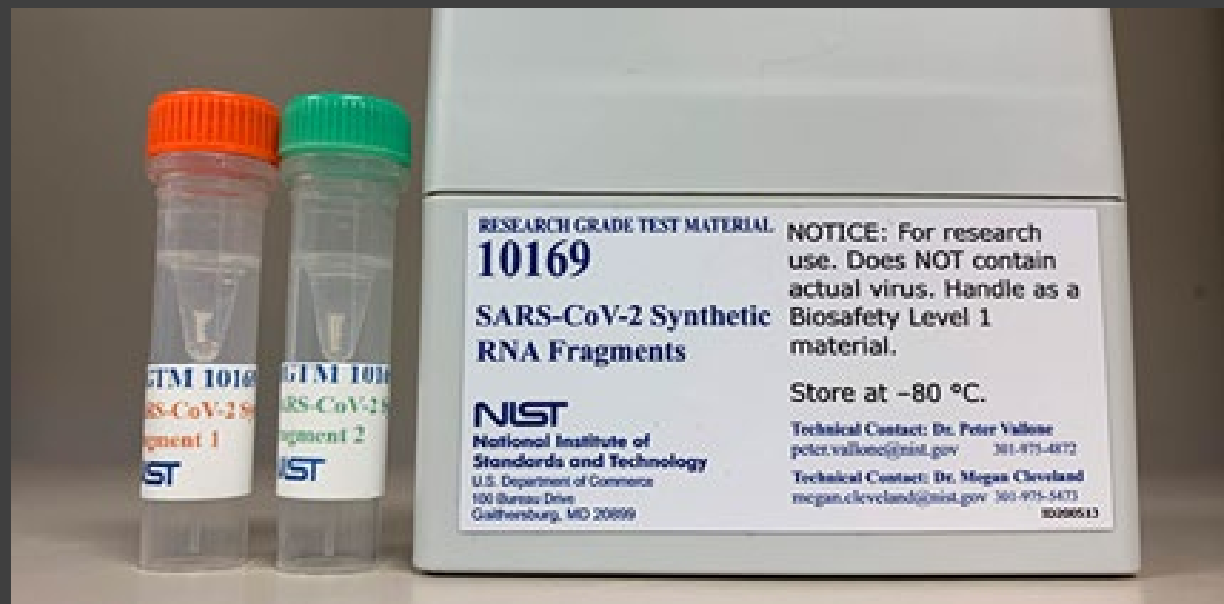
Coordinates **Standard Reference Materials (SRM)** and **Standard Reference Data (SRD)** programs.

MML Highlight: Biological Science and Technology

COVID-19 Measurements

- NIST created SARS-CoV-2 Synthetic RNA fragments, packed as a RESEARCH GRADE TEST MATERIAL (RGTM)
- Over 180 units of RGTM shipped to customers in the US and 25 countries abroad
- Used for an interlaboratory study with other National Metrology Institutes
- Other efforts related to COVID-19 include participating in coordinated efforts with NIH, CDC, and FDA to study immune response
- Similar rapid development for a Monkey Pox RGTM issued in July 2022 to validate tests





Information Technology Laboratory (ITL)

Cultivating Trust in Information Technology and Metrology

ITL conducts **fundamental and applied research** and develops **standards and best practice guides** to make information systems more secure, usable, interoperable, and reliable

- Cybersecurity and Privacy
- Quantum Information
- Artificial Intelligence
- Information Science

Credit: ©Nick MacIntosh

ITL Highlight: National Cybersecurity Center of Excellence (NCCoE)

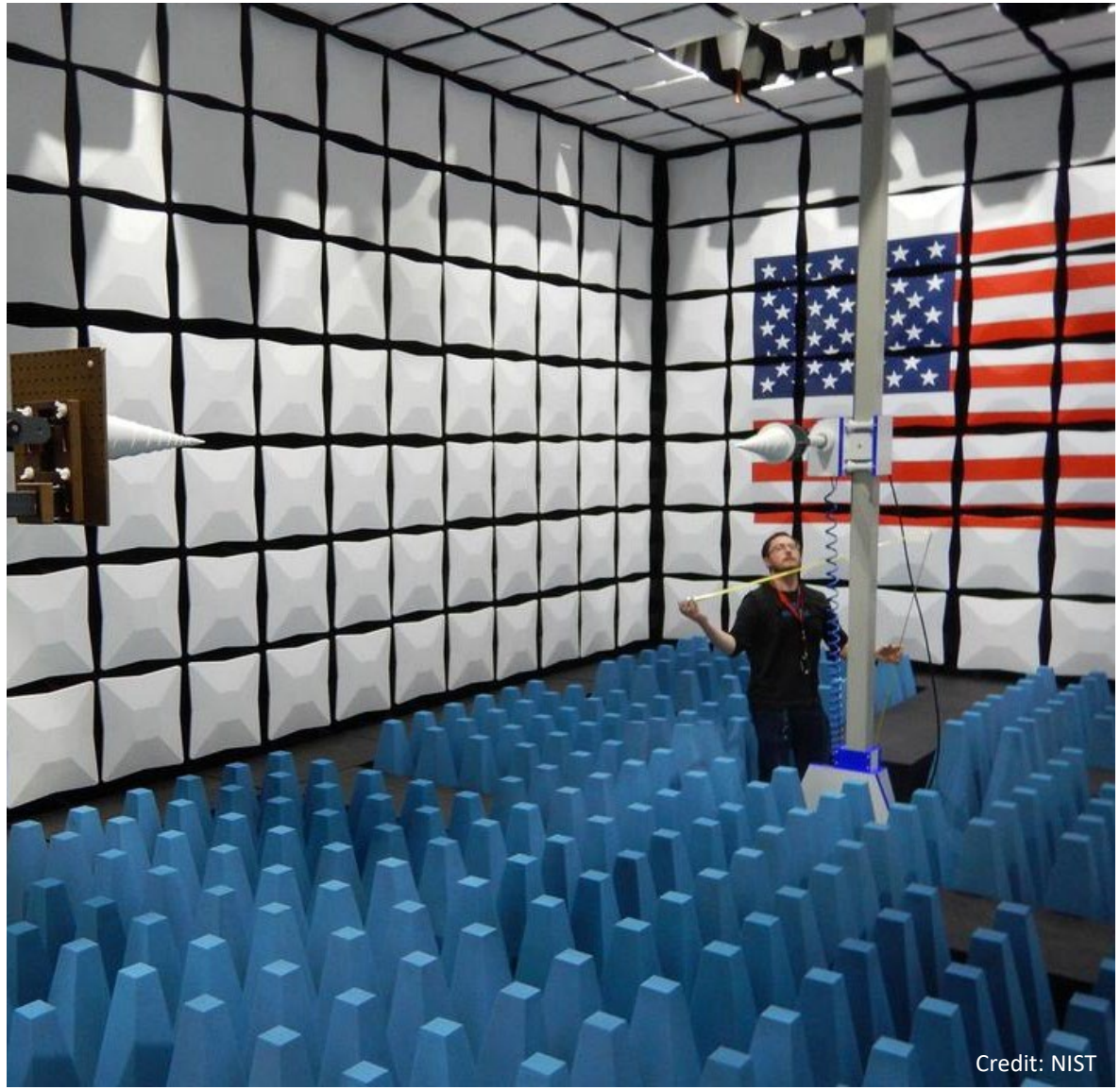
A collaborative hub where industry organizations, government agencies, and academic institutions work together to address businesses' most pressing cybersecurity challenges

- Public-private partnership est. in 2012 with State of Maryland and Montgomery County, MD
- Creates practical cybersecurity solutions
- Technology partners include Fortune 50 market leaders and small companies
- NCCoE documents solutions in NIST Special Publication 1800 series
- Federally Funded Research and Development Center (FFRDC) operated by MITRE, facility is offsite in Rockville, MD

Communications Technology Laboratory (CTL)

NIST

- Core Network Technology
- Fundamental Electromagnetic Technologies & Standards
- Next Generation Wireless Systems
- Public Safety Communications
- Smart Infrastructure & Manufacturing
- Spectrum Sharing & Sensing

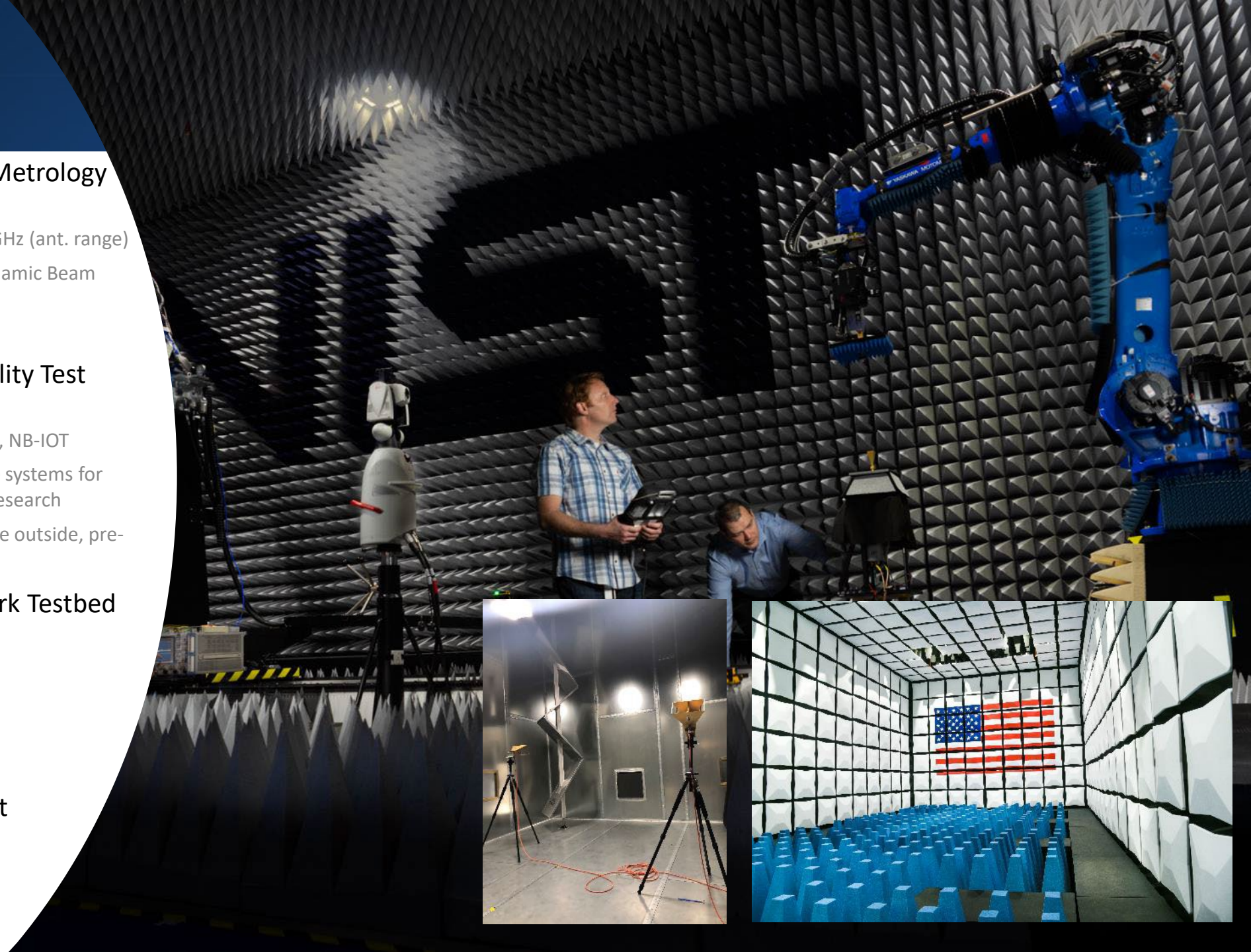


State-of-the-Art Testing Facilities

- Advanced Communications and Metrology Laboratory (ACML)
  - 1-50GHz (ant. characterize), 50-500GHz (ant. range)
  - Characterize mm-Wave systems, Dynamic Beam Steering, AOA/AOD
  - Micron resolution, doppler effects
- National Broadband Interoperability Test Bed (NBIT)
  - 5G, 4G, Wi-Fi, Live-Sky GPS, LTE MTC, NB-IOT
  - Designed for deployment of multiple systems for co-existence and spectrum sharing research
  - Enables scenarios difficult to replicate outside, pre-deployment exploration
- 5G/4G Cellular Metrology Network Testbed
  - Commercial grade
  - Complete Network Infrastructure
  - Comprehensive Signal Analysis
- Smart Grid Testbed

Controlled laboratory environment

- Correlated, multi-layer analysis
- Repeatable measurements
- Uncertainty analyses
- Measurement tools and methods

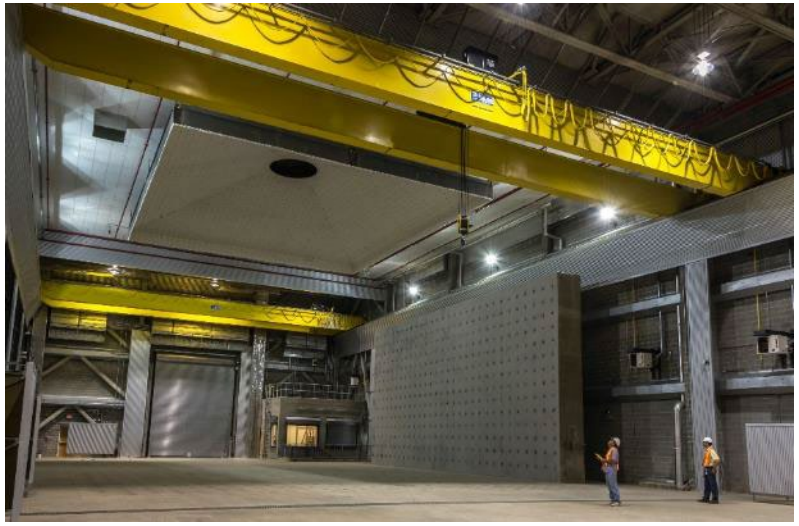


Engineering Laboratory (EL)

EL promotes U.S. innovation and industrial competitiveness by advancing **measurement science**, **standards**, and **technology for engineered systems** in ways that enhance economic security and improve the quality of life

Disaster Resilience

National Fire Research Laboratory



Advanced Manufacturing

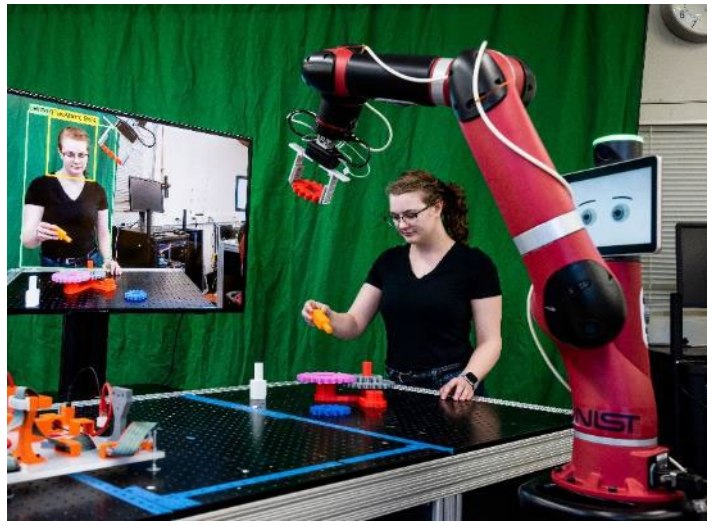


Image credits: NIST

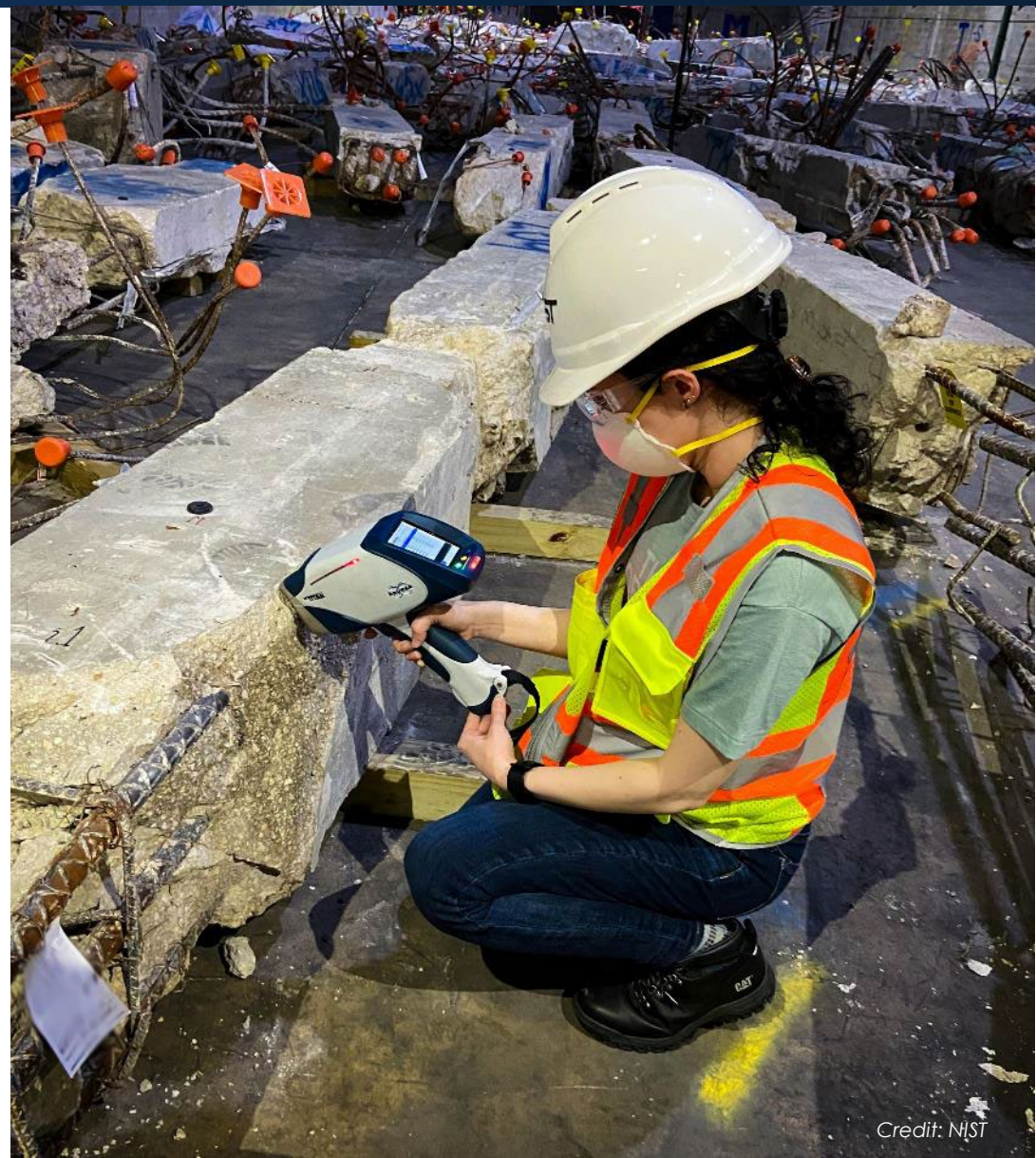
EL highlight: Champlain Towers South Investigation

Background

- Champlain Towers South Condominium in Surfside, FL collapsed on June 24, 2021
- NIST was on-site June 25, 2021
- NIST Director established a National Construction Safety Team (NCST) on June 30

Activities include:

- Field deployment
- Rubble, unstable structures
- Severe weather
- Utilities (water, electricity, communications) unavailable



NIST Center for Neutron Research (NCNR)


Credit: NIST

Provides **neutron measurement capabilities** to the U.S. research community

Conducts research using neutron techniques and developing and applying new **neutron measurement techniques**

Serves a diverse set of stakeholders: Over **3,000 researchers** annually from about **170 universities, 50 industrial entities, 40 government organizations**

National Institute of Standards and Technology
U.S. Department of Commerce

THANK YOU