Lawrence Livermore National Laboratory

Laboratory Overview

PSAAP III Kickoff Meeting

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Lawrence Livermore National Laboratory

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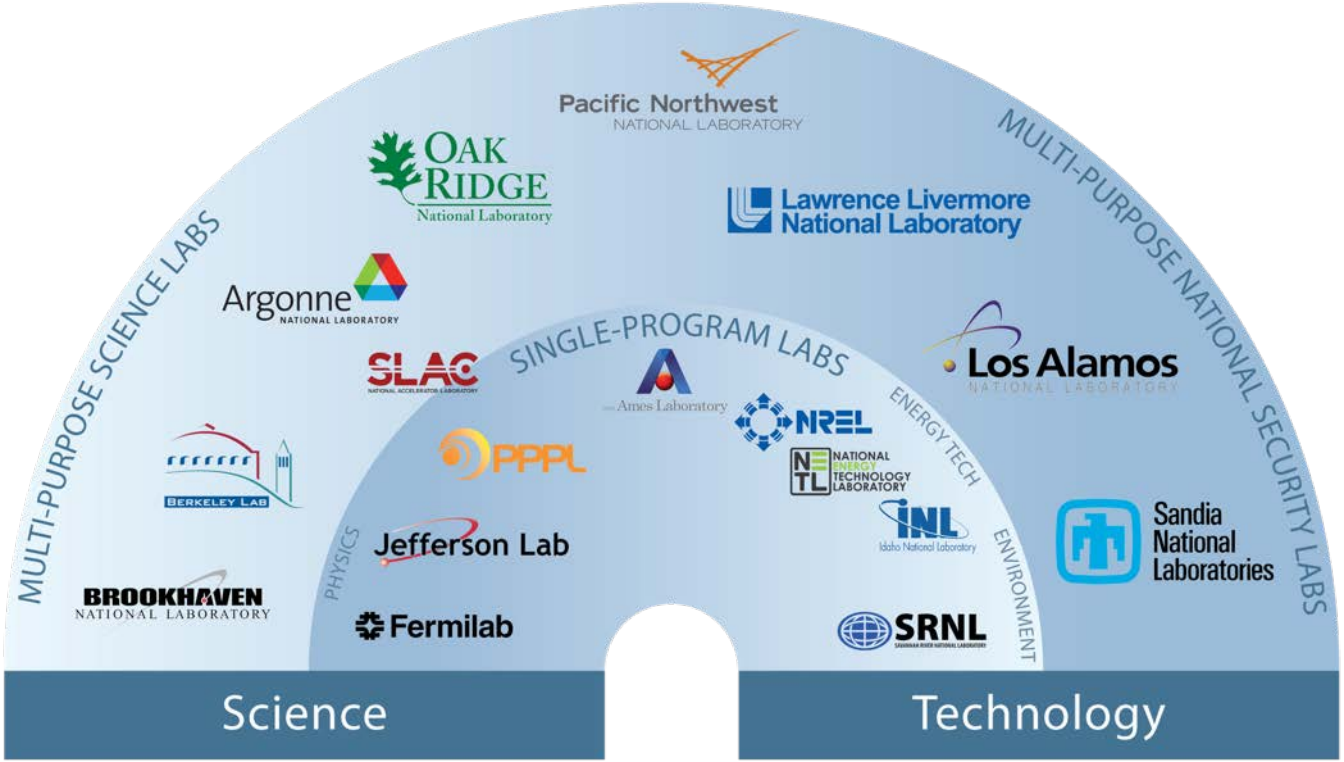
LLNL-PRES-000000

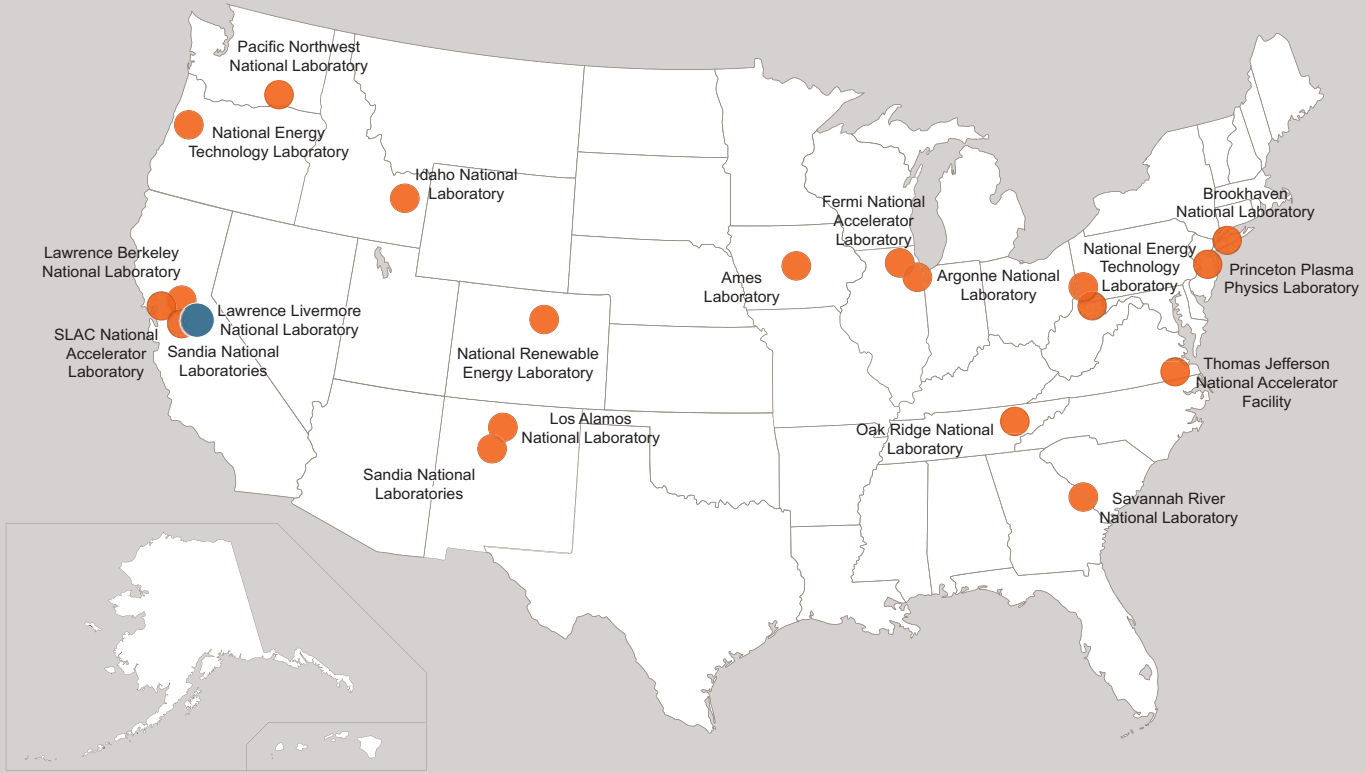
This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

National Nuclear Security Administration

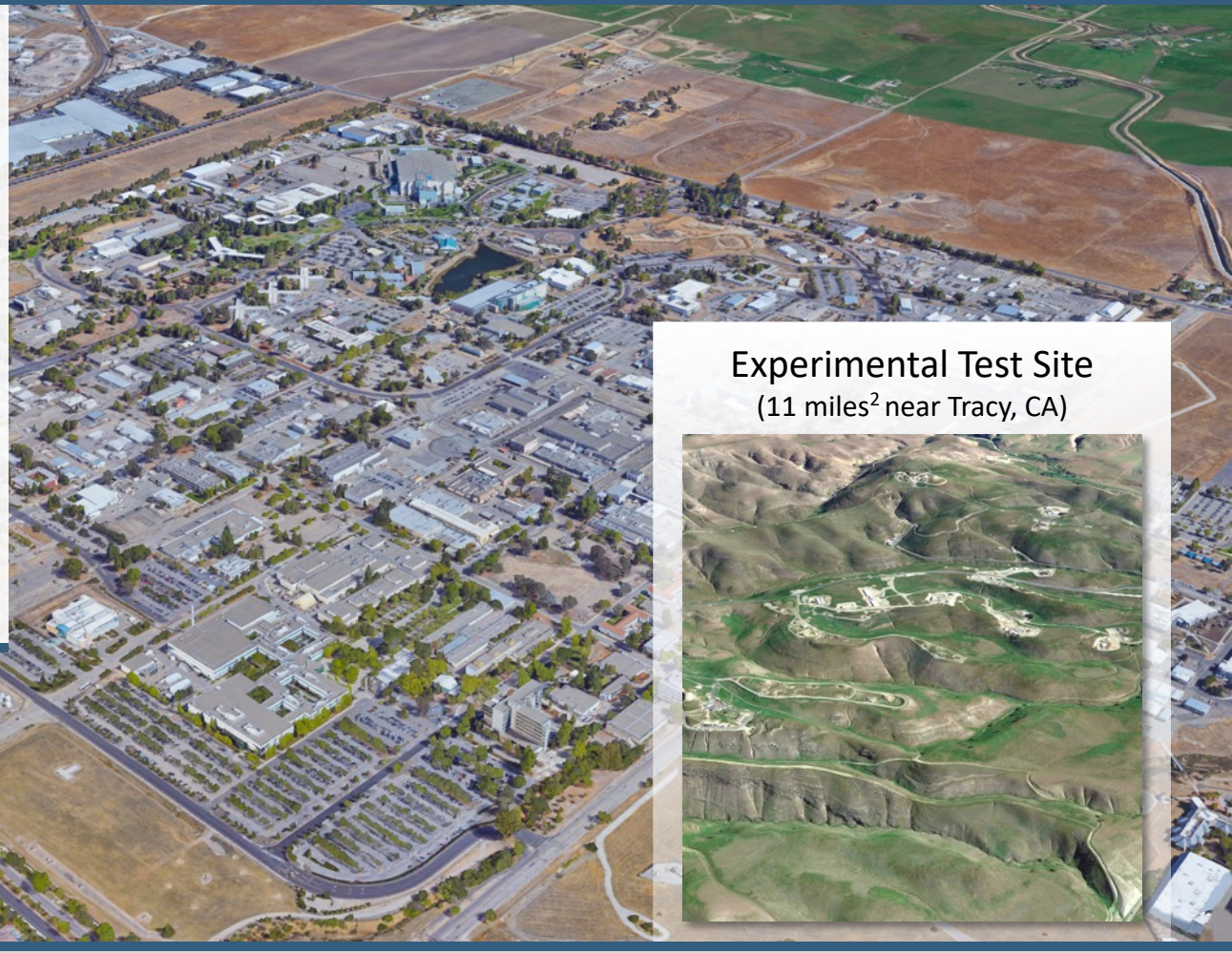
LLNL is one of 17 Department of Energy national laboratories



The Department of Energy national laboratories are located across the nation

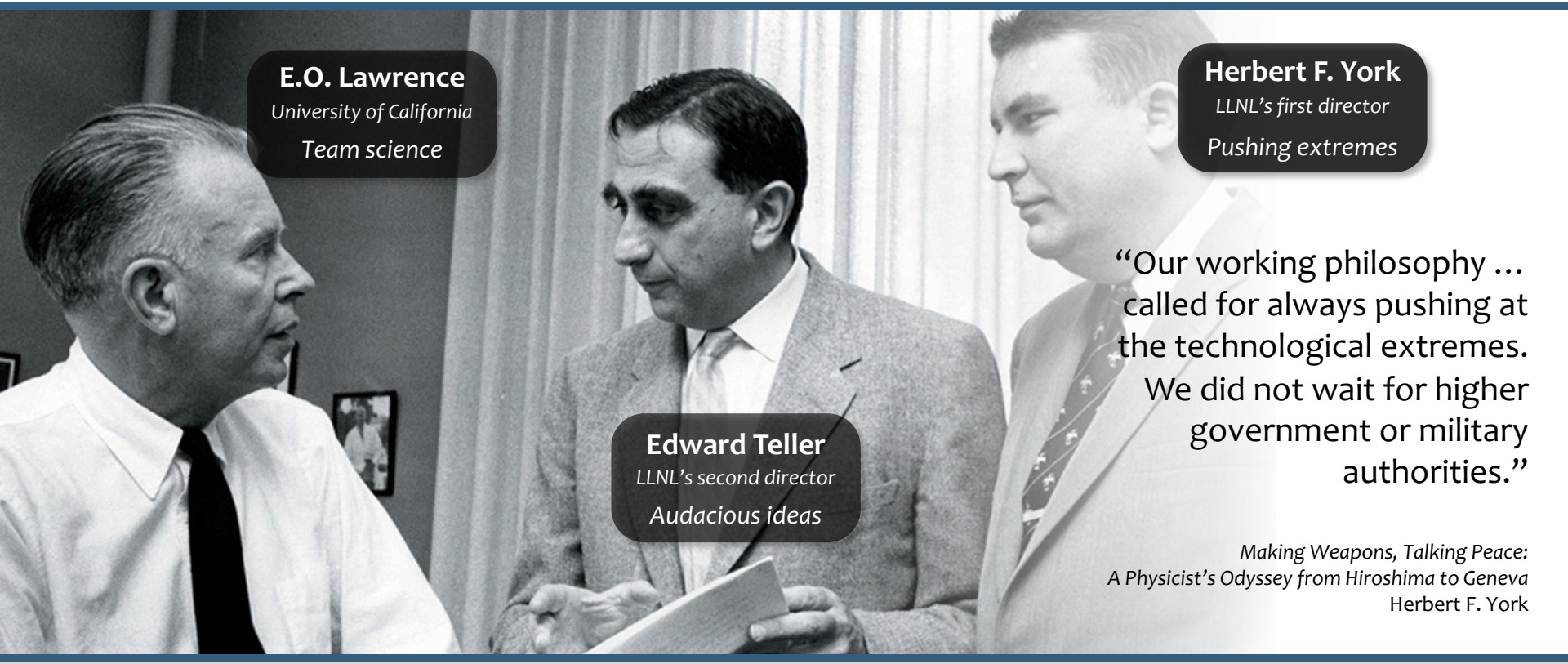


- Established in 1952
- ~ 7,400 LLNS employees
- 1 square mile and 517 facilities, ~40 miles from San Francisco
- Annual budget: ~ $2.3B
- Operated by LLNS, LLC (University of California and Bechtel, BWXT, Amentum)



Experimental Test Site
(11 miles^2 near Tracy, CA)

Our heritage: team science, audacious ideas, and pushing the extremes



"Our working philosophy … called for always pushing at the technological extremes. We did not wait for higher government or military authorities."

Making Weapons, Talking Peace: A Physicist's Odyssey from Hiroshima to Geneva
Herbert F. York

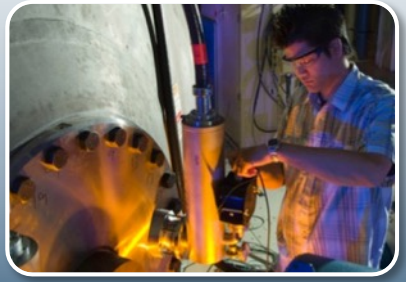
Our Mission: to strengthen national security through world-class science, technology, and engineering

Stockpile Stewardship

All-WMD Threat Reduction

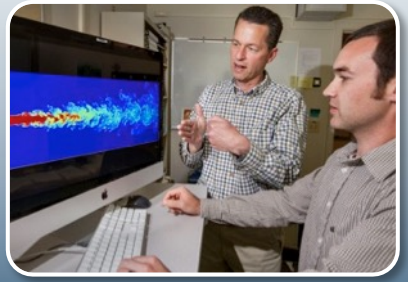
Multi-Domain Deterrence

Energy Security & Climate Resilience



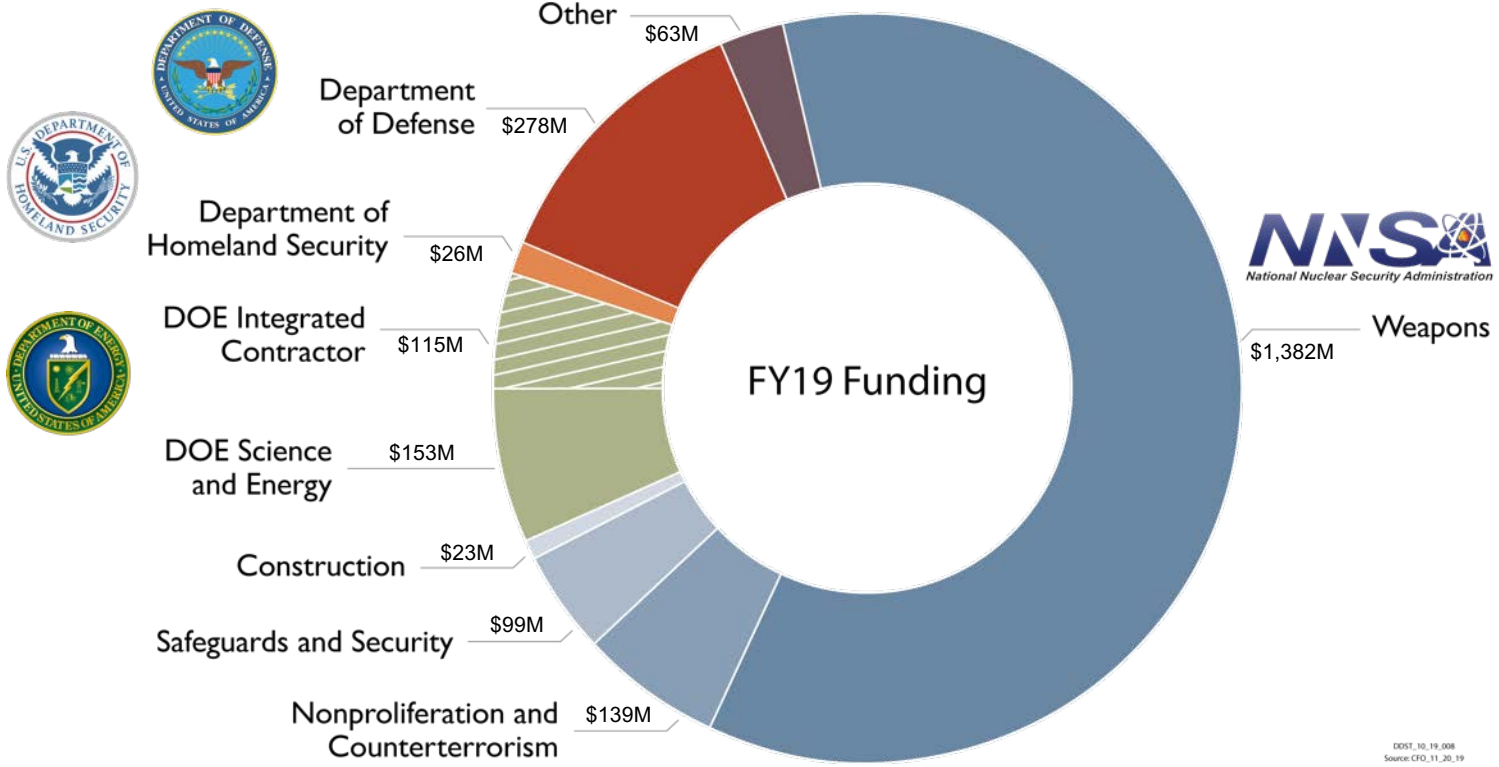
Science

Engineering

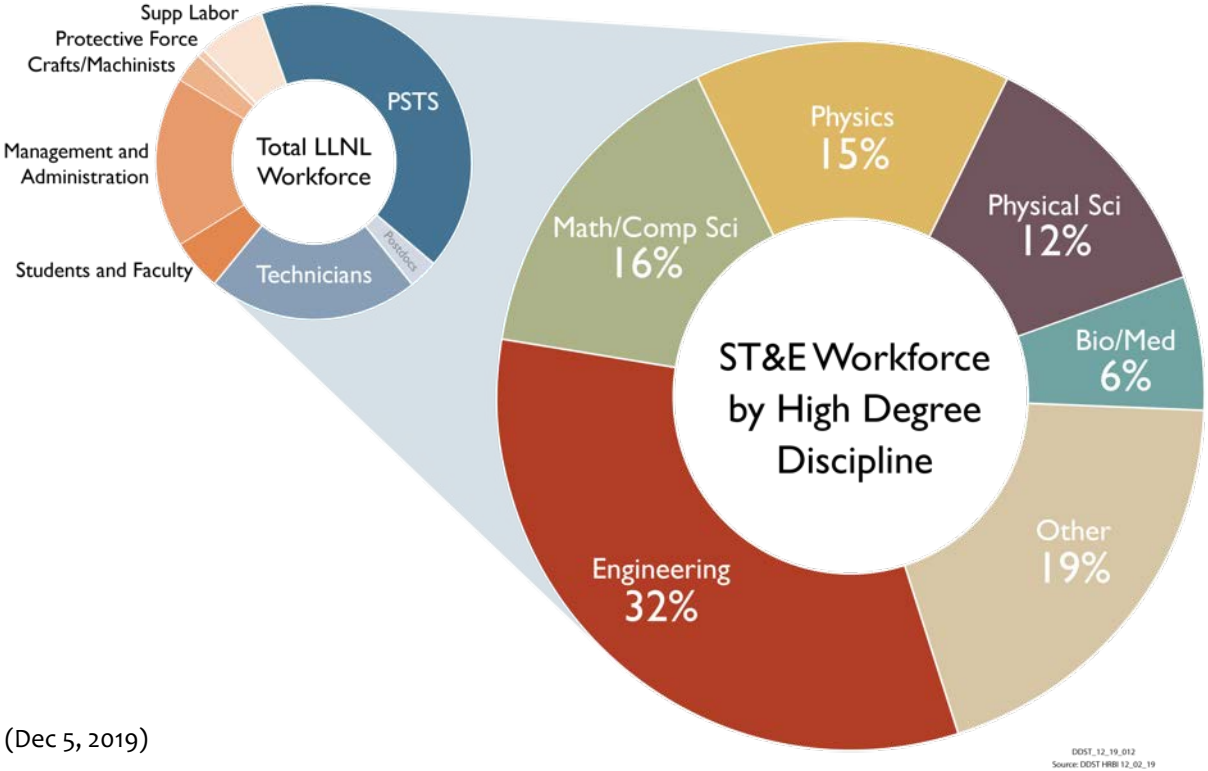


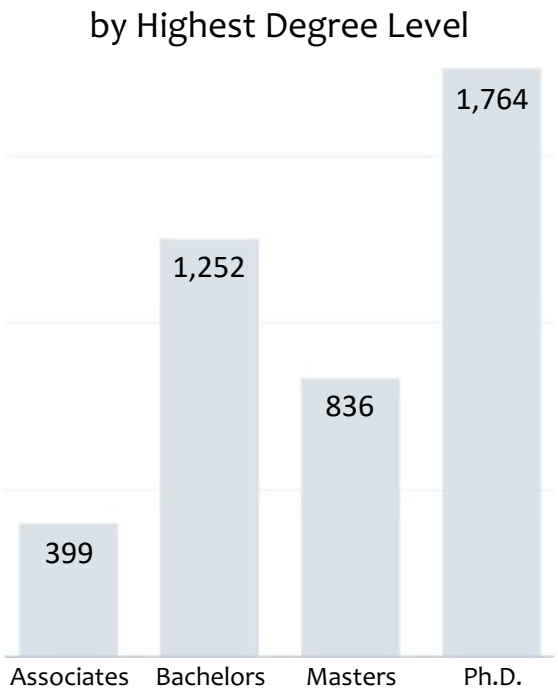
Computing

LLNL's ~$2.3B budget reflects our national security focus



LLNL has a talented and multidisciplinary technical workforce





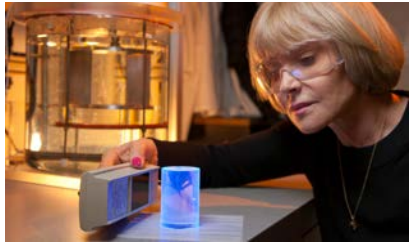
(Dec 5, 2019)

Our work diminishes the likelihood and impact of war, terrorism, and disasters through the innovative application of cutting-edge S&T

Stockpile Stewardship

- Annual Assessment
- Life extensions
- Improved predictive capability
- Enterprise integration and responsiveness

All-WMD Threat Reduction



- Nuclear counter proliferation and counterterrorism
- Chem/biosecurity
- Forensic science
- All-source intelligence

Multi-Domain Deterrence

- Strategic defense
- Conventional strike
- Space security
- Cybersecurity

Energy Security and Climate Resilience

- Diverse domestic energy resources
- Enhancing reliable delivery
- Climate impact assessment

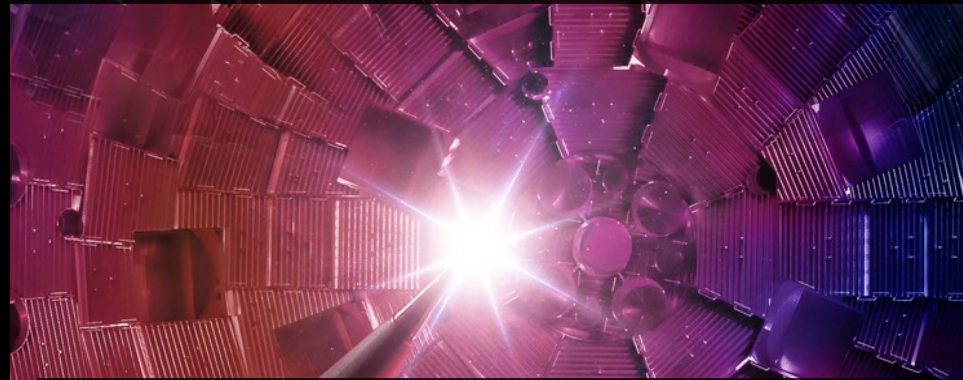
Science-based stockpile stewardship is rooted in challenging our predictions with experiments

High-performance computing, modeling, and simulation

Sierra

#3 on	95 petaflops	125 petaflops
Top 500 List*	sustained	peak

Experimental challenge and validation



National Ignition Facility

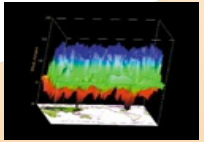
192	500 terawatts	2.15 MJ
laser beams	power output	to target

LLNL has long been at the forefront of enabling HPC hardware and software

1953

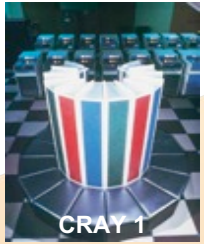
Pioneering simulations of particle tracking

1960s



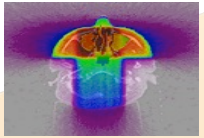
Ozone mixing models

1970s

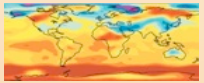


Dynamics in three dimensions

1980s

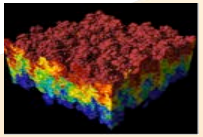


Helping the medical community plan radiation treatment

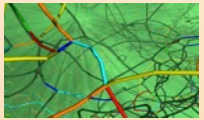


Global climate modeling

1990s

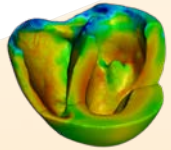


Breakthrough visualizations of mixing fluids

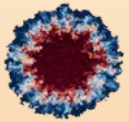


Unprecedented dislocation dynamics simulations

2000s



World's most detailed simulation of the human heart in action



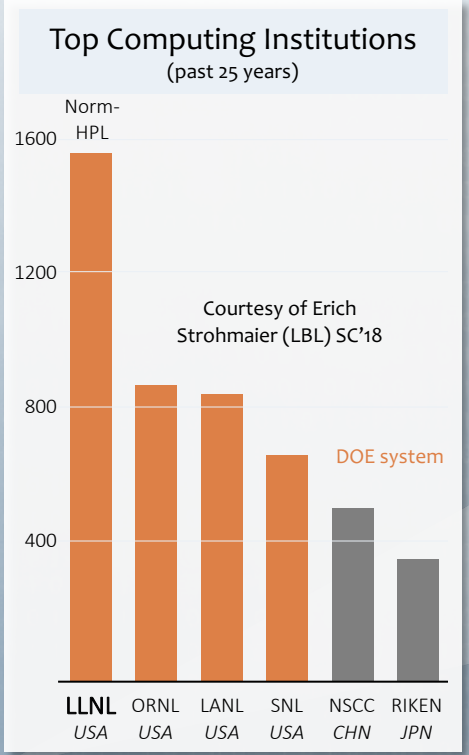
3D 98-billion-cell hydrodynamic instability simulation (ICF-inspired)

2010s

Projected to be the world's most powerful supercomputer

2023

LLNL continues to define the "bleeding edge" of high-performance computing



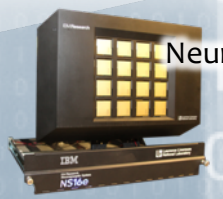
Sierra

- On the path to exascale
- First NNSA GPU platform
- 125 petaflops (peak)
- On-line since 2018

El Capitan

- NNSA's 1st exascale supercomputer
- Silicon based
- 1.5 exaflops (peak)
- Delivery late 2022

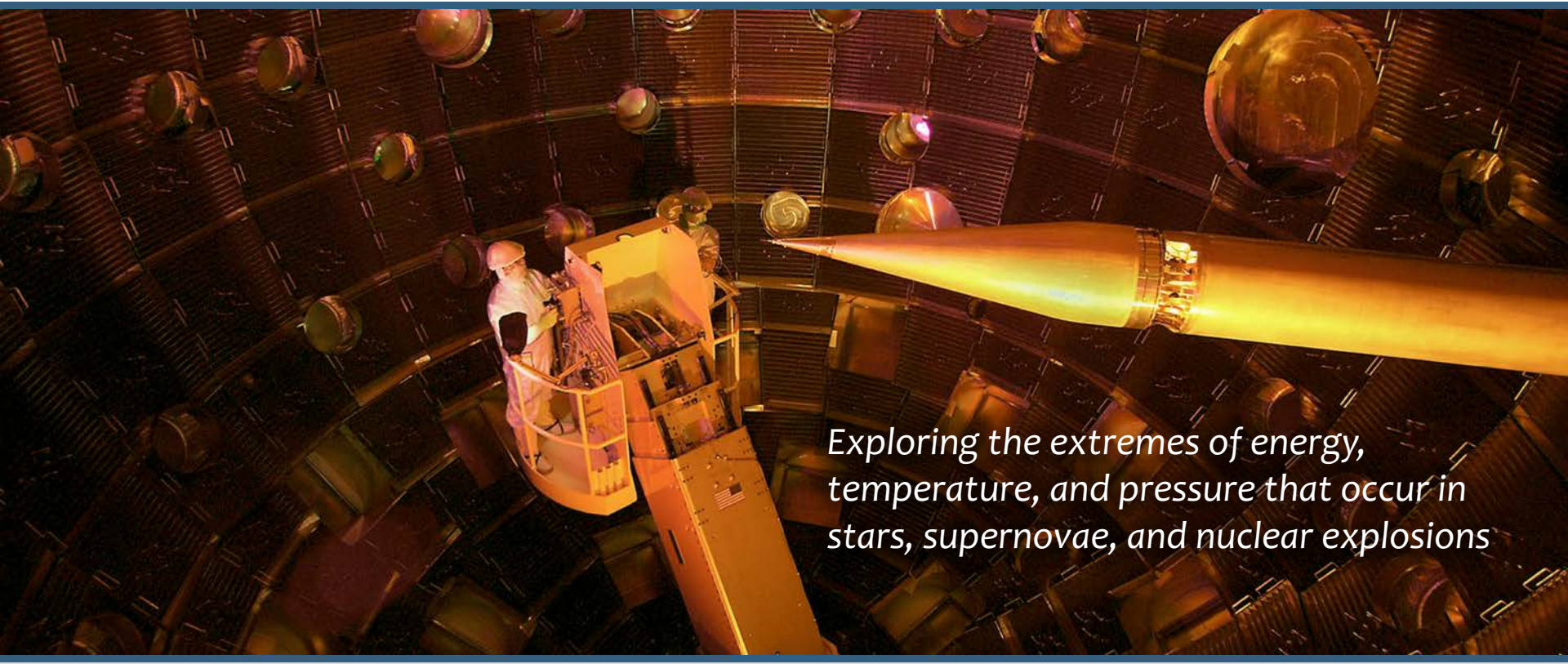
Beyond Moore's Law



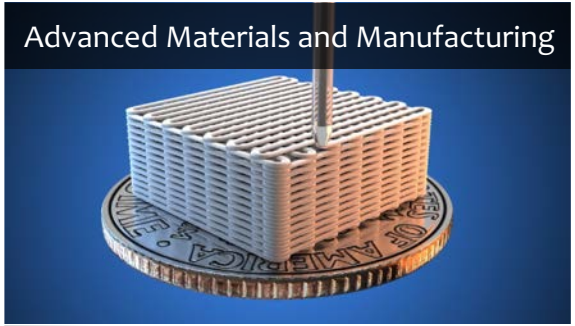
Neuromorphic

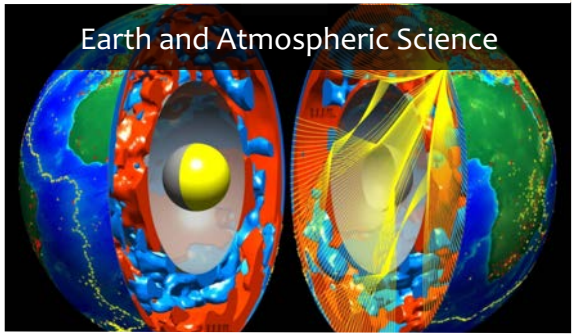
Quantum

The National Ignition Facility is the largest and most energetic laser facility ever built



Core Competencies





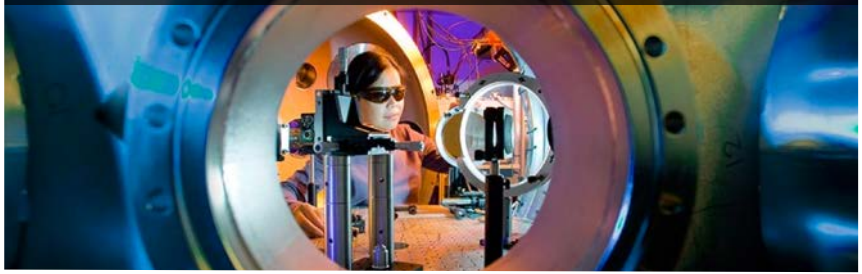
Unique R&D Facilities

National Ignition Facility

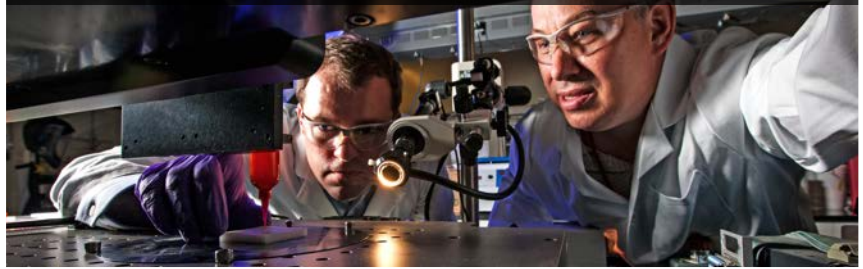
Livermore Computing Complex B453

Site 300

Jupiter Laser Facility



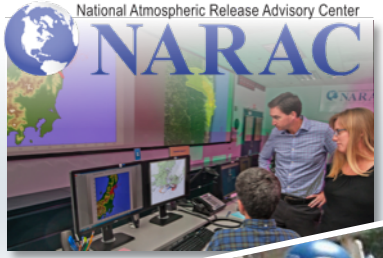
Advanced Manufacturing Laboratory



High Explosives Applications Facility

The Laboratory provides critical reach-back capabilities to the nation and beyond

National Atmospheric Release Advisory Center

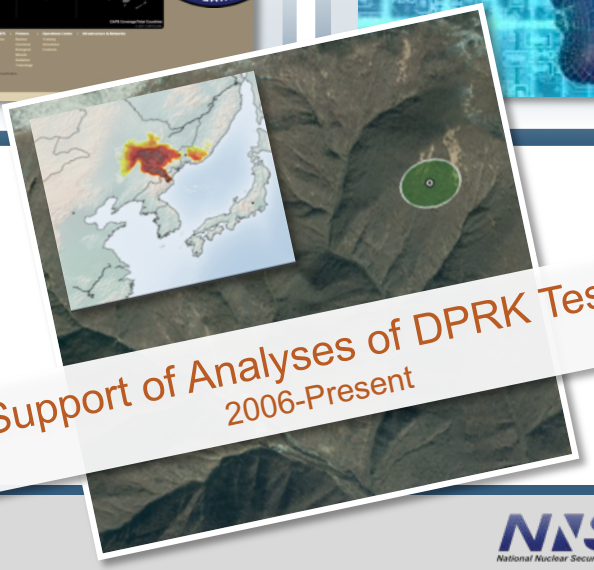


Forensic Science Center

Counterproliferation Analysis & Planning System

Biodefense Knowledge Center

OPCW Support
2013 – Present

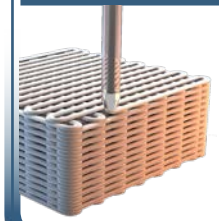


Support of Analyses of DPRK Tests
2006-Present

Beyond today's challenges

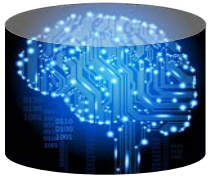
Anticipating unexpected and potentially disruptive developments

Accelerated Materials and Manufacturing



Working towards accelerated qualification of components and novel materials, and an integrated materials and manufacturing strategy

Cognitive Simulation



Developing machine learning solutions that augment large-scale simulation and experiments to improve prediction

Predictive Biology

Developing new approaches to biosecurity countermeasures through systems biology

Space Science and Security

Applying expertise in intel analysis, modeling and simulation, and design and fabrication for advantages in contested space

Engineering the Carbon Economy

Anticipating the threat and preparing for the next major phase of climate mitigation technology

LLNL technologies: a multi-billion-dollar impact on the economy

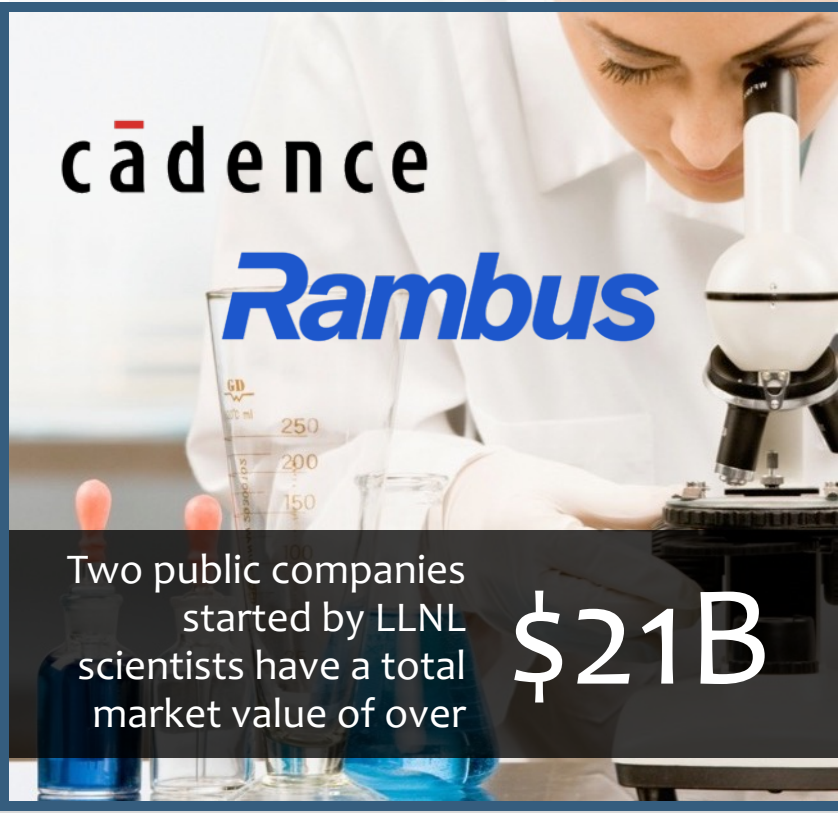
Over $1.4B of products with "LLNL Inside" were sold in the past 5 years

Higher fuel efficiency

Advanced medical devices

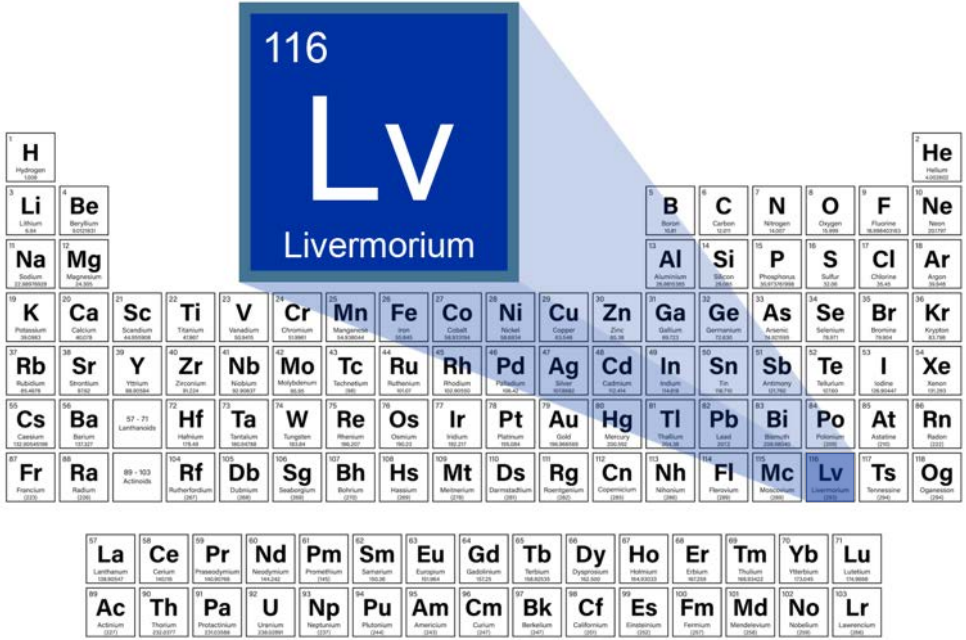
Better disease diagnosis

Improved airplane safety



Two public companies started by LLNL scientists have a total market value of over $21B

Frontier research underlies our ability to deliver cutting-edge solutions



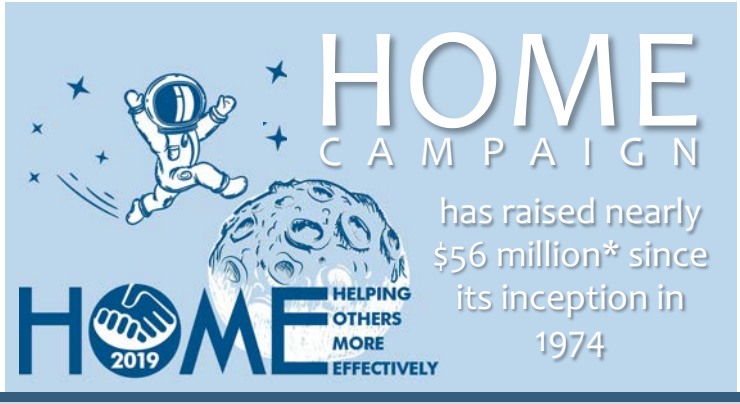
The Dubna-LLNL collaboration has discovered 6 new elements since 1989

LLNL embraces its role in fostering education in and giving to the local community

STAR

expanding your horizons

Teacher Research Academies TRA



Science and Technology on a Mission

Lawrence Livermore National Laboratory