

The National Laboratories and their Role in National Security

Presented to:

George Washington University

Virginia Science and Technology Campus

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Lawrence Livermore National Laboratory**

 **Lawrence Livermore
National Laboratory**

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Who are we?



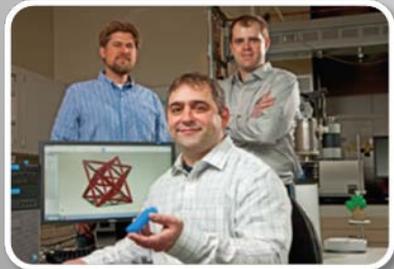
We are multi-sponsor FFRDCs, managed by NNSA

- Responding to the needs of the Nation
- Anticipating the future
- Delivering solutions



To do this we...

- Are trusted partners with our sponsors
 - Free of conflicts of interest, real or perceived
 - Objective
 - Technically excellent
- Provide enduring focus on enduring issues in national security
- Leverage our multidisciplinary capabilities across all of science and engineering to deliver innovative solutions
- Invest in the future



Our goal is to turn *transformative ideas* into *solutions* for the nation

Our Mission

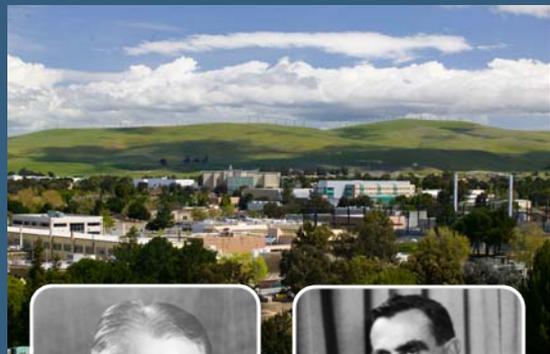
Lawrence Livermore's Mission Statement:

Our mission is to strengthen the United States' security through the development and application of world-class science and technology to: enhance the nation's defense; reduce the global threat from terrorism and weapons of mass destruction; and, more broadly, respond with vision, quality, integrity, and technical excellence to scientific issues of national importance.

“Your mission is to make the Nation safer.”

— George P. Shultz





FY12 \$1.6 billion



FY12 \$2.2 billion



FY12 \$2.4 billion
(all sites combined)

Lawrence Livermore National Laboratory

Livermore, California



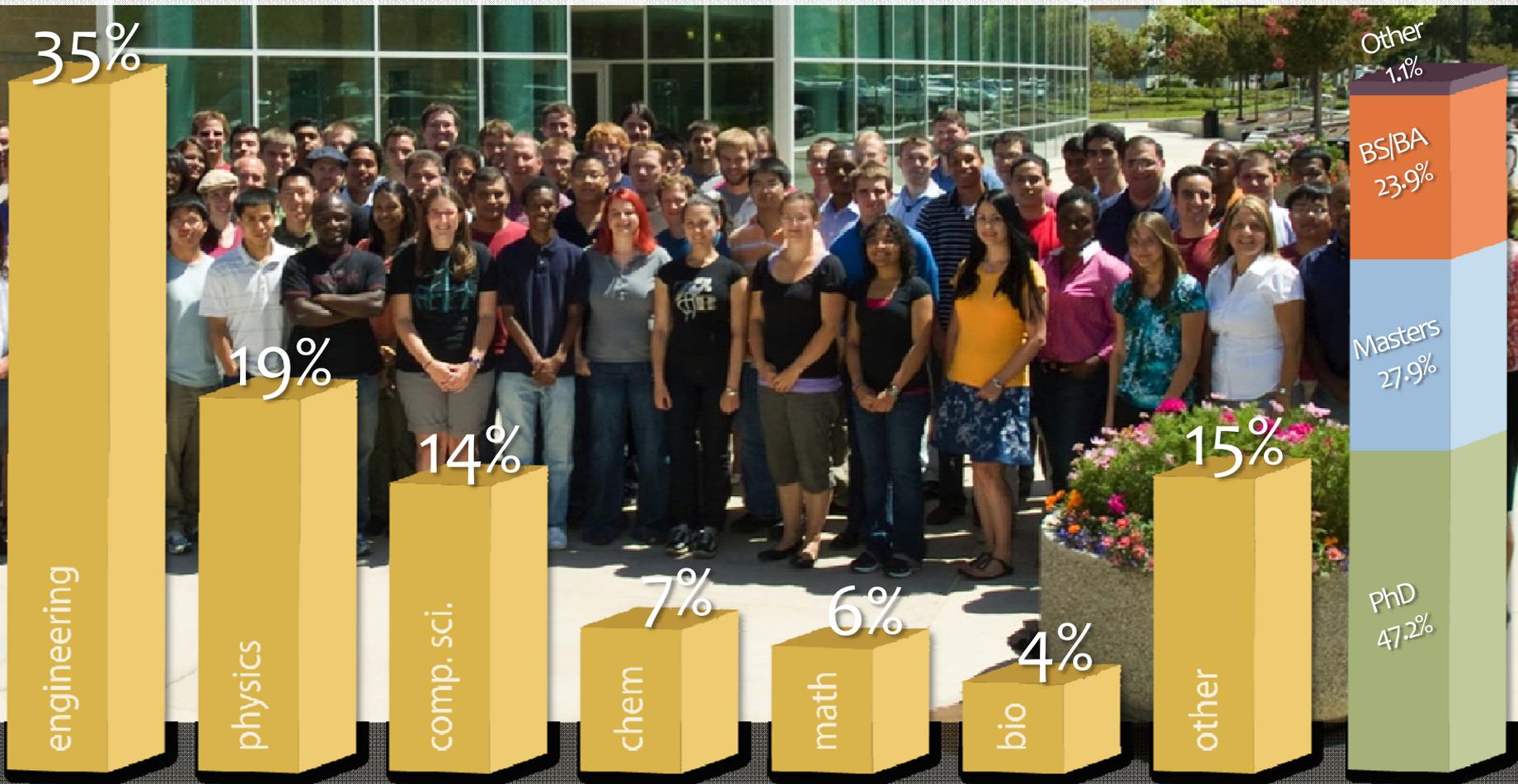
Experimental Test Site
(11 miles² near Tracy, CA)



- Established in 1952
- Approximately 7,300 employees
- 7.4 million gsf, 677 facilities
- Annual federal budget: ~ \$1.6B (~\$160M IR&D)

*as of 10/01/12

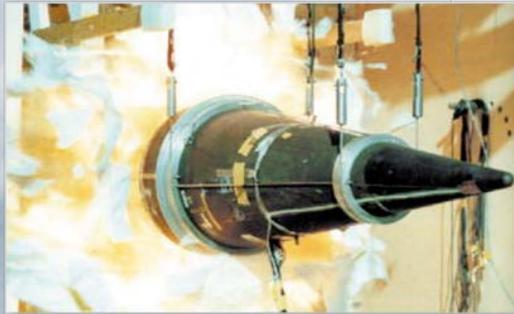
LLNL has broad, multidisciplinary teams



Our diverse staff allows us to tackle a myriad of complex challenges

Stockpile Stewardship Program

Our core mission



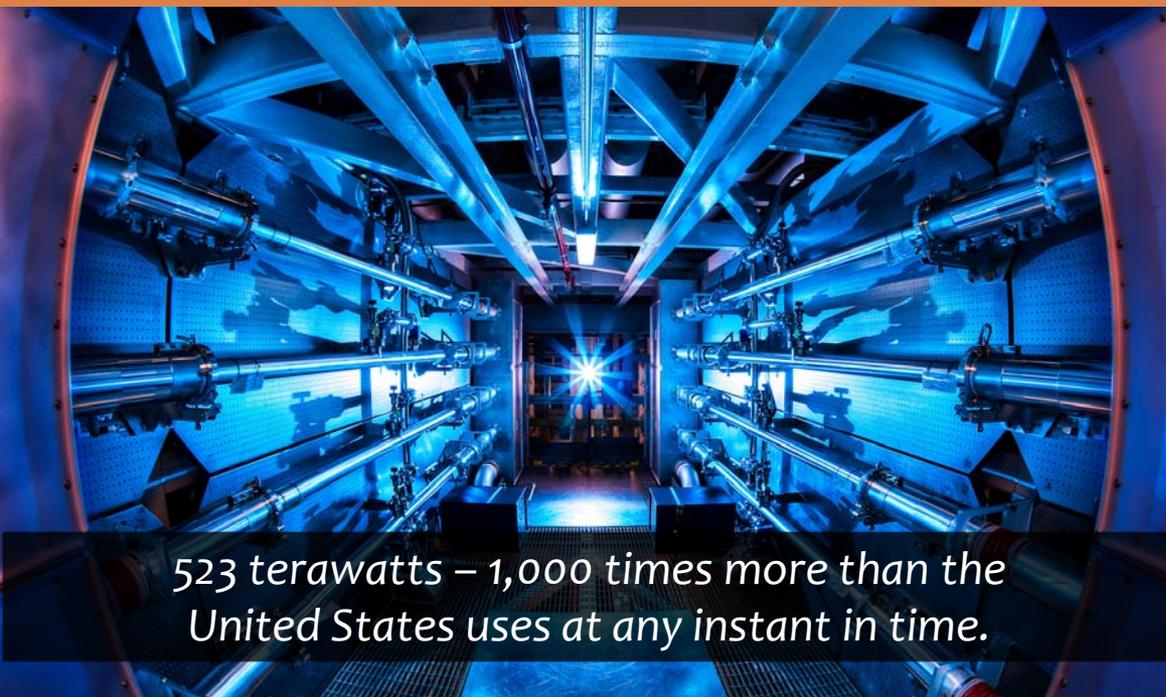
- Each year the Lab Directors assess the safety, security, and reliability of the stockpile
- The Stockpile Stewardship Program has successfully maintained the nuclear deterrent in the absence of nuclear testing since 1992
- High level objectives include:
 - Meet the immediate needs of the stockpile – continually assess the stockpile to ensure design intent is maintained
 - Transform the stockpile consistent with U.S. policy – maintain confidence, improve warhead safety and security, and enable hedge stockpile size reduction
 - Strengthen ST&E to support the stockpile and broader nuclear security needs

Scientific Stockpile Stewardship implies a broad set of scientific capabilities





NIF explores regions of energy, temperature, and material science that occur in an operating nuclear weapon



523 terawatts – 1,000 times more than the United States uses at any instant in time.

- 192 pulsed laser beams
- Energy: 1.855 MJ
- Power: 523 TW
- 350,000 m³ building
- 8,000 large optics
- 30,000 small optics
- 60,000 control points
- U.S. vendors: 3,241
- U.S. contracts: 12,847
- U.S. total: \$2,071,190,352

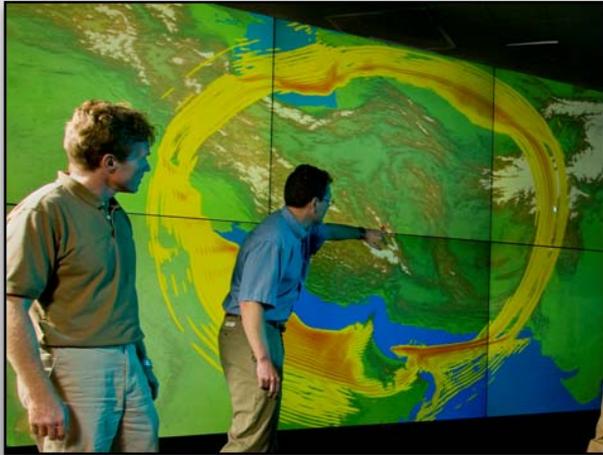
LLNL's Sequoia supercomputer ranked as world's fastest by Top 500 Supercomputers

16.32
sustained petaflops



Solving broad security challenges for the Nation

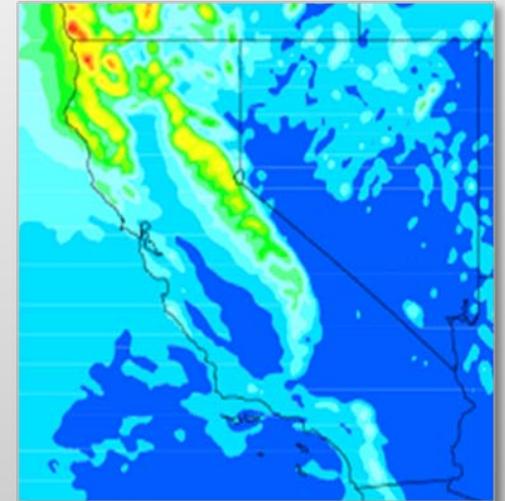
Nuclear Security



International and Domestic Security



Energy and Environmental Security



Basic Science

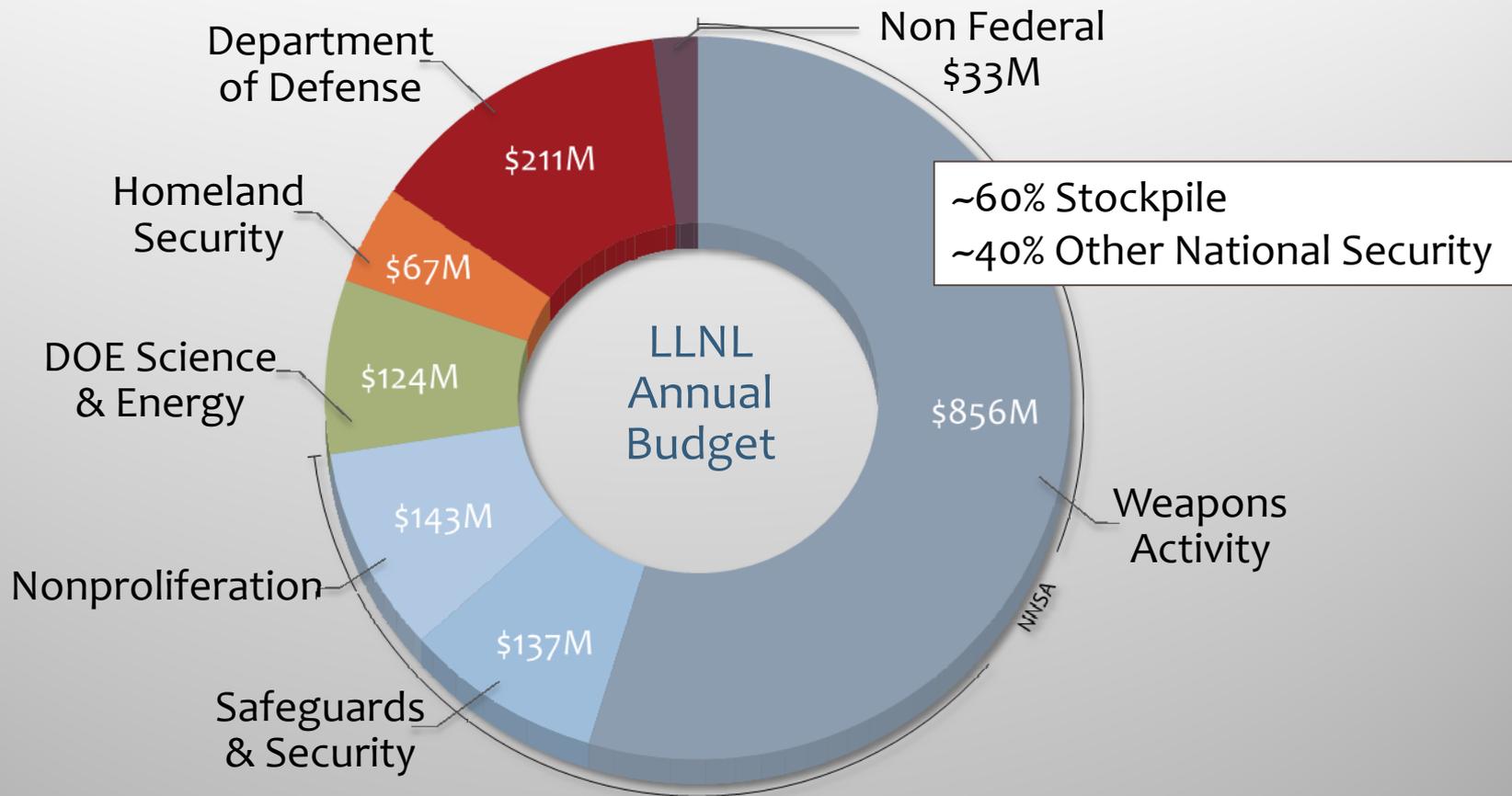


Engineering



Computation

LLNL's annual budget reflects our national security focus

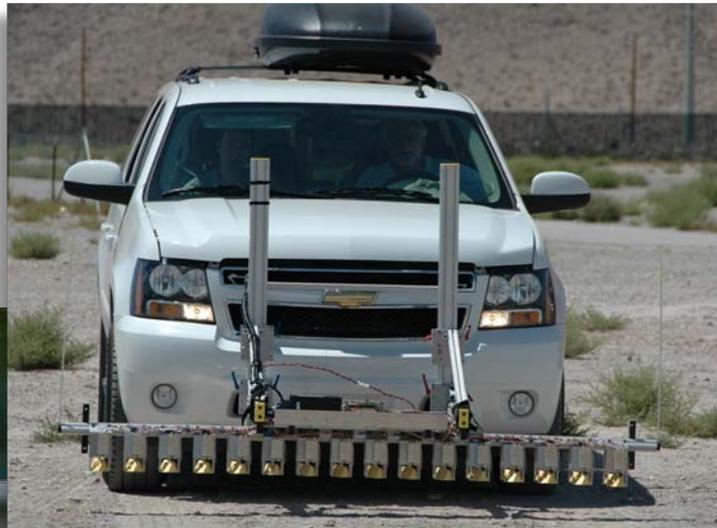
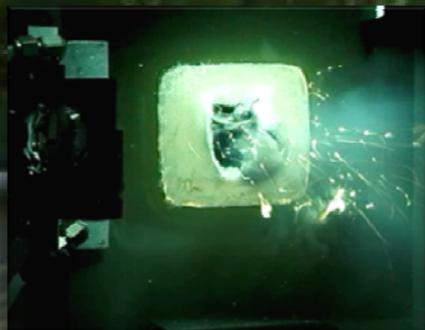


The Laboratory's scientific and technical capability is supported principally by DOE/NNSA



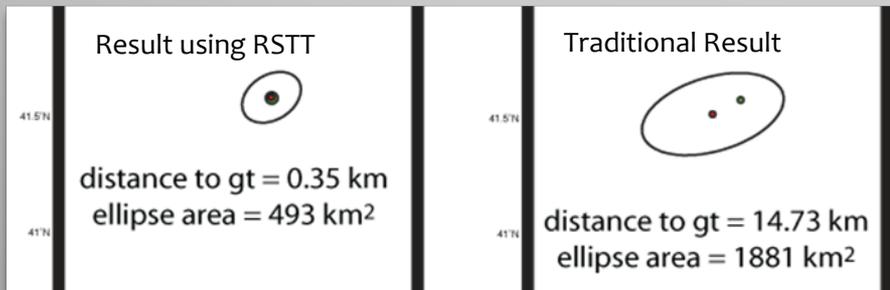
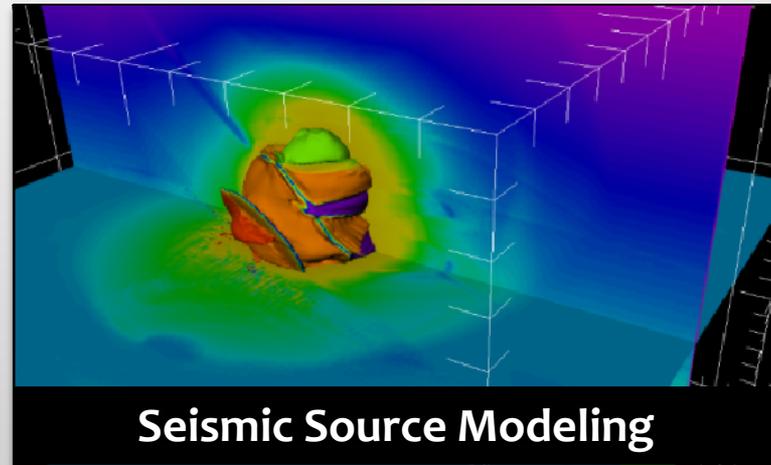
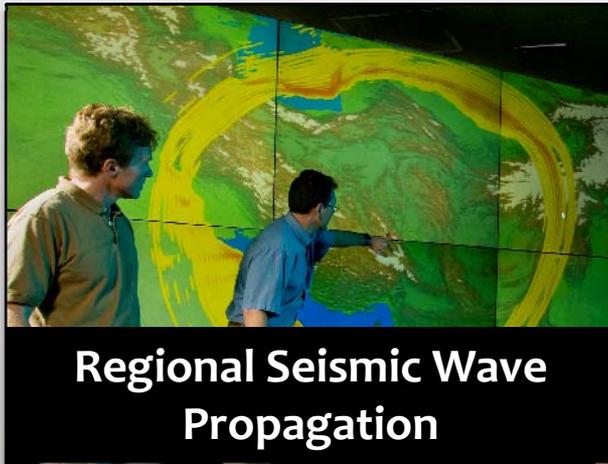
Defense

Directed Energy • IEDs • ISR • Munitions

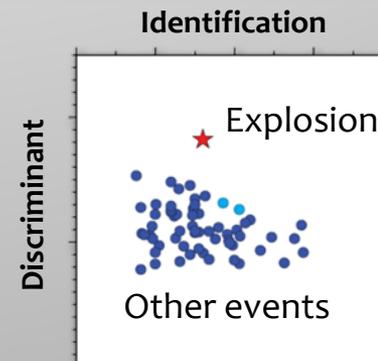


Ground-based nuclear explosion monitoring efforts advance the capabilities to detect, locate, and identify nuclear explosions

Advanced modeling using high performance computing

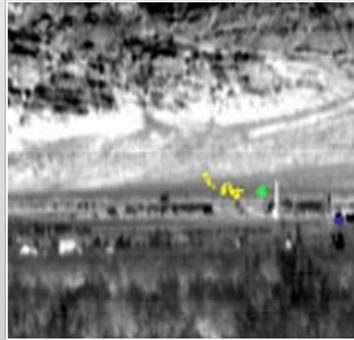


Event Location



Seismic Magnitude

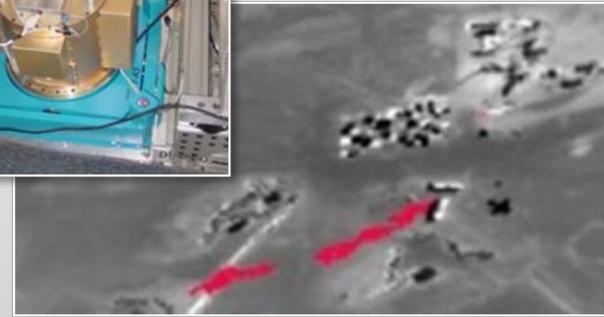
LLNL is developing remote sensing instruments and algorithms for proliferation detection



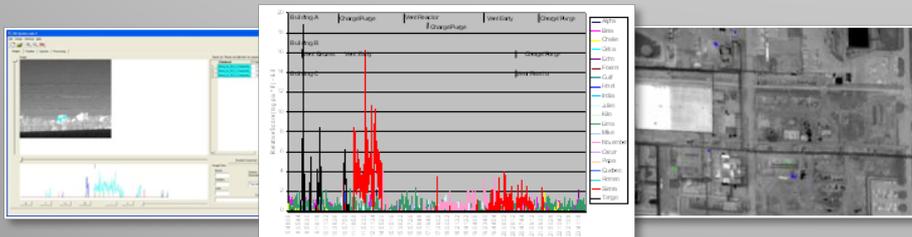
Ground-based



Airborne



Data reduction and analysis tools



Wide-angle
airborne
video

Biosciences at LLNL has a long history

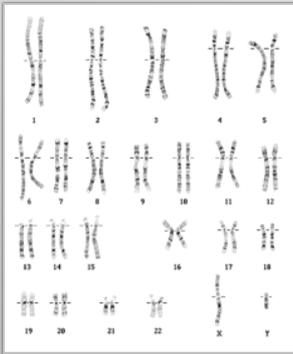
1960's

1970's

1980's

1990's

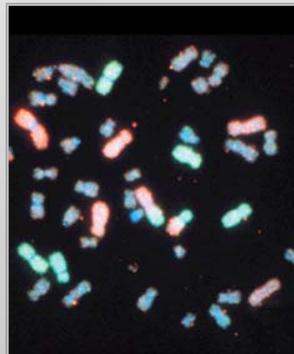
2000's



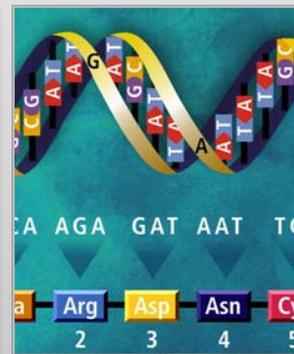
Radiation
Effects



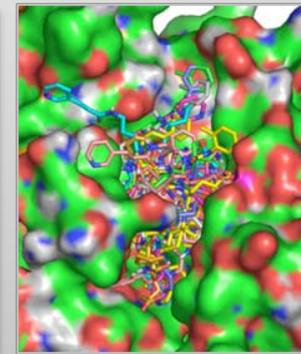
Automated Cell
Sorting



FISH
Chromosome
Painting



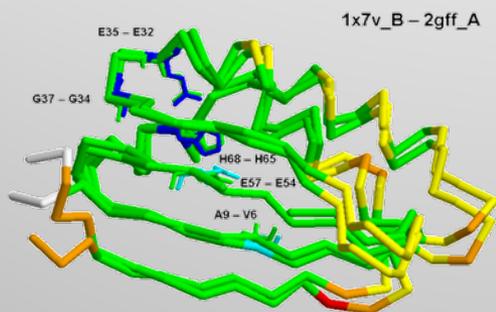
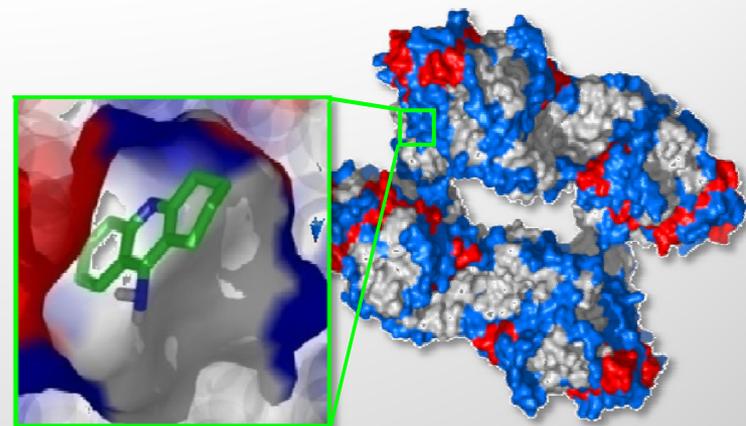
Human Genome
Project



High
Performance
Simulations

Bioinformatics analysis and computational biology

- We compare Genomes and Proteomes to find conserved or unique regions useful for designing diagnostics and forensics



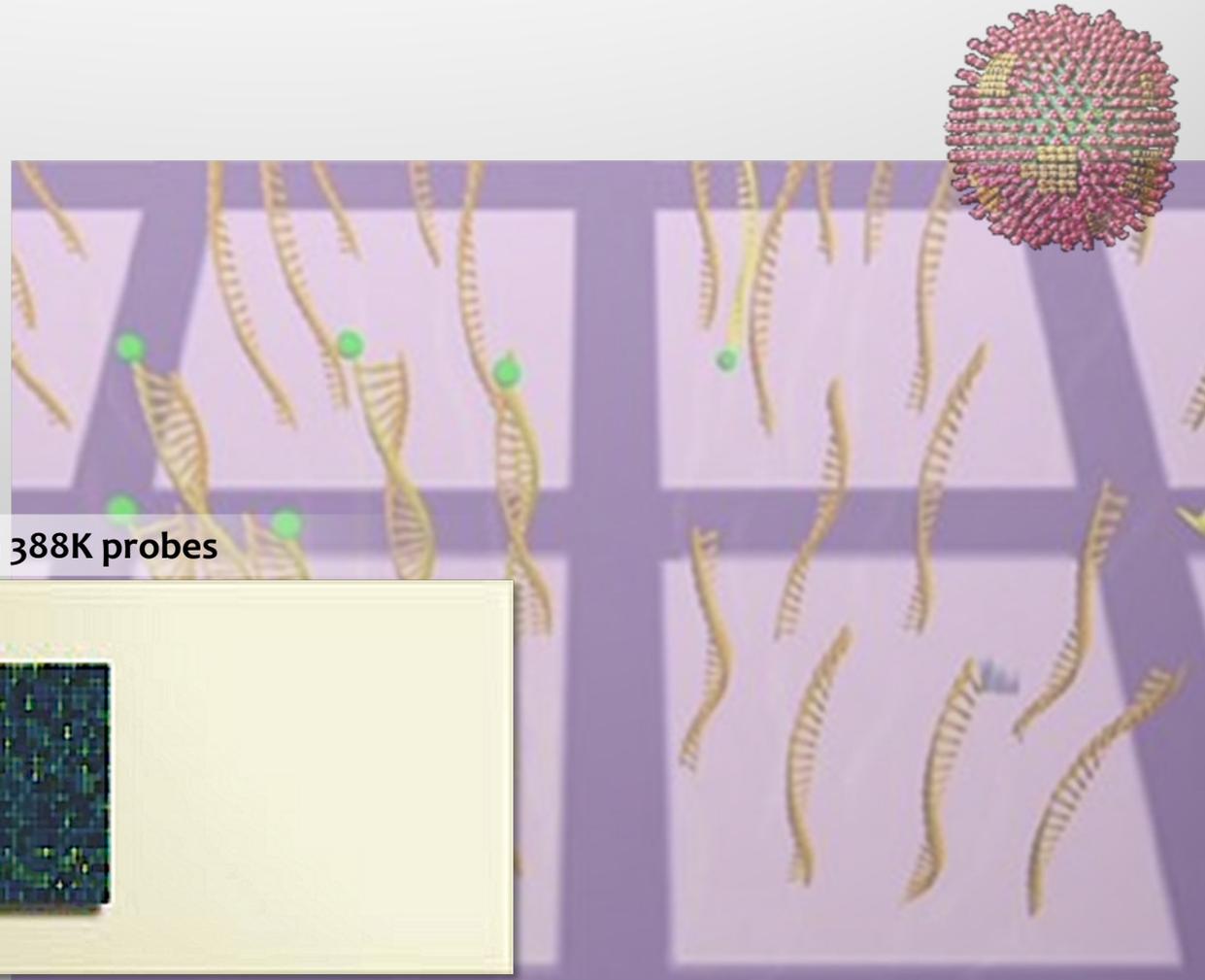
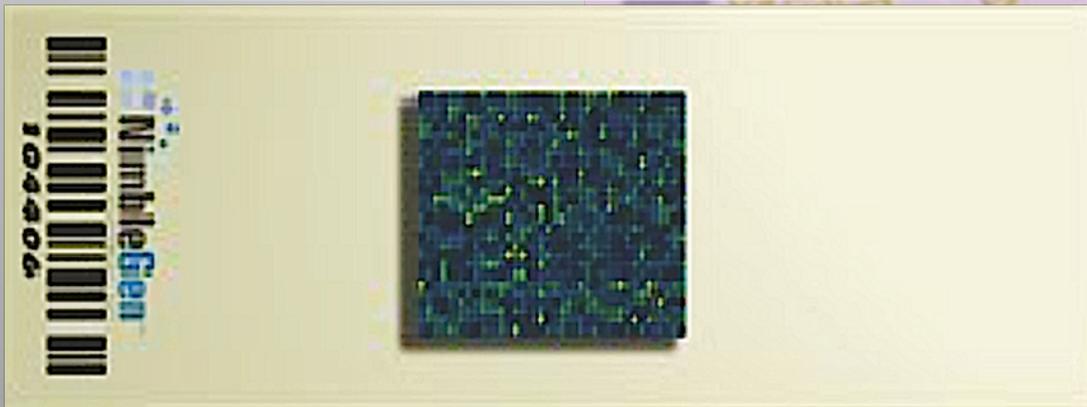
Assess countermeasure effectiveness by molecular modeling of protein-protein and receptor-agent interactions

We augment open-source tools as needed to push the state of the art

HPC was used to develop the 400,000 DNA probes that are on this microbial detection microarray

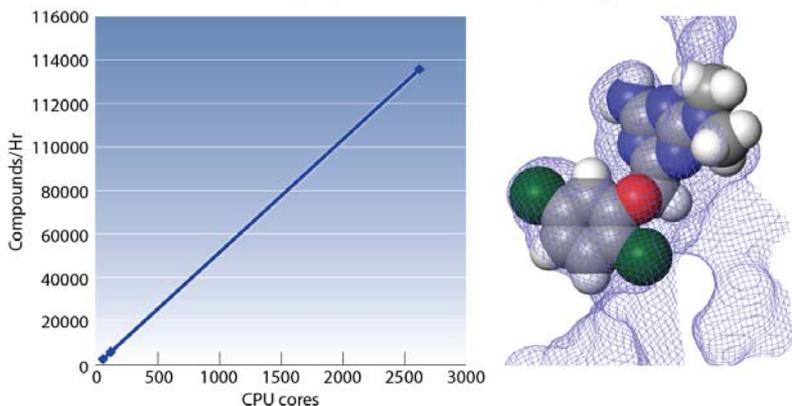
Microarrays allow very rapid detection of every virus, bacteria, fungus, and protozoa that has been sequenced or is closely related to something that has been sequenced

Microarray with 388K probes

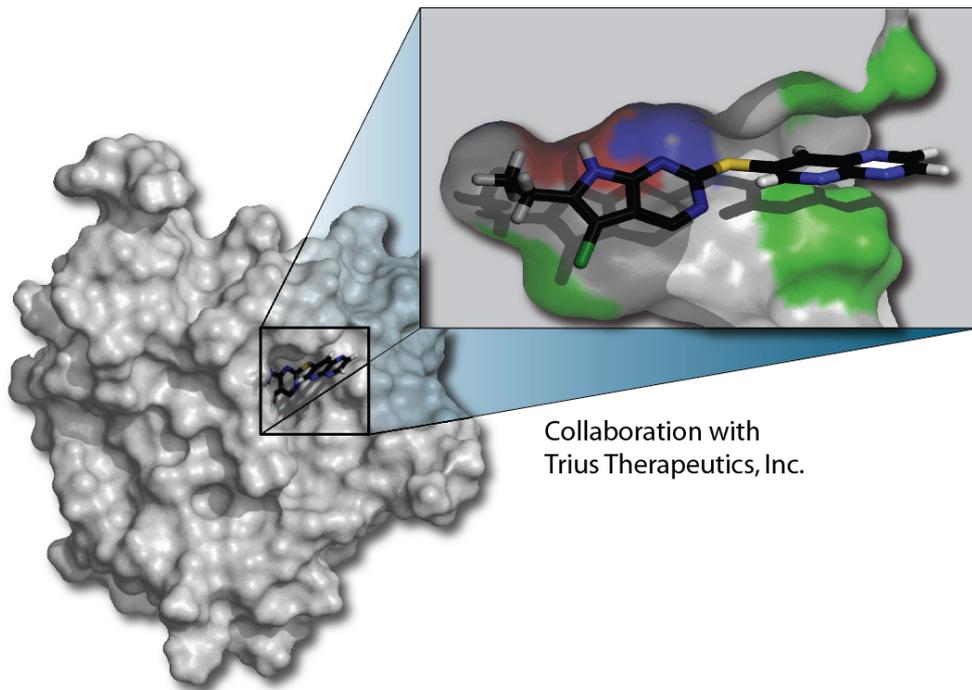


Computational drug design is being used to make new antibacterials

One million compounds docked in eight hours on high-performance computing



We have accelerated the development of a new series from one year to three months



Collaboration with Trius Therapeutics, Inc.

The Laboratory provides 24/7 operational capabilities for the nation

National Atmospheric Release Advisory Center



Forensic Science Center



Counterproliferation Analysis & Planning System

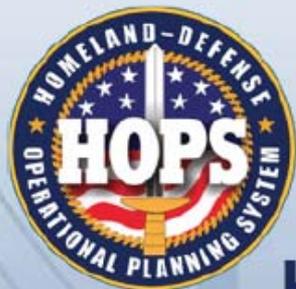


Biodefense Knowledge Center



Deep Water Horizon Spill
April 20, 2010

Fukushima Daiichi Reactors
March 11, 2011



HOMELAND-DEFENSE OPERATIONAL PLANNING SYSTEM (HOPS)



Anticipate, innovate and deliver solutions

Answering challenging issues on a global scale

**National security —
our defining mission**

**Innovative applied S&T —
our core contribution**



The best and the brightest — our greatest strength

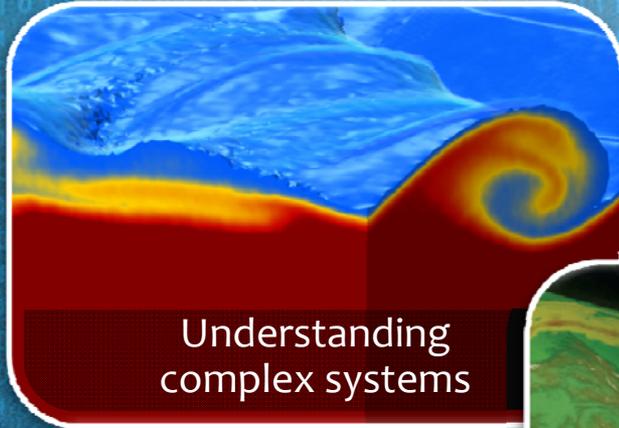




Our Vision

- Lead the nation in stockpile science, innovation and sustainment
- Be the foremost national security laboratory, anticipating, innovating, and delivering solutions for the nation's most challenging security problems
- Be the premier destination for our nation's very best scientists and engineers who want to solve big challenges in the national interest.

We leverage High Performance Computing for analysis and simulation to offset risk and reduce costs



A new campus is creating a venue to better engage U.S. industry and promote collaboration

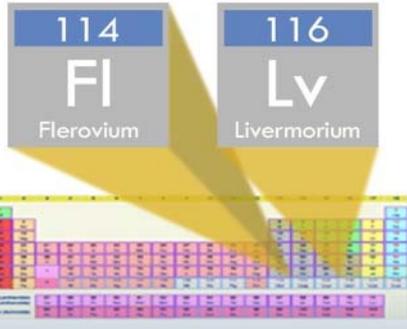
Open Campus Attributes

- Campus-like environment with collaborative space
- Ready access for all partners, including foreign nationals
- Expansion of academic programs
- Access to world-renown LLNL resources

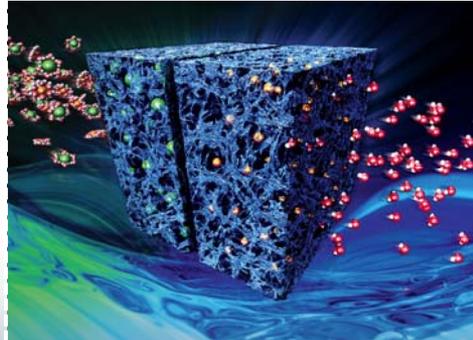


2.5 million square feet of laboratory and office space
to accommodate up to 3000 people

LLNL has recently achieved several recent significant science, technology, and engineering successes

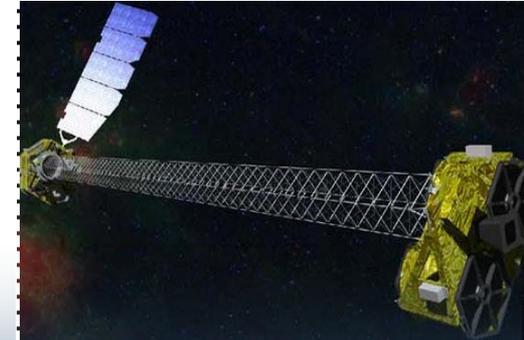


Elements 114 and 116 are formally recognized by IUPAC

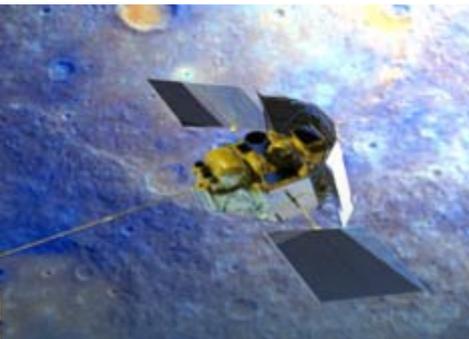


New desalination technique is faster and at a lower cost

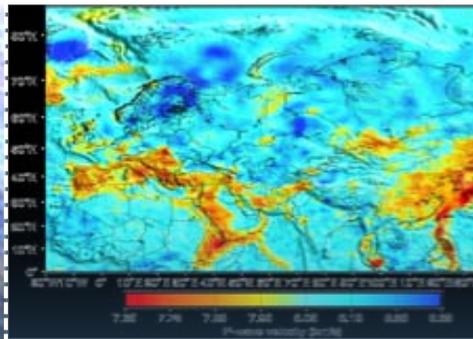
Lab study finds way to mitigate traumatic brain injury



NuSTAR will image the sky in the high energy X-ray region of the spectrum



LLNL gamma ray spectrometer orbiting Mercury



Regional Seismic Travel Time (RSTT) project for CTBTO



“Big Green” hyperspectral sensor in final stages of integration



Advancements make possible near-instantaneous DNA analysis