Lawrence Livermore National Laboratory Informational Briefing to BERAC

Henry F. Shaw
Deputy Associate Director for S&T
Physical & Life Sciences Directorate

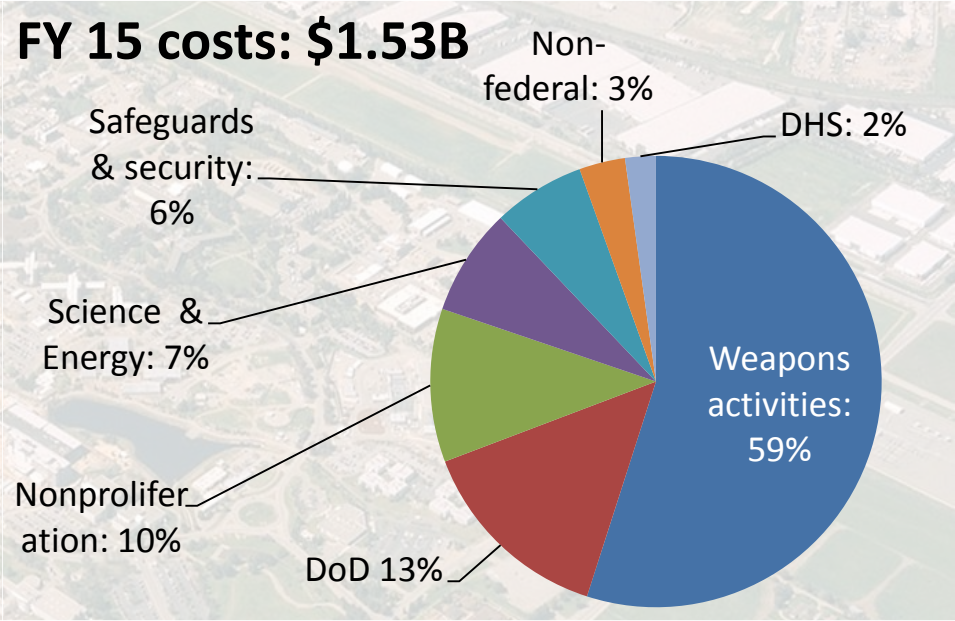
March 22, 2016

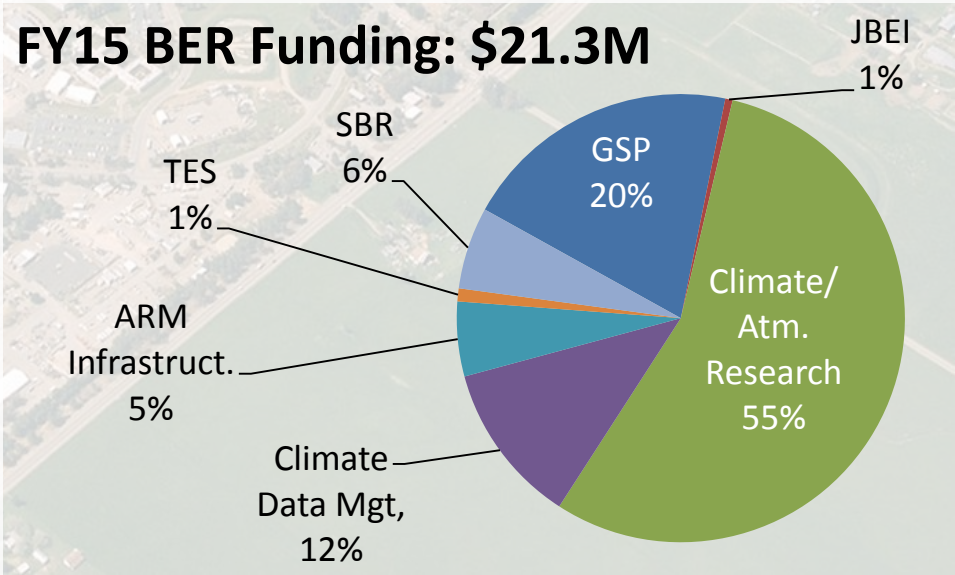
LLNL-PRES-xxxxxxxThis work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

Lawrence Livermore National Laboratory

LLNL is a multi-program national security laboratory

- LLNL's defining responsibility is to ensure the safety, security, and reliability of the nation's nuclear deterrent
- LLNL's missions encompass counterterrorism/ nonproliferation, defense/ intelligence, energy and environmental security, and discovery science
- Established in 1952
- ~6,000 employees; ~2,700 scientists and engineers (~50% Ph.D.s)
- ~1.3 mi^2, 684 facilities
- Annual budget: ~ $1.5B
- FY15 BER funding: $21M.





Core capabilities: research & facilities

Core Research Capabilities

- Climate model diagnosis and comparison
- Climate change detection and attribution
- Cloud parameterization development and diagnostics
- Cloud feedback analysis
- Federated data systems for data distribution
- ^{14}C analysis applied to carbon cycle and labeled biological systems
- Environmental radiochemistry of the actinides
- Isotopic methods for age-dating and understanding groundwater dynamics
- Microbial community analysis, especially by novel stable isotope probing techniques
- Microbial metabolic network analysis and modeling
- Microarray design and analysis
- Protein structure-function prediction
- Sensor and analytical systems development
- High Performance Computing

Core Facilities

- Center for Accelerator Mass Spectrometry and NIH National Resource for Biomedical Accelerator Mass Spectrometry .
- NanoSIMS Laboratory - imaging secondary ion mass spectrometer
- Noble Gas Mass Laboratory includes automated system for analysis of noble gases and tritiogenic helium in water and unique field systems for groundwater tracer experiments.
- Livermore Microarray Center - a NimbleGen Maskless Array Synthesizer for custom high-density chips optimized for NanoSIMS analysis.
- ESGF@DOE/LLNL is the home of the Earth System Grid Federation
- Bioengineering Center - miniaturized devices and systems for monitoring of complex biological micro and macro systems.
- Micro/Nanotechnology Center - fabricates custom devices and systems including microelectromechanical systems, electronics, photonics, and micro- and nanoactuators
- Livermore Computing Center is home to a world-class computational infrastructure

Future strategic science priorities and partners

- ***Quantitative Microbiome Initiative*** will use a community systems biology approach to provide foundational data for redesigned Earth-system models with enhanced predictive power. Strategic partners: ORNL
- ***An end-to-end system to characterize the physical and biochemical functions of environmental proteins*** will build a unified program to characterize the physical and biochemical functions of environmental proteins. Strategic partners: SLAC
- ***Multi-isotope, multi-metal subcellular imaging for cell biology*****;** use the nanoscale imaging capabilities of the NanoSIMS in conjunction with other techniques to build a program in subcellular elemental/image analysis using multi-isotope and multi-metal studies for cell biology. Strategic partners: LBNL, UCLA
- ***FutureBio – a vision for a concerted effort in bio-manufacturing*****.** LLNL has teamed with a consortium of 7 other institutions to develop a multi-agency program to accelerate the development of bio-manufacturing and its application to fuels, chemicals, agriculture, pharmaceuticals and biomedicine, environmental stewardship, and national security. Strategic partners: LBNL, SNL, PNNL, UCB, UCD, UCSF, NIST

Future strategic science priorities and partners (cont.)

- ***Application of isotope tracers to understanding watershed dynamics.*** LLNL has unique capabilities for age-dating groundwater and constraining groundwater dynamics that are directly applicable to the SBR Program's goal of understanding how watersheds function, and how these systems respond to perturbations caused by changes in climate, land use and cover, and contaminant loading. Strategic partners: TBD
- ***Advancing Environmental Science through the fusion of small-sensor observations and simulation*.** Advances in small/cheap sensor technology presents new opportunities for environmental remote sensing from *in-situ*, airborne, and space -based platforms. Independent data streams could be coupled with large-scale data analytics and model simulations to produce unprecedented depictions of the Earth's environment. This would enable data-assimilation systems of the Earth System, especially the ocean, that are necessary for initializing models to predict the effects of climate change on a decadal timescale, the timescale relevant for investments in energy and infrastructure. Strategic partners: TBD