



U.S. DEPARTMENT OF
ENERGY

Office of
Science

DOE's Office of Science

Welcome WDTS 2013 Summer Term Participant

Webinar on:

Perspectives on WDTS internship programs, and a brief overview on the DOE, some of its history, with an emphasis on the Office of Science's mission, facilities, and programs.

June 20, 2013

Cindy White, Brian O'Donnell*, and Jim Glownia***

**Office of Workforce Development for Teachers and Scientists (WDTS)*

***Office of the Deputy Director for Science Programs*

Office of Science, U.S. Department of Energy

Why Office of Science (SC) funded internships?

In a word... **WORKFORCE**

From the DOE Strategic Plan, May 2011:

SUSTAIN A WORLD-LEADING TECHNICAL WORKFORCE

“Excellent scientists, technologists, and engineers are the creative engine of the Department. The Department and its national laboratories must cooperate to create conditions that allow today’s researchers to be as productive as possible, as well as to ensure an adequate supply of tomorrow’s researchers. Investments will help develop the next generation of scientists and engineers to support Department missions, administer its programs, and conduct the research that will realize the nation’s science and innovation agenda. These investments will enrich the diversity of the STEM pipeline so that it is more inclusive of women, minorities, and persons with disabilities while mentoring the next generation of scientists, technologists, and engineers. ...”

SC funds these programs to help sustain the DOE’s scientific and technical workforce pipeline

Who manages these programs?

Office of Workforce Development for Teachers and Scientists (WDTS)

Mission: WDTS program mission is to ensure that DOE has a sustained pipeline of highly skilled and diverse science, technology, engineering, and mathematics (STEM) workers.

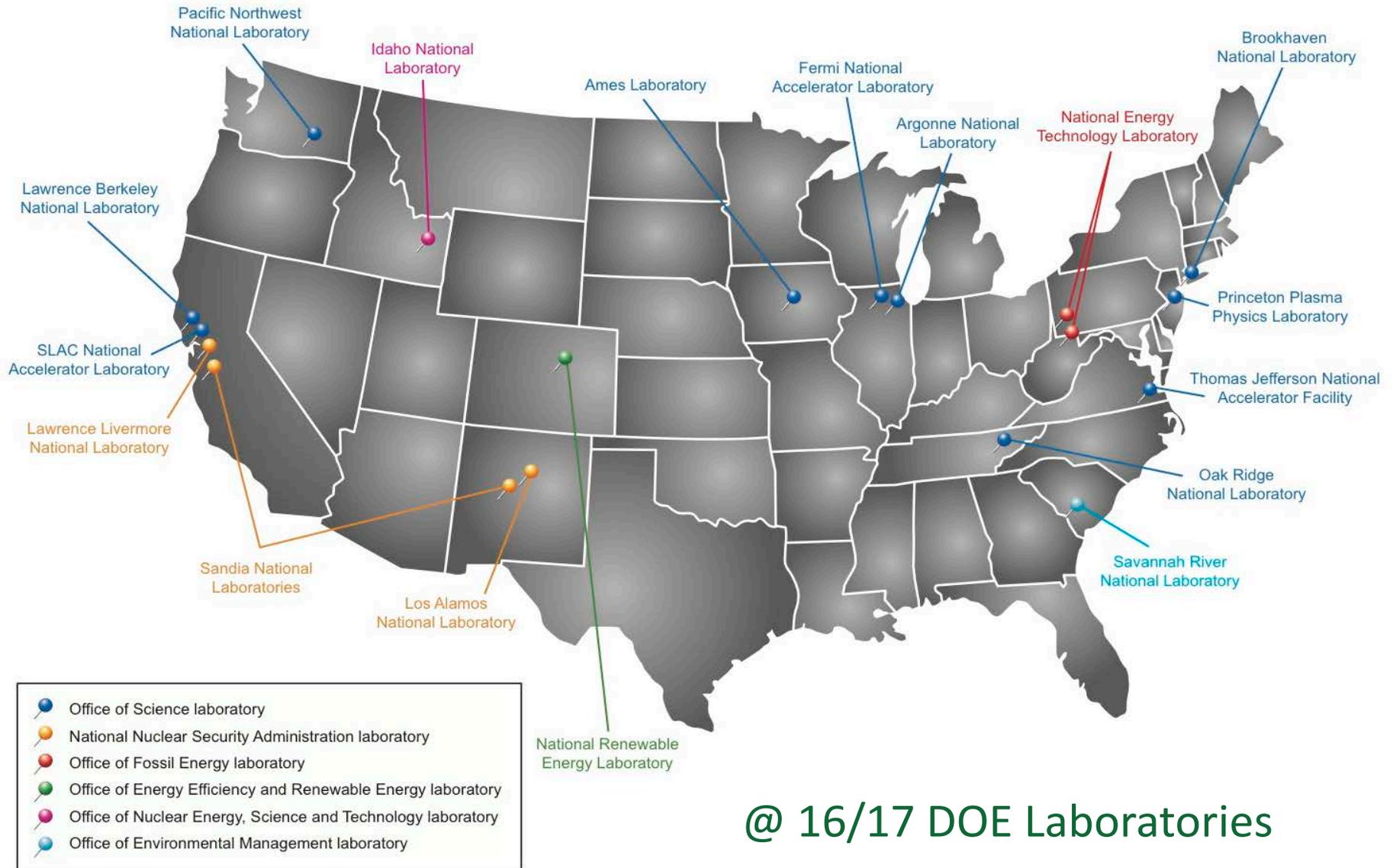
Vision: To be the standard for workforce development programs in a mission agency where “Science and Technology lie at the heart of the mission.”

Current WDTS programs:

- At the DOE laboratories: Undergraduate student intern programs (one for 2/4-yr institutions and one for community colleges) and a visiting faculty program:
 - Science Undergraduate Laboratory Internship (SULI) - ~700/year
 - Community College Internship (CCI) - ~70/year
 - Visiting Faculty Program (VFP) - ~(50/25)/year
- Office of Science Graduate Fellowship
- Albert Einstein Distinguished Educator Fellowship
- National Science Bowl



Where are interns currently placed?



@ 16/17 DOE Laboratories



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When, Who, What, How much?

- 10 weeks (Summer Term) or 16 weeks (Semester Term) internships at a DOE host Laboratory for undergraduates to become engaged in a *research project* under the guidance of a laboratory scientist or engineer (SULI).
- CCI participants work on a *technical project* (10-week Summer Term only) under the guidance of a laboratory scientist or engineer.
- Enrichment activities including career professional development workshops, writing and presentation skills development activities, laboratory tours, scientific lectures and seminars, *etc.*
 - *you experience the professional life of lab personnel, and hopefully learn valuable out-of-classroom professional skills, heightening your interest to continue in STEM studies and pursue related careers*
- Obligations/Deliverables include pre- and post- participation surveys, presentation of results, a written report (SULI and CCI have different specific requirement), *etc.*
 - *this is hard work with formalized/normalized requirements well beyond that of typical research experience opportunities*
 - *informs us regarding what works and what does not (we do want to know)*
- Paid internship: stipend of \$500 per week; one round trip domestic travel to the host laboratory; housing options that vary with host laboratory.
- There are approximately 710 2013 Summer Term participants.



DOE and its Predecessors

... and the Formation of the DOE Laboratories



- 1942-1946 Manhattan Project, War Department Army Corps of Engineers

- Wartime weapons development
- Foundations of first DOE multi-purpose labs



- 1946-1974 Atomic Energy Commission created by the 1946 Atomic Energy Act (P.L. 79-585)

- Research in basic nuclear processes, nuclear reactor technologies, use of nuclear materials for variety of purposes
- Establishment of 9 of the 10 DOE/SC labs



- 1974-1977 Energy Research and Development Administration, a new energy R&D agency motivated by Arab oil embargo and created by (P.L. 93-438)

- Research expands to include solar, fossil, geothermal, synthetic fuels, transmission, conservation, etc.

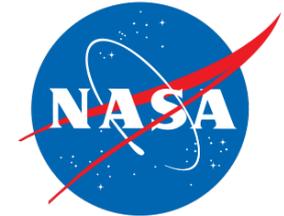


- 1977-present Department of Energy (P.L. 95-91)

- Separation of management oversight of weapons and non-weapons labs and separation of basic and applied research
- DOE/SC labs undergo transition to “open” labs with 1000s of visitors/users annually

Mission is central to the development of the DOE lab complex

Major Federal R&D Agencies



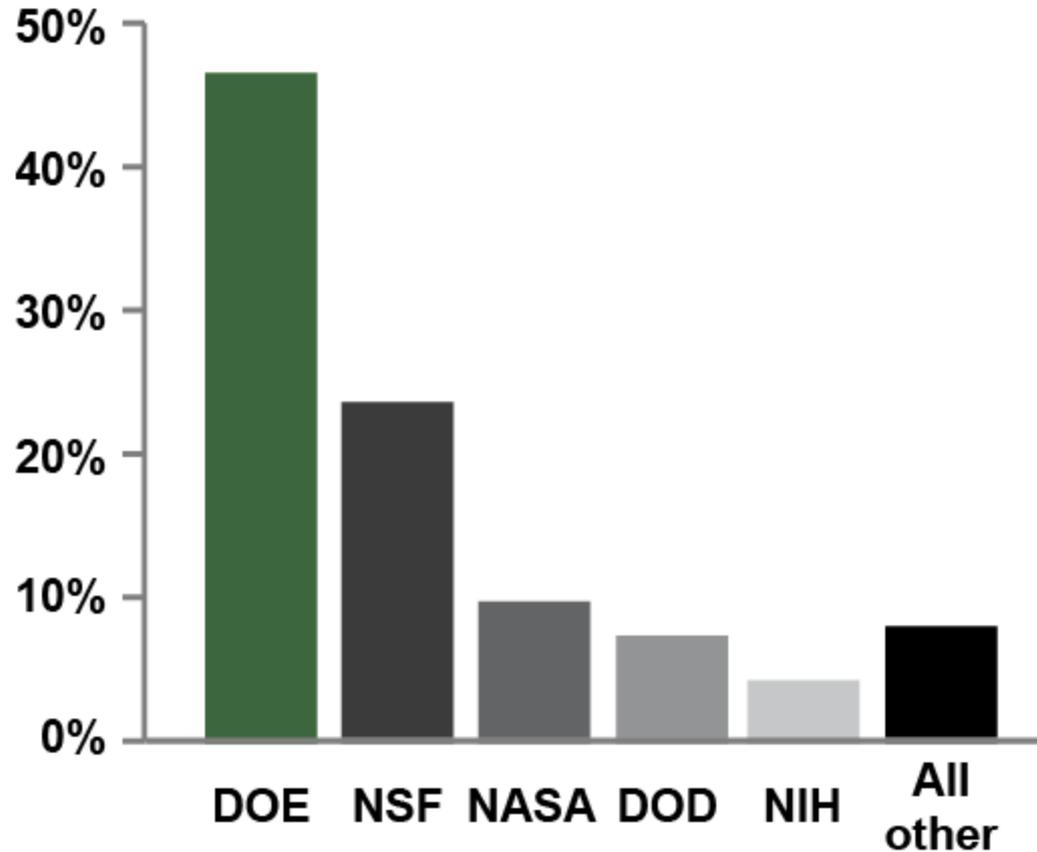
NIST



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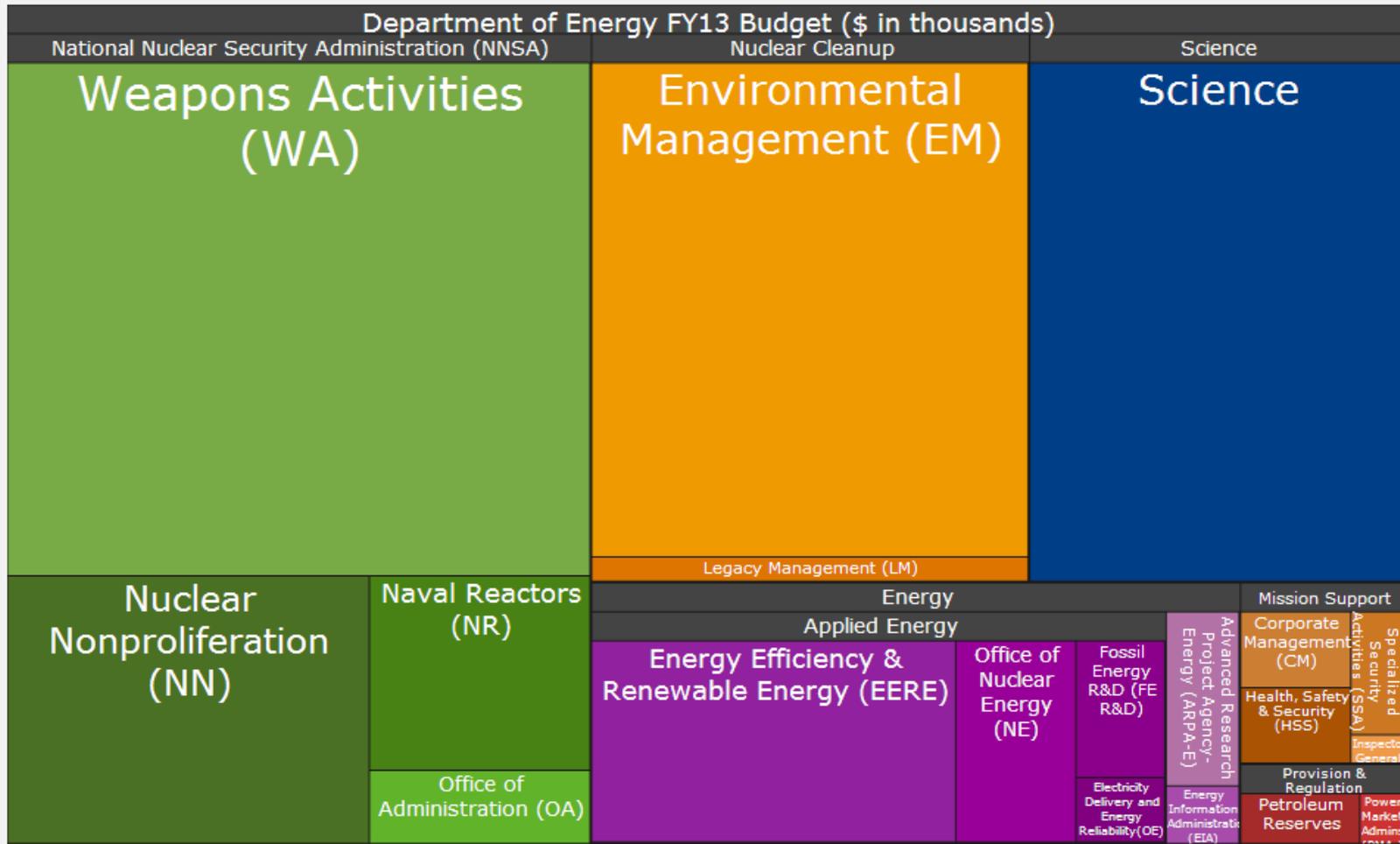
SC is the Largest Federal Supporter of Basic Research in the Physical Sciences



Source: NSF data tables on Federal Funds for Research and Development: Fiscal Year 2010.

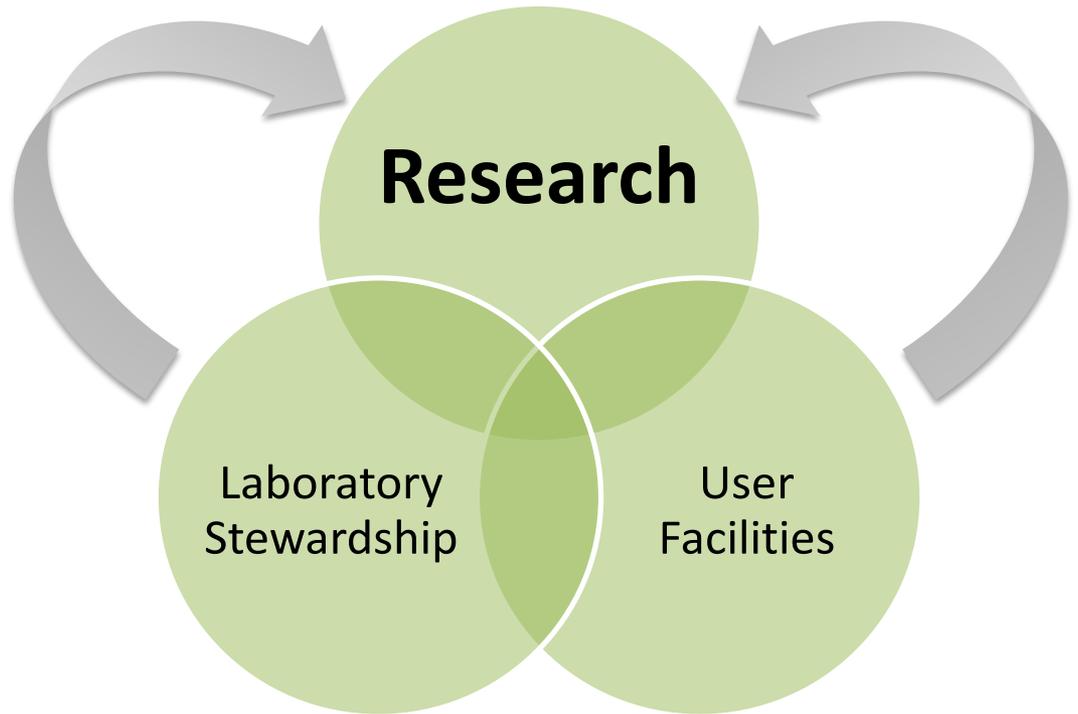
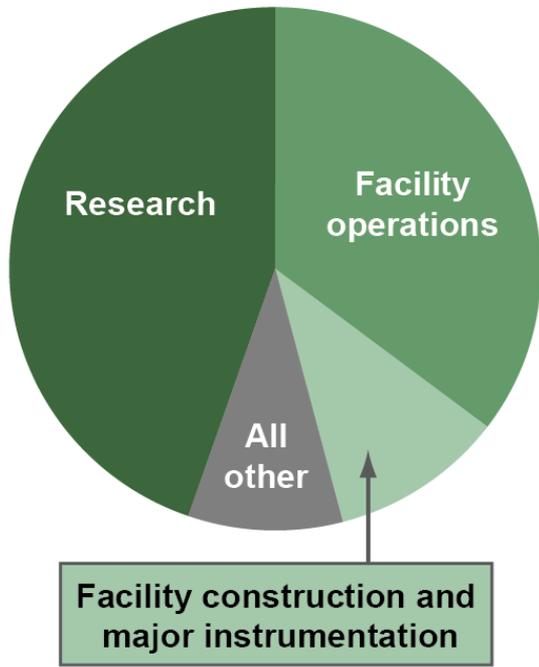
The DOE Portfolio Today

Area map of the FY 2013 budget request to Congress



Delivering science to advance DOE's mission

**FY 2012 appropriations
\$4.9 billion**



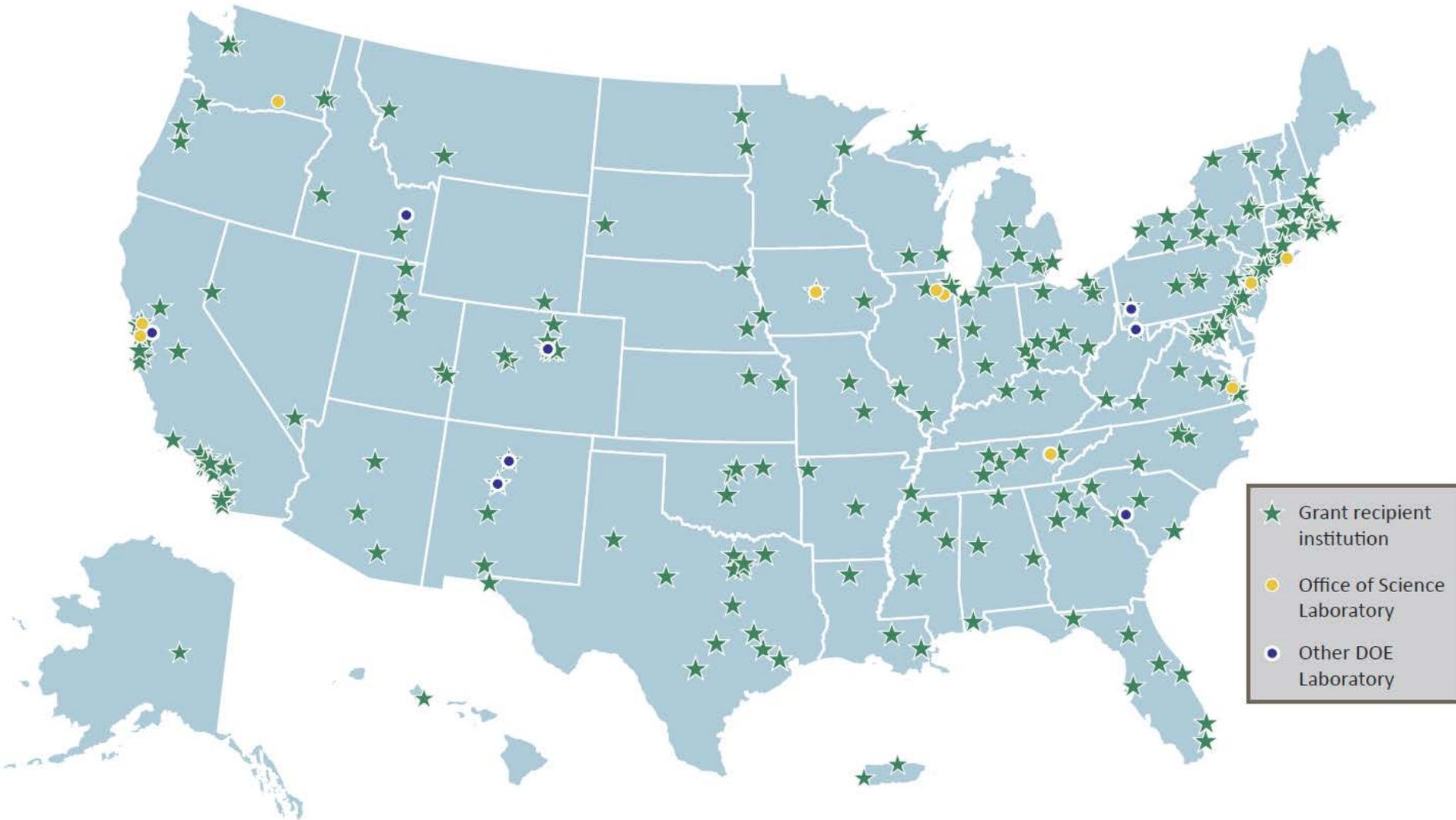
DOE Labs Employ >30,000 Scientists and Engineers



- Office of Science laboratory
- National Nuclear Security Administration laboratory
- Office of Fossil Energy laboratory
- Office of Energy Efficiency and Renewable Energy laboratory
- Office of Nuclear Energy, Science and Technology laboratory
- Office of Environmental Management laboratory

Together, the DOE labs employ about 32,000 S&T staff; SC labs employ about 14,000 S&T staff; many at the Ph.D. level.

FY 2011 Funding Recipient Institutions



The DOE Office of Science (~\$5B/year)



- Funds 25,000 Ph.D. scientists, graduate students, undergraduates, engineers, and technical staff supported at more than 300 institutions in all 50 States and DC through competitive awards
- 31 national user facilities serving more than 29,000 users each year
- 100 Nobel Prizes during the past 6 decades—more than 20 in the past 10 years

The undulator hall at the Linac Coherent Light Source (LCLS) , SLAC, 2011.

Where the user facilities are: DOE Laboratories (mostly)



★ SC is the steward of these ten DOE laboratories

The DOE/SC Labs Today – User Facilities Us



Berkeley, California
202 acres and 106 buildings
3,400 FTEs
1,084 students & postdocs
8,579 facility users

www.lbl.gov



Pacific Northwest
NATIONAL LABORATORY



Richland, Washington
600 acres and 101 buildings
4,180 FTEs
567 students & postdocs
2,414 facility users

www.pnnl.gov

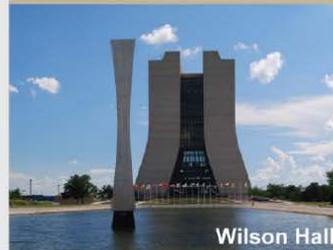


THE Ames Laboratory



Ames, Iowa
10 acres and 12 buildings
315 FTEs
210 students & postdocs

www.ameslab.gov



Wilson Hall

Batavia, Illinois
6,800 acres and 356 buildings
1,914 FTEs
1,090 students & postdocs
2,317 facility users

www.fnal.gov



Advanced Photon Source

Argonne, Illinois
1,500 acres and 99 buildings
3,375 FTEs
1,147 students & postdocs
4,289 facility users

www.anl.gov



Menlo Park, California
426 acres and 142 buildings
1,681 FTEs
300 students & postdocs
3,384 facility users

www.slac.stanford.edu



Spallation Neutron Source

Oak Ridge, Tennessee
4,470 acres and 252 buildings
4,533 FTEs
1,753 students & postdocs
3,116 facility users

www.ornl.gov



Newport News, Virginia
169 acres and 63 buildings
769 FTEs
74 students & postdocs
1,376 facility users

www.jlab.org



NSTX Spherical Tokamak

Princeton, New Jersey
89 acres and 34 buildings
428 FTEs
66 students & postdocs
145 facility users

www.pppl.gov



Relativistic Heavy Ion Collider

Upton, New York
5,320 acres and 331 buildings
2,990 FTEs
593 students & postdocs
4,253 facility users

www.bnl.gov

Office of Science User Facilities



31 world-leading facilities serving over 29,000 researchers annually

- supercomputers,
 - high intensity x-ray, neutron, and electron sources,
 - nanoscience facilities,
 - genomic sequencing facilities,
 - particle accelerators,
 - fusion/plasma physics facilities, and
 - atmospheric monitoring capabilities.
-
- Open access; allocation determined through peer review of proposals
 - Free for non-proprietary work published in the open literature
 - Full cost recovery for proprietary work



SC User Facilities – From Nobel Prize winning work ...

3 Nobel Prizes in 6 Years for work at the synchrotron x-ray light sources

2009 Prize in Chemistry: Venkatraman Ramakrishnan, Thomas Steitz, and Ada Yonath) "for studies of the structure and function of the ribosome." *Used all 4 light sources.*



Venkatraman
Ramakrishnan



Thomas
Steitz



Ada Yonath

2006 Prize in Chemistry: Roger Kornberg "for his studies of the molecular basis of eukaryotic transcription." *Used SSRL macromolecular crystallography beamlines.*

2003 Prize in Chemistry: Roderick MacKinnon for "structural and mechanistic studies of ion channels." *Used NSLS beamlines X25 and X29.*



... to recent Fortune 500 users



MONSANTO



Honeywell



JOHN DEERE

3M



Raytheon

Lilly



ExxonMobil

P&G



IBM



AMGEN



AIR PRODUCTS



NORTHROP GRUMMAN



Bristol-Myers Squibb



ITT



HALLIBURTON

Kodak

LOCKHEED MARTIN



SAIC

Johnson & Johnson



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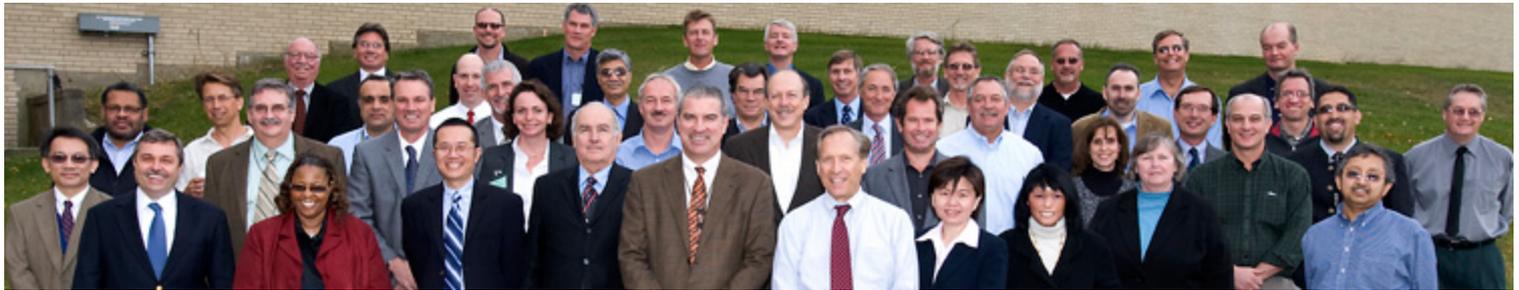
SC Builds (big) Stuff!



SC has completed 40 projects each of total cost greater than \$10 million in the last ten years. **90% of these projects were delivered on time and on budget** with cumulative cost growth across all projects held below 5%.



A culture of project management

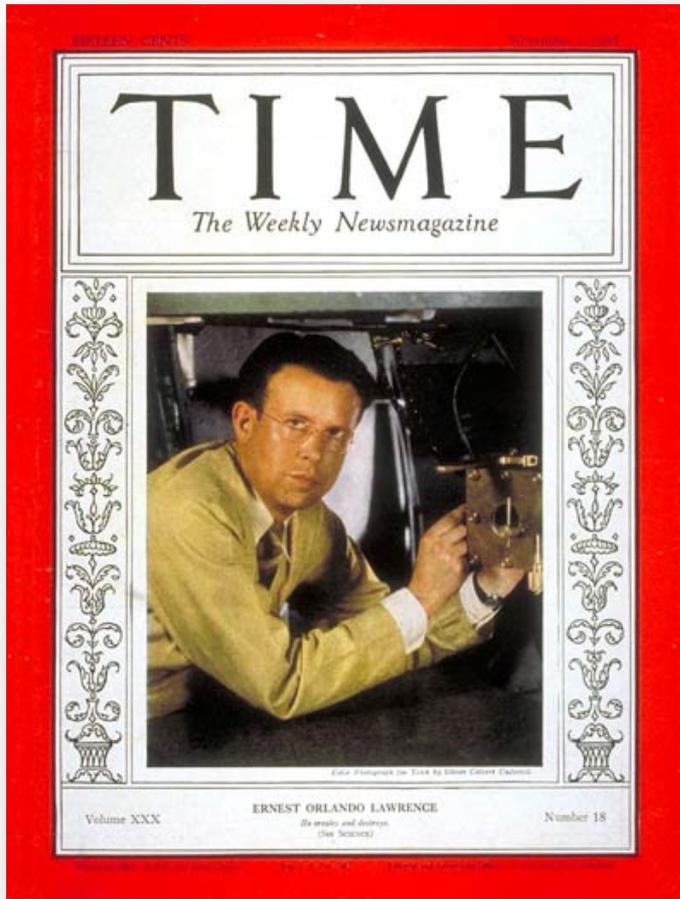


An Historical Detour: Big Science and the Office of Science

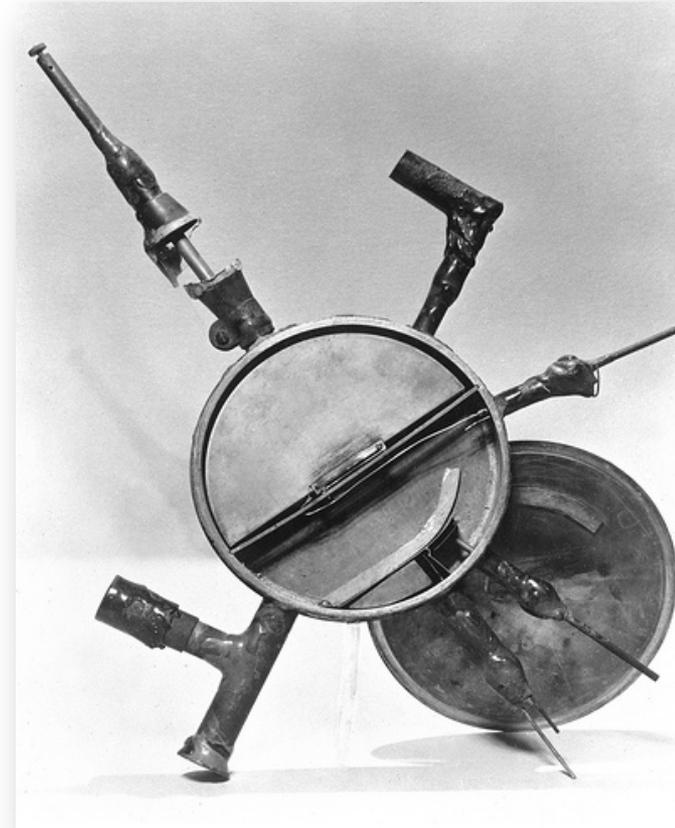
- Big science was born at the labs after World War II, on the heels of the Manhattan Project.
- Over time, big science begat the large suite of Office of Science user facilities.
- These facilities transformed the nature of the labs, and they define the Office of Science today.



Origins of Accelerator Science in (the Earliest Predecessor of) the Office of Science



Ernest O. Lawrence
November 1, 1937



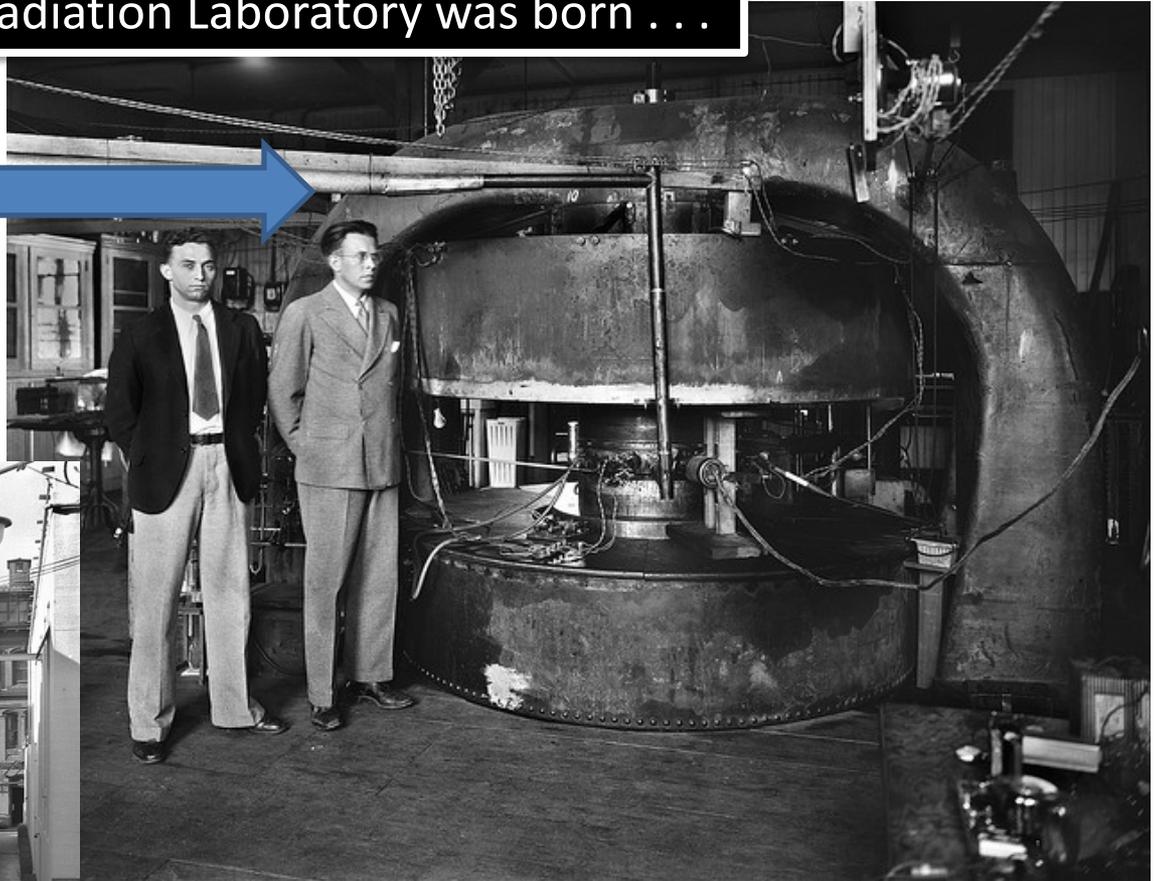
Lawrence's original
5-inch cyclotron, 80 keV, 1931



Lawrence's Pursuit of Bigger and Bigger and Bigger Machines

Later that year the Berkeley Radiation Laboratory was born . . .

Surplus 80 ton magnet from the Federal Telegraph Company



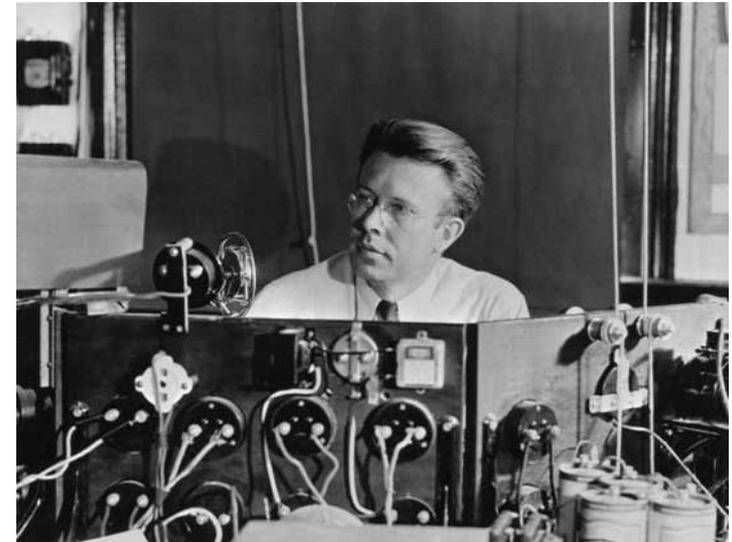
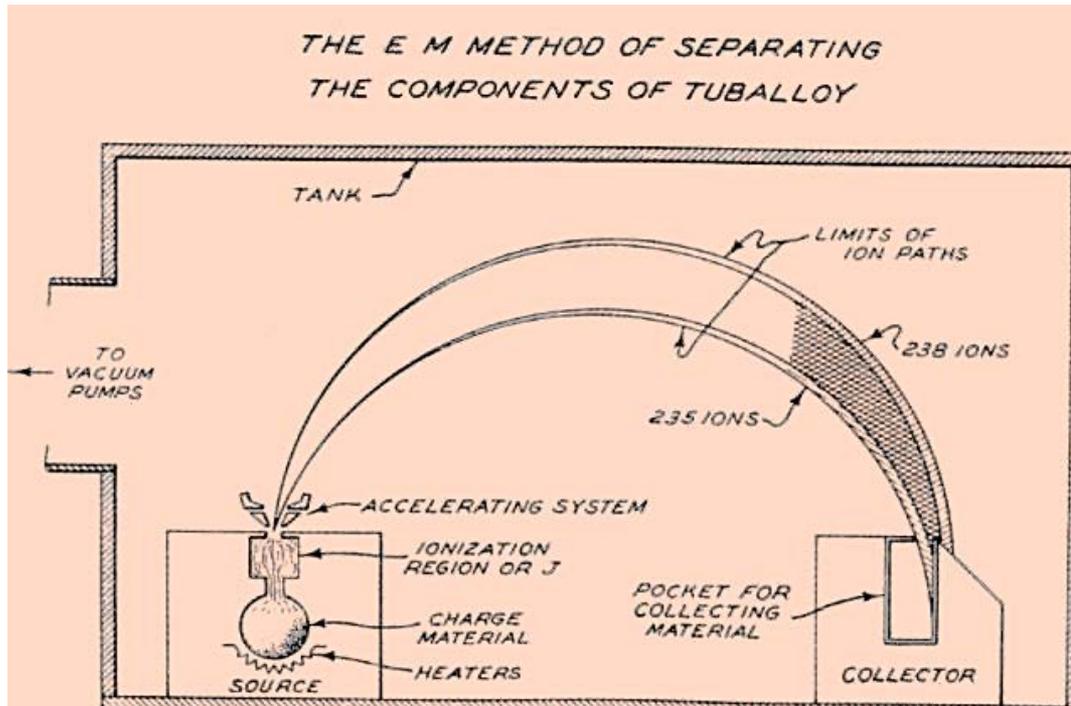
27-inch cyclotron, 3.6 MeV, 1932

During the decade, Rad Lab staff grew from 5 to 60



Accelerators and the Manhattan Project

Challenge: uranium isotope separation

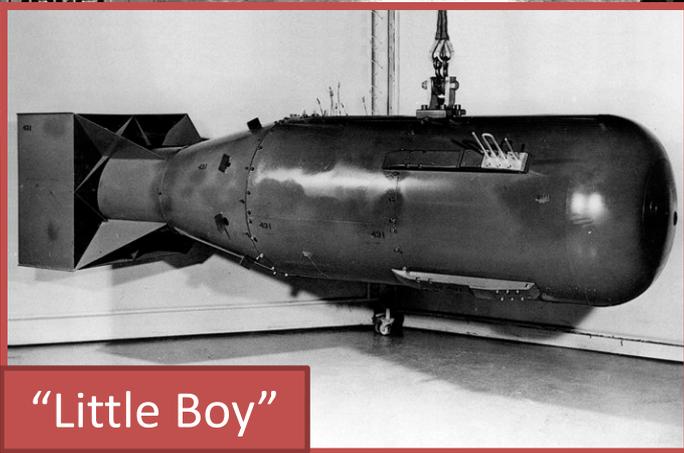
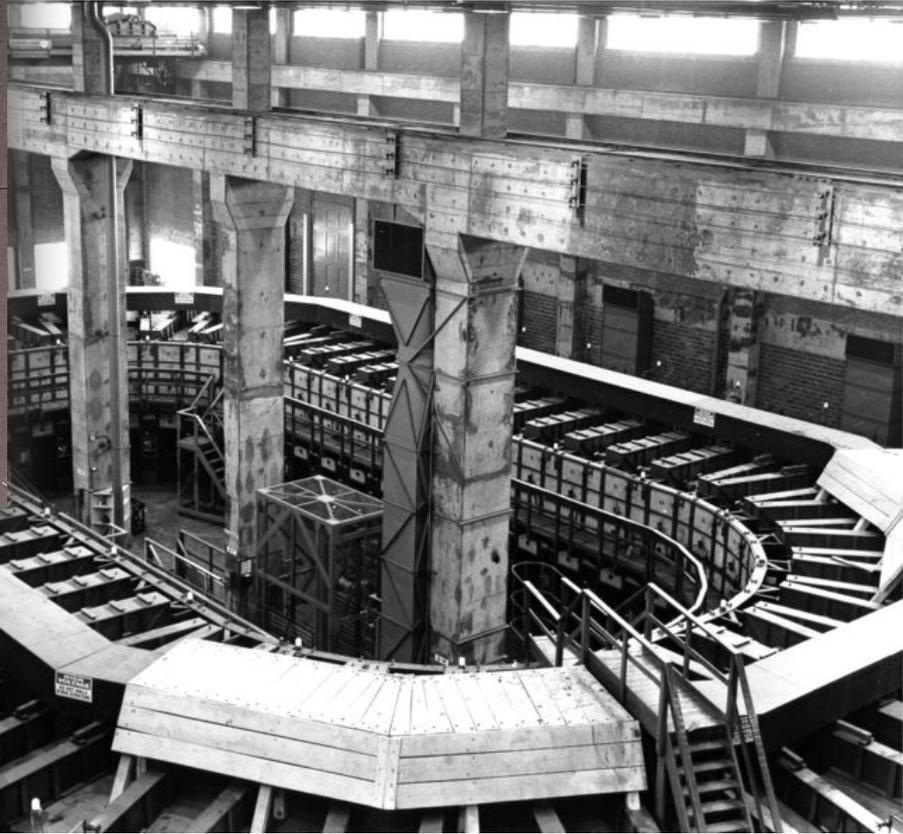
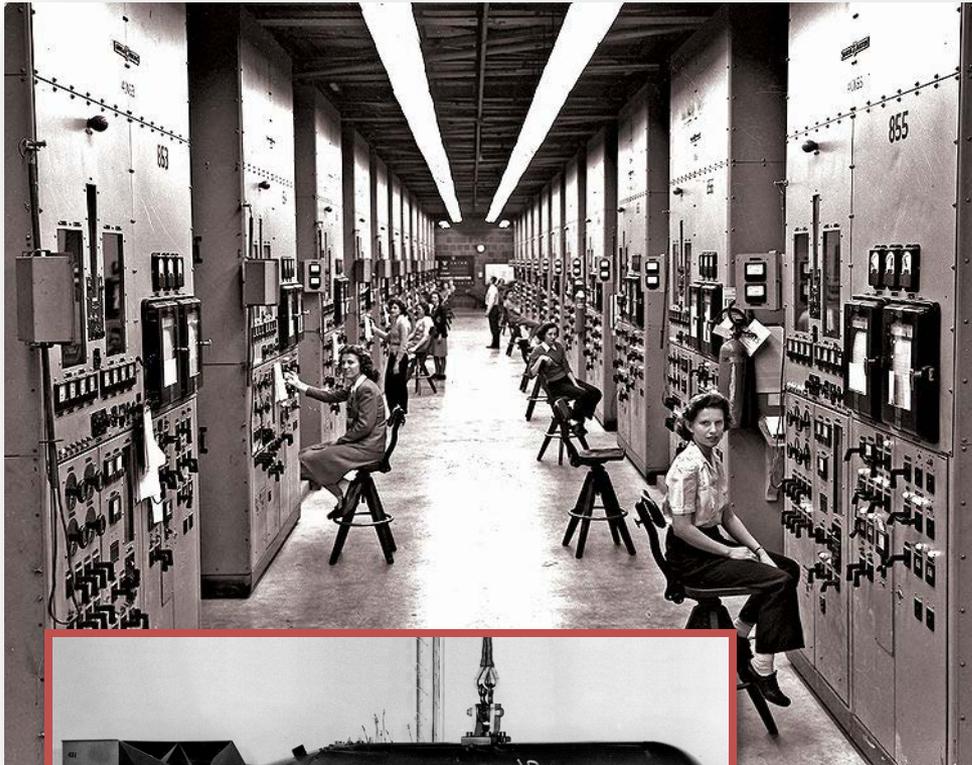


Lawrence advanced accelerators as mass separators through modification of the 37-inch cyclotron; he named the new configuration . . . the “**calutron.**”



From Prototype to (Big Time) Reality

Lawrence's calutrons were built at industrial scale at the Oak Ridge Y-12 complex to yield usable quantities of uranium 235.



"Little Boy"



After several intermediate sizes came the 184-inch cyclotron ...



4,000 ton magnet

184-inch cyclotron, > 100 MeV, 1946



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... housed in its own designer building at LBNL , *circa* 1941



This building was later expanded to house the Advanced Light Source, a current SC User Facility



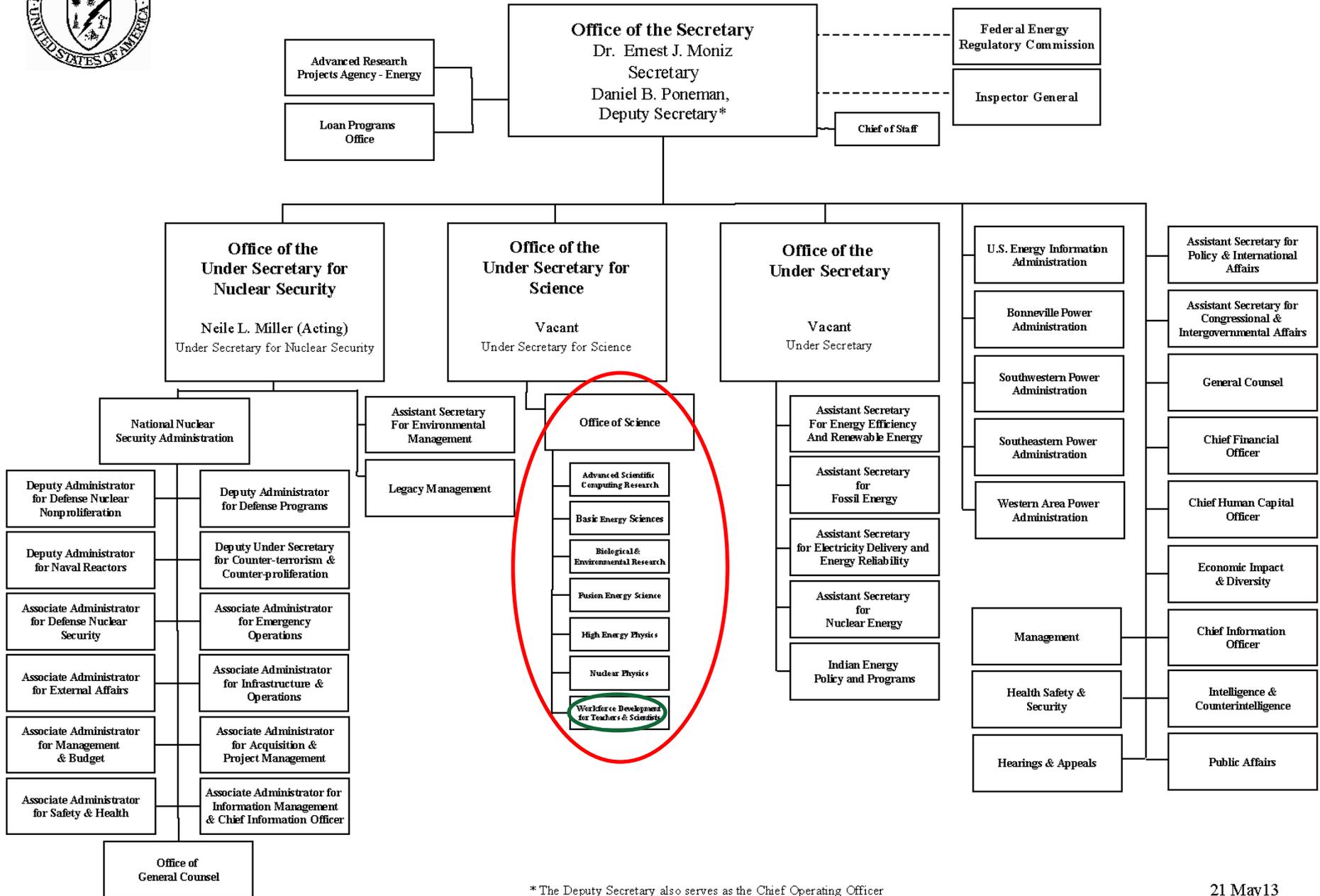
Big Science at the 10 DOE/SC labs in their Earliest Days

1931	LBL	E.O. Lawrence and the cyclotron at the “Rad Lab”
1943	ORNL	Nuclear reactor technology
1946	ANL	Nuclear reactor technology
1947	AMES	High-purity uranium production; heavy-element chemistry
1947	BNL	Construction/operation of large facilities for NE universities
1951	PPPL	Magnetic fusion research
1962	SLAC	(Electron) accelerator technology; particle physics research
1965	PNNL	Independent R&D associated with the Hanford site
1967	FNAL	(Proton) accelerator technology; particle physics research
1984	TJNAF	(Electron) accelerator technology; nuclear physics research





DEPARTMENT OF ENERGY



* The Deputy Secretary also serves as the Chief Operating Officer

Challenges for the Office of Science

Energy

Leading Basic Research
for a Sustainable Future

Environment

Understanding Climate Change and
Improving the Environment

Innovation

Building Research Infrastructure and
Partnerships that Foster Innovation

Discovery

Unraveling Nature's
Deepest Mysteries



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The Office of Science Research Portfolio

Advanced Scientific Computing Research

- **Delivering world leading computational and networking capabilities to extend the frontiers of science and technology**

Basic Energy Sciences

- **Understanding, predicting, and ultimately controlling matter and energy flow at the electronic, atomic, and molecular levels**

Biological and Environmental Research

- **Understanding complex biological, climatic, and environmental systems**

Fusion Energy Sciences

- **Building the scientific foundations for a fusion energy source**

High Energy Physics

- **Understanding how the universe works at its most fundamental level**

Nuclear Physics

- **Discovering, exploring, and understanding all forms of nuclear matter**



Advanced Scientific Computing Research

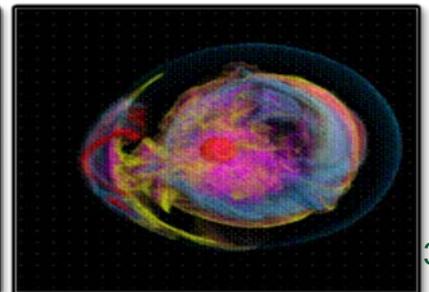
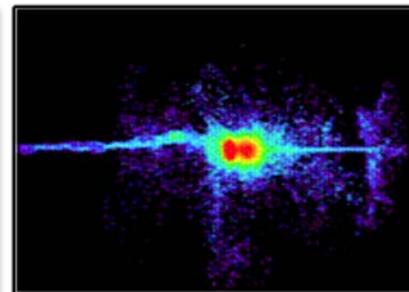
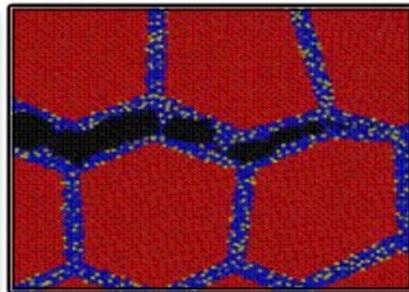
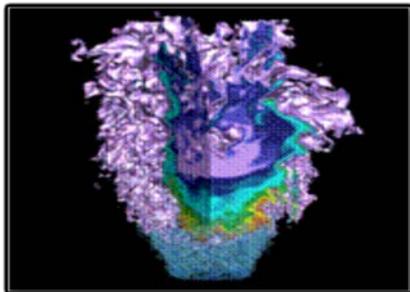
Delivering world leading computational and networking capabilities to extend the frontiers of science and technology

The Scientific Challenges:

- Deliver next-generation scientific and energy applications on multi-petaflop computers.
- Discover, develop and deploy exascale computing and networking capabilities.
- Partner with U.S. industry to develop the next generation computing hardware and tools for science.
- Discover new applied mathematics, computer science, and networking tools for the ultra-low power, multicore-computing future and data-intensive science.
- Provide technological innovations for U.S. leadership in Information Technology to advance competitiveness.

FY 2013 Highlights:

- Co-design centers to deliver next generation scientific applications.
- Investments with U.S. industry to address critical challenges on the path to exascale.
- Operation of a 10 petaflop low-power IBM Blue Gene/Q at the Argonne Leadership Computing Facility and installation and early science access to a hybrid, multi-core computer at the Oak Ridge Leadership Computing Facility.
- Research efforts across the portfolio in support of data-intensive science including the massive data produced by Scientific User Facilities.



Basic Energy Sciences

Understanding, predicting, and ultimately controlling matter and energy flow at the electronic, atomic, and molecular levels

The Program:

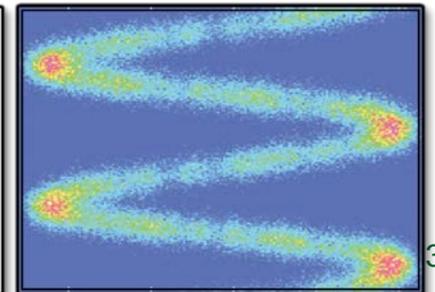
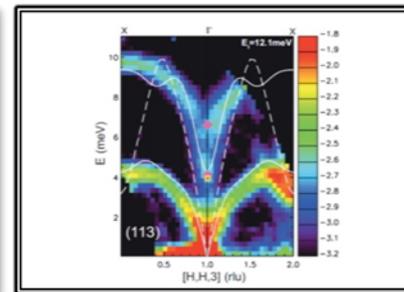
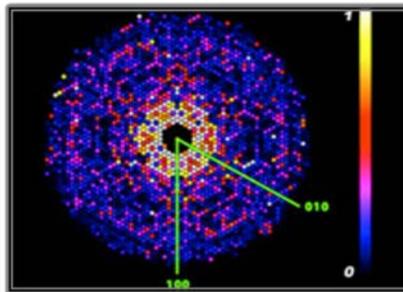
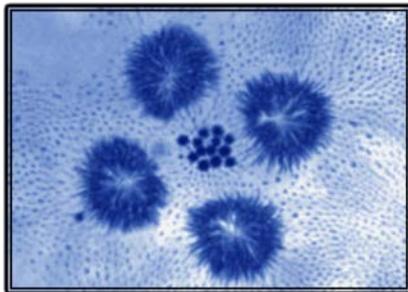
Materials sciences & engineering—exploring macroscopic and microscopic material behaviors and their connections to various energy technologies

Chemical sciences, geosciences, and energy biosciences—exploring the fundamental aspects of chemical reactivity and energy transduction over wide ranges of scale and complexity and their applications to energy technologies

Scientific User Facilities—supporting the largest collection of facilities for electron, x-ray, and neutron scattering in the world

FY 2013 Highlights:

- Science for clean energy
 - Science-based chemical and materials discovery to enable manufacturing innovations
 - R&D for next-generation clean energy applications jointly funded with EERE
- Materials and chemistry by design: discovery grounded in theory and modeling
- National Synchrotron Light Source-II construction and early operations
- User facilities at near optimum operations; facility upgrades and enhancements
 - LCLS expansion (LCLS-II); NSLS-II EXperimental Tools (NEXT); APS Upgrade (APS-U)



Biological and Environmental Research

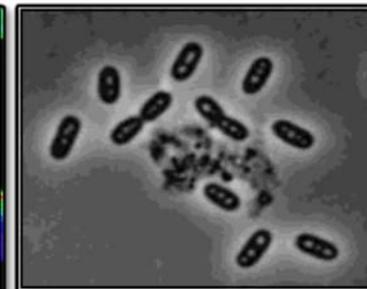
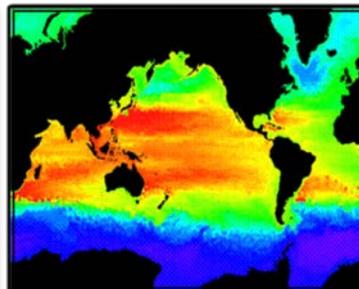
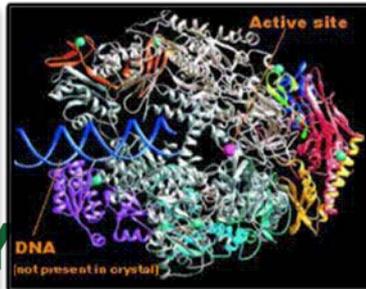
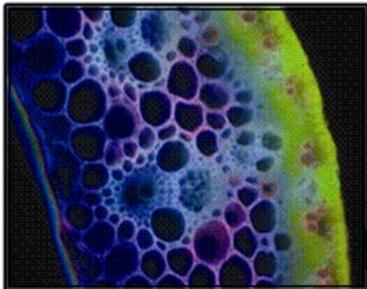
Understanding complex biological, climatic, and environmental systems across vast spatial and temporal scales

The Scientific Challenges:

- Understand how genomic information is translated to functional capabilities, enabling more confident redesign of microbes and plants for sustainable biofuel production, improved carbon storage, or contaminant remediation.
- Understand the roles of Earth's biogeochemical systems (atmosphere, land, oceans, sea ice, subsurface) in determining climate so we can predict climate decades or centuries into the future, information needed to plan for future energy and resource needs.

FY 2013 Highlights:

- Clean energy biodesign on plant and microbial systems through development of new molecular toolkits for systems and synthetic biology research.
- Research and new capabilities to develop comprehensive environmental system models in the Arctic and tropics, regions especially vulnerable to rapid climate change.
- Continue support for the three DOE Bioenergy Research Centers, and operations of the Joint Genome Institute, the Environmental Molecular Sciences Laboratory, and the Atmospheric Radiation Measurement Climate Research Facility.



Fusion Energy Sciences

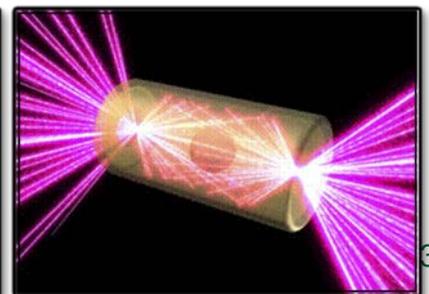
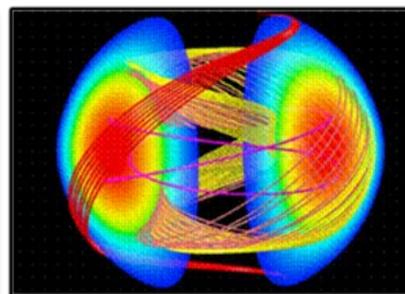
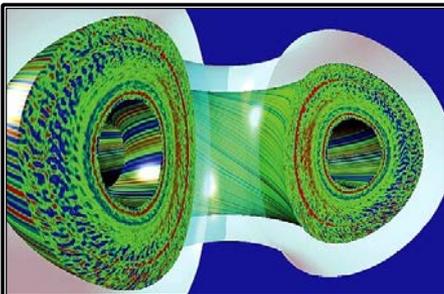
Understanding matter at very high temperatures and densities and building the scientific foundations for a fusion energy source

The Scientific Challenges:

- Control a burning plasma state to form the basis for fusion energy.
- Develop materials that can withstand the harsh heat and neutron irradiation in fusion facilities.
- Manipulate and control intense transient flows of energy and particles.
- Control the interaction of matter under extreme conditions for enabling practical inertial fusion energy.

FY 2013 Highlights:

- ITER construction is advancing.
- DIII-D investigates predictive science for ITER; NSTX undergoes performance upgrade; and Alcator C-Mod is closed.
- Matter in Extreme Condition Instrument begins operation at LCLS to study high-energy-density laboratory physics.
- New SciDAC high-performance computing projects are selected, in partnership with ASCR, to advance scientific discovery.
- International activities on experiments with world-leading technologies are increased.
- Fusion materials research is enhanced.



High Energy Physics

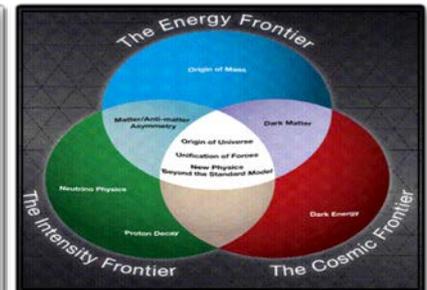
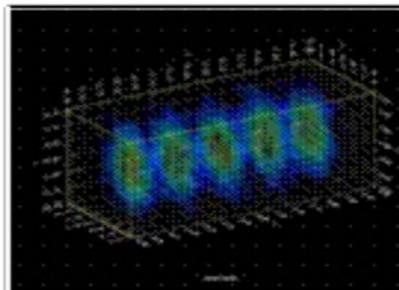
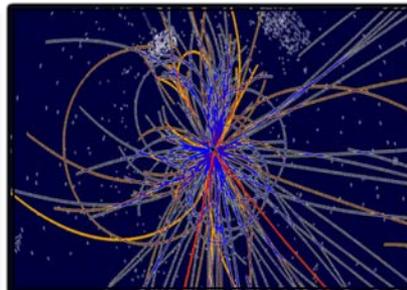
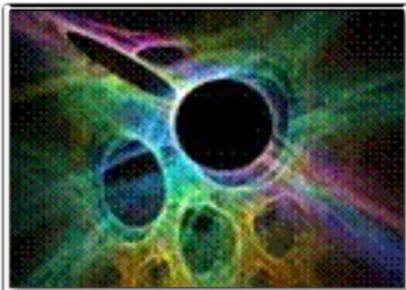
Understanding how the universe works at its most fundamental level

The Scientific Challenges:

- Determine the origins of mass in terms of the fundamental particles and their properties
- Exploit the unique properties of neutrinos to discover new ways to explain the diversity of particles
- Discover new principles of nature, such as new symmetries, new physical laws, or unseen extra dimensions of space-time
- Explore the “dark” sector that is 95% of the Universe (Dark Matter and Dark Energy)
- Invent better and cheaper accelerator and detector technologies to extend the frontiers of science and benefit society

FY 2013 Highlights:

- Energy Frontier: Continued support for U.S. researchers at the LHC. The number of researchers is constant with FY 2012
- Intensity Frontier: Research, design, and construction for NOvA, LBNE neutrino experiments, and Mu2e muon experiments. The Reactor Neutrino Experiment in China begins operations in FY 2012
- Cosmic Frontier: U.S. participation in international collaborations pursuing dark matter, dark energy. The Dark Energy Survey in Chile begins operations in FY 2012
- Research in accelerator technologies including superconducting radio frequency and plasma wakefield acceleration



Nuclear Physics

Discovering, exploring, and understanding all forms of nuclear matter

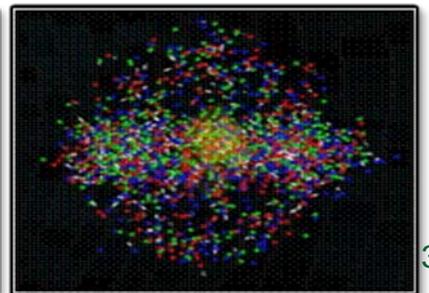
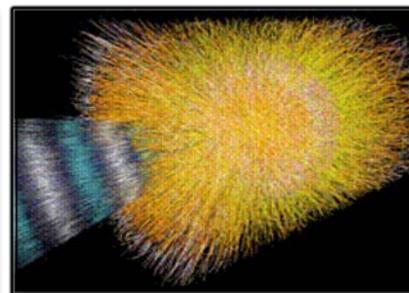
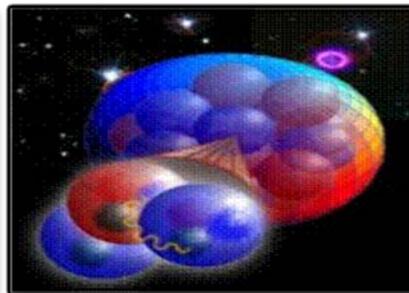
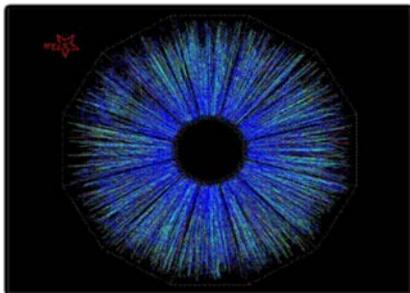
The Scientific Challenges:

Understand:

- The existence and properties of nuclear matter under extreme conditions, including that which existed at the beginning of the universe
- The exotic and excited bound states of quarks and gluons, including new tests of the Standard Model
- The ultimate limits of existence of bound systems of protons and neutrons
- Nuclear processes that power stars and supernovae, and synthesize the elements
- The nature and fundamental properties of neutrinos and neutrons and their role in the matter-antimatter asymmetry of the universe

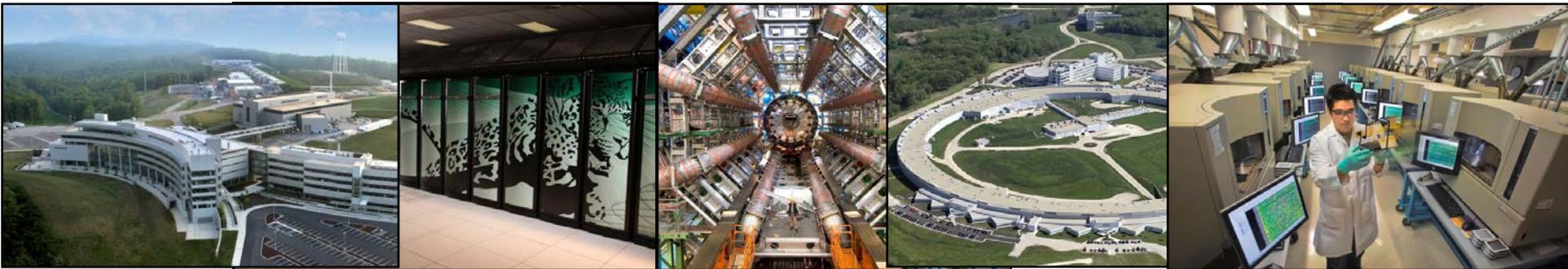
FY 2013 Highlights:

- Operations and research at three nuclear science user facilities (RHIC, CEBAF, ATLAS)
- 12 GeV CEBAF Upgrade to study systems of quarks and gluons and the force that creates protons and neutrons.
- Continued preparation for construction of the Facility for Rare Isotope Beams to study the limits of nuclear existence.
- Research, development, and production of stable and radioactive isotopes for science, medicine, industry, and national security.
- New strategic planning activity begins in FY 2012.



21st Century Tools for Science: National Scientific User Facilities

- Advanced computational resources – terascale to petascale computing and networks for open science
- Five light sources, and one next-generation light source under construction
- Three neutron sources for scattering
- Particle accelerators/colliders/detectors for high energy and nuclear physics
- Fusion/plasma facilities, including ITER which seeks to demonstrate a sustained burning plasma
- Five Nanoscale Science Research Centers – capabilities for fabrication and characterization of materials at the nanoscale
- Joint Genome Institute for rapid whole genome sequencing
- Environmental Molecular Science Laboratory – experimental and computational resources for environmental molecular sciences
- Atmospheric and Environmental Facilities – capabilities for cloud and aerosol measurement and for carbon cycling measurements



Research Internship Programs at the DOE Labs

Best wishes for a productive, safe, and secure summer, and please do stay in touch regarding notable outcomes (using your online application system profile)!

Questions?

Best resource for Office of Science and WDTs information:

<http://science.energy.gov>

<http://science.energy.gov/discovery-and-innovation/>

<http://science.energy.gov/wdts>

Please also feel free to contact me:

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