U.S. DEPARTMENT OF ENERGY | Office of Science

DOE's Office of Science

Welcome WDTS 2015 Summer Term Participant Webinar

July 30, 2015

In this webinar, we provide some perspectives on WDTS internship programs, a brief overview on the DOE, some of its history, and an introduction to the Office of Science's mission, facilities, and programs.

Jim Glownia
Office of the Deputy Director for Science Programs
Office of Science, U.S. Department of Energy

Why does the Office of Science (SC) sponsor internships?

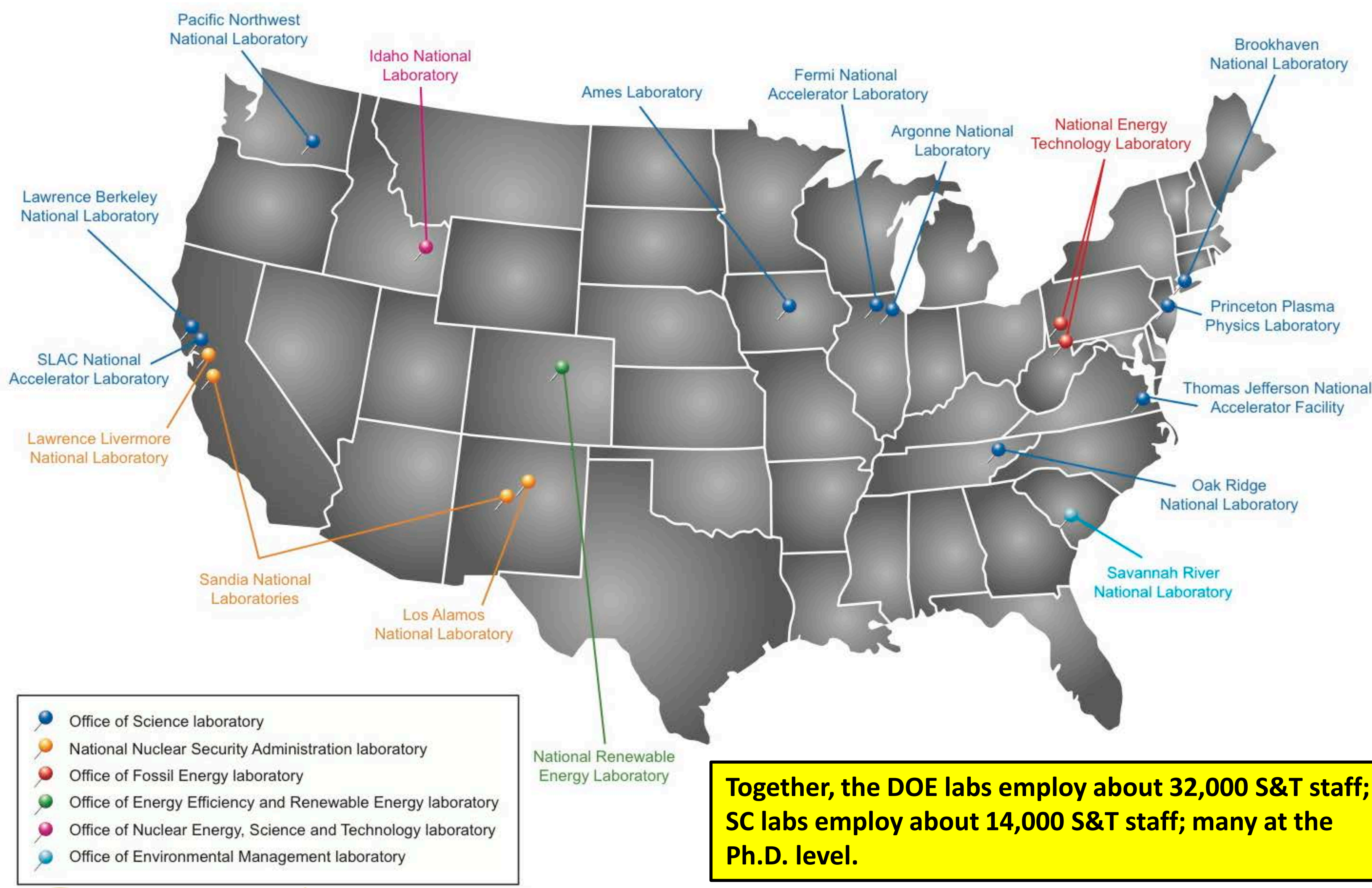
In a word… **WORKFORCE**

The Workforce Development for Teachers and Scientists (WDTS) program mission is to ensure that DOE has a sustained pipeline of science, technology, engineering, and mathematics (STEM) workers. This is accomplished, in part, through support of undergraduate internships and visiting faculty programs at the DOE laboratories, graduate student thesis research opportunities at DOE laboratories, all administered by WDTS for DOE; and Nation-wide, middle- and high-school science competitions that annually culminate in the National Science Bowl® in Washington D.C. These investments help develop the next generation of scientists and engineers required to execute the DOE mission, administer its programs, and conduct its research.

WDTS activities rely significantly on DOE's 17 laboratories and facilities, which employ more than 30,000 workers with STEM backgrounds. The DOE laboratory system provides access to leading scientists; world-class scientific user facilities and instrumentation; and large-scale, multidisciplinary research programs unavailable in universities or industry. WDTS leverages these assets to develop and train post-secondary students and educators to enhance the DOE mission.

SC sponsors and operates these programs to help sustain the DOE's scientific and technical workforce pipeline.

DOE Labs Employ >30,000 Scientists and Engineers



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.

SC Workforce Programs

Managed by SC's 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) ~750/year
  - Community College Internship (CCI) ~90/year
  - Visiting Faculty Program (VFP) ~(55-Faculty / 30-Students)/year
- Also at the DOE laboratories:
  - Office of Science Graduate Student Research Program
    - Help prepare graduate students for science, technology, engineering, or mathematics (STEM) careers critically important to the DOE Office of Science mission, by providing graduate thesis research opportunities at DOE laboratories
- Albert Einstein Distinguished Educator Fellowship
- National Science Bowl®

2015 Summer Term Summary

- 10 weeks (Summer Term) or 16 weeks (Semester Term) at a DOE host Laboratory engaged in a *research project* under the guidance of a laboratory scientist or engineer (2016 SULI & CCI (pilot semester) program Spring Term applications are now open through Oct. 9, 2015).

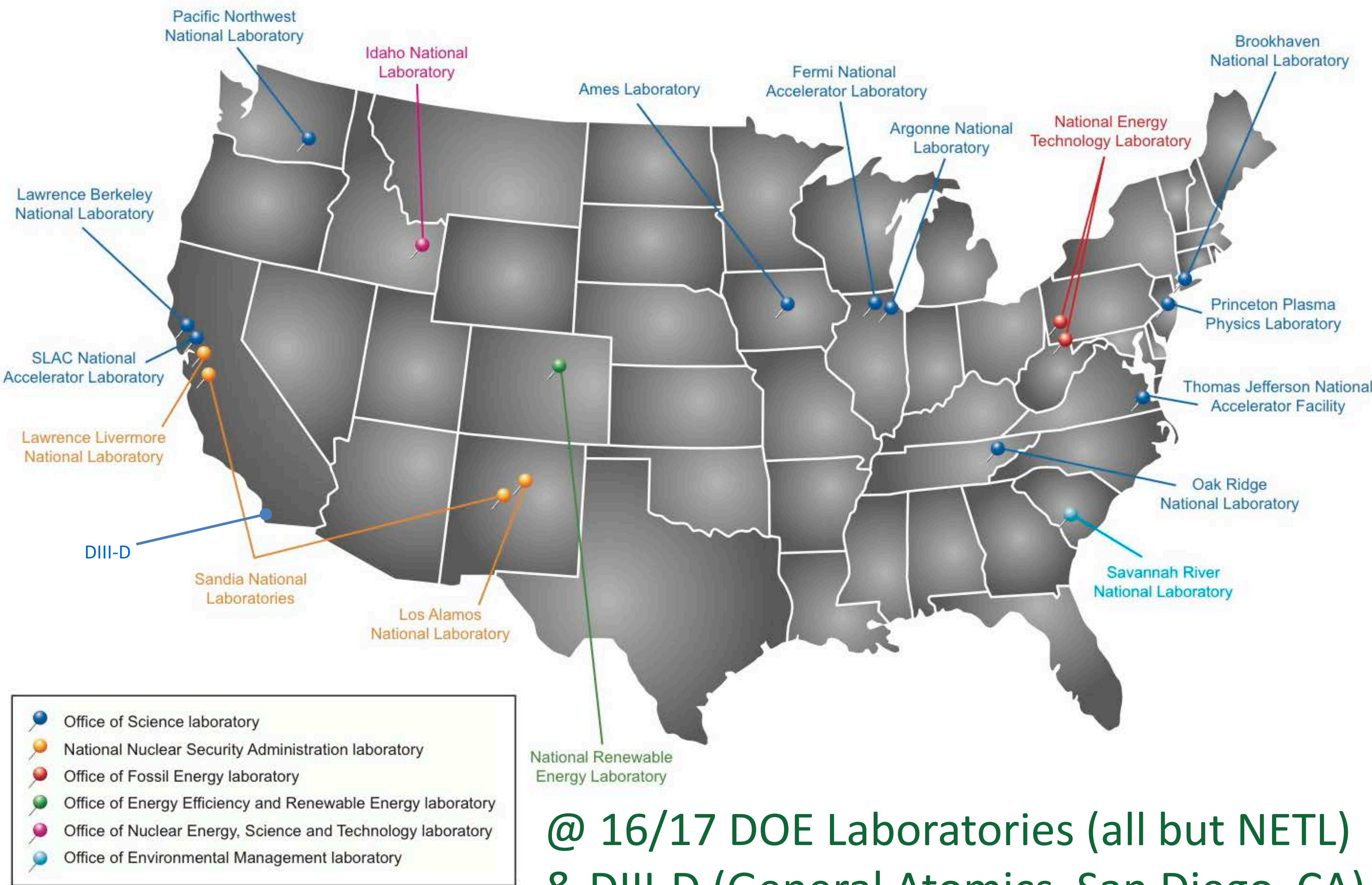
- CCI participants work on a *technical project* (10-week Summer Term & pilot semester program at BNL, LBNL, & ORNL) under the guidance of a laboratory scientist or engineer.

- Enrichment activities including career professional development workshops, writing and presentation skills development activities, laboratory tours, scientific lectures and seminars, *etc.*
  - *working side-by-side, you gain first-hand experience with our lab personnel, you participate in their research activities, gain valuable out-of-classroom professional skills, and heighten your interest to continue in STEM studies and pursue related careers (perhaps at a DOE lab)*

- Obligations/Deliverables include pre- and post- participation questionnaires, 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*
  - *questionnaires inform us regarding what works and what does not (we do want to know)*
  - *we want to stay in touch with program participants - stay tuned*

- There are 709 2015 Summer Term SULI, CCI, & VFP internship participants (+54 faculty).

Where are undergraduate interns currently placed?



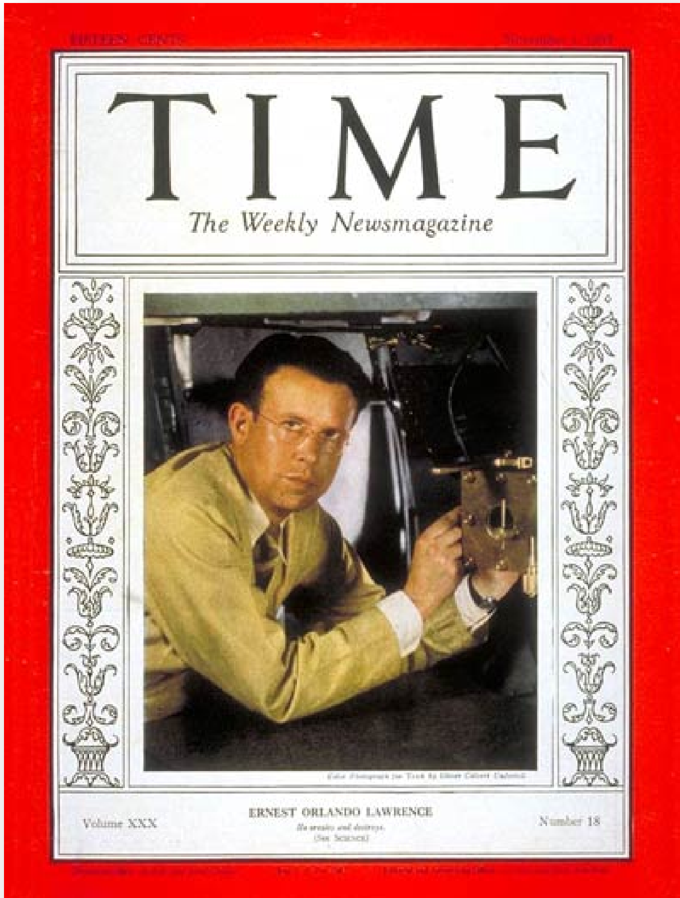
U.S. DEPARTMENT OF ENERGY | Office of Science

@ 16/17 DOE Laboratories (all but NETL) & DIII-D (General Atomics, San Diego, CA)

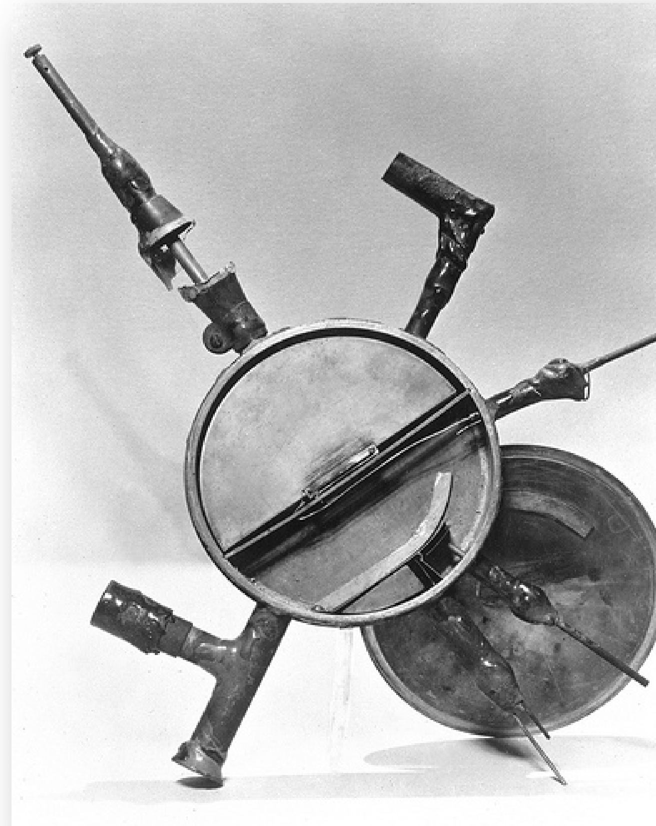
An Historical Detour: Big Science and the Office of Science

- 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 help 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 (Nobel Prize 78 years ago)

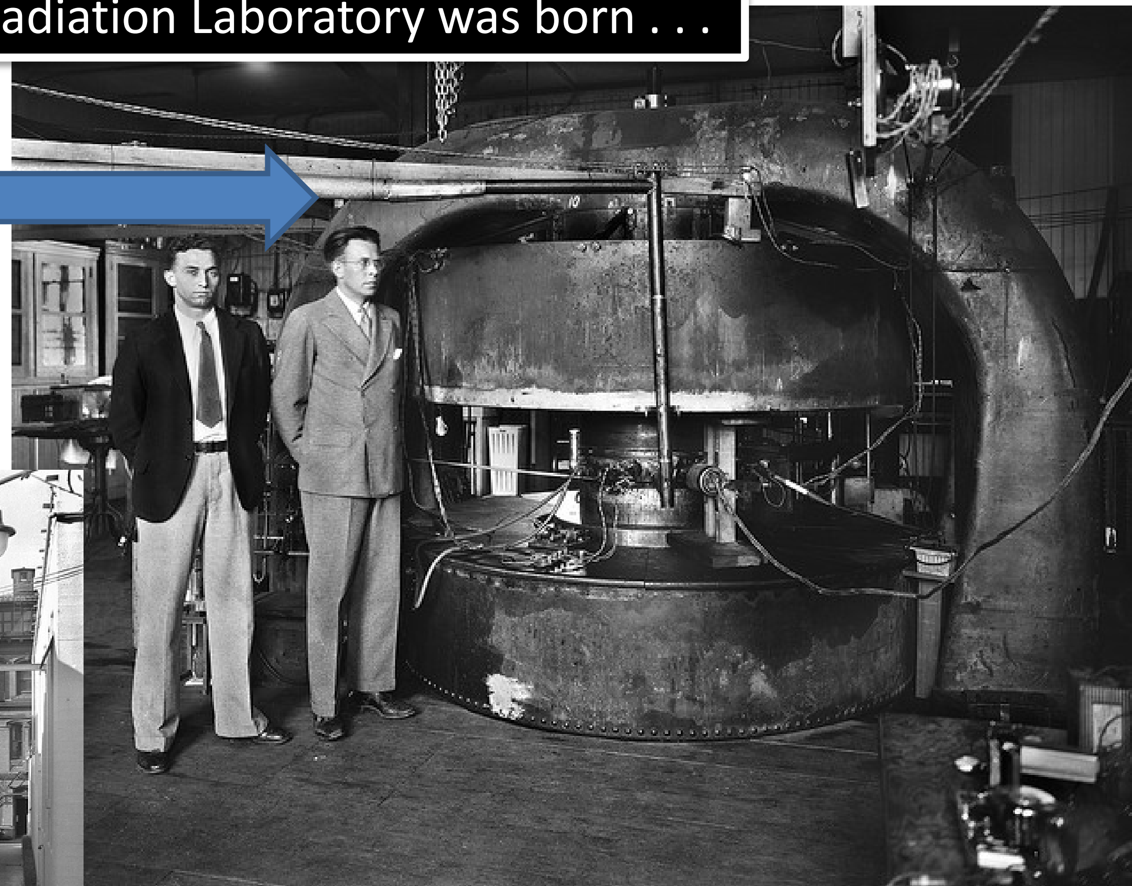


Lawrence's original
5-inch cyclotron, 80 keV, 1931

Lawrence's Pursuit of Bigger and Bigger and Bigger Machines

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

Surplus **<u>80 ton</u>** magnet from the Federal Telegraph Company

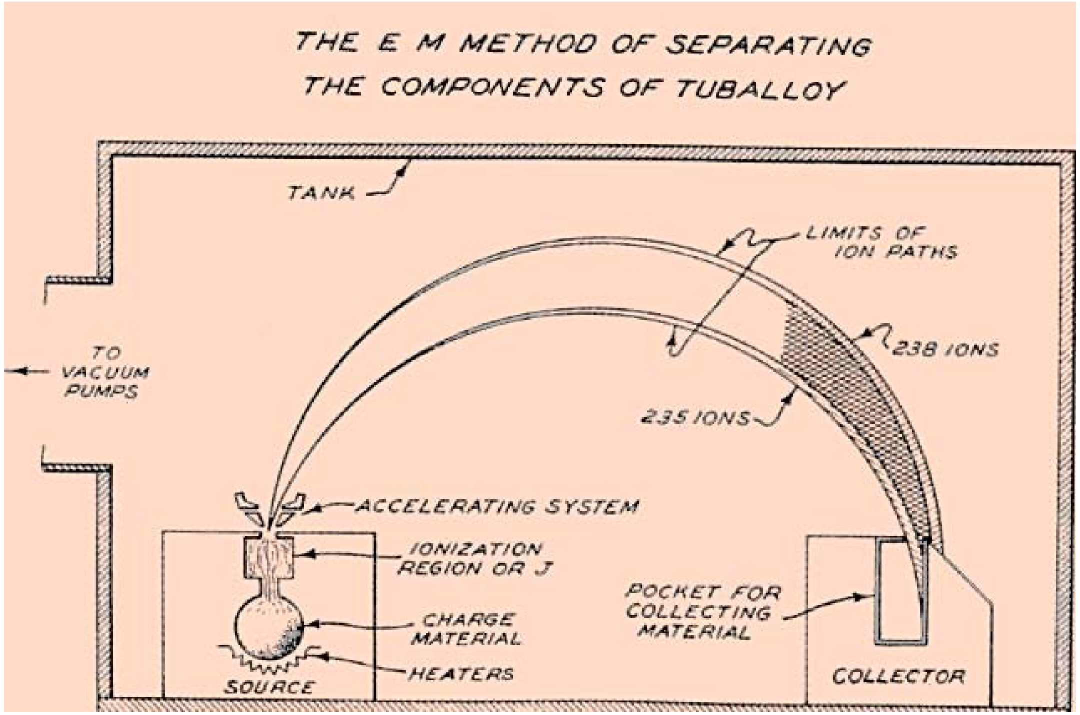


27-inch cyclotron, 3.6 MeV, 1932

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

Accelerators and the Manhattan Project

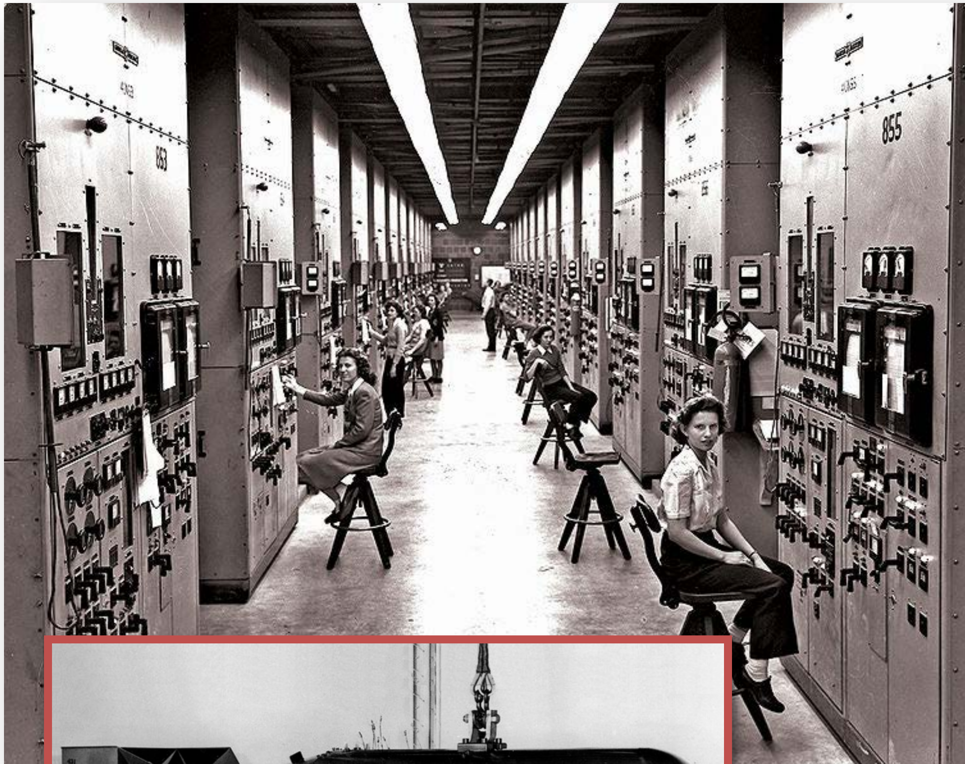
Challenge: uranium isotope separation

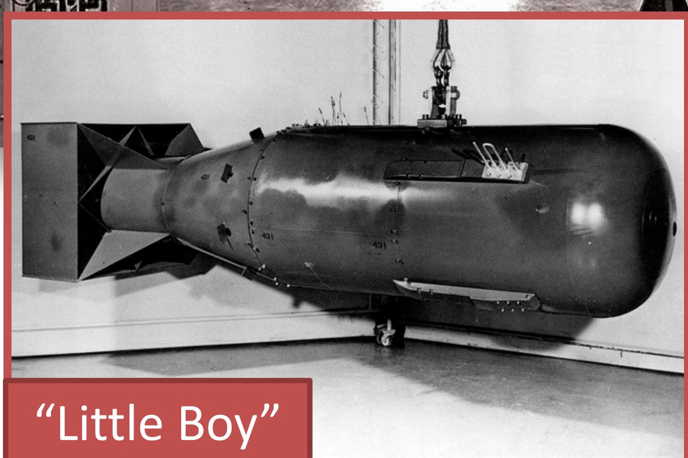


Lawrence advanced accelerators as mass separators through modification of the 37-inch cyclotron; he named the new configuration . . . the "**calutron**" (California University Cyclotron).

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

… 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

DOE and its Predecessors
… and the Formation of the DOE Laboratories

Manhattan Project Locations http://www.trinityremembered.com/index.html

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
  - 5:29:45 July 16, 1945 Los Alamos scientists successfully conducted the world's first nuclear weapons test (http://www.trinityremembered.com/index.html)
- 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

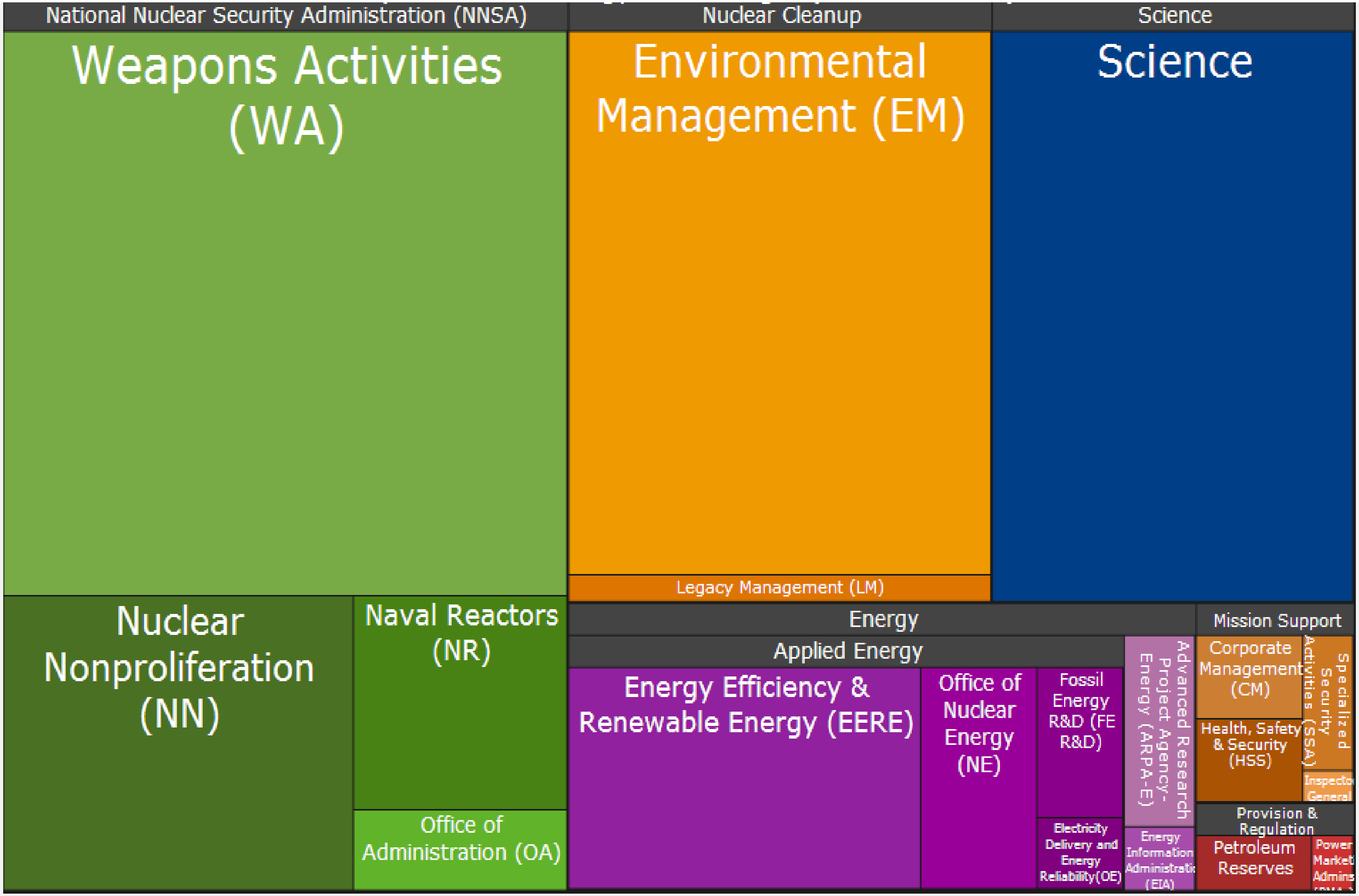
Big Science at the 10 DOE/SC labs in their Earliest Days

1931	**LBNL**	**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, LINAC remains in use for Linac Coherent Light Source (LCLS, an X-ray FEL)**
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**

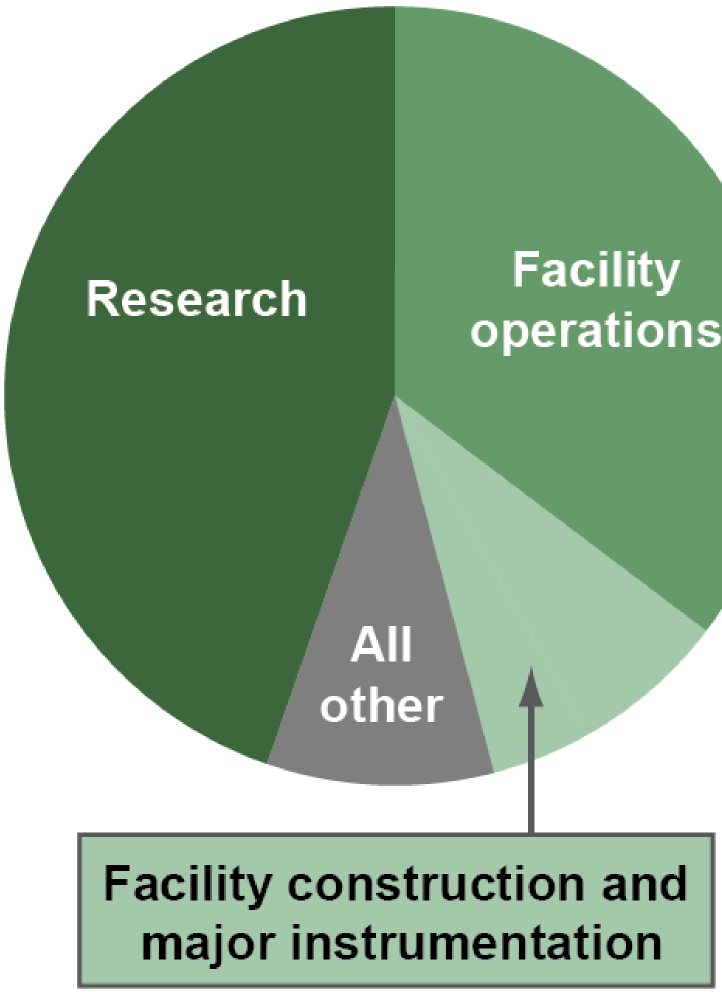
Major Federal R&D Agencies

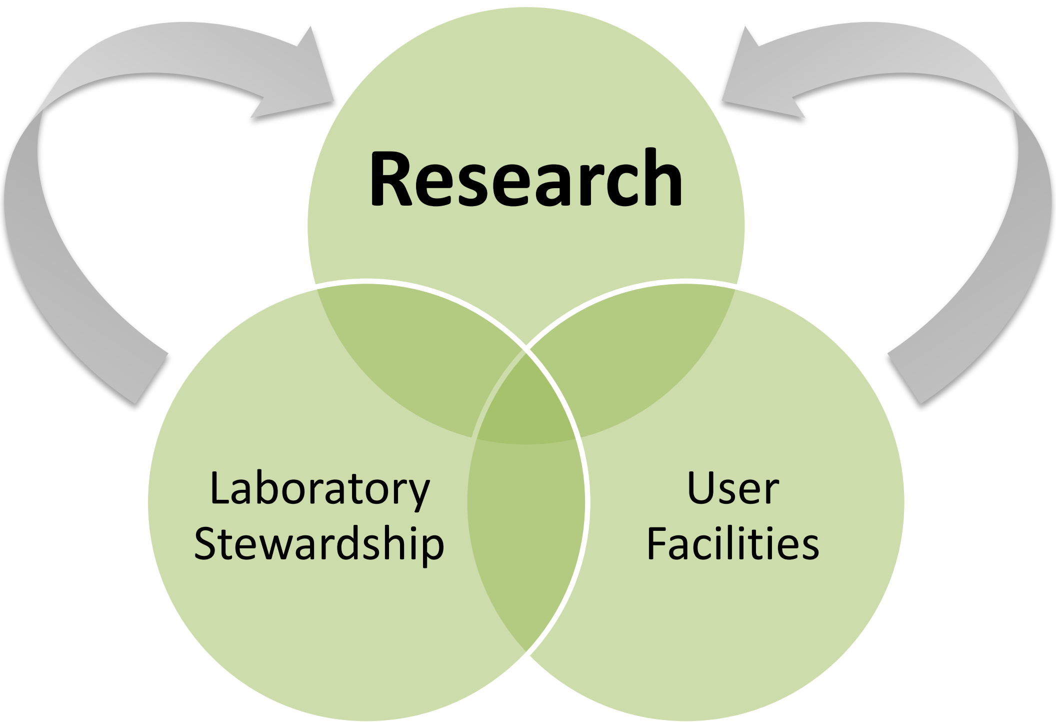
The DOE Portfolio

Area map of DOE's budget request to Congress (~$27B)



Delivering science to advance DOE's mission





Office of Science Mission

The Office of Science's (SC) mission is to deliver scientific discoveries and major scientific tools to transform our understanding of nature and advance the energy, economic, and national security of the United States. SC is the Nation's largest Federal sponsor of basic research in the physical sciences and the lead Federal agency supporting fundamental scientific research for energy.

Office of Science Mission

The frontiers of science - discovering nature's mysteries from the study of subatomic particles, atoms, and molecules that are the building blocks of the materials of our everyday world to the DNA, proteins, and cells that are the building blocks of entire biological systems; each of the programs in the SC supports research to probe the most fundamental questions of its disciplines.

***The 21st Century tools of science* -** providing the Nation's researchers with 26 state-of-the-art national scientific user facilities, the most advanced tools of modern science, enabling the U.S. to remain at the forefront of science, technology, and innovation.

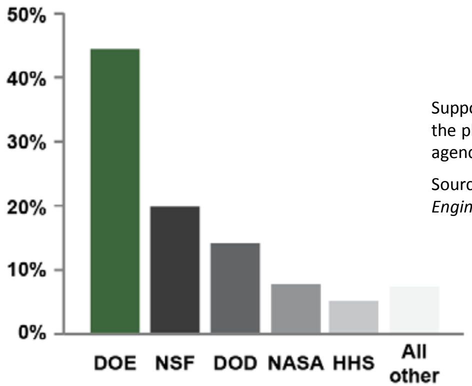
***Science for energy and the environment* -** advancing a clean energy agenda through fundamental research on energy production, conversion, storage, transmission, and use and through advancing our understanding of the earth and its climate; targeted investments include the three DOE Bioenergy Research Centers (BRCs), the Energy Frontier Research Centers (EFRCs), two Energy Innovation Hubs, and atmospheric process and climate modeling research.

Shown is a portion of SLAC's two-mile-long linear accelerator (or linac), which provides the electron beam for the new Linac Coherent Light Source (LCLS) – the world's first hard x-ray, free-electron laser. For nearly 50 years, SLAC's linac had produced high-energy electrons for physics experiments. Now researchers use the very intense X-ray pulses (more than a billion times brighter than the most powerful existing sources) much like a high-speed camera to take stop-motion pictures of atoms and molecules in motion, examining fundamental processes on femtosecond timescales.

SC delivers scientific discoveries and tools to transform our understanding of nature and advance the energy, economic, and national security of the U.S.

Research

- Support for 47% of the U.S. Federal support of basic research in the physical sciences;
- ~22,000 Ph.D. scientists, grad students, engineers, and support staff at >300 institutions, including all 17 DOE labs;
- U.S. and world leadership in high-performance computing and computational sciences for open research;
- Major U.S. supporter of physics, chemistry, materials sciences, and biology for discovery and for energy sciences.

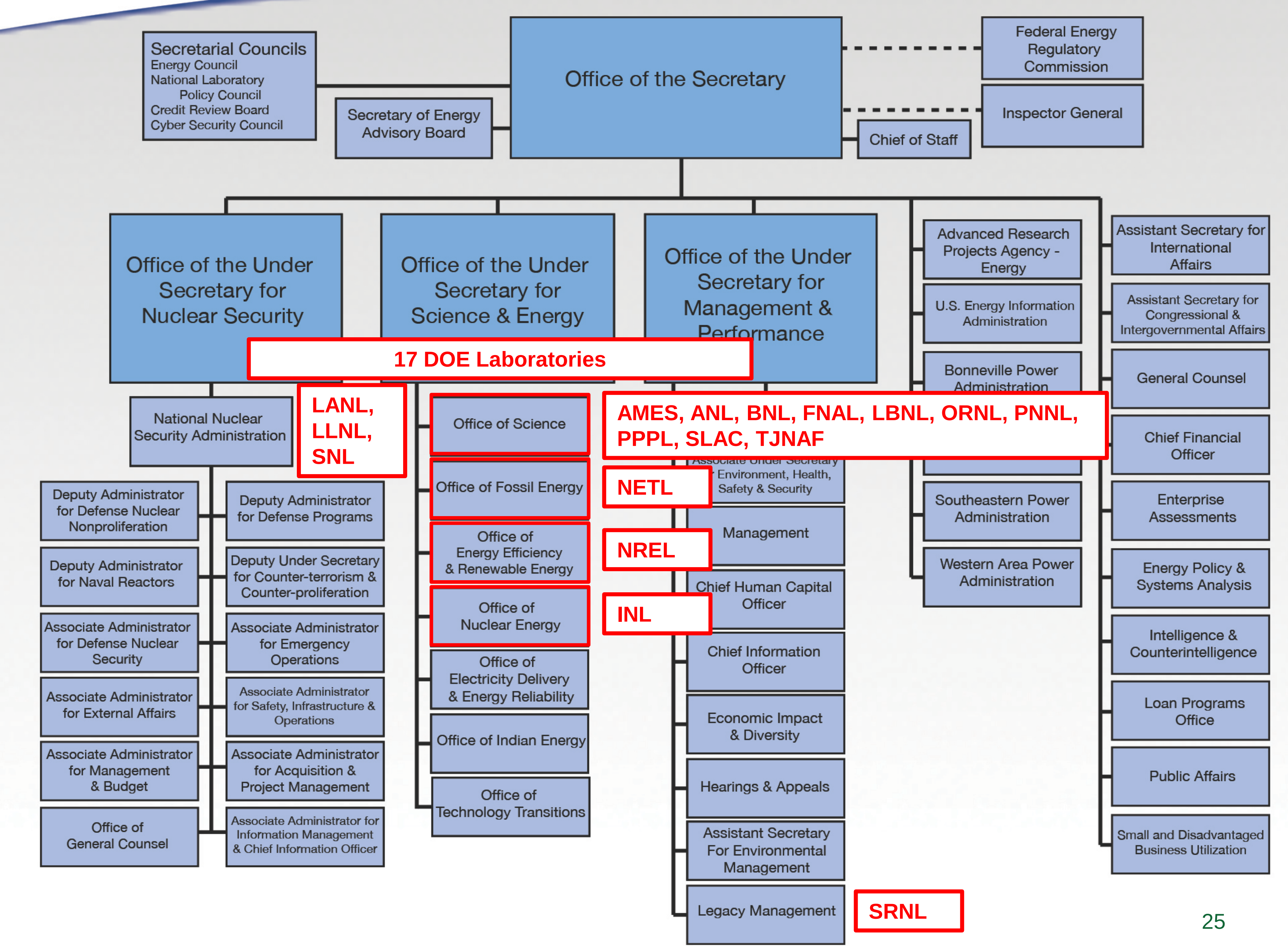


Support for basic research in the physical sciences by agency.

Source: *NSF Science and Engineering Indicators 2012*

Scientific User Facilities

- The world's largest collection of scientific user facilities (aka research infrastructure) operated by a single organization in the world, used by 31,000 researchers each year.



Secretarial Councils
Energy Council
National Laboratory Policy Council
Credit Review Board
Cyber Security Council
Secretary of Energy Advisory Board
Office of the Secretary
Federal Energy Regulatory Commission
Inspector General
Chief of Staff
Office of the Under Secretary for Nuclear Security
Office of the Under Secretary for Science & Energy
Office of the Under Secretary for Management & Performance
17 DOE Laboratories
National Nuclear Security Administration
LANL, LLNL, SNL
Deputy Administrator for Defense Nuclear Nonproliferation
Deputy Administrator for Defense Programs
Deputy Administrator for Naval Reactors
Deputy Under Secretary for Counter-terrorism & Counter-proliferation
Associate Administrator for Defense Nuclear Security
Associate Administrator for Emergency Operations
Associate Administrator for External Affairs
Associate Administrator for Safety, Infrastructure & Operations
Associate Administrator for Management & Budget
Associate Administrator for Acquisition & Project Management
Office of General Counsel
Associate Administrator for Information Management & Chief Information Officer
Office of Science
AMES, ANL, BNL, FNAL, LBNL, ORNL, PNNL, PPPL, SLAC, TJNAF
Office of Fossil Energy
NETL
Office of Energy Efficiency & Renewable Energy
NREL
Office of Nuclear Energy
INL
Office of Electricity Delivery & Energy Reliability
Office of Indian Energy
Office of Technology Transitions
Environment, Health, Safety & Security
Management
Chief Human Capital Officer
Chief Information Officer
Economic Impact & Diversity
Hearings & Appeals
Assistant Secretary For Environmental Management
Legacy Management
SRNL
Advanced Research Projects Agency - Energy
U.S. Energy Information Administration
Bonneville Power Administration
Southeastern Power Administration
Western Area Power Administration
Assistant Secretary for International Affairs
Assistant Secretary for Congressional & Intergovernmental Affairs
General Counsel
Chief Financial Officer
Enterprise Assessments
Energy Policy & Systems Analysis
Intelligence & Counterintelligence
Loan Programs Office
Public Affairs
Small and Disadvantaged Business Utilization

The Office of Science research portfolio

Advanced Scientific Computing Research	• Computational and networking capabilities to extend the frontiers of science and technology
Basic Energy Sciences	• Understanding, predicting, and controlling matter and energy at the electronic, atomic, and molecular levels
Biological and Environmental Research	• Understanding complex biological, climatic, and environmental systems
Fusion Energy Sciences	• Matter at very high temperatures and densities and the scientific foundations for fusion
High Energy Physics	• Understanding how the universe works at its most fundamental level
Nuclear Physics	• Discovering, exploring, and understanding all forms of nuclear matter

Office of the Director
Patricia Dehmer (A)

FY 2016 Congressional Request = $5,339,794K

Deputy Director for Field Operations
Joseph McBrearty

Associate Deputy – *Stephanie Short*

- Ames Site Office – *Cynthia Baebler*
- Argonne Site Office – *Joanna Livengood*
- Berkeley Site Office – *Paul Golan (A)*
- Brookhaven Site Office – *Frank Crescenzo*
- Fermi Site Office – *Michael Weis*
- Thomas Jefferson Site Office – *Joseph Arango*
- ORNL Site Office – *Johnny Moore*
- Princeton Site Office – *Frank Crescenzo (A)*
- Pacific NW Site Office – *Roger Snyder*
- SLAC Site Office – *Paul Golan*
- Chicago Office – *Roxanne Purucker*
- SC Integrated Support Center
- Oak Ridge Office – *Larry Kelly*
- $103,000K – Office of Safety and Security Policy – *Gene Runkle (A)*
- Office of Laboratory Policy – *Steven Jones (A)*
- $113,600K – Office of Operations Program Management – *Stephanie Short (A)*

Deputy Director for Science Programs
Patricia Dehmer

- $620,994K – Advanced Scientific Computing Research – *J. Steve Binkley*
- $20,500K – Workforce Development f/Teachers & Scientists – *Patricia Dehmer*
- $1,849,300K – Basic Energy Sciences – *Harriet Kung*
- Project Assessment – *Stephen Meador*
- $612,400K – Biological & Environ-mental Research – *Sharlene Weatherwax*
- SBIR/STTR Programs Office – *Manuel Oliver*
- $420,000K – Fusion Energy Sciences – *Edmund Synakowski*
- $788,000K – High Energy Physics – *James Siegrist*
- $624,600K – Nuclear Physics – *Timothy Hallman*

Deputy Director for Resource Management
Jeffrey Salmon

Executive Officer - *Helen DeHart*

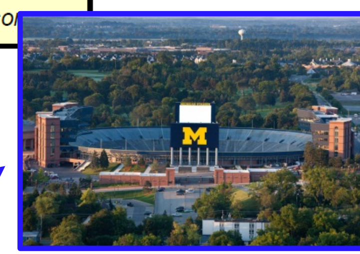
- Budget – *Kathleen Klausing*
- Information Technology and Services – *Vasilios Kountouris*
- Grants & Contracts – *Linda Shariati*
- SC Communications and Public Affairs – *Rick Borchelt*
- $187,400K – SCPD & Analysis – *Daniel Division*
- Human Resources and Administration – *Waltrunette Gardner*
- Scientific and Technical Information – *Brian Hitson*

FY 2015	
Research	42%
Facility Ops	39%
Projects	13%
Other	6%

73%

FY 2014

16% universities



industries 6%

Program Planning in SC

Mission Need

- Executive branch priorities
  - Administration priorities
    - National Science and Technology Council (and WGs)
    - Office of Science and Technology Policy (and WGs)
    - Other Administration convened ad hoc WGs
    - Interagency coordination
  - Departmental priorities
    - DOE and program strategic plans
    - Quadrennial Technology Review/Quadrennial Energy Review
- Congressional branch priorities
  - Legislative authorities and annual appropriations

Scientific Opportunity

- Program priorities, via engagement of community experts and stakeholders
  - Federal Advisory Committees*
  - DOE sponsored scientific and technical workshops/reports
  - Non-DOE (NRC, JASONS, …) sponsored scientific and technical workshops/reports

* *Virtually all major facilities and research programs in SC have roots in Federal Advisory Committee reports and recommendations.*

The day-to-day business of SC

To achieve its mission, the SC workforce is charged with three core jobs: Execution, Defense, and Formulation.

- **Job #1: Execution**
  - **Fund the best science and research facilities to fulfill the DOE mission**
  - **Deliver the awarded funds to the research performers**
  - **Oversee and provide stewardship of the taxpayers' investments**

- **Job #1A: Defense**

  Justify the investments

- **Job #1B: Formulation**

  Develop strategies to succeed in the future

SC Has Stewardship Responsibility for Ten DOE Laboratories

Berkeley Lab

Berkeley, California
202 acres and 97 buildings
3,396 FTEs
950 students & postdocs
9,320 facility users
www.lbl.gov

Pacific Northwest National Laboratory

Richland, Washington
346 acres and 19 buildings
4,344 FTEs
550 students & postdocs
1,733 facility users
www.pnnl.gov

The Ames Laboratory

Ames, Iowa
8 acres and 12 buildings
308 FTEs
158 students & postdocs
www.ameslab.gov

Fermilab

Wilson Hall

Batavia, Illinois
6,800 acres and 354 buildings
1,720 FTEs
55 students & postdocs
2,097 facility users
www.fnal.gov

Argonne National Laboratory

Advanced Photon Source

Argonne, Illinois
1,517 acres and 100 buildings
3,460 FTEs
1,054 students & postdocs
6,547 facility users
www.anl.gov

SLAC National Accelerator Laboratory

Menlo Park, California
426 acres and 151 buildings
1,596 FTEs
213 students & postdocs
4,474 facility users
www.slac.stanford.edu

Oak Ridge National Laboratory

Spallation Neutron Source

Oak Ridge, Tennessee
4,421 acres and 194 buildings
4,586 FTEs
1,080 students & postdocs
3,215 facility users
www.ornl.gov

Jefferson Lab

Newport News, Virginia
169 acres and 72 buildings
729 FTEs
60 students & postdocs
1,261 facility users
www.jlab.org

PPPL — Princeton Plasma Physics Laboratory

NSTX Spherical Tokamak

Princeton, New Jersey
89 acres and 34 buildings
429 FTEs
54 students & postdocs
290 facility users
www.pppl.gov

Brookhaven National Laboratory

Relativistic Heavy Ion Collider

Upton, New York
5,322 acres and 310 buildings
2,882 FTEs
642 students & postdocs
4,134 facility users
www.bnl.gov

SC Builds (big) Stuff! … and does this well

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

Office of Science User Facilities

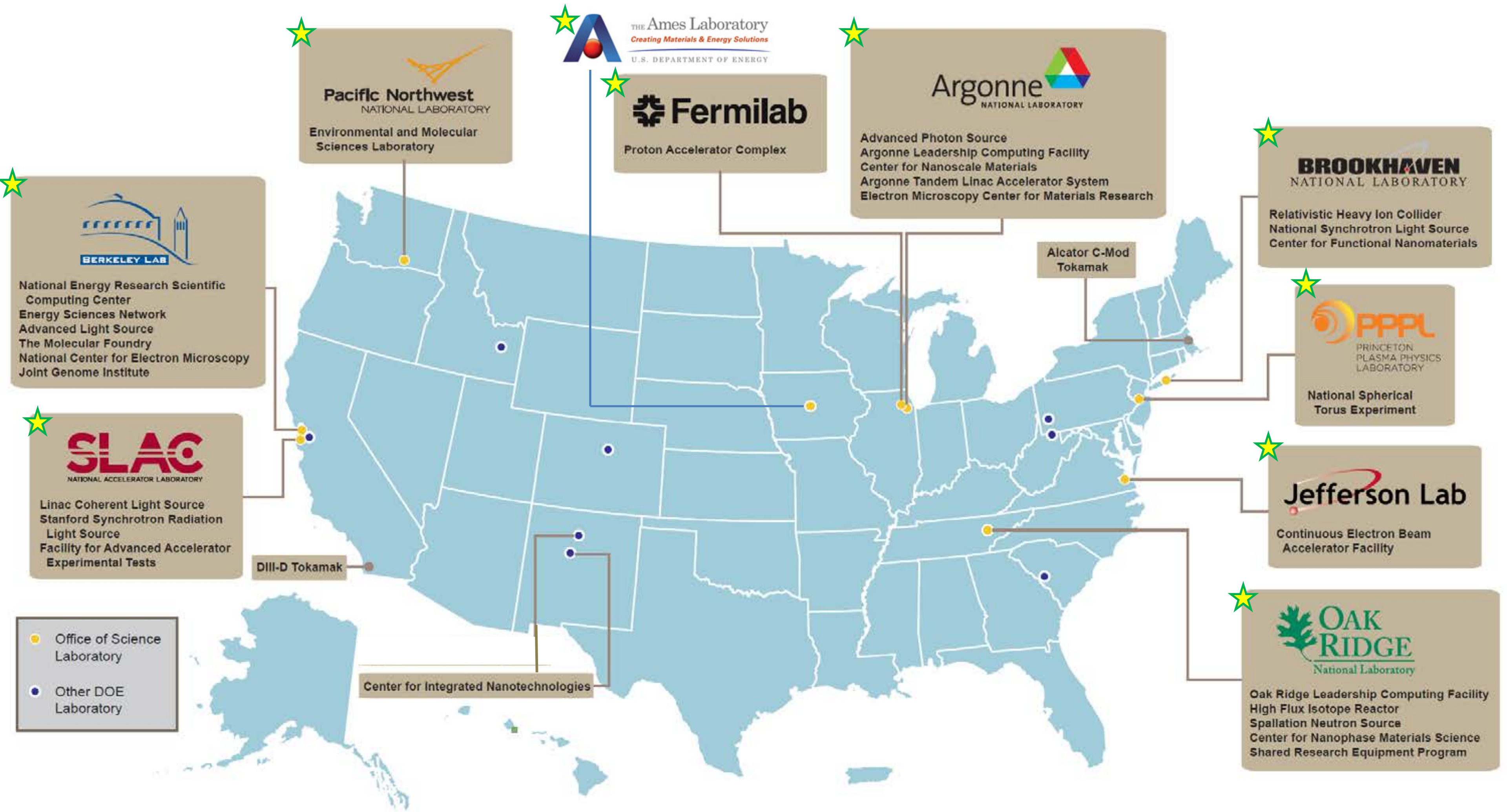
- **supercomputers,**
- **high intensity x-ray, neutron, and electron sources,**
- **nanoscience facilities,**
- **genomic sequencing facilities,**
- **particle accelerators,**
- **fusion/plasma physics facilities, and**
- **atmospheric monitoring capabilities.**

- 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

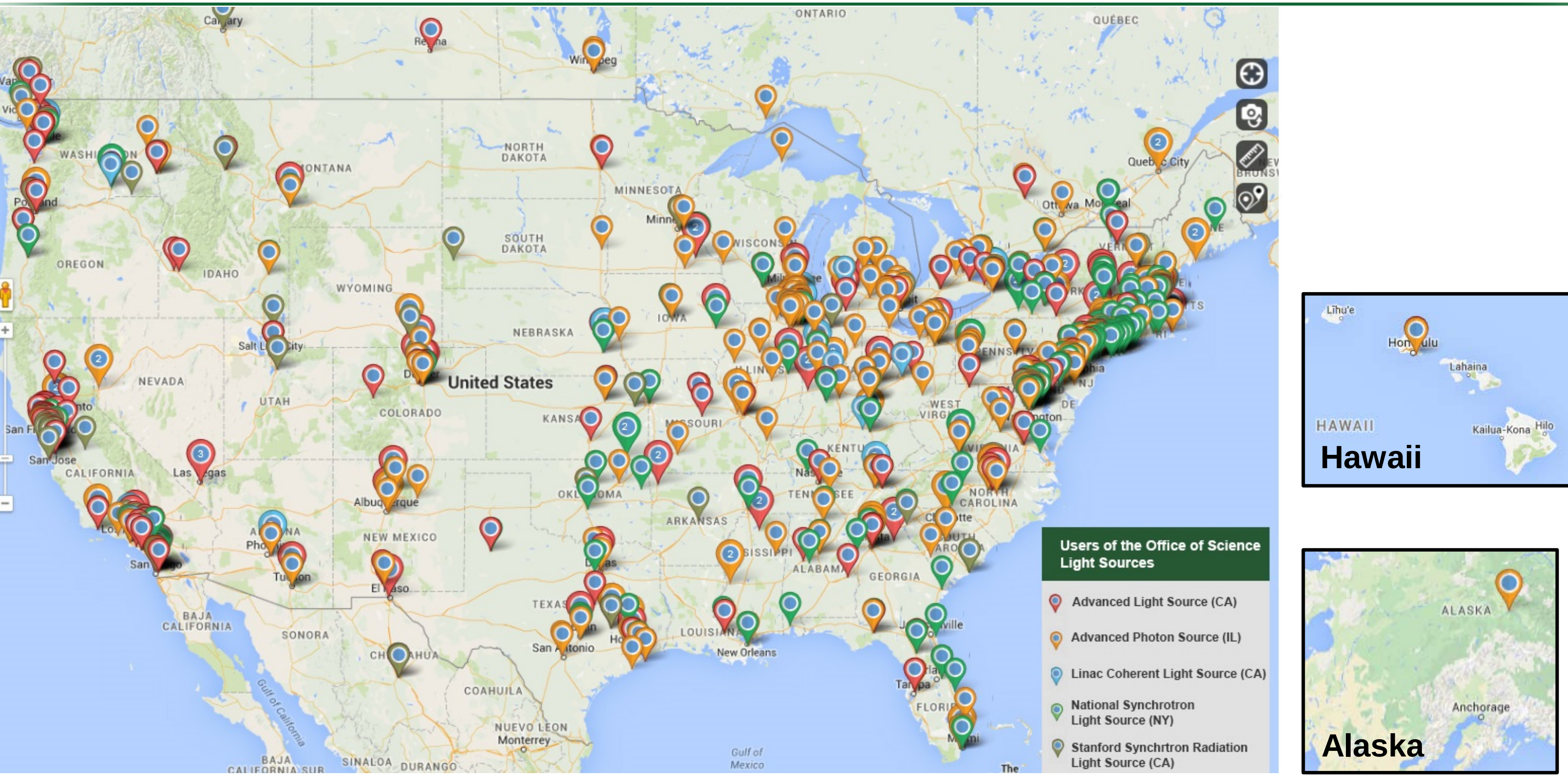
Where the user facilities are: DOE Laboratories (mostly)



★ SC is the steward of these ten DOE laboratories

Where Do the U.S. Light Source Users Come From*?

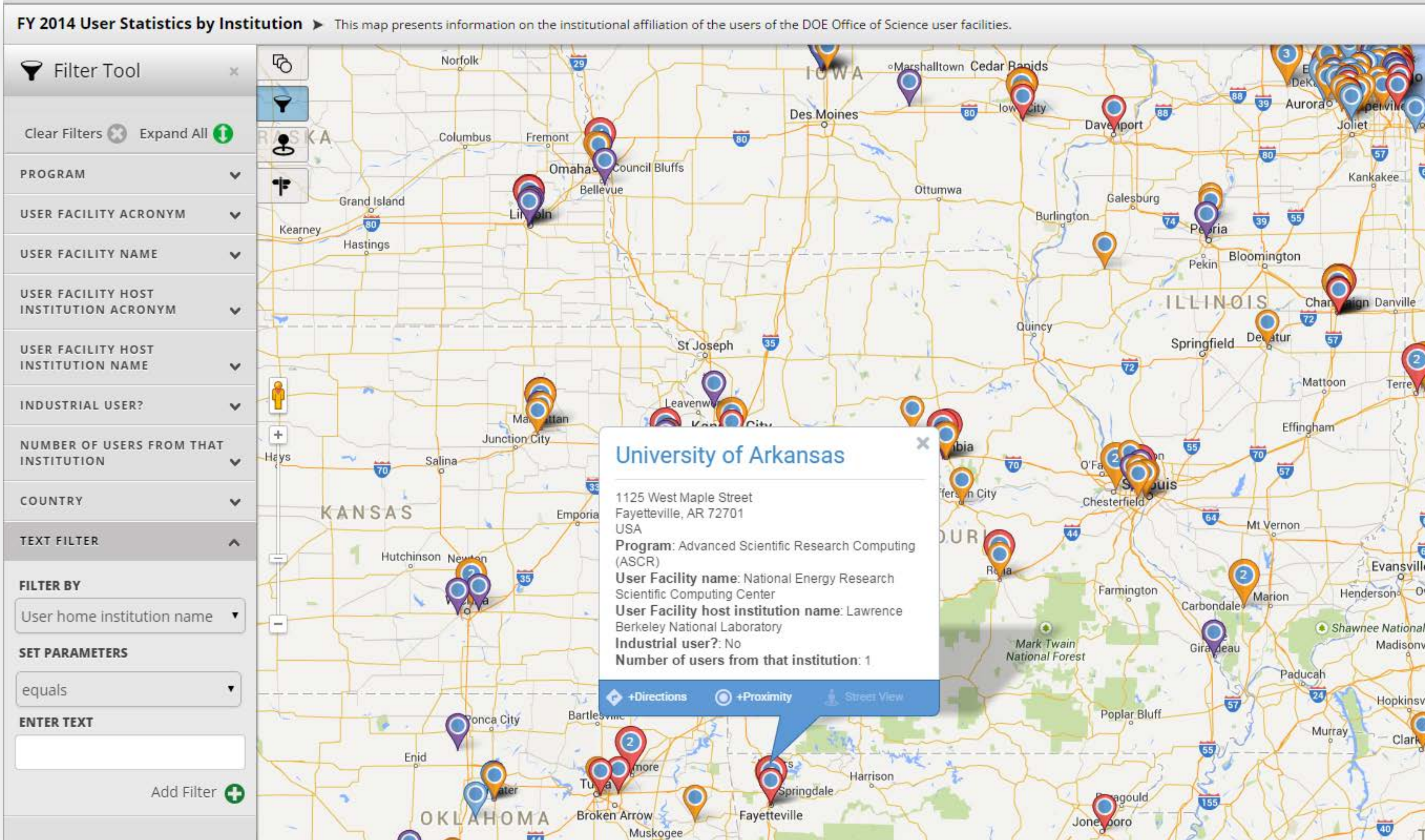
http://science.energy.gov/user-facilities/user-statistics/



~11,400 users; ~50% funded by non-SC/DOE resources

*for all facilities, >31,000 researchers each year; ~1/2 of the facility users come from universities; ~1/3 of the users come from DOE national laboratories; the remaining come from industry, other agencies, and international entities.

Explore interactive maps of SC grantees and facility users



Recent DOE/SC Nobel Prize winning work …100 Nobel Prizes during the past 6 decades—more than 20 in the past 12 years (some associated with SC user facilities)

Year	Prize	Name	Home Institution(s)	DOE-SC Affiliation
2013	Chemistry	Martin Karplus Nobel Lecture	Universite dé Strasbourg; Harvard University	•National Energy Research Scientific Computing Center (NERSC)
2013	Chemistry	Michael Levitt Nobel Lecture	Stanford University School of Medicine	•Biological and Environmental Research
2012	Chemistry	Brian K. Kobilka Nobel Lecture	Stanford University School of Medicine	•Argonne National Laboratory
2011	Physics	Saul Perlmutter Nobel Lecture	University of California, Berkeley	•Lawrence Berkeley National Laboratory •High Energy Physics
2009	Chemistry	Venkatraman Ramakrishnan Nobel Lecture	MRC Laboratory of Molecular Biology	•Brookhaven National Laboratory •Basic Energy Sciences
2009	Chemistry	Thomas A. Steitz Nobel Lecture	Howard Hughes Medical Institute; Yale University	•Brookhaven National Laboratory •Basic Energy Sciences
2009	Chemistry	Ada E. Yonath Nobel Lecture	Weizman Institute of Science, Israel	•Argonne National Laboratory •Basic Energy Sciences

Recent DOE/SC Nobel Prize winning work (cont.)…
(many associated with SC user facilities)

2008	Chemistry	Roger Y. Tsien Nobel Lecture	University of California, San Diego	•Brookhaven National Laboratory •Biological and Environmental Research
2008	Physics	Yoichiro Nambu Nobel Lecture	Enrico Fermi Institute; University of Chicago	
2007	Physics	Peter Grünberg Nobel Lecture	Forschungszentrum Jülich	•Argonne National Laboratory
2006	Chemistry	Roger D. Kornberg Nobel Lecture	Stanford University	•Stanford Linear Accelerator Center
2006	Physics	John C. Mather Nobel Lecture	Goddard Space Flight Center (NASA)	•Lawrence Berkeley National Laboratory •High Energy Physics
2006	Physics	George F. Smoot Nobel Lecture	University of California, Berkeley	•Lawrence Berkeley National Laboratory •High Energy Physics
2005	Chemistry	Robert H. Grubbs Nobel Lecture	California Institute of Technology	•Basic Energy Sciences
2005	Chemistry	Richard R. Schrock Nobel Lecture	Massachusetts Institute of Technology	•Basic Energy Sciences

Recent DOE/SC Nobel Prize winning work (cont.)…
(many associated with SC user facilities)

2004	Physics	David J. Gross Nobel Lecture	Princeton University; University of California, Santa Barbara	•Fermi National Laboratory •Lawrence Berkeley National Laboratory •High Energy Physics
2004	Physics	H. David Politzer Nobel Lecture	California Institute of Technology	•High Energy Physics
2004	Physics	Frank Wilczek Nobel Lecture	Massachusetts Institute of Technology	•High Energy Physics
2003	Chemistry	Peter Agre Nobel Lecture	Johns Hopkins University	•Lawrence Berkeley National Laboratory •Biological and Environmental Research
2003	Chemistry	Roderick MacKinnon Nobel Lecture	Rockefeller University	•Brookhaven National Laboratory
2003	Physics	Alexei A. Abrikosov Nobel Lecture	Institute for Physical Problems	•Argonne National Laboratory
2003	Physiology or Medicine	Sir Peter Mansfield Nobel Lecture	University of Nottingham	•Basic Energy Sciences

… to recent Fortune 500 users

DUPONT
MONSANTO
GE
Honeywell
WD Western Digital
JOHN DEERE
3M
Abbott A Promise for Life
BOEING
Medtronic
Raytheon
Lilly
DOW
Ford
Chevron
ExxonMobil
P&G
MERCK
IBM
Pfizer
intel
GM
hp
AMGEN
Ball
AIR PRODUCTS
MOTOROLA
NORTHROP GRUMMAN
Bristol-Myers Squibb
ITT
CAT
HALLIBURTON
Kodak
LOCKHEED MARTIN
Cummins
SAIC
Johnson & Johnson
TEXAS INSTRUMENTS
United Technologies

Thank you!

Best wishes for a productive summer…

work safely & securely, and …

please stay in touch via the Notable Outcomes portal, which is accessible in perpetuity using your WDTS online application system profile.

Questions/Comments? – Please email SULI, CCI, or VFP inquiries to:

sc.suli@science.doe.gov; sc.cci@science.doe.gov; sc.vfp@science.doe.gov (respectively)

Web resources for Office of Science and WDTS information:

http://science.energy.gov

http://science.energy.gov/wdts

Please also feel free to contact me:

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