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Introduction to Laboratory Directed Research and Development (LDRD)

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Photo: Argonne National Laboratory

Outline

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- What is LDRD
- Background – Statutory Basis, Reports, & Studies
- Facts, Figures, and Trends
- Value of LDRD
- Performance Measures
- LDRD Authorities and Requirements
- How do the labs run their programs?
- How does DOE guide and oversee their programs?
- How does DOE approve LDRD projects?
- Possible Improvements to LDRD
- Recurring Congressional Concerns
- Success Stories

What is LDRD

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- **Laboratory Directed Research and Development (LDRD)** is research and development (R&D) work of a creative and innovative nature that is selected by the director of a national laboratory for the purpose of building new capabilities, identifying and developing potential applications, and formulating new theories, hypotheses, and approaches that advance the DOE's missions.
- LDRD both opens new avenues for the Department's programs and contributes to maintaining the vitality of the laboratories in R&D areas important to the DOE.

Statutory Basis

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- **The Atomic Energy Act of 1954, as amended, Title 42 U.S.C. 2103, 2051, and 2053 -** Provides broad authority for research and development activities and their funding
- **An Act for Authorizations and Appropriations for the Energy Research and Development Administration for FY 1977 (P.L. 95-39) -** Authorizes any laboratory under contract with the Energy Research and Development Administration, with the Administrator's approval, to "use a reasonable amount of its operating budget for the funding of employee-suggested research projects.
- **The Consolidated Appropriations Act, 2014 (P.L. 113-76) –** Reduced the maximum allowable funding level of an LDRD program to 6% of a laboratory's operating/capital equipment budget.

Reports on LDRD

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- **Packard Panel 1983**

  If U.S. taxpayers are to get the most return from their support of R&D, government laboratories must have sufficient discretionary funding for independent research and development. Almost every laboratory has found that the most important innovation often comes from the scientists' independent ideas or actions. Thus the productivity of the U.S. R&D establishment depends on a vigorous independent R&D program.

- **The Energy Research Advisory Board (ERAB) December 1985 Guidelines:**

  The ERAB reiterates its 1982 recommendation "that laboratory directors have substantial flexibility to reprogram assigned laboratory resources . . . and to initiate or adapt programs in accordance with research opportunities." Current exploratory R&D levels of 1 to 2 percent over total operational funding should be increased to the range of 5 to 10 percent over the next five years.

- **The Commission to Review the Effectiveness of the National Energy Laboratories:**

  LDRD's accomplishments are noteworthy. Multiple programs across the system have often begun through initial LDRD investments in capabilities and expertise, and the investments have often produced significant returns—both scientific and financial.

Studies and Audits

- **2001 GAO review (GAO-01-927)**

  National Laboratories: Better Performance Reporting Could Aid Oversight of Laboratory-Directed R&D Program validated improvements made by DOE and only provided one recommendation related to a more consistent approach to reporting on the LDRD performance across the laboratories.

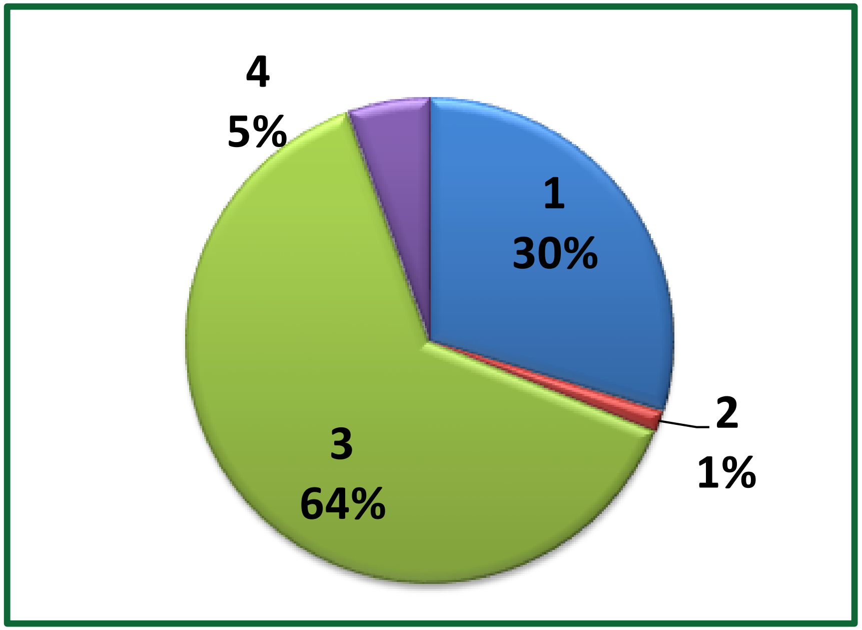
- **2004 GAO review (GAO-04-489)**

  Federal Research: Information on DOE's Laboratory-Directed R&D Program did not result in any recommendations and stated that DOE has policies and procedures in place "to ensure departmental compliance with statutory requirements and congressional direction in committee reports."

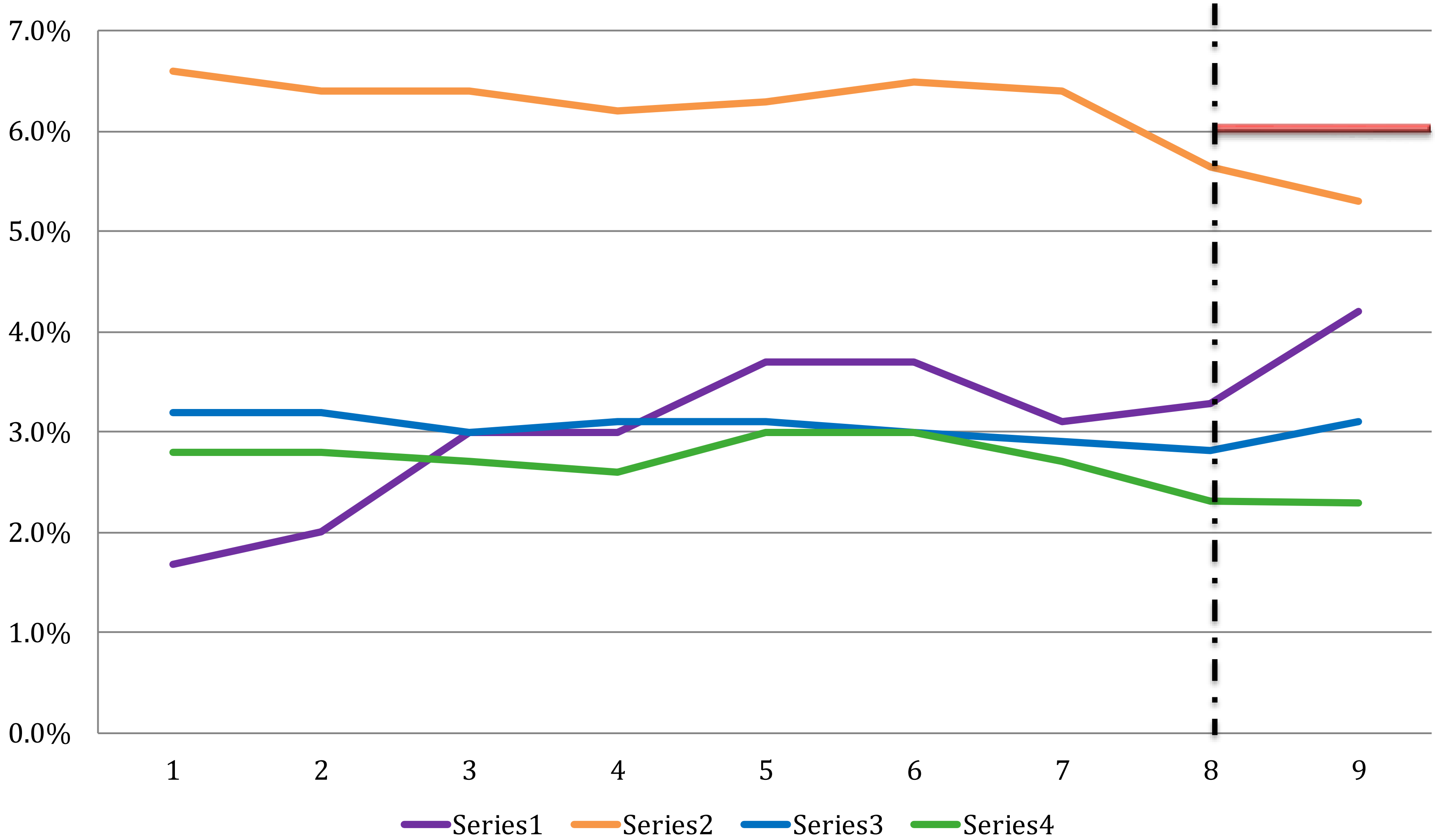
- **IG audits (2005 and 2009) were terminated after the initial survey phase**

LDRD Programs

- All DOE labs are eligible for LDRD funding under the FY 2006 Energy and Water Appropriations Act (P.L. 109-103).
- **Currently 16 Labs will have LDRD programs:** AMES, ANL, BNL, FNAL, INL, LANL, LBNL, LLNL, NREL, ORNL, PNNL, PPPL, SLAC, SNL, SRNL, and TJNAF
- The labs spent the following on LDRD in FY 2015:
  - $160.7 M at SC labs
  - $344 M at NNSA labs
  - $29.6 M at Energy labs
  - $7.7 M at SRNL (EM)



History of Actual LDRD %



Beginning in FY 2014 the maximum LDRD funding level was reduced to 6%

LDRD Costs by Program

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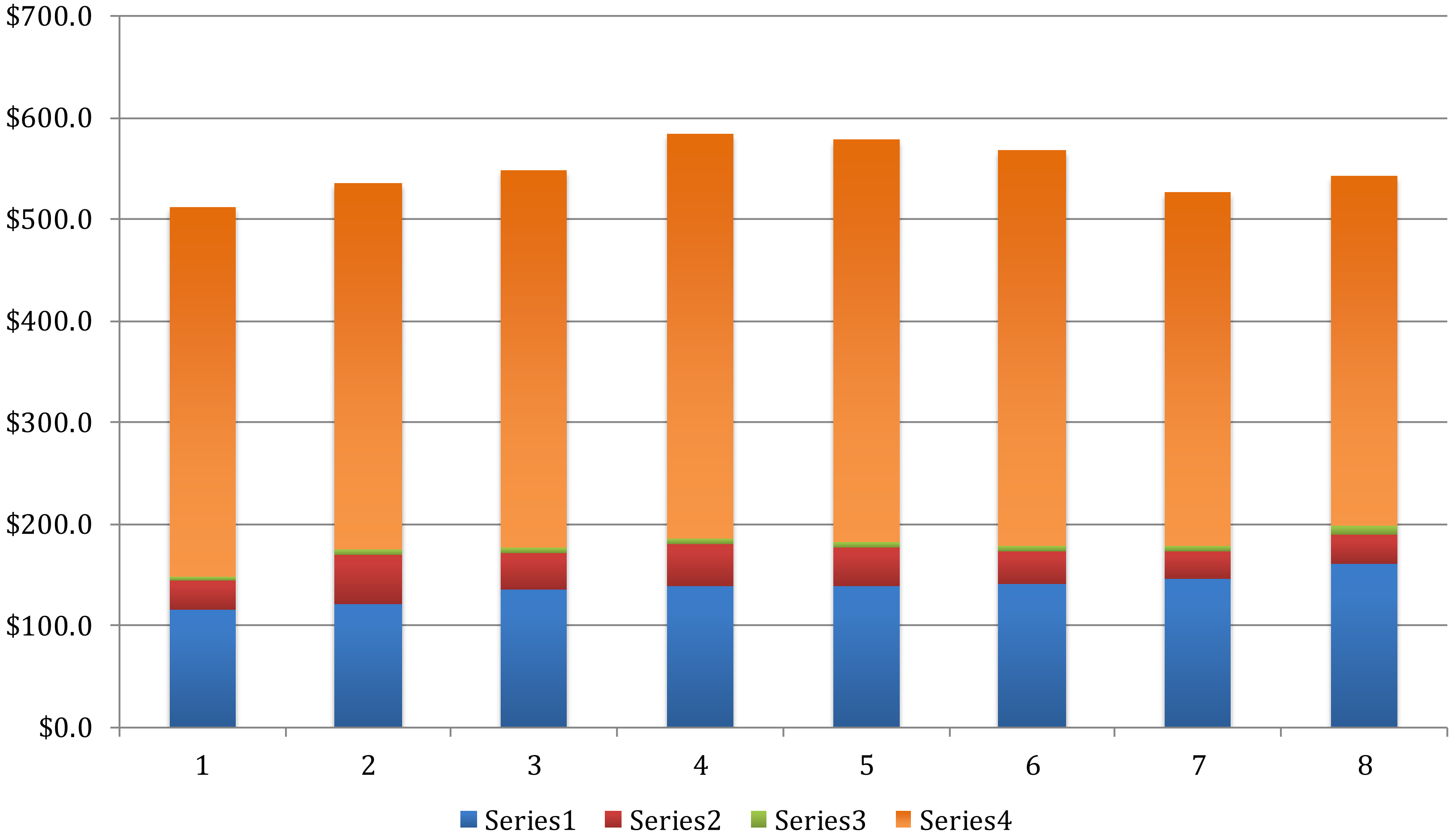

Value of LDRD

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- **Laboratory Directed Research and Development (LDRD)** provides the laboratories with the opportunity to invest in high-risk, potentially high-value research and development that aims to:
  - Maintain the scientific and technical vitality of the laboratories;
  - Enhance the laboratories' ability to address future DOE/NNSA missions;
  - Foster creativity and stimulate exploration of forefront science and technology; and
  - Serve as a proving ground for new concepts in research and development.
- Provides avenue to recruit strategic new hires, support students/post-docs and retain key scientists
- LDRD is the *only discretionary research funding* available to the Laboratory Director to use to strengthen the lab's core competencies and position it for the future

FY 2015 Performance Metrics

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Laboratory	Number of postdoctoral researchers supported (over 10%) by LDRD	Number of postdoctoral researchers supported by all Laboratory Programs	Percentage of postdoctoral researchers supported at least 10% by LDRD
National Renewable Energy Laboratory	14	32	44%
Idaho National Laboratory	30	85	35%
Savannah River National Laboratory	4	13	31%
Energy and Environment Total	**48**	**130**	**37%**
Lawrence Livermore National Laboratory	88	236	37%
Los Alamos National Laboratory	266	488	55%
Sandia National Laboratory	104	263	40%
NNSA Total	**458**	**987**	**46%**
Ames National Laboratory	2	64	3%
Argonne National Laboratory	122	355	34%
Brookhaven National Laboratory	35	148	24%
Fermi National Accelerator Laboratory	1	69	1%
Lawrence Berkley National Laboratory	69	647	11%
Oak Ridge National Laboratory	77	395	19%
Pacific Northwest National Laboratory	75	260	29%
Princeton Plasma Physics Laboratory	4	26	15%
SLAC National Accelerator Laboratory	24	171	14%
Thomas Jefferson National Accelerator Facility	4	23	17%
SC Total	**413**	**2158**	**19%**
Total			

LDRD Authorities & Policies

- Authority of the LDRD program and various requirements are set in law. The requirements include caps on LDRD spending levels, an annual report to congress, certifications of the use of LDRD funding, and an overhead charge on LDRD projects.
- **DOE Order 413.2C, *Laboratory Directed Research and Development*** sets the specific requirements for LDRD projects, plans, and reports.
- Each Program Secretarial Officer issues a **Roles and Responsibilities Document** that defines expectations for the LDRD projects, plans, and reports. A working group with representatives from programs with LDRD projects works to ensure these R&R documents are as consistent as is reasonable, given the various needs of each program office.

LDRD Requirements

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- A laboratory's maximum allowable LDRD funding level is 6% of its operating/capital equipment budget.
- Per DOE O 413.2C, each LDRD project:
  - must be in the forefront areas of science and technology relevant to DOE/NNSA missions.
  - will normally be relatively small and include one or more of the following characteristics:
    - advanced study of hypotheses, concepts, or innovative approaches to scientific or technical problems;
    - experiments and analyses directed towards "proof of principle" or early determination of the utility of new scientific ideas, technical concepts, or devices; and
    - conception and preliminary technical analyses of experimental facilities or devices.
  - must be limited to a maximum period of performance of 36 months, unless an exception is granted by the (CSO)/Deputy Administrator, NNSA, or his/her authorized designee.

LDRD Requirements (cont.)

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- In addition, LDRD funds will not be used to:
  - substitute for or increase funding for any tasks for which a specific limitation has been established by Congress or the Department or for any specific tasks that are funded by DOE/NNSA or other users of the laboratory;
  - fund projects that will require the addition of non-LDRD funds to accomplish the technical goals of the LDRD project, except as provided by legislation;
  - fund construction design beyond the preliminary phase or fund line-item construction projects; or
  - fund general purpose capital expenditures with the exception of acquisition of general purpose equipment that is clearly required for the project and is not otherwise readily available from laboratory inventory.

How Programs Operate

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- The specific details of a laboratory's LDRD program are left to the discretion of the laboratories themselves, yet, several similarities remain among the different laboratories' programs:
  - LDRD programs are designed to enhance and develop the S&T capabilities of the laboratories to support DOE mission needs
  - LDRD projects are chosen through competitive, peer-reviewed proposal processes that focus on their scientific merit
  - LDRD projects are checked for consistency with the requirements of the LDRD Order

DOE Oversight

- **DOE Headquarters**
  - Cognizant Secretarial Officer approves each laboratory's annual LDRD program plan and associated maximum LDRD funding levels based on the laboratory's request and the responsible field/site office recommendation
  - Office of Science has responsibility for the overall DOE policy (DOE Order 413.2C) and is primary contact for policy clarification and issue resolution

- **DOE Field/Site Offices**
  - Review and provide recommendations on the laboratories' annual LDRD program plans, and certifies LDRD accounting methods
  - Monitor compliance with LDRD policies/procedures by their contractors
  - Assures the laboratories submit annual LDRD Program Reports to DOE that include specific data on each LDRD project, as required by the Department

DOE Approval of Projects

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- **DOE field/site offices** review and concur on each proposed LDRD project prior to the obligation of funds and the start of work to determine that the projects support one or more DOE/NNSA missions and meet other relevant regulations and policy requirements

Possible Improvements

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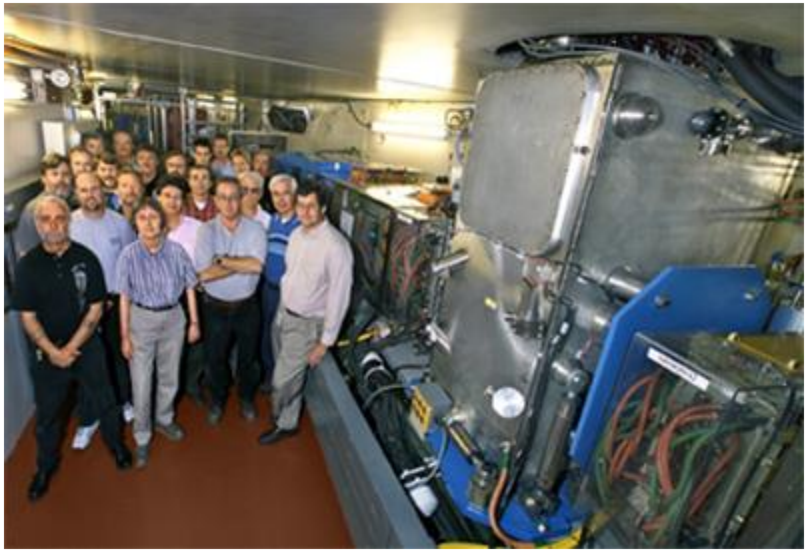
- Develop better methods for measuring and communicating the value and impact of LDRD to key stakeholders (e.g., Congress)
- In addition to the annual program reviews, conduct an independent review of LDRD using the federal advisory committee model.

Recurring Concerns

- **Recurring concerns from Congress**
  - DOE has not effectively demonstrated LDRD benefits
  - LDRD takes away already limited resources from mission work
  - LDRD provides laboratories with a vehicle to expand their missions
  - Programs are not taxed evenly
- **How has/will DOE address these**
  - Share stories where LDRD projects lead to breakthroughs that support mission needs
  - Laboratory plans identify how LDRD investments strengthen core capabilities needed to achieve DOE missions
  - DOE reviews and approves annual program plan and all projects
  - DOE annually certifies that LDRD funds are accrued consistently and equitably across all programs

Success Stories

- LDRD projects lead to improved scientific capabilities. The initial LDRD proof-of-principal studies justified construction and installation of several beamlines using actual "superbend" magnets enabling upgrades to the LBNL's Advanced Light Source. These new capabilities were an important component, along with other work at the Stanford Synchrotron Light Source, of Roger Kornberg's determination of the structure of RNA Polymerase II, and for which Kornberg received the 2006 Nobel Prize in Chemistry.



Advanced Light Source Superbend installation
Photo courtesy of Lawrence Berkeley National Laboratory

Success Stories

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- LDRD funds work that reduces the cost of DOE cleanup work. PNNL scientists developed a coating process to make sponge-like silica latch onto toxic metals, like mercury. This technology allows remediation of complex environmental contamination issues, including the removal of mercury, without creating hazardous waste or by-products. Called SAMMS, short for self-assembled monolayers on mesoporous support, can be used to create a product that is about 500 times faster and much less expensive than previous mercury remediation methods.

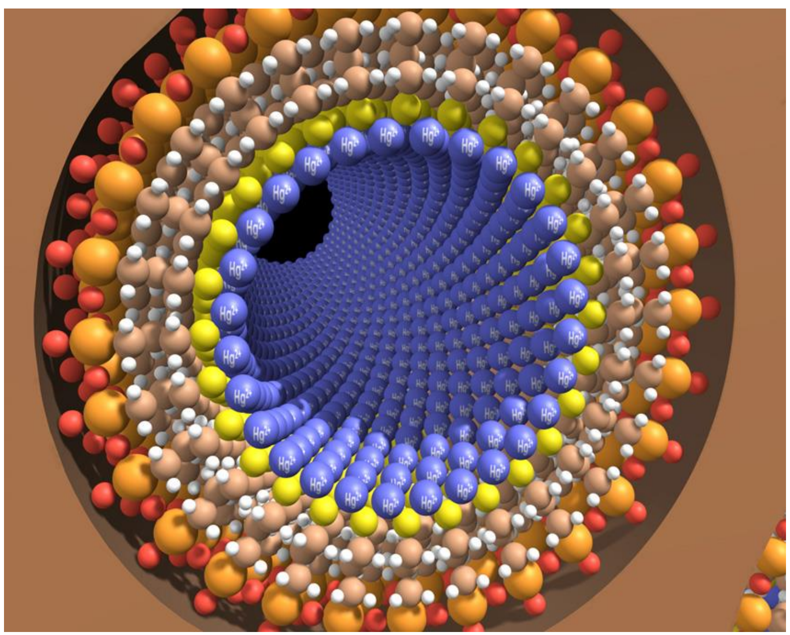
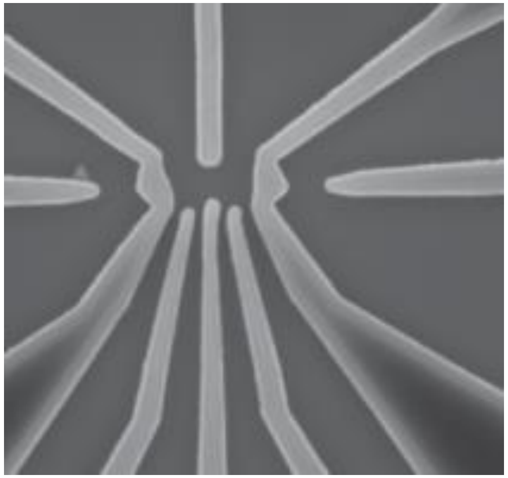


Illustration of a SAMMS structure
Photo courtesy of Pacific Northwest National Laboratory

Success Stories

- LDRD enables more powerful computers by through discoveries related to quantum bits (qubits), essential elements of a quantum computer. LDRD work at SNL has allowed scientists to isolate a few electrons in silicon quantum dots, creating qubits that can be more-readily integrated with the silicon-based semiconductor circuitry that forms the basis for much of modern electronics. Precision simulation of complex quantum systems have important national security applications that are of interest to DOE, DoD, and DHS.



Electron micrograph of the fabricated silicon electrostatic electron-confinement chamber. *Photo courtesy of Sandi National Laboratory*

Success Stories

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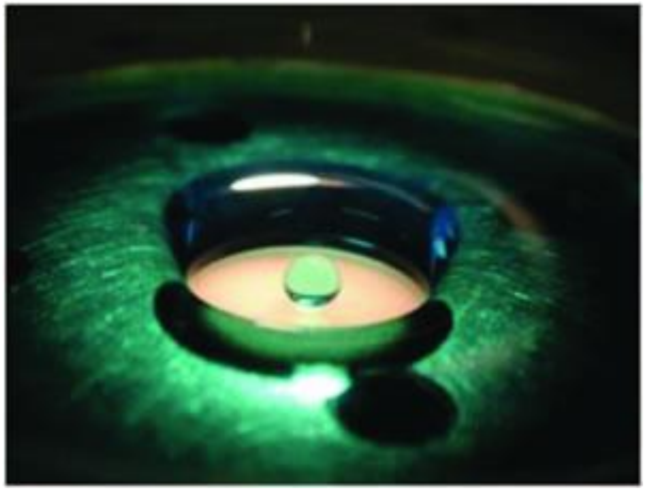
- LDRD enables longer lasting materials. Superhydrophobic silica-based coatings and deposition methods provide unprecedented protection, substantially increasing the life of equipment while lowering maintenance costs. The “wettability” of a surface is determined by the water-surface interactions and the surface roughness. A team, lead by John Simpson, was able to change the wettability state by tailoring the surface topology and surface chemistry. The resulting structures consist of an outer layer of nanotextured sand with dimensions ranging from tens of nanometers to a few microns.



Superhydrophobic surface surrounded by a layer of water on an untreated surface
Photo courtesy of Oak Ridge National Laboratory