Research Opportunities in the DOE Office of Science

2008 American Society for Engineering Education (ASEE) Engineering Research Council Forum

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Office of Science
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www.science.doe.gov
The Office of Science supports basic research in support of the DOE mission.

The DOE is a mission agency with responsibilities in energy, environment, and national security.

The Office of Science supports research within the DOE mission at universities and national laboratories.

The Office of Science also plans, builds, and operates user facilities for the scientific community.
Fiscal Year 2009 DOE Budget Request to Congress

- Energy & Environment: $10.1B
- National Security: $9.1B
- Corporate Management: $10.9B
- Science: $4.7B
The Office of Science supports research and facilities within defined scientific programs.

**Basic Energy Sciences** - Advance the Basic Sciences for Energy Independence.

Provide the scientific knowledge and tools to achieve energy independence, securing U.S. leadership and essential breakthroughs in basic energy sciences.

**Biological and Environmental Research** - Harness the Power of Our Living World.

Provide the biological and environmental discoveries necessary to clean and protect our environment, offer new energy alternatives, and fundamentally alter the future of medical care and human health.

**Fusion Energy Sciences** - Bring the Power of the Stars to Earth.

Answer the key scientific questions and overcome the enormous technical challenges to harness the power that fuels a star, realizing by the middle of this century a landmark scientific achievement by bringing fusion power to the U.S. electrical grid.


Understand the unification of fundamental particles and forces and the mysterious forms of unseen energy and matter that dominate the universe, search for possible new dimensions of space, and investigate the nature of time itself.

**Nuclear Physics** - Explore Nuclear Matter - from Quarks to Stars.

Understand the evolution and structure of nuclear matter, from the smallest building blocks, quarks and gluons; to the elements in the universe created by stars; to unique isotopes created in the laboratory that exist at the limits of stability, possessing radically different properties from known matter.

**Advanced Scientific Computing Research** - Deliver Computing for the Frontiers of Science.

Deliver forefront computational and networking capabilities to scientists nationwide that enable them to extend the frontiers of science, answering critical questions that range from the function of living cells to the power of fusion energy.

**Office of Workforce Development for Teachers and Scientists**
## Office of Science FY 2009 Budget Request to Congress

### (dollars in thousands)

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<tbody>
<tr>
<td>Basic Energy Sciences</td>
<td>1,221,380</td>
<td>1,269,902</td>
<td>1,568,160</td>
<td>+298,258 (+23.5%)</td>
</tr>
<tr>
<td>Advanced Scientific Computing Research</td>
<td>275,734</td>
<td>351,173</td>
<td>368,820</td>
<td>+17,647 (+5.0%)</td>
</tr>
<tr>
<td>Biological and Environmental Research</td>
<td>480,104</td>
<td>544,397</td>
<td>568,540</td>
<td>+24,143 (+4.4%)</td>
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<tr>
<td>High Energy Physics</td>
<td>732,434</td>
<td>689,331</td>
<td>804,960</td>
<td>+115,629 (+16.8%)</td>
</tr>
<tr>
<td>Nuclear Physics</td>
<td>412,330</td>
<td>432,726</td>
<td>510,080</td>
<td>+77,354 (+17.9%)</td>
</tr>
<tr>
<td>Fusion Energy Sciences</td>
<td>311,664</td>
<td>286,548</td>
<td>493,050</td>
<td>+206,502 (+72.1%)</td>
</tr>
<tr>
<td>Science Laboratories Infrastructure</td>
<td>41,986</td>
<td>66,861</td>
<td>110,260</td>
<td>+43,399 (+64.9%)</td>
</tr>
<tr>
<td>Science Program Direction</td>
<td>166,469</td>
<td>177,779</td>
<td>203,913</td>
<td>+26,134 (+14.7%)</td>
</tr>
<tr>
<td>Workforce Dev. for Teachers &amp; Scientists</td>
<td>7,952</td>
<td>8,044</td>
<td>13,583</td>
<td>+5,539 (+68.9%)</td>
</tr>
<tr>
<td>Safeguards and Security (gross)</td>
<td>75,830</td>
<td>75,946</td>
<td>80,603</td>
<td>+4,657 (+6.1%)</td>
</tr>
<tr>
<td>SBIR/STTR (SC funding)</td>
<td>86,936</td>
<td>——</td>
<td>——</td>
<td>——</td>
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<tr>
<td><strong>Subtotal, Office of Science</strong></td>
<td>3,812,819</td>
<td>3,902,707</td>
<td>4,721,969</td>
<td>+819,262 (+21.0%)</td>
</tr>
<tr>
<td>Adjustments*</td>
<td>23,794</td>
<td>70,435</td>
<td>——</td>
<td>-70,435 (—)</td>
</tr>
<tr>
<td><strong>Total, Office of Science</strong></td>
<td>3,836,613</td>
<td>3,973,142</td>
<td>4,721,969</td>
<td>+748,827 (+18.8%)</td>
</tr>
</tbody>
</table>

* Adjustments include SBIR/STTR funding transferred from other DOE offices (FY 2007 only), a charge to reimbursable customers for their share of safeguards and security costs (FY 2007 and FY 2008), Congressionally-directed projects and a rescission of a prior year Congressionally-directed project (FY 2008 only), and offsets for the use of prior year balances to fund current year activities (FY 2007 and FY 2008).
The Office of Science is a steward for 10 of 17 DOE national labs and operates more than 30 major scientific user facilities.

Approximately 1/2 of the budget supports operations of the scientific user facilities and construction of new facilities; the other 1/2 supports research at the national laboratories and universities.

In FY 2009 SC plans to support the research of ~24,000 faculty, postdoctoral researchers, graduate students, and undergraduates.

~20,000 users of scientific facilities a year
~1/2 of the annual 20,000 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.
World-Class Facilities for Science

Basic Energy Sciences (BES)
- Spallation Neutron Source
- Light Sources – e.g., Advanced Photon Source (APS), Advanced Light Source (ALS), Linac Coherent Light Source (LCLS)
- 5 Nanoscale Science Research Centers

Fusion Energy Sciences (FES)
- ITER
- National Spherical Torus Experiment (NSTX), DIII-D Tokamak, Alcator C-Mod Tokamak

Advanced Scientific Computing Research (ASCR)
- Leadership Computing Facilities
- National Energy Research Scientific Computing Center (NERSC)

High Energy Physics (HEP)
- Fermilab's Tevatron Collider
- Large Hadron Collider (LHC)

Biological and Environmental Research (BER)
- 3 Bioenergy Research Centers
- The Joint Genome Institute
- Environmental Molecular Sciences Laboratory

Nuclear Physics (NP)
- Relativistic Heavy Ion Collider (RHIC)
- Continuous Electron Beam Accelerator Facility (CEBAF)
- Rare Isotope Beam Facility
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All research funded at laboratories and universities, including facilities construction and operations, is awarded through a peer-reviewed, merit-based process.

**Merit Review Criteria:**
- Scientific and/or technical merit of the project
- Appropriateness of the proposed method or approach
- Competency of the personnel and adequacy of proposed resources
- Reasonableness and appropriateness of the proposed budget

*The Office of Science has ~3000 active university grants, entertaining ~2000 new and renewal applications per year.*
The Office of Science develops its programs and plans within the context of the DOE mission and in concert with the science community.

Research areas are identified using federal advisory committees, program and topical workshops, interagency groups, National Academies’ studies, and open and targeted solicitations.

As an example, the Office of Basic Energy Sciences (BES) recently completed an important workshop series....
“Basic Research Needs” Workshops

- **Basic Research Needs to Assure a Secure Energy Future**  
  BESAC Workshop, October 21-25, 2002  
  The foundation workshop that set the model for the focused workshops that follow.

- **Basic Research Needs for the Hydrogen Economy**  

- **Basic Research Needs for Solar Energy Utilization**  
  BES Workshop, April 18-21, 2005

- **Basic Research Needs for Superconductivity**  
  BES Workshop, May 8-10, 2006

- **Basic Research Needs for Solid-state Lighting**  
  BES Workshop, May 22-24, 2006

- **Basic Research Needs for Advanced Nuclear Energy Systems**  
  BES Workshop, July 31-August 3, 2006

- **Basic Research Needs for the Clean and Efficient Combustion of 21st Century Transportation Fuels**  
  BES Workshop, October 30-November 1, 2006

  BES Workshop, February 21-23, 2007

- **Basic Research Needs for Electrical Energy Storage**  
  BES Workshop, April 2-5, 2007

- **Basic Research Needs for Materials under Extreme Environments**  
  BES Workshop, June 10-14, 2007

- **Basic Research Needs for Catalysis for Energy**  
  BES Workshop, August 5-10, 2007

Reports available at  
[http://www.sc.doe.gov/bes/reports/list.html](http://www.sc.doe.gov/bes/reports/list.html)  

(BESAC = Basic Energy Sciences Advisory Committee)
The scientific challenges that emerge from the workshop series are no longer discussed in terms of traditional scientific disciplines.

**Directing Matter and Energy: Five Challenges for Science and the Imagination**

- How do we control materials processes at the level of electrons?
- How do we design and perfect atom- and energy-efficient syntheses of revolutionary new forms of matter with tailored properties?
- How do remarkable properties of matter emerge from the complex correlations of atomic or electronic constituents and how can we control these properties?
- How can we master energy and information on the nanoscale to create new technologies with capabilities rivaling those of living things?
- How do we characterize and control matter away—especially very far away—from equilibrium?

Addressing these grand challenges is key to making the transition from observation to control of matter.

Research Opportunities
Energy Frontier Research Centers (~$100M/yr)

Innovative basic research to accelerate scientific breakthroughs needed to create advanced energy technologies for the 21st century

Awards to be $2M-$5M per year for an initial 5-year period

The Office of Science seeks to engage the Nation’s intellectual and creative talent to tackle the scientific grand challenges associated with determining how nature works, leading the scientific community to direct and control matter at the quantum, atomic, and molecular levels, and harness this new knowledge and capability for some of our most critical real-world challenges.

Energy Frontier Research Centers will pursue fundamental basic research in areas such as:

- Solar Energy Utilization
- Catalysis for Energy
- Electrical Energy Storage
- Solid State Lighting
- Superconductivity
- Geosciences for Nuclear Waste and CO₂ Storage
- Advanced Nuclear Energy Systems
- Combustion of 21st Century Transportation Fuels
- Hydrogen Production, Storage, and Use
- Materials Under Extreme Environments

U.S. universities, DOE laboratories, and other institutions are eligible

http://www.sc.doe.gov/bes/EFRC.html
Energy Frontier Research Centers are based on the scientific knowledge base of energy-relevant research that has been articulated through the series of twelve workshop reports and have the following attributes:

The research program is at the forefront of one or more of the challenges described in the BESAC report Directing Matter and Energy: Five Challenges for Science and the Imagination.

The research program addresses one or more of the energy challenges described in the ten BES workshop reports in the Basic Research Needs series.

The program is balanced and comprehensive, and, as needed, supports experimental, theoretical, and computational efforts and develops new approaches in these areas.

The program provides opportunities to inspire, train, and support leading scientists of the future who have an appreciation for the global energy challenges of the 21st century.

The center leadership communicates effectively with scientists of all disciplines and promotes awareness of the importance of energy science and technology.

There is a comprehensive management plan for a world-leading program that encourages high-risk, high-reward research. The Center’s management plan demonstrates that the whole is substantially greater than the sum of the individual parts.

A number of EFRC awards will be initiated in FY 2009 based on an open competition among academic institutions, DOE laboratories, and other institutions. Research activities may be sited at universities, at DOE laboratories, or in joint university-laboratory collaborations.

The EFRC awards are expected to be in the $2–5 million range annually for an initial 5-year period. Pending Congressional appropriations, it is anticipated that approximately $100 million will be available for multiple EFRC awards.

A Funding Opportunity Announcement (FOA) will be issued in FY 2008 to request applications from the scientific community for the establishment of the initial suite of EFRCs.

As the EFRC program matures, it is anticipated that EFRC competitions will be held every 2 or 3 years and that renewal submissions will be openly competed with new submissions.

Out-year funding is subject to satisfactory progress in the research and the availability of funding appropriations.

While capital investment in instrumentation and infrastructure are expected as part of the EFRC awards, usage and leverage of existing facilities, including the BES user facilities, is encouraged.

Updates and further information on the FOA will be available at http://www.sc.doe.gov/bes/.
Pending Congressional appropriation, it is anticipated that up to $60 million will be available for core research program awards in FY 09.

Web announcement will be issued in FY 08 to request applications from the scientific community as part of the Office of Science Financial Assistance Funding Opportunity Announcement.

While no limit is set for each of the awards, this funding is primarily aimed at single PI or small-group projects with an initial funding of 3 years.

Examples of topical areas covered in the solicitations include:
- mid-scale instrumentation, ultrafast science, chemical imaging, emergent behavior;
- basic research for electrical energy storage, advanced nuclear energy systems, solar energy utilization, hydrogen production, storage, and use;
- other research areas identified in the BESAC and BES workshop reports, with an emphasis on nanoscale phenomena;
- accelerator research and development

Further updates and information will be available through a link on the BES home page (http://www.sc.doe.gov/bes/).
Opportunities in Other DOE Science Programs
Office of Science
Financial Assistance
Funding Opportunity Announcement
DE-PS02-08ER08-01

Annual Notice
Continuation of Solicitation for the Office of Science Financial Assistance Program

The Office of Science of the Department of Energy hereby announces its continuing interest in receiving grant applications for support of work in the following program areas: Basic Energy Sciences, High Energy Physics, Nuclear Physics, Advanced Scientific Computing, Fusion Energy Sciences, Biological and Environmental Research, and Workforce Development for Teachers and Scientists. On September 3, 1992, DOE published in the Federal Register the Office of Energy Research Financial Assistance Program (now called the Office of Science Financial Assistance Program), 10 CFR Part 605, Final Rule, which contained a solicitation for this program. Information about submission of applications, eligibility, limitations, evaluation and selection processes and other policies and procedures are specified in 10 CFR Part 605.

APPLICATION DUE DATE: September 30, 2008, 8 PM Eastern Time.

Submission is through Grants.gov.
More information on funding opportunities can be found on the program websites.

Advanced Scientific Computing Research
  http://www.sc.doe.gov/ascr/index.html

Basic Energy Sciences
  http://www.sc.doe.gov/bes/bes.html

Biological and Environmental Research
  http://www.sc.doe.gov/ober/ober_top.html

Fusion Energy Sciences
  http://www.science.doe.gov/ofes/

High Energy Physics
  http://www.science.doe.gov/hep/index.shtm

Nuclear Physics
  http://www.sc.doe.gov/np/

Workforce Development for Teachers and Scientists
  http://www.scied.science.doe.gov/scied/sci_ed.htm
Advanced Scientific Computing Research (ASCR)

- Steward of DOE’s open science research in:
  - Applied Mathematics
  - Computer Science
  - Computational Science (SciDAC)
  - Networking Research
  - High Performance Computing Prototypes
- Deploys and operates high performance computing user facilities and Networks
  - National Energy Research Scientific Computing Facility (NERSC) at Lawrence Berkeley National Laboratory (LBNL)
  - Leadership Computing Facility at Argonne National Laboratory (ANL)
  - Leadership Computing Facility at Oak Ridge National Laboratory (ORNL)
  - Energy Sciences Network (ESnet)

Research Opportunities in Applied Math, Computer Science, Networking, Computational Science; High Performance Computing Time Available
• Effective/efficient delivery, management and operation of petascale and beyond computing systems (with hundreds of thousands of multi-core processors).
  - Leadership Computing Facilities – open to all through INCITE
  - NERSC – computing resources for over 2,000 Office of Science users
  - Energy Science Network - for facility access and sharing large scale scientific data
• Basic research necessary for effective scientific utilization of those systems
  - Applied Mathematics
    ▪ Multi-scale, multi-physics and complex hybrid models; optimization and risk assessment of complex systems; mathematics of large datasets
  - Computer Science
    ▪ Petascale tools; operating and runtime systems for extreme scale scientific computation; programming models; performance analysis; petascale data management, analytics and visualization
  - Computational Science
    ▪ Scientific Discovery through Advanced Computing (SciDAC) partnerships in astrophysics, biology, chemistry, climate, fusion, materials, nuclear structure, physics, & reactive flows
  - Next Generation Networks for Science
    ▪ Cyber security research for open science networks
    ▪ Middleware, protocols, and other networking infrastructure

Research Opportunities in Applied Math, Computer Science, Networking, Computational Science; High Performance Computing Time Available
**Life Sciences**: Provide the fundamental scientific understanding of plants and microbes necessary to develop new robust and transformational basic research strategies for producing biofuels, cleaning up waste, and sequestering carbon.

**Climate Change Research**: Deliver improved scientific data and models about the potential response of the Earth’s climate and terrestrial biosphere to increased greenhouse gas levels for policy makers to determine safe levels of greenhouse gases in the atmosphere.

**Environmental Remediation**: Provide sufficient scientific understanding such that DOE sites would be able to incorporate coupled physical, chemical and biological processes into decision making for environmental remediation and long-term stewardship.

**Medical Applications and Measurement Science**: Develop intelligent biomimetic electronics that can both sense and correctly stimulate the nervous system.

Research Opportunities in technologies to probe the basic science areas described above. User facilities for genomics and molecular science.
Develop the knowledge base for a new energy source and expand the underlying scientific foundations of matter at very high temperatures and density.


If fusion energy reaches its potential as an energy source, it will be the ultimate in “high risk, high reward” research.
Recent Examples of Topical Solicitations: Watch http://www.sc.doe.gov/grants for future opportunities


Environmental Remediation Science Program Notice DE-PS02-08ER08-09 --Posted December 19, 2007, Preapplications are strongly encouraged and must be received by January 22, 2008. Formal applications due by March 26, 2008.

Research Opportunities at Rare Isotope Beam Facilities Notice DE-PS02-08ER08-10 --Posted February 14, 2008, Preapplications required by June 2, 2008. Formal applications due by November 10, 2008.


The Office of Science provides opportunities for early career researchers.

(1) Fusion Energy Sciences Plasma Physics Junior Faculty Development Program
(2) Advanced Scientific Computing Research Early Career Principal Investigator Program
(3) High Energy Physics Outstanding Junior Investigator Program
(4) Nuclear Physics Outstanding Junior Investigator Program
(5) SC Early Career Scientist and Engineer Award (SC-ECASE) recognizes researchers at national laboratories. If an SC-ECASE winner is selected for PECASE, they receive ~$50k per year for five years.
University researchers can become involved in many ways.

Read about the core research areas on our websites and contact program managers to discuss whether your ideas fit within their programs.

Volunteer to become a reviewer or participate in a workshop.

Incorporate our large scientific user facilities into your research. Apply to compete for time at one of them.

Follow federal advisory committee meetings. Respond to open and topical solicitations.
Additional Opportunities
Nominations for the 2008 Enrico Fermi Award are due April 1, 2008.

Bestowed by the President of the United States to an individual or individuals of international stature in recognition of a lifetime of exceptional scientific, technical, engineering, and/or management achievements related to the development, use, control, or production of energy.

The Fermi Award is given for a lifetime of achievement. Only living nominees will be considered. The Fermi Award is not limited to U.S. citizens. The Fermi Award is not limited to scientists whose work has been funded by the U.S. DOE (or its predecessor agencies).

A Fermi Award recipient receives:
- a citation signed by the President of the United States and the Secretary of Energy;
- a gold medal bearing the likeness of Enrico Fermi; and
- a $375,000 honorarium.

http://www.science.doe.gov/fermi/index.htm
The Office of Science currently employs ~300 federal staff at headquarters in Washington, D.C. and Germantown, MD.

The scientific direction for our programs is provided from headquarters.

We anticipate hiring several program managers and other technical experts this year.

Watch http://www.usajobs.gov for opportunities.

Ask me how much I love my job!
Thank You

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301-903-1293