Office of Science
Financial Assistance
Funding Opportunity Announcement
DE-PS02-09ER09-01

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

SUMMARY

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, 2009, 8:00 PM Eastern Time.

This Announcement will be posted annually and will remain in effect until it is succeeded by another issuance by the Office of Science, usually published after the beginning of the Fiscal Year (October 1, 2009).

This Annual Announcement DE-PS02-09ER09-01, posted March 5, 2009, has been edited to address the change in the forms package from PureEdge to Adobe and succeeds Announcement DE-PS02-09ER09-01 originally posted October 1, 2008.

Applications submitted to the Office of Science must be submitted electronically through Grants.gov to be considered for award. The Funding Opportunity Number is: DE-PS02-09ER09-01 and the CFDA Number for the Office of Science is: 81.049. Instructions and forms are available on the Grants.gov website. Please see the information below. If you experience problems when submitting your application to Grants.gov, please visit their customer support website: http://www.grants.gov/CustomerSupport; email: support@grants.gov; or call 1-800-518-4726.

Registration Requirements: There are several one-time actions you must complete in order to submit an application through Grants.gov (e.g., obtain a Dun and Bradstreet Data Universal

Numbering System (DUNS) number, register with the Central Contract Registry (CCR), register with the credential provider and register with Grants.Gov). See http://www.grants.gov/GetStarted. Use the Grants.gov Organization Registration Checklist at http://www.grants.gov/assets/organizationRegCheck.doc to guide you through the process. Designating an E-Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in the CCR registration process. Applicants, who are not registered with CCR and Grants.gov, should allow at least 21 days to complete these requirements. It is suggested that the process be started as soon as possible.

PROGRAM MANAGER CONTACTS: Questions regarding the specific program areas/technical requirements should be directed to the points of contact listed for each program office within the Notice and not to the Notice Administrative Contact.

SUPPLEMENTARY INFORMATION: It is anticipated that approximately $400 million will be available for grant and cooperative agreement awards in FY 2009. The DOE is under no obligation to pay for any costs associated with the preparation or submission of an application. DOE reserves the right to fund, in whole or in part, any, all, or none of the applications submitted in response to this Notice.

The following program descriptions are offered to provide more in-depth information on scientific and technical areas of interest to the Office of Science:

1. Basic Energy Sciences

The mission of the Basic Energy Sciences (BES) program-a multipurpose, scientific research effort-is to foster and support fundamental research to expand the scientific foundations for new and improved energy technologies and for understanding and mitigating the environmental impacts of energy use. The portfolio supports work in the natural sciences by emphasizing fundamental research in materials sciences, chemistry, geosciences, and physical biosciences.

The four long-term goals in scientific advancement that the BES program is committed to and against which progress can be measured are:

- Design, model, fabricate, characterize, analyze, assemble, and use a variety of new materials and structures, including metals, alloys, ceramics, polymers, biomaterials and more-particularly at the nanoscale-for energy-related applications.
- Understand, model, and control chemical reactivity and energy transfer processes in the gas phase, in solutions, at interfaces, and on surfaces for energy-related applications, employing lessons from inorganic and biological systems.
- Develop new concepts and improve existing methods to assure a secure energy future, e.g., for solar energy conversion and for other energy sources.
- Conceive, design, fabricate, and use new scientific instruments to characterize and ultimately control materials, especially instruments for x-ray, neutron, and electron beam scattering and for use with high magnetic and electric fields.

Program Website: http://www.science.doe.gov/bes/bes.html

The BES science subprograms and their objectives are as follows:

(a) Materials Sciences and Engineering

The objective of this subprogram is to support fundamental experimental and theoretical research to provide the knowledge base for the discovery and design of new materials with novel structures, functions, and properties. These research activities emphasize the design and synthesis of materials; the characterization of their structure and defect state; the understanding of their physical, chemical, and irradiation-induced behaviors over multiple length and time scales; and the development and advancement of new experimental and computational tools and techniques. The main research elements of the subprogram are condensed matter and materials physics; scattering and instrumentation sciences; and materials discovery, design, and synthesis.

In condensed matter and materials physics - including activities in experimental condensed matter physics, theoretical condensed matter physics, mechanical behavior and radiation effects, and physical behavior of materials - research is supported to understand, design, and control materials properties and function. These goals are accomplished through studies of the relationship of materials structures to their electrical, optical, magnetic, surface reactivity, and mechanical properties and the way in which materials respond to external forces such as stress, chemical and electrochemical environments, radiation, and the proximity of materials to surfaces and interfaces. The activity emphasizes correlation effects, which can lead to the formation of new particles, new phases of matter, and unexpected phenomena. The theoretical efforts focus on the development of advanced computer algorithms and codes to treat large or complex systems.

In scattering and instrumentation sciences - including activities in neutron and x-ray scattering and electron and scanning microscopies - research is supported on the fundamental interactions of photons, neutrons, and electrons with matter to understand the atomic, electronic, and magnetic structures and excitations of materials and the relationship of these structures and excitations to materials properties and behavior. Major research areas include fundamental dynamics in complex materials, correlated electron systems, nanostructures, and the characterization of novel systems. The development of next-generation neutron, x-ray, and electron microscopy instrumentation is a key element of this portfolio.

In materials discovery, design, and synthesis - including activities in synthesis and processing science, materials chemistry, and biomolecular materials - research is supported in the discovery and design of novel materials and the development of innovative materials synthesis and processing methods. Major research thrust areas include nanoscale synthesis, organization of nanostructures into macroscopic structures, solid state chemistry, polymers and polymer composites, surface and interfacial chemistry including electrochemistry and electro-catalysis, and synthesis and processing science including biomimetic and bioinspired routes to functional materials and complex structures.

Program Contact: Phone (301) 903-3427
Website - http://www.science.doe.gov/bes/dms/DMSE.htm

(b) Chemical Sciences, Geosciences, and Biosciences

The objective of this subprogram is to support fundamental research enabling the understanding of chemical transformations and energy flow in systems relevant to DOE missions. This knowledge serves as a basis for the development of new processes for the generation, storage, and use of energy and for mitigation of the environmental impacts of energy use. New experimental techniques are developed to investigate chemical processes and energy transfer over a wide range of spatial and temporal scales: from atomic to kilometer spatial scales and from femtosecond to millennia time scales. Theory, modeling, and computational simulations are performed, from detailed quantum calculations of chemical properties and reactivity to multi- scale simulations of combustion devices. The main research activities within the subprogram are fundamental interactions; photo- and biochemistry; and chemical transformations.

In fundamental interactions, basic research is supported in atomic, molecular and optical sciences; gas-phase chemical physics; ultrafast chemical science; and condensed phase and interfacial molecular science. Emphasis is placed on structural and dynamical studies of atoms, molecules, and nanostructures, and the description of their interactions in full quantum detail, with the aim of providing a complete understanding of reactive chemistry in the gas phase, condensed phase, and at interfaces. Novel sources of photons, electrons, and ions are used to probe and control atomic, molecular, and nanoscale matter. Ultrafast optical and x-ray techniques are developed and used to study chemical dynamics. There is a focus on cooperative phenomena in complex chemical systems, such as the effect of solvation on chemical structure, reactivity, and transport and the coupling of complex gas-phase chemistry with turbulent flow in combustion.

In photo- and biochemistry, including solar photochemistry, photosynthetic systems, and physical biosciences, research is supported on the molecular mechanisms involved in the capture of light energy and its conversion into chemical and electrical energy through biological and chemical pathways. Natural photosynthetic systems are studied to create robust artificial and bio-hybrid systems that exhibit the biological traits of self assembly, regulation, and self repair. Complementary research encompasses organic and inorganic photochemistry, photo-induced electron and energy transfer, photoelectrochemistry, and molecular assemblies for artificial photosynthesis. Inorganic and organic photochemical studies provide information on new chromophores, donor-acceptor complexes, and multi-electron photocatalytic cycles. Photoelectrochemical conversion is explored in studies of nanostructured semiconductors at liquid interfaces. Biological energy transduction systems are investigated, with an emphasis on the coupling of plant development and microbial biochemistry with the experimental and computational tools of the physical sciences.

In chemical transformations, the themes are characterization, control, and optimization of chemical transformations, including efforts in catalysis science; separations and analytical science; actinide chemistry; and geosciences. Catalysis science underpins the design of new catalytic methods for the clean and efficient production of fuels and chemicals and emphasizes inorganic and organic complexes; interfacial chemistry; nanostructured and supramolecular catalysts; photocatalysis and electrochemistry; and bio-inspired catalytic processes. Heavy element chemistry focuses on the spectroscopy, bonding, and reactivity of actinides and fission products; complementary research on chemical separations focuses on the use of nanoscale membranes and the development of novel metal-adduct complexes. Chemical analysis research emphasizes laser-based and ionization techniques for molecular detection, particularly the development of chemical imaging techniques. Geosciences research covers analytical and physical geochemistry, rock-fluid interactions, and flow/transport phenomena; this research provides a fundamental basis for understanding the environmental contaminant fate and transport and for predicting the performance of repositories for radioactive waste or carbon dioxide sequestration.

Program Contact: Phone (301) 903-2046
Website - http://www.science.doe.gov/bes/Division.htm#chemical

(c) Accelerator and Detector Research

The objective of this program is to improve the output and capabilities of synchrotron radiation light source and neutron scattering facilities that are the most advanced of their kind in the world. This program supports basic research in accelerator physics and x-ray and neutron detectors. Research is supported that seeks to achieve a fundamental understanding beyond the traditional accelerator science and technology in order to develop new concepts to be used in the design of new accelerator facilities for synchrotron radiation and spallation neutron sources. To exploit fully the fluxes delivered by synchrotron radiation facilities and spallation neutron sources, new detectors capable of acquiring data several orders of magnitude faster are required. Improved detectors are especially important in the study of multi-length scale systems such as protein-membrane interactions as well as nucleation and crystallization in nanophase materials. They will also enable real-time kinetic studies and studies of weak scattering samples. This program strongly interacts with BES programmatic research that uses synchrotron radiation and neutron sources.

Program Contact: Phone (301) 903-1873
Website - http://www.science.doe.gov/bes/User_Facilities/dsuf/DSUF.htm

(d) Experimental Program to Stimulate Competitive Research (EPSCoR)

The objective of the EPSCoR program is to enhance the capabilities of EPSCoR states to conduct nationally competitive energy-related research and to develop science and engineering manpower to meet current and future needs in energy-related fields. The program supports basic research spanning the broad range of science and technology programs within the DOE in states that have historically received relatively less Federal research funding. The EPSCoR states are Alabama, Alaska, Arkansas, Delaware, Hawaii, Idaho, Iowa, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Rhode Island, South

Carolina, South Dakota, Tennessee, Utah, Vermont, West Virginia, and Wyoming, along with the Commonwealth of Puerto Rico and the U.S. Virgin Islands. The research supported by EPSCoR includes materials sciences, chemical sciences, physics, energy-relevant biological sciences, geological and environmental sciences, high energy physics, nuclear physics, fusion energy sciences, advanced computing, and the basic sciences underpinning fossil energy, nuclear energy, energy efficiency, and renewable energy. The core activity interfaces with all other core activities within the Office of Science. It is also responsive and supports the DOE mission in the areas of energy and national security and in mitigating their associated environmental impacts.
Program Contact: Phone - (301) 903-9830
Website - http://www.science.doe.gov/bes/EPSCoR/index.htm

2. High Energy Physics

The primary objectives of the High Energy Physics (HEP) program are to explore the most elementary constituents of matter and energy and their fundamental interactions, including the unknown "dark" forms of matter and energy that appear to dominate the universe; to understand if fundamental forces may ultimately be unified; and to explore the basic nature of space and time itself.

In support of these broad scientific objectives, the HEP program has established specific long-term goals that correspond very roughly to current research priorities, and are representative of the program:

- Measure the properties and interactions of the heaviest known particle (the top quark) in order to understand its particular role in the Standard Model.
- Measure the matter-antimatter asymmetry in many particle decay modes with high precision.
- Discover or rule out the Standard Model Higgs particle, thought to be responsible for generating mass of elementary particles.
- Determine the pattern of the neutrino masses and the details of their mixing parameters.
- Confirm the existence of new supersymmetric (SUSY) particles, or rule out the minimal SUSY "Standard Model" of new physics.
- Directly discover, or rule out, new particles which could explain the cosmological "dark matter".

All grant proposals should address one or more of these goals, or else explain how the proposed research supports the broad scientific objectives outlined above.

There are two subprograms within the Office of High Energy Physics that support research and technology development aimed at these objectives.

a) High Energy Physics Research

This research falls into two broad categories: experimental research and theoretical research. The High Energy Physics Research subprogram supports research aimed at the long term scientific goals outlined above, with experiments utilizing man-made and naturally occurring particle sources, and theoretical studies that provide or extend the framework of understanding for HEP. This subprogram has also provided graduate and postdoctoral research training for HEP scientists in pursuit of these goals, and equipment for experiments and related computational efforts.

Topics studied in the experimental research program include, but are not limited to: proton- (anti)proton collisions at the highest possible energies; studies of neutrino properties using accelerator-produced neutrino beams as well as neutrinos from nuclear reactors; sensitive measurements of rarely occurring phenomena that can indicate new physics beyond the Standard Model; measurements of dark energy; and detection of the particles that make up cosmic dark matter. Topics studied in the theoretical research program include, but are not limited to: phenomenological and theoretical studies that support the experimental research program, both in understanding the data and in finding new directions for experimental exploration; developing analytical and numerical computational techniques for these studies; and to find theoretical frameworks for understanding fundamental particles and forces at the deepest level possible.

Program Contact: Phone (301) 903-4829;
Website - http://www.science.doe.gov/hep/physics_research.shtm

b) Advanced Accelerator Research and Development

This research falls into two broad categories: accelerator science and particle detector development. The goal of this subprogram is to enable forefront research and development in those aspects of accelerator and detector technology that have a strong potential to advance the capabilities of HEP research. The subprogram has also provided training for new scientists and had significant impact on other sciences, the economy, health, and other sectors.

The technology R&D subprogram supports long-range, exploratory research aimed at developing new concepts. Topics studied in the accelerator science program include, but are not limited to: analytic and computational techniques for modeling particle beams; novel acceleration concepts; muon colliders and neutrino factories; the science of high gradients in room-temperature accelerating cavities; high-brightness beam sources; and cutting-edge beam diagnostic techniques. Topics studied in the detector development program include, but are not limited to: low-mass, high channel density charged particle tracking detectors; high resolution, fast-readout calorimeters and particle identification detectors; improving the radiation tolerance of particle detectors; and advanced electronics and data acquisition systems.

Program Contact: Phone (301) 903-5228
Website - http://www.science.doe.gov/hep/advanced_technology.shtm

3. Nuclear Physics

The Nuclear Physics program supports basic research, technical developments and world-class accelerator facilities to expand our fundamental understanding of the interactions and structures of atomic nuclei and nuclear matter, and an understanding of the forces of nature as manifested in nuclear matter. Today, the reach of nuclear physics extends from the quarks and gluons that form the substructure of the once-elementary protons and neutrons, to the most dramatic of cosmic events-supernovae. These and many other diverse activities are driven by five broad questions articulated recently by the Nuclear Science Advisory Committee (NSAC) in the Opportunities in Nuclear Science: A Long-Range Plan for the Next Decade. The four subprogram areas and their objectives are organized around answering these five key questions. Research activities supported by the Office of Nuclear Physics are aligned with and contribute to the overall progress of the following long term performance measures:

Make precision measurements of fundamental properties of the proton, neutron and simple nuclei for comparison with theoretical calculations to provide a quantitative understanding of their quark substructure.

Recreate brief, tiny samples of hot, dense nuclear matter to search for the quark-gluon plasma and characterize its properties.

Investigate new regions of nuclear structure, study interactions in nuclear matter like those occurring in neutron stars, and determine the reactions that created the nuclei of atomic elements inside stars and supernovae.

Measure fundamental properties of neutrinos and fundamental symmetries by using neutrinos from the sun and nuclear reactors and by using radioactive decay measurements.

Contribute to the theoretical understanding of any of the above.

The program is organized into the following four subprograms:

a) Medium Energy Nuclear Physics

This subprogram supports experimental research primarily at the Thomas Jefferson National Accelerator Facility and with the polarized proton collision program at the Relativistic Heavy Ion Collider (RHIC-Spin), directed at answering the first key question: What is the structure of the nucleon? Detailed investigations of the structure of the nucleon are aimed at understanding how these basic building blocks of matter are constructed from the elementary quarks and gluons of Quantum Chromo-Dynamics (QCD) and how complex interactions among them generate all the properties of the nucleon, including its electromagnetic and spin properties. New knowledge in this area would also allow the nuclear binding force to be described in terms of QCD, thus providing a path for understanding the structure of atomic nuclei from first principles.
Program Contact: Dr. Brad Tippens (301) 903-3904

b) Heavy Ion Nuclear Physics

This subprogram supports experimental research primarily at the Relativistic Heavy Ion Collider (RHIC) directed at answering the second question: What are the properties of

hot nuclear matter? At extremely high temperatures, such as those that existed in the early universe immediately after the "Big Bang," normal nuclear matter is believed to revert to its primeval state called the quark-gluon plasma. This research program aims to recreate extremely small and brief samples of this high energy density phase of matter in the laboratory by colliding heavy nuclei at relativistic energies. At much lower temperatures, nuclear matter passes through another phase transition from a Fermi liquid to a Fermi gas of free roaming nucleons; understanding this phase transition is also a goal of the subprogram.
Program Contact: Dr. Gulshan Rai (301) 903-4702

c) Low Energy Nuclear Physics

This subprogram supports experimental research directed at understanding the remaining three questions: What is the structure of nucleonic matter? Forefront nuclear structure research lies in studies of nuclei at the limits of excitation energy, deformation, angular momentum, and isotopic stability. The properties of nuclei at these extremes are not known and such knowledge is needed to test and drive improvement in nuclear models and theories about the nuclear many-body system. What is the nuclear microphysics of the universe? Knowledge of the detailed nuclear structure, nuclear reaction rates, half-lives of specific nuclei, and the limits of nuclear existence at both the proton and neutron drip lines is crucial for understanding the nuclear astrophysics processes responsible for the production of the chemical elements in the universe, and the explosive dynamics of supernovae. Is there new physics beyond the Standard Model? Studies of fundamental interactions and symmetries, including those of neutrino oscillations, are indicating that our current "Standard Model" theory which explains what the universe is and what holds it together is incomplete, opening up possibilities for new discoveries by precision experiments.
Program Contact: Dr. Cyrus Baktash (301) 903-0258

d) Nuclear Theory (including the Nuclear Data subprogram)

Progress in nuclear physics, as in any science, depends critically on improvements in the theoretical techniques and on new insights that will lead to new models and theories that can be applied to interpret experimental data and predict new behavior. The Nuclear Theory program supports theoretical research directed at understanding all five of the central questions identified in the NSAC 2002 Long Range Plan. Included in the theory program are the activities that are aimed at providing information services on critical nuclear data and have as a goal the compilation and dissemination of an accurate and complete nuclear data information base that is readily accessible and user oriented.
Program Contact: Dr. Gene Henry (301) 903-6093

4. Advanced Scientific Computing Research (ASCR)

The mission of the Advanced Scientific Computing Research Program is to deliver forefront computational and networking capabilities to enable scientists to extend the frontiers of science, answering critical questions that range from nanoscience to astrophysics and include nuclear structure, the function of living cells and the power of fusion energy. For example, two long term measures for the program are:

- Demonstrate progress toward developing the mathematics, algorithms, and software that enable effective scientifically critical models of complex systems, including highly nonlinear or uncertain phenomena, or processes that interact on vastly different scales or contain both discrete and continuous elements.
- Demonstrate progress toward developing, through the Genomes to Life partnership with the Biological and Environmental Research program, the computational science capability to model a complete microbe and a simple microbial community.

In order to accomplish this mission, the Advanced Scientific Computing Research program supports research in applied mathematics, computer science and networking. ASCR also operates Leadership Computing facilities, a high-performance production computing center, and a high-speed network to facilitate the analysis, modeling, simulation, and prediction of complex phenomena important to the Department of Energy.

The computing resources and the networks required to meet Office of Science needs exceed the state-of- the-art by a significant margin. Furthermore, the algorithms, software tools, the software libraries and the distributed software environments needed to accelerate scientific discovery through modeling and simulation are beyond the realm of commercial interest. To establish and maintain DOE's modeling and simulation leadership in scientific areas that are important to its mission, ASCR implements a broad base research portfolio in applied mathematics, computer science, and network research to underpin advances in mathematical methods, software tools, software libraries, software environments and networks needed to solve complex problems on computational resources that are on a trajectory to reach well beyond a petascale within a few years. Research areas of interest include:

a) Applied Mathematics

Research on the mathematical methods and numerical algorithms that enable the effective description, understanding, and prediction of complex physical, biological, and human-engineered systems. For example, the subjects of supported research efforts may include: (1) numerical methods for the parallel solution of systems of partial differential equations, large- scale linear or nonlinear systems, or very large parameter-estimation problems; (2) analytical or numerical techniques for modeling complex physical or biological phenomena, such as fluid turbulence or microbial populations; (3) analytical or numerical methods for bridging a broad range of temporal and spatial scales; (4) optimization, control, and risk analysis of complex systems, such as computer networks and electrical power grids; and (5) mathematical research issues related to petascale science.

b) Computer Science

Research in computer science to enable petascale scientific applications through advances in massively parallel computing such as scalable and fault tolerant operating systems, programming models, performance modeling and assessment tools, development tools, interoperability and infrastructure methodology, and large scale data management and visualization. The development of new computer and computational science techniques will allow scientists to use the most advanced computers without being overwhelmed by the complexity of rewriting their codes with each new generation of high performance architectures.

c) Network Environment Research

Research to develop and deploy a high-performance network and collaborative technologies to support distributed high-end science applications and large-scale scientific collaborations. The current focus areas include but are not limited to cyber security systems, dynamic bandwidth allocation services, network measurement and analysis, ultra high-speed transport protocols, and advanced application layer services that make it easy for scientists to effectively and efficiently access and use distributed resources, such as advanced services for group collaboration, secure services for remote access of distributed resources, and innovative technologies for sharing, controlling, and managing distributed computing resources.

(d) Broadening Participation and Collaboration

Activities that develop innovative approaches for broadening and strengthening participation in applied mathematics, computer science, computational science and high performance computing.

Program Contact: (301) 903-5800

5. Fusion Energy Sciences

The Office of Fusion Energy Sciences (OFES) program supports the Department's Energy Security and World-Class Scientific Research Capacity goals. The OFES program goal is to advance plasma science, fusion science, and fusion technology -- the knowledge base needed for an economically and environmentally attractive fusion energy source. The OFES supports basic and applied research, encourages technical cross-fertilization with the broader U.S. science community, and uses international collaboration to accomplish this goal.

The OFES program contributes to the Energy Security goal through participation in ITER, an experiment to study and demonstrate the sustained burning of fusion fuel. ITER will provide an unparalleled scientific research opportunity and will test the scientific and technical feasibility of fusion power, will also be the penultimate step before a demonstration fusion power plant. The ITER negotiations were successfully completed in fiscal year (FY) 2006 and the ITER Agreement was signed and ratified by the ITER parties in FY 2008. Currently OFES scientists and engineers are supporting the design activities, technical R&D, hardware procurement and other construction activities.

The OFES program contributes to the World-Class Scientific Research Capacity goal by managing a program of fundamental research into the nature of fusion plasmas and the means for confining plasma to yield energy. This includes: 1) exploring basic issues in plasma science; 2) developing the scientific basis and computational tools to predict the behavior of magnetically confined plasmas; 3) using the advances in tokamak research to enhance the initiation of the burning plasma physics phase of the OFES program; 4) exploring innovative confinement options that offer the potential of more attractive fusion energy sources in the long term; 5) advancing our understanding of high energy density laboratory plasmas and exploring attractive pathways to attaining states of high energy density matter, (in collaboration with the Department of Energy (DOE) National Nuclear Security Administration); 6) developing the cutting edge technologies that enable fusion facilities to achieve their scientific goals; and 7) advancing the science base for innovative materials to establish the economic feasibility and environmental quality of fusion energy.

The overall effort requires operation of a set of unique and diversified experimental facilities, ranging from smaller-scale university experiments to large national facilities that involve extensive collaborations. These facilities provide scientists with the experimental data to validate theoretical understanding and computer models-leading ultimately to an improved predictive capability for fusion science. Scientists from the U.S. also participate in leading edge experiments on fusion facilities abroad and conduct comparative studies to supplement the scientific understanding they can obtain from domestic facilities.

Operation of the major fusion facilities will be focused on science issues relevant to ITER design and operation. The United States is an active participant in the International Tokamak Physics Activity, which facilitates identification of high priority research for burning plasmas in general, and for ITER specifically, through workshops and assigned tasks. In addition, there will be continuing efforts to investigate simulations of fusion plasmas in collaboration with the Office of Advanced Scientific Computing Research.

There are three measures that will be used to demonstrate that progress is being made towards meeting the overall program goal over the next ten years. These performance measures are:

1. Predictive Capability for Burning Plasmas: Develop a predictive capability for key aspects of burning plasmas using advances in theory and simulation benchmarked against a comprehensive experimental database of stability, transport, wave-particle interaction, and edge effects.

2. Configuration Optimization: Demonstrate enhanced fundamental understanding of magnetic confinement and improved basis for future burning plasma experiments through research on magnetic confinement configuration optimization.

3. High Energy Density Physics: Develop the fundamental understanding and predictability of high energy density plasmas for potential energy applications.

The Science and Facility Operations Subprograms

The Science subprogram seeks to develop the physics knowledge base needed to advance the OFES program. Research is conducted on small to large-scale confinement devices to study physics issues relevant to fusion and plasma physics and to the production of fusion energy. Experiments on these devices are used to explore the limits of specific confinement concepts, as well as study associated physical phenomena. Specific topics of interest to ITER include: (1) reducing plasma energy and particle transport at high densities and temperatures; (2) understanding the physical laws governing stability of high pressure plasmas; (3) investigating plasma wave interactions; (4) studying and controlling impurity particle transport and exhaust in plasmas; and (5) understanding the interaction and coupling among these four issues in a fusion experiment.

Research is also carried out in the following areas: (1) basic plasma science directed at furthering the understanding of fundamental processes in plasmas; (2) theory and modeling to provide the understanding of fusion plasmas necessary for interpreting results from present experiments, planning future experiments, and designing future confinement devices; (3) atomic physics and the development of new diagnostic techniques for support of confinement experiments; (4) innovative confinement concepts; and (5) high energy density laboratory plasmas and issues that support the development of Inertial Fusion Energy Sciences (IFES). The high energy density physics necessary for IFE target development is carried out by the Office of Defense Programs in the DOE's National Nuclear Security Administration.

The Enabling R&D Subprogram

The Enabling R&D subprogram supports the advancement of fusion science in the nearer-term by carrying out research on technological topics that: (1) enable domestic experiments to achieve their full performance potential and scientific research goals; (2) permit scientific exploitation of the performance gains being sought from physics concept improvements; (3) allow the U.S. to enter into international collaborations gaining access to experimental conditions not available domestically; and (4) explore the science underlying these technological advances.

Research is also carried out in the following areas: (1) plasma facing components, (2) structural and special purpose materials, (3) heating and fueling technologies, (4) breeding blankets and fuel cycle and (5) safety and neutronics.

In addition, the Enabling R&D subprogram also supports pursuit of fusion energy science for the longer-term by conducting research aimed at innovative technologies, designs and materials to point toward an attractive fusion energy vision and affordable pathways for optimized fusion development.

Program Contact: (301) 903-4095

6. Biological and Environmental Research Program

For over 50 years the Biological and Environmental Research (BER) Program has been investing in the biological and environmental sciences related to energy production. The hallmark of BER programs is a systems science approach employing a range of disciplines to address DOE-relevant mission needs. A key element is BER's focus on scales, both spatial and temporal, ranging from the molecular to the global (Earth scale) and from the nanosecond to the century. This trans-disciplinary, multi-dimensional science moves beyond traditional single-disciplinary approaches, resulting in entirely new fields of research. BER science focuses "over-the-horizon," with broad and novel impacts on DOE's energy and environmental missions.

The BER program provides fundamental science to underpin the Department's strategic plan; specifically, Strategic Theme 3, Scientific Discovery & Innovation.

Strategic Goal 3.1, Scientific Breakthroughs: Achieve the major scientific discoveries that will drive U.S. competitiveness; inspire America; and revolutionize our approaches to the Nation's energy, national security, and environmental quality challenges. Strategic Goal 3.2, Foundations of Science: Deliver the scientific facilities, train the next generation of scientists and engineers, and provide the laboratory infrastructure required for U.S. scientific primacy.

Through its support of peer-reviewed research at national laboratories, universities, and private institutions, the program develops the basic knowledge needed to address the following established indicators that the BER program is committed to, and progress can be measured against:

- Life Sciences Research: Provide the fundamental scientific understanding of plants and microbes necessary to develop new robust and transformational basic research strategies for producing biofuels, cleaning up environmental contamination, and sequestering carbon. Seek understanding of biological effects of low doses of ionizing radiation. Develop enabling tools based on radiochemistry and imaging technologies for BER missions in bioenergy, subsurface, and climate change.
- Environmental Remediation Research: 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.
- 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.

All grant applications should address one or more of these measures and/or explain how the proposed research supports the broad scientific objectives outlined above. More information on the program and the scientific research it supports can be found at our website http://www.science.doe.gov/ober/.

a) Life Sciences Research

Research is focused on using DOE's unique resources and facilities to develop fundamental knowledge of biological systems that can be used to address DOE needs in clean energy, carbon sequestration, and environmental cleanup and that will underpin biotechnology based solutions to energy challenges. The objectives are: (1) to develop the experimental and, together with the Advanced Scientific Computing Research program, the computational resources, tools, and technologies needed to understand and predict the complex behavior of complete biological systems, principally microbes and microbial communities; (2) to take advantage of the remarkable high throughput and cost-effective DNA sequencing capacity at the Joint Genome Institute to meet the DNA sequencing needs of the scientific community through competitive, peer-reviewed nominations for DNA sequencing; (3) to understand and characterize the risks to human health from exposures to low levels of ionizing radiation; (4) to operate experimental biological stations at synchrotron and neutron sources; (5) to anticipate and address ethical, legal, and social implications arising from Office of Science-supported biological research, especially synthetic biology and nano technology and (6) to develop radiochemistry and advanced technologies for imaging and high through-put characterization and analysis for BER missions in bioenergy, subsurface, and climate change.

Program Contact: (301) 903-3213

b) Environmental Remediation Research

The program supports research to understand the processes controlling DOE-relevant contaminant mobility in the subsurface; to exploit that understanding in ways that ameliorate the impacts of subsurface contamination; and to develop the tools needed to accomplish these goals. The aim of the program is to provide the scientific knowledge, tools, and enabling discoveries needed to reduce the costs, risks, and schedules associated with the cleanup and stewardship of the DOE complex. Basic scientific knowledge and tools developed through this program will elucidate the fundamental mechanisms of contaminant transport in the environment. Research priorities include contaminant fate and transport assessment and simulation, fundamental science supporting subsurface remediation (e.g., bioremediation), and the development of tools and techniques to evaluate and/or validate conceptual models of contaminant mobility in the subsurface. The research performed for this program will provide fundamental knowledge on a broad range of DOE-specific environmental remediation problems. Applications should address the applicability of the proposed research on subsurface transport processes of DOE relevant contaminants in the context of remediation and/or long-term stewardship of DOE sites.

Program Contact: (301) 903-3213

c) Climate Change Research

The program seeks to understand the basic physical, chemical, and biological processes of the Earth's System and how these processes may be affected by energy production and use. The research is designed to provide data that will enable an objective, scientifically-based assessment of the potential for, and the consequences of, human-induced climate change at global and regional scales. Climate Change Research also provides data and models to enable assessments of mitigation options to prevent such a change. The program is comprehensive with an emphasis on: (1) understanding and simulating the radiation balance from the surface of the Earth to the top of the atmosphere (including the

effect of clouds, water vapor, trace gases, and aerosols); (2) enhancing and evaluating the quantitative models necessary to predict natural climatic variability and possible human-caused climate change at global and regional scales; (3) understanding and simulating the net exchange of carbon dioxide between the atmosphere, and terrestrial systems, as well as the effects of climate change on the global carbon cycle; (4) understanding ecological effects of climate change; (5) improving approaches to integrated assessments of effects of, and options to mitigate, climatic change; and (6) basic research directed at understanding options for sequestering excess atmospheric carbon dioxide in terrestrial ecosystems, including potential environmental implications of such sequestration.
Program Contact: (301) 903-3281

7. Workforce Development for Teachers and Scientists

This program provides a continuum of opportunities to the Nation's K-16 students and teachers/faculty in science, technology, engineering and mathematics (STEM) areas. This program funds student internships, faculty and teacher fellowships and professional development programs. The goal of this program is to prepare a diverse workforce of scientists, engineers, and educators to keep America at the forefront of innovation, by utilizing its unique intellectual and physical resources to enhance the ability of educators and our Nation's educational systems to teach science and mathematics.
Program Contact: Sue Ellen Walbridge (202) 586-7231
Program Website: http://www.scied.science.doe.gov

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