Office of Science
Financial Assistance
Funding Opportunity Announcement
DE-FOA-0000178

FY 2010
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: Advanced Scientific Computing, Biological and Environmental Research, Basic Energy Sciences, Fusion Energy Sciences, High Energy Physics, Nuclear Physics, 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, 2010, 8:00 PM Eastern Time.

This announcement will remain open until September 30, 2010, or until it is succeeded by another issuance, whichever occurs first. 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, 2010).

IMPORTANT SUBMISSION INFORMATION:

The full text of the Funding Opportunity Announcement (FOA) is located on FedConnect. Instructions for completing the Grant Application Package are contained in the full text of the FOA which can be obtained at: https://www.fedconnect.net/FedConnect/?doc=DE-FOA-0000178&agency=DOE. To search for the FOA in FedConnect click on "Search Public Opportunities". Under "Search Criteria", select "Advanced Options", enter a portion of the title "FY 2010 Annual Notice Submission of Renewal and Supplemental Applications for the Office of Science Grants and Cooperative Agreements", then click on "Search". Once the screen comes up, locate the appropriate Announcement.

In order to be considered for award, Applicants must follow the instructions contained in the Funding Opportunity Announcement.

WHERE TO SUBMIT: Applications must be submitted through Grants.gov to be considered for award.

You cannot submit an application through Grants.gov unless you are registered. Please read the registration requirements carefully and start the process immediately. Remember you have to update your CCR registration annually. If you have any questions about your registration, you should contact the Grants.gov Helpdesk at 1-800-518-4726 to verify that you are still registered in Grants.gov.

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.pdf 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.

IMPORTANT NOTICE TO POTENTIAL APPLICANTS: When you have completed the process, you should call the Grants.gov Helpdesk at 1-800-518-4726 to verify that you have completed the final step (i.e. Grants.gov registration).

Questions: Questions relating to the registration process, system requirements, how an application form works, or the submittal process must be directed to Grants.gov at 1-800-518-4726 or support@grants.gov. Part VII of the FOA explains how to submit other questions to the Department of Energy (DOE).

All applications should be in a single PDF file.

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 2010. 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. Advanced Scientific Computing Research

Program Website: http://www.sc.doe.gov/ascr/

The mission of the Advanced Scientific Computing Research (ASCR) program is to discover, develop, and deploy the computational and networking capabilities that enable researchers in the scientific disciplines to analyze, model, simulate, and predict complex phenomena important to the Department of Energy. A particular challenge of this program is fulfilling the science potential of emerging multi-core computing systems and other novel "extreme-scale" computing architectures, which will require significant modifications to today's tools and techniques.

The priority areas for ASCR include the following:

- Develop mathematical models, methods and algorithms to accurately describe and predict the behavior of complex systems involving processes that span vastly different time and/or length scales.
- Develop the theoretical underpinning and the software to make effective use of computers at extreme scales.
- Transform extreme scale data from experiments and simulations into scientific insight.
- Advance key areas of computational science and discovery that advance the missions of the Office of Science through mutually beneficial partnerships.
- Deliver the forefront computational and networking capabilities to extend the frontiers of science.
- Develop networking and collaboration tools and facilities that enable scientists worldwide to work together.

The computing resources and high-speed 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 operates Leadership Computing facilities, a high-performance production computing center, and a high-speed network and implements a broad base research portfolio in applied mathematics, computer science, computational science and network research to solve complex problems on computational resources that are on a trajectory to reach well beyond a petascale within a few years.

The ASCR subprograms and their objectives follow:

a) Applied Mathematics

This subprogram supports basic research for fundamental mathematical advances and computational breakthroughs across DOE and Office of Science missions, by supporting research on mathematical models, methods, and numerical algorithms to accurately describe and predict the behavior of complex physical and engineered systems.

Main areas of basic research efforts include: (1) numerical and multiscale methods for large-scale systems of partial differential equations; (2) advanced solution techniques for systems formulated as linear, multilinear, or nonlinear problems; (3) novel approaches for the analysis and/or optimization of complex, discrete, or networked systems; (4) theory and techniques to quantify the effects of numerical errors, uncertainties and sensitivity analysis of complex systems; and (5) mathematical approaches for extracting insights from large-scale data sets.

Subprogram Contact: Phone (301) 903-5800
Website: http://www.sc.doe.gov/ascr/Research/AppliedMath.html

(b) Computer Science

This subprogram supports basic research to advance extreme scale computing and data. It also supports research in computer science to enable peta-scale scientific applications and data-driven computational science through advances in massively parallel computing such as scalable and fault tolerant operating systems, programming models, performance modeling and assessment tools, development tools, methods for improving software resilience, interoperability and infrastructure methodology, large scale data management, data analytics and visualization techniques for understanding and representing complex physical or biological phenomena across multiple spatial and temporal scales, and validation metrics and methods. 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.

Research topics include 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.

Subprogram Contact: Phone (301) 903-5800
Website: http://www.sc.doe.gov/ascr/Research/ComSci.html

(c) Computational Science

This subprogram supports research in pioneering science applications for the next generations of high performance computers. It also supports research in computational science that allow scientists to tap the potential of peta-scale computers and advance science for discovery, national need. Recognizing that truly transformative computational science research needs to be integrated across computer science, applied mathematics and domain sciences, research in this area is funded through partnerships with other SC Offices and NNSA to solve science Grand Challenges and DOE science missions.

Research topics include the development of transformative new science application software, techniques and methods and the development of advanced collaboratory, data management and visualization tools. The development of new computational science techniques will allow scientists to tap the potential of extreme scale computers to advance science.

Subprogram Contact: Phone (301) 903-5800
Website: http://www.sc.doe.gov/ascr/Research/SciDAC.html

(d) Network Environment Research

The subprogram supports 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 dynamic bandwidth allocation services, network measurement and analysis, ultra high-speed transport protocols, fault tolerance, self correction techniques, and advanced application layer services. The development of the next generation of networks will allow 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.

Subprogram Contact: Phone (301) 903-5800
Website: http://www.sc.doe.gov/ascr/Research/NextGen.html

Proposed research may include one or more of the areas listed above.

2. Biological and Environmental Research

Program Website: http://www.sc.doe.gov/ober

The mission of the Biological and Environmental Research (BER) program is to understand complex biological, climatic, and environmental systems across spatial and temporal scales ranging from sub-micron to the global, from individual molecules to ecosystems, and from nanoseconds to millennia. This is accomplished by exploring the frontiers of genome-enabled biology; discovering the physical, chemical and biological drivers of climate change; and seeking the molecular determinants of environmental sustainability and stewardship.

The priority areas for BER include the following:

- Use systems biology approaches to understand enzymatic, microbial, and plant interactions for the conversion of biomass into liquid transportation fuels.
- Use advanced atmospheric measurements together with high-end computation and modeling to predict the impact of greenhouse gases on climate change.
- Model and measure the fate and transport of contaminants in the subsurface environment at DOE sites to predict contaminant flows.
- Develop new tools to explore the interface of biological and physical sciences.

The BER subprograms and their objectives follow:

(a) Biological Systems Science

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 computational resources, tools, and technologies needed to understand and predict complex behavior of complete biological systems, principally plants, microbes and microbial communities or plant-microbe associations; (2) to take advantage of the remarkable high throughput and cost-effective DNA sequencing capacity at the national user facility, 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, sustainability, 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.

Subprogram Contact: Dr. Sharlene Weatherwax, (301) 903-3213,
sharlene.weatherwax@science.doe.gov
Website: http://www.science.doe.gov/ober/lmsd_top.html

(b) Climate and Environmental Sciences

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. Research is designed to provide data to enable an objective, scientifically based assessment of the potential for, and the consequences of, human-induced climate change at global and regional scales. The program also provides data and models to enable assessments of mitigation options to prevent such change. The program is comprehensive with 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. (The national user facility, the Atmospheric Radiation Measurement Climate Research Facility, provides key observational data to the climate research community on the radiative properties of the atmosphere, especially clouds and aerosols. This national user facility includes highly instrumented ground stations, a mobile facility, and an aerial vehicles program.); (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 impacts of climate change on ecosystems; (5) improving approaches to integrated assessments of effects of, and options to mitigate, climatic change; (6) basic research directed at understanding options for sequestering excess atmospheric carbon dioxide in terrestrial ecosystems, including potential environmental implications of such sequestration; (7) subsurface biogeochemical research to understand and predict subsurface contaminant fate and transport; and (8) taking advantage of the national user facility, the Environmental Molecular Sciences Laboratory (EMSL) that houses an unparalleled collection of state-of-the-art capabilities, including a supercomputer and over 60 major instruments, providing integrated experimental and computational resources for discovery and technological innovation in the environmental molecular sciences. EMSL also contributes to systems biology by providing leading edge capabilities in proteomics.

Subprogram Contact: Dr. J. Michael Kuperberg or Dr. Wanda Ferrell, (301) 903-3281, mike.kuperberg@science.doe.gov and wanda.ferrell@science.doe.gov
Website: http://www.science.doe.gov/ober/CCRD_top.html

3. Basic Energy Sciences

Program Website: http://www.sc.doe.gov/bes

The mission of the Basic Energy Sciences (BES) program is to support fundamental research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels in order to provide the foundations for new energy technologies and to support other aspects of DOE missions in energy, environment, and national security.

The priority areas for BES include the following:

- Create a new paradigm for the design of materials, especially those related to the efficient production, storage, transmission, and use of energy.
- Through observation and manipulation of matter at the atomic and molecular scales, achieve mastery of material syntheses and chemical transformations relevant to real-world energy systems.
- Understand and control fundamental interactions between matter and energy, especially at the nanoscale.
- Conceive, construct, and operate open-access scientific user facilities to probe materials at the limits of time, space, and energy resolution.

The BES subprograms and their objectives follow:

(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, synthesis and processing science, and biomimetic and bioinspired routes to functional materials and complex structures.

Subprogram 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.

Subprogram 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.

Subprogram 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.

Subprogram Contact: Phone (301) 903-9830
Website: http://www.science.doe.gov/bes/EPSCoR/index.htm

4. Fusion Energy Sciences

Program Website: http://www.science.doe.gov/ofes/

The mission of the Fusion Energy Sciences (FES) program is to expand the fundamental understanding of matter at very high temperatures and densities and the scientific foundations needed to develop a fusion energy source. This is accomplished by studying plasmas and their interactions with their surroundings under a wide range of temperature and density, developing advanced diagnostics to make detailed measurements of their properties, and creating theoretical/computational models to resolve the essential physics.

The priority areas for FES include the following:

- Advance the fundamental science of magnetically confined plasmas to develop the predictive capability needed for a sustainable fusion energy source.

- Pursue scientific opportunities and grand challenges in high energy density plasma science to explore the feasibility of the inertial confinement approach as a fusion energy source, to better understand our universe, and to enhance national security and economic competitiveness.
- Support development of the scientific understanding required to design and deploy the materials needed to support a burning plasma environment.
- Increase the fundamental understanding of basic plasma science, including both burning plasma and low temperature plasma science and engineering, to enhance economic competiveness and to create opportunities for a broader range of science-based applications.

An essential element of the FES program is the invention of advanced measurement techniques to ascertain the properties of plasma and its surroundings at a level required to test, challenge, and advance theoretical models. This validation forms the foundation of computational tools used to understand and predict the behavior of natural and man- made plasma systems, including burning plasmas for fusion energy.

The overarching FES goal is to develop the science needed to create a fusion energy source. This includes exploring basic issues in plasma science; developing the scientific basis and computational tools to predict the behavior of magnetically confined plasmas; using advances in tokamak research to begin investigating burning plasma physics; exploring innovative confinement options that offer the potential to increase the scientific understanding and to improve the confinement of plasmas in various configurations; investigating non-neutral plasmas and high energy density physics; support the development of the scientific understanding required to design and deploy the materials needed to support a burning plasma environment; and developing the cutting edge technologies that enable fusion facilities to achieve their scientific goals. These research areas allow us to better understand the nature of plasmas and their interactions with their environment wherever they exist, including naturally-occurring plasmas in space and on Earth, as well as man-made plasmas created in research facilities. These activities require operation of a set of unique and diversified experimental facilities, including smaller-scale devices at universities involving individual principal investigators, larger national facilities that require extensive collaboration among domestic institutions, and an even larger-scale experiments that requires an international partnership to share the costs and integrate diverse scientific and engineering expertise. These facilities provide scientists with the means to test and extend theoretical understanding and computer models-leading ultimately to an improved predictive capability for fusion science. In addition, the FES program has developed a strong partnership with the Department of Energy's National Nuclear Security Administration (NNSA) in High Energy Density Physics to take advantage of strong U.S. capabilities in inertial confinement fusion (ICF). The National Ignition Facility, or NIF, is NNSA's world-leading inertial confinement facility, which is expected to significantly advance the understanding of ICF for use as a potential energy source.

The FES long-term goal is to create an economical, abundant, and environmentally benign energy source by bringing the power of the sun and stars to Earth. Fusion energy holds the potential to provide virtually unlimited energy for mankind. FES is the U.S. participant in the construction and operation of the international ITER project. ITER, which will demonstrate a self-sustaining burning plasma for the first time, will provide an unparalleled scientific research opportunity and will test the scientific and technical feasibility of fusion power. ITER is the most significant step taken in over 25 years to advance the understanding of fusion plasmas and advance the global effort towards a feasible fusion energy source.

The specific long-term (10-year) goals for scientific advancement to which FES is committed and against which progress can be measured are:

- *Predictive Capability for Burning Plasmas*: Progress toward developing 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.
- *Configuration Optimization*: Progress toward demonstrating enhanced fundamental understanding of magnetic confinement and improved basis for future burning plasma experiments through research on magnetic confinement configuration optimization.
- *High Energy Density Plasma Physics*: Progress toward developing the fundamental understanding and predictability of high energy density plasma physics.

To accomplish its mission and address the strategic goals described above, the FES program is organized into three subprograms-Science, Facility Operations, and Enabling R&D.

The FES subprograms and their objectives follow:

(a) Science and Facility Operations

The *Science* subprogram is developing a predictive understanding of fusion plasmas in a range of plasma confinement configurations. The emphasis is presently weighted towards understanding the plasma state and its properties for stable fusion systems, but increasing emphasis is expected in the areas of plasma-material interaction and the simultaneous effects of high heat and neutron fluxes that will be encountered in a burning plasma environment. This subprogram contains research activities in magnetic fusion energy science and in plasma science, including activities to investigate the fundamental science of high energy density laboratory plasmas (HEDLP). 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. The Facilities Operations subprogram includes efforts to build, operate, maintain, and upgrade the larger-scale facilities needed to carry out research on fusion energy science. The funding for facility operations includes expenses for running the facility; providing the required plasma diagnostics; and for facility maintenance, refurbishment, and minor upgrades.

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 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) HEDLP and issues that support the development of Inertial Fusion Energy Sciences (IFES). That part of HEDLP necessary for IFE target development is carried out by NNSA's Office of Defense Programs.

Subprogram Contact: Dr. Stephen Eckstrand (301) 903-4095
Website: http://www.science.doe.gov/ofes/

(b) Enabling R&D

The Enabling R&D subprogram supports research to optimize and control plasma states in the laboratory, increasing the scientific output of present experiments and the likelihood of success of future fusion facilities. Research is aimed at improving the components and systems that are used to build present and future fusion facilities, thereby enabling them to achieve improved performance and scientific output and bring us closer to the goal of achieving practical fusion energy. 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. Research is 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, (5) safety and neutronics and (6) system studies of future devices.

Subprogram Contact: Gene Nardella (301) 903-4095
Website: http://www.science.doe.gov/ofes/

5. High Energy Physics

Program Website: http://www.science.doe.gov/hep

The mission of the High Energy Physics (HEP) program is to understand how our universe works at its most fundamental level. This is accomplished by discovering the most elementary constituents of matter and energy, probing the interactions between them, and exploring the basic nature of space and time itself.

The priority areas for HEP include the following:

- Use the highest-energy particle accelerators, discover as yet undetected elementary particles, elucidate their properties, and thereby advance our knowledge of the most fundamental forces of nature.
- Use high intensity particle beams and/or high precision, ultra-sensitive detectors, observe very rare events that help uncover the fundamental symmetries that govern the interactions of elementary particles or elucidate new phenomena.
- Obtain new insights from instrument-assisted observations of naturally occurring processes in the cosmos.

- Steward a national accelerator science program with a strategy that is inclusive and cross-disciplinary.

Taken together, these interrelated and complementary discovery priorities and the program of enabling technology research and development (R&D) offer the opportunity to answer some of the most basic questions about the world around us. All grant proposals should address specific research goals in one or more of these frontiers, or else explain how the proposed research or technology development supports the broad scientific objectives of the HEP program.

There are three broad areas within the Office of High Energy Physics that support research and technology development aimed at these objectives. New proposals should generally focus on one of these areas.

The HEP subprograms and their objectives follow:

(a) Experimental High Energy Physics Research

The experimental HEP research effort supports experiments utilizing man-made and naturally occurring particle sources to study fundamental particles and their interactions. This subprogram also provides graduate and postdoctoral research training for the next generation of scientists, equipment for experiments, and related computational support.

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; electron-positron collisions at high intensities to make 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.

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

(b) Theoretical High Energy Physics Research

The theoretical HEP research subprogram provides the vision and mathematical framework for understanding and extending the knowledge of particles, forces, space- time, and the universe. This subprogram also provides graduate and postdoctoral research training for the next generation of scientists and computational resources needed for theoretical calculations. 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.

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

(c) Advanced Technology Research and Development

The advanced technology R&D subprogram develops the next generation of particle accelerator and detector technologies for the future advancement of high-energy physics and other sciences, supporting world-leading research in the physics of particle beams and fundamental advances in particle detection. This subprogram also makes targeted investments in specialized or custom-built software and computing technologies in order to meet HEP research goals; and provides graduate and postdoctoral research training and equipment to support experiments and R&D activities.

This subprogram supports long-range, exploratory research aimed at developing new concepts, as well as efforts which can significantly improve the cost, efficiency or efficacy of existing technologies. 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 R&D program include, but are not limited to: low-mass, high channel density charged particle tracking detectors; low-level photon detectors; high resolution, fast-readout calorimeters and particle identification detectors; improving the radiation tolerance of particle detectors; and advanced electronics and data acquisition systems.

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

6. Nuclear Physics

Program Website: http://www.sc.doe.gov/np/

The mission of the Nuclear Physics (NP) program is to discover, explore, and understand all forms of nuclear matter. The fundamental particles that compose nuclear matter-quarks and gluons-are relatively well understood, but exactly how they fit together and interact to create different types of matter in the universe is still largely not understood. To solve this mystery, the NP program supports experimental and theoretical research-along with the development and operation of particle accelerators and advanced technologies-to create, detect, and describe the different forms and complexities of nuclear matter that can exist in the universe, including those that are no longer found naturally. The NP program also produces stable and radioactive isotopes that are critical for the Nation.

The priority areas for NP include the following:

- Understand how nucleons-protons and neutrons-combine to form atomic nuclei and how these nuclei have emerged since the origin of the cosmos.
- Using particle accelerators operating at less extreme energy ranges, illuminate the structure of the nucleon-the core building block of matter; understand how quarks and gluons assemble to form matter's core; and search for undiscovered forms of matter.
- Penetrate the respective mysteries surrounding the properties of the neutron and the neutrino.

- Conceive, construct, and operate national scientific user facilities.
- Steward isotope development, production, and technologies for research and applications.

To carry out its mission and address these priorities, the NP program focuses on three frontiers, Quantum Chromodynamics; Nuclei and Nuclear Astrophysics; and Fundamental Symmetries and Neutrinos. NP supports basic research in four subprograms: medium energy, heavy ion, and low energy nuclear physics, and nuclear theory (a through d). The program is the steward of the isotopes program for the nation (e) and supports the development of the tools and capabilities that make fundamental research possible (f).

The NP subprograms and their objectives follow:

(a) Medium Energy Nuclear Physics

The Medium Energy subprogram focuses primarily on questions having to do with Quantum Chromodynamics (QCD) and the behavior of quarks inside protons and neutrons. Specific questions that are being addressed include: *What is the internal landscape of the nucleons? What does QCD predict for the properties of strongly interacting matter? What governs the transition of quarks and gluons into pions and nucleons? What is the role of gluons and gluon self-interactions in nucleons and nuclei?* One major goal, for example, is to achieve an experimental description of the substructure of the proton and the neutron. The subprogram supports investigations into a few aspects of the second frontier, Nuclei and Nuclear Astrophysics, such as the question: *What is the nature of the nuclear force that binds protons and neutrons into stable nuclei?* The subprogram also examines aspects of the third area, Fundamental Symmetries and Nuclei, including the questions: *Why is there now more visible matter than antimatter in the universe? What are the unseen forces that were present at the dawn of the universe, but disappeared from view as it evolved?* In pursuing these goals the Medium Energy subprogram supports different experimental approaches primarily at the Thomas Jefferson National Accelerator Facility and the Relativistic Heavy Ion Collider.

Subprogram Contact: W. B. Tippens, (301) 903-3904, brad.tippens@science.doe.gov
Website: http://www.sc.doe.gov/np/

(b) Heavy Ion Nuclear Physics

The Heavy Ion subprogram supports experimental research that investigates the frontier of Quantum Chromodynamics (QCD) by attempting to recreate and characterize new and predicted forms of matter and other new phenomena that might occur in extremely hot, dense nuclear matter and which have not existed since the Big Bang. This subprogram addresses what happens when nucleons "melt." QCD predicts that nuclear matter can change its state in somewhat the same way that ordinary matter can change from solid to liquid to gas. The fundamental questions addressed include: *What are the phases of strongly interacting matter, and what roles do they play in the cosmos? What governs the transition of quarks and gluons into pions and nucleons? What determines the key features of QCD, and what is their relation to the nature of gravity and spacetime?* Experimental research is carried out primarily using the U.S. Relativistic Heavy Ion

Collider (RHIC) facility and the Large Hadron Collider (LHC) at the European Organization for Nuclear Research (CERN).

Subprogram Contact: G. Rai, (301) 903-4702, gulshan.rai@science.doe.gov
Website: http://www.sc.doe.gov/np/

(c) Low Energy Nuclear Physics

The Low Energy subprogram aims primarily at answering the overarching questions associated with the second frontier identified by NSAC- Nuclei and Nuclear Astrophysics. These questions include: *What is the nature of the nucleonic matter? What is the origin of simple patterns in complex nuclei? What is the nature of neutron stars and dense nuclear matter? What is the origin of the elements in the cosmos? What are the nuclear reactions that drive stars and stellar explosions?* Major goals of this subprogram are to develop a comprehensive description of nuclei across the entire nuclear chart, to utilize rare isotope beams to reveal new nuclear phenomena and structures unlike those that are derived from studies using stable nuclei, and to measure the cross sections of nuclear reactions that power stars and spectacular stellar explosions and are responsible for the synthesis of the elements. The subprogram also investigates aspects of the third frontier of Fundamental Symmetries and Neutrinos. Questions addressed in this frontier include: *What is the nature of the neutrinos, what are their masses, and how have they shaped the evolution of the universe? Why is there now more visible matter than antimatter in the universe? What are the unseen forces that were present at the dawn of the universe but disappeared from view as the universe evolved?* The subprogram seeks to measure, or set a limit on, the neutrino mass and to determine if the neutrino is its own antiparticle. Experiments with cold neutrons also investigate the dominance of matter over antimatter in the universe, as well as other aspects of Fundamental Symmetries and Interactions.

Subprogram Contact: C. Baktash, (301) 903-0258, cyrus.baktash@science.doe.gov
Website: http://www.sc.doe.gov/np/

(d) Nuclear Theory (including the Nuclear Data subprogram)

The Nuclear Theory subprogram supports theoretical research at universities and DOE national laboratories with the goal of improving our fundamental understanding of nuclear physics, interpreting the results of experiments, and identifying and exploring important new areas of research. This subprogram addresses all three of the field's scientific frontiers described in NSAC's long range plan, which are Quantum Chromodynamics (QCD), Nuclei and Nuclear Astrophysics, and Fundamental Symmetries and Neutrinos, and the associated specific questions listed for the experimental subprograms above.

Theoretical research on QCD (the fundamental theory of quarks and gluons) addresses how the properties of the nuclei, hadrons, and nuclear matter observed experimentally arise from this theory, how the phenomena of quark confinement arises, and what phases of nuclear matter occur at high densities and temperatures. In Nuclei and Nuclear Astrophysics, theorists investigate a broad range of topics, including calculations of the properties of stable and unstable nuclear species, the limits of nuclear stability, the various types of nuclear transitions and decays, how nuclei arise from the forces between nucleons, and how nuclei are formed in cataclysmic astronomical events such as supernovae. In Fundamental Symmetries and Neutrinos, nucleons and nuclei are used to test the Standard Model, which describes the interactions of elementary particles at the most fundamental level. Theoretical research in this area is concerned with determining how various aspects of the Standard Model can be explored through nuclear physics experiments, including the interactions of neutrinos, unusual nuclear transitions, rare decays, and high-precision studies of cold neutrons.

Nuclear Theory activities at DOE also include the Nuclear Data subprogram, which compiles, maintains and distributes a database of information on nuclear properties and reactions that is of critical interest both to researchers and to developers of industrial applications of nuclear technology.

Subprogram Contact: G. Fai, (301) 903-8954, george.fai@science.doe.gov
Website: http://www.sc.doe.gov/np/

(e) Isotope Development and Production for Research and Applications

The Isotope Development and Production for Research and Applications subprogram supports the production and development of production techniques of radioactive and stable isotopes that are in short supply. The program provides facilities and capabilities for the production of research and commercial stable and radioactive isotopes, scientific and technical staff associated with general isotope research and production, and a supply of critical isotopes to address the needs of the Nation. Isotopes are made available by using the Department's unique facilities, the Brookhaven Linear Isotope Producer (BLIP) at BNL and the Isotope Production Facility (IPF) at LANL, of which the subprogram has stewardship responsibilities. The Program also coordinates and supports isotope production at a suite of university, national laboratory, and commercial accelerator and reactor facilities throughout the Nation to promote a reliable supply of domestic isotopes. Topics of interest include research that is focused on the development of advanced, cost- effective and efficient technologies for producing, processing, recycling and distributing isotopes in short supply. This includes innovative approaches to model and predict behavior and yields of targets undergoing irradiation in order to minimize target failures during routine isotope production.

Subprogram Contact: J. Pantaleo, (301) 903-2525, john.pantaleo@science.doe.gov
Website: http://www.sc.doe.gov/np/

(f) Accelerator Research and Development for Current and Future Nuclear Physics Facilities

The Nuclear Physics program supports a broad range of activities aimed at research and development related to the science, engineering, and technology of heavy-ion, electron, and proton accelerators and associated systems. Areas of interest include the R&D technologies of the Brookhaven National Laboratory's Relativistic Heavy Ion Collider (RHIC), with heavy ion and polarized proton beam; the development of an electron-ion collider (EIC); linear accelerators such as the Continuous Electron Beam Accelerator Facility (CEBAF) at the Thomas Jefferson

National Accelerator Facility (TJNAF); and development of devices and/or methods that would be useful in the generation of intense rare isotope beams for the next generation rare isotope beam accelerator facility (FRIB).

Subprogram Contact: M. Farkhondeh, (301) 903-4398, manouchehr.farkhondeh@science.doe.gov
Website: http://www.sc.doe.gov/np/

7. Workforce Development for Teachers and Scientists

Program Website: http://www.scied.science.doe.gov

The mission of the Workforce Development for Teachers and Scientists (WDTS) program is to help ensure that DOE and the Nation have a sustained pipeline of highly trained Science, Technology, Engineering, and Mathematics (STEM) workers.

The priority areas for WDTS include the following:

- Increase participation of under-represented students and faculty in STEM education and careers, using opportunities afforded by the DOE national laboratories.
- Contribute to the development of STEM K-16 educators through experiential- based programs at the DOE national laboratories.
- Provide mentored research experiences to undergraduate students and faculty through participation in the DOE research enterprise at the DOE national laboratories.
- Provide graduate fellowships for the pursuit of advanced degrees in scientific disciplines that prepare U.S. students for careers important to the Office of Science mission.

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 undergraduate student internships, faculty and teacher fellowships and professional development programs at the DOE national laboratories. It also provides graduate fellowships for the pursuit of advanced degrees in scientific disciplines that prepare U.S. students for careers important to the Office of Science Mission. 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: Brian O'Donnell (202) 586-7399
Website: http://www.scied.science.doe.gov

For further submission information please see the full version of this FOA, DE-FOA-0000178, which can be obtained at: https://www.fedconnect.net by clicking on "Search Public Opportunities". Under "Search Criteria", select "Advanced Options", enter a portion of the title "FY 2010 Continuation of Solicitation for the Office of Science Financial Assistance Program", then click on "Search". Once the screen comes up, locate the appropriate Announcement.

The Catalog of Federal Domestic Assistance number for this program is 81.049, and the solicitation control number is ERFAP 10 CFR Part 605.

Posted on the Office of Science Grants and Contracts Web Site
December 4, 2009.