Office of Science
Financial Assistance
Funding Opportunity Announcement

DE-FOA-0000396

National Spherical Torus Experiment: Collaborative Research on Configuration Optimization

SUMMARY:

The Fusion Energy Sciences (FES) Program of the Office of Science (SC), U.S. Department of Energy (DOE), hereby announces its interest in receiving grant applications for collaborative research on the National Spherical Torus Experiment (NSTX) at Princeton Plasma Physics Laboratory. The NSTX program contributes to two goals of the FES program: developing a predictive understanding of magnetically confined plasmas and investigating the unique properties of the spherical torus configuration. All individuals or groups planning to submit applications for new or renewal funding in Fiscal Year 2011 should submit applications in response to this FOA. Applications for collaborative research focused primarily on implementing a diagnostic instrument on NSTX or on operating a diagnostic instrument and analyzing the resulting data should not be submitted in response to this FOA.

The NSTX program helps to build the scientific foundations for fusion energy by both contributing to the fundamental understanding of magnetically confined plasmas and assessing the attractiveness of the spherical torus for future fusion facilities. Applications for collaborative research must support the NSTX Program by addressing key scientific issues related to one or more of the following topics: Macroscopic Stability, Multi-Scale Transport Physics, Plasma Boundary Interfaces, Energetic Particles, Start-up, Ramp-up and Sustainment without a Solenoid, and Advanced Operating Scenarios. To be considered for funding, applicants must have discussed their proposed research with the NSTX National Research Program Leaders and must include a Record of Discussion that specifies the benefits of proposed research to the NSTX program and the interface support required to carry it out. Applications to renew on-going NSTX collaborative research must include a list of project goals from the previous project period and a summary of the actual accomplishments.

PREAPPLICATIONS:

Preapplications are **REQUIRED** and must be submitted by August 19, 2010, 11:59 PM Eastern Time. **Failure to submit a preapplication by an applicant will preclude the full application from due consideration.** The preapplication should be submitted electronically by E-mail to john.sauter@science.doe.gov and Steve.eckstrand@science.doe.gov. **Please include "Preapplication for DE-FOA-0000396" in the subject line.**

Preapplications should include cover page information, a brief description of the proposed work (1-2 pages, including text with minimum font size 11 point, figures, and references), and a one-page curriculum vitae from each Principal Investigator (PI), co- Principal Investigator (co-PI), and senior collaborator or consultant. The cover page should include: (a) A statement that the document is a preapplication in response to Funding Opportunity DE-FOA-0000396; (b) PI information: name, institutional affiliation, telephone number, fax number, and e-mail address; and, (c) names and institutions of all co-PIs, and senior collaborators or consultants (excluding postdoctoral associates). Since among the purposes of the preapplication is to facilitate FES in planning the merit review and the selection of peer-reviewers without conflicts of interest, it is important that applicants ensure their list of supported or unsupported participants is as comprehensive as possible.

Preapplications will be reviewed by FES program officials for responsiveness to this Funding Opportunity and the NSTX program, eligibility of the applicant organization, and qualification of the applicant's personnel for carrying out a large-scale computational research activity. Only those applicants who receive notification from DOE encouraging a full application may submit a formal application. **No other formal applications will be considered.**

APPLICATION DUE DATE: September 28, 2010, 11:59 PM Eastern Time

Formal applications submitted in response to this FOA must be received by September 28, 2010, 11:59 PM Eastern Time, to permit timely consideration of awards in Fiscal Year 2011. **You are encouraged to transmit your application well before the deadline. APPLICATIONS RECEIVED AFTER THE DEADLINE WILL NOT BE REVIEWED OR CONSIDERED FOR AWARD.**

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-0000396&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 " Scientific Discovery through Advanced Computing: Advanced Simulation of Fusion Plasmas", 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).

GENERAL INQUIRIES ABOUT THIS FOA SHOULD BE DIRECTED TO:

Dr. Stephen Eckstrand, Office of Fusion Energy Sciences, SC-24.2
PHONE: 301-903-5546
FAX: 301-903-4716
E-MAIL: Steve.Eckstrand@science.doe.gov

SUPPLEMENTARY INFORMATION:

National Spherical Torus Experiment

The NSTX is a major facility designed to study the physics of fusion plasmas confined in a very low aspect-ratio Spherical Torus (ST) configuration. The ST is characterized by strong magnetic field curvature and high toroidal beta (the ratio of the average plasma pressure to the applied toroidal magnetic field pressure) due to its very low aspect ratio. These unique properties extend and complement the normal aspect ratio tokamak in addressing several overarching scientific issues in magnetic fusion energy science. The long-term programmatic goals of the NSTX

program are to evaluate the attractiveness of a compact ST configuration, such as a Fusion Nuclear Science Facility (FNSF), as a cost-effective element in the development of practical fusion power, and to contribute to resolving important issues in predicting the physics of burning plasmas anticipated in ITER. The first programmatic goal encompasses the research elements for the ST identified in Thrust 16 of the report *Research Needs for Fusion Energy Sciences* http://www.science.doe.gov/ofes/ReNeW_report_press.pdf. The NSTX program includes research in all of the following topical areas: Macroscopic Stability, Multi-Scale Transport Physics, Plasma Boundary Interfaces, Energetic Particles, Start-up, Ramp-up and Sustainment without a Solenoid, and Advanced Operating Scenarios.

More detailed information on the NSTX program is available in the peer reviewed five-year research program for NSTX starting in FY 2009, which is available at http://nstx.pppl.gov/DragNDrop/Five_Year_Plans/2009_2013/NSTX_Research_Plan_2009-2013.pdf

An NSTX Program Letter providing updated information on the NSTX research priorities and collaboration opportunities during the next three years, based on the advice of the NSTX Program Advisory Committee, will be available on July 29, 2010 at:

http://nstx.pppl.gov/DragNDrop/Program_PAC/Program_Letters/NSTX_Program_Letter_FY2011-13.pdfResearch on NSTX is carried out by a national research team, which includes scientific personnel from many of the leading U.S. fusion research institutions. Researchers from outside of PPPL are involved in nearly all areas of research on NSTX. The following research areas are included in this solicitation.

I. Macroscopic Stability
II. Multi-Scale Transport Physics
III. Plasma Boundary Interfaces
IV. Energetic Particles
V. Start-up, Ramp-up, and Sustainment without a Solenoid
VI. Advanced Operating Scenarios

The following sections provide a brief description of the high-priority research topics in each research area in the NSTX Program during FY 2011-2013, the time frame for which collaborative research proposals are being solicited.

NSTX Research Priorities for FY 2011-2013

The projected NSTX priorities for FY 2011-2013 are provided below and grouped in the following scientific areas:

I. Macroscopic Stability - role of magnetic structure in plasma confinement and the limits to plasma pressure in sustained magnetic configurations.

I-1. *Identify and understand modes that tear magnetic field surfaces and limit plasma pressure and energy confinement as the plasma pressure increases above the "no-wall" limit.*

I-2. *Optimize error-field and resistive wall mode (RWM) control to sustain stable, strongly shaped, toroidally rotating plasmas above the "no-wall" pressure limit relevant to advanced operating modes expected in ITER and FNSF.*

I-3. *Understand the role of kinetic effects in RWM stability and toroidal rotation damping to optimize RWM stability and rotation in ITER and future facilities.*

I-4. *Assess RWM stability and neoclassical toroidal viscosity at reduced collisionality.*

I-5. *Investigate the physics and control of toroidal rotation at low collisionality.*

II. Multi-Scale Transport Physics - physical processes that govern the confinement of heat, momentum, and particles in plasmas.

II-1. *Determine relationship between local turbulence measurements (low-k and high-k) and ion and electron heat diffusivities inferred from power balance.*

II-2. *Compare turbulence measurements with theory and simulation using a suite of micro-turbulence codes.*

II-3. *Assess main-ion fueling and impurity ion transport in the presence of lithium plasma facing components, and compare to existing theories.*

III. Plasma Boundary Interfaces - interface between fusion plasma and its lower temperature plasma-facing material surroundings.

III-1. *Assess divertor pumping with liquid lithium and the effect of reduced edge density on edge and core plasma conditions.*

III-2. *Investigate boundary plasma response to applied 3D magnetic field perturbations and other perturbations designed to control edge plasma transport and stability.*

III-3. *Assess the compatibility of the liquid lithium divertor with high flux expansion and radiative divertor solutions*

III-4. *Model and assess experimentally the impact of off-normal events (disruptions, ELMs) on liquid lithium surfaces in the divertor.*

IV. Energetic Particles - use of electromagnetic waves and energetic particles to sustain and control high-temperature plasmas.

IV-1. *Measure the transport of supra-Alfvénic fast ions due to Alfven eigenmode avalanches and other Alfvenic instabilities.*

IV-2. *Validate models of fast-ion transport by avalanche to develop a predictive capability for fast-ion transport relevant to ITER and FNSF.*

IV-3. *Measure and simulate interactions between high-harmonic fast-waves (HHFW) and neutral beam fast-ions with application to optimizing plasma heating by the HHFW.*

V. Start-up, Ramp-up and Sustainment without solenoid - physical processes of magnetic flux generation and sustainment.

V-1. *Investigate high harmonic fast wave (HHFW) heating, current drive, and ramp up with the goal of sustaining a plasma with 100% non-inductive current drive.*

V-2. *Assess confinement, heating, and ramp-up of plasmas formed using Coaxial Helicity Injection (CHI).*

VI. Advanced Operating Scenarios - physics synergy of external control and self-organization of the plasma.

VI-1. *Develop operating scenarios with high non-inductive current fraction, high-bootstrap-fraction, and high-beta, and assess the dependence of integrated plasma performance on collisionality.*

VI-2. *Explore the cross-cutting effects of toroidal rotation and rotation shear at low collisionality, including the effect of rotation on transport, bootstrap current, edge localized modes, and impurity transport.*

VI-3 *Assess rotation profile control with varied neutral beam injection torque, and via magnetic braking utilizing independent control of n=1, 2, and 3 magnetic fields.*

Collaboration

Because NSTX is a collaborative national program, all applicants must collaborate with researchers from other institutions who are part of the NSTX National Research Team. The team currently includes researchers from Princeton Plasma Physics Laboratory, industry, universities, and other DOE National Laboratories. Planning for collaborative research on NSTX must begin in advance of submitting an application. Thus, applications submitted in response to this notice must include a Record of Discussion indicating the benefits of proposed research to the planned NSTX research program, the interface support required by the proposed collaborative work, and a description of how the proposed work will be integrated into the overall NSTX program.

In addition, applications submitted from different institutions, which are directed at a common research activity, should clearly indicate that they are part of a proposed collaboration and contain a brief description of the overall research project. However, each application must have a distinct scope of work and a qualified principal investigator who is responsible for the research effort being performed at his or her institution. Synergistic collaborations with researchers in Federally Funded Research and Development Centers (FFRDCs), including the DOE National Laboratories, are also encouraged though no funds will be provided to these organizations under this FOA. Further information on preparation of collaborative applications may be accessed via the Internet at: http://www.sc.doe.gov/grants/Colab.asp.

Program Funding:

It is anticipated that up to $1.5 million from DOE/OFES for new collaborative research awards during FY 2011 will be available, contingent upon the availability of funds. Multi-year funding of grant awards is expected, with out-year support contingent upon the availability of appropriated funds in future years, progress of the research, and continuing program need. It is expected that up to 10 awards will be made, depending on the size of the awards. Most awards will be for 3 years and will range from $50,000 to $350,000 per year (total costs). DOE is under no obligation to pay for any costs associated with preparation or submission of applications.

The Catalog of Federal Domestic Assistance (CFDA) 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: July 9, 2010.