Office of Science
Notice DE-FG01-05ER05-20

National Spherical Torus Experiment - Innovative Measurements of Spherical Torus Plasmas

Department of Energy

Office of Science Financial Assistance Program Notice
DE-FG01-05ER05-20; National Spherical Torus Experiment - Innovative Measurements of Spherical Torus Plasmas

AGENCY: U.S. Department of Energy

ACTION: Notice inviting grant applications.

SUMMARY: The Office of Fusion Energy Sciences (OFES) of the Office of Science (SC), U.S. Department of Energy (DOE) hereby announces its interest in receiving grant applications for collaborative research involving innovative diagnostics on the National Spherical Torus Experiment (NSTX) at Princeton Plasma Physics Laboratory. The NSTX program addresses two of the long term goals of OFES: **Configuration Optimization** and developing a **Predictive Capability for Burning Plasmas**. Collaborative research involving innovative diagnostics must support the NSTX program goals by making important measurements related to plasma profile evolution, plasma control and stability, plasma turbulence and transport, or edge plasma characteristics. 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 indicating the benefits of their proposed research to the planned NSTX research program and the interface support required by the proposed collaborative work. Applications to renew on-going NSTX collaborative research must include a list of project goals from the previous statement of work and a summary of the actual accomplishments. Applications focusing primarily on design of potential diagnostics for NSTX or on planning/analysis of experiments on NSTX will not be considered under this notice.

DATES: A Letter-of-Intent (LOI) to submit an application is REQUIRED and should be submitted by September 14, 2005. Failure to submit a Letter-of-Intent by an applicant may preclude the full application from due consideration.

Formal applications submitted in response to this notice must be received by 8:00 p.m., Eastern Time, October 13, 2005, in order to be accepted for merit review and to permit timely consideration for award in Fiscal Year 2006.

Please see the "Addresses" section below for further instructions on the method of submission for the Letter-of-Intent and formal application.

Please see the "Supplementary Information" section below for further instructions on the preparation of the Letter-of-Intent and the full application. Electronic submission of the Letter-of-Intent and the formal application in PDF format are required.

ADDRESSES: Letters-of-Intent referencing Program Notice DE-FG01-05ER05-20, should be sent to Mr. John Sauter by E-mail: john.sauter@science.doe.gov, with a copy to Dr. Stephen Eckstrand at: steve.eckstrand@science.doe.gov. Please include "Letter-of-Intent for Program Notice DE-FG01-05ER05-20" in the subject line.

Formal applications

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-FG01-05ER05-20 and the CFDA Number for the Office of Science is: 81.049. Instructions and forms are available on the Grants.Gov website. Please see below and also refer to the "Funding Opportunity Announcement", Part IV - Application and Submission Information; H.Other Submission and Registration Requirements, for more specific guidance on "Where to Submit" and "Grants.gov Registration Process." 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 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 14 days to complete these requirements. It is suggested that the process be started as soon as possible.

VERY IMPORTANT - Download PureEdge Viewer: In order to download the application package, you will need to install PureEdge Viewer. This small, free program will allow you to access, complete, and submit applications electronically and securely. For a free version of the software, visit the following Web site: http://www.grants.gov/DownloadViewer.

FOR FURTHER INFORMATION CONTACT: Office of Fusion Energy Sciences, U.S. Department of Energy, SC-24.2/Germantown Building, 1000 Independence Avenue, SW, Washington, DC 20585-1290. Dr. Stephen Eckstrand, SC-24.2, (301) 903-5546, steve.eckstrand@science.doe.gov, is the Program Manager for the OFES NSTX Program, and may be contacted for technical information. Mr. John Sauter, SC-24.2, (301) 903-3287, john.sauter@science.doe.gov may be contacted for administrative information relating to the submission of the Letter-of-Intent.

SUPPLEMENTARY INFORMATION

The scientific mission of the National Spherical Torus Experiment (NSTX) is to advance fusion plasma science by determining and understanding the physics principles of the Spherical Torus (ST), which is characterized by strong magnetic field curvature and high bT (the ratio of the average plasma pressure to the applied toroidal magnetic field pressure) due to its low aspect ratio. These unique properties complement the normal aspect ratio tokamak in addressing the overarching scientific issues in magnetic fusion energy science, covering turbulence and transport, macroscopic MHD stability, wave- particle interaction, solenoid-free generation and sustainment of magnetic flux, and plasma interface with the surrounding environment. The programmatic mission of NSTX is to contribute to resolving important burning plasma physics issues anticipated in ITER and to determine the attractiveness of the ST for reducing cost, time and risk of development of practical fusion energy, through these scientific investigations.

More detail of the NSTX program is described in the peer reviewed five-year research program for NSTX starting in FY 2004, available at http://nstx.pppl.gov/Pages_folder/research_folder/5YrPlan.html.

A NSTX Program Letter providing updated information on the NSTX research priorities and collaboration opportunities during the upcoming three years, accounting for the advice of the NSTX Program Advisory Committee, will be available on or before August 15, 2005 at http://nstx.pppl.gov/nstx/NSTX_Program_Letters/.

The low toroidal field of a spherical torus results in plasmas with different parameters from those in conventional aspect ratio tokamaks. This in turn leads to new challenges for making some measurements and new requirements for others. Diagnostic instruments on NSTX are provided by a broadly based research team, which includes scientists from many of the leading U.S. fusion research institutions and PPPL. The following sections provide a brief description of the topical areas, for which enhanced measurement capabilities are required and included in this solicitation.

I. Measurement of Transport and Turbulence - physical processes that govern heat, particle and momentum confinement

II. Measurement of Macroscopic MHD Stability Properties - role of magnetic structure on plasma pressure and bootstrap current

III. Measurement of Wave-Particle Interactions - role of electromagnetic waves, modes and energetic particles in sustaining and controlling hot plasmas

IV. Measurement of Startup, Ramp-up and Sustainment Processes - physical processes of magnetic flux generation and sustainment

V. Measurement of Boundary Physics - interface between fusion plasmas and normal temperature surroundings

VI. Measurement of Physics Integration Processes - physics synergy of external control and self-organization.

The NSTX research goals for FY 2006 - 2008 in the above topical areas are provided below. These goals, together with the diagnostics already in operation or under active preparation on NSTX, form the information base on which to determine the priority, timeliness, and complementarity of the desired new measurement capabilities on NSTX. Details of these will be contained in the above-mentioned NSTX Program Letter.

I. FY 2006 - 2008 Research Goals in Transport and Turbulence

- *Characterize the effects of variations in the magnetic shear and gradients in Te on electron transport in low-aspect ratio plasmas.*
- *Measure short wavelength turbulence in the plasma core in a range of plasma conditions.*
- *Assess the correlation between measured and calculated high-k turbulence spectra, and the measured electron thermal conductivity.*

II. FY 2006 - 2008 Research Goals in Macroscopic MHD Stability

- *Produce and characterize strongly shaped, rotating, low aspect ratio plasmas close to the "wall-stabilized" pressure limits with error field correction.*
- *Characterize the effectiveness of active feedback control of resonant error fields (Sept. '06) and pressure-limiting global modes (Sept. '07) using closed-loop control of currents in ex-vessel correction coils.*
- *Identify modes that tear magnetic field surfaces and limit plasma pressure and energy confinement as the plasma pressure increases toward the "wall- stabilized" limit.*

III. FY 2006 - 2008 Research Goals in Wave-Particle Interactions

- *Assess the effects of supra-Alfvénic fast ion driven instabilities on driven current in the plasma core.*
- *Compare data on supra-Alfvénic fast ion driven modes with non-linear simulations of these modes.*
- *Characterize the interaction between the edge plasma region and the launched High Harmonic Fast Waves (HHFW), and determine plasma conditions that permit efficient heating and current drive via HHFW.*
- *Characterize the diffusion and loss of supra-Alfvénic fast ions due to fast-ion driven oscillations in low-aspect ratio, high-beta plasmas.*

IV. FY 2006 - 2008 Research Goals in Startup, Ramp-up and Sustainment

- *Assess the conditions in which a substantial amount of closed poloidal magnetic flux is created via Coaxial Helicity Injection.*
- *Test conditions for solenoid-free ramp-up of plasma to substantial plasma current.*

V. FY 2006 - 2008 Research Goals in Boundary Physics

- *Characterize the plasma edge pedestals and scrape-off layer of low-aspect ratio, high confinement, high P/R plasmas.*
- *Characterize the effectiveness of lithium pellet injection and tile coating in controlling fuel recycling from the plasma facing components.*
- *Assess the long-pulse plasma conditions and operational requirements of edge heat and particle control of low-aspect ratio, high-confinement, high P/R plasmas.*

VI. FY 2006 - 2008 Research Goals in Physics Integration

- *Characterize strongly shaped low-aspect ratio plasmas with high fractions of self- driven current and low toroidal induction voltage for durations that allow internal currents to redistribute.*
- *Benchmark and improve physics models and the time-dependent simulation codes with data from high-performance plasmas characterized by large self-driven current, high pressure relative to the applied toroidal field, and low toroidal induction voltage.*
- *Characterize strongly shaped low-aspect ratio plasmas with high fractions of bootstrap current and zero toroidal induction voltage (solenoid-free) for durations that allow internal currents to redistribute.*

Program Funding

It is anticipated that about $1.8 million will be available from DOE/OFES for new collaborative research awards during FY 2006, contingent upon the availability of funds. Multi-year funding of grant awards is expected, and is also contingent upon the availability of appropriated funds in future years, progress of the research, and continuing program need. It is expected that up to 5-6 awards will be made, depending on the size of the awards. Most awards will be for 3 years and will range from $200,000 to $400,000 per year (total costs). It is planned that awards will be announced in early January 2006 and funding will begin in early March.

Collaboration

Applicants must collaborate with researchers from other institutions who are part of the NSTX National Research Team, which includes researchers from Princeton Plasma Physics Laboratory, industry, universities, and other DOE National Laboratories, as appropriate. In addition, applicants must include a collaboration plan and a Record of Discussion indicating the benefits of the proposed research to the planned NSTX research program and the interface support required by the proposed collaborative work.

Additional information on collaboration is available in the Application Guide for the Office of Science Financial Assistance Program that is available via the Internet at: http://www.science.doe.gov/grants/Colab.html.

Letter-of-Intent

The primary purpose of the Letter-of-Intent (LOI) is to assist the OFES in planning the review and the selection of potential reviewers for the application. For this purpose, the LOI must

include a one-page abstract of the proposed research, and list the names and institutional affiliations of Principal Investigators, any Co-Principal Investigators, key investigators, collaborators, or consultants, so as to reveal any potential conflict of interest in the selection of reviewers for the application.

Application

(Please Note Special Instructions Below on Page Limits and Content)

Since we expect that some reviewers will be asked to review several applications, all applications should be limited to a maximum of twenty (20) pages (including text and figures) of technical information (sections two through six below). Applications exceeding these page limits may be rejected without review. The PDF file may also include a few selected publications in an Appendix as background information. In addition, please limit biographical and publication information for the principal investigator and key personnel to no more than two pages each. The page count of 20 does not include the Face Page and Budget Pages, the Title Page, the biographical material and publication information, or any Appendices. However, it is important that the 20 page technical information section provide a complete description of the proposed work, since reviewers are not obliged to read the Appendices.

The application should be written in strict compliance with the following format:

1. Abstract - brief description of the project purpose and goals in no more than 250 words

2. Executive Summary - summary of the application in one to two pages

3. Background and Recent Accomplishments

3.1. Background - explanation of the importance and relevance of the proposed work
3.2. Recent Accomplishments - description of relevant work carried out by the PI and/or co-PIs during the past 2-3 years (for renewal applications this section should summarize the previous scope of work and the actual accomplishments of the current grant period)

4. Proposed Research Project

4.1. Detailed description of proposed research
4.2. Project schedules, milestones, and deliverables

5. Narrative explanation of the overall budget

6. Description of facilities, resources, and personnel

6.1 Discussion of the responsibilities of the senior personnel involved in the research project and description of applicant's facilities and resources that will be

used in carrying out the proposed research
6.2. Discussion about base program support that is assumed in developing budget estimates

7. Other current and pending support.

General information about development and submission of applications, eligibility, limitations, evaluations and selection processes, and other policies and procedures may be found in the Application Guide for the Office of Science Financial Assistance Program and 10 CFR Part 605. Electronic access to SC's Financial Assistance Guide is possible via the Internet using the following Web site address: http://www.science.doe.gov/grants/. **Any specific instructions included in this notice supersede those in the general information referred to above.** DOE is under no obligation to pay for any costs associated with the preparation or submission of an application if an award is not made. The information required by 10 CFR Part 605 should be conveyed by the application using the above format wherever possible.

Merit and Relevance Review

Applications will be subjected to formal merit review and will be evaluated against the following criteria, which are listed in descending order of importance as set forth in 10 CFR Part 605. (http://www.science.doe.gov/grants/605index.html). Included with each criterion are the detailed questions that are asked of the reviewers.

1. Scientific and/or technical merit of the project;

- What important problem(s) in plasma science or fusion science does this application address?
- How will the proposed research contribute to the NSTX program during the next three years and how important is this contribution to the overall NSTX program?
- How does the proposed research compare with other research in its field, both in terms of scientific and/or technical merit and originality?
- What is the likelihood that it will lead to new or fundamental advances in its field?
- In the case of an application to renew an on-going research project, how well has the applicant performed under the existing award?

  In answering these questions, please identify the topics described in Supplemental Information to which the proposed research will most likely contribute and why.

2. Appropriateness of the proposed method or approach;

- To what extent are the conceptual framework, methods, and analyses adequately developed and likely to lead to scientifically valid conclusions?
- What innovative concepts or methods will be employed in the proposed research?
- Are there significant potential problems and how well does the applicant address these potential problems?

3. Competency of the applicant's personnel and adequacy of the proposed resources;

- How well qualified are the applicant's personnel to carry out the proposed research? (If appropriate, please comment on the scientific reputation and quality of recent research by the principal investigator and other key personnel.)
- Please comment on the applicant's research environment and resources.
- To what extent does the proposed research take advantage of unique facilities and capabilities and/or make good use of collaborative arrangements?
- In the case of an application to renew an on-going research project, have the applicant's personnel played a leading role in any aspect of the NSTX program?

4. Reasonableness and appropriateness of the proposed budget.

The reviewers are also asked to comment on **Other Appropriate Factors:**

- What are the overall strengths and weaknesses of the application?
- Could the proposed research make a significant contribution to another field?
- If applicable, please comment on the educational benefits of the proposed activity.

The evaluation will include program policy factors such as the relevance of the proposed research to the terms of the announcement, the Department's programmatic needs, and quality of previous performance. External peer reviewers are selected with regard to both their scientific expertise and the absence of conflict-of-interest issues. Non-federal reviewers may be used, and submission of an application constitutes agreement that this is acceptable to the investigator(s) and the submitting institution. Applications found to be scientifically meritorious and programmatically relevant will be selected in consultation with DOE selecting officials depending upon availability of funds in the DOE budget. Funding under this Notice is limited to supporting research activities based in the U.S., though subcontracts with limited funding for collaborators outside the U.S. may be allowed with appropriate justifications. The selected projects will be required to acknowledge support by DOE in all public communications of the research results.

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

Martin Rubinstein
Grants and Contracts Division
Office of Science

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