Office of Science
Financial Assistance
Funding Opportunity Announcement
DE-PS02-08ER08-29

National Spherical Torus Experiment
Innovative Measurements of
Spherical Torus Plasmas

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 applications for collaborative research employing innovative diagnostic instruments on the National Spherical Torus Experiment (NSTX) at Princeton Plasma Physics Laboratory. The NSTX program addresses two of the long term goals of the OFES program: **Configuration Optimization** and developing a **Predictive Capability for Burning Plasmas**. Applications for collaborative research must support the NSTX Program by addressing key scientific issues related to these goals, such as Macroscopic Stability, Multi-Scale Transport Physics, Plasma Boundary Interfaces, Waves and Energetic Particles, and Start-up, Ramp-up and Sustainment without a Solenoid, and Integration of Physics and Operational Requirements for Achieving Burning Plasma Conditions. 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 research 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 statement of work and a summary of the actual accomplishments.

LETTER OF INTENT DUE DATE: September 4, 2008

A Letter of Intent (LOI) to submit an application is **REQUIRED** and should be submitted by September 4, 2008. **Failure to submit a Letter of Intent by an applicant may preclude the full application from due consideration.** The LOI should be submitted electronically by E-mail to: marty.carlin@science.doe.govand Steve.Eckstrand@science.doe.gov. Please include "Letter of Intent for Announcement DE-PS02-08ER08-29" in the subject line. The purpose of the LOI is to facilitate the OFES in planning the peer review and the selection of potential reviewers for the proposal. 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 identify any potential conflict of interest in the selection of qualified reviewers for the application.

APPLICATION DUE DATE: September 25, 2008, 8 PM Eastern Time

Applications must be submitted using Grants.gov, the Funding Opportunity Announcement can be found using the CFDA Number, 81.049 or the Funding Opportunity Announcement number,

DE-PS02-08ER08-29. Applicants must follow the instructions and use the forms provided on Grants.gov.

PROGRAM MANAGER:

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SUPPLEMENTARY INFORMATION:

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 long-term programmatic goals of the NSTX program are to evaluate the potential of a compact ST configuration, such as a Component Test Facility (CTF), to be 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. This addresses two of the long term goals of the Office of Fusion Energy Sciences (OFES) program: Configuration Optimization and developing a Predictive Capability for Burning Plasmas. ITER participation and a CTF are included in the USDOE 20-year strategic plan for the Fusion Energy Sciences Program (http://www.sc.doe.gov/bes/archives/plans/SCSP_12FEB04.pdf). In support of the above goals, the scientific objective of the National Spherical Torus Experiment (NSTX) is to understand the physics of the ST, which 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. These issues are defined by the 2005 Fusion Energy Sciences Advisory Committee (FESAC) Priorities Panel report (http://www.ofes.fusion.doe.gov/more_html/FESAC/PP_Rpt_Apr05R.pdf) and can be organized into the following topical areas: Macroscopic Stability, Multi-Scale Transport Physics, Plasma Boundary Interfaces, Waves and Energetic Particles, and Start-up, Ramp-up and Sustainment without a Solenoid, and Integration of Physics and Operational Requirements for Achieving Burning Plasma Conditions.

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/.

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 August 20 at http://nstx.pppl.gov/nstx/NSTX_Program_Letters/.

Research 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. Transport and Turbulence
III. Boundary Physics
IV. Waves and Energetic Particles
V. Solenoid-free Plasma Start-up, Ramp-up, and Sustainment

The following sections provide a brief description of the high-priority research topics in each research area in the NSTX Program during FY 2009-2011, the time frame for which collaborative research proposals are being solicited.

NSTX Research Priorities for FY 2009-2011

The major NSTX research goals for FY 2009-2011 are provided below grouped by scientific area:

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

I-1. *Determine the physics of Resistive Wall Mode (RWM) stabilization, by both passive and active means, and apply this understanding to reliably sustain high-beta low-aspect-ratio plasmas.*

I-2. *Study the impact of low aspect ratio, high beta, large ion gyro-radius, and strong flow shear on classical and neoclassical tearing mode stability.*

I-3. *Characterize the effects of disruptions at low aspect ratio and high beta by measuring halo currents, and thermal and current quench characteristics.*

I-4. *Develop understanding of non-axisymmetric field induced plasma viscosity for both resonant and non-resonant fields, and apply results to optimize error field correction and for rotation profile control.*

NOTE: *For I-4 above, plasma rotation modification by 3D fields also impacts the transport and turbulence and boundary physics scientific areas of NSTX.*

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

II-1. *Determine the modes (low-k, high-k, electrostatic, electromagnetic, Alfvénic) responsible for causing anomalous electron transport.*

II-2. *Determine the role of low-k turbulence in causing anomalous ion energy and momentum transport, and understand the influence of plasma rotation on low-k and high-k turbulence.*

II-3. *Determine the relationship between observed particle and impurity transport and measured and simulated micro-turbulence.*

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

III-1. *Measure and understand the impact of a liquid lithium divertor (LLD) on particle control, energy confinement, and H-mode pedestal transport and stability. Further, analyze the LLD surface characteristics and the interactions between the LLD and the edge plasma, including the transport of lithium from the edge to the core under both steady-state and transient edge conditions.*

III-2. *Characterize the parallel and cross-field transport of heat and particles in the Scrape-Off-Layer (SOL), and understand the linkage between SOL transport and turbulence and the peak heat flux to the divertor.*

III-3. *Understand the H-mode pedestal characteristics that provide access to small ELM and ELM-free regimes in the ST, and understand how boundary modifications including plasma shaping, 3D fields, and lithium impact pedestal transport and ELM stability.*

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

IV-1. *Study and optimize high-harmonic fast-wave (HHFW) heating and current drive in deuterium H-mode plasmas, with emphasis on understanding and minimizing surface wave excitation and interactions between the HHFW and Neutral Beam Injection (NBI) fast ions.*

IV-2. *Study the range of observed energetic-particle-driven instabilities (for example Toroidal Alfvén Eigenmode (TAE) avalanches) and their possible role in redistribution of neutral-beam-driven current.*

IV-3. *Measure and understand Electron Bernstein Wave (EBW) emission from over-dense plasmas with emphasis on maximizing mode conversion efficiency by minimizing collisional damping and conversion efficiency fluctuations.*

V. Solenoid-free Plasma Start-up, Ramp-up, and Sustainment - physical processes of magnetic flux generation and sustainment.

V-1. *Develop and characterize efficient plasma current start-up utilizing techniques such as coaxial helicity injection, plasma guns, and poloidal-field ramp-up incorporating the impact of increased divertor pumping and increased ECH pre-ionization and heating power.*

V-2. *Assess non-inductively-driven plasma current ramp-up utilizing high-harmonic fast-wave heating and current-drive with increased RF power and with improved resilience to variations in plasma edge density.*

V-3. *Assess the impact of reduced density and collisionality and Lithium on discharges with high non-inductive current fraction - in particular changes in the neutral beam current drive efficiency, core and pedestal confinement and stability, edge bootstrap current density, and plasma impurity content.*

For further submission information please see the full version of this notice, DE-PS02-08ER08-29, located at: Grants.gov.

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
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