Theoretical and Computational Astrophysics Networks (TCAN)

PROGRAM SOLICITATION
NSF 13-512

National Science Foundation

Directorate for Mathematical & Physical Sciences
Division of Astronomical Sciences

National Aeronautics and Space Administration

Submission Window Date(s) (due by 5 p.m. submitter's local time):

February 01, 2013 - February 14, 2013

IMPORTANT INFORMATION AND REVISION NOTES

A revised version of the *NSF Proposal & Award Policies & Procedures Guide (PAPPG),* NSF 13-1, was issued on October 4, 2012 and is effective for proposals submitted, or due, on or after January 14, 2013. Please be advised that the guidelines contained in NSF 13-1 apply to proposals submitted in response to this funding opportunity. Proposers who opt to submit prior to January 14, 2013, must also follow the guidelines contained in NSF 13-1.

Please be aware that significant changes have been made to the PAPPG to implement revised merit review criteria based on the National Science Board (NSB) report, National Science Foundation's Merit Review Criteria: Review and Revisions. While the two merit review criteria remain unchanged (Intellectual Merit and Broader Impacts), guidance has been provided to clarify and improve the function of the criteria. Changes will affect the project summary and project description sections of proposals. Annual and final reports also will be affected.

A by-chapter summary of this and other significant changes is provided at the beginning of both the *Grant Proposal Guide* and the *Award & Administration Guide*.

Please note that this program solicitation may contain supplemental proposal preparation guidance and/or guidance that deviates from the guidelines established in the Grant Proposal Guide.

Important Information

Results from Prior NSF Support: Proposers are reminded that a report on results from prior NSF support is a required component of the proposal's Project Description. This requirement applies to all Principal Investigators (PIs) and co-Principal Investigators (co-PIs) as identified on the Cover Sheet. If any PI or co-PI identified on the project has received NSF funding (including any current funding) in the past five years, information on the award(s) is required, irrespective of whether the support was directly related to the proposal or not. Funding includes not just salary support, but any funding awarded by NSF. Proposers to this program are encouraged to be concise, but the information listed in Section II.C.2.d(iii) of the GPG must be provided. Failure to meet this requirement may result in the proposal being returned without review.

Use of NASA funds: No NASA funds can be used to support proposals that include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement. For more on this see Public Law 112-55, Section 539(a) and the FAQ at http://science.nasa.gov/researchers/sara/faqs/prc-faq-roses-2012/ .

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 16-1), which is effective for proposals submitted, or due, on or after January 25, 2016.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Theoretical and Computational Astrophysics Networks (TCAN)

Synopsis of Program:

The *New Worlds, New Horizons* report of the Astro2010 Decadal Survey observed that key challenges in theoretical astrophysics "are of a scale and complexity that require sustained, multi-institutional collaborations," but that there was "no mechanism to support these coordinated efforts at the needed level in the US." NSF's Division of Astronomical Sciences (AST) and NASA's Astrophysics Division (APD) agree that theory and computation are highly complementary "pillars of science," and that major progress in one can enable progress in the other. NSF/AST and

NASA/APD have therefore initiated the Theoretical and Computational Astrophysics Networks (TCAN) program with the following goals:

- To support coordinated efforts in fundamental theory and computational techniques in order to make groundbreaking advances in astrophysics;
- To strengthen theoretical and computational astrophysics in the US by uniting researchers in collaborative networks that cross institutional and geographical divides; and
- To advance the training of the future workforce of theoretical and computational scientists.

A network is a combination of *nodes* and *connections.* A node is a group of researchers at an existing institution, along with the local resources (e.g., computational, educational, communications) that sustain them. A connection is a significant exchange of expertise or capabilities between nodes (e.g., exchange of personnel, web-based training, sharing of access to resources). Multiple connections between nodes, that enable an integrated and focused collaborative effort, constitute a network. The TCAN program will support research networks with *3 or more nodes at distinct institutions.* Proposals must demonstrate clear management structure and clear protocols for communication, planning, distribution of effort, and tracking of progress. Supported projects will develop new theoretical and/or computational paradigms directly addressing key "frontier" questions in astrophysics. In cases where code will be produced for community use, projects will develop a transition plan to maintain and sustain it.

TCAN projects are expected to target fundamental issues in theoretical and computational astrophysics and to display a depth and breadth of concept qualitatively beyond those typical of the existing NSF Astronomy and Astrophysics Research Grants (AAG) and NASA Astrophysics Theory Program (ATP) programs. Prospective proposers are strongly urged to contact the cognizant program officers in either or both agencies to discuss the suitability of their projects for the TCAN program before preparing their proposals.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- David Boboltz,1030 S, telephone: (703) 292-2199, email: dboboltz@nsf.gov
- Joan M. Centrella,(NASA), telephone: (202) 358-2522, email: Joan.M.Centrella@nasa.gov

Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 43.001 --- National Aeronautics and Space Administration (Science)
- 47.049 --- Mathematical and Physical Sciences

Award Information

Anticipated Type of Award: Continuing Grant

Estimated Number of Awards: 4 to 6

Pending availability of funds, and depending on the quality and scope of submitted proposals, it is anticipated that a total of 4 to 6 projects will be funded by both agencies, starting in FY13 for a nominal 3-year period.

Anticipated Funding Amount: $2,000,000 to $3,000,000

(program total per year anticipated in FY 2013, 2014, and 2015 from both NSF and NASA)

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in, the US acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- For-profit organizations: U.S. commercial organizations, especially small businesses with strong capabilities in scientific or engineering research or education.
- Other Federal Agencies and Federally Funded Research and Development Centers (FFRDCs): Contact the appropriate program before preparing a proposal for submission.

Who May Serve as PI:

FFRDCs (including those funded by NSF) and NASA centers will be eligible to submit proposals as components of multi-institution collaborative sets. Proposals from non-NSF-funded FFRDCs or NASA centers will be eligible for funding only by NASA. In order for *any component* of a collaborative project to be eligible for NSF funding, the lead proposal of the collaborative set must be from an organization that is eligible for NSF funding. Thus, *all components* of a collaborative project in which the lead proposal is from a non-NSF-funded FFRDC or NASA center will be eligible for funding only by NASA.

Proposals from FFRDCs must obey NSF budget guidelines and may not include costs already covered by federal funds.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI:

An individual may appear as PI or co-PI on **no more than one proposal** in response to this solicitation.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposal Preparation Instructions:** This solicitation contains information that deviates from the standard NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) proposal preparation guidelines. Please see the full text of this solicitation for further information.

B. Budgetary Information

- **Cost Sharing Requirements:**

  Inclusion of voluntary committed cost sharing is prohibited.

- **Indirect Cost (F&A) Limitations:**

  Not Applicable

- **Other Budgetary Limitations:**

  Not Applicable

C. Due Dates

- **Submission Window Date(s)** (due by 5 p.m. submitter's local time):

  February 01, 2013 - February 14, 2013

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions:

Additional award conditions apply. Please see the full text of this solicitation for further information.

Reporting Requirements:

Standard NSF reporting requirements apply.

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I. INTRODUCTION

The Division of Astronomical Sciences (AST) of the National Science Foundation and the Astrophysics Division (APD) of the National Aeronautics and Space Administration are, respectively, the primary sources of support for ground-based and space-based astronomy in the U.S. In addition to major observational facilities, both agencies support individual investigators and small groups engaged in a broad array of observational, theoretical, computational, and laboratory research.

Theoretical astrophysics, in particular, has been supported by NASA APD primarily through the Astrophysics Theory Program (ATP), and by NSF AST primarily through the Astronomy and Astrophysics Research Grants (AAG) program and, secondarily, through the Faculty Early Career Development (CAREER) and Astronomy and Astrophysics Postdoctoral Fellowship (AAPF)programs. However, the report of the 2010 National Academies' Decadal Survey of Astronomy and Astrophysics, *New Worlds, New Horizons in Astronomy and Astrophysics* (NWNH), observed that key challenges in theoretical astrophysics "are of a scale and complexity that require sustained, multi-institutional collaborations." The report further noted that there was "no mechanism to support these coordinated efforts at the needed level in the US," and recommended a multi-agency program to support "research networks in theoretical and computational astrophysics."

NASA APD and NSF AST are in agreement that theory and computation are highly complementary "pillars of science," and that major progress in one can enable progress in the other. NSF AST and NASA APD solicited advice from the Astronomy and Astrophysics Advisory Committee (AAAC), and on the basis of this advice are jointly soliciting proposals for the Theoretical and Computational Astrophysics Networks (TCAN) program.

II. PROGRAM DESCRIPTION

The goals of the TCAN program are to:

- Support coordinated efforts in fundamental theory and computational techniques in order to make groundbreaking advances in astrophysics;
- Strengthen theoretical and computational astrophysics in the US by uniting researchers in collaborative networks that cross institutional and geographical divides; and
- Advance the training of the future workforce of theoretical and computational scientists.

TCAN seeks to achieve these goals through the support of networks. A network is best seen as a combination of *nodes* and *connections.* A node is a group of researchers at an existing institution, along with the local resources (e.g., computational, educational, communications) that sustain them; a connection is a significant exchange of expertise or capabilities between nodes (e.g., exchange of personnel, web-based training, sharing of access to resources). Multiple connections between nodes, that enable a *highly integrated and focused collaborative effort*, constitute a network. Note that a network is qualitatively different from typical collaborative projects supported by the AAG and ATP programs, in which work at the collaborating institutions, while complementary, may often be carried out nearly independently. A network is a more coordinated effort, with multiple channels of interaction, achieving significantly more than its individual nodes could achieve on their own.

The TCAN program will support research networks with *3 or more major nodes at distinct institutions.* Proposals may address fundamental questions in any area of astronomy regularly supported through the AAG or ATP programs, namely:

- *Planetary Astronomy*, including the origin, formation, and development of the Solar System and other planetary systems;
- *Stellar Astronomy*, including star formation, stellar evolution, nucleosynthesis, and compact objects;
- *Galactic Astronomy*, including the structure and evolution of the Milky Way and nearby galaxies, stellar populations, and the interstellar medium;
- *Extragalactic Astronomy*, including the formation evolution of normal and active galaxies, the intergalactic medium, large-scale structure; and
- *Cosmology*, including physical processes and growth of structure in the early Universe.

However, it is emphasized that TCAN projects are expected to target *fundamental issues* in theoretical and computational astrophysics and to display a depth and breadth of concept qualitatively beyond those typical of the existing NSF AAG and NASA ATP programs.

The TCAN program will ***not*** support

- Projects that are wholly theoretical in nature, without a significant computational component;
- Projects that are wholly computational in nature, without significant development of fundamental theory;
- Incremental development of existing numerical codes; or
- Incremental development of graduate or undergraduate curricula.

Only proposals that show direct relevance to the goals of NASA's Astrophysics Division, by facilitating the interpretation of data from space astrophysics missions, or by leading to predictions that can be tested with space astrophysics observations, will be eligible for NASA funding. Consistent with those goals, TCAN proposals that deal strictly or predominantly with Solar System objects or solar-terrestrial interaction studies, including solar energetic particles, will not be eligible for NASA funding. NASA will not provide support through TCAN for substantial computing facilities or resources, or for education and public outreach. Proposers who receive an award from NASA will have the opportunity to apply for computing time on the two NASA high-performance computing facilities, at the Goddard Space Flight Center's Computational and Information Sciences and Technology Office and in the Ames Research Center's Advanced Supercomputing Division.

No NASA funds can be used to support proposals that include bilateral participation, collaboration, or coordination with China or any Chinese-owned company or entity, whether funded or performed under a no-exchange-of-funds arrangement. For more on this see Public Law 112-55, Section 539(a) and the FAQ at http://science.nasa.gov/researchers/sara/faqs/prc-faq-roses-2012/ .

Additional Funding Opportunities

Research in Undergraduate Institutions (RUI)

The TCAN program will accept RUI proposals as components of a collaborative project, for possible support by NSF. RUI submissions must be received by the deadline specified in this solicitation. Information on the scope of RUI projects and the format of these proposals, including required Supplemental Documents, can be found at http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5518&org=NSF.

Computational and Data-Enabled Science and Engineering (CDS&E)

The TCAN Program will accept proposals for the NSF funding opportunity in Computational and Data Enabled Science and Engineering (CDS&E). CDS&E proposals submitted to the TCAN program must meet the TCAN requirements, guidelines, and deadlines. In addition, proposals must explicitly address the CDS&E program goals within the 15-page Project Description. Please see the program description, PD 12-8084, for the CDS&E program at http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504813.

III. AWARD INFORMATION

Pending availability of funds, and depending on the quality and scope of submitted proposals, it is anticipated that a total of 4 to

6 projects will be funded by both agencies starting in FY13 for a nominal 3-year period. Typical awards, again depending upon the above factors, are expected to be in the approximate vicinity of $500,000 per year *per network*.

A network project may be funded by either agency individually or by both agencies jointly; if the latter, each individual component proposal in the collaborative set will be funded by only one agency.

Projects will be funded by continuing (i.e., annual) awards. Annual increments will be contingent upon submission of acceptable annual progress reports. In addition, a reverse site visit via videoconference will be conducted not less than 16 months nor more than 19 months after the date of the initial award to the lead institution, and third-year funding will be contingent upon a satisfactory outcome. (See Section VII.B. of this solicitation.)

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in, the US acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- For-profit organizations: U.S. commercial organizations, especially small businesses with strong capabilities in scientific or engineering research or education.
- Other Federal Agencies and Federally Funded Research and Development Centers (FFRDCs): Contact the appropriate program before preparing a proposal for submission.

Who May Serve as PI:

FFRDCs (including those funded by NSF) and NASA centers will be eligible to submit proposals as components of multi-institution collaborative sets. Proposals from non-NSF-funded FFRDCs or NASA centers will be eligible for funding only by NASA. In order for *any component* of a collaborative project to be eligible for NSF funding, the lead proposal of the collaborative set must be from an organization that is eligible for NSF funding. Thus, *all components* of a collaborative project in which the lead proposal is from a non-NSF-funded FFRDC or NASA center will be eligible for funding only by NASA.

Proposals from FFRDCs must obey NSF budget guidelines and may not include costs already covered by federal funds.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI:

An individual may appear as PI or co-PI on **no more than one proposal** in response to this solicitation.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Instructions: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the guidelines specified in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-PUBS (7827) or by e-mail from nsfpubs@nsf.gov.

See Chapter II.C.2 of the GPG for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the GPG instructions.

Proposals to the TCAN program must be submitted as separately submitted collaborative proposals (see GPG Chapter II.D.4.b). Collaboratively linked proposals are submitted by multiple organizations but share a single Project Summary and Project Description. One proposal of the linked set is designated as the "lead," and the lead submitting organization should coordinate the submission activities of the others. Each major node in the network should prepare its own proposal as part of the linked set. In special circumstances, funding of minor nodes may be proposed by way of subawards; however, networks must consist of at least 3 major nodes having comparable roles.

Proposals submitted to the TCAN program should:

- Demonstrate that the proposed work focuses on an issue or problem of fundamental importance, progress on which is critical for addressing questions widely acknowledged to be central to astronomy;
- Demonstrate that the proposed approach has a high probability of achieving significant progress, and identify the potential risks;
- Demonstrate that the proposed network has the expertise and access to resources necessary to successfully carry out the proposed work;
- Describe the roles of the participating *nodes* and the *connections* between those nodes that will establish the proposed project as a *network*;
- Describe how the activities of the network will contribute to the training and development of the future scientific workforce;
- Describe a plan for the support and maintenance of any software to be developed and released to the community;
- Describe clear management structures and procedures for allocating responsibilities, reaching decisions, monitoring progress, correcting errors, resolving conflicts, and assessing results;
- Define metrics and milestones by which the performance of the network will be evaluated.

The following exceptions and additions to the GPG guidelines apply to proposals submitted to this Program:

- **Extended 3-page limit per biographical sketch to accommodate collaborator listings.** Each biographical sketch requires a list of collaborators and co-editors (including their current organizational affiliations) in alphabetical order (see GPG Chapter II.C.2.f.i.e). In some cases the collaborator lists may be extensive. In order to accommodate longer collaborator listings using prescribed font and margin sizes (see GPG Chapter II.B), a biographical sketch may be extended to a maximum of three pages instead of the two-page limit given in the GPG. Senior personnel involved in large collaboration(s) should list the name of the collaboration(s) and only those persons from the collaboration(s) with whom they interact directly. *Please note that a third page is permitted only to accommodate a long collaborator listing, and should not be used to expand other required sections of the biographical sketch.*
- **Letters of Collaboration.** Supplementary Documents may include letters of collaboration from individuals or organizations that are integral parts of the proposed project but are not supported by subawards. Such involvement may include subsidiary involvement in some aspect of the project, cooperation on outreach efforts, or documentation of permission to access materials or data. Letters of collaboration should focus solely on affirming that the individual or organization is willing to collaborate on the project as specified in the project description. No additional text, especially elaboration of the nature of activities to be undertaken by the collaborator and endorsements of the potential value or significance of the project for the collaborator, may be included. Letters deviating from these instructions will not be accepted. A template that may be used for the preparation of letters of collaboration is provided below.

  Letters of collaboration should not be provided from any individual designated as a principal investigator or senior personnel, nor are letters of collaboration required from any organization that will be a subawardee in the proposal budget.

  Each letter of collaboration must be signed (or be transmitted electronically to the principal investigator) by the designated collaborator. Requests to collaborators for letters of collaboration should be made by the PI well in advance of the proposal submission deadline because they *must* be included at the time of the proposal submission.

  Template for letters of collaboration:

  To: NSF _____*(Program Title)*_____ Program

  From: _____

  (*Printed name and affiliation of the individual collaborator or name of the organization and name and position of the official submitting this memo)*

  By signing below (or transmitting electronically), I acknowledge that I am listed as a collaborator on this proposal submitted to NSF, entitled "_____(*proposal title*)_____," with _____(*PI name*)_____ as the Principal Investigator. I agree to undertake the tasks assigned to me or my organization, as described in the project description of the proposal, and I commit to provide or make available the resources specified therein.

  Signed: _____

  Organization: _____

  Date: _____

Proposers are reminded to identify the NSF publication number (located on the first page of this document) in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

C. Due Dates

- **Submission Window Date(s)** (due by 5 p.m. submitter's local time):

  February 01, 2013 - February 14, 2013

Note that this is *not* an annually recurring submission window.

D. FastLane Requirements

Proposers are required to prepare and submit all proposals for this program solicitation through use of the NSF FastLane system. Detailed instructions regarding the technical aspects of proposal preparation and submission via FastLane are available at: http://www.fastlane.nsf.gov/a1/newstan.htm. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

Submission of Electronically Signed Cover Sheets. The Authorized Organizational Representative (AOR) must electronically sign the proposal Cover Sheet to submit the required proposal certifications (see Chapter II, Section C of the Grant Proposal Guide for a listing of the certifications). The AOR must provide the required electronic certifications within five working days following the electronic submission of the proposal. Further instructions regarding this process are available on the FastLane Website at: https://www.fastlane.nsf.gov/fastlane.jsp.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in the GPG as Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: http://www.nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014-2018*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should

include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (GPG Chapter II.C.2.d.i. contains additional information for use by proposers in development of the Project Description section of the proposal.) Reviewers are strongly encouraged to review the criteria, including GPG Chapter II.C.2.d.i., prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
    a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
    b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

In addition to the standard merit review criteria, proposals to the TCAN program will be evaluated on the degree to which they:

- Demonstrate that the proposed work focuses on an issue or problem of fundamental importance, progress on which is critical for addressing questions widely acknowledged to be central to astronomy;
- Demonstrate that the proposed approach has a high probability of achieving significant progress, and identify the potential risks;
- Demonstrate that the proposed network has the expertise and access to resources necessary to successfully carry out the proposed work;
- Describe the roles of the participating *nodes* and the *connections* between those nodes that will establish the proposed project as a *network*;
- Demonstrate that the activities of the network will contribute to the training and development of the future scientific workforce;
- Describe a plan for the support and maintenance of any software to be developed and released to the community;
- Describe clear management structures and procedures for allocating responsibilities, reaching decisions, monitoring progress, correcting errors, resolving conflicts, and assessing results;
- Define metrics and milestones by which the performance of the network will be evaluated.

Only proposals that show direct relevance to the goals of NASA's Astrophysics Division, by facilitating the interpretation of data from space astrophysics missions, or by leading to predictions that can be tested with space astrophysics observations, will be eligible for NASA funding. Consistent with those goals, TCAN proposals that deal strictly or predominantly with Solar System objects or solar-terrestrial interaction studies, including solar energetic particles, will not be eligible for NASA funding. NASA will not provide support through TCAN for substantial computing facilities or resources, or for education and public outreach. Proposers who receive an award from NASA will have the opportunity to apply for computing time on the two NASA high-performance computing facilities, at the Goddard Space Flight Center's Computational and Information Sciences and Technology Office and in the Ames Research Center's Advanced Supercomputing Division.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by

Ad Hoc and/or Panel Review, in accordance with the process below.

A uniform review process will be conducted by NSF, in consultation with NASA, for all proposals received responding to this solicitation. One or more review panels, consisting of experts in the field, will be assembled, supplemented by additional *ad hoc* reviewers as needed. The number and topical focus of panels will be determined according to the number and topical areas of the proposals received. NASA Program Managers may attend the review panel(s). Reviewers will be asked to formulate a recommendation to either support or decline each proposal. A summary rating and accompanying narrative will be completed and submitted by each reviewer. In

all cases, reviews are treated as confidential documents. The Program Officer(s) assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

In consultation with NASA, NSF will select collaborative projects to be funded following the review process. A *project* may be funded by either agency individually or by both agencies jointly; if the latter, each individual component *proposal* in the collaborative project will be funded by only one agency. Subsequent grant administration procedures will be in accordance with the individual policies of the awarding agency.

NASA Process: For those selected proposals identified as candidates for NASA funding, NSF will provide all unattributed ad hoc and panel reviews to NASA. The submitter will be asked to withdraw the proposal from NSF and resubmit the proposal to NASA in accordance with that agency's award process. Submitters will not be allowed to increase the proposed budget or change the scientific content of the proposal resubmitted to NASA for funding consideration. Any resulting awards will be based on selection criteria and themes specified in this solicitation.

NSF Process: Those proposals selected for funding by NSF will be handled in accordance with standard NSF procedures.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1)*; or Research Terms and Conditions* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

Special Award Conditions:

The text in subsections A and B above refer to awards made by NSF. For information on NASA award notification and award conditions, contact the cognizant NASA program manager.

As all supported projects will be funded by continuing awards, annual incremental funding will be contingent upon submission of acceptable annual progress reports as described in subsection C below. In addition, a reverse site visit will be conducted by videoconference not less than 16 months nor more than 19 months after the date of the initial award to the lead institution. This videoconference will be attended by Program Officers/Program Managers from the funding agency/agencies, who will assess the degree to which the project is functioning as a network and meeting the goals of the proposal. Funding for the third year of the project will be contingent upon a satisfactory assessment.

Awardees will be expected to include appropriate acknowledgement of support for the entire collaborative project in reports and/or publications on work performed under the award. For projects with component proposals funded by both NASA and NSF, awardees will be expected to acknowledge both agencies.

Annual and final project reports on awards managed by NSF will be submitted to NSF using FastLane. Investigators receiving NASA funds will submit their progress reports as required in the NASA award documentation.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- David Boboltz, 1030 S, telephone: (703) 292-2199, email: dboboltz@nsf.gov
- Joan M. Centrella, (NASA), telephone: (202) 358-2522, email: Joan.M.Centrella@nasa.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.

IX. OTHER INFORMATION

The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Grants Conferences. Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on NSF's website.

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this mechanism. Further information on Grants.gov may be obtained at http://www.grants.gov.

Related Programs:

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at http://www.nsf.gov

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
- **For General Information** (NSF Information Center)**:** (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**

  Send an e-mail to: nsfpubs@nsf.gov

  or telephone: (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Office of the General Counsel
National Science Foundation
Arlington, VA 22230