# NSF/Intel Partnership on Computer Assisted Programming for Heterogeneous Architectures (CAPA)

## PROGRAM SOLICITATION
### NSF 16-606

**National Science Foundation**

Directorate for Computer & Information Science & Engineering
Division of Computing and Communication Foundations

Intel Labs University Collaboration Office

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

December 08, 2016 - December 15, 2016

## IMPORTANT INFORMATION AND REVISION NOTES

This joint solicitation from NSF and Intel seeks proposals to be considered for both NSF Grants and Intel Agreements (i.e., contracts, grants, or gifts). Intel Agreements contain provisions for possible direct, on-site participation in research by Intel researchers-in-residence (RinRs).

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:**

NSF/Intel Partnership on Computer Assisted Programming for Heterogeneous Architectures (CAPA)

**Synopsis of Program:**

An emerging trend in hardware platforms is that of *architectural heterogeneity*. While modern central processing units (CPUs) provide a flexible set of hardware resources and rich instruction sets for implementing a broad spectrum of compute tasks, specialized workloads have motivated the introduction of alternative hardware architectures to accelerate operations using specialized circuit design and additional parallelism. Some examples of such hardware include graphical processing units (GPUs), digital signal processors (DSPs), programmable accelerators, and customizable field programmable gate arrays (FPGAs). Meanwhile, CPU designs have grown in diversity also, with considerable variation in number of cores, memory hierarchy, core organization, inter-core communication, and vector instruction sets. The trend toward data centers as a new computing platform adds even more complexity. Target architectures now can include thousands of geographically distributed computing elements, varying communication speeds, complex storage hierarchies, and a diverse set of underlying hardware platforms.

Software development is now transitioning from a specialized practice by a small number of experts to an everyday skill for a broad spectrum of non-specialists. But at the same time, the increasing complexity and diversity of programming models and hardware platforms requires specialized knowledge to develop and maintain efficient software solutions. The result is a widening gap between programmers with general skills and specialized knowledge required to effectively utilize today's heterogeneous hardware platforms. Many platform types fail to be utilized to their full potential, and the performance and energy efficiency gains needed to solve the next frontier of computing challenges fail to be realized. To efficiently utilize the computing power of future computer architectures without specialized expertise will require a transformational leap in software development methodologies.

The NSF/Intel Partnership on Computer Assisted Programming for Heterogeneous Architectures (CAPA) aims to address the problem of effective software development for diverse hardware architectures through groundbreaking university research that will lead to a significant, measurable leap in software development productivity by partially or fully automating software development tasks that are currently performed by humans. The main research objectives for CAPA include programmer effectiveness, performance portability, and performance predictability. In order to address these objectives, CAPA seeks research proposals that explore (1) programming abstractions and/or methodologies that separate performance-related aspects of program design from how they are implemented; (2) program synthesis and machine learning approaches for automatic software construction that are demonstrably correct; (3) advanced hardware-based cost models and abstractions to support multi-target code generation and performance predictability for specified heterogeneous hardware architectures; and (4) integration

of research results into principled software development practices.

**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.*

- Nina Amla, Program Director, CISE/CCF, telephone: (703) 292-7991, email: namla@nsf.gov
- Anindya Banerjee, Program Director, CISE/CCF, telephone: (703) 292-7885, email: abanerje@nsf.gov
- Sol Greenspan, Program Director, CISE/CCF, telephone: (703) 292-8910, email: sgreensp@nsf.gov
- Tatiana Shpeisman, Director, Programming Systems Research, Intel Labs, telephone: (408) 765-0172, email: tatiana.shpeisman@intel.com
- Justin Gottschlich, Senior Staff Research Scientist, Intel Labs, telephone: (408) 765-3783, email: justin.gottschlich@intel.com
- Shalom Goldenberg, Program Director, Intel Labs, telephone: (971) 258-6941, email: dshalom.goldenberg@intel.com

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

- 47.070 --- Computer and Information Science and Engineering

## Award Information

**Anticipated Type of Award:** Standard Grant or Continuing Grant or or Intel Agreement (i.e., contract, grant or gift)

**Estimated Number of Awards:** 2 to 3

Subject to the availability of funds and quality of proposals received.

**Anticipated Funding Amount:** $6,000,000

The awards are expected to have a total budget of $2-3 million per award for a duration of 3 years, subject to the availability of funds and quality of proposals received.

## 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.

**Who May Serve as PI:**

There are no restrictions or limits.

**Limit on Number of Proposals per Organization:**

There are no restrictions or limits.

**Limit on Number of Proposals per PI or Co-PI:** 1

An individual may participate as PI, co-PI, or senior personnel in **no more than one proposal** submitted in response to this solicitation. In the event that an individual exceeds this limit, the first proposal received within the limits will be accepted based on the earliest date and time of proposal submission (i.e., the first proposal received will be accepted and the remainder will be returned without review). **No exceptions will be made.**

## Proposal Preparation and Submission Instructions

**A. Proposal Preparation Instructions**

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
  - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. 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.
  - Full Proposals submitted via Grants.gov: NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)

**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):

  December 08, 2016 - December 15, 2016

## 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:**

Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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## I. INTRODUCTION

The constant push for improved computational and energy efficiency through advancing hardware technologies has led to increasingly complex and specialized computer architectures. New instructions and computing paradigms are continually entering the mainstream, and will push the boundaries in the future. Some examples include non-von Neumann approaches to computing, 3D stacking, memory hierarchy innovations, and processor-in-memory architectures. Specific workload and application requirements are also driving the need for new instruction sets that programmers will need to understand and use. New workloads are continually evolving from the massive amounts of new and specialized data, diversity of storage and networking infrastructure, and the widespread use of distributed processing. All of these factors have led to new demands on programmers who must now master a broad spectrum of programming paradigms and computer architectures in order to develop software that runs efficiently on state-of-the-art hardware.

An emerging trend in hardware platforms is that of *architectural heterogeneity*. While modern CPUs provide a flexible set of hardware resources and rich instruction set for implementing a broad spectrum of compute tasks, specialized workloads have motivated the introduction of alternative hardware architectures to accelerate operations using specialized circuit design and additional parallelism. Some examples of such hardware include GPUs, DSPs, programmable accelerators, and customizable FPGAs. Meanwhile, CPU designs have grown in diversity also, with considerable variation in number of cores, memory hierarchy, core organization, inter-core communication, and vector instruction sets. The trend toward data centers as a new computing platform adds even more complexity. Target architectures now can include thousands of geographically distributed computing elements, varying communication speeds, complex storage hierarchies, and a diverse set of underlying hardware platforms.

Developing software that effectively harnesses the power of the underlying hardware architecture is a major challenge. With all trends pointing toward an era of multi-core, heterogeneous and distributed hardware architectures, it is more critical than ever to revisit the fundamentals of computer programming. Software development is in the process of transitioning from a specialized practice by a small number of experts to an everyday skill for a broad spectrum of non-specialists. But at the same time, the increasing complexity and diversity of programming models and hardware platforms requires specialized knowledge to develop and maintain efficient software solutions. The result is a widening gap between programmers with general skills and specialized knowledge required to effectively utilize today's heterogeneous hardware platforms.

To efficiently utilize the full potential of many platform types and realize performance and energy efficiency gains needed to solve the next frontier of computing challenges *without* specialized expertise will require a transformational leap in software development methodologies. Such methodologies should enable general programmers to develop software that effectively utilizes specialized hardware capabilities, but without demanding undue expertise and in a fraction of the time it takes today.

## II. PROGRAM DESCRIPTION

The NSF/Intel Partnership on Computer Assisted Programming for Heterogeneous Architectures (CAPA) aims to address the problem of effective software development for diverse hardware architectures through groundbreaking university research that will lead to a significant, measurable leap in software development productivity by partially or fully automating software development tasks that are currently performed by humans.

The high-level research objectives for CAPA are the following:

- **Programmer Effectiveness**: Empower mainstream software developers with the ability to achieve near-expert programming efficiency for diverse hardware architectures in significantly reduced development time over what it would take an expert programmer;
- **Performance Portability**: Develop software that achieves near-expert efficiency on multiple hardware architectures; also, take expert-level software that has been developed for a specific architecture and achieve a similar level of hardware utilization on a different architecture; and
- **Performance Predictability**: Predict application performance for a diverse set of architectures and provide guarantees that these predictions are correct.

To achieve these objectives, CAPA seeks the development and validation of foundational scientific principles of computer-aided models of programming: these principles will rely on interdisciplinary research and advances in programming languages, compilers and runtime systems, program synthesis, machine learning, formal methods, verification, and software engineering. Automatically generating expert-level software is complicated by today's diverse set of modern architectures that feature different types of processing units, high levels of concurrency, deep memory hierarchies and non-uniform communication subsystems. CAPA seeks proposals that can be applied to a wide variety of processing units, such as CPUs, GPUs, FPGAs, and programmable accelerators, as well as heterogeneous and distributed mixtures thereof. Unlike existing systems that support various hardware targets through specialized programmed back-ends, CAPA seeks solutions that will automatically generate efficient and correct programs for different architectures by utilizing generic hardware cost models and abstractions.

To achieve these goals, CAPA seeks proposals that address all of the above objectives in the following research areas:

1. **Programming abstractions and methodologies**: The CAPA program seeks innovative programming abstractions and/or methodologies that separate performance-related aspects of program design from how they are implemented. CAPA is predicated on the belief that this separation will have long-term benefits to programmer effectiveness and software performance portability. A key question is, "What is the right level of abstraction to support the automated generation of source code optimized for a variety of architectures?" For example, an approach to program abstraction might include the definition of program tasks in terms of high-level, domain-specific abstractions. Another approach might consider methodologies that address the problem of converting programs optimized for a particular architecture to equivalent programs that run efficiently on a different architecture.
2. **Program synthesis and learning**: A basic premise of the CAPA program is that correct-by-construction program synthesis and machine learning are fundamental building blocks for the future of automatic software construction. We seek advanced research in these areas, including formal reasoning components as needed, for the purpose of achieving automatic, near-optimal code generation to be applied to a wide variety of heterogeneous hardware platforms. These could include changes to the basic algorithm, optimizations to current code segments, or alternate implementations of parallel constructions that yield better performance on a target architecture. Techniques will automatically discover and compose a program based on user intent, program properties, historical program executions, available hardware features, and other relevant specified or learned information.
3. **Hardware-based abstractions:** CAPA welcomes research on advanced hardware-based cost models and abstractions. Such models will support the capability of efficient multi-target code generation and performance predictability for specified heterogeneous hardware architectures. These models can then be utilized within the solution search space of program synthesis tools that are designed to identify near-optimal program performance for a given task. Likewise, they can be leveraged by machine learning systems that must satisfy certain performance requirements within their training and inference phases. Furthermore, they can be used by formal systems to reason about performance and provide performance predictability.
4. **Software engineering tools and practices:** A key objective for the CAPA research program is the integration of research results into principled software development practices, which should pay special attention to demonstrable correctness of generated code. Researchers should demonstrate how their work may be incorporated into current and emerging software engineering tools and best practices, including such areas as debugging, testing, verification, analysis, and configuration management. Prototyping such new capabilities in popular open-source programming platforms (e.g., LLVM among others) is a good way to accomplish this task.

All CAPA proposals are expected to benchmark results using appropriate metrics, and to measure the efficacy and correctness of their approaches. CAPA seeks complete end-to-end solutions, including a fully functional prototype. The authors of proposals that cover a subset of the above topics are encouraged to form collaborations with other researchers to produce a complete end-to-end solution.

Project personnel must consist of two or more principal investigators with complementary expertise in all four of the research areas pertinent to the three CAPA objectives. All proposals must contain a Collaboration Plan that elaborates on PIs' expertise in the relevant areas and how the project personnel will work together.

Proposals submitted to this solicitation must be consistent with the Large project class defined below.

Large projects, with total budgets ranging from $2,000,000 to $3,000,000 for durations of three years, are well-suited to a small number of investigators (PI, co-PI and/or other Senior Personnel) and several students and/or postdocs. Projects are encouraged to include a prototyping effort for the researched solutions.

All proposals must justify the proposed budget in terms of the resources needed to carry out the proposed work.

## III. AWARD INFORMATION

**Anticipated Type of Award:** Continuing Grant or Standard Grant or Intel Agreement (i.e., contract, grant or gift)

**Estimated Number of Awards:** 2 to 3

Subject to the availability of funds and quality of proposals received.

**Anticipated Funding Amount:** $6,000,000

The awards are expected to have a total budget of $2-3 million per award for a duration of 3 years, subject to the availability of funds and quality of proposals received.

## 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.

**Who May Serve as PI:**

There are no restrictions or limits.

**Limit on Number of Proposals per Organization:**

There are no restrictions or limits.

**Limit on Number of Proposals per PI or Co-PI:** 1

An individual may participate as PI, co-PI, or senior personnel in **no more than one proposal** submitted in response to this solicitation. In the event that an individual exceeds this limit, the first proposal received within the limits will be accepted based on the earliest date and time of proposal submission (i.e., the first proposal received will be accepted and the remainder will be returned without review). **No exceptions will be made.**

**Additional Eligibility Info:**

For U.S. universities and two- and four-year colleges with overseas campuses, this solicitation restricts eligibility to research activities using the facilities, equipment, and other resources of the campus(es) located in the U.S. only. Note: this restriction is directed at institutional eligibility only; it is not intended to restrict international collaborations or research activities by subsequent awardees.

## V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

### A. Proposal Preparation Instructions

**Full Proposal Preparation Instructions**: Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained 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) 292-7827 or by e-mail from nsfpubs@nsf.gov. Proposers are reminded to identify this program solicitation number 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.

- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. Chapter II, Section D.5 of the Grant Proposal Guide provides additional information on collaborative proposals.

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.

**Proposal Titles:**

A proposal title must begin with “CAPA:” followed by the title. If you submit a proposal as part of a set of collaborative proposals, the title of the proposal should begin with "CAPA:" followed by "Collaborative Research:" and then the title. For example, if you are submitting a collaborative set of proposals for a project, the title of each would be **CAPA: Collaborative Research: Title.**

**Project Descriptions:**

For all collaborative projects, project descriptions must be comprehensive and well-integrated, and should make a convincing case that the collaborative contributions of the project team will be greater than the sum of each of their individual contributions.

**Supplementary Documents:**

In the Supplementary Documents section, upload the following information where relevant:

*(1) A list of Project Personnel and Partner Institutions (Note: In collaborative proposals, only the lead institution should provide this information):*

Provide current, accurate information for all personnel and institutions involved in the project. NSF staff will use this information in the merit review process to manage conflicts of interest. The list **must** include all PIs, Co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, Postdocs, project-level advisory committee members, and writers of letters of support. This list should be numbered and include (in this order) Full name, Organization(s), and Role in the project, with each item separated by a semi-colon. Each person listed should start a new numbered line. For example:

1. Mary Smith; XYZ University; PI
2. John Jones; University of PQR; Senior Personnel
3. Jane Brown; XYZ University; Postdoc
4. Bob Adams; ABC Community College; Paid Consultant
5. Susan White; Welldone Institution; Unpaid Collaborator
6. Tim Green; ZZZ University; Subawardee

*(2) Collaboration Plan:*

Achieving the breakthroughs that the CAPA program seeks will require collaborative research efforts that cover areas of expertise pertinent to the three CAPA objectives. Each proposal is therefore required to have two or more PIs providing different and distinct expertise relevant to the program’s focus. All proposals must include a collaboration plan as a separate supplementary document (limited to 2 pages). This document must describe the backgrounds and different expertise of the PIs, how these relate to the proposed work, and how the PIs plan to collaborate. The length of, and level of, detail provided in the Collaboration Plan should be commensurate with the complexity of the proposed project. **If a proposal does not include a Collaboration Plan, that proposal will be returned without review.**

*(3) Postdoctoral Researcher Mentoring Plan (if applicable):*

Each proposal that requests funding to support postdoctoral researchers must include, as a supplementary document, a description of the mentoring activities that will be provided for such individuals. In no more than one page, the mentoring plan must describe the mentoring that will be provided to all postdoctoral researchers supported by the project, irrespective of whether they reside at the submitting organization, any subawardee organization, or at any organization participating in a simultaneously submitted collaborative project. Please be advised that if required, FastLane will not permit submission of a proposal that is missing a Postdoctoral Researcher Mentoring Plan. See Chapter II.C.2.j of the GPG for further information about the implementation of this requirement.

*(4) Data Management Plan (required):*

Proposals must include a supplementary document of no more than two pages labeled "Data Management Plan." This supplementary document should describe how the proposal will conform to NSF policy on the dissemination and sharing of research results.

See Chapter II.C.2.j of the GPG for full policy implementation.

For additional information see: http://www.nsf.gov/bfa/dias/policy/dmp.jsp.

For specific guidance for proposals submitted to the Directorate for Computer and Information Science and Engineering (CISE) see: http://www.nsf.gov/cise/cise_dmp.jsp.

**Single Copy Documents:**

*(1) A list of Collaborators: In lieu of the instructions specified in the GPG, Collaborators and Other Affiliations Information should be submitted as follows.(Note: In collaborative proposals, only the lead institution should provide this information):*

Provide current, accurate information for all active or recent collaborators of personnel and institutions involved in the project. NSF staff will use this information in the merit review process to manage conflicts of interest. **This list is distinct from (1) under Supplementary Documents in that it must include all active or recent Collaborators of all personnel involved with the proposed project.** Collaborators include any individual with whom any member of the project team -- including PIs, Co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, Postdocs, and project-level advisory committee members -- has collaborated on a project, book, article, report, or paper within the preceding 48 months; or co-edited a journal, compendium, or conference proceedings within the preceding 24 months. This list should be numbered and include (in this order) Full name and Organization(s), with each item separated by a semi-colon. Each person listed should start a new numbered line.

1. Collaborators for Mary Smith; XYZ University; PI
    a. Helen Gupta; ABC University
    b. John Jones; University of PQR
    c. Fred Gonzales; DEF Corporation
    d. Susan White; DEF Corporation
2. Collaborators for John Jones; University of PQR; Senior Personnel
    a. Tim Green; ZZZ University
    b. Ping Chang, ZZZ University
    c. Mary Smith; XYZ University
3. Collaborators for Jane Brown; XYZ University; Postdoc
    a. Fred Gonzales; DEF Corporation
4. Collaborators for Bob Adams; ABC Community College; Paid Consultant
    a. None
5. Collaborators for Susan White; Welldone Institution; Unpaid Collaborator
    a. Mary Smith; XYZ University
    b. Harry Nguyen; Welldone Institution
6. Collaborators for Tim Green; ZZZ University; Subawardee
    a. John Jones; University of PQR

## B. Budgetary Information

**Cost Sharing:**

Inclusion of voluntary committed cost sharing is prohibited.

**Budget Preparation Instructions:**

Budgets for projects should include funding for one or more project representatives (PI/co-PI/senior researcher or NSF-approved replacement) to attend PI meetings/annual retreats to be held annually after the beginning of the award.

The budget submitted with the proposal should include all necessary project funds without regard to the two funding organizations; NSF and Intel will inform selected PIs of the breakdown in funding between the two organizations, and will request revised budgets at that point.

## C. Due Dates

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

  December 08, 2016 - December 15, 2016

## D. FastLane / Grants.gov Requirements

**For Proposals Submitted Via FastLane:**

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: https://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.

**For Proposals Submitted Via Grants.gov:**

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: http://www.grants.gov/web/grants/applicants.html. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

***Submitting the Proposal:*** Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

Proposers that submitted via FastLane are strongly encouraged to use FastLane to verify the status of their submission to NSF. For

proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

## 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**

- **Technical innovation, non-incremental potential, and relevance.** The extent to which the proposal's problem formulation and key approaches are innovative, important, and relevant to the problem at hand in addressing *the three objectives identified in the Program Description*, and more specifically the degree to which the project's technical research is likely to result in a measurable leap in software development productivity by partially or fully automating software development tasks that are currently performed by humans.
- **Clarity of overall objectives, intermediate milestones, and success criteria**. All teams are expected to demonstrate progress toward project goals at quarterly milestones. The extent to which these milestones are articulated will be considered in evaluating proposals.
- **Collaboration**. The extent of planned collaboration for sufficient exploration and subsequent refined focus to ensure the success of the project. **If** the proposal involves a collaboration spanning multiple institutions, a compelling rationale for the multi-institution structure of the project and an explanation of how effective collaboration will be assured.
- **Cost effectiveness and cost realism**. The extent to which the proposed work can, within the proposed resource levels, both develop and implement demonstrations of the research ideas. These demonstrations, along with the research outcomes, should serve as a call to action by the CAPA software ecosystem.

## B. Review and Selection Process

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

Ad hoc Review and/or Panel Review, Site Visit Review, or Internal Review by Intel Corporation.

Intel and NSF will each conduct separate proposal reviews. For Intel, internal review will be conducted, and will consider the degree to which proposals have a substantial potential for influencing the direction of Intel's long-range technology plans, as well as industry software ecosystem plans. Also, Intel has a strong commitment to broadening participation, as does NSF (http://www.nsf.gov/od/broadeningparticipation/bp.jsp), and will provide the same considerations as NSF to the diversity of the proposer team in the evaluation of the proposals. Proposals and other relevant information about proposals including reviews will be shared between the participating organizations as appropriate.

Upon conclusion of the separate reviews, award recommendations will be coordinated by a Joint NSF and Intel Working Group (hereafter referred to as JWG) comprising personnel from both NSF and Intel. The JWG will recommend meritorious proposals for award.

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:**

Each awarded project will be jointly funded by the NSF and Intel through separate NSF and Intel funding instruments. NSF awards will be made as continuing or standard grants. Intel awards will be made as Intel agreements (i.e., contracts, grants or gifts). NSF and Intel will manage their respective awards/agreements in accordance with their own guidelines and regulations.

1. **Site visits, meetings, and annual retreats**

   Awardees are expected to organize an annual PI meeting, which all awardees under this solicitation are expected to attend. NSF and Intel personnel who have interest in the program will attend this PI meeting. The meeting will involve reviews of the research underway in each project along with presentations from NSF and Intel on technical areas of interest related to each awarded project. Ample time will be provided for face to face interaction between participants in these retreats. Intel and NSF will work with academic leadership to organize these events. Proposers should budget the appropriate level of travel funds and participant support costs in the proposal for supporting these annual PI meetings.

2. **Intellectual property, publishing, and licensing**

   Awardees will be required to include appropriate acknowledgment of NSF and Intel support in reports, software, websites and/or publications on work performed under the award. An example of such an acknowledgement would be: "This material is based upon work supported by NSF/Intel Partnership on Computer Assisted Programming for Heterogeneous Architectures program under Award Title and No. [Recipient enters project title and awards number(s)]."

   All projects agree to distribute all source code that has been authored while working on an NSF/Intel award under a BSD, Apache or other equivalent open source license. Software licenses that require as a condition of use, modification and/or distribution that the software or other software incorporated into, derived from or distributed with the software be licensed by the user to third-parties for the purpose of making and/or distributing derivative works are not permitted. Licenses not appropriate thus include any version of GNU's General Public License (GPL) or Lesser/Library GPL (LGPL), the Artistic License (e.g., PERL), and the Mozilla Public License.

   Exceptions to this policy may be granted to address the problem of participation in established open source software projects or standards already licensed under GPL, LGPL, or other copy left open source licenses.

   Projects that generate data or software in performing the work under an award agree not to incorporate into said data or software, except by separate prearrangement with NSF and Intel, any third-party code or background intellectual property that would limit or restrict the ability to distribute said data or software under an open source license.

   Awardees may file patent applications, providing that they grant to Intel a non-exclusive, worldwide, royalty-free, sub-licensable license to all intellectual property rights in any inventions or works of authorship resulting from research conducted under the joint award.

   All awarded projects must maintain a website that is updated on a monthly basis with the latest details on the projects.

3. **Intel participation in research**

   Intel may separately fund its own personnel to directly participate in NSF/Intel Partnership research, part-time or full-time, with the universities awarded NSF/Intel Partnership projects. Proposals do not need to budget for the cost of such personnel. These Intel researchers will work alongside the academic researchers, identifying opportunities for tech transfer, and being involved with the projects as advisors or as fellow researchers. Optional deployment of Intel Researchers in Residence (RinR) on campuses will require mutual consent by the Parties and respective awardees in the Project Management Plan for each NSF/Intel Partnership award. Further, Intel may designate one of its more senior, separately funded researchers to work alongside NSF/Intel Partnership academic lead PIs. The Intel CAPA Program Director and the lead Intel researcher may work with the academic PI of each project to collaboratively oversee the project, manage Intel's participation in each project, champion considerations related to innovation – the translation of discoveries into industry impact – and to manage the center on a day-by-day basis. He/she would inject a perspective on commercial aspects and help with the day-to-day leadership of the center. He/she would also be responsible for working with the Intel Program Director to oversee the engagement of all other Intel researchers.

4. **Program management**

   The Intel CAPA Program Director overseeing funded projects may become a member of the Project Management Team for the Intel award. Intel may choose to organize, at its own expense, additional retreats in collaboration with NSF and may require deliverable reports to monitor project progress. Annual reviews may be conducted jointly by NSF and Intel in conjunction with the PI meetings. Intel may lead the organization of semi-annual phone calls with a project team, with NSF participation. NSF and Intel may request visits to the research institutions or may ask PIs to visit NSF or Intel over the duration of the award.

5. **Funding Support and Budget Revisions**

   Individual awards selected for joint funding by NSF and Intel will be funded through separate NSF and Intel funding instruments. For each such project, NSF support will be provided via an NSF grant and Intel support will be provided via an Intel agreement (i.e., contract, grant or gift). Either organization may supplement a project without requiring the other party to provide any additional funds.

   The budget submitted with the proposal should include all necessary project funds without regard to the two funding organizations; NSF and Intel will inform selected PIs of the breakdown in funding between the two organizations, and will request revised budgets at that point.

## 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.

In addition, Intel may require deliverable reports to monitor project progress.

## 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:

- Nina Amla, Program Director, CISE/CCF, telephone: (703) 292-7991, email: namla@nsf.gov
- Anindya Banerjee, Program Director, CISE/CCF, telephone: (703) 292-7885, email: abanerje@nsf.gov
- Sol Greenspan, Program Director, CISE/CCF, telephone: (703) 292-8910, email: sgreensp@nsf.gov
- Tatiana Shpeisman, Director, Programming Systems Research, Intel Labs, telephone: (408) 765-0172, email: tatiana.shpeisman@intel.com
- Justin Gottschlich, Senior Staff Research Scientist, Intel Labs, telephone: (408) 765-3783, email: justin.gottschlich@intel.com
- Shalom Goldenberg, Program Director, Intel Labs, telephone: (971) 258-6941, email: shalom.goldenberg@intel.com

For questions related to the use of FastLane, contact:

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

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.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.

## 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
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