Request for Application
Joint Quantum Institute
University of Maryland, College Park
February 2011

SUMMARY:

This request for application is presented to the University of Maryland College Park, a constituent institution of the University System of Maryland, itself a public agency and instrumentality of the State of Maryland, located in College Park, Maryland, (hereinafter referred to as the "University" or "UMCP"). The National Institute of Standards and Technology ("NIST") has a long history of collaboration with the University in research areas such as Atomic, Molecular, and Optical (AMO) Physics; Condensed Matter (CM) Physics, Quantum Physics, and Quantum Information Science (QIS). In an effort to continue this collaborative effort the NIST invites the University to apply for continued support of the Joint Quantum Institute (JQI), which is a joint enterprise between the NIST and the UMCP, with the support and participation of the National Security Agency / Central Security Service Laboratory for Physical Sciences ("NSA/CSS LPS" or "LPS"). The JQI is currently an institute with facilities shared by the NIST, the University, and the LPS but is expected to be primarily housed by the University before the end of this grant period. The JQI in addition to current and future housing receives other resources from the University.

DATES: The University's full proposal shall be submitted by April 15, 2011.

ADDRESSES: If the University submits its application on paper, one (1) original and three (3) copies of the application and proposal should be provided to:

Dr. Carl J. Williams, Division Chief
Atomic Physics Division, Physical Measurement Laboratory/NIST
100 Bureau Drive, MS 8420
Gaithersburg, MD 20899-8420

If the University wishes to apply electronically, Grants.gov must be used. The University should contact Christopher Hunton of NIST's Grants and Agreements Management Division, at 301-975-5718, or at chunton@nist.gov, for details on applying through Grants.gov.

FOR FURTHER INFORMATION CONTACT: The University may contact Judy Murphy, Grants Officer, NIST, at 301-975-5603, or at judy.murphy@nist.gov for technical matters should contact Carl Williams, of NIST, at 301-975-3531, or at Carl.Williams@nist.gov.

SUPPLEMENTARY INFORMATION

CATALOG OF FEDERAL DOMESTIC ASSISTANCE NAME AND NUMBER:
Measurement Science and Engineering Research - 11.609

PROGRAM DESCRIPTION:

Under this program, University personnel will perform research in the areas of AMO, CM, and quantum physics and the broader area of QIS. These activities will be undertaken upon request by and in close collaboration with staff members of the NIST Atomic Physics Division (APD) and or its successor who are engaged as Fellows of the Joint Quantum Institute. The collaboration will include the development, fabrication, and construction of scientific apparatuses and the collection, analysis, and modeling of experimental results as well as related theoretical activities. These activities will require computing (both hardware and software) support, electronics and instrument maker support and a full range of administrative and clerical support, including outreach and web/communications support.

University personnel will interact and collaborate with members of the NIST Atomic Physics Division or its successor in advancing scientific knowledge and practice in areas basic to the mission of the Division. It is the purpose of this program to produce scientifically appropriate research that is consistent with the mission of the APD. This currently includes research within the following broad areas:

- Atomic, molecular, and optical physics, *e.g*. ultra-cold atomic gases, cavity quantum electrodynamics, matter wave optics, quantum optics, degenerate gases, optical lattices; and
- Condensed matter physics, *e.g*. quantum dots, superconductivity; and
- Quantum information science, *e.g*. quantum measurement theory, quantum computation, and quantum communication.

Among the specific areas of interest:

1) Experimental and theoretical investigation of fundamental atomic systems (both neutral and charged), including the manipulation of ultra-cold atomic vapors and ions with light and magnetic fields, the extension of these techniques to ultra-cold molecular vapors and the study of quantum degenerate gasses.
2) Experimental and theoretical investigation of fundamental condensed matter systems that possess long coherence times that could contribute to quantum information science, including the manipulation and control of Josephson Junctions, spins in semiconductors and quantum dots and their applications to device technology and improved quantum measurements.
3) Development of measurement techniques that exploit quantum behaviour to improve our fundamental measurement capabilities including the development of sources and detectors for the single quanta (photons, spins, *etc.*) and measurements that surpass the Heisenberg or shot-noise limit.
4) Experimental and theoretical studies that allow for the transformation, transmission, and/or coupling of quanta from one characteristic system to another including nano-mechanical systems, quantum optic systems, and cavity quantum electrodynamics.
5) Development of nanotechnology techniques and concepts to advance the state of the art for quantum limited electronics, such as single electron transistors, and their utilization for applications such as quantum information and sensors.
6) Development of control techniques including ultra-fast laser techniques that improve our ability to control or manipulate quantum systems

7) Development and study of exotic states of quantum matter and the development of quantum materials that support the above endeavours.
8) Development of precision measurement tools that support improved measurement of fundamental constants and that help to test fundamental physical theories and their limitations.

The data and knowledge gained will benefit NIST, the University and the general public in supporting high technology industry and innovation as well as pushing current scientific limits. NIST scientists will bring to bear their unique expertise and resources in collaboration with University technical personnel.

UNIVERSITY ACTIVITIES TO BE FUNDED UNDER THE COOPERATIVE AGREEMENT

Through the JQI, the University will provide a number of technical experts with expertise complementary to those in the Division and of considerable interest to NIST. By working in collaboration with NIST scientists, these technical experts will carry out important research aimed at advancing the nation's technology base. The JQI organization is unique in this respect, having been organized with the express intention of creating such close collaboration with common facilities and eventually a permanent facility for the majority of their activities. This permanent facility is expected to become available during the forth coming funding period with occupancy expected in 2013. The JQI has in its initial five years demonstrated many efficiencies and much synergism. It is expected with the new space and facilities that many new efficiencies and synergisms will result from this exceptional arrangement, not the least of which will be an increasing flexible interaction among a group of scientists with varied and diverse expertise and background working on common problems.

Using Federal funds received under the cooperative agreement along with matching funds provided by the University, the University will provide qualified personnel and support for those personnel to include equipment; materials; communications services; mail services; transportation; parking; plant services; telephones; all utilities; computer services; multi-user instrumentation; furniture and facilities; renovation of space occupied by the JQI at the University; and other office or lab supplies or services as may be required for these collaborative projects and programs. The following are included as items to be funded under the cooperative agreement:

1) Salaries and wages of full and part-time professional engineers, scientists, postdoctoral research associates, administrative and clerical staff, technicians, mechanics and other employees including executives who are directly engaged in the program. Included among these are individuals to provide a robust dissemination through modern digital media and the web of the scientific output of the JQI. This output is expected to be accessible to the broader scientific public and should include material for educating the public in the broad areas of research relevant to the JQI.
2) Research assistantships for graduate and undergraduate students.
3) All materials and supplies including machinery, tools and equipment acquired or fabricated for the purpose of performing work under this program.

4) Travel and subsistence expenses that are essential for performance of this contract in accordance with the contractors practices and travel regulations in effect on the date(s) of travel, including necessary visa fees. This travel and subsistence includes support for a robust JQI seminar series and support of participants to JQI sponsored workshops and conferences.
5) Support for the JQI Visiting Fellows Program, the JQI Postdoctoral-Fellow program, the JQI Graduate Research-Fellow program, and the JQI Cooperative Research program.

Application: The application should include: SF424 - Application for Federal Assistance; SF424-A – Budget Information – Non-Construction Program; SF424-B – Assurances Non-Construction; CD-511 – Certification Regarding Lobbying; SF-LLL – Disclosure of Lobbying Activities; a Technical Proposal; and a Budget Narrative. All forms must be complete and signed by an authorized official of the University. If the University chooses to submit a paper application, one original and three copies of the application must be submitted.

The Technical Proposal shall provide a full description of the types of research activities that may be undertaken during the life of the project (5 years). The Proposal shall provide for a list of proposed research collaboration efforts that the University intends to conduct with NIST's support. The proposed research collaboration descriptions should provide enough detail to allow NIST to determine the level and types of effort to be devoted to the project. Research goals and objectives should be clearly stated.

This program is funded through a five-year cooperative agreement, as NIST will be substantially involved in its implementation. NIST shall collaborate with the University on the scope of work. NIST involvement will include:

1) Approval by an appropriate DOC official of substantive provisions of proposed subawards.
2) Involvement in the selection of key JQI personnel. The University has final authority over its own personnel.
3) Requirement that the appropriate DOC official (a) collaborate with the recipient by working jointly with a recipient scientist or technician, in carrying out the scope of work, (b) assist in training recipient personnel, or (c) detail Federal personnel to work on the project effort.
4) Specify direction or redirection of the scope of work due to inter-relationships with other projects, such as requiring recipients to achieve a specific level of cooperation with other projects.
5) DOC operational involvement during the project to ensure compliance with such statutory requirements as civil rights and environmental protection
6) Limitation on recipient discretion with respect to scope of work, organizational structure, staffing, mode of operations and other management processes, coupled with close monitoring of operational involvement during performance.

A cooperative agreement will be entered into in the context of the JQI, a joint enterprise between the NIST and the UMCP, with the support and participation of the National Security Agency / Central Security Service Laboratory for Physical Sciences ("NSA/CSS LPS" or "LPS"). The

involvement of the NIST, the UMCP, and the NSA/CSS LPS in the JQI is detailed in the Memorandum of Understanding (MOU) between NIST, the UMCP, and the NSA/CSS LPS that established the JQI and the JQI By-Laws, which derive from the MOU. Both the MOU and By-Laws will be incorporated into any resulting award by reference. The cooperative agreement does not obligate the LPS beyond that described by the MOU but allows for their engagement through either separate funding instruments directly with the University or through the cooperative agreement under separate interagency funding agreements entered into by the NIST and the NSA/CSS. In the latter case NIST will use the cooperative agreement to fulfill the obligations set forth in the interagency agreements.

Budget and Budget Narrative: The applicant must provide a budget that delineates the expected **annual** funding that NIST will contribute. The budget should be delineated by Object Class using the SF-424-A, Budget Information – Non-Construction Programs. The following assumptions should be used when preparing the budget:

The number of Research Associates, Graduate Research Assistants, Professional Research Assistants, Instrument Maker Fabricators, Electronic Engineers & Specialists, Administrative & Clerical Support, and Student Assistants proposed should be consistent with the levels of support provided over the past year. The budget should grow in a manner consistent with projections from the past three years and projected forward. Additionally, the level of Technical & Administrative Supplies/Services, Equipment, and Travel proposed should also be consistent with that funded over the past year with growth projected as mentioned previously. Any increased costs related to the consolidation of the JQI into a shared permanent facility or the addition of new support personnel should be clearly noted.

The matching funds provided by the University are expected to be consistent with the formula used in the past funding period. In accordance with the previous arrangement it is expected that the JQI will provide funds for renovating the space occupied by the JQI and to provide research support for the hiring of new JQI Fellows.

The Budget Narrative should provide enough detail so that NIST can make a determination of cost allowability, allocablility and reasonableness.

Funding Availability: It is anticipated that any resulting award from this request could receive funding over a five year period not to exceed $34 million, with the NIST contribution not exceeding $21.5 million. Any resulting award will be funded in increments. Funded award amendments may be executed through out a fiscal year. The actual amount of available funding will vary from year to year and is subject to availability, satisfactory performance, funding priorities of NIST, and is at the sole discretion of NIST.

Statutory Authority: As authorized by 15 U.S.C. § 272 (b)(1)(4)(5)(6)(9)(11)(12) and (c)(2)(3)(5)(10)(11)(16)(17)(21), NIST conducts directly, and supports through grants and cooperative agreements, a basic and applied research program in the general area of fundamental measurement and the determination of fundamental constants of nature.

Eligibility: The only eligible applicant is the University of Maryland College Park. The

proposed award is an institutional award under the Department of Commerce Grants and Cooperative Agreement Interim Manual, Chapter 6, Paragraph 2, and Chapter 3, paragraph A.26.

Review and Selection Process: The application and proposal will undergo a merit review by a group of at least three professionally and technically qualified individuals who are independent and objective.

Katharine B. Gebbie, Director of the Physical Measurement Laboratory, NIST will serve as the selecting official. The selecting official will take into consideration the results of the merit review, availability of funding, and relevance to the program objectives as described above in the Program Description.

Evaluation Criteria: The evaluation criteria to be used in evaluating the proposal will be as follows:

1) Quality of previous work performed by the JQI with a focus on collaborations and synergies between UMCP professors, scientists, research associates, and graduate students and NIST permanent staff.
2) Quality of proposed work to be performed under the cooperative agreement including potential synergism of UMCP personnel to complement and reinforce the primary objectives of the JQI as demonstrated by current and future possible collaborations with the NIST as documented in the proposal.
3) Quality of the proposal in terms of providing easily accessible Research Associates, Research Assistants and other administrative and support staff to be located at the JQI facility at the University campus or to collaborate with JQI Fellows on the NIST campus. This includes support for the JQI Graduate Research Fellowship Program, the JQI Postdoctoral Research Fellowship Program, the JQI Visiting Fellows Program, and the JQI seminar series that support the broader research ecosystem.
4) Quality of the proposal in terms of the University's dedication to the JQI as demonstrated both by the level of the matching funds provided and the accessibility of administrative services in order to procure equipment, materials and supplies, travel arrangements, and laboratory renovations as deemed necessary based upon the needs of the JQI/NIST researchers.
5) Potential broader impact of the proposal including its ability to advance discovery, disseminate results through modern digital media and the web, education, training and creating a robust research environment relevant to NIST and the nation.

Each of the above criteria is of equal importance.

The final approval of selected application and award of a cooperative agreement will be made by the NIST Grants Officer based on compliance with application requirements as published in this notice, compliance with applicable legal and regulatory requirements.

The applicant may be asked to modify objectives, work plans, or budgets and provide supplemental information required by NIST prior to award.

The decision of the Grants Officer is final.

Cost Share Requirements: The University cost share to be negotiated is expected to be consistent with existing agreements.

The Department of Commerce Pre-Award Notification Requirements for Grants and Cooperative Agreements: The Department of Commerce Pre-Award Notification Requirements for Grants and Cooperative Agreements, which are contained in the Federal Register Notice of February 11, 2008 (73 FR 7696), are applicable to this notice. On the form SF-424 items 8.b. and 8.c., the applicant's 9-digit Employer/Taxpayer Identification Number (EIN/TIN) and 9-digit Dun and Bradstreet Data Universal Numbering System (DUNS) number must be consistent with the information on the Central Contractor Registration (CCR) (www.ccr.gov) and Automated Standard Application for Payment System (ASAP). For complex organizations with multiple EIN/TIN and DUNS numbers, the EIN/TIN and DUNS numbers MUST be the numbers for the applying organization. An organization that provides incorrect/inconsistent EIN/TIN and DUNS numbers may experience significant delays in receiving funds if its proposal is selected for funding. Please confirm that the EIN/TIN and DUNS numbers are consistent with the information on the CCR and ASAP.

Collaborations with NIST Employees: All applications should include a description of any work proposed to be performed by an entity other than the applicant, and the cost of such work should ordinarily be included in the budget.

If an applicant proposes collaboration with NIST, the statement of work should include a statement of this intention, a description of the collaboration, and prominently identify the NIST employee(s) involved, if known. Any collaboration by a NIST employee must be approved by appropriate NIST management and is at the sole discretion of NIST. Prior to beginning the merit review process, NIST will verify the approval of the proposed collaboration. Any unapproved 23 collaboration will be stricken from the proposal prior to the merit review. *For the JQI, collaboration with NIST employees is expected.*

Use of NIST Intellectual Property: If the applicant anticipates using any NIST-owned intellectual property to carry out the work proposed, the applicant should identify such intellectual property. This information will be used to ensure that no NIST employee involved in the development of the intellectual property will participate in the review process for that competition. In addition, if the applicant intends to use NIST-owned intellectual property, the applicant must comply with all statutes and regulations governing the licensing of Federal government patents and inventions, described at 35 U.S.C. sec. 200-212, 37 CFR part 401, 15 CFR 14.36, and in Section B.21 of the Department of Commerce Pre-Award Notification Requirements, 73 Fed. Reg. 7696 (Feb. 11, 2008).

Any use of NIST-owned intellectual property by a proposer is at the sole discretion of NIST and will be negotiated on a case-by-case basis if a project is deemed meritorious. The applicant should indicate within the statement of work whether it already has a license to use such

intellectual property or whether it intends to seek one.

If any inventions made in whole or in part by a NIST employee arise in the course of an award made pursuant to this notice, the United States government may retain its ownership rights in any such invention. Licensing or other disposition of NIST's rights in such inventions will be determined solely by NIST, and include the possibility of NIST putting the intellectual property into the public domain.

Paperwork Reduction Act: The standard forms in the application kit involve a collection of information subject to the Paperwork Reduction Act. The use of Standard Forms 424, 424A, 424B, SF-LLL, and CD-346 have been approved by OMB under the respective Control Numbers 0348-0043, 0348-0044, 0348-0040, 0348-0046, and 0605-0001.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number.

Research Projects Involving Human Subjects, Human Tissue, Data or Recordings Involving Human Subjects: Any proposal that includes research involving human subjects, human tissue, data or recordings involving human subjects must meet the requirements of the Common Rule for the Protection of Human Subjects (Common Rule), codified for the Department of Commerce at 15 C.F.R. Part 27. In addition, any proposal that includes research on these topics must be in compliance with any statutory requirements imposed upon the Department of Health and Human Services (DHHS) and other federal agencies regarding these topics, all regulatory policies and guidance adopted by DHHS, the Food and Drug Administration, and other Federal agencies on these topics, and all Presidential statements of policy on these topics. NIST will accept the submission of human subjects protocols that have been approved by Institutional Review Boards (IRBs) possessing a current registration filed with DHHS and to be performed by institutions possessing a current, valid Federal-wide Assurance (FWA) from DHHS. NIST will not issue a single project assurance (SPA) for any IRB reviewing any human subjects protocol proposed to NIST.

President Obama has issued Executive Order No. 13,505 (74 FR. 10667, March 9, 2009), revoking previous Executive Orders and Presidential statements regarding the use of human embryonic stem cells in research. On July 30, 2009, President Obama issued a memorandum directing that agencies that support and conduct stem cell research adopt the "National Institutes of Health Guidelines for Human Stem Cell Research" (NIH Guidelines), which became effective on July 7, 2009, "to the fullest extent practicable in light of legal authorities and obligations." On September 21, 2009, the Department of Commerce submitted to the Office of Management and Budget a statement of compliance with the NIH Guidelines. In accordance with the President's memorandum, the NIH Guidelines, and the Department of Commerce statement of compliance, NIST will support and conduct research using only human embryonic stem cell lines that have been approved by NIH in accordance with the NIH Guidelines and will review such research in accordance with the Common Rule, as appropriate. NIST will not support or conduct any type of research that the NIH Guidelines prohibit.

Research Projects Involving Vertebrate Animals: Any proposal that includes research involving vertebrate animals must be in compliance with the National Research Council's "Guide for the Care and Use of Laboratory Animals" which can be obtained from National Academies Press, 500 Fifth Street, N.W., Lockbox 285, , Washington, DC 20055. In addition, such proposals must meet the requirements of the Animal Welfare Act (7 U.S.C. 2131 et seq.), 9 CFR parts 1, 2, and 3, and if appropriate, 21 CFR part 58. These regulations do not apply to proposed research using pre-existing images of animals or to research plans that do not include live animals that are being cared for, euthanized, or used by the project participants to accomplish research goals, teaching, or testing. These regulations also do not apply to obtaining animal materials from commercial processors of animal products or to animal cell lines or tissues from tissue banks.

Funding Availability and Limitation of Liability: Funding for the program listed in this notice is contingent upon the availability of Fiscal Year 2011 appropriations. NIST issues this notice subject to the appropriations made available under the current continuing resolution funding the Department of Commerce, H.R 3082, "Continuing Appropriations and Surface Transportation Extensions Act, 2011," Public Law 111-322. NIST anticipates making awards for the program listed in this notice provided that funding for the program is continued beyond March 4, 2011, the expiration of the current continuing resolution. In no event will NIST or the Department of Commerce be responsible for proposal preparation costs if these programs fail to receive funding or are cancelled because of agency priorities. Publication of this announcement does not oblige NIST or the Department of Commerce to award any specific project or to obligate any available funds.

Reporting: Successful finalists will be required to submit, on a semi-annual basis, for the periods ending March 31 and September 30 of each year, a technical progress report and a SF-425, Financial Status Report. From time to time, and in accordance with the Uniform Administrative Requirements and other terms and conditions governing the award, the recipient may need to submit property and patent reports. The Federal Funding Accountability and Transparency Act of 2006 includes a requirement for awardees of applicable Federal grants to report information about first-tier subawards and executive compensation under Federal assistance awards issued in FY 2011 or later. All awardees of applicable grants and cooperative agreements are required to report to the Federal Subaward Reporting System (FSRS) available at www.FSRS.gov on all subawards over $25,000.

Executive Order 12372: Applications under this program are not subject to Executive Order 12372, ``Intergovernmental Review of Federal Programs."