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AO 00-OBPR-01
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National Aeronautics and
Space Administration

Announcement of Opportunity

Microgravity Flight Research Opportunities on the International Space Station

Physical Sciences Research Division
Office of Biological and Physical Research

Notices of Intent Due: **November 27, 2000**
Proposals Due: **January 12, 2001**

Announcement of Opportunity:
Microgravity Flight Research Opportunities on the
International Space Station

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Microgravity Flight Research Opportunities on the International Space Station

I. Introduction

This Announcement of Opportunity (AO) solicits proposals for flight experiments that will use the research apparatus currently planned to be available on board the International Space Station (ISS) for microgravity research in the approximate period 2004-2006. The capabilities are described in more detail later in this announcement. This opportunity is limited to flight research that can use the apparatus offered in this announcement, with only minor modifications. Permissible modifications will generally be limited to slight changes in instrumentation using existing flight qualified technologies.

The Physical Sciences Research Division directs a program of research in the biological, physical, chemical, and engineering sciences as an element of NASA's Biological and Physical Research (BPR) strategic enterprise. One of the near-term priorities of the BPR enterprise is to establish the ISS as a national resource for research, using the unprecedented laboratory capabilities of the ISS to advance knowledge in chemical, physical, and biological systems..

This announcement is being released in coordination with other space agencies with established interest in the development of microgravity research on the ISS, who have joined as participants in the International Microgravity Strategic Planning Group (IMSPG), to make the most efficient use of the research resources of the ISS by coordinating the development and use of ISS research instruments and facilities.

As a first step in enhancing international coordination of the use of ISS for microgravity research, the agencies participating in this coordinated announcement — the European Space Agency (ESA), and the space agencies of Canada (Canadian Space Agency, CSA), France (Centre National d'Ètudes Spatiales, CNES), Germany (Deutsches Zentrum für Luft und Raumfahrt, DLR), Italy (Agenzia Spaziale Italiana, ASI), and Japan (National Space Development Agency of Japan, NASDA) have agreed to integrate their review of proposals for flight experiments for the approximate period 2004-2006, and to mutually discuss, within the IMSPG, agency plans for selection. In order to facilitate the review of proposals and subsequent interagency discussions for cooperative research projects, the IMSPG has produced a *Standard Companion Document* that describes the available research apparatus and the evaluation criteria that will be used in the peer review. The *Standard Companion Document* is provided as Appendix C to this AO.

Proposals may be for activities lasting up to five years. They will be evaluated for overall merit by independent peer review panels. Relevance to NASA's programmatic needs and goals, and the feasibility of flight experiment execution will be evaluated separately by NASA. The government's obligation to make awards is contingent upon the availability of funds from which

awards can be made and the receipt of proposals that are determined to be acceptable for award under this AO. It is anticipated that awards will average $175,000 in total annual costs.

Participation in this Announcement is open to all categories of domestic and foreign organizations, industry, educational institutions, other nonprofit organizations, NASA laboratories, and other government agencies. This solicitation is being coordinated with solicitations from the member agencies of the IMSPG: European Space Agency (ESA), and the space agencies of Canada (Canadian Space Agency, CSA), France (Centre National d'Ètudes Spatiales, CNES), Germany (Deutsches Zentrum für Luft und Raumfahrt, DLR), Italy (Agenzia Spaziale Italiana, ASI), and Japan (National Space Development Agency of Japan, NASDA). Proposals from entities of the member countries of ESA, and the countries names above must be submitted to their respective space agency, including those with U.S. researchers and co-investigators. **Though under certain circumstances NASA will review proposals from non-U.S. institutions, NASA does not fund non-U.S. institutions.** (See Section IV, Part C of this Announcement for details.)

A notice of intent (NOI) to propose is requested by November 27, 2000 (see Section IV, Part E of this Announcement). NOIs may be submitted electronically at the following web address:

http://peer1.idi.usra.edu/peer_review/ao/00-OBPR-01/ao_00_OBPR_01.html

Electronic submission is the highly preferred method of NOI submission as it facilitates tracking and processing of resulting proposals.

NOIs may also be submitted:

- via e-mail to the following address with the subject heading "NOI AO-00-OBPR-01": **noi@hq.nasa.gov**
- via U.S. Postal Service or commercial delivery to the address below.

Proposals may not be submitted electronically. Twenty-five (25) proposals must be received by January 12, 2001. Proposals and NOIs mailed through the U.S. Postal Service by express, first class, registered, or certified mail are to be sent to the following address:

Dr. Bradley Carpenter
c/o NASA Peer Review Services
SUBJECT: AO 00-OBPR -01
500 E Street, SW
Suite 200
Washington, DC 20024

Proposals and NOIs that are hand delivered or sent by commercial delivery or courier services are to be delivered to the above address between 8:00 AM and 4:30 PM. The telephone number, (202) 479-9030, may be used when required for reference by delivery services. Deliveries cannot be received on Saturdays, Sundays, or federal holidays. Upon receiving a proposal, NASA will send an e-mail to the proposer confirming its arrival.

Because this Announcement solicits proposals that will be evaluated in a coordinated international effort, in order to be accepted as a complete submission, proposals **must include** completed copies of the appropriate forms provided in Appendix B (which are required to fulfill requirements unique to U.S. proposals for NASA support), and in Appendix C (which are standard for all proposals responding to the coordinated international solicitations). Special instructions apply to proposals by institutions that are not entities of the United States (see Section IV, Part C and Appendix B of this Announcement).

Additional information is available from Dr. Bradley Carpenter at the following address:

Code UG
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-0826
Fax: (202) 358-3091

It is expected that, as research operations aboard the ISS mature, this Announcement of Opportunity will be followed by others that will invite proposals for the coordinated use of microgravity research capabilities on the ISS. However, a schedule for the release of future announcements is still under discussion among the participating agencies of the IMSPG.

Your interest and cooperation in participating in this effort is appreciated.

Kathie L. Olsen, Ph.D.
Acting Associate Administrator for
Biological and Physical Research

II. Description of Opportunity

The International Space Station (ISS) is one of the largest peaceful projects ever undertaken by a group of nations. It represents a shared commitment by most of the technologically advanced societies on Earth to a common purpose, the pursuit of scientific inquiry and the exploration of Space. As a laboratory, the ISS offers revolutionary new capabilities for scientific research. The Physical Sciences Research Division of NASA is responsible for developing a program of basic and applied research in the physical and engineering sciences, and biotechnology, that will provide scientists an opportunity to gain access to the capabilities of the ISS on a fair and open competitive basis. This Announcement is one of a continuing series of solicitations offering access to the research capabilities of the ISS.

Individuals participating in NASA's Physical Sciences Research Program have a responsibility to foster the development of a scientifically informed public. All participants in the Physical Sciences Research Program are strongly encouraged to promote general scientific literacy and public understanding of science, the space environment, and microgravity research through education and public outreach opportunities. Where appropriate (for example, in connection with preparation for a mission launch) supported investigators will be required to produce, in collaboration with NASA, a plan for communicating their work to the public.

A. Proposal Types

This section describes the types of proposals that are acceptable for submission in response to this Announcement, defines the research programs of the Division that are included in this Announcement, and describes the current specific areas of ground-based and flight research that proposals should address. In addition, this section includes guidelines for preparing and submitting proposals and defines the administrative policies governing the program and awardees. Only proposals for space flight experiments in specific areas identified by NASA, which will be described in Part B of this section, are being sought through this AO. Proposals for ground-based research, including analysis, theoretical studies and experimental work intended to develop concepts for future flight research, are regularly invited by the Physical Sciences Division in other solicitations. For more information on support for ground-based research by the Physical Sciences Research Division, please contact:

Dr. Bradley M. Carpenter
Mail Code UG
NASA Headquarters
Washington, DC 20546-0001
Phone: (202) 358-0826;
Email: bradley.carpenter@hq.nasa.gov

Proposals submitted in response to this AO must be for flight experiments that can effectively use the apparatus that are currently planned to be on board the ISS in the period of approximately 2004-2006 and are being offered by the members of the IMSPG for potential cooperative activities. This apparatus is identified in the *Standard Companion Document* included as Appendix C. Proposals for microgravity flight research that will require substantial development

of new apparatus will be invited through other announcements.. Proposals submitted to this AO that require substantial development of new apparatus will be declined as non-responsive.

Proposals may be submitted to NASA by scientists at U.S. institutions seeking support to participate in flight experiments, either in the traditional capacity of Principal Investigator responsible for the scientific aspect of a flight experiment, or in roles that have been defined to better accommodate international collaboration, including co-investigator, team coordinator, and team member. These categories are defined in the *Standard Companion Document* found in Appendix C. Proposals in which a US investigator seeks NASA support for participation as a co-investigator or team member in an international collaboration should be submitted both to NASA and to other agencies from which support is being requested. The proposal submitted to NASA must meet the requirements identified in this section.

B. Research Areas and Emphases

This section provides a brief summary of the research areas accommodated by the apparatus offered through this Announcement. More complete information is available in Appendix C, the *Standard Companion Document* to this Announcement. It should be kept in mind by potential proposers that the capabilities offered through this Announcement represent the current plans or intentions of the participating agencies, but may not ultimately be developed or accommodated aboard the ISS.

Biotechnology

The common research interest in biotechnology among the IMSPG agencies is macromolecular crystal growth. In Appendix C, the *Standard Companion Document* to this Announcement, the ESA Protein Crystallisation Diagnostics Facility and the NASDA Solution Protein Crystal Growth Facility are described. NASA is currently assessing its long-term plans for research in protein crystal growth and is not offering any apparatus for cooperative research, but will consider proposals to use the NASDA and ESA apparatus.

Combustion Science

NASA is developing the only facility intended to support combustion research on the ISS, the Fluids and Combustion Facility. Combustion experiment modules available for this facility are under development by NASA and are being proposed by DLR and ESA. NASA's modules support droplet combustion experiments and a variety of flame spread experiments in the combustion of thick or thin solid fuels. One of NASA's primary objectives in developing these modules is to advance fundamental research important to fire safety and risk management in flight vehicles. The ESA module is directed toward experiments in spray systems. DLR is developing diagnostic technologies adaptable to a range of experiments. These are described in Appendix C, the *Standard Companion Document* to this Announcement.

Fluid Physics

The IMSPG agencies are offering a wide range of fluid physics and transport phenomena capabilities that are available through this announcement. See Appendix C, the *Standard Companion Document* to this Announcement, for a description of the apparatus being offered.

Fundamental Physics

NASA's Fundamental Physics program, which spans a range of research areas including cooperative phenomena in condensed matter physics, applications of laser cooling in atomic physics, and gravitational physics, does not have a close counterpart among the agencies participating in the IMSPG. Though agencies such as ESA have interests similar to NASA's in gravitational and atomic physics, the IMSPG does not coordinate these efforts. NASA is offering ISS capabilities in atomic physics and low temperature physics through this Announcement, and research in cooperative phenomena is supported by apparatus such as the DECLIC offered by CNES. See Appendix C, the *Standard Companion Document* to this Announcement, for a description of the apparatus being offered.

Materials Science

The IMSPG agencies are offering a wide range of materials science capabilities that are available through this announcement. Several member agencies of the IMSPG are developing research apparatus that offer unique capabilities to U.S. investigators, particularly with respect to furnace designs for materials processing. See Appendix C, the *Standard Companion Document* to this Announcement, for a description of the apparatus being offered.

III. Proposal Evaluation and Selection Process

A. Process

A critical feature of the evaluation and selection process for this Announcement derives from the effort being made to coordinate the use of microgravity research resources among the participants in the ISS program through the IMSPG. Although every agency participating in the IMSPG, including NASA, retains independent authority to make selection decisions for proposals submitted to it, the agencies have agreed to coordinate their selection efforts in the interest of achieving the best return on the resources available aboard the ISS. In order to place the proposals submitted to the participating agencies on a uniform beginning, it has been agreed that the proposals will be evaluated for scientific merit in a common process that will be jointly implemented. The IMSPG has agreed to an evaluation process that is described in the *Standard Companion Document.*

As described in the *Standard Companion Document*, following NASA's determination that the proposals submitted in response to this Announcement are broadly responsive to the requirements of the Announcement, the proposals will be evaluated for scientific merit by an internationally overseen peer review panel, and will be assessed for feasibility of execution in available instruments by relevant project staff. The IMSPG will also make a recommendation, based on the evaluations and provided resources, for proposal selection that will, in the view of the IMSPG, produce a fair return to the participating agencies for their contributed resources, and will result in an optimally productive use of the available resources.

NASA personnel will complete an evaluation of the programmatic relevance, including any education and public outreach components, and the cost of each proposal. Evaluation of the cost of a proposed effort includes consideration of the realism and reasonableness of the proposed cost and the relationship of the proposed cost to available funds. Programmatic relevance will include an evaluation of how the proposed work may help achieve an appropriate balance of scientific and technical tasks required by the Physical Sciences Research Division to fulfill its mission for NASA.

Applying the evaluation criteria described in the following section, this information will be used by NASA to categorize the proposals submitted to NASA, in accordance with the NASA Federal Acquisitions Regulation Supplement (NFS) Part 1872. An *Ad Hoc* Categorization Committee, composed wholly of civil servants, will convene to consider the peer review results. This Committee will categorize the proposals in accordance with procedures required by NFS Part 1872.403-1. These categories are defined as follows:

> Category I. Well-conceived and scientifically and technically sound investigations pertinent to the goals of the program and the AO's objectives and offered by a competent investigator from an institution capable of supplying the necessary support to ensure that any essential flight hardware or other support can be delivered on time and that data can be properly reduced, analyzed, interpreted, and published in a reasonable time. Investigations in Category I are recommended for acceptance and normally will be displaced only by other Category I investigations.

Category II. Well-conceived and scientifically or technically sound investigations that are recommended for acceptance, but at a lower priority than Category I.
Category III. Scientifically or technically sound investigations that require further development.
Category IV. Proposed investigations which are recommended for rejection for the particular opportunity under consideration, whatever the reason.

Following the process described in NFS Part 1872, the results of the proposal categorization and evaluation will be reviewed by a steering committee, which will conduct an independent assessment of the evaluation and categorization processes. After this review, the final evaluation and categorization results will be presented to the Director of the Physical Sciences Research Division, who will make selections for an initial two-year period of definition-phase support.

During the two-year period, NASA will conduct further negotiations with the other members of the IMSPG to arrive at mutually satisfactory agreements necessary for the execution of the selected proposals. At the conclusion of the definition phase, NASA will conduct a review of the selected investigations. This review will consider any modifications to the scientific objectives, design of the investigation hardware, and plans for mission implementation, including all technical, management, and cost factors. The result of this review will be a decision to proceed to execution, with awards for execution-phase support, to continue definition-phase activities for a further period, or to discontinue the investigation. It is anticipated that not all selected proposals will ultimately be accommodated and carried forward to execution. Investigations may be discontinued at the end of the two-year definition period, or at any subsequent time when, in NASA's judgement, the project is unlikely to be completed with the available resources.

B. Evaluation Criteria

The evaluation criteria below will be used to evaluate and categorize proposals as described in the previous section. The evaluation factors (which are defined more fully in subsections below) are as follows:

- Microgravity relevance
- Scientific merit
- Preliminary technical assessment
- Relevance to the NASA microgravity program
- Cost

The proposal categorizations, discussed above, will be based on these criteria.

Microgravity relevance is a unique requirement of research selected for the International Space Station. Every proposal selected for potential execution aboard the ISS through this AO must demonstrate a clear and compelling requirement for a microgravity environment to achieve its scientific objectives.

Microgravity Relevance

Proposals that do not establish microgravity relevance by demonstrating a clear and compelling requirement for a microgravity environment to achieve their objectives will be recommended for rejection. Among proposals that do clearly establish a microgravity relevance, the scientific merit of the proposal is the most important criterion, followed by the technical assessment and the programmatic relevance, which are approximately equal in importance, followed by cost.

Scientific Merit of the Proposed Investigation

Scientific merit will be evaluated using the criteria described in the *Standard Companion Document*, in order of priority:

Significance: Does this study address an important problem? If the aims of the application are achieved, how will scientific knowledge or technology be advanced? What will be the effect of these studies on the concepts, methods, or products that drive this field?

Approach: Are the theoretical framework, experimental design, data analysis and interpretation methods adequately developed, well integrated, and appropriate to the aims of the project? Is the proposed approach likely to yield the desired results? Does the applicant acknowledge potential problem areas?

Innovation: Does the project employ novel concepts, approaches, or methods? Are the aims original and innovative? Does the project challenge existing paradigms or develop new methodologies or technologies?

Personnel: Are the scientific personnel appropriately trained and well suited to carry out this work? Is the evidence of the personnel's productivity satisfactory? Are the functions and responsibilities of the team members adequately described and appropriate? Does the project employ useful collaborative arrangements?

Environment: Does the institutional environment in which the work will be performed contribute to the probability of success?

Technical Assessment of the Proposed Investigation

As described in the *Standard Companion Document*, each proposal will be assessed for its technical merit, feasibility, and the probability of success. Technical merit and feasibility will be evaluated by assessing the degree to which the offered apparatus can accommodate the proposed research. Areas requiring critical technology development for flight readiness shall be identified. Other elements include the proposed data analysis and archiving plan. Should a new technology that represents an untested advance in the state of the art be proposed for use, an assessment will be made of the likelihood of its success. The probability of success will be evaluated by assessing science team roles, experience, expertise, and the organizational structure of the science team and the technical risk associated with the overall investigation. The role of <u>each</u> Co-Investigator will be evaluated for necessary contributions to the proposed investigation. The

assessment will consider the proposed mission design approach, management approach, schedule, and the NASA cost in determining the likelihood, at a top level, that the proposed investigation can be implemented within program resource constraints. The recommendation of the IMSPG regarding the optimal use of contributed resources and the balancing of scientific merit and the resources of the participating agencies will be considered. The management and schedule approaches will be assessed to determine the degree of the proposer's understanding of the work to be done and the time it takes to do it.

Relevance to the NASA Microgravity Program

The major goals of the NASA microgravity program focus on four elements broadly defined in the NASA strategic plan: acquire knowledge to enable safe development of space by humans, expand scientific knowledge using the characteristics of the space environment, enable and promote commercial research in space, and engage and involve the public in the excitement and benefits of research in space. Proposals will be assessed by NASA to determine the extent to which the proposed effort will contribute to achieving these goals.

Cost

The costs will be reviewed to assure that they are realistic and reasonable for the proposed effort.

C. Selection Factors

The results of the proposal evaluation based on the criteria above and the resulting proposal categorization will be considered in the selection process.

Proposers to this AO should recognize that the program of the Physical Sciences Division is an evolving activity that critically depends upon Administration policies and budgets, as well as NASA objectives and priorities, and the continued progress of the International Space Station program, any of which may change quickly. Therefore, it is incumbent upon the Director of the Physical Sciences Division to use all relevant science planning, policy, and cost considerations when making selection(s) among top ranked proposals submitted in response to this AO.

IV. General Information

A. Prospective Awards to be Made

Funding duration:	Two to five years, depending on proposal requirement, review panel recommendation, successful accommodation within available resources, and continuing progress of the activity
Direct and Indirect Costs:	NASA does not provide separate funding for direct and indirect costs; thus, the amount of the award requested is the total of all costs submitted in the proposed budget
Number awarded:	Approximately eight expected, depending on number received, review panel recommendation, and available funding
Average funding:	$175,000 per year

B. Eligibility

All categories of institutions are eligible to submit proposals in response to this AO. Principal Investigators may collaborate with universities, Federal Government laboratories, the private sector, and state and local government laboratories. In all such arrangements, the applying entity is expected to be responsible for administering the project according to the management approach presented in the proposal.

The applying entity must have in place a documented base of ongoing high quality research in science and technology or in those areas of science and engineering clearly relevant to the specific programmatic objectives and research emphases indicated in this Announcement. Present or prior support by NASA of research or training in any institution or for any investigator is not a prerequisite to submission of a proposal or a competing factor in the selection process.

All categories of institutions are eligible to submit proposals in response to this AO, but only approved proposals from U.S. institutions will be selected for funding.

C. Nondomestic Proposals

This solicitation is being coordinated with solicitations from the European Space Agency (ESA), and the space agencies of Canada (Canadian Space Agency, CSA), France (Centre National d'Ètudes Spatiales, CNES), Germany (Deutsches Zentrum für Luft und Raumfahrt, DLR), Italy (Agenzia Spaziale Italiana, ASI), and Japan (National Space Development Agency of Japan, NASDA). Proposals from entities of the member countries of ESA and the countries named above must be submitted to their respective space agency, including those with U.S. researchers and co-investigators. U.S. co-investigators who are collaborating on such proposals must ensure that their scientific role is clearly delineated in the proposal, that their expertise is shown to make a substantial contribution, and that their funding requirements are included in the proposal. A copy of this proposal with original authorizing institutional signatures, using the NASA application form, must be submitted to NASA. The solicitation, review, and selection process for flight experiments proposed through this coordinated effort is described in the *Standard Companion Document*.

Although NASA does not fund proposals from non-U.S. entities, NASA will accept for review foreign proposals from institutions that are not entities of the member countries of ESA or the countries named above and which require use of NASA apparatus or resources. Such proposals must include a written endorsement from the respective government agency or funding/sponsoring institution in the country from which the proposal originates. This endorsement must indicate that:

1) The proposal merits careful consideration by NASA, and
2) If the proposal is selected, sufficient funds will be made available by that country or agency to undertake the activity as proposed.

Should such a proposal be selected, NASA will arrange with the non-U.S. sponsoring agency for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging its respective responsibilities. Proposals by a U.S. institution which include participation by non-U.S. institutions who are also not entities of the member countries of ESA, or the countries named above require the same endorsement and, if selected, will also undergo similar coordination with the non-U.S. sponsoring agency.

D. Program Reporting

It is expected that results from funded research will be submitted to peer-reviewed journals as the work progresses. Only published papers that acknowledge NASA's support and identify the grant or contract will be counted as resulting from the research project and used to evaluate its productivity.

Annual Reports Investigators will be expected to provide NASA with annual summary information. This information will consist primarily of:

- an abstract
- a bibliographic list
- copies of publications
- a statement of progress

This information will be made available to the scientific community and will be used to assess the strength of the Division's programs. It will also serve as the basis for determining the degree of progress of the project.

Annual Task Book Reports The NASA Physical Sciences Research Division publishes a comprehensive annual document titled Physical Sciences Research Program Tasks and Bibliography which includes descriptions of all peer-reviewed activities funded by the division during the previous fiscal year. The Task Book serves as an invaluable source of information for NASA as well as the scientific and technical communities.

Investigators are required to provide information for this publication on an annual basis. Please note that this requirement is in addition to the annual report which investigators are required to submit at the end of each funding cycle. Supplying the requested information for the Physical Sciences Research Task Book does NOT fulfill the requirement for the annual report. Unlike the annual report, information requested for the Task Book must be for the government's fiscal year rather than the project funding cycle and brief.

The information requested for inclusion in the Task Book consists primarily of:

- an abstract
- a brief statement of progress during the fiscal year
- a brief statement of benefits of the research with respect to life on Earth
- a bibliographic list for the fiscal year
- a copy or reprint of each publication listed in the bibliography for the fiscal year

Note that although this publication will be made available to the general scientific community, it is not a substitute for traditional scientific reporting in journals and elsewhere.

Final Report A final report is required which shall include all peer-reviewed publications.

Flight Experiment Reports Investigators selected to carry out space flight experiments are expected to provide NASA with two reports:

(1) A "quick-look" report of preliminary flight results that is due one month after the space flight takes place, and

(2) A final report containing all data and information on the flight study is due approximately one year after all required data/materials are provided by NASA to the investigator. At this time, all of the data must also be provided to NASA for placement in a data archive; data in this archive will be made available to the scientific and technical community.

E. Notice of Intent and Proposal Submission Information

Notices of Intent To facilitate proposal processing, potential Principal Investigators are requested to confirm plans to submit a proposal responding to this Announcement by sending a ***notice of intent to propose***, which is not binding, by ***November 27, 2000.*** The notice of intent, which should be no more than two pages, should contain:

- The names, addresses, and telephone numbers of a single Principal Investigator or team coordinator and all co-investigators or team members
- A descriptive title of the research or technical proposal
- A brief summary describing the proposed research major participating institutions

The more preferred method of NOI submission is electronically at the following web address:

http://peer1.idi.usra.edu/peer_review/ao/00-OBPR-01/ao_00_OBPR_01.html

NOIs can also be submitted via:

- via e-mail to the following address with the subject heading "NOI AO-00-OBPR-01": **noi@hq.nasa.gov**
- via U.S. Postal Service or commercial delivery to the address below.

Proposals An original signed proposal, plus twenty-four (24) complete copies of that proposal (for a total of 25 copies) and a 3.5-inch computer disk (containing an electronic copy of the Principal Investigator's name, address, telephone and fax numbers, e-mail address and the complete project title and abstract, as provided on Form B) in either Macintosh or PC format ***must be received by January 12, 2001.***

Proposals and Notices of Intent mailed through the U.S. Postal Service by express, first class, registered, or certified mail are to be sent to the following address:

Dr. Bradley Carpenter
c/o NASA Peer Review Services
Subject: NASA Research Proposal (AO 00-OBPR -01)
500 E Street, SW, Suite 200
Washington, DC 20024
Telephone number for delivery services: (202) 479-9030

Proposals and Notices of Intent hand delivered or sent by commercial delivery or courier services are to be delivered to the above address between the hours of 8:00 AM and 4:30 PM. The telephone number (202) 479-9030 may be used when required for reference by delivery services.

Note that NASA Peer Review Services cannot receive deliveries on Saturdays, Sundays, or federal holidays.

F. Tentative Announcement Schedule

The following schedule is planned for the acquisition of investigations under this Announcement:

Notice of Intent to Propose Due	November 27, 2000
Proposal Due	January 12, 2001
Selection Announcement	July 2001
Initial Funding Available	October 2001

G. Bibliography

The *Microgravity Science and Applications Program Tasks and Bibliography for FY 1999*, which contains a searchable data base on currently funded research, provides useful information to proposers about current program content. It can be viewed at the following web location:
http://peer1.idi.usra.edu/peer_review/taskbook/taskbook.html

As described in the Standard Companion Document, information on research apparatus offered for use on the ISS through this announcement, as well as general programmatic information from NASA and the IMSPG, is available at the following website:
http://www.science.sp-agency.ca/K3-IMSPG(Eng).htm.

APPENDIX A
AO 00-OBPR-01

GENERAL INSTRUCTIONS AND PROVISIONS

I. INSTRUMENTATION AND/OR GROUND EQUIPMENT

By submitting a proposal, the investigator and institution agree that NASA has the option to accept all or part of the offeror's plan to provide the instrumentation or ground support equipment required for the investigation, or NASA may furnish or obtain such instrumentation or equipment from any other source as determined by the selecting official. In addition, NASA reserves the right to require use of Government instrumentation or property that subsequently becomes available, with or without modification, that meets the investigative objectives.

NOTICE TO ALL OFFERORS: In the event that a Principal Investigator employed by NASA is selected under this Announcement of Opportunity (AO), NASA will award prime contracts to non-Government participants, including co-investigators, hardware fabricators, and service providers, who are named members of the proposing team, as long as the selecting official specifically designates the participant(s) in the selection decision. Each NASA contract with a team member selected in this manner will be supported by an appropriate justification for other than full and open competition, as necessary.

II. TENTATIVE SELECTIONS, PHASED DEVELOPMENT, PARTIAL SELECTIONS, AND PARTICIPATION WITH OTHERS

By submitting a proposal, the investigator and the organization agree that NASA has the option to make a tentative selection pending a successful feasibility or definition effort. NASA has the option to contract in phases for a proposed experiment and to discontinue the investigative effort at the completion of any phase. NASA may desire to select only a portion of the proposed investigation and/or that the individual participates with other investigators in a joint investigation. In this case, the investigator will be given the opportunity to accept or decline such partial acceptance or participation with other investigators prior to a NASA selection. Where participation with other investigators as a team is agreed upon, one of the team members will normally be designated as its leader or contact point. NASA reserves the right not to make an award or cancel this AO at any time.

III. SELECTION WITHOUT DISCUSSION

The Government intends to evaluate proposals and award contracts without discussions with offerors. Therefore, each initial offer should contain the offeror's best terms from a cost or price and technical standpoint. However, the Government reserves the right to conduct discussions, if later determined by the Contracting Officer to be necessary.

IV. NONDOMESTIC PROPOSALS

The guidelines for proposals originating outside of the United States are the same as those for proposals originating within the United States, except that the additional conditions described in Section IV, Part C shall also apply.

V. TREATMENT OF PROPOSAL DATA

It is NASA policy to use information contained in proposals and quotations for evaluation purposes only. While this policy does not require that the proposal or quotation bear a restrictive notice, offerors or quoters should, in order to maximize protection of trade secrets or other information that is commercial or financial and confidential or privileged, place the following notice on the title page of the proposal or quotation and specify the information, subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals and quotations will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

RESTRICTION ON USE AND DISCLOSURE OF
PROPOSAL AND QUOTATION INFORMATION (DATA)

The information (data) contained in (insert page numbers or other identification) of this proposal or quotation constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed for other than evaluation purposes; provided, however, that in the event a contract is awarded on the basis of this proposal or quotation, the Government shall have the right to use and disclose this information (data) to the extent provided in the contract. This restriction does not limit the Government's right to use or disclose this information (data), if obtained from another source without restriction.

VI. STATUS OF COST PROPOSALS

Submission of cost or pricing data is required if the costs exceed $500,000. Cost or pricing data will also be required for proposals for subsequent mission phases. The investigator's institution agrees that the cost proposal submitted in response to the Announcement is for proposal evaluation and selection purposes, and that, following selection and during negotiations leading to a definitive contract, the institution may be required to resubmit or execute all certifications and representations required by law and regulation.

Full Cost Accounting

If any NASA costs are to be considered as contributed costs, the contributed item(s) or service must be separately funded by an effort complementary to the proposed investigation and the funding sources must be identified. Where NASA-provided services are used, NASA Civil Service labor and supporting NASA Center infrastructure must be costed on a full cost

accounting basis. If NASA guidance for full cost accounting has not been fully developed by the closing date for completion of the concept study, NASA Centers may submit full cost proposals based on the instructions in the NASA Financial Management Manual, Section 9091-5, Cost Principles for Reimbursable Agreements, or based on their own Center-approved full cost accounting models. Other Federal Government elements of proposals must follow their agency cost accounting standards for full cost. If no standards are in effect, the proposers must then follow the Managerial Cost Accounting Standards for the Federal Government as recommended by the Federal Accounting Standards Advisory Board.

Goods and/or Services Offered on a No Exchange of Funds Basis

Contributions of any kind, whether cash or noncash (property and services), are welcome. Values for all contributions of property and services shall be established in accordance with applicable cost principles. Such contributions may be applied to any part or parts of an investigation. A letter of endorsement that provides evidence that the institution and/or government officials are aware and supportive of the proposed investigation and will pursue funding for the investigation if selected by NASA must be submitted with the proposals for all U..S. components.

The cost of contributed hardware or software should be estimated as either: (1) the cost associated with the development and production of the item if this is the first time the item has been developed and if the investigation represents the primary application for which the item was developed; or (2) the cost associated with the reproduction and modification of the item (i.e., any recurring and investigation-unique costs) if this is not a first-time development. If an item is being developed primarily for an application other than the one in which it will be used in the proposed investigation, then it may be considered as falling into the second category (with the estimated cost calculated as that associated with the reproduction and modification alone).

The cost of contributed labor and services should be consistent with rates paid for similar work in the offeror's organization. The cost of contributions does not need to include funding spent before the start of the investigation (before completing a contract, grant, or cooperative agreement with NASA). The value of materials and supplies shall be reasonable and shall not exceed the fair market value of the property at the time of the contribution.

VII. LATE PROPOSALS

The Government reserves the right to consider proposals or modifications thereof received after the date indicated for such purpose, if the selecting official deems it to offer NASA a significant technical advantage or cost reduction. (See NFS 18-15.208.)

VIII. SOURCE OF SPACE INVESTIGATIONS

Investigators are advised that candidate investigations for space missions can come from many sources. These sources include those selected through the AO, those generated by NASA in-house research and development, and those derived from contracts and other agreements between NASA and external entities.

IX. DISCLOSURE OF PROPOSALS OUTSIDE THE GOVERNMENT

NASA may find it necessary to obtain proposal evaluation assistance outside the Government. Where NASA determines it is necessary to disclose a proposal outside the Government for evaluation purposes, arrangements will be made with the evaluator for appropriate handling of the proposal information. Therefore, by submitting a proposal, the investigator and institution agree that NASA may have the proposal evaluated outside the Government. If the investigator or institution desires to preclude NASA from using an outside evaluation, the investigator or institution should so indicate on the cover. However, notice is given that if NASA is precluded from using outside evaluation, it may be unable to consider the proposal.

X. EQUAL OPPORTUNITY

For any NASA contract resulting from this solicitation, the clause at FAR 52.222-26, "Equal Opportunity," shall apply.

XI. PATENT RIGHTS

A. For any NASA contract resulting from this solicitation awarded to other than a small business firm or nonprofit organization, the clause at NFS 18-52.227-70, New Technology, shall apply. Such contractors may, in advance of a contract, request waiver of rights as set forth in the provision at NFS 18-52.227-71, Requests for Waiver of Rights to Inventions.

B. For any NASA contract resulting from this solicitation awarded to a small business firm or nonprofit organization, the clause at FAR 52.227-11, Patent Rights--Retention by the Contractor (Short Form), (as modified by NFS 18-52.227-11) shall apply.

XII. RIGHTS IN DATA

Any contract resulting from this solicitation will contain the Rights in Data - General clause: FAR 52.227-14.

APPENDIX B
AO 00-OBPR -01

Instructions for Proposal Preparation and Required Application Forms

This section contains the general instructions for proposal preparation and the forms required of proposers responding to the NASA Announcement of Opportunity AO 00-OBPR -01. The required forms include a special application form, Form U.S.A., which is necessary to conform to U.S. legal and regulatory requirements, as well as a series of forms found in Section IV of Appendix C, the *Standard Companion Document* for the internationally coordinated solicitations. Form U.S.A. is found at the end of this section. The instructions for proposal preparation found in Appendix C, Section IV, of the *Standard Companion Document* should be followed by proposers to this Announcement, but a completed Form U.S. A. must be attached as the first page of a proposal submitted to NASA in response to this Announcement.

Letter of Assurance of Foreign Support

Applications submitted to this Announcement by organizations outside of the U.S., European member countries of the European Space Agency, Canada, or Japan must include a written endorsement from the respective agency or funding/sponsoring institution (see Section IV, Part C of this Announcement for details).

For your convenience, a Mailing List Update form is also included at the end of the appendices to this Announcement.

CERTIFICATION REGARDING
DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS
PRIMARY COVERED TRANSACTIONS

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 14 CFR Part 1269.

A. The applicant certifies that it and its principals:

a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

b) Have not within a three-year period preceding this application been convicted or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph A.(b) of this certification; and

d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or Local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

C. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lowered Tier Covered Transactions (Subgrants or Subcontracts)

a) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principles is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department of agency.

b) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

This page has been included for your information. Do not submit this page with your application. Item 21 of Form A satisfies the requirement of compliance with the provisions, rules, and stipulations described on this page.

CERTIFICATION REGARDING LOBBYING

As required by S 1352 Title 31 of the U.S. Code for persons entering into a grant or cooperative agreement over $100,000, the applicant certifies that:

(a) No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, in connection with making of any Federal grant, the entering into of any cooperative, and the extension, continuation, renewal, amendment, or modification of any Federal grant or cooperative agreement;

(b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting an officer or employee of any agency, Member of Congress, an or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(c) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subgrants, contracts under grants and cooperative agreements, and subcontracts), and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by S1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

This page has been included for your information. Do not submit this page with your application. Item 21 of Form A satisfies the requirement of compliance with the provisions, rules, and stipulations described on this page.

CERTIFICATION OF COMPLIANCE WITH THE NASA REGULATIONS PURSUANT TO NONDISCRIMINATION IN FEDERALLY ASSISTED PROGRAMS

The (Institution, corporation, firm, or other organization on whose behalf this assurance is signed, hereinafter called "Applicant") hereby agrees that it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352), Title IX of the Education Amendments of 1962 (20 U.S. 1680 et seq.), Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S. 794), and the Age Discrimination Act of 1975 (42 U.S. 16101 et seq.), and all requirements imposed by or pursuant to the Regulation of the National Aeronautics and Space Administration (14 CFR Part 1250) (hereinafter called "NASA") issued pursuant to these laws, to the end that in accordance with these laws and regulations, no person in the United States shall, on the basis of race, color, national origin, sex, handicapped condition, or age be excluded from participating in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity for which the Applicant receives federal financial assistance from NASA; and hereby give assurance that it will immediately take any measure necessary to effectuate this agreement.

If any real property or structure thereon is provided or improved with the aid of federal financial assistance extended to the Applicant by NASA, this assurance shall obligate the Applicant, or in the case of any transfer of such property, any transferee, for the period during which the real property or structure is used for a purpose for which the federal financial assistance is extended or for another purpose involving the provision of similar services or benefits. If any personal property is so provided, this assurance shall obligate the Applicant for the period during which the federal financial assistance is extended to it by NASA.

This assurance is given in consideration of and for the purpose of obtaining any and all federal grants, loans, contracts, property, discounts, or other federal financial assistance extended after the date hereof to the Applicant by NASA, including installment payments after such date on account of applications for federal financial assistance which were approved before such date. The Applicant recognized and agrees that such federal financial assistance will be extended in reliance on the representations and agreements made in this assurance, and the United States shall have the right to seek judicial enforcement of this assurance. His assurance is binding on the Applicant, its successors, transferees, and assignees, and the person or persons whose signatures appear below are authorized to sign on behalf of the Applicant.

This page has been included for your information. Do not submit this page with your application. Item 21 of Form A satisfies the requirement of compliance with the provisions, rules, and stipulations described on this page.

The Required Application Forms

must be downloaded separately from

http://peer1.idi.usra.edu/peer_review/AO/00-OBPR-01/00-OBPR-01.html

APPENDIX C
AO 00-OBPR-01

Microgravity Science Research
International Announcement of Opportunity 2000

Standard Companion Document

Issued by the International Microgravity Strategic Planning Group

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Microgravity Science Research
International Announcement of Opportunity 2000
Standard Companion Document

Table of Contents

Introduction

This supplement is a companion to research solicitations released by agency members of the International Microgravity Strategic Planning Group: Agenzia Spaziale Italiana (ASI – Italy), Canadian Space Agency (CSA - Canada), Centre National d'Ètudes Spatiales (CNES - France), Deutsches Zentrum für Luft und Raumfahrt (DLR - Germany), the European Space Agency (ESA - Europe), National Aeronautics and Space Administration, (NASA - United States), and the National Space Development Agency of Japan (NASDA - Japan). The various sections of this supplement provide a common basis for proposal preparation and submission by any eligible scientist, regardless of the country of origin.

The purpose of the International Announcement of Opportunity (IAO) is to obtain the highest quality research through international solicitation and scientific peer review of research proposals, to increase the effective use of the International Space Station (ISS) through international cooperation and utilization of the ISS facilities, and to avoid duplication of projects by fostering international collaboration.

The research solicitations coordinated by this document aim to optimize the use of facilities available for microgravity research on the International Space Station. The equipment offered through the coordinated announcements during the period spanning Station assembly and the first years beyond assembly completion (approximately 2002-2006) is listed in Section III. This AO is principally a solicitation for research on the ISS. However, if space shuttle opportunities become available during this period, participating agencies may carry out some of the selected experiments on these missions.

This document provides a common basis for proposal preparation and submission. Each participating agency will release an announcement of opportunity (AO) which will accompany this document and will include the unique requirements of the agency.

Interested persons who do not have a copy of the announcement of opportunity should contact one of the following persons for more information:

Dr. Vittorio Cotronei
Agenzia Spaziale Italiana (ASI)

Dr. Rodney Herring
Canadian Space Agency (CSA)

Dr. Bernard Zappoli
Centre National d'Ètudes Spatiales (CNES)

Dr. Rainer Kuhl
Deutsches Zentrum für Luft und Raumfahrt (DLR)

Dr. Olivier Minster
European Space Agency (ESA)

Dr. Bradley Carpenter
National Aeronautics and Space Administration (NASA)

Dr. Makoto Natsuisaka
National Space Development Agency of Japan (NASDA)

The deadline for submitting a proposal for the IAO to any of the participating agencies is January 12, 2001.

A non-committing notice of intent should be submitted to the same participating agency by November 27, 2000. This notice of intent should provide a preliminary abstract of the project and a list of the potential participants.

I. International Microgravity Research Proposal Evaluation Process

This section describes the evaluation and selection processes that will be used for funding proposals submitted to any agency participating in the IAO in reply to the coordinated 2000 flight research solicitation.

Each research proposal must be a complete response to the appropriate individual space agency's official solicitation. In that solicitation, an agency may define a number of critical constraints that proposals must satisfy to be considered for selection. For example, an agency may fund no work in certain discipline areas, or no work without a flight component. Proposals to these agencies to carry out work that will not be funded by them will be returned to the proposer immediately following submission. For this reason, proposers are advised to communicate with their agency officials prior to submission if there is any doubt of the acceptability of a proposal by the agency in question. **Any request for supplementary support from an agency by a project, or by co-investigators or team members on a project (see section F), other than the primary agency from which overall project sponsorship is being sought, must include a proposal meeting the requirements of the agency from which the support is being requested.**

The overall review process for each proposal will include the following factors:

- Microgravity relevance
- Scientific merit
- Preliminary technical assessment
- Relevance to the programs of the soliciting agencies
- Cost

Clear microgravity relevance will be a requirement for the selection. Apart from microgravity relevance, the most important criterion in the evaluation is the scientific merit, followed by flight feasibility, relevance to agency programs, and cost. Compliant proposals will undergo a three-tiered review process to assess these factors.

A. Microgravity Relevance and Science Merit Review

The first review tier will be a peer review assessment of the microgravity relevance and the science merit by scientific experts. In general, proposals will be reviewed by a panel of experts drawn from the international scientific community. All panels will utilize the same factors in their evaluation and all panel meetings will be conducted using the same review guidelines. The merit review panel will assign a score [from 1 to 100] or recommend no further consideration of the proposal, based upon its scientific merit.

The score assigned by this panel will not be affected by the cost of the proposed work or reflect the programmatic relevance of the proposed work to the sponsoring agency. However, the panel will be asked to include, in their critique of each proposal, any comments they may have concerning the budget. The peer review will consist of two categories, i.e., microgravity relevance and scientific merit.

Microgravity Relevance

Does the proposed project require the microgravity condition? Does the experiment need long duration microgravity to obtain unique scientific information not accessible by other means?

Scientific Merit

The following criteria in order of priority will be used in determining the merit score:

Significance: Does this study address an important problem? If the aims of the application are achieved, how will scientific knowledge or technology be advanced? What will be the effect of these studies on the concepts, methods, or products that drive this field?

Approach: Are the theoretical framework, experimental design, data analysis and interpretation methods adequately developed, well integrated, and appropriate to the aims of the project? Is the proposed approach likely to yield the desired results? Does the applicant acknowledge potential problem areas?
Innovation: Does the project employ novel concepts, approaches, or methods? Are the aims original and innovative? Does the project challenge existing paradigms or develop new methodologies or technologies?

Personnel: Are the scientific personnel appropriately trained and well suited to carry out this work? Is the evidence of the personnel's productivity satisfactory? Are the functions and responsibilities of the team members adequately described and appropriate? Does the project employ useful collaborative arrangements?

Environment: Does the institutional environment, in which the work will be performed, contribute to the probability of success?

B. Preliminary Technical Assessment

The second tier involves a technical assessment, or engineering review, that will evaluate the feasibility of implementation of the proposed work on the research facilities offered in this IAO. This review will be conducted by a qualified international team of engineers representing the research facilities. A detailed experiment description, necessary for this evaluation, should be clearly and succinctly included in the proposal. Because of the limited resources available for use of the experimental facilities, experiment requirement for volume, mass, power, etc will be an important aspect in the technical assessment.. It is important to note that during the early utilization phase, resource constraints will favor selection of proposals with simple requirements and procedures. Of particular concern regarding the evaluation of the feasibility of a proposal is the identification of the risk factors that could impact the implementation of an otherwise meritorious proposal. Therefore, the feasibility of implementing the proposal and associated risks will be evaluated using the following technical criteria:

Functional Requirements: Will the available flight hardware and related ground support resources meet the functional requirements of the experiment? How much experiment-unique equipment will be required, and can it be developed in time for the projected flight opportunities?

Space Platform Resource Requirements: To what extent will this experiment consume the launch vehicle capacity and flight platform resources (such as crew time and electrical power) that are projected to be available? Are sufficient resources available? Does this experiment require such a large amount of the available resources that it will preclude conduct of other experiments? Can the experiment be carried out within a reasonable period of time?

Safety: Are there elements of the proposed activities and hardware that pose concerns for the health and safety of personnel and/or the environment? [Proposers should carefully address this issue if a potential exists for safety concerns.]

C. Evaluation of Programmatic Relevance and Cost

The third tier of review will consider two factors: programmatic relevance and cost. This review will be conducted independently by program scientists and managers from each soliciting agency for proposals submitted to their specific solicitation. Programmatic relevance will include an evaluation of how the proposed work may help achieve agency goals. Evaluation of cost will be performed for proposals by the agencies from which funds are requested, including the development and support for the flight experiment. This evaluation includes consideration of the realism and the reasonableness of the cost of the proposed research, and the relationship of the overall cost to available funds.

D. Development of Selection Recommendation

The results of these three levels of review will be used to prepare a selection recommendation developed by each of the soliciting agencies. This recommendation will be based on:

- the numerical score for merit from the peer review panel,
- the results of the technical assessment,
- the programmatic relevance and an estimated cost.

At a coordination meeting, each agency involved in supporting a proposal will present its tentative selection plan and identify proposed funding of scientists and utilization of resources described in the IAO. The participating agencies of the IAO will establish a coordinated recommendation of selection based on a preliminary allocation of shared resources in order to optimize the science return and resource utilization. Participating agencies retain the authority for proposal selection and funding decisions for IAO proposals that have been submitted to them. The agency sponsoring an investigator retains responsibility for the management of the scope, duration and performance of the investigation.

It may be more efficient or effective to form international teams of researchers addressing overlapping questions or requiring similar, limited resources, than to have individuals competing for the same samples or flight apparatus. Experience has clearly shown that such teams are best formed before submission of proposals, rather than later in the flight experiment development process.

Applicants should be aware that selection for flight is a multi-step process. Following the evaluation of flight proposals, investigators will be informed if their experiment has been selected for definition phase support. During the definition phase, the agency(ies) with responsibility for the project will interact with the investigators in order to confirm that the proposed experiment can actually be implemented. At the end of this phase, projects may be committed to flight development. Selected flight experiments will be reviewed periodically and may be deselected based upon the policy of each agency.

II. Flight Opportunities Available for Microgravity Research

Proposals for space flight experiments for the time period spanning Station assembly and the first years beyond assembly completion (approximately 2002-2006) may be submitted. All proposals must address one or more of the research programs and emphases defined in the sponsoring agency(ies) research solicitation.

It is expected that the majority of experiments selected will be performed on the International Space Station (ISS). A small number of opportunities may exist for experiments that do not require ISS resources and can be accommodated in the Space Shuttle.

The investigator should allow for flexibility in selecting the best hardware to be used to accomplish the experiment goals. Reference sources for information on specific hardware items are listed in Section III.

Research opportunities will be available during the construction phase of the ISS. Experiments with few or simple requirements have the greatest potential for selection during this time frame.

Research selected for the period following the completion of the ISS will have more extensive resources available. After assembly complete, the ISS laboratories will be more extensively outfitted for research. Capabilities will be introduced over several years. Research facilities and apparatus, for which proposals are solicited, are listed in Section III.

III. Flight Research Capabilities

Information on all the facilities and experiment unique equipment offered through this announcement is available at: http://www.science.sp-agency.ca/K3-IMSPG(Eng).htm.. The following is a summary of facilities and equipment planned for ISS utilization and offered through this announcement.

Some facility descriptions on the internet include a form that allows for the assessment of the suitability of this facility for performing the proposed experiment. When provided, a completed copy of this form will be used in the technical evaluation of your proposal.

ASI Research Apparatus

GLAD G-Level Analysis Drawer

The presence of the unavoidable residual-g on the ISS, which depends on the distance from the center of mass of the platform (gravity gradient and centrifugal acceleration), and on other external forces (e.g., the aerodynamic drag and the solar pressure) may have a large impact on microgravity experiment sensitivity, resulting in undesired effects able to spoil completely the results.

GLAD is a Multi-user Italian Facility conceived to study the effects of the experiment orientation with respect to residual-g on board the ISS. It allows to evaluate the effects of the residual-g vector on simple microgravity study cases and to establish if highly accurate numerical models can be utilised to predict the acceleration effects on future experiments on the ISS. The facilty is conceived as a rotating support, oriented at a given angle wrt the residual-g vector, on which dedicated experiment containers can be hosted. It is designed as a standard 8PU Drawer to be allocated into the U.S EXPRESS Drawer Rack as well as in the European one and can accommodate different Test Containers (TC). The exchangeable test containers are stored into a passive 4PU Drawer. A detailed description of the facility is available at: http://www.marscenter.it/asi/glad/html.

CNES Research Apparatus

DECLIC Material Sciences and Fluid Physics Facility

DECLIC is dedicated to the physics of transparent media in general and to model material sciences and near-critical and supercritical research in particular. It is accommodated into two lockers of an express rack structure (2 x 32 Kg), its electrical power is 200 W, the video transmission for telescience works at 1 kHz, telemetry 4Mbps and telecommand 1 kbps. The crew time needed per experiment is 15 minutes in average. The experiments are performed into dedicated experimental containers 400 x 200 x 200 (mm) (average weight 15 Kg) that are inserted into the facility. The available optical diagnoses are: direct observation (∅ light beam = 12 mm spatial resolution = 10 µm), microscopy (∅ observation = 1mm, spatial resolution = 1 µm), grid observation (∅ observation = 1 mm, spatial resolution =10 µm), immersed microscopy (∅ observation = 1 mm, spatial resolution =5 µm, light transmission measurement (accuracy 1%) small angle scattering (13° angular resolution 2 m. radian), interferometry (∅ observation = 12 mm, spatial resolution =25 µm), phase shift interferometry (∅ observation = 12 mm, spatial resolution =1 µm); pressure measurements, from 0 to 500 bars DC to 10 kHz. Thermal diagnoses performances depend on experiments. For example the set point temperature stability for near –critical fluids studies, is ± 30 µK from 25 C to 70 C, and it is ± 31 mK from 300 C to 600 C; for directional solidification studies it is ± 0.1 K from –20 C to 150 C.

CSA Research Apparatus

ATEN Furnace for the ISS

ATEN (the Advanced Thermal ENvironment) is a furnace designed to meet a wide range of scientific requirements. It will allow investigators to do fundamental studies (diffusion, Ostwald ripening, particle migration) as well as improving material processing techniques to grow semi-conductors, ceramics, and glasses of better quality. ATEN will be the size of a Standard Middeck Locker (MDL) and will be mounted on the Microgravity Vibration Isolation Mount Base Unit (MIMBU) that will be used to isolate ATEN from any vibrations, which would affect the experiment. The facility will contain one furnace core, a rapid cooling block and a sample cartridge system with an automated loading system to reduce handling by the crew. ATEN will be able to process samples up to 10 mm in diameter and 80 mm in length. The furnace will operate in isothermal mode at temperatures varying from 100ºC to 1300ºC and in temperature gradient mode with a gradient varying from 5ºC/cm to 50ºC/cm. The facility will also provide melt zone mode. The facility will allow the temperature to be regulated to a precision of ±0.25% at high temperature and controlled to a precision of ±1ºC. ATEN will be remotely controlled from the ground or directly from space. Ground units will be made available to scientists for ground base experiments and mission preparation.

MIMBU Microgravity-Vibration Isolation Mount Base Unit

The MIMBU is a research support facility, housed in a double middeck locker in an EXPRESS rack, for experimental payloads on the size of an ISS middeck locker. It provides g-jitter isolation, as well as, controlled g-inputs into the experiments for their study. It is counter balanced for experiments needing large g-inputs during the microgravity period of the ISS. MIMBU will be visited by many types of experimental facilities. It provides common services such as power, data collection and analysis, as well as, control of the experiment if required. These services reduce duplication within the experimental facilities, making them lighter, smaller and cheaper. Direct feed-through from the experiment facility to the EXPRESS rack, bypassing MIMBU is also possible. MIMBU offers an enclosure which will limit heat losses from the payload to the cabin and protect the payload which is attached to Stator (non-isolated region) and removable for large facilities on flotor. Open for use by ISS partner's facilities. To be housed permanently on the ISS.

DLR Research Apparatus

FMF Float Zone Furnace

The Float Zone Furnace with Rotating Magnetic Field (FMF) represents a heater insert for the Materials Science Laboratory (MSL) of the ISS. It is dedicated to crystal growth experiments and can create a floating zone with a maximum temperature of 1500°C. The heater design sustains the formation of adjacent gradients in the range of 5-25 K/cm (for Si).

FMF consists of 7 heating zones whose temperature can be individually adjusted and controlled. By using optical fiber sensors for temperature control the temperature stability is better than

±0.02 K. Due to the implementation of graphite diffusors the azimuthal temperature distribution for each zone is better than 1°C. The height of the molten zone will be visualized during processing. The flow field in the molten zone can be influenced by applying a rotating magnetic field (5-400 Hz) with a maximum induction of 5 mT. The furnace is mounted on a very stable, low-noise drive unit which allows for a pulling length of 120 mm with a rate adjustable from 0.8 mm/d up to 10 mm/min. Cartridge rotation is possible.

The cartridge design relies on the utilization of transparent ampoules (quartz or sapphire). The facility allows for processing samples up to a diameter of 20 mm. FMF supports a high-vacuum processing environment and a 200 mbar Ar atmosphere.

FMF is currently designed/breadboarded by DLR and planned as its facility contribution for a NASA selected flight experiment to be performed in the MSL (ESA) as part of the MSRR-1 (NASA) in the US Lab. The availability is planned for 2003.

IMPF Plasma Facility

The International Microgravity Plasma Facility (IMPF) introduces a new concept for plasma research in space. Its purpose is to provide flexible and diversified possibilities for fundamental research as well as applications. The design is modular, with the "support equipment" able to service a number of "research platforms", which can be exchanged. The main research area is "complex plasmas" (multicomponent plasmas containing ions, electrons, charged microparticles and neutral gas), with the emphasis on measurements at the kinetic level on such topics as strong coupling phenomena, liquid and crystalline plasmas, phase transitions, interfaces and surface phenomena, waves, shocks and global modes, homogeneous, inhomogeneous and anisotropic systems, transition to turbulence etc. In the more applied studies, topics such as particle growth, coagulation, disagglomeration and surface treatment of microparticles - amongst others - are envisaged.

The predecessor of IMPF is the Plasma Crystal Experiment (PKE) facility developed by DLR. PKE will be operational on the Russian Service Module in late 2000 for one year exploitation as a cooperative effort with RSC Energia and ROSAVIAKOSMOS.

After completion of a feasibility study on IMPF DLR is currently funding the predevelopment of critical subcomponents. The facility is designed for accommodation onboard the ISS in different station modules. ESA is planning an accommodation study of IMPF for its own facilities.

The IMPF flight hardware development is under consideration as a common effort by several parties beginning in 2002/2003.

ADL Advanced Disc Laser System

The Advanced Disk Laser (ADL) is a modular, pulsed, all solid state laser system which combines high laser output energies of several tenths of millijoules with high repetition rates in the kilohertz range. In combination with an intensified high speed camera system spatially and temporally resolved diagnostics of combustion processes and of flow dynamics can be

performed. The system supplies spectrally narrowed radiation in the near infrared (NIR), visible (VIS) and ultraviolet (UV) spectral region.

To enable the application in different spectral regions the tunable NIR radiation of the laser source is converted by harmonics generation in nonlinear optical crystals. The laser system is applied for planar laser induced fluorescence (PLIF) measurements of combustion relevant species as e.g. OH, NO, O_2, CHO or HCHO. Additionally established laser diagnostic techniques as Raman-, Mie- and Rayleigh-scattering, laser induced incandescence (Lll) or particle imaging velocimetry (PIV) become available. Besides species and velocity fields also temperature distributions can be detected.

The robust laser system is designed for research in the Combustion Integrated Rack (NASA) but also for experiments in drop towers and parabolic airplane flights. Because of the modular design the laser system performance can be adapted to special experimental requirements.

The disc laser as the core element of the new diagnostic system is under development by DLR. The complete module is planned to be available for the ISS in 2005.

Advanced **TITUS**

Advanced TITUS is a new, modular multi-user facility designed for a wide spectrum of materials science experiments (solidification dynamics, crystal growth, thermophysical properties, etc.). Its concept and design are based on the experiences from the predecessor TITUS on board MIR since 1995.

The main features are plain technical interfaces to the ISS, in the first configuration 9 individually controlled heater segments with a maximum heater temperature of 1500 °C, and a dedicated laptop for process control, data storage, re-programming of process parameters, and telemetry link. A 3-axis acceleration measurement of the µg environment is provided throughout operation.

The facility is sub-divided into a furnace and an electronic module. The furnace module can be located conveniently within the ISS and oriented with respect to the vector of residual gravity to minimize its influence. Heater assembly, sample cartridge, cartridge fixation and feeding unit are insulated against µg disturbances. The modular concept allows for exchangeable subunits for various diagnostic techniques and heater inserts.

Advanced TITUS is planned as a DLR development for the Russian research modules of the ISS. So far DLR has developed a technological model for laboratory experiments.

ESA Research Apparatus

MSL Materials Sciences Laboratory

The MSL aims to support priority areas of microgravity research: solidification physics, the measurement of thermophysical properties of materials and crystal growth. ESA's MSL furnace facility will be located in NASA's Materials Science Research Rack in the US Laboratory

Module of the ISS. The MSL-Electro Magnetic Levitator is developed cooperatively with DLR and will be located in ESA's Columbus laboratory.

LGF Low Gradient Furnace Insert

This will be the first European furnace insert in the MSL and is developed to support research in the field of Bridgman crystal growth. The LGF consists of two heated cavities separated by an insulating, "adiabatic" zone. It is intended to provide restricted but well-controlled gradients between two stable temperature plateaux. Crystal growth is performed by translating the furnace over a stationary sample; thermomechanical stresses in the grown crystal are minimised by maintaining the solidified part of the sample in the heated cavity throughout processing. Alternatively, the insert can be used for thermodiffusion experiments by keeping the furnace stationary and using only the gradient capability. Isothermal experiments can also be carried out with suitable sample/cartridge configurations.

SQF Solidification and Quenching Furnace Insert

This is the second European furnace insert. The SQF consists of a hot cavity separated from a water-cooled cooling zone by an insulating "adiabatic" zone. It is primarily intended for metallurgical solidification research under steep temperature gradients, with the possibility of quenching the solidifying interface at the end of processing (by quick displacement of the cooling zone). Directional solidification is achieved by translating the furnace over a stationary experiment cartridge. High gradients are established by coupling the cartridge to the cooling zone with a liquid metal contact. The furnace is re-configurable to different sample diameters and gradients by exchange of the components providing the adiabatic zone.

MSL-EML Material Science Laboratory - Electro-Magnetic Levitator

The Materials Science Laboratory – Electro-Magnetic Levitator (MSL-EML) is an ISS experiment platform for investigations on solidification phenomena and for the measurements of thermophysical properties in metallic and possibly semiconductors melts. The samples can be containerlessly processed in ultra-high vacuum or high-purity gas atmospheres and at temperatures ranging from about 400 °C to 2400 °C. This is important for reactive sample materials, the properties of which are sensitive to contamination. Solidification speeds can be measured from different undercoolings by inducing heterogeneous nucleation and observing the pyrometer signal with time resolutions up to 1 µsec. Thermophysical properties can be measured in stable and undercooled melts over wide temperature ranges. These properties include surface tension, viscosity, heat capacity, melting enthalpy, electrical conductivity, thermal expansion and volume increase with melting. The MSL-EML capitalises on the experience acquired on Spacelab flights with the TEMPUS facility, during which most of these capabilities were demonstrated. For the ISS a modular design concept is adopted which encompasses exchangeable experiment inserts where all these capabilities are maintained, with enhanced accuracy and over longer term operation. These experiment inserts accommodate 15 individual samples and will serve as sealed transport container as well as in-orbit processing chamber. They can be adapted to specific user requirements and could potentially accommodate new diagnostics and stimuli.

The MSL-EML is a cooperative ESA/DLR development and will be hosted in the COLUMBUS laboratory. Its availability is planned for 2004.

FSL Fluid Science Laboratory

The FSL is a multi-user research facility dedicated to investigations in fluid physics under microgravity conditions. It can be operated in a fully automatic or semi-automatic mode on the station by the flight crew or remotely controlled from ground in the so called tele-science mode. The design concept of the FSL facility is based on user requirements as well as the Space Station utilisation requirements and constraints. This essentially resulted in a highly modular concept allowing for continuous upgrades of the system capabilities throughout its operational life-time. The central element to the FSL is the Facility Core Element comprising the Central Experiment Module with the dedicated Experiment Container (EC) and the Optical Diagnostics Module which carries the equipment for optical diagnostics, related control electronics and accommodates Front Mounted Cameras (e.g. High Speed, High Resolution, Infrared). Different types of interferometric measurements can be performed, including Electronic Speckle Pattern Interferometry, Differential Interferometry and Holographic Interferometry. In addition a Schlieren observation mode is available. The implementation of a Microgravity Vibration Isolation System and of digital holography are considered.

FSL Experiment Container for Investigations on Aqueous Foams

A modular Experiment Container (EC) devoted to investigations on Aqueous Foams in the Fluid Science Laboratory (FSL) is studied. It will address both liquid drainage in foams and foam bubble stability.

In this EC, columns of foams will be produced with high liquid fraction and the propagation of a liquid front generated by forced flow or capillary forces will be accurately measured. The liquid distribution in the foam will be analysed by a novel method. Other experiments will focus on the physico-chemical understanding of the mechanisms that affect foam film rupture. The fluid motions in the liquid films between foam bubbles and the motions at the liquid-gas interfaces will be quantitatively investigated.

In addition to the liquid front analysis method implemented in the EC, the various optical diagnostic tools of the FSL will be employed.

FSL Experiment Container for Investigations on Emulsions

Complementary to the facility addressing this topic above, this modular experiment container for the FSL will enable investigations on drop/drop interactions and diluted emulsions as well as investigations on concentrated or opaque emulsions and on phase inversion.

The EC will allow using the optical diagnostic tools of the FSL to study drop/drop interactions, droplet size evolutions, droplet motions, as well as their aggregation and coalescence in diluted, transparent emulsions. Specifically for diluted emulsions droplet-freezing temperatures will be studied by cooling emulsions in specific steps and monitoring the number and the sizes of droplets freezing at each step. Analogously also a stepwise heating of frozen emulsions while monitoring the number and sizes of melting droplets will be possible.

Furthermore, the EC will allow experiments that aim at analysing phase inversion mechanisms in emulsions using Differential Scanning Calorimetry (DSC) and Conductometry. During cooling and heating emulsions, the DSC method will serve to analyse heat flow rates in the emulsions in comparison to a reference sample.

Since the conductivity of specific emulsions depends on their droplet size distribution, Conductometry allows experts to investigate the transition from the dispersed to the matrix phase. A dedicated experiment container will therefore represent a Micro-Calorimeter being useful for general investigations on phase transition phenomena, with a high potential to serve as a multi-user facility.

FSL Experiment Container for Investigations on Convection and Interfacial Mass Exchange

This dedicated FSL EC will allow studying mass transfer processes through interfaces and their coupling with surface-tension driven flows and instabilities that affect mass and energy transfer. The interfaces the facility will be primarily addressing will be those of evaporating pure liquids and evaporating multicomponent liquids.

Studies on the coupling between evaporation and convection are relevant for heat-pipe grooves and thin-film evaporators. The first set of experiments that are planned to be integrated in this modular EC will evaporate fluid volumes while fluid surface deformation and local temperatures will be measured and effects of Marangoni convection studied.

The facility will allow an automatic and telescience mode.

FSL Experiment Container for Investigations on Fluid Motions in Spherical Gaps

This FSL EC will be devoted to study in microgravity fluids between rotating spherical gaps. The facility consists basically of a sphere that is surrounded by a sphere shell that forms an equilibrium gap with the sphere. The modular EC offers a set up in which the inner and out sphere are either rotating with the same or different velocities. Various gap sizes will be offered as well as various rotation speeds. Additionally the inner and out sphere are independently temperature controlled making temperature gradients over the gap possible. A high voltage at the level of about 0.5 kV allows simulations of fluid motions under concentric forces, such as geophysical fluid motions.

Facility for Investigations on Interactions in Cosmic and Atmospheric Particle Systems

The objective is to investigate the various interaction processes of small solid and liquid particles with an ambient gaseous atmosphere, with electromagnetic radiation, and with other particles in their vicinity. The fundamental mechanisms to be addressed are important for understanding a large number of physical phenomena such as the light-scattering properties of particulate media and the aggregation of dust particle, aerosols, the interaction of particles with growing ice crystals. This research relates to the formation of planetary systems, the surface properties of low-gravity Solar System objects, such as comets and asteroids, the behaviour of airborne

aerosols and their effect on clouds, rain formation, dust storms, and climate. Composition, albedo, size distribution will be derived from light scattering measurements.

The facility is considered for the European Drawer Rack. ESA will investigate the feasibility of combining it with the Microgravity Plasma Facility studied by DLR.

Facility for Investigations in Plasma Physics

This facility will back a scientific programme to study the physics of plasmas in the strong-coupled regime (where electrostatic forces between particles are much greater than any thermal effects). Condensed plasma states (liquid and crystalline) can be achieved by using ionised colloidal particles. This facility will serve investigations in fundamental new physics, and related applications. Technical studies have already been initiated by DLR and synergy with the development of the Facility for investigations on Interactions in Cosmic and Atmospheric Particle Systems will be exploited.

PCDF Protein Crystallisation Diagnostics Facility

The PCDF will be installed in the European Drawer Rack (EDR) in ESA's Columbus Laboratory. This new instrument focuses on understanding the nucleation and crystallisation processes and the influence of gravity thereon. It will enable the monitoring of these processes over long periods in microgravity using advanced diagnostics instruments (light scattering, high resolution video and phase shift interferometry). In turn, each individual reactor is provided with temperature and solution composition control to enable the scientists to control the process. PCDF basically consists of two drawer units, a process unit, including the process chamber with the crystallisation reactors and an electronics unit accommodating the main controls and support systems for the performance of experiments.

Facility for Investigations on Metallic Foams

A facility for investigating metallic foams is studied for either the European Drawer Rack (EDR) or alternatively, the Materials Sciences Laboratory (MSL) as a low temperature furnace insert. The facility will consist of a furnace that allows processing of metal powders above their melting temperature. The maximum achievable temperature will be at least 700 deg.C. The facility will encompass a system for controlling the injection of bubbles in the molten material. In the case of a drawer accommodation, a cartridge exchange mechanism will be used which enables the consecutive processing of up to 6 different cartridges. The experiment scenario includes holding the foamed material molten over various durations, followed by a controlled directional solidification process, including the possibility of varying the solidification rate. Magnetic and electric fields will serve as tools to control the bubble distribution during the period over which the foamed material remains molten. Diagnostic tools will enable investigators to monitor the foaming process and investigate bubble stability and coarsening. This includes tools to analyse the structure of non-transparent materials in the liquid and the solid state.

Drawer Facility for Investigations on Magnetic Fluids

This self-standing drawer-type facility will be accommodated in the European Drawer Rack (EDR).

Cylindrical probes of magnetic fluids, the temperature of which can be controlled in the range of 10 to 50 °C will be exposed to axial and azimuthal magnetic fields of controlled strength. The diagnostic tools will enable the scientists to monitor the interactions between magnetic particle, the spatial distribution of these particles, the temperature distribution in the ferro-fluid and the thermomagnetic convection flows as a function of the experimental conditions. The facility will be designed to allow for both automatic and telescience operation mode.

Drawer Facility for Diffusion and Soret Coefficient (DSC) Measurements in Crude Oils

This self-standing drawer-type facility will be accommodated in the European Drawer Rack (EDR).

The DSC facility is dedicated to measurements the diffusion coefficients of binary and ternary liquid mixtures, primarily crude oils. Each diffusion cell will first be activated under isothermal conditions to allow for interdiffusion measurements, then under various thermal gradients for thermodiffusion investigations. The sample pressures will be adaptable to realistic oil reservoir conditions ranging up to about 350 bars. The analysis of the samples is planned to be performed onboard the ISS. The facility design will allow for both telescience and automatic control mode.

Drawer Facility for Investigations on Emulsions (single drop or bubble)

This self-standing drawer-type facility will be accommodated in the European Drawer Rack (EDR).

This EDR facility will employ the oscillating bubble or drop technique. Gas bubbles or liquid drops are formed in another fluid, a gas or a liquid in a temperature controlled environment. Both single and double interfaces can be established to enable investigations of thin films. The bubbles, drops and thin films are then submitted to oscillations with controlled shape. The concentration of surfactant can be changed between runs. The exchange of liquids and surfactants is envisaged. Optical diagnostic tools provide for the analysis of the bubble, drop or film shape as well as of the motions in the films and at interfaces. Accurate dynamic measurement of the pressure in the bubble or drop enable investigations of surfactant effects. The facility design will allow for both telescience and automatic control mode.

Insert for NASA's Combustion Integrated Rack for Investigations on the Combustion Properties of Partially Premixed Spray Systems (CPS)

ESA is studying the development of an insert for NASA's Combustion Integrated Rack primarily aiming at investigations of the vaporisation and autoignition behaviour of droplets and droplet arrays. The experiment chamber will be capable of providing controllable environmental conditions, including high pressure and temperature. Droplet ignition will be investigated in a premixed atmosphere that provides a mixture ratio below the relevant flammability limits. Investigations on the vaporisation behaviour at sub- and supercritical conditions will require an

inert gas atmosphere. Another objective with this facility is to study the dependency of NO generation in combusted droplet clouds under atmospheric and increased pressure conditions on premixing and fuel vapour concentration in the gas phase. Diagnostics to investigate effects originating from slip-velocities between droplets and gas are also considered.

NASA Research Apparatus

QMI Quench Module Insert

The Quench Module Insert provides for unique rapid quenching of the solidification interface. This insert is a Bridgman type furnace with an actively cooled cold zone and gas quenching capability. The maximum temperature accommodated is 1400°C and helium is used as the quench medium. Gradients of up to 100°C/cm are required. An experiment-specific electronic package for resistance measurement is included. The MI envelope is 22 cm in diameter and up to 62 cm long depending on the translation stroke. The furnace is planned to operate in a partial pressure gas environment. Key processing operations include sample melting and rapid quenching of the solidification interface.

DMI Diffusion Module Insert

The Diffusion Module Insert provides both precision isothermality in the heated zones and axial gradient between the zones to accommodate diffusion studies using the shear cell method. The DMI is a Bridgman type furnace insert designed for processing temperatures up to 1600°C with good isothermality and controllability. The isothermal zone length is approximately 10 cm. An adiabatic zone is used between the heated zones to achieve the desired axial gradient of up to 100°C/cm. Furnace translation capability is also provided. Both Fickian and Soret diffusion experiment can be carried out using a shear cell in which the diffusion process is allowed to occur inside the capillary tubes and the experiment is terminated by the shearing of the cell. The MI envelope is 22 cm diameter and up to 62 cm long depending on the translation stroke. The Diffusion Module Insert will nominally operate in a vacuum environment

SDLE/TPP Self-Diffusion in Liquid Elements/Thermophysical Properties Experiment Module

This experiment module is envisioned as a self contained, semi automatic, sealed, and multiple temperature apparatus. All furnace components, samples, sample exchange mechanism, electronics/microprocessors are within or on the sealed experiment container. The SDLE experiment container is divided into a processing volume and a non-processing volume. The experiment container will provide for either a vacuum or an inert gas environment surrounding the measurement cell. The Experiment Module diffusion sample cartridge container will be designed to be changed out on-orbit to accommodate multiple runs of up to 5-10 samples each. Processing temperatures up to 1400°C can be achieved.

HGDS High Gradient Directional Solidification Furnace Experiment Module

The HGDS will be a directional solidification furnace supported by its own subsystems for operation. The module is designed to support studies involving crystal growth processes, segregation in alloys and interface pattern selection criteria. The furnace can accommodate processing temperatures up to 1600°C and includes a reconfigurable gradient zone length from 1 to 5 cm in order to be able to achieve an axial gradient of 50 to 150°C in the sample. The processing atmosphere can be either inert gas or vacuum. A precise translation drive is provided. Quench capability from either water or gas or phase change collet will be provided to achieve

quench rates up to 100°C/sec in the sample. An automatic sample exchange capability (up to 20 samples) with provision for crew interaction is provided. Sample size up to 2 cm in diameter and 20 cm long can be accommodated. Higher gradient, accommodation of larger size samples, provision of an automatic sample exchange capability distinguishes this furnace module from the Quench Module Insert.

DSVT Directional Solidification and Vapor Transport Experiment Module

This Experiment Module provides capabilities for both directional solidification and vapor transport crystal growth processing. In addition, it will provide current pulse interface demarcation, very precise and extremely low translation rates, and in situ optical measurement features. The furnace can accommodate processing temperatures up to 1400°C and includes a reconfigurable gradient zone length from 1 to 5 cm. The processing atmosphere can be either inert gas or vacuum. A very precise and extremely low translation (0.028 to 0.058 μm/sec) drive is provided. An automatic sample exchange capability (up to 20 samples) with provision for crew interaction is also provided. The sample will be contained in ampoules housed in special cartridges to obtain a single level of containment. Sample size up to 2 cm in diameter and 20 cm long can be accommodated. Programmable current pulses up to 100 A are required. Video capability includes resolution comparable to NTSC TV at a frame rate of about 1 per second.

Suspension Research Apparatus

A couette cell is being developed to study the flow of bubbly suspensions. The couette device is 30 cm high, with an outer cylinder diameter of 30cm and gap-thickness of 3 cm. The outer cylinder is capable of rotating at variable speeds (up to 100 rpm), while the inner cylinder remains stationary. Bubbles are introduced into the couette cell at gap-averaged volume fractions ranging from 0.1 to 0.2. The bubble diameters vary from 2 to 3 mm and are uniform within 10% of the mean bubble radius. The instrumentation consists of hot wire probes to measure liquid velocity and the bubble collision rate, wall shear stress probes, and photography to visualize the flow cell.

LMM Light Microscopy Module

The LMM is currently under development for several colloid science investigations. The LMM will include a fully remotely-controlled, up-right microscope containing a video microscopy system that includes variable magnification optics, video camera, and color illumination sources. The system will be capable of resolving down to 0.5 micron structures within thin cell samples of approximately 100 microns thick. The LMM will also be employing light scattering techniques (Bragg, Dynamic Light Scattering, Static Light Scattering) to provide data on crystal growth and dynamics. The means for handling multiple samples will be included, to permit sample manipulation and change-out of test samples. The sample system will also contain a homogenizer to provide for a homogenous sample before the growth cycle begins. A confocal optics attachment may be included to improve resolution of the focal plane and to aid in the construction of 3-D imaging of the crystalline structures. The use of LASER Tweezers during real-time operations to manipulate and capture sample particles to affect crystal growth possibly may be included.

Granular Flow Apparatus

A shear cell is being developed to study an aspect of particle segregation important in reduced gravity. In this device, bumpy frictional boundaries in an oval channel will be used to control the energy of particle velocity fluctuations in the fully-developed flow in the straight sections. The device is approximately 34 inches long, 9.5 inches wide and 6.6 inches high. Cross section of the flow area is about 2.5 cm.. by 4 cm. The outer boundary is stationary, while the inner boundary is capable of being driven at speeds up to at least 1 meter/second. Various material and size particles can be used. The instrumentation consists of temperature, tachometer and acceleration probes, as well as photography to visualize the flow at a window located along the straight section.

Pool Boiling Apparatus

An apparatus suitable for a variety of pool boiling investigations is being developed. It consists of a pool boiling chamber, with an envelope measuring 35 cm x 35 cm x 75 cm, several imaging cameras and light sources, a nitrogen fed pressure control system and bellows, a stirrer, a smooth silicon surface over a microheater, and cooling system. A computer controller is used to regulate the temperature of the boiling surface and the bulk fluid. The temperatures in the pool, as well as on the backside of the silicon wafer are measured using thermocouples. The variation of the temperature in different parts of the pool held to within ±0.2°C of the mean temperature. The system pressure above the liquid pool is measured with an accuracy of ±0.5 kPa. The hardware has a video imaging system that will operate at a frame rate of 10-50 fps. The addition of a holographic interferometer for temperature distribution measurements around the bubble is being contemplated.

Physics of Colloids in Space Apparatus

The PCSA apparatus is designed to study colloidal systems with light scattering diagnostics. The apparatus can study fractal phenomena, growth of super-lattice structures from binary (two-component) solutions of hard-sphere colloidal particles, and behavior of polymer-colloidal mixtures (e.g. depletion flocculation). It also has applications in studying a wide range of fundamental problems in colloid physics, physical chemistry, chemical physics, materials science, and biological fluids. The PCSA provides four basic diagnostic measurements. These include non-invasive dynamic light scattering (DLS), static light scattering (SLS), Bragg scattering, and rheological measurements. The light scattering measurements are provided by two Nd-Yag lasers (maximum incident power of 40 mW) and either avalanche photo diodes or digital cameras for scattered light detection/measurement.

MDCA Multi-user Droplet Combustion Apparatus

The MDCA design is strongly based upon the NASA Droplet Combustion Experiment design, with requirements influences of other droplet investigations being added to enable completion of multiple investigator-specific conditions. The MDCA deploys and ignites fuel droplets ranging from 1 mm to 5 mm. Multiple viewing angles (back lit and dark field) are supported. The

droplets are freely deployed or deployed onto a fiber. The fiber tether method restrains the droplet from drifting, allowing higher resolution imaging, though with some loss of droplet uniformity. The MDCA is planned to conduct four current investigations as first user of the Combustion Integrated Rack (CIR) system.

FEANICS Flow Enclosure Accommodating Novel Investigations in Combustion of Solids

The FEANICS design is based on a series of thin and thick fuel solids combustion investigator requirements. The FEANICS apparatus accommodates both quiescent and flow conditions. Flows ranging from near quiescent to 200 mm/sec are provided. A carousel sample-changeout arrangement is implemented for thick fuel samples, minimizing CIR chamber openings. Thin fuels can be dispensed at the centerline of the chamber in a single sheet form or on a continuous roll. Depending on the fuel type, a variety of diagnostic views are available including fuel surface and fuel edge views. The FEANICS apparatus is planned to be the second microgravity science system to use CIR.

LTMPF Low Temperature Microgravity Physics Facility

The LTMPF superfluid helium dewar maintains a base temperature pre-selected at between 1.6 K to 2.0 K for a period of approximately five months. The dewar insert (the instrument) is configured to accommodate two experiments. It consists of two sets of thermal-mechanical platforms called probes. Attached to each probe are the experiment unique cells and sensors. Both probes and experiment hardware occupy a cylindrical volume 19 cm in diameter and 70 cm long. The weight for both sets of experiment hardware attached to the probes (but excluding the probe mass) is 12 Kg or less. Electronics are built on a modular VME chassis with up to 42 slots for electronic boards. High-resolution temperature and pressure sensors have been developed based on Super-conducting Quantum Interference Device magnetometers. These high-resolution thermometers have demonstrated sub-nano-Kelvin temperature resolution in past space experiments. Other instruments include resistance thermometers, precision heaters, capacitance bridges, precision clocks and frequency counters, gas handling systems, and optical access capability. An onboard flight computer controls all facility and instrument electronics, all ISS interfaces, command, telemetry, and data storage during on-orbit operations.

LCAP Laser Cooling and Atomic Physics Hardware

To support future flight experiments, a variety of technologies will be developed to enable space flight experiments involving Cs and Rb. A number of specific hardware packages are currently under development or are planned for development, including: Lasers - NASA is currently developing injection-locked laser systems capable of producing several hundred milliwatts of tunable, frequency stabilized light suitable for a typical Magneto-Optical Trap (MOT) or molasses experiment; Vacuum systems - Ultra-High Vacuum systems employing a combination of ion pump and getter technologies will be developed to provide vacuum capability below 10^{-10} torr; Cold atom sources - NASA is currently developing capabilities to collect atoms in a vapor cell molasses or magneto-optical trap (MOT), cool them to a temperature below 2 μK and then launch them with a moving molasses into an UHV region, such as is required for a Bose-Einstein Condensation experiment; Compact Magnetic traps - in addition to MOTs and optical molasses, NASA will also develop compact magnetic traps of the Ioffe-Pritchard type suitable for BEC experiments; Raman-cooling laser systems - a laser system suitable for driving Raman transitions in cesium is a planned future development for a Raman-cooling experiment or for an atom interferometer.

NASDA Research Apparatus

GHF Gradient Heating Furnace

The GHF is an experiment facility for investigating crystal growth and gaseous phase growth of semiconductors. The GHF is a multiuser furnace, consisting of the Material Processing Unit (MP), which directly operates the heating and cooling process of samples; the GHF Control Equipment (GHF-CE), which controls the overall operation of the GHF and communications with ISS; the Sample Cartridge Automatic Exchange Mechanism (SCAM), which can automatically exchange up to 15 samples cartridge; and the SCAM Control Equipment (SACM-CE). The MP has three independent heating zones that can provide various temperature profiles to the sample in accordance with the experiment requirements under vacuum conditions. In order to conserve crew resources on orbit, the sample cartridge is automatically exchanged by the Sample Cartridge Automatic Exchange Mechanism (SCAM). Ten channel thermocouples allow measurement of the sample temperature distribution.

Availability will be May 2005 after ISS assembly complete.

AFEX Advanced Furnace for Microgravity Experiment with X-ray Radiography

The AFEX can perform single-crystal growth experiments by the Floating Zone method. AFEX is a multiuser image furnace which has the capability of in-situ observation of semiconductor crystallization and Marangoni convection by using X-ray radiography. The AFEX has a gold-plated ellipsoidal mirror. The sample placed in one focus of the mirror is heated and melted by the radiation from a 1500W halogen lamp, placed in another focus. With ceramic heaters attached around the sample, instead of the halogen lamp, the AFEX can perform isothermal heating experiments and thermal gradient control experiments. X-ray radiography (two axes), a sample monitor camera, an infrared thermometer, and five channel thermocouples allow observation and measurement of the samples.

Availability will be May 2005 after ISS assembly complete.

FPEF Fluid Physics Experiment Facility

The FPEF is used to conduct fluid physics experiments in a moderate temperature environment. In the microgravity environment, Marangoni convection, which is driven by the difference of surface tension, affects the behavior of convection. The main purpose of this facility is to investigate the effects of the Marangoni convection on space experiments (such as semiconductor crystal growth in the Floating Zone Method). Observing the Marangoni convection is considered to be a prerequisite for future techniques such as controlling Marangoni convection and applying Marangoni convection to remove air bubbles in liquids.

The FPEF's observation capabilities include two/three dimensional flow field observations, surface temperature measurement, ultrasonic velocity profile measurement and surface-flow rate observation. Currently, Marangoni convection research with a liquid bridge is supposed as standard experiment, and suitable experiment units are being developed for that purpose. Bubble

generation, heat transfer, liquid wettability, combustion and bubble behavior experiments are considered as feasible experiments using FPEF.

Availability will be May 2005 after ISS assembly complete.

SPCF Solution Protein Crystal Growth Facility

The SPCF can provide opportunities for fundamental study of crystal growth of various solutions and proteins in space. SPCF consists of two major units, the Solution Crystallization Observation Facility (SCOF) and the Protein Crystallization Research Facility (PCRF).

The SCOF has a cell cartridge for growing the crystal in solution. The temperature of crystal can be controlled. Moreover the SCOF provides the in-situ observation capability. The SCOF has several observation equipment, the two wavelength Mach-Zehnder interferometer microscope, the Michelson interferometer microscope and the light scattering measurement. They provide the capability to observe the crystallization morphology and the crystal surface and to measure the temperature of the liquid phase, the concentration distribution and the particle size.

The PCRF realize the protein crystal growth with real-time observation by CCD camera. Simultaneously, up to six protein crystal growth cartridges can be installed and can be selected with each arbitrary temperature profile. The sample cartridge could be designed to contain several cells. These two units can be operated independently as two separate facilities.

Availability will be May 2005 after ISS assembly complete.

IV. International Application Forms and Instructions for Proposal Preparation

This section contains the general instructions for proposal preparation and the specific forms required by proposers responding to agency solicitations for flight experiments in the microgravity sciences IAO for 2000. The forms at the end of this section include the following:

Form A	Solicited IAO Application
Form B	Proposal Executive Summary
Form C	Signature Page
Form D	Biographical Sketch
Form E*	Other Support
Form F*	Detailed Budget, First Year
Form G*	Summary Budget Projection
Form H	Distribution List
Form I	Checklist for Proposers

*Refer to your agency's solicitation for any specific requirements.

Instructions for Proposal Preparation

The proposal must include the following material, in this order:

(1) Cover Page: Solicited Proposal Application (Form A)
(2) Proposal Executive Summary (Form B)
(3) Project Signature Page (Form C)
(4) Distribution List (Form H)
(5) Project Description
(6) Management Approach
(7) Letter of Assurance of Foreign Support (if applicable)*
(8) Biographical Sketch (Form D)
(9) Other Support (Form E)*
(10) Supporting Budgetary Information (if applicable)*
(11) Detailed Budget, 12 Month (Form F)*
(12) Summary Budget Projection (Form G)*
(13) Facilities and Equipment
(14) Any other information required by the sponsoring agency*
(15) Checklist for Proposers (Form I)
(16) Appendices, if any
(17) Computer diskette (3.5 inch, Macintosh or PC format) containing an electronic copy of the principal investigator/team coordinator's name, address, telephone and fax numbers, e-mail address, and the complete project title and executive summary as provided on Form B.

*Refer to your agency's solicitation for any specific requirements.

Proposals must be written in English. The Project Description Section is limited to 20 pages. Any pages in this section beyond 20 will not be reviewed. The name of the Principal Investigator should appear in the upper right hand corner of each page of the proposal, except on the forms in this document where special places are provided for this information. Note that the proposal must specify the period of performance for the work described; periods of performance may be for any duration up to three (3) years but should be suitable for the project proposed.

A. Cover Page: Solicited IAO Application (Form A)

All of the information requested on Form A must be provided. The cover page should contain the project title, name and address of the submitting institution, the name, address and telephone number of the principal investigator/team coordinator, and the names and institutions of any co-investigators/team member. Proposers should refer to agency specific solicitations for instructions regarding additional information that should be included on the cover page(s).

B. Proposal Executive Summary (Form B)

The information requested on this form is essential to the review of the proposal. It determines how the application will be evaluated and which agency manager(s) will receive the final review materials for possible inclusion in one of the research programs of the agency.

C. Proposal Signature Page (Form C)

By signing this page, the primary participants in the research activities being proposed indicate their commitment to the proposed project. Other signatures may be required, on other forms, by the various agencies participating in the IAO. See the solicitation released by the agency to which you are responding to confirm that you are meeting their requirements.

D. Biographical Sketch (Form D)

A short biographical sketch of the Principal Investigator that includes his or her current position title and educational background, a list of principal publications, and a description of any exceptional qualifications must be included. Use Form D to describe the research and professional experience of each professional staff member. Concluding with present position, list, in chronological order, previous employment, experience, and honors. Include present membership on any government public advisory committee. List, in chronological order, the titles, all authors, and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. If the list of publications in the last three years exceeds two pages, select the most pertinent publications. Do not exceed two pages. Omit personal information that does not merit consideration in evaluation of the proposal. Provide similar biographical information on other senior professional personnel who will be directly associated with the project. Provide the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

E. Project Description

The length of the Project Description section of the proposal should not exceed 20 pages using regular (12 point) type, using 8 ½" x 11" or A4 size paper. Any pages beyond 20 will not be reviewed. The proposal should contain sufficient detail to enable a reviewer to make informed judgments about the overall merit of the proposed research. The proposal should identify specific aims of the project, and demonstrate that the investigators will be able to accomplish their stated objectives with the resources requested and with their own resources. The proposal should indicate clearly the relationship between the proposed work and the research emphases defined in the agency specific solicitations. The proposal should describe the position of the proposed research in the context of the current research in the field.

F. Management Approach

Scientists active in the same research field may consider it beneficial to adopt a coordinated or collaborative approach to the definition, preparation and execution of space experiments. This approach is of clear relevance if the experiments require, for example, the development of a modular insert for one of the facilities proposed for utilisation in this IAO. In this case, the team can submit a proposal encompassing the joint definition, specification and utilisation of a dedicated insert for, e.g., multiparametric investigations. Such an approach may result in a higher yield of scientific results and, thereby, an optimised scientific return on the investment made in the development and flight on ISS of any insert.

Each team member who contributes to the project must then have clearly identified in the proposal his tasks and responsibilities in reaching the global objectives set by the team. All team members must sign the signature page. The funding each team member requests from his sponsoring agency for performing the tasks he is responsible for must be clearly defined in the proposal, using the specific form of this particular agency.

A single team coordinator must be agreed upon by the team members. He is responsible for submitting the proposal to the IAO through the participating agency that represents him. He becomes the contact point to the whole team with the responsibility of coordinating the activities of and inputs needed from the team related to the project.

Alternatively, proposals must specify a single principal investigator who is responsible for carrying out the proposed project and coordinating the work of other personnel involved in the project. In proposals that designate several senior professionals as key participants in the research project, the management approach section should define the roles and responsibilities of each participant, and note the proportion of each individual's time to be devoted to the proposed research activity. The proposal must clearly and unambiguously state whether these key personnel have reviewed the proposal and endorsed their participation.

G. Facilities and Equipment

Describe the available facilities and major items of equipment specially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any

government-owned facilities, industrial plant equipment, or special tooling that are proposed for use on the project. The need for items that can be typically used for research and non-research purposes should be explained.

H. Other Support (Form E)

This form describes the other research support currently active or pending decisions, for the principal investigator/team coordinator and other senior project scientific participants.

It should be clear that the work described in the submitted proposal is new and not being supported by other sources, and that the senior scientific participants are available for their proposed time commitments. Not all participating agencies can ask for this information. Refer to your agency's solicitation to determine what information should be provided.

I. Detailed Budget, First Year (Form F)

J. Summary Budget Projection (Form G)

Not all participating agencies can ask for the information requested on these forms. Refer to your agency's solicitation to determine what information should be provided.

Direct Costs - Please detail, explain, and substantiate other significant cost categories as described below:

a) Subcontracts: Describe the work to be contracted, estimated amount, recipient (if known), and the reason for subcontracting.
b) Consultants: Identify consultants to be used, why they are necessary, the time they will spend on the project, and the rates of pay.
c) Equipment: List separately. Explain the need for items costing more than $5,000. Describe basis for estimated cost. Any equipment purchase requested to be made as a direct charge under this award must include the equipment description, how it will be used in the conduct of the basic research proposed, and why it cannot be purchased with indirect funds.
d) Supplies: Provide general categories of needed supplies, the method of acquisition, and estimated cost.
e) Travel: Describe the purpose of the proposed travel in relation to the grant and provide the basis of estimate, including information on destination and number of travelers where known.
f) Other: Enter the total of direct costs not covered by a) through e). Attach an itemized list explaining the need for each item and the basis for the estimate.

Indirect Costs - Indirect costs should be explained to an extent that will allow the agencies to understand the basis for the estimate.

K. Distribution List Form (H)

This form indicates which agencies are being requested to support parts of the project, and therefore are receiving copies of the proposal. Every agency from which support is being

requested must receive the proposal, and the proposal each agency receives must meet its requirements.

L. Checklist for Proposers (Form I)

One copy of a completed version of this checklist should be attached to the transmittal letter.

M. Appendices

Some facility descriptions on the internet include a form that allows for the assessment of the suitability of this facility for performing the proposed experiment. When provided, a completed copy of this form will be used in the technical evaluation of your proposal.

N. Computer Diskette

A diskette (3.5 inch, Macintosh or PC format) should contain an electronic copy, Rich Text Format, of the Principal Investigator/Team coordinator's name, address, telephone and fax numbers, e-mail address, and the complete Project Title and Executive Summary as provided on Form B.

NASA Announcement of Opportunity (AO) Mailing List Update

This is the form to update information for the NASA Office of Biological and Physical Research(OBPR) mailing list. Please fill out ***CONTACT INFORMATION*** *completely. Check only those that apply in* ***INSTITUTION TYPE*** *and* ***PROGRAM AREAS/DISCIPLINE. Fold the form, secure with tape (do not staple), and mail it back to the address on the reverse.***

Proper postage must be applied.

Mailing list updates may also be submitted electronically via E-Mail or World Wide Web to the following addresses:
E-Mail: noi@hq.nasa.gov
World Wide Web: http://peer1.idi.usra.edu/

Check one:

- ☐ 1. Please **add** my name to the mailing list.
- ☐ 2. Please **remove** my name from the mailing list (please attach mailing label).
- ☐ 3. Please **change** my current listing (please attach mailing label).
- ☐ 4. Please leave my current listing unchanged (please attach mailing label).

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If your address has changed or your mailing label is incorrect, please provide COMPLETE contact information

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Name, First: _____ **Last:** _____

Position Title: _____

Mail Code, Loc: _____

Office, Dept, Div: _____

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Org (Agency/Ctr, Univ): _____

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Street or PO Box: _____

City: _____ **State:** _____

Zip Code: _____ **Country:** _____

Telephone No: _____ **Fax No:** _____

Internet/E-Mail: _____

Institution Type

(check all that apply)

- ☐ 1. College or University
- ☐ 2. Minority College or University
- ☐ 3. Minority Business
- ☐ 4. NASA Center
- ☐ 5. Other Government Agency
- ☐ 6. Nonprofit Corporation
- ☐ 7. Small Business
- ☐ 8. Private Industry
- ☐ 9. Foreign Addressee

Program Areas/Disciplines

(check main area of interest)

☐ **1. Life Sciences**

- ☐ A. Advanced Life Support
- ☐ B. Advanced Technology Development
- ☐ C. Data Analysis
- ☐ D. Environmental Health
- ☐ E. Space Biology
- ☐ F. Space Human Factors
- ☐ G. Space Physiology & Countermeasures
- ☐ H. Space Radiation Health

☐ **2. Microgravity Sciences**

- ☐ A. Biotechnology
- ☐ B. Combustion Science
- ☐ C. Fluid Physics
- ☐ D. Fundamental Physics
- ☐ E. Materials Science

☐ Please send me notifications of announcements via E-Mail only.

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