

## A.2.4 ORIGINS OF SOLAR SYSTEMS

### 1. Scope of Program

This program element solicits basic research proposals (1) to conduct scientific investigations related to understanding the formation and early evolution of planetary systems, (2) to provide the fundamental research and analysis necessary to detect and characterize other planetary systems, and (3) to define the necessary scientific performance of possible future space missions that would perform spectroscopy of extra-solar planets. These investigations may involve analytical and numerical modeling, laboratory research, and observational studies in the following areas: star formation and the relationship to planetary system formation, solar nebula processes, accumulation and dynamical evolution, analysis of primitive materials, and the detection of other planetary systems. The investigations supported through this NRA should directly support the goals related to understanding planetary system formation.

For example, key questions addressed by the research activities supported by this program may include: What was the initial mass, structure, motions, and temperature of the solar nebula and the time scales over which planets formed? What are the conditions of star formation that lead to a single star surrounded by a protoplanetary disk? How was angular momentum transported in the nebula? What determined the masses of the giant planets? By what mechanism did the most primitive bodies in the solar system accumulate? What factors influence the growth of planetary embryos into planets? What processes were responsible for the patterns of chemical fractionation observed in the primitive meteorites and the volatile abundances in the planets? What is the frequency of the occurrence of planetary systems? Also included under topic (1) are questions for which modeling or numerical simulation are appropriate, for example: Under what conditions are multiple-planet systems stable? How do giant planets evolve due to interactions with remnant disks? What effects do planetary systems have on zodiacal and Kuiper belt dust disks?

The development of scientific requirements for future space missions to study extra-solar planets (objective (3) above) may include ground-based observing programs, theoretical studies, and modeling. These efforts should be directed toward eventually establishing a firm set of requirements that should be met by a future spectroscopy mission to study extra-solar planets. Observing programs that characterize planetary systems and their environments are included, such as radial-velocity (Doppler) monitoring of stars, microlensing, planetary transits, astrometry, direct imaging, and imaging and spectroscopy of circumstellar disks. Archival research using databases from ground surveys and space missions may also be proposed to address objective (3).

Studies of specific instrument architectures for a spectroscopy mission to study extra-solar planets are not solicited in this NRA. However, proposed observing, modeling, and theory programs should contribute to defining the ‘scientific context’ for such a future mission by guiding the eventual selection of key parameters including required spectral

resolution, spatial resolution, sensitivity, optimal waveband, contrast ratio, background rejection, and observing strategies. The implications of these parameters for interpreting possible biomarkers may be considered, but detailed modeling of biological systems in various physical and chemical regimes is outside the scope of this program element. Modeling of the formation, evolution, and dissolution of exozodiacal disks would also be relevant to the scientific specification of future missions to study planets and their environments.

This Origins program realizes the existing potential for complementary interdisciplinary efforts to solve key scientific questions. To achieve this goal, proposals are encouraged that involve joint research efforts by investigators from different scientific communities. Interdisciplinary investigations may include, for example, studies of nebular chemistry and dynamics to understand the composition of primitive volatile-rich solar system bodies, or collaborations between observational astronomers and modelers to study the initial collapse of a protostellar cloud to form a nebula. Proposals that involve joint efforts may be submitted as separate proposals from participating institutions for each of their respective part of the investigation or as an a single all inclusive proposal. With respect to all-inclusive proposals, proposers should keep in mind that it is the OSS policy that all subcontracts for work at an institution other than the lead institution must be handled by the lead institution (See section 2.3.10 of the NASA Guidebook for Proposers: web address given in material entitled “Important Information” in Section 2 below).

Proposals for topical conferences, workshops, symposia, or other new initiatives related to the Origins program are also solicited through this NRA. For more information about the type of research supported by this program, abstracts for currently funded investigations are available at <http://spacescience.nasa.gov/codesr/welcome.html>.

## 2. Programmatic Information

It is estimated that the funding level for this program for fiscal year 2003 will be approximately \$6.7M and that this level of funding will support approximately 105 research investigations, including both new proposals and in-progress multiple year proposals. Awards under this NRA are subject to the availability of program funds.

Of this \$6.7M, approximately \$2.5M will be used to support searches for extrasolar planets. It is expected that the total support for extrasolar planet studies will increase in fiscal years 2004 and 2005 through funding new proposals with durations of 2 or 3 years. A range of contract sizes is expected, with the largest contract no larger than about \$500K per year. For administrative purposes the search for extrasolar planet investigations will be managed by the Astronomy and Physics Division.

Under objective (3), long-term programs (more than 3 years) will be considered, based on demonstrated scientific requirements. Investigators are especially encouraged to consider how effective use of small telescopes worldwide may be used to further the scientific

goals described above under this objective that might include the provision of new instrumentation or creative arrangements to ensure long term operations support for these investigations. For long term programs, investigators should consider proposing 'pilot' studies initially, including in their proposals an outline of the long-term plan and how the pilot program will be used to confirm its viability. Note also that NASA procurement policy requires that grants having a period of performance longer than 3 years be reviewed at 3 year intervals through the submission of a full proposal for the remaining work.

Status Reports: Holders of existing, multiple year awards in this Program Element that are entering their second or third year of a three-year award from a previous NRA must submit a Status Report (previously called an Annual Report). This Status Report should cover the progress made toward completing the originally proposed research since the initiation of the award or last year's deadline for new proposals, whichever came last. This Status Report is due by the same deadline as that for new proposals for this program element (see Table 1 or 2 in the Summary of Solicitation of this NRA). These Status Reports will be screened by the same peer review panel that will be convened to review new proposals as an aid to NASA's evaluation of existing awards. Such a Status Report should not exceed three single-spaced, typewritten pages with roughly two pages used for a description of the progress made during the previous period and the remainder for a statement of the work planned for the coming year (Note: this three page limit does not include references, figures, reprints, or appendices). The Status Report should be prefaced by a new electronic proposal Cover Page submitted through the Web at the same site specified for new proposals in the Summary of Solicitation of this NRA (Note: the home page for this program element will provide the option to designate whether the Cover Page is for a new proposal or for a Status Report). Any request for an augmentation to the budget relative to the current approved funding level must be supported by detailed information in conformance with Section 2.3.10 of the NASA Guidebook for Proposers. Submission of hard copies of the Status Report must include an original plus four copies. Also note that it is expected that within a year a new electronic proposal data system that is now under development will begin to automatically notify holders of existing awards 75 days in advance of their award's anniversary date to submit the Annual Progress Report that is required to implement the next funding supplement of their award. The conflict of possibly calling for two reports per year for existing awards in this Program Element will be resolved at that time.

## **IMPORTANT INFORMATION**

As discussed in the *Summary of Solicitation* of this NRA, the Office of Space Science (OSS) is now using a single, unified set of instructions for the submission of proposals. This material is contained in the document entitled *NASA Guidebook for Proposers Responding to NASA Research Announcement – 2001* (or *NASA Guidebook for Proposers* for short) that is accessible by opening URL <http://research.hq.nasa.gov>, and linking through the menu item "Helpful References," or may be directly accessed online at URL

<http://www.hq.nasa.gov/office/procurement/nraguidebook/>. This NRA's Summary of Solicitation also contains the schedule and instructions for the electronic submission of a *Notice of Intent* (NOI) to propose and a proposal's *Cover Page/Proposal Summary*, which now also includes the required *Budget Summary*, and the mailing address for the submission of a proposal.

Questions about this program element may be directed to the cognizant Discipline Scientist:

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