

## B.9 VIRTUAL OBSERVATORIES FOR HELIOPHYSICS DATA

### 1. Scope of Program

#### 1.1 Background

The new challenges in solar and space physics, including linking solar phenomena to human consequences as studied in NASA's Living With a Star (LWS) program, will require unprecedented integration of data and models across many missions, data centers, agencies, and countries. Accomplishing this requires a coordinated effort to link data and service providers to scientific users through software that uses descriptions of resources in a largely universal language to give a uniform face to an underlying heterogeneous and distributed set of sources.

The Virtual Observatories for Heliophysics Data program solicits proposals to develop, demonstrate, and enhance prototypes of software applications generally known as virtual observatories.

*“A Virtual Observatory (VO) is a suite of software applications on a set of computers that allows users to uniformly find, access, and use resources (data, software, document, and image products and services using these) from a collection of distributed product repositories and service providers. A VO is a service that unites services and/or multiple repositories.”<sup>1</sup>*

This program particularly targets the integration of the many data services for solar and space physics data necessary to the conduct of research in the Heliophysics field. A secondary part of this program permits holders of Heliophysics data to propose for grants to upgrade or maintain their data services in order to participate in one of the several VxOs<sup>2</sup> either in existence or proposed.

Background information on the Heliophysics data environment, virtual observatories, and the move to provide VOs to the Heliophysics research community can be found at <http://lwsde.gsfc.nasa.gov/>. Attention should be given to the presentations and report from the *Space and Solar Physics Virtual Observatories Workshop* held on October 27-29, 2004, and the kickoff meeting of the 2006 VxO awardees, held on May 22, 2006. This information is located at the same site.

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<sup>1</sup> From A. Roberts, “VO Framework,” presented at the Virtual Observatories in Space and Solar Physics Workshop, Greenbelt, Maryland; October 27, 2004. See [http://lwsde.gsfc.nasa.gov/vo\\_workshop\\_papers.html](http://lwsde.gsfc.nasa.gov/vo_workshop_papers.html).

<sup>2</sup> The ‘x’ in VxO denotes a virtual observatory for the ‘x’ scientific community in the Heliophysics research field. Examples would include VSO for the Virtual Solar Observatory, VMO for a Virtual Magnetospheric Observatory, etc.

## 1.2 Virtual Observatories

A proposed VxO should focus on a specific research community and target that community's data repositories and services. The construction of a VxO is to provide for significant enhancement to the abilities to conduct research by members of that community. More specifically, a VxO should:

- Provide coordinated discovery and access to data and service resources for a specific scientific discipline by:
  - Identifying relevant data sources and appropriate repositories,
  - Allowing queries that yield data granules or pointers to them,
  - Providing a user interface to access resources both through an application program interface (API) (or equivalent machine access) and a Web browser application, and
  - Being able to accommodate a wide range of provider types, as needed.
- Understand the data needs of its discipline area by:
  - Recruiting potential new providers,
  - Providing support and "cookbooks" for easy incorporation of providers,
  - Helping to assure high data quality and completeness of the product set, and
  - Resolving issues of multiple versions of datasets.
- Provide documentation for metadata that:
  - Sets standards for metadata and query items,
  - Assists providers and review metadata,
  - Maintains a global knowledge of data availability, and
  - Possibly maintains collection-catalog metadata.
- Provide an API or other means for the VxO to appear to others as a single provider.
- Potentially provide value-added services for data handling and manipulation (can be done by providers or elsewhere) such as:
  - Data Subsetting,
  - Averaging,
  - Filtering,
  - Merging, and
  - Format Conversion.
- Provide access to event lists and ancillary data.
- Collect statistical information and community comments to assess success.

The VxO should access data from NASA's science missions, including those with which NASA has international partnerships. NASA recognizes that the use of collaborative data from space sensors or ground observations sponsored by other sources such as the U.S. Government or international agencies may be important and necessary to support many types of research. Therefore, the incorporation of collaborative data services is appropriate, so long as it is clearly demonstrated that the proposed VxO will primarily be a service portal to data from NASA's Heliophysics missions.

Since there are number of VxOs in existence or under development, proposers are expected not to propose to duplicate these. Proposers are encouraged to consult <http://lwsde.gsfc.nasa.gov> for background on the scope of existing activities, and to contact these groups for further information. While the emphasis in selections will be on uniform access to data, compelling proposals primarily offering clearly new value-added services, well coordinated with VxO efforts, are encouraged.

The Heliophysics data program strives to foster collaboration and communication amongst the several nascent VxOs. While it is the responsibility of a selected VxO team to serve the science needs of its focused community, the teams should also plan on participating in one technical meeting and/or workshop per year to develop cross-VxO coordination and technical linkage. These meetings and workshops will share the status of VxO investigations and exchange ideas and lessons learned. Furthermore, newly selected VxO teams will be expected to join and participate in ongoing electronic-based discussions among the established VxO teams.

### 1.3 Data Services Upgrades and Maintenance

Also solicited by this program are proposals designed to upgrade existing Heliophysics data repositories to improve the accessibility of data sets relevant to the Heliophysics research, in general, as well as to become a data provider to a VxO. Relevant tasks could include (but are not limited to) placing data sets on-line, translating data sets into more readily accessible formats, improving the data quality, providing data access and interpretation tools, improving metadata, and otherwise improving the interface of the data service to an existing or proposed VxO. Note that the term data set can apply not only to data products derived directly from NASA-funded instruments or other instrumentation, but also to higher-level data sets derived from the results of data analyses, data assimilation, and modeling. We are also soliciting proposals to maintain existing data services featuring data from Heliophysics missions that have terminated or will soon terminate – the so called “resident archives.”

### 1.4 General Scope

This program seeks improvements to the Heliophysics data environment through specific activities described in sections 1.2 and 1.3 above. Note that there are programs advertised in this NRA that have provided opportunities to improve the Heliophysics data environment, for example, the Living With A Star Targeted Research and Technology program (see Appendix B.7 of this NRA), and the Applied Information Systems Research program (see Appendix E.2 of this NRA).

## 2. Programmatic Considerations

### 2.1 Virtual Observatory Proposals

Periods of performance from one to three years may be proposed as appropriate to the nature of the contemplated investigation. It is expected that approximately \$800K will be

available in Fiscal Year 2009 to support two or three new investigations. As noted above, proposals should be clearly complementary to ongoing efforts.

A VxO proposal must discuss the relationship of the proposed VxO to the present, as well as anticipated, state of knowledge in the field, to the anticipated readiness of needed technologies, to the relevant data sets that should be available from any related planned missions, and to any related NASA community research efforts.

The proposal should address the following major characteristics of the proposed VxO:

1. Science Rationale
  - a. key objectives
  - b. relationship to NASA strategic plans
  - c. uniqueness or scientific advantages of the proposed approach compared to alternatives
2. Architecture and Implementation Approach
  - a. VxO architecture
  - b. science instrumentation supported
  - c. other scientific data accessed
  - d. infrastructure and constraints assumed in place at the time of implementation
  - e. compatibility with other VxOs and the SPASE Data Model<sup>3</sup>

Key elements within the scope of this initial effort should include, but are not limited to:

- Assessment of community needs
- Identification of means to get community involvement
- Identification of means to get community acceptance
- Identification of potential and viable VxO data sources
- Formulation of the technical approach for the VxO
- Identification of necessary services, resources, and tools the VxO needs to provide both initially and in the future as add-on capabilities
- Identification of requirements for data providers

The proposers will be expected to demonstrate, among other things:

- Prototype user interface query mechanism(s)
- Extensible communication with other VxOs
- Implementation of a prototype which will provide a small subset of the postulated VxOs functionality

The proposal must provide a detailed statement of the work to be undertaken over the period of performance to develop and demonstrate the VxO concept and include a summary schedule for completing the proposed work.

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<sup>3</sup> See <http://lwsde.gsfc.nasa.gov/> and references contained therein for more information on the SPASE Data Model.

The titles of proposals submitted to this portion of the NRA must contain the words “VxO for Heliophysics Data.” The Scientific/Technical/Management Section (including figures) of proposals submitted to this portion of the NRA should be no more than 20 pages.

## 2.2 Data Services Upgrades Proposals

In addition to the opportunity described above, funds are also available to support about eight small (~\$30–50K), short-term (one year) awards to improve the accessibility of data sets relevant to the Heliophysics research, in general, and specifically could become a data provider for a VxO. Note that priority will be given to those proposals from data providers of NASA-sponsored data sets.

The titles of proposals submitted to this portion of the NRA must contain the words “Data Services Upgrades.” The Scientific/Technical/Management section (including figures) of proposals submitted to this portion of the NRA should be no more than five pages.

## 2.3 Data Services Maintenance Proposals

This is a new feature of the Heliophysics Virtual Observatory program. Funds are available to support about two to four awards (~\$50–150K each) for up to three years starting in FY 2009 to maintain existing data services, the so-called “resident archives.” A resident archive (RA<sup>4</sup>) was created by the members of a once-active mission and is continuing to serve mission data or a subset of a mission’s data (e.g., data products for a single instrument) after the mission ended. This arrangement is intended to keep those most familiar with the data and its caveats involved such that a user will have access to expert assistance in using the data for research.

The proposal must demonstrate that the data services provided by the resident archive are vital to ongoing Heliophysics research activities or will be important to future research activities. Those resident archives that are or will be accessed via one or more virtual observatories will be given preferential treatment.

The data services to be maintained include the open, electronic distribution of RA data, the serving of the metadata for the RA data sets, the provision of documentation describing the resident data including calibration and validation procedures and methodologies. The maintenance of RAs includes ensuring adequate security is provided to preclude the irreversible loss of mission data. Limited user support, whether the user is a virtual observatory or a general member of the research community, is expected to be provided at a level commensurate with the budget limitations. The resident archive should include software tools with user documentation needed for accessing and displaying the resident data.

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<sup>4</sup> More information on the topic of Heliophysics resident archives may be found at <http://lwsde.gsfc.nasa.gov/>.

Items that are not to be proposed would be the generation of significant upgrades to the data set, reprocessing data, data processing algorithms, or new data products derived from the resident data. These types of postmission data activities need to be funded from other sources. On the other hand, maintaining an RA could include “loading” newly derived data products into the archive with appropriate changes to metadata, documentation, Web interfaces, etc.

The proposal should maintain reserves such that, if the RA maintenance award is not renewed or merged under another RA structure, the RA would be responsible for delivering its holdings to the National Space Science Data Center (NSSDC).

The titles of proposals submitted to this portion of the NRA must contain the words “Resident Archive Services.” The Scientific/Technical/Management section (including figures) of proposals submitted to this portion of the NRA should be no more than 10 pages.

#### 2.4 Summary of Key Information

Expected annual program budget for new awards	See Sections 2.1, 2.2, and 2.3.
Number of new awards pending adequate proposals of merit	See Sections 2.1, 2.2, and 2.3.
Maximum duration of awards	See Sections 2.1, 2.2, and 2.3.
Due date for Notice of Intent to propose (NOI)	See Tables 2 and 3 in the <i>Summary of Solicitation</i> of this NRA.
Due date for proposals	See Tables 2 and 3 in the <i>Summary of Solicitation</i> of this NRA.
NASA strategic objective(s) which proposals must state and demonstrate relevance to	Every proposal must address one or more strategic goal(s) or strategic outcome(s) from Table 1. See also Sections I(a) and IV(e) in the <i>Summary of Solicitation</i> of this NRA.
General information and overview of this solicitation	See the <i>Summary of Solicitation</i> of this NRA.
Detailed instructions for the preparation and submission of proposals	See the <i>NASA Guidebook for Proposers Responding to a NASA Research Announcement – 2007</i> at <a href="http://www.hq.nasa.gov/office/procurement/nraguidebook/">http://www.hq.nasa.gov/office/procurement/nraguidebook/</a> .
Page limit for the central Science-Technical-Management section of proposal	See Sections 2.1, 2.2, and 2.3. See also Chapter 2 of the <i>NASA Guidebook for Proposers</i>

Submission medium	Electronic proposal submission is required; no hard copy is required. See also Section IV in the <i>Summary of Solicitation</i> of this NRA and Chapter 3 of the <i>NASA Guidebook for Proposers</i> .
Web site for submission of proposal via NSPIRES	<a href="http://nspires.nasaprs.com/">http://nspires.nasaprs.com/</a> (help desk available at <a href="mailto:nspires-help@nasaprs.com">nspires-help@nasaprs.com</a> or (202) 479-9376)
Web site for submission of proposal via Grants.gov	<a href="http://grants.gov">http://grants.gov</a> (help desk available at <a href="mailto:support@grants.gov">support@grants.gov</a> or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH07ZDA001N-VxO
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