B.13 HELIOPHYSICS PHASE I DRIVE SCIENCE CENTERS

NOTICE: Amended March 11, 2019. To permit NASA adequate time to carefully review the larger than expected number (44) of Step-1 proposals, the Step-2 due date for this program has been delayed to June 20, 2019.

Amended January 30, 2019. The proposal due dates for this program element were previously temporarily changed to "TBD" as a result of the partial government shutdown. This amendment releases new due dates for the effected program elements in Appendix B. ~~For this program element the new Step-1 due date is March 1, 2019 and the new Step-2 due date is May 2, 2019~~.

~~Amended December 18, 2018. This amendment delays the due dates for this program element. Step-1 proposals are now due February 1, 2019, and Step-2 proposals are due April 5, 2019~~

Amended November 30, 2018. This amendment presents final text for this program element, which was previously released as a draft for community comment. ~~Step-1 proposals are due January 15, 2019, and Step-2 proposals are due March 5, 2019~~. A FAQ will posted on the NSPIRES page for this program element under "Other Documents".

This program element will take proposals for Phase I Drive Science Centers by a two-step process, in which a Step-1 proposal submitted by an Authorized Organizational Representative (AOR) is required. Only proposers who submit a Step-1 proposal are eligible to submit a Step-2 proposal. Step-1 proposals will be checked for compliance and proposers encouraged or discouraged from submitting Step-2 full proposals based on internal review. Step-2 proposals will be evaluated by a review panel with input where appropriate from external reviewers, along with a uniform limited "request for clarification" step to all PIs as part of the review process. See Section 9.1 for details.

1. Introduction

DRIVE Science Centers (DSCs) are part of an integrated multi-agency initiative, DRIVE (Diversify, Realize, Integrate, Venture, Educate), put forward as a high priority recommendation of the 2013 Solar and Space Physics Decadal Survey. DSCs, which fall under the "Venture" aspect of the DRIVE initiative, address grand challenge goals that are both ambitious and focused enough to be achievable within the lifetime of the center - in other words, problems poised and ready for major advances. This program is intended to support science that cannot be effectively done by individual investigators or small teams, but requires the synergistic, coordinated efforts of a research center. In order to maximize the potential for these science centers to deliver on innovative and breakthrough science, they are expected to include aspects in their design that support collaboration and deep knowledge integration across the full range of expertise (scientific, computational, educational) within them, as recommended in a recent report by the National Academy of Sciences, *Enhancing the Effectiveness of Team Science*. With this motivation, NASA and NSF joined forces to design a DSC program implemented in this ROSES-18 program element by NASA, that takes advantage of lessons learned from ongoing and past science centers and the growing body of information on team science.

The DSC Program is two-phase. This program element solicits only Phase I DSCs proposals. Solicitation for Phase II DSCs proposals will be seperate. 2-year grants that result from Phase I proposals funded in FY 2019 may seek funding in FY 2021 by the submission of a proposal to the anticipated follow-on Phase II DSC solicitation. Some examples of appropriate Phase I DSC activities are given in Section 4.

2. Scope of the Program

2.1 Challenges and Goals

Exciting discoveries in Solar and Space Physics over the past decade have produced spectacular insights and provide a base upon which to pursue transformative advances in the next decade. A selection of recent major advances is presented in the 2013 Solar and Space Physics Decadal Survey. As described in this survey, the emerging view of the interactions within and between elements in the solar and space physics domains (Sun, Heliosphere, Geospace, the Earth's upper atmosphere, and other planetary space environments) is that of a complex and nonlinear pattern of multiple causes feeding into large-scale responses. Some of the most challenging problems are centered on aspects of these interconnections. Progress requires "a deep understanding of multiple connected physical systems" motivating "a sea change in the way breakthrough science is done".

2.2 Operating Principles

The program described in this Program Element combines inputs from a variety of sources, including: (1) the NASA Heliophysics Advisory Committee, (2) the Committee on Solar and Space Physics (CSSP) of the National Academy of Sciences, (3) the Heliophysics community through a previously released RFI NNH17ZDA008L, and (4) documents describing the practices and structure of six other NASA and NSF Center programs augmented by discussion with a variety of center directors. Much of the information from sources (1)-(3) is contained in the following reports:

Solar and Space Physics: A Science for a Technological Society,
Enhancing the Effectiveness of Team Science,
Committee on Solar and Space Physics: Heliophysics Science Centers,
Portfolio Review of the NSF Geospace Section,
Advanced Computational Capabilities for Exploration in Heliophysical Science (ACCEHS) ,
AAAS Review of the NSF Science and Technology Centers Integrative Partnerships (STC) Program 2000-2009, and
NASA Heliophysics Science and Technology Roadmap 2014-2033.

The following basic principles underlying the design of the DSCs, derived from these sources, are:

- Transformative results are best pursued by:
  - Openly competing science objectives
  - Giving proposers as much freedom as possible to define tools, methods, team composition and management
  - Requiring metrics and making their evaluation part of the proposal selection process
  - Limiting renewals, expecting significant progress or solutions in the DSC primary lifetime. This enables DSCs to be used as agile tools for addressing pressing strategic research problems as they emerge.
- Centers play a major role in enabling interdisciplinary science and innovative approaches
- Centers create a rich environment that provides valuable research and educational experiences for the broader community (visiting scientist programs, workshops, summer schools, etc.)
- Research in centers has a strong potential for positive societal impacts
- The unique capabilities presented by DSCs augment and do not replace, existing research programs in Solar and Space Physics
- The existence of multiple simultaneous centers introduces opportunities for enriching scientific discovery through cross-center interactions

2.3 Features of a Successful DSC

The characteristics of a successful DSC, include:

- the potential for breakthrough science within its 5-year lifetime
- a talented, diverse, multi/inter/trans-disciplinary, and fully integrated team to execute the research program
- empowered leadership that will define and manage all research tasks to realize the research center's vision,
- a supportive infrastructure and management system; adequate personnel commitments to manage the research program and interact with outside entities
- creative, substantive activities aimed at enhancing education, diversity, and public outreach
- potential for impacts on other field(s) and/or benefits to society
- a synergy or value-added rationale that justifies a center- or institute-like approach.

Successful centers tackle challenges of large scope and impact, producing transformative research leading to innovation and enhanced scientific returns. DSC awards bring researchers with shared and complementary interests into productive contact to foster synergy, potentially transformative research, and innovation.

3. Foundational Elements of a DSC

DSC awards support the formation and development (Phase I) or the sustained funding (Phase II) of research centers that can address major research challenges in Solar and Space Physics. Some detailed examples of Phase I activities are provided in Section 4. The most important elements to consider in the planning and extended operation of a DSC (Phases I and II) are described below:

3.1 Synergistic Research

DSCs are built around a compelling research challenge. The proposed research must be ambitious and potentially transformative. Research topics are selected through open competition based on their significance and alignment with NAS Decadal Survey goals. Many of the most exciting questions at the very edge of current understanding are strongly interdisciplinary in scope and require the merging of perspectives from different parts of the heliophysics community and possibly other discipline areas. The DSC Program is intended to support science that cannot be effectively done by individual investigators or small teams, but requires the synergistic, coordinated efforts of a research center. The potential for synergy is explicitly evaluated during the review process. A lesson learned from existing center programs at NSF and NASA is that "Major advances occur when scientists who would not normally work together are brought together."

Developing a distinct and distinctive science portfolio is essential for any DSC. However, members of the team requesting DSC funding may already have, or choose to apply for, funding outside the context of the DSC funds. Overlap in focus of existing grants with the DSC overarching science goals can provide leveraged benefits as long as the research is synergistic and not duplicative. If an existing grant is related to the objectives of the proposed DSC, it is critical to demonstrate in the proposal that the research for which DSC funds are requested is connected to the collaborative grant activity (both center and individual grants) in such a way as to foster progress that would not be realized in the absence of the synergy provided by the DSC effort. If members of the science team apply for additional support from other programs after the DSC is operative, these proposals are required to demonstrate that this new work is unique and not already funded as part of the DSC grant.

3.2 Data Availability

If the proposed methodology involves the use of anticipated data sets not yet available, a contingency plan must be presented to address how the research will be carried out in the event these data sources do not materialize or are significantly delayed. Proposed research must be achievable with currently available data sets alone.

With respect to data not publicly available at the time of the proposal submission, NASA data policy (*NASA Plan: Increasing Access to the Results of Scientific Research)* requires data sharing and preservation in order to enable validation of results, or a plan for how results could be validated if data are not shared or preserved. This plan must be included as part of the Data Management Plan (see Section 7.2.5).

3.3 Formation of High-Functioning Science Teams

High functioning teams for this call include multi/inter/trans-disciplinary teams that require a center environment to effectively address the science goals of the proposed DSC.

3.3.1 *The Need for Science Teams*

Research efforts that span a broad range in size and scope contribute significantly to pushing forward frontiers in Solar and Space Physics. Individual investigators and small research groups have always provided a large component of this progress and continue to do so. However, as knowledge of the space environment grows so does appreciation of its complexity. Progress on some of the most compelling questions draws on the perspectives of multiple discipline areas and requires the close interaction between team members, which may include modelers, theoreticians, laboratory experimentalists, computer scientists, and observers. Coherent attacks on these scientific frontiers require multi/inter/trans-disciplinary teams and more resources than are normally available to individual investigators or small groups. Such activities may take new research directions and involve considerable risk. They combine research tools such as models, observational techniques, high performance computing, and others in synergistic ways to achieve the desired outcome. DSCs will facilitate the formation of the needed diverse teams, supporting multi/inter/trans-disciplinary science in a way that is uniquely cross-cutting.

Note: Proposals that have as their primary objective instrument development, CubeSat and balloon flights, or sounding rockets are out of scope. Proposals for those investigations are better suited for ROSES element Heliophysics Technology and Instrument Development for Science.

3.3.2 *Team Formation Risk Factors*

Team formation is the process by which all necessary disciplines, skills, perspectives, and capabilities are brought together. Successful teams are interdependent, multidisciplinary, and diverse and can work and communicate effectively even when geographically dispersed. Team formation includes strategies to overcome barriers to effective, dynamic teaming, including the integration of members with different areas of expertise, different vocabularies and ways of approaching problems, different understanding of the problems to be addressed, and different working styles. DSCs may partner with researchers from academia, commercial entities, government laboratories, and international organizations forming broader teams with more diverse viewpoints.

Following experiences from more than 40 Science and Technology Centers and the availability of a burgeoning amount of information on the "science of team science", the National Research Council undertook a study of the factors associated with successful and effective center experiences. As described in the report *Enhancing the Effectiveness of Team Science*, the science of team science is "concerned with understanding and managing circumstances that facilitate or hinder the effectiveness of collaborative research, including translational research." Although DSCs will potentially bring increased scientific expertise, advances in computing, and the latest data integration and analysis technologies to a critical research question, as pointed out by the NRC report, the synthesis and deep knowledge integration that is an essential part of this process increases the time needed for communication and coordination among team members. The structure and/or environment within the center can actually enhance this integration or throw up roadblocks that decrease the "hoped-for" science impact. If these aspects are not addressed adequately, risk is introduced that may affect the Center's abilities to fully achieve its stated goals. A major recommendation is that solicitations "[r]equire authors of proposals for team-based research to include collaboration plans and, for interdisciplinary or transdisciplinary projects, specify how they will foster deep knowledge integration over the life of the research project." In addition, the NRC report provides a series of recommendations aimed at researchers, center managers, and funding agencies that address "human-centered" challenges associated with team science centers.

3.4 Center Communication Challenges

For the most part, science questions that are complex enough to justify a value-added center approach involve a set of multidisciplinary skills that may not be available at a single institution, requiring collaboration across distance. In fact, evidence suggests that even people on the same campus but in different buildings or on different floors of the same building are likely to be communicating using virtual technologies. Interactions between multi-institutional geographically-dispersed teams are of necessity both physical and virtual. A major challenge, among others, in managing a virtual interaction is "members being blind and invisible to one another" when they do not work in the same location (*Enhancing the Effectiveness of Team Science)*. Due to the complexity and interdependency of the work, keeping track of what needs to be done, in what order, and by whom is challenging. Equally concerning, there is evidence to suggest that geographic dispersion has a negative impact on innovation.

The size of the team is also a critical factor in communication challenges. While there is no upper limit on the number of investigators in a given DSC, proposers are cautioned to avoid teams that are too large to collaborate effectively. The purpose of teams is to enhance communication and take advantage of their collective intelligence to solve problems. As the team size increases, research indicates that members find it more difficult to contribute to their full potentials hindering balanced contributions from the carefully assembled range of expertise. This is especially a problem for interdisciplinary teams in which full contributions from all members are needed. Resources devoted to maintaining good communications increase rapidly with team size.

Proposals are expected to address plans for establishing robust and effective communication channels among science team members with both face-to-face and virtual elements if needed for their proposed center structure

3.5 High-Performance Computing Needs

In the dynamically complex, nonlinearly coupled domains of heliophysics, computer simulations provide the third leg of discovery (in addition to observations and theory) and are "as important as access to state-of-the-art *in situ* and remote-sensing instrumentation" (ACCEHS report). Rapid advancements in computational capabilities are a potentially important resource for the DSCs if NASA can take advantage of the developments in synergistic communities to develop further and modernize the heliophysics computing frontier. To this end, experts in computer science, algorithm development, visualization and data analytics may contribute important capabilities to multi/inter/trans-disciplinary teams.

HEC computational resources enable research at scientific frontiers that would otherwise be impossible. Because this is a limited resource, proposals must discuss access to time on HEC machines and expertise to optimize its usage if this is a needed resource.

NASA maintains two major computing facilities – the NASA Center for Climate Simulation (NCCS) at the Goddard Space Flight Center, and the NASA Advanced Supercomputing (NAS) facility at the Ames Research Center. If the program specific data question on the use of NASA-provided HEC is answered in the affirmative, an appendix document must be provided which is discussed in Section 1(d) of the *ROSES Summary of Solicitation*.

NSF supports Blue Waters, one of the most powerful supercomputers in the world, located in the National Center for Supercomputing Applications at the University of Illinois, Urbana-Champaign. NSF controls roughly 80% of the available time on Blue Waters. This time is allocated through NSF's PRAC program and must be pursued independent of the current DSC funding opportunity. The PRAC program does not provide direct funding support for research but instead provides indirect support for projects requiring peta-scale computing resources on the Blue Waters system. The core research, which may be funded by NSF or other agencies (NASA, NOAA, DOE, etc.), must show compelling science or engineering challenges that require, and can effectively exploit, the petascale computing capabilities offered by Blue Waters.

3.6 Researcher Time and Commitment

Serving as the Principal Investigator of a center award requires scientific leadership and vision. It is also a significant commitment of time and will be a primary professional focus for the duration of the DSC. For this reason, the evaluation will include a careful examination of the time commitment of Principal Investigators (nominally ~30%). Furthermore, it is required that a DSC Project Manager (PM) be identified on the proposal cover page and assigned the role "Project Manager" in NSPIRES. The role of the PM is to help the PI (Director) manage and administer the DSC. All Co-Is must have an identified substantial role in the proposed effort. Team members committing a significant part of their professional effort should take this into account if participating as Co-Is in more than one DSC submission. Reviewers will evaluate the qualifications of the team and the resources available to the project (including researcher time and commitment).

3.7 Center Management Plans

Center Management Plans address leadership of the center, how decisions will be made, including the roles of any internal committees, and how synergy among projects and activities will be actively promoted in service of the DSC's vision. These plans include mechanisms for the ongoing assessment of research outcomes and impact broadening activities; implementation and periodic modification of strategic plans; allocation of resources; the ability to initiate new lines of research and terminate support for lower priority efforts; and approaches to encourage and promote effective use of the center's communication capabilities to optimize science team interactions. Organization of such activities will vary widely, depending on the particular needs of the research. It follows that maximum flexibility in the design of units funded through the program is essential, so the specific organization of the unit is left to the creativity of the Principal Investigators.

Since the DSC program is designed to foster research at the intellectual frontiers, new types of joint efforts may be needed to address the most promising problems. In all cases, however, a center must demonstrate that the whole is substantially greater than the sum of the parts. The center must have a PI who takes overall responsibility for the effort and a Project Manager to aid the PI in managing the DSC.

3.8 Effective Leadership/Management

Effective Leadership/Management describes the skills needed by DSC leaders including intellectual vision and leadership, effective management of center activities, successful entrepreneurial experience, a track record of delivering results, and the ability to communicate clearly and effectively with diverse audiences, such as team members, sponsors, partners, host institutions, stakeholders, press and media, and the public. Effective DSC leadership and management teams may, for example:

- Empower all team members to contribute regardless of status and power differences;
- Establish a culture of deep collaboration and inclusion;
- Build consensus around goals and problem definition;
- Facilitate communication to ensure a common understanding; and
- Resolve conflicts and build trust.

It is rare that a single person will have all of these attributes; thus, a strong leader will need to assemble an executive team that covers this broad spectrum of skills. The Center PI should understand his/her strengths and limitations and be effective in assembling an executive leadership team that fills in any leadership/management gaps. A Project Manager is required.

3.9 Impact Broadening Activities

DSCs are expected to integrate their research with activities that broaden the impact of their research. For this program activities for broadening impacts refers to STEM engagement and future workforce development, higher education & professional learning, diversity and inclusion, and/or outreach and informal science communication. Phase I DSCs plan and may pilot Impact Broadening Activities in some or all of these areas that would be fully implemented in Phase II.

3.9.1 *Heliophysics Workforce Development*

Science centers can be major attractors for faculty at research-based institutions as well as undergraduate and graduate students. DSCs are expected to provide an exceptionally stimulating environment so that students and/or other team members will benefit from interactions with a large, often multi/inter/trans-disciplinary, group of scientists at all career levels. This workforce development is a challenge confronting Solar and Space Physics encompassing all four pillars of discovery: theory, observations, data analysis, and computer simulations.

3.9.2 *Increasing Diversity and Inclusion*

Science centers also create an environment conducive to addressing diversity issues. The 2010 *AAAS Review of the NSF Science and Technology Centers Integrative Partnerships (STC) Program 2000-2009* found that science centers "harbor the potential to cultivate cohorts of students who look more like America than the current U.S. science workforce." Diversity Plans outline the context, goals and specific actions for promoting diversity within the center's supported researchers (faculty, postdoctoral researchers, graduate students), partners, and advisers. These plans are developed as part of the strategic planning activities of a Phase I DSC. Phase II DSCs are expected to implement these plans, building capacity while creating an inclusive culture to support research, discovery, education, and innovation, producing significant outcomes within their 5-year timeframe.

3.9.3 *Informal Science Communication*

DSCs are expected to develop a web presence. The internet can be used both to enable communication of science results and center opportunities to researchers in the community as well as to report new discoveries to younger students and the public to increase science interest and literacy.

3.10 Collaboration

DSCs are encouraged to take advantage of the opportunity to collaborate broadly with academia, commercial entities, government laboratories, and international organizations. There are no requirements on the number of collaborations. However, for any collaborators that contribute significantly to research objectives in the DSC, the proposal must provide sufficient evidence of a viable collaboration.

4. Phase I DRIVE Science Centers

4.1 Examples of Appropriate Center Formation and Development Activities

Phase I DSCs will engage in research, broader impact activities, and center development activities over the two-year duration of this award. The research activities may build on pre-existing efforts, and new, collaborative results attributed to the DSC award may result but are not required. The Phase-I award will also develop activities that broaden its impact, including developing and piloting center-scale activities that ultimately would be commensurate with a Phase II DSC. Phase-I activities include the development of a strategic plan covering all aspects of a DSC.

Proposers funded through this program element may use the Phase I DSC funding to organize catalytic activities (e.g., workshops and conferences) that can help crystallize the interdisciplinary research theme, develop the approach and strengthen the following areas:

- Overarching goals that engage and excite all discipline areas in the DSC
- Team formation/roles & responsibilities
- Deep knowledge integration, and communication plans
- Effective leadership/management
- Diversity/culture of inclusion
- Relationships with stakeholder communities
- Website and public outreach planning

Taking risks and innovative approaches are encouraged. The complexity of the problem argues for a deliberate, early-stage process for the development and formation of a highly effective research team. Potential challenges to be addressed for team science arise from seven key features (*Enhancing the Effectiveness of Team Science*): (1)

highly diverse team membership, (2) deep knowledge integration across disparate disciplines, (3) the large size of the team, (4) alignment of goals across all members of the team, (5) wide geographic dispersion, (6) permeability of team boundaries, and (7) high task interdependence.

For these types of challenges, Phase I DSC grants can be used to support team formation activities (e.g., filling expertise gaps, developing team charters, roles and responsibilities, aligning individual goals with overarching team goals). As described in *Enhancing the Effectiveness of Team Science*, studies have found that, "the quality of team charters is related to the quality of the team's performance."

Phase I funding can also be used to develop and nurture relationships with the stakeholder community, or to access specialized frameworks (i.e., virtual communication, shared data, etc.) or resources (i.e., HEC allocations, postdoc mentoring, graduate/undergraduate training programs, team training, etc.) needed to address the proposal challenges

5. Award Information

It is expected that there will be approximately $4.0 M available in Fiscal Year (FY) 2019 to support ~6 Phase I DSCs selected through this solicitation. Annual funding is unlikely to exceed $650K per investigation. This is subject to receipt of meritorious proposals and the availability of funds. The actual number of awards will depend on the quality of the proposals received; NASA reserves the right to make no awards, or more than 6 awards.

Awards made in response to proposals to this program element are planned to be grants 2 years in duration after which time DSCs will be eligible to submit a proposal for Phase II funding. The intent is to construct a DSC that "solves or makes significant progress in solving a problem and then diminishes in intensity of effort" to enable a subsequent DSC with different team composition and center features to be created and focused toward investigation of another of the most pressing research frontiers [*Committee on Solar and Space Physics: Heliophysics Science Centers*].

It is anticipated that $6 M will be available for Phase II awards in 2021 with the expectation that we will select at least 1-2 Phase II DSCs.

6. Eligibility Information

6.1 What Types of Organizations May Submit Proposals?

To be eligible the proposal must be submitted by a U.S. organization excluding NASA field centers. JPL is eligible to submit. Collaborations between institutions of different types are encouraged, keeping in mind that NASA is seeking diversity of thinking and new approaches that could lead to exciting new solutions and advances. Collaboration by non-U.S. organizations in proposed efforts is permitted. However, please refer to Section III.c of the *ROSES 2018 Summary of Solicitation* and/or the FAQ regarding restrictions.

Only organizations that previously submitted a Step-1 proposal can submit Step-2 proposals. See Section 9.1. There are no restrictions or limits on the number of proposals per organization.

While more than one institution may participate in a Step-1 or Step-2 proposal, a single institution must accept overall management responsibility for the DSC. The proposal can be submitted by only one institution with funding provided to non-governmental institutions through subawards (see Section IV(d) of the *ROSES Summary of Solicitation*); use of separately submitted collaborative proposals is not permitted.

6.2 Who May Serve as PI/Co-I?

Researchers may serve as the Principal Investigator for Phase I DSCs, provided they are affiliated with an eligible organization (see above). The PI becomes the Center Director. Because of the direct funding available to the NASA field centers, NASA Civil servants may serve as Co-investigators, but not as PI or PM. Co-Is are required in the institutions with subawards on the Phase I DSC proposal, if they are responsible for leading and managing major elements of the research. Co-Is are also permitted from the lead institution.

An investigator may participate as PI in only one Step-1 and one Step-2 proposal submitted in response to this program element. See also Section 3.6 regarding time commitment. A Co-I on one proposal may also participate in other proposals.

7. Proposal Preparation and Submission

The submission of proposals in response to this program element is a two-step process. Proposers not already familiar with the two-step process are strongly encouraged to read Section IV(b)vii of the *ROSES 2018 Summary of Solicitation* and Section 1.3 of the Heliophysics Division Overview. For this Program Element, the Step-1 proposal is a 8-page white paper plus references and citations (as needed), with 6 pages of this devoted to the Technical and Management section (see Table 1, below).

Step-1 proposals will be checked for compliance. Those that are non-compliant may be returned without review. The PIs of Step-1 proposals will be encouraged to, or discouraged from, submitting Step-2 proposals based on internal review.

7.1 Step-1 Proposal Preparation

The Step-1 proposal includes a Proposal Cover Page and proposal attachment. The Step-1 Proposal pdf uploaded must include the components listed in Table 1 in the order specified.

Note the following:

- The title given to the Step-1 proposal must be descriptive of the proposed research.
- Letters of commitment are not required for Step-1 proposals.
- Step-1 proposals are likely to be evaluated internally by NASA civil servants who are solar and space physics reviewers with broad knowledge but not necessarily domain expertise on the topic of the DSC. It is, therefore, important that they be written to be comprehensible to these reviewers and that proposals emphasize

impact on Heliophysics in a broad context.

Table 1 Step-1 Proposal Contents and Page Limits

Section Number	Proposal Section	Maximum Page Length
S1	Executive Summary	1
S2	Summary Chart	1
S3	Technical and Management Section	6
S4	References and Citations	as needed

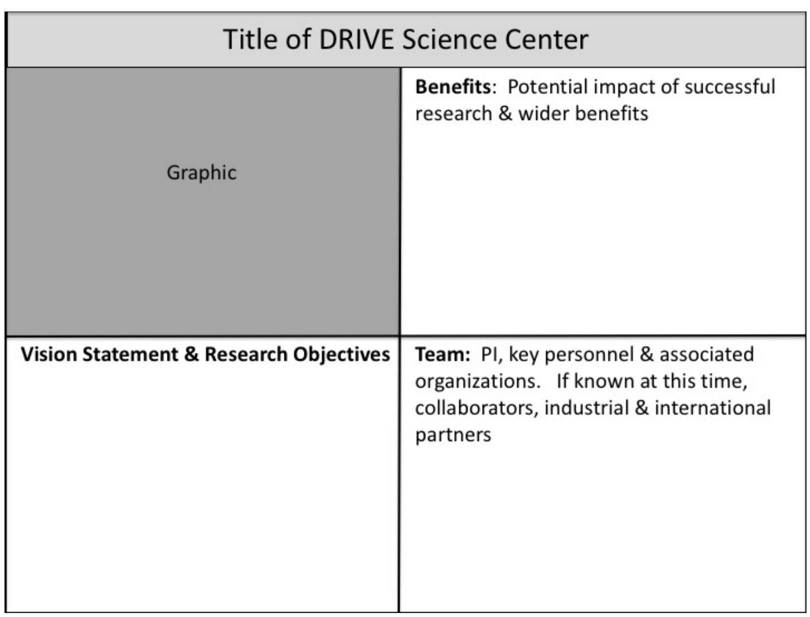
7.1.1 *Executive Summary (S1)*

The Executive Summary is limited to one page and should include: Vision, research objectives, impact, relevance, and impact broadening activities.

7.1.2 *Summary Chart (S2)*

The Summary Chart [link to page to download pptx template] shown in Figure 1 is intended to provide a quick sense of the proposed DSC and should stand alone (i.e., not require the Step-1 or Step-2 proposal to be understood). It should not include any proprietary or sensitive data as NASA may use all or some of the information on the summary chart, including images, for communications about the selections (e.g., press releases). Note: Step-2 proposals are permitted to make minor changes to the summary chart submitted in Step-1.

Figure 1 - Format for Required Summary Chart (S2)



7.1.3 *Technical and Management Section (S3)*

Proposers are encouraged to read the Technical and Management Section requirements for the Step-2 proposal (below) when preparing this section for the Step-1 proposal. The project description should address the following points:

Technical and Management Section (6 pages):

- Center Overview including the center vision, potential for transformative impact in Heliophysics, potential for synergy, key personnel and organizations, and, if known at this time, collaborators, international and industrial partners.
- Phase-I Research Plan including the group of initiating investigators, an outline of the research goals.
- Summaries of plans for center management
- Brief summaries of plans for innovation, higher education and/or professional development, broadening participation, and informal science communication

7.1.4 *References and Citations (S4)*

All references and citations given in the *Technical and Management Section* must be provided using easily understood, standard abbreviations for journals and complete names for books. It is highly preferred but not required that these references include the full title of the cited paper or report. Only the most relevant and impactful references should be referenced in the *Technical and Management Section* and provided in this section of the Step-1 proposal.

7.2 Step-2 Proposal Preparation

Step-2 proposals submitted in response to this program must originate from Principal Investigators who submitted a Step-1 proposal. Any proposals not meeting this requirement may be returned without review. Proposals are likely to be read and evaluated by solar and space physics reviewers with broad knowledge but not necessarily domain expertise on the topic of the DSC at some stage of the review process. It is therefore particularly important that they be written to emphasize their impact on Heliophysics in a broad context. Proposers are strongly encouraged to consult the proposal preparation and submission instructions in the *ROSES 2018 Summary of Solicitation*. Proposals not compliant with the proposal preparation guidelines, as supplemented by the following instructions, may be returned without review. To aid in the preparation of Step-2 Phase I proposals, examples of some activities appropriate for a selected Phase-I center are given in Section 4.

Note the following:

- Between Step-1 to Step-2:
  - Change in PI is not permitted.
  - Change in science topic is not permitted.

Table 2 shows the proposal content and page limits. Note that additional documents are required to be uploaded separately such as (optional) High-End Computing request or Total budget file.

Table 2 Step-2 Proposal Contents and Page Limits

Section	Proposal Section	Maximum Length
S1	Executive Summary	1
S2	Table of Contents	1

S3	Summary Chart	1
S4	Technical and Management Section	25
S5	Data Management Plan	2
S6	References and Citations	As needed
S7	Biographical Sketches for PI and Co-Is	2 pages for each
S8	Current and Pending Support	As needed
S9	Supplemental Documents	As needed
S10	Facilities, Equipment and Other Resources	As needed
S11	Budget Justification Plan/Cost Proposal	As needed

7.2.1 *Executive Summary (S1)*

The Executive Summary is limited to one page and should include: Vision, research objectives, impact, relevance, and impact broadening activities.

7.2.2 *Table of Contents (S2)*

A brief table of contents provides a guide to the organization and contents of the proposal.

7.2.3 *Summary Chart (S3)*

The Summary Chart [link to page to download pptx template] should be the same as that submitted as part of the Step-1 proposal, although it is permitted to make minor updates or clarifications that do not substantively change the proposed DSC.

7.2.4 *Technical and Management Section (S4)*

The *Technical and Management Section* must be 25 pages or fewer in total with standard ROSES formatting rules. This page limit includes illustrations, tables, figures, and all sub-sections and must contain the following elements:

- Center Overview: DSC vision, potential for transformative impact in Solar and Space Physics, and potential for synergy within the science team
- Center Research Plan: Narrative consisting of the following:
    - A description of the research proposed in Phase I
    - The relevance of the proposed research to solar and space physics and the anticipated outcome.
    - A brief description of the contribution to be made to each Phase I DSC by the PI, PM, and each Co-I.
    - A justification for why the DSC mode of research is appropriate (compared with individual or collaborative awards)
    - A discussion of how the Phase I research efforts can lead to a much larger Phase II effort. A discussion of the needed expertise or skills for Phase II is appropriate, but it is not necessary to name specific individuals or institutions.
- Center Development and Management Plan: Narrative consisting of the

following:

- Description of how decisions will be made regarding the project
- The roles of internal leadership
- How individual research efforts will be integrated synergistically to achieve the Center's vision
- The coordination of the DSC effort and partnerships, including how new members of the center will be identified and integrated into the Phase II effort
- How the research and broadening impact programs will be monitored, evaluated and altered as needed
- The approaches to be used during the Phase I period to develop a strategic plan for the potential Phase II Center, including the development of center-wide data management, team communication, knowledge integration, and diversity plans.
- An external advisory board is optional during Phase I. Please do not name prospective members of the external advisory board and do not include letters of commitment from prospective members in the Phase I proposal.

- Broadening Impacts: For this Proposal broadening impacts refers to the components listed below. Since broadening impacts activities are part of the evaluation of merit (Section 8.2), proposers are strongly encouraged to include at least some of the activities listed below. This section should include a discussion of how selected activities will be integrated with the research and other activities of the DSC. The following integrative components include:
  - STEM engagement and future workforce development
  - Higher Education and/or Professional Development, including training of researchers in the terminology and challenges associated with discipline areas in the DSC outside their own, interdisciplinary mentorship of undergraduate, graduate, and postdoctoral students, and any other education activities.
    - Note: Each proposal that requests funding to support postdoctoral researchers should also include, as a supplementary document, a description of the professional development and mentoring activities that will be provided for such individuals.
    - Examples of postdoctoral mentoring activities include, but are not limited to: providing career counseling, training in proposal preparation, training in responsible professional practices, developing publications and presentations, providing guidance on techniques to improve teaching and mentoring skills, and providing counseling on how to effectively collaborate with researchers from diverse backgrounds and disciplinary areas.
  - Diversity and Inclusion: NASA is invested in attracting, developing, and leveraging the full spectrum of intellectual talent in the country. Diversity is defined as the similarities and differences in individuals representing more than one national origin, color, religion, socioeconomic stratum, and sexual orientation, etc. The strengths afforded by diversity in styles, ideas, and organizational contributions drive innovation, creativity and engagement. An important mechanism for enabling diversity is ensuring that the pipeline

leading to science and engineering careers affords equal opportunities to a diverse population of students.

- Outreach and Informal Science Communication, describing the DSC approach to communicating Solar and Space Physics research to public audiences and possible ways to evaluate the impact of these outreach efforts. Partnerships with informal science education organizations are encouraged.

7.2.5 *Data Management Plan (S5)*

NASA ROSES requires that most solicitations collect Data Management Plans (DMPs) with proposals. The DSC program element treats DMPs differently. Rather than collect DMPs in a plan text box on the NSPIRES cover page, the DMP is included in the proposal document in a special two-page section, entitled "Data Management Plan" immediately following the references and citations for the Scientific/Technical/ Management (S/T/M) portion of the proposal. A template is provided for the DMP as a downloadable docx file [link to page to download template].

The Data Management Plans (DMPs) describes how all center researchers will store, access, share and archive data, with emphasis on data- sharing across collaborative teams. This is a particularly challenging prospect as the center expands, so proposals should address features such as how each team member will gain access to data in real time, how data will be archived and validated and how, as the team expands, new members will be integrated into the data management plan in ways that enhance collaboration and synergy. New approaches to, and pilot activities, in data management are encouraged during Phase I. Note: Data management at the DSCs does not replace or supplant mission data archives that are in place or planned.

7.2.6 *References and Citations (S6)*

All references and citations given in the *Technical and Management Section* must be provided using easily understood, standard abbreviations for journals and complete names for books. It is highly preferred but not required that these references include the full title of the cited paper or report (Section 3.14 of the *NASA Guidebook*). Indicate with an asterisk (*) references co-authored by two or more proposal investigators.

7.2.7 *Biographical Sketches for PI, PM, and Co-Is (S7)*

The PI – the Director of the research institute – must include a biographical sketch (not to exceed two pages) that includes his/her professional experiences and positions and a bibliography of recent publications, especially those relevant to the proposed investigation. The PI’s and PM’s biographical sketch must clearly show how he/she meets the requirements for Center Director and Project Manager, respectively. A one- to two-page sketch for each Co-I must also be included. For the PI, PM, and any Co-Is who are required to provide Current and Pending Support information, the biographical sketch must include a description of scientific, technical, and management performance on relevant prior research efforts. Those participants who will play critical management or technical roles in the proposed investigation must demonstrate that their qualifications, capabilities, and experience are appropriate to provide confidence that the proposed objectives will be achieved. (see Section 3.15 of the *NASA Guidebook*).

7.2.8 *Current and Pending Support (S8)*

Proposers must follow the current and pending requirements provided in Table 1 of the *ROSES 2018 Summary of Solicitation*. Intellectual and materials overlap between any Federally funded projects or projects submitted for Federal funding and the proposed research must be clarified by discussing the relationship between this proposed project and each of the these other potentially overlapping Federal awards. For pending research proposals involving substantially the same kind of research as that being proposed to NASA in this proposal, the proposing PI must notify the NASA Program Officer identified in Section 11 of this program element immediately of any successful proposals that are awarded any time between the proposal due date and the date that NASA's selections are announced.

7.2.9 *Supplemental Documents (S9)*

Letters of Support from the owner of any necessary facility or resource that is not under the direct control of the PI or a Co-I may be included as needed.

7.2.10 *Facilities, Equipment and Other Resources (S10)*

This section catalogs the resources and facilities (including laboratories, computational facilities, data infrastructure and other tools that support collaboration) that will be made available to the project, including resources and facilities accessed through collaboration (Section 3.18 and Appendix C in the *NASA Guidebook*).

7.2.11 *Budget Justification Plan/Cost Proposal (S11)*

The maximum aggregate two-year budget for a Phase I DSC should not exceed $1.3M. The budget should include funding for center development activities (website, strategic planning, travel etc.) in addition to research and broader impact activities. The annual budgets can vary in amount. A detailed budget justification from the lead and each Co-I institution must document proposed expenses. Proposers must follow the budget format requirements from Section IV(b)(iii) and Table 1 of the *ROSES Summary of Solicitation* (SoS) and examples on the SARA website. Proposal funding restrictions are detailed in Section IV(d) of the SoS. Because NASA field centers receive direct funding, a maximum of 30% of the proposal budget is allowed to fund the NASA field centers.

8. DSC Proposal Evaluation Criteria

8.1 Phase I Step 1 - Evaluation Criteria

Step-1 proposals are required in this ROSES program element in order to make an initial assessment of relevance and feasibility. The evaluation focuses on the case made for the (1) vision for the center, (2) the science merit of the questions addressed, (3) the potential for significant progress in answering these questions, and (3) the reason that a center environment is needed for success.

8.2 Phase I Step 2 - Evaluation Criteria

The primary evaluation criteria for this program element are described in Section IV.(a) of the *ROSES Summary of Solicitation*. However, additional factors that will be included in the evaluation of Merit of proposals submitted in response to this program element are grouped below under each of the aspects of the definition of Merit found in

Appendix D of The *2018 NRA and CAN Proposers' Guidebook*.

The evaluation of the Scientific Quality of the proposed project will include:

- The extent to which the scientific vision commensurate with a center investment.
- The extent to which there the potential for transformative impact or innovation in solar and space physics.
- The extent to which the science question is poised for near-term significant advances.
- The extent ot which the the research plan is comprehensive in laying out interdependent research objectives with clear research goals, and the likelihood it will lead to significant progress in overcoming well-defined critical gaps or barriers to existing understanding, and lead to anticipated breakthroughs.

The evaluation of the Overall Technical Quality of the proposed project will include:

- The extent to which the proposal demonstrates a clear understanding of the state of the art, including appropriate leveraging of available knowledge and technologies outside of the DSC, and make a case for significant advances.
- The extent to which the proposal demonstrates a clear understanding of the primary risks, and the mitigation strategies to address them.
- The extent to which the center leadership and the management plan foster sound decisions regarding the project, including:
    - The roles of internal leadership and any external advisory groups
    - The ability to carry out careful internal evaluations of research and broadening impacts activities
    - Promotion and evaluation of synergy in center activities
    - Development and implementation of strategic plans (described in Section 10.1)
    - Allocation of resources; the ability to initiate new lines of research and terminate support for lower priority efforts
    - Communication throughout the center and with partners?
- The extent to which the milestones are realistic and illustrate the critical paths, contributions from research projects, interdependence of research activities, and research objectives consistent with the DSC vision.
- The extent to which there is a reasonable plan to develop clear (specific, measurable and attainable) metrics for milestones associated with critical path activities.

The evaluation of the Qualifications, Capabilities, and Experience of Personnel includes:

- The extent to which the PI demonstrated qualifications to lead a major research center and the PM qualifications to manage one.
- The extent to which the proposed team assembles the broad, deep and diverse mix of expertise and talent needed to best advance the DSC’s vision and research objectives.
- The extent to which the levels of effort ascribed to the PI, PM, and Co-Is are realistic and reasonable for the scope of the proposed program.

The evaluation of Facilities, instruments, equipment and other resources or support systems includes:

- The extent to which the proposal demonstrates access to, or plans for, adequate facilities, computational resources, and data to conduct the proposed research.
- The extent to which there is evidence of the institutional commitment of the lead and partner organizations to the goals of the proposed Center.

In addition to these factors, the evaluation of DSC proposals will include mentoring and broadening impact activities (see Section 7.2.4 for more details). If reasonable plans for broadening impact activities are included in the proposal, the panel will evaluate this as a major or minor strength but not as a weakness if these plans are inadequate or absent. Since relevance to the NASA strategic plans is already described in this ROSES-18 funding opportunity, it is not necessary for proposals to show relevance to NASA's broader goals and objectives but, rather only to demonstrate relevance to the DSC program.

9. Review and Selection Processes

9.1 Proposal Review Process

Step-1 proposals will be checked for compliance. Those that are non-compliant may be returned without review. The PIs of Step-1 proposals will be encouraged to, or discouraged from, submitting Step-2 proposals based on internal review. NASA will notify the proposers of the results after the evaluation process is completed.

Submission of a Step-2 proposal is open only to those who have submitted a Step-1 proposal, but even proposals that have been discouraged may be submitted. Step-2 proposals will be evaluated by a review panel with input where appropriate from external reviewers based on the review criteria specified in Section 8.2. These reviewers will be asked to specifically address the innovative and frontier aspects of the science proposed as well as the DSC-appropriate nature of the project. Panelists and external reviewers will be scientific experts across the broad range of physics covered by the Step-2 proposals.

Proposers should be aware that, during the evaluation, NASA may request clarification of specific points in a proposal; if so, such a request from NASA and the proposer's response must be in writing. In particular, before finalizing the evaluation, NASA may request clarification on specific, potential major weaknesses that have been identified in the proposal. NASA will not enter into discussions with proposers. If NASA requests clarification it will do so in a uniform manner from all proposers. The ability of proposers to provide clarification to NASA is limited to a few types of responses:

- Identification of the locations in the proposal (page(s), section(s), line(s)) where the potential major weakness is addressed.
- Noting that the potential major weakness is not addressed in the proposal.
- Stating that the potential major weakness is invalidated by information that is common knowledge and is therefore not included in the proposal.
- Stating that the analysis leading to the potential major weakness is incorrect and identifying a placed in the proposal where data supporting a correct analysis

may be found.
- Stating that a typographical error appears in the proposal and that the correct data is available elsewhere inside or outside of the proposal.

The PI will be given time to respond to the request for clarification, which is nominally 48 hours. Any response that goes beyond a clarification in the above forms will be deleted and will not be shown to the evaluation panel.

9.2 Selection Procedure

The NASA program officer will recommend for selection proposals to the NASA Selection Official who will make the final decisions. NSF Program Officers will provide input during the preparation of the NASA selection recommendation documentation. As stated in the *ROSES Summary of Solicitation* (SoS), page SoS-39, the selection recommendation should generally be consistent with the peer review findings, unless there are programmatic and/or other considerations.

Notifications about funding decisions (both awards and declines) will be sent to each lead PI and submitting institution Authorized Organizational Representative via NSPIRES. Debriefs offering feedback to proposing teams will be provided consistent with the SMD Reconsideration Policy.

10. Award Administration

10.1 Award Reporting Requirements

The reporting requirements will be consistent with 2 CFR 1800.902 "Technical Publications and Reports" and Exhibit E - Required Publications and Reports of the NASA Grant and Cooperative Agreement Manual. Grants require annual and final technical reports, financial reports, and final patent/new technology reports. The following additional requirements will be incorporated into the DSC awards:

10.2 Strategic Plan and Program Evaluation Plan

10.2.1 *Strategic Planning Activities*

A major activity of a Phase I center is the development of a strategic plan. This plan cover all aspects of a DSC including research, team communication, deep knowledge integration, center management, center-wide data management, postdoc mentoring, and diversity. The complete strategic plan will be submitted to NASA as part of the first annual report. Developing a strong strategic plan may include consultation with strategic planning experts at the discretion of the PI. Phase I proposals will discuss their approach and timeline for strategic planning in their management plan section.

10.2.2 *Program Evaluation Plan*

NASA will provide instructions to PIs regarding how to develop a Program Evaluation Plan for the Phase II DSC by the end of Phase I that will mutually benefit the Agency and program participants. As part of developing this plan, DSCs should design metrics best suited to demonstrate progress in achieving broadly defined science goals and specific objectives. Metrics for DSC success would provide evidence of scientific impact. In addition to scientific publications and communications, other appropriate types of metrics, include providing: high-value community resources, including models or model frameworks, model outputs, and value-added datasets; support of innovation, patents, and inventions; evidence of team formation and integration; community impacts such as student and postdoc involvement, degrees awarded, workshops, and opportunities for guest investigators and early career investigators represent appropriate types of metrics. Evaluation throughout the DSC lifetime by an external science center advisory group could be built into the process to ensure quality and give objective perspectives.

10.3 Kick-Off Meeting

The PI is required to organize a kick-off meeting to bring together the members of his/her Phase I DSC just after funding is awarded. The kick-off is meant to set the course and tone for the rest of the project. It is an opportunity to communicate the vision for the center, establish common goals and purpose throughout the team; to introduce the team members to each other; to provide information on each member’s expertise, roles and responsibilities, and to create an understanding of the project background along with what success looks like, and what needs to be accomplished. It is also the opportunity to review, and possibly refine, the timeline and initial statement of work with the entire team, create a center-wide understanding of the flow of the project, the activities and their level of interconnectedness, define the outputs and deliverables that are anticipated, and possibly begin a discussion of potential risks and mitigation strategies. Lastly, this is the opportunity to introduce NASA and NSF representatives to the team and create a dialogue with them about, for example, the agencies’ perspectives on what success means, on expectations, the scope of the project, details of reporting requirements, and any other issues the team would like to address. Another advantage of a well-designed kick-off meeting is that the free exchange of information establishes an atmosphere of openness that initiates and supports the process of forming a high-functioning team.

10.4 Web Presence

The DSC is expected to establish and maintain a web presence to communicate technical and programmatic results down to the project level, new discoveries and opportunities to the research community, and new discoveries to the public.

10.5 Data Accessibility and Public Disclosure of Results

As a Federal Agency, NASA requires prompt public disclosure of the results of its sponsored research to generate knowledge that benefits the Nation. It is NASA’s intent that all knowledge developed under awards resulting from this Program Element be shared broadly. DSC award recipients will be expected to publish their work in peer-reviewed, open literature publications to the greatest extent practical. In keeping with the *NASA Plan: Increasing Access to the Results of Scientific Research*, terms and conditions about making manuscripts and data publicly accessible will be attached to awards that result from this Program Element.

11. Summary of Key Information

Expected total program budget for new awards	$4M
Number of new awards	~6
Maximum duration of awards	2 years
Due date for Step-1 proposal	See Tables 2 and 3 of this ROSES NRA
Due date for Step-2 proposals	See Tables 2 and 3 of this ROSES NRA
Start Date for new Awards	~6 months after Step-2 proposal due date
Page length for the Science-Technical-Management section of Step-1 proposals	6 pages, see Table 1 in Section 7.1
Page length for the Science-Technical-Management section of Step-2 proposal	25 pages, see Table 2 in Section 7.2
Relevance to NASA	This program is relevant to the Heliophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	Please see *ROSES Summary of Solicitation* Section I(g) Order of Precedence and the *NASA Guidebook for Proposers* at https://www.hq.nasa.gov/office/procurement/nraguidebook/
Submission medium	Electronic proposal submission is required; no hard copy is permitted.
Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com
Web site for submission of proposal via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH18ZDA001N-DRIVE

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