APPENDIX B. HELIOPHYSICS RESEARCH PROGRAM

B.1 HELIOPHYSICS RESEARCH PROGRAM OVERVIEW

NOTICE: On May 1, 2014 references to B.7 have been updated throughout the text as a result of Amendments 17 and 18. New text is displayed in bold font and old text is maintained here in strikethrough.

1. Overview

NASA's Heliophysics Research Program supports the four high level science goals from the Heliophysics Decadal survey (Solar and Space Physics: A Science for a Technological Society www.nap.edu/catalog.php?record_id=13060) which are:

1. Determine the origins of the Sun's activity and predict the variations in the space environment;
2. Determine the dynamics and coupling of Earth's magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs;
3. Determine the interaction of the Sun with the solar system and the interstellar medium;
4. Discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe.

The program supports investigations in each of the four subdisciplines of Heliophysics and also supports investigations that span the subdisciplines and address a systems approach — emphasizing the understanding of fundamental processes and interconnections across the traditional science disciplines. The program seeks to characterize these phenomena on a broad range of spatial and temporal scales, to understand the fundamental processes that drive them, to understand how these processes combine to create space weather events, and to enable a capability for predicting future space weather events. In concert with the other NASA science divisions (Planetary Science, Astrophysics, and Earth Science), the Program shares responsibility for learning about the Earth, our solar system, the universe, and their interrelationships.

The program supports investigations of the Sun, including processes taking place throughout the solar interior and atmosphere and the evolution and cyclic activity of the Sun. It supports investigations of the origin and behavior of the solar wind, energetic particles, and magnetic fields in the heliosphere and their interaction with the Earth and other planets, as well as with the interstellar medium. The program supports investigations of the physics of magnetospheres, including fundamental interactions of plasmas and particles with fields and waves, and coupling to the solar wind and ionosphere. It supports the physics of the terrestrial mesosphere, thermosphere, ionosphere, and auroras, including the coupling of these phenomena to the lower atmosphere and magnetosphere.

The program elements are as follows:

- B.2 Heliophysics Supporting Research (H-SR)
- B.3 Heliophysics Technology and Instrument Development for Science (H-TIDeS)
- B.4 Heliophysics Guest Investigators (H-GI)
- B.5 Heliophysics Grand Challenges Research (H-GCR)

- B.6 Heliophysics Living With a Star Science (H-LWS)
- B.7 Heliophysics Infrastructure and Data Environment Enhancements (H-IDEE)

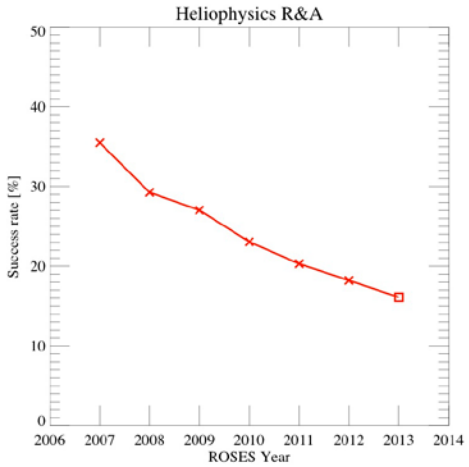
It is the overall objective of each of the program elements to contribute as effectively and directly as possible to the achievement of NASA Heliophysics strategic goals. Priority for selection is given to those proposals that most clearly demonstrate the potential for such contributions.

Proposal submission to all elements in Heliophysics will continue using a two-step process, in which the Notice of Intent is replaced by a required Step-1 proposal. The title and investigators cannot be changed between the Step-1 and Step-2 proposals. All Heliophysics programs will continue reviewing Step-1 and/or Step-2 proposals for compliance. Step-1 proposals for H-TIDeS, H-IDEE and H-LWS will continue to require a description that is limited to one page of science goals and objectives and of the proposed methodology. H-GI and now also H-SR require submission of Step-1 proposals that are up to three pages in length. The H-GI and H-SR Step-1 proposals will be reviewed for importance of the science, feasibility of the methodology, and likelihood of success by a combination of unconflicted mail-in reviewers from the science community and NASA Headquarters personnel, and will result in encouragement or discouragement to submit a full proposal.

1.1 Recent Trends in Proposal Selection Rates

The Heliophysics research budget that is competed through ROSES continues to experience high demand through increased numbers of proposals submitted by the community, which could be an effect of the increased attention paid by the scientific community to space weather and its underlying physics. At the same time, funding for Heliophysics research has not kept up with inflation. The number of active missions of the Heliophysics System Observatory (HSO) has increased through recent successful launches and the longevity and ongoing high productivity of the missions in extended operations phase. As a result, the success rate of proposals submitted to the ROSES portfolio that Heliophysics offers has seen near-constant decline.

The graph shows the evolution of proposal success rates over the ROSES years 2007-2012 and a best estimate based on proposal submissions and a subset of selections for ROSES 2013. Only full proposals (as compared to step-1 proposals) are recognized in the selection rate.



2. Program Elements

A brief description of each program element offered in the Heliophysics Research Program is given below. Note that the program elements underwent major restructuring between ROSES-12 and ROSES-13. The ROSES-13 structure is generally maintained in ROSES-14, but there are minor changes. The intent of these summaries is to give the prospective proposer some insight into the element's purpose within the context of the overall program structure. Detailed descriptions of each element are to be found in Appendices B.2 through B.7.

Heliophysics Supporting Research (H-SR):

Heliophysics SR awards are small focused individual research investigations that employ a variety of techniques, including theory, numerical simulation, modeling, analysis, and interpretation of space data. The investigations that will be of highest priority to the Heliophysics SR program will be those that use data from current or historical NASA spacecraft together with theory and/or numerical simulation to address one of the four Heliophysics Decadal Survey goals. Heliophysics SR supports investigations of the solar interior, solar photosphere, solar chromosphere, transition region, and corona; the inner and outer heliosphere and the interstellar boundary; solar wind – magnetosphere coupling, dayside outer magnetosphere, inner magnetosphere, magnetosphere-ionosphere coupling and magnetotail; ionosphere – atmosphere coupling, neutral atmosphere and solar output-ionosphere/atmosphere coupling; and other planetary magnetospheres. The Heliophysics Supporting Research program is described in Appendix B.2. **[The text of B.2 was updated on May 1 with Amendment 18]**

Heliophysics Technology and Instrument Development for Science (H-TIDeS):

The H-TIDeS program solicits proposals for investigations that are relevant to NASA's programs in Heliophysics. The H-TIDeS program seeks to investigate key Heliophysics science questions by addressing the best possible (i) science and/or technology investigations that can be carried out with instruments flown on suborbital sounding rockets, stratospheric balloons, CubeSats, or other platforms; (ii) state-of-the-art instrument technology development for instruments that may be proposed as candidate experiments for future space flight opportunities; (iii) laboratory research.

Low Cost Access to Space (LCAS) investigations may be science investigations in and of themselves or proof-of-concept experiments for techniques/detectors that enable new Heliophysics science. LCAS includes rides on research balloons, sounding rockets, the International Space Station, commercial reusable suborbital rockets, and CubeSats. LCAS investigations that launch into space in order to return scientific data are expected to make direct contributions to the science of Heliophysics.

Instrument and Technology Development (ITD) investigations have as their objective the development of instrument technologies that show promise for use in scientific investigations on future Heliophysics science missions, including the development of laboratory instrument prototypes, but not of flight hardware. Instrument development proposals are not necessarily expected to apply the results of their efforts to science questions within the time period of the proposed effort. They must, however, demonstrate that there are specific scientific problem(s), for which the development is a necessary precursor.

The Laboratory Nuclear, Atomic, and Plasma Physics (LNAPP) subelement supports studies that probe fundamental plasma physical processes and produce chemical, spectroscopic and nuclear measurements that support spacecraft measurements and atmospheric models.

The Heliophysics Technology and Instrument Development for Science program with sub-elements Low-Cost Access to Space (LCAS), Instrument and Technology Development (ITD), and Laboratory Nuclear, Atomic and Plasma Physics (LNAPP) is described in Appendix B.3.

Heliophysics Guest Investigators (H-GI):

The Heliophysics Guest Investigators (H-GI) program is offered for investigations that draw extensively upon the data sets from the missions of the Heliophysics System Observatory. The focus of the solicited research continuously evolves to ensure that the most important questions identified for recently launched Heliophysics missions are addressed and that high-value data products of currently operating missions of the HSO are created to enable significant advances in Heliophysics science. ROSES-14 H-GI will consist of two specific calls, one for investigations related to the recently launched Interface Region Imaging Spectrograph (IRIS) mission and the other enabling scientific advances with the combined Van Allen Probes mission and simultaneous observations from the Balloon Array for RBSP Relativistic Electron Losses (BARREL) deployment(s). A third element, the Open Data Development Element, will support development of data products from the Heliophysics System Observatory that show promise for use in scientific investigations. The Heliophysics Guest Investigators program is described in Appendix B.4.

Heliophysics Grand Challenges Research (H-GCR):

The Heliophysics Grand Challenges Research (H-GCR) program serves as a placeholder for future larger research efforts or Heliophysics science centers as recommended in the 2012 Decadal Survey. All Heliophysics Theory, Modeling, and Simulations (H-TMS) funds have been competed in ROSES-13, so there is no H-GCR solicitation in ROSES 2014. The Heliophysics Grand Challenges Research program is described in Appendix B.5.

Heliophysics LWS Science (H-LWS):

The goal of NASA's Living With a Star (LWS) Program is to develop the scientific understanding needed to effectively address those aspects of Heliophysics science that affect life and society. To ensure this, the Heliophysics LWS Science program solicits proposals for Focus Teams which coordinate large-scale investigations that cross discipline and technique boundaries leading to an understanding of the system linking the Sun to the Solar System both directly and via the heliosphere, planetary magnetospheres, and ionospheres.

A primary goal of NASA's LWS Program is the development of first-principles-based models for the coupled Sun-Earth and Sun-Solar System, similar in spirit to the first-principles models for the lower terrestrial atmosphere. Such models can act as tools for science investigations, as prototypes and test beds for prediction and specification capabilities, as frameworks for linking disparate data sets at vantage points throughout the Sun-Solar System, and as strategic planning aids to enable exploration of outer space and testing new mission concepts. Strategic Capabilities are the development and integration of such models for all the various components of this

system. The LWS Science - Strategic Capability sub-element will not be competed in ROSES-14.

The Heliophysics LWS Science program is described in Appendix B.6.

Heliophysics Infrastructure and Data Environment Enhancements (H-IDEE):

Progress in space science is sparked by the synthesis of ground- and space-based observations and open data access. It is essential that observations be properly recorded, analyzed, released to the general public, documented, and rapidly turned into scientific results. Heliophysics Infrastructure and Data Enhancement investigations support ground-based observational facilities that openly provide observations in support of Heliophysics space missions, and they extend data services necessary for the conduct of Heliophysics research. This program has two main subelements: Data Environment Enhancements and Infrastructure. **However, the Infrastructure element is not being competed in ROSES-2014. The Data Environment Enhancement element with reduced scope has been reinstated and is open for competition in ROSES-2014. Complementary to the Data Environment Enhancement element, a Cooperative Agreement Notice (CAN) will be released that will better serve this purpose and in the future will fully replace of the DEE element.**

~~However, the Data Environment Enhancement element is not being competed in ROSES-2014. Instead a Cooperative Agreement Notice (CAN) will be released in early 2014 that better serves this purpose.~~ Remaining program funds for new awards have been provided to ~~supplement the Infrastructure (H-I) program element and~~ the Heliophysics Guest Investigator Program's Open Data Development Element.

~~Awards are available to support facilities that actively pursue observations with Heliophysics relevance and that make these data publicly available.~~ Proposers should take into account the special needs driven by the increasing complexity of missions, the associated increasing complexity and volume of data, and the need for innovative and enabling technologies. The Heliophysics Infrastructure and Data Environment Enhancement program is described in Appendix B.7 **as amended**. **[This section was updated on May 1 with Amendment 18]**