New report presents research program for solar and space physics over the next decade

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A new report from the National Research Council presents a prioritized program of basic and applied research for 2013-2022 that will advance scientific understanding of the sun, sun-Earth connections and the origins of "space weather," and the sun's interactions with other bodies in the solar system. This second decadal survey in solar and space physics -- the product of a 18-month effort by more than 85 solar and space physicists and space system engineers -- lays out four scientific goals for the next 10 years along with guiding principles and recommended actions.

Immediate recommended actions include completion of projects in the current program of NASA and the National Science Foundation, creation of a new "mid-scale" line of projects at NSF, augmentation of NASA and NSF "enabling" programs, and acceleration and expansion of NASA's Heliophysics Explorer Program. The report also recommends beginning later in the decade new moderate-size NASA missions to address high-priority science targets, as well as a multiagency initiative to address pressing needs for improved forecasts of space weather and predictions of its impacts on society.

"The significant achievements of the past decade set the stage for transformative advances in solar and space physics," said Daniel Baker, director of the Laboratory for Atmospheric and Space Physics at the University of Colorado, Boulder, and chair of the committee that wrote the report. "In turn, these advances will support critical national needs for information that can be used to anticipate, recognize, and mitigate

space weather effects that are adverse to human life and the technological systems society depends upon," he said.

"The proposed strategy directed at NSF, NASA, and also NOAA is one that recognizes the increased societal importance of solar and space physics, and how important it is to tackle these new opportunities with a diverse set of tools -- from miniature satellites like cubesats to moderate and large missions," said Thomas Zurbuchen, a professor and associate dean for entrepreneurship at the University of Michigan's College of Engineering and vice chair of the study committee.

Four scientific goals should drive solar and space physics in the next 10 years, the report says. These are to establish the origins of the sun's activity and predict variations in the space environment; determine the dynamics and coupling of Earth's magnetosphere, ionosphere, and atmosphere and their response to solar and terrestrial inputs; understand the interaction of the sun with the solar system and the interstellar medium; and discover and characterize fundamental processes that occur both within the heliosphere and throughout the universe.

Taking into account cost, schedule, and complexity, the decadal survey provides a number of research recommendations to reach these goals. It also considers challenges that could impede achievement of the recommended program, including budget issues, the necessity to coordinate activities across multiple agencies, and the limited availability of appropriately sized and affordable space launch vehicles.

The report says that support should continue in the near term for the key existing program elements that comprise the Heliophysics Systems Observatory -- the entire fleet of heliospheric, geospace, and planetary spacecraft -- and for successful implementation of programs in advanced stages of development.

Additional recommendations include establishing a new, integrated multiagency initiative -- DRIVE -- that will more effectively exploit NASA and NSF scientific assets. Five directives make up the DRIVE initiative:

- Diversify observing platforms with microsatellites and mid-scale ground-based assets;
- Realize scientific potential by sufficiently funding operations and data analysis;
- Integrate observing platforms and strengthen ties between agency disciplines;
- Venture forward with science centers and instrument and technology development; and
- Educate, empower, and inspire the next generation of space researchers.

NASA should also accelerate and expand the Heliophysics Explorer program, which provides frequent flight opportunities to enable the definition, development, and implementation of mission concepts. Augmenting the current program by $70 million per year, in fiscal year 2012 dollars, will restore the option of mid-size Explorers, allowing them to alternate with small Explorers every 2 to 3 years. As part of the augmented Explorer program, NASA should support regular selections of "Missions of Opportunity," which allow the research community to respond quickly and to leverage limited resources with interagency, international, and commercial flight partnerships. For relatively modest investments, such opportunities can potentially address high-priority science aims identified in this survey.

New moderate- and large-class missions later in the decade would investigate space physics at the edge of the heliosphere where the sun's influence wanes, the effects of processes in Earth's lower atmosphere on

conditions in space, fundamental questions related to the creation and transport of plasma in Earth's ionosphere and magnetosphere, and how the Earth responds globally to magnetic storms from the sun.

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