



**JANUARY — MARCH 2009**

**INSIDE THIS ISSUE**

## From the Chair

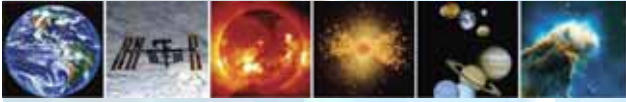


*On behalf of the members of the Space Studies Board, I wish to express our appreciation for the energy and precision Marcia Smith brought to the task of SSB Board Director during the past 3 years. We are pleased that she will continue to be in the Space Policy World, and we wish her well.*

*—Charles F. Kennel, chair, SSB*

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# SPACE STUDIES BOARD NEWS



## FROM THE CHAIR

As I write, our president has just completed his first trip abroad to meet with the leaders of the 20 greatest economic powers on Earth. As they struggled to find common ground in their approaches to the global economic crisis, one could see the beginnings of a new world order in the making—a world in which, President Obama has promised, America would not—could not—act as a hegemon, but would strive to lead in the role of “first among equals.”

As it is in the world at large, so it will be in space. Much as some may regret the loss of our complete dominance of the space enterprise, the competitive arena brings opportunity. Nearly all of NASA’s major space projects in the past 25 years have involved Europe or Japan or Russia, or in the case of the International Space station (ISS), all three. The ISS partnership has survived changing governments, budget lapses, and periods when the larger political atmosphere was antagonistic. NASA and its partners have been creative in dealing with the complexities of international collaboration and have gotten the work done.

Note that the economic crisis required the attention of the G-20, not just the G-8, which has our present major space partners. New candidates are knocking at the door of the spacefarers’ club—China, India, and others. Scientific talent knows no boundaries, and many countries large and small now are working effectively on space research. We are seeing the evolution of a truly global space enterprise. In the fullness of time, financial and intellectual resources of at least a factor of ten larger than at present will be available to the global space community.

It is not too soon to start thinking about this new world order. What new kinds of scientific investigations are possible, with additional financial resources, and the efforts of many more talented people and capable institutions? Will human exploration beyond the Moon, and to Mars and beyond, only be possible at the global scale? Will the global space enterprise populate the solar system with networks of instruments, for things like gravitational wave interferometry? Will we routinely monitor every planet in the solar system? Will a global space enterprise be required to go beyond diagnosing the world’s climate problem to mitigating it, as some have suggested?

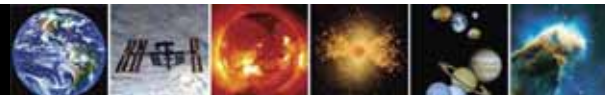
It is also not too soon to start thinking about how to get started. Are the arrangements and organizations that currently support international space cooperation scalable to the global level? How should the spacefarers’ club prepare for new members? How do old and potential new members get to know one another? Should the ISS

partnership be open to new partners? Will a global space project be managed the way big projects are today? Will it be a large top-down international bureaucracy, or will the algorithmic methods that spread the internet around the world integrate space research and exploration?

Could NASA’s promotion of a global space enterprise serve President Obama’s goals? Could it help strengthen relations with China and India? Could NASA’s leadership as “first among equals” exemplify the broader goals of U.S. foreign policy? NASA projects have done so in the past, and they could do so in the future.

All of these issues, and many more, were debated by the participants in a workshop entitled “Future International Space Cooperation and Competition in a Globalizing World” in Irvine, California, on November 18-20, 2008. The workshop was sponsored by the Space Studies Board and the Aeronautics Space and Engineering Board. A talented team led by Jim Zimmerman, former NASA European Representative and Chief of NASA’s International Planning and Programs Office, kept a record of what was said, and you will find many interesting and creative ideas in the team’s workshop report, which is coming soon to an NAS newsstand near you.

*Much as some may regret the loss of our complete dominance of the space enterprise, the competitive arena brings opportunity. Nearly all NASA’s major space projects in the past 25 years have involved Europe or Japan or Russia, or in the case of the International Space station (ISS), all three.*



## DIRECTOR'S CORNER



As most of you are aware, there has been a change in leadership of the SSB. After 3 years of a very successful tenure, Marcia Smith has retired from the NRC to pursue her long-time wish to start her own website about space policy issues. Marcia talked a lot about this wish the years we worked together at the

Congressional Research Service. We all wish she would have stayed longer here as Board Director, but we all knew the day was coming when she would finally take that step. Marcia did a superb job as Board Director, building on the strong base established by Joe Alexander during his tenure, to firmly root it as one of the most successful Boards in the NRC. It is now my privilege to step into this role while the Division on Engineering and Physical Sciences (DEPS) leads the search for a permanent replacement. It is certainly an honor to be asked to lead such an outstanding staff and to be associated with such a distinguished Board. At the same time, I do this with some trepidation. I have been at the National Academies for over 7 years now including a 6-month stint as Acting Director of the Computer Science and Telecommunications Board. That experience has given me first hand knowledge about how important and difficult the Board Director's job is. Fortunately, I am able to share my new responsibilities with a very talented and experienced staff that makes the job much more manageable.

As noted, we are now in the process of looking for a permanent Board Director. Peter Blair, the DEPS Executive Director, has started that search and a listing is posted on the National Academies web site (<http://www.nationalacademies.org/careers/>). In addition, we are advertising the position extensively. Please let us know if you have recommendations for this position. Note that the SSB Director is also director of the Aeronautics and Space Engineering Board (ASEB)

I am quite pleased to be working with Charlie Kennel, the SSB Chair. I first got to know him when he joined the UCLA faculty in the 1960s when I was a graduate student in plasma physics there. I still remember his sparkling seminars on space plasmas. We have intersected off and on over the years as he became more active in science policy, and it is great to be connected with him again in my new role.

The SSB staff continues to be very productive as indicated by the projects currently underway. Details of these studies are shown elsewhere in this newsletter. Leading the list are three decadal surveys including our contribution to the Astro2010 survey led by the Board on Physics and Astronomy. In addition to BPA staff, Brian Dewhurst (ASEB), Brant Sponberg, and Carmela Chamberlain are working on that project. David Smith, Dwayne Day, and Rodney Howard are moving forward with the planetary science decadal survey, and Sandra Graham, Maureen Mellody (ASEB), Roc Riemer (BPA), Ian Pryke, Alan Angleman (ASEB), Lewis Groswald, and Danielle Johnson (DBASSE) are launching the decadal survey on biological and

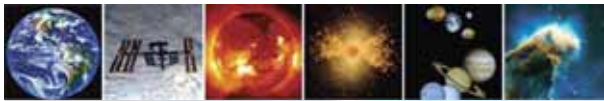
physical sciences in space. In addition, we have several projects nearing or in the review stage, others in the writing phase, and still others just starting. Included in the first group are the planetary protection study with David and Rodney; the workshop on international cooperation and competition (joint with ASEB) with Ian, Joe Alexander, and Carmela; and the radioisotope power systems study (joint with ASEB) with Alan, Dwayne, and Andrea Rebholz (ASEB). Now underway are the near Earth object study (joint with ASEB) with Dwayne, Paul Jackson (ASEB), David, Victoria Swisher, Lewis, Rodney, and Andrea; the rationale and goals study (joint with ASEB) with Joe, Brian, Victoria, Lewis, and Carmela; and the "research and analysis" study with Joe, Victoria, and Linda Walker. In the final category are the suborbital research program study with Roc, Dwayne, and Linda; the impediments to interagency cooperation with Art Charo and Theresa Fisher; the cost growth study with Alan and Brian; and the NASA Laboratories study which is being done by the DEPS Laboratory Assessments Board but will be directed by John Wendt (ASEB) with help from Paul. Of course providing critical management, financial, and editorial services for the board are Tanja Pilzak, Christina Shipman, Sandra Wilson, Celeste Naylor, and Cathy Gruber. This is quite an array of studies and activities, and it clearly shows the breadth and intensity of the SSB/ASEB staff.

I should also add that Art is working on the America's Climate Choices study. This is a major, multi-board project being led by the Board on Atmospheric Sciences and Climate in the Division on Earth and Life Studies. Our decadal survey on Earth sciences and applications from space, directed by Art, served as a foundation for this climate choices effort.

Several Board activities are scheduled for the next few months. In May we have the spring meeting of the SSB, which includes a 1-day joint meeting with the ASEB. I believe this will provide a chance for the two boards to get a better idea how each approaches its charge. That meeting, we hope, will also give us a chance to listen to officials from NASA, NOAA, NSF, and DOE discuss the FY 2010 budget. Budget details are now scheduled to be released on May 6, however, so we do not have much margin for slippage. In August we will be holding the meeting of the SSB Executive Committee to discuss details for the November workshop, as well as a number of other topics of interest to the future of SSB. In November, there will be the workshop itself in conjunction with the Board meeting. We hope to have a topic decided by the end of the May meeting.

Finally, watching the SSB/ASEB staff in action as Acting Board Director has shown me just how impressive this staff is. The normal flow of business is handled smoothly and directly, and they are very adept at handling the various glitches and unexpected problems that arise on occasion. The NRC can be justly proud of the SSB/ASEB staff, and I certainly appreciate their efforts.

—Richard Rowberg, Acting Board Director



## SSB ACTIVITIES

### THE BOARD AND ITS STANDING COMMITTEES

The **Space Studies Board (SSB)** did not meet during this quarter. The Board's next meeting will be held May 13-15, 2009, in Washington, DC to allow for a discussion of the FY 2010 budget. The first day of the meeting will be a joint session with the ASEB to allow both boards to hear from officials from NASA, the Office of Science and Technology Policy, and the Office of Management and Budget; and from congressional staff.

The **Committee on Astronomy and Astrophysics (CAA)** is on hiatus until the completion of the astronomy and astrophysics decadal survey.

The **Committee on Earth Studies (CES)** did not meet during this quarter. As the quarter ended, members were preparing for a meeting that will take place on April 16-17, 2009, at the National Academies' Keck Center in Washington, DC. Highlights of the meeting will include briefings from heads of NOAA-NESDIS and NASA Earth Science, a discussion with Hank Revercomb from the University of Wisconsin regarding recovery options for advanced sounders on future spacecraft in the GOES series, and a videoconference briefing by scientists at the University of Colorado on the results of a recent workshop on the potential for small satellites in Earth-observation programs.

The **Committee on the Origins and Evolution of Life (COEL)** began 2009 with a major membership rotation to replace those individuals whose terms ended in 2008. Six new appointments were made including that of J. Gregory Ferry (Pennsylvania State University), who was named the committee's new life-sciences co-chair. COEL held its first meeting of 2009 at the National Academies' Keck Center in Washington, DC, on February 18-20, 2009. The meeting was primarily devoted to various aspects of the NASA Astrobiology Institute's (NAI's) activities, including presentations from Mary Voytek, acting director of NASA's Astrobiology Program; Carl Pilcher, director of the NAI; and the principal investigators of the NAI teams at the Carnegie Institution of Washington, the Georgia Institute of Technology, and the New York Center for Astrobiology. In addition, COEL was briefed on the process being used to identify the landing site for the Mars Science Laboratory and on the outcome of the NASA-ESA prioritization process for the outer solar system flagship missions. Finally, the committee heard a presentation from Frances Westall, COEL's liaison with the European Space Science Committee, on the challenges of searching for traces of life in 3.5-billion-year-old rocks on Earth. The committee's next meetings will take place in Bozeman, MT, and Irvine, CA, on September 1-3, and December 1-3, respectively.

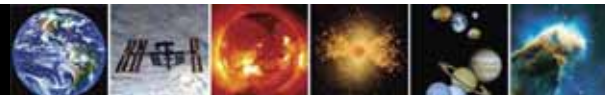
The **Committee on Planetary and Lunar Exploration (COMPLEX)** is on hiatus until the completion of the planetary sciences decadal survey.

The **Committee on Solar and Space Physics (CSSP)** did not meet this quarter, pending the release of NASA's FY 2010 budget request. The committee's next meeting is being planned in Washington, DC, in the first half of May to hear about the FY 2010 budget.

## SSB MEMBERSHIP JULY 1, 2008—JUNE 30, 2009

<b>CHARLES F. KENNEL, CHAIR</b> Scripps Institution of Oceanography, University of California, San Diego	<b>MOLLY K. MACAULEY</b> Resources for the Future, Inc.
<b>A. THOMAS YOUNG, VICE CHAIR</b> Lockheed Martin Corporation (ret.)	<b>BERRIEN MOORE III</b> Climate Central, Inc.
<b>DANIEL N. BAKER</b> University of Colorado	<b>ROBERT T. PAPPALARDO</b> Jet Propulsion Laboratory
<b>STEVEN J. BATTEL</b> Battel Engineering	<b>JAMES PAWELCZYK</b> Pennsylvania State University
<b>CHARLES L. BENNETT</b> Johns Hopkins University	<b>SOROOSH SOROOSHIAN</b> University of California, Irvine
<b>YVONNE C. BRILL</b> Aerospace Consultant	<b>JOAN VERNIKOS</b> Thirddage, LLC
<b>ELIZABETH R. CANTWELL</b> Oak Ridge National Laboratory	<b>JOSEPH F. VEVERKA</b> Cornell University
<b>ANDREW B. CHRISTENSEN</b> Dixie State College and The Aerospace Corporation	<b>WARREN M. WASHINGTON</b> National Center for Atmospheric Research
<b>ALAN DRESSLER</b> The Observatories of the Carnegie Institution	<b>CHARLES E. WOODWARD</b> University of Minnesota
<b>JACK D. FELLOWS</b> University Corporation for Atmospheric Research	<b>ELLEN G. ZWEIBEL</b> University of Wisconsin, Madison
<b>FIONA A. HARRISON</b> California Institute of Technology	<b>LIAISON</b> U.S. REPRESENTATIVE TO COSPAR
<b>JOAN JOHNSON-FREESE</b> U.S. Naval War College	<b>EDWARD C. STONE</b> California Institute of Technology
<b>KLAUS KEIL</b> University of Hawaii at Manoa	

For more information on the membership of the SSB please visit our website at <[www.nationalacademies.org/ssb](http://www.nationalacademies.org/ssb)>.



**STUDY COMMITTEES**

In March the NRC Governing Board Executive Committee approved the prospectus for a study on **Assessment of Impediments to Interagency Cooperation on Space and Earth Science Missions**. An ad hoc committee is being formed to assess impediments, including cost growth, to the successful conduct of interagency cooperation on Earth science and space science missions; identify lessons learned and best practices from past interagency Earth science and space science missions; and recommend steps to help facilitate successful interagency collaborations on Earth science and space science missions.

The ad hoc **Astronomy and Astrophysics Decadal Survey Committee (Astro2010)** held its second meeting on January 9-10, in Irvine, CA. The committee planned the future activities of the studies and the roles and memberships of the survey panels. The five Science Frontier Panels (SFPs) began their work in February 2009 and are expected to provide their proposed key science questions to the survey committee at its next meeting, May 11-13 in Irvine, CA. This meeting will also be the first meeting of the four Program Priority Panels (PPPs). For further details, including community input to the study, please see: <http://www.nationalacademies.org/bpa/Astro2010.html>.

Work continued in this period on committee formation activities for the **Decadal Survey on Biological and Physical Sciences in Space**. This congressionally requested study is expected to establish priorities and provide recommendations for life and physical sciences space research, including research that will enable exploration missions in microgravity and partial gravity for the 2010-2020 decade. A membership slate for the survey steering committee was completed in early March and final approval was received at the end of this period. The first meeting of the steering committee is tentatively set for May 6-8 in Washington, DC. At that meeting, the committee will carry out planning activities for the study and receive briefings on the status and plans of the relevant NASA programs and research facilities.

The ad hoc **Planning Committee for the Future International Space Cooperation and Competition in a Globalizing World: A Workshop** organized a public workshop which took place on November 18-20, 2008, in Irvine, CA. Its purpose was to review past and present cooperation and coordination mechanisms for space and Earth science research and space exploration, identify significant lessons learned, and discuss how those lessons could best be applied in the future. The workshop featured invited presentations, panel discussions, and four discussion groups dedicated to specific topics. Approximately 50 individuals participated, including the majority of SSB members and one member of the ASEB. The workshop rapporteur and SSB staff have prepared a draft report summarizing the panel sessions and the output of the four discussion groups. The draft has been reviewed by a panel of external reviewers and is in the final stages of preparation. Release is targeted for the end of April 2009. The workshop agenda and the two workshop keynotes can be found at <http://www.nationalacademies.org/ssb/InternationalCooperationWorkshop2008.html>.

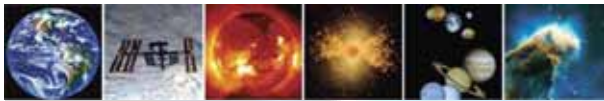
The ad hoc **Heliophysics Performance Assessment Committee** delivered the prepublication version of its report on February 17. The published version is now available.

The ad hoc **Committee on NASA's Suborbital Research Capabilities** has been formed to conduct a study of suborbital flight activities, including the use of sounding rockets, aircraft, balloons, and suborbital reusable launch vehicles, as well as opportunities for research, training, and education. Steven Bohlen, interim director of the Integrated Ocean Drilling Program and research professor in geology and geophysics, Texas A&M University, has been appointed chair. The committee's first meeting will be held at the National Academies' Keck Center May 20-21 in Washington, DC.

The **Committee on Planetary Protection Requirements for Mars Sample-Return Missions** has been charged to review and update the 1997 NRC report, *Mars Sample Return: Issues and Recommendations*, in light of new findings about Mars and advances in the biological sciences. The committee completed all of its scheduled meetings in 2008 and completed an initial draft of its report in early-December 2008. The committee spent the first 6 weeks of 2009 revising this draft in response to comments provided by seven external reviewers. The revised report was submitted to the NRC's Report Review Committee on February 23 and the report was approved for public release on March 6. The report is currently being prepared for publication by the National Academies Press. It is scheduled to be delivered to NASA in May and will be available to the public no later than the end of May.

The **Planetary Sciences Decadal Survey** began its formal activities with the announcement that this 2-year study to define a new science and mission strategy for solar system exploration activities at NASA and NSF will be lead by Steven Squyres (Cornell University). Lawrence Soderblom (U.S. Geological Survey) was named the vice chair of the study. Dr. Squyres led a town hall session designed to inform the scientific community of the decadal survey's goals and schedule at the Lunar and Planetary Sciences Conference (Houston, TX, March 25). Committee staff conducted similar outreach activities at a variety of venues including the meetings of the Venus Exploration Analysis Group (Houston, TX, February 25), Mars Exploration Program Analysis Group (Arlington, VA, March 3-4), Outer Planets Assessment Group (Bethesda, MD, March 9-10), the Royal Astronomical Society (London, England, March 13), and the Curation and Analysis Team for Extraterrestrial Materials (Houston, TX, March 28-29). The decadal survey is scheduled to be delivered to NASA and NSF by the end of March 2011.

The ad hoc **Committee on Radioisotope Power Systems** held its final committee meeting on January 12-13, at the National Academies' Arnold and Mabel Beckman Center, in Irvine, CA. The committee is assessing the technical readiness and programmatic balance of NASA's radioisotope power systems technology portfolio in terms of its ability to support NASA's near- and long-term missions of exploration and discovery. The committee prepared a complete draft of its final report and submitted it for external review on March 31. The committee expects to



release the final report well before the due date of June 30.

The **Committee on Rationale and Goals of the U.S. Civil Space Program** met on January 13-15, at the National Academies' Keck Center in Washington, DC for discussions with outside experts regarding public interests and attitudes about space exploration, alternative exploration approaches, commercial and economic aspects of space activities, and the implications of two National Academies reports, *Rising Above the Gathering Storm* and *Beyond "Fortress America,"* for the committee's task. The committee also began to organize its study report, and work on the draft report continued at the March 2 meeting. The committee aims to complete its report and submit it for external NRC review in April.

The steering group of the ad hoc **Committee for the Review of Near-Earth Object (NEO) Surveys and Hazard Mitigation Strategies** held its first meeting at the National Academies' Keck Center, in Washington, DC, on December 9-11, 2008. The steering group's second meeting will take place at Arecibo in Puerto Rico, May 18-20, 2009. The study's Survey/Detection Panel held its first meeting at the National Academies' Keck Center, in Washington, DC, on January 28-30, 2009; the panel will hold its second meeting at the Lunar and Planetary Laboratory in Tucson, Arizona April 20-22, where it will also visit the Catalina Sky Survey Telescope. The chair and a member of the Mitigation Panel will visit the Pan-STARRS-1 telescope facility on Maui on April 29-30. The Survey/Detection Panel will have its final meeting in the summer. The committee's Mitigation Panel was approved in February and held its first meeting March 30-April 1 at the Keck Center.

The ad hoc **Committee on the Role and Scope of Mission-Enabling Activities in NASA's Space and Earth Science Missions** met at the National Academies' Beckman Center in Irvine, CA, on January 21-23 and again at the National Academy of Sciences Building in Washington, DC, on March 11-13 to gather information from NASA program managers and other experts on aspects relevant to the study charge. At the March meeting the committee began to discuss approaches for responding to the study charge. The committee will meet next at the National Academies' Keck Center in Washington, DC, on May 20-22.

The ad hoc **Planning Committee on the Societal and Economic Impacts of Severe Space Weather Events Workshop** released its report, *Severe Space Weather Events—Understanding Societal and Economic Impacts: A Workshop Report*, to the public on January 5. The report had been delivered to NASA in December 2008.

Since its release, the report has attracted broad media attention, much of which has been focused on the workshop discussion of the prolonged electrical grid outages that could result from a particularly severe event. Some of the articles have been of a rather sensational nature, and the NRC's Office of News and Public Information continues to coordinate with SSB staff to monitor the report press and to field incoming requests for information and interviews.

The committee chair, Dan Baker, briefed the report to NASA on March 25, 2009. Among its other impacts, NASA indicated

that the workshop had created momentum for interagency talks on creating an operational solar monitoring capability. NASA has also requested a follow-on product from the report, essentially an expanded version of the report's executive summary that can be used to educate policy makers and officials in other agencies.

## OTHER ACTIVITIES

The **Committee on Space Research (COSPAR)** of the International Council of Science held its annual business meetings in Paris on March 16-19, 2009. The next COSPAR scientific assemblies will take place in Bremen, Germany, on July 18-25, 2010, and Mysore, India, on July 15-22, 2014.



## SSB STANDING COMMITTEE CHAIRS

### COMMITTEE ON ASTRONOMY AND ASTROPHYSICS (CAA)\*

#### COMMITTEE ON EARTH STUDIES (CES)

Chair: Berrien Moore III

Vice Chair: Ruth Defries

#### COMMITTEE ON THE ORIGINS AND EVOLUTION OF LIFE (COEL)\*\*

Co-Chairs: Robert T. Pappalardo and J. Gregory Ferry

#### COMMITTEE ON PLANETARY AND LUNAR EXPLORATION (COMPLEX)\*\*\*

Chair: Joseph F. Veverka

#### COMMITTEE ON SOLAR AND SPACE PHYSICS (CSSP)

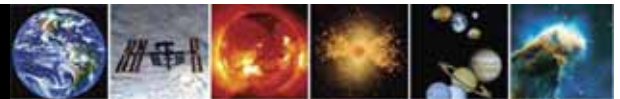
Chair: Daniel N. Baker

Vice Chair: Thomas H. Zurbuchen

\*Joint with the Board on Physics and Astronomy. CAA is on hiatus during the Astro 2010 decadal survey.

\*\*Joint with the Board on Life Sciences.

\*\*\*COMPLEX is on hiatus during the planetary sciences decadal survey.



## NEW RELEASES FROM THE SSB

Summaries are reproduced here without references, notes, figures, tables, boxes, or attachments. Copies of reports are available from the SSB office at 202-334-3477 or online at <[www.nap.edu/](http://www.nap.edu/)>.

### A Performance Assessment of NASA's Heliophysics Program



*This report by the Committee on Heliophysics Performance Assessment is available at [http://www.nap.edu/catalog.php?record\\_id=12608](http://www.nap.edu/catalog.php?record_id=12608). The study was led by co-chairs Stephen A. Fuselier and Roderick A. Heelis and staffed by Brant Sponberg, Study Director, Carmela Chamberlain, Program Associate, and Catherine A. Gruber, Assistant Editor.*

Since the 1990s, the pace of discovery in the field of solar and space physics has accelerated, largely owing to prior and continuing NASA investments in its Heliophysics Great Observatory fleet of spacecraft. These enable researchers to investigate connections between events on the Sun and in the space environment by combining multiple points of view. The field of solar and space physics comprises the phenomenology and physics of space plasmas and neutral gases, both individually and as coupled, nonlinear interacting systems driven from the Sun to Earth, to other members of the solar system, and out to the very edge of the heliosphere. Through NASA's current Heliophysics Great Observatory, researchers use 12 spacecraft to address the basic science of variable solar outputs, their transmission to the geospace environment and beyond, and their impacts on technological systems.

Solar and space physics requires synergy between observational and theoretical initiatives, and between basic research and targeted research programs. Investments by NASA, the National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation (NSF), and the Department of Defense (DOD) in space weather instruments, ground-based observatories, research, technology, and education have been important to sustaining progress. Collectively, they enable humanity's deepest understanding of our nearest star and its interactions with all members of the heliosphere, including the technologies that sustain and nurture our presence in geospace and beyond.

Recognizing the importance of distributed observations of all elements of the Sun-to-Earth system and the synergies between observation and theory and between basic and targeted research, the National Research Council's (NRC's) 2003 solar and space physics decadal survey laid out an Integrated Research Strategy that sought to extend and augment what has now become the Heliophysics Great Observatory as well as to enhance NASA, NOAA, NSF, and DOD's other solar and space physics research activities. The Integrated Research Strategy provided a prioritized list of flight missions and theory and modeling programs that would advance the relevant physical theories, incorporate those theories in models that describe a system of interactions between the Sun and the space environment, obtain data on the system, and analyze and test the adequacy of the theories and models. As directed by Congress in the NASA Authorization Act of 2005, the purpose of this report is to assess the progress of NASA's Heliophysics Division at the 5-year mark against the NASA goals and priorities laid out in the decadal survey.

In addition to the Integrated Research Strategy, the decadal survey also considered non-mission-specific initiatives to foster a robust solar and space physics program. The decadal survey set forth driving science challenges as well as recommendations devoted to the need for technology development, collaborations and cooperation with other disciplines, understanding the effects of the space environment on technology and society, education and public outreach, and steps that could strengthen and enhance the research enterprise.

**Unfortunately, very little of the recommended NASA program priorities from the decadal survey's Integrated Research Strategy will be**

**realized during the period (2004-2013) covered by the survey. Mission cost growth, reordering of survey mission priorities, and unrealized budget assumptions have delayed or deferred nearly all of the NASA spacecraft missions recommended in the survey. As a result, the status of the Integrated Research Strategy going forward is in jeopardy, and the loss of synergistic capabilities in space will constitute a serious impediment to future progress.**

Some of these factors were largely outside NASA's control, but as the assessments in Chapter 2 of this report detail, many factors were driven by subsequent NASA decisions about mission science content, mission size, and mission sequence. Overcoming these challenges, as well as other key issues like launch vehicle availability, will be critical if NASA is to realize more of the decadal survey's priorities over the next 5 years as well as priorities in solar and space physics research in the long term. Chapter 3 of this report provides recommendations about how NASA can better fulfill the 2003 decadal survey and improve future decadal surveys in solar and space physics.

### ASSESSMENT

Chapter 2 of this report contains the committee's assessment of NASA's progress against the 2003 decadal survey recommendations. To make its assessment, the committee employed the following grading system:

- A—Achieved or exceeded the goal established in the decadal survey.
- B—Made significant progress toward the goal.
- C—Made some progress toward the goal.
- D—Made little progress toward meeting the decadal goal.
- F—Made no progress toward meeting the decadal goal or actually regressed from it.

The committee developed a summary finding to support each grade in this report. Chapter 2 provides additional information supporting each grade, including restatements of the specific recommendations from the decadal survey and a more detailed assessment of the NASA program response to those recommendations.

Table S.1 summarizes the committee's assessment, which consists of 21 grades, divided into seven area assessments covering each chapter of the 2003 decadal survey and 14 program assessments covering the NASA program priorities recommended in the decadal survey.

### Area Assessments

Seven of the committee's grades correspond to the seven chapters in the decadal survey, which covered the following areas:

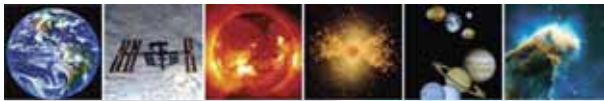
1. Milestones and Science Challenges;
2. Integrated Research Strategy;
3. Technology Development;
4. Connections Between Solar and Space Physics and Other Disciplines;
5. Effects of the Solar and Space Environment on Technology and Society;
6. Education and Public Outreach (E/PO); and
7. Strengthening the Solar and Space Physics Research Enterprise.

The committee provided a summary grade of NASA's progress against the recommendations found in each chapter of the decadal survey. The grades and findings for each of these areas are as follows:

#### Milestones and Science Challenges

##### Grade: B

**Finding:** The highest level objectives and research focus areas in the NASA Heliophysics Roadmap align with the decadal survey science challenges. However, there are several science questions in the decadal survey<sup>3/4</sup>most notably, coronal heating, magnetospheres and ionospheres of other planets, and interaction with the interstellar medium<sup>3/4</sup>that receive little or no attention in the roadmap.



(Continued from page 7)

## Program Assessments

### Integrated Research Strategy

#### Grade: C

**Finding:** Progress in almost all the programs is seriously compromised by mission cost growth and rescoping and by reductions in funding for programs that provide regular mission opportunities. In addition, decisions to reorder the mission sequence recommended in the decadal survey undermined the Integrated Research Strategy set forth in the decadal survey, which was built around a set of spacecraft missions coordinated to afford opportunities to examine complex, interacting Sun-Earth subsystems from different regions simultaneously. The originally conceived program cannot be recovered before the next decadal survey. Thus, the status of the Integrated Research Strategy going forward is in jeopardy with the potential for loss of synergistic space research capabilities.

### Technology Development

#### Grade: C

**Finding:** NASA is planning to add new small and medium launch capabilities and has made some progress in developing advanced spacecraft systems and command-and-control and data acquisition technologies for spacecraft constellations. But NASA's progress in developing solar sails is limited, and NASA has only recently begun studying the feasibility of advanced space nuclear power systems and the availability of the necessary radioactive isotopes. These technologies have been identified as strategic needs for upcoming missions. It is also unclear if the rate of technological progress in spacecraft systems can be sustained in the absence of a replacement for NASA's cancelled New Millennium Program, which provided a testbed for new technologies. NASA has also not followed up on decadal survey recommendations regarding advanced scientific instrumentation.

### Connections Between Solar and Space Physics and Other Disciplines

#### Grade: F

**Finding:** NASA has taken no specific action on these recommendations, which remain valid. However, community interest in interdisciplinary interactions remains strong, and supporting research and technology programs continue to elicit interdisciplinary interest.

### Effects of Solar and Space Environment on Technology and Society

#### Grade: C

**Finding:** NASA/NOAA/NSF joint efforts on modeling and simulations are excellent examples of successful and close interagency coordination. However, the Heliophysics Division's continued application of scientific spacecraft for operational purposes at L1 is ill-advised and is a potential obstacle to an independent space weather monitoring program.

### Education and Public Outreach

#### Grade: C

**Finding:** NASA's E/PO programs are regarded as generally successful with several notable successes among the mission-associated programs. However, NASA programs have emphasized elementary school and public education despite the decadal survey recommendation that educational efforts should focus on college and university-level training, a goal that remains poorly addressed.

### Strengthening the Solar and Space Physics Research Enterprise

#### Grade: C

**Finding:** Some initiatives to strengthen the solar and space physics enterprise have made progress. NASA has processes in place to capitalize on existing research assets, has allocated funding to revitalize the Suborbital Program, includes space physics instruments in Planetary Division missions, and continues to have an open door data policy. However, there has been limited or no progress on other initiatives. Launch capabilities continue to be inadequate, NASA has not undertaken an independent review of its relationship with academia, and some Announcements of Opportunity could better tailor mission rules to mission scope. Moreover, International Traffic in Arms Regulations (ITAR) continue to hamper international cooperation on missions.

In its chapter on the Integrated Research Strategy, the decadal survey recommended a prioritized list of programs. The committee graded NASA's progress on 14 of the recommended programs that have entered formulation or implementation. For NASA programs that were recommended by the decadal survey but have not entered formulation, the committee provided no grade.

### Solar Probe

#### Program Grade: A

**Finding:** NASA is to be commended for reconstituting the Solar Probe science definition team and producing a Solar Probe Plus mission implementation plan that could be conducted with a restricted cost profile. Although its mission design is promising, Solar Probe Plus sequencing is in conflict with the decadal survey, which conditioned Solar Probe implementation on the implementation of all the moderate mission recommendations in the survey or on a budget augmentation to accelerate Solar Probe implementation. Neither condition has been met. Solar Probe receives the highest possible grade due to efforts to control cost via intelligent mission redefinition. However, NASA has compromised the decadal survey's mission sequence by advancing Solar Probe ahead of the fourth (Multi-Heliospheric Probes), fifth (Geospace Electrodynamics Connections), and seventh (Magnetospheric Constellation) moderate mission priorities identified in the survey, which has reduced the overall grade given to the Integrated Research Strategy.

### Magnetospheric Multiscale

#### Program Grade: B

**Finding:** Magnetospheric Multiscale (MMS) is the number one priority moderate mission, with a *science focus on reconnection as a fundamental plasma physical process*. MMS is scheduled for launch in 2014 and has an estimated cost of \$990 million. The launch date places it outside the time-frame addressed by the decadal survey (2004-2013) and the cost places it well outside the moderate mission category of the decadal survey. Changes in payload capability, launch vehicles, and project requirements have all contributed to the increases in time and cost. Although it is encouraging to see MMS moving forward, its problems have necessitated the re-programming of subsequent moderate missions.

### Geospace Network

#### Program Grade: D

**Finding:** The Geospace Network mission as originally conceived *aimed at exploring the synergy and coupling between the radiation environment in the inner magnetosphere and the underlying ionosphere and thermosphere, key regions for space weather effects*. It has not been implemented, and the present plan essentially eliminates it from consideration.

### Jupiter Polar Mission

#### Program Grade: B

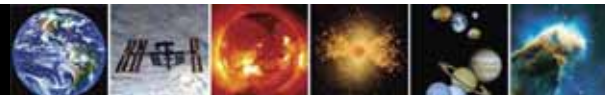
**Finding:** Although there are some limitations due to mission design, instrumentation on the recently selected New Horizons Juno mission will allow the main objectives of the decadal survey Jupiter Polar Mission to be accomplished.

### Suborbital Program

#### Program Grade: B

**Finding:** NASA significantly increased its funding request for the suborbital program in FY 2009 in response to multiple findings over the years from the community. If passed, this increase appears to be sufficient to bring the support level back above the critical threshold for a viable program. This increased support for operational engineering, infrastructure, and inventory is in line with the relevant recommendation from the decadal survey. Meeting the decadal survey recommendation for a revitalized suborbital program will also require an increase in science investigations to take advantage of the increased flight rate.





(Continued from page 8)

**Explorer Program**

**Program Grade: C**

**Finding:** The Explorer Program is characterized by high science return and a minimum of cost overruns and mission expansion. However, reductions in Explorer Program funding have reduced the mission flight rate from one or more missions per year at the time of the decadal survey to one mission every four years, with serious implications for the vitality and balance of programs within the Heliophysics Division. The reinstatement of the Small Explorer and Mission of Opportunity competition in 2007 reversed a downward trend but has not restored funding to levels assumed by the decadal survey.

**Small Programs**

**Program Grade: A**

**Finding:** Significant enhancements to scientific productivity in heliophysics are being achieved with relatively small resource commitments, including NASA cooperation on the European Space Agency's Solar Orbiter mission.

**Vitality Programs**

**Program Grade: B**

**Finding:** While some of the specific initiatives recommended by the decadal survey were not undertaken, NASA's Research and Analysis budget has effectively addressed the needs of present and future flight programs while continuing to foster new ideas and innovation.

**Supporting Research and Technology**

**Program Grade: C**

**Finding:** The decadal survey recommended that funding for the Supporting Research and Technology (SR&T) program be increased to maximize the productivity of existing resources and ensure a sound foundation for the development of future programs. However, funding for this key activity was severely cut in FY 2006. In FY 2008, funding amounts have only recovered to their levels at the time of the decadal survey.

**Coupling Complexity Initiative**

**Program Grade: C**

**Finding:** No federal agency has led the way in creating new, interagency theory and modeling programs, such as the Coupling Complexity Initiative recommended by the decadal survey. However, within constrained budgets, NASA has supported the development of some portion of these activities through existing programs, such as its Targeted Research and Technology (TR&T) and its Community Coordinated Modeling Center (CCMC).

**Solar and Space Physics Information System**

**Program Grade: A**

**Finding:** The capabilities of a Solar and Space Physics Information System are being realized through the CCMC and the emerging capabilities of virtual observatories. However, these projects are in their infancy, and continuous, careful examination should be undertaken to identify needed capabilities and specific weaknesses that could hamper their productivity.

**Guest Investigator Program**

**Program Grade: A**

**Finding:** The importance of the Guest Investigator Program in maximizing scientific returns from mission data sets and from the Heliophysics Great Observatory by broadening the types and range of scientific investigations is well recognized by NASA, and funding has been increased to maximize its effectiveness.

**Theory and Data Analysis Program**

**Program Grade: B**

**Finding:** The Heliophysics Theory and Data Analysis Program has labored under a flat funding profile. In order to fulfill its mission supporting groups of critical mass without increasing resources, the number of awards made every 3 years has been decreased. While such flat funding at least stems deterioration of capabilities in theory and modeling, it cannot foster the bold

advances envisioned by the decadal survey.

**Virtual Sun**

**Program Grade: B**

**Finding:** While no new program element has been created in response to the Virtual Sun recommendation, which proposes an interagency program to develop the theoretical and modeling framework to represent the major elements of the Sun-Earth system, some of its objectives have been achieved through existing programs. Living With a Star (LWS) TR&T, for example, supports elements of Virtual Sun that will eventually lead to improvements in space weather applications.

**RECOMMENDATIONS**

In addition to assessing NASA's progress against the decadal survey recommendations, the committee was charged with delivering recommendations that can optimize the value of NASA's heliophysics programs without altering the priorities and recommendations of the 2003 decadal survey and that can improve the next decadal survey. Based on the information and grades provided in Chapters 1 and 2 of this report, the committee made nine recommendations and wrote eight guidelines.

**Recommendations to Fulfill the Integrated Research Strategy**

The central recommendation of the decadal survey was the Integrated Research Strategy. Although it would be extremely difficult now to restore all of the content anticipated in the Integrated Research Strategy, the committee made five recommendations that could help restore key features before the end of the decade.

**Recommendation 1:** (a) If no budget augmentation is forthcoming that is large enough to support the planned Solar Probe launch date of 2017 without impacting other Heliophysics Division missions, NASA should consult with the community through a formal review mechanism (such as committees of the NASA Advisory Council or other independent, external, community priority-setting bodies) to determine Solar Probe's priority relative to other decadal survey recommendations and its launch date and (b) An implementation plan for the science objectives of the Geospace Network that includes both ionosphere-thermosphere and magnetosphere components should be developed as soon as possible in advance of lower-ranked moderate missions in the 2003 decadal survey's recommended mission queue.

**Recommendation 2:** Funding for the Heliophysics Explorer Program to recommended levels should be restored as rapidly as possible. The ramp-up in the current five-year projection budget is encouraging and should be accelerated as soon as possible.

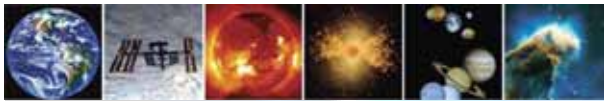
**Recommendation 3:** Funding for the Solar-Terrestrial Probes flight program should be restored to enable the recommended coordination of investigations.

**Recommendation 4:** Future Solar-Terrestrial Probes and Living With a Star missions should reduce mission requirements that exceed those assumed in the decadal survey to match resource constraints.

**Recommendation 5:** The mission management mode (principal investigator-led versus center-led) on future Solar-Terrestrial Probe and Living With a Star missions should match resource constraints. Changes in management mode and in associated overhead costs that depart from the original decadal survey should be matched by changes in mission budgets.

**Other Recommendations to Fulfill the Decadal Survey**

In addition to the Integrated Research Strategy, the 2003 decadal survey provided guidance on science challenges and made other recommendations on technology development, societal effects, education and public outreach,



(Continued from page 9)

and supporting activities. The committee made four recommendations to improve NASA's execution of the decadal survey recommendations in these areas.

**Recommendation 6:** NASA's mission roadmapping activities should seek to retain the balance and synergy of the decadal survey's Integrated Research Strategy.

**Recommendation 7:** NASA should continue to aggressively pursue the recovery of a range of launch capabilities, including replacement or restoration of the Delta II medium-lift launch vehicle, secondary payload capabilities, and access to foreign launch capabilities.

**Recommendation 8:** The future of key measurements at L1 needs to be resolved between NASA and NOAA at the earliest possible time.

**Recommendation 9:** NASA should emphasize the involvement of undergraduate and graduate students in educational outreach grants. NASA should also consider restoring facilitator positions for coordinating educational outreach efforts between researchers and NASA and should improve the coordination of education efforts between NASA's Heliophysics Division and its Office of Education.

### Guidance to Improve the Next Decadal Survey

The committee provided eight guidelines to improve the quality of the next decadal survey in solar and space physics. These guidelines are not formal recommendations to NASA, but they do give important advice for negotiating the statement of task for the next decadal survey and its committee.

**Guideline 1:** Schedules for future NASA roadmapping exercises should be phased to follow future NRC decadal surveys and midterm assessments.

**Guideline 2:** The next decadal survey should revisit any missions from the 2003 decadal survey that have not begun development at the time of the next decadal survey.

**Guideline 3:** The next decadal survey should incorporate cost thresholds beyond which NASA must consult with the community through a formal mechanism (such as committees of the NASA Advisory Council or other independent, external, community priority-setting bodies) to review a mission's continued priority.

**Guideline 4:** The next decadal survey should develop a methodology to preserve mission coordination when mission coordination is of equal or greater importance than the missions themselves.

**Guideline 5:** In addition to refining cost estimates for mission development, the next decadal survey should improve cost estimates for mission operations and data analysis.

**Guideline 6:** The next decadal survey should explicitly budget for all recommendations, not just those associated with missions, MO&DA, and research.

**Guideline 7:** The next decadal survey should maintain the practice of providing a prioritized consensus list of program recommendations.

**Guideline 8:** The next decadal survey should include a sufficient number of scientists with spaceflight investigation experience from each of the relevant subdisciplines.

## Summary of a Congressional Hearing of Interest

*Attended and summarized by  
Victoria Swisher, Research Associate*

House Committee on Science and Technology  
*Impacts of U.S. Export Control Policies on Science and Technology Activities and Competitiveness*  
February 25, 2009

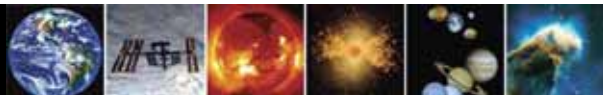
Witnesses: Lt. General Brent Scowcroft, President of the Scowcroft Group; Mr. A Thomas Young, Lockheed Martin Corporation (Retired); Professor Claude Canizares, Vice President for Research and Associate Provost at MIT; and Maj. Gen. Robert Dickman, Executive Director of the American Institute of Aeronautics and Astronautics.

Members: Bart Gordon (D-TN), Ralph Hall (R-TX), Gabrielle Giffords (D-AZ), Dana Rohrabacher (R-CA).

Chairman Gordon began the hearing noting that "National security controls that regulate access to science technology are broken." He added that it was time to take another look at the export control regime to make sure it is working effectively without significant negative impacts. Representative Hall noted that while export control is "critically important" to prevent the transfer of technologies to U.S. adversaries, the current regulations lack clear standards. Representative Rohrabacher agreed with his colleagues that ITAR needs reform, but that it was also important to realize the United States has dangerous adversaries.

Lt. General Scowcroft began his prepared remarks by saying that controls established during the Cold War no longer work as effectively because Cold War reasoning no longer applies. He suggested creating an economic competitiveness exemption for licenses (if that technology is available without restriction on the open markets outside the United States) and establishing a coordinated center for export control that would be a "one-stop shop" for licenses. Mr. Young noted that export controls protect technology critical to national security, but that right now those controls are adversely affecting national security, have a negative impact on the industrial base, and complicate relationships with international partners. Other countries have determined that it is easier to develop indigenous capabilities than to rely upon the United States because of the onerous burden of the control process. Export controls regulations need major correction by the administration and Congress, but Mr. Young emphasized that he did not believe that the controls should be abolished.

Claude Canizares stated that by 2000, one-fourth of workers in the United States were foreign nationals, and currently two-thirds of post-doctoral researchers are internationals. In this environment, the current controls are outdated and too broad. Despite the fundamental research exclusion, controls still inhibit research. Maj. Gen. Dickman said that by training foreign nationals in our universities and then forcing them to leave (because of stringent export controls), we are creating our own brain drain. He and others urged the committee to consider revising the H-1 visa process. He also noted that export controls are a major concern to the AIAA workforce, particularly the loss of knowledge and collaboration caused by those controls. During the question and answer session, Congressman Rohrabacher suggested having a dual-track system that places heavier restrictions on "nondemocratic countries like China," and Mr. Canizares and Mr. Young both said that this was a feasible, if incomplete, option. The hearing was cut short due to a vote, but Chairman Gordon said that the issue was very important and there needs to be more hearings about ITAR. He added that he would contact the president and ask him to start taking a serious look at these export control issues.



## STAFF NEWS

### DEPARTURES

The staff of the Space Studies Board is saddened by the resignation of Marcia Smith. Marcia was an enthusiastic and motivating Board Director. We all wish her well in her future endeavors and hope our paths continue to cross.

### PROMOTIONS

We are happy to announce that Carmela Chamberlain has been promoted to Administrative Coordinator and Cathy Gruber has been promoted to Editor. Carmela will be working with the new Space Studies Board/Aeronautics and Space Engineering Board Director and will be the administrative contact for both boards, in addition to working on ad hoc committees. Cathy will be increasing her editorial duties, editing reports for both the SSB and the ASEB, and working closely with the Division's editorial staff. Congratulations to both Carmela and Cathy!

### LLOYD V. BERKNER SPACE POLICY INTERNSHIP

The Lloyd V. Berkner Space Policy Internship Program selected Jordan Bock (Harvard University) and Angie Wolfgang (Cornell University) as participants in its 2009 summer session. The goal of the program is to provide promising students with the opportunity to work in the area of civil space-research policy in the nation's capital, under the aegis of the SSB. The program is currently accepting applications for graduate and undergraduate students for its 2009 autumn session. The deadline for applications is August 3, 2009. Successful candidates will be contacted no later than September 4, 2009. Additional information about the program is available at [http://www.nationalacademies.org/ssb/Berkner\\_Space\\_Policy\\_Internships.html](http://www.nationalacademies.org/ssb/Berkner_Space_Policy_Internships.html).

Angie Wolfgang is currently a senior at Cornell University. She will graduate this May as a physics major, education minor, and Merill Presidential Research Scholar. While at school, Angie does research in infrared astronomy with Cornell professor James Lloyd, and she studies star clusters with Penn State professor Jason Wright. Angie became interested in science policy when she discovered her passion for science education and began exploring careers which facilitate interaction between the scientific community and the public. When Angie is not doing research, she is volunteering for informal science education programs and mentoring high school students and younger undergraduate science majors. Her interests also include marching band, concert band, hiking, tennis, and team sports. In the fall she will be attending the University of California, Santa Cruz, for graduate school in astronomy and astrophysics.

Jordan Bock will enter her senior year this fall at Harvard University, where she majors in physics and astrophysics and minors in government. One of her academic highlights thus far was visiting the Cerro Tololo and Magellan Observatories in Chile with the Harvard astrophysics department last winter. Outside of class, Jordan enjoys serving on the board of Women in Science at Harvard-Radcliffe, chairing the house committee which governs the residential life of her college, and rowing on the women's crew team. Jordan became interested in science policy while trying to combine her love of science with her interest in government and international affairs. Last summer, she worked as a research assistant for Professor Henry Hertzfeld at the Space Policy Institute in Washington, DC, researching the role of international organizations in space. After graduating in May of 2010, Jordan intends to work for 1 to 2 years before returning to school to pursue a joint J.D. and M.P.P. with the goal of working in science policy. She is very excited to be interning at the Space Studies Board this summer.

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Autumn 2008  
Lloyd V. Berkner  
Space Policy Intern

\*Staff of other NRC Boards who are shared with the SSB

\*\*Editor as of March 14, 2009

\*\*\*Administrative Coordinator as of March 14, 2009



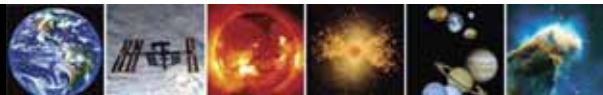
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- April 2-3      *Astro 2010-Galaxies across Cosmic Time Panel—Washington, DC*
- April 9-10    *Astro 2010-Planetary and Star Formation Panel—Irvine, CA*
- April 16-17   *Committee on Earth Studies—Washington, DC*
- April 17-18   *Astro 2010-Stars and Stellar Evolution Panel—Irvine, CA*
- April 20-22   *Committee for the Review of Near-Earth Object Surveys and Hazard Mitigation Strategies-Survey/Detection Panel—Tucson, AZ*
- April 29-30   *Committee for the Review of Near-Earth Object Surveys and Hazard Mitigation Strategies-Survey/Detection Panel—Maui, HI*
- May 6-8      *Decadal Survey on Biological and Physical Sciences in Space Steering Committee—Washington, DC*
- May 11-13    *Astro 2010 Survey Committee and joint Panel meetings—Irvine, CA*
- May 13-15    *Space Studies Board Meeting—Washington, DC*
- May 18-20    *Committee for the Review of Near-Earth Object Surveys and Hazard Mitigation Strategies-Steering Committee—Arecibo, Puerto Rico*
- May 20-21    *Committee on NASA's Suborbital Research Capabilities—Washington, DC*
- May 20-22    *The Role and Scope of Mission-Enabling Activities in NASA's Space and Earth Science Missions—Washington, DC*
- June 8-11     *Astro 2010-Program Prioritization Panels—Pasadena, CA*
- June 18-19   *Astro 2010-Stars and Stellar Evolution Panel—Woods Hole, MA*



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