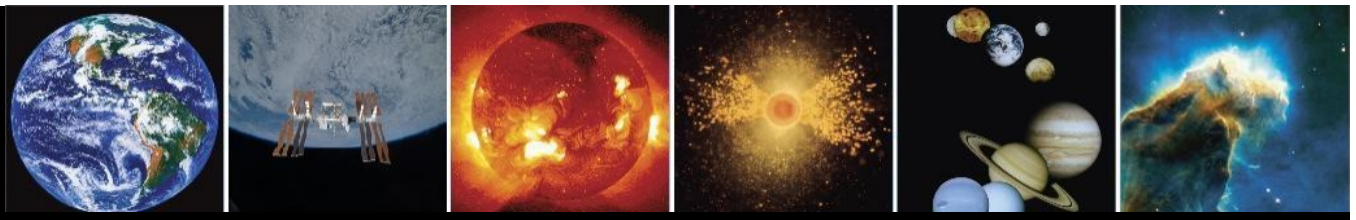
SPACE STUDIES BOARD NEWS



JANUARY—MARCH 2016

INSIDE THIS ISSUE

"A question arises: if a future privately owned operated set of LEO facilities were to include a post-ISS space station, who would pay for it? "

—SSB Chair David Spergel

The National Academies of
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JANUARY-MARCH 2015

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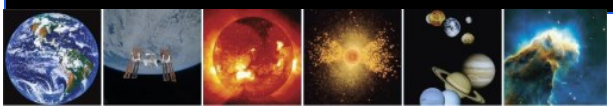

FROM THE CHAIR

What is NASA's future role in Low Earth Orbit (LEO)? Over the past 40 years, the NASA human space program has been focused on LEO. The International Space Station (ISS) is the crowning achievement of these efforts. However, the ISS may be approaching the end of its life: NASA's current plan is to end its operations in 2024. What is next?

The NRC "Pathways" report emphasized that Mars is the horizon goal for human space exploration and noted that all long-range space programs, by all potential partners, for human space exploration converge on that goal. Exploration of the red planet may reveal revolutionary insights into the origin of life and the challenge will motivate innovation in the coming decades. Over the past month, William Gerstenmaier, the Associate Administrator for Human Exploration and Operations, has made impressive presentations to both the NASA Advisory Council and the joint meeting of the ASEB/SSB that outlined a vision for NASA, first exploring cis-lunar space while developing the knowledge, procedures and systems that will enable humans to move on toward Mars. If successful, the recently announced mission planned by SpaceX to land an unmanned vehicle on Mars in 2018 could also accelerate our journey outward.

Under a flat budget, NASA cannot afford to both develop a deep space exploration program and continue to maintain the ISS if the goal is to put humans on Mars by the 2030's. NASA currently plans to operate the ISS until 2024. During the next eight years, ISS will be a platform for scientific investigations, for developing hardware for future missions, and for supporting commercial uses of LEO.

What will replace the ISS? NASA hopes that the commercial users will develop sufficient demand to motivate private industry investment and development of a post-ISS commercial space transportation infrastructure—an infrastructure that could include privately owned and operated orbital facilities. Without a thriving human presence in LEO and the vibrant space sector that such a presence would support, NASA's Mars plans could be further delayed by the need for continued expenditures and development in LEO on the part of the agency, should U.S. policy or the needs of the research community require this. If our journey to Mars relies upon a vibrant commercial market in LEO, then there is need for a viable post-ISS plan to realize that vision.

A question arises: if a future privately owned operated set of LEO facilities were to include a post-ISS space station, who would pay for it? NASA's current hope is that a successful multi-billion dollar private market for humans in LEO will materialize in the next couple of decades. While there is a thriving private industry of launch vehicle and satellite suppliers that can provide NASA with capabilities, there is currently only a small market demand for astronaut time for LEO operations. By providing the transportation to ISS and 50% of the resources accruing to the U.S. segment of the ISS (including astronaut time for research as well as power, rack space, etc.) to support the activities of the ISS National Laboratory, NASA is underwriting current commercial operations at LEO. Despite this subsidy, the private sector to date is making minimal investments in ISS experiments. Any viable business case will require multiple revenue streams, likely including tourism and international (government) commitments for utilization. It remains unclear whether potentially economically viable uses of a commercial privately-owned station will exist.

As we contemplate the post-ISS scenario, we should recognize the successes of the ISS program. The construction of ISS was one of the humanity's greatest engineering accomplishments. The ISS is also a model for US leadership, engaging nations through an exercise of "soft power" to work toward a common and technically challenging goal that conveys significant international prestige. The US has built and maintained a coalition of space-faring nations. While many nations have sent astronauts to the ISS, the US, Russia, Canada, Europe and Japan form the core of this partnership. Despite conflicting American and Russian geo-political interests , Roscosmos and NASA have maintained a very successful working relationship. Europe and Japan are the United States' two most important economic rivals and allies. Their high technology industries compete aggressively with US companies. Nevertheless, we have all recognized that we can accomplish much more in space exploration and in space science by working closely with other space agencies, including JAXA, ESA and national space agencies in Europe.

China is the one major nation missing from our ISS consortium of space-faring nations. If we were to include China as a partner, then this radically alters the landscape for the US space program and may provide an alternative path for our LEO plans.

In the 2020's, China is planning to launch Tiangong 2 - its own Space Station as a follow on to its current Tiangong orbital outpost. What if we were to use this station as the environment for our LEO human program? What if we were flying our commercial launch vehicles to

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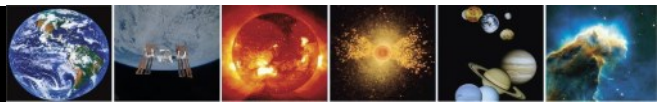

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LIAISON

CHARLES KENNEL
U.S. REPRESENTATIVE TO COSPAR

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this station as part of an international collaboration with China in LEO? Our scientific program of low gravity research in the biological and physical sciences could thrive by using a combination of US-launched robotic satellites and the Chinese station. At the same time, China would be a partner in a US-led program of leading humanity to Mars and could contribute one of the key components used in the journey.

There are risks in NASA working with China. Our relationship with Russia is a good model for any Sino-American collaboration. Russia is not our ally and there are many areas of tension between our two nations. Nevertheless, human space exploration and space sciences are areas where we have cooperated successfully. While there are significant challenges in limiting any technology transfer to China, a clear division of responsibilities and clear interfaces between contributions is both good space engineering practice and good technology security policy.

The potential rewards vastly outweigh the risks. The combined resources of the world's largest economies could enable humanity to more rapidly move outwards into deep space. The experience of working together towards common goals would likely forge friendship, and improve trust between our nations and did I mention that it could help us get to Mars?

—David Spergel, SSB Chair

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MEMBER NEWS

National Academy of Engineering

CESAS member Tony Busalacchi, Jr. and current ASEB member (former SSB member) Steve Battel were elected to the National Academy of Engineering. Dr. Busalacchi was elected for contributions to the development of subsurface flow and transport models in groundwater remediation and CO_2 sequestration and Mr. Battel was elected for engineering design and implementation of space flight systems. For more information about 2016 election see the full press release at https://www.nae.edu/Projects/MediaRoom/20095/149240/149788.aspx

New Director for the NASA Astrobiology Institute

Posing with Naica Cave gypsum crystals. *Photo courtesy of Dr. Tom Kieft, New Mexico Tech*

SSB member, Penelope Boston has been selected as the director of NASA's Astrobiology Institute, effective May 31, 2016. According to the NASA press release, "Boston will lead the NAI in fulfilling its mission to perform, support and catalyze collaborative interdisciplinary astrobiology research; train the next generation of astrobiologists; provide scientific and technical leadership for astrobiology space mission investigations; and develop new information technology approaches for collaborations among widely distributed investigators."
For more information see the full press release at http://www.nasa.gov/release/ames/nasa-selects-new-director-for-astrobiology-institute.

Ocean Worlds

The New Frontiers program is without doubt one of the jewels in the crown of NASA's planetary science activities. This billion-dollar class of principal investigator (PI) led missions is perhaps the most positive outcome of the Space Studies Board's first planetary science decadal survey, *New Frontiers in the Solar System: An Integrated Exploration Strategy* (The National Academies Press, 2002). NASA's other PI-led missions—e.g., Discovery, Mid-size Explorer, and Small Explorer—issue solicitations that are open to proposals addressing all relevant scientific goals. However, New Frontiers proposals are specifically restricted to those address key strategic themes identified via the planetary decadal survey process. Thus, it came as a surprise to many earlier this year that the draft solicitation for the fourth New Frontiers (NF-4) mission contained a strategic theme—Ocean Worlds—that was not included in the current planetary decadal survey, *Vision and Voyages for Planetary Sciences in the Decade 2013-2022* (The National Academies Press, 2011).

Thus it was with great anticipation that the members of the Committee on Astrobiology and Planetary Science (CAPS) were briefed on NASA's plans for NF-4 by Planetary Science Division Director James L. Green during Space Science Week 2016. Dr. Green explained that there has been a great deal of recent interest regarding Ocean Worlds—i.e., those icy moons of the outer solar system harboring global, subsurface oceans—in the science community, Congress, the Administration, and NASA Headquarters. This interest prompted Congress to include the following report language in the 2016 Commerce, Justice, Science, and Related Agencies Appropriations Bill ((House Report 114-130, p. 59): "The Committee directs NASA to create an Ocean World Exploration Program whose primary goal is to discover extant life on another world using a mix of Discovery, New Frontiers and flagship class missions consistent with the recommendations of current and future Planetary Decadal surveys." A key ocean world, Europa, is already the destination for a flagship-class, decadal-endorsed mission currently under development for launch in the 2020s.

Against this backdrop, Dr. Green discussed his rationale for including missions to Saturn's moons Titan and Enceladus to the scientific themes that were recommended for NF-4 in *Vision and Voyages*.

While CAPS is not chartered to provide consensus advice, it does take its prime role of overseeing the implementation of the decadal survey very seriously. As such, individual members of the committee were not shy about letting Dr. Green know what they thought—pro and con—about NASA's intention of including the Ocean Worlds theme in the announcement of opportunity for NF-4 when it is released later this year. I unashamedly use my prerogative as co-chair of CAPS to abstract what I thought were the five most compelling arguments made by individual members of CAPS during the committee's extensive discussions concerning the solicitation for NF-4.

First, that any changes to the New Frontiers program not alter the scientific priorities laid out in the current planetary decadal survey. While they were not explicitly listed as destinations for NF-4, the scientific importance of both Titan and Enceladus is discussed in detail in *Vision and Voyages*. Enceladus is identified as a potential large-mission target if additional resources were available. Similarly, Titan is identified in the decadal survey as the destination for a high-priority, but deferred, large mission. Therefore, the addition of Titan and Enceladus as potential targets for study by NF-4 is consistent with the overall scientific priorities discussed in the survey report.

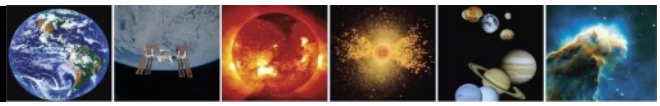
Second, while the planetary decadal survey is intended to present guidelines to NASA, any sound management approach will allow program managers the flexibility to add elements to the program as the situation changes throughout the decade. The proposed additions to NF-4 are consistent with new discoveries that have been made, and to the potential availability of additional resources and opportunities.

Third, the peer review process used by NASA to select the first three New Frontiers missions—New Horizons Pluto-Kuiper belt flyby, Juno Jupiter orbiter,

SPACE SCIENCE WEEK PUBLIC LECTURE

Alan Stern, New Horizon's Principal Investigator gave a public lecture held March 30, 2016, in conjunction with the SSB's Space Science Week. The lecture drew approximately 250 attendees and another 100 watched via the livestream. The recording is available at http://livestream.com/accounts/7036396/SSWLecture2016..

Alan Stern with the SSB Research Associates, Charlie Harris (left) and Katie Daud (right) and friend of the SSB Joshua Huminski (right) giving the nine finger Pluto salute after Dr. Stern's lecture.



(Ocean Worlds continued from page 4)

and OSIRIS REx asteroid sample-return mission—is the appropriate means to rank all of the missions that are proposed for NF-4.

Fourth, the addition of missions to Titan and Enceladus addressing the Ocean Worlds theme opens the question as to whether or not the themes recommended in *Vision and Voyages* for NF-5—i.e., Lunar Geophysical Network and Io Observer—also be included in the solicitation for NF-4. Again, it is appropriate that this decision be made by the leadership of the Planetary Science Division and the Science Mission Directorate based on a clear view of current situation and all of its scientific, programmatic and political ramifications.

Fifth, and most important of all, it is essential that whatever mission is eventually selected for NF-4 be capable of accomplishing New-Frontier-class science. And as we learned during Alan Stern's scientific presentation to CAPS and the associated public lecture during Space Science Week, last-July's flyby of Pluto by New Horizons has set a very high bar in terms of scientific discoveries.

In summary, New Frontiers offers the scientific community a unique opportunity to respond to new discoveries and new priorities. However, developing these mission concepts requires a great deal of effort and cost, and carries heavy responsibilities for those proposing, assessing, and selecting missions. Most successful missions have gone through several prior rounds of proposal, rejection, and refinement. While the science community leads the prioritization of the New Frontiers missions via the decadal survey process,, NASA is responsible for determining the goals for their program. Ultimately the selection of the mission with highest science return and likelihood of success must come from the competitive peer review process.

—Philip R. Christensen, CAPS Co-Chair

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SSB ACTIVITIES

THE BOARD AND ITS STANDING COMMITTEES

The **Space Studies Board (SSB)** did not meet during this quarter. The spring meeting will be held in Washington, DC, April 26-28, 2016. Visit <www.nas.edu/ssb> to stay up to date on board, workshop, and study committee meetings and developments.

Space Science Week (www.nationalacademies.org/spacescienceweek) was held March 29-31, 2016 in Washington, DC. All five of the SSB's active standing committees met in parallel (see descriptions of the individual standing committee meetings below). On the afternoon of March 29 the standing committees conducted a plenary session at which there was a presentation on the NASA SMD budget and its current program and priorities by John Grunsfeld, SMD Associate Administrator. The committees then held a focus session on International Programs and Cooperation which began with individual presentations from Fabio Favata, ESA, Maurice Borgeaud, ESA, Chi Wang, CAS, Masaki Fujimoto, JAXA, and Pascal Ehrenfreund, DLR. That was followed by a discussion panel where the international members were joined by John Grunsfeld, NASA and moderator David Spergel, SSB Chair. The afternoon concluded with a briefing from Vicky Hamilton, Southwest Research Institute and co-chair for the Committee on NASA Science Mission Extension on the committee's progress; a briefing by Tom Hammond, House Science, Space and Technology Committee; and a briefing from Angela Jackman from NASA's Marshall Space Flight Center on the use of the Space Launch System for science.

This year there was no snow falling during Space Science Week, March 29-31., instead the cherry blossoms were blooming. *Photo courtesy or Dwayne Day, ASEB staff*

On the evening of March 30, the **Space Science Week Public Lecture** by Alan Stern, Southwest Research Institute, Principal Investigator for New Horizons. To view a video replay of *Mission to Pluto: Exploring the Frontier of Our Solar System*, please visit http://sites.nationalacademies.org/SSB/SSB_170496.

The **Committee on Astrobiology and Planetary Science (CAPS)** held its first meeting of 2016 in conjunction with the SSB's annual Space Science Week. A new co-chair—Christopher House (Pennsylvania State University) — and seven new members—Bethany Ehlmann (California Institute of Technology), Kevin Hand (Jet Propulsion Laboratory), Sarah Horst (Johns Hopkins University), William McKinnon (Washington University), David Stevenson (California Institute of Technology), Sarah Stewart (University of California, Davis), and Elizabeth Turtle (Applied Physics Laboratory)—made their debut. The committee heard briefings on the status of NASA's Planetary Science Division, Mars exploration activities, and astrobiology program by James Green, James Watzin, and Mary Voytek, respectively. Athena Coustenis (Paris Observatory) gave an update on ESA's planetary science missions and Gerda Hornek (German Aerospace Center, retired)

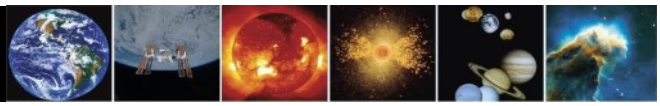
described the results of the AstRoMap Astrobiology roadmap study. Presentation on the results from the New Horizon's mission to Pluto and Dawn mission to Ceres were given by Alan Stern (Southwest Research Institute) and Christopher Russell (University of California, Los Angeles). Caleb Scarf (Columbia University) described the results of a recent workshop to define a strategy for origins of life research and Carolyn Porco (Space Science Institute) presented the case for future studies of Enceladus. In addition, the committee continued its close oversight of planning for a Europa mission. The committee's discussions also included the pros and cons for the inclusion of "ocean worlds" missions in the call for the fourth New Frontiers mission (see separate item by Philip Christensen) and the draft statement of task for the forthcoming midterm decadal review. The next meeting of CAPS will be held at the Academies' Beckman Center in Irvine, California, on September 14-15. To learn about upcoming meetings, and download presentations from past meetings, please visit http://sites.nationalacademies.org/SSB/SSB_067577.

John Grunsfeld presenting during the plenary session of the SSB's Space Science Week, March 29, 2016. *Photo courtesy of Dwayne Day, ASEB staff*

The **Committee on Astronomy and Astrophysics (CAA)** met in-person during Space Science Week on March 29-31, 2016. The CAA met by itself on the morning of March 29, all day March 30 and the morning of March 31. The afternoon of March 29 was spent in plenary with all five standing committees. The CAA meeting featured presentations from Alan Dressler on the report *The Space Science Decadal Surveys: Lessons Learned and Best Practices*; Vicky Kalogera on LIGO and Gravitational Wave Astrophysics; Paul Hertz on NASA Astrophysics Division activities; Angela Olinto on the Astronomy and Astrophysics Advisory Committee Annual Report; Jim Ulvestad on NSF Division of Astronomical Sciences activities; and Kathy Turner on DOE HEP Activities. The meeting also featured much discussion of planning for the next decadal survey in astronomy and astrophysics. Prior to this meeting the CAA held a teleconference to conduct its annual balance and composition discussion and review the agenda for the March 29-31 meeting. For more information about the CAA, and to download presentations from past meetings, please visit http://sites.nationalacademies.org/BPA/BPA_048755.

The **Committee on Biological and Physical Sciences in Space (CBPSS)** held a meeting March 29-31 at the NAS Building in Washington, DC as part of Space Science Week, an annual Space Studies Board sponsored series of meetings and lectures. The primary focus of the meeting was a 1-day symposium titled **"Research In Commercial LEO"** that had been planned and coordinated by the committee with the input of CASIS and NASA following the committee's October meeting. The symposium was organized to explore the landscape in which commercial support for research in LEO is evolving by bringing together participants from the potential commercial provider and customer communities for research services in LEO, along with key players in the development of a commercial ecosystem. The event included presentations, moderated panel sessions, and roundtable discussion among the committee, speakers, and key NASA and CASIS participants. The providers panel featured industry representatives such as Bigelow Aerospace, Sierra Nevada, Orbital ATK, and NanoRacks. The afternoon panel featured a diverse range of customer perspectives from Eli Lilly, Merck, ACME Advanced Materials, Inc., LaunchPad Medical, and Purdue University. The meeting participants also heard about NASA planning for commercial LEO from Sam Scimemi, NASA headquarters, LEO Ecosystems from Cynthia Bouthot and Michael Roberts of CASIS, and economic considerations for LEO research platform markets from Ioana Cozmuta, NASA Ames Research Center. During the meeting the committee also received a status update from Marshall Porterfield, NASA on the life and physical sciences program and discussed the upcoming mid-term review of the Decadal Survey. More information about the committee and its membership can be found at http://sites.nationalacademies.org/SSB/SSB_145312.

The **Committee on Earth Science and Applications from Space (CESAS)** met March 29-30 during the Space Studies Board's annual Space Science Week at the National Academy of Sciences building in Washington, DC. Principal agenda items included a discussion with Lawrence Friedl, Director, NASA Applied Sciences Program; a discussion about the European Earth Observation Programs with Jean-Luc Bald, EU and Maurice Borgeaud, ESA; a discussion on implementing the Value-Framework of the "Continuity" Report with Byron Tapley, UT Austin; Bruce Wielicki, NASA LaRC; and Randy Friedl, JPL (by telephone); a discussion on big data and Earth science with Ed Kearns, NOAA; and Earth science research on the International Space Station with Julie Robinson, ISS Chief Scientist, NASA. The next CESAS meeting will be in fall 2016 in Washington, D.C. The CESAS website, http://sites.nationalacademies.org/SSB/SSB_066587, has further infor-



mation about the committee and its members, as well as links to the presentations made to the committee during Space Science Week and during other recent meetings.

The **Committee on Solar and Space Physics (CSSP)** met March 29-31, 2016 in Washington, DC, as part of Space Science Week. At the meeting, CSSP heard briefings from Michael Liemohn, University of Michigan, on topics from the NASA Advisory Council Science Committee – Heliophysics Subcommittee and from Byron Tapley, University of Texas at Austin, chair of the study on *Continuity of NASA Earth Observations from Space: A Value Framework.* The committee received updates from Steven Clarke, NASA, on the NASA Heliophysics Division, from Thomas Berger, NOAA, on the Space Weather Prediction Center, from Therese Moretto-Jorgensen, NSF, on the Geospace Division, and from David Boboltz, NSF, on the Astronomy Division and the National Solar Observatory and the Daniel K. Inouye Solar Telescope. The committee also held discussions on NASA's Living With a Star program and decadal survey goals, NASA's Solar Terrestrial Probes Program, heliophysics science centers, and a panel discussion on the National Space Weather Action Plan with representatives from NOAA, NASA, NSF, and DoD. The committee also began a discussion of planning for the Solar and Space Physics Decadal Survey Midterm Assessment, preparing material on their discipline for the transition team of an incoming administration, and details of the CSSP's rotation of committee members for Fall 2016. The committee has also met via teleconference monthly to discuss current events and for meeting planning. Further information about the committee is available at http://sites.nationalacademies.org/SSB/SSB_052324.

STUDY COMMITTEES

The **Committee on Achieving Science Goals with CubeSats** sent several members to attend a forum on Performing High-Quality Science on CubeSats hosted by the International Space Science Institute in Bern, Switzerland, on January 19-20, 2016. The committee's draft report entered review in March 2016, and the prepublication report is expected to be available in May 2016. More information about this project is available at: http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_160539.

Membership for the **Committee on the Assessment of the National Science Foundation's 2015 Geospace Portfolio Review** has been appointed. Pending the expected release of the Geospace Portfolio Review in April, the committee will begin planning for their first meeting shortly afterwards. More information about this project is available at: http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_169109.

The **2017-2027 Decadal Survey for Earth Science and Applications from Space (ESAS 2017)** is underway. Sponsored by NASA, NOAA, and the USGS, the survey will produce a report by July 31, 2017 that will:

- Assess progress in addressing the major scientific and application challenges outlined in the 2007 survey;
- Develop a prioritized list of top-level science and application objectives to guide space-based Earth observations over the survey interval;
- Identify gaps and opportunities in the programs of record at NASA, NOAA, and USGS in pursuit of the top-level science and application challenges—including space-based opportunities that provide both sustained and experimental observations; and
- Recommend—considering science priorities, implementation costs, new technologies and platforms, interagency partnerships, international partners, and in situ and other complementary programs—approaches to facilitate the development of a robust, resilient, and appropriately balanced U.S. program of Earth observations from space.

Like the 2007 inaugural decadal survey (http://www.nap.edu/openbook.php?record_id=11820), ESAS 2017 will help shape science priorities and guide agency investments into the next decade. Detailed information about the survey and a calendar of upcoming events is availableat www.nas.edu/esas2017.

Notable events in the past quarter included the organization of a Town Hall on January 13, 2016 at the 96th annual meeting of the American Meteorological Society; the organization of a Town Hall on February 22, 2016 at the Ocean Sciences Meeting; the announcement of the Study Panels that will support the decadal survey steering committee; and the release of a second "Request for Information." As the quarter ended, nominations for the survey study panels committee were being finalized. In addition, plans were underway for a joint meeting of the steering committee and the study panels on June 2-5, 2016 at the Beckman Center on the UC Irvine campus. The survey will be supported by several study panels and working groups; in total some 100 members of the community are expected to participate on one or more of the survey's committees. For further information, please visit the survey website; for questions not answered on the site, please write to esas2017@nas.edu.

The **Committee on Large Strategic NASA Science Missions: Science Value and Role in a Balanced Portfolio** was initiated in March. Recruitment of committee members has begun and it is expected that the first meeting will occur in the early summer.

The **Committee on NASA Science Mission Extensions** was named in October and held its first in-person meeting February 1-2, 2016 at the Keck Center in Washington DC and the second meeting March 2-4, 2016 at the Beckman Center in Irvine. The committee's third meeting was scheduled for April 18-20 at the NAS Building in Washington, DC. The committee is drafting its final report, which is due for delivery later this summer. The com-

The SSB's sister Board, the Aeronautics and Space Engineering Board, also publishes a newsletter; visit <http://sites.nationalacademies.org/DEPS/ASEB/DEPS_046908> to subscribe or to view past newsletters. SSB's division, the Division on Engineering and Physical Sciences, also pub-

(Study Committees continued from page 7)

mittee will be looking at the process by which NASA conducts science mission extensions. More information about this project can be found at: http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_169078.

The **Review of NASA's Planetary Science Division's Restructured Research and Analysis Programs** was formally initiated toward the end of the final quarter of 2015. Recruitment on committee members commenced in the New Year and a slate of nominees has been submitted for approval. It is anticipated that the committee's first meeting will take place at the NAS building in Washington, D.C., on May 12-13. The second and third meetings are scheduled for August 16-18 (Keck Center, Washington, DC) and September 21-23 (Jonsson Center, Woods Hole, MA). The committee's report is scheduled to be delivered to NASA by December 2016. Additional information about this project can be found at http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_169563.

The **Committee to Review of Progress Toward the Decadal Survey Vision in New Worlds, New Horizons in Astronomy and Astrophysics,** chaired by Jacqueline Hewitt held a splinter session at the American Astronomical Society meeting on January 5, 2016 to gather community input. The committee held its third meeting on January on January 11-13, 2016, in Washington, D.C. At this meeting the committee spoke with NASA APD, NSF AST, and DOE HEP, and spent most of the meeting in closed session. The fourth and final meeting of the committee, held on February 26-27, allowed the committee to have further discussions with NASA, NSF, and DOE and to work on the report in closed session. For more information on the project please visit: http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_161177.

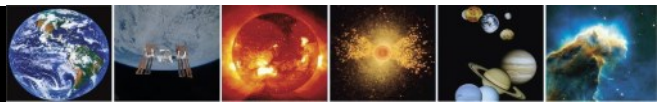
Searching for Life Across Space and Time: A Workshop, is currently recruiting individuals for membership of the committee scheduled to organize the aforementioned workshop in the final quarter of 2016. The workshop was requested by NASA to address issues relating to the detection of solar system and extrasolar planetary systems.

OTHER ACTIVITIES

The **Forum for New Leaders in Space Science,** a cooperative activity between the Academies and the Chinese Academy of Sciences (CAS) designed to provide opportunities for a highly select group of young space scientists from China and the United States to discuss their research activities in an intimate and collegial environment, will hold the second meeting of its second cohort of young scientists at the Academies' Beckman Center in Irvine, California on May 16-17, 2016. Scientific discussions in Irvine will focus on planetary science and Earth science from space. Funding has now been secured to facilitate the recruitment of a third cohort of young scientists in the third quarter 2016 and to hold the fifth and six forums in Beijing and Woods Hole in December, 2016 and May, 2017, respectively. Additional details will be made available as soon as discussions with CAS have been concluded. Additional details can be found at http://sites.nationalacademies.org/SSB/SSB_086017.

COSPAR: Planning for COSPAR 2018 passed another milestone with the successful conclusion of the inspection tour of the Pasadena Convention Center, adjacent hotels and other facilities by COSPAR's leadership on January 25-26. Two months later, Gregg Vane, chair of the Pasadena 2018 Local Organizing Committee, and Thomas Prince and Rosaly Lopes, chair and vice chair, respectively, of the Pasadena 2018 Science Program Committee, gathered first hand experience on the organizing of a major COSPAR event by participating in the final organizing meeting for 2016 Istanbul Scientific Assembly held at COSPAR headquarters in Paris, France on March 22. The March 2016 Paris business meetings that also featured annual meetings of the COSPAR Scientific Advisory Committee (March 23) and Bureau (March 24) and the first organizing meeting (March 21) for the third of COSPAR's new series of "off-year" topical symposia. The theme of the third symposium is "space research with new technology: from nano to micro satellites and beyond." The third symposium is tentatively scheduled to be held on Jeju Island, South Korea on September 18-22, 2017. held in Istanbul, Turkey, on July 30 -7 August, 2016, and Pasadena, California on 14-22 July, 2018, respectively. The next milestone in the planning for the latter is. The next round of COSPAR business meetings will be held at the organization's Paris headquarters on March 22-24, 2016.

Planetary Protection for Outer Solar System Bodies: The first meeting of the steering group for this complex, multifaceted European initiative was held at the Paris headquarters of EuroSpace on March 25. This 3-year activity, funded via the European Union's Horizon 2020 funding program and organized by the European Science Foundation is designed to address a series of closely related topics in the general area of planetary protection. Specific task included with PPOSS include the hosting of a planetary protection website, the drafting of a textbook describing planetary-protection best practices, the construction of a roadmap of planetary-protection technologies, a series of education/training seminars on planetary protection, and discussion/deliberations on planetary protection issues for the icy bodies of the outer solar system. The SSB has observer status on the steering group and is not a formal participant in any of its activities. PPOSS' next major activity will be a workshop to be held on the margins of the COSPAR Scientific Assembly in Istanbul, Turkey, on July 31.



FORUM for NEW LEADERS in SPACE SCIENCE

中國科學院 CHINESE ACADEMY OF SCIENCES

NATIONAL ACADEMY OF SCIENCES

The National Space Science Center of the Chinese Academy of Sciences and the Space Studies Board of U.S. National Academies of Sciences, Engineering, and Medicine are pleased to invite applications to participate in the ***2016-17 Forum for New Leaders in Space Science***. The Forum, initiated in 2014, is designed to provide opportunities for a highly select group of young Earth and space scientists from China and the United States to discuss their research activities in an intimate and collegial environment at meetings to be held in China and the United States.

The goals of the Forum are threefold:

1. To identify and highlight the research achievements of the best and brightest young scientists currently working at the frontiers of their respective disciplines;
2. To build informal bridges between the Earth- and space-science communities in China and the United States; and
3. To enhance the diffusion of insights gained from participation in the Forum to the larger Earth- and space-science communities in China and the United States.

The 1st and 2nd Forums were held in Beijing and the Irvine, California in May and November, 2014, respectively. The 3rd Forum was held, in Shanghai on 9-10 October, 2015 and the 4th Forum will be held in Irvine, California on 16-17 May, 2016. The 5th and 6th Forums will be held in Beijing and Woods Hole, Massachusetts, on 2-3 December, 2016, and 16-17 May, 2017, respectively. The scientific scope of the 5th and 6th Forums is limited to the biological/biomedical and physical (including fundamental physics) research in the space environment. Both events will include focused presentations by young scientists, topical presentations by senior scientists and group discussions. Participants will be selected by an International Program Committee. The travel and subsistence costs for U.S. participants will be paid by the U.S. Academies. Travel costs for Chinese participants will be paid by their own organizations. Three nights of local accommodation plus selected meals and transportation to/from the meeting site will be provided by the local host organization.

Eligibility

The Forum is open to all active researchers meeting the following criteria:

1. Hold an academic/research position at the postdoctoral level or above at a university or research institute in China or the United States;
2. Be no more than 40 years old on 30 June, 2017;
3. Be sufficiently proficient in written and spoken English to be an active participant in high-level scientific discussions;
4. Be eligible to obtain the visa necessary to permit travel to China and the United States;
5. Be available to participate in both the December and May Forums; and
6. Be currently engaged in biological/biomedical and physical (including fundamental physics) research in the space environment.

How to Apply

All applicants must submit the following documents (in pdf format and in English):

1. A one-page letter outlining why you wish to participate in the Forum.
2. A resume, including a list of peer-reviewed scientific publications.
3. A 2-page abstract (minimum 750 words, maximum 1000 words) of the presentation you wish to give at the Forum in December, 2016. The abstract must include a title, your name, academic affiliation and all necessary references. Figures, equations, and special characters should only be used only if absolutely essential. Multi-author abstracts are strongly discouraged.
4. The title of a substantially different presentation you wish to make at the Forum in May, 2017.
5. Letters of recommendation from two faculty members familiar with your work. Recommendations should be in pdf. format, on institutional stationery, signed by their authors and sent directly to the Program Committee at the email addresses listed below.
6. Current contact information including name, gender, date of birth, citizenship, mailing address, telephone numbers, and email address

All application materials must be emailed to both cas-nas-forum@nssc.ac.cn and dhsmith@nas.edu. ***Incomplete applications and application materials received after 24 June, 2016, will not be considered.***

Individuals residing in China may direct enquiries to Dr. Quanlin FAN at cas-nas-forum@nssc.ac.cn

Individuals residing in the United States may direct enquiries to Dr. David H. SMITH at dhsmith@nas.edu

A representative of the International Program Committee will contact successful applicants no later than 12 August, 2016.

Staff News

Su Liu joined us as a senior accounting/financial assistant for the Space Studies Board and the Aeronautics and Space Engineering Board. She comes from Kansas State University where she was an accountant. She holds an M.A. from University of Illinois at Urbana-Champaign, and a B.S. from Kansas State University.

Nathan Boll joined the SSB for 12 weeks from January to April as a 2016 Christine Mirzayan Science and Technology Policy Graduate Fellow. Nathan is a graduate fellow at the Space Policy Institute of George Washington University where he is completing an M.A. in international science and technology policy at the Elliott School of International Affairs. His current focus is on building international and intergovernmental cooperation toward the exploration and development of outer space. Nathan holds an M.S. in space science and a graduate certificate in science, technology and public policy from the University of Michigan, as well as a B.S. in mathematics from the University of Montana Western. His research has included environmental analysis of Venus and Mars, and the development of the CYGNSS satellite constellation. Nathan has recently served in various divisions of NASA, including the Office of International and Interagency Relations and the Office of Education Infrastructure Division at NASA Headquarters, the NASA Space Academy and the Multidisciplinary Aeronautics Research Team Initiative programs at the Glenn Research Center, and the Planetary Science Division of the Jet Propulsion Laboratory. Throughout, he has maintained a commitment to public service, completing multiple terms as a member of the Montana Space Grant Consortium Advisory Board and as an elected leader of student government.

SSB STANDING COMMITTEES

Committee on Astrobiology and Planetary Science (CAPS)

Philip R. Christensen, Arizona State University (Co-Chair)
J. Gregory Ferry, Pennsylvania State University (Co-Chair) *through January 2016*
Christopher H. House (Co-Chair) *from March 2016*

Committee on Astronomy and Astrophysics (CAA)
(joint with the Board on Physics and Astronomy)

Steven Ritz, University of California, Santa Cruz (Co-Chair)
Marcia Rieke, University of Arizona (Co-Chair)

Committee on Biological and Physical Sciences in Space (CBPSS)
(joint with the Aeronautics and Space Engineering Board)

Elizabeth Cantwell, Lawrence Livermore National Laboratory (Co-Chair)
Robert J. Ferl, University of Florida (Co-Chair)

Committee on Earth Science and Applications from Space (CESAS)

Michael D. King, University of Colorado, Boulder (Co-Chair) *from March 2016*
Joyce E. Penner, University of Michigan (Co-Chair)

Committee on Solar and Space Physics (CSSP)

J. Todd Hoeksema, Stanford University (Co-Chair)
Mary K. Hudson, Dartmouth College (Co-Chair)

For more information, go to <http://sites.nationalacademies.org/SSB/ssb_052296>.

SSB Staff

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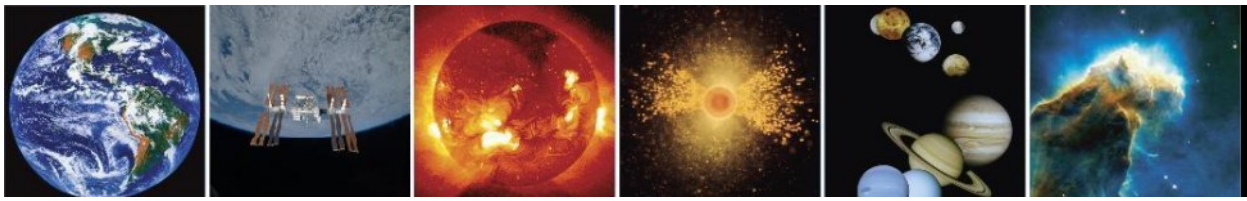
NATHAN BOLL
Christine Mirzayan Science and Technolgy Policy Graduate Fellow

* Staff of other Academies boards who are shared with the SSB.


Astronomy Festival
On the National Mall
Friday, June 10, 6 -11 pm
North of the Washington Monument
15th Street NW and Constitution Ave.
Rain date: June 11th, Catholic University of America Metro: Brookland-CUA station
Free day/night telescope observations with
Close-up views of the Sun, Moon, Jupiter, Saturn and Mars
Planetarium shows under a 25 - foot portable dome
Hands-on interactive exhibits
Organized by Dr. Donald Lubowich
Sponsored by Hofstra University
www.hofstra.edu/dcstars
Image: ©Geoff Chester



SSB Calendar

April

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April 18-20, 2016	NASA Science Mission Extensions	Washington, DC
April 26-28, 2016	Space Studies Board Meeting	Washington, DC
May 12-13, 2016	Review of NASA's Planetary Science Division's Restructured Research and Analysis Program	Washington, DC
May 13-14, 2016	Assessment of the National Science Foundation's 2015 Geospace Portfolio Review	Washington, DC
May 16-17	Forum for New Leaders in Space Science	Irvine, CA
June 2-5	Decadal Survey for Earth Science and Applications from Space Steering Committee Panel on Global Hydrological Cycles and Water Resources Panel on Weather and Air Quality: Minutes to Subseasonal Panel on Marine and Terrestrial Ecosystems and Natural Resource Management Panel on Climate Variability and Change: Seasonal to Centennial Earth Surface and Interior: Dynamics and Hazards	Irvine, CA

More information on the SSB and ASEB Board meetings can be found at <http://sites.nationalacademies.org/SSB/SSB_054577 > (SSB) and <http://sites.nationalacademies.org/DEPS/ASEB/DEPS_058923> (ASEB)

Our meeting facilities

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Washington, DC

Keck Center
500 Fifth St NW,
Washington, DC

Arnold and Mabel Beckman
100 Academy Drive
Irvine, CA

J. Erik Jonsson Conference Center
314 Quissett Ave
Woods Hole, MA

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- ☐ Review of the Draft 2014 Science Mission Directorate Science Plan (2014)
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- ☐ The Role of Life and Physical Sciences (2012) Booklet
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- ☐ Assessment of a Plan for U.S. Participation in Euclid CD Only
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- ☐ Report of the Panel on Implementing Recommendations from the New Worlds, New Horizons Decadal Survey (2012)
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