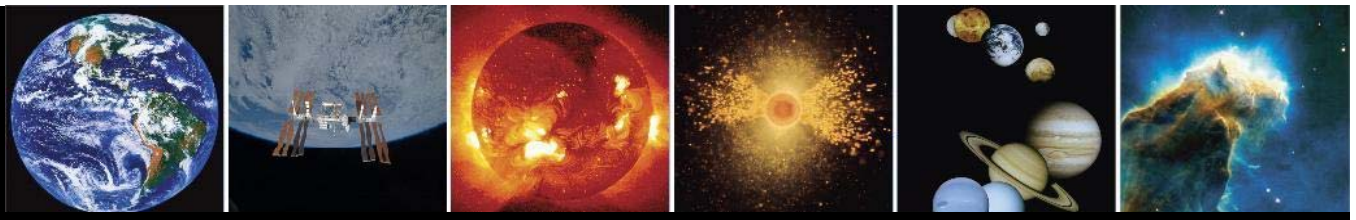
SPACE STUDIES BOARD NEWS



JANUARY—MARCH 2012

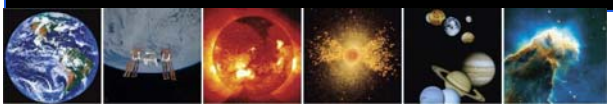
INSIDE THIS ISSUE

"Are the big issues paralyzing creativity everywhere in NASA space science? We cannot let that happen. These big issues are slowing us down, but they are not going to stop the progress of space science. Remember that NASA, and the science and engineering community that it leads, is the greatest repository of knowledge and techniques regarding space science on the planet."

Charles F. Kennel, Chair, SSB

JANUARY—MARCH 2012

SPACE STUDIES BOARD NEWS



FROM THE CHAIR

If I were back at NASA Headquarters, the present state of NASA science would have me thoroughly perplexed, and I can only imagine that our colleagues there who are responsible today for ensuring the success of American space science must be equally perplexed. Or more so, for they live day-by-day with stresses that a chair of the Space Studies Board can only see dimly, or not at all. But what I do see is worrying enough, or perhaps it is what I do not see that is worrying me. That is, I do not see how Congress and the Administration will decide on long-term deficit reduction and how that will mold NASA's vision of its future.

I do see that NASA's human spaceflight enterprise is in the midst of a profound transition from which it will take a decade or more to emerge, but, quite frankly, I cannot see that far. (Perhaps the forthcoming NRC study on the long-range goals of the human spaceflight enterprise will help.) Without a settled direction for human spaceflight and the public clarity that goes with it, this is bound to unsettle those planning the future of space science at NASA.

I do see that NASA will soon run out of launchers for the mid-size payloads so important to science, but I do not see what will take their place. I do see that the troubles with the James Webb Space Telescope have placed a major burden on all of NASA, but I do not see whether or when the NASA Astrophysics Division will be able to proceed with the *New Worlds, New Horizons* decadal's first priority large space-based mission, the Wide-Field Infrared Space Telescope. We had thought of it, after all, as a relatively modest technical challenge.

I do see that the Administration, wary of making new long-term commitments at a time when it knows it has to engage in deficit reduction, cancelled a well-planned joint program of Mars science with the European Space Agency. I do not see what will take its place. I do see that NASA's Planetary Science Division is engaging in discussions about a joint program with NASA's Human Explorations and Operations Mission Directorate, but I wonder whether dependence on a program whose long-term direction I cannot see is a good way to move Mars science along.

These are the big things that anyone who follows NASA can see; what about the many other smaller things that our colleagues are also responsible for? Are the big issues paralyzing creativity everywhere in NASA space science? We cannot let that happen. These big issues are slowing us down, but they are not going to stop the progress of space science. Remember that NASA, and the science and engineering community that it leads, is the greatest repository of knowledge and techniques regarding space science on the planet. Now is the time to draw on that community for inspiration and new ideas. It is, paradoxically, a time for science managers to take risks. Measured ones.

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One thing I learned during my watch at Headquarters was that billion-dollar programs have a billion dollars worth of fingerprints all over them. My job was only to try to navigate such programs through seas made stormy by forces far beyond my influence. But a sum that was small to Headquarters—say $10 million—is still a lot of money and here I had discretion in how it would be spent; moreover I found that relatively small sums can have a liberating impact. Indeed, the smaller programs are one area where we can work while we wait for the big issues to sort themselves out (or not). When we do this, we pay attention to the faint first whispers of new ideas, and we seed the future.

Upcoming Events

Workshop on Lessons Learned in Decadal Planning in Space Science
to be held during the November 12-14, 2012 Space Studies Board meeting

SSB Standing Committees'
Space Science Week
March 6-8, 2013
Washington, DC

Seen from the grounds of the Steven F. Udvar-Hazy Center: Space Shuttle Discovery (top) and Space Shuttle Enterprise (middle and bottom). Photos courtesy of Dwayne Day.

SSB MEMBERSHIP

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ROBERT P. LIN
University of California, Berkeley

For more information on SSB membership, visit our website at <http://www.nationalacademies.org/ssb>.

SSB STANDING COMMITTEES

Committee on Astrobiology and Planetary Science (CAPS)

The overarching purpose of CAPS is to support scientific progress in astrobiology and planetary science and assist the federal government in integrating and planning programs in these fields. CAPS's scope spans space-based and supporting ground-based planetary research within our own solar system, including, for example, geosciences, atmospheres, particles and fields of planets, moons, and small bodies, as well as astrobiology, planetary astronomy, and planetary protection. CAPS provides an independent, authoritative forum for identifying and discussing issues in astrobiology and planetary science between the research community, the federal government, and the interested public.

Philip R. Christensen, Arizona State University (Co-Chair)
J. Gregory Ferry, Pennsylvania State University (Co-Chair)
Sushil K. Atreya, University of Michigan
Amy C. Barr, Brown University
Richard P. Binzel, Massachusetts Institute of Technology
John Clarke, Boston University
Geoffrey Collins, Wheaton College
Pascale Ehrenfreund, George Washington University
Linda T. Elkins-Tanton, Carnegie Institution for Science
G. Scott Hubbard, Stanford University
Laurie A. Leshin, Rensselaer Polytechnic Institute
Stephen Mackwell, Lunar and Planetary Institute
Michael Russell, Jet Propulsion Laboratory
Gary Ruvkun (NAS, IOM), Harvard Medical School
Gerald Schubert (NAS), University of California, Los Angeles
Barbara Sherwood Lollar, University of Toronto
Norman H. Sleep (NAS), Stanford University
Cristina Takacs-Vesbach, University of Mexico
Roger Yelle, University of Arizona

Staff David H. Smith, Senior Program Officer, SSB
Amanda Thibault, Research Associate, ASEB
Rodney N. Howard, Senior Program Assistant, SSB

Committee on Astronomy and Astrophysics (CAA)

(joint with the Board on Physics and Astronomy)

The overarching purpose of CAA is to support scientific progress in astronomy and astrophysics and assist the federal government in integrating and planning programs in these fields. CAA's scope spans the full range of astronomy and astrophysics research, including space- and ground-based observations. CAA's domain encompasses stellar, galactic, and extragalactic astronomy, particle astrophysics, cosmology, the search for extra-solar planets, and aspects of fundamental physics relating to astronomical objects. CAA's scope also includes appropriate cross-disciplinary areas. CAA provides an independent, authoritative forum for identifying and discussing issues in astronomy and astrophysics between the research community, the federal government, and the interested public.

Paul L. Schechter, MIT (Co-Chair)
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Jeremiah K. Darling, University of Colorado, Boulder
Megan Donahue, Michigan State University
Debra Fischer, Yale University
Joshua A. Frieman, Fermilab and University of Chicago
Charles F. Gammie, University of Illinois, Urbana-Champaign
Timothy M. Heckman, Johns Hopkins University
Lynne Hillenbrand, California Institute of Technology
Robert P. Kirshner (NAS), Harvard-Smithsonian Center for Astrophysics
Christopher F. McKee (NAS), University of California, Berkeley
Rene A. Ong, University of California, Los Angeles
Eve C. Ostriker, University of Maryland, College Park
Marcia J. Rieke, University of Arizona
J. Craig Wheeler, University of Texas, Austin
Eric M. Wilcots, University of Wisconsin, Madison
A. Thomas Young (NAE), Lockheed Martin (retired)

Staff David Lang, Program Officer, BPA
Lewis Groswald, Research Associate, SSB
Dionna Williams, Program Associate, SSB

Committee on Earth Science and Applications from Space (CESAS)

The overarching purpose of CESAS is to support scientific progress in Earth system science and applications, with an emphasis on research requiring global data that are best acquired from space. CESAS's scope includes programs that develop a scientific understanding of the Earth system and its response to natural and human-induced changes in order to enable improved prediction of climate, weather, and natural hazards for present and future generations. These programs include an end-to-end approach encompassing observations from space-based and suborbital platforms, data and information management, research and analysis, modeling, scientific assessments, applications demonstration, technology development, and education. CESAS provides an independent, authoritative forum for identifying and discussing issues in earth sciences and applications from space between the research community, the federal government, and the interested public.

Mark R. Abbott, Oregon State University (Chair)
Joyce E. Penner, University of Michigan (Vice Chair)
Steven A. Ackerman, University of Wisconsin, Madison
Stacey W. Boland, Jet Propulsion Laboratory
Antonio J. Busalacchi, Jr. University of Maryland
Lennard A. Fisk (NAS), University of Michigan
Lee-Lueng Fu (NAE), Jet Propulsion Laboratory
Inez Y. Fung (NAS,) University of California, Berkeley
Efi Foufoula-Georgiou, University of Minnesota, Twin Cities
Chelle L. Gentemann, Remote Sensing Systems
Kenneth C. Jezek, Ohio State University
Molly K. Macauley, Resources for the Future
Michael D. King (NAE), University of Colorado, Boulder
Walter S. Scott, Digital Globe, Inc.
David L. Skole, Michigan State University
William F. Townsend, Independent Aerospace Consultant
Steven C. Wofsy (NAS), Harvard University

Staff Arthur A. Charo, Senior Program Officer, SSB
Lewis Groswald, Research Associate, SSB
Terri Baker, Senior Program Assistant, SSB

Committee on Solar and Space Physics (CSSP)

(On hiatus during the solar and space physics decadal survey)

The overarching purpose of CSSP is to support scientific progress in solar and heliospheric physics, plasma physics, magnetospheric physics, aeronomy, physics of the upper atmospheres of Earth and other planets, solar-planetary interactions, and cosmic ray physics. CSSP's scope spans areas of those physical sciences that can be conducted from space and via ground-based activities in support of space-based efforts, such as modeling and laboratory work. CSSP provides an independent, authoritative forum for identifying and discussing issues in solar, heliospheric and space physics between the research community, the federal government, and the interested public.

Staff Arthur A. Charo, Senior Program Officer, SSB
Abigail Sheffer, Associate Program Officer , SSB
Amanda Thibault, Research Associate, ASEB
Linda M. Walker, Senior Program Assistant, SSB

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

SSB ACTIVITIES

THE BOARD AND ITS STANDING COMMITTEES

The **Space Studies Board (SSB)** did not meet during the first quarter of 2012. The SSB spring meeting was held in the second quarter, April 4-5, in Washington, DC. The first day of the meeting was a joint session with the Aeronautics and Space Engineering Board where the boards heard from Gale Allen from NASA's Office of the Chief Scientist, Mason Peck, NASA's Chief Technologist, Bill Gerstenmaier, Associate Administrator for NASA's Human Exploration and Operations Mission Directorate, as well as NASA's Associate Administrator Robert Lightfoot. The boards also received updates from OSTP, OMB, and Senate and House staffers. On April 5 the boards met individually. SSB had discussions with NASA Science Mission Directorate (SMD) Deputy Associate Administrator Chuck Gay, and SMD Division directors and also received updates from NOAA and NSF representatives. The Board's next meeting and a workshop on Lessons Learned in Decadal Planning in Space Science will be held November 12-14. Please visit <http://www.nas.edu/ssb> to stay up to date on board, workshop, and study committee meetings and developments.

The **Committee on Astronomy and Astrophysics (CAA)** has been reconstituted and has begun its work. CAA will hold its first meeting in on June 4-6 at the Keck Center of the National Academies, located at 500 5th Street, NW, Washington, DC. All who are interested in attending should contact Dionna Williams (dwilliams@nas.edu) in advance to register. More information about CAA is available at <http://sites.nationalacademies.org/BPA/BPA_048755>.

The Committee on Earth Studies has been renamed the **Committee on Earth Sciences and Applications from Space (CESAS)**. CESAS did not meet during the first quarter; however, several former members of the committee are serving on an ad hoc committee that is assessing Earth science programs at NASA at the mid-point of the decadal survey cycle (the first NRC decadal survey in Earth science, *Earth Science and Applications from Space,* published in 2007). As the quarter ended, that report was completing its response to external review.

Nominations to the committee were approved by the NRC shortly before the quarter ended.

The **Committee on Astrobiology and Planetary Science (CAPS)** is a new activity combining the responsibilities formerly exercised by COMPLEX and COEL. The committee's co chairs and 17 members were appointed during the first quarter of 2012 . The committee's first meeting will take place at the National Academies' Keck Center in Washington, DC, on May 23-25 , 2012. The committee's second meeting will be held at the National Academy of Sciences building in Washington, DC, on March 6-8, 2013.

The **Committee on Solar and Space Physics (CSSP)** is on hiatus until the completion of the solar and space physics (heliophysics) decadal survey. As the quarter ended, plans were underway to nominate new members to the committee with the expectation that the committee would restart during the coming quarter.

STUDY COMMITTEES

Dissemination activities for the **Committee for the Decadal Survey on Biological and Physical Sciences in Space** report *Recapturing a Future for Space Exploration: Life and Physical Sciences Research for a New Era,* continued in this period, including work on a short derivative product intended to highlight some of the topic areas in the full report. NASA has indicated that it is continuing to work to integrate the report recommendations into its planning for the International Space Station and its new Space Life and Physical Sciences Research and Applications Division.

More information on the SSB and ASEB Board Meetings is at http://sites.nationalacademies.org/SSB/SSB_054577 (SSB) and http://sites.nationalacademies.org/DEPS/ASEB/DEPS_058923 (ASEB)

Joint meeting of the Space Studies Board and the Aeronautics and Space Engineering Board, April 4. Photo courtesy of Dwayne Day.

SSB ACTIVITIES, CONTINUED

The **Planetary Science Decadal Survey,** *Vision and Voyages for Planetary Science in the Decade 2013-2022,* was released in its final printed form in late December 2011. A second printing is in progress, and additional copies of the report should be available toward the end of the second quarter of 2012. The full text of the report (plus the reports of all of the mission and technology studies conducted in support of the survey) is available for download at <http://www.nap.edu/catalog.php?record_id=13117> and is available on a single DVD from the SSB. To request a DVD, send an email to ssb@nas.edu.

An illustrated version of the survey report intended for a popular audience is currently in preparation and is currently scheduled for publication in the third quarter of 2012.

A draft report from the ad hoc **Committee on A Decadal Strategy for Solar and Space Physics (Heliophysics)** entered the Academy's review process early in March 2012. As the quarter ended, a majority of reviewer comments were in hand and the committee had begun crafting a revised version of its draft. Detailed information about the survey is available at <http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_056864>. Plans for the public release of the report, including a live webcast, will be posted on the SSB website.

The ad hoc **Committee on Planetary Protection Standards for Icy Bodies in the Solar System** has completed its activities and its report, *Assessment of Planetary Protection Requirements for Spacecraft Missions to Icy Solar System Bodies,* was released to the public on April 16. The final, printed version of the text will be available from the National Academies Press in the third quarter of 2012.

The ad hoc **Committee on the Assessment of NASA's Earth Science Program** was formed to review the alignment of the NASA Earth Science Division's program with previous NRC advice, primarily the 2007 NRC decadal survey report *Earth Science and Applications from Space*. In carrying out this study, the committee was directed to neither revisit nor alter the scientific priorities or mission recommendations provided in the decadal survey and related NRC reports; however, the committee may provide guidance about implementing the recommended mission portfolio in preparation for the next decadal survey. The committee began work in March 2011 and held meetings on April 27-29 in Washington, DC; July 6-8 in Seattle, WA; and September 21-23 in Irvine, CA. An NRC-approved prepublication version of the committee's report was released to the public on May 2, 2012. For more information, go to <http://www8.nationalacademies. org/cp/projectview.aspx?key=49354>.

The report of the ad hoc **Committee for Evaluation of Space Radiation Cancer Risk Model**, *Technical Evaluation of the NASA Model for Cancer Risk to Astronauts Due to Space Radiation,* was publicly released and briefed to NASA on January 27 . This short report consists of a narrowly focused but highly in-depth technical analysis of the various components of NASA's proposed risk model and the research on which they are based. The report briefing was very well received by NASA, particularly with regard to the thoroughness of the committee's assessment. Briefing questions focused on the supporting details of the individual terms analyses and on recommendations for steps NASA should take prior to adoption of the proposed model. NASA indicated that they anticipated that they could carry out the committee's near term recommendations within about 6 months. The committee subsequently worked with NRC staff to complete the final editing of the report and the final publication occurred in mid-April. Contract work on the study will be completed at the end of April 2012.

The summary report of the workshop for **Effects of Solar Variability on Earth's Climate** is approaching review and will be available in Spring 2012. The workshop agenda and abstract booklet is available at <http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_061983>.

The ad hoc **Committee on the Assessment of a Plan for U.S. Participation in Euclid** was formed in December 2011 to determine whether a proposed NASA plan to make a small hardware contribution (around $20 million) to the European Space Agency Euclid mission, in exchange for U.S. membership on the Euclid Science Team and science data access, is a viable part of an overall strategy to pursue the science goals (dark energy measurements, exoplanet detection, and infrared survey science) of the New Worlds, New Horizons report's (the 2010 NRC's astronomy and astrophysics decadal survey) top-ranked, large-scale, space-based priority: the Wide Field Infrared Survey Telescope (WFIRST). Owing to the mid-February deadline for NASA's preliminary confirmation to the European Space Agency (ESA) of its interest in participating in the Euclid mission, the study was conducted on an expedited schedule. The committee held its first and only meeting in Washington, D.C., on January 18-20, 2012, and the report was released publicly on February 3, 2012. The final report, *Assessment of a Plan for U.S. Participation in Euclid,* is available for free as a PDF at <http://www.nap.edu/catalog.php?record_id=13357>. Subsequent to the report's release, NASA began the process of engagement with ESA to participate in the Euclid mission through the provision of near-infrared detectors.

The **Committee for the Implementation of a Sustained Land Imaging Program** held its first meeting on February 1-3, 2012, in Washington, DC. The committee heard briefings from the USGS, NASA, NOAA, and the USDA regarding their use of land imaging data. The committee also heard from a panel of commercial data services providers and discussed administration perspectives with OSTP representatives. The committee held its second meeting on April 25-27, 2012, in Washington, DC. More information is available at <http://sites.nationalacademies.org/SSB/CurrentProjects/SSB_065886>.

A congressionally requested **Human Spaceflight Study** to examine the value of human spaceflight has been discussed several times by the Board over the past year. Following an extended series of discussions with NASA, a statement of task was agreed on earlier this year and approved in February by the NRC Governing Board. Funding for the study is not expected to arrive before May; however, NASA has made available some initiation funds that are currently being used to begin assembling nominations for the steering committee and panels that will conduct the study. The NRC's Committee on National Statistics will be partnering with the ASEB and SSB in overseeing this study. ***Suggestions for areas of member-***

ship, as well as names, can be sent to Sandra Graham at sgraham@nas.edu. Please provide as much information as possible about why you are nominating an individual. As the Board has discussed, this study addresses cultural and sociological issues, as well as technical and scientific questions, and the make-up of the committees and panels will be critical to its success.

The parent division of SSB and ASEB, the Division on Engineering and Physical Sciences (DEPS), has been asked to conduct a comprehensive, agency-wide assessment of NASA's strategic direction. ASEB and SSB staff will help manage a study on **NASA's Strategic Direction** for DEPS. The NRC has formed a committee for this activity, and the committee's first meeting was held May 1-2 at the National Academies' Keck Center. A final report is expected in fall 2012. This activity will be chaired by Albert Carnesdale, chancellor emeritus and professor at the University of California, Los Angeles. Any recommendations made by the committee will be predicated on the assumption that NASA's out year budget profile will be constrained due to continuing deficit reduction.

OTHER ACTIVITIES

At the 2012 scientific assembly of the **Committee on Space Research (COSPAR)** in Mysore, India, on July 14-22, staff members David Smith and Michael Moloney will be attending, and committee chair Mitchell Sogin will present the report of the Committee on Planetary Protection Standards for Icy Bodies in the Solar System.

The 2014 scientific assembly will be held on August 2-10 at the Lomonosov Moscow State University in Russia.

Staff members Abigail Sheffer and David Smith attended the **Lunar and Planetary Science Conference** on March 19-23 in The Woodland, TX. Utilizing an exhibit booth, we also displayed various representative reports and distributed over 200 complimentary copies of the *Space Studies Board 1958-2011 Compilation of Reports* DVD as well as CDs of the *Visions and Voyages* report.

In partnership with the Board on Physics and Astronomy, Michael Moloney and David Smith attended and exhibited at the **American Astronomical Society** meeting on January 8-12, 2012, in Austin, TX, where we distributed complimentary copies of *New Worlds New Horizons* and a variety of other reports, including the SSB DVD.

On behalf of the SSB, and in partnership with the NRC communications office, NAP, and ASEB, staff member Celeste Naylor exhibited and distributed reports and DVDs of the Board at a variety of professional society conferences, including **AAAS** (February 16-20, Vancouver, BC) and the **National Science Teachers Association** (March 29-April 1, Indianapolis, IN).

Staff members Celeste Naylor and Dionna Williams volunteered with other NRC staff members for the **USA Science and Engineering Festival** held at the Washington Convention Center on April 28-29, 2012, in DC.

Top: Indianapolis skyline. Bottom: SSB table at National Academies' booth at the National Science Teachers Association's 2012 National Conference in Indianapolis, Indiana, March 29-April 1. Photos courtesy of Celeste Naylor.

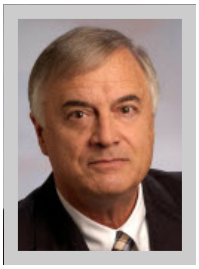
On March 30, 2012, the SSB convened a "meeting of experts" on the topic, **Towards the Use of Lower-Cost Platforms for the Acquisition of Environmental Data from Space.** A meeting of experts is not a study or workshop, and a written report is not produced. The meeting was convened at the request of the Office of Science and Technology Policy (OSTP), with financial support derived from NASA, NOAA, and USGS. The increasing mismatch between the fiscal resources likely to be available and those required for timely execution of the decadal survey and related Earth observation missions informed the request from OSTP for a meeting of experts that would examine the potential for alternative platforms and/or the use of novel techniques to lower the cost of making the requisite observations. OSTP also requested that the meeting include sessions that would focus in particular on potential ways to lower the cost of acquiring the moderate-resolution, multispectral observations that are currently made by Landsat-7. Some 50 participants from the sponsoring agencies, OSTP, the Office of Management and Budget, academia, industry and government were in attendance.

News from the National Academy of Sciences

On January 19, 2012, the National Academy of Sciences honored 17 individuals with awards in recognition of their extraordinary scientific achievements in a wide range of fields spanning the physical, biological, and social sciences. Three of the recipients for 2012 have served on the Space Studies Board and its committees:

Andrew H. Knoll, Fisher Professor of Natural History in the department of organismic and evolutionary biology at Harvard University, received the Mary Clark Thompson Medal. Dr. Knoll was recognized for his unparalleled contributions relating Precambrian life to Earth's physical and chemical history and for innovative contributions on the paleophysiology and evolution of algae and angiosperms. Established in 1919, the Mary Clark Thompson Medal honors important services to geology and paleontology and is presented with a $15,000 prize.

Dr. Knoll served on the Space Studies Board, the Steering Group for the Workshop on Size Limits of Very Small Microorganisms (co-chair), and Committee on Planetary Biology and Chemical Evolution, among others.



Harry Y. McSween, Jr., Chancellor's Professor and Distinguished Professor of Science at the University of Tennessee, received the J. Lawrence Smith Medal. He was honored for his pioneering studies of the igneous and metamorphic histories of the parent planets of the chondritic and achondritic meteorites, with particular emphasis on his work on the geological history of Mars based on studies of martian meteorites and spacecraft missions to the planet. The medal and prize of $25,000 are awarded for recent original and meritorious investigations of meteoric bodies. The award was established as a gift from Sarah Julia Smith in memory of her husband and has been presented since 1888.

Dr. McSween recently served on the NRC's Planetary Science Decadal Survey: 2013-2022 as a member of the steering committee and as vice chair of the survey's Primitive Bodies Panel. He also served on the Space Studies Board, the Committee on the Origins and Evolution of Life, the Committee on Astrobiology Strategy for the Exploration of Mars, the Committee on Precursor Measurements Necessary to Support Human Operations on the Surface of Mars (vice chair), the Committee on Human Exploration, and the Committee on Planetary and Lunar Exploration.

Jeremiah P. Ostriker, professor in the Department of Astrophysical Sciences at Princeton University, is the recipient of the James Craig Watson Medal. Dr. Ostriker was selected for his seminal contributions to the theory of the interstellar and intergalactic medium, his cosmological simulations that help illuminate the formation and evolution of structure in the universe, his theoretical contribution to the existence of dark matter halos around galaxies, and his dedication to the scientific and academic communities through service as a provost, builder of the Sloan Digital Sky Survey, and mentor to generations of young astronomers. The medal is given every 3 years to honor contributions to the science of astronomy and carries an award of $25,000, plus $25,000 to support the recipient's research.

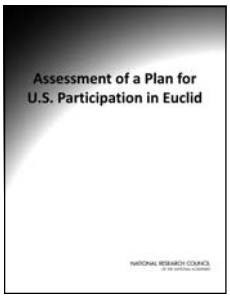
NAS Building Update As the NAS Annual Meeting approached (April 28-May 1), the finishing touches were being put on the NAS building and grounds. Photos courtesy of Cultural Programs of the NAS.

The West Court, which will be used for receptions and other events.

An expanded conference room on the first floor.

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 at <http://www.nap.edu/>.



Assessment of a Plan for U.S. Participation in Euclid

This report of the ad hoc Committee on the Assessment of a Plan for U.S. Participation in Euclid of the Board on Physics and Astronomy (BPA) and the Space Studies Board (SSB) is available at <http://www.nap.edu/catalog.php?record_id=13357>. The study was led by Chair David N. Spergel. The study was staffed by Co-Study Directors David Lang and Caryn Joy Knutsen (BPA), Research Associate Lewis B. Groswald (SSB), Research Associate Amanda R. Thibault (Aeronautics and Space Engineering Board), and Program Associate Dionna Williams (SSB). Other staff are listed in the report.

Executive Summary

NASA has proposed to make a hardware contribution to the European Space Agency's (ESA's) Euclid mission in exchange for U.S. membership on the Euclid Science Team and science data access.

The Euclid mission will employ a space telescope that will make potentially important contributions to probing dark energy and to the measurement of cosmological parameters. Euclid will image a large fraction of the extragalactic sky at unprecedented resolution and measure spectra for millions of galaxies.

This report responds to a request from NASA to evaluate whether a small investment in Euclid (around $20 million in hardware) is a viable part of an overall strategy to pursue the science goals of the New Worlds, New Horizons (NWNH) report's top-ranked large-scale, space-based priority: the Wide-Field Infrared Survey Telescope (WFIRST). WFIRST has a broad, wide-field, near-infrared capability that will serve a wide variety of science programs of U.S. astronomers, including exoplanet research, near-infrared sky surveys, a guest observer program, and dark energy research. In carrying out this study the committee's intent has been to be clear that this report does not alter NWNH's plans for the implementation of the survey's priorities.

The Committee on the Assessment of a Plan for U.S. Participation in Euclid concludes that the NASA proposal would represent a valuable first step toward meeting one of the science goals (furthering dark energy research) of WFIRST.

While WFIRST dark energy measurements are expected to be superior to Euclid's, U.S. participation in Euclid will have clear scientific, technical, and programmatic benefits to the U.S. community as WFIRST and Euclid go forward.

NASA should make a hardware contribution of approximately $20 million1 to the Euclid mission to enable U.S. participation. This investment should be made in the context of a strong U.S.

commitment to move forward with the full implementation of WFIRST in order to fully realize the decadal science priorities of the NWNH report.

In exchange for this small, but crucial contribution, NASA should secure through negotiation with the European Space Agency both a U.S. position on the Euclid Science Team with full data access and the inclusion of a team of U.S. scientists in the Euclid Consortium that would be selected by a peer-reviewed process with full data access as well as authorship rights consistent with Euclid policies still to be formulated.

NASA should seek independent community review of any financial commitment for hardware expenditures beyond $30 million for Euclid.

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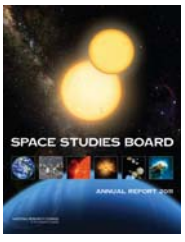

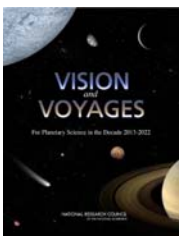

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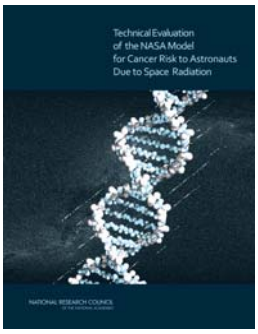


Technical Evaluation of the NASA Model for Cancer Risk to Astronauts Due to Space Radiation

This report of the ad hoc Committee for Evaluation of Space Radiation Cancer Risk Model of the Space Studies Board (SSB) is available at <http://www.nap.edu/catalog.php?record_id=13343>. The study was led by Chair R. Julian Preston. The study was staffed by Study Director Sandra J. Graham (SSB), Research Associate Amanda R. Thibault (Aeronautics and Space Engineering Board), and Senior Program Assistant Rodney Howard (SSB). Other staff are listed in the report.

Summary

At the request of NASA, the National Research Council's (NRC's) Committee for Evaluation of Space Radiation Cancer Risk Model[1] reviewed a number of changes that NASA proposes to make to its model for estimating the risk of radiation-induced cancer in astronauts. The NASA model in current use was last updated in 2005, and the proposed model would incorporate recent research directed at improving the quantification and understanding of the health risks posed by the space radiation environment. NASA's proposed model is defined by the 2011 NASA report *Space Radiation Cancer Risk Projections and Uncertainties—2010* (Cucinotta et al., 2011). The committee's evaluation is based primarily on this source, which is referred to hereafter as the 2011 NASA report, with mention of specific sections or tables cited more formally as Cucinotta et al. (2011).

The overall process for estimating cancer risks due to low linear energy transfer (LET)[2] radiation exposure has been fully described in reports by a number of organizations. They include, more recently:

- The "BEIR VII Phase 2" report from the NRC's Committee on Biological Effects of Ionizing Radiation (BEIR) (NRC, 2006);[3]
- *Studies of Radiation and Cancer* from the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 2006),
- *The 2007 Recommendations of the International Commission on Radiological Protection (ICRP),* ICRP Publication 103 (ICRP, 2007); and
- The Environmental Protection Agency's (EPA's) report *EPA Radiogenic Cancer Risk Models and Projections for the U.S. Population* (EPA, 2011).

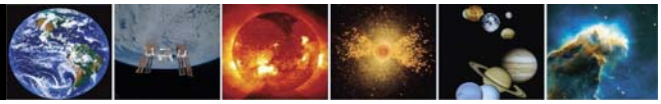
The approaches described in the reports from all of these expert groups are quite similar. NASA's proposed space radiation cancer risk assessment model calculates, as its main output, age- and gender-specific risk of exposure-induced death (REID) for use in the estimation of mission and astronaut-specific cancer risk. The model also calculates the associated uncertainties in REID.

The general approach for estimating risk and uncertainty in the proposed model is broadly similar to that used for the current (2005) NASA model and is based on recommendations by the National Council on Radiation Protection and Measurements (NCRP, 2000, 2006). However, NASA's proposed model has significant changes with respect to the following: the integration of new findings and methods into its components by taking into account newer epidemiological data and analyses, new radiobiological data indicating that quality factors differ for leukemia and solid cancers, an improved method for specifying quality factors in terms of radiation track structure concepts as opposed to the previous approach based on linear energy transfer, the development of a new solar particle event (SPE) model, and the updates to galactic cosmic ray (GCR) and shielding transport models. The newer epidemiological information includes updates to the cancer incidence rates from the life span study (LSS) of the Japanese atomic bomb survivors (Preston et al., 2007), transferred to the U.S. population and converted to cancer mortality rates from U.S. population statistics. In addition, the proposed model provides an alternative analysis applicable to lifetime never-smokers (NSs). Details of the uncertainty analysis in the model have also been updated and revised.

NASA's proposed model and associated uncertainties are complex in their formulation and as such require a very clear and precise set of descriptions. The committee found the 2011 NASA report challenging to review largely because of the lack of clarity in the model descriptions and derivation of the various parameters used. The committee requested some clarifications from NASA throughout its review and was able to resolve many, but not all, of the ambiguities in the written description.

PROPOSED MODEL—OVERALL CONCLUSION

In considering NASA's proposed model as a whole, the committee noted that the general approach to estimating cancer risks from exposure to low-LET radiation follows that utilized by ICRP, NCRP, EPA, and BEIR VII, and as such is state of the art. The specific data incorporated into NASA's proposed model are generally appropriate, with some exceptions, noted below, relating to new data that have become available since the development of the model or additional data sets that were already available and not selected for use by NASA. There remains a need for development of additional data to enhance the current approach and to reduce uncertainty in the model; specific needs have been identified by the committee. The committee has some concerns about specific model compo-



nents, particularly related to the change to an "incidence-mortality" approach for calculating mortality and to the risk-transfer approach used by NASA. The question of the effectiveness of the combination of the several modules into the proposed integrated model was most appropriately answered by the committee's observing of a live demonstration by NASA of the application of the model for assessing risk to astronauts under some selected specific mission conditions. This demonstration showed that the model was indeed an integrated one—something that was not immediately apparent from the rather complex descriptions provided in the 2011 NASA report. The committee's overall evaluation is that NASA's proposed model represents a definite improvement over the current one. However, the committee urges that the necessary improvements identified in the specific recommendations provided below be incorporated before the proposed integrated model is implemented.

NASA's proposed model is composed of a number of components or modules that separately address highly distinct aspects of radiation risk and uncertainty. The committee assessed each of the individual components of the model as well as the integrated model as a whole. The key results of its evaluations are summarized below. Possible improvements to components of the model and to the integrated model are provided, together with recommendations for addressing gaps in the model. In some cases, specific research is identified that could help NASA address gaps and/or uncertainties in its proposed model for cancer risk projections. The specific research identified is not necessarily a comprehensive list but is intended to include efforts that would have a significant impact and at the same time would be feasible to undertake within the short to medium term (less than 5 years). The recommendations provided in this Summary address those areas for which the committee perceived more substantial gaps or issues. The model components are discussed in more detail in the main body of the report (see Chapter 2), which contains advice in addition to the major recommendations and conclusions. It is the integrated model that will actually be implemented by NASA, and so it is also assessed in detail in Chapter 2 of this report, particularly with regard to the integration methodology.

PROPOSED MODEL—ASSESSMENT OF COMPONENTS

Tissue-Specific Particle Spectra

The committee considers that the radiation environment and shielding transport models used in NASA's proposed model are a major step forward compared to previous models used. This is especially the case for the statistical solar particle event model. The current models have been developed by making extensive use of available data and rigorous mathematical analyses. The uncertainties conservatively allocated to the space physics parameters (i.e., environment and shielding transport models) are deemed to be adequate at this time, considering that the space physics uncertainty is only a minor contributor to the overall cancer risk assessment. Although further research in this area could reduce the uncertainty, the law of diminishing returns may prevail.

Given the above considerations, the committee does not recommend any specific research to improve the proposed model for tissue-specific particle spectra at this time. However, in this report the committee has identified several specific research areas that could improve the proposed environment models for tissue-specific particle spectra, including additional statistical analysis of the radial dependence of SPE intensity and solar-cycle dependence of SPE frequency and extreme events. The estimates could be further improved by adding physics-based studies of particle transport using the current picture of the heliosphere and its magnetic fields. Particle transport in the interplanetary medium is determined by its electric and magnetic fields. Theoretical and numerical studies of particle trajectories would certainly result in improved transport models and smaller uncertainties in the environmental estimates, but would involve a major effort and a change in modeling approach. NASA would need to weigh the added value of such an approach to its model outputs.

Cancer Risk Projection Model for Low-LET Exposures

Epidemiology Data

A major change proposed in NASA's model is to use the "incidence-mortality" approach used by BEIR VII (NRC, 2006) for the development of a REID. For this approach, risk coefficients from LSS cancer incidence models are converted into cancer mortality risks. A major reason for the use of the LSS cancer incidence data is that these are likely to be more accurate with respect to diagnosis than are mortality data, which suffer from misclassification of causes on death certificates. The approach results in considerable changes in the REID estimates, particularly in the pattern with age at exposure, and the committee considers this to be an improvement for site-specific cancer mortality estimation.

Recommendation: Before NASA implements its proposed major change to the "incidence-mortality" approach, the committee recommends that NASA conduct more research into the specific patterns of the underlying epidemiological biases that drive these changes. The committee also highlights a specific problem with the method of estimating the mortality probability from the ratio of cancer mortality to incidence as developed by the BEIR VII report published by the National Research Council in 2006 and proposed for use by NASA. In response, the committee recommends that NASA consider alternative methods for improved estimation of mortality probabilities for each cancer site. For example, as presented in its 2011 report *EPA Radiogenic Cancer Risk Models and Projections for the U.S. Population,* the Environmental Protection Agency has developed an alternative approach for breast cancer mortality estimation, and this could serve as a suitable approach to be applied by NASA.

Transfer of Cancer Risk Estimates from the Japanese to the U.S. Population

Because underlying cancer incidence rates for some cancer sites differ greatly between the Japanese and the U.S. populations, risk estimates based on an excess relative risk (ERR) model can give REID values very different from those based on an excess absolute risk (EAR) model. A number of organizations and committees (ICRP, the National Council on Radiation Protection and Measurements [NCRP], BEIR VII) have recommended that a sitespecific weighted average of the ERR and EAR models be used. The proposed NASA approach follows BEIR VII (NRC, 2006) in calculating a weighted average with uncertain weights and generally follows the recommended BEIR VII weights.

Recommendation: Because there are some deviations in NASA's proposed model from the weights recommended by BEIR VII for the excess relative risk and excess absolute risk models, the committee recommends that NASA provide additional justification for these alternative weights.

Dose and Dose Rate Effectiveness Factor

A dose and dose rate effectiveness factor (DDREF) value is applied, when appropriate, to reduce the LSSbased cancer risk coefficients for protracted exposures. A median value of 1.75 was selected by NASA for its proposed model, based on an assessment made by the National Institutes of Health (NIH) for a previous estimate and its uncertainty (NIH, 2003). For its proposed model, NASA assumed that the DDREF applies only to low- LET radiations and consequently that there is no dependence of space radiation risks on dose rate. Differences in risks between space radiation charged particles and gamma rays at low dose rate are encompassed entirely within the quality factor, QF, discussed below. A number of publications issued since the NIH report are relevant to this issue, and although these were discussed in the 2011 NASA report, they were not used by NASA in its choice of DDREF or in the associated uncertainty analysis. These studies include the Mayak workers study (Shilnikova et al., 2003), the third analysis of the United Kingdom's National Registry for Radiation Workers (Muirhead et al., 2009), and the 15-country nuclear workers study (Cardis et al., 2007), together with the review of these studies and comparison with the life span study by Jacob et al. (2009).

Conclusion: Although the proposed NASA approach for estimating a DDREF describes a number of limitations in these newer epidemiological studies and in the BEIR VII DDREF methodology, the justification given for preferring the older approach taken by the National Institutes of Health in 2003 is that it is close to the average of various recommended values of slightly less than 2. The use of this average value is somewhat problematic, given that the recommended values used to derive this average are not independent and thus applying equal weights to these is not justifiable.

Recommendation: The committee agrees with the use of an uncertainty approach for estimating DDREF, but it recommends that NASA use a central value and distribution that better accounts for the recent epidemiological and laboratory animal data.

Risk Models for Never-Smokers

The issue of the smoking status of astronauts and the potential implications for risk projections for smokingrelated cancers are important, and it is appropriate that this should be investigated. Most astronauts are non-smokers, which would likely lower the risk projections for astronauts compared to estimates for the general population (a mix of never- and ever-smokers).

Recommendation: The proposed NASA approach for estimating lung cancer risks for astronauts who are never-smokers is limited and does not consider competing risks. Thus, the committee recommends that the NASA approach be developed further, given the important impact that it has on reducing estimated risk. The revised approach should use survival probabilities for competing risks that are specific to never-smokers. Further, the committee recommends that NASA make no changes at this time in the proposed model to include other smoking-related cancers. The data are not sufficiently robust for use in the modification of the REID estimate.

Uncertainties in Low-LET Cancer Risk Model and Overall Uncertainties in Cancer Risk Projections for High-LET Exposures

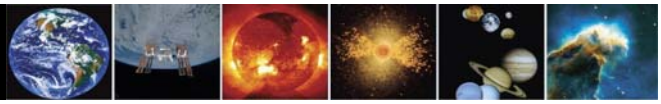
The 2011 NASA report addresses risk estimates and their uncertainties associated with exposure to low-LET radiation. Uncertainties are important because risk protection involves the use of safety factors, and NASA sets radiation permissible exposure limits (PELs) based on the 95 percent confidence limit that takes into account the uncertainties in risk projection models (NASA, 2005).

Uncertainty Limits and Methodology

Conclusion: Uncertainty limits on radiation-related risk reflect information about anticipated environmental radiation dose levels and accumulated knowledge about the relationship between radiation dose and cancer risk. For the approach used by NASA, more information, if available, might reduce statistical uncertainty and, assuming that the new information did not increase the central risk estimate, lower the upper 95 percent uncertainty bound criterion used by NASA to evaluate the acceptability of activity-related mortality risk.

Maximum Likelihood and Empirical Bayes Estimates

In the 2011 NASA report's description of the proposed model, the discussion of the use of a maximum likelihood estimate (MLE) and/or empirical Bayes (EB) estimate of site-specific ERR per sievert is ambiguous with respect to the specific approach that was used in specific instances. For example, the site-specific EB estimate of ERR per sievert for kidney



cancer (0.40) would be similar to the MLE (also 0.40 for this particular organ site), with a lower estimated standard error (0.19) compared to the MLE standard error of 0.32.

Recommendation: On the assumption that the empirical Bayes approach has been used in NASA's proposed model, the committee recommends that the authors ensure that the off-diagonal covariance information has been taken into account. If the EB approach has not been used, either this fact should be stated in the text of the 2011 NASA report (Cucinotta et al., 2011) or the references to the EB approach should be removed from the text.

Uncertainty in the Value of the Quality Factor

The uncertainty analysis in NASA's proposed model reveals that the value of the quality factor (QF, as defined in NASA's proposed model) is the largest contributor to the uncertainty of REID, introducing about a 3.4-fold uncertainty in risk. Additional analysis by NASA (Cucinotta et al., 2011) using its proposed model finds that this component could be reduced to a 2.8-fold uncertainty if two of the track structure parameters were constrained to a fixed algebraic relationship to one another (such that the Z^{*2}/β^2 position of the maximum value of QF is held fixed). In this context, the committee notes that different values of QF are used for leukemia and solid cancers based on recent studies using animal tumor models.

Conclusion: According to NASA's proposed model, the observation that the use of a fixed relationship between two track structure parameters reduces the uncertainty is a potentially valuable finding that may provide a method to reduce uncertainty in estimations of the risk of exposure-induced death. However, little indication is given in the 2011 NASA report as to why such a fixed position might be justified or expected. The committee suggests that further investigations into the validity and usefulness of this approach would be worthwhile.

Radiation Quality and Track Structure Risk Cross Section

The main parameter used to specify radiation quality is Z^{*2}/β^2, where Z^* is the effective charge number of the particle and β its speed relative to the speed of light. Z^{*2}/β^2 replaces LET used in the conventional quality factor definition, and also by NASA in its current model. However, three additional empirical parameters (κ, Σ_0/α_γ, and m) are introduced to define the quality factor-risk relationships as a function of Z^{*2}/β^2. For NASA's proposed model, values for these parameters have been selected by comparison with experimentally observed variations in relative biological effectiveness (RBE) for different types of radiation for various cellular biological effects and for selected cancer types. While this approach is broadly appropriate for the proposed model parameters, the committee was unable to determine from the 2011 NASA report or from inquiries how the particular parameter values were selected.

Recommendation: The committee recommends that NASA make a detailed comparison of the relative biological effectiveness versus Z^{*2}/β^2 dependence of the experimental data with the proposed form and parameters of the quality factor, QF, equation in order to improve the transparency of the basis for the selection of the proposed parameter values for the model and to provide guidance for future research to test, validate, modify, and/or extend the parameterization. This analysis needs to include the defined selection of different values for parameters κ and Σ_0/α_γ for ions of $Z \leq 4$ compared to all ions of higher charge.

Conclusion: In the proposed model, different maximum values of quality factor, QF, are assumed for leukemia (maximum 10) and for solid tumors (maximum 40). This is a change from the current NASA risk model. The committee agrees that it is reasonable to make such a distinction on the basis of the limited animal and human data available.

Effective Dose

NASA's proposed model defines a quantity that is analogous to "effective dose" as defined by ICRP, but it uses different gender-specific sets of normalized tissue weighting factors (w_T) to match the estimated risks to the various tissues in representative space radiation environments. NASA proposes to use this as a summary quantity for mission operational purposes and, in NASA's proposed model, it is simply termed "effective dose." Effective dose is, strictly speaking, a quantity defined by ICRP that includes the ICRP-defined specification of numerical values for weighting factors and sex-averaging. If considerably different tissue weighting factors and radiation quality specifications are used and "effective dose" is evaluated without sex-averaging, it is problematic for the resulting quantity still to be termed "effective dose," and the unit sievert given to its numerical values. The committee believes that the NASA description of the proposed model would be improved by the use of terminology and notation that distinguish NASA-defined quantities (especially the quantity termed "effective dose") from quantities defined by ICRP.

Other Issues

Non-Cancer Effects (Tissue Reactions)

In its proposed approach to estimating the safe days in deep space, NASA has used a 3 percent REID for fatal cancer as the limit. In its current model, NASA also considers dose limits for non-cancer effects—lens, skin, blood-forming organs, heart, and central nervous system. For example, "career limits for the heart are intended to limit the REID for heart disease to be below approximately 3 to 5 percent, and are expected to be largely age and sex independent" (NASA, 2005, p. 65). It was further assumed by NASA that the limits established would restrict mortality values for these non-cancer effects to less than the risk level for cancer mortality. The cancer and noncancer risks were not combined into a single REID. More recent data have led ICRP to reconsider the threshold dose values particularly for the cardiovascular system (and cataracts) (see ICRP, 2011). It is concluded by ICRP (2011) that a threshold absorbed dose of 0.5 Gy should be considered for cardiovascular disease (and cataracts) for acute and for fractionated/

protracted exposures. It is appreciated by ICRP that these values have a degree of uncertainty associated with them.

Conclusion: The revised value for the threshold dose value proposed by ICRP suggests that NASA may need to consider how it might account for cardiovascular disease in its calculations of dose limits. However, it is noted that to date there exists very little of the information on relative biological effectiveness for non-cancer effects that is needed for estimates of risks posed by exposure to space radiation.

Delayed Effects

Delayed effects pertinent to the assessment of risk principally relate to observations whereby ongoing radiation- induced genomic instability is expressed, even at long times after radiation exposure. Such effects could have important implications for radiation protection in view of current notions of the multistep mutational processes involved in carcinogenesis. An early induced change in subsequent and ongoing mutation rates in irradiated somatic cells could accelerate this process.

Conclusion: There are conflicting reports on the generality of the phenomenon of radiation-induced delayed genomic instability and some question about variation in the susceptibilities of cells from different individuals with regard to this effect. Thus, the committee concludes that it is appropriate that genomic instability not be incorporated into NASA's proposed model, in agreement with the proposed NASA approach. However, the committee considers that further investigation of the phenomenon is certainly warranted.

Non-Targeted Effects

Non-targeted effects (NTEs) largely refer to the so-called bystander effects, by which responses can be produced in an unirradiated cell as a result of the transfer of a signal from an irradiated cell. For high atomic number and energy (HZE) radiations, doses that may be received by astronauts are very nonuniform in the sense that some cells will be traversed by the primary particle itself, whereas other cells will not be traversed; thus, an NTE is also a phenomenon that is of considerable interest.

Conclusion: Although the 2011 NASA report (Cucinotta et al., 2011) contains an extended discussion on nontargeted effects and their potential impact on risk estimates, NASA appropriately chose not to include these NTEs in its proposed model at this time. Little is known in qualitative or quantitative terms of the contribution of these NTEs directly related to radiation-induced carcinogenesis, but the committee believes that studies to elucidate any such relevance should be encouraged.

Qualitative Differences

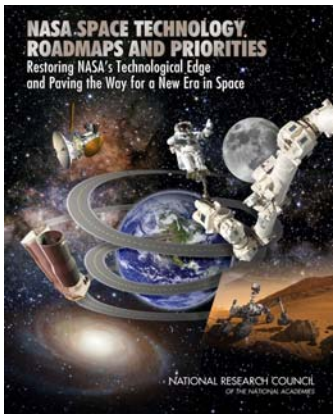
It is recognized that there are qualitative differences in the nature of the initial energy depositions and hence in initial chemical, biochemical, and biological damages from different types of ionizing radiation. Differences are particularly great between low-LET gamma rays and the wide variety of high-LET heavy ions in space radiation. This may lead to observed differences in responses of cells, tissues, and organisms such as differences in spectra of mutations and chromosome aberrations, altered gene-expression patterns, and different spectra and latencies for carcinogenesis. There is some experimental evidence for qualitative differences at each of the above levels of biological effect. As a result, it may not be entirely appropriate to apply universal values for quality factors as quantitative scaling factors, based on empirical data such as RBE that assume similar underlying biological processes.

The committee notes that this is an area in which experiments quantifying types, frequencies, and latencies of various cancers—for example, lung, colon, and breast cancer, with further study of liver cancer and leukemia—are sorely needed for radiations of varying LET, especially for high-LET particles at low particle fluences such as occur in space. Furthermore, the committee suggests that the tumor studies should be coupled with appropriate mechanistic investigations to provide an understanding of the underlying carcinogenic processes.

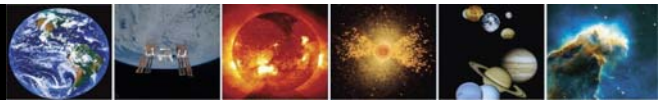
Probabilistic Risk Assessment

The committee notes that the risk projections discussed in NASA's proposed space radiation cancer risk assessment model and uncertainties are not presented or intended as being based on a probabilistic risk assessment (PRA) approach. NASA's proposed model is a health-effects model intended to provide estimates of cancer risk and uncertainties for defined space radiation exposure scenarios. More generally, however, the cancer risk to astronauts is dependent on much more than a defined scenario model of health effects, with engineered barriers, in the space radiation environment. Experience with full-scope PRAs of complex systems indicates the importance of accounting for the "what can go wrong during actual operations" scenarios, as such scenarios generally drive the overall risk. Thus, the committee suggests that comprehensive, mission-specific PRAs also be considered so as to enable accountability for the "what can go wrong" scenarios in the overall risk projections. ■

REPORT NEWS FROM THE ASEB



The Aeronautics and Space Engineering Board has released a new report, *NASA Space Technology Roadmaps and Priorities: Restoring NASA's Technological Edge and Paving the Way for a New Era in Space*, a large undertaking that included the participation of 74 panel and committee members. A copy of the report can be purchased, or downloaded as a PDF document for free, from <http://www.nap.edu/catalog.php?record_id=13354>.



STAFF NEWS

Christine Mirzayan Science and Technology Policy Graduate Fellowship Program

The Christine Mirzayan Science and Technology Policy Graduate Fellowship Program within the Policy and Global Affairs Division of the National Academies is designed to engage its fellows in the analytical process that informs U.S. science and technology policy. Fellows develop basic skills essential to working or participating in science policy at the federal, state, or local levels. More information about the fellows program can be found at <http://sites.nationalacademies.org/PGA/policyfellows/index.htm>.

Chase Estrin, a Mirzayan fellow working primarily with the ASEB, recently graduated from the master's program in space systems engineering and previously received his bachelor's in aerospace engineering, both from the University of Michigan. While at Michigan, he worked in Dr. Nilton Renno's laboratory developing a mill-type electric field sensor that is designed to be flown to Mars to determine if lightning exists and may lead to an explanation of such phenomena as why methane is present on Mars. After the sensor's development, Mr. Estrin interned at NASA Glenn Research Center, where he tested the sensor and wrote a grant proposal for a future model of the sensor. He is an avid member of the Students for the Exploration and Development of Space and Sigma Gamma Tau Aerospace Honors Society where he planned events to bring in members of the space industry and was a mentor for younger students. He is excited to participate in the Mirzayan Fellowship Program to learn how policy decisions are made and about recent policy changes regarding the interface between the government and private space industry. When not in lab, he can be found scaling a climbing wall, getting lost in the woods, or volunteering on a farm.

SSB Interns

SSB will welcome three interns this summer: two Lloyd V. Berkner Space Policy Interns, Michael W. Barton and Joseph G. O'Rourke, and SSB Summer intern Miles Lifson.

Miles Lifson is a rising senior at Claremont McKenna College fascinated by both politics and space science, and interested in a professional career that will combine both areas. He is pursuing a double major in physics and government with an emphasis on a space policy. Last summer he did optics research in a National Science Foundation-sponsored program and also has experience with political organizing, including campaign work, congressional lobbying, and other advocacy activities. At college he is a debater and serves as the President Pro Tempore of his student government. As an intern with the Space Studies Board, he is looking forward to getting firsthand exposure to the processes involved in the formulation and implementation of national space policy, and applying his skills to contribute to these activities.

Lloyd V. Berkner Space Policy Internship

Our Fall 2011 Lloyd V. Berkner Space Policy Intern **Danielle Piskorz** returned to the SSB in March for a continuation of her internship. Our Summer 2012 Lloyd V. Berkner Space Policy Interns will be **Michael W. Barton** and **Joseph G. O'Rourke**.

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. Additional information on the program can be found at <http://sites.nationalacademies.org/SSB/ssb_052239>.

Michael Barton is currently completing his B.S. at Mississippi State University, where he is studying aerospace engineering with a concentration in astronautics and a minor in leadership studies. He spent last summer in the NASA Academy for Space Exploration at NASA Glenn Research Center, where he worked on research projects in computational fluid dynamics and microgravity test beds. As part of the NASA Academy, Mr. Barton was able to tour other NASA centers and commercial space operations, as well as meet many engineers and managers across the workforce. Previous to that, he was a co-op engineer in space shuttle guidance and navigation during the waning years of the Space Shuttle Program at NASA Kennedy Space Center. These experiences have given him insight into the culture and operational processes of NASA. At Mississippi State, Mr. Barton has served as president or vice president of several engineering student organizations and honor societies, and he has worked as an undergraduate teaching assistant and researcher in computational fluid dynamics. Mr. Barton plans to pursue a master's degree in aerospace engineering next fall.

Joseph O'Rourke is currently completing his senior year at Yale University, where he will receive a B.S. in astronomy and physics and geology and geophysics. His senior thesis is centered on the evolution of terrestrial planets in the stagnant-lid regime of mantle convection. Previously, he modeled the thermal evolution of Titan with Professor David Stevenson at the California Institute of Technology, with support from the NASA Planetary Geology & Geophysics Undergraduate Research Program. Since his freshman year, Mr. O'Rourke has also performed reduced gravity experiments during parabolic flight campaigns, under the auspices of NASA Johnson Space Center's Reduced Gravity Educational Flight Program. At Yale, Mr. O'Rourke served as co-President of the Society of Physics Students and writes opinion columns for the Yale Daily News. He eagerly anticipates spending another summer in Washington, D.C., having interned for his congressman in 2008. Mr. O'Rourke will return to Caltech in the fall of 2012 to begin graduate study in planetary science.

From the terrace of the Keck Center, NRC staff watched as space shuttle Discovery flew over Washington on its way to the National Air and Space Museum annex in Northern Virginia. Photo courtesy of Lewis Groswald.

Staff from SSB, ASEB, and BPA. Left to right: Lewis Groswald, Caryn Knutsen, Tanja Pilzak, Amanda Thibault, and Abigail Sheffer. Photo courtesy of Sandra Wilson.

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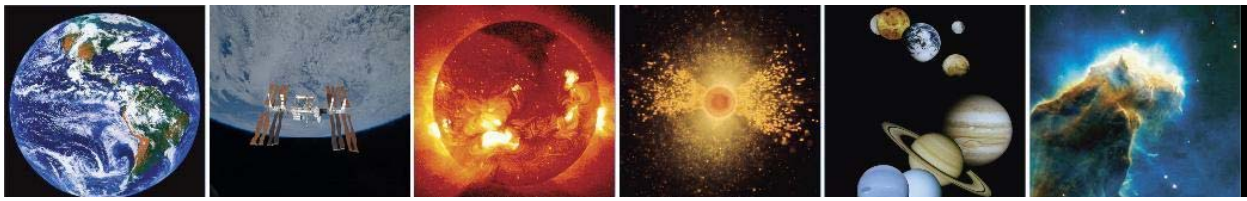

SSB Calendar

APRIL

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8	9	10	11	12	13	14
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MAY

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JUNE

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JULY

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April 4-5	Space Studies Board (April 4 joint with ASEB)	Washington, DC
April 25-27	Committee on the Implementation of a Sustained Land Imaging Program	Washington, DC
May 1-2	Committee on NASA's Strategic Direction	Washington, DC
May 23-25	Committee on Astrobiology and Planetary Science (CAPS)	Washington, DC
June 4-6	Committee on Astronomy and Astrophysics (CAA)	Washington, DC
June TBD	Committee on the Implementation of a Sustained Land Imaging Program	TBD
June 25-27	Committee on NASA's Strategic Direction	Washington, DC
July 10-11	Committee on Earth Sciences and Applications (CESAS)	Washington, DC

Future SSB Meetings

August 8-9, 2012, California TBD (Executive Committee)

November 12-14, 2012, Irvine, CA
(including a Workshop on Lessons Learned in Decadal Planning in Space Science)

March 6-8, 2013, SSB Standing Committee Space Science Week, Washington, DC

April 4-5, 2013, Washington, DC

November 7-8, 2013, Irvine, CA

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