

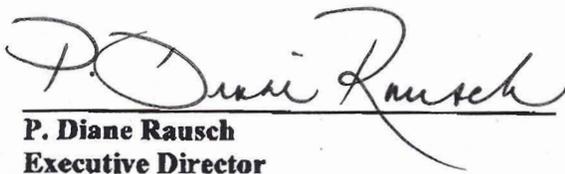
**National Aeronautics and Space Administration  
Washington, DC**

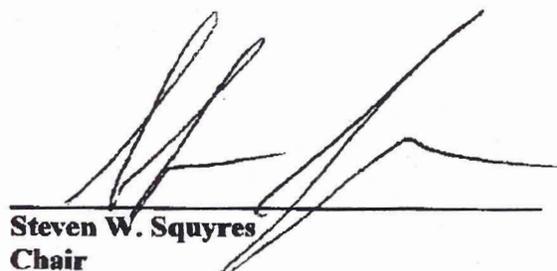
**NASA ADVISORY COUNCIL**

**July 25-27, 2012**

**Goddard Space Flight Center  
Greenbelt, Maryland**

**MEETING MINUTES**

  
**P. Diane Rausch  
Executive Director**

  
**Steven W. Squyres  
Chair**

NASA ADVISORY COUNCIL  
Goddard Space Flight Center  
Greenbelt, MD  
July 25-27, 2012

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Meeting Report prepared by  
David J. Frankel, Consultant  
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## NASA ADVISORY COUNCIL MEETING

NASA Goddard Space Flight Center  
Greenbelt, Maryland 20771

*GSFC Training Center, Building 1, Rooms E100D/E*

### PUBLIC MEETING

July 25-27, 2012

#### Wednesday, July 25, 2012

##### Call to Order, Announcements

Ms. Diane Rausch, Director, Advisory Committee Management Division, NASA Headquarters (HQ), and Executive Director, NASA Advisory Council (NAC or Council), called the meeting to order and welcomed the NAC members and attendees to the NASA Goddard Space Flight Center in Greenbelt, Maryland. She stated that the NAC is a Federal advisory committee established under the Federal Advisory Committee Act (FACA). The meeting is open to the public. A dial-in capability is available for members of the public to listen to the meeting. WebEx is also available to view the NAC presentations online. Meeting minutes will be taken by Mr. David Frankel and will be posted to the NAC website, [www.nasa.gov/offices/nac](http://www.nasa.gov/offices/nac), soon after the meeting. Each NAC member has been appointed by the NASA Administrator, Mr. Charles F. Bolden, Jr., based on the member's individual subject matter expertise. Each member is a Special Government Employee, subject to ethics regulations, and must recuse himself or herself from discussions on any topic in which there could be a potential conflict of interest. All presentations will be part of the public record. Time has been set aside at the end of the day for public comments.

##### Opening Remarks by Council Chair

Ms. Rausch introduced Dr. Steven W. Squyres, Council Chair, who presided over the meeting. He welcomed everyone to the Council's public meeting and noted that Dr. David McComas would be substituting for the Science Committee Chair, Dr. Wesley Huntress. The planned agenda for the meeting was reviewed.

##### Welcome to NASA Goddard Space Flight Center

Dr. Squyres introduced Mr. Christopher Scolese, Director, NASA Goddard Space Flight Center (GSFC or Goddard), and thanked him for hosting the NAC. Mr. Scolese welcomed the NAC members to Goddard. He explained that Goddard was the first NASA spaceflight center to be established after NASA was established in 1959. The work at Goddard covers everything worked on by NASA, other than aeronautics. Goddard has the largest collection of scientists and engineers in the U.S., is responsible for two Nobel Prizes, and has produced over 300 successful missions, including the world's first weather satellite and the Hubble Space Telescope (HST). In addition to the Center located in Greenbelt, Maryland, Goddard operates the Wallops Flight Facility in Virginia, the Institute for Space Studies in New York City, ground stations at the White Sands Complex in New Mexico, and the Independent Verification and Validation Facility in West Virginia. Goddard employs across its facilities 3,400 civil servants and 6,400 contractors, of whom 61 percent are scientists and engineers. Mr. Scolese presented a slide showing Goddard's leadership team and noted the team's diverse background. Recent Goddard accomplishments include: the Robotic Refueling Mission on Space Shuttle Mission STS-135, Operation Icebridge, Suomi National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP)- Revisiting the Blue Marble, Nuclear Spectroscopic Telescope Array (NuSTAR) Optics, and the Sample Analysis at Mars (SAM) instrument on the Mars Science Laboratory (MSL or Curiosity). Upcoming milestones are expected to include an Antares test launch, the MSL landing with Goddard's SAM instrument onboard, the Radiation Belt Storm Probes (RBSP) launch, the Tracking and Data Relay Satellite (TDRS) K launch, the Landsat Data Continuity Mission (LDCM) launch, the Lunar Atmosphere and Dust Environment Explorer (LADEE) launch, the Mars Atmosphere and Volatile Evolution (MAVEN) launch, the Global Precipitation Measurement (GPM) launch, and the Magnetospheric Multiscale (MMS) launch. Goddard currently has three National Oceanic and Atmospheric

Administration (NOAA) reimbursable projects: the Joint Polar Satellite System (JPSS), formerly NPOESS, the Next Generation of Geostationary Operational Environmental Satellite (GOES) R, and Deep Space Climate Observatory (DSCOVR). The James Webb Space Telescope (JWST) is being managed at Goddard and the parts are arriving from all over the world. Early career recruitment and retention at Goddard was discussed. Mr. Scolese concluded with a quotation from Robert H Goddard: *"It is difficult to say what is impossible, for the dream of yesterday is the hope of today and the reality of tomorrow."*

Dr. Squyres thanked Mr. Scolese for his presentation, for a great Council tour of Goddard earlier in the day, and for the excellent meeting support provided by his Goddard team.

#### Remarks by NASA Administrator

Dr. Squyres introduced Mr. Charles Bolden as the next speaker. Mr. Bolden thanked Mr. Scolese for his hospitality in hosting the NAC meeting and noted that he is missed at NASA HQ. He thanked the NAC members for their willingness to serve on the Council, and he thanked Dr. Squyres for his leadership on the NAC.

Mr. Bolden stressed that diversity and inclusion are very important at NASA and that, while work remains to be done in that area, the leadership team at Goddard is a great example. There are not many NASA Centers where there are so many women at the leadership level. He noted that Dr. Colleen Hartman, Goddard's Deputy Director for Science, Operations, and Program Performance, and Ms. Christyl Johnson, Goddard's Deputy Director for Technology and Research Investments, are incredible leaders. NASA's diversity inclusion plan has been recognized by the White House. He explained that Goddard has struggled with more diversity issues than any other Center in the Agency because Goddard has more diversity than any other Center. Diversity does not happen by itself, you have to work at it. Goddard is supporting incredible science missions. The Goddard facility at Wallops will be used as a commercial launch site and demonstrates the challenges involved in introducing commercial space. Mr. Bolden commended Orbital Sciences Corporation for helping the state of Virginia in keeping its promises in that regard. The NAC's recommendations are critical to Mr. Bolden and to the Agency. Mr. Bolden noted that NASA has responded to all eight recommendations submitted to him thus far in 2012 by the NAC. At the last Council meeting, a need was expressed for more balance on the eight NAC committees. As a result, over 20 new members have been added to those committees. Dr. Squyres thanked Ms. Rausch for her efforts in making that happen.

Mr. Bolden described his recent trip to Dublin, Ireland, where he met with NASA's colleagues and partners in the European space industry. He explained that the Europeans are as committed to space exploration as NASA is and do not think that the U.S. is backing down from that commitment. The decision that NASA has made to support a commercial space industry is gaining more traction abroad. NASA remains the world's undisputed leader in space exploration. Nothing underscores that leadership more than the upcoming MSL landing on Mars on August 6, 2012 (at 1:31 am EDT). This is the most difficult robotic mission that NASA will ever have attempted. Mars is similar to Earth in many ways; learning more about Mars will teach us about Earth's history and will ultimately lead to a human mission to Mars in the 2030's, which is a goal set by President Obama. More than 5,000 people from 35 states have worked on this mission. For more information, you can visit [www.nasa.gov/msl](http://www.nasa.gov/msl). Tweets can be received from the MSL rover Curiosity, at <http://twitter.com/MarsCuriosity>. The Orion Multi-Purpose Crew Vehicle (MPCV) will soon be launched and will carry humans further into space than any time since the last Moon mission. It is undergoing final inspection at Kennedy Space Center (KSC). This past May, Space Exploration Technologies Corporation (SpaceX) made history when its Dragon spacecraft became the first commercial vehicle in history to successfully berth with the International Space Station (ISS). Dragon is a free-flying, reusable spacecraft developed by SpaceX under NASA's Commercial Orbital Transportation Services (COTS) program. Later this year, Orbital Sciences will launch a similar mission. By 2017, we will be relying on private companies for launch and rescue services through NASA's Commercial Crew Program, under which private companies will be awarded Space Act Agreements and FAR-based contracts to develop manned vehicles, with an aim to transport crews to the ISS. Working with industry, Congress, and others, NASA will be looking within the next 22 months for companies to bid on a very specific requirements contract to indicate how they would meet human ratings requirements. With that information, we should have a well-defined system, so that we can issue a Request for Proposal (RFP) with confidence that the successful bidder or bidders will deliver a product that NASA can use. The ISS is one of the greatest technological achievements in world history. We have had people continuously on orbit for over 11 years. ISS is a test bed for new technology and international cooperation. More than 400 scientific studies were completed last year and are proving helpful to everyday problems here on Earth. Many more are expected. The James Webb Space Telescope (JWST), the successor to the Hubble Space Telescope (HST), is taking shape at Goddard and will revolutionize our understanding of the universe. Launch is planned for 2018. In May, Goddard took delivery on the first of four main instruments that will be attached to the JWST.

Mr. Bolden noted with sadness the recent passing of two American icons and personal friends: Lt. Gen. Forrest S. McCartney (USAF, Ret.), former Director of NASA Kennedy Space Center, and Astronaut Sally Ride, the first American woman to fly in space. He extended his best wishes to the Council members for a productive meeting. Gen. Lester Lyles thanked Mr. Bolden for

his heartfelt recognition of Gen. McCartney and Ms. Ride. Gen. Lyles offered a suggestion that Mr. Bolden give more emphasis to NASA Aeronautics at the next meeting.

Dr. Squyres thanked Mr. Bolden for his time and for his comments.

#### NASA's Science Mission Directorate (SMD): Overview and Budgetary Outlook

Dr. Squyres introduced Dr. John Grunsfeld, Associate Administrator, SMD, NASA HQ. Dr. Grunsfeld explained that SMD has four main divisions: Earth Science, Heliophysics, Astrophysics, and Planetary Science. Additional responsibilities include the JWST and the Joint Agency Satellite Division (JASD), which was established following the decision to replace the NPOESS program with the NOAA/NASA JPSS and the DoD Defense Weather Satellite System. He described the MSL, which is a one-ton, car-sized rover named "Curiosity" that is scheduled to land on Mars on August 6, 2012. Curiosity is headed to Gale Crater. The plan for entry, descent, and landing (EDL) was described. Radar will be used for a guided entry to land Curiosity within a relatively small "uncertainty" ellipse near Mt. Sharp. A supersonic parachute will bring the rover close to the surface, where rockets will be used to hover over the landing area while an aerial crane lowers the rover to the ground. A video animation entitled, "*7 Minutes of Terror: Curiosity Rover's Risky Mars Landing*," depicting the process has been posted on YouTube and can be found at <http://www.youtube.com/watch?v=h2I8AoB1xgU>. The landing will require 7 minutes; however, it will take 14 minutes for information about the landing to be received on Earth due to the distance from Mars. Curiosity has several cameras. The Mars Descent Imager (MARDI) will take color video about the descent. The Mast Camera (Mastcam) has one camera for color images of the Martian terrain and another camera offering telephoto capability. The Mars Hand Lens Imager (MAHLI) will provide close-up views of rocks and dust. The instruments on Curiosity are designed to search for evidence that there might once have been the building blocks of life on Mars. The Alpha Particle X-Ray Spectrometer (APXS) will measure chemical elements in rocks and soils. The Chemistry and Mineralogy instrument (CheMin) will identify minerals. The SAM instrument suite will search for carbon compounds, including ones that are associated with life. The Radiation Assessment Detector (RAD) will measure high-energy radiation. A pulsing neutron generator called the Dynamic Albedo of Neutrons (DAN) will be used to detect subsurface hydrogen. The Rover Environmental Monitoring Station (REMS) is a weather monitoring station contributed by the Spanish government. Dr. Grunsfeld presented a chart showing how the MSL is being treated as a major NASA public relations event as well as a science event. Toshiba will be sponsoring a live telecast of the landing on the large video screen at Times Square in New York City. More information can be found at <http://mars.jpl.nasa.gov/msl/> and [http://www.nasa.gov/mission\\_pages/msl/index.html](http://www.nasa.gov/mission_pages/msl/index.html).

Dr. Grunsfeld reviewed SMD's three guiding principles: its programs are driven by science; the science community is involved in program development; and there is transparency and openness in decision-making. He discussed SMD's program and budget strategy for FY13. It will be guided by national priorities and informed by recommendations in National Research Council (NRC) Decadal Surveys. The JWST will be closely managed to its new cost and schedule baseline. SMD, with other NASA organizations, will plan and conduct a new Mars program to meet both human exploration and science goals. Dr. Grunsfeld presented a chart on the Planetary Decadal Survey recommendations, and he discussed a graph showing divergences between the President's FY13 Budget Request and the costs needed to implement the Decadal recommended program. Research and Analysis (R&A) funding will be maintained at the current level over the budget horizon. The next Discovery solicitation will be delayed to FY15. NASA is reformulating the Mars Exploration Program (MEP) and is strategically aligning its science, human spaceflight, and technology objectives to enable future missions that will achieve the NRC's Planetary Science Decadal Survey goal of sample return and to prepare for eventual human expeditions to Mars. SMD has established the Mars Program Planning Group (MPPG) to address the next step in Mars exploration. More information about this work can be found at [www.lpi.usra.edu/meetings/marsconcepts2012/](http://www.lpi.usra.edu/meetings/marsconcepts2012/). Another rover similar to Curiosity will not be feasible under the current budget outlook.

Dr. Grunsfeld reported on several other activities and accomplishments. The National Reconnaissance Office (NRO) recently transferred to NASA two sets of space qualified telescope hardware. The asset has a 1,700 kg mass, including telescope and outer thermal barrel. While the elements have been declassified, there are still issues that limit NASA's ability to share detailed information widely. NASA has no funding dedicated to using the new optics, but is reviewing this opportunity through its Strategic Implementation Panel. This is the 40<sup>th</sup> anniversary year of the first Landsat launch. Over that time, Landsat has been a unique resource providing data for global change research and applications in agriculture, cartography, geology, forestry, regional planning, surveillance, education, and national security. The HST recently provided images showing a fifth moon around Pluto.

Dr. Squyres thanked Dr. Grunsfeld for his presentation and advised that it is important to gain the support of the entire planetary community and space science community for the MEP reformulation. That support will largely depend on the extent to which the reformulation is responsive to the Decadal Survey's recommendation that the next step forward should be towards Mars sample

return. Showing the community the connection to the Decadal Survey Mars sample return is going to be very important in order to get their support for the reformulation.

#### James Webb Space Telescope Update; NASA Office of Evaluation Overview

Dr. Squyres introduced Mr. Geoffrey Yoder, JWST Program Director, and former Director, Office of Evaluation (OE) at NASA HQ, who briefed the Council on the JWST program's status. JWST program re-planning was completed in September 2011, and the new launch date is October 2018. The plan has adequate cost and schedule reserves that are consistent with the Independent Comprehensive Review Panel (ICRP) recommendations. An additional \$44 million was approved by Congress for FY11. The FY12 budget approved by Congress provides full funding for JWST, and the FY13 President's Budget Request fully funds the new baseline. Recent accomplishments were reviewed. The flight optics has been cryo-vacuum tested. Instrument deliveries to GSFC have begun. The Mid-Infrared Instrument (MIRI) was delivered in May, and the Fine Guidance Sensor (FGS) will be delivered in the beginning of August. There are now 14 months of funded schedule reserves on the critical path, compared to 13 months when the new baseline was approved. The Integrated Science Instrument Module (ISIM) delivery has slipped by five months, from 26 months to 31 months; however, there is still nine months slack time on the critical path for that delivery. Mr. Yoder emphasized that it is important to stay focused. This will be accomplished through execution, communication, and education. The OE completed a program progress assessment in May 2012. It found that the project is operating within the September 2011 re-baseline and continues to make good technical progress, while preserving the level of schedule reserve on the critical path and performing to the re-baseline budget, including Unallocated Future Expenses (UFE). The OE expressed concern over the ISIM cryo-vacuum testing and with risks associated with the detector change-out and undelivered instruments. A chart showing the JWST schedule was presented, and recent instrument progress was discussed. All mirrors are complete. Aft Optics Assembly (AOS) integration and testing is complete. The Primary Mirror Backplane Support Structure (PMBSS) has been completed and the primary mirror wings are being assembled. Progress on the sunshield template membrane was described. Slides were presented showing the Optical Simulator (OSIM) and ISIM in the Space Environment Simulator Chamber at GSFC. Mr. Yoder described progress by the Space Telescope Science Institute (STScI), which is the science operations center for the JWST. The center is operated for NASA by the Association of Universities for Research in Astronomy (AURA) on the Johns Hopkins University campus in Baltimore, Maryland. The first prototype version of Near Infrared Camera (NIRCam) data pipeline is on track for completion in September 2012. An update to the Science Operations Design Reference Mission (SODRM) is also nearing completion. Several charts were presented showing the JWST program's milestones.

Mr. Yoder discussed the assessments and analyses being conducted by the Study Work Group (SWG), the OE, the Independent Program Assessment Office (IPAO), the Cost Analysis Division (CAD), and Standing Review Boards (SRBs). IPAO leads the capture of best practices for independent assessment on behalf of the Agency. One example is periodic Pause and Learn (PAL) activities with review participants and stakeholders. The One NASA Cost Engineering (ONCE) database will facilitate analysis. There are 37 active SRBs; 25 are non-consensus and 12 are consensus. He explained that in a consensus board, all members are civil servants, the chair prepares the final report, and dissenting opinions are documented in the report. In a non-consensus board, the board members can include non-civil servants, and the members are asked for their individual opinions. Mr. Richard Kohrs expressed concern for the need to demonstrate value-added from the cost incurred by 37 SRBs for travel and meetings. He noted that the Constellation program had seven or eight SRBs that cost around \$11 million per year. Mr. Yoder explained that the IPAO funds the review manager and the SRBs are funded by the project. He added that the challenge is to make sure that each board is the right size. Sometimes it is overdone; this is what can be learned from the PAL. Gen. Lyles observed that while it is important to have a PAL, the number of reviews looks like DoD. He cautioned that these reviews take time away from the people responsible for execution, and that is the number one responsibility. Dr. William Ballhaus explained that the value comes from having the right people with the right experience, and that the consensus process makes them think things through thoroughly. He asserted that the FACA restrictions are an impediment to getting the job done. Dr. McComas suggested adopting a procedure from academia, wherein students grade the reviewers. He explained that evaluating evaluators is important, that students do that well, and that the process motivates the reviewers. Mr. Yoder agreed that the suggestion should be pursued.

Dr. Squyres thanked Mr. Yoder for his presentation.

#### The President's Export Control Reform (ECR) Initiative

Dr. Squyres introduced Mr. Brian H. Nilsson, Director, Non-Proliferation – Export Controls, National Security Staff, The White House. Mr. Nilsson briefed the Council on the progress that has been made in the President's ECR initiative. The last major legislative overhaul in export controls occurred almost 40 years ago. Many changes have been made incrementally over time, and further incremental changes are no longer feasible; hence the need for an overall reform, which the President initiated in 2009. The intent is to enhance national security by focusing resources on the threats that matter most, increasing

interoperability with our allies, and strengthening the U.S. defense industrial base by reducing incentives for foreign manufacturers to avoid using U.S. components. The system has four parts: control lists; licensing; export enforcement; and the information technology infrastructure. The plan to reform the system will be implemented in three phases. Developments on ECR can be followed at [www.export.gov/ECR](http://www.export.gov/ECR). Over 21 U.S. Government agencies have some responsibility for export licensing and are involved in the process. A methodology has been developed and agreed upon. There are 19 U.S. Munitions List (USML) categories, and 19 technical teams have been formed to review those categories. The plan is to expedite the export process by moving defense articles from the State Department's U.S. Munitions List to the Commerce Department's Commerce Control List (CCL). New rules will need to be promulgated for each Department, and new legislation will also be needed. Three categories are now being translated into regulatory text, including Category XV, Spacecraft Systems. The U.S. now has only 25 percent of the world satellite market due in part to the unintended consequences from putting satellites on the U.S. Munitions List. The reforms will harmonize International Traffic in Arms Regulations (ITAR) embargos with Export Administration Regulations (EAR) embargos, thus tightening the embargos. A License Exception Strategic Trade Authorization (STA) will allow most current Commerce Control List items to move to 36 allies without a license. An Export Enforcement Coordination Center (E2C2) will have several functions, including de-confliction and coordination, statistical analysis and reporting, dispute resolution, lead referral, outreach coordination, licensing coordination, and intelligence collaboration activities. Licensing and enforcement agencies will have full access for the first time to the Automated Export System (AES), and there will be a transition to the DoD secure USXPORTS licensing database.

In response to a question from Gen. Lyles, Mr. Nilsson advised that President Ford originally had assigned the ITAR responsibility to the State Department, rather than DoD, in order to create checks and balances; most of the State Department's expertise, however, comes from DoD. Gen. Lyles remarked that the State Department takes a long time to act. Mr. Nilsson noted that the State Department approved 85,000 licenses last year. He believes there will be many benefits as the Commerce Department assumes jurisdiction. Dr. Ballhaus reported that the Europeans advertise an ITAR-free satellite, and he asked when the U.S. would be able to offer one. Mr. Nilsson responded it will require some time, probably into next spring due to the need for regulations and legislation. Ms. Marion Blakey advised that this is important "must-pass" legislation that will be a huge step forward for commercial satellites. Dr. Ballhaus noted that the U.S. has been locked out of satellite competition for 15 years. Dr. Squyres asked whether NASA was monitoring the restructuring. Ms. Paula Geisz, Manager, International Technology Transfer Policy, Office of International and Interagency Relations, NASA HQ, responded that they have been involved at the staff level and have been participating on several teams. Dr. David McComas asked how scientific instrumentation was treated under ITAR. Ms. Geisz responded that those items would fall under ITAR if designed for a spacecraft, and might still be otherwise controlled. Dr. Squyres advised that it was critical for NASA to be involved in the restructuring due to NASA's intensive use of scientific instruments in space. Ms. Blakey acknowledged Mr. Nilsson for great work in a mammoth undertaking. She noted that there are problems in this area when academic research teams include foreign nationals. Many educational institutions are not bidding on research projects, which is a growing problem that should be better understood. Dr. Squyres noted that the Council does not give advice to the White House, but could give advice to the NASA Administrator on cross-cutting matters that transcend individual committees. He requested that Ms. Blakey work with Dr. McComas to draft a proposed recommendation for the Council to consider. Dr. Squyres believes that many universities are not confident that they understand the legal ramifications concerning ITAR and tend to be advised by their legal departments to either exclude foreign students or not engage in the activity. In response to a question from Dr. Larry Smarr, Mr. Nilsson explained that NASA has been actively engaged with the process since the working groups were formed, particularly the working group for Category XV/Spacecraft Systems. Gen. Lyles advised that legislation is essential and that the NASA Centers and Center Directors need to stay informed and be involved in the process. In response to a question from Dr. Charles Kennel, Ms. Geisz explained that NASA does not have authority to provide advice to universities on ITAR compliance.

Dr. Squyres thanked Mr. Nilsson for his presentation.

#### Public Input

Dr. Squyres invited comments from the public. There were none.

#### Adjournment

The meeting was adjourned for the day at 4:45 p.m.

Thursday, July 26, 2012

Call to Order, Announcements

Ms. Rausch called the meeting to order and welcomed everyone to the second day of the meeting. She stated that the NAC is a Federal advisory committee established under the FACA. The meeting is open to the public. A dial-in capability is available for members of the public to listen to the meeting. WebEx is also available. Meeting minutes will be posted to the NAC website, [www.nasa.gov/offices/nac](http://www.nasa.gov/offices/nac), soon after the meeting. All presentations will be part of the public record. Time has been set aside at the end of the day for public comments.

Remarks by Council Chair

Dr. Squyres thanked the Council members for a productive first day. He provided information for WebEx users and reviewed the proposed agenda.

Aeronautics Committee Report

Dr. Squyres introduced Ms. Marion Blakey, Chair, Aeronautics Committee. Ms. Blakey reported that the Committee had an excellent meeting just prior to the NAC meeting. She described the Committee's membership and observed that it has a good mix between academia and industry. She noted that Gen. Lyles, a Council ex officio member, also attended the Aeronautics Committee meeting. The Committee's next meeting will be in October 2012 at NASA Glenn Research Center in Cleveland, Ohio. The areas explored by the Committee at its meeting were the National Aeronautics Research Agenda (the "Agenda"), aeronautics international partner engagement, NextGen research and development activities, and Unmanned Aircraft Systems (UAS). In addition, the Education and Public Outreach (EPO) activities of the NASA Aeronautics Research Mission Directorate (ARMD) were the subject of a joint session held with the NAC's EPO Committee. The Agenda supports NextGen, safety, vehicle efficiency, environmental improvements, and UAS in the National Air Space (NAS). The Agenda also includes taking the next steps in advancing supersonic transportation. There are research thrusts in a low boom supersonics demonstration, composite materials and structures, autonomous and intelligent aviation systems, electric aircraft systems technology, and complex systems engineering. A study by the National Academy of Sciences (the "Academy") may be needed to ensure that clear needs and priorities for the Agenda are properly articulated.

Ms. Blakey described how ARMD's approach to international collaboration has evolved, and she discussed a chart showing the number of ARMD international agreements that are in force around the world. The distinction between collaboration and competition must be carefully considered. European funding for Research and Development (R&D) has become more coordinated, with a less competitive focus. There is an enhanced interest in collaboration by non-traditional partners. The Congressional prohibition on NASA collaboration with China presents difficulties. The International Forum for Aviation Research (IFAR) provides a forum to engage with non-traditional partners on areas of common interest. Singapore is seeking to be a major transportation hub and is looking for partners. Australia has become an early adopter of new technologies and is a potential test bed for demonstration work that requires unused airspace. High Ice Water Content (HIWC) research was described as an example of ARMD international collaboration. Ms. Blakey discussed NASA's approach to NextGen R&D. There is now a lively collaboration with the Federal Aviation Administration (FAA), when only a few years ago there was very little. There has been an effort to add value by defining partnered integrated technology evaluations and demonstrations. ARMD air traffic management (ATM) technology demonstration activities are an example. These activities are aimed at accelerating airspace technology transition. ATM Technology Demonstration 1 was designed to accelerate the transfer of NASA's scheduling and spacing technologies for use in the NAS. Dr. Ballhaus suggested that the NAC Aeronautics Committee explore what is being done to maintain core competencies in research capability at the NASA's aeronautical research centers.

Ms. Blakey presented for the Council's consideration a proposed Finding on collaboration between NASA and the Federal Aviation Administration (FAA). The Council approved the Finding as follows:

*The Council commends the strong coordination and collaboration between NASA and the Federal Aviation Administration (FAA) in air traffic management research. In particular, the Council finds that the use of research technology transition teams (RTTs) by NASA and the FAA are a key component that enables NASA research to be integrated with stakeholder needs and facilitates the successful transition of research technologies into an operational environment. The Council encourages NASA to continue to foster a strong collaborative environment with the FAA as it moves forward with plans for air traffic management technology demonstrations within the Airspace Systems Program.*

Ms. Blakey described the membership for the UAS Subcommittee. The Subcommittee strongly applauds NASA's re-entry into the field of unmanned air vehicles. It observed that the NASA technical team spent considerable time re-learning the state of the art due to NASA's limited activity in this field over the past decade. There was concern that the UAS project is focused solely on "pilot in the loop" type aircraft and does not include more increased levels of autonomy. Additional concern was expressed over the need for a central systems engineering function. A slide was presented showing a refueling demonstration between two unmanned air vehicles. Dr. Squyres expressed excitement over the potential for using unmanned air vehicles as a platform for flying science missions. Ms. Blakey explained that that is close to becoming an application. Dr. Squyres encouraged greater interaction between the NAC Science Committee and NAC Aeronautics Committee on potential science applications. He counseled that this is an emerging area where there is tremendous opportunity for synergy between the Aeronautics Research Mission Directorate and the Science Mission Directorate. There is a need to educate the science community about this through the NAC Science Committee.

Ms. Blakey presented for the Council's consideration a proposed Finding on the UAS program. The Council approved the Finding as follows:

*The Council is pleased that NASA ARMD is working to address the challenges of the integration of Unmanned Aircraft Systems (UAS) into the National Airspace System (NAS). Given the complex issues surrounding UAS, the Council has found very valuable the work of the UAS Subcommittee which is able to delve into issues in greater depth with NASA staff. The Council endorses the continued work of the Subcommittee and looks forward to further discussions between the Subcommittee and NASA.*

*In its review of the UAS integration into the NAS project, the UAS Subcommittee reported that the project appeared to lack an overall systems engineering approach to addressing the challenges to UAS integration. This is a cause of concern for the Council as it is important to handle the transition of integration of UAS into the NAS in a stepwise, systematic approach. The Council strongly believes that the project needs to take a rigorous overall systems engineering approach to ensure that the right steps are identified and the activities within the project are better coordinated.*

A new slogan, "NASA Is With You When You Fly," was discussed by Ms. Blakey. This message is aligned with the Agency vision, mission, and goals. It is designed to improve awareness about NASA's fundamental research efforts in aeronautics and is focused on the relevance of ARMD work to the economic health of the U.S. air transportation system. She described the success of a recent "NASA Aeronautics Day on the Hill," which took place on July 18, 2012. It was attended by 11 Members of Congress, all the professional staff from the House Committee on Science, and 206 other Congressional staffers.

Ms. Blakey presented for the Council's consideration a proposed Finding on featuring aeronautics programs in NASA's education and outreach initiatives. The Council approved the Finding as follows:

*The Council notes and applauds NASA's proactive Education and Outreach initiatives. We note, however, that the Aeronautics programs are not frequently prominently featured or highlighted in these initiatives. The general public and NASA could benefit from understanding the scope and depth to which the Aeronautics activities at NASA contribute to the nation's aviation economy.*

Dr. Squyres thanked Mr. Blakey for her presentation.

#### Technology and Innovation Committee Report

Dr. Squyres introduced Dr. William Ballhaus, Chair, Technology and Innovation Committee. Dr. Ballhaus described the presentations that had been given to the Committee at its last meeting. Dr. James Reuther, Deputy Director, NASA Space Technology Program (NSTP), gave an update on the program. Dr. Mason Peck, NASA Chief Technologist, provided an update on the Office of the Chief Technologist (OCT). Ms. Faith Chandler, Acting Director, Program Management and Integration Office, and Dr. Peck provided a presentation on NASA's draft Strategic Space Technology Investment Plan (SSTIP). Mr. Peter Hughes, GSFC Chief Technologist, discussed GSFC's technology programs. Dr. Ballhaus presented a slide showing how NASA's technology portfolio is developed. He explained that the Office of Management and Budget (OMB) had requested NASA to prepare a plan for space technology investment, and for the plan to be independently reviewed. NASA asked the Committee to perform that review. He described how the SSTIP was developed. The starting point was 14 Space Technology Roadmaps developed by OCT. A study was then performed by the NRC, which prioritized 83 high-priority technologies and identified the 16 highest priority technologies. The SSTIP updated the roadmaps to incorporate the feedback from the NRC's study. The roadmaps will be revised every four years, and a new NRC study will be requested every four years. The SSTIP uses a 20-year horizon and provides investment guidance for the next four years. It calls for 70 percent of available technology funds to be invested in eight core technologies, representing 12 of the NRC's top priority recommendations. The eight core

technologies are: launch and in-space propulsion; high data rate communications; lightweight space structures; robotics and autonomous systems; environmental control and life support systems; space radiation; science instruments and sensors; and Entry, Descent and Landing (EDL). Twenty percent will be spent on adjacent technologies that are not part of the core, but are part of the NRC's 83 high priorities. The remaining 10 percent will be used for seeding innovation by making smaller investments in the remaining technologies that were not part of the NRC's 83 high priorities. The plan will be governed by the NASA Technology Executive Council (NTEC), which will serve as the decision making body for directing and balancing the investment portfolio. The NTEC will be chaired by the Chief Technologist. The SSTIP was distributed to the Council Members for their review.

Dr. Ballhaus presented for the Council's consideration a proposed Recommendation that the NASA Administrator adopt the SSTIP, with minor revisions, as the Agency's space technology strategic plan. After discussion, the Council agreed to reformulate the proposed Recommendation present it as a Finding because formal action by the Administrator is not actually required by OMB. The Council approved the initial wording of the Recommendation, subject to additional offline editing to reformulate it as a Finding:

*The Council recommends that the NASA Administrator adopt a revised version of the Strategic Space Technology Investment Plan (SSTIP) as the Agency's space technology strategic plan moving forward, with the following input:*

- *The Council agrees with the content and strategy of the SSTIP.*
- *The Council offered two suggestions to: (a) simplify the description of the plan in SSTIP; and (b) reorganize the SSTIP to emphasize what the plan is, and de-emphasize how it was delivered.*

Dr. Ballhaus noted that the SSTIP defines technology as "A solution that arises from applying the disciplines of engineering science to synthesize a device, process, or subsystem, to enable a specific capability." Technology, therefore, does not include basic research. Tremendous benefit has come from basic research that would not fall under the definition for technology. A method for managing that research is needed.

Dr. Ballhaus presented for the Council's consideration a proposed Recommendation for NASA to establish a basic research program. The language was modified at Dr. Squyres' request to show that funding would be consolidated, rather than sought. The language was further modified at Gen. Lyles' request to clarify that the program would be for space research and would not extend to aeronautics research. Dr. Ballhaus agreed to provide specific examples of the kind of research contemplated by the Recommendation. The Council approved the revised Recommendation as follows, subject to additional offline editing:

*The Council recommends that NASA establish a basic space research (engineering science) program relevant to its long-term needs and goals.*

- *The Council suggests that the Chief Technologist collaborate with the Chief Scientist and the Chief Engineer to establish formal guidance and consolidate funding for basic space research in engineering science. The Council further suggests that NASA begin by managing the agency's basic space research portfolio as a pilot activity that is funded separately from the Space Technology Program, similar to how OCT coordinates the agency's technology portfolio.*

Dr. Squyres thanked Dr. Ballhaus for his presentation.

#### Administration

Dr. Squyres provided information for WebEx users.

#### Commercial Space Committee Report

Dr. Squyres introduced Ms. Patti Grace Smith, Chair, Commercial Space Committee. After describing the Committee's membership, Ms. Smith discussed the Committee's strategy for 2012, reviewed the Committee's planned meeting schedule, and presented slides summarizing the Committee's recent meetings. She reported that the Committee applauds the accomplishments of Space X and NASA's COTS Program on the recent demonstration flight to the ISS. She observed that there are a variety of acquisition approaches available for NASA's commercial space endeavors. There is no absolute, uniform approach that is best. The key is to identify an approach that best enables the desired objectives and attributes for a particular phase and situation. She noted that GSFC has a long history of commercial partnerships that are continuing under the present Agency transition.

Ms. Smith presented for the Council's consideration a proposed Finding on the example being set by the KSC on accepting the commercial space policy. After discussion and agreement to language suggested by Mr. Lars Perkins, the Council approved the Finding to read as follows:

*The Council finds that Kennedy Space Center sets an excellent example of how to gain acceptance by its employees and contractors of the commercial space policy—specifically, commercial space initiatives at the center director level, including documents like the KSC Director’s Planning Guidance, 2011.*

Ms. Smith presented for the Council’s consideration a proposed Recommendation for the Commercial Space Committee to receive draft legislation submitted by NASA Centers regarding commercial space. Mr. Kohrs counseled that this would require releasing pre-decisional information. Dr. Squyres concurred and suggested that the recommendation be reformulated as a Finding that stresses the importance of having Center Directors’ concerns heard by the Committee. The Council agreed. The initial proposed Recommendation as presented read as follows:

*The Council recommends that the Commercial Space Committee be given access to draft legislation submitted by NASA Centers to Headquarters regarding commercial space issues.*

Ms. Smith presented for the Council’s consideration a proposed Recommendation for NASA to ensure that the SSTIP supports future needs of the commercial space industry. Dr. Squyres suggested that this recommendation be incorporated into the previously approved Finding on the SSTIP. Dr. Ballhaus concurred, subject to ascertaining whether commercial space was already included in the plan, in which case the recommendation would be unnecessary. The Council agreed to table the proposed Recommendation.

Ms. Smith presented for the Council’s consideration a proposed Recommendation for NASA regarding Commercial Crew Program Office size and involvement. Mr. Kohrs noted that the proposal does not address crew safety. He explained that NASA will do what it needs to do to protect its crews. Ms. Smith concurred. Gen. Lyles suggested that this could be expressed as a Finding that the size needs to be watched carefully to see that it does not overgrow. Dr. Squyres agreed that it would be desirable to reformulate the proposed Recommendation as a Finding. The Council agreed. The initial proposed Recommendation as presented read as follows:

*The Council recommends that NASA constrain both the size and the level of technical involvement of the Commercial Crew Program Office, in favor of an “insight,” versus “oversight,” role in program management.*

Ms. Smith presented for the Council’s consideration a proposed Recommendation that NASA adjust its workforce to meet the needs of the commercial space access environment. Mr. Kohrs opined that the Administrator would reply that this is already being done. Dr. Squyres explained that NASA is transitioning to a different way of managing spaceflight. He suggested that the reasons for the recommendation be expanded to provide examples on what skills are needed. The section on consequences should be revised to recognize the contributions that have been made by those who worked on the space program. The wording of the Recommendation itself could be enhanced by some editing as well. Accepting Dr. Squyres suggestions, the Council approved the Recommendation, subject to additional offline editing:

*The Council recommends that NASA evaluate and adjust its workforce skill mix to meet the needs of the commercial space access environment. These adjustments should include revised personnel strategies in human capital planning.*

Ms. Smith presented for the Council’s consideration a proposed Recommendation that NASA Centers promote opportunities for public use of their capabilities without negative consequences of highlighting underutilization. Dr. Squyres requested each Council member to canvas the segment of the Agency over which they have cognizance in order to identify the facilities that are underutilized. The Council agreed to table the proposed Recommendation.

Dr. Squyres thanked Ms. Smith for her presentation.

#### NASA Early Career Scientist Presentation: “DNA Building Blocks Can be Made in Space”

Dr. Squyres introduced Dr. Michael P. Callahan, Research Physical Scientist, Astrobiology Analytical Laboratory at GSFC. In a presentation that drew an ovation from the Council members, Dr. Callahan described his role in discovering some of the basic building blocks for DNA in meteorites. He circulated an actual meteorite among the Council and explained that meteorites are usually a fragment from an asteroid or a comet. They are primitive objects that were formed at the beginning of the solar system. There are trillions of them, and they are found in the asteroid belt, in the Kuiper belt, and in the Oort Cloud. He described NASA’s comet sample return mission, Stardust. Details about this mission can be found at <http://stardust.jpl.nasa.gov/home/index.html>. Another mission, called Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer (OSIRIS-REx), will be launched in 2016 and will be the first U.S. mission to carry samples from an

asteroid back to Earth. The Antarctic Search for Meteorites (ANSMET) program has been recovering meteorite specimens from the East Antarctic Icesheet since 1976, and has uncovered nearly 20,000 to date. Details can be found at <http://geology.cwru.edu/~ansmet/>.

Dr. Callahan described the organic chemistry of meteorites. He explained how it was discovered that highly complex meteorites known as carbonaceous chondrites contain amino acids and nucleobases, which are molecules essential for all life. A recent research article asserts that the indigenous chemical diversity found in an object known as the Murchison meteorite can be extended to tens of thousands of different molecular compositions and likely millions of diverse structures. How nucleobases originated in meteorites was a 50 year old mystery. Dr. Callahan described his experimental procedure and the laboratory instruments he uses for liquid chromatography mass spectrometry and gas chromatography mass spectrometry in “fishing out” desired compounds. He described how mass spectrometry is used to accurately measure mass. One question being asked, he noted, is whether alternative nucleobases could play a role in constructing the first genetic code. Meteorites contain both biological and non-biological nucleobases, and the distribution of nucleobases is distinct in different meteorite groups. The Antarctic ice and terrestrial soil from which the meteorites were found do not contain non-biological nucleobases. Accordingly, there is now laboratory evidence that the nucleobases in the meteorites are extraterrestrial. Dr. Callahan presented slides showing news media reporting on the fact that NASA-funded researchers had discovered evidence that some DNA building blocks had been made in space. He explained that in a sufficiently energetic impact, rocks from the Martian surface can be ejected with enough velocity to escape the planet’s gravity and find their way to Earth as a meteorite. Some meteorites now being examined have been determined to have originated from Mars. In response to a question from Ms. Blakey, Dr. Callahan explained that this determination was possible because meteorites from Mars contain trapped gases that match measurements obtained from the Viking Mars mission in 1976. A 4.1 billion year old meteorite from Mars possibly contains amino acids, the building blocks of proteins.

Dr. Callahan advised that much work remains to be done in this field, making MSL very timely. The project will search for amino acids and nucleobases. Science is fun, he asserted. High school students are working on the project. MSL supports missions and fundamental science, and it captures the media’s attention. The public can understand it. Gen. Lyles asked whether he had a well understood career path at Goddard. Dr. Callahan replied it has not been projected long-term; instead, he finds that he is always writing proposals. In response to a question from Dr. Larry Smarr about the possibility that life exists throughout the galaxy if the seeding of organic materials is a general process, Dr. Callahan noted that when looking at extraterrestrial input, meteorites represent only a small percentage of what is rained on Earth all the time, compared to extraterrestrial dust. In response to a question from Ms. Blakey, Dr. Callahan shared his opinion that sending a person to Mars would be more exciting than to an asteroid. Ms. Smith complemented Dr. Callahan on his passion and enthusiasm and asked what he would say to someone about NASA’s importance to the Nation. Dr. Callahan responded that everyone he talks to likes NASA, even if they do not know what it does. To reach that group, he suggested doing things that are understandable to the public. Our education system needs to foster science, learning, enjoyment, and creativity. The connection to that gets lost if you are only focused on fundamentals. You need to get early involvement. What motivates him is he likes what he does; it is not a job.

Dr. Squyres explained that one purpose in having Dr. Callahan speak to the NAC was to show why NASA is so exciting. He thanked Dr. Callahan for his presentation.

#### Education and Public Outreach Committee Report

Dr. Squyres introduced Mr. Lars Perkins, Chair, Education and Public Outreach Committee. Mr. Perkins described the Committee’s membership and noted that two members were new, Ms. Pilar Monoya, and Mr. Matthew Chamberlin. He presented several slides showing Will.i.am, an entertainer and member of the Black Eyed Peas, and former Astronaut Mr. Leland Melvin, NASA Associate Administrator for Education, at KSC during prelaunch activities for the MSL mission. Mr. Perkins discussed what he refers to as “the taxi driver problem” – the Space Shuttle Program does not equal NASA. With the end of the Shuttle Program, people do not know what NASA does and think it is going out of business. That is the fundamental challenge. He noted that NASA’s budget continues to decline, and that Mr. Melvin manages only \$73 million in discretionary programs out of a total \$173 million budget. The budget for public outreach, managed by Mr. David Weaver, Associate Administrator for Communications, is even more limited at \$5.8 million. That office handles Freedom of Information Act (FOIA) requests as well, which occupy a great deal of its time. There is no known number on how much the entire Agency spends on education and outreach; estimates range as high as \$500 million. NASA continues to do extremely well in social media, particularly when compared to other Federal agencies. The “7 Minutes of Terror” MSL landing video produced at JPL has gone viral and has been featured on major television networks. A NASA game, “Angry Birds Space,” is the most popular game in history and was downloaded more than 20 million times in ten days. It began with a simple Twitter tweet from NASA: “Hey, @RovioMobile, our computers are a bit better than they were in ’69. We might be able to help you launch birds if you find pigs in space.” A

demo download is available at <http://download.angrybirds.com/>. The Twitter account “@NASA” has 2.6 million followers and was honored with a 2012 Shorty Award.

Mr. Perkins presented for the Council’s consideration a proposed Finding to acknowledge the Office of Education for recent success. The Council approved the Finding as follows:

*The Office of Education should be recognized for its initiative in creating the Education Coordinating Committee, and for its success in driving closer collaboration between Centers’ education activities. As an example, we applaud the planned multi-center Curiosity @NASASocial event. In the future, we strongly encourage NASA senior management to support the ECC’s oversight role.*

Mr. Perkins presented for the Council’s consideration a proposed Recommendation to elevate the Education Coordinating Committee to a Council. Mr. Kohrs noted that this involves the Associate Administrators, who have their own budgets for public outreach. Dr. McComas opined that there is value in decentralized EPO efforts from SMD. Mr. Perkins observed that there had been days when press releases from different Agency organizations have taken attention away from each other because there was no coordination. After further discussion, the Council approved the Recommendation as follows:

*Building on the success of the ECC, the Communications Coordinating Committee (CCC) should be elevated to a Council, moving it from a coordination role to strategic and decisional function.*

The Committee’s recent meeting with Dr. Michelle Thaller, GSFC Assistant Director for Science Communication, was discussed. A chart was presented that provided statistics on NASA’s purchase of billboard space from Clear Channel.

Mr. Perkins described SMD’s requirement that 1% of each prime mission’s cost, excluding launch vehicle, be used to fund an EPO program. He presented for the Council’s consideration a proposed Recommendation to extend that practice to the other directorates. Dr. Kennel noted that this is patterned after a National Science Foundation (NSF) practice where all proposals must have a section dedicated to EPO; it gets everybody thinking about their obligation to communicate. Dr. Squyres cautioned that the Agency does not know where funds are being spent for EPO, and that there is a need for guidance as to what would be subject to the 1% tax. Gen. Lyles agreed with the concept, but expressed concern as to whether 1% was the right number. Dr. Squyres advised that EPO is a critically important part of what NASA does. The proposed Recommendation was not actionable as drafted, however, and should be revised. He requested the EPO Committee to ascertain how and where EPO money is being spent. Gen. Lyles suggested that a future Council Finding in this area would be a good place to start. Dr. Squyres concurred.

Mr. Perkins presented for the Council’s consideration a proposed Recommendation for NASA to identify centers of excellence for EPO activities. Ms. Blakey endorsed the concept and explained that she prefers centers of excellence because “best practices” come and go. She requested that the language cover coordination. The Council approved the revised Recommendation as follows:

*NASA should identify “centers of excellence” for EPO activities with which project teams can coordinate when developing their EPO programs. These should include (but not be limited to): social media, website design, app development, data visualization, and video production.*

A video entitled “Riding the Boosters” was shown to the Council.

Mr. Perkins described the confusion that arises from the many different styles used for various NASA websites and applications. He presented for the Council’s consideration a proposed Recommendation for NASA to develop one message under which its activities and programs could be presented to the public. A sample website prepared by Mr. Perkins was shown; Dr. Smarr described it as brilliant and Dr. Squyres remarked that it looked “awesome.” The Council approved the Recommendation as follows:

*NASA should develop one overarching message under which all NASA activities and programs (e.g. Aeronautics) can be integrated and presented to the public. All NASA websites, videos, apps, and social media should be consolidated and be organized thematically under this message and exposed via WWW.NASA.GOV.*

Dr. Squyres thanked Mr. Perkins for his presentation.

Human Exploration and Operations Committee Report

Dr. Squyres introduced Mr. Richard Kohrs, Chair, Human Exploration and Operations Committee. Mr. Kohrs described the Committee's membership and noted that two new members had been added. He reviewed the Committee's agenda from its last meeting. The ISS program status was reviewed. A chart showing the ISS Flight Plan was presented. Mr. Kohrs quipped that the chart shows everything you want to know about the ISS. He noted that careful attention has to be paid to berthing with the correct port. Recent mission accomplishments were reviewed. There were three dockings in the last four months. The SpaceX vehicle objectives were successfully demonstrated with the tracking, capture, berthing, cargo operations, un-berthing, and release of Dragon, the first commercial vehicle to the ISS. Research on the ISS averaged 35 hours per week. The checkout for Robonaut continued. Part 2 of the Robotic Refueling Mission (RRM) was completed. The Alpha Magnetic Spectrometer (AMS) detected its 19 billionth cosmic particle. Mission objectives for the next four months were discussed. There will be five berthings or dockings, two extravehicular activities (EVAs), and a transition to the Waste Recovery System (WRS) reusable Advanced Recycle Filter Tank Assembly (ARFTA), which reduces the need for delivery and disposal of consumables for nominal operations. New science to be delivered includes the Advanced Colloids Experiment-1, the Aquatic Habitat, the ISS SERVIR ("to serve" in Spanish) Environmental Research and Visualization System, the Space Communications and Navigation (SCaN) Testbed, the Small Sat Deploy Demo, the YouTube Space Lab, the Spacecraft Single Event Environments at High Shielding Mass (HiMassSEE), and the Radiation Environment Monitor (REM). Charts showing crew time utilization and ISS research statistics were discussed. There were 201 investigations in Expeditions 31 and 32. From Expedition 0 to date, over 500 scientific results have been published. Dr. Squyres requested a summary on what has been published. He believes that the ISS is one of NASA's great success stories and that the peer-reviewed research that has been published is a story that needs to be told. Slides discussing the SpaceX Demonstration Mission and the Orbital Sciences Demonstration Mission were presented. The SpaceX mission successfully met all necessary ISS cargo demonstration activities. Its Dragon capsule was retrieved from the Pacific Ocean. Orbital Sciences has been delayed by Virginia's turnover of the Wallops Flight Facility (WFF) launch pad. The ISS Program official launch date for the Orbital Sciences demonstration is scheduled for December 2012. Mr. Kohrs reviewed a chart showing the ISS top risk matrix, which factors together likelihood and consequence. He noted that none of the top risks appeared to be major risks. The highest one was a schedule overlap in Commercial Crew and Soyuz Launch Services.

The Space Launch System (SLS) exploration flight and mission plans were discussed. Exploration Flight Test (EFT) 1, scheduled for 2014, will test the Orion capsule's deep space return entry velocity. Exploration Mission (EM)-1 will weigh 70 tons and will be an uncrewed lunar fly-by in 2017. EM-2 will weigh 70 tons and be a crewed mission to an undetermined destination in 2021. A slide was presented showing the planned mission configuration. Dr. Squyres expressed concern that the flight rate is unprecedentedly low and may adversely affect the ability to maintain a sharp team. Mr. Kohrs advised that the flight rate would go up if there were DoD or SMD customers. He discussed a chart on the Exploration Systems Development (ESD) Tri-Program Summary Schedule.

Mr. Kohrs presented for the Council's consideration a proposed Recommendation for integrating the SLS, Orion, and Ground Systems programs. After discussion, and with the caveat that Mr. Kohrs and Dr. Squyres would strengthen the language by offline editing, the Council approved the Recommendation as follows:

*Integration between SLS, Orion, and Ground Systems programs requires definition and implementation. A small team of experienced integrators, led by an empowered, accountable and responsible leader, should be established to ensure adequate integration of the three programs.*

Mr. Kohrs discussed the future work plan for the Committee. Dr. Squyres recommended that the Committee look at including a civilian tourist on Commercial Crew flights. He noted that the Russians are getting paid for doing that. Mr. Robert Hanisee cautioned that civilian tourism should be the responsibility of the contractor for liability reasons. Mr. Kohrs criticized NASA Procedural Requirement (NPR) 7120.5, which defines what must be done to properly and successfully manage NASA programs and projects. He asserted that successful programs like Apollo would not have flown if they had to follow that directive. Dr. Ballhaus requested information on NASA's accountability for safety in the Commercial Crew Program. Mr. Hanisee advised that there has to be a bifurcation for the commercial crew contractor between doing its work and doing work for NASA.

Dr. Squyres thanked Mr. Kohrs for his presentation.

Information Technology (IT) Infrastructure Committee Report

Dr. Squyres introduced Dr. Larry Smarr, Chair, IT Infrastructure Committee. Dr. Smarr noted that the Committee had slimmed down to two or three people. Seven new members have recently been added and he thanked Ms. Rausch for her assistance in finding nationally prominent people to join the Committee. The new additions will enable the Committee to look at NASA's high performance computing capabilities at a level that has not been available for some time. He discussed how scientific data can be used for education and outreach. One example is the "Science on a Sphere" at the GFSC Visitors Center. Another example is the "Hyperwall" at the GSFC Scientific Visualization Studio. Dr. Smarr reviewed the Committee's Finding 1 that had been approved at the March 2012 NAC meeting. It called for NASA to develop a more productive IT infrastructure through "frugal innovation" and "agile development." There was a question at that time as to whether NASA was capable of frugal innovation. The Committee, at its most recent meeting, found two examples moving in this direction at Goddard. The first example is the Community Coordinated Modeling Center (CCMC), which includes people from NASA and from outside NASA, including internationals. They developed a software architecture that allows the output from multiple SMD satellite missions to be used without requiring the user to work on a particular machine and use a particular code. This makes the data much more widely available than to only the people who wrote the original codes. A graph with statistics that demonstrated the success was presented. A picture of the CCMC members was shown to indicate the group's diversity. The second example found by the Committee is NASA's new Cyber Continuous Diagnostics and Mitigation Program, which already is used at half of NASA's Centers. It provides a large, immediate, and continued improvement in reducing cyber risk as measured by vulnerability elimination. Data is delivered directly to technicians showing what they should do first to lower vulnerabilities. The total investment was \$1,500 and 400 hours.

Dr. Smarr reviewed his Committee's Recommendation 1 from the March 2012 NAC meeting, which had been accepted by the NASA Administrator, and which called on NASA to pursue partnerships with other Federal agencies in four areas: data-intensive cyber-infrastructure, 100 Gbps networking, graphics processing unit (GPU) clusters, and hybrid high-performance computing (HPC) architectures. A small group of three people at NASA have implemented that recommendation and have begun to develop the ability to transfer data at speeds that would enable one terabit to be transferred almost interactively. Last year, working with different networks, universities, and vendors, the group achieved 72 Gbps locally and 60 Gbps across the entire United States. This is only three or four people working in a back room. One of them was Pat Guerry. He recently passed away and NASA is not going to be able to replace him. Dr. Smarr noted that on March 29, 2012, the White House had issued a press release on a "Big Data Initiative," which identified five lead Federal agencies; regretfully, NASA was not included in the list. He reported that the Committee would be meeting in the near future with the Science Committee, as requested at the last NAC meeting in March 2012 by Dr. Squyres, to develop revised wording for draft Recommendation 2 which had been presented at that meeting. He introduced the Committee's new Executive Secretary, Mr. Jason Gillis.

Dr. Squyres commented that it was great to hear about the results from a Committee's recommendation. He thanked Dr. Smarr for his presentation.

Public Input

Dr. Squyres invited comments from the public. There were none.

Adjournment

Dr. Squyres announced information for WebEx users. The meeting was then adjourned at 4:30 p.m.

***Friday, July 27, 2012***Call to Order, Announcements

Ms. Rausch called the meeting to order and welcomed everyone to the third day of the meeting. She stated that the NAC is a Federal advisory committee established under the FACA. The meeting is open to the public. A dial-in capability is available for members of the public to listen to the meeting. WebEx is also available. Meeting minutes will be posted to the NAC website, [www.nasa.gov/offices/nac](http://www.nasa.gov/offices/nac), soon after the meeting. All presentations will be part of the public record. Time has been set aside at the end of the day for public comments.

Remarks by Council Chair

Dr. Squyres thanked the Council members for a productive second day. Excellent briefings and timely recommendations were received. He provided information for WebEx users.

Science Committee Report

Dr. Squyres introduced Dr. David McComas, who was substituting for Dr. Wesley Huntress, Chair, Science Committee. Dr. McComas described the Committee's members and noted that three new members have been added to the Committee. He discussed recent science results. Large extraterrestrial L-amino acid excesses have been discovered in the Tagish Lake Meteorite. This provides an important clue to how left-handed based protein life started on the primitive Earth. For more information on this, see <http://www.nasa.gov/topics/solarsystem/features/life-turned-left.html>. A fifth moon has been found orbiting the planet Pluto. Titan's interior has been studied by six close gravity flybys. Large "solid" tides have been detected and indicate a liquid water ocean under Titan's ice shelf. A slide was presented showing the "Greeley Panorama," which is a full-circle scene that combines 817 images taken by the panoramic camera (Pancam) on NASA's Mars Exploration Rover "Opportunity." It shows the terrain that surrounded Opportunity while it was stationary for four months during the most recent Martian winter. In a significant accomplishment, the HST had been able to measure the tangential motion of light from the Andromeda galaxy, which is over 2.5 million light years from Earth. Simulations based on extrapolations from that data indicate that the Andromeda galaxy and the Milky Way system will collide and merge in 4 billion years. The Solar Dynamics Observatory (SDO) has observed ultrafine loops of hot plasma in the Sun's corona. The Interstellar Boundary Explorer (IBEX) has obtained measurements that reveal that the heliosphere moves through interstellar space more slowly than previously thought and at a speed too slow to produce a bow shock wave. This is important to manned space flight.

Dr. McComas discussed SMD's programmatic status. The MSL rover "Curiosity" will be landing on Mars on August 6, 2012. More information about this can be found at [www.nasa.gov/mars](http://www.nasa.gov/mars). The Dawn spacecraft has begun to spiral out and will leave Vesta for Ceres on August 23, 2012. The MAVEN mission and the LADEE are both in the final phases of development for 2013 launch dates. He described a NASA Space Act Agreement entered into on June 19, 2012, with the B612 Foundation, which is a private, nonprofit, 501(c)(3) organization dedicated to preventing future asteroid impacts. NASA will provide technical engineering advice, tracking and telemetry, and coordination with the existing Near-Earth Object (NEO) data network. The Foundation is now in a preliminary fund-raising phase. The mission plan is to use infrared detectors with a spacecraft on an interior Venus-like orbit. The tentative launch date is in 2017. The NRC has released a favorable Earth Science Decadal Survey Mid-Term Report. Among other things, it found the following: that NASA responded favorably and aggressively to the decadal survey; that the Earth Venture class program is being well implemented; and that NASA has made considerable efforts to secure international partnerships. A chart was presented showing the NASA Earth Science Division's orbital flight portfolio. Dr. McComas discussed a Senate Appropriations Committee proposal for responsibility and \$1.6 billion in funding for development and launch of NOAA's Earth observing satellite missions be transferred from NOAA to NASA. The House has passed its own version of the FY13 NASA/NOAA budgets, without the transfer of this funding and responsibility. The transfer, if enacted, will not change the basic work and interagency collaborations. The NuSTAR spacecraft was successfully launched on June 13, 2012. Its science mission has a two-year baseline, beginning on August 1, 2012. The Galaxy Evolution Explorer (GALEX) is being operated by the California Institute of Technology with private funds. There will be no change in data access; all data will continue to be made publicly available after a 12 month period of exclusivity. NASA will retain long-term responsibility for the spacecraft and will be responsible for its decommissioning. The NASA SMD Program Management Council has evaluated the Gravity and Extreme Magnetism Small Explorer (GEMS) Key Decision Point C (Confirmation Review). Based on this review, the Decision Authority for the GEMS project has non-confirmed the GEMS project to enter implementation, thereby terminating the mission. NASA is conducting an independent review of SMD's decision to non-confirm GEMS and, pursuant to Public Law 112-55, a report will be provided to Congress. The funds from GEMS will go back into the Explorer Budget.

Dr. McComas described telescope assets recently donated to NASA by the National Reconnaissance Office (NRO). He presented for the Council's consideration a proposed Recommendation for NASA to study possible scientific uses of the NRO-donated telescope assets. Dr. Squyres commented that NASA should be expected to undertake the study. The Council approved the Recommendation as follows:

*NASA should study possible scientific uses of the NRO-donated telescope assets, to see whether it can capitalize on this opportunity or not, exploring possible applications to high priority science identified in the various Decadal surveys in consultation with the broad scientific community.*

Dr. McComas presented for the Council's consideration a proposed Recommendation that NASA specify planetary protection procedural requirements for human extraterrestrial missions as soon as practicable. Dr. Squyres explained that NASA currently

does not sterilize spacecraft and that, while it can be done, it is a budgetary trade. He believes that this requires a study that should be undertaken by the Academy. Dr. Kennel concurred. Ms. Cassie Conley, SMD Planetary Protection Officer, informed the Council that there had been an Academy study on this matter in 2005 that led to the development of guidelines that have been incorporated into the European Space Agency's (ESA) policy. Another Academy study is needed, she asserted, to look in depth at what should be done for humans, including the ability to monitor infections. Dr. Squyres counseled that NASA is very far from sending people to Mars and that the science is still developing rapidly. The mission won't happen for 30 years and it should be preceded by an Academy study that should take place two decades from now. Dr. McComas disagreed and opined that the timing for the study should depend on when technologies start to be developed, and that it is better to get the rules set from the start. Mr. Kohrs observed that while NASA was going to Mars two years ago, all that work has stopped. He explained that Mars may be 50 years away and that more information is needed on human spaceflight destinations. Dr. Kennel noted that he is nervous about embedding the current level of knowledge. Dr. Squyres suggested that the Recommendation be tabled until after Curiosity is safely on Mars. The Council agreed to table the Recommendation.

Dr. McComas presented for the Council's consideration a proposed Recommendation for NASA to obtain assessment and advice through the National Research Council (NRC) about the new cross-Directorate partnership for exploring Mars. The Council approved the Recommendation as follows:

*The Council recommends that NASA arrange for independent, authoritative assessment and advice through the NRC about the newly established cross-Directorate partnership for the exploration of Mars.*

Dr. McComas presented for the Council's consideration a proposed Recommendation for NASA to encourage export control reform and to discuss how export control restrictions affect research involving foreign nationals. The Council approved the Recommendation as follows:

*The Council recommends that NASA even more fully embrace and support the ongoing President's Export Control Reform (ECR) effort. To ensure that open scientific and international collaboration is enabled to the maximum extent possible, the Council further recommends that NASA convene a discussion with the academic and non-profit community on the effects of current export control restrictions on international research and research projects that include foreign nationals.*

Dr. Squyres thanked Dr. McComas for his presentation and for substituting for Dr. Huntress.

#### Audit, Finance and Analysis Committee Report

Dr. Squyres introduced Mr. Robert Hanisee, Chair, Audit, Finance and Analysis Committee. Mr. Hanisee reviewed the Committee's agenda from its last meeting. He discussed Goddard Space Flight Center. There are 3,351 civil servants and 7,769 contractors. Scientists and engineers comprise 63 percent of the workforce. The services provided by Goddard's Office of the Chief Financial Officer (OCFO) were described. They include financial management, resources management, cost estimating, financial systems, as well as quality assurance, policy, process, and standards. Goddard's OCFO workforce profile was described. Graphs showing GSFC budgets for 2011, 2012, and 2013 were presented. The Committee received an update from NASA's new Deputy Chief Financial Officer, Ms. Pamela Hanes. She replaces Mr. Terry Bowie, who retired in February 2012. Mr. Hanisee opined that she is highly qualified, with over 30 years at NASA. She reported that future focus areas include employee performance and development, environmental liabilities, contractor-held assets, continued system refinements and enhancements, and maintaining strong policy and internal control focus.

Mr. Hanisee discussed NASA's overall budget. The outlook for FY13 is still murky. The Administration and the Congress are not likely to resolve the budget situation until after the election. He believes that NASA can take some direction from the House and Senate bills, which largely reflect FY12 enacted appropriations. The big threat is sequestration, which takes effect automatically on January 1, 2013, and would seriously disrupt activities. NASA has been directed to not plan for sequestration. For FY14 and beyond, most observers expect continued pressure on the overall size of non-defense discretionary activities, which include NASA. NASA has experienced and in all likelihood will continue to experience reductions in buying power. Within this environment, NASA is discussing how best to maintain its capabilities, retain its focus efforts on priorities, and increase the effectiveness of programs. A chart showing Congressional FY13 marks was presented. Mr. Kohrs noted that Exploration and Space Operations were still being maintained as separate budget categories. Charts were presented showing that NASA is below where it would expect to be at this point in the current fiscal year for commitments, obligations, and costs. Projections based on current trends indicate that the unobligated carryover will be approximately \$522.9 million. NASA's campaign to cut waste from travel expenditures was described.

Mr. Hanisee briefed the Council on NASA's Financial Statement Audit. He noted that there has been a significant change in attitude since the new NASA Inspector General, Mr. Paul Martin, came on board two years ago. A chart showing the results from financial statement audits over the past decade was discussed. Price, Waterhouse & Cooper (PWC) has replaced Ernst & Young (EY) as NASA's outside auditors and has been working very well with the Agency. PWC's client service goals were reviewed. Those goals include working collaboratively with NASA and avoiding surprises by communicating their approach and the results from testing on a regular basis. The planned sequence for performing the audit and the status of its execution was described. PWC believes that systems and technology are of critical importance to process, record and report the financial results of NASA's operations. Its FY12 testing focus will include Information Technology General Controls (ITGC) over financially-significant system environments, specifically the following: the NASA Enterprise Applications Competency Center (NEACC) and GSFC; internal and external network security testing; and operating system and database diagnostics. Mr. Hanisee discussed two significant deficiencies in the FY11 audit. One is the environmental liability estimation process. The other is privileged user access controls and monitoring of the SAP (NASA's core financial software) environment, where it was found that access weaknesses and inadequate logging and monitoring increased the risk that unauthorized, undetected modifications could be made to NASA's financial data and systems. The 2011 year end unfunded environmental liability estimate was \$1.04 billion; it is now \$980 million. Mr. Hanisee discussed the status of the audit on NASA's information technology and financial systems. He described the eInvoicing Pilot and discussed NASA's IT strategy and governance. A chart on a proposed governance model for Federal agencies by the U.S. Department of Treasury's Office of Financial Innovation & Transformation (OFIT) was discussed. Mr. Hanisee explained that this is being directed by OMB and Treasury, and that its purpose is to develop better procedures for financial control. He believes it will bring about an improvement.

In response to a question from Mr. Kohrs, Mr. Hanisee advised that the next audit would be released on November 15, 2012. In response to a question from Dr. McComas, Mr. Hanisee described the audit difficulties that were experienced due to a prior Financial Accounting Standing Board rule on accounting for property, plant, and equipment. Mr. Hanisee noted that his Committee will begin to get involved in providing an analysis on the costs of major new programs. Dr. Ballhaus agreed that that role is needed, and he suggested that members with the necessary experience be added to the Committee. Mr. Hanisee concurred and expressed concern that it would add costs. Dr. Squyres advised that changes would be made in the Committee's membership as the Committee's portfolio changed.

Dr. Squyres thanked Mr. Hanisee for his presentation.

#### Council Roundtable Discussion

Dr. Steven W. Squyres solicited general comments from the Council members. Dr. Kennel noted that he appreciated the Council's new, more relaxed meeting schedule. Mr. Perkins concurred. Mr. Hanisee observed that the biggest challenge facing the Agency is getting people and materials to the ISS and that flight safety certification for that is a big concern. He is not sure that the commercial companies know what they are getting into. Dr. Ballhaus advised that it is important to assess the national need for the country's aeronautical facilities. Dr. Squyres concurred and expressed confidence that the Aeronautics Committee will cover that. Dr. McComas thanked the Council Members for their warm welcome. He advised that the work in EPO was very important. He believes that a simple statement on what NASA does is necessary. Mr. Kohrs noted that more explicit NASA answers are needed to his committee's last three recommendations from the March 2012 meeting. He added that the NASA budget has no money for Exploration; it is all being spent on the ISS, Orion, and ground stations.

Dr. Squyres explained that the most serious issue is the current mismatch between the expressed goals for human exploration and the current plan. The plan does not fund the work that NASA is being directed to do. This is fundamental to the Agency's future. Dr. Squyres remarked that he was still "buzzing" from the outstanding presentation by Dr. Callahan, and that he is leaving the meeting with strong hope for NASA's future because of people like him.

#### Public Input

Dr. Squyres invited comments from the public. There were none.

#### Adjournment

The meeting was adjourned at 12:00 noon.

**NASA ADVISORY COUNCIL MEETING**

**NASA Goddard Space Flight Center  
8800 Greenbelt Road  
Greenbelt, Maryland 20771**

**PUBLIC MEETING****July 25-27, 2012****Agenda****Wednesday, July 25, 2012****Council Public Meeting***GSFC Training Center, Building 1, Rooms E100D/E*

12:00 – 12:03 pm	Call to Order, Announcements	Ms. Diane Rausch Executive Director NASA Advisory Council, NASA HQ
12:03 – 12:10 pm	Opening Remarks by Council Chair	Dr. Steven W. Squyres Chair, NASA Advisory Council
12:10 – 12:30 pm	Welcome to NASA Goddard Space Flight Center	Mr. Christopher Scolese, Director Goddard Space Flight Center
12:30 – 1:15 am	Remarks by NASA Administrator	Mr. Charles F. Bolden, Jr. NASA Administrator
1:15 – 2:00 pm	NASA's Science Mission Directorate: Overview and Budgetary Outlook	Dr. John Grunsfeld Associate Administrator Science Mission Directorate NASA HQ
2:00 – 2:45 pm	James Webb Space Telescope Update; NASA Office of Evaluation Overview	Mr. Geoffrey Yoder JWST Program Director Former Director, Office of Evaluation NASA HQ
2:45 – 3:00 pm	Break <i>GSFC Training Center, Room E100B</i>	
3:00 – 4:00 pm	The President's Export Control Reform (ECR) Initiative	Mr. Brian H. Nilsson Director, Non-Proliferation – Export Controls, National Security Staff The White House
4:00 – 4:15 pm	Council Discussion	
4:15 – 4:30 pm	Public Input	
4:30 pm	Adjourn	

**Thursday, July 26, 2012****Council Public Meeting***GSFC Training Center, Building 1, Rooms E100D/E*

9:00 – 9:02 am	Call to Order, Announcements	Ms. Diane Rausch Executive Director NASA Advisory Council, NASA HQ
9:02 – 9:10 am	Remarks by Council Chair	Dr. Steven W. Squyres Chair, NASA Advisory Council
9:10 – 10:00 am	Aeronautics Committee Report	Ms. Marion Blakey, Chair
10:00 – 10:45 am	Technology and Innovation Committee Report	Dr. William Ballhaus, Chair
10:45 – 11:00 am	Break	
11:00 – 11:45 am	Commercial Space Committee Report	Ms. Patti Grace Smith, Chair
11:45 – 12:00 noon	Council Discussion	
12:00 – 1:00 pm	<b>Lunch</b>	
1:00 – 1:45 pm	NASA Early Career Scientist Presentation: “DNA Building Blocks Can be Made in Space”	Dr. Michael P. Callahan NASA Goddard Space Flight Center
1:45 – 2:30 pm	Education and Public Outreach Committee Report	Mr. Lars Perkins, Chair
2:30 – 3:15 pm	Human Exploration and Operations Committee Report	Mr. Richard Kohrs, Chair
3:15 – 3:30 pm	Break	
3:30 – 4:15 pm	IT Infrastructure Committee Report	Dr. Larry Smarr, Chair
4:15 – 4:30 pm	Public Input	
4:30 pm	Adjourn	

**Friday, July 27, 2012****Council Public Meeting***GSFC Training Center, Building 1, Rooms E100D/E*

9:00 – 9:02 am	Call to Order, Announcements	Ms. Diane Rausch Executive Director NASA Advisory Council, NASA HQ
9:02 – 9:10 am	Remarks by Council Chair	Dr. Steven W. Squyres Chair, NASA Advisory Council
9:10 – 10:00 am	Science Committee Report	Dr. David McComas <i>(for Dr. Wesley Huntress, Chair)</i>
10:00 – 10:45 am	Audit, Finance and Analysis Committee Report	Mr. Robert Hanisee, Chair
10:45 – 11:00 am	Break	
11:00 – 11:45 am	Council Roundtable Discussion	Dr. Steven W. Squyres Chair, NASA Advisory Council
11:45 – 12:00 noon	Public Input	
12:00 noon	Adjourn	

## NASA ADVISORY COUNCIL MEMBERS

July 2012

Role	Council Members
Chair – NASA Advisory Council	<b>Dr. Steven Squyres</b> , <i>Goldwin Smith Professor of Astronomy, Cornell University</i>
Chair – Aeronautics Committee	<b>The Honorable Marion Blakey</b> , <i>Chief Executive Officer, Aerospace Industries Association</i>
Chair – Audit, Finance, and Analysis Committee	<b>Mr. Robert M. Hanisee</b> , <i>CFA, Managing Director, Trust Company of the West</i>
Chair – Commercial Space Committee	<b>Ms. Patti Grace Smith</b> , <i>Patti Grace Smith Consulting, LLC</i>
Chair – Education and Public Outreach Committee	<b>Mr. Lars Perkins</b> , <i>Entrepreneur</i>
Chair – Human Exploration and Operations Committee	<b>Mr. Richard Kohrs</b> , <i>NASA (Ret.)</i>
Chair – Information Technology Infrastructure Committee	<b>Dr. Larry Smarr</b> , <i>Director, California Institute for Telecommunications and Information Technology</i>
Chair – Science Committee	<b>Dr. Wesley T. Huntress, Jr.</b> , <i>Director Emeritus, Geophysical Laboratory, Carnegie Institute of Washington</i>
Chair – Technology and Innovation Committee	<b>Dr. William F. Ballhaus Jr.</b> , <i>President and Chief Executive Officer (Ret.), The Aerospace Corporation</i>
Ex-Officio Members	<p><b>Gen. Lester Lyles</b>, <i>Chair, Aeronautics and Space Engineering Board, National Academies; USAF (Ret.)</i></p> <p><b>Dr. Charles F. Kennel</b>, <i>Chair, Space Studies Board, National Academies</i></p>

**NASA ADVISORY COUNCIL  
Goddard Space Flight Center  
Greenbelt, MD  
July 25-27, 2012**

**MEETING ATTENDEES**

*NASA Advisory Council Members:*

Dr. Steven W. Squyres, <i>Chair</i>	Cornell University
Dr. William F. Ballhaus Jr.	The Aerospace Corporation (Ret.)
Ms. Marion C. Blakey	Aerospace Industries Association
Mr. Robert M. Hanisee	Trust Company of the West
Dr. David McComas ( <i>for Dr. Wesley T. Huntress, Jr.</i> )	Southwest Research Institute
Mr. Richard Kohrs	NASA (Ret.)
Mr. Lars Perkins	Entrepreneur
Dr. Larry Smarr	California Institute for Telecommunications and Information Technology
Ms. Patti Grace Smith	Patti Grace Smith Consulting, LLC
Dr. Charles F. Kennel, <i>Ex-Officio Member</i>	Space Studies Board, National Academies
Gen. Lester L. Lyles, <i>Ex-Officio Member</i>	Aeronautics and Space Engineering Board, National Academies
Ms. P. Diane Rausch, <i>Executive Director</i>	NASA Headquarters

*NASA Attendees:*

Callahan, Michael	NASA/GSFC
Campbell, Bill	NAC Audit, Finance and Analysis Committee
Centrella, Joan	GSFC
Chandler, Faith	NASA HQ
Conley, Cassie	NASA HQ
Connerton, Bob	NASA/GSFC
Dembling, Anyah	NASA HQ
Durning, John	NASA/GSFC
Feeley, Jens	NASA HQ
Furrell, Kelly	NASA/GSFC
Geisz, Paula	NASA HQ
Gills, Jason	NASA HQ
Green, Mike	NASA HQ
Grunsfeld, John	NASA HQ
Hess, Mark	NASA/GSFC
King, Marla	NASA HQ
Kinsley, Anne	NASA/GSFC
Mandell, Avi	NASA/GSFC
McCuiston, Doug	NASA HQ
Minor, Susan	NASA HQ
Niedner, Malcolm	NASA/GSFC
Queen, Sophia	NASA/GSFC

Rathjen, Tom  
Robinson, Shawanda  
Scolese, Chris  
Siegel, Bette  
White, Nicholas  
Yoder, Geoffrey

NASA HQ  
NASA HQ  
NASA/GSFC  
NASA HQ  
NASA/GSFC  
NASA HQ

*Other Attendees:*

Barton, Michael  
Bruegman, Uma  
Drosdend, Bob  
Frankel, David  
Libson, Miles  
O'Rourke, Joseph  
Malay, Jon  
Nilsson, Brian  
Price, Steve  
Richardson, Larry

National Academies  
The Aerospace Corporation  
CSC  
P B Frankel, LLC  
Space Studies Board, National Academies  
Space Studies Board, National Academies  
Lockheed Martin  
The White House  
Lockheed Martin  
United Launch Alliance