

National Aeronautics and Space Administration  
Washington, DC

NASA ADVISORY COUNCIL

SCIENCE COMMITTEE

August 2-3, 2011

Ames Research Center  
Moffett Field, California

MEETING MINUTES



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**Byron Tapley**  
Vice-Chair



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**T. Jens Feeley**  
Executive Secretary

**NASA ADVISORY COUNCIL (NAC) SCIENCE COMMITTEE  
Ames Research Center  
Moffett Field, California  
August 2-3, 2011**

**MEETING MINUTES  
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**Science Committee Meeting  
Ames Research Center  
Moffett Field, CA  
August 2-3, 2011**

***Tuesday, August 2***

The Science Committee meeting opened in a Joint Session with the Exploration and Science Operations Committees of the NASA Advisory Council (NAC) to hear about and discuss the Final Report of the Task Group on Analysis Groups (TagAG). Dr. Bette Siegel, Executive Secretary of the Exploration Committee, called the meeting to order. She noted that this was a public meeting under the Federal Advisory Committee Act (FACA), and that Committee members should recuse themselves if they saw a possible conflict of interest on any topic.

**Task Group on Analysis Groups (TagAG) Final Report**

Dr. T. Jens Feeley, Executive Secretary of the TagAG, presented the Final Report. He reviewed the TagAG membership, which consisted of representatives from the Science and Exploration Committees as well as NASA representatives from the Science Mission Directorate (SMD) and the Exploration Systems Mission Directorate (ESMD). The TagAG's assignment was to devise a plan for how the NAC Science Committee could organize, particularly with respect to the NAC Planetary Science Subcommittee (PSS) Analysis Groups, to provide advice to both SMD and ESMD for integration of science into the exploration mission objectives. The TagAG was officially established as a subgroup of the NAC Science Committee.

Two FACA telecons were conducted in May, and three analysis groups of interest to ESMD were identified: the Lunar Exploration Analysis Group (LEAG), the Mars Exploration Planning Analysis Group (MEPAG), and the Small Bodies Analysis Group (SBAG). The groups' terms of reference were examined, and changes needed to enable ESMD to have direct connection to the analysis groups were identified. The TagAG requested feedback from the Chairs of the affected analysis groups, and consensus on the final recommendations was reached. The next step was to present the recommendations to a joint meeting of the Science and Exploration Committees.

The TagAG recommended that the terms of reference for the three analysis groups be revised to add the following: explicit tasking authority for ESMD and the relevant NAC Committees; acknowledgement of a role for both SMD and ESMD Associate Administrators (AAs) in the appointment process; updated language in the topic areas covered by the analysis groups; acknowledgement of the uniqueness of the LEAG; and changes in the language regarding the role of the Designated Federal Official (DFO). In addition, input was requested from the PSS on whether the existing structure of the analysis groups was still appropriate. At this time, the PSS felt that there was no need to re-align the analysis groups.

Dr. Feeley invited comments from the Committees. In response to a question, he indicated that the terms of reference would reflect the name of the new Exploration organization and Committee: Human Exploration and Operations. All three analysis groups will have the changes noted above; however, the LEAG will be treated more specially—there will be a Co-Chair for Science, appointed by the AA for Science after consultation with the AA for Exploration, who will sit on the PSS; and a Co-Chair for Exploration, appointed by the AA for Exploration after consultation with the AA for Science, who will sit on the new Human Exploration and Operations Committee. If the recommendations are accepted by the Science Committee and the Exploration Committee, they will be carried forward to the NAC for approval; if approved, the Executive Secretaries of the respective Committees will move forward with the implementation process.

Representatives from both Committees indicated that the discussions had been very productive, and this would be a good way to better integrate the science community with the implementation plans for exploration. In addition, having the two groups work together should help during the budget cycle. In response to comments from some of the Committee members, Dr. Feeley acknowledged that there had been discussions regarding how SMD and ESMD would coordinate, but those discussions were separate from the TagAG activity. In response to a question, Dr.

Feeley noted that these changes do not specifically do anything to help the interactions between the medical sciences and exploration. It was suggested that this might be a good topic for a separate discussion. Both Committees approved the recommended changes going forward to the NAC.

The Science Committee members adjourned from the Joint Session.

Before continuing the Science Committee Meeting in the Ames Conference Facility, the members and attendees received a short safety briefing on the facility.

Dr. Feeley called the Science Committee public meeting to order at 8:50 am. Dr. Byron Tapley, Vice-Chair (and acting as Chair at this meeting in the absence of Dr. Wesley Huntress), welcomed members and attendees. He noted that the agenda was very full and included some engaging topics.

Discussion with Science Missions Directorate (SMD) Associate Administrator

Mr. Rick Howard opened the two-part briefing with an update on the James Webb Space Telescope (JWST) status and replan. The Independent Comprehensive Review Panel (ICRP) confirmed that there are no technical issues on JWST and significant progress has been made since the program's start. The ICRP made 22 recommendations, and NASA has implemented or is in the process of implementing them. The Program's visibility was elevated at NASA Headquarters and the Centers, and all senior managers were replaced. Mr. Howard, the Program Director, reports organizationally to the SMD AA (Dr. Ed Weiler) and programmatically to the NASA AA (Mr. Chris Scolese). The ICRP cost and schedule estimate was used as an input to develop the new baseline. NASA's response to the ICRP report was provided to Congress in April and is available online.

Mr. Howard discussed the context in which the report was done. A short time period was allowed to conduct the review and prepare the report. The ICRP was charged with developing a cost estimate to provide the earliest possible launch date; however, the ICRP did not look back beyond spring 2008 and did not take into account the environment prior to that, which led to inadequate reserves in the early years and work slippage into the out years. The ICRP provided a cost to complete estimate (adding \$1.4B including \$500M in 2011 and 2012) and a launch date as early as September 2015. This funding level is very optimistic given the budget environment in 2011 and forward, and the launch date is unrealistic from a budget and schedule perspective. The SMD budget history starting with the FY04 President's Budget Request reflects a loss of flexibility (\$10B over a five year period), compounded with loss of stability and limited authority to reprogram funds without approval from both the Office of Management and Budget (OMB) and Congress.

Mr. Howard reviewed the Program status on the telescope, science instruments, sunshield, and spacecraft. Completion of the mirrors is proceeding very well and the flight backplane structure is under development and moving along. The instruments are in various stages of integration and test (I&T). Sunshield testing has been completed; the spacecraft continues to mature and various subsystem components have completed Critical Design Reviews (CDRs). With regard to completion of major hardware elements, most elements are 95-100 percent complete; the sunshield membranes are ten percent complete and the spacecraft bus is 25 percent complete. Mr. Howard briefly reviewed the overall schedule for the replan. The FY11 schedule is aggressive for both the contractor and government teams; however, the project is on track and all replan activities in FY11 so far have been completed. The replanned Program went to the Administrator in July and is now at the next stage.

The replan assumed a constrained budget in FY11 and FY12, and unconstrained budget in FY13 and forward. The government and contractor team developed a high confidence, realistic schedule with adequate reserves that supports an October 2018 launch date. A Joint Cost and Schedule Confidence Level (JCL) analysis was done, and the replan is consistent with an 80 percent confidence level. Standing Review Board (SRB) findings and recommendations have been factored into the replan. Funding for the replan must fit within the Agency's overall budget. Mr. Howard showed the replan flow, including a number of meetings leading to the replan. He highlighted the important activities on the detailed, top-level schedule through the October 2018 launch readiness date.

There are 13 months of funded, critical-path schedule reserve,. The schedule has two long, low-level activity periods. During the first period, the program will maintain a very low level of experts, which creates an issue with regard to the workforce and the long-term hardware storage. During the Integrated Science Instrument Module (ISIM) schedule, there is another long low-level period; however, during this period, the mid-infrared detectors will be replaced, which will take up some slack.

In summary, JWST continues to make great progress this year, achieving milestones within cost and schedule. The major concerns are the schedule stretch-out to 2018, NASA budget uncertainty for FY11 and out as a result of budget negotiations in the House and Senate, and the need to keep the JWST team focused and motivated to maintain momentum. There has been a groundswell of support for JWST on the internet, e.g., [www.facebook.com/save/JWST](http://www.facebook.com/save/JWST).

Dr. Hinners had several questions relating to the I&T phase and the independent verification and validation (IV&V) activity that will provide an independent look at the system level. Mr. Howard stated that the I&T phase, which consumes the last three years, is preceded by a series of tests on subsystems and at the systems level, e.g., the sunshield test. There will be a deployment of one-half of the full sunshield. The project is building a set of all five layers (full scale) of the sunshade and will do photogrammetry at the contractor facility in Huntsville, AL and verify the models. The design and deployment sequence is being examined to make simplifications that improve reliability and reduce the number of actuations. With respect to IV&V, the SRB is very involved; it weighs in on technical and performance aspects. Dr. Hinners indicated that he would discuss the topic further later. In response to a question from Dr. Kennel regarding the budget constraints, Mr. Howard noted that the FY11 and FY12 constraints were examined in light of what work on the critical path needs to be continued, and what work could be slipped out to FY13 and beyond, taking into account the ramp-ups on funding profile. The review team was also concerned over how to smooth out the funding profile so there is not a steep spike in FY13, and this has been done. In response to a question from Dr. Hubbard, Mr. Howard stated that he is satisfied that the integrated profile supports the October 2018 launch date. This was examined independently from the project. Starting in FY12, the funding is adequate to support the year by year reserves. The workforce slow spot was driven primarily by the budget profile and constraints in FY11 and FY12. In terms of design goals vs. level one requirements, Mr. Howard noted that the program is designing to the level one requirements. The mirrors and instruments are basically done; any real savings would have to be in the test phase, and this is where there may be some flexibility. The Program will look at the test results and assess them against the requirements; the decisions will be addressed at that time. So far, everything is in specification or better. In response to a comment about what appears to be an inefficient funding profile, Dr. Weiler added that there are the political realities—funding JWST for an earlier launch would create havoc in the rest of the science program.

At this time, Dr. Weiler discussed the FY12 budget request. The House Appropriations Committee recommended cancelling JWST, but discussed possibly reinserting funding later in the Appropriation process. The House has not rescheduled the floor debate. A Senate markup is possible in September, but the Senate has not yet scheduled its markups for this bill. The process is likely to be lengthy again this year, and the government will probably be on a Continuing Resolution (CR) through at least the fall.

Dr. Weiler discussed the status of other SMD programs. The Mars 2016 and 2018 planning is progressing, and NASA is still moving forward with a joint program with ESA. Funds have been found to do the minimum work required for the FY18 mission. The Administrator has promised a letter by September 15 regarding what parts ESA will do and what parts NASA will do. Dr. Weiler reviewed other key programmatic or decision dates in 2011 and 2012. Juno is coming in on cost and schedule. The Gravity Recovery and Interior Laboratory (GRAIL) is also on cost and schedule and may even return some funds. These are not single-project programs, and there is more flexibility to move funds and actively manage them. In late September, the Stratospheric Observatory for Infrared Astronomy (SOFIA) will be deployed to Germany, stopping by Andrews Air Force Base for an education and public outreach event that may include the First Lady. The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) launch is scheduled for October 25. The next Science Committee meeting is planned for October 31-November 1. The Mars Science Laboratory (MSL) is still on track for a November 25 launch, landing on Mars next August.

In response to questions regarding the budget and JWST, Dr. Weiler noted that JWST is now an Agency-level program and the funding profile will be decided at the Administrator's level. He indicated that he is hopeful that the rest of the Agency will come through with cost sharing. NASA is actively working various options, but cannot talk about the out-year program at this time. Dr. Weiler promised that if there are major impacts passed down to SMD, he will not make any major cuts without going back to the Science Committee Subcommittees. At this point, it is not clear that there is a need to get the Subcommittees together in September. JWST may or may not be a big impact to the Directorate. Since NASA is a discretionary Agency, the real impacts may come to NASA as a whole. If it appears that any missions are in serious jeopardy, he will get together with the Subcommittees. With respect to the CR, NASA has had a lot of practice in dealing with that situation. In fact, a CR starting in October will freeze NASA at the FY11 level, and this is probably the best that SMD can hope for. However, the project should resist spending at a level that assumes that the FY11 level will continue. In response to a comment from Dr. Hubbard, Dr. Weiler agreed that NASA has a lot of exciting missions. The Administrator is aware of the word going around in the public domain that NASA is "out of business," and he and the public affairs office have directed that every press release and conference emphasize the exciting stories, such as the robotic precursor missions to Mars.

Dr. Boss commented that the Astrophysics Subcommittee (APS) would like to understand how decisions were made during the JWST replan. He noted that the Subcommittee had requested the following documentation: recent studies on de-scope/re-scope options for JWST; studies on alternative means of achieving the scientific goals of JWST; the history of JWST project status reports for the last three years; and estimates on what percentage (by cost) of JWST parts have already been fabricated or are in fabrication process. He inquired whether this documentation would be available at the next meeting. Mr. Howard indicated that NASA would provide these items as they are available, and will add the Science Committee to the distribution list.

#### Astrophysics/Astrophysics Subcommittee (APS)

Dr. Jon Morse, Astrophysics Division (APD) Director, reviewed the topics discussed at the last APS meeting. The Subcommittee members received the normal APD update, a status report on research and analysis (R&A) and the Senior Review, an interim report on the Wide-Field Infrared Survey Telescope (WFIRST), and updates on JWST, the ESA L1 astrophysics missions, the soon-to-be decommissioned operating missions, and the Government Performance and Review Act (GPRA) assessment.

The Nuclear Spectroscopic Telescope Array (NuSTAR) is APD's next launch. It is in final I&T at Orbital in Virginia, and is on track to complete around Thanksgiving. It will be delivered for integration with the launch vehicle in December for a February 2012 launch. The Announcement of Opportunity (AO) for the second generation of instruments for SOFIA was released, and proposals are due in October. The observatory completed seven of the eleven planned science flights; the last four will occur after the observatory undergoes upgrades in August. The program is getting close to demonstrating SOFIA's full operational capability. Teacher-educators from around the country will fly on the plane. The first six flew during Basic Science #1. On June 23, the observatory successfully accomplished a Pluto occultation, and 100 seconds of data were obtained.

Dr. Alan Boss highlighted the APS letter report on future missions. ESA will select two M-class missions in October and possible L-class mission concepts in February. APD is trying to retain the option of NASA participation in some of the ESA-led missions. The Division will task the National Research Council (NRC) Committee on Astronomy and Astrophysics (CAA) to begin reviewing NASA's options in Spring 2012. The CAA will function as the Decadal Survey Implementation Advisory Committee (DSIAC) that was called for in the Astro2010 Decadal Survey. SMD's Explorer-class mission competition is underway. Overall, the APS is pleased with these activities.

The APS has an issue with the APD plans for a NASA Research Announcement (NRA) in Fall 2011. The APS is requesting that the NAC Science Committee reconsider the timing of this NRA release—to after the announcement of ESA's L-class mission selections in February 2012. Dr. Morse indicated that this situation has been discussed with ESA, and the Division is looking at broadening community input in a more rapid timeframe. Instead of NRA study teams, the idea is to look at a Request for Information (RFI) process with inclusive workshops, with the

technical work being done at the Field Centers to support the ideas that come out of the workshops. This would be a timely and cost-effective way to have something to look at next spring when the CAA is performing its assessment. Important questions are: What do we do with the recommendations and various concepts that will take L1 into account? Is cost a driver in the way we look at future mission implementations? Dr. Boss noted that given the APD's response, there is not much for the APS to do with respect to a recommendation to the Science Committee. The APS can let the CAA address this when time comes. Dr. Morse agreed. If the CAA comes back with a recommendation on the direction of future missions in the next decade, NASA can form a Science Definition Team (SDT) and put more "meat" on the concepts. The APD will provide an update on this subject at the next Science Committee meeting in late October. Dr. Morse noted that another reason for going the RFI route is that it is more cost-efficient than NRA studies. The Science Committee was supportive of the proposed APD action.

Dr. Boss continued his presentation on the APS letter report. With regard to WFIRST, the APS encouraged the SDT to continue the trade studies discussed in the report and further recommended that changes in the field-of-view or nominal mission duration be added to the list of future SDT studies. With regard to JWST, it appears that sources for any increased funding for JWST are unclear. The APS is very concerned that the cost and schedule problems generated in the past continue to threaten the mission. The Subcommittee is also concerned about the overall health and funding of APD. The APS requested a lengthy briefing on the JWST at the next meeting. Specifically, the APS would like NASA to provide the documentation that Dr. Boss noted earlier in the meeting. With regard to the FY12 budget, the APS has a role to play in the budget process. Dr. Weiler noted that when Subcommittee involvement was originally suggested, he had no idea how the funding requirements would be covered—by APD, by SMD, or by the Agency. SMD is willing to call the Subcommittees together in September, but would like some advice from the Subcommittees on what the "breakpoint" is on cuts versus cancelation of missions in development or operation. When does the Subcommittee want to get involved and at what level? Dr. Torbert noted that it appears that NASA will not have clarity on the budget until December. Dr. Weiler indicated that the September date was picked before the recent debt crisis. Some things have been clarified, but not everything. NASA now understands the schedule from Congress. If the Subcommittees meet, perhaps it would be better to wait until there is more to clarify. He reiterated that SMD will not do anything draconian without the Subcommittees' advice. He can talk about the FY11 and FY12 budget, but FY13 and out is OMB-embargoed. By the next Science Committee meeting the end of October, the status will be shared with everyone. Dr. Morse noted that more information about the budget cycle was depicted in his backup charts. SMD will only go back to the National Academies of Science (NAS) if there is a major disruptive issue that requires a new strategy.

With regard to the ESA missions, ESA has decided that its best choice would be to go forward with an ESA-led mission; however, ESA has not decided on how many L-class missions will be selected. Both the re-scoped Laser Interferometer Space Antenna (LISA) and International X-ray Observatory (IXO) missions could go forward, or only one, or neither.

There was a general discussion on the timeframe for the next Subcommittee meetings vis-à-vis near term Congressional events. Dr. Feeley reminded everyone that there is a FACA requirement for at least a one-month advance notice for any meeting. It appears that the best timing would be later in FY12; the Agency will probably not have an appropriation until after December 23. If there will be September meetings, SMD needs to make the announcement soon. Dr. Weiler posed the question: At what point does budget data become public enough to discuss at a FACA meeting? Dr. Feeley responded that NASA would have to hear from OMB on when it would be releasable publically. It may or may not be worthwhile to schedule Subcommittee meetings in late September. Dr. Feeley also discussed the potential timeframe for Subcommittee meetings in October.

Dr. Morse thanked the Science Committee and APS members for their work. He announced that he is leaving NASA in the mid-September timeframe to return to academia. The APS and the Science Committee members thanked Dr. Morse for serving in his capacity as Division Director.

#### Science in NASA's New Education and Public Outreach Framework

The NAC Education and Public Outreach (EPO) Committee joined the Science Committee for a joint session. Ms. Erica Vick, Executive Secretary of the EPO Committee, introduced the members of her group. Dr. Leland Melvin,

NASA's AA for Education, discussed NASA's education redesign. It focuses the NASA Education Program to improve its impact on areas of greatest national need, identifies and manages Education partnerships, and participates in National and State Science, Technology, Engineering, and Math (STEM) education policy discussions. The Education Program includes professional training and development of educators working with middle-school students and a higher education program that provides opportunities for students. Organizationally, the redesign will try to establish a structure to allow the Office of Education, the Centers, and the Mission Directorates to implement an integrated portfolio. It will also expand the Education Coordinating Committee's (ECC) charter to enable education program design and evaluation. Dr. Melvin reviewed the milestones in the education redesign activity, the draft governance charter for the ECC, and the ECC working groups. A NASA Education Vision Statement was formally adopted: *To advance high quality STEM education using NASA's unique capabilities*. Dr. Melvin emphasized "high-quality STEM" and "NASA unique." The ECC working groups have six focus areas: programmatic implementation; partnership implementation; staff development; vision and oversight; communication; and coordination and integration.

Dr. Melvin showed the criteria that will be used to assess whether or not each project in the portfolio is working vis-à-vis the strategic goal. International partnerships include the International Astronautical Conference (IAC), the International Space Education Board (ISEB), the International Space Station Education Plan, and the Committee on Peaceful Uses of Outer Space (COPUOS). Some of the stakeholder involvement includes STS-135 students, the STS-134 military families' conference, the STS-133 partnership summit, Congressional briefings, and the National Science and Technology Council (NSTC) Committee on STEM Education (CoSTEM). The Education Design Team (EDT) recommendations will be implemented over a 24-month period, with milestones being reported on a quarterly basis. The programmatic milestones document the planned changes associated with the portfolio of NASA Education projects and structure. The milestones also document staff development. Changes include: a systematic review of all projects in the current portfolio; a portfolio transition plan; and processes to measure the effectiveness of strategies that will be delivered in the fourth quarter. Quarters five through eight will begin the process of annually assessing and reviewing the portfolio. Organizational milestones will continue to document the planned changes to organizational structures. Due to funding constraints, the portfolio is being scaled back.

Dr. Tapley noted that there are some 60-plus projects for \$180M. In response to his question, Dr. Melvin indicated that there is intent to reduce the number, because the portfolio must be trimmed to what NASA can afford. His office needs to do an assessment on whether efforts are being duplicated with other Federal agencies. They will look to see if the project is NASA-unique, high quality, and whether someone else can do it. Ms. Stephanie Stockman, the EPO lead in SMD, noted that SMD had 15 missions that were \$300K or more for 2010. This reflects the way SMD is doing business now. The emphasis will be on quality, what SMD is getting for the dollars, and where NASA can make the biggest impact. Dr. Hinners observed that from an international perspective, the U.S. has a poor record in STEM. He posed these questions: Is the technical world really improving the quality of students going into the science and engineering world? How is this taken into account? How does NASA measure the effectiveness of the evaluation? Ms. Stockman noted that on the larger programs, evaluations were built in. The one-stop-shopping initiative evaluations should be able to track students over time to see if they go into STEM careers. Dr. Eugene Levy observed that the evaluation efforts are broadly directed, and it is extremely difficult to evaluate any program because there is not a population with which to compare. Ms. Stockman agreed that it is difficult to assess informal activities.

The EPO Committee Chair, Mr. Lars Perkins, stated that the best one can do in the real world is to try to put resources into the most effective area, and hope that the anecdotal data supports it. We need to do more to get the anecdotal data in the system. With regard to the number of projects, they should be rank-ordered. Are they measureable? What is the cost? It is probably more effective to do a smaller number of things well. In response to a question, Dr. Melvin noted that the Office of Education will have a \$130M budget this year; projects have been distributed to the Centers for management. The Mission Directorates all have their education and public outreach efforts that the Office of Education tries to align with. Ms. Stockman added that SMD's education portfolio is aligned to the Office of Education portfolio. Information is collected from all missions on how they are contributing to outcomes, and this information is part of the recording system in the Office of Education. The Office of



Education has its budget and the Mission Directorates all have their budgets for education; also, the Centers have their unique funds that go toward education. Obviously, coordination is very important.

Ms. Stockman reviewed the EDT recommendations that impact SMD. The largest part of SMD's contribution to the Office of Education is to align the education projects and activities to support the unifying strategy. SMD also has the Grants Program and the Cooperative Announcement Notices (CANs). The majority of the content that comes through missions is at the middle school level. With regard to the commitment to provide graduate and faculty fellowships, SMD is putting in a request to collect information on graduates that are supported through the R&A program. In terms of partnering with informal learning providers, SMD is very active in informal learning. The mission science teams build partnerships into their plans. SMD will explore with the Office of Education the concept of joint solicitations with other agencies. With respect to the recommendation on structure, SMD feels comfortable that it addresses NASA Procedural Requirement (NPR) 7120.7. SMD will be working with the Office of Education to establish the criteria for investments that comply with the NPR. SMD is better positioned to deal with the project life-cycle. The Senior Review process also allows for EPO changes. SMD has worked with the Office of Education evaluation team to have criteria for educational investments that will be held to the NPR. Both the Office of Education and the Office of Communications should be involved in SMD's early planning efforts.

In response to a question from Dr. Tapley, Ms. Stockman noted that the Space Grants Program invites SMD to be part of its program and works with the missions. SMD is also looking at developing orbital opportunities for student instruments to fly under Space Grants. SMD will get report on numbers of student in the internship program piloted this year. The intent is to get them into the system so they can be tracked.

#### Science Talk on SOFIA

During lunch, Dr. Erick Young gave a science talk on SOFIA, including recent highlights—the Pluto occultation that occurred on June 23, the Faint Object Infrared Camera for the SOFIA Telescope (FORCAST) Orion Nebula observations, and the German Receiver for Astronomy at Terahertz Frequencies (GREAT) observations at the 2.4 – 2.7 THz frequencies. SOFIA has an important role in education and public outreach events. In response to questions, Dr. Young discussed what improvements are expected in the next generation of instruments.

#### Planetary Science/Planetary Science Subcommittee (PSS)

Dr. Jim Green, Planetary Science Division (PSD) Director, provided an overview of PSD mission events, new selections, missions in assembly test and launch operations (ATLO), and “science nuggets.” Over the past year, there have been a series of planetary science events, including release of the Planetary Science Decadal Survey, the MErcury Surface, Space ENvironment, GEochemistry and Ranging (MESSENGER) orbit insertion at Mercury, and Dawn orbit insertion at the asteroid Vesta. The next event is the Juno launch to Jupiter on August 5, followed by the GRAIL launch to the Moon in September, the Mars Exploration Rover *Opportunity* arrival at the Endeavor Crater, and the Mars Science Laboratory (MSL) launch to Mars in November. In late December/early January both GRAIL spacecraft will enter the Moon's orbit, and next Summer Dawn will leave Vesta and start on its journey to Ceres. Next August, MSL will land on Mars.

With regard to recent selections, there were three mission studies selected in the Discovery Program: Comet Hopper (CHopper), which is a lander mission on Comet Wirtanen; GEophysical Monitoring Station (GEMS), which is a Mars lander mission; and Titan Mare Explorer (TiME), which is a Titan lander mission. Reports on these missions will be due about this time next year, and one will be selected for implementation. There were several technology development selections under Discovery-12: Primitive Material Explorer (PriME), a cometary mass spectrometer; Whipple, an outer solar system blink occultation technique; and NEOCam, a near Earth object telescope technology. OSIRIS-Rex, an asteroid sample return mission, was recently selected for implementation under the New Frontiers program and is planned for launch in 2018. Dr. Green discussed the three missions in ATLO that are proceeding toward launch—Juno, GRAIL, and MSL. The Gale Crater has been selected as the landing site for MSL. *Opportunity* has less than two km to go until it reaches the Endeavor Crater on Mars this fall. Dawn entered into orbit around Vesta in July, and many interesting images have already been released. The survey science campaign will begin August 11. In response to a question, Dr. Boss noted that the landing target for MSL

will be the middle of the ellipse, and it may get partway up the central mound. Dr. Green narrated a video depicting a simulated landing in the ellipse.

Dr. Bill McKinnon (representing Dr. Ron Greeley, Chair of the PSS, in his absence) reviewed the recent activities since the last meeting. The PSS decadal survey telecon was held on June 22, at which the PSS reviewed the PSD response to *Visions and Voyages*, discussed whether or not to realign the Analysis Groups to the decadal survey structure, and discussed the two-step R&A Review pilot study. Ongoing issues include the Mars flagship, the Outer Planets flagship, R&A, and Pu-238. Overall, the planetary community did an excellent job with the decadal survey. PSD response to the decadal survey will be posted soon. The PSS supports PSD's response to the recommendations. R&A will be maintained at \$200M per year. The PSD will strive to achieve a 24-month Discovery AO cadence. New Frontiers 4 and 5 are planned for the decade within 2013 – 2022. The Mars 2018 Flagship mission will be developed with ESA as a first stage of Mars Sample Return (MSR). A study of a de-scoped Jupiter Europa Orbiter (JEO) will be initiated, with possible implementation as funds allow.

With regard to the planetary analysis group structure, the PSS felt that realignment of the planetary analysis groups with the decadal survey structure would not be an improvement. With regard to Mars Flagship, neither ESA nor NASA alone have the resources for the Flagship mission. The budget outlook is \$1.2B plus launcher for the U.S. portion of Mars 2018. There will be NASA support for the U.S. instruments (ExoMars/Trace Gas Orbiter) on Mars 2016. The overall message is: Mars Flagship will require successful international collaboration. The design study for the joint lander opportunity in 2018 is due September 2011. The baseline has NASA focusing on entry, descent, and landing (EDL) and sample caching, with ESA providing the drill and the science payload. At this point, ESA is moving ahead at a modest rate for the 2016 mission, but needs a firmer NASA commitment to a Mars 2018 joint mission.

With regard to Outer Planets Flagship, there are no funds available in the five-year run-out to initiate the Jupiter Europa Orbiter (JEO) mission. The decadal recommendation is to de-scope JEO to less than \$2B in order to be considered later in the decade 2013-2022. Options will be presented to the Outer Planets Analysis Group (OPAG) in October. The overall ESA decision on the competed L-class mission is expected in February 2012. A Working Group, led by Dr. Greeley, has assessed PSD's mission-enabling activities. The findings and recommendations are in alignment with the decadal survey. Pu-238 restart is critical for continued solar system exploration, especially the outer solar system. Progress is incremental, but the House language is positive.

Dr. Weiler directed that the JPL Europa estimate be run through Aerospace for validation. McKinnon responded that such a review is already planned. In response to a question from Dr. Kennel regarding the decadal study team contact with ESA during formulation of its review, Dr. Weiler noted that Dr. Marc Allen is already working on this with his counterpart in ESA. The MEPAG executive committee is planning to alternate its meetings between ESA and the U.S.

#### Earth Science/Earth Science Subcommittee (ESS)

Dr. Michael Freilich discussed the 2011 Earth Science Senior Review, Aquarius launch and commissioning status, Venture-Class activities and status, the budget, upcoming events and activities, and launch vehicles and the Earth Science Division (ESD) access to space. ESD has budgeted for continuation of all on-going Earth Science missions. Since the last meeting, there was a successful launch of Aquarius/SAC-D, an international collaborative mission between NASA and CONAE (the Argentine space agency) on June 10. Aquarius will contribute to a better understanding and prediction of ocean circulation, Earth's hydrologic cycle, and climate. Checkout is taking longer than expected, but with no insurmountable problems. Venture-Class is the science-driven, Principal Investigator (PI)-led, cost- and schedule-constrained class of orbital and suborbital missions. Venture-Class investigations complement the missions identified in the decadal survey. Venture-Class is fully funded, with three strands: EV-1, EV-2, and EV-Instrument. EV-1 and EV-2 will be solicited every four years; EV instrument will be solicited annually. Dr. Freilich described the investigations on EV-1 and noted that four of the five investigations have gone through the system of reviews and have been confirmed; the last is set for September 2011. All of the investigations are doing test flights. Each investigation will have extensive science campaigns. There are very few issues in EV-1.

EV-2 consists of small, complete missions, five years in duration. EV-Instrument consists of space borne instruments for flight on Missions of Opportunity (MoO).

With respect to the budget outlook, the House mark was \$100M less than the President's Budget Request for FY12. Based on the Climate Initiative submitted last year, the House is looking for a balanced (R&A, applied science, and technology) plan.

Dr. Freilich reviewed the missions in formulation and implementation: NPP, which is moving ahead for an October 25 launch; the Landsat Data Continuity Mission (LDCM), scheduled for launch in December 2012; the Orbiting Carbon Observatory (OCO)-2 planned for launch in 2013; and the Global Precipitation Measurement (GPM) mission, planned for launch in December 2013. The Soil Moisture Active Passive (SMAP) mission and the Ice, Cloud, and land Elevation Satellite (ICESat)-II are proceeding for launches in 2014 and 2016. The orbital mission line-up is the same as briefed at the last meeting. The President's Budget and the FY11 appropriations allow the Division to launch a couple of missions per year.

Dr. Freilich discussed how measurements of many different quantities can be used to understand general processes, e.g., the impact of declining Arctic sea ice on winter snowfall. Increased atmospheric water vapor content in the Arctic region during late autumn and winter in response to the reduction of sea ice provides enhanced local moisture sources, supporting increased heavy snowfall in Europe and northeastern and mid-west US.

Dr. Freilich noted that none of the launch vehicle problems presented at the last meeting have been solved. The ESD continues to await information on the recent Taurus-XL fairing failure and continues to explore ways to use Minotaur and possibly Falcon-9.

Dr. Tapley provided a brief summary of the ESS meeting on May 11-12, 2011. Topics covered included the ESD status report, Tier One mission plans—Deformation, Ecosystem Structure and Dynamics of Ice (DESDynI) and CLimate Absolute Radiance and REfractivity Observatory (CLARREO)—modeling data assimilation activities, and launch vehicle status. The FY12 budget submission contained direction that CLARREO and DESDynI be placed in a state of indefinite delay. This is a significant concern to the ESS. The direction from the Administration is that the DESDynI-Radar be deferred until affordable. The ESS believes that there is science margin available for redefining the mission to achieve a lower cost, and formulated the following recommendation:

*In response to Administration directions from the FY12 budget related to the DESDynI mission cost, and in view of the urgent science and application needs, the ESS recommends that ESD initiate the activities required to develop a reduced cost L-band radar mission, where the final mission concept would be based on an acceptable compromise between mission cost and science objectives. The potential for international partnership should be considered as a means of achieving the optimum cost/science compromise.*

Dr. Freilich stated that ESD is funding studies for an L-band radar mission. In response to a question, Dr. Tapley noted that the original cost was \$1.2M in the radar component. Dr. Freilich added that the definition of "affordable" is to not cause delays in other elements of the initiative. The funding for the near term cannot be more than about \$300M in this budget period.

There were no public comments, and the public meeting on August 2 was adjourned.

### **Wednesday, August 3**

#### Recap of First Day

Dr. Tapley asked for reactions to the presentations and discussions from the previous day, and whether there were any action items. Four items were noted: the budget issues related to JWST; the best timeframe for Subcommittee meetings in the fall; the recommendation from the APS on the timing of the NRA release; and the ESS recommendation regarding a reduced scope/cost DESDynI mission. It was noted that at this time, the ESS

recommendation does not need to go forward because actions are underway for a more stringent cost cap. Dr. Boss noted that the APS concurs with Dr. Morse's plans regarding ESA, the NRA, and the RFI.

Several Committee members made comments. Dr. McKinnon noted that planetary support is still avid, and the PSS supports what the PSD is doing. Dr. Hinners observed that given the budget situation and pressure, the community needs to encourage the continued, full-up operation of the Hubble Space Telescope. Dr. Hubbard noted that the deployment of SOFIA is another way to continue engagement with the public and education. Dr. Kennel questioned whether there is enough outreach. It is essential to get news out all the time and to respond with alacrity. He reinforced the Science Committee's observation that with the Shuttle Program's termination, there is a public perception that NASA is not continuing exploration. Many extremely interesting science programs are ongoing. The ISS partnership will be in place for a long time. In response to a comment from Dr. Levy, Dr. Hubbard observed that even some senior members of the high-tech community have the perception that NASA is "going out of business." Dr. Kennel reminded everyone that from 2000 on, everyone knew that the Shuttle had to be retired, and the NAC was deeply involved with that. With the Columbia accident, the plans for Shuttle retirement moved forward. Dr. McComas opined that there is a time for science to step forward, and this is it. Dr. Tapley suggested that the Science Committee may need to craft a recommendation to take forward to the NAC. Dr. Torbert observed that in the near term (the next six months), the big issue is what will come out of the JWST replan and what impact it will have on science going forward. How should the Science Committee work with Dr. Weiler on this? The members agreed that the Science Committee is on the front lines on this issue. Dr. Tapley asked Dr. Kennel and Dr. McComas to draft a recommendation on the JWST replan and frame it within the broader science issue.

Dr. Feeley presented the draft recommendation on PSS Analysis Groups (based on the TagAg recommendations covered the previous day). The action is on the Science Committee, since the Analysis Groups are subgroups of the Science Subcommittees and because the NASA Administrator established the TagAG as a subgroup of the Science Committee. He indicated that he would send the proposed recommendation to the Executive Secretary of the Exploration Committee to confirm their endorsement; which was later received.

#### Heliophysics/Heliophysics Subcommittee (HPS)

Dr. Richard Fisher, Heliophysics Division (HPD) Director, showed the heliophysics mission events timeline. Two missions are scheduled for launch in 2012 and one at the beginning of 2013: Radiation Belt Storm Probes (RBSP), Space Environment Testbeds (SET), and Interface Region Imaging Spectrograph (IRIS). Magnetospheric Multiscale (MMS) is planned for launch in 2014. Dr. Fisher briefly discussed heliophysics key events in 2011 and 2012 and reviewed the programs in progress. In the Living With a Star Program, RBSP has a new launch manifest date of September 6, 2012. The Solar Probe Plus (SPP) Mission Definition Review (MDR) is planned for October 2011, and Solar Observatory Collaboration activities are progressing. In the Solar Terrestrial Probes (STP) Program, work continues on MMS and flight instrument manufacturing. In the Explorers Program, the AO evaluation is proceeding per plan. Target selection date is September 2011. With a constrained budget, Missions of Opportunity are looking very attractive. There are some schedule concerns on the communications system and optical gratings for IRIS.

In the Sounding Rocket Program, the launch manifest is in jeopardy due to technical issues with the Black Brant motor and schedule delays of the new Thrust Termination System. The technical problems with the Black Brant have not been resolved, and the inventory of motors is not adequate to support the manifest. Arrangements are being made to purchase two additional Brant motors and six Oriole motors to augment the supply. RockOn IV (an Education Outreach mission) was launched successfully June 23; Daytime Dynamo was launched July 10, and RockSat X (another Education Outreach mission) was successfully launched July 21. Upcoming missions of interest include the Terrier Malemute test flight in August, the Planet Imaging Concept Testbed Using a Rocket Experiment (PICTURE) in September, and the Rapid Acquisition Imaging Spectrograph Experiment (RAISE) in October.

At this time, there are no issues in the operating missions; however, pressures on the Deep Space Network (DSN) are beginning, which will increase next year with the planetary launches. With respect to missions in development, there are some cost and schedule concerns with IRIS, but it is not yet in the "red." There is an ongoing concern

about launch vehicle costs for SPP. In the STP program, the management baseline for MMS was increased by \$35M from unallocated future expenses (UFE); the Agency baseline remains unchanged.

Dr. Fisher noted some recent science highlights. He showed the heliophysics spacecraft observations of the giant solar eruption on June 7. The event was one of the most spectacular ever recorded and best observed, with complementary data from several spacecraft and vantage points. ACE obtained data on the solar wind at L1. The next large solar flare is projected in September. Using data from the Solar and Heliospheric Observatory (SOHO) and the two Solar TERrestrial RELations Observatory (STEREO) spacecraft, NASA researchers have devised a new method to measure the Sun's magnetic environment. The second Artemis spacecraft successfully entered lunar orbit in July. Observations from Voyager suggest that our solar system's edge may not be smooth, but filled with a turbulent sea of magnetic bubbles.

In response to a question from Dr. Hinners regarding the upcoming Explorer selection, Dr. Fisher indicated that by the time the full-up missions and the MoOs get through the first selection, all are judged to be scientifically significant. Risks (technical and programmatic) are assessed. HPD looks to the 2003 decadal survey and whether or not there will be new system insights, e.g., the interaction of stars and planetary magnetic fields. Dr. Hertz noted that the AO says that at least one full mission will be selected; other selections could be full missions or MoOs.

Dr. Tolbert, HPS Chair, reviewed the membership on HPS and noted that the membership number is down. The Subcommittee is still awaiting replacements, but will soon be back to its full complement. HPS will conduct a review of the R&A program and provide advice on a possible restructuring. Among changes under consideration are consolidation and reduction in the number of solicitations per year, increase in the average grant size, and a two-step proposal process. The current proportion of targeted and non-targeted research is about right, but HPS will also look at this topic also. HPS will continue to stay involved in the budget issues. Pending positive results on Earth Science's EV-2, the Subcommittee recommends that HPD formulate a plan for a smaller class of Explorers patterned after the EV-2 concept and bring that forward for comment. The HPS is also concerned about the Black Brandt motors and will monitor progress. HPS will continue working on the data archiving issue. At the last meeting, the HPS conducted the HPD science review for the GPRA assessment. For each objective, expectations for the research program were fully met in the context of resources invested, and all three were rated "green."

Dr. Torbert discussed the coronal mass ejection (CME) on June 7 and the characteristics of solar cycles 24 and 25. There are controversial aspects of solar cycle 25 and recent predictions. An unusual (weaker) solar minimum is being seen by SOHO, Thermosphere, Ionosphere, Mesosphere Energetics and Dynamics (TIMED), and Sounding Rockets. The Aeronomy of Ice in the Mesosphere (AIM) mission is seeing changes in the polar atmosphere.

With regard to restructuring R&A, Dr. Hertz noted that Planetary Science just went through similar reviews and HPS should get the benefit from that activity. Dr. Torbert stated that the HPS has requested that information, but has not yet been briefed. With regard to the data archiving issue, Dr. Kennel observed that people will want the data; there should be a data set that is vetted and controlled so that the community can use the data properly.

#### Lessons Learned from NRC Decadal Surveys

Dr. Hertz discuss some lessons learned from the most recent round of NRC decadal surveys, which included Earth Science in 2007, Astrophysics in 2010, and Planetary Science in 2011. These surveys had a large impact on the planning processes. The new decadal survey on Heliophysics is expected in Spring 2012 and will be used to shape the FY14 budget request. Dr. Hertz made some specific observations on the Earth Science, Astrophysics, and Planetary Science surveys and some general observations (from the NASA perspective) on all of them. Future budget projections can change dramatically during the course of a survey preparation period, but that information is embargoed until after the annual budget submission in February. Mission cost estimates are pre-Phase A, and while independent review makes them less subject to bias, it doesn't make them more accurate. NASA must respond to national priorities in addition to survey priorities, especially in Earth Science. A decade is about the right cadence for the community surveys.

Dr. Hertz presented some considerations for the next round of surveys. The science priorities are more stable over decadal timeframes than either budgets or mission cost estimates; therefore, the focus should be on science and measurement priorities and targets of interest rather than specific mission concepts. Funded studies of mission concepts in advance of surveys can be useful to demonstrate feasibility. Survey committees should be chaired by persons with space mission experience, and survey committees should have an adequate portion of these people. Surveys should fully consider a variety of budget scenarios and provide decision rules/priorities for them. They should avoid over-specifying mission implementation. Large numbers of recommendations of varying importance and scope can dilute the impact of the survey. Mission concept studies should be spread out across the decade. Surveys should be acquired via contracts, rather than grants.

Dr. Hertz noted that Astrophysics 2010 aligned the science discussion with programmatic discussion. It included a large number of small-scale recommendations that were helpful in formulating the budget. It was the first survey that had a robust cost assessment that helped build a more realistic program. However, it recommended large and small missions, but no medium-size missions, so there is no ready-made pool of these missions to fit into the budget. Also, it prioritized missions rather than science. SMD is now very careful in writing guidance for surveys to prioritize science. The survey recommendations on international partnerships were confusing, and the balance between space and ground-based astronomy wasn't clear. The survey also recommended an independent non-FACA standing committee to provide strategic advice on survey implementation. Dr. Hertz stated that in the negotiations with the Space Studies Board (SSB), NASA has not been able to follow this recommendation. Dr. Kennel added that the Committee first looked at science objectives, then looked at how to mix and match the missions into an affordable set. The Committee recognized that in a constrained budget scenario, the objectives of three missions could be met with a single mission. Dr. Turner, who was on the survey team, indicated via telephone that with respect to budget, it was a very dynamic situation.

Dr. Hertz noted that the Planetary Science Decadal Survey provided recommendations and mission priorities as well as clear decision rules for balancing among programs under four budget scenarios. However, before the survey was even released, the budget outlook became worse than the most pessimistic budget envisioned by the survey. Dr. Hertz reviewed some of the language in the Heliophysics survey direction. The survey should prioritize among strategic science targets rather than specific mission design or implementation concepts. The flight mission priorities should be provided in a single list and must be achievable within the boundaries of the ten-year funding profile. Missions not yet in formulation must be reprioritized. The study panels' work should not result in separate, independent reports. Any potential deviations or significant developments that would warrant a NRC reexamination of the recommendations should be identified.

In response to a question, Dr. Marc Allen addressed the issue of contracts versus grants as the vehicle for the Decadal Surveys. In contracts, NASA can do a better job of negotiating specifics and reaching an understanding on what is wanted. Grants are more "hands off." In response to a question from Dr. Tapley on bilateral strategic planning with the international community, Dr. Hertz noted that Dr. Allen is taking the lead on how to accomplish planning with international partners. Dr. Allen indicated that he has had some discussions with ESA, and the subject will be pursued further at the NASA-ESA bilateral meeting in October. Several top-priority issues will be discussed.

In response to a question from Dr. Hubbard, Dr. Hertz stated that the findings he presented are only from SMD. Dr. Hubbard suggested having a dialog with some people who have served on survey committees to get their perspective. Dr. Hertz agreed, and stated that before the next round, it would be a good idea to have an SSB-sponsored workshop and discuss lessons learned. Dr. Turner added that with regard to a dialog with NRC, it would be valuable to get feedback from NRC sooner rather than later so that the lessons learned reflect both sides and contribute to a better survey next time. Dr. Allen suggested that Solar Probe may need to have some "machinery" associated with it similar to what the Mars Program had. Dr. Fisher pointed out that the worry is about having a committee study something that is not possible to implement; therefore, it is a good idea to have some clear decision rules.

Planetary Protection/Planetary Protection Subcommittee (PPS)

Dr. Levy provided an update on the PPS. He reminded everyone that planetary protection is an obligation under international treaty. It is intended to fulfill the obligation to protect Earth from any deleterious effect from alien biological organisms, and to protect other planets for the purposes of scientific observation, i.e., long enough to preserve the scientific ability to ascertain whether life exists or has existed elsewhere in the solar system. Planetary protection is always a balance of risk—to allow science and protect the environment long enough to fulfill science goals. The environment has been changing since the protocols have been in effect. Studies of terrestrial organisms have revealed the ability for organisms to thrive under a wide range of environments not previously thought possible.

The PPS has recently taken up several issues: questions surrounding final selection of the MSL landing target; NASA support of the Russian Space Agency's Phobos Grunt Mission; and NASA involvement in launches by non-governmental organizations. The PPS reviewed MSL. The spacecraft and lander are not devoid of living organisms; the landing site contains ice. There is a need to guard against inadvertent failures that could provide a local environment that is hospitable to the growth of biological organisms. The PPS found no reason to question the proposed landing sites, based on analysis by the MSL project. The Phobos Grunt Mission must comport with the Committee on Space Research (COSPAR) requirements for planetary protection. Aspects of the analysis were not accessible or did not comport with the way NASA does the analysis. The PPS recommended that NASA re-analyze the Russian data in a way that comports with NASA's protocol.

One of the challenges is to develop appropriate approaches to approval and control of activities in space. This subject has entailed much discussion. The PPS understands that the licensing of launches and returns to Earth is controlled by the FAA. In that licensing, FAA consults with NASA's Space Operations Mission Directorate (SOMD). The PPS met with representatives from SOMD and noted the desirability of including the planetary protection aspects in licensing. There was agreement that these requirements will be worked on, and the SOMD will have a recommendation coming back to the NAC or the PPS in the future.

Looking ahead, the PPS will be focusing on the planetary protection requirements for future missions planned in the context of the decadal survey, technology development for planetary protection, and the adequacy of support for planetary protection activities. Currently, the Planetary Protection Officer (PPO) reports to the Associate Administrator for SMD and the PPS reports to the NAC Science Committee. The PPS is somewhat uncomfortable with that, and feels that the PPO should report to the Administrator and the NAC. Dr. Weiler agrees with that view; however, that is not the way it is now. The NASA policy document states that the PPO reports to SMD, but has the authority to go higher.

In response to a question, Dr. Levy noted that the treaty does not directly address non-governmental activities; however, at the level of the Outer Space Treaty, governments are responsible for actions of their internal, non-governmental organizations. Although not legally binding, it has been the practice for COSPAR to speak in terms of planetary protection. The question has been: What is the line of authority within the current licensing and approval process in the U.S.? That precipitated the discussions among SOMD, FAA, and the PPO. In response to a question from Dr. Kennel on whether the planetary protection issues and guidance is focused properly in Exploration, Dr. Levy indicated that work needs to be done in that area. Planetary protection issues will play a significant role in human exploration. The main motivation for planetary protection of other bodies is to protect them long enough to answer questions about the possible distribution of life elsewhere. Protection levels are set to give science a reasonable timeframe to answer the scientific questions. In response to a question from Dr. McComas, Dr. Levy indicated that there is not a requirement to send robotic explorers before humans, but one could take the position that we cannot send humans to Mars cleanly, so one would want to have done all the science prior to sending humans. Dr. Tapley flagged this topic for the discussion period.

#### SMD Response to Office of the Chief Engineer (OCE) Management Operations Working Group (MOWG)

Via telecon, Mr. Mike Luther, Deputy Associate Administrator for Programs, discussed controlling costs for future mission development. The content of the briefing was driven by a study that Mr. Scolese requested from Aerospace to examine the history of SMD's mission development – an “explanation of change” study. The results were shared

with Dr. Hinner's MOWG in the late March timeframe. Subsequently, the MOWG documented its assessment of the recommendations.

Mr. Luther summarized some of the latest and newest changes that SMD has been making to address cost growth in missions. He briefly reviewed the SMD principles and showed the breadth of the nature of the program. The SMD portfolio includes 84 missions (96 spacecraft) in formulation, development, or operations, with 27 missions in formulation or development alone. SMD's approach to mission development is to continuously improve SMD's ability to define, commit, and execute the technical, risk, and resource requirements of its space flight mission developments while optimizing science output. There are Agency guidelines on programmatic risk, contained in NM 7120.81, *Policy for NASA Acquisition*. To implement the policy statement on "confidence level," SMD is using the confirmation review, which brings together a number of risk-based analyses to assess the risk level of a project. Almost all projects are confirmed at the 70 percent level. If projects are confirmed at a lower level, additional reserves are held by SMD at the Directorate level. The confirmation process and the follow-on decision points are the major safeguards. SMD has taken additional steps to include the probability of success to improve the oversight and insight level and feedback to the project. There have been a number of adjustments to the AO process to improve cost estimating capability, and SMD's capabilities for independent cost estimates and programmatic analyses have been greatly expanded. In addition, the program offices have been given increased responsibilities for tracking and reporting programmatic performance. A pilot program is underway to establish the capability for Earned Value Management (EVM) at NASA Centers for in-house work.

Mr. Luther addressed the question: How are we doing? He cited some recent launches that were within about five percent or less of their cost commitments. GRAIL is in KSC processing for a September launch and is still within its management commitment. Juno has overrun its management commitment by about 4 percent, but remains under the Congressional commitment. NPP, scheduled for launch in September, breached its Congressional commitment due to failure of the Air Force partner to deliver key instruments. MSL, scheduled for launch in November, has breached its Congressional commitment; however, it was confirmed prior to full implementation of the current control processes. Other missions in development, e.g., NuStar, RBSP, LDCM, and MMS are all within their Congressional commitments and most are within one to two percent of their management commitments. SMD is continuing to assess its tools, and has been having some success in the near term. Mr. Luther noted that Juno is the first AO mission that came under the new policy; however, NPP and MSL started before the new processes came into play. SMD will continue to evaluate tools, bring missions in on cost, and have a very stable program.

In response to a question from Dr. Boss, Mr. Luther indicated that the JWST replan is under the new processes, and the team is following the processes very rigorously. Dr. Kennel observed that the new processes should bring in missions within five percent. The next stage could be to select special processes at the beginning for those missions that appear riskier due to complexity. Mr. Luther agreed and offered the following questions: How do we deal with a complex mission such as JWST? What kind of tools and capabilities are needed for a mission like this? How do we model it? This is the challenge that Mr. Scolese has given the MOWG—how do we deal with missions that are complex, large, have a long development cycle, and involve politics. may be political sensitive due to their cost and extended schedule. Dr. Hinner commented that it is important to have adequate Phase A and Phase B activities, both technical and budgetary. Juno had a good Phase A and B schedule. Mr. Luther agreed, noting the SMD has been having the dialog over the last six months, and there is more rigor in the commitments between the projects and SMD. With regard to the complexity issues, Dr. McComas observed that all missions are complicated and difficult, and he suggested that SMD may consider separating the new elements from what projects already know how to do well and look at how to do those new aspects differently. In response to a question from Dr. Tapley regarding whether or not 70 percent is the right number for small missions, Mr. Luther indicated that the policy allows project confirmation at the 50 percent level, but SMD holds the additional resources. SMD is continuing to discuss the 50 – 70 percent range. Dr. Torbert added that the HPS has discussed these issues, and feels that during Phase A, NASA should have a more rigorous process to identify and address new technology items. Dr. Hubbard noted that complexity is one of the analogs that is used in the Cost Assessment and Program Evaluation (CAPE) process. As using the CAPE process becomes more routine, we will see more analogies. Dr. Weiler stated that there was a difference in the management tools for AO selections versus strategic missions. Mr. Luther amplified his comment--mapping the Agency process on top of the AO process results in less insight and confidence in



Phases A and B. There is more flexibility for strategic missions. The tools in the early phases are different; however, once there is confirmation, the tools are the same. In response to a comment from Dr. Hinnners regarding heritage, Mr. Luther agreed that “heritage value” is overestimated. SMD is trying to be more careful about giving confidence credit for anything called “heritage.” With respect to more budget flexibility, NASA needs to get by the Congressional aspect, but has made a step with the new approach. UFE may be added and held at the Directorate level at NASA Headquarters, and these dollars can be provided to the Center and project fairly quickly.

#### Public Comments

There were no public comments or questions.

#### Discussion and Preparation for the NAC meeting

Dr. Tapley asked if there were any other discussion topics. Dr. Hinnners expressed some discomfort with what he had heard on NASA’s education activities—he did not get a sense that the education program relates directly to what NASA is doing; rather, it appears to be a “mishmash” of activities. He posed the question: Is there a better way to be looking at the investment NASA is making so that it will have broader educational impact? Dr. Tapley asked if there were any comments regarding the NRC Decadal Surveys. Should there be changes in the assessment process? Dr. Kennel explained how the SSB is making changes to be more responsive, e.g., using ad hoc committees and being more interactive with NASA. The SSB’s new survey style puts much more emphasis on judgment at the time the survey is accomplished.

The Committee discussed proposed recommendations on lessons learned from recent decadal surveys, the SMD plan for Subcommittees to evaluate budget options, the role of public outreach, and PSS analysis groups. The Committee’s discussions resulted in four recommendations that were carried forward to the NAC at its meeting on August 4-5:

#### Capturing Decadal Survey Lessons Learned

*Recommendation: NASA should request a formal examination by the National Research Council (NRC) of the lessons learned, from the perspective of the National Academies, from recent NASA-related decadal surveys. Planning for this examination should be initiated after the release of the Heliophysics Decadal Survey in early 2012, and the examination should make recommendations about the next cycle of decadal surveys, which will begin circa 2015.*

*Major Reasons for the Recommendation: Lessons learned, from NASA’s perspective, are being captured. But the lessons learned, from the perspective of the National Academies, are also vital to maintaining the importance and continued value of the decadal surveys.*

*Consequences of No Action on the Recommendation: The collection and examination of lessons learned will become more difficult with the passage of time, and the failure to capture these lessons could adversely affect the importance and continued value of future decadal surveys.*

#### Science Budget Options

*Recommendation: The Science Committee supports the intention of SMD to task the relevant NAC Subcommittees with evaluating possible division-level budget options, once the FY12 budget process results in an SMD appropriation or year-long Continuing Resolution. The Science Committee and its Subcommittees have a key role to play in this difficult process, especially in the event that major changes result from the budgetary process. The Science Committee stands ready to meet to provide SMD the desired results.*

*Major Reasons for the Recommendation: The NAC Committees and Subcommittees are the only vehicle for timely advice concerning budget options that require major changes in programs.*

*Consequences of No Action on the Recommendation: SMD is left without a timely source of advice for how to deal with the science and programmatic trades necessitated by major funding changes.*

NASA Press and Outreach Programs

*Recommendation: NASA's ongoing program of scientific challenges and exciting science missions (those launched in the coming year, in development, and planned over the rest of the decade) will provide outstanding results and new discoveries. The NAC encourages NASA's press and outreach programs to strengthen their focus on science missions and stands ready to help formulate, facilitate, and champion these activities.*

*Major Reason for the Recommendation: NASA's science programs provide numerous opportunities for carrying the excitement of the U.S. space program to the public throughout the next decade and beyond.*

*Consequences of No Action on the Recommendation: Missed opportunities to inspire the next generation of space explorers and inform the public about the results of NASA's science programs.*

Planetary Science Subcommittee Analysis Groups

*Recommendation: NASA should revise the Terms of Reference (TOR) for the Lunar Exploration Analysis Group (LEAG), Mars Exploration Analysis Group (MEPAG), and the Small Bodies Assessment Group (SBAG) to reflect the recommendations contained in the Task Group of the NAC Science Committee (TagAG) final report.*

*Specifically:*

- (1) Add explicit tasking authority for the Exploration Systems Mission Directorate (ESMD) and relevant Committees of the NAC;*
- (2) Add language concerning the appointment of the Chair (and in the case of LEAG, Co-Chairs) that has appointment made by the Associate Administrator (AA) for Science after consultation with the AA for Exploration Systems;*
- (3) Update language to capture revisions in the topic areas covered by the respective Analysis Groups; and*
- (4) Acknowledge the uniqueness of LEAG by:
  - a. Establishing a LEAG Co-Chair for Science (appointed by the AA for Science after consultation with AA for Exploration) who would replace the current LEAG Chair as a member of the NAC Science Committee's Planetary Science Subcommittee;*
  - b. Establishing a LEAG Co-Chair for Exploration (appointed by the AA for Exploration Systems after consultation with AA for Science) who would be added to the membership of the NAC Exploration Committee; and,*
  - c. Incorporating language that the LEAG Executive Secretary should be appointed by AA for Science after consultation with AA for Exploration Systems;**
- (5) Refine the working concerning the role of the Designated Federal Official (DFO)/Executive Secretary to ensure consistency with the Federal Advisory Committee Act (FACA) Final Rule and NASA Policy, while recognizing the value of a close working relationship between the Executive Secretary and the Chair.*

*Major Reasons for the Recommendation: These recommended changes would update the three relevant Planetary Science Subcommittee Analysis Groups so that they can more directly provide analysis not only to the Science Mission Directorate (SMD), but also to the ESMD for integration of science into its exploration mission objectives.*

*Consequences of No Action on the Recommendation: ESMD is left without a clear and direct mechanism for tasking the three relevant Planetary Science Subcommittee Analysis Groups that cover targets of interest to ESMD, namely, LEAG (Moon), MEPAG (Mars), and SBAG (asteroids).*

Dr. Tapley adjourned the meeting.

Agenda  
(all times PACIFIC)Tuesday, August 2

- 7:30-7:45 Arrive and Depart to Building 152, Room 171 for Joint Session
- 7:45-8:30 Task Group on Analysis Groups (TagAG) Final Report – Feeley  
*Joint session with Exploration & Space Operations Committees*
- 8:30-8:45 Depart and Arrive in NACC – Bldg 3, Showroom
- 8:45-9:45 Discussion with SMD Associate Administrator – E. Weiler / R. Howard
- 9:45-10:45 Astrophysics / APS – J. Morse / A. Boss
- 10:45-11:00 Break**
- 11:00-12:30 Science in NASA’s New Education and Public Outreach Framework  
*Joint session with Education & Public Outreach Committee*
- 12:30-1:15 Lunch & Science talk: SOFIA – E. Young**
- 1:15-2:00 Planetary Science / PSS – J. Green / B. McKinnon
- 2:00-2:45 Earth Science / ESS – M. Freilich / B. Tapley
- 2:45-3:00 Adjourn -- Proceed to Plenary Session of NAC Committees  
(Council and 9 Committees only, non-public)**

Wednesday, August 3 (Building 3, Conference Center, Showroom)

- 7:30-8:00 Recap of 1st Day
- 8:00-8:45 Heliophysics / HPS – R. Fisher / R. Torbert
- 8:45-9:30 Lessons Learned from NRC Decadal Surveys – P. Hertz
- 9:30-10:00 Planetary Protection / PPS – E. Levy
- 10:00-10:30 SMD Response to OCE MOWG – M. Luther
- 10:30-10:45 Public Comment Period
- 10:45-11:30 Discussion and Prep for NAC Meeting
- 11:30 Adjourn**

NAC Science Committee  
Membership List

Dr. Wesley T. Huntress, Jr. Chair	Director, Emeritus, Geophysical Laboratory Carnegie Institute of Washington
T. Jens Feeley Executive Secretary	NASA Headquarters Science Mission Directorate
Dr. Byron Tapley Vice Chair	Director, Center for Space Research University of Texas, Austin
Dr. Alan P. Boss	Carnegie Institution for Science Department of Terrestrial Magnetism
Dr. Ronald Greeley	School of Earth and Space Exploration Arizona State University
Dr. G. Scott Hubbard	Department of Aeronautics and Astronautics Stanford University
Dr. Noel W. Hinners	Consultant
Dr. Eugenia Kalnay	Department of Atmospheric and Oceanic Science University of Maryland
Dr. Charles F. Kennel	Space Studies Board Scripps Institution of Oceanography, UCSD
Dr. Eugene H. Levy	Provost & Professor of Physics and Astronomy Rice University
Dr. David J. McComas	Space Science and Engineering Division Southwest Research Institute
Dr. Roy B. Torbert	Space Science Center University of New Hampshire
Dr. Michael S. Turner	Kavli Institute for Cosmological Physics The University of Chicago

## NAC Science Committee

## Attendees

Committee Members

Byron Tapley, Vice Chair	University of Texas, Austin
T. Jens Feeley, Executive Secretary	Science Mission Directorate, NASA Headquarters
Alan P. Boss	Carnegie Institution for Science
Noel W. Hinners	Consultant
G. Scott Hubbard	Stanford University
Charles F. Kennel	Scripps Institution of Oceanography, UCSD
Eugene H. Levy	Rice University
David J. McComas	Southwest Research Institute
William McKinnon (for Ron Greeley)	Washington University
Roy B. Torbert	University of New Hampshire
Michael S. Turner (via telecon)	The University of Chicago

NASA Attendees

Christensen, Chris	NASA/Ames
Coe, Liza	NASA/Ames
Fanelli, M.	NASA/Ames
Hertz, Paul	NASA Headquarters
Martin, Gary	NASA/Ames
Norris, Marian	NASA Headquarters
Vick, Erika	NASA Headquarters
Weiler, Ed	NASA Headquarters

Other Attendees

Bostick, Michael	Walden Media
Frankel, Paula	Zantech/P B Frankel LLC
McCay, Dwayne	Florida Institute of Technology
Shakaal, Peter	Geek Factory

Attendees via Telecon & WebEx

Allen, Gale	NASA Headquarters
Anderson, Dale	City Institute
Anderson, J.C.	SAIC
Capps, Richard	NASA/JPL
Conley, Catharine	NASA Headquarters
Conte, Dominick	Orbital Sciences
Cowing, Keith	[self]

Devirian, Michael	NASA/JPL
Garder, Jonathan	NASA/GSFC
Giles, Barbara	NASA Headquarters
Greenhouse, Matthew	NASA/GSFC
Hand, Eric	Nature
Kaliria, Jason	Space Telescope Science Institute
Leone, Dan	Space News
Levit, Creon	NASA Headquarters
Luther, Mike	NASA Headquarters
Lystrup, Makenzie	University of Colorado
Mather, John	NASA/GSFC
Mattozzi, Kristen	NASA/Ames
Melvin, Leland	NASA Headquarters
Rutkowski, Mike	Arizona State University
Sladek, Mary	NASA Headquarters
Smith, Robert	University of Alberta
Sohus, Anita	NASA/JPL
Stiavelli, Massimo	Space Telescope Science Institute
Stockman, Stephanie	NASA Headquarters
Svitak, Amy	Aviation Week
Swick, Frank	NASA Headquarters
Tahu, George	NASA Headquarters
Taylor, Ray	NASA Headquarters
White, Nicholas	NASA/GSFC

NAC Science Committee  
List of Presentation Materials

- 1) Task Group on Analysis Groups (TagAG) Final Report [Feeley]
- 2) James Webb Space Telescope (JWST) Program Status and Replan [Howard]
- 3) NASA Science [Weiler]
- 4) Astrophysics Subcommittee Summary [Morse, Boss]
- 5) Education [Melvin]
- 6) NASA Education Design Team Recommendations and SMD [Stockman]
- 7) SOFIA: The Stratospheric Observatory for Infrared Astronomy [Young]
- 8) Planetary Science Update [Green]
- 9) Planetary Science Subcommittee [McKinnon]
- 10) NASA's Earth Science Division [Freilich]
- 11) NAC Heliophysics Status Review [Fisher]
- 12) Heliophysics Subcommittee [Torbert]
- 13) Lessons Learned from This Round of NRC Decadal Surveys [Hertz]
- 14) Planetary Protection Subcommittee [Levy]
- 15) SMD Mission Development: Controlling Costs for the Future [Luther]