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Washington, D.C.

NASA ADVISORY COUNCIL

SCIENCE COMMITTEE

April 9, 2014

NASA Headquarters

Washington, D.C.

Meeting (Telecon) Minutes



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David J. McComas, Chair



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T. Jens Feeley, Executive Secretary

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Zantech IT*

April 9, 2014

Introduction/Opening remarks

Dr. T. Jens Feeley, Executive Secretary of the NASA Advisory Council (NAC) Science Committee (SC) opened the meeting with some administrative remarks. Dr. David McComas, SC Chair, welcomed new committee member Dr. Harlan Spence, and noted that Dr. Meg Urry would be resigning the committee shortly. He also noted that Planetary Science Subcommittee (PSS) Chair Dr. Janet Luhmann would be represented by Dr. Julie Castillo-Rogez for the present meeting, which will be largely concerned with the Fiscal Year 2015 (FY15) budget. An earnest effort is under way to arrange a face-to-face meeting for the Science Committee's next convening.

Science Mission Directorate Budget Request Overview

Mr. Craig Tupper, Director of SMD's Resources Management Division, gave a briefing on SMD's portion of the President's Fiscal Year 2015 (FY15) budget request. The FY15 request contains an expanded Near Earth Object program that will include support of a future human mission (the potential Asteroid Redirect Mission). It also contains a potential Europa mission, the first time a budget request has explicitly referenced this prepre-formulation activity; and a Science Technology Engineering Mathematics (STEM) education program that has been consolidated across SMD and bookkept in the Astrophysics portion of the budget request.

FY15 represents a significant increase over FY13, and NASA currently has an Operating Plan for FY14 pending with Congress. The Agency expects to have the Operating Plan approved at the level of \$17.646B. For the FY15 request, the numbers are significantly lower than the FY14-enacted levels; the reduction amounts to about \$46M less. None of the numbers include funding for the Opportunity Growth and Security Initiative (OGSI). Senator Barbara Mikulski has been suggesting a top line for FY15 that is above the FY14 enacted level. Mr. Tupper felt it would be possible to achieve this suggested top line, and to actually have a budget before the start of FY15 (October 1, 2014).

In terms of Agency and SMD budget trends, the big message is that during the last decade, SMD has mostly tracked the Agency budget trend, as approximately 28 percent of the total budget, excluding a deviation in 2006-11 that coincided with the Constellation program. SMD has since recovered but the trend is down. Since August 2011, there have been 11 missions for which NASA had made commitments; more and more missions are coming in on schedule and within our budget commitments. Nine missions have underrun their original cost estimates, in the aggregate, by about 6 percent or ~\$200M.

Recent cost and schedule performance indicators show that the Ice, Cloud, and land Elevation Satellite (ICE-Sat-2) mission has breached its cap by a fair amount. The other problematic mission is Magnetospheric Multiscale (MMS), which is "on the bubble." There is a significant chance it will not stay within its budget commitment, but the growth is not expected to be large. Four other missions in development are green; it is expected that funding will be returned from the Mars aeronomy mission MAVEN, and Global Precipitation Measurement (GPM), as well as the Orbiting Carbon Observatory

(OCO-2) and Soil Moisture Active Passive (SMAP). The high-level message is that mission cost and scheduling is going pretty well.

Tentative future opportunities include a potential Pre-Aerosol, Clouds, and ocean Ecosystem (PACE) mission Announcement of Opportunity (AO) next year, and a Europa instrument AO in late 2014. The next Heliophysics Explorer AO is scheduled for no earlier than 2016. Timing for a new Planetary New Frontiers/Discovery mission is still to be determined.

The FY15 Opportunity Growth and Security Initiative (OGSI) is an augmentation requested for multiple agencies, of which NASA is one. In SMD, the Administration has proposed as part of the OGSI an additional \$187.3M for an OCO-3 and an augmented PACE mission (an extra \$50M to ensure it is ready to go by 2020). OGSI also mentions various Planetary Science Extended Missions (EMs), proposing an extra \$35M to increase support for EMs. There are 7 Planetary Science Division (PSD) missions in Senior Review (SR) right now; the current budget request shows no funding for the Lunar Reconnaissance Orbiter (LRO) or the Mars Exploration Rover (MER) Opportunity; these two missions must await the outcome of the Senior Review. However, if there is no additional funding, SMD may have to terminate some of these EMs. Within the OGSI, there is also an extra \$15M for radioisotope power systems; \$20M for Research and Analysis (R&A); \$20M for the Wide-Field Infrared Survey Telescope/Astrophysics Focused Telescope Assets (WFIRST/AFTA) decadal survey mission; and \$18M for additional Earth Science Division (ESD) work.

#### Heliophysics Division Update

Dr. David Chenette, Director of the Heliophysics Division (HPD) presented a budget briefing. The HPD budget for FY14 shows a modest increase compared to FY13, restoring \$20M of the \$30M sequester cut. The FY14 Appropriation provided for Solar Probe-Plus (SPP) on a 2018 launch schedule, as well as funding for MMS, Explorers, and Heliophysics research. For FY15, the net HPD budget is \$613.9M; the gross budget is \$668.9M, and includes administrative items not specific to HPD. There is reason to be optimistic about the future and executing SPP as planned and committed. The key consequences of the FY15 Presidential Budget Request include a modest increase of a \$4M net of administrative items. HPD is coming closer to pre-sequester levels; the current budget sustains R&A and Operating Missions support and constant dollar levels. It covers SPP for a 2018 launch without impacting other elements of the budget. SPP was approved at a cost that was 20% higher than the guidelines provided in the Heliophysics Decadal Survey. That cost change is being covered. The budget also maintains Solar Orbiter through providing a launch vehicle; supports MMS through final integration and test; funds both of the recently-selected Explorers, Global-scale Observations of the Limb and Disk (GOLD) and Ionospheric Connection Explorer (ICON), and enables HPD to continue to implement the Diversify, Realize, Integrate, Venture, Educate (DRIVE) initiative. The CubeSat line continues, and this is considered a modest success.

The SPP budget does not impact research, as Dr. Chenette detailed by describing some relevant items in the Living With a Star (LWS) program. The CCSP considered the

reviews in the process of getting to Key Decision Point-C (KDP-C), as adequate to satisfy the trigger criteria in the recent Heliophysics Decadal Survey, and an agreement was reached to set the new trigger level and go forward.

HPD continues to address the DRIVE initiative by rebalancing the program to increase the share of the research budget, and accelerating and expanding the Heliophysics Explorer program, sustaining the Explorer mission cadence that is consistent with the budget.

Dr. McComas asked about the contents of the Administrative and Directed Research and Technology (R&T) line. Dr. Chenette explained that some items in these that serve all SMD; the line covers civil service salaries that are not otherwise accounted for. The line must be held somewhere, and in this case it is held in HPD. Dr. Feeley added that there are other line items that are treated similarly, and that the practice is simply a bookkeeping method. Dr. McComas asked if there were a more straightforward way to manage the line item. Dr. Paul Hertz, Director of the Astrophysics Division (APD) commented that such line items represent the cost of running SMD; every division carries about a quarter of the budget for SMD. The money is not a tax, it just where it is bookkept. Dr. Chenette added that he showed the net budget numbers in order to be completely transparent. Mr. David Schurr added that the funds are bookkept in the line for ease of execution only, for management of financial systems. Dr. Spence supported Dr. McComas' comments and concerns.

#### Planetary Science Division (PSD) Update

Mr. David Schurr, the Deputy Director, presented a status of the PSD. The strategic objective for the division has not changed. Major activities continue at Mercury, the Moon, Mars, and Saturn. New Horizons is en route to Pluto. Most planetary missions have significant international involvement. PSD continues the process of restructuring R&A; the present budget reflects this. PSD is working with the Department of Energy (DOE) for re-instating domestic production of Pu-238. There are 3 major missions in the development phase: Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) at Mars, the European Space Agency's (ESA's) Exobiology on Mars (ExoMars), and Mars Rover 2020. These are Decadal Survey missions.

The division has had a busy successful year, with many mission activities. What has changed from the previous budget request is the following: PSD will conduct the next Discovery AO in 2014; the intent is to do this on a 3-year cadence. Pre-formulation work for a potential mission to Europa is also in progress; plans are underway to release an AO for instruments (phase A studies). PSD is continuing to restructure R&A programs with planetary science goals, and is closing out the Lunar Quest program, with LRO being moved to Discovery.

The latest science results from Europa include the sighting of presumptive water plumes by the Hubble Space Telescope. PSD is on a path to release a Request for Information (RFI), looking for ideas on a billion-dollar class mission to Europa. PSD continues work with its international partners, including ESA, on the Strofio instrument (for the Bepi-

Colombo mission), the Mars Organics Molecule Organizer (MOMA) and the Jupiter Icy Moons Explorer (JUICE) mission, as well as with the Japanese Space Agency (JAXA) on the Venus orbiter Akatsuki, and the Hayabusa-2 mission. The division is operating 10 planetary spacecraft and 2 rover missions, and is maintaining the Near-Earth Object (NEO) program, having re-purposed the Wide-Area Infrared Survey Experiment (WISE) spacecraft for this purpose. Planned accomplishments for 2014 and 2015 include the selection of instruments for the Mars 2020 rover; the release of a Discovery AO in FY 14, with candidates to be selected in 2015; the completion of the Lunar Atmosphere and Dust Environment Explorer (LADEE) mission, ending with lunar impact in April 2014; and the traverse of the Curiosity rover to Mount Sharp in the late summer or early fall of 2014. The Mars aeronomy MAVEN mission is scheduled to insert into Mars orbit in September 2014. Current plans are to keep Cassini going to the end of its intended lifespan in 2017; the EM is fully funded but is still subject to the outcome of the Senior Review. Curiosity will be transferred to extended operations shortly. Senior Review panels are being set up in preparation for evaluating extended missions. The Mars 2020 AO has received 58 proposals, and is scheduled to downselect in July.

Addressing actual budgets, Mr. Schurr noted there had been a fairly substantial drop in the Discovery line, reflecting the funding for InSight. The New Frontiers line fully funds the Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer (OSIRIS-Rex) asteroid sample return mission. The Mars Exploration program has re-phased the Mars 2020 mission to the left, and as a result it is currently fully funded toward a 2020 launch. Technology funding in support of the Pu-238 re-start has been slowed down due to some concerns with hot press equipment at the Los Alamos National Laboratory. The budget will not allow the construction of any additional MMRTG devices. Dr. McComas asked how the RFI for the Europa mission would work. Mr. Schurr replied that NASA is trying to figure out how to handle submissions of proprietary information, which will require more discussion with the community and with Congress.

Dr. Castillo-Rogez discussed the outcome of the most recent Planetary Science Subcommittee (PSS) meetings. The subcommittee held a face-to-face meeting on 21 January, and a telecom conference on 12 March. The next meeting will take place during the first week of September. PSS has voiced continuing concerns with the impact of sequestration and rescission cuts to the PSD budget, the health of the planetary science workforce, the restoration of mission opportunities, and the preservation of Decadal Survey science objectives for Europa in light of the RFI for a \$1B-class mission.

Near-term concerns for the subcommittee include a continued discussion of the restructuring of the R&A program, Europa mission studies, planetary science as carried out through NASA Institutes, science-related missions being planned by the Human Exploration and Operations Mission Directorate (HEOMD), and a proposed review of NASA facilities for planetary science.

Recent science results regarding the water plumes at Europa are consistent with a predicted tidal response to Jupiter's influence. Other results of note are that Saturn's Enceladus is thought to harbor a 6-mile deep underground ocean of liquid water, as

suggested by Cassini gravity measurements. Ground-based telescopes have detected the disintegration of Asteroid P/2013; initial images have been resolved by HST to reveal a multiple evolving body. Last week, a second inner Oort Cloud object was found by Scott Shepard. At Mars, the deuterium/hydrogen ratio of the Yellowknife Bay mudstone at Gale Crater has established some time constraints on when the mudstone formed. The LRO Camera (LRO) has revealed detailed images of 20 new lunar craters, and suggestions of the existence of lunar pits and sublunarean tubes, or subsurface voids. PSS minutes and findings are posted at [www.lpi.usra.edu](http://www.lpi.usra.edu). PSS issued findings on LRO and support for funding several active and important EMs, as well as a finding on R&A restructuring and implementation, and a suggestion on how to perform a Senior Review on NASA facilities.

#### Astrophysics Division Update and JWST

Dr. Hertz briefed the Science Committee on the status of APD. Strategic objectives for the division (how did the universe begin, how did our galaxy come to be, are we alone?) remain unchanged. APD is following the guidelines of the 2010 Astrophysics Decadal Survey. The HST, Chandra and Spitzer observatories have been transformative; the James Webb Space Telescope (JWST) is expected to be just as transformative as its immediate predecessor. In addition, APD has begun pre-formulation activities for WFIRST. The budget for APD is \$1.3B in FY15. This figure is down by about \$80M compared to the previous year. This year will include a Senior Review, which will entail hard decisions. JWST remains on schedule for an October 2018 launch. APD is on track for a small Explorer AO later this year. The division has maintained growth in its R&A program, amounting to about 20% growth over 7 years. The budgetary future is uncertain, and the notional out year budget is inadequate to carry out all of the high-priority items desired by the community.

The current FY14 President's Budget Request (PBR) is \$642M for APD and \$658M for JWST. The final FY14 appropriation is \$668M for APD and \$658M for JWST. The increase of \$26M above the PBR must accommodate an increase of \$43M (to \$56M) for WFIRST. The remainder of APD must be adjusted for the difference, which will be determined through the Operating Plan. SMD is continuing to conduct education activities.

The FY15 request contains language that for the first time explicitly states support for WFIRST including a coronagraph for directly imaging planets and taking spectra. It also supports a growing Astrophysics Explorers program and operating missions. However, the Stratospheric Observatory for Infrared Astronomy (SOFIA) mission has been zeroed out in 2016. Unless NASA is able to find partners for the US portion of SOFIA, the vehicle will be placed into storage.

Dr. Hertz discussed budgets by program, noting a small growth in the Astrophysics research program, the establishment of a wedge for the upcoming Senior Review, and the Explorer program growing to accommodate 4 AOs per decade. JWST continues to make excellent technical progress. The telescope optics are complete, all instruments have been integrated for cryovacuum testing. The JWST spacecraft has passed its Critical Design

Review (CDR) milestone and is now moving to integrate spacecraft components. FY14 is the year of maximum spending for JWST. The project is progressing efficiently.

APD is currently studying a version of WFIRST called AFTA, which uses telescope assets made available by the National Reconnaissance Office (NRO). The study baseline payload includes 2.4-m existing telescope assets, a widefield imager, and a coronagraph. Science objectives include determining the history of cosmic expansion, completing a statistical census of planetary systems, producing a deep-sky map at near-infrared wavelengths, directly imaging giant planets and debris disks, and carrying out a general observer program. The coronagraph is not currently required. Science Committee member Dr. Noel Hinners asked Dr. Hertz to elaborate on how the completion of the census of planetary systems would be carried out. Dr. Hertz explained that the Decadal Survey states that WFIRST would use gravitational microlensing, which complements the transit technique used by Kepler and the Transiting Exoplanet Survey Satellite (TESS) to detect planets. Microlensing is more sensitive to the detection of planets in the habitable zone outwards. The coronagraph concept will be studied in NASA testbeds. The earliest start WFIRST could be started in FY17, so NASA is moving forward with technology plans to support a KDP-A no earlier than FY17.

In February of this year, SOFIA completed all technical requirements for operational capability, and its development is complete. Since February, the mission has flown the Echelon-Cross-Echelle Spectrograph (EXES) and the Field-Imaging Far-Infrared Line Spectrometer (FIFI-LS). On the science side, SOFIA has been observing supernova 2014J. However, due to the reduced astrophysics budget, SOFIA's operating costs can't be accommodated beyond 2014, thus NASA has been working with Germany to find a way forward. A joint DLR-NASA Working Group has been at work on this matter for four weeks. There is an appropriation for SOFIA for 2014, and the aircraft will be operated accordingly. The next NASA Operating Plan would have to be altered in order to change how the Agency disposes of SOFIA. Letters have been sent to all international space funding agencies, offering them an opportunity to partner. A domestic RFI has also been issued.

Dr. Hertz briefly discussed the Astrophysics R&A program and noted that community funding comes in two flavors: the R&A portion that is competed through the Research Opportunities in Space and Earth Sciences (ROSES) program, and Guest Investigator programs for observing time, which is of comparable size, in terms of total funding, to R&A. Over the last 7 years, APD has succeeded in increasing the budget from \$65M to \$80M. The number of proposals has grown from 400/year to 750/year (up 87%). This growth, coupled with time-consuming reviews, is becoming an issue for the community.

Citing some highlights in the program, Dr. Hertz noted that the Neutron star Interior Composition Explorer (NICER) mission was confirmed at a KDP-C milestone in February of this year. NASA also delivered the ASTRO-H Calorimeter Spectrometer Insert (CSI) instrument to JAXA in March, ahead of schedule. APD has held 3 Senior Review panels this year, and based on Lessons Learned from previous Senior Reviews, has put together specialized review panels for both Chandra and HST, looking for ways



to improve science and increase efficiencies. NASA is also supporting ESA's next L2 X-ray observatory mission concept studies. APD is consolidating its Education and Public Outreach (EPO) activities in this bridge year. Dr. McComas asked how the WFIRST/AFTA costs, with and without a coronagraph, are stacking up. Dr. Hertz responded that the Decadal Survey strawman, with a 1.6m telescope and without a coronagraph is \$1.8B according to a Cost Analysis Technical Evaluation (CATE) exercise completed in 2012. In same-year (FY2012) dollars, a preliminary CATE exercise completed in 2013 estimated that the cost for a mission with an existing 2.4m telescope would be approximately \$2.1B without the coronagraph. The WFIRST/AFTA Study Office estimates that adding a coronagraph will increase the WFIRST/AFTA life cycle cost by approximately \$0.3B. WFIRST/AFTA, with and without the coronagraph, will be subjected to an additional CATE by early CY2015. Dr. McComas commented that these costs seemed incredibly low.

#### *APS*

Dr. Peterson, Chair of the Astrophysics Subcommittee (APS), delivered a brief status from its most recent report, citing two primary concerns: EPO funding, which has been reduced by about two thirds. The APS has recommended that the Science Committee commission a task force and make recommendations for FY15 EPO funding. The APS is also concerned about termination of SOFIA, as it had been so abrupt and outside the Senior Review process. APS was further concerned that the community had not been consulted and feared that the international community would lose its confidence in NASA partnerships. APS urged NASA to accelerate its efforts to find a sustainable path forward for SOFIA, and to retain corporate knowledge, and sought an endorsement from the Science Committee in this matter.

#### Public comment

The committee paused to receive public comment. Ms. Marcia Smith, of Space Policy Online, asked whether science activities were being impacted by the diplomatic situation with Russia. Dr. John Grunsfeld, SMD Associate Administrator, answered this question, noting that a Working Group for participation in Russia's Venera-D mission was not exempted from a recently imposed communication ban. Thus far, there has been minimal impact on the science portfolio. Dr. Hertz added that in APD, a joint activity for R-Gamma mirrors had been exempted from the ban.

#### Discussion with SMD AA John Grunsfeld

The Science Committee engaged in a Q&A session with Dr. Grunsfeld. Dr. Peterson asked for his take on the SOFIA situation. Dr. Grunsfeld replied that in the budget preparation phase, many scenarios had been considered. Faced with a minus-10 percent scenario for APD, the decision was to go after a large discrete object and leave the rest unharmed. The Working Group is going forward, and the appropriations committees are also going through the data.

Dr. Grunsfeld introduced the topic of a new budget feature for NASA, namely the Landsat and sustained land-imaging program. Landsat 8 was just recently launched;

NASA has been tasked with developing a sustained land-imaging program for the next 20 years (at about \$120M/year) and is now studying the architecture for this task. NASA also continues to work with the National Oceanic and Atmospheric Administration (NOAA) on the Geostationary Operational Environmental Satellite (GOES) and Joint Polar Satellite System (JPSS) programs, the Suomi-National Polar Partnership (Suomi-NPP) satellite, and atmospheric science instruments. On the good news side, a Europa mission has finally been identified, and there is now a specific line for WFIRST/AFTA. JWST is also doing very well; previously noted mid-infrared instrument (MIRI) cryocooler system problems have been solved, with 13 months of schedule reserve remains. Dr. Hagan raised the issue of EPO. Dr. Grunsfeld noted that SMD still has about \$21M of EPO funding for 2015: \$6M for the GLOBE project and \$15M for the rest of SMD, consistent with Administration policy; NASA is working within SMD to consolidate this funding. The money is held in APD but it is intended for use by all of SMD. EPO is still a high-priority activity for all of SMD. Dr. McComas commented that in the prior EPO program, there were many successful and outstanding small-mission, very high impact-per-dollar activities, and asked if there might be a way to reconstitute some of these activities. Dr. Grunsfeld responded that a pathway might be found, but the way to compete (it) will be different. There will likely be a larger coordinated, thematic, interdisciplinary effort for EPO at NASA. Dr. Castillo-Rogez expressed concerns over LRO and Opportunity, and asked if there were any prospects for continuing their funding. Dr. Grunsfeld noted that Lunar Quest funding goes to zero this year. Funding for Opportunity and LRO will be determined by the outcome of the Senior Review; it is very likely that the two missions will receive high scores. In addition, the OGSF fund adds to Senior Review funding. The bottom line is that PSD is under a fair amount of stress in the current climate. Dr. Hinners inquired as to the current status of SMD's interest in the Asteroid Redirect Mission. Dr. Grunsfeld explained that the prime mission of SMD relative to the ARM is to search for, and characterize potential target asteroids within the NEO program. It will be necessary to identify and characterize many potentially hazardous objects, especially smaller NEOs, to meet this Agency priority. Part of this effort was in re-activating the WISE spacecraft and using its passively cooled channels to look for NEOs. SMD will be getting \$40M per year in the budget runout for all of its NEO-related activities. NASA is also evaluating a slightly different mission concept, and has spent a little PSD money to evaluate whether it would be feasible to visit a 120m or larger NEONEO and bring back to cis-lunar space a carefully selected boulder from the parent NEO. There are now two ideas with cooperating study teams.

### Earth Science Division Update

Ms. Peg Luce, Deputy Director of the Earth Science Division (ESD), gave a briefing on the budget. She noted the importance of maintaining a balanced program, while still supporting advances in Earth system science, delivering societal benefit through the Applications program, and providing essential spaceborne measurements in support of science and operations. ESD is currently showing a convergence toward a stable budget, with many missions in primary and extended operations. GPM was just launched. A sustainable land-imaging program is in an architecture study phase. The International Space Station (ISS) is flying the Earth Science instruments ISS Environmental Research

and Visualization System (ISERV) and Hyperspectral Imager for the Coastal Ocean (HICO). ISS will be flying SAGE III in the future.

For mission launches through 2020, there is a relatively stable budget throughout programs for multi-mission operations, flight program, applied sciences, and technology, and is actually growing a bit over the budget horizon. In addition to having OCO-3 eliminated after FY14, the FY15 calls for termination of the satellites Active Cavity Radiometer Irradiance Monitor Satellite (ACRIMSAT), Quick Scatterometer (QuikSCAT), and Solar Radiation and Climate Experiment (SORCE). Missions in development are fully funded, however; OCO-2 and SMAP are scheduled to launch in CY2014. The Cyclone Global Navigation Satellite System (CYGNSS) and Gravity Recovery and Climate Experiment Follow-On (GRACE-FO) missions are in phase C and will be proceeding to launch in 2016/17. SAGE-III is funded but is preparing for a re-plan to accommodate delays in the ESA-provided hexapod mount. The ICESat-2 mission is undergoing a significant re-baseline in light of instrument problems, and will be the subject of a Program Management Council (PMC) in May. Launch readiness dates are still a matter of debate. The technical issue is a photon-counting laser, which is an in-house instrument developed at Goddard Space Flight Center (GSFC). It was discovered that aspects of the system must be better understood, and a new team is currently revisiting requirements.

Missions in formulation include Tropospheric Emissions: Monitoring of Pollution (TEMPO) and Surface Water Ocean Topography (SWOT) are fully funded. NI-SAR- the incarnation of the Deformation, Ecosystem Structure and Dynamics of Ice (DesDynI) mission, which had to be de-scoped as it was unaffordable, has been transformed into a partnership with the Indian space agency ISRO, and entered phase A in April. The OMPS-Limb and TSIS instruments are funded for flight in the JPSS-2 era. RBI is under SEB review for procurement at LaRC.

Missions in pre-formulation include PACE, an ocean color instrument, which will enter phase A studies late this year or early next year. Farther out are the Climate Absolute Radiance and Refractivity Observatory (CLARREO) and Advanced Composition Explorer (ACE), which are primarily Tier 2 Decadal Survey missions. The next Earth Science Decadal Survey comes out in 2017; new mission recommendations will be coming.

Within the ESD budget, there has been excellent performance by GPM, SMAP and GRACE-FO, and each of the missions are giving back funds., The division has made some adjustments accordingly, within other missions and the Data Analysis line. NASA's responsibility for sustained measurements of solar irradiance will continue. The Ozone Mapping and Profiler Suite Limb (OMPS-L) and Radiation Budget Instrument (RBI), formerly within the NOAA domain, will be accommodated on JPSS-2. Sustainable Land Imaging, another significant part of the Earth Science program, is in the midst of an architecture study with the US Geological Survey (USGS). NASA is also interacting with industry. Within the Venture class program, EVI-2 evaluations will be completed with a selection planned for late FY14, and EVS-2 selections for late FY14. OCO-2 is expected

to return UFE upon its launch. If OGSi comes to pass, OCO-3 can be revived; ISS is holding a slot for this potential mission. Dr. Hinners commented that he was overwhelmed by the huge number of satellites, and asked if there were a “grand integrator” of all these data, in order to make systems-sense out of it. Ms. Luce responded that ESD’s very mature data system is organized according to focus areas, accompanied by a robust research program that is managed to ensure that the breadth of Earth science is examined (water cycle, carbon cycle, land images). Dr. Jack Kaye commented, adding that within flight programs, there are the Earth-Observing System (EOS) research, Earth Systematic Missions (ESM), and Earth System Science Pathfinder (ESSP), and then things tied to missions or sets of missions. This provides a way of emphasizing some things that ESD does to facilitate the use of science measurements. It also encourages people to look across systems and disciplines, e.g. through multidisciplinary and multiple platform/instrument science. It is also useful to remind people about the existence of the A-train satellites, which provide near-simultaneous measurements.

#### Discussion/Findings and Recommendations

The committee discussed the recommendation from APS on SOFIA. Dr. Peterson suggested a specific finding on EPO. Dr. Castillo-Rogez recommended formulating finding on the OGSi, emphasizing its importance. Dr. Hagan noted that the significant line item on R&T in HPD creates a perception in the community that this money gets spent on Heliophysics. Dr. McComas recommended talking about the issue at the next face-to-face meeting of the Science Committee. Dr. Hagan agreed, and took the issue as an action item for the Heliophysics Subcommittee.

Revisiting recent APS findings, Dr. Peterson commented that someone needs to take a broad look across SMD and other agencies to see where education monies are being spent. Dr. McComas asked whether a task force would be better qualified to decide this issue rather than SMD. Dr. Peterson felt that SMD combined with external people on a task force would be appropriate. Dr. Urry raised a concern about the draconian cut in EPO and what it signified, and seconded the idea of a task force. Dr. Feeley noted that a task force with non-government members raises FACA issues. There is no travel budget for such a task force. However, NASA may be able to frame this effort as a workshop to help decide on priorities for EPO, which can enable individual inputs. Dr. Peterson feared that a workshop would be too broad and unfocused. Dr. Hinners asked for a charter for what EPO wants to accomplish, something that has never been done. There seems to be no specific goal for EPO, nor a way to evaluate pieces of the program. There is a lack of specificity of activities, and rationale. Dr. McComas asked that the subcommittees come back with some names for a potential task force, and placed it on the agenda for the next face-to-face meeting.

Dr. Peterson returned to the cancellation of SOFIA, and regarded it as an international embarrassment. The committee supported the formulation of a finding on the subject, to bring to the NAC. Dr. Feeley took an action to format the finding. Dr. McComas adjourned the meeting at 6:08 pm.

Dr. McComas summarized the numerous difficulties with trying to discuss issues or come to consensus among the NAC Science Committee in the current telecon format and noted that it was essentially impossible to carry out the work of the Committee this way; the Committee indicated a very strong preference for face-to-face meetings in the future.

Appendix A  
Attendees

NAC Science Committee members

David J. McComas, Southwest Research Institute, *Chair, Science Committee*

Maura Hagan, NCAR, Chair, Heliophysics Subcommittee

Noel Hinners, Lockheed-Martin, retired

\*Julie Castillo-Rogez, NASA Jet Propulsion Laboratory (Vice Chair, Planetary Science Subcommittee)

Bradley Peterson, Ohio State University, Chair, Astrophysics Subcommittee

Steven Running, Chair, University of Montana, Earth Science Subcommittee

Harlan Spence, University of New Hampshire

Meg Urry, Yale University

T. Jens Feeley, NASA Headquarters, *Executive Secretary*

Note: \* representing the PSS Chair

NASA Attendees

Louis Barbier, NASA Headquarters

Joan Centrella, NASA Headquarters

David Chenette, NASA Headquarters

Steven Clarke, NASA Headquarters

Catharine Conley, NASA Headquarters

J.C. Duh, NASA Headquarters

David Eisenman, NASA Jet Propulsion Laboratory

John Gagosian, NASA Headquarters

John Grunsfeld, NASA Headquarters

Hashima Hasan, NASA Headquarters

Jeffrey Hayes, NASA Headquarters

Paul Hertz, NASA Headquarters

William Horne, NASA Headquarters

W. Vernon Jones, NASA Headquarters

Jack Kaye, NASA Headquarters

Jennifer Kearns, NASA Headquarters

David Klumpar, NASA Headquarters

Peg Luce, NASA Headquarters

Michael New, NASA Headquarters

Jeffrey Newmark, NASA Headquarters

Mihir Pathak, NASA Headquarters

Bill Paterson, NASA Headquarters

Arik Posner, NASA Headquarters

Jonathan Rall, NASA Headquarters

Christy Rivera, NASA Headquarters

David Schurr, NASA Headquarters

Rita Sambruna, NASA Headquarters  
Wilton Sanders, NASA Headquarters  
Eric Smith, NASA Headquarters  
Ellen Stofan, NASA Headquarters  
Craig Tupper, NASA Headquarters  
Gregg Vane, NASA Jet Propulsion Laboratory  
Mary Voytek, NASA Headquarters  
Dan Woods, NASA Headquarters

Non-NASA Attendees

Kreston Barron, Orbital Sciences Corporation  
Stephen Clark, Spaceflight Now  
Dom Conte, Millennium Space Systems  
Jeff Foust, The Space Review  
Rob Fulton, Orbital Sciences Corporation  
Andrea Hughes, American Association for the Advancement of Science (AAAS)  
Irene Klotz, Reuters  
Kate Kronmiller, Orbital Sciences Corporation  
Dan Leone, Space News  
James Lochner, Universities Space Research Association (USRA)  
Mackenzie Lystrup, Ball Aerospace  
Larry Richardson, United Launch Alliance  
Marcia Smith, SpacePolicyOnline.com  
Amy Svitak, Aviation Week  
Anne Verbiscer, University of Virginia  
Carl Weimer, Ball Aerospace  
Joan Zimmermann, Zantech IT

Appendix B  
NAC Science Committee Membership

Dr. David J. McComas  
Southwest Research Institute (Chair)

Dr. Douglas Duncan  
University of Colorado

Dr. Maura Hagan  
National Center for Atmospheric Research

Dr. Noel W. Hinnners  
Lockheed-Martin (retired)

Dr. Eugene H. Levy  
Rice University

Dr. Janet Luhmann  
University of California, Berkeley

Dr. Carle Pieters  
Brown University

Dr. Bradley Peterson  
Ohio State University

Dr. Steven Running  
University of Montana

Dr. Harlan Spence  
University of New Hampshire

Dr. Meg Urry  
Yale University

Dr. T. Jens Feeley  
Executive Secretary  
NASA Headquarters



Appendix C  
Presentations

1. Science Mission Directorate FY2015 Budget Update to the NAC Science Committee; *Craig Tupper*
2. Heliophysics Division Update; *David Chenette*
3. Planetary Science FY2015 Budget Request; *David Schurr*
4. Planetary Science Subcommittee Report to the NAC Science Committee; *Julie Castillo-Rogez*
5. Astrophysics Update to the Science Committee; *Paul Hertz, Bradley Peterson*
6. Earth Science Division Update; *Peg Luce*

Appendix D  
Agenda

NAC Science Committee  
April 9, 2014  
Agenda  
(all times EASTERN)

Wednesday, April 9 (Telecon and WebEx only)

2:00pm-2:05pm	Opening Remarks – J. Feeley/D. McComas
2:05pm-2:30pm	SMD FY15 Budget Request Overview – C. Tupper
2:30pm-2:55pm	Heliophysics FY15 Budget Request – D. Chenette
2:55pm-3:35pm	Planetary Science FY15 Budget Request/ PSS Report – D. Schurr /J. Castillo
3:35pm-4:20pm	Astrophysics & JWST FY15 Budget Request/APS Report – P. Hertz/B. Peterson
4:20pm-4:25 pm	Public Comment
4:25pm-4:50pm	Discussion with SMD Associate Administrator – J. Grunsfeld
4:50pm-5:15pm	Earth Science FY15 Budget Request – P. Luce
5:15pm-6:15pm	Discussion/Findings and Recommendations
6:15pm-6:20pm	Wrap-up – J. Feeley /D. McComas
<b>6:20pm</b>	<b>Adjourn</b>

**Telecon & WebEx Information:**

Any interested person may call the USA toll free conference call number 888-982-4613, passcode Science, to listen to this meeting by telephone.

The WebEx link is <https://nasa.webex.com/>

The meeting number is 396 523 409, and the password is SC@April9