**National Aeronautics and Space Administration**

# Astrophysics Subcommittee
# of the
# NASA Advisory Council Science Committee

**July 7-8, 2010**
**NASA Headquarters**
**Washington, DC**

# MEETING SUMMARY

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Executive Secretary

Alan P. Boss
Chair

# Astrophysics Subcommittee (APS)

NASA Headquarters
Washington, DC 20546
July 7-8, 2010

## Meeting Summary
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***Meeting Report Prepared By***
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**ASTROPHYSICS SUBCOMMITTEE MEETING MINUTES**

**Wednesday July 7, 2010**

The Astrophysics Subcommittee (APS) meeting was convened at 08:30 a.m.

Introduction and Announcements

Dr. Alan Boss, APS Chairman, welcomed the meeting attendees. At his request, the APS members and the guests attending the meeting introduced themselves. There were no announcements.

Ethics Briefing

Dr. Boss introduced Ms. Katie Spears, Associate General Counsel for NASA.

Ms. Spears briefed the APS on government-mandated ethics requirements. She informed the APS members that they are technically Special Government Employees (SGE). Ms. Spears described the basic ethics principles: public service is a public trust; the members may not have conflicting financial interests; the members may not improperly use nonpublic information; and the members should avoid even the appearance of impropriety. In response to a question from Dr. Boss regarding his participation on the Kepler science team, where he has no financial interest, Ms. Spears advised that if there is no financial interest or employer with a financial interest, at most he would have an appearance concern. In response to a question from Dr. Steven Ritz, Ms. Spears explained that contracts and grants were treated similarly and that the conflict provisions would apply if a member was representing a grantee for the purpose of obtaining business. In response to a question from Dr. Arjun Dey, Ms. Spears advised that members submitting applications for telescope time need not recuse themselves as long as they are not interested in a contract being discussed by the APS. Ms. Spears requested the APS members to contact her if they wanted to discuss any specific issues in detail.

Dr. Boss thanked Ms. Spears for her presentation.

Overview of Federal Advisory Committee Act (FACA)

Dr. Boss introduced Mr. T. Jens Feeley, Executive Secretary, NASA Advisory Council (NAC) Science Committee, who briefed the APS on the FACA. Mr. Feeley explained that the NAC, of which the APS is a subcommittee, is a FACA committee. He described the general FACA requirements, as follows. There must be a balanced membership. The meetings, with limited exceptions not generally applicable to science committees, should be open to the public. Minutes or summaries of the meetings must be maintained. The public must be allowed to file written statements. The meetings must be announced in the Federal Register. Documents must be maintained for public information. Each agency must designate an Advisory Committee Management Officer (CMO). NASA's CMO is Ms. Diane Rausch. In addition, each FACA-compliant committee must have a Designated Federal Official (DFO), who calls, attends, and adjourns the meeting. The DFO for the APS is its Executive Secretary, Dr. Hashima Hasan. Mr. Feeley explained that the reason for public meetings is to ensure transparency and good government. He advised that greater openness and transparency is an Administration goal. He noted, however, that the FACA is intended to facilitate public access, not public participation.

In response to a question from Dr. Shaul Hanany, Mr. Feeley advised that sub-subcommittees should comply with the FACA rules. In response to a question from Dr. Ritz, Dr. Jon Morse, Director, NASA Astrophysics Division, explained that the APS reports to the NAC's Science Committee, which is responsible for considering and adopting APS recommendations. Dr. Ritz stated that it would be useful to the APS to know when advice has been accepted or rejected. Dr. Morse explained that he had that responsibility.

Dr. Boss thanked Mr. Feeley for his presentation.

Astrophysics Division Update

Dr. Morse gave the APS an update on NASA's Astrophysics Division. He described science highlights and presented several slides, including the Abell 2218 cluster as seen by the Spectral and Photometric Imaging Receiver (SPIRE) instrument on Herschel, the Heart and Soul nebulae from NASA's Wide-field Infrared Survey Explorer (WISE); Swift-detected active black holes in merging galaxies, the ultraviolet tail of Galaxy IC 3418 from the Galaxy Evolution Explorer (GALEX); and a composite infrared image of Jupiter made during the Stratospheric Observatory for Infrared Astronomy (SOFIA) observatory's "first light" flight. Dr. Morse reviewed charts showing the timeline and activities for 21 different Astrophysics operating missions. He reviewed accomplishments and significant events relating to the Nuclear Spectroscopic Telescope Array (NuStar), the James Webb Space Telescope (JWST), and SOFIA. He described two recent balloon mishaps. Dr. Morse outlined the basic issues to be addressed by the APS at the current meeting: the Chandra Guaranteed Time Observer (GTO) policy; International Space Station (ISS) science utilization; and Government Performance and Results Act (GPRA) metrics.

In response to a question from Dr. Hanany, Dr. Morse described how the Senior Review Process is used for deciding whether to extend missions. Dr. Elizabeth Kaiser asked whether the same process was used for the Great Observatories, and Dr. Morse responded affirmatively. Dr. John Huchra asked whether there is a problem due to the helium supply issue. Dr. Morse explained that a decision was made during the Clinton Administration to sell the nation's helium reserve by 2015; they are now getting close to the end of the strategic reserve and the situation is being reviewed by the National Academy of Sciences. [Report entitled "Selling the Nation's Helium Reserve" is now public.]

Dr. Boss thanked Dr. Morse for his presentation.

Meeting with Science Mission Directorate Chief Scientist

Dr. Boss introduced Dr. Paul Hertz, Chief Scientist, Science Mission Directorate (SMD). Dr. Boss commented that the APS work is not well broadcast and he expressed an interest in developing the APS webpage. Dr. Hertz stated that the minutes and agendas for the APS meetings would be posted on the webpage, but that presentations could not yet be posted due to Section 508 compliance concerns, which requires tags to be inserted for people who are vision-impaired. Dr. Sara Heap stated that she was impressed with the Decadal Survey request for white papers; she added that asking the community for agenda items and topics to be explored would be very useful. Dr. Ritz cautioned against soliciting agenda items from too broad an audience.

Dr. Hertz briefed the APS on SMD missions planned for the next two years. There will be 84 missions and 98 spacecraft. He described the Gravity Recovery and Climate Experiment (GRACE) and Solar Dynamics Observatory (SDO) missions. He reviewed SMD's FY11 budget strategy. They will support the priorities established in the relevant National Research Council (NRC) Decadal Surveys, one of which is due to be released late-summer 2010. NASA will use these Surveys to justify requests for funding from the Administration and Congress. Missions will be chosen through Decadal Survey prioritization or competitive peer review. Missions in the development phase that will be funded include the JWST, SOFIA, NuStar, Astro-H, and Gravity and Extreme Magnetism Small Explorer (GEMS). Funding for APD missions in extended science phases will reflect the outcome of the APD Senior Review for Operating Missions. In response to a question from Dr. Arjun Dey, Dr. Hertz discussed how funds are allocated among SMD's four science divisions. Dr. James Kasting asked about the effect on unmanned lunar science from the decision to not send humans back to the moon. Dr. Hertz responded that the Planetary Decadal Survey had been asked for priorities. Dr. Morse discussed the new budget accounting process. He noted that most funds are going to the community or contractors and that civil servant labor represents only about 7% of the budget.

Dr. Boss thanked Dr. Hertz for his presentation.

Research & Technology Update – Part 1

Dr. Boss introduced Mr. Rick Howard, NASA Deputy Chief Technologist and Mr. Michael Moore, NASA SMD Technology Point of Contact (POC).

Mr. Howard described the goals and responsibilities of the Office of the Chief Technologist (OCT). It serves as the principal NASA advisor and advocate on matters concerning Agency-wide technology policy and programs, manages the Space Technology Programs, and coordinates technology investments across the Agency. OCT will work to change the culture towards creativity and innovation at NASA Centers, particularly in regard to workforce development and will foster the societal impact of NASA technology investments. It will lead technology transfer and commercialization opportunities across the Agency. OCT has three main divisions. The Early-Stage Innovation Division will sponsor low technology readiness level (TRL) efforts for advanced space system concepts, and initial technology development across academia, industry, and at the NASA field Centers. The Game Changing Technology (GCT) Division will focus on maturing advanced space technologies that may lead to entirely new approaches for the Agency's future space missions and solutions to significant national needs. The Crosscutting Capability Demonstrations (CCD) Division focuses on maturation to flight readiness of cross-cutting capabilities that advance multiple future space missions, including flight test projects where in-space demonstration is needed before the capability can transition to direct mission applications. It will also help mature to flight readiness status technologies that benefit multiple customers. More than 70% of GCT and CCD selections will be made competitively. Mr. Howard described the NASA Technology Executive Council (NTEC), which will perform Agency-level technology integration, coordination and strategic planning, and the Center Technology Council (CTC), which will focus upon institutionally funded activities. He described the Aero-Space Technology Area Roadmap (A-STAR), which provides recommendations covering NASA's current and planned technology investments. He explained that the A-STAR technology roadmaps will be peer reviewed through an open and transparent process that will include internal and external review teams. The OCT is waiting for congressional budget approval.

In response to a question from Dr. Boss about existing technology development programs, Mr. Howard explained that mission-focused items would remain at the Mission Directorate level. Dr. Morse noted that Astrophysics has more difficulty making cross-agency arguments than the other SMD Divisions. Dr. Heap stated it would be helpful to know what is being done by the Defense Advanced Research Projects Agency (DARPA) and by the Department of Energy (DOE). Mr. Howard responded that the OCT would be interacting with those agencies.

Mr. Moore described SMD's budget structure. SMD's primary purpose is to support NASA's science flight missions. Over $500 million is being invested in technology development via four avenues: mission specific technology developments with flight projects; individual Principal Investigator (PI) research investigations; suborbital research programs; and the Earth science technology program. He described two ways in which SMD will integrate with OCT: first, the NTEC membership includes the Mission Directorate Associate Administrators (AAs); second, that the Mission Directorates will have observers on the CTC. Mr. Moore discussed strategic integration and the technology roadmapping process. He stated that SMD is mission-focused and is coordinating with and supporting the OCT effort to improve the overall Agency capabilities in science and technology development. Dr. Ronald Polidan noted that non-NASA technology is often sitting unused on people's shelves. Dr. Morse explained that the roadmapping activity is important and that Astrophysics is in a good position because the Astro2010 Decadal Survey will be coming out soon.

Dr. Boss thanked Mr. Howard and Mr. Moore for their presentations.

Research & Technology Update – Part 2

Dr. Boss introduced Dr. Linda Sparke, Research Program Manager, SMD Astrophysics Division.

Dr. Sparke discussed the Astrophysics research and technology budget. She presented a slide showing how the Astrophysics budget is divided among theory, data analysis, supporting technology, detectors, rockets, and balloons. She discussed the December 2009 NRC review of mission-enabling activities in NASA's space and Earth science programs. The NRC recommended that NASA should ensure that mission-

enabling activities are clearly linked to strategic goals, using metrics to actively manage its portfolio. In addition, it recommended that NASA pay special attention to innovative high-risk/high-payoff research and technology, and development of the scientific and technical workforce. Dr. Sparke discussed the plans for a Senior Review of supporting research and technology (SRT) programs. She explained that Astrophysics research and technology programs are competed through the Research Opportunities in Space and Earth Sciences program (ROSES). She noted that funding levels for guest observer (GO) programs competed through ROSES are set by the Mission Reviews, not by the Senior Review. Dr. Sparke discussed funding allocations among current and future missions. Competing interests include the different wavelength disciplines, suborbital payloads, small grants for GOs, and support for longer investigations. She described models for partnerships outside NASA. She reviewed the proposed timeline for the SRT Senior Review, which will follow the release of the Astro2010 Decadal Survey results. Recruitment for the SRT Senior Review will begin in September 2010.

Dr. Sparke described a problem with uncosted carryovers. In program years 2006 through 2008, NASA had been awarded $687 million more than was reported spent by September 2009. NASA has promised Congress that it will do better in 2010. PIs can help mitigate the problem by informing their program managers when they run behind on spending so that the money can be rephrased. Universities should be urged to submit bills promptly, especially on subcontracts. Dr. Ritz suggested that this problem may not be unique to NASA and that it might help to look at the experience at the National Science Foundation (NSF) and the National Institutes of Health (NIH). Dr. Huchra explained that NASA is the only agency with a large number of one year grants, and that scientific staffs tend to hoard funds because universities will not let them hire or advertise until funds have been obligated. Dr. Morse observed that grants may sit uncosted for 9 or 10 months. Dr. Kasting noted that this issue had been discussed several years ago and that recommendations from those discussions may be available. Dr. Leisa Townsley described the hardship involved with living on small grants. She explained that when funding for any subsequent year is not available, most universities will cut off health care. It causes people to stay away from astronomy. Dr. Morse observed that there are other funding models and that there may be a need to consider mechanisms that on balance fund people for longer periods of time.

Dr. Boss thanked Dr. Sparke for her presentation.

Public Comment Period

Dr. Boss announced that this time period had been set aside to give members of the public an opportunity to make comments. Dr. Dan Lester urged the APS to work with the American Astronomical Society (AAS) in communicating information back to the astronomy community. Dr. Ritz suggested that the Division of Astrophysics at the American Physical Society also be considered for that purpose.

GPRA Discussion

Dr. Boss introduced Ms. Jennifer Kearns, NASA Headquarters staff, who led a discussion on grading NASA's Astrophysics Division according to the GPRA. Grading was to be color-coded, using green (expectations fully met), yellow (some shortfalls compared to investments) and red (major disappointments). The outcomes to be graded for the Division's science goals were:

3D.1 Progress in understanding the origin and destiny of the Universe, phenomena near black holes, and the nature of gravity.

3D.2 Progress in understanding how the first stars and galaxies formed, and how they changed over time into the objects recognized in the present Universe.

3D.3 Progress in understanding how individual stars form and how will those processes ultimately affect the formation of planetary systems.

3D.4 Progress in creating a census of extra-solar planets and measuring their properties.

The APS members reviewed highlights suggested by Dr. Hashima Hasan that supported the accomplishment of the stated outcomes. After discussing the accomplishments, the members voted unanimously on a green grade for each outcome. In response to a question from Dr. Ritz, Ms. Kearns stated that the grades would be seen by the Office of Management and Budget (OMB) and Congress, and would be included in the Agency's Annual Report. The members selected several highlights for each accomplishment and prepared evaluation texts for them.

Dr. Boss thanked Ms. Kearns for her assistance and thanked the members for their help in completing the GPRA task.

The APS meeting was recessed for the day.

**Thursday July 8, 2010**

The APS meeting was reconvened at 08:30 a.m.

Decadal Update

Dr. Boss introduced Dr. John Huchra, who briefed the APS on the status of the Decadal Survey. Dr. Huchra stated that it is on schedule and that the Agency rollout will occur in August. He explained that the Agency rollout must be within 10 days of the public release. A draft report has been through review and the comments from the nineteen reviewers have been sent to the Decadal Survey committee. He does not expect the next draft to be resubmitted to the reviewers for further review.

Dr. Boss thanked Dr. Huchra for his comments.

ISS Utilization

Dr. Boss introduced Dr. W. Vernon Jones, Senior Scientist for Suborbital Research, SMD Astrophysics Division. Dr. Jones led a discussion on a request by the Science Committee for the APS to suggest ways in which the ISS could be utilized for Astrophysics. He described the history of astrophysics planning for ISS utilization and explained that some astrophysics missions are compatible with the ISS orbit and environment. High energy cosmic-ray, particle astrophysics, and x-ray astrophysics have been the science and disciplines most interested in ISS missions. Launch opportunities to the ISS in the 2010 - 2020 timeframe are available. The SMD will be issuing solicitations for those opportunities. SMD funding may be limited but international cooperation may offset those limitations.

Dr. Jones stated that the ISS inclination (51°), altitude (330-460 km), external contamination, and attitude holding capability are suitable for selected astrophysics missions. He explained that the ISS ability to accommodate large payloads makes it nearly ideal for high-energy cosmic ray/particle astrophysics investigations that require long-duration observations. The ISS program would not charge users for the following: up-mass for US payloads; on-orbit accommodations; power, thermal, data, and on-orbit operations services; crew tending; end of life disposal and sample return; and ISS program-side planning, safety and flight certification. This is analogous to the NASA balloon program, with the difference being that the ISS offers much longer duration. NASA has scheduled launch of the Department of Energy's Alpha Magnetic Spectrometer (AMS) to the ISS in February 2011. The Japan Aerospace Exploration Agency (JAXA) has scheduled launch of the the Alpha Magnetic Spectrometer (AMS), the Calorimetric Electron Telescope (CALET) in 2013, and is planning launch of the the Extreme Universe Space Observatory on the ISS Japanese Experiment Module (JEM-EUSO in 2015. There is currently an Agency-wide call to the Field Centers to identify technology projects implementable within 36 months. Dr. Jones explained that the ISS life has been extended from 2015 to 2021, and may be further extended to 2028. This has been game changing. ISS sites are available and waiting for astrophysics payloads. Dr. Morse clarified that the APS is being asked only for a scientific assessment and that budgetary factors should not be considered. Dr. Dey suggested that it would be more meaningful if they had more time to respond to the inquiry so that they could consult with their colleagues.

Dr. Jones introduced Dr. Julie A. Robinson, ISS Program Scientist, who briefed the APS on the ISS external accommodations and manifest opportunities. The ISS assembly is almost complete and they are looking for experiments that might be cost effective and scientifically useful. She explained that one advantage to using the ISS as a platform is that when things break they can be fixed, which a big difference from free-flying platforms. She reviewed slides showing the ISS external research facilities. These include the Japanese Experiment Module Exposed Facility (JEM EF), the Columbus module, and the Express Logistics Carriers. Dr. Robinson reviewed a chart on allowable payload up-mass and volumes, and another chart on external manifesting. She reported that the ISS provides an exceptionally clean environment for external payloads and science assets compared to previous space stations. She reviewed a chart on the ISS quiescent mode truss vibratory environment for external payload pointing instruments, and a chart describing the ISS attitude torque equilibrium attitude and wobble oscillation. In response to a question from Dr. John Hughes, Dr. Robinson stated that contamination decay information is being developed.

Dr. Boss thanked Dr. Jones and Dr. Robinson for their presentations.

Senior Review Update

Dr. Boss introduced Ms. Jaya Bajpayee, Program Executive for Operating Missions, SMD Astrophysics Division. Ms. Bajpayee briefed the APS on the Senior Review of Astrophysics operating missions. She explained that the Senior Review enables NASA to maximize scientific productivity. The reviews are held every two years and the results are used to prioritize operating missions and to provide programmatic direction. She reviewed a chart showing the composition of the Senior Review Committee and their breadth of expertise. The Senior Review 2010 rankings were as follows: Planck (9.6), Chandra (9.5), Warm Spitzer (8.7), Swift (8.5), X-ray Multi-mirror Mission (XMM)-Newton (8.2), Wilkinson Microwave Anisotropy Probe (WMAP) (7.6), Suzaku (7.5), Galaxy Evolution Explorer (GALEX) (6), Rossi X-ray Timing Explorer (RXTE) (5.5), International Gamma Ray Astrophysics Laboratory (INTEGRAL) (3.5), and Warm WISE (3.5). Based on these recommendations and subject to resource availability, the Astrophysics Division intends to augment funding for Planck, Chandra, Spitzer, Swift, XMM-Newton, WMAP, and Suzaku. GALEX will be de-scoped and RXTE will be partially funded through FY11.

Dr. Heap asked whether Kepler would be an extended mission in 2012. Dr. Morse explained that Kepler was launched in 2009 and is a 3 ½ year mission, which takes it through the end of calendar year 2012. Dr. Hughes asked whether abstracts for the proposals were available. He asserted that they are not intellectual property and should be available to the community. Dr. Morse explained that this is not a common practice and only abstracts of proposals that are selected are typically posted; the analogy is not exact in this case Dr. Boss stated that a summary of each of the proposals is in the Senior Review report.

Dr. Boss thanked Ms. Bajpayee for her presentation.

Exoplanet Exploration Program Analysis Group (ExoPAG) Update

Dr. Boss introduced Dr. Kasting for a report on the ExoPAG. Dr. Kasting explained that the ExoPAG is one of three program analysis groups that are being created. They are not advisory groups; they are analysis groups that report to the APS. ExoPAG is interested in Exoplanet exploration and has received reports from the five Science Analysis Groups (SAGs) that the APS charted at its last meeting. The SAGs cover the following subjects: (1) debris disks and exozodiacal dust; (2) the potential for exoplanet science measurements from Solar System probes; (3) planetary architecture and dynamical stability; (4) planetary measurements needed for exoplanet characterization; and (5) the state of external occulter concepts and technology. Dr. Kasting presented several slides with recent images, including one from Hubble revealing three planets in the dust ring around Fomalhaut. Dr. Heap noted that data was recently released showing the orbital motion of a planet in a dust cloud around Beta Pictoris. Dr. Kasting discussed a chart showing the capabilities of existing and planned instruments for measuring the brightness of exozodiacal clouds. He showed slides demonstrating the abilities of the Large Binocular Telescope (LBT), which is already operational, and the Large Binocular Telescope Interferometer (LBTI), which will be installed in September. SAG 2 will be looking at the collaboration between astrophysics and planetary science. The two disciplines are converging on exoplanets and asking whether planetary science missions can be used to

learn about exoplanets. Dr. Kasting explained that people with planetary missions do not want to divert their resources to exoplanet missions until they have completed their main science objectives.

Dr. Boss explained that the lead item in the ExoPAG's charter is to articulate the key scientific drivers for exoplanet research. He thanked Dr. Kasting for his presentation.

Physics of the Universe Program Advisory Group (PhysPAG)/Cosmic Origins Program Advisory Group (COPAG) Update

Dr. Boss introduced Dr. Louis Kaluzienski, Program Scientist and Dr. Eric Smith, Program Scientist for updates on the PhysPAG and the COPAG, respectively. The COPAG is making plans for its first meeting and will solicit for membership on its Executive Committee. People will be allowed to nominate themselves or others to serve on the committee. Dr. John Huchra will Chair the COPAG. The PhysPAG will be following the same schedule and procedure as the COPAG. Dr. Ritz has volunteered to serve as the PhysPAG chair. Dr. Morse noted that people interested in serving should submit an application in response to the Dear Colleague letter. Dr. Ritz stated it is important for the membership to be balanced among the various disciplines. Dr. Polidan advised that industry representatives should not be excluded. Dr. Boss agreed that industrial representatives should not be excluded and thanked Dr. Kaluzienski and Dr. Smith.

Kepler Update

Dr. Boss introduced Dr. Douglas Hudgins, SMD Astrophysics Division, who briefed the APS on the status of the Kepler Mission. The Kepler Mission is a NASA space observatory launched in March 2009, and is designed to discover Earth-like planets orbiting other stars. The first public data has been released and the next data release is scheduled for early 2011. Approval has been granted for the mission to temporarily hold back from public release data on 400 objects of interest. There are 706 exoplanet candidates; 306 were included in the release. Most of the 306 released candidates are smaller than Neptune. Five exoplanets have been confirmed. Dr. Hudgins explained that many withheld candidates and released candidates are expected to be false positives. He reviewed a chart showing statistics on the released candidates. Dr. Kasting advised that the statistics are not reliable because 400 objects were withheld. Dr. Hudgins noted that the APS had emphasized that it was important to establish a Kepler User's Panel (KUP). That panel has now been established and its first meeting is scheduled for September 6, 2010.

Dr. Boss thanked Dr. Hudgins for his presentation.

Hubble Space Telescope Update

Dr. Boss introduced Dr. George Sonneborn, Hubble Space Telescope (HST) Senior Project Scientist (Acting), who briefed the APS on the program's status. The observatory is functioning extremely well. Recent instrument performance issues that could affect science are not serious at the current time, but are being actively pursued. Dr. Sonneborn described the HST Multi-Cycle Treasury (MCT) Program. Under that program, up to 750 orbits per cycle are made available for MCT Programs. The selection criterion is whether a proposal has the potential to solve a scientific question that cannot be achieved through the GO program. The MCT Time Allocation Committee (TAC) identified six key science areas for consideration: legacy observations of galaxy clusters; resolved stellar populations in nearby galaxies; galaxy assembly and deep near-infrared imaging surveys; probing dark energy through high-red shift supernovae surveys; exoplanet research; and ultraviolet (UV) observations of the interstellar/intergalactic medium (ISM/IGM). Four proposals were identified for implementation. Dr. Sonneborn described the Cycle 18 results. It had one of the largest GO over-subscriptions ever. 146 GO programs were approved for 2578 orbits. 24.3% of Cycle 18 was awarded to Large/Treasury Programs, 41% for imaging, and 59% for spectroscopy. Dr. Sonneborn reviewed a chart showing the Cycle 18 Large/Treasury Programs. He described the Project's recent reorganization and personnel changes.

Dr. Sonneborn gave a status report on the HST flight hardware. All spacecraft subsystems are performing well. Three gyros are in science mode and three gyros are in reserve. Recently installed thermal blankets have improved thermal environments in the equipment bays. All science instruments except the Near

Infrared Camera/Multi-Object Spectrometer (NICMOS) are fully operational. The instrument data computer lock-up frequency is now manageable. The lock-up mechanism is now understood to be caused by a rare, non-synchronous state between two power control circuits and is corrected by power cycling. A decision on the availability of NICMOS beyond Cycle 18 has not been made and awaits further discussion. Dr. Sonneborn described the status of the Cosmic Origins Spectrograph (COS) Far Ultraviolet (FUV) channel and Near Ultraviolet (NUV) channels. COS sensitivity is decreasing by 3 to 12% per year, depending on the wavelength. The current leading theory for the degradation is photocathode exposure to atomic oxygen. He discussed the Automated Operations Development (AOD). The goal is to automate HST day-to-day "nominal" flight operations to the extent possible, while maintaining vehicle health and safety and data recovery consistent with the current 24 x 7 operations. They expect to have automated operations in regular use by June 2011. Due to budget reductions, recovery from anomalies will take longer due to increased durations for both investigation and recovery. The Goddard Space Flight Center predicts HST arrival at a 450km altitude in 2026, which is when a de-orbit entry module would be needed. Re-entry is predicted in 2031. In response to a question from Dr. Boss, Dr. Morse explained that the division would like to have a plan for de-orbiting Hubble when it is no longer scientifically usable, though the actual timing of the implementation is still to be determined. The community-based Senior Review process will be used to determine when it is no longer scientifically viable or worth the cost of operation. There is no plan to bring it down safely for display in a museum.

Dr. Boss thanked Dr. Sonneborn for he presentation.

Space Station Utilization

The APS discussed a request from the Science Committee for suggestions on how the Astrophysics Division could utilize the ISS. Dr. Hanany asked whether it would be competed. Dr. Morse explained that the APS was being asked to offer ideas on what science could be done on the ISS and that it would be developed through a call announcing a competitive opportunity. Dr. Ritz commended NASA for making the opportunity available. Dr. Louis Allamandola recommended against spelling out possible uses at this time. He believes that there are a number of astrophysical experiments that could be carried out on the ISS and that they should be competed and subjected to peer review. Dr. Hughes advised that technology should not be ignored. Dr. Polidan recommended opening the process to whoever wanted to compete. Dr. Huchra suggested that the ISS could provide an opportunity for UV spectroscopy. Dr. Dey stated that he would be reluctant to develop specific recommendations without first consulting with his colleagues. Dr. Ritz agreed that he, too, is not sure what is possible and noted that this opportunity has been around for 20 years. He does not see excitement for using the ISS as a science platform and he cautioned against setting aside funds for that purpose. Dr. Heap stated that she would prefer to see the recommendation weighted towards enabling technology.

Chandra Update/Guaranteed Time Observer Policy

Dr. Boss introduced Dr. Martin Weisskopf, Chandra Project Scientist, for an update on the Chandra X-Ray Observatory, and Dr. Wilton Sanders, Chandra Program Scientist, for a briefing on the Chandra GTO Policy. Dr. Polidan and Dr. Townsley recused themselves from the second discussion due to possible conflicts of interest.

Dr. Weisskopf described the observatory. It has an x-ray telescope in the front and two sets of transmission gratings to allow high resolution spectroscopy. There are two solar arrays, a sunshade door, a high resolution camera, and a charge-coupled device (CCD) imaging spectrometer. It features sub-arcsecond angular resolution. It is now averaging over 500 refereed papers per year. Dr. Weisskopf presented slides showing images from Chandra and charts on grating spectra. He discussed a slide showing how Chandra was able to provide firm warm-hot intergalactic medium (WHIM) detection. He discussed a slide showing how Chandra and HST lensing contours demonstrate the presence of non-interacting dark matter. Dr. Weisskopf explained that Chandra was helping to further constrain cosmological parameters and discussed possible future projects for Chandra. The science for those projects include dark energy, dark matter decay, missing baryons, active galactic nucleus (AGN) feedback, metal enrichment in starburst galaxies, the evolution of supernova remnants, and the formation of protoplanetary disks. Dr. Weisskopf reported that he

spacecraft is in excellent health as it approaches its 12th year of operation. All redundant systems are available except one pair of gyro rotors. Thermal insulation has slowly degraded and some systems are warming. Overall observatory performance remains superb and he sees no limitations to a 20-plus year mission.

Dr. Sanders discussed the GTO policy issue. He explained that the Astrophysics Division is seeking guidance from the APS in the form of a recommendation on whether the Chandra GTO program should continue as it is presently implemented, continued in some modified form, or discontinued. The 2010 Senior Review noted that the Chandra GTO program remained in effect more than a decade after launch and questioned whether this is appropriate "when considering the inevitable pressures on observing time and funding that will persist in future years." Dr. Morse clarified that the proposal is to end the GTO set-aside and give the observing time to the community, and to cease science funding for the GTO instrument teams (but to continue funding for instrument monitoring) because Chandra has a budget decline coming. He explained that the question came up as part of the Astrophysics Division budget process and also through the Senior Review committee because they had to prepare budget targets. One of the items in their trade space for meeting the budget guidelines was whether to end the GTO funding. Dr. Ritz asked whether the Chandra project suggested ending the GTO program. Dr. Morse stated that this course is in the project's trade space during the internal annual budget process. The Chandra team, like all other missions, would like more money, he noted, but it is not available. In addition, the Astrophysics Division is interested in developing a core policy to treat missions in extended phases uniformly.

Dr. Sanders explained that the source of the problem was a change that had been agreed to by the parties prior to the launch of Chandra. In order to get more data to the GOs sooner, the Chandra teams agreed to receive less up-front GTO data, in exchange for a guaranteed 15% GTO time after month 20 for "the remainder of the mission lifetime." The Chandra mission has lasted much longer than the original projected mission lifetime. Dr. Ritz suggested asking the Chandra users group for their opinion on how this should be resolved. Dr. James Rhoads observed that the gamble has paid off well for the GTO team. Dr. Kasting noted that the agreement only dealt with observation time; it did not guarantee funding in perpetuity. Dr. Boss asked the APS to come to a consensus. Dr. Ritz explained that having a healthy instrument team helps maximize the opportunities for science. An audience member observed that as missions age it is hard to keep people around who have knowledge about the instrument and that keeping funding in place will help. Dr. Hughes noted that when he chaired the Chandra user's group, the users group supported keeping the GTO policy in place. He believes that the users group would have the same recommendation today.

Dr. Boss proposed a consensus to leave the policy as is, with the caveat that the users group would be solicited for their opinion. The members concurred.

Dr. Boss thanked Dr. Weisskopf and Dr. Sanders for their presentations.

Planck Update

Dr. Boss introduced Dr. William C. Danchi, Program Scientist, SMD Astrophysics Division, SMD, and Dr. Michael Seiffert, Lead Scientist for Cosmology, Jet Propulsion Laboratory (JPL).

Dr. Danchi described the Planck mission and its supporting organization at NASA. It is principally European, with a strong US contribution. Planck and Herschel are related missions; they were on a dual manifest launch on May 14, 2009, on the Ariane 5. Planck is involved in an all-sky survey, primarily in the cosmic microwave background. It is a mid-sized mission, with two instruments; one operates at low frequencies (LFI) and one operates at high frequencies (HFI). Planck is a spinning mission, with one rotation per minute, and produces one map of the sky every six months. The original mission was two skies and it has been extended to 30 months to produce four skies. The low frequency instrument may be extended from 30 to 40 months. JPL will soon deliver an early release compact source catalog. Dr. Danchi described the US hardware contributions to the mission. One of the principal contributions is an active cooling system, which cools to 1/10th of a degree Kelvin. Another US contribution is the spider-web and polarization-sensitive bolometers. Planck is about 75% complete on its second survey. It received the highest ranking in the 2010 Senior Review.

Dr. Seiffert described Planck's contributions to science. It gathers an order of magnitude more information from temperature anisotropies than WMAP. In polarization, the ratio is even greater. He described Planck's impact on Cosmology. It offers a dramatic refinement of key cosmological parameters and provides unprecedented constraints on the mechanism that generated primordial fluctuations. It will enable a great leap forward in understanding reionization process, and will provide information about the first generation of stars and the energetics of the universe. It removes the largest degeneracy preventing the fluctuation's amplitude from being accurately measured. Planck will show the distribution of matter at intermediate redshift through highly significant detection of gravitational lensing by intervening galaxies. All 9 frequency bands are operational. Dr. Seiffert reviewed several slides from Planck's first light survey. Because the data is not yet public, the images have been intentionally degraded. Papers will be released, simultaneously with the first data products, two years after the second all-sky survey is completed. There will be core cosmology papers, including major data processing steps, and other science papers, including non-Gaussianity, secondary anisotropies, extragalactic science, and galactic science. The US team will contribute fully on both parts. Dr. Seiffert described several areas of current data reduction work. The cosmic ray hit rate in the HFI is 8 times higher than expected and is causing the removal of 15-25% of data; that is expected to be reduced to less than 10% of data with improved cosmic ray template subtraction under development. There are cooler-induced fluctuations in the LFI. Standard processing is being used to remove the effects from that. Heat from cosmic rays is producing low-frequency fluctuations in the HFI that are well below the spin frequency and removed effectively by scan strategy and normal processing. Direct temperature measurements can be used to correct for the fluctuations, if necessary. Helium 3, used for cooling, will be depleted by February, 2012. The current timeline calls for data and results from the first 15 months of observing to be released in November, 2012. In response to a question from Dr. Boss, Dr. Seiffert stated that there will be a proposal for a warm Planck mission.

Dr. Boss thanked Dr. Danchi and Dr. Seiffert for their presentations.

Herschel Space Observatory

Dr. Boss introduced Dr. Paul F. Goldsmith, Herschel Project Scientist, Jet Propulsion Laboratory. Dr. Danchi and Dr. Goldsmith briefed the APS on the status of the Herschel Space Observatory. Dr. Danchi discussed the program for the mission. Like Planck, it is principally European, with a strong US contribution for instruments. It is a pointed type of observatory and is keyed toward galactic and intergalactic themes. It has a 3.5 m diameter telescope that is passively cooled and three helium cooled instruments: the Heterodyne Instrument for the Far Infrared (HIFI); the SPIRE; and the Photodetector Array Camera and Spectrometer (PACS). It has a 3 1/2 year planned lifetime with a 5 1/2 year goal. PIs have significant Guaranteed Time on HIFI and SPIRE due to the US investments. All instruments are operating nominally. Initial science papers will be in a special issue of *Astronomy & Astrophysics*. There is a call for proposals, which will be due July 22, 2010.

Dr. Goldsmith explained that the main reason for Herschel is to escape the poor transmission properties of the Earth's atmosphere in the sub-millimeter spectral range. Herschel's target is the cool, dusty universe. It will be able to observe water molecules, which are a key coolant of interstellar clouds and which are difficult to observe from the Earth's surface. Dr. Goldsmith described Herschel instruments: PACS, SPIRE, and HIFI. The wavelength coverage will be from 700 microns to 60 microns. Beam size will be measured in arc seconds, rather than arc minutes. It is passively cooled with helium, while Planck is mechanically cooled. SPIRE and HIFI were technologically enabled by detectors provided by NASA. Dr. Goldsmith reported that there is a very significant appreciation of this contribution by the Europeans. He presented slides showing the production of the hardware and the launch of the Ariane 5, slides showing the galaxies that make up the cosmic infrared background, and slides showing composite images from Herschel's instruments. He discussed HIFI and Spectral surveys and noted that it can now be seen that the interstellar medium in nearby star-forming regions is not spherical. There have been many molecular species discovered by HIFI. He observed that there is good preliminary science coming from Herschel and that the surface is just being scratched.

Dr. Boss thanked Dr. Danchi and Dr. Goldsmith for their presentations.

JWST Update

Dr. Boss introduced Dr. Kathryn Flanagan, JWST Mission Head, Space Telescope Science Institute (STScI). Dr. Flanagan and Dr. Smith briefed the APS on the status of the JWST. Dr. Polidan and Dr. Huchra recused themselves from participating in the discussion due to potential conflicts of interest.

Dr. Smith provided an overview of the mission. The Goddard Spaceflight Center is the mission lead. NASA is collaborating in this mission with the European Space Agency (ESA) and the Canadian Space Agency (CSA). The prime contractor is Northrop Grumman Aerospace Systems. JWST will carry four instruments: the Near Infrared Camera (NIRCam), Near Infrared Spectrograph (NIRSpec), Mid-Infrared Instrument (MIRI), and Fine Guidance Sensor (FGS). The JWST will be operated by the STScI. JWST will carry a deployable infrared telescope with a 6.5 m diameter segmented adjustable primary mirror, which will be passively cooled. It is under construction and is expected to launch in June of 2014 on an ESA-supplied Ariane 5 rocket. The science mission is planned to last for five years, with a 10 year goal. Dr. Smith presented several slides showing the progress of instrument construction. The final major mission level design review conducted by the Standing Review Board (SRB) has been completed. Mission Critical Design Review (MCDR) was completed in April of 2010. Post-MCDR Program review will continue through the summer. Schedule and budgetary issues have been identified. The Program is developing a plan that meets the FY11 budget guidelines. The JWST Science Working Group (SWT) is involved in risk reduction, cost avoidance, and descoping discussions. The JWST Space Telescope Advisory Committee (JSTAC) is reviewing operations issues. Dr. Smith noted that people are beginning to build the JWST into their science papers.

Dr. Flanagan presented a chart showing the planning timeline for JWST science. It is expected to look at first light and reionization, the assembly of galaxies, the birth of stars and protoplanetary systems, and the origins of life. JWST has four complex instruments. She described the NIRSpec micro-shutter array and its planning tool. It is configurable to allow spectra of about 100 distinct sources simultaneously. Operations will begin six months after launch. The mission cannot be refurbished and is propellant limited. After observations begin, there will be a Cycle 2 call for proposals. Dr. Flanagan described the Astronomers Proposal Tool (APT), which will be used for all four JWST Instruments and uses templates similar to Hubble's. She discussed two recent JSTAC recommendations. One recommendation is to place GOs and GTOs on equal footing so that both are subject to the same overheads. The other recommendation is to explore ways to involve the community in advance to prepare them for science operations. Dr. Flanagan explained that the JWST instruments will produce data that are more complex than HST and will require more sophisticated software. They are having discussions with NASA about funding the community to participate in this opportunity. Dr. Flanagan described plans for data challenges to engage the community more broadly, and she described JWST outreach activities. Dr. Heap expressed interest in the data challenges and recommended that people from the Sloan Digital Sky Survey be included. Dr Heap also suggested that the Hubble imaging data be reorganized as a relational database. Dr. Ritz observed that the JSTAC looks great and, to "nucleate" the effort, recommended adding a few young people who will be using the tools.

Dr. Boss thanked Dr. Smith and Dr. Flanagan for their presentations.

Public Comment Period

Dr. Boss announced that this time period had been set aside to give members of the public an opportunity to make comments. Dr. Dan Lester suggested that the idea to use the ISS as a technology test bed might be the most meaningful use for astrophysics. He noted that the ISS is a platform that offers mounting points for large instruments, some stability, loads of power, and a high bandwidth for communications. He also noted that there is a huge technology program in development. Dr. Lester asserted that in-space construction is the future of astronomy and that the ISS is a good platform for testing construction techniques. He suggested that there would be value in the astronomy community extending a hand and building bridges to the human spaceflight community. Dr. Polidan endorsed Dr. Lester's comments.

Discussion, Recommendations, Actions

Dr. Boss summarized the members' collective thinking on the ISS science utilization question. The opportunity has been around for several decades. It is a continuation of business as usual and should be considered at the current level of Explorers and stand-alone missions, where the ideas have to be peer reviewed and competed with other ideas. We don't know enough at this point about what the opportunities might be. There is no interest in requesting detailed white papers; the input should be through proposals. Science has a reason for being on the space station. There is a fair amount of interest in technology being a driver; for example, using the ISS as a platform for checking new detectors and pointing mechanisms. Astrophysics potentially can use the ISS in the technology area, whether or not human beings are involved.

Dr. Ritz cautioned against giving any endorsements and recommended being neutral about specific instruments. Dr. Dey recommended against mentioning missions by name and suggested that the APS focus on what should be done in the future. Dr. Allamandola asserted that most astrophysicists have not thought about this opportunity and recommended bringing it to their attention. Dr. Jones noted that the Space Operations Mission Directorate will be putting funds into developing technological for use on the ISS. Dr. Boss concluded that the APS members had reached a consensus, and stated that he would prepare and circulate a draft letter to the Science Committee.

Dr. Morse discussed the planning for the next APS meeting. He thanked the APS members for their discussion and thoughtful comments on a broad range of subjects.

Dr. Boss thanked the members for their participation and expressed his appreciation to the staff for their assistance.

The APS meeting was adjourned.

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| **Agenda** | | |
| **Astrophysics Subcommittee** | | |
| **July 7-8, 2010** | | |
| **NASA Headquarters Room MIC 3** | | |
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| **Wednesday 7 July** | | |
| | | |
| 8:30 a.m. | Introduction and Announcements | Alan Boss |
| 8:40 a.m. | Ethics Briefing | Katie Spear |
| 9:40 a.m. | Overview of FACA | Jens Feeley |
| 10:10 a.m. | Break | |
| 10:20 a.m. | Astrophysics Division Update | Jon Morse |
| 11:45 a.m. | Break for lunch | |
| 12:00 noon | Working Lunch/ Meeting with SMD Chief Scientist | Paul Hertz |
| 1:00 p.m. | Research & Technology Update – Part 1 | Michael Moore/Richard Howard |
| 1:30 p.m | Research & Technology Update – Part 2 | Linda Sparke |
| 2:10 p.m. | Public Comment period | |
| 2:25 p.m. | Break | |
| 2:40 p.m. | GPRA discussion | All |
| 5:00 p.m. | Wrap up for Day 1 | Alan Boss |
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| **Thursday 8 July** | | |
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| 8:30 a.m. | Re-cap of Day 1 | Alan Boss |
| 9:00 a.m. | Decadal Update | John Huchra |
| 9:10 a.m. | ISS Utilization | Vernon Jones |
| 9:50 a.m. | Senior Review Update | Jaya Bajpayee |
| 10:20 a.m. | Break | |
| 10:35 a.m. | ExoPAG Update | Doug Hudgins/James Kasting |
| 11:05 a.m. | PhysPAG/COPAG Update | Lou Kaluzienski/Eric Smith |
| 11:15 a.m. | Kepler Update | Doug Hudgins |
| 11:35 a.m. | HST Update | Eric Smith/George Sonneborn |
| 12:10 p.m. | Working Lunch | |
| 1:10 p.m. | Chandra Update/Guaranteed Time Observer Policy | Wilton Sanders/Martin Weisskopf |
| 1:55 p.m. | Planck Update | William Danchi/Mike Seiffert |
| 2:15 p.m. | Herschel Update | William Danchi/Paul Goldsmith |
| 2:35 p.m. | JWST Update | Eric Smith/Kathy Flanagan |
| 3:20 p.m. | Public Comment period | |
| 3:30 p.m. | Discussion, Recommendations, Actions | Alan Boss |
| 4:30 p.m. | Brief to Morse | Alan Boss |
| **4:45 p.m.** | **Adjourn** | |
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# Astrophysics Subcommittee (APS)

NASA Headquarters
Washington, DC 20546
July 7-8, 2010

## MEETING ATTENDEES

### *Subcommittee Members:*

| | |
|---|---|
| Boss, Alan P. (Chair) | Carnegie Institution for Science |
| Hasan, Hashima (Executive Secretary) | NASA HQ |
| Allamandola, Louis J. | NASA/ARC |
| Dey, Arjun | National Optical Astronomy Observatory |
| Hanany, Shaul | University of Minnesota |
| Heap, Sara R. | NASA/GSFC |
| Hughes, John (Jack) P. | Rutgers University |
| Huchra, John | Harvard-Smithsonian Center for Astrophysics |
| Kaiser, Mary Elizabeth | The Johns Hopkins University |
| Kasting, James F. | The Pennsylvania State University |
| Polidan, Ronald S. | Northrop Grumman Aerospace Systems |
| Rhoads, James | Arizona State University |
| Ritz, Steven | University of California, Santa Cruz |
| Townsley, Leisa | Pennsylvania State University |

### *NASA Attendees:*

| | |
|---|---|
| Andruski, Linda | NASA HQ |
| Bajpayee, Jaya | NASA HQ |
| Centrella, Joan (telecom) | NASA/GSFC |
| Clampin, Mark | NASA/GSFC |
| Danchi, Bill | NASA HQ |
| Darbouze, David (telecom) | NASA HQ |
| Degn, Holly | NASA HQ |
| Devirian, Michael (telecom) | NASA/JPL |
| Feeley, T. Jens | NASA HQ |
| Geldzahler, Barry | NASA HQ |
| Goldsmith, Paul | NASA/JPL |
| Griffiths, Richard (telecom) | NASA HQ |
| Harrington, J.D. | NASA HQ |
| Harris, Dana | NASA HQ |
| Hefner, Keith (telecom) | NASA/MSFC |
| Hood, David (telecom) | NASA HQ |
| Howard, Rick | NASA HQ |
| Jones, W. Vernon | NASA HQ |
| Kaluzienski, Lou | NASA HQ |
| Kearns, Jennifer | NASA HQ |
| Kouveliotou, Chryssa (telecom) | NASA/MSFC |
| Lanz, Thierry | NASA HQ |
| LaPiana, Lia | NASA HQ |
| Leisawitz, Dave | NASA HQ |
| Levine, Marie (telecom) | NASA/JPL |
| Marshik, Charles (telecom) | NASA HQ |
| Moore, Mike | NASA HQ |

| | |
|---|---|
| Morse, Jon | NASA HQ |
| Norris, Marian | NASA HQ |
| Novo-Gradac, Anne-Marie | NASA HQ |
| Oegerle, Bill (telecom) | NASA/GSFC |
| Perez, Mario | NASA HQ |
| Sanders, Wilton | NASA HQ |
| Seiffert, Michael | NASA/JPL |
| Smith, Eric | NASA HQ |
| Sonneborn, George | NASA/GSFC |
| Spavhe, Linda | NASA HQ |
| Spear, Kathleen | NASA HQ |
| Taylor, Ray (telecom) | NASA HQ |
| Troxell, Jennifer (telecom) | NASA HQ |
| Unwin, Steve (telecom) | NASA/JPL |
| Weisskopf, Martin | NASA/MSFC |
| Williams, Gary | NASA HQ |
| Yotz, Geoff | NASA HQ |

## *Other Attendees:*

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|---|---|
| Bautz, Marshall (telecom) | MIT |
| Berwick, Elissa (telecom) | House of Representatives |
| Bicay, Michael (telecom) | ARS |
| Bookbinder, Jay | SAO |
| Burns, Jack (telecom) | University of Colorado |
| Flanagan, Kathryn | STScI |
| Klamper, Amy | Space News |
| Kniffen, Don | USRA |
| Lester, Dan (telecom) | University of Texas |
| Mountain, Matt | STScI |
| Murray, Stephen (telecom) | Johns Hopkins University |
| Quintal, Miriam | California Institute of Technology |
| Sembach, Ken | STScI |
| Tanenbaum, Harvey (telecom) | SAO |
| Turner, Michael (telecom) | University of Chicago |
| Young, Erick (telecom) | USRA |

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# Astrophysics Subcommittee (APS)

NASA Headquarters
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LIST OF PRESENTATION MATERIAL

1) Federal Advisory Committee Act [Feeley]
2) Astrophysics Division Update [Morse]
3) NASA Science Mission Directorate [Hertz]
4) Office of the Chief Technology – Overview to Astrophysics Subcommittee [Howard]
5) SMD/OCT Coordination on Innovation and Technology Activities [Moore]
6) Research and Technology Programs [Sparke]
7) 2010 Astrophysics Division Government Performance and Result Act Input [Kearns]
8) Astrophysics Utilization of the ISS – Part 1[Jones]
9) Astrophysics Utilization of the ISS – Part 2 [Robinson]
10) Senior Review 2010 of Astrophysics Operating Missions [Bajpayee]
11) ExoPAG Report [Kasting]
12) Hubble Space Telescope Program Status [Sonneborn]
13) The Chandra X-ray Observatory [Weisskopt]
14) Chandra Guaranteed Time Observer Policy [Sanders]
15) Planck Programmatics [Danchi]
16) Planck Update [Seiffert]
17) Herschel Programmatics [Danchi]
18) The Herschel Space Observatory: Past, Present, and Future [Goldsmith]
19) James Webb Space Telescope [Smith]
20) JWST S&OC Update [Flanagan]

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# GOVERNMENT PERFORMANCE & RESULTS ACT (GPRA) EVAULATION TEXTS