National Aeronautics and Space Administration

Astrophysics Subcommittee
of the
NASA Advisory Council Science Committee

May 3–4, 2006
University of Maryland University College Conference Center
Adelphi, Maryland

MEETING SUMMARY

Eric Smith
Executive Secretary

David Spergel
Astrophysics Subcommittee Chair

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University of Maryland University College Conference Center
Adelphi, MD
May 3–4, 2006

Meeting Summary

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Meeting Report Prepared By:
Robert J. Katt, Consultant
INFONETIC

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Wednesday, May 3, 2006

Plenary Session

During the morning and early afternoon, the Astrophysics Subcommittee of the NASA Advisory Council (NAC) Science Committee joined the other three subcommittees in plenary session to hear presentations and participate in question and answer sessions with the presenters. This part of the meeting is covered in the separate meting summary for the Science Subcommittee Planning Conference. The plenary session ended at 2:00 p.m., at which time the Astrophysics Subcommittee convened in separate session.

Wednesday Afternoon Subcommittee Breakout Session

Dr. David Spergel, chair of the Astrophysics Subcommittee, opened the separate session. Mr. Richard Howard, Astrophysics Division Acting Director, briefed the subcommittee on the current status of the Division's programs; budget principles, priorities, and constraints that affect the programs; issues concerning the future program mix; and other budget-related issues. Of the 13 missions in operation, 8 will be under consideration for mission extension or termination at the April 2006 Senior Review. The Galaxy Evolution Explorer (GALEX) experienced a short in its far ultraviolet (FUV) detector channel on March 31. NASA has terminated funding for the High Energy Transient Explorer 2 (HETE-2), and the Massachusetts Institute of Technology is now running the spacecraft. The other 13 operating missions have a "green" operating status.

The status of missions in development is much more problematic, given the impact of budget changes. The two major missions in the Beyond Einstein program, the Laser Interferometer Space Antenna (LISA) and Constellation X (Con-X), are being scaled back in light of budget changes. The Keck Outriggers and the Terrestrial Planet Finder (TPF) mission are not funded starting in fiscal year (FY) 2007. The Stratospheric Observatory for Infrared Astronomy (SOFIA) has a reduced budget for FY 2006 and no budget after this year. Options are being reviewed, with a decision anticipated in early summer. The Large Binocular Telescope Interferometer (LBTI) and Gamma ray Large Area Space Telescope (GLAST) have yellow status because of issues that put their FY 2007 launch dates at risk. Per a request from SMD, a new plan and profile will be proposed for the Widefield Infrared Survey Explorer (WISE), a medium-class Explorer (MIDEX) mission, and the project status is red. Replanning is complete for the James Webb Space Telescope (JWST), but contingency funding still needs to be addressed. Its project status remains yellow. Kepler is undergoing a cost and schedule review. The budget contingency for the Balloon Program has been expended, and the long-term funding status for the Ultra-Long Duration Balloon activity (ULDB) is unclear. Developmental projects with a green status are the Keck Interferometer, Servicing Mission 4 to the Hubble Space Telescope (HST SM-4), Herschel, Planck, and the Space Interferometry Mission (SIM). Although the scope of the Michelson Science Center has been reduced, it will still be able to provide timely support for the Keck Interferometer, LBTI, and SIM missions.

Mr. Howard discussed a list of budget problems and issues for the Astrophysics Division that must be dealt with this summer. In addition to the issues for JWST, SOFIA, GLAST, WISE, Kepler, and ULDB mentioned above, additional funding will be needed if the schedule for launch

of HST SM-4 slips beyond December 2007. Another issue is restoration of funds to the R&A program, which was cut 15 percent as part of a general R&A cut in SMD. After discussing budget priorities, constraints, and other considerations that will be used in addressing these issues, Mr. Howard discussed the mission mix through 2011 in terms of coverage of the electromagnetic spectrum by operating and planned instruments, science theme mix, and mission size mix. Next, he discussed details of the changes from the fiscal year (FY) 2006 Presidential Budget Request to the FY 2007 request, including changes in outyear (FY 2008–2011) line item amounts and changes to individual missions in the Astrophysics Division programs. Mr. Howard concluded his presentation with some examples of the trade alternatives confronting the Division in addressing current budget issues.

Dr. Spergel led the subcommittee in discussing the content for the three briefing slides to be delivered during the closing plenary session of all four NAC Science Committee subcommittees. From this discussion, the subcommittee arrived at the following content for the briefing slides to be presented at the plenary session.

Slide 1: Recommendations

- Astrophysics is facing a 25% cut in real dollars over the next five years. This will have a very negative impact on the field: the agency will go from ~10 operating missions to a handful and face a significant reduction in workforce.

Slide 2: Principles

- Decadal survey including prerequisites and assumptions (p36-38) and NAS reports
- Prepare for the Future (students, technology)
- Intellectual diversity
  - Balance between large, medium and small
  - Balance among lines in the decadal report
  - Science per dollar
- Complete and launch healthy missions in development and operating budget

Slide 3: Recommendations

- Maintain healthy R&A.
- Provide sufficient technology development for Beyond Einstein & TPF.
- Restore Explorer program.
- Need both short-term solutions to 2006 problems and long-term solutions.

Wednesday Afternoon Closing Plenary Session

At 5:00 p.m., the Astrophysics Subcommittee returned to plenary session with the other three subcommittees. The chair of each subcommittee presented and discussed the three charts from the afternoon's breakout sessions. In presenting the Astrophysics Subcommittee charts, Dr. Spergel said that the subcommittee's major concern was the 25 percent reduction in the FY 2011 budget request, in real (constant) dollars. For its suggested principles, the subcommittee tried to formulate principles that should applied in astrophysics research. The point of the first bullet under *Principles* is that NASA and others making decisions about astrophysics programs and missions should pay attention to the prerequisites and assumptions enunciated in the National Academies of Science National Research Council (NAS/NRC) Decadal Survey, not just the list of

top priority missions. The subcommittee began work on a list of priorities but did not get to the hard decisions about what to cut. The losses to the Explorer Program will have a substantial impact on the field of astrophysics research.

Thursday, May 4, 2006

The morning plenary session began with comments from the public, in accordance with the rules for addressing the subcommittees announced by Dr. Marc Allen on the previous day. Each speaker who had registered to comment received a 3-minute allotment to address the subcommittees and other conference attendees. Several comments were received in written form only.

After the public comment session, Dr. Gregory Williams explained the procedure for developing the next revision of the NASA Science Plan. He said that the biggest challenge for the subcommittees would be to create a prioritized list of missions, by Division within SMD. The three charts to be prepared by each subcommittee during the morning breakout session should discuss and capture any findings on: (1) the section outline for the Science Plan; (2) prioritization criteria or considerations for missions within their respective SMD Divisions; (3) if possible, a prioritized list of Division missions; and (4) any additional issues or concerns.

Thursday Morning Subcommittee Breakout Session

Dr. Spergel opened the session with a discussion of how the Astrophysics Subcommittee might prioritize missions in the Astrophysics Division. Source documents include the Decadal Survey and the Universe Roadmap.

The Astronomy and Astrophysics Advisory Committee

Dr. Garth Illingworth, the chair of the Astronomy and Astrophysics Advisory Committee (AAAC), briefed the subcommittee on the AAAC's recent activities and task forces. He presented highlights of the AAAC's latest report to Congress, OMB, and the three agencies to which it reports (National Science Foundation, NASA, and the Department of Energy [DOE]). The report comments on the impact that the cuts in NASA's Astrophysics Division will have on astronomy and astrophysics and expresses concern about the lack of an advisory structure at NASA when the cuts were decided. Dr. Illingworth discussed with the subcommittee the issues of balance resulting from the budget cuts and how to present a justified case for restoration of R&A funding. He suggested identifying specific returns of value to NASA, rather than focusing on the impact on recipients. Another concern expressed in the AAAC report is the cost growth for JWST. In general, lifecycle costs for flagship missions are significant. Because flagship missions are costly, it is crucial to select missions whose science and public visibility will be commensurate with their developmental and operational costs. The AAAC report recommends that Con-X, LISA, and TPF have at least $10 million per year to provide a planning basis and realistic cost estimates to inform the next Decadal Survey. The AAAC also expressed bewilderment at cuts in NASA basic science at the same time that the American Competitiveness Initiative was being announced.

After Dr. Illingworth's presentation, Dr. Spergel noted the importance of sustained coordination between the AAAC and the Astrophysics Subcommittee, as well as continued cooperation with the Committee on Astronomy and Astrophysics (CAA) and the Board on Physics and Astronomy at the NAS/NRC.

Public Comment Period

Several members of the public had asked for opportunity to address the Astrophysics Subcommittee.

Dr. Eric Becklin, Chief Scientist of the SOFIA project from NASA Ames Research Center, reviewed the fundamental parameters of SOFIA, which is a joint U.S.-German project. Germany is paying 20 percent of the initial baseline operating cost. He described the planning for SOFIA operations and the science fundamentals of observing in the far infrared (IR) region using an airborne telescope flying in the upper stratosphere. In his report on the current status of SOFIA development, he noted that the telescope door controller is still being built, but the project is aiming for a first flight in the fall of 2006.

In answer to a question on the overlap of capability between SOFIA and the Herschel and Spitzer spaced-based observatories, Dr. Becklin said that, after Spitzer has completed its mission, SOFIA would be the only capability for observations in the 30-60 μ window between JWST and Herschel. When SOFIA has multichannel capability, it will be able to map more effectively than Herschel. The primary mission duration for Herschel is 3 years, so SOFIA's potential operating life would extend much longer. Dr. Becklin also said that Herschel will be concentrating on high-redshift galaxies, which will cut down on the observing time available for other astrophysics objectives. He disagreed with the operating cost numbers estimated by NASA and said the project was examining ways to cut operating costs substantially.

The second public comment was from Dr. Harley Thronson, currently at NASA Goddard Space Flight Center. He noted that SOFIA is about 90 percent complete. One of its exciting capabilities as an aircraft-carried telescope is that instruments can be replaced with new ones during SOFIA's operating life. It will also have a highly visible public outreach program. On a second subject Dr. Thronson noted that the Exploration Systems Mission Directorate (ESMD) recently began a process to identify priorities for lunar surface exploration and will complete the process in December 2006. On this topic of Moon-based astronomical and astrophysical science activities, Dr. Spergel expressed two concerns. (1) The astronomical community as a whole has not been involved. (2) Decisions are being made quickly, rather than through an orderly process that allows for community involvement.

Dr. Thronson suggested that the subcommittee be specific about what it wants in the Astrophysics Division program and not simply allude to "balance," which management can interpret any way it chooses. Another concern is that SMD has limited funding for technology development to support future missions.

Dr. Wesley Traub, Chief Scientist for the Navigator Program, which includes SIM and TPF, commented on the importance of a logical, methodical approach to a planet-finding program. In this context, he argued the case for keeping SIM in its position in the mission sequence.

Peter Eisenhart commented on the WISE Explorer mission.

Astrophysics Division Planning Process and the NASA Science Plan

Dr. Michael Salamon, Discipline Scientist in the Astrophysics Division, gave the subcommittee an overview of recent and current planning processes in the Division. He then followed up on Dr. Williams' presentation, during the previous plenary session, on the NASA Science Plan drafting process. In past planning cycles, separate plans were developed for the Structure and Evolution of

the Universe (SEUS) and Search for Astronomical Origins (Origins) themes in what was then the Astronomy and Physics Division of the Space Science Enterprise. Roadmaps for each theme were produced every 3 years with substantial community input through the theme-specific subcommittees of the Space Science Advisory Committee. These theme roadmaps were used as input to the Space Science strategic plan. After the 2004 reorganization of the Agency, the two theme-specific subcommittees were merged into one Universe Subcommittee, which undertook the task of producing a single roadmap for the new Universe Division. While this work was in progress, the strategic roadmapping (SRM) process, with its set of goals for top-down planning, was announced by NASA Administrator Sean O'Keefe. A Universe Roadmap document was completed before the overall SRM process was halted by the current Administrator. A number of members of the current Astrophysics Subcommittee participated in these earlier roadmapping teams and on the theme subcommittees.

Dr. Salamon next described the role for the Astrophysics Subcommittee in developing this year's Science Plan. The page allocation for the Astrophysics Research Area is 20 pages, and Dr. Salamon reviewed the draft outline for this section. A first draft is to be submitted for integration with the other sections by the end of May, with the integrated draft Science Plan to be reviewed by the NAC Science Committee and committees of the NRC in mid-June.

Material from the Universe Roadmap will be the main source for the 20-page draft section on astrophysics research. However, because of changes in the Division budget and subsequent replanning, some parts of the Universe Roadmap need to be revised. The issues involved in updating from that plan to a new one consistent with the current budget are an area where NASA is asking for help from the Astrophysics Subcommittee. An example is the change in time horizon for the Beyond Einstein missions.

Subcommittee Discussion of the Science Plan, Mission Prioritization, and Other Topics

Dr. Spergel suggested that the subcommittee identify and discuss issues that have arisen since the Universe Roadmap was developed, as most members are familiar with it. The subcommittee could hold a teleconference near the end of May to discuss the draft section on astrophysics research, which will be prepared by Division staff.

The subcommittee discussed the requirements in the congressional authorization for the Science Plan content and how this process for prioritizing missions for a decade or more should fit with the reconsideration of astrophysics missions and priorities in the next Decadal Survey process. Concerns were expressed about the need for representation from the astronomy and astrophysics science community to address issues such as R&A funding, since the Universe Roadmap and Decadal Survey were written under different assumptions about funding levels. Another concern raised was the need to consider the standing and timing of the Beyond Einstein missions relative to JWST and SIM.

Dr. Spergel asked the members to speak to the proposed missions they found exciting but in which they were not directly involved. Common concerns voiced by several members included sustaining the R&A funding level and the importance of the Explorer Program not only for developing and maturing technology but also to provide opportunities for professional development of young scientists. Issues and points made by individual members included the following:

- Some near-term activities that were supposed to be near realization two years ago, such as the HST SM-4, are not in the Universe Roadmap because its planning time frame was later.
- Funding for technology development for future missions is too low (concern expressed by several members).
- Perhaps the NAS/NRC should examine the large missions, taking into account the funding now available, the updated cost profiles for those missions, and their scientific value, then recommend which missions should fly within the budget constraints.
- A re-examination like that in the previous bullet will require planning teams to have sufficient funding now to produce the more accurate cost assessments required. In general, the next Decadal Survey should have more-realistic cost estimates with which to work (point made or seconded by several members).
- The funding reality has changed so much that it is difficult to decide now how to alter the planning done in the roadmap to fit the new circumstances.
- Perhaps costs can be cut on some of the large commitments to HST, JWST, and other large items in the Division budget?
- Establishing general percentage-of-budget targets for large missions and for crucial smaller program elements such as R&A and the Explorer Program might protect the smaller areas from being raided to cover cost growth on large missions.
- Important missions are being cut or delayed, despite their value to the health of the science, because they lack strong or visible congressional support.
- The subcommittee might group certain program elements together from the standpoint of making cost trades. Examples might be HST and JWST. To preserve high-priority smaller program elements such as R&A and the Explorer Program, large budget items such SOFIA or SIM might be designated as being "in play" with respect to resource balancing.

Mr. Howard commented on the difficulties and secondary consequences for some of the suggested options, such as trying to accelerate a major mission or cut costs by rebaselining a major mission. He emphasized that the message from all the subcommittees about maintaining R&A funding and preserving the Explorer Program opportunities has been heard by Division- and Directorate-level management. He discussed with the subcommittee the recent reassessment of JWST's science scope. In the end, there was little room for scope change because some of the JWST instruments are coming from international partners. Most of the reassessment recommendations were aimed at simplifications that could save money.

The suggestion on setting a budget fraction for an area such as R&A led to discussion of whether the R&A amount should decrease proportionally to any further budget decreases. After members expressed their major mission interests and concerns, Dr. Spergel turned the discussion from general issues to specific projects. On SOFIA, he suggested that the project seek additional partners to cover its increased operating costs. A contribution to general operating costs could be paired with contribution of and access to a new SOFIA instrument later in the mission. This might attract new players such as Korea or Taiwan.

Mr. Howard provided further details about the shortfall in SOFIA funding. Last summer, the $48 million needed in FY 2006, according to the initial operating plan, was estimated to be more in the range of $65 to $75 million, just to keep development on schedule. A second problem is the growth in operating cost over time. However, the termination liabilities for the project are also

large. He also described the thinking last year that led to the decision that SIM and JWST could not be carried together, so one mission would have to go first. JWST was chosen in part because it was the highest priority new initiative in the Decadal Survey. Mr. Howard also described the reasoning involved in deciding how much funding was needed for the delayed missions, to sustain competency until a mission could go forward.

The subcommittee discussed having the next Decadal Survey re-examine the relative priority of missions like JWST and SIM, whether the NAS/NRC Committee on Astronomy and Astrophysics could re-examine priorities sooner, and the assessment already in progress by one of the AAAC task forces.

Near the end of the morning session, the subcommittee discussed logistics for providing its input for the new Science Plan. May 22 at 2 p.m. was agreed upon as the date and time for a teleconference to discuss the staff-prepared draft for the astrophysics research area. The draft should be distributed to the members the preceding Friday (May 19). The tentative dates for the next two subcommittee meetings are July 6–7 and September 14–15.

Thursday Afternoon Subcommittee Breakout Session

Dr. Spergel reviewed the topics and points agreed upon during the Wednesday session, which he will include in a draft letter from the subcommittee to the NAC Science Committee. The letter is due by May 10. He then asked the members about other issues the letter should address. The subcommittee discussed ways of noting the impact of the delays in HST SM-4, the impact of the drop in funding for the Division on the astronomy and astrophysics science communities, other consequences of mission delays or cancellation such as international commitments on LISA and the partnership with DOE on the Joint Dark Energy Mission (JDEM). Several of the issues discussed at length in the morning session were discussed again for potential inclusion in the letter. Also discussed were (1) the status of the Keck Outrigger project and the impact of its funding being dropped; (2) the impact on potential proposers of cancellations in the Explorer Program due to funding reductions; and (3) a process for involving the community in the request for potential Moon-based astronomy and astrophysics research projects.

The subcommittee discussed topics and issues that should be on the agenda for either its July or September meetings. Among these topics were the following:

- Report from the AAAC joint task force on dark energy (joint with DOE's High Energy Physics Advisory Panel [HEPAP]).
- Details of operating cost growth for SOFIA.

Dr. Spergel adjourned the meeting shortly after 2:00 p.m.

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AGENDA

Plenary sessions are in roman face; subcommittee breakout sessions are in *italics*.

May 3, 2006

8:00 –8:30 am	Welcome and Advisory Committee Structure	H. Schmitt
8:30– 8:45 am	Agenda and Meeting Plan	M. Allen
8:45–9:45 am	SMD Status and FY06/07 Budget Overview	M. Cleave
9:45–10:00 am	BREAK	
10:00–11:00	Conversation with the Administrator	M. Griffin
11:00 am–12:00 pm	Ethics and FACA Briefings	D. Rausch A. Greenstone
12:00–1:00 pm	WORKING LUNCH	
1:00–1:45 pm	Science AOs and Grants	P. Hertz
1:45–2:00 pm	Plan for the Afternoon Breakout Sessions	M. Allen
2:00– 5:00 pm	*Breakout: Discussion on R&A and Program Mix*	*Division Directors*
5:00–6:00 pm	*Subcommittee Reports and Plenary Discussion*	*Subcommittee Chairs*
	SUBCOMMITTEES WORKING DINNER	

May 4

8:00– 8:30 am	Public Comment Period	
8:30–9:00 am	Science Plan Overview and Plan for Breakout Sessions	G. Williams
9:00 am–12:00 pm	*Breakout: Roadmaps and Community Input to NASA Science Plan*	*Division Directors*
12:00–1:00 pm	WORKING LUNCH	
1:00–2:30 pm	Subcommittee Reports, Discussion, and Next Steps	Subcommittee Chairs
2:30 pm	ADJOURN	

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SUBCOMMITTEE MEETING PARTICIPANTS

Dr. David Spergel, *Chair*
Princeton University

Dr. Michael Cherry
Louisiana State University

Dr. Michael Brown
California Institute of Technology

Dr. Robert Clayton
University of Chicago

Dr. Neil Cornish
Montana State University

Dr. Brenda Dingus
Los Alamos National Laboratory

Dr. Alan Dressler
Observatories of the Carnegie Institution of Washington

Dr. Debra Fischer
San Francisco State University

Dr. Kathryn Flanagan
Massachusetts Institute of Technology

Dr. Lucy Fortson
Adler Planetarium/University of Chicago

Dr. Thomas Greene
NASA Ames Research Center

Dr. Heidi Hammel
Space Science Institute

Dr. Craig Hogan
University of Washington

Dr. Robert Kennicutt
Cambridge University

Dr. Fred Lo
National Radio Astronomy Observatory

Dr. John Mather
NASA Goddard Space Flight Center

Dr. Christopher McKee
University of California, Berkeley

Dr. Belinda Wilkes
Center for Astrophysics, Harvard University

Dr. Eric Smith, *Executive Secretary*
NASA Science Mission Directorate

Presentation Materials

1. Rick Howard, Astrophysics Division Acting Director, Science Mission Directorate, NASA. *NASA Science Subcommittee Planning Conference. Astrophysics Breakout Session.* May 3, 2006.
2. Michael Salamon. NASA Science Mission Directorate. *Overview of Astrophysics Division Planning Process. NAC Astrophysics Subcommittee Meeting*. May 3-4, 2006.