NASA ADVISORY COUNCIL

ASTROPHYSICS SUBCOMMITTEE

February 14, 2013

Teleconference

MEETING MINUTES

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Brad Peterson, Chair

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Joan Centrella, Executive Secretary

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Zantech IT

Thursday, February 14, 2013

Welcome and Introductions

Dr. Bradley Peterson, Chair of the NASA Advisory Council (NAC) Astrophysics Subcommittee (APS), opened the meeting by welcoming the participants. Dr. Joan Centrella, Executive Secretary of APS, asked the participants to identify themselves and noted that there would be a public comment period at the end of the meeting.

WFIRST and AFTA Update

Dr. Neil Gehrels, of NASA's Goddard Space Flight Center (GSFC), and Dr. David Spergel, of Princeton University, discussed the new science definition team for the proposed Wide Field Infra-Red Space Telescope (WFIRST) mission. The specific purpose of the team, known as the Astrophysics Focused Telescopes Assets (AFTA) team, is to study the potential for using the 2.4-meter telescope assets with WFIRST. Drs. Gehrels and Spergel co-chair the team, which is working with GSFC and the Jet Propulsion Laboratory (JPL).

Dr. Gehrels reviewed the previous design concepts, Design Reference Mission 1 (DRM1) and DRM2. DRM1 sought to meet the recommendations of the 2010 Astrophysics Decadal Survey (DS) for WFIRST, including a 1.3-meter off-axis telescope and a single channel payload on a 5-year mission with an evolved expendable launch vehicle (EELV). DRM2 was designed as a probe-version of WFIRST, at less cost than DRM1 with a 1.1 meter off-axis telescope and a single channel payload on a 3-year mission with a medium launch vehicle (MLV). The AFTA-WFIRST design concept incorporates the 2.4-meter on-axis telescope made available by the National Reconnaissance Organization (NRO) with a single-channel payload and coronagraph on a 5-year mission, using either an EELV or a MLV.

Dr. Spergel explained that the AFTA-WFIRST team is in the middle of the study, which has a deadline of April 30. Because the team did not yet have cost estimates or schedules, Dr. Spergel focused on the science aspects of this concept. The available telescope is 2.4 meters, with a high-quality mirror and optical system. It is easily used with a wide-field mission. It is not only well-suited to WFIRST, it in many ways exceeds the DS concept by offering higher spatial resolution and a larger collecting area.

The AFTA-WFIRST will be complementary to the Large Synoptic Survey Telescope (LSST), the European Space Agency's (ESA's) Euclid mission, and the James Webb Space Telescope (JWST). The system was designed to look down at a warm Earth, so the presumption is that the AFTA-WFIRST will operate in a warmer environment in order to ensure minimal modifications. Euclid covers a lot of the sky, but it will be about three levels of magnitude shallower than AFTA-WFIRST in the infrared. Dr. Spergel also described the comparative resolution for the multichroic view of galaxies by Euclid, WFIRST, and JWST.

New science enabled by the 2.4-meter telescope includes a higher resolution galaxy survey, which is the largest benefit and which is roughly three times deeper per unit time than the DRM1 version of WFIRST, as well as being higher resolution. This opens up new areas such as dark matter studies and developing the dark matter map of the cosmos. The 2.4-meter telescope should enable a good precision study of how the dark matter is distributed and where the galaxies are. It will easily be at least an order of magnitude greater than other currently available measurements.

Improved dark energy measurement shows up in three areas. In investigating supernovae, the Integral Function Unit (IFU) offers vastly more information on the redshift and supernova properties. The Baryon

Acoustic Oscillation (BAO) is six times deeper in H-alpha, but will only be able to go out to two microns due to the temperature limitations. However, other capabilities include doubly ionized oxygen (OIII) luminosity functions to estimate the ability to use OIII measurements to go out to redshift of 2.9. Finally, AFTA-WFIRST will provide improved lensing.

The strong lensing is another science area in which AFTA-WFIRST has benefits, in that it can look at a large number of galaxies, including those that are very faint and distant. Dr. Spergel gave an example of the level of characterization possible with the 2.4-meter telescope.

There will be a significant advantage if NASA can operate AFTA-WFIRST while JWST is still operating. There is a great deal of uncertainty at high redshift, but AFTA-WFIRST should be able to detect and characterize a large number of rare objects that JWST will not be able to detect on its own but could then point to once AFTA-WFIRST has found them.

The science definition team has determined that, in the area of astrometry and dark matter, the AFTA-WFIRST's larger telescope can achieve accuracy 10 times faster than the telescope from the DRM1 concept. The 2.4-meter telescope has greater accuracy in detecting faint stars when compared to the Global Astrometric Interferometer for Astrophysics (GAIA) mission, depending on the color of the stars. This could lead to some very interesting science and enable investigators to see more of what is going on with dwarf stars, galaxy formation, cold dark matter, and more. It will also allow investigators to test whether dark matter is warm dark matter, trace the motion of individual stars, and look for the signature of dark matter connections. In terms of the connections between dark and luminous matter, AFTA-WFIRST will have the capacity to use the local universe as a dark matter laboratory, determine the baryon-dark matter connection at low galaxy masses, and gauge how much low-mass substructure exists locally. These are the questions that the DS identified as key for study in the galactic neighborhood.

Coronagraphy is still under study. The science definition team is trying to determine whether the 2.4-meter telescope is large enough to enable imaging of planets around nearby stars. The hope is to achieve a contrast ratio of 1e-9.

The team has reached out to the community and collected information on the science that potential investigators would want to do. It is clear that this program would be heavily oversubscribed, because there are many ideas. The report is due on April 30, and the team will have an independent cost estimate at that time.

Discussion
When asked if the team had studied the effect on the lensing resulting from the structure of the secondary, and if the plan was to use the Hawaii 4RG detector arrays, Dr. Spergel said that the team has looked at the Point Spread Function (PSF) with the support structure. The enclosed area is likely to be stable and unlikely to degrade the lensing signal. The team is hoping to use the H4RGs.

APD Update
Dr. Paul Hertz, Director of NASA's Astrophysics Division (APD), provided an update on Division activities.

Among significant personnel changes, Mr. Michael Moore retired and Dr. Ilana Harrus moved to the National Science Foundation (NSF). Dr. Tony Carro joined APD as the Exoplanet Exploration Lead Program Executive, and Dr. Debra Wallace is now in charge of fellowship programs. There has also been some movement within the Division.

From a "big picture" perspective, this is a great time for astrophysics, with the budget at a high level, great data coming in from many missions, and JWST on schedule and budget. In addition, the suborbital investigations have been going extremely well, the grants program is being maintained, and the Division is preparing for the strategic mission that will follow JWST.

Budget
Despite the positive general picture, the budget is uncertain. Dr. Hertz showed a graph of the JWST and non-JWST budgets separately and in total, the latter coming to $1.3 billion. JWST is an astrophysics mission. Beyond JWST, APD has more to do than the budget allows, but overall the Division is doing valuable high-priority activities. Dr. Hertz also showed the breakdown of funding within the Division.

He next presented a chart showing the allocation of Research Opportunities in Earth and Space Science (ROSES) selection trends. The selection rates have been in the 25-30 percent range, which is good, though he would like it to be higher. The number of proposals has grown faster than the budget, however. Astronomy and Physics Research and Analysis (APRA), the biggest program, has a rather flat funding rate. On the other hand, the number of proposals for the Astrophysics Data Analysis Program (ADAP) has shot up. In addition to the increased number of proposals, the size of proposal budget requests has grown. ROSES applications for the new Theory and Computational Astrophysics Networks (TCAN), a joint program with NSF, were due on the day of the meeting. TCAN reflects a DS recommendation.

Mission update
The Nuclear Spectroscopic Telescope Array (NuSTAR) mission is performing well, though there are challenges with the ground stations. The mission has done simultaneous views with other missions, and there are now papers being submitted to refereed journals.

JWST is making great progress; it is within the budget and on schedule. Two of the four instruments have been delivered to GSFC for testing. The other two are about to undergo cryo-vac testing and will be delivered during the summer. Three mirror segments have been delivered, and engineering units of three of the five sunshields are complete, with the other two in process. There was a need to modify the large vacuum chamber at Johnson Space Center for cold temperature testing.

Dr. Hertz showed some photos of elements coming together for the Integrated Science Instrument Module (ISIM) test at Goddard, which is ongoing this year. Dr. Eric Smith of NASA explained that to evacuate the thermal vacuum chamber, it takes a week or so to pump down, with the cool-down taking longer, possibly 3 weeks. He noted that on the Optical Telescope Element and Integrated Science Instrument Module Assembly (OTIS) for the optical telescope, there is a schedule margin, but no plan for a delay.

The Kepler mission had a big presence at the recent American Astronomical Society (AAS) meeting. The archive is making all of the Kepler data available to the entire scientific community now that it is in extended mission mode. There are concerns about Kepler's lifetime. One reaction wheel was offline due to failure when a second reaction wheel developed elevated friction. The second reaction wheel was taken offline for a while, but now that it is back, it is still showing signs of elevated friction. NASA is studying the issue further.

The Stratospheric Observatory for Infrared Astronomy (SOFIA) mission is flying again. NASA recently upgraded the entire observatory system, including software, avionics, and workstations. The Agency's German partners have provided a new focal plane imager, which was tested on a flight the previous night. The program will now commission the first generation instruments. The plan is to accomplish all Cycle 1 science by the end of 2013.

NASA's Astro-H team was flying to Japan for meetings with the Japan Aerospace Exploration Agency (JAXA). NASA's part of the mission is on track, and the Agency recently completed the first flight mirror module. NASA has also verified that the detector is capable of 5eV resolution, 7eV being the requirement. Within the engineering unit of the spacecraft, there is a cryocoolers vibration issue that degrades resolution. JAXA is working to fix that, and will review the schedule once that is done. NASA will support JAXA's decision.

The Antarctic long-duration balloon campaign has been successful, with three missions operating at the same time. These include the E and B Experiment (EBEX), the Balloon-borne Large-Aperture Submillimeter Telescope (BLAST), and the Super- Trans-Iron Galactic Element Recorder (Super-TIGER), which flew for 55 days, setting the record for duration. The Super-TIGER was ultimately brought down because the winds were changing and the investigators had to recover some of its elements.

The Alpha Magnetic Spectrometer is already on the International Space Station (ISS). APD has selected some payloads to go onto ISS. Upcoming payloads include the Calorimetric Electron Telescope (CALET), an instrument that JAXA will launch next year; the ISS- Cosmic Ray Energetics And Mass (ISS-CREAM) experiment, which is currently planned as a SpaceX flight for late 2014; and the Japanese Experiment Module- Extreme Universe Space Observatory (JEM-EUSO), which is in competition at JAXA for a launch in 2017. These were all selected within the APRA program and will collect very high quality data at relatively low cost.

NASA has signed a Memorandum of Understanding (MOU) with ESA for the Euclid mission. NASA's portion of the project was approved to enter Phase B on Dec. 21, 2012. The Agency is providing the flight Sensor Chip Subsystems (SCS, or triplet) for the Euclid Near Infrared Spectrometer and Photometer (NISP) instrument. The SCS consists of an H2RG sensor chip subassembly, a System for Image Digitization, Enhancement, Control And Retrieval Application Specific Integrated Circuit (SIDECAR ASIC), and a flex-cable. NASA has selected three proposals for the Euclid science investigations.

The Study on Applications of Large Space Optics (SALSO) is a call for ideas for ways to use the NRO telescope assets in addition to AFTA-WFIRST. A recent workshop in Huntsville, Alabama, generated 35 concepts that are now being reviewed to determine which, if any, should go to the NASA Administrator.

Discussion
In answer to a question, Dr. Centrella said that peer reviews for the TCAN proposals are likely to occur in late May. Notifications will go out in June or July, in keeping with the typical 5 months to selection.

Dr. Karl Stapelfeldt asked about the resources available for SALSO. Dr. Hertz explained that the Study only sought concepts that would inform NASA's programmatic and strategic planning. The Agency is now deciding whether to do design center runs at JPL and Goddard, which would occur in the spring. The next step will be to decide whether there is a reason to go forward with studying use of the telescope assets further. This is happening at the Agency level, not APD. For example, some of the ideas were for heliophysics. Dr. Hertz will be going forward to the Agency with the AFTA-WFIRST report output. A parallel activity is going on with other goals. The highest priority is to find the best use of the telescope assets in advancing Agency objectives. This does not change the fact that the DS prioritized WFIRST for astrophysics.

In answer to a question about the funding trend graph and ADAP, Dr. Hertz explained that a steady acceptance rate is not an objective. Proposal pressure does not create additional funding. Therefore, the goal is to be strategic in allocating funding among the various programs in order to advance the DS priorities in the best way possible. From 2011 to 2012, APD was able to raise total spending. The numbers fluctuate according to what is spent in a given year, not what is approved. In addition, APD

provides awarded funds when they are needed, not when they are awarded. That accounts for some of the changes on the graph. The size of the average theory grant has grown, which has also driven down the percentage of proposals accepted. The growing size of the grants within a flat budget results in fewer grant awards.

Review of Astrophysics Performance Goals

Dr. Centrella explained that as NASA develops a new strategic plan and the Science Mission Directorate (SMD) puts together a new science plan, the divisions were asked to review and update their objectives and goals as needed. The nomenclature for these plans had changed. What were previously "outcomes" are now "strategic objectives." In addition, "objectives" are now "performance goals."

In conducting the review, it was important to consider the main audience. It is not the science community. Rather, it is the Office of Management and Budget (OMB), the Office of Science and Technology Policy (OSTP), Congressional staff, non-technical leadership at NASA, and the general public. Therefore, the review was to avoid jargon, be user-friendly, and provide exciting examples.

Prior to the meeting, Dr. Centrella sent APS members reworded objectives and goals. To develop these, APD had internal discussions, followed by telecons with the Physics of the Cosmos (PCOS), Cosmic Origins (COR), and Exoplanet Exploration (ExEP) program scientists, program office chief scientists, and their deputies. The chief scientists then consulted with their respective Program Analysis Group (PAG) executive committees to provide suggested changes that were sent back to APD for discussion. Dr. Centrella was presenting the results to APS for their comments. The deadline was tight, as the new goals and objectives had to be finalized within 2 working days.

As part of the SMD revision process, the astrophysics chapter of the science plan was to be rewritten, providing an opportunity to include more information on science and the scope of NASA's efforts. The process was to be similar to that for the revised objectives and goals, with APS asked to review the revised chapter at the April meeting.

Dr. Centrella showed the proposed reworded performance goals and strategic objectives alongside the current wording.

The existing wording of the astrophysics strategic objective was:
Discover how the universe works, explore how it and evolved, and search for Earth-like planets.
The proposed wording was:
Discover how the universe works, explore how it began and evolved, and search for life on planets around other stars.
The revision emphasized life on planets on other stars. Searching for life is now within Agency goals. The Planetary Science Division (PSD) is charged with the search within our solar system, while APD looks outside of it.

Individual programs have shorter timeframes in which to show progress, which accounts for some of the revised language in the program goals and objectives.

The existing wording for PCOS was:
Understand the origin and destiny of the universe, and the nature of black holes, dark energy, dark matter and gravity.
The proposed revision used the word "probe" rather than "understand" in order to show progress:
Probe the origin and destiny of the universe, and the nature of black holes, dark energy, dark matter and gravity.

The existing wording for COR was:
Understand the many phenomena and processes associated with galaxy, stellar, and planetary system formation and evolution from the earliest epochs to today.
The proposed revision was more concise, with the jargon removed, and also used "explore" instead of "understand":
Explore the origin and evolution of the galaxies, stars and planets that make up our universe.

The existing wording for ExEP was:
Generate a census of extra-solar planets and measure their properties.
The revised wording broadened what was essentially a Kepler mission statement:
Discover planets around other stars, and explore whether they could harbor life.

Discussion
Dr. Paul Ray was concerned that the ExEP wording was not quite rich enough, and left out science that was not related to habitability. He noted that APS member Dr. Scott Gaudi, who was not able to participate in the telecom, agreed with that view, and gave Dr. Ray an alternative version to present at the meeting: "Determine the frequency and diversity of planets around other stars, and understand the character and habitability of these worlds." There was also concern about the focus on whether exoplanets could support life. Another suggestion that had the support of several APS members was to add the words "discover" and "characterize," though that was later changed to "discover and study planets." In addition, there was concern that the word "systems" was close to being jargon. Dr. Hertz noted that the purpose of the strategic objectives and performance goals is to communicate the richness of astrophysics activities to non-scientists. There was additional discussion about the distinction between COR and ExEP. COR was set up to address the origins of planets.

Dr. Steve Ritz had a comment on PCOS, noting that for most people "probe" is lower priority than "explore." While he agreed that "understand" needed to change, he preferred "explore the origin and destiny." He also noted that the PCOS statement referred to "the universe" while the other goals mentioned "our universe." Dr. Ray wanted to keep "probe" instead of continually using "understand." However, Dr. Mary Elizabeth Kaiser said that in order to convey excitement, "explore" is better than "probe." There was no consensus on this wording. Dr. Ray added that the PCOS statement seemed overly specific about the black holes, dark energy, etc., and it might be helpful to broaden it. The word "and" was replaced with "including." Dr. Centrella cautioned that SMD could change any of the wording.

As Dr. Ritz had to leave the meeting, which was his last, Dr. Hertz thanked him and the other APS members whose terms were expiring. Those members included Drs. Lou Allamandola, Kaiser, Chris Martin, and Vicki Kalogera. Dr. Peterson said that the letter coming out of the meeting would include a commendation of them.

<u>Astrophysics Roadmap</u>
Dr. Centrella explained that the DS came out in 2010, and the 2013 Implementation Plan was just released. It would also be useful to have a roadmap for APD. A strong roadmap would accomplish the following:

- Articulate NASA's astrophysics vision looking out 30 years;
- Identify key science investigations and challenges for the future;
- Identify notional missions and technologies needed to enable the science;
- Result from the efforts of an APS task force;
- Include community input, such as town halls; and,

- Be ready for public release in mid-December 2013 and presentation at the AAS meeting in January 2014.

The Implementation Plan is a response to the DS. The APD Roadmap will be a visionary document that looks beyond the 2020 and 2030 Decadal Surveys and articulates the value of continued investment in astrophysics. The Roadmap will show that there is compelling astrophysics work to do after JWST and WFIRST, and that the funding wedge can be continued after those missions.

Dr. Hertz elaborated, explaining that a lot of money has been going into JWST, but it is not clear to all those who fund astrophysics that there is a convincing argument for continued funding of astrophysics missions after JWST. The DS is long and detailed. It would be useful if the science community were to develop something that was exciting and pithy in order to convey the enthusiasm in the field. The Roadmap should motivate everyone to continue doing space astrophysics into the future. It is not a funding plan.

The Roadmap will start from and build on the DS, extrapolating beyond it to think decades ahead. However, Dr. Peterson explained, it is not meant to influence future Decadal Surveys. He reiterated Dr. Centrella's point that the most important outcome is a compelling 30-year vision. The Roadmap should be science-based, not mission-based, though it may include some notional missions. Although it will be developed by an independent task force and the community, the report will ultimately be presented to APS, and the final version will go forward as an APS document.

Dr. Peterson explained that the Roadmap should:

- Have a compelling, over-arching theme;
- Contain multiple paths (science areas) forward towards a long-range vision;
- Consider cross-cutting opportunities as well as the larger context of ground-based and international astrophysics;
- Be built on science investigations, leading to notional missions that achieve the science;
- Identify challenges such as science challenges, technology challenges, etc.;
- Consider the technology needed to achieve the goals;
- Consider a variety of mission sizes to achieve the science; and,
- Consider way-stations at 10 and 20 years out, as well the full vision at 30 years out.

The Roadmap should not be a mini-DS or implementation plan, nor should it present priorities unless they are precursors to realizing the vision. It should be a long-range vision document offering options, possibilities, and a view of the future. The intent is to develop it quickly, within 6 months, and to keep the document to fewer than 100 pages. The Roadmap task force will report to Dr. Peterson at least monthly, and will present to the entire APS at regular meetings. An interim report with high-level themes will be presented to APS for approval by August 30, with the final report presented for APS approval by December 16, 2013. Once the final report has been approved and accepted by APS, the task force will be disbanded.

While there were already some nominations for individuals to serve on the task force, Dr. Peterson wanted APS input, which he hoped to receive by the end of the next business day. He was especially interested in having participation by early-career people. He also asked that APS discuss approval of charter information that he and Dr. Centrella had presented.

Discussion

Dr. Gary Melnick had two questions. The first was about logistics, and how the task force meetings would be conducted. Dr. Centrella said that there would be a combination of some face-to-face and town

halls, with NASA Headquarters paying for travel. There would also be weekly telecons so that members did not have to attend all of the meetings in person. Dr. Melnick next noted that a 30-year roadmap made him think of what a task force might have foreseen 30 years ago. Had there been one, it might have missed some exciting current areas like dark energy. He hoped the task force would keep in mind that there is a need to react to recent discoveries. An endorsement of the Explorer mission line would reinforce that. Dr. Peterson said that such an endorsement would be welcome if that is what the task force concludes.

Dr. Peterson explained that he, Dr. Centrella, and the task force chair would be choosing participants from among the task force nominees. He would have the final say but wanted input from APD and nominations from APS. He hoped to achieve a good balance of people to cover the breadth of the field. There was not time for self-nominations from the community. Dr. Centrella added that she had a list of volunteers who came forward after Dr. Hertz told AAS meeting participants to contact her if they were interested. Dr. Peterson said that an option would be to show APS the proposed list so that they could note any significant omissions. Dr. Hertz said that the task force members should be affiliated with U.S. institutions or otherwise be eligible for NASA funding.

Dr. Gabriela Gonzalez asked if there was a way to avoid having the elements of the Roadmap being taken as recommendations. Dr. Peterson said that a recommendation this far out would not have a lot of weight, and that the document will state that these are not recommendations. He will present the Roadmap to the NASA Advisory Committee (NAC) Science Committee. Dr. Centrella explained that the task force will present drafts to APS, and if APS does not like something, they can give the task force that feedback. The final version of the Roadmap must be acceptable to APS, which does not have to send everything forward.

Dr. Terry Oswalt raised the issue of avoiding impact on the next DS. Dr. Peterson said that that is not the intention. The Roadmap is to identify areas for the future. The next DS is not due until 2020, but before that, there is a need to show a viable and exciting future for astrophysics. If the DS authors find the Roadmap useful, that is fine. Dr. Ray noted that while the DS committee might not use the Roadmap as a foundation, others might take some of it into papers to submit for consideration in the next DS.

In further discussion about nominations for the task force, Dr. Hertz explained that APD was casting a wide net among trusted advisors, in part because the rejection rate for volunteers was likely to be high. Dr. Centrella added that the team wanted coverage of a broad swath of astrophysics, and Dr. Peterson explained that the goal was to have a cross-cutting and knowledgeable group that could look at a broad range of science. It was noted that the point heard most often among community complaints about committee membership is lack of institutional diversity, especially from the Midwest.

Charter Approval

Dr. Peterson thanked Dr. Sarah (Sally) Heap, a former APS member, for her input on the Roadmap. Dr. Heap said that it would be nice to involve the community more directly. She was not thinking so much about the formation of the task force, but rather noted that town hall participation can be uneven. She suggested sending a blast email to AAS announcing the new task force and inviting the public to write to task force members providing their thoughts. Dr. Hertz said that that would occur once the task force was established and populated.

Dr. Peterson called for an APS vote to approve the charter for the Roadmap team; the members received the charter in an email the previous day. The vote among the 10 members present at the time was 1 abstention and 9 votes for approval. The motion passed.

Explorer Update

Dr. Wilton Sanders provided an update on the Explorer program. There are two Announcements of Opportunity (AO) in progress, with two upcoming. A call for Small Explorers (SMEX) was planned for late 2013 or early 2014.

From the 2011 Explorer and Mission of Opportunity (MoO), there were four missions in Phase A:

- Fast INfrared Exoplanet Spectroscopy Survey Explorer (FINESSE);
- Transiting Exoplanet Survey Satellite (TESS);
- Gal/Xgal U/LDB Spectroscopic/Stratospheric Terahertz Observatory (GUSSTO); and,
- Neutron star Interior Composition ExploreR (NICER).

APD planned to select two of these to go forward, with a goal of launching in 2017.

Dr. Sanders described the 2012 MoO solicitation, which sought proposals in four categories: Partner Mission of Opportunity (PMO); Small Complete Missions (SCM); New Missions using Existing Spacecraft (NMES); and, U.S. Participating Investigator (USPI). The PI-managed mission cost cap is $60 million, or $30 million for an Ultra-Long Duration Balloon (ULDB) mission. The program may select one MoO at $60 million, or two MoOs if both are ULDB missions or other proposed investigations well below the $60 million PI-managed cost cap. There were 14 proposals across all categories. Final selection was planned for the summer.

In answer to a question about MoOs that involve ESA down-selections, Dr. Hertz replied that it is not unusual for partner MoOs to be proposed. APD may approve them conditionally. If the partner is not selected by ESA, APD will not take the mission. He noted that in this situation, the Division does not select back-ups. Most ESA missions have international partnerships, and NASA's selection does not affect ESA selections.

Dr. Sanders reviewed the cost cap for the next SMEX. Factors to be considered include the future mission budget, desired flight rate, desired mission mix, launch vehicle costs, and inflation. A chart broke out funding details to illustrate what goes into planning the Explorer budget. Ultimately, increasing the cost cap results in AO delays. The recommended DS Explorer program expenditures of $1.4 billion are reached with the scenario, but funding is tight initially.

Discussion

The unspent funds that had been allocated to the Gravity and Extreme Magnetism Small Explorer (GEMS) mission have gone back into the Explorer budget line, accounting for an increase in 2014. The artificially high 2014 budget makes the 2015 number look low by comparison, so the context of GEMS reallocation is necessary. In addition, the Explorer budget was recently divided into an APD and a Heliophysics Division (HPD) piece, with the ramp-up starting from a low baseline. The GEMS cancellation involved cost cap issues.

This is APD's effort to accomplish what the DS recommends, and the proposed program is one the Division could actually do. It was suggested that the GEMS situation did not indicate a problem with the cost caps. APD might watch in case the number of proposals for an AO were to fall off or if the scientific impact of proposals was not exciting. Those situations would argue for more funding. Dr. Ray said that overpromising and not delivering is another metric for more funds, and it was pointed out that if the only proposals were to come from Goddard and JPL, that would indicate a problem as well.

Committee Discussion

Dr. Peterson asked if any APS members had issues they wanted to discuss. Dr. Ray asked about launch vehicle costs for the 2015 Explorer class. Dr. Hertz explained that APD uses certain numbers for budget planning, but does not have the precise cost for a launch until the Division solicits for a vehicle. APD takes advantage of any launch vehicle that is on NASA's contract and certified for a science mission. A number of providers are developing launch vehicles for the ISS, and NASA is taking advantage of those flights to certify the vehicles for science missions. APD is not looking for more until 2017, so Dr. Hertz is optimistic that the Division will be able to match the launch vehicle with the payload.

There was another question about transporting JWST components by truck. Dr. Smith explained that to find the necessary roads without overpasses, NASA does a route survey that considers all such elements. This has happened many times. In addition, there is not a lot of overland travel, as much transportation is done by air. The bigger ground transportation difficulty is moving the pieces around the launch facility.

Public Comment Period

Ron Pollidan of Northrup Grumman noted that a document had been issued about the impact of sequestration on NASA, and it mentioned cuts to Explorer funding. The document was in the form of a letter from NASA Administrator Charles Bolden to Senator Barbara Mikulski, and it was available online. Dr. Hertz said that he had not seen the letter, but that if APD must cut funding in the current year due to the sequestration, one option is to delay the start of Explorers in the down-select phase. As a general policy with budget reductions that cannot be planned, SMD prioritizes projects that are selected and ongoing over those that have not yet been selected or started.

Dr. Michael Bicay from NASA's Ames Research Center explained that while he did not have the exact number, he had heard that GEMS was 50 percent over budget. The HPD sister mission has been well-executed to date, but that will also be over the cost cap. He believes that it is especially and increasingly difficult for APD to fit into arbitrary cost caps and advised running the pricing models to learn what kind of science is being left behind. Some of the missed science opportunities might be compelling. The cost caps seem arbitrary and tight, and it is a contrast to the PSD competitions.

Adjourn

Drs. Kaiser and Kalogera expressed appreciation of the time they spent on APS. Dr. Peterson thanked the Subcommittee and the meeting presenters, then adjourned the meeting at 4:07 p.m.

Appendix A
Attendees

Subcommittee members
Bradley Peterson, Ohio State University, *Chair Astrophysics Subcommittee*
Joan Centrella, NASA, *Executive Secretary*
Gary Bernstein, University of Pennsylvania (via WebEx)
Edna DeVore, SETI Institute (via WebEx)
Gabriela Gonzalez, Louisiana State University
Mary Elizabeth Kaiser, The Johns Hopkins University
Vicki Kalogera, Northwestern University
Chris Martin, CalTech
Gary Melnick, Harvard University
Terry Oswalt, Florida Institute of Technology
Paul Ray, Naval Research Laboratory
Steven Ritz, University of California Santa Cruz (via WebEx)
Karl Stapelfeldt, Goddard Space Flight Center

NASA attendees
Paul Hertz, NASA HQ, *Director, Astrophysics Division*
Lia LaPiana, NASA HQ
Marian Norris, NASA HQ
Wilton Sanders, NASA HQ
Lisa Wainio, NASA HQ

Webex
Mansoor Ahmed, NASA GSFC
Michael Bicay, NASA GSFC
Gary Blackwood, NASA JPL
Jerry Blazey, Science & Technology Policies
Jamie Bock, Caltech
Joel Bregman, University of Michigan
Mark Clamdin, NASA GSFC
Stephen Clark, Space Flight Now
Anne Connor, Subcommittee on Space
Dominick Conte, Orbital Sciences
Julianne Dalcanton, University of Washington
Lamont DiBiasi, Southwest Research Institute
Mike Fanelli, NASA Ames
Giovanni Fazio, Harvard Smithsonian
Kathryn Flanagan, STSCI
Jeff Foust, The Space Review
Neil Gehrels, NASA Goddard
Richard Griffiths, NASA
Fiona Harrison, Caltech
Hashima Hasan, NASA Headquarters

Sara Heap, NASA GSFC
Tim Heckman, Johns Hopkins University
Ingolf Heinrichsen, NASAJPL
Cuong Huynh, NASA HQ
Bethany Johns, AAS
Jason Kalirai, Space Telescope Science Institute
Louis Kaluzienski, NASA
Chrissa Kouveliotou, NASA MSFC
Peter Lawson, NASA JPL
Greg Lee, Northrup Grummon
Daniel Lester, University of Texas
Marie Levine, NASA JPL
Mackenzie Lystrup, Ball Aerospace
Stephen Murray, Johns Hopkins University
Susan Neff, NASA GSFC
Joel Parriott, American Astronomical Society
Mario Perez, NASA HQ
Ronald Polidan, Northrup Grumman
Marc Postman, Space Telescope Science Institute
Aki Roberge, NASA GSFC
Wilton Sanders, NASA Headquarters
Eric Smith, NASA
Marcia Smith, spacepolicyonline.com
David Spergel, Princeton University
Amy Svitak, Aviation Week
Stephen Unwin, NASA JPL
Michael Werner, NASA JPL
Alexey Vikhlinin, Smithsonian Observatory

Appendix B
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Department of Physics and Space Sciences
Florida Institute of Technology

Paul S. Ray
Naval Research Laboratory

Steven Ritz
Santa Cruz Institute for Particle Physics
University of California

Karl Stapelfeldt
Goddard Space Flight Center

Appendix C
Presentations

1. *AFTA WFIRST,* Neil Gehrels and David Spergel
2. *Astrophysics Division Update*, Paul Hertz
3. *Astrophysics Strategic Objectives and Goals,* Joan Centrella
4. *Astrophysics Roadmap Overview,* Joan Centrella and Brad Peterson
5. *The Explorer Program,* Wilton Sanders

Appendix D
Agenda

Astrophysics Subcommittee meeting
February 14, 2013
Teleconference
AGENDA

Thursday, February 14

1:00 – 1:15 pm	Welcome and Introductions	P. Hertz/B. Peterson
1:15 – 1:45	WFIRST and AFTA Update	N. Gehrels/D. Spergel
1:45 – 2:25	Astrophysics Division Update	P. Hertz
2:25 – 2:45	Review of Astrophysics Performance Goals	J. Centrella
2:45 – 3:15	Astrophysics Roadmap	J. Centrella/B. Peterson
3:15 – 3:45	Explorer Update	W. Sanders
3:45 – 4:00	Committee Discussion and Matters Arising	B. Peterson/APS Members
4:00 – 4:10	Public Comment Period	B. Peterson
4:10 – 5:00	Continue Committee Discussion	B. Peterson
5:00	Adjourn	B. Peterson