

NASA ADVISORY COUNCIL

HELIOPHYSICS SUBCOMMITTEE

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MEETING MINUTES

Maura Hagan, Chair

Jeffrey Newmark, Executive Secretary

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Tuesday, September 17, 2013

Welcome, Overview of Agenda

Dr. Maura Hagan, Heliophysics Subcommittee (HPS) Chair, opened the meeting. Dr. Jeffrey Newmark, Executive Secretary of HPS, took roll. It was noted that Ms. Marian Norris, who for many years served as the Management Support Specialist for the Science Mission Directorate (SMD), was leaving to take another position within NASA. Ms. Ann Delo will now be filling the role of Management Support Specialist. Dr. Hagan and HPS thanked Ms. Norris for her service and welcomed Ms. Lelo.

Dr. Hagan explained that while there were no objections sent forward when the agenda was circulated for comments, it was still open to be changed if needed. In addition, the presentation scheduled for Tuesday at 1:30 p.m. would not occur at this meeting.

Dr. Karel Schrijver was concerned about the discussion of the Heliophysics Roadmap being scheduled for the end of the meeting, and asked if it could be moved up. Dr. Newmark explained that the Government Performance and Results Act Modernization Act (GPRAMA) Performance Assessment Report (PAR) had to be done at the meeting, as it was a deliverable that was due immediately and therefore had a higher priority than the Roadmap. Depending on the Subcommittee's progress with the PAR, earlier discussion of the Roadmap could be an option, but the PAR had to come first. Dr. Hagan noted that the first part of the afternoon was set aside for work sessions, but HPS could then consider rearranging the next day's schedule. As it was, they had 90 minutes for the Roadmap that day. Because Dr. Leonard Strachan was not available the next morning, she would have the GPRAMA vote in the afternoon so that he could participate.

Heliophysics Division Overview

Dr. Newmark noted that it was not possible to postpone this meeting until after the new Heliophysics Division (HPD) Director, Dr. David Chenette, joined the Division on September 30. A number of HPS members were scheduled to rotate off the Subcommittee in November, and it was unlikely that there would be a face-to-face meeting with Dr. Chenette before then. In the meantime, Dr. Jeffrey Hayes was the current Acting Director.

Dr. Hayes said that education and public outreach (E/PO) had been on some people's minds following issuance of the President's Fiscal Year 2014 (FY14) budget, which had consolidated E/PO functions into three other agencies. Since the consolidation status was unclear, NASA was still developing its approach. There would be no new funding for E/PO at NASA, but the Agency wanted to manage the function, as did Dr. John Grunsfeld, SMD Associate Administrator. However, HPD received \$3 million less in the projected FY14 budget than in the existing FY14 budget. This required a strategy that was still being developed. Dr. Hayes noted three "moving parts" to the situation. First, there was no budget yet, and it was also not yet clear whether the budget that would pass would be subject to a sequestration reduction. HPD had a senior review on E/PO as well. Finally, Dr. Chenette had not yet joined the Division, so it was not known what he would want to do in that area. Dr. Hayes did add that Dr. Grunsfeld is happy with HPD's E/PO activities and performance.

Dr. Newmark began his presentation of the HPD overview by stating that the Voyager 1 spacecraft has been determined to be in, or at least close to, interstellar space. More specifically, most agree that Voyager is in a transitional region immediately outside the solar bubble. This development has received a lot of great press attention, which is also good for NASA science in general.

On June 27, NASA launched the Interface Region Imaging Spectrograph (IRIS), HPD's newest solar observatory. The telescope door was successfully opened on July 17 and good quality images and spectra

were acquired in all channels within minutes. A comparison indicates that IRIS has about four to five times the spatial resolution of the Solar Dynamics Observatory (SDO). IRIS has one telescope, two channels for spectroscopy, and two channels for imagers. The program is still learning to understand the instrument, as the mission is in the transition phase. However, the expectation is for good results and interesting science.

The Interstellar Boundary Explorer (IBEX) spacecraft provides a view of the solar system's tail, called the "heliotail." Dr. Mihir Desai referred to a paper about IBEX that notes that current and historical data indicate that the solar system is not in the same interstellar space or region as 20 or 30 years ago.

Dr. Newmark explained that the Heliophysics System Observatory (HSO) has 18 operating missions.. He next reviewed the upcoming Living with a Star (LWS) and Solar Terrestrial Probes (STP) missions. Under LWS, the Balloon Array for RBSP Relativistic Electron Losses (BARREL) balloon mission will augment the measurements of the Van Allen Probes mission. BARREL 1 was launched in January, 2013, and BARREL 2 is planned for January, 2014.

The Space Environment Testbeds (SET) will characterize the space environment and its impact on hardware performance in space, with a launch scheduled for August, 2015. The Solar Orbiter Collaboration (SOC) is to go up no earlier than 2017. This mission will determine how solar transients alter the plasma and magnetic field structure of the inner heliosphere, and will also measure the solar polar magnetic fields. The Solar Probe Plus (SPP) mission will travel close to the surface of the Sun in order to sample the near-Sun environment and probe the solar corona. It will launch no sooner than 2018.

The Magnetospheric Multiscale (MMS) is an STP mission that will use Earth's magnetosphere to study magnetic reconnection. It will launch no later than March, 2015. MMS has completed integration of instrument and spacecraft decks and now has four observatories. Instrument integration and testing continues. Solar Terrestrial Probe #5 has no date and depends upon the budget, but when it launches, if following the decadal survey recommendation it will aid understanding of the outer heliosphere with the interstellar medium, including space weather observations.

In the Explorer program, the IRIS mission will help expand the capacity to forecast space weather. In the spring of 2013, HPD selected the Ionospheric Connection (ICON) and Global-scale Observations of the Limb and Disk (GOLD) missions to enter into Phase B. Based on the President's FY14 budget, it appears that the next Announcement of Opportunity (AO) will be in FY16. An earlier AO is very unlikely. Great science and technology development and training are coming from the Low Cost Access to Space (LCAS) program, which is one of the brightest areas and which HPD wants to continue supporting.

HPD completed a successful confirmation review of the Solar Orbiter collaboration with the European Space Agency (ESA). Dr. Newmark noted that there had been a meeting, part of a regular series, the previous week concerning the launch date. The instruments provided by the United States are on track to meet a 2017 launch, and ESA determines any delay. The budget is set up to accommodate a range of dates between a launch-readiness date and a "no later than" date. The U.S. team is delivering to the former, providing a launcher and integration support for the U.S. instruments. NASA does need to be able to pay the integration teams and to provide support up to the launch. He did not know the cost for the requested launch vehicle. NASA's Launch Services Program (LSP) negotiates this. There is some indication that the ATLAS rocket is not as expensive as previously thought.

The biennial Senior Review of operating missions was completed, and the termination of Cluster II had begun. Dr. Newmark noted that serious budget issues affect all HPS missions. There has been a 14 percent decrease in the operating budget, which affects the operating missions within the portfolio. The trend in the President's budget is not favorable, even going into the future.

At the previous HPS meeting, there was a discussion of the differences between the budgets of the Roadmap and the Decadal Survey (DS). Dr. Newmark explained that the Roadmap, being more recent, had a flattened budget that represented a more conservative approach. Going by the DS projections, HPD has lost money. Neither budget considered sequestration, which could lead to another 5 to 7 percent cut, or even more.

Dr. Hagan pointed out a bookkeeping issue, in that there is a section of the Research budget attributed to HPD that does not, in fact, support HPD work. Dr. Newmark explained that this includes the sounding rockets for all of SMD, half of which are launched by the Astrophysics Division (APD). That budget line also includes the Wallops Research facility. Some of the budget items are simply pass-throughs, and therefore the top line is less than it appears to be. Dr. Hayes confirmed this, adding that APD manages the balloon programs for all of SMD, and the Earth Sciences Division (ESD) is responsible for the airborne missions for SMD, which are mostly, but not entirely, ESD programs. Dr. Newmark further noted that a number of other programs are included in the HPD Research budget, as well as some of the costs associated with NASA center civil servants. However, Congress sees the top line, not the real research amount. Dr. Hagan thought that HPS should be very clear about this. There was discussion about pulling out some of the numbers in the Roadmap in order to provide greater clarity and accuracy, but Dr. Newmark said that it was important to keep the Roadmap and DS comparable. It was further pointed out that the DS mistakenly assumed all of the funds were for research.

Flight Program Status

Dr. Newmark next discussed the status of HPD's flight program. He began by showing a schematic of the dates on which missions are scheduled to launch. ICON and GOLD will need to launch close to each other in order to have synergy in their overlapping science. The MMS and SET launches are scheduled for 2015.

In August, the sounding rocket program launched the VErY high angular Resolution Imaging Spectrometer (VERIS) and RockSat-X missions. The RockSat program launches provide hands-on experience for students, some of whom are now working at Wallops. The Research Range launched the Lunar Atmosphere and Dust Environment Explorer (LADEE) mission and was about to launch the Antares ORB-D1. While these were not HPD missions, they do benefit all of SMD by virtue of the new capabilities that could eventually lead to greater cost-efficiency, among other things.

In the STP area, MMS has had some challenges, such as couplers and a transition issue that have created schedule pressures. Dr. Hagan pointed out that delays increase costs, and a cost overrun in a strategic mission will affect everything else in HPD. This highlights the need to be on time and on budget. Dr. Newmark said that HPD tries to actively manage this. The Van Allen mission was slightly under budget, and HPD would like to replicate that. When missions are under budget, the funds should come back to the Division, which can apply them to accelerate another mission. HPD applied the returned Van Allen funds to sequestration costs.

While there is not an automatic termination associated with overruns of a certain percentage, any cost overrun above 30 percent must go to Congress for review, and there are other trigger points for internal actions. For the most part, the percentages are calculated by lifecycle costs, not by phase, although a cost overrun of over 70 percent in a single phase does require Congressional review.

The LWS program is in good shape overall. The SPP faces a challenge in dealing with temperatures. The mission has a 2-year phase B, which is long. However, the idea is to retire all technology risks in order to

have greater confidence in passing Phases C and D. Therefore, the mission is investing a lot of time and funds up front. The Explorer program is also going well.

Heliophysics Science Performance Assessment Input the FY2013 NASA PAR – Overview

Dr. Newmark led the discussion of the Government Performance and Results Act Modernization Act (GPRAMA), which is a tool to improve the efficiency of all Federal agencies. As part of GPRAMA, NASA's FACA committees and subcommittees serve as the required "expert external review" in evaluating the Agency's work for FY13. Therefore, HPS was asked to evaluate how HPD has demonstrated progress in meeting three key objectives. To provide context and background prior to the meeting, Dr. Newmark had shared with the Subcommittee some additional performance metrics that HPD uses internally.

The three performance goals that HPS was being asked to evaluate are:

- Objective 2.2.1: Improve understanding of the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium.
- Objective 2.2.2: Improve understanding of how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres.
- Objective 2.2.3: Maximize the safety and productivity of human and robotic explorers by developing the capability to predict extreme and dynamic conditions in space.

The top level goals were set in the 2010 science plan, which will be updated in 2014. These goals are consistent with the 2009 Roadmap, and factor into the budget. The Office of Management and Budget (OMB) requires that the science plan serve as a source document. The wording will change slightly in the new Roadmap, new NASA strategic plan and science plan, and future budgets.

Dr. Newmark's foundation document that had been sent to the HPS members prior to the meeting included press releases reflecting a number of missions and accomplishments. The Subcommittee was to determine whether those accomplishments were truly reflective of HPD during FY13, adding or subtracting examples as needed, and writing the examples in their own words. The goal was to have at least a couple of accomplishments under each of the three objectives. Each accomplishment used as an example should have appeared in a peer-reviewed journal or in a NASA press release. Unpublished accomplishments were not acceptable.

Dr. Newmark explained that he asked the project scientists to send their thoughts about potential accomplishments. His foundation document also drew from senior review proposals and the internal evaluations mentioned earlier. However, this was just a starting point. HPS was free to do as they saw fit.

Ms. Jennifer Kearns, Kearns, a Program Analyst within SMD, explained that what HPS wrote would be submitted for inclusion into NASA's annual performance report, which has the intended audience of Congressional staffers and the public. She advised HPS to make note of any accomplishments they considered particularly significant, as the tendency within NASA is to include the information that is most easily grasped by the intelligent layperson. She added that it would be helpful to write the examples in an accessible way. The metrics HPS was to include were the science results, unless there was a very significant issue to address. Ms. Kearns further noted that for each of the three objectives, the performance report would include three or four items, depending on length.

Dr. Hagan asked the HPS membership for their thoughts on potential topics that were not included in Dr. Newmark's list. The following suggestions were made:

- Dr. Schrijver's work on the impact of geomagnetic storms on power systems, which had been published that spring and fell under objective 2.2.2, about effects on society and technology. (Dr. Charles Swenson)
- The changing interstellar conditions related to the third radiation belt for objective 2.2.1. (Dr. Swenson)
- The hiss in the slot region for 2.2.3. (Dr. Swenson)
- The observatories systems under objective 2.2.3, specifically addressing coronal mass ejections (CMEs) and their effect on Earth. (Dr. Schrijver)
- The departure of Voyager 1 from the solar system.
- The Van Allen probes discoveries related to the third radiation belt.
- A combination of two accomplishments from the Aeronomy of Ice in the Mesosphere (AIM) mission. It was noted that one of them had a challenging result. (Dr. Ennio Sanchez)
- The work on characterizing the radiation environment of the moon, which would go into objective 2.2.3. (Dr. W. Jeffrey Hughes)
- Several accomplishments combined into the theme of the magnetospheric response and the influences on its behavior. (Dr. Robert McPherron) Dr. Newmark liked the idea of multiple missions increasing the understanding of a topic, combining multiple observations thematically with new advances.
- Steady magnetic reconnection. (Dr. Schrijver)
- The impact of storms on satellite drag, as a way to highlight the observatory. (Dr. Swenson)

The Subcommittee members volunteered to write about the identified topics individually and in partnerships.

Heliophysics Roadmap Summary

Dr. Edward DeLuca, Chair of the Heliophysics Roadmap Committee, provided an update on the Committee's activities. He explained that the goal of the Roadmap is to implement the DS recommendations to the extent possible, taking into account the constrained budget. To that end, the Committee has constructed a budget that completes the existing program, implements the NASA components of the DRIVE initiative, and evolves the HPD budget distributions to increase emphasis on the grants program, the Explorer program, and missions of opportunity (MoOs). He noted that the Committee cannot determine what the DS panel would have done with the existing budget, and cannot put resources into recreating it.

One of the issues in completing the Roadmap is that the LWS role in space weather research needs to be articulated, and the role of the HSO in supporting space weather enterprise requires near real-time data. At the same time, the HSO is aging, and funds to replace it do not exist.

Dr. DeLuca presented a chart showing the allocated and unallocated budget commitments from 2013 through 2024. There is not much room to maneuver between now and 2019, and DS projects recommended for 2016 will not begin until 2018 at best. Dr. Newmark pointed out that ICON and GOLD were selected after the President's FY14 budget was developed, so the allocated portion of the overall funds is even greater than depicted on the chart. This means that new Explorers are not likely to enter the picture until 2017, when ICON and GOLD are scheduled to launch and some funds become available.

The combination of the DRIVE program with the Explorer program comes close to the DS for the period 2019-2024, despite impact of budget cuts and other funding factors. In terms of emphasis, HPD is doing what the DS asked, but what DS deemed to be research is hidden among a variety of budget lines; the DS did not break it out correctly. Dr. Schrijver pointed out that the spreadsheets HPS receives all have different numbers. He understood that the research budget was either shrinking or growing only

marginally, while the DS saw it growing a lot. He nonetheless thought that Dr. DeLuca was presenting the data optimistically, however.

Dr. Schrijver recommended that the Roadmap state that HPD is struggling and cutting, and therefore cannot really implement the DS. Dr. Newmark suggested that it state that HPD is implementing DRIVE but is not receiving the inflation that was assumed to be in the budgets and the total is less than envisioned, and therefore HPD will not be able to address all of the DS goals.

Dr. DeLuca said it was easier to make an argument that there is a problem with the biggest programs, instead of saying that there is a problem with a program that is 10 percent of the yearly budget. Dr. Schrijver noted that everything is affected, and HPD has not followed what the DS recommended. He thought the Roadmap team and HPD had done a good job of protecting programs, but he saw the out-years as an issue. He hears from the science community that there is much frustration in coming up with a vibrant program that provides launch opportunities and excites the next generation. For the immediate future, NASA has saved programs in development, but the Agency should make clear to OMB that there is a problem going forward. In addition, he believed the Explorer program was in "dismal shape." HPD should have calls for Explorers every 18-24 months, and instead the calls occur at 4-year intervals. DRIVE was meant to be an augmentation of the research line, and yet it seems to be separate.

Dr. Hagan noted that the Roadmap is HPS's document, and the Roadmap team works on their behalf. The science community is experiencing frustration with what they have to work with. The flat budget, and the delayed Explorers and strategic missions, raise questions as to what the community and HPS can do. She felt that they should ask themselves if there might be a way to fix things and improve upon the budget philosophy, leading to an alternative plan. They could not create funding that does not exist, however. Dr. Newmark noted that the Roadmap had taken the first step by saying that the budget is flat. He did not see a problem of getting to FY19; after that, HPD can augment the research line. He added that HPD has asked that the top number remain flat in the Roadmap, and within that, the team has not specified what might be done after the out-years.

Dr. Swenson said that without sufficient resources to implement the DS, HPD will have to cut the scope of what it does. Therefore, since the resources are indeed insufficient, he saw a need to determine the healthiest way to cut the scope. Every element could take an equal percentage reduction, or the Division could cut an element to keep everything else going. It is not possible to reduce all of the projects, so the question then becomes which element is proposed to be sacrificed. He believed the final choice was between cutting strategic missions, or smaller missions, including Explorers.

Dr. Hagan said that the DS provided guidance for this situation, providing a bottom-up approach in which the elements listed at the bottom are most important. She thought Dr. Swenson made a very good point nonetheless. It was noted that the Roadmap team has an impossible task, and they should not try to do the impossible just because they were given this task. Dr. Hagan added that finishing projects that HPD has started takes the Division to 2019, when work on the next DS begins.

Dr. DeLuca said that the numbers and the discussion of numbers must be presented in the right way. The Roadmap team is carrying the STP and LWS costs as in the DS. The team is not going to redo the science priorities. Dr. Schrijver stated that the Roadmap is forcing the community to see that HPD cannot implement what it wants without cutting an individual component. Removing a mission makes no sense, however. The community must think in terms of lower numbers, maybe 40 percent less.

Dr. Sanchez advised thinking outside the box, telling the community that HPD has a set amount of funding to address certain science objectives, then asking what they can do. Dr. Newmark said that the Roadmap has tried to do that in general, but he thought it could be useful to talk about specifics. NASA

needs the community to do the science faster and cheaper. Dr. DeLuca offered to present that graphically in flow charts that could appear in the Roadmap; Dr. Hagan suggested also stating in the text that if HPD saved 40 percent on strategic missions, it could do certain things sooner.

Dr. Newmark thought that instructing the Roadmap team to incorporate 3 percent annual growth after 2019 would be helpful. He pointed out that there are infinite possibilities with the numbers in terms of juggling funds and remaking the science targets. The result would be arbitrary, and the Roadmap team does not have the capability to get into that. The Roadmap should emphasize achievement of cost-effective science targets through the community competing to be innovative. This could be through an open AO, which would solicit proposals for a specific science target.

Dr. Hagan noted that HPS was headed in the direction of such a finding in April, recommending that strategic missions should achieve science through the most efficient means. Dr. Lika Guhathakurta, of NASA, said that the focus has continued to be on large strategic missions that are hard to achieve. She thought the Roadmap could recommend that HPD ask the community to determine what they can do with small missions. The cube satellites do great work, for example, and it is now apparent that they have even greater capabilities. There should be a plan for that, which the Roadmap can articulate. No one knows yet if there is a solution, but the community needs to explore this.

Dr. DeLuca said that the Roadmap team has done what they could with the Explorer program, which has projected budgets of \$133 million by 2020, \$154 million in 2021, and continues at about \$150 million annually after that. This is close to the DS recommendation. Although some in HPS thought that Explorer augmentation should occur sooner, and that the Roadmap should state that this is not happening as planned, Dr. Newmark suggested that the document point out that costs should be kept relatively flat with Explorers to allow technology to make up for inflation. Despite the desire several HPS members expressed for greater frequency, a 3-year cadence is about what is realistic at this point.

Dr. Swenson summarized that HPS would like to see the inflation continue for research, DRIVE, and Explorers, observing that there was a strong feeling that cadence is more important than size with Explorers. He also heard members promote the idea that the strategic missions could become led by principal investigators (PIs) and become the mid-level Explorer missions of the future. Finally, he had a sense that they were giving up for the future the even larger strategic missions HPD used to have.

Dr. DeLuca noted that STPs and the Geospace Dynamics Constellation (GDC) are delayed. He presented pie charges of the programmatic balance, indicating that even with flat budgets, HPD can change the allocations. He identified several long-term missions that are planned to launch in the 2020s. The Roadmap team had plans to specifically articulate that there should be a reordering of the projects for greater synergies among the missions. In comparing the DS recommendations for LWS with the Roadmap, Dr. DeLuca said that HPD is allowed to have smaller, affordable items in the mission lines.

Cost control measures center around three principles:

- Stay flexible;
- Identify cost growth early; and,
- Protect the research program.

Dr. DeLuca saw the community relationship to and NASA definitions of cost growth as being different. At NASA, the cost is not confirmed until Key Decision Point (KDP) C, while the community sees cost growth as starting from the very beginning of a project. The only way to be certain of costs is to have greater reserves. Dr. Newmark added that NASA has been addressing cost issues through a number of measures, including increased scrutiny in the range of costs and schedules in Phase A or early Phase B. This helps identify the likely costs, given the project's complexity. Drs. DeLuca and Swenson agreed that

the strategic missions are the concern here, but Dr. Swenson thought the acquisition strategy was the issue underlying excessive growth, while Dr. Newmark maintained that the issue was the complexity level.

Dr. DeLuca presented the Roadmap team's two recommendations for cost control:

- Implement STP missions as PI-led missions, with the PI fully empowered and motivated to make scientific and mission trade-offs necessary to remain within the cost cap.
- Management of the STP Program will be assigned by NASA Headquarters to a NASA center using a competitive process. The center must demonstrate ability to successfully execute the program for the minimum cost. Program management must also be periodically reviewed by Headquarters and be subject to reassignment in the event of unsatisfactory performance.

He noted that the team had not explicitly identified a budget line supporting the HSOs and the aging infrastructure, and had not decided on the best approach, whether through a competitive program, straightforward replacement of what exists, or some other method. A chart identified which key system science measurements were being taken according to the missions taking those measurements, new programs that will become part of the HSO, and the ages of the measurement programs. It will be important to identify what measurements other satellites require. The intent is to maintain a set of measurements.

Dr. Swenson expressed discomfort with discussing replacement of an aging fleet. He wondered how a spacecraft was determined to be "aging" and whether it is possible to know how long a spacecraft really lasts, or whether or when it needs to be replaced. He would rather focus on science and select the best instruments for the next mission. Dr. Sanchez pointed out that if a spacecraft were to fail, there could be a gap in measurement of key parameters, creating a risk for science. Dr. Swenson recommended stating that NASA needs redundancy to maintain the continuity of key measurements, rather than tying the measurements to specific spacecraft.

Dr. DeLuca agreed. If the goal is to take specific measurements, that is not the same as replicating what already exists. He preferred to identify the key measurements. This was directly related to the final conclusion from his Roadmap presentation:

- Currently there is no funding to replace the functionality of the HSO as it ages.
 - System science requires observations across the system
 - Space weather improvement depends on replacing the HSO and including some near-real time capability.

Dr. Hagan thought that replacement of aging infrastructure was not the best concept to present to those involved in funding. She preferred focusing on the need to ensure continuity in the measurement of key parameters. Dr. Hughes added that they should point out that redundancy is necessary for continuity. Dr. Swenson said that NASA does not launch HSOs for measurements, but gets the measurements from launches. He preferred doing more frequent launches. Dr. DeLuca said that the Roadmap committee felt that people become dependent on certain measurements.

Dr. Schrijver thought that importance is relative to affordability. There are things HPD chooses not to invest in because they preclude other things. He advised staying away from the word "replace," stating that they can increase capacity or upgrade, and noting that modern trains can run on old tracks.

Heliophysics Roadmap Summary Discussion

Dr. Swenson said that he liked the idea of a science queue instead of a mission queue, so that the community can do science instead of focusing on specific missions. Dr. DeLuca noted that at some level, the Roadmap team is tied to the DS regarding specific missions. The intent is to refer to the missions more descriptively, rather than by titles. This meant that instead of an “IMAP” mission, the discussion would be about “an interplanetary particle mission.”

Dr. Swenson was uncomfortable with the idea of saying that there will be a mission in a certain time period with a defined budget. He preferred to identify science objectives, then say whether it would take a small, medium, or large effort to accomplish the objectives. A specific mission locks in the community, whereas science objectives provide the opportunity to be more innovative. Dr. DeLuca suggested wording that offers the possibility of breaking apart the components of the measurements. Dr. Newmark said that if the science targets are primary, a DS mission can be presented as one option for implementation, like a design reference mission (DRM). This approach allows for other implementations might achieve the science target better or more cost effectively.

Subcommittee Discussion

Dr. Hagan had the HPS members report on their progress with the GPRAMA writing assignments. She planned to consolidate the drafts into a master document and distribute it to the Subcommittee. She suggested that those who were finished could start writing about various Roadmap issues.

After discussing writing assignments, Dr. Hagan adjourned the meeting for the day.

Wednesday, September 18, 2013

Heliophysics Senior Review Briefing

Dr. Hayes discussed the results of the recent HPD senior review. IRIS is now part of the suite, and ARTEMIS is now part of the Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission. HPD’s missions are all very stable.

In 2005, Congress passed a law requiring senior reviews of Mission Operations and Data Analysis (MO&DA) programs every 2 years. These reviews allow NASA to justify continuation of missions. “Senior” implies that the review is comparative, as opposed to a peer review. HPD’s senior review makes two assumptions:

- When a mission has completed its prime phase, NASA will accept a higher operational risk, lower data collection efficiency, and instrument/mission degradation due to aging.
- Along with this greater risk, the cost of continuing the mission is expected to be about one third lower than that of the prime mission.

The HPD senior review panel met in late April, and had the following charges:

- Rank the scientific merits on the expected returns from the projects reviewed during the period FY14 through FY19.
- Assess the cost efficiency, data availability and usability, and vitality of each mission’s science team.
- Provide findings on an implementation strategy for the MO&DA portfolio for FY14 through FY19, resulting in one of the following outcomes:
 - Continuation of projects as currently baselined;
 - Continuation of projects with either enhancements or reductions to the current baseline;
 - Project termination.
- Assessment of the strength and ability of the MO&DA portfolio to meet the expectations of the HSO from FY14 through FY19.

All of the missions provided the information the review panel needed. The panel also evaluated the missions against what the science teams said they would do, which helps HPD in its budget justification to Congress, as well as potentially contributing to GPRAMA and subsequent senior reviews.

At the time of the review, each mission was required to have an E/PO component. The review examined data issues as well: the type of data, where it is archived, etc. OMB and the Office of Science and Technology Policy (OSTP) place great value on “big data” that are publicly accessible. One of the President’s goals is to ensure that data, where not personal and where not violating intellectual property rights, are accessible to the taxpayers. However, this brings with it questions about how to prevent misinterpretation and erroneous descriptions.

Dr. Swenson questioned the concern that people will misinterpret data, stating that in a free society, NASA should not worry about that. Dr. Hayes said that everyone comes to data differently. Among the concerns is that published data might be seen as endorsed by the government. Dr. Newmark added that this is a Federal directive, and does not originate with NASA. Dr. Hayes pointed out that HPD is fully compliant with everything the President wants to do, and has open data, as does SMD. Some parts of the Agency are less so, as in accessing astronaut data, for example.

Regarding historical budgets, the 2010 senior review was working with a higher budget, while the FY13 budget was affected by sequestration and other factors, resulting in a net 14 percent cut in the funding of the 14 operating missions within the portfolio, all within the space of 2 years. The senior review panel concluded that this presents a clear and elevated risk to continued successful operations of the mission suite.

The senior review resulted in six findings:

1. The Advanced Colloids Experiment (ACE) and Wind are complementary missions and both should be supported as long as possible;
2. Cluster-II did not make a sufficiently compelling case for continued support, and therefore NASA will withdraw support by 2015;
3. The Solar TERrestrial RELations Observatory (STEREO) and, especially, Hinode missions had larger budgets than the other missions in the portfolio, with unclear justification;
4. The Solar and Heliospheric Observatory (SOHO) mission was determined to be less scientifically useful than before, but the senior review recognized that it has now become an operational asset for NASA and other agencies. The panel found that the SOHO mission should be removed from the MO&DA portfolio, and funded outside of Heliophysics;
5. Voyager is extremely important and unique, but emphasis should be placed on making all the magnetometer data publicly accessible; and,
6. THEMIS has an outstanding and innovative approach, and its funding should be a priority.

Dr. Hayes presented graphic illustrations comparing the scientific merit and system observatory contributions of each mission.

The low budget brings with it two ongoing issues that will have a negative impact on heliophysics:

- Conjunction assessment, and the need to move instruments and spacecraft in order to avoid collisions in space. Each move currently costs about \$87,000, and these add up, especially since they are prorated. When a mission ends, the surviving missions have to pay to avoid potential collisions, so the costs for the survivors continue to increase.
- NASA’s Space Communication and Navigation (SCAN) Program activities are beyond the control of SMD, and Dr. Hayes is concerned that SCAN might someday come to SMD seeking funds for the Program’s activities in support of the science divisions.

The senior review panel developed a budget solution consistent with the President's FY14 budget. However, sequestration is likely to occur for a second year, meaning that the HPD budget will likely drop by 5 to 8 percent, or even more. HPD can justify continued operations of missions, but overall the division will have to be clever and less ambitious. Dr. Newmark added that the "top number" is used in calculating the reduction, not the actual number. In addition, the Agency does not allocate the overall cut evenly, so HPD may lose as much as 10 to 12 percent, probably part of the way into the year.

Dr. McPherron noted that the success rate for proposals has dropped from one in three to about one in seven. He wondered if this was due to funding or the growth in the number of proposals. Dr. Newmark explained that HPD has not reduced the funding, but the budget in the grants program has been flat while costs continue to rise. There are more people asking for more grants with higher costs. Dr. Hayes added that the Research and Analysis (R&A) program has not been augmented since 2004. HPD had to cut the guest investigator program at one point.

Solar and Heliospheric Management Operations Working Group (SH-MOWG) Findings

Dr. James Klimchuk, an astrophysicist with NASA's Goddard Space Flight Center (GSFC), presented the findings from the August Solar and Heliospheric Management Operations Working Group (SH-MOWG) meeting.

The group's first finding had to do with *implementing the recommendations of the DS*. SH-MOWG felt that NASA and the Roadmap team have taken a realistic approach. DS priorities are: continue ongoing missions, implement DRIVE, grow the Explorer program, and leverage with other agencies. The next finding addressed *the Guest Investigator program*. This program should grow, though not at expense of other programs.

It was noted that there is often debate about R&A programs that might receive proposals to use the data. Under the circumstances, it was not clear why HPD needs a special Guest Investigator program, since they all use the same data. Dr. Klimchuk said that the idea is that when new missions are launched, the community might be excited and have a lot of ideas. However, it is important to ensure the emphasis on the original mission goals. Dr. Swenson suggested instead sending funds to the programs to have a dedicated data analyst, for example. Dr. Klimchuk replied that that was similar to what happens. The point is to ensure that there are people committed to that function.

Dr. Schrijver said that if the goal is to ensure detailed interaction with the instrument team, it should be embedded. He thought the difference was fuzzy. Dr. Swenson added that the community does not understand the difference, and this finding perpetuates the ambiguity. The Guest Investigator program should become more distinct. Dr. Klimchuk said that a consolidated R&A program would be more vulnerable to budget cuts. He would like to have the community decide what they want to work on. Dr. Swenson said that the community needs to have a group that understands the experiments and data sets well. There is also a need to bring in new people. He was concerned about losing people, and thought that the Guest Investigator program should address this.

The third SH-MOWG finding concerned *directed and undirected research within the R&A program*. The MOWG opposes more directed research, believing that it should be minor fraction of the R&A program so that the community can research the most promising areas. The type of research being done is evolving somewhat, but there is no need to define a system science program, which involves more costly projects. HPS had recommended that one third be directed; the MOWG preferred less than that. Dr. Newmark explained that the competed R&A program is between one quarter and one third directed.

The fourth finding discussed hardware, specifically *CubeSats*. The DS advises that there be more opportunities in this area, and the MOWG agreed. The fifth finding supports *partnerships* in the United States in order to accomplish the larger science projects. There is a long history of success in this area, which the DS promoted as well. The sixth and final finding supported the NASA Advisory Committee (NAC) recommendation to *keep some E/PO at NASA*. The NASA Administrator did not agree with this recommendation, but the MOWG agrees with the NAC. Specifically, the SH-MOWG states, “Rather than halting nearly all NASA Education and Public Outreach programs immediately, fund and recast FY 2014 as a transitional year where existing programs can be evaluated, and slated for shutdown, transfer to other agencies, or continuance in an orderly fashion. In particular, the Agency should fight for continuance of E/PO activities that are enabled by capabilities that are uniquely NASA’s.”

In discussion, Dr. Desai cautioned that partnerships with the international community must have some balance. Dr. Klimchuk agreed, noting that most such efforts are successful. Not all of the partnership decisions are transparent, though NASA Headquarters would prefer more transparency. It is an evolving situation. Sometimes the decision must be made quickly. While the idea of a cost cap for NASA contributions to international partnerships is appealing, there may be times when the Agency wants to invest more. In retrospect, he wished the first finding had mentioned cost growth.

Dr. Schrijver said that while there have been situations in which collaboration did not work out as planned, as with the Solar Orbiter, that was an opportunity to learn a lesson, and in many cases, international collaboration allows larger missions. Dr. Newmark added that the way HPD does these partnerships evolves over time. A difficulty he sees is that the Agency’s goal for transparency troubles some partners that are more accustomed to working behind closed doors. NASA as a whole wants greater transparency, and seeks opportunities where both sides have a lot to gain. But sometimes the burdens will be uneven in order to keep a long-term partnership going.

Heliophysics Science Performance Assessment, Input for the FY2013 NASA PAR

Dr. Hagan asked the members for the status of their GPRAMA write-ups. She planned on circulating two documents – the working document and an outline for reordering. They would not edit the wording, but rather review content.

Working backwards, HPS began with Objective 2.2.3: “Maximize the safety and productivity of human and robotic explorers by developing the capability to predict extreme and dynamic conditions in space.” The goal was to submit three to five pieces. The following contributions were made:

- Dr. Hughes had written about the moon radiation environment.
- Dr. Hughes also wrote a piece on the extreme CME and solar energetic particle (SEP).
- Dr. McPherron contributed a piece on the magnetosphere/solar wind structures.
- Dr. Desai addressed the Rover voyage to Mars.
- Drs. Schrijver and Strachan wrote about the origin and structure of incoming magnetic storms.
- Other pieces that had been considered were deleted.

For Objective 2.2.2, “Improve understanding of how human society, technological systems, and the habitability of planets are affected by solar variability interacting with planetary magnetic fields and atmospheres,” HPS wrote the following:

- Dr. Swenson wrote about the new radiation belt hazards discovered by the Van Allen probes and the HSO.
- Dr. Swenson contributed a piece on slow solar storms.
- Dr. Swenson also produced an example about space weather impacts on the U.S. electric power grid.
- Drs. Sanchez and Hagan wrote about trophospheric footprints in polar mesospheric clouds.

The following pieces were chosen to be kept under Objective 2.2.1, “Improve understanding of the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium”:

- NASA Voyager leaving the solar system was combined with IBEX images of the heliotail and shifting cosmic wind information.
- There was a piece on the solar wind and coronal heating.
- There was also a write-up about Earth’s extended atmosphere, which was one of the few geospace contributions, though it had to be retitled.
- New SDO observations.
- Exceptionally high-resolution measurements on a sounding rocket.
- “Storm time energy inputs” was moved to Objective 2.2.2.

Dr. Hagan committed to a third version for review later that day.

Heliophysics Science Performance Assessment, Input for the FY2013 NASA PAR

After lunch, Dr. Hagan asked HPS to think about their goal with this exercise. During the lunch break, she and Dr. Newmark had analyzed what made it into the previous year’s report. They realized that there were only two examples per objective, and that the language had to be extremely accessible. Some of the examples they had been working on during this meeting were more accessible than others. She suggested having fewer in each area and prioritizing them.

Dr. Schrijver said that under Objective 2.2.1, the least accessible example was about solar heat. He thought the SDO piece could be edited, with fewer references. Dr. McPherron thought the Voyager and IBEX, new SDO, and sounding rockets pieces should stay. Drs. Sanchez and Hughes advised keeping the one about Earth’s extended atmosphere. There was some debate about this. One reason to keep it was that it was in the area of geospace, which some felt was underrepresented. However, others felt the example was not strong enough to warrant inclusion. Dr. Hagan ultimately removed the solar wind and coronal heating example, and decided that they should revisit the geospace corona and SDO write-ups.

Under Objective 2.2.2, it was agreed to retain the sections on the radiation belt and the impact on the power grid. The polar mesospheric clouds piece was debated, while the traveling atmospheric disturbances section was cut. For Objective 2.2.3, there were write-ups on the magnetosphere, the moon’s radiation environment, and the response of the magnetosphere to solar wind structures.

Final Review and Voting

Dr. Hagan reviewed the SMD criteria for GPRAMA voting:

- Green – Expectations for the research program fully met in context of resources invested.
- Yellow – Some notable or significant shortfalls, but some worthy scientific advancements achieved.
- Red – Major disappointments or shortfalls in scientific outcomes, uncompensated by other unusually positive results.

Subject to additional wordsmithing, the examples kept for Objective 2.2.1 were:

- Voyager enters interstellar space;
- IBEX images the tail of the solar bubble and discovers the shifting of cosmic winds;
- New SDO observations help explain rapid changes in the dynamic corona; and,
- Exceptionally high-resolution measurements on a NASA sounding rocket of a solar coronal active region reveal magnetic braids.

HPS unanimously voted for a green rating.

The examples for Objective 2.2.2 were:

- New radiation belt hazards discovered by the Van Allen probes and the heliophysics system observatory;
- Space weather impacts on the U.S. electric power grid;
- Space traffic may increase polar mesospheric cloud frequency; and,
- Slow solar storm onsets buffer satellites from solar storm effects.

HPS unanimously voted for a green rating.

For Objective 2.2.3, there were three examples:

- Characterizing the Moon's radiation environment through the Cosmic Ray Telescope for the Effects of Radiation (CRaTER) mission;
- Heliophysics data from NASA Rover's voyage to Mars aids human exploration planning; and
- An extreme CME and SEP event.

HPS unanimously voted for a green rating.

Heliophysics Roadmap Discussion

Dr. Hagan welcomed Dr. Larry Kepko of GSFC, Co-Chair of the Roadmap team who was filling in for Dr. DeLuca that day. HPS members asked him for an explanation of the term "unallocated," which seemed to be a misperception. Dr. Kepko explained that "allocated" items cannot be touched, while "unallocated" budget lines could be changed, the grants program being an example.

Dr. Hagan listed some recommendations that HPS had been considering. First, the Roadmap should explicitly state that the DS recommendations cannot be implemented in the DS timeframe because of the substantially reduced budget projections provided to the Roadmap team. Dr. Kepko replied that this might go into an executive summary. Dr. Hagan emphasized the need to make this point repeatedly.

Next, the Explorer frequency remains too low, with substantially longer phasing of the missions, thus posing a serious threat to the required synergy with the HSO. Dr. Newmark said that it is hard to commit to anything where the costs and budgets are unknown. The greater Explorer cadence is not possible without cutting elsewhere. Dr. Schrijver said that the cadence is more important than the full magnitude. If HPD can find ways to lower costs or create opportunities below the cap, that stays within the spirit of the Roadmap.

Dr. Hagan thought that was consistent with the overarching philosophy the Roadmap team wants to espouse, of what can be done with the funds that are, in fact, available. Dr. Kepko said that the executive summary makes the point that the cadence is more important than the program size. Dr. Hagan added that while this philosophy works during times of tremendous budget pressure, it is important to not preclude the ability to do big missions should future budgets allow. It would be better to say that they will see how much science can be achieved with the available dollars.

The third point followed on the discussion of the reduced budget. There should be a finding for HPD to engage the community to help identify ways of achieving the DS science targets. NASA should then assess how the science targets can be accomplished. Dr. Schrijver pointed out that if an AO is issued with a cap, everyone will propose to the cap. So there needs to be an incentive to come in lower.

The next recommendation to the Roadmap team reflects the need to shift from maintaining the HSO to emphasizing that the HSO is a resource for first-rate science. The point is not so much that the components need to be replaced, as it is that the measurements need to be captured in a technologically enhanced manner. The purpose is to ensure continuity.

HPS also debated whether and how to modify cost and inflation assumptions in the out-years of the budget. The amount never reaches the end result of the DS recommendation in absolute dollars, although the percentage might be similar. Dr. Kepko said that the Roadmap team had made that change, highlighting that research was cut and the Roadmap restores it. The highest priority and message is protecting core research. HPS recommended that the Explorer program have the same inflation rate after 5 years. Dr. Newmark explained that, based on the pie charts, the budget percentage is in keeping with the DS recommendations, and HPS wants the actual numbers to match those in the DS. The issue of Explorer cadence came up again. Dr. Hughes noted that although HPD is doing the best it can, the cadence should be every 2 years despite the budget.

Dr. Swenson noted that he had sent an email to the HPS members that included a report outline, draft, and letter from the Coupling, Energetics and Dynamics of Atmospheric Regions (CEDAR) Science Steering Committee (CSSC). The Committee was concerned that NASA is not doing enough for space weather. There was also concern that other SMD divisions spend more on smaller programs compared to HPD, and that HPD is short-sighted in its decisions. Finally, CSSC decried the flat budgets. Dr. Newmark said that HPD has received this letter and was working on a response. The Division largely agrees with the letter and the response will explain why HPD acts as it does. The President's FY14 budget was developed before the DS came out, so the FY15 budget will be first that could reflect the DS. Regarding space weather, the DS recommends a multi-agency study that NASA hopes to pursue as part of a larger program. Nothing has been finalized, however.

Dr. Swenson sought more clarity on the Guest Investigator program. Dr. Newmark said that the DS articulated in the text its vision for why this is needed. A Guest Investigator augmentation is a specific part of the DRIVE program.

Dr. Hagan noted that the SH-MOWG findings were transmitted to HPD and will be reviewed. HPS discussed some of the findings with Dr. Kepko. Regarding the finding about directed versus undirected research, he said that the percentage being spent is close to what was advised.

Subcommittee Discussion

HPS resumed discussion of the SH-MOWG findings. It was noted that the President's FY14 cubesat augmentation does not fall under the DRIVE initiative. Dr. Newmark said that SMD would make the allocation in a way that had yet to be determined. The recommendation was directed to HPD even though the funding is SMD-wide. Dr. Hagan determined that, under those circumstances, and considering the hefty investment level that was beyond the capacity of HPD alone, HPS could do nothing with that finding. HPS agreed with SH-MOWG on the mission partnerships and the E/PO finding.

HPS next returned to its own draft findings. On the topic of the Roadmap, HPS found that the HPD Roadmap team is to be commended for its attempts to implement the research recommendations. It was noted also that HPS views the projected consequences of the budget reduction with grave concern. The reduced mission frequency in all of HPD's budget lines will cause the HSO to lag behind the technological and scientific frontiers at a time when the target of comprehensive observations of the Sun-Earth system is within reach. Moreover, until the early 2020s, the Roadmap does not enable Explorers or MoOs to implement timely, compelling, state-of-the-art missions to support HPD's objectives.

Another finding stated that attempts to implement the NASA/HPD programs as envisioned by the 2013 DS for solar and space physics with the current budget result in a worryingly low mission frequency for the strategic lines (LWS and STP), as well as until the early 2020s for the Explorer MoO line. HPS sees this as a significant risk to HPD's progress toward understanding the physics of the sun's interaction with the Earth, planets, and interstellar medium and to support society's needs for space weather information and forecasts, and as a significant obstacle to the timely deployment of state-of-the-art technology in support of NASA's goals. HPS recommends that HPD urgently study and implement ways to increase its mission frequency within its budget ability. Options to be explored include the application of state-of-the-art technology to meet science goals at reduced expense, exploring the value of missions with full lifecycle costs below \$100 million to reach NASA's goals, optimizing domestic and international partnerships for missions and launch vehicles, and adjusting the scope and sequencing of planned missions.

Dr. Newmark noted that some proposals for MoOs are less costly than others. There are also opportunities with the International Space Station (ISS), as well as balloon missions in conjunction with APD. Dr. Schrijver suggested stating that the MoOs are also extremely valuable and should be even more frequent. Dr. Newmark explained that while MoOs are often associated with Explorers, they can also be independent of Explorers. Historically, MoOs have been about \$50-60 million, which is not a requirement. Dr. Hagan suggested letting Dr. Newmark work on the piece and circulate it for edits so that those HPS members who had had to leave early could provide their input.

Discussion of Future Meeting Dates, Potential Agenda Topics, and Action Items

Dr. Hagan noted that the next HPS meeting will be with a very different group, as most of the current members are cycling off. She asked for ideas from the members on issues to address. One suggestion was for a briefing from the Office of the Chief Technologist, which Dr. Newmark said he would pursue, especially regarding current focus, future projects, and AO opportunities. The geospace MOWG will be on the agenda. Another thought was to learn about the developments with the ISS, and there was interest in the science of space weather. There will also be a long talk with the new director about his vision for HPD. Finally, HPS will see another draft of the Roadmap.

Adjourn

The meeting was adjourned at 4:10 p.m.

Appendix A Attendees

Heliophysics Subcommittee members

Maura Hagan, Chair, National Center for Atmospheric Research

Mihir Desai, Southwest Research Institute

W. Jeffrey Hughes, Boston University

Robert McPherron, University of California

Ennio Sanchez, SRI International

Karel Schrijver, Lockheed Martin Advanced Technology Center

Leonard Strachan, Harvard Smithsonian Center for Astrophysics

Charles Swenson, Utah State University

Jeffrey Newmark, NASA HQ, Executive Secretary

NASA Attendees

Ann Delo, NASA

Lika Guhathakurta, NASA HQ

Jeffrey Hayes, NASA HQ

Larry Kepko, NASA GSFC

Jennifer Kearns, NASA

Jeff Newmark, NASA HQ

Marian Norris, NASA HQ

Christy Rivera, NASA

Other Attendees

Dom Conte, Millennium Space Systems

Ed Deluca, SAO

Lamont DiBiasi, SWRI

John McCarthy, Orbital Sciences

Amy Reis, Zantech IT

Elizabeth Sheley, Zantech IT

Appendix B
Subcommittee Membership

Maura Hagan (Chair)

National Center for Atmospheric Research
Boulder, CO

Mihir I. Desai
Science and Engineering Division
Southwest Research Institute

W. Jeffrey Hughes
Astronomy Department
Boston University

Judith Karpen
NASA Goddard Space Flight Center

Robert McPherron
Institute of Geophysics and Planetary Physics
University of California at Los Angeles

Ennio Sanchez
SRI International

Karel Schrijver
Solar and Astrophysics Laboratory
Lockheed Martin Advanced Technology Center

Leonard Strachan
Smithsonian Astrophysical Observatory
Harvard-Smithsonian Center for Astrophysics

Charles Swenson
Center for Space Engineering
Utah State University

Jeffrey Newmark
Executive Secretary HPS
NASA Headquarters

Marion Norris
Management Support Specialist
Science Mission Directorate
NASA Headquarters

Appendix C
Presentations

1. Heliophysics Division Status; Jeffrey Newmark
2. Heliophysics Division Flight Program Status; Jeffrey Newmark
3. FY13 Heliophysics Science Performance Assessment; Jeffrey Newmark
4. Update on Roadmap Committee Activities; Ed Deluca
5. SH-MOWG Letter; James Klimchuk
6. Heliophysics Senior Review Briefing; Jeffrey Hayes

Appendix D
Agenda

**Heliophysics Subcommittee Meeting
September 17-18, 2013**

Tuesday September 17; 6J42 (MIC 6)

8:30 Subcommittee Room Open

9:00 Welcome, Overview of Agenda M. Hagan, HPS Chair

9:15 Heliophysics Division Overview J. Newmark, NASA HQ

9:45 Flight Program Status J. Newmark, NASA HQ

10:15 BREAK

10:30 Heliophysics Science Performance Assessment J. Newmark, NASA HQ
Input the FY2013 NASA PAR – Overview

11:00 Heliophysics Science Performance Assessment, input for Subcommittee
the FY2013 NASA PAR – Review and Assignments

12:30 LUNCH:

1:30 Geospace MOWG Findings D. Rowland, GSFC

1:45 Subcommittee Work session(s) Subcommittee

3:15 BREAK

3:30 Heliophysics Roadmap Summary E. Deluca, Roadmap Chair

5:00 ADJOURN

Group Dinner

Heliophysics Subcommittee Meeting September 17-18, 2013

Wednesday September 18: 1Q39 (Glennan Room)

8:30 Subcommittee Room Open

9:00 Solar-Heliosphere MOWG Findings

J. Klimchuk, GSFC

10:00 Senior Review of Operating Missions

J. Hayes, NASA HQ

10:30 Heliophysics Science Performance Assessment, input for Subcommittee the FY2013 NASA PAR – Working

Subcommittee

12:00 LUNCH (Move to 6J42 (MIC 6) after lunch)

1:15 Heliophysics Science Performance Assessment, input for Subcommittee the FY2013 NASA PAR – Final Work and Voting

Subcommittee

2:00 Heliophysics Roadmap Discussion

Subcommittee

3:00 BREAK

3:45 Discussion, including future meeting dates, potential agenda topics, action items

Subcommittee

4:00 ADJOURN