

National Aeronautics and Space Administration
Planetary Science Subcommittee
of the
NASA Advisory Council
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NASA Headquarters
Washington, D.C.

MIC-5 11AM-4PM

Teleconference Minutes

Agenda

- PSD Update - Jim Green
 - Status of budget and programmatic impacts
 - Status of the Joint NASA-ESA Mars Program
- Status of R&A Program - Michael New
- Status of PSS Assessment Report & Recommendations to PSD - Jon Rall
- Update on Europa Jupiter System Mission Descoped Options - Curt
- Status of European Space Agency's Potential Jupiter Icy moon Explorer
- Mission – Joan Salute
- Assessment Group Reports

Planetary Science Division Update

Dr. James Green, Director of the Planetary Science Division (PSD), addressed the state of the division in terms of budget, programmatic impacts and a gratifying number of successes to report. He praised the efforts of both the community and the Agency in enabling the recent launch of the Mars Science Laboratory (MSL), for the upcoming orbital insertions of the Gravity Recovery And Interior Laboratory (GRAIL) spacecrafts A and B around the Moon, and the midyear Dawn spacecraft visit to the asteroid Ceres. In mid-August of 2012, MSL is scheduled to land on Mars.

Having only a few budget details, Dr. Green reported that the PSD has been allotted \$1.5B for 2012 in Congressional Appropriations; this is a fairly healthy sum. General language of the bill includes some direction, and NASA will develop a budget plan for each division that incorporates any necessary reductions, being careful to protect high-priority activities, and the balance between missions and critical mission-enabling activities. NASA is in the process of developing an Operations Plan, which has not yet

been provided to Congress. The Appropriations bill also includes specific language for planetary missions, requiring that PSD spend no less than \$581.7 M for Mars exploration, should NASA continue its Mars mission planning. The amount of \$43M has been targeted for an Outer Planets (OP) flagship mission, with the understanding that de-scoping studies will be carried out and submitted to Congress as soon as possible. NASA has also been directed to detail the definition of an appropriately descope OP mission based on the results of the most recent planetary Decadal Survey (DS). Dr. Green indicated that the Department of Energy (DOE) budget has been passed, and has included a clause for \$64M to be put aside for the support of radiological facilities management for space and defense, including \$15M for infrastructure at Oak Ridge National Laboratories. Pointedly, however, there is no specific funding for a re-start of domestic Pu-238 production. NASA will continue to provide funding to DOE for necessary forward studies and assessments in Fiscal Year 2012 (FY12).

Referring to the joint European Space Agency (ESA)/Mars program, Dr. Green reported that NASA has received Congressional encouragement to continue to explore partnership opportunities for future Mars missions. Aside from ESA, Roscosmos (Russia) has also been invited to join this effort. Technical discussions continue and demonstrate high interest from all three parties. Any NASA decisions on future joint Mars missions will hinge on the outcome of these ongoing discussions, and the release of the FY13 budget in February 2012. NASA is committed to a robust robotic and human Mars exploration program.

Senior Review status

NASA sent out draft guidelines for a Senior Review (SR) on September 30th without budget guidance and incorporated them into new guidelines. Due to budgetary problems, the guideline info will be delayed. Working hard to firm up the budgets in FY13 and FY14, the years of the extended missions (EMs) to be considered under the SR. The final deadline is February 2012, which puts the GRAIL mission status at a potential disadvantage for consideration, thus PSD seeks the Planetary Science Subcommittee's (PSS) recommendation to allow GRAIL to conduct its SR earlier, as had been done in the past for the MESSENGER mission to Mercury. The prime mission for GRAIL runs from March to June 2012. A quick turnaround will be needed to properly assess GRAIL for an EM.

Dr. Jim Bell commented on the funding in 2012 for NASA's initial support of Pu-238. Dr. Green indicated that the amount, \$15M, is the same as that allotted in 2011. This sum is more than adequate for DOE to complete its required studies. Referring to NASA/ESA's 2016 Mars mission opportunity, a meeting participant expressed concern about the number of teams currently developing instruments and heading into critical design review (CDR) milestones, getting ready to build; should these teams press on? Dr. Green reported that there has been no direction to stop work on 2016 instruments, but felt it important to note that the 2016 mission is related to the 2018 mission. There is no other direction than to proceed as originally planned.

Dr. Paul Steffes, referring to budget wording for FY12 on Outer Planets (OP) flagships, commented that the language seemed to imply more than a study. Dr. Green replied that it is critical to understand that there are several other OP flagship missions studies recommended in the DS, and there will be some interaction necessary with the study lead (Jet Propulsion Laboratory; JPL) to broaden the study scope to include Enceladus, Uranus, and Venus. NASA is not reading some of the flagship language to mean "outer planets only." The \$122M requested for flagships and OP also includes Cassini, its associated research and analysis (R&A) program, OP R&A, and future missions. The line therefore is not just confined to studies. A question was raised about Titan being recognized as a high-priority planetary target, but with a requirement for considerable technology development. Dr. Green explained that this sort of development is normally addressed in competition-based planetary instrument development calls; these will come out in the February 2012 Research Opportunities in Space and Earth Science (ROSES) call, bearing in mind that the \$43M identified for OP does not yet have an approved Operations Plan.

Dr. Sanjay Limaye asked if the \$43M was also inclusive of the language that describes an appropriately descope flagship mission (not necessarily OP?). Dr. Green answered in the affirmative. Dr. Julie Castillo asked about the status of NASA's participation in ESA's Marco Polo R. Dr. Green explained that NASA has been asked to describe what it would provide to ESA, and has written to ESA a letter for their eyes only. Dr. Green expressed great interest in participating, and looked forward to starting a dialogue, including the provision of some open-ended elements to allow ESA some independence. The next step would be a teleconference, followed by another exchange of boundary-defining letters. Addressing a question on an early review of GRAIL, Dr. Green explained that an early review call might allow GRAIL to be reviewed with other missions if NASA got a request out the following week. A GRAIL EM would start in 2012 and finish in 2013, if approved. The latest GRAIL analysis indicates a chance at surviving their eclipse; their proposal would concern the science possible given that survival.

Dr. Bill McKinnon noted that NASA is conducting consolidated reviews and asked why this is occurring. Dr. Green replied that there is now a philosophy at NASA supporting general regular reviews, in part to discuss missions in relationship to other disciplines' missions, given that there are limited resources in EM lines; these budgets continue to decline in the outyears. NASA expects further changes in the 2013-16 projections, based on current economic realities. These budget cuts can put additional stress on operating missions in outyears, and consequently NASA has been unable to create a budget profile for EMs that is realistic and executable. NASA has tried to communicate this repeatedly to the community: everyone must recognize this. NASA operates via Congressional appropriations and executes Congressional law, on year-by-year basis. Each year, NASA also gets an updated outyear projection. Without a future budget projection, it is not a viable approach for NASA to start a mission by trying to obtain year-by-year funding from Congress. It is a better approach to work within the Administration and understand its priorities. When budgets move down rapidly and in large amounts, NASA must make reductions in content and scope, which can mean mission cancellations.

Dr. Mark Sykes raised a question about ongoing missions and guidelines, whether the guideline planned for extended missions allowed for all of those missions to continue if their science still warranted continuation, or did the guideline set at a level that would not allow this? Dr. Green replied that a notional approach is usually applied to this scenario, noting however that the final guidance may be very different, depending on what the budget is. Dr. John Grant asked if a Discovery mission could be postponed in this scenario. Dr. Green responded that this can occur if NASA knows it has a certain amount of money in the outyears; NASA is not yet at the stage to be able to look at the trades. Dr. Jim Bell, referring to the Mars 2018 mission, expressed concern that ESA may have a time limit on its commitment. Dr. Green felt that ESA has been more than generous in working with NASA, and that the Agency is pushing the limits even on the 2016 mission. However, he believed strongly that ESA is putting forth its best effort, given the current situation, and would like to think ESA and NASA can move forward on Mars no matter what happens in FY12.

Dr. Limaye complimented both Dr. Green and Dr. Steve Squyres on recent subcommittee testimony on the subject of the planetary DS and the future directions of planetary science. PSS briefly discussed details of a GRAIL EM, which would run 9 months from its inception, placing its ending roughly in the first quarter of 2013. The cost would be a “handful” of millions per month. Dr. Green noted that GRAIL has come in under budget, and under external cost commitment, and is carrying reserve on top of that. GRAIL by nature of its observations, will also have a very finite lifetime due to fuel; it takes energy to stay in a lower orbit, and the proposed EM would be the only EM possible. There was general PSS support for this early request, but PSS also recommended that NASA review GRAIL alongside other missions if possible. PSS also noted the arrival of new SMD Associate Administrator John Grunsfeld, who comes to the directorate with excellent human exploration experience. He will arrive in early January, with a loaded schedule, and opportunities for one-on-ones and more formal meetings.

Asked when other SR proposals would be requested, Dr. Green replied that once NASA gets its 5-year budget horizon (through 2017) in mid February; then it would be possible to construct a budget that will enable NASA to issue guidelines. This could possibly happen before the budget announcement. Dr. Green’s approach would be to issue the guidelines the day following the announcement. There will still be a 120-day period for proposals, which is workable even with major changes.

R&A Update: Analysis of Proposer and Reviewer Workloads

Dr. Michael New addressed anecdotal evidence that has built up over time concerning the workload of the community. In his analysis, he tried to statistically tease out information about the issue. Using NSPIRES data, Dr. New looked at proposer workload. In this database, there were 1375 proposals to 17 solicitations in the 2009 ROSES call. The 1375 proposals had 917 unique principal investigators (PIs). An Excel spreadsheet was used to examine the cumulative distribution function (CDF) of distribution, with the following results: 69% of the PIs submitted only a single proposal, 95% submitted 3 or fewer proposals, and 5% submitted 4 or more proposals. There was some variation across

institution type, with researchers from nonprofit organizations more likely to submit more than one proposal, compared to researchers from other organization types. Researchers from NASA centers were also likely to submit more than one proposal.

Supporting data comes from a 2010 American Astronomical Society (AAS) Division for Planetary Sciences (DPS) member survey; 1290 surveys were mailed out, and 590 responded. Fifty-seven percent of respondents reported needing one or 2 active grants, and 76% reported needing 3 or fewer grants, to stay afloat. In terms of reviewer workload, Dr. New referred to a set of data compiled by Susan Keddie, contained within the ROSES-2010 Reviewer Database. Dr. New noted that there were 7813 assignments (not including APD), with 1699 individuals participating as reviewers; 35% of these reviewers were PIs receiving FY10 funds. The median number of review assignments was 3 per year.

Dr. New estimated the size of the planetary community at roughly 5000, including astrobiologists who might not be included based on some survey criteria. Given estimated data from various sources, including the Planetary Science Workforce Survey, about 30-60% of the community appears to have been involved in evaluating proposals for ROSES-2010. Sources indicate that 90% of those reviewers who serve on a panel, serve on only one panel. About 90% of those who provide external reviews do so for just over 2 panels. There is a wide variation in workload however, and being a funded PI seemed to have a small effect on reviewer workload. There was really no notable effect observed on panelist reviewer workload.

Dr. New's conclusions were that, on average, the community is not submitting multiple proposals to NASA. On average, community members are serving on only one review panel per year, with a small number of nonpanelist reviewers serving on 2 other panels.

Dr. Dave Desmarais asked about the perception that NASA program managers (PMs) are overburdened. Dr. New responded that anecdotally, one can say that managing 1700 proposals is a huge undertaking, and managing just two grants is a full-time job. The most recent DS addressed this workload issue as well. Dr. Green added that the National Research Council (NRC) also stated clearly that NASA Headquarters (HQ) is overworked across the disciplines; this information has been provided to the new AA. Dr. Jim Slavin commented that HQ labors under severe limits that cap the number of employees who can do such work; in the community, conversely, overwork would quickly be seen as a drop in proposals and an increase in success rate. A participant commented that if, as the data indicate, 15% of the community has agreed to do 10 or more reviews a year, this is also a significant burden. Dr. New added that it would be necessary to investigate why such individuals would be asked to do so many reviews. Are the people who are making more proposals involved on more review panels?

Dr. New reminded PSS that serving on review panels is a voluntary process. Asked how other agencies compare, Dr. New replied that at NSF, an average individual workload could be reviewing 30-40 proposals, easily, per year. A subcommittee member with NSF experience supported that notion, and added that NSF is trying to address the problem.

PSS expressed much gratitude for Dr. New's work. Dr. Castillo felt data on age and career level might be useful. Dr. New reported that NASA did not collect that information. Dr. Castillo further suggested that when the number of missions decreased, researchers might have to write more proposals. Asked if PI data of related interest be generated in automated fashion, Dr. New replied in the affirmative, but added that any change to NSPIRES would require funding; such changes would also be negotiated between NASA Research and Education Support Services (NRESS) and the four directorates at HQ that use NSPIRES. Funding would most likely to come from SMD. Reporting options are not publicly exposed' one cannot simply go to the website, set up a query and get a response. Addressing the question of how to help out those overburdened reviewers, Dr. New noted that pertinent information is available, and agreed to explore whether NRESS might report that data as a matter of course, but agreed that this would not capture all the burden, as it covers only those who were asked to give reviews and agreed to do so. Dr. New added that there is also a fraction who were asked to and who did not consent to provide a review- they do not appear in NSPIRES. Dr. New agreed to put a version of his slides on the SARA website, where they would be useful in dispelling misperceptions. Dr. Green agreed to pursuing similar data on NSF and trying to determine an overlap of names, to shed more light on the matter.

Status of R&A Assessment Report

Dr. Jonathan Rall reported on the progress of an internal NASA assessment of PSD's R&A program; the final version has been circulated to the various officers in SMD, and on the preceding day there had been a Planetary offsite retreat discussing how the R&A program will be revamped in light of the budget. Dr. Green is committed to sustaining flat funding of \$200M per year for the foreseeable future, based in part on historical needs for the program. Once again, it was noted that HQ will continue to have a limit on how many full-time employees (FTEs) can be maintained at SMD. Currently, SMD is filling vacant slots with detailees; there is not a lot of latitude in hiring more officers. Internal review and comment will continue, with a more thorough discussion promised for the PSS Spring meeting. PSD is pursuing identification of what needs to be in and out of the R&A program. The \$200M figure is up for modification, however, PSD can't base its future on this year's budget. The planetary research line contains many things that are not solicited R&A. Dr. Sykes commented that the DS and NRC both support a figure of \$220M. Dr. Rall assured participants that the report will continue to be vetted through the PSS.

Responding to an assertion that percentage success ratios and their trends are on the downswing (as low as 10%), Dr. Rall reported that the average success ratio is in fact in excess of 30-34% of proposals. This figure is much better than NSF's. However success rates do vary, and assessing the reason for that variation will be part of the internal R&A review. However, success rate is not the only metric. The fact remains that PSD will not get more money and therefore must plan on real and substantial criteria for programs. Rearranging panels to reduce the workload at HQ is one item being discussed and will be further evaluated with PSS. Dr. Limaye asked if it were possible to break data into targets, as the Venus community felt their proposals were not reviewed properly due to

the small size of their community. Dr. Rall noted that NSPIRES lacks the key-word analysis capability to enable such targeting.

A participant commented that a rumor had surfaced that some programs had few proposals, such as Lunar Advanced Science and Exploration Research (LASER) and MMAMA. Dr. Rall pointed out that LASER had made selections this year, and had sent awards to 22 PIs, and will probably be able to fund several more proposals. LASER received 121 proposals this year, a 20% increase over last year. However R&A did not get a 20% increase in budget. Ultimately, LASER is expected to have about a 23% success rate. Dr. Sarah Noble noted that MMAMA had increased proposals, as well as a large number of 4-year proposals, thus the selection rate went down due to the flat budget. All data on success rates are available on the SARA website. There was a call for statements from program officers on why these rates were low, and a suggestion to exclude participating scientists from these success rate numbers, as it distorts success rate for US investigators (the foreign investigators do not get NASA funds).

Status of Europa mission

Dr. Curt Niebur reported on the status of the newly descoped Jupiter Europa Orbiter (JEO) mission, which had seemed to be firmly in place in January 2011. The DS recommended this mission as second highest priority behind MAX-C. Thus the DS made it clear that the mission that had been designed toward for many years was no longer viable. Beyond the DS language, the mission opportunity for Europa is not currently defined, and there is no set of mission parameters like budget, launch date, etc. PSD is wary of moving forward on a mission concept before such parameters are in place. Since the DS came out, PSD has been evolving the JEO so as to be responsive to budgetary and programmatic changes. NASA must match the mission concepts and technologies under development to the likely mission opportunity.

Study guidelines for the newly descoped mission will help to define and validate a set of minimum concepts that demonstrate missions at the low end of the cost spectrum, which are effectively subsets of JEO missions. The cost target is \$1.5B (excluding launch vehicle), and the reliability of the cost estimate takes precedence over target. A small revitalized SDT continues to emphasize cost models.

The mission retains the goal of exploring Europa to investigate its habitability in terms of water, chemistry, and energy, characterizing its internal ocean, ice shell, any subsurface water above the ocean, the composition of surface, and the geology (level of interaction between surface and sub-ice ocean). Last spring a Science Definition Team (SDT) was established to deconvolve JEO into a fly-by element and an orbiter element, each of which can accomplish compelling, stand-alone science. The orbiter will characterize Europa's ocean as only can be done from Europa orbit. The fly-by is to use remote measurements to study the ice shell, composition, and geology that can be accomplished by multiple fly-bys (about 35). The concepts are quite mature. NASA HQ has asked the SDT to consider a mission lander for *in situ* measurements of composition and

seismology (this concept is not quite as mature). The orbiter and fly-by concepts have been presented to the Outer Planets Assessment Group (OPAG).

The orbiter is being designed to conduct a 1.5-year, Jovian tour, spending 30 days in near-polar orbit around Europa, with 5 instruments operating simultaneously (22 kg, 30 W), including radio science, laser altimeter, magnetometer, Langmuir probe, and mapping camera. A total radiation dose of 1.5 Mrad is expected to impact the orbiter. Getting into Europa orbit is time-consuming and power-consuming. Sterilization of the craft would be carried out via Viking-level microbial reduction methods. A new Planetary Protection policy on icy bodies is coming out and will have to be considered as well.

The fly-by concept includes 34 fly-bys over 28 months. The spacecraft payload would include ice-penetrating radar, shortwave IR spectrometry, topographical imager, and ion and neutral mass spectrometers. A total ionizing dose of 2.0 Mrad is expected to be absorbed by the fly-by craft. There are robust margins on mass and power. Disposal of the DHMR-sterilized fly-by craft would be onto the Ganymede surface. An independent technical review chaired by Scott Hubbard was held on November 15, 2011. The review concluded that the mission scenario contains mature concepts, no showstoppers, and creative approaches to reducing cost and risk. The general opinion is that the fly-by would yield more science than the orbiter mission. The most significant technical risks to the mission are Advanced Sterling Radioisotope Generator (ASRG) performance re: Pu-238 availability, and instrument detectors withstanding high radiation loads.

An identical technical review will be held for a lander mission concept in March. Aerospace Corporation will perform independent cost and technical analyses. Dr. Niebur felt confident that NASA would have a variety of Europa mission concepts available when an opportunity arises. Until some knowledge of cost and schedule are gained, however, it will be prudent to concentrate on reducing the risks of any Europa mission, such as ASRG availability. PSD will be delivering concepts to the Congressional Appropriations Committee in late Spring 2012. There is no assumption for having to fly two spacecraft on one launch vehicle; the missions are designed to be independent. Dr. Hubbard's committee was not chartered to evaluate cost, but did conclude that the missions were within the scope of the stated costs. However, it must be noted that this not an official cost assessment. Dr. McKinnon noted that the OPAG had commented that no new technology was needed for the missions. Dr. Niebur reported that this comment was correct; this approach uses only off-the-shelf instruments, and these will need to be well shielded. Detectors are a different issue; they need to be tested in a linear accelerator. Dr. McKinnon felt that this seemed to be an appropriate place to spend some of the \$43M. Dr. Niebur replied that JPL is not going to build every detector; instruments need to be developed from a broad array of sources. The fly-by approach will eliminate any global mapping of Europa. The radiation dose is also dependent on the number of fly-bys. The fly-by speed of Europa is too fast for radar mapping. Each fly-by can store a lot of data without significant onboard processing. With this approach, data can be sent back directly to Earth. Some scientists are very happy about this. Final results of the concept studies will be presented in May/June, and budgets must wait until February 2012.

ESA's Juice Mission Update

Ms. Joan Salute presented details on ESA's restructured Europa Jupiter System Mission (EJSM)-LaPlace concept, which is now known as the Jupiter Icy Moons Explorer (JUICE). The major task of the re-structure was to reformulate the science case, mission, and study to determine if, and which of, the original science goals are worth pursuing. ESA has added two Europa fly-bys, interleaved with a Callisto option. JUICE will provide new science at Europa and retains the Jupiter and magnetosphere concepts.

The JUICE mission would consist of a multipurpose orbiter designed to orbit first around Jupiter, then around Callisto after 2 Europa fly-bys, followed by disposal into Ganymede after 9 months of orbit around Ganymede. The "yellow book" was turned in in late 2011. The current plans for milestones are: Downselection to one mission in April 2012; instrument AO in the second quarter of 2012; launch in 2022/23; with arrival at Jupiter in 2030. Some changes from the original mission include more radiation exposure, thus the instruments will require more shielding mass, and more radiation-tolerant instruments must also be developed. There are minor additional delta-v requirements, and only 20% mass margins. NASA plans to support instruments on JUICE if it is selected, with further details yet to be determined depending on the number of instruments, call vehicles (SALMON or other), timing, the nature of agreement with ESA, To date, there have been no discussions of integrating the mission beyond instruments being shared.

Assessment Groups Reporting

Mars Exploration Program Assessment Group (MEPAG)

Dr. Desmarais presented recent results in the Mars program. MSL has launched successfully, representing a major milestone, and is on its way to Gale Crater on Mars, a site that contains evidence of water-related minerals such as polyhydrated sulfates and clays, hematite, olivine, etc., which may provide a record of water activity over time. The Mars Exploration Rover Opportunity has completed its 3-year journey to the Endeavour crater. The rover has conducted an analysis of bedrock, which appears to be a suevite of basaltic composition, and also appears to be altered by impact-related hydrothermal activity. The challenge now is to face the sun in order to survive Opportunity's 5th winter. Dr. Desmarais displayed views of the Homestake Vein Deposit, a bright linear feature rich in calcium and sulfur, possibly representing gypsum, and altered carbonate that is consistent with fluid flow.

ESA and NASA met in Lisbon in June 2011. Lisbon meeting participants endorsed the 2016/2018 DS priorities for Mars, and endorsed a proposal to emulate the MSL site selection process for the 2018 Joint Rover. Dr. Desmarais noted the urgency of using existing orbital assets. An End-2-End International SAG (E2E-iSAG) report on sample return was issued addressing Mars Sample Return (MSR) science objectives, landing sites, sample types and priorities, and Earth-based laboratory concepts. The report was endorsed by the joint community. Discussions of prioritized MSR science objectives, derived implications, critical science planning questions for 2018, etc., also took place

The key message is that MSR should address eight, major community-developed science questions, through a carefully selected sample suite. There are multiple potential landing sites for achieving various objectives. The eight major questions include evaluating potential critical resources for future human explorers, as well as examining the atmosphere, regolith, and unaltered igneous rocks. An effort was made to keep mission complexity down through the use of Mars Exploration Rover (MER)-class instruments and rover, plus a caching ability. Extended missions being considered under the upcoming Senior Review include MER-Opportunity, Mars Odyssey, and the Mars Reconnaissance Orbiter (MRO).

Some science highlights were discussed, such as MRO's images of seasonal flows on warm Martian slopes; the activity of brines appears to be the best model for this behavior. Massive south polar CO₂ deposits have also been documented by MRO's Shallow Subsurface Radar Detector (SHARAD) detector- this new inventory would increase Mars' atmospheric mass by 80% if released.

In future planning are the Mars Recent Climate change workshop, and a meeting marking the MSL landing on Mars in August 2012. MEPAG remains committed to the Mars 2016/2018 plan, and has noted the high scientific and programmatic value of the Mars program. Asked about the planning phase for a Mars sample cacher and the technologies for bringing it to orbit and back to Earth, Dr. Desmarais felt that the community had a good idea of what can be handled.

Venus Exploration Assessment Group (VeXAG)

Dr. Sanjay Limaye presented recent results from the VeXAG. Sue Smrekar stepped down in September 2011; VeXAG held its last meeting in late August/September, which covered the development of new focus groups, a discussion with Discovery Venus PIs, and a discussion of the upcoming 2012 Venus Transit Activities (June 5-6, 2012). A steering committee meeting was held in November. The Venus Comparative Climatology meeting (Boulder, June 2012) will be sponsored by all four divisions of SMD. VeXAG has formed new focus groups: VEXAG goals, objectives, and investigations; technology and laboratory measurements; international Venus Exploration, and a Young Scientists and Students Focus Group, the latter of which is an effort to bring new blood into the community.

Another new effort for VeXAG is a bimonthly newsletter for the Venus community; the first was released in October, and the December issue is coming out shortly. The newsletter is posted on the VEXAG URL (www.lpi.usra.edu/vexag). Future meetings include Planetary Science from a Balloon Platform, an LPSC "Special Session" on Venus and Townhall meeting. There will be another VEXAG meeting in the Spring in Washington, D.C. (TBA); and an Exploration Sites workshop is also being planned. Meetings of interest to the community include an International Planetary Probe Workshop in June, an "Exploration of Venus" subsection at COSPAR in July 2012 in Mysore; and the AOGS-WPGM Joint Meeting in August in Singapore.

The Venus Express mission has been extended through 2014. Operations are normal, and a decision on aerobraking operations to reduce the orbit period has been postponed; the VIRTIS cooler has reached the end of its life, and is returning only visible data. The Japanese Akatsuki mission, which launched in May 2010 and arrived at Venus December 2010, did not achieve orbit. However, mission operators were able to conduct successful orbit trim maneuvers in November 2011 that will enable a close fly-by in 2015, followed by options to enter into a long equatorial orbit in 2016 and beyond, using the reaction control system (thrusters). A danger is getting too close to sun, as 8 perihelial passes will be made through 2015. Dr. Limaye hoped to resurrect the participating scientist program at NASA at that time. Future missions in discussion include a JAXA follow-on mission to Venus; Russia is still studying VENERA-D, which is likely to be postponed beyond 2016.

Researchers are looking forward to this year's Venus transit. Scientific (particularly coronagraphic) observations are being planned; with a potential demonstration of capabilities for observing extrasolar terrestrial planet atmospheres. VeXAG is coordinating and working with NASA/SMD Education Public Outreach (EPO) for Venus Transit events worldwide.

New results have been obtained from Venus Express: Venus possesses an ozone layer, and there are new measurements of the thermal structure in the 90-110 km range. VMC continues to see new morphologies of the global cloud cover. Asymmetrical vortices have also been observed on Venus. Venus spiral bands behave like tropical cyclone rain bands, implying that the bands move slower than the ambient flow. Vortex spin-up and spin-down have been also observed for the first time. Dr. Limaye also reported that an update to the Venus International Reference Atmosphere model is to be published by 2014.

Small Bodies Assessment Group (SBAG)

Dr. Mark Sykes presented the latest SBAG results. The AG held its last meeting in August, wherein it discussed a SB Exploration Roadmap. The roadmap is an ongoing process, and is being condensed by a Roadmap Action Team. Work has begun on a white paper on a Small Bodies Science Institute, containing some "cornerstone projects." SBAG is expanding its Steering Group representation to include technology representation, and selected John Dankanitch, from NASA Goddard Research Center GRC. Dr. Dankanitch is also the lead of the Technology chapter of the SBAG Roadmap. Science highlights include Dawn's images at Vesta, which have revealed the varied surface of the asteroid as well as landslides. WISE discovered the first Earth Trojan asteroid, an object of a few hundred meters in diameter. A carbonaceous Near-Earth Object (NEO) came within 0.85 lunar distance on Nov 8, 2011; the object is considered both a potential resource target and a hazard.

Outer Planets Assessment Group (OPAG)

Dr. McKinnon presented the latest activities encompassed by OPAG. The Juno spacecraft to Jupiter was successfully launched in July 2011; the mission was featured in the

September issue of *Sky and Telescope*. Juno will observe gravity, magnetic field, water abundance, deep atmospheric characterization, polar magnetosphere and aurorae at Jupiter. The Cassini Solstice mission detected strong radio emissions, dubbed the “Serpent Storm 2011,” an upwelling storm that spread in a latitudinal band across Saturn. The storm was also observed by an amateur astronomer and continues to evolve. Ripples in Saturn’s rings, believed to result from perturbations by the tail of a passing comet, were also closely observed. The same phenomenon is believed to occur in Jupiter’s faint rings. Spring “rain” was noted on Saturn’s moon Titan, represented by a huge cloud observed in September 2010, followed by extensive changes in a 500,000-km² area. This activity may be analogous to desert Southwest storms on Earth.

In a summary of OPAG findings from October 2011, the Cassini Solstice mission science was strongly endorsed, particularly the final phase. OPAG urged NASA to continue to fund the mission at a level to safely operate spacecraft and to obtain and analyze the data. The end of the mission is deemed to be a fantastic opportunity for science. The plan is to shift to a proximal orbit inside the ring, to become a Juno-like mission around Saturn; this has the potential to “close the loop” on the two giant planets.

OPAG also expressed its concern that Cassini, like the Mars mission, is an international mission. The uncertainty about NASA’s budget in Europe has been reflected in a finding of ESA’s Solar System Exploration Working Group (SSEWG). Regarding the consolidated Senior Review at NASA, OPAG urged that rationales for all cuts be clearly specified, called for transparency in the process between NASA, the affected projects, PSS, and the community. Regarding the Europa Flagship mission de-scope, OPAG strongly encouraged selection and a new start of a Europa mission ASAP, given the required technical and cost parameters. OPAG also strongly endorsed the recommendations of the Planetary Science Technology Review Panel, and felt that PSS should urge NASA to adopt them, particularly a recommendation to hire a Technology Director within PSD. OPAG also recommends study to begin on a Uranus flagship mission.

Science highlights include the image of an Enceladus plume taken in October 2011 during a Cassini fly-by; the majority of the moon’s low-altitude plumes are salty and fall back to the surface. Europa has also been featured in *Nature* (Schmidt, *et al.*), in a paper positing that the feature Thera Macula is active at present; a chaos region in formation. This paper is based on archival data from the Galileo mission.

Lunar Exploration Assessment Group (LEAG)

Dr. Chip Shearer reported on LEAG results. A LEAG workshop on a “wet vs. dry” Moon was held; its purpose was to integrate mission observations from the Lunar Reconnaissance Orbiter (LRO), the LCROSS impact mission, and sample data, and modeling, to gain understanding reservoirs of volatiles on the Moon, as well as future visions of exploring and utilizing these volatiles. LEAG is currently evaluating the Lunar Exploration Roadmap against the Planetary Decadal Survey, and devised an enabling robotic precursor campaign; all results to be found at lpi.usra.edu/leag.

In July, LEAG had a workshop involving the participants of the Google X prize teams, which seek to put a package on the Moon. LEAG attempted to educate the teams on lunar surface science via a series of town hall meetings, included a panel discussion on human destinations. Rob Kelso made a presentation on lunar heritage sites, suggesting how one should approach Apollo and other historic sites on the Moon. The annual meeting of LEAG discussed options and opportunities for the next decade, focusing on breakthrough science, commercial opportunities, and the Moon as a gateway for future Solar System exploration. LEAG has completed reports, both in tandem with CAPTEM, on human activities on planetary surfaces and sample curation on Earth, and lunar regolith simulants. LEAG also carried out a GAP-SAT activity, which was an analysis of strategic gaps and the next asteroid scenario, and L2-SAT, a team that studied the best work that could be done at the Earth/Moon/Lagrange Point 2 system.

Science results include observations of non-mare silicic volcanism on the lunar farside, a material that is different from the mare basalts and is thought to be similar to Alaskan Katmai domes. High pre-eruptive water contents preserved in lunar melt inclusions were featured in a report by Hauri *et al.* in *Science*, suggesting chronological evidence that the Moon is either young or did not have a global magma ocean. The inclusions were found in a sample of oldest primordial crust on Moon, thought to be only about 4.25 to 4.3B years old.

Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM)

CAPTEM's last meeting was held in September 2011. CAPTEM's active sample allocation program is continuing. Current issues for CAPTEM include the E2EiSAG report on Mars, and the development of a long-term curation plan. The Hayabusa allocation subcommittee is ramping up; 10% of the comet sample set will be coming to NASA over the next year. New initiatives for CAPTEM will include these first Hayabusa samples, to be distributed by Spring 2012. The Inspector General Report on NASA's management of lunar samples and other astromaterials has been completed.

CAPTEM considered the issue of whether Mercury have its own AG, and concluded that it did not. The MESSENGER team concurred with this conclusion. Sufficient meetings and workshops on Mercury are already in place, as are relations with the Bepi-Colombo project. The question may be revisited in 2-3 years. CAPTEM would like to make sure Mercury science remains well represented on PSS, particularly with regard to data storage and processing in the aftermath of missions.

Dr. Anna Louise Reysenbach reported briefly that MESSENGER is doing well, instrumentally and craft-wise. Science has been accomplished en route and during fly-bys; and was presented at 3 sessions at the American Geophysical Union (AGU) meeting. Mercury harbors more volatiles than expected, with an unexpected richness in volcanic and tectonic history. The internal magnetic field is an offset dipole. Mercury also exhibits hollows in its surface, perhaps connected to volatile loss; the hollows appear very young. MESSENGER continues to study the composition of poles and shadows. The planet's exosphere and magnetosphere are very dynamic on a daily scale. The *Science* September 2011 issue was devoted to MESSENGER. An EM has been approved for a 12-month

mission; during this time MESSENGER will observe Sun-planet interactions during a phase of solar activity not seen by prior or planned missions.

Wrap-up

Dr. Rall noted the sole action item, which was a request to Dr. Green to issue the GRAIL proposal ASAP. Dr. Rall agreed to give an update on the Program Office response to PSS recommendations, and to post success rates in funding on the SARA website. PSS tentatively agreed to hold a teleconference after the February budget release.

Participants

Ben Bass, Congressional Quarterly
Patricia Beauchamp, JPL
Jim Beel, ASU
Yudhijit Bhattacharjee, Science
Michael Bickay, ARC
Linda Billings, GWU
Janice Buckner, NASA HQ
Julie Castillo, JPL
Caitlin Chell, Caltech
Dennon Clardy, MSFC
Stephen Clark, Space Flight Now
Anne Connor, House Space Science and
Tech Committee
Dominick Conte, Orbital Sciences
Tom Cravens, U Kansas
David Desmarais, ARC
Sean Domagal-Goldman, NASA HQ
CG Essex, No Affiliation/Retired
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