# NASA Astrophysics

# ASTROPHYSICS ADVISORY COMMITTEE

March 29-30, 2023
Hybrid Meeting

MEETING MINUTES

Kelly Holley-Bockelmann, Chair

HASHIMA HASAN

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Hashima Hasan, Executive Secretary

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*Tom & Jerry, Inc.*

Wednesday, March 29

Introduction and Announcements

Dr. Hashima Hasan, Executive Secretary of the Astrophysics Advisory Committee (APAC), welcomed the members of the committee to the meeting and called the meeting to order at 10:02 a.m. EST. APAC is a federal advisory committee established under the Federal Advisory Committee Act. The meeting is open to the public and is being recorded on Webex by NASA. By attending the meeting, participants consent to their voice and likeness being recorded for use for government purposes on the APAC website and in any media now known or hereafter. Participants released NASA from any claims and demands that may arise from such use, including claims for compensation. While discussions during the meeting were for APAC members only, the public would have opportunities to ask questions via the WebEx chat feature and a web portal. Any member of the public who wished to speak during the public comment period could use the Raise Hand feature to be recognized by the Chair before unmuting and speaking. All presentations, discussions and comments by the Committee members were on the record, the meeting was being recorded, and formal minutes were taken.

The NASA Science Mission Directorate (SMD) Associate Administrator (AA) appointed the members of APAC based on their subject matter expertise as individuals, and each member must comply with the Federal ethics laws applying to Special Government Employees (SGEs). Committee members were required to recuse themselves from discussion of any topics for which they had personal or institutional financial conflicts of interest (COIs). The following conflicts were identified and the members were requested to leave during the presentation and discussion of the topics noted: Dr. Erika Hamden and Dr. Ilaria Pascucci from the University of Arizona on the Galactic/Extragalactic ULDB Spectroscopic Terahertz Observatory (GUSTO), Dr. Alina Kiessling from JPL on the Spectro-Photometer for the History of the Universe and Ices Explorer (SPHEREx) and Euclid, and Dr. Daniela Calzetti from University of Massachusetts, Amherst, on Euclid. Members should address any ethics questions to Dr. Hasan.

Dr. Hasan welcomed four new members to the committee: Dr. Regina Caputo, Dr. Daniela Calzetti, Dr. Shardha Jogee and Dr. Hsiao-Wen Chen and introduced Dr. Kelly Holley-Bockelmann, APAC Chair.

Dr. Holley-Bockelmann welcomed everyone and thanked the members of the committee and the public for attending the meeting.

Astrophysics Division Update

Dr. Mark Clampin, NASA's Director of the Astrophysics Division (APD) began his presentation by reviewing the current organizational chart for the Division. Next, he gave an SMD by the numbers overview of all the work going on in Astrophysics including the launches scheduled in 2023. He noted that the X-Ray Imaging and Spectroscopy Mission (XRISM), a partnership with the Japanese Space Agency, will launch mid-summer from Tanegeshima. The first science highlight showed the dynamic gamma-ray sky captured by Fermi's large area telescope (LAT) instrument in one year of activity, a nice representation of the science that NASA is trying to do with Time Domain Astronomy/Multi-Messenger Astrophysics (TDAMM). In another highlight, Dr. Clampin showed GRB 221009A, one of the brightest gamma ray bursts ever observed. The Swift result captures the afterglow of a gamma ray burst that lights up several layers of the intergalactic medium, picking up dust between Earth and the burst itself. As a precursor to the amazing exoplanet spectra expected from James Webb Space Telescope (JWST), Dr. Clampin showed an image of one of the many transit spectra captured of the giant exoplanet Wasp-39b with the NIRSPEC prism. The result shows the first detection of carbon dioxide and sulfur dioxide, pointing to evidence of photochemistry in the planet's atmosphere. JWST is meeting its science goals, doing what it was built to do, as well as more than it was originally conceived to do in the early 2000s.

Dr. Clampin then addressed the recommendations APAC made at its October meeting. APAC requested a presentation on the new pending process for naming missions in the future. Dr. Clampin said there is a new naming policy, NPD 7620.1J, which would be posted on the webpage, and strongly recommended that everyone read the entire policy.

APAC had requested several mission updates and they were scheduled to be given during the meeting: Dr. Chris Walker on GUSTO; Dr. James Rhoads on the Ultraviolet Transient Astronomy Satellite (ULTRASAT); Julie Crooke on the Great Observatory Mission and Technology Maturation (GOMAP) program and the implementation roadmap that APD is following ; and Dr. Valerie Connaughton on TDAMM science, the possibility of a TDAMM-related Science Interest Group (SIG) and a Science Advisory Group (SAG). Dr. Julie McHenry was to provide an update on the cost and schedule of the Roman Observatory, an update regarding Roman's response to the Committee for Astronomy and Astrophysics (CAA) recommendation about approaches to designing the Roman survey program, and a conversation about the stand-up of infrastructure teams, especially those focused on pipeline and user-tool software architectures. In addition, NASA historian Dr. Brian Odom was to give a report about the Webb investigation and the final decision on the naming of the Webb telescope.

APAC advised that the program analysis groups (PAGs) elicit feedback from their communities on the impacts of minimal exclusive use periods associated with APD mission data, especially early career scientists. The PAGs were to address this issue in their presentations at the meeting. The three PAGS were also encouraged to develop terms of reference for a cross-PAG, TDAMM SAG or SIG, and that is in process.

APAC asked APD to look at working industry agency center partnerships that would enable workforce development and retention opportunities within the scope of the MPP program. After looking at this, APD did not see any easy way to impact that program in the way that was recommended.

APAC asked APD to assess the balance in technology funding opportunities in strategic astrophysics technology and Astrophysics Research abd Analysis (APRA) to ensure that there is a range of opportunities available to the diverse scientific communities within astrophysics developing mission concepts. Dr. Clampin addressed this in his presentation.

APAC asked APD to develop a mission and vision statement for the NASA Hubble Fellowship Program that aligns with SMD six core values and recommended that APD continue implementation of the NASA Hubble Fellowship Program reviews and recommendations. Dr. Clampin addressed that in his presentation.

APAC requested a complete briefing of the overall feasibility assessment of NASA's posture on the Advanced Telescope for High-Enery Astrophysics (ATHENA) and Laser Interferometry Space Antenna (LISA) missions based on recent developments. Dr. Clampin noted that much work is underway, especially with ATHENA in terms of the formulation, and would provide updates on both missions in his presentation.

APAC also advised that APD not only supports cross-SAGs and SIGs as community interfaces but explore the efficacy of establishing formal GOMAP structures operated by the Division for all three great observatories simultaneously. APD is not going to do that and Dr. Clampin addressed why in his presentation.

APAC asked ADP to consider formal stewardship of the early GOMAP integration strategy teams for x-ray acquiring career concept missions envisaged within Astro2020 so that they can again interface with

community led initiatives. Dr. Clampin said they do not want to move forward with this right now and he addressed it in his presentation.

APAC recommended that APD adopt the U.S. stance on data access, data release policy, and publication rights that support Astro2020 Survey recommendations to ensure that LISA achieves its full scientific scope and capabilities as a flagship mission. Dr. Clampin said it is early days. LISA has not even been adopted by the European Space Agency (ESA) yet. There has been some early work done in this area, but APD is not ready to start talking about detailed plans. They are in the very early stages of figuring out how they will respond to the report that was provided to them on the different options about how they would implement a U.S. science center, which would have the primary responsibility for data access, data release publication, etc.

The APAC fully endorses the conclusions in the LISA Science Ground Segment study for NASA to invest in a substantial U.S. role in LISA data analysis, interpretation, and science. The report is consistent with the Astronomy and Astrophysics 2020 Decadal Survey (DS) recommendation that NASA establish funding for a LISA science ground segment at an aggressive level to ensure that U.S. scientists can fully participate in LISA analysis, interpretation, and theory. This is not a recommendation, but an endorsement of the conclusions in the LISA Science Ground Segment study. Dr. Clampin said they are still taking that report under advisement and working through the recommendations to see how they could best implement those. They acknowledge that the impact fully endorses those conclusions.

The APAC requested frequent updates on the roles NASA is taking in the LISA mission particularly in terms of the APD response to the recommendations from the LISA Science Ground Segment study. APD is working the issue and having some very early-stage discussions about how to implement the recommendations for the ground segment study. The APAC also recommended that NASA continue calls for LISA preparatory science with the yearly cadence and they will continue to try to do that.

APAC asked APD to understand whether the demands on the telecom infrastructure and data downlink bandwidth is sufficiently robust for Webb alongside simultaneous operations of pending missions and those envisioned in the GOMAP mission, in concert with the broader portfolio of missions. Dr. Clampin said it is an SMD issue and is in process and he cannot provide a report on it at the time. But to give APAC an idea of the level of importance attached to it, Astrophysics Division Deputy Director Sandra Cauffman is now the SMD lead for addressing issues related to Low Earth Orbit (LEO) and Deep Space Network (DSN) activities on NASA's missions. That provides a good interface to both DSN and also for our TDAMM-related requirements going forward.

Dr. Clampin gave a brief overview of the budget and noted that the Stratospheric Observatory For Infrared Astronomy (SOFIA) close-out budget was reduced in the FY24 request but there is additional funding in the FY23 appropriations to continue the project close out. SOFIA was a very large program so a lot of hardware needs to be dispositioned, including spare engines, parts, and planes, in some cases. All of the data from the last cycles need to be reprocessed and put into the InfraRed Science Archive (IRSA). They are also providing career transition support, especially for early career science community. SOFIA itself is now dispositioned and will be on permanent display at the Pima Air and Spac Museum in Arizona. Another budget-related issue is the delay in the Explorer program, including moving the next Small Explorer (SMEX) call to 2025.

The funding for ATHENA was reduced going forward, pending the completion of ESA's reformulation of the program. They reduced the amount of money being invested in the instrument and the detector system that were primarily being done at the Goddard Space Flight Center. In light of the fact that ESA is now pointing NASA toward two contributions, the instrument and a 50K -> 4K cryocooler to the X-IFU

instrument, rather than testing, there has been a significant change to X-ray and Cryogenic Facility (XRCF) support in the President's FY24 budget. The assumption is that they will not be requiring XRCF for ATHENA in the subsequent years, so NASA will instead provide a cryocooler for ATHENA.

After an overview of the LISA and ATHENA programs, Dr. Clampin gave a big picture overview of the Explorers program. The program is currently in the middle of a competitive Phase A downselect on the Medium-class Explorer (MIDEX) 2021 call with two MIDEX concepts and two missions of opportunity currently putting together their proposals for a downselect, which they expect to do early next year. XRISM is pretty much ready to fly and will be moved to Tanegashima, Japan, very soon. He commended the XRISM team who worked through extremely challenging times during COVID to work on the instrument and support the testing. Quarantining on their way in and out of Japan was extremely stressful, but they did a good job and delivered on NASA's obligations.

Currently APD is focused on two Decadal Studies (DS's). The first is the 2010 DS and the DS recommendation, which is the current flagship mission of record, the Roman Space Telescope. Making sure that Roman delivers on its science promise remains the highest priority. Roman will be the first NASA flagship designed from day one to be a survey mission, so it is a very different concept and requires different thinking about how to do the science. The Space Telescope Science Institute (STScI) and the Infrared Processing and Analysis Center (IPAC) are working through this, along with the project science team for Roman. They are doing a great job and Roman has made great progress.

Dr. Clampin reminded the group about the key recommendations from the 2021 DS, paying special attention to TDAMM. APD's focus is on making sure that they have the infrastructure and coordination in place to make proper TDAMM coordination a reality.

The DS's primary recommendation is designed to address the question of habitable planets harboring life elsewhere in the universe. The survey recommended a space telescope and a program in general astrophysics, exactly what APD has done on previous flagships, and until it becomes a formal project, the working name of the observatory is the Habitable Worlds Observatory (HWO). The strategy for this observatory came from the DS, and they have also gone back and drawn on the NASA Large Mission Study report, which was done a few years ago and looked at the lessons learned from large missions across all four science divisions that build large missions within the SMD. The DS said to spend about four to five years developing the technology to technical readiness level (TRL) 9 and then start formulating the mission. To do that with the level of investment that NASA can expect to get, they plan to build upon current NASA investments and existing TRL technology, including the JWST segmented optical telescope system and the coronograph on Roman. By leveraging the work they are doing there and then investing, they look to take it to the point they can build a coronagraph that will work with a segmented mirror telescope.

APD plans to leverage the next generation rockets in the commercial world and envision the next generation fairings providing two things. One, you can be more flexible with your telescope aperture and may not need to fold it as much as with James Webb for the same size of telescope aperture. They also offer flexibility. One of the ways to get missions built quickly is by being able to solve technical problems while moving forward. The way technical problems are solved, in general, is with mass, and in the case of telescopes like this, volume. With a big fairing, problems can be solved along the way more quickly if you have the flexibility to add mass.

This telescope must be designed to have large scientific and technical and programmatic margins because exoplanet survey missions are a lot less forgiving. If you miss a requirement by a small amount, you can fall off the yield cliff very easily. With a typical imaging mission, if you just miss your background level, you can usually adjust by doing longer science exposures or you end up with slightly better throughput.

When you start looking at the trade between inner working angle contrast and throughput coronagraphs, there is not a lot of leeway. This design must begin with very robust margins that would allow for the trades needed as the telescope is built.

Dr. Clampinexplained they are focusing on large, segmented mirrors andcoronagraphs, in part, because of the investments made over the last two decades in large, segmented mirror telescopes. NASA's segmented mirror technology program is continuing and has made great steps toward the ultrastable technologies needed for this mission. Segmented mirror telescopes are also scalable and that comes back to maturing the technologies first before formulating the mission. It is almost certain that the size of the mirror will need to be fine-tuned when they start the formulation, so they cannot have invested in a mirror that is the wrong size. Also, a lot of industry capabilities out there are not designed to do large single-field aperture glass mirrors of the size that they are talking about, and they will be taking advice from industry about what they think is the best approach for telescopes. So, the strategy is to focus the investments on the tall poles rather than going back and investing in infrastructure and developing technologies that probably will not serve as well.

The Astro2020 mentions future great observatories and future x-ray and far-IR great observatories. The recommendation in the survey is to start investments in these additional observatories toward the end of the decade, once good progress has been made on the first observatory. NASA cannot develop three flagships in parallel, nor will there be funding to do that. So SMD has taken the approach to focus on the first one, while maintaining the x-ray and far-IR community and the technical capabilities of that community through the decade.

Dr. Jessica Gaskin asked if there was a funding profile ramp-up for the other two great observatories that has been looked at to optimize the technology development needed going into the next decade? Dr. Clampin replied there are notional profiles out there but it is premature to talk about technology funding profiles at the end of the decade. In 2023, the primary goal is to start moving forward with HWO. For the budget, they have an extremely modest wedge, just enough to do the Science, Technology, Architecture Review Team (START). Most of the technology is just vectoring some of the Strategic Astrophysics Technology (SAT) emphasis toward the technologies needed. There is not funding to do directed technology development for the first one, so it is not productive to talk about wedges for two more before they have even established a workable funding profile for the first one.

One of the DS's recommendations is to add strategic capabilities based on science priorities. Some of those will be at NASA facilities, while others will be coordinated with other agencies to have the best possible network for alerts. They are doing a gravitational wave mission with the Europeans and they are also engaged in international discussions to coordinate missions. The idea is that through these discussions they can understand what to emphasize and what other people are emphasizing, so there are not 15 space agencies all trying to do the same mission. It also means that they can do a better job of working through coordination issues across both NASA and National Science Foundation (NSF), Department of Energy (DOE), and with other space agencies.

Dr. Clampin gave an overview of the inclusion, diversity, equity and accessibility (IDEA) initiatives. APD had their first community days where they reached out to the current astrophysics community, but also tried to create new elements of the astrophysics community by talking to underserved institutions. The first virtual visit to the University of Puerto Rico was on March 7 and was well attended. In that visit, APD gave an overview of what it does; talked about opportunities for getting involved in APD science, internships with NASA, and various programs that NASA runs and operates; and set up connections with faculty and graduate students who attended. APD will continue to follow up with the institutions that they engage with and tie them back to resources at the NASA centers. One of the key ways to get into

internships is by going to the NASA centers to do research or work in astrophysics. So APD will continue to visit underserved institutions and include the more regular astrophysics community.

Dr. Calzetti asked how well the coronagraph on Roman is expected to perform relative to the performance that would be desirable for HWO. Dr. Clampin answered that Webb was initially designed to do corrections every 14 days, but it has proved to be so stable that has not needed. He has seen a chart from the Space Telescope Science Institute suggesting that for months at a time it varies by plus or minus two nanometers. So that means they are talking about a factor of a hundred to get to the kind of stability that is required. For the Coronagraph Instrument (CGI), he believes the goal is to get to contrast levels of $10^8$, which puts it a factor of 100 from where they want to be.

Dr. Kiessling pointed out that it seems that NASA has focused in on a coronagraph plus segmented design, which means they are carrying a lot of risks moving forward. She asked about the plan for how the agency and APAC will be informed on the mitigation of this risk and what are the jumping off points if they feel they are not approaching convergence on the requirements? Dr. Clampin replied that they do not have the funding needed to make directed technology investments. Right now, they are developing technology roadmaps and will use those to make investments and request the needed funding. The Cosmic Origins Program Office will create a similar roadmap for the ultrastable technology for the primary mirror. Initial progress will be reported on the roadmapping and as they start to make technology investments. He suggested a recommendation that some of the people doing research in the area provide an update at the next meeting. He noted that the current strategy was chosen because it was the lowest risk platform, in particular, the cost risk.

Dr. Calzetti asked if they are still considering possible tradeoffs between on-axis and off-axis coronagraphs and how one or the other might give the extra factor 100 that is needed. They will not formulate the architecture of the telescope or the observatory until they have done the technologies, Dr. Clampin said. Part of the technology roadmap is looking at doing on- versus off-axis segmented mirror coronagraphs. As the staff groups work in this area, it is expected that they will identify science trades that require thinking about on- versus off-axis.

Dr. Caputo noted that the main workhorse missions that Dr. Clampin has referred to are Fermi and Swift, both at least 15 years old. CubeSats have been proposed to replace or augment them to satisfy the DS, with a recommended augmentation of $500 to $800 million. Though that is not going to happen, she is concerned that the community's need is not going to be addressed going forward. Other agencies, in particular the NSF, are investing in IceCube and LIGO upgrades. The experiments depend on large, sensitive gamma instruments, so it does not seem that there is a replacement plan for these going forward, because none of the big mission plans talk about gamma ray specifically. How will this need and longevity be addressed? Dr. Clampin said they are making very significant investments in TDAMM science but it is incorrect to say the recommendation was focused on one single mission. The probes are primarily x-ray and far-infrared (far-IR) so there may be an option for some of the capabilities that some of those missions have. They are thinking about how to address missions like Fermi and Swift in the long term, but that has not yet been addressed. Though people have proposed to do the science using the CubeSat, it is not part of a formalized strategy.

Dr. Clampin remarked that they are always looking for opportunities to partner with other international partners to fill some of the gaps for TDAMM science. They are looking for partnering opportunities if they serve the science community and help fill areas that were identified in the Annapolis report.

Dr. Hamden asked Dr. Clampin to talk about the budget. Dr. Clampin said that $8.3M is a great budget for SMD, but there are priorities. The technology investments for HWO are not moving forward as quickly as they would like, so that is a concern.

Dr. Hamden noted that in the presentation on the HWO, Dr. Clampin referenced the SAT and Astrophysics Research and Analysis (APRA) program investments and the Explorers program. She asked if those were general recommendations that they could propose x-ray and far-IR programs or would there be specific wavelength callouts the way there were for the probe. Dr. Clampin said there were not. But he noted they are putting the AO for the probe out in a couple of months and hoping that people are going to want to do interesting and groundbreaking science with those missions, and there are other opportunities. GUSTO is a space mission that is doing far-IR science, and there are other opportunities to propose x-ray and far-IR missions. One of the MIDEX's currently in competitive downselect is STARX, which is another area for x-ray technology.

After Dr. Hamden asked about proposal strain, Dr. Clampin gave an example where they identified a particular technology that was not available anywhere in the U.S. except at the Goddard Space Flight Center. So, they had to direct the center to provide support to the proposal to make sure they had an even playing field. In the future, those kinds of situations need to be avoided.

Dr. Ryan Hickox said the probe will either be an x-ray or a far-IR mission, and there is a real concern that whichever one of those does not get selected, especially if that same wavelength community does not get selected for the MIDEX, it will be a long time before a major mission can get supported that would involve technological and science activity for a significant portion of the community. The risk of not having something to look forward to is a significant concern for many people involved in far-IR and x-ray in particular. Does APD share that concern and is there a possibility of trying to guide some of the future Explorer calls to specifically fill those gaps? Dr. Hamden noted that though she asked about it, she was not recommending it. Dr. Clampin does not believe that trying to direct individual mission lines to particular wavelengths serves the community from a scientific perspective. They always have to focus on selecting the best missions based on compelling science. But a lot of people do far-IR on balloon, so there are still opportunities. Dr. Gaskin talked about the distinction between maintaining and planning, saying APD has done a good job maintaining capability across multiple wavelengths, but those efforts are not necessarily geared toward maturing technologies for a future flagship mission. It has to be a focused effort on technologies that make sense for whatever that next flagship and HWO look like. Some decisions have been made to help move that in the right direction and optimize the investment needed for that observatory. But understanding what the community ultimately needs to do or can do to help prepare for when that time comes to direct the efforts to optimize the technology developments that need to be made is a different thing. It is important to maintain not just funding but also hope and allow the communities to see that there is something in the 2020 Astrophysics DS for those other communities. She also noted that Compton Gamma-Ray Observatory (CGRO) and gamma rays have been removed from the DS slide in Dr. Clampin's presentation. Dr. Clampin added it always comes back to what to do with the budget. He is concerned that if they try to do too many things in different directions, it can appear they do not have the focus that is required. For now, they are going to focus on the top priority and get it to a point where it is viable and moving forward. But they will address the issue when they do the mid-Decadal review and ask the Academies to comment on it.

Dr. Jogee asked about the state of the scientific workforce. Specifically, what current collaborative or coordination platforms has NASA explored for concrete discussions between academia; funding agencies like NSF, NASA, DoD and others; and the National Academy of Sciences, with a focus toward addressing concrete issues for training the next generation of scientists, grad students, and postdocs, and address thorny issues they are facing right now? Grad student funding levels across the country simply cannot be solved unless it is coordinated between federal agencies, academia, and high-level NAS policies. Dr. Clampin noted that there was an extensive discussion of support for grad students at the last AAAC meeting. If APAC would like to make recommendations, he would try to follow up and get a specific response that they could discuss at the next meeting.

Dr. Jogee asked about the status of the current discussions about segmented mirror technology. Active discussions are ongoing at both the academic level with Keck Observatory and also with the industrial base that makes segmented mirror systems, Dr. Clampin said. NASA is heavily involved with the Keck Observatory, and they have had a number of discussions with Dr. John O'Meara, Keck's chief scientist, about opportunities in the future to do technology demonstrations using Keck. One of the technologies that people are talking about for maintaining picometer stability are edge sensors, so that could be something they could experiment with at Keck.

JWST Update

Dr. Eric Smith began his update of JWST by showing a ten-light-year diameter image of a star expelling its outer layers, showing the stochastic nature of the ejecta. The image is a combination of both NIRCam and MIRIimaging of the type coming out almost every week from JWST. Dr. Smith then reviewed some of the science highlights from the mission and the members of the JWST team who have received awards.

One new aspect of missions' operations for Cycle 2 is a micrometeoroid avoidance zone. This means they will preferentially not look in the RAM direction, the direction the observatory is orbiting towards, and will try to schedule observations so they do not present the face of a mirror in the ongoing direction unless necessary. This new constraint is already in the observations planning tool.

There have been some anomalies during this first year of operations, the bulk of them are software related. In every case, the software has been adjusted. The only hardware related issue was with the MIRI MRS grating wheel. As it was moved, they saw a higher current in a motor, and so they stopped the motion and devised a workaround. The original plan had the grating wheel moving in one direction so you could keep turning it around. Now it is rotated back and forth to make sure they do not encounter the problem. Deep Space Network (DSN) had one issue with data latency, a ground DSN problem. To account for times when access to DSN is less than the 8 hrs/day required (and data would need to be held on the observatory's solid state recorder) the Institute has asked for proposals with Space Telescope Science Institute (STScI) has asked for proposals with observations that do not fill up the solid state recorder so quickly, so you could miss a pass and still keep taking science.

There are now 117 terabytes of data available, more than half of it is public, that includes all of the calibration and commissioning data. The rest will become public as the proprietary period expires, which is one year by default. About a third of the first year's data was nonexclusive use.

Dr. Smith closed with information about the Cycle 2 proposals. The Institute received 1,600 proposals, the most it has ever received for any JWST or Hubble Space Telescope (HST) cycle, with 15 percent from student PIs, the highest fraction ever. Like the first cycle, almost three quarters of the observations proposed were for spectroscopy. The distribution of science is similar to what it was in Cycle 1, with the majority of proposals focused on exoplanets and the deep universe. The proposal call for Cycle 3 will go out in August with a deadline of October.

Dr. Grant Tremblay noted the micrometeoroid impact rate is about what people at Marshall expected. But the size distribution might be a little more worrying if they get, for example, another C3 impact within a short period of time. He asked if headquarters is thinking about future architecture and risk trades at Level 2 and will every risk Class A mission now need a baffle around the mirror. Dr. Smith confirmed that the micrometeoroid frequency and mass spectrum looks pretty much like the Marshall model. They got a high energy one early, but they expected about one of those a year. They did not have a baffle, primarily for mass constraints, but future observatories will now probably say the baffle is valuable for micrometeoroid protection.

Euclid Update

Dr. Jason Rhodes began his update on Euclid by saying mission is about to kick off a golden age of optical and infrared survey astronomy later this year. The mission is led jointly by the European Space Agency and the Euclid Consortium, which has about 2,000 scientists and engineers, largely in Europe, but with contributions from the U.S. via NASA, Japan, and Canada. The mission's objectives are to make a definitive measurement of the expansion of the universe and quantify four things: the dark energy as parameterized by its equation of state; possible modifications to Einstein's theory of relativity or modified gravity; dark matter through the mass of neutrinos; and the universe's initial conditions.

Astronomy's golden age is going to be enabled by the fantastic telescopes that will be coming online in the next few years: Euclid, the ground-based Vera Rubin Observatory, which will perform the Legacy Survey of Space and Time (LSST), and NASA's Nancy Grace Roman Space Telescope. Rubin and Roman do not have cosmology as their only goal, but the design of these three telescopes has precision cosmology as a design driver, one of the most demanding driver of requirements of these observatories. For the first time, NASA will be able to make precise measurements in cosmology, but the data sets that they collect will be useful for a wide range of other science.

Euclid will survey the best 15,000 square degrees of the extragalactic sky, where best is the fewest bright stars and lowest background. This is a single pass survey, meaning Euclid will not go over that 15,000 square degree area again; however, 50 square degrees of Euclid data will be in deep fields that will be visited over and over through the course of the survey.

The Euclid consortium acknowledges the contributions of ground-based telescopes and the local indigenous people that have allowed the telescopes to be built on their sacred land. They feel privileged and honored to be able to use these telescopes to gather the ground-based data necessary to make Euclid a success.

Dr. Rhodes gave examples of some of the legacy science that is going to come out of Euclid, including cool brown dwarves and giant branch stars, and an overview of the Euclid instruments. Launch is planned for July in Florida on a SpaceX Falcon9 for a six-year primary mission at Level 2. Data will be released to the public each year. Fifty square degrees will be released after the first year, which is relatively small compared to the size of the Euclid survey. Euclid data is nearly HST resolution so 50 square degrees of space-based infrared data at high resolution is a huge amount of data compared to what they have had before.

NASA is contributing to processing and serving of the Euclid data through the Euclid NASA Science Center at IPAC (ENSCI). ENSCI's primary role is supporting the U.S. community to do science with Euclid. ENSCI is one of nine nodes, mostly across Europe, of the Euclid science ground segment. It is a distributed system where each node is developing specific parts of the Euclid pipeline, but each node is expected to process Euclid data through the whole pipeline. ENSCI's role is leveraging U.S. expertise and the near infrared detectors that NASA has provided for Euclid.

Euclid is going to inform how Roman is used on detector systematics from the infrared detectors on wide field, weak lensing, and galaxy clustering science that they have in common and in combination with ground-based data. Both Euclid and Roman require ground-based data and need to be combined with the ground-based data to achieve their science goals. How they combine Euclid data with Rubin is going to inform the combination of Roman and Rubin data in the future.

The Euclid Consortium Board is a 20-member body that governs the 2,000-member Euclid Consortium. The people on the board are appointed by national agencies. Dr. Rhodes is now chair of that board. The ESA Euclid Science Team (EST) defines additional surveys, and currently, Euclid has about 10 percent of

its survey time unallocated during the primary mission. There will be a call for how to allocate that time, and it will be open to anyone to propose ideas. The data will have no proprietary period.

In summary, Dr. Rhodes stressed that the sum of the Euclid, Roman and Rubin missions will be greater than the sum of the parts if they are clever about how they combine the data and do the joint analysis and joint processing of the data from these missions. One example is deep blending and photometric red shifts where they take the high resolution, space-based data and then deblend the much deeper ground-based data to find where the galaxies are, get better ideas of how to separate those galaxies, and better photometric red shifts. Early Euclid data, which is relatively shallow, will be well matched to the early Rubin data, which is also shallow, and that will inform how to process and analyze the data from Roman and Rubin, which will both be deeper later this decade. The DS explicitly called this out as something they should think about. Dr. Rhodes ended by asking APAC to encourage NASA and the other agencies to think about how they can best use the data from these three telescopes together.

Dr. Hickox noted that Roman is thinking about doing most of their analysis in the cloud and asked if Euclid has a similar plan and if there were any lessons that could be carried on to Roman. Dr. Rhodes replied that Euclid is probably behind where Roman is in thinking about that, largely because the plan for Euclid had to be matured earlier and is essentially ready now. As they progress on Euclid, they will see what works with Euclid data processing being distributed to various nodes, which in some ways act as a cloud where everything is not done in one centralized place. IPAC is also involved in Roman data processing, working with Space Telescope Science Institute, and discussions are ongoing, at least on the U.S. side, between the various institutes on how to best do this.

Dr. Holley-Bockelmann asked that given the data are analyzed in a distributed model, what is the body that decides how to combine all the data? Is it done at ESA or the Consortium? Dr. Rhodes explained the process. The science ground segment of Euclid, which is a distributed science ground segment, has nine nodes. One of them is an ESA node and the other eight are Euclid Consortium nodes, so it is a joint effort between ESA and the Euclid Consortium. ESA oversees taking the raw data and developing the pipelines to do the very first level and the Consortium is responsible for getting the data from Level 1 to science-ready data. Typically, ESA pays for missions and producing the data, but ESA does not pay for science, which is a big difference between ESA and NASA. The Consortium pays for the science, or put another way, the science is paid for by the national agencies.

Roman Update

After lunch, Dr. Julie McEnery gave an update on Roman, beginning with the mission hardware status. The forward structure assembly, which is the primary mirror, the secondary mirror, and the associated structures that pull them together, is now complete and represents the completion of the hardware that they inherited from NRO. The mirrors were refigured, recoated, some newly redesigned. Everything is moving forward with the telescope and where they encounter issues, they have an adequate schedule margin to deal with it. On the spacecraft, things are all coming along well. For the Wide Field instrument, they are really making good progress integrating components into the optical bench, so the optical bench is complete. The flight element wheel assembly is complete and installed into the optical bench. The Simplified Relative Calibration System is also installed. The focal plane assembly has been reassembled and realigned following the replacement of three detectors. They will put the focal plane assembly and the electronics together for the first time, do a focal plane system test in mid-April, and deliver the focal plane system to Ball at the beginning of May. For the coronagraph, the team is currently preparing test plans and equipment to allow the possibility of testing and using modes beyond the required.

For the budget and schedule, they had a complete replan and optimization of integration and testing flow at high levels to accommodate updated delivery dates of various subsystems, which allowed for

consolidation of some aspects of testing. They now have a healthy schedule margin to the planned launch date in October 2026, which is well ahead of the agency baseline commitment of May 2027.

Dr. McEnery reviewed the three paths to community engagement with Roman. To plan and shape core community surveys, they have requested science pitches and/or white papers from the community. The science pitches were a very low bar to make it easy for people to get engaged, and they do not want people to feel like they have to have already been involved in Roman. The goal was to get all the science ideas onto the table and then have a white paper deadline in June. Having a two-phase process gives them the opportunity to work with the community on the basis of what they received from the science pitches to make the white papers more useful.

They are rebooting their joint technical working groups. In Roman they pursue topics of interest to multiple science areas, or technical topics that are the base of everything, in groups that are open to all. There are two active ones (calibration and software), but they will either restart or start new ones once the new science teams come on board. The deadline for the proposals for funding to prepare for and enhance Roman science was March 21. We received around 90 proposals, which will be reviewed over the next couple of months with selections in early summer. They are already delayed with science teams, and the work on finalizing the algorithms being run in things like spectroscopic pipelines has been placed on hold until they have the science team input they need to ensure they are implementing algorithms that will be the most useful to everyone.

APAC had posed a question on conversations regarding the stand up of the infrastructure teams, especially those with a focus on pipeline and user tool software architectures. Dr. McEnery said that discussion will be very meaningful at either the next APAC meeting or the one after that because by then they will have made selections and will know what teams are working on. However, she said they can discuss about their philosophy on organizing and coordinating pipelines and user tools independently of the specifics of any individual infrastructure teams. Their science centers, a Science Operations Center at the Institute and the Science Support Center at IPAC, are responsible for production-level pipelines, user tools, and the associated architecture. The software group, one of the joint working groups, is coordinated by a group with representatives from both science centers and is open to all. That group discusses the specifics of what will be run in the pipelines at the SOC and the SSC. Because those groups are open, they have people like the software folks from the Rubin community and discussions address topics like making sure images are registered in a consistent way with other observatories. So, while they do not yet have infrastructure teams, they want those teams to work with the SOC and the SSC so the processing that makes sense to be done in the production pipelines is done there. Any work on refining the details of algorithms or calibrations, should be applied centrally and run in one central place. Currently, high-level processing for both the SOC and the SSC is managed in the cloud through Amazon Web services. Dr. McEnery closed her presentation by saying they can come back to this topic when they know which infrastructure teams are selected and what they are doing. There are possibilities for infrastructure teams to propose high-level processing that is a significant extension of capabilities relative to what the SOC and the SSC are already doing.

Dr. Calzetti asked how many proposals they expect to select out of the 90 proposals they received. Dr. McEnery said it would be somewhere between 18 and 32, but the number is uncertain for the main proposal line, Wide Field science, because people had an opportunity to propose for large or regular size. These proposals are for everything and include four or five for the infrastructure teams.

Dr. Calzetti asked if the report issued last August from the CAA provided any information toward what they are doing now. Dr. McEnery pointed out that mapping out and planning Roman observations is extremely complex. The committee provided a set of ten principles to guide NASA and Roman on the process for assigning observing time allocations, and the science centers and the project together have

developed and started implementing a plan to define the core community surveys that build on those principles. The key takeaways from the report is that the committee broadly concurred with a community-led approach to setting Roman observation programing, but the committee felt it was extremely important to have elements of competition and a true balancing and trades between the different surveys and the amount of time that is set aside for general astrophysics surveys. Rather than discuss the report, she said she would be more interested in getting feedback from APAC on what they are doing to define the surveys.

Once the White papers come in, they will form Survey Definition Committees and the Roman Observations Time Allocation Committee and there will be an extensive period of community engagement and additional White Paper polls and workshops that will be spearheaded by the individual survey committees who will provide options. The top-level committee, Roman Observations Time Allocation Committee, will have representation not just from people who have science interests that can be addressed by the core surveys but also have people who have interests in science areas that would be addressed by general astrophysics surveys. Next, they want to make sure that all the science cases are considered when they are defining the Core Community Survey. Ultimately, both the definition of the survey and the evaluation of how well it is doing will be based on a broad science menu and not on one tightly defined science case.

Dr. Gaskin asked if they did something different to try to attract the newer generation and is it somehow tied to this new, broader pool of ideas that are coming through. Dr. McEnery said it was key to make it easy to submit a pitch. Respondents only needed to come up with two paragraphs, and most of the questions on the questionnaire were optional, so that made the bar low. The pitches have been extraordinarily useful in helping them establish what the science base is. The Core Community Surveys will not be successful if they are focused only on one or two science cases. To be true community surveys, they must support a wide fraction of the community and to do that they have to identify the science topics and how that can be used as a starting point for people to talk to. They want people to tell them what the properties are of a survey that will address their science and how is their science is affected by changing various parameters. Ultimately there will have to be optimization across many science areas, so the white papers will be more detailed, and they are encouraging many of the people who are involved in the pitches to write white papers. She anticipates that as they are going through the process of defining the community surveys, they will adjust their plan to respond to what seems to be sensible.

She addressed the question of what coronagraph observations should be and talked about whether they plan to continue Roman coronagraph observations past the initial 18 months tech demo. After a brisk overview of the coronagraph instrument and the issues to consider for observations beyond the 18 months, Dr. McEnery gave a possible option for continued observations: Hold a review early in the mission (e.g., 6 months into science observations), reschedule some of the Core Community Survey observations to later years to create space for coronagraph instrument observations early in the mission, continue (or recompete) the Community Participation program, and plan the second set of CGI observations in a similar way as the first three months.

SMD Bridge Program Update

Dr. Patricia Boyd gave a presentation on the SMD Bridge program in which she talked about the landscape of their professions and addressed how they got here, where they are going, why they have an SMD Bridge program, what are its goals and their expectations.

She began by using a braided river as an analogy for a career journey in which there are multiple jumping in points and there are ways to get in and out of the river. It is very different from a pipeline model, but it is more inclusive because it allows people to come in at different parts of their journeys and at different ages. People on a braided river are not necessarily in the same career point when they are at the same age

as other people. So, when talking about being more inclusive in Science, Technology, Engineering and Mathematics (STEM), and certainly in the goals that NASA would like to see for the Bridge program, it is necessary think about the workforce as part of a braided river. There are many ways in and many speeds to go through there, as well. Also, the varying impact the pandemic has had on different communities needs to be considered constantly when developing a new program with goals that are different from other NASA programs.

Dr. Boyd looked at SMD's science by the numbers to show the missions in development or launched and how much money is awarded or invested annually. She asked the group to see each of these as points into SMD's infrastructure and its science culture. Of the $968M SMD had for FY 22 in grants and fixed charges, eight institutions took a quarter of the budget. Many of them are close to NASA centers, are operating parts of the SMD mission infrastructure, have a lot of resources to propose and manage grants, and these resources positively impact everybody on their staff. The Bridge program would like to bring in more scientists from under-resourced universities that do not necessarily have the infrastructure to easily propose, but students and faculty at those institutions have backgrounds and interests that are very much aligned with the science and engineering done at NASA. NASA would also like to provide the opportunity for very highly research-intensive universities to be involved if it is a benefit to the students, the faculty, and the institutions themselves. They specifically want to include NASA centers or facilities in these bridges, so NASA's bridges are focused not just on individual students, but on faculty and students at under-resourced institutions.

Dr. Hickox asked if students would be doing an internship with scientists at the NASA centers, facilities, or the research-intensive institutions or would they be doing a project with a faculty member at their own institution that would then be funded and supported by those institutions. Dr. Boyd said the model is that faculty, NASA mentors, and students would form a cohort. The program would be open to all Bridges.

Dr. Calzetti wondered whether the program has milestones to determine whether it has been successful. Dr. Boyd said that one of the reasons they held the workshop was to look for the intersection between the goals for the program that were specific to different institution types and faculty and the goals that were interesting and attractive to NASA. One goal would be how many students are impacted in a positive way so they feel that their trajectory is going to keep them in STEM. Another goal would be to look at proposal numbers coming in from different institutions, as a function of time.

Dr. Mark Mozena asked about the involvement of public companies in the effort and how it ties into the larger effort from the White House and the Administration about workforce training and development with underrepresented university groups and students. Dr. Boyd said will hold more than one workshop and realized that they did not have a huge engagement with industry in the first workshop. They are writing the calls in such a way that industry can be partners if it can be justified as an important component of the Bridge for an institution. In particular, it is a way of broadening the types of available engineering and science internships for students.

Last spring when they put a call out for a Bridge Workshop Organizing Committee through a Dear Colleague letter that went out on the SMD listserv, they received 80-plus applications from a wide variety of people and were able to pull together a very diverse set of people on the committee who know how things have been and know where they would like to see NASA and these institutions go. The Working Groups that were engaged before the workshop, during the workshop, and after the workshop to make sure they were focusing in on very specific concerns or communities included:

- Early Career Perspectives: Focused on students and will also engage more early-career faculty to make sure their voices are heard.
- Community Colleges: Many students pass through community colleges at some point, so how do they make sure that community is heard?

- STEM Mentoring: This is a huge part of what they are going to do.
- Capacity Building and Professional Societies: What does capacity building mean for different organizations and how do they engage the professional societies in a way that allows all the work that they have done to amplify the program.
- NASA's Existing Programs: What already exists and how are those things leveraged?

Dr. Boyd reviewed the Workshop, which took place virtually over one week in October 2022. They had 421 attendees from 41 countries. On the last day, they had twelve reports from all the breakout sessions, in which a real desire was expressed for long-term connections, not just one to five years. NASA does many things long-term, so there are ways to tie in with longer-term commitments. There was also a huge focus on mentoring, particularly for early career and STEM mentoring. Another issue that came up was accessibility, which means different things to different people. Some institutions need better internet, while some people need to understand the opportunities available in order to be able to participate.

The SMD Bridge program needs to very intentional about centering the needs of students, faculty, and research capacity at under-resourced institutions and to use it as an opportunity to lead a paradigm shift within NASA where they assume the primary responsibility for building those relationships. That means instead of having a proposal call come out and hoping for the best and funding what comes through, they need to do two things: actively engage teams so they to want to propose and be a better partner. The traditional ROSES call for Bridge partnerships is not enough for every potential partner. Some potential partners require seed funding and networking events to develop that relationship with NASA, and a seed funding call will be sent out very soon. Also, NASA needs to be more intentional to develop these partnerships with URIs that they have not partnered with in the past.

After the call for seed funding, they will release a call for the traditional Bridge partnership pilot proposal that will be called Year 1 pilot. It will give more mature teams an opportunity to go for a Bridge partnership in the first year but will allow teams that need help to develop a partnership with NASA the opportunity to investigate that funding.

The program is developing a communications plan now that will describe how to communicate within NASA headquarters, centers, missions, and the external community, and they will organize network events to foster new partnerships and develop symposia after they have selected teams to bring these teams together so that they can collaborate with each other, learn from each other, and can form their own larger cohort.

Right now, they are working to get the first calls out in ROSES 23 in the next couple of weeks. The final report from the workshop will be made public at the same time as the response.

<u>JWST Naming Investigation Report</u>
Dr. Brian Odom told the committee that his investigation into James Webb's role in the "lavender scare," the firing homosexuals from the federal workforce, particularly from the years 1947 and into the 1970s, is complete. During their investigation they looked at the big question of what was James Webb's role in this when he worked for the State Department. Was he leader of it? Was he a proponent of it? Was he drafting policy for this?

Due to COVID and the need to ensure that they had access to all of the relevant collections, the report took a while to complete. Dr. Odom released the report in November after people at NASA had a chance to consider what the report said. The full report is now online, and he has published all of the evidence pertinent to James Webb's role or to understand the context of it.

Dr. Mozena asked Dr. Odom to remind them of the timeline, when he started the report, when he got access to the collections. Odom's team started looking into it in March 2021 but it took a while for the National Archives and College Park to reopen. They concluded their investigation in October 2022.

Dr. Tremblay asked if the policy for naming NASA projects, NPD7620, which was posted on December 20, was directly informed by the agency's experience with the JWST naming debate. Dr. Odom said he had not spoken to the other people who put that policy together, but he thought the JWST naming debate was definitely a consideration.

Public Comment Period
The meeting provided an opportunity for public comment.

Dr. Hickox read the public comments from the web portal.

"Given recent controversy over the naming of large missions, can the Agency commit to not renaming "Habitable Worlds Observatory" after a person, however deserving and unobjectionable they may currently appear to be?" Dr. Clampin said he could not make that commitment because there is a policy that explains the naming process. The policy does show there is a desire not to name things after specific people, but there are different cases. He encouraged people to read the policy.

"Will the available 'standard' launch altitude for SMEX be raised because of the increase in orbital debris below 700km and would access to geosynchronous, super geosynchronous, or cislunar orbits be made available for SMEX/MIDEX to counter the proliferation of LEO satellites?" Dr. Sparke answered that the MIDEX already offers that capability. One of the two MIDEXs in the Phase A study is going to a cislunar orbit. The next SMEX is in 2025, and the launch vehicle market is evolving pretty rapidly, so they do not know what they will be able to offer at this point. That will be decided when it is time to put out the draft AO in late 2024.

"To enable technology maturation, could a dual emphasis - technology development/science type of small, capped mission line item be added to an annual call?" Dr. Clampin said at this time, there are no plans to do so. They will continue to rely on existing programs such as the APRA andSAT programs.

Dr. Holley-Bockelmann wrapped up the public comment period and noted that earlier there had been a question about the percent of the respondents to the Roman science pitch call who were new to Roman. Dr. McEnery said that 52 percent had not been previously involved.

GUSTO Update
Dr. Chris Walker presented an update on GUSTO, which will explore the entire lifecycle of the ISM. The goals for the program have not changed.

GUSTO is scheduled to be launched from the vicinity of McMurdo, Antarctica, in early December of this very year. Dr. Walker showed an image of the section of Milky Way that it will map, which embraces both the galactic center and both sides of it. And as it goes up, GUSTO will take the line of sight through Milky Way. It has three heterodyne receivers that look at the carbon, oxygen and nitrogen lines simultaneously in all three bands.

He described GUSTO's capabilities and mission, as well as the threshold and baseline mission, and reviewed the payload and components. The Level-1 requirements are stable and have not changed since SRR/MDR. One critical observatory level test is to put hot and cold loads in front of the telescope's secondary and monitor the instrument response. s Another test is to inject tones into the telescope's

optical path to simulate the spectral line emission from astrophysical sources. These tests are used to confirm the overall sensitivity, stability, frequency response, and data pipeline of the system. They are pleased with current performance, and Dr. Walker showed a slide illustrating that the GUSTO payload has exceeded threshold mission requirements with margin. The system passed its preship review a few weeks ago at the University of Arizona. In the next couple of weeks the payload (telescope + instrument) and gondola will be integrated together and the new telescope will be put in.

Dr. Walker ended his presentation by reviewing the schedule. They are officially in Phase D as of March 16 and will spend the next couple of months integrating and testing the system at the full observatory level. It will be shipped to Palestine, Texas, just after the week of July 4 to have its compatibility test. For this test the satellite's telecom system will fully integrated and tested to make sure it still meets all requirements. If it passes that milestone, which is common to all balloon missions, it will be shipped to Antarctica via air for launch in early December.

Dr. Hickox noted that one of Dr. Walker's slides said that the baseline coverage was 150 square degrees but the threshold is 88 square degrees. The difference in time between the threshold and baseline missions is only 50 to 70 or 55 to 70. He asked if they were getting more efficient in covering area later on in the mission. Dr. Walker said it is a little bit complicated because when they go down there the sun is right at the galactic center. So, they will have to start their survey on one side of the sun and then go to the other side and continue. Then they have to wait for the Sun to move out of the way to go back to get the actual galactic center. So, it does become more efficient as they get away from that restriction.

Dr. Gaskin asked about the positives of going through the process the way they did versus a traditional balloon program. Dr. Walker said it made them much better at planning, but they have had to grow the team. With APRA it is best effort, but with an Explorer mission they are under NPR 7120.5D and have a contract to meet requirements, so their feet were held to the fire much more rigorously. But then, they were given more resources to achieve those goals. When Dr. Gaskin asked if they have a more robust payload now because of it, Dr. Walker said he believed they do. He noted GUSTO is the most complicated, most powerful Terahertz system ever created on Earth, and they are about to launch it.

Dr. Jogee asked, "Compared to previous balloon experiments in the far-IR, what gives GUSTO its superior capability?" The heterodyne receivers give it the edge, Dr. Walker replied, and they are flying an arrays of detectors. They have eight pixels in each of the three bands and they have designed the optics so they can observe in all three bands simultaneously. If there was just one array to do it, the mission would have to be three times longer. The three lines that they are going to observe are far enough apart in frequency that they could efficiently use dichroics to split the photons up, so they can observe them simultaneously without losing a lot of signal on each of the three bands.

Noting the difference between GUSTO and other balloon missions, Dr. Caputo asked about the team demographics and how much they had to change, given the new requirements and that it is more of an Explorer than a traditional APRA. Dr. Walker explained that there was a pathfinder APRA balloon mission, Stratospheric Terrahertz and Territory, STO-1 and STO-2, and the core team members from STO are on GUSTO. While they did have grad students on GUSTO, they had more on the STO missions. One reason was that APRA missions have a faster turnaround of three to five years. GUSTO took longer and students have a lifetime — undergrads a couple of years, and grad students typical five years — so there were not able to keep as many students involved in the Explorer mission as they would have otherwise. Also, APRA missions are more risk tolerant than Explorer missions, so there can be more R&D on APRA missions that can be used in a student's dissertation. With an Explorer mission they had to freeze the technology pretty early in order to meet the risk reduction requirements for a space mission compared to APRA. The main drawback he found was not being able to have students do real R&D that could be incorporated into their PhD thesis.

Great Observatories Maturation Program (GOMAP)
Ms. Julie Crooke, began her presentation on the program by introducing and acknowledging Shawn Domagal-Goldman, the program scientist. Astro2020 recommended that NASA establish a great observatories mission and technology maturation program and GOMAP was established. Astro2020 also recommended a fleet of future great observatories, the first entrant being an infrared optical ultraviolet observatory followed by far-IR and x-ray observatories. NASA is trying to start the HWO as soon as possible, and the far-IR and x-ray observatories will begin when appropriate.

Ms. Crooke went through some of the systemic challenges and solutions to large, complex, multi-year projects. NASA is going to begin with the science, look at the Astro2020 DS and tease apart the science objectives and goals that Astro2020 recommended and quantify them, figure out what enables those. What are the observations, both at the observatory level and the instrument level, that will help achieve those science goals and objectives? NASA must decide what to build and do it from a holistic perspective, looking at the science requirements, the different mission implementation strategies, and what technologies perform best. Then they can converge on a future mission.

The program wants to build in large scientific margins to account for uncertainties, and look at architectures, maximize the use of mature architectures that NASA is invested in, and survey the industry landscape that offers different opportunities today. The potentially larger mass and volume capacity launch vehicles might need fewer deployments and can offer larger technical margins, which will help reduce system complexities. NASA will need standard interfaces, robotic interfaces, tool interfaces, and even at L2, they will need robotic servicing, and industry has taken off in that area.

Ms. Crooke talked about specific learnings from HST (UV coatings and servicing), JWST (deployed segmented telescope with a scalable architecture) and Nancy Grace Roman (high contrast imaging and spectroscopy with CGIand VisNIR detectors) and reiterated the goal to leverage these learnings. In fact, technology maturity and design stability have been cited by the United States Government Accountability Office as the top two reasons that NASA exceeds cost and schedule in their projects.

NASA wants to plan out the entire mission development lifecycle holistically, meaning considering the things the project will need at the later stages of development. The complexity of large missions can be managed by designing a modular system and employing parallel manufacturing, integration, and testing. Parallel operations really help with more efficient schedules and do not rely on a single subject matter expert. Also, this mission can be a perfect opportunity to build up IDEA aspects by constantly infusing multiple subject matter experts in the critical areas and providing multiple lines of assembly and precision engineering and scientific aspects.

Ms. Crooke reviewed their near-term plans and their goals for what to have complete by Asto2030. Before they stand up an HWO project, they are going to release a Dear Colleague letter soon. They are calling it a START, which will take the Astro2020 DS, look at all the science goals and objectives that are applicable to HWO, quantify the actual science objectives, understand what observations each objective needs, and document that information in a report. At this time, the START will not make any decisions. Once they have a HWO project, that will be managed out of NASA Headquarters Astrophysics Strategic Mission Program. Once that happens, we will stand up pre-Astro2030 study teams for the far-IR and x-ray communities to develop the technology roadmap to the science and technology development aspects.

Ms. Crooke finished her overview by talking about the opportunities for people to get involved. She mentioned the Dear Colleague letter that will be released soon for the Science, Technology, Architecture review team, specifically for HWO at this point. Next year, they plan to release an Extreme Precision Radial Velocity via a Research Opportunity for Space and Earth Science (ROSES) solicitation and then

the existing technology development solicitations that will be used by the SAT, APRA, ROSES,Directed, etc. They will have the roadmapping exercises and would like to stand up a small interoperable integrated modeling team soon, as well.

Dr. Calzetti asked that if the idea with the coronagraph is to leverage what is learned from Roman, and Roman will go no higher than TRL 5 and is not expected to launch until 2027, will GOMAP have enough time between 2027 and the 2030 survey to develop it beyond what will be funded for Roman and go beyond TRL 5. Ms. Crooke said it is hard to answer that question given the budget uncertainties and the question of whether the Astro2030 DS will happen in 2030. Dr. Calzetti followed up by asking what the coronagraph team will do between now and when Roman launches. Ms. Crook said they are doing roadmapping, which means that there is no downselects or decisions being made. That will be saved for a future HWO project office. They do not want to overconstrain the project by having made predecisions.

Dr. Clampin pointed out that there are two basic challenges for the coronagraphs. One is mapping out a technology development plan for scaling the mirrors to what is required for a segmented mirror coronagraph, and the other team is working on mapping out an investment plan for testing and developing different kinds of coronagraphic approaches to get to $10^{10}$ contrast and have backup options.

Dr. Hamden asked how someone who is not at Goddard or JPL can get involved in these two technologies, and Dr. Domangal-Goldman said there will be two workshops this summer. People who want to get involved prior to those workshops can email Mr. Jason Derleth from program office who is overseeing the ultrastable observatory technology roadmapping group and Dr. Nick Siegler for the coronagraph. In response to a question about the timing of the workshops and the Dear Colleague letter, Dr. Domangal-Goldman said the coronagraph workshop will be in August and the date of the ultrastable observatory workshop is being finalized. The Dear Colleague letter is awaiting final approval. Dr. Clampin said he paused the letter until he was sure he could fund it.

Dr. Pascucci noted that a lot of the start team's work will be done by the community and asked how the program is envisioning support to the community for that type of type of work. Ms. Crooke replied that the START team will be relatively small and there will be an automatic bridge with the PAGs, SIGs, and SAGs, so a lot of work will be coordinated. Based on the expertise and time availability of the START team, as yet undetermined, they will be able to assess the best things that the PAGs, SIGs, and SAGs can do, but it will be coordinated. Dr. Domangal-Goldman added that at the NASA-level they will be taking the roadmaps and trying to figure out how to fill in the gaps. If a deep dive requiring research is required, that could be a precursor science opportunity. A lot of what the START will be doing is helping to find the right level of activity for the unanswered questions.

Dr. Pascucci asked that if START team does not make any decisions or prioritizations, when and how will the prioritization happen. Ms. Crooke explained that the future NASA HWO project will make those decisions and she does not know when that will be established. It will depend on the budgets.

Dr. Gaskin asked if START will be interfacing with the roadmapping team. Ms. Crooke said the roadmap will flow into the other columns of the STM to keep them from becoming siloed. They want to have an overarching team that is overseeing what is going on and, for the most part, that team will be Dr. Domangal-Goldman, Ms. Crooke, Dr. Clampin, and APD.

Dr. Gaskin asked if START does not have the ability to make decisions or set priorities, how is it different from what the STDTs did, and how will those people roll into what becomes the single project program office. Ms. Crooke said the difference is that the pre-Decadal STDTs had a timeline and had to deliver final reports and have a master equipment list. They had to get costed and were forced to pick point designs. Dr. Domangal-Goldman added that they want to start with the Astro2020 science goals,

identify the ones that are relevant to HWO, and then flow down from those. Ms. Crooke noted that Astro2020 said that HWO is supposed to address two-thirds of their science objectives. So, they need to quantify and break each one down another level to figure out what that means. At what point does that science break off and is there a cliff or is it a step or a smooth slope? By doing that, it would help a future project make informed decisions — in order to have robust science or technical and programmatic margins, it will show how to converge on a mission.

Discussion

Dr. Holley-Bockelmann informed the group it was time to start the day's discussion.

Dr. Caputo asked Ms. Cooke, if the plan for technology development for HWO comes through the SAT, APRA, ROSES, and Directed programs, is it going to consume APRA, for example? Ms. Cooke replied that when the HWO gets significant funding, it will have a focused technology program and that will free up SAT, APRA, and ROSES funding for the other missions. Dr. Clampin added that the idea of saying they are revectoring is so people who are thinking about writing an SAT proposal for a coronagraph will think about writing one for a segmented coronagraph or another technology focused on HWO. The SAT program will not be turned into a development program for a flagship; about half of the SAT programs currently being funded are relevant to HWO. The goal is to get people to think about finetuning their approach for things that are relevant to HWO.

Dr. Kiessling asked if there were any plans to start conversations in a formal way about transferring technology from non-NASA organizations in the security field. Dr. Clampin could not address that question in that type of venue.

Dr. Hickox asked about where technologies fail in the TRL ladder. If something makes it to TRL 6, is it highly likely that it will make it to TRL 9 without a huge amount of reinvestment? Ms. Crooke said the independent costing entities say if your technology is a TRL 6, which means it has been demonstrated in a system or subsystem already in a relevant environment, statistically speaking, the risk is retired. Dr. Clampin noted that he has often seen a company or institution get something to TRL 5 and it worked on a breadboard, but they were unable to consistently make the same device.

Dr. Domangal-Goldman commended Ms. Crooke's qualifications to lead the HWO effort, saying she has expertise with flight projects that are flagship class and complex, has managed to run a technology portfolio and see things advanced from the low TRL stage of software flight, and is someone who is familiar with the precursor studies.

Time Domain Multi-Messenger Astronomy (TDAMM)

Dr. Valerie Connaughton began her presentation on TDAMM by providing updates on some of the upcoming TDAMM missions. NEO Surveyor is a Planetary Science Division IR survey mission with a focus on detecting things that move. The future of NEO Surveyor had been somewhat in doubt, but after an infusion of dollars in the appropriated budget, NEO Surveyor is now scheduled for a launch in June 2028. The mission is initiating the task at IPAC in the coming fiscal year.

For ULTRASAT, earlier this year they signed the implementing arrangement, which is like a memorandum of understanding for NASA participation in ULTRASAT. There is also a call on the street for Participating Scientists awards, which will be the way NASA participates in the science of the ULTRASAT mission. The deadline was at the end of March.

The APRA-funded GlowBug experiment launched to ISS earlier in the month. The instrument has been turned on and is taking data. GlowBug is a wide-field gamma-ray scintillator experiment sensitive to

gamma bursts and other high-energy transients. The Principal Investigator (PI) of the experiment has reported that the experiment has likely already detected gamma bursts.

In the area of the mission support infrastructure TDAMM, an ongoing study, sponsored through the Physics of the Cosmos program office, is looking at the possibility of optimizing the NASA fleet for TDAMM through centralized planning, proposal submission, target of opportunity initiation, and science-driven coordination of observations. The motivation for this process, to make TDAMM a coordinated, whole fleet endeavor rather than a mission-by-mission activity, comes from the DS, two senior reviews of operating missions, and the findings of the task force headquarters sponsored to look at APD's fleet response to gravitational wave follow up, which is a multi-mission, but also a time-critical science case.

One of their two directed work packages involves the General Coordinates Network (GCN), which has evolved since its initiation in the 1990s as a gamma burst alert system from the Compton Gamma Observatory era and now serves much of the broader multi-mission and multi-messenger community. With the growth and changes in IT capabilities, as well as the upcoming Rubin Transient machine with 10 million alerts a night, GCN is evolving. Some of these changes are in response to the growth of the network and the fact it serves a larger community of missions and a larger scope of science, and some of them are in response to IT regulations, which are increasing and changing all the time.

PhysPAG has seen a lot of TDAMM activity. Along with the activities mentioned in the presentation, there is a brand-new proposed SAG on Space Communications, which is the community part of the post-Tracking and Delay Satellite System (TDRSS) era, an area of a lot of interest for the agency as a whole and certainly for APD. The goal of this SAG is to define the science requirements and goals from the TDAMM perspective for a broad swath of TDAMM science cases, as well as what will be lost if the desired latencies, coverage, and bandwidths are not achieved. It is an important part of any discussion on the post-TDRSS era.

In closing, Dr. Connaughton noted the many questions and multifaceted needs required to address the open science questions in the TDAMM white paper. There are science gaps to close before even defining the needed capabilities, and she hopes the SIG will embrace the opportunity to put together what NASA needs to take the next steps in addressing all the TDAMM science that the NASA fleet can address.

Dr. Caputo asked how the results of the SIG and the workshop going to inform future missions to address the science. Dr. Connaughton replied that the big output of the workshop is the white paper. In order to take next steps, they need to understand where NASA is doing a good job. NASA has a lot of TDAMM missions, a program of record with a lot of missions, and upcoming missions that have already been selected. So where are NASA's gaps, what might need more focus, does NASA need strategic technology investments to inform future efforts? The SAGs on the Gamma Transient Networks and space communications will have direct relevance and input into possible infrastructure investments that NASA needs to make, at least to make sure that any solutions they come up with for future space communications capabilities consider the science drivers. They cannot do it without the community. The SIG is going to be the central community group, both for helping to define the type of considerations needed when making financial and policy decisions, but also for gathering the community itself. Currently, there is not a forum for mission development outside of the specific wavelength groups. The existing PhysPAGs SIGs tend to be wavelength-based. She has not heard any big community discussions about TDAMM-specific based needs, although the MEV session the previous day came pretty close. Dr. Caputo asked how they are going to make sure that the needs of the community are addressed through the SIG process. Dr. Connaughton noted that the SAGs produce reports and other products and recommendations are made based on those. There may be aspects of the current Explorer program, for example, that are not optimized for TDAMM science. The Explorer program is much broader than just

TDAMM, but there may be things that the program may need to know and hear. The SIG can be a forum for helping NASA do better within the things they are already doing.

Dr. Hickox asked if what they will need for better alerts and communication is broad enough that they can define something that would meet a lot of future needs or would they first need a clear sense of what kind of missions are coming in the future. Dr. Connaughton said that what kind of missions is secondary to what kind of science. The science cases, to some extent, should be agnostic of the mission type. What they really want are the science cases. There is some coupling with the mission type, particularly with the orbit type, because communications for Low Earth Orbit are not the same as communications at L2 and beyond. The SAG team, led by Mr. Jamie Kania and Ms. Judy Rackerson, have been very thoughtful in putting together all these axes on which they have to consider the science drivers, but also the type of mission that will be doing the science, whether it is the Low Earth Orbit or it needs repointing, needs commanding.

Wrap up for Day 1

In wrapping up the day, Dr. Holley-Bockelmann asked the group what they would like to discuss on Day 2. The group requested more discussion on the following: the Bridge program; TDAMM; ATHENA and how it figures into the larger question of technology development for a variety of missions and balancing the multi-wavelength and technology portfolio; the development schedule for the HWO, CGI, and PR5 and what is required of CGI for HWO; the schedule for the GOMAP program; coordination between the new survey telescopes Rubin, Euclid, and Roman; the maturation program with respect to orbital debris; IDEA initiatives other than the Bridge program; the demographics for JWST Cycle 1 and Roman in terms of race, gender, ethnicity, first generation students, historically Black colleges and universities (HBCUs), Hispanic-serving institutions (HSIs), and the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS); and graduate student pay.

The meeting was adjourned for the day at 5:04 p.m.

Thursday, March 30

Opening Remarks
Dr. Hasan welcomed the group to the second day of the meeting at 9:07 a.m. and turned it over to Dr. Hickox, APAC Deputy Chair.

Dr. Hickox pointed out that on the previous day several interesting questions came up about the Bridge program, technology maturation, and coordination between different survey observatories. He asked the group if there was anything further they would like to discuss that day. Dr. Pascucci mentioned that she was interested in discussing GOMAP.

Science Activation Program Update
Ms. Kristen Erickson apologized for not being at the meeting in person then recognized Dr. Hasan for having been such a stalwart supporter of the Science Activation Program. The astrophysics community is a large reason why the Science Activation Program has been so successful. The previous day it had been announced that NASA, for the 11th year in a row, is the best place to work in the federal government, and Ms. Erickson said programs like the Science Activation Program are one of many reasons for that. The previous week, the Science Activation Program found out that they received one of the group achievement awards, the agency's highest honor, and will be recognized in the April 26, 2023, ceremony. Deputy Director Dr. Linn Chambers, who is critical to the program's success, will receive the award on behalf of the program.

Ms. Erickson then provided some background and gave an overview of the program, which started in 2016 in reaction to the administration at the time taking away the funding for what was called education and public outreach for the NASA Science Activation Program, the National Science Foundation, the Smithsonian, and others.

Dr. John Grunsfeld, who was the associate administrator (AA) at the time, refused to relinquish NASA's leadership in science and connecting with communities and learners. He moved Dr. Erickson to a different position where she worked with science division heads like Dr. Paul Hertz and Dr. Michael Freilich to fashion what is now in the seventh year of a ten-year initial effort to build trust and relationships with those that NASA tended not to work with much. The program inspires and connects learners with NASA science across all 50 states, in every zip code, and internationally. They have built a sustained investment using a national collaborative network of community-based teams committed to connecting learners of all ages with authentic NASA experiences.

The program relies on rigorous, independent evaluation, and every one of their competitively, peer-reviewed, awarded teams has an independent evaluator. Plus, they have a portfolio evaluator to help them refine and adapt the program, which was very instrumental during the pandemic. The program's vision is active participation in the advancement of knowledge for learners of all ages. They call it K-to-gray and are not just in formal education settings; the meet the learners wherever they are.

Ms. Erickson discussed their Metrics of Success dashboard, pointing out that their program has the rigor of education, but also the rigor of science, so it is all about the publications. Their 110 peer-reviewed publications in 2022 was up 50 percent from the previous year, and their citations were up 60 percent. They have 48 teams, twelve of which are called infrastructure. All the 36 competitively awarded teams are either focused on broadening participation or support. The subject matter experts power the engine of science activation. Since 2021 the number of subject matter experts (SMEs) increased by 70 percent to 745. A couple of national academy reports said they needed to do a better job of connecting the experts with the learners, so they went through the ROSES program and awarded three awards to do that.

Dr. Meenakshi Wadhwa from Arizona State University runs the SCoPE program. She and her team go to affinity science conferences, like AAS, AGU, and the Biological Physical Sciences annual conference, to recruit people and tell them about science activation. The people who have some time and the passion to work with learners get stipends. In the planetary community, the REACH program, which is run out of the Lunar Planetary Institute, conducts workshops for SMEs. REACH has a targeted set of efforts geared toward upping the level of SMEs.

The program's 528 leveraged partnerships around the country are similar to a network of networks. For example, they hired a group through the competition to work with libraries around the country, and part of the way they do that is their partnership with the American Library Association, which already has those established relationships. The Science Activation Program relies on them to know what the libraries need. This was extremely important during the 2017 total solar eclipse, and it will be again for the upcoming eclipses.

Dr. Erickson then reviewed the members of the Science Activation Program team, which she credited for the program's excellence, and the investments by division. Forty percent of her portfolio is devoted to astrophysics. They have a group managed by Dr. Denise Smith from the Space Telescope Institute who has all of the astrophysics science and a network of networks, in addition to the program's overall network of networks.

The Science Activation Program funds groups that are making a difference in people's lives every day in astrophysics. The Astronomy Picture of the Day, an infrastructure program, gets more than 1.2 million unique visitors each day and is the second most popular NASA website. They also fund the Neurodiverse Network, led by Dr. Lynn Cominsky from Sonoma State University. Dr. Cominsky had a neurodiverse student and saw how his focus using NASA data had value. She applied for and received a competitive solicitation for high school interns that are on the spectrum to work with mentors and help them help the program, but also to help them on their journey. The high school student that inspired Dr. Cominsky to help us is now working on his PhD. Through Cosmic Storytelling with Harvard, Dr. Alyssa Goodman with the WorldWide Telescope and her team are figuring out how to use incredible data sets to make the universe more accessible and fun to play in. The program also funds the Open Space folks from the American Museum of Natural History, who are their planetarium group.

In 2022, the program reached 50-plus million learners, an increase from 21 million in 2021. About 19 million of that increase was through a coordinated effort at more than 620 Webb sites across the country, and all of those sites held hybrid events when the first images from the Webb space telescope were released. They also hired 600 more volunteers, the solar system ambassadors and the night sky networks that they fund, and hired more for the upcoming eclipses.

Also within the program they coordinate all the Citizen Science, led by SMD's Citizen Science Officer Dr. Marc Kuchner. He has points of contact in each one of the science divisions, and through ROSES they manage unique programs that are funded by the Science Division but coordinated by Dr. Kuchner and the team. Science Activation cofunds some of these projects within all six sciences discipline.

It is not unusual for cross-cutting activities to be included in some of the other science discipline budget line items, so Science Activation is within the APD budget line item. In fiscal year 2023, their budget was cut to $52 million. For the upcoming fiscal year, the budget has flatlined, but it is back to $55.6 million, and that is the run out.

What is coming up? For the two eclipses they have six teams within Science Activation that are actively involved in managing those events across the country. The Exploratorium in San Francisco will be

streaming in both English and Spanish and in multiple filters without narration so people can see the solar eclipse.

Secondly, for the upcoming anniversary of Webb's first images, Erickson provided background on the community events related to the Webb Space Telescope, which started about a year and a half before the actual launch and first images. Those efforts were coordinated by Ms. Anita Dey, the strategic partnerships manager, who worked closely with the Goddard program. She created a network of communities around the country, not unlike what they did for the 2017 Eclipse, so that after the successful launch and incredible deployment the of the satellite, 620 sites were ready to share in Webb's discoveries.

Ms. Erickson closed by talking about the lessons learned and noted that if someone wants to run these types of events, Ms. Dey put together a wonderful primer to use. The Science Activation team has a report out from the evaluator that is in its final form.

Dr. Jogee was happy to see that the Science Activation program has elements in common with NASA's old EPO program. She asked Ms. Erickson to talk about the metrics other than publication that she compiles and uses to address impact. Ms. Erickson said that they had a National Academies assessment that was completed in 2020 that produced seven and a half findings. In looking at what they could affect for the relatively few dollars they have, they talked to the experts and saw that throughout a learner's entire journey the best investment and impact they could make is with identity in the front of the process, connecting learners with people that look like them. They have a very diverse group and a lot of training in the universal design for learning, so they focused on the front end of the process and found the key is whether or not the learners would be self-advocates and speak up in that advocacy role to say, "I like science." They have learned a lot as a collective and have had experts come in and they help them. They just had a review presentation by Dr. Louise Archer on the science capital index, and they are processing that, employing it, and trying to figure out what areas they can affect and how they measure it to make a difference.

Dr. Jogee noted that teacher professional development workshops are great magnifiers. One can give each high school teacher some material to include in the classroom where they reach 100 students a year, so it is a continuous training pipeline. But there are challenges because one has to align those materials with the National Science Education Standard, the Next Generation Science Standard, state-level requirements, and science standards. Dr. Jogee asked if Science Activation was doing teacher workshops and, if so, how they are dealing with those challenges. Ms. Erickson responded that when it moved from No Child Left Behind to the Every Student Succeeds Act, which is more state-based funding-wise, everything became driven by the Department of Education through the state grant process. So if something is not approved through that process in the public-school setting, materials cannot get into a school to help a teacher unless it is enrichment. So, Science Activation leaves professional development as an objective to others. They have some areas where they do EPD, like the established areas in the Earth Science, but they do not do EPD writ large for that reason. Dr. Erickson would like to have stronger connections at the state level.

Explorer Program Update

Dr. Linda Sparke gave an update on the Astrophysics Explorers program and began by showing a slide with everything that is either flying, in formulation or implementation, or currently in competitive review. The Astro2010 DS told Astrophysics to aim for four Explorers AOs per decade and they have kept up with that pace. The Explorers program also manages two directed missions, Euclid and XRISM,, which are launching in 2023.

Dr. Sparke introduced the COmpton Spectrometer and Imager, COSI, which is led from UC Berkeley with Dr. John Tomsick as the PI. COSI is a lowish energy gamma-ray experiment in the Compton regime. With a Compton telescope, the data analysis yields information on polarization. COSI is optimized to measure polarization and spectral lines, with enough spectral resolution to pick up the individual lines for nuclear decay from the unstable atomic nuclei that are produced in supernovae. COSI will measure the radioactive decay of nuclei of aluminum 26, iron 60, and titanium 44, which all have different half-lives. If a supernova remnant is bright in $^{26}$Al (with a very short half-life), the supernova must be recent. Gamma rays will go through almost anything, certainly interstellar gas. So COSI should find young supernova remnants that cannot be seen in the visible or near infrared, which are too young to give much radio emission. From COSI's measurements of supernova remnants and the decaying nuclei, astronomers can work backwards to understand what kind of star it was that blew up.

COSI will test models for the puzzling positron excess observed from the Galactic center. The spatial distribution and the width of the line will show whether those positrons are coming from regions that are highly turbulent with fast motions, or from cosmic rays interacting with cool gas. For bright gamma-ray sources like gamma-ray bursts, COSI will make polarization measurements to distinguish between proposed emission mechanisms. If the gamma rays are polarized, one emission mechanism can be distinguished from another. If they are not polarized, then either the emission mechanism does not produce polarization, or the emitting region is disordered and turbulent.

When the 2014 SMEX mission IXPE was launched to measure X-ray polarization, we did not know whether there were polarized X-ray sources to observe. It is very encouraging that IXPE is seeing high levels of polarization, tens of percent, in the types of sources, active galaxies and accreting black holes, that COSI will be able to monitor. That suggests that COSI will also measure polarization, not just place an upper limit on it. The IXPE team was able to conclude that the X-rays from those blazars are coming out of a shock, whereas the ones from Cyg X-3 are reflecting off a dusty torus. IXPE is coming to the end of its initial mission. If it passes review, it will start a guest observer program from next February.

In summary: COSI is expected to turn up young supernova remnants and provide constraints on the star(s) that exploded, it will measure the positron excess from the galactic center to constrain what might be causing it (unfamiliar physics or known effects), and it will provide polarization measurements on bright gamma-ray sources. Most of our information on transient gamma-ray burst sources is now from the Fermi satellite, which surveys 60% of the sky at any time. But if a burst occurs in a source that happens to be behind the Earth for Fermi, it may be visible to COSI. It is not primarily a burst-hunter, but aims to get alerts down within an hour of observing a burst, using TDRSS.

Two MIDEX concepts are in competitive Phase A studies. STAR-X is an X-ray telescope with a co-aligned UV telescope. The X-ray telescope is in the softish x-ray up to about six keV. Below two keV it has 1.4 times the effective area of Chandra at far less cost; the images are slightly less sharp than Chandra's. With a degree-wide field, STAR-X will see transient sources in the field where it is pointing, and plans to distribute alerts promptly. If a ground-based observatory (such as LIGO) issues an alert, STAR-X can be re-pointed within two hours. STAR-X will do X-ray surveys, looking deeply at the gas in and around the galaxies.

UVEX is a larger version of GALEX with added spectroscopy, and a much wider field. It will see much deeper, mapping simultaneously in roughly the same two UV bands, with images that are less than 3 arc-seconds. The spectrograph gives low resolution R~1000 spectroscopy over 150 nm to 250 nm. In addition to doing a sky survey, UVEX will do deep work pointing the spectrograph at hot star regions in our Galaxy or the nearby Magellanic clouds, to understand galactic evolution and the stellar lifecycle. STAR-X also allows a fast slew, and aims to follow up alerts within three hours. It is in a lunar resonant orbit,

with four data dumps each day. For transient sources that it observes, UVEX will distribute alerts within an hour of downlinking the data.

The LargE Area burst Polarimeter (LEAP) will measure the polarization of gamma ray bursts from the International Space Station (ISS). It optimizes polarimetric sensitivity, but does not have as good spectral resolution as COSI. LEAP's main science is to measure the polarization from multiple tens of bright gamma-ray bursts, which will distinguish between the three popular models for emission. LEAP will also detect some gamma-ray bursts that Fermi misses, because a burst that is behind the Earth for Fermi will not necessarily be behind the Earth for LEAP. Since it is on ISS, LEAP can almost always communicate fast down to the ground when it sees a gamma-ray burst.

MoonBEAM is in a cislunar orbit, spending most of its time far from Earth; it and is sensitive to soft gamma-rays below 5 MeV. Because the Earth blocks only a little of the sky, MoonBEAM has up to 13 days of continuous uninterrupted viewing of almost all the sky – only 4% is not accessible at any one time. MoonBEAM is similar to the gamma-ray burst monitor on Fermi,. For a short gamma-ray burst, triangulating between the distant MoonBEAM and a measurement on the ground (e.g. from LIGO) or from Fermi in low Earth orbit gives a much better fix on the sky position. MoonBEAM aims to get alerts down within five minutes by communicating direct to Earth. STAR-X, UVEX, LEAP and MoonBEAM will turn in their Phase A studies at the beginning of June. An evaluation will be done and the plan is to get a downselect announcement out in the first quarter of the next calendar year.

A draft Announcement of Opportunity (AO) for the Astrophysics Probe was released last August and the final AO will be released in July, with proposals due no earlier than mid-November. There is a $1B cost cap and, unlike the MIDEX, there is a requirement that 70% of the observing time on a pointed observatory goes to general observers. For a survey experiment, the data must be made public right away. This is a two-step AO like the MIDEX, but since the Probes are more complex, the competitive Phase A will be twelve months rather than nine months, and with a slightly higher funding level.. In response to Astro2020, the Probe AO invites proposals for a far-IR imaging or spectroscopy mission, or for an x-ray mission. It is not wide open like the SMEX or MIDEX calls.

While the Explorers Program has been able to follow the Decadal Study recommendation to maintain four AOs a decade, the FY 2024 President's budget request does not accommodate a 2024 SMEX. The SMEX and MO call will slip forward from a Spring 2024 to a Spring 2025 AO release.

Dr. Hamden asked if budget issues would impact the Phase B starts of the MIDEX. Dr. Sparke replied that Dr. Paul Hertz had said a year ago that the downselected missions may have a delay to the Phase B or more likely a slow onramp. Those missions will be asked to replan to the budget that the Astrophysics Division can actually provide. In response to a comment about the delay, Dr. Sparke clarified that while the SMEX 2024 will incur a one-year delay, hopefully the MIDEX implementation will not be extended by that much. The downselected MIDEX and MO teams will start work as soon as they have been downselected, nobody will sit on their hands, but Astrophysics may not be able to accommodate the requested budget profile so work might have to slow down.

Dr. Tremblay asked whether Astrophysics can afford two or three Phase A Probe studies. Dr. Sparke said Astrophysics is budgeting for three Phase A studies, with half of the $15 million in FY 2024 and half of it in the following year. It is normal to budget for three Phase A studies, since sometimes three are selected, though mostly it is only two.

Dr. Caputo asked that since the Astrophysics budget often does not accommodate the schedule and budget profile that was originally proposed, would it make sense to anticipate schedule lengthening during the AO or the call when teams are proposing. Dr. Sparke said it would not, for two reasons. First,

Astrophysics does not know what to anticipate and must give a planning target. Second, the request from Congress must match what is in the AO. The annual appropriation usually does not give Astrophysics everything that was asked for, it is always necessary to make budget adjustments, and the cheapest place to adjust within a mission is at the beginning. It is costly to slow work down in Phase C or D, so it is always the newly selected missions that get cut. Astrophysics cannot anticipate the cuts because the final appropriation is not known.

Dr. Hickox wanted to know about the criteria that would determine whether or not IXPE would continue and asked Dr. Sparke to give them a sense of how that kind of review happens and if it differs from the way the Senior Review would go. Dr. Sparke said for the first extension of a mission, Astrophysics would look at whether the prime mission had met its Level 1 requirements. If those are met, Astrophysics considers the science return for continuing, versus the cost of continuing. If, for example, a mission has already looked at every object in the sky that is bright enough to see, or if it is deteriorating, that is a minus. If community scientists have expressed interest in a General Observer program and NASA thinks the mission will produce good science, it is a plus. NASA does an interim review for every mission at the end of its prime phase, to decide whether to extend the mission until the next Senior Review.

Dr. Caputo asked if the Phase A for the Probes was more complex because it is a different mission class than other Explorers or because Astrophysics was setting a higher standard for the Phase A. Dr. Sparke explained that the Probe is more complex because it is a larger mission with a guest observer program, where the proposing team is expected to defend that guest observer program and explain it, and also, because the Probe is a new kind of solicitation that will likely generate more questions from the Phase A teams.

Dr. Tremblay pointed out that a large community of stakeholders in MIDEX and SMEX would love to see an expanded menu of options from launch services. Dr. Sparke replied that MIDEX already provides that. For the SMEX, it depends on what launch vehicles are available at the time that the AO is released. The Astrophysics Division is aware that people want more launch vehicle options, but the question is, what is available and at what expected cost?

Dr. Holley-Bockelmann read a question from the chat: “According to the nominal schedule, when in 2026 will the MIDEX AO be released?” Dr. Sparke replied that the MIDEX AO is planned for release every five years to the month, and the SMEX also. The SMEX and MIDEX are on two-and-a-half year cycles.

ULTRASAT Update

Dr. James Rhoads, the NASA project scientist for the Ultraviolet Transient Astronomy Satellite (ULTRASAT) mission, began his update with an overview of ULTRASAT. The satellite will be in geostationary orbit, and the operations mode is both a high-frequency monitoring with a five-minute cadence and a rapid target of opportunity response for gravitational wave events, and presumably other classes of transients. ULTRASAT will conduct an all-sky survey during the first six months at about two magnitudes deeper than the GALEX All-Sky Survey. Compared to GALEX, it has one band instead of two, considerably higher efficiency for the detectors, which compensates for a slightly smaller aperture. The point spread function on average across the field is about eight-and-a-half arc seconds. But in the best 50 square degrees, it is as good as GALEX.

ULTRASAT is an Israeli mission with participation from the U.S. and Germany. Dr. Rhoads reviewed the key partners and their responsibilities, along with NASA’s project organization. NASA Goddard is the project management center and the Kennedy Space Center has responsibility for launch. He reviewed NASA’s contributions to this program and noted that NASA is selecting scientists to participate in the ULTRASAT working groups. The Science Archive is going to be hosted at the IRSA archive at IPAC.

Dr. Rhoads then discussed the key science objectives. The first objective is to study electromagnetic counterparts to gravitational wave sources. He showed an image (slide 12, top) that had ULTRASAT fields superimposed on a representative gravitational wave error region. It also showed the exclusion zones for the sun, which is the biggest exclusion zone. There are smaller exclusion zones for Earthlight and moonlight avoidance, but even putting them all together, it can always reach at least half the sky. The top figure also had a region in the antisun direction where the spacecraft has to rotate so far from its nominal orientation that it has to draw down batteries to observe there. There is a limit on how many targets of opportunities can be done in that region and how long they can take, but it is not a very restrictive limit. The batteries are sufficient that it will rarely have to avoid a targeted antisun region. The second science objective is to learn things about supernovae that can only be learned by staring and seeing the beginning of the event, which requires high quality, early cadence, ultraviolet data. They are hoping to learn about shock breakout, but there will also be other interesting information about what they have been doing. Watching that early time-light curve tells a great deal about the size of the photosphere at the time of the explosion and the distribution of mass in the immediate region around the progenitor supernova.

Dr. Rhoads reviewed the thirteen science working groups, the primary way of coordinating the ultimate science planning. They have wide-ranging topics and each working group is expected to find key science questions to be addressed in its topic area. He specifically focused on three groups: WG1 - Transient Stellar Explosions and WG2 - Gravitational Wave Sources, which are relevant to ULTRASAT's science objectives, and WG12 - Transient Alerts, which is explicitly called out in the implementing arrangement as a place where NASA will have a role.

Another part of the landscape is the Vera Rubin Observatory, which has sensitivity and sky coverage, both of which are nicely matched to what ULTRASAT will do. It has wavelength coverage that is highly complementary to ULTRASAT, and the ULTRASAT project in Israel was very keen to pursue a partnership with Rubin. NASA's discussions with the Rubin Observatory have focused on having a unified U.S. community that will not be fragmented into NASA people and Rubin Observatory people. The most concrete consequence of that is that the participating scientist program call is a joint call that will select all of the U.S. participating scientists in those working groups without labeling anybody as a NASA or a Rubin participant.

Dr. Rhoads showed a snapshot of WISE data (slide 21) being examined in the IRSA time series viewer. In the top right is a phase-folded light curve, and by zooming in on this and looking at the table on the left, you realize that that phase-folded light curve actually spans data taken over a very long range of times. This is something that people may be interested in exploring with ULTRASAT, because they are going to have an archive that spans three years with a five-minute cadence for about 200 square degrees.

ULTRASAT is going to be in a staring mode for most of the time, about 20 hours a day and is going to look the same 200 square degrees on a five-minute cadence, which is when shock breakout and supernova rise and tidal disruption events will appear, along with many other different and unknown transients. For the remaining four hours or so in each day, in the first six months of the mission, it will complete its all-sky survey. And after that, it is going to do a lower-cadence, wider area survey. For about four hours a day it will survey 40 fields on a four-day cadence, which is basically 15 minutes and move on, 15 minutes and move on. This process provides 8,000 square degrees of monitoring, with the four-day cadence.

For further information, Dr. Rhoads provided links to an ULTRASAT project website at the Weizmann Institute that has the greatest amount of technical detail, and presentations from past events. A mission description journal paper, led by Dr. Yossi Shvartzvald, project scientist in Israel, is in the works and will have a lot more information than is currently on the website.

Dr. Shirley Ho asked that given the fast-moving landscape in machine learning or AI, or the recent recommendation from the Astro2020 DS, were there specific plans to incorporate what they have developed — time series analysis tools, image analysis tools — into one serving the data to the community. Dr. Rhoads said he does not know of such plans yet. Dr. Ho said she imagines that for serving up time series data, there are a lot of modern-day tools that we already know what to do with machine learning and also image analysis. She asked how they possibly incorporate some of these analysis tools into the public-facing data servers.

Dr. Vandana Desai (IRSA Science Lead) said that in the archive world, there has been a lot of talk about making machine learning and AI tools work for users in analyzing their data. The approach they are taking is trying to put tools in users' hands that allow them to use the algorithms they think will be most helpful in their science. So, they have been talking a lot about, for instance, science platforms. ULTRASAT is very big data, 50 billion rows of catalog data for the first release, and each subsequent annual release will be double that size. So they need to make these data sets available to users in a way that users can make full use of the big data. They are looking at cloud technologies to make sure people can access the full data set and have their compute near the data to make that possible. That unlocks the ability of users to apply machine learning algorithms to the data analysis because they can be quite computationally intensive and need to touch all of the rows of the data or many of the pixels of the images. Dr. Ho asked if they were providing the tools or are they expecting the users to import their own tools into the cloud service. Dr. Desai said the tools that will be available through the cloud services would be all of the industry standard tools for applying machine learning algorithms. But they do not want to be doing the science for the community, they want to be enabling the science for the community. The choice of algorithms does affect the results very sensitively, so they are trying to bring the industry standard libraries that users would want to use and make it easy for users to apply the scientifically relevant algorithms.

Dr. Hamden asked if they have an expectation of how many people they might fund this year in the participating scientist program and if the opportunity was going to be available every year. Dr. Rhoads replied that they anticipate being able to select 14 participating scientists and provide funding to ten of them. The rest can join the working groups but have to figure out funding for themselves as a result from their merger with Vera Rubin Observatory. The opportunities are three-year opportunities, and at the end of three years, they anticipate running a second selection.

SPHEREx Update

Dr. Jamie Bock provided an update on SPHEREx, NASA's next medium-scale explorer mission that is currently in development. SPHEREx will deliver a unique data product to the community, the first all-sky spectral survey in the infrared. Their three science themes are how did the universe begin, how did galaxies begin, and what were the conditions for life set up outside the solar system? These three questions form their driving three Level 1 requirements, with instruments built to address each of these three. Their fourth Level 1 requirement is creating the all-sky spectral survey.

How did the universe begin? The current understanding of the beginning of the universe is that it started with an initial superluminal exponential expansion called inflation. The physics of inflation are certainly exotic, but not well constrained. Nevertheless, the basic predictions of inflation have been validated through four decades of extremely precise measurements of the cosmic microwave background. This basic picture paradigm of inflation remains, and it is thought to occur at energy scales up to $10^{16}$ GeV, perhaps something to do with grand unification. It is far beyond our ability to access this kind of physics through terrestrial particle physics. The energy scales are inaccessible, so the best laboratory to understand the physics of inflation is likely the universe itself. The key fact is the initial perturbation set up by inflation, are the seeds of structure that form the hot spots and cold spots in the microwave background, but they go on to seed the large-scale structure that is later traced out by galaxies. The

measurements that can be done that are specific to the physics of inflation are few and very challenging. With SPHEREx, they are focused on a measurement called non-Gaussianity, which has to do with the statistical nature of these fluctuations.

As they study the large-scale structure of galaxies with SPHEREx, they will do this over the full sky, which is important for measuring non-Gaussianity and putting these measurements of non-gaussianity in a completely new regime of accuracy. Non-Gaussianity is sensitive to the number of fields behind inflation. If multiple fields are involved in inflation, and there are always some theoretical reasons to suspect this, generally they predict levels of non-Gaussianity on the order of a few. The challenge is to get from accuracy on non-Gaussianity of five or so down to below one. Their requirement is to produce measurements of an error of about a half. One does not know where that error ellipse is going to fall, but if it fell where it was shown (on slide three), that would rule out single field inflation, which would be a big deal. Conversely, if that error ellipse landed on the Y axis, that would rule out most of multifield inflation. So this is an important discriminatory measurement between these two broad classes of inflation.

A new method has come out that exploits the fact that galaxies have a bias to these primordial fluctuations that provides additional leverage, which may reduce these error bars significantly. The importance of this science is flagged by the Astro2020 DS, which foresees non-Gaussianity as an emerging measurement.

Their second theme is the origin of galaxies. SPHEREx does something quite different from a large telescope, such as JWST. It studies the extragalactic background light, a harbinger that collects all the photons emitted over cosmic time. The background contains the light emitted by all sources, including galaxies, over cosmic history. They study the anisotropy in the extragalactic background light.
What SPHEREx does with its small telescope is study the large-scale clustering anisotropies (shown on slide 4), and that pattern of clustering emission traces the total light emission and does so in a democratic way by measuring the total photons. The measurement includes emission from all galaxies, all types, including dwarf galaxies or diffuse galaxies and even potentially exotic sources of emission, such as dark matter decay, as long as the emitting source gravitationally clusters. These sorts of measurements have been done in the infrared and the far-IR but in continuum bands. SPHEREx has spectroscopy, which allows them to decompose the emission, so instead of looking at an integrated band, they can break it up into wavelength channels and also break up the emission into redshift slices going back from today out to redshift six or so. It is very orthogonal to current measurements that are done galaxy-by-galaxy with large telescopes.

Their third theme is to trace the abundance of water in the early stages of star formation. From Herschel and SWAS measurements, water in these early stages of dense molecular clouds where stars form is not in the form of water vapor, but mainly ice. These interstellar ices are what sourced - through some intermediate steps -the oceans on the terrestrial Earth. That water started as interstellar ice in the interstellar medium.

They will do absorption spectroscopy, and along with the deep-water feature there are other features — methanol, carbon dioxide, carbon monoxide — biogenic tracers, harbingers of biogenic molecules that are in the interstellar medium and also of great interest. This will be done with absorption spectroscopy going through the early stages of star and planet formation, from dense molecular clouds to young solar systems. SPHEREx delivers a huge dataset of millions of sources through an unbiased survey.
In the process of doing these measurements, this unique all-sky spectral survey will be made available to the community in the form of spectral images within two months, but probably with a much faster collection of the data and basic photometry tools to allow the public to explore the data on their own.

The instrument is a small humble telescope, with only a 20-centimeter aperture, but there is a large collecting throughput, which is reflected by a large solid angle on the sky. They are at infrared wavelengths, so the telescope has to be cooled, and in LEO, so that is a thermal challenge. But they passively cool the telescope below 80 K, and the coldest point is the long wavelengths detector rays, which are cooled to below 55 K.

Dr. Bock described how they do spectroscopy. It is a linear variable filter, and at each wavelength the filter is transparent across the band and that wavelength transmission varies linearly over the filter, about a four centimeter by four-centimeter piece of sapphire. They place it on top of the detector, and each point on the detector sees one wavelength and then through a series of exposures they build up a complete spectrum. They are doing low resolution spectroscopy with the resolving power of about 35 to 130, depending on the wavelength and fairly large 6 arcsecond pixels in order to build up the sensitivity for spectroscopy. The observing sequence is driven by the spacecraft.

It takes six months to get a complete spectral survey and their base mission is two years. Over that time they will get four all-sky spectral surveys. At the poles, they have deep coverage because the observation pattern overlaps and that is where they do the intensity mapping.

Dr. Bock gave an overview of the instrument's hardware, most of which has already been delivered. The photon shields, which keep the instrument from seeing the Earth and sun, are expected to be delivered in September, but are not needed until March 2024. The focal plane radiator panel is due in May but are not needed for the upcoming test. Most of the components of the spacecraft have also been delivered. There are two outstanding units: the K-band transmitter is due in April and the Integrated Avionics unit, which needed some rework due to an incompatibility problem with the torque rods, is now expected in June.

The summer will be busy. Once the telescope gets through its cryofocus test, which is happening now, and is delivered, it will be integrated with the thermal system and the focal planes. Then the whole system, which is basically the instrument chain, goes into cryogenic chamber and is tested end-to-end. A custom cryogenic test chamber was delivered by their partners in Korea to use for focus tests, environmental tests, focus recheck and then a final spectral calibration. The instrument will be sent off approximately in March 2024 for integration with the spacecraft, for launch in February 2025. The photon shields do not fit into the chamber, so they are set separately and integrated with the spacecraft after instrument delivery.

In conclusion, Dr. Bock noted they have had challenges resulting from the health and economic implications of the COVID pandemic that led to them expending reserves and a slip in schedule. The ABC cost and schedule caps that were set at PDR have not changed. They had to replan their science funding, and they had identified at PDR that the science program had a risk in order to handle the requirements of the cosmology and galaxy formation science, which are very involved and have an integrated cosmology-style pipeline. But with COVID and their current reserves posture, they are unable to fund that in Phase E and F through the project. They have alerted NASA to the situation going back to the days of the PDR and are looking forward to a resolution at the upcoming SIR review.

The flight hardware is almost complete and everything they have tested has performed beautifully. Dr. Bock is very happy with the performance of the focal planes, detectors, LVFs and the readout electronics. The sensitivity is near their best-case estimates in the cosmology bands at short wavelengths. All of the instrument performance testing will be happening in Caltech labs this summer.

Dr. Mozena asked about the threats via the science that Dr. Bock described. Dr. Bock replied that they have the Baseline science program and the Threshold Program. The Threshold Program is to deliver the

Ice science and the survey data products to the community, so they are committed to doing that at a bare minimum. The cosmology and galaxy formation science is challenging because of its complexity, and each requires an integrated pipeline that has to be developed well ahead of time. Currently, people from the science and engineering team are developing those pipelines. This analysis sits on top of the lower-level pipeline that is done at IPAC for producing the images. Though the cosmology and galaxy formation pipelines are being developed now, their current funding within the project is not sufficient to continue that into Phase E. So at the time of launch, they would not be able to deliver the cosmology and galaxy-formation scientific products. The pipeline is planned to get to the prototype stage at launch. When they get on the sky, they are anticipating that they will have to deal with additional issues associated with real-time data. The prototype stage demonstrates basic functionality. The lower-level pipelines of IPAC does have to be fully ready at launch due to the requirement of prompt data product delivery. Dr. Mozena followed up and asked when the go-no go decision to stop would be for the science pipeline. Dr. Bock said the funding discontinuity point is at launch.

Dr. Ho was concerned that there is not enough funding to have a large-scale structure survey analysis planned ahead of time. Euclid has been doing it for ten years and Roman is doing it ahead of time. She said it is possible that none of the science will get done simply because they are not funding early integrated pipeline development. She asked how much money they need or, given that these are very important goals for NASA, what they can do to make sure the science will get done. Dr. Bock said they put forth a menu of options for the A-Z shortfall, which included doing part of the cosmology and galaxy formation programs. Also, many tools for the community were cut in this process. So there is also a menu item for having full community tools developed in order to make SPHEREx's somewhat custom data product easy to access. However advance funding for the cosmology and galaxy formation pipelines is largely not the issue (there is a small shortfall in phase D), it is continuing this work into phases E and F.

Dr. Hamden was curious about the photon shield because for small sats or CubeSats one of the big issues is keeping things cold in a way that is inexpensive. She asked whether their design for the photon shield could be applicable to a smaller instrument or if it is a unique thing that SPHEREx can do. Dr. Bock said he did not see why it would not scale but he has not looked through the numbers. It was originally designed as a deployed structure, but it was changed to a fixed structure when the launch vehicle shroud was known to be large enough, as this was lower risk. But there is no reason it could not be deployable for other reasons. They did test the thermal performance on a scale model and showed that they could get down to those temperatures. Dr. Hamden asked if they had published the thermal design and said APAC would like them to. They had not published it.

Public Comment Period

Dr. Hickox read the questions voted on by the public.

The first question: "How have dual anonymous peer review (DAPR) requirements been affecting selection rates in ROSES, and will the requirements spread to more ROSES opportunities or other opportunities where it does not make sense?"

Dr. Hasan read a response from their Research and Analysis (R&A) lead, Dr. Stefan Immler. "The dual anonymous peer review format has been adopted for most R&A peer reviews across SMD and has been encouraged by STScI's successful incubation of the review format of the Hubble Space Telescope (HST) Observing Program in 2018. STScI and other studies have shown that the DAPR process can successfully steer discussion away from people, teams, and institutions and towards the science and technical merits of the proposal while preserving the quality of the review. This has led to higher proposal selection rates for early career and female PIs, along with more diverse selection in terms of funded institution and institution type. NASA will continue conducting peer review under the dual anonymous peer review for most R&A programs."

Dr. Smith pointed out that Dr. Doug Hudgens, one of their program scientists, is now working at the SMD level to infuse or spread DAPR throughout other R&A programs. Others are already doing it and expanding it and it is working well and doing what they expected. Dr. Hickox added that there are opportunities where it does not make sense that have been considered by NASA. For example, the recent Roman call was not dual anonymous because of the need of the teams to be collaborating with the Roman team. Dr. Smith agreed, saying that where a case is explicitly about a person, it would not make sense to make it anonymous. They are experimenting with cases where the science review is done in the DAPR mode and an expertise and resources review follows after the fact. So, the science gets a merit grade that is unchangeable, and then they say this is the institution and their resources that propose to do it and that could get evaluated. Dr. Hasan said in APD it has been implemented across all the General Observer (GO) programs and they are beginning to implement it across others.

Dr. Hickok read the next question: "It has been a little over a year since NASA Headquarters (HQ) ended Goddard Space Flight Center's initiative to optionally include pronouns in IT identities. Is there an update on the reinstating and expanding of this functionality, especially considering the LGBTQ+ community's concerns regarding the decision against renaming the James Webb space telescope. Dr. Smith offered an update from the APD's public affairs specialist, Ms. Alise Fisher. She double checked this question and confirmed that they do not have further updates since the statements were issued the previous year. Dr. Smith then read the statement that Mr. Steve Shih, NASA's associate administrator for diversity and equal opportunity, posted on March 9, 2022. He wrote, "Through an effort to create a more inclusive workplace, NASA recently implemented an IT project at Goddard Space Flight Center that allowed approximately 125 employees to test the option of including their gender pronouns in NASA's email display fields, which currently include the employee's name, center, organizational code. The learnings from this test will be used to inform the advancement of DEIA. NASA is fully committed to supporting every employee's right to be addressed by their correct name and pronouns. All NASA employees currently have the option and flexibility to include their gender pronouns in their customized email signature box. This option remains unchanged and is supported by NASA leadership so that employees can share their gender identities and show allyship to the LGBTQIA+ community." Dr. Holley-Bockelmann noted that it had been a year since they had done the pilot and there was no news, but they are studying it. So, for the record, there is no movement at all on this pilot. Dr. Hickox said it was something the APAC could weigh in on.

Dr. Hickox read the next question. "What is the vision for trade study support on the compatibility of general Astro tech with coronagraph tech to maximize science return for the HWO?" Ms. Crooke said that it is very clear from the Astro2020 DS it is going to be an equally exoplanet and general astrophysics observatory, despite the name, because they can explain the name very easily to the public. The START is going to begin by looking at all the science objectives and goals for all HWO, the majority of which might be on the general astrophysics side. Astro2020 was quantitative in the 25 exoworks. The other two-thirds of the science objectives and goals that were identified in the Astro2020 that applied to the general astrophysics side is exactly what the START is going to do. They are going to take all those qualitative science goals and objectives and quantify them. They are going to break them down, understand them and identify what observations are needed to achieve those science goals and objectives. Is it an instrument capability combined with an observatory capability or one or the other? After they find out what those are, and they will cross-correlate all the capabilities needed for the observatory so they maximize the science they can do on the general astrophysics side that is compatible with the general exoplanetary science. This is not just looking for exowork, it is looking at the zoology of planets, so they are going to want to bring on solar system science experts, as well. It would never be able to drive the observational requirements, but if there should be a serendipitous choice between two things, they can absolutely take advantage of that. Once they know what all the observational requirements are for all of the science

objectives identified by Astro2020, they will be able to map those observations, and then will break it down even further. But they will trace the technologies and the architectures they need to enable them.

Dr. Hickox read the final question: "As the AAS and Royal Astronomical Society have both echoed JWST naming concerns representing a significant portion of the astronomy community, and as this is an international mission, why is NASA choosing this name despite so many concerns?" Dr. Smith noted that they had heard the report from the historian the previous day and that reflected the agency's investigation of the process and decision not to change the name based upon that research. He pointed out that NASA has a new naming policy in place that it hopes will avoid such controversies in the future. Dr. Hickox added that given the concerns about the JWST naming bubbling up from the community, it would seem to make sense to have some broad community engagement with the naming process in the future. He supports moving away from naming after individuals as a general policy, but it would be better to have an explicit way of including community input early on so that people feel some ownership over what an observatory is called. He asked if APD would consider something like that in addition to the smaller group that is specified in the policy. Dr. Smith said his reading of that policy does not preclude that option and it does not say how the division whose mission it is gets input. Dr. Holley-Bockelmann added that there will be an effort solicit suggestions, so they could clarify that.

Discussion

Dr. Holley-Bockelmann led off the discussion on TDAMM by saying that she hoped they could develop a more deliberate and strategic TDAMM plan than what they have currently. She understands they are not going to invest $800M, as the DS recommended, but she believes they need to be more organized and deliberate about what they will do to address the initiative. Dr. Hickox said that one thing that would help, not just with TDAMM but with other broader priorities, is if there is a cross-cutting APD priority that is not necessarily targeted to one Explorer opportunity or mission call or program but could potentially be addressed by many different programs as TDAMM could be. If there is an understanding that TDAMM is a priority, then it would be nice to have a set of relatively clear criteria for what it means to be addressing that priority in a proposal call to specify that, if you address this set of priorities, please clearly spell out how this is true, and it would be considered in the review process. If you do not address TDAMM, then that is fine. If things are laid out broadly, you could still propose for any of these things. But if you do, then that would be an additional criterion to judge on.

Dr. Holley-Bockelmann noted that they asked TDAMM to be prioritized for selection of almost any of the programs, and the answer was no. That was unfortunate. It is more than just mission selection, but it is something as fundamental as how to deal with data from two very different types of instruments and surveys. What is the systematics of combining these data? There needs to be a concerted effort, not just with the mission selection, but how to deal with the data itself and the infrastructure that is required.

Dr. Caputo agreed with what the others had said. There is not a deliberate plan with Headquarters, and they are calling everything TDAMM, which is not productive. TDAMM needs to be baked in from mission onset, with the capabilities that are required through TDAMM, which need to be defined by the community. She wondered if APAC could request to receive a report from the workshops that are being organized. They need a set of priorities because randomly labeling everything as TDAMM is not going to serve any community, and a lot of things are going to be missed.

Dr. Tremblay noted that on the day the most recent MIDEX downselects were announced, the press releases for STAR-x and UVEX read as if they were being recorded as TDAMM missions having high TDAMM responsiveness. Astro2020 came out, had TDAMM in it explicitly as a high priority, medium-scale program, higher priority than even the probe AO, and recommended it as an $800M augmentation to the Explorers program. NASA is, in fact, going to try to retcon existing programs into TDAMM responsiveness to kind of make a Frankenstein TDAMM program out of existing programs. The previous

day he had heard Roman being referred to as kind of a TDAMM responsive mission, which is true, but also Roman existed prior to Astro2020. In Astro2020, it is technically a higher priority than the probe AO. He agreed that they need a clear definition, partly coming out of the reports on the most recent workshop, about what a TDAMM mission means to NASA and if it is truly responsive to Astro2020.

Dr. Calzetti asked if the concern from the community is that reporting or renaming missions as TDAMM is unfair or inappropriate or that they will be qualifying as TDAMM missions no matter what because of the response times or what they do. She understands they do not want something pigeonholed as TDAMM when it was not to start, but would it be detrimental to the program if they are called TDAMM or maybe TDAMM-style? Is this just a question of naming and being concerned over the effort toward things that were not born as TDAMM? Can you become TDAMM or is that forbidden? Dr. Holley-Bockelmann said that a lot of things can be considered TDAMM, and she does not think it is inherently wrong to rebrand something. But they would also have to put in the infrastructure to be able to enable the data to be used in the way that you can make it TDAMM. To have a catalog of gravitational wave signals and be able to talk to a catalog made from Roman data, that is possible and would be consistent with TDAMM. However, a lot of foundational work goes into it, not only with computing, but to understand the systematics of both of these data, to educate the gravitational wave person, to educate the optical person, to be able to talk to one another. There is a lot of community building and infrastructure to be done. It is possible to rebrand the whole suite as a TDAMM suite if you enable or put in the infrastructure to allow the science to be done this way. Dr. Hickox added that how you do these things is something that the PAG activities are explicitly supposed to address and have already started to address. The process is underway on understanding what we need to do to build this capability. The real question is how do you provide the resources to actually do that once we know what we need to do? It seems possible that even if we do not have the full $800M investment, some existing funding resources like ADAP or other grants programs could be used to develop the kind of things that would be needed. But in order to make that happen, those requirements need to be made clear, and it needs to be clear that there is a benefit in responding to those requirements. Right now, that connection between figuring out what we need and how to provide the resources to do it is the missing piece. Dr. Holley-Bockelmann said that since it involves all ground-based facilities, it is not just NASA's list and it should not be, part of the solution could well be partnering with other agencies.

Dr. Caputo said the analogy that she thinks of is Exoplanets. Swift was a mission that was designed inherently for TDAMM before TDAMM was a thing. It autonomously has three points, a UV optical telescope, and a gamma reverse telescope that is set to trigger. However, you can use Swift also to study exoplanets. You can look at it, you can get x-ray measurements, you could look at the stars near the exoplanet as flaring. It can do other science beyond what it was originally designed to do, but you would never design a mission like Swift to study exoplanets. The concern she had about headquarters calling everything, like Roman and some of the explorers, TDAMM missions, is that they can certainly be helpful because astronomers will always use whatever resources are available and it certainly will contribute to the field. But it is going to be missing key capabilities, things like autonomously repointing. If you have multiple-hour response time, you are going to miss things. That was the main concern, to answer the original question. It is not that any resource is going to be useless, but you need to have it baked in from the ground as part of your Level 1 science requirements to really address some of the issues. She agreed it is good idea to have the TDAMM community identify things that they would require for missions to have it baked in from the ground that their community needs.

Dr. Holley-Bockelmann said that because she is more in the Multi Messenger Astrophysics (MMA) community, she thinks that when most people think of TDAMM, they only think about the time domain part or about contemporaneous follow-up of sources. Because the only gravitational wave experience they have is from LIGO where things happen quickly. A lot of science can be done with archival data, with surveys, with thinking about statistics of populations, and she thinks they have not yet fully explored how

to enable that type of science. Dr. Caputo completely agreed with that statement. She said it is beyond just gravitational wave counterparts. It would be like saying there was a pioneer that was accepted that studies exoplanets like Pandora, so that is addressing habitable worlds. Nobody is saying that. But it plays a certain part, and it provides a service to the community, but you also need bigger things. She also did not understand why Headquarters decided to prioritize the probe over this because they have a similar budget profile.

Dr. Pascucci pointed out that she is not working on TDAMM and is not an expert on it, but she had two points. First clarifying what is TDAMM is very important, not only for the community that is working on it, but also for other communities. Also, she related to what Dr. Tremblay said in relation to the MIDEX because ~~she was~~ some community members related to her that they were concerned after the selection that there was a preference for TDAMM science, although it was not advertised that way. It is important to have that clarification upfront. Her second point was that there is going to be a cross-PAG SIG seat on TDAMM and she suggested that would be the best venue for the community to discuss the identified priorities. Perhaps APAC could request a report from them, not in June since they are still assembling, but later on. Dr. Holley-Bockelmann agreed that is something APAC can do. She summarized the discussion: there is a general sentiment that TDAMM needs to be defined and perhaps prioritized at least with a plan and that they can perhaps use the new prospect SIG to be able to gather information and community response about that.

Lunch

During lunch a Science Talk was presented by Dr. Jeyhan Kartaltepe.

COPAG/PhysPAG/ExoPAG Discussion

Dr. Holley-Bockelmann suggested that the group begin by going through their questions for Dr. Justin Finke about PhysPAG. They began with a general question, how can APAC help and what would the PAGs like APAC to do other than a new TDAMM communications SAG? Dr. Finke said the new SAG was the primary ask in his presentation.

The next question was how START is related to the PAGs? Dr. Clampin answered that START will try to work with the PAGs when it has analysis questions but also just to have a two-way flow of information as they start to do their science. They are going to begin with a very clear set of questions and they will probably take some of those to the PAGs.

Dr. Tremblay told the group they are spinning up the new great observatory SAG. Astro2020 was a great and visionary report, but you cannot get a clean citable science case for the GOMAP itself from the executive summary. This PAG does not want to repeat any or be counterproductive to the work that the START is doing. They want to be in constant touch with the appropriate people to make sure they are providing a science case, yes for HWO and ultimately yes for x-ray and far-IR, that can interface cleanly and efficiently with the science and architecture trades that START will do. They will start at the highest level from the 79 key science questions from the DS. Dr. Amanda Hendrix from the Planetary Science Institute is the planetary scientist cochair. As they go down the list of Planetary Science Decadal questions, they are writing out notional science cases for each of the observatories and each of the observatories together. Dr. Clampin asked that everyone work through Dr. Domagal-Goldman and Ms. Crooke so they can be the central point of contact and kept aware of what is going on. Dr. Tremblay said it is their intention that the SAG is only helpful to Ms. Crooke and Dr. Domagal-Goldman and they will effectively report to them.

Dr. Tremblay noted that he is a cochair for the new great observatory SAG along with Dr. Jesse Christiansen from CalTech (exoplanets), Dr. Meredith McGregor from UC Boulder (far-IR), Dr. O'Meara

from Keck Observatory and Dr. Hendrix from the Planetary Science Institute (planetary science/solar system).

Dr. Holley-Bockelmann remarked on a difference between each PAG's activities as COPAG SIGs and STIGs have talks, COPAG is proposing a student SIG (which she really likes), COPAG-EC is planning a strategic planning retreat and standing up a UV Working Group, EXOPAG has two day workshops, and asked what plans PhysPAG has for ramping up activity as their area becomes more and more important. Dr. Finke said they were doing many of the things the other PAGs are doing. They are having regular meetings, creating new SAGs for the GR SIG. They will soon have regular meetings on the science that can be done with a future gamma ray missions and have a TDAMM SIG that will most likely create a SAG on the science that needs to be done with a TDAMM mission. Their main focus will be advising NASA on what it can do with the TDAMM recommendation from the Astro2020 DS. Other SIGs are having regular meetings, and the Cosmic Ray SIG has started regular virtual meetings. When Dr. Tremblay came on as chair, they discussed having a talk series, but with the concerns about oversaturation and the time spent on Zoom during COVID, they decided to defer it, although it has never been off the table.

Dr. Hickox said that, compared to the other PAGs, PhysPAG is a very disparate set of science activities, and the kind of observations and data they are talking about are broad. But you could imagine having a talk series, for example, or another way that people can engage with each other based around science topics that would be interesting to people from across PhysPAG. If the APAC has suggestions for this, it would be helpful because that has been one of the challenges that the PhysPAG has repeatedly come up against.

Dr. Gaskin reminded the group that they had heard about the exoexplorers at a couple of APAC meetings, and that could possibly be a good way to bond them all together in a different type of series. It is based on people writing into to say these are the talks they could give, but it also offers stipends to those speakers and it reaches out to a broad base. Diversity and inclusion are a big factor in it as is early career.

Dr. Kiessling pointed out that COPAG is the only PAG that has a science and technology interest group. Given the amount of conversation about technology now, why do PhysPAG and ExoPAG not have the technology components represented in their interest groups? Dr. Finke said that was a good idea. The science topics for PhysPAG are very broad and the technologies also are quite different, but they do review the technology gaps as the other PAGs do when they get those from the community. They have been talking about having a science gaps group within PhysPAG similar to what the ExoPAG does. Dr. Pascucci pointed out that SIGs and SAGs are proposed by community members and at the moment a technology SIG had not been proposed. But she supports the idea and thinks it should be proposed. A more technology-based SAG is going to be proposed to the ExoPAG on Starshade and it is specifically on the science that the Starshade could do that is unique and complementary to the coronagraph. The SAG should start to be discussed in either in June or in the fall. These communities need to work together very closely for HWO and coexist and design in a way that everyone's science can be addressed, so they are planning joint workshops with ExoPAG, but if it makes sense, they can do it with PhysPAG.

Dr. Holley-Bockelmann commended Dr. Pascucci for the discussion about the zero proprietary period and asked about her impressions of the response to the discussion. Dr. Pascucci said she wanted APAC, as well as NASA, to be aware that the ExoPAG community may have different needs than other communities in relation to the zero proprietary period. It was reflected in the presentation of Professor Wright at the ExoPAG27 meeting in Seattle who not only gave his input in relation to the topic but had collected comments prior to his presentation from the community. There is a lot of anxiety, especially among early-career scientists, about the possibility of having by default HST or JWST targeted observations that would have zero proprietary period. It is reasonable to have zero proprietary period for

surveys: There are plenty of ideas that can be developed and science that can be done with surveys. Most of the time, especially in relation to HST and JWST, the characterization of exoplanets is limited to a small number of sources. She thinks that should be considered as a different need and encouraged APAC to look at the summary of the business meeting discussion and the anonymous comments from community members and early career scientists. She said the topic took about an hour to discuss and there was much input from the community. Dr. Holley-Bockelmann said it would be useful for the other PAGs to take a look at this topic.

Dr. Finke said PhysPAG will take the topic up in the future. Informally he has heard a concern from people in the TDAMM community with the asymmetry between the between the proprietary period for NASA and the proprietary period for NSF, since NSF has a proprietary period for their telescopes, gravitational wave, and Neutrino instruments and NASA does not. Dr. Clampin noted that NASA's open science policy is basically following open science guidelines from the Office of Science and Technology Policy (OSTP). Ultimately NSF's federally funded programs will be moving toward implementing the OSTP guidelines. Dr. Holley-Bockelmann added that from what she understands, LIGO periods are trending towards SPD-41 regulations. Dr. Pascucci noted that Professor Wright's presentation explicitly says the data should be publicly accessible by default at the time of publication, it does not say immediately, and she asked for clarification. Dr. Clampin clarified that NASA is moving to zero proprietary period for new programs. They have not yet changed the proprietary periods for the HST and JWST communities, which would require a dialogue with international partners. He also reminded the group of the option to request an additional proprietary period for early career scientists. Dr. Pascucci said there is no support for a zero proprietary period on JWST or HST in the ExoPAG community.

Dr. Clampin pointed out that the early release science program on JWST has benefited the early career scientists who may not have won time in Cycle 1 but have had access to real JWST data very early on, which will help improve Cycle 2 proposals. Also, the dual anonymous review process has been beneficial to early career scientists. Dr. Pascucci said that some early career scientists who used the early release science data shared stories that were not positive and they are documented in the anonymous summary.

Dr. Calzetti proposed a one path forward to allow early career scientists, or anyone who asks for an extra proprietary period, but not make that information available to the selection panels. Anecdotally, she has heard that people are reluctant to ask for an extra period because they think they would be downgraded by the selection panel. Perhaps there could be an extra box, like the one for team expertise, to say why they are requesting it. This would allow a person could say, "I am an early career scientist, I really need some protection from the data and that is why I am requesting it." The Time Allocation Committee (TAC) knows when a request is made. Dr. Holley-Bockelmann said it would be helpful to gather evidence that people are reluctant to request an extra proprietary period because it could be viewed poorly by the TAC.

Dr. Pascucci said she would like to know the fraction of proposals in the exo-planet field that have asked for a zero proprietary period in Cycle 2 compared to Cycle 1 and suspects Cycle 1 was much higher. Dr. Holley-Bockelmann added it would be good to know the acceptance rate for each category. Dr. Hickox has heard discussions that having a zero proprietary period was seen as a plus and having that decision be made by a different body makes sense. Dr. Holley-Bockelmann asked if it would make sense for the APAC to recommend a rubric or develop a rubric themselves, or they could recommend a study to determine a rubric for which to make these decisions. Dr. Hickox replied it is probably beyond APAC's scope and expertise, but it would be worthwhile to recommend it be explored as a possibility.

Dr. Kiessling asked what action came out of the recommendation to have more interactions and workshops supported by the program office and when could they expect to hear progress toward that request. Dr. Shouleh Nikzad said when she took over as chair in late Fall of 2022, she started looking at making a plan and assigning champions for every member to be responsible for actionable objectives. In

terms of the workshops, they have some in mind they want to do as it was described in the presentation, a series of workshop will be planned so that the COPAG and EXOPAG communities can work closely. Dr. Nikzad emaphasized that she believes HWO is a great opportunitiey for these two communities to work together. Dr. Kiessling commended Dr. Nikzad and COPAG for planning to create a strategic plan and she noted that it sounds like the strategic planning is focused on the PAG and not on a larger more encompassing strategic plan for the program. Dr. Nikzad responded that the strategic planning is for the COPAG in order to to be focused, effective, and efficient in responding to the needs of the COR community and NASA. Dr. Holley-Bockelmann said she does not remember having a budget or the ability to plan meetings (referring to the COPAG strategic planning retreat Dr. Nikzad had described in her presentation) when she was PhysCOS chair and asked where Dr. Nikzad got funding for COPAG activities. Dr. Nikzad said the chief scientist has a budget that would cover the travel to the meeting for COPAG-EC as well as the facilitator's time. She arranged for a venue that is free.

Dr. Hickox said that AGN, in particular, is an area where there is a lot of overlap between COR and PhysCOS. He asked if there are opportunities for that particular series to be advertised to PhysCOS members. And likewise, if there is a similar science series run by PhysCOS, that could be advertised to the same group. Dr. Nikzad said they are counting and planning on that. The AAS splinter UV STIG that covered HWO technology and science was very well attended and the community recommended having workshops under the auspices of PAGs and joint PAGS that covered overlapping science interests. They are following up on that in planning a series of workshops.

Dr. Kiessling said she was fascinated with the workforce gap proposal and asked when there might be more information in progress. Dr. Nikzad said the issue came up in the splinter session and it really resonated with the community. They are going to address it but have not done so yet.

Dr. Holley-Bockelmann thanked the PAGs for having a conversation with them with rather than just reporting out. Dr. Kiessling commended Dr. Pascucci for having people assigned to help presenters make their presentations more accessible. She suggested they could potentially adopt it with the APAC. Dr. Pascucci said the experiment was very successful and was glad those who were presenting at the ExoPAG were actually willing to share their slides in advance and adopt recommended changes.

Discussion

Dr. Holley-Bockelmann kicked off the discussion period and said she was struck by the way in which the science teams are selected for SPHEREx, which is not dissimilar to the Euclid and ULTRASAT model. How can they make it compatible with NASA's broadening participation and inclusion goals? Dr. Caputo shared the concern and asked what happens to the data, specifically in ULTRSAT, and how long is the proprietary period. Dr. Calzetti said they were expecting data releases every six months, starting 18 months after launch, making it about twelve months of proprietary period. Dr. Caputo asked if there was a reason it is not done like Explorers where there is a guest investigator, for the U.S. portion, and many people apply and many get grants to do the science. Dr. Clampin said the agreement precedes his arrival, but it is a consequence of the international agreement put in place when the collaboration with the Israelis was set up. There is a limited number of participants because that is what was negotiated, then there is a twelve-month proprietary period. Once data is validated and calibrated, it will be available. The initial discussion established there would be a core U.S. team involved from the beginning and they would compete the membership of that core team to work with the ULTRASAT team. Dr. Holley-Bockelmann said a limited number has been negotiated, but NASA gets to select the folks who applied, and she hopes that diversity plans, like an inclusion plan to commit to broadening participation, will be part of the selection criteria in the future.

Dr. Calzetti asked if there is a notional plan for meeting the various milestones for HWO. Dr. Clampin answered that currently program offices are doing roadmaps, and as they get funded, they will start

following those roadmaps. Initially the program offices will do the investments and track the TRL levels as they progress. Several years later, when they are sufficiently well funded, they can move forward. They will do what the large mission study to start a project and have a program manager and a system engineer. They will work the way Roman currently operates with them at the center that has the lead for the program, but they will report directly into Headquarters and take over the initial stages of the program formulation. Also, they will be responsible for getting the technology programs, and the technologies that go forward, through a nonadvocate review for the TRL assessments. Dr. Calzetti asked if interfacing the coronagraph with the segmented mirror for HWO is on the roadmap. Dr. Clampin said it would be part of the technology roadmap that XF is doing and noted that there are already coronagraphs that work with segmented apertures. They are not at $10^{10}$ yet, but it is encouraging. Another roadmap will be prepared for the maturation of the technologies. The coronagraph will need deformable mirrors, which will require right industrial base to provide those mirrors. As they learned from JWST they do not want to rely on one vendor, so they are looking at two or three different companies that could be mature to the point where a competitive downselect could be done for the final technology.

Dr. Hickox asked about the process for determining that a potential technology is not going to reach its goals. What can be done to be prepared to pivot to a different technology if something that looked promising does not work out? Dr. Clampin noted the standard process within the project management documentation for NASA that explains how to do technology reviews. They did six or seven technologies on JWST. It basically involves bringing in an independent set of reviewers with subject matter expertise. To determine whether something is going to work, they determine first and foremost if it is going to meet the requirements. They do a competitive downselect to decide between one, two, or three different technologies. Dr. Gaskin added that it can also be schedule-driven. If two technologies are similar, you must downselect at some point.

Dr. Clampin circled back to a comment he made the previous day. Another recommendation from the large mission study was that, in addition to putting a program manager and a system engineer in place as soon as they formally create projects, they also put in place an independent review board from day one.

Dr. Tremblay asked about the process for deconflicting the habitable world START team and whether the mechanism by which they have been deconflicted will limit their ability to make impactful recommendations. Ms. Crooke replied that for anything they do before the project gets stood up, there will be no decisions, recommendations, advice, or prioritization. They cannot make an STM. They will be in an analysis period, where the charter of the START is to document the pros and cons of everything. First START is going to use the Astro2020, look at all the end science goals related to HWO and quantify them, understand what observatory observations are needed, whether they are instrument- or observatory-level or both, and understand their breakpoints. They will assess the maturities potential of applicable architectures and technologies and document it so an independent review board can assess it for accuracy and completeness. Dr. Pascucci asked for the notional year when the HWO is going to be established, and Dr. Clampin said it depends on how fast they move forward with technology development. A lot will depend on budget.

Dr. Jogee asked whether there is any synergy with H1 intensity line-mapping that has been going on in terms of software sharing. If not, what are the plans to address this critical gap? Dr. Clampin said that they will address funding for the Phase E shortfall when they get to the key decision point D.

Dr. Ho asked if for SPHEREx key decision point B was enough time for the team to build up a complete analysis pipeline for cosmology and galaxies if they only get the funding at that point. Dr. Clampin responded that key decision point D, where they will look at the Phase E budget for SPHEREx, will notionally be in January 2024. Several discussions with the project have to take place prior to that to maintain the schedule and they are ongoing.

Dr. Ho also asked how NASA plans to respond to the Astro DS recommendations in terms of data science and modernizing analysis with recent deep learning and open data. Dr. Clampin said that part of the NASA open science program is moving to the science cloud and will be one of the ways they start looking at modernizing analysis talks. They also have the ROSES programs where people propose to address some of the big challenges and data analysis.

Dr. Kiessling asked if NASA intends to undertake a review for HWO before the Astro2030 in order to have it in Astro2030 as a program of record. Dr. Clampin answered there is an expectation that they would do a mid-Decadal review and HWO will be one of the major subjects. A notation in the DS indicated the DS panel would like to be involved in such a review before the end of the decade. That morning he initiated a mid-Decadal timeframe discussion that would include HWO. The mid-Decadal review is not necessarily the gate review for HWO GOMAP. Dr. Tremblay noted Astro2020 wants the gate review for GOMAP, but that was meant to happen after the probe downselect because that committee is meant to include the winner of the probe downselect in their programmatic decision-making.

Dr. Holley-Bockelmann reintroduced Dr. Boyd to the group who has returned to answer questions.

Dr. Hickox asked about the process for under-resourced institutions to initially engage with the Bridge Program. Dr. Boyd explained the program was approved with the goal to increase sustainable partnerships with a variety of minority serving institutions (MSIs), which specifically refers to Historically Black Colleges and Univesrities (HBCUs), Hispanic-Serving Institutions (HSIs), primarily Black institutions, tribal colleges and universities, but also other classes of institutions that are under-resourced and do not traditionally participate in NASA research. Community colleges and primarily undergraduate institutions are examples. For the call, which is not yet approved, they plan to talk about their goals for increasing the partnerships and will have checkboxes on the (NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) cover pages to allow teams to select the types of institutions they are. The current plan is they would also encourage the PIs to be at those institutions unless there is a compelling reason why they cannot propose at this time as a PI. They have a link to the R1 institutions, so they are not looking to have PIs come in from R1 institutions.

Dr. Hickox followed up. If an institution does not have a grants officer, are there mechanisms to provide that administrative support and guidance on how to do a proposal in order to make this as broadly accessible as possible? Dr. Boyd said they have been actively investigating several responses to try to mitigate those barriers, which exist in NASA's process of accepting proposals and the process of submitting a proposal from the institutions. The program's first seed funding opportunity will encourage PIs to be at these institutions, but it is a no-due-date opportunity. They will encourage people to submit by a certain date, but if that is onerous on the PI, they will have additional time. In addition, during the call they plan to have regular office hours like what the NSF is doing. They will pick a topic for the office hours, for example budget submission, and will have some slides and answer questions. It will be recorded, and resources will be available asynchronously, as well. Also, some companies are doing research and surveys to try to uncover the barriers and work with those PIs to get proposals in and manage the grants afterwards. In some states, legislatures are taking on some of the onus of putting in budgets for those institutions, so they will communicate those opportunities in those states to the PIs.

Dr. Jogee suggested there may be an opportunity to collaborate and share resources and other mutually beneficial synergies with long-established NSF Research Experience for Undergraduates (REU) and DOE Assure programs. She detailed some of her work with REUs and noted a gap in longer-term mentoring and the bandwidth issue in institutions where faculty are stretched, particularly in underserved institutions. Dr. Boyd noted they spent the bulk of the past year doing a similar exercise internal to NASA. They are working closely with the Office of STEM Engagement and the Minority University

Research Experience Program, which have programs with similar goals and audiences, to see where they can amplify their programs and vice versa. The faculty component of the Bridge triad sets the program apart from other internal NASA opportunities. The challenge for the next year will be to look closely at the programs in the community; that would be part of the external communications path forward for 2023. A subgroup of the Workshop Organizing Committee is focused on capacity-building and external organizations.

Dr. Gaskin asked what success looks like for the faculty-student relationship. How will they balance situations where many students want to be part of one of these programs but fewer faculty members are available to support them through it? Dr. Boyd said that for the faculty capacity issue at some of these institutions themselves, they expect funding will be available for faculty buyout and to fund the NASA scientists and engineers for the time spent working with these students. In addition, they hope funding will be available to support the mentoring component if there is a need to have a mentor training program or an expert in mentoring and STEM come in and work with the team. She noted that a lot of these issues were discussed in the workshop. The workshop report, a succinct summary of the conversations and the themes that came out of the workshop, will be made public but currently is available on the Lunar Planetary Institute (LPI) Bridge Workshop site. Looking at the program longer term, they hope some of the proposals come in for students to be involved in research experiences over several years. The students will move on, but the hope is that the partnership between the faculty and the scientists that was the basis of the Bridge partnership will have enough energy and momentum for teams to continue to propose beyond Bridge. That would also be one of the metrics for success. Dr. Hickox asked how students will be recruited into the Bridge program and how the program can make that process as accessible as possible. Dr. Boyd said the faculty picks the students, and the faculty in an under-resourced institution would partner with a NASA partner to write a Bridge proposal that would support students. Dr. Hickox recommended they develop guidelines to try to make the recruiting and selection of the students as inclusive as possible.

Dr. Mozena reemphasized the opportunity to be creative with the Bridge program and think outside the traditional box of NASA centers and professors to explicitly include NASA's industry partners. Dr. Boyd said this would be a great topic to continue to explore in webinars promoting the program to the community. r. Michael New pointed out there are ethical considerations to consider when engaging with private industry partners. Engaging in conversations is probably the best way to start.

Dr. Caputo asked if the program would have a mechanism for students to report issues with their advisors or perhaps an ombudsperson. Dr. Boyd acknowledged that students and early career people would love to see that addressed, but she does not think the Bridge program will propose a solution first. The current plan is to suggest periodic check-ins with the mentors and the students and an intentional plan to look at mentor-mentee relationships that are not working and solve them for both parties. In addition, they are going to have symposia to pull the Bridge teams together in one place and learn from each other. Mentoring and the mentoring relationship would be a fantastic topic for a guest speaker or a working group. Also, they are considering a cohort of mentors. The National Astronomy Consortium developed a model of cohorts wherein students could peer mentor each other and have access to professionals in the field, not just their individual mentor.

Dr. Holley-Bockelmann stressed the importance of good oversight of the team and asked if they are planning to pay a summer salary for the faculty. Dr. Boyd said it would be allowable to fund summer salary for faculty as the call is currently written. Dr. Holley-Bockelmann suggested it may be useful in the future to consider a faculty hiring program as part of capacity-building. Dr. Jogee pointed out that faculty from marginalized groups do a huge amount of mentoring and unrecognized service for which they get zero credit and is not counted in their time balance. She asked if the program could provide a certificate or a letter of statement that could go in the faculty member's promotion and tenure dossier. Phrased

appropriately with a legal expert for the relevant state, she said it could replace that the contribution to DEI statement. Dr. Boyd asked if being the PI of a Bridge partnership grant would be a sufficient message that it is valued and rewarded by NASA. It would be part of the message, Dr. Jogee said, but a statement about a contribution to mentoring and an inclusive community and DI coming from NASA would have a great weight with promotion and tenure committees and with the external letter writer.

Formulate Recommendations

Dr. Holley-Bockelmann asked the group what they would like to address or recommend.

Dr. Jogee said she would like more information on and a thorough discussion of IDEA initiatives and funding: the budget (the dollar amount and the fraction of the total APD budget that is going towards the IDEA initiative in FY 22 and 23); the PI of demographics of the proposals in terms of gender minorities, racial and ethnic minorities, first generation college graduates, PIs with disabilities, and then PIs from R1, Association of American Universities (AAU), HSI, HBCU, and Society for Advancement of Chicanos/Hispanics & Native Americans in Science (SACNAS); the dual anonymous peer review approach; the efforts to engage a broader cross section of the community science and working group. Dr. Clampin said this material has been presented in the past and can certainly provide what they have. Dr. Hasan noted that the previous APAC had also asked for that information, but there is a limit to how much they can provide because they are not permitted to collect a lot of demographics. APAC can be provided what they have been given.

Dr. Pascucci proposed a presentation and discussion about these topics: the Astrobiology program, the NEXUS for Exoplanet System Science initiative, which is going through a senior review, and NASA's support in Astrobiology in light of the new position advertised for a senior scientist for Astrobiology.

Dr. Holley-Bockelmann suggested they look at ways to make the ULTRASAT model of NASA selection of working groups more inclusive.

Dr. Mozena said he would be interested in hearing a breakdown of how the broader astrophysics community is looking at longevity operations in space from a constellation's interference standpoint, especially ground-based observatory. Dr. Clampin said they cannot speak for NSF as far as how grounded appearance with constellations is being handled. But they are getting more and more conjunction issues, so they can ask about that and talk about any other potential interference issues.

Dr. Pascucci suggested a presentation about two technical aspects of HWO that were discussed: the picometer stability and the expected AO performance. Dr. Holley-Bockelmann agreed it would be useful to have a deeper dive into those topics. Where are they now with those two technologies, how far do they have to get, and what ideas do they have to get there?

Dr. Pascucci said that since there was a lot of discussion about the GOMAP structure and timeline, it might be appropriate to have an additional presentation in June or in the fall, given the timeline.

Dr. Tremblay suggested APAC have a presentation or a discussion in the next year or so about NASA's vision for servicing. It is hard to imagine robots servicing HWO at L2 and installing new modular instruments. But if there is a new paradigm change in how observatories are built, less as fully integrated observatories and more as exquisite mirrors with telephone booth modules at the bottom that can be plugged in and out and kept alive for 60 years, it would be helpful to know the agency is thinking.

Dr. Hickox noted that since inclusion in a priority, it would be valuable to have a way to explicitly express how a program is meeting that priority. Not every program or research proposal would have to

address the TDAMM priorities, but if they do, it should generally be a plus if it is a priority for NASA astrophysics.

Dr. Caputo expressed concern that in the discussions of future observatories, there was no mention of gamma ray and an explicit plan for how to maintain that capability program.

There were several recommendations related to TDAMM.

Dr. Gaskin suggested they look at the metric for what TDAMM is or have some criteria everyone can adhere to or understand. Dr. Holley-Bockelmann asked about making a report or a presentation about the current landscape of what defines TDAMM. What is the landscape of current TDAMM investments? Where are the gaps and what decision trees will happen when there will be gaps? Dr. Caputo said based on our discussion, we would like TDAMM to be defined specifically and how it can be determined if missions are specifically addressing needs of the TDAMM community. The other side is the capabilities of the NASA fleet going forward, especially regimes that do not seem to be covered but are DS priorities. Dr. Holley-Bockelmann wondered if the current TDAMM workshops and the infrastructure with the new SAG fulfills this need, or if it is something APAC can ask them to do, or if it is a separate issue.

Dr. Jogee asked if the questions were answered related to a criterion definition for TDAMM if something gets designated as TDAMM, does it come with resources, funding, software, infrastructure, and can new missions be added to TDAMM? What is the process for a new mission to be added to what is considered the TDAMM fleet? Dr. Clampin said there no additional funding if a mission has a TDAMM element. It is expected that the PI will have included it in the proposal as part of the cost cap. Also, they are not creating a line for TDAMM missions or identifying it as a criterion for current mission AOs. In the future, they will look at the long-term prospects for some current missions, specifically referring to Swift and Fermi. Dr. Holley-Bockelmann asked why there is no need to prioritize TDAMM in an AO. Dr. Clampin responded that they have concluded it is not needed. People are not proposing them, and it is important to focus on the most compelling science investigations. Some that rise to the top have a strong TDAMM element because it is an area that is attracting a lot of ideas and attention.

Dr. Tremblay asked that since TDAMM is technically a higher priority than the probe in Astro2020, was the probe AO driven largely by programmatic thinking. Was it more for portfolio balance and large-scale strategic thinking at Headquarters? Dr. Clampin offered his perspective. The probe provides some balance between relatively small missions like Explorers and the large flagships, so it produces a broader range of mission sizes. One of the consistent messages from the Annapolis workshop was that better coordination and better alert networks are the highest priority, along with talking with international partners so that as ideas come up, NASA can participate to get a very balanced portfolio across the range of TDAMM science areas. Several proposals and discussions are going on as a result of those workshops for future mission opportunities. Dr. Tremblay pointed out the community perception that NASA is trying to ignore TDAMM by calling every past mission TDAMM, although he does not agree with that. Dr. Caputo echoed Dr. Tremblay comments and said she appreciates the systematic approach to trying to balance the portfolio. In order to be successful in TDAMM, they need a balanced portfolio across many wavelengths. She has heard community concerns that the NASA fleet has focused so much on a particular wavelength that it is going to lose a lot of coverage in the next ten years or so because the portfolio has not been balanced. Dr. Clampin said one of the things he will be asking the ABT team to look at, and has already had discussions about, is the status of the existing missions in extended life and what should they be worried about first. Where are the likely gaps?

Dr. Gaskin asked the group if they want to add a discussion on creating the infrastructure, the multiple wavelengths and the ground-based observatories. Who is creating the infrastructure and how will that ultimately happen to facilitate TDAMM? Dr. Clampin talked about the work going on to figure out how

to work with LIGO effectively for future runs. Coordination between different agencies will be very important, and it is an important component of TDAMM. Another is making sure there are good interfaces with Rubin. The GCN team have been working to make sure that they are using the right software protocols to make effective alert networks that will work with Rubin and the infrastructure Rubin has created. If APAC would like a more detailed presentation, Goddard and Marshall groups can come in for a briefing.

Dr. Holley-Bockelmann said it be useful to consider more investment in joint analysis of different mission data, not just providing data, but thinking about what science questions you can ask and providing the tools to the community that would enable you to put together two messengers and get science out. Dr. Clampin agreed and said that may be a subject for the next workshop to focus on addressing that question. NASA cannot fully rely on the science community to provide that advice and guidance. Dr. Gaskin said they had talked about decoupling the science reviews from requesting more criteria.
Dr. Hickox said given the large amount of data that will be coming from Euclid, ULTRASAT, and Roman, he would like to hear about how to best make these huge data sets available to the community, the possibility of using machine learning and Artificial Intelligence (AI) algorithms to analyze some of these data, and how the missions plan to work together, perhaps with a set of jointly applicable platforms and algorithms to address the massive flood of data.

Dr. Jogee introduced the issue of funding for graduate students, saying it is paradoxical that the best and brightest minds that are going to drive future research and innovation are supported at such a nonoptimal level. Funding graduate students is broadly tied to the state of the scientific workforce, so it is a very important, but also challenging, broad-ranging issue that requires conversation across agencies. She asked what others think and if APAC is the right place to address this issue? Dr. Clampin asked if it is primarily the institutions at which the students are located that set the funding levels, how do federal agencies play a role in working with universities to set funding levels? NASA provides the funding through grants but does not tell the institutions how to set salaries or stipends for students. Dr. Holley-Bockelmann said that when NSF, NIH, and NASA give fellowships, they have an amount that they are going to pay. There has been work on what constitutes an appropriate stipend at least at the fellowship level, so APAC can explore what the consequences are or whether to implement that as a standard minimum for graduate student support.

Dr. Caputo said that Future Investigators in NASA Earth and Space Science and Technology (FINESST) solicitation states that the stipends could be up to $50,000, but whatever is commensurate with the university, so it provides a maximum framework because it is designed specifically to fund a student. But she is concerned about trying to put in language in a proposal designating student pay, because it would not be equitable among all agencies or among different groups within the university, it would be specifically for that one funding. Dr. Holley-Bockelmann said it could lead to inequities, although it also would put pressure on an institution to meet those same standards because there is inequity. Dr. Jogee added that APAC could at least recommend the maximum amount of the fellowship be increased because a higher NSF and NASA fellowship is an incredible driver for institutions and for Graduate Research Assistants (GRAs) to go up concurrently. Otherwise, it could create a two standard system where the people on fellowship have more money for three years and then they go back on a regular GRA. Dr. Holley-Bockelmann said APAC could ask APD to investigate what an appropriate graduate student stipend would be and what the consequences would be of raising it. Dr. Tremblay said he would like to discuss it but is concerned about APAC writing a recommendation that asks NASA do something that is out of its scope, getting into the weeds of university business, which NASA cannot dictate.

Dr. Holley-Bockelmann said one very concrete recommendation she will make is that when people give APAC presentations about mission updates, etc., there be at least one slide or mention of what that

mission is doing towards IDEA. Also, APAC was told that Astrophysics Theory Program (ATP) is going to have a big change because the DS recommended they offer it every year and increase the amount they funded. That is not happening, so she would like to know where things stand on the ATP decision. Dr. Hickox noted they occasionally get updates from R&A at Apex. So, it might be reasonable to request a full update of that next time and have this be one of the points.

Dr. Gaskin said that by the next meeting they will have the APRA and SATs selected, so she recommended a presentation/breakdown of the SATs.

Dr. Hickox said that given the interest in the community, he would like APAC to make a comment about the JWST naming and the new naming procedure, and he would like a more robust process for checking with the greater community to make sure that everyone feels they can have ownership over it. That is something APAC could recommend. Dr. Holley-Bockelmann noted that given that the name change is not under APD's control, APAC is in a bind. Dr. Pascucci said she would expand the recommendation to say that instead of using people's names they use inspirational names.

Dr. Hasan thanked Dr. Holley-Bockelmann and the APAC members who attended in person and virtually, along with the speakers who gave presentations.

Adjourn

The meeting was adjourned at 4:00 p.m.

**Appendix A**
**Participants**

Committee members
Kelly Holley-Bockelmann, Vanderbilt University, *Chair, Astrophysics Advisory Committee*
Hashima Hasan, NASA Astrophysics Division, Science Mission Directorate, *Executive Secretary*
Daniella Calzetti, University of Massachusetts
Regina Caputo, NASA – Goddard Space Flight Center
Hsiao Wen-Chen, University of Chicago
Jessica Gaskin, NASA – Marshall Space Flight Center
Erika Hamden, Steward Observatory
Ryan Hickox, Dartmouth CollegeShirley Ho, Flatiron Institute
Shardha Jogee, University of Texas, AustinAlina Kiessling, NASA Jet Propulsion Laboratory
Mark Mozena, Planet Labs Inc.
Ilaria Pascucci, University of Arizona
Grant Tremblay, Harvard-Smithsonian Center for Astrophysics

NASA
Mark Clampin,
*Director, APD*
Lorella Angelini
Catherine Barclay
Manuel Bautista-Plaza
Dominic Benford
Gary Blackwood
Jamie Bock
Patricia Boyd
Jenna Cann
Regina Caputo
Sandra Cauffman
Hsiao-Wen Chen
Francesca Civano
Rachele Cocks
Valerie Connaughton
Elbert Cox
Brendan Crill
Julie Crooke
Antonio Cucchiara
Doris Daou
Jason Derleth
Anita Dey
Shawn Domagal-Goldman
Kristen Erickson
Erik Edwardson
Ingrid Farrell
Justin Finke
Alise Fisher
Ronald Gamble
Michael Garcia
Jonathon Garnder
Edwin Griego
Barbara Grofic
Shahid Habib
Thomas Hams
Hashima Hasan
*Executive Secretary, APAC*
John Hennessy
Garth Henning
Paul Hertz
Brian Humensky
Stefan Immler
Hannah Jang-Condell
Shardha Jogee
Jeyhan Kartaltepe
Bernard Kelly
Alina Kiessling
Pamela King-Williams
Patricia Knezek
Peter Kurczynski
William Latter
Janet Letchworth
Sangeeta Malhotra
Eric Mamajek
Julie McEnery
Arielle Moullet
Michael New
Shouleh Nikzad
Omid Noroozian

Jessica Noviello
Brian Odom
Roopesh Ojha
Lucas Paganini
Ilaria Pascucci
Joshua Pepper
Mario Perez
Natasha Pinol
Naseem Rangwala
James Rhoads
Jason Rhodes
Rachel Rivera
Aki Roberge
Rhiannon Roberts
Jenna Robinson
Andres Romero-Wolf
Sara Schwartzman
Paul Scowen
Kartik Sheth
Nicholas Siegler
Jacob Slutsky
Alan Smale
Eric Smith
Joseph Smith
Linda Sparke
H. Stahl
Karl Stapelfeldt
Amber Straughn
James Thorpe
Neal Turner
Sanaz Vahidinia
Chris Walker
Keith Warfield
Feng Zhao

Non-NASA/Unknown

Vanessa Bailey
Gary Blackwood
Mia Bovill
Teddy Cheung
Laura Coyle
L. Curtis
Vandana Desai
Monty Di Biasi
Matthew East
Arika Egan
Mike Fanelli
Jeff Foust
Cynthia Froning
Gary Gilbert
Lewis B. Groswald
Sharon Hannon
Murdock Hart
Alex Haughton
Sara Heap
George Helou
Ryan Hickox
Dean C. Hines
Shirley Ho
Teresa Jensen
Jeyhan Kartaltepe
Steve Kendrick
Sridharan Tirupati Kumara
Elizabeth Landau
Brandon Lawton
Cathirame Lee
Emma Marcucci
Stephan McCandliss
Gene Mikulka
Mayra Montrose
Arielle Moullet
Robert O'Connell
Rachel O'Connor
Roopesh Ojha
April Olson
Amy Reis
Phil Scott
Vidushi Sharma
Evganya Shkolnik
David Shoemaker
Denise Smith
Sabrina Stierwalt
Harvey Tananbaum
Harry Teplitz
Alan Thurgood
David Traore
Grant Tremblay
Gopal Vasudevan
John Wisniewski
Emily Witt
Alexandra Witze

## Appendix B
## Astrophysics Advisory Committee Members

**Kelly Holley-Bockelmann,** Chair, Astrophysics Advisory Committee
Vanderbilt University

**Hashima Hasan**, Executive Secretary
Astrophysics Division
Science Mission Directorate
NASA Headquarters

Daniella Calzetti
University of Massachusetts

Regina Caputo
NASA – Goddard Space Flight Center

Hsiao Wen-Chen
University of Chicago

Jessica Gaskin
NASA — Marshall Space Flight Center

Erika Hamden
Steward Observatory

Ryan Hickox
Dartmouth College

Shirley Ho
Flatiron Institute

Shardha Jogee
University of Texas, Austin

Alina Kiessling
NASA Jet Propulsion Laboratory

Mark Mozena
Planet Labs Inc.

Ilaria Pascucci
University of Arizona

Grant Tremblay
Harvard-Smithsonian Center for Astrophysics

## Appendix C
## Presentations

*NASA Astrophysics Update,* Mark Clampin
*JWST Update,* Eric Smith
*Euclid and the Golden Age of Optical/IR Survey Astronomy,* Jason Rhodes
*Roman Space Telescope Project Status,* Julie McEnery
*NASA SMD Bridge Program: Workshop and 2023 Plan*, Padi Boyd
*NASA Historical Investigation into James E. Webb's Relationship to the Lavender Scare,* Brian Odom
*GUSTO Update,* Chris Walker
*A Better Path to Habitable Worlds,* Julie Crooke, Shawn Domagal-Goldman
*Time Domain Multi-Messenger Astronomy Update*, Valerie Connaughton
*2023 Science Activation,* Kristen Erickson
*Solar System & Beyond, Astrophysics Explorers Update,* Pat Knezek and Linda Sparke
*ULTRASAT Mission Science Overview,* James Rhoads
*SPHEREx: An All-Sky Infrared Spectral Survey Satellite,* Jamie Bock
*Cosmic Origins Program Analysis Group (COPAG) Update,* Shouleh Nikzad
*Physics of the Cosmos Program Analysis Group (PhysPAG),* Justin Finke
*Exoplanet Program Analysis Group (ExoPAG) Report,* Ilaria Pascucci

**Appendix D**
**Agenda**

**Astrophysics Advisory Committee**
**Virtual**
**March 29-30, 2023**

**Wednesday, March 29**

| | | |
|---|---|---|
| 10:00 a.m. | Introduction and Announcements | Hashima Hasan/Kelly Holley-Bockelmann |
| 10:05 a.m. | Astrophysics Division Update | Mark Clampin |
| 12:00 p.m. | Webb Update | Eric Smith |
| 12:15 p.m. | Euclid Update | Jason Rhodes |
| 12:35 p.m. | Lunch | |
| 1:30 p.m. | Roman Update | Julie McEnery |
| 2:00 p.m. | SMD Bridge Program Update | Patricia Boyd |
| 2:30 p.m. | JWST Naming Investigation Report | Brian Odom |
| 2:50 p.m. | Public Comment Period | |
| 3:00 p.m. | Break | |
| 3:15 p.m. | GUSTO Update | Chris Walker |
| 3:35 p.m. | Great Observatories Maturation Program | Julie Crooke/Shawn Domagal-Goldman |
| 4:00 p.m. | Discussion | |
| 4:30 p.m. | Time Domain Multi-Messenger Astronomy | Valerie Connaughton |
| 5:00 p.m. | Wrap up for Day 1 | Kelly Holley-Bockelmann |

**Thursday, March 30**

| | | |
|---|---|---|
| 9:00 a.m. | Opening Remarks | Hashima Hasan/Kelly Holley-Bockelmann |
| 9:10 a.m. | Science Activation Program Update | Kristen Erickson |
| 9:40 a.m. | Explorer Program Update | Patricia Knezek/Linda Sparke |
| 10:10 a.m. | ULTRASAT Update | James Rhoads |
| 10:40 a.m. | SPHEREx Update | Jamie Bock |
| 11:10 a.m. | Public Comment Period | |
| 11:20 a.m. | Discussion | APAC members |
| 12:00 p.m. | Lunch | |
| 12:15 p.m. | Science Talk | Jeyhan Kartaltepe |
| 1:00 | COPAG/PhysPAG/ExoPAG Discussion | Shouleh Nikzad/Justin Finke/Ilaria Pascucci |
| 2:00 p.m. | Discussion | APAC members |
| 3:00 p.m. | Formulate Recommendations | APAC members |
| 3:55 p.m. | Debrief Division Director | APAC members |
| 4:00 p.m. | Adjourn | |

**Appendix E**
**WebEx Chat Transcripts**

Chat Day One

from Grant Tremblay APAC member (Ext) (privately): 9:59 AM

Hi Ingrid! can you allow me to unmute when you get a chance? I'm an APAC member - I guess typically you make us co-hosts?

from Ilaria Pascucci (Ext) (privately): 9:59 AM

Good morning Ingrid. I am one of the APAC member but noticed that I cannot mute myself. could you maybe change this setting? Thank you

from Ilaria Pascucci (Ext) (privately): 9:59 AM

Thank you!

from Barbara Grofic (Ext) to Everyone: 10:00 AM

no sound?

from Dean C. Hines (Ext) to Everyone: 10:01 AM

No sound for me as well

from Ilaria Pascucci (Ext) to Everyone: 10:01 AM

Same here

from Barbara Grofic (Ext) to Everyone: 10:01 AM

hello!

from Grant Tremblay APAC member (Ext) to Everyone: 10:02 AM

lost audio

from Paul Scowen (Ext) to Everyone: 10:02 AM

Intermittent mic

from Ilaria Pascucci (Ext) to Everyone: 10:02 AM

We cannot hear

from PAUL HERTZ (Int) to Everyone: 10:02 AM

lost audio

from Paul Scowen (Ext) to Everyone: 10:03 AM

coming and going

from Ilaria Pascucci (Ext) to Everyone: 10:03 AM

audio is intermittent

from David Shoemaker (Ext) to Everyone: 10:03 AM

audio is broken up

from Dean C. Hines (Ext) to Everyone: 10:03 AM

Sound is not working well.... very choppy

from Dean C. Hines (Ext) to Everyone: 10:04 AM

Please pause and fix

from Paul Scowen (Ext) to Everyone: 10:04 AM

we cannot understand what Hashima is saying

from PAMELA KING-WILLIAMS (Int) to Everyone: 10:04 AM

Can you hear better now?

from Paul Scowen (Ext) to Everyone: 10:04 AM

no

from Dean C. Hines (Ext) to Everyone: 10:04 AM

terrible

from PAUL HERTZ (Int) to Everyone: 10:04 AM

Turn on microphones on both sides of Hashima

from Dean C. Hines (Ext) to Everyone: 10:05 AM

Better, thanks

from Grant Tremblay APAC member (Ext) to Everyone: 10:05 AM

maybe solved ...

from Paul Scowen (Ext) to Everyone: 10:05 AM

better

from PAMELA KING-WILLIAMS (Int) to Everyone: 10:05 AM

OK. Is that better?

from PAUL HERTZ (Int) to Everyone: 10:06 AM

yes

from Paul Scowen (Ext) to Everyone: 10:06 AM

yes - seems to be

from Grant Tremblay APAC member (Ext) to Everyone: 10:06 AM

yes thanks Pamela! and thanks Paul for the expert IT help

from HASHIMA HASAN (Int) to Everyone: 10:09 AM

NASA Astrophysics Advisory Committee's website: https://science.nasa.gov/researchers/nac/science-advisory-committees/apac

The public may submit and upvote comments/questions ahead of the meeting through the website https://nasa.cnf.io/sessions/k5s2/#!/dashboard

from Kelly Holley-Bockelmann (Ext) to Everyone: 10:15 AM

Kelly Holley-Bockelmann here -- good morning and welcome!

from Grant Tremblay APAC member (Ext) to Everyone: 11:37 AM

thanks for getting up so early, Regina!

from Regina Caputo (Int) to Everyone: 11:51 AM

thank you for bringing up the CGRO on the decadal slide

from PAUL HERTZ (Int) to Everyone: 11:53 AM

CGRO was never the top recommendation of a Decadal Survey. It was the recommendation of a different National Academies study (1979 CSAA study)

from Ryan Hickox (Ext) to Everyone: 11:53 AM

Welcome Shardha!

from Grant Tremblay APAC member (Ext) to Everyone: 11:56 AM

Kelly - to respect the schedule and Eric's presentation, I can defer my questions until later this afternoon, maybe after Julie/Shawn's GOMaP presentation

from Kelly Holley-Bockelmann (Ext) to Everyone: 11:57 AM

Grant, I'll take you up on that. You'll have first dibs then.

from Grant Tremblay APAC member (Ext) to Everyone: 11:58 AM

can we mute the room?

from Bernard Kelly (Ext) to Everyone: 11:59 AM

Will the online questions on the dashboard be addressed after the break, or at the end of the day?

from Bernard Kelly (Ext) to Everyone: 11:59 AM

(... or at the end of tomorrow's session?)

from Grant Tremblay APAC member (Ext) to Everyone: 11:59 AM

we usually get to those during the public comment period (today at 2:50p ET)

from Bernard Kelly (Ext) to Everyone: 11:59 AM

Thanks, Grant.

from Paul Scowen (Ext) to Everyone: 12:06 PM

we can not hear Eric

from Ilaria Pascucci (Ext) to Everyone: 12:07 PM

the audio is not working

from Dean C. Hines (Ext) to Everyone: 12:07 PM

Audio?

from Ryan Hickox (Ext) to Everyone: 12:07 PM

Just to answer Bernard's question, yes we will get to the dashboard questions during public comment period this afternoon.

from Grant Tremblay APAC member (Ext) to Everyone: 12:08 PM

well ... I heard Hashima but not Eric!

from Ilaria Pascucci (Ext) to Everyone: 12:08 PM

if Eric is talking now we cannot hear him

from Paul Scowen (Ext) to Everyone: 12:08 PM

right!

from Grant Tremblay APAC member (Ext) to Everyone: 12:08 PM

much better, thank you Mark!

from Ilaria Pascucci (Ext) to Everyone: 12:08 PM

Thank you

from Regina Caputo (Int) to Everyone: 12:08 PM

thank you!

from Ryan Hickox (Ext) to Everyone: 12:13 PM

Not sure either - I think someone else promoted Kelly earlier :-)

from Ryan Hickox (Ext) to Everyone: 12:14 PM

Yes I think maybe only the host can do that. (may have to be Pamela)

from Ilaria Pascucci (Ext) to Everyone: 12:16 PM

Yes

from PAUL HERTZ (Int) to Everyone: 12:16 PM

We can hear you online

from Paul Scowen (Ext) to Everyone: 12:16 PM

in-room cannot

from Grant Tremblay APAC member (Ext) to Everyone: 12:16 PM

please finish Eric!

from Grant Tremblay APAC member (Ext) to Everyone: 12:16 PM

sorry!!

from Grant Tremblay APAC member (Ext) to Everyone: 12:16 PM

nevermind sorry!!

from Alina Kiessling (Ext) to Everyone: 12:17 PM

No apologies, Grant! We need to troubleshoot audio on this end

from Grant Tremblay APAC member (Ext) to Everyone: 12:17 PM

(Ingrid - I guess we need to unmute webex in the room?)

from Stephan McCandliss (Ext) to Everyone: 12:18 PM

I can hear Grant...

from Grant Tremblay APAC member (Ext) to Everyone: 12:20 PM

Thank you - and sorry for causing delay!

from Bernard Kelly (Ext) to Everyone: 12:21 PM

Looks good!

from Shardha Jogee-Bromm (Ext) to Everyone: 12:23 PM

Eric gave demographics of received Cy 2 proposals. Can we also have denographics of accepted proposals

from Kelly Holley-Bockelmann (Ext) to Everyone: 12:23 PM

We can ask, but notification is not until 5/10

from Grant Tremblay APAC member (Ext) to Everyone: 12:24 PM

STScI's newsletter following the Cycle 2 TAC will almost certainly release demographic info of accepted proposals, they almost always do

from JONATHAN GARDNER (Ext) to Everyone: 12:30 PM

JWST's Cycle 1 accepted proposal demographics were presented to the JSTUC on April 8, 2021. The charts are available here: https://www.stsci.edu/contents/events/jwst/2021/april/the-8th-meeting-of-the-jwst-users-committee-jstuc?filterUUID=b192a413-817a-42cf-9f69-70e03d52c4f9

from george helou (Ext) to Everyone: 12:42 PM

The baseline for the NASA Archive for Euclid (implemented by IRSA at IPAC) is to house the data on a NASA Cloud

from Grant Tremblay APAC member (Ext) to Everyone: 2:21 PM

UMD must be largely the CRESST II agreement, no?

from Shardha Jogee-Bromm (Ext) to Everyone: 2:21 PM

Do we have institutions split by R1, AAU, HSI, HBCU and SACNAS ?

from Ronald Gamble (Int) to Everyone: 2:23 PM

@Grant Yup, UMD is the lead university for CRESST II

from Mia Bovill (Ext) to Everyone: 2:31 PM

Could SMD bridge also find a way to mentor and support the faculty at those underresourced institutions as they support the students?

from Shardha Jogee-Bromm (Ext) to Everyone: 2:32 PM

Can one coordinate strategy with NSF REU and ASSURE that do this in the summer and have lessons - learnt, and metrics for success?

from Kelly Holley-Bockelmann (Ext) to Everyone: 2:32 PM

My sense is yes -- Padi mentioned being flexible to the needs/interests of the faculty member. We will ask

from Ronald Gamble (Int) to Everyone: 2:33 PM

@Mia There was a working group, I co-lead, that looked specifically at this and the overall "Capacity Building"

from Kelly Holley-Bockelmann (Ext) to Everyone: 2:35 PM

Ronald, this is key -- I'm so glad attention is being paid to that.

from Ronald Gamble (Int) to Everyone: 2:35 PM

Thanks! We looked at how you could evaluate the research/proposal based on the capacity of the faculty-student relationship.

from Mia Bovill (Ext) to Everyone: 2:37 PM

@Kelly, in particular for faculty in combined departments where the values of NASA/astronomy are having to interface with other fields. To get good buy in, faculty need something they can take to their colleagues during the tenure and promotion process..

from Peter Kurczynski (Ext) to Everyone: 2:37 PM

Ron Gamble is in the Cosmic Origins Program

from Kelly Holley-Bockelmann (Ext) to Everyone: 2:38 PM

It would be especially great if there were funding to support faculty so that they can devote time to this -- thinking specifically of course-buyout.

from Ronald Gamble (Int) to Everyone: 2:42 PM

@Kelly we talked about faculty buyout for a while, but it's very difficult to implement that’s most impactful for faculty.

from Kelly Holley-Bockelmann (Ext) to Everyone: 2:44 PM

agree that it's tricky...

from Grant Tremblay APAC member (Ext) to Everyone: 2:46 PM

We had a long discussion as part of the AWESOM SAG on this - indeed it's tough. NASA can and does give funding effectively for fractional FTE buyouts of committee members, but course buyout is much trickier - NASA can not exactly find someone to teach your class for you! Really tricky.

from Ronald Gamble (Int) to Everyone: 2:48 PM

exactly Grant!

from Brian Odom (Ext) to Everyone: 2:51 PM

works for me.

from Shardha Jogee-Bromm (Ext) to Everyone: 2:51 PM

May we please set aside discussion time for the bridge program and related IDEA issues. I have tons of questions and so do others.

from Bernard Kelly (Ext) to Everyone: 2:52 PM

Dashboard reminder: https://nasa.cnf.io/sessions/k5s2/#!/dashboard

from Kelly Holley-Bockelmann (Ext) to Everyone: 2:53 PM

We will have absolutely have time for discussion.

from Kelly Holley-Bockelmann (Ext) to Everyone: 2:53 PM

Promise!

from Grant Tremblay APAC member (Ext) to Everyone: 2:53 PM

Reminder that you can read the full JWST naming report here: https://www.nasa.gov/sites/default/files/atoms/files/nasa_historical_investigation_james_webb_0.pdf

from Grant Tremblay APAC member (Ext) to Everyone: 2:58 PM

you can read the new full policy here: https://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPD&c=7620&s=1J

from Grant Tremblay APAC member (Ext) to Everyone: 3:00 PM

it says "(2) Where possible, limit the practice of naming projects, missions, instruments, etc., after individuals.

(a) Instead use the theme of unity, inspiration, or the accomplishments of a person as the primary criterion for a project or mission name."

from Alexandra Witze (Ext) to Everyone: 3:02 PM

Thanks for the link, Grant.

from Kelly Holley-Bockelmann (Ext) to Everyone: 3:07 PM

Folks, if we haven't asked your question in the dashboard today, we will ask it tomorrow!

from Grant Tremblay APAC member (Ext) to Everyone: 3:33 PM

aren't we know on 7120.5 *F* ?! =P

from Grant Tremblay APAC member (Ext) to Everyone: 3:33 PM

now*

from Ilaria Pascucci (Ext) to Everyone: 3:38 PM

Yes

from Kelly Holley-Bockelmann (Ext) to Everyone: 4:00 PM

I see you, Ilaria -- you're after Erica

from Blackwood, Gary (Ext) to Everyone: 4:06 PM

Jason Derleth and Nick Siegler

from Kelly Holley-Bockelmann (Ext) to Everyone: 4:10 PM

Regina, Jessica's next, then you.

from Regina Caputo (Int) to Everyone: 4:13 PM

perfect! Thanks

from Kelly Holley-Bockelmann (Ext) to Everyone: 4:19 PM

Alina, are you still a 'go' for a question?

from Alina Kiessling (Ext) to Everyone: 4:19 PM

Yes please

from Kelly Holley-Bockelmann (Ext) to Everyone: 4:20 PM

Of course! We can focus our discussion on this today and table some of the other things. Since Padi agreed to stay over today, though, we should get to Bridge questions.

from Kelly Holley-Bockelmann (Ext) to Everyone: 4:25 PM

Padi Boyd just graciously agreed to give us more time tomorrow afternoon, so we will be able to devote more time to discuss the SMD Bridge.