



Directorate for Mathematical and Physical Sciences (MPS) Advisory Committee Meeting
August 14-15, 2018 (all times EST)
National Science Foundation,
2415 Eisenhower Ave, Alexandria, VA
Room E2030

Minutes

Tuesday, August 14, 2018

12:30 – 12:45 PM Meeting opening, FACA briefing, and approval of prior meeting minutes
Anne Kinney, Assistant Director, MPS
John Gillaspay, Staff Associate, Office of the Assistant Director, MPS
Catherine Pilachowski, MPS Advisory Committee Chair

The meeting was opened by Dr. Kinney and began with a reminder from Dr. Gillaspay that the meeting was open to the public. The minutes of the last meeting were unanimously approved.

12:45-1:30 PM MPS Update
Anne Kinney, Assistant Director, MPS

Dr. Kinney introduced herself to the AC for the first time and presented an overview of MPS activities to the committee. This included a statement emphasizing the large amount of discussion time built into the agenda, a breakdown of the budget for the directorate and the portfolio of each division, an update on efforts to increase NSF branding, and a nod to the Director's work with leadership on the Hill. Dr. Kinney also mentioned multiple staffing changes that occurred within MPS since the last AC meeting. She introduced Dr. Juan Meza, the new Division Director for DMS, and noted the hire of Dr. Chris Smith, the new Senior Facilities Advisor.

1:30 – 2:00 PM Big Ideas I: Quantum Leap
Saul Gonzalez, Program Director for Elementary Particle Physics, MPS
Sohi Rastegar, Senior Advisor, ENG
Science hors d'oeuvre: *Materials for Quantum Leap – Select Examples*
Tomasz Durakiewicz, Program Director for Condensed Matter Physics, MPS

Dr. Saul Gonzalez and Dr. Sohi Rastegar presented the first NSF Big Idea of the day, Quantum Leap. The goal of the Quantum Leap initiative is for NSF to play a key role in the discovery and exploitation of quantum science and engineering to realize dramatic advances in devices, systems, and in science and engineering itself. QL has three major focuses: fundamental science, understanding natural and engineered quantum systems, and technologies and devices. There are over 10 different activities underway for FY 17-18 related to QL, including multiple DCLs, workshops, Ideas labs, and the Triplets network which brings students, faculty, and industry together to work on quantum challenges. Following this presentation, Dr. Tomasz Durakiewicz provided a short science highlight about finding novel materials for quantum engineering purposes.

2:00 – 2:30 PM Big Ideas I: Quantum Leap
Discussion by the Committee
Discussion leaders: P. Bucksbaum, R. Bryant, and D. Awschalom

The discussion began with Dr. Denise Caldwell explaining the current state of quantum research in the community and the goal of the NSF to coordinate efforts on a national level. Discussion centered on the scientific interests and impacts, the connection with technology, and community workforce and development. AC members and NSF staff discussed at what level NSF should focus their efforts and how it can impact the community. This included relationships with industries, connections to other federal agencies, and relationships with universities. It was noted to invest in the workforce and developing students and curriculums for quantum education.



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2:30 – 2:45 PM Break

2:45 – 3:15 PM Big Ideas II: Windows on the Universe
Jean Cottam Allen, acting Deputy Director, Division of Physics, MPS
Joe Pesce, Program Director for the National Radio Astronomy Observatory, MPS
Science hors d'oeuvre: *The Era of Multi-Messenger Astrophysics*, Pedro Marronetti &
Jim Whitmore, Program Directors for Gravitational Physics and Particle Astrophysics,
MPS

Dr. Pedro Marronetti and Dr. Jim Whitmore presented on two 2017 scientific breakthroughs in multi-messenger astrophysics: the LIGO detection of a binary neutron star merger and the IceCube detection of high energy neutrinos and electromagnetic radiation coming from a blazar. Dr. Jean Cottam Allen and Dr. Joe Pesce next presented on the Windows on the Universe Big Idea which is being implemented with the goal of building capabilities and accelerating synergy and interoperability of messengers to realize integrated multi-messenger astrophysical explorations of the Universe. WoU will be affecting research at the PI/award level, midscale experimentation and instrumentation level, and large-scale facility level. A program description was posted on 7/31/18 with participation from AST, PHY, and GEO/OPP, for proposals which will be funded through the \$30M Big Idea allocation as well as existing program budgets. The WoU approach to implementation will be tightly integrated with existing structures, but with new goals and new funds.

3:15 – 3:45 PM Big Ideas II: Windows on the Universe
Discussion by the Committee
Discussion leaders: L. Hillenbrand and C. Pilachowski

Key Points from the Discussion

- Data sharing, generation, and appropriate management is critical for AST, PHY and astrophysics. These areas are all currently experiencing a lot of excitement and growth, a lot is happening organically in the communities. [Hillenbrand]
- Filtering real-time event alerts is important for AST facilities such as the future LSST which will be potentially detecting millions of events and will need to prioritize them and communicate effectively with other facilities. Need theory to select the critical events. [Hillenbrand, Millis, Kinney, Pilachowski]
- The committee likes the approach of using existing directorate programs and pulling out and prioritizing what is relevant to WoU [Pilachowski]
- NSF is only agency that can *currently* utilize all 3 of the messengers described above. We're in a unique position, want to exploit that position and investment [Cottam Allen]
- WoU hopes to couple strongly to the Mid-Scale and Harnessing the Data Revolution Big Ideas. Important in all these research areas to work closely with other Big Ideas. [Cottam Allen]
- In addition to top-down leadership, there is a need for bottom-up initiative from program directors to coordinate communication and resource-sharing between messengers [Green]

3:45 – 4:45 PM Prep for meeting with NSF Director and Chief Operating Officer
Catherine Pilachowski, MPS Advisory Committee Chair

The committee discussed several topics that would be valuable to bring up to Dr. Córdova and Dr. Crim. Major topics were:



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- Big Ideas – the desired scope of each idea, the different implementation across the divisions, the impact of partnerships, and the need for strategic goals given the limited funding being specifically allocated to each Idea
- Operations & Maintenance budgets and their impact on MPS and individual divisions. AC members stated a wish to express their concern about this to the Director.
- NSF policies regarding sexual harassment, especially given the recent NASEM report

4:45 – 5:00 PM Closing remarks and adjourn for the day
Anne Kinney, Assistant Director, MPS

Short mentions of logistics for the following day and reminders about the Conflict of Interest forms for the following calendar year.

Wednesday, August 15th, 2018

8:30 – 8:35 AM Call to Order and official opening of the second day of the meeting
Anne Kinney, Assistant Director, MPS

FACA briefing
John Gillaspay, Staff Associate, Office of the Assistant Director, MPS

The second day of the meeting was opened with a reminder to the committee that the proceedings are open to the public.

8:35 – 8:50 AM NSF's Policy on Sexual Harassment
Robert Cosgrove, Compliance Program Manager, NSF Office of Diversity and Inclusion
and Discussion by the Committee

Bob Cosgrove gave a presentation on the current NSF policy regarding sexual harassment. The NSF ensures compliance with laws and regulations, specifically Title IX. It was then presented how the NSF handles investigations of harassment and discrimination complaints. The presentation ended with NSF's policy on privacy protection and FOIA. The Committee asked about the prevalence of sexual harassment complaints and investigations in MPS, the status of PIs and institutions, and how the NSF checks institutions for compliance.

8:50 – 9:20 AM Big Ideas III: Harnessing the Data Revolution
Juan Meza, Director, Division of Mathematical Sciences, MPS
Chaitanya Baru, Senior Advisor for Data Science, CISE
Science hors d'oeuvre: Daryl Hess, Program Director, Condensed Matter and Materials Theory, MPS

Dr. Daryl Hess began the presentations on Harnessing the Data Revolution with a presentation on applications of data science to materials research. He focused on a case study question: Can dye sensitized solar cells achieve a comparable price/performance ratio to fossil fuel electricity generation? One way to approach this problem is to study the microstructure of dye molecules by applying concepts from data science such as algebraic topology and geometry, applied statistics, algorithms, graph theory. The Materials Genome Initiative



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promotes this type of synergistic interaction among computation, data, experimentation, and theory to improve materials discovery.

Dr. Juan Meza and Dr. Chaitanya Baru presented on the plan for the HDR Big Idea. Science-Driven HDR Institutes will tackle data-intensive problems, including ecosystem forecasting, MMA, novel catalysis design, genotype to phenotype, and more. The TRIPODS and TRIPODS+X programs (Transdisciplinary Research in Principles of Data Science) will fund multiple phases of projects that bring computer scientists, statisticians, and mathematicians together. NSF will also support an open knowledge network to promote the sharing of models and data concepts. Education and workforce are included in the HDR plan through the planning of an HDR academy, Bootcamps, and the support of postdocs.

9:20 – 9:50 AM Big Ideas III: Harnessing the Data Revolution
Discussion by the Committee
Discussion leaders: S. Brenner, C. Hunt, and A. Millis

Key Points from the Discussion

- Is data science a tool or an area of research in its own right? [Pilachowski]
 - It is both, and it's necessary both for researchers across disciplines to become more data-literate and for others to become experts in data science specifically [Baru, Meza]
- MPS hopes these institutes will limit unnecessary duplications in data science by overseeing multiple disciplines, extracting the common threads and developing cross-disciplinary tools [Hillenbrand, Meza]
- Impressed by NSF's efforts and engagement with the topic but cautions that the independence of individual PIs and small-scale interdisciplinary interactions are extremely important and shouldn't be limited by top-down institutional pressure. Also need more engagement with the big and small companies doing big data work. [Millis]
- Dissemination should be part of all activities (such as HDR Academy) [Brenner]
- Researchers and students need to be both specialized and broad in their expertise and the questions they ask [Hunt]

9:50 – 10:15 AM Break

10:15 – 10:45 AM Big Ideas IV: Understanding the Rules of Life
Denise Caldwell, Director, Division of Physics, MPS
Theresa Good, Deputy Director, Division of Molecular and Cellular Biosciences, BIO
Deborah Olster, Senior Advisor, SBE
Science hors d'oeuvre: *Can Zeroing In Shine Light on the Rules of Life?*
Catalina Achim, Program Director for Chemistry of Life Processes, MPS

The last Big Idea of the day was Understanding the Rules of Life. Dr. Denise Caldwell, Dr. Theresa Good, and Dr. Deborah Olster presented on this topic, noting that MPS is not the primary or secondary directorate for URoL but it is a natural partner for collaboration and has been a partner with BIO for years. URoL has 3 major levels at which it is approaching the Rules of Life: Minimal rule set (cellular scale, minimal set of functions, what physical laws), rules of interaction (govern interaction of cells into microbiome or organism), and rules of Complexity (assembly, robustness of evolution, explain adaptation and variation). This is an especially important time to be asking these questions given the technological advances in biological sciences, such as the



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reduced cost in DNA sequencing, new optical and imagine methods, and CRISPR-Cas9. Multiple DCLs were issued for URoL in FY 17 with 2 more on the way. Outcomes from this Big Idea are expected to resonate across society. Dr. Catalina Achim's science talk broadly touched on several topics, including chemical evolution, biological variation, DNA-RNA transcription, and epigenetics, that all merit further scientific exploration.

10:45 – 11:15 AM Big Ideas IV: Understanding the Rules of Life
Discussion by the Committee
Discussion leaders: J. Lewis and M. Sanford

The committee expressed their excitement to be looking at this topic more closely but expressed concern that the scope of the idea is so huge that it is challenging to balance all the players and focus on what is important. It was noted that the position of MPS within the larger URoL portfolio did not feel clear to the committee. Dr. Kinney noted that NSF should not overpromise to the public on the impact that this research will have on medicine or other aspects of society of large. The Chair also pointed out that each Big Idea appears to be applying itself in a different way – some are building on existing programs and supplementing them, some are creating new programs altogether, so knowing exactly how the \$30M is being spent and why is critical to evaluating the success of each approach.

11:15 – 11:45 AM Discussion about possible future subcommittee on Synthetic "Materials" Biology
Linda Sapochak, Director, Division of Materials Research, MPS
Richard Dickinson, Director, Division of Chemical, Bioengineering, Environmental, and Transport Systems, ENG

The discussion began with Dr. Linda Sapochak emphasizing the need to invest in the emergent field of synthetic materials biology and opened a discussion about a synthetic materials biology subcommittee. Dr. Richard Dickinson explained the current state of biology for materials research, and the state of synthetic materials biology research. Discussion focused on collaboration between directorates within the NSF and other agencies. It was suggested that the subcommittee could discuss how DMR should leverage ongoing activities, how sustainable materials development and synthetic materials biology can be complementary, how we can bring new approaches to current efforts, and what opportunities synthetic materials biology holds for interdisciplinary approaches. The AC members clarified how synthetic materials biology is defined, and what current community exists. The Committee agreed to look into this possibility, and Dr. Catherine Hunt volunteered to continue this discussion with the NSF.

11:45 – 12:00 noon Update on MPSAC Subcommittee on Physics Frontiers Centers Program (PFC)
Jean Cottam Allen, acting Deputy Director, Division of Physics, MPS
Donald Geesaman, Chair of the PFC Subcommittee, Argonne National Laboratory

The discussion began with Dr. Jean Cottam Allen and Dr. Donald Geesaman reminding the Committee of the current charge, status, and plans of the subcommittee. Updates included what subfields are being funded, and the status of future meetings. Input was requested from the Committee, specifically about the nature of the charge, and what type and how input from the community should be collected. The Committee mentioned that there was an upcoming APS meeting where the community could be directly engaged, and that the subcommittee could reference the National Academy Decadal in Physics to compare input. It was noted that the subcommittee should be sure that input is comparative since there could be bias towards positive reviews.

12:00 – 1:30 PM Working lunch (take-out from cafeteria on 2nd floor)



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The NSF 2026 Idea Machine (creating the Big Ideas of the future)
Lin He, acting Deputy Director, Chemistry Division, MPS

Dr. Lin He presented to the committee on the NSF 2026 Idea Machine, a prize competition to select the next NSF Big Ideas which is open to the general public. The competition runs from Sept 1st to Oct 26th 2018. After all entries are received, they will be narrowed down to about 30 ideas, which will be solicited for a video proposal and judged by a Blue-Ribbon Panel. There is a \$26,000 prize per idea with smaller prizes for second stage advancement. The committee agreed that this is a great opportunity for branding, recommended that there be separate prizes or categories for submissions from high schoolers or young students, and the members wanted to be notified about how they can amplify the contest personally.

1:30 – 2:30 PM Discussion with NSF Director and Chief Operating Officer
France A. Córdoba, Director, NSF
Fleming Crim, Chief Operating Officer, NSF

Dr. France Córdoba participated in the meeting virtually. She delivered prepared remarks that covered the topic of budget, noting the O&M relief that was provided by additional funds made available to MPS at the end of FY 2018, as well as scientific highlights from MPS in the last year and a summary of major meetings that Dr. Córdoba attended domestically and internationally to represent NSF.

Key Points from the Discussion

- The role of BIs to inspire and underscore research goals is very important [Pilachowski]
- Quantum Leap catching national attention. Administration is interested in the deliverables of quantum computing. Director's role is being able to generalize the very disparate contributions of physics, chemistry, etc. to the quantum conversation. Congress is generally approving of all the Big Ideas [Sanford, Córdoba]
- Flexibility is very important for each Big Idea and its implementation will have to vary based on existing programs. [Bucksbaum]
- NSF serves the nation by making investments now in things that will come to fruition far down the road. This story is helpful for ACs to relate. [Crim, Bucksbaum]
- Director has a long-term plan to buttress O&M and shore up affected grant programs with expensive facilities [Córdoba]

2:30 – 3:15 PM Recap/revisit items from above
Anne Kinney, Assistant Director, MPS
Catherine Pilachowski, MPS Advisory Committee Chair
Discussion by the Committee

It was noted that there were two items to revisit before ending the meeting: a discussion of a possible synthetic materials biology subcommittee, and a preliminary exploration on the question of adjusting grant size vs. funding rates. The Committee discussed what the scope was and who the stakeholders would be for a synthetic materials biology subcommittee. The question of adjusting grant size vs. funding rate was then discussed. It was noted that this is a large topic that can be discussed in depth later, and that the Committee was just looking to introduce ideas. The discussion revolved around the current size and funding rates for MPS, the length of grants, and rolling deadlines. It was noted that this issue would involve a culture change in the grant writing and reviewing communities.



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3:15 – 3:30 PM Break

3:30 – 3:45 PM Opportunity for public Q&A/Comments
Catherine Pilachowski, MPS Advisory Committee Chair

There were no questions from the public at this time.

3:45 – 4:00 PM Preparation/assignments for next meeting
Catherine Pilachowski, MPS Advisory Committee Chair

Dr. Pilachowski asked for a 1-paragraph summary of the meeting from each Big Idea group in one week.

4:00 PM Adjourn
Anne Kinney, Assistant Director, MPS