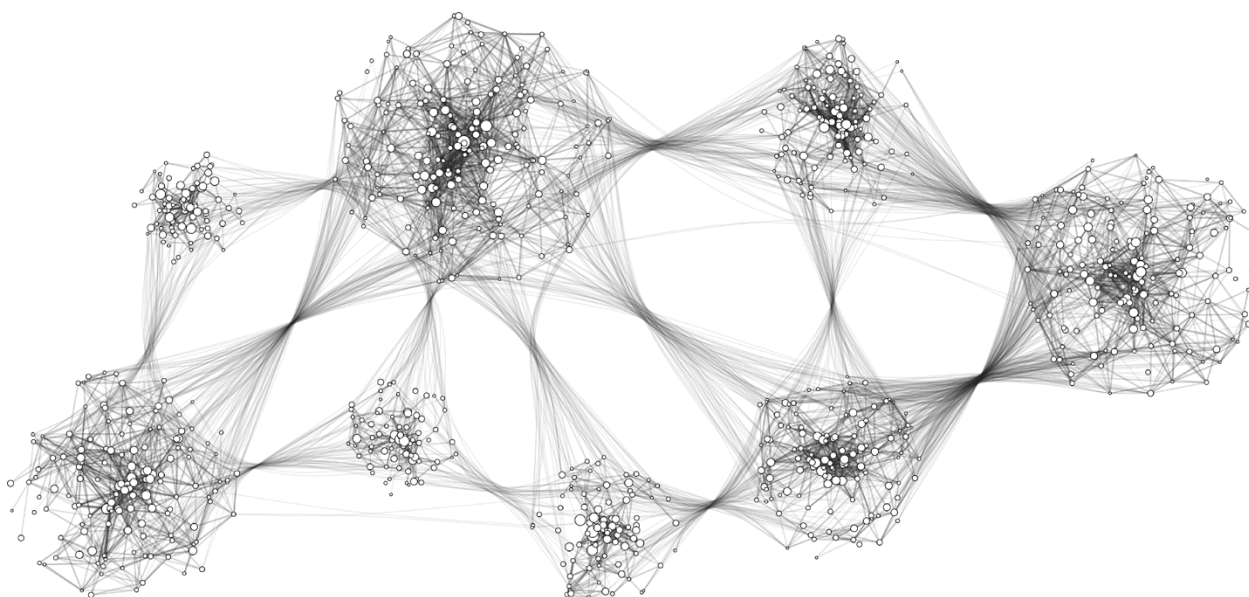


**Report of the 2023 Committee of Visitors
Division of Materials Research
National Science Foundation**



Submitted on behalf of the 2023 Committee of Visitors by
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Report of the 2023 NSF DMR Committee of Visitors

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1 Executive Summary

The 2023 Committee of Visitors (COV) met in Alexandria VA on September 13-15, 2023 to review all aspects of the Division of Materials Research (DMR) over the time period FY 2019-2022. Pursuant to our charge (Appendix A), we reviewed twelve separate programs. Members of the COV examined the integrity and efficacy of processes used to solicit, review, recommend, and document proposal actions; the quality, breadth, and significance of the Division's results during the last four years; and the current balance of investments across large infrastructure programs (NaFI), large institutional awards (MRSEC), and single PI awards across a range of technical disciplines (TMRPs). We make key recommendations in Section 2, "Key Recommendations," and provide program-specific reports in Section 4, "Reports of the Working Groups".

The Committee of Visitors appreciated the warm welcome and intensive preparation by the staff of DMR. The opening presentation from Dr. Germano Iannacchione, DMR Division Director, demonstrated DMR's strategic impact and importance. The presentation from Ms. Velma Lawson, DMR Program Support Manager, highlighted DMR's commitment to culture, people, teamwork, respect, and fair process. The extensive documentation of peer review panels, ad hoc peer reviews, and review analyses facilitated an efficient comprehensive review by the COV.

The COV found that the quality and effectiveness of the DMR programs are excellent. DMR's success depends on, and is driven by, the Program Directors' passion, expertise, and ability to recruit expert reviewers. The COV found that the reviewers are well selected; that the overall review process is deep, substantive, and core to the success of the program; that the programs are well managed; and that the portfolio of awards is excellent. We applaud the Division's current efforts to ensure PI and institution diversity and encourage such activities into the future to the extent enabled by federal policy. The award portfolio capitalizes on and reflects DMR's unique position as a multidisciplinary division operating at and across the interface of fundamental and use-inspired research.

The COV also observed that the costs of conducting research at universities nationally is rising more rapidly than the size of a single-investigator award. In this context, the COV believes that even greater effort is needed to plan for the Division's balance of investments, priorities, and future directions. Such planning should ensure that the quality and significance of the results of the Division's broad and extensive programmatic investments continue to achieve the level of excellence necessary to support the Foundation's strategic goals and mandate to advance the progress of science.

The quote below exemplifies the importance and centrality of material science between knowledge and the application of that knowledge to technology development. DMR occupies this position in the S&T ecosystem. The breadth of materials research creates great opportunities across the varied S&T components of NSF and the larger S&T federal ecosystem, placing a correspondingly high demand on the division staff and PIs. There are exciting opportunities in materials research that open new scientific frontiers, address society's greatest concerns, are central to the development of new technologies, and ensure the security of the Nation. It is critical that the Division conveys this message to its stakeholders, both within and outside NSF.

“Technologists appreciate that everything that we do technically depends on material science, EVERYTHING.”

- Frank Kendall, Secretary of the Air Force, at the 2022 Award Ceremony for the Harold Brown Award.

We hope that the following recommendations further enhance DMR's ability to conduct strategic planning, to lead materials research strategy and activities across NSF and the whole of government, to improve operational excellence, to develop the R&D workforce of today and tomorrow, and to foster excellent science and engineering research throughout the United States of America.

2 Key Recommendations

1. **Formulate an explicit strategy for the balance of investments.** We recommend that a strategy for investment balance in the future for the Division be formulated. A strategic plan for DMR will simultaneously help the Division Director and his team determine future allocations between existing programs while enabling advocacy to be built around future investment areas within NSF and with external stakeholders (OSTP, Congress, DoE, etc) for growing investment in materials research. An understanding of where the division believes it sits at unique junctures of future transformative research (autonomous laboratories of the future as an example) should be utilized to focus and synergize future growth opportunities. A future looking strategic plan helps balance the day-to-day reactive budget pressures with higher order, proactive aspirational goals for the division.
 - a. Strategic planning should include a discussion on the future opportunities and threats for TMRP, infrastructure and facilities, the MRSEC program, and other current division-led activities, to drive macroscopic balancing decisions. The extensive core expertise of the DMR PDs should be an input to this strategic planning process.
 - b. As part of this forward looking activity, DMR (and NSF as a whole) must address the fact that over the last several years there has been historic increases in the cost of living (increased graduate student, postdoctoral, and PI salaries) as well as the cost of scientific equipment and supplies. The rapidly declining purchasing power of the typical grant and the implications to what is and what is not being funded needs to be considered proactively and as a division. Scientific inflation compared to flat funding levels on single-investigator awards is an existential threat to the health of the NSF and therefore the nation's R&D ecosystem. This poses a major risk to the productivity level of work funded by the NSF. It is critical that NSF and DMR be

prepared and have mapped out a strategy; will the division (and directorate/NSF) benefit from fewer, larger grants or a constant number of grants that may no longer fund a full graduate student for a full year? Should priority be placed on large centers with the ability to build significant infrastructure or single PI grants that are distributed more broadly and touch statistically a more diverse institution and PI base?

2. **Commission a workforce study.** The workforce produced by DMR activities feeds and cultivates the economic fabric of the country. We recommend that DMR invite other agencies to join in commissioning a study on the Economic Impact of the Materials Science Workforce, recognizing the breadth of materials research across research disciplines, federal agencies, and industry. The new study should not duplicate but might **refresh or expand** the 2019 National Academy study, “Frontiers of Materials Research”. What is timely now, given NSF’s mandate to “advance the national health, prosperity, and welfare”, is to assess the economic impact of the materials research workforce previously developed by the NSF along with future materials research workforce needs to maintain global leadership in key economic areas. This study should serve as a foundation for further justification for expanded materials science and engineering activities across the S&T ecosystem.
3. **Support best practices for data management that are appropriate to open science.** The impact of the rapidly evolving research security landscape on the materials research community is unclear given recent shifts in policy. The near- and far-term primary and secondary effects to the basic research community of open data migration, FAIR data best practices, and increasing policies on information protection are currently unknown. Given the division’s unique portfolio, DMR should be proactive in the community (along with NSF as a whole) ensuring

the right balance of openness and accessibility through participation in expected further community and policy discussions.

4. **Strongly articulate the relevance of the Division's portfolio to the entirety of NSF's mandate.** Within the context of NSF's mandate to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense, DMR should be more proactive in messaging their accomplishments related to the 2nd and 3rd mandates more explicitly within DMR, within the directorate, within NSF, and externally. The division sits at a unique juxtaposition of basic vs use-inspired research content and should utilize its pulpit to ensure that their mission and accomplishments are messaged as more than 'do and publish good science' only. Activities could include seeking science-driven opportunities to conduct open research that is collaborative with mission-focused agencies and/or facilitating interactions of PDs and PIs with mission-focused agencies to understand shared interests (as an existing example - DMREF).

5. **Increase access to shared experimental and computational facilities.** Shared facilities can provide on-demand access to transformative research capabilities and thereby greatly increase the pace, the impact, and the number of participants in cutting-edge research. The COV applauds the large DMR investment that is associated with infrastructure through NaFI, MRSEC, and MIPs. The division could take an even stronger leadership role in ensuring these enabling capabilities are understood across the materials community. Repeatedly, we heard on the one hand there were extensive shared networks of shared facilities (to include computational assets) while on the other hand everyone was wishing for more ability to compete for equipment purchases individually. Is it a supply issue? Is it a demand issue? Is it a lack of awareness issue? Under the programs that DMR owns and leverages, the division should demystify experimental and computational facilities that are available to the general user

community. We encourage the DMR to pilot programs that ensure that access to national and regional facilities is broadly available and is directed to the highest-impact work. For example, as a pilot, NSF could direct TACC to set aside a certain number of node-hours for DMR or for a key program within DMR, enabling the program officers to award not only dollars but also access to computing capability.

6. **Develop a plan for partnering with TIP.** DMR should develop a plan on how best to partner and synergize resources with the new TIP directorate given its infancy. This plan should explicitly address the balance of fundamental and use-inspired research, the importance of fundamental research for translation, and the value of human capital development through academic materials research.
7. **Evaluate the factors that affect proposal volume.** DMR should conduct a self-study on staffing and practices for panel reviews and the effect of the switch from open solicitation vs fixed deadline for proposal submission. The DMR PD's should track the quality of their unfunded proposals to help with future allocations and to determine if there has been a drop in the number of quality proposals. Analysis to include determination of a root cause (switch to open call, size of awards, migration to other funding sources etc) on why the number of proposals seems to have dropped in some areas for the TMRP groups should be conducted.
8. **Develop additional staffing capacity to realize the transformative opportunities of interdisciplinary activities across program lines.** As science becomes more multi- and interdisciplinary, it is crucial to find a way for different programs and divisions to share the costs of this joint research taking into consideration the additional time requirements it puts on a finite workforce. The workload of managing each PD's core program, already a full-time activity, is exacerbated as additional opportunities (many prescriptive from higher order

leadership) continue to present themselves. This is particularly acute for DMR PD's given the uniqueness of its portfolio. DMR should ensure that current policies enable both internal and external opportunities to be managed with similar integrity and rigor. The division needs to make sure additional PD workload and financial gymnastics within the foundation are considered in the day to day execution of the DMR mission. The division should seek to minimize the possibility that truly transformative research is not evaluated and/or not funded due to logistical concerns inherent in the historical NSF business model. DMR should consider monitoring and documenting the workload of DMR PD's on collaborative efforts/programs centered in other divisions.

9. **Reinvigorate the Federal interagency for Materials Research (FiMaR) community.** DMR should take a leadership role reinvigorating the Federal interagency for Materials Research (FiMaR) S&T community, making sure there is adequate communication amongst the various governmental materials science activities to ensure awareness, to enable synergism of efforts, and to perhaps jointly identify cross-organizational efforts. Given the second and third mandate of NSF, “advance the national health, prosperity, and welfare; and secure the national defense”, DMR should utilize these exchanges and linkages arising from within to strengthen connections to synergistic and complimentary work enabling the mandates.

10. **Document the lessons learned from this 2023 COV process for the next COV.** Given the four year time frame and given the personnel turnover typical in that time frame within the division, DMR should document lessons learned re: the 2023 COV process. DMR staff clearly did an incredible amount work to prepare for this COV. Question 5 of the ‘Other Section’ in the feedback forms of each program “NSF would appreciate your comments on how to improve the COV review process, format, and report template” has extensive thoughts from this year's COV participants in the individual program responses

showing that COV could have benefitted from more tutorials about the tasks at hand. DMR should internalize and consolidate these extensive comments from the individual programs into a 'brain book', documenting procedures, expectations, and lessons learned. This documented 'book' would then be available to DMR and the COV leadership in 3.5 yrs as the next COV is gearing up. The vast majority of the participants at this event were participating for the first time and so few lessons learned were available from participants. Documentation of what did and did not work well will help shape a successful 2027 COV.

11. Continue to develop best post-pandemic practices for NSF staff and reviewers. DMR, together with the whole of NSF, should continue to review lessons learned during the pandemic recovery to establish and document best practices in a post-pandemic environment. These activities should be conducted with transparent and extensive communication between staff and all levels of management, and should address the following topics:

- the balance of remote/hybrid/telework for NSF staff in the new era of hybrid work and telecommuting to include discussion on best optimizing in-person space assignments for division personnel
- best practices for ad-hoc reviews vs review panels
- For review panels, lessons learned on best optimizing 'hybrid' review panels
- the highest priorities for modern and appropriate IT that is uniform and easy to use for both virtual and hybrid review panel activities
- given the strength of DMR's support staff and the existing esprit de corps, the division should participate strongly in a leadership role to develop a MPS Training Framework for support staff which documents best practices re teamwork, and career development.

- 12. Improve clarity and consistency on broader impact criteria for proposers and reviewers.** Given the breadth of DMR's footprint, DMR should assess whether additional discussion and/or training is needed w/r to the topic of broader impact. Depending on the nature of the program (single PI, MRSEC, DMREF, etc), what constitutes broader impact is very different. This was a topic of discussion with the larger COV body and several of the programs had specific written comments on the topic in the report. Given it is one of only two merit-based criteria, clear expectations on what constitutes broader impact for BOTH proposers and reviewers is important to the entirety of the community.

- 13. Consider computation-first proposals in programs beyond CMMT.** DMR needs to re-examine the existing policy of CMMT being the TMRP that reviews computation-based proposals (theory development) regardless of technical discipline. Given the explosion of modern-day theory development in almost every technical discipline and the ever expanding growth of proposals which have an intertwined experimental and computational component (to include method development), DMR should examine the historical roots of the policy and consider whether changes are needed to realize the current potential for computationally-intensive research.

Report of the 2023 NSF DMR Committee of Visitors

3 Members of the COV

COV Member	Home Institution	Working Group
Acoff, Viola	University of Mississippi	PREM
Adenwalla, Shireen	University of Nebraska-Lincoln	CMP
Bowman, Keith	University of Maryland Baltimore County	PREM
Brennecka, Geoff	Colorado School of Mines	DMREF
Broholm, Collin	Johns Hopkins University	NaFI
Brown, Craig	National Inst. of Standards and Technology	SSMC
Buchanan, Kristen	Colorado State University	CMP
Bunning, Timothy	Air Force Research Laboratory	co-chair
Cai, Chengzhi	University of Houston	BMAT
Daniel, Jaffe	University of Texas-Austin	PREM
Das, Moumita	Rochester Institute of Technology	MRSEC
Dolgos, Michelle	University of Calgary	CER
Fertig, Herbert	Indiana University	CMMT
Geddis, Demetris	Hampton University	EPM
Gilbert, Pupa	University of Wisconsin-Madison	BMAT
Goldberger, Joshua	Ohio State University	SSMC
Granick, Steven	University of Massachusetts-Amherst	POL
Gutierrez, Carlos	Sandia National Laboratories	EPM
Hart, Gus	Brigham Young University	CMMT
Latturner, Susan	Florida State University	SSMC
Lodge, Tim	University of Minnesota	DMREF
Madhavan, Vidya	University of Illinois at Urbana-Champaign	CMP
Manning, Lisa	Syracuse University	MRSEC
Mendenhall, Juana	Morehouse College	PREM
Moler, Kathryn	Stanford University	co-chair
Morgan, Sara	University of Southern Mississippi	POL
Naughton, Michael	Boston College	NaFI
Ostroverkhova, Oksana	Oregon State University	EPM
Partridge, Harry	NASA Ames Research Center	DMREF
Rodriguez, George	Exxon Mobil	DMREF
Rosenkranz, Stephan	Argonne National Laboratory	CMP
Segalman, Rachel	University of California-Santa Barbara	MRSEC
Segre, Carlo	Illinois Institute of Technology	NaFI
Stone, Tonya	Mississippi State University	MMN
Voorhees, Peter	Northwestern University	CER
Westervelt, Robert	Harvard University	NaFI
Williams, Cyril	Army Research Laboratory	MMN
Zandi, Roya	University of California-Riverside	CMMT

4 Reports of the Working Groups

4.1 National Facilities and Instrumentation (NaFI)

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>CHRNS: The proposal was reviewed before panel site visit by multiple reviewers, some of whom were on the panel. PI was given the opportunity to respond to individual reviews as well as the site visit report. PD wrote an extensive report based on all of these documents to justify the award.</p> <p>Post-award site visit reviews were performed annually 2021 and 2022 with Program Directors only, 2023 with a full external panel. COVID-19 limited 2021 and 2022 visits to virtual only. Site visit reports and PI responses were recorded in each of the three years. The external site visit report was more formal while the PD-only reports were more like notes from the review.</p> <p>The most consequential issue over the term of the COV review was the unscheduled shutdown of the reactor in February 2021. This was referred to extensively in all documents reviewed. The NSF approach to this incident was appropriate and steady, making sure that this valuable resource is maintained beyond the restart of the reactor.</p> <p>MIP: The approach for selecting MIP awards includes a written review followed by a panel review that covers intellectual merit, broader impacts, plus vision, knowledge sharing, research, infrastructure, facility operation, education/training, and knowledge transfer. For renewals the review consists of an evaluation of existing platforms, while for the initial competition the panel selects finalists to undergo a reverse site visit with an external panel, resulting in the NSF awards.</p> <p>NHMFL: The NHMFL 2021 renewal proposal 2128556 underwent a particular review process that included external “mail” reviews by 18 (of 20 sent the proposal) ad hoc subject matter expert reviewers, followed by a written response by the lab to those reviewers’ comments. This was then followed by a Site Review with NSF staff and 11 external reviewers from a wide range of disciplines and, again, a written response by the lab. This site visit occurred 4 months after proposal submission. In response to the site visit report, it is presumed that NaFI program managers negotiated with the lab with regard to the research program and budget, and then made a recommendation to DMR for funding. DMR then recommended to MPS, who forwarded the request to the National Science Boards MPS’ Action Review Board, who approved the request and forwarded to the NSB Director’s Review Board.</p> <p>For an award of this scale (~\$200M), this seems an appropriate review method.</p> <p>CHEXS: A 2018 site visit by nine referees resulted in a comprehensive, thoughtful and generally positive report. Individual referee reports from the visitors were supplemented by other referees for a total of 15 substantive referee reports. The program director (PD) solicited responses from the</p>	<p>YES</p> <p>YES</p>

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>PI to questions raised in the referee reports. The PD prepared a detailed report analyzing this information with a recommendation for funding that was presented to the National Science Board.</p>	
<p>2. Are both merit review criteria addressed</p> <ul style="list-style-type: none"> a) In individual reviews? b) In panel summaries? c) In Program Officer review analyses? <p>CHRNS: Most reviews addressed the two merit criteria explicitly, however one of the individual reviews did not. Note that the panel review was in the form of a site visit report with a somewhat different format.</p> <p>The program specific criteria were not addressed in all the individual reviews.</p> <p>MIP:</p> <ul style="list-style-type: none"> a) In individual reviews - mostly - to various degrees b) In panel summaries? - yes - they are carefully considered and used to select the winning proposals. c) In Program Officer review analyses? - yes - the panel summaries by the program officers view both merit criteria - intellectual merit and broader impact - as essential parts of the proposed MIP program. <p>NHMFL: While not always specifically in the manner suggested by NSF in its guide to reviewers, each of the 20+18 = 38 reviewers (across two NHMFL renewal proposals) addressed both merit review criteria in their reviews. No review panels were convened, so no panel summaries exist.</p> <p>The PD review summaries also thoroughly addressed both criteria.</p> <p>CHEXS: The referee reports, site visit report, and officer review are detailed and thoroughly cover all review criteria. There is detailed consideration of the scientific capabilities to be provided in the context of other national and international facilities. Serious consideration and analysis is presented regarding the transition from NSF stewardship of, to partnership with, the CHESS facility.</p>	<p>YES, FOR THE MOST PART</p> <p>YES</p> <p>N/A for NHMFL</p> <p>YES</p>
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>CHRNS: The individual reviews are quite detailed and provide backing information for their conclusions.</p>	<p>YES</p>

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>MIP: The individual reviewers provide substantial advice about the proposals. The style of the review varies with the reviewer.</p> <p>NHMFL: The <i>ad hoc</i> reviews were of varying degrees of comprehensiveness, but all provided sufficiently substantive comments explaining their respective assessments. This included discussion of the proposed Science Drivers, the appropriateness of the budget request, outreach, and diversity efforts and plans.</p> <p>CHEXS: The individual reviewers all provide substantive comments that reflect relevant expertise applied to analyze the proposal. Distinctions are made between different aspects of the proposal such as the strength of the scientific and educational aspects of the proposal, which were generally very well received versus concerns for some referees about the novel governance model proposed.</p>	YES
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>CHRNS: Site visit reports are thorough and contain detailed backing information, a series of recommendations for the NSF and questions for the PI who is able to respond. Since this is a renewal proposal, the previous track record of the project is included in the report.</p> <p>MIP: The panels do a thorough job of analyzing the written reviews. Panel summaries of the panel members' opinions are well-written and include both their assessment of the written reviews and their own opinions. The consensus for the decision is described clearly in the summaries.</p> <p>NHMFL: As per above, there was no panel summary. However, the PO review summary accurately reflected the review process quality.</p> <p>CHEXS: The site 2018 CHEXS site visit report is comprehensive and appears to present the panel consensus.</p>	YES YES
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>CHRNS: The PD review analysis is detailed, echoing the individual reviews and the site visit report. The basis for the decision is clearly laid out.</p>	

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>MIP: The documentation in the jacket provides a thorough evaluation of each proposal given the NSF rules, including intellectual merit and broader impact. The panel response is written in a way which both communicates the strengths and weaknesses in the proposal in a way that could be useful to the PI for future projects, using a balanced consideration of the strengths and the weaknesses of the proposal.</p> <p>NHMFL: The Jacket provided two proposal dossiers (DMR – 2128556, NHMFL Renewal for 2023-2027 and DMR – 1644779, NHFL Renewal for 2018-2022), the full reviews (18 of proposal '556 and 20 of proposal '779) of the <i>ad hoc</i> reviewers, the Site Visit Reports (5 and 2), the PD's responses (5 and 1) to those reports, plus extensive Correspondences, Diary Notes, Context and Process Statements, and Revised Budget documents. In congregate, these dossiers provided sufficient rationale for the award decisions.</p> <p>CHEXS: Supported by the referee report and PI response, the PD review analysis provides detailed justification for the recommendation to fund the project. The budget was reduced relative to the proposal. The rationale in the program officer review analysis is that: <i>"By focusing on supporting the most meritorious beamlines, the budget will provide adequate support for the strongest high energy X-ray science at CHESS."</i> The reduction resulted in the removal of two instruments from the project (IMP and CBM), which were generally assessed to be less competitive by the referees.</p>	<p>YES</p> <p>YES</p>
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>CHRNS: The PI has multiple opportunities to respond to comments and answer questions during the process.</p> <p>MIP: As above, the consideration of each proposal is carefully done by the panel. In cases where the written reviews were not strong, the documentation is briefer, but in proposals that do have both strong and weak points, a careful examination is given, along with a summary of the reasons for the final decision.</p> <p>NHMFL: The documentation made available to the PI teams, inclusive of the material elaborated in Question 5 above, was extensive, and sufficient to justify the NSF's rationale for their ultimate decisions.</p> <p>CHEXS:</p>	<p>YES</p> <p>YES</p>

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
The referee reports provide justification for the assessment of the proposal. Ongoing interactions with the CHEXS project indicate that the project is aware of the reasoning that lies behind for example the reduced level of funding relative to the requested amount.	
<p>7. Additional comments on the quality and effectiveness of the program’s use of merit review process:</p> <p>CHRNS: It is not clear whether the PD-only site visits are a standard part of the review process but external reviewers were only used in 2023.</p> <p>MIP: Very well done.</p> <p>NHMFL: Not included in the Jacket but surely available to the proposing teams at the NHMFL and possibly to the reviewers of the two NHMFL proposals under consideration by the COV are the reports of the NHMFL User Committees over the relevant years, 2016-2023. There is an abundance of data and information in the Jacket dossiers, such that the absence of these Reports is unlikely to change ones assessment of the review process, but their inclusion would be appropriate for completeness.</p> <p>CHEXS: A thorough and effective assessment of the proposal was obtained through the review process.</p>	

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>CHRNS: All the reviewers are accomplished scientists with experience at user facilities and specifically at neutron facilities. They are knowledgeable about the challenges of running a major facility.</p> <p>MIP: An excellent choice of reviewers, for both the written reviews and the panels, was made by the program officers, including a variety of institutions across the US with different focuses, and good diversity among the reviewers.</p> <p>NHMFL: As the NHMFL serves a wide range of disciplines and inter/cross-disciplinary areas, it is appropriate to solicit reviews from a similar cross-section of disciplines. This is indeed the case for the two proposals considered here. As per the PD’s Review Analysis, “three reviewers (were) female, while two (were) from underrepresented minority groups. The reviewers (were) from</p>	<p>YES</p> <p>YES</p>

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>academia, national laboratories, and international laboratories, and (brought) a broad range of expertise spanning condensed matter physics and materials science, biology, chemistry, instrument development, and facility management.”</p> <p>The qualifications of the 18+20 = 38 reviewers were stellar and appropriate.</p> <p>CHEXS: The referees include a good distribution of scientific and administrative expertise and demographics and include individuals who were and who were not recommended by the proposers.</p>	
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>CHRNS: The choice of reviewers was made with COI in mind.</p> <p>MIP Conflicts of interest are recognized and marked in the review summaries.</p> <p>NHMFL: There is not a lot of direct evidence for the appearance and resolution of COIs in the provided Jacket. However, the requirement of COI forms by NSF, and by extension DMR, is a thorough and appropriate process, and the existence of a COI officer within DMR is appropriate and commendable.</p> <p>CHEXS: The NSF processes to identify and avoid COIs were applied. The referees describe potential conflicts of interest including situations that could give rise to the appearance of a conflict of interest. These are considered and resolved by the program managers. Some referees are CHES users and mention this. While these referees are inevitably closer to the proposal and will be impacted by the outcome of the review this is not a COI but a fact considered in the review analysis, It is important to have direct experience with the facility reflected in the assessment.</p>	<p>YES</p> <p>YES</p>
<p>3. Additional comments on reviewer selection:</p> <p>MIP: Well done.</p> <p>NHMFL: The reviewer selection process developed and employed by NSF, DMR and NaFI is excellent. Appreciating that addressing diversity and inclusion remains difficult in the physical sciences, the Program does a good job at identifying women and members of underrepresented groups as reviewer candidates.</p>	

MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

CHRNS:

The program is managed effectively. With annual site visits by either a team of PDs (2021, 2022) or an external team (2023). During COVID, the site visit was virtual. The PI of the project was given the opportunity to comment on all the concerns of the site visit team. After the unplanned shutdown of the reactor, the PDs have consistently supported the project by encouraging the PI to use staff to support users in bringing their data to publication and continuing outreach efforts.

MIP:

The program officers are doing an excellent job managing the Materials Innovation Platforms (MIP) program. They have exercised care in both the selection of focus areas for upcoming announcements, such as the focus on biomaterials for the 2019 MIP competition, and they have done a great job selecting reviewers, and carrying out the review. After an award, the program officers periodically review the progress in establishing the proposed platform, and its success in both conducting research and building a community of users.

NHMFL:

NaFI operates as a sub-program of DMR, with a number of portfolio items. The largest item by expenditure is the NHMFL, which therefore requires significant management oversight. Having a capable and dedicated DMR staff member (Dr. Spinu) assigned to manage the NHMFL grant portfolio, while also supported by NaFI co-PD's, is an excellent – really the only – way to operate such a large and important program. Dr. Spinu has constant contact with management and staff of the NHMFL's three sites, and ably manages the budgetary and other exigencies as they arise.

CHEXS:

Through regular interactions with the facility and very extensive annual reports, NAFI/NSF is well informed about activities and accomplishments at CHEXS. The annual reports indicate that the facility understands and is aligned with NSF priorities. The facility operates with a high level of reliability during 125 days per year.

The average beamline oversubscription rate was reported to be 1.9 in the 2022 annual report, which indicates the CHEXS facility fills a need in the scientific community. While the over-subscription rate for the high-pressure biology beamline (HpBio) was fairly low (1.1 compared to 3.2 for PIPOXS, the photon spectrometer in the third reporting period of 2022), the number of HpBio publications was 43 (37%) out of 116 for all of CHEXS in the latest annual report. This is indicative of a scientific development phase where most of the experiments are done by a smaller group of scientists who are familiar with the new scientific capabilities. Ideally these publications will attract more users to the HpBio beamlines in the future.

2. Responsiveness of the program to emerging research and education opportunities.

CHRNS:

The incorporation of the upgraded NSE facility (Mid-Scale RI) provides an excellent opportunity to improve the facility. The forethought in improving data collection and management will pay dividends in the future. The changes in utilization and funding for the different SANS instruments will serve the users well for the future.

MIP:

For the MIP renewals, Cornell and Penn State had both created excellent MIP programs using their original funding, and the renewal review was thorough but straightforward, because it was limited to the two institutions. The selection of biomaterials for the 2019 competition was an excellent choice of fields to expand the MIP program, which is complementary to the previous work on hard materials. The shift to biologically

MANAGEMENT OF THE PROGRAM UNDER REVIEW

created materials mirrors the current shift in interest to biological systems, and takes advantage of advances in bioengineering.

NHMFL:

There is constant pressure on NSF, DMR and, in particular, the NaFI programs, to anticipate and respond to the ever-changing, ever-advancing scientific realm. This is entirely appropriate, and their respective attentiveness and responsiveness to this pressure is what keeps the US at the forefront of discovery in science and engineering. At the NHMFL, support in terms of access to, and design and construction of, magnets, to measurement device development, and to personnel expertise all need to be in constant states of flux, as new materials and physical phenomena are discovered that attract the attention of the user communities. Accordingly, the NaFI program needs to be responsive to their respective research base. By all accounts, this is the case, with e.g. the detail in the oversight and review of the NHMFL renewal proposal, where Science Drivers were first of all, required, and second, heavily scrutinized. As it turned out, two such proposed Drivers were deemed insufficiently justified, and the NaFI PDs directed the lab to scale back their program and budget to focus on what the research community judged as the most important components for funding. This shows true leadership by the NaFI program.

In parallel, or perhaps more accurately, in advance of such discovery, is education. Encouraged and in part mandated by NaFI, the NHMFL does an outstanding job of offering wide-ranging educational opportunities, including summer schools, workshops, tours, public talks, and roadshows that involve learners from K-12, college, postdoc, and professional academic and industry realms. This is fully recognized by NaFI as a critically important enterprise for our future national competitiveness.

CHEXS:

The decision to fund CHEXS was informed by the broader landscape of light sources. The facility offers a unique hard x-ray source within a world class educational environment. Prior NSF investments in CHESS have produced innovation in x-ray science and drawn a new generation of talent into the field.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

CHRNS:

The PDs rightly recognize that the CHRNS has an important place in the nation's scientific infrastructure, not only in providing access to cold neutrons to the community through a peer review proposal process, but also in training young scientists in neutron techniques.

MIP:

As stated above, the selection of biomaterials for the 2019 MIP call for proposals, was a wise choice, given rapidly advancing advances in bioengineering tools and AI analysis techniques, biologically based materials have great promise.

NHMFL:

As mentioned previously, the NaFI program, informed by its review process, directed the NHMFL to prioritize its Science Drivers, ultimately removing from the proposed renewal program two proposed Driver sections, and revising the budget accordingly. This demonstrates good stewardship of taxpayer dollars, keeping the eye on the most effective use of funds while remaining nimble and ready for forward-looking surprises.

CHEXS:

The program managers' analysis of the CHEXS proposal reflects a strategy to support a unique scientific resource and implement a method of engagement (partnership) that best leverages the investment.

MANAGEMENT OF THE PROGRAM UNDER REVIEW

4. Responsiveness of program to previous COV comments and recommendations.

MIP:

During the COV presentations, the program officers presented comments from the previous COV review, which mentioned positive features, as well as weaknesses that should be addressed. For each weakness, the program officers described the actions taken that address and remedy these problems.

NHMFL:

The first response to the 2019 COV held in September of 2019 was provided in January 2020, followed by annual updates. The responses were thorough and comprehensive. It is not known exactly how to judge the timeliness of the response, which appears to have been one year after the report and another year for the update.

CHEXS:

Developments in the CHEXS project, in particular the transition to the partnership model were well received by the previous committee of visitors.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>CHRNS: CHRNS users come from a broad range of disciplines.</p> <p>MIP: The MIP awards are well chosen in important fields, through a carefully conducted review procedure. The choice of biomaterials for the 2019 competition balances the earlier focus on hard 3D and 2D materials.</p> <p>NHMFL: The NHMFL (~\$200M/5 years) consumes significant fractions of the NaFI (~67%) and DMR (~12%) budgets. With regard to its research expenditures, including the in-house research program, there is excellent balance among the many constituent disciplines.</p> <p>CHEXS: Driven by hard x-ray scattering techniques, the CEXS facility covers a broad range of science including biology, quantum materials and materials science.</p>	<p>YES</p> <p>YES</p>
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>CHRNS: The funding for this project and the partnership with NIST is appropriate and should continue. The Staff size is adequate for the support and training functions of the project.</p>	<p>YES</p>

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>MIP: Creating a platform to create new materials for a community of users, typically requires \$10M - \$50M over 5 years, due to the cost of the instruments, the creation of suitable space, the installation of the facilities, and establishing support staff. The NSF structure of an original MIP award followed a renewal, each for \$25M over 5 years, is well suited to the task. Ten years are needed to create a fully functioning Materials Innovation Platform for a new category of materials. Over the first 5 years, the MIP is created at each site, and over the renewal period the MIP establishes a fully functioning site with a community of users. Ten years is needed because processing and analysis techniques must be developed to find ways to efficiently grow, synthesize or assemble a new material. In addition, the students, faculty, and staff must develop the skills and knowledge needed to carry out the work. To expand the community, training and educational routines need to be developed.</p> <p>NHMFL: Awarded funding for the NHMFL has been appropriate and consistent with the proposal requests, after judicious scrutiny by DMR of the various subprojects within those proposals (i.e. not all subprojects necessarily funded). In the context of the aforementioned fraction of DMR funding being dedicated to the National Facilities, and perhaps especially to the NHHMFL, it has been noted that the average single-investigator award within DMR has not increased much over several decades, from maybe \$100k/y to \$150k/y. Meanwhile, a significant expenditure on such grants, graduate student stipends, has maybe tripled or quadrupled (while still being unsustainably low). It is not known how to “solve” this issue, as there will always be pressure to support even more proposals than are funded in a given year. DMR does a good job of balancing single-investigator, Center and National Facility expenditures, but/and is encouraged to continue to vigorously advocate for a level of overall funding commensurate with our national need.</p> <p>To that end, we reemphasize that the value of materials research be ever more strongly iterated and emphasized to the American public and their representatives in the US Congress, and to NSF leadership. Superconductors and magnets are materials, cells and neurons are materials, molecules and pharmaceuticals are materials, stars and planets are materials, pollutants of air and water are materials, hurricanes and floods are composed of materials, fissioned and fused nuclei are materials, and all the properties of materials being mined in large data sets for AI are driving the future of the American and global economies.</p> <p>CHEXS: The funding level is appropriate for the initial phase of a light source facility with five beam lines. The CHEXS Project (DMR-1829070) has so far led to 132 publications with 1,145 citations for an H index of 15 (ISI Web of Science). In 2022 the most highly cited papers received 135, 66, 33, 26, 17, 13, and 11 citations respectively. While these numbers are not at the level expected for a light source at the \$54M funding level in steady state, the publication and citation rate continues to increase as expected for a young facility.</p>	<p>YES</p>
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>CHRNS: The CHRNS is implementing improved neutron tracking and data collection during the</p>	

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>unscheduled shutdown. This will provide users with better information about their data when experiments resume.</p> <p>MIP: The selection of topics for the two MIP cycles was excellent. The two awards for biomaterials are both innovative.</p> <p>NHMFL: NaFI is keenly attuned to funding forward-looking projects, and with the NHMFL user community, keeps constant pressure on the laboratory to be current in its capabilities and expenditures.</p> <p>CHEXS: Each beam line provides unique capabilities, which is reflected in the strong user interest (1.9 average oversubscription rate in the third 2022 proposal call) and in the publication record.</p>	<p>YES</p> <p>YES</p>
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>CHRNS: A significant portion of the user base appears to be multidisciplinary.</p> <p>MIP: The awarded MIP programs all include an array of expertise to grow/synthesize/assemble new materials, to analyze their properties using microscopy and imaging techniques, to understand their behavior using theory, and to develop new growth techniques using engineering. Educational expertise is needed to build up effective training programs for students and for technical staff who would like to learn the new approaches.</p> <p>NHMFL: Beyond its traditional CMP community, the NHMFL supports magnetic resonance, biological, chemical, environmental science and engineering research activities, including inter/multi-disciplinary endeavors.</p> <p>CHEXS: By nature scattering facilities are inter- and multi-disciplinary and the CHEXS program is no exception. The program included biology, quantum materials, manufacturing, and materials sciences. The facility provides an important opportunity for scientists from these distinct scientific areas to meet and exchange ideas often stimulated by their common interests in x-ray scattering instrumentation and techniques.</p>	<p>YES</p> <p>YES</p>
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>CHRNS: In 2020, experimenters from 30 states and 17 countries performed experiments at CHRNS. There are no statistics from 2021 or 2022 because of the shutdown.</p>	<p>YES</p>

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>MIP: The awards are located on both sides of the US.</p> <p>NHMFL: Yes</p> <p>CHEXS: While Cornell as the home institution and quasi-steward of the facility is heavily overrepresented (36% of the PIs), a total of 76 institutions and 115 PIs are represented amongst CHEXS users. Users from many states and several different countries come to CHEXS to do science with the Northeastern US being the dominant region.</p>	YES
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>CHRNS: This information is not available in any of the documents provided.</p> <p>MIP: The MIP program includes both private and public universities and have subawards to smaller schools.</p> <p>NHMFL: The balance between R1 and non-R1 institutions among the user-base of the NHMFL is appropriate and even commendable.</p> <p>CHEXS: CHEXS serves scientists from universities ranging from elite private institutions to large state universities and small colleges with a stronger focus on education. There are also users from national laboratories and from industry.</p>	N/A YES
<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>CHRNS: Depending on the instrument, the fraction of junior scientists participating in experiments is between 25-50%. It is quite likely that this is higher as students and post-docs are generally those who come to a facility for experiments. Only data for 2020 is available.</p> <p>MIP: Although the PI typically has been a PI on prior NSF award, the MIPs include younger faculty members who are early-career investigators.</p>	YES YES

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>NHMFL: N/A</p> <p>CHEXS: CHEXS prioritizes projects for younger scientists and first time users and this is having a positive impact. Five CHEXS users received a DOE or NSF early career award.</p>	
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>CHRNS: The workshops provide an excellent platform to bring young scientists in as new users. They have good geographic distribution and participation by underrepresented groups.</p> <p>MIP: The MIP program emphasizes that each MIP award should serve as a platform that involves students in the innovation process, and integrated research and education by training them how to develop a new material and understand its properties.</p> <p>NHMFL: The NHMFL does an excellent job integrating research and education, as evidenced by its myriad educational outreach and inreach programs, and record of Ph.D. and postdoc participants at its facilities.</p> <p>CHEXS: Most reviewers highlighted the CHEXS educational program. Integration of research and education all the way from the undergraduate to the postdoctoral level is clearly a focus and a strength of the project.</p>	<p>YES</p> <p>YES</p>
<p>9. Does the program portfolio have appropriate participation of underrepresented groups¹?</p> <p>CHRNS: Since 2005, the participation of women and minorities has increased, with the former reaching 25% of all users and the latter more than tripling to 7% as of 2020 (the last year of full operations). These numbers have been only growing slowly or remaining stable over the time under consideration by this review.</p> <p>The participation in the summer school and SURF program is better and could lead to further increases in coming years.</p> <p>MIP: The participation of underrepresented groups in the students and users is very good, and the program officers stress the importance to the PIs.</p>	<p>YES BUT NEEDS IMPROVEMENT</p> <p>YES</p>

¹ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>NHMFL: One can always improve on the women and under-represented minorities front. Given the availability and applicant pools, the NHMFL has been proactive on these issues.</p> <p>CHEXS: Approximately 25% of the users are women and 10% of the users are underrepresented minorities. In both categories there is a larger fraction of underrepresented groups among undergraduate students but a smaller fraction amongst postdocs. This could indicate there may be opportunities for the postdoc program to impact a more diverse group in the future.</p>	
<p>10. Is the program relevant to national priorities, agency mission, relevant fields, and other constituent needs? Include citations of relevant external reports.</p> <p>CHRNS: The availability of neutrons is a vital part of the US research infrastructure as described in the 2018 APS report "Neutrons for the Nation"[1]</p> <p><i>Neutron scattering is often an essential part of a broader experimental study that uses a complementary suite of tools (e.g., light sources, high-performance computers). Thus, neutron sources play a key role in overall U.S. innovation capacity.</i></p> <p><i>World-class neutron science and engineering require the comprehensive benefits of spallation facilities, research reactors, and high-performance instrumentation. While there is some overlap in the capabilities provided by spallation and reactor sources, each provides certain capabilities that cannot now be duplicated by the other type of source.</i></p> <p>In this context, the NSF support of the CHRNS provides a significant amount of beam time to users who have highly rated proposals. The oversubscription rate of ~2 makes clear the demand for a reactor source. The APS report notes that</p> <p><i>The United States has lost important capability in neutron R&D in the last two decades and is no longer the world leader. The United States cannot afford to lose its remaining capacity and capability without significant detriment to the quality and quantity of science, engineering, and even medical and manufacturing processes that rely on neutron sources.</i></p> <p>The unscheduled shutdown of the CHRNS over the past 2 years has resulted in a significant loss in experimental capabilities for neutron scattering and the upcoming scheduled shutdown for conversion to LEU and a D2 cold neutron source will only make the situation worse. The DMR's approach to making sure that the CHRNS will continue to be a viable source of neutrons for the community is prudent and forward-thinking.</p> <p>[1] https://www.aps.org/policy/reports/popa-reports/upload/APSNeutronsfortheNation.pdf</p> <p>MIP: To stay at the forefront of materials science, the US must invest in the development of new materials with properties that go beyond what is currently available. To do this, the NSF uses the MIP program to create user communities that are involved in developing materials which</p>	<p>YES</p>

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>can be used to create new applications and products in the future. For hard materials, the oxides lithium niobate and barium titanate are used to switch light channels in fiber optics, and 100+ GHz chips have been developed to integrate this ability. 2D materials including graphene, transition metal dichalcogenides, such as MoS₂, and topological materials, have created a new field of science and engineering resulting in the Nobel Prize to Geim and Novoselov. These materials show exceptional electronic and photonic behavior with promise as both sensors, and signal processing devices. For biological materials, biology promises to be the science of this century. Advances in our technical ability to manipulate biological systems and the use of machine learning to analyze and control their behavior create new ways to produce biological materials.</p> <p>The importance of building new technologies in the US to compete with the rest of the world is emphasized by the passage of the CHIPS and Science Act by Congress. https://www.congress.gov/117/plaws/publ167/PLAW-117publ167.pdf</p> <p>NHMFL: The NHMFL continually does an excellent job at justifying its continued existence, and the important role it plays in US competitiveness. Its annual reports keep the scientific and lay communities up to date, highlighting its users' achievements and their relevance to American life.</p> <p>CHEXS: X-ray science is critical to leadership in fundamental and applied materials. In addition the particular areas covered by the five beamlines are identified as national priorities in multiple NRC, DOE, and NSF reports. The addition of a high magnetic field capability to the quantum materials beamline is consistent with recommendations in NRC reports on high magnetic field science.</p>	<p>YES</p>
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>CHRNS: The publication output in 2020 was 107 journal articles and in 2021 it was 104. This is a very consistent output which likely reflects experiments done in previous years. It is expected that the unscheduled shutdown will have a significant effect on publications in future years.</p> <p>MIP: This is an outstanding program. Given the importance given by Congress in advancing new technologies, the MIP program might be given stronger financial support within the NSF.</p> <p>CHEXS: The transition from NSF stewardship to partnership at CHEXS was not easy but is so far going remarkably well. NSF/NaFi has managed the process commendably. A lively user facility with five beamlines is now operating and producing excellent science and contributing to education and development of much needed expertise. We look forward to seeing the scientific impact grow as the facility matures and reaches a steady state.</p>	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

Given the importance the NaFI PDs put on the three workshops about the Materials Lab of the Future, it is disappointing that the three final reports have not yet been completed by the panels and released. While this is out of the control of DMR, we hope that the PDs can encourage the panels to complete the reports. The Lab of the Future workshops could lead to new major infrastructure proposals and this delay will make the eventual outcomes less timely.

The unscheduled shutdown of CHRNS has had a large impact on the national neutron scattering community. It is important that the CMR continue to monitor the situation and provide encouragement to NIST to ensure that the facility comes back online and continues to be an important resource for neutron scientists in the USA. NSF's contribution of only one-third the cost of the entire facility is a bargain.

As noted above the choice of MIP awards was well done, creating 4 MIP programs with great promise. If we want to build infrastructure within the US to promote science and create business opportunities, the NSF could provide additional funding for the MIP program.

It should go without saying that, if one has not yet been identified, the NHMFL needs to find a dynamic and internationally renowned scientist to be its next Laboratory Director, who will shepherd the lab on its increasingly important path to scientific discovery and technical advancement in magnet and measurement device development.

NaFI should encourage the lab to continue to expand its reach in co-developing high field magnets for other measurement facilities (neutron, x-ray, etc.), and position itself for development of novel designs of superconducting magnets for a budding magnetic confinement nuclear fusion industry. As no one has yet demonstrated net scientific gain for fusion energy, it is optimistically anticipated that that time will come in the not-too-distant future, and the NHMFL should be poised to contribute when that time comes.

There has been and is likely to be considerable turnover of essential support staff at the lab, and the NaFI program should encourage the lab to use that as an opportunity to expand its diversity portfolio, while attracting the world's best minds to this outstanding national facility.

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

An NSF wide problem: Using new funds from Congress, the NSF is creating program announcements on new topics that have a very short turn-around time: only 3 months from announcement to the proposal NSF due-date, and 3 months to deciding the awards. Six months in total. Some members of the COV worried that this timing is so short that many prospective submitters would not be able to learn about the new program in time to submit a proposal and felt that it would be better to return to the traditional timing, while others acknowledged that other PIs regularly read the RFPs and email announcements and are happy for the opportunity to respond quickly.

Materials sciences are increasingly driven by access to advanced instrumentation for synthesis, processing, characterization, and computation. Education of the next generation of leaders in the field also requires efficient access to the very latest types of equipment and there is a need to foster

continued innovation in development of new instrumentation and experimental methods. NSF plays a very important role funding these activities through the MRI and the Midscale R11 and R12 programs all the way to National facilities. Establishing the right balance of NSF investment between these programs and relative to individual investigator funding is complicated but extremely important. Since there is currently no program for single-investigator instrumentation, we recommend that a study be conducted to gauge whether DMR-funded scientists have sufficient access to state-of-the-art equipment, whether the balance between shared access relative to individual group access is appropriate, and how to stimulate continued innovation and progress in instrumentation for the materials sciences.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

The NaFI group of the DMR is responsible for large facilities which need constant management that is not as necessary for individual investigator grants. This means annual site visits for the larger programs and monthly or quarterly check-ins with PIs. Each area of responsibility of the NaFI group has a primary and secondary permanent staff member who is responsible for primary communications with the PIs. In addition, the entire staff is generally involved with the evaluation of major proposals and site visits. This group also has primary responsibility for evaluating DMR-related MRI and Mid-Scale RI proposals from the open calls. The group is responsible for approximately 18% of the overall MRI awards and, one assumes, the overall proposal load. Given that there are 16 divisions in the NSF, this is a proportionally large workload which is outside the DMR direct budget. The load for Mid-Scale R1 and R2 is about 10% of the NSF total which is still proportionally more than average. While there is generally help available for the proposal review process from other divisions within the MPS directorate, the management of the awards is an additional load.

Beyond the NaFI staff alone, a question arose regarding the staffing level of DMR relative to the magnitude of its responsibilities, and whether the current level is appropriate for the proposal and program, etc. workload. It is suggested that the MPS Directorate review this issue, and take appropriate action.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

In the "DD DMR COV Talk 2023" presentation given to the COV is shown the number of submissions to the DMR TMRP program vs month of submission. The COV asked also the number or fraction of funded submissions vs month of submission, *i.e.* the success rate vs. submission time. This would inform the COV and the research community about the effectiveness of the open vs. fixed deadline ... *i.e.* are the majority of funds committed in the early months, or are funds held back in anticipation of later submissions? After this inquiry, we learned that when program funds are exhausted, proposals worthy of funding are carried over the fiscal year boundary and are funded in the next FY.

5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

The report template is somewhat ambiguous from the perspective of the NaFI group since there are only a few projects awarded and being managed at one time, the template would be better served in specifying that some of the Tables refer to the facilities user programs. The assignment of an individual large project to each member of the COV is an effective way of performing the review.

The current approach works very well, and the program officers are doing an excellent job, both in appropriately applying NSF criteria, and providing clear explanations of the panel's reasoning when an award is given or declined.

4.2 Materials Research Science and Engineering Centers (MRSEC)

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>The mixture of review methods seems extremely well-matched to handle the volume and breadth of proposals for the MRSEC funding mechanism.</p> <p>For the preliminary proposal slate, the panel reviews with panel expertise in distinct areas, which allows comparisons between IRGs in related areas, is appropriate, and necessary to handle the volume of applications (~180 per cycle).</p> <p>At the next stage, evaluating full proposals via ad hoc mail review with at least 6-7 independent reviews per IRG is also appropriate.</p> <p>At the last stage, evaluating proposals via a reverse site visit, with each reverse site panelist reviewing 2-3 institutions, allows a reasonable comparison between projects. It also gives the program directors from relevant programs within DMR as well as the panel reviewers and MRSEC program officers an opportunity to probe strengths and weaknesses identified at earlier stages of review.</p> <p>We note that this volume of proposals is very large, and although the current program officers are doing an outstanding job, the workload in competition years is very large and perhaps unsustainable.</p>	YES
<p>2. Are both merit review criteria addressed?</p> <p>a) In individual reviews?</p> <p>b) In panel summaries?</p> <p>c) In Program Officer review analyses?</p> <p>Both merit review criteria are addressed at all stages of the review process including the panel summaries, individual ad hoc reviews and in the review analyses. This is a strength of the multi-layer review process inherent in the MRSEC program and also the very deliberate efforts of the PDs to train the reviewer community via a pre-review webinar. This webinar focuses on MRSEC specific criteria but has the added benefit of emphasizing the importance of broader impacts and also calibrating expectations with respect to the review criteria. Moreover, the program directors' review analyses directly comment on both merit review criteria, summarizing the input from both reviews and summaries.</p>	YES
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>The vast majority of individual reviewers provide substantive comments that align with their overall scores and are responsive to the program-specific solicitation criteria. There are a few cases where comments are less substantive, but good program management ensures that there are multiple other reviews to rely upon in those cases, and the program officers are careful to</p>	YES

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>note and appropriately weigh the less substantive opinions in their review analyses. In addition, the program officers are also careful to note the rare cases where biases clearly creep into reviews (such as focusing on past accomplishments rather than what is currently being proposed), to ensure that such comments are not the basis for award decisions.</p>	
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>The panel summaries are overall quite well written and are also highly aligned with the panel recommendations to award or decline funding. The summaries provide specific details with rationale for panel consensus. We commend the program officers for developing reviewer training webinars this past cycle in advance of panels to advance this goal – it appears to have been quite effective.</p>	YES
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>The documentation in the e-jacket is overall superb. It provides a clear track record of multiple different kinds of reviews, how the information in those reviews were weighted and integrated at each stage, and how the program officers and staff ultimately arrived at a well-justified award/decline decision about each award. In particular, comments from the PD that calibrate the different panels to allow for disciplinary differences are extremely carefully constructed and well justified. Overall, the rationale that is provided in the jacket is coherent and related back to the review criteria that are stated in the program solicitation. Moreover, there is significant continuity between different review stages: the same weaknesses and strengths are often identified by multiple reviewers in multiple modalities, and those are well-communicated to submitters, including those who move on to additional stages, to help submitters efficiently update and improve proposals.</p>	YES
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>For cases where the preliminary proposals were not invited to submit a full proposal, PIs received panel summaries, which, as described above, generally provide a strong, explicit rationale for the award/decline, plus an invitation to ask for a zoom conversation with the program officer. We view this as substantial documentation.</p> <p>For cases where full proposals were not invited to a reverse site visit, PIs received the full reviews from a large number of reviewers (at least 6-7 and often more), which were well aligned with the overall decision and clearly stated the rationale for award decisions, and again offer</p>	YES

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>zoom conversations. We view this as excellent documentation that gives PIs (even those who are declined after long hours of work) confidence that the review process was fair and valid.</p> <p>For cases where the reverse site visits were not funded, the program officers participate in a zoom conversation with PIs to explain the funding decision. While it is clear that the program officer review analyses cannot be released to PIs, it remains unclear which parts of the analyses are actually discussed over zoom. We wonder whether short (2-3 line) statements about the context of the zoom conversation could be included in the diary notes in order to ensure uniform documentation about this part of the process.</p>	
<p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>We view the outstanding merit review process as a strength of the program. It is well-executed, so that even PIs with declined proposals feel that they were treated fairly. The community has tremendous respect for the program, and as a result many researchers from a diversity of fields and institutions are willing to participate in the review process.</p>	

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>The MRSEC program has excelled in engaging reviewers with appropriate domain expertise and excellent qualifications. The MRSEC has immense respect within the DMR and broader scientific community, inspiring the community to generously contribute their time. Notably, the MRSEC programs' adeptness in harnessing this support has led to a truly diverse pool of reviewers representing various subfields of DMR, institution types, and demographics.</p>	YES
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>The MRSEC program impressively avoided conflicts and expertly resolved them when they arose. The COV notes that it is extraordinarily hard to find COI free committees at later stages of proposals, and we commend their very considered approach. We understand they judiciously request waivers for relatively inconsequential COI's (for example, investigators in very large collaborations (>50 participants)) to ensure appropriate and critical domain expertise.</p>	YES

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>3. Additional comments on reviewer selection:</p> <p>The COV applauds the MRSEC program’s commitment to the diversity of panelists and reviewers’ demographics and institution types since it is increasingly acknowledged that diverse and inclusive scientific teams yield heightened innovation and impact.</p> <p>Taking inspiration from the 2021-2022 CEOSE (Committee on Equal Opportunities in Science and Engineering) Biennial Report to Congress, "Understanding Intersectionality", we suggest that the NSF proactively consider the intersectional dimensions of race/ethnicity, gender, disability, and other identities when selecting reviewers and assembling panels.</p>	

MANAGEMENT OF THE PROGRAM UNDER REVIEW
<p>1. Management of the program.</p> <p>We view the management of the program as outstanding. The solicitation and selection of IRGs via the review process are both very carefully constructed to reflect emerging areas as well as NSF-wide initiatives. The PDs also are careful to create and manage a broad portfolio that both reflects these priorities and ensures a balance between existing strengths and new initiatives. In particular, when the PDs include new areas in a solicitation, there is recognition that in the initial phases, the community may lack the expertise to prepare and review proposals in nascent areas. Care is taken to nurture these nascent, emerging areas – both in terms of the drawing of outside expertise in the review process at the ad hoc full proposal stage, and careful mentoring of new PIs and IRG/centers. This ensures that there is balance in terms of risk, so that both new MRSECs that are competing against established MRSECs, and IRGs proposing entirely new areas of sciences appear in the portfolio. In addition, it is clear that the MRSECs are the home for interdisciplinary science. As such, no successful IRG fits exclusively into a single TMRP (said another way: any mapping of the IRG representation onto the TMRPs is in-exact.) Further, it is clear that this balance is needed within an entire MRSEC family in addition to within any given competition.</p> <p>Sustainability of program management: The COV is tremendously impressed by the thoughtfulness, commitment, and strategic directions of the PDs. We note, however, the herculean effort required to complete new MRSEC competitions every three years and then the ensuing 2nd and 4th year site visits (which due to the staggering of the portfolio results in the construction of a minimum of 10 panels and 10 site visits a year for every non-competition year). We are concerned that this is currently only sustainable via the personal attributes (energy and dedication) of the current lead PD and half-time contributing PD. This suggests that sustainability of this important, leading program in DMR requires two full-time PDs or the equivalent in additional personnel at minimum, and we strongly recommend that this program be supported at this level.</p>
<p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>The COV applauds the MRSEC program for its proactive response to emerging research trends through the construction of the solicitation, initiatives such as Superseeds and iSuperseeds, and the proactive seeding of MRSECs in emerging areas (for example: new MRSECs focused on AI/ML materials and materials synthetic biology). Additionally, the program's emphasis on fostering collaborations with MIP Centers and creating new educational opportunities through its partnership with PREM is highly effective.</p>

MANAGEMENT OF THE PROGRAM UNDER REVIEW

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

The MRSEC PDs have performed an exemplary job of incorporating NSF priorities (10 Big Ideas) as well as DMR-specific areas of interest into the call for proposals and subsequent webinars. They are also clearly cognizant of the need to balance the IRG portfolio. The review notes associated with assuring that there is sufficient representation in the IRG group from different areas at each stage of the review are very clear and logical.

We note that starting in 2019-20 competition and then again in 2022-23 the MRSEC's changed from having a large number of 3-IRG centers to being predominantly 2-IRG centers with only a very few exceptions. The PDs stated during the COV process that this was the result of the extremely competitive review process for IRGs at the pre- and full proposal stages. We note that this change has the potential to have a dramatic effect on the portfolio. For example, since MRSECs are funded on a per-IRG basis, this change necessitates 2-IRG centers to either significantly reduce activities related to shared use facility and education/outreach or redirect a larger share of its funds to these activities and away from the scientific endeavor of the IRGs. We would suggest that rather than having such a major change be the consequence of the IRG merit review process alone, this question of how to balance or optimize MRSEC center sizes be considered directly by the program officers and by a possible upcoming National Academies study.

4. Responsiveness of program to previous COV comments and recommendations.

2019 COV Comment 1: Although we understand the desire to cut down on the work and time commitment of the panelists and the difficulties associated with putting together a panel with no COIs, some of us feel that the model where a given panel reviews a larger number (3-4) of proposed centers may be preferable to the current one where each panel reviews only two. On the other hand, reviewing fewer proposals provides the opportunity for more extensive discussion among the panelists.

- NSF Response:: RSVs in FY20 (remote) and FY23 (in person) reviewed 2-3 proposals each, but the PD's note a challenge associated with finding reviewers who can commit to 3-day, in-person panels.
- The 2023 COV agrees that an in-person format is critical for the MRSEC RSVs as it allows for detailed interaction between the proposing team and the panel. We commend the POs for recognizing this and returning this critical feature of the review process. We also understand that finding reviewers who are willing to commit to a 3-day visit poses an additional, perhaps insurmountable constraints, although we agree with the sentiment of the 2019 COV that a panel that evaluates a larger number of proposals might lead to a more balanced review process.

2019 COV Comment 2: Overall the majority of individual reviewers provided substantive comments. Only a few of the reviews were rather short and occasionally lacking in meaningful content. In a few instances, the overall score seemed a bit at odds with the text. On the other hand, the PO pays attention to the substance of the report over the rating.

- NSF Response: Starting in FY21 MRSEC PDs held webinars with each reviewers' cohort, describing the review process, review criteria, and preparation of reviews for either upcoming review panels or ad hoc reviews. The quality and consistency of written reviews has markedly improved following these webinars.
- The 2023 COV commends the PDs on this response. Not only did the webinars reduce (though not completely eliminate) the number of non-substantive reviews, it also helped to introduce the entire reviewing group to the MRSEC-specific review criteria. We believe this is also a best practice in terms of explaining DMR's mission and goals and should be more broadly used across the DMR portfolio.

2019 COV Comment 3: To increase both geographic and institutional diversity, the COV recommends the creation of a new MRSEC track supporting a network model. It is important to lower the barrier to entry without jeopardizing the success of the existing MRSEC program. The COV recommends a separate track, and additional funding, to support a network model, in which several institutions can collaborate to support two joint IRGs. Such a track would require separate review criteria, additional support to administer the program, and additional funds.

MANAGEMENT OF THE PROGRAM UNDER REVIEW

- Program change in response: The Network Model is compelling; DMR will explore it both internally and through a planned National Academies Study of the MRSEC Program. Meanwhile, MRSEC PDs were able to secure EPSCoR funding in FY20, to establish a new Center at U Delaware. Since then, MRSEC PDs increased outreach efforts (e.g., through public webinars) and are actively engaged in educating the research community on various approaches that may be used to achieve a MRSEC, including Centers comprising 2+ institutions. The proposal pool in FY23 has shown some signs of response to these efforts.
- We appreciate the NSF response. We concur that new models to encourage the response of new, competitive MRSECs is important and think that a possible National Academy Study of the issue is ideal. We would suggest that such a National Academy Study consider solutions that encourage new programs without diluting the strengths of the MRSEC program. Specifically, some of us are concerned that a network model would result in diffuse centers without the educational and shared use facility strength characteristic of the MRSEC program. Alternatives such as a Superseed program for nascent MRSECs (discussed below) should also be considered.

2019 COV Comment 4: The COV recommends strongly against sunseting MRSECs. Sunseting MRSECs would risk destroying significant infrastructure, including expert staff, that has been developed over the years for facilities and education/outreach efforts.

- The MRSEC sunseting provision was only brought up as a possibility for consideration and has not been introduced into policy. The COV Report makes convincing arguments, and therefore MRSECs do not sunset.
- We concur that one value of the MRSEC programs is the combination of some continuity in the program (which maintains infrastructure) with a high degree of competitiveness resulting in significant opportunities for new center.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>The COV was extremely impressed with the balance of awards across disciplines. The Program Officers actively managed the review process in order to level-set different panels with different calibrations while also actively seeking to maintain representation across both traditional disciplines within DMR, NSF-wide initiatives, and areas of significant programmatic growth. In the 2019-2020 competition, specific care was taken to encourage representation in areas including Harnessing the Data Revolution, Understanding the Rules of Life, and Quantum Leap.</p>	APPROPRIATE
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>The 2019 COV report noted that this is one of the NSF’s oldest and highest impact programs, but that the number and size of awards relative to scientific inflation had not kept up. We note that this problem, if anything, has exacerbated in the ensuing 4 years. While the funding per IRG has increased from \$1.3M to \$1.5M, this has been more than counteracted by the combination of inflationary pressures and the fact that the vast majority of MRSEC’s now consist of only two IRG’s whereas prior to 2019 many MRSEC’s contained three. We understand that the funding of a larger number of 2-IRG MRSEC’s has the potential to increase geographic diversity and broaden participation in many advantageous ways. We</p>	APPROPRIATE BUT CONCERN NOTED

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>encourage the PMs to continue to consider the unintended consequences of this shift on the Center-type activities and potentially on the scientific output of the IRG's since the Centers are funded on a per-IRG basis. Our observation is that these now smaller centers continue to run vibrant shared use facilities and education/outreach initiatives which do not appear to have been scaled down to 2/3 the size as the centers shrank. The period 2019-2023 was also characterized by historic inflationary pressures in scientific supplies and equipment and significant pressure to increase graduate student stipends to match cost of living. Together, this poses a significant threat to the scientific productivity of the MRSEC program. The COV panel strongly endorses an increase in the level of support for the MRSEC program.</p>	
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Over their history, the MRSEC awards have been highly innovative and transformative. This is especially true in the last cycle with respect to projects related to quantum materials, sustainability, and active matter. While the level of risk in an IRG is somewhat moderate given the funding mechanism, the Seed and Superseed programs have been a tremendous engine for encompassing higher risk ideas and allowing them to transform current IRGs, grow into new IRGs for future cycles, or even spin off towards new funding mechanisms. Another indicator of the innovative/transformational nature of the MRSEC's is the resulting number of awarded patents (26 in 2022 alone). Furthermore, since 1985, the MRSEC program has launched 198 companies, a full 10% of which have amassed sufficient value to be acquired by larger companies.</p>	APPROPRIATE
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Interdisciplinarity is the hallmark of the MRSEC program with the funded unit being referred to, tellingly, as an Interdisciplinary Research Group. The COV wishes to commend the program over its long history for strongly encouraging and indeed favoring the bridging of fields and scientific communities in its programs. This is evident from both in the choice to construct panels capable of reviewing work emerging from highly orthogonal but complimentary groups. Indeed, the emergence of active matter as a major part of the MRSEC portfolio bringing together biology and soft condensed matter physics is a great example of the success of this approach.</p>	APPROPRIATE
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>The COV commends the Program Officers on achieving a good distribution of centers in terms of geography and type of institution specifically with the three new centers funded in 2020. MRSECs are now hosted at a range of institutions including several Minority Serving Institutions (for example: the University of Texas at Austin and two campuses at the University of California). The MRSEC program requires significant institutional infrastructure in terms of scientific depth of materials, building/space, and educational/outreach infrastructure, In and of itself, this limits the number and kind of institutions that can field a competitive proposal.</p>	APPROPRIATE

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>As discussed in detail in Table 5 Question 4, the COV recommends a Seed program specifically pointed at institutions that have not previously hosted a MRSEC to help broaden participation in this important program. We note that this suggestion of a Seed MRSEC track was also recognized in the 2019 COV report and the response from DMR is that they have succeeded in funding several new MRSEC's, particularly one in an EPSCOR state in the interim. The PD's should also be commended for significant outreach efforts (webinars) to actively encourage proposals from a broader community. We, however, view this as separate from an external Seed program that would help improve the competitiveness of proposals from these new institutions.</p>	
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>The COV was pleased to find that the MRSEC program incorporates a diversity of institutions in terms of public vs. private, large vs. small, and over a geographic range (with the caveat discussed in #5 above). The portfolio is dominated by R1 institutions for reasons having to do with the large amount of organizational infrastructure and investment necessary to field a competitive MRSEC proposal. The existence of PREM partners that can be nurtured towards MRSEC competitiveness is likely to be a long-term investment. The creation of a SuperSeed program outside of existing MRSEC's could serve to help mentor new institutions through the proposal process while generating essential documentation of a collaborative culture and collaborative productivity at new institutions prior to a MRSEC competition.</p>	APPROPRIATE
<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>An appropriate balance of new and early-career investigators is an important element in the review and ultimate selection of IRGs and as a result the MRSECs have been an important avenue by which new investigators join the DMR portfolio. Just as importantly, the MRSEC program has served as an important mechanism for leadership training with well-established centers routinely mentoring early-career faculty towards IRG leadership and eventually MRSEC directorships with each cycle of re-competition. Indeed, a healthy IRG (as evidenced by documentation of 2nd and 4th year site visits) has regular cross-IRG meetings where faculty across a range of seniority interact with and mentor each other as well as students and postdocs. We echo the 2019 COV in recognizing that the MRSECs play an important role in training the next generation of scientific leaders.</p>	APPROPRIATE
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>The integration of research and education is another hallmark of the MRSEC program. Each MRSEC is required to house a Research Experience for Undergraduate (REU) program. Further, the MRSECs have impacted more than 650 pre-college teachers via workshops and</p>	APPROPRIATE

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>research experiences directly related to the IRG portfolio of each center. Furthermore, via a variety of outreach efforts including classroom visits, workshops, and public events, the MRSECs have impacted an incredible 70,000 pre-college (K-12 students). The MRSECs represent an economy of scale where via the efforts of each center’s Education Director and broad participation of faculty, students, and staff, the ability to offer large and expansive programs is maximized. Furthermore, they are encouraged to explore regional networks and national repositories as well as leverage extramural resources to maximize their impact.</p>	
<p>9. Does the program portfolio have appropriate participation of underrepresented groups²?</p> <p>The percentage representation of female and URM graduate students and postdocs has grown admirably in recent years (%female postdocs grew from 21% to 30%; %UR postdocs from 4.5% to 6%; %female grad students grew from 32%-35% and % URM grad students from 7% to 10.5%). More impressively these trends are consistent with strong and consistent growth over the 10 years over which we were able to view statistics. We attribute this growth to both strong efforts by the MRSECs in their diversity planning supported strongly by the PDs.</p> <p>Somewhat frustratingly, the female and URM participation at faculty levels has been consistently flat across this time period (fluctuating between 18-20% female and 3-7% URM with no discernable trend). This reflects the roughly constant representation of women and URM faculty in STEM in the US. We do, however, note a laudable increase in the representation of URM and female MRSEC leadership (directors and IRG leaders) since the last COV report. We attribute this to very careful, diplomatic guidance and leadership demonstrated by the PDs. The existing relationship between the PREM and MRSEC program is a tremendous advantage, and we encourage the MRSEC PD’s to explore more ways to take advantage of this interaction to improve the pipeline of underrepresented participants in the MRSEC program.</p>	APPROPRIATE
<p>10. Is the program relevant to national priorities, agency mission, relevant fields, and other constituent needs? Include citations of relevant external reports.</p> <p>The program officers are extremely skilled in using not only the call for proposals but also subsequent webinars and Zoom meetings at every stage of the process to inform potential PI’s of the specific areas of interest, national priorities, and agency mission. The NSF’s 10 Big Ideas have heavily influenced the MRSEC Program’s portfolio in FY18 and FY21. The result has been a significant emphasis on IRGs related to Harnessing the Data Revolution, Understanding the Rules of Life, and Quantum Leap over the last 4 years. Further in FY21, the MRSEC program for the first time encouraged submission of proposals that are purely of theoretical and/or computational nature. It is clear that proposals comprising partnerships</p>	APPROPRIATE

² NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
and participants that expand the disciplinary makeup of the MRSEC portfolio are strongly encouraged. In each competition, a few proposals (3) were received that were not compliant with the DMR mission and/or proposal requirements and were withdrawn after discussion with the PMs.	
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>The MRSEC program is recognized by the both the DMR community and the broader scientific community as a key driver of innovation in the United States. The discoveries incubated within MRSECs over the past 50 years have been in fields across the DMR portfolio, and have transformed manufacturing, medicine, and sustainability. This vibrancy is in evidence in the impressive outcomes of the MRSEC programs over the past 4 years, including:</p> <ul style="list-style-type: none"> ● Development of a manufacturing process for polymer systems with embedded dye molecules that improves medical imaging and removes the need for injecting toxic dye chemicals into patients ● Creating a new way to characterize the dynamics of active matter via a topological parameter. This allows exquisite control of small-scale active flows in new microfluidic devices, and enables new ways to identify pathologies in biological tissues during development and disease ● New direct synthesis and chemical vapor deposition methods for scalable synthesis of materials (MXenes) that are very promising for energy storage/Li-ion batteries ● Discovery of a method to reliably self-assemble 2D lattices where individual lattice sites can be individually addressed, to make new magnetic materials or template growth of novel 3D materials <p>Overall, the excellent portfolio management of the program has enabled major societal impacts.</p>	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

Overall, as highlighted in table 6 above, the performance of the MRSEC is completely outstanding. As a flagship program of the division of materials research, it is important that the MRSEC retain its identity and value derived from focusing on materials-related questions. On the other hand, for several other collaborative funding mechanisms (DMREF, EFRI) there are clear mechanisms for inter-division and inter-directorate collaboration, and given that some of the exciting emerging ideas in materials that appear in the solicitations are based in synthetic biology and bio-inspired systems, it may be worth exploring whether inter-division partnerships — in identifying of types of questions that might be addressed by IRGs, recruiting reviewers, and funding projects – might improve research outcomes even further.

2. Please provide comments as appropriate on the program’s performance in meeting program-specific goals and objectives that are not covered by the above questions.

The program's performance is outstanding and depends on the tremendous hard work and dedication of the PDs to the program. We recommend that the program be provided additional support in the form of more PDs or equivalent personnel for long-term sustainability.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.
 - A. Through a variety of interactions with PD's from across the directorate, we got the sense that the management of NSF has become increasingly prescriptive. While we appreciate the need for NSF-wide initiatives and consistency, we also feel that this is not taking advantage of the extraordinary creative strength at the PD level. Specifically, current policies may lead PDs to focus specifically on their programs and be responsive to building bridges and inter-directorate programs only when asked. This eliminates the ability of a PD (with significant scientific depth) to nurture emerging areas that may bridge programs, divisions, or directorates. We feel that space for PD-led initiatives, particularly with respect to interdisciplinarity and emerging topics that are not yet part of a major initiative, is an important part of the strength of DMR. Furthermore, this ability to lead and envision a program is an important attractor of the talented next generation of NSF PDs.
 - B. While not covered by this review, the COV is aware that the last several years have seen historic increases in cost of living (and a concomitant push for increased graduate student and postdoctoral salaries) as well as the cost of scientific equipment and supplies. This poses a major risk to the productivity level of work funded by the NSF. While a significant increase in federal budgets to match these increasing costs may not be possible, it is critical that NSF and DMR be prepared and have mapped out a strategy – will the division benefit from fewer, larger grants or a constant number of grants that may no longer fund a full graduate student for a full year? Should priority be placed on large centers with the ability to build significant infrastructure or single PI grants that are distributed more broadly?

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

We commend the new joint seed programs between DMR and NCI, and DMR and NIBIB. We would like to see a clear path forward for continued support of successful seed projects funded by this initiative. Furthermore, we would very much like to see similar joint initiatives between DMR and NIGMS given the preponderance of open questions that straddle the domain expertise of these programs and would immensely benefit the DMR community, the scientific community, and society at large.

5. We appreciate your comments on how to improve the COV review process, format, and report template.

While we understand the shortage of space, the meeting of two separate COV breakout groups in a single room was not an efficient use of time and in some cases led to confusion. It is unclear why we were unable to use NSF facilities next door.

While we appreciate the thorough introduction to the e-jacket system included in the pre-COV webinar, a reminder on the framework and charge of the COV as well as specific recommendations on pre-reading expectations would have benefited the group overall. Our observation was that while most participants were familiar with the protocol, there were some who were less aware at the beginning of the COV, particularly with respect to the distinction of reviews being provided for different programs (even if they shared a single meeting room for the COV).

4.3 Partnerships for Research and Education in Materials (PREM)

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>The panel review with written reviews by a subset of subject matter experts from the panel is quite well-suited to the heterogeneous mix of proposals. The on-site visits during the performance period give the program officers a realistic picture of how the proposals translate to implementation that informs future reviews. For reviews of programs like PREM, we commend the use of in-person panel reviews.</p>	YES
<p>2. Are both merit review criteria addressed?</p> <p>a) In individual reviews?</p> <p>b) In panel summaries?</p> <p>c) In Program Officer review analyses?</p> <p>Intellectual merit and broader impacts are better integrated in the PREM program than in most other programs. The reviews explicitly address both in detail and with significant care.</p>	YES
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>The individual ratings often have a significant variance, from good to excellent. Given that the accompanying reviews are coming from panel members present for the panel review, it is helpful to the proposers if the panel review consensus narrative wrestles with any inconsistencies between the different individual reviews or between these reviews and the consensus.</p>	YES
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>The tone and the content of the narrative is appropriate for the recommendation given by the panel. However, many of the proposals rated “fund if possible” were funded at a “Seed” level, a small fraction of the requested amount. The panel narratives do not speak to this alternative outcome.</p>	YES IN SOME CASES
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>The individual reviews, panel review, and the analysis by the program officer together form a complete and well-reasoned picture of why the decision was arrived at. In the case of funding at</p>	YES, USUALLY

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>a Seed level, the rationale only appears in the program officer analysis. It always has a logic that flows from the panel comments, but there is no clear lineage for that decision in the other material (see response to 7, below).</p>	
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>In the case of outright awards and of declinations, this information is available to the PI in the reviews and grades that they receive and, in supplementary form from discussions with the program officer. For the awards made at the Seed level, the documentation in the jacket that is shared with the PIs does not contain any clear information about the decision to fund in this way. Our understanding is that the program officers make a brief informal site visit shortly after the award and that the logic behind this outcome is made clear to the investigators during that visit. With this as the communication modality, information about the rationale is not available to the PI within the ejacket contents they receive.</p>	YES
<p>7. Additional comments on the quality and effectiveness of the program’s use of merit review process:</p> <p>On the whole, the process is highly effective and produces outcomes that are both fair and supportive of the overall goals of the PREM program. In the most recent round of PREM selections, the selection of a large number of proposals for “Seed” funding has broadened the range of schools involved in the program. The rising prominence of this mode leads us to consider a small number of issues that suggest avenues for improving the process and outcomes.</p> <p>- Currently, there is a single proposal category. PIs submit proposals and are either declined, accepted as full PREM programs, or awarded Seed awards at a much lower funding level. The review panel is asked to evaluate the proposals on the basis of their quality as proposals for full programs. The written reviews and panel summaries all are written within this framework. The panel then recommends proposals to fund, to decline, or to “fund if possible”. The program officers would obtain better guidance if the panel were instructed to provide a secondary evaluation for all proposals not recommended for full funding as to the merits of funding them as Seed projects.</p> <p>- An alternative and perhaps more effective way to incorporate Seed projects into the PREM program would be to have explicit tracks in the call for proposals, a Track 1 for full proposals and a Track 2 for smaller and shorter duration Seed programs. Track 2 would allow institutions to try out aspects of their interaction with a MRSEC or other partner and would allow the proposers to do proof of concept experiments to improve the potential outcomes of a full program.</p>	YES

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>The program utilizes a diverse group of reviewers who not only have expertise in the subject matter but are also knowledgeable of the challenges and opportunities at MSIs. The program officers are commended for emphasizing diversity and inclusivity of the panel with respect to gender, race/ethnicity, experienced and new reviewers, and sub-disciplines. This level of diversity provides a broad range of views which is vital for the review process.</p>	YES
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>The Support Specialist collects COIs.</p>	YES
<p>3. Additional comments on reviewer selection:</p> <p>None.</p>	

MANAGEMENT OF THE PROGRAM UNDER REVIEW
<p>1. Management of the program.</p> <p>The management of the program continues to be quite good with committed staffing and a passion for the potential and impact of PREM. PREM has the potential to be even more influential in advancing equity and inclusion in the materials research community. PREM has created a legacy community of faculty and students connecting institutions that excel in supporting underserved students. Fostering leadership development within that community and promoting connectivity would likely enhance the impact of the PREM institutions on materials research at the PREM programs and for the materials science community. Expanded connectivity to other NSF Divisions, including EDU, would be beneficial.</p>
<p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>The unique role of the PREM program continues to define its impact. The further refinement of the PREM pathway and accommodating the unique characteristics of PREM lead institutions and partners would be beneficial. Greater integration between the PREM and PREM partner organizations is a continued opportunity for regular grants and for the expanded number of Seed grants. For example, a relatively small fraction of the publications are with the partner institutions. The PREM management should ensure that it is understood that publications between the PREM and PREM partner organizations are an important outcome. There is also an opportunity to emphasize information tied to the Key Performance Indicators (KPIs) in PREM annual reports and the annual reports of the partner programs in addition to site visits and annual meetings.</p>
<p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>Although the PREM Seed program was lauded in the prior COV report, the diversion of full proposals into the Seed program appears to be somewhat ad hoc in nature. As described above, this may not be the best use of the panel/review input and creates an opportunity for proposals tailored to better match Seed funding.</p>

MANAGEMENT OF THE PROGRAM UNDER REVIEW

There continues to be a benefit from developing more substantive quantitative measures of student persistence and success. For example, the National Student Clearinghouse or program evaluators could be utilized to learn more about the educational trajectories of PREM-supported students. This may enable PREM to further clarify success in meeting the KPIs.

The portfolio could be broader if the limitation of PREM partners being funded by DMR was eliminated. That constraint may be a limiting factor for the balance of the research portfolio. With the growth of TIP and development of other NSF Centers with a strong materials emphasis expansion of PREM beyond DMR-funded centers would be advantageous.

4. Responsiveness of program to previous COV comments and recommendations.

It appears that PREM has been responsive in seeking added data resources, but it does not appear that they have uncovered an effective solution.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>PREM awards span across disciplines and sub-disciplines supporting the national effort to increase diversity within the material science community. The COV acknowledges the PREM topical research disciplines are adequately distributed across divisions and subdivisions ranging from chemistry of materials, nanoparticles, thin films, semiconductor, and machine learning.</p>	APPROPRIATE
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>The duration and scope of the full PREM award is an average of \$3.9 million for six years or \$800,000 of Seed funding for three years. The time is feasible to achieve the three components of the PREM model with appropriate time to prepare for the next grant cycle.</p>	APPROPRIATE
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>The COV recommends enhancing the partner institution and PREM institution interaction via robust cross collaborations between partner institutions during the Seed grant phase. The strength of the Seed-phase partnerships can provide evidence in a later full proposal review that a true and equal partnership will result.</p>	APPROPRIATE
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>PREM program appears to have a wide distribution of inter- and multidisciplinary projects. The COV encourages more touch points (student, postdoc and faculty exchange visits, REU</p>	APPROPRIATE

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
participation, joint seminars, joint proposals, virtual group meetings etc.) with the partner institutions to enhance innovative projects and to improve the number of joint publications.	
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>The COV supports the geographical distribution of PREM awardees and partner institutions. Although most PREM institutions are primarily located in the southeast, the incorporation of western PREM institutions diversifies the portfolio.</p>	APPROPRIATE
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>The COV agrees that the PREM portfolio has a balance of awardees at different types of institutions ranging from HBCU's, HSI's, and TCU's with diverse student trainees.</p>	APPROPRIATE
<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>The COV determined that most of the funding for PREM awardees were not balanced. Senior level faculty were received more awards (87%) than mid-career (5%), and junior faculty (1%) and research faculty (1%). The COV believes the PREM portfolio could benefit from a wider distribution of mid-career and junior faculty awardees.</p>	APPROPRIATE
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>The PREM award is designed to support research and education efforts. The research highlights are well established and documented, however the COV noticed limited evidence on the educational outcomes and new equipment acquisition to enhance the research enterprise at the home institutions.</p>	APPROPRIATE
<p>9. Does the program portfolio have appropriate participation of underrepresented groups³?</p> <p>The PREM portfolio has an excellent track record of exposing and training underrepresented groups with large numbers continuing to pursue STEM careers in materials (baccalaureate 79%, graduate 89%, postdocs 97%). These numbers are appropriate.</p>	APPROPRIATE

³ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>10. Is the program relevant to national priorities, agency mission, relevant fields, and other constituent needs? Include citations of relevant external reports.</p> <p>In line with the NSF initiatives, the PREM program is a pathway program to expose and train underrepresented students to material science at minority serving institutions. These opportunities support exposure to cutting-edge research and high-quality education, mentorship to enhance the research productivity and infrastructure. The COV found that the PREM program could benefit from strategic alignment of research projects, outcomes, and post-baccalaureate careers between the PREM awardee and the partner institution. Soliciting topics to support climate-change efforts for low-carbon-intensity materials, spurring the circular economy, and autonomous materials synthesis with the partner institutions could support more innovation. (White House Bold Ideas, 2023).</p>	APPROPRIATE
11. Additional comments on the quality of the projects or the balance of the portfolio:	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.
 - a. The PREM program provides significant benefits to those MRSECs that have one through the possibility that the partnership can nucleate talent development, inclusivity, and new research directions. Given the significant load that managing a MRSEC places on the MRSEC PI, however, not all MRSEC partners pay sufficient attention to their partner PREM and there are known examples of MRSEC teams that feel they cannot support a partnership. A small but noticeable supplement to MRSECs with PREM partners would likely ameliorate this situation.
2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.
3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.
4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.
 - a. The individual presentations by PDs often include good ideas and approaches. The PDs might consider sharing their best ideas for representing trends and changes that have occurred in the review period. Graphical representations of award rates relative to review/panel ratings, e.g., via Sankey Diagrams, can be one good way to provide improved information to future COV.

5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

4.4 Designing Materials to Revolutionize and Engineer our Future (DMREF)

<p style="text-align: center;">QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</p>	<p style="text-align: center;">YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</p>
<p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Review panels are largely employed. The COV strongly supports the use of panels for this program because of the breadth of technical topics. Ad hoc reviews are used as necessary.</p>	<p>YES</p>
<p>2. Are both merit review criteria addressed?</p> <p style="margin-left: 20px;">a) In individual reviews?</p> <p style="margin-left: 20px;">b) In panel summaries?</p> <p style="margin-left: 20px;">c) In Program Officer review analyses?</p> <p>The intellectual merit comments clearly receive the majority of reviewer attention and are generally excellent. Many of the broader impact evaluations appear cursory. Because the DMREF program is attempting to drive a cultural shift in materials research, program directors might consider emphasizing particular focused Broader Impacts activities or goals. Potential examples include student training in FAIR data practices, cross-training of students in computation and experiment, etc.</p>	<p>YES</p>
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>In general, the individual reviews are thoughtful and detailed.</p>	<p>YES</p>
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Panel summaries highlight the strengths and weaknesses of the proposal. At times the panel summaries do not seem consistent with the panel consensus score. The COV suggests that the PO provide more guidance on content of the panel summary to ensure consistency. This should limit the occasions when the PO recommendation differs from the panel ranking.</p>	<p>MIXED</p>
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>The rationale for the award decisions provided by the PO were excellent and in many cases were more informative than the panel summary, including additional context of the panel discussions.</p>	<p>YES</p>
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p>	<p>MIXED</p>

<p align="center">QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</p>	<p align="center">YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</p>
<p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Proposers get the individual reviews and the panel consensus report. PIs may also contact the PO to get more details on the decision. The COV wondered if it would be more efficient for a summary of the justification to be provided with the feedback to the proposers rather than requiring a proposer to reach out to the program director.</p>	
<p>7. Additional comments on the quality and effectiveness of the program’s use of merit review process:</p> <p>The NSF merit review process has been reviewed many times and continues doing what is intended. However, it is not clear that the community appreciates how other factors contributing to the overall program portfolio directly affect award selection. For example, DMREF award decisions also involve co-funding negotiations with multiple units and outside agencies, further complicating this process.</p>	<p align="center">MIXED</p>

<p align="center">SELECTION OF REVIEWERS</p>	<p align="center">YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</p>
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>For an intentionally interdisciplinary program like DMREF, this is a significant challenge, but the program directors have done an admirable job. Having at least one data and at least one theory expert on each panel has been effective. The program makes effective use of the reviewer pool involving reviewers that are appropriately distributed across the community.</p>	<p align="center">YES</p>
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>The avoidance of COI is continually addressed. All indications are that official COIs were handled appropriately. Several program director summaries included sidebar notes that implied (and at least once explicitly stated) that the program director suspected that a reviewer may not have been fully neutral towards a PI and/or team despite there not being an official COI. In such cases, the program director’s summary included a description of the concern and how it was addressed (e.g., less weight ascribed to this particular reviewer’s comments on this aspect of this proposal).</p>	<p align="center">YES (AS FAR AS WE CAN TELL)</p>

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>3. Additional comments on reviewer selection:</p> <p>The COV is impressed with the high positive response rate of reviewer requests. This suggests strong support of the program from the community.</p>	

MANAGEMENT OF THE PROGRAM UNDER REVIEW
<p>1. Management of the program.</p> <p>As summarized in the National Academies report “NSF efforts to Achieve the Nation’s vision for the Materials Genome Initiative”, DMREF represents NSF’s role in the MGI. DMREF is structured such that small teams investigate proposer specific projects that address the MGI goals in general. The process has the advantage of being open to original and transformative ideas. DMREF’s focus on fundamental science and theoretical-experimental integration has produced ground-breaking research on many fronts.</p> <p>The management of the program is generally excellent. Particularly noteworthy aspects include the consistency of funding over time despite the remarkable growth of submissions and integration with other NSF units and other agencies for co-funding. The program directors commissioned the aforementioned National Academies study of DMREF (2023), which documents the quality and impact of the program.</p> <p>One of the recognized challenges introduced by the innovative co-funding approach is the reliance on non-annual contributions from partnering units. Annualizing contributions by committing funding 2 years at a time may help to reduce associated uncertainty.</p>
<p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>The highly interdisciplinary nature of the work sponsored by DMREF should facilitate the incorporation of advances as they emerge from research areas comprising the wide-ranging topics funded. Even the speed of development is affected. For example, the rate of developments in Artificial Intelligence (e.g., Machine Learning, Large Language Models), and Data Sciences (e.g., cyber-infrastructure) have been incorporated fairly quickly into programs within DMREF despite the comparatively slower rate of development historically observed in Material Sciences.</p> <p>The Materials Genome Initiative Workforce report providing recommendations for the academic preparation of those preparing to address the new paradigm for materials research represents a significant commitment to address education opportunities in connection with materials science and engineering.</p> <p>The COV echoes Key Finding 4.1 of the NA report that student training is uneven across DMREF projects and recommends that the program directors strongly encourage PIs to (better) implement MGI-driven interdisciplinary training. One option by which the program could facilitate such training (e.g., in data sharing, management and FAIR practices) might be through a student-targeted workshop at the PI meeting and/or at relevant professional society meetings.</p>
<p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p>

MANAGEMENT OF THE PROGRAM UNDER REVIEW

The program has demonstrated a strong plan for implementing the MGI vision across materials classes with a strong emphasis on the discovery phase. For effective transition toward deployment, program directors may wish to encourage partnering with TIP and/or other entities for translational research.

Alignment with prioritization of other major agencies, the thoughtfulness around diversity, and the wide geographical dispersion of awards provide evidence of how well the programs is planned. The program directors have assembled a portfolio with reasonable geographic, institutional, and demographic diversity. An area for potential improvement is the transparency of prioritization of non-technical criteria on portfolio development. For example, the manner in which *broader impact, outreach and other DMREF* criteria in proposals are evaluated by panels and weighted by program directors is not clear. Specifically, upon reading a proposal one cannot easily assess the importance of these dimensions relative to the Intellectual Merit of the proposed work.

Outreach of the DMREF program as a whole has been exceptional through the extensive interactions with many partner organizations, workshops, and professional society engagement. The visibility of the DMREF website with more than 40,000 visits in 90 days is also noteworthy when assessing the program’s outreach and awareness efforts.

4. Responsiveness of program to previous COV comments and recommendations.

The responsiveness to the previous program assessment was superb and can be measured by how well they addressed the 15 major points identified. Some of these points included: (1) improving the identification and preparation of panel reviewers, as well as setting appropriate representation of the various expertise necessary to provide proper coverage; (2) exploring a mechanism to increase participation of URM; (3) expanding the list of participating institutions; (4) increasing the number of early-career PIs.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>The portfolio shows a good balance across disciplines supporting infusion of MGI principles across the entire materials portfolio.</p> <p>On the basis of home departments of PIs, the distribution of fields is very broad and comprehensive. The commendable fact that DMREF funding is also drawn from many other units with DMR and within NSF, and even external agencies, contributes significantly to the maintenance of the broadest possible portfolio.</p> <p>That said, there was some concern that a proposal rated only “competitive” by the relevant panel could be promoted to “funded” on the basis of it being the only proposal in a certain technical sub-field. Given a total of 40 awards in 2021, it may just be that not all areas can be funded every time.</p>	YES
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p>	YES

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>Yes, funding levels are appropriate for the size of the teams needed.</p> <p>In the judgement of the COV, the consistent 4-year duration appears to be a good choice, balancing the need for urgency in producing exciting new results with the induction time associated with forging a productive new partnership. Similarly, the budget allocation is an effective compromise. Given the current (and historical) funding rate near 10%, it is hard to make a compelling case for much larger awards, which would further reduce the success rate.</p>	
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Given that the overall success rate is near 10%, the bar for an award is quite high. Consequently, enthusiasm from the DMREF panel, from the program director, and from another funding unit (either within or external to NSF) are all required. While this combination alone is no guarantee of a project of being potentially transformative, it certainly favors proposals that feature materials science that is clearly new, different, and exciting. Further, the MGI approach to science itself adopted by DMREF is transformative relative to classic materials research.</p>	YES
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>The design of the program, involving computation and/or data-driven materials science combined with synthesis/preparation of materials and advanced characterization/property assessment, guarantees a certain level of interdisciplinarity. On the other hand, the size/scope of an award serves as a constraint on how multi-disciplinary a given project can reasonably be.</p> <p>Conversations with the program directors indicate that ~30% of cumulative DMREF-sponsored publications include two or more co-PIs as coauthors. The COV feels that this is on the low side of what should be expected from an integrative multi-disciplinary program like DMREF. The program directors may want to consider additional encouragement of publication co-authorship with multiple co-PIs from DMREF teams to highlight inter- and multi-disciplinarity.</p>	YES
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>The distribution of awards appears to match relatively well with the distribution of submissions. It might be beneficial to encourage additional participation from regions of the country that are not significantly involved.</p>	YES
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Yes. As a specific example, in 2021, EPSCOR awards were 10% of the total, which appears reasonable.</p>	YES

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>In the most recent cycle (2021) the fraction of awards going to early-career investigators increased and represents a non-negligible portion of the whole (ca. 23%, matching also the proportion in the submission pool). The overall distribution of awards versus PI seniority appears to be perfectly satisfactory, and we do not see any compelling reason for the program director to try and micromanage this aspect of the portfolio.</p>	YES
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Education and training of students in data science as it applies to materials is a core element of DMREF awards. That said, it is not obvious how the DMREF program can assess progress in this area. Also, given that many awards feature PIs at different institutions, it is not clear that all students in a project will benefit from education efforts based elsewhere. The COV recommends that the program directors consider opportunities to facilitate supplemental training for DMREF students.</p>	MOSTLY
<p>9. Does the program portfolio have appropriate participation of underrepresented groups⁴?</p> <p>In the latest cycle (2021), the funding rate for women PIs was 25%, and for underrepresented minorities 4%. These metrics are not atypical and are reflective of the percentages in the submission pool, underscoring the need for continued efforts to broaden participation in the submission pool.</p>	MOSTLY
<p>10. Is the program relevant to national priorities, agency mission, relevant fields, and other constituent needs? Include citations of relevant external reports.</p> <p>Yes, directly supports MGI and other national priorities. DMREF has unique stature and importance, as it represents the core of NSF's contribution to the Materials Genome Initiative. This is laid out in exemplary detail in the 2023 National Academies Consensus Study Report "NSF Efforts to Achieve the Nation's Vision of the Materials Genome Initiative" (https://nap.nationalacademies.org/catalog/26723/nsf-efforts-to-achieve-the-nations-vision-for-the-materials-genome-initiative).</p>	YES

⁴ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
DMREF also supports many other national priorities, such as: <ul style="list-style-type: none"> - The National Quantum Initiative (www.quantum.gov) - The National Artificial Intelligence Initiative (www.ai.gov) - The National Nanotechnology Initiative (www.nano.gov) - The National Strategy for Advanced Manufacturing (https://www.whitehouse.gov/wp-content/uploads/2022/10/National-Strategy-for-Advanced-Manufacturing-10072022.pdf) and directly supports advancing many of the items on the Critical and Emerging Technologies List (https://www.whitehouse.gov/wp-content/uploads/2022/02/02-2022-Critical-and-Emerging-Technologies-List-Update.pdf)	
11. Additional comments on the quality of the projects or the balance of the portfolio:	NONE

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

Even with increasing proposal volume, there are still sufficiently low numbers of funded projects per solicitation that demanding balance across technical areas (as defined by, for example, materials classes) in any given funding cycle promotes lower-ranked proposals over others that have a stronger technical basis. The COV recommends that technical balance be viewed over multiple funding cycles.

DMREF has a strong presence in the discovery and development portions of materials innovation. While the COV recommends against any attempts to extend the DMREF reach to higher technology readiness levels, there are opportunities to partner with other units (e.g., TIP) to assist with transition of DMREF-initiated advances.

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

It is not clear how DMREF has (or will) prioritize and/or more effectively encourage consideration of eventual deployment of new materials into the discovery and development that naturally occur within DMREF projects. Certification and Manufacturing seem to be particularly underrepresented in the DMREF portfolio; this may be intentional and appropriate, but their non-inclusion contradicts the revised MGI concept figure for materials innovation infrastructure. The COV does *not* recommend skewing the DMREF portfolio to higher TRLs but *does* acknowledge potential value of engaging more deployment-focused thinking earlier in the materials development process.

There are significant opportunities and challenges associated with shared data. As the DMREF program has matured, additional focus on data consolidation/sharing/access/use is encouraged.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

PIs are clearly attracted to the DMREF program. Unless the low funding rate reflects a comparably lower average proposal quality (an open question), there may be value in further facilitating additional intra- and inter-agency co-funding of DMREF proposals, perhaps by identifying and reducing barriers to such partnering.

Especially as the proposal volume has increased and with the complexity associated with co-funding, the program director staffing level seems low, and the staff are overburdened.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.
5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

It was informative to see the inner workings of the selection process, and all of the NSF staff and program officers have been extremely supportive and responsive. However, there are several aspects of the COV experience that could be improved.

The briefings on the first morning were inefficient. If the information had been provided ahead of time, the content could have been covered effectively in 30 minutes rather than 2.5 hours. Similarly, there was insufficient clarity about what was expected of COV members ahead of time. Access was provided to a great deal of information, but it was not clear what was to be done with said information or what would be expected of the COV on-site, so people often ended up browsing (at most) using a random-walk approach. The scope of review and expected actions of each COV member were not clear prior to arrival on-site. The charge provided in April applied to the entire COV, and the webinar in August was focused on details of electronic access. Clear communication of the roles and expectations of individual COV members would be helpful. This insufficient communication of expectations and schedule was again problematic on the last day of the visit. Bugs within eJacket that required logging out/in added noticeably to the time burden.

There were some advantages to hosting the working groups outside of the NSF building, but the use of hotel rooms was not ideal. Combining two programs into a single briefing added far more time than value and sharing meeting/hotel rooms added unnecessary logistical challenges.

The COV seems to be a high priority for and of high value to DMR (as evidenced by the attentiveness and responsiveness of the program officers and staff, for example) but not to the rest of the agency (as evidenced by the sequestration of the COV to a hotel, for example).

4.5 Biomaterials (BMAT)

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Yes, they include:</p> <ol style="list-style-type: none"> 1. <i>Ad hoc</i>, which is the main mode for open window 2. Zoom, which is good for panels (e.g. CAREER, TMRPs (single PI) with a common topic are BMAT panels) also sustainability (only for POL not for BMAT, Andy Lovinger said) 3. Site visits, which are only done for centers and facilities (PREM, MIP, MRSEC for BMAT). <p>Prior to the open-window submission policy, panel meeting via zoom is efficient. The open-window submission is highly recommended since the overall quality of the proposals are greatly improved, although it is challenging for the program officer to manage it.</p>	<p>YES</p>
<p>2. Are both merit review criteria addressed?</p> <ol style="list-style-type: none"> a) In individual reviews? b) In panel summaries? c) In Program Officer review analyses? <p>The format is very effective.</p>	<p>YES</p> <p>YES</p> <p>YES</p>
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Yes, the reviewer comments are in general concise and quite helpful.</p>	<p>YES</p>
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>The panel summaries summarize the discussion and are helpful.</p>	<p>YES</p>
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p>	<p>YES</p>
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or</p>	<p>YES</p>

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]	
7. Additional comments on the quality and effectiveness of the program's use of merit review process: the current process is effective.	NONE

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
1. Did the program make use of reviewers having appropriate expertise and/or qualifications?	YES
2. Did the program recognize and resolve conflicts of interest when appropriate?	YES
3. Additional comments on reviewer selection:	

MANAGEMENT OF THE PROGRAM UNDER REVIEW
<p>1. Management of the program.</p> <p>The management is effective. EXCELLENT</p>
<p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>The program officer puts extra effort to establish several collaborative initiatives, including the one with the NIH which will make a great impact on expanding the program and connect funded projects to the real-world application, thus attracting more funding to the program and NSF in general.</p> <p>EXCELLENT</p> <p>I especially appreciate that AI, climate change, sustainability, and energy can be included in any proposal. Thus, flexibility is built into the system. This is very clever for 2 reasons: (1) it makes the NSF open to new ideas from the community, and (2) it makes it possible for NSF to change quickly as the community changes.</p>
<p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>Program planning and prioritization have guided the expansion to the areas of AI and climate change and applications.</p> <p>GOOD</p>

MANAGEMENT OF THE PROGRAM UNDER REVIEW

4. Responsiveness of program to previous COV comments and recommendations.

Adequate. **GOOD**

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Yes, in general, and some important emerging areas related to AI and biomedical applications are being developed.</p> <p>Yes, it includes PIs from all these disciplines: MS&E Physics Chem Chem E Cell biology and engineering CEE Biology Biophysics BME Biomedical (MD-PhD, etc)</p>	YES
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Extension of the funding period to 4 years is particularly helpful, which is probably facilitated by the open-window submission policy that reduces the number of proposals and increases their quality. As a result, the funding rate and average budget are increased.</p> <p>The award size has NOT increased proportionate to inflation. NSF is severely underfunding its most brilliant PIs. See below for a proposed solution.</p>	NO
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Yes</p>	YES
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Absolutely.</p>	YES
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p>	YES

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
Yes.	
6. Does the program portfolio have an appropriate balance of awards to different types of institutions? Yes.	YES
7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators? NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award. Yes, about 30% of the awards were made to new investigators.	YES
8. Does the program portfolio include projects that integrate research and education? Yes, like all NSF awarded projects, broader impact including the educational components is emphasized.	YES
9. Does the program portfolio have appropriate participation of underrepresented groups ⁵ ? Yes, like all NSF awarded projects, participation of underrepresented groups is strongly emphasized.	YES
10. Is the program relevant to national priorities, agency mission, relevant fields, and other constituent needs? Include citations of relevant external reports. Yes, the BMAT program does it particularly well.	YES
11. Additional comments on the quality of the projects or the balance of the portfolio: The PO of BMAT took the initiative to outreach NIH to establish new directions that connect to the real world.	

OTHER TOPICS

⁵ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas. No gaps in need of improvement were identified.

We recommend expanding the BMAT program to include new emerging areas involving AI and climate change, as well as fundamental science that greatly impacts the clinical application of biomaterials. For the latter, it is important to identify and narrow down the specific topics and areas in fundamental science that are the most impactful for clinical application of biomaterials. This is best done by collaboration between NSF BMAT and other programs with individual institutes of NIH, and between PIs and their clinical collaborators. To facilitate the process, NSF should organize workshops jointly with NIH institutes to bring in NSF awardees and experts on the fields to identify focused areas and topics that are fundamental science and directly relevant to applications in the clinical side. The workshops will greatly facilitate the development of joint funding solicitation with NIH and other funding agencies.

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

The goals of the BMAT program are perfectly met.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance. Underfunding is the major problem identified.

The progress of science in biomaterials is limited by the lack of modern instrumentation. For example, most advanced and sensitive mass spectrometry is strongly needed for identification and structural determination of tiny amount (<10 ng) of heterogeneous protein mixtures at interfaces of biomaterials, which determine the interactions with the host and thus performance of the implants. However, traditionally the MRI program does not support acquisition of such instrument for DMR. DMR should advocate to the MRI program for the need of such instrument.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

The main problem the NSF faces, and therefore BMAT also faces, is underfunding. The budget has not significantly increased in decades, not even to keep up with inflation.

A possible solution is to co-fund with other, richer funding agencies. I propose that the NSF negotiate joint solicitations with NIH, DOE, industry, EPA, NIST, NASA, DOA, etc. Effective examples are the NCI-NSF joint solicitation that the BMAT PD Nitsa Rosenzweig developed, and the one between BMAT and NIBIB / NIGMS at NIH, currently being established. Many more following this model are strongly encouraged.

Another idea is to generate agreements with private foundations, offering the excellent and well-established peer-reviewing at NSF, and getting co-funding of NSF PIs. Agreements could be made with Guggenheim Foundation, John D. and Catherine T. McArthur Foundation, Hertz Foundation, Sloan Foundation, Packard Foundation, Keck Foundation, etc.

Matching funds from the PI's institution or its academic and industrial partners are encouraged. NSF could develop a mechanism to encourage awardees to seek co-funding from local industries.

Co-funding may also be done with the new TIP directorate.

In all cases, the tremendous extra efforts contributed by the PD is greatly appreciated! This extra work may (will!) result in agreements with other funding agencies, foundations, industry, and universities.

5. NSF would appreciate your comments on how to improve the COV review process, format, and report template. No major problems were identified. Possible improvements include:
 - Hosting the COV at NSF would be a lot simpler logistically, so coffee breaks and lunches would be a lot easier for the staff to handle.
 - The Director’s presentation on day 1 could be improved. The fonts were too small, and the Powerpoint slides were not readable even if one sat in the first row. Legends and axis labels were also too small to understand.

4.6 Ceramics (CER)

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>In 2019 and 2020 there were no panels, only ad hoc reviews. In 2021, it was mostly virtual panels, and in 2022 it was a mostly an even mix of virtual panels and ad hoc reviews. There is a benefit to both panels as well as ad hoc reviews, so we strongly recommend that the program moves forward with the trend from 2022 where there was an approximately even mix of ad hoc and virtual panels. This will allow the program to evaluate proposals in areas in which they do not receive a sufficient number of proposals to convene a panel, yet still have panels in areas where a large number of proposals is received. Also, panels can be helpful when there is a wide scoring range from the ad hoc reviews. We recognize the difficulty in holding panels when there is no deadline for proposal submission, and we commend the program directors for their use of panels as well as joint panels with SSMC and MMN to overcome this challenge. Site visits are not applicable for these proposals.</p>	YES
<p>2. Are both merit review criteria addressed.</p> <p>a) In individual reviews? Yes</p> <p>b) In panel summaries? Yes</p> <p>c) In Program Officer review analyses? For the review analysis in 2021-22, yes. For the ones from 2019-20, they were not addressed for the declined proposals. The program officer just simply stated they agreed with the reviews.</p>	YES
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>For the most part, individual reviewers do provide helpful feedback. There is a wide range of how much effort each reviewer puts into their comments. The comments for the intellectual merit were generally more detailed than the broader impacts. This is not unexpected, but it sounds like DMR is trying to take broader impacts more seriously, so in the future it would be helpful if more guidance on the review criteria on BI is provided to reviewers. It is particularly</p>	YES

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>important for this guidance to be transmitted to the PI if the proposed activities aren't up to standards as this would help the PI in future proposals. In addition, the reviews asked for the five criteria to be addressed, and many times, not all of them were directly addressed. It would be particularly helpful to encourage reviewers to make a clear statement as to whether the proposed research is potentially transformative or not. Such statements seemed to be missing in quite a few of the reviews.</p>	
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>The panels do a nice job at providing thorough comments to the PI. It appears that there is the same level of detail in each of the panel reviews.</p>	YES
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Most of the proposals provided to us are from 2021 and 2022. The PD reviews from these years are thorough and summarize ad hoc and panel comments well. We were only given a few proposals to review from 2020 and 2019 – 4 total from those two years. The review analysis documents from the later years (2021 and 2022) have more details, and thus better descriptions of the rationale for the decisions, than those from 2020 and 2019. However, there were only 4 proposals for us to look at from 2019-20 and roughly 30 from 2021-22 so we are not sure how typical the 2019-20 analysis is.</p>	YES
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Feedback from the PD to the PI form a critical part of the proposal review process. This is quite important in cases where the proposal has been declined, since this provides insight on which factors (usually a subset of the many mentioned in the reviews) that form the basis of the decision. Moreover, given the stated goal to increase the number of PI's in the program, it is important that PI's whose proposals are declined are not discouraged from reapplying. The feedback to the PI's is thus critical and is very helpful in the preparation of a new proposal. In some cases, especially in the 2019-2020 timeframe, the comments sent to the PI's were not as helpful as they could have been. By contrast, the communications with PI for more recent proposals are much better, and we encourage the PDs to continue in this vein.</p>	YES

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>7. Additional comments on the quality and effectiveness of the program’s use of merit review process:</p> <p>Everything looks good for the most part. We would recommend continuing the 2022 trend of a good balance of ad hoc and panel reviews, rather than what happened in the earlier years where it was mostly ad hoc, then 2021 mostly panels.</p>	

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Selection of reviewers with the relevant expertise is critical to ensure high quality reviews of proposals. For the few proposals in our area, the reviewers seemed appropriate. However, the topics covered by the Ceramics program are quite broad and thus we can’t speak to the appropriate reviewer expertise in most cases.</p>	YES
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>From a read of the few cases where a COI is noted in e-jacket but, more importantly, from discussions with the PD’s COI is a central consideration in the review of proposals. We appreciate the PD’s efforts to insure fair and thorough review process.</p>	YES
<p>3. Additional comments on reviewer selection:</p>	

Management of the Program under Review
<p>1. Management of the program.</p> <p>A permanent program director is essential in setting and accomplishing the long-term strategy for building and maintaining a TRMP. While the Drs. Schwenzler and Yang have done a wonderful job as temporary directors, and Dr. Bassiri-Gharb has great plans for the future, the absence of permanent director has not been beneficial to the Ceramics community. We strongly support DMR’s goal of hiring a permanent Program Director in the future. Despite these challenges, we are extremely impressed at the care and deep thought given to the funding decisions, the importance of maintaining programmatic balance, and the important outreach to other programs at NSF. We note that the fraction of grants that have not been acted on for over six months is larger for the past two years, with some taking longer than 9 months. We understand that this is a result of the change of program director during this time, which underscores the need for a permanent program director. There should also always be a rotator in the program to provide new perspectives and to allow for the permanent person go on detail. We appreciate the efforts of other program directors to cover the Ceramics portfolio and understand the difficulty in taking on additional duties.</p>

Management of the Program under Review

2. Responsiveness of the program to emerging research and education opportunities.

Ceramics is a core area of materials science and engineering. There are many exciting research opportunities in the field that can enhance the existing program. To generate excitement in the community and to formulate a forward-looking research strategy, we suggest that the program convene a workshop to identify those many promising areas and formulate a research strategy for the Ceramics Program. The Program, of course, must still be receptive to all proposals received, even in areas not mentioned in the report. However, the goal is to enhance the breadth of proposals submitted to the program and to convey the excitement of research in the field and its ability to impact society. The workshop should involve a diverse set of researchers at all career stages while ensuring geographic and institutional representation. The result of the workshop should be a short report for internal use as well as a journal publication (review article) or a short article for a widely distributed society magazine. We recommend specific outreach to R2, PUI, and HBCU institutions, for example.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

There is a strong and important culture of supporting the diverse areas of materials research represented in the program. Ensuring this diversity is extremely important. However, a research strategy for the future is needed, as mentioned above.

4. Responsiveness of program to previous COV comments and recommendations.

The Ceramics Program has been responsive to the previous COV comments and recommendations.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Maintaining a balanced portfolio across subdisciplines is important. The program has done a laudable job at maintaining this balance. However, it would be advantageous if balance between these areas, along with the potential addition of new areas, was guided by a research strategy.</p>	YES
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>The program has been a leader in DMR in recognizing the importance of four-year awards. While this is not the entire tenure of a Ph.D. student, this is a much-preferred approach given the challenges of educating beginning students.</p> <p>The program should strive to increase the average funding per grant in the future, since it has been stagnant since the last COV report. Grants involving two PIs offer the possibility of bringing together the expertise from two different areas to focus on a research objective. It is very good that the program funds such proposals. However, to extract the full benefit of two-investigator programs, it is necessary for the total funding to be increased proportionately. At the current funding rate, it is difficult to support one full student per PI in a two-investigator proposal. This discourages such projects, which is unfortunate as small collaborations can have tremendous impact on advancing science. In addition, looking to the future, as stipends for graduate students are increased due to unionization and the equity issues at institutions without unions, it will be necessary to increase the size of the awards. This will put unwanted and considerable pressure on proposal success rates. This is not just a CER or DMR issue, but an entire NSF-wide issue.</p>	NO
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>We do believe that the portfolio includes research that is innovative and could be transformative. This is especially shown through the large number of GOALI awards distributed from Ceramics. A testament to the transformative nature of ceramics research is that 10% of awards in the program are GOALI awards.</p>	YES
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>There are inter- and multi-disciplinary projects within the Ceramics program. It appears as though there is more money coming in from other programs for shared funding compared to money coming from Ceramics going to other programs for joint funding. Modern science is becoming more inter- and multi-disciplinary so we would expect to see more joint funding both in the COV period and in the future. However, it can be challenging for proposals to be jointly funded as this relies on having good relationships between different program directors. Also, with programs and divisions wanting to keep money within their sphere, we worry that meritorious inter- and multi-disciplinary proposals could fall through the cracks and not be funded. This would slow the advancement of science, which is the main mission of the NSF.</p>	YES

<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>The geographical distribution of the awards is very good. Most regions of the country are represented. We encourage the PD to continue this in the future.</p>	<p>YES</p>
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>There is a good distribution between public, private, RO1, non RO1, and non-PhD granting institutions. It is important to maintain this balance or even look to increase outreach to non-RO1 institutions in the future.</p>	<p>YES</p>
<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>One of the challenges of the Ceramics Program is the need to bring new investigators and early-career investigators into the program. Thus, it is key to ensure that they are engaged (submitting proposals) and funded. The funding rate for CAREER proposals is acceptable but could be a bit higher. However, given the state of the Ceramics program it is quite surprising that zero new PI's were added to the program in 2022. Of course, this could simply be due to the poor quality of these proposals. Careful consideration of proposals from new investigators is critical in growing the cadre of investigators in the Ceramics program. It is incredibly important to encourage proposal submissions from early-career and new investigators. We know Dr. Bassiri-Gharb, the new rotating program director, has been attending conferences in the field to network and discuss the program with PIs, and we encourage this activity to continue.</p>	<p>NO (YES FOR EARLY CAREER, BUT NO TO NEW)</p>
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Yes, through the BI statements and CAREER proposals, it is clear that education and research are often, but not always, linked.</p>	<p>YES</p>
<p>9. Does the program portfolio have appropriate participation of underrepresented groups⁶?</p> <p>We appreciate the support for these underrepresented groups when making funding decisions. However, there is a small number of proposals submitted to the Ceramics program by investigators from underrepresented groups. Thus, to achieve the goal of a truly diverse cadre of investigators greater outreach to underrepresented groups is needed to increase the number of proposals.</p>	<p>YES</p>

⁶ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

<p>10. Is the program relevant to national priorities, agency mission, relevant fields, and other constituent needs? Include citations of relevant external reports.</p> <p>A variety of ceramics topics are important to the NSF priorities. In particular, materials in extreme conditions, semiconductors, clean energy, sustainability, and harnessing data revolution for the 21st century can all benefit from the research portfolio in Ceramics.</p>	<p>YES</p>
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p>	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

There are exciting opportunities in materials research that open new scientific frontiers, address society's greatest concerns, are central the development of new technologies, and ensure the security of the Nation. It is critical that the Division conveys this message to its stakeholders, both within and outside NSF. Moreover, it is essential to decide how to balance the additions of new research areas with the exciting research in the core programs. To meet these goals, we recommend that a research strategy for the Division be formulated. DMR, of course, must still be receptive to all proposals received (which is an excellent way to determine new areas that are currently not in the program). A strategy will also be the guide for the Division that will enable it to quickly respond to the new research themes that often change from one administration to the next. Moreover, such a plan should make the case for new research themes that can resonate with OSTP, other divisions in NSF, and other government agencies. Such new research themes can indeed start in DMR. An example of such a program that has been widely embraced and is central to DMR is the Materials Genome Initiative. A strategic plan for DMR will help the Division Director and his team to make allocations between programs as well as to make the case to the OSTP, NSF, and Congress for growing the investment in materials research.

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.
 - a. One of the goals of the Ceramics program was to increase the efficiency with which proposals are processed. This was done with the CAREER awards in the last three years of the COV; all proposals were processed within 6 months. However, the time to decision for the regular proposals saw an increase in the amount of time to process. We do understand this is due to a change in the PD halfway through the COV period. While the Ceramics program is small, we feel it would be beneficial to have both a permanent and a rotator program director, to ensure continuity when one of the PDs leaves. A permanent PD brings institutional knowledge and long-standing relationships to the program while a rotator can bring in fresh research perspectives. Both of these things are beneficial to the goals stated for the Ceramics program. If budget limitations are a concern, a possible first step is to consider a single rotator for two smaller programs.
 - b. Another goal of the program was to reinvigorate the ceramics program through new investigators submitting proposals. One suggestion of how to do this was to encourage collaboration. However, because there have traditionally not been larger awards for two-investigator grants, this does not seem like a viable approach for meeting this goal. As mentioned previously, the award sizes likely do not allow for the full support of one student per PI on these smaller collaborative awards. We recommend that the DMR consider appropriately funding multi-investigator programs.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.
 - a. The NSF budget allocations to DMR seem rather stagnant despite the increasing costs of doing research. In particular, student stipends will need to increase in the future, consumable costs have increased significantly due to inflation, and universities are increasing their overhead costs. Despite this, the average award amount has not increased much over the COV period. It is approaching the point, where it is getting difficult to carry out the proposed research activities with a single award. We are encouraged to see the relatively new approach for fully funding programs based upon the submitted budget. We strongly endorse this approach and hope that the DMR can obtain sufficient funding in the future to keep the success rate of proposals constant while the budgets increase as needed.
 - b. It appears difficult to provide awards with multi- and inter-disciplinary research that are jointly funded. The NSF politics behind sharing the costs between programs may prevent some potentially transformative research from receiving awards. As science becomes more multi- and interdisciplinary, it is crucial to find a way for different programs and different divisions to share the costs of this research.
4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.
5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

We appreciate the extensive planning by the PD's and support of the NSF staff for our visit. For the next COV, it would be helpful if there were clear directions about what tasks should be done before we arrive versus what tasks will be accomplished during the visit. Communicating that clearly, well in advance, would be helpful for the COV to better manage their time.

4.7 Condensed Matter and Materials Theory (CMMT)

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>The COV found that the majority of evaluations are conducted by referees via email communication. Generally, CMMT reaches out to 5-7 reviewers, resulting in 3-5 assessments for each proposal. The COV finds the CMMT's strategy of mainly obtaining reviews through email plausible because of the CMMT's extensive coverage of various topics and research directions. The COV found that the CMMT has selected the reviewers thoughtfully based on their expertise in the relevant field, and that the reviewers come from diverse experience backgrounds. Clearly, a deliberate attempt is made by POs to ensure a diverse group of reviewers.</p>	YES
<p>2. Are both merit review criteria addressed?</p> <p>a) In individual reviews?</p> <p>b) In panel summaries?</p> <p>c) In Program Officer review analyses?</p> <p>The reviews in general addressed both the intellectual merit (IM) and broader impacts (BI) of the proposal, although at varying levels of detail. The PO review analyses in general showed awareness of the level of engagement apparent in a given review, and appropriately weighted the review in coming to recommendations on funding. PO's made significant efforts to understand how reviewers arrived at their letter grades and to understand why different reviewers arrived at different conclusions. The declination messages generally contain an analysis helpful to the proposer, with concrete suggestions and specific reasons for the declination.</p> <p>Analyses usually involved identifying which aspect(s) of a proposal a given reviewer may have focused on, and the PO's tried to evaluate the importance of these in light of the CMMT program priorities. The PO's also demonstrated awareness that some reviewers tend to grade high, and others low, and where they had a track record on this for a given reviewer, this was taken into account.</p> <p>Reviewers and PO's took into account both originality of proposals and their scale. Reviewers were in general less skilled in evaluating the proposed BI work than the IM work, and their written remarks tended to have fewer helpful or useful suggestions to improve these aspects of the proposals.</p>	YES
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Certainly, the review process shows variability in the feedback provided, but on the whole the process is good considering all reviewers are busy volunteers. On the one hand, some reviewers</p>	YES

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>offer comprehensive assessments, providing valuable insights and constructive criticism that are beneficial for the decision-making process.</p> <p>On the other, there are instances where reviews lack the necessary depth to justify a proposal's ranking. This is particularly unhelpful to the PIs of rejected proposals who do not receive actionable feedback for future submissions (or resubmissions). The PO analyses seem to be generally high quality and strive to justify declination decisions.</p> <p>Understanding that POs have limited time, perhaps it would be possible for CMMT to take proactive measures, such as reaching out to reviewers and requesting more detailed explanations for specific evaluation points when a review falls short. This might help CMMT to enhance transparency, fairness, and the overall informativeness of the review process, ultimately improving the decision-making process. And it could also function as impactful "coaching" that could help reviewers to be more effective in future reviews.</p>	
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>This doesn't apply because panel summaries are not typically used in the assessment of CMMT proposals.</p>	NOT APPLICABLE
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>The POs do an excellent job in writing the review analyses explaining how they went through the review process and why they made certain decisions. The documents clearly illustrate the PO's exceptional ability to assess a broad spectrum of scientific topics and effectively align them with CMMT's current mission. The careful analyses by the PO's helps the community have trust in the process.</p>	YES
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>The program officer comments sent to PI's clearly explain the rationale for the final decision on the proposal. The comments are brief but hit the main points that led to the decision. For declined proposals, useful feedback is provided on how proposals could be improved. PI's are always directed to the reviewer comments for further details that illuminated the decision. The</p>	YES

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
tone of the PO's toward the PI's are respectful and encouraging. The POs also field phone calls from disappointed PIs. The Diary Notes indicate a real effort to be helpful with useful feedback.	
<p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>The review process is well-documented, and the reasoning behind CMMT PO decisions are easily understood. Overall, the COV felt that the review process is conducted in a fair, professional, and unbiased way, and results in a well-diversified portfolio of excellent research.</p>	

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Reviewers had the right expertise to evaluate the proposals they read. The program made good use of experts across a number of fields that were relevant to each proposal. PO's were also well-aware when experienced reviewers tended to grade high or low, which helped in interpreting their reviews. This knowledge should be internally documented in some way so that this information is maintained and available to new PO's.</p>	YES
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>One reviewer mentioned some connection to the proposing PI but turned in a review anyway. The PO reached out for more information and decided that the reviewer had been mentored by the PI some years earlier to the degree that it constituted a mild COI. The review was subsequently disregarded. Because the other reviews were (also?) strong, the PO felt that the outcome was unchanged by disregarding the review with a potential COI.</p> <p>We had only one other case of a proposal in our eJacket set (56 proposals) that had a COI. A reviewer was asked to review a proposal and then, before returning the review, submitted a proposal himself. This is not allowed under current rules—it obviously creates a COI between the submitter/reviewer and the original PI. So that review could not be used.</p> <p>Our data about COI issues faced by CMMT is limited because COIs arise are prevented effectively and arise only rarely. Based on these two cases that we had access too, and based discussions and interactions with POs over the years (and serving on panels ourselves), we believe that POs are thorough in upholding COI policies and are committed to the integrity—actual and perceived—of the review process. We are grateful for a review process which engenders trust in the community and the CMMT's management of the program.</p>	YES
3. Additional comments on reviewer selection:	

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
It was noted that PO's consulted reviewers suggested by PI's when possible. We think this is very worthwhile and can provide a perspective on a given proposal that might otherwise be missed.	

MANAGEMENT OF THE PROGRAM UNDER REVIEW
<p>1. Management of the program.</p> <p>Despite the size of the program and its complexity, the COV finds that the program's management is highly effective. The program officers do a great job in handling all the various aspects of the program. The organization seems to be efficient and lean. The COV finds it may be a little bit too lean. It seems that the workload of the POs, PDS, and other staff may sometimes exceed reasonable expectations.</p>
<p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>The PO's are clearly aware of emerging and under-represented research areas that need more emphasis/support from the program. Indeed, they may have a broader view than most of the PIs. They are also aware of educational efforts and community-supporting activities (workshops, etc.) that help the field communicate about research direction and importance. The PO's should help the community to recognize new directions as they emerge.</p>
<p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>The program planning and prioritization represents a balance of "top-down" initiatives (e.g., Materials Genome Initiative, National Quantum Initiative) and "bottom-up" topics that appear in the proposals as new areas emerge in the community. It is important that the program is mindful of both. The former aligns the program with national priorities, and sometimes facilitates partnership with other programs that help fund common proposals. The latter allows CMMT to recognize trends followed by the community in a timely way. As CMMT is one of the few programs that PI's in materials theory can turn to for support to develop new research directions, this helps keep the program portfolio at the cutting edge. Moreover, it serves a unique and important function for the materials theory community. The PO's are largely successful in finding the right balance of these, and the COV commends this essential work.</p> <p>The program demonstrates a strong commitment to broad participation. This includes distribution of funding across regions and across institutions within a region, as well as encouraging inclusiveness with respect to gender and underrepresented groups. The recent increase in the funding rate of CAREER proposals improves age diversity in the community as well.</p> <p>Workshops funded and sometimes initiated by the program facilitate community development. Researchers working on related projects may be unaware of one another, and CMMT PO's are sometimes in the unique position to bring PI's together to form new collaborations and sub-communities. The 2021 MMN – CMMT Workshop on Opportunities in Metals and Metallic Nanostructures: Experiment, Computation, Theory and AI is an example. The COV applauds and encourages these types of activities. Funding for PO participation in workshops and conferences that help them track the evolution of research directions is encouraged.</p>

MANAGEMENT OF THE PROGRAM UNDER REVIEW

4. Responsiveness of program to previous COV comments and recommendations.

Based on the comments of the previous COV, CMMT have made several 4-year regular awards. If possible, we recommend that CMMT increase the number of 4-year awards for the sake of the graduate student life cycle. In general, the majority of the comments and recommendations made by the previous COV have been effectively resolved or implemented.

Additionally, the previous COV noted that the area of nonequilibrium phenomena appeared to be inadequately represented. The POs have taken steps to increase funding for awards relevant to nonequilibrium phenomena.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>The portfolio covers a broad range of condensed matter and materials theory. Both hard and soft matter areas are well-covered, and important new trends that have emerged in the last four years are well-represented given the relatively limited resources of the program.</p> <p>There is a clear mindfulness toward funding projects that effectively leverage AI, ML, and data-driven methods. This emphasis is particularly useful for the training of students for STEM careers. The methods however are not treated as disciplines in and of themselves, but rather as tools that can be useful in many of the proposed projects, but do not enter as a separate category in the program portfolio. The COV feels this is an appropriate approach to the incorporation of these rapidly developing methodologies in the program and should be continued.</p> <p>The review analyses indicated an effort to broaden the representation of polymers and soft material research trends in the portfolio. The PO's successfully identified and funded several strong proposals that did so.</p>	APPROPRIATE
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>The COV generally considers the size and duration of the awards to be appropriate. However, as mentioned earlier, increasing both the award size, and <i>especially</i> duration (e.g., from 3 to 4 years) could significantly enhance student success rates. Students often need more than three years to complete their studies and extending the award period could reduce stress/risk for both PIs and students while also improving the overall rate of student success.</p>	YES
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Projects that were awarded by the program all reflect a high level of creativity. Several were "high risk/high reward", and the PO's did not shy away from recommending funding for</p>	APPROPRIATE

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
young investigators in this category, which seemed appropriate to the COV. In a small number of cases, more senior researchers pursuing ideas that contained significant transformative potential received creativity extensions.	
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Many of the soft matter and active matter projects are inherently multi-disciplinary, incorporating material properties, non-equilibrium statistical mechanics and biology in fundamental ways.</p> <p>The emphasis in the portfolio on ML and AI across different disciplines incorporates projects in which PI's develop computational methods that are widely applicable. Such awards necessarily have a multi-disciplinary impact.</p>	APPROPRIATE
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>The geographical distribution generally matches the number of proposals received. The POs are aware of the lower number of awards in certain regions and have been making efforts to address the issue, with a focus on increasing support for regions that have received fewer funds.</p>	YES
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>The COV understands the difficulty faced by POs in managing proposals, especially when some institutions submit a considerably larger number than others. Nonetheless, the COV recognizes the efforts made by the POs to achieve a balanced distribution among various institutions.</p>	YES
<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>The charts provided by the POs illustrate a consistent upward trend in the number of awards granted to early-career investigators.</p>	YES
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Training of students is an integral part of essentially all the awards. Such research projects are always carried out with an educational component. The program also emphasizes</p>	APPROPRIATE

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>developing “soft skills” among young scientists. This is one of the important purposes of the Postdoctoral Mentoring Plans, where PI’s must consider what activities and training they will be required to position their advisees for future STEM careers.</p> <p>The program also funds two summer schools (Boulder Summer School in Condensed Matter and Materials Theory and the DMR Summer School for Integrated Computational Materials Education) in which active practitioners introduce students to the basic physics, as well as the analytical and computational methods, used in their research.</p>	
<p>9. Does the program portfolio have appropriate participation of underrepresented groups⁷?</p> <p>The success rate of proposals submitted by underrepresented PIs has steadily risen, from 14% in 2019 to 50% in 2022. While the COV acknowledges this notable increase, it's important to note that the overall number of underrepresented proposals remains relatively low. Perhaps additional efforts could be made to encourage more submissions from underrepresented groups, such as holding workshops that address barriers to submitting proposals for external funding.</p>	YES
<p>10. Is the program relevant to national priorities, agency mission, relevant fields, and other constituent needs? Include citations of relevant external reports.</p> <p>The mission of the NSF generally is to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense; (and for other purposes). The CMMT program, with its focus on materials generally, and its focus on theory and computation particularly, support these three purposes perfectly.</p> <p>Materials are the linchpin of new technological advances (for support see www.mgi.gov and, in particular, https://www.mgi.gov/sites/default/files/documents/materials_genome_initiative-final.pdf). This is true in high-tech applications such as aerospace technologies, quantum computing, medical advances, renewable and green energy technology, and advanced batteries. But it is also true for advances in “commodity” materials’ applications such as structural metals (steel in buildings, bridges; automotive alloys for lightweighting, higher-efficiency engines), batteries in EVs and personal electronics, semiconductor materials for consumer-grade electronics. Both ends of the spectrum have deeply impacted the advances in materials science.</p> <p>As a result, supporting materials research not only has a long-term impact in promoting the progress of science, but a direct impact on national prosperity and American competitiveness because of the technological innovations that are enabled as higher-performance materials are developed. Materials themselves are very complex, with many important length scales, from the nanoscopic, through the mesoscopic, to the macroscopic. As such, materials theory/computation play dual roles: 1) supporting and explaining complex</p>	YES

⁷ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
experimental efforts, as well as 2) providing fundamental theoretic underpinnings that are important to advancements in the basic science of materials.	
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>The quality of the projects funded by CMMT is evidenced by the number of papers published and cited as outcomes from the awards. Approximately 900 papers were published in a variety of journals from Nature and Science to ACS Nano and NPJ Comp Materials between 2019 and 2022 with more than 6000 citations. Both the number of papers and their impact (as evidenced by the average number of citations) speak to the quality of the results.</p>	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

It seems that important topics in the program are covered by funded proposals. We identify no obvious gaps or shortcomings. We appreciate that the dwell time has been reduced over these past four years since the last COV. We applaud the POs' effort to make this happen. All the same, there are still examples of long dwell times and these can hamper a PI's ability to provide for their graduate students and support an active research program. Perhaps the restriction against submitting new proposals to the same program, while a current proposal is under review, could be lifted so that PIs of proposals with long dwell times are not disadvantaged.

On another topic, several COV members expressed concern that open deadlines were not good, that perhaps they were hurting under-represented groups. There seems to be no evidence for this. Furthermore, in contrast, we see that the number of high-quality proposals submitted to CMMT, for which funding would be well-justified, far exceeds the number for which there is actual budget to support. A reduction in the total number of submissions is not necessarily a bad thing. Reducing the total number of proposals that PIs write and that reviewers must review is good as long as the funding rate is high and not all high-quality proposals can be funded.

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

Broader impacts are one of only two merit criteria by which research proposals are judged. There is some concern about whether broader impacts "promises" are kept to the same degree that scientific intentions are. How do we keep PIs accountable when it is easy to make statements about broader impacts but which do not have the same deliverables (papers) as research does? A couple of ideas include holding PIs accountable via the annual reporting process or reporting previous broader impact efforts as part of the "Prior Funding" part of new research proposals.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

In real dollars, NSF budget has been decreasing over many years. In terms of global competitiveness, this seems unwise. Although there are many ways to spend tax-payer money, investment in science and

technology has a history of paying very large dividends, supporting not only the national well-being but also national security.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.
5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

Our CMMT group felt that we learned a lot about the COV process during our three days at NSF. We could have benefitted from more specific guidelines and directions to help us prepare *before* the COV meeting started. We only had 55 proposals in our eJacket folder, so it would have been entirely possible for our group to have read (between the three of us) *all* of the PO analyses, for example, and looked through *all* the Diary Notes. But we didn't know that we had to do it and this was hard to do during the COV meeting. This level of preparation would have helped us be better informed and would have been entirely possible in the weeks leading up to the COV onsite meeting. As it was, we had to read this information at the same time we were writing the report.

Also, it would also have been nice to be acquainted with our team some time before the meeting. We could have divided up reading, strategized about how to work effectively together at the meeting, brainstormed together. If the members of the COV subgroups could establish contact with one another other before the meeting and begin distributing the materials among themselves, it could enhance the thoroughness of the material review process, given the substantial volume of materials involved.

4.8 Condensed Matter Physics (CMP)

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>1) Panel reviews Vs Ad Hoc: Panel reviews (in-person, hybrid, and virtual) are in general more efficient and comprehensive compared to adhoc reviews. Panelists can compare proposals and during discussions have the opportunity to see aspects of the proposal they might have missed. Panel reviews are also important because conversations with other experts in the field may lead a reviewer to change her/his rating. This is difficult to do without real time interaction. Hence panel reviews offer a much fairer process. Panel reviews are also efficient from the PO's perspective. Ad Hoc reviewers cannot give comparative ratings which panelists can. Such comparative ratings are crucial in determining the relative quality of a proposal.</p> <p>2) The open submission window has made it more difficult to organize Panel reviews. The impact of the no-deadline submission model on organizing the panel reviews and the impact on the quality of the review process remains concerning. This was already noted by the previous COV. With the open submission, it takes longer to organize panels which has resulted in an increased response time.</p> <p>3) Virtual panels play an important role in the review process. Virtual panels allow reviewers who may not be able to fit travel into their schedules</p>	<p>YES</p>

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>easily to participate in the process and this can help to engage people with small children or other caregiver responsibilities, high teaching loads, remote areas, disabilities, etc.</p> <p>4) Site visits are important and appropriate for large group proposals. They provide crucial information about existing facilities as well as institutional support.</p>	
<p>2. Are both merit review criteria addressed?</p> <p>a) In individual reviews?</p> <p>b) In panel summaries?</p> <p>c) In Program Officer review analyses?</p> <p>In general, both merit review criteria are addressed in individual, panel review summaries and in PO review analysis. In individual reviews, the quality of the feedback on intellectual merit (IM) is generally very good, however, the comments on broader impacts (BI) can be quite perfunctory.</p> <p>a) In individual reviews: IM is always addressed, whereas the quality of the comments on BI are highly varied in the reviews. The level of expertise regarding BI varies quite widely. Among reviewers there is substantial confusion about what BI entails, and the time, energy, novelty and assessment tools that make for a strong BI. There are frequent comments on the lack of a specific element or elements, e.g., outreach, or recruitment plan. These comments suggest that reviewers often have a very specific idea of what they think the BI should entail. There is a growing appreciation of BI within the community, but more education on the importance, purpose, and breadth of possibilities for the BI is still needed.</p> <p>b) In panel summaries: These too, tend towards more details regarding the IM. However, the COV notes that panel summaries allow for more nuanced understanding of BI, often driven by the PO.</p> <p>c) In Program Officer review analyses: The Program officer’s review analyses cover both merit review criteria in substantial detail.</p>	YES
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>1) Most reviewers offer a careful and detailed assessment. There are a few reviews that either have less technical knowledge of the topic, or offer little to no rationale for the ratings they propose. Occasionally, reviews verge on rude (and not useful). A minority of the reviews contain comments that are not based on information provided in the proposal This is true for both the Intellectual Merit and the Broader Impact. The COV recognizes that NSF has added training to address the issue of using information from outside the proposal. This should be continued.</p>	YES

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>2) There is a lack of uniformity in the level of detail provided in individual reviews. More troubling is the situation in which a particular reviewer gives a low rating (such as good or poor) but does not provide either justification for the rating or feedback to the PI on how the proposal can be improved. Perhaps better guidelines for what the review should include should be provided to ad hoc reviewers.</p> <p>3) The discussions of broader impact at the start of panels has been helpful to try to educate reviewers and should be continued. Reviewers do not all consider the broader impact with the same level of importance. Additional reminders on what BI should be provided to reviewers at the time the reviews are assigned.</p> <p>4) In reading through the large number of reviews available for this COV, there are a SMALL minority of startlingly dismissive reviews, that are both discouraging and unhelpful for the PIs. PO intervention in these cases may be useful.</p>	
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>In most cases they do.</p> <p>In some cases the panel summaries are more superficial than substantive. Panel summaries are more important when the PI receives a low rating and/or the proposal is not recommended for funding.</p> <p>For proposals that are rated moderately competitive, special attention should be paid to the panel summary so that the PIs can better understand the merits that lead to funding if funded, or, conversely, the primary issues that led to a decline. Many of the panel summaries do achieve this but not all do, and this information is helpful to PIs for both funded and declined proposals.</p>	YES
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>1) Yes, the documentation in the jacket (especially the PO's review analysis) is valuable to understanding the rationale for award/decline decision.</p> <p>2) The POs review analyses are well written, provide a lot of candid detail, and are an important reference especially in cases when excellent proposals are declined. These reports also reflect the extent and efforts of the POs in reviewing the proposals and reviews in their analysis towards making award decisions and are important to obtain a full understanding of the rationale of decisions. (The COV notes that it would be useful if part of this analysis could be made available to the PIs. It would provide valuable information to the PIs).</p>	YES

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <ol style="list-style-type: none"> 1) The quality of individual reviews can vary considerably. Reviewers' comments (especially those of ad hoc reviewers) can sometimes be terse. When reviewers fail to read the proposal carefully, this can be frustrating and bewildering. Clear guidance on what is expected from reviewers would be useful. 2) From the reviews, it is sometimes hard to tell the difference between critical flaws in a proposal and small issues. Again, it might be a good idea to give guidance to reviewers on how reviews should be written to give the best possible feedback to the PI. 3) As described above, there are numerous misconceptions about BI and the scope and extent of the BI efforts that are required/ desirable. Here, the panel summary which often contains the gist of the discussion can be very helpful. 4) A helpful aspect is a conversation with the PO because this provides further context on the reviewer's comments and helps the PI determine which reviews were given more or less weight during the panel discussion. 5) In response to the 2019 COV report, the CMP Program added PO comments to every declination. This provides important insight into the rationale for the decision that is valuable to PIs. The COV suggests that these comments should be more extensive when the proposal is declined. 6) The review analysis of the POs generally contains detailed information that provides clearer insight into the rationale for the decision. Some of this information may be very valuable to the PIs. This is especially important for moderately competitive but declined proposals. 	YES
7. Additional comments on the quality and effectiveness of the program's use of merit review process:	

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>1) The reviewers have a good range of expertise. The fact that the POs make every effort to find qualified reviewers is especially commendable given the large COI issues that many PIs have.</p> <p>2) We commend the POs for their efforts to recruit new qualified reviewers (more junior as well as from underrepresented communities).</p>	YES
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>As far as we can tell. There is a well-defined process for reporting and evaluating conflicts of interest.</p>	YES
<p>3. Additional comments on reviewer selection:</p> <p>The COV would like to comment that sometimes panels get hijacked by one or two aggressive panelists. In these cases it is important for the PO to consider whether the reviewer should be invited back for service on future panels or to find an active mechanism for managing such panelists.</p> <p>PO control of the panel is very important in these cases, and skilled coordination of the panel can make an important difference.</p>	YES

MANAGEMENT OF THE PROGRAM UNDER REVIEW
<p>1. Management of the program.</p> <p>1) The POs are doing an excellent job managing the program and maintaining a very diverse portfolio covering a wide area of topics in CMP. This is especially commendable given the large numbers of proposals and programs the PO has to interface with.</p> <p>2) The COV appreciates that the POs in CMP are focused on and committed to supporting fundamental research.</p> <p>3) The POs are very proactive in recognizing and developing emerging areas with community input with opportunities to grow the role of CMP in materials for Quantum Information Sciences and to expand in areas in soft condensed matter.</p> <p>4) The program managers do an excellent job of coordinating with other divisions and agencies to look out for the best interests of the CMP community.</p> <p>5) The open submission window has made program management more difficult. It is difficult to compare proposals arriving at vastly different times. Panel reviews are highly valued by the COV, however, panel reviews have become difficult to organize since proposals on one topic are not</p>

MANAGEMENT OF THE PROGRAM UNDER REVIEW	
<p>submitted within a certain time period. If the open submission window is continued, creative solutions may have to be found for these problems.</p> <p>6) The PO's workload in CMP seems to be excessive. Hiring more POs is important. Given how lean NSF's operational budget is, it seems like it could be well justified.</p> <p>7) Ideas to encourage quality submissions from minorities and from geographic regions with low submission numbers and low funding rates should be encouraged. Suggest using regional meetings attended by smaller institutions as an outreach opportunity in underserved regions.</p>	
<p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>1) CMP is certainly responsive to emerging research opportunities. This is apparent in the way program portfolios have evolved with clear changes in the relative funding levels of various topics over time in response to emerging interests in the community.</p> <p>2) In addition, programs like EAGER allow for a rapid response to high risk but potentially exciting new ideas.</p> <p>3) There is a huge untapped potential for improving diversity and broadening participation through education and outreach in traditionally disadvantaged populations (either geographically or economically). Some programmatic changes at the higher levels may be needed to make larger impacts. As was noted already by the previous COV, the very high workload for CMP Program officers remains unsustainable and hampers progress in this area.</p> <p>4) The limited resources available are a concern and many highly rated proposals in emerging areas cannot be funded.</p>	
<p>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</p> <p>The portfolio is driven by the need to support fundamental research in TMRP and Career proposals that the program receives. Through community input (organizing workshops to discuss community needs), the POs identify new areas of funding that are not well represented in the portfolio. New areas can then be funded through the mechanism of 'Dear Colleague Letters'.</p>	
<p>4. Responsiveness of program to previous COV comments and recommendations.</p> <p>1) Some comments of the previous COV have been addressed/incorporated while others have not. For example, the previous COV clearly indicated that an open submission window was not recommended and also indicated that more POs lines are needed for the CMP program.</p> <p>2) The program has responded to the previous comments regarding the confusion about BI by instituting more training. Data on the effectiveness of this training would be useful.</p>	

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p>	<p>YES PARTIALLY</p>

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1) Since the CMP portfolio is developed in response to the submitted proposals, it is well representative of the disciplines and subdisciplines within CMP.</p>	
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>1) Award sizes have not changed much over the last few decades while inflation and graduate student and post-doc salaries have increased dramatically. While this is a welcome development for humane reasons, (and makes PhDs more attractive for promising students), it puts huge upward pressure on budgets. Moreover, expectations for the scope of an NSF proposal have remained unchanged. This makes it difficult to carry out a proposed project with just one award.</p> <p>2) A three-year award means that the PI has to write a new proposal after two years of the award. Depending on the complexity of the projects this is sometimes too little time to make progress. This award time period is also not consistent with a typical graduate students PhD time frame. A four year award would allow PIs to plan their projects as well as their budgets, while making it possible to support a student through the attainment of their PhDs.</p> <p>3) While large equipment requests can be made through the MRI program, there is no clear funding mechanism for small equipment (\$100K to \$300K) other than supplemental funding, or through a limited number of larger grants, e.g., MRSEC. There was a program called Instrumentation for Materials Research that funded exactly these types of proposals more than a decade ago. This type of funding is critically needed in institutions with fewer resources, and at larger institutions where resources are also increasingly strained. CMP PIs often need very specialized equipment that is critical for research and training students but not necessarily well suited to the broad user base that is often favored at the institutional stage of the MRI process since the MRI grants are limited submission. The NSF should consider bringing the Instrumentation for Materials Research program back.</p>	YES, PARTIALLY
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>1) The CMP program does endorse truly innovative proposals. The reviewers' responses to innovative proposals vary. Some level of innovation is looked upon favorably by reviewers and is generally viewed as necessary. However, it is difficult for truly transformative/highly innovative proposals to get funded. This is partly due to the perceived risk. In these kinds of proposals there is often less proof that the idea will work and reviewers often react to this negatively. The balance/benefits of higher risk/highly innovative versus no-risk programs should be discussed in detail in panel reviews, further illustrating the importance of the panel process. POs may have to use their discretion in handling these proposals,</p>	YES, PARTIALLY

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>and potentially facilitate matching proposals to suitable mechanisms, e.g., EAGER.</p> <p>2) PIs also recognize that high risk projects may or may not generate a plethora of results. The need to balance impact (number of publications versus citation) can give PIs pause. It would be advisable to take a holistic approach to evaluating Final Reports that weighs these factors, and avoid focusing solely on highly cited publications.</p> <p>3) The EAGER funding mechanism provides an important avenue for potentially transformative research that are considered high risk, high payoff.</p>	
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>1) CMP itself funds mainly disciplinary condensed matter research, which is appropriate for this program, however the larger portfolio of DMR is extremely inter- and multidisciplinary (MRSEC and DMREF are great examples). Having said this, there are some proposals within CMP that are co-funded with other programs within DMR. CMP POs also manage the Quantum Foundries which are multidisciplinary centers,</p>	YES
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>1) The two coasts have a disproportionately higher number of funded grants, with large gaps in the center of the country. The Expand QISE call is a great example of a program that seeks to remedy this situation. More such directed programs may be necessary to improve geographic diversity, including visits by NSF personnel to these states to increase the number of applicants.</p>	NO
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Despite the existence of a large number of public bachelor's granting institutions, there are a negligible number of awards going to these institutions, as opposed to private ones. This may be a matter of submissions, so outreach to these institutions is important.</p>	YES
<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p>	YES

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1) The Career program is a lovely tool for early career investigators and should receive continued support. The career program is always reviewed by a panel and is therefore a very good training ground for early career investigators to learn how to write successful grants.</p> <p>2) The career program likely does not capture many young PIs not from R1 institutions. A program specifically dedicated to them may be worth considering.</p> <p>3) Outside the Career program, CMP data on new investigators were not available. However, the POs are active in engaging in new faculty. The program officers of CMP continue to host workshops for new PIs and engage in outreach to the general community and early career researchers through site visits and hosting workshops at major meetings such as the march meeting.</p>	
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>1) While all (a very high proportion) of funded projects include an educational and outreach component, some proposals go the extra step and integrate research with education (for example a course or a hands-on activity that is connected to the research being done). But this integration is not a necessary component of broader impacts.</p> <p>2) The quality of these efforts often depends on the resources available to the PIs within their departments and Universities. Moreover, the quality of this integration varies because the audience (for example, whether for elementary, middle or high school, vs. outreach to the public) varies. Integrating schoolteachers and other stakeholders within the project is important and necessary for these efforts to be impactful.</p> <p>3) In this context, clear guidance on what is expected for broader impacts would be useful. Also, clear guidance on how PIs may leverage existing education and outreach programs while making their own impact on the programs would also be very useful.</p>	YES
<p>9. Does the program portfolio have appropriate participation of underrepresented groups [1]?</p> <p>The DMR program has made strides in increasing the representation of PIs who are minorities so that funding rates are equalized. (This is less so for TMRP grants). However, there are several concerns:</p> <ol style="list-style-type: none"> 1. The number of proposals submitted each year by minority institutions is small. Efforts should be made to encourage submissions from minority institutions either through outreach to these schools or other efforts. 2. The number of proposals, both submitted and funded, written by minority PIs is very low. The COV strongly endorses the plans for CMP to restart workshops for new PIs, and to encourage the attendance of minority PIs. 	YES, PARTIALLY

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>3. As raised in a recent publication, https://elifesciences.org/articles/83071#sa1, there has been a significantly lower NSF funding rate for Asian as compared to non-Asian PIs. DMR statistics provided to the COV show a similar trend. Note that the statistics provided to the COV, indicate that the success rate of an 'unknown' population (not self-identified) is by far the lowest. It could be that if that population is not homogenous it could change the relative success rate - Asian, white, black or African American. The COV encourages the POs to monitor this trend and to understand it.</p>	
<p>10. Is the program relevant to national priorities, agency mission, relevant fields, and other constituent needs? Include citations of relevant external reports.</p> <p>1) Yes, the program both influences and draws upon national priorities and agency missions. For example, in response to the national quantum initiative the agency created new large scale multi-institutional centers, i.e., the Quantum Leap Challenge Institutes. There are currently five of these Institutes. CMP has also responded to the NQI act by increasing the fraction of PIs funded in Quantum. CMP POs manage the Quantum Foundries which are multidisciplinary centers.</p> <p>2) The POs obtain input from the community by organizing workshops, attending conferences and visiting individual institutions. This allows them to remain current and respond swiftly to constituent needs. A very nice example of this is that even before Helium instrumentation was included as track 3 in MRI, the CMP POs were able to support PIs using helium by providing funding for small scale liquefiers.</p>	YES
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>The support of fundamental research is a key aspect of the CMP program. Connections to applications are important, but fundamental research is the basis of long term progress. The COV commends the POs for maintaining an emphasis on fundamental research.</p>	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.
 - A. Better definition of broader impacts and training for PIs and reviewers on what Broader impact activities are suitable for the scope of the proposal.
 - B. More funding for underrepresented/minority serving institutions.
2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

CMP is an excellent program, with a diverse portfolio. The untapped breadth and depth of the CMP research is curtailed by the lack of funds. Increased funding would lead to increased high quality fundamental research.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.
 - a. The POs are extremely dedicated, but they are stretched very thin, and the COV is concerned that this is unsustainable without an influx of additional resources. The NSF should consider increasing the number of POs for CMP.
 - b. NSF must maintain its commitment to fundamental scientific research as outlined in the mission statement.
 - c. NSF should make an effort to increase the number of panel reviews as these lead to stronger outcomes and better feedback to PIs.
 - d. Outreach to minority serving, primarily undergraduate institutions and underrepresented states is best done by POs traveling to regions that are currently showing low submission rates and/or experiencing a low funding rate and talking to potential PIs. This should be encouraged.
 - e. The landscape of data management is changing rapidly at present. During the time period considered by the COV, the POs in CMP have offered PIs the opportunity to amend data management plans that are present but not completely in line with FAIR data practices without this having an effect on funding decisions. The COV encourages this educational approach. Additional guidance or examples of how to store data in a way that is useful to the community is needed.
 - f. The NSF should work on providing or directing PIs to a centralized set of tools for data archiving. This will help PIs to more easily satisfy the FAIR data practices, and ensure that the investment in time needed to organize and query the submitted datasets is reasonable. In the absence of a centralized tool, the PIs will need to spend a significant amount of time figuring out how to satisfy the FAIR requirements.
4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

The percentage of funded proposals in the area of soft condensed matter as compared to hard condensed matter has increased from 14% in 2018 to 22% 2022 and, because this represents a substantial increase, the COV discussed the pros and cons of separating soft and hard CMP. The COV feels that this is too soon to make a decision on whether to separate the two areas or not, especially since these last four years have been somewhat unusual for a variety of reasons. The COV recommends that CMP look into the reasons for the increase and suggests this could be done by holding a workshop to survey the soft condensed matter community and continue to monitor the submissions to determine if this trend continues.

5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.
 - a. We strongly support the COV process. There are technical details that could be improved, including the e-jacket and Sharepoint systems which were clunky and took some getting used to.
 - b. Separate break out rooms for each group, or more space between tables, would improve the working experience since, while cross conversations are fun, it is difficult to concentrate.
 - c. Some additional data that would have been relevant for the COV to perform the assessment include:
 - the number and funding rate of new investigators being awarded grants,

- the evolution of the size of requested funds for non-funded proposals vs funded proposals, and
 - the proportion and number of awards and dollars provided to-non R1 institutions, HBCUs and other minority serving institutions.
- d. The table should include the ability to write Yes , No or Partially. In many cases some of the criteria are satisfied but not all.

4.9 Electronic and Photonic Materials (EPM)

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>The review methods are appropriate. Three to five independent reviewers evaluate the proposal, which is followed by panel discussion. When a PI changes institutions, the PD has a process to assure that the project can transfer to an institution that is capable of supporting the work (no additional reviews needed). The outcome of the panel is a panel summary with recommendation for priority for funding considerations. Since March 2020, all panels have been virtual. Proposals needing specific expertise had additional ad-hoc reviews. Each panelist is assigned up to 6 proposals. Up to 30% of the proposals with below-average review ratings are eligible to be placed in the “do not discuss” category. The decision for such placement has to be voted on and approved unanimously by all panelists. For proposals that are discussed by the panel, the placement of the proposal in the “highly competitive”, “moderately competitive”, and “not competitive” categories are based on the panel consensus. The panel summary reflects the nature of panel discussion and disagreements between panelists’ opinions, if any. When one of the reviewers had a very low rating as compared to the other three reviewers and disagreed with the panel assessment, the PDs secured an additional review and wrote an extensive analysis. This effort ultimately led to funding of the proposal, and it speaks to the diligence of the PDs.</p> <p>EAGER proposals and Creative Extensions are reviewed internally by the PDs.</p> <p>The COV finds the review methods in EPM to be appropriate and to be implemented thoughtfully and fairly.</p>	<p>YES</p>
<p>2. Are both merit review criteria addressed?</p> <ul style="list-style-type: none"> a. In individual reviews? b. In panel summaries? c. In Program Officer review analyses? <p>The criteria of “Intellectual Merit” and “Broader Impact” are considered by the individual reviewers, addressed in the panel summary, and reflected in the PD review analysis. The PDs send out templates and instructions to reviewers and panelists which specifically emphasize the importance of addressing both criteria. The PD’s presentation to the panelists, preceding each panel review, also includes this information.</p>	<p>YES</p>
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>There is a diversity of substantive comments from the reviewers from their perspectives which must be assessed by the panel. There was varying emphasis from the reviewers on the science merit strengths and weaknesses, others the broader impacts, and others the</p>	

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>transition to possible applications. In some cases, it appears that an additional review was sought to clarify reviewer disagreements or supplement possible lack of specific technical reviewer insight. The panels generally translated, added towards, and merged the reviewer information in their panel summaries, with edits to maintain anonymity. Given the future NSF emphasis shift towards use inspired research, it will be interesting how future panels will shift emphasis to reflect this goal.</p>	YES
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>The panel summaries provide the strengths and weaknesses related to intellectual merit and broader impacts, and proposal competitiveness. The panel summary also reflects discussion and, in some cases, statements on disagreements among the panelists, if any. Each panel summary provides the rationale for the panel consensus and concludes with the following statement: "The summary was read by/to the panel and the panel concurred the summary accurately reflects the panel discussion."</p>	YES
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>The PD's review analysis was greatly aided by a thorough panel review - when available. However, there was unevenness between the various available panel summaries. PD should aim for more consistency from panel summaries. If the PD can coax more discussions from panels for lower rated proposals, this information is potentially useful for providing areas of improvement for PIs encouraging them to participate in future calls.</p>	YES
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>The rationale offered in communications could be more consistent from proposal to proposal. Proposals that were competitive during the review but were declined generally had more useful feedback for the PI to help them improve. However, the available panel summaries were somewhat uneven in the specificity offered. More help from the PD for reaching panel summary feedback consistency would be helpful. Also, more encouragement from the PD to help panels generate more comprehensive summaries</p>	YES

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
(even with brief statements of strengths and weaknesses) will be helpful for the PIs improve and encourage future proposal submissions.	
<p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>The COV was inspired by the example of the project that had impactful innovation but was deemed too high-risk by the reviewers, for which the PDs found a four year/CGI mechanism to fund the innovation. This highlights the commitment of PDs to promote innovative science.</p>	

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>The EPM program has a diverse research portfolio, which requires diverse reviewer expertise to evaluate the proposals. This is reflected in the reviewer pool which shows affiliations across a variety of disciplines - Physics, Chemistry, Chemical Engineering, Materials Science, Mechanical Engineering, etc. There were examples of reviewers from a diversity of organizations, i.e. different types and locations of universities and national/government labs. The PDs use the Suggest Reviewer Dashboard and have developed an extensive database of potential reviewers based on previously and currently funded researchers in the appropriate field and researchers identified via relevant presentations at professional meetings and keyword searches on databases such as Web of Science.</p> <p>The PDs attend three professional conferences (APS, MRS, AVS, etc.) a year, to stay current. This practice should continue, and PDs should be encouraged to attend various professional meetings, including regional conferences. It might help further diversify the reviewer pool to solicit interest in identifying potential reviewers at these meetings, including those from relevant session chairs or topical groups/forums/committees at professional meetings. NSF could consider offering a reviewer boot camp for postdocs or early career faculty at some of these meetings.</p>	YES
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>The PDs use established guidelines for identifying conflicts of interest (COI) which are applied consistently in proposal evaluation. Reviewers are required to complete a conflict-of-interest form prior to reviewing proposals. PDs also remind panelists to</p>	

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>excuse themselves if they discover a conflict after the submission of the COI form. A possible area of improvement is to provide more background and discussion at the start of the reviews or carry out a pre-review training session.</p>	<p>YES</p>
<p>3. Additional comments on reviewer selection:</p> <p>Some science groups or meetings have a diverse membership from underrepresented groups, genders etc. For example, SACNAS, NSBP, NSHP etc. NSF could benefit from engagement with these groups to identify and train new reviewers, which may also help solicit broader proposal participation.</p>	

MANAGEMENT OF THE PROGRAM UNDER REVIEW
<p>1. Management of the program.</p> <p>The EPM program is managed by two PDs - a permanent staff member and a rotator, a welcome change from two rotators (which was suggested by the COV 2019 and implemented in 2020) and a program specialist. The permanent PD position is an excellent way to ensure continuity and longevity of institutional knowledge relevant to the program. The PDs have passionate support from their staff, although student intern turnover is a challenge. To further promote continuity, it would be helpful to have an overlap between outgoing and incoming rotators. Given that the PDs are involved in a number of other activities such as interdisciplinary programs, in addition to managing the EPM program, it would be helpful to coordinate the solicitations deadlines to balance the workload for the PDs.</p> <p>The PDs are clearly passionate about the program and creative in finding ways to fund higher numbers of competitive proposals via partnerships with other NSF programs and help PIs understand the process and feedback to improve their chances for getting funded. They clearly work hard, but perhaps have limitations in terms of time for reaching out and networking with various science communities or with program officers in other relevant agencies (like Office of Science, ARPA-E etc.)</p>
<p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>The EPM program responds to national and societal priorities classified as the NSF 10 Big Ideas. Building on semiconductor research in response to the CHIPS and Science Act, and emerging research in Quantum Materials and Clean and Sustainable Energy are program priorities. The EPM program also works jointly with the Designing Materials to Revolutionize and Engineer our Future (DMREF) and Electronics, Photonics and Magnetic Devices (EPMD) programs to respond to emerging research.</p>

MANAGEMENT OF THE PROGRAM UNDER REVIEW

To continue this responsiveness, support for PD participation at relevant scientific conferences is important. In addition to Science conferences like APS, ACS etc., networking at conferences like the ARPA-E Summit may also be helpful since these conferences offer a complementary perspective in topics like Climate Change and Clean Energy that could help guide fundamental science investment that may have a chance to realize science inspired research aspirations.

There are engagement gaps in ‘inspiring the missing millions’ by a lack of proposal successes in a number of states, like NM, the Dakotas, Idaho and Alabama. Some of these locations have government or national lab R&D that could be leveraged via collaboration by local universities for successful EPM engagement. Dialogue with universities and scientific meetings at these locations could result in positive change. Broader DOE dialogue (beyond Office of Science, like ARPA-E or AMMTO) could help EPM better understand the fundamental science needs that applied energy programs can build from for their translation of use inspired research for accelerating technology and innovation as targeted by NSF. This could also help EPM sponsor workshops to guide future fundamental research strategy.

It would help future EPM PIs if “best practices” for research-education integration for past and existing projects could be shared by EPM for continued adaptation and innovation.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

The EPM has a diverse portfolio of funded research related to semiconductors, quantum materials and clean energy. In addition to the NSF Big Ideas driven by the agency as a whole, the program would make use of a strategy for portfolio development or prioritization. Engagement with other agencies interested in clean energy (like ARPA-E) or beyond Moore devices (like AMMTO) can potentially guide fundamental research priorities that can meet NSF goals for fundamental science as a foundation for use-inspired research for accelerating technology and innovation.

4. Responsiveness of program to previous COV comments and recommendations.

The EPM responded to five concerns from the 2019 COV.

1. Template for Panel Reviews
 - a. Response: Specific reviewer instructions and template are provided in advance of panel
2. Selection of Reviewers
 - a. Response: Actively use the “Suggest Reviewer Dashboard” and maintain comprehensive list
3. Program Management Concerns
 - a. Response: A permanent EPM PD was hired in 2020
4. Provision for Small or Medium Scale Instrumentation Awards
 - a. Response: EPM now allows for inclusion of mid-level instrumentation funds in project budget
5. Award Amounts in Program Portfolio
 - a. Response: EPM award budgets increased as well as the award rates. This improvement was partially due to the decrease in post-COVID submissions. COV hopes that this trend continues when the submission level recovers.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>50% of the awards are to Material Science and & Engineering and Physics disciplines. The other half is awarded to engineering disciplines such as Electrical and Computer Engineering and Mechanical Engineering. The top 5 awarded multidisciplinary topics include:</p> <ul style="list-style-type: none"> ● Thin-films (29) - structure, electronic transport, optoelectronic and magnetic properties, etc. ● Band-gap (43) - single particles, wide bandgap, carrier lifetime, etc. ● Charge Transport (22) - charge and energy transfer, electronic coupling excited states dynamics, etc. ● Magnetic Fields (15) - field effects, domain walls, polarization states, magnetic moments, etc. ● Room Temperature (15) - quantum emitters, point defects, free carrier generation, etc. <p>EPM program interfaces with other programs within the DMR (CMP, BMAT, DMREF) and Engineering (EPMD), while maintaining a balance between the fundamental materials science and applications. The fundamental versus use-inspired balance of awarded projects is difficult to quantify, but the EPM strategy might be positively impacted by dialogue with agencies that focus more on use inspired R&D like ARPA-E (clean energy) and AMMTO (energy efficient microelectronics and manufacturing for clean energy). This has the potential to identify fundamental science needs that could translate to use-inspired R&D for accelerated technology and innovation.</p>	<p>APPROPRIATE</p>
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>The average award size and duration are generally appropriate for the scope of the project, with the data showing an upward trend of the average award size with time. This is partially due to open submissions which resulted in a decrease in the number of proposals. It is recognized, however, that the operational costs of carrying out research projects have considerably increased. COV commends the PDs for finding creative ways for expanding the budget via partnerships and hopes that it would be possible to identify additional mechanisms to increase the purchasing power of the NSF awards.</p>	<p>APPROPRIATE</p>
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>About 10-20% of the projects have potentially transformative ideas and generate publications in Science, Nature, Physical Review Letters, and Nano Letters. There are</p>	

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>projects that have relevance for fundamental science needs for next generation microelectronics. There is a recent shift for fundamental science for energy efficient microelectronics (i.e., reflected by AMMTO and the SRC), which is an opportunity for more investment in fundamental neuromorphic computing materials R&D. Also, clean energy priorities reflected by ARPA-E etc. suggest the need for more fundamental science investment in wide band gap materials and properties for power electronics needed for radical implementation of electrification for transportation, renewable energy integration and the next generation grid.</p>	APPROPRIATE
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>About 20% of all EPM proposals are multi-institutional; additional collaborative proposals include interdisciplinary collaborations from the same institution. There is a significant flow of funds received by and provided to EPM from divisions such as the divisions of chemistry, physics, materials research, and the electrical, communications, and cyber systems, which highlights the inter- and multi-disciplinary nature of the program portfolio.</p>	APPROPRIATE
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>The research portfolio has a good representation of many states across the US. The funding rates are varied, with institutions on both coasts having higher success rates. There are geographic engagement gaps in ‘inspiring the missing millions’ by a lack of proposal successes in a number of states, like NM, the Dakotas, Idaho and Alabama. This gap would be mitigated by an engagement strategy for these areas that could help generate more competitive proposals, possibly leveraging collaborative resources at nearby government or national labs to augment university resources. Creative use of virtual engagements with more technical conferences or universities may help overcome time and budgetary constraints.</p>	APPROPRIATE
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>About 90% of funded proposals come from PhD-granting institutions .Over the past three years, five RUI awards were made to PUIs, which is a good beginning, but would be important to grow. Engaging with potential PIs from the PUIs via institution visits or at events such as regional professional society meetings may encourage higher numbers of quality submissions from these institutions.</p>	APPROPRIATE
<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate</p>	

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>About 25% of all proposals are those from new investigators. The funding rates for the new investigator proposals are in the 16-29% range, and are similar to those for the proposals from experienced PIs.</p>	APPROPRIATE
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>EPM leverages CAREER projects which have a major education component. The program receives 25-35 CAREER proposals (which require integration of research and education activities) a year and funds 20-28 % of these proposals, comparable to the overall funding rate of 16-29% in the EPM program and more broadly across the DMR. Other EPM projects also have an education component, which usually targets student researcher STEM development, as a part of workforce training.</p>	APPROPRIATE
<p>9. Does the program portfolio have appropriate participation of underrepresented groups?</p> <p>About 25% of all proposals submitted to the EPM program are from female PIs, with funding rates in the 14-40% range, comparable to that of 21-31% for male PIs. The number of proposals from ethnic minority PIs remains low. COV encourages active efforts in engaging with HBCU/minority-serving institutions. Some of these are located in states that do not have any active EPM projects. Engagement in professional societies that have significant populations of underrepresented groups may help identify and inform new PIs that can help diversity the EPM portfolio. COV notes that the demographic data are self-reported and so the reported values could underestimate the true participation of PIs from under-represented minorities in the program.</p> <p>There is an opportunity for EPM to leverage NSF PREM investment with EPM relevant thrusts for PI pipeline development.</p>	APPROPRIATE
<p>10. Is the program relevant to national priorities, agency mission, relevant fields, and other constituent needs? Include citations of relevant external reports.</p> <p>The agency targets Chips Act, Quantum Initiative and Clean energy initiatives. Fundamental research is needed to enable other agency or industry development for accelerating technology innovation. When handing off fundamental science for science with a purpose, balance must be maintained between the investigation of novel materials and a deeper understanding of fewer, most technologically relevant materials. Engagement with agencies interested in fundamental science to application development (like ARPA-E, AMMTO) may help EPM better guide fundamental R&D for accelerating impactful innovation.</p>	APPROPRIATE

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>Relevant External Documents:</p> <ol style="list-style-type: none"> 1. The 2017 NSF-EPM Workshop Report on <i>Current Challenges and Future Opportunities in Electronic and Photonic Materials</i> and the 2019 <i>National Academies’ Frontiers of Materials Research: A Decadal Survey</i> outline research priorities critical for the nation’s prosperity and security and for the NSF mission. These reports lay foundations for the needs in development and understanding of conventional materials and emerging materials systems. 2. The reports on the Materials Genome Initiative (MGI) which was launched in 2011 by the White House Office of Science and Technology Policy such as the most recent 2023 report entitled “<i>NSF efforts to achieve the Nation’s Vision for the Materials Genome Initiative</i>” impact the EPM program in two ways. The first one is through encouraging integrated experimental and theoretical/modeling projects, especially incorporating AI (and machine learning in particular). Examples of Awards related to this aspect are the CAREER award on understanding factors limiting stability of hybrid perovskites via automated synthesis of a diverse range of novel compositions (DMR-2043205) and a project focusing on the discovery of materials for new THz sources (DMR-2104317). The second is through embracing FAIR data standards, particularly for the integrated experimental/modeling projects such as those noted above. 	
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>The EPM portfolio has a good balance of new topical materials research program (TMRP) grants and continuing grant increment (CGI) awards. 20% of the portfolio budget is allocated to CAREER awards.</p>	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

The EPM portfolio could benefit from projects targeting a more fundamental understanding of materials with potential for enabling energy efficient electronics like neuromorphic devices. This is also potentially relevant for calibrating spintronics, 2D materials and plasmonics R&D priorities. Achieving energy efficiency requires a deeper fundamental understanding of mechanisms that mitigate energy dissipation, that can be handed off for use inspired R&D and accelerated application. PD discussions with agencies like AMMTO or industry/consortia (like SRC) can help guide EPM goals consistent with NSF goals. These discussions can also help calibrate thermoelectrics R&D activity, since sustainable clean energy priorities have evolved. There is a need for more fundamental science understanding of

wide bandgap semiconductors relevant for next generation power electronics with higher breakdown, frequency and efficiency characteristics. Advancing fundamental power electronics understanding is useful for handing off to sustainable clean energy development for enabling improved renewable energy integration, transportation electrification, and next generation electric grids.

The organic semiconductor and perovskites investment might benefit from a renewed R&D strategy. These materials have limitations or bottlenecks that threaten materials stability and performance. It could be beneficial to prioritize R&D efforts that better understand and tackle these limitations using innovative approaches rather than investigate more and more systems with limited fundamental understanding of bottlenecks. Additional benefit may come from investigating specifically targeted organic-inorganic hybrid materials where organic layers enhance device performance and/or functionality.

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

EPM reports a low number of proposals from underrepresented populations like African Americans, Hispanics, gender groups etc. Therefore, the number of awards are also quite low. New strategies for encouraging the submission and award rates should be a priority (i.e., leveraging PREM investment in EPM relevant areas, pro-active virtual or other engagements with committees/forums at conferences with significant populations of underrepresented groups). Virtual or other sessions to better inform and equip these new investigators are also needed. New investigator workshops for postdocs and early career investigators should continue and expand their reach to non-R1 and under-represented minority-serving institutions, to help new investigators prepare for peer reviews, as a step towards preparing them for successful submissions.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

NSF has done a great job of funding universities to conduct scientific research. However, it has not developed a good strategy to incorporate the k-12 community into the proposal submission and project implementation process. The teachers are completely dependent on university faculty for involvement in research and/or educational integration. All funds and materials must pass through the university first. This is not always the case for projects funded by industry.

NSF should also be vigilant for unintentional stovepipes that may exist that may adversely affect projects that may lie in a gap between different parts of the agency. This should be a consideration if existing topics split further into additional parts.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

Given the NSF priorities to link fundamental research to use inspired R&D that impacts clean energy, beyond Moore's Law, and photonics with accelerated technology and innovation, EPM would benefit from increased dialogue and interaction with agencies like ARPA-E and AMMTO. NSF would benefit from more discussion that leads to a more consistent agency understanding of the fundamental science versus use inspired science balance for achieving accelerated technology and innovation goals, and the useful coordination needed with other agencies.

5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

COV highly appreciated the availability of PDs to answer the COV questions and provide additional information and insight into the program. Participants from some organizations (i.e. Sandia) could not access the NSF SharePoint due to organization computer policy issues. This difficulty should be addressed to help make these participants better equipped to contribute. Having a shared platform in place for the sub-groups to work collaboratively at the onset would be desirable.

4.10 Metals and Metallic Nanostructures (MMN)

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE OR NOT APPLICABLE
<p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>Since the last COV report in 2018, the MMN program has continued to rely on off-site panel reviews. The number of fully <i>ad hoc</i> mail reviews decreased from 45 in 2019 to under 20 in 2020-2022. After 2020, most proposals were by virtual panels that included at least 1 or more <i>ad hoc</i> reviews. The PO noted that the addition of <i>ad hoc</i> reviewers with deep expertise in the subject matter of the proposal was particularly helpful when the virtual panelists lacked expertise in the specific topic area which in general resulted in higher quality reviews.</p>	YES
<p>2. Are both merit review criteria addressed?</p> <p>a) In individual reviews?</p> <p>b) In panel summaries?</p> <p>c) In Program Officer review analyses?</p> <p>Intellectual Merit (IM) and Broader Impacts (BI) are both addressed in individual reviews, as well as in the panel summaries and PO review analyses.</p>	YES
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Individual reviewers provided substantive comments to explain their assessments of most proposals they reviewed.</p>	YES
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>The panel summaries provided a detailed rationale for the panel consensus of a given proposal. If the panelists were not able to reach a consensus on their assessment of a proposal, the reasons were provided in the panel summary.</p>	YES
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision? [Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>When proposals are rated, they are placed into categories ranging from “do not consider” to “non-competitive”, “moderately competitive, and “highly competitive”. The rationale for a decision to award or decline is thoroughly documented in the panel summaries and in the PO review analysis. The PO review analyses are very detailed and provide explanations and justifications of the rationale for the award/decline decisions.</p>	YES
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision? [Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the</p>	

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE OR NOT APPLICABLE
<p>panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Individual reviews and a panel summary are shared with the PI and provide the rationale for the award/decline decision. In the case of a declined award, PO Comments are provided to the PI as a way for the PO to suggest a path forward and provide feedback on the proposed work. Additionally, the PO encourages telephone conversations with the PIs, especially to provide further feedback for a decline.</p>	YES
<p>7. Additional comments on the quality and effectiveness of the program’s use of merit review process: The quality and effectiveness of the merit review process is more than adequate and meets all acceptable standards.</p>	YES

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p><i>Ad hoc</i> reviews provided a way to target reviewers in terms of expertise and demographics and is a helpful mechanism for growing the diversity of the virtual panels. The PO utilized NSF’s database of past reviewers, along with reaching out to the researchers in the metals community in order to expand the pool of potential reviewers in terms of demographics, geography and institution.</p>	YES
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>MMN does a good job of recognizing and resolving conflicts of interest (COI) when appropriate. COI documents submitted by proposal PIs are reviewed by the PO during selection of reviewers to avoid COIs, particularly for institutional COIs. Reviewers are also vetted for potential COI when being assigned proposals.</p>	YES
<p>3. Additional comments on reviewer selection:</p> <p>The COV panel notes that although the total number of Topical Materials Research Program (TMRP) proposals reviewed decreased during 2020 to 2022 (from 103 to 63, respectively), the total number of reviewers increased during the same period (from 94 to 130, respectively). This was due to the virtual panels (5-6 panelists) typically being smaller than in person panels and reviewing fewer TMRP proposals, which ideally resulted in more comprehensive reviews.</p>	YES

MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

MMN is supported by one PO and one administrative support staff member, who also supports CER and SSMC. The COV found that MMN has done a great job in meeting its performance goals which include increasing diversity in qualified reviewers, making award determinations within 6 months for at least 75% of proposals, and responding to PI inquiries on average within 2 weeks. Although the MMN Program is a relatively small program within DMR (~\$10M), it maintains a similar funding rate to other programs within DMR (approx. 25%) and continues to serve PIs across the US. Since the 2019 COV report, the total number of proposals reviewed by MMN decreased from 151 in 2018 to 117 in 2019, and later dropped to 76 in 2022. MMN transitioned to a no-deadline model in FY22 which could be one explanation for the decrease in number of proposals received. The reduction in number of proposals provided opportunities for the PO to extend the average award durations from 3.0 years in 2019 to 3.3 years in 2022.

2. Responsiveness of the program to emerging research and education opportunities.

The COV is impressed with the breadth and depth of the MMN portfolio and found that the POs have done a good job staying abreast of developments in the field and investing its available resources. MMN sponsored several workshops of relevance to the Metals community, such as workshops on ICME, nano-alloys, physical metallurgy, materials needed for space, and glass science and engineering. The MMN program has funded cutting-edge research in several areas, including additive manufacturing, property-microstructure relationships in new complex alloys, e.g., high-entropy alloys, electrochemistry, oxidation and classical nucleation.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

The MMN portfolio has changed significantly since 2018. For example, the investment in core Physical Metallurgy research has decreased from ~50% in 2018 to ~30% in 2022. The 2019 COV report expressed that new insights into oxidation mechanisms would benefit the development of new advanced Ni-and Co-based superalloys. The current portfolio includes continued investments in high-entropy alloys, oxidation and nucleation.

4. Responsiveness of program to previous COV comments and recommendations.

The 2019 COV report noted concerns that MMN did not have any EAGER proposals in its portfolio. In 2022 MMN funded one exploratory proposal at the level of an EAGER. DMR also responded to the 2019 COV concern by hiring a permanent PO for MMN in January 2023. The 2019 COV also recommended that MMN be more active in workshops. MMN responded by sponsoring 8 workshops of relevance to the Metals community. The PO anticipates that more engagement with PIs and researchers through MMN sponsored workshops will provide space for authentic conversations on cutting edge research and relevant research topics, potentially leading to more solicitations for EAGER proposals going forward.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?	APPROPRIATE

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>The program portfolio consisted of an appropriate balance of awards across topic areas, such as 30% physical metallurgy (mechanical properties, grain structures, plasticity), 20% nanocrystals, 15% phase transformations, 10% metallic glasses, 10% magnetic materials, 5% high entropy alloys, 5% oxidation, and 5% electrochemistry corrosion.</p>	
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>The TMRP program portfolio included average total award dollars that ranged from approximately \$450k to \$600k for durations ranging from 3.0 years to 3.3 years from 2019 to 2022, respectively. The COV found this to be an appropriate size and duration for the MMN program.</p>	APPROPRIATE
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>The COV is impressed with the portfolio of projects which included several that were innovative and/or potentially transformative. Some examples include the development of a pioneering and new technique in MSE, cepstral scanning electron microscopy that will provide the ability to view nanometer scale defects with atomic resolution; work on sustainability and performance in renewable energy storage via Li alloying and dealloying; and high-pressure diamond anvil cell research combined with CVD deposition and FIB toroidal designs.</p>	APPROPRIATE
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>In 2019-2022, MMN funded shared projects with CBET, CMMI, DMS, and DMR. Additionally, while the program portfolio was primarily composed of MSE (41%) and ME (26%), other disciplines such as physics (11%), chemical engineering (10%), aerospace (3%), etc. were appropriately represented.</p>	APPROPRIATE
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>The geographical distribution of the MMN portfolio is like that of DMR as a whole. However, some upper Midwest and Southern states were not well represented. Several public institutions awarding Metallurgical Engineering degrees are located in EPSCoR states (AL, MT, NV, SD) and are not funded (MT, SD). There are also several states with strong research infrastructure and notable metals research efforts that are generally unrepresented in MMN (e.g. SC, MS, WA, OK, WV etc.) with several being EPSCoR states. The current PO sees these EPSCoR states as opportunities from which to expand geographical representation of reviewers which hopefully will lead to more proposals submitted from these states.</p>	APPROPRIATE
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>The program portfolio appears to have an appropriate balance of awards from HBCUs, private institutions, and public institutions.</p>	APPROPRIATE

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>During 2019-2021, MMN has funded between three and five new CAREER awards each year at an average award size of ~\$550K, averaging ~\$110K/yr for a typical 5-year grant. In 2022, ARP funds received in 2022 facilitated an increase to nine new CAREER awards. The level of support to new and early career investigators seems appropriate for the MMN program.</p>	APPROPRIATE
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Yes, at least 50% of projects integrated research and education, mostly through broader impacts. Some examples of this integration included undergrad research support and advancements in research leading to outcomes resulting in updating outdated textbooks. This MNN portfolio also included CAREER awards which represented 5% of the MMN total budget for 2022.</p>	APPROPRIATE
<p>9. Does the program portfolio have appropriate participation of underrepresented groups⁸?</p> <p>The program portfolio includes several projects that are led by PIs who are underrepresented in engineering. Also, many projects aim to work with underrepresented populations as part of their outreach activities in broader impact activities. However, overall, the number of participants from underrepresented groups is still quite low in comparison to total number of projects funded. The PO aims to increase the diversification of the reviewer pool indirectly increase the diversity of the PIs submitting proposals to MMN. The COV recognize this is a common problem across all programs within DMR and within NSF.</p>	SOMEWHAT APPROPRIATE
<p>10. Is the program relevant to national priorities, agency mission, relevant fields, and other constituent needs? Include citations of relevant external reports.</p> <p>Yes, but materials behavior under extreme conditions is lacking. This is possibly due to the fact that facilities well suited for experimental studies of materials under extreme conditions are quite expensive to purchase and operate. For instance, there are less than 10 universities in the U.S. with gas gun and explosive facilities, which are routinely employed to</p>	APPROPRIATE

⁸ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
study materials under extreme dynamic environments. NSF must encourage university researchers to collaborate with national laboratories where these facilities are common.	
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>This COV panel is strongly impressed with the quality of the awarded projects and how balanced the portfolio is.</p>	APPROPRIATE

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

There exists a major gap in materials behavior under extreme conditions. Novel materials are being developed for use in extreme dynamic conditions, but universities are not well equipped to properly study them experimentally. The experimental facilities required to study and develop a fundamental understanding of material behavior under extreme dynamic environments can be quite expensive to develop and maintain i.e. gas or powder guns, explosives, etc. Therefore, NSF must encourage university researchers to collaborate with national and defense laboratories where these facilities are common and well-funded.

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

Although NSF has done a good job with increasing the participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); it is of paramount importance to maintain such a program to facilitate a diverse workforce in the future. Note that industry leaders are encouraging STEM diversity in the workplace because it has been good for business.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

None.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

None.

5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

Details of the review process, as well as a webinar, were provided to COV members early on. Materials were also available in advance of the onsite meeting. Because this process was new and unfamiliar to many, and a lot of information and materials were provided, there was uncertainty in what was expected for the reporting until the first meeting day. The review process can be further improved by ensuring earlier in the process that COV members understand what is required of them and how to navigate NSF systems. The reviewers appreciated the responsiveness of the PO in answering all questions and providing clarification when needed.

4.11 Polymers (POL)

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>The COV members find that the email review of individual proposals is very effective in soliciting a range of useful opinions and diverse expertise and background. The panels for CAREER and other specific solicitations likewise are appropriate. The choice of review methods is appropriate. Fittingly, panel reviews have been used for groups of similar proposals, but email reviews allow a greater diversity of reviewers to be involved in the review process. The reviews by the Program Officer made rapid funding decisions possible when appropriate, and they encouraged the seeding of higher-risk research.</p> <p>As the Polymers Program evolves under later leadership, we strongly urge continued use of email review to the utmost extent practical with a focus on including interdisciplinary reviewers from diverse backgrounds in the broader materials community.</p>	YES
<p>2. Are both merit review criteria addressed?</p> <p>In individual reviews?</p> <p>In panel summaries?</p> <p>In Program Officer review analyses?</p> <p>The reviewers on the whole are selected to be experienced and knowledgeable, and hence provide usefully detailed reviews. Merit review criteria were addressed effectively in the individual reviews and panel summaries. The Program Officer Review analyses and summaries were found to be superb and judicious. The COV members were impressed by the high-level balance and perspective in the Program Officer review analyses and summaries.</p>	<p>YES</p> <p>YES</p> <p>YES</p>
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Nearly all the reviewers wrote substantive comments. The program officers are congratulated on finding reviewers who provided substantive comments in lieu of vague generalities. The COV members were impressed by the positive and constructive feedback given to the PIs. We were favorably impressed that reviewers were selected from a researcher cohort to which the prospective PI belongs: senior PIs were reviewed by established experts while CAREER award reviewers included a broader range of experience. All levels of review included reviewers from communities with appropriate diversity.</p>	YES
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Panel summaries provided to us concerned only the CAREER awards, as other proposals were reviewed <i>ad hoc</i>. The panel summary decisions were found to effectively capture reasons for the</p>	YES

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>final decision. The rationales for decisions were expressed constructively and adequately addressed strengths and weaknesses with balanced discussion.</p> <p>Especially impressive was that the panel summaries provided to the prospective PI were so extended and detailed in instances when the proposal was declined. This effectively serves as constructively valuable training for when the PI will submit other proposals at later times.</p>	
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>The Program Directors provided rationales that were exceptionally effective. They were found to be clear, lucid, thoughtful, constructive, and convincing. They synthesized the ad hoc reviews and were fair in identifying the occasional reviews that were superficial in the sense of being too brief or lacking in depth. The Panel Summaries and Program Officer review analyses were consistent.</p> <p>The COV members were provided with a worthwhile balance of easy decisions for and against funding, and other useful instances that were borderline, giving us the opportunity to gauge the appropriateness of the program review process. The COV members are favorably impressed.</p> <p>Panel reviews especially of declined proposals sometimes lacked detail, but this was not the case of the Program Officer review analyses, which contained extended discussion tailored to the particular proposal, and avoided the boilerplate language found in the panel review.</p>	YES
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>The decisions were communicated exceptionally clearly with written documentation and phone calls as appropriate. Declines were handled gently and constructively, pointing out clearly to the PI the strengths and specific weaknesses that could be improved. We are impressed that decisions were written as specific responses to specific proposals, avoiding boilerplate language.</p>	YES
<p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>Reviewers were judiciously chosen to provide diverse backgrounds and expertise, and they were capable of providing negative reviews in cases that warranted this. All comments were</p>	

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
considered carefully and adequate justification for the ultimate decision was communicated clearly. The only area in which we see opportunity to improve the merit review is by bringing into the process some reviewers from a broader materials community.	

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>The reviewers came from a mix of academia and national labs as well as industry, as appropriate. Proposals from primarily undergraduate institutions or other institutions with special circumstances appropriately included some reviewers from these communities. The COV members are favorably impressed that reviewers were selected from a researcher cohort to which the prospective PI belongs: senior PIs were reviewed by established experts while CAREER award reviewers included a broader range of experience. All levels of review included reviewers from communities with appropriate diversity.</p>	YES
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>We did not perceive conflicts of interest and presume that potential conflicts were resolved before the formal review process. It appears that reviewers were appropriately screened at the stage of reviewer selection. Anecdotally we learned that in the rare case when a conflict of interest was identified, the reviewer was removed accordingly.</p>	YES
<p>3. Additional comments on reviewer selection:</p> <p>The use of reviewers from the broader international polymer community was viewed very favorably by the COV members.</p>	

MANAGEMENT OF THE PROGRAM UNDER REVIEW
<p>1. Management of the program.</p> <p>The Polymers Program has been fortunate to be led by a permanent Program Officer with superb connections with the polymer community, spanning industry, national labs, and universities, both within the U.S. and internationally. The Program Officer's deep involvement in the relevant professional organizations, especially those in the ACS, APS and MRS, has benefited the program and provided guidance to these communities, while interactions and promotions of polymer science across NSF have expanded new cross-cutting initiatives. Of special significance was this program's leadership in identifying sustainability as a cutting-edge programmatic need to which NSF now contributes broadly across many programs.</p>

MANAGEMENT OF THE PROGRAM UNDER REVIEW

The Program Officer is commended for having such an efficient and rapid review process. We were informed that 97% of proposals received a decision within 6 months of submission. The Program Officer’s effective management of this program has been recognized at upper levels of the NSF for exceptional breadth, multidisciplinary, and diversity. The program has supported young investigators and diverse communities with exceptional success. Notably, the Program Manager was twice recognized by the NSF Director for success in diversity, most recently during the current COV review period.

We also recognize that the Program Officer’s wise service to the broader NSF community outside the Polymers Program has contributed to advancement of the TIP and sustainability efforts, and surely to other DMR efforts more widely. The institutional memory of having a Program Officer with longevity at NSF has served the program well and likewise the Division. Tangible evidence of this impact includes co-funding with other programs.

2. Responsiveness of the program to emerging research and education opportunities.

The program has a significant focus on CAREER awards, with a funding success of more than 30%. It has funded 11 RUIs, and also LEAP and EIR grants. We find that the program successfully participates in all relevant opportunities of which we are aware. It has an exceptionally good record in broadening participation (25 EPSCoR, 14 HBCU/HSI). These education opportunities have successfully merged the education and research missions, while allying the program’s research with NSF-wide priorities relating to sustainability, health, climate, and emerging industries.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Planning and prioritization received much community input through the decadal NSF Polymer Workshop with 6 other agencies (2017) report, updated by the NASEM Decadal Materials Survey (2019), and dozens of conferences, workshops and symposia, as well as meetings with hundreds of PIs. The alignment with NSF priorities including sustainability and TIP is also excellent.

4. Responsiveness of program to previous COV comments and recommendations.

The Program has convincingly responded to the previous COV comments and recommendations. We note that although the previous COV recommended more investment in the Polymers program, contrary to this recommendation the DMR Management cut the FY22 budget by 13%, this reduced budgetary level becoming the new base for FY23.

In response to the previous COV Report’s opinion that funding per year should be higher, we commend the program for finding methods to highly increase the average award size. In response to the previous COV Report’s recommendation to see more investment in depolymerization, the Program noted that this area is primarily covered in CHE but nonetheless strongly increased its investment.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>This field’s exceptional breadth and multidisciplinary are correctly reflected in the Program’s portfolio. Dispersed among 13 self-identified disciplines, sustainability is rightly</p>	YES

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
the largest component, tied with self-assembly/nano. The newer disciplines such as AI and machine learning are not part of the program's mandate because DMR reviews theory and modeling separately in CMMT. Proposals that combined experiment and modeling were appropriately co-reviewed by the Polymers Program.	
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>The Program is commended for finding ways to increase both the size and duration of the awards. The average of \$143 K/year and 3.9 yr mean duration are impressive. We urge the Program to continue this pattern of long-term funding under the management of new Program Directors.</p>	YES
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>The multiple Creativity extensions, EAGER and RAPID proposals funded represent the impressive innovativeness of this Program. One example of output is the work on a single-component mRNA delivery system, published in 2021 and 2022, which is currently in negotiating agreement with multiple mRNA companies.</p> <p>Other examples are 3 Science papers generated from 3 separate awards, on the subjects of electron transfer in all-polymer materials, desalination membranes, and stretchable electronic devices. The excellent representation of Polymers Program grant awardees in not only NAE but also NAS further shows the transformative track record of this Program.</p> <p>Other outstanding evidence of the Program's success is the metric of awards. PIs supported by this Program dominate the list of recipients of the ACS Polymer Chemistry Award and the APS Dillon Medal for young scientists.</p>	YES
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>The Program invests systematically in such projects. For example, in 2021 \$783 K were co-funded to other programs, of which \$463 K was co-funded to DMREF.</p>	YES
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>The Program funded, during FY19-FY22, awards in 39 of the 50 states distributed across the U.S., including 25 EPSCOR awards. The number of awards appears to be appropriately weighted when one considers relative population and abundance of higher learning institutions in the respective states.</p>	YES
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Awards are weighted to Ph.D. institutions but also include a significant percentage of PUI institutions. The number of HBCU and HSI awards is impressive.</p>	YES

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p> <p>The funding rate is slightly less for new than prior PIs, for example 14% as against 28% in FY2021, but the number of submissions from new PIs is small, so these different fractions may not be statistically significant. In FY22, CAREER awards amounted to 6 out of 20 total awards; amounting to nearly 30%, this is a healthy proportion. When defining early-career as within ten years of receiving the last diploma, the Program funds approximately 30% early-career investigators, which is a healthy number.</p>	YES
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>The program has a significant focus on CAREER awards, with a funding success of more than 30%. It has funded 11 RUIs, 4 REU supplements, and also LEAP and EIR grants. The COV members find that the program successfully participates in all relevant opportunities of which we are aware.</p>	YES
<p>9. Does the program portfolio have appropriate participation of underrepresented groups⁹?</p> <p>It has an exceptionally good record in broadening participation (25 EPSCoR, 14 HBCU/HSI). These education opportunities have successfully merged the education and research missions.</p>	YES
<p>10. Is the program relevant to national priorities, agency mission, relevant fields, and other constituent needs? Include citations of relevant external reports.</p> <p>Planning and prioritization received much community input through the decadal NSF Polymer Workshop with 6 other agencies (2017) report, updated by the NASEM Decadal Materials Survey (2019). The Program was responsive to constituent needs, for example by participation at dozens of conferences, workshops, and symposia, as well as meetings with hundreds of PIs. The responsive alignment with NSF priorities including sustainability and TIP is also excellent.</p>	YES
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p>	

⁹ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

<p style="text-align: center;">RESULTING PORTFOLIO OF AWARDS</p>	<p style="text-align: center;">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p>
<p>There was considerable discussion about the fact that the number of submitted proposals declined by nearly 50% between 2019 and 2022, from 120 to 67. Reasons for this alarming decline are unclear but are consistent with the experience of other DMR programs that switched to open-submission procedure. Whatever the underlying reason, the tangible effect was that the Polymers Program suffered a budget reduction of \$2M in FY22, which because it becomes the new base budget will present a sad loss of opportunity for upcoming years for the Program to fund deserving research and aid deserving new investigators.</p> <p>The COV members recommend that the Program proactively plan measures to prevent a similar misfortune from repeating. One method might be to even more broadly publicize and disseminate the successes of previous POLY award winners and the opportunities for new investigators to join them in emerging areas. Another method might be to even more broadly identify the opportunities in areas of fundamental polymer science to address the grand challenges of science and engineering.</p>	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

The COV members are surprised to find that DMR policy is to review theory and modeling centrally in the single CMMT program. With the increasing prominence of AI, machine learning, and sophisticated modeling and computational approaches generally, DMR may want to consider that theory and modeling can no longer be so cleanly separated from experiment as in the past. We recommend that DMR reconsider its policy to sequester theory and modeling to the CMMT program. Without wishing to be extreme, the COV members find this restrictive policy to be old-fashioned.

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.
3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

With the recent Supreme Court decision related to Affirmative Action, and the current elimination of DEI initiatives at many universities, the COV members are concerned about the capacity to respond to the need to broaden participation and address the "missing millions" priority area at NSF. We recommend that NSF consider this issue carefully to ensure the effective implementation of broader impacts to benefit society in line with the NSF mission.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

The COV members are concerned about the funding and integration of the TIP initiative. While the potential benefits remain compelling, we perceive that the actual implementation process is not clearly defined. With these uncertainties, we recommend that NSF carefully consider the implementation and plan appropriately to ensure that implementation does not come at prohibitive cost to existing programs.

The COV members would have liked more clarity about how budgetary decisions are made about distribution of funds between the DMR programs. It is unsatisfactory that we were given no information about internal DMR metrics used to compare the programs. It is unsatisfactory that we were given no information about feedback used by the DMR management to evaluate and compare the track records, relative importance, and relative achievements of the programs. We recommend that such information be given and emphasize that the previous COV report made a similar recommendation in 2019 that was not implemented.

Recognizing that every program is underfunded when one considers that so many deserving proposals are received, the COV members nonetheless feel that science evolves. We recommend that a strategic plan be developed by DMR management aligned with the NSF mission.

5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

The COV members consider that their review of this program would have been more informed and better balanced, had they been provided needed comparative information about the performance of other programs. We were given statistical information but not access to raw data about other programs. We felt this limited our effectiveness to evaluate the operation of this program.

The Program Director was wonderfully responsive to all questions and requests for clarification, and the COV hopes that this tradition will be maintained when the Polymers Program passes to leadership by others.

4.12 Solid State Materials Chemistry (SSMC)

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, <i>ad hoc</i>, site visits) appropriate?</p> <p>SSMC conducts reviews using in-person panels at NSF, <i>ad hoc</i> mail reviews, and virtual panels. 2019 and 2020 had similar numbers of total proposals (193 and 223 respectively) with a drop in 2021 (164) and further down to 2022 (110). These totals are predominantly TMRP proposals (148, 176, 128, 78; for 2019-2022 in order), CAREER proposals (40, 41, 30, 28; for 2019-2022 in order). It is uncertain why there is a recent falloff in some proposal numbers; factors could include the COVID pandemic and that over a period from 2020 to Q1 2021 the program moved to a pilot of a rolling submission rather than the fixed date deadline.</p> <p>In 2019 about 50% of the TMRP proposals were reviewed in-person, with slightly more than 25% virtual, and the remainder as <i>ad hoc</i>. In 2020 the proportion of TMRP proposals done in person increased to about 80% with the remainder shared between the two other methods. This drastically changed in 2021 where 95% of the proposals were reviewed in virtual panels the remainder being <i>ad hoc</i>, in 2022 the distribution was 50% virtual, 50% <i>ad hoc</i>. The change from in person panels was clearly influenced by the COVID pandemic. Additionally, in 2021 SSMC was allowed to suggest dates for themed submissions, that allowed for timely panels to be convened, but in 2022 it moved to totally open submission and hence a larger proportion of <i>ad hoc</i> reviews. The minimum number of reviews per proposals is mandated to be 3, but the vast majority had 4 reviews.</p> <p>For 2021, each proposal required at least two <i>ad hoc</i> reviewers in addition to three panel reviewers, but in 2022 one <i>ad hoc</i> reviewer was effectively expected. In panel reviews, the additional <i>ad hoc</i> reviewers, can provide specialized expertise that complements the knowledge base of the panel. However, the previous requirement of having 2 <i>ad hoc</i> reviewers in addition to panel reviewers was unjustified and did not always provide an added benefit. Flexibility in choosing an additional <i>ad hoc</i> review should be left to the discretion of the PO.</p> <p>The 2019 and 2020 CAREER panels were performed predominantly using on-site panels (~90%), and in 2021 and 2022, these were reviewed predominantly with virtual panels. A small number of CAREER proposals were reviewed via <i>ad hoc</i>. Most (if not all) CAREER proposals had 4 or 5 reviewers.</p> <p>In general, the review methods are appropriate. Given a sufficient number of proposals in a certain topical area, the COV feels strongly that panels are preferred over <i>ad hoc</i> reviews, with in person panels being preferred over virtual panels. The additional discussion that each proposal receives during a panel review enables a much more thorough review process and often more detailed positive and negative feedback for proposal writers. However, there are many topical areas where a critical mass of proposals is insufficient to justify a panel, and for those proposals, <i>ad hoc</i> reviews are justified.</p>	<p>YES</p>

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>However, the COV is concerned that making decisions based solely on <i>ad hoc</i> reviews eliminates the possibility of debate and community consensus, and has the potential to introduce bias into the decision making process.</p> <p>Recommendation: For proposals that show a wide discrepancy of scoring among <i>ad hoc</i> reviewers, it would be preferable to schedule a short virtual meeting amongst the reviewers and program officers, to gain greater consensus.</p>	
<p>2. Are both merit review criteria addressed</p> <p>a) In individual reviews?</p> <p>b) In panel summaries?</p> <p>c) In Program Officer review analyses?</p> <p>The intellectual merit and broader impacts are addressed in the individual reviews and panel summaries. Oftentimes the panel summaries provide a more detailed perspective of the committee and discussion on both intellectual merits and broader impacts. The PO review analysis brings together all aspects of the reviews and comprehensively discusses all criteria.</p>	YES
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>The individual reviews mostly do an excellent job in addressing the intellectual merits of proposals and the majority do an excellent job in providing constructive praise and criticism of the proposed science with sufficient context and depth.</p> <p>Reviews of the Broader impacts section can vary, with some positively reviewed but also rather sparsely discussed. This gives the impression that many reviewers focus more on the scientific impacts on society rather than on education and outreach. For the CAREER awards, the quality of the Broader Impacts elicits more substantive discussion. This can be counterbalanced by a more substantive report in the Panel Summary, when available.</p> <p>Recommendation: Effort should be made to help reviewers understand the importance of providing sufficient feedback in this section to help make the weighing of Broader Impacts consistent between panels and <i>ad hoc</i> reviews easier. This is particularly important in the current rolling submission where relative comparison from a panel is not always possible. Perhaps this warrants a stronger statement to reviewers with respect to the Broader Impacts across the NSF.</p>	YES
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>The panel summaries provide additional rationale for the panel consensus, beyond the additional reviewer comments, and are helpful in summarizing the important aspects of the group discussion beyond the details of the individual results.</p>	YES

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>The documents in the jacket were complete and provided an excellent overview of the review process and documented all steps taken for each proposal extremely well. The PO in his/her review analysis does an excellent job in summarizing the Intellectual Merit, the Broader Impacts, the panel discussion, and makes it very clear why a proposal was funded or not funded.</p>	YES
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>The panels typically triage the lowest ranked proposals, specifically those that have no chance to be funded. This leaves more time for discussion of the more meritorious submissions. The downside for PIs is that the individuals who are triaged do not receive feedback summaries from the panel, although they do receive the individual comments from each reviewer. Overall, the POs make a strong effort to provide constructive and specific feedback on proposals that are not funded, in order to help submitters. The POs write very detailed summaries to explain why a proposal was or was not funded and address both the Intellectual Merit and Broader Impacts. For many borderline proposals the review analyses do an extremely effective job of capturing the dynamics of the panel discussions. The PIs should be aware that the PO's have much more extensive insight into the panel discussion, and why the proposal was subsequently declined.</p> <p>To further aid PIs understanding of the decisions, the current SSMC POs generously make themselves available to personally discuss with a PI why a decision was made.</p> <p>Recommendation: PIs should be encouraged to contact the PO directly with a goal to improving proposal quality. POs should continue to engage with PIs who have unfunded proposals.</p>	YES
<p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>The COV members consider the PO dedication to the review process to be exemplary and they ensure that the review process is rigorous and fair.</p> <p>Recommendation: Succession planning needs to be considered for both PD and PO positions to allow sufficient time for transfer of knowledge, community understanding, and expertise in best practices for program operations.</p>	YES

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>We laud the SSMC program officers for being open in the process in choosing a diverse and balanced reviewing pool which they do by making efforts to meet the appropriate scientific communities at workshops and conferences. The fact that there is now a permanent program director maintains an institutional memory of the reviewer community, and aids in identifying high-quality reviewers.</p>	YES
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Conflicts of interests (COI's) are detected by place of employment and possible co-authors/collaborators as well as previous employers. This also includes COIs with any collaborators identified by PI's of proposals, identified by letters of collaboration. Reviewers are also asked to self-identify possible additional COIs with specific proposal PI's when assigned to the panel. These are resolved by either not selecting a possible reviewer for a panel or asking a reviewer to leave the room during discussion of a COI proposal. Only one proposal was identified where a COI existed between an invited reviewer and a PI. The reviewer was identified as a COI in that panel and submitted no reviews.</p> <p>Recommendation: Master thesis and Postdoctoral advisors should be permanent COIs (add a specific entry for "postdoctoral advisor" on proposal COA form, and also take into account when selecting review panels).</p>	YES
<p>3. Additional comments on reviewer selection:</p> <p>In-person panels are more effective for "training" new reviewers in the evaluation of proposals, and they are also excellent opportunities for more junior PI's to have exposure to the mechanics of the funding process and potential to weigh the diversity of proposal qualities. The POs are cognizant not to over-burden young faculty when deciding on reviewers.</p>	YES

MANAGEMENT OF THE PROGRAM UNDER REVIEW
<p>1. Management of the program.</p> <p>SSMC has one permanent PO and one rotating PO (2-4 year rotation cycle). The permanent PO position enables suitable knowledge of the SSMC community and the state of the art in the field.</p>

MANAGEMENT OF THE PROGRAM UNDER REVIEW

Workload comments The PO's have done an admirable job in handling the high number of proposals and processing them in a suitable timeframe, mostly faster than the 6-months mandate (one notable exception was in 2019 which included a period of extended government shutdown). This timeframe is in some cases dependent on outside factors such as EPSCOR. The PO's handle not only the high number of SSMC TMRP proposals, but also the additional workload that comes from specialty proposals from different programs.

Recommendation: adding another PO would benefit the program. *See additional considerations at the end of these tables.*

2. Responsiveness of the program to emerging research and education opportunities.

The PO's attend the major conferences in the SSMC field, ensuring they are knowledgeable about the current state of the art and emerging new research areas. SSMC also provides valuable funding to conference organizers including the Solid State Chemistry and Crystal Engineering Gordon Research Conferences, MRS conference, Winter schools and topical conferences such as the MXenes conference. It is commendable that the funding is targeted to support attendance by students or junior researchers. PO's should be cognizant of the level of effort it requires to organize workshops. When selecting organizers for a workshop, the POs should be aware that asking junior faculty to lead these workshops may exert undue influence, and junior faculty may feel pressured to comply.

SSMC also leverages support and funding for a number of programs to promote educational opportunities in the materials field, including:

- Alliances for Graduate Education and the Professoriate = to support graduate students from underrepresented groups, that are co-funded from MPS, DMR
- Graduate Research Supplement for Veterans = to support veteran graduate students that are co-funded from MPS, DMR
- Career Life Balances = 6 months extra funding for salary support in cases where PI's are undergoing significant life changes
- MPSI-High= to support high school student research
- Excellence in Research = a targeted program to support faculty at HBCU

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

The PO's keep abreast of the rising areas of importance in the field by attending conferences. NSF-sponsored workshops (such as a 2019 workshop on hybrid materials, and Hackathon 2020 on machine learning which was delayed due to COVID but occurred in Jan 2023) are also very useful in determining which research directions to prioritize. These enable the POs (and invited PIs) to learn about new research areas and future trends. SSMC/NSF identifies the nucleus of the topic and selects suitable PI's to organize the conference/workshop and set the agenda. Selection of PI's to organize these workshops prioritizes those who have not previously organized conferences and workshops and are not collaborators, providing a valuable opportunity for junior PI's to grow their network.

Recommendation: Continue interacting and engagement with the community to ensure a responsive program

4. Responsiveness of program to previous COV comments and recommendations.

The previous COV recommendations indicated "program would benefit from a more formal process to guide the identification of new research areas and prioritize current efforts, ideally taking advantage of the aforementioned periodic reports on emerging areas relevant to SSMC" and also included a similar comment "it is important to

MANAGEMENT OF THE PROGRAM UNDER REVIEW

continue to convene representative groups to help identify future directions of solid state and materials chemistry. Specifically, in order for the POs to identify emerging areas and for SSMC to remain responsive to emerging areas, new educational opportunities, and to pursue cutting edge science, it is necessary that such groups be convened on a regular basis, ideally every 5 years, to generate reports”

While NSF does not have an established series of “emerging research area” workshops and associated reports like DOE, the workshops that SSMC helps organize often result in summary reports (for instance, the Hybrid Materials workshop summary was published in *MRS Bulletin*) which point out the future directions of the new research area. The SSMC also looks at DOE, National Academy, and other agency reports from their workshops to identify areas of interest to SSMC.

Previous COV stated “Cutting edge research requires a strong foundation of functional equipment. Much of the equipment needed for a materials research lab is too expensive to be included in a TMRP grant, but not expensive enough for the high end major research instrumentation grants.” Unfortunately, establishment of “intermediate instrumentation funding” is not an issue that can be addressed within a program or division.

The previous COV indicated that “SSMC is a topically diverse program that is grounded in experiment and while computational contributions are welcome and, in fact essential for the success of the program, it is vital that computations are connected to experimental material science.” The SSMC responded to this recommendation by adding statements in the synopsis of their program that “While the SSMC program acknowledges the importance of computational materials chemistry and sees merit in studies that combine experimental and computational aspects, proposals submitted to the SSMC program need to contain at least an experimental validation component, if experimental materials chemistry is not the major focus of the research project.” This emphasis of the importance of experimental materials chemistry should be continued.

The previous COV requested “The PO should be prepared to direct the PI to look at individual reviews in order to obtain more specific critiques or examples of what can be improved.” This information is given to PI’s in the notification letter which provides links to the individual reviews and also contact information for the PO.

Recommendation: The PO should strongly encourage that the PI call them, since they can provide additional information about aspects of their proposal that were discussed during the panel review which can further educate the PI about how to improve the proposal for a future submission.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p style="padding-left: 40px;">The SSMC program portfolio maintains a balance of ~40 % inorganic solid state materials, ~30% organic materials, and ~30% hybrid materials. In addition, SSMC is one of the few funding mechanisms across NSF and for certain disciplines, for which the PD and PO recognize. Within each discipline, there are an appropriate number of proposals funded in the different sub-disciplines between material types, growth methodologies, and new characterization methodologies.</p>	APPROPRIATE
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p>	

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>From 2019-2022, the average TMRP award duration has been between 2.8-3.0 years, and 5 years for the CAREER proposal. For single-PI proposals, the average TMRP per-year amount has steadily increased from \$150K in 2019 to \$169K in 2022, which is much needed, considering the steady increase in graduate student salaries, tuition, overhead, and inflation. There is no increase in budget for multi-PI proposals. And it is notable that across DMR in general, funding has been flat for the last decade. The number of students per proposal supported has also been constant, while grad student stipends have increased. The method of dealing with this is that PI's decrease their summer salary in their proposal budget in order to pay their grad students. This is akin to elementary school teachers having to buy their students school supplies out of their own salaries.</p> <p>The changes in SSMC budget, either due to the 2022 American Rescue Plan (ARP) or budget increases, do not affect the per year amount, but the percentage of proposals that are funded. In 2020 there was a budget increase from \$16.1M to \$18.0M in 2022 ARP provided additional funding that went essentially to CAREER proposals, and improved success rates across the board for FY22.</p> <p>SSMC determines the award sizes and duration based on the proposed budget justification. Almost all PIs submit 3 year proposals due to historical trends, despite the fact that it typically takes 5 years for a student to earn a PhD. The PDs and POs do not discourage longer proposals, nor is there any evidence that such proposals are evaluated more harshly. There have been instances where the PD and PO have recommended shorter or longer proposals based on the reviews and the amount of work proposed due to hindered access to national facilities caused by shutdowns/upgrades. These recommendations occur along with a concomitant budget decrease/increase.</p> <p>With the recent drop in total submissions upon transitioning to an open submission deadline for the TMRP program, there is an excellent opportunity for the program and PI's to consider longer term proposals that align with the training of PhD students for the TMRP program. Recommendations: 1) provide guidance about submission of 4-year proposals. 2) funding level per grant should be increased in parallel with the rising costs of salaries and research materials.</p>	SOMEWHAT APPROPRIATE
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>:</p> <p>In general, the committee considers that at least 50% of submitted proposals are innovative and potentially transformative, receiving high rankings and complimentary reviews from panelists. This is based on the survey of the proposals that were funded and declined, as well as the COV's collective experience serving on panels.</p> <p>The quality of the funded proposals is borne out through the analysis of publications resulting from prior funding which have led to ~700 publications over</p>	APPROPRIATE

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>the last 4 years (with over 80 being in high impact factor journals) the total being cited ~5000 times. Similar impact would be expected from those proposals that were meritorious but declined due to lack of funds.</p>	
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>The very nature of solid-state and materials chemistry makes it a foundational science for materials research and technologies, and thus a central program to facilitate interdisciplinary projects. From 2019-2022, SSMC has actively jointly funded a large number of proposals that are interdisciplinary and multidisciplinary, as evidenced by the number of co-funded proposals across NSF. There were over 45 TMRP/EAGER proposals that have been co-funded within DMR (EPM, MMN, CER, CMP, POL, BMAT, and CMMT), along with CHE (CAT, CSDMB, SYN), and CBET (IE, CAT), along with OMA. In addition, SSMC has jointly funded a large number of workshops and conferences across these divisions as well as others including DMS, to target new and emerging interdisciplinary areas.</p>	APPROPRIATE
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>From 2019-2022, SSMC has received proposals from 46 states and Puerto Rico. SSMC awards have been made to PIs in 34 states. The geographical distribution is incredibly well-balanced across the United States, with the number of awards per region relatively proportional to the number of proposals received. In addition, no single state has a disproportionately larger funding rate.</p>	APPROPRIATE
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>The SSMC portfolio is balanced upon institution type. From 2019-2022 the number of TMRP awards granted to PI's at BS/MS-granting institutions have been 10%, 3%, 13%, and 3%, respectively. During these same years, the number of TMRP awards granted to private PhD-granting universities ranged from 23-36% and grants to public PhD-granting universities ranged 61-69%.</p> <p>The Proposals from primarily undergraduate institutions are reviewed in panels alongside proposals from R1 and R2 universities and are often among the highest reviewed proposals in each panel.</p>	APPROPRIATE
<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>NOTE: A new investigator is an individual who has not served as the PI or Co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or post-doctoral fellowships, research planning grants, or conferences, symposia and workshop grants.) An early-career investigator is defined as someone within ten years of receiving his or her last degree at the time of the award.</p>	APPROPRIATE

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>The SSMC has an excellent balance between new and early-career investigators. Across both the TMRP and CAREER awards, a total of 20-33% of the new awards are given to new and early-career investigators (2019-2022).</p>	
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Each TMRP and CAREER project in the SSMC portfolio has a significant broader impacts component in which the research and education components are effectively integrated. Across the entire portfolio, there is a diverse and complementary array of local, national, and international activities.</p>	APPROPRIATE
<p>9. Does the program portfolio have appropriate participation of underrepresented groups¹⁰?</p> <p>From 2019-2022, the funding rate for women ranged from 13-42%, for men ranged from 20-44%, and 14-45% when undeclared. The funding rate for self-identified minorities ranged from 8-43%, for non-minorities ranged from 21-43%, and undeclared 14-45%. There is no evidence of bias across different groups, the greater variance in per year funding rates for women and underrepresented groups is due to the fewer number of proposals received.</p> <p>Recommendation: Pursue and continue to improve all potential avenues to continue broadening participation of underrepresented groups.</p>	APPROPRIATE
<p>10. Is the program relevant to national priorities, agency mission, relevant fields, and other constituent needs? Include citations of relevant external reports.</p> <p>Several reports (2016 DOE Synthesis science report, NASEM 2019 Decadal report) indicate the importance of synthesis of advanced materials to the national economy and national priorities. It is notable that China is heavily investing in materials science (quadrupling their funding in this area), and this has resulted in publication rates that have now exceeded those of US researchers. Unless major increases in research support are made, the US will cede dominance in materials research. The research projects supported by SSMC are carrying out important work in relevant fields such as energy materials, batteries, superconductors, magnetism, quantum materials, and semiconductors. SSMC should be supporting a much larger fraction of submitted grants which are well-reviewed (on average, SSMC has enough funds to support the top 20-30% of submitted grants, but analysis of the reviews indicate that the top 50% of submitted grants are well-reviewed and merit funding). We note that in FY2022, the SSMC TMRP program had a 45% funding rate, due to a reduced number of proposals submitted, and the one-time supplemental 2022 ARP</p>	MOSTLY APPROPRIATE

¹⁰ NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p>funds, which means this high of a funding rate is unlikely to continue without a dedicated and consistent increase in funding.</p> <p>Recommendation: increase in amount of funding available, to support more research grants</p> <p>Scientific workforce development is also a national priority, and the work of SSMC is definitely relevant to this. In particular, support for graduate students is available. The emphasis on broader impacts leads to outreach at all levels (K-12, undergraduate, and graduate). It is notable that postdoctoral research is less supported, despite their importance to academic, industrial, and national lab activities. Numerous studies have approximated that >50% of chemistry PhD's immediately work in postdoctoral research positions.</p> <p>Recommendation: consider additional funding and/or fellowships for postdoctoral researchers.</p>	
11. Additional comments on the quality of the projects or the balance of the portfolio:	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

The COV feels that SSMC is well-balanced and reflects the breadth of research that occurs across organic, inorganic, hybrid, and nanomaterials. With the rolling submission deadline and broad materials mission, SSMC has sufficient flexibility to enable projects by new researchers, who are encouraged to investigate new directions in the field as they establish their scientific career. It is important to point out that throughout its entire history, research progress in the field of solid-state and materials chemistry has been extensively propelled by exploratory synthesis. A central aspect of exploratory synthesis is that it can appear random or scatter-shot but is typically hypothesis-driven. The fact that exploratory synthesis is supported by SSMC, enables discoveries of new materials and potentially new properties, applications, and research directions. The continued investment in solid state materials chemistry, synthesis and characterization science will continue to enable access to new synthetic regimes (pressure, solution-phase) that may facilitate discovery of new materials with the potential for transformative impact.

Recommendation: There is a need to educate the PIs that proposals are not restricted to only 3 year awards and that 4 may be justified.

Recommendation: Promoting and facilitating 2-PI grant submissions may be beneficial, given the increasingly collaborative nature of research projects (often combining experiment and theory)

Recommendation: Budgets for student and postdoc stipends need to be addressed in a national context.

Recommendation: Consideration should be given to increasing individual proposal funding maximums.

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

Workforce development and the education of future scientists is a stated goal of NSF. This needs to target all educational levels, including post-doctoral researchers. Funding levels should allow for the support of postdoctoral researchers if justified in the proposal. Establishment of suitable fellowships is also recommended. We note that while other divisions in NSF have postdoctoral fellowship calls, besides the ASCEND fellowship, DMR does not.

Recommendation: broaden opportunities for postdoc participation

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

It is evident that the workload on the program POs is excessive and runs the risk of PO burn-out and/or poses a risk to due diligence and rigor in the review process. The average workload for programmatic work in SSMS was 179 (for 1999), 178 (for 2000), 267 (for 2021), and 284 (2022) with additional proposal reviews needed co-funded proposals (~20 per year), supplements, and additional efforts needed for outlines (~400 in 2023). Further some POs have other program responsibility and

Roughly, this requires the PO to handle a proposal every 1-2 days. POs also have responsibilities to participate in other NSF working groups and other non-program related work which, while valuable for the agency at large, essentially reduces the work time that POs can dedicate to the program and reduces the handling time per proposal. The handling time for a proposal requires multiple steps: a rapid compliance scan; proposal sorting; detailed reading of the proposal; securing and assigning reviewers; holding the multi-day panel, writing RA review analysis and communicating results.

Recommendation: A detailed analysis of the SSMC and DMR workload should be performed to better understand current DMR portfolios and assess appropriate staffing across DMR.

4. Please provide comments on any other issues the COV feels are relevant, bearing in mind that COV reviews do not include assessment or evaluation of the outcomes or long-term impacts of program investments.

The increasing variety of state-level regulations and limitations on diversity equity, inclusion and accessibility (DEIA) statements may lead to confusion for PI's preparing broader impact plans.

Recommendation: the NSF should provide guidance on how to handle this aspect of proposal design, submission, and subsequent activities involving the PIs and grants.

5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

Eliminate questions in the report that are redundant.

Also, while the number of available proposal jackets is limited by COIs with the COV panelists, providing a list of the titles of funded proposals would give a better overview of research areas that have been supported by SSMC.

Appendix A: Charge to Committee

Division of Materials Research – Charge to 2023 Committee of Visitors (COV)

By NSF policy, each program that awards grants and cooperative agreements must be reviewed at four-year intervals by a COV comprised of qualified external experts. NSF relies on their judgment to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Reports generated by COVs are used in assessing agency progress in order to meet government-wide performance reporting requirements and are made available to the public.

Decisions to award or decline proposals are ultimately based on the informed judgment of NSF staff, based on evaluations by qualified reviewers who reflect the breadth and diversity of the proposed activities and the community. Systematic examination by the COV of a wide range of funding decisions provides an independent mechanism for monitoring and evaluating the overall quality of the Division's decisions on proposals, program management and processes, and results.

The 2023 DMR COV is charged to address and prepare a report on:

- the integrity and efficacy of the programs' processes and management including those used to solicit, review, recommend, and document proposal actions;
- the quality and significance of the results of the Division's programmatic investments;
- the relationship between award decisions, program goals, and Foundation-wide programs and strategic goals;
- the Division's balance, priorities, and future directions;
- the Division's response to the prior COV report of 2019; and
- any other issues that the COV feels are relevant to the review.

The COV report is made available to the public to ensure openness to the research and education community served by the Foundation.

The review will assess operations of individual programs in DMR as well as the Division as a whole for four fiscal years: FY 2019, FY 2020, FY 2021, and FY 2022. The DMR programs under review include:

- Biomaterials
- Ceramics
- Condensed Matter and Materials Physics
- Condensed Matter Physics
- Designing Materials to Revolutionize and Engineer our Future
- Electronic and Photonic Materials
- Materials Research Science and Engineering Centers
- Metals and Metallic Nanostructures
- Solid State and Materials Chemistry
- National Facilities and Instrumentation
- Partnerships for Research and Education in Materials
- Polymers

Division of Materials Research (DMR) COV Agenda

Where Materials Begin & Society Benefits

Location: Residence Inn


Address: 2345 Mill Rd. Alexandria, VA 22314

Date: September 13 – 15, 2023

Time: 7:30 am - 5:30 pm

WEDNESDAY, SEPTEMBER 13 – (NSF-E3410 (AM), Residence Inn)

- 7:30 am Light Refreshments (NSF)
- 8:00 am Welcome & Introduce COV Chair
Germano Iannacchione, Division Director, DMR
Tim Bunning, Chair and Kathryn Moler, Co-Chair
- 8:10 am Charge to the Committee of Visitors
Sean L. Jones, Assistant Director, Mathematical and Physical Sciences
- 8:20 am Overview of COI Policies
Germano Iannacchione, Division Director, DMR
- 8:35 am Overview of Division
Germano Iannacchione, Division Director, DMR
- 9:50 am Coffee Break
- 10:00 am Staff Environment & Activities
Velma Lawson, Program Support Manager, DMR
- 10:20 am COV Chairs Explain Agenda and Tasks
- 10:45 am Program Review (**Walk to the Residence Inn**)
COV assembles into 6 breakout groups in breakout rooms
Introduction to Programs by Program Directors
- 12:30 pm Working Lunch ([Lost Dog](#) - Alexandria)
Administrative Team – Meeting w/COV Chairs and Subcommittee





Division of Materials Research (DMR) COV Agenda

- 1:30 pm COV Review Jackets
- 3:30 pm Coffee Break
- 3:45 pm Finish Reading and Taking Notes on Tables 1 – 6
- 4:30 pm Chairs Meet with Committee to Discuss Progress ([Main Zoom Link](#))
- Any issues with tables 1-6, possible recommendations: Questions Tim and Kathryn should pose to the COV
- 5:30 pm Social Hour - (COV and DMR Staff @ Residence Inn)

DAY 2

THURSDAY, SEPTEMBER 14 – (Residence Inn)

- 
- 8:00 am Residence Inn
- 8:30 am COV returns to breakout groups to prepare the reports on Tables 1-6
- Combine individual templates into 1 report for each program
- 10:30 am Coffee Break
- 10:45 am Breakout Groups Complete Draft Reports
- 12:00 pm Working Lunch (Discuss progress and introduce other topics (questions 1-5) - (Tim) ([Main Zoom Link](#)))
- 1:00 pm Continue Lunch Discussion and Split into Breakouts to Work on Questions 1-5
- 3:00 pm Coffee Break
- 3:30 pm Re-convene to Consolidate Answers for Questions 1-5
- Tim and Kathryn should complete rough draft to look over by COB
- 5:30 pm Social Hour - (COV and DMR Staff @ Residence Inn)



Division of Materials Research (DMR) COV Agenda

DAY 3

FRIDAY, SEPTEMBER 15 – (National Science Foundation Room E3410)

- 8:00 am Light Refreshment
- 8:30 am Finalize Report and Prepare Final Recommendation/Findings Presentation
- 10:00 am Coffee Break
- 10:15 am Continue Finalizing Report and Preparing Final Recommendation/Findings
Presentation (COV Members)
- 10:15 am Meet to go over draft, assign tasks, decide what to ask DMR
Management and Krystle Wilson (COV Chair Tim Bunning and Co-Chair
Kathryn Moler) – Germano's Office **RM E9483**
- 12:00 pm [Working Lunch](#) (Prepare for Briefing the AD)
- 1:00 pm Meeting with Sean L. Jones ([Main Zoom Link](#))
- 2:00 pm Close



Appendix C: Summary of Materials Reviewed by Breakout Groups

NaFI- Summary Information

Summary Information
Date of COV: 9/13 – 9/15
Program/Cluster/Section: National Facilities (NaFI)
Division: Division of Materials Research (DMR)
Directorate: Mathematical and Physical Sciences (MPS)
Number of actions reviewed: 30 Awards: 17 Declinations: 13 Other: 0
Total number of actions within Program/Cluster/Division during period under review: 34 Awards: 9 Declinations: 25 Other:
Manner in which reviewed actions were selected: Manually selected, excluding conflicted proposals.

MRSEC- Summary Information

Summary Information
Date of COV: 9/13 – 9/15
Program/Cluster/Section: Materials Research Science and Engineering Centers (MRSEC)
Division: Division of Materials Research (DMR)
Directorate: Mathematical and Physical Sciences (MPS)
Number of actions reviewed: 21 Awards: 5 Declinations: 7 Other: 9
Total number of actions within Program/Cluster/Division during period under review: 86 Awards: 11 Declinations: 7 Other: 68
Manner in which reviewed actions were selected: Manually selected, excluding conflicted proposals.

PREM- Summary Information

Summary Information
Date of COV: 9/13 – 9/15
Program/Cluster/Section: Partnership for Research and Education in Materials (PREM)
Division: Division of Materials Research (DMR)
Directorate: Mathematical and Physical Sciences (MPS)
Number of actions reviewed: 23 Awards: 16 Declinations: 7 Other: 0
Total number of actions within Program/Cluster/Division during period under review: 28 Awards: 20 Declinations: 8 Other: 0
Manner in which reviewed actions were selected: All proposals submitted to program under review, only excluding conflicted proposals.

DMREF- Summary Information

Summary Information
Date of COV: 9/13 – 9/15
Program/Cluster/Section: Designing Materials to Revolutionize and Engineer our Future (DMREF)
Division: Division of Materials Research (DMR)
Directorate: Mathematical and Physical Sciences (MPS)
Number of actions reviewed: 95 Awards: 32 Declinations: 63 Other: 0
Total number of actions within Program/Cluster/Division during period under review: 776 Awards: 94 Declinations: 682 Other: 0
Manner in which reviewed actions were selected: Approximately 3% manually selected actions and 2% randomly selected actions, with additions to ensure all types of actions are represented.

BMAT- Summary Information

Summary Information
Date of COV: 9/13 – 9/15
Program/Cluster/Section: Biomaterials (BMAT)
Division: Division of Materials Research (DMR)
Directorate: Mathematical and Physical Sciences (MPS)
Number of actions reviewed: 43 Awards: 18 Declinations: 25 Other: 0
Total number of actions within Program/Cluster/Division during period under review: 858 Awards: 191 Declinations: 667 Other: 0
Manner in which reviewed actions were selected: Approximately 3% manually selected actions and 2% randomly selected actions, with additions to ensure all types of actions are represented.

CER- Summary Information

Summary Information
Date of COV: 9/13 – 9/15
Program/Cluster/Section: Ceramics (CER)
Division: Division of Materials Research (DMR)
Directorate: Mathematical and Physical Sciences (MPS)
Number of actions reviewed: 31 Awards: 14 Declinations: 17 Other: 0
Total number of actions within Program/Cluster/Division during period under review: 313 Awards: 96 Declinations: 217 Other: 0
Manner in which reviewed actions were selected: Approximately 3% manually selected actions and 2% randomly selected actions, with additions to ensure all types of actions are represented.

CMMT- Summary Information

Summary Information
Date of COV: 9/13 – 9/15
Program/Cluster/Section: Condensed Matter and Materials Theory (CMMT)
Division: Division of Materials Research (DMR)
Directorate: Mathematical and Physical Sciences (MPS)
Number of actions reviewed: 55 Awards: 31 Declinations: 24 Other: 0
Total number of actions within Program/Cluster/Division during period under review: 817 Awards: 254 Declinations: 563 Other: 0
Manner in which reviewed actions were selected: Approximately 3% manually selected actions and 2% randomly selected actions, with additions to ensure all types of actions are represented.

CMP- Summary Information

Summary Information
Date of COV: 9/13 – 9/15
Program/Cluster/Section: Condensed Matter Physics (CMP)
Division: Division of Materials Research (DMR)
Directorate: Mathematical and Physical Sciences (MPS)
Number of actions reviewed: 91 Awards: 52 Declinations: 39 Other: 0
Total number of actions within Program/Cluster/Division during period under review: 926 Awards: 253 Declinations: 673 Other: 0
Manner in which reviewed actions were selected: Approximately 3% manually selected actions and 2% randomly selected actions, with additions to ensure all types of actions are represented.

EPM- Summary Information

Summary Information
Date of COV: 9/13 – 9/15
Program/Cluster/Section: Electronic/Photonic Materials (EPM)
Division: Division of Materials Research (DMR)
Directorate: Mathematical and Physical Sciences (MPS)
Number of actions reviewed: 64 Awards: 27 Declinations: 37 Other: 0
Total number of actions within Program/Cluster/Division during period under review: 876 Awards: 195 Declinations: 681 Other: 0
Manner in which reviewed actions were selected: Approximately 3% manually selected actions and 2% randomly selected actions, with additions to ensure all types of actions are represented.

MMN- Summary Information

Summary Information
Date of COV: 9/13 – 9/15
Program/Cluster/Section: Metal & Metallic Nanostructures (MMN)
Division: Division of Materials Research (DMR)
Directorate: Mathematical and Physical Sciences (MPS)
Number of actions reviewed: 32 Awards: 20 Declinations: 12 Other: 0
Total number of actions within Program/Cluster/Division during period under review: 430 Awards: 106 Declinations: 324 Other: 0
Manner in which reviewed actions were selected: Approximately 3% manually selected actions and 2% randomly selected actions, with additions to ensure all types of actions are represented.

POL- Summary Information

Summary Information
Date of COV: 9/13 – 9/15
Program/Cluster/Section: Polymers (POL)
Division: Division of Materials Research (DMR)
Directorate: Mathematical and Physical Sciences (MPS)
Number of actions reviewed: 37 Awards: 23 Declinations: 14 Other: 0
Total number of actions within Program/Cluster/Division during period under review: 388 Awards: 110 Declinations: 278 Other: 0
Manner in which reviewed actions were selected: Approximately 3% manually selected actions and 2% randomly selected actions, with additions to ensure all types of actions are represented.

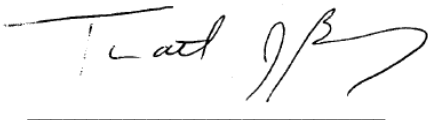
SSMC- Summary Information

Summary Information
Date of COV: 9/13 – 9/15
Program/Cluster/Section: Solid State Materials Chemistry (SSMC)
Division: Division of Materials Research (DMR)
Directorate: Mathematical and Physical Sciences (MPS)
Number of actions reviewed: 44 Awards: 21 Declinations: 23 Other: 0
Total number of actions within Program/Cluster/Division during period under review: 669 Awards: 170 Declinations: 499 Other: 0
Manner in which reviewed actions were selected: Approximately 3% manually selected actions and 2% randomly selected actions, with additions to ensure all types of actions are represented.

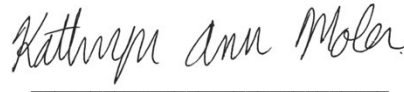
Co-Chair Signatures for the Committee

The Committee of Visitors is part of a Federal Advisory Committee. The function of Federal Advisory Committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.

SIGNATURE BLOCK:



Timothy J. Bunning, Ph.D., ST, co-Chair



Kathryn A. Moler, Ph.D., co-Chair

For the 2023 Committee of Visitors
Division of Materials Research