Update from the Condensed Matter and Materials Research Committee (CMMRC)

Presentation to NASEM Board of Physics and Astronomy

Leslie Momoda, CMMRC Chair

November 21, 2024

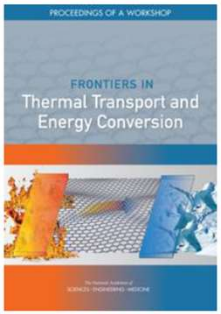
Committee Charge

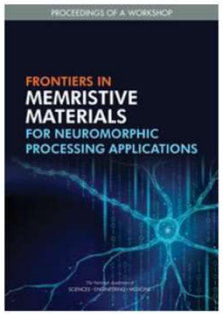
- Standing committee responsible for advising on the fields of condensed matter science and materials research, including physics, chemistry, and biological applications.
- A principal role is to plan, develop programs, and oversee activities initiated under its auspices.
- Hold discussions with researchers across the broad community (academics, industry, and government laboratories; research managers; policy leaders and federal agency representatives providing support for the CMMRC fields focusing on current programs, policies, trends, and issues.
- The CMMRC plans and develops workshops carried out by appointed committees/panels resulting in Academies reports assessing areas of research areas with recommendations to facilitate scientific progress in the forefront areas of research in these fields.
- The CMMRC may also track initial topics to consider as part of the decadal survey's Condensed Matter and Materials Physics (CMMP) volume.
- Sponsors: NSF Department of Materials Research and DoE Materials Science and Engineering, Office of Basic Science

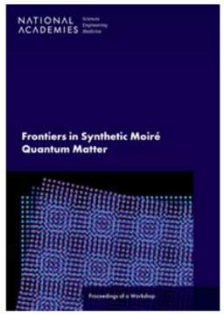
Current CMMRC Focus

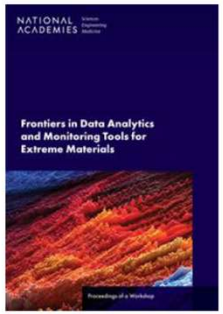
Primary focus on workshop development

- Published summaries on emerging topics in condensed physics and materials research of potential impact to our sponsors
  - Topic development facilitated by CMMRC committee members in collaboration with sponsors
  - "Fill the bookshelf of emerging topics" to inform the decade ahead
- Sponsors continue to be pleased with development rate, i.e., from ideation -> workshop event -> publicly available workshop summary
  - Events are typically one day hybrid events with rapporteur facilitated reports published (with two-day, all virtual exceptions during the pandemic)
- Continue to expand community engagement (more on this later)
- One annual workshop per year









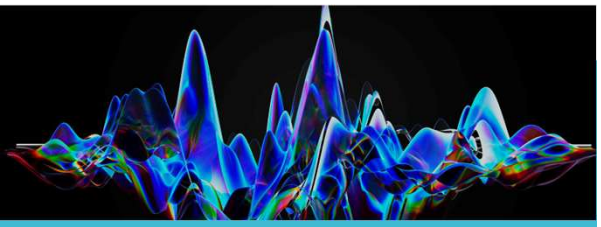
Coherent Matter 2024

Learning Materials 2025

Committee Membership

- **Leslie Momoda, Chair:** Exec Vice President, HRL Laboratories
- **Raymundo Arroyave:** Prof & Presidential Impact Fellow, Materials Sci & Engineering, Texas A&M University
- **Maria K. Chan:** Scientist, Center for Nanoscale Materials, Argonne National Labs
- **Young-Kai Chen (NAE)*:** Deputy CTO, Coherent Inc.
- **Steve Granick (NAS)*:** Professor, Polymer Science & Engineering, U Massachusetts Amherst
- **Samson Jenekhe (NAE):** Chair & Professor, Chemical Engineering & Chemistry, U Washington
- **Eun-Ha Kim*:** Professor, Physics, Cornell University
- **M. Lisa Manning:** Professor, Physics, Syracuse University
- **Nadya Mason (NAS):** Dean and Professor, Pritzker School of Molecular Engineering, U Chicago
- **Jagdish (Jay) Narayan (NAE):** Chair & Prof, Materials Science & Engineering, North Carolina State U
- **Monica Olvera de la Cruz (NAS):** Prof, Materials Science & Engineering, Chemistry, Chemical & Biological Engineering, Physics & Astronomy & Director, Center for Computation & Theory of Soft Materials; Deputy-Director, Center for Bio-Inspired Energy Science, Northwestern U.
- **Michael Rubenstein*:** Professor, Physics, Duke University
- **Jill E. Seebergh (NAE):** Principal Senior Technical Fellow, The Boeing Company
- **Subash Singhal (NAE):** Retired, former Battelle Fellow & Director, Pacific Northwest Nat Lab
- **Victor R. Vasquez:** Prof & Chair, Chemical & Materials Engineering Dept, Univ. Nevada, Reno
- **Steven Zinkle (NAE):** Professor, Nuclear & Materials Science & Engineering, U Tennessee at Knoxville

* New member in 2024



Recent Activities

- **Workshop on Frontiers of Engineered Coherent Matter and Systems** October 3, 2024
  - Topics: Quantum networks, complex interacting systems of quantum-coherent elements needed for advances in quantum information, communication, and computation.
    - Discussion of networks that can simulate complex materials and study the emergence of order in many-body systems.
    - Covered quantum networks of sizes from chip-scale quantum simulators to global quantum communication systems, with platforms from superconductors to ions.
  - Planning committee chair: Charlie Marcus, Professor, U. Washington and former CMMRC committee member
  - 8 expert speakers & panelists: including David Awschalom (U Chicago), Will Oliver (MIT), Pedram Roshan (Google), Charlie Tahan (Microsoft)
  - ~420 hybrid participants
    - 384 online participants; 173 for more than an hour
    - 30-40 in person participants
  - Brought experts together from multiple disciplines and planted a seed for future discussions

Recent & Upcoming Activities

- **Spring CMMRC Committee Meeting** April 30-May 1, 2024
  - Engaged with community members to refine workshop ideas
  - Topical speakers elaborated on top contending workshop descriptions
    - "Learning Materials" by Arvind Murugan, University of Chicago
    - "Organic and Hybrid Mixed Ionic/electronic Conductors" by Jonathan Rivnay, Northwestern University
    - "Metastable Materials and AI" by Boris Kozinsky, Harvard University
  - Outcome: led to choice of preferred, current 2025 workshop topic

- **Fall CMMRC Committee Meeting** October 1-2, 2024
  - Engaged with DOE and NSF sponsors
  - Brainstormed new topical workshop descriptions
  - Topical speakers
    - Emerging Areas in Soft Matter: David Weitz (NAS/NAE), Harvard
    - Emerging Areas in Soft Matter Theory: Andrea Liu (NAS), U Pennsylvania
    - Emerging Areas in Polymers: Robert Allen (NAE), NREL

- **2025 Workshop topic in preparation** Date TBD
  - *"Learning Materials"*
    - Concept generated by CMMRC member Prof. M. Lisa Manning
  - Target: Spring or Fall 2025
  - Workshop description now under consideration by the Academies' Governing Board Project Approval Committee

Future Committee Activities

- **Continued focus on workshop development**
  - Focus on finding emerging topics of interest to our sponsors
  - Soliciting topic input from community through CMMRC business cards
- **Increased post-workshop dissemination & community engagement**
  - Considering options with staff, such as "reflecting back to the community" a summary of most recent workshop at society annual meetings (APS, MRS, etc.)
- **Future decadal survey?**
  - Condensed matter and materials science are very broad topic areas. What would be most impactful?
  - CMMRC workshops may inform potential decadal topic areas
  - Executed by separate Academies body