Summer 2024 Newsletter

DMP NEWSLETTER
Division of Materials Physics

In this Issue

Important Dates

September 02, 2024 Application deadline for the Richard L. Greene Dissertation Award in Experimental Condensed Matter or Materials Physics: https://www.aps.org/programs/honors/prizes/greene.cfm.

September 09, 2024- October 25, 2024 Abstract submission open for 2025 Joint March Meeting and April Meeting: APS Global Physics Summit. Submission is via the web at https://PHYSICS.planion.com/Z?496136C28

October 31, 2024 Submission deadline for the first DMP Image Contest.

November 04, 2024 Application deadline for the DMP Ovshinsky Student Travel Awards and the DMP Post-Doctoral Travel Awards. Advisors will be asked to complete a letter of support by **November 18, 2024.**

March 16 - March 21, 2024 (with short courses/tutorials on **March 15**): APS Global Physics Summit in Anaheim, CA

A Note from the Chair

We hope you are enjoying the summer months. With the Minneapolis March Meeting in the rear view mirror, we are now in the midst of preparing for 2025 March Meeting and finalizing DMP award, prize and fellowship recognition. Our 2025 March meeting will be held jointly with APS April meeting this year and we are excited to convene the 2025

March Meeting from March 16-21, 2025 in Anaheim, CA. As always, your participation in nominating speakers and giving us feedback is key to the success of DMP's activities.

Junqiao Wu, DMP Chair-Elect, is our 2025 March Meeting DMP program chair. He is putting together an exciting program with help from the entire Executive Committee. As described below, Junqiao has assembled a strong line-up of 21 *Focus Topics*, covering a diverse range of contemporary topics in materials physics, including the exciting physics that arises at the intersection of materials science with topology, strong correlations, quantum information, and reduced dimensionality. We anticipate that the DMP *Focus Topics* will continue to attract outstanding invited and contributed talks as well as posters. We appreciate your continued support in nominating excellent speakers is key for the success of our DMP *Focus Topics*.

Focus Topic sessions provide an excellent venue for the presentation of your most recent exciting advances among descriptions with your students and colleagues, so that you can plan in advance about submitting your most exciting advances to relevant sessions. As you know, the March Meeting provides an excellent venue for both advancing the state of knowledge in our research areas as well as training beginning scientists in the skill sets that are so crucial for their professional development.

DMP also facilitates the recognition of the many achievements of our community via awards, prizes and fellowship. First of all, I would like to thank the DMP community for submitting strong nominations. I would also like to thank my colleagues from the community as well as the DMP Executive Committee who chaired and served on selection committees for APS Fellows, the James C. McGroddy Prize for New Materials, and the David Adler Lectureship in Materials Physics. DMP also has representation on the selection committee for the Mildred Dresselhaus Prize in Nanoscience and Nanomaterials. These committees have been hard at work over the summer months, selecting winners from the nominations from the APS community. The final selections will be announced by APS in late Fall. If you wish to nominate well deserving colleagues for the above recognition in the future, please note that the DMP nomination deadline for APS fellowship is the beginning of April and the award/prize nomination for McGroddy, Adler and Dresselhaus is usually the beginning of June. DMP and APS encourage nominations of women and members of under-represented minority groups for these prizes, awards, and fellowships.

DMP is also heavily invested in recognizing junior members of our community. We would like to remind you of the **September 02** nomination deadline for the *Richard L. Greene*

Dissertation Award in Experimental Condensed Matter Materials Physics. The 2024 awardees are:

> **Augusto Ghiotto**, Columbia University, "*For the discovery of a continuous metal-insulator transition and quantum critical behavior in Moire transition metal dichalcogenides*" and
>
> **Tanya Berry**, Johns Hopkins University, "*For exceptional contributions to the discovery of topological materials through Zintl chemistry and advances in synthesis*"
>
> See *https://www.aps.org/programs/honors/prizes/greene.cfm* for full details.

I would also like to remind everyone about the DMP travel awards for students and post-docs. Student presenters at the March Meeting are invited to apply for a *Stanford and Iris Ovshinsky Student Travel Award*. Postdoctoral presenters are also invited to apply for a *DMP Postdoctoral Travel Award*. These highly competitive and prestigious awards are available to students and postdocs whose abstracts are submitted to DMP-sponsored contributed sessions. The awards provide travel support and the awardees will be publicly recognized at our Reception at the 2025 March Meeting. Applications must be completed by **November 04, 2024.** Advisors will be asked to complete a letter of support by **November 18, 2024**.

We have an excellent slate of candidates for next year's vice chair, two new members at large and councilor. I encourage you to vote when you receive your election information via email in September. I would also like to encourage you to nominate colleagues or self-nominate for the DMP nominating committee.

Finally, I would like to recognize the members of the DMP Executive Committee who have recently completed their service. Vivien Zapf (LANL) completed her four years in the chair line, while Judy J. Cha (Cornell) and Jorge A. Muñoz (UT El Paso) completed their terms as Members-at-Large. We appreciate all their time and effort to better our community and their contributions have been invaluable.

I look forward to seeing you all in Anaheim next March!

James M. Rondinelli*, DMP Chair*

The DMP Executive Committee

Chair: James M. Rondinelli, Northwestern University (03/24 - 03/25)
Chair Elect: Junqiao Wu, University of California, Berkeley (03/24 - 03/25)

Vice Chair: Quanxi Jia, State University of NY – Buffalo (03/24 - 03/25)
Past Chair: Yuri Suzuki, Stanford University (03/24 - 03/25)
Councilor: Peter E. Schiffer, Princeton University (01/21 - 12/24)
Secretary/Treasurer: Ni Ni, University of California, Los Angeles (03/23 - 03/26)

Members-at-Large:

Prineha Narang, University of California, Los Angeles (03/22 – 03/25)
Xiuling Li, University of Texas at Austin (03/22 – 03/25)
Bharat Jalan, University of Minnesota (03/23/-03/26)
Paul E. Sokol, Indiana University Bloomington (03/23-03/26)
Harry B. Radousky, Lawrence Livermore National Laboratory (03/24 – 03/27)
Dagmar Franziska Weickert, Physikalisch-Technische Bundesanstalt (03/24 – 03/27)

First Annual DMP Image Contest

Are you interested in having an image of your research displayed on our first ever DMP T-shirt? We are currently soliciting images or artwork of your research to place on the back side of a DMP T-shirt. Submissions accepted until **October 31, 2024**. Three to four winners will be selected in the late fall and receive free registration at the 2025 March Meeting. They will also be recognized at our awards ceremony. DMP T-shirts will be distributed to DMP members at the Division desk on a first come first serve basis at the upcoming March Meeting. *Please stay tuned for the submission link, which will be made available shortly*.

DMP Childcare Support Awards

On-site Childcare will be provided in the 2025 March Meeting. To support attendees who face additional childcare expenses, DMP will be sponsoring Childcare Support Awards for those presenting at the APS March Meeting in DMP Focus Topic sessions.

We anticipate that there will be around 5 DMP Childcare Support Awards in 2025, with the child travel and on-site childcare reimbursement up to $800 each, for the awardee to give in-person presentation in DMP Focus Topic sessions at the APS March Meeting. Priorities will be given to the primary childcare givers who are in the early stage of their careers. The selection committee will consist of members of the DMP Executive Committee*. Please stay tuned for the submission link, which will be made available shortly.*

The Division of Materials Physics March Meeting Postdoctoral Travel Awards

To recognize innovative materials physics research by post-doctoral researchers, the DMP will again be sponsoring March Meeting Postdoctoral Travel Awards for those presenting at the APS March Meeting.

We anticipate that there will be around 10 post-doctoral Travel Awards in 2025, with reimbursement up to $1200 to support participation in DMP Focus Topic sessions at the APS March Meeting sessions. The selection will be based on the research quality, the impact of the research at the March Meeting and the innovative contribution of the postdoctoral researcher. The selection committee will consist of members of the DMP Executive Committee.

Postdoctoral researchers interested in being considered for an award must apply online. The application deadline is **November 04, 2024**; a link to the application site will be available on the DMP website in October. Nominations of members belonging to groups traditionally underrepresented in physics, such as women, LGBT+ scientists, scientists who are Black, Indigenous, and people of color (BIPOC), disabled scientists, and scientists from outside the United States are especially encouraged.

The Division of Materials Physics Ovshinsky Student Travel Awards

The Ovshinsky Student Travel Awards were established to assist the career of student researchers. The Awards are named after Stanford and Iris Ovshinsky, who had a very strong interest in, and commitment to, scientific education. The awards have been endowed by the Ovshinsky family, their colleagues at Energy Conversion Devices (ECD) companies and all their numerous friends from many social, intellectual and business relationships.

We anticipate that there will be around 20 Ovshinsky Student Travel Awards in 2025, with reimbursement up to $800, to enable students to participate in the APS March Meeting sessions that are sponsored by DMP. The selection will be based on merit and the selection committee will consist of members of the DMP Executive Committee.

Students interested in being considered for an award must apply online, and information can be found on the DMP pages under ‘Prizes and Awards’. The application deadline is **November 04, 2024**; a link to the application site will be available on the DMP website in October. Nominations of members belonging to groups traditionally underrepresented in physics, such as women, LGBT+ scientists, scientists who are Black, Indigenous, and people of color (BIPOC), disabled scientists, and scientists from outside the United States are especially encouraged.

The recipients of the 2024 Ovshinsky Student Travel and Honorable Mention Awards as well as the 2024 Post-Doctoral Travel Awards were listed in the 2024 Winter DMP Newsletter.

The Richard L. Greene Dissertation Award

The Richard L. Greene Dissertation Award in Experimental Condensed Matter or Materials Physics was established in 2013 to honor the scientific and administrative contributions of Richard L. Greene to experimental condensed matter and materials physics. This award recognizes doctoral thesis research of exceptional quality and importance in experimental condensed matter or experimental materials physics. The annual award consists of $3000, a certificate, travel reimbursement up to $1000, and a registration waiver to attend to give an invited talk and accept the award at APS March Meeting.

Nominations will be accepted for doctoral dissertations written in English and submitted to any college or university, worldwide. Nominees must have submitted their dissertations after January 1, two years prior to the award year. For example, if submitting a nomination for the award to be presented in 2025, the nominee must have submitted their dissertation after January 1, 2023. Nominations may be considered for up to two consecutive review cycles if they continue to meet these criteria and the nominator re-certifies the nomination before the next deadline.

More information about the award can be found at https://www.aps.org/programs/honors/prizes/greene.cfm. The application deadline is **September 02, 2024.**

DMP Nominating Committee

We are inviting your suggestions for candidates for the 2025 DMP Nominating Committee, which should be emailed to the DMP Chair, James M. Rondinelli (jrondinelli@northwestern.edu) and copied to the DMP Secretary, Ni Ni (nini@physics.ucla.edu). *Please stay tuned for further details on the nomination process from DMP.*

It is important to remember the membership of APS is diverse and global, so the Executive Committees of the APS should reflect that diversity. Nominations of women, members of underrepresented minority groups, and scientists from outside the United States are especially encouraged.

DMP Focus Topics for the 2025 APS March Meeting

The DMP is delighted to announce the program of DMP Focus Topics for the 2025 APS March Meeting (March 16 – March 21, 2025) in this Newsletter.

A Focus Topic generally consists of a series of sessions, each of which is typically seeded with one invited talk, the remainder of the session being composed of contributed presentations.

For the 2025 March Meeting, DMP is the lead organization unit on 21 different Focus Topics and is the co-sponsoring unit for an additional 12 (see lists below).

You have all received an email from Chair-elect Junqiao Wu soliciting nominations for invited speakers for the *Focus Topics* sessions and may have also received an email from individual topic organizers.

Finally, note that the contents of this Newsletter will be available electronically on the DMP website at https://engage.aps.org/dmp/home. Corrections or updates will also be posted at this location.

List of DMP-Sponsored Focus Topics and Sorting Categories for the 2025 APS March Meeting

07.01.01 Topological Materials: Synthesis, Characterization and Modeling
Organizers:
Jin Hu, University of Arkansas, jinhu@uark.edu
Tay-Rong Chang, National Cheng Kung University, u32trc00@phys.ncku.edu.tw
Linlin Wang, Ames National Laboratory, llw@ameslab.gov

There has been explosive growth in the field of topological materials in which electronic band structure harbors novel gapless states in the bulk and on the boundaries of 3-dimensional (3D), 2D, and 1D systems. Moreover, the field has expanded to include topological phases in more complex materials such as Kondo systems, magnetic and superconducting materials, Kagome lattices, twist structures, complex heterostructures, and more. These systems are capable of hosting exotic topologically nontrivial states of quantum matter. The realization of theoretical predictions and understanding of observed phenomena, however, depends greatly on sample quality. As such, there remain significant challenges in identifying and synthesizing materials that have properties amenable to the study of bulk, thin films, surface and interface states of interest. This topic will focus on fundamental advances in synthesis, characterization, theoretical modeling, and predictions of candidate topological materials aimed at guiding synthesis efforts. This will encompass all forms including single crystals, exfoliated and epitaxial thin films and heterostructures, and nanowires and nanoribbons. Of equal interest is the characterization of these materials using structural, transport, magnetic, optical, scanning probe, photoemission and other spectroscopic techniques, and related theoretical efforts to model key experimental observations.

07.01.02 Dirac and Weyl Semimetals

Organizers:
Dr. Na Hyun Jo, University of Michigan, nhjo@umich.edu
Dr. Neupane Madhab, University of Central Florida, madhab.neupane@ucf.edu
Dr. Zhiqiang Mao, The Pennsylvania State University, zim1@psu.edu

The field of topological semimetals has developed dramatically over the past few years. After the initial prediction and discovery of Dirac and Weyl semimetals – materials whose low energy excitations can be described by the Dirac or Weyl equation of high-energy physics – the field has now expanded to include new low-energy excitations not possible in a high-energy setting. Semimetals with different degeneracy at crossing points or lines have been predicted. Theories and experiments have been predicted and proposed in order to measure a small subset of the topological characteristics of semimetals (such as Chern numbers). Furthermore, semimetals whose existence is guaranteed by filling constraints derived from the presence of certain orbitals at certain points in specific lattices have also been mentioned in the literature. Distinct from conventional low carrier density systems, Dirac, Weyl, and other semimetals are expected to possess exotic properties due to the nontrivial topologies of their electronic wave functions. A subset of the novel properties predicted include Berry phase contributions to linear and nonlinear transport properties, chiral anomaly, quantized nonlinear transport under circularly polarized light, protected Fermi arc surface states, suppressed scattering, optical control of topology, Landau level spectroscopy, and superconductivity. Another exciting development is the discovery of Dirac and Weyl semimetal in ferromagnetic, antiferromagnetic and charge density wave materials. The interplay between symmetry breaking phases and topological band structure leads to even richer phenomena. While promising candidate materials exist for many but certainly not all of the topological semimetals, many phenomena have yet to be clearly resolved. This focus topic aims to explore Dirac, Weyl and other new semimetals and the novel phenomena associated with them. We solicit contributions on predictions, new materials synthesis and characterization, and new phenomena in topological semimetals both in the bulk and on the surfaces of samples that accentuate the non-trivial topological character of the new semimetals.

07.01.03 Topological Superconductivity: Materials, Measurement, and Modeling

Organizers:
Daniel Rhodes, University of Wisconsin, darhodes@wisc.edu
Vlad Pribiag, University of Minnesota, vpribiag@umn.edu

Topological superconductors are characterized by nontrivial topological invariants associated with the energy dispersion of Bogoliubov quasiparticles. This Focus Topic covers topological superconductivity, as well as noncentrosymmetric and triplet superconductivity in various physical systems, including bulk and layered crystals, engineered heterostructures, lower-dimensional interfaces, and wires. Studies of interest include experimental probes of superconductivity, characterization of host materials, theory and calculations of superconductivity and materials, the role of electronic correlations, heavy fermion phenomena, and strategies for quantum information processing using topological superconductivity.

07.01.04 Magnetic topological materials
Organizers:
Kelly Luo, University of Southern California, kelly.y.luo@usc.edu
Dmitry Ovchinnikov, University of Kansas, d.ovchinnikov@ku.edu
Linda Ye, Caltech, lindaye@caltech.edu

The intersection of magnetism and topological electronic states is an exciting and rapidly advancing field of research in condensed matter materials and physics. A variety of exotic quantum phenomena and states have been predicted in magnetic topological materials, such as the quantum anomalous Hall effect, Weyl semimetals, and axion insulators. Experimental development has also been rapid with multiple candidate materials having been proposed or synthesized very recently. Extensive efforts are being dedicated to studying such new magnetic phases as altermagnets and coupling of magnetism to band structure topology in these materials. Alongside these developments, there are many open questions that are inspiring rapid developments in both theoretical and experimental fronts of magnetic topological materials, such as Kagome systems and beyond. This will be a focus session on both theoretical predictions and experimental methods that are sensitive to the topological nature of magnetic materials, and the discovery of magnetic topological materials in single-crystal, thin film, and heterostructure morphologies.

08.01.01 Dopants and Defects in Semiconductors
Organizers:
Joel Varley, Lawrence Livermore National Laboratory, varley2@llnl.gov
Peter Sushko, Pacific Northwest National Laboratory, peter.sushko@pnnl.gov
Hari Nair, Cornell University, hari.nair@cornell.edu

Defects heavily contribute to the electronic and optical properties of semiconductors, as well as their stability. Defects also regulate mass-transport processes involved in migration, diffusion, and precipitation, carrier lifetimes through recombination rates, as well as energy level alignment and charge transfer at interfaces. The success of semiconductor devices has largely relied on the optimization of beneficial defects while mitigating unwanted ones. Understanding, characterizing, and deterministic control of dopants and defects is critical for technologies such as power and RF electronics, quantum devices, logic and memory devices, light emitters and detectors, and photovoltaics. The focus of this topic is on the physics of dopants and defects in widely used and emerging semiconductors, from bulk to atomic scales, encompassing point, line, and planar defects, including surfaces and interfaces. This topic will cover experimental, computational, and theoretical investigations of the electronic, structural, optical, magnetic, and other properties of dopants and defects in elemental and compound semiconductors, whether in bulk crystals, polycrystals, or nanoscale structures and across applications. In particular, submissions on (1) defect management in (ultra)wide-band-gap materials, such as diamond, nitrides, and oxides; (2) defects in inorganic semiconductors for energy storage and conversion, and (3) defects in complex materials for conventional and emerging applications in microelectronics and sensor devices, are highly encouraged. Furthermore, we welcome submissions on recent advances in computational modeling, characterization, and materials processing techniques relevant to defect management and understanding their behaviors.

08.01.02 Metal Halide Perovskites – From Fundamentals to Applications

Organizers:

Robert Hoye, Oxford University, robert.hoye@chem.ox.ac.uk
Juan-Pablo Correa-Baena, Georgia Institute of Technology, jpcorrea@gatech.edu
Byungha Shin, KAIST, byungha@kaist.ac.kr

The scientific community has shown significant interest in metal halide perovskites due to their impressive optoelectronic properties and outstanding performance in electronic devices such as solar cells, light-emitting diodes, photodetectors, and neuromorphic devices. Despite the progress made in understanding their fundamental physical and chemical properties, many aspects of these materials remain controversial, such as their defect physics and the extent of their defect tolerance. Furthermore, the role of microstructure and grain boundaries is not yet well-understood. These unresolved issues highlight the need for further research to advance the field of perovskite semiconductors. Recent efforts have been focused on overcoming challenges associated with the application of perovskite materials in electronic devices, including stability, sustainability, and reproducibility. Developing effective mitigation strategies to address these challenges is crucial for the future of this technology. To advance the field, this Focus Topic welcomes contributions on experimental or modeling studies of the optical, electronic, structural, and defect properties of metal halide perovskites, as well as advancements in materials engineering and practical applications. In addition to their remarkable optoelectronic properties, metal halide perovskites are unique due to their wide compositional space and structural variability, making them ideal for designing and discovering new materials for various functionalities. Moreover, this Focus Topic seeks to explore the novel physics of lower dimensional perovskites. Despite the extensive research in this field, much remains to be discovered, making it an exciting area of study for both experimentalists and theorists. Contributions that shed light on the fundamental physical and chemical properties of these materials, as well as their potential applications, are highly encouraged.

08.01.03 Multiferroics, magnetoelectrics, spin-electric coupling, and ferroelectrics

Organizers:

Cheng Gong, University of Maryland, gongc@umd.edu
Yingying Wu, University of Florida, yingyingwu@ufl.edu
Li Yang, Washington University, YANGLI@WUSTL.EDU

This focus topic covers the challenge of coupling magnetic and electric properties in diverse materials as well as ferroelectricity in different materials classes. Topics include:

- Ferroelectricity in inorganic, organic and inorganic-organic hybrid materials
- Ferroelectricity in oxides and nitrides
- Ferroelectricity in two-dimensional (2D) van der Waals (vdW) materials and stacking-engineered 2D vdW materials
- Molecular ferroelectric materials

- Bulk multiferroic and magnetoelectric oxides
- Bulk multiferroic and magnetoelectric non-oxide materials
- Multiferroicity and magnetoelectricity in 2D materials and vdW heterostructures
- Heterostructured magnetoelectrics such as thin film, pillar and nanostructured materials
- Metal-organic frameworks, organometallics, molecule-based materials, organic thin films and other soft materials that can exhibit magnetoelectric properties
- Spin-electric coupling in single molecule magnets
- Magnetoelectric coupling at surfaces and interfaces
- Other novel theoretical and experimental routes to multifunctional cross coupling of magnetic, electric and strain properties.

08.01.04 Exploring Complex Chalcogenides: Properties, Synthesis, and Applications

Organizers:
Hao Zeng, University at Buffalo, SUNY, haozeng@buffalo.edu
Mythili Surendran, University of Southern California, msurendr@usc.edu
Rafael Jaramillo, Massachusetts Institute of Technology, rjaramil@mit.edu

Today, semiconductor technology predominantly relies on group-IV, III-V, and II-VI materials characterized by four-fold coordination and covalent sp3 bonding. However, the remarkable emergence of halide perovskite semiconductors has ignited interest in materials exhibiting ionic bonding and more intricate crystal structures, promising advancements in optoelectronic applications such as photovoltaics and solid-state lighting. Balancing ionic and covalent bonding within complex structural motifs presents opportunities to discover semiconductors with properties and processing pathways previously unattainable in conventional materials. Examples include chalcogenide perovskites engineered to exhibit giant anisotropy in the near-infrared range, as well as those exhibiting outstanding light absorption and environmental stability. This Focus Topic Session aims to provide a platform for the dissemination of exciting advancements in these emerging complex chalcogenide semiconductors, with a particular focus on chalcogenides perovskites and related compounds, as well as nitrides. We invite contributions spanning various activities, including theoretical investigations, materials synthesis and characterization, device fabrication, and real-world applications.

09.01.01 Fe-based Superconductors

Organizers:
Pascal Reiß, Max Planck Institute for Solid State Research, p.reiss@fkf.mpg.de
Heike Pfau, Penn State University, heike.pfau@psu.edu

More than a decade after their discovery, Fe-based superconductors (FeSCs) continue to fascinate the materials and condensed matter physics communities, not only due to their potential to lead to higher superconducting transition temperatures, but also as a platform to investigate the complicated interaction(s) of correlated quantum matter and new techniques. Considerable synthesis, experimental, and theoretical progress has been made in elucidating the defining properties, including the role of electron-electron interactions in shaping their normal state; the intertwining between different ordered states involving spin, orbital, charge, and lattice degrees of freedom; the relevance of nematicity, magnetism, and quantum criticality to the pairing interaction; and the symmetry effects associated with the multi-orbital nature. At the same time, there is progress in understanding the unifying principles causing superconductivity and finding connections with other unconventional superconductors such as cuprates, heavy fermions and organic charge-transfer salts. In recent years, topological phenomena in the normal state and the superconducting state have been explored in the FeSCs such that these systems allow additional insights into the role of different degrees of freedom for topological phases. In addition to advancing our fundamental understanding of superconductivity and correlated electron systems, the unique material parameters of FeSCs (relatively high Tc, low anisotropy, high critical fields) offer new approaches to the design of applications such as superconducting wires, magnets and thin-film devices. This focus topic will cover the pertinent recent developments in the materials growth, experimental measurements, and theoretical approaches, and survey the potential for discovering new applications and new superconducting systems.

11.01.01 4d/5d Transition Metal Systems: Spin-orbit Driven Emergent Phases and Phenomena

Organizers:

Srimanta Middey, Indian Institute of Science, Bangalore, smiddey@iisc.ac.in
Joseph Falson, California Institute of Technology, falson@caltech.edu
Jian Jiu, University of Tennessee, Knoxville, jianliu@utk.edu

Transition metal compounds with 4d/5d elements exhibit rich electronic and magnetic phenomena as spinor bit coupling becomes a comparable energy scale with electron-electron interactions and crystal electric fields. With different filling of the 4d/5d states in conjunction with different lattice geometries available, a rich variety of material systems in both bulk and thin films are being experimentally and theoretically investigated. This Focus Topic explores the nature of exotic phases of spin-orbit-entangled matter and how they enrich our understanding of magnetism, topology, spin liquids, unconventional superconductivity, metal-insulator transitions, for example. Contributions are solicited in areas that reflect recent advances in synthesis, experiment, theory, and simulation of bulk crystals, thin films, and heterostructure morphologies. Specific topics of interest include, but are not limited to:

- 4d/5d oxides including Rhodates, Ruthenates, Iridates, Osmates, Tantalate, Niobate
- Kitaev materials
- Anomalous and topological Hall effects
- Tunability and dynamics under external stimuli.

11.01.02: Light-Induced Dynamical Control of Electronic Phases

Organizers:

Matteo Mitrano, Harvard University, mmitrano@g.harvard.edu
Edoardo Baldini, The University of Texas at Austin, edoardo.baldini@austin.utexas.edu

The novel electronic properties of strongly correlated materials typically arise from complex interactions among various degrees of freedom (charge, spin, orbital, and lattice). Controlling these interactions at various length and time scales is thus key to understanding unconventional material properties and establishing routes to functionalize their physical states. New light sources, ultrafast probes, and the achievement of strong light-matter coupling have made it possible to directly induce changes in the electronic, magnetic, or crystal structure with light, enabling the control and examination of nonequilibrium states in a wide variety of materials. Examples range from driving phase transitions by nonlinear phononics and observing coherently dressed states to demonstrating effects of pure vacuum fluctuations on material properties in light-matter hybrid systems. This focus topic aims to create a platform for communicating high-impact developments in light-induced dynamical control of novel phasesto a broad audience, involving both theorists and experimentalists. Particular emphasis is placed on topics such as ultrafast dynamics in correlated and low-dimensional materials, mode-selective control, light-induced phase transitions and symmetry breaking, non-thermal and metastable states, ultrafast band structure engineering, and light-driven entangled states of matter.

12.01.01: 2D Materials: Formation Pathways and Mechanisms, Heterostructures, and Defects

Organizers:
Lincoln Lauhon, Northwestern University, lauhon@northwestern.edu
Ageeth Bol, University of Michigan, aabol@umich.edu
Kate Reidy, Massachusetts Institute of Technology, kareidy@mit.edu

The multitude of two-dimensional (2D) materials in regard to composition, crystal structure and layer thickness leads to a variety of material properties, including semiconducting, metallic, insulating, superconducting and magnetic, covering all of the components necessary to address voltage, interconnect, energy, and dimensional scaling issues for a plethora of future applications and technology. Their structural anisotropy provides new pathways to the controlled formation and interfacing of atomically thin crystals and layers. The underlying mechanisms remain, however poorly understood, which manifests itself in limited control and scalability, when it comes to integration with industrial process flows. This focus topic will concentrate on the science of scalable and controlled synthesis and tuning of 2D materials and their heterostructures, covering both experimental and computational approaches. This comprises reaction design, crystal and amorphous layer formation, phase engineering, confined growth phenomena, post-growth transformation, defect engineering (structural and chemical), in-plane and out-of-plane heterostructures, approaches to clean interfacing, 2D-3D interfacing, substrate preparation for large scale synthesis and area-select approaches.

12.01.02 2D Materials: Frontiers of Van der Waals Assembly and Moiré Materials

Organizers:
Suyang Xu, Harvard University, suyangxu@fas.harvard.edu
Xiaoxiao Zhang, University of Florida, xxzhang@ufl.edu Edoardo Baldini
University of Texas Austin, edoardo.baldini@austin.utexas.edu

2D layered materials provide a unique platform to assemble heterostructures without the typical constraints of epitaxial interfaces, providing exciting opportunities for the discovery of emergent interfacial phenomena unique to these non-covalently bonded interfaces. A prime example concerns moiré patterns emerging at twisted and/or strained interfaces, which may simultaneously modify the momentum-space registry, interlayer hybridization, and/or shape and period of the periodic potential superlattice. Recent advances have highlighted unique electronic, optical, topological, and magnetic properties that emerge from the interfaces of bilayers involving two otherwise trivial materials. The exciting opportunities to translate these emergent properties into new functional devices require concurrently:
(i) enhanced processes for assembling and modifying layered material heterostructures
(ii) an improved understanding of interfacial device physics, including the role of strain and atomic relaxation effects in the emerging electronic and optical interfacial properties, the physics of beyondbilayer systems, the coupling and engineering of quantum defects, the engineering of thermal coupling in heterostructures, and beyond. This focus topic will cover experimental and theoretical/computational work related to devices based on the growing array of 2D materials that exhibit a wide variety of behaviors. Our focus section invites contributions on topics including theory, computation, synthesis and device fabrication, and experimental characterization covering the wide-ranging library of 2D materials and their heterostructures.

12.01.03 2D Materials: Advanced Characterization
Organizers:
Kayla Nguyen, University of Oregon, kxn@uoregon.edu
Pengjie Wang, UIUC, pengjiew@illinois.edu
Christopher Guttierrez, UCLA, gutierrez@physics.ucla.edu

The ever-increasing class of 2D materials, with their various polymorphs, distinct electronic phases, and 2D heterostructures, require sophisticated characterization methods to both understand their emergent electronic and magnetic phases as well as establish structure-property relationships. This focus topic will concentrate on advanced and novel characterization methods to probe structural, optical, electronic, magnetic, and other properties of 2D materials and heterostructures. Characterization methods include but are not limited to advanced electron microscopy and spectroscopy (ex: 4D STEM, in situ techniques, ARPES, and momentum-resolved EELS), advanced optical microscopy and spectroscopy (nanoscale imaging, ultrafast time-resolved, non-linear), and various scanning probes, and multi-modal characterization methods. Theory development for data interpretation, treatment of large data sets, and machine learning approaches applied to 2D material characterization are also relevant to this focus topic.

12.01.04 2D Materials: Correlated States: Superconductivity, Density Waves, and Ferroelectricity
Organizers:
Kenji Yasuda, Cornell University, kenji.yasuda@cornell.edu
Tiancheng Song, University of Wisconsin, tsong47@wisc.edu

Yang Zhang, University of Tennessee, Knoxville, yangzhang@utk.edu

The low-dimensional nature of 2D materials alters bulk crystalline symmetries, weakens screening effects, boosts interactions, promotes fluctuations, and facilitates exceptional physical tunability, thereby introducing many novel states of matter. The interconnection between spontaneous symmetry breaking and emerging orders in low-dimensional systems, such as superconductivity, density waves, and ferroelectricity, is a fascinating topic for both fundamental physics and applications. This focus topic will cover theoretical and experimental studies of the emerging correlated states in 2D stacked or epitaxial systems, including:
• Unconventional superconductivity in naturally occurring and engineered materials and interfaces • Emergent charge, spin or pair density wave orders and nematicity
• Ferroelectricity arising from engineered lattice or electron structures • Emergent phenomena as the above effects couple, such as multiferroicity
• Related novel device engineering and applications

13.01.01 Optical, Acoustic/Elastic, Thermal, and Nanophononic Metamaterials
Organizers:
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Metamaterials are artificially designed structured materials with subwavelength constituents that exhibit exotic properties not occurring in nature. Metamaterials are opening new avenues in the control of electromagnetic, acoustic, and elastic waves across different scales. Because of advances in state-of-the-art nanofabrication technologies, sophisticated metamaterials and structures may now be realized precisely at the nanoscale. Metamaterials research is merging with nanophotonics and nanophononics, leading to new fundamental phenomena and applications. The transition from three-dimensional metamaterials, at the various scales, to planar two-dimensional metasurfaces further facilitates novel functionality, structure fabrication, material integration, and system miniaturization, thereby finding a wide range of new potential applications. This focus topic will include, but is not limited to: nanophotonics, nanophononics, optical/acoustic/elastic/thermal metamaterials and metadevices, topological and non-Hermitian optics/acoustics, energy harvesting, active/reconfigurable/flexible/dynamically tunable metamaterials, inverse designs, machine-learned metamaterials, and metamaterial device integration.

13.01.02: Electron, Exciton, and Phonon Transport in Nanostructures
Organizers:
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Flow of energy in nanoscale devices is often the key to their performance. Energy can be carried by a variety of quasiparticles like electrons, phonons, plasmons and excitons. The efficiency of energy transport depends on the interaction of the quasiparticles with the lattice in solids and the nanoscale substructure within such a lattice. Such interactions with the lattice can lead to coupling between different quasiparticles, resulting in novel emergent phenomena. Contributions are solicited in areas that reflect recent advances in measurement, theory, and modeling of transport mechanisms of quasiparticles in nanoscale materials and across interfaces. This includes, but is not limited to, studies of classical and quantum scaling effects, electron-phonon coupling in low-dimensional materials, emergent electronic and thermal phenomena in heterostructures, nanoscale phonon transport, quasiparticle-defect interactions, strong light-matter coupling, and related areas.

13.01.03 Complex Oxide Interfaces and Heterostructures

Organizers:
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Emergent physics in complex oxides is made richer by the integration of these correlated compounds in heterostructures. Interfacial phenomena may arise, including charge transfer, exchange coupling, orbital reconstructions, proximity effects, frustration, dimensionality, and mechanical and electric boundary conditions. These effects make complex oxide heterostructures ideal for the study of the fundamental organizing principles of quantum matter and provide a framework for building transformative technologies of the future. This Focus Topic is dedicated to the latest developments in the synthesis, characterization, theoretical understanding and applications of complex oxide thin films, membranes, heterostructures, superlattices, and nanostructures. Specific areas of interest include but are not limited to: magnetic, electronic, optical and mechanical properties, ordering phenomena and phase transitions, superconductivity, multiferroicity, magnetotransport, topological properties, spin-orbit coupling, ionic conduction and mixed anion compounds, and developments in theoretical prediction and materials-by-design approaches. Advances in techniques to design, probe and image electronic, structural, and magnetic states at heterostructure interfaces are also emphasized. Note that some overlap may exist with other DMP and GMAG focus sessions. As a rule of thumb, if complex oxides and their heterostructures are at the core of the investigation, then the talk is appropriate for this focus topic.

13.01.04 Design and Synthesis of New Bulk and Thin-Film Quantum Materials

Organizers:
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The rapid progress in computational material search and theoretical prediction of emergent quantum phases (e.g., quantum spin liquids, p-wave superconductors, heterostructures hosting Majorana fermions, etc.) calls for the development of advanced synthesis techniques for achieving previously inaccessible quantum materials. This Focus Topic addresses the materials synthesis challenges in the following key areas: (1) Design of new quantum materials (either in single phase or heterointerface form) exhibiting exotic states, such as strong frustration/quantum spin liquids, novel superconductivity, emergent phenomena driven by strong correlation and/or spin-orbit coupling, topological states, heavy fermion states without f-electrons, proximity effect, etc. (2) Novel bulk synthesis techniques, such as hightemperature synthesis under extreme conditions of high pressures or magnetic/electric fields, laser floating-zone techniques. (3) Advanced thin film, membrane, and heterostructure synthesis, such as heterostructures via hybrid pulsed laser deposition, remote epitaxy, advanced layer-by-layer growth methods, novel methods for synthesizing complex oxide membranes, etc. (4) Theoretical design of materials and machine learning approaches to materials discovery that include synthesizability.

13.01.05 Ultrawide-Bandgap Semiconductors: Growth, Characterization, Theory, and Devices

Organizers:
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Ultrawide-bandgap semiconductors (UWBGS) represent an emerging new area of materials that are engaging researchers in material science and condensed-matter physics from fundamentals to devices and applications. This new class of semiconductors, all of which have band gaps in excess of 4.0 eV, has promising applications for future generations of RF and high-power electronics, as well as for deep-UV optoelectronics, quantum information science, and harsh-environment applications. This focus topic will cover broad research subtopics, including (but not limited to) UWBG bulk crystal growth/substrate development, thin film deposition, the electronic, photonic and optoelectronic properties of UWBG crystals, films, and interfaces, the science of defects and dopants in UWBGS, doping and carrier dynamics for quantum information science, WBG/UWBG ferroelectrics, related low-dimensional structures and devices, applications in power electronic and RF electronic devices, and UV light emitting diodes and detectors. Theoretical, computational, and experimental contributions are all sought, and this Focus Topic also welcomes researchers investigating a wide variety of materials, including (but not limited to) diamond, gallium oxide (Ga2O3), aluminum nitride (AlN), aluminum gallium nitride (AlGaN), ScAl(Ga)N, AlBN, cubic and hexagonal boron nitride (BN)

16.01.12: Computational Design, Understanding, and Discovery of Novel Materials.

Organizers:
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Data and algorithms are essential components of materials research, aiding and guiding experiments, enabling materials discovery, and accelerating simulations. Data-driven approaches improve upon the brute-force combinatorial methods of the past, providing a general strategy for materials development that may optimize exploration toward desired target properties. This focus topic encompasses both new developments of techniques and applications of such approaches for tailored materials design and discovery. Abstracts are solicited in computational materials design and discovery; development of new data analytic tools and statistical algorithms; ab-initio and data science-augmented simulation development; advanced simulations of materials properties in conjunction with new device functionality; data uncertainty quantification; advances in predictive modeling that leverage machine learning and data mining; development of resources for findable, accessible, interoperable, and reusable (FAIR) materials data; algorithms for global structure and property optimizations; thermodynamic modeling; and computational modeling of materials synthesis processes. Technical applications include, but are not limited to, electronic and optoelectronic materials; magnetic materials; materials enabling novel computing paradigms including spintronics, neuromorphic, and quantum computing; energy conversion and storage; polymers and soft materials; metallic alloys; and two-dimensional materials. Contributions that feature strong connections to experiments are of especial interest.

List of DMP-Co-Sponsored Focus Topics led by other APS Units for the 2025 March Meeting

<u>Please submit invited talk nominations through primary sponsoring Unit</u>

01.01.36 Molecular Dynamics and Deep Learning for Materials Including TMDC & Oxide Moire Structures (DCOMP, DPOLY, DBIO, DMP, DSOFT) [same as 16.01.09, 02.01.54]

05.01.01 Advancements and Applications of Density Functional Theory (DCP, DMP, DCMP) [same as 07.01.05, 12.01.05, 09.01.02, 13.01.06]

05.01.03 Molecular Polaritonics: Chemical Dynamics and Spectroscopy (DCP, DMP)

05.01.07 First Principles Modeling of Excited-State Phenomena in Materials (DCOMP, DMP, DCP) [same as 16.01.03]

10.01.03 Spin Transport and Magnetization Dynamics in Metals-Based Systems (GMAG, DMP, FIAP) [same as 22.01.07]

16.01.01 Matter at Extreme Conditions (DCOMP, DMP, GCCM) [same as 18.01.01]

16.01.04 Machine Learning for Atomistic Simulations (DCOMP, GDS, DMP) [same as 23.01.20]

16.01.08 Recent applications and developments in Quantum Embedding (DCOMP, DMP, DCMP)

16.01.12 Computational Design and Discovery of Novel Materials (DCOMP, DMP, DCMP)

16.01.13 Recent Advances in Computational Methods and Simulation for Fusion Materials (DCOMP, DMP)

16.01.15 The Quantum Monte Carlo Sign Problem: Recent Advances and Paths Forward (DCOMP, DCMP, DMP)

16.01.19 Modern atomistic modeling of disordered materials (DCOMP, DMP)