



2023 WINTER CONFERENCE

DISORDER AND QUANTUM PHASES OF MATTER

DECEMBER 10 – 15, 2023

**Sunday evening welcome reception
Meetings Monday through Friday morning**

A principal goal of modern condensed matter physics is control: Control of topological properties, emergent collective phases, decoherence, and entanglement. In seeking these goals, complex aspects of quantum materials physics are often purposefully or inadvertently ignored. Quenched disorder is such an aspect that complicates the interpretation of experiments and the formulation of theory, despite the fact that perfect crystallinity is a never-realized ideal in materials.

In this conference, we seek to shift the focus to disorder itself, as a source or an unavoidable accompanying feature of many remarkable phenomena observed in modern quantum materials. Although randomness has driven a wide range of modern theoretical developments in recent years (such as many-body localization), there has not been a US-based conference in recent memory with a singular focus on disorder effects in quantum materials physics.

Themes will include, but are not limited to:

- Disorder, strange metals, and superconductivity
- The effects of disorder on competing phases and quantum phase transitions
- Localized strongly interacting states of matter
- The intertwining of disorder and topology

Questions driving our workshop include:

- Is disorder a necessary ingredient for strange metallicity in non-Fermi liquids? What role does it play in high-T_c superconductivity?
- How can disorder be used to control and probe the physics of intertwined orders in strongly correlated materials?
- Are quasiparticles well-defined in a strongly localized and interacting Coulomb glass?
- How protected are topological excitations like Majorana-fermion zero modes in the presence of quantum fluctuations and disorder?

APPLICATION DEADLINE – AUGUST 31, 2023

PLEASE COMPLETE YOUR APPLICATION AT

<http://www.aspenphys.org/physicists/winter/winterapps.html>

Conference Website:

<https://sites.google.com/view/dirtyqmat-aspen-23>

ORGANIZERS:

N. Peter Armitage, Johns Hopkins University

Matthew S. Foster, Rice University

Steven Allen Kivelson, Stanford University

***Yi Li**, Johns Hopkins University

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**PROPOSALS FOR THE 2025 WINTER CONFERENCES ARE INVITED
AND MUST BE SUBMITTED BY JANUARY 15, 2024**

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2024 WINTER CONFERENCE

COMPUTING WITH PHYSICAL SYSTEMS

JANUARY 7 – 12, 2024

Sunday evening welcome reception
Sunday through Friday morning

There has been an explosion of interest in unconventional approaches to computing with physical systems. This has been driven by multiple factors, including (1) the realization that there is the potential to build vastly more energy-efficient or faster computers if we rethink how we harness physical processes for computing – giving up some of the abstractions computers have relied on for 50+ years in exchange for being able to operate closer to the fundamental limits that physics allows, and (2) the growth of machine learning – which provides both a strong motivator for more efficient machines to be built, as well as a wealth of methods that can be used to reimagine how computers work. This conference will bring together both theorists and experimentalists across a broad range of disciplines – including soft condensed matter, biological physics, neuroscience, machine learning, hard condensed matter, optics, fluid dynamics, and quantum information science – who typically do not have the opportunity to interact but who are all exploring various aspects of computing in different physical systems.

Topics will include:

- Information processing and dynamics in classical and quantum systems, including (but not limited to) electronic, spintronic, optical, mechanical, fluidic, biological, and chemical systems.
- Devices, architectures, and algorithms for constructing physical machines that can learn without electronic processors.
- Fundamental limits to computing: time, energy, precision.
- Integrated sensing, computation, and actuation.

The conference will feature invited talks and discussion sessions. All participants will be invited to present posters.

APPLICATION DEADLINE – AUGUST 31, 2023

PLEASE COMPLETE YOUR APPLICATION AT
<http://www.aspenphys.org/physicists/winter/winterapps.html>

Conference Website:
<https://mcmahon.aep.cornell.edu/aspen/2024/>

ORGANIZERS:

Andrea J. Liu, University of Pennsylvania
*Peter McMahon, Cornell University
Arvind Murugan, University of Chicago
Hakan E. Türeci, Princeton University

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2024 WINTER CONFERENCE

STRINGS, FIELDS, AND DEEP LEARNING

JANUARY 14 - 19, 2024

Sunday evening welcome reception
Meetings Monday through Friday morning

Progress in deep learning has traditionally involved experimental data, but in recent years it has impacted our understanding of formal structures arising in theoretical high energy physics and pure mathematics, via both theoretical and applied deep learning. This conference will bring together high energy theorists, mathematicians, and computer scientists across a broad variety of topics at the interface of these fields. Featured topics include the interface of neural network theory with quantum field theory, lattice field theory, conformal field theory, and the renormalization group; theoretical physics for AI, including diffusion models and equivariant models; ML for pure mathematics, including knot theory and special holonomy metrics, and deep learning for applications in string theory and holography.

APPLICATION DEADLINE – AUGUST 31, 2023

PLEASE COMPLETE YOUR APPLICATION AT
<http://www.aspenphys.org/physicists/winter/winterapps.html>

Conference Website:
<https://indico.cern.ch/event/1299185/>

ORGANIZERS:

Miranda Cheng, Academia Sinica

Michael Douglas, Harvard University

James Halverson, Northeastern University

*Fabian Ruehle, Northeastern University

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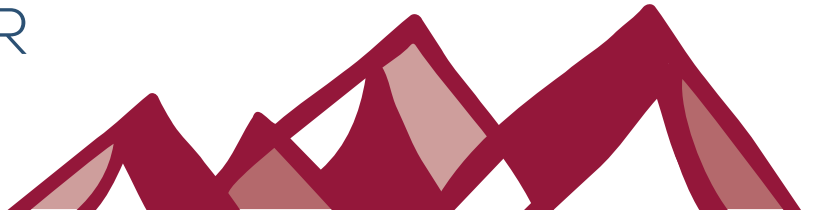
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2024 WINTER CONFERENCE

QUANTUM MATERIALS IN THE QUANTUM INFORMATION ERA: FROM THEORY TO EXPERIMENT

FEBRUARY 4 – 9, 2024

**Sunday evening welcome reception
Meetings Monday through Friday morning**

There has been a recent surge in interest in the scientific community in quantum information technologies, including quantum computing, quantum sensing, and quantum communication. At the heart of each of these are the quantum materials which will serve as the platform for their operation, akin to the role of semiconductors in conventional computation. Despite this pivotal role, there remains a significant gap between the study of modern quantum materials and the requirements, goals, and current status of quantum information science. This conference will bring together scientists working in a variety of “quantum information relevant” quantum material areas to engage with this challenge. We expect that quantum information may provide a new common thread to tie these subfields together and help shape a vision for the future of the fundamental science of quantum materials.

The conference will combine contributions for theory, experiment, and computation and draw from a broad community united by connections to quantum materials and quantum information. This will include physicists who have made or been guided by the QI-QM connection in various ways - bringing such a community together has the potential to strengthen and unify these connections. At the same time, given the fast moving nature of this subfield, a subsection of the program will be allocated for recent developments germane to the theme of the conference.

APPLICATION DEADLINE – SEPTEMBER 15, 2023

PLEASE COMPLETE YOUR APPLICATION AT

<http://www.aspenphys.org/physicists/winter/winterapps.html>

Conference Website:

<https://sites.google.com/view/acp-winter-2024-quantum/home>

ORGANIZERS:

James G Analytis, University of California Berkeley

***Joseph Checkelsky**, MIT

****Hae-Young Kee**, University of Toronto

Yong-Baek Kim, University of Toronto

Rahul Nandkishore, University of Colorado Boulder

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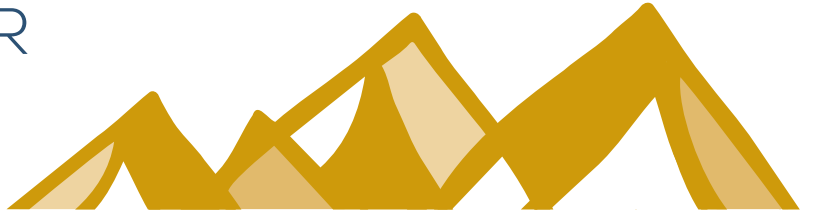
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2024 WINTER CONFERENCE

NOISE AND DECOHERENCE IN QUBITS

FEBRUARY 25 – MARCH 1, 2024

**Sunday evening welcome reception
Meetings Monday through Friday morning**

Quantum computers hold great promise, but a major impediment to their realization is noise and decoherence. This conference will bring together both experimental and theoretical researchers working on various qubit modalities, i.e., superconducting, semiconducting, trapped ion and Rydberg atom qubits, to understand the microscopic sources of noise and decoherence as well as how they can be overcome. Some of these sources of noise and decoherence also interfere with the sensitivity of detectors of, e.g., gravitational waves, dark matter, etc. We will also have special sessions to discuss the current cutting edge of multi-qubit systems as well as recent breakthroughs and advances in various qubit technologies.

APPLICATION DEADLINE – SEPTEMBER 15, 2023

PLEASE COMPLETE YOUR APPLICATION AT

<http://www.aspenphys.org/physicists/winter/winterapps.html>

Conference Website:

<https://sites.google.com/view/qubitnoise-aspenwinterconf2024/home>

ORGANIZERS:

Kenneth Brown, Duke University

***Susan Coppersmith**, University of New South Wales

Christian Enss, Heidelberg University

Clare Yu, University of California

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2024 WINTER CONFERENCE

THE PHYSICS AND IMPACT OF ASTROPHYSICAL DUST: FROM STAR FORMATION THROUGH COSMOLOGY

MARCH 3 - 8, 2024

**Sunday evening welcome reception
Meetings Monday through Friday morning**

The impact of astrophysical dust on our study of the cosmos is wide-ranging, impacting fields as diverse as star formation through cosmology. With the recent launch of the James Webb Space Telescope, our understanding of the physics and impact of interstellar dust is poised to be revolutionized. At this Aspen Winter Conference, we will bring together scientists from a wide range of sub-disciplines to discuss state-of-the-art observational and theoretical results, and make headway toward identifying both open problems, as well as areas of consensus.

Topics covered in this meeting will include:

- Grain size distributions, dust extinction and attenuation
- Polycyclic Aromatic Hydrocarbons: Underlying physics, and observational constraints at low and high-z
- The lifecycle of dust: formation, growth, and destruction in normal environments
- Spectral Energy Distribution fitting techniques
- Dust emission as a tracer of galaxy properties near and far
- Foregrounds, and the impact on precision cosmology
- The first dust: dusty galaxies in the EoR
- Compact Obscured Nuclei

APPLICATION DEADLINE – SEPTEMBER 30, 2023

PLEASE COMPLETE YOUR APPLICATION AT
<http://www.aspenphys.org/physicists/winter/winterapps.html>

Conference Website:
<https://astro.ufl.edu/aspemdust2024/>

ORGANIZERS:

Daniela Calzetti, University of Massachusetts Amherst
Caitlin Casey, University of Texas Austin
***Desika Narayanan**, University of Florida
****George Privon**, NRAO
Karin Sandstrom, University of California San Diego

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2024 WINTER CONFERENCE

THE FUTURE OF HIGH ENERGY PHYSICS: A NEW GENERATION, A NEW VISION

MARCH 24 – 29, 2024

**Sunday evening welcome reception
Meetings Monday through Friday morning**

The Energy and Cosmic frontiers of particle physics aim to address deeply connected questions with innovative and complementary approaches. This ACP conference will focus on the bold long-term visions for both sub-fields, and particularly highlight the role of Early Career researchers in making those visions a reality. In moving forward, it is crucial we break down artificial barriers between the subfields in order to tackle these questions together. An emphasis will be placed on questions related to the Higgs Boson, dark matter, naturalness, and the origin and evolution of the universe, with an eye towards long-term ideas and R&D. This workshop will create an opportunity for both early career and veteran physicists driving these new efforts to share recent progress and form new collaborations.

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<http://www.aspenphys.org/physicists/winter/winterapps.html>

Conference Website:
<https://indico.cern.ch/e/AspenHEP2024>

ORGANIZERS:

Karri DiPetrillo, University of Chicago
***Lawrence Lee Jr**, University of Tennessee Knoxville
Nausheen R. Shah, Wayne State University
Sally Shaw, University of Edinburgh

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2024 WINTER CONFERENCE

DIFFUSE COSMIC BACKGROUNDS AND THE LOW SURFACE BRIGHTNESS UNIVERSE

MARCH 31 – APRIL 5, 2024

Sunday evening welcome reception
Meetings Monday through Friday morning

The background radiation at optical and near-infrared wavelengths is thought to be sourced largely by stars in galaxies, but tensions in recent measurements indicate that our census of galaxy populations might be incomplete. A significant missing fraction of the starlight might be sourced by low surface brightness populations that are difficult to observe, and indeed searches for faint and diffuse extragalactic sources have found a wealth of new populations. These faint sources contain important information to understand star formation in low-mass galaxies, the hierarchical assembly of galaxies and galaxy clusters over cosmic history, and the nature of dark matter. Progress in this regime has been slow due to the scarcity of high-quality, wide-area, ultra-deep images needed to produce statistically significant and homogeneous samples, but dramatic improvements in telescope and detector technology will lead to a wealth of exciting scientific discoveries to emerge from the low surface brightness universe.

In this conference, we will bring together experts in the history of galaxy formation, low surface brightness populations, the cosmic background light, and astrophysical theory to discuss how to reconcile the observations and their implications for cosmic structure formation.

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<http://www.aspenphys.org/physicists/winter/winterapps.html>

Conference Website:

<https://sites.google.com/view/aspen-2024-diffuse-universe/>

ORGANIZERS:

Kenneth M. Lanzetta, SUNY Stony Brook

***Mireia Montes**, Instituto de Astrofísica de Canarias

***John Webb**, Cambridge University

Michael Zemcov, Rochester Institute of Technology

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