ASPEN CENTER FOR PHYSICS

2025 WINTER CONFERENCE

SINGLE MOLECULE BIOPHYSICS

JANUARY 5 – 9, 2025

Sunday evening welcome reception through Thursday evening

This meeting will be the 12th biennial workshop on Single Molecule Biophysics (SMB) held at the Aspen Center for Physics (ACP), building on a successful series begun in 2001. The SMB meeting highlights recent progress in the field of single-molecule biophysics, both from its experimental and theoretical frontiers. Topics vary somewhat from year to year. Biological systems covered in past meetings have included nucleic acid-based enzymes (polymerases, topoisomerases, helicases, etc.), nucleic acids (DNA, RNA), mechanoenzymes (myosin, kinesin, dynein, ATP synthase, flagellar motors), and aspects of molecule physiology (folding/unfolding, binding, signaling, and other biostructural changes). Featured experimental techniques have included advanced fluorescence, optical tweezers, magnetic tweezers, scanned-probed techniques, nanopores, cryo-electron microscopy, and super-resolution techniques. This workshop has traditionally attracted an admixture of experimentalists, computational scientists, and theorists.

Biologists, biochemists, and physicists with either a newfound or longstanding interest in biophysics are strongly encouraged to apply: all levels of accomplishment are welcome. This intellectual diversity of participants is complemented by diversity in gender, geography, and age. The meeting strives for a lively mixture of students, postdocs, and professors. We hope to continue our tradition of raising substantial funds that can subsidize expenses such as ACP registration and other meeting costs, especially for junior scientists and those traveling from overseas. The SMB workshop has been oversubscribed in the past, so a higher priority will be assigned to those applicants who present significant new findings and commit to remaining the entire duration of the meeting.

APPLICATION DEADLINE – SEPTEMBER 15, 2024

PLEASE COMPLETE YOUR APPLICATION AT BOTH ACP & SMB WEBSITES:

https://aspenphys.org/winter-conferences/
https://jila.colorado.edu/smb/

ORGANIZERS:
***Aaron Hoskins**, University of Wisconsin-Madison
Thomas Perkins, JILA, University of Colorado & NIST
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2025 WINTER CONFERENCE

OBSERVABLES IN QUANTUM GRAVITY: FROM THEORY TO EXPERIMENT

JANUARY 12 – 17, 2025

Sunday evening welcome reception
Meetings Monday through Friday morning

Progress on quantum gravity observables has accelerated in recent years. However, the subject is interdisciplinary, and the expertise landscape is highly fragmented. Subfields range from algebraic quantum field theory to experiments, and few connections have been made between areas even though many ideas appear to overlap. This conference seeks to change this situation by convening members of many different communities, identifying pipelines between formal ideas and experiments, and critically assessing long standing proposals.

We aim to incorporate diverse approaches, from algebras of observables, dressing, and relational observables to measurable systems, including gravitational wave memory, cosmology, black holes, quantum simulation, and tabletop tests. At this conference, we will compare and contrast approaches to observables in quantum gravity, connect researchers working on the same topics but in disparate communities, and galvanize progress by spelling out concrete problems for experimentalists and theorists to study in a language widely understood across communities.

APPLICATION DEADLINE – SEPTEMBER 15, 2024

PLEASE COMPLETE YOUR APPLICATION AT
https://aspenphys.org/winter-conferences/

Conference Website:
https://indico.cern.ch/e/aspen-QG-observables

ORGANIZERS:
****Daniel Carney,** LBNL
****Tom Faulkner,** UIUC
Cynthia Keeler, Arizona State University
Nima Lashkari, Purdue University
*__Allic Sivaramakrishnan,__** Caltech
Antony Speranza, UIUC

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2025 WINTER CONFERENCE

THE ERA OF BINARY SUPERMASSIVE BLACK HOLES:

COORDINATION OF NANOHERTZ-FREQUENCY GRAVITATIONAL-WAVE FOLLOW-UP

FEBRUARY 2 – 7, 2025

Sunday evening welcome reception
Meetings Monday through Friday morning

This Aspen conference will mark the notable recent demonstration of evidence for a gravitational-wave background of binary supermassive black holes published by pulsar timing arrays (PTAs). Based on cosmological simulations, binary supermassive black holes are predicted to be the dominant source of low-frequency gravitational-waves, both as individual sources and as a gravitational-wave background. In 2023, international PTA teams announced their findings of evidence for the gravitational-wave background. There are significant prospects for finding "continuous wave" emission from individual foreground binaries in the coming years. These will represent the very first conclusive, direct detections of these gargantuan binary systems. As we enter this significant era of first discovery, coordination is crucial: rich science will come from the identification of host galaxies of continuous-wave detections. This pursuit will necessarily involve a broad-strokes multi-wavelength effort, coordinated between PTAs, astronomical archives, new wide-field surveys, and new targeted observations. In this era of imminent continuous-wave detections by PTAs, it will be important to provide a roadmap towards observational coordination between these efforts. This workshop will draw a broad range of electromagnetic and gravitational-wave observers, large-survey scientists, and astronomy cyberinfrastructure scientists, to plan and coordinate such follow-up. We anticipate that this Aspen meeting will facilitate new collaborations and lead to significantly accelerated progress in this field.

APPLICATION DEADLINE – SEPTEMBER 15, 2024

PLEASE COMPLETE YOUR APPLICATION AT
https://aspenphys.org/winter-conferences/

Conference Website:
https://gwac.wvu.edu/aspen-physics-conference

ORGANIZERS:

***Sarah Burke-Spolaor,** West Virginia University
Kayhan Gültekin, University of Michigan
Jeffrey Hazboun, Oregon State University
Chiara Mingarelli, Yale University

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2025 WINTER CONFERENCE

AI + QUANTUM

FEBRUARY 9 - 14, 2025

Sunday evening welcome reception
Meetings Monday through Friday morning

Artificial Intelligence (AI) and Quantum Science are among the most active areas in cutting-edge science and technology, with both addressing the computational complexity frontier. Although these two domains have evolved separately in the past, there are growing efforts to leverage recent breakthroughs in each field and tackle outstanding challenges through AI-Quantum synergy. The breakthroughs in language model (LLM) are enroute to establishing LLMs as new computational languages and breaking down barriers between domains. QI science is entering a new era, approaching error-corrected logical qubits and logical quantum processors, enabling quantum algorithms of unprecedented complexity. This conference aims to bring together researchers from academia and industry, leading the movement of AI-Quantum interdisciplinary research to address bottleneck issues and propel progress.

Topics will include:

- Application of LLM for state characterization and error correction on quantum hardware.
- Bootstrapping classical computing for quantum simulation.
- Using quantum hardware to explore improvements in AI's learning dynamics.
- Using Quantum many-body physics research tasks as a testing ground for LLMs.

APPLICATION DEADLINE – SEPTEMBER 15, 2024

PLEASE COMPLETE YOUR APPLICATION AT
https://aspenphys.org/winter-conferences/

Conference Website:
https://sites.google.com/view/quai-acp-2025/home

ORGANIZERS:
***Eun-Ah Kim,** Cornell University
Xiaoliang Qi, Stanford University
Victor Galitsky, University of Maryland
Michael Brenner, Harvard University and Google Research

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2025 WINTER CONFERENCE

NEW FRONTIERS OF UNCONVENTIONAL AND HIGH TEMPERATURE SUPERCONDUCTIVITY

FEBRUARY 23 – 28, 2025

Sunday evening welcome reception
Meetings Monday through Friday morning

This winter conference will bring together communities interested in a variety of systems for high temperature or unconventional superconductivity. The recent discoveries of high temperature superconductivity in the nickelates have brought renewed intensity to the interest in this problem. A number of emerging phenomena experimentally reported as well as theoretical ideas developed are highly reminiscent of those of other established unconventional superconductors such as the copper oxides, iron pnictides, and the heavy fermions. This is therefore a particularly opportune time to bring together the communities working on these superconducting families to identify and develop the common threads across the recently discovered nickelate superconductors, new advances on the iron-based superconductors, and major new insights for strange metallicity and superconductivity in the copper-based and heavy fermion superconductors.

The conference will:

- Highlight the extensive recent experimental and theoretical developments in each of the material systems, with an emphasis on the nickelates;
- Identify the phenomena that are common across the materials platforms for unconventional superconductivity, highlight the emerging principles with the potential to unify their understanding, and develop overarching perspectives that may advance progress towards yet more unconventional superconducting phenomena.

APPLICATION DEADLINE – SEPTEMBER 15, 2024

PLEASE COMPLETE YOUR APPLICATION AT
https://aspenphys.org/winter-conferences/

Conference Website:
https://eqma.rice.edu/aspen-center-physics-winter-conference

ORGANIZERS:

Harold Y. Hwang, Stanford University
Suchitra Sebastian, Cambridge University
***Qimiao Si,** Rice University
Ming Yi, Rice University

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2025 WINTER CONFERENCE

EMPOWERING THE NEW VISION IN HIGH ENERGY PHYSICS

MARCH 2 – 7, 2025

Sunday evening welcome reception
Meetings Monday through Friday morning

This Aspen Winter Conference serves as an essential forum for the high-energy physics community, timed with recent breakthroughs and strategic updates. The conference will focus on integrating theoretical and experimental approaches across particle physics, including collider physics and neutrino physics, and their intersections with astrophysics and cosmology. Key topics will include exploring the electroweak scale, particularly the properties and implications of the Higgs boson and dark matter, as well as advancing new physics searches in the high-luminosity LHC environment using innovative strategies like machine learning.

Additionally, the conference will highlight the significant potential of neutrino experiments, like the DUNE project, to probe beyond the standard model. This gathering is set against the backdrop of the Snowmass Community Planning Exercise and the 2023 P5 report, and it aims to foster robust interdisciplinary dialogues that could propel significant advancements in understanding fundamental particles and forces while also exploring future collider programs and opportunities. The event seeks to catalyze new collaborations and insights, driving forward the exploration of the quantum universe.

APPLICATION DEADLINE – SEPTEMBER 30, 2024

PLEASE COMPLETE YOUR APPLICATION AT
https://aspenphys.org/winter-conferences/

Conference Website:
https://indico.fnal.gov/e/AspenHEP2025

ORGANIZERS:

Zhen Liu, University of Minnesota
Isobel J. Ojalvo, Princeton University
Shufang Su, University of Arizona
***Zahra Khajeh Tabrizi,** Northwestern University

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2025 WINTER CONFERENCE

FRONTIERS OF QUANTUM SCIENCE WITH ATOM/MOLECULE TWEEZER ARRAYS

MARCH 23 – 28, 2025

Sunday evening welcome reception
Meetings Monday through Friday morning

Optical tweezer arrays are being used to assemble many-body quantum systems, atom by atom and molecule by molecule. This new experimental approach is revolutionizing quantum science, allowing precise manipulation from single atoms or molecules to thousands. The scientific scope and potential applications of this quantum platform are expanding rapidly.

The goal of this Winter Conference is to provide a forum to exchange ideas and foster innovation. We invite both theorists and experimentalists, for whom tweezer arrays serve as a playground for new theoretical concepts and experimental forays, and whose collaboration will invariably drive new advances. We seek a wide range of expertise, including many-body quantum theorists, quantum computer scientists, AMO physicists, precision-measurement experts, and physical chemists for a productive exchange. We invite contributors from across sectors, including both academia and industry, and strongly encourage participants from the full diversity of backgrounds, career stage, and institutional affiliations.

Among the range of applications for tweezer arrays, we will consider the following:

- quantum simulation of many-body quantum physics;
- quantum information processing;
- ultracold quantum chemistry;
- quantum sensing and metrology;
- applications in quantum optics, including assembling atomic optical metamaterials;
- and, of course, many more unforeseen innovations.

APPLICATION DEADLINE – SEPTEMBER 30, 2024

PLEASE COMPLETE YOUR APPLICATION AT
https://aspenphys.org/winter-conferences/

Conference Website:
https://sites.google.com/berkeley.edu/aspenwinterconference-2025?usp=sharing

ORGANIZERS:
***Dan Stamper-Kurn,** University of California, Berkeley
Hannes Bernien, University of Chicago
Monika Schleier-Smith, Stanford University
Jake Covey, University of Illinois – Urbana/Champaign

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2025 WINTER CONFERENCE

ATMOSPHERIC CHARACTERIZATION OF ROCKY TO GIANT EXOPLANETS IN THERMAL EMISSION WITH JWST

MARCH 30 - APRIL 4, 2025

Sunday evening welcome reception
Meetings Monday through Friday morning

JWST provides transformative infrared observational capability. This is especially advantageous for observing exoplanets in thermal emission as typical planet flux peaks in the infrared. This Aspen Winter Conference will focus on the atmospheric characterization of exoplanets from rocky planets to gas giants in thermal emission using JWST. The topics include but are not limited to the following:

- Detecting atmospheres on rocky planets orbiting M-dwarf stars and potential implications for habitability
- Understanding atmospheric composition and thermal structure from sub-Neptunes to hot Jupiters
- Connecting directly imaged substellar objects to transiting exoplanets in the context of planet formation and evolution

APPLICATION DEADLINE – SEPTEMBER 30, 2024

PLEASE COMPLETE YOUR APPLICATION AT
https://aspenphys.org/winter-conferences/

Conference Website:
https://sites.google.com/view/acp-winter-2025-exoplanet/home

ORGANIZERS:

Hayley Beltz, University of Maryland College Park
***Guangwei Fu,** Johns Hopkins University
Joshua Lothringer, Space Telescope Science Institute
Kevin Stevenson, Johns Hopkins University Applied Physics Laboratory
****Thaddeus Komacek,** University of Maryland College Park

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