



ASPEN CENTER
FOR PHYSICS



2021 WINTER CONFERENCE

MANY-BODY CAVITY QED

DECEMBER 5 – 10, 2021

Sunday evening welcome reception
Meetings Monday through Friday morning

Cavity quantum electrodynamics (QED) – the study of individual atoms interacting with high finesse optical cavities – connects quantum optics and AMO physics. Recent developments have included replacing the single atoms with a Bose-Einstein condensate (BEC), using multimode cavities or multiple single-mode cavities for quantum simulation of many-body physics, and on-chip realizations where arrays of microwave cavities are coupled to superconducting artificial atoms (qubits). These advances have gone hand in hand with important applications of cavity QED, including the development of ultrastable lasers and the creation of highly entangled squeezed states, together allowing the use of cavity QED for precision measurements including atomic clocks.

This Aspen Winter Conference will bring together leading theorists and experimentalists to foster collaboration across this rapidly developing field. We will bring together groups advancing Many Body Cavity QED in the following four major arenas:

- increasing the flexibility and range of the many-body atomic Hamiltonian within the cavity
- modifying and/or coupling the cavities themselves
- characterizing non-equilibrium driven-dissipative phases of matter
- applying the precision of Many Body Cavity QED to metrology and quantum information

Together these areas of research combine expertise in many-body physics, open quantum systems, quantum optics, metrology, superconducting circuits, and cold atoms.

APPLICATION DEADLINE – OCTOBER 15, 2021

PLEASE COMPLETE YOUR APPLICATION AT

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

Conference Website:

<https://sites.google.com/view/mbcqed2020/>

ORGANIZERS:

*Jonathan Keeling, University of St Andrews

Alicia Kollár, University of Maryland

Michael Kolodrubetz, University of Texas at Dallas

Benjamin Lev, Stanford University

James Thompson, University of Colorado Boulder

*PHYSICIST IN CHARGE OF DIVERSITY

PROPOSALS FOR THE 2023 WINTER CONFERENCES ARE INVITED
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2022 WINTER CONFERENCE

DYNAMICAL FORMATION OF GRAVITATIONAL WAVE SOURCES

JANUARY 2 – 7, 2022

Sunday evening welcome reception
Meetings Monday through Friday morning

Gravitational wave astrophysics is now one of the most active research areas at the interface between physics and astronomy. This conference will cover broadly the astrophysics of gravitational wave sources both for current detectors like LIGO and for future observatories like the space-based LISA, with a particular focus on gravitational dynamics and the dynamical formation of merging compact binaries. While the traditional channel for forming compact binaries containing black holes and neutron stars through the evolution of isolated massive binaries has been well studied in the past, it has now also been challenged as the first LIGO detections revealed many surprises. Of particular current interest as a promising alternative is the dynamical assembly of merging black hole binaries in dense star clusters such as globular clusters or the central nuclei of galaxies. Other dynamical processes of interest include interactions between compact stellar remnants and gaseous accretion disks around supermassive black holes, as well as the evolution of hierarchical multiple-star systems (triples, quadruples). The group we are targeting for this conference includes theoretical astrophysicists, physicists working in gravitational wave data analysis or detector design, and astronomers observing the rich variety of electromagnetic counterparts and progenitors of gravitational wave sources (e.g., gamma ray bursts, supernovae, X-ray binaries, binary radio pulsars).

APPLICATION DEADLINE – OCTOBER 31, 2021

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

Conference Website:
<https://sites.northwestern.edu/aspengw2022/>

ORGANIZERS:

Smadar Naoz, University of California Los Angeles
***Enrico Ramirez-Ruiz**, University of California Santa Cruz
Frederic Rasio, Northwestern University
Steinn Sigurdsson, Pennsylvania State University

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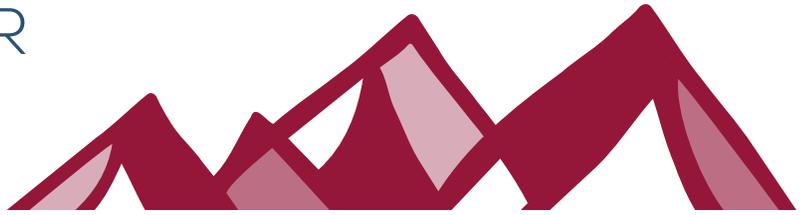
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2022

WINTER CONFERENCE

QUANTUM SIMULATION WITH QUANTUM HARDWARE

JANUARY 9 – 14, 2022

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

While simulation of quantum problems with classical computers has revolutionized fields like chemistry, materials science, condensed matter and nuclear physics, successful implementation of quantum algorithms has the potential to yield enormous additional computational capabilities for studying complex quantum systems. Over the past several decades there has been considerable progress in the development of quantum hardware. Currently, state of the art quantum machines, both analog and digital, are at the threshold where the computational power of these machines is about to exceed that of conventional computers.

At this Aspen Winter Conference, we will bring together people working on state-of-the-art quantum hardware, both analog and digital, with leading theoretical physicists in order to explore how to harness the power of quantum computers for solving a broad range of hard quantum problems. The meeting will foster collaborations by exploring what can be done with the current generation of quantum hardware, identifying quantum problems/models which may be solvable using quantum hardware in the future, and determining how to optimize quantum hardware for solving physics problems.

APPLICATION DEADLINE – OCTOBER 31, 2021

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

Conference Website:
<https://www.pqi.org/aspen2022>

ORGANIZERS:

Susan N. Coppersmith, University of New South Wales

***Jeremy Levy**, University of Pittsburgh

David Pekker, University of Pittsburgh

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WINTER CONFERENCE

NEW DIRECTIONS IN STRONG CORRELATION PHYSICS: FROM STRANGE METALS TO TOPOLOGICAL SUPERCONDUCTIVITY

JANUARY 23 – 28, 2022

Sunday evening welcome reception
Meetings Monday through Friday evening

A number of recent developments in the field of strongly correlated electron systems, including strange metal behavior detected in new settings or probed by new tools, and new types of unconventional and candidate topological superconductors are creating a lot of excitement. Yet these developments have often taken place in isolation, with very limited cross-talk between the topics. We believe that discussing them under a common umbrella has enormous potential to advance understanding.

This Aspen Winter Conference will bring together the broad community of researchers interested in these topics. We aim to have a healthy mix of experimentalists and theorists, and will recruit high-quality speakers in all of the topics mentioned above. Finally, as the progress in the field is very fast, a few slots will be reserved for breaking news related to the conference topics.

APPLICATION DEADLINE – OCTOBER 31, 2021

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

Conference Website:
<http://acp-sc2022.physics.illinois.edu/>

ORGANIZERS:

Daniel F. Agterberg, University of Wisconsin
*Silke Bühler-Paschen, Vienna University of Technology
Vidya Madhavan, University of Illinois at Urbana-Champaign
T. Senthil, Massachusetts Institute of Technology

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2022 WINTER CONFERENCE

GEOMETRIZATION OF (S)QFTs IN $D \leq 6$

FEBRUARY 6 – 11, 2022

Sunday evening welcome reception
Meetings Monday through Friday evening

Quantum field theory is a ubiquitous framework to describe a wide variety of physical phenomena. The applicability of QFT ranges from very high energies (models of particle physics) to low energies (condensed matter and statistical physics systems). One of the main challenges in understanding better QFTs is to get a better grip on strong coupling dynamics. If a model is in a regime where the relevant couplings are not small the textbook definitions of the QFT using weakly coupled fields, Lagrangians, and perturbative expansion are insufficient to understand the dynamics. There is thus a need to find novel ways of thinking about QFTs which go beyond the weak coupling paradigm.

In recent years, building on the confluence of ideas from various research directions, an alternative way to think about QFTs, and especially supersymmetric QFTs (SQFTs), has emerged. The new paradigm can be roughly characterized as geometrization of quantum field theory. Incarnations of this idea include among others: geometry of spaces of couplings and spaces of vacua, engineering lower dimensional QFTs as geometric compactifications of higher dimensional ones, generalized symmetries and their anomalies, holographic constructions of QFTs and stringy constructions.

APPLICATION DEADLINE – NOVEMBER 30, 2021

PLEASE COMPLETE YOUR APPLICATION AT

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

Conference Website:

<https://sites.google.com/view/geometryqftaspen2022/home>

ORGANIZERS:

Ibrahima Bah, Johns Hopkins University

*Jonathan Heckman, University of Pennsylvania

Ken Intriligator, University of California San Diego

Sara Pasquetti, University of Milano Bicocca

Shlomo S. Razamat, Technion-Israel Institute of Technology

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2022 WINTER CONFERENCE

LOW DIMENSIONAL MODELS OF QUANTUM GRAVITY

FEBRUARY 12 – 17, 2022

**Saturday evening welcome reception
Meetings Sunday through Thursday evening**

The quantization of gravity remains one of the most important and challenging unresolved problems in theoretical physics. The holographic correspondence provides a way, at least in principle, to describe certain theories of quantum gravity in terms of dual quantum field theories that live at the boundary of space-time. Over the last two decades this has led to a number of remarkable developments, which culminated in 2019 with a computation of the Page curve, matching the expected dynamics of black hole evaporation in a unitary quantum theory. This conference will focus on recent developments in the field, predominantly in the context of low-dimensional holographic models of quantum gravity. The specific questions to be addressed include:

- The role of disorder and ensemble averaging in holographic models, in particular Jackiw-Teitelboim gravity, SYK models, and Narain theories
- Virasoro symmetry and the role of Schwarzian dynamics in the models of quantum gravity in 2 and 3 dimensions
- Progress in entanglement wedge reconstruction and the entanglement islands prescription
- Replica wormholes and unitarity restoration
- Potential generalizations of holographic models to de Sitter space and flat space

The conference will bring together a diverse group of researchers working in the areas of AdS/CFT, classical and numerical relativity, as well as quantum information theory to discuss ongoing progress in quantum gravity and black hole physics.

APPLICATION DEADLINE – NOVEMBER 30, 2021

PLEASE COMPLETE YOUR APPLICATION AT

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

Conference Website:

<https://sites.google.com/view/aspen-2021-low-d-qg/home>

ORGANIZERS:

Alejandra Castro, University of Amsterdam

***Anatoly Dymarsky**, University of Kentucky

Alexander Maloney, McGill University

****Hirosi Ooguri**, California Institute of Technology

****Stephen Shenker**, Stanford University

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**SCIENTIFIC ADVISOR

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2022 WINTER CONFERENCE

ILLUMINATING GALAXY FORMATION WITH ANCIENT GLOBULAR STAR CLUSTERS AND THEIR PROGENITORS

MARCH 13 – 18, 2022

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

Globular clusters in the local Universe are common, bright tracers of galactic halos. Their progenitors were plausibly the first gravitationally bound baryonic systems to form in the Universe and may represent the dominant mode of star formation at early times. The ancestors of globular clusters are widely expected to be visible in deep James Webb Space Telescope (JWST) images, providing insight into the earliest stages of star formation at high redshift, a key science goal of JWST. Since they are thought to form in high-pressure environments during epochs of intense star formation and are dense enough to resist tidal disruption over the age of the Universe, globular clusters link the small-scale physics of star formation with the large-scale physics of galaxy formation, and the properties of the early Universe with the present day. There is much work to be done to understand exactly how they formed and the connection of that process to the collapse of early dark matter haloes. Vigorous effort is underway to explore the formation of globular clusters within cosmological simulations, with attendant predictions for JWST, and other observatories. In parallel, dynamical modeling of both systems of globular clusters and internal motions for individual clusters has been galvanized by transformational Gaia astrometric data. The long-standing question of the dark-matter content of globular clusters is under new investigation. Further, ongoing imaging and spectroscopic surveys are improving quantification of the fossil record held in the properties of globular clusters in the local Universe.

This Aspen Winter Conference will bring together theorists and observers to exchange recent results and prepare for the era of JWST.

APPLICATION DEADLINE – DECEMBER 15, 2021

PLEASE COMPLETE YOUR APPLICATION AT

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

Conference Website:

<https://www.as.utexas.edu/~mbk/aspen2022/>

ORGANIZERS:

Mike Boylan-Kolchin, University of Texas Austin

Jean Brodie, Swinburne University and University of California Santa Cruz

Ray Carlberg, University of Toronto

Soren Larsen, Radboud University

***Rosemary Wyse**, Johns Hopkins University

****Massimo Stiavelli**, Space Telescope Science Institute

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WINTER CONFERENCE

NEW METHODS AND IDEAS AT THE FRONTIERS OF PARTICLE PHYSICS MARCH 20 – 25, 2022

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

Particle physics finds itself at a crossroads, and this meeting will serve as a fruitful venue to confront new ideas regarding the profound questions facing the field. On one hand, there is strong experimental evidence and theoretical arguments for the existence of new physics beyond the Standard Model (SM). These include the overwhelming evidence for dark matter, which is absent in the SM, and several puzzling aspects of the SM, including the strong CP problem, the stability of the electroweak scale, and the excess of matter over antimatter. On the other hand, so far there is no robust evidence, despite intriguing hints, for new physics after Run 2 of the LHC and following a wide range of searches across the different frontiers, including flavor and low-energy (table-top) precision measurements, dark-matter direct and indirect searches, astrophysical probes of fundamental physics, and gravitational waves.

This Aspen Winter Conference will bring together a broad range of leading theorists and experimentalists from a diverse range of backgrounds and career stages to outline new paths towards the discovery of new physics. The conference will therefore cover a broad class of timely topics related to particle physics with a focus on novel probes of new physics and the interplay between different energy scales and fields. Compelling novel and interesting ideas from the fields of collider physics, flavor physics, neutrino physics, low energy probes of new physics, dark matter (direct and indirect detection), astrophysical probes, gravitational waves, and the interplay with fundamental physics will be discussed.

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PLEASE COMPLETE YOUR APPLICATION AT

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

Conference Website:

<https://indico.cern.ch/event/1066999/>

ORGANIZERS:

Elina Fuchs, CERN

Heather Gray, University of California Berkeley & LBNL

Nicholas Rodd, CERN

***Yotam Soreq**, Technion - Israel Institute of Technology

Jure Zupan, University of Cincinnati

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2022

WINTER CONFERENCE

THE DYNAMICS OF SOCIAL INTERACTIONS

MARCH 27 – APRIL 1, 2022

Sunday evening welcome reception
Meetings Monday through Friday morning

Social interactions shape our lives and those of many animal species. What are the rules governing the complex dynamics of social interactions in living systems? Topics in this realm vary from systems of flocking birds and schooling fish performing “collective behavior” to the intricate interplay between small groups of individuals during activities such as courtship and aggression. But we also wish to consider less-well-known examples such as plants that use infra-red light to distinguish shade producing plants from inanimate objects and insect swarms that harness air-flow to coordinate thermoregulation.

This workshop aims to bring together a group of physicists who are addressing this question in a wide range of systems and over a wide range of scales from experiment and theory. Key topics that will be addressed include:

- decoupling behavior from mechanics to separate social and physical forces
- signal design, propagation, and interpretation in large groups
- efforts to understand closed-loop communication between multiple individuals
- social interactions in plants above ground through volatile organic compounds and below ground through Mycorrhizal networks

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PLEASE COMPLETE YOUR APPLICATION AT

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

Conference Website:

<https://shaevitzlab.princeton.edu/socialinteractions2022>

ORGANIZERS:

Orit Peleg, University of Colorado, Boulder

*Joshua Shaevitz, Princeton University

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