2023 Rising Stars in Physics Workshop

Berkeley Physics

Welcome

2023 Rising Stars in Physics Workshop

Dear Rising Stars in Physics Participants,

It is with great pleasure that we welcome you all to the 2023 Rising Stars in Physics workshop, which has been made possible by support from the Heising-Simons Foundation. This workshop is a unique opportunity for young women physicists from around the country to come together and discuss issues that are relevant to academic careers and engage in interdisciplinary scientific discussions. We are pleased to encourage and support the next generation of women physicists.

During the course of the workshop, you will have the opportunity to participate in panel discussions with faculty, who will share their insights and experiences on a range of topics, including research, teaching, and professional development. We hope that these discussions will provide you with valuable insights and inspiration as you navigate your own academic careers.

In addition to the formal sessions, we have also planned several opportunities for informal networking. These will give you the chance to connect with other young women physicists and to build relationships that will serve you well in the years to come.

Once again, we extend our warmest welcome to all of you, and we look forward to meeting you in person soon.

James Analytis
Department Chair and
Associate Professor of Physics

Alessandra Lanzara
Workshop Co-Chair
Professor, Charles Kittel Chair in Physics

Pablo Jarillo-Herrero
Workshop Co-Chair
Associate Professor of Physics

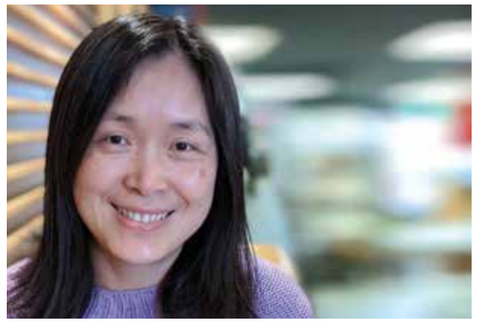
HEISING-SIMONS FOUNDATION

The 2023 Rising Stars in Physics Workshop was made possible thanks to the support of the Heising-Simons Foundation.

Welcome

The Rising Stars Workshop Organizing Committee

UC Berkeley
Department of Physics



Na Ji
Professor of Physics

Ehud Altman
Professor of Physics

Chung-Pei Ma
Judy Chandler Webb Professor of Astronomy and Physics

Eugene Chiang
Professor of Astronomy and Earth and Planetary Science

Ahmet Yildiz
Professor of Physics and Molecular and Cellular Biology

External Speakers

Kimberly Budil
Laboratory Director,
Lawrence Livermore National Laboratory

Shafi Goldwasser
Director of the Simons Center
for Computing, UC Berkeley

Inna Vishik
Associate Professor of Physics
and Astronomy, UC Davis

Lauren Tompkins
Associate Professor of Physics
Stanford University

UC Berkeley Guest Speakers

Mark Asta
Professor of Materials Science and Engineering
and Executive Associate Dean of Engineering

Joelle Frechette
Professor of Chemical and
Biomolecular Engineering

Barbara Jacak
Professor of Physics

UC Berkeley Guest Speakers

Raffaella Margutti
Associate Professor of
Astronomy and Physics

Geoff Penington
Assistant Professor of Physics

Gabriel Orebi Gann
Professor of Physics

Kristin Persson
Daniel M. Tellep Distinguished Professor
in Engineering

Aaron Parsons
Professor of Astronomy

Mary Scott
Associate Professor of
Materials Science and Engineering

Agenda

Monday, May 22, 2023

8:00 – 10:00 pm Networking Reception for Workshop Participants
Location: Heyn's Patio, Men's Faculty Club

Tuesday, May 23, 2023

8:30 – 9:00 am **Breakfast**
Location: Physics North 375

9:00 – 9:30 am **Welcome from Physics Department Chair and Workshop Co-Chairs**

James Analytis, Professor and Department Chair, UC Berkeley Physics
Alessandra Lanzara, Charles Kittel Professor of Physics, UCB
Pablo Jarillo-Herrero, Cecil and Ida Green Professor of Physics, MIT

9:30 – 10:45 am **Research Talks by Participants**
Moderator: Ehud Altman

Shining bicircular light on topological materials: tuning band topology and nonlinear responses
Thais Victa Trevisan, LBNL

Shining light on low-dimensional materials with ab initio computational approaches
Aurelie Champagne, LBNL and UC Berkeley

Exploring strongly correlated electron systems with scanning tunneling microscopy
Anuva Aishwarya, Harvard

Quantum-Enabled Searches for New Physics
Erin Hansen, UC Berkeley

Visualizing the Surface States of Topological Superconductors
Shuqiu Wang, Oxford and Cornell

Diamagnetic response and phase stiffness for interacting isolated narrow bands
Dan Mao, Cornell

10:45 – 11:20 am **Group Photo and Coffee Break**

11:20 - 12:20 pm **Panel 1: The Job Search and Interview Process**
A discussion on applications, the interview process, and negotiating job offers
Moderator: Eugene Chiang

James Analytis, Professor and Department Chair, UC Berkeley Physics
Aaron Parsons, Professor of Astronomy, UC Berkeley
Mary Scott, Associate Professor of Materials Science and Engineering, UC Berkeley

12:20 – 1:30 pm **Lunch and Keynote Address**
Moderator: Alessandra Lanzara

Kimberly Budil, Laboratory Director, Lawrence Livermore National Laboratory

1:30 – 2:45 pm **Research Talks by Participants**
Moderator: Chung Pei Ma

Superconducting Circuit Architectures Based on Light-Matter Interactions
Xueyue Zhang, LBNL

Distributed entanglement generation between solid state defects in diamond nanocavities
Aziza Suleymanzade, Harvard

Measurement-altered Ising quantum criticality
Sara Murciano, CalTech

Entanglement transitions in non-unitary quantum circuits
Carolyn Zhang, University of Chicago

Magneto-optical probes shed light on symmetry
Veronika Sunko, UC Berkeley

Tessellated granular metamaterials with tunable elastic moduli
Nidhi Pashine, Yale

2:45 – 3:15 pm **Coffee Break**

3:15 – 4:15 pm **Panel 2: The First Few Years of a Faculty Career**
Mentoring, promotion, and tenure
Moderator: Ahmet Yildiz

Rafaella Margutti, Associate Professor of Astronomy and Physics, UC Berkeley
Geoff Penington, Assistant Professor of Physics, UC Berkeley
Inna Vishik, Associate Professor of Physics and Astronomy, UC Davis

4:30 – 5:30 pm **Networking Reception**
Location: Women's Faculty Club - Stebbins Lounge

6:00 – 8:30 pm **Dinner and Keynote Address**
Location: Women's Faculty Club Dining Room
Moderator: Alessandra Lanzara

Shafi Goldwasser, Director of the Simons Center for Computing, UC Berkeley

Agenda

Wednesday, May 24, 2023

8:30 – 9:00 am **Breakfast**
Physics North 375

9:00 – 10:15 am **Research Talks by Participants**
Moderator: Ahmet Yildiz

Quantum simulation for high energy physics
Federica Maria Surace, CalTech

Searching for new light particles in the early universe
Weishuang (Linda) Xu, UC Berkeley

Seeing the invisible: the search for axion dark matter
Chiara Salemi, Stanford and SLAC

A hunt for elusive particle interactions, with a boost
Cristina Mantilla Suarez, Fermilab

Colloidal Gymnastics: Understanding the Jeffery Orbits of Axisymmetric Particles with Holographic Microscopy and Effective Medium Theory
Lauren Altman, University of Pennsylvania

Looking for new physics in rare and novel processes at the Large Hadron Collider
Saptaparna Bhattacharya, University of Illinois, Urbana-Champaign

10:15 – 10:45 am **Coffee Break**

10:45 - 11:45 am **Panel 3: Building a Research Group and Funding**
A discussion on how to build a research group, including how to set up a lab, hire/manage members, and apply for funding.
Moderator: Na Ji

Mark Asta, Professor of Materials Science and Engineering and Executive Associate Dean of Engineering, UC Berkeley
Joelle Frechette, Professor of Chemical and Biomolecular Engineering, UC Berkeley
Barbara Jacak, Professor of Physics, UC Berkeley

12:00 – 1:00 pm **Lunch and Keynote Address**
Moderator: Ehud Altman
Kristin Persson, Daniel M. Tellep Distinguished Professor in Engineering, UC Berkeley

1:00 – 2:15 pm **Research Talks by Participants**
Moderator: Eugene Chiang

At the quantum limit of gravitational-wave detection
Victoria Xu, MIT

Unveiling quantum gravity through holography and stringy origins
Monica Jinwoo Kang, CalTech

Looking through the window to the soul - high-resolution in vivo imaging of the retina using adaptive optics
Qinrong Zhang, UC Berkeley

Investigating plasmid localization and replication control with super-resolution microscopy
Dora Mahecic, Haravard Medical School

Small samples, large facilities
Jennifer Fowlie, Stanford

Electron Scattering As Our Microscope
Burcu Duran, University of Tennessee, Knoxville

Floquet engineering of magnetic interactions in quantum materials
Carina Belvin, CalTech

2:30 - 3:45 pm **Panel 4: Balancing Act**
A discussion on time management for new faculty, including how to balance research, teaching, service, family and other commitments.
Moderator: Chung Pei Ma

Lauren Tompkins, Associate Professor of Physics, Stanford University
Gabriel Orebi Gann, Professor of Physics, UC Berkeley
Na Ji, Professor of Physics, UC Berkeley

3:45 – 4:00 pm **Adjourn**

Workshop Participants

Anuva Aishwarya

Postdoctoral Fellow
University of Illinois, Urbana-Champaign

Talk Title: Exploring strongly correlated electron systems with scanning tunneling microscopy

Bio: Anuva Aishwarya was born and raised in Bhubaneswar, India. She obtained her Bachelor of Science degree with a major in physics from the Indian Institute of Science, Bangalore in 2017. Subsequently, she moved to the United States to pursue her graduate studies at the University of Illinois, Urbana-Champaign. She started working in the lab of Vidya Madhavan in 2018 where she now studies various strongly correlated electron systems using low temperature scanning tunneling microscopy. She is expecting to finish her PhD in the summer of 2023 before she will join Amir Yacoby's group at Harvard University as a postdoctoral fellow.

Research Interests: One of the biggest breakthrough technologies in the present decade are quantum computers that rely on the principles of quantum mechanics and can in principle outperform any of their present-day counterparts at unprecedented scales. Many such technological applications are on the horizon to shape our future, owing to the untapped potential inherent to quantum technology. Research in this field needs an amalgamation of the fundamental branches of science like physics, chemistry, and the engineering disciplines, which have been the backbone of my work as an experimental condensed matter physicist. My doctoral work is primarily focused on performing scanning tunneling microscopy / spectroscopy on strongly correlated electron systems and topological superconductors and developing tools that allow probing various spin and charge excitations in situ. My current and long-term goals will be to harness these quantum mechanical properties of electrons to develop new technology which has been challenging so far.

Lauren Altman

Postdoctoral Researcher
University of Pennsylvania

Talk Title: Colloidal gymnastics: understanding the jeffery orbits of axisymmetric particles with holographic microscopy and effective medium theory

Bio: Lauren Altman is a postdoctoral researcher in experimental soft condensed matter physics at the University of Pennsylvania. She earned her PhD from New York University in 2022, developing machine-learning techniques for holographic microscopy and studying the microfluidics of colloidal suspensions. In her postdoctoral work, she is working to develop a tunable elastic metamaterial that can perform decentralized coupled learning. Lauren was born and raised in New York and enjoys running, photography, and dancing in her spare time.

Research Interests: My research as a soft matter physicist spans a variety of topics, though my interests primarily lie in microhydrodynamics and understanding the mechanics of learning. Using machine-learning models to make predictions on holographic images, it is possible to extract a wealth of information about the properties of colloidal particles in suspensions. When coupled with effective medium theory, this analytical pipeline can offer a never-before-seen look into the dynamics of anisotropic particles as they flow through microscopic channels. Notably, in response to the COVID-19 pandemic, I used this technique to aid in the development of a multiplexed viral diagnostic test using holographic molecular binding assays.

In my postdoctoral work, I seek to apply my machine-learning expertise to understand the mechanisms by which physical systems can learn. The coupled learning process involves tuning the properties of individual elements within a collective material to exhibit unusual and emergent behaviors. This learning scheme takes advantage of the physics of the system to perform decentralized computation without the need for a processor or external memory, and hints at a new class of "smart" metamaterials.

Carina Belvin

Postdoctoral Fellow
California Institute of Technology

Talk Title: Floquet engineering of magnetic interactions in quantum materials

Bio: Carina Belvin is a postdoctoral researcher at Caltech supported by a Prize Postdoctoral Fellowship and a Caltech Presidential Postdoctoral Fellowship. She is an experimental condensed matter physicist using ultrafast spectroscopy to control the properties of quantum materials via Floquet engineering. Carina received her B.A. in physics and mathematics from Wellesley College in 2016 and her Ph.D. in physics from MIT in 2022. Her Ph.D. thesis research focused on revealing low-energy collective excitations in correlated materials through ultrafast terahertz spectroscopy. Outside of research, Carina engages in outreach initiatives to support women and girls in STEM.

Research Interests: My research lies in the area of experimental condensed matter physics. I study solids known as quantum materials, which exhibit striking phases of matter ranging from magnetism to superconductivity. In particular, I focus on a class of quantum matter called strongly correlated materials that possess strong interactions between their electrons and are governed by an intricate interplay among different degrees of freedom – the lattice, charges, orbitals, and spins. My research aims to understand how the collective actions of these constituent elements conspire to produce exotic phases of matter and how they can in turn be manipulated to achieve desired properties on demand. The experimental approach that I employ is ultrafast spectroscopy. This technique involves shining an intense, ultrashort laser pulse on a sample and then detecting the altered state of the system using a subsequent weaker light pulse. At Caltech, I am specializing in the framework of Floquet engineering, in which the periodic modulation of the electric field of the laser pulse can modify the underlying microscopic interactions in a solid. My goal is to control the spin interactions in magnetic materials on ultrafast timescales in order to realize new magnetic and spin liquid phases of matter.

Workshop Participants

Saptaparna Bhattacharya

Postdoctoral Researcher
Northwestern University

Talk Title: Exploring strongly correlated electron systems with scanning tunneling microscopy

Bio: Saptaparna Bhattacharya is a postdoctoral Research Associate at Northwestern University and a Humboldt Fellow at DESY. She has been a member of the Compact Muon Solenoid (CMS) Collaboration since 2009. Saptaparna received her doctoral degree in May 2016 from Brown University. She was awarded the LHC Physics Center Distinguished Researcher Award both in 2019 and 2020. She has been an elected member of the Fermilab Users Executive Committee and served as the chair of the committee in 2019-2020.

Research Interests: My primary research interests lie in the field of multiboson physics and exploration of physics beyond the Standard Model in the context of effective field theories. I played a central role in the recent discovery of triboson production at the LHC. The production rate of tribosons is extremely low and their discovery is a significant achievement in Standard Model physics and led to a press release by the CMS Collaboration. I have contributed significantly to the simulation and performance of the High Granularity Calorimeter (HGCAL), with a specific focus on the timing capabilities of the detector. Throughout my postdoctoral career, I have held leadership positions in CMS and currently serve as the convener of the group responsible for delivering state-of-the-art physics simulations, overseeing the activities of four subgroups ranging from technical development to event generator tuning studies that lead to substantial improvement. Since 2020, I have also served as a convener in the group responsible for assessing the physics potential of detector upgrades for the High Luminosity (HL) LHC. These studies have culminated in a community report from CMS as part of the Snowmass 2021-2022 process.

Workshop Participants

Aurelie Champagne

Postdoctoral Fellow
Lawrence Berkeley National Laboratory
and University of California Berkeley

Talk Title: Shining light on low-dimensional materials with ab initio computational approaches

Bio: Aurelie Champagne obtained her undergraduate and master's degree in Civil Engineering, specializing in Materials Science, at the Université catholique de Louvain in Belgium in 2016. She obtained her PhD in Science Engineering and Technology, also at the Université catholique de Louvain in Belgium, in 2020 for theoretical and experimental studies on a novel family of low-dimensional materials, MXenes, with Prof. Jean-Christophe Charlier. Since 2021, she has been a postdoctoral researcher at the Lawrence Berkeley National Laboratory and the Department of Physics at UC Berkeley, with Prof. Jeffrey B Neaton. Her research interests are in materials and condensed matter physics, and involve the development and use of theories for prediction and understanding of electronic, excitonic, and optical properties of low-dimensional materials, primarily using ab initio Green's function formalisms and computational methods, such as the GW approximation and the Bethe Salpeter equation approach.

Research Interests: As a computational scientist in materials physics, my research focuses on the discovery and description of materials and physical phenomena at the atomic scale by developing and using advanced theories. My postdoctoral research involves the creation and application of theoretical models based on ab initio many-body perturbation theory to predict and explore the physics of light-matter interactions in low-dimensional materials, systems with potential applications in optoelectronic and energy-related devices. I collaborate closely with experimental groups, to guide and be inspired by leading-edge measurements. Most recently, I have been interested in screening effects on strongly-bound excitons in novel low-dimensional materials and layered heterostructures, where in particular I have developed predictive approaches to capture the detailed effects of free carrier screening and non-local adsorbate / substrate screening on excited states.

Burcu Duran

Postdoctoral Researcher
University of Tennessee, Knoxville

Talk Title: Electron scattering as our microscope

Bio: Burcu Duran grew up in the west part of Turkey, by the beautiful Aegean Sea, and went to Boğaziçi University in Istanbul for her undergraduate studies in physics. She then moved to the US to pursue a PhD at Temple University where she joined Dr Zein-Eddine Meziani's experimental nuclear physics research group. She conducted her PhD research at Jefferson Lab and her research focused on the J/psi-007 experiment that measured the near threshold J/psi photoproduction cross section in Hall C. Burcu joined Prof. Nadia Fomin's experimental nuclear physics group at the University of Tennessee in 2021 and she is currently stationed at Jefferson Lab. Her current research focuses on the short-range structure of the nuclei and its potential connection to the EMC effect.

Research Interests: My primary research interests revolve around understanding the nucleon structure in terms of the quark and gluon degrees of freedom and the nuclear structure. From the historical perspective, identifying that the nucleons have a finite size and they are not fundamental particles with elastic electron scattering on hydrogen started the investigation of the nucleon structure. So far, the theory of Quantum ChromoDynamics successfully describes the interactions between the quarks and gluons, the constituents of strongly interacting matter. However, understanding how the quarks and gluons give rise to the mass, spin, and mechanical properties of the nucleons remains as one of the greatest challenges for nuclear physicists. I am using the fixed-target electron scattering experiments with high luminosity electron beams at Jefferson Lab to probe the structure of the nucleon as well as the non-trivial aspects of the nuclear structure such as modifications to the nucleons in the nuclear medium and their short-range structure.

Jennifer Fowlie
Associate Scientist
Stanford University

Talk Title: Small samples, large facilities

Bio: Jennifer Fowlie is currently starting a new position as an Associate Scientist in the Stanford Institute for Materials and Energy Science at SLAC National Lab. This follows on from two years as a Swiss National Science Foundation Postdoctoral Fellow in Stanford University's Department of Applied Physics. Originally from Scotland, Jennifer did her undergraduate degree at the University of St Andrews and then moved to Switzerland to pursue a PhD in the Department of Quantum Matter Physics at the University of Geneva.

Research Interests: Quantum materials can display so-called emergent phenomena – exotic properties that appear on the macro-scale that are not expected from considering only the micro-scale physics. Examples are complex magnetic structures and superconductivity.

I grow and study quantum materials in the form of heterostructures, that is when more than one material is brought together into a single sample. Making heterostructures of quantum materials renders them effectively doubly-emergent as new properties can appear in heterostructures that cannot be achieved in the constituent materials alone. This can be due to discontinuities at the interfaces, the chemistry of the surface, strain effects, proximity effects, spin frustration, charge transfer – the list goes on. The physics of quantum materials heterostructures is very rich indeed. The other side of the coin is that creating and probing these materials is fraught with challenges. Within the subfield of epitaxial oxide heterostructures, my research tries to push the limits of what materials we can create and what techniques can be used to probe them. All of this is with the goal of better understanding the fundamental properties of matter.

Workshop Participants

Erin Hansen
Postdoctoral Scholar
University of California Berkeley

Talk Title: Quantum-enabled searches for new physics

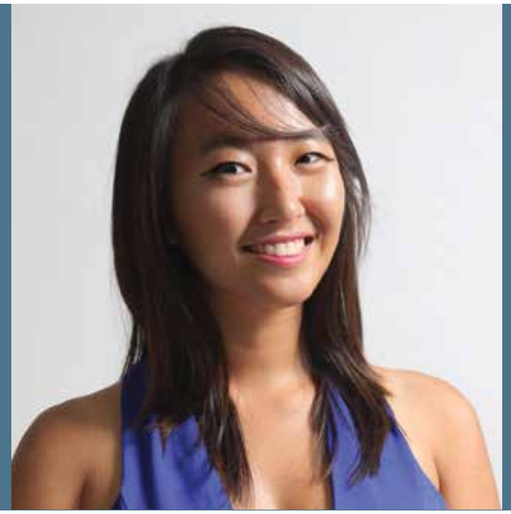
Bio: Erin Hansen has been working in detector physics for the study of neutrinos since 2009. She started as an undergraduate researcher with the Daya Bay Experiment at Rensselaer Polytechnic Institute, and she joined the EXO-200 and nEXO experiments for graduate study at Drexel University in 2016. Erin defended her dissertation in 2019, focused on calibration for nEXO using dissolved radon. She simultaneously earned a graduate minor in Undergraduate STEM Education.

Erin is now a postdoctoral scholar at UC Berkeley and a member of the CUORE / CUPID collaborations. Outside of physics, she plays D&D with her friends from graduate school, and is baking her way through several cookbooks.

Research Interests: I study the nature of neutrinos – specifically whether or not neutrinos are their own antiparticle, which has implications for the origin of the matter-antimatter asymmetry in the very early universe. In other words, we are using neutrinos to ask "Why are we made of matter?" We can probe this question through the search for neutrinoless double beta decay, which is an ultra-rare nuclear process that occurs in a very limited number of isotopes.

More specifically, I enjoy working on detector physics, both design and processing. My current project is DEMETER, which combines knowledge from the fields of nuclear and quantum physics. We are developing multiplexed readout of quantum sensors for next-to-next generation rare event searches with energy and position topological reconstruction within single bolometric crystals.

Workshop Participants



Monica Jinwoo Kang

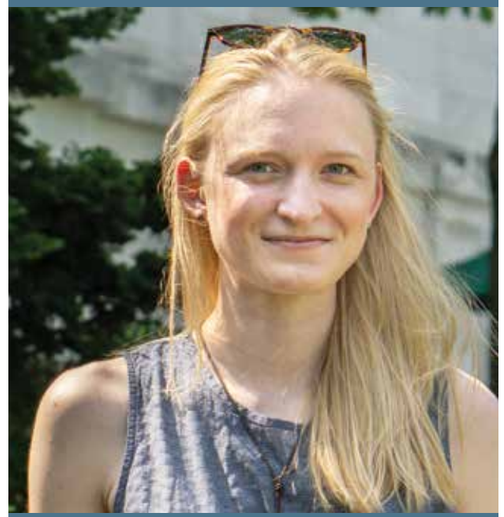
Sherman Fairchild Postdoctoral Fellow
California Institute of Technology

Talk Title: Unveiling quantum gravity through holography and stringy origins

Bio: Monica Kang is a Sherman Fairchild Postdoctoral Fellow at the California Institute of Technology, where she collaborates with theoretical physicists in high energy physics and quantum information theory and mathematicians. Monica received her Ph.D. in physics at Harvard University in 2019 on "Two Views on Gravity: F-theory and Holography," and her bachelor's degree in mathematics and physics at UC Berkeley in 2012, where she worked on condensed matter physics, geometry, and analysis. Monica grew up in Daejeon, South Korea. In her spare time, Monica enjoys Latin dancing, singing, and playing the violin.

Research Interests: My research program is driven by my desire to understand the theory of quantum gravity, to describe our universe from large to small scales. Using symmetry, I work directly on gravitational theories, as well as understanding diverse aspects of quantum field theory, motivated by the connection to quantum gravity via holographic duality. My work ranges from studying supersymmetric theories from three to six dimensions using both bottom-up field-theoretic approaches and top-down string-theoretic approaches, and explicit gravity theories and holographic constructions, to operator-algebraic approaches to holography with entanglement entropy, and holographic codes as holographic models.

The core aspect of my research program is holography, which enables lower dimensional boundary conformal field theory (CFT) to describe the emergent bulk gravity theory. The holographic principle then provides a way to analyze quantum gravity in certain regimes by utilizing the developed toolkits for working with CFT. Hence, strongly-coupled dynamics of CFTs is really the key to describe their holographic gravity duals via emergent bulk spacetime geometry. Using these perspectives, I have constructed and analyzed field theories coupled to gravity and CFTs, with or without supersymmetry. I have focused on understanding arising geometric structures of the bulk gravity theory or the manifestation of the strong-coupling regime via geometrization to unveil the vacuum moduli space, the global and gauge structure, the spectra of states and operators, geometric or stringy origins of the theories, and the highly entangled structure of the gravity theories and their field theory duals.



Dora Mahecic

Postdoctoral Research Fellow
Harvard Medical School

Talk Title: Investigating plasmid localization and replication control with super-resolution microscopy

Bio: Dora Mahecic is a postdoctoral research fellow at the Harvard Medical School, in the lab of Prof. Johan Paulsson at the Department of Systems Biology. She studied at the Ecole Polytechnique Fédérale de Lausanne (EPFL) in Switzerland, obtaining her bachelor's and master's degrees in physics. Dora continued her studies at EPFL, earning her PhD in photonics in 2020 under the supervision of Prof. Suliana Manley. During her PhD, she developed high-throughput and adaptive super-resolution microscopy to study the spatiotemporal organization of organelles. In 2021, Dora was awarded the European Molecular Biology Organization (EMBO) fellowship to pursue her postdoctoral work.

Research Interests: Broadly, my research interests lie in the development of new microscopy tools and study of physical workings governing living systems. My background in physics allows me to engage across a range of technical and biological contexts, with the aim of understanding how transient or stochastic interactions unfold in cells to give rise to spatial and temporal organization. This includes the development of new tools to capture the stochastic behavior and variability of biological systems, at the scale at which these fluctuations occur. During my PhD, I developed high-throughput and "self-driving" super-resolution microscopes that generate statistically significant datasets while capturing the variability and stochasticity of biological processes at the required microscopic scale. By studying living cells, I developed a model accounting for the role of mechanical fluctuations in the stochasticity of mitochondrial division.

In my postdoctoral work, I study plasmid copy number control in bacteria. Bacterial plasmids are major sources of antibiotic resistance and under evolutionary pressure to minimize fluctuations in their copy numbers. While how plasmids autoregulate their own replication is well characterized molecularly, methods to quantify plasmid copy numbers in single cells have been lacking. This has made it impossible to evaluate plasmid control mechanisms against the fluctuations they are selected to regulate. Since joining the Paulsson lab, I have validated a new imaging approach for detecting plasmid copies in single cells to elucidate the roles of regulatory factors in checking fluctuations and regulating plasmid replication, at a single-cell level, and tested the fundamental limits on noise suppression in cells.

Cristina Mantilla Suarez

Postdoctoral Fellow
Fermilab

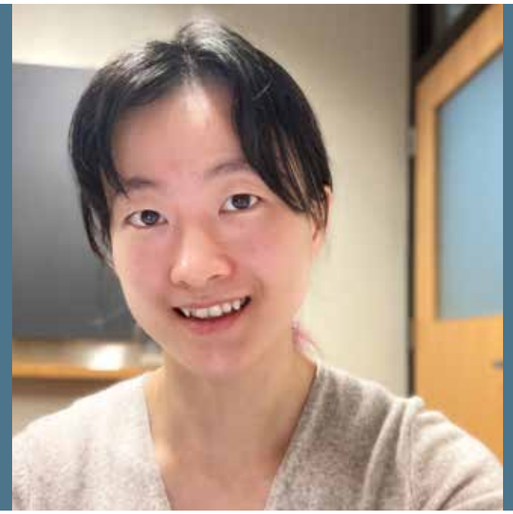
Talk Title: A hunt for elusive particle interactions, with a boost

Bio: Cristina Mantilla Suarez is an experimental particle physicist, born and raised in Quito, Ecuador. She is currently a postdoctoral fellow at Fermilab working with data from the Large Hadron Collider. For the past three years, Cristina has also been exploring the usage of low cost but high intensity accelerator beam-lines to expand the search for new physics. She received her Ph.D. from Johns Hopkins University in 2020 and her thesis work was awarded the 2021 APS Mitsuyoshi Tanaka Dissertation Award.

Research Interests: My research aims to push the boundaries of searches for elusive and anomalous particle interactions. My research focuses on data analysis techniques that enable more precise measurements of the interactions of the Higgs boson, using data from the Large Hadron Collider. Because any departure from the prediction implies the existence of additional particles, these measurements turn into a search.

I also test fast and smart micro-electronics (ASICs) that are needed to read out large amounts of data in high-intensity environments. One example of such environments is a proposed experiment called LDMX, that uses a very intense electron beam incident on a target to search for the production of particle dark matter. I am working on the design of this accelerator-based experiment that will be able to fully explore a theoretically motivated range of dark matter masses below the proton mass.

Workshop Participants



Dan Mao

Bethe / KIC Postdoctoral Fellow
Cornell University

Talk Title: Diamagnetic response and phase stiffness for interacting isolated narrow bands

Bio: Dan Mao is a theoretical physicist specializing in quantum many-body physics. She is currently a Bethe / KIC postdoctoral fellow at Cornell University, where she conducts cutting-edge research in her field. Dan obtained her Ph.D from the Massachusetts Institute of Technology (MIT). In addition to her academic pursuits, Dan enjoys staying active by playing volleyball and rock climbing.

Research Interests: I am intrigued by the collective behavior that can emerge in quantum many-body systems. Despite the simple microscopic degrees of freedom, namely electrons or spins, correlation and quantum entanglement give birth to various exotic emergent phenomena that drastically differ from the individual constituent. Currently, I am exploring these exotic phases and their possible experimental realizations by proposing tractable, relevant models and developing new theoretical frameworks. Some of the topics I've been working on recently include correlated phases in moiré graphene materials, superconductivity in narrow-band systems, and novel states of matter induced by measurements.

Workshop Participants

Sara Murciano

Sherman Fairchild Postdoctoral
Research Fellow
California Institute of Technology

Talk Title: Measurement-altered Ising quantum criticality

Bio: Sara Murciano is a Sherman Fairchild Postdoctoral Research Fellow at Caltech. Before moving to the US in October 2022, she received her Ph.D. in SISSA (Trieste), where she worked in the group of Statistical Physics, under the supervision of Prof. Pasquale Calabrese. She completed her undergraduate education in the University of Salento (South of Italy), and during that time she spent some months at ENS (Paris) and SISSA, where she worked on her master's thesis.

Research Interests: Entanglement has been a characteristic trait of quantum mechanics since its early days and it has recently become a fundamental tool to study many-body systems with extensions to different fields of research. My research activity fits into this context, being devoted to the characterization of entanglement and its interplay with symmetries, another evergreen topic in physics. During my Ph.D., I have been focused on studying the entanglement in the charge sectors of a system with internal symmetries, showing that it is an insightful probe of the fine structure of the total entanglement in many-body systems. Although the charm of nature resides in the presence of symmetries, lots of interesting and relevant phenomena are due to their breaking: recently, I have been interested in how entanglement can be also used to quantify how much a symmetry is broken in a system and its interesting behavior under a dynamical restoration of the symmetry. Finally, I am curious to investigate how quantum critical systems are altered by measurements and how they can be used as a resource for generating novel phenomena ranging from entanglement phase transitions to efficient preparation of exotic ground states.

Nidhi Pashine

Postdoctoral Associate
Yale University

Talk Title: Tessellated granular metamaterials with tunable elastic moduli

Bio: Nidhi Pashine is a postdoctoral associate in Mechanical Engineering at Yale University in Prof. Rebecca Kramer-Bottiglio's lab. Working in an interdisciplinary field, she uses tools and techniques from soft robotics and applies them to soft matter physics. She obtained her Ph.D. in physics in 2021 from the University of Chicago working with Prof. Sidney Nagel. Nidhi grew up in India and received her undergraduate degree from IIT Kanpur. Her interests include mechanical metamaterials, granular systems, robotic soft materials, and memory and training in materials. In her spare time, she enjoys sewing and rock climbing.

Research Interests: I work in the field of mechanical metamaterials that broadly deals with designing and building new kinds of materials with unusual and interesting mechanical properties. I am an experimentalist who conducts macroscopic, table-top experiments. My approach to building new metamaterials is characterized by starting from disordered systems instead of ordered structures, training my materials instead of designing them from the ground up, and using individually addressable functional granular particles to create novel bulk functionality.

Disordered systems are often out-of-equilibrium, have multiple low energy states, and can evolve over time. This makes disordered systems relatively easy to manipulate. I am interested in understanding how mechanical properties of disordered systems can be modified and harnessing disorder to develop new functionalities in materials.

Another area of interest is granular materials. I have developed "robotic" grains where I can vary the size, shape, and stiffness of individual particles on demand. Working with such systems allows me to tune the bulk properties of a packing by modifying individual grains. Such a system can help us understand how the local behavior of granular systems affects the global response of a packing, and eventually lead to tunable and adaptable granular metamaterials.

Chiara Salemi
Postdoctoral Fellow
Stanford University and
Stanford Linear Accelerator Center

Talk Title: Seeing the invisible:
the search for axion dark matter

Bio: Chiara Salemi is a Porat postdoctoral fellow at Stanford University and SLAC. She completed her Ph.D. in 2022 at the Massachusetts Institute of Technology after getting a bachelor's in physics and Mathematics from the University of North Carolina at Chapel Hill in 2017. Chiara's research lies at the intersection of particle astrophysics and quantum sensing. She develops the sensors and detector systems to search for axion dark matter. When she is not in the lab working on detecting these elusive particles, Chiara likes spending time outdoors and cooking for people.

Research Interests: My research centers on the detection of axion dark matter. During my time at MIT, I built and operated the ABRACADABRA-10cm prototype experiment, which set world-leading limits on the interaction of low-mass axion dark matter using a novel lumped-element detection method. Now at Stanford, I am working on the DOE-funded DMRadio experiments, a series of larger, more sensitive detectors that use the same technique as ABRACADABRA. In addition, I am working on developing qubit-based single-photon sensors that are an enabling technology for higher-mass (THz-frequency) axion searches such as BREAD. These sensors may also be used to search for low-mass particle-like dark matter candidates.

Workshop Participants

Aziza Suleymanzade
Postdoctoral Fellow
Harvard University

Talk Title: Distributed entanglement generation between solid state defects in diamond nanocavities

Bio: Aziza Suleymanzade is currently a HQI postdoctoral fellow at Harvard University, where she works in the Mikhail Lukin group. Prior to this, she obtained her PhD from the University of Chicago under the supervision of Jonathan Simon and David Schuster. Aziza's interest in the field of cold atoms began during her MPhil degree in Zoran Hadzibabic's lab at the University of Cambridge as a Harvard-Cambridge scholar. She completed her undergraduate degree at Harvard University.

Research Interests: I am an experimentalist building hybrid quantum systems with unique capabilities. My research aims to develop new methods for generating and controlling highly entangled states of matter and light to serve as a resource for quantum applications. I have worked on various quantum systems, including Bose-Einstein Condensates of neutral atoms, Rydberg atoms in optical and superconducting cavities, and a circuit-QED platform in the millimeter wave frequency band. As a postdoctoral researcher, I am focused on developing quantum networks with solid-state defects in diamond nanophotonic cavities, with a particular interest in distributed entanglement generation and teleportation. I hope to continue working at the interface of various quantum platforms using cavity and circuit-QED tools to advance quantum technology for useful applications in quantum communication and non-local sensing.

Workshop Participants

Veronika Sunko

Miller Postdoctoral Fellow
University of California Berkeley

Talk Title: Magneto-optical probes shed light on symmetry

Bio: Veronika Sunko is originally from Zagreb, Croatia, where she obtained a master's degree in physics. She proceeded to pursue a PhD in condensed matter physics at the University of St Andrews in Scotland and Max Planck Institute for Chemical Physics of Solids in Dresden, Germany. During this time, she specialized in experimental probes of electronic structure and properties. Her thesis work was awarded several prizes, including the Springer thesis prize, the Richard L. Greene Dissertation Award, and the Otto Hahn Medal. For her postdoctoral work she moved to UC Berkeley as a Miller Fellow, where she is developing and using optical probes of symmetry in the group of Joe Orenstein.

Research Interests: My main research motivation is discovering and understanding emergent phases and phenomena in quantum materials, thereby opening new windows onto the underlying quantum many-body problem. Due to the complexity of these systems, no single technique is sufficient to understand their behavior, motivating me to specialize in multiple experimental probes, to theoretically model experimental results, and to collaborate both with theorists and experimentalists.

I am currently interested in understanding the subtle interplay between electronic and magnetic degrees of freedom. On one hand, the symmetry induced by magnetic order may protect topological electronic structure. On the other hand, electronic structure may play a critical role in determining the magnetic order in the first place. I have been using sensitive optical probes of symmetry to uncover magnetic structures, and theoretical tools to understand the consequences of magnetism on electronic properties. Going forward, I am interested in further developing optical probes of symmetry and combining them with probes of electronic structure to study the interplay of symmetry and electronic properties across a broad range of quantum materials.

Federica Surace

Postdoctoral Scholar
California Institute of Technology

Talk Title: Quantum simulation for high energy physics

Bio: Federica Surace is an AWS Quantum Postdoctoral Scholar at the California Institute of Technology, and a member of Caltech's Institute for Quantum Information and Matter. She works at the intersection of condensed matter physics and quantum information, investigating the non-equilibrium dynamics of quantum many-body systems and the capabilities of quantum simulators. After receiving a bachelor's and a master's degree in physics at the University of Pisa and Scuola Normale Superiore, she completed her Ph.D. at the International School of Advanced Studies (SISSA) and at the International Center for Theoretical Physics (ICTP) in Trieste, Italy, in 2021.

interacting particles are difficult to study with traditional techniques: because of the large computational cost, numerical simulations are typically limited to systems with a small number of components. A promising solution is to use other quantum systems that can be easily controlled in table-top experiments, and tune their parameters to mimic the properties of the model that we want to study. These "quantum simulators" may for example be used to study interesting problems in condensed matter, high-energy physics, and quantum chemistry. My research aims, in particular, at developing tools for simulating high-energy physics with quantum simulators. I am also interested in understanding the emergence (or the absence) of thermodynamics and statistical mechanics in quantum many-body systems.

Statistical mechanics is based on the concept of thermal equilibrium: in virtue of this fundamental assumption, we can use few relevant quantities to describe our system and discard the majority of the information about the enormous number of degrees of freedom that it contains. A fundamental question is to understand how (and under which conditions) thermal equilibrium is reached from the time evolution of isolated and nearly-isolated quantum many-body systems, such as the ones studied in quantum simulators.

Thais Victa Trevisan

Postdoctoral Scholar
Lawrence Berkeley National Laboratory
and University of California Berkeley

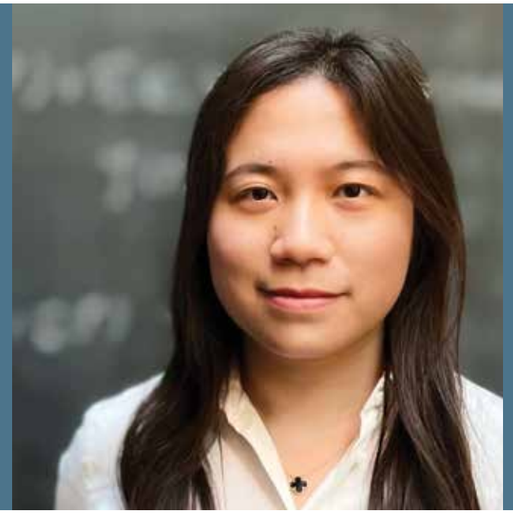
Talk Title: Shining bicircular light on topological materials: tuning band topology and nonlinear responses

Bio: Thais Victa Trevisan is a postdoctoral scholar at Berkeley Lab. Her work focuses on understanding, predicting, and designing properties of quantum materials. Originally from Brazil, she received her PhD in physics from the University of Campinas in 2019. Over that time, Thais was also a visiting scholar at the University of Minnesota on a graduate student research fellowship from the São Paulo Research Foundation. Before her current position, Thais was a post-doctoral scholar at Ames Lab and Iowa State University, working on finding novel ways to realize and manipulate topological states of matter. Thais contributes to outreach activities in the United States and Brazil.

Research Interests: I am a theoretical physicist studying condensed matter. I am fascinated by the exotic properties of quantum materials, where many-body correlations and/or the quantum geometry and topology of the electronic states lead to the emergence of new phenomena. My research involves a broad range of topics, such as topological states of matter, magnetism, the interplay between magnetism and topology, light-matter interaction, and unconventional superconductivity. In the past few years, my main focus has been on understanding and manipulating the topological and geometrical properties of the electronic states in solids.

A change of paradigm in condensed matter physics followed the discovery that the sole knowledge of the electronic band structure is not enough to completely describe the physical properties of materials. It is fundamental to consider the topological and geometrical features of the electronic wave functions to describe macroscopic observables in solids. Therefore, finding ways of manipulating the topology and geometry of electronic states is of great interest as it offers a pathway to design material properties on demand. In my work, I investigate how to tune topological states of matter via external stimuli by an intense coherent light with a spatial structure. Complementarily, I also study how the interplay between exotic magnetism and topological electrons leads to the emergence of rare topological states and how we can probe electronic geometry and topology via nonlinear responses of matter.

Workshop Participants



Shuqiu (Sue) Wang

Postdoctoral Researcher
Oxford University
and Cornell University

Talk Title: Visualizing the surface states of topological superconductors

Bio: Shuqiu Wang is a postdoctoral researcher at Oxford University and Cornell University. As a condensed matter experimentalist, she is investigating the unconventional superconductivity using millikelvin-STMs in Seamus Davis's group at both Oxford and Cornell. She has discovered several novel quantum states in strongly correlated systems. Shuqiu received her DPhil in Materials from Oxford in 2019, at the age of 23. She worked on thin film synthesis using high-temperature STMs at up to 1000 K in Martin Castell's lab. Outside of the lab, Shuqiu likes traveling, going to theaters, and encouraging junior students to pursue a career in STEM.

Research Interests: I am investigating the unconventional superconductivity in quantum matter, particularly in strongly correlated systems. Quantum matter exhibits extraordinary properties due to the strongly correlated effects of electrons. For example, high-temperature superconductors enable near-lossless electric current transmission, paving the way for energy-efficient power grids and reduced energy waste. Moreover, topological superconductors are a cutting-edge focus in quantum computing, as they can host topologically protected qubits. These qubits are less prone to environmental noise-induced errors, unlocking new possibilities for more reliable and practical quantum computing applications. Motivated by such extraordinary prospects, I am focusing on visualizing the quantum states in cuprate high-temperature superconductors and topological matter using a millikelvin scanning tunneling microscope (mK-STM).

I have discovered several exotic quantum states such as pair density waves and orbital ordering in quantum matter such as cuprates, candidate topological superconductors UTe2, and other U-based compounds. I developed the scanned single-electron tunneling, Josephson Tunneling, and Andreev Tunneling Microscope at Oxford and Cornell. My recent work has focused on the topological surface states and persistent chiral currents of the chiral spin-triplet superconductors UTe2. My long-term scientific vision is to understand the pairing mechanism of high-temperature superconductivity and discover bulk topological superconductivity.

Workshop Participants

Weishuang (Linda) Xu

Postdoctoral Researcher
University of California Berkeley and
Lawrence Berkeley National Laboratory

Talk Title: Searching for new
light particles in the early universe

Bio: Weishuang (Linda) Xu is a postdoctoral researcher in the Berkeley Center for Theoretical Physics, studying the particle nature of dark matter with a primarily astrophysics and cosmology -focused toolkit. She moved to Berkeley in 2021 from Harvard, where she received her PhD working primarily with Lisa Randall and Cora Dvorkin. Before that she did her undergraduate studies at MIT, which was a significantly shorter move away.

Research Interests: I'm very broadly interested in any particle physics beyond the Standard Model, but have primarily studied dark matter in a cosmological and astrophysical context. I have worked on building models and identifying classes of scenarios that may be best tested with space-based probes, developing pipelines to connect theory to observable predictions, and analyzing the data to constrain the parameter space of various models as well as projecting the reach of future experiments into these spaces. I have worked with gamma rays, charged cosmic rays, cosmic microwave background anisotropies, large-scale galaxy surveys, and precision astrometry of local stars; we are at a juncture where our access to all these and more probes of the universe is rapidly expanding, and every bit of this information may be powerfully leveraged to teach us about new fundamental interactions. Finally, I think about follow-up strategies for discoveries with this data: when we find anomalies, how can we localize the explanation to new particle physics? How do we narrow down which interactions could be causing this phenomenon? How do we ensure that our predictions are made self-consistently? Where do we look next?

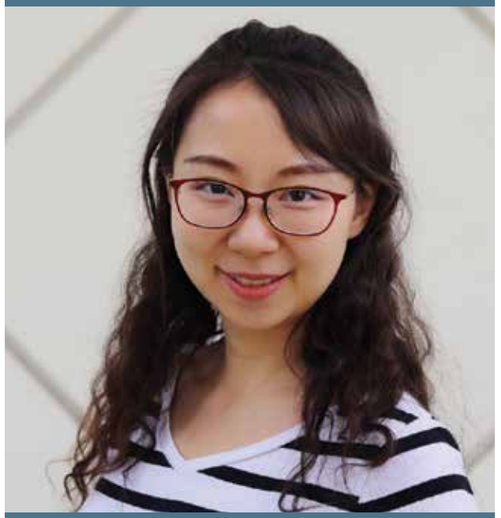
Victoria Xu

Postdoctoral Associate
Massachusetts Institute of Technology

Talk Title: At the quantum limit of
gravitational-wave detection

Bio: Victoria Xu joined MIT as a Postdoctoral Associate in the summer of 2021, and she works on quantum technologies for the Laser Interferometer Gravitational-wave Observatory, LIGO. Her postdoctoral research focuses on commissioning the filter cavity upgrade to frequency-dependent squeezing in LIGO, specifically at the LIGO Hanford Observatory in Eastern Washington. Before joining LIGO-MIT, she completed her PhD in physics at UC Berkeley, studying experimental atomic physics in the group of Prof. Holger Müller. Her graduate work focused on advancing trapped atom interferometry for quantum gravimetry and fundamental physics. She is interested in building experiments that leverage precision interferometry and quantum mechanics to observe how nature works, from the smallest to largest scales.

Research Interests: My research interests center around using precision measurements for fundamental science, from table-top atomic interferometry to long-baseline gravitational-wave interferometry. I am interested in how measurements are designed, how instruments are built, how instruments can be realized at full sensitivity, and how they can surprise us with their functionality and quirks. My experience has particularly focused on leveraging the quantum nature of matter and light for metrology. This matters greatly in, for example, gravitational-wave detection, where current observatories are now largely limited by quantum noise across the astrophysical signal band. The use of squeezed light has already begun to reduce quantum noise in current observatories. In turn, quantum enhancement has begun to directly expand the observable horizons of gravitational-wave astronomy. My research aims to advance the limits of quantum enhancement in large-scale gravitational observatories, and explore how new technologies can be used to maximize our astrophysical horizons.



Xueyue (Sherry) Zhang
Miller Postdoctoral Fellow
University of California Berkeley

Talk Title: Superconducting circuit architectures based on light-matter interactions

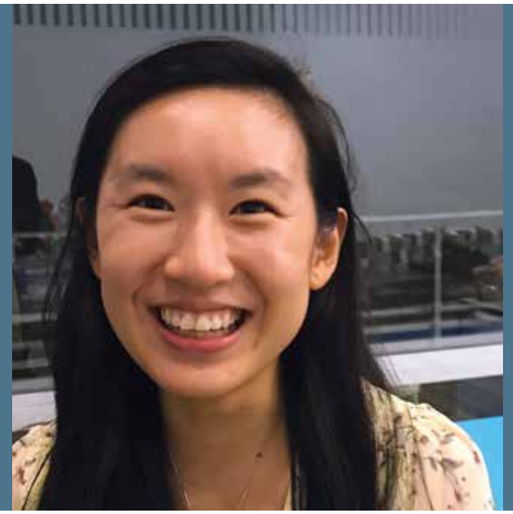
Bio: Xueyue Zhang is a Miller Postdoctoral Fellow at UC Berkeley, working with Prof. Alp Sipahigil across EECS / Physics. She earned her Ph.D. in Applied Physics from Caltech in 2023 under Prof. Oskar Painter and her B.Eng. with highest honor from Tsinghua University in 2017. Xueyue has received both the Miller Fellowship in 2023 and the Yariv / Blauvelt Fellowship in 2017.

Research Interests: My research interests lie in the evolving field of quantum science and technology, which has the potential to address complex challenges in information processing and fundamental sciences. I am keen to explore the development of innovative quantum hardware that could help circumvent the limitations of current solid-state quantum platforms and delve into unexplored areas of physics research.

Previously, I have contributed to system-level advancements by integrating long-range connectivity into superconducting circuit architectures through light-matter interactions. Specifically, we introduce non-local degrees of freedom, such as microwave photonic buses, to create scalable superconducting circuit architectures. These structures enable access to experimentally unexplored strong coupling regimes in waveguide environments and interactions between topological photons and superconducting qubits. Moreover, I have developed a multi-qubit architecture with tunable range and strength of photon-mediated interactions between qubits, facilitating the investigation of quantum many-body chaotic dynamics.

As a Miller Fellow, I am currently shifting my focus to component-level research, exploring novel telecom-band color centers in the mature host material of silicon.

Workshop Participants



Carolyn Zhang
Ph.D.
University of Chicago

Talk Title: Entanglement transitions in non-unitary quantum circuits

Bio: Carolyn Zhang graduated from Yale in 2013. She recently completed her PhD under the supervision of Michael Levin at UChicago, with the support of the NSF GRFP and the Bloomenthal Fellowship. Earlier in her PhD, she was also advised by Erez Berg. Next, she will be a Junior Fellow at the Harvard Society of Fellows. Carolyn loves all activities related to mountains, including running, climbing, hiking, and biking.

Research Interests: I am broadly interested in quantum phases of matter, in and out of equilibrium, and the transitions between them. These quantum phases include stationary topological phases, Floquet topological phases, and dynamical entanglement phases. My research covers both the abstract classification of such phases, as well as methods for characterizing, preparing, and detecting these phases. These topics share close ties with aspects of quantum information theory, high energy theory, and mathematical physics. I particularly enjoy using simple toy models and physical intuition to understand seemingly complex phenomena. For example, with Michael Levin, I constructed a simple, exactly solvable model for an unusual quantum phase transition called a deconfined quantum critical point.

Workshop Participants

Qinrong Zhang
Postdoctoral Fellow
University of California Berkeley

Talk Title: Looking through the window to the soul - high-resolution in vivo imaging of the retina using adaptive optics

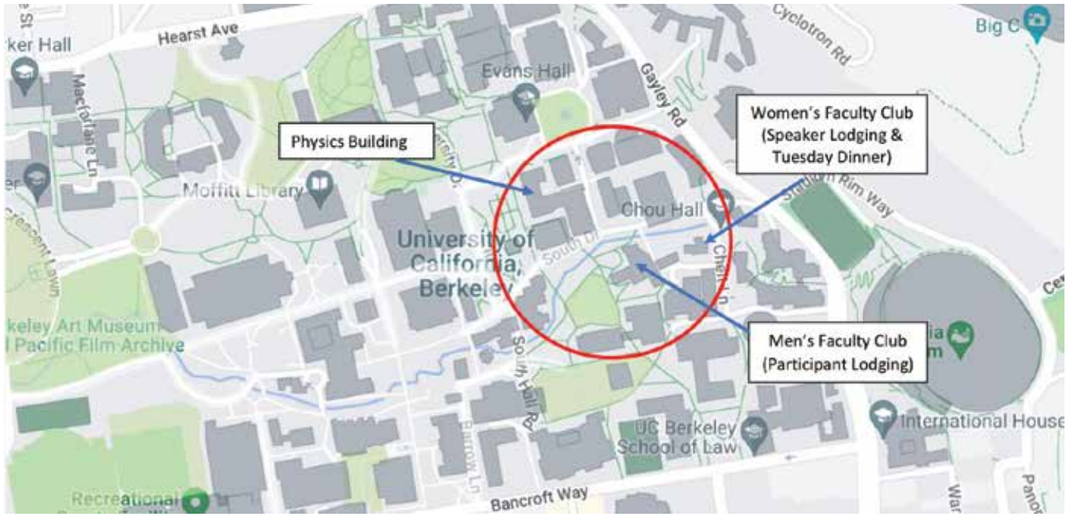
Bio: Qinrong Zhang obtained her Ph.D. in physics from the University of Waterloo and is presently a postdoctoral fellow working with Prof. Na Ji at the University of California, Berkeley, in the Departments of Physics & of Molecular and Cell Biology. Over the past decade, she has focused on developing and applying physics, particularly optical, tools, such as optical microscopy and ultra-fast spectroscopy techniques, to address challenges in biomedical studies. Qinrong's research has covered a wide range of topics, including investigating brain structures and functions in living organisms, retinal pathology and pharmacology, and the development of cancer treatments.

Research Interests: My current research is focused on advancing imaging technologies to better understand the brain and retina in living animals. Optical microscopy has revolutionized biomedical research by providing subcellular resolution noninvasively. However, the current techniques require further refinement to capture the complexity of living biological systems. To address critical challenges, my research combines ideas drawn from astronomy, optics, computational imaging, and machine learning to improve in vivo imaging.

Through these efforts, we have achieved faster imaging speed, higher resolution, higher contrast, and deeper penetration in in vivo bioimaging. Specifically, my research has focused on developing adaptive-optics-assisted microscopy and microendoscopy. By applying these imaging methods, we have achieved high-resolution high-contrast widefield imaging in living organisms and demonstrated synapse-resolving 2-photon fluorescence imaging of retinal pathology and pharmacology in vivo.

Currently, I am working to further improve the sensitivity and versatility of imaging technologies to explore a broader range of biological questions that can be probed using optical microscopy.

Campus Map



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