Welcome to the Institute for Condensed Matter Theory

Due to the COVID-19 outbreak most Physics staff are now working remotely.

If you need to contact Janice Benner please email her at jbenner@illinois.edu or call her at 217-244-4268

If you need to contact Stephen Bullwinkel please email him at bullwink@illinois.edu.

We will get back to you as soon as we can.
Welcome to Fall 2020: to get Zoom meeting details for seminars please email jbenner@illinois.edu or bullwink@Illinois.edu

Friday, November 13: Condensed Matter Seminar  “Non-Fermi Liquids and Novel Broken Symmetries in Multipolar Quantum Materials”: Yong Baek Kim, HU. Of Toronto  1:00 pm – via Zoom

Saturday, November 14: Physics for Everyone: “Turning fold into the most perfect liquid” Professor Jaki Noronha-Hostler, UIUC, 10:15 am via Zoom

Monday, November 16: ICMT Seminar: “A tale of two insulators: TaSe2 and WTe2.” Patrick Lee, MIT, 12:00 pm via Zoom

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Tuesday, November 17: Condensed Matter Journal Club: “Persistent Homology Analysis for Quantum Many-Body Systems”, Greg Hamilton, 4:00 pm via Zoom

Wednesday, November 18: Physics Colloquium: “Novel Probes of Dark Matter”, Cora Dvorkin, Harvard, 4:00 pm - via Zoom

Title:  "Non-Fermi Liquids and Novel Broken Symmetries in Multipolar Quantum Materials"

Speaker: Yong-Baek Kim, University of Toronto

Date: November 13, 2020    Time: 1:00 pm via Zoom

Abstract: The hallmarks of non-Fermi liquids are singular thermodynamic and transport properties that are distinct from those associated with a Fermi liquid. Non-Fermi liquid behaviors are famously seen in cuprates, heavy fermion materials, and metallic quantum critical systems. In this talk, I discuss possible non-Fermi liquids in multipolar quantum materials, where conduction electrons interact with the local moments that do not carry any dipole moment, but possess higher-rank quadrupolar and octupolar moments. This theoretical work is partly motivated by recent experiments on cubic f-electron systems, where the local moments arise from non-Kramers ground states.

I present the renormalization group and conformal field theory solutions of a multipolar Kondo problem, where a single multipolar moment is interacting with the orbital and spin degrees of freedom of conduction electrons. I show that an unexpected non-Fermi liquid state arises in this system. I also discuss hidden multipolar orders in the lattice version of the model and how to experimentally detect such subtle broken symmetries.

Recordings of Condensed Matter Seminar events can be found on mediaspace: https://mediaspace.illinois.edu/channel/Condensed%2BMatter%2BSeminar%2BTalks%2BFall%2B2020/178724052
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Saturday Physics for Everyone: Turning gold into the most perfect liquid

**Speaker:** Professor Jaki Noronha-Hostler, University of Illinois Urbana Champaign

**Date:** 11/14/2020 **Time** 10:15 am

Via Zoom, Registration required for Zoom link

Theoretical Physicist Prof. Jaki Noronha-Hostler presents a Saturday Physics for Everyone (SPE) talked entitled "Reverse alchemy: turning gold into the most perfect liquid" on Nov. 14, from 10:15-11:30. Also, don’t miss the panel discussion for high school students interested in majoring in physics, held at noon CT, using the same link. **REGISTRATION IS REQUIRED**

**Abstract:**
We are all familiar with liquids such as water and intuitively know many of its basic properties. But what happens when a liquid is moving at 99.9999% the speed of light? What happens when we heat it up to the hottest temperatures ever reached on Earth? What happens when the liquid forms the smallest droplet known to humanity? To answer these questions, physicists have been performing reverse alchemy. Instead of turning lead into gold, scientists have been working for the past 20 years to turn gold ions into the smallest, hottest, and fastest flowing droplets of liquid created on Earth- the Quark-Gluon Plasma. In this talk, I will explain how we can study such an extreme liquid and explain why it can provide insight into the Early Universe and potentially what lies inside a neutron star’s core.

A Q&A discussion panel for high school students interested in majoring in physics will be held directly after Prof. Noronha-Hostler's lecture, from 12:00-12:45 CT. This panel will include current and former Illinois Physics undergraduate students answering prospective student questions including:
How do you best prepare for an undergraduate physics degree in high school?
What types of things will you learn as an undergraduate Illinois Physics student?
Common questions regarding on-campus life, housing, and food
Where do our graduates end up? What types of positions do they take?
Much more, including any questions you bring!
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Title: "A tale of two insulators: TaSe2 and WTe2."

Speaker: Patrick Lee, Massachusetts Institute of Technology

Date: November 16, 2020  Time: 12:00 pm   via Zoom

Abstract: I shall discuss two monolayer transition metal dichalcogenides (TMD) that have unusual properties and are insulating for very different reasons. TaSe2 is a cluster Mott insulator that is a promising candidate for a quantum spin liquid with spinon Fermi surface. I shall discuss the formation of a Kondo resonance between a magnetic impurity and the spinon Fermi surface and its consequence for STM tunneling. Monolayer WTe2 is a topological quantum spin Hall insulator. Recently sharp quantum oscillation peaks in the conductivity have been discovered in the insulator that resembles the quantum oscillations in metals. I shall show that modeling the system as an excitonic insulator can provide an explanation.

There is a new Zoom Link for this seminar series. If you have not received it, please email Janice at  jbenner@Illinois.edu
Title: Quantum Money" presented by Peter Shor

Speaker: Peter Shor, MIT

Date: November 17, 2020  Time: 11:00 am  via Zoom

Abstract: Quantum money is a quantum cryptographic protocol that allows for the creation of verifiable but uncopyable states. The requirements are:
A) One player (the mint) must be able to produce a quantum money state, along with a serial number.
B) The serial number gives a verification test, and the quantum money state must pass this test with very high probability.
C) If some aspiring counterfeiter has the quantum money state and knows the verification test, they cannot create two quantum states that both pass the verification test.

Quantum money was first proposed in 2009. Since then, several protocols for quantum money have been proposed. We will discuss these protocols and the underlying mechanisms by which they operate.

https://illinois.zoom.us/j/87818353802?pwd=ZWJLQUhwsDFBOWoyZkpSNkJKSmhndz09
Password: IQUIST
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**Title:** "Persistent Homology Analysis for Quantum Many-Body Systems"

**Speaker:** Greg Hamilton

**Date:** November 17, 2020  **Time:** 4:00 pm   via Zoom

**Abstract:** Recent years have seen the onslaught of new and exciting computational methods to both assess and compress the rich informational structure in quantum many-body systems, including neural networks, autoencoders, and dimensional reduction techniques. One continuing challenge is to robustly quantify long-range behavior in quantum systems vis-à-vis measures beyond correlation functions. Persistent homology, a unique computational tool central to topological data analysis, is well-suited to this task. In this talk I will give an overview and example of persistent homology applied, as well as recent research that used persistent homology to identify quantum and classical phase transitions.

The Zoom link will be sent to the Graduate Student and PDRA mailing lists. If you are not on one of those lists and are interested in attending, please email Mark Hirsbrunner at hrsbrnn2@illinois.edu for the link.
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Title: Novel Probes of Dark Matter"

Speaker: Cora Dvorkin, Harvard University

Date: November 18, 2020  Time: 4:00 pm  via Zoom

Abstract: Measurements of the Cosmic Microwave Background and the large-scale structure of the universe have made it possible to determine with great precision the universe’s inventory, as well as properties of its initial conditions. However, there are profound questions that remain unanswered.

Cosmological observations and galaxy dynamics seem to imply that 84% of all matter in the universe is composed of dark matter, which is not accounted for by the Standard Model of particles. The particle nature of dark matter is one of the most intriguing puzzles of our time.

The wealth of knowledge which is and will soon be available from cosmological surveys will reveal new information about our universe. I will discuss how we can use new and complementary data sets to improve our understanding of the particle nature of dark matter at different scales.

The ZOOM link will be sent on Wednesday morning to the Physics Faculty, Graduate student, PDRA, and AP mailing lists. If you are not on one of those lists and are interested in attending, please email Suzanne Hallihan at shalliha@illinois.edu for the link.
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Job Opportunity

Faculty Position in Theoretical Condensed Matter Physics Department of Physics & Astronomy, University of California, Davis

The Department of Physics & Astronomy at the University of California, Davis invites applications for a full-time faculty position in theoretical condensed matter physics. Applications will be considered for a tenure-track appointment at the level of Assistant Professor. Candidates must possess a Ph.D. or equivalent in physics or related area. A successful candidate will be expected to demonstrate the potential to develop a world-class research program, achieve excellence in teaching students at all levels, and possess a strong commitment to providing service to the department, university and professional communities.

The position will remain open until filled, but to be assured full consideration, submit your application including CV, publication list, statements of research plans and teaching interests, diversity, equity, and inclusion statement, as well as contact information for four references, by November 15, 2020. Submit applications online via the job listing #JPF03695 at https://recruit.ucdavis.edu/JPF03695.

Inquiries may be addressed to CMT Search Committee Chair, Department of Physics & Astronomy, University of California, One Shields Ave, Davis, CA 95616, or by e-mail to cmtsearch@ucdavis.edu. For further information about the department, please visit http://www.physics.ucdavis.edu.

UC Davis is an affirmative action/equal employment opportunity employer and is dedicated to recruiting a diverse faculty community. We encourage all qualified applicants to apply, in particular, women, minorities, individuals with disabilities, veterans, and applicants whose research, teaching, and community outreach demonstrate their commitment to inclusion of under-represented and/or non-majority individuals into their respective area of specialization within their discipline.
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Perimeter Institute for Theoretical Physics is now accepting applications for the 2021/2022 Perimeter Scholars International (PSI) program.

PSI is a master's-level course in theoretical physics designed to bring highly qualified and exceptionally motivated graduate students to the cutting edge of the field in an inclusive training environment. This unique Master’s program, in partnership with the University of Waterloo, seeks not only students with stellar undergraduate physics and/or mathematics track records, but also those with diverse backgrounds, collaborative spirit, creativity, and other attributes that will set them apart as future innovators.

Program features

- Removal of financial barriers: Most students who receive and accept offers of admission to PSI will receive a full scholarship. Perimeter Institute also helps with travel arrangements and any immigration arrangements necessary.
- Students learn from many of the leading minds in theoretical physics while earning a Master's degree from the University of Waterloo
- Collaboration is valued over competition; deep understanding and creativity are valued over rote learning and examination
- PSI recruits worldwide: 85 percent of students come from outside of Canada
- PSI seeks extraordinary talent who may have non-traditional academic backgrounds, but have demonstrated exceptional scientific aptitude
- Direct all to the Perimeter Scholars International website for more information
- Paste this key program information on your sites and blogs

Early application deadline: November 15, 2020.

Final application deadline: February 1, 2021.
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Postdoctoral position in Quantum Condensed Matter Theory

The quantum condensed matter theory group and the Center for Precision Many-body Physics at UMass Amherst invite applications for a postdoctoral position in quantum condensed matter theory. The successful candidate will work in the group of Romain Vasseur; although collaborations with other faculty at UMass Amherst in that area, including Tigran Sedrakyan, Boris Svetunov and Nikolay Prokofiev, will be encouraged. Topics of interest cover a wide range of areas including quantum dynamics, hybrid quantum circuits, quantum entanglement, hydrodynamics of quantum systems, quantum transport, integrability breaking, disordered systems and topological phases. Expertise in some of these areas and/or numerical techniques including tensor networks is desirable.

The appointment is expected to be for 2-3 years starting Fall 2021 or earlier, and include competitive salary, benefits, and travel funding.

Applicants are requested to provide a CV (including a publication list), a brief statement of research interests, and the name and contact information of three references. Please send application materials directly to Prof. Vasseur at rvasseur@umass.edu. To receive full consideration, all application materials should be submitted by December 31, 2020.
**Postdoctoral Position in quantum condensed matter theory**

*Job Summary:* A Postdoctoral Associate position is available at the Center for Quantum Phenomena, Department of Physics, New York University under the supervision of Professor Aditi Mitra.

The position is funded by federal grants and will broadly involve the study of non-equilibrium and topological states of matter. There are opportunities to develop collaborations with neighboring institutions in the NY metropolitan area. Candidates for the position must have a Doctorate degree in Physics or a related discipline.

The start date is June 1, 2021, but later start dates are also possible. The appointment is for two years with the possibility of a third year subject to performance and continued funding.

Applicants should submit their CV on interfolio, and also arrange for 2 letters of recommendation to be submitted on interfolio. The link is:

http://apply.interfolio.com/79276

*Qualifications:* PhD in Physics or related research fields, and within 0-5 years of their PhD.

NYU is an Equal Opportunity Employer and is committed to a policy of equal treatment and opportunity in every aspect of its recruitment and hiring process without regard to age, alienage, caregiver status, childbirth, citizenship status, color, creed, disability, domestic violence victim status, ethnicity, familial status, gender and/or gender identity or expression, marital status, military status, national origin, parental status, partnership status, predisposing genetic characteristics, pregnancy, race, religion, sex, sexual orientation, unemployment status, veteran status, or any other legally protected basis. Women, racial and ethnic minorities, persons of minority sexual orientation or gender identity, individuals with disabilities, and veterans are encouraged to apply for vacant positions at all levels.

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**CALENDAR OF EVENTS**

http://physics.illinois.edu/bluesheet.asp

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Joint Postdoc position – Ben Gurion University and Tel Aviv University

Profs. Yigal Meir (Ben Gurion University) and Eran Sela (Tel Aviv University) invite applications for postdoctoral research positions in theoretical condensed matter physics in the framework of an ERC synergy project. The successful candidates will be appointed at one of the institutes, but will work with both researchers, although they will also be encouraged to collaborate with other members of the collaborative team, and to perform autonomous research. Research areas of interest to this collaboration include entropy probes of mesoscopic systems, strongly correlated systems, topological materials, layered materials, and measurements of quantum entanglement. Close collaboration with experimental groups of the ERC synergy collaboration [Klaus Ensslin (ETH), Josh Folk (UBC), Frederic Pierre (Paris)] and elsewhere is anticipated. We expect several positions to become available, each position is expected to extend for a period of two years, with the first one beginning in the summer or fall of 2021, with a possibility of renewal for a third year. Applicants should upload a cover letter, CV and have at least two recommendation letters uploaded to https://academicjobsonline.org/ajo/jobs/17519.
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Postdoctoral Position in Condensed Matter Theory
Department of Physics and Astronomy, Texas Tech University

Applications are invited for a postdoctoral position in condensed matter theory at Texas Tech University in the group of Prof. Wade DeGottardi (Department of Physics and Astronomy) starting in Spring 2021. This research position will focus on the study of low-dimensional systems and materials that exhibit non-trivial topology. A likely focus of this work will be on engineered systems such as networks of superconducting circuits and photonic devices. Other potential projects involve exploring out-of-equilibrium behavior of strongly correlated quantum systems.

As an Equal Employment Opportunity/Affirmative Action employer, Texas Tech University is dedicated to the goal of building a culturally diverse faculty and staff committed to teaching and working in a multicultural environment. We actively encourage applications from all those who can contribute, through their research, teaching, and/or service, to the diversity and excellence of the academic community at Texas Tech University. The university does not discriminate on the basis of an applicant’s race, ethnicity, color, religion, sex, sexual orientation, gender identity, national origin, age, disability, genetic information or status as a protected veteran.

A PhD in physics or a closely related field is required. Interested applications should submit a curriculum vitae, a brief statement of research interests, and the contact information of at least three references. Applications should be submitted online at http://jobs.texastech.edu using requisition ID 22107BR. Any questions about the position should be directed to Prof. DeGottardi, wdegotta@ttu.edu. The review of applications will begin December 10 and will continue until the position is filled.

https://sjobs.brassring.com/TGnewUI/Search/home/HomeWithPreLoad?PageType=JobDetails&partnerid=25898&siteid=5635&Areq=22107BR&codes=PHYDAY#jobDetails=540783_5635
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The Ohio State University

Postdoctoral Researcher Position
Condensed Matter Theory

The Department of Physics at the Ohio State University (OSU) invites applications for a postdoctoral research position in theoretical condensed matter physics. The successful candidate will work in the group of Prof. Brian Skinner, although they will also be encouraged to collaborate with other members of the Physics Department at OSU and to perform autonomous research. Research areas of interest to Prof. Skinner’s group include transport in topological and correlated materials, and the statistical mechanics of quantum entanglement. Close collaboration with experimental groups at OSU and elsewhere is anticipated.

The position is expected to extend for a period of two years, beginning in the summer or fall of 2021, with a possibility of renewal for a third year. For further information regarding the position, please contact Prof. Skinner at skinner.352@osu.edu.

Applicants should provide: a curriculum vitae, the names and contact information of two or three references, and a short statement (not exceeding three pages) describing past research efforts and future research goals. Please send application materials directly to Prof. Skinner at skinner.352@osu.edu with the subject heading “postdoctoral application”. Review of applications will begin on Dec. 31, 2020 and will continue until the position is filled.