Subir Sachdev
Curriculum Vitae

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Employment

- Herchel Smith Professor of Physics, Harvard University, July 1, 2015 onwards.
- Chair, Department of Physics, Harvard University, January 1, 2018 to June 30, 2020.
- Professor of Physics, Harvard University, July 1, 2005 to June 30, 2015.
- Miguel Virasoro Visiting International Chair, International Centre for Theoretical Physics, Trieste, 2024, 2025.
- Raman Chair, Indian Academy of Sciences, 2023-24.
- Jacques Solvay International Chair in Physics, International Solvay Institutes, Brussels, 2023.
- Visiting Scholar, Flatiron Institute, Simons Foundation, July 2019 onwards.
- Visiting Professor, College de France, Paris, May-June 2022.
- Maureen and John Hendricks Distinguished Visiting Professor, Institute for Advanced Study, Princeton, July 1, 2021 to June 30, 2022.
- Cenovus Energy James Clerk Maxwell Chair in Theoretical Physics (Visiting), Perimeter Institute for Theoretical Physics, Feb 1, 2014 to Jan 31, 2019; Feb 1, 2022 to Jan 31, 2025.
- Stanley S. Hanna Visiting Professor, Stanford University, Fall 2017.
- Dr. Homi Bhabha Chair Professorship, Tata Institute of Fundamental Research, Mumbai, July 1, 2016 to June 30, 2019.
- Professor of Physics and Applied Physics, Yale University, July 1, 1995 to June 30, 2005.
- Associate Professor (tenured) of Physics and Applied Physics, Yale University, July 1, 1992 to June 30, 1995.
- Associate Professor (term) of Physics and Applied Physics, Yale University, July 1, 1989 to June 30, 1992
- Assistant Professor of Physics and Applied Physics, Yale University, July 1, 1987 to June 30, 1989
- Postdoctoral Member of Technical Staff at AT&T Bell Laboratories, Murray Hill, N.J., September 1, 1985 to August 31, 1987.

Degrees Received

- Freshman year at the Indian Institute of Technology, Delhi, 1978-79
- S.B. (Bachelor of Science) in Physics from the Massachusetts Institute of Technology, February 1982 (picture).
- A.M. (Master of Arts) in Physics from Harvard University, June 1984 (picture).
- Ph.D. in Theoretical Physics from Harvard University, November 1985. Thesis title: Frustration and Order in Rapidly Cooled Metals (picture).
- M.A. (honorary) from Yale University, 1995..

Honors

- Guest of Honor at the 130th Statistical Mechanics Conference, Rutgers University, May 10-12, 2026.
- Miguel Virasoro Visiting International Chair, International Centre for Theoretical Physics, 2024, 2025.
- PROSE (PROfessional and Scholarly Excellence) Award Winner (2024) in the category of chemistry, physics, astronomy and cosmology. Awarded by the Association of American Publishers for Quantum Phases of Matter.
- Raman Chair, Indian Academy of Sciences, 2023-24.
- Foreign Member, The Royal Society, 2023.
  Citation: Subir Sachdev has made profound contributions to theoretical condensed matter physics research. His main interests have been in quantum magnetism, quantum criticality, and perhaps most innovative of all, links between the nature of quantum entanglement in black holes and strongly interacting electrons in materials.
- Jacques Solvay International Chair in Physics 2023, International Solvay Institutes, Brussels.
- Member of the American Academy of Arts and Sciences, 2019 (picture).
- Honorary Fellow, Indian Academy of Sciences, Bengaluru, 2019.
- Foreign Fellow of the Indian National Science Academy, 2019 (picture).
  Citation: Professor Subir Sachdev is a world renowned condensed matter theorist, with many seminal contributions to the theory of strongly interacting condensed matter systems. He is a pioneer in the study of systems near quantum phase transitions. He has also pioneered the exploration of the connection between physical properties of modern quantum materials and the nature of quantum entanglement in their many-particle state, elucidating the diverse varieties of entangled states of quantum matter.
- New England Choice Award, Academics, 2018.
- Dirac Medal (picture), International Center for Theoretical Physics, Trieste, 2018; shared with Dam Thanh Son and Xiao-Gang Wen for "independent contributions towards understanding novel phases in strongly interacting many-body systems, introducing original transdisciplinary techniques".
  Citation: Subir Sachdev has made pioneering contributions to many areas of theoretical condensed matter physics. Of particular importance were the development of the theory of quantum critical phenomena in insulators, superconductors and metals; the theory of spin-liquid states of quantum antiferromagnets and the theory of fractionalized phases of matter; the study of novel deconfinement

phase transitions; the theory of quantum matter without quasiparticles; and the application of many of these ideas to a priori unrelated problems in black hole physics, including a concrete model of non-Fermi liquids.

- Lars Onsager Prize (picture), American Physical Society, 2018.
  Citation: for his seminal contributions to the theory of quantum phase transitions, quantum magnetism, and fractionalized spin liquids, and for his leadership in the physics community.

- Star Family Prize for Excellence in Advising, Certificate of Distinction, Harvard University, 2016.

- Dirac Medal for the Advancement of Theoretical Physics (picture), the Australian Institute of Physics, the University of New South Wales, and the Royal Society of New South Wales, 2015.
  Citation: The Dirac Medal was awarded to Professor Sachdev in recognition of his many seminal contributions to the theory of strongly interacting condensed matter systems: quantum phase transitions, including the idea of critical deconfinement and the breakdown of the conventional symmetry based Landau-Ginsburg-Wilson paradigm; the prediction of exotic 'spin-liquid' and fractionalized states; and applications to the theory of high-temperature superconductivity in the cuprate materials.

- Elected to the U.S. National Academy of Sciences, April 2014 (picture).
  Citation: Sachdev has made seminal advances in the theory of condensed matter systems near a quantum phase transition, which have elucidated the rich variety of static and dynamic behavior in such systems, both at finite temperatures and at $T = 0$. His book, *Quantum Phase Transitions*, is the basic text of the field.

- Lifetime Achievement Award, by the Old Boys' Association (picture), St. Joseph's Boys' High School, Bangalore, September 8, 2013.

- Lorentz Chair, Instituut-Lorentz, 2012

- Distinguished Visiting Research Chair at the Perimeter Institute for Theoretical Physics, 2009 onwards

- Highly ranked in Diffusion of scientific credits and the ranking of scientists, F. Radicchi, S. Fortunato, B. Markines, and A. Vespignani, Physical Review E **80**, 056103 (2009).

- APS Outstanding Referee, 2009.

- John Simon Guggenheim Memorial Foundation fellow, 2003.

- Fellow of the American Physical Society, 2001.
  Citation: For his contributions to the theory of quantum phase transitions and its application to correlated electron materials.

- Creativity Award from the National Science Foundation, May 1998.

- Alfred P. Sloan Foundation Fellow, February 1989.

- Presidential Young Investigator Award, National Science Foundation, July 1988 - July 1993 (picture).

- LeRoy Apker Award (picture), American Physical Society, January 1983.
  Citation: For his accomplishments as an undergraduate students at the Massachusetts Institute of Technology, including his research "Quantum Electrodynamics in a Damped Cavity".

- Honorable Mention in the William Lowell Putnam Mathematical competition, 1980.

- Ranked second (all India) in the Joint Entrance Examination to the Indian Institutes of Technology, 1978.

Introduction to Research

Sachdev's research describes the consequences of quantum entanglement on the macroscopic properties of natural systems. He has made extensive contributions to the description of the diverse varieties of states of quantum matter, and of their behavior near quantum phase transitions. Many of these contributions have been linked to experiments, especially to the rich phase diagrams of the copper-oxide high temperature superconductors. Sachdev's research has also exposed remarkable connections between the nature of multi-particle quantum entanglement in certain laboratory materials, and the quantum entanglement in astrophysical black holes, and these connections have led to new insights on the entropy and radiation of black holes.

Research Highlights

Sachdev has studied the nature of quantum entanglement in two-dimensional antiferromagnets, introducing several key ideas in a series of papers in 1989-1992, and reviewed in his book *Quantum Phases of Matter*. The first complete emergent gauge theory of quantum antiferromagnets with time-reversal symmetry was introduced. The importance of Berry phases (now often characterized as 'anomalies') was pointed out, and these Berry phases have played a central role in the theory of gapped and gapless quantum spin liquids, including those realized by 'deconfined critiality'. By considering Higgs transitions of the emergent U(1) gauge field, the first theory of a gapped fractionalized spin liquid phase with time-reversal symmetry, the $\mathbb{Z}_2$ spin liquid, was presented. This was described by an emergent $\mathbb{Z}_2$ gauge theory, with the same structure of excitations that appeared later in Kitaev's solvable toric code model. This framework also led to the discovery in 2002 of quantum spin liquid states which have metallic Fermi surfaces in 'fractionalized Fermi liquids (FL*)'. The FL* Fermi surface does not enclose the Luttinger volume, and this is allowed because the anomaly of a quantum spin liquid can offset the Luttinger count.

Sachdev has developed the theory of quantum criticality, elucidating its implications for experimental observations on materials at non-zero temperature. This theory led to the proposal of hydrodynamic electron flow in graphene and related two-dimensional materials. He proposed a solvable model of complex quantum entanglement in a metal which does not have any particle-like excitations in 1993: an extension of this is now called the Sachdev-Ye-Kitaev (SYK) model. These works have led to a theory of quantum phase transitions in metals in the presence of impurity-induced disorder, and a universal theory of strange metals.

Sachdev's theories apply to a wide variety of correlated electron materials, including the copper-oxide materials exhibiting high temperature superconductivity. Many puzzling features of the 'pseudogap' phase of these materials are addressed by his works on the interplay between antiferromagnetism and superconductivity, using the theory of critical quantum spin liquids without quasiparticles.

A connection between the structure of quantum entanglement in the SYK model and in black holes was first proposed by Sachdev in 2010, and these connections have led to extensive developments in the quantum theory of black holes.

Quantum criticality, superconductors, and black holes

Extreme examples of complex quantum entanglement arise in metallic states of matter without quasiparticle excitations, often called *strange metals*. Such metals are invariably present in higher temperature superconductors, above the highest transition temperatures for superconductivity. The strange metallicity and superconductivity are manifestations of an underlying quantum critical state of matter without quasiparticle excitations. Remarkably, there is an intimate connection between the quantum physics of strange metals in modern materials (which can be studied in tabletop experiments), and quantum entanglement near black holes of astrophysics.

This connection is most clearly seen by thinking more carefully about the defining characteristic of a strange metal: the absence of quasiparticles. In practice, given a state of quantum matter, it is difficult to completely rule out the existence of quasiparticles: while one can confirm that certain perturbations do not create single quasiparticle excitations, it is almost impossible to rule out a non-local operator which could create an exotic quasiparticle in which the underlying electrons are non-locally entangled. Using theories of quantum phase transitions, Sachdev argued (*Quantum Phase Transitions*, Physical Review B **56**, 8714 (1997)) instead that it is better to examine how rapidly the system loses quantum phase coherence, or reaches local thermal equilibrium in response to general external perturbations. If quasiparticles existed, dephasing would take a long time during which the excited quasiparticles collide with each other. In contrast, states without quasiparticles reach local thermal equilibrium in the fastest possible time, bounded below by a value of order (Planck constant)/((Boltzmann constant)×(absolute temperature)). Sachdev proposed (Physical Review Letters **70**, 3339 (1993), Physical Review X **5**, 041025 (2015)) a solvable model of a strange metal (a variant of which is now called the Sachdev-Ye-Kitaev (SYK) model), which was shown to saturate such a bound on the time to reach quantum chaos (Journal of High Energy Physics **2016**, 106 (2016)).

We can now make the connection to the quantum theory of black holes: quite generally, black holes also thermalize and reach quantum chaos in a time of order (Planck constant)/((Boltzmann constant) x (absolute temperature)), where the absolute temperature is the black hole's Hawking temperature. And this similarity to quantum matter without quasiparticles is not a co-incidence: Sachdev argued (Physical Review Letters **105**, 151602 (2010)) that the SYK model maps holographically to the low energy physics of charged black holes in 4 spacetime dimension. Also key to this connection were the facts that in the limit of zero temperature, charged black holes have a non-zero entropy proportional to the horizon area, and the SYK model has a non-zero entropy density (Physical Review B **63**, 134406 (2001)). Indeed, the SYK model was the first model to exhibit a non-vanishing zero temperature entropy density *without* an exponentially large ground state degeneracy, and so the holographic mapping implied that charged black holes share this feature.

These and other related works on quantum criticality by Sachdev and collaborators have led to insights on the properties of electronic quantum matter, and on the nature of Hawking radiation from black holes. Solvable models related to gravitational duals and the SYK model have led to the discovery of more realistic models of quantum phase transitions in the high temperature superconductors and other compounds. Advances in the theory of quantum transitions in metals in the presence of impurities have led to a universal theory of strange metals which applies across a wide range of correlated electron compounds. Such predictions (Physical Review B **78**, 115419 (2008), Science **381**, 790 (2023), Physical Review Letters **133**, 186502 (2024)) have been connected to experiments on graphene (Science **351**, 1055 (2016), Science **351**, 1058 (2016)) and the cuprate superconductors (Nature Communications **14**, 3033 (2023)). The SYK model plays a key role in the computation of the density of low energy quantum states of non-supersymmetric charged black holes in 4 spacetime dimensions (arXiv:2209.13608, arXiv:2304.13744), and provides the underlying Hamiltonian system upon which advances on the Page curve of entanglement entropy of evaporating black holes have been tested (see arXiv:2201.03096 for a review).

Sachdev has also developed the theory of critical quantum spin liquids which feature fractionalization and emergent gauge fields, along with absence of quasiparticles. Such spin liquids with gapless excitations play an important role in the theory of the cuprate superconductors.

Resonating valence bonds and $\mathbb{Z}_2$ quantum spin liquids

P.W. Anderson proposed in 1973 that Mott insulators realize antiferromagnets which could form resonating valence bond (RVB) states *i.e.* quantum spin liquid states with an energy gap to spin excitations without breaking time-reversal symmetry. (Anderson also proposed in 1987 that RVB spin correlations are important for high temperature superconductivity in the cuprates; but as noted above, Sachdev has instead argued that the relevant states are critical quantum spin liquids without quasiparticles.) It was conjectured that such RVB states have excitations with fractional quantum numbers, such as a fractional spin 1/2. The existence of such RVB ground states, and of the deconfinement of fractionalized excitations was first established by Read and Sachdev (Physical Review Letters **66**, 1773 (1991)) and Wen (Physical Review B **44**, 2664 (1991)) by the connection to a $\mathbb{Z}_2$ gauge theory. Sachdev was also the first to show that the RVB state is an 'odd' $\mathbb{Z}_2$ gauge theory, (Physical Review B **44**, 686 (1991), Journal of the Physical Society of Japan **69,** Suppl. B, 1 (2000), Reports on Progress in Physics **82**, 014001 (2019)). An odd $\mathbb{Z}_2$ spin liquid has a background $\mathbb{Z}_2$ electric charge on each lattice site (equivalently, translations in the x and y directions anti-commute with each other in the super-selection sector of states associated with a $\mathbb{Z}_2$ gauge flux (also known as the m sector)); this is another example of a 't Hooft/LSM anomaly. Sachdev showed that antiferromagnets with half-integer spin form odd $\mathbb{Z}_2$ spin liquids, and those with integer spin form even $\mathbb{Z}_2$ spin liquids. Using this theory, various universal properties of the RVB state were understood, including constraints on the symmetry transformations of the anyon excitations. Sachdev also obtained many results on the confinement transitions of the RVB state, including restrictions on proximate quantum phases and the nature of quantum phase transitions to them.

The topological order (*i.e.* ground state degeneracies on 2-manifolds) and anyons of $\mathbb{Z}_2$ quantum spin liquids are identical to those which appeared later in the solvable toric code model, which plays a key role in quantum error correction in qubit devices.

$\mathbb{Z}_2$ spin liquids are ground states of spin models on the kagome lattice, and this has been connected to experiments on correlated electron materials and arrays of trapped Rydberg atoms.

Books

- *Quantum Phase Transitions*, by Subir Sachdev, published by Cambridge University Press, Cambridge (1999); paperback in 2001; expanded second edition in 2011. For reviews see
  - Physics Today, vol **54**, number 2, page 56 (February 2001).
  - Contemporary Physics, vol **42**, number 2, page 141, March 2001.
  - Physikalische Blatter, vol **57**, number 10, page 68 (2001).
  - Journal of Statistical Physics, vol **103**, 1139 (2001).
- *Holographic Quantum Matter*, by Sean Hartnoll, Andrew Lucas, and Subir Sachdev, published by MIT Press (2018).
- *Quantum Phases of Matter*, by Subir Sachdev, published by Cambridge University Press, Cambridge (2023).
  - **Prose Award** winner in the category "Chemistry, Physics, Astronomy, and Cosmology" from "The Association of American Publishers" recognizing "significant contributions in scholarly publishing".

Articles

- All publications https://sachdev.physics.harvard.edu/Sachdev-pubs
- 5 selected Papers with Commentaries https://sachdev.physics.harvard.edu/top-5
- 20 selected Papers with Commentaries https://sachdev.physics.harvard.edu/top-20
- All papers on arXiv.org https://arxiv.org/a/sachdev_s_1.html
- All papers not on arXiv.org https://sachdev.physics.harvard.edu/pre-arxiv
- Citations and publications on Google Scholar.
- Highly ranked in Diffusion of scientific credits and the ranking of scientists (F. Radicchi, S. Fortunato, B. Markines, and A. Vespignani, Physical Review E **80**, 056103 (2009)).
- Highly Ranked Scholars, in Physics Lifetime, 2024, by ScholarGPS.

Talks

Files of all talks since 1999 https://sachdev.physics.harvard.edu/talks

Named and plenary lectures

- 10th Abdus Salam Memorial Lecture, Syed Babar Ali School of Science & Engineering, LUMS, Lahore, April 7, 2026.
- Opening plenary talk at Conference on Strongly Correlated Electron Systems 2025, Montreal, July 7, 2025.
- eQMA Distinguished Lecture, Rice University, February 20, 2025.
- Feenberg Lecture, Washington University in St. Louis, September 25, 2024
- Raman Chair Public Lecture of the Indian Academy of Sciences, National College, Bengaluru, December 28, 2023.
- Rapporteur at the 29th Solvay Conference on Physics, The Structure and Dynamics of Disordered Systems, Brussels, October 19-21, 2023.
- 2023 Jacques Solvay International Chair in Physics, Inaugural Lecture, Brussels, June 20, 2023.
- Llewellyn G. Hoxton Lecture, University of Virginia, Charlottesville, April 6, 2023.
- Peterson Public Lecture, Kansas State University, Manhattan, Kansas, April 26, 2022.
- Arline and Michael Magde Colloquium, Boston College, March 2, 2022.
- Boltzmann Lecture, Scuola Internazionale Superiore di Studi Avanzati, Trieste, February 21, 2022.
- The Racah Memorial Lecture, The Racah Institute of Physics, The Hebrew University of Jerusalem, June 21, 2021.
- H. L. Welsh Lectures in Physics, University of Toronto, May 6,7, 2021.
- New Horizons in Physics-IPA50, Commemorating 50 years of Indian Physics Association, APS-IPA Joint Lecture, February 27, 2021.
- Distinguished Colloquium and Lectureship, Korea Advanced Institute of Science and Technology, Daejeon, South Korea, February 17-19, 2021.
- Helen and Morton Sternheim Lecture, University of Massachusetts, Amherst, March 10, 2020.
- Marker Lectures, Penn State University, State College, December 4-6, 2019.
- R.E. Bell Lecture, McGill University, Montreal, February 22, 2019.
- Physics Department Memorial Lectureship, University of California, San Diego, February 14, 2019.
- Homi Bhabha Memorial Public Lecture, IISER Pune, November 14, 2017.
- Distinguished lecture, Texas A&M University, November 9, 2017.
- Biard Lecture, California Institute of Technology, Pasadena, November 2, 2017.
- Dirac Lecture, University of New South Wales, Australia, September 1, 2015.

- Salam Distinguished Lectures, The Abdus Salam International Center for Theoretical Physics, Trieste, Italy, January 27-30, 2014.
- Institute Lecture, Indian Institute of Technology, Kanpur, January 21, 2014.
- Arnold Sommerfeld Lectures, University of Munich, January 31 - February 3, 2012.
- HRI-Girdharilal Mehta Lecture, Harish-Chandra Research Institute, Allahabad, January 13, 2012.
- Rapporteur at the 25th Solvay Conference on Physics, The Theory of the Quantum World, Brussels, October 19-22, 2011.
- Plenary talk at the International Conference on Strong Correlated Electron Systems, August 30, 2011.
- Marc Kac Memorial Lectures, Los Alamos National Laboratory, May 3-5, 2011.
- Moshe Flato Lectures, Ben Gurion University, Israel, March 10, 2011.
- Subramanyan Chandrasekhar Lectures, International Center for Theoretical Sciences, Bangalore, Dec 6-8, 2010
- Plenary talk at the 24th International Conference on Statistical Physics, Cairns, Australia, July 2010.
- Niels Bohr Lecture, Niels Bohr Institute, May 5, 2010
- Colloquium Pierre et Marie Curie, University of Paris, May 3, 2010
- De Sitter Lecture Series in Theoretical Physics 2009, University of Groningen, November 2009
- Solvay colloquium, International Solvay Institutes, Brussels, October 2009
- Plenary talk at the 25th International Conference on Low Temperature Physics, Amsterdam, August 2008
- Rapporteur at the 24th Solvay Conference on Physics, Quantum Theory of Condensed Matter, Brussels, Oct 11-13, 2008
- Distinguished Lecture Series, Technion, Israel, March 2007.
- Plenary talk at the International Conference on Strongly Correlated Electronic Systems, Karlsruhe, Germany, July 2004
- Matsen Lecture at the University of Texas, Austin, October 2002.
- Ehrenfrest Lecturer at the Lorentz Institute in Leiden, Holland, May 1998.
- Plenary talk at the 19th International Conference on Statistical Physics, Xiamen, August 1995.

Ph.D. students

- Jinwu Ye, Great Bay University, Guangdong, China
  Thesis: Some Examples of Quantum Phase Transitions
- T. Senthil, Professor, Department of Physics, Massachusetts Institute of Technology.
  Thesis: Quantum Phase Transitions in Random Spin Systems

- Kedar Damle, Professor, Department of Theoretical Physics, Tata Institute of Fundamental Research, Mumbai, India.
  Thesis: Turning on the Heat: Non-zero Temperature Dynamical Properties of Quantum Many-body Systems
- Chiranjeeb Buragohain, Architect, Oracle.
  Thesis: Dynamical Properties of Quantum Antiferromagnets in One and Two Dimensions
- Ying Zhang, Portfolio Manager at Millennium, London.
  Thesis: Competing Orders in the Cuprate Superconductors
- Anatoli Polkovnikov, Professor of Physics, Boston University.
  Thesis: Manifestation of Quantum Fluctuations in Strongly Correlated Systems
- Stephen Powell, Associate Professor, University of Nottingham
  Thesis: Quantum phases and transitions of many-body systems realized using cold atomic gases
- Adrian Del Maestro, Professor, University of Tennessee
  Thesis: The superconductor-metal quantum phase transition in ultra-narrow wires
- Emily Dunkel (with David Coker, Boston University), NASA Jet Propulsion Laboratory
  Thesis: Quantum Phenomena in Condensed Phase Systems
- Yang Qi, Researcher, Department of Physics, Fudan University, Shanghai
  Thesis: Spin and Charge Fluctuations in Strongly Correlated Systems.
- Rudro Rana Biswas, Assistant Professor, Purdue University
  Thesis: Explorations in Dirac Fermions and Spin Liquids.
- Eun Gook Moon, Associate Professor, Korea Advanced Institute of Science and Technology
  Thesis: Superfluidity in Strongly Correlated Systems
- Max Metlitski, Associate Professor, Department of Physics, Massachusetts Institute of Technology
  Thesis: Aspects of Critical Behavior of Two Dimensional Electron Systems
- Yejin Huh, Founding AI Scientist at Stealth
  Thesis: Quantum Phase Transitions in d-wave Superconductors and Antiferromagnetic Kagome Lattices
- Susanne Pielawa, Algorithm Developer, BMW Group
  Thesis: Metastable Phases and Dynamics of Low-Dimensional Strongly-Correlated Atomic Quantum Gases
- Debanjan Chowdhury, Assistant Professor, Cornell University
  Thesis: Interplay of Broken Symmetries and Quantum Criticality in Correlated Electronic Systems
- Junhyun Lee, Postdoctoral fellow, University of Maryland
  Thesis: Novel quantum phase transitions in low-dimensional systems
- Andrew Lucas, Associate Professor, University of Colorado
  Thesis: Transport and hydrodynamics in holography, strange metals and graphene
- Shubhayu Chatterjee, Assistant Professor, Carnegie Mellon University
  Thesis: Transport and symmetry breaking in strongly correlated systems with topological order

- Wenbo Fu, Data Scientist, Med Data Quest, Cambridge MA
  Thesis: The Sachdev-Ye-Kitaev model and matter without quasiparticles
- Seth Whitsitt, Senior Principal Transformational Quantum Physicist, Northrop Grumman
  Thesis: Universal non-local observables at interacting quantum critical points
- Alex Thomson, Assistant Professor, University of California, Davis
  Thesis: Emergent gapless fermions in strongly-correlated phases of matter and quantum critical points
- Aavishkar Patel, Center for Computational Quantum Physics, Flatiron Institute
  Thesis: Transport, criticality, and chaos in fermionic quantum matter at nonzero density
- Julia Steinberg, Quantitative Researcher at Radix Trading
  Thesis: Universal Aspects of Quantum-Critical Dynamics In and Out of Equilibrium
- Rhine Samajdar, Princeton University
  Thesis: Topological and symmetry-breaking phases of strongly correlated systems: From quantum materials to ultracold atoms
- Haoyu Guo, Cornell University
  Thesis: Novel Transport Phenomena in Quantum Matter
- Henry Shackleton, Pappalardo Fellow, MIT
  Thesis: Fractionalization and disorder in quantum many-body systems
- Chenyuan Li, Academy of Fellows, Rice University
  Thesis: Quantum Criticality and Superconductivity in Systems Without Quasiparticles
- Yanting Teng, Scientist, Laboratory of Quantum Information and Computation, École Polytechnique Fédérale de Lausanne
  Thesis: Exploring Topological Phases in Quantum Many-Body Physics
- Maria Tikhanovskaya, Research Fellow, Allen Institute & University of Washington
  Thesis: Disorder in quantum many-body physics: from strange metal to spin glass systems
- Maine Christos, AWS Postdoctoral Scholar Research Associate in Theoretical Physics, Caltech
  Thesis: Criticality, fractionalization, and superconductivity in two-dimensional quantum materials
- Alexander Nikolaenko, Harvard University
- Serhii Kryhin, Harvard University

Postdocs

- Pierre Le Doussal, Directeur de Recherche de Classe Exceptionnelle, Laboratoire de Physique Théorique de l' Ecole Normale Supérieure, Paris, France.
- Rodolfo Jalabert, Professeur à l'Université Louis Pasteur, Institut de Physique et Chimie des Matériaux de Strasbourg, France.
- Andrey Chubukov, William I. and Bianca M. Fine Chair in Theoretical Physics, University of Minnesota, Minneapolis.
- Satya Majumdar, Directeur de Recherche, Laboratoire de Physique Théorique et Modèles Statistiques, University of Paris XI, France.

- Matthias Vojta, Chair of Theoretical Solid State Physics, Technische Universität, Dresden, Germany
- Oleg Starykh, Professor, Department of Physics, University of Utah.
- Marcus Kollar, Theoretische Physik III, Institut für Physik, Universität Augsburg, Germany.
- Kwon Park, Professor, Korea Institute for Advanced Study, Seoul.
- Takao Morinari, Kyoto University, Kyoto, Japan.
- Adam Durst, Professor, Hofstra University.
- Krishnendu Sengupta, Senior Professor, Indian Association for the Cultivation of Science, Kolkata, India.
- Lorenz Bartosch, Assistant Professor, University of Frankfurt.
- Predrag Nikolic, Associate Professor, George Mason University
- Ribhu Kaul, Professor, Penn State University
- Markus Müller, Senior Scientist, Paul Scherrer Institute, Switzerland.
- Lars Fritz, Associate Professor, University of Utrecht
- Michael Levin, Professor, University of Chicago
- Cenke Xu, Professor, University of California, Santa Barbara
- Sean Hartnoll, Professorship of Mathematical Physics (1967), University of Cambridge
- Erez Berg, Faculty, Department of Condensed Matter Physics, Weizmann Institute of Science, Israel
- Liang Fu, Professor of Physics, Massachusetts Institute of Technology
- Liza Huijse, Co-founder and Head of Data Analytics at Base5 Genomics
- Chris Laumann, Associate Professor, Boston University
- Matthias Punk, Professor, Ludwig-Maximilians-University, Munich
- Philipp Strack, Department Head Strategic Business Development at ASML
- Brian Swingle, Associate Professor, Brandeis University
- Dmitry Abanin, Professor of Physics, Princeton University
- Ling-Yan (Janet) Hung, Professor, Yau Mathematical Sciences Center, Tsinghua University, Beijing
- Jay Sau, Professor of Physics and Co-director, Joint Quantum Institute, University of Maryland
- Sarang Gopalakrishnan, Assistant Professor, Princeton University
- Andrea Allais, Senior Software Engineer - Autonomous Vehicles - Perception, Nuro
- Johannes Bauer, Data Science Executive Director at S&P Global
- Paul Chesler, Technical Staff, MIT Lincoln Laboratory
- Andreas Eberlein, Harvard University

- William Witczak-Krempa, Professeur agrégé, University of Montreal
- Richard Davison, Associate Professor, Heriot-Watt University, Edinburgh
- Chong Wang, Faculty, Perimeter Institute
- Mathias Scheurer, Professor, University of Stuttgart
- Yingfei Gu, Institute for Advanced Study at Tsinghua University
- Grigory Tarnopolsky, Assistant Professor, Carnegie Mellon University
- Harley Scammell, Senior Lecturer, University of Technology, Sydney
- Darshan Joshi, Assistant Professor, Tata Institute for Fundamental Research, Hyderabad
- Alex Kruchkov, Princeton University
- Ya-Hui Zhang, Assistant Professor, Johns Hopkins University
- Zhu-Xi Luo, Assistant Professor, Georgia Institute of Technology
- Daniel Parker, Assistant Professor, University of California, San Diego
- Ilya Esterlis, Assistant Professor, University of Wisconsin-Madison
- Pavel Volkov, Assistant Professor, University of Connecticut
- Peter Lunts, Episteme.
- Pietro Bonetti, Max Planck Institute for Solid State Research, Stuttgart.
- Zhaoyu Han, Harvard University
- Pavel Nosov, Harvard University
- Felix Desrochers, Harvard University
- Oriana K. Diessel, Harvard University
- Carl P. Zelle, Harvard University

Teaching

I have taught the following courses to undergraduate and graduate students.

- Quantum Theory of Solids (Physics 295b, Spring 2025)
- Introduction to Quantum Theory of Solids (Physics 295a/Applied Physics 295a, Fall 2024)
- Quantum Theory of Solids (Physics 295b, Spring 2024)
- Quantum Phases of Matter (Physics 268R, Fall 2023)
- Quantum Theory of Solids (Physics 295b, Spring 2023)
- Introduction to Quantum Theory of Solids (Physics 295a/Applied Physics 295a, Fall 2022)
- Quantum Theory of Solids (Physics 295b, Spring 2021)

- Quantum Phases of Matter (Physics 268R, Fall 2020)
- Advanced Electromagnetism (Physics 232, Spring 2020)
- Introduction to Quantum Theory of Solids (Physics 295a/Applied Physics 295a, Fall 2019)
- Quantum Entanglement (FRSEMR 50L, Spring 2019)
- Quantum Mechanics I (Physics 143a, Fall 2018)
- Quantum Phases of Matter (Physics 268br, Spring 2018)
- Quantum Entanglement (FRSEMR 50L, Spring 2017)
- Quantum Theory of Solids (Physics 295b, Fall 2016)
- Quantum Phases of Matter (Physics 268br, Spring 2016)
- Spring 2015 - Physics 143a, Quantum Mechanics I
- Fall 2014 - Physics 295b, Quantum Theory of Solids
- Fall 2013 - Physics 143b, Quantum Mechanics II
- Spring 2013 - no teaching
- Fall 2012 - Physics 295b, Quantum Theory of Solids
- Fall 2012 - Physics 143b, Quantum Mechanics II
- Fall 2011 - Physics 143b, Quantum Mechanics II
- Spring 2011 - Physics 268r, Classical and Quantum Phase Transitions
- Fall 2010 - Physics 143b, Quantum Mechanics II
- Spring 2010 - Applied Physics 295b, Quantum Theory of Solids
- Spring 2009 - Physics 268r, Classical and Quantum Phase Transitions
- Fall 2008 - Physics 262, Statistical Thermodynamics
- Spring 2008 - Physics 15b
- Fall 2007 - Applied Physics 284, Statistical Thermodynamics
- Fall 2006 - Physics 262, Statistical Thermodynamics
- Spring 2006 - Physics 268r, Classical and Quantum Phase Transitions
- Fall 2005 - Applied Physics 284, Statistical Thermodynamics
- Spring 2005 - Physics 440b, Quantum Mechanics I
- Fall 2004 - Physics 441a, Quantum Mechanics II
- Spring 2004 - Physics 440b, Quantum Mechanics I
- Fall 2003 - Physics 628, Statistical Physics II

- Spring 2003 - Physics 441b, Quantum Mechanics II
- Fall 2002 - Physics 440a, Quantum Mechanics I
- Spring 2002 - Physics 509a, Many Body Theory
- Spring 2001 - Physics 268r (Harvard University), Theory of Many Particle Systems
- Fall 2000 - Physics 509a, Many-Body theory
- Spring 2000 - Physics 628b, Statistical Physics II
- Spring 1999 - Physics 441b, Quantum Mechanics II
- Fall 1998 - Physics 440a, Quantum Mechanics I, and a section for Physics 200a, Fundamentals of Physics I
- Spring 1998 - Physics 628, Statistical Physics II
- Spring 1997 - Physics 602b, Classical Field Theory
- Fall 1996 - Physics 509a, Many Body Theory
- Fall 1995 - Physics 509a, Many Body Theory
- Spring 1995 - Physics 608b, Quantum Mechanics II
- Spring 1994 - Physics 608b, Quantum Mechanics II
- Fall 1993 - Physics 509a, Many-Body theory, and a section for Physics 200a, Fundamentals of Physics I
- Spring 1993 - Physics 608b, Quantum Mechanics II
- Fall 1992 - Two sections for Physics 180a, Advanced General Physics
- Fall 1991 - Two sections for Physics 180a, Advanced General Physics
- Spring 1991 - Physics 512b, Statistical Mechanics, and a section for Physics 201b, Fundamentals of Physics II
- Spring 1990 - Physics 512b, Statistical Mechanics
- Fall 1989 - Physics 460a/506a, Mathematical methods for physicists
- Spring 1989 - Physics 512b, Statistical Mechanics
- Fall 1988 - Physics 460a/506a, Mathematical methods for physicists
- Spring 1988 - Physics 628, Special topics in condensed matter physics

Research appointments

- Research at Harvard and Yale has been continually supported by grants from the Division of Materials Research of the National Science Foundation since 1988.
- Visiting professor at Harvard University, January-June 2001.
- Visiting professor at the University of Fribourg, Switzerland, June 2000.
- Visiting professor at the Institut Henri Poincare, Paris, July 1999.
- Visiting professor at Université Joseph Fourier, Grenoble, France, Nov-Dec, 1997.
- Visiting professor at Université de Paris VII, May-July 1993.
- Visiting Scientist at AT&T Bell Laboratories, 1987, 1988, 1989.
- Visiting Scientist at IBM Thomas J. Watson Research Center, August 1988.
- Ph.D. dissertation research under Prof. D.R. Nelson at Harvard University involving the statistical mechanics of liquids and glasses.
- Undergraduate thesis research under Prof. D. Kleppner at M.I.T. involving theory on atom-field interactions.

Professional

- Editor-in-Chief, Reports on Progress in Physics
- Jury, Infosys Prize, 2018, 2019, 2020.
- Co-editor, Annual Reviews of Condensed Matter Physics
- Scientific Council, International Center for Theoretical Physics, Trieste.
- International Advisory Committee, Higgs Centre for Theoretical Physics, Edinburgh.
- International Advisory Board, International Center for Theoretical Sciences, TIFR, Bangalore.
- Divisional Associate Editor, Physical Review Letters.
- Advisory board, Dutch Research School of Theoretical Physics.
- Chair of steering committee and advisory board, Kavli Institute for Theoretical Physics, Santa Barbara.
- General member and admissions committee, Aspen Center for Physics.
- Review panel for Condensed Matter Science, Brookhaven National Laboratory.