Tankut Can

tankut.can@gmail.com (408) 829-3777
Google Scholar profile citizenship: USA

Research Interests

Artificial intelligence, machine learning, theoretical neuroscience, statistical physics, condensed matter physics, mathematical physics, random matrix theory

Current Projects

- Develop theoretical foundations for gated recurrent neural networks utilizing tools from random matrix theory, statistical physics, and dynamical systems theory.
- Understand the nature of information processing in recurrent neural networks with applications to machine learning and neuroscience.

Employment

2017- present **Research Associate**, Initiative for the Theoretical Sciences
The Graduate Center, CUNY, New York, NY
• Independent postdoctoral research in statistical physics and machine learning

2014-2017 **Research Assistant Professor**, Simons Center for Geometry and Physics,
Stony Brook University, Stony Brook, NY
• Independent postdoctoral research in mathematical condensed matter physics

Education

2014 **Ph.D. Physics**, University of Chicago
Thesis: Fractional Quantum Hall Effect in a Curved Space
Advisor: Prof. Paul B. Wiegmann

2008 **B.A Physics and Applied Mathematics**, University of California, Berkeley
Honors Thesis: Laser Frequency Stabilization on Cesium Resonance Lines by Doppler Free Magnetic Circular Dichroism
Advisor: Prof. Eugene D. Commins

Honors and Awards

2018 General workshop award ($20,000) from Institute for Complex Adaptive Matter (ICAM) for "Machine Learning and Statistical Physics" (with S. Gopalakrishnan, V. Oganesyan, and D. Schwab)

2016 Invited paper for "Emerging Talents" special issue of Journal Physics A: Mathematical and Theoretical

2013 Gregor Wentzel Research Prize, University of Chicago, for outstanding work in theoretical physics

2011 Secondment at University of Leipzig, Summer Research Stipend

2010-2012 University of Chicago Robert A. Millikan Fellowship (U.S. Department of Education Graduate Assistance in Areas of National Need (GAANN) Fellowship)

2008 Distinction in general scholarship, University of California, Berkeley (cum laude equivalent)

2008 High Honors in Physics, University of California, Berkeley

2006-2007 Pomerantz Scholarship, University of California, Berkeley

2006 Berkeley Physics Undergraduate Research Scholar

Professional Associations

- Member, American Physical Society

Service

- Organizer (with S. Gopalakrishnan, V. Oganesyan, and D. Schwab), Workshop: Machine Learning and Statistical Physics, The Graduate Center, CUNY, New York, NY, Nov. 13 - 15, 2018.
- Organizer (with A. Abanov, A. Kapustin, and P. Wiegmann), Workshop: Geometry of Quantum States in Condensed Matter Systems, Simons Center for Geometry and Physics, Stony Brook University, Stony Brook, NY, April 18-22, 2016.
- Organizer (with A. Abanov, A. Kapustin, and P. Wiegmann), Program: Geometry of Quantum Hall States, Simons Center for Geometry and Physics, Stony Brook University, Stony Brook, NY, April 18 - June 17, 2016.
- Session Chair, 2016 APS March Meeting 2016 Session: Fractional QHE: Level Mixing & Transitions
- Referee for Physical Review Letters, Physical Review B, Physical Review E, Annals of Physics, Journal of Physics A: Mathematical and Theoretical, Journal of Physics Communications

Publications and Preprints

19. **Tankut Can**, Kamesh Krishnamurthy, David Schwab, Gating creates slow modes and controls phase-space complexity in GRUs and LSTMs, *under review for the Mathematical and Scientific Machine Learning Conference 2020, Princeton, NJ.*

18. Alexander G. Abanov, **Tankut Can**, Sriram Ganeshan, Gustavo M. Monteiro, Hydrodynamics of two-dimensional compressible fluid with broken parity: variational principle and free surface dynamics in the absence of dissipation, arXiv:1907.11196 (2019).

17. **Tankut Can**, Vadim Oganesyan, Dror Orgad, and Sarang Gopalakrishnan, Spectral gaps and mid-gap states in random quantum master equations, Physical Review Letters **123**, 234103 (2019).

16. **Tankut Can**, Random Lindblad Dynamics, Journal of Physics A: Mathematical and Theoretical **52** 485302 (2019).

15. Nathan Schine, Michelle Chalupnik, **Tankut Can**, Andrey Gromov, and Jonathan Simon, Electromagnetic and Gravitational Responses of Photonic Landau Levels, Nature **565**, 173 (2019).

14. Alexander G. Abanov, **Tankut Can**, Sriram Ganeshan, Odd surface waves in two-dimensional incompressible fluids, SciPost Phys. **5**, 010 (2018).

13. **T. Can**, P. Wiegmann, Quantum Hall states and conformal field theory on a singular surface, Journal of Physics A: Mathematical and Theoretical **50**, 494003 (2017). **Invited Paper** for "John Cardy's scale-invariant journey in low dimensions: a special issue for his 70th birthday".

12. Dung Xuan Nguyen, **Tankut Can**, and Andrey Gromov, Particle-Hole Duality in the Lowest Landau Level, Physical Review Letters **118**, 206602 (2017).

11. **Tankut Can**, Central charge from adiabatic transport of cusp singularities in the quantum Hall effect, Journal of Physics A: Mathematical and Theoretical **50**, 174004 (2017). **Invited Paper** for "Emerging Talents" special issue.

10. **T. Can**, Y. H. Chiu, M. Laskin, and P. Wiegmann, Emergent Conformal Symmetry and Geometric Transport Properties of Quantum Hall States on Singular Surfaces, Physical Review Letters **117**, 266803 (2016).

9. M. Laskin, **T. Can**, and P. Wiegmann, Collective Field Theory of Quantum Hall States, Physical Review B **92**, 235141 (2015).

8. **T. Can**, M. Laskin, P. Wiegmann, Geometry of quantum Hall states: Gravitational anomaly and transport coefficients, Annals of Physics **362**, 752 (2015).

7. **T. Can**, P. J. Forrester, G. Téllez, and P. Wiegmann, Exact and Asymptotic Features of the Edge Density Profile for the One Component Plasma in Two Dimensions, Journal of Statistical Physics **158**, 1147 (2015).

6. **T. Can**, M. Laskin, and P. Wiegmann, Fractional Quantum Hall Effect in a Curved Space: Gravitational Anomaly and Electromagnetic Response, Physical Review Letters **113**, 046803 (2014). **Editors' Suggestion**

5. **T. Can**, P. J. Forrester, G. Téllez, and P. Wiegmann, Singular Behavior at the Edge of Laughlin States, Physical Review B **89**, 235137 (2014).

4. Kenley M. Pelzer, **Tankut Can**, Stephen K. Gray, Dirk K. Morr, and Gregory S. Engel, Coherent Transport and Energy Flow Patterns in Photosynthesis under Incoherent Excitation, Journal of Physical Chemistry B **118**(10), 2693 (2014).

3. Joel Mabillard, **Tankut Can**, and Dirk K. Morr, Spatial current patterns, dephasing and current imaging in graphene nanoribbons, New Journal of Physics **16**, 013054 (2014).

2. **Tankut Can** and Dirk K. Morr, Atomic Resolution Imaging of Currents in Nanoscopic Quantum Networks via Scanning Tunneling Microscopy, Physical Review Letters **110**, 086802 (2013).

1. **Tankut Can**, Hui Dai, and Dirk K. Morr, Current eigenmodes and dephasing in nanoscopic quantum networks, Physical Review B **85**, 195459 (2012).

Talks and Presentations

29. "Spectral Gaps and Mid-gap modes in Random Quantum Markov Master Equations", *Invited Speaker*, Universality and Ergodicity Program Seminar, Simons Center for Geometry and Physics, Stony Brook, NY, October 3, 2019.

28. "Coulomb Gas in Superspace", *Invited Speaker*, New Directions in Mathematics of Coulomb Gases and Quantum Hall Effect, Mittag-Leffler Institute, Djursholm, Sweden, July 4, 2019.

27. "Geometric Response of Quantum Hall Liquids", *Invited Speaker*, High Energy Physics seminar, City College of New York, New York, March 22, 2019.

26. "Spectral Gaps in Random Master Equations", *Invited Speaker*, Snapshots of quantum dynamics: constraints, integrability and hidden orders, Graduate Center, City University of New York, New York, March 11, 2019.

25. "Random Lindblad Dynamics", American Physical Society March Meeting, Boston, MA, 2019.

24. Journal Club: "Path Integral for Random Neural Networks", Initiative for the Theoretical Sciences Journal Club, CUNY Graduate Center, New York, NY, Oct. 15 & 23, 2018.

23. "Random Lindblad Dynamics", Random Matrices, Integrability and Complex Systems, Yad Hashmona, Israel, Oct. 4, 2018.

22. "Non-dissipative odd viscosity in quantum and classical systems", Statistical techniques for correlation analysis: Quantum Many-body Systems and more, Centro International de Ciencias A.C., Cuernavaca, México, July 18, 2018.

21. Journal Club: "Eigenvector Statistics of Random Non-Hermitian Matrices", Initiative for the Theoretical Sciences Journal Club, CUNY Graduate Center, New York, NY, June 4, 2018.

20. "Edge Waves in Odd Fluids", American Physical Society March Meeting, Los Angeles, CA, March 2018.

19. "Adiabatic Charge and Momentum Transport in the Fractional Quantum Hall Effect", *Invited Speaker*, Kadanoff Center for Theoretical Physics weekly seminar, Chicago, IL, Nov. 6, 2017.

18. "Coulomb Plasma on a Singular Surface", Summer School: Dyson-Schwinger equations, topological expansions, and random matrices, Columbia University, New York, NY, Aug. 28, 2017.

17. "Adiabatic Charge and Momentum Transport in the Fractional Quantum Hall Effect", Mathematics of Topological Phases of Matter, Simons Center for Geometry and Physics, Stony Brook, NY, June 15, 2017.

16. "Central Charge from Adiabatic Transport of Cusp Singularities in the Quantum Hall Effect", American Physical Society March Meeting, New Orleans, LA, March 2017.

15. "Probing Quantum Hall States with Singularities and Defects" *Invited Speaker*, Symposium on new results in collective phenomena, Graduate Center, City University of New York, New York, January 31, 2017.

14. "Probing Quantum Hall States with Flux Tubes, Cones, and Cusps" *Invited Speaker*, Geometrical Degrees of Freedom in Topological Phases, Banff Institute for Research Sciences, Banff, Canada, August 24, 2016.

13. "Beyond the Plasma Analogy: Collective Field Theory for Quantum Hall States", American Physical Society March Meeting, Baltimore, MD, 2016.

12. "Probing Quantum Hall States with Flux Tubes and Cones", *Invited Speaker*, Workshop on Geometric Aspects of the Quantum Hall Effect, University of Cologne, Cologne, Germany, December 15, 2015.

11. "Collective Field Theory of Quantum Hall states as Random Geometry", *Invited Speaker*, Quantum Geometry, Stochastic Geometry, Random Geometry, you name it, Simons Center for Geometry and Physics, Stony Brook, NY, June 17, 2015.

10. "Ward Identities for Fractional Quantum Hall states", *Invited Speaker*, Program: Large N limit problems in Kahler geometry, Simons Center for Geometry and Physics, Stony Brook, NY, May 28, 2015

9. "Introduction to the Quantum Hall Effect and Geometry", Simons Center for Geometry and Physics weekly seminar, Feb. 23, 2015.

8. "Fractional Quantum Hall Effect in a Curved Space", Non-Hermitean Random Matrices: 50 years after Ginibre, Research Workshop of the Israel Science Foundation, Yad Hashmona, Israel, Oct. 26, 2014.

7. "Fractional Quantum Hall Effect in a curved space", Condensed Matter Theory seminar, Stony Brook University, Sept. 22 and 29, 2014.

6. Journal Club: "Laughlin wave function and anyons", Kadanoff Center for Theoretical Physics, University of Chicago, Chicago, IL,May 2, 2014.

5. Journal Club: "Non-equilibrium dynamics of entanglement entropy quench", Kadanoff Center for Theoretical Physics, University of Chicago, Chicago, IL, Feb. 27, 2014

4. Journal Club: "3D Topological Insulators", Kadanoff Center for Theoretical Physics, University of Chicago, Chicago, IL, Nov. 7, 2013

3. "Singular behavior at the edge of fractional quantum Hall states", *Invited Speaker*, Kadanoff Center for Theoretical Physics weekly seminar, Chicago, IL, Oct. 14, 2013.

2. "Imaging Spatial Current Eigenmodes in Nanoscopic Quantum Networks", American Physical Society March Meeting, Boston, MA, 2012

1. "Imaging Spatial Current Eigenmodes in 2D Nanostructures", Nano Talk Student Symposium, University of Chicago, Chicago, IL, 2011.

Posters

3. T. Can, Adiabatic Charge and Momentum Transport in the Fractional Quantum Hall Effect, Summer School: Dyson-Schwinger equations, topological expansions, and random matrices, Columbia University, New York, NY, Aug. 28, 2017.

2. T. Can, Adiabatic Charge and Momentum Transport in the Fractional Quantum Hall Effect, Frontiers in Emergent Quantum Phenomena, New York University, New York, NY, 2017.

1. T. Can, H. Dai, D. K. Morr, Imaging Real Space Currents in Nanostructures, Electronic Transport in Nanoengineered Materials Workshop, University of Chicago, Chicago, IL, 2010.

Teaching

2019 — Adjunct Assistant Professor, City College CUNY, New York, NY
General Physics I (Physics 203), Summer Session

- Designed and taught introductory undergraduate physics course for life sciences majors.
- 5/5 score on ratemyprofessors.com

2017 — Instructor, Stony Brook University, Stony Brook, NY
Classical Physics II (Physics 132), Spring Semester

- Weekly duties included teaching 1 hour recitation section, and grading homework.

2008-2012 — Graduate Teaching Assistant, University of Chicago
Undergraduate physics courses for majors, 8 semesters total

- Weekly duties included teaching 1 hour discussion section, 4 hour lab sections, 2 hours of office hours, and grading homework, labs, and exams.

2007 — Undergraduate Student Instructor, University of California, Berkeley
Physics for Scientists and Engineers (Physics 7B)
Fall Semester

- Duties included 4 hours laboratory/discussion per week, grading homework, labs and exams.

Selected Independent Study & Attended Conferences

- *Completed Courses*: Neural Networks and Machine Learning (Coursera, 2019); Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization (Coursera, 2019); Structuring Machine Learning Projects (Coursera, 2019).
- *Conferences*: Machine Learning and Statistical Physics (Graduate Center CUNY, New York, NY 2018); Workshop on Theory of Deep Learning: Where next? (Institute of Advanced Study, Princeton, NJ 2019); NeurIPS 2019 (Vancouver, BC Canada).

Skills

- *Programming:* MATLAB/Octave, Mathematica (advanced); Python, Fortran (intermediate)
- *ML Libraries:* PyTorch, TensorFlow (beginner)

References

Paul B. Wiegmann
Professor, Physics
University of Chicago
wiegmann@uchicago.edu

Alexander G. Abanov
Professor, Physics
Stony Brook University
aabanov@scgp.stonybrook.edu

Jonathan Simon
Associate Professor, Physics
University of Chicago
simonjon@uchicago.edu

Peter J. Forrester
Professor, Mathematics and Statistics
The University of Melbourne
pjforr@unimelb.edu.au

David J. Schwab
Assistant Professor, Physics and Biology
The Graduate Center
dschwab@gc.cuny.edu