

Martin Claassen

Assistant Professor of Physics

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Current Employment

Aug.2020 – now **Assistant Professor**,
Department of Physics and Astronomy,
University of Pennsylvania, Philadelphia, PA.

Previous Employment

Sep.2017 – Jul.2020 **Flatiron Research Fellow**,
Center for Computational Quantum Physics,
Simons Foundation Flatiron Institute, NY.

Education

Sep.2010 – Jul.2017 **PhD Studies in Applied Physics**,
Stanford University.

Sep.2007 – Sep.2009 **Master Studies in Information Technology and Electrical Engineering**,
Swiss Federal Institute Of Technology Zürich (ETH).

Oct.2004 – Sep.2007 **Bachelor Studies in Information Technology and Electrical Engineering**,
Swiss Federal Institute Of Technology Zürich (ETH).

Publications

1. S. Gassner, C. S. Weber, M. Claassen, Light-induced switching between singlet and triplet superconducting states, *arXiv:2306.13632* (2023).
2. W. T. Tai, M. Claassen, Quantum-Geometric Light-Matter Coupling in Correlated Quantum Materials, *arXiv:2303.01597* (2023).
3. Y. Li, M. Claassen, Statistical Mechanics of Monitored Dissipative Random Circuits, *arXiv:2303.08152* (2023).
4. L. Weber, E. V. Boström, M. Claassen, A. Rubio, D. M. Kennes, Cavity-renormalized quantum criticality in a honeycomb bilayer antiferromagnet, *arXiv:2302.08528* (2023).
5. D. R. Baykusheva, M. H. Kalthoff, D. Hofmann, M. Claassen, D. M. Kennes, M. A. Sentef, and M. Mitrano, Witnessing Nonequilibrium Entanglement Dynamics in a Strongly Correlated Fermionic Chain, *Phys. Rev. Lett.* **130**, 106902 (2023).
6. E. V. Boström, A. Sriram, M. Claassen, A. Rubio, Controlling the magnetic state of the proximate quantum spin liquid α - RuCl_3 with an optical cavity, *arXiv:2211.07247* (2022).

7. M. Claassen, L. Xian, D. M. Kennes, and A. Rubio, Ultra-Strong Spin-Orbit Coupling and Topological Moiré Engineering in Twisted ZrS₂ Bilayers, *Nature Comm.* **13**, 4915 (2022).
8. S. Talkington, and M. Claassen, Dissipation Induced Flat Bands, *Phys. Rev. B* **106**, L161109 (2022).
9. A. Sriram, and M. Claassen, Light-Induced Control of Magnetic Phases in Kitaev Quantum Magnets, *Phys. Rev. Research* **4**, L032036 (2022).
10. Y. Gao, A. Fischer, L. Klebl, M. Claassen, A. Rubio, L. Huang, D. Kennes, and L. Xian, Moiré Engineering of Nonsymmorphic Symmetries and Hourglass Superconductors, *arXiv:2207.02806* (2022).
11. J. Zhang, N. Tancogne-Dejean, L. Xian, E. V. Boström, M. Claassen, D. M. Kennes, and A. Rubio, Ultrafast Spin Dynamics and Photoinduced Insulator-to-Metal Transition in α -RuCl₃, *arXiv:2208.10222* (2022).
12. P. M. Tam, M. Claassen, and C. L. Kane, Topological Multipartite Entanglement in a Fermi Liquid, *Phys. Rev. X* **12**, 031022 (2022).
13. L. Klebl, Q. Xu, A. Fischer, L. Xian, M. Claassen, A. Rubio, and D. M. Kennes, Moiré Engineering of Spin-Orbit Coupling in Twisted Platinum Diselenide, *Electronic Structure* **4**, 014004 (2022).
14. X. X. Huang, B. Moritz, M. Claassen, and T. P. Devereaux, Sign-Free Determinant Quantum Monte Carlo Study of Excitonic Density Orders in a Two-Orbital Hubbard-Kanamori Model, *Phys. Rev. B* **105**, 165124 (2022).
15. A. de la Torre, D. M. Kennes, M. Claassen, S. Gerber, J. W. McIver, and M. Sentef, Nonthermal pathways to ultrafast control in quantum materials, *Rev. Mod. Phys.* **93**, 041002 (2021).
16. M. Claassen, Flow Renormalization and Emergent Prethermal Regimes of Periodically-Driven Quantum Systems, *arXiv:2103.07485* (2021).
17. L. Xian, A. Fischer, M. Claassen, J. Zhang, A. Rubio, and D. M. Kennes, Engineering Three Dimensional Moiré Flat Bands, *Nano Lett.* **21**, 7519 (2021).
18. L. Xian, M. Claassen, D. Kiese, M. M. Scherer, S. Trebst, D. M. Kennes, and A. Rubio, Realization of Nearly Dispersionless Bands with Strong Orbital Anisotropy from Destructive Interference in Twisted Bilayer MoS₂, *Nature Comm.* **12**, 5644 (2021).
19. D. M. Kennes, M. Claassen, L. Xian, A. Georges, A. J. Millis, J. Hone, C. R. Dean, D. N. Basov, A. Pasupathy, and A. Rubio, Moiré heterostructures as a condensed matter quantum simulator, *Nature Phys.* **17**, 155 (2021).
20. T. Yu, M. Claassen, D. M. Kennes, and M. A. Sentef, Optical Manipulation of Domains in Chiral Topological Superconductors, *Phys. Rev. Research* **3**, 013253 (2021).
21. E. V. Boström, M. Claassen, J. W. McIver, G. Jotzu, A. Rubio, and M. A. Sentef, Light-induced topological magnons in two-dimensional van der Waals magnets, *SciPost Phys.* **9**, 061 (2020).

22. Y. Chen, Y. Wang, M. Claassen, B. Moritz, and T. P. Devereaux, Observing photo-induced chiral edge states of graphene nanoribbons in pump-probe spectroscopies, *npj Quantum Mat.* **5**, 84 (2020).
23. D. M. Kennes, L. Xian, M. Claassen, and A. Rubio, A New Twist in the Realization of One-Dimensional Physics, *Nature Comm.* **11**, 1124 (2020).
24. X. Huang, M. Claassen, E. Huang, B. Moritz, and T. P. Devereaux, Exciton Condensation in Electron-hole Doped Hubbard Bilayers – A Sign-problem-free Quantum Monte Carlo Study, *Phys. Rev. Lett.* **124**, 077601 (2020).
25. L. Wang, E.-M. Shih, A. Ghiotto, L. Xian, D. A. Rhodes, C. Tan, M. Claassen, D. M. Kennes, Y. Bai, B. Kim, K. Watanabe, T. Taniguchi, X. Zhu, J. Hone, A. Rubio, A. Pasupathy, C. R. Dean, Correlated Electronic Phases in Twisted Bilayer Transition Metal Dichalcogenides, *Nature Mat.* **19**, 861 (2020).
26. M. Claassen, D. M. Kennes, M. Zingl, M. A. Sentef, and A. Rubio, Universal Optical Control of Chiral Superconductors and Majorana Modes, *Nature Phys.* **15**, 766 (2019).
27. D. M. Kennes, M. Claassen, M. A. Sentef, and C. Karrasch, Light-induced d-wave superconductivity through Floquet-engineered Fermi surfaces in cuprates, *Phys. Rev. B* **100**, 075115 (2019).
28. Y. Wang, M. Claassen, C. D. Pemmaraju, C. Jia, B. Moritz, and T. P. Devereaux, *Nature Rev. Mater.* **3**, 312 (2018).
29. Y. Wang, M. Claassen, B. Moritz, and T. P. Devereaux, Producing Coherent Excitations in Pumped Mott Antiferromagnetic Insulators, *Phys. Rev. B* **96**, 235142 (2017).
30. C. H. Lee, M. Claassen, and R. Thomale, Band Structure Engineering of Ideal Fractional Chern Insulators, *Phys. Rev. B* **96**, 165150 (2017).
31. M. Claassen, H.-C. Jiang, B. Moritz, and T. P. Devereaux, Dynamical Time-Reversal Symmetry Breaking and Photo-Induced Chiral Spin Liquid in Frustrated Mott Insulators, *Nature Comm.* **8**, 1192 (2017).
32. S. Tang, C. Zhang, D. Wong, Z. Pedramrazi, H.-Z. Tsai, C. Jia, B. Moritz, M. Claassen, H. Ryu, S. Kahn, J. Jiang, H. Yan, M. Hashimoto, D. Lu, R. G. Moore, C. Hwang, C. Hwang, Z. Hussain, Y. Chen, M. M. Ugeda, Z. Liu, X. Xie, T. P. Devereaux, M. F. Crommie, S.-K. Mo, and Z.-X. Shen, Quantum Spin Hall State in Monolayer 1T'-WTe₂, *Nature Phys.* **13**, 683 (2017).
33. M. Claassen, C. Jia, B. Moritz, and T. P. Devereaux, All-Optical Materials Design of Chiral Edge Modes in Transition-Metal Dichalcogenides, *Nature Comm.* **7**, 13074 (2016).
34. W. Li, M. Claassen, C.-Z. Chang, B. Moritz, T. Jia, C. Zhang, S. Rebec, J. J. Lee, M. Hashimoto, D.-H. Lu, R. G. Moore, J. S. Moodera, T. P. Devereaux, and Z.-X. Shen, Origin of the Low Critical Observing Temperature of the Quantum Anomalous Hall effect in V-doped (Bi, Sb)₂Te₃ film, *Scientific Reports* **6**, 32732 (2016).

35. M. Sentef, M. Claassen, A. F. Kemper, B. Moritz, T. Oka, J. K. Freericks, and T. P. Devereaux, Theory of Floquet band formation and local pseudospin textures in pump-probe photoemission of graphene, *Nature Comm.* **6**, 7047 (2015).
36. M. Claassen, C. H. Lee, R. Thomale, X.-L. Qi, and T. P. Devereaux, Position-Momentum Duality and Fractional Quantum Hall Effect in Chern Insulators, *Phys. Rev. Lett.* **114**, 236802 (2015).
37. J. J. Cha, M. Claassen, D. Kong, S. S. Hong, K. J. Koski, X.-L. Qi, and Y. Cui, Effects of Magnetic Doping on Weak Antilocalization in Narrow Bi₂Se₃ Nanoribbons, *Nano Lett.* **12**, 4355 (2012).
38. A. Högele, M. Kroner, C. Latta, M. Claassen, I. Carusotto, C. Bulutay, and A. Imamoglu, Dynamic nuclear spin polarization in resonant laser spectroscopy of an InGaAs quantum dot, *Phys. Rev. Lett.* **108**, 197403 (2012).
39. C. Latta, F. Haupt, M. Hanl, A. Weichselbaum, M. Claassen, W. Wuester, P. Fallahi, S. Faelt, L. Glazman, J. von Delft, H. E. Türeci, and A. Imamoglu, Quantum quench of Kondo correlations in optical absorption, *Nature* **474**, 627 (2011).
40. H. E. Türeci, M. Hanl, M. Claassen, A. Weichselbaum, T. Hecht, B. Braunecker, A. Govorov, L. Glazman, A. Imamoglu, and J. von Delft, Many-Body Dynamics of Exciton Creation in a Quantum Dot by Optical Absorption: A Quantum Quench towards Kondo Correlations, *Phys. Rev. Lett.* **106**, 107402 (2011).
41. M. Claassen, and H. E. Türeci, in A. Serpengüzel, Constant Flux States and Their Applications, in A. Serpengüzel, A. Poon (Eds.), *Optical Processes in Microparticles and Nanostructures* (pp. 269-281). World Scientific Publishing (2010).
42. M. Claassen, H. E. Türeci, and Atac Imamoglu, Solid-State Spin-Photon Quantum Interface without Spin-Orbit Coupling, *Phys. Rev. Lett.* **104**, 177403 (2010).

Recent Invited Talks

- Jun 28, 2023 **Quantum-Geometric Interactions of Light and Strongly Correlated Electrons**,
SPICE Workshop Non-equilibrium Quantum Materials Design, Mainz, Germany.
- Jun 19, 2023 **Quantum Geometry In Non-Equilibrium Moiré Materials and Beyond**,
ICTS Workshop, Bangalore, India.
- May 25, 2023 **Non-Equilibrium Moiré Materials**,
Dynamical Control in Quantum Materials Workshop, MPI-PKS, Germany.
- Apr. 6, 2023 **Topology, Quantum Geometry and Light-Matter Interactions in Moiré Heterostructures and Beyond**,
Emory University Condensed Matter Seminar.
- Mar. 30, 2023 **Quantum Geometric Light-Matter Interactions and Optical Control in Topological and Dissipative Quantum Systems**,
University of Tokyo ISSP Theory Seminar.

- Mar. 22, 2023 **Coupling Quantum Geometry and Light in Moiré Materials and Beyond**,
Columbia University Zeminar.
- Feb. 13, 2023 **Topology and Light-Matter Interactions in Moiré Heterostructures**,
Penn State, CAMP Seminar.
- Nov. 8, 2022 **Topological and light-induced phases in Moiré heterostructures**,
Cornell, LASSP Seminar.
- Oct. 13, 2022 **Light-induced nonthermal states – from metastable triplet superconductors to topological phases**,
Gordon Research Conference, Ultrafast Phenomena in Cooperative Systems.
- Sep. 05, 2022 **Spin-orbit coupling, topology and Wannier-obstructed Mott insulators in transition-metal dichalcogenide Moiré heterostructures**,
NGSCES, Italy.

Recent Teaching

- Spring 2023 **PHYS 662**,
Lecturer, Advanced Quantum Condensed Matter Theory and Introduction to Computational Many-Body Physics.
- Fall 2022 **PHYS 140/150**,
Lecturer, Introduction to Mechanics.
- Spring 2021 **PHYS 662**,
Lecturer, Solid State Theory II.

Recent Professional Activities

- Aug. 8–11, 2022 **Workshop: Harnessing Light-Matter Interactions in Quantum Materials**,
Organizer of an international workshop on non-equilibrium quantum phenomena, at the Center for Computational Quantum Physics, Flatiron Institute, NY.
- Nov. 2020 – now **Guest Editor**, *Nature Communications Physics, Focus Collection: Floquet engineering of quantum materials.*