

Ruichao (Alex) Ma

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ACADEMIC POSITIONS

Assistant Professor **Purdue University**
Department of Physics and Astronomy Aug 2019 - Present
Superconducting circuits for many-body physics and quantum information science

Kadanoff-Rice Postdoctoral Fellow **University of Chicago**
Groups of Prof. David Schuster and Prof. Jonathan Simon 2015 - 2019
Building synthetic quantum materials with microwave photons in superconducting circuits

Postdoctoral Researcher **Harvard University**
Group of Prof. Markus Greiner 2014 - 2015
Quantum Gas Microscope - Quantum simulation using cold atoms in optical lattices

EDUCATION

Ph.D. in Physics, Harvard University 2009 - 2014
Dissertation: Engineered potentials and dynamics of ultracold quantum gases under the microscope. (Advisor: Markus Greiner)

B.Sc. (Hons) in Physics, Nanyang Technological University, Singapore 2006 - 2009
Honor's thesis: Compact laser system for Rb BEC in optical surface trap experiments. (Advisor: Rainer Dumke)

HONORS AND AWARDS

- National Science Foundation CAREER Award 2022
- Kadanoff-Rice Postdoctoral Fellowship, University of Chicago 2015 - 2017
- AAAS Newcomb Cleveland Prize 2011
- An Wang Fellowship, Harvard University 2010
- Purcell Fellowship, Harvard University 2009
- Lee Kuan Yew Gold Medal, Nanyang Technological University, Singapore 2009
- Chinese SM2 Undergraduate Scholarship, Singapore Ministry of Education 2006 - 2009

FUNDING SUPPORT

- **DOE:** Quantum Science Center: Superconducting circuit QED sensors 2020 - 2025
- **NSF:** CAREER: Synthetic quantum materials in superconducting circuits 2022 - 2027
- **ARO:** DEPSCoR: Tailoring quantum entanglement in driven-dissipative superconducting circuits 2023 - 2026
- **Purdue:** Start-up Grant 2019 -

PEER-REVIEWED PUBLICATION

- John C. Owens, Margaret G. Panetta, Brendan Saxberg, Gabrielle Roberts, Srivatsan Chakram, Ruichao Ma, Andrei Vrajitoarea, Jonathan Simon, David Schuster, **Chiral Cavity Quantum Electrodynamics**. *Nature Physics* 18 (9), 1048-1052 (2022).
- Thomas E. Roth, Ruichao Ma, Weng C. Chew, **The Transmon Qubit for Electromagnetics Engineers: An Introduction.**, *IEEE Antennas and Propagation Magazine*, 65 (2), 8-20 (2022).

- E. Altman et. al., **Quantum Simulators: Architectures and Opportunities.** *Phys. Rev. X Quantum* 2, 017003 (2021). [Roadmap paper by participants of the NSF workshop on “Programmable Quantum Simulators”]
- Ruichao Ma, Brendan Saxberg, Clai Owens, Nelson Leung and Yao Lu, Jonathan Simon and David Schuster, **A Dissipatively Stabilized Mott Insulator of Photons.** *Nature* 566, 51–57 (2019). [Selected for a Nature “News and Views”]
- Nelson Leung, Yao Lu, Srivatsan Chakram, Ravi K. Naik, Nate Earnest, Ruichao Ma, Kurt Jacobs, Andrew N. Cleland, David I. Schuster, **Deterministic bidirectional communication and remote entanglement generation between superconducting qubits.** *npj Quantum Inf.* 5: 18 (2019).
- Clai Owens, Aman LaChapelle, Brendan Saxberg, Brandon Anderson, Ruichao Ma, Jonathan Simon, David I. Schuster, **Quarter-Flux Hofstadter Lattice in Qubit-Compatible Microwave Cavity Array.** *Phys. Rev. A* 97, 013818 (2018).
- Ruichao Ma, Clai Owens, Andrew Houck, David I. Schuster, Jonathan Simon, **An Autonomous Stabilizer for Incompressible Photon Fluids and Solids.** *Phys. Rev. A* 95, 043811 (2017).
- Ruichao Ma, Clai Owens, Aman LaChapelle, David I. Schuster, Jonathan Simon, **Hamiltonian Tomography of Photonic Lattices.** *Phys. Rev. A* 95, 062120 (2017).
- Brandon M. Anderson, Ruichao Ma, Clai Owens, David I. Schuster, Jonathan Simon, **Engineering Topological Many-Body Materials in Microwave Cavity Arrays.** *Phys. Rev. X* 6, 041043 (2016).
- Philip Zupancic, Philipp M. Preiss, Ruichao Ma, Alexander Lukin, M. Eric Tai, Matthew Rispoli, Rajibul Islam, Markus Greiner, **Ultra-precise holographic beam shaping for microscopic quantum control.** *Opt. Express* 24: 13881–13893 (2016).
- Rajibul Islam, Ruichao Ma, Philipp M. Preiss, M. Eric Tai, Alexander Lukin, Matthew Rispoli, Markus Greiner, **Measuring entanglement entropy in a quantum many-body system.** *Nature* 528: 77–83 (2015). [Selected for a Nature “News and Views”]
- Philipp M. Preiss, Ruichao Ma, M. Eric Tai, Jonathan Simon, Markus Greiner, **Quantum gas microscopy with spin, atom-number, and multilayer readout.** *Phys. Rev. A* 91, 041602(R) (2015).
- Philipp M. Preiss, Ruichao Ma, M. Eric Tai, Alexander Lukin, Matthew Rispoli, Philip Zupancic, Yoav Lahini, Rajibul Islam, Markus Greiner, **Strongly correlated quantum walks in optical lattices.** *Science* 347: 1229–1233 (2015). [Selected for a Science “Perspective”]
- Waseem S. Bakr, Philipp M. Preiss, M. Eric Tai, Ruichao Ma, Jonathan Simon, Markus Greiner, **Orbital excitation blockade and algorithmic cooling in quantum gases.** *Nature* 480, 500-503 (2011) [Selected for a Nature “News and Views”]
- Ruichao Ma, M. Eric Tai, Philipp M. Preiss, Waseem S. Bakr, Jonathan Simon, Markus Greiner, **Photon-Assisted Tunneling in a Biased, Strongly Correlated Bose Gas.** *Phys. Rev. Lett.* 107, 095301 (2011).
- Jonathan Simon, Waseem S. Bakr, Ruichao Ma, M. Eric Tai, Philipp M. Preiss, Markus Greiner, **Quantum Simulation of Antiferromagnetic Spin Chains in an Optical Lattice.** *Nature* 472, 307-312 (2011). [Selected for a Nature “News and Views”]
- Waseem S. Bakr, Amy Peng, M. Eric Tai, Ruichao Ma, Jonathan Simon, Jonathon Gillen, Simon Fölling, Lode Pollet, Markus Greiner, **Probing the Superfluid-to-Mott-Insulator Transition at the Single-Atom Level.** *Science* 329, 547-550 (2010). [Selected for a Science “Perspective”]

TEACHING
EXPERIENCE

- **PHYS 342** *Modern physics*, Purdue
- **PHYS 422** *Waves and oscillations*, Purdue

Fall 2022-2023
Spring 2021-2023

- **PHYS 221** *General Physics: Electricity, light, and modern physics*, Purdue
Fall 2019 / Spring 2020 / Fall 2021
- **Physics 123** Teaching fellow for *Laboratory Electronics*, Harvard University Spring 2012

SERVICE TO THE
COMMUNITY

- Guest Editor, Eur. Phys. J. D Topical Issue (2019): Topological Ultracold Atoms and Photonic Systems
- Reviewer for DOE, NSF, NSERC (Canada)
- Reviewer for Nature, Nature Communications, Nature Materials, Physical Review Journals (PRX, PRL, PRA), npj Quantum Information, Reports on Progress in Physics, Annalen der Physik, New Journal of Physics, Optics Letters, Journal of Physics B, Chinese Physics Letters, Chinese Optics Letters, etc.
- Session Chair, APS March Meeting 2019, 2020, 2021; Abstract Sorter, APS March Meeting 2020.

SERVICE AT
PURDUE
UNIVERSITY

- Graduate Admissions Committee 2020 - Present
- PhD. Thesis Defense Committee (7) 2020 - Present
- Faculty mentor for Emergent Leader Science Scholars (ELSS) program 2020 - Present
- Quantum Information Science Faculty Search Committee 2023
- College of Science Grade Appeals Committee 2023- 2025

ADVISORS AND
ADVISEES

Supervisors:

- **Markus Greiner**: PI's graduate supervisor
- **David Schuster**: PI's postdoctoral co-supervisor
- **Jonathan Simon**: PI's postdoctoral co-supervisor

Doctoral and Post-Doctoral Researchers (Purdue):

- **Botao Du**: Graduate Student, Purdue 2019 - Present
- **Ramya Suresh**: Graduate Student, Purdue 2020 - Present
- **Sheng-Wen Huang**: Graduate Student, Purdue 2022 - Present
- **Qihao Guo**: Graduate Student, Purdue 2022 - Present
- **Kevin Barrow**: Graduate Student, Purdue 2022 - Present

Undergraduates Student Researchers (Purdue):

Santiago López (2021 - Present), **Darin Tsai** (2023 - Present), **Zach Miles** (2023 - Present), **Nathan Henry** (2023 - Present), **Mackenzie Geckler** (2019 - 2021), **Maaz Ahmed** (2019 - 2021), **Lingxue He** (2019 - 2020), **Sean Khomphengchan** (2021), **Andrew Rockovich** (2021), **Gözde İloğlu** (2020 - 2022), **Hyeonwoo Wang** (2022), **Nicholas Kapsos** (2022), **Peter Salisbury** (2021 - 2023).

Emergent Leader Science Scholars (ELSS) Mentees (Purdue):

Melody Shimba (2020 - Present), **Santiago López** (2021 - Present)

SELECTED
PRESENTATIONS

- **Invited Talk**, The 6th International Workshop on Quantum Coherence, Information, and Computing, Stevens Institute of Technology, New Jersey, Oct 2022; *Many-body entanglement in superconducting quantum circuits*.
- **Invited Colloquium**, Advanced Quantum Testbed, Lawrence Berkeley National Laboratory, July 2022; *Many-body physics in driven dissipative superconducting circuits*.

- **Invited EE Seminar**, University of Notre Dame, Notre Dame, Indiana, April 2022; *Synthetic quantum matter in superconducting circuits - Making materials from microwave photons.*
- **Invited Talk**, APS March Meeting 2022, Chicago, Illinois, March 2022; *Many-body physics in driven-dissipative superconducting quantum circuits.*
- **Invited Talk**, Aspen Many-Body Cavity QED Conference, Dec 2021; *Dissipative many-body dynamics in superconducting quantum circuits.*
- **Invited Talk**, APS Prairie Meeting, Nov 2020; *Exploring synthetic quantum matter in superconducting circuits.*
- **Invited Talk**, Indiana University - Purdue University Indianapolis (IUPUI), Indianapolis, Indiana, Feb 2020; *Exploring synthetic quantum matter in superconducting circuits.*
- **Colloquium**, Purdue University, West Lafayette, Indiana, Feb 2020; *Exploring synthetic quantum matter in superconducting circuits.*
- **Invited Talk**, Midwestern Cold Atom Workshop, Northwestern University, Evanston, Illinois, Nov 2019; *Synthetic quantum matter in superconducting circuits.*
- **Invited Talk**, KITS program on emergent phenomena in ultracold atoms, Kavli ITS, Beijing, China, Jun 2019; *Exploring synthetic quantum matter in superconducting circuits.*
- **Invited Talk**, TopoLyon workshop on topological synthetic phases with photons, Lyon, France, May 2019; *Exploring synthetic quantum materials in superconducting circuits.*
- **AMO Seminar**, Northwestern University, Chicago, Illinois, Sep 2018; *Strongly-correlated quantum matter in superconducting circuits.*
- **Invited Talk**, APS March Meeting 2018, Los Angeles, California, March 2018; *Synthetic quantum matter in superconducting circuits.*
- **Invited Talk**, 26th International Conference on Low Temperature Physics, Beijing, China, August 2011; *Quantum simulation of an antiferromagnetic Ising chain in an optical lattice.*
- **Invited Talk**, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Shanghai, China, August 2011; *Quantum simulation of an antiferromagnetic Ising chain in an optical lattice.*
- **Physics & Applied Physics Seminar**, Nanyang Technological University, Singapore, May 2011; *Quantum magnetism in optical lattices.*

Last updated: June 25, 2023