Rahul Trivedi

Max Planck Institute of Quantum Optics, Garching bei Muenchen
Contact: rahul.trivedi@mpq.mpg.de

EDUCATION

January 2021 PhD Electrical Engineering, Stanford University
January 2021 MS Electrical Engineering, Stanford University
May 2016 BTech Electrical Engineering, Indian Institute of Technology, Delhi

ACADEMIC APPOINTMENTS

July 2024 - Present:

- Senior researcher and group leader (tenured), Max Planck Institute of Quantum Optics.
- Affiliate Assistant Professor, Physics and Electrical & Computer Engineering, University of Washington Seattle.

September 2022 - June 2024:

- Assistant Professor, Electrical & Computer Engineering, University of Washington Seattle.
- Adjunct Assistant Professor, Physics, University of Washington Seattle.

January 2021 - August 2022:

Postdoctoral Scholar, Max Planck Harvard Research Center for Quantum Optics.

September 2016 - January 2021:

Graduate research and teaching assistant, Stanford University.

PROFESSIONAL ACTIVITIES

- Associate editor, NPJ Quantum Information (2025 - Present).
- Member of program committee, Quantum Information Processing (QIP), 2025.
- Steering committee, Quantum X, University of Washington (2024).
- QFarm curriculum committee, Stanford (2020).
- Regular reviewer for

  Science, Science Advances, Nature Physics.
  Physical Review Letters, Physical Review A, Physical Review Applied, Physical Review X.
  Quantum Journal.
  Optica, Optics Express, Optics Letters, ACS Photonics.

RESEARCH INTEREST

Broad definition: Analysis, design and applications of quantum information technologies.
Specific Interests: Theory of open quantum systems, many-body quantum optics, quantum simulation, quantum metrology, non-classical light generation.

AWARDS AND SCHOLARSHIP

2024: DOE EFRC center grant as co-PI for “Quantum-photonic Integrated Design Center”.
2023: NSF IMOD seed grant as PI for “Quantum-enhanced spectroscopy with solid-state light sources”.
2022: Quantum Innovator for Science and Engineering, Institute for Quantum Computing and University of Waterloo.
2021: Postdoctoral fellowship from Max Planck Harvard research center for quantum optics.

2020: Runner up for Ken Hass Outstanding student paper award at APS March Meeting.
2019: Quantum Innovator for Science and Engineering, Institute for Quantum Computing and University of Waterloo.
2019: Stanford Electrical Engineering Teaching fellowship.
2019: Centennial Teaching Assistant award.
2016: Thomas and Sarah Kailath Stanford Graduate fellowship.
2016: Silver Medal at Indian Institute of Technology Delhi for Department Rank 1 (Electrical Engineering).
2016: Bambewala award for best undergraduate thesis at Indian Institute of Technology Delhi.
2014: OP Jindal Engineering and Management Fellowship.
2013: Aditya Birla Scholarship.
2012: Gold medal at the 42nd International Physics Olympiad, Estonia
2012: Gold medal at the 13th Asian Physics Olympiad, India.

PUBLICATIONS
Citations (as of 01/2025) > 2600, h-index = 22.
Equal contribution indicated by *
Manuscripts with principal author or primary supervisor boldfaced.

Preprints (in review)
1. G. Gonzalez, A. V. Gorshkov, J. I. Cirac, **R. Trivedi**, "Dynamical complexity of non-Gaussian many-body systems with dissipation," arXiv:2502.05658 (2024) [Under review at Physical Review Letters].
2. A. Kundu, R. Trivedi. A. Javadi, H. Alaeian, "Cooperative effects in thin dielectrics: Long-range Dicke Superradiance," arXiv:2501.14913 (2025) [Under review at Physical Review Letters].
3. **R. Trivedi**, M. Rudner, "A Lieb-Robinson bounds for open quantum systems with memory," arXiv:2410.15481 (2024) [Under review at Nature Communications].
4. G. Gonzalez, J. I. Cirac, **R. Trivedi**, "Pauli-path simulations of noisy quantum circuits beyond the average-case," arXiv:2407.16068 (2024) [Under review at Quantum Journal].
5. B. Schiffer, A. Franco Rubio, R. Trivedi, J. I. Cirac, "The quantum adiabatic algorithm suppresses the proliferation of errors," arXiv:2404.15397 (2024). [Under review at Physical Review Letters].
6. A. D. White, R. Trivedi, "Rigorous bound on violation of dynamic reciprocity induced by four-wave mixing," arXiv:2408.12768 (2024).
7. **R. Trivedi**, "Description and complexity of non-Markovian open quantum dynamics," arXiv:2204.0963 (2022).
8. **R. Trivedi**, "Gradient descent globally solves average-case non-resonant physical design problems," arXiv:2111.02978 (2021).

Published (in-press)
1. V. Kashyap, G. Styliaris, J. I. Cirac, S. Mouradian, **R. Trivedi**, "Analogue simulation of open quantum systems with accuracy guarantees and quantum advantage in the presence of noise," arXiv:2404.11081 (2024). [Accepted in Physical Review X]
2. G. Styliaris, R. Trivedi, D. Perez-Garcia, J. I. Cirac, "Matrix product unitaries: Non tensors and open boundaries," Quantum 9, 1645 (2025).

3. A. Saxena, E. Abbasgholinejad, A. Majumdar, **R. Trivedi**, "Boundary measurement tomography of the Bose Hubbard model on general graphs," Physical Review Research 6 (3), 033058 (2024).
4. **R. Trivedi***, A. Franco Rubio*, J. Ignacio Cirac, "Quantum advantage and stability to errors in analogue quantum simulators," Nature Communications 15 (1), 6507 (2024).
5. S. D. Mishra, M. Frias, **R. Trivedi**, "Classically computing performance bounds on depolarized quantum circuits," Physical Review X Quantum 5 (2), 020317 (2024).
6. M. Luo, R. Trivedi, M. C. Banuls, J. I. Cirac, "Probing Off-diagonal Eigenstate Thermalization with Tensor Networks," Physical Review B 109 (13), 134304 (2024).
7. A. Saxena, A. Manna, R. Trivedi, A. Majumdar, "Realizing tight-binding Hamiltonians using site-controlled coupled cavity arrays," Nature Communications 14 (1), 5260 (2023).
8. V. Villafane, B. Scaparra, M. Rieger, S. Appel, R. Trivedi et al, "Three-photon excitation of InGaN quantum dots," Physical Review Letters 130 (8), 083602 (2023).
9. **R. Trivedi**, J. I. Cirac, "Transitions in computational complexity of continuous-time local open-quantum dynamics," Physical Review Letters 129 (26), 260405 (2022).
10. G. Gonzalez*, **R. Trivedi***, J. I. Cirac, "Error propagation in NISQ devices for solving classical optimization problems," Physical Review X Quantum 3, 040326 (2022).
11. D. Malz, R. Trivedi, J. I. Cirac, "Large-N limit of spontaneous superradiance," Physical Review A 106(1), 013716 (2022).
12. A. D. White*, **R. Trivedi***, K. Narayanan, J. Vuckovic, "Superradiance in dynamically modulated Tavis-Cumming model with spectral disorder," ACS photonics 9(7), 2467-2472 (2022).
13. G. H. Ahn, K. Y. Yang, R. Trivedi, A. D. White, L. Su, J. Skarda, J. Vuckovic, "Augmenting On-Chip Microresonator through Photonic Inverse Design," ACS photonics 9(6), 1875-1881 (2022).
14. J. Skarda*, **R. Trivedi***, L. Su*, D. Ahmad-Stein, H. Kwon, S. Han, S. Fan, J. Vuckovic, "Simulation of large-area metasurfaces with a distributed transition matrix method," NPJ computational materials 8, 78 (2022).
15. **R. Trivedi**, K. Fischer, S. Fan, J. Vuckovic, "Few-particle scattering from localized systems in spatially structured bosonic baths," Quantum 6, 691 (2022).
16. **R. Trivedi**, D. Malz, J. I. Cirac, "Convergence guarantees for discrete mode approximations to non- Markovian quantum baths," Physical Review Letters 127, 250404 (2021).
17. M. A. Guidry, D. M. Lukin, K. Y. Yang, R. Trivedi, J. Vuckovic, "Quantum optics of Kerr frequency combs," Nature Photonics 16(1), 52-28 (2021).
18. G. Gonzalez*, **R. Trivedi***, J. I Cirac, "Quantum algorithms for powering stable Hermitian matrices," Physical Review A 103, 062420 (2021).
19. S. D. Mishra*, **R. Trivedi***, A. Safavi-Naeini, J. Vuckovic, "Quantum control for inhomogeneous broadening compensation in single photon transducers," Physical Review Applied 16 (4), 044025 (2021).
20. **R. Trivedi**, D. Malz, S. Fan, J. Vuckovic, "Optimal two-photon excitation of bound states in non- Markovian waveguide QED." Physical Review A 104 (1), 013705 (2021).
21. **R. Trivedi**, A. D. White, S. Fan, J. Vuckovic, "Analytic and geometric properties of scattering from periodically modulated quantum optical systems." Physical Review A 102 (3), 033707 (2020).
22. **R. Trivedi**, G. Angeris, L. Su, S. Boyd, S. Fan, J. Vuckovic, "Bounds for scattering from absorptionless electromagnetic structures." Physical Review Applied 14 (1), 014205 (2020).

23. D. M. Lukin, A. D. White, R. Trivedi, M. A. Guidry et al, "Spectrally reconfigurable quantum emitters enabled by optimized fast modulation." NPJ Quantum information 6, 80 (2020).
24. E. Scholl, L. Schweickert, L. Hanschke, K. D. Zeuner, F. Sbresny, T. Lettner, R. Trivedi et al, "The crux of using cascaded emission of a 3-level quantum system to generate indistinguishable photons." Physical Review Letters 125 (23) 233605 (2020).
25. D. M. Lukin, C. Dory, M. A. Guidry, K.Y. Yang, S. D. Mishra, R. Trivedi, M. Radulaski, S. Sun, D. Vercruysse, G. H. Ahn, J. Vuckovic, "4H-silicon-carbide-on-insulator for integrated quantum and nonlinear optics." Nature Photonics 14 (5), 330-334 (2020).
26. N. V. Sapra, K. Y. Yang, D. Vercruysse, K. J. Leedle, D. S. Black, R. J. England, L. Su, R. Trivedi, Y. Miao, O. Solgaard, R. L. Byer, J. Vuckovic, "On-chip integrated laser-driven particle accelerator," Science 376 (6473), 79-83 (2020).
27. **R. Trivedi**, L. Su, J. Lu, M. F. Schubert, J. Vuckovic, "Data-driven acceleration of photonic simulations," Scientific reports 9 (1), 1-7 (2020).
28. **R. Trivedi***, K. Fischer*, S. D. Mishra, J. Vuckovic, "Point-coupling Hamiltonian for frequency-independent linear optical devices," Physical Review A 100 (4), 043827 (2019).
29. D. Vercruysse, N. V. Sapra, L. Su, R. Trivedi, J. Vuckovic, "Analytical level set fabrication constraints for inverse design," Scientific Reports 9 (1), 1-7 (2019).
30. **R. Trivedi**, M. Radulaski, K. Fischer, S. Fan, J. Vuckovic, "Photon blockade in weakly driven cavity quantum electrodynamic systems with many emitters." Physical Review Letters 122 (24), 243602 (2019).
31. L. Hanschke, K. Fischer, S. Appel, D. M. Lukin, J. Wierzbowski, S. Sun, R. Trivedi, J. Vuckovic, J. J. Finley, K. Muller, "Quantum dot single-photon sources with ultra-low multi-photon probability," NPJ Quantum information 4 (1), 1-6 (2018).
32. K. Fischer, R. Trivedi, D. M. Lukin, "Particle emission from open-quantum systems," Physical Review A 98 (2), 023853 (2018).
33. K. Fischer, S. Sun, D. M. Lukin, Y. Kelaita, R. Trivedi, J. Vuckovic, "Pulsed coherent drive in the Jaynes-Cummings model," Physical Review A (2), 021802 (2018).
34. **R. Trivedi**, K. Fischer, S. Xu, S. Fan, J.Vuckovic, "Few-photon scattering and emission from low-dimensional systems." Physical Review B 98, Issue 14, 144112 (2018).
35. K. Fischer, R. Trivedi, V. Ramesh, I. Siddiqui, J. Vuckovic, "Scattering into one-dimensional waveguides from a coherently driven quantum optical system." Quantum 2, 69 (2018).
36. L. Su, R. Trivedi, N. V. Sapra, A. Piggott, D. Vercruysse, J. Vuckovic, "Fully-automated optimization of grating couplers," Optics Express 26 (4), 4023-4034 (2018).
37. A. Thomas, R. Trivedi, A. Dhawan, "Plane-wave scattering from a plasmonic nanowire array spacer- separated from a plasmonic film," Materials Research Express 3 (6), 065004 (2016).
38. **R. Trivedi**, U. Khankhoje, A. Majumdar, "Cavity-enhanced second-order nonlinear photonic logic circuits," Physical Review Applied 5 (5), 054001 (2016).
39. A. Zhan, S. Colburn, R. Trivedi, T. Fryett, C. Dodson, A. Majumdar, "Low-contrast dielectric metasurface optics," ACS photonics 3(2), 209-214 (2016).
40. **R. Trivedi**, Y. Sharma, A. Dhawan, "Plane-wave scattering from a plasmonic nanowire-file system with the inclusion of non-local effects," Optics Express 23 (20), 26064-26079 (2015).
41. **R. Trivedi**, U. Khankhoje, "A perturbative solution to plane-wave scattering from a rough dielectric cylinder," IEEE transactions on antennas and propagation 63 (9), 4069-4080 (2015).
42. **R. Trivedi**, A. Thomas, A. Dhawan, "Full-wave electromagnetic analysis of a plasmonic nanoparticle separated from a plasmonic film by a thin spacer layer," Optics Express 22 (17),

19970-19989 (2014).

BOOKS, REVIEW ARTICLES AND BOOK CHAPTERS

1. J. Vuckovic and R. Trivedi, "Physics and applications of optical cavities," American Institute of Physics Publishing (Under preparation, 2020).
2. **R. Trivedi**, D. M. Lukin and J. Vuckovic, "Quantum optics and non-classical light generation," in Proceedings of international physics school of Enrico Fermi, Course 204 on Nanoscale Quantum Optics, Varenna. Edited by Mario Agio et al, Italian Physical Society in partnership with IOS Press, Amsterdam (2020).
3. J. Skarda, G. H. Ahn, R. Trivedi, T. Wu. S. Mitra, J. Vuckovic, "Inverse design of optical interconnects," in Silicon photonics for high performance computing and beyond edited by Mahdi Nikdast, CRC Press/Taylor & Francis Group (2020).
4. **R. Trivedi**, K. A. Fischer, J. Vuckovic, K. Muller, "Generation of non-classical light using semiconductor quantum dots," Advanced Quantum Technologies 3 (1), 1900007 (2020).

PRESENTATIONS

1. [Invited] R. Trivedi, "Non-Markovian open quantum systems - description and quasi-locality", New Perspectives in Many-body quantum optics conference, Kavli Institute of Theoretical Physics (2024).
2. [Invited] R. Trivedi, "Accuracy guarantees and quantum advantage for analog quantum simulators", Entanglement in many-body systems workshop, Incubator for Quantum Simulation (IQuS), University of Washington Seattle (2024).
3. [Invited] R. Trivedi, "Analog quantum simulation in the presence of errors," Quantum matter and quantum information (QMQI) seminar, Technische Universitat Muenchen (TUM) (2024) [Invited].
4. [Invited] R. Trivedi, "Simulating many-body physics with noisy quantum devices," Lorentz center workshop Bridging the gap between classical and quantum simulation (2024).
5. [Invited] R. Trivedi, "Quantum Simulation of many-body physics with accuracy guarantees," APS March meeting (2024).
6. [Invited] R. Trivedi, "Collective phenomena in quantum optics - tomography and metrological applications," IEEE Photonics Conference (2023).
7. [Invited] R. Trivedi, "Simulating many-body physics with noisy quantum devices," International workshop on general purpose quantum computing and quantum information theory, Institute of Theoretical Physics (ITP), Chinese Academy of Sciences (2023).
8. R. Trivedi, A. Franco Rubio, J. Ignacio Cirac "Accuracy guarantees for quantum simulators," Quantum 2.0 conference (2023).
9. A. Saxena, E. Abbasgholinejad, A. Majumdar, R. Trivedi, "Boundary Scattering tomography of quantum photonic lattices," Quantum 2.0 conference (2023).
10. [Invited] R. Trivedi, "Advantages and limitations of noisy quantum simulators," Bernoulli Center workshop on Quantum-classical quantum simulations, EPFL (2023).
11. [Invited] R. Trivedi, "Computational bounds on depolarized quantum circuits," Amazon Braket (2023).
12. [Invited] R. Trivedi, "Quantum simulation of many-body physics in the near-term," Purdue AMO-QIS seminar (2023).

13. [Invited] R. Trivedi, “Errors in near-term quantum hardware,” UC Davis AMO-QIS seminar (2022).
14. [Invited] R. Trivedi, “Errors in near-term quantum hardware: models and algorithms,” Columbia AMO-QIS seminar (2022).
15. [Invited] R. Trivedi, “Impact of errors on near-term quantum hardware,” IQC and U. Waterloo Quantum Innovators in Science and Engineering Workshop (2022).
16. [Invited] R. Trivedi, “Non-Markovian open quantum systems: Theoretical description and simulatability,” UW Physics ABC seminar (2022).
17. [Invited] R. Trivedi, “Non-Markovian open quantum systems: Theoretical description and simulatability,” Stanford QFarm seminar (2022).
18. [Invited] R. Trivedi, “Dynamics of many-body open quantum systems: Theoretical description, simulatability and technological implications,” UW ECE colloquium (2022) [Invited]
19. [Invited] R. Trivedi, “Global Optimality of Photonic Inverse Design,” Metamaterial Congress (2021).
20. [Invited] R. Trivedi, “Simulation methods for non-Markovian quantum optics,” Second workshop on waveguide QED (2021).
21. R. Trivedi, G. Angeris, L. Su, S. Fan and J. Vuckovic, “Fundamental limits on the performance of electromagnetic devices,” APS March Meeting (2020). [Runner up for Ken Hass Outstanding student paper award].
22. R. Trivedi and J. Vuckovic, “Inverse-design of large area metasurfaces,” OSA Incubator Workshop (2020).
23. R. Trivedi and J. Vuckovic, “Inverse-design of large-scale practical photonic circuits,” Physics of Quantum Electronics (2020).
24. [Invited] R. Trivedi, “Scattering theory in quantum optics,” IQC and U. Waterloo Quantum Innovators in Science and Engineering Workshop (2019).
25. R. Trivedi, M. Radulaski, K. Fischer, S. Fan and J. Vuckovic, “Photon blockade in weakly-driven cavity QED systems with many emitters,” APS March Meeting (2019).
26. R. Trivedi, K. Fischer, S. Xu. S. Fan. J. Vuckovic, “Few-photon scattering and emission in low-dimensional systems,” APS March Meeting (2018).
27. R. Trivedi and U. Khankhoje, “Polarization response of a cloud of rough cylinder,” International conference on electromagnetics in advanced applications (2016).
28. R.Trivedi and U.Khankhoje,“A perturbative solution to plane-waves cattering from a rough dielectric cylinder,” Progress in electromagnetics research symposium (2015).

PATENTS

1. Sattwik Deb Mishra, Rahul Trivedi, Amir H. Safavi-Naeini, and Jelena Vuckovic, “Optimized quantum transduction,” filed November 2020 (Stanford disclosure S20-514).
2. Rahul Trivedi, Logan Su, Jelena Vuckovic, “Fast and Accurate Large-Scale Optimization of Metasurfaces", filed January 2020 (Stanford disclosure S18-558).
3. Logan Su, Alex Piggott, Dries Vercruysse, Rahul Trivedi, Neil Sapra, Jelena Vuckovic, “Title: Fully- automated design of grating couplers,” filed January 2018 (Stanford Disclosure S18-019).
4. Jesse Lu, Jan. Petykiewitz, Alex Piggott, Logan Su, Dries Vercruysse, Neil Sapra, Jinhie Skarda, Rahul Trivedi, Geun Ho Ahn, Jelena Vuckovic, “SPINS: Stanford Photonics Inverse Design Software,” filed January 2018 (Stanford Disclosure S18-012).

TEACHING

Principal instructor/Co-instructor for

- Probability for information and communication engineering (EE329), University of Washington Seattle - 2024.
- (Quantum and Classical) Stochastic calculus (EE539) at the University of Washington, Seattle – 2024.
- Quantum Optics (EE528) at the University of Washington, Seattle – 2023.
- Circuit Theory (EE233) at the University of Washington, Seattle – 2023.
- Probability and Stochastic Processes (EE505) at the University of Washington, Seattle – 2022, 2023.
- Optical micro and nanocavities (EE340) at Stanford University – 2019, 2020.

Teaching assistant/Supporting instructor for electrical engineering/applied physics courses

- Quantum information science and Technology (Theory) at Technische Universität München – 2021.
- Optical micro and nanocavities (EE340), Stanford University – 2018, 2020.
- Applied Quantum Mechanics (EE222/223), Stanford University – 2017-2019.
- Analog Circuit Design, Indian Institute of Technology Delhi – 2015.
- Engineering Electromagnetics, Indian Institute of Technology Delhi – 2014, 2015.

SUPERVISION

- Drishti Baruah (PhD student co-advised with Ignacio Cirac, 2024 - Current)
- Guillermo Gonzalez (PhD student co-advised with Ignacio Cirac, 2022 - Current).
- Jordi Montana Lopez (PhD student, 2023 - Current).
- Abhi Saxena (PhD student co-advised with Arka Majumdar, 2022 - 2023, now postdoctoral scholar at NIST Boulder).
- Erfan Abbasgholinejad (MS student, 2022 - 2024, now PhD student at University of Maryland).
- Vikram Kashyap (pre-graduate researcher co-advised with Sara Mouradian, 2023 – 2024, now PhD student at University of Maryland).

INDUSTRY EXPERIENCE

May 2018 – Sept 2018: Research Intern at Google X, Mountain View.
May 2015 – July 2015: Analog Design Intern at Texas Instruments, Bangalore.
May 2014 – July 2014: Research intern at NSF ASSIST Nanosystems Center, Raleigh.