

CONTACT INFORMATION	Theoretical Physics Group, Raman Research Institute CV Raman Avenue, Sadashivanagar, Bangalore 560080	Website: https://shovandutta.org/ Email: shovan.dutta@rri.res.in
ACADEMIC POSITION	Assistant Professor Raman Research Institute , India	Dec 2022 - present
	Postdoctoral Guest Scientist, Condensed Matter MPI for the Physics of Complex Systems , Dresden, Germany	Oct 2021 - Nov 2022
	Postdoctoral Research Associate [TCM website] University of Cambridge, Cavendish Laboratory , UK Supervisor: Prof. Nigel Cooper	Sep 2018 - Sep 2021
EDUCATION	Cornell University , Ithaca, USA Ph.D. in Physics (Theoretical) Advisor: Prof. Erich Mueller Dissertation: Collective Phenomena in Quantum Gases	Aug 2012 - Aug 2018
	Jadavpur University , Kolkata, India B.E. in Electronics and Tele-Communication Engineering 1st class Honours	Jul 2008 - Jul 2012
AWARDS AND ACADEMIC ACHIEVEMENTS	Postdoctoral Fellowships (declined): <ul style="list-style-type: none"> • International Centre for Theoretical Physics (ICTP), Trieste, 2021 [Rosario Fazio] • Center for Theory of Quantum Matter (CTQM), CU Boulder, 2020 [Ana Maria Rey] • Max Planck-Harvard Research Center for Quantum optics (MPHQ), 2018 [J. Ignacio Cirac] Research Associateship at Darwin College , University of Cambridge, 2018-21 Dr. V. Ramachandra Rao Summer Fellowship, Cornell University, 2013 Hartmann Memorial Teaching Award, Cornell University, 2012-13 Dr. Shyama Prasad Mukherjee (SPM) Fellowship offer from CSIR, India, 2012 1st in entrance exams for PhD in Physics: <ul style="list-style-type: none"> • National Eligibility Test (NET), June 2012, organised by CSIR, India • Joint Entrance Screening Test (JEST) 2012, organised by leading research institutes in India • Graduate Aptitude Test in Engineering (GATE) 2011, organised by IITs and IISc Jadavpur University Medals in different engineering subjects, 2012: (i) Prof. J. C. Memorial Gold Medal, (ii) Prof. D. M. Memorial Silver Medal, (iii) M. N. C. Memorial Bronze Medal, (iv) Indu Bhusan and Shanti Sudha Putatunda Memorial Award (2010) Best paper award in National Students Paper and Circuit Design Contest (NSPCDC) 2011, organised by IEEE [paper available at tinyurl.com/y4wuuedl] Late Supriya Basu Scholarship from Jadavpur University Alumni Association (Mumbai) , 2010, for highest grade in engineering departments 1st among ~ 70000 students in the West Bengal Joint Entrance Examination (WBJEE) in Engineering, 2008 [news article on The Telegraph] – Gold Medal from Howrah Zilla School	
RESEARCH SUMMARY	My research is focused on predicting new phenomena in quantum gases of atoms and photons using a blend of analytical and numerical methods. During PhD, I studied exotic phases of matter, collective excitations, and quantum kinetics of such systems. My recent work has unearthed	

novel out-of-equilibrium physics arising in the presence of symmetry, dissipation, periodic driving, or gauge fields, and how they can be accessed in experiments. I am also actively involved in developing widely applicable tensor-network techniques, such as continuum DMRG.

RESEARCH HIGHLIGHTS

Found a class of integrable star graphs of qubits where one can produce multipartite long-range entanglement using a local dissipative drive [in preparation]

Discovered a hidden symmetry that stabilises controllable long-range entanglement in a lossy qubit array [PRL '20, PRR (Letter) '21], accessible by a simple pulse sequence [arXiv '22]

Predicted tuneable quantum phase transitions with metastability in a resonantly shaken lattice, realised in collaboration with Ulrich Schneider's experimental group [Nature Physics '22]

Developed a novel computational technique and [open-source codes](#) enabling the use of Density-Matrix Renormalisation Group (DMRG) for systems in the continuum [PRL '22]

Showed how a dissipatively pumped nonlinear oscillator can be used for quantum sensing [PRL '19], and how limit cycles and critical slowing down emerge in the classical limit [in preparation]

Devised a protocol for preparing photonic fractional quantum Hall states and braiding topological excitations (anyons) in an optical cavity, in close contact with experiments [PRA '18]

Discovered a dynamical instability of solitons in a Fermi gas [PRL '17, PRA '17], and showed how to engineer domain walls carrying synthetic gauge fields in a Bose gas [arXiv '22]

PUBLICATIONS

[Summary, slides, and other illustrations updated at <https://shovandutta.org/#publications>] [arXiv] [ORCID]

PUBLISHED PAPERS

12. **Shovan Dutta**, Anton Buyskikh, [Andrew J. Daley](#), and Erich J. Mueller, "Density Matrix Renormalization Group for Continuous Quantum Systems," *Phys. Rev. Lett.* **128**, 230401 (2022) [pdf] [arXiv:2108.05366] [open-source code] [TCM highlight] [slides].
11. Bo Song, **Shovan Dutta**, Shaurya Bhawe, Jr-Chiun Yu, Ed Carter, Nigel R. Cooper, and [Ulrich Schneider](#), "Realizing discontinuous quantum phase transitions in a strongly-correlated driven optical lattice," *Nat. Phys.* (2022) [pdf] [arXiv:2105.12146] [Physics World] [press release] [TCM highlight] [slides].
10. [Liam L.H. Lau](#) and **Shovan Dutta**, "Quantum walk of two anyons across a statistical boundary," *Phys. Rev. Research (Letter)* **4**, L012007 (2022) [pdf] [arXiv:2012.03977] [press release] [TCM highlight].
9. **Shovan Dutta** and Nigel R. Cooper, "Out-of-equilibrium steady states of a locally driven lossy qubit array," *Phys. Rev. Research (Letter)* **3**, L012016 (2021) [pdf] [arXiv:2007.08938].
8. **Shovan Dutta** and Nigel R. Cooper, "Long-Range Coherence and Multiple Steady States in a Lossy Qubit Array," *Phys. Rev. Lett.* **125**, 240404 (2020) [pdf] [arXiv:2004.07981] [press release] [TCM highlight] [slides].
7. **Shovan Dutta** and Nigel R. Cooper, "Critical Response of a Quantum van der Pol Oscillator," *Phys. Rev. Lett.* **123**, 250401 (2019) [pdf] [arXiv:1908.01002] [TCM highlight] [slides].
6. **Shovan Dutta** and Erich J. Mueller, "Coherent generation of photonic fractional quantum Hall states in a cavity and the search for anyonic quasiparticles," *Phys. Rev. A* **97**, 033825 (2018) [pdf] [arXiv:1711.08059] [press release] [slides].
5. **Shovan Dutta** and Erich J. Mueller, "Protocol to engineer Fulde-Ferrell-Larkin-Ovchinnikov states in a cold Fermi gas," *Phys. Rev. A* **96**, 023612 (2017) [pdf] [arXiv:1706.00994].
4. **Shovan Dutta** and Erich J. Mueller, "Collective Modes of a Soliton Train in a Fermi Superfluid," *Phys. Rev. Lett.* **118**, 260402 (2017) [pdf] [arXiv:1612.04845] [press release] [slides].

3. **Shovan Dutta** and Erich J. Mueller, “Dimensional crossover in a spin-imbalanced Fermi gas,” *Phys. Rev. A* **94**, 063627 (2016) [pdf] [arXiv:1508.03352].
 2. **Shovan Dutta** and Erich J. Mueller, “Kinetics of Bose-Einstein condensation in a dimple potential,” *Phys. Rev. A* **91**, 013601 (2015) [pdf] [arXiv:1407.2557].
 1. **Shovan Dutta** and Erich J. Mueller, “Variational study of polarons and bipolarons in a one-dimensional Bose lattice gas in both the superfluid and the Mott-insulator regimes,” *Phys. Rev. A* **88**, 053601 (2013) [pdf] [arXiv:1308.4876] [slides].
- UNDER REVIEW
2. Sayak Bhattacharjee, **Roderich Moessner**, and **Shovan Dutta**, “Density-and-phase domain walls in a condensate with dynamical gauge potential,” arXiv:2212.14195.
 1. **Shovan Dutta**, **Stefan Kuhr**, and Nigel R. Cooper, “Generating Symmetry-Protected Long-Range Entanglement in Many-Body Systems,” arXiv:2201.10564 [slides].
- IN PREPARATION
2. **Shovan Dutta**, “Multipartite long-range entanglement from a central dissipative drive.”
 1. **Shovan Dutta**, Shu Zhang, and **Masudul Haque**, “Approaching the classical limit of Lindblad dynamics: Emergence of limit cycles, fixed points, and algebraic decay.”
- OLDER PREPRINTS
4. **Shovan Dutta** and **Subhankar Ray**, “Damped bead on a rotating circular hoop - a bifurcation zoo,” arXiv:1201.1218.
 3. **Shovan Dutta** and Subhankar Ray, “Bead on a rotating circular hoop: a simple yet feature-rich dynamical system,” arXiv:1112.4697.
 2. **Shovan Dutta**, Subhankar Ray, and **J. Shamanna**, “Continuous Time Random Walk with time-dependent jump probability: A direct probabilistic approach,” arXiv:1112.3253.
 1. **Shovan Dutta**, “A simple circuit model showing feature-rich Bogdanov-Takens bifurcation.” Selected as the best paper in the IEEE National Students Paper and Circuit Design Contest, 2011. Available at tinyurl.com/y4wuuedl.
- RESEARCH SUPERVISION
- Conceived and supervised research projects:
2. MIPPKS, summer 2022: Internship of an undergraduate physics student from IIT Kanpur, Sayak Bhattacharjee – arXiv:2212.14195.
 1. University of Cambridge, autumn 2020: Independent project of a Masters physics student, Liam Lau – *Phys. Rev. Research (Letter)* **4**, L012007 (2022) [pdf] [press release].
- SELECTED TALKS
- (Invited) “Mapping spins to fermions: how one gets entanglement from loss,” Condensed Matter for Dummies (CMD), MIPPKS, Germany, June 2022
 - (Invited) “Long-range entanglement in lossy qubit arrays,” Open System Control of Atomic and Photonic Matter (OSCAR), Bad Honnef, Germany, June 2022
 - (Invited) “Hidden symmetry and long-range entanglement in a lossy qubit array,” Quantum Optics Group Meeting (online), University of Liège, November 2021
 - “DMRG for continuous systems,” Condensed Matter and Quantum Materials (CMQM) Conference (online), June 2021 [video]
 - (Invited) “Hysteretic quantum phase transitions in a strongly-correlated driven optical lattice,” Physics of Quantum Materials Seminar (online), University of Kent, June 2021 [slides]
 - (Invited) “Long-range entanglement and multiple steady states in a lossy qubit array,” Theoretical Physics Seminar (online), University of Birmingham, March 2021

- “Out-of-Equilibrium Steady States of Driven Lossy Qubit Arrays,” [Many Body Physics in Open Quantum Systems](#), Princeton Center for Theoretical Science, Jan 2021 [[video](#)]
- “Long-range entanglement and multiple steady states in a lossy qubit array,” [Random Interactions Seminar](#), Tata Institute of Fundamental Research (TIFR), November 2020 [[video](#)]
- “Critical Response of a Quantum van der Pol Oscillator,” Centre for Condensed Matter Theory (CCMT) Seminar, Indian Institute of Science (IISc), December 2019 [[slides](#)]
- “Critical Response of a Quantum van der Pol Oscillator,” [Joint DesOEQ-QSUM meeting](#), University of Oxford, September 2019
- “Paving an enlightened path to anyons and quantum computation,” [Science Lunchtime Seminar](#), Darwin College, University of Cambridge, April 2019 [[slides](#)]
- “Collective Dynamics of Solitons in Superfluids,” Research highlight for prospective graduate students, Department of Physics, Cornell University, March 2017 [[slides](#)]

POSTERS

Please see <https://shovandutta.org/#posters> for a list

TEACHING EXPERIENCE

[All courses and student evaluations available at shovandutta.org/teaching/#courses]

- Head of class and co-examiner for [TP2: Advanced Quantum Mech.](#), Cambridge, Lent 2020
- Supervisor for [Part IB Physics A: 2nd year Natural Sciences](#), Cambridge, 2018-19
Experimental methods, Waves, Quantum physics, Condensed matter physics
- Teaching assistant for a diverse set of undergraduate courses at Cornell University, 2012-16
Electromagnetism, Mechanics & special relativity, and courses for non-physics majors

PUBLIC ENGAGEMENT

News articles and research highlights written for a general audience:

- [Mutating Quantum Particles Set in Motion](#)
- [Towards table-top quantum simulation of vacuum decay](#)
- [Hidden symmetry could be key to more robust quantum systems, researchers find](#)
- [A quantum ear](#)
- [Researchers pave an enlightened path to anyons and quantum computation](#)
- [Surprising nature of quantum solitary waves revealed](#)

Non-technical summary and illustrations of research on personal website: shovandutta.org

Lunchtime seminars at Darwin college, Cambridge for non-physicists – see Talks above

Judge in the National Finals for 2022 [Raman Awards](#).

Short presentations on YouTube: tinyurl.com/yyqmc2d4

UNPUBLISHED RESEARCH

- Understanding nucleation of superfluid B phase in ^3He , 2018 (with E. Mueller and [J. Parpia](#))
- Thermalisation in a quasi-one-dimensional quantum gas, 2015 [[manuscript](#)] [[slides](#)]
- Photoemission from thin semiconductor films, 2012 (with [C. Bose](#) and M. Bose)
- Liquid-gas phase transition of cold nuclear matter, 2011 (with S. Ray and J. Shamanna)

EDITORIAL

Referee for PRL (since 2017), PRA (since 2018), and PRB (since 2019)

ADMINISTRATIVE

Co-organised the [Cavendish Quantum Colloquia](#), 2018-19, University of Cambridge
Group representative within the multi-university [DesOEQ](#) programme grant, 2020-21