

CONTACT INFORMATION	<p>Max Planck Institute for the Physics of Complex Systems Nöthnitzer Straße 38, 01187 Dresden, Germany</p> <p>Website: https://shovandutta.org/ Email: sdutta@pks.mpg.de</p>
ACADEMIC POSITION	<p>Guest Scientist, Condensed Matter Max Planck Institute for the Physics of Complex Systems Head of Group: Prof. Roderich Moessner</p> <p>Postdoctoral Research Associate [TCM website] University of Cambridge, Cavendish Laboratory (UK) Supervisor: Prof. Nigel Cooper</p>
EDUCATION	<p>Cornell University, Ithaca, USA Ph.D. in Physics (Theoretical) Advisor: Prof. Erich Mueller Dissertation: Collective Phenomena in Quantum Gases</p> <p>Jadavpur University, Kolkata, India B.E. in Electronics and Tele-Communication Engineering 1st class with Honours, CGPA: 9.42/10</p>
AWARDS AND ACADEMIC ACHIEVEMENTS	<p>Postdoctoral Fellowship offers:</p> <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] <p>Research Associateship at Darwin College, University of Cambridge, 2018-21</p> <p>Dr. V. Ramachandra Rao Summer Fellowship, Cornell University, 2013</p> <p>Hartmann Memorial Teaching Award, Cornell University, 2012-13</p> <p>Dr. Shyama Prasad Mukherjee (SPM) Fellowship offer from CSIR, India, 2012</p> <p>1st all over India in competitive entrance exams for PhD in Physics:</p> <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 <p>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)</p> <p>Best paper award in National Students Paper and Circuit Design Contest (NSPCDC) 2011, organised by IEEE [paper available at tinyurl.com/y4wuuedl]</p> <p>Late Supriya Basu Scholarship from Jadavpur University Alumni Association (Mumbai), 2010, for highest grade in all engineering departments</p> <p>1st among 67,655 students in the West Bengal Joint Entrance Examination (WBJEE) in Engineering, 2008 [news article on The Telegraph] – Gold Medal from Howrah Zilla School</p>
RESEARCH SUMMARY	<p>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.</p>

RESEARCH
HIGHLIGHTS

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 [arXiv '21]

Showed how a dissipative quantum nonlinear oscillator close to a dynamical critical point can sense very weak signals, beyond what is possible classically or in a passive system [PRL '19]

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 domain walls (solitons) in a Fermi gas [PRL '17], showed how they can be efficiently driven to a long-sought-after (FFLO) superfluid state [PRA '17]

PUBLICATIONS

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

PUBLISHED
PAPERS

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. **Shovan Dutta**, **Stefan Kuhr**, and Nigel R. Cooper, “Generating Symmetry-Protected Long-Range Entanglement in Many-Body Systems,” [arXiv:2201.10564](#) (2022) [[slides](#)].
 1. **Shovan Dutta**, Anton Buyskikh, **Andrew J. Daley**, and Erich J. Mueller, “Density-Matrix Renormalization Group for Continuous Quantum Systems,” [arXiv:2108.05366](#) (2021) [[open-source code](#)] [[slides](#)].
- OLDER PREPRINTS
4. **Shovan Dutta** and **Subhankar Ray**, “Damped bead on a rotating circular hoop - a bifurcation zoo,” [arXiv:1201.1218](#) (2012).
 3. **Shovan Dutta** and Subhankar Ray, “Bead on a rotating circular hoop: a simple yet feature-rich dynamical system,” [arXiv:1112.4697](#) (2011).
 2. **Shovan Dutta**, Subhankar Ray, and **J. Shamanna**, “Continuous Time Random Walk with time-dependent jump probability: A direct probabilistic approach,” [arXiv:1112.3253](#) (2011).
 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
- Designed and supervised a full research project for a Master’s physics student in Cambridge – [Phys. Rev. Research \(Letter\) 4, L012007](#) (2022) [[pdf](#)] [[press release](#)]
- SELECTED TALKS
- (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,” Stat. Phys. Journal Club [Seminar](#), International Centre for Theoretical Sciences (ICTS), Jan 2021
 - “Long-range entanglement and multiple steady states in a lossy qubit array,” [Random Interactions Seminar](#), Tata Institute of Fundamental Research (TIFR), November 2020 [[video](#)]
 - “Long-range coherence and multiple steady states in a lossy qubit array,” Center for Theory of Quantum Matter (CTQM) Seminar, CU Boulder, November 2020
 - “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
 - “Critical Response of a Quantum van der Pol Oscillator,” Condensed Matter and Quantum Materials ([CMQM](#)) Conference, University of St Andrews, July 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	<p>[All courses and student evaluations available at shovandutta.org/teaching/#courses]</p> <ul style="list-style-type: none"> • 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	<p>News articles and research highlights written for a general audience:</p> <ul style="list-style-type: none"> • 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 <p>Non-technical summary and illustrations of research on personal website: shovandutta.org</p> <p>Lunchtime seminars at Darwin college, Cambridge for non-physicists – see Talks above</p> <p>Short presentations on YouTube: tinyurl.com/yyqmc2d4</p>
UNPUBLISHED RESEARCH	<ul style="list-style-type: none"> • 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