Dr. Mrittunjoy Guha Majumdar

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Career Objective

Quantum physicist with expertise and experience in the domain of harnessing resources of, and in, quantum mechanics for quantum computing and quantum information, particularly algorithm-design leveraging quantum phenomena like entanglement within and across transverse quantum degrees-of-freedom, and transformative teaching with technology-driven innovations in scientific pedagogy.

Education

2015 - 2019 PhD (Physics) at *Cavendish Laboratory, University of Cambridge*
2014 - 2015 MASt at *Cavendish Laboratory, University of Cambridge*
2011-2014 B.Sc. (Honours) Physics at *St. Stephen's College, University of Delhi*

2022 Certification in Artificial Intelligence and Machine Learning *MIT Stephen A. Schwarzman College of Computing, Massachusetts Institute of Technology (MIT)*

Work Experience

Teaching Experience

Assistant Professor, *Center for Excellence in Quantum Technology, UPES Dehradun* 2023 - Present

Specialization: Quantum Information Processing, Quantum Networks, Quantum Steganography

Assistant Professor, *Department of Physics, Amrita Vishwavidyapeetham, Coimbatore* 2023

Specialization: Quantum Physics, Entanglement and Quantum Information

Guest Faculty, *Department of Physics and Astrophysics, Delhi University* 2020-2021

Taught postgraduate (M.Sc. Honours) papers on Statistical Physics, Biophysics as well as Waves and Optics.

Laboratory Supervisor, *Cavendish Laboratory, University of Cambridge* 2016-2018

Taught and supervised undergraduate (Natural Sciences TRIPOS IA) experiments in Mechanics, Optics, Thermodynamics and Gravity.

Research Experience

Postdoctoral Research Experience

Postdoctoral Fellow, *Harvard University* 2022 - 2023

Investigation of Statistical thermodynamics and non-equilibrium systems, particularly the study of force-flux contributions as well as variational principles, using machine learning.

Senior Postdoctoral Researcher, *Indian Institute of Science* 2021 - 2022

Investigation of path-polarisation-frequency hyperentanglement using quantum random walks as well as development of schemes for optoelectromechanical transduction.

Institute Postdoctoral Fellow, *Tata Institute of Fundamental Research* 2020 - 2021

Investigation of Majorana Fermions in proximity-induced superconductivity and topological insulators for the realisation of topological quantum computing along with Anomalous Hall Effect in Weyl Semi-metals.

Postdoctoral Associate, *Prof. Brian Josephson Group, Cambridge University* 2019 - 2020

Study of relation between (global and gauge) symmetries in physical systems and quantum correlations in physical systems, such as using AdS/CFT Correspondence. Collaboration continues till present.

Predoctoral Research Experience

TIFR National Initiative on Undergraduate Science (NIUS) Fellow under Prof. Prasanta Panigrahi at TIFR, Mumbai and IISER, Kolkata from 2012-2014 | *'Teleportation and Multipartite Quantum State Sharing using a Seven Qubit Genuinely Entangled State'.*

Research Associate under Prof. Munshi Golam Mustafa at SINP, Kolkata in 2014 | *'Colour Screening and Deconfinement of Quarkonium in Medium'.*

Innovation Project Research Scholar under Dr. S.V. Eswaran, Dr. Harish Yadav and Dr. Shabnam Johry at St. Stephen's College (Delhi University), in collaboration with SSPL - Government of India from 2013-2014 | *'Devices based on Photo-Microlithography and Soluble Nano-Carbon Materials'.*

Summer Intern under Prof. A. Srinivasan at IIT, Guwahati in 2012 | *'Magneto-caloric Effect and Magnetic Field Induced Strain of Heusler Alloys'.*

Summer Intern under Prof. K. Sreenivas at USIC – Delhi University in 2012 | *'Analysis of Stress-Coupled Magneto-Electric Effect in BaTiO3-CoFe2O4 Composites using Raman Spectroscopy'*

Training

Research Visitor, *Physical Research Laboratory, Ahmedabad* March 2020

Experimental realisation of quantum information processing using optical systems on a test-bench, particularly focussing on quantum teleportation, quantum cryptography (with focus on BB84 protocol) and Bell state measurements.

Selected Publications

Guha Majumdar, Mrittunjoy, and C. M. Chandrashekar (2023). *"Harnessing Brillouin Interaction in Rare-earth Aluminosilicate Glass Microwires for Optoelectromechanic Quantum Transduction."* Physics Letters A (2023): 128829. Elsevier. DOI 10.1016/j.physleta.2023.128829.

Guha Majumdar, Mrittunjoy and CM Chandrashekar (2022). *"Polarization-path-frequency entanglement using interferometry and frequency shifters"*. Journal of Physics B: Atomic, Molecular and Optical Physics 55.4, p. 045501. IOP Publishing. DOI 10.1088/1361-6455/ac5261.

Guha Majumdar, Mrittunjoy (2022). *"Quantum Transduction Using Optoelectromechanical Systems"*. Resonance 27.10, pp. 1703–1717. Springer Nature. DOI: 10.1007/s12045-022-1465-4.

Guha Majumdar, Mrittunjoy and Shayan Srinivasa Garani (2021). *"Quantum network recovery from multinode failure using network encoding with GHZ states on higher-order butterfly networks"*. Quantum Information Processing 20.12, pp. 1–7. Springer Nature. DOI: 10.1007/s11128-021-03350-3.

Guha Majumdar, Mrittunjoy (2021). *"Nested multilevel entanglement in Matryoshka states"*. Pramana 95.4, pp. 1–10. Springer Nature. DOI: 10.1007/s12043-021-02213-x.

Guha Majumdar, Mrittunjoy (2020). *"Quantum hyper-CPHASE gates with polarisation and orbital angular momentum degrees of freedom and generalisation to arbitrary hyper-conditional gates"*. Quantum In-

formation Processing 19.10, pp. 1–16. Springer Nature. DOI: 10.1007/s11128-020-02862-8.

Scientific Articles

1. MG Majumdar. "A Topological Window into Exotic Matter". *BlueSci-Science Magazine of Cambridge University*. Issue 38. Lent 2017.
2. MG Majumdar. "Tete-a-tete with a Cavendish Luminary: Professor Brian Josephson". *BlueSci-Science Magazine of Cambridge University*. Issue 45. Summer 2019.
3. MG Majumdar. "The Art of Science Diplomacy". Repository, University of Cambridge. Cambridge University Science Policy and Exchange Publications (2018).

Invited Scientific Talks

1. Keynote address at National Workshop on NEP 2020 Model Curriculum and Content in Physics, organized by Ministry of Education - Government of India and National Institute of Technical Teachers' Training and Research (2024).
2. Keynote address at National Workshop on Quantum Computing with *Qiskit*, organized by UPES Dehradun (2024).
3. Chair of session on Quantum Computing and Sustainability at the UPES Sustainability Fair 2.0, sponsored by Springer Nature Group and American Chemical Society International (2023).
4. Talk on 'Quantum Technology: Applications and Implications' in Hemwati Nandan Bahuguna Garhwal University, organized by Department of Physics and Vigyan Setu Forum - DIBNS (2023).
5. Talk on 'Hyperentanglement' at the Ramaiah Institute of Technology (RIT), organized by IEEE CIS and RIT (2022).
6. Talk on "Harnessing Entanglement within and across Transverse Degrees-of-Freedom for Quantum Information Processing" in the Department of Physics, IIT Hyderabad (2022).
7. Talk on 'The Wonders of Quantum Entanglement' in the India International Science Festival, organized by Ministry of Science and Technology, Ministry of Earth Sciences and Ministry of Health and Family Welfare, Government of India (2020).
8. Talk on 'Quirks of the Quantum' organized by Department of Physics, Jawaharlal Nehru College, Boko under DBT Star Status Scheme.

Science Communication

Invited to formulate and present a documentary on Quantum Mechanics named '*Chancing upon the Quantum*' in Doordarshan, India's national broadcaster, in 2019.

Scientific Strategy and Policy

National Lead for the vertical of *Quantum Error Correction and Quantum Error Mitigation* in the in the consultations for national strategy for the National Quantum Mission, organized by Office of the Principal Scientific Adviser to the Government of India and Ministry of Science and Technology, Government of India on 25 July 2023.

Head of Communications of the Cambridge University Science Policy and Exchange (CUSPE) from 2017-2019 at Cambridge University. CUSPE aims at connecting early career researchers to the world of scientific policy making as well as national governments around the world.

Intern and Associate of Ministry of Human Resource Development, Government of India in 2019 on 'Competency-based education in Indian Schools and Programme for International Student Assessment 2021', a policy report in the run-up to the launch of the National Education Policy, with a focus on policy and strategy for improvements in scientific teaching and learning in the country.

Notable Achievements

1. Awarded the prestigious Trinity Barlow Scholarship by Trinity College, University of Cambridge in 2015-2019.
2. Chair of Civil20 Policy Session on 'Technology and Education' in C20 Technology and Security for One World Summit 2023.
3. Showcased by UNESCO in its special documentary for its *Convention on Higher Education* in 2019, with focus on science and technology.
4. Selected by the Department of Science and Technology, Government of India as Youth Scientist Representative the Republic of India at the 1st ASEAN Youth Science Summit, Manila, Philippines in 2008.
5. Awarded INSPIRE Scholarship by Department of Science and Technology, Government of India in 2011-2014.

Workshops in Quantum Information

Convenor, Introduction to Quantum Computing with Qiskit (IQCQ) 2024 Workshop at UPES Dehradun, with Prof. Prasanta Panigrahi, Prof. Anirban Pathak and Prof. Chiranjib Mitra as plenary speakers.

Membership and Associations

1. Member, American Association for the Advancement of Science
2. Member, The Royal Statistical Society
3. Member, Institute of Electrical and Electronics Engineer

Programming Languages Proficiency

Programming Language	Tools for Quantum Computing Known
MATLAB	QETLAB, QLib
Mathematica	QI, QuantumFramework
Python	Toqito, QCircuits, Qiskit
C/C++	Eqcs, Quantum++

Proficiency in IBM Quantum Experience Simulations.

References

References available upon request.