Ganga Singh Manchanda

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EDUCATION

Imperial College London   *Oct 2023 - Oct 2024*
MSc Quantum Fields & Fundamental Forces, 80.52%
    Graduated with Distinction
    Nominated for Imperial President's Scholarship
    Shortlisted for Bayforest Technologies Limited Prize

Imperial College London   *Oct 2020 - Jun 2023*
BSc Physics with Theoretical Physics, First Class Honours

PUBLICATIONS

[1] G. S. Manchanda, "When energy isn't enough: Understanding structural failures in VQE", *Submitted to Phys.Rev.A*.

[2] G. S. Manchanda, "A classification of gauge degrees of freedom in constrained Hamiltonians", *in progress*.

[3] J. Magueijo and G. S. Manchanda, "Quantum wormholes at spatial infinity", *Phys.Lett.B* **864** *139434 (2025)*.

RESEARCH EXPERIENCE

Unaffiliated   London, England
Independent Researcher   *Jun 2025 - Present*

· Independently initiated research in Quantum Computing after identifying poorly understood failure modes in the Variational Quantum Eigensolver.
· Communicated with experts in the field about formalising my results and understanding their wider implications.
· Prepared and submitted a manuscript to *Physical Review A* for peer-review.

Imperial College London   London, England
Postgraduate Researcher - Abdus Salam Centre for Theoretical Physics   *Oct 2024 - Mar 2025*

· Co-authored a peer-reviewed paper published in *Physics Letters B* in the field of Canonical Quantum Gravity.
· Collaborated at every stage of the research process, from model building and theoretical analysis to interpretation of results, addressing key challenges along the way.
· Independently began a follow-up paper addressing key questions raised about gauge degrees of freedom.

SELECTED PROJECTS

When energy isn't enough: Understanding structural failures in VQE

· Presented a novel phenomenon where VQE can fail to reproduce key observables even when energy is successfully minimised to match theoretical expectations.
· Proposed three sources of failure in the VQE sequence: deep-local minima, non-linear error amplification, and resolution ambiguity to explain the discrepancies.
· Identified a class of Hamiltonians which are more susceptible to these errors and gave solutions to how one can avoid them during.

Quantum wormholes at spatial infinity

· Co-developed a theory of quantum wormholes which exist at spatial infinity and whose existence is enforced by unitarity in quantum gravity.
· Worked with constrained Hamiltonians to derive and solve Wheeler-DeWitt partial differential equations using a variety of theoretical techniques, numerical methods, and approximation schemes.

· Predicted corrections to the far out Newtonian potential due to attraction from across the wormhole.

Distances in Discrete Space-time

· Investigated various measures of distance in causal set space-times by analysing procedurally generated directed acyclic graphs.
· Developed algorithms to identify extremal chains under the class of metrics defined by the Minkowski distance.
· Identified phase transitions in geodesic behaviour and discussed the Lorentzian continuous structure expected to emerge under coarse-graining.

Investigations on the Barabási-Albert model

· Simulated large networks (10^6 nodes), modelling stochastic and preferential growth to study critical exponents in network structure evolution.
· Employed statistical methods including log-binning, χ^2 testing, Kolmogorov-Smirnov testing, and data collapse to validate scale-free behaviour and finite-size effects.
· Built efficient analysis tools in Python to visualise behaviour across hundreds of simulations and graph sizes.

EMPLOYMENT

4G Ventures Limited   Birmingham, England
Property Developer   *Jan 2025 - Present*

· Oversaw the redevelopment of derelict properties in the Jewellery quarter and Digbeth.
· Managed building operations, delivering long-term value to both the tenants and the landlord.

Visely (AI EdTech Company)   (Remote) London, England
Academic Writer   *Mar 2025 - Present*

· Generated graduate-level exam questions in topics ranging from Riemannian Geometry to Quantum Information.
· Designed and refined LLM prompts to improve solution accuracy and academic rigour, ensuring high-quality content.

Tutorful   Online
Private Tutor   *Mar 2025 - Present*

· Tutored students taking A-level and undergraduate examinations in Physics and Mathematics.
· Led students to improve their grades from the ranges B/C to A/A*.

OUTREACH

Meditations on Second Philosophy (Physics & Philosophy Blog)   Online
Creator \ Writer   *Jun 2025 - Present*

· Explored and communicated foundational issues in Quantum Mechanics and Gravity.
· Produced an article contributing to the 3Blue1Brown Summer of Math Exposition.

Imperial College Punjabi Society   London, England
President \ Vice-President   *Oct 2022 - Jun 2024*

· Oversaw operations and co-organized the UK's largest annual student-run dance competition (∼£50,000 budget).
· Represented Imperial on stage in our national competition (The Bhangra Showdown).

TECHNICAL SKILLS

Programming: Python (Pennylane, NumPy, SciPy, Pandas, Matplotlib, NetworkX), Git, Jupyter, LaTeX

Languages: English, Punjabi, Hindi, French, Thai

REFERENCES AVAILABLE UPON REQUEST