Syed Hussain Haider

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syedhussainhaider137 Personal Website

Personal Profile

I am an undergraduate physicist with a strong interest in the mathematical structures that shape quantum theory, field dynamics and gravitation. My studies in quantum mechanics, electromagnetism, statistical mechanics and symmetry have drawn me toward questions where abstraction sharpens our understanding of physical systems. Under Prof. James Millen and Dr. Qiongyuan Wu, I explored imaginary-time evolution, examining how Wick rotation transforms the Schrödinger equation into diffusion-type behaviour. Implementing numerical methods to study the decay of higher-energy states strengthened my analytical intuition and deepened my appreciation for how mathematical transformations reveal physical structure. Strong performance in theoretical modules, including 94% in Electromagnetism and a consistently high First-Class average, reflects my commitment to the subject. I now hope to build on this preparation through a rigorous research-focused environment, particularly within high-energy physics, quantum field theory, gravity, and the foundations of modern theoretical physics, so that I can lay a strong foundation for future work in the field.

Education

King's College London: BSc Physics with Theoretical Physics **Sep 2023 – Present**

- Achieved: 80.9% Overall in Year 2 (3.9 GPA equivalent)
  Predicted: 80%+ Overall, Expected Completion: May 2026

Relevant Modules: *Experimental Physics, Quantum Mechanics I & II, Electromagnetism, Thermal Physics and Properties of Matter, Relativity and Sub-Atomic Physics, Mathematical Methods for Physics, Mathematical Methods for Theoretical Physics, Symmetry in Physics, Statistical Mechanics, Advanced Mathematical Methods, Optics, Condensed Matter Physics, Particle Physics, General Relativity & Cosmology, Third-Year Project in Physics*

Research Experience

Undergraduate Researcher, King's College London **August 2025 – Oct 2025**

- Conducted research under supervision of Prof. James Millen and Dr. Qiongyuan Wu as part of the **King's Experience Research Award**.
- Applied Wick rotation to reformulate the Schrödinger equation as a heat equation, enabling imaginary-time evolution of quantum states to project out the ground state and lower-lying eigenstates.
- Developed Python solvers implementing Crank–Nicolson scheme, tridiagonal solvers, and Gram–Schmidt orthogonalization to compute eigenstates of asymmetric double wells, quartic oscillators, position-dependent mass systems, and hydrogen-like potentials.
- Benchmarked numerical methods against published literature, achieving agreement to multiple significant figures, and investigated tunneling splittings and parameter dependencies.
- Produced computational results, academic poster, and reflective essay for formal recognition through the award.

Dark Matter Communication in the AI Era, King's College London **October 2025 – Present**

- Conducting a research-led project under the supervision of Dr. Christopher McCabe, examining how core concepts in **dark-matter theory and experiment** can be communicated effectively in the era of generative AI.
- Analysing weekly themes in early-universe physics and dark-matter detection while critically evaluating the behaviour, limitations, and biases of **AI-generated scientific content**.
- Producing structured LaTeX reports for each investigation and preparing an assessed **research poster** together with a corresponding **oral presentation**.
- Developing technically rigorous science-communication outputs across written, visual, and multimedia formats, with emphasis on clarity, precision, and audience adaptation.

Research Project (Supervised by Dr. Rishav Roshan) **Oct 2025 – Present**
Postdoctoral Researcher in High-Energy Theory, University of Southampton

- Working on theoretical aspects of **dark matter production and evolution in the early universe**, with exposure to frameworks such as *freeze-in* and *freeze-out* scenarios.
- Developing practical skills in **Python** for symbolic manipulation, cosmology-related calculations, and verification of analytical results.
- Preparing structured LaTeX notes that document derivations, literature insights, and simplified analyses of early-universe dynamics.
- Gaining first-hand insight into how **theoretical physics research** is conducted, including model exploration, reading advanced papers, and organising calculations coherently.

Conference Presentations

Speaker, QUIRK+ 2026 Student Research Conference **January 2026**

- Delivered a research talk titled *"Why Imaginary Numbers Matter in Quantum Mechanics"*.
- Contributed to QUIRK+, a multi-university physics conference jointly organised by QMUL, UCL, Imperial, RHUL, KCL, Oxford, Cambridge, and others.
- Presented results from King's Experience Research Award research on Wick rotation and imaginary-time evolution in quantum mechanics.
- Demonstrated how diffusion-like evolution enables numerical extraction of ground and excited states in quantum systems.

Science Communication

Founder, Short Science (Instagram, TikTok, YouTube) **2022 – Present**

- Built an educational platform with **25,000+ followers on Instagram** and audiences across TikTok and YouTube, with videos reaching millions of views.
- Produced short-form educational content on physics, philosophy, and psychology, making complex ideas accessible through engaging visuals and narration.

Scientific Essay Project (Personal Website) **2024 – Present**

- Authored **30+ scientific essays** expanding on video topics, published on personal website.
- Essays provide rigorous, detailed, and accessible explanations for a wide audience in physics and related fields.

Additional Experience

Maths & Physics Tutor, Axis Tuition Centre (GCSE & A-Level) **Nov 2024 – Jan 2025**

- Delivered targeted instruction to GCSE and A-Level students in mathematics and physics.
- Designed and implemented structured lesson plans to improve understanding and exam performance.

Vice President, KCL Quantum Mechanics Society **May 2025 – Present**

- Led the society's academic initiatives, including organizing and delivering student lectures introducing foundational topics in quantum mechanics to audiences of 50+.
- Coordinated guest seminars featuring researchers such as Prof. James Millen, fostering discussions on cutting-edge developments in quantum physics.
- Established and hosted weekly problem-solving sessions, supporting students with coursework and deepening conceptual understanding in physics.

Relevant Research Skills

- Computational modelling in Python and advanced proficiency in LaTeX
- Persistence and independence in tackling open-ended research problems
- Precision in mathematical reasoning and analytical derivations
- Strong ability to interpret and synthesise theoretical physics literature