Daniel Barron

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Education

University of Oxford 2026 – Present
MSc in Mathematical and Theoretical Physics

Trinity College Dublin 2023 – 2026
BA (Hons) in Theoretical Physics. Graduated with First Class Honours (82%).

Trinity College Dublin 2021 – 2023
BA (Hons) In Physical Sciences, completed 2nd year before transferring.

Research Experience

Survival of the Laughlin Wave-Function Phase October 2026 – Present
Master's Dissertation - University of Oxford

- Supervisors: Prof. Steve Simon and Dr. Luca Rüegg.
- Using Diffusion Monte Carlo to test generalised Laughlin-wavefunction stability in varying magnetic fields.
- Comparing variational and fixed-phase energies as field inhomogeneity and Landau-level mixing vary, with implications for fractional Chern insulators.

Extending atomistic modelling with machine learning June – August 2026
Summer Fellowship Programme - Tyndall National Institute

- Supervisor: Dr. Michael Nolan; produced a poster and gave presentations at group meetings throughout.
- Used ORCA to compute vibrational modes, IR spectra, and NMR shifts for PFAS molecules to develop machine learning models for spectral prediction and molecular identification.
- Applied DeepMD and Matlantis machine learning potentials to simulate the oxidation of transition metal nitrides, extending accessible simulation timescales beyond conventional DFT calculations.

Keldysh Field Theory for Lattice Population Dynamics May – July 2026
Hamilton Trust Internship - Trinity College Dublin

- Supervised by Prof. Karen Wiltshire; produced a report, presentation and poster.
- Derived classical Langevin and Fokker–Planck equations from quantum field theory.
- Investigated noise-induced stabilisation and spatial population dynamics using lattice field-theoretic methods, including a Bose–Hubbard-type representation.

Higher-dimensional Integrability and Twistor Actions September 2025 – April 2026
Undergraduate Dissertation - Trinity College Dublin

- Supervisor: Prof. Tristan McLoughlin; produced a report, presentation and poster.
- Studied holomorphic Chern–Simons theory on twistor space and its dimensional reductions to integrable models, following Bittleston–Skinner.
- Established an incompatibility between the Atiyah–Ward ansatz and the Bittleston–Skinner reduction chain.

Dimer models as models of Majorana fermions June – August 2025
Summer Studentship in Theoretical Physics - Dublin Institute for Advanced Studies

- Supervised by Prof. Denjoe O'Connor; produced a report and presentation.
- Computed partition functions of bipartite/non-bipartite dimer models using Kasteleyn's Pfaffian method.
- Studied critical behaviour, continuum limits and connections to Dirac/Majorana fermions and Ising CFT.

Topology in the Quantum Hall Effect and Non-Abelian Anyons May – July 2025
Hamilton Trust Internship - Trinity College Dublin

- Supervised by Dr. Chaolun Wu; produced a report, presentation and poster.
- Investigated integer and fractional quantum Hall states, including Laughlin, Moore–Read and Read–Rezayi states, non-Abelian anyons, and their descriptions using Chern–Simons theory and CFT.

Density Functional Theory Internship May – September 2024
CRANN - Trinity College Dublin

- Conducted research in Density Functional Theory, supervised by Prof. Stefano Sanvito.
- Used a Jacobi polynomial basis in a self-consistent cycle to solve electron structure theory problems.
- Developed and implemented a Python workflow using the Kohn–Sham method to compute eigenfunctions and observables from the density matrix, a portion of which can be found here.

Natural Language Processing Internship May – August 2023

CRANN - Trinity College Dublin

- Under Prof. Stefano Sanvito, trained a MatSciBERT model on materials science research papers to automatically extract a database of materials and their corresponding band gaps.
- A short presentation I gave on the project can be found here .

Work Experience

Maths and Physics Tutor 2021 – Present

Freelance

- Teach Maths and Physics grinds to both secondary school and undergraduate students.

Teaching Assistant 2025 – 2026

Trinity College Dublin - School of Mathematics

- Delivered tutorials and assessed coursework for the first year module "Techniques in Theoretical Physics" and the second year modules "Advanced Classical Mechanics I" and "Advanced Classical Mechanics II."

Awards & Honours

George Moore Scholarship 2026

Awarded full scholarship by The Ireland Funds for master's programme at the University of Oxford

Gold Medal 2026

Awarded by Trinity College Dublin for achieving a grade above 80% across my whole degree

Minchin Prize 2025

Awarded by Trinity College Dublin for outstanding Junior Sophister examination results

Andy Grove Scholarship 2024

Awarded a competitive scholarship by Intel for employees' children in higher education

Trinity Entrance Exhibition Award 2021

Awarded by Trinity College Dublin to students who achieve high Leaving Certificate points

Specialised Skills

Programming: Python, MATLAB, LaTeX, Git, Linux, Bash, Mathematica

Computational Physics: ORCA, Density Functional Theory (DFT), Avogadro

Machine Learning & AI: Neural Network Potentials (DeepMD, Matlantis), Transformer Models (MatSciBERT), Spectral Feature Analysis

Leadership, Outreach & Activities

Theoretical Physics Student Association of Ireland (TPSA): Former Treasurer (2025–2026) and Video Coordinator (2023–2024). Talks and student lecture series I recorded, edited and uploaded can be found here. I also was involved in editing videos for the Ecnetica project with The Problem Solving Association C.L.G., creating free maths resources for disadvantaged Leaving Certificate students.

Workshops: Delivered a day-long scientific Python workshop for the TPSA in August 2024.

PLANCKS Captain: I captained a Trinity College Dublin team at the 2025 UK & Ireland preliminary. PLANCKS is a physics competition for bachelor's and master's students.

Hackathons: Participated in three TPSA hackathons (2023–2025), applying concepts from graph theory and DFT to tackle open-ended real-world problems.

Gaelic Football: Member of Leighlinbridge GFC first team; Division 3 league winners 2024, Championship finalists three of the last five years, and Carlow U20 representative.