

# Nishwal Gora

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## Research Interests

Quantum Magnetism, Neutron Diffraction, Biological Physics, Bacterial Turbulence, Statistical Physics, Computational Physics, Modelling and Visualisation of Physical Systems, Polymer assembly, Chromatin Dynamics.

## Education

University of Edinburgh, MPhys in Physics

Sept 2021 – Present

- Average: 86.7 %
- Awards and Scholarships:
  - 2021/2022 Certificate of Merit for MPhys Physics (Year 1)
  - 2022/2023 Certificate of Merit for MPhys Physics (Year 2)
  - 2023/2024 Career Development Scholarship, School of Physics and Astronomy
  - 2024/2025 **Senior Honours (Bsc) Class Medal** for Best Academic Performance in Physics

Bishop Anstey and Trinity College East Sixth Form

Trinidad and Tobago

Caribbean Advanced Proficiency Examination (CAPE)

July 2018 – July 2020

- *Education:* Physics, Pure Mathematics, Chemistry, Caribbean Studies, Communication Studies. Achieved 1's in every subject.
- *Achievements:* On the Merit List (a ranking listing the highest marks achieved at the yearly diet), placed 6<sup>th</sup> (Unit 1, 2019) and 8<sup>th</sup> (Unit 2, 2020) for Pure Mathematics. Also ranked 4<sup>th</sup> (Unit 1, 2019) and 1<sup>st</sup> (Unit 2, 2020) in Physics.

## Research Experience

Zeeman Split Kramers Doublets in Spin–Supersolid Candidate  $\text{Na}_2\text{BaCo}(\text{PO}_4)_2$

Edinburgh, Scotland

July 2024 – August 2024

- Used high-resolution neutron spectroscopy to track magnetic excitations across a field-tuned quantum-critical region in triangular antiferromagnet  $\text{Na}_2\text{BaCo}(\text{PO}_4)_2$ .
- Showed overdamping of ferromagnetic fluctuations near criticality; modelled as coupled Zeeman-split Kramers doublets explaining enhanced magnetocaloric performance.

**Supervisor:** Prof. Chris Stock

Magnetoelastic Honeycomb Fragmentation in  $\text{VI}_3$

Edinburgh, Scotland

April 2025 – August 2025

- Identified a single structural transition at  $\sim 80$  K (rhombohedral  $R3 \rightarrow$  triclinic  $P1$ ), followed by ferromagnetic order at  $\sim 50$  K, splitting the honeycomb into two distinct  $\text{V}^{3+}$  sublattices.
- Neutron spectroscopy + Green's-function modelling reveal strong SOC and dominant NNN exchange, linking magnetoelastic distortion to stabilized long-range order.

**Supervisor:** Prof. Chris Stock

Beamtime at the ISIS Neutron and Muon Source (MAPS Instrument)

Didcot, England

August 2024

- Participated in 3-day beamtime session on MAPS spectrometer to collect neutron scattering data on transition-metal compounds.

**Facility:** Prof. Chris Stock | **Facility:** Rutherford Appleton Laboratory, UK

Cellular Memory and Hopfield Networks

Edinburgh, Scotland

Sep. 2025 – Present

- MPhys project connecting phase-separation-driven chromatin folding and transcription factories to attractor dynamics in Hopfield networks.
- Recasts the Waddington landscape as memory basins, linking conformational states to robust cellular identity.

**Supervisor:** Prof. Davide Marenduzzo

## Bacterial Turbulence and Finite Tumbling

Edinburgh, Scotland  
Jun. 2025 – Present

- Two-population kinetic model (runners/tumblers) with finite tumbling time; coupled Smoluchowski equations + spherical-harmonic stability analysis.
- Derived eigenvalue problem quantifying how tumbling alters instability thresholds and growth rates in active flows.

**Supervisor:** Prof. Alexander Morozov

## Understanding Bond-Dependent Exchange in $\text{CoTiO}_3$

Edinburgh, Scotland  
Jan. 2025 – March 2025

- Green's-function/RPA + mean-field analysis of spin-wave dynamics; spin-rotation handling of non-collinear order for direct comparison with neutron data.
- Found bond-dependent interactions enhance out-of-plane coupling, likely via low-temperature symmetry reduction and directional dimer formation.

**Supervisor:** Prof. Chris Stock

## Publications

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- N. Gora and A. Morozov, "Hydrodynamic Instabilities in bacteria with finite tumbling time," in preparation.
- N. Gora, T. I. Popescu, and C. Stock, "Dimer Formation and Bond-Dependent Exchange in  $\text{CoTiO}_3$ ," in preparation.
- E. Shen, T. I. Popescu, N. Gora, K. Guratinder, E. Chan, H. Lane, J. A. Rodriguez-Rivera, G. Xu, P. M. Gehring, A. N. Fitch, and C. Stock, "Magnetoelastic Honeycomb Fragmentation in  $\text{VI}_3$ ," *Phys. Rev. B*, under review.
- T. I. Popescu, N. Gora, F. Demmel, Z. Xu, R. Zhong, T. J. Williams, R. J. Cava, G. Xu, and C. Stock, "Zeeman Split Kramers Doublets in Spin-Supersolid Candidate  $\text{Na}_2\text{BaCo}(\text{PO}_4)_2$ ," *Phys. Rev. Lett.* **134**, 136703 (2025).  
doi:10.1103/PhysRevLett.134.136703

**References (Research Supervisors):** Prof. Chris Stock (C.Stock@ed.ac.uk) | Prof. Davide Marenduzzo (Davide.Marenduzzo@ed.ac.uk) | Prof. Alexander Morozov (Alexander.Morozov@ed.ac.uk)

## Extra-Curricular Activities

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### Edinburgh Scientific Researchers Association (ESRA)

Edinburgh, Scotland  
Sep 2021 – Present

- September 2021 – September 2022: *Member of Physics Department in ESRA*. pursued project to age a Galaxy Cluster using a telescope in the Royal Observatory, Edinburgh.
- September 2022 – April 2023: *Co-Head of Department of Physics*, guiding research projects on 1) computer simulation, 2) Finding the value of the cosmological constant 3) Building an efficient Solar Panel.
- April 2023 – Present: *Treasurer of ESRA*, providing and securing funding for projects in Biology, Social Sciences, Chemistry and Physics.

### Edinburgh University Science Media (EUSci)

Edinburgh, Scotland  
Feb 2024 – Present

- *Contributing Editor* – Edited articles for Issue 32 of the EUSci Magazine (link).
- *Contributing Writer* – Authored science communication articles for the EUSci website on topics including "Crisis in Cosmology – The Laniakea Supercluster and What It Means for the Universe" (link) and "Fusion Energy: A Viable Alternative to Fossil Fuels?" (link).

### Global Buddies

Edinburgh, Scotland  
Sep 2022 – July 2023

- *Buddy Leader* – Assisted group of international students adjust to Edinburgh by organising meet ups, group activities, tours etc.

### Prism Caribbean

Trinidad and Tobago  
Jan 2021 – Jun 2021

- *Founder/Contributor* – Developed learning material (specifically mathematics) for Caribbean students who are economically disadvantaged.

## Technological Proficiency

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**Languages:** Python (proficient), MATLAB (proficient), R (intermediate), HTML (basic)

**Modelling & Visualisation:** LAMMPS (proficient), VMD (proficient), AutoCAD—Engineering Drawing (Qualified) (intermediate)