Hongyu Wang

Mathematics Undergraduate Student at Imperial College London
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EDUCATION

Imperial College London London, UK
Bachelor of Science, Mathematics, on the track of 1st Class Honours Oct 2022 — Jul 2026
Selected Modules:

- Analysis: *Real Analysis and Topology, Complex Analysis, Lebesgue Measure and Integration*
- Algebra: *Linear Algebra, Groups and Rings, Galois Theory, Commutative Algebra (Master level), Lie Algebra (Master level), Algebraic Number Theory, Group Representation Theory*
- Geometry: *Manifolds, Algebraic Geometry (Master level), Algebraic Topology*

RESEARCH INTERESTS

Algebraic Geometry, Arithmetic Geometry, Algebraic Number Theory, Representation Theory, Formalising Mathematics.

RESEARCH EXPERIENCE

D-modules and Beilinson-Bernstein localization London, UK
Undergraduate Thesis, supervised by Prof. Travis Schedler Oct 2025 — Now

- Undertaking an advanced research project on D-modules and the Beilinson-Bernstein localisation theorem under the supervision of Prof. Travis Schedler.
- Develops rigorous foundations of algebraic D-modules on smooth varieties and proves the localisation equivalence between suitable blocks of complex semisimple Lie algebra representations and twisted Dmodules on the flag variety.
- Produces a substantial thesis that derives Borel-Weil from localisation and frames the work as preparation for geometric Satake and the geometric Langlands program.

Low-dimensional Topology and Formalisation
Fields Institute for Research in Mathematical Sciences Ottawa, Canada
Fields Undergraduate Summer Research Program June 2025 — Aug 2025
Fully funded by The Fields Institute for Research in Mathematical Sciences
Supervised by Prof. Fraser Maia and Prof. C.-M. Michael Wong

- Developing foundational knowledge in low-dimensional topology, including knot theory, Morse theory, and Heegaard Floer homology, under the guidance of Prof. C.-M. Michael Wong.
- Drafting a formal blueprint for toroidal grid homology, a combinatorial model for Heegaard Floer homology, intended for eventual formalisation in the Lean proof assistant.
- Collaborating with three other undergraduate students on a challenging research problem at the intersection of low-dimensional topology and formal verification.

Noether's Theorem in Lean
Yau Mathematical Sciences Centre, Tsinghua University Beijing, China
Visiting Student, fully funded by Yau Mathematical Science Centre Oct 2024 — Apr 2025
Supervised by Prof. William Donovan

- Investigated Noether's theorem in the context of Lean 4 to formalise the relationship between symmetries and conservation laws in physics.
- Applied advanced mathematical concepts to formalise Noether's theorem, including the theory of calculus of variations, Euler-Lagrange equations, continuous symmetries, and conserved quantities.
- Developed a comprehensive understanding of Noether's theorem and its applications in physics, enhancing problem-solving skills and mathematical expertise through the formalisation process.

Group Theory Game in Lean 4
Imperial College London London, UK
UROP project Apr 2023 — Sep 2023
Supervised by Prof. Kevin Buzzard

- Utilized Lean 4, an advanced theorem prover, to formalise various aspects of group theory, including the basic definitions of groups, group actions, and the orbit-stabilizer theorem, under the supervision of Prof. Kevin Buzzard.
- Currently developing a comprehensive website that serves as an educational platform. This platform aims to teach users how to use Lean 4 to prove mathematical theorems and understand fundamental concepts of group theory.
- The website is designed to make mathematics more accessible and interactive, inspiring users to explore the beauty and logic of group theory through an engaging and user-friendly interface.

Simple Groups Imperial College London, Grade: 85%
Year 2 Group Project, supervised by Prof. Martin Liebeck May 2024 — Jun 2024

- Collaborated with a research team to investigate the classification of finite simple groups, analysing their structure, properties, and applications within group theory.
- Applied Sylow's theorems and group actions to classify simple groups of order less than 100, providing detailed and rigorous proofs.
- Presented a comprehensive analysis on the classification of simple groups, highlighting research findings and insights to students and faculty at Imperial College London.

The Euler Characteristic through Morse Theory Imperial College London, Grade: 90%
Year 1 Individual Project May 2023 — Jun 2023

- Conducted an independent study of fundamental concepts in differential geometry, algebraic topology, and Morse theory, enhancing my theoretical foundation in these areas.
- Initiated a self-guided research project applying Morse Theory to validate the Euler Characteristic for manifolds, demonstrating the practical application of advanced mathematical theories.
- Designed and presented a comprehensive poster using LaTeX, elucidating the concepts mentioned above to students and faculty at Imperial College London, showcasing my ability to communicate complex ideas effectively.

READING COURSES & SEMINARS

Algebraic Geometry Learning Seminar
Imperial College London & Yau Mathematical Sciences Center, Tsinghua University London, UK
DRP project, led and organised by me Oct 2025 — Now

- Organised and led a collaborative seminar for 7 undergraduate students spanning Years 1-4 and one phd student at YMSC, guiding the rigorous study of modern scheme-theoretic algebraic geometry through Ravi Vakil's The Rising Sea
- Delivered weekly technical presentations and facilitated Bourbaki-style discussions to consolidate foundational concepts, including sheaves, spectra, and morphisms of schemes.
- Coordinated the production of comprehensive LaTeXreading notes and exercise solutions to serve as a formal blueprint, while establishing a parallel track to formalise the material in Lean 4 aligned with research at YMSC, Tsinghua University.

Geometric Langlands Seminar
Organised by Prof. Dennis Gaitsgory, Max Planck Institute for Mathematics Bonn, Germany and online
Regular participant via Zoom Dec 2024 — Now

- Attend weekly talks in the Geometric Langlands seminar at MPIM, following current developments on geometric Langlands, D-modules and Hecke eigensheaves.
- Maintain detailed notes on selected talks by Dennis Gaitsgory and invited speakers to consolidate advanced concepts in geometric representation theory and derived algebraic geometry.
- Use the seminar as structured preparation for future research in geometric Langlands and its connections with number theory and arithmetic geometry.

Classical Mechanics Reading Course London, UK
UROP, funded by Dept. of Mathematics; Supervised by Dr. Marco Guaraco May 2024 — Aug 2024

- Studied Arnold's *Mathematical Methods of Classical Mechanics*, mastering Lagrangian and Hamiltonian mechanics via symplectic manifolds.
- Applied differential geometric techniques to analyze rigid body dynamics, specifically solving the heavy symmetric top problem.
- Developed a robust understanding of differential geometry and its applications in classical mechanics.

Geometric Representation Theory Learning Seminar
Organised by Prof. Travis Schedler London, UK
Participated as a member Jun 2023 — Sep 2023

- Undertook an advanced study of Lie algebras and quantum groups, focusing on their structural properties and representation theory to bridge concepts between algebra and mathematical physics.
- Produced comprehensive lecture notes in LaTeX, synthesizing complex oral arguments into rigorous written proofs to serve as a permanent reference for the seminar cohort.
- Mastered the theory of R-matrices and the quantum Yang-Baxter equation, analyzing their role in constructing invariants and defining the structure of quasitriangular Hopf algebras.

SKILLS

- **Programming**: Lean 4, Macaulay2, SageMath, HTML, CSS, JavaScript
- **Software**: LaTeX, Typst, Git
- **Soft Skills**: Independent Study and Concentration