Manav Madan Rawal

Date of Birth: 2nd January 2002
Nationality: Indian
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Education

Bielefeld University 2026 – 2029
Bielefeld, North Rhine-Westphalia, Germany

Doctor of Philosophy in Theoretical Physics
Supervisor: PD Dr. Christian Schmidt-Sonntag

University of Glasgow 2024 – 2025
Glasgow, Scotland, United Kingdom

Master of Science in Theoretical Physics
Supervisor: Prof. Andy Buckley

St. Joseph's College (Autonomous), Bengaluru City University 2020 – 2023
Bengaluru, Karnataka, India

Bachelor of Science in Physics, Chemistry, Mathematics

Research

QCD Internship September, 2025 – April, 2026
Title: Generative AI in Lattice QCD [view GitHub]

- Under the guidance of Dr. Chris Bouchard at the University of Glasgow.
- Reproduced and validated state-of-the-art Normalising Flow models from recent literature (scalar ϕ^4, U(1), SU(2), SU(3)), establishing fully reproducible baselines for likelihoods, observables, and sampling performance.
- Developed a unified codebase for lattice flows and HMC comparisons, enabling controlled experiments across multiple field theories with consistent architectures, training schemes, and gauge-invariant diagnostics.
- Formulated the theory of Quotient Normalising Flows, proving G-invariance, universality, and likelihood-equivalence for flows trained on canonical representatives; conducted the first systematic empirical evaluation across scalar and gauge theories, identifying both successful regimes and sharp negative results due to geometric ill-conditioning in U(1)/SU(2) gauge quotients. [view PDF]
- Introduced Rao–Blackwellised orbit-averaged SNIS for lattice field theory, achieving exact zero-variance estimators for symmetry-odd observables and volume-scaling variance reduction for translation symmetries; demonstrated improvements independent of flow architecture. [view PDF]

MSc Research Project May, 2025 – September, 2025
Title: QCD colour-flow in top-quark decays [view PDF] [view GitHub]

- Under the guidance of Prof. Andy Buckley at the University of Glasgow.
- Investigated the use of QCD colour flow to distinguish colour-singlet hadronic decays, such as $H \to bb$, from their dominant backgrounds.

- Presented a phenomenological comparison between the established Jet Pull observable and the novel Jet Colour Ring (JCR), a theoretically optimal discriminant derived from the likelihood ratio of matrix elements.

Projects

Luxera October, 2025 – Present

Professional Lighting Design & Simulation Software (300k+ LOC) [private repo]

- Architected a full-stack cross-platform lighting analysis application from the ground up in Python, Rust, and TypeScript, covering radiosity, ray tracing, photometric standards (IES/CIE/EN), roadway luminance, daylight modelling, and compliance checking against international standards.
- Implemented a progressive radiosity solver (Jacobi/Gauss-Seidel + shooting), direct illuminance engine, and BVH-accelerated backward ray tracer with specular transport and tone mapping.
- Built domain engines for daylight (CIE skies, Perez All-Weather, sDA/ASE per LM-83), roadway luminance (IES RP-8, CIE 140, EN 13201, AS/NZS 1158), sports (EN 12193), emergency (EN 1838), obtrusive light (CIE 150), and UGR/glare (CIE 117/190).
- Designed an agentic AI system using LLMs with a tool registry that autonomously performs end-to-end lighting design, room creation, luminaire placement, compliance diagnostics, layout optimisation, and report generation, from a single natural-language prompt.
- Built the desktop application in Tauri + React + WebGL with 2D/3D viewports, snap engine, undo/redo, scene management, and a Page Builder for multi-page PDF report generation.

Axioma November, 2025 – Present

Open-Source Computer Symbolic Algebra System (180k+ LOC) [view GitHub]

- Designed and implemented a Rust-based scientific computing language with a full native symbolic tensor algebra engine supporting tensors with abstract index notation, automatic symmetry handling (Young tableaux), canonicalisation, contraction, and pattern-matching rewrite rules.
- Built a WebAssembly plugin system enabling user-defined extensions, alongside a Model Context Protocol (MCP) server exposing Axioma's algebra engine to LLM tool calls.
- Implemented a VS Code extension with syntax highlighting, diagnostics, and an AI-assist protocol (Blake3-verified) for LLM-assisted code generation; auto-generated documentation infrastructure from source.

ScribeTeX July, 2024 – January, 2026

AI-Powered LaTeX Document Generator [view GitHub]

- Developed a web application that converts handwritten mathematical notes and diagrams into properly formatted LaTeX documents using frontier large language models.
- Achieved over 90% accuracy in converting large files with complex mathematical expressions and symbols.
- Built an intuitive user interface for uploading images, editing recognised content, and exporting LaTeX code.

Test Scores and Results

IELTS 2024

Secured an overall Band score of 8.5

- Listening - 9.0
- Speaking - 8.5
- Reading - 8.5
- Writing - 7.5
- Click here to view certificate

Other Academic Achievements

International Leadership Scholarship 2024

Secured the highly competitive 'University of Glasgow International Leadership Scholarship'.

Technical Skills

Programming Languages: Python, C/C++, Rust, R, Julia, Java, JavaScript, LaTeX
Tools: Linux, Git, Docker, Bash, HPC, CI/CD
AI/ML: Pytorch/JAX, CUDA
Particle Physics Tools: RIVET, Pythia
Database: MySQL, NoSQL
Click here to view Github page