Collin Wittenstein

Curriculum Vitæ

As of February 2026

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Academic Background

Visiting Student, Massachusetts Institute of Technology (Sep 2025–May 2026)

- Master Thesis Research: GPU-Accelerated Three-Dimensional Simulation of Deep Borehole Heat Exchanger Arrays
- Advisors: Prof. Alan Edelman, Prof. Robert Metcalfe, and Prof. Henrik Ranocha

Johannes Gutenberg University Mainz, Germany (Oct 2019–May 2026)

- **M.Sc. Computational Sciences** (2023–present)
  Grade 1.0 (US GPA: 4.0)
- **M.Sc. Physics** (2023–present)
  Grade 1.1 (US GPA: 3.9)
- **B.Sc. Mathematics** (2020–2025)
  Grade 1.2 (US GPA: 3.8), Best Thesis of the Year 2024
- **B.Sc. Physics** (2019–2023)
  Grade 1.3 (US GPA: 3.7)

Publications

- *A Full Three-Dimensional GPU-Accelerated Model for Deep Borehole Heat Exchangers (DBHEs) Enabling Simulation of Well Arrays*
  C. Wittenstein, E. Lujan, A. Inglis, R. Metcalfe, A. Edelman, H. Ranocha
  Proceedings of the 51st Stanford Geothermal Workshop, Feb 2026

- *Arrays of Networked Standard Geothermal Wells*
  R. Metcalfe, E. Lujan, **C. Wittenstein**, A. Inglis, A. Edelman
  Proceedings of the 51st Stanford Geothermal Workshop, Feb 2026

- *GPU-Accelerated Energy-Conserving Methods for the Hyperbolized Serre-Green-Naghdi Equations in 2D*
  C. Wittenstein, V. Marks, M. Ricchiuto, H. Ranocha
  arXiv preprint arXiv:2601.02540, Jan 2026

- *DispersiveShallowWater.jl: A Julia Library of Structure-Preserving Numerical Methods for Dispersive Wave Equations*
  J. Lampert, **C. Wittenstein**, H. Ranocha
  Journal of Open Source Software 10 (116), 9361, Dec 2025

Selected Research & Open Source Contributions

GPU-Accelerated Modeling of Deep Borehole Heat Exchanger Arrays (Winter 2025)

- Developed vendor-agnostic GPU-accelerated 3D simulation framework in Julia for deep borehole heat exchanger arrays, making full three-dimensional well array simulations computationally tractable for the first time — previously considered prohibitively expensive due to the problem's multi-scale geometry (mm-scale boreholes to km-scale depths)

- Designed operator splitting strategy tailored to the strongly anisotropic grid structure, separating vertical diffusion (stabilized explicit Runge–Kutta–Chebyshev), horizontal diffusion (alternating direction implicit), and advection (semi-Lagrangian) to achieve near-unconditional stability while maintaining computational efficiency
- Open-source release: GeothermalWells.jl

Core Developer, DispersiveShallowWater.jl (Summer 2025)

- Co-authored and maintain open-source Julia package implementing provably conservative, entropy-conserving, and well-balanced schemes for dispersive shallow water PDEs
- Contributed new solver implementations, extended functionality of existing solvers, performance optimizations, and comprehensive documentation improvements

Structure-Preserving Methods for 2D Hyperbolic SGN PDEs (Summer 2025)

- Developed provably energy-conservative semi-discretizations for the 2D hyperbolic approximation of the Serre-Green-Naghdi equations using split forms in the summation-by-parts framework, supporting both periodic and reflecting boundary conditions
- Implemented vendor-agnostic GPU acceleration achieving significant computational speedups

Simulation of the Rattleback (Bachelor Thesis, 2024)

- Simulated the dynamics of a semi-ellipsoid with inhomogeneous mass distribution exhibiting counterintuitive reversal behavior
- Supervisors: Prof. Hendrik Ranocha, Prof. Elmar Schömer
- Open-source release: Simulation-of-the-Rattleback

Core Contributor, OrdinaryDiffEq.jl (Summer 2024)

- Implemented 10+ new Rosenbrock and Runge-Kutta solver methods with comprehensive tests and documentation
- Extended *callback* functionality across multiple implicit and adaptive solver families

Julia Ecosystem Contributions (2023–present)

- Additional contributions across broader Julia ecosystem including Trixi.jl, RecursiveArrayTools.jl, AirspeedVelocity.jl, Dagger.jl, and official Julia language documentation

Teaching Experience

Teaching Assistant, Theoretical Physics (2021–2023)

- Quantum Mechanics (Summer 2023), Classical Mechanics (Summer 2022), Special Relativity and Electrodynamics (Winter 2021)

Awards & Honors

Best Thesis of the Year 2024, Mathematics

- Awarded by the Department of Mathematics, Johannes Gutenberg University Mainz, for outstanding Bachelor's thesis "Simulation of the Rattleback"

Deutschlandstipendium (2020–present)

- Five-time recipient of Germany's merit-based scholarship providing financial and non-material support to high-achieving and committed students

Environmental Service Award (2022)

- Awarded by the City of Mainz for voluntary environmental and nature service

DPG Award for Excellence in Physics (2018)

- Awarded by the German Physical Society upon recommendation of school administration for outstanding achievements in physics

Service & Leadership

Student Representative, Examination Board (Prüfungsausschuss) (2024–present)

- Sole student representative for Computational Sciences program at Johannes Gutenberg University Mainz, participating in curriculum and examination policy decisions

Co-founder & Vice Chair, Klimaliste Rhineland-Palatinate (2020–2021)

- Led grassroots climate organization with 200+ members advocating for Paris Agreement-aligned climate policies in state elections
- Interviewed by Teen Vogue (US) and featured in The Guardian (UK) for climate activism leadership

Organizer, Fridays for Future (2019–2021)

- Organized climate protests with up to 12,000 participants in Mainz region
- Participated in panel discussions with state political leaders including Minister-President Malu Dreyer