

Elia Mazzucchelli

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Research Interests

I am a theoretical physicist interested in mathematical structures arising in quantum field theory, with a particular focus on geometric structures. Recently, I have worked on positive geometries describing scattering amplitudes in $\mathcal{N} = 4$ super Yang–Mills theory, studying them both mathematically and in terms of their implications for singularity structures and positivity of amplitudes.

Current Position

Institute for Advanced Study

Member, School of Natural Sciences

Princeton, NJ, USA

09/2026–07/2029

Education

Max Planck Institute for Physics

PhD Student, Thesis: “Positive Singularities and Volumes in Scattering Amplitudes”

Funded by the ERC Synergy Grant UNIVERSE+

Advisor: Johannes Henn

2023–2026

Swiss Federal Institute of Technology

MSc in mathematics, Thesis: “Wess-Zumino-Witten model on $\mathfrak{psu}(2|2)$ ”

Advisor: Matthias Gaberdiel

2021–2023

Swiss Federal Institute of Technology

BSc in mathematics, Thesis: “Minimal Surfaces in S^3 ”

Advisor: Alessandro Carlotto

2018–2021

Publications

- 1: “Landau Analysis in the Grassmannian”, B. Hollering, [E. Mazzucchelli](#), M. Parisi, B. Sturmfels, *e-Print* (2026) [arXiv:2603.25454]
- 2: “Positivity and Cluster Structures in Landau Analysis”, B. Hollering, [E. Mazzucchelli](#), M. Parisi, B. Sturmfels, *e-Print* (2026) [arXiv:2603.25493]
- 3: “Varieties of Lines in 3-Space”, B. Hollering, [E. Mazzucchelli](#), M. Parisi, B. Sturmfels, *submitted to MEGA 2026 (Effective Methods in Algebraic Geometry 2026)* (2025) [arXiv:2511.21333]
- 4: “Canonical Forms as Dual Volumes”, [E. Mazzucchelli](#) and P. Raman, *submitted to Algebraic Statistics* (2025) [arXiv:2509.02239]
- 5: “Geometric Landau Analysis and Symbol Bootstrap”, D. Chicherin, J. Henn, [E. Mazzucchelli](#), J. Trnka, Q. Yang, S. Zhang, *JHEP* (2025) [arXiv:2508.05443]
- 6: “Exterior Cyclic Polytopes and Convexity of Amplituhedra”, [E. Mazzucchelli](#) and L. Pratt, *submitted to Advances in Math* (2025) [arXiv:2507.17620]
- 7: “All-loop Leading Singularities of Wilson Loops”, T. Brown, J. Henn, [E. Mazzucchelli](#) and J. Trnka, *JHEP* (2025) [arXiv:2503.17185]
- 8: “The $\mathfrak{su}(2)_{-1}$ WZW model”, [E. Mazzucchelli](#), *JHEP* (2024) [arXiv:2410.13017]
- 9: “The two-loop Amplituhedron”, G. Dian, [E. Mazzucchelli](#) and F. Tellander, *Le Matematiche* (2024) [arXiv:2410.11501]

10: "Hyperplane Arrangements in the Grassmannian", *E. Mazzucchelli*, D. Pavlov and K. Wang, *Le Matematiche* (2024) [arXiv:2409.04288]

11: "The $u(2|2)_1$ WZW model", G. Matthias and *E. Mazzucchelli*, *JHEP* (2024) [arXiv:2312.03135]

Talks

23.03.2026: "Positive Geometries as Dual Volumes", Invited speaker, Thematic Programme on "Amplitudes and Algebraic Geometry", Erwin Schrödinger Institute Vienna, Austria

10.12.2025: "From Amplituhedra to Exterior Cyclic Polytopes", Invited speaker, Graduate Online Combinatorics Colloquium, online

6-8.10.2025: "Positive Geometries and Canonical Forms", Invited lecturer, Chow Lectures, MPI Leipzig, Germany

25.09.2025: "Positive Geometries for the Wilson Loop with Lagrangian Insertion", Invited speaker, Brown University, USA

23.09.2025: "Towards the Dual Amplituhedron", Amplitudes Seminar, IAS, Princeton, USA

7-11.07.2025: "Towards the Dual Amplituhedron", Invited speaker, SIAM conference, Madison, USA

29.04-06.07.2025: "Towards the Dual Amplituhedron", Invited speaker, SwissMAP conference, Les Diablerets, Switzerland

5.05.2025: "What are Positive Geometries?", IMPRS Colloquium, MPP Munich, Germany

25.09.2024: "The two-loop Amplituhedron", Invited speaker, Wachspress Geometry, University of Leipzig, Germany

9.09.2024: "The $u(2|2)_1$ Wess-Zumino-Witten model", online seminar, Virginia Tech

Conferences and Workshops

16-27.02.2026+23-27.03.2026: *Thematic Programme on "Amplitudes and Algebraic Geometry"* (talk given), Erwin Schrödinger Institute Vienna, Austria

15-18.12.2025: *Symbolology@15*, MPP Munich, Germany

6-8.10.2025: *Chow Lectures* (invited lecture given), MPI Leipzig, Germany

24-29.08.2025: *Computational Aspects of Algebraic Geometry* (presented a poster), ETH, Switzerland

27-30.07.2025: *Annual UNIVERSE+ Meeting 2025* (talk given), Schloss Ringberg, Germany

7-11.07.2025: *SIAM Conference on Applied Algebraic Geometry* (invited talk given), Madison, Wisconsin, USA

29.04-06.07.2025: *Amplituhedron Conference* (invited talk given), SwissMAP, Les Diablerets, Switzerland

16-20.06.2025: *Amplitudes 2025* (presented a poster), SNU, Seoul, Korea

09-28.03.2025: *Program on "What is particle physics?"* (invited as visiting affiliate), KITP Santa Barbara, USA

10-14.02.2025: *Lectures on cohomology and integration*, MPI Leipzig, Germany

8.10.2024: *Workshop on completely monotonic functions*, MPP Munich, Germany

11-22.11.2024: *Combinatorics of Fundamental Physics Workshop*, IAS Princeton, USA

14-18.10.2024: *Holonomic Techniques for Feynman Integrals*, MPP Munich, Germany

26-27.09.2024: *Discrete Mathematics and Biology: the legacy of Andreas Dress*, MPI Leipzig, Germany

24-25.09.2024: *Wachspress Geometry* (invited talk given), University of Leipzig, Germany

19-23.08.2024: *Kick-Off Meeting UNIVERSE+*, Physikzentrum Bad Honnef, Germany

5-30.08.2024: *Special Functions: From Geometry to Fundamental Interactions*, MPP Munich, MIAPP, Germany

10-21.06.2024: *Amplitudes 2024 conference* (Gong show given), IAS Princeton, USA

29-31.05.2024: *Amplituhedra, Cluster Algebras, and Positive Geometry*, CMSA Harvard, USA

12-16.02.2024: *UNIVERSE+ Pre-Kick-Off Workshop*, MPI Leipzig, Germany

4-8.12.2023: *Workshop: Computer Algebra for Functional Equations in Combinatorics and Physics*, Institut Henri Poincaré in Paris, France

Schools

21-25.07.2025: *IMPRS Young Scientist Workshop 2025*, Schloss Ringberg, Germany

10-21.06.2024: *Amplitudes 2024 summer school*, IAS Princeton, USA

2-5.06.2024: *IMPRS Young Scientist Workshop 2024*, Schloss Ringberg, Germany

13-17.05.2024: *Summer school on Moduli spaces in positive geometry*, MPI Leipzig, Germany

22-25.11.2023: *IMPRS Young Scientist Workshop 2023*, Schloss Ringberg, Germany

Teaching

Spring 2022: Teaching Assistant for Topology, Swiss Federal Institute of Technology

Autumn 2021: Teaching Assistant for Differential Geometry I, Swiss Federal Institute of Technology

Outreach Activities

21.10.2025: *Unschärfe – von Heisenberg zur Quantenfeldtheorie (Uncertainties - from Heisenberg to Quantum Field Theory)*, talk at Café & Kosmos on the history of quantum physics, Munich, Germany

Skills

Computer Languages: LaTeX, Mathematica, Python, Julia, Macaulay2, C++

Languages: Italian, Hungarian, English, German, French