Alexander Elzenaar

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RESEARCH INTERESTS

- Groups related to geometry and topology in low dimensions. Kleinian groups and their deformation theory; other aspects of geometric group theory, conformal geometry, and 3-manifold theory. Applications of techniques from representation theory and algebraic geometry.
- Exemplar MSC codes: 20F65, 20H10, 22E40, 30F40, 30F60, 32G15, 51F15, 57K31, 57K32.

RESEARCH & TEACHING POSITIONS

School of Mathematics, **Monash University**, Melbourne, Australia

- Sessional teaching associate — 2025
  - Tutoring and marking MAT 1020 (calculus service course for non-mathematicians) — Sem. 1 2025

Ministry of Business, Innovation, and Employment, Wellington, New Zealand

- Research and data analyst, Evidence & Insights branch — 2023–2024
  - Mathematical modelling and statistics to support ministerial offices and policy evaluators with particular focus in carbon modelling and econometric forecasting for the building and construction industry, including production and peer review of departmental research output.

Max-Planck-Institut für Mathematik in den Naturwissenschaften, Leipzig, Germany

- Doctoral student (withdrew), combinatorial algebraic geometry — 2022–2023

Dept. of Mathematics, **The University of Auckland**, New Zealand

- Research assistant (Professional Casual Staff) — 2020–2021
  - Construction and symmetry properties of spherical (t, t)-designs (funded by Dr. Shayne Waldron)
  - Teaching of semester-long graduate seminar on Kleinian groups (funded by Dr. Jeroen Schillewaert)
- Graduate Teaching Assistant (GTA) — 2019–2022
  - Marking MATHS 208 (multivariate calculus service course) — Summer sem. 2022
  - Tutoring & marking MATHS 332 (real analysis); tutoring MATHS 190 (general education course) — Sem. 2 2021
  - Tutoring & marking MATHS 250 (calculus & linear algebra II); tutoring COMPSCI 225 (discrete mathematics for CS); marking MATHS 254 (elementary number theory; groups; metric spaces) — Sem. 1 2021
  - Tutoring & marking MATHS 190 (general education course); tutoring MATHS 120 (linear algebra); marking MATHS 340 (real & complex calculus) — Sem. 2 2020
  - Tutoring MATHS 162 (computational mathematics & combinatorics); assistance room tutor; marking MATHS 120 (linear algebra), MATHS 130 (calculus), COMPSCI 120 (mathematics for CS) — Sem. 1 2020
  - Marking MATHS 253 (calculus & linear algebra III) — Sem. 2 2019

TERTIARY EDUCATION

Monash University, Melbourne, Australia

- (Ongoing) PhD candidate, Geometry and topology — Likely completion 2027
  - Advisor: Prof. Jessica Purcell

The University of Auckland, New Zealand

- Master of Science with First Class Honours in mathematics — 2021–2022
  - Thesis: *Deformation spaces of Kleinian groups* (https://aelzenaar.github.io/msc_thesis.pdf)
  - Advisors: Dist. Prof. Gaven Martin (NZ Inst. of Adv. Study, Massey Uni.), Dr. Jeroen Schillewaert
- Bachelor of Science (Hons) with First Class Honours in mathematics — 2020
  - Dissertation: *Toric varieties* (https://aelzenaar.github.io/hons/dissertation.pdf)
  - Advisor: Dr. Jeroen Schillewaert
- Certificate in Languages — awarded 2020
  - Russian and Ancient Egyptian
- Bachelor of Science, major in mathematics — 2017–2019
  - Exchange student at the University of Toronto, 2018 fall semester

The University of Canterbury, New Zealand

- STAR programme — 2016
  - First year university mathematics program for secondary school students

AWARDS, GRANTS, & SCHOLARSHIPS

- AustMS Student Support Scheme — 2024
  - for attendance of Joint Meeting of the NZMS, AustMS, and AMS in Auckland
- Institute for Mathematical Sciences (Singapore) travel allowance — 2024
  - for attendance of program *Computational Aspects of Thin Groups* (3–14 June)
- Research Training Program (RTP) Stipend (Australian Government) — ongoing from 2024
- Clay Mathematics Institute Early Career Researcher Support — 2023
  - for attendance of NZMRI Summer School on Groups and Dynamics, Nelson
- Kalman Summer Scholarship — 2022
  - for attendance of NZMRI summer meeting on number theory, Akaroa
- University of Auckland Department of Mathematics Student Research Conference prize — 2021
- Kalman Summer Scholarship — 2021

- for attendance of NZMRI summer meeting, Napier

- University of Auckland Postgraduate Honours / PG Diploma Scholarship 2020
- University of Auckland Summer Research Scholarship 2019–2020
  - Project: Numerical construction of spherical (t, t)-designs
  - Advisor: Dr. Shayne Waldron
- University of Auckland Faculty of Arts Deans List 2017
- NZQA Outstanding Scholar Award 2016
  - Limited to top 40–60 secondary school students in New Zealand
- Royal Society of New Zealand scholarship 2016
  - to attend XVI Summer Research School in Mathematics and Informatics, Blagoevgrad, Bulgaria

PREPRINTS & SUBMITTED

[10] A. Elzenaar, "Expansion joints in hyperbolic manifolds".
To appear shortly (available on request), 2025.

[9] A. Elzenaar, "Peripheral subgroups of Kleinian groups".
arXiv: 2508.00297 [math.GT], 2025.

[8] A. Elzenaar, "From disc patterns in the plane to character varieties of knot groups".
arXiv: 2503.13829 [math.GT], 2025.

[7] A. Elzenaar, "Changing topological type of compression bodies through cone manifolds".
arXiv: 2411.17940 [math.GT], 2024.

[6] A. Elzenaar, G. Martin, and J. Schillewaert, "On thin Heckoid and generalised triangle groups in $\mathsf{PSL}(2, \mathbb{C})$".
arXiv: 2409.04438 [math.GR], 2024.

[5] A. Elzenaar, J. Gong, G. Martin, and J. Schillewaert, "Bounding deformation spaces of 2-generator Kleinian groups".
arXiv: 2405.15970 [math.CV], 2024.

PUBLICATIONS

[4] A. Elzenaar and S. Waldron, "Putatively optimal projective spherical designs with little apparent symmetry". In: *Journal of Combinatorial Designs* **33**.6 (2025), pp. 222–234.
DOI: 10.1002/jcd.21979. arXiv: 2405.19353 [math.CO], 2024.

[3] A. Elzenaar, G. Martin, and J. Schillewaert, "The combinatorics of the Farey words and their traces". In: *Groups, Geometry and Dynamics* (2024), published online first.
DOI: 10.4171/GGD/832. arXiv: 2204.08076 [math.GT], 2022.

[2] A. Elzenaar, G. Martin, and J. Schillewaert, "Concrete one complex dimensional moduli spaces of hyperbolic manifolds and orbifolds". In: *2021-22 MATRIX annals*. Ed. by David R. Wood, Jan de Gier, and Cheryl E. Prager. MATRIX Book Series 5. Springer, 2024, pp. 31–74.
DOI: 10.1007/978-3-031-47417-0_2. arXiv: 2204.11422 [math.GT], 2022.

[1] A. Elzenaar, G. Martin, and J. Schillewaert, "Approximations of the Riley slice". In: *Expositiones Mathematicae* **41**.1 (2023), pp. 20–54.
DOI: 10.1016/j.exmath.2022.12.002. arXiv: 2111.03230 [math.GT], 2021

SELECTED TALKS

[12] "Cone manifolds and compression bodies", Topology Seminar (Monash Uni.), 2025.

[11] "Deformations of 3-orbifold holonomy groups and applications", Early Career Showcase in Low-Dimensional Topology, Joint Meeting of the NZMS, AustMS, and AMS (Uni. of Auckland), 2024.

[10] "Combinatorial structures in trace polynomials of function groups", 8th Australian Algebra Conference (ANU, Canberra), 2024.

[9] "Two-bridge knots, genus two surfaces, and discrete groups with two generators", Hodgsonfest: Geometry and topology in low dimensions (Uni. Melbourne), 2024.

[8] "Is $\mathsf{PSL}(2, \mathbb{C})$ discrete?", Topology Seminar (Monash Uni.), 2024.

[7] "The dynamic in the static: Manifolds, braids, and classical number theory", Regiomontanus PhD Seminar (Uni. Leipzig), 2023.

[6] "What is a Kleinian group?", Australian Postgraduate Algebra Colloquium, 2022.

[5] "Pictures of hyperbolic spaces", Discrete Mathematics and Geometry Seminar (TU Berlin), 2022.

[4] "Strange circles: The Riley slice of quasi-Fuchsian space", Seminar on Nonlinear Algebra (MPI MiS), 2022.

[3] "Approximating the Riley slice exterior", Matrix Inst. workshop on Groups and Geometries, 2021.

[2] "Some properties of 2×2 matrices", Dept. of Mathematics Student Research Conference (Uni. of Auckland), 2021.

[1] "Real varieties of spherical designs", Algebra and Combinatorics Seminar (Uni. of Auckland), 2021.

PROFESSIONAL SERVICE

- Refereeing for scholarly publications
  - *Algebraic and Geometric Topology* 2025
- Other activities
  - Reviewing for zbMATH Open 2025

EVENTS (CO-)ORGANISED

[8] Guest lectures for MATHS 782 "Geometric Group Theory" (Uni. Auckland), 2024.
- Two hours of lectures invited by Jeroen Schillewaert in the first week of a graduate course to provide a 'preview' of basic geometric and topological ideas e.g. quotients by discrete groups and hyperbolic geometry.

[7] Minicourse on knot theory and geometry (Uni. Auckland), 2023.
- Eight 2-hour lectures at the University of Auckland, aimed at graduate students in geometric group theory.
- Six lectures were given by me, and two honours students at Auckland (Lavender Marshall and Josh Lehman) were invited to give talks related to their work. Lecture notes for the entire course were produced by me.

[6] Minicourse on deformation theory of Kleinian groups (MPI and Uni. Auckland), 2022, 2023.
- One afternoon workshop at the MPI and Three 2-hour lectures at the University of Auckland subsequent to the NZMRI Summer School on Groups and Dynamics, Nelson.

[5] Uniformisation of Riemann surfaces workshop afternoon (MPI), 2022.
- Produced expository note Uniformisation, equivariance, and vanishing—Three kinds of functions hanging around your Riemann surface.

[4] Reproducibility in Computer Algebra event (MPI/TU Berlin), 2022.
- Co-organised with Christiane Görgen and Lars Kastner.

[3] A Day of Geometry and Lorentzian Polynomials (MPI), 2022.
- Sole organiser, single day of short informal talks in preparation for Göran Gustafsson Symposium at the Institut Mittag-Leffler (May 2022).

[2] Seminar on Kleinian groups (Uni. Auckland), 2021–2021.
- Gave two 2-hour lectures per week, covering approximately the first half of *Kleinian Groups* by B. Maskit along some sections of Thurston's lecture notes and the book *Hyperbolic Manifolds and Discrete Groups* by M. Kapovich.
- Organised with financial support of Jeroen Schillewaert who employed me as a Research Assistant for the purpose of giving these lectures.

[1] Reading group in Algebraic Geometry (Uni. Auckland), 2019–2020.
- Co-organised with Oliver Li, initially following sections of Hartshorne's introductory textbook and then later more specialised sources.

PROFESSIONAL AFFILIATIONS

New Zealand Mathematical Society, Student member

Australian Mathematical Society, Student member

REFERENCES

Teaching and research reference letters available on request.

[*2025-10-31*]