
Curriculum Vitae

Martin Winter
Mathematician (PhD)

Professional experience

- starting 09/2025 Principal Investigator for DFG project at Max-Planck Institute of Mathematics in the Sciences (Leipzig)
- Since 08/2024 Guest researcher at the Max-Planck Institute of Mathematics in the Sciences (Leipzig)
- Since 07/2024 Dirichlet Fellow at TU Berlin
- 09/2021 – 06/2024 Postdoctoral research fellow at the University of Warwick (UK) (with Agelos Georgakopoulos)
- 03/2018 – 08/2021 Research fellow at TU Chemnitz (Germany), working group *Algorithmic and Discrete Mathematics* (Christoph Helmberg)
- 01/2016 – 02/2018 Research fellow at TU Chemnitz (Germany), working group *Graphical Data Processing and Visualization* (Guido Brunnett)
- 04/2014 – 03/2015 Research assistant at Fraunhofer Institute for Machine Tools and Forming Technology (Chemnitz, Germany)
- 10/2012 – 09/2013 Research assistant at TU Chemnitz (Germany), working group *Computational Physics* (Heinz Hoffmann)

Education

- 03/2018 – 06/2021 PhD program in Mathematics (TU Chemnitz)
Thesis: *Spectral Realizations of Symmetric Graphs, Spectral Polytopes and Edge-Transitivity* (grade: summa cum laude)
Supervisors: Christoph Helmberg
External referees: Michael Joswig, Egon Schulte
- 10/2013 – 09/2015 Master program in Mathematics with Computer Science (minor in Physics) (TU Chemnitz)
Thesis: *On $P(k)$ -graphs and the conjecture of Kotzig* (grade: 1.1*, with distinction)
- 10/2010 – 09/2013 Bachelor program in Computational Science (TU Chemnitz)
Thesis: *Image alignment* (grade: 1.0*, with distinction)

*Grades are from 1.0 (best) to 5.0 (not passed).

Third-party Fundings

- 2024 – 2027 DFG research grant (for position as principal investigator)
Project: “*Wachspress Coordinates: a bridge between Algebra, Geometry and Combinatorics*”
as part of the SPP2458 “Combinatorial Synergies”
335,622€
- 2018 – 2021 ESF State Innovation Promotion
Project: “*Spectral relations between the Laplace matrix and sparse cuts in graphs via semi-definite optimization*”
57,600€

Prizes & Awards

- 2024 FSEM Post-Doctoral Research Prize 2024 (University of Warwick)
Marie Skłodowska Curie Actions “Seal of Excellence”
- 2022 University Prize for dissertation (TU Chemnitz)
Shortlisted for the Richard-Rado Prize 2022
- 2014 Deutschlandstipendium of the Institute of Mathematics (TU Chemnitz)
- 2012 Deutschlandstipendium of the Institute of Natural Sciences (TU Chemnitz)

Publications

Published

1. *Kalai’s 3^d conjecture for unconditional and locally anti-blocking polytopes.*
with Raman Sanyal
accepted at Proceedings of the AMS (2024)
2. *Characterising clique convergence for locally cyclic graphs of minimum degree $\delta \geq 6$.*
with Anna M. Limbach
Discrete Mathematics (2024)
3. *The clique graphs of the hexagonal lattice – an explicit construction and a short proof of divergence.*
Discrete Mathematics (2024)
4. *Rigidity, tensegrity and reconstruction of polytopes under metric constraints.*
International Mathematics Research Notices (2023)
5. *(Random) trees of uniform intermediate volume growth.*
with G. Kontogeorgiou
European Conference on Combinatorics, Graph Theory and Applications (2023)
6. *Capturing polytopal symmetries by coloring the edge-graph.*
Discrete & Computational Geometry (2023)
7. *The edge-transitive polytopes that are not vertex-transitive.*
with F. Göring
Ars Mathematica Contemporanea (2022)
8. *Classification of vertex-transitive zonotopes.*
Discrete & Computational Geometry (2021)
9. *Geometry and topology of symmetric point arrangements.*
Linear Algebra and its Applications (2021)
10. *Vertex-facet assignments for polytopes.*
with T. Jahn
Contributions to Algebra and Geometry (2020)

Preprints

11. *Rigidity of polytopes with edge length and coplanarity constraints.*
with Bernd Schulze and Matthias Himmelfmann (2025)
12. *When do graph covers preserve the clique dynamics of infinite graphs?*
with Anna M. Limbach (2025)
13. *On 2-complexes embeddable in 4-space, and the excluded minors of their underlying graphs.*
with Agelos Georgakopoulos (2024)
14. *Energies on coned convex polytopes.*
with Robert Connelly, Steven J. Gortler, Louis Theran (2024)
15. *The stress-flex conjecture.*
with Robert Connelly, Steven J. Gortler, Louis Theran (2024)

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16. *Eigenpolytopes, spectral polytopes and edge-transitivity*, (2020).
 17. *Symmetric and spectral realizations of highly symmetric graphs*, (2020).

Invited talks

- 2025 (upcoming) Seminar of Discrete Mathematics at Goethe University Frankfurt
(upcoming) Oberseminar “Discrete Mathematics” at University of Kassel
Seminar of the Groups of Discrete Mathematics and Algebra at TU Bergakademie Freiberg
Adjoint degrees and scissors congruence for polytopes
Nonlinear Algebra Seminar at Max Planck Institute for Mathematics in the Sciences (Leipzig)
Adjoint degrees and scissors congruence for polytopes
Seminar talk during the special semester “Geometry of Materials, Packings and Rigid Frameworks” at ICERM
Progress on the stress-flex conjecture for coned polytope frameworks
Combinatorics Seminar at BTU Cottbus-Senftenberg
The structure of 2-level polytopes
Combinatorics Seminar at the Czech Academy of Sciences
Kalai’s 3d Conjecture for Coordinate Symmetric Polytopes
Seminar “Differential Geometry and Geometric Structures” at TU Wien
Rigidity and Reconstruction of Convex Polytopes – an Application of Wachspress Geometry
- 2024 MATH+ Spotlight Talk (Berlin)
Rigidity and Reconstruction of Convex Polytopes via Wachspress Geometry
Annual Conference of the Priority Program “Combinatorial Synergies” at University Osnabrück
The Stress-Flex Conjecture on Coned Polytope Frameworks
Combinatorics Seminar at University of Bristol
Kalai’s 3^d conjecture for coordinate-symmetric polytopes
“Landscapes of Rigidity” Workshop at RICAM’s Special Semester on Rigidity and Flexibility (Linz)
Rigidity of Polyhedral Spheres beyond Triangulations
Algebra & Geometry Seminar at KTH Stockholm
Wachspress Objects and the Reconstruction of Convex Polytopes from Partial Data
- 2023 Joint Algebra Seminar at RWTH Aachen
Wachspress Objects and the Reconstruction of Polytopes from Partial Metric Data
Birmingham-Warwick One-Day Combinatorics Meeting at the University of Birmingham
Kalai’s 3^d conjecture for coordinate-symmetric polytopes
Seminar on Algorithms, Logic and Discrete Mathematics (ALMA) at the National and Kapodistrian University of Athens
Kalai’s conjecture for coordinate-symmetric polytopes
Seminar Discrete Mathematics / Geometry & Discrete Geometry at TU Berlin
Rigidity, tensegrity and reconstruction of polytopes under metric constraints
Rigidity Seminar at Lancaster University
Rigidity, tensegrity and reconstruction of polytopes and their skeleta
Seminar of the Discrete Geometry workgroup at FU Berlin
On 4-flat graphs and the embeddability of 2-complexes in dimension four
- 2022 Algorithms and Complexity Seminar at the University of Durham
(Random) trees of intermediate volume growth
Symposium of Discrete Mathematics at TU Hamburg
Using Izvestiev’s Theorem – a tool in spectral polytope theory

Combinatorics Seminar at Pretoria University

When edges shrink then polytope become smaller – a proof in geometric polytope theory

2021 Combinatorics Seminar at KTH Royal Institute of Technology (Stockholm)

Capturing polytopal symmetries in the edge-graph

Research Seminar at the National University of Galway

On symmetry, rigidity and spectrum

2020 Seminar of the working groups Discrete Mathematics / Geometry & Discrete Mathematics at TU Berlin

Edge-transitive polytopes

Seminar Discrete Mathematics at Goethe University Frankfurt

Edge-transitive polytopes

Algorithmic and Discrete Mathematics Seminar at University of Rostock

Edge-transitive polytopes

Invited research visits

2025 (upcoming) Goethe University Frankfurt (Raman Sanyal)

(upcoming) University of Kassel (Torsten Mütze)

BTU Cottbus-Senftenberg (Matthias Schymura)

Combinatorial Group at the Czech Academy of Sciences (Anna M. Limbach)

TU Wien (Ivan Izvestiev)

2024 Lancaster University (Bernd Schulze)

University of Bristol (Sean Dewar)

KTH Stockholm (Katharina Jochemko)

2023 Osnabrück University (Martina Juhnke-Kubitzke)

Lancaster University (Bernd Schulze)

FU Berlin (Raman Sanyal)

Other invitations

2025 (upcoming) Workshop on “Rigidity, Flexibility and Complexity of Geometric Constraint Systems” at the Chennai Mathematical Institute (Chennai, India)

Combinatorial Synergies East (MPI Leipzig) – declined

2024 NII Shonan Meeting “Theory and Algorithms in Graph Rigidity and Algebraic Statistics” (Tokyo) – declined

Combinatorial Coworkspace

2023 10th Heidelberg Laureate Forum (invited as young researcher nominated by the DMV)

2022 Combinatorial Coworkspace

2020 Combinatorial Coworkspace

Contributed talks

2024 Combinatorial Coworkspace (Kleinwalsertal)

Wachspress coordinates – a bridge between algebra, geometry and combinatorics

Workshop on Geometric and Algebraic Combinatorics (Santander)

Kalai’s 3^d conjecture for coordinate-symmetric polytopes

2023 British Early Career Mathematicians’ Colloquium (Birmingham)

Infinite linkless graphs and their forbidden minors

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- Workshop on Geometric Constraints (Fields Institute, Toronto)
Rigidity and tensegrity of frameworks from convex polytopes
 - Graph rigidity and applications (Lancaster)
Rigidity and tensegrity of frameworks from convex polytopes
 - 2022 Annual Meeting of the German Mathematics Society (FU Berlin)
Geometric expansion and rigidity properties of polytope skeleta
 - British Combinatorics Conference (Lancaster)
(Random) trees of intermediate volume growth
 - Combinatorial Coworkspace (Kleinwalsertal)
Geometric expansion properties of polytope skeleta
 - 2021 Combinatorics seminar (University of Warwick)
Some modern open problems on convex polytopes with symmetries and regularities
 - Polytopics Conference (Max Planck Institute for Mathematics in the Sciences, Leipzig)
Capturing polytopal symmetries in the edge-graph
 - 2020 Annual Meeting of the German Mathematics Society (Chemnitz)
Spectral graph theory for polytopes
 - Combinatorial Coworkspace (Kleinwalsertal)
Inscribed zonotopes and hyperplane arrangements with congruent chambers
 - 2019 Geometry Day (Jena)
Edge-transitive polytopes
 - Colloquium on Combinatorics (Paderborn)
Edge-transitive polytopes
 - South-Eastern Graph Theory Workshop (Chemnitz)
Edge-transitive polytopes
 - Discrete Geometry Day 2 (Budapest)
Spectral methods for symmetric polytopes
 - Polytope Spring School (Bochum)
Spectral methods for symmetric polytopes
 - 2018 Workshop on Future Research in Combinatorial Optimization (Chemnitz)
Spectral methods for symmetric polytopes

Other participations

- 2025 (upcoming) Annual Conference of the “Combinatorial Synergies” Priority Program at the Leibniz University Hannover
- 2024 Discrete Geometry Nexus (FU Berlin)
Symposium Discrete Mathematics (TU Berlin)
Summer School in Algebraic Combinatorics (Max-Planck-Institute, Leipzig)
- 2023 Autumn Day of Combinatorics (Birmingham)
24 Hours of Combinatorial Synergies (Magdeburg)
- 2022 Geometry meets Combinatorics (Bielefeld)
LMS Research School on “Rigidity, Flexibility and Applications” (Lancaster)
Birmingham-Warwick One-Day Combinatorics Meeting (Warwick)
- 2021 DMV-ÖMG Annual Conference (Passau)
- 2019 Summer School on Geometric and Algebraic Combinatorics (Paris)
- 2018 Geometry Day (Dresden)

Event Organization

2024 Workshop “Wachspress Geometry” (at University of Leipzig)

2018 22nd Workshop on Future Research in Combinatorial Optimization (at TU Chemnitz)

Refereeing and Review activity

1. Discrete & Computational Geometry
2. SIAM Journal on Discrete Mathematics (SIDMA)
3. Discrete Mathematics
4. Electronic Journal of Combinatorics
5. Combinatorial Theory
6. Contributions to Algebra and Geometry
7. Journal of Graph Theory
8. Linear Algebra and Applications
9. Computer-Aided Design
10. Experimental Mathematics
11. Formal Power Series and Algebraic Combinatorics (FPSAC)
12. International Conference on Algebraic Informatics
13. AMS Mathematical Reviews
14. Rose-Hulman Undergraduate Mathematics Journal

Teaching

Lectures

2024 *Rigidity Theory for Frameworks and Polytopes* (TU Berlin)

2022 *Polytope Theory* (as part of the Oxford based Taught Course Center)

2017 *Computer Aided Geometric Design* (TU Chemnitz)

2016 *Solid Modeling* (TU Chemnitz)

Tutorials

2020 *Discrete Mathematics*

2019 *Graph Theory*

2018 *Mathematical Optimization*

2017 *Computer Aided Geometric Design*

2016 *Solid Modeling*

Other

2020 – 2021 Director of the LernRAUM Mathematik (TU Chemnitz)

2015 – 2016 Preparatory courses for first semester students (TU Chemnitz)

2013 Student tutor for Bachelor Computational Science (TU Chemnitz)

Supervising and mentoring

Master theses

2023 K. K. Gottwald, *Approaching a Characterization of Generically Closed Orthogonal Matrix Groups*.

2022 N. Nagel, *Notes on the Union Closed Sets Conjecture*.

Third-year projects

2024 D. E. Türköz, *Properties of Circulants and Related Graphs* (Warwick)

Administrative role

2017 – 2019 Academic commission for the MINT (STEM) study program (TU Chemnitz)

2016 – 2018 Examination committee for the MINT (STEM) study program (TU Chemnitz)

Further training

2024 Workshop on “Implicit and Unconscious Biases”

Public and outreach activities

Since 2023 Contributor to Wikipedia

2021 “Tag der Mathematik” at TU Chemnitz (preparation and execution)

2020 Entry in the Scientific Christmas Calendar at TU Chemnitz (“*The spectral Christmas star*”)

Since 2016 Contributor to the Mathematics StackExchange and MathOverflow networks

Other knowledge

- High proficiency in C/C++ and Mathematica, as well as experience with scientific computing (MATLAB), Python and SageMath.
- Experienced in proof formalization with Lean
- Fluent in German, English; experienced with French