

# Marie-Charlotte Brandenburg

## Curriculum Vitæ

KTH Royal Institute of Technology  
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## Education and Professional Experience

2024 – today	<b>KTH Royal Institute of Technology</b> , Postdoctoral Researcher Research Group: Combinatorics (Katharina Jochemko)
2023	<b>Max Planck Institute for Mathematics in the Sciences</b> , Postdoctoral Researcher Research Group: Mathematical Machine Learning (Guido Montúfar)
2020 – 2022	<b>Max Planck Institute for Mathematics in the Sciences</b> , Ph.D. Student Ph.D. Thesis: <i>Tropical Positivity and Semialgebraic Sets from Polytopes</i> Advisor: Rainer Sinn Research Group: Non-Linear Algebra (Bernd Sturmfels)
2019 – 2020	<b>Berlin Mathematical School   Freie Universität Berlin</b> , Ph.D. Student Advisor: Rainer Sinn Research Groups: Discrete Geometry and Topological Combinatorics (Günter M. Ziegler, Rainer Sinn, Matthias Beck) and Discrete Methods in Algebraic Geometry (Christian Haase)
2019	<b>Freie Universität Berlin</b> , M.Sc. Mathematics Master Thesis: <i>Competitive Equilibrium and Lattice Polytopes</i> Advisor: Christian Haase
2016 – 2017	<b>Minodes GmbH</b> , Data Analyst, Business Intelligence
2016	<b>Freie Universität Berlin</b> , B.Sc. Mathematics Bachelor Thesis: <i>A 4-Simple 4-Simplicial 8-Polytope</i> . Advisor: Günter M. Ziegler

## Publications

2024	<b>Combinatorics of Correlated Equilibria</b> with Benjamin Hollering and Irem Portakal accepted in <i>Experimental Mathematics</i> <a href="https://arxiv.org/abs/2209.13938">arXiv:2209.13938</a>
2023	<b>Tropical Positivity and Determinantal Varieties</b> with Georg Loho and Rainer Sinn <i>Algebraic Combinatorics</i> , 6(4):999-1040, August 2023 <a href="https://doi.org/10.5802/alco.286">10.5802/alco.286</a>
2023	<b>Competitive equilibrium always exists for combinatorial auctions with graphical pricing schemes</b> with Christian Haase and Ngoc Mai Tran <i>La Matematica (Official Journal of the Association for Women in Mathematics)</i> , 2:1–30, March 2023 <a href="https://doi.org/10.1007/s44007-022-00038-7">doi:10.1007/s44007-022-00038-7</a>

- 2023      **Multivariate Volume, Ehrhart and  $h^*$ -Polynomials of Polytopes**  
with Sophia Elia and Leon Zhang  
*Journal of Symbolic Computation*, 114:209–230, January 2023.  
[doi:10.1016/j.jsc.2022.04.011](https://doi.org/10.1016/j.jsc.2022.04.011)
- 2022      **Intersection Bodies of Polytopes**  
with Katalin Berlow, Chiara Meroni and Isabelle Shankar  
*Contributions to Algebra and Geometry*, 63(2):419–439, June 2022.  
[doi:10.1007/s13366-022-00621-7](https://doi.org/10.1007/s13366-022-00621-7)
- 2021      **Investigation of hydro-mechanical processes in fluid-saturated fractured rock based on numerical model generation**  
with Nele Pollmann, Julia Gallas, Lucas Witte and Tobias Backers  
*IOP Conference Series: Earth and Environmental Science*, 833(1):012107, August 2021.  
[doi:10.1088/1755-1315/833/1/012107](https://doi.org/10.1088/1755-1315/833/1/012107)

## Preprints

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- 2024      **The real tropical geometry of neural networks**  
with Georg Loho and Guido Montúfar  
[arXiv:2403.11871](https://arxiv.org/abs/2403.11871)
- 2024      **Quotients of M-convex sets and M-convex functions**  
with Georg Loho and Ben Smith  
[arXiv:2403.07751](https://arxiv.org/abs/2403.07751)
- 2023      **The Best Ways to Slice a Polytope**  
with Jesús A. de Loera and Chiara Meroni  
[arXiv:2304.14239](https://arxiv.org/abs/2304.14239)
- 2023      **Intersection Bodies of Polytopes: Translations and Convexity**  
with Chiara Meroni  
[arXiv:2302.11764](https://arxiv.org/abs/2302.11764)

## Published Conference Contributions

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- 2022      **Extended Abstract: Competitive equilibrium always exists for combinatorial auctions with graphical pricing schemes**  
with Christian Haase and Ngoc Mai Tran  
In: L.F. Tabera Alonso (ed.), *Discrete Mathematics Days 2022*, pp. 64 – 70. Editorial Universidad de Cantabria, Santander, June 2022  
[doi:10.22429/Euc2022.016](https://doi.org/10.22429/Euc2022.016)

## Invited Conference Talks

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- January 2024      **Separating Points by Hyperplanes – Discrete and Real Tropical Geometry of Neural Networks**, *Workshop Discrete Geometry* at Mathematisches Forschungsinstitut Oberwolfach, Germany
- February 2023      **Tropical Geometry and Neural Networks**, *Tropical Geometry in Applications* at Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany

September 2022	<b>Tropical Positivity and Determinantal Varieties</b> , <i>Geometry meets Combinatorics in Bielefeld</i> at Universität Bielefeld, Germany
July 2022	<b>Tropical Positivity and Determinantal Varieties</b> , <i>Matroids, Ordered Structures, and Arrangements in Combinatorics</i> at University of Manchester, England
March 2022	<b>Intersection Bodies of Polytopes</b> , <i>Combinatorial Coworkspace</i> at Goethe-Universität Frankfurt, Germany
March 2022	<b>The Positive Tropicalization of Low Rank Matrices</b> , <i>Discrete and Convex Day</i> at Freie Universität Berlin, Germany
March 2022	<b>Competitive Equilibrium and Lattice Polytopes</b> , <i>Mini-Symposium on Lattice Polytopes</i> at KTH Royal Institute of Technology in Stockholm, Sweden and University of Nottingham, England

## Contributed Conference Talks

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March 2024	<b>Separating Points by Hyperplanes – Discrete and Real Tropical Geometry of Neural Networks</b> , <i>Combinatorial Coworkspace</i> at Goethe-Universität Frankfurt, Germany
November 2023	<b>Combinatorial and Algebraic Approaches to Deep Learning</b> , <i>Annual Meeting of the DFG Priority Program Theoretical Foundations of Deep Learning</i> at Ludwig-Maximilians-Universität München, Germany
July 2022	<b>Competitive Equilibrium Always Exists</b> , <i>Discrete Mathematics Days</i> at University of Cantabria, Santander, Spain
June 2022	<b>The Positive Tropicalization of Low Rank Matrices</b> , <i>VII Encuentro Colombiano de Combinatoria (ECCO)</i> at Universidad de los Andes, Pontificia Universidad Javeriana, and Universidad Sergio Arboleda in Bogotá, Colombia
December 2021	<b>Intersection Bodies of Polytopes</b> , <i>Conference for Women in Algebra and Symbolic Computation II</i> at Technische Universität Kaiserslautern, Germany

## Research Seminar Talks

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March 2024	<b>The Best Ways to Slice a Polytope</b> , <i>Combinatorics Seminar</i> at KTH Royal Institute of Technology, Stockholm, Sweden
February 2024	<b>Separating Points by Hyperplanes – Real Tropical Geometry of Neural Networks</b> , <i>Applied Combinatorics, Algebra, Topology and Statistics Seminar</i> at KTH Royal Institute of Technology, Stockholm, Sweden
November 2023	<b>The Best Ways to Slice a Polytope</b> , <i>Research Seminar Nonlinear Algebra</i> at Freie Universität Berlin, Germany
June 2023	<b>The Best Ways to Slice a Polytope</b> , <i>Research Seminar Nonlinear Algebra</i> at Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany
May 2023	<b>Competitive Equilibrium and Lattice Polytopes</b> , <i>Postdoc and Graduate Student Seminar</i> at ICERM - Institute for Computational and Experimental Research in Mathematics, Providence, RI, USA
October 2022	<b>Competitive Equilibrium and Lattice Polytopes</b> , <i>Mathematical Operations Research Seminar</i> at University of Twente, Netherlands
August 2022	<b>Tropical Positivity and Determinantal Varieties</b> , <i>Copenhagen-Jerusalem Combinatorics Seminar</i> at University of Copenhagen, Denmark and Hebrew University of Jerusalem, Israel

May 2022	<b>The Positive Tropicalization of Low Rank Matrices</b> , <i>Research Seminar Algebra</i> at Friedrich-Schiller-Universität Jena, Germany
May 2022	<b>The Positive Tropicalization of Low Rank Matrices</b> , <i>Research Seminar Algebra and Geometry</i> at Universität Osnabrück, Germany
March 2022	<b>Competitive Equilibrium and Lattice Polytopes</b> , <i>Research Seminar Discrete Mathematics and Geometry</i> at Technische Universität Berlin, Germany
February 2022	<b>Intersection Bodies of Polytopes</b> , <i>Colloquium of the Graduate School "Facets of Complexity"</i> at Freie Universität Berlin, Germany
November 2021	<b>Intersection Bodies of Polytopes</b> , <i>Research Seminar Nonlinear Algebra</i> at Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany
May 2021	<b>The Positive Tropicalization of Low Rank Matrices</b> , <i>Research Seminar Nonlinear Algebra</i> at Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany
July 2020	<b>Multivariate Volume, Ehrhart and <math>h^*</math>-Polynomials of Polytopes</b> , <i>Research Seminar Discrete Geometry</i> at Freie Universität Berlin, Germany
October 2019	<b>Competitive Equilibrium and Lattice Polytopes</b> , <i>Research Seminar Algebra and Geometry</i> at Otto-von-Guericke-Universität Magdeburg, Germany
December 2018	<b>Product-Mix Auctions, Competitive Equilibrium and Lattice Polytopes</b> , <i>Colloquium of the Graduate School "Facets of Complexity"</i> at Freie Universität Berlin, Germany

## Posters

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December 2019	<b>Multivariate Volume, Ehrhart and <math>h^*</math>-Polynomials of Polytopes</b> , <i>Conference for Women in Algebra and Symbolic Computation I</i> at Technische Universität Kaiserslautern, Germany
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## Teaching

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2020	<b>Linear Algebra II</b> Teaching Assistant for a class for first-year math students at Freie Universität Berlin, Germany
2019	<b>Panorama der Mathematik</b> Teaching Assistant for a class for first-year math teachers in training at Freie Universität Berlin, Germany
2018	<b>Geometry</b> Teaching Assistant for a class for advanced bachelor and early master students at Freie Universität Berlin, Germany

## Services

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### Refereed for

Advances in Geometry  
FPSAC '22 – Formal Power Series and Algebraic Combinatorics  
Linear and Multilinear Algebra  
Scientific Reports  
SIAM Journal on Optimization

**Conferences / Seminars organized**

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| October 2023   | <b>Chow Lectures</b><br>Conference at MPI MiS (Leipzig) with June Huh as keynote speaker  |
| September 2023 | <b>Hodge and K-Theory meet Combinatorics</b><br>Workshop at Bernoulli Center, EPFL (Lausanne)   |
| Summer 2022    | <b>Nonlinear Algebra Seminar</b><br>Research Seminar of the Nonlinear Algebra Group at MPI MiS (Leipzig)                                |
| December 2019  | <b>MATH+ Algebraic Geometry Research Retreat</b><br>Workshop within the MATH+ Thematic Einstein Semester (Berlin) on Algebraic Geometry |

**Extended Stays**

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|---------------------------------|---|
| June 2019 –<br>September 2019   | <b>Max Planck Institute for Mathematics in the Sciences</b> , Leipzig, Germany<br>Research Group: Nonlinear Algebra |
| January 2019 –<br>February 2019 | <b>Simons Institute for the Theory of Computing</b> , Berkeley, CA, USA<br>Program: Geometry of Polynomials         |