

## Personal information

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<b>Date of birth</b>	December 7, 1994

## Education and Work Experience

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<b>Sep 2022 – Sep 2023</b>	Postdoc in the Applied non-linear algebra group of Kaie Kubjas at Aalto University, Espoo.
<b>Oct 2021 – Sep 2022</b>	Postdoc in the Non-linear Algebra group of Bernd Sturmfels at the Max-Planck Institute for Mathematics in the Sciences, Leipzig.
<b>Oct 2018 – Oct 2021</b>	PhD studies at OvGU Magdeburg within the research training group “Mathematical complexity reduction” (MathCoRe). Thesis title: <i>The Gaussian conditional independence inference problem</i> ; advisors: Thomas Kahle and Volker Kaibel. Defense on 22 April 2022 with total predicate <b>summa cum laude</b> .
<b>Oct 2016 – Oct 2018</b>	Master of Science in Mathematics with honors at University of Magdeburg, with secondary subject Computer science. Thesis title: <i>Construction methods for gaussoids</i> ; advisor: Thomas Kahle.
<b>Oct 2013 – Nov 2016</b>	Bachelor of Science in Mathematics with honors at University of Magdeburg, with secondary subject Computer science. Thesis title: <i>On permutations with decidable cycles</i> ; advisor: Thomas Kahle.

## Awards and honors

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<b>Nov 2022</b>	FAIRest MathRepo page of 2022 for <i>Selfadhesivity in Gaussian conditional independence structures</i> : <a href="https://mathrepo.mis.mpg.de/SelfadhesiveGaussianCI/index.html">https://mathrepo.mis.mpg.de/SelfadhesiveGaussianCI/index.html</a> .
<b>Sep 2022</b>	Best doctoral dissertation of the University of Magdeburg.
<b>Oct 2018</b>	Best M. Sc. graduate of the Mathematics department in Magdeburg.
<b>Nov 2016</b>	Best B. Sc. graduate of the Mathematics department in Magdeburg.

## Research

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**Research interests.** My research focuses on the fundamental laws and limits in algebraic statistics, information theory and computational geometry. I am particularly interested in conditional independence structures and matroids as the basic combinatorial objects. Fundamental laws of geometry and probability are encoded in the representability and inference questions for these objects. Common techniques from algebra can be used to transfer methods and results between these areas.

In general the representability problems are hard in the sense of algorithmic and algebraic complexity. To overcome these difficulties in practice, I devise heuristic and approximate algorithms for proving and certifying representability and non-representability. Since a part of my work is experimental, I care deeply about data and exact computational methods for certification and verification of results.

## Publications.

- Tobias Boege, René Fritze, Christiane Görgen, Jeroen Hanselman, Dorothea Iglezakis, Lars Kastner, Thomas Koprucki, Tabea Krause, Christoph Lehrenfeld, Silvia Polla, Marco Reidelbach, Christian Riedel, Jens Saak, Björn Schembera, Karsten Tabelow, and Marcus Weber. *Research-Data Management Planning in the German Mathematical Community*. 2022. arXiv: [2211.12071](https://arxiv.org/abs/2211.12071) [math.HO].
- Tobias Boege. “Algebra in probabilistic reasoning”. In: *Computeralgebra-Rundbrief* 71 (2022), pp. 15–20.
- Tobias Boege. “The Gaussian conditional independence inference problem”. PhD thesis. OvGU Magdeburg, 2022. DOI: <https://doi.org/10.25673/86275>.
- Tobias Boege. “Selfadhesivity in Gaussian conditional independence structures”. In: *Proceedings of the 12th Workshop on Uncertainty Processing*. Ed. by Milan Studený, Nihat Ay, Giulianella Coletti, Gernot D. Kleitner, and Prakash P. Shenoy. 2022, pp. 25–36.
- Tobias Boege. *No eleventh conditional Ingleton inequality*. 2022. arXiv: [2204.03971](https://arxiv.org/abs/2204.03971) [cs.IT].
- Tobias Boege, Sonja Petrović, and Bernd Sturmfels. “Marginal Independence Models”. In: *Proceedings of the 2022 International Symposium on Symbolic and Algebraic Computation*. ISSAC ’22. Villeneuve-d’Ascq, France: Association for Computing Machinery (ACM), 2022, pp. 263–271. DOI: [10.1145/3476446.3536193](https://doi.org/10.1145/3476446.3536193).
- Tobias Boege, Thomas Kahle, Andreas Kretschmer, and Frank Röttger. “The geometry of Gaussian double Markovian distributions”. In: *Scandinavian Journal of Statistics* (2022). DOI: <https://doi.org/10.1111/sjos.12604>.
- Tobias Boege. *Incidence geometry in the projective plane via almost-principal minors of symmetric matrices*. 2021. arXiv: [2103.02589](https://arxiv.org/abs/2103.02589) [math.ST].
- Tobias Boege. “Gaussoids are two-antecedental approximations of Gaussian conditional independence structures”. In: *Ann. Math. Artif. Intell.* 90 (2022), pp. 645–673. DOI: [10.1007/s10472-021-09780-0](https://doi.org/10.1007/s10472-021-09780-0).
- Tobias Boege, Jane Ivy Coons, Christopher Eur, Aida Maraj, and Frank Röttger. “Reciprocal Maximum Likelihood Degrees of Brownian Motion Tree Models”. In: *Le Matematiche* 76.2 (2021), pp. 383–398. DOI: [10.4418/2021.76.2.6](https://doi.org/10.4418/2021.76.2.6).
- Tobias Boege and Thomas Kahle. “Construction Methods for Gaussoids”. In: *Kybernetika* 56.6 (2020), pp. 1045–1062. DOI: [10.14736/kyb-2020-6-1045](https://doi.org/10.14736/kyb-2020-6-1045).
- Tobias Boege, Alessio D’Alì, Thomas Kahle, and Bernd Sturmfels. “The Geometry of Gaussoids”. In: *Found. Comput. Math.* 19.4 (2019), pp. 775–812. DOI: [10.1007/s10208-018-9396-x](https://doi.org/10.1007/s10208-018-9396-x).
- Tobias Boege. *On permutations with decidable cycles*. B.Sc. thesis. 2016. arXiv: [1612.05136](https://arxiv.org/abs/1612.05136) [math.LO].

## Talks given at conferences.

- Graduate Student Meeting on Applied Algebra and Combinatorics, April 2023, KTH Stockholm: “Matroids in information theory: conditional Ingleton inequalities”.
- Workshop on Algebraic structures in statistical methodology, December 2022, Mathematisches Forschungsinstitut Oberwolfach: “The complexity of Gaussian conditional independence inference”.
- Workshop on Algorithmic aspects of information theory, July 2022, Schloss Dagstuhl: “Universality of Gaussian conditional independence models”.
- 47th International Symposium on Symbolic and Algebraic Computation (ISSAC), July 2022, Lille: “Marginal independence models”.
- Annual meeting of the IMS, June 2022, London: “Gaussian conditional independence beyond graphical models”.
- 12th Workshop on Uncertainty Processing, June 2022, Kutná Hora: “Selfadhesivity in Gaussian conditional independence structures”.
- Tagung der Fachgruppe Computeralgebra, March 2022, München: “The laws of Gaussian conditional independence”.
- Mini-symposium on Decision Making Theory, September 2021, Prague: “The Gaussian conditional independence inference problem”.
- Prague Stochastics Workshop in Memory of František Matúš, August 2019, Prague: “On discrete representability of Gaussian CI models (from the perspective of the identity matrix)”.

## Teaching

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- *Scheduled for Spring 2023: Real algebraic geometry, Aalto University.*
- Winter 2020: organized and taught 5-day intensive preparation course “Financial Mathematics and Statistics” for 180 incoming economics students.
- Winter 2019: substitute tutor for “Linear Algebra I”.
- Winter 2015 – Summer 2017: tutor for “Linear Algebra I and II”.
- Winter 2015: tutor for “Foundations of Theoretical Computer Science I”.

## Student supervision

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- M. Sc. thesis of Emil Verkama on “Repairing the Universality theorem for 4-polytopes” at Aalto University.

## Service

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- Co-organizer of the Applied Algebra workshop, scheduled for September 2023 in Osnabrück, jointly with Paul Breiding, Lukas Gustafsson and Pierpaola Santarsiero, Tim Römer and Timo de Wolff.
- Co-organizer of the “Data and certificates in algebra and geometry” minisymposium at SIAM AG 2023, jointly with Julia Lindberg.
- Co-editor of the Oberwolfach workshop report 2249a on “Algebraic structures in statistical methodology”.
- Co-organizer of the Discrete mathematics and algebra seminar at Aalto University since Fall 2022, jointly with Muhammad Ardiyansyah and Milo Orlich.
- Co-editor of the Dagstuhl seminar report 22301 on “Algorithmic aspects of information theory” contributing an extensive list of open problems gathered from the participants in informal discussions, talks and the dedicated open problem sessions.
- Co-organizer of the “Leipzig–Magdeburg seminar day” at MPI-MiS Leipzig, together with Thomas Kahle.
- Tutorial on “Mathematical Software: How to get started” at MPI-MiS Leipzig, together with Ronald Kriemann and Javier Sendra.
- Co-organizer of the Non-linear algebra seminar at MPI-MiS Leipzig in the summer term 2022 with Alessandro Neri.
- Co-organizer of the Graduate Student Meeting in Applied Algebra and Combinatorics, April 2021, Copenhagen, jointly organized with Angelica Torres, Beatriz Escudero and Benjamin Smith.
- Supervision of Garrett Cunningham (Ohio Univ.) in RISE Germany internship “Formal conditional independence structures”, June – August 2020.
- December 2020 – October 2021, organization of the weekly MathCoRe fellow seminar and website.
- Referee for *SIAM Journal on Discrete Mathematics*, *SIAM Journal on Applied Algebra and Geometry*, *Electronic Journal of Statistics*, *International Journal of Approximate Reasoning*, *International Mathematics Research Notices* and *SODA* conference. Reviewer for zbMATH.

## Third-party funding

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- Seal of Excellence (90.6%) from the European Commission for my Marie-Skłodowska-Curie Actions proposal in 2022.

## Skills

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- Languages: German (native), English (fluent).
- Successful participation in “Presentations skills” course by the German National Institute for Science Communication (NaWik).
- Programming languages: Perl, Macaulay2, Julia (proficient), Mathematica, C99, C++11 (experienced), Polymake, sagemath (acquainted).
- Experience in problem modeling and solving using SAT (#SAT, ALLSAT) solvers, linear programming and discrete geometry (soplex, normaliz).