# Curriculum vitæ
## Alex Fink
## July 5, 2024

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**Research interests**   The meeting of combinatorics with algebra and geometry, in particular matroids and tropical mathematics.

## Positions held

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|---|---|
| 2013– | Academic post in the School of Mathematical Sciences, Queen Mary University of London. Professor, 2023–present; Reader, 2019–2023; Senior Lecturer, 2016–2019; Lecturer, 2013–2016. |
| 2018 | Mercator Fellow Gastdozentur under the Deutsche Forschungsgemeinschaft grant *Facets of Complexity*, Technische Universität Berlin. |
| 2010–2013 | Research Associate (Postdoc), mentored by Seth Sullivant, North Carolina State University. |

## Education

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| 2006–2010 | PhD, mathematics, advised by Bernd Sturmfels and Federico Ardila, University of California, Berkeley. |
| 2002–2006 | BSc Honours, pure mathematics, and BSc Honours, computer science, University of Calgary. |

## Major grants

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|---|---|
| 2023–2026 | EPSRC Standard Grant *Extensions of matroid Hodge theory*, EP/X001229/1, £419,371 FEC. |
| 2018–2020 | Marie Skłodowska-Curie Actions grant No 792432, *Tropical differential geometry*, €195454.80. |
| 2015–2017 | EPSRC First Grant *Algebra and geometry of matroids*, EP/M01245X/1, £125,148 FEC. |

## Publications

### Preprints, articles submitted

1. with Jeff Giansiracusa and Noah Giansiracusa, with an appendix by Joshua Mundinger, *Projective hypersurfaces in tropical scheme theory I: the Macaulay ideal.* arXiv:2405.16338.
2. with Jorge Alberto Olarte, *Extensions of transversal valuated matroids*, arXiv:2308.05556.
3. with Javier Elizondo and Cristhian Garay López, *Matroids and the space of torus-invariant subvarieties of the Grassmannian with given homology class*, arXiv:2112.15334.

**Accepted and published articles**

4. with Christopher Eur, Matt Larson and Hunter Spink, *Signed permutohedra, delta-matroids, and beyond*, Proceedings of the London Mathematical Society **128** no. 3 (2024), e12592. arXiv:2209.06752.

5. with Laura Escobar, Jenna Rajchgot and Alexander Woo, *Gröbner bases, symmetric matrices, and type C Kazhdan-Lusztig varieties*, Journal of the London Mathematical Society **109** no. 2 (2024), e12856. arXiv:2104.09589.

6. with Zeinab Toghani, *Initial forms and a notion of basis for tropical differential equations*, Pacific Journal of Mathematics **318** no. 2 (2022), 453–468. arXiv:2004.08258.

7. with Amanda Cameron, *The Tutte polynomial via lattice point counting*, Journal of Combinatorial Theory, Series A **188** (2022), 105584. arXiv:1802.09859. Also extended abstract accepted to FPSAC 2016, arXiv:1604.00962.

8. with Jorge Alberto Olarte, *Presentations of transversal valuated matroids*, Journal of the London Mathematical Society **105** no. 1 (2022), 24–62. arXiv:1903.08288.

9. with Andrew Berget, *Equivariant K-theory classes of matrix orbit closures*, International Mathematics Research Notices **2022** no. 18 (2022), 14105–14133. arXiv:1904.10047.

10. with Karola Mészáros and Avery St Dizier, *Zero-one Schubert polynomials*, Mathematische Zeitschrift **297** no. 3 (2020), 1023–1042. arXiv:1903.10332.

11. with Luca Moci, *Polytopes and parameter spaces for matroids over valuation rings*, Advances in Mathematics **343** (2019), 448–494. arXiv:1707.01026.

12. with Clément Dupont and Luca Moci, *Universal Tutte characters via combinatorial coalgebras*, Algebraic Combinatorics **1** no. 5 (2018), 603–651. arXiv:1711.09028.

13. with Andrew Berget, *Matrix orbit closures*, Beiträge zur Algebra und Geometrie **59** no. 3 (2018), 1–34.

14. with Karola Mészáros and Avery St. Dizier, *Schubert polynomials as integer point transforms of generalized permutahedra*, Advances in Mathematics **332** (2018), 465–475. arXiv:1706.04935.

15. with David Speyer and Alexander Woo, *A Gröbner basis for the graph of the reciprocal plane*, Journal of Commutative Algebra **12** no. 1 (2020), 77–86. arXiv:1703.05967.

16. with Jenna Rajchgot and Seth Sullivant, *Matrix Schubert varieties and Gaussian conditional independence models*, Journal of Algebraic Combinatorics **44** no. 4 (2016), 1009–1046. arXiv:1510.04124.

17. with Richard K Guy, *The outercoarseness of the n-cube*, Contributions to Discrete Math. **12** no. 2 (2017), #582.

18. with Andrew Berget, *Equivariant Chow classes of matrix orbit closures*, Transformation Groups **22** no. 3 (2016).

19. with Felipe Rincon, *Stiefel tropical linear spaces*, Journal of Combinatorial Theory, Series A **135** (2015), 291–331. arXiv:1305.6329.

20. with Luca Moci, *Matroids over a ring*, J. Eur. Math. Soc. **18** issue 4 (2016), 681–731. arXiv:1209.6571.

21. with Aviezri Fraenkel and Carlos Santos, *Lim is not slim*, International Journal of Game Theory **43** issue 2 (2014), 269–281.

22. with David Speyer, *K-classes of matroids and equivariant localization*, Duke Math. J. **161** no. 14 (2012), 2699–2723. arXiv:1004.2403.

23. with Richard Nowakowski and Aaron Siegel and David Wolfe, *Toppling conjectures*, Games of No Chance 4, MSRI Publications volume 63 (2015), 65–76.

24. *Chow polytopes and tropical cycles*, Beiträge zur Algebra und Geometrie **54** no. 1 (2013), 13–40. arXiv:1001.4784.

25. *Lattice games without rational strategies*, Journal of Combinatorial Theory, Series A **119** (2012), pp. 450–459. doi:10.1016/j.jcta.2011.10.005.

26. *The binomial ideal of the intersection axiom for conditional probabilities*, J. of Algebraic Combinatorics **33** issue 3 (2011), 455–463. doi:10.1007/s10801-010-0253-5.

27. with Benjamin Iriarte Giraldo, *Bijections between noncrossing and nonnesting partitions for classical reflection groups*, Portugal. Math. **67** fasc. 3 (2010), 369–401. Extended abstract in Discrete Mathematics and Theoretical Computer Science.

28. with Harm Derksen, *Valuative invariants for polymatroids*, Advances in Math. **225** no. 4 (2010), 1840–1892. doi:10.1016/j.aim.2010.04.016. Extended abstract in Discrete Mathematics and Theoretical Computer Science.

29. with Federico Ardila and Felipe Rincón, *Valuations for matroid polytope subdivisions*, Canadian Journal of Mathematics **62** (2010), 1228–1245. doi:10.4153/CJM-2010-064-9, arXiv:0710.4424v2.

30. with Richard Guy and Mark Krusemeyer, *Partitions with parts appearing at most thrice*, Contributions to Discrete Math. **3** (2008), #79.

31. with Richard Guy, *The number-pad game*, Coll. Math. J. **38** (2007), 260–264.

32. *A generalization of an IMO problem*, Integers, Electronic Journal of Combinatorial Number Theory **6** (2006), #A17.

33. with Bill Sands, *Rationals whose sum equals the reciprocal of their product*, Crux Math. **30** (2004), 292–295.

### Conference publications

34. with Jörg Denzinger and John Aycock, *Extracting NPC behavior from Computer Games using Computer Vision and Machine Learning Techniques*, IEEE Symposium on Computational Intelligence and Games, 2007, 24–31.

### Expository writing

35. *Matroid subdivisions, with a computational appendix.* Written for my teaching in Jack Edmonds' courses on Polyhedral Combinatorics and Exponential Polytime in summer 2015.

36. with Richard Guy, *Rick's Tricky Six Puzzle: $S_5$ sits specially in $S_6$*, Math. Magazine **82** no. 2 (April, 2009).

37. *If two were three, what would Hex be?*, 2008, Gathering for Gardner 8.

38. with Derek Kisman and Richard Guy, *Patulous pegboard polygons*, 2006, Gathering for Gardner 7.

### Theme semesters attended

| | |
|---|---|
| 2025 | Special Year on *Algebraic and Geometric Combinatorics*, Institute for Advanced Study. |
| 2018 | *Tropical Geometry, Amoebas, and Polytopes*, Mittag-Leffler Institute. |
| 2016 | *Combinatorial Algebraic Geometry*, Fields Institute. |
| 2012 | Postdoctoral Fellowship, *Commutative Algebra*, Mathematical Sciences Research Institute. |

### Conferences and sessions at meetings organized

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|---|---|
| 2023 | *Queer and Trans Mathematicians in Combinatorics*, QMUL. Joint organiser with Aram Dermenjian, Érika Roldán Roa, Kris Shaw. |
| 2020 | *Respectable recreations: combinatorics in tribute to Richard Guy*, session of talks at a memorial conference, University of Calgary. |
| (cancelled) | Workshop proposal *The algebraic geometry of matroids* accepted by the ICMS. Was to be jointly organised with Diane Maclagan and Felipe Rincón. Could not take place due to Covid. |
| 2019 | Workshop *Tropical differential algebra*, QMUL. Joint organiser with Zeinab Toghani. |

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|---|---|
| 2019 | Minisymposium *New developments in matroid theory* at the SIAM Conference on Applied Algebraic Geometry (SIAMAG19), Universität Bern. Joint organiser with Ivan Martino and Luca Moci. |
| 2019, 2015 | Meetings of the LMS working group *Tropical mathematics and its applications*, QMUL. |
| 2016 | *Tensors, their decompositions, and applications*, QMUL. |
| 2011–2013 | Four instances of the *Triangle Lectures in Combinatorics*, North Carolina State. Joint organizer with subsets of Patricia Hersh, Carla Savage, Sarah Mason, Ed Allen. |
| 2012 | Session of introductory talks for the postdocs attending for the fall 2012 MSRI programmes. |
| 2011 | *Algebraic and geometric aspects of matroids*, special session #1A at the Fall 2011 Southeastern Sectional Meeting of the AMS, Wake Forest University. Joint organizer with Hoda Bidkhori and Seth Sullivant. |

### Small grants

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| 2023 | LMS Scheme 1, £4 000, to support *Queer and Trans Mathematicians in Combinatorics*. |
| 2019 | ICMS Research in Pairs, *Eigenvalue spaces of matrices – a generalisation of Gelfand-Zetlin polytopes*, with Milena Hering and Chris Manon. |

## Academic awards

| | |
|---|---|
| 2006–2009 | Berkeley Fellowship (UC Berkeley) |
| 2007–2008 | NSERC Julie Payette PGS M Research Scholarship |

## Editorial roles

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|---|---|
| 2023– | Editorial board, Algebraic Combinatorics. |
| 2019– | Editorial board, London Mathematical Society. From 2023 onwards, Section Editor for Combinatorics, Discrete and Computational Mathematics, and Logic. |
| 2014– | Editorial board, Theoretical Computer Science, series A. |

## Grant review panel memberships

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| 2024 | DFG priority programme "Combinatorial Synergies" (SPP 2458) |
| 2021 | NSF panel "Combinatorics + Friends" |

## Programme committee memberships

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| 2023 | Formal Power Series and Algebraic Combinatorics 2023, Davis, USA. |
| 2015–2017 | Co-chair of programme committee, Formal Power Series and Algebraic Combinatorics 2017. |
| 2015 | Formal Power Series and Algebraic Combinatorics 2015, Daejeon, South Korea. |

## Seminars run

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|---|---|
| 2019– | with Felipe Rincón–Pabon and several others, Tropical reading group, QMUL. |
| 2014–2016 | with Matt Fayers, Algebra seminar and London Algebra Colloquium, QMUL. |
| 2014 | with Behrang Noohi, Quantum algebras seminar, QMUL. |
| 2011–2013 | with Bojko Bakalov, Combinatorics / algebra seminar, NCSU. |
| 2009 | with Franziska Schroeder, Graduate student tropical geometry seminar, MSRI. |
| 2006–2007 | with William Slofstra, Many Cheerful Facts (the PhD student seminar), Berkeley. |

**Group**

### Postdocs mentored

| | |
|---|---|
| 2023–2025 | Basile Coron |
| 2018–2020 | Zeinab Toghani |
| 2015–2016 | Madhusudan Manjunath |

### PhD students supervised   (as first supervisor)

| | |
|---|---|
| 2023– | Linxuan Li |
| 2021– | Ben Dobres |
| 2019– | Sam Gardiner |
| 2017–2021 | Scott Kemp |
| 2015–2019 | Ben P. Smith |
| 2014–2017 | Amanda Cameron |

## PhD thesis examinations

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| 2023 | Universitetet i Oslo (master's). |
| 2021 | University of Bristol; Università di Bologna. |
| 2020 | Queen Mary University of London. |
| 2019 | London School of Economics. |
| 2018 | University of Sussex; Dalhousie University. |
| 2017 | Queen Mary University of London; University of Warwick; Technische Universität Berlin; University of Fribourg. |

## External examining roles

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| 2024–(exp.) 2028 | Pure Mathematics, University of Sheffield. |

## Fellowships of professional bodies

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| 2015 | Fellow of the Higher Education Academy. |

**Administration**   All of the below are in the School of Mathematical Sciences at QMUL.

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| 2023– | Head of the Centre for Combinatorics, Algebra and Number Theory. |
| 2022– | Co-head of the EDI Subgroup for LGBTQ+. |
| 2019–2023 | Director of Postgraduate Research. Member of Senior Management Team. |
| 2017–2019 | Director of Undergraduate Admissions. |
| 2015–2017 | Postgraduate Admissions Tutor. |
| 2014–2015 | Communications Coordinator. |
| 2013–2014 | Programme Director for BSc and MSci programmes in mathematics and pure mathematics. Member of Teaching and Learning Committee. |

**Courses taught**

**Graduate courses**

- *Algebraic geometry for matroids*, 2018, at Technische Universität Berlin. Fourteen attendees, mostly PhD students. Designed based on my research. 8 hours, 40pp lecture notes.
- *Enumerative combinatorics*, 2015, at the London Taught Course Centre. Eleven PhD students. 10 hours, 91pp lecture notes.
- *Matroid subdivisions*, 2015, a component of Jack Edmonds' course *Polyhedral combinatorics and exponential polytime* hosted by the London Taught Course Centre. Designed based on my research. 2 hours, 27pp lecture notes.

**PhD summer schools**

- *K-theory in combinatorics*, 2023, at the Bernoulli Centre, EPFL. 6 hours.

**Undergraduate and masters teaching at Queen Mary**

- *Introduction to Algebra*, yearly, 2014–2023. An introduction to groups, rings and fields, with heavy emphasis on examples: the complex numbers; modular arithmetic via equivalence relations; rings of matrices and polynomials; permutation groups. Approx. 250 first- and second-year undergraduates. Module heavily redesigned from its previous incarnation.
- *MSci Independent Study in Mathematics*, 2018. A reading course on homological algebra and noncommutative rings. Four masters students. Three colleagues and I designed this module, including assessment structure, at the students' request.
- Project supervision for *Third-year / MSci Project*, regularly since 2013, and *Data Analytics MSc Project*, yearly since 2020. This role involves setting readings and project questions for students, periodic (perhaps fortnightly) meetings with the student to discuss the project work over the course of a semester, and marking their final project report.

**Undergraduate teaching at North Carolina State University**

- *Applied Differential Equations I.*

    Differential equations and systems of differential equations. Methods for solving ordinary differential equations including Laplace transforms, phase plane analysis, and numerical methods. Matrix techniques for systems of linear ordinary differential equations.

- *Calculus III.*

    Third of three semesters in a calculus sequence for science and engineering majors. Vectors, vector algebra, and vector functions. Functions of several variables, partial derivatives, gradients, directional derivatives, maxima and mimima. Multiple integration. Line and surface integrals, Green's Theorem, Divergence Theorems, Stokes' Theorem, and applications. Use of computational tools.

- *Calculus for Life and Management Sciences B.*

    Differential equations — population growth, flow processes, finance and investment models, systems; functions of several variables — partial derivatives, optimization, least squares, multiple integrals; Lagrange multiplier method — chain rule, gradient; Taylor polynomials and series; numerical methods.

**Other mentoring activities**

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| 2013– | Advisor for maths undergraduates, QMUL. |
| 2022 | Supervisor of two undergraduate summer research projects, QMUL. |
| 2012, 2011, 2007 | Training at the Canadian IMO summer training camp, Banff. |
| 2006–2007 | Coaching contestants in the ACM International Collegiate Programming Competition, Calgary. |
| 2003–2006 | Informal tutoring with the Society of Calgary Undergrad Mathematics, Calgary. |
| 2002–2006 | Volunteer at the math enrichment program and International Math. Olympiad training program, Calgary. |