

Federico Castillo

Curriculum Vitae

Employment

- 2021 - **Assistant Professor**, *Pontificia Universidad Catolica de Chile*
- 2020 - 2021 **Postdoctoral Researcher**, *Max Planck Institute for Mathematics in the Sciences*
- 2018 -2020 **Visiting Assistant Professor**, *University of Kansas*
- Fall 2017 **Postdoctoral Fellow**, *Mathematical Sciences Research Institute (MSRI)*, In the program *Geometric and Topological Combinatorics*

Education

- 2012 - 2017 **Ph.D.**, *University of California, Davis*, Mathematics, advisor: Fu Liu
- 2008 - 2012 **B.S.**, *Universidad de los Andes*, Mathematics

Research Interests

Discrete geometry, algebraic combinatorics. Particular topics of interests include matroids, toric varieties, lattice polytopes and Ehrhart theory.

Published Articles

- 14 **The permuto-associahedron revisited**, *With Fu Liu*, *European Journal of Combinatorics*, (2023), 10, 103706
- 13 **An effective solution to convex 1-body N-representability**, *With Jean-Philippe Labbé, Julia Liebert, Arnau Padrol, Eva Philippe, and Christian Schilling.*, *Annales Henri Poincaré*, (2023), 24: 2241-2321
- 12 **Foundation of one-particle reduced density matrix functional theory for excited states**, *With Jean-Philippe Labbé, Julia Liebert, and Christian Schilling.*, *Journal of Chemical Theory and Computation*, (2022) , 18, 1, 124–140
- 11 **Minkowski summands of cubes**, *With Joseph Doolittle, Bennet Goeckner, Michael S. Ross, and Li Ying.*, *Bulletin of London Mathematical Society*, (2022), 54: 996-1009
- 10 **On the Todd Class of the Permutohedral variety**, *With Fu Liu.*, *Algebraic Combinatorics*, Volume 4 (2021) no. 3, pp. 387-407. (2021)
- 9 **Finiteness theorems for Matroid Complexes with prescribed topology**, *With Jose Samper.*, *European Journal of Combinatorics* (2021)
- 8 **When are multidegrees positive?**, *With Yairon Cid-Ruiz, Binglin Li, Jonathan Montaña and Naizhen Zhang.*, *Advances in Mathematics*, 374 (2020)
- 7 **Deformation cones of nested Braid fans**, *With Fu Liu.* *University of California, Davis*, *International Math. Research Notices*, (2020)

- 6 **Coxeter submodular functions and deformations of Coxeter permutahedra**, *With Federico Ardila, Chris Eur, and Alexander Postnikov.*, Advances in Mathematics, 365 (2020)
- 5 **A pithy look at the polytope algebra**, Proceedings of The 2018 Summer Workshop on Lattice Polytopes, Osaka University (2018).
- 4 **Smooth polytopes with negative Ehrhart coefficients**, *With Fu Liu, Benjamin Nill, and Andreas Paffenholz.*, Journal of Combinatorial Theory Ser. A, 160 (2018), 316-331
- 3 **Berline-Vergne valuation and generalized permutohedra**, *With Fu Liu*, Discrete and Computational Geometry, 60 (2018), no. 4, 885-908.
- 2 **The topology of the external activity complex of a matroid**, *With Federico Ardila and Jose Samper*, Electronic Journal of Combinatorics, 23 (2016), P3.8
- 1 **The arithmetic Tutte polynomials of the classical root systems, Ph.D.**, *With Federico Ardila and Mike Henley*, International Math. Research Notices, (2015) 2015 3830-3877

Preprints

- 1 **Hopf monoids of ordered simplicial complexes**, *With Jeremy Martin and Jose Samper*, arXiv:2004.07308
- 3 **Common tangents to polytopes**, *With Jose Samper and Joseph Doolittle*, arXiv:2108.13569
- 5 **Double Schubert polynomials do have saturated Newton polytopes**, *With Yairon Cid-Ruiz, Fatemeh Mohammadi, and Jonathan Montaño*, arXiv:2109.10299
- 6 **Partial Permutohedra**, *With Roger Behrend, Anastasia Chavez, Alexander Diaz-Lopez, Laura Escobar, Pamela E. Harris, and Erik Insko*, arXiv:2207.14253
- 7 **K-polynomials of multiplicity-free varieties**, *With Yairon Cid-Ruiz, Fatemeh Mohammadi, and Jonathan Montaño*, arXiv:2212.13091
- 8 **Lineup polytopes of products of simplices**, *With Jean-Philippe Labbé*, arXiv:2306.00082

Grants and Awards

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| 2022 | Research Fellow , <i>Mathematisches Forschungsinstitut Oberwolfach</i> |
| 2022-2026 | FONDECYT regular |
| 2021-2024 | SQuaREs , <i>PIs: Federico Castillo, Anastasia Chavez, Alexander Diaz-Lopez, Laura Escobar, Pamela E. Harris, and Erik Insko</i> , American Institute of Mathematics, Peak and Descent Polytopes |
| 2016 | Miguel Velez Scholarship , <i>This scholarship is given to the graduate student who has shown excellence in Mathematics</i> , UC Davis |
| 2016 | Graduate Student Travel Award , UC Davis |
| 2015 | Miguel Velez Scholarship , <i>for Latin American students in UC Davis</i> |

Selected talks

March 2023 Combinatorics and Geometry of Convex Polyhedra, Simons Center for Geometry and Physics.
 November 2022 The Fields Seminar, online
 January 2022 FPSAC 2021
 July 2021 New Developments in Moment Polytopes, ICMAT, online
 April 2021 Algebraic Geometry and Polyhedra, ICERM, online
 June 2020 FPSAC 2020, online
 September 2019 KUMUNU 2019, Lincoln, NE
 August 2019 Coloquio Latinoamericano de Algebra, Mexico DF, Mexico
 August 2018 Summer Workshop on Lattice Polytopes, Osaka, Japan
 July 2018 ALTENCOA 8(Minicourse), Popayan, Colombia
 April 2018 Great Plains Combinatorics Conference, Manhattan, KS
 November 2017 Bay Area Discrete Math Day, Oakland, CA
 January 2017 Algebraic and Geometric Combinatorics , Osaka, Japan
 December 2016 Einstein Workshop on Lattice Polytopes, Berlin, Germany

Talks

August 2023 KTH Sweden, Online
 August 2023 Coloquio de Combinatoria algebraica, Online
 October 2022 University of Vermont, Online
 July 2022 Institut fur Mathematik Postdam, Online
 July 2022 Goethe-Universitat , Frankfurt
 July 2022 University of Copenhaguen, Online
 March 2022 University of Waterloo, Online
 November 2021 University of Wyoming, Online
 October 2021 Seminario Sabanero de Combinatoria, Online
 October 2021 Seminario Geometria Algebraica (PUC), Santiago
 June 2021 Nonlinear Algebra Seminar, MPI, Leipzig
 May 2021 Institut de Mathematiques de Jussieu, Online
 May 2021 Ghent University, Online
 April 2021 Freie Universitat, Berlin, Online
 November 2020 Seminario Pregunton, UNAM, Online
 October 2020 KTH Royal Institute of Technology, Stockholm , Online
 October 2020 Technische Universitat Berlin, Online
 August 2020 Colorado State, Boulder, Online
 August 2020 Nonlinear Algebra Seminar, Leipzig, Online
 May 2020 University of California, Davis, Online
 November 2019 Ohio State University, Columbus
 November 2019 New Mexico State University, Las Cruces, NM
 July 2019 Freie Universitat, Berlin, Germany
 May 2019 University of Miami, Miami, FL
 March 2019 University of California, Davis, Davis, CA
 November 2018 Washington University, St Louis, MI
 October 2018 San Francisco State University, San Francisco
 April 2018 Reed's College Math Colloquium, Portland, OR
 November 2017 Saint Mary College, Oakland, CA
 November 2017 San Jose State University, San Jose, CA

February 2017 University of Washington, Seattle, WA
November 2016 University of California, Los Angeles, Los Angeles, CA
April 2015 San Francisco State University, San Francisco, CA

Talks at AMS sectional meetings

May 2021 Algebra and Combinatorics of Polytopes, San Francisco, CA
September 2020 Algebraic and topological combinatorics, El Paso, TX
November 2019 Geometric and Topological Combinatorics, Gainesville, FL
September 2019 Combinatorial Algebraic Geometry, Madison, WI
September 2019 Algebraic and Geometric Combinatorics, Madison, WI
March 2019 Geometric and Topological Combinatorics, Honolulu, HI
April 2019 Combinatorial Commutative Algebra and Polyhedral Geometry, Hartford, CO
March 2018 Commutative Algebra, Portland, OR
September 2017 Polynomials in Enumerative, Algebraic, and Geometric Combinatorics, Buffalo, NY
September 2017 Geometric Combinatorics and Combinatorial Commutative Algebra, Denton, TX
April 2016 Combinatorial and Computational Commutative Algebra, Salt Lake City, UT
January 2016 Topological Combinatorics, Seattle, WA

Contributed talks and posters to conferences

July 2020 32nd Conference on Formal Power Series and Algebraic Combinatorics, Online
July 2019 **poster** 31st International Conference on Formal Power Series and Algebraic Combinatorics, Ljubljana, Slovenia
February 2018 CombinaTexas, College Station, TX
April 2017 Graduate Student Combinatorics Conference, Lawrence, KS
August 2016 **poster** Introductory Workshop, Combinatorial Algebraic Geometry thematic program, Toronto, Canada
July 2016 **poster** 28th International Conference on Formal Power Series and Algebraic Combinatorics, Vancouver, Canada
June 2016 CIMPA Research School: Algebraic, Enumerative and Geometric Combinatorics, Medellin, Colombia
July 2015 **poster** 2nd Algorithmic and Enumerative Combinatorics - Summer School, Hagenberg, Austria
June 2015 **poster** 27th International Conference on Formal Power Series and Algebraic Combinatorics, Daejeon, Korea
October 2014 UC Berkeley/Davis Combinatorics Gathering, Berkeley, CA
June 2014 **poster** 28th International Conference on Formal Power Series and Algebraic Combinatorics, Chicago, IL
June 2014 Encuentro Colombiano de Combinatoria, Bogota, Colombia
April 2013 Graduate Student Combinatorics Conference, Minneapolis, MN
June 2012 Encuentro Colombiano de Combinatoria, Bogota, Colombia
July 2011 Congreso Colombiano de Matematicas, Bucaramanga, Colombia

Professional Service and outreach

- **Referee** Journal of Combinatorial Theory Series A, Discrete & Computational Geometry, SIAM Journal on Discrete Mathematics, Discrete Mathematics, International Research Mathematical Notices, Electronic Journal of Combinatorics, Selecta Mathematica.
- **Co-organizer** (Polytop)ics: Recent advances on polytopes April 6-9, 2021.
- **Co-organizer** Combinatorics Seminar at KU (2018-2020).

- **Member of the Organizing Committee** Combinatorics meets Algebra, Geometry and Optimization ECCO, Universidad del Norte, Barranquilla, Colombia. (June 2018)
- **Speaker** at Nerd Nite Lawrence. (May 2019 and November 2019)
- **Co-organizer** AMS Special Session on Multiplicities and Volumes: An Interplay Among Algebra, Combinatorics, and Geometry, Ann Arbor, MI. (October 2018)
- **Co-organizer** of UC Berkeley/Davis Combinatorics Gathering 2015-2016.
- **Organizer** of the Student Run Discrete Math seminar, UC Davis 2013-2014.
- **Organizing committee of** Colombian National Math Olympiad 2008-2012.

Teaching

Courses at University of Kansas

- Math 220, Differential Equations (S'19)
- Math 290, Elementary Linear Algebra (S'18, F'18)
- Math 409, Topics in Geometry for Secondary/Middle School Teachers (S'19)
- Math 410, Topics in History of Math for Secondary/Middle School Teachers (S'19)
- Math 724, Combinatorial Mathematics (F'19)
- Math 725, Graph Theory (S'18)

Courses at University of California, Davis

- Math 16A, Short Calculus (F'15)
- Math 16B, Short Calculus (F'16)
- Math 16C, Short Calculus (Summer '15)