Curriculum Vitæ
Jean-Philippe Labbé
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Arbeitsgruppe Diskrete Geometrie
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Area of Specialization

My research is at the intersection of combinatorics, discrete geometry and group theory. My speciality is combining geometric, combinatorial and computational approaches to study properties of algebraic and topological structures. In particular, my research merges abstract modelizations and computational experimentations to tackle open problems related to Coxeter groups, polytopes (in particular permutahedra, associahedra, and their applications to quantum physics), triangulations, and simplicial complexes.

MSC2010 keywords:

05 Combinatorics: Groups and algebras, Reflection and Coxeter groups (05E15, 20F55, 20B40)

52 Discrete Geometry: Combinatorial and computational aspects of polytopes, Special polytopes (52B05, 52B12, 52B55)

Work Experience

11/2021 –	**Maître d'enseignement** – (*Lecturer*, tenure-track) École de Technologie Supérieure, Université du Québec, Montréal, Québec
11/2020 – 10/2021	**Privatdozent**, (without employment contract) Freie Universität Berlin, Germany
10/2016 – 09/2020	**Research Fellow**, *SFB Transregio* "Discretization in Geometry and Dynamics" Freie Universität Berlin, Germany
10/2014 – 09/2016	**Research Fellow**, *Israel Science Foundation Grant* of Prof. Eran Nevo Hebrew University of Jerusalem, Israel
02/2015 – 10/2015	**Research Fellow**, Fonds de recherche Nature et Technologies (Québec) Universitad de Cantabria, Santander, Spain
07/2013 – 06/2014	**Research Fellow**, *SFB Transregio* "Discretization in Geometry and Dynamics" Freie Universität Berlin, Germany

Teaching Experience

2016 –	**Programming** Sagemath: SageDays 79 (Teaching python and Sagemath)
Summer Term 2021	**Geometrie** Bachelor course, Freie Universität Berlin ≈60 students, 1 SWS (1h/week, 16 weeks), held in German
Winter Term 2018 – 2019	**Wahrscheinlichkeit & Statistik** Bachelor course, Freie Universität Berlin 81 students, 4 SWS (4h/week, 16 weeks), held in German
	Seminar zur Geometrie Bachelor course, Freie Universität Berlin 3 Students, 2 SWS (2h/week, 16 weeks), held in German
Winter Term 2017- 2018	**Seminar Discrete Mathematics I** Bachelor/Master course, Freie Universität Berlin 8 students, 2 SWS (2h/week, 16 weeks)
Summer Term 2017	**Discrete Mathematics I** Bachelor/Master course, Freie Universität Berlin 45 students, 4 SWS (4h/week, 16 weeks)

Winter Term 2010	**Algèbre Matricielle** (Teaching Assistant) Bachelor course, UQAM 60 students
Winter Term 2010	**Combinatoire** (Teaching Assistant) Bachelor course, UQAM 15 students
Fall Term 2009	**Algèbre II** (Teaching Assistant) Bachelor course, UQAM 15 students

EDUCATION

07/2020	**Habilitation**, Mathematics / Freie Universität Berlin Title: *Convex Geometry of Subword Complexes of Coxeter Groups* Teaching Evaluation: *Probability and Statistics* Habilitation Presentation: *Jones Unknotting Conjecture*
10/2010 – 07/2013	**Dr. rer. nat.**, Mathematics / Freie Universität Berlin Title: *Polyhedral Combinatorics of Coxeter Groups* Advisor: Prof. Günter M. Ziegler
05/2008 – 08/2010	**Maîtrise ès Sciences**, Mathématiques / Université du Québec à Montréal Title: *Approche combinatoire des amas par les éléments triés des groupes de Coxeter* Advisor: Prof. Christophe Hohlweg
09/2005 – 04/2008	**Bachelier ès Sciences**, Mathématiques / Université Laval, Québec City
09/2007 – 12/2007	**Math in Moscow** / Independent University of Moscow
09/2006 – 12/2006	**Budapest Semesters in Mathematics** / Eötvös University

ARTICLES IN PREPARATION

[1] Federico Castillo, Jean-Philippe Labbé, Julia Liebert, and Christian Schilling, *Generalization of Pauli's exclusion principle for fermions and bosons*, in preparation (2021) 6 pp.

[2] Winfried Bruns, Vincent Delecroix, Matthias Köppe, and Jean-Philippe Labbé, *Algebraic polyhedra in Sagemath with Normaliz*, in preparation (2020) 21 pp.

PREPRINTS

[3] Federico Castillo, Jean-Philippe Labbé, Julia Liebert, Arnau Padrol, Eva Philippe, and Christian Schilling, *An effective solution to convex 1-body N-representability*, `arXiv:2105.06459` (2021) 59 pp.

[4] Jean-Philippe Labbé, *Combinatorial foundations for geometric realizations of subword complexes of Coxeter groups*, `arXiv:2003.02753` (2020) 34 pp.

PUBLICATIONS

[5] Michael Cuntz, Sophia Elia, and Jean-Philippe Labbé, *Congruence normality of simplicial hyperplane arrangements via oriented matroids*, Ann. Comb. (2021) to appear.

[6] Julia Liebert, Federico Castillo, Jean-Philippe Labbé, and Christian Schilling, *Foundation of one-particle reduced density matrix functional theory for excited states*, J. Chem. Theory Comput. (2021) to appear.

[7] Joseph Doolittle, Jean-Philippe Labbé, Carsten Lange, Rainer Sinn, Jonathan Spreer, and Günter M. Ziegler, *Combinatorial inscribability obstructions for higher-dimensional polytopes*, Mathematika **66** (2020) no. 4, 927–953.

[8] Jean-Philippe Labbé and Carsten Lange, *Cambrian acyclic domains: counting c-singletons*, Order **37** (2020) no. 3, 571–603.

[9] Jean-Philippe Labbé, Günter Rote, and Günter M. Ziegler, *Area difference bounds for dissections of a square into an odd number of triangles*, Exp. Math. **29** (2020) no. 3, 253–275.

[10] Sarah B. Brodsky, Cesar Ceballos, and Jean-Philippe Labbé, *Cluster algebras of type D_4, tropical planes, and the positive tropical Grassmannian*, Beitr. Algebra Geom. **58** (2017) no. 1, 25–46.

[11] Hao Chen and Jean-Philippe Labbé, *Limit directions for Lorentzian Coxeter systems*, Groups Geom. Dyn. **11** (2017) no. 2, 469–498.

[12] Jean-Philippe Labbé, *Brocoli: Sagemath package dealing with LImit ROots of COxeter groups*, https://github.com/jplab/brocoli (2017) version 1.0.0 3500 lines.

[13] Jean-Philippe Labbé, Thibault Manneville, and Francisco Santos, *Hirsch polytopes with exponentially long combinatorial segments*, Math. Program. **165** (2017) no. 2, Ser. A, 663–688.

[14] Jean-Philippe Labbé and Eran Nevo, *Bounds for entries of γ-vectors of flag homology spheres*, SIAM J. Discrete Math. **31** (2017) no. 3, 2064–2078.

[15] Christophe Hohlweg and Jean-Philippe Labbé, *On inversion sets and the weak order in Coxeter groups*, European J. Combin. **55** (2016) 1–19.

[16] Nantel Bergeron, Cesar Ceballos, and Jean-Philippe Labbé, *Fan realizations of type A subword complexes and multi-associahedra of rank 3*, Discrete Comput. Geom. **54** (2015) no. 1, 195–231.

[17] Hao Chen and Jean-Philippe Labbé, *Lorentzian Coxeter systems and Boyd-Maxwell ball packings*, Geom. Dedicata **174** (2015) 43–73.

[18] Cesar Ceballos, Jean-Philippe Labbé, and Christian Stump, *Subword complexes, cluster complexes, and generalized multi-associahedra*, J. Algebraic Combin. **39** (2014) no. 1, 17–51.

[19] Christophe Hohlweg, Jean-Philippe Labbé, and Vivien Ripoll, *Asymptotical behaviour of roots of infinite Coxeter groups*, Canad. J. Math. **66** (2014) no. 2, 323–353.

[20] Srečko Brlek, Jean-Philippe Labbé, and Michel Mendès France, *Combinatorial variations on Cantor's diagonal*, J. Combin. Theory Ser. A **119** (2012) no. 3, 655–667.

Book Chapters

[21] Ana Maria Botero, Jean-Philippe Labbé, and Lauren Williams. *Introduction to total positivity and cluster algebras*. In: *ECCO – Lectures Notes*. (Book in preparation). Cambridge University Press, 2019, 32 pp.

Conference Proceedings

[22] Jean-Philippe Labbé. *Universal Oriented Matroids for Subword Complexes of Coxeter Groups*. In: *FPSAC 2020*. 2020, pp. 12.

[23] Nantel Bergeron, Cesar Ceballos, and Jean-Philippe Labbé. *Fan realizations of type A subword complexes and multi-associahedra of rank 3*. In: *Proceedings of FPSAC 2015*. DMTCS Proc. Assoc. DMTCS, Nancy, 2015, 429–440.

[24] Hao Chen and Jean-Philippe Labbé. *Lorentzian Coxeter groups and Boyd-Maxwell ball packings*. In: *26th FPSAC*. DMTCS Proc. Assoc. DMTCS, Nancy, 2014, 103–111.

[25] Cesar Ceballos, Jean-Philippe Labbé, and Christian Stump. *Multi-cluster complexes*. In: *24th FPSAC*. DMTCS Proc. Assoc. DMTCS, Nancy, 2012, 1–8.

[26] Christophe Hohlweg, Jean-Philippe Labbé, and Vivien Ripoll. *Asymptotical behaviour of roots of infinite Coxeter groups I*. In: *24th FPSAC*. DMTCS Proc. Assoc. DMTCS, Nancy, 2012, 851–862.

Honors, Awards and Grants

Awards

- Study Merit
  Berlin Mathematical School – Certificate of Distinction, 2013
  Université du Québec à Montréal – Mention d'Honneur – Top Score Thesis, 2010
  Université Laval – Tableau d'Honneur – Perfect Grade Point Average (4.3/4.3), 2006
- Public Prize for Best Talk
  Math Slam (Sandwich Theory) – BMS Days February, 2013

Research Fellowships

- *Fonds de recherche Nature et Technologies (Québec)* – **by Competition**
  Postdoctorate (70 000$CAD)
  Doctorate (60 000$CAD)
  Master (30 000$CAD)

- *Summer Research Grant* – **by Competition**
  LaCIM (5 000$CAD)
  NSERC (2×6 250$CAD)
- *Math in Moscow Scholarship* – **by National Competition**
  CMS and NSERC, 3 Prizes/Year (9 000$CAD)

Mentions
- Ambassador, Centre d'étude Collégial, Lac-Mégantic, 2011–
- *Deux frères dans les hautes sphères des mathématiques internationales*
  News article, Ronald Martel, *La Tribune*, appeared 14 March 2016

Selected Scientific Invitations

FPSAC International Conferences (acceptance: ≈5% talk, ≈15% poster)
Tel Aviv Israel (Poster, 2020), Daejeon South Korea (Poster, 2015), Chicago USA (Poster, 2014), Nagoya Japan (2 Talks, 2012)

Research invitations
Oberwolfach *Discrete Geometry* (09/2020), Oberwolfach *Algorithms in Polyhedral Geometry* (Research in Pairs, 04/2019), Institute for Mathematics and its Applications – Minneapolis (Research in Pairs, 04/2018), Oberwolfach *Algebraic and Geometric Combinatorics* (02/2015), Centre International de Rencontres Mathématiques (05/2010)

Invited Talks
AMS Sectional Meeting *Geometric and Topological Combinatorics* (11/2019), Institute for Mathematics and its Applications (08/2017), Encuentro Colombiano de Combinatoria (06/2016)

Combinatorics & Geometry Seminars
Max Planck Institute Leipzig (03/2020), UCLA (11/2019), University of Southern California (11/2019), University of Washington (11/2019), University of Miami (11/2019), Institut Henri-Poincaré (03/2019), University of Minnesota (04/2018), LaBRI Bordeaux (11/2017)

Professional Services

Referee
Advances in Mathematics, Comptes Rendus Mathématique, Transactions of the AMS, Annales Henri Lebesgue, Experimental Mathematics, Israel Journal of Mathematics, Journal of Algebra, Algebraic Combinatorics, Discrete & Computational Geometry, New York Journal of Mathematics, Beiträge zur Algebra und Geometrie, Journal of Combinatorial Theory A, European Journal of Combinatorics, Electronic Journal of Combinatorics, Séminaire Lotharingien de Combinatoire, Discrete Mathematics, Australasian Journal of Combinatorics, Publicationes Mathematicae Debrecen

Conference and Research Seminar Organizer
- Coordinated communication to maximize the outcomes of 7 successful international conferences.
- Invited talented speakers and created a agreable atmosphere to motivate doctoral students, ensuring a diverse and large audience.
- Chair of organization committee (Sage Days 79, 1st BMS Student Conference)
- Member of international organization committee (ECCO 2020, 1st and 2nd BMS–BGSMath Joint Junior Meeting, Sage Days 84, Coxeter Groups meet Convex Geometry 2012)
- Member of organization committee of research seminars at the Freie Universität Berlin (Discrete Geometry group seminar, Polyhedral Combinatorics research seminar)

Representative Role
Was attentive to the problems of my colleagues and negociated solutions with the deciding instances to improve the quality of the working environment.

(3×) Elected student representative
(2×) appointed postdoctoral faculty spokesperson
(2×) Graduate School Board Member
    Gender & Diversity committee
    Representative for the Berlin Excellence Strategy University Alliance

<u>Superviser & Manager</u>

Established and scheduled result-oriented projects and regular meetings to ensure the success of my students.

- Bachelor:
  Claudia Mitukiewicz, *Tiling the plane with distinct squares*, 2019
  Natalia Konstantinova, *Flow polytopes and their enumerative properties*, 2019
  Aljoscha Rudawski, *The Hadwiger–Nelson problem*, 2019

- Master:
  Christina Simantiri, *The Diameter of Associahedra*, 2019
  Justine Mullon, *Inscribability of the Associahedron on a Sphere*, 2018
  Sophia Elia, *A Survey of Quotient Posets*, 2018

- Doctorate:
  Sophia Elia, Freie Universität Berlin, 2018–2021

- Mentorship:
  4 University students

- Evaluation Committee
  (6×) Bachelor thesis
  (1×) Master thesis
  (3×) PhD Qualifying Exams
  (3×) PhD Defenses
  (2×) Hiring Committee postdoctoral fellowship

REFERENCES

Günter M. Ziegler (PhD Advisor)
Freie Universität Berlin, Germany

Eran Nevo
Hebrew University Jerusalem, Israel

Victor Reiner
University of Minnesota, USA

Francisco Santos
Universidad de Cantabria, Spain

Matthias Beck (Habil. Vorsitzender)
San Francisco State University, USA

Volkmar Welker
Philipps-Universität Marburg, Germany

INTERESTS

<u>Languages</u>

French:	Native speaker	English:	Fluent	German:	Fluent
Russian:	Pushkin State Institute, Moscow	Spanish:	Upper Intermediate	Italian:	Beginner
	McGill University (Advanced 2)				
Hungarian:	Budapest Semesters (Beginner)	Hebrew:	Beginner		

<u>Cycling</u>

- Constructed three single-speed bikes
- Cyclo-camping: Québec City – Îles-de-la-Madeleine (1200km in 7 days)
- Race: Vélothon Berlin 2012 (60km in 1h38min12sec)

<u>Other</u>

Colonial History of the Americas	Ultimate frisbee	Sustainable gardening
Theater of the Absurd	French poetry	Fine Woodworking