Mathieu **Vallée**

01/08/1998

Postdoc · Algorithm team

Université Libre de Bruxelles, CP212, Boulevard du Triomphe, 1050 Brussels, Belgium

mathieu.vallee@protonmail.com | mvallee1998.github.io | MVallee1998 | 0000-0001-6336-9225

Interests

Toric topology, operad theory, discrete optimization.

Current position

Université Libre de Bruxelles *Brussels, Belgium*

Postdoc *Oct. 2025 - Sept. 2026*

- Advisor: Pr. Jean Cardinal
- Project: "Algorithms in Delta-matroids"

Education

Université Sorbonne Paris Nord *Villetaneuse, France*

PhD in Computer science & Mathematics *Sept. 2022 – Sept. 2025*

- Advisor: Pr. Roland Grappe
- Co-Advisor: Pr. Bruno Vallette
- Title: "Cones, fans, and wedges: combinatorial and geometrical perspectives"

Université de Rennes 1 & École Normale Supérieure (ENS) de Rennes *Rennes, France*

Licence (third year) & Master - Mathematics *Sept. 2018 – July 2022*

- Last year out of three of the Licence in Mathematics and then Master degree
- Licence in Physics simultaneaously: third year spread out in two years

Ajou University *Suwon, Republic of Korea*

Exchange program - Mathematics *Sept. 2020 – July 2021*

Two semesters exchange program

Lycée François René de Chateaubriand *Rennes, France*

Classe Préparatoire aux Grandes écoles (CPGE) - Mathematics & Physics *Sept. 2015 – July 2018*

Equivalent to the first and second years of French Licence in both Mathematics and Physics.

Professional Experience

2025-2026 **Graduate Teaching Assistant**, Department of Computer Science, Université Libre de Bruxelles (ULB)
2022-2025 **Graduate Teaching Assistant**, Department of Computer Science, IUT de Villetaneuse (IUT-V)
2020-2021 **Undergraduate Research Assistant**, Department of Mathematics, Ajou University
2018-2022 **Tutoring in Mathematics and Physics**, High school students, Rennes and Paris

Publications

Journals

Toric wedge induction and toric lifting property for piecewise linear spheres with a few vertices
with Suyoung Choi and Hyeontae jang (2025)
Journal of the London Mathematical Society. Vol. 112-1, e70231.

The characterization of (n−1)-spheres with n+4 vertices having maximal Buchstaber number
with Suyoung Choi and Hyeontae jang (2024)
Journal für die reine und angewandte Mathematik (Crelles Journal), Vol. 2024, no. 811, 2024, pages 267–292.

An algorithmic strategy for finding characteristic maps over wedged simplicial complexes
with Suyoung Choi (2022)
Pacific Journal of Mathematics, Vol. 320-1, pages 13–43.

Cohomological rigidity of the connected sum of three real projective spaces
with Suyoung Choi (2022)
Proceedings of the Steklov Institute of Mathematics, Vol. 317, pages 178–188.

Conference proceedings

GPU Algorithm for Enumerating PL Spheres of Picard Number 4: Application to Toric Topology
with Suyoung Choi and Hyeontae jang (2024)
40th International Symposium on Computational Geometry (SoCG 2024). Leibniz International Proceedings in Informatics (LIPIcs), Volume 293, pp. 41:1–41:15

Submitted

Complete non-singular toric varieties with Picard number 4
with Suyoung Choi and Hyeontae Jang (2025+)
ArXiv:2504.18134, in revision

Totally equimodular matrices: decomposition and triangulation
with Patrick Chervet and Roland Grappe (2025+)
ArXiv:2504.05930, in revision

Talks

2025

Totally equimodular matrices: decomposition and triangulation Joint with Patrick Chervet and Roland Grappe

- OR seminar, CORE, UCLouvain, Belgium.
- MIP Europe, Clermont-Ferrand, France. (poster)
- JPOC14, Caen, France.
- Algolunch seminar, Université libre de Bruxelles, Belgium.

2024

Toric wedge induction and application to the toric lifting problem Joint with Suyoung Choi and Hyeontae Jang

- International Polyhedral Products Seminar, Princeton, USA (Online).
- PhD students seminar, Laboratoire Paul Painlevé, Lille, France.

GPU algorithm for enumerating PL spheres of Picard number 4: Application to toric topology Joint with Suyoung Choi and Hyeontae Jang

- 40th Symposium on Computational Geometry (SoCG), Athens, Greece.

Totale équimodularité: complexité, base de Hilbert et propriétés de décomposition entière Joint with Francesco Pisanu

- Rencontres Doctorales Lebesgue 2024, Angers, France (Poster).

Total equimodularity: simplicial cones, Hilbert basis, and triangulation Joint with Roland Grappe

- PhD student seminar IRMAR, Rennes, France.

2023

Hilbert basis and unimodular triangulation of simplicial totally equimodular cones Joint with Roland Grappe

- Journées polyèdre et optimisation combinatoire 13, Clermont-Ferrand, France.

Sur des outils de combinatoire et leurs applications

- Rencontres Doctorales Lebesgue 2023, Rennes, France.

2021-2022

On the enumeration of Real *Toric manifolds of Picard number 4* Joint with Suyoung Choi and Hyeontae Jang

- The 6th Korea Toric Topology Workshop, KAIST, Daejeon, Republic of Korea.
- Contributed talk in Topology: Spring meeting of the KMS, Seoul, Republic of Korea. (Online)
- Toric Topology 2021 in Osaka, Osaka, Japan. (Online)

Teaching Experience

2025-2026	**Randomized algorithms**, Teaching Assistant, 12h/y, 15 students	*ULB*
2025-2026	**Combinatorial optimization**, Teaching Assistant, 12h/y, 5 students	*ULB*
2022-2024	**Introduction to Databases and SQL**, Teaching Assistant, 41h/y, 25-30 students	*IUT-V*
2022-2024	**Project in Databases and SQL**, Teaching Assistant, 5h/y, 25-30 students	*IUT-V*
2022-2024	**Efficient structures in programming**, Teacher, 17h/y, 20 students	*IUT-V*

Undergraduate Research Experience

Université Sorbonne Paris Nord - LIPN

99 Av. Jean-Baptiste Clément, 93430, Villetaneuse, France

January – June 2022

Advisor: Pr. Roland Grappe

MS Thesis: "On the strong Hilbert basis conjecture"

Ajou University - Department of Mathematics

206 World cup-ro, 16499 Suwon, Republic of Korea

September 2020 – July 2021

Advisor: Pr. Suyoung Choi

Project: "Classification of toric manifolds of Picard number 4"

Outreach & Professional Development

Service and Outreach

2023-2025	**Laboratory board**, Representative of the non-permanent members, $\simeq 1$ meeting a month	*LIPN*
2023-2025	**Doctoral school board**, Representative of the Ph.D. Students, $\simeq 6$ meetings a year.	*ED Galilée*
2023-2024	**Ph.D. and Postdoc seminars**, Organizer, $\simeq 1$ seminar a month.	*LIPN*

Workshops and Working Groups

Focus program in toric topology and polyhedral product, *July 22 - August 23 (2024)* Fields Institute, Toronto, Canada. My interest for this focus program follows directly from the homotopy theory of polyhedral products working group. During this one month long focus program, I met many members of these two communities and had very fruitful conversations with many researchers, especially with Pr. Jongbaek Song, Pr. Anthony Bahri, Pr. Jelena Grbić, and some students of Pr. Taras Panov. The first graduate course week made me more confident in my understanding of the subjects. The two workshop weeks provided me with the last results in the domain and lead other discussions with the speakers, especially with Dr. Eunjeong Lee, Pr. Megumi Harada, and Carlos Gabriel Valenzuela Ruiz. Finally I could meet my co-authors Pr. Suyoung Choi and Hyeontae Jang, as well as Pr. Suyoung Choi's new Ph.D. students Yu Seonghyeon and Yun Yeonghan.

Matroid theory and Seymour's decomposition theorem of regular matroids (Combinatorial optimization team), *January - February (2024)* LIPN, Villetaneuse, France. I decided to organize a working group on this subject after seeing the Ph.D. subject of a new student (Jules Nicolas-Thouvenin). In fact, I was interested in this subject and I suggested it to the whole combinatorial optimization team of my lab. There were 6 sessions of 1h30 each. I presented the two first introductory ones, Alexis Schneider (Ph.D. student) presented the third one, Pr. Roland Grappe the fourth one, and Jules Nicolas-Thouvenin (Ph.D. student) the two last ones. Approximately 10 people attended weekly. Books used: *Matroid Theory* by James Oxley and *Combinatorial optimization: Packing and Covering* by Gérard Cornuéjols.

Homotopy of polyhedral products (Algebraic Topology team), *October - December (2023)*, LAGA, Villetaneuse, France. Pr. Bruno Vallette and I co-organized this working group for introducing the AT team of the LAGA to polyhedral products which are topological spaces whose some particular cases such a the (real) moment-angle complexes appear in toric topology. They are great examples for testing conjectures and provide many fine examples for which one can make actual computations. After a first session of set up by Pr. Bruno Vallete, I gave the first introductory presentation on definitions and the first properties of moment-angle complexes and Davis-Januszkiewicz spaces. Marcus Nicolas presented the cohomology of such spaces in a second session. Nicolas Guespresented higher Massey products and discussed about formality of such spaces. Finally, Coline Emprin exposed on loop spaces and coformality. Approximately 8 people attended weekly. Book used: *Toric Topology* by Victor M. Buchstaber and Taras E. Panov. Articles used: *Koszul spaces* by Alexander Berglund, *Lie model in topology* by Urtzi Buijs, Yves Félix, Aniceto Murillo, and Daniel Tanré.

Doctoral School Trainings

- **Parallel programming** *(12h)* OpenMP, Open MPI, Docker.

- **Pedagogy** *(6h)* "How to design an academic course?", "Training on pedagogy for university's teaching mission".
- **Open science: HAL, researcher's social networks, compilatio** *(4h30)*
- **Prevention of Sexual and Gender-Based Violence – Forum Theatre** *(1 day)*
- **Ethics in research and scientific integrity** *(1 day)*.
- **A Cross-Disciplinary Vision of Science** *(1 day)*.
- **Research project and General Data Protection Regulation** *(6h)*.

Others

Languages spoken: French (native language), English (fluent, C1), Spanish (medium B1), Korean (basic), Chinese (basic).

Programming language: Python, Julia, Sagemath, C++, Nvidia CUDA, SQL, Arduino.

Hobbies: Photography (especially street photography), indoor and outdoor bouldering, vocalist and bass player in a small band. Co-writer/co-director of the 2020 musical and vocalist/actor in the 2019 musical of the student association "Muses et Co." of the ENS Rennes (around 200h of rehearsal, 70 students part of the project, 2h30 long musical). Design and assembly of rhythm game controllers using Arduino, laser-cutting machine, electronics and soldering.