# Balthazar Fléchelles

# March 2025

## **E**ducation

- 2017 to 2021 ÉNS de Paris, student of the maths department (DMA), Paris, France
  - Jul. 2018 Bachelor's degree of mathematics, Sorbonne Université
  - Jul. 2020 Master's degree of mathematics, Sorbonne Université
  - Sep. 2024 PhD degree, under the supervision of Fanny Kassel (IHÉS, France) and Gye-Seon Lee (SNU, South Korea). Dissertation entitled "Geometric Finiteness in Convex Projective Geometry", IHÉS (Université Paris-Saclay)
- since Oct. 2024 Postdoctoral researcher at Institut Fourier (Université Grenoble-Alpes), under the supervision of Anne Parreau (Institut Fourier)

## Travel

- Feb. 18, 2019 Research internship at Heidelberg under the supervision of Gye-Seon Lee and Anna to Jul. 15, 2019 Wienhard on the article Bowditch's Q-conditions and Minsky's primitive stability by Jaejeong Lee and Binbin Xu on the geometry and dynamics of hyperbolic representations of free groups
- Mar. 30, 2022 First visit to Gye-Seon Lee at SNU to work on my PhD (mainly worked on revising to Jun. 3, 2022 the draft of article about the results from my M1 internship, as well as about deformation spaces of convex cocompact reflection groups)
- Mar. 1, 2023 Second visit to Gye-Seon Lee at SNU to work on my PhD (mainly worked on my to Jun. 30, 2023 article about strictly convex cusps, and my collaboration with S. Douba, T. Weisman and F. Zhu)

Mar. 14, 2024 Third visit to Gye-Seon Lee at SNU (writing my PhD thesis, starting a collaboration to May 18, 2024 with another PhD student of Gye-Seon about Vinberg theory)

## Research interests

- convex projective geometry — geometric finiteness — Vinberg theory and Coxeter groups — hyperbolic geometry — discrete subgroups of Lie groups
- (relative) Anosov representations
- unipotent representations

## Research projects and works

## Theses and preprints

- Jul. 2018 Bachelor's thesis about quasi-periodic functions on topological groups with Colin Davalo, under the supervision of Patrick Bernard
- Sep. 2020 Master's thesis on Coxeter tilings in Hilbert geometries under the supervision of Antonin Guilloux
- Sep. 2023 Cubulated hyperbolic groups admit Anosov representations, with Sami Douba, Theodore Weisman and Feng Zhu (arXiv:2309.03695, to appear in Geom. Topol.)
- PhD thesis entitled "Geometric finiteness in convex projective geometry" under the Sep. 2024 supervision of Fanny Kassel and Gye-Seon Lee (referees : Daryl Cooper and Olivier Guichard)
- since Jul. 2019 I prove the equivalence between Primitive stability and Bowditch's conditions in the hyperbolic space under technical assumptions (to be uploaded on arXiv)

Postdoc at Institut Fourier, Université Grenoble-Alpes

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#### Advanced projects

- since Jun. 2022 Geometric finiteness in the infinite dimensional hyperbolic space, with David Xu (Univ. de Lorraine). We define geometric finiteness for weakly discrete subgroups of  $\operatorname{Isom}(\mathbb{H}^{\infty})$
- since Feb. 2023 Classification of the holonomies of strictly convex and round cusps, includes new examples of relative Anosov representations and of generalized cusps of non-maximal rank
- since Jul. 2024 Visibility, geometric finiteness and (relative) Anosov representations, with Mitul Islam (MPI Leipzig) and Feng Xu (Univ. Wisconsin-Madison). We generalize the notion of relative Anosov representations and relate it to geometric finiteness in convex projective geometry
- since Sep. 2024 Gromov-Hausdorff limits of the deformations of the Tits representation of Lannér Coxeter groups, with Anne Parreau (Institut Fourier). We compute exactly the limit geometry of deformations of some Vinberg representations in dimension 2, 3 and 4

## Talks

- Aug. 31, 2021 Anosov representations and strong projective convex cocompactness, Workshop on Anosov representations, Centre Paul Langevin, Aussois, France
- Jan. 13, 2022 **The Classification of theta positive structures**, Young researcher's workshop on positivity in Lie groups, IWH, Heidelberg, Germany, joint with Pierre-Louis Blayac
- Oct. 10, 2022 **Teichmüller space II**, Arbeitsgemeinshaft : Higher rank Teichmüller theory, MFO, Öberwolfach, Germany
- Feb. 8, 2023 Introduction to convex projective reflection groups and their applications, Mini-Workshop Reflection groups in Magdeburg, (IHES, France) & (University of Magdeburg, Germany)
- Jun. 21-30, 2023 Strictly convex cusps with nilpotent holonomy, Nearly Carbon Neutral Geometric Topology conference, online
  - Nov. 6, 2023 Représentations anosoviennes pour les groupes hyperboliques cubulables, Ergodic theory seminar, IRMAR, Rennes
  - Jan. 25, 2024 Représentations anosoviennes pour les groupes hyperboliques cubulables, Séminaire virtuel francophone de groupes et géométrie, online
  - Feb 13, 2024 Cubulated hyperbolic groups admit Anosov representations, *PS-SNU Geo*metry/Topology Online Seminar, online (Paris-Saclay Univ. and Seoul National Univ.)
  - Nov. 18, 2024 Geometric finiteness, convex projective geometry and relative Anosov representations, 2024 meeting of the junior researchers of Plato's tetrahedron network, École Normale Supérieure de Paris
  - Jan. 16, 2025 Représentations relativement anosoviennes et finitude géométrique en géométrie projective convexe, Séminaire de théorie spectrale et géométrie, Institut Fourier

#### Workshops and conferences

Aug. 28, 2021 Workshop on Anosov representations, Centre Paul Langevin, Aussois, France to Sep. 4, 2021

Nov. 15, 2021 The young researchers in geometry and dynamics' meeting, CIRM, Luminy, to Nov. 17, 2021 France

| Jan. 10, 2022<br>to Jan. 14, 2022 | Young Researcher's Workshop on Positivity in Lie Groups, IWH, Heidelberg, Germany   |
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| Jun. 6, 2022<br>to Jun. 10, 2022  | Groups, Geometry and Dynamics : a conference in honor of François<br>Labourie, IESC, Cargèse, France  |
| Oct. 9, 2022<br>to Oct. 14, 2022  | <b>Arbeitsgemeinschaft : Higher Rank Teichmüller Theory</b> , MFO, Oberwolfach, Germany   |
| Nov. 23, 2022<br>to Nov. 25, 2022 | The young researchers in geometry and dynamics' meeting, IMO, Orsay, France   |
| Feb. 08, 2023<br>to Feb. 09, 2023 | <b>Mini-Workshop Reflection groups in Magdeburg</b> , <i>online</i> , from Magdeburg university, Germany and IHÉS, France                               |
| Jun. 21, 2023<br>to Jun. 30, 2023 | Nearly Carbon Neutral Geometric Topology conference, online   |
| Nov. 20, 2023<br>to Nov. 22, 2023 | The young researchers in geometry and dynamics' meeting, Institut Fourier, Grenoble, France   |
| Nov. 18, 2024<br>to Nov. 21, 2024 | <b>2024 meeting of the junior researchers of Plato's tetrahedron network</b> ,<br>École Normale Supérieure de Paris                                     |
|                                   | Teaching and math popularization  |
| Sep. 2017<br>to Jul. 2018         | Maths oral preparation and examination for students of "classes prépara-<br>toires", Institut Bossuet, Paris  |
| Sep. 2017<br>to Jul. 2018         | Teaching maths and computer sciences to talented high school students through the association TalENS  |
|                                   | I gave a serie of 5 lectures of 2 hours duration each to a group of 10 high school students about algorithmics, algorithmic complexity, and asymptotics |
| Sep. 2021                         | Exercise sessions for physics L2 students about multivariable calculus  |

- to Jan. 2024 and linear algebra, Université Paris-Saclay
- since Sep. 2022 Research advisor for a MATh.en.JEANS workshop, Collège Alexandre Flemming, Orsay

Every week, the students participating in the workshop work on the research problem they chose in the beginning of the year. I come regularly to guide them in their research, help them learning how to write proofs, and see how far they went.

Oct. 15, 2022 Running a mathematical workshop at the "Fête de la science" in Jussieu, Oct. 15, 2023 Sorbonne Université

I ran along with 2 friends a 2 hours workshop for the popularization of mathematics, in 2022 about the change-making problem, and in 2023 about periodic and aperiodic tilings

Nov. 7, 2024 Minicourse for PhD tudents entitled "Hilbert geometries and tilings of Nov. 21, 2024 convex sets", Institut Fourier

I gave an introductory minicourse (three times 2h) on convex projective geometry for PhD students from various scientific backgrounds

since Dec. 2024 Organization of a reading group on convex projective geometry with Colin Davalo, Institut Fourier We meet every week to discuss the basics of Hilbert geometry, following my minicourse. We studied Benzécri's theorems, different Gromov hyperbolicity criterion for groups dividing a properly convex domain, and Vinberg theory