Christopher-Lloyd Simon

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« Connaître ce n'est point démontrer, ni expliquer. C'est accéder à la vision. » Antoine de Saint-Exupéry

Education and Positions

2022–2025 **S. Chowla Research Assistant Professor**, *Pennsylvania State University*.

2019–2022 **Thesis in mathematics**, *Laboratoire Paul Painlevé de Lille*, Linking forms of Fuchsian groups, supervised by Étienne Ghys and Patrick Popescu-Pampu.

2016–2018 **Master in mathematics**, *ENS Lyon*, Specialization in groups and geometry.

2015–2016 **Licence de mathematiques**, *ENS Lyon*.

2013–2015 **Maths-Sup, Maths-Spé**, *Lycée Louis-Le-Grand*, Paris.

Research Interests in keywords

Curves in Surfaces — Curves in hyperbolic surfaces, Fricke polynomials, simple intersection equivalence. Character varieties of surfaces and their compactifications.

Geometry of groups — Hyperbolic groups, Bass-Serre theory, Fuchsian groups acting on trees, cohomology and bounded cohomology, actions on the circle.

3-manifold Topology — Surgery and cobordism distances between 3-manifolds, linking forms, signatures and characteristic classes, Gordian space of knots.

Modular arithmetics — Integral binary quadratic forms, Gauss composition, conjugacy classes in the modular group, linking numbers of modular geodesics.

Plane curve singularities — Topology of the singularities of real and complex algebraic curves and surfaces. Combinatorics of harmonic loci in the plane.

Combinatorial Algebra — Generating series and analytic combinatorics for the enumeration of structures. Tutte polynomials, partition functions, traces, Euler characteristics and homology.

Languages and Computer skills

English — Native ; fluent — *CAE : Grade A, Level C2.*

French — Native ; fluent.

Spanish — Scholar level — *Baccalauréat : level B2.*

Latex — Articles, reports and beamer presentations

Python — Algorithms and computations dealing with symmetric groups and generating series ; with continued fractions, the modular group, Fricke polynomials and linking numbers.

Thesis (2019-2022)

Title Arithmetic and topology of modular knots

Supervisors Étienne Ghys and Patrick Popescu-Pampu

Description The modular group $\mathrm{PSL}_2(\mathbb{Z})$ acts on the hyperbolic plane with quotient the modular orbifold, whose unit tangent bundle is a 3-manifold homeorphic to the complement of the trefoil knot in the 3-sphere, endowed with the geodesic flow. I study the linking numbers of periodic orbits and relate them to the arithmetics of quadratic forms, the special values of Poincaré series, and the bounded cohomology of $\mathrm{PSL}_2(\mathbb{Z})$.

Master thesis (2016-2018)

Title *Topology and enumeration of real planar algebraic curves*

Supervisor Étienne Ghys

Description The topology of a real planar algebraic curve is described in the neighborhood of a singularity by a combinatorial invariant, namely a chord diagram. Most chord diagrams do not arise as such, we characterize which ones do, and enumerate them. We introduce the concept of *combinatorial curves*, enriching that of combinatorial maps, in order to describe the global topology of connected singular algebraic curves in the real sphere. From there, we count their topological types and deduce a bound on the number of connected singular algebraic curves of a given degree in the real projective plane.

Supervised Research Experiences as a Visiting student

Spring 2019 **Julien Marché**, *IMJ-PRG*, 5 months.
Character varieties : compactifications and automorphisms.
(Publication [MS21] available online.)

Autumn 2018 **Étienne Ghys**, *ENS Lyon*, 4 months.
Cobordism distances between 3-manifolds.
(Work in slow progress, available some day)

Summer 2018 **Étienne Ghys**, *UMPA, Lyon and IMPA, Rio-de-Janeiro*, 4 months.
Topology and combinatorics of the singularities of plane real algebraic curves.
(Publication [Sim22b] and slides in french available on demand.)

Summer 2017 **Moira Chas and Dennis Sullivan**, *Stony Brook, New York*, 3 months.
Low dimensional topology : equivalencies of curves in hyperbolic surfaces.
(Written report in english available on demand.)

Summer 2016 **Jean-Pierre Wintenberger**, *IRMA Strasbourg*, 2 months.
Research experience on L-functions and modular forms.
(Written report in french available on demand.)

Références

[GS20] É. Ghys and C.-L. Simon. On the topology of a real analytic curve in the neighbourhood of a singular point. *Astérisque*, No. 415, Quelques aspects de la théorie des systèmes dynamiques : un hommage à Jean-Christophe Yoccoz. I :pages 1–33, 2020.

[MS] J. Marché and C.-L. Simon. Valuations on the character variety: Newton polytopes and Residual Poisson Bracket. Submitted for publication.

[MS21] J. Marché and C.-L. Simon. Automorphisms of character varieties. *Annales Henri Lebesgue*, 4 :591–603, 2021.

[Sim22a] Christopher-Lloyd Simon. *Arithmetic and Topology of Modular knots*. Thèse, Université de Lille, June 2022. Link to HAL.

[Sim22b] Christopher-Lloyd Simon. Topologie et dénombrement des courbes algébriques réelles. *Annales de la Faculté des sciences de Toulouse : Mathématiques*, 6e série, 31(2) :383–422, 2022.

Invited talks in conferences and seminars

August 2023 **Algebraic, Asymptotic and Enumerative Combinatorics**, *Summer School in Bedlewo, Poland*, Short talk, Combinatorics and enumeration of chord diagrams.
https://sites.google.com/impan.pl/23-summeralgcom/home

June 2023 **Geometric group theory, low-dimensional geometry and topology**, *ICMAT, Madrid*, Arithmetic and topology of modular knots.
https://www.icmat.es/RT/2023/GGTLDGT/index.php

April 2023 **Dynamical Systems Seminar**, *Pennsylvania State University*, Linking forms and quasi-morphisms of Fuchsian groups.
https://math-cal.cloud.science.psu.edu/events/seminar/439

April 2023 **GAP Seminar**, *Pennsylvania State University*, Valuations on the character variety : Newton Polygons and residual Poisson brackets.
https://math-cal.cloud.science.psu.edu/events/seminar/408

Dec 2022 **Le séminaire virtuel francophone Groupes et Géométrie**, *Université Joseph Fourier, Grenoble*, Arithmétique et topologie des noeuds modulaires.
https://www-fourier.univ-grenoble-alpes.fr/seminaire-gg/?q=node/84

Oct. 2022 **Algebra and Number Theory Seminar**, *Pennsylvania State University*, Conjugacy classes in $\mathrm{PSL}_2(\mathbb{K})$ and genera of binary quadratic forms.
https://math-cal.cloud.science.psu.edu/events/seminar/372

Nov. 2022 **Geometry/Topology Seminar**, *Brown University*, Linking numbers of modular knots.
https://www.math.brown.edu/reschwar/seminar.html

Oct. 2022 **Dynamical Systems Working Seminar**, *Pennsylvania State University*, Linking numbers of modular knots.
https://math-cal.cloud.science.psu.edu/events/seminar/400

Oct. 2022 **Department of Mathematics Colloquium**, *Pennsylvania State University*, Arithmetic and Topology of Modular Knots.
https://math-cal.cloud.science.psu.edu/events/seminar/377

June 2022 **Séminaire de Géométrie des Espaces Singuliers**, *Laboratoire Painlevé, Lille*, Arithmétique et topologie des noeuds modulaires.
https://pro.univ-lille.fr/patrick-popescu-pampu/responsabilites/

June 2022 **Conference in enumerative, real and birational geometry**, *1 week in Le Croisic*, Topology and enumeration of real planar algebraic curves.
https://math.univ-angers.fr/~zimmermann/Croisic/Croisic.html

May 2022 **Séminaire de Géométrie des Espaces Singuliers**, *Laboratoire Painlevé, Lille*, Valuations on the character variety : Newton polygons and residual Poisson bracket.
https://pro.univ-lille.fr/patrick-popescu-pampu/responsabilites/

Jan 2022 **Séminaire de Géométrie des Espaces Singuliers**, *Laboratoire Painlevé, Lille*, Arithmetic equivalence of modular geodesics, (Series of two talks).
https://pro.univ-lille.fr/patrick-popescu-pampu/responsabilites/

April 2020 **Séminaire de Géométrie complexe**, *Nancy*, online, Automorphismes des variétés de caractères.
https://iecl.univ-lorraine.fr/events/categories/geometrie/

2019–2020 **Séminaire de Géométrie des Espaces Singuliers**, *Laboratoire Painlevé, Lille*, (Series of talks : Nov, Dec, Jan), Conjugacy classes in the modular group.
https://math.univ-lille1.fr/d7/sgeoessing

Nov. 2019 **Conference Géométrie et Dynamique**, *Goutelas*, en l'honneur de B. Sevennec, Distances pour le cobordisme entre les 3-variétés.
http://perso.ens-lyon.fr/sevennec/GoutelasNovembre2019/

April 2019 **Séminaire Géométrie et Topologie**, *IMJ-PRG, Paris*, Topologie et combinatoire des courbes algébriques réelles singulières.
https://www.imj-prg.fr/gestion/evenement/affSeance/6486

Dec. 2018 **Séminaire de Combinatoire**, *ENS Lyon*, Topologie et combinatoire des courbes algébriques réelles.
https://indico.math.cnrs.fr/event/3370/

Nov. 2018 **Séminaire de Géométrie des Espaces Singuliers**, *Laboratoire Painlevé, Lille*, Topologie et dénombrement des courbes algébriques réelles singulières.
https://math.univ-lille1.fr/d7/sgeoessing

Mathematical Events : Thematic Schools and Conferences

August 2023 **Algebraic, Asymptotic and Enumerative Combinatorics**, *Summer School in Będlewo, Poland*, Combinatorics and enumeration of chord diagrams.
https://sites.google.com/impan.pl/23-summeralgcom/home

Jully 2023 **Group actions and low-dimensional topology**, *Conference in El Barco de Avila*.
https://www.icmat.es/RT/2023/GGTLDGT/week4.php

June 2023 **Geometric group theory, low-dimensional geometry and topology**, *ICMAT, Madrid*, Workshop on Orderings and Groups ; Workshop on Profinite Rigidity.
https://www.icmat.es/RT/2023/GGTLDGT/index.php

June 2022 **Conference in enumerative, real and birational geometry**, *1 week in Le Croisic*.
https://math.univ-angers.fr/~zimmermann/Croisic/Croisic.html

Nov. 2019 **Géométrie & Dynamique**, *Goutelas*, week-end in honor of Bruno Sevennec.
http://perso.ens-lyon.fr/sevennec/GoutelasNovembre2019/

May 2019 **Geometry and Topology of singularities**, *Budapest*, 1 week conference in honor of András Némethi.
https://ap60.sciencesconf.org/

April 2019 **Singularités réelles et complexes à Cargèse**, *Cargèse*, 1 week conference in honor of Adam Parusińsky.
www.renyi.hu/conferences/nemethi60

Jan 2019 **Groups and geometries**, *CIRM*, 1 week master class.
https://mcgg.sciencesconf.org/

Aug. 2018 **ICM**, *Rio de Janeiro, Brasil*.
www.icm2018.org

June 2018 **Teichmüller dynamics, mapping class groups and applications**, *Institut Fourier, Grenoble, France*, 3 week Summer school.
https://if-summer2018.sciencesconf.org/

Organising activities

Dec. 2019 **Week-end mathématique pour les élèves de l'ENS Lyon**, *Château du Goutelas*, Alain Connes, Calcul différentiel quantique et fonction zeta de Riemann.
Edition d'un compte rendu : https://jmeenslyon.wordpress.com/hors-serie/

Nov. 2019 **Conférence en l'honneur de Bruno Sevennec**, *Château du Goutelas*, 3 jours, Equation de Joanolou, Spectre du Laplacien, Groupe modulaire.
http://perso.ens-lyon.fr/sevennec/GoutelasNovembre2019/

Nov. 2018 **Week-end mathématique pour les élèves de l'ENS Lyon**, *Château du Goutelas*, Nalini Anantharaman, Géométries aléatoires.

Students

2023 **Undergraduate Research Experience**, *Independant Studies*, Mayank Yadav, Combinatorics of chord diagrams and their interlace graphs.
https://github.com/mayankyadavblr

Teaching activities

Autumn 2023 **MATH 141, 4 credits**, *Penn. State Univ.*, Calculus with Analytic Geometry II.

Spring 2023 **MATH 311W, 3 credits**, *Pennsylvania State University*, Discrete mathematics.

Autumn 2022 **MATH 141, 4 credits**, *Penn. State Univ.*, Calculus with Analytic Geometry II.

Spring 2021 **TD (exercise sessions) 36h**, *Univ. Lille*, Fonctions de plusieurs variables L2.

Spring 2020 **TD (exercise sessions) 24h**, *Univ. Lille*, Probabilités discrètes L2.

Spring 2020 **TD (exercise sessions) 36h**, *Univ. Lille*, Calcul différentiel L3.

2016-2017 **Colles (exercise sessions) 72h**, *Prépa du Parc de Lyon*, MP*.

Mathematical awareness

Summer 2021 **Article en ligne**, *Images des mathématiques*, Un rebondissement inattendu.
https://images.math.cnrs.fr/Un-rebondissement-inattendu

Spring 2018 **Conférence**, *Séminaire de la détente mathématique de l'ENS Lyon*, Courbes, cartes et dessins d'enfants.
https://indico.math.cnrs.fr/event/3142/

Spring 2017 **Conférence**, *Prépa du Parc, Lyon*, Topologie et combinatoire des courbes planes.

Spring 2016 **Conférence**, *Séminaire de la détente mathématique de l'ENS Lyon*, Théorème de Brower via le lemme de Sperner.
https://www.umpa.ens-lyon.fr/seminaires/detente