Christopher-Lloyd Simon

Doctor in Mathematics

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"What could I say to you that would be of value, except that perhaps you seek too much, that as a result of your seeking you cannot find." Hermann Hesse, Siddhartha

Education and Positions

2025–2027 **PostDoc**, *IRMAR, UMR 6625*, Rennes, (ERC Groups of Algebraic Transformations).

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

2019–2022 **Doctoral Thesis in Mathematics**, *Laboratoire Paul Painlevé*, Université de Lille, supervised by Étienne Ghys and Patrick Popescu-Pampu.

2015–2018 **Master in mathematics**, *ENS Lyon*, Specialization in Groups and Geometry.

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

Research Interests in keywords

Modular Arithmetic: binary quadratic forms, Gauss composition, Modular forms, Poincaré series, continued fractions, intersections numbers and linking numbers of modular geodesics.

Geometry of groups: Representations of Fuchsian groups and mapping class groups, moduli spaces, character varieties, actions on trees, bounded cohomology.

Arithmetic Dynamics: Diophantine approximation, continued fractions, interval exchanges, translation surfaces, renormalisation, subshifts of low complexity and S-adic representations.

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

Singularity theory: Topological classification of singular curves in surfaces, real or complex, algebraic or analytic, using chord diagrams, linking forms, Witt-rings, cluster algebras.

Combinatorial Algebra: Graphs in surfaces, chord diagrams, their polynomial invariants and Hopf algebras. Enumeration using formal generating series and analyzing their singularities.

Languages and Computer skills

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

French: Native ; fluent.

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

Latex: articles, memoirs, thesis 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 [2] 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 [5] 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.)

Undergraduate Students

2025 **Undergraduate Research Experience**, *Eric Seo (supervised with Ben Stucky)*, The complexity of pinning simple multiloops.
This project led to the following [16, (pre)publication]

2024 **Undergraduate Research Experience**, *Ryan Pham (supervised with Ben Stucky)*, Implementing the Schor–Van-Wick algorithm to compute pinning ideals of loops.
This project was mentioned here.

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

Teaching activities

Spring 2025 **MATH 597, 5 credits**, *PSU*, Integrable Systems, T.A. of Prof. Sergei Tabachnikov.

Spring 2025 **MATH 310, 3 credits**, *PSU*, Elementary Combinatorics.

Autumn 2024 **MATH 141, 4 credits**, *PSU*, Calculus with Analytic Geometry II, Instructor.

Spring 2024 **MATH 141, 4 credits**, *PSU*, Calculus with Analytic Geometry II, Instructor.

Autumn 2023 **MATH 141, 4 credits**, *PSU*, Calculus with Analytic Geometry II, Instructor.

Spring 2023 **MATH 311W, 3 credits**, *PSU*, Discrete mathematics, Instructor.

Autumn 2022 **MATH 141, 4 credits**, *PSU*, Calculus with Analytic Geometry II, Instructor.

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://doi.org/10.60868/yz12-p539

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

Responsibilities

2026 **Organisation du Séminaire**, *à l'IRMAR*, de Théorie Ergodique.
https://irmar.univ-rennes.fr/seminaire-de-theorie-ergodique

Since 2025 **Editor and Translator**, *for the AMR selection of articles from Image des Mathématiques*.
From https://images.math.cnrs.fr/ to https://amathr.org/images/.

Dec. 2019 **Editor**, *JME de l'ENS Lyon*, Volume Hors-Série 4 : Compte rendu du week-end avec Alain Connes, Calcul différentiel quantique et fonction zeta de Riemann.
https://jmeenslyon.wordpress.com/wp-content/uploads/2021/11/journal.pdf

Since 2017 **Referee**, *for various journals*, in geometry, topology, combinatorics, arithmetic.

Organizing 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.

Invited talks in conferences and seminars

June 2026 **Séminaire de Topologie**, *Institut Fourier, Grenoble*, Pseudocharacters of the modular group from linking numbers of modular knots.
https://www-fourier.univ-grenoble-alpes.fr/~courtes/topo.html

May 2026 **Simons Semester on Continued Fractions**, *Poland*, Invited as Early Career Researcher, Mini-Course (6h) *Diophantine Approximation of Simple Geodesics in Arithmetic Surfaces*.
https://sites.google.com/impan.pl/simons-cfd2026/home-page

March 2026 **Séminaire de Géométrie, Algèbre, Dynamique et Topologie**, *Dijon*, Pseudocharacters of the modular group from linking numbers of modular knots.
https://indico.math.cnrs.fr/category/329/

Nov. 2025 **Théorie ergodique**, *IRMAR*, La dimension de Hausdorff d'un ensemble de convergence.
https://irmar.univ-rennes.fr/seminars?f[0]=seminar_type%3A241

Aug. 2025 **GGD+NCG**, *Texas AMU*, Pseudocharacters of the modular group from linking numbers of modular knots.
https://artsci.tamu.edu/mathematics/research/seminars/geometry

May 2025 **Departement Colloquium**, *Neuchâtel*, Arithmetic and Topology of Modular Knots.
https://www.unine.ch/evenement/colloque-du-mardi

Jan. 2025 **Perspectives on Markov Numbers**, *Banff IRS*, Workshop (25w5411), Markov numbers and diophantine approximation of hyperbolic geodesics.
https://www.birs.ca/events/2025/5-day-workshops/25w5411/videos

Oct. 2024 **Geometry Lunch Seminar**, *The Pennsylvania State University*, Complexity of pinning loops in the plane.
https://math-cal.cloud.science.psu.edu/events/74691

June 2024 **Séminaire Géométrie Topologie Dynamique**, *Orsay, Université Paris-Saclay*, Valuations on the character variety : Newton Polygons and residual Poisson brackets.
https://www.imo.universite-paris-saclay.fr/fr/events/7333

April 2024 **Philadelphia Area Number Theory Seminar**, *Bryn Maur College*, Arithmetic and Topology of Modular Knots.
Bryn Maur Calendar to the Philadelphia Area Number Theory Seminar

April 2024 **Seminar**, *Princeton*, Arithmetics and Dynamics of the Hexponential map.
https://www.math.princeton.edu/events/arithmetics-and-dynamics-2024-04

Feb. 2024 **Student Colloquium Seminar**, *The Pennsylvania State University*, TopoloGames : "hang the chain" and "pin the loop".
https://math-cal.cloud.science.psu.edu/events/73782

Feb. 2024 **GAP Seminar**, *The Pennsylvania State University*, Loops in surfaces, chord diagrams and interlace graphs : minimal genus.
https://math-cal.cloud.science.psu.edu/events/72378

Dec. 2023 **Monodromy and its Applications, Conference in honor of Nicholas Katz**, *Princeton*, Short talk, Quasicharacters of the modular group from linking numbers of modular knots.
https://sites.google.com/princeton.edu/katz80

Aug. 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**, *The Pennsylvania State University*, Linking forms and quasimorphisms of Fuchsian groups.
https://math-cal.cloud.science.psu.edu/events/seminar/439

April 2023 **GAP Seminar**, *The 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**, *The 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**, *The Pennsylvania State University*, Linking numbers of modular knots.
https://math-cal.cloud.science.psu.edu/events/seminar/400

Oct. 2022 **Department of Mathematics Colloquium**, *The 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

Participation in Thematic Schools and Conferences

May 2026 **Simons Semester on Continued Fractions**, *Poland*, Invited as Early Career Researcher, Mini-Course (6h) *Diophantine Approximation of Simple Geodesics in Arithmetic Surfaces*.
https://sites.google.com/impan.pl/simons-cfd2026/home-page

Oct. 2025 **Combinatorics, Automata, and Number Theory**, *CIRM, Marseille*, Conference.
https://conferences.cirm-math.fr/3355.html

Sept. 2025 **Higher dimensional hyperbolic geometry**, *Ventotene, Italy*, Conference.
https://www.ventoteneinternationalworkshops.net/

Aug. 2025 **Finite Dimensional Integrable Systems in Geometry & Mathematical Physics**, *Guanajuato, Mexico*, CIMAT.
https://fdis2025.eventos.cimat.mx/home_fdis2025

June 2025 **Groups, Logic and Computation**, *Stevens Institute of Technology*, GAGTA.
https://web.stevens.edu/algebraic/Stevens2025/

May 2025 **Anniversaire Étienne Ghys**, *Villers-le-Lac*, Évasion tonique.
https://mtriestino.perso.math.cnrs.fr/EG70programme.html

May 2025 **Frieze patterns in algebra, combinatorics and geometry**, *Marseille*, CIRM.
https://conferences.cirm-math.fr/3214.html

Jan. 2025 **Perspectives on Markov Numbers**, *Banff IRS*, Workshop (25w5411).
https://www.birs.ca/events/2025/5-day-workshops/25w5411

May 2024 **École de Printemps en Informatique Théorique**, *Aussois, France*.
https://perso.ens-lyon.fr/edouard.bonnet/springSchool.htm

Dec. 2023 **Monodromy and its Applications**, *Princeton*, Conference for Nicholas Katz.
https://sites.google.com/princeton.edu/katz80

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

July 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**, *Madrid*, ICMAT, 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**, *Marseille*, 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 school.
https://if-summer2018.sciencesconf.org/

Research in Groups

2023-2024 **JGA**, *Research in groups on graphs and algorithms*, with Pierre Aboulker, Nacim Oijid, Robin Petit, Mathis Rocton, Computing the degreewidth of a digraph is hard.
arXiv version [8]

List of (Pre)Publications

Accepted for Publication

[1] Étienne Ghys et Christopher-Lloyd Simon. « On the topology of a real analytic curve in the neighborhood of a singular point ». In : *Astérisque* Some aspects of the theory of dynamical systems : a tribute to Jean-Christophe Yoccoz. Vol. I.415 (2020). HAL version, p. 1–33. ISSN : 0303-1179,2492-5926. DOI : 10.24033/ast. URL : https://doi.org/10.24033/ast.

[2] Julien Marché et Christopher-Lloyd Simon. « Automorphisms of character varieties ». In : *Ann. H. Lebesgue* 4 (2021). arXiv version, p. 591–603. ISSN : 2644-9463. DOI : 10.5802/ahl.82. URL : https://doi.org/10.5802/ahl.82.

[3] Christopher-Lloyd Simon. « Un rebondissement inattendu ». In : *Images des mathématiques* (2021). DOI : 10.60868/yz12-p539.

[4] Christopher-Lloyd Simon. « Arithmetic and Topology of Modular knots ». HAL version. Thèse. Université de Lille, juin 2022. URL : https://tel.archives-ouvertes.fr/tel-03755147.

[5] Christopher-Lloyd Simon. « Topologie et dénombrement des courbes algébriques réelles ». In : *Ann. Fac. Sci. Toulouse Math. (6)* 31.2 (2022). arXiv version, p. 383–422. ISSN : 0240-2963,2258-7519. DOI : 10.5802/afst.1698. URL : https://doi.org/10.5802/afst.1698.

[6] Christopher-Lloyd Simon. « Conjugacy classes in $\mathrm{PSL}_2(\mathbb{K})$ ». en. In : *Mathematics Research Reports* 4 (2023). arXiv version, p. 23–45. DOI : 10.5802/mrr.16. URL : https://mrr.centre-mersenne.org/articles/10.5802/mrr.16/.

[7] Christopher-Lloyd Simon. *Loops in surfaces, chord diagrams, interlace graphs : operad factorisations and generating grammars*. Accepted in Arnold Math Journal, arXiv version. 2023.

[8] Pierre Aboulker et al. *Computing the degreewidth of a digraph is hard*. To appear in DMTCS. 2024. arXiv : 2407.19270 [math.CO]. URL : https://arxiv.org/abs/2407.19270.

[9] Julien Marché et Christopher-Lloyd Simon. « Valuations on the character variety : Newton polytopes and residual Poisson bracket ». In : *Geom. Topol.* 28.2 (2024). arXiv version, p. 593–625. ISSN : 1465-3060,1364-0380. DOI : 10.2140/gt.2024.28.593. URL : https://doi.org/10.2140/gt.2024.28.593.

[10] Christopher-Lloyd Simon. « Linking numbers of modular knots ». In : *Geometry and Topology* 29.6 (2025), p. 3241–3270. ISSN : 1465-3060,1364-0380. DOI : 10.2140/gt.2025.29.3241. URL : https://doi.org/10.2140/gt.2025.29.3241.

Submitted and in Revision

[11] Scott Schmieding et Christopher-Lloyd Simon. *Geometry and Transcendence of the Hexponential*. 2024. arXiv : 2402.17628 [math.NT]. URL : https://arxiv.org/abs/2402.17628.

[12] Christopher-Lloyd Simon et Ben Stucky. *The pinning ideal of a multiloop*. 2024. arXiv : 2405.16216 [math.GT]. URL : https://arxiv.org/abs/2405.16216.

[13] Bruno Duchesne et Christopher-Lloyd Simon. *Hyperbolic Simplices of Maximal Inradius*. 2025. arXiv : 2512.17096 [math.MG]. URL : https://arxiv.org/abs/2512.17096.

[14] Scott Schmieding et Christopher-Lloyd Simon. *Isogenies of minimal Cantor systems : from Sturmian to Denjoy and interval exchanges*. 2025. arXiv : 2503.02168 [math.DS]. URL : https://arxiv.org/abs/2503.02168.

[15] Bruno Duchesne et Christopher-Lloyd Simon. *The variety of group actions on all algebraic real hyperbolic spaces*. 2026. arXiv : 2603.03863 [math.MG]. URL : https://arxiv.org/abs/2603.03863.

[16] Eric Seo, Christopher-Lloyd Simon et Ben Stucky. *The complexity of pinning simple multiloops*. 2026. arXiv : 2602.07344 [math.GT]. URL : https://arxiv.org/abs/2602.07344.