

# CURRICULUM VITAE

Frédéric Paugam

## Personal information

Born : july, 15th 1976 in Clermont Ferrand (France).

Citizenship : french.

Marital status : married, three kids.

Current position : Maître de conférences (permanent position), Université Pierre et Marie Curie, Paris (France).

Laboratory : Institut de Mathématiques de Jussieu.

Networks : University Pierre and Marie Curie, GdR Algebraic Topology, GdR Renormalization, ANR Global Berkovich Spaces.

## Professional address

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## Work experience

*Maître de conférences (permanent position)*

Institut de Mathématiques de Jussieu (France).

team "Algebraic Analysis"

March 2010 -

*Maître de conférences (permanent position)*

Institut de Mathématiques de Jussieu (France).

team "Operator algebras and representations"

September 2005 - June 2010

*Post-doctoral position*

Institut des Hautes Etudes Scientifiques (France).

February 2005 - June 2005

*Post-doctoral position*

Max-Planck-Institut für Mathematik (Germany).

September 2004 - January 2005

*Post-doctoral position*

Universität Regensburg (Germany).

September 2003 - March 2004

## Education and training

*Habilitation thesis in mathematics*

"From arithmetic geometry to mathematics of quantum field theory".

Université Pierre et Marie Curie (France)

December 2012

*Phd in mathematics*

"Représentations galoisiennes, groupe de Mumford-Tate et bonne réduction des variétés abéliennes".

Supervisor: Rutger Noot.

Université de Rennes 1 (France)

December 2002



# RESEARCH ACTIVITIES

## Subjects

**Arithmetic geometry** : Global analytic geometry, global motivic and derived geometry, cohomological invariants of arithmetic varieties; moduli spaces, Abelian varieties, Hodge structures, Galois representations, Shimura varieties, Mumford-Tate groups, representations of reductive groups.

**Interactions physics/geometries** : Algebraic and categorical methods in quantum field theory, geometry of non-linear partial differential equations, homotopical Poisson reduction of general gauge theories, factorization algebras, perturbative and non-perturbative renormalization; Spontaneous symmetry breaking in number theory, quantum statistical physics of  $\mathbb{Q}$ -lattices with additional structures.

## Publications

### Book

"Towards the mathematics of quantum field theory", *Ergebnisse der Mathematik und ihrer Grenzgebiete, Volume 59*, Springer (2014)

### Preprints

"Berkovich-Gelfand duality in constructive mathematics", work in progress (2023)

"Berkovich analytic geometry and dynamical systems", preprint (2022)

"Banach halos and short isometries", preprint in collaboration with Tomoki Mihara (2022)

"A note on the nonlinear derived Cauchy problem", preprint (2020)

"Spectral analytic geometry (a short note)", preprint in collaboration with Tomoki Mihara (2020)

"Overconvergent global analytic geometry", preprint (2014)

### Publications

"Analytic spectrum of rig categories", *Theory and Application of Categories* 29 (2014)

"Homotopical poisson reduction of gauge theories", *Proc. Symp. Pure Math.* 83 (2011)

"Histories and observables in covariant field theory", *Journal of Geometry and Physics* 61, 9 (2011)

"Global analytic geometry", *Journal of Number Theory* 129, 10 (2009)

"Symétries spectrales des fonctions zêtas", *Journal de Théorie des Nombres de Bordeaux* 21, 2 (2009)

"Bost-Connes-Marcolli systems for Shimura varieties", by E. Ha, F. Paugam, *International Mathematics Research Papers* 5 (2005)

"Galois representations, Mumford-Tate groups and good reduction of abelian varieties", *Math. Ann.* 329 (2004)

### Publications in conferences

"Categorical methods in quantum field theory", proceedings of the conference "Quantum Mathematical Physics, a bridge between Mathematics and Physics", F. Finster, J. Kleiner, C. Roeken, J. Tolksdorf Ed. (2016)

"Three examples of noncommutative boundaries of Shimura varieties", proceedings of the conference "Noncommutative Geometry and Number Theory", Bonn, organised by K.Consani, Y. Manin and M.Marcolli (2004)

"Quelques bords irrationnels de variétés de Shimura", *Mathematisches Institut, Seminars, Universitätsverlag Goettingen*, Y.Tschinkel Ed. (2004)

### Other publications

"De la géométrie arithmétique aux mathématiques la théorie quantique des champs", *Habilitation thesis, Université Pierre et Marie Curie* (2012)

"Représentations galoisiennes, groupe de Mumford-Tate et bonne réduction des variétés abéliennes", *Phd thesis, Université de Rennes 1* (2002)



## Invitations

### *Visit*

University of Luxembourg (Luxembourg).  
May 2011

### *Visit*

Instituto Nacional de Matematica Pura e Aplicada (Brazil).  
February 2012 - March 2012

### *Visit*

Johns Hopkins University (USA).  
April 2007, Two weeks, invited by K. Consani.

### *Visit*

Max-Planck-Institut für Mathematik (Germany).  
March 2005, Two weeks, invited by Matilde Marcolli.

### *Research visit*

Max-Planck-Institut für Mathematik (Germany).  
November 2002, Two weeks, invited by Matilde Marcolli.

## Research grants

2011 - : UPMC research investment grant.  
September 2012 - January 2013: CNRS grant.  
2011 - 2012: UPMC research grant.

## Research administration

2010 - : Coorganizer of the algebraic analysis seminar.  
2008 - 2009: Assessor of the recruiting committee at Paris 6 mathematics faculty.  
2007 - 2009: Member of the recruiting committee at Paris 6 mathematics faculty.  
2007 - 2013: Member of the scientific committee at Paris 6 mathematics faculty.  
2006 - 2012: EMS newsletter editorial board member.

## Organization

February 2012 - March 2012: workshop "Hypothèse du cobordisme et théories des champs topologiques", avec G. Ginot et G. Maltsiniotis, IMJ, Paris (France).  
September 2011 - January 2012: workshop "Renormalisation et algèbres de factorisation II", avec G. Ginot, IMJ, Paris (France).  
December 2010: meeting "Renormalisation et algèbres de factorisation", avec D. Calaque et G. Ginot, IMJ/GdR renormalisation, Paris (France).  
September 2010 - December 2010: workshop "Renormalisation et algèbres de factorisation", avec D. Calaque et G. Ginot, IMJ, Paris (France).  
March 2010: school "Berkovich spaces", member of the organization committee, IMJ, Paris (France).  
February 2008 - January 2010: workshop "Les mathématiques de la physique moderne", avec M. Bermudez, IMJ, Paris (France).

## Research supervision

2010 - 2011: Research project, master 2.  
2010 - 2011: Research project, master 2.

2008 - 2009: Research project, master 1. Javier Fresan: The field with one element following Durov (arithmetic algebraic geometry).

### Talks

November 2016: "Geometrie des espaces de jets et theories de jauge", seminaire du LMBA, LMBA, Vannes.

June 2015: "Overconvergent global analytic geometry", workshop on analytic and arithmetic geometry, Oxford mathematical institute, Oxford.

June 2015: "Methodes categorielles en theorie des champs", seminaire Darboux, LPTHE, Paris.

April 2015: "Geometrie analytique globale surconvergente", seminaire d'algebre et geometrie, LAREMA, Angers.

March 2015: "Geometrie analytique globale surconvergente", seminaire de geometrie algebrique, IRMAR, Rennes.

September 2014: "Categorical methods in quantum field theory", conference "Quantum Mathematical Physics", Universitaet Regensburg, Regensburg.

April 2014: "Analyse algebrique et formalisme de Batalin-Vilkovisky", seminaire "Physique Mathematique et Geometrie", Universite Paris Diderot, Paris.

March 2014: "Reduction de Poisson homotopique des theories de jauge", seminaire "Geometrie et Quantification", IHP, Paris.

March 2013: "Determinant, logarithme, et nouveaux invariants en geometrie analytique globale", seminaire de theorie des nombres, IMJ, Bordeaux.

December 2012: "Outils mathematiques pour la theorie quantique des champs", soutenance de these d'habilitation, IMJ, Paris.

April 2012: "Higher algebra and topological quantum field theory", groupe de travail "Hypothese du cobordisme et theories des champs topologiques", IMJ, Paris.

January 2012: "Algebres de factorisation et quantification par deformations", groupe de travail "Renormalisation et algebres de factorisation II", IMJ, Paris.

November 2011: "Functorial analysis and nonperturbative quantum field theory", conference "Categories and physics", University Paris 7, Paris.

October 2011: "Introduction aux travaux de Francis-Gaiatsgory (avec G. Ginot)", groupe de travail "Renormalisation et algebres de factorisation II", IMJ, Paris.

June 2011: "Homotopical Poisson reduction of gauge theories", ESF Exploratory Workshop on "Current Problems in Differential Calculus over Commutative Algebras, Secondary Calculus, and Solution Singularities of Nonlinear PDEs", Levi-Civita Institute, Salerno.

January 2011: "Chern-Simons et genre de Todd: la quantification est non obstruée", groupe de travail "Renormalisation et algebres de factorisation I", IMJ, Paris.

November 2010: "Renormalisation a la Wilson/Costello des theories scalaires (avec Dang Nguyen V.)", groupe de travail "Renormalisation et algebres de factorisation I", IMJ, Paris.

November 2010: "L'algebre de factorisation commutative des observables classiques", groupe de travail "Renormalisation et algebres de factorisation I", IMJ, Paris.

October 2010: "Theorie des champs locale et formalisme BV", groupe de travail "Renormalisation et algebres de factorisation I", IMJ, Paris.

September 2010: "Theorie des champs classiques et calcul fonctionnel local", groupe de travail "Renormalisation et algebres de factorisation I", IMJ, Paris.

September 2010: "Programme (avec G. Ginot)", groupe de travail "Renormalisation et algebres de factorisation I", IMJ, Paris.

March 2010: "Spectral symmetries of zeta functions and global analytic geometry", summer school on berkovich spaces, Institut de mathematiques de Jussieu, Paris.

June 2010: "Geometria algebrica differential e fisica local", seminario de fisica matematica, IMPA, Rio de Janeiro.

June 2010: "Geometria algebrica differential e fisica local", Coloquio do Departamento de Matematica Aplicada, MAP, IME-USP, Sao Paulo.

June 2010: "Geometria algebraica differential e fisica local", seminario de geometria algebraica, UNICAMP, Campinas (SP).

April 2010: "Geometria algebraica differential e fisica local", sextas matematicas, UFRJ, Rio de Janeiro.

April 2010: "Geometria algebraica differential e fisica local", pos-graduacao em Matematica, UFF, Rio de Janeiro.

March 2010: "Observables and local functional calculus from the point of view of differential algebra", Seminario do Algebra, IMPA, Rio de Janeiro.

February 2010: "Global analytic geometry", Coloquio Interdisciplinar, IMPA, Rio de Janeiro.

January 2010: "Observables et calcul fonctionnel local du point de vue de l'algebre differentielle", groupe de travail differentiel, Institut de Mathematiques de Jussieu, Paris.

December 2009: "Symétries spectrales des fonctions zêtas et géométrie analytique globale", séminaire de theorie des nombres, Université Bordeaux 1, Bordeaux.

June 2009: "Symétries spectrales des fonctions zêtas et géométrie analytique globale", séminaire de géométrie arithmétique et motivique, Université Paris 13, Villetaneuse.

June 2009: "Symétries spectrales des fonctions zêtas et géométrie analytique globale", séminaire d'algèbre et géométrie, Université de Versailles-Saint-Quentin, Versailles.

2008 - 2009: "Mathématiques de la physique moderne (Nombreux exposés)", groupe de travail, IMJ, Paris.

March 2009: "Spectral symmetries of zeta functions and global analytic geometry", Workshop on F1, Johns Hopkins University, Baltimore.

December 2008: "Global analytic geometry and the functional equation", Number theory lunch seminar, Max-Planck-Institut fuer Mathematik, Bonn.

November 2008: "Global analytic geometry and the functional equation", Number theory seminar, University of Nottingham, Nottingham.

May 2008: "Géométrie analytique globale", séminaire du LMAM, Université de Bretagne Sud, Vannes.

May 2008: "Géométrie analytique globale", Groupe de travail différentiel, Institut de Mathématiques de Jussieu, Paris.

February 2008: "Arithmetic geometry and the functional equation (a survey)", Colloquium, University of Liverpool, Liverpool.

November 2007: "Comment comprendre spectralement l'équation fonctionnelle de la fonction zêta", Séminaire Algèbres d'opérateurs, Institut de Mathématiques de Jussieu, Paris.

October 2007: "Géométrie arithmétique et équation fonctionnelle (une introduction)", Séminaire de théorie des nombres, Institut de Mathématiques de Jussieu, Paris.

June 2007: "Geometry of the functional equation of Riemann's zeta function (a survey)", Geometria e Sistemas Dinamicos, Instituto Superior Tecnico, Lisboa.

June 2007: "Noncommutative geometry and number theoretical dynamical systems", Geometria e Sistemas Dinamicos, Instituto Superior Tecnico, Lisboa.

June 2007: "Quelle géométrie arithmétique pour l'équation fonctionnelle?", Séminaire arithmétique et théorie de l'information, institut de mathématiques de Luminy, Marseille.

May 2007: "Arithmetic geometry and the functional equation (a survey)", Seminario Teoria dei numeri, Universita di Roma, Rome.

April 2007: "Bost-Connes-Marcolli systems for Shimura varieties", workshop in noncommutative geometry and arithmetic geometry, Johns Hopkins University, Baltimore.

April 2007: "Arithmetic geometry and the functional equation (a survey)", number theory seminar, Johns Hopkins University, Baltimore.

January 2007: "Sur la géométrie arithmétique de l'équation fonctionnelle (une introduction)", séminaire de théorie des nombres, Laboratoire Paul Painlevé, Lille.

June 2006: "Quelques mystères de théorie des nombres et travaux de Deninger (une introduction)", séminaire Algèbres d'Opérateur, Institut Mathématique de Jussieu, Paris.

May 2006: "Bost-Connes-Marcolli systems for Shimura varieties", Conference on Noncommutative Geometry, Quantum Field Theory and Motives, Vanderbilt University, Nashville.

April 2006: "Quelques mystères de théorie des nombres et travaux de Deninger", groupe de travail Algèbre et Topologie Homotopiques, Laboratoire Emile Picard, Toulouse.

November 2005: "Variétés de Shimura unitaires sur les corps de nombres", groupe de travail sur le projet de livre de M. Harris et son équipe, Institut de mathématiques de Jussieu, Paris.

April 2005: "Systèmes de Bost-Connes-Marcolli pour les variétés de Shimura", séminaire de Géométrie algébrique, IRMAR, Rennes.

April 2005: "Systèmes de Bost-Connes-Marcolli pour les variétés de Shimura", séminaire "Algèbres d'opérateurs", Institut de Mathématiques de Jussieu, Paris.

March 2005: "Groupe de Mumford-Tate et bonne réduction des variétés abéliennes", séminaire "Groupes réductifs et formes automorphes", Institut de Mathématiques de Jussieu, Paris.

March 2005: "Systèmes de Bost-Connes-Marcolli pour les variétés de Shimura", séminaire "algèbres d'opérateurs", laboratoire MAPMO, Orléans.

March 2005: "Systèmes de Bost-Connes-Marcolli pour les variétés de Shimura", groupe de travail "Champs et homotopie en géométrie algébrique", laboratoire Emile Picard, Toulouse.

March 2005: "Systèmes de Bost-Connes-Marcolli pour les variétés de Shimura", séminaire d'arithmétique, laboratoire d'Arithmétique et d'Algèbre, St Etienne.

February 2005: "Systèmes de Bost-Connes-Marcolli pour les variétés de Shimura", séminaire de théorie des nombres, laboratoire Nicolas Oresme, Caen.

January 2005: "Bost-Connes-Marcolli systems for Shimura varieties", number theory seminar, Max-Planck-Institut für Mathematik, Bonn.

March 2004: "On good reduction of abelian varieties", conference "Motives, K-theory and arithmetical geometry", Genova (Italy).

June 2004: "Irrational boundaries of Shimura varieties", workshop "Noncommutative geometry and number theory, II", Max-Planck-Institut für Mathematik, Bonn.

June 2004: "Irrational boundaries of Shimura varieties", conférence "Diophantine geometry", Goettingen.

May 2004: "Noncommutative degenerations of abelian varieties ?", semester "K-theory and noncommutative geometry", Institut Henri Poincaré, Paris.

February 2004: "Sur une conjecture de Morita", number theory seminar, Montpellier.

January 2004: "On Connes-Moscovici's local index formula", workshop "Nichtkommutativ Geometrie", Regensburg.

December 2003: "Galoisdarstellungen, Mumford-Tate Gruppe und schöne Ermässigung von Abelschevariäten", Oberseminar Arithmetische Geometrie, Regensburg.

November 2003: "Compléments de théorie d'Iwasawa", workshop on an article by Pierre Colmez about Iwasawa theory of p-adic representations, Regensburg.

June 2003: "Geometrie de  $GL_2(\mathbb{Z}) \backslash GL_2(\mathbb{R})$  des points de vue commutatif et non commutatif", rencontres doctorales de l'ouest, Angers.

January 2003: "Courbe modulaire non commutative et structures de Hodge", Jeunes chercheurs en géométries, Rennes.

November 2002: "Déformations analytiques et arithmétiques des variétés abéliennes", présentation pour l'évaluation du laboratoire, Rennes.

May 2002: "De Rham and cristalline Galois representations", conférence "Tamagawa numbers and special values of L-functions", université Paris XIII, Villetaneuse.

May 2002: "Courbes elliptiques et courbes modulaires non commutatives", rencontres doctorales de l'ouest, Dinard.

April 2002: "Groupe de Mumford-Tate, représentations galoisiennes et bonne réduction des variétés abéliennes", colloque "Jeunes chercheurs en théorie des nombres", Besançon.

December 2001: "Groupe de Mumford-Tate et bonne réduction des variétés abéliennes", séminaire de Géométrie algébrique, Rennes.



# TEACHING ACTIVITIES

## Lectures

2014 - 2015: Course on *multiple integrals and vectorial analysis*, for undergraduate students of the second year at university of Paris 6.

May 2012: *Geometry of quantum field theory*, graduate students at UL (Luxembourg).

2012: *Geometry of quantum field theory*, for master 2 students at UPMC (Paris 6).

2011: *Geometry of quantum field theory*, for master 2 students at UPMC (Paris 6).

2010: *Towards the mathematics of quantum field theory*, for master 2 students at IMPA (Rio).

February 2010: *Global analytic geometry and the functional equation*, for master 2 students at IMPA (Rio).

2003: *Analysis*, for undergraduate students of university of Rennes 1.

## Problem sessions

2013 - 2014: *Topology and differential calculus*, for undergraduate students of the third year.

2013 - 2014: *Algebra and geometry*, for undergraduate students of the second year.

2010 - 2011: *Elementary differential geometry*, for undergraduate students of the third year.

2010 - 2014: *Vectorial analysis and multiple integrals*, for undergraduate students of the second year.

2008 - 2009: *Partial differential equations*, for master 1 students.

2008 - 2009: *Algebra and Galois theory*, for master 1.

2006 - 2009: *Topology and differential calculus*, for undergraduate students of the third year.

2006 - 2011: *Holomorphic functions*, for undergraduate students of the third year.

2005 - 2007: *Integration and measure theory*, for undergraduate students of the third year.

2005 - 2006: *Arithmetic*, for undergraduate students of the second year.

2005 - 2006: *Linear algebra*, for undergraduate students of the first year.

2001 - 2003: *Probability and statistics*, for undergraduate students.

1999 - 2001: *Linear algebra and analysis*, for undergraduate students.

## Practical teaching

2001 - 2003: Computer assisted mathematics in scilab: statistics , for undergraduate students.

2000: Computer assisted mathematics in maple: algebra, for undergraduate students.