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Born: 30th August 1995 – Anhui, China

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Current situation

From **Research Assistant (Post-doc)**, *Department Mathematik/Informatik, Abteilung Mathematik*, Universität zu Köln.

SPP project: Random polynomials and random Kähler geometry,
in DFG Priority Programme "Random Geometric Systems".

Principal investigators: Prof. Dr. Alexander Drewitz and Prof. Dr. George Marinescu.

Research domain

Differential geometry, local index theory, Riemannian and complex geometry.

Key-words Hypoelliptic Laplacian, Selberg trace formula, analytic torsion, Bergman kernel, heat operator, Kähler geometry, random holomorphic sections.

Education

2014-2018 **Thesis on fundamental mathematics**, *Laboratoire de Mathématiques d'Orsay*, Université Paris-Sud (Paris-Saclay), Orsay, France.

Supervisor: Prof. Jean-Michel Bismut, Université Paris-Sud(Orsay)

Thesis title: Hypoelliptic Laplacian and twisted trace formula.

Thesis defense date: 15/06/2018.

Jury members of thesis defense: Prof. Jean-Michel Bismut (supervisor)

Prof. Jochen Brüning

Prof. Laurent Clozel

Prof. Colin Guillarmou (president)

Prof. George Marinescu

Prof. Gérard Freixas I Montplet

Prof. Werner Müller.

Reviewers of thesis: Prof. George Marinescu; Prof. Werner Müller.

2013-2014 **Master 2 on Fundamental Mathematics**, *Université Paris-Diderot (now Université Paris Cité)*.

The graduation project focused on constructing the hypoelliptic Laplacian on a symmetric space under the supervision of Prof. Jean-Michel Bismut.

2009-2013 **Bachelor of Science in Mathematics and Applied Mathematics**, *University of Science and Technology of China (USTC)*, Hefei, P.R. China.

I was a student of the **School of the Gifted Young**. My graduation project was about the asymptotic geometry of the asymptotic null spacelike hypersurface in Kerr spacetime under the direction of Prof. Xiao Zhang (AMSS, Beijing).

09/2012-**Scientific Research Training**, *Academy of Mathematics and Systems Science (AMSS,*
06/2013 *Chinese Academy of Sciences)*, Beijing, P.R. China.

I was a member of the Hua Loo-Keng Talent Program in Mathematics, which allowed me to study in AMSS for one year.

Academic Appointments

- 09/2018-10/2020 **Postdoctoral Fellow**, *Max-Planck-Institut für Mathematik (MPIM)*, Bonn.
Mentor: Prof. Werner Müller (Universität Bonn/MPIM)
- 2017-2018 **A.T.E.R.**, Université Paris-Sud (Paris-Saclay), Orsay, France.
I was in charge of several tutorials for undergraduate students, with a teaching load of 192 hours.

Organization of conference

- 4 - **Geometric and Topological Properties of Random Algebraic Varieties**, Universität zu Köln, Cologne, Germany.
6/10/2023 <http://www.mi.uni-koeln.de/~bxliu/GeToRAV.html>

Publications

- 1 with Alexander Drewitz and George Marinescu, *Gaussian holomorphic sections on noncompact complex manifolds*. **Journal of the Institute of Mathematics of Jussieu**. vol. 24, no. 4, pp. 1197 - 1262, 2025. doi:10.1017/S1474748024000422.
- 2 with Dominik Zielinski, *Semipositive line bundles on punctured Riemann surfaces: Bergman kernels and random zeros*. **Analysis and Mathematical Physics**, 15(2):article number 38, 61 pages, 2025.
- 3 *On full asymptotics of analytic torsions for compact locally symmetric orbifolds*. **Analysis & PDE**, 17(4):1261–1329, 2024.
- 4 with Alexander Drewitz and George Marinescu, *Large deviations for zeros of holomorphic sections on punctured Riemann surfaces*. **Michigan Mathematical Journal** 75 (2) 381 - 421, 2025. DOI: 10.1307/mmj/20226253.
- 5 *Hypoelliptic Laplacian and twisted trace formula*. **Annales de l'Institut Fourier**, 73(5):1909–1985, 2023.
- 6 *Asymptotic equivariant real analytic torsions for compact locally symmetric spaces*. **Journal of Functional Analysis**, 281(7):Paper No. 109117, 54 pages, 2021.
- 7 *Hypoelliptic Laplacian and twisted trace formula*. **C. R. Math. Acad. Sci. Paris**, 357(1):74–83, 2019.

Preprints

- 1 with George Marinescu and Huan Wang, *Nakano-Griffiths inequality, holomorphic Morse inequalities, and extension theorems for q -concave domains* (49 pages, submitted). arXiv:2506.00879.
- 2 with Turgay Bayraktar, Dan Coman and George Marinescu, *Tian's theorem for Grassmannian embeddings and degeneracy sets of random sections* (32 pages, submitted). arXiv:2504.19731.
- 3 with Alexander Drewitz and George Marinescu, *Toeplitz operators and zeros of square-integrable random holomorphic sections* (66 pages, submitted). arXiv:2404.15983.
- 4 with Hisatoshi Kodani, *Integral invariants for framed 3-manifolds associated to trivalent graphs possibly with self-loops* (52 pages, submitted). arXiv:2311.02682.

Oberwolfach Reports (OWR)

- 1 Hypoelliptic Laplacian of Bismut on symmetric spaces. in Workshop: Hypoelliptic Operators in Geometry. Oberwolfach Rep. 24 (2023). DOI: 10.4171/OWR/2023/24.
- 2 Hypoelliptic Laplacian on symmetric spaces and twisted trace formula. in Mini-Workshop: Recent Progress in Path Integration on Graphs and Manifolds. Oberwolfach Rep. 16 (2019), no. 2, pp. 1037–1040. DOI: 10.4171/OWR/2019/16.

Teaching and tutorial experience

1. **Universität zu Köln**, *Summer semester 2025*, Lecturer.
Master's lecture: *Introduction to the Atiyah-Singer Index Theorem*.
2. **Universität zu Köln**, *Teaching assistant*.
 - Winter semester 2022 , Tutorial classes for the master's lecture *Complex Geometry* by Prof. Marinescu.
 - Winter semester 2023 , Tutorial classes for the master's lecture *Random Kähler Geometry* by Prof. Marinescu.
3. **Université Paris-Saclay**, *2017 – 2018*, A.T.E.R. (Teaching assistant), with teaching load of 192 hours.
 - Tutorial classes for L1 and L3: Calculus, Linear System, Probability, Université Paris Sud.
 - Tutorial classes for PEIP: Matrices and Linear Equation, Polytech Paris-Sud.

Talks in Conferences and Seminars

- A. **In workshops & conferences.**
- 23 - **Bernoulli External Program 2025: New Trends and Applications Around Generalized Fokker-Planck Operators**, *Bernoulli Center for Fundamental Studies*, Lausanne, Switzerland, Week 2 of the 4-week programme.
27/06/2025 Title: *Asymptotic analytic torsions for compact locally symmetric orbifolds*.
- 16 - **School: Probabilistic Methods in Complex Geometry**, *Lake Como School of Advanced Studies*, Lake Como, Italy.
20/06/2025 Mini-course titled *Random holomorphic sections and their zeros*, jointly with A. Drewitz and G. Marinescu.
- 12/05/2025 **Conference: From Complex Analysis to Quantization – in honour of Professor George Marinescu's 60th Birthday**, *Chern Institute of Mathematics (CIM)*, Nankai University, Tianjin, China, 12 - 16/05/2025.
Title: *Tian's theorem for Grassmannian embeddings and degeneracy sets of random sections*.
- 19/12/2024 **Conference: Around local index theory**, *École polytechnique, CMLS*, Palaiseau, France, 16 - 20/12/2024.
Title: *Toeplitz-Fubini-Study forms and lowest eigenvalues of Toeplitz operators*.
- 10/09/2024 **Conference: Randomness in Complex Analysis and Complex Geometry**, *Nesin Mathematics Village (Şirince)*, Izmir, Türkiye (Turkey), 09 - 13/09/2024.
Title: *Toeplitz operators and zeros of square-integrable Gaussian holomorphic sections*.
- 03/09/2024 **Conference: Analytic torsion and interactions**, *Universität Münster*, Germany, 02 - 06/09/2024.
Title: *Asymptotic analytic torsions for compact locally symmetric orbifolds*.

- 28/08/2024 **Conference on Complex analysis and Geometry**, Vietnam Institute for Advanced Study in Mathematics (VIASM), Hanoi, Vietnam, 26 - 29/08/2024.
Title: *Toeplitz-Fubini-Study forms and lowest eigenvalues of Toeplitz operators* (on-line talk).
- 05 - **Workshop: Global Analysis on Manifolds 2024**, Wuhan University, Wuhan, China.
- 09/08/2024 I gave a mini-course with title *Superconnection and complex immersions* consisting of five lectures.
- 12/07/2024 **Joint Seminar on Complex Algebraic Geometry and Complex Analysis (Bochum - Essen - Köln - Münster - Wuppertal)**, Ruhr-Universität Bochum, Bochum, Germany.
Title: *Toeplitz-Fubini-Study forms and lowest eigenvalues of Toeplitz operators*.
- 26/10/2023 **Workshop on Pluripotential Theory and Holomorphic foliations**, Université Polytechnique Hauts-de-France, Valenciennes, France, 25 - 27/10/2023.
Title: *Random holomorphic sections on noncompact complex manifolds*.
- 26/07/2023 **Conference: Quantization in Geometry**, Universität zu Köln, Cologne, Germany, 24 - 28/07/2023.
Title: *Random holomorphic sections on noncompact complex manifolds*.
- 25/05/2023 **Oberwolfach Workshop: Hypoelliptic Operators in Geometry (Workshop ID 2321)**, MFO, Oberwolfach, Germany, 21 - 26/05/2023.
Title: *Hypoelliptic Laplacian of Bismut on symmetric spaces*.
- 07/03/2023 **German Probability and Statistics Days (GPSD 2023)**, Session: *Limit theorems, large deviations and extremes*, Essen, Germany, 07 - 10/03/2023.
Title: *Zeros of random holomorphic sections on complex manifolds*.
- 15/11/2022 **Workshop Cologne-Nice Complex and CR Geometries, Dynamics**, Nice, France, 14 - 15/11/2022.
Title: *Zeros of random holomorphic sections on noncompact complex manifolds*.
- 26/10/2021 **Conference ACQUA: Quantitative Aspects in Complex analysis, Geometry and Dynamics**, Lille, France, 25-29/10/2021.
Title: *Large deviation estimates for zeros of random holomorphic sections for punctured Riemann surfaces*.
- 29/07 - **Workshop: Global Analysis on Manifolds**, USTC, Hefei, China.
- 02/08/2019 I gave a mini-course with title *An introduction to symmetric spaces* consisting of five lectures.
- 15/07/2019 **Conference: Quantization in Symplectic Geometry**, Universität zu Köln, Köln, Germany, 15-19/07/2019.
Title: *Asymptotics of equivariant analytic torsion on compact locally symmetric spaces*.
- 07/05-10/05/2019 **International Micro-Workshop on the Hypoelliptic Laplacian**, Penn. State U., State College, USA.
I gave two talks about the construction of hypoelliptic Laplacians on symmetric spaces.
- 30/04/2019 **Conference: Noncommutative Geometry Festival 2019**, Washington U. in St. Louis, USA, 29/04-03/05/2019.
Title: *Hypoelliptic Laplacians on symmetric spaces and twisted orbital integrals*.
- 12/04/2019 **Mini-Workshop: Recent Progress in Path Integration on Graphs and Manifolds**, MFO, Oberwolfach, Germany, 07-13/04/2019.
Title: *Hypoelliptic Laplacians on symmetric spaces and twisted trace formula*.
- 09/10/2018 **International Workshop on Geometric Quantization and Applications**, CIRM, Luminy, France, 08-12/10/2018.
Title: *Selberg's twisted trace formula and asymptotics of equivariant analytic torsion*.

- 01/08/2018 **Workshop: Global Analysis on Manifolds**, *Uni. of Sci. & Tech. of China*, Hefei, China, 30/07-03/08/2018.
Title: *Hypoelliptic Laplacian and twisted orbital integrals.*
- B. **In seminars.**
- 25/03/2025 **Laboratoire J.A. Dieudonné, Université Côte d'Azur, Nice, France**, Séminaire Analyse et Dynamique.
Title: *Théorème de Tian et valeurs propres d'opérateur de Toeplitz*
- 13/03/2025 **Université du Littoral Côte d'Opale, Calais, France**, Séminaire équipe EMA.
Title: *L'espace de Wiener abstrait et sections holomorphes gaussiennes de carré intégrable*
- 11/03/2025 **Université Paris-Saclay, Orsay, France**, Séminaire Analyse Harmonique.
Title: *Tian's approximation theorem and eigenvalues of Toeplitz operators*
- 27/09/2024 **Academy of Mathematics and Systems Science, CAS, Beijing, China**, Seminar on several complex variables and complex geometry.
Title: *Toeplitz-Fubini-Study forms and lowest eigenvalues of Toeplitz operators.*
- 26/09/2024 **Academy of Mathematics and Systems Science, CAS, Beijing, China**, Seminar on several complex variables and complex geometry.
Title: *Toeplitz operators and zeros of square-integrable Gaussian holomorphic sections.*
- 29/04/2024 **NYU-ECNU Institute of Mathematical Sciences, NYU Shanghai, Shanghai, China**, Probability Seminar Series.
Title: *Toeplitz Operators and Zeros of Square-integrable Gaussian Holomorphic Sections.*
- 04/04/2024 **Laboratoire J.A. Dieudonné, Université Côte d'Azur, Nice, France**, Séminaire d'algèbre, topologie et géométrie.
Title: *Opérateur de Toeplitz et zéros de sections holomorphes gaussiennes de carré intégrable.*
- 19, 21, 26, **Academy of Mathematics and Systems Science, CAS, Beijing, China**, on-line
28/03/2024 mini-course.
Title: *Introduction to random zeros of holomorphic sections.*
- 28/04/2023 **East China Normal University, Shanghai, China**, ECNU Differential Geometry Seminar.
Title: *Hypoelliptic Laplacian of Bismut on symmetric spaces and applications.*
- 17/01/2023 **Université Paris-Saclay, Orsay, France**, Séminaire Analyse Harmonique.
Title: *Zeros of random holomorphic sections on noncompact complex manifolds.*
- 15/12/2022 **East China Normal University, Shanghai, China**, ECNU Differential Geometry Seminar (on-line).
Title: *Zeros of random holomorphic sections on noncompact complex manifolds.*
- 08/03/2022 **Sorbonne Université, Jussieu, Paris, France**, Séminaire d'Analyse et Géométrie.
Title: *Large deviation estimates for zeros of random holomorphic sections on punctured Riemann surfaces.*
- 17, 24, **Tongji University, Shanghai, China**, School of Mathematical Sciences, On-line mini-
26/11/2021 course.
Title: *Introduction to Hypoelliptic Laplacian of Bismut on Symmetric Spaces.*
- 13/07/2021 **Universität zu Köln, Cologne, Germany**, Seminar semiklassische Analysis und Darstellungstheorie.
Title: *Asymptotic real analytic torsions for compact locally symmetric orbifold.*

- 02/02/2021 **On-line Seminar**, *Probability / SPP 2265 Research Seminar Ruhr.*, with Prof. Dr. Drewitz.
Title: *Random polynomials and random Kähler geometry.*
- 15/05/2020 **On-line Seminar**, *China-France-USA*, The Hypoelliptic Laplacian and NCG.
Title: *Asymptotic analytic torsion for compact locally symmetric orbifold.*
- 18/12/2018 **Universität Bonn**, *Bonn, Germany*, Oberseminar Global Analysis and Operator Algebras.
Title: *Introductions to hypoelliptic Laplacian on symmetric spaces.*
- 11/11/2018 **Universität zu Köln**, *Cologne, Germany*, Semiklassische Analysis und Darstellungstheorie.
Title: *Asymptotics of equivariant analytic torsion on compact locally symmetric spaces.*
- 30/06/2018 **Université Paris-Sud**, *Orsay, France*, Séminaire Mathjeunes.
Title: *Hypoelliptic Laplacian and semisimple orbital integrals.*
- 05/05/2018 **Université Paris-Sud**, *Orsay, France*, Séminaire Mathjeunes.
Title: *Semisimple orbital integrals associated with real reductive groups.*