

# Bingxiao LIU, Ph.D.

## List of Publications & Preprints

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### Publications and publications to appear

- 1 with Alexander Drewitz and George Marinescu, *Gaussian holomorphic sections on noncompact complex manifolds*. **Journal of the Institute of Mathematics of Jussieu**. Publication online, pp. 1 - 66, 2025. doi:10.1017/S1474748024000422.  
**Abstract:** We provide two constructions of Gaussian random holomorphic sections of a Hermitian holomorphic line bundle  $(L, h_L)$  on a Hermitian complex manifold  $(X, \Theta)$ , that are particularly interesting in the case where the space of  $\mathcal{L}^2$ -holomorphic sections  $H_{(2)}^0(X, L)$  is infinite dimensional. We first provide a general construction of Gaussian random holomorphic sections of  $L$ , which, if  $H_{(2)}^0(X, L)$  is infinite dimensional, are almost never  $\mathcal{L}^2$ -integrable on  $X$ . The second construction combines the abstract Wiener space theory with the Berezin-Toeplitz quantization and yields a Gaussian ensemble of random  $\mathcal{L}^2$ -holomorphic sections. Furthermore, we study their random zeros in the context of semiclassical limits, including their distributions, large deviation estimates, local fluctuations, and hole probabilities.
- 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.  
**Abstract:** We present an extensive study on the Bergman kernel expansions and the random zeros associated with the high tensor powers of a semipositive line bundle on a complete punctured Riemann surface. We prove several results for the zeros of Gaussian holomorphic sections in the semi-classical limit, including the equidistribution, large deviation estimates, central limit theorem, and number variances.
- 3 *On full asymptotics of analytic torsions for compact locally symmetric orbifolds*. **Analysis & PDE**, 17(4):1261–1329, 2024.  
**Abstract:** We consider a certain sequence of flat vector bundles on a compact locally symmetric orbifold, and we evaluate explicitly the associated asymptotic Ray-Singer real analytic torsion. The basic idea is to compute the heat trace via Selberg's trace formula, so that a key point in this paper is to evaluate the orbital integrals associated with nontrivial elliptic elements. For that purpose, we deduce a geometric localization formula, so that we can rewrite an elliptic orbital integral as a sum of certain identity orbital integrals associated with the centralizer of that elliptic element. The explicit geometric formula of Bismut for semisimple orbital integrals plays an essential role in these computations.

- 4 with Alexander Drewitz and George Marinescu, *Large deviations for zeros of holomorphic sections on punctured Riemann surfaces*. **Michigan Mathematical Journal**, Advance Publication 1-41 (2023). DOI: 10.1307/mmj/20226253.  
**Abstract:** In this article we obtain large deviation estimates for zeros of random holomorphic sections on punctured Riemann surfaces. These estimates are then employed to yield estimates for the respective hole probabilities. A particular case of relevance that is covered by our setting is that of cusp forms on arithmetic surfaces. Most of the results we obtain also allow for reasonably general probability distributions on holomorphic sections, which underlines the universal character of these estimates. Finally, we also extend our results to the case of certain higher dimensional complete Hermitian manifolds, which are not necessarily assumed to be compact.
- 5 *Hypoelliptic Laplacian and twisted trace formula*. **Annales de l'Institut Fourier**, 73(5):1909–1985, 2023.  
**Abstract:** We give an explicit geometric formula for the twisted orbital integrals using the method of the hypoelliptic Laplacian developed by Bismut. Combining with the twisted trace formula, we can evaluate the equivariant trace of the heat operators of the Laplacians on a compact locally symmetric space. In particular, we revisit the equivariant local index theorems and twisted  $L_2$ -torsions for locally symmetric spaces.
- 6 *Asymptotic equivariant real analytic torsions for compact locally symmetric spaces*. **Journal of Functional Analysis**, 281(7):Paper No. 109117, 54 pages, 2021.  
**Abstract:** In this paper, we study the asymptotics of the equivariant analytic torsions for a certain sequence of flat vector bundles over a compact locally symmetric space. Our approach is combining the twisted trace formula with an explicit geometric formula for the twisted orbital integrals. We show that the leading term of asymptotic equivariant analytic torsion is given in terms of  $W$ -invariants with oscillating coefficients.
- 7 *Hypoelliptic Laplacian and twisted trace formula*. **C. R. Math. Acad. Sci. Paris**, 357(1):74–83, 2019.  
**Abstract:** In this Note, we give an explicit geometric formula for twisted orbital integrals using the method of the hypoelliptic Laplacian developed by Bismut. We apply this formula to evaluate the leading term in the asymptotic expansion of the equivariant Ray–Singer analytic torsion on compact locally symmetric spaces.

## Preprints

- 1 with Alexander Drewitz and George Marinescu, *Toeplitz operators and zeros of square-integrable random holomorphic sections* (66 pages). arXiv:2404.15983.
- 2 with Hisatoshi Kodani, *Integral invariants for framed 3-manifolds associated to trivalent graphs possibly with self-loops* (52 pages). 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.