

Lutian Zhao

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Universe
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RESEARCH INTERESTS

Perverse sheaves, moduli of sheaves, and moduli of parahoric torsors; enumerative invariants of Calabi–Yau threefolds and surfaces.

POSITIONS

2024–

Project Researcher
Kavli IPMU, University of Tokyo

2021–2024

Serguei Novikov Postdoctoral Fellow
University of Maryland, College Park. Mentor: Amin Gholampour

EDUCATION

2021

Ph.D. in Mathematics, University of Illinois, Urbana-Champaign
Dissertation: *Gopakumar-Vafa invariant and Macdonald formula*
Advisor: Sheldon Katz

2015

B.A. in Mathematics, Zhiyuan College, Shanghai Jiao Tong University
Highest honors in mathematics, highest distinction in general scholarship

AWARDS & FUNDING

2025–2027

JSPS KAKENHI, Grant-in-Aid for Early-Career Scientists, JP25K17226
Moduli spaces of sheaves from geometry and physics

2020

Irving Reiner Memorial Award in Algebra, University of Illinois

2011–2015

Kaiyuan Scholarship, Shanghai Jiao Tong University

PUBLICATIONS

PUBLISHED AND ACCEPTED

Pengfei Huang, Georgios Kydonakis, Hao Sun and Lutian Zhao. *Tame parahoric nonabelian Hodge correspondence on curves*. To appear in *Annali della Scuola Normale Superiore di Pisa, Classe di Scienze*. [arXiv:2205.15475](https://arxiv.org/abs/2205.15475)

Georgios Kydonakis, Hao Sun and Lutian Zhao. *Logahoric Higgs torsors for a complex reductive group*. *Mathematische Annalen* **388** (2024), 3183–3228. [doi:10.1007/s00208-023-02605-x](https://doi.org/10.1007/s00208-023-02605-x)

Georgios Kydonakis, Hao Sun and Lutian Zhao. *Poisson structures on moduli spaces of Higgs bundles over stacky curves*. *Advances in Geometry* **24** (2024), no. 2, 163–182. [doi:10.1515/advgeom-2024-0004](https://doi.org/10.1515/advgeom-2024-0004)

Georgios Kydonakis, Hao Sun and Lutian Zhao. *Monodromy of rank 2 parabolic Hitchin systems*. *Journal of Geometry and Physics* **171** (2022), 104411. doi:10.1016/j.geomphys.2021.104411

Georgios Kydonakis, Hao Sun and Lutian Zhao. *The Beauville-Narasimhan-Ramanan correspondence for twisted Higgs V -bundles and components of parabolic $\mathrm{Sp}(2n, \mathbb{R})$ -Higgs moduli spaces*. *Transactions of the American Mathematical Society* **374** (2021), no. 6, 4023–4057. doi:10.1090/tran/8284

Georgios Kydonakis, Hao Sun and Lutian Zhao. *Topological invariants of parabolic G -Higgs bundles*. *Mathematische Zeitschrift* **297** (2021), 585–632. doi:10.1007/s00209-020-02526-4

Hongyu Gong, Luoyi Fu, Xinzhe Fu, Lutian Zhao, Kainan Wang and Xinbing Wang. *Distributed multicast tree construction in wireless sensor networks*. *IEEE Transactions on Information Theory* **63** (2017), no. 1, 280–296. doi:10.1109/TIT.2016.2623317

Hongyu Gong, Lutian Zhao, Kainan Wang, Weijie Wu and Xinbing Wang. *A distributed algorithm to construct multicast trees in WSNs: an approximate Steiner tree approach*. *Proc. 16th ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc '15)*, Hangzhou, 2015, 347–356. doi:10.1145/2746285.2746296

PREPRINTS AND WORK UNDER REVIEW

Lutian Zhao. *Topological string blowup equations via stable pairs*. arXiv:2608.25397 (2026)

Georgios Kydonakis and Lutian Zhao. *Level structures on parahoric torsors and complete integrability*. arXiv:2506.12302 (2025)

Lutian Zhao. *Gopakumar-Vafa invariants and Macdonald formula*. arXiv:2306.05547 (2023)

TALKS

May 2026	<i>Vafa-Witten invariants, fixed loci, and ruled surfaces</i> Geometry, Algebra and Mathematical Physics Seminar, Nanjing University
Feb 2026	<i>Tame defects and parahoric Hitchin systems</i> Derived & Noncommutative Geometry Seminar, SIMIS, Shanghai
Dec 2025	<i>Perverse sheaf Gopakumar-Vafa/Pandharipande-Thomas correspondence for local del Pezzo surfaces</i> Workshop on Mirror Symmetry and Related Topics, Kyoto University
Oct 2025	<i>Vafa-Witten invariants for ruled surfaces</i> GTM Seminar, Kavli IPMU
Sep 2025	<i>Perverse sheaf Gopakumar-Vafa/Pandharipande-Thomas correspondence for local del Pezzo surfaces</i> Counting Invariants and Enumerative Geometry, Brin Mathematics Research Center, University of Maryland
Feb 2025	<i>Moduli of parabolic Higgs bundles and Langlands duality</i> Tsukuba Workshop for Young Mathematicians, University of Tsukuba
Oct 2024	<i>Parahoric Higgs bundles and related geometry</i> GTM Seminar, Kavli IPMU

Jun 2024	<i>Geometry of parahoric Higgs bundles</i> Foundational Mathematics Research Seminar, Xi'an Jiaotong-Liverpool University
Apr–May 2024	<i>BPS counting from spectral networks (three talks)</i> RIT on Geometry and Physics, University of Maryland
Nov 2023	<i>Nonabelian Hodge theory for parahoric torsors</i> Workshop on Geometric Representation Theory and Moduli Spaces, University of North Carolina at Chapel Hill
May 2023	<i>The journey through nonabelian Hodge theory: from vector bundles to parahoric torsors</i> Hua Luogeng Youth Forum, AMSS, Chinese Academy of Sciences
Jul 2022	<i>Stability of parahoric Higgs bundles</i> Mid-South Algebraic Topology and Geometry Workshop
Mar–Apr 2022	<i>Gopakumar-Vafa invariants and support theorems (two talks)</i> Algebra-Number Theory Seminar, University of Maryland
Feb 2022	<i>Supersymmetric Yang-Mills theory and geometric Langlands duality; Topological twists</i> RIT on Geometry and Physics, University of Maryland
Nov 2021	<i>Stability condition for tame parahoric Higgs bundles</i> Geometry and Topology Seminar, Chern Institute of Mathematics, Nankai University
Sep 2021	<i>Intersection cohomology and moduli space (mini-course)</i> South China University of Technology
Oct 2020	<i>Gopakumar-Vafa invariants from Macdonald formula</i> Joint CUHK-Harvard-YMSC Differential Geometry Seminar, Harvard University
Feb 2020	<i>Gopakumar-Vafa invariants from Macdonald formula</i> Séminaire Arithmétique et géométrie algébrique, University of Strasbourg
Jun 2018	<i>Calculating Gopakumar-Vafa invariants</i> Summer School on Geometry of Moduli Spaces of Curves, ICTP, Trieste

RESEARCH VISITS

Jul–Aug 2024	<i>Mirror partners from parahoric integrable systems</i> Research in Residence, CIRM Luminy , Marseille. With Pengfei Huang and Georgios Kydonakis
Jun 2024	<i>Mirror partners from parahoric integrable systems</i> Research stay, Mathematisches Forschungsinstitut Oberwolfach. With Pengfei Huang, Georgios Kydonakis and Hao Sun

ORGANIZING

Jun 2026	<i>The Geometry and Physics of Higgs Bundles</i> Kavli IPMU, 22–24 June. With Hisashi Kasuya, Hiraku Nakajima, Laura Schaposnik and Mengxue Yang
2017–2021	<i>Sheldon Katz's Student Seminar (UIUC)</i>

2017–2018 *Graduate Student Algebraic Geometry Seminar* (UIUC)
 2016–2017 *Geometric Langlands Learning Group* (UIUC)

TEACHING

UNIVERSITY OF MARYLAND, COLLEGE PARK — instructor of record
 Sp 22, Fa 23 MATH 401, Applications of Linear Algebra
 Fall 2022 MATH 406, Introduction to Number Theory
 Fa 22, Sp 23 MATH 135, Discrete Mathematics for Life Sciences
 Fall 2023 MATH 605, Homological Algebra (graduate)
UNIVERSITY OF ILLINOIS, URBANA-CHAMPAIGN — discussion sections
 2017–2020 MATH 220, Calculus I
 Sp 17, Sp 19 MATH 234, Calculus for Business

OUTREACH

Jun 2026 *How to count to 2875 without starting at one: the art of curve counting*
 Science Cafe 2026 “Universe”, Tamarokuto Science Center, Nishi-Tokyo
 May 2025 *Moduli spaces of Higgs bundles: from Hitchin systems to quantum field theory*
 “Dialogue with Alumni” series no. 18, Zhiyuan College, Shanghai Jiao Tong University
 2023, 2024 Department of Mathematics activity table
 Maryland Day campus open house, University of Maryland