

Xu Gao

Curriculum Vitae

School of Mathematical Sciences, Tongji University
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Experience

- 2023–Present **Postdoctoral**, School of Mathematical Sciences, Tongji University, Shanghai, China
Fall 2024 **Visiting Scholar**, Department of Mathematics, University of Pennsylvania, Philadelphia, USA

Education

- 2016–2023 **Ph.D.**, Mathematics Department, University of California, Santa Cruz, USA
Advisors: Prof. Chongying Dong & Prof. Junecue Suh
- 2012–2015 **M.S.**, Chern Institute of Mathematics, Nankai University, Tianjin, China
Advisor: Prof. Chengming Bai
- 2008–2012 **B.S.**, School of Mathematical Sciences, Nankai University, Tianjin, China

Research Interests & Selected Publications

My research lies at the intersection of algebra, geometry, and mathematical physics, with a particular focus on topics where category theory and geometry intertwine. My main results are categorized by theme as follows:

Algebro-geometric Study of VOA Conformal Blocks

This is my primary research area. I focus on using modern algebraic geometry tools to study the geometric representation theory of Vertex Operator Algebras (VOAs) on algebraic curves and their degenerations (e.g., nodal curves, orbicurves). My current goals are to establish factorization theorems in vast generality and to develop an algebro-geometric theory of vertex tensor categories.

- **Xu Gao**, Jianqi Liu and Yiyi Zhu, *Twisted restricted conformal blocks of vertex operator algebras I: g -twisted correlation functions and fusion rules*, **Journal of Algebra** 675 (2025), pp. 59–132.
- **Xu Gao**, Jianqi Liu and Yiyi Zhu, *Twisted restricted conformal blocks of vertex operator algebras II: twisted restricted conformal blocks on totally ramified orbicurves*, arXiv:2403.00545.
- **Xu Gao**, Jianqi Liu, *Applications of the factorization theorem and fusion rings of vertex operator algebras*, arXiv:2508.01294.
- **Xu Gao**, Yiyi Zhu, *Twisted and untwisted universal enveloping algebras for permutation orbifolds*, (submitted).
- **Xu Gao**, Angela Gibney, Daniel Krashen, and Jianqi Liu, *On the strong identity condition for almost-canonically seminormed rings*, to be submitted.

Tensor Triangular Geometry and Algebraic Topology

Applying tensor triangular geometry to study geometric invariants of stable homotopy categories in algebraic topology and representation theory.

- **Xu Gao**, Ang Li, *The stable Picard group of finite Adams Hopf algebroids with an application to the \mathbb{R} -motivic Steenrod subalgebra $\mathcal{A}^{\mathbb{R}}(1)$* , **Journal of Pure and Applied Algebra** 228 (2024), no. 11, 107732.
- **Xu Gao**, *Stratification for finite groupoids*, available on webpage.

Bruhat-Tits Buildings and p -adic Representation Theory

This study involves combinatorial structures in non-Archimedean geometry and their applications to p -adic group representation theory. It also serves as a foundation for research in arithmetic conformal field theory.

- **Xu Gao**, *Simplicial distance in Bruhat-Tits buildings of split classical type*, **Ph.D. Dissertation**, University of California, Santa Cruz (2023).

Rota-Baxter Operators and Pre-Lie Algebras (Early Work)

Research on Rota-Baxter operators, pre-Lie algebra structures, and deformation theory conducted during my Master's studies.

- Chengming Bai, **Xu Gao**, Ming Liu, and Naihuan Jing, *Rota-Baxter Operators on Witt and Virasoro Algebras*, **Journal of Geometry and Physics** 108 (2016), pp. 1–20.
- **Xu Gao**, *Extensions and Non-abelian Cohomology of Pre-Lie Algebras*, **Master's Thesis**, Nankai University (2015).

Teaching Experience

Extensive experience in independent instruction and teaching assistance abroad. Competent in teaching courses ranging from undergraduate general education (Calculus/Linear Algebra) to advanced major courses (Number Theory/Algebra).

Instructor

- **University of California, Santa Cruz** Santa Cruz, USA
MATH 110: Introduction to Number Theory 2022.09 – 2023.06
Served as the sole instructor for three consecutive quarters. Responsibility includes syllabus design, lecturing, creating homework and exams, and final grading. Complete teaching materials are available on my website (gausyu.top/Teaching/).

Teaching Assistant

- **University of California, Santa Cruz** Santa Cruz, USA
Core Courses and Advanced Courses 2016.09 – 2022.08
Assisted in teaching core undergraduate mathematics courses and advanced courses for six years, serving over a thousand students. Courses covered include:
 - **Calculus Series:** MATH 11A (Calculus with Applications), MATH 19A/B (Calculus for Science, Engineering, and Mathematics), MATH 22 (Calculus of Several Variables);

- **Algebra Series:** MATH 21 (Linear Algebra), MATH 117 (Advanced Linear Algebra), MATH 111 (Algebra);
- **Advanced Courses:** MATH 100 (Introduction to Proof and Problem Solving), MATH 110 (Introduction to Number Theory).

Academic Activities

(Selected List)

Conference Talks

- **19th National Conference on Lie Theory** Guangdong Univ. of Tech., Guangzhou
Orbifold Theory of VOAs via Algebro-geometric Conformal Blocks 2025.11
- **AMS 2025 Summer Research Institute in Algebraic Geometry** Fort Collins, CO, USA
Monoidal Structure on Representations of VOAs via Algebrogeometric Conformal Blocks 2025.07
- **2025 International Conference on Representation Theory** Jimei University, Xiamen
Strong Identity Condition for Almost Canonically Seminormed Rings 2025.06
- **18th National Conference on Lie Theory** Tongji University, Shanghai
 p -adic Representations and Simplicial Distance in Bruhat-Tits Buildings 2023.07
- **AMS 2023 Spring Western Sectional Meeting** Fresno, CA, USA
 p -adic Representations and Simplicial Balls in Bruhat-Tits Buildings 2023.05

Invited Seminars

- **Youth Forum on New Progress in Lie Theory** Nankai University, Tianjin
Orbifold Theory of VOAs via Algebro-geometric Conformal Blocks 2025.12
- **Seminar on Tensor Categories of VOAs** Shanghai Jiao Tong University
Ribbon Monoidal Category via Algebrogeometric Conformal Blocks 2025.05
- **Vertex Operator Algebra Seminar** Tongji University
Ribbon Monoidal Category via Conformal Blocks and Strong Identity Condition... 2025.05
- **Algebra Seminar, Chern Institute of Mathematics** Nankai University, Tianjin
Towards a Ribbon Monoidal Category Structure via Conformal Blocks of VOAs in representation theory 2025.01 (Co)stratifications 2025.01
- **Math-Physics Joint Seminar, University of Pennsylvania** Philadelphia, USA
Twisted Restricted Conformal Blocks of Vertex Operator Algebras 2024.10
- **Number Theory Seminar, UC San Diego** San Diego, USA
 p -adic Representations and Simplicial Distance in Bruhat-Tits Buildings 2023.03
- **Algebra & Number Theory Seminar, University of Arizona** Tucson, USA
 p -adic Representations and Simplicial Balls in Bruhat-Tits Buildings 2023.01

Summer Schools & Other Activities

- **AMS 2024 Fall Eastern Sectional Meeting** Albany, NY, USA
University at Albany, SUNY 2024.10
- **MSRI Summer Graduate School: Sparsity of Algebraic Points** Berkeley, USA
Mathematical Sciences Research Institute (SLMath) 2021.06
- **Arizona Winter School: Topology and Arithmetic** Tucson, USA
University of Arizona 2019.03