

ZHONGKAI TAO

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RESEARCH INTERESTS

Partial differential equations, harmonic and microlocal analysis, spectral theory, dynamical systems.

EDUCATION

University of California, Berkeley

August 2020 - Present

PhD candidate in Mathematics.

Advisor: Maciej Zworski.

Xi'an Jiaotong University

September 2016 - July 2020

Bachelor of Science in Mathematics.

RESEARCH WORKS

1. Integral formulas for under/overdetermined differential operators via recovery on curves and the finite-dimensional cokernel condition, with Philip Isett, Yuchen Mao and Sung-Jin Oh, in preparation.
2. Flexibility of maximal asymptotically flat initial data sets, with Yuchen Mao and Sung-Jin Oh, in preparation.
3. Selberg, Ihara and Berkovich, with Jialun Li, Carlos Matheus and Wenyu Pan, in preparation.
4. Dirac cones and magic angles in the Bistritzer–MacDonald TBG Hamiltonian, with Simon Becker, Solomon Quinn, Alexander Watson and Mengxuan Yang, arXiv:2407.06316
5. Spectral gap for surfaces of infinite volume with negative curvature, arXiv:2403.19550.
6. Optimal enhanced dissipation for contact Anosov flows, with Maciej Zworski, arXiv:2311.01000.
7. Appendix to “Mathematical results on the chiral model of twisted bilayer graphene”, with Mengxuan Yang, J. Spectr. Theory 14(2024), no.3, 1063–1107.
8. Appendix to “Classically forbidden regions in the chiral model of twisted bilayer graphene”, with Maciej Zworski, to appear in Probability and Mathematical Physics.
9. Initial data gluing in the asymptotically flat regime via solution operators with prescribed support properties, with Yuchen Mao and Sung-Jin Oh, arXiv:2308.13031.
10. Counting Pollicott–Ruelle resonances for Axiom A flows, with Long Jin, to appear in Communications in Mathematical Physics.
11. The fractal uncertainty principle via Dolgopyat’s method in higher dimensions, with Aidan Backus and James Leng, to appear in Analysis and PDE.
12. Spectral asymptotics for kinetic Brownian motion on Riemannian manifolds, with Qiuyu Ren, arXiv:2212.05394.
13. Localized initial data for Einstein equations, with Yuchen Mao, arXiv:2210.09437.
14. Spectral asymptotics for kinetic Brownian motion on locally symmetric spaces, with Qiuyu Ren, arXiv:2208.13111.
15. Flat trace estimates for Anosov flows, with Long Jin, to appear in Mathematical Research Letters.
16. Exact Control for Schrödinger Equation on Torus, Pure Appl. Anal.3 (2021), no.2, 387–401.

17. 0-th Order Pseudo-differential Operator on the Circle, Proc. Amer. Math. Soc. 152(2024), no.8, 3289–3297.

RESEARCH TALKS

- Spectral gap for asymptotically hyperbolic surfaces with infinite area, AMS sectional meeting, Riverside, October 2024.
- Dirac cones and magic angles in the Bistritzer–MacDonald TBG Hamiltonian, Roscoff workshop on 2D and moiré materials, Roscoff, July 2024.
- Resonances on hyperbolic surfaces and Berkovich space, Harmonic Analysis and Differential Equations Seminar (HADES), UC Berkeley, February 2024.
- Optimal enhanced dissipation for contact Anosov flows. Oberwolfach, November 2023; Tsinghua University, December 2023.
- Solution operators for the Einstein constraint equation. Thematic Programme on Spectral Theory and Mathematical Relativity, Erwin Schrödinger International Institute for Mathematical Physics, July 2023; Analysis and PDE seminar, Berkeley, September 2023.
- Spectral asymptotics for kinetic Brownian motion on Riemannian manifolds. PDE/Analysis seminar, MIT, May 2023; LAGA Université de Paris 13, June 2023; Jussieu, November 2023.
- Fractal uncertainty principle via Dolgopyat’s method in higher dimensions. Analysis and Differential Equations Seminar (HADES), UC Berkeley, March 2023; Group actions seminar, UCSD, April 2023.
- Spectral asymptotics for kinetic Brownian motion on locally symmetric spaces, Geometric Analysis and Number Theory Seminar, Universities of Aarhus, Bielefeld and Paderborn, October 2022.
- The magic of Schur complement formula, Harmonic Analysis and Differential Equations Seminar (HADES), UC Berkeley, September 2022.
- Observability for Schrodinger equation on the torus, Harmonic Analysis and Differential Equations Seminar (HADES), UC Berkeley, October 2021.

ORGANIZED SEMINARS

- Co-organized a learning seminar on orbit method for automorphic forms, UC Berkeley, Fall 2023.
- Co-organized Harmonic Analysis and Differential Equations Seminar (HADES), UC Berkeley, Fall 2022 to Spring 2023.
- Organized seminar in semiclassical analysis, UC Berkeley, Spring 2022.

TEACHING

- Fall 2021, Math 53 (Multivariable Calculus), UC Berkeley, teaching assistant.
- Spring 2021, Math 53 (Multivariable Calculus), UC Berkeley, teaching assistant.