Tianyu Kong

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Research Interests

Mathematical modeling, numerical analysis, partial differential equations, multiple-scale analysis, mathematical physics, quantum physics, and optimization

Education

University of Minnesota Twin Cities, Minneapolis, MN   *09.2021 – 2026*
PhD in Applied Mathematics   *(Expected)*
- Advisor: Mitchell Luskin, Alexander B. Watson
- GPA: 3.96/4.00

University of Chicago, Chicago, IL   *09.2017 – 06.2021*
Honors BS in Applied Mathematics & Physics
- GPA: 3.73/4.00

Honors and Scholarships

SIAM Student Travel Award	*09.2025*
Great Lakes SIAM Travel Award	*08.2025*
UMN Doctoral Dissertation Fellowship	*05.2024*
SIAM Student Travel Award	*03.2024*
UMN Vanky Men Memorial Fellowship	*12.2023*
UChicago Dean's List	*07.2018, 07.2019*

Publications

1. **Higher-order continuum models for twisted bilayer graphene**
   Solomon Quinn, **Tianyu Kong**, Mitchell Luskin, Alexander B. Watson
   Journal of Mathematical Physics 66.10 (2025)

2. **Interacting twisted bilayer graphene with systematic modeling of structural relaxation**
   Tianyu Kong, Alexander B. Watson, Mitchell Luskin, Kevin D. Stubbs
   Electronic Structure. 035001 (2025).

3. **Modeling of electronic dynamics in twisted bilayer graphene**
   Tianyu Kong, Diyi Liu, Mitchell Luskin, Alexander B. Watson
   SIAM Journal on Applied Mathematics. 84, 1011 (2024).

4. **Bistritzer-MacDonald dynamics in twisted bilayer graphene**
   Alexander B. Watson, **Tianyu Kong**, Allan H. MacDonald, Mitchell Luskin
   Journal of Mathematical Physics 64.3 (2023). Editor's Choice

Research Experience

Graduate Research Assistant, UMN   *06.2021 – Present*
Advisor: Mitchell Luskin and Alexander B. Watson
- Developed and analyzed mathematical models for incommensurate 2D materials, focusing on the electronic properties of twisted bilayer graphene with mechanical effects
- Used multiple-scale analysis to identify a regime where the discrete aperiodic model can be reduced to a periodic continuum model

- Derived a domain truncation scheme to approximate the electron dynamics in an infinite system
- Validated analytical models by implementing numerical simulations in Python, confirming theoretical predictions of electron dynamics

Student Assistant, Lawrence Berkeley National Laboratory   *05.2024 – 08.2024*
Advisor: Chao Yang and Lin Lin   *05.2023 – 08.2023*

- Studied exotic quantum phases in magic angle twisted bilayer graphene using interacting models that accounts for electron-electron correlation
- Implemented Hartree-Fock (HF) and Coupled Clusters (CC) methods with Python-based Simulation of Chemistry Framework (PySCF)
- Developed an accurate continuum model to compute the electron dispersion with uniform strain and structural relaxation, and computed Coulomb interaction between electrons in deformed materials

Undergraduate Research Assistant, UChicago   *04.2020 – 05.2021*
Advisor: Mary Silber

- Studied different types of Minimum Action Methods to determine the transition of states in a dynamical system subject to random perturbation
- Implemented MATLAB code and used steepest descent and quasi-Newton methods to calculate the Minimum Action Path in Lorenz systems

Teaching Experience

Teaching assistant, School of Mathematics, UMN   *09.2021 – 05.2024*
Honors Calculus
Calculus for College of Science and Engineering

- Held 2 workshop sessions per week for 3 hours total, lectured and organized group discussions on challenging concepts and problems, and responded to students' questions in an engaging manner.
- Graded weekly homework, quizzes and final exams promptly, and provided detailed feedback.

Grader, School of Mathematics, UMN   *09.2022 – 05.2024*
Mathematical Modeling and Applied Mathematics
Functional Analysis

Grader, Department of Mathematics, UChicago   *09.2018 – 05.2020*
Mathematical Methods for Physical Sciences
Honors Calculus

- Promptly graded weekly homework and exams for ~ 30 students.

Talks and Seminar Presentations

Continuum Model for Relaxed Moire Bilayer Graphene [upcoming]   *11.2025*
SIAM Conference on Analysis of Partial Differential Equations, Pittsburgh, PA

Multiscale Modeling of Electron Dynamics in Twisted Bilayer Graphene   *10.2025*
University of Minnesota Duluth Math Colloquium, Duluth MN

Multi-scale Modeling of Electron Dynamics in Twisted Bilayer Graphene   *10.2025*
UMN Seminar of Mathematical Applications & Computations, Minneapolis MN

Multiscale Modeling in Twisted Bilayer Graphene with Strain and Relaxation *09.2025*
SIAM Great Lakes Section Annual Meeting, Chicago IL

"Magic" in Moiré Materials – An Applied Mathematics Perspective   *03.2025*
UMN Seminar of Mathematical Applications & Computations, Minneapolis MN

Modeling of Electronic Dynamics in Twisted Bilayer Graphene   *07.2024*
International workshop on 2D and moiré materials, Roscoff France

Modeling of Electronic Dynamics in Twisted Bilayer Graphene *05.2024*

SIAM Conference on Materials Science, Pittsburgh, PA

Modeling of Electronic Dynamics in Twisted Bilayer Graphene *03.2024*

Brin Mathematics Research Center Workshop, College Park, MD

Poster Presentations

Interacting Twisted Bilayer Graphene with Systematic Modeling of Structural Relaxation *05.2025*

Simons Foundation Moiré Materials Magic Workshop, New York, NY

A Comparison of Minimum Action Methods for Computing Noise-induced Transitions of the Lorenz System *05.2021*

SIAM Conference on Applications of Dynamical Systems (DS21), Remote

Professional Affiliations

Webmaster, SIAM student chapter, UMN *09.2024 – Present*

- Managed the website and official documents for the SIAM student chapter at UMN
- Co-organized the annual student Integration Bee contest

Technologies

Python, MATLAB, Julia, R, MySQL