

Siwei Luo

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RESEARCH INTEREST

Applied Analysis, PDE, Kinetic Theory, AI4Math, Probability

EDUCATION

University of Science and Technology of China

Hefei, Anhui, China

B.Sc. in Mathematics & Applied Mathematics; GPA: 4.05/4.30 (92.64/100) Sep 2023 – Jun 2027 (expected)

Relevant coursework¹: Combinatorics (A+, 95/100), Advanced Combinatorics (A+, 95/100), Differential Geometry (H) (A+, 95/100), Advanced Real Analysis (Graduate) (A+, 98/100), Functional Analysis (A+, 98/100), Complex Analysis (H)(En) (A+, 95/100), Modern Algebra (H) (A+, 97/100), Stochastic Process (Graduate) (A+, 95/100), Advanced Probability Theory (A+, 97/100), Partial Differential Equations (Graduate) (A, 90/100), Real Analysis (H) (A, 90/100), Probability Theory (A, 93/100), Topology (H) (A, 93/100), Introduction to Differential Equations (A, 91/100).

Rank: Rank **1st** among all the students majoring in **Applied Mathematics** at USTC.

Honorable Position: I was admitted to **School of the Gifted Young**, USTC in 2023 when I was **15** years old. Then in the sophomore year I was enrolled in the **Hua Loo-Keng Talent Program** in USTC.

PREPRINTS

S. Luo and J.-G. Liu, *No Gelation and Global Existence for a Boltzmann Equation with Regularly Varying Mass-Exchange Rates*, 2026. [arXiv:2607.25112](#). Submitted to *Analysis & PDE*.

S. Luo and J.-G. Liu, *On the Spatially Homogeneous Boltzmann Equation with Mass Exchange*, 2026. [arXiv:2607.20684](#). Submitted to the *Journal of Differential Equations*.

MANUSCRIPT IN PREPARATION

S. Luo and J.-G. Liu, *Bose–Einstein Condensation without Initial Low-Energy Concentration*, 2026.

AWARDS & HONORS

Finalist in Team Contest, S.-T. Yau College Student Mathematics Contest, 2026. Our team placed **7th** in the team contest.

Excellent Presentation and Poster Awards, USTC Basic Sciences Talent Program Symposium, 2026.

Honorable Mention in Analysis and Differential Equations, S.-T. Yau College Student Mathematics Contest, 2025. Placed **29th** in the Analysis & Differential Equations examination.

Huawei Scholarship, USTC, 2025. This award recognizes undergraduate excellence.

Scholarship for Hua Loo-Keng Talent Program in Mathematics, USTC, 2024 and 2025.

Chen Linyi Scholarship, USTC, 2024. Established in 2010 with a donation by Prof. Chen Linyi of USTC, the scholarship recognizes outstanding academic achievement.

Outstanding Freshman Scholarship, USTC, 2023.

ACADEMIC PRESENTATIONS

On the Discrete-to-Continuous Mass Limit for BME

Wuhan / Hefei, China

Wuhan University / University of Science and Technology of China

March / May 2026

- Presented results on the discrete-to-continuous mass limit for the Boltzmann equation with mass exchange at Wuhan University in March 2026 and at the USTC Basic Sciences Talent Program Symposium in May 2026.

¹(H) stands for the honorary course and (En) stands for the course in English language.

RESEARCH EXPERIENCE

Undergraduate Thesis Research in AI4Math

University of Science and Technology of China; Advisor: Prof. Xiao Ma

Hefei, Anhui, China

September 2026 – Present

- Designing a qmd-prover pipeline that converts structured source code (in QMD) and its dependency graph into rigorous L^AT_EX manuscripts.

Bose–Einstein Condensation without Initial Low-Energy Concentration

Duke University; Mentor: Prof. Jian-Guo Liu

Durham, NC, USA

August 2026 – Present

- For conservative isotropic measure solutions of the spatially homogeneous Bose–Einstein Boltzmann equation, proved the implication $N_c > 0$ and $\|F_t - F_{be}\|_1^o \rightarrow 0 \implies F_T(\{0\}) > 0$ for some $T < \infty$, together with persistence of the atom, $F_t(\{0\}) \rightarrow N_c$, and $\|F_t - F_{be}\|_1 \rightarrow 0$. Applied this to subcritical Cai–Lu solutions, $\bar{T}/\bar{T}_c < 1$, without any atomic or quantitative low-energy condition on F_0 .
- Introduced a one-scale/multiscale mechanism that turns low-energy mass at one fixed scale into an atom: $N_{0,2}(F_{t_0}, \varepsilon) \geq h \implies \exists T \in [t_0, t_0 + C\varepsilon^{1-\eta} \log \varepsilon^2]$ with $F_T(\{0\}) \geq ch$. The proof couples a one-scale collision estimate to a logarithmically weighted dyadic functional, whose derivative lower bound contradicts its mass–energy upper bound if the low-energy mass remains spread over incomplete shells.

Boltzmann Equation with Mass Exchange

Duke University; Mentor: Prof. Jian-Guo Liu

Durham, NC, USA

July 2026 – August 2026

- For $\partial_t f = \mathbf{Q}(f, f)$ on $X = (0, \infty)_m \times \mathbf{R}_v^d$ with $B(E, \xi) = E^\gamma b(\xi)$, $0 < \gamma < 1$, proved global nonnegative L^1 -integral weak solutions for bounded mass-exchange rates. The compactness argument uses a new two-stage bootstrap: a small-mass gain estimate rules out concentration at $m = 0$, after which gain-set geometry yields uniform integrability, without detailed balance or relative entropy.
- Proved propagation of $(1 + \delta)$ -energy moment, hence conservation of kinetic energy, and uniqueness under an $(1 + \gamma)$ -higher moment bound. For $H_p(f) := \int_X (1 + m + m|v|^2)^p f dm dv$ and $a(m, m_1, \alpha) \leq C(1 + m + m_1)$, established conservative local H_p -solutions for $p \geq 1 + \gamma$ with continuation criterion $H_{1+\gamma}(f) \in L^1(0, T)$.
- For $a(m, m_1, \alpha) = \lambda(m, m_1)g(\alpha)$ with $c\kappa(S) \leq \lambda(m, m_1) \leq C\kappa(S)$, $S = m + m_1$, and $\kappa \in \text{RV}_p$, $p \in [0, 1]$, constructed a tail-adapted convex weight Φ satisfying $\Phi(m)/m \rightarrow \infty$ and showed its propagation. Comparing large–large production with dissipation against a bounded-mass reservoir yields $L^{\gamma-1} \rightarrow 0$, excluding finite-time gelation without any higher initial mass moment, which implies the global existence of a mild solution.

Discrete-to-Continuous Mass Limit for Binary Mass Exchange

University of Science and Technology of China; Mentor: Prof. Shunlin Shen

Hefei, Anhui, China

November 2025 – February 2026

- For lattice masses $m_i = i\varepsilon$, reconstructed $f^\varepsilon(t, m, v) = \varepsilon^{-1} \sum_{i \geq 1} F_i^\varepsilon(t, v) \mathbf{1}_{[m_i, m_{i+1})}(m)$ and proved $f^\varepsilon \rightharpoonup f$ in $C([0, T]; L_{\text{loc}}^1\text{-weak})$, where $\partial_t f = Q(f, f)$.

Summer Research in Kinetic Theory

Institute of Mathematical Science, Chinese University of Hong Kong

Hong Kong, China

July 2025 – August 2025

- Worked as an Honorable Research Assistant (junior) under Prof. Renjun Duan and Prof. Zhouping Xin, studying Villani’s Fisher-information method in kinetic theory.

Algebra and Number Theory Summer School

Academy of Mathematics and Systems Science, Chinese Academy of Sciences

Beijing, China

July 2024 – August 2024

- Completed intensive courses in algebraic geometry, algebraic number theory and representation theory of finite groups at the summer school founded by Prof. Shouwu Zhang.

TEACHING ASSISTANT EXPERIENCE

Foundation of Algebra

University of Science and Technology of China

Hefei, Anhui, China

Fall 2025

Foundation of Geometry

University of Science and Technology of China

Hefei, Anhui, China

Fall 2025

Complex Analysis (H)(En)

University of Science and Technology of China

Hefei, Anhui, China

Spring 2026

Advanced Real Analysis (Graduate)

University of Science and Technology of China

Hefei, Anhui, China

Fall 2026

SEMINARS, CONGRESS & VISITS

USTC-FDU Honorable Class Communication

Fudan University

Shanghai, China

Fall 2024

Smooth Manifold Seminar

University of Science and Technology of China

Online

Winter 2025

Representation Theory Seminar

University of Science and Technology of China

Hefei, Anhui, China

Spring 2025

USTC-XMU Honorable Class Communication

Xiamen University

Xiamen, Fujian, China

Fall 2025

2026 ICCM Congress

Shanghai Institute for Mathematics and Interdisciplinary Sciences

Shanghai, China

Spring 2026

Workshop on AI for Mathematical Research

Feishu Institute

Shanghai, China

Spring 2026

USTC-WHU Honorable Class Communication

Wuhan University

Wuhan, Hubei, China

Spring 2026

AI & Math Seminar

University of Science and Technology of China

Hefei, Anhui, China

Fall 2026

LANGUAGES

English—TOEFL IBT Test

- Overall Score 5 of 6 (100 of 120) (Reading 5 of 6, Listening 5 of 6, Speaking 5 of 6, Writing 5.5 of 6)