ZHI-HAO ZHANG 张智浩

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Postdoc at Beijing Institute of Mathematical Sciences and Applications (BIMSA)

EDUCATION

University of Science and Technology of China — *September 2018 – June 2024*
School of Mathematical Sciences — Hefei, China
Integrated Master's-Ph.D. program
- Ph.D. in Mathematics - Mathematical Physics — *May 2020 – June 2024*
  Advisors: Prof. Sen Hu and Prof. Liang Kong
- M.Sc in Mathematics - Mathematical Physics — *September 2018 – May 2020*
  Advisors: Prof. Zheng Yin and Prof. Liang Kong

University of Science and Technology of China — *September 2014 – June 2018*
School of Physics — Hefei, China
B.S. in Physics - Theoretical Physics

EXPERIENCE

Beijing Institute of Mathematical Sciences and Applications — *September 2023 – Janurary 2024*
Visiting student — Beijing, China

The first International Congress of Basic Science — July 2023
Poster presentation — Beijing, China

Shenzhen Institute for Quantum Science and Engineering — *November 2018 – December 2023*
Visiting student — Shenzhen, China

HONOR

National Scholoarship for doctoral students — *2022*

National Scholoarship for postgraduate students — *2020*

ACADEMIC INTERESTS

My primary academic interests lie in the theoretical foundations of topological order and tensor category theory. I am equally intrigued by related areas, such as topological quantum field theory and conformal field theory.

Currently, my research efforts are focused on projects related to enriched (higher) category theory. These projects draw their physical motivation from the study of condensation theory and 3+1D topological orders with (generalized) symmetries. I am particularly excited about the potential insights they offer into phase transition theory and quantum gravity. Additionally, I am actively involved in projects related to 2-groups and their 2-representation theory, as well as fusion 2-categories.

Looking ahead, I aspire to deepen my understanding of conformal field theory from both mathematical and physical perspectives, with the aim of enhancing my research into the mathematical theory of gapless quantum liquids and phase transition theory. Simultaneously, I seek to explore higher category theory from a topological viewpoint.

TALKS

Categorical description of 1+1D gapped phases with onsite symmetries. BIMSA TQFT and Higher Symmetries Seminar. Link: BIMSA.

The 2-character theory of finite 2-groups. Shenzhen-Nagoya Workshop on Quantum Science 2024. September 20, 2024. Link: youtube.

Enriched categories and their centers. Moscow-Beijing Topology Seminar. January 24, 2024.

Classification of SPT/SET orders: boundary-bulk relation and higher categories. BIMSA-Tsinghua quantum symmetry Seminar. November 8, 2023. Link: BIMSA, youtube.

Classification of SPT/SET orders and modular extensions. BIMSA-Tsinghua quantum symmetry Seminar. November 1, 2023.

Enriched categories and their centers. SUSTech-Nagoya workshop on Quantum Science 2022. May 31, 2022. Link: youtube.

Topological orders and category theory (in Chinese). Higher structures in geometry and physics. November 22 – November 25, 2021. Links on koushare: part 1, part 2, part 3, part 4.

Categories in the toric code model (in Chinese). Seminar on topological orders and category theory at Tsinghua university. October 26 and November 1, 2021. Links on bilibili: part 1, part 2.

Classification of SPT/SET orders with onsite symmetries. Strings and QFTs for Eurasian time zone. July 30, 2020. Link: youtube, bilibili.

PUBLICATIONS AND PREPRINTS

Preprints on arXiv: `https://arxiv.org/a/zhang_z_12.html`.

[1] Mo Huang, Hao Xu, and Zhi-Hao Zhang. *The 2-character theory for finite 2-groups*. arXiv preprint, 2024. arXiv:2404.01162.

[2] Liang Kong, Zhi-Hao Zhang, Jiaheng Zhao, and Hao Zheng. *Higher condensation theory*. arXiv preprint, 2024. arXiv:2403.07813.

[3] Mo Huang and Zhi-Hao Zhang. *Tannaka-Krein duality for finite 2-groups*. arXiv preprint, 2023. arXiv:2305.18151.

[4] Jiaheng Zhao, Jia-Qi Lou, Zhi-Hao Zhang, Ling-Yan Hung, Liang Kong, and Yin Tian. *String condensations in 3+1D and Lagrangian algebras*. Advances in Theoretical and Mathematical Physics, 27(2), 2023. arXiv:2208.07865.

[5] Rongge Xu and Zhi-Hao Zhang. *Categorical descriptions of one-dimensional gapped phases with Abelian onsite symmetries*. Physical Review B, 110(15):155106, 2024. arXiv:2205.09656.

[6] Liang Kong and Zhi-Hao Zhang. *An invitation to topological orders and category theory*. arXiv preprint, 2022. arXiv:2205.05565.

[7] Liang Kong, Wei Yuan, Zhi-Hao Zhang, and Hao Zheng. *Enriched monoidal categories I: Centers*. Quantum Topology, 2024. arXiv:2104.03121.

[8] Liang Kong, Yin Tian, and Zhi-Hao Zhang. *Defects in the 3-dimensional toric code model form a braided fusion 2-category*. Journal of High Energy Physics, 2020(78), 2020. arXiv:2009.06564.

[9] Liang Kong, Tian Lan, Xiao-Gang Wen, Zhi-Hao Zhang, and Hao Zheng. *Algebraic higher symmetry and categorical symmetry: A holographic and entanglement view of symmetry*. Physical Review Research, 2(4), 2020. arXiv:2005.14178.

[10] Liang Kong, Tian Lan, Xiao-Gang Wen, Zhi-Hao Zhang, and Hao Zheng. *Classification of topological phases with finite internal symmetries in all dimensions*. Journal of High Energy Physics, 2020(9), 2020. arXiv:2003.08898.

[11] Wenjie Xi, Zhi-Hao Zhang, Zheng-Cheng Gu, and Wei-Qiang Chen. *Classification of topological phases in one dimensional interacting non-Hermitian systems and emergent unitarity*. Science Bulletin, 66(17):1731–1739, 2021. arXiv:1911.01590.