

Binbin LIU

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Educations

- 2020– **M. S. in Physics**, *Beihang University*, Beijing, China. GPA: 3.87/4.
Major GPA: 3.96/4, ranking **1/20**.
- 2016–2020 **B. S. in Applied Physics**, *Beihang University*, Beijing, China. GPA: 3.78/4.
Major GPA: 3.91/4, ranking **top 3%**.

Honors and Awards

- 09.2022 National Scholarship. **1%**
- 05.2019 Beihang “Yuanhang” Global Study Summer Research Scholarship Award. **1.5%**
- 2018–2022 First Prize in the Learning Excellence Scholarship of Beihang University. **3%**

Publications

- [1] **Binbin Liu** et al., *Second-order and real Chern topological insulator in twisted bilayer α -graphyne*, *Phys. Rev. B* **106**, 035153 (2022). [PDF]
 - [2] Wang Yang*, **Binbin Liu***, et al., *Large bilinear magnetoresistance from Rashba spin-splitting on the surface of a topological insulator*, *Phys. Rev. B* **106**, L241401 (2022), (Letter). [PDF]
 - [3] **Binbin Liu**[†], Xian-Lei Sheng[†], Yuxin Zhao[†] and Shengyuan A. Yang, *Non-centered inversion symmetry in momentum space*. (To be submitted to PRL.) [PDF]
 - [4] Xu-Tao Zeng, **Binbin Liu**, et al., *Three-dimensional real Chern insulator in bulk γ -graphyne*, *arXiv: 2302.13090*. (Submitted to PRB.) [PDF]
 - [5] Xu-Tao Zeng, Ziyu Chen, Cong Chen, **Binbin Liu**, et al., *Topological hinge modes in Dirac semimetals*, *Front. Phys.* **18**, 13308 (2023).
 - [6] **Binbin Liu** et al., *First and second-order topological insulator in 2D elementary materials*. (Invited review, in preparation.)
 - [7] **Binbin Liu**, *Spinless eightfold fermions from projective symmetries*. (In preparation.)
 - [8] **Binbin Liu** and Chueng Ji, *Anatomy of nucleon self-energy from equal-time to light-front*. (To be submitted to PRD.)
- (* equal contributions, [†] correspondence)

Research

- 2022– **Non-centered inversion symmetry in momentum space**, Nanjing U, Nanjing, China
- Advisors Prof. Yuxin Zhao, Nanjing U., Prof. Shengyuan A. Yang, Singapore U. of Technology and Design, and Prof. Xian-Lei Sheng, Beihang U.

- Description Discovered non-centered inversion symmetries in the momentum space from projective symmetry algebras, identified and characterized novel twisted inverse topological edge states with off-centered crossing points in the momentum space, distinct from edge states protected by the normal inversion symmetry. Designed topological circuits to simulate the nontrivial states [3].
- 2021–2022 **Higher-order Topology in Graphyne Families**, Beihang U, Beijing, China
 Advisors Prof. Xian-Lei Sheng, Beihang U. and Prof. Shengyuan A. Yang, Singapore U. of Technology and Design.
- Description Identified twisted bilayer α -graphyne as a second-order topological insulator in 2D and γ -graphyne as a real Chern insulator with higher-order hinge states in 3D using first-principles calculations [1,4]. Demonstrated that higher-order topological states in these materials are induced by effective moiré magnetism or Zeeman fields [1,4-6].
- 2021–2022 **Large Bilinear Magnetoresistance (BMR) from Rashba Spin-Splitting on the Surface of a Topological Insulator**, international
 Advisors Prof. John Q. Xiao, U. of Delaware, Prof. Xian-Lei Sheng, Beihang U. and Prof. Shengyuan A. Yang, Singapore U. of Technology and Design.
- Description Discovered Rashba spin-splitting quantum well states developed near the surface of Bi_2Se_3 decorated with transition-metal atoms Cu or Au, explaining the observed unusual large BMR in experiments [2].
- 2019–2022 **Anatomy of Nucleon Self-energy from Equal-time to Light-front**, NC, USA
 Advisor Prof. Chueng Ji, APS fellow, North Carolina State U.
- Description First to derive the leading non-analytic behavior of a light-front instantaneous Feynman diagram, providing new insights into understanding the backward moving part of a nucleon-pion loop in light-front dynamics [8].

Presentation

- 12.2021 Light-Cone 2021 (Korea). [Anatomy of nucleon self-energy from equal-time to light-front.](#)

Skills

- Models** Tight-binding (TB) and $k \cdot p$ models.
- Materials** VASP, Wannier90, and Slator-Koster method.
- Circuits** Circuit constructions and simulations with “hspice”.
- Computer** Skilled in Matlab, Mathematica, Python, Linux, Latex, Cinema 4D, Adobe Illustrator and Photoshop.
- Theories** Topological characterization using K-theory and topological quantum chemistry; Feynman diagram calculations using quantum field theory.

Advanced Courses

- M. S.** Group Theory (98), Quantum Many-Body Theory (95), Quantum Optics (96).
B. S. Solid State Physics II (95), Advanced Quantum Mechanics (94).

Extracurricular Activities

- 2021/2022 Teaching Assistant, Solid State Physics (2 semesters).
 2020–2021 Student President, Department Academic Associations (graduate focus).
 2012– Classical Pianist (Bach, Beethoven, Chopin, Mozart).