Binbin LIU

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Educations

2020– **M. S. in Physics**, *Beihang University,* Beijing, China.
Major GPA: 3.96/4, ranking **1/20**.

2016–2020 **B. S. in Applied Physics**, *Beihang University,* Beijing, China.
Major GPA: 3.91/4, ranking **top 3**%.

Honors and Awards

09.2022 National Scholarship. Ministry of Education. ***1***%

05.2019 "Yuanhang" Global Study Summer Research Scholarship Award. Beihang U. ***1.5***%

2018–2022 First Prize in the Learning Excellence Scholarship×4. Beihang U. ***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 · 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).

2017– Membership in the Opera House, World Genius Directory.