TIXUAN TAN

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EDUCATION

University of Hong Kong Sept 2018 - Present
Bsc in Physics(starting from September 2020) *GPA: 4.3/4.3, ranking 1/44*[1]

University of Chicago Jan 2021- June 2021
Two-Quarter Exchange *GPA: 4.0/4.0*

RESEARCH INTEREST

Primary Interest (Trained)

- **Condensed Matter Theory**, including strongly correlated system, topological system, Moiré system, superconductivity, etc.
- **High Energy Theory**, including gravity, collider physics, models beyond SM (dark matter, SUSY, etc.), etc.

Other Interest

- Condensed Matter Experiment, Quantum Information

RESEARCH EXPERIENCE

Condensed Matter Theory Jan 2021 - Present
Moiré physics/Edge State physics *Prof. Wang Yao of HKU*

- We study how an hBN substrate can couple with bilayer graphene system and the resulting property. A collaboration with experimental group has been carried out and the result has been submitted. I am responsible for theoretical calculation on the phase transition.
- We observe a new kind of edge state in bilayer graphene with hybridized edge. It exhibits topological phase transition between two distinct topological phases. I am responsible for all calculation involved and writing. For detail, see publication.
- We study the Bloch Oscillations in the above-mentioned graphene-based system. Anomalous Bloach oscillation and electrical control of edge magnetization are observed. I am responsible for the calculation and writing.
- We study the correlated electron/exciton states in Moiré platform and dual Moiré platform. I am responsible for all calculation involved, electron states, topological invariants etc.

High Energy Theory July 2021 - Present
Dark Matter *Prof. Tao Liu of HKUST*

- We focus on fuzzy dark matter, and probe the possibility of using binary black hole to probe their existence. I am responsible for dark matter evolution calculation.
- We study how to use the coupling of axion with photon and gravity to detect its existence.

High Energy Theory Jan 2022-Present
Axion Detection *Prof. Liantao Wang of UChicago and Prof. Zhen Liu of UMN*

- We study the dynamics of necleus under the influence of cosmological axion background and the possibility of using the mechanism to probe the parameter space of axion. I work independetly with help of my advisors. I am responsible for all the literature review, as well as code implementation of my advisors' advice.

[1] I have transferred program, and this GPA includes only post-transfer courses, according to HKU's policy. GPA including pre-transfer courses would be 4.18/4.3. Before 2020, I was in other programs in the Business School. For ranking, see awards.

PROFESSIONAL SKILLS

Language

- IELTS:8/9, speaking 7, Dec 2021
- GRE 336 (V:166 Q:170), pGRE is cancelled due to Covid-19 in Hong Kong.

Programming

- Mathematica (advanced), Matlab (advanced, primary use), Python, HTML
- Moire band caclulation, tight-binding calculation, topological invariant calculation, Hartree-Fock calculation, etc.

Courses

- 8 undergraduate physics courses+ 7 graduate physics courses, all of which are full grade point.
- Undergraduate Courses: QM, Advanced Stat Mech, Classical Mech, Relativity, PDE, Nuclear Physics.
- Graduate Courses: Particle Physics, Group Theory in Physics (Lie algebra & manifold), Graduate QM(Scattering & Quantum Information), Graduate EM I&II, Graduate Stat Mech, General Relativity.

Miscellaneous

- I wrote a QFT note as my Particle Physics course project, available at *An Introduction to Quantum Field Theory and Feynman Rules*
- I investigated into the theory of topological insulator, as requested by Prof. Wang Yao during my project.
- I participated in the writing of the textbook *Advanced Classical Electromagnetism* by R. Wald and was mentioned in preface

AWARDS AND SCHOLARSHIP

Grace Wei Huang Memorial Prize-2019 Jun,academic-merit-based scholarship

Noel Chau Scholarship-2020 Jun, academic-merit-based scholarship

AEON Scholarship- 2020 May, academic-merit-based scholarship

China Soong Ching Ling Foundation, Zhi Yuan Scholarship, 2018-2022, merit-based scholarship

Lam Chi Him Memorial Prize in Physics 2020-2021, for being the best Year 2 physics student

Outstanding Poster Presentation, in the Poster Presentation of SRF and ORF Schemes and Summer Research Internship of URFP Programme 2020-21 of University of Hong Kong

Undergraduate Research Fellowship, awarded by HKU

International theoretical physics competition PLANCKS2022, Hong Kong District Champion, Captain of team

PUBLICATION, PREPRINTS AND TALKS

Accepted

- **T. Tan** , C. Li, and W. Yao, Edge state in AB-stacked bilayer graphene and its correspondence with SSH ladder, Phys. Rev. B **104**, 245419 (2021)
- **T. Tan**, F. Fan, C. Li, and W. Yao, Anomalous Bloch oscillation and electrical switching of edge magnetization in bilayer graphene nanoribbon, Phys. Rev. B **106**, 045405 (2022)

Submitted

- D. Kim, R. Mayorga-Luna, D. Ye, **T. Tan** et al., Engineering Universal Potential of hBN Double Moiré Superlattices, **Currently Under Review**.

Working Paper

- **Excitonic insulator states on the dual Moiré platform, with W. Yao.**
  In this project we study how the electron correlation may manifest itself on the platform via symmetry breaking, superfluid state, and charge-transfer exciton states.
- **Axion detection via qubit decoherence, with L. Wang and Z. Liu**
  In this project we work on how the interaction between axion and nucleon may be understood using quantum information formuation, and how this interaction may be implemented in near future for axion detection.

Talks and Poster

- **Talk** at **APS March Meeting**, March 15, 2022, Chicago. Connecting edge states in bilayer graphene nanoribbon with SSH ladder. Session F56.00013
- **Invited Talk** at **Research Colloquium** hosted by University of Hong Kong, October 28, 2021, on projects involving graphene nanoribbon.
- **Poster** at **Poster Presentation of SRF and ORF Schemes and Summer Research Internship of URFP Programme 2020-21 of University of Hong Kong**, October 21, 2021, on projects involving graphene nanoribbon.
- **Poster** at **The 24th International Conference on High Magnetic Fields in Semiconductor Physics (HMF-24)**, July, 2022