

SHUANG (Tim) LIANG

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EDUCATION

Wuhan University (WHU), School of Physics and Technology

Sep. 2020 - Jun. 2024

Bachelor of Science, Physics

Overall GPA: 3.78/4.00, 89.62/100; **Last two years:** 3.96/4.00, 92.78/100

Core courses: *Methods of Mathematical Physics (100), Electrodynamics (93), Circuit Analysis (96), Quantum Mechanics (90), Thermodynamics and Statistical Physics (93), Computational Physics (Python) (96), Solid State Physics (89), Optics (94), C Programming (87)*

Peking University (PKU)

June 2023 - Jul. 2023

Summer School Program, *Introduction to Quantum Information Technology (97)*

PUBLICATION

Shuang Liang, Yuze Lu, Haimu Liu, Xiaohe Shang, Rongguang Du, Jiamin Ji, Shunping Zhang*, Saturable Absorption of Few-layer WSe₂ and WS₂ at Exciton Resonance. (In Submission to *Applied Physics Letters*.)

RESEARCH EXPERIENCE

Research Intern | Rama Alpaca Co., LTD | Advisor: Prof. Yingcong Chen & Prof. Yuan Yuan

Feb. 2024 - Present

Repurposing the Stable Diffusion Model for Pose Estimation

- Conducted in-depth literature review focused on the Stable Diffusion model, ControlNet, and OpenPose to underpin research and development efforts.
- Engineered and tested a demo pipeline integrating Stable Diffusion ControlNet with DWPose, tailored for illustrated characters using the Bizarre pose dataset. Achieved a 2.3% improvement in mean Average Precision (mAP) over the current state-of-the-art pose estimation algorithms.
- Explored the latent space of the Stable Diffusion model to train a new UNet model specifically repurposed for enhanced pose estimation, leveraging the existing Stable Diffusion architecture as a backbone.
- Drafting a conference paper on the advancements in pose estimation methods developed, targeting submission for the upcoming fall conference season.

Undergraduate Thesis Project | Wuhan University, China | Advisor: Prof. Shengjun Yuan

Oct. 2023 – May 2024

Constructing the Tight-binding Model Based on Deep Learning

- Developed and trained neural networks using the DeePTB framework based on PyTorch to predict the Hamiltonian of tight-binding models, focusing on enhancing computational efficiency and predictive accuracy.
- Compiled and prepared datasets detailing the positions and band structure eigenvalues of WS₂ and WSe₂ lattices under various thermal conditions, utilizing LAMMPS for molecular dynamics simulations and VASP for electronic structure calculations.
- Employed pre-trained neural networks to predict the Hamiltonian of specified systems, achieving high efficiency and density functional theory (DFT)-level accuracy, streamlining the process of band structure prediction.
- Conducted comparative analyses between the DeePTB model and traditional DFT methods on the same CPU cluster. Demonstrated that the DeePTB model could predict the band structure of a 192-atom lattice in 70 seconds—a significant improvement over the traditional DFT methods, which required approximately two days for the same task.

Independent Research | Wuhan University | Advisor: Prof. Shunping Zhang

Sep. 2022 - Oct. 2023

Saturable Absorption of Few-layer TMDs at Exciton Resonance

- Constructed a light path for changing the laser power based on a rotating motor embedded with a half wavelength plate and a polarizer and adjusted the power of the laser beam according to the Malus's Law.
- Prepared 2-D TMD samples including WS₂ and WSe₂ by mechanical exfoliation on quartz substrate and performed characterization to confirm the layers structure with AFM and PL measurement.
- Developed a program to control the piezo stage, the rotation of motor, the conversion of the wavelength of the super continuous laser source and the spectrometer simultaneously to optimize the signal to noise ratio with LabVIEW. Conducted repeated power-dependent reflectance contrast measurement.
- Comprehensively investigated the evolution of power density threshold in monolayer, bilayer and trilayer TMDs at the at

the wavelength of A exciton resonant areas, systematically reported the evolution of power density threshold with respect to wavelength and layer number, which has potential application for optical switching devices and mode-locked laser.

- Journal paper in submission to *Applied Physics Letters* as the first author.

Independent Research | Wuhan University | Advisor: Prof. Shengjun Yuan

Apr. 2023 – Jan. 2024

Simulation of Strain Induced Deformation of Twisted Bilayer Graphene Moiré Superlattice

- Utilized Non-dominated Sorting Genetic Algorithm (NSGA) to match the in-plane strain distribution according to real space Moire superlattice information.
- Developed algorithm with python to introduced strain and twist angle to the twisted bilayer graphene model. Conducted molecular dynamics simulation via LAMMPS to simulate the relaxation of TBG superlattice.
- Developed algorithm to derive strain tensor at specific points in graphene lattice. Simulated the strain-induced polarization based on the evolution of strain tensor along the domain wall according to flexoelectric effect.
- The strain distribution of relaxed Moire superlattice could be predicted automatically by feeding the real Moire superlattice to the algorithm, which is significant for the design and strain analysis of 2-D materials-based microelectronic devices.

Research Assistant | Wuhan University | Advisor: Prof. Shengjun Yuan

Jan. 2023 - Jun. 2023

Simulation on the Effect of Voltage Bias to hBN-Graphene Structure by Tight-Binding Propagation Method

- Conducted literature investigation on twisted bilayer graphene (TBG), particularly on the strongly correlated effects.
- Programmed with Python to construct model of TBG super lattice samples. Simulated LDOS and band structure of the ABBC stacking regions of TBG with TBPLaS (tight-binding package for large scale simulation) in Python.
- Simulated the effect of various v-bias applied in z-direction and compare the simulation results with experimental data, studied the effect of voltage bias on the electronic band structure of TBG system.

Independent Research | Wuhan University | Advisor: Prof. Shunping Zhang

Jan. 2022 – Sep. 2022

Probing Reflectance Contrast of Dark Exciton in TMDs With z-Polarized Beam

- Prepared TMD samples including WS₂, MoSe₂, MoS₂ and WSe₂ by mechanical exfoliation on quartz substrate, and verified the monolayers by Raman spectroscopy.
- Constructed light path to manipulate the light field distribution with half wave plates and Spatial Light Modulator (SLM), successfully generated Radially Polarized Beams (RPB) in the wavelength range from 500nm to 900nm.
- Utilize LabVIEW to control the super continuous laser source, SLM and the spectrometer in which way simultaneously execute the conversion of wavelength, the modulation of the spatial phase of light and spectral acquisition, to eliminate the influence of low frequency background noise that vibrated over time.
- Observed a weak signal at the wavelength of 629.27 nm in monolayer WS₂, suspected to be the signal of dark exciton.

WORK EXPERIENCE

MLE Intern | Beijing Rama Alpaca Co., LTD | Supervisor: Dr. Guo Zhang

Feb. 2024 - Present

- Developed algorithms for generative AI, including Stable Diffusion, and explored techniques for motion-controlled video generation using pose estimation.
- Led a collaborative research project on enhancing pose estimation for anime characters, working with faculty from HKUST and Boston College.

SELECTED PROJECTS

The 7th Hubei College Physics Innovation Experiment Competition | Advisor: Prof. Xiaofeng Wang

Construction and Experiment of Two-dimensional Sound Source Localization Device

Jan. 2022 - June 2022

- Realized sound source localization based on the receivers' time differences with microphone audio receiver array.
- Implemented Generalized Cross-Correlation algorithm (GCC - PHAT) in Matlab based on the weighted function in the inverted space to filter out noise to enhance SNR of the signal.
- Second Prize in "The 7th Hubei Provincial Experiment Innovation Design Competition" was awarded to this project.

The 6th Hubei College Physics Innovation Experiment Competition | Advisor: Prof. Weihua Lin

Measurement of Liquid Viscosity Coefficient Based on Mobile Phone

Jan. 2021 - July 2021

- Optimized the traditional falling-ball method by relating velocity of the ball in the liquid with the angular velocity of the turntable and used Stokes law and rigid rotation law to measure liquid viscosity coefficient.
- Programmed with OpenCV by Python, and realized the real-time tracking and motion analysis of the ball.

- Developed iOS application with Swift and the angular velocity sensor of iPhone gyroscope was invoked to realize real-time measurement of turntable angular velocity.
- First Prize in “The 6th Hubei Provincial Experiment Innovation Design Competition” and “National Excellence Award in College Physics Experiment Innovation Competition” were awarded to this project.

LEADERSHIP AND ACTIVITIES

Minister | Department of Press and Publicity | Wuhan University **Jul. 2021 - Jul. 2022**

- Oversee the whole department’s Press and Publicity affairs including members’ recruitment, budget and final accounts, events’ planning, internal and external communication.
- Operated the WeChat publicity platform to inform the faculties and students on academic news and events on the campus.
- Directed videos about campus life in Wuhan University, grasped skills like video editing and camera.

Admission Publicity Ambassador | Undergraduate Admission Office | Wuhan University **Sep. 2021 - Present**

- Responsible for the publicity of undergraduate admission of Wuhan University in Henan Province.
- Organized yearly admission campaigns in Henan Province in the past few years. Coordinated the operation of new media platforms of the admission office.

SELECTED HONORS & AWARDS

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| • First Prize in “The 6th Hubei Provincial Experiment Innovation Design Competition” | Jul.2021 |
| • Second Prize in “The 7th Hubei Provincial Experiment Innovation Design Competition” | Jul.2022 |
| • National Excellence Award in “College Physics Experiment Innovation Competition” | Oct. 2021 |
| • Third Prize in “National Mathematics Competition for College Students (Non-Mathematics)” | Dec. 2020 |
| • Wuhan University First Class Scholarship (5%, for academic excellence) | Dec.2021 |

SKILLS

Programming: Python, C, Swift, MATLAB, LabVIEW

Framework: PyTorch

Platform: Linux

Software: Stable Diffusion, TBPLaS, DeePTB, VASP, COMSOL, LAMMPS

Development Skills: Machine Learning, Web Development, iOS Application Development, Object Oriented Programming