

# Ruiheng Su

I am excited about exploring quantum materials with strongly correlated phases using novel transport or spectroscopic probes.

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## EDUCATION

2024 **Bachelor of Applied Science in Engineering Physics, University of British Columbia (UBC)**

GPA: 87.7/100.0 (Letter Grade: A)

**Relevant coursework:**

Graduate Condensed Matter I (PHYS 502, Grade: A+)

Quantum Mechanics, Statistical Mechanics, Optics

## PUBLICATIONS

1. **Su, R.**, Kuiri, M., Watanabe, K., Taniguchi, T., and Folk, J. Superconductivity in twisted double bilayer graphene stabilized by WSe<sub>2</sub>. *Nat. Mater.* (2023). <https://doi.org/10.1038/s41563-023-01653-7>  
Featured in: News & Views - Nature Materials

## CONTRIBUTED TALKS

- 2024 (Submitted) **“Current-bias spectroscopy of in-plane magnetoresistance on the microtesla scale in twisted monolayer-trilayer graphene.”** APS March Meeting, Minneapolis, MN, March 3-8<sup>th</sup> (Speaker)
- “Moiré-localized flat bands in a family of twisted Bernal-stacked graphene multilayers.”**  
APS March Meeting, Minneapolis, MN, March 3-8<sup>th</sup> (Co-author, in collaboration with Prof. M. Yankowitz, University of Washington)
- 2023 **“Superconductivity in twisted double bilayer graphene stabilized by WSe<sub>2</sub>.”** APS March Meeting, Las Vegas, NV, March 6-10<sup>th</sup> (Speaker)

## POSTER PRESENTATIONS

- 2023 **First place award: “Superconductivity and Isospin Order in Twisted Double Bilayer Graphene on WSe<sub>2</sub>.”** Stewart Blusson Quantum Matter Institute (SBQMI) International Scientific Advisory Board Meeting, September 19-20<sup>th</sup>
- “Electronic phases of twisted double bilayer graphene on WSe<sub>2</sub>.”** Canadian Institute for Advanced Research (CIFAR) Quantum Materials Program Spring School, Montreal, May 8-12<sup>th</sup>

## AWARDS AND HONOURS

- 2023 **Edward G. Auld Prize in Engineering Physics, UBC**  
**Undergraduate Student Research Award, Natural Sciences and Engineering Research Council of Canada (NSERC)**  
**First Place Poster Award, International Scientific Advisory Board Meeting, SBQMI, UBC**
- 2022 **Trek Excellence Scholarship, UBC**
- 2018 **Academic Bronze Medal, The Governor General of Canada**  
**British Columbia Government Scholarship**  
**Community Service Award, Knights of Columbus Council**

## RESEARCH EXPERIENCE

2021 – Present **Electronic phases of multilayer graphene**  
*Undergraduate Researcher*

Prof. Joshua Folk, UBC

**Transport experiments:** I have led several experiments through the efforts of nanofabrication (electron beam lithography), electronic instrumentation (in Bluefors LD/XLD dilution refrigerators and ICEoxford VTI), data analysis, figure preparation, and manuscript writing. This includes a **first-author publication on superconductivity in twisted double bilayer graphene (TDBG)** in Nature Materials (2023).

Other experimental observations I have led include:

- **Unconventional sequence of finite-magnetic field Chern insulators in TDBG** at integer and half-integer filling factors, inconsistent with a picture of sequential populations of  $|C| = 2$  Chern bands

Collaborating with the group of Prof. Matthew Yankowitz, *University of Washington, Seattle*, I found:

- **Quantum anomalous hall effect at  $\nu = 1/4$  in twisted bilayer-trilayer graphene (T2+3)**, and independent control of orbital magnetic order by both an in-plane and out-of-plane magnetic field
- **Anomalous hall effect at  $\nu = 3$  in twisted mono-trilayer graphene (T1+3)**, and an associated **extraordinary resistivity response to  $< 1 \mu\text{V}$  of bias and  $< 1 \text{ mT}$  of in-plane magnetic field**

These results are the subjects of manuscripts in preparation.

**I often use low-field quantum oscillations to tell the material's Fermi surface degeneracy.** I performed band structure calculations of AB-stacked tetralayer graphene and compared the theory to my measurements in an ultraclean sample.

**Thermodynamic measurements:** I also led instrumentation efforts to probe 2D materials using aluminum single-electron transistors in both DC and phase-sensitive (AC) modes. I assembled the experiment set up, involving:

- eliminating ground loops, optimizing passive circuits and feedback controllers to work in conjunction with DC voltage sources and lock-in amplifiers

to yield robust, direct measurements of the inverse electronic compressibility

May 2021 – January 2022 **Charge noise in GaAs/AlGaAs quantum wells**  
*Undergraduate Researcher*

Prof. Joshua Folk, UBC

Utilized the edge of a Coulomb blockade peak in a GaAs/AlGaAs quantum dot to obtain sensitive measurements of the noise power spectral density

- Optimized ohmic contacts to the quantum well and fabricated quantum dots

May – August 2019 **X-ray Detection and Radiotherapy Response Modelling**  
*Research Assistant*

Prof. Geordi Pang, *University of Toronto*

- Wrote C++ programs to perform Monte-Carlo simulations of a MeV X-ray detector
- Implemented a mathematical model to simulate the external beam radiotherapy treatment response of non-small cell lung cancer patients, reproducing the results of a reference publication, involving developing heuristics to improve fitting to a model with 16 parameters, using parallelism to speed up calculations

May – August 2019 **Measurement Interface for Silicon Photonics**  
*Research Assistant*

Prof. Jeff Young, UBC

Designed a Python-based web interface to measure photonic devices, implementing features such as:

- Global sample alignment, mapping design file coordinates to physical coordinates
- Closed-loop fine alignment using a modified gradient descent algorithm between an optical fiber array and grating couplers

## TECHNICAL PROJECT EXPERIENCE

September – January 2020 **Virtual Parking Attendant**  
*Course Project, ENPH 353, UBC*

- Combined classical and machine learning techniques in Python (OpenCV, TensorFlow) to develop a virtual parking attendant
- The system autonomously navigated a competition area, avoiding other vehicles and pedestrians, and performed license plate identification with 80% accuracy, achieving 2<sup>nd</sup> place in time required to complete competition tasks

May – September 2020 **Autonomous Recycling Robot**  
*Course Project, ENPH 480, UBC*

Prototyped, constructed, and programmed a fully autonomous robot capable of detecting and retrieving randomly scattered soda cans to a 12-inch-tall recycling bin. Gained experience in:

- Assembling and troubleshooting of electronic circuits for noise-tolerant electromechanical systems
- State-machine programming of microcontrollers in C++, including developing algorithms for sonar detection and retrieval of soda scans

## SKILLS

### Nanoscale sample preparation

- Electron beam/photolithography
- Dry (RIE)/wet etching (HF)
- Electron beam evaporation
- Wiring bonding/sample preparation
- Wafer dicing

### 2D materials

- Dry transfer
- Exfoliation

### Programming /Software

- Python (including QCodes), Igor Pro, C++, Java, MATLAB, LaTeX, Processing, Assembly
- Adobe Illustrator, Microsoft Office

### Electro/Mechanical

- Machine shop: Lathe, Milling
- Experience with CAD, PCB design, Soldering

### Language

- English, Mandarin/Cantonese Chinese

## ADDITIONAL WORK EXPERIENCE

August 2020 **Teaching Assistant** Prof. Sarah Burke, UBC  
*PHYS 159 - Introductory Physics Laboratory for Engineers*

- Created instructional materials and user interface features for an Arduino-based oscilloscope, supporting over 1,000 first-year engineering students in a swift transition to remote learning during the COVID-19 pandemic

May 2017 **District Electoral Officer**  
*Elections British Columbia*

May – August 2017 **Day Care Assistant**  
*CPE Force Vive, Laval, Québec (French Speaking)*

2017, 2018 **Customer Service Representative** for *PNE Vancouver, AMS UBC*

## COMMUNITY SERVICE

2012 - 2018 **Sergeant and Bagpipe Instructor**  
*Army Cadets of Canada*

- Trained new army cadets, learned and taught the Scottish bagpipes to members of the marching band

2018 **General Council Secretary**  
*Engineering Undergraduate Society, UBC*