Rui XUE

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Education

University of Pittsburgh   *Aug. 2021 – Aug. 2027 (Expected)*
Ph.D. candidate, M.Sc. in Physics (Apr. 2023)
- **GPA:** 3.934
- Predoctoral Fellowship (2021)

University of California, Berkeley   *Aug. 2019 – May 2020*
Visiting Physics Student
- **GPA:** 3.94

ShanghaiTech University   *Sept. 2017 – Jun. 2021*
B.S. in Physics
- **GPA (Until Application):** 3.63 ‖ **Major GPA:** 3.80
- Merit Student (2019), Merit Student (2020)
- Merit Scholarship (2020)

Experience

Physics Analysis of $t\bar{t}$ Decaying Process   *Pittsburgh → CERN*
Graduate Research Assistant   *Sept. 2023 – Present*
- Conducted DIM6 and SMEFTsim **model verification studies** using MadGraph.
- **Cleaned and processed 100 TB** of high-energy particle collision data, and used the refined data for physics process reconstruction.
- Developed an **automatic data processing pipeline** (NTupleRecon ☑) in **C++** and **Python**, which can **download**, **reconstruct**, **merge**, and **update** the NTuple data slices from the **CERN distributed computational sites**.
- Developed an **analysis framework** (tenAngleAnalysis ☑) in **C++** for top-quark decay studies. The pipeline is accelerated by **OpenMP**, and store results via **SQLite database**. Acheived a **1000x reduction** in data processing.
- Performed **consistency validations** on the analysis results using **Mathematical Physics techniques**.
- Employed the **Monte-Carlo method** for **maximum likelihood fitting** to **constrain Wilson coefficients**.

Top Physics Monte Carlo Simulation Contact   *Pittsburgh, PA*
Graduate Research Assistant   *Jan. 2025 – Present*
- **Collaborate** with international researchers on generating top quark simulation events.
- **Validate, register, and submit** top quark simulation jobs, **maintain** the remote GitLab repository.

GeoModel Toolkit Development   *CERN, Geneva, Switzerland*
Graduate Research Assistant   *Apr. 2024 – Nov. 2024*
- Designed and implemented **object-oriented classes** for **particle tracking and reconstruction** in the GeoModel visualization toolkit.
- Performed comprehensive **compatibility checks**, including **class hierarchy traversal**, **data aggregation**, **UI testing**, and **I/O operations**.
- Contributed to the maintenance and updated the **development documentation**. See here ☑.
- Passed qualification and got **ATLAS authorship**.
- Presented on the ATLAS Software & Computing Week ☑.

Exciton-Polariton Microsystem   *Pittsburgh, PA*
Graduate Research Assistant   *Dec. 2021 – Apr. 2023*
- Utilized **Atomic Force Microscope (AFM)** and **Photoluminescence (PL)** heavily to characterize the **two-dimensional material**. Qualified in using **Maskless Aligner (MLA)**, **PECVD** and **PE-ALD** to fabricate nano-devices. Experienced in **cleanroom fabrication**.
- Developed a program to automatically detect the thickness of nano-material.

○ Presented results on the APS March Meeting ↗.

Theoretical Study of Disordered Systems *Shanghai, China*
Undergraduate Research Assistant *June. 2020 – Jan. 2021*
- Developed **theoretical framework** to compute **the phonon spectrum** of the 1D disordered binary-alloy systems in FORTRAN.
- Worked extensively with **Green's functions**, **Partial Differential Equations** and **Linear Algebra**, developed a strong foundation in **mathematical physics**.
- Published the paper as **the second author** on Physics Review B ↗.

Condensed Matter Experiments *LBNL, Berkeley, CA*
Undergraduate Research Assistant *Jan. 2020 – May. 2020*
- Collaborated with LBNL scientists and got ideas in scientific research.

Projects

Generating Particle Physics Events *Oct. 2024 – Dec. 2024*
- Trained two **generative models**, the **Variational Autoencoder (VAE)** and **Flow-VAE**, to generate **high-dimensional** $t\bar{t}$ decay events.
- Both models **captured the correlation** between physics variables; notably, the Flow-VAE **outperformed** the VAE in **capturing the marginal distribution**, reducing test loss by **50%**. See the detailed report here ↗.
- Tools Used: Python, PyTorch, C++, ROOT

Detecting Nano-Material Thickness *Jul. 2022 – Aug. 2022*
- Developed an interactive framework for **image processing** in MATLAB, enabling the generation of sufficient training samples.
- Used **Support Vector Machine (SVM) model** for rapid nano-material thickness detection, which is now used by at least **two labs** in the US and China. See the code repository here ↗.
- Tools Used: Matlab, Python, Scikit-learn

Courses at Carnegie Mellon University *Aug. 2024 – May. 2025*
- Enrolled in **10617 Deep Learning**. Gained deep understanding of Bayesian statistics, deep neural networks, and generative models, which are widely used in particle physics fast simulation.
- Enrolled in **15513 Computer System**. Gained deep understanding of the computer architecture, which is the basis of high-performance particle physics software development.

Teaching

- Served as a graduate teaching assistant for **five semesters** in *the University of Pittsburgh*. Experienced in teaching **recitation classes**, including the topics of **Classic Mechanics**, **Electromagnetism**, **Thermodynamics**, and **Optics**. Prepared **review notes** and **example problems** for the class. Experienced in operating **lab sessions**, efficiently **identifying device failures** and **guiding students** through technical and conceptual challenges.
- Held office hours to answer undergraduate students' questions. **Good at explaining complicated concepts**. Have already taught more than **300 students**.
- Served as an undergraduate teaching assistant for **Differential Equations in Mathematical Physics** in *ShanghaiTech University*. The topics include **Diffusion Equations**, **Wave Equations** and **Electrostatic Equations**, and techniques to solve them, including **Fourier/Laplace technique**, **Green's Functions**, **Legendre/Bessel Expansion**, **Separation of Variables**. Prepared homework solutions, exam solutions for the class and answered students' questions.

Technologies

Programming Language: Python, C++, C, SQL, FORTRAN
Toolkit: MadGraph, ROOT, GeoModel, Git, Matlab, Mathematica, PyTorch, TensorFlow, Scikit-learn, Numpy, Matplotlib, Pandas, Open Inventor