Peiyuan Chen

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Education

B.S. in Physics (Rank in major: 8/29) Sep 2020–Jun 2026
Jilin University *Changchun, China*

Double First-Class University; Project 985/211.

B.S. thesis: *Development and Testing of R12699 and R11410 PMT Arrays: A Comparative Study of Position-Reconstruction Algorithms.* **Outstanding Undergraduate Thesis Award, Jilin University**.

Visiting Undergraduate Student, Physics Jan 2024–May 2024
Georgia Institute of Technology *Atlanta, GA, USA*

Research Experience

Research Assistant, PandaX Collaboration Jun 2024–Present
TDLI, Shanghai Jiao Tong University *Shanghai, China*

- **Detector Signal Acquisition and PMT Performance Evaluation**
  - **192-channel test platform:** Led development and maintenance of a universal PMT signal acquisition system, integrating high-voltage supply, signal readout and separation, **500 MS/s** waveform digitization, **over 1,000 MB/s** readout bandwidth, and data storage. The platform has operated stably for **more than 500 days**, supporting batch testing, calibration, and abnormal-waveform analysis.
  - **PMT characterization:** To support PMT selection for the future PandaX-nT experiment, established waveform-processing workflows and a performance database for dark-count, gain, and afterpulse evaluation. Characterized more than **160 R11410** and **500 R12699** PMTs, including ambient- and low-temperature tests.
  - **Rigid-flex PMT base evaluation:** Tested thermal stability, channel connectivity, noise, attenuation, and crosstalk; used the results to improve signal-trace spacing and GND isolation. Noise and attenuation fell to about 1/5 and 1/3 of their original levels, respectively; average crosstalk fell to 1/15–1/20 (15–20% to about 1%), and maximum crosstalk to less than 1/9 (28% to below 3%).
- **PMT Large-Signal Response, Modeling, and Waveform Correction**
  - **Experimental response:** measured nonlinear responses of multiple PMTs under conditions ranging from 10^0–10^5 photoelectrons (PE) per channel, with pulse intervals of 5–100 μs; clarified mechanisms of large-signal saturation and continuous-pulse suppression and their temporal recovery patterns; provided algorithms and experimental basis for restoring the original signal amplitude. Part of the results was published in ***IEEE Transactions on Nuclear Science*** (co-first author).
  - **Response modeling:** Proposed and developed a coupled simulation using a **PMT base-circuit model** and a **custom 2.5D electron-transport model** to study saturation and suppression. The diagnostic framework reproduced key features of small-signal multiplication and large-signal nonlinearity.
  - **Detector-data correction:** Derived waveform corrections from measured and simulated response curves, then applied them to saturated and suppressed signals in detector data. Using the same event selection before and after correction, reduced the difference between multi-site (MS) and single-site (SS) reconstructed energy peak positions by **85%**.
- **PMT Arrays and Position Reconstruction**
  - Led hardware development, DAQ, calibration, Geant4 optical simulation, and reconstruction analysis for a 55-channel R11410 PMT array. Compared center-of-gravity, template-matching, light-response-function, and machine-learning methods; achieved an overall spatial resolution of approximately **0.66 mm** in array performance tests.

Research Experience (continued)

Research Intern, Trinity PeV Neutrino Observatory Mar 2024–May 2024
Georgia Institute of Technology *Atlanta, GA, USA*

- Designed and fabricated cable-connection components and supported detector hardware integration.

PandaX-III Gaseous-Xenon TPC Calibration Device Jan 2022–Mar 2022
PandaX Collaboration *Shanghai, China*

- Designed a calibration device for the PandaX-III high-pressure gaseous-xenon TPC with Micromegas readout; reduced device thickness while maintaining mechanical strength and leak-tightness, achieving sub-millimeter position precision.

Publications & Patents

- **Chen, P.***, Huang, H.*, Ke, H., et al. "Performance Study and Circuit Simulation for R12699-406-M4 Photomultiplier Tube Base." *IEEE Transactions on Nuclear Science*, 2026. DOI: 10.1109/TNS.2026.3689710. (*Co-first authors)
- Xu, J.*, Gong, X.*, Meng, Z., **Chen, P.**, et al. "Bi-Interlayer Strategy for Modulating NiCoP-Based Heterostructure toward High-Performance Aqueous Energy Storage Devices." *Advanced Materials*, 2024. DOI: 10.1002/adma.202401452. (*Co-first authors; third author when counted jointly; experiments and simulations.)
- CN215414302U, *A Small Wind Tunnel Device Used in Laboratory*; CN113466487B, *Method of Measuring Wind Speed Using a Constant-Flow Thermal Anemometer*. Contributed to design, fabrication, and testing.
- **Working title:** "Coupled PMT Electron-Transport and Base-Circuit Modeling for Saturation and Suppression Correction in Liquid-Xenon Detector Data." *Manuscript in preparation.*

Awards & Honors

- 2026: First Prize, Annual Review of Nuclear and Particle Science Video Contest (Annual Reviews).
- 2025: High-Level Academic Competition Achievement Scholarship, Jilin University.
- 2023: National First Prize, ranked 1st nationwide, China Undergraduate Physics Experiment Tournament.
- 2023: Student of the Year, Shanghai Jiao Tong University (group member).
- 2021: National 13th Place, China Undergraduate Physics Tournament; Grand Prize, Northeast Division.

Leadership & Service

Founder & Chairman, CUPT Community Feb 2021–Jun 2023
Jilin University *Changchun, China*

- **Team leadership:** Founded the China Undergraduate Physics Tournament (CUPT) community at Jilin University and led approximately 30 members; coordinated a five-member executive committee, recruitment, and competition preparation.
- **Teaching:** Delivered five training sessions for audiences of 20–100 on instrument use, experimental design, uncertainty analysis, and data analysis; trainees from that cohort won a national first prize.

Chair & Referee, Jilin University Physics Tournament (JLUPT) May 2022
Jilin University *Changchun, China*

Organized the university physics tournament and established standardized scoring guidelines.

Technical Skills

Programming: Python, C++, MATLAB, ROOT, Geant4, Git, LaTeX
Data analysis: Waveform analysis, statistical analysis, detector calibration, Monte Carlo methods, ML methods
Instrumentation: PMT characterization, DAQ systems, front-end electronics, high-voltage systems, vacuum and high-pressure detector hardware

Certification

National Level II Sports Referee in Cycling & Mountain Biking and Triathlon (2023–Present).