

YIHUI LAI

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EDUCATION

University of Maryland, College Park, Maryland, USA

Aug. 2019 - Oct. 2024

Ph.D. in Physics

Shanghai Jiao Tong University, Shanghai, China

Aug. 2015 - June 2019

B.S. in Physics

- Thesis: Searching for neutrino-less double beta decay of ^{136}Xe with PandaX-II liquid xenon detector
- *Excellent Bachelor Thesis award, Top 1%*

RESEARCH EXPERIENCE

Search for Higgs boson pair production with one associated vector boson [[PAS-HIG-22-006](#)]

Feb. 2021 - Present (lead analyzer)

- Developed the overall analysis strategy to optimize simultaneously for the Higgs boson self-coupling κ_λ and the coupling of two Higgs bosons with two vector bosons κ_{2V}
- Led studies in the lepton decay channels of vector boson
- Led studies in the boosted topology, demonstrated its importance to κ_{2V} sensitivity
- Integrated this analysis into the di-Higgs combination

STXS measurement of the Higgs boson produced in association with W or Z bosons in the $H \rightarrow b\bar{b}$ decay channel [[HIG-20-001](#)]

Aug. 2022 - Mar. 2024 (analyzer)

- Collaborated with the Princeton team on the mass-based analysis
- Performed comprehensive background model validation to avoid bias on signal strength
- Managed to update the effective field theory interpretation of this measurement

Precision measurement of Higgs boson properties with combination

Aug. 2022 - Present (analyzer)

- Collaborating on the Run-II **single Higgs boson** combination and developing the combination tools [[HIG-21-018](#)]
- Collaborating on the combined measurements of Run-II **double Higgs boson** production [[HIG-20-011](#)]
- Collaborating on the combination of **single and double Higgs boson** production to constrain the Higgs boson self-coupling [[PAS-HIG-23-006](#)]

Search for new particles decaying into W boson and photon [[PAS-EXO-21-017](#)]

July 2021 - Present (analysis contact)

- Leading the search for new particles in the $W\gamma$ final state, with W boson decays leptonically
- Achieved the strongest exclusion limits on the cross-section of new particles decaying in the $W\gamma$ final state within the search region

Missing transverse momentum (MET) estimator developments

Feb. 2021 - Present

- Development of Graph Neural Network-based MET estimator (DeepMETv2), with 10% to 20% improvements in resolution compared to PF and Puppi MET
- Preparation of the training sample

Other research within CMS

Sep. 2019 - Present

- **Analyzer** for the Run-III HF-based luminosity measurement. Working on the luminosity calibration, lookup table maintenance, and daily shifts [[PAS-LUM-22-001](#)]
- **HCAL operation and detector performance study**
 - Optimized zero suppression thresholds for the Run-III operation via Monte Carlo simulation. Improved pulse shape simulation using HCAL phase scan
 - HCAL operation on-call, took the most shifts during the 2022 data-taking period
- **HGCAL scintillation tiles optical simulation** [[paper](#)]
 - Co-developed a Monte Carlo optical simulation framework to simulate the photoresponse of SiPM-on-tile configurations
 - Analyzed simulation data and compared it with test beam results to validate simulation models and optimize scintillation tile designs

Radiation damage study of plastic scintillators [[paper](#)]

Feb. 2020 - Feb. 2022

- Investigated the scintillator light yields for different materials, under different radiation damage conditions
- Developed an experimental setup to study the recovery of damaged scintillators using LED lights

Study of homogeneous dual-readout calorimeter for future collider [[paper](#)]

Feb. 2020 - July 2022

- Implemented and verified the optical simulation with a crystal calorimeter
- Developed Monte Carlo tools to guide experimental design and material selection

Searching for Neutrino-less Double Beta Decay of ^{136}Xe [[paper](#)]

Aug. 2018 - July 2019

- Lead analyzer for this first NLDBD result reported from a dual-phase xenon experiment
- Led the study of event selection criteria, developed the statistical fitting tool

PROFESSIONAL EXPERIENCE

- **Combine Contact** for Higgs Group Sep. 2023 - Present
- **Monte Carlo Contact** for the Higgs to $b\bar{b}$ Group July 2023 - Present

PUBLICATIONS

- Constraints on the Higgs boson self-coupling with combination of single and double Higgs boson production. [CMS-PAS-HIG-23-006](#). To be submitted to *PLB*

- Search for Higgs boson pair production with one associated vector boson in proton-proton collisions at $\sqrt{s} = 13$ TeV. [CMS-PAS-HIG-22-006](#). To be submitted to *JHEP*
- Luminosity measurement in proton-proton collisions at 13.6 TeV in 2022 at CMS. [CMS-PAS-LUM-22-001](#)
- Search for a resonance decaying to a W boson and a photon in proton-proton collisions at $\sqrt{s} = 13$ TeV using leptonic W boson decays. [CMS-PAS-EXO-21-017](#). To be submitted to *JHEP*
- Measurement of simplified template cross sections of the Higgs boson produced in association with W or Z bosons in the $H \rightarrow b\bar{b}$ decay channel in proton-proton collisions at $\sqrt{s} = 13$ TeV. [arXiv:2312.07562](#). Accepted by *PRD* (2024) (**Selected as editor's suggestion**)
- C. Papageorgakis *et al.*, Dose rate effects in radiation-induced changes to phenyl-based polymeric scintillators. *Nucl. Instrum. Meth. A* 1042, 167445 (2022), [doi:10.1016/j.nima.2022.167445](#), [arXiv:2203.15923](#)
- G. Bernardi *et al.* The Future Circular Collider: A Summary for the US 2021 Snowmass Process. March, 2022. [arXiv:2203.06520](#)
- A. Belloni *et al.* Test beam study of SiPM-on-tile configurations. *JINST* 16, P07022 (2021), [doi:10.1088/1748-0221/16/07/P07022](#), [arXiv:2102.08499](#)
- M. T. Lucchini *et al.* New perspectives on segmented crystal calorimeters for future colliders. *JINST* 15, P11005 (2020). [doi:10.1088/1748-0221/15/11/P11005](#), [arXiv:2008.00338](#)
- Q. Wang *et al.* An improved evaluation of the neutron background in the PandaX-II experiment. *Sci. China Phys. Mech. Astron.* 63, 231011 (2020). [doi:10.1007/s11433-019-9603-9](#), [arXiv:1907.00545](#)
- Kaixiang Ni, Yihui Lai *et al.* Searching for neutrino-less double beta decay of ^{136}Xe with PandaX-II liquid xenon detector. *Chinese Phys. C* 43, 113001 (2019). [doi:10.1088/1674-1137/43/11/113001](#), [arXiv:1906.11457](#) (**Selected as The Most Influential Paper of 2020 by the Chinese Physical Society**)

HONORS AND AWARDS

Dean's Fellowship, UMD, <i>The highest honor awarded to entering graduate students</i>	2019 - 2020
Excellent Bachelor Thesis award of SJTU, <i>Top 1%</i>	2019
Outstanding Graduates Award of Shanghai, <i>Top 5%</i>	2019
Overseas Alumni Scholarship, SJTU	2017
International Summer school on TeV Experimental Physics "individual excellence award"	2017
Academic Excellence Scholarship of SJTU	2017
National Endeavor Scholarship, SJTU	2016

PRESENTATIONS AND POSTERS

- Invited to the 73rd Lindau Nobel Laureate Meeting (only 600 Young Scientists from all over the world were invited), Lindau, Germany, June 2024
- *Latest combined Higgs boson measurements from CMS*. **Talk** presented at the Higgs 2023 conference, Beijing, China, Nov. 2023
- *Search for Higgs boson pair production with one associated vector boson in proton-proton collisions at $\sqrt{s} = 13$ TeV on CMS*. **Poster** presented at the CMS 2023 collaboration meeting in Saint-Malo, Saint-Malo, France, April 2023

- *Combining Dual-Readout Crystals and Fibers in a Hybrid Calorimeter for Future e^+e^- Higgs Factories*. **Talk** presented at the 2022, 19th International Conference on Calorimetry in Particle Physics, University of Sussex, Brighton, UK, May 2022

OUTREACH

- CERN Certifications: CMS underground visit guide
- Mentor: Maryland Physics Mentorship program