Yun-Yi Pai

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Current Position

Oak Ridge National Lab, Oak Ridge, TN
Postdoctoral Research Associate, April 2020 - Present

Education

University of Pittsburgh, Pittsburgh, Pittsburgh, PA
Ph.D. in Physics, 2020.
Thesis: Superconductivity and Mesoscopic Physics at $LaAlO_3/SrTiO_3$
Supervisor: Jeremy Levy
- Observed "1D nature" of the superconductivity at $LaAlO_3/SrTiO_3$
- Proposed a possible source of superconductivity in $SrTiO_3$ (a 50-year puzzle)
- Investigate superconductivity in 1D Zigzag nanowires
- Characterize electron waveguides, single electron transistors
- Work on instrumentation of milli-Kelvin scanning probe microscope

Cornell University, Ithaca, NY
Master of Science in Applied Physics, 2014.
Thesis: "Investigation and Perturbation of the Optical Properties of the Single Defects in Zinc Oxide"
Supervisor: Gregory David Fuchs

Visiting, Internship

Oak Ridge National Lab, Oak Ridge, TN
Sep. 2019 - Mar. 2020
Supervisor: Benjamin J. Lawrie and Ho-Nyung Lee
MilliKelvin optical characterization of $SrTiO_3$.

Pennsylvania State University, State College, PA
July. 2019 - Dec. 2019
Supervisor: Long-Qing Chen
Modeled the ferroelastic morphology of $SrTiO_3$, the interplay between charge, polar and octatilt degree of freedoms, using phase-field methods with High-Performance Computing (HPC) system.

Honors

Dean's Tuition Scholarship 2020 Spring
Kenneth P. Dietrich School of Arts & Sciences Predoctoral Fellowship, 2019 Fall
Andrew Mellon Predoctoral Fellowship 2018-2019
Kenneth P. Dietrich School of Arts & Sciences Fellowship 2014-2015

Teaching

University of Pittsburgh, Pittsburgh, PA
Teaching Assistant
PHYS 0212 Introduction to Laboratory Physics, Jan. 2019 - Apr. 2019
PHYS 1426 Modern Physics Laboratory, Jan. 2018 - Apr. 2018
PHYS 0175 Basic Physics for Science and Engineering II, May 2015 - Jun. 2015
My website for PHYS 0175 http://www.pitt.edu/ yup7/

Cornell University, Ithaca, NY
Lab Assistant
AEP 2640 Computer Instrumentation Design, Aug. 2013 - Dec. 2013

Publications

Yun-Yi Pai, Hyungwoo Lee, Jung-Woo Lee, Anil Annadi, Guanglei Cheng, Shicheng Lu, Michelle Tomczyk, Mengchen Huang, Chang-Beom Eom, Patrick Irvin, Jeremy Levy, "One-Dimensional Nature of Pairing and Superconductivity at the $LaAlO_3/SrTiO_3$ Interface." *Phys. Rev. Lett.* **120**, 147001 (2018).

Yun-Yi Pai, Anthony Tylan-Tyler, Patrick Irvin, Jeremy Levy, "Physics of $SrTiO_3$-based heterostructures and nanostructures: a review." 2018 *Rep. Prog. Phys.* **81** 036503.

L. Chen, J. Li, Y. Tang, **Y-Y Pai**, Y. Chen, N. Pryds, P. Irvin and J. Levy, "Extreme reconfigurable nanoelectronics at the $CaZrO_3/SrTiO_3$ interface." *Advanced Materials*, **2018**, 1801794.

Yun-Yi Pai, Anthony Tylan-Tyler, Patrick Irvin, Jeremy Levy, "$LaAlO_3/SrTiO_3$: a tale of two magnetisms.", in Vol. 2, Sec. 5 of "Spintronics Handbook: Spin Transport and Magnetism, 2nd ed" by CRC Press (2019).

N. R. Jungwirth, **Y. Y. Pai**, H. S. Chang, Evan. R. MacQuarrie, K. X. Nguyen, and G. D. Fuchs, "A single-molecule approach to ZnO defect studies: single photons and single defects." *J. Appl. Phys.* **116**, 043509 (2014).

Invited Talks

Materials Science Seminar, Penn State University, State College, PA. 11/19/2019.
Oak Ridge National Lab, Oak Ridge, TN. 8/29/2019.

Conference Talks

Yun-Yi Pai, Megan Briggeman, Hyungwoo Lee, Jung-Woo Lee, Xiaoxing Cheng, Muqing Yu, Mengchen Huang, Jianan Li, Chang-Beom Eom, Long-Qing Chen, Patrick Irvin, Jeremy Levy, "Superconductivity at the $LaAlO_3/SrTiO_3$ 1D Zigzag Nanowires", 2020 APS March Meeting, B48.11. (APS Online, Virtual Meeting).

Yun-Yi Pai, Megan Briggeman, Hyungwoo Lee, Jung-Woo Lee, Mengchen Huang, Jianan Li, Chang-Beom Eom, Patrick Irvin, Jeremy Levy, "Superconductivity in 1D Zigzag Nanowires", 2019 APS March Meeting, P09.14.

Yun-Yi Pai, Hyungwoo Lee, Jung-Woo Lee, Anil Annadi, Guanglei Cheng, Shicheng Lu, Michelle Tomczyk, Mengchen Huang, Chang-Beom Eom, Patrick Irvin, Jeremy Levy, "One-Dimensional Nature of Pairing and Superconductivity at the $LaAlO_3/SrTiO_3$", 2018 Materials and Mechanisms of Superconductivity (M2S-2018), Beijing, Th-S48-05.

Yun-Yi Pai, Hyungwoo Lee, Jung-Woo Lee, Anil Annadi, Guanglei Cheng, Shicheng Lu, Michelle Tomczyk, Mengchen Huang, Chang-Beom Eom, Patrick Irvin, Jeremy Levy, "One-Dimensional Nature of Pairing and Superconductivity at the $LaAlO_3/SrTiO_3$", 2018 APS March Meeting, B30.12.

Yun-Yi Pai, Anthony Tylan-Tyler, Patrick Irvin, Jeremy Levy, "$LaAlO_3/SrTiO_3$: a tale of two magnetisms", 2017 APS March Meeting, A37a.12.

Yun-Yi Pai, Dong-Wook Park, Mengchen Huang, Anil Annadi, Hyungwoo Lee, Zhenqiang Ma, Chang-Beom Eom, Patrick Irvin, Jeremy Levy, "Vertical gating of sketched nanodevices", 2016 APS March Meeting, S24.3.

Yun-Yi Pai, Mengchen Huang, Hyungwoo Lee, Chang-Beom Eom, Patrick Irvin, Jeremy Levy, "$LaAlO_3/SrTiO_3$ field-effect nanodevices using in-situ-grown Au top gates", 2015 APS March Meeting, G13.4.

Service

Journal Review
ACS Materials Letters Jan. 2020 - present
ACS Nano Letters Sep. 2019 - Present

Outreach
Lab tour For students from Taylor Allderdice High School. 2015, 2016, 2017
Investing Now! Science demo for students from under-represented groups. 2017

Expertise

Quantum Transport Measurements
Fabricate (conductive-AFM lithography) and characterize (5 years): quantum dots, electron waveguides, superconducting nanowires.

Instrument troubleshoots and maintenance: Quantum Design PPMS (4 years as the superuser) with experience on Quantum Design Vibration Sampling Magnetometry (PPMS-VSM) and Quantum Design dilution refrigerator (PPMS-DR).
Dilution refrigerators: Leiden CF900 (3 years as the superuser), Oxford Triton.
Helium leak detection: Adixen ASM 340, Inficon UL 1000, UL 5000.

Scanning Probe Microscopy
Asylum Research MFP-3D (>1,000 hours of usage; 2 years as the superuser), Asylum Research Cypher. Nanomagnetics milliKelvin-Scanning Probe Microscope (mK-SPM) (> 3 years).

C-AFM lithography. Setup the c-AFM lithography for electron waveguides with mK-SPM.

Confocal Microscopy and Single-Photon Characterization
Built a confocal microscope onto Asylum Research MFP-3D. Used time-correlated single-photon counting to characterize single photon source in ZnO. MilliKelvin Confocal Microscopy (mK-CFM).

Programming
GitHub: https://github.com/yypai
Python: data analysis and multi-index manipulation (Numpy, Scipy and Pandas), visualization (matplotlib, plot.ly), website (Django), interfacing instruments (PyVisa), machine learning (scikit-learn, lgbm), deep learning (Keras, tensorflow 2.0).

LabVIEW: NI-DAQmx, JKI state machine, etc; Mathematica; bash, zsh.

Database Management
https://yypai.github.io/database.html
I setup and manage (for 5 years) a lab-wide database in our research group. It collects the stats for various instruments of the lab as time series. It has now about 650 time-series and size about 400 GB. The database has successfully helped us troubleshoot our lab instruments numerous times, such as IVC leak in our Leiden fridge, humidity anomaly, power gaps due to emergency generator tests, chilled water issues, etc.

CAD, Modeling and graphical design, multimedia
AutoCAD, Blender (my gallery: https://www.behance.net/yypai),
Pad2Pad (PCB design), Illustrator, Photoshop, InDesign, Lightroom, machine shop.