

# JANNICKE PEARKES

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## EDUCATION

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### Stanford University

Dec 2022 (expected)

Ph.D. Candidate in Experimental Particle Physics

### University of British Columbia

2017

B.A.Sc. Engineering Physics – Electrical Specialization

## RESEARCH EXPERIENCE

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### SLAC National Accelerator Laboratory

Sept 2017 – Present

ATLAS Experiment – PhD Candidate (with C. Vernieri and S. Dong)

Menlo Park, USA

*Searches for Di-Higgs to  $bb\gamma\gamma$  - Key analyzer and internal note editor:*

- Prepared and validated Monte Carlo requests for updated  $HH$  signal models
- Developed and implemented new calibration method for b-jets using deep neural network regression
- Designed and produced our data/monte carlo comparison plots
- Identified, debugged and characterized a wide array of features in our analysis
- Optimized analysis selection for sensitivity to Higgs self-coupling ( $\kappa_\lambda$ ) via parameterized neural networks
- Contributed to analysis framework in python and C++ with version control via git
- Actively participates in group meetings and promotes collaboration between institutes and individuals

*Di-Higgs Combination - Key analyzer and internal note editor:*

- Performed non-resonant  $\kappa_\lambda$  scan and produced final limit and efficiency plots
- Prepared datasets for overlap studies between analysis channels to ensure statistical independence
- Co-editor of the ATLAS Physics Briefing for the general public

*Di-Higgs HL-LHC Prospects Combination - Key editor of the conference note*

- Collaborated with the  $bb\tau\tau$  and  $bb\gamma\gamma$  projections teams to produce the combined projections for Snowmass

*Inner Tracker Upgrade (ITk) - Qualification Task:*

- Assembled test stands for electrical quality control testing of RD53As with RCE and YARR
- Performed electrical quality control tests of FE-I4 pixel modules used in the CERN Outer Tracker prototype
- Developed the ITk production database and produced tutorials used by  $\sim 100$  people

### Stanford University

June 2017 – Aug 2017

ATLAS Experiment – CERN Summer Student (with L. Tompkins)

Meyrin, Switzerland

- Assisted in the commissioning of the Data Formatter (DF) for the ATLAS Fast Tracker (FTk)
- Assembled, programmed, installed, tested and debugged hardware in the DF system
- Performed bit error rate and data rate tests with pseudodata with the commissioned ATCA racks

### University of British Columbia

Sept 2015 – May 2017

ATLAS Experiment – NSERC USRA (with W. Fedorko, A. Lister and C. Gay) Vancouver, BC, Canada

*Boosted Top Quark Tagging:*

- Designed deep neural networks for boosted top tagging in ATLAS
- Produced the first results applying deep learning to jet images using ATLAS full simulation
- Tagger was used to perform the first tests of a constituent level deep neural network on ATLAS data
- Four papers originated from this project, our first author paper has been cited 80 times to date

#### *Z' to Di-lepton Analysis:*

- Performed signal injection tests with the BumpHunter algorithm
- Optimized input parameters to the BumpHunter for increased sensitivity to  $Z'$  signal models

### University of Victoria

May 2015 – Aug 2015

ATLAS Experiment – NSERC USRA (with R. Kowalewski)

Victoria, BC, Canada

- Designed deep convolutional neural networks for classification of ATLAS calorimeter images for the ATLAS Missing Transverse Energy trigger

### TRIUMF

Jan 2015 – April 2015

DAQ Group – Senior Design Project (with T. Lindner and F. Retiere)

Vancouver, BC, Canada

- Created a simulation of shaping and read-out electronics with LTSpice for the Hyper Kamiokande Experiment

### TRIUMF

Sept 2014 – Dec 2014

EMMA Co-op Student (with B. Davids)

Vancouver, BC, Canada

- Prepared surfaces of ultra-high voltage electrodes and simulated surface defects with ANSYS FEA software

### Deutsches Elektronen Synchrotron (DESY)

July 2014 – Sept 2014

CMS Summer Student -  $\mu$ TCA Group (with U. Behrens and I. Melzer-Pellmann) Hamburg, Germany

- Programmed FPGAs in VHDL and tested performance of high speed electronics for the CMS HCAL

### TRIUMF

Jan 2013 – Apr 2013

TITAN Co-op Student (with B. Schultz and J. Dilling)

Vancouver, BC, Canada

- Simulated ion beams, created an ultra-high vacuum monitoring system with LabView, experimental data analysis

### PUBLICATIONS

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1. Measurement Prospects of Higgs boson pair production combining the  $b\bar{b}\gamma\gamma$  and  $b\bar{b}\tau^+\tau^-$  final states with the ATLAS detector at the HL-LHC, *ATLAS Collaboration*, ATL-PHYS-PUB-2022-005.  
<http://cdsweb.cern.ch/record/2802127>
2. Combination of searches for non-resonant and resonant Higgs boson pair production in the  $b\bar{b}\gamma\gamma$ ,  $b\bar{b}\tau^+\tau^-$  and  $b\bar{b}b\bar{b}$  decay channels using  $pp$  collisions at  $\sqrt{s} = 13$  TeV with the ATLAS detector, *ATLAS Collaboration*, ATLAS-CONF-2021-052. <http://cdsweb.cern.ch/record/2786865>
3. Search for Higgs boson pair production in the two bottom quarks plus two photons final state in  $pp$  collisions at  $\sqrt{s} = 13$  TeV with the ATLAS detector, *ATLAS Collaboration*, ATLAS-CONF-2021-016. (2021) <https://cds.cern.ch/record/2759683>
4. The Machine Learning Landscape of Top Taggers. *Butter, A. et al.*, SciPost Phys. 7.1.014, (2019).  
<https://arxiv.org/abs/1902.09914>

5. Performance of top-quark and  $W$ -boson tagging with ATLAS in Run 2 of the LHC, *ATLAS Collaboration* Eur. Phys. J., (2019). <https://arxiv.org/abs/1808.07858>
6. Long Short-Term Memory (LSTM) networks with jet constituents for boosted top tagging at the LHC, *S. Egan, W. Fedorko, A. Lister, J. Pearkes, C. Gay*, (2017). <https://arxiv.org/abs/1711.09059>
7. Jet Constituents for Deep Neural Network Based Top Quark Tagging, *J. Pearkes, W. Fedorko, A. Lister, and C. Gay*, (2017). <https://arxiv.org/abs/1704.02124>
8. Search for high-mass new phenomena in the dilepton final state using proton-proton collisions at  $\sqrt{s}=13$  TeV with the ATLAS detector, *ATLAS Collaboration*, Phys. Lett. B 761 (2016). <https://arxiv.org/abs/1607.03669>
9. Mass measurements of neutron-rich Rb and Sr isotopes, *TITAN Experiment*, Phys. Rev. C 93, 045807 (2016). <https://arxiv.org/abs/1512.07105>
10. First direct mass measurement of the neutron-deficient nucleus  $^{24}\text{Al}$ , *TITAN Experiment*, Phys. Rev. C 92, 045803 (2015). <https://doi.org/10.1103/PhysRevC.92.045803>

## CONFERENCES

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<b>International Conference on High Energy Physics – Virtual</b>	<b>Apr 2022</b>
Poster: <i>ATLAS Di-Higgs Combination Results</i>	
<b>APS April Meeting – New York, NY</b>	<b>Apr 2022</b>
Talk: <i>ATLAS Di-Higgs Combination Results</i>	
<b>New Methods and Ideas in Particle Physics – Aspen, Colorado</b>	<b>Mar 2022</b>
Talk: <i>HH Searches with ATLAS</i>	
<b>Higgs 2021 – Virtual, Stony Brook</b>	<b>Aug 2021</b>
Plenary YSF Talk: <i>Search for non-resonant di-Higgs production in the <math>bb\gamma\gamma</math> final state at 13 TeV with ATLAS</i>	
<b>Machine Learning for Jets – New York, NY</b>	<b>Jan 2020</b>
<b>Hadronic Calibration Workshop – Heidelberg, Germany</b>	<b>Sept 2018</b>
<b>Machine Learning for Jets – Berkeley, CA</b>	<b>Nov 2017</b>
<b>Inter-Experimental Machine Learning Workshop – CERN, Switzerland</b>	<b>Mar 2017</b>
Talk: <i>Top Tagging with Deep Neural Networks</i>	
<b>APS Northwest Meeting – Penticton, BC , Canada</b>	<b>May 2016</b>
Talk: <i>Using Neural Networks to Separate Signal from Background with Real Missing Transverse Energy</i>	

## NOTABLE ATLAS INTERNAL PRESENTATIONS

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<b>ATLAS Upgrade Meeting – CERN, Switzerland</b>	<b>Jan 2022</b>
Talk: <i>Di-Higgs Prospects - Latest and Upcoming Results</i>	
<b>ATLAS HH Workshop – CERN, Switzerland</b>	<b>Oct 2021</b>
Talk: <i>Current Combination Results</i>	
<b>Physics Approval Meeting – CERN, Switzerland</b>	<b>Oct 2021</b>
Talk: <i>HH Combination Results</i>	
<b>Di-Higgs Subgroup Meeting – CERN, Switzerland</b>	<b>Aug 2021</b>
Talk: <i>HH Combination Status Report</i>	
<b>Di-Higgs Subgroup Meeting – CERN, Switzerland</b>	<b>Apr 2021</b>
Talk: <i>VBF HH Herwig 7 Signal Request</i>	
<b>Di-Higgs Subgroup Meeting – CERN, Switzerland</b>	<b>Apr 2021</b>
Talk: <i>ggF HH <math>bb\gamma\gamma</math> Signal Request</i>	
<b>ITk Pre-PDR Meeting – CERN, Switzerland</b>	<b>Jul 2019</b>
Talk: <i>ITk Production Database Tutorial</i>	
<b>ATLAS HDBS Workshop – CERN, Switzerland</b>	<b>Nov 2018</b>
Talk: <i>B-Jet Energy Regression for Di-Higgs Searches</i>	

<b>ITk Pixel Module WG</b> – CERN, Switzerland	<b>Mar 2019</b>
Talk: ITk Module Building Survey	
<b>Di-Higgs Kickoff Workshop</b> – CERN, Switzerland	<b>Feb 2019</b>
Talk: B-Jet Energy Corrections and Improvements to the $m_{bb}$ Resolution	
<b>ITk QA/QC Workshop</b> – CERN, Switzerland	<b>Mar 2019</b>
Talk: Pixel Module Technical Specifications	
<b>ITk Pixel Module WG</b> – CERN, Switzerland	<b>Oct 2018</b>
Talk: Status of Database for Modules	
<b>FTk Meeting</b> – CERN, Switzerland	<b>Aug 2017</b>
Talk: Data Formatter Rate Studies	
<b>ATLAS ML Forum</b> – CERN, Switzerland	<b>Nov 2016</b>
Talk: Deep Neural Networks for Jet Tagging	

## SUMMER SCHOOLS

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<b>SLAC Summer Institute</b> – Virtual, SLAC	<b>August 2021</b>
Poster: Searches for Di-Higgs Decaying to $bb\gamma\gamma$ with the ATLAS Detector	
<b>Hadron Collider Physics Summer School</b> – Virtual, Fermilab	<b>July 2020</b>
<b>SLAC Summer Institute</b> – Menlo Park, CA	<b>August 2019</b>
Poster: B-jet Energy Regression for HH Searches	
<b>CTEQ Summer School</b> – Mayaguez, Puerto Rico	<b>June 2018</b>

## AWARDS

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APS Grad Slam (APS membership for 1 year)	<b>2022</b>
Martin and Beate Block Award - most promising young physicist, Aspen Center for Physics (\$500)	<b>2022</b>
NSERC Undergraduate Student Research Award (\$4,500)	<b>2016</b>
2nd Place Canadian Undergraduate Physics Conference	<b>2015</b>
NSERC Undergraduate Student Research Award (\$4,500)	<b>2015</b>
1st Place TRIUMF Undergraduate Student Symposium	<b>2014</b>
3rd Place Canadian Undergraduate Physics Conference	<b>2014</b>
2nd Place TRIUMF Undergraduate Student Symposium	<b>2013</b>

## RESEARCH MENTORING

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Everett Lee - $HH \rightarrow bb\gamma\gamma$ kinematic fit	2022
Mirella Vassilev - b-jet working point studies for VBF $HH \rightarrow bb\gamma\gamma$ analysis	2022
Brandon Zhang - $HH \rightarrow bb\gamma\gamma$ kinematic fit	2021
Jake Hofgard - HL-LHC Prospects for $HH \rightarrow bb\gamma\gamma$ analysis	2021
David Wendt - VBF sensitivity studies for $HH \rightarrow bb\gamma\gamma$ analysis	2020
Ishira Fernando, Sean Hackett, Alex Boulton-McKeehan - Dark photon prospects with Mu3e	2020
Genevieve Hayes - Tracks as inputs for boosted top tagging	2019
Shannon Egan - LSTMs for boosted top tagging	2018
Anita Mahinpei - Adversarial training for boosted top tagging	2018

## TEACHING EXPERIENCE

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<b>Stanford University</b>	<b>Stanford, CA</b>
<i>Advanced Physics Laboratory - Teaching Assistant</i>	April 2020 – June 2020
<ul style="list-style-type: none"><li>Advanced undergraduate physics course in which students researched and proposed an experiment of their choice. Mentored a group of students interested in the Atomki anomaly and resonance searches with Mu3e. Student report at: <a href="https://arxiv.org/abs/2009.03540">https://arxiv.org/abs/2009.03540</a></li></ul>	
<i>Mechanics Laboratory - Teaching Assistant</i>	October 2019 – December 2019
<ul style="list-style-type: none"><li>Enriched introductory physics labs covering experimental design and data analysis.</li><li>Taught students to design research questions, collect and analyse data from pendulums and water bottle rockets, and quantitatively assess where their models fit the data.</li></ul>	
<i>Introduction to Laboratory Physics - Teaching Assistant</i>	March 2018 – June 2018
<ul style="list-style-type: none"><li>Enriched introductory physics labs covering optics, heat transfer, radiation, and electronic circuits.</li><li>Designed and ran introductory python data analysis tutorials</li></ul>	
<b>Byte Camp Education Society</b>	<b>June 2012 – August 2012</b>
<i>Lead Instructor</i>	Vancouver, BC, Canada
<ul style="list-style-type: none"><li>Taught programming, animation and video game design in Flash to summer camp students ages 11-14</li></ul>	

## LEADERSHIP ACTIVITIES

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<b>SLAC Users Organization – High Energy Physics Advocacy Representative</b>	<b>March 2020 &amp; 2018</b>
<ul style="list-style-type: none"><li>Lead meetings with 25 congressional offices in Washington DC to advocate for High Energy Physics</li></ul>	
<b>UBC Snowbots – Autonomous Robotics Team</b>	<b>Sept 2012 – Dec 2015</b>
<b>Member → Software Team Lead → Team Captain</b>	
<ul style="list-style-type: none"><li>As software lead, developed computer vision system (filtering, lane following) with OpenCV in C++, developed LIDAR obstacle avoidance, GPS navigation algorithms, and high level AI for integrating the multiple subsystems.</li><li>As team captain, co-ordinated growth of the team from 15 to 56 active students</li><li>Raised over \$30,000 in funding for the team and organized team travel to 3 international competitions</li></ul>	

## OUTREACH

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Discotracker - an ATLAS Inner Tracker inspired art installation <a href="https://drive.google.com/drive/folders/1EVuN55Nu1YM3Ch_q093ieuq2117qaPdv?usp=sharing">https://drive.google.com/drive/folders/1EVuN55Nu1YM3Ch_q093ieuq2117qaPdv?usp=sharing</a>	2022
ATLAS Physics Briefing - HH Combination, lead author <a href="https://atlas.cern/updates/briefing/new-milestone-di-Higgs-search">https://atlas.cern/updates/briefing/new-milestone-di-Higgs-search</a>	2021
ATLAS Physics Results Explained Video for $b\bar{b}\gamma\gamma$ analysis - participant <a href="https://fb.watch/eGNhVNugbC/">https://fb.watch/eGNhVNugbC/</a>	2020
"What is a particle?" - York House Girls School outreach presentation	2019

## SKILLS

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**Languages:** English and German (bilingual), French (intermediate)  
**Programming Languages:** Python, C++, Bash, C, VHDL, Verilog, MATLAB, LabView  
**Libraries:** Tensorflow, Keras, Numpy, Pandas, Scikit-learn, Matplotlib, Open-CV, ROS  
**High Performance Computing:** Slurm, condor, torque, moab  
**Laboratory:** Ultra high voltage and ultra high vacuum cleanroom experience  
**Rapid Prototyping:** Water-jet, laser-cutter, 3D printer, lathe, 40 hour machine shop course  
**Communication:** Award winning public speaking skills and writing of papers/documentation  
**Group Culture:** Regular organizer of research group dinners and social activities

## OTHER ACTIVITIES

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Enjoys backpacking, hiking, skiing, climbing and listening to podcasts. AIARE 1 (avalanche safety) and wilderness first aid certified.