

TYLER JAMES BURCH

PHONE: +1 (346) 202 4693
EMAIL: tyler.james.burch@cern.ch
WEBPAGE: tjburch.github.io

RESEARCH INTERESTS: Experimental high-energy collider physics, Higgs boson physics, trigger and data acquisition systems, high performance photon identification, machine learning applications in HEP

EDUCATION

AUG 2014 - **Northern Illinois University**, DeKalb, Illinois
PRESENT Physics Ph.D. candidate
Advised by Jahred A. Adelman. Expected graduation - March 2020.
Thesis: "A search for resonant and non-resonant di-Higgs production in the $\gamma\gamma b\bar{b}$ channel using the ATLAS Detector"

AUG 2011 - **Murray State University**, Murray, Kentucky
MAY 2014 Bachelor of Science in Physics (*Cum Laude*)
Minors: Mathematics, Music

SCHOLARSHIPS AND AWARDS

APRIL 2019 **Outstanding PhD Student 2019** - Northern Illinois University, Department of Physics

SEPTEMBER 2018 - **DOE Office of Science Graduate Student Research (SCGSR) Award Recipient**
AUGUST 2019 Research Project: "Utilizing Machine Learning Classifiers for Photon Identification"
Conducted at Argonne National Laboratory

FEBRUARY 2019 **Competitively Selected to attend International School of Trigger and Data Acquisition (ISOTDAQ)** - Vienna, Austria

TALKS

Photon Identification Optimization US ATLAS Physics Workshop. Amherst, MA. August 8, 2019.

ATLAS Searches for VH/HH Resonances Phenomenology Symposium (PHENO). Pittsburgh, PA. May 6, 2019.

Photon Identification Optimization, Tests on Data, and MVA Perspectives ATLAS e/γ Workshop. Sheffield, England. January 29, 2019.

Why Do We Care About Looking for di-Higgs Production? 2018 US LHC Users Association Meeting. Fermilab, Batavia, Illinois. October 25, 2018.

Vector Boson Fusion di-Higgs Generation and Benchmarks Double Higgs Production at Colliders Workshop. Fermilab, Batavia, Illinois. September 7, 2018.

T.J. Burch, "Online Software in the ATLAS FastTracker System". Poster Session, ATLAS Collaboration Week, Bratislava. October 9, 2017.

RESEARCH EXPERIENCE

AUGUST 2015 - **Northern Illinois University**
PRESENT ATLAS EXPERIMENT

ATLAS Search for $HH \rightarrow b\bar{b}\gamma\gamma$

- Main analyzer on search utilizing the full Run 2 data set collected from 2015 through 2018.
- Analysis probes both Standard Model (SM) di-Higgs production as well as enhanced production due to physics beyond the SM.
- Adding Vector Boson Fusion (VBF) production mode to analysis, first to look at this topology for HH . Completed Monte Carlo production and validation for VBF mode.
- Using a multiclassifier Boosted Decision Tree to define VBF enriched category.
- Editor for internal support document.
- Participated in search using 2015 and 2016 data. Published July 2018

ATLAS Photon Identification Group

- Investigated adding variables based on topological clusters to current photon ID, provided an additional 10% improvement in background rejection.
- Studied utilization of a Boosted Decision Tree and a Neural Network to improve photon classification, providing up to 20% improvement over the current cut-based method.
- Ultimately, studies showed as much as a 25% improvement in background rejection at the same signal efficiency.

ATLAS FastTracker (FTK) Upgrade

- Offline software - compared simulated performance to offline, served as authorship qualification project (August 2015 - June 2017; qualified January 2017)
- Online software and day-to-day operations, specifically focused on operation of the Input Mezzanine Card (March 2017 - September 2018).
- System commissioning in 2017-2018, involved in installation, testing, and scaling of massively parallel system.

Service work:

- Responsible for running validation on Monte Carlo for the HGamma subgroup and maintaining webpage containing validation information.
- Frequent on-call shifter for the FTK subsystem (2017 - 2018).
- Run Control shifts in the ATLAS control room (2017).

MAY 2015 - **Northern Illinois University**
AUGUST 2015 Mu2e - *Supervised by Vishnu Zutshi*

Investigated radiation effects on performance of silicon photomultipliers (SiPM) for use in the Mu2e experiment

PUBLICATIONS

225 publications as a member of the **ATLAS Collaboration**, January 2017 to present (SPIRES)

Selected Publications:

- (1) ATLAS Collaboration. "Search for Higgs boson pair production in the $\gamma\gamma b\bar{b}$ final state with 13 TeV pp collision data collected by the ATLAS experiment". In: *JHEP* 11 (2018). doi: 10.1007/JHEP11(2018)040. arXiv: 1807.04873 [hep-ex].
- (2) ATLAS Collaboration. "Combination of searches for Higgs boson pairs in pp collisions at $s=13$ TeV with the ATLAS detector". In: *Physics Letters B* 800 (2020), p. 135103. issn: 0370-2693. doi: <https://doi.org/10.1016/j.physletb.2019.135103>. URL: <http://www.sciencedirect.com/science/article/pii/S0370269319308251>.
- (4) *Validation of signal Monte Carlo event generation in searches for Higgs boson pairs with the ATLAS detector*. Tech. rep. ATL-PHYS-PUB-2019-007. Geneva: CERN, 2019. URL: <http://cds.cern.ch/record/2665057>.
- (5) J. Alison et al. "Higgs boson pair production at colliders: status and perspectives". In: *Double Higgs Production at Colliders Batavia, IL, USA, September 4, 2018-9, 2019*. Ed. by B. Di Micco et al. 2019. arXiv: 1910.00012 [hep-ph].

CONFERENCES, WORKSHOPS, SCHOOLS

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| Nov 14 -16, 2018 | Machine Learning for Jet Physics Fermilab, Batavia, Illinois. |
| Oct 24 - 26, 2018 | 2018 US LHC Users Association Meeting Fermilab, Batavia, Illinois. |
| Apr 9 - 12, 2018 | 2nd Inter-experimental Machine Learning Workshop , CERN, Geneva, Switzerland. |
| Feb 14 - 22, 2018 | International School of Trigger and Data Acquisition (ISOTDAQ) , Vienna, Austria. |
| Nov 13 - 16, 2017 | DBL/HBSM Joint Workshop , LAPP, Annecy, France. |
| Oct 8 - 13, 2017 | ATLAS Collaboration Week , Bratislava, Slovakia. |

TEACHING AND OUTREACH

2014 - 2019

- **CAMPFIRE 2019 Workshop Volunteer**, Argonne National Laboratory. June 9-14, 2019. Trained new graduate students on the ATLAS experiment, provided career guidance from the perspective of a senior graduate student.
- **STEMfest Volunteer**, Northern Illinois University. Oct 8, 2016.
- **QuarkNet Volunteer Instructor**, Northern Illinois University. June 6-10, 2016.
- **Graduate Colloquium Chair**, Northern Illinois University. Aug 2015 - Dec 2016. Invited 2-3 speakers to NIU each semester on behalf of the physics graduate students through university's Graduate Colloquium Program. Oversaw speaker selection and coordination of visits.
- **Graduate Teaching Assistant**, Northern Illinois University. Fall 2014 - Spring 2015. Instructed labs for Phys 210 (Fall 2014; supervised by Prof. Lyle Marschand) and Phys 253 (Spring 2015; supervised by Prof. Dennis Brown)

2012 - 2014

- **Undergraduate Teaching Assistant**, Murray State University. Graded for an introductory C++ class (Fall 2012; supervised by Prof. James Hereford). Instructed various general physics labs (Spring 2013 - Spring 2014).

SKILLS

PROGRAMMING: C++, ROOT, Python, MATLAB, \LaTeX
PYTHON LIBRARIES: Numpy, Pandas, Matplotlib, Seaborn, Keras, XGBoost, Scikit-Learn, Scipy
GITLAB AND GITHUB: @tjburch

MENTORING

ARI JOSEPHSON (OHIO STATE) Summer 2019 REU

INTERESTS AND HOBBIES

Music - 2014 KMEA Intercollegiate jazz guitarist, 2011 IMEA All-State bassoonist
Baseball - Several articles published to the statistics site *Fangraphs* (see personal website for links)