

# TYLER JAMES BURCH

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**RESEARCH INTERESTS:** Experimental high-energy collider physics, Higgs boson physics, high-performance computing, machine learning applications in HEP

## EDUCATION

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AUG 2014 - MARCH 2020 **Northern Illinois University**, DeKalb, Illinois  
Doctor of Philosophy in Physics - Advised by Jahred Adelman.  
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 - MAY 2014 **Murray State University**, Murray, Kentucky  
Bachelor of Science in Physics (*Cum Laude*)  
Minors: Mathematics, Music

## RESEARCH EXPERIENCE

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MAY 2020 - PRESENT **Argonne National Laboratory**  
Postdoctoral Appointee - ARGONNE LEADERSHIP COMPUTING FACILITY

Aurora Early Science Program

- Developing the particle physics event generator MadGraph for use on the first US Exascale Computer, Aurora.
- Studying application of uncertainty quantification methods for machine learning models used in HEP object identification.

AUGUST 2015 - MARCH 2020 **Northern Illinois University**  
Graduate Student - ATLAS EXPERIMENT

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

- Main analyzer and editor for internal support document for full Run 2 search, utilizing the data collected from 2015 through 2018.
- 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 an XGBoost multiclassifier to define VBF enriched category, projected to improve Asimov significance by 10%.
- Studies of background composition in search using 2015 and 2016 data. Published July 2018.

#### ATLAS Photon Identification Group

T.J. Burch

- 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 Graduate Student - Mu2E

Investigated radiation effects on performance of silicon photomultipliers (SiPM) for use in the Mu2e experiment. Supervised by Vishnu Zutshi.

## SCHOLARSHIPS AND AWARDS

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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

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**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  $e/\gamma$  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.

## POSTERS

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

## PUBLICATIONS

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282 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  $s=13\text{TeV}$  with the ATLAS detector". In: *Physics Letters B* 800 (2020), p. 135103. doi: <https://doi.org/10.1016/j.physletb.2019.135103>.
- (3) *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>.
- (4) J. Alison et al. "Higgs boson pair production at colliders: status and perspectives". In: ed. by B. Di Micco et al. 2019. arXiv: 1910.00012 [hep-ph].  
- Sole author of Section 5.6: *HH production in the VBF mode*.

## TEACHING AND OUTREACH

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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

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

## MENTORING

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ARI JOSEPHSON (OHIO STATE) Summer 2019 REU

## INTERESTS AND HOBBIES

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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)