# Tyler James Burch, Ph.D.

Data Analysis, Machine Learning, Particle Physics, Performance Computing

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## Experience

### Argonne National Laboratory — *Lemont, IL*

Postdoctoral Appointee - Particle Physics Simulation with Machine Learning on Exascale Supercomputers — *May 2020 - Present*

- Adapting particle physics simulation software (`MadGraph`) to Intel's oneAPI for use on the first US exascale supercomputer
- Studying Bayesian uncertainty quantification methods in machine learning models used in particle physics object identification

### Northern Illinois University — *DeKalb, Illinois*

Graduate Research Assistant — *May 2015 - March 2020*

- Main analyzer on a team searching for a rare physics process, Higgs boson pair production, in one of the world's largest datasets
  - Generated simulation of previously unstudied particle physics processes and detector effects using Monte Carlo methods
  - Employed an XGBoost multiclassifier to identify candidate signal events, ultimately improving projected Asimov significance by 10%
- Studied detector signatures to identify those coming from photons, ultimately showing up to a 25% improvement in background rejection over previous methods
  - Employed new variables which parameterize the topology of the signature in the detector
  - Studied transition of cut-based methods to an XGBoost decision tree and a neural network developed in Keras
- Involved in the commissioning of an FPGA-based hardware system, which tracks particle trajectories in real-time
- Performed shift work for general operations, both running the detector and as an on-call expert
- Research mentor of 3 undergraduate physics students, instructor of two undergraduate general physics laboratory courses

### Independent Research and Projects

- Contributor to the Community Research blog at *Fangraphs* - three articles published
- Recent contributor to `pybaseball`, a library to scrape various baseball data streams into python
- Frequent submitter of solutions to FiveThirtyEight's weekly *Riddler* competition - two solutions featured

## Skills

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| **Programming Languages** | Python, C++, Matlab |
| **Libraries and Frameworks** | Numpy, Pandas, Scikit-Learn, XGBoost, Keras, PyTorch, Scipy, Matplotlib, Seaborn, PyMC3 Jupyter, SYCL |
| **Computing and software** | Git, SVN, LaTeX, JIRA, Emacs, VSCode, Microsoft Office |

## Education

### Northern Illinois University — *Dekalb, IL*

Doctor of Philosophy — *August 2014 - 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
- **CERN (European Organization for Nuclear Research)**, Geneva, Switzerland — *April 2017 - August 2018*

### Murray State University — *Murray, KY*

Bachelor of Science, Cum Laude — *August 2011 - May 2014*

- Major in physics, minors in mathematics and music

## Awards

### DOE Office of Science Graduate Student Research (SCGSR) Fellowship — *Lemont, Illinois*

**Proposal:** Utilizing Machine Learning Classifiers for Photon Identification — *September 2018 - August 2019*

## Publications & Talks

### Phenomenology Symposium (PHENO) 2019 — *University of Pittsburgh*

ATLAS Searches for VH/HH Resonances — *Invited Talk - May 6, 2019*

### Higgs Boson Pair Production at Colliders: Status and Perspective

Reviews in Physics, p. 100045.doi:https://doi.org/10.1016/j.revip.2020.100045. — *White Paper - September 30, 2019*

Sole author of Section 5.6: HH production in the VBF mode

300 publications as a member of the ATLAS Collaboration, January 2017 to present