Garrett Merz
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Github Page: https://github.com/GarrettMerz
Website: https://garrettmerz.github.io/

EDUCATION:
University of Michigan, Ann Arbor MI.
Ph.D. Physics, expected 2021
GPA: 3.744 (4.0 scale)

The Ohio State University, Columbus, OH
B.S. Physics, Mathematics with Honors Research Distinction, 2016
Overall GPA: 3.811 (4.0 scale)
Physics Major GPA: 3.891
Mathematics Major GPA: 3.545

RESEARCH EXPERIENCE:
ATLAS Group at University of Michigan
PhD Candidate
Advisor: Dr. Tom Schwarz

All-Hadronic Search for Vector-Like Quarks in ATLAS at 13 TeV: June 2016-January 2017

- Perform trigger studies to determine optimal data acquisition conditions
- Develop jet-tagging algorithm to classify variable-radius reclustered hadronic jets

Search for Pair Production of Scalar Leptoquarks Decaying to bτbτ with the ATLAS Detector : June 2017-June 2018

- Topic of PhD Candidacy Exam
- Validate samples for off-diagonal decays (cτcτ/jτjτ)
- Train Boosted Decision Tree to discriminate between signal and background events in the single b-tag signal region
- Generate exclusion contour plots for use in setting final limits
- Attended Machine Learning in High Energy Physics (MLHEP 2017) summer school in Reading, UK

Observation of Higgs boson production in association with a top quark pair at the LHC with the ATLAS detector: May 2018-June 2018

- Generate analysis ntuples from MxAODs
- Perform maintenance and documentation of analysis framework

Measurements of Higgs boson properties in the diphoton decay channel using 80 fb−1 of *pp* collision data at $\sqrt{s}$ = 13 TeV with the ATLAS detector: May 2018-July 2018

- Generate analysis ntuples from MxAODs
- Perform maintenance and documentation of analysis framework
- Create continuum background templates for measurement of “spurious signal” systematic
  - Perform tests to evaluate the fitness of these templates

Further Measurements of of Higgs boson production in association with a top quark pair at the LHC with the ATLAS detector: June 2018-March 2019

- Implement and develop top reconstruction methods, including the Kinematic Likelihood Fitter (KLFitter)
- Create continuum background templates for spurious signal measurement
  - Perform studies to determine optimal method for template construction
- Perform signal parameterization

Measuring the CP Properties of a Neutral Higgs with ttH→yy: October 2018-Present

- Produce DAOD and MxAOD samples
- Implement and develop top reconstruction methods, including the top reconstruction BDT and Kinematic Likelihood Fitter (KLFitter)
- Validate Monte Carlo Samples
- Construct, optimize and train a series of Boosted Decision Trees to discriminate between Standard Model ttH, CP-odd Higgs ttH, and continuum diphoton background events
  - Measure significance in order to determine optimal BDT configuration
- Create continuum background templates for spurious signal measurement
  - Perform studies to determine optimal method for template construction
- Perform signal parameterization
- Present analysis summary at 2019 USATLAS Meeting in Amherst, Massachusetts
- Investigate the applicability of a multiclassifier BDT to discriminate between CP-even ttH, CP-odd ttH, and continuum diphoton background events
  - Develop a novel multidimensional fitting technique to extract significance from Boosted Decision Tree outputs
- As Internal Note Editor, produce and maintain internal documentation related to the analysis

Measurements of Higgs boson properties in the diphoton decay channel using 138 fb−1 of *pp* collision data at $\sqrt{s}$ = 13 TeV with the ATLAS detector: March 2019-Present

- As HGAM analysis DAOD contact, promptly produce and monitor DAOD samples
- Respond promptly to ATLASSIAN JIRA tickets
- Maintain the HGAM DAOD production codebase

Construction and Testing of Prototype Small Monitored Drift Tube Chamber: May 2018-May 2019

- ATLAS authorship qualification task
- Travel to Max Planck Institute in Munich, Germany, to build and test 500 small monitored drift tubes for use in a protoype muon test chamber
- Assist in the construction of said muon chamber
- Collect cosmic-ray data using prototype chamber; using this, measure spatial resolution of new chamber
  - Calibrate timing offset for each tube by fitting TDC and ADC spectra

CMS/CDF Computational Physics Lab at The Ohio State University
Undergraduate Researcher
Advisor: Dr. Richard Hughes

W-Boson Forward-Backward Asymmetry Analysis at the Fermilab Tevatron: January 2013- March 2013

- Used ROOT analysis framework to plot and study attributes of weak decays in the CDF Detector at the Fermilab Tevatron
- Studied Monte Carlo simulations to model expected asymmetry values

Measurement of Top Quark Pair Production Cross Section in the Fermilab Tevatron: March 2013- June 2014

- Wrote scripts to remove duplicate data events, plot histograms of various attributes of CDF data
- Used statistical analysis methods to calculate uncertainties on *ttbar* cross-section measurement
- Analyzed systematic effects on simulated data
- Trained boosted decision trees to discriminate between signal and background events
- Used Bayesian algorithm to measure interaction cross-section
- Presented progress at Fall Undergraduate Poster Forum, Natural and Mathematical Sciences Poster forum, and Denman Undergraduate Research Forum (Honorable Mention)

Using Convolutional Neural Networks to Identify ttH Events at the LHC: August 2014-June 2016

- Learned to write and implement Convolutional Neural Networks (CNNs) in MatLab and Torch7
- Tested these networks' ability to effectively analyze Monte Carlo simulations of event images gathered from a multipurpose detector such as CMS
- Investigated CNNs' ability to discriminate between similar processes, namely *ttbar* and *W+jets*
- Modified network architecture in order to optimize analysis capabilities
- Explored implementation of scene labeling techniques on simulated detector images
- Presented progress at 2015 Fall Undergraduate Poster Forum and 2015 Natural and Mathematical Sciences Forum
- Undergraduate thesis defended in spring of 2016

Georg-August Universität Göttingen, Second Institute of Physics: June 2014- August 2014
DAAD RISE Intern
Group Leader: Prof. Dr. Arnulf Quadt
Project Advisor: Philipp Stolte

- Modified the Kinematic Likelihood Fitter (KLFitter) Framework for kinematic fitting of top quark pair production events in the ATLAS detector
- Rewrote parts of KLFitter code to run over differently-structured sets of Monte Carlo simulated data
- Modified MatchMonster program to match simulated data at detector level with particles at parton level
- Attended Hadron Collider Summer School (HASCO) program

TEACHING EXPERIENCE

University of Michigan Department of Physics
Graduate Student Intructor, Physics 136: September 2016-December 2017

- Instructor for a total of seven sections of introductory physics lab work
- Design and administer weekly quizzes and facilitate the completion of weekly lab reports
- Participate in general physics tutoring through the Physics Help Room

TECHNICAL AND COMPUTING SKILLS:
C++, Mathematica, ROOT, MatLab, Python (including numpy and scikit-learn), Lua, Torch7, UNIX/Linux, TensorFlow

SCHOLARSHIPS AND AWARDS:
2012 Valentino Physics Scholarship
2012 Honors Medalist Scholarship
2012 National Merit Commended Scholar
2013 Physics Summer Research Scholarship
2013 Hellen Cowan Book Award
2013 Phi Kappa Phi Student Honorary
2014 Smith Sophomore Award
2014 Kenneth Cummins Scholarship
2014 Sigma Pi Sigma Honorary
2014 Denman Research Forum Honorable Mention
2015 Undergraduate Research Office Summer Scholarship
2015 Staninovski Mathematics Scholarship
2015 Phi Beta Kappa Honorary
2016 Denman Research Forum, First Prize
2016 National Science Foundation Graduate Research Fellowship Program, Honorable Mention
2017 Norman Barnett Award
2018 UM Science Communication Fellowship Program
2018 National Science Foundation Graduate Research Fellowship

LEADERSHIP ROLES:
University of Michigan Department of Physics: *Graduate Student Mentor* 2017-2018

High Energy Physics Journal Club at the Ohio State University: *Secretary* 2013- 2016
Ohio State University Department of Physics: *Peer Mentor* 2013- 2016
Undergraduate Research Office: *Peer Research Contact* 2013- 2016
Society of Physics Students, OSU Chapter: *Vice President* 2013-2015

DATA SCIENCE:

UMich Data Science Team: Member, September 2019-Present

- Attend weekly learning workshops to better develop data science skills
- Work in groups on projects such as Kaggle challenges

SCIENCE COMMUNICATION:

"My Scientist Friend" Science Communication Podcast Host:

- Developed as a tool to colloquialize science and scientists
- Answer listener science questions
- Interview other scientists
- Tell interesting anecdotes from science history

"Saturday Morning Physics: Update on Physics from the LHC": 30 March 2019

- Assist in delivery of televised lecture on top-associated Higgs production
- Perform and discuss various demonstrations

UM Science Communication Fellowship Program

- Construct tabletop cosmic-ray cloud chamber
- Present along with other hands-on demonstrations at several public events

ComSciCon 2019 Attendee

- Attend seminars on science journalism, data visualization, podcast development
- Produce and workshop a piece of science communication writing

UMATLAS Virtual and Augmented Reality Outreach Program: June 2016-Present

- Assist in development of the ATLASRift virtual reality experience for the HTC Vive headset
- Present the ATLASRift software to the general public at museums and showcases
- Develop novel pedagogical experiences integrating virtual and augmented reality demonstrations into introductory physics laboratory classes

Females Excelling More in Math, Engineering, and the Sciences (FEMMES) Camp: *Demo Organizer/Volunteer*, 2017

Girls Reaching to Achieve in Sports and Physics (GRASP) Camp: *Volunteer*, 2013

OSU Physics Summit for High School Students: *Volunteer*, 2012