

# John Alison

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## CONTACT INFORMATION

Department of Physics  
Carnegie Mellon University  
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## CURRENT POSITION

**Assistant Professor**, Carnegie Mellon University  
- Joined the CMS group at CMU, Fall 2018

## PREVIOUSLY

**Fermi/McCormick Fellow**, University of Chicago  
- Member ATLAS group at Chicago, January 2013 - Fall 2018  
- Awarded Fermi/McCormick Fellowship  
- 85th Compton Lecturer: *“How and Why to Go Beyond the Discovery of the Higgs Boson”*

## EDUCATION

### University of Pennsylvania

- Ph.D. Physics, December 2012
- Dissertation Title: “The Road to Discovery: TRT Alignment, Electron Identification, Particle Mis-identification, WW Physics, and the Discovery of the Higgs Boson”
  - Adviser: I. J. Kroll
  - Received 2013 ATLAS thesis award
  - Awarded Springer Thesis prize

### University of Pittsburgh

- Graduated with Highest Honors, May 2006
- B.S. Physics and Astronomy
- B.A. Philosophy
- Received the Peter F. M. Koehler Academic Achievement Award
- Received the Halliday Award for Excellence in Undergraduate Research

## CURRENT RESEARCH

The CMS Experiment, CERN

### High-Granularity End-cap Calorimeter Upgrade

- Needed to cope w/radiation foreseen during High-Luminosity LHC data taking
- Imaging-like physics reconstruction (>50 sampling layers !)
- Module Assembly Center at CMU
- CMU responsible for ~5000 silicon modules (half of all hadronic Si-modules)
- Automated module assembly, wire bonding, and testing all done in-house

### Search for New physics in events with pairs of Higgs bosons

- Long/Rich future with the High-Luminosity LHC dataset
- New physics sensitivity interesting already
- Higgs self-coupling flagship measurement with upgraded LHC/detectors

### Machine Learning

- Exploit recent advances in image processing to fully exploit data
- Capitalize on CMU’s world-class School of Computer Science
- Directly applicable now for Di-Higgs analyses
- Important in future to get most out of the High-Granularity Calorimeter

POSTDOCTORAL  
RESEARCH

The ATLAS Experiment, CERN

- Convener of ATLAS di-Higgs group (2016 - 2018)
- Convener ATLAS b-jet trigger group (2015 - 2018)
- Fast TracKer (FTK): A hardware-based track-trigger upgrade (2013 - 2018)
- Convener of ATLAS “Jets and Dark Matter” group (2014 - 2015)
- Lead roles in analyses searching for new physics: (2013 - 2018)
  - Search for di-Higgs production in 4b final state
  - Search for low mass di-jet resonances (below one TeV) using di-jet + ISR production
  - Search for resonant di-b-quark production
  - Multi-jet search for TeV Black Holes
- Reviews and Editorial Board Membership:
  - Referee Physics Letters B (2017)
  - National Science Foundation, panelist (2016)
  - Served on several internal ATLAS editorial boards
- Student Supervision:
  - Dr. Yangyang Cheng, Graduated Chicago 2015, now Cornell.
  - Dr. Jordan Webster, Graduated Chicago 2015, private sector
  - Dr. Karol Krizka, Graduated Chicago 2017, now Berkeley
  - Dr. Patrick Bryant, Graduated Chicago 2018, now CMU
  - Zihao Jiang, Chicago undergraduate, now Stanford for Ph.D.

GRADUATE  
RESEARCH

The ATLAS Experiment, CERN

- Higgs analyses and Standard Model Electroweak measurements:
  - $H \rightarrow WW \rightarrow l\nu l\nu$  /  $WW \rightarrow l\nu l\nu$  production /  $W \rightarrow e\nu$ ,  $Z \rightarrow ee$  measurements
- Led effort to develop electron identification algorithms
- Responsible for alignment of the Transition Radiation Tracker
- Commissioned Inner Detector tracking with cosmic rays prior to LHC collisions
- Joined ATLAS collaboration in 2008

UNDERGRADUATE  
RESEARCH

CDF, Fermilab

- Research at the Tevatron with Professor Joe Boudreau
- Estimated a systematic uncertainty in B lifetime measurement in the mode  $B^0 \rightarrow J/\psi K_S^0$
- Awarded the Halliday Award for Excellence in Undergraduate Research

AWARDS AND  
FELLOWSHIPS

- 85th Arthur H. Compton Lecturer, 2017
- Fermi/McCormick Fellowship, University of Chicago, 2013 - 2016
- ATLAS Thesis Award, 2013
- Springer Thesis Prize, 2013
- Peter F. M. Koehler Academic Achievement Award, 2006
- Halliday Award for Excellence in Undergraduate Research, 2006
- Member of Phi Beta Kappa Academic Honor Society, 2006 - Present

## OUTREACH

- Spring 2017: 85th Compton Lecturer, The Enrico Fermi Institute, University of Chicago
  - More information: <https://efi.uchicago.edu/page/compton-lectures>
  - Series of nine hour-long lectures for the general public
  - Series title: *How and Why to Go Beyond the Discovery of the Higgs Boson*
  - Slides and videos: <http://hep.uchicago.edu/~johnda/ComptonLectures.html>
- 2017/2012: Lectures to high school students in “Quark Net” at University of Pennsylvania
- 2015: “Rent a scientist for the day” fund-raising auction for Chicago Science & Arts Academy
- 2013-2014: “Career Day” for 3rd and 5th graders at Greenfield Elementary School, Philadelphia

## LEADERSHIP ROLES

- Organizing committee for Di-Higgs Workshop *Fall 2018*
- Convener of ATLAS b-jet trigger group *2015 - 2018*
- Convener of ATLAS di-Higgs group *2016 - 2018*
- Coordinating low mass di-jet resonances search *2015 - 2018*
- Convener of ATLAS Jets and Dark Matter exotics group *2014 - 2015*
- Co-led search for TeV black holes with first 13 TeV data *2015*
- Led group measuring  $W$ +jet background in  $WW$  and  $H \rightarrow WW$  di-lepton analyses
- Led effort to develop Run-1 electron identification algorithms
- Led group responsible of alignment of ATLAS Transition Radiation Tracker

## SELECTED PUBLICATIONS

**The list of publications for which I am the primary author or have made major contributions is provided below. As these publications arise from a large collaborative program, I have added comments underneath each reference to give context for the work and to try to indicate my role and contribution. I am also an author on over 500 other ATLAS publications. A full list is available on request.**

ATLAS Collaboration, *Search for pair production of higgsinos in final states with at least three b-tagged jets in  $\sqrt{s} = 13$  TeV collisions using the ATLAS detector*, Submitted to Phys. Rev. D, [arXiv:1806.04030](https://arxiv.org/abs/1806.04030).

- Extension of the  $HH \rightarrow 4b$  analysis requiring large missing transverse energy to search for supersymmetric partners of the Higgs Boson.
- I was responsible for the trigger strategy and measuring the b-jet trigger efficiencies in data.

ATLAS Collaboration, *Search for resonances in the mass distribution of jet pairs with one or two jets identified as b-jets at  $\sqrt{s} = 13$  TeV with the ATLAS detector*, Submitted to Phys. Rev. D, [arXiv:1805.09299](https://arxiv.org/abs/1805.09299).

- Search for b-jet resonances above 600 GeV using b-jet triggers.
- I was responsible for the b-jet trigger strategy used in the low-mass analysis.

ATLAS Collaboration, *Search for pair production of Higgs bosons in the  $bbbb$  final state at  $\sqrt{s} = 13$  TeV with the ATLAS detector*, Submitted to JHEP, [arXiv:1804.06174](https://arxiv.org/abs/1804.06174).

- Updated di-Higgs search with major improvements at low-mass / Strongest limits on resonant and non-resonant  $HH$  production.
- I was analysis contact and led the non-resonant/low-mass analysis.

ATLAS Collaboration, *Search for light resonances decaying to boosted quark pairs and produced in association with a photon or a jet at  $\sqrt{s}=13$  TeV with the ATLAS detector*, Submitted to Phys. Lett. B., [arXiv:1801.08769](#).

- First ATLAS search in large-radius jet mass spectra/Extended sensitivity to lower mass.
- I convened the group responsible for analysis, was responsible for supporting documentation.

ATLAS Collaboration, *Performance of the ATLAS Trigger System in 2015*, Eur. Phys. J. C **77** 317 (2017), [arXiv:1611.09661](#).

- Documents the performance of ATLAS triggers in Run-2 data taking.
- I wrote the b-jet trigger section and was responsible for associated performance studies.

ATLAS Collaboration, *Search for pair production of Higgs bosons in the  $b\bar{b}b\bar{b}$  final state using proton-proton collisions at  $\sqrt{s} = 13$  TeV with the ATLAS detector*, Phys. Rev. D **94** (2016) 052002, [arXiv:1606.04782](#).

- 1st di-Higgs publication at 13 TeV, extended sensitivity for low and high-mass  $HH$  resonances.
- I was primary analyzer, developed background modeling and overall trigger strategy.

ATLAS Collaboration, *Search for strong gravity in multi-jet final states produced in pp collisions at  $\sqrt{s} = 13$  TeV using the ATLAS detector at the LHC*, JHEP **03** (2016) 026, [arXiv:1512.02586](#).

- One of the first searches for new physics at 13 TeV / Dramatic extension in sensitivity.
- Convened the analysis group, was primary analyzer, and developed the analysis tools.

ATLAS Collaboration, *Search for New Phenomena in Dijet Mass and Angular Distributions with the ATLAS Detector at  $\sqrt{s} = 13$  TeV*, Phys. Lett. B **754** (2016) 302-322, [arXiv:1512.01530](#).

- First publication searching for new physics at 13 TeV / Large increase in reach w/higher energy.
- I convened the group responsible for this analysis / oversaw strategic planning and execution.
- **100+ Citations**

ATLAS Collaboration, *Searches for Higgs boson pair production in the  $HH \rightarrow b\bar{b}\tau\tau, \gamma\gamma WW^*, \gamma\gamma b\bar{b}, b\bar{b}b\bar{b}$  channels with the ATLAS detector*, Phys. Rev. D **92** (2015) 092004, [arXiv:1509.04670](#).

- Run-1 legacy  $HH$  combination.
- I was a primary analyzer in the most sensitive  $HH \rightarrow 4b$  channel.
- **100+ Citations**

ATLAS Collaboration, *Search for Higgs boson pair production in the  $b\bar{b}b\bar{b}$  final state from pp collisions at  $\sqrt{s} = 8$  TeV with the ATLAS detector*, Eur. Phys. J. C **75** 412 (2015), [arXiv:1506.00285](#).

- 1st  $HH$  publication in 4b final state. / Strongest limit on non-resonant  $HH$  production.
- I was a primary analyzer and developed the overall trigger strategy and background modeling.

ATLAS Collaboration, *Observation and measurement of Higgs boson decays to  $WW^*$  with the ATLAS detector*, Phys. Rev. D **92** (2015) 012006, [arXiv:1412.2641](#).

- Run-1 legacy  $H \rightarrow WW$  paper / Most precise Run-1 Higgs signal strength measurement.
- Led group responsible for measuring  $W$ +jet background / optimized lepton identification.
- **100+ Citations**

ATLAS Collaboration, *Electron reconstruction and identification efficiency measurements with the ATLAS detector using the 2011 LHC proton-proton collision data*, Eur. Phys. J. C **74** (2014) 2941, [arXiv:1404.2240](#).

- Documents electron identification algorithms default in all 2011 ATLAS analyses.
- I led the effort to develop and implement electron identification algorithms described here.
- **250+ Citations**

ATLAS Collaboration, *Fast TracKer (FTK) Technical Design Report*, CERN-LHCC-2013-007. [ATLAS-TDR-021](#), 2013.

- Documents expected performance and technical details of hardware-based track-trigger upgrade.
- I provided low-level tracking performance studies and physics case for b-tagging with FTK.

ATLAS Collaboration, *Measurements of Higgs boson production and couplings in diboson final states with the ATLAS detector at the LHC*, Phys. Lett. B **726** (2013) 88-119, [arXiv:1307.1427](#).

- Combination of Higgs coupling measurements to vector bosons with the full Run-1 data-set.
- I was a primary analyzer in the  $H \rightarrow WW \rightarrow l\nu l\nu$  input channel.
- **500+ Citations**

J. Alison, *The Road to Discovery: Detector Alignment, Electron Identification, Particle Misidentification, WW Physics, and the Discovery of the Higgs Boson*, [CERN-THESIS-2012-295](#), 2012.

- Published in Springer thesis series recognizing outstanding Ph.D. research.
- Awarded 2013 ATLAS thesis prize.

ATLAS Collaboration, *Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC*, Phys. Lett. B **716** (2012) 1-29, [arXiv:1207.7214](#).

- Discovery of the Higgs boson.
- I was a primary analyzer in the  $H \rightarrow WW \rightarrow l\nu l\nu$  channel.
- **5000+ Citations**

ATLAS Collaboration, *Measurement of the WW cross section in  $\sqrt{s} = 7$  TeV pp collisions with the ATLAS detector and limits on anomalous gauge couplings*, Phys. Lett. B **712** (2012) 289-308, [arXiv:1203.6232](#).

- First constraints on anomalous gauge couplings in the WW channel from ATLAS.
- Measured electron efficiencies and the mis-identified lepton background.

ATLAS Collaboration, *Search for the Standard Model Higgs boson in the  $H \rightarrow WW^{(*)} \rightarrow l\nu l\nu$  decay mode with  $4.7 \text{ fb}^{-1}$  of ATLAS data at  $\sqrt{s} = 7$  TeV*, Phys. Lett. B **716** (2012) 62-81, [arXiv:1206.0756](#).

- SM Higgs search in  $H \rightarrow WW \rightarrow l\nu l\nu$  channel using the full 7 TeV dataset.
- I was responsible for the lepton identification, W+jet background, and trigger strategy.
- **100+ Citations**

ATLAS Collaboration, *Search for the Higgs boson in the  $H \rightarrow WW \rightarrow l\nu l\nu$  decay channel in pp collisions at  $\sqrt{s} = 7$  TeV with the ATLAS detector*, Phys. Rev. Lett. **108** (2012) 111802, [arXiv:1112.2577](#).

- One of the first publications from the LHC with significant constraints on the SM Higgs boson.
- I developed a data-driven model for W+jet background / responsible for lepton identification.

ATLAS Collaboration, *Electron performance measurements with the ATLAS detector using the 2010 LHC proton-proton collision data*, Eur. Phys. J. C **72** (2012) 1909, [arXiv:1110.3174](#).

- Documents electron identification algorithms used in all 2010 ATLAS analyses.
- I led the effort to develop and implement the electron identification algorithms described here.
- **500+ Citations**

SELECTED  
PUBLICATIONS  
(CONTINUED)

ATLAS Collaboration, *Measurement of the  $WW$  cross section in  $\sqrt{s} = 7$  TeV  $pp$  collisions with ATLAS*, Phys. Rev. Lett. **107** (2011) 041802, [arXiv:1104.5225](#).

- First publication of  $WW$  cross section measurement from ATLAS.
- I was responsible for the trigger strategy, lepton ID and the modeling of the  $W$ +jet background.

ATLAS Collaboration, *Studies of the performance of the ATLAS detector using cosmic-ray muons*, Eur. Phys. J. C **71** (2011) 1593, [arXiv:1011.6665](#).

- Documents work done to commission the ATLAS detector before LHC turn on.
- I developed a method to study performance of the Inner Detector charged particle reconstruction.

ATLAS Collaboration, *Performance of the ATLAS Detector using First Collision Data*, J. High Energy Phys. **1009** (2010) 056, [arXiv:1005.5254](#).

- Documents work done to commission the ATLAS detector with first data from the LHC.
- I was responsible for performance studies of Transition Radiation Tracker.

ATLAS Collaboration, *Measurement of the  $W \rightarrow l\nu$  and  $Z/\gamma^* \rightarrow ll$  production cross sections in proton-proton collisions at  $\sqrt{s} = 7$  TeV with the ATLAS detector*, JHEP **12** (2010) 060, [arXiv:1010.2130](#).

- First electro-weak measurements from ATLAS.
- I was responsible for electron identification (offline and trigger) and efficiency measurement.
- **250+ Citations**

ATLAS Collaboration, *The ATLAS Inner Detector commissioning and calibration*, Eur. Phys. J. C **70** (2010) 787, [arXiv:1004.5293](#).

- Documents commission and performance of the Inner Detector before LHC turn on.
- I was responsible for detector alignment / charged particle reconstruction performance studies.
- **100+ Citations**

The ATLAS TRT Collaboration, *The ATLAS TRT Barrel Detector*, J. Instrum. **3** (2008) P02014.  
The ATLAS TRT Collaboration, *The ATLAS TRT end-cap detectors*, J. Instrum. **3** (2008) P10003.

- Documents Transition Radiation Tracker (TRT) Barrel and End-cap detectors.
- I was responsible for alignment of the TRT and low-level tracking performance studies.
- **100+ Citations**

SEMINARS AND  
CONFERENCE  
PRESENTATIONS

**Di-Higgs 2018  $B$ -Jet Trigger: Status and Future Plans**, September 2018.

**La Thuile 2018 Searches for Di-Boson and Di-Lepton Resonances at the LHC**, March 2018.  
(First public presentation of the 2015-2016  $HH \rightarrow 4b$  results.)

**Seminar Fall 2016  $Di$ -Higgs Production at the LHC: Current Status and Future Prospective**  
(Summary of recent di-Higgs results and projected sensitivities.)

- Experimental Particle Physics Seminar, University of Oxford, October 2016.
- Particle Physics Seminar, Rutherford Appleton Laboratory, October 2016.

**PHENO 2016 Searches for New Physics at the LHC**, May 2016.  
(Invited plenary summarizing ATLAS/CMS searches for new physics with 13 TeV data.)

**DPF 2015 Searches for New Physics at the Energy Frontier**, August 2015.  
(Invited plenary summarizing LHC Run-1 searches for new physics.)

**DPF 2015 Real-time Flavor Tagging in ATLAS: Where we are and where we are going.**  
(Status and challenges of identifying  $b$ -quark jets and hadronic  $\tau$  decays in the trigger.)

**LHC Higgs Exotic Decay Working Group**, *New Trigger Capabilities with FTK*, May 2015.  
(Review of FTK capabilities and potential applications for exotic Higgs decays.)

**Seminar Spring 2015** *Fast Track Finding at the LHC: How and Why*.  
(Summary of design, implementation and expected performance of ATLAS Fast TracKer.)  
- Experimental Particle Physics Seminar, University of Pennsylvania, March 2015.  
- HEP Seminar, Argonne National Laboratory, April 2015.

**Higgs Couplings 2014** *Experimental studies of di-Higgs production with ATLAS and CMS*.  
October 2014. (Overview of current status and prospects of di-Higgs production.)

**Seminar Fall 2013** *Higgs Physics Post-Discovery: What we know and where we are going*.  
(Overview of the experimental status of Higgs physics after Run-1 of the LHC.)  
- HEP seminar, University of Chicago, September 2013.  
- PITT-PACC seminar, University of Pittsburgh/Carnegie Mellon University, November 2013.

**ASPEN 2013** *H→WW Results from ATLAS*, March 2013.  
(First public presentation of the H→WW results with the full Run-1 dataset.)

**Moriond EW 2011** *Standard Model Measurements at ATLAS*, 46th Rencontres de Moriond on Electroweak Interactions and Unified Theories, March 2011.  
(First public presentation of the ATLAS WW cross section measurement.)

**APS 2009** *Alignment of the ATLAS Inner Detector Tracking System*, American Physical Society April Meeting, 2009.