Othmane Rifki

Personal Data

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Current Employment

2017–	Postdoctoral Research Fellow **DESY**, Hamburg, Germany

Education

2012–2017	Ph.D. in Physics - **University of Oklahoma**, Norman, OK, USA Supervisor: Brad Abbott Thesis: *"Search for supersymmetry in final states with two same-sign or three leptons and jets with the ATLAS detector at the LHC"*, CERN-THESIS-2017-181
2009–2012	B.Sc. in Physics, with Honors - **Drexel University**, Philadelphia, PA, USA Supervisors: Gordon Richards, Mitch Newcomer Thesis: *"Precision characterization of prototype electronics for readout of the 3.2 gigapixels Camera for the LSST"*

Leadership Roles

Analysis Contact	ATLAS search for invisible VBF Higgs decays	(2018–)
Editorial Board Member	ATLAS search for electroweak SUSY production (3 publications)	(2017–2019)
JINST referee	Invited referee in two publications	(2018–2019)
Coordinator	ATLAS SUSY fake objects review group	(2015–2018)
On-call expert	ATLAS readout system and RoI builder operational support	(2015–2017)
ATLAS shifter	Shift leader, trigger, and run control shifts	(2015–2018)

Awards

2019	*Bonus Merit for the contributions to the ATLAS detector upgrade* - DESY
2019	*Dodge Award to invite PhD graduate back for a department colloquium* - University of Oklahoma
2018	*Nielsen Prize for excellence in doctoral research* - University of Oklahoma
2017	*Kalbfleisch Prize for a distinguished graduate student* - University of Oklahoma
2015	*Graduate Student Senate Grant* - University of Oklahoma
2014-2015	*ATLAS Analysis Support Center Graduate Fellowship* - Argonne National Laboratory
2013	*Arts and Sciences Merit Scholarship* - University of Oklahoma
2011	*Larson Physics Scholarship for outstanding student in experimental science* - Drexel University
2009-2012	*Drexel University's Dean Scholarship* - Drexel University

Current Activities in ATLAS

Upgrade

ATLAS upgrade for High-Luminosity LHC: Inner Strip tracking detector
Built an automated robotic assembly system to pick and place modules using an advanced camera with magnifying optics running vision algorithms, custom-designed vacuum pickup tools, and a high precision glue dispensing system to achieve a module placement accuracy of less than 50 microns. Loading demonstration available here: https://youtu.be/rU1wHZcM4Ng

- Decided on the hardware needed to meet the specifications required for module loading
- Oversaw the purchasing of the equipment to build the module loading station that totaled over $200k
- Managed the assembly of the loading station in the DESY clean room, and the production of custom tools at DESY and industry
- Harmonized the loading procedure and software with the other module loading sites (TRIUMF, IFIC, Freiburg)
- Coordinated the module reception tests (electrical and mechanical) and repairs of wire-bonds with DESY technicians
- Successfully built and tested the first semi-electrical petal at DESY with which we passed the Final Design Review in Feb 2020

Analysis

Search for invisible Higgs boson decays in Vector Boson Fusion
Led the most sensitive channel to search for direct decays of the Higgs boson to invisible final states, and played the key role in improving the sensitivity by 30% on the same dataset as the last publication, and 54% with the full Run-2 dataset, setting the best LHC limit to date.

- Coordinated the analysis activities and supervised the work of PhD students as Analysis Contact
- Developed the full analysis software framework used by the analysis team and produced the Monte Carlo simulation for the signal and background processes
- Established an Analysis Contact Expert (ACE) collaboration with three theorists to improve filtering algorithms in Sherpa to simulate more V + jets processes with less CPU. Uncertainties from the limited amount of simulation was the leading uncertainty in the previous publication
- Developed a theoretical model to extrapolate between electroweak bosons to more accurately constrain the main $Z(\nu\nu)$+jets background in collaboration with the ACE
- Refined the lepton selection to reduce the background in the signal region by 31% and increase acceptance of background processes in the control region by 34%
- Improved the event categorization to improve sensitivity to the Higgs boson signal

Previous Activities in ATLAS

2015–2017

Search for supersymmetry (SUSY) at 13 TeV with the ATLAS detector
Performed a search for SUSY with multiple leptons and jets which benefits from a low standard model (SM) background allowing the physics analysis to reach the best sensitivity in scenarios with small mass differences between SUSY particles.

- Identified uncovered regions of the SUSY parameter space and designed search regions to target them expanding the potential discovery reach of ATLAS
- Pioneered a search with a novel experimental signature of three leptons of the same electric charge to target a model proposed by ANL theorists Carlos Waigner and Ian Low
- Developed new data-driven analysis techniques to measure and validate the analysis backgrounds, in particular mis-identified leptons from experimental effects
- Maintained the analysis software framework and produced data and Monte Carlo analysis samples used by the analysis team

2016–2017 **Experimental backgrounds review group in SUSY**
Led a review team to evaluate the analysis techniques used to estimate backgrounds from mis-identified particles (leptons, photons, taus, and b-jets) due to instrumental effects in all ATLAS SUSY analyses.

- Harmonized the procedures employed in estimating instrumental backgrounds across SUSY analyses
- Provided recommendations and software tools to measure these backgrounds
- Expanded the usage of a new data-driven method I developed for estimating mis-identified lepton background to other ATLAS analyses, method continue to be used in ATLAS

2014–2016 **Evolution of the Region of Interest Builder of the ATLAS detector**
Migrated the functionality of the multi-card custom electronics Region of Interest Builder (RoIB), which seeds the retrieval of every event recorded by ATLAS to a single PCI-Express card hosted in a commodity computing node (PC RoIB). This evolution was undertaken to increase the system flexibility and reduce the operational overload associated with custom electronics.

- Developed a multi-threaded C++ library that collects the ATLAS regions of interest (RoIs) identified by the first level trigger and forwards them at 100 kHz rate to a computing farm
- Used modern Intel resource manager tools to efficiently balance the sharing of memory usage between hardware resources
- Tested the RoIB performance system in a test setup at ANL and CERN during the R&D phase of the project
- Installed the PC RoIB in the ATLAS detector and started taking data since early 2016
- Implemented diagnostic tools to monitor the RoIB system information in real time

2014–2015 **First observation of the $t\bar{t}W$ and $t\bar{t}Z$ processes with the ATLAS detector**
Performed the first measurement of the $t\bar{t}W$ and $t\bar{t}Z$ production cross-sections at 8 TeV, and played the key role in improving the sensitivity of the $t\bar{t}W$ cross section from 3σ to 5σ and in reducing the uncertainty on the measurement by 40%.

- Developed a new technique that exploits correlations between the event kinematics (missing transverse momentum and the multiplicity of jets and b-jets) to separate signal from background
- Quantified the SM backgrounds and calculated the experimental backgrounds of the analysis
- Evaluated the signal modeling uncertainties affecting the precision of the measurement

2014–2015 **Photon production cross section measurement with the ATLAS detector**
Observed photons above 1 TeV for the first time and provided the measurement data to test the precision of QCD modelling and reduce the Parton Distribution Function (PDF) uncertainties used in every analysis at the LHC.

- Calculated the computing intensive higher order corrections to the photon production rate using Mira at ALCF with ANL physicist Sergei Chekanov allowing the generation of high statistics Monte Carlo simulation with a speed up factor of 1000
- Achieved an agreement between prediction and data over ten orders of magnitude

Previous research experience

2011–2012 **Precision characterization of the LSST camera readout electronics at UPenn**
Participated in the assembly and testing of the electronics that read out the three billion pixels of the Large Synoptic Survey Telescope (LSST) camera.

- Assembled hardware and tested software and firmware for readout tests of the silicon pixels of the LSST camera
- Developed analysis tools for precision characterization of the readout electronics in terms of gain, noise, and channel crosstalk

2010–2011 **Assembly and characterization of the Double Chooz PMTs at Drexel University**

- Set up a data acquisition system to read out Photomultiplier tubes (PMTs)
- Characterized the PMTs by calibrating them and measuring their gains, dark rates, and afterpulsing rates
- Built and tested voltage dividers for the PMTs

Teaching and Mentoring Experience

2018–	**Mentorship** of several Ph.D. students in the search for invisible VBF Higgs decays
2019–	**Day-to-day supervision** of two Ph.D. students (Pablo Rivadeneira, Alessia Renardi)
2018–2019	**Day-to-day supervision** of Master's student (Janik von Ahnen) and summer student (Maren Stratmann)
2017–2018	**Day-to-day upervision** of Ph.D. student (Vincent Kitali)
2016	**Supervision** of two graduate students (Rishabh Jain and Joseph Lambert) in physics analysis
2015	**Support** of an undergraduate student (Taira Lamphere) in final year research project at OU
2013	**Course instructor** of electricity and magnetism for engineering students (1 semester)
2012–2014	**Teaching Assistant** of general physics for engineers (4 semesters)

Journal Publications

ATLAS author since June 2015. Over 470 published papers as part of the ATLAS collaboration Inspire. Selected publications with significant contributions are listed below.

- ATLAS Collaboration, "Search for invisible Higgs boson decays in vector boson fusion at $\sqrt{s} = 13$ TeV with the ATLAS detector", Phys. Lett. **B793** (2019) 499
- ATLAS Collaboration, "Search for supersymmetry in final states with two same-sign or three leptons and jets using 36 fb^{-1} of $\sqrt{s} = 13$ TeV pp collision data with the ATLAS detector", J. High Energy Phys. **09** (2017) 084
- ATLAS Collaboration, "Search for supersymmetry at $\sqrt{s} = 13$ TeV in final states with jets and two same-sign leptons or three leptons with the ATLAS detector", Eur. Phys. J. **C76** (2016) 259
- ATLAS Collaboration, "Measurement of the inclusive isolated prompt photon cross section in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector", J. High Energy Phys. **06** (2016) 005
- ATLAS Collaboration, "Measurement of the $t\bar{t}W$ and $t\bar{t}Z$ production cross sections in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector", J. High Energy Phys. **11** (2015) 172

Conference Notes and Proceedings

- ATLAS Collaboration, "Search for invisible Higgs boson decays with vector boson fusion signatures with the ATLAS detector using an integrated luminosity of 139 fb^{-1}", ATLAS-CONF-2020-008 (2020)
- O. Rifki, "The ATLAS dataflow system in Run-2: Design and Performance", 38$^{\text{th}}$ International Conference of High Energy Physics, PoS ICHEP2016 (2017) 240
- O. Rifki, "Search for supersymmetry at $\sqrt{s} = 13$ TeV in final states with two same-sign leptons or at least three leptons and jets using pp collisions recorded with the ATLAS detector", 38$^{\text{th}}$ International Conference of High Energy Physics, PoS ICHEP2016 (2017) 1126
- O. Rifki et al., "The evolution of the region of interest builder for the ATLAS experiment at CERN", JINST 11 C02080 (2016)

- ATLAS Collaboration, "Search for supersymmetry with two same-sign leptons or three leptons using 13.2 fb^{-1} of $\sqrt{s} = 13$ TeV pp collision data collected by the ATLAS detector", ATLAS-CONF-2016-037 (2016)
- O. Rifki, "ATLAS searches for squarks and gluinos using leptons or multiple b-jets with 3.2 fb^{-1} of pp collisions at $\sqrt{s} = 13$ TeV", 4$^{\text{th}}$ Large Hadron Collider Physics Conference, PoS LHCP2016 (2016) 236

Presentations at International Conferences

Jul. 2019	**European Physical Society Conference on High Energy Physics**	Ghent, Belgium
	"Dark matter searches with the ATLAS detector"	
Jun. 2016	**4$^{\text{th}}$ Large Hadron Collider Physics Conference**	Lund, Sweden
	"ATLAS searches for squarks and gluinos" (Poster)	
Aug. 2016	**38$^{\text{th}}$ International Conference of High Energy Physics**	Chicago, IL, USA
	"The ATLAS Data Flow system in Run-2: Design and Performance"	
Aug. 2016	**38$^{\text{th}}$ International Conference of High Energy Physics**	Chicago, IL, USA
	"Search for supersymmetry with multiple leptons and jets with the ATLAS detector" (Poster)	

Other Conference Presentations and Seminars

Apr. 2020	**Quantum Universe Day**	Hamburg, Germany
	"Probing dark matter with the Higgs boson via invisible decays"	
Apr. 2020	**89$^{\text{th}}$ DESY Physics Research Committee Meeting**	Hamburg, Germany
	"ATLAS group highlights at DESY"	
Sep. 2019	**OU Physics Department Colloquium**	Norman, OK, USA
	"Higgs as a probe for dark matter"	
Sep. 2019	**OU HEP Seminar**	Norman, OK, USA
	"Invisible Higgs decay searches at the LHC"	
Sep. 2019	**ANL HEP Division Seminar**	Lemont, IL, USA
	"Searches for invisible Higgs decays with the ATLAS detector"	
Aug. 2019	**DESY HEP Experiment-Theory Seminar**	Hamburg, Germany
	"Searches for invisible Higgs decays in the VBF channel with ATLAS"	
Jul. 2019	**Division of Particles & Fields of the American Physical Society**	Boston, MA, USA
	"Searches for invisible Higgs decays with the ATLAS detector"	
Sep. 2018	**DESY LHC Physics Seminar**	Hamburg, Germany
	"Invisible Higgs decays in Vector Boson Fusion (VBF)"	
Jun. 2018	**1$^{\text{st}}$ African Conference on Fundamental Physics and Applications**	Windhoek, Namibia
	"Dark Matter Searches at the LHC"	
May 2017	**Phenomenology Symposium**	Pittsburgh, PA, USA
	"Inclusive searches for squarks and gluinos with the ATLAS detector"	
Aug. 2016	**ANL HEP division seminar**	Lemont, IL, USA
	"Search for supersymmetry at $\sqrt{s} = 13$ TeV in leptonic final states with the ATLAS detector"	
Jun. 2016	**Low-x Workshop**	Gyongyos, Hungary
	"Measurements of exclusive dilepton production at 7 TeV and 8 TeV with the ATLAS detector"	
Oct. 2015	**Topical Workshop on Electronics for Particle Physics (TWEPP)**	Lisbon, Portugal
	"The evolution of the Region of Interest Builder in the ATLAS experiment" (Poster)	
Sep. 2015	**European School of High Energy Physics**	Bansko, Bulgaria
	"Measurement of the associated production cross section of a vector boson (W,Z) and top quark pair in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector" (Poster)	
Mar. 2015	**LHC Experiments Committee (LHCC)** at CERN	Geneva, Switzerland
	"The evolution of the Region of Interest Builder in the ATLAS experiment" (Poster)	
Oct. 2014	**ANL Postdoctoral Research and Career Symposium**	Lemont, IL, USA
	"The evolution of the Region of Interest Builder in the ATLAS experiment" (Poster)	

Selected ATLAS Presentations

Feb. 2020	**Final Design Review of ITk Strip Local Support Structures** "Module loading for the ITk end-cap petal cores"	Geneva, Switzerland
Feb. 2020	**ATLAS Collaboration Week** "Searches for dark matter"	Geneva, Switzerland
Apr. 2019	**ATLAS Upgrade Week** "Progress on end-cap module loading at DESY and IFIC"	Geneva, Switzerland
Nov. 2019	**ATLAS Upgrade Week** "Status of end-cap loading at DESY"	Geneva, Switzerland
Oct. 2016	**ATLAS Collaboration Week** "Performance of the PC based RoIB/HLTSV during 2016 Data-taking"	Geneva, Switzerland
May 2016	**ATLAS TDAQ week** "PC based RoIB: Installation, Operations, and Performance"	Geneva, Switzerland
Nov. 2015	**High Level Trigger Supervisor and RoI Builder Software Review** "PC based RoIB performance"	Geneva, Switzerland
Jun. 2015	**US ATLAS Workshop at UIUC** "Measurement of the inclusive isolated prompt photon cross section in pp collisions at 8 TeV with the ATLAS detector using 20 fb^{-1}"	Champaign, IL, USA
Jun. 2015	**US ATLAS Workshop at UIUC** "Simultaneous measurements of the $t\bar{t}W$ and $t\bar{t}Z$ production cross-sections using events with same-sign leptons from pp collisions at 8 TeV using 20 fb^{-1}"	Champaign, IL, USA

Outreach Activities

2020 **Physics**: contributed to briefings for ATLAS, CERN, and Symmetry magazine websites
2020 **High school student**: hosted and prepared projects for student to learn about particle physics
2019 **DESY behind the scenes**: organizer of ATLAS exhibition "shedding light on the dark universe"
2017 **DESY open day**: organizer of ATLAS exhibition and speaker (*+20,000 visitors*)
2016 **Outreach during ICHEP**: Hands-on physics lectures in Chicago public libraries

Computing Skills

Operating Systems:	Mac OS X, Linux SLC5/SLC6/CC7/Ubuntu, Windows 10
Programming:	C, C++, Python, Bash scripting, LaTeX
Libraries:	STL, Boost, Intel TBB
Software:	Matlab, Mathematica, QT, ATLAS Athena, Pythia, MadGraph, Sherpa, ROOT
Machine Learning:	Pandas, Scikit-learn, Numpy, Scipy, Keras, TensorFlow, OpenCV

Languages

English:	Fluent
French:	Native
Arabic:	Native
German:	Elementary Proficiency