

Lailin Xu

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Professional Experience

- 2015-Present **Postdoctoral Research Associate**, Brookhaven National Lab, Upton, NY, USA, stationed at CERN working on the ATLAS experiment
- 2011-2013 **Visiting Research Investigator**, University of Michigan, Ann Arbor, MI, USA
- 2010-2015 **Research Assistant**, University of Sci. and Tech. of China (USTC), Hefei, China

Education

- 2010-2015 **Ph.D. in Physics**, USTC, Hefei, China.
 Thesis: Study of Electroweak and Higgs Physics with ZZ Production in ATLAS.
 Advisor: Bing Zhou (University of Michigan); Zhengguo Zhao (USTC).
- 2006-2010 **B.Sc in Physics**, USTC, Hefei, China.
 Thesis: R&D of Long-strip Multi-gap Resistive Plate Chambers as a Time-Of-Flight detector.

Honors and Awards

- 2014 Scholarship for Innovative Thesis Research, USTC.
- 2013 ATLAS PhD Grant, CERN, one of the first three recipients of the ATLAS PhD Grant, founded by ATLAS ex-spokespersons Peter Jenni and Fabiola Ginanotti.
- 2011-2013 PhD Fellowship for co-education, China Scholarship Council, selected by the Ministry of Education of the People's Republic of China.
- 2012 Young Scholar of Distinction, Ministry of Education of the People's Republic of China.
- 2010 Guo Moruo Award, USTC, highest honor of USTC undergraduate students.
- 2010 Excellent Undergraduate Thesis Award, USTC.

Selected Research Experience

Leadership Activities

- 2019-Present **Convener of Weak Boson Processes Subgroup, ATLAS Physics Modeling Group**: Coordinating all aspects of Monte Carlo modelling of Single-boson and Multiboson processes in the whole ATLAS collaboration.
- 2019-Present **Convener of Off-shell and Interference Subgroup, LHC Higgs Cross Section Working Group**: Stimulate and facilitate experimental and theoretical efforts on off-shell Higgs and signal-background interference studies at the LHC.
- 2018-2019 **Coordinator of ATLAS Physics Modeling Group–Multiboson Focus Group**: Coordinating all aspects of Monte Carlo modelling of Multiboson processes in the whole ATLAS collaboration.
- 2016-Present Co-leader of several key physics analyses in ATLAS, using multiple gauge bosons to search for new phenomena and measure the Higgs boson properties:
 - **Higgs boson properties and couplings measurements in $H \rightarrow ZZ^* \rightarrow 4\ell$ channel, 2016-present.**

- **Higgs boson off-shell coupling measurements and constraints on the Higgs total width in $H \rightarrow ZZ$ channel at $\sqrt{s} = 13$ TeV, 2016-2018**, published in PLB 786 (2018) 223.
- **Search for heavy ZZ resonances in the 4ℓ and $\ell\nu\nu$ final states using full Run 2 data, 2018-present**, aiming for publication in 2019.
- **Search for heavy $WW/WZ/ZZ$ resonances in the semileptonic final states using full Run 2 data, 2018-present**, aiming for publication in 2019.
- **Searches for heavy ZZ and ZW resonances in the $\ell q q$ and $\nu\nu q q$ final states at $\sqrt{s} = 13$ TeV, 2016-2017**, published in JHEP 03 (2018) 009.
- **Study of vector boson scattering in $WWjj/WZjj/ZZjj$ with semileptonic decay final states at $\sqrt{s} = 13$ TeV, 2017-2019**, published in PRD 100, 032007 (2019).

Hardware work

- 2009-Present Extensive experience on R&D of novel silicon detectors and gaseous detectors, including development of data acquisition system and characterization of detectors using testbeam:
- **Testbeam for silicon sensors and beam telescope data acquisition system development, 2015-present**,
 - Contributed to the development of telescope readout system based on Front-End Lnk eXchange (FELIX), a new detector interface for the ATLAS Trigger and Data Acquisition Phase-II upgrade.
 - R&D of High-voltage CMOS sensors for ATLAS Inner Tracker Phase-II upgrade, including testbeam at the CERN SPS and at Fermilab, operation and monitoring of the data acquisition system, analysis of the testbeam data, published in JINST 13 (2018) P02011, JINST 11 (2016) P07019.
 - Integrated MIMOSA26 pixel sensors into a FE-I4 silicon planar sensor telescope with an FPGA-based readout system, aimed to improve the spatial resolution of the telescope system.
 - **Maintained the ATLAS MDT gas system and the gas monitor, 2013-2015**, including the daily check of the MDT gas status, leak rate test of the whole MDT multi-layers, purging of the repaired chambers and other operational activities.
 - **Contributed to the commissioning of ATLAS Endcap Extension (EE) MDT chambers, 2010**, including gas leakage test, front-end readout electronics test, high voltage test, etc.
 - **Built and measured thin gap Resistive Plate Chambers (RPC) for ATLAS New Small Wheel upgrade, 2011-2012**, published in NIMA 714 (2013) 115-120, including the construction of the RPC prototypes with low resistance Bakelite and testbeam at Fermilab.
 - **Built and measured Long-strip Multiple-RPC detectors for BESIII ETOF upgrade and CBM time of flight detector, 2009-2011**, published in CPC 36 (2012) 429 and CPC 35 (2011) 838, contributed to construction of MRPC prototypes, developed novel data acquisition system (Labview[®]), participated in testbeam experiment, and analyzed testbeam data.

Physics Analyses as Main Contributor

2011-Present Significant contributions to multiboson physics in ATLAS, including precision tests of the Standard Model and searches for new phenomena:

Searches for new physics beyond the Standard Model

- **Searches for heavy diboson resonances at $\sqrt{s} = 13$ TeV, 2015-2016**, published in JHEP 09 (2016) 173, leading analyzer for the $\ell\ell qq$ channel using novel jet substructure and boson tagging techniques.
- **Search for high mass Higgs with $H \rightarrow ZZ$ channel at $\sqrt{s} = 8$ TeV, 2013-2015**, published in EPJC 76 (2016) 45, significant contributions to all aspects of the $ZZ \rightarrow \ell\ell\nu\nu$ channel, including event selection optimization, background estimation, systematic uncertainties study, and the statistical interpretation.
- **Search for dark matter produced in association with a hadronically decaying vector boson (mono- V) at $\sqrt{s} = 13$ TeV, 2017-2018**, published in JHEP 10 (2018) 180, major contributions to Monte Carlo (MC) study of novel dark matter signal models and interpretation of the analysis results.
- **Search for dark matter with mono- Z events at $\sqrt{s} = 8$ TeV, 2013-2014**, published in PRD 90, 012004 (2014), novel search for dark matter at colliders, significant contributions to the WW /Top background estimation with a data driven method, systematic uncertainties of the key SM ZZ / WZ background, and the signal acceptance and systematic uncertainties study.

Higgs boson properties measurements

- **Higgs off-shell coupling measurements and constraints on the Higgs total width at $\sqrt{s} = 8$ TeV, 2014-2015**, published in EPJC (2015) 75:335, initiated novel analysis in $ZZ \rightarrow \ell\ell\nu\nu$ final states, significant contributions to the background estimation (ZZ , WZ , WW /Top data driven, W +jets data driven), signal MC generator validation, acceptance and systematic uncertainty study, and the statistical interpretation.
- **Spin and parity measurement of the Higgs boson in $H \rightarrow ZZ \rightarrow 4\ell$, 2012-2013**, published in PLB 726 (2013) 120, major contributions to the signal MC sample validation and generation, development and optimization of novel Boosted Decision Tree (BDT) method, and statistical analysis development.
- **Search for invisible decays of a Higgs boson produced in association with a Z boson, 2012-2013**, published in PRL 112, 201802 (2014), first direct search for invisible Higgs at the LHC and novel search for dark matter at colliders, major contributions to the W +jets background estimation with a data driven method and theoretical modeling systematics study for the main SM ZZ background.

Measurements of electroweak interactions

- **Measurement of the four-lepton invariant mass spectrum at $\sqrt{s} = 8$ TeV, 2017-2019**, published in JHEP 04 (2019) 048, significant contributions to interpretations on off-shell Higgs boson signal strength measurement and constraint on modified Higgs boson couplings in an Effective Field Theory.

- **ZZ production cross section measurement at $\sqrt{s} = 8$ TeV, 2014-2016**, published in JHEP 01 (2017) 099, significant contributions to event selection optimization for the $ZZ \rightarrow \ell\nu\nu$ channel and searches for anomalous triple gauge boson couplings.
- **Measurements of four-lepton production at the Z resonance at $\sqrt{s} = 7$ and 8 TeV, 2013-2014**, published in PRL 112, 231806 (2014), first observation of $Z \rightarrow 4\ell$ in ATLAS, major contributions to μ fake background estimation with a data driven method, extraction and combination of the cross section and branching fraction measurements.
- **ZZ production cross section measurement at $\sqrt{s} = 7$ TeV, 2011-2012**, published in JHEP 03 (2013) 128, first measurement of the SM ZZ production in $\ell\nu\nu$ final states at the LHC, significant contributions to the $ZZ \rightarrow \ell\nu\nu$ channel, including event selection optimization, responsible for the WW/Top data driven background estimation, W +jets data driven background estimation, signal acceptance and efficiency study.

Professional Service and Committees

2017-2018 Member, Analysis Review Committee in ATLAS:

- Search for heavy Majorana or Dirac neutrinos and right-handed W gauge bosons in final states with two charged leptons and two jets, published in JHEP 01 (2019) 016.
- Search for resonances in the mass distribution of jet pairs with full Run 2 data, EXOT-2018-38, preliminary results ATLAS-CONF-2019-007.
- Search for dijet resonances in events with an isolated lepton with full Run 2 data, EXOT-2018-32.

2018.4 Session chair, Off-shell, ATLAS Higgs to ZZ workshop, University of Oxford, UK

2017.11 Session chair, VV/Vh semileptonic, ATLAS DBL-HBSM joint workshop, LAPP, Annecy, France.

2016.4 Session chair, $H \rightarrow ZZ \rightarrow \ell\ell qq/\nu\nu qq$, ATLAS Higgs to ZZ workshop, Max-Planck-Institut für Physik, Germany.

Teaching and Mentorship

2015-Present Yicheng Guo, joint Michigan-USTC PhD student, supervising his thesis work, including searches for heavy resonances in $\nu\nu qq$ final states, searches for dark matter produced in association with a hadronically decaying vector boson (mono- V).

2016-Present Heling Zhu, joint BNL-USTC PhD student, supervising her thesis work, including study of off-shell Higgs couplings, vector boson scattering in semileptonic final states, and Higgs properties measurements in 4ℓ final states.

2016-Present Andrey Ryzhov, PhD student from IHEP Protvino, supervising his thesis work, including searches for heavy resonances in $\ell\ell qq$ final states, and vector boson scattering in semileptonic final states.

2012-2014 Kareem Hegazy, undergraduate student at Michigan, supervised him to work on Higgs boson spin and parity measurement in the 4ℓ channel, and he made significant contribution to the ATLAS paper PLB 726 (2013) 120.

- 2013 Yutong Pan, undergraduate student at Michigan, supervised him to work on Higgs boson mass measurement in the 4ℓ channel, and his study was presented at the US-ATLAS workshop and included in his senior thesis.
- 2012 Danielle Norcini, undergraduate summer student at Michigan via the Research Experience for Undergraduate (REU) program, guided her to build and test a Resistive Plate Chamber.
- 2012 Wenjuan Zhang, REU undergraduate summer student at Michigan, guided her to search for a heavy Higgs boson decaying to a pair of light pseudoscalars in 4μ final states.

Selected Conference, Seminar and Workshop Presentations

Invited Seminars

- 2019.3 **Seminar**, Fermilab LHC Physics Center, Topic of the Week, Batavia, IL, USA. *Probing New Physics and the Nature of the Higgs Boson at ATLAS.*
- 2019.3 **Seminar**, Argonne National Lab, HEP Division Seminar, Lemont, IL, USA. *Probing New Physics and the Nature of the Higgs Boson at ATLAS.*
- 2019.2 **Seminar**, Stony Brook University, Particle Physics Seminar, Stony Brook, NY, USA. *Probing New Physics and the Nature of the Higgs Boson at ATLAS.*
- 2019.2 **Seminar**, Brookhaven National Lab, Particle Physics Seminar, Upton, NY, USA. *Probing New Physics and the Nature of the Higgs Boson at ATLAS.*
- 2017.12 **Seminar**, Institute of High Energy Physics, Beijing, China. *Measurements of Higgs boson properties and searches for new physics in HZZ with the ATLAS detector.*
- 2017.12 **Seminar**, Shanghai Jiao Tong University & T. D. Lee Institute, Shanghai, China. *Measurements of Higgs boson properties and searches for new physics in HZZ with the ATLAS detector.*
- 2017.12 **Seminar**, Shandong University, Jinan, China. *Measurements of Higgs boson properties and searches for new physics in HZZ with the ATLAS detector.*
- 2017.12 **Seminar**, USTC, Hefei, China. *Measurements of Higgs boson properties and searches for new physics in HZZ with the ATLAS detector.*

Conference Talks

- 2017.3 **La Thuile 2017**, 31st Les Rencontres de Physique de la Vallee d'Aoste, La Thuile, Aosta Valley, Italy. *Production of the Quarkonia States with the ATLAS Detector.*
- 2017.1 **BTTB 2017**, 5th Beam Telescopes and Test Beams Workshop, Barcelona, Spain. *Integration of MIMOSA26 sensors into a FEI4 planar sensor telescope.*
- 2015.7 **EPS-HEP 2015**, European Physical Society Conference on High Energy Physics, Vienna, Austria. *The Inclusive four-lepton lineshape measurement from pp collisions at 8 TeV with ATLAS.*
- 2013.8 **LPC Workshop on Gauge Boson Couplings 2013**, Fermilab, Batavia, IL, US. *ATLAS results on gauge coupling measurements.*
- 2013.8 **DPF 2013**, Meeting of the American Physical Society (APS) Division of Particles and Fields, UC Santa Cruz, CA, US. *Search for invisible decays of a Higgs boson produced in association with a Z boson in ATLAS.*
- 2013.4 **APS 2013**, APS April Meeting, Denver, CO, US. *Measurement of the ZZ production cross section in 20.7fb^{-1} of proton-proton collisions at $\sqrt{s} = 8\text{TeV}$ with the ATLAS detector.*

Selected Publications

Primary Author

2019

2018

- [26] ATLAS Collaboration, "Constraints on off-shell Higgs boson production and the Higgs boson total width in $ZZ \rightarrow 4\ell$ and $ZZ \rightarrow 2\ell 2\nu$ final states with the ATLAS detector", *Phys. Lett. B* 786, p. 223, DOI: 10.1016/j.physletb.2018.09.048, arXiv: 1808.01191 [hep-ex].

- [25] ATLAS Collaboration, "Searches for heavy ZZ and ZW resonances in the $\ell\ell qq$ and $\nu\nu qq$ final states in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector", *JHEP* 03, p. 009, DOI: 10.1007/JHEP03(2018)009, arXiv: 1708.09638 [hep-ex].

2017

- [24] ATLAS Collaboration, "Measurement of the ZZ production cross section in proton-proton collisions at $\sqrt{s} = 8$ TeV using the $ZZ \rightarrow \ell^-\ell^+\ell'^-\ell'^+$ and $ZZ \rightarrow \ell^-\ell^+\nu\bar{\nu}$ channels with the ATLAS detector", *JHEP* 01, p. 099, DOI: 10.1007/JHEP01(2017)099, arXiv: 1610.07585 [hep-ex].

2016

- [23] ATLAS Collaboration, "Searches for heavy diboson resonances in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector", *JHEP* 09, p. 173, DOI: 10.1007/JHEP09(2016)173, arXiv: 1606.04833 [hep-ex].

- [22] ATLAS Collaboration, "Search for an additional, heavy Higgs boson in the $H \rightarrow ZZ$ decay channel at $\sqrt{s} = 8$ TeV in pp collision data with the ATLAS detector", *Eur. Phys. J. C* 76.1, p. 45, DOI: 10.1140/epjc/s10052-015-3820-z, arXiv: 1507.05930 [hep-ex].

2015 and before

- [21] ATLAS Collaboration, "Constraints on the off-shell Higgs boson signal strength in the high-mass ZZ and WW final states with the ATLAS detector", *Eur. Phys. J. C* 75.7, p. 335, DOI: 10.1140/epjc/s10052-015-3542-2, arXiv: 1503.01060 [hep-ex].

- [20] ATLAS Collaboration, "Search for dark matter in events with a Z boson and missing transverse momentum in pp collisions at $\sqrt{s}=8$ TeV with the ATLAS detector", *Phys. Rev. D* 90.1, p. 012004, DOI: 10.1103/PhysRevD.90.012004, arXiv: 1404.0051 [hep-ex].

- [19] ATLAS Collaboration, "Search for Invisible Decays of a Higgs Boson Produced in Association with a Z Boson in ATLAS", *Phys. Rev. Lett.* 112, p. 201802, DOI: 10.1103/PhysRevLett.112.201802, arXiv: 1402.3244 [hep-ex].

- [18] ATLAS Collaboration, "Measurement of ZZ production in pp collisions at $\sqrt{s} = 7$ TeV and limits on anomalous ZZZ and $ZZ\gamma$ couplings with the ATLAS detector", *JHEP* 03, p. 128, DOI: 10.1007/JHEP03(2013)128, arXiv: 1211.6096 [hep-ex].

Contributing Author

2019

- [17] ATLAS Collaboration, "Measurement of the four-lepton invariant mass spectrum in 13 TeV proton-proton collisions with the ATLAS detector", *JHEP* 04, p. 048, DOI: 10.1007/JHEP04(2019)048, arXiv: 1902.05892 [hep-ex].

- [16] ATLAS Collaboration, “Constraints on mediator-based dark matter and scalar dark energy models using $\sqrt{s} = 13$ TeV pp collision data collected by the ATLAS detector”, *JHEP* 05, p. 142, DOI: 10.1007/JHEP05(2019)142, arXiv: 1903.01400 [hep-ex].
- [15] ATLAS Collaboration, “Search for heavy Majorana or Dirac neutrinos and right-handed W gauge bosons in final states with two charged leptons and two jets at $\sqrt{s} = 13$ TeV with the ATLAS detector”, *JHEP* 01, p. 016, DOI: 10.1007/JHEP01(2019)016, arXiv: 1809.11105 [hep-ex].
2018
- [14] ATLAS Collaboration, “Search for dark matter in events with a hadronically decaying vector boson and missing transverse momentum in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector”, *JHEP* 10, p. 180, DOI: 10.1007/JHEP10(2018)180, arXiv: 1807.11471 [hep-ex].
- [13] M. Benoit et al., “Testbeam results of irradiated ams H18 HV-CMOS pixel sensor prototypes”, *JINST* 13.02, P02011, DOI: 10.1088/1748-0221/13/02/P02011, arXiv: 1611.02669 [physics.ins-det].
2016
- [12] ATLAS Collaboration, “Measurement of total and differential W^+W^- production cross sections in proton-proton collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector and limits on anomalous triple-gauge-boson couplings”, *JHEP* 09, p. 029, DOI: 10.1007/JHEP09(2016)029, arXiv: 1603.01702 [hep-ex].
- [11] ATLAS Collaboration, “Measurements of four-lepton production in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector”, *Phys. Lett. B* 753, pp. 552–572, DOI: 10.1016/j.physletb.2015.12.048, arXiv: 1509.07844 [hep-ex].
- [10] M. Benoit et al., “Results of the 2015 testbeam of a 180 nm AMS High-Voltage CMOS sensor prototype”, *JINST* 11.07, P07019, DOI: 10.1088/1748-0221/11/07/P07019, arXiv: 1603.07798 [physics.ins-det].
2015 and before
- [9] ATLAS Collaboration, “Evidence for Electroweak Production of $W^\pm W^\pm jj$ in pp Collisions at $\sqrt{s} = 8$ TeV with the ATLAS Detector”, *Phys. Rev. Lett.* 113.14, p. 141803, DOI: 10.1103/PhysRevLett.113.141803, arXiv: 1405.6241 [hep-ex].
- [8] ATLAS Collaboration, “Evidence for the spin-0 nature of the Higgs boson using ATLAS data”, *Phys. Lett. B* 726, pp. 120–144, DOI: 10.1016/j.physletb.2013.08.026, arXiv: 1307.1432 [hep-ex].
- [7] ATLAS Collaboration, “Study of the spin and parity of the Higgs boson in diboson decays with the ATLAS detector”, *Eur. Phys. J. C* 75.10, [Erratum: *Eur. Phys. J. C* 76, no.3, 152(2016)], p. 476, DOI: 10.1140/epjc/s10052-015-3685-1, 10.1140/epjc/s10052-016-3934-y, arXiv: 1506.05669 [hep-ex].
- [6] ATLAS Collaboration, “Measurements of Four-Lepton Production at the Z Resonance in pp Collisions at $\sqrt{s} = 7$ and 8 TeV with ATLAS”, *Phys. Rev. Lett.* 112.23, p. 231806, DOI: 10.1103/PhysRevLett.112.231806, arXiv: 1403.5657 [hep-ex].
- [5] G. Aielli et al., “Studies on fast triggering and high precision tracking with Resistive Plate Chambers”, *Nucl. Instrum. Meth. A* 714, pp. 115–120, DOI: 10.1016/j.nima.2013.02.044, arXiv: 1210.6696 [physics.ins-det].

- [4] Y. Sun *et.al*, "A prototype MRPC beam test for the BESIII ETOF upgrade", *Chinese Physics C* 36, pp. 429–433, DOI: 10.1088/1674-1137/36/5/008.
- [3] Y. Sun *et.al*, "Beam test of signal cross-talk and transmission for LMPC", *Chinese Physics C* 36, pp. 838–843, DOI: 10.1088/1674-1137/35/9/010, arXiv: 1101.0224 [physics.ins-det].

[Public Results](#)

- [2] ATLAS Collaboration, *Multi-Boson Simulation for 13 TeV ATLAS Analyses*, tech. rep. ATL-PHYS-PUB-2017-005.