Elham E Khoda

Personal Data

Place and date of birth:	India | December 25, 1992
Address:	413-2730 Acadia Road, Vancouver, V6T IR9, BC, Canada
email:	ekhoda@uw.edu
Language:	Bengali (mother tongue), English, Hindi

Education

Sept 2015- March 2021
PhD, **The University of British Columbia**, Vancouver, Canada
Supervisor: Prof. Alison Lister, GPA: 94%
Dissertation: *Searches for new high-mass resonances in top-antitop and di-electron final states using the ATLAS detector* [link]

Aug 2010- May 2015
BS-MS Dual Degree in Physics, GPA: 8.96/10
Indian Institute of Science Education and Research, Kolkata, India
Thesis Supervisor: Prof. Ritesh K. Singh
Thesis: *Measuring CP properties of Higgs using $\tau - \tau$ spin correlation at LHC*

July 2008- May 2010
Higher Secondary Study in Science
Ramakrishna Mission Vidyalaya, Narendrapur, Kolkata, India
Final Grade: 89.50 %, West Bengal Council for Higher Secondary Education

April 2002- Mar 2008
High School Secondary Study
Ramakrishna Mission Vidyalaya, Narendrapur, Kolkata, India
Final Grade: 92.16 %, West Bengal Board of Secondary Education

Professional Appointments

March 2021
Postdoctoral Scholar, **University of Washington**, Seattle, WA, USA
Supervisor: Prof. Shih-Chieh Hsu

Research Experience

Current
$t\bar{t}$ Resonance Search with the ATLAS: lepton + jet channel
- Analysis contact for the full run-2 paper
- One of the main analyzers, maintainer of the analysis framework, optimizing event selection
- Developing an overlap removal strategy to reconstruct very close-by electron and jet coming from boosted top decay
- Studying $t\bar{t}$ mass reconstruction using neural network based regression method
- Studied electron isolation with the help of ATLAS Isolation and Fake forum
- Studied b-tagging and top-tagging to reduce dominant QCD and W+jets background
- Involving in the statistical analysis
- Status: *work in progress*

Current
BDT-based trigger for tau-particle identification
- Evaluating BDT-based tau identification algorithm
- Implementing the BDT algorithm on the FPGA using `hls4ml` and `conifer` packages
- Status: *work in progress*

Current
Machine Learning Liaison, ATLAS Exotics Group
- Liaison between the ATLAS ML forum and Exotics group
- ML support to the exotics searches in ATLAS

CURRENT

EXOT4 derivation contact

- Provide support for multiple searches by helping to use EXOT4 derivation format of ATLAS simulation and data
- Maintains the EXOT4 derivation code and do necessary updates

2018-2020

$t\bar{t}$ Resonance Search with the ATLAS: all-hadronic channel

- One of the main analyzers; maintainer of the analysis framework, sample production
- Optimised event selection and b-tagging method to increase the sensitivity
- Studied top-tagging effects of the DNN based top-tagger on $t\bar{t}$ mass reconstruction
- Working on data-driven background estimate using global fit and related studies like spurious signal test, signal injection test
- Evaluated systematic uncertainties and background/ signal yields
- One of the main analyzers for the statistical analysis, interpreting search results in the context of narrow width Z'_{TC2} resonance
- Final result: arXiv:2005.05138 (*submitted JHEP*)

JAN 2017-MAY 2019

ATLAS pixel cluster splitting using Mixture Density Network

- Studied the current Neural Network based algorithm used in ATLAS tracking for pixel cluster splitting and estimating the hit positions and uncertainties
- Developed an alternative algorithm based on probabilistic learning using Mixture Density Networks
- The performance is better than the existing algorithms and currently being studied for run-3
- Conference proceedings: LHCP 2019

AUG 2016-MAR 2017

Developed a treatment to include systematic uncertainties in BUMPHUNTER statistical search method

- Studied the BUMPHUNTER search in the context of dilepton resonance search
- Developed the machinery to add systematic uncertainties in the BUMPHUNTER framework by profiling them

DEC 2015-JUNE 2017

Search for new high-mass phenomena in the dilepton final state using 36 fb^{-1} proton-proton collisions data at $\sqrt{s} = 13$ TeV with the ATLAS detector

- Main electron channel analyzer; developed analysis framework, implemented analysis strategy, evaluated systematic uncertainties and background/signal yields
- Interpreted search results in the context of a various theoretical models such as Z' models and contact interactions
- Performed the BUMPHUNTER statistical search
- Final result: Journal of High Energy Physics, 10, 182

AUG 2014-MAY 2015

Measuring CP properties of Higgs using τ-τ spin correlation at LHC

MASTERS PROJECT Supervisor: Prof. Ritesh K. Singh, IISER Kolkata

- Use the $\tau - \tau$ spin correlation to suppress the $Z \to \tau^+\tau^-$ background and enhance the Higgs signal
- Measure the CP quantum number or the CP-mixing angle of the Higgs boson at LHC using simulation
- Studied various CP sensitive variables to enhance the sensitivity

JAN 2014-MAY 2014

Lorentz and CPT violation in Neutrinos

SEMESTER PROJECT Supervisor: Prof. Prasanta K. Panigrahi, IISER Kolkata, India

- Studied violations of Lorentz and CPT symmetry in the neutrino sector.
- The properties of the effective Hamiltonian for neutrino in presence of Lorentz and CPT violation are studied.

SUMMER 2014

A Model independent way of spin measurement of top quark through azimuthal angle distribution

Supervisor: Prof. Ritesh K. Singh, IISER Kolkata, India

- Top quark spin was estimated using the azimuthal angle distributions of top decay products
- Theoretical results were compared with Monte Carlo simulation.

JAN 2014-MAY 2014

XRD and Raman analysis of multiferroic perovskite compounds

SEMESTER PROJECT Supervisor: Prof. Goutam Dev Mukherjee, IISER Kolkata, India

- Two multiferroic perovskite compounds, $BaRuO_3$ and $GdCoO_3$ were studied
- Electronic structure was studied using X-ray Diffraction (XRD) and Raman spectroscopy

Sep 2013- Dec 2013	Study of Constrained Systems Semester project Supervisor: Prof. Prasanta K. Panigrahi, IISER Kolkata, India • The classification of the constraints were studied with some examples • The correspondence between constraint theory and gauge theory was further studied
Sep 2013 Dec 2013	Term paper on Berry's Phase Supervisor: Dr. Siddhrta Lal, IISER Kolkata, India • The theory formulation of Berry's phase was studied • General concept of geometric phase was discussed in the context of Aharonov-Bohm and Aharonov-Anandan effects, Pancharatnam's phase in addition to Quantum Entanglement and Bell's inequalities
Summer 2013	Electron and Photon identification at CMS detector at LHC Supervisor: Prof. Satyaki Bhattarcharya, Prof. Sunanda Banerjee, Dr. Subir Sarkar CMS group, Saha Institute of Nuclear Physics, Kolkata, India • Electron and Photon identification efficiency of the tight WP was studied using $Z \longrightarrow e^+e^-\gamma$ Monte Carlo sample • The parameters used in the identification was further varied for the efficiency study • Z invariant mass was constructed and fitted with Breit-Wigner function
Summer 2012	Neutrino Oscillations and Neutrino-less double beta decay Supervisor: Prof. Amitave Raychaudhury, Culcutta University, India • The theory of neutrino oscillation and neutrinoless double beta decay was studied. • The relation between effective mass and smallest neutrino mass from neutrinoless double beta decay was studied using Δm_{31} value measured by the Daya Bay experiment in 2012.
Summer 2012	Simulation of GPS System with necessary relativistic corrections Supervisor: Prof. Golam Mortuza Hossain, IISER Kolkata, India • Simulated triangulation method for determining the position of a point using the signal from several satellites with necessary relativistic correction

Computer Skills

Expert:	C, C++, Root, LaTeX
Advanced:	Python, Matlab, Linux, ubuntu, Windows, MadGraph, Mathematica, OS X
Basic:	mySQL, html, Pythia

Fellowships, Scholarships and Awards

2021	UW Data Science Postdoctoral Fellow
2021	Graduate Student Travel Award
2020-2021	President's Academic Excellence Initiative PhD Award
2019	Best Poster Award, LHCP 2019
2019	LHCP Travel Award, LOC LHCP 2019
2016-2020	Faculty of Science PhD Tuition Award, UBC
2015-2021	International Tuition Award, UBC
2016	Physics and Astronomy Graduate Scholarship (*departmental award for academic performance*)
2015-2016	UBC Faculty of Science Graduate Award
2010-2015	**INSPIRE Scholarship**, Dept. of Science and Technology, Govt. of India
2012	Summer Research Fellowship, Indian Academy of Science

Publications

Journal Publication

ATLAS Collaboration, *Search for $t\bar{t}$ resonances in fully hadronic final states in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*
Journal of High Energy Physics, 10, 061 (2020)

ATLAS Collaboration, *Search for new high-mass phenomena in the dilepton final state using* 36 *fb*$^{-1}$ *proton-proton collisions data at* $\sqrt{s} = 13$ *TeV with the ATLAS detector*
Journal of High Energy Physics, 10, 182 (2017)

Public Results and Conference Notes

E.Khoda, *Searches for new phenomena in final states with* 3^{rd} *generation quarks using the ATLAS detector*
ATL-PHYS-PROC-2021-009 , ICNFP-2020 Conference Proceedings (2021) [submitted to Int. J of Mod. Phys. A]

ATLAS Collaboration, *Dark matter summary plots for* s*-channel mediators*
ATL-PHYS-PUB-2020-021, Publication Note (2020)

E.Khoda, *ATLAS pixel cluster splitting using Mixture Density Networks*
PoS LHCP2019 (2019) 009, LHCP Conference Proceedings (2019)

ATLAS Collaboration, *Search for new high-mass resonances in the dilepton final state using proton-proton collisions at* $\sqrt{s} = 13$ *TeV with the ATLAS detector*
ATLAS-CONF-2016-045, Public Conference Note (2016)

Presentations

Conference Presentations

2020 Searches for new phenomena in final states with 3rd generation quarks using the ATLAS detector
9^{th} International Conference on New Frontiers in Physics 2020, Crete, Greece, September 2020

2020 Mixture Density Networks for tracking in dense environments on ATLAS (plenary talk)
ML4Jets, New York, US, Jan 2020

2019 ATLAS pixel cluster splitting using Mixture Density Networks (poster)
7^{th} Large Hadron Collider Physics Conference, Puebla, Mexico, May 2019

2017 Hunting for 'Bumps' in the Dilepton Invariant Mass Spectrum using BumpHunter at the ATLAS Detector
54^{th} Winter Nuclear and Particle Physics Conference, Banff, Alberta, Canada, February 2017

2016 Searching for 'Bumps' in the Dilepton Invariant Mass Spectrum using BumpHunter in pp collision at $\sqrt{s} = 13$ TeV with the ATLAS Detector
American Physical Society Northwest Section Meeting, Penticton, Canada, May 2016

Public Posters

2016 *Searching new massive particle in the ATLAS detector at the Large Hadron Collider*
TRISEP 2016, Science World, Vancouver

Other Presentations

2018 *Neural networks in silicon tracker cluster splitting*
ATLAS Machine Learning Workshop, CERN, Geneva, Switzerland

2018 *Pixel cluster splitting using Mixture Density Network* (poster)
ATLAS Week, CERN, Geneva, Switzerland

Summer Schools

2018 Machine Learning in High Energy Physics Summer School
University of Oxford, Oxford, United Kingdom

2018 MCnet Summer School
Monash University Prato Centre, Prato, Italy

2016 Tri-Institute Summer School on Elementary Particles (TRISEP)
TRIUMF, Vancouver, Canada

Teaching and Mentoring Experience

Summer 2020 Co-supervising a summer student (NSERC USRA 2020 program) with Prof. Alison Lister

Fall 2019 Teaching Assistant for Physics 309 (Electrical Lab for 3rd year undergraduates) course at The University of British Columbia

March 2019 Became Center for the Integration of Research, Teaching and Learning (CIRTL) associate

Winter 2019 Teaching Assistant for Physics 229 (General Physics Lab for 2nd year undergraduates) course at The University of British Columbia

Winter 2018 Teaching Assistant for Physics 229 (General Physics Lab for 2nd year undergraduates) course at The University of British Columbia

Fall 2017 Teaching Assistant for Physics 219 (Electronics Lab for 2nd year undergraduates) course at The University of British Columbia

Winter 2017 Teaching Assistant for Physics 506 (Elementary Particle Physics) course at The University of British Columbia

Fall 2016 Teaching Assistant for Physics 504 (Classical Electromagnetism) and Physics 509C (Theory of Measurement) course at The University of British Columbia

Winter 2016 Teaching Assistant for Physics 101 course at The University of British Columbia

Fall 2015 Teaching Assistant for Physics 100 course at The University of British Columbia

Spring 2015 Teaching Assistant for a Physics course (Covering Quantum Mechanics mechanics) for 2nd year undergraduates at IISER Kolkata.

Autumn 2014 Teaching Assistant for a Physics course (Covering classical mechanics and wave mechanics) for 1st year undergraduates at IISER Kolkata.

Extra-Curricular Activities

2019-2020 Coordinator of Equity and Inclusion in Physics and Astronomy
The University of British Columbia, Vancouver, Canada

March 2019 UBC Physics Olympics Volunteer
The University of British Columbia, Vancouver, Canada

2017-2018 Member, Committee for Culture at the Graduate Student Association
The University of British Columbia, Vancouver, Canada

March 2018 UBC Physics Olympics Volunteer
The University of British Columbia, Vancouver, Canada

2016-2017 VP Culture at the Graduate Student Association
The University of British Columbia, Vancouver, Canada

May 2017 Science Escapades (High School Conference) Volunteer
The University of British Columbia, Vancouver, Canada

April 2017 ATLAS Masterclass Volunteer
TRIUMF, Vancouver, Canada

March 2017 UBC Physics Olympics Volunteer
The University of British Columbia, Vancouver, Canada

2016-2018 Let's Talk Science (LTS) Volunteer
The University of British Columbia, Vancouver, Canada

2013-2014 **Gymkhana Committee** (students' representative body), Treasurer
Indian Institute of Science Education and Research, Kolkata

2012-2013 Inquivesta (Annual Science Festival) Head of publicity team
Indian Institute of Science Education and Research, Kolkata

Mar 2012 Inquivesta (Annual Science Festival) Event organizer, Junkyard Wars
Indian Institute of Science Education and Research, Kolkata

Interests and Activities

Programming, Administrative activities
Music (play flute, tabla), Drama
Football, Hiking, Travelling

References

Prof. Shih-Chieh Hsu
Associate Professor, Department of Physics
University of Washington, USA
schsu@uw.edu

Prof. Alison Lister
Associate Professor, Department of Physics and Astronomy
The University of British Columbia, Canada
alister@phas.ubc.ca

Prof. Koji Terashi
Assistant Professor, Tokyo ICEPP
University of Tokyo, Japan
koji.terashi@cern.ch

Prof. Gabriel Facini
Assistant Professor, Department of Physics
University of Warwick, United Kingdom
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Prof. Daniel Hayden
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