Rehearsal talks for the 2022 APS April Meeting

Thursday 17 March 2022 - Wednesday 30 March 2022

US

Book of Abstracts

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B and Top / **91**

Studies of C-jet spectra in various Flavor Schemes for $t\bar{t} + c$ cross section measurement

Author: Calvin Ainsworth[1]

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A comparison of three flavor scheme, four flavor scheme and five flavor scheme has been performed using top quark pair-production with additional charm jet $(t\bar{t} + c)$ events simulated by MadGraph and showered by Pythia8. Spectra of additional c-jets that do not originate from the top quark decay are compared in the three schemes. These studies are motivated by the upcoming $t\bar{t} + c$ jets cross section measurement. No significant differences in spectra of additional c-jets are observed in the different flavor schemes.

Career stage:

Graduate student

Instrumentation I / **118**

Construction and Testing of the first 12 sMDT Chambers at University of Michigan for the ATLAS HL-LHC upgrade

Author: Neal Anderson[1]

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The Large Hadron Collider (LHC) will be upgraded to increase its luminosity by a factor of 7.5 relative to the design luminosity. The ATLAS detector will undergo a major upgrade to fully explore the physics opportunities provided by the upgraded LHC. In order to optimize trigger efficiencies at the High-Luminosity LHC (HL-LHC), the Muon Spectrometer will be upgraded by replacing the MDT (Monitored Drift Tube) chambers by smaller-diameter MDT (sMDT) chambers and additional thin-gap RPC (Resistive Plate Chamber) trigger chambers in the barrel inner station. The University of Michigan ATLAS group is responsible for building 50% of the sMDT chambers. I will report on the construction and testing of the first 12 sMDT chambers built at the University of Michigan in 2021. Precision measurements and testing procedures will be described and the chamber precision and performance results will be presented.

Career stage:

B and Top / **93**

Identification of additional b-jets in the $t\bar{t}$ plus heavy flavor production with two leptons of the opposite sign in the final state using BDT for differential cross- section measurements

Author: Egor Antipov[1]

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Top quark pair-production in association with one or two additional b-jets is one of the main backgrounds in the search for $t\bar{t}+H$ production, and in BSM physics searches involving top and bottom quarks in the final states. Precise measurement of $t\bar{t}+b$ and $t\bar{t}+b\bar{b}$ differential cross sections will help to significantly reduce systematic and modeling uncertainties in future BSM searches and measurements of the top-Higgs coupling. A BDT that discriminates between b-jets which do or do not originate from top quarks decays has been developed in the opposite-sign dilepton channel. The method has higher purity compared to the existing method based on the angular distributions between b-jets and leptons. Preliminary results show that with the new method we can accurately measure the p_T spectra of b-jets from top quark decays and of the leading additional b-jet up to 400 GeV, and the sub-leading additional b-jets p_T up to 300 GeV. The analysis uses LHC proton-proton collision data at the center-of-mass energy $\sqrt{s}=13$ TeV with an integrated luminosity of 139 fb^{-1} collected with the ATLAS detector in 2015-2018.

Career stage:

Graduate student

SM I / **97**

Study of Wˆ±Z longitudinal-longitudinal interactions ($W_0^{\pm}Z_0$) with Full Leptonic Final States ($W^{\pm}Z \rightarrow l^{\pm}l^{\pm}l^{\mp}$)

Author: Prachi Atmasiddha[1]

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In the Standard Model of particle physics, the spontaneous symmetry breaking of the complex Higgs field gives rise to the massive Higgs boson and three Goldstone bosons, which represent the longitudinal degrees of freedom of the $W^{\pm}$ and Z bosons. It is therefore critical to study the interactions of longitudinally-polarized $W^{\pm}$ and Z bosons ($W_0^{\pm}$ and Z_0). Here, we present the first such analysis, in inclusive fully-leptonic final states ($W^{\pm}Z \rightarrow l^{\pm}l^{\pm}l$) with 139 fb^{-1} of proton-proton collision data recorded with the ATLAS detector at a 13 TeV of center of mass energy. We use kinematic variables like p_T^Z and $p_T^{W^{\pm}Z}$ to enhance the $W_0^{\pm}Z_0$ contribution. The so called radiation amplitude zero effect also enhances the $W_0^{\pm}Z_0$ contribution in the central region ($\cos\theta_V$ ˜ 0, where θ_V is the scattering angle of the $W^{\pm}$ or Z boson in the parton center-of-mass frame). A multivariate variable is developed to separate the longitudinal-longitudinal polarization from other polarizations. A template fit will be performed to extract polarization fractions.

Career stage:

Graduate student

Poster / **103**

Predicting the missing transverse momentum trigger rate at ATLAS with machine learning

Authors: Ben Carlson[1]; Chandler Baker[1]

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One of the challenges of the ATLAS missing transverse momentum trigger is understanding how the trigger rate will evolve with the number of proton collisions per bunch crossing, or pileup. In the past, the data have been fit to parametric functions and extrapolated to higher pileup values. In this poster, we present a new technique using machine learning regression models to describe the trigger rate, and allow for extrapolation to higher values of pileup.

Career stage:

Undergraduate student

SM I / **104**

(Withdraw) Observation of the WWW Production in p-p Collision at √s = 13 TeV with the ATLAS Detector

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Co-author: Jessica Metcalfe [1]

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WWW production was recently observed by the ATLAS collaboration using the full Run II data set with an integrated luminosity of 139 fb^{-1} at $\sqrt{s} = 13$ TeV. These first observation and cross-section measurements are presented. Measurements are performed in two final states. Events with two same-sign electrons or muons in association with two jets as well as events with three charged leptons with no same flavor opposite sign lepton pairs are selected. Machine learning techniques are used to improve the signal sensitivity by training different kinematic variables separately for each channel. Triboson WWW production is observed with a significance of 8.0σ, where the expectation is 5.4σ. The inclusive WWW production cross-section is measured to be 820 ± 100 (stat.) ± 80 (syst.) fb.

Career stage:

Postdoc

Poster / **120**

Improvements to and Functionality Testing of ATLAS Online Trigger Rate Prediction Tool in Preparation for Run 3

Author: Enzo Daniele Brandani[1]

Co-authors: Connor Harrison Menzel [1]; Joerg Stelzer [1]; Tae Min Hong [1]

[1] *University of Pittsburgh (US)*

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The ATLAS detector at the LHC is subject to millions of events per second. ATLAS employs a trigger system to select events of high importance for offline storage. To ensure the triggers are working

as expected, we use a software tool called xMon, which has been in operation in the ATLAS control room for a decade. xMon works by predicting the trigger rate based on offline fits from previous runs, which can then be compared to the live trigger rates at ATLAS. We discuss the recent developments to prepare xMon for Run 3: (1) formatting the new visual interface hosted within the Grafana TRP dashboard, (2) analysis of results from pilot beam data, (3) addition of a bunch factor callback function.

Career stage:

Poster / 99

Improvements to and Functionality Testing of ATLAS Online Trigger Rate Prediction Tool in Preparation for Run 3

Author: Enzo Daniele Brandani[1]

Co-authors: Tae Min Hong [1]; Joerg Stelzer [1]

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Career stage:

Undergraduate student

116

Expected physics reach for the High-Luminosity LHC

Author: Elizabeth Brost[1]

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The High-Luminosity Large Hadron Collider (HL-LHC) project, a planned upgrade to the Large Hadron Collider (LHC) at CERN, is scheduled to begin colliding protons at unprecedented instantaneous luminosity later this decade. The HL-LHC will deliver a total of 3000 fb^{-1} of proton-proton collision data to the LHC experiments at a center-of-mass energy of 14 TeV. The experiments - ATLAS, CMS, LHCb, and ALICE - have planned a series of major detector upgrades to prepare for the higher instantaneous luminosity and center-of-mass energy, as well as the increase in simultaneous collisions (or pileup) foreseen for the HL-LHC program. These upgrades will allow the experiments to maintain or improve physics performance, despite the more challenging environment. Using the HL-LHC dataset, we will be able to improve on statistically-limited Standard Model measurements, and extend the sensitivity of searches. In this talk, we present a selection of physics prospects for

the HL-LHC, including Higgs boson properties, searches for Standard Model Higgs pair production, and searches for new physics beyond-the-Standard-Model.

Career stage:

Faculty/Scientist

Plenary / 121

Expected physics reach for the High-Luminosity LHC

Corresponding Author: elizabeth.brost@cern.ch

The High-Luminosity Large Hadron Collider (HL-LHC) project, a planned upgrade to the Large Hadron Collider (LHC) at CERN, is scheduled to begin colliding protons at unprecedented instantaneous luminosity later this decade. The HL-LHC will deliver an unprecedented proton-proton collision dataset to the LHC experiments at a center-of-mass energy of 14 TeV. The experiments - ATLAS, CMS, LHCb, and ALICE - have planned a series of major detector upgrades to prepare for the higher instantaneous luminosity and center-of-mass energy, as well as the increase in simultaneous collisions (or pileup) foreseen for the HL-LHC program. These upgrades will allow the experiments to maintain or improve physics performance, despite the more challenging environment. Using the HL-LHC dataset, we will be able to improve on statistically-limited Standard Model measurements, and extend the sensitivity of searches. In this talk, we present a selection of physics prospects for the HL-LHC, including Higgs boson properties, searches for Standard Model Higgs pair production, and searches for new physics beyond-the-Standard-Model.

Career stage:

SM II / 89

Cross section measurement of associated $J/\psi + W^{\pm}$ production with the ATLAS detector

Author: Charles Burton[1]

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The cross-sections of prompt and non-prompt production of $J/\psi + W^{\pm}$ are being measured by the ATLAS Collaboration using the 139 fb^{-1} Run II 13 TeV pp collision data set. The prompt production of J/ψ associated with a $W^{\pm}$, where both particles are produced in a single parton-parton interaction, provides constraints on models of non-relativistic QCD, especially in the realm of heavy quarkonia production. The measurement is an all-leptonic final state with $J/\psi \rightarrow \mu^{+}\mu^{-}$ and $W^{\pm} \rightarrow \ell^{\pm}\nu$, and it is performed differentially in J/ψ transverse momentum and rapidity. Finally, the non-prompt measurement allows for the study of top production and b-quark fragmentation.

Career stage:

Graduate student

Instrumentation II / **122**

Electrical characterisation of stave prototypes for the ATLAS ITk Upgrade

Corresponding Author: francesca.capocasa@cern.ch

The ATLAS experiment is currently preparing for an upgrade of the inner tracking detector for High-Luminosity LHC operation, scheduled to start in 2027. The new detector, known as the Inner Tracker or ITk, employs an all-silicon design with five inner Pixel layers and four outer Strip layers. The staves are the building blocks of the ITk Strip barrel layers. Each stave consists of a low-mass support structure which hosts the common electrical, optical and cooling services as well as 28 silicon modules, 14 on each side. Two prototype electrical long-strip staves have been assembled at BNL.In this talk, we will present the deliverables of this prototyping phase highlighting the improvent of the stave layout and the results on the most recent stave.

Career stage:

90

(Withdraw) New methods for missing transverse momentum triggers at ATLAS Run 3

Author: Ben Carlson[1]

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The ATLAS trigger system underwent major upgrades between 2018-2022. In particular, the level-1 calorimeter (L1Calo) hardware trigger has been upgraded, and tracking introduced in the software-based missing transverse momentum triggers. In this talk, I will present preliminary performance projections for the L1Calo missing transverse momentum triggers. I will also describe the algorithms in the high-level trigger incorporating tracking and machine learning.

Career stage:

Faculty/Scientist

BSM I / **108**

Search for Dark Matter produced in association with a Higgs boson decaying to a pair of b quarks and combination of Dark Matter search with 2HDM+a with the ATLAS detector

Author: Jay Chan[1]

[1] *University of Wisconsin Madison (US)*

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Dark Matter (DM) searches are of great importantance to the LHC program. In this talk, I will first present a DM search using the Higgs boson as a portal. This search targets events that contain large

missing transverse momentum and either two b-tagged small-radius jets or a single large-radius jet associated with two b-tagged sub-jets. No significant excess with respect to the SM prediction is observed. The results are then interpreted to set limits on two benchmark models with a second Higgs doublet and an additional heavy vector boson (2HDM+Z) or a pseudoscalar singlet (2HDM+a), both of which provide a viable DM candidate. I will focus on how events are selected and categorized to enhance sensitivity to DM signals, and to help model the major backgrounds. Finally, I will also talk about the latest summary and combination of the searches for DM within the 2HDM+a model.

Career stage:

Graduate student

Instrumentation I / **67**

sMDT Production and Testing at UM for the HL-LHC ATLAS Muon Spectrometer Upgrade

Author: Andy Chen[1]

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To accommodate the high trigger-rate conditions at the High Luminosity Large Hadron Collider (HL-LHC) in Run 4 and onwards, the Monitoring Drift Tube (MDT) chambers in the inner barrel layer of the ATLAS muon spectrometer will be replaced with new small-diameter MDTs. The upgrade will allow for better muon tracking resolution and for the installation of new Resistive Plate Chambers (RPCs) to maintain a high trigger efficiency. To ensure consistency and quality in each individual drift tube, a detailed construction and testing process is developed and used for the sMDT production process at the University of Michigan (UM) and Michigan State University (MSU). A major effort in tube production was made by UM during 2021 to ensure a timely sMDT chamber construction schedule. In this talk, I will present the cumulative testing results between the two sites which show an excellent production year in quality and quantity.

Career stage:

Graduate student

Higgs / **110**

Combination of searches for resonant and non-resonant Higgs boson pair production in the bbyy, bb⊠⊠ and bbbb decay channels using pp collisions at √s= 13 TeV with the ATLAS detectors = 13 TeV with the ATLAS detector

Author: Alkaid Cheng[1]

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A combination of searches for Higgs boson pair production is performed using up to 139 fb^{-1} of proton-proton collision data at a center-of-mass energy $\sqrt{s} = 13$ TeV recorded with the ATLAS

detector at the LHC. The combination exploits three analyses searching for HH decays to $bb\gamma\gamma$, $bb\tau\tau$ and $bbbb$. Results are interpreted in the context of non-resonant and resonant Higgs boson pair production scenarios. In the non-resonant interpretation, upper limits are set on the Higgs boson pair production cross-section and on the self-coupling modifier κ_λ. In the resonant interpretation, upper limits are set on the Higgs boson pair production cross-section as a function of the heavy resonance mass.

Career stage:

Graduate student

SM II / 73

Measurement of Z plus Heavy Flavor Jets Differential Cross Section with Full Run-2 ATLAS data

Author: Alec Drobac[1]

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Measurements of the production rate of Z bosons in association with heavy quarks provide sensitive tests of perturbative quantum chromodynamics (pQCD) predictions, which are made at next-to-leading-order (NLO) accuracy using either a 4-flavor number scheme (4FNS) or 5-flavor number scheme (5FNS). In the 4FNS, b-quarks are not present in the parton distribution functions (PDFs) and only appear as a product of gluon splitting ($g \to bb$). In the 5FNS, on the other hand, a (massless) b-quark PDF is included. A previous analysis studying $Z \to ee/\mu\mu$ + b-jet events using 2015 & 2016 data showed that the 5FNS predictions match the data well, while the 4FNS predictions underestimate the data. The uncertainties are substantial, however. In our analysis we are attempting to further investigate these results by also including Z + c-jet events and looking at the combined "heavy-flavor"(b+c) region to reduce uncertainties. We are also updating the 2015-2016 results with 140 fb^{-1} (up from 35.6 fb^{-1}) of ATLAS Run-2 data at $\sqrt(s) = 13$ TeV. This is still a work in progress, but important milestones will be presented.

Career stage:

Graduate student

SM II / 105

Measurement of four-jet production in the ATLAS experiment

Author: Zahra Farazpay[1]

Co-authors: Lee Sawyer ; Markus Wobisch

[1] *Louisiana Tech University (US)*

Corresponding Author: zahrafar86@gmail.com

Measurements of multi-jet cross-section ratios are presented.
The measured quantities are the ratio of the four-jet and three-jet
cross-sections and the ratio of the four-jet and two-jet cross-sections.

The data were collected with the ATLAS detector in proton-proton collisions at a center of mass energy of 13 TeV during 2015-2018. The results are presented as a function of the transverse jet momentum. Predictions from different Monte Carlo event generators are compared to the data.

Career stage:

Graduate student

BSM I / 81

Search for dark mesons decaying to top and bottom quarks in 139 fb-1 of proton-proton collision data at √s = 13 TeV with the ATLAS detector at the LHC.

Authors: Galen Gledhill[1]; Jochen Jens Heinrich[1]; Stephanie Majewski[1]

[1] *University of Oregon (US)*

Corresponding Author: galen.rhodes.gledhill@cern.ch

Extending the Standard Model (SM) with a new strongly coupled dark sector can generate models with both an experimentally accessible dark meson production mechanism and a viable dark matter candidate particle. A search for dark mesons is presented in an integrated luminosity of 139 fb^{-1} of proton-proton collision data at a center of mass energy of 13 TeV with the ATLAS detector at the Large Hadron Collider (LHC). In this model, dark pions are pair-produced and then decay to top-antitop or top-antibottom quark pairs. This talk describes the strategy and expected sensitivity of the all-hadronic channel of this search, with a signature of six or more jets and no additional missing transverse energy. Exclusion limits from this analysis are expected to provide new dedicated constraints on dark meson parameter space, exceeding existing limits derived from the reinterpretation of prior analyses.

Career stage:

Graduate student

Instrumentation II / 96

Development and Testing of the AMACStar ASIC at Penn for the ATLAS ITk Detector

Author: Thomas Christopher Gosart[1]

[1] *University of Pennsylvania (US)*

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In preparation for the high-luminosity LHC (HL-LHC), the ATLAS detector will be upgraded with a new silicon-strip charged-particle tracking detector (ITk strip detector) to satisfy the radiation, granularity and timing requirements. The AMACStar (Autonomous Monitor and Control) is one of three ITk application-specific integrated circuits (ASICs). It is designed to monitor and control temperatures, voltages, and currents in the detector modules. This is an essential function for the

ITk detector; the ASIC can autonomously (and quickly) identify hazards in the detector modules, controlling and preventing them from spreading.

The ITk ASICs are produced on wafers containing several hundred chips. In order to ensure that each AMACStar chip works and performs as expected, a comprehensive probe-station testing software and procedure have been developed. This setup tests the digital and analog functionality of each AMACStar to be installed in the ITk modules. I will present the probe-station setup and probing results of pre-production AMACStar chips.

Career stage:

Graduate student

Instrumentation II / **68**

CSM FPGA Irradiation Test at LANSCE for the HL-LHC ATLAS Muon Spectrometer Upgrade

Author: Jem Aizen Mendiola Guhit[1]

Co-authors: Yuxiang Guo [1]; Xueye Hu [1]; Thomas Andrew Schwarz [1]; Xiong Xiao [1]

[1] *University of Michigan (US)*

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The increased radiation environment and data rate for the High Luminosity Large Hadron Collider (HL-LHC) require upgrades to the readout electronics for the Muon Spectrometer (MS) electronics. In this talk, I will present ongoing irradiation studies of a custom-built front-end electronics board, the chamber service module (CSM), which is responsible for multiplexing data read out from on-detector electronics as well as passing configuration information to them. An important component of the CSM is a Field-programmable gate array (FPGA), specifically using the FPGA Artix7 xc7a35T, which is responsible for fanout of configuration and control information for 18 mezzanine cards. The Artix-7 is a commercial component with a history of meeting our radiation specifications. The specific model used in the CSM was tested in a radiation hard environment with an average flux 103 higher than ATLAS (6.02E+3 n/cm^2/s vs 1.3E+6 n/cm^2/s). Preliminary results show that the LANSCE Single Event Upset (SEU) test approximately had 3 years of ATLAS in comparison with ˜ 1.9E+11n/cm^2/y fluence (MDT CSM Requirement) and accumulated 18 SEU errors for two boards.

Career stage:

Graduate student

SUSY / **100**

(Withdraw) Search for higgsinos using one electron and one electron-like track using the ATLAS detector with full Run-2 data set

Author: Luis Felipe Gutierrez Zagazeta[1]

[1] *University of Pennsylvania (US)*

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Higgsinos with masses near the electroweak scale and within a compressed mass spectrum represent a poorly constrained region of the SUSY parameter space that is nonetheless strongly motivated by both naturalness and dark matter considerations. In this talk we develop a search for higgsinos in compressed scenarios by studying the production of the second lightest neutralino ($\tilde{\chi}_2^0$) in association with the lightest chargino ($\tilde{\chi}_1^\pm$) or the lightest neutralino ($\tilde{\chi}_1^0$) and a hard initial state radiation jet. We assume the mass difference between $\tilde{\chi}_1^0$ and $\tilde{\chi}_2^0$ is below 5 GeV, R-parity is conserved, and $\tilde{\chi}_1^0$ is the lightest supersymmetric particle. Specifically, we consider the case where $\tilde{\chi}_2^0$ decays to $\tilde{\chi}_1^0$ and two opposite-sign same-flavor leptons (via an off-shell Z boson). Due to the small mass splitting, the final-state leptons tend to have low-p_T and small calorimeter energy depositions. These "soft" leptons suffer from low reconstruction efficiencies using standard algorithms, severely limiting the di-lepton channel's sensitivity to mass splittings below 5 GeV. Instead, this search targets events containing one well-identified electron and one electron-like track. In this talk, we discuss the signal track selection strategy which uses a new boosted decision tree developed to identify electrons below the standard 4.5 GeV reconstruction threshold within ATLAS. Additionally, we present the status of our event selection optimization, background estimation strategy, and preliminary sensitivity estimates using the full Run 2 ATLAS data set.

Career stage:

Graduate student

Instrumentation II / 75

Hough Transform pattern recognition for track finding at the ATLAS experiment at the LHC

Authors: Alexander Paramonov[1]; Antonio Boveia[2]; Natalie Harrison[2]

[1] *Argonne National Laboratory (US)*

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Corresponding Author: harrison.762@osu.edu

We are exploring Hough Transform (HT) algorithms in FPGAs to identify charged particle trajectories in the ATLAS detector at the HL-LHC. The Inner Detector of the ATLAS experiment measures the trajectories of charged particles in a uniform magnetic field. Our approach is to perform the Hough transformation pattern identification in two steps. The "first-stage"HT uses parameter space in phi0 and q/pT using hits from the semiconductor tracker and identifies those that are consistent with being from the same track. We evaluate adding a second HT step using eta-z0 track coordinate plane, that processes hits identified from roads in the first stage. A working firmware prototype for FPGAs is designed. The performance of this second stage HT is measured as the efficiency and rejection of MC simulations and is presented here, along with an estimation of the resources required of the firmware.

Career stage:

Graduate student

SUSY / 106

Search for B-L RPV Supersymmetry Through Stop Pair Production in Final States with 2 b-jets and 2 Leptons Using the Run 2 Data from the ATLAS Detector

Author: James Heinlein[1]

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Supersymmetry is a natural solution to many phenomena left unexplained by the Standard Model, such as the hierarchy problem that arises due to quantum corrections to the Higgs boson mass. Models which allow for R-parity violation (RPV) are favored by recent lepton flavor anomalies and can provide insight into the neutrino mixing hierarchy. The direct pair production of the stop, the supersymmetric partner to the top quark, is of particular interest due its sizable production cross section at the LHC, which allows for searches at the TeV scale. We present a search for stop pair production, with each stop decaying via an RPV coupling to a b quark and a charged lepton. This final state with two oppositely-charged leptons and two b-quark-initiated jets allows for a high reconstruction efficiency. The reconstructed mass asymmetry is used to properly pair candidate jets and leptons to form stop candidates, enabling powerful background rejection. In this talk, I will discuss the current work on the *B-L* RPV stop analysis using the full Run 2 dataset collected with the ATLAS detector.

Career stage:

Graduate student

Instrumentation II / **92**

ATLAS Global Tau Trigger Performance Study for Run 4

Author: Katherine Rose Kaylegian-Starkey[1]

Co-authors: Stephanie Majewski [1]; Anni Xiong [1]; Eric Torrence [1]

[1] *University of Oregon (US)*

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Tau decays are notoriously difficult to detect because many particles decay with a similar signature. When searching for taus, capturing data from tau-lookalikes has been an ongoing problem, and previous global tau trigger algorithms have only had access to coarse granularity data from the calorimeters. The upgrade of the ATLAS Trigger and Data Acquisition system for the High-Luminosity Large Hadron Collider will provide high-granularity calorimeter information, offering enhanced performance required for operation during Run 4 (with 200 interactions per bunch crossing). Here we present the expected tau trigger performance, including the efficiency and background rejection.

Career stage:

Undergraduate student

Poster / **86**

ATLAS NSW sTGC Readout Electronic Integration and Commissioning

Author: Nicholas Graves Kyriacou[1]

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Corresponding Author: nkyriaco@umich.edu

The most challenging ATLAS Phase I upgrade project during Long Shutdown 2 (2019-2021) is the New Small-Wheel (NSW) for Muon Spectrometer. The main purpose of the NSW upgrade is to improve the performance of muon triggering and precision tracking for the High-Luminosity Large-Hadron-Collider (HL-LHC), which will deliver 3,000 fb-1 of data at √s = 14 TeV. The NSW will feature two new detector technologies: Resistive Micromegas (MM) and small-strip Thin Gap Chambers (sTGC), with MM playing the role of a primary tracking detector and sTGC as a primary trigger. To retain the good precision tracking capabilities in the high background environment of the HL-LHC, each sTGC plane must achieve a spatial resolution better than 100 μm to allow reconstruction of the Level-1 trigger track segments with an angular resolution of approximately 1mrad. This presentation focuses on the electronic readout integration and readout commissioning of sTGC detectors at CERN, both in the integration phase and for the two, separate, NSW commissionings, including a summary of the progress achieved, the problems encountered, and adapted solutions.

Career stage:

Graduate student

BSM II / **88**

Search for Resonant and Non-Resonant VHH Production

Authors: Jianming Qian[1]; Nicholas Graves Kyriacou[1]; Lianliang Ma[2]; Matthew Henry Klein[1]; Nikolaos Rompotis[3]; Tong Li[2]; Zhongyukun Xu[2]

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Studies of Higgs boson pair production (hh) represent the next crucial step to constraining the Higgs sector and allow the chance to refine measurements of the Higgs boson self-coupling. While previous searches have focused on the hh production in the gluon-gluon fusion (ggF) and vector-boson fusion (VBF) modes, this analysis documents a new search, with 139 fb-1 of pp collisions at $\sqrt{s}$ = 13 TeV collected by the ATLAS detector in LHC Run 2, for di-Higgs production in the Vhh final-state. It searches for both resonant and non-resonant hh production, with only hh⟶$b\bar{b}b\bar{b}$ considered for simplicity, in association with a leptonically decaying vector boson (W or Z). While this process has a lower cross-section than ggF and VBF hh production, it offers a clean final state with relatively small backgrounds, due to the presence of leptons. The analysis benefits from small backgrounds and attempts to set limits for the first time on Vhh production. Analysis techniques and expected significance will be presented.

Career stage:

Graduate student

BSM I / **115**

Search for Dark Matter Produced in Association with a Dark Higgs Boson Decaying to two b-quarks Using full Run-2 data set from the ATLAS detector

Author: Qibin Liu[1]

Co-authors: Changqiao Li [2]; Shih-Chieh Hsu [3]; Shu Li [4]

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A hypothetical dark Higgs boson was proposed in a dark matter (DM) model to explain the origin of mass in dark sector as well as to open up new annihilation channel relaxing the DM relic density constraint from cosmological observation. The search focusing on Majorana DM produced with a low mass dark Higgs boson decaying to two b-quarks is proposed and working in progress using the 139fb-1 of proton-proton collision data collected with ATLAS detector at √s=13 TeV.
The event selection and categorization are optimized based on the varying dark Higgs mass. Advanced jet clustering and boosted tagging techniques are applied to achieve higher efficiency and better signal over background ratio.
The analysis method and model interpretation strategy together with the result of expected sensitivity will be presented.

Career stage:

Graduate student

SUSY / **95**

Search for Higgsinos Decaying into Semi-Long-Lived Charged Particles in the ATLAS Detector with LHC Run 2 Data

Author: Sicong Lu[1]

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Higgsinos with compressed mass spectra and masses near the electroweak scale are highly motivated by naturalness considerations and consistent with cosmological evidence, yet still poorly constrained by the LHC. This search will focus on the neutralino mass splitting $m = m_{\tilde{\chi}^0_2} - m_{\tilde{\chi}^0_1}$, in the region of 0.3˜2 GeV, which has not been covered by ATLAS analyses to date. The current limit set by LEP only excludes up to $m_{\tilde{\chi}^\pm_1}$˜95 GeV. We plan to probe higher masses by identifying the track corresponding to a soft charged pion from the slightly long-lived (with cτ ˜1 mm) higgsino decay. The analysis will look for the associated production of higgsino-like chargino ($\tilde{\chi}^\pm_1$) and neutralino ($\tilde{\chi}^0_2$) in LHC pp collisions using the ATLAS Run-2 dataset. The event signature includes a high momentum jet from initial state radiation, and a displaced pion $^\pm$ from $\tilde{\chi}^\pm_1/\tilde{\chi}^0_2$ decay aligned with significant missing energy in the transverse plane. Using Monte Carlo simulation, I will present a preliminary sensitivity estimate for $m_{\tilde{\chi}^0_1}$˜150 GeV, and suppression strategy against backgrounds from semi-long-lived particles using track energy loss and secondary vertex reconstruction.

Career stage:

Graduate student

Poster / **102**

Investigating Gluon Fusion as New Channel to Search for Dark Matter

Author: Connor Harrison Menzel[1]

Co-authors: Tae Min Hong [1]; Ben Carlson [2]

[1] *University of Pittsburgh (US)*

[2] *Westmont College*

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In Higgs portal models, it is predicted that the Higgs boson could decay into dark matter particles. We may be able to detect these processes with the ATLAS detector, located at the Large Hadron Collider in Geneva Switzerland. There are many different production modes of the Higgs boson that could be used in a search for these Higgs boson to invisible decays, and when used together they provide our best chance at discovering new physics. Previous work has been done with vector-boson fusion production (VBF), but gluon fusion (ggF) production has a larger cross section, making it a promising candidate to aid in the search. Therefore, we are investigating the feasibility of using a MET+photon trigger at ATLAS to provide sensitivity to ggF production of the Higgs boson; Large MET is characteristic of any Higgs boson to invisible decay, and the photon requirement would provide sensitivity to $H \to \gamma\gamma_d$ decays, where γ_d is a dark photon.

Career stage:

Undergraduate student

B and Top / 65

Measurement of the CP-violating phase ϕ_s in $B_s^0 \to J/\psi\phi$ decays in ATLAS at $13\ \mathrm{TeV}$

Author: Easwar Anand Narayanan[1]

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A measurement of the $B_s^0 \to J/\psi\phi$ decay parameters using $80\ \mathrm{fb}^{-1}$ of integrated luminosity collected with the ATLAS detector from $13\ \mathrm{TeV}$ proton-proton collisions at the LHC is presented. The measured parameters include the *CP*-violating phase ϕ_s, the width difference $\Delta\Gamma_s$ between the B_s^0 meson mass eigenstates and the average decay width Γ_s. The values measured for the physical parameters are combined with those from $19.2\ \mathrm{fb}^{-1}$ of $7\ \mathrm{TeV}$ and $8\ \mathrm{TeV}$ data, leading to the following:
\begin{equation}
\phi_s=-0.087\pm0.036(\mathrm{stat.})\pm0.021(\mathrm{syst.})\ \mathrm{rad}
\end{equation}
\begin{equation}
\Delta\Gamma_s=0.0657\pm0.0043(\mathrm{stat.})\pm0.0037(\mathrm{syst.})\ \mathrm{ps}^{-1}
\end{equation}
\begin{equation}
\Gamma_s=0.6703\pm0.0014(\mathrm{stat.})\pm0.0018(\mathrm{syst.})\ \mathrm{ps}^{-1}
\end{equation}
Results for ϕ_s and $\Delta\Gamma_s$ are also presented as 68% confidence level contours in the $\phi_s - \Delta\Gamma_s$ plane. Furthermore, the transversity amplitudes and corresponding strong phases are measured. ϕ_s and $\Delta\Gamma_s$ measurements are in agreement with the Standard Model predictions.

Career stage:

Graduate student

Instrumentation I / 66

Performance of sMDT chambers for the HL-LHC ATLAS muon spectrometer upgrade

Author: Kevin Michael Nelson[1]

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New small Monitored Drift Tube (sMDT) chambers were developed by the Max Planck Institute (MPI) for the ATLAS muon spectrometer upgrade. The smaller tube size allows sMDT chambers to cope with the increased luminosity of the High Luminosity LHC (HL-LHC) and make space for additional Resistive Plate Chamber (RPC) layers. The University of Michigan will construct 48 sMDT chambers containing over 23,000 drift tubes by 2024. This talk will report on the methodology used to reconstruct cosmic-ray muon tracks in the sMDT chambers assembled at the University of Michigan, including a Geant4 simulation of the sMDT chambers. Chamber commissioning test results using cosmic-ray muons are presented, including noise rate, efficiency, and resolution studies.

Career stage:

Graduate student

Higgs / 119

Search for Higgs Boson Pair Production in the Multi-lepton Final State Using Proton-Proton Collision Data at $\sqrt{s} = 13$ TeV from the ATLAS Detector

Author: Santosh Parajuli[1]

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This talk will present a search strategy for Higgs boson pair-production in final states with three electrons or muons. The analysis is performed using an integrated luminosity of 139 fb^{-1} of pp collision at $\sqrt{s} = 13$ TeV collected by the ATLAS detector at the LHC. There are many decay modes of Higgs boson pairs that have low branching ratios, and many of these are not covered by dedicated analyses. Some example modes of particular interest for a three lepton final state are WWWW, WW$\tau\tau$, $\tau\tau\tau\tau$, etc. This talk presents the development of a multivariate strategy (boosted decision trees) and current work on background estimation methods and statistical analysis.

Career stage:

Graduate student

Instrumentation I / 70

Alignment system of the muon end-cap new small wheels

Author: Camila Pazos[1]

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The muon spectrometer of the ATLAS detector at the LHC consists of thousands of muon precision chambers. Precise muon track reconstruction is crucial in order to achieve the physics goals of the ATLAS experiment, but attaining the required level of precision is not trivial due to the size and nature of the muon detectors. To reach the 80 microns precision needed to obtain a 10% precision on 1 TeV-momentum muon, an optical-based alignment system has been designed and installed on the muon spectrometer. In this talk I will describe this alignment system, which consists of thousands of coupled light sources and optical sensors, focusing on the upgrade and commissioning of the system for the New Small Wheels, a brand-new addition to the muon end-cap spectrometer.

Career stage:

Graduate student

Higgs / 107

Combination of Searches for HH Production with ATLAS Run 2 Data

Author: Jannicke Pearkes[1]

[1] *SLAC National Accelerator Laboratory (US)*

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Searches for di-Higgs production are some of the most exciting new results at the LHC. This talk will present the latest ATLAS HH combination results with the full Run 2 dataset of 139/fb at $\sqrt{s} = 13$ TeV. By combining results from three different complementary search channels, bbγγ, bbττ, and bbbb, the HH combination has high sensitivity in both non-resonant and resonant interpretations.

In the non-resonant interpretation, bbγγ and bbττ channels are combined to produce limits on the Standard Model (SM) HH production cross-section and the Higgs boson self-coupling. Although no evidence for a signal was observed, the observed (expected) upper limits on SM HH production cross-section at 95% confidence level are 91.44 fb (92.10 fb). The combination of both channels also provides strong observed (expected) limits on Higgs self-coupling modifier, , between -1.0 6.6 (-1.2 7.2).

For the resonant interpretation, bbγγ, bbττ, and bbbb, are combined to search for a heavy scalar decaying into two Higgs bosons with masses between 251 GeV - 3 TeV. Upper limits on the observed (expected) production cross-section are set ranging between 1.1 and 595 fb (1.2 and 393 fb).

Career stage:

Graduate student

ML / 83

Point Cloud Deep Learning Methods for Pion Reconstruction in the ATLAS Detector

Author: Mariel Pettee[1]

Co-authors: Aaron Angerami [2]; Ben Nachman [1]; Maximilian J Swiatlowski [3]

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Reconstructing the type and energy of isolated pions from the ATLAS calorimeters is a key step in hadronic reconstruction. The existing methods were optimized early in the experiment lifetime. We recently showed that image-based deep learning can significantly improve the performance over these traditional techniques. This note presents an extension of that work using point cloud methods that do not require calorimeter clusters to be projected onto a fixed and regular grid. Instead, we use transformer, deep sets, and graph neural network architectures to process calorimeter clusters as point clouds. We demonstrate the performance of these new approaches as an important step towards a full deep learning-based low-level hadronic reconstruction.

Career stage:

Postdoc

BSM I / 84

Search for neutral long-lived particles decaying into displaced jets in the ATLAS calorimeter

Author: Mason Proffitt[1]

[1] *University of Washington (US)*

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New long-lived particles are a feature of many extensions to the Standard Model and may elude searches for promptly decaying particles. An analysis of data collected in pp collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector at the Large Hadron Collider is described, focusing on identifying signatures of jets produced by long-lived particles decaying to Standard Model fermions within the ATLAS calorimeter system. The analysis considers benchmark hidden sector models of neutral long-lived scalars with masses between 5 GeV and 475 GeV produced by decays of heavy mediators with masses between 60 GeV and 1000 GeV. Models of stealth supersymmetry, Higgs-portal baryogenesis, and dark photons are also considered. The results of this analysis are presented using the full Run 2 (2015-2018) data set, corresponding to an integrated luminosity of 139 fb^{-1}.

Career stage:

Graduate student

Instrumentation II / 76

Thermal and electrical performance tests of ATLAS silicon strip detector modules at BNL

Author: Punit Sharma[1]

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The inner tracking detector of the ATLAS experiment at CERN is currently preparing for an upgrade to operate in the High Luminosity LHC, scheduled for the late 2020s. A complete replacement of the existing Inner Detector of ATLAS is required to cope with the expected luminosity and radiation damage. The all-silicon Inner Tracker (ITk) design under construction composes a mixture of Pixel and Strips layers. At the core of the strip, barrel detector is the stave, thermo-mechanical support structures, each of which hosts 28 silicon modules. A thorough characterization of the modules before the assembly on each stave is critical; thus, each module has to undergo electrical and thermal quality control (QC) testing between module production and stave assembly. The modules are thermal cycled ten times between -35C and +40C. This talk will discuss the thermal and electrical performance of the US testing setup, focusing on the difficulties encountered to meet the QC requirements. It will also give an overview of the results obtained by analyzing the first batch of produced modules during pre-production.

Career stage:

Graduate student

Higgs / 69

Measuring Diphoton Production in Association with Heavy Flavor with the ATLAS Detector

Author: Brianna Stamas[1]

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This unique analysis investigates the production of two photons in conjunction with heavy flavor quarks using the ATLAS detector at the Large Hadron Collider at CERN using the full Run 2 dataset with a center-of-mass energy of $\sqrt{s} = 13$ TeV. The $\gamma\gamma$ + heavy flavor jets process is a dominant background in at least two important analyses: the $HH \rightarrow \gamma\gamma bb$ process, which provides a direct probe of Electroweak Symmetry Breaking due to observation of the Higgs boson self-coupling and the $t\bar{t}H \rightarrow \gamma\gamma$ process, which is important for measuring the Yukawa coupling between the Higgs and top quark. Despite its importance, $\gamma\gamma$ + heavy flavor jets process has never generically been measured before, nor is there any direct prediction in literature. A template fit will be implemented to the jet flavor-tagging discriminant to extract the signal to measure the components of heavy flavor in $\gamma\gamma + jets$. The measurements will be made in the single-jet or multi-jet categories that are a combination of b-, c-, and light-flavor jets (bb, bc, bl, etc.). Preliminary sensitivity estimates will be shown.

Career stage:

Graduate student

(Withdraw) TT->Wb+X VLQ Pair Production

Author: Joshua Ryan Stewart[1]

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The Standard Model (SM) of particle physics explains many natural phenomena yet remains incomplete. Vector-like quarks (VLQs) lie at the heart of many extensions to the SM seeking to address the hierarchy problem. VLQs could be produced either singly or in pairs, and then decay to a SM boson and a third-generation quark. While single-production depends on the coupling of the VLQ to the SM particles, pair-production via the QCD interaction provides a model-independent test for VLQs. This talk presents a search for pair-produced VLQs that decay into a W boson and a bottom quark, with one W decaying leptonically while the other decays hadronically. The analysis uses b-tagging algorithms, charge asymmetry metrics, multiple online triggers, and data driven corrections of the ttbar and W+jets background Monte Carlo samples to improve sensitivity during the analysis of the full LHC Run 2 ATLAS dataset.

Career stage:

Graduate student

112

(Withdraw) The measurement for a Standard Model Higgs boson, prooduced in association with a W or Z boson, decaying into a pair of b-quarks in pp collisions at 13 TeV with the ATLAS detector

Author: Amy Tee[1]

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Following the discovery of the Higgs boson in 2012 by both the ATLAS and CMS experiments, a wealth of papers have been published concerning measurements or observations of the Higgs' decay modes. However, the most dominant decay mode, $H \to b\bar{b}$, proved to be an elusive and challenging search due to the low signal-to-background environment, and a diverse range of backgrounds arising from multiple Standard Model processes. The backgrounds include W+jets, Z+jets, and $t\bar{t}$ production, among others. Measurements of WH and ZH production based on 139 fb^{-1} of 13 TeV pp collisions with the ATLAS detector are presented, with the W or Z boson decaying into charged leptons (electrons or muons, including those produced from the leptonic decay of a tau lepton), in the $H \to b\bar{b}$ decay channel. The production of a Higgs boson in association with a W or Z boson has been established with observed (expected) significances of 4.0 (4.1) and 5.3 (5.1) standard deviations, respectively.

Career stage:

Postdoc

Higgs / 74

Measurement of the Higgs boson production cross section using the H -> tau tau process in Run 2 ATLAS data

Author: Marc Tost[1]

[1] *University of Texas at Austin (US)*

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A measurement of the Higgs boson cross section using H -> tau tau decays is performed, with the result split into 4 production modes, with both hadronic and semi-hadronic decays considered. Data was taken by the ATLAS detector during Run 2 of CERN's Large Hadron Collider, with a center-of-mass energy of 13 TeV, resulting in 139 fbˆ{-1} of proton-proton collision data. Full unblinded results are shown. Special attention is paid to the associated top quark pair production mode, including a proposed differential cross section measurement of the transverse momentum of the Higgs boson using a neural network to improve the resolution.

Career stage:

Graduate student

Poster / 78

Commissioning of the Phase-1 BIS78 pilot project for Phase-2 upgrade of the ATLAS muon spectrometer

Author: Meng-Ju Tsai[1]

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The Monitored Drift Tube (MDT) provides precise tracking and momentum measurement in the ATLAS muon spectrometer. To accommodate higher event rates and provide better fake rejection in the High Luminosity LHC, a new integrated chamber with small-diameter MDT (sMDT) and thin Resistive Plate Chambers (tRPC) had been developed and will be installed into barrel inner layer of the muon detector for the phase-2 upgrade. The BIS78 project serves as a pilot project for the barrel inner layer upgrade (1 < |η| < 1.3) during the LHC LS1 shutdown (2019-2021). Several sMDT+tRPC chambers have been installed and operated in the ATLAS detector. An overview of the commissioning status of BIS78 in the ATLAS experiment will be presented.

Career stage:

Graduate student

BSM I / 79

Search for Heavy (pseudo)Higgs boson A/H produced in association with a top-antitop quark pair leading to the final state with four top quarks in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector

Author: Meng-Ju Tsai[1]

[1] *University of Michigan*

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Four top-quark production, a rare process in the Standard Model (SM) with a cross-section around 12 fb, is one of the heaviest final states produced at the LHC, and it is naturally sensitive to physics beyond the Standard Model (BSM). A data excess is observed with twice of the expectation. A follow-up analysis is the search for Heavy (pseudo)Higgs boson A/H produced in association with a top-antitop quark pair leading to the final state with four top quarks. The data analyzed correspond to an integrated luminosity of 139 fbˆ-1. In this talk, the four top-quark decay final states containing either a pair of same-sign leptons or multi-lepton (SSML) are considered. To enhance the search sensitivity, a mass-parameterized BDT is introduced to discriminate the BSM signal against the irreducible SM four-top and other dominant SM backgrounds. Expected upper bounds on the production cross-section of A/H are derived in the mass range from 400 GeV to 1000 GeV.

Career stage:

Graduate student

BSM I / **87**

Search for the pair production of vector-like quarks in the Wq+X fianl state with the full Run 2 ATLAS dataset

Author: Evan Richard Van De Wall[1]

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Vector-like quarks (VLQ) are predicted in many extensions to the Standard Model (SM) as their vector-like nature allows them to extend the SM while still being compatible with electroweak sector measurements. Pair production of VLQ provides a model-independent method of searching due to the QCD production of the particles. While most searches have focused on VLQs that decay to an SM boson and a third-generation quark, decays to light quarks have been largely overlooked. This talk presents the expected results of a search for pair production of vector-like down quarks that decay into a leptonically decaying SM W boson and a light quark, with the other VLQ decaying to a hadronically decay boson and a light quark. The analysis uses boosted boson identification and data-driven correction of the dominant W+jets background prediction to improve sensitivity. Further, this analysis extends the sensitivity of previous analysis done in Run 1 by increasing the collision energy and the statistics by including the full Run 2 ATLAS dataset with an integrated luminosity of 139 fb^{-1}.

Career stage:

Graduate student

Higgs / **109**

Measurement prospects for di-Higgs production in the HH->bbyy channel with the ATLAS experiment at the HL-LHC

Author: Alex Zeng Wang[1]

Co-author: Sau Lan Wu [1]

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We present a prospect study on di-Higgs production in the $HH \rightarrow b\bar{b}\gamma\gamma$ decay channel with the ATLAS experiment at the High Luminosity LHC (HL-LHC). The results are obtained by extrapolating the results from the Run 2 measurement, with 139 fb^{-1} of data at a center-of-mass energy of 13 TeV, to the conditions expected at the HL-LHC. While there is no sign of di-Higgs production with the current LHC dataset, the much higher luminosity (3000 fb^{-1}) and energy (14 TeV) at the HL-LHC will enable a much better measurement of this important process. We describe in detail the extrapolation process and assumptions, and multiple scenarios for the treatment of systematic uncertainties at the HL-LHC are considered. Under the baseline systematic uncertainty scenario, the extrapolated precision on the Standard Model di-Higgs signal strength measurement is 50%, corresponding to a significance of 2.2σ. The extrapolated precision on a measurement of κ_λ, the trilinear Higgs boson self-coupling modifier, is [0.3, 1.9].

Career stage:

Graduate student

SM I / 71

Study of WWZ tri-boson production at ATLAS

Author: Zhichen Wang[1]

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The Standard Model predicts self interactions between gauge bosons, including triple gauge boson couplings (TGC) and quartic gauge boson couplings (QGC). In addition, the interactions between the Higgs boson and gauge bosons are also of interest. In ATLAS group, events with four leptons (electrons or muons) in the final state are used to search for the production of WWZ -> lvlvll. The total luminosity used is 139 fb-1 at sqrt{s}=13 TeV. Events are further divided into three categories based on the invariant mass and the flavor of the two leptons from the decays of the two W bosons to increase the search sensitivity. A multivariate variable is further developed to increase the separation between the signal and background. I will present optimization on event selection and search sensitivity studies using simulated Monte Carlo events.

Career stage:

Graduate student

Instrumentation II / 94

ATLAS Tau Trigger Algorithm for Global Trigger using Full Granularity Data

Author: Anni Xiong[1]

Co-authors: Stephanie Majewski [1]; Eric Torrence [1]; Kirk Weedman [1]

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The High-Luminosity Large Hadron Collider (HL-LHC) is expected to deliver 10 times the integrated luminosity as the previous three runs combined, with approximately 200 inelastic collisions per bunch crossing. This large increase in pileup imposes significant challenges on the ATLAS Trigger and Data Acquisition system hardware electronics. To meet this challenge, the Global Trigger is designed to accept full-granularity data from the calorimeter and muon systems at 40 MHz to perform offline-like trigger algorithms. Hadronically decaying tau leptons play a key role in Standard Model (SM) measurements and searches beyond the SM, but taus are challenging to trigger on due to their resemblance to QCD jets. A window-based tau trigger algorithm is being developed for the Global Trigger firmware using system Verilog. The presentation will focus on the progress on both software and the firmware aspects of this algorithm development as part of the ATLAS HL-LHC upgrade.

Career stage:

Graduate student

BSM II / 114

Search for Generic Heavy Higgs Boson Using 13 TeV pp Collision Data at ATLAS

Author: Yue Xu[1]

Co-authors: Shih-Chieh Hsu [2]; Ke Li [3]; Xin Chen [1]

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A search for a fermi-phobic heavy Higgs boson via the $pp \to W^{\pm}H \to W^{\pm}W^{\pm}W^{\mp}$ process with 139 fb^{-1} of pp collision data at $\sqrt{s} = 13$ TeV collected by the ATLAS detector is presented.
The heavy Higgs boson has potential dimension-6 effects in an effective field theory context, which can cause significant kinematic deviations from those predicted within the Standard Model. Events with two same-sign leptons (e or μ) in association with one large-R jet or two small-R jets with an invariant mass consistent with a hadronically decaying W-boson are analyzed to test for the presence of effects from new physics.

Career stage:

Graduate student

Instrumentation I / 85

Test beam and performance study of ATLAS New Small Wheel small-strip Thin Gap Chamber

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The Large Hadron Collider is expected to reach an instantaneous luminosity of $5-7.5\times10^{34}cm^{-2}s^{-1}$ towards high-luminosity runs in the future. The ATLAS Phase-I upgrade plans to replace the present innermost station of Muon Spectrometer in the forward region, Small Wheels, with the New Small Wheel (NSW) detector system in order to improve Level-1 muon trigger selectivity and maintain good muon tracking capability under high background rate. The NSW features two gaseous detector technologies, Micro Mesh Gaseous Structures (MM) and small-strip Thin Gap Chambers (sTGC), with 2.4 million readout channels and a total surface area of more than $2,500m^2$. Both detectors have trigger and precision tracking capabilities.
The new Gamma Irradiation Facility (GIF++) located at the H4 beam line of SPS at CERN is a unique place where high energy muon and pion beams are combined with a 14TBq ^{137}Cesium source to test the detector tracking ability in a high background rate environment. One fully integrated sTGC quadruplet was tested at GIF++ in a muon beam during Oct-Nov 2021. This is the first time a test beam is performed on the sTGC with final version electronics and using the final DAQ (data acquisition) system. In this talk we present the test beam setup and performance results, namely efficiency and resolution at different track inclination and photon background rates. Studies of the impact of different electronics configuration will also be presented.

Career stage:

Graduate student

Instrumentation I / **72**

sTGC Trigger Chain Cosmic Ray Test

Author: Man Yuan[1]

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The New Small Wheel (NSW) phase-I upgrade is an extremely challenging project for high-luminosity LHC operations to improve both tracking and trigger capability of the ATLAS muon spectrometer for discoveries at the LHC.

NSW consists of two types of new detectors, the small-strip Thin Gap Chambers (sTGCs) and the MicroMegas (MM) chambers, both are capable of precision tracking and fast triggering. This is the first time such new detectors were built at large scales. It has taken 10 years to design and build the NSW. Intensive integration and commissioning were carried out in the past three years. I will report the sTGC integration and commissioning work, including the cosmic ray test. I will describe in detail about how the sTGC trigger chain works and present some important cosmic test results to demonstrate the sTGC level-0 trigger performance.

Career stage:

Graduate student

111

(Withdraw) Search for resonant pair production of Higgs bosons in the bbbb final state using 139 fb^{-1} of $\sqrt{s}$ = 13 TeV pp collision data with the ATLAS detector

Author: Rui Zhang[1]

[1] *University of Wisconsin Madison (US)*

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A search for resonant Higgs boson pair production in the four b-jet final state is conducted. The analysis uses 139 fb^{-1} of pp collision data at $\sqrt{s}$ = 13 TeV collected with the ATLAS detector. The analysis is divided into two regimes, targeting Higgs boson decays which are reconstructed as pairs of b-tagged small-radius jets or as single large-radius jets associated with b-tagged track-jets. Spin-0 and spin-2 benchmark signal models are considered, both of which correspond to resonant HH production via gluon–gluon fusion. No significant evidence for a signal is observed. Upper limits are set on the production cross-section times branching ratio for a new resonance in the mass range from 251 GeV to 5 TeV decaying to Higgs boson pairs.

Career stage:

Postdoc

ML / 117

Quark and Gluon Tagging Calibration with the ATLAS

Authors: Haoran Zhao[1]; Shih-Chieh Hsu[2]; Ke Li[1]; Wanyun Su[3]

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The separation of quark and gluon initiated jets(q/g jets) is crucial to enhance the reach of many new physics searches at the ATLAS experiment in the Large Hadron Collider. A tagger serving as a tool to distinguish quark and gluon jets is developed based on the Boosted Decision Tree using charged-particle track observables associated with the jet. However, quark-versus-gluon jet tagging is difficult to be calibrated due to the difficulty of the hadronization modeling. To improve the performance of the tagger, a “matrix method” is applied to extract the q/g distributions to obtain a scale factor which is a ratio between data and Monte Carlo. The data taken from 2015 to 2018 with an integrated luminosity of 139.0 fb-1 are used to calibrate the tagger with two control samples to select dijet and gamma+jet events, providing various gluon and quark enriched samples. In this talk, the latest results of calibration and systematic uncertainties will be presented.

Career stage:

Graduate student

SM I / 82

Measurement of collinear W boson emission off high transverse momentum jets using full Run-2 data.

Author: Yuzhan Zhao[1]

Co-authors: Matthew Gignac [1]; Giordon Holtsberg Stark [1]; Bruce Andrew Schumm [1]

[1] *University of California,Santa Cruz (US)*

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The production of a single electroweak vector boson in association with jets (V+jets) is one of the fundamental processes at the Large Hadron Collider (LHC) experiment. The leptonic decay modes of this process provides a clean experimental signature for measuring the electroweak sector of the Standard Model and the perturbative QCD accuracy in multi-jets final states.

In the talk, we will focus on the differential measurement of single W decaying to an electron or muon from a high transverse momentum jet with small angular separation, the so called collinear W+jets production. This measurement makes use of the LHC full Run-2 proton-proton collision datasets, corresponding to an integrated luminosity of 139.0 fb-1 . The data is compared against newly develop state-of-the-art multi-jet merged setups accurate to next-to-leading order in the strong and weak coupling constants. The details of the generator configurations and their CPU costs will be discussed, and unfolded kinematic distributions at particle level in the collinear W+jets phase-space will be compared with the measured data cross sections.

Career stage:

Graduate student