BOOST 2021 : 13th International Workshop on Boosted Object Phenomenology, Reconstruction and Searches in HEP

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Online

Book of Abstracts

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QCD physics measurements at the LHCb experiment

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LHCb is a spectrometer that covers the forward region of proton-proton collisions, corresponding to the pseudo-rapidity range $2< \eta <5$. In this unique phase space, LHCb can perform tests of perturbative and non-perturbative QCD models, by studying the production of heavy flavor quarks, like charm and top quarks. In this context the production of a Z boson in association with a c-jet can be studied to measure the intrinsic charm content of the proton. Moreover LHCb can test phenomenological models of soft QCD processes, by measuring the production of forward hadrons in pp collisions.

Heavy Ions at the LHC and EIC / **6**

Ab Initio Coupling of Jets to Collective Flow in the Opacity Expansion Approach

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Droplets of quark-gluon plasma produced in heavy-ion collisions rapidly evolve expanding and cooling. During considerable part of this dynamics, the system can be described within relativistic hydrodynamics. Recently, there were some attempts to include effects of the medium motion to the jet energy loss and jet modification calculations in a variety of models. Here we will present the first principle consideration of the medium motion effects on the jet broadening and soft gluon radiation within opacity expansion approach. We will show that the developed formalism can be also applied to derive the effects of in-medium fluctuations on a wide range of the jet observables at EIC.

QCD Measurements + Spin Physics / **9**

Jet Angularities in Z+jet production at the LHC

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We present a phenomenological study of the ungrommed and groomed jet angularities measured in Z+jet production at 13 TeV collision energy. We provide resummed predictions for the angularity distributions at NLO+NLL' accuracy level which are compared to the state-of-the-art NLO Monte Carlo simulations. Our predictions include the effect of soft emissions at large angles, treated as a power expansion in the jet radius as well as non-global logarithms.

Our results account for realistic experimental cuts and can be easily compared to the experimental results recently collected by the LHC collaborations.

Precision Calculations + Experimental Heavy-Ions Results / 11

The soft drop momentum sharing fraction zg beyond leading-logarithmic accuracy

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Based on: https://arxiv.org/abs/2106.04589

Abstract:

Grooming techniques, such as soft drop, play a central role in reducing sensitivity of jets to e.g. underlying event and hadronization at current collider experiments. The momentum sharing fraction zg, of the two branches in a jet that pass the soft drop condition, is one of the most important observables characterizing a collinear splitting inside the jet, and directly probes the QCD splitting functions. In this work, we present a factorization framework that enables a systematic calculation of the corresponding cross section beyond leading-logarithmic (LL) accuracy, showing that thi measurement is not only sensitive to the QCD charge but also the spin of the parton that initiates the jet. Our results at next-to-leading logarithmic (NLL') accuracy include non-global logarithms, and provide a first meaningful assessment of the perturbative uncertainty. We present a comparison to the available experimental data from ALICE, ATLAS, and STAR and find excellent agreement.

Jet tagging / 12

Understanding top tagging with N-subjettiness and prong finding

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N-subjettiness has proven to be a powerful tool for discriminating between boosted signal jets (typically boosted electroweak bosons or top quarks) and light QCD background jets. In this talk I will examine how it can be most effectively used in conjunction with prong finding and grooming algorithms to tag boosted top quarks. I will first examine the performance and effect of hadronisation and underlying event on this tagging procedure using a Monte Carlo study before discussing the results of our resummed calculations of the tagged cross section for this procedure, considering

both signal and background jets. Finally I will show that the understanding gained from carrying out this calculation can be used to optimize the discriminating power available from this tagging procedure.

Heavy Ions at the LHC and EIC / **14**

Time-reversal Odd Side of a Jet

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We re-examine the jet probes of the nucleon spin and flavor structures. We find for the first time that the time-reversal odd (T-odd) component of a jet, conventionally thought to vanish, can survive due to the nonperturbative fragmentation and hadronization effects. This additional contribution of a jet will lead to novel jet phenomena relevant for unlocking the access to several spin structures of the nucleon, which were thought to be impossible by using jets. As examples, we show how the T-odd constituent can couple to the proton transversity at the Electron Ion Collider (EIC) and can give rise to the anisotropy in the jet production in e+ e− annihilations. We expect the T-odd contribution of the jet to have broad applications in high energy nuclear physics.

QCD Measurements + Spin Physics / **15**

Spin-sensitive jet observables and their resummation

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I present two novel jet observables, based on Lund-declustering, sensitive to the spin-correlations between partons within and between jets respectively (arXiv:2103.16526). I discuss the general structure of these observables for quark and gluon initiated jets at both fixed order and all orders in QCD. For the latter we have extended the MicroJets resummation code and the PanScales showers to include collinear spin correlations. The new observables and their resummation further open the pathway to phenomenological studies of these important quantum mechanical effects.

Boosted Higgs + Heavy-Flavour / **17**

Measurements of jet energy correlations and jet fragmentation, including heavy flavour, using the ATLAS detector

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In this talk, we present measurements of jet energy-energy correlations and jet fragmentation properties using data collected by the ATLAS experiment at $\sqrt{s}$ = 13 TeV. Measurements of transverse energy-energy correlations and their associated azimuthal asymmetries in multi-jet events are compared to next-to-leading-order perturbative QCD calculations and provide a precision test of QCD at large momentum transfers. The strong coupling constant is extracted from these data at different scale regimes. For jet fragmentation, if available, we present a measurement of the fragmentation properties of b-quark initiated jets, studied using charged B mesons. This analysis provides key measurements with which to better understand the fragmentation functions of heavy quarks. Both results are corrected for detector effects and compared to several Monte Carlo predictions with different parton shower and hadronisation models.

Recent results from the ATLAS experiment on charmonium production will be presented with emphasis on the boosted signatures. The measurement of the associated production of the J/psi meson and a gauge boson, including the separation of single and double parton scattering components will be discussed. The measurements of J/psi and psi(2S) differential cross sections at large transverse momentum values will also be reported.

Top physics + track functions / **18**

Testing the Standard Model using boosted top quark production with the ATLAS experiment at the LHC

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Measurements in boosted top quark production test the Standard Model in a previously unexplored regime with a strongly enhanced sensitivity to high-scale new phenomena. Dedicated techniques have been developed to reconstruct and identify boosted top quarks. In this contribution measurements of the ATLAS experiment are presented of the differential cross section and asymmetries in this extreme kinematic regime. The measurements are interpreted within the Standard Model Effective Field Theory, yielding stringent bounds on the Wilson coefficients of two-light-quark-two-quark operators.

Searches for BSM Physics / **21**

Boosting sensitivity in searches for Dark Matter and heavy resonances with ATLAS

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Several extensions of the Standard Model predict new resonances at the TeV scale, which can be expected to couple to gauge and Higgs bosons (W,Z,H,y). These and other new physics signatures at the LHC produce highly boosted particles, leading to close-by objects in the detector and necessitating jet substructure techniques to disentangle the hadronic decay products. This talk presents the latest ATLAS searches including topologies with boosted new scalar or vector bosons, vector-like quarks or leptoquarks, or new resonances decaying to a photon plus a Higgs (Hy) or W/Z (Vy) boson using the full Run 2 dataset. This talk will explain the techniques used, including new tagging techniques using machine learning and the use of large-radius jets and variable-radius track jets, as well as a novel double-b-tagging algorithm for tagging the Higgs boson candidates.

Hadronic object reconstruction + q/g discriminants / **22**

Jet and MET reconstruction and calibration in ATLAS

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The reconstruction and calibration of hadronic final states is an extremely challenging experimental aspect of measurements and searches at the LHC. This talk summarizes the latest results from ATLAS on the calibration of the jet energy and mass scale and resolution of anti-kt R = 0.4 and R = 1.0 jets. Measurements of the calorimeter response to single hadrons will be presented which are the largest source of uncertainty on the jet energy scale at high transverse momentum. Additionally, new inputs to jet reconstruction will be discussed that better utilize relationships between calorimeter and tracking information. Finally, machine learning approaches will be discussed to improve the reconstruction of missing transverse momentum.

Jet tagging / **23**

Tagging boosted decays using large-radius jets with ATLAS

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The ATLAS experiment has extensively explored tagging boosted hadronic objects, especially W/Z bosons and top quarks, using featured-based techniques and machine-learning combinations of features. A variety of tagging algorithms for large-radius jets, reconstructed from unified-flow-objects (UFOs), are presented to identify jets containing the hadronic decay of W/Z bosons and top quarks, including both cut-based taggers and machine learning discriminants. The performance of new UFO jet-based taggers will be compared to the taggers deployed in ATLAS during Run-2 for jets reconstructed sole from calorimeter deposits. The performance of these new taggers is quantified, and where possible compared to existing techniques. The new final state targets enable exciting new sensitivity to final states beyond the traditional boosted object tagging.

Boosted Higgs + Heavy-Flavour / **25**

Performance and calibration of boosted H(bb) tagging, including applications in physics analysis with ATLAS

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The physics programme at ATLAS involves a variety of Standard Model and Beyond Standard Model resonances decaying to two b-quarks, or to a pair of bosons, including the Higgs Boson. In order to identify these resonances at high momentum, ATLAS has developed a boosted X?bb tagger, a new NN-based tagging algorithm which combines the flavour information of up to three sub-jets associated to the large-R jet capturing the decays of these particles. This talk presents the Monte Carlo performance for the boosted X?bb tagger and the corresponding calibration strategy using the full Run-2 dataset gathered by ATLAS and comparing to simulation. Foreseen results include the signal tagging efficiencies derived using Z (->bb)+jets and Z(->bb)+gamma events, and background mistag rates measured using ttbar and g->bb splitting in multi-jet events. This talk also presents measurements of Higgs boson properties using signatures for boosted jets containing two heavy-flavour hadrons and results of searches for high-mass resonances with at least one highly boosted Higgs boson in the final state, reconstructed via single large-radius jets and dedicated flavour tagging techniques.

Searches for BSM Physics / **26**

New Physics searches in boosted diboson final states at CMS

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A summary of searches for nonresonant HH production as well as heavy resonances with masses exceeding 1 TeV decaying into pairs of bosons is presented, performed on data produced by LHC pp collisions at $\sqrt{s}$ = 13 TeV and collected with the CMS detector during 2016, 2017, and 2018. The common feature of these analyses is the boosted topology, namely the decay products of the considered bosons (both electroweak W, Z bosons and the Higgs boson) are expected to be highly energetic and close in angle, leading to a non-trivial identification of the quarks and leptons in the final state. The exploitation of jet substructure techniques allows to increase the sensitivity of the searches where at least one boson decays hadronically. Various background estimation techniques are adopted, based on data-MC hybrid approaches or relying only in control regions in data. Results are interpreted in the context of the Warped Extra Dimension and Heavy Vector Triplet theoretical models, two possible scenarios beyond the standard model.

Searches for BSM Physics / **27**

Searches for heavy BSM particles resulting in boosted final states at CMS

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We present results from searches for resonances with enhanced couplings to third generation quarks, based on proton-proton collision data at a centre-of-mass energy of 13 TeV recorded by CMS. The signatures include single and pair production of vector-like quarks and heavy resonances decaying to third generation quarks. A wide range of final states, from multi-leptonic to entirely hadronic is covered. Jet substructure techniques are employed to identify highly-boosted heavy SM particles in their hadronic decay modes.
Furthermore, we present a search for a heavy resonance that decays in cascade though a radion and a boson into three bosons using proton-proton collision data collected with the CMS detector at the CERN LHC at a center-of-mass energy of 13 TeV. The final states analysed contain leptons and massive jets, where the latter contain the decay products of one or two Lorentz-boosted boson(s). The jet substructure observed in these final states is uncommon and therefore requires dedicated calibration methods, which are discussed in this talk. We set limits on the production of a massive excited Kaluza-Klein gauge boson.

QCD Measurements + Spin Physics / **30**

Jet substructure measurements at CMS

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Jet substructure techniques are increasingly important for LHC searches and measurements alike. QCD multijet final states remain a significant background for these physics analyses but are not well-modeled in Monte Carlo. Jet substructure measurements can probe QCD shower evolution and help improve our understanding and modeling of multijet final states. We present the latest jet substructure measurements in CMS, with an emphasis on groomed observables.

Hadronic object reconstruction + q/g discriminants / **31**

Recent Developments in Jet Reconstruction and Calibration for LHC Runs 2 and 3 in CMS

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For all areas of jet physics, jet corrections, calibration, and reconstruction are essential tools. We present the latest developments explored by the CMS collaboration in jet energy and mass reconstruction and calibration. In addition to traditional techniques, we present novel machine learning methods that boost our physics potential.
Files

Jet tagging / **33**

Boosted jet tagging in CMS

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The use of jet substructure techniques to identify highly boosted top/W/Z/H/b jets has become an important tool for physics searches and measurements at the LHC. We present the latest jet tagging techniques in CMS, including state-of-the-art machine learning methods.

Precision Calculations + Experimental Heavy-Ions Results / **34**

Dynamical grooming beyond the leading-log approximation

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Dynamically grooming a jet (1) amounts to isolate the hardest splitting in the branching story. The properties of the branching tagged by dynamical grooming can be computed using resummation techniques. In this talk, based on (2), I will present the resummation structure of dynamically groomed observables, some of them infra-red and collinear safe and others Sudakov safe only, up to next-to next-to-double logarithm accuracy. I will highlight some interesting features of this jet substructure observable, such as the absence of clustering logarithms. After a leading order in α_s matching, and after including non-perturbative corrections, determined through Monte-Carlo, this theoretical calculation provides a very good description of the preliminary ALICE data (3,4).

(1): arXiv/hep-ph/1911.00375
(2): arXiv/hep-ph/2103.06566
(3): arXiv/nucl-ex/2009.07172
(4): arXiv/nucl-ex//2009.12247

Precision Calculations + Experimental Heavy-Ions Results / **36**

Jet substructure measurements in pp and heavy-ion collisions with ALICE

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Jet substructure, defined by observables constructed from the distribution of constituents within a jet, provides the versatility to tailor observables to specific regions of QCD radiation phase space. This flexibility provides exciting new opportunities to study jet quenching in heavy-ion collisions and to
ultimately help reveal the nature of the quark-gluon plasma. The ALICE detector is particularly well-suited to jet substructure measurements in heavy-ion collisions due to its high-precision tracking system. In this talk, we overview recent jet substructure measurements in proton–proton and Pb–Pb collisions with ALICE.

In heavy-ion collisions, these include subjet fragmentation, N-subjettiness, the groomed jet momentum fraction, z_g, and the groomed jet radius, $\theta_g \equiv R_g/R$. By correcting these measurements for the large heavy-ion underlying event, and by selecting observables that are calculable in proton-proton collisions, these measurements allow direct comparison to theoretical models and begin to establish a phenomenological picture of the physics underlying jet quenching.

In proton–proton collisions, a new measurement of the primary Lund plane density for inclusive charged-particle jets in the transverse momentum range of $20 \leq p_{\mathrm{T,jet}}^{\mathrm{ch}} \leq 120$ GeV/c with the ALICE detector will be presented. This is the first measurement of the Lund plane density in an intermediate jet p_{T} range where hadronization and underlying event effects play a dominant role. In addition to the Lund jet plane, new ALICE measurements of generalized angularities of groomed and inclusive jets, jet axis differences, and dynamically groomed jets will be discussed.

Precision Calculations + Experimental Heavy-Ions Results / **37**

Measurement of splittings along a jet shower in $\sqrt{s} = 200$ GeV pp collisions at STAR

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Jets are algorithmic proxies of hard scattered partons, i.e. quarks/gluons, in collisions of high energy particles. Jets derived from clustering algorithms contain information regarding the parton shower, which can be accessed via the SoftDrop algorithm and the Cambridge/Aachen de-clustering. The STAR collaboration has recently measured jet sub-structure observables in pp collisions at $\sqrt{s} = 200$ GeV including the jet mass (M), SoftDrop groomed jet mass (Mg), groomed jet radius (Rg) and shared momentum fraction (zg) for jets with varying radius and momentum. To further explore the jet sub-structure, we present two sets of novel multi-dimensional fully corrected measurements of the jet shower. We first present the inherent correlation between the zg and Rg for jets of varying momenta. Given that the sub-structure extends beyond the first split, we also present fully corrected sub-structure observables at the first, second and third splits determined via the iterative SoftDrop procedure. For each of these splits, we measure the fully corrected zg and Rg distributions and showcase a gradual variation in both the angular and momentum scales which can theoretically be related to virtuality evolution.

These recursive measurements of the jet shower allow us to test the self-similarity of the splitting kinematics across different splits. We also measure the formation time defined as $f \frac{1}{2Ez(1-z)(1-cos_{1,2})}$ where E is the parent's energy, z is the momentum fraction and $_{1,2}$ is the opening angle. We compare

the formation times for SoftDrop splits $_{split}$ to the formation time calculated via the two highest-pT charged constituents within the jet to study the onset of non-perturbative region of the jet shower. We compare our measurements to state-of-the-art Monte Carlo models, providing stringent constraints on model parameters related to the parton shower and non-perturbative effects such as hadronization, that become increasingly significant as we travel further along the jet shower.

ML : Pileup Mitigation + Jet Tagging / **41**

Safely Eating Junk: Pileup and Infrared Radiation Annihilation

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Jet grooming is an important tool for the analysis of relativistic particle collisions despite the presence of contaminating radiation. Modern jet grooming techniques, such as Soft Drop grooming, introduce sharp cutoffs to remove soft radiation. These sharp cutoffs can lead to discontinuous behavior and associated experimental and theoretical challenges. In this talk, I introduce a new class of grooming procedures, Pileup and Infrared Radiation Annihilation (PIRANHA), motivated by ideas from optimal transport theory. I explore the behavior of the PIRANHA class of grooming procedures, both analytically and in Pythia 8, and detail the extent to which PIRANHA grooming procedures are more continuous than other grooming methods. I demonstrate that the PIRANHA strategy can overcome some of the challenges of previous grooming procedures, and explore its robustness to non-perturbative physics, detector effects, and the underlying event.

Hadronic object reconstruction + q/g discriminants / **42**

Pure Quark and Gluon Observables in Collinear Drop

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A key application of jet substructure techniques is to disentangle quark- and gluon-initiated jets. One data-driven method to realize the disentangling is jet topics which can give the individual quark and gluon contributions to an observable, but faces challenges associated to finding regions of phase space that can be associated with pure quark and gluon samples. In this talk, I construct a set of pure quark and gluon observables with the collinear drop grooming technique. For example, a gluon observable is constructed so as to give a vanishing distribution for any sample that has only quark jets, and a non-vanishing result for any process which can produce gluon jets. The construction utilizes factorization formulas constructed using Soft-Collinear Effective Theory (SCET) which crucially include both perturbative and non-perturbative effects. Results of these pure quark and gluon observables will be shown and discussed.

Heavy Ions at the LHC and EIC / **44**

Momentum and charge correlations within jets : a new observable to probe nonperturbative aspects of jet evolution

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The planned future Electron Ion Collider (EIC) will provide a unique laboratory for precise studies of both perturbative and non-perturbative QCD through examining the time evolution of jets and their constituents from short to long distances scales. Correlations among identified particle species within jets can reveal tremendous information of this evolution. Utilizing the particle identification (PID) capabilities of the EIC detectors, one can study hadronization within jets in a wide kinematic regime by characterizing the x and Q^2 scales of the process.

We propose a new class of jet substructure observables constructed with identified leading and first subleading particles within jets (for example, pion-pion). Comparing numbers of events where the electric charges of the two leading particles are of the same sign ($N_{C\overline{C}}$) or opposite sign ($N_{C\overline{C}}$), we define a ratio observable $r_c = (N_{CC} - N_{C\overline{C}})/(N_{CC} + N_{C\overline{C}})$ which can be a function of any jet observables. Specifically, the formation time extracted from the two leading particle kinematics gives information on the space-time evolution of jets. Sub-jet kinematics obtained from the C/A reclustering tree also provides a complementary method to formulate r_c. We will demonstrate the correlations for identified particles at the proposed top collision energy at the EIC using PYTHIA and Herwig event generators. One specific example of connecting strange flavor tagging to string or cluster hadronization through such correlations will be presented.

QCD Measurements + Spin Physics / **46**

Probing Spin Interference with Energy Correlators

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The study of spin effects in QCD has a long history. Precision jet substructure opens new doors for studying these effects. To achieve this goal, one hopes to find a spin-sensitive observable that is also theoretically accessible to perturbative calculation and resummation, which is in general not an easy task.

In this talk, I will show that spin effects are encoded in the shape dependence of multipoint energy correlators. In a particular kinematic limit, called the squeezed limit, one can see a sinusoidal pattern in the angular distribution of energy, which is the result of the interference of gluon spin in the jet. All orders resummation in the squeezed limit is governed by the twist-2 transverse spin-2 gluon operator. I will also discuss how to enhance the spin effects within this approach, as well as other observables for gluon spin interference.

Top physics + track functions / **53**

Extending Precision Perturbative QCD with Track Functions

Authors: Huaxing Zhu[1]; Solange Schrijnder van Velzen[None]; Ian James Moult[None]; Wouter Waalewijn[2]; Yibei Li[3]

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Using the tracking system at the LHC, one can efficiently suppress pile-up contamination and improve angular resolution. Observables that only depend on charged particles (tracks) are not infrared safe in perturbation theory, so any calculation of track-based observables must account for hadronization effects. This can be done by matching the partonic cross section onto perturbative objects that absorb the infrared divergences, called track functions. These track functions describe the energy fraction of a hard parton which is converted into charged hadrons. We demonstrate the validity of the track function approach at order alpha_sˆ2 by calculating its renormalisation group evolution at this order, using two different approaches: The first uses analytic results for the projected Energy-Energy Correlator to extract the evolution for moments of the track function. The second involves a calculation of a track-based jet function in Soft-Collinear Effective Theory. This result is also an important input for higher-order calculations of track-based observables. Our results open the door to the application of advances in perturbative quantum field theory to observables defined on a subset of final-state particles, with a wide range of applications from the LHC to the EIC.

ML : Pileup Mitigation + Jet Tagging / **54**

Semi-supervised machine learning for pileup per particle identification at the LHC with Graph Neural Networks

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The high instantaneous luminosity of the LHC leads to multiple proton-proton interactions in the same or nearby bunch crossings (pileup). With the planned increasing instantaneous luminosity in the LHC's future runs, precise identification of individual particles produced from the hard scattering against pileup becomes crucial as this can significantly improve the performance of many physics observables. Thanks to the excellent performance of the tracking detector and reconstruction algorithm, most of the charged particles from the hard scattering and pileup can be correctly distinguished, while for neutral particles this remains uncertain. Studies have been performed for applying machine learning techniques in pileup mitigation tasks, but most of them rely on the accurate labels of neutral particles, which is hard to retrieve in full simulations and real data.

This talk presents a study of applying Graph Neural Network (GNN) for pileup per particle identification. A semi-supervised machine learning approach is used and the GNN is trained exclusively on the charged particles, whose labels can be determined in the real data without relying on any ground truth information from simulation. The post-training model is then inferred on neutral particles to identify if each of them is produced from pileup. The effectiveness of this approach is validated in the simulation of different physics processes under different pileup conditions, at the particle level and the event level with jet observables and missing transverse momentum. The performance is similar to fully supervised training, consistently better than widely-used domain algorithms such as PUPPI.

Top physics + track functions / **55**

Towards precision strong coupling and top mass extraction using soft-drop jet mass

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The soft drop jet mass cross section is as an attractive candidate for precision measurements such as □□ and top mass, as it can be perturbatively calculable to high accuracy besides being more robust against nonperturbative and underlying event corrections. In this talk I will focus our work on studying prospects of measurement of □□ at the LHC using state of the art resummed cross section matched to fixed order, including power corrections in a field theoretic framework, and a precise treatment of the soft drop cusp. We estimate the ultimate theoretical limitation on □□ measurement at the LHC from the perturbative, nonperturbative and normalisation uncertainties. I will also provide updates on our theory effort on top mass measurement using soft drop jet mass as a part of the collaboration with ATLAS, and recent work on improvements in the description of the hadronization corrections and effects of underlying event for the observable.

I will also provide updates on our theory effort on top mass measurement using soft drop jet mass as a part of the collaboration with ATLAS, and recent work on improvements in the description of the hadronization corrections and effects of underlying event for the observable.

Overview Talks / **57**

Introductory Remarks

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Theory Introduction

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Experimental Introduction

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Summary of CERN-TH Jets & JSS Workshop

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Summary of ML4Jets Workshop

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Panel Discussion / **62**

Panel Discussion : Future Directions

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Please add questions & topics for discussion to the bottom of the google document linked from the "Collecting Discussion Items" page!

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Concluding Remarks

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Introductory Remarks

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ML : Pileup Mitigation + Jet Tagging / **95**

Jet tagging in the Lund plane with graph networks

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The identification of boosted heavy particles such as top quarks or vector bosons is one of the key problems arising in experimental studies at the Large Hadron Collider. In this talk, we present LundNet, a novel jet tagging method which relies on graph neural networks and an efficient description of the radiation patterns within a jet to optimally disentangle signatures of boosted objects from background events. We apply this framework to a number of different benchmarks, showing significantly improved performance for top tagging compared to existing state-of-the-art algorithms. We study the robustness of the LundNet taggers to non-perturbative and detector effects, and show how kinematic cuts in the Lund plane can mitigate overfitting of the neural network to model-dependent contributions. Finally, we consider the computational complexity of this method and its scaling as a

function of kinematic Lund plane cuts, showing an order of magnitude improvement in speed over previous graph-based taggers.