22nd MCnet Meeting

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CERN

Book of Abstracts

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Discussion session: Future of MCnet

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The Chirality-Flow Formalism for the Standard Model

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Scattering amplitudes are often split up into their gauge (su(N)) and kinematic (two copies of complexified su(2)) components. Since the su(N) gauge part is often calculated using flows of colour, it should similarly be possible to describe the su(2) $\oplus$ su(2) kinematics of an amplitude in terms of flows of chirality. In two recent papers (hep-ph:2003.05877 & hep-ph:2011.10075) we showed that this is indeed the case, introducing the chirality-flow formalism for Standard Model calculations. In the chirality-flow method (which simplifies the spinor-helicity method) Feynman diagrams can be directly written down in terms of Lorentz-invariant spinor inner products, allowing the simplest and most direct possible path from Feynman diagram to complex number. In this talk, I will introduce this method and show some examples

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Decoding QGP signals with Lund strings at the LHC

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In this talk, we will present our novel approach, implemented in PYTHIA8, of including string shoving and forming ropes with strings in a special Lorentz frame, called parallel frame, where we have a pair of strings in symmetric geometry. We will discuss results to check if this formulation can achieve the particle production yields, namely strangeness enhancement, and their v_2 as seen in data from p-p and heavy-ion collisions at the LHC and also present the challenges involved in the new implementation.

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Hadronic rescattering in pA and AA collisions

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I have earlier presented a framework for hadronic rescattering Pythia in the context of pp collisions. In this talk, I will present the results from our recent paper where we have studied rescattering in pPb and PbPb collisions, using the Angantyr framework to generate heavy ion collisions. This will give a detailed view on how rescattering affects charged multiplicity and transverse momentum distributions, and where rescattering occurs in spacetime. We will see that rescattering gives rise to a significant v_2 flow coefficient, which describes PbPb data surprisingly well at high multiplicities. There is also a possible indication of jet quenching due to rescattering.

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Fixed color and QED effects in matrix-element corrected parton showers

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QCD parton showers can be improved by including different kinds of corrections. Among these are subleading color corrections, the modeling of QED emissions, and matrix element corrections. We implement a fixed color mode in the DIRE parton shower and combine it with QED shower emissions and mixed QCD-QED matrix element corrections to use these improvements simultaneously and compare their respective effects.

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Soft radiation beyond leading color

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In this talk, we discuss a novel method to probing soft radiation beyond leading color with jet substructure, which measures the radiation pattern by looking at the difference between the direction point towards and away from the other jet of interest. In particular, we present some preliminary results for both color singlet and non-singlet configuration with the $e^+e^- \rightarrow$ three jets process.

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Towards a Herwig dark shower and hadronisation module

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If dark mesons exist, their evolution and hadronization procedure are currently little constrained. They could decay promptly and result in a very SM QCD like jet structure, even though the original decaying particles are dark sector ones; they could behave as semi-visible jets; or they could behave as completely detector-stable hadrons, in which case the final state is just the missing transverse momentum. Apart from the last case, which is more like a conventional BSM MET signature, the modelling of these scenarios is somewhat an unexplored area, other than the range of phenomenological predictions as implemented in Pythia8's HV module. In this talk I will cover the proposed idea of having a Herwig hidden valley dark shower and hadronisation module, as part of my MCnet short term studentship, and the prospect of using jet substructure methods for designing observable/s to distinguish between dark jets, semi-visible jets and light q/g jets, by comparing different observables in a IRC-safe linear basis.

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Preparing Sherpa for e+e-

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Future lepton colliders, whether circular or linear, will provide unprecedented precision on standard model observables. The improvement to both the luminosity and detector techniques means that experimental error will be reduced by a factor 5-100 and therefore the theory uncertainties must also be reduced to the level of 0.001%. One of the major sources of theoretical uncertainties for lepton colliders are QED corrections. In this talk, I will present the Yennie-Frautschi-Surra formalism for the resummation of soft photons to all orders and its matching to higher order Matrix element corrections. It's implementation in the SHERPA event generator will be presented and some results will be discussed.

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Searching for new physics in boosted tops

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We present a "realistic" and in-depth analysis of how boosted top quark reconstruction techniques, e.g. using the HEPTopTagger toolkit, could be used to constrain the Wilson Coefficients (WCs) of top-sector BSM physics. The goal is to include the effects of jet-substructure mis-reconstruction on expected WC constraints and the effect of the on/off-shell nature of underlying top quark on the tagger's performance. Furthermore, detector inefficiency can significantly affect the tagger efficiency, which will conclusively lead to a bias in WC constraints. We will present the preliminary results of our analysis and discuss the following steps of the project.

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Dynamical grooming meets LHC data

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In this work, we analyse the all-orders resummation structure of the momentum sharing fraction, z_g, opening angle, θ_g, and relative transverse momentum, $k_{t,g}$, of the splitting tagged by the dynamical grooming procedure in hadronic collisions. We demonstrate that their resummation does non-exponentiate and it is free of clustering logarithms. Then, we analytically compute the probability distributions of $(z_g, \theta_g, k_{t,g})$ up to next-to next-to-double logarithm accuracy (N2DL) in the narrow jet limit, including a matching to leading order in α_s. On the phenomenological side, we perform an analytic-to-parton level comparison with Pythia and Herwig. We find that differences between the analytic and the Monte-Carlo results are dominated by the infra-red regulator of the parton shower. Further, we present the first analytic comparison to preliminary ALICE data and highlight the role of non-perturbative corrections in such low-pt regime. Once the analytic result is corrected by a phenomenologically determined non-perturbative factor, we find very good agreement with the data.

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TMDs in Monte Carlo calculations

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Transverse momentum dependent parton distributions (TMDs) are crucial to increase precision in the calculations of LHC observables that are sensitive to multiple soft gluon emissions and low-x effects. Collinear parton showers can resum the cross section to take into account large contributions at high orders in the strong coupling. However, in this case transverse momentum is not present in the hard scattering event and purely arises from the shower. This gives rise to a mismatch between the matrix element and the parton shower. In the Monte Carlo event generator Cascade, a procedure is implemented to treat both the incoming partons in the hard event and the parton shower with TMDs. Current studies are performed to implement such a procedure in Pythia8.

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Meeting opening

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Improvements to diboson production through higher order corrections

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With the Run 2 and the upcoming high-luminosity phase at the LHC, improvements of theoretical predictions are crucial. In this talk I'll be discussing the impact of EW corrections and approximations such as EW Sudakov logarithms using a generic and fully automated framework implemented in SHERPA. Another piece to consider in order to improve predictions is the loop induced through gluon fusion channel at NLO. The virtual part of this process is currently one of the most complicated matrix element known and its complete expression is not yet available, indeed only recently its top mass dependence has been computed for the on-shell case. For off-shell bosons a good approximation of it can be achieved through reweighing the virtual amplitude or using the large top mass approximation. In this talk I'll be showing the state-of-the-art of this process and how it has been implemented into SHERPA