

23rd MCnet Meeting



Report of Contributions

Contribution ID: 74

Type: **not specified**

String interactions in PYTHIA8/Angantyr

Tuesday, December 7, 2021 11:00 AM (25 minutes)

Summary of the research done in Pythia8/Anagntyr as an MCnetITN3 PhD student.

The first project was to develop a string “shoving” model to describe collective effects in heavy-ion collisions in terms of string interactions within the Lund model. This is done by constructing the Lorentz transformation to a symmetric frame where two string pieces are in parallel planes to calculate the resulting pairwise force due to the space-time overlap. Considering all such pairs of string pieces in a collision, the resulting total momentum change on a string piece is calculated. There is ongoing work to implement this along with the rope hadronization model in PYTHIA8.

The model is now further expanded using rope hadronization in heavy-ion collisions. Analysis involving the effects of string interactions on jets, known as jet quenching and the production yields of different hadron species in leading jets is also to be discussed.

Primary author: CHAKRABORTY, Smita

Presenter: CHAKRABORTY, Smita

Session Classification: Student talks / Discussion topic

Contribution ID: 75

Type: **not specified**

Berends-Giele recursion and a 1/Nc expansion in MadGraph

Tuesday, December 7, 2021 4:50 PM (20 minutes)

In this talk we introduce the still-developing `color_ordering` branch of `MadGraph5_amc@NLO`. This branch uses Berends-Giele recursions to calculate the matrix element, leading to more compact kinematics calculations. Additionally, this branch allows one to calculate matrix elements to a given order in the $1/N_c$ colour expansion in the trace basis. In this talk, we give an overview of the status of the branch, describe the physics of the colour expansion, show the results of this approximation, and show some speed comparisons with standard MadGraph.

Primary author: LIFSON, Andrew

Co-author: MATTELAER, Olivier (UCLouvain)

Presenter: LIFSON, Andrew

Session Classification: Student talks / Discussion topic

Contribution ID: 76

Type: **not specified**

Rivet status report

Tuesday, December 7, 2021 2:30 PM (30 minutes)

Status report on Rivet summing up developments in the closing MCnet period.

Primary author: BUCKLEY, Andy (University of Glasgow (GB))

Presenter: BUCKLEY, Andy (University of Glasgow (GB))

Session Classification: Student talks / Discussion topic

Contribution ID: 77

Type: **not specified**

Contur status report

Tuesday, December 7, 2021 3:00 PM (30 minutes)

Status report on Contur summing up developments in the closing MCnet period

Primary author: BUTTERWORTH, Jonathan (UCL)

Presenter: BUTTERWORTH, Jonathan (UCL)

Session Classification: Student talks / Discussion topic

Contribution ID: 78

Type: **not specified**

Diboson production including NLO QCD and electroweak corrections

Tuesday, December 7, 2021 4:00 PM (25 minutes)

Summary of the research done as an MCnetITN3 PhD student.

Di-boson production processes play an important role in many Standard Model studies, including Higgs-boson and electroweak precision measurements. They also form an important background in searches for phenomena beyond the Standard Model. In this talk I will present a recent study on the inclusion of electroweak corrections to $pp \rightarrow e^+ e^- \mu^+ \mu^-$ and $pp \rightarrow e^+ e^- \mu^+ \mu^- j$, both at exact NLO and using two approximations: the EW virtual and EW Sudakov approach. We also consider for the first time the all-order NLL Sudakov corrections to the fixed-order prediction. Finally, I am going to present prediction for $pp \rightarrow e^+ e^- \mu^+ \mu^- + \text{jets}$ production based on merged NLO QCD matrix-element plus parton-shower simulations in the framework of the Sherpa event generator including electroweak corrections through the aforementioned approximations.

Primary author: VILLANI, Simon Luca

Presenter: VILLANI, Simon Luca

Session Classification: Student talks / Discussion topic

Contribution ID: 79

Type: **not specified**

HEJ2+PYTHIA - Merging High Energy and Soft-Collinear Resummation

Tuesday, December 7, 2021 11:50 AM (20 minutes)

Matching of logarithms of high-energy and of the parton shower have previously been reported for the (high energy) leading logarithmic component of the cross section, and only up to the first emission from PYTHIA.

We discuss a method for both extending this matching both to all orders, and to include the non-resummable component of the cross section through standard CKKW-L merging.

First results are presented from a flexible implementation using HEJ2 and PYTHIA, which also allows for matching of the recently calculated leading-logarithmic resummation of the first sub-leading processes.

Primary author: HASSAN, Hitham (Durham University)

Presenter: HASSAN, Hitham (Durham University)

Session Classification: Student talks / Discussion topic

Contribution ID: **80**

Type: **not specified**

MadGraph5_aMC@NLO: progress realised thanks to MCnet

Tuesday, December 7, 2021 2:00 PM (30 minutes)

- short presentation of all the papers that intersect between mG5aMC and Mcnet. (likely one slide per paper)
- short Presentation of the work still in progress (likely on slide per project)

Primary author: MATTELAER, Olivier (UCLouvain)

Presenter: MATTELAER, Olivier (UCLouvain)

Session Classification: Student talks / Discussion topic

Contribution ID: **81**

Type: **not specified**

PYTHIA status report

Tuesday, December 7, 2021 9:30 AM (30 minutes)

Status report on developments in Pythia8 in the closing MCnet-funded period.

Primary author: BIERLICH, Christian (Lund University (SE))

Presenter: BIERLICH, Christian (Lund University (SE))

Session Classification: Student talks / Discussion topic

Contribution ID: 82

Type: **not specified**

QED real corrections in the Sherpa event generator

Tuesday, December 7, 2021 12:10 PM (20 minutes)

In this talk I will present my work implementing QED real corrections in the Sherpa event generator. Using the Catani-Seymour dipole formalism, a k_T -ordered QED parton shower was constructed. The correct radiation pattern was obtained by applying negative weights to same-charge dipoles using the existing framework for applying analytic weights in the veto algorithm.

I will also present a supplement to the YFS resummation for Z decay to leptons which allows photons to split into fermion-antifermion pairs. This is motivated by the experimental practice of correcting to Born leptons informed by Monte Carlo simulations. Photon splittings appear at NNLO but are logarithmically enhanced with the fermion mass; this work quantifies their contribution.

Primary author: FLOWER, Lois (IPPP, Durham University)

Presenter: FLOWER, Lois (IPPP, Durham University)

Session Classification: Student talks / Discussion topic

Contribution ID: **83**

Type: **not specified**

Herwig 7 status report

Tuesday, December 7, 2021 10:00 AM (30 minutes)

Status report on Herwig 7

Primary author: KIRCHGAESSER, Patrick (Lund University)

Presenter: KIRCHGAESSER, Patrick (Lund University)

Session Classification: Student talks / Discussion topic

Contribution ID: 84

Type: **not specified**

Subleading high-energy logarithms and NLO accuracy for $W + \text{jets}$

Monday, December 6, 2021 4:00 PM (20 minutes)

Several important processes and analyses at the LHC are sensitive to higher-order perturbative corrections beyond what can currently be calculated at fixed order. One important class of large logarithmic corrections are so-called high-energy logarithms which appear when the centre-of-mass energy of a QCD collision is much larger than the transverse momenta of the observed jets. In this talk I will describe the High Energy Jets (HEJ) framework, which includes the dominant high-energy logarithms to provide all-order predictions for several relevant LHC processes. I will summarise the results of a recent study of W boson production in association with at least two jets (arXiv:2012.10310), where we introduced a class of next-to-leading logarithmic improvements to the HEJ description of this process, and we performed the first bin-by-bin matching of HEJ to NLO accuracy.

Primary author: BYRNE, Emmet

Presenter: BYRNE, Emmet

Session Classification: Student talks / Discussion topic

Contribution ID: **85**

Type: **not specified**

Sherpa status report

Tuesday, December 7, 2021 9:00 AM (30 minutes)

Status report on Sherpa summing up developments in the closing MCnet period

Primary author: Dr REICHELDT, Daniel (IPPP Durham)

Presenter: Dr REICHELDT, Daniel (IPPP Durham)

Session Classification: Student talks / Discussion topic

Contribution ID: 86

Type: **not specified**

Quarkonia showers in PYTHIA8

Wednesday, December 8, 2021 10:45 AM (20 minutes)

Quarkonia production has been a long-standing puzzle in particle physics. The polarisation measurement of J/ψ is expected to have significant transverse polarisation at large p_T , but has been experimentally observed to be consistent with zero. Hard production of onia processes using NRQCD formalism are available in the Pythia8 framework. However, these processes alone cannot fully describe the data; LHCb and CMS have shown with normalised cross section measurements of $z = p_T(J/\psi)/p_T(jet)$ that J/ψ 's are produced softer than expected. Hence the need to incorporate onia production within the parton shower. A status report for incorporating quarkonia showers into Pythia8 will be presented.

Primary author: COOKE, Naomi (University of Birmingham (GB))

Co-authors: LÖNNBLAD, Leif (Lund University (SE)); ILTEN, Philip (University of Cincinnati (US)); MRENNNA, Stephen (FERMILAB)

Presenter: COOKE, Naomi (University of Birmingham (GB))

Session Classification: Student talks / Discussion topic

Contribution ID: 87

Type: **not specified**

MadGraph-Rivet/Contur interface development

Tuesday, December 7, 2021 5:10 PM (20 minutes)

For the MCnet shortterm studentship program, my task was to construct the interface that connects MadGraph to Rivet and in the end, Contur to do reinterpretation studies. The interface construction was successfully done, with actual working examples (physics results). The talk will be about latest updates to MadGraph interfaced to Rivet/Contur and reinterpretation results on several heavy neutrino mass models with Contur.

Primary author: JEON, Si Hyun (Seoul National University (KR))

Co-authors: BUTTERWORTH, Jonathan (UCL); MATTELAER, Olivier (UCLouvain)

Presenter: JEON, Si Hyun (Seoul National University (KR))

Session Classification: Student talks / Discussion topic

Contribution ID: 88

Type: **not specified**

Searches for new interactions within the SMEFT framework

Tuesday, December 7, 2021 11:25 AM (25 minutes)

Summary of my PhD thesis.

In the hypothesis that the scale of new physics is considerably higher than the energies probed at colliders, we can parametrise modified interactions induced by BSM effects among SM particles in a model-independent framework, the Standard Model Effective Field Theory (SMEFT).

In the thesis, several phenomenological aspects of the SMEFT are discussed, both at present and future colliders.

A characteristic feature of modified interactions is that they can induce unitarity violating effects which can be exploited to gain sensitivity. In this direction, a thorough study of the top quark electroweak sector will be presented, focusing on $2 \rightarrow 2$ scatterings and their embeddings in physical processes at colliders. This analysis allows us to identify several final states that have a good potential to explore the SMEFT parameter space and that could be particularly relevant in a global analysis.

One of the key features of the SMEFT is indeed that deviations from the SM interactions are correlated and global interpretations are therefore of fundamental importance. A combined interpretation of the Higgs, top and diboson data from the LHC is here presented and the interplay between the various datasets discussed.

Finally, the physics potential of a futuristic muon collider will be analysed, focusing in particular on the prospects to determine the Higgs self-interactions, a task that is arduous even in proposed 100 TeV proton colliders.

Primary author: MANTANI, Luca (DAMTP, University of Cambridge)

Presenter: MANTANI, Luca (DAMTP, University of Cambridge)

Session Classification: Student talks / Discussion topic

Contribution ID: **89**

Type: **not specified**

Photoproduction events in Sherpa

Monday, December 6, 2021 4:40 PM (20 minutes)

I will review recent efforts to extend Sherpa to include photon PDFs in Sherpa and to describe photoproduction events.

Primary author: MEINZINGER, Peter

Presenter: MEINZINGER, Peter

Session Classification: Student talks / Discussion topic

Contribution ID: 90

Type: **not specified**

The K^*/K ratio in heavy ion collisions

Monday, December 6, 2021 3:40 PM (20 minutes)

In this talk I will give a brief introduction about myself as a new PhD student starting to work with Monte Carlo event generators, more specifically, SHERPA. I will also present the main results obtained during my masters' when I studied the K/K ratio in heavy ion collisions. *The goal of this project was to understand the suppression of this ratio during the hadron gas phase that the collision system undergoes after the hadronization of the quark gluon plasma. Given that the lifetime of the K meson is shorter than that of the hadron gas itself, it's expected that the daughter particles of the K decay will rescatter during this phase and, as a result, the observed K/K ratio will be suppressed when compared with predictions by statistical hadronization models. To take into account these hadronic interactions, we solve a system of differential equations for the abundances of K and K mesons and compute the value of the K/K ratio at the moment of thermal freeze-out, i.e., when the hadronic interactions cease. We explored how this solution was affected by different factors: the temperature evolution of the system, the kinetic freeze-out temperature and the interaction mechanisms for the K and K mesons with the constituents of the gas. This analysis showed that the experimental data observed for the K/K ratio in different collision systems can be described using a Bjorken-like temperature evolution and considering that the thermal freeze-out temperature decreases with the size of the post-collision system. We also showed that the most relevant interaction mechanisms in the hadron gas are $K^* \rightarrow K\pi$ and $K\pi \rightarrow K^*$.*

Primary author: LE ROUX, Chiara

Presenter: LE ROUX, Chiara

Session Classification: Student talks / Discussion topic

Contribution ID: 91

Type: **not specified**

Preparing Sherpa for e+e-

Wednesday, December 8, 2021 9:00 AM (25 minutes)

I will present Sherpa's ongoing development for future lepton colliders.

Primary author: PRICE, Alan (Siegen University)

Presenter: PRICE, Alan (Siegen University)

Session Classification: Student talks / Discussion topic

Contribution ID: 93

Type: **not specified**

Recent updates in LHAPDF

Monday, December 6, 2021 5:00 PM (20 minutes)

Review of the most recent changes to the LHAPDF PDF interpolator.

Primary author: KNOBBE, Max

Presenter: KNOBBE, Max

Session Classification: Student talks / Discussion topic

Contribution ID: 94

Type: **not specified**

Towards discrimination and improved modelling of dark-sector showers

Monday, December 6, 2021 4:20 PM (20 minutes)

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 discuss 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, with some preliminary results, as well as the proposed idea of having a Herwig hidden valley dark shower and hadronisation module. Both these topics are part of my recent MCnet short-term studentship.

Primary author: SINHA, Sukanya (University of Witwatersrand)

Co-author: BUCKLEY, Andy (University of Glasgow (GB))

Presenter: SINHA, Sukanya (University of Witwatersrand)

Session Classification: Student talks / Discussion topic

Contribution ID: 95

Type: **not specified**

Tackling the Uncertainties of Event Generators

Wednesday, December 8, 2021 9:25 AM (25 minutes)

Summary of the work done during my PhD studies in Lund.

Primary author: GELLERSEN, Leif

Presenter: GELLERSEN, Leif

Session Classification: Student talks / Discussion topic

Contribution ID: 96

Type: **not specified**

Search for non-resonant di-Higgs searches in $bb\text{-}\gamma\gamma$ channel in CMS experiment and diphoton modelling in Herwig

Wednesday, December 8, 2021 11:05 AM (20 minutes)

After the discovery of Higgs boson by CMS and ATLAS experiment in 2012 the current mandate of the LHC is to search for the Higgs Boson self coupling along, which is yet to be measured. CMS and ATLAS are performing the search in different channels of non -resonant Higgs boson production using full Run-2 data taken by LHC. In this context one of the most clear channels is di-Higgs to $bb\text{-}\gamma\gamma$ final state due to less background and better calorimetric resolution. But it's difficult to estimate the di photon background spectrum along with some jets in Monte Carlo. My talk will cover the basic strategy of di Higgs to $bb\text{-}\gamma\gamma$ searches in CMS and recent work on the di photon background modelling in Herwig interface under MC-Net project.

Primary author: MUKHERJEE, Soumya (Tata Institute of Fundamental Research)

Presenter: MUKHERJEE, Soumya (Tata Institute of Fundamental Research)

Session Classification: Student talks / Discussion topic

Contribution ID: 97

Type: **not specified**

Implementing BSM radiations to angular-ordered parton shower process in Herwig and searching for the signal in the CMS detector

Wednesday, December 8, 2021 11:25 AM (20 minutes)

After the discovery of the Higgs boson at 2012, there is no direct evidence for new physics. It is thus a good time to explore a new phase space. We perform a search for new physics inside a jet using non-isolated leptons related with the muon $g-2$ and LHCb's lepton universality violation results. There is no proper shower generator to generate the signal sample for this search, we implement BSM parton showers in Herwig 7. This presentation informs a preliminary result of a non-isolated dimuon production using the CMS dataset and BSM parton radiations.

Primary author: LEE, Joon-Bin (Seoul National University (KR))

Presenter: LEE, Joon-Bin (Seoul National University (KR))

Session Classification: Student talks / Discussion topic

Contribution ID: 98

Type: **not specified**

HEJ status report

Wednesday, December 8, 2021 9:50 AM (30 minutes)

Status report on HEJ summing up developments in the closing MCnet period.

Primary author: ANDERSEN, Jeppe Rosenkrantz (IPPP, University of Durham)

Presenter: ANDERSEN, Jeppe Rosenkrantz (IPPP, University of Durham)

Session Classification: Student talks / Discussion topic

Contribution ID: 99

Type: **not specified**

Hadronic Interactions at High and Low Energies

Tuesday, December 7, 2021 4:25 PM (25 minutes)

In this talk, which will follow a somewhat unconventional format, I will share with you a few things I learned during my PhD that I found particularly interesting. The specific topics I will touch on are hadronic rescattering, exotic hadrons and cosmic rays.

Primary author: UTHEIM, Marius

Presenter: UTHEIM, Marius

Session Classification: Student talks / Discussion topic