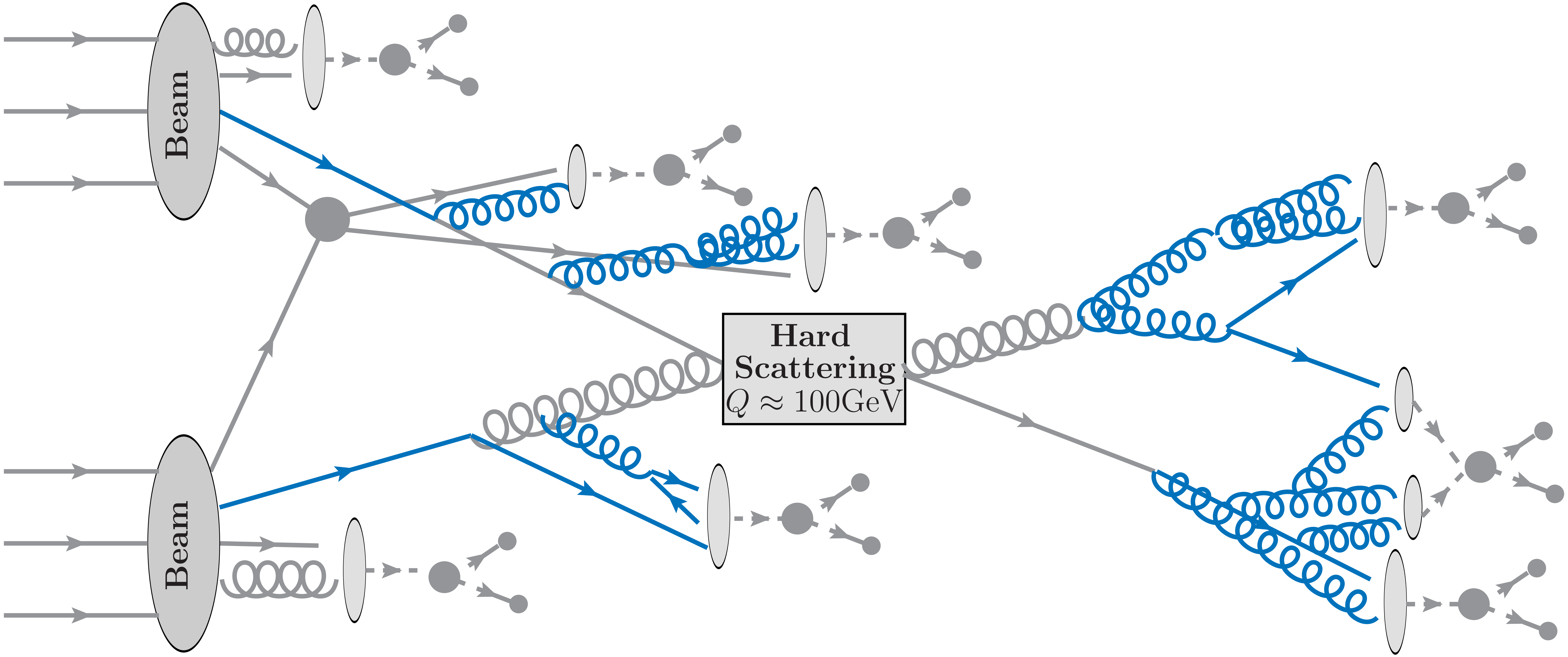
Les Houches MC & Tools theory overview



Physics at TeV Colliders and Beyond the Standard Model 2025: SM Session

Silvia Ferrario Ravasio, Daniel Reichelt, Andrzej Siodmok
(+ Chris Hayes, Alexander Grohsjean, Jennifer Roloff)

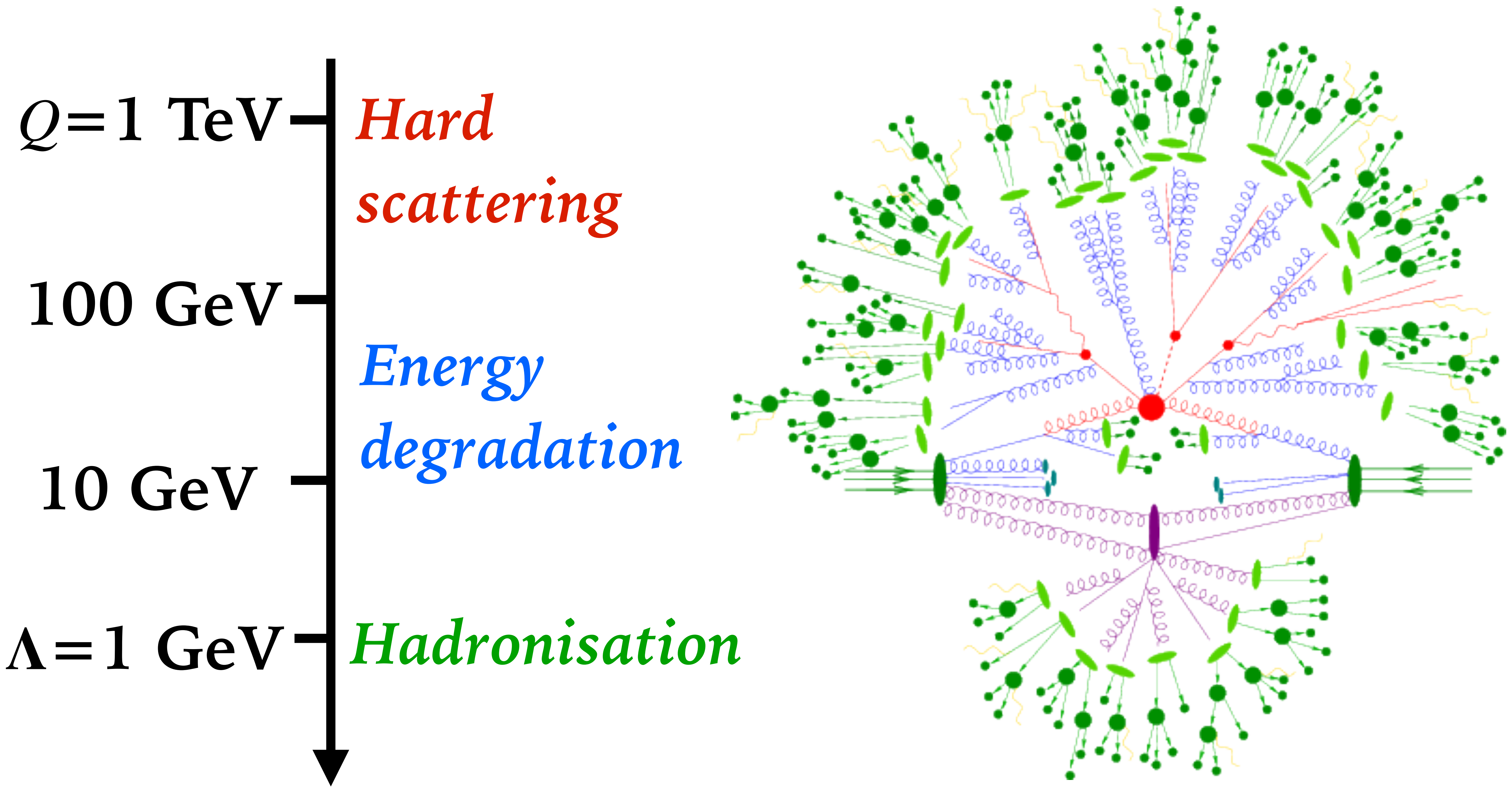
17th June 2025, Les Houches

The point of Les Houches is to ***acknowledge our ignorance*** *behind closed doors and to study such ignorance together*

Gherardo Vita, 12/06/2025

Shower Monte Carlo event generators

- **Shower Monte Carlo Event** generators favourite theory tool at the **LHC** (**FCC-ee ?**)



Shower Monte Carlo event generators

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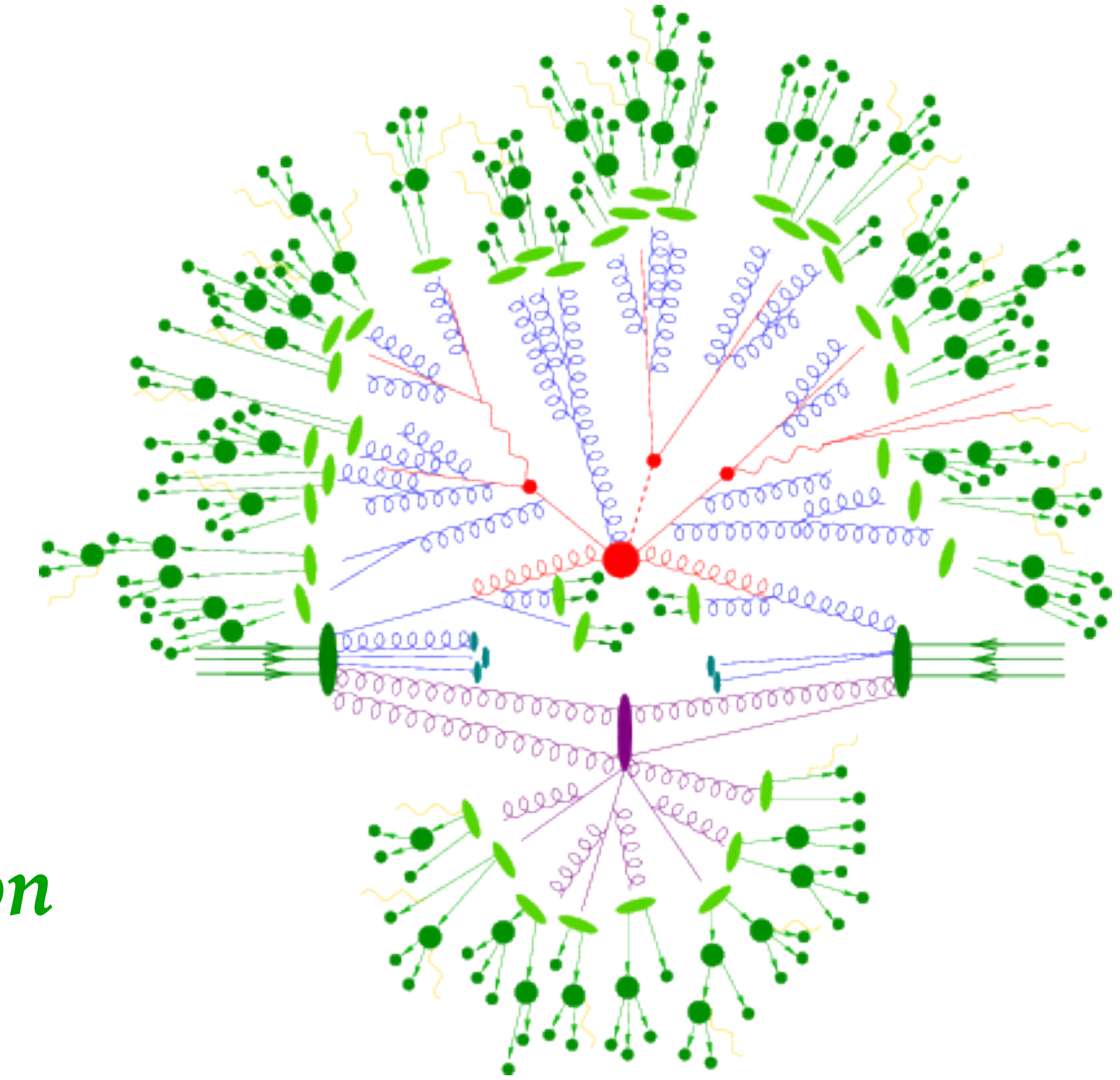
Q=1 TeV — *Hard scattering*

100 GeV — *Energy degradation*

10 GeV

Λ=1 GeV — *Hadronisation*



SMC

Matching

↑

Parton Showers

↓

Soft physics models

Practical accuracy

Shower Monte Carlo event generators

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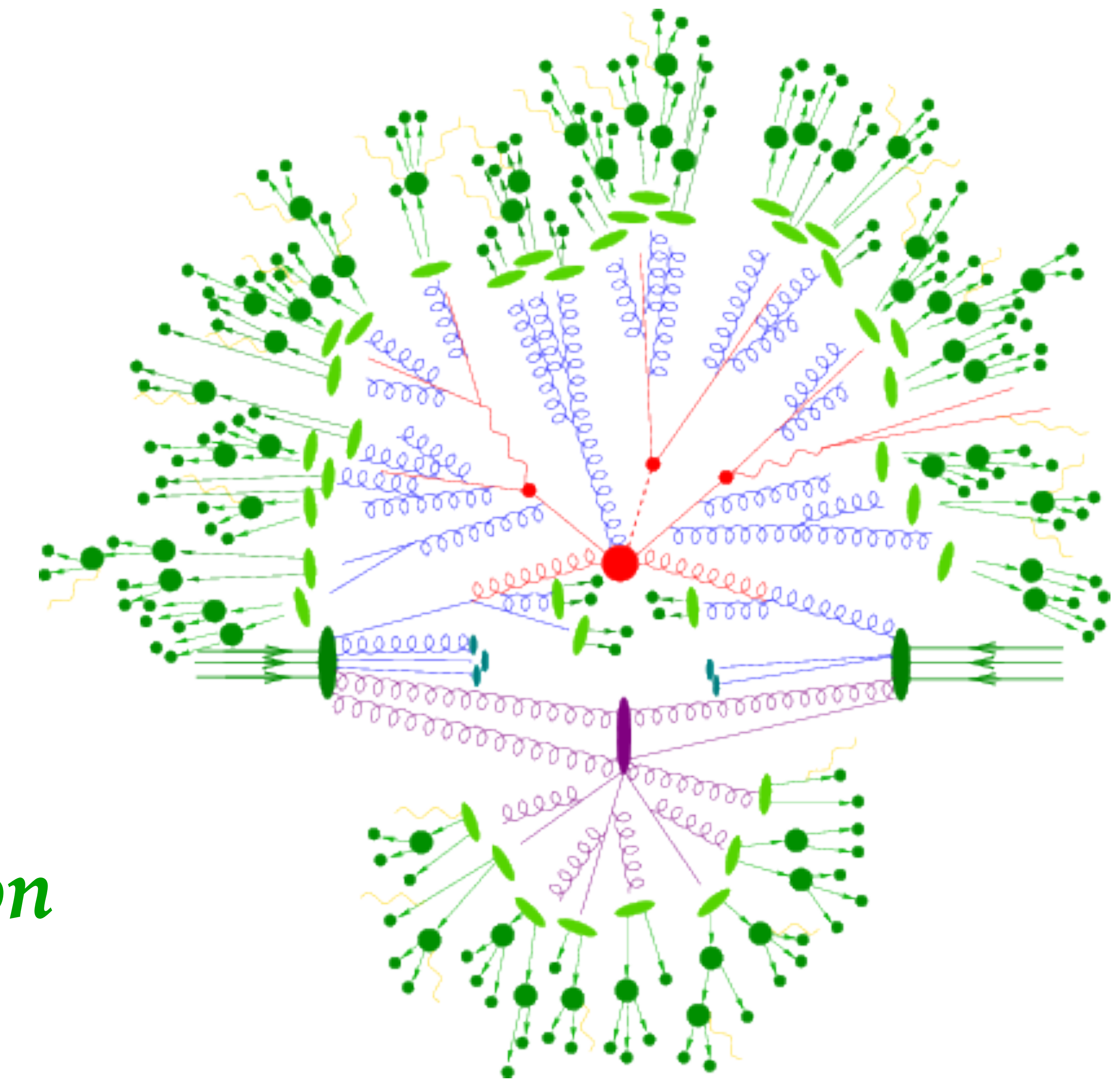

SMC	Analytic
Matching	Fixed order
Parton Showers	Resummation
Soft physics models	Fragmentation functions / analytic models for power corrections

Practical accuracy

Formal accuracy

Parton showers accuracy: where do we stand and where we are headed to

Let's begin simple: perturbative physics in SMC.

Two pressing issues for (matched) parton shower predictions:

1. How do we assess **uncertainties to current parton shower** predictions?

$\updownarrow$

2. Can we get an **analytic understanding of the formal accuracy** of Parton Showers and **improve it sytematically** as done in analytic calculations?

Parton Shower formal accuracy

- For many decades, parton showers accuracy has been improved via **matching** with fixed order calculations
- One can however use **analytic resummation** as inspiration to assess and improve the **logarithmic accuracy** [Catani, Marchesini, Webber *Nucl.Phys.B* 349 (1991) 635-654]

Parton Shower formal accuracy

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- Parton showers used to interpret LHC data are **Leading Logarithmic**, with partial Next-To-Leading-Logarithmic correction taken into account [Dagupta et al, *JHEP* 09 (2018) 033]

"N(N)LL" revolution

PanScales
Phys.Rev.Lett. 125 (2020) 5, 052002

FHP
JHEP 09 (2020) 014

Deductor
Phys.Rev.D 104 (2021) 5, 054049

Alaric
JHEP 10 (2023) 091

Apollo
JHEP 07 (2024) 161

N(N)LL parton showers: recent selected highlights

ALARIC parton shower for hadron colliders

Stefan Höche,[1] Frank Krauss,[2] and Daniel Reichelt[2]
[1]*Fermi National Accelerator Laboratory, Batavia, Illinois 60510, USA*
[2]*Institute for Particle Physics Phenomenology, Durham University, Durham DH1 3LE, United Kingdom*

(Received 22 April 2024; accepted 5 April 2025; published 22 May 2025)

We introduce the ALARIC parton shower for simulating quantum chromodynamics (QCD) radiation at hadron colliders and present numerical results from an implementation in the event generator SHERPA. ALARIC provides a consistent framework to quantify certain systematic uncertainties which cannot be eliminated by comparing the parton shower with analytic resummation. In particular, it allows us to study recoil effects away from the soft and collinear limits without the need to change the evolution variable or the splitting functions. We assess the performance of ALARIC in Drell-Yan lepton pair and QCD jet production, and present the first multijet merging for the new algorithm.

DOI: 10.1103/PhysRevD.111.094032

NLL shower for *pp* collisions with **LO multi-jet merging** [Alaric]

NLO matching to achieve **NNDL accuracy** for 2-legged processes [PanScales]

Matching and event-shape NNDL accuracy in parton showers

Keith Hamilton,[a] Alexander Karlberg,[b,c] Gavin P. Salam,[b,d] Ludovic Scyboz[b] and Rob Verheyen[a]
[a]*Department of Physics and Astronomy, University College London, London, WC1E 6BT, U.K.*
[b]*Rudolf Peierls Centre for Theoretical Physics, Clarendon Laboratory, Parks Road, University of Oxford, Oxford OX1 3PU, U.K.*
[c]*CERN, Theoretical Physics Department, CH-1211 Geneva 23, Switzerland*
[d]*All Souls College, Oxford OX1 4AL, U.K.*

ABSTRACT: To explore the interplay of NLO matching and next-to-leading logarithmic (NLL) parton showers, we consider the simplest case of γ^* and Higgs-boson decays to $q\bar{q}$ and gg respectively. Not only should shower NLL accuracy be retained across observables after matching, but for global event-shape observables and the two-jet rate, matching can augment the shower in such a way that it additionally achieves next-to-next-to-double-logarithmic (NNDL) accuracy, a first step on the route towards general NNLL. As a proof-of-concept exploration of this question, we consider direct application of multiplicative matrix-element corrections, as well as simple implementations of MC@NLO and POWHEG-style matching. We find that the first two straightforwardly bring NNDL accuracy, and that this can also be achieved with POWHEG, although particular care is needed in the handover between POWHEG and the shower. Our study involves both analytic and numerical components and we also touch on some phenomenological considerations.

Logarithmically-accurate and positive-definite NLO shower matching

Melissa van Beekveld,[a] Silvia Ferrario Ravasio,[b] Jack Helliwell,[c] Alexander Karlberg,[b] Gavin P. Salam,[d,e] Ludovic Scyboz,[c] Alba Soto-Ontoso,[f] Gregory Soyez,[g] Silvia Zanoli[d]
[a]*Nikhef, Theory Group, Science Park 105, 1098 XG, Amsterdam, The Netherlands*
[b]*CERN, Theoretical Physics Department, CH-1211 Geneva 23, Switzerland*
[c]*School of Physics and Astronomy, Monash University, Wellington Rd, Clayton VIC-3800, Australia*
[d]*Rudolf Peierls Centre for Theoretical Physics, Clarendon Laboratory, Parks Road, University of Oxford, Oxford OX1 3PU, UK*
[e]*All Souls College, Oxford OX1 4AL, UK*
[f]*Departamento de Física Teórica y del Cosmos, Universidad de Granada, Campus de Fuentenueva, E-18071 Granada, Spain*
[g]*Université Paris-Saclay, CNRS, CEA, Institut de physique théorique, 91191, Gif-sur-Yvette, France*

ABSTRACT: We present methods to achieve NLL+NLO accurate parton showering for processes with two coloured legs: neutral- and charged-current Drell–Yan, and Higgs production in pp collisions, as well as DIS and e^+e^- to jets. The methods include adaptations of existing approaches, as well as a new NLO matching scheme, ESME, that is positive-definite by construction. Our implementations of the methods within the PanScales framework yield highly competitive NLO event generation speeds. We validate the fixed-order and combined resummation accuracy with tests in the limit of small QCD coupling and briefly touch on phenomenological comparisons to standard NLO results and to Drell–Yan data. The progress reported here is an essential step towards showers with logarithmic accuracy beyond NLL for processes with incoming hadrons.

Parton Showering with Higher Logarithmic Accuracy for Soft Emissions

Silvia Ferrario Ravasio,[1] Keith Hamilton,[2] Alexander Karlberg,[1] Gavin P. Salam,[3,4] Ludovic Scyboz,[3] and Gregory Soyez[1,5]
[1]*CERN, Theoretical Physics Department, CH-1211 Geneva 23, Switzerland*
[2]*Department of Physics and Astronomy, University College London, London WC1E 6BT, United Kingdom*
[3]*Rudolf Peierls Centre for Theoretical Physics, Clarendon Laboratory, Parks Road, Oxford OX1 3PU, United Kingdom*
[4]*All Souls College, Oxford OX1 4AL, United Kingdom*
[5]*IPhT, Université Paris-Saclay, CNRS UMR 3681, CEA Saclay, F-91191 Gif-sur-Yvette, France*

(Received 4 August 2023; revised 13 September 2023; accepted 14 September 2023; published 18 October 2023)

The accuracy of parton-shower simulations is often a limiting factor in the interpretation of data from high-energy colliders. We present the first formulation of parton showers with accuracy 1 order beyond state-of-the-art next-to-leading logarithms, for classes of observables that are dominantly sensitive to low-energy (soft) emissions, specifically nonglobal observables and subjet multiplicities. This represents a major step toward general next-to-next-to-leading logarithmic accuracy for parton showers.

New Standard for the Logarithmic Accuracy of Parton Showers

Melissa van Beekveld,[1] Mrinal Dasgupta,[2] Basem Kamal El-Menoufi,[3] Silvia Ferrario Ravasio,[4] Keith Hamilton,[5] Jack Helliwell,[6] Alexander Karlberg,[4] Pier Francesco Monni,[4] Gavin P. Salam,[6,7] Ludovic Scyboz,[3] Alba Soto-Ontoso,[4] and Gregory Soyez[8]
[1]*Nikhef, Theory Group, Science Park 105, 1098 XG Amsterdam, The Netherlands*
[2]*Department of Physics & Astronomy, University of Manchester, Manchester M13 9PL, United Kingdom*
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[8]*IPhT, Université Paris-Saclay, CNRS UMR 3681, CEA Saclay, F-91191 Gif-sur-Yvette, France*

(Received 14 June 2024; revised 10 October 2024; accepted 5 December 2024; published 3 January 2025)

We report on a major milestone in the construction of logarithmically accurate final-state parton showers, achieving next-to-next-to-leading-logarithmic (NNLL) accuracy for the wide class of observables known as event shapes. The key to this advance lies in the identification of the relation between critical NNLL analytic resummation ingredients and their parton-shower counterparts. Our analytic discussion is supplemented with numerical tests of the logarithmic accuracy of three shower variants for more than a dozen distinct event-shape observables in $Z \to q\bar{q}$ and Higgs $\to gg$ decays. The NNLL terms are phenomenologically sizeable, as illustrated in comparisons to data.

DOI: 10.1103/PhysRevLett.134.011901

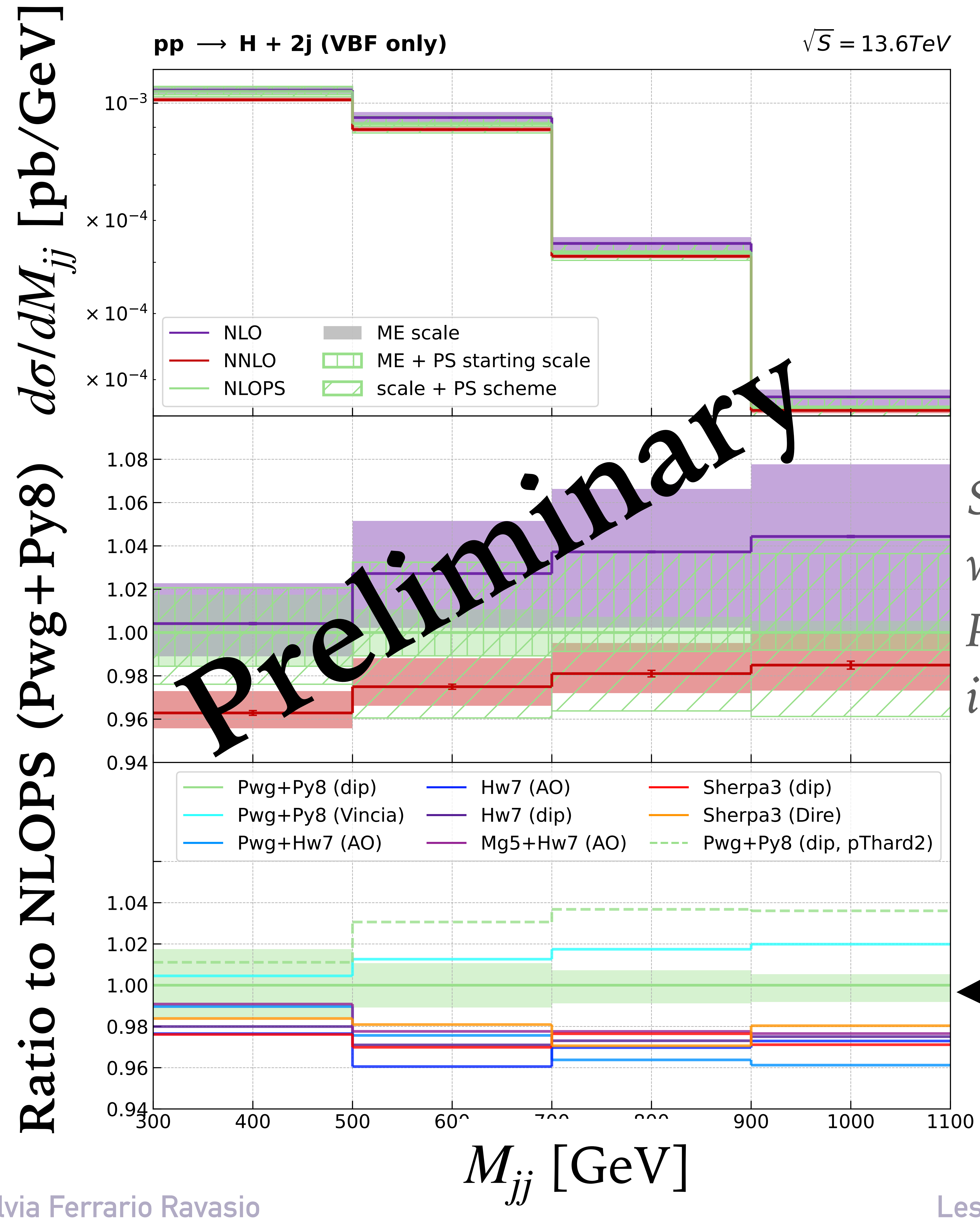
NNLL shower for $e^+e^- \to jj$ [Panscales]

Parton Shower uncertainties

- (N)NLL parton showers are ready for FCC-ee studies, and will (hopefully!) soon be ready for pheno applications for the LHC (MPI / NLO matching with many legs…)

- We need to devise a **robust way of assessing uncertainties given the current state-of-the-art** (LL for now, will evolve soon)

Harmonisation of Monte Carlo and uncertainties estimates, which must be as consistent as possible across processes (top, DY, ggF, VBF etc)!



Scale variations within a single PS simultation is not sufficient!

Higgs production via vector-boson fusion at the LHC

Gaetano Barone[1], Jiayi Chen[2], Stephane Cooperstein[3], Nikita Dolganov[2], Silvia Ferrario Ravasio[4], Yacine Haddad[5], Stefan Höche[6], Barbara Jäger[7], Alexander Karlberg[4], Alexander Mück[8], Mathieu Pellen[9], Christian T. Preuss[10], Daniel Reichelt[4], Simon Reinhardt[7], Marco Zaro[11]

1. Produce 3 preductions: one with **Pythia8**, one with **Herwig7** and one with **Sherpa3** (with your favourite matching and PS)
2. For one of this, include uncertainties stemming from renormalisation, factorisation (in the hard and PS MEs) and starting **scale variations**
3. Sum in quadrature these uncertainties

There is no ***PS vs matching uncertainty****: all at once*

Matching and negative weights

- Accuracy is not sufficient alone: efficiency is also important!
- Issue arising from *negative fraction of events* f, as we need $(1-2f)^2$ times more data to have the same statistical precision of a positive defined sample!
- Negative weights are difficult to handle in **Machine Learning** applications

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What are the currents needs?
Are they process-dependent?

Standard candles
e.g. $pp \to V$

High multiplicity processess
e.g. $pp \to V j_1 \ldots j_n$

Matching and negative weights

- It is possible to devise solutions that are **positive-definite**

Standard candles

e.g. $pp \to Z$

$$\bar{B} = B + V + C_{\text{int}} + \int R - C$$

Matching and negative weights

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KrkNLO: modification of the PDF factorisation scheme to allow NLO accuracy to be achieved by a multiplicative positive reweight. This gives positive weights by construction, since it does not use subtractions.
JHEP10(2015)052
JHEP 2025, 62 (2025)

ESME: Subtracted real cross section are converted into non-negative integers such that

$$\langle n \rangle = 1 + \frac{\int R - C}{B} + \mathcal{O}(\alpha_s^2)$$

arXiv:2504.05377

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arXiv:2504.05377

Can be (at least partially) extendend to more complex processes?
Can be useful for FO as well?

General advances

Negative-weights suppression in Monte Carlo samples

5 May 2025, 09:00 → 9 May 2025, 18:00 Europe/Zurich

4/3-006 - TH Conference Room (CERN)

Jeppe Rosenkrantz Andersen (IPPP, University of Durham), Michelangelo Mangano (CERN)

Description This Workshop provides a forum to review, discuss and improve techniques to reduce the impact of negative weights in LHC event generators working at the NLO and beyond. Negative weights induce a significant dilution of the statistical power of large MC event samples, leading to a huge burden for the computing resources required to match the HL-LHC needs. Negative weights pose challenges also to efficient numerical calculations of higher-order parton-level calculations at NNLO and beyond, an issue that will also be covered during the Workshop.

16:00 **ARCANE Reweighting to reduce negative weights** 30m

Negative weights in next-to-leading-order (NLO) event generation pose a significant computational challenge in collider physics. In this talk, I will describe a new Monte Carlo technique called ARCANE reweighting for tackling the negative weights problem. By applying ARCANE reweighting, one can reduce or even completely eliminate the negative weights in Monte Carlo datasets a) without introducing any biases in the distribution of physical observables, b) without requiring any changes to the matching and merging prescriptions used in NLO event generation, and c) without introducing any uncertainties that will not be captured by the standard error formulas used in HEP data analyses.
I will demonstrate the technique for the generation of e+ e- --> q qbar + 1 jet events using the MC@NLO formalism. I will also discuss what the next steps to implement ARCANE reweighting for processes relevant for LHC experiments might look like.

Speaker: Prasanth Shyamsundar (Fermi National Accelerator Laboratory)

ARCANE talk - CER...

14:15 **Cell Resampling to reduce negative weights** 30m

Cell resampling is a method for suppressing negative weights and generally improving statistical convergence in Monte Carlo event generation. I review the lessons learned from applications to showered and large fixed-order event samples and present a new phase-space metric designed to better match the sensitivity of experimental analyses. I conclude with an overview over some of open questions: systematic uncertainty estimates, optimisation of event generation, and the definition of the objects entering the metric.

Speaker: Andreas Maier (IFAE)

cell_resampling.pdf

11:00 **Resampling for event generators**

Speaker: Simon Platzer (University of Graz (AT))

slides.pdf

https://indico.cern.ch/event/1501347

A new way of reducing negative weights in MC@NLO

Rikkert Frederix[1] and Paolo Torrielli[2]

[1] Division of Particle and Nuclear Physics, Department of Physics, Lund University, Box 118, SE-221 00 Lund, Sweden
[2] Dipartimento di Fisica, Università di Torino and INFN, Sezione di Torino, I-10125 Torino, Italy
e-mail: rikkert.frederix@hep.lu.se, paolo.torrielli@unito.it

Abstract We introduce a new technique, that we dub *Born spreading*, aimed at reducing the number of negative-weight $\mathbb{S}$ events in the MC@NLO matching of NLO calculations with parton-shower simulations. We show that such a technique, based on a re-distribution of Born matrix elements in the radiative phase space, achieves a sizeable reduction of negative-weight events at little computational cost. The method does not induce any biases in physical distributions.

Non-perturbative physics: formal accuracy?

- Past years have seen a lot of attention to the perturbative components of SMC: here at least defining the accuracy is "easy", how do we define the **formal accuracy of a hadronisation model**?

- **Analytic models** for hadronisation should provide a pathway, but their formulation is still quite simplified / **under scrutinity**

WHICH INSIGHTS CAN HADRONISATION DEVELOPMENS IN SMC GET FROM ANALYTIC MODELS AND VICEVERSA?

Non-perturbative physics: formal accuracy?

Matching Hadronization and Perturbative Evolution: The Cluster Model in Light of Infrared Shower Cutoff Dependence

André H. Hoang[a] Oliver L. Jin[a] Simon Plätzer[b,a] Daniel Samitz[c]

[a] *Faculty of Physics, University of Vienna, Boltzmanngasse 5, A-1090 Vienna, Austria*
[b] *Institute of Physics, NAWI Graz, University of Graz, Universitätsplatz 5, A-8010 Graz, Austria*
[c] *Stefan Meyer Institute for Subatomic Physics, Dominikanerbastei 16, A-1010 Vienna, Austria*

*The **cutoff Q_0** terminating the shower evolution should be viewed as an **infrared factorization scale** so that parameters or non-perturbative effects of the MC generator may have a field theoretic interpretation with a controllable scheme dependence. This implies that the generator's parton level should be carefully defined within QCD perturbation theory with subleading order precision. Furthermore, it entails that the **shower cut Q_0 is not treated as one of the generator's tuning parameters**, but that the tuning can be carried out reliably for a range of Q_0 values and that he hadron level description is Q_0-invariant. This in turn imposes non-trival constraints on the behavior of the generator's hadronization model, so that its parameters can adapt accordingly when the Q_0 value is changed.*

Phenomenological constraints of the building blocks of the cluster hadronization model

Stefan Gieseke[1], Stefan Kiebacher[1], Simon Plätzer[2,3], Jan Priedigkeit[2]

[1] Institute for Theoretical Physics (ITP), KIT, Wolfgang-Gaede-Straße 1, D-76128 Karlsruhe
[2] Institute of Physics, NAWI Graz, University of Graz, Universitätsplatz 5, A-8010 Graz, Austria
[3] Particle Physics, Faculty of Physics, University of Vienna, Boltzmanngasse 5, A-1090 Wien, Austria

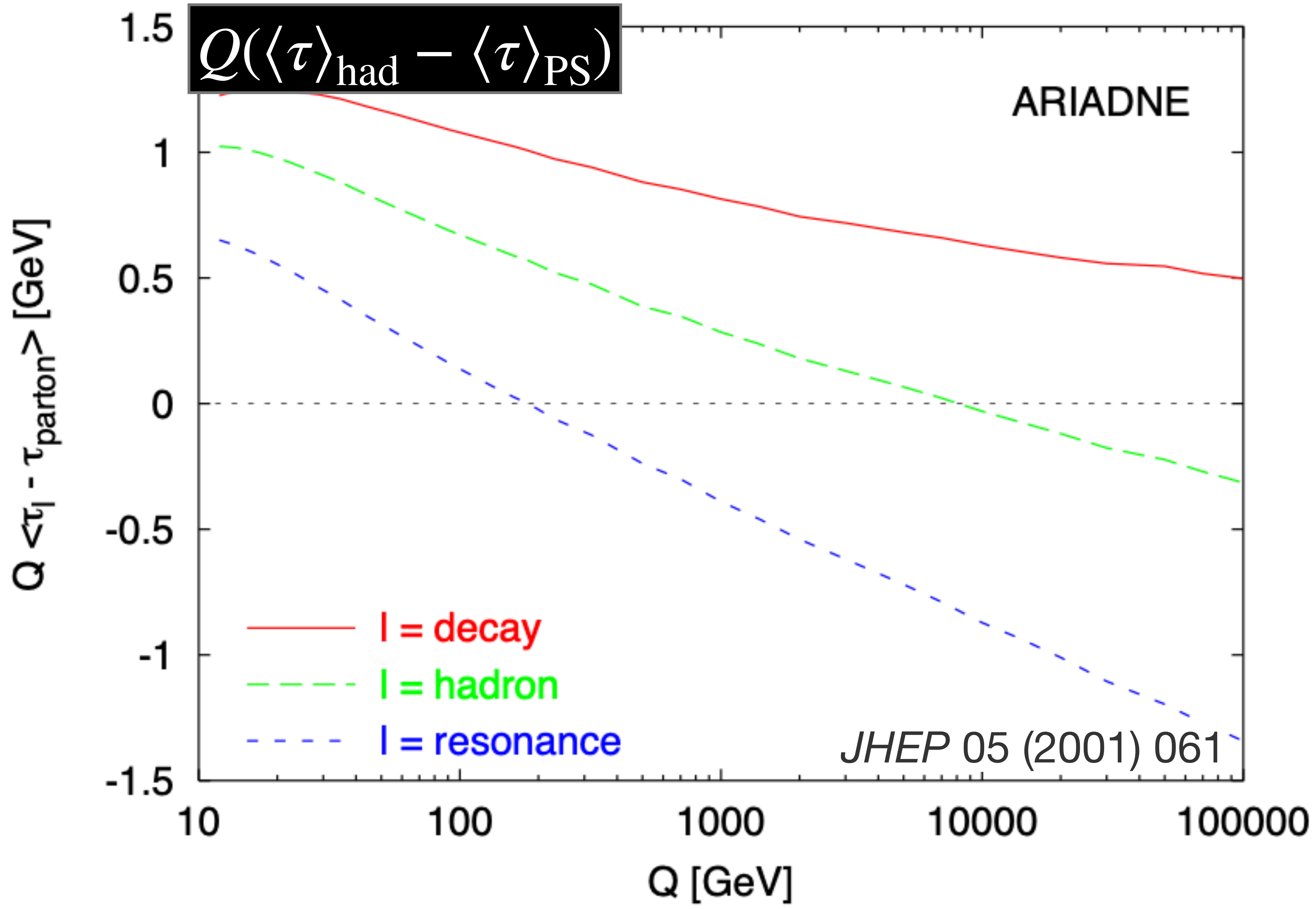
June 12, 2025

Abstract. We introduce building blocks for the cluster hadronization model in light of a new structure, focusing on cluster fission and cluster decay. We propose theoretically motivated matrix elements for cluster fission and decay as building blocks and study some first phenomenological implications at different energies. In particular we develop a set of observables which can be used to dissect the hadronization history and have constraining power on the individual building blocks. Our analysis will be completed by including colour reconnection in a follow-up work.

Hadronisation corrections: **energy scaling for event shapes**

How does the difference between hadronised and PS predictions scale with energy? How does it behave for different generators?

How does it compare to **analytic models used for α_s extractions**? *(e.g. 2506.09130 , 2412.15164, 2204.02247,2301.03607 +…)*



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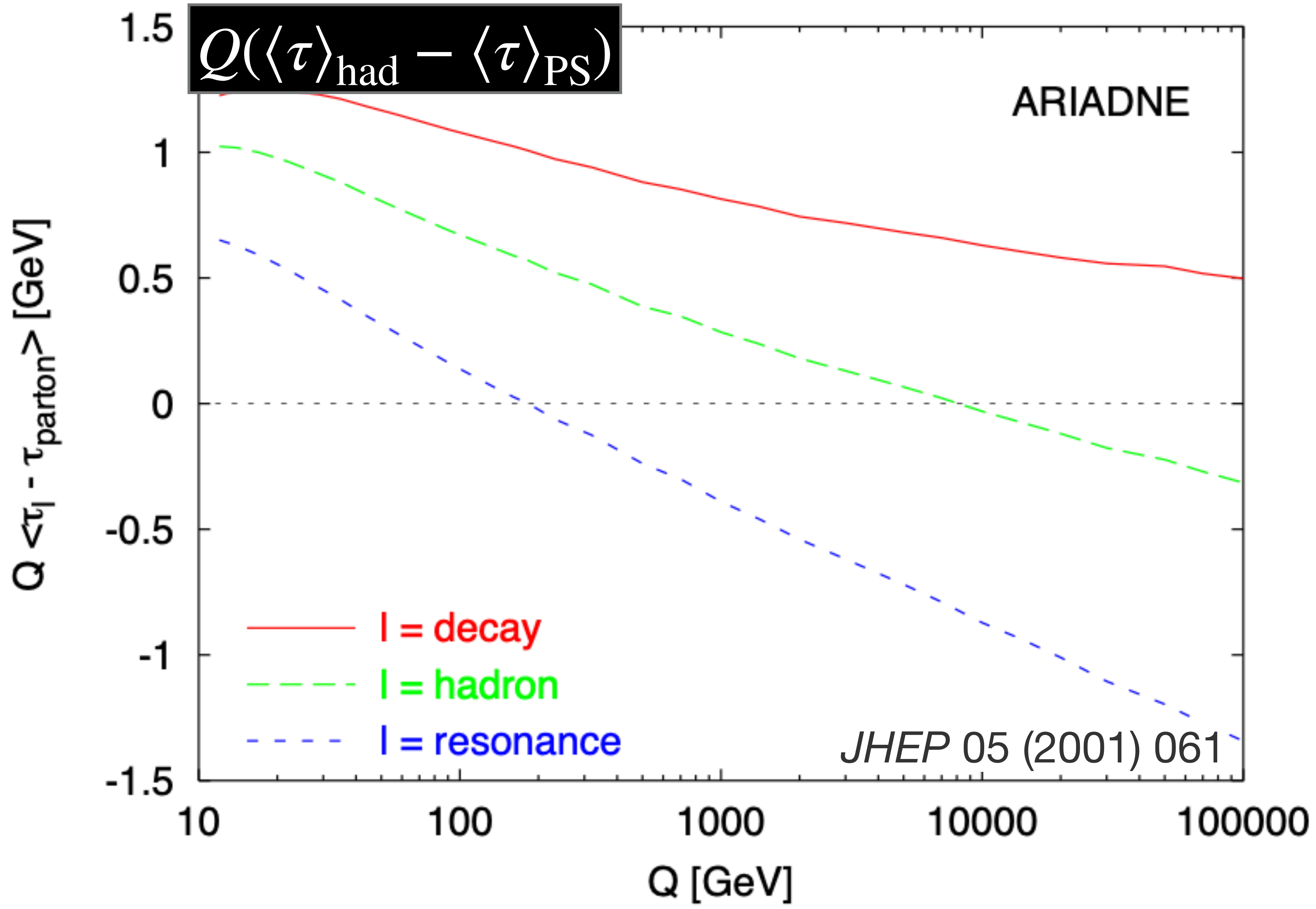
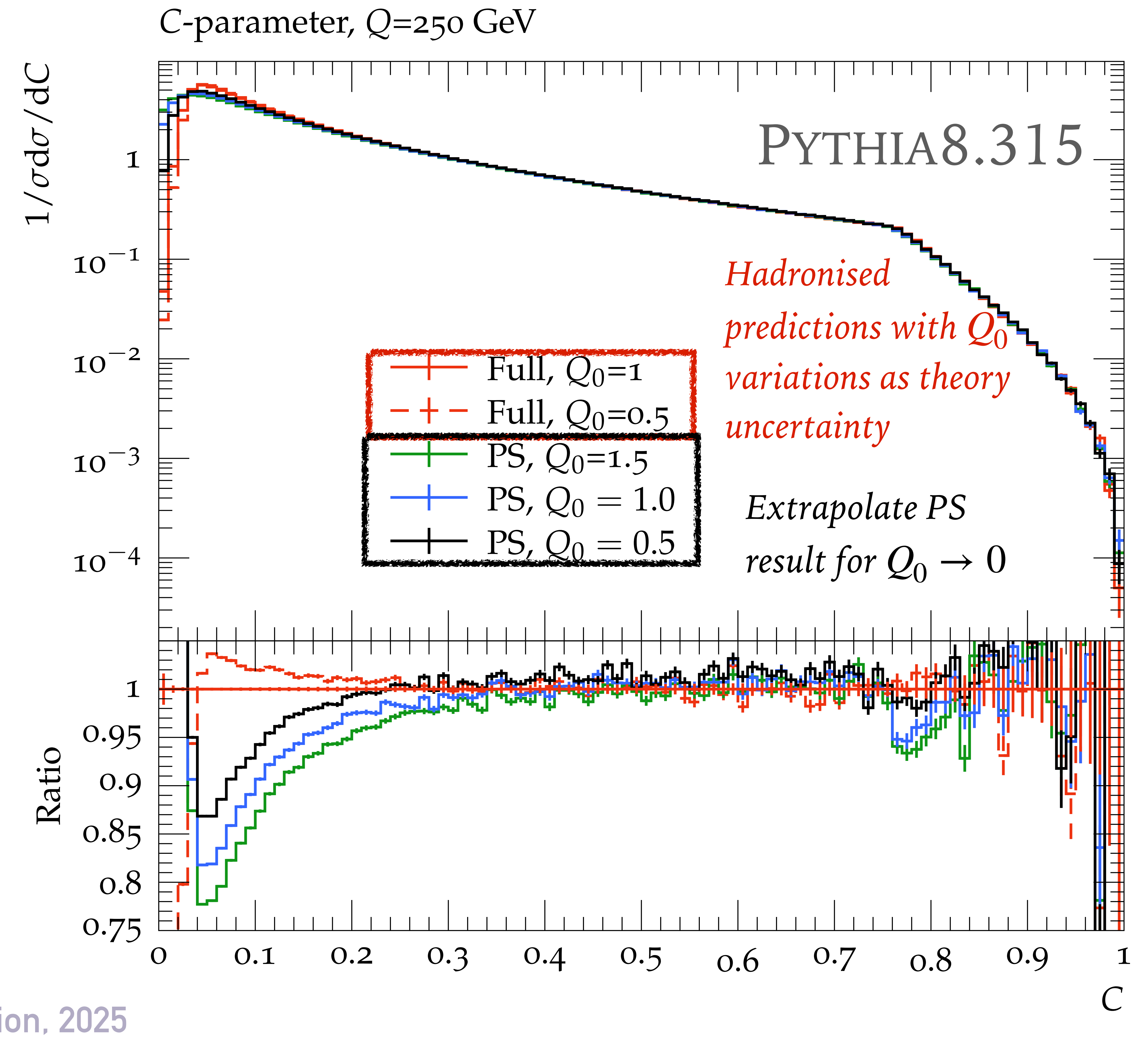




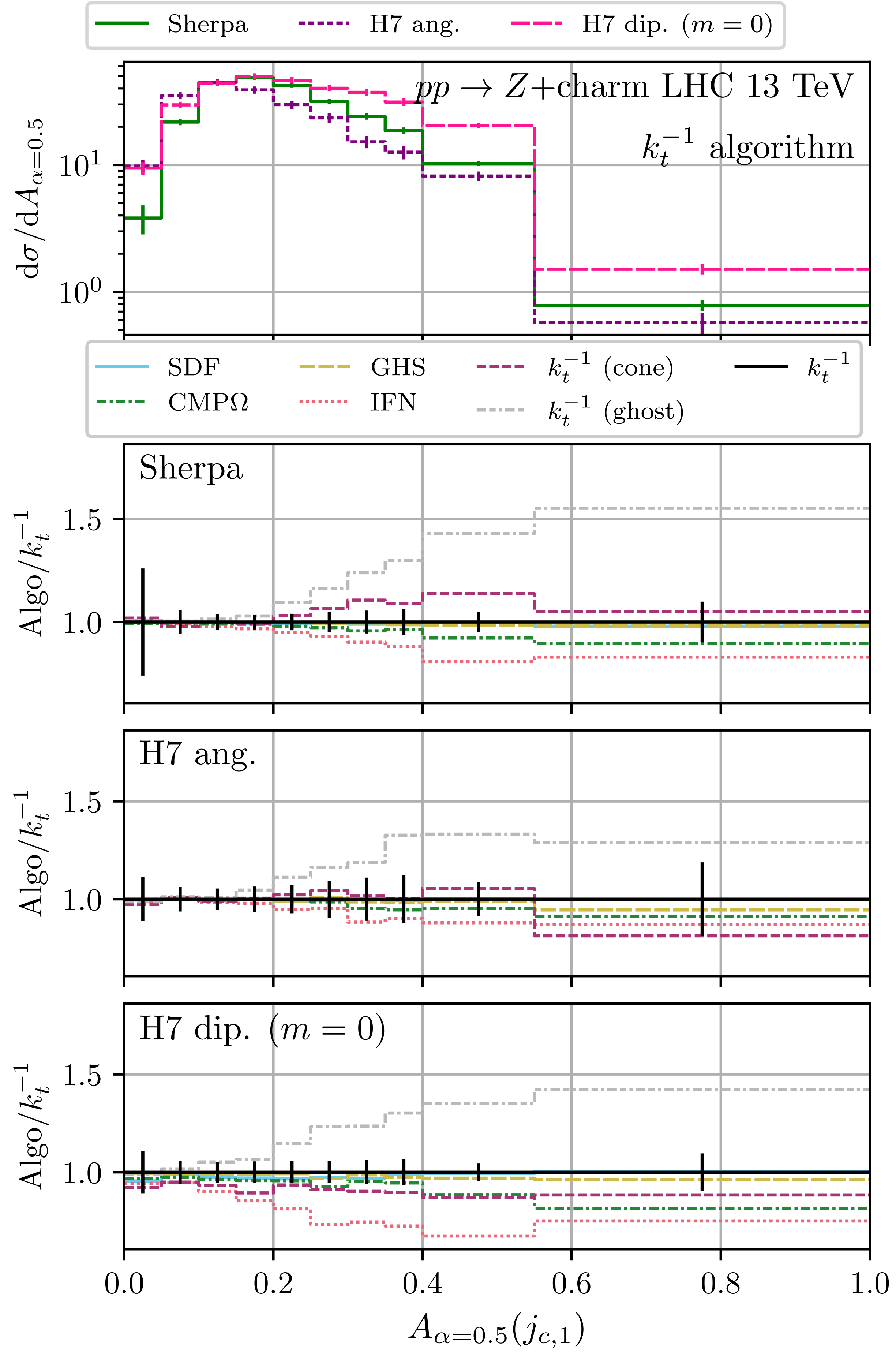
SMC and jets phenomenology: building on 2023 LHE studies

- 2023 LHE study (involving e.g. Jennifer, Daniel and Andrzej) https://phystev.cnrs.fr/wiki/2023:groups:smjets:jss-measurements:start
  jet substructure: benchmariking excercise across several SMC investigating particle correlators, Lund plane densities in $\{pp, ee\} \to$ dijet events

Flavoured jet algorithms: a comparative study

Arnd Behring,[1] Simone Caletti,[2] Francesco Giuli,[3] Radosław Grabarczyk,[4,5] Andreas Hinzmann,[6] Alexander Huss,[7] Joey Huston,[8] Ezra D. Lesser,[7] Simone Marzani,[9] Davide Napoletano,[10] Rene Poncelet,[11] Daniel Reichelt,[7,12] Alberto Rescia,[9] Gavin P. Salam,[5,14] Ludovic Scyboz,[15] Federico Sforza,[9] Andrzej Siódmok,[7,16] Giovanni Stagnitto,[10] James Whitehead,[16] Ruide Xu[17]

- Comparisons between **flavoured jet algorithms** using NLOPS and fixed order calculations



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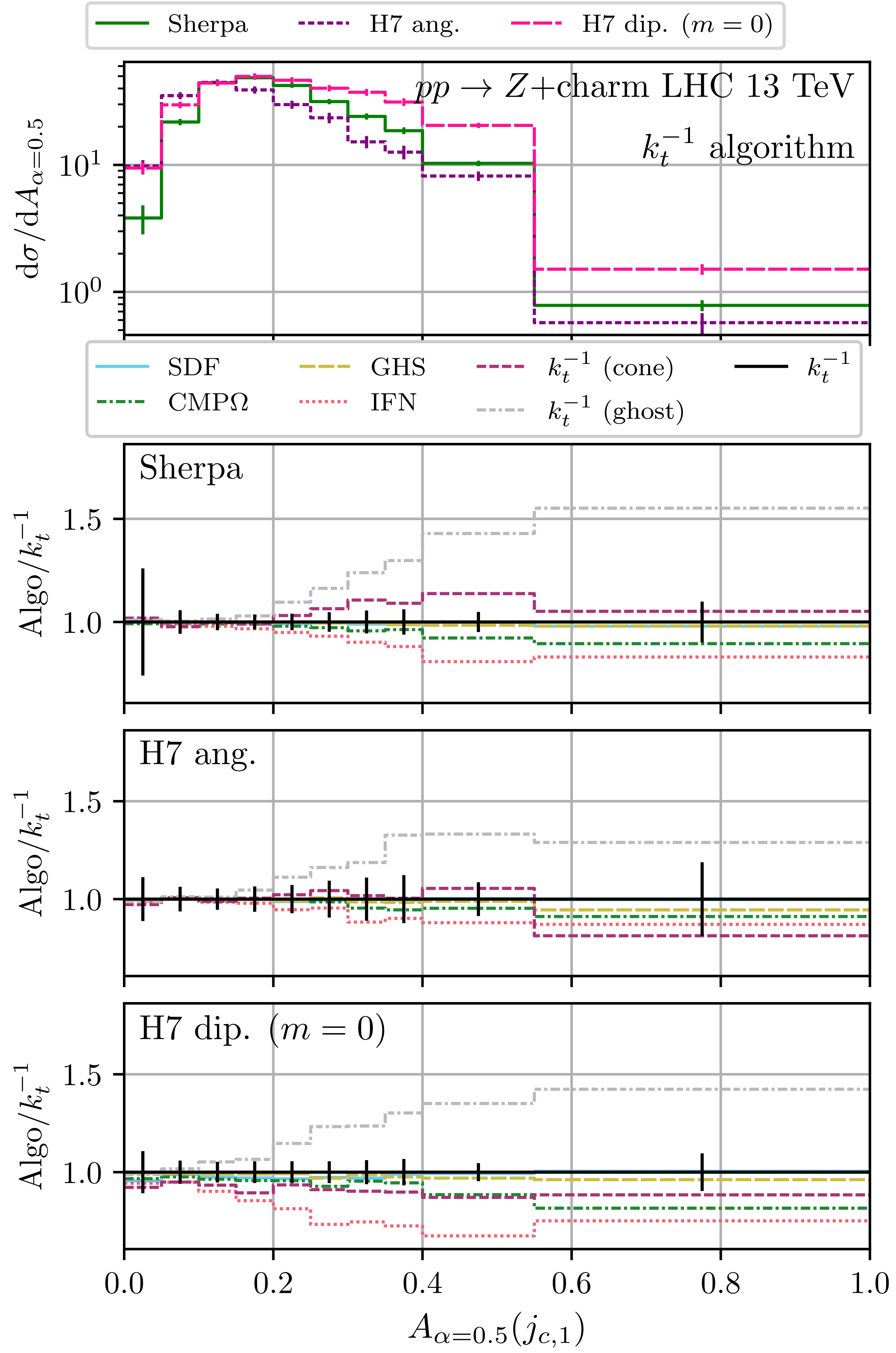

> DELVE DEEPER INTO **JET SUBSTRUCTURES** AND **LUND PLANE** FOR **HEAVY QUARKS**?
>
> NEW IDEAS FOR **JSS** BUILT FROM **LUND TREES**?

Some more recent highlights

Beyond Scale Variations: Perturbative Theory Uncertainties from Nuisance Parameters

Frank J. Tackmann

ABSTRACT: We develop a new approach to estimate the uncertainty due to missing higher orders in perturbative predictions (the perturbative "theory uncertainty"), which overcomes many inherent limitations of the currently prevalent methods based on varying unphysical renormalization scales. In our approach, the true underlying sources of the theory uncertainty, namely the missing higher-order terms, are identified and parameterized in terms of mutually independent theory nuisance parameters (TNPs). The TNPs are true parameters of the calculation, i.e., they have a well-defined true value that is not or only imprecisely known. This approach affords the theory uncertainty all benefits of a truly parametric uncertainty: It provides correct correlations and allows for consistent error propagation and combination. Furthermore, the TNPs can be profiled in fits, allowing the data to reduce the theory uncertainties. On the theory side, it allows maximally exploiting all available higher-order information to reduce the theory uncertainty, such as partial higher-order results or any nontrivial knowledge of the higher-order or all-order structure.

We first discuss the method in general as it can be applied across the board of perturbative calculations. As a concrete application, we then discuss the resummed transverse momentum (q_T) spectrum in Drell-Yan production, and how TNP-based uncertainties can correctly capture the correlations across the q_T spectrum and between Z and W production. This application is the basis of the theory model enabling the recent precise measurement of the W-boson mass by the CMS experiment. In a forthcoming paper, we use it to study the theory uncertainties in extracting the strong coupling constant α_s from the Z q_T spectrum.

Simulating toponium formation signals at the LHC

Benjamin Fuks[1,a], Kaoru Hagiwara[2,b], Kai Ma[3,c], Ya-Juan Zheng[4,d]

Abstract We present a method to simulate toponium formation events at the LHC using the Green's function of non-relativistic QCD in the Coulomb gauge, which governs the momentum distribution of top quarks in the presence of the QCD potential. This Green's function can be employed to re-weight any matrix elements relevant for $t\bar{t}$ production and decay processes where a colour-singlet top–antitop pair is produced in the S-wave at threshold. As an example, we study the formation of η_t toponium states in the gluon fusion channel at the LHC, combining the re-weighted matrix elements with parton showering.

Algorithms for numerically stable scattering amplitudes

Enrico Bothmann,[1] John M. Campbell,[2] Stefan Höche,[2] and Max Knobbe[1]

The numerically stable evaluation of scattering matrix elements near the infrared limit of gauge theories is of great importance for the success of collider physics experiments. We present a novel algorithm that utilizes double precision arithmetic and reaches higher recision than a naive quadruple precision implementation at smaller computational cost. The method is based on physics-driven modifications to propagators, vertices, and external polarizations.

Resumming transverse observables for NNLO+PS matching in GENEVA

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We study the use of higher-order resummation for transverse observables to achieve NNLO+PS matching within the GENEVA framework. In particular, we embed q_T resummation for colour-singlet production at N^{3}LL obtained via soft-collinear effective theory and implemented in the library SCETLIB within GENEVA. We also study for the first time the use of the generalised N-jettiness variable in parton shower matching, and achieve the resummation of the one-jettiness defined with transverse measures up to NLL$'$ accuracy. As a case study, we use these resummed calculations to construct a GENEVA NNLO+PS generator for Higgs boson production in heavy-quark annihilation (with beauty or charm-quarks in the initial state). The use of transverse measures facilitates the matching to showers ordered in transverse momentum, and opens the door to possible future extensions of this approach to the production of colour singlets in association with final-state jets.

Spin Correlations in $t\bar{t}$ Production and Decay at the LHC in QCD Perturbation Theory.

ABSTRACT: In this work we consider the QCD predictions for spin correlations in $t\bar{t}$ production in hadronic collisions. In view of recent tensions between experimental data and theoretical calculations, it has been argued that one should include in the predictions also the effects of the production of the η_t, i.e. the pseudoscalar $t\bar{t}$ bound state, or alternatively the full effects of the non-relativistic dynamics of the $t\bar{t}$ pair near threshold. This implies the resummation of all corrections that scale like powers of α_s/v (where v is the velocity of the top quark in the $t\bar{t}$ rest frame) which are dominated by values of v of order α_s. In this work, we show that, since the observables that are usually considered for these studies are integrated cross sections up to a $t\bar{t}$ mass cut that is not small, it is possible to perform the calculation using perturbation theory, considering only the contributions that scale as the first few powers of α_s/v. We examine the implications of our approach by computing corrections to nominal Monte Carlo results for correlation-sensitive observables, and compare them with available data, showing that the tension with data is no longer present.

Concluding (or opening?) remarks

- This is our biased review of recent developments which can lead to possible collaborative projetcs: we encourage you to make more suggestions!

- Les Houches is always a good place to discuss:
  - **event format standard**: does it meet the requirements of more sophisticated showers
  - tuning strategies
  - (let me repeat) **uncertanties estimate** (not just NLOPS/SMC…)
  - **wishlists** (LHC, but also **FCC-ee — tempatively scheduled on 21/06/2025**)