Measurement of the Lund jet plane using charged particles with the ATLAS detector from 13 TeV proton--proton collisions

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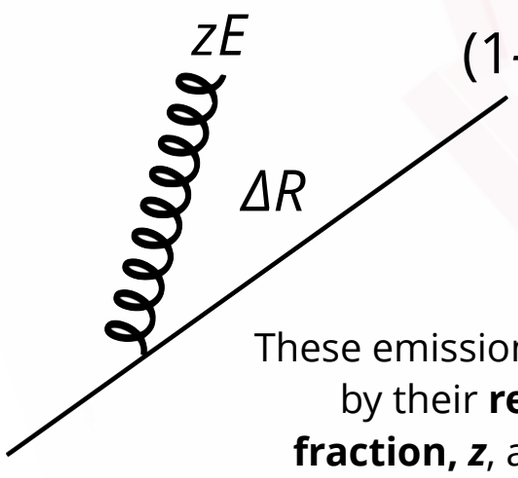
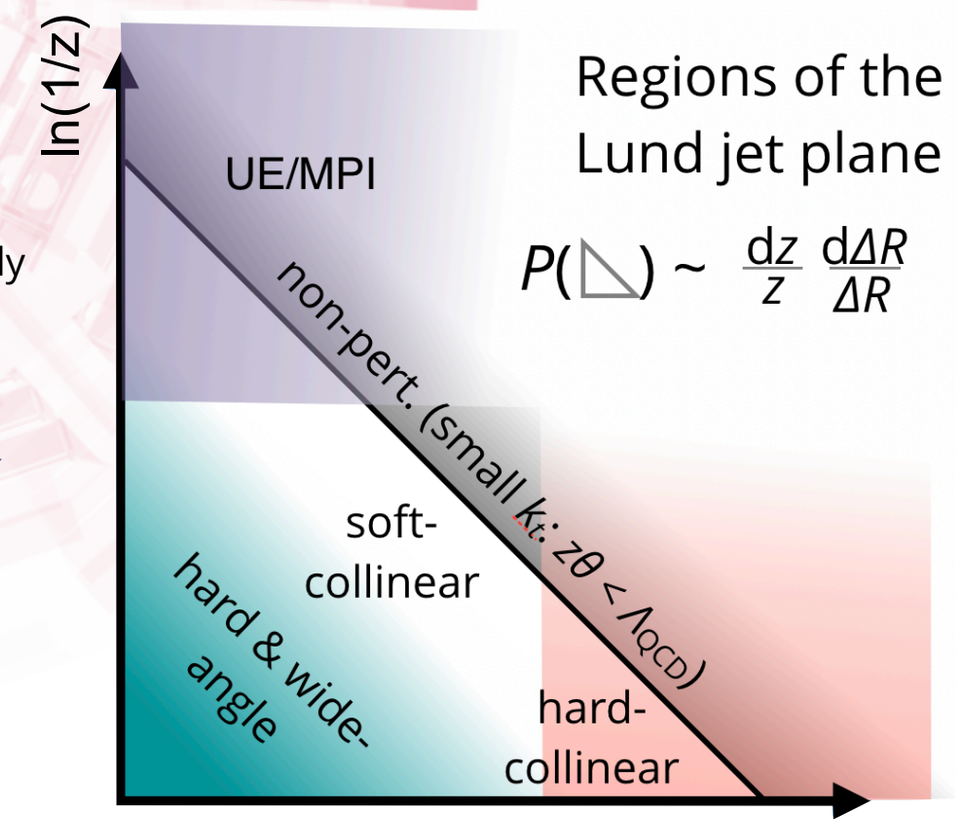
Introduction

A jet may be approximated as **soft emissions** around a **hard core** which represents the originating quark or gluon.



These emissions can be parameterised by their **relative momentum fraction, *z***, and **angle of emission relative to the jet core, *ΔR*.**

The Lund plane [1] is the phase space of these emissions: it naturally factorises perturbative and non-perturbative effects, UE/MPI, collinear splittings, *etc.*



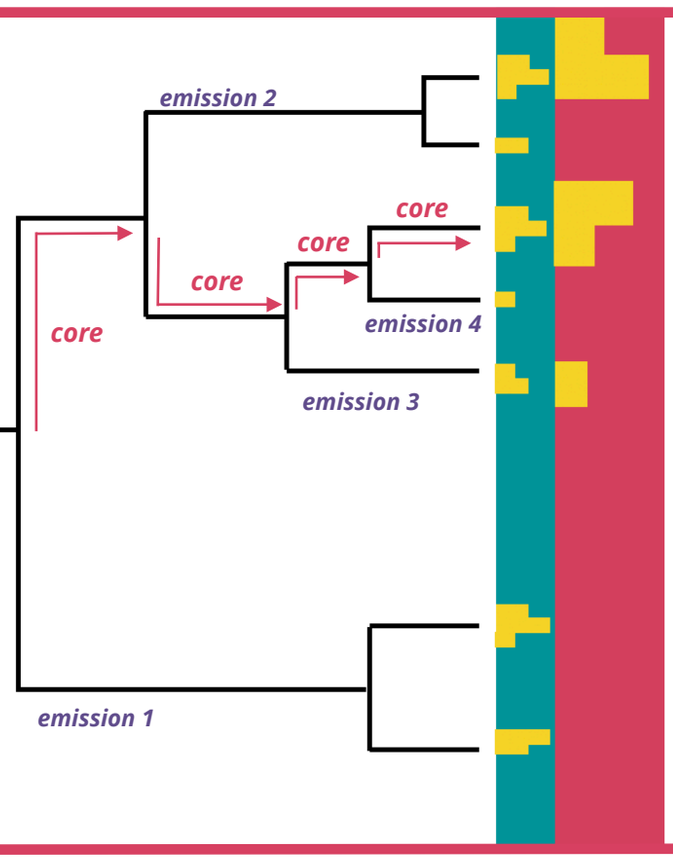
Measuring factorised observables like the Lund jet plane can inform our understanding of QCD and help improve future parton shower Monte Carlo simulations!

Reconstruction

Tracks associated to high-p_T R=0.4 jets are clustered using the **Cambridge/Aachen (C/A) algorithm** (angular-ordering).

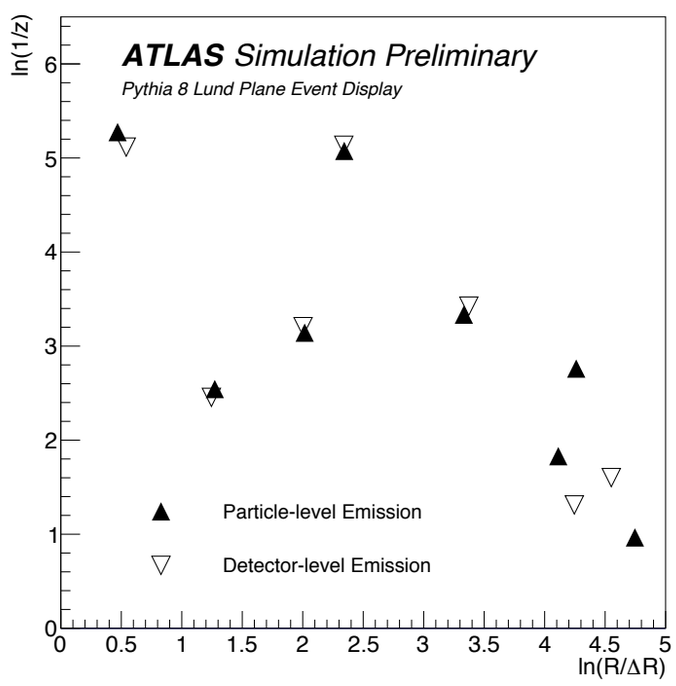
The **primary C/A clustering sequence** is used to approximate the Lund plane.

The **harder and softer proto-jets** at each step are proxies for the **emission and core [2]**.

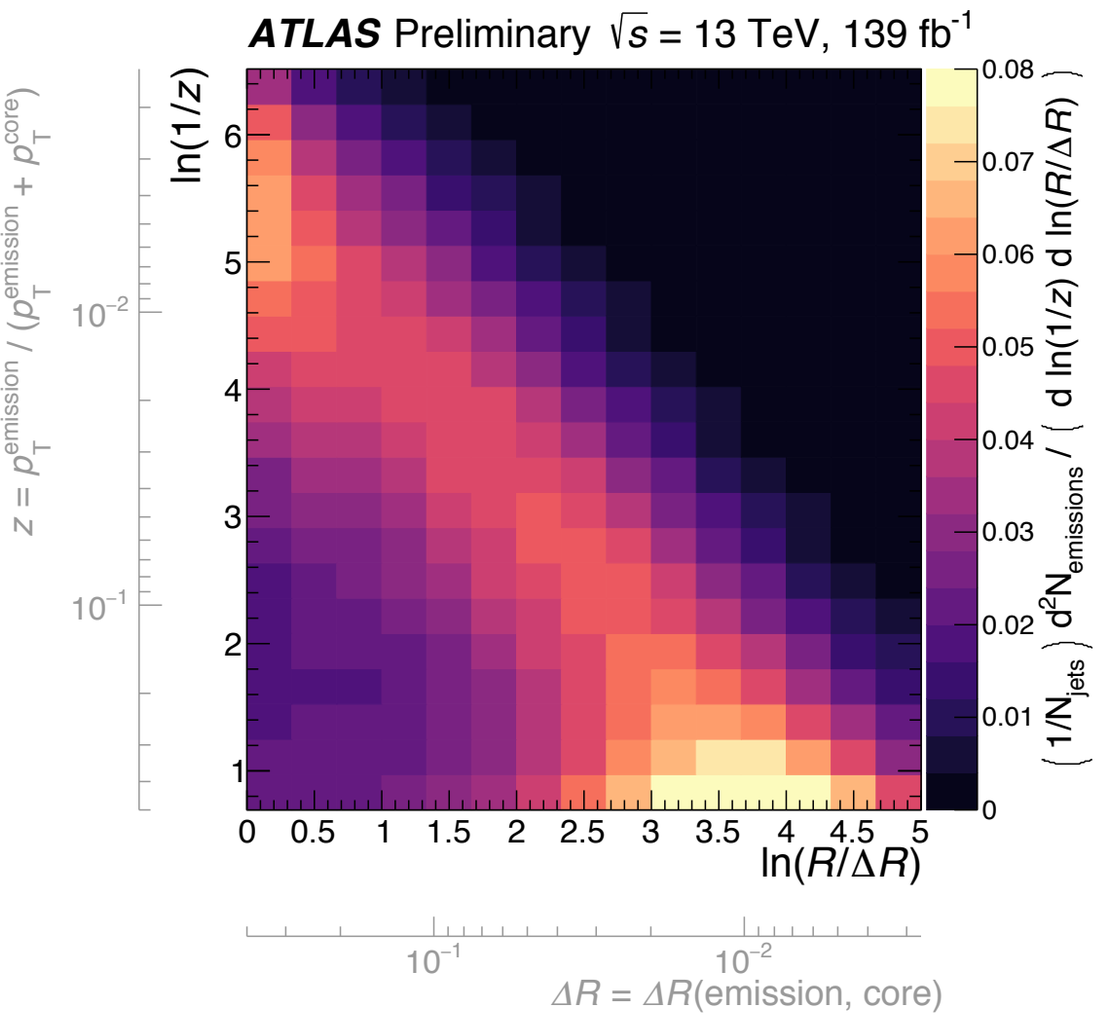


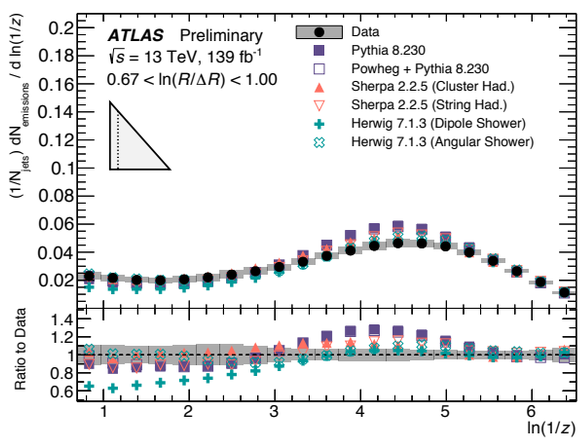
Emissions at detector- & truth-level are **geometrically matched** when constructing the response matrix.

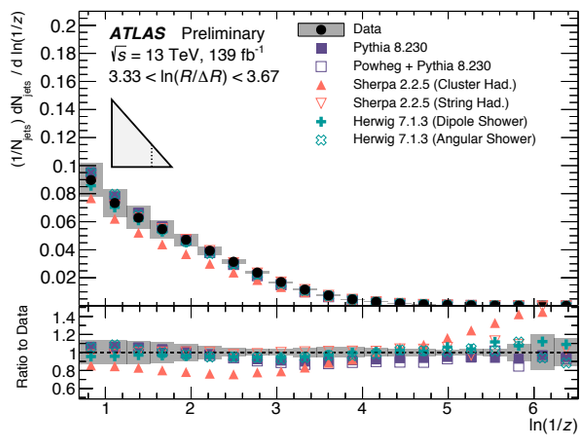
An **iterative Bayesian unfolding procedure** is applied to correct for acceptance and detector resolution effects, with **4 iterations.**



Unfolded Results







Various Monte Carlo simulations are compared to the unfolded data.

None are compatible across the entire 2D space. In particular:

- **Matrix element effects** do not have a large impact.
- **Hadronization effects** are large for **non-perturbative emissions**.
- **Parton shower effects** are large for **wide-angle emissions**.

Precision of ~10% or better is achieved throughout most of the Lund jet plane. The largest source of uncertainty is typically due to **Monte Carlo modelling effects** or the **jet energy scale**.

Over **115 million jets** are included in this measurement!

[1] Andersson *et al.* Z. Phys. C - Particles and Fields (1989) 43: 625.
[2] Dreyer, Salam & Soyez, J. High Energ. Phys. (2018) 2018: 64.

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