The first look at the Inclusive charged-particle jet spectrum in pp collisions in Run 3 at 13.6 TeV with ALICE

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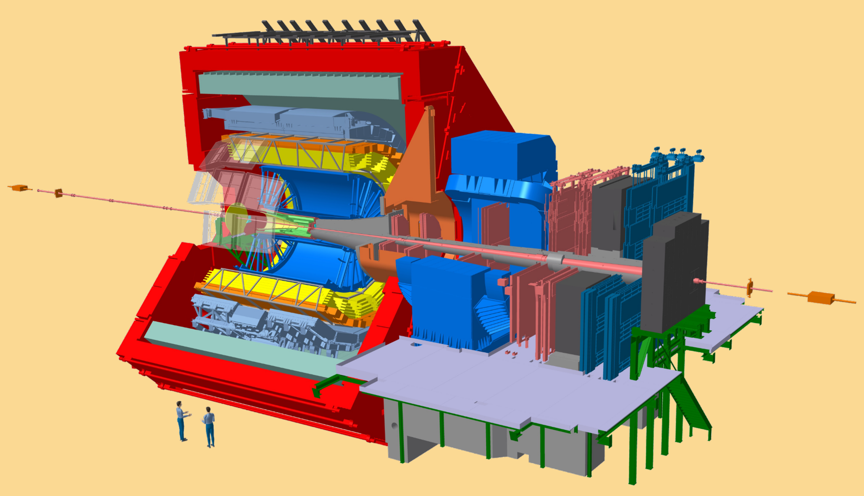
Motivation

- **Jets**: collimated bunches of particles from initial hard-scattered partons.
- **High p_T (Q^2)**: critical for testing **pQCD models**.
- **Jet modification**: searches in small systems
- **QGP properties (AA collisions)**: probe via **jet quenching**.
- **ALICE Run 3 validation**:
  first charged jet spectrum analysis using **new detectors** and **framework**.

ALICE upgrades

with significantly increased statistics



ITS 2
- Fully ALPIDE silicon-pixel-based

TPC
- Continuous readout based on GEM stacks

Framework (O^2)
- Table-base

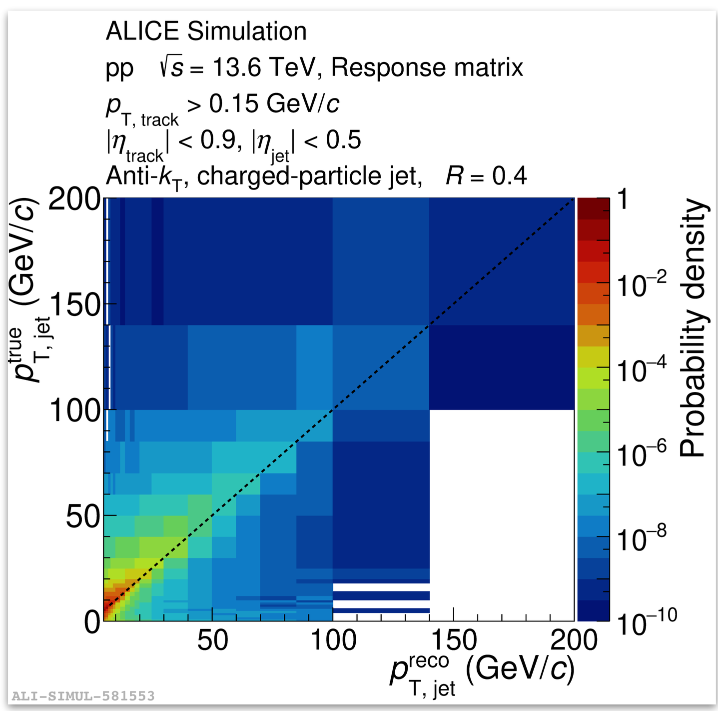
Analysis Setup

Datasets

- **Data**
  small fraction of the data collected in **2022**, kept as a **minimum bias** sample **2.24B** events (**2.21B** in the full **Run 2** sample)
- **MC**
  PYTHIA8 + GEANT 4

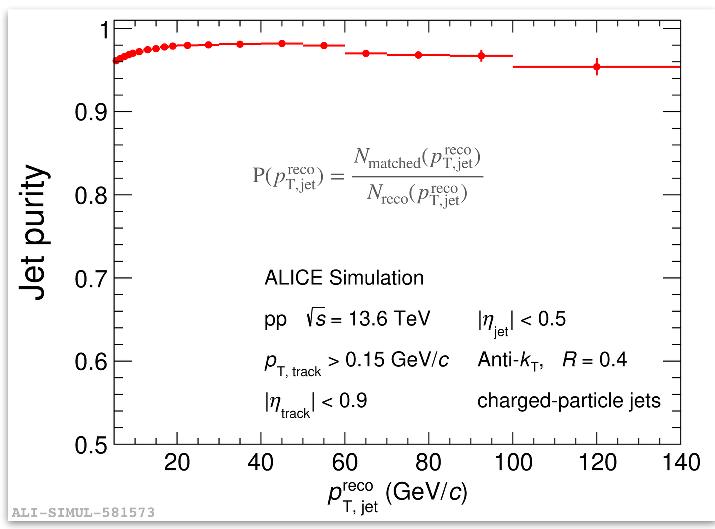
Selections

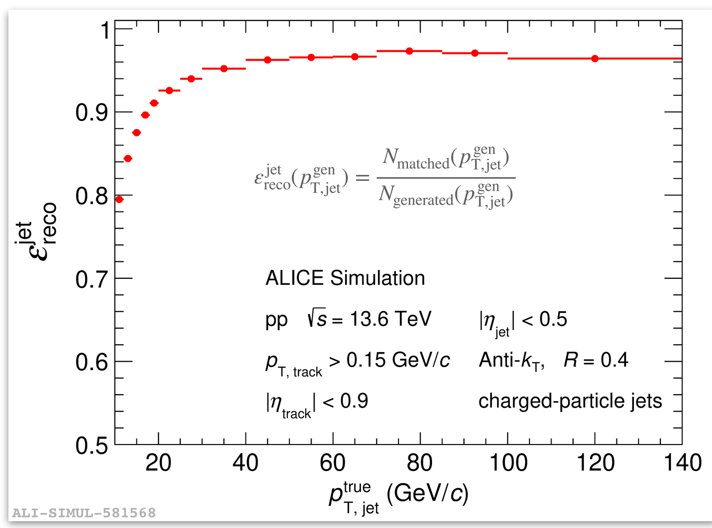
- **Events**
  MB selections & $|z_{vtx}| \leq 10\,\mathrm{cm}$
- **Tracks**
  $150\,\mathrm{MeV}/c \leq p_T < 100\,\mathrm{GeV}/c$
  $|\eta| \leq 0.9$
  $|DCA_z| \leq 2\,\mathrm{cm}$
- **Jets**
  Anti-k_T, $R = 0.4$
  $|\eta_{jet}| \leq 0.9 - R$
  $10\,\mathrm{GeV} \leq p^{rec}_{T,jet} \leq 140\,\mathrm{GeV}$

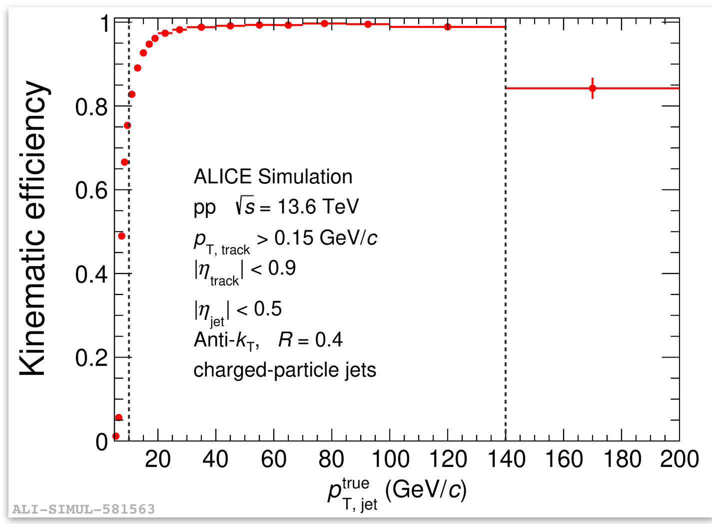


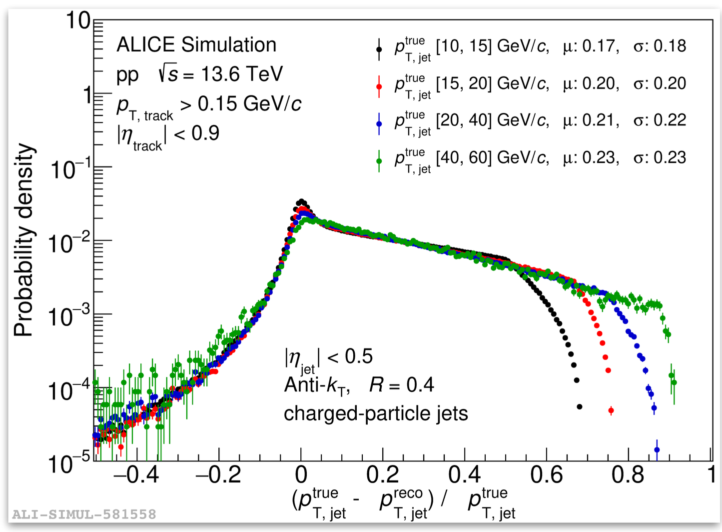
Detector response & Corrections

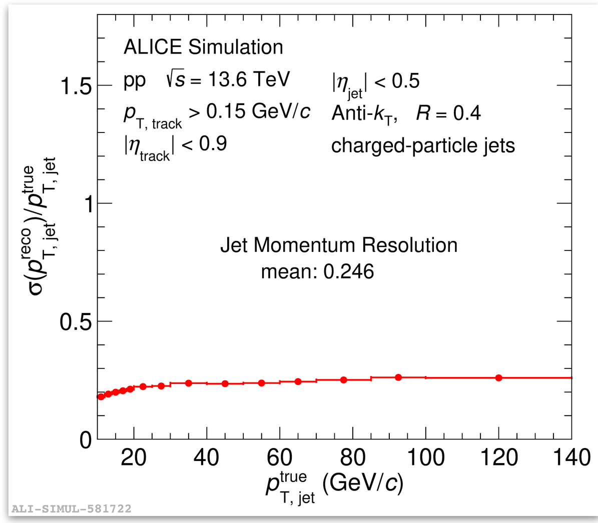
- The measured jet momentum is impacted by instrumental effects like momentum resolution and jet efficiencies. The response matrix includes corrections for the jet efficiency and purity. The jet spectrum was corrected using a Bayesian unfolding procedure to obtain the truth-level spectrum.





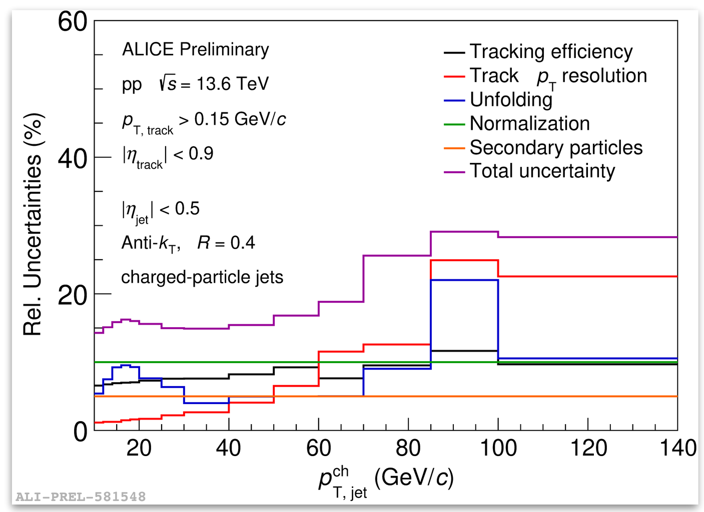






Systematic errors

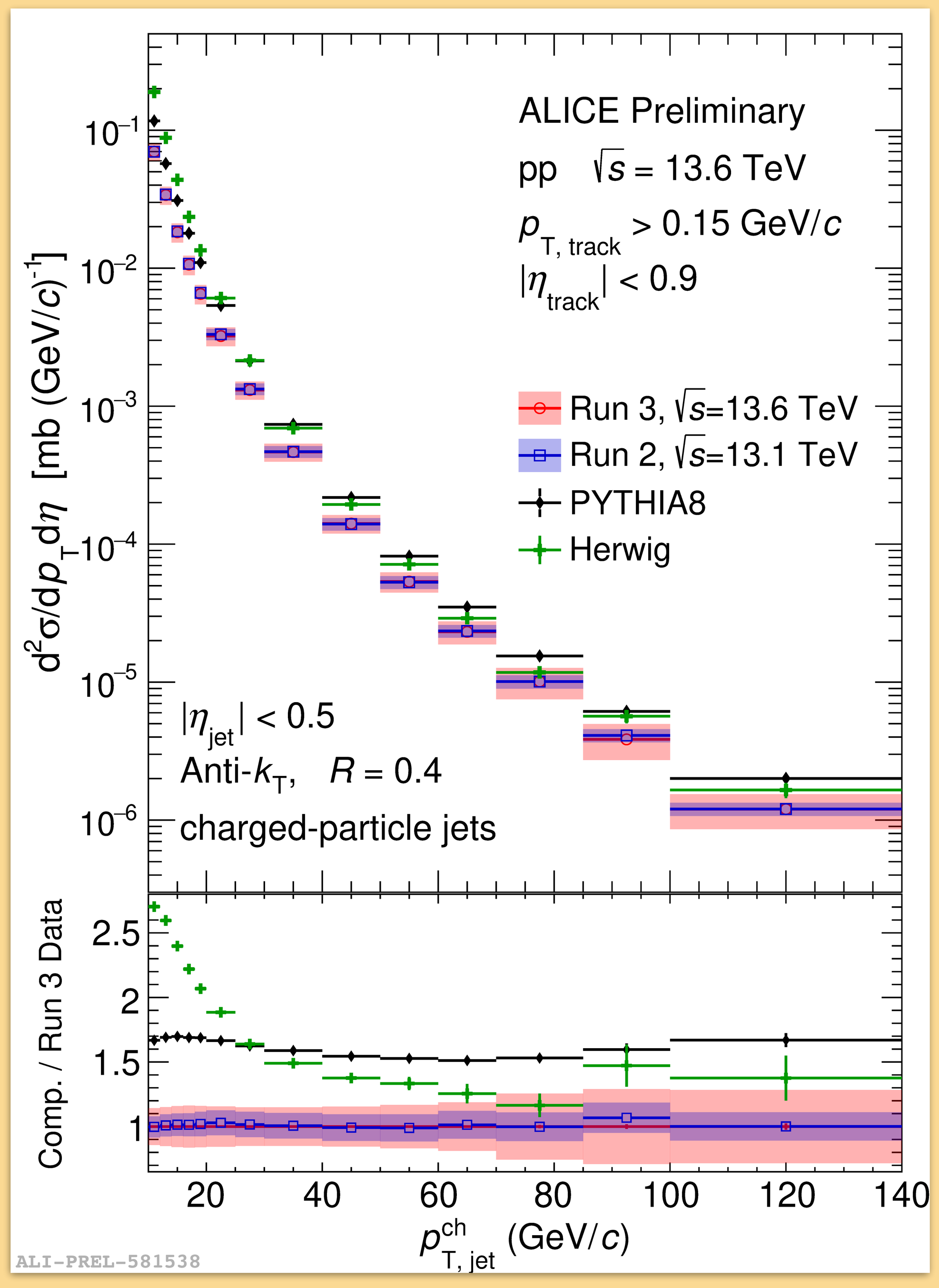
- The sources that affect the jet measurement



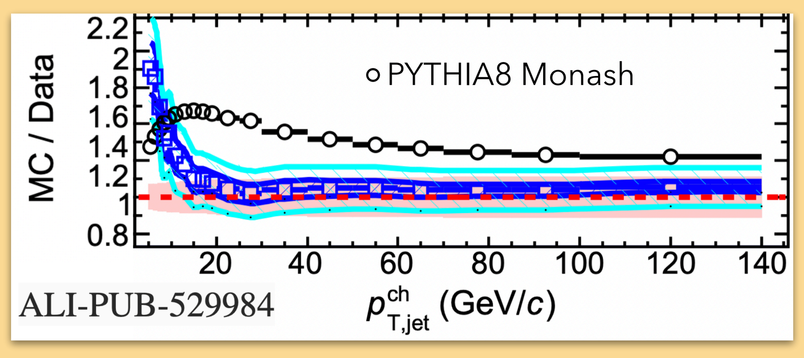
Models

- **PYTHIA 8:** features a **leading-logarithmic, k_T-ordered** parton shower model using **Lund string model** for hadronisation, where partons hadronise through string fragmentation.
- **HERWIG:** utilises the **cluster hadronization model**, where color-singlet clusters decay into hadrons. It implements an **angular-ordered** parton shower, offering a different treatment of parton showering compared to PYTHIA.

Results



- **First jet cross section measurement from ALICE at 13.6 TeV**
- Consistent with measurement at 13 TeV within uncertainties.
- **Data-Model comparisons**:
  consistent trends as with Run 2.



- **Low $p_{T,jet}$ Overestimation** (10 ~ 20 GeV/c):
  Both **Herwig** and **Pythia8** overestimate data, with Herwig showing a larger discrepancy.
- **Mid $p_{T,jet}$ Accuracy** (40 ~ 80 GeV/c):
  Herwig performs better in this region.
- **High $p_{T,jet}$ Rising Trend** (80 ~ 140 GeV/c):
  A rising trend for both models.
- Without underlying event correction.

Summary & Outlook

- **Charged-jet cross section (pp, 13.6 TeV)**:
  First jet measurement in ALICE at 13.6 TeV, consistent with ALICE measurement at 13 TeV.
- **Data-model agreement**:
  Ratio of models to data show same behaviour as at 13 TeV.
- **Prospects**:
  Further statistics from 2023 and 2024 will enable finer binning and higher $p_{T,jet}$ for advanced studies.

Next Steps

- **Background subtraction / Reducing systematics**:
  Van Der Meer scans will reduce the error on the luminosity which is currently significant.
- **Multiplicity dependence**:
  Study jet quenching in extremely high multiplicity pp events, e.g. 0.1% highest multiplicity

References

"Multiplicity dependence of charged-particle jet production in pp collisions at s = 13 TeV", Eur. Phys. J. C (2022) 82:514
"Measurement of the radius dependence of charged-particle jet suppression in Pb–Pb collisions at √sNN = 5.02 TeV", Phys. Lett. B 849 (2024) 138412
"Measurement of the inclusive differential jet cross section in pp collisions at √s = 2.76 TeV", Phys. Lett. B 722 (2013) 262-272

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