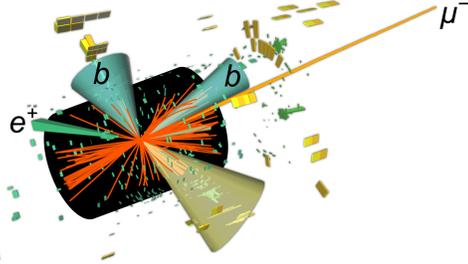


1 Introduction



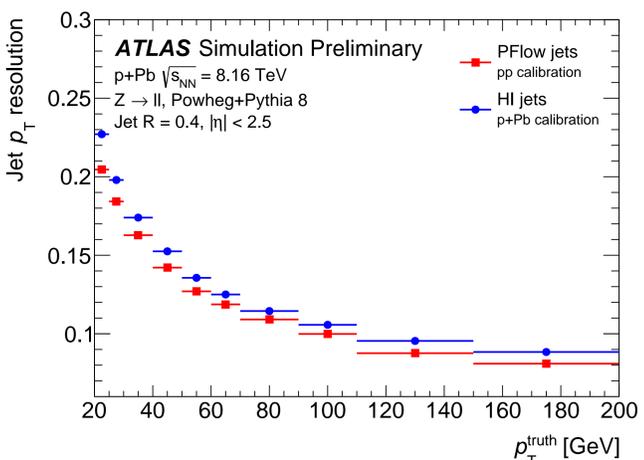
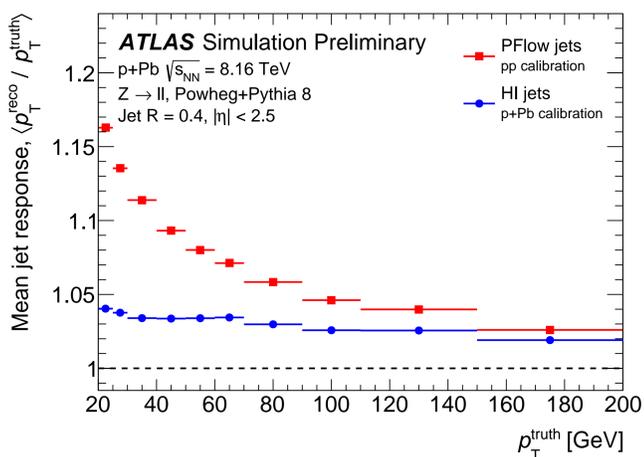
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- The studies are a key input to the ongoing $t\bar{t}$ analysis in p+Pb collisions, which uses two types of jets: particle flow jets for b -tagging and heavy ion jets for kinematics.
- Jet performance in the ATLAS detector is evaluated using two alternative methods: **truth** and **Z-jet balance**.
- The **particle flow (PFlow) jets** combine measurements from the inner detector and the calorimeter, and use high-pileup pp calibration [1].
- The **heavy ion (HI) jets** include the underlying event subtraction and use a dedicated p+Pb calibration.
- The analysis uses p+Pb data collected at $\sqrt{s_{NN}} = 8.16$ TeV in 2016 with an integrated luminosity of 165 nb^{-1} and Powheg+Pythia 8 Monte Carlo samples with data overlay.

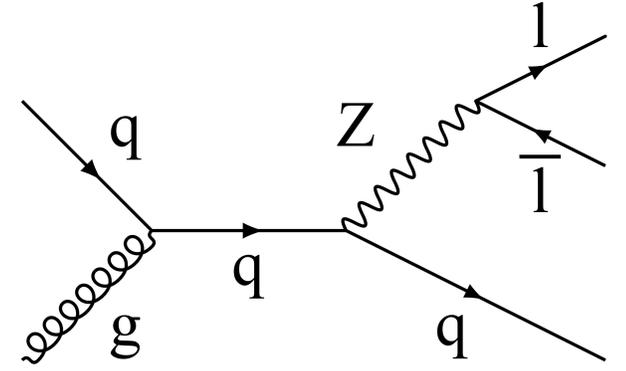
2 Truth method

- The **truth method** compares reconstructed jets with corresponding truth jets from Monte Carlo simulation.
- Reconstructed jets are **geometrically matched** to truth jets by imposing a criterion on the distance, $\Delta R < 0.4$.
- The **mean jet response** is derived as the mean of a Gaussian function fitted to the jet p_T response $p_T^{\text{reco}}/p_T^{\text{truth}}$.
- The **jet p_T resolution** is evaluated as the ratio of the standard deviation over the mean of the same Gaussian fit.
- The mean jet response above unity comes from a **quark-dominated composition** of $Z \rightarrow \ell\ell$ events and additionally from the **underlying event** for PFlow jets.



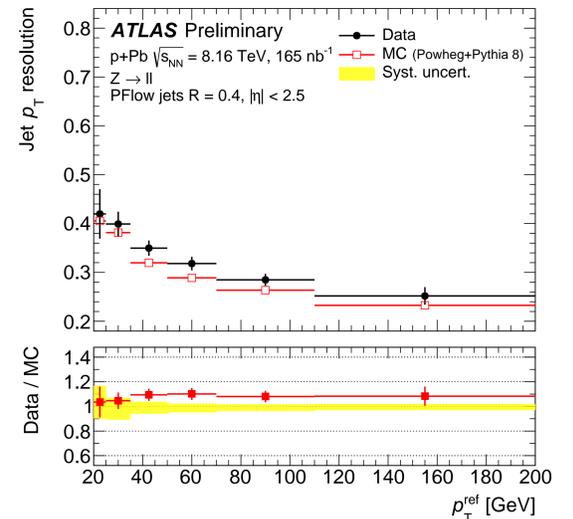
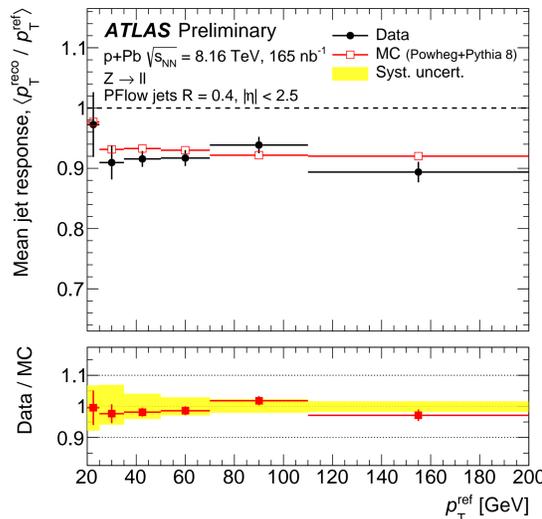
3 Z-jet balance method

- The jet p_T scale and resolution can also be evaluated using the **Z-jet momentum balance**.
- The algorithm uses jets recoiling against a Z boson, which decay to electron or muon pairs.
- $|\Delta\phi(Z, \text{jet})| > 2.8$ cut is imposed to ensure the **back-to-back emission** of the Z boson and the jet.
- The same method can be applied to both data and Monte Carlo simulation.
- The **reference transverse momentum** p_T^{ref} is the projection of the Z boson transverse momentum p_T^Z along the jet axis, given by the formula $p_T^{\text{ref}} = p_T^Z |\cos \Delta\phi(Z, \text{jet})|$.



3.1 Z-jet balance: PFlow jets

- The PFlow jets are used for b -tagging in the ongoing $t\bar{t}$ analysis in p+Pb collisions.
- Relatively high jet p_T scale originates from the **underlying event**, which is present in p+Pb collisions.
- Jet p_T resolution is found to be better for the PFlow jets compared to the HI jets.



3.2 Z-jet balance: HI jets

- The HI jets are used for kinematics in the ongoing $t\bar{t}$ analysis in p+Pb collisions.
- Lower mean jet response is observed due to the **underlying event subtraction**.
- Worse jet p_T resolution compared to the truth method comes from **intrinsic broadening** due to physics of $Z \rightarrow \ell\ell$ decays.

