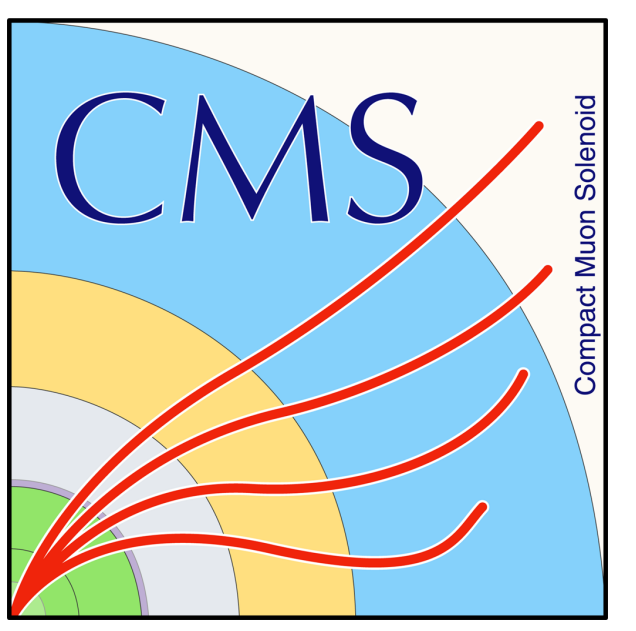




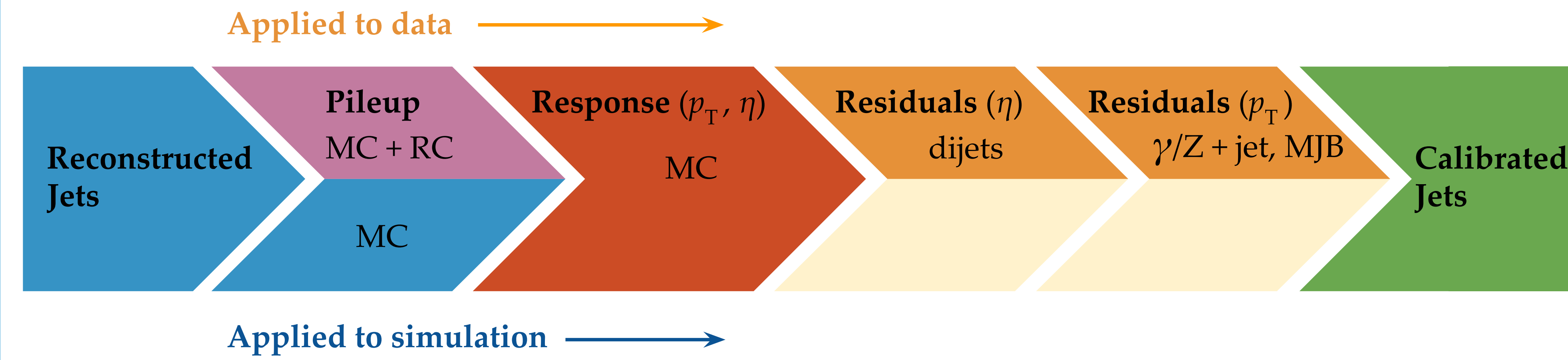
# Jet Energy Scale and Resolution Measurements with Legacy Run 2 CMS Data

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ON BEHALF OF THE CMS COLLABORATION



## INTRODUCTION

Reconstructed jets are corrected up to the level of jets clustered from stable ( $c\tau > 1\text{cm}$ ) and visible (excluding weakly interacting neutral particles) final state particles, referred to as particle (ptcl) jets.



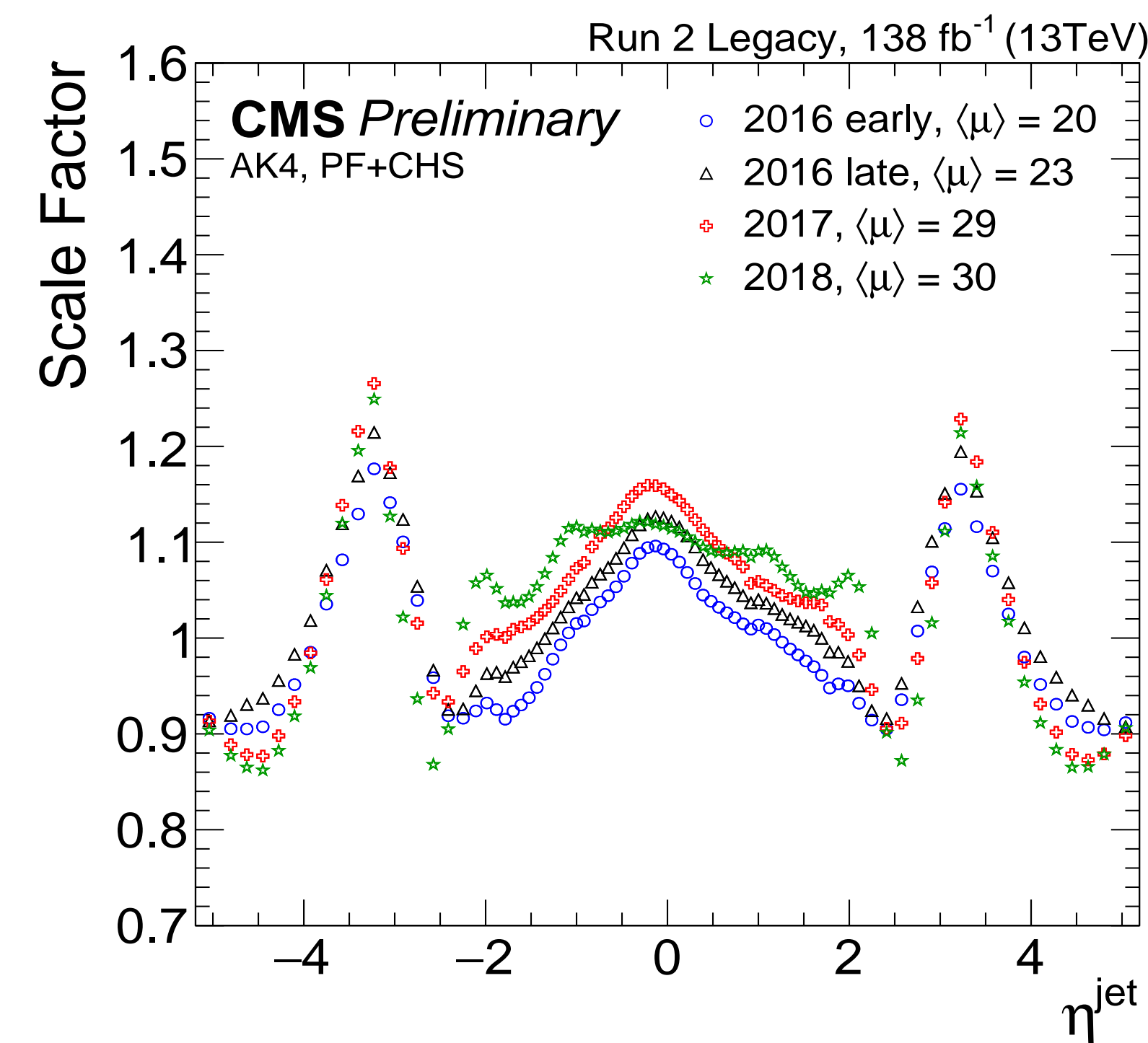
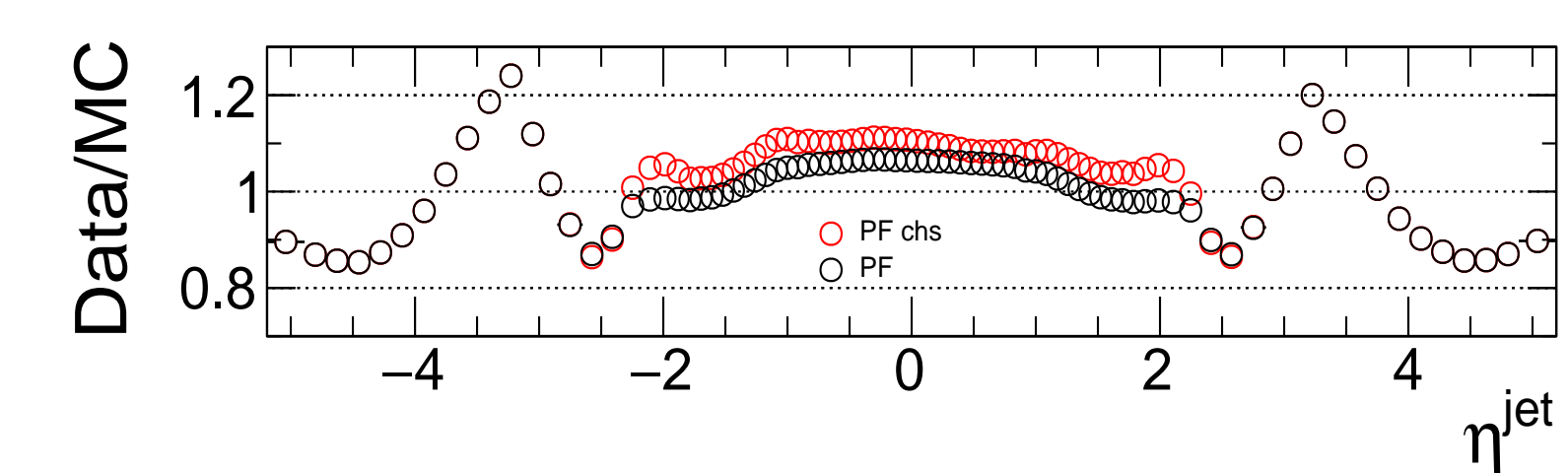
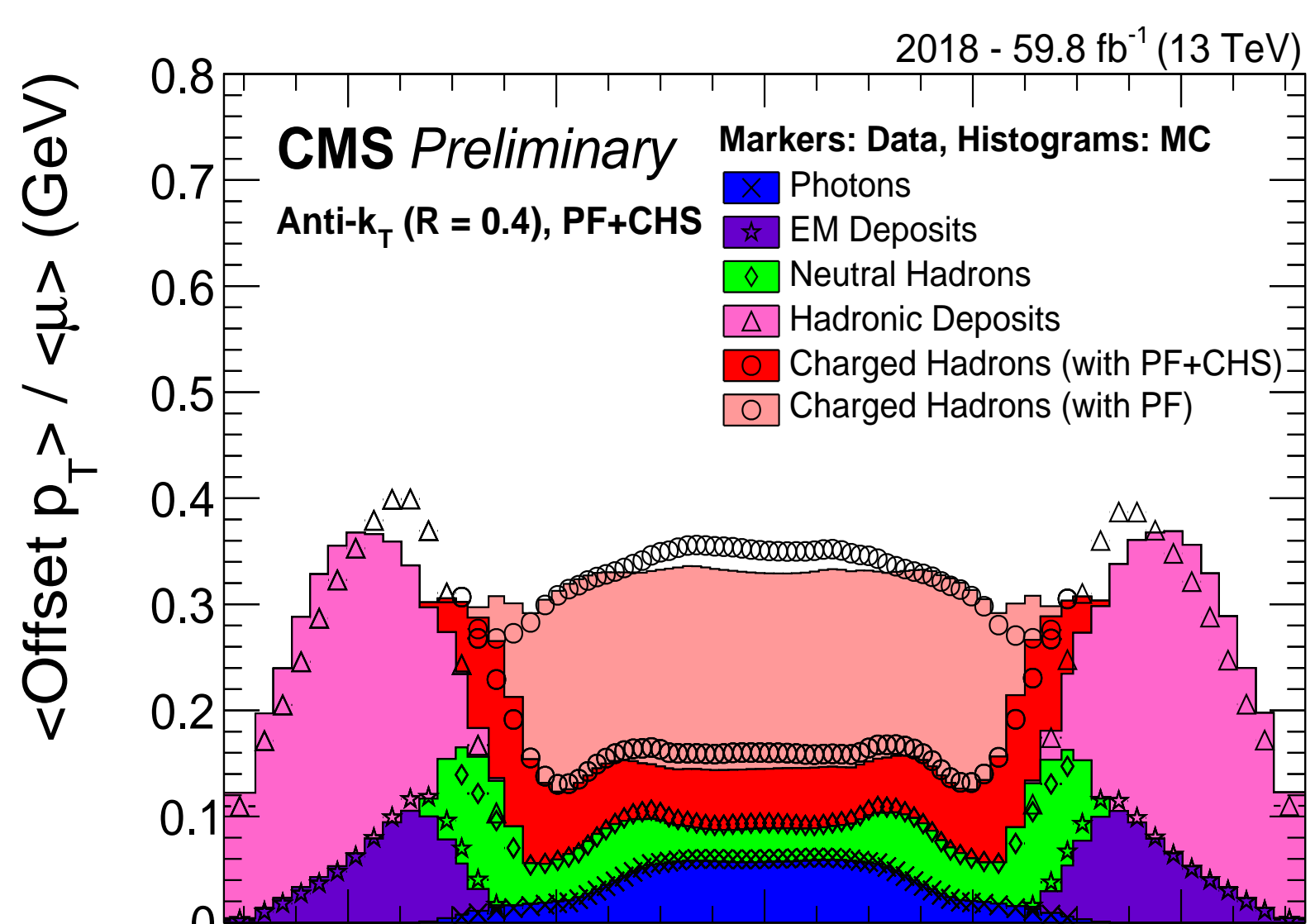
The jets are calibrated sequentially with:

- pileup offset subtraction
- detector response correction from simulation
- residual corrections for differences between data and detector simulation
- optional corrections for jet flavour composition

## PILEUP OFFSET SUBTRACTION

Additional pp interactions in the same and neighbouring bunch crossings produce event pileup. This leads to unwanted energy offset in reconstructed jets. Pileup offset in simulation is calculated by taking the average difference in between matched jets in simulated samples with and without pileup overlay.

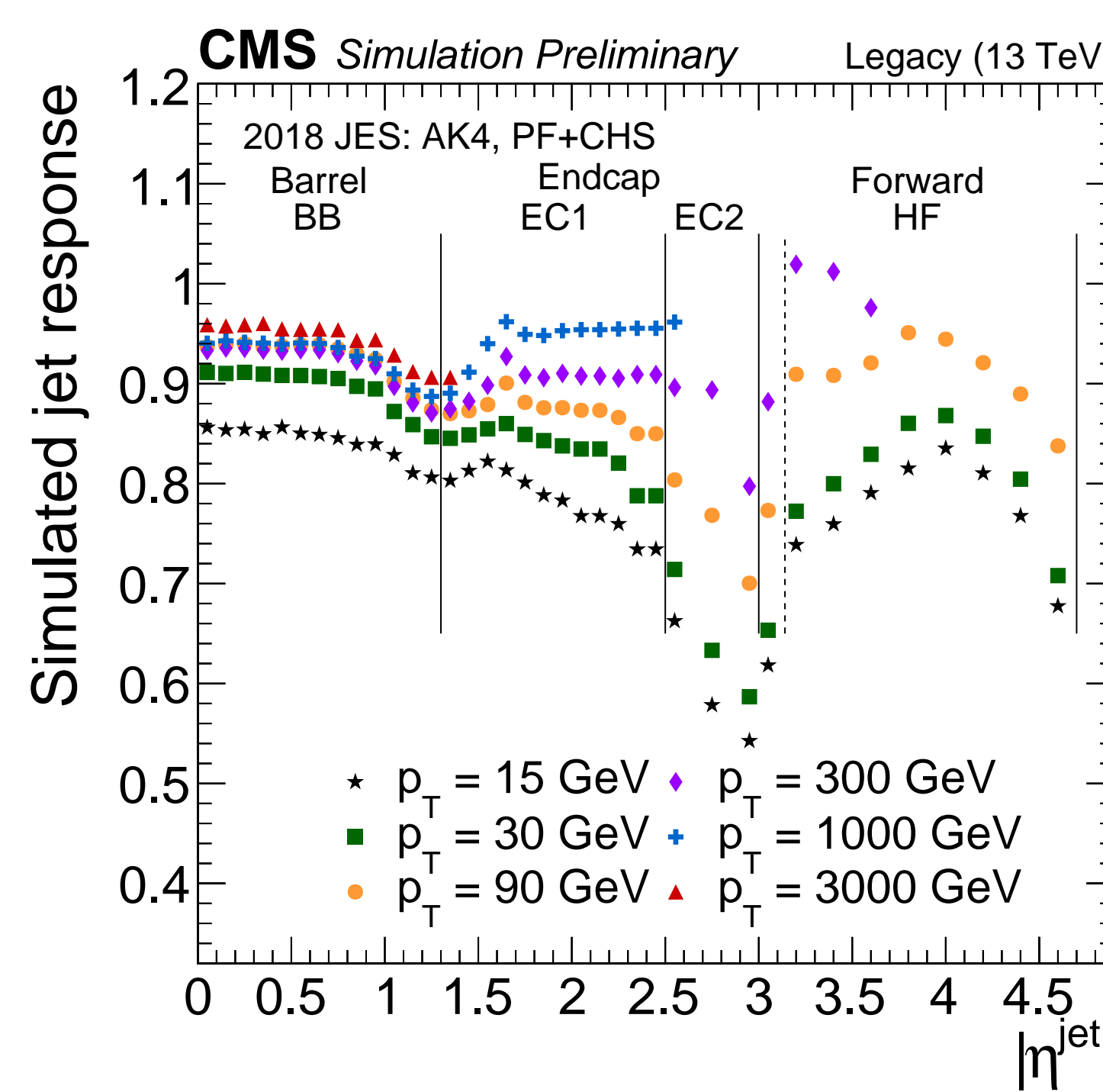
Offset residual corrections (RC) are derived with Random Cone method applied to ZeroBias data vs. NeutrinoGun simulation.



**Figure 1:** Average offset per pileup interaction, calculated for each type of PF candidates (top). Data/MC scale factors for pileup offset over the years (bottom).

## RESPONSE CORRECTION

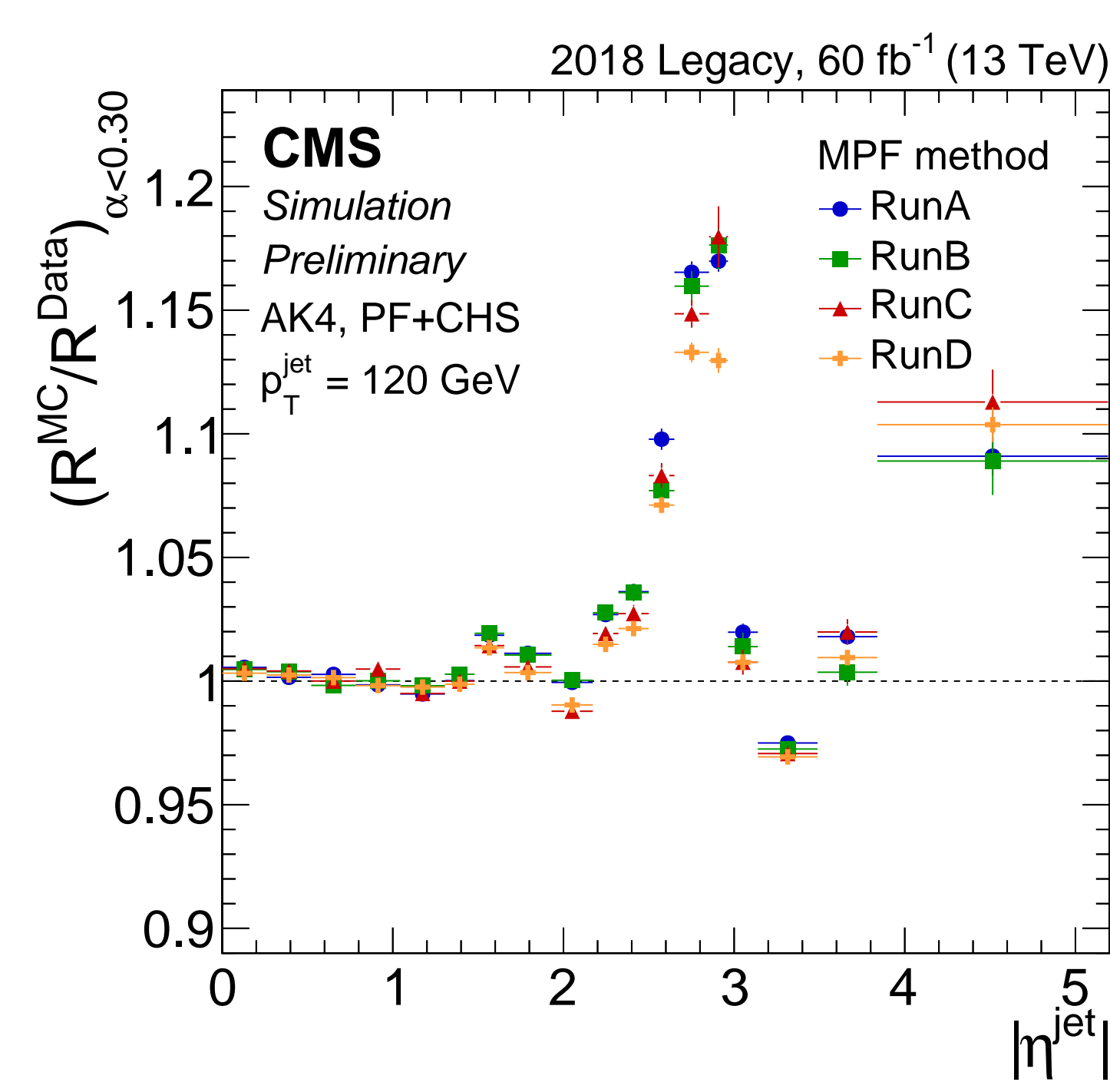
Monte Carlo truth jet energy response is defined as  $R = \frac{\langle p_T^{\text{reco}} \rangle}{\langle p_T^{\text{ptcl}} \rangle}$ . R is derived in bins of  $p_T^{\text{jet}}$  and  $\eta^{\text{jet}}$ .



**Figure 2:** Simulated jet response as a function of  $\eta^{\text{jet}}$  for various values of  $p_T^{\text{jet}}$ .

## eta-DEP. RESIDUAL CORRECTION

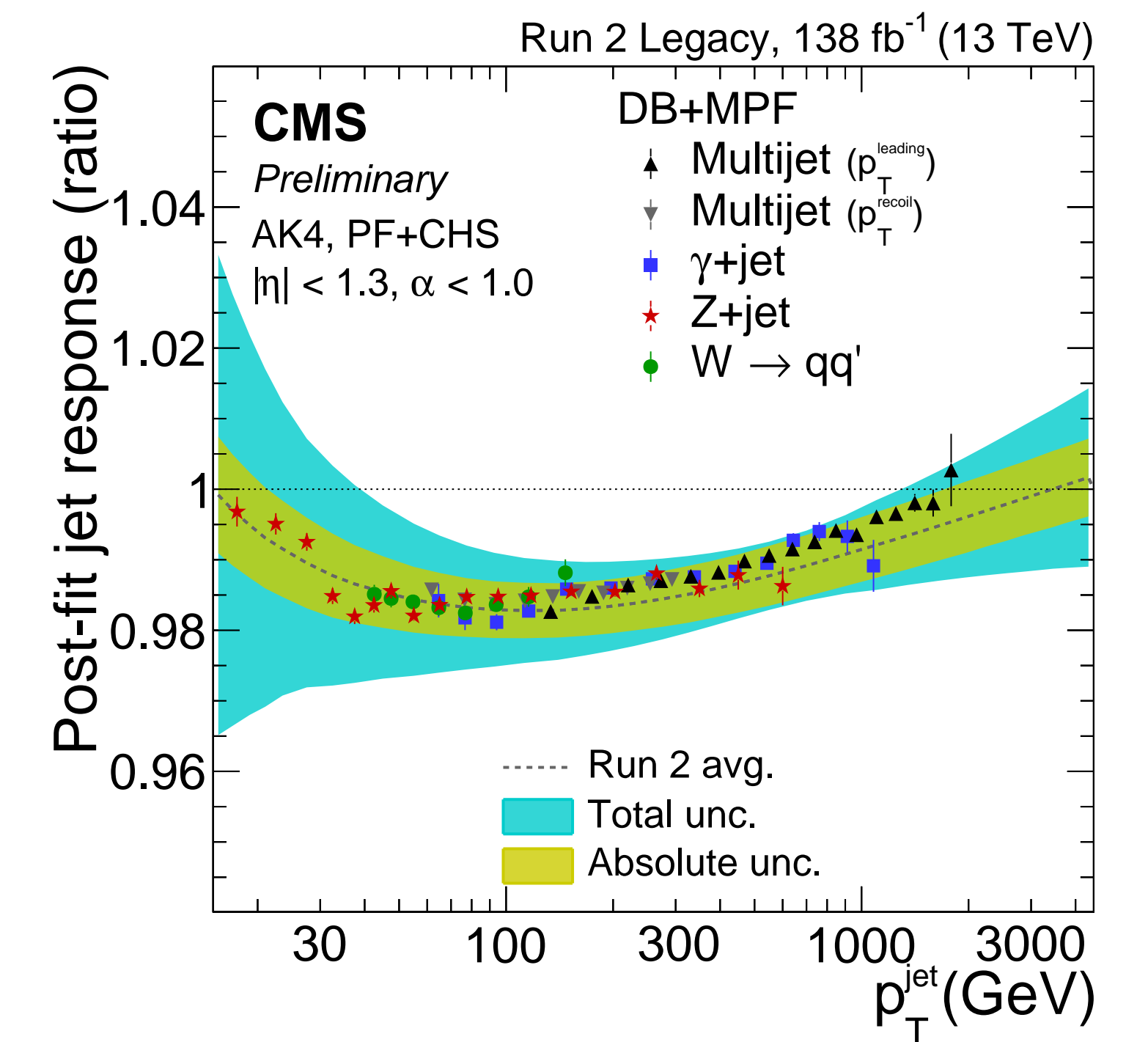
Residual correction of jet response normalised to the response in the barrel derived in bins of  $\eta^{\text{jet}}$  and  $p_T^{\text{jet}}$  using dijet events in data and simulation.



**Figure 3:** Relative  $\eta$ -dependent residual correction over different data-taking periods in year 2018.

## pT-DEP. RESIDUAL CORRECTION

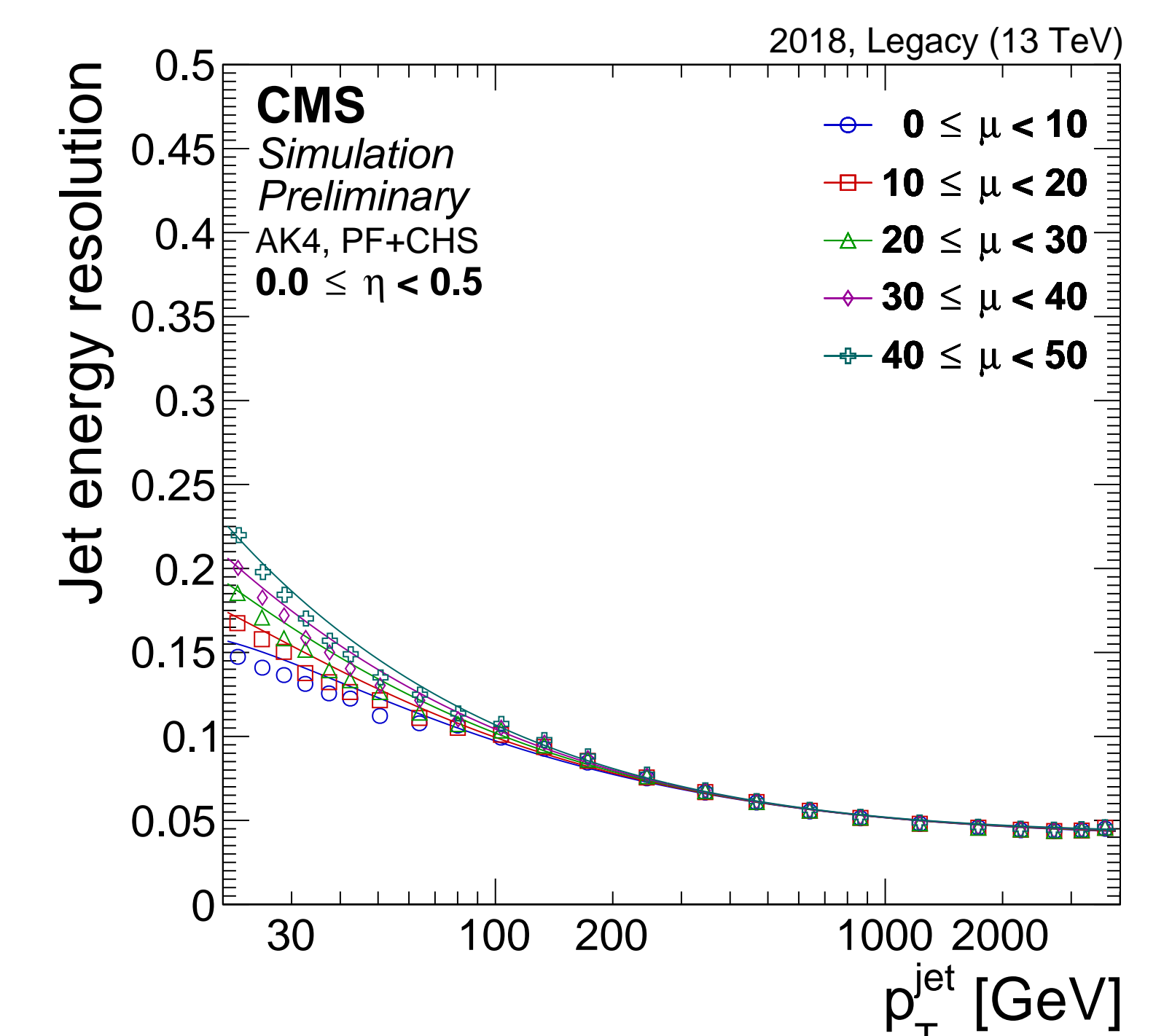
Data-to-simulation comparison for the jet response dependence on  $p_T^{\text{jet}}$ .



**Figure 4:** Yellow band indicates absolute scale uncertainty that is centred around the luminosity-weighted average response per year.

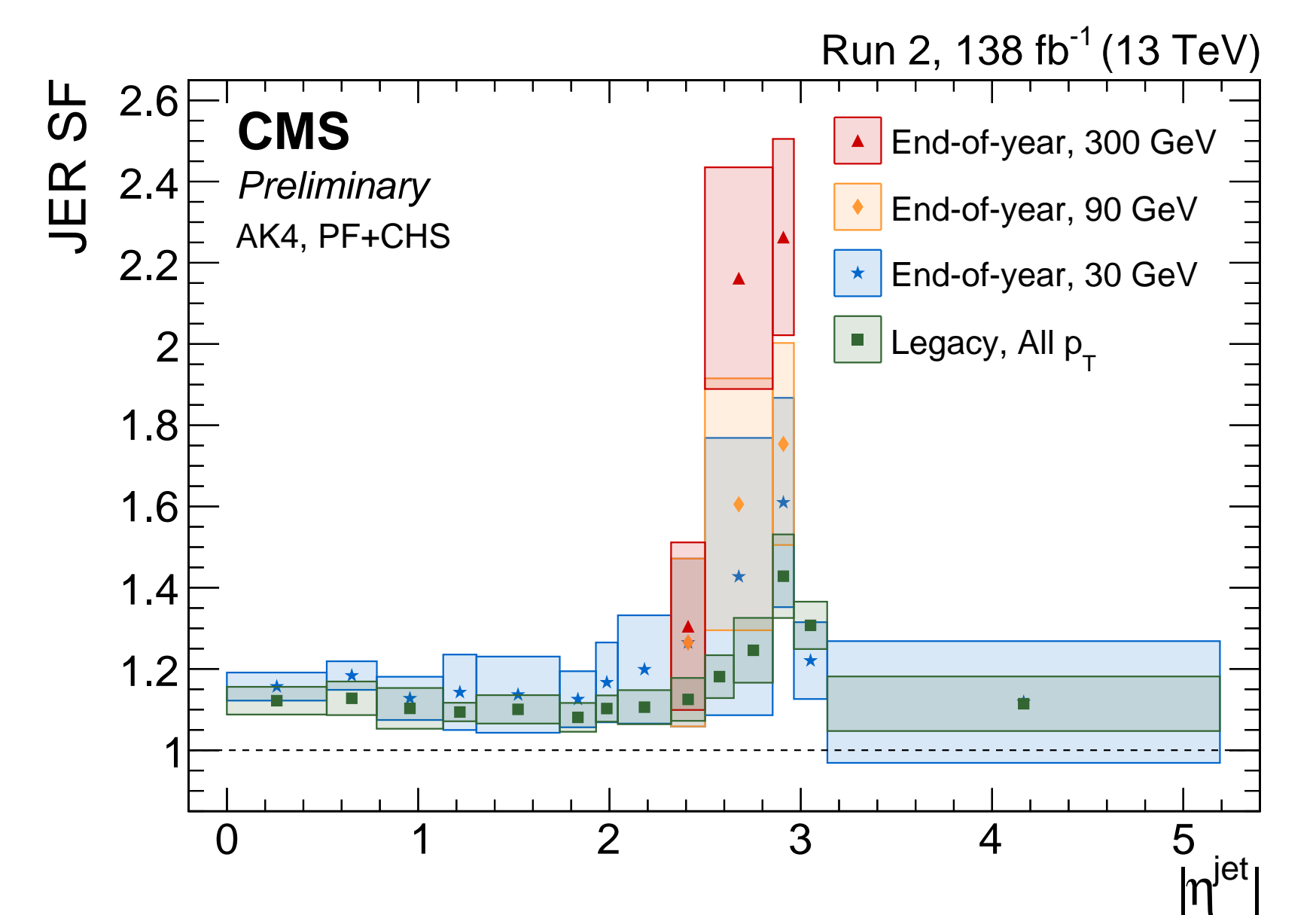
Post-fit values for nuisance parameters (scales of reference objects) used to demonstrate the consistency between the data sets.

## JER AND SCALE FACTORS



**Figure 5:** Monte Carlo truth JER as a function of  $p_T^{\text{jet}}$  for barrel region.

JER Scale factors are derived applying  $p_T$ -balance method to dijet events in data and simulated samples for JES-corrected jets.



**Figure 6:** Luminosity-weighted average of the JER SF per year with total uncertainty shown with colored bands.

## REFERENCES

- [1] Jet Energy Scale and Resolution Measurements with Legacy Run 2 Data Collected by CMS at 13 TeV, Nov 2021.
- [2] V. Khachatryan, A.M. Sirunyan, A. Tumasyan, W. Adam, E. Asilar, T. Bergauer, J. Brandstetter, E. Brondolin, M. Dragicevic, J. Erö, and et al. Jet energy scale and resolution in the cms experiment in pp collisions at 8 tev. *Journal of Instrumentation*, 12(02):P02014–P02014, Feb 2017.