Jet Residual Correction with 2017 Dijet Data at CMS

FSP CMS workshop 2018

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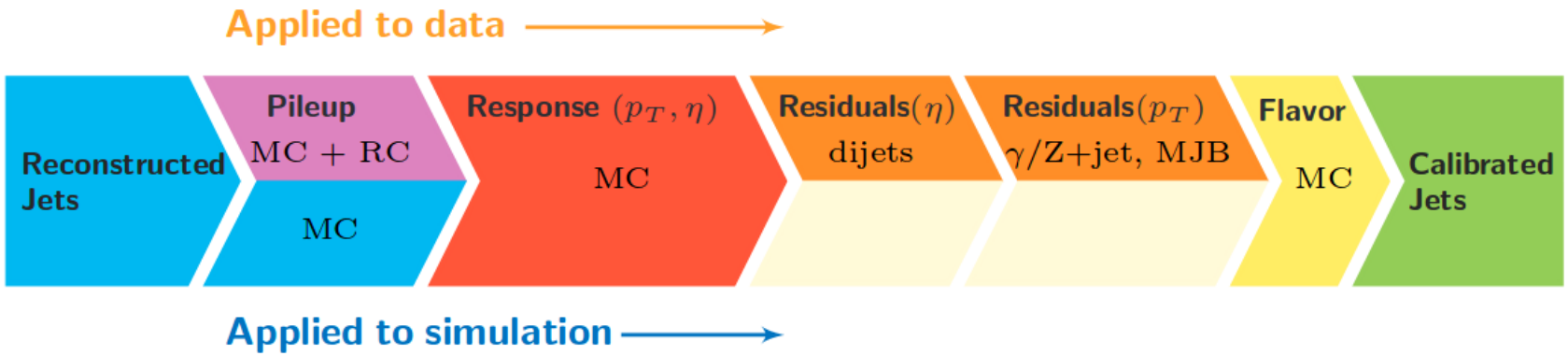
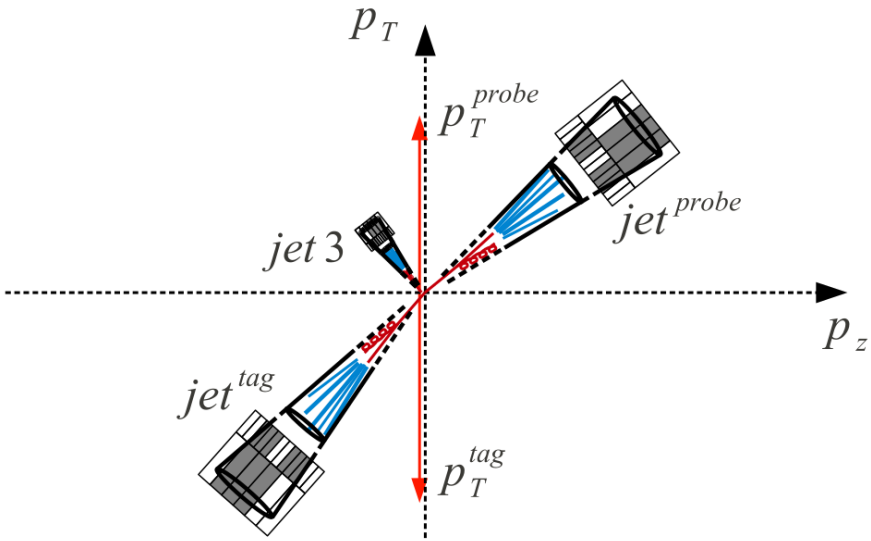
Relative Residual Correction



- Ideal dijet jets are balanced
- Barrel ($|\eta| < 1.3$) jet as reference
- Calibrate probe jet ($|\eta| < 5.2$)
- Dijet events are rare, $n_{jet} > 2$ events are considered to improve statistic



Input and Selection

Data

RunII 2017 41 fb^{-1}

Simulation

QCD MC `pythia8`

Selection:

- Lepton veto
- At least two particle flow jets with charged hadron substruction, clustered with anti-kt with R=0.4 (AK4CHS)
- $|\eta_{tag}| < 1.3$
- Filter pre-fired events (details later)

Response Definition

p_T-balance response

- $A = \frac{p_T^{probe} - p_T^{tag}}{p_T^{probe} + p_T^{tag}}$
- $< A >$ is calculated in bins of $|\eta_{probe}|$ and p_T^{ave}
- Relative response $R_{rel}^{p_T}(|\eta_{probe}|, p_T^{ave}) = \frac{1+<A>}{1-<A>}$

MET projection fraction (MPF) response

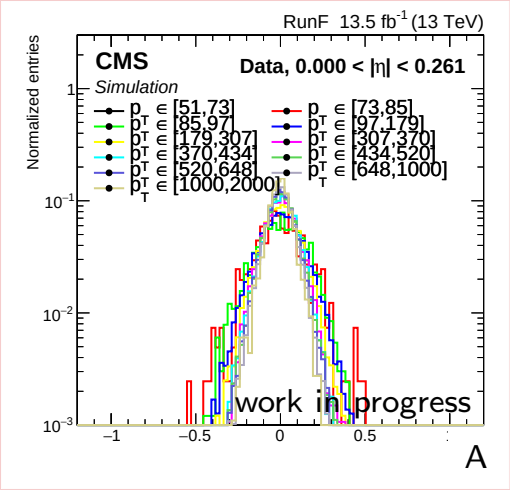
- $B = \frac{\vec{\not{E}}_T \cdot \vec{p_T^{tag}} / p_T^{tag}}{p_T^{probe} + p_T^{tag}}$
- $< B >$ is calculated in bins of $|\eta_{probe}|$ and p_T^{ave}
- Relative response $R_{rel}^{p_T}(|\eta_{probe}|, p_T^{ave}) = \frac{1+<B>}{1-<B>}$

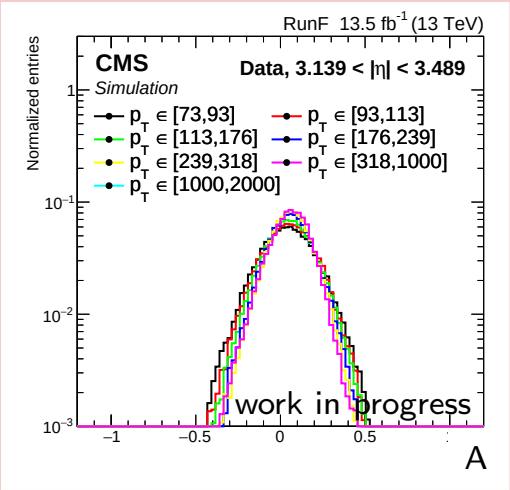
$$p_T^{ave} = \frac{p_T^{jet1} + p_T^{jet2}}{2}$$

Asymmetry and MPF

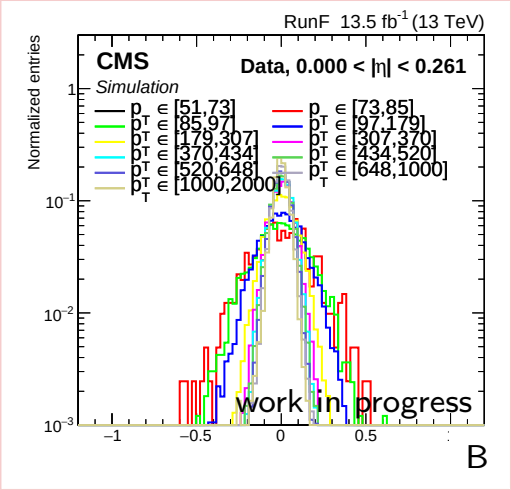
Following slides use an example part of the data

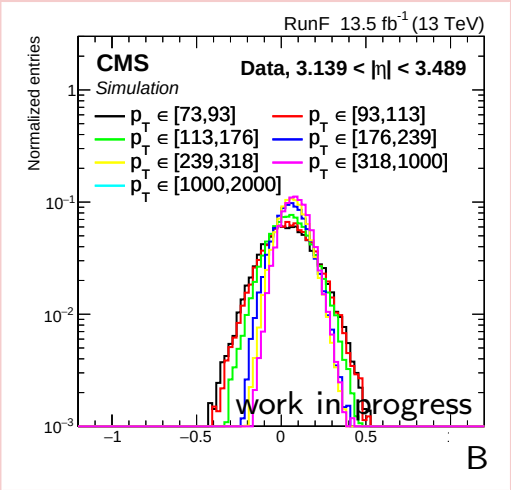
p_T-balance response





MPF response

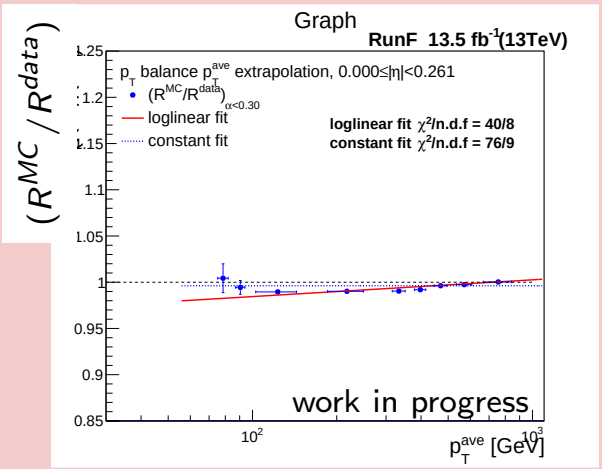


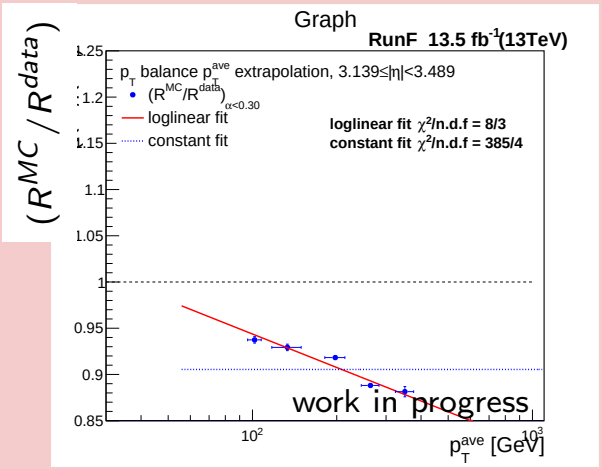


Relative Response at $\alpha < 0.3$

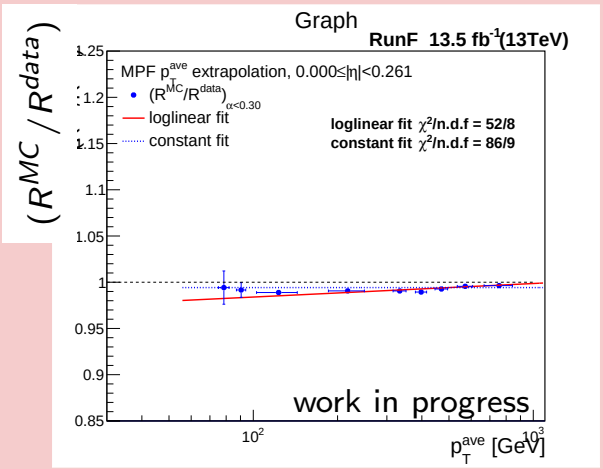
$\alpha = p_T^{jet3} / p_T^{ave}$

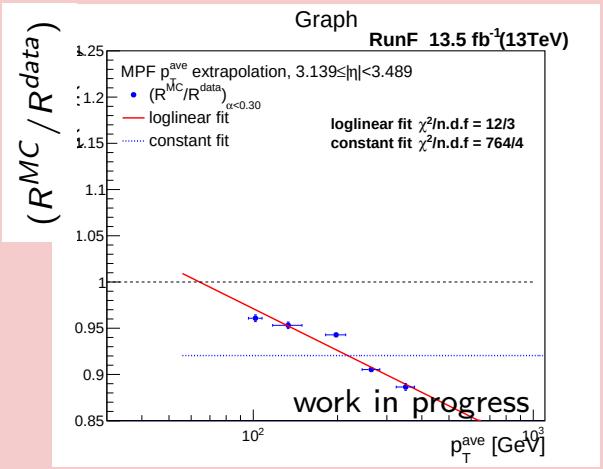
p_T-balance response





MPF response

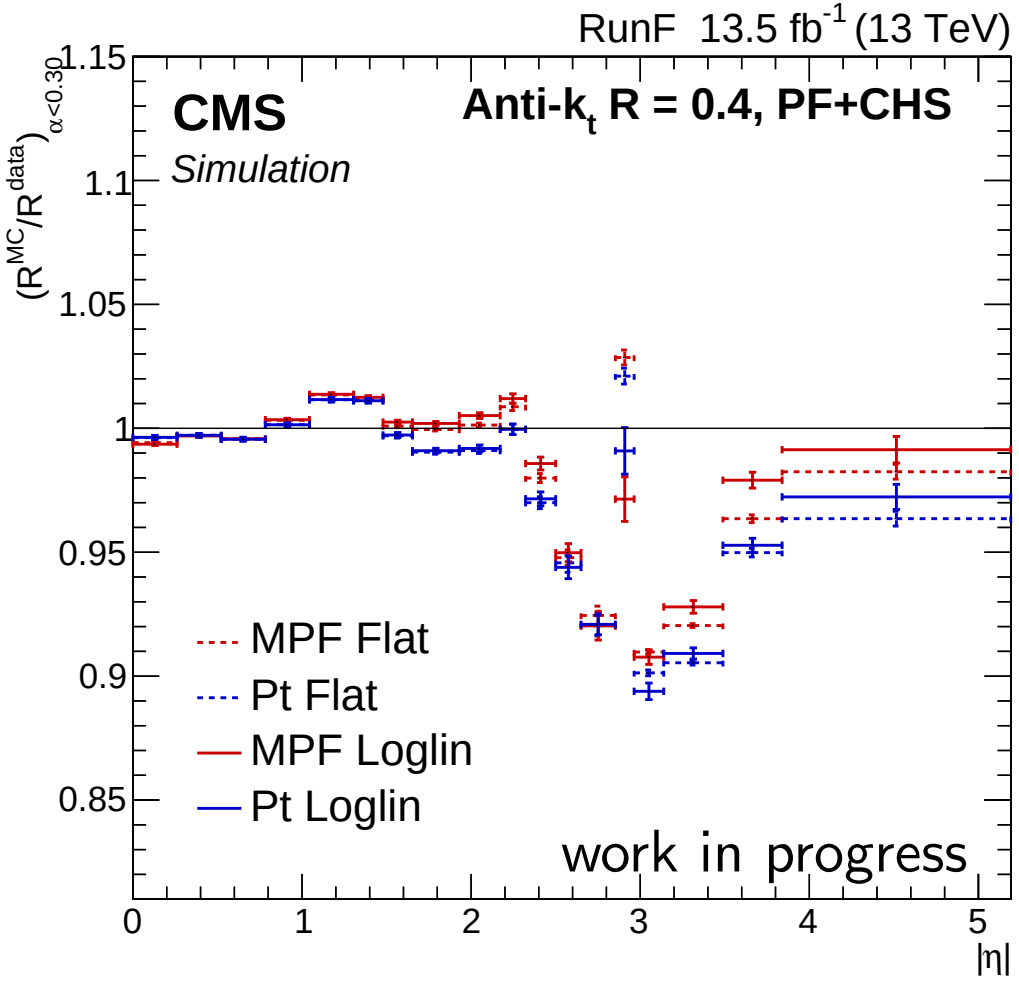




$(R^{MC}/R^{data})_{\alpha<0.3}$ per p_T^{ave} is fitted constant and loglinear

Ratio of Responses at $\alpha < 0.3$

Take loglinear function at $< p_T^{ave} >$



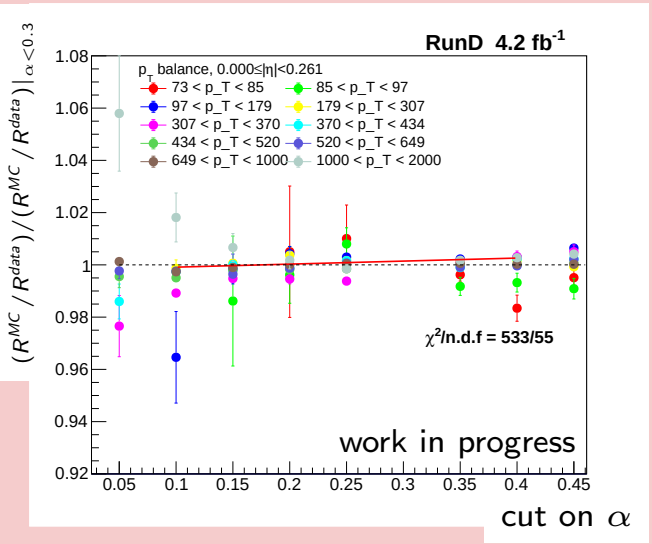
Difference between p_T-balance and MPF method is expected due to additional radiation

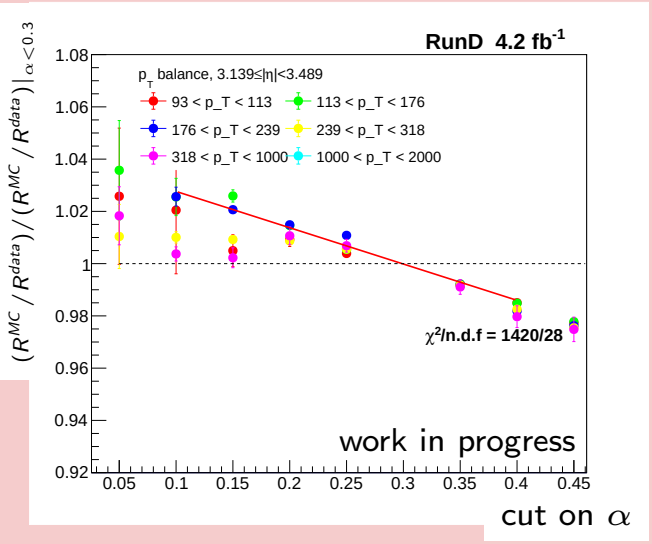
$$\mathcal{C}(|\eta_{probe}|) = \left\langle R^{MC}/R^{data} \right\rangle_{\alpha<0.3} \cdot k_{FSR}, \text{ with } k_{FSR} = \frac{\left\langle R^{MC}/R^{data} \right\rangle_{\alpha\to 0}}{\left\langle R^{MC}/R^{data} \right\rangle_{\alpha<0.3}}$$

$\alpha \to 0$ extrapolation

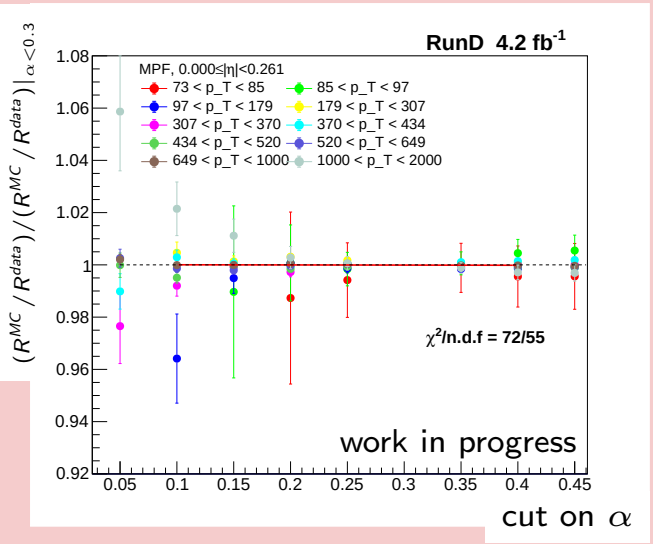
Fit $(R^{MC}/R^{data})/(R^{MC}/R^{data})|_{\alpha<0.3}$(cut on α)

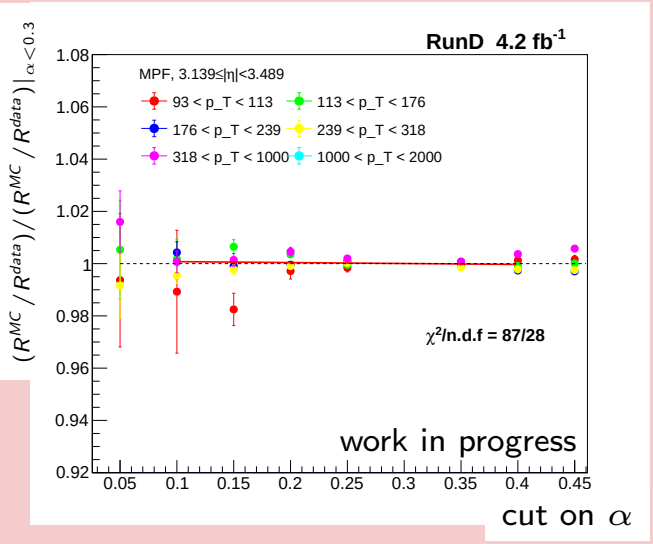
p_T-balance response



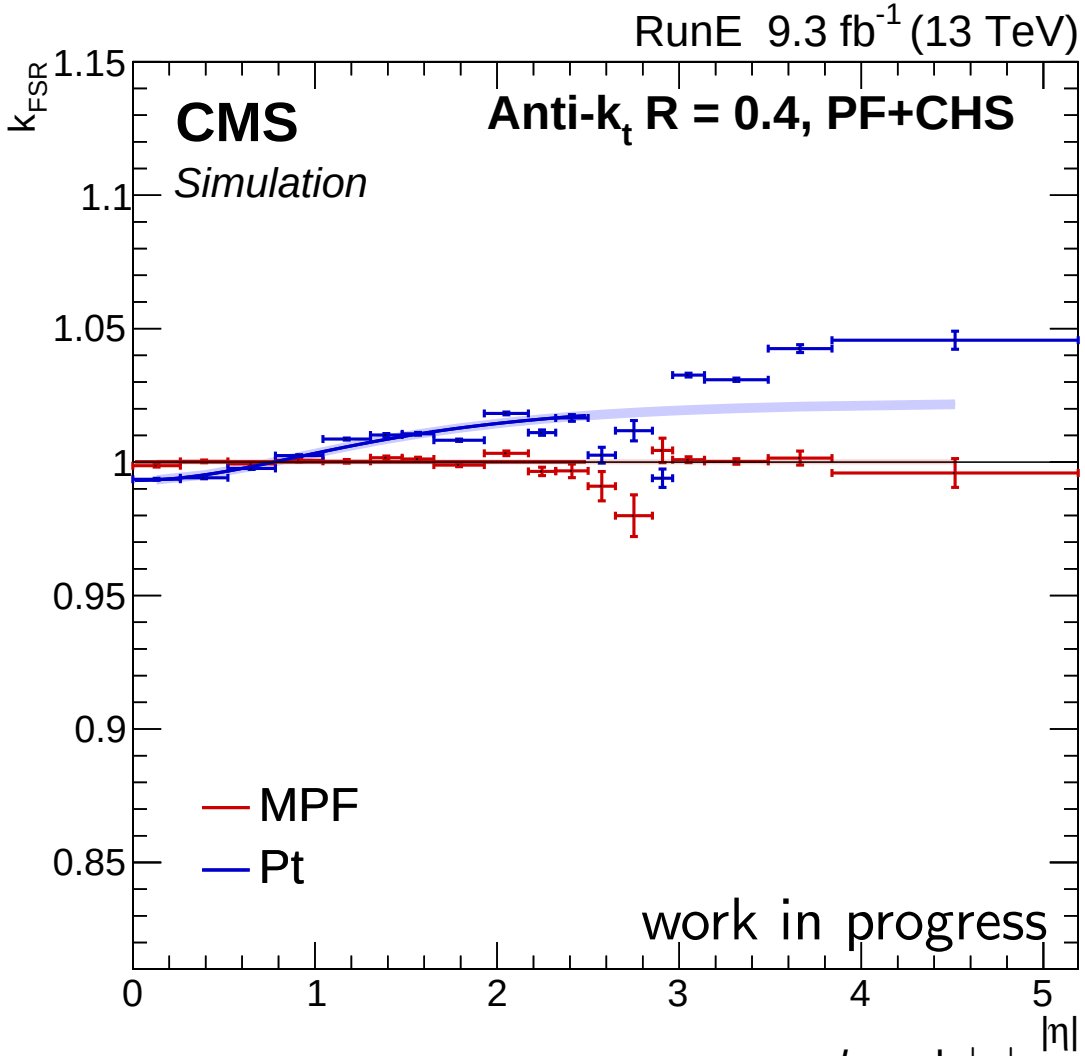


MPF response





Residual Correction for Additional Radiation



Fitted with $k_{FSR}^{fit}(|\eta|) = a + \frac{b \cdot \cosh|\eta|}{1 + c \cdot \cosh|\eta|}$

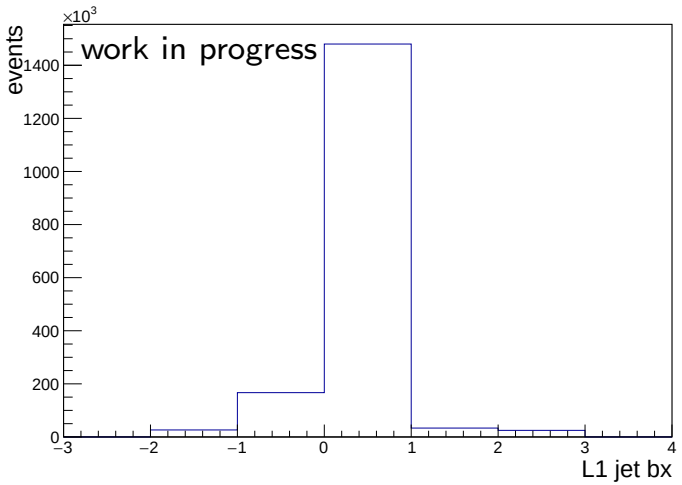
Basics of ECAL Pre-Firing

as reported at PPD General Meeting 05/24/18 by Andrew Brinkerhoff

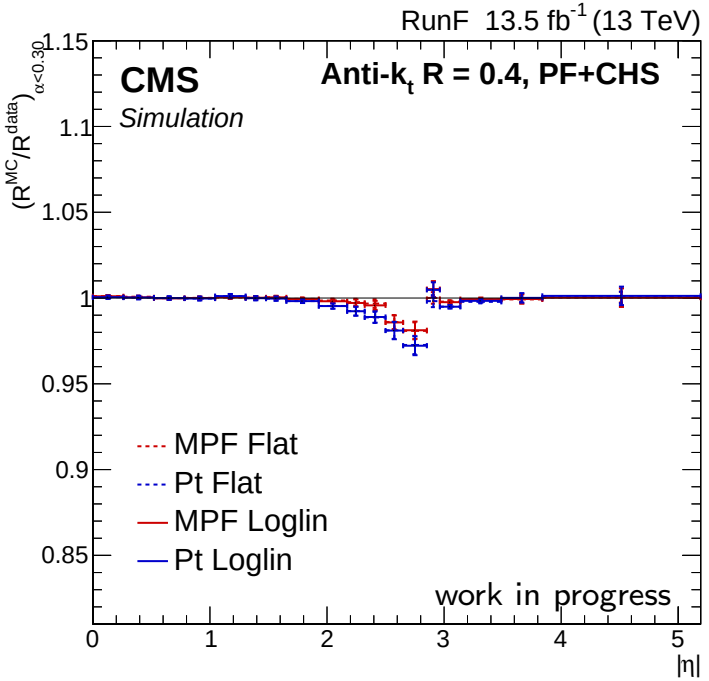
- Mis-timing of L1 objects due to ECAL transparency loss
- If a mis-timed (early) L1 object is above the E_T threshold for an unprescaled L1 path, the previous event will be sent to HLT, and the event actually containing the offline object will be discarded
- Potentially leads to trigger inefficiency and energy bias
- The impact of this is highly Analysis dependent

Filter Pre-Fired Events

L1 bunch crossings matched to the three leading jets for $2.2 < \eta < 3.2$



Example influence of the pre-firing cleaning, without cleaning as MC

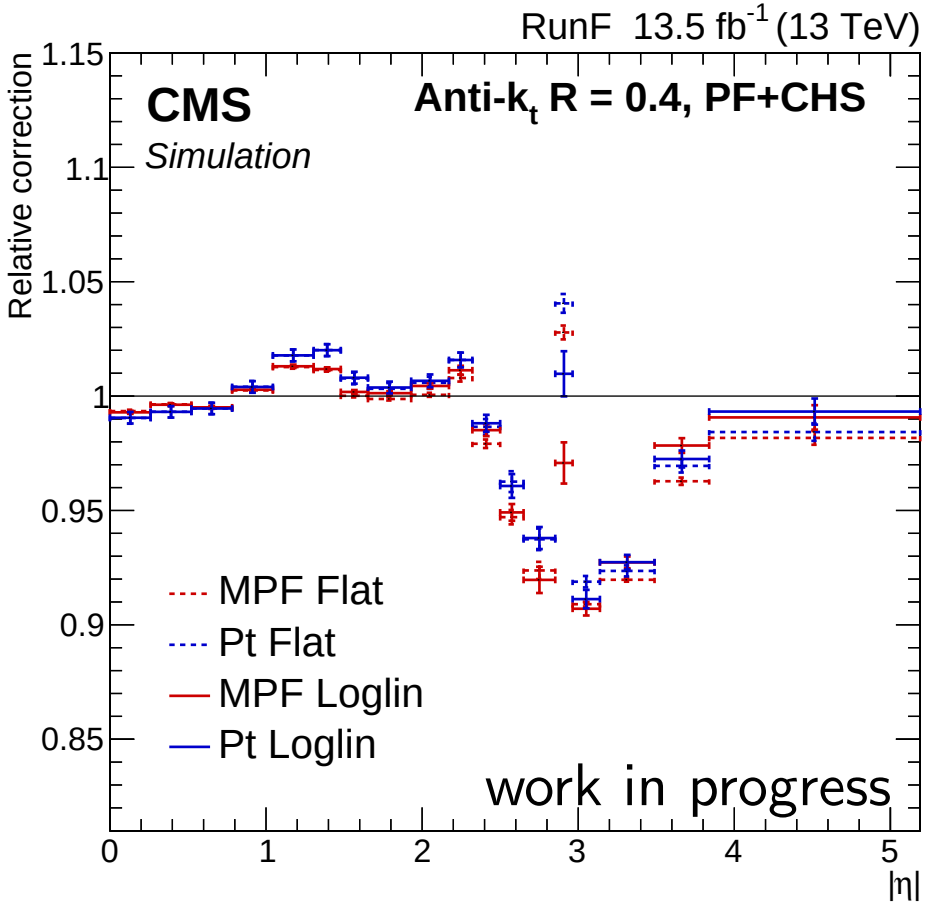


L1Jet Seed Based Cleaning:

- $\Delta R\left(\text{jet}_i, \text{L1Jet}_{\text{bx}=-1}\right) < 0.4$ for $i \in [1, 2, 3]$
- $\text{L1Jet}_{\text{bx}=-1} p_t > 20\%$ of matched jet p_t

Relative Residual Corrections

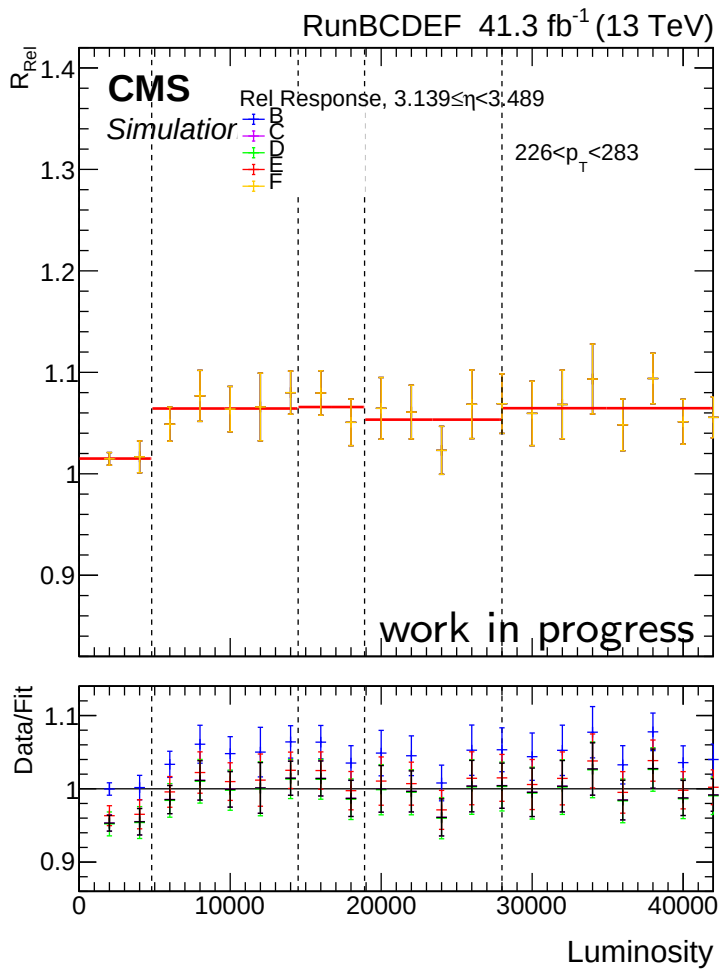
$$\mathcal{C}(|\eta_{probe}|) = \left\langle R^{MC}/R^{data} \right\rangle_{\alpha<0.3} \cdot k_{FSR}$$



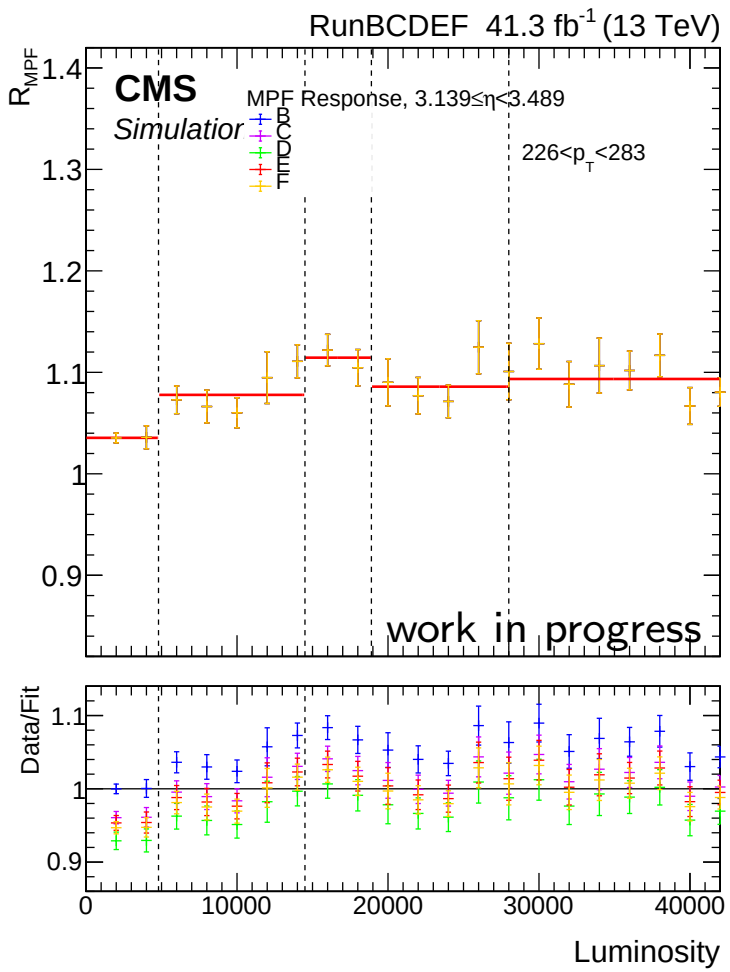
Final Pt and MPF response corr. are expected to be compatible

Relative Response Time Dependence

p_T-balance response

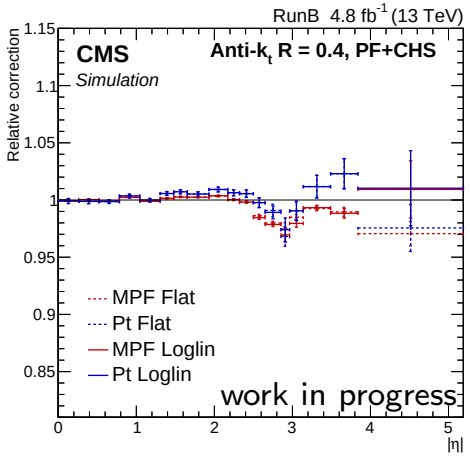


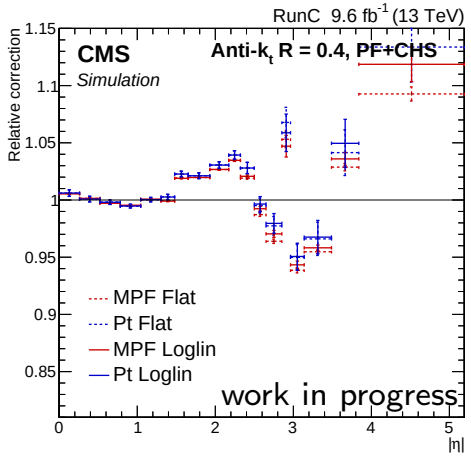
MPF response

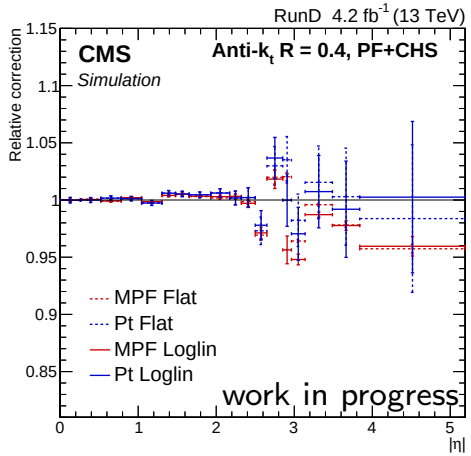


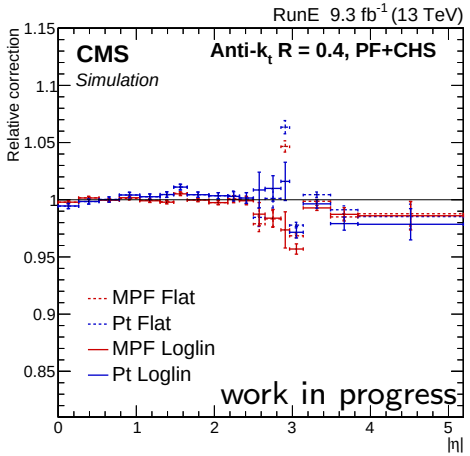
typical time dependece for lower η is more even with much smaller uncertainties

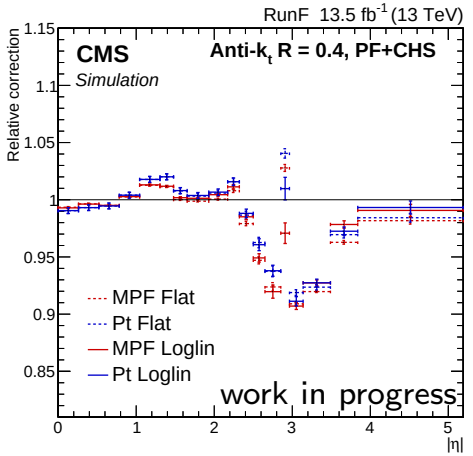
Relative Residual Corrections











Summary

- Preliminary residual corrections for 2017 CMS data are available
- Pre-firing effect on relative residual correction up to 5%
- Investigation of method discrepancy, time dependence and fit stability