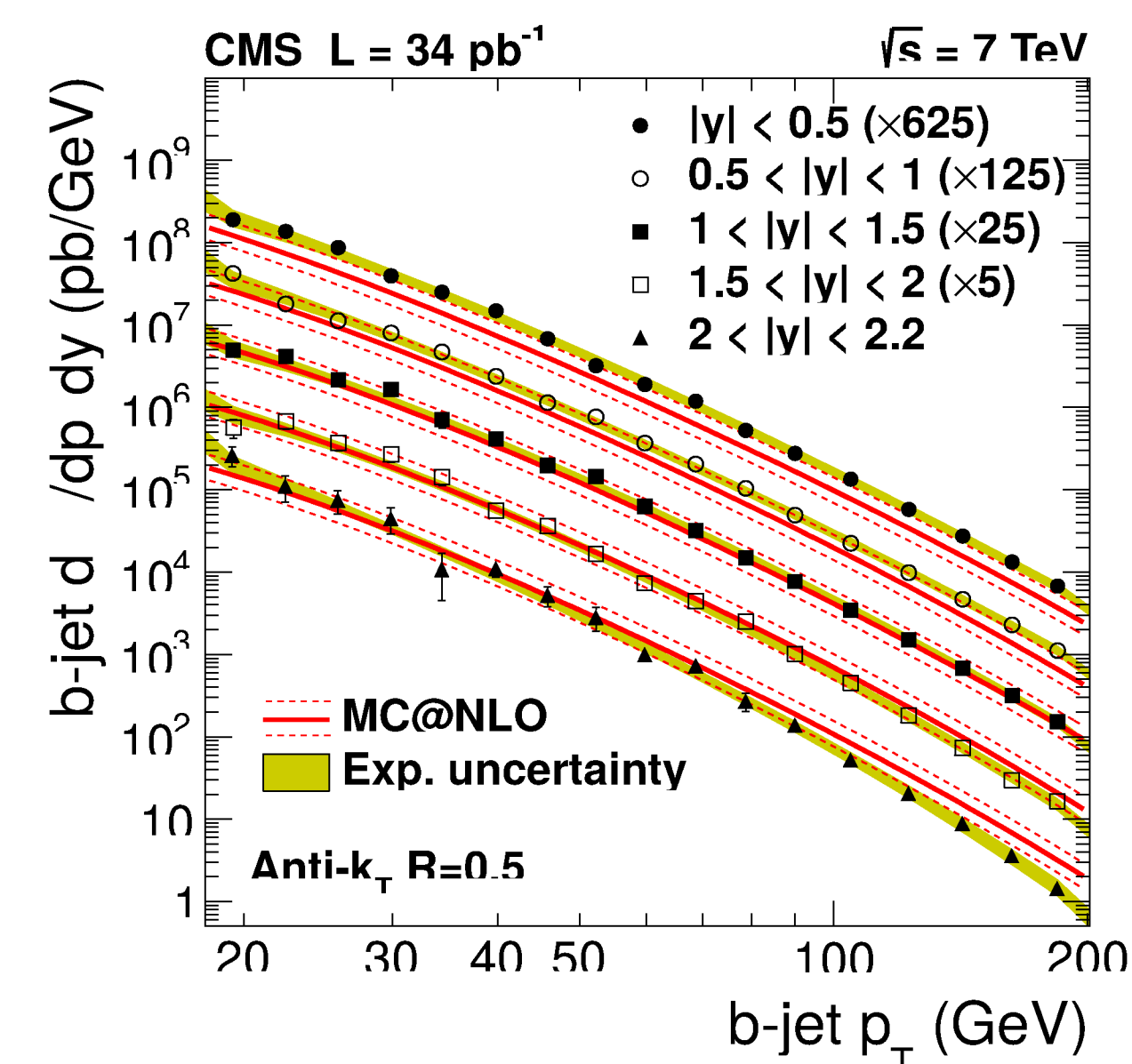


# Measurement and study of inclusive b jet production with 2016 data.

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## Previous measurement [1]



B tagging is challenging at high  $p_T$

### In 2016

- > 1000x larger luminosity
- > Higher energy in c.m.s.
- > Improved performance of b tagging

→ TeV scale can be reached!

## The analysis in a nutshell

Measurement of **double differential cross section** with anti- $k_T$  jet clustering algorithm ( $R = 0.4$ ) and **fraction** in inclusive jet production

**Perform unfolding with simulation corrected to the data**

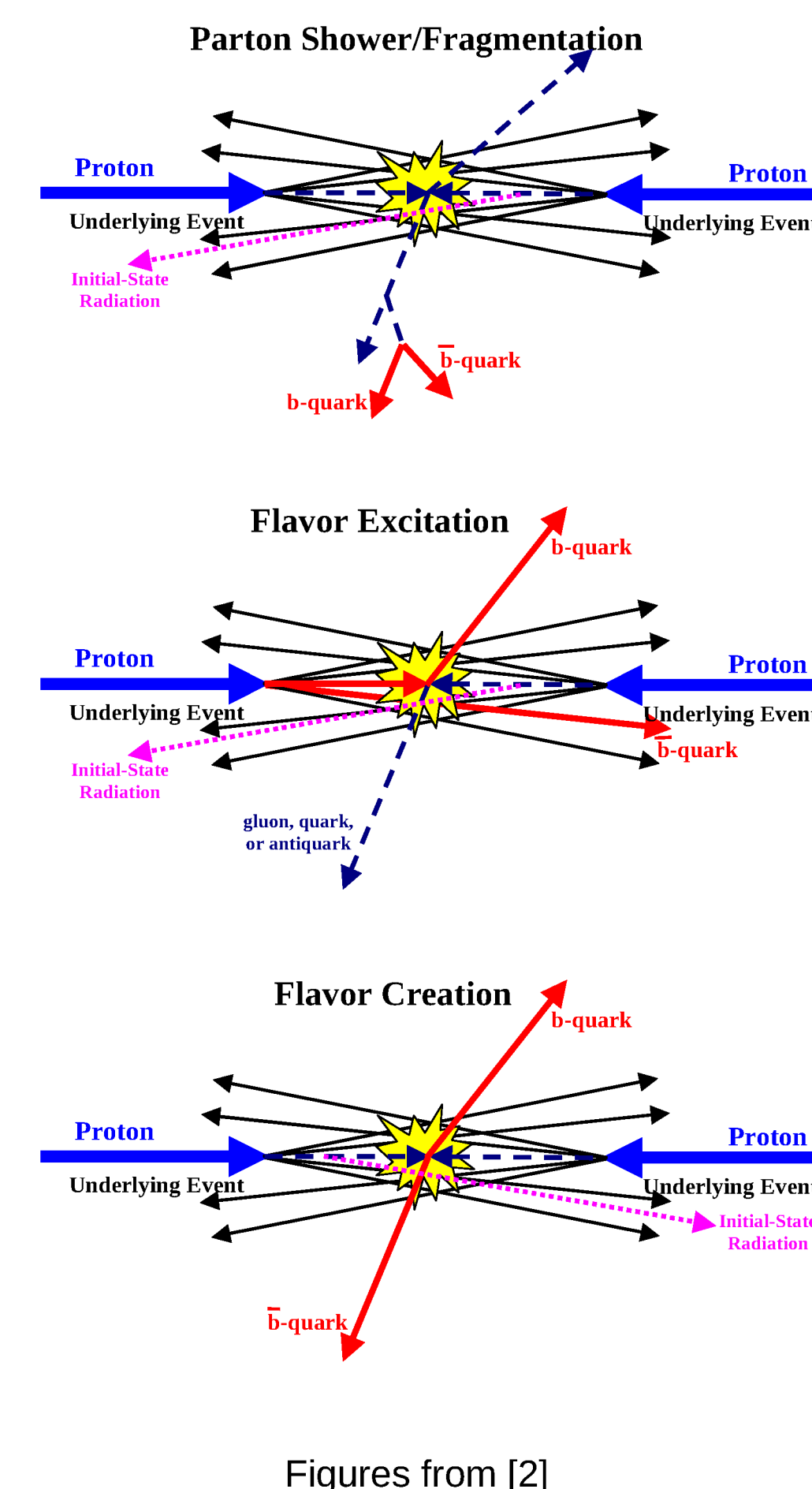
### Corrections to simulation

- > **PU corrections:** sampling correction and profile reweighting
- > **JECs:** scale and resolution
- > **B tagging:** CSV2, calibration (standard + additional correction)

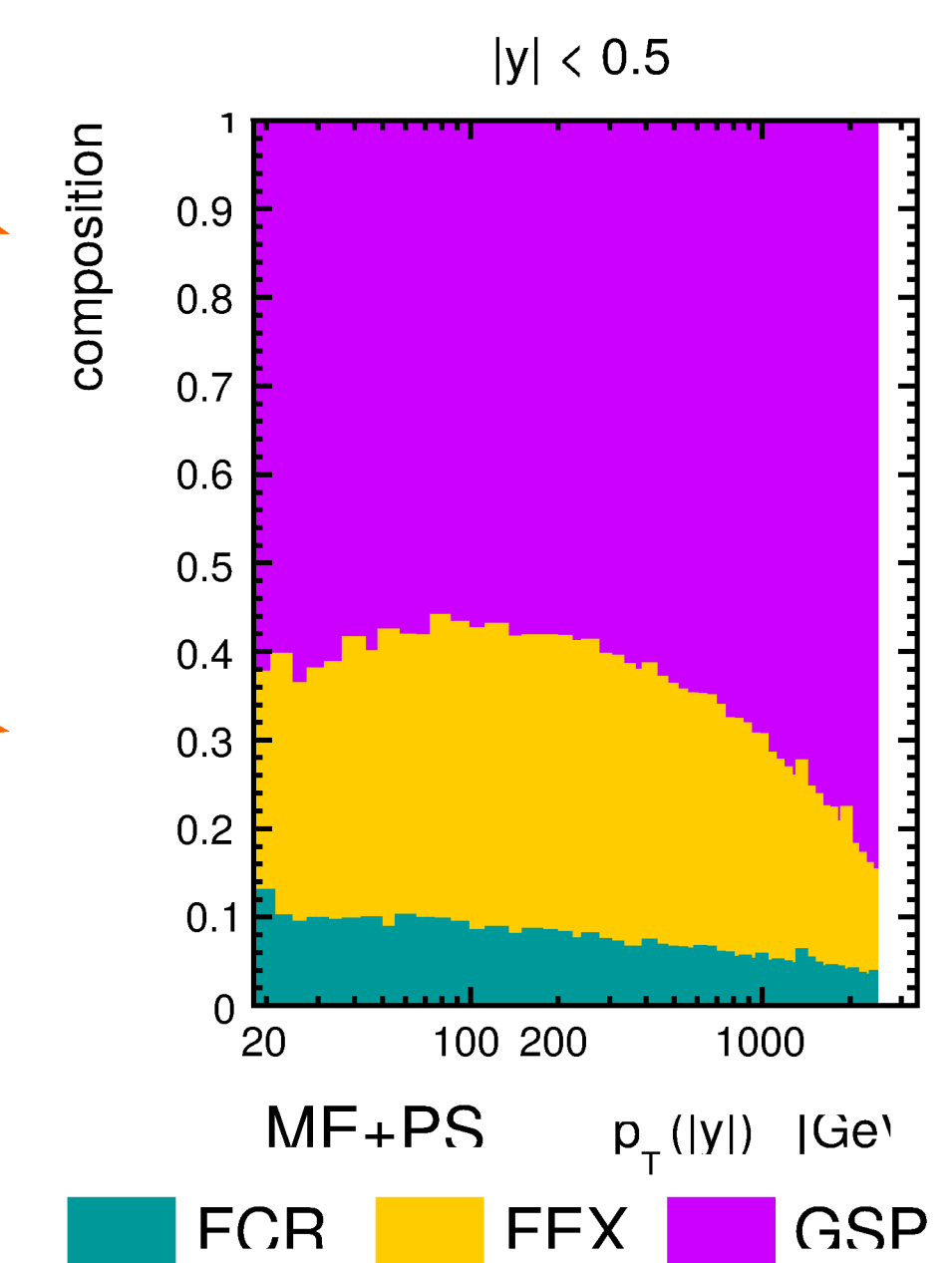
### Corrections to data

- > **Trigger:** emulation & tag-and-probe methods
- > **JECs:** scale only
- > **Unfolding:** regularisation with Tikhonov, cross-checked with D'Agostini

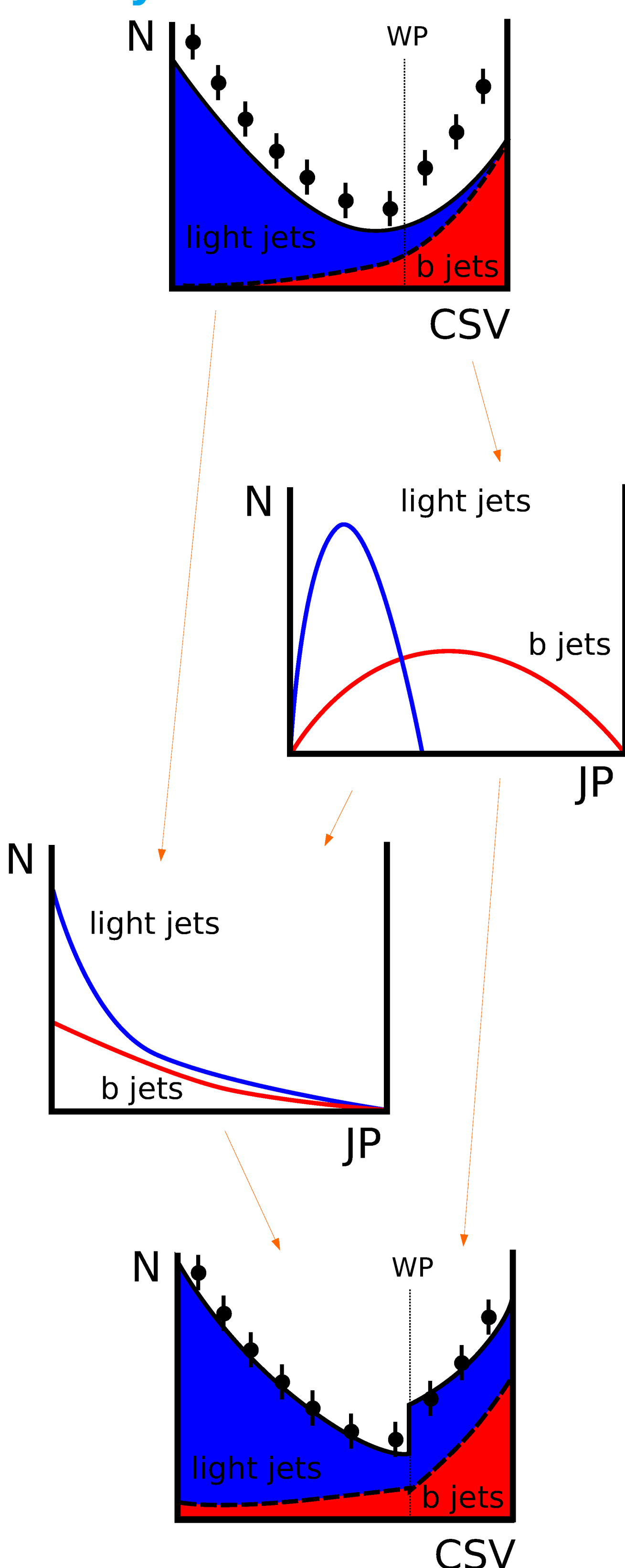
## Production modes



**Inclusive b jet is more sensitive to extra radiation than inclusive jet production**



## Purity fit



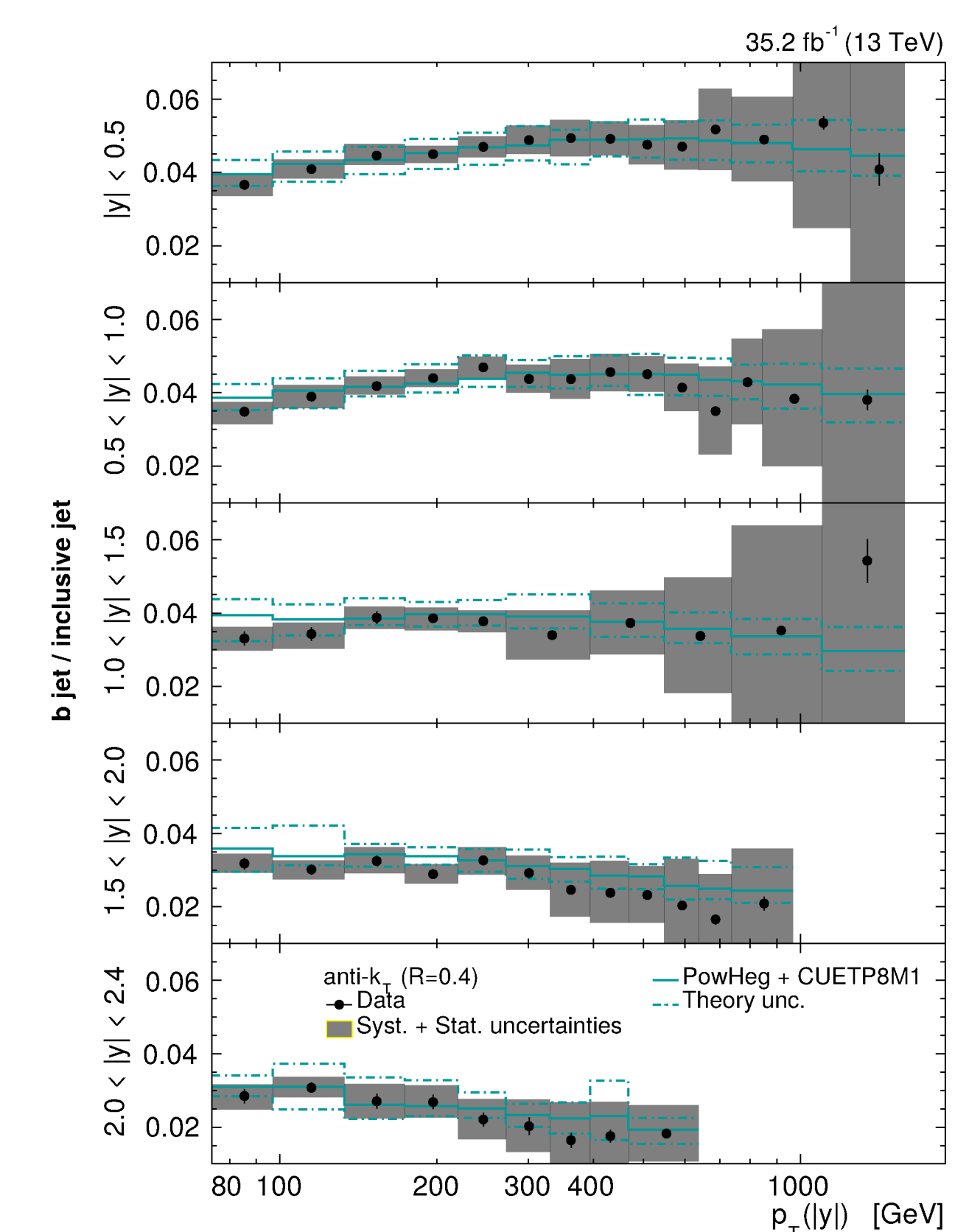
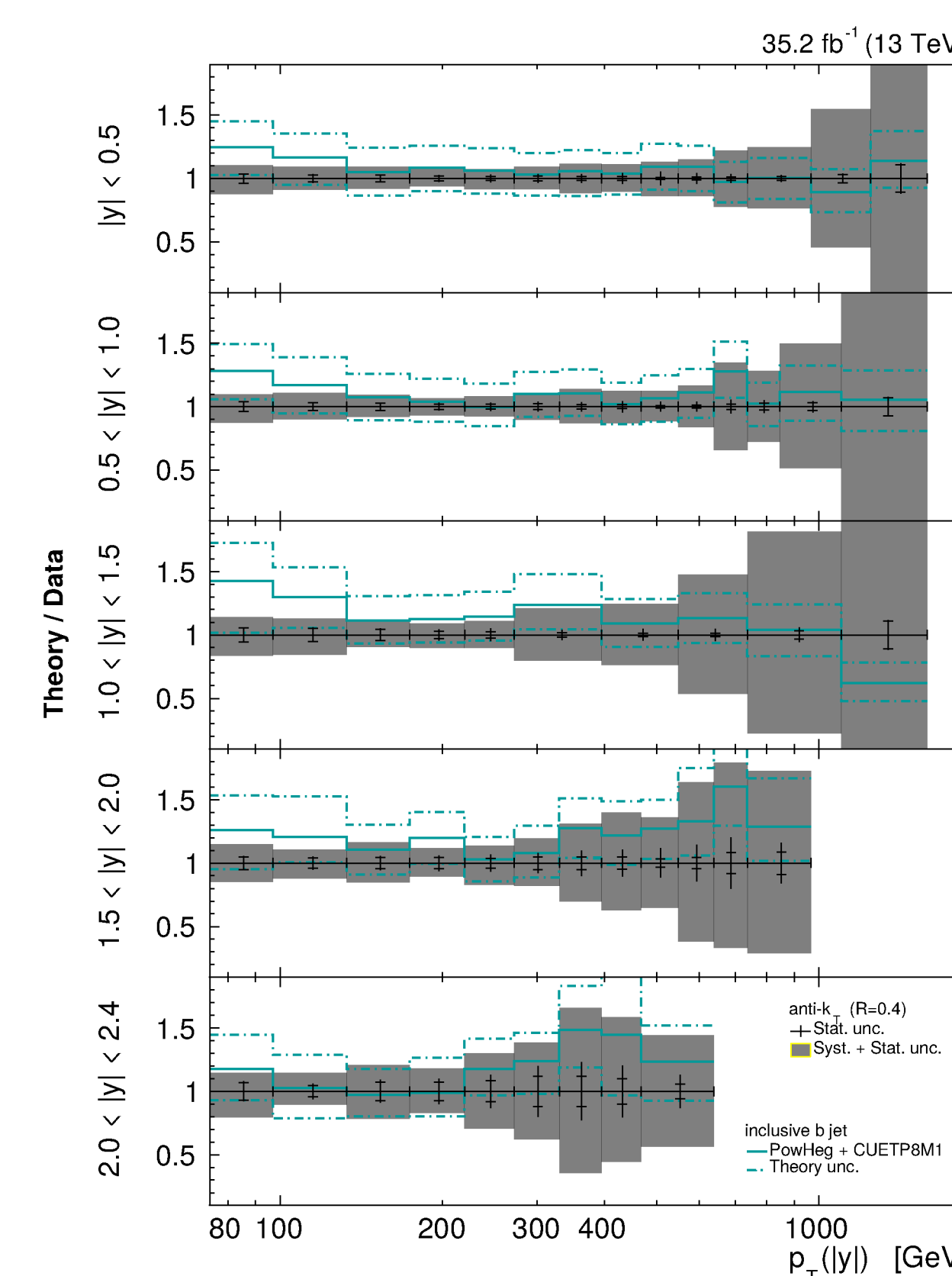
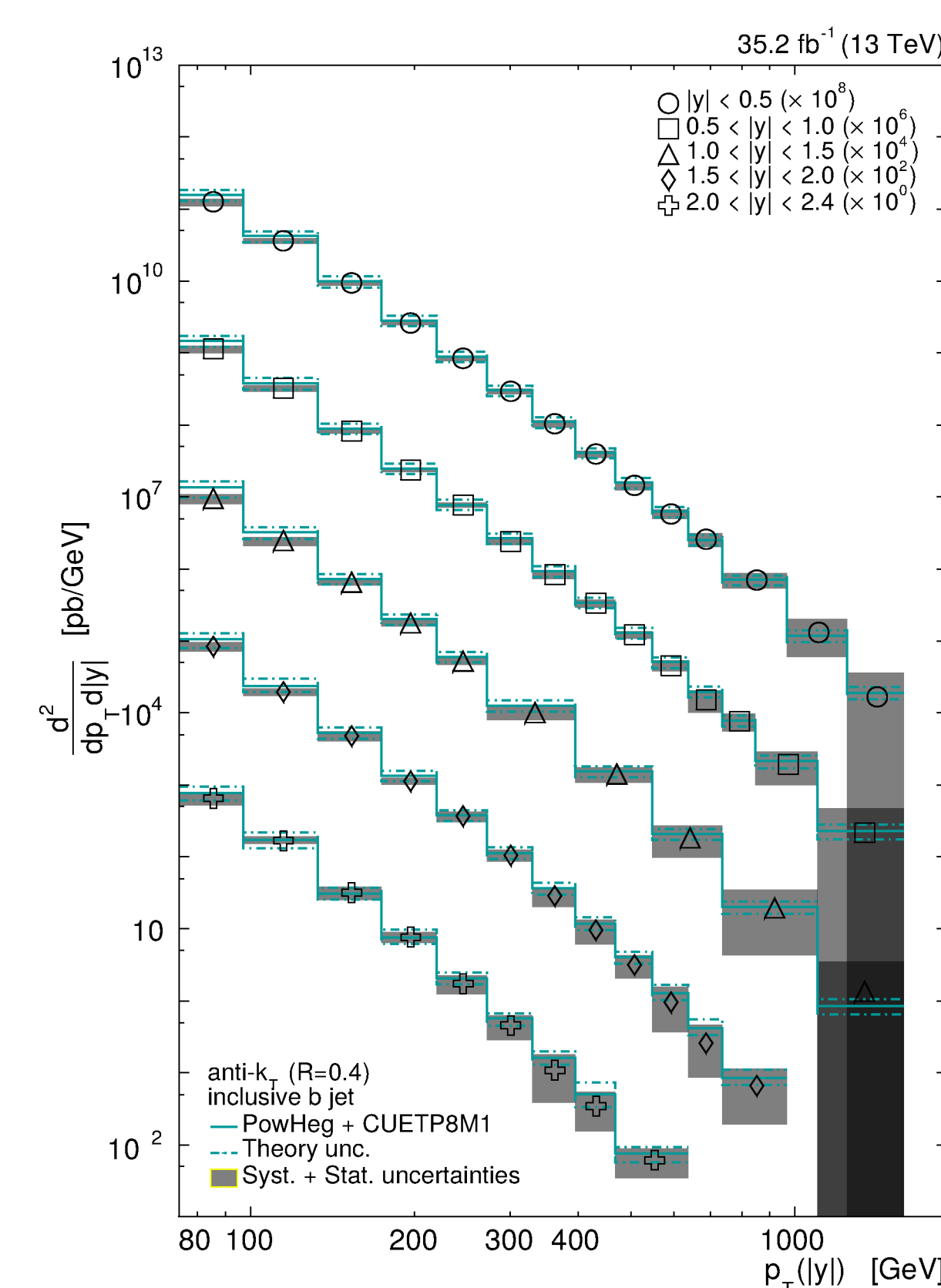
$$\begin{bmatrix} \sigma_b \\ \sigma_n \end{bmatrix} = \begin{bmatrix} P_{bb} & 1 - P_{nn} \\ 1 - P_{bb} & P_{nn} \end{bmatrix} \times \begin{bmatrix} \sigma_{\hat{b}} \\ \sigma_{\hat{n}} \end{bmatrix}$$

### In 2016

- > Template fit of JP in CSV-tagged region
- > Extrapolate fit parameter for b component in non-CSV-tagged region
- > Rescale the non-b component to fit the data in non-CSV-tagged region

→ **dominant systematic uncertainty**

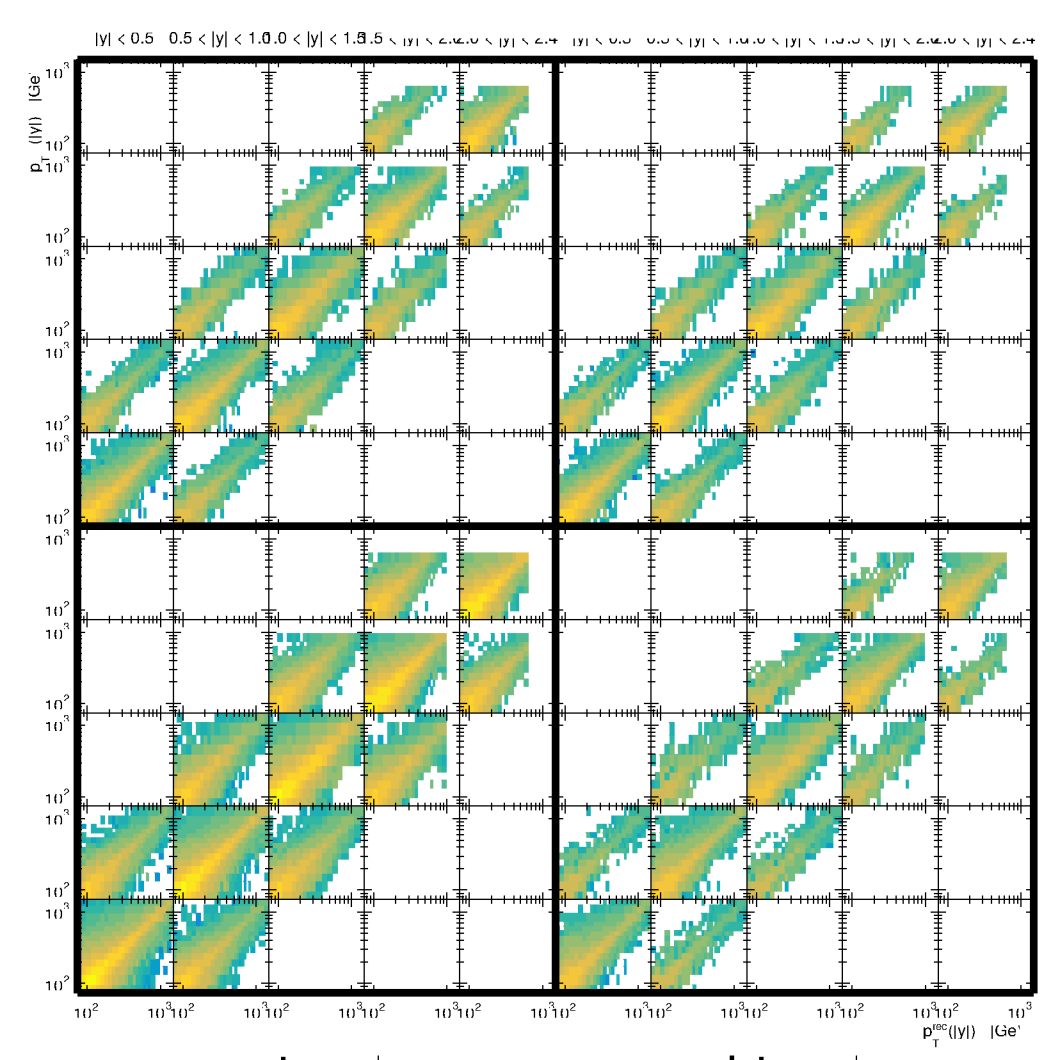
## Result



- > Data compared to **Powheg + Pythia 8** prediction
- > **Agreement** is observed up to the TeV scale!

## Unfolding

$$\chi^2 = \underbrace{(\mathbf{y} - \mathbf{Ax})^T \mathbf{V}_y^{-1} (\mathbf{y} - \mathbf{Ax})}_{\text{inversion}} + \underbrace{\tau^2 \|\mathbf{Lx}\|^2}_{\text{regularisation}}$$



### Tikhonov regularisation [3]

- > Performed with TUnfold package [4,5]
- > Regularisation is adapted to steeply falling  $p_T$  spectrum
- > 3D unfolding is most appropriate to deal with background and low purities

### Systematics

- > All uncertainties are inferred at hadron-level by unfolding with variations of the simulation samples.

### Cross-checks

- > D'Agostini
- > Bottom Line Test
- > Closure tests

$$\mathbf{L} = \begin{bmatrix} 0 & \dots & 0 & 0 & \frac{1}{x_{j3}^{MC}} & -\frac{1}{x_{j3}^{MC}} & -\frac{1}{x_{j1}^{MC}} & \frac{1}{x_{j1}^{MC}} \\ 0 & \dots & 0 & \frac{1}{x_{k3}^{MC}} & \frac{1}{x_{k3}^{MC}} & -\frac{1}{x_{k1}^{MC}} & \frac{1}{x_{k1}^{MC}} & 0 \\ 0 & \dots & \frac{1}{x_{l3}^{MC}} & \frac{1}{x_{l3}^{MC}} & -\frac{1}{x_{l1}^{MC}} & \frac{1}{x_{l1}^{MC}} & 0 & 0 \\ \vdots & & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

## Prospects

### This analysis (SMP-17-007)

- > Analysis was pre-approved
- > Discussions are ongoing with ARC and BTv

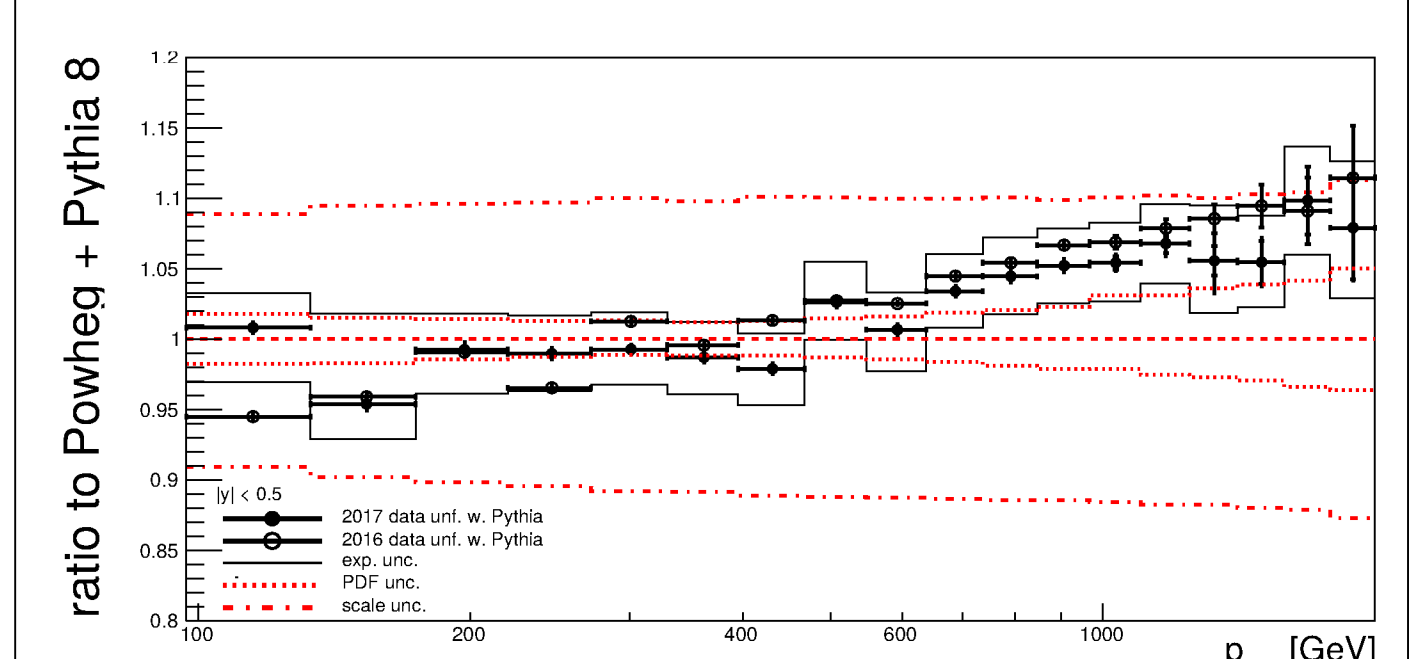
### Extensions

- > Cross check fit of JP with a fit of SV
- > Full Run-II measurement with DeepCSV

### Further measurements

- > Low- $p_T$  b jets
- > c jet measurement
- > Back-to-back topologies

## Apetiser



**Inclusive jet production in 2016 and 2017 data!**

- [1] Serguei Chatrchyan et al. "Inclusive b-jet production in pp collisions at  $\sqrt{s} = 7$  TeV". In: JHEP 04 (2012), p. 084. doi: 10.1007/JHEP04(2012)084. arXiv: 1202.4617 [hep-ex]
- [2] R. D. Field. "The Sources of b quarks at the Tevatron and their correlations". In: Phys. Rev. D65 (2002), p. 094006. doi: 10.1103/PhysRevD.65.094006. arXiv: hep-ph/0201112 [hep-ph]
- [3] Andreas Hocker and Vakhtang Kartvelishvili. "SVD approach to data unfolding". In: Nucl. Instrum. Meth. A372 (1996), pp. 469–481. doi: 10.1016/0168-9002(95)01478-0. arXiv: hep-ph/9509307 [hep-ph]
- [4] Stefan Schmitt. "TUnfold: an algorithm for correcting migration effects in high energy physics". In: JINST 7 (2012), T10003. doi: 10.1088/1748-0221/7/10/T10003. arXiv: 1205.6201 [physics.data-an]
- [5] Stefan Schmitt. "Data Unfolding Methods in High Energy Physics". In: EPJ Web Conf. 137 (2017), p. 11008. doi: 10.1051/epjconf/201713711008. arXiv: 1611.01927 [physics.data-an]

