Study of non-gaussian tails in jet response

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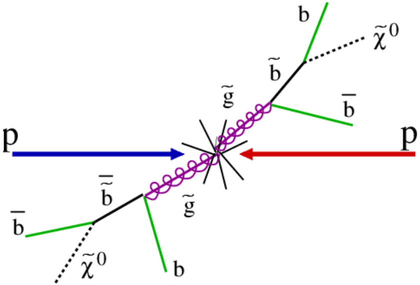
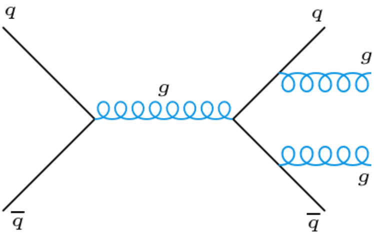
Searches with jets and MET



SUSY signal process

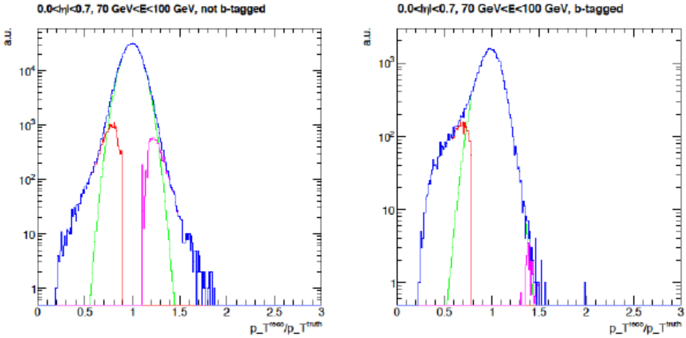


background process

Multijet events produce background in MET searches

Jet response and b-jet dependence

Important quantity: jet response $\frac{p_T^{reco}}{p_T^{truth}}$



Problem: Can not measure p_T^{truth} in data

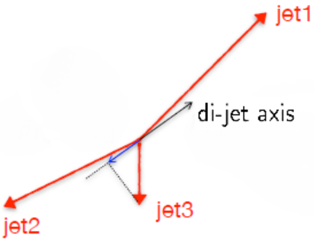
Important observables - Asymmetry

- Study Asymmetry of di-jet events
- Asymmetry A$=\frac{p_{j1}-p_{j2}}{p_{j1}+p_{j2}}$

  $\rightarrow$ Connected to jet response via resolution:

$$\frac{\sigma(p_T^{jet})}{(p_T^{jet})} = \sqrt{2}\sigma(A(p_T))$$

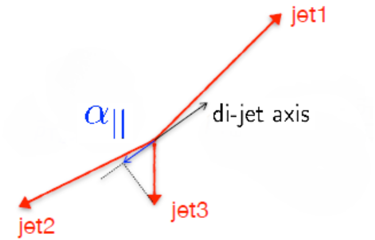
  $\rightarrow$ Assume tail fractions are also related



Important observables - Alpha

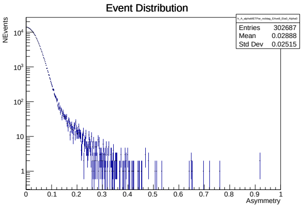
- Asymmetry $A = \frac{p_{j1} - p_{j2}}{p_{j1} + p_{j2}}$
- $\alpha_{||} = \frac{p_{j3||}}{p_{ave}}$

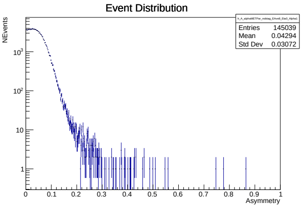
  $\rightarrow$ Measure for expected Asymmetry without MET

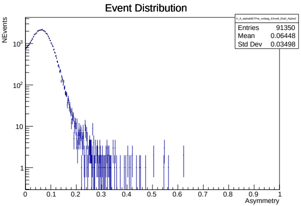


Root Histograms

Histograms binned in EAve, Eta, Alpha



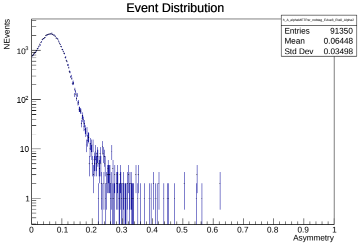




Mean of distribution increases for large Alpha values

Analysis aim

- Compare MC and data non-gaussian tails
  $\rightarrow$ Expectation: MC/data ratio close to one
- Separate analysis for b-jet events
  $\rightarrow$ Expectation: larger non-gaussian tails for b-jet events



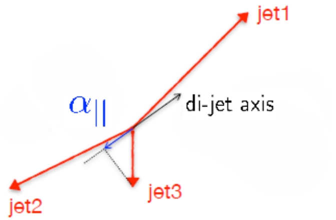
Alpha-hypothesis

Fit gaussian with mean fixed to $\frac{\alpha_{||}}{2}$

$$\alpha_{||} = \frac{p_{j3||}}{p_{ave}}$$

$$A = \frac{p_{j1} - p_{j2}}{p_{j1} + p_{j2}} = \frac{p_{j3||}}{2 \cdot p_{ave}}$$

$$\Rightarrow \langle A \rangle = \frac{\alpha_{||}}{2}$$

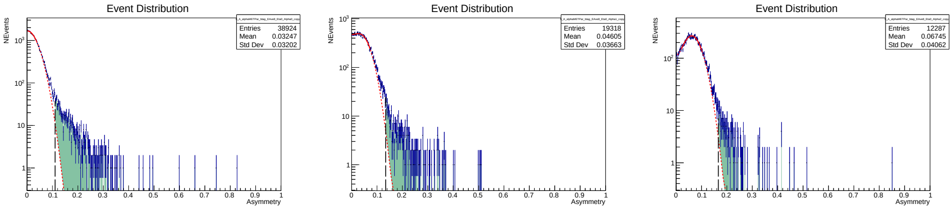


Fit procedure

- get $\frac{\alpha_{||}}{2}$ from ROOT
- chose height and RMS of histogram as start parameters
- do fit in range $[\mu - RMS, \mu + RMS]$
- if fit probability < 0.1: increase fit range by one bin
- if fit probability > 0.55: decrease fit range by one bin

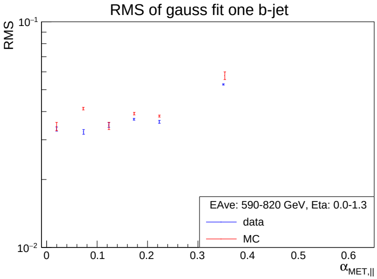
Determining the tail fraction

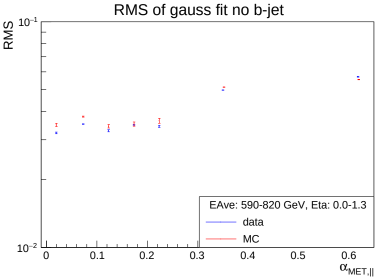
ROOT histograms with fit results



Use 3σ of the gaussian as lower end of the tail

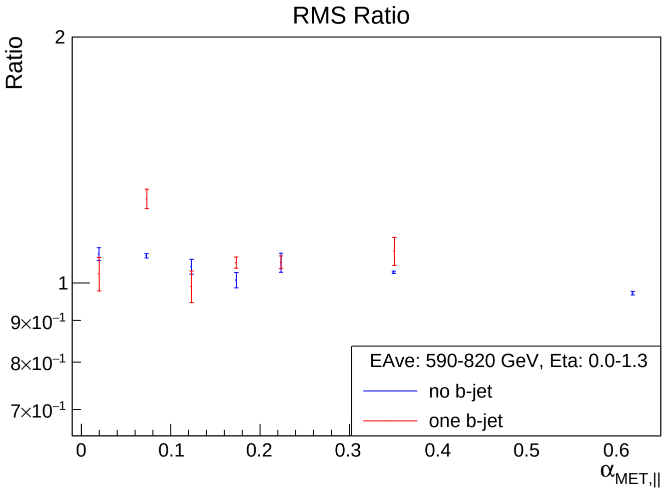
Results - RMS fractions





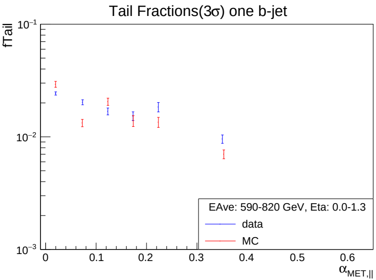
RMS of data and MC samples close together with a slight Alpha dependence

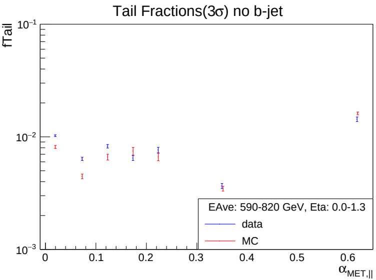
Results - RMS ratio



Starting point for tail fractions can be based on RMS of the fits

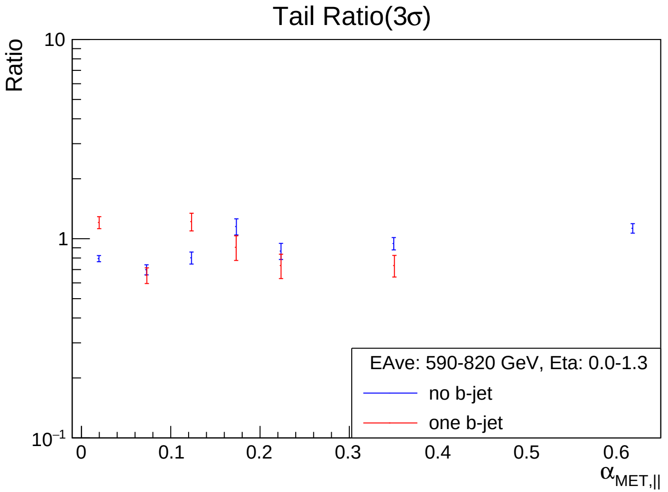
Results -Tail fractions





B-tagged events show higher tail fraction

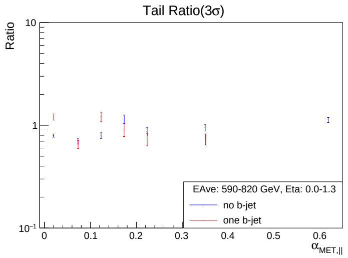
Results - Tail ratio



MC simulation agrees with data

Conclusion

- For central energy and Eta bins, the non-gaussian tails of the jet response agree between simulation and data for both b-tagged and non b-tagged jets

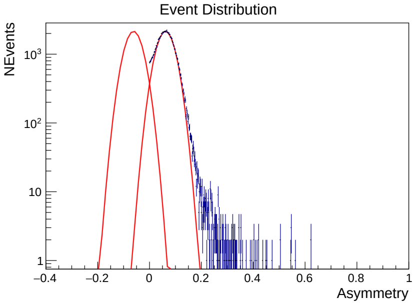


Backup - Fit starting point

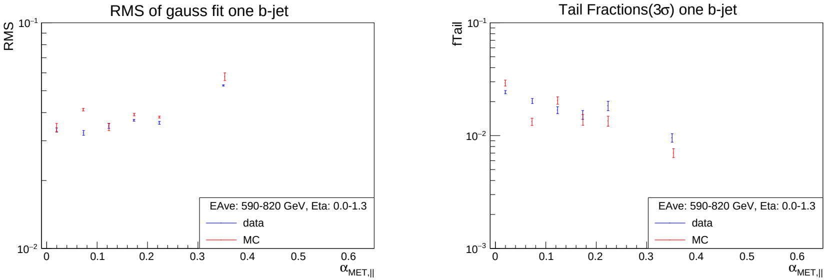
- fit double gaussian to data

$$f(x) = h \cdot \left(e^{\frac{(x-\mu)^2}{\sigma^2}} + e^{\frac{(x+\mu)^2}{\sigma^2}}\right)$$

- fix μ to $\frac{\alpha_{||}}{2}$



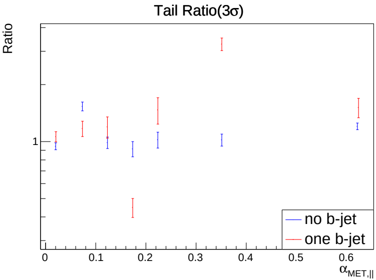
Backup - Alpha dependence



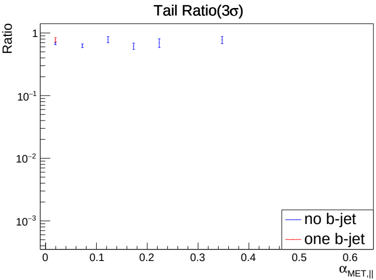
Larger Alpha values have larger uncertainties

Larger RMS results in smaller tail calculation range

Backup - Other EAve Bins



EAve= 400-590 GeV

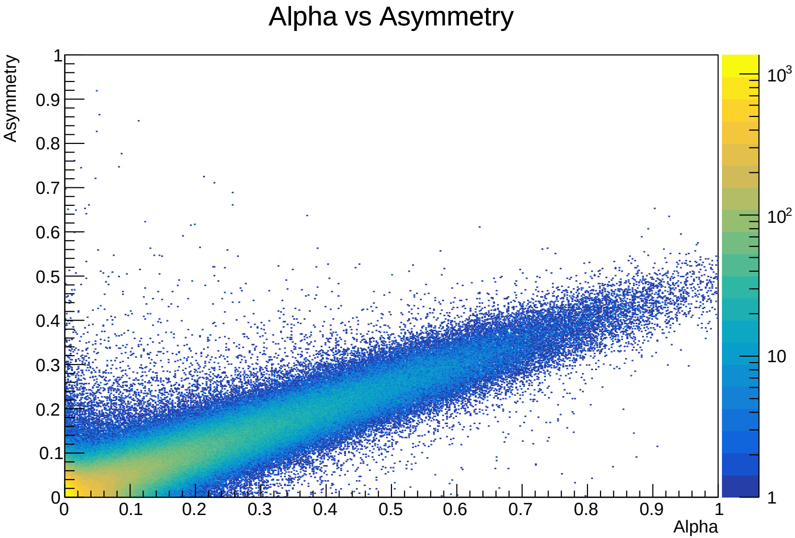


EAve= 820-1019 GeV

Backup - Bin Edges

EAve	0	20	50	100	190	250	400	
	590	820	1090	1400	1750	2140	3000	
Eta	0.0	1.3	2.5	5.0				
Alpha	0.0	0.05	0.1	0.15	0.2	0.25	0.5	1.0

Backup - 2D Histogram



Backup - Two b-jets statistic