Update on response fit
UHH CMS SUSY Meeting

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GEFÖRDERT VOM
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für Bildung
und Forschung

Spotted a bug in the pdf. . .

- Spotted a bug in the dijet pdf
  - When fitting over a large p_T range, fitted spectrum was too steep
  - For a ToyMC, dijet pdf did not predict the number of events correctly
- Identified and fixed the bug thanks to Friederike and Hartmut
  - Inconsistent construction of $p(p_T|p_T^{true}) \leftrightarrow p(r|p_T^{true})$ and normalisation
  - For a powerlaw truth spectrum additional factor $(p_T^{true})^2$ in integrand of normalisation
  - Need to reconsider previous analyses. . .

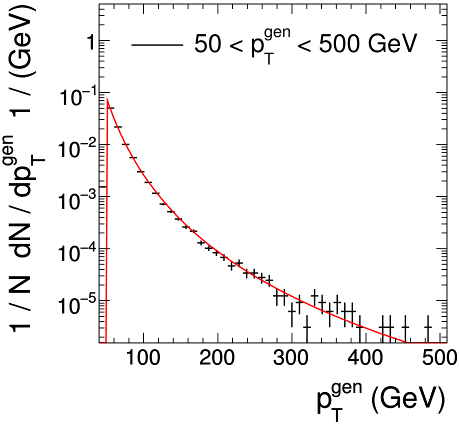
The (hopefully correct) dijet pdf

- Notation
  - x Measured jet p_{T}
  - t True jet p_{T}
  - $\vec{b}$ Parameters of the pdfs
- Ingredients of the dijet pdf
  1. $p_{\vec{b}}(t)$: pdf of measured true jet p_{T}, $\int_{t_0}^{t_1} \mathrm{d}t\, p_{\vec{b}}(t) = 1$
  2. $p_{\vec{b}}(x|t)$: pdf of measured jet p_{T} for a given true jet p_{T}, $\int_0^{\infty} \mathrm{d}x\, p_{\vec{b}}(x|t) = 1$
- The dijet pdf $p_{\vec{b}}(x_1, x_2) = \int_{t_0}^{t_1} \mathrm{d}t\, p_{\vec{b}}(t) p_{\vec{b}}(x_1|t) p_{\vec{b}}(x_2|t)$
- Then by construction $\int_0^{\infty} \mathrm{d}x_1 \int_0^{\infty} \mathrm{d}x_2\, p_{\vec{b}}(x_1, x_2) = 1$ if $\int_0^{\infty} \mathrm{d}x_1 \int_0^{\infty} \mathrm{d}x_2 \int_{t_0}^{t_1} \mathrm{d}t\, p_{\vec{b}}(t) p_{\vec{b}}(x_1|t) p_{\vec{b}}(x_2|t) =$ $\int_{t_0}^{t_1} \mathrm{d}t \int_0^{\infty} \mathrm{d}x_1 \int_0^{\infty} \mathrm{d}x_2\, p_{\vec{b}}(t) p_{\vec{b}}(x_1|t) p_{\vec{b}}(x_2|t)$

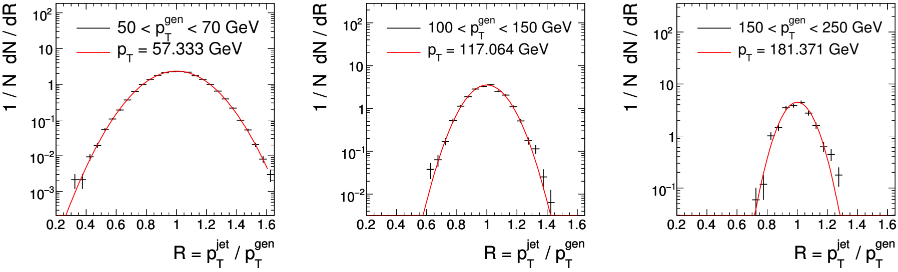
ToyMC study with Gaussian resolution (1)

- Powerlaw spectrum
  - $p_n(t) = \frac{1}{\mathcal{N}_t} t^{-n}$
  - $\mathcal{N}_t = \frac{1}{1-n}(t_1^{1-n} - t_0^{1-n})$
- Gaussian resolution
  - $p_\sigma(x|t) = \frac{1}{\mathcal{N}_x} \mathrm{e}^{-\frac{1}{2}(\frac{x-t}{\sigma})^2}$
  - $\mathcal{N}_x = \sqrt{2\pi}\sigma \cdot \frac{1}{2}(1 + \mathrm{erf}(\frac{t}{\sqrt{2}\sigma}))$
  - $\sigma = a_0 \oplus a_1\sqrt{t} \oplus a_2 t$

	true	fitted
a_1	4.44	4.6 ± 0.5
a_2	1.11	1.13 ± 0.04
a_3	0.03	0.02 ± 0.01
n	5	4.89 ± 0.02

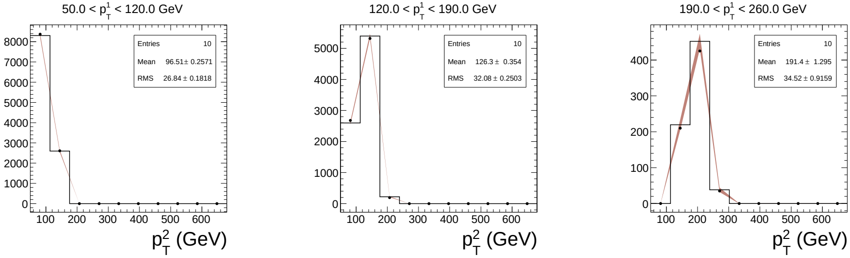


ToyMC study with Gaussian resolution (2)



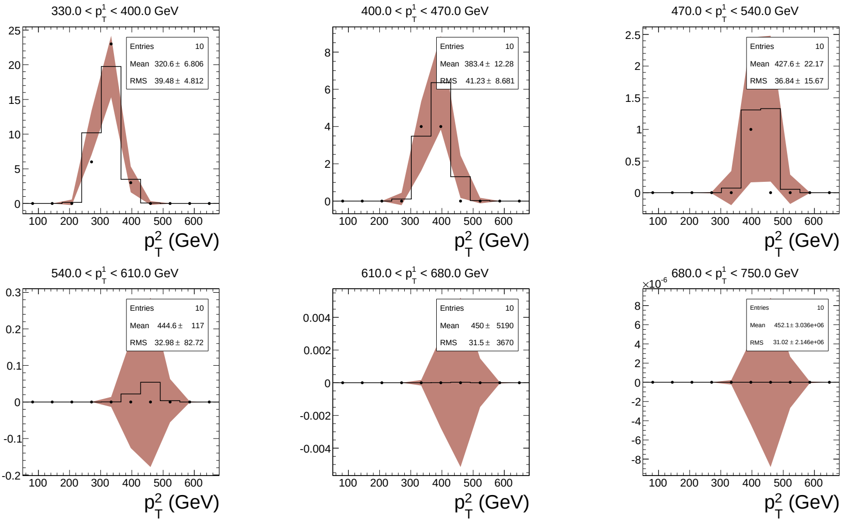
- Fitted are the parameters of $p_{a_i}(x|t)$, the pdf of the measured jet p_T
- Shown in red is the response pdf $p_\sigma(r|t) = \frac{1}{\mathcal{N}_r}\,\mathrm{e}^{-\frac{1}{2}\left(\frac{r-1}{\sigma/t}\right)^2}$, which has the same parameters a_i in σ

ToyMC study with Gaussian resolution (3)



- Generation of 20000 dijet events
- Prediction of number of events in different (x_1, x_2) bins from dijet pdf
- Agreement within statistical uncertainties

ToyMC study with Gaussian resolution (4)



Next steps

- Strategy: fit over large p_{T} range
- Dealing with the spectrum (slope + cut-off effects)
  1. Spectrum from MC
     - + Simpler dijet pdf, fit more robust
     - - Propagates uncertainty in MC description of spectrum and resolution (cut-off effects!) into fitted resolution
     - ⋆ Evaluation of dependence of fitted resolution on assumend spectrum
  2. Description of cut-off effects from fitted resolution
     - + Less dependent on MC description
     - - More complex dijet pdf
- Resolution parameterisation
  - Gaussian
    - ✓ Reimplemented, fit over large $p_{\mathrm{T}}^{\mathrm{gen}}$ range
    - ⋆ Systematic studies esp. of description of cut-off effects
  - Crystal Ball
    - ✓ Reimplemented, fit in different $p_{\mathrm{T}}^{\mathrm{gen}}$ bins
    - ⋆ Parameterisation of parameter dependence on p_{T}, fit over large $p_{\mathrm{T}}^{\mathrm{gen}}$ range