Measurement of the CDF Run II $b \to J/\psi X$ Cross-section

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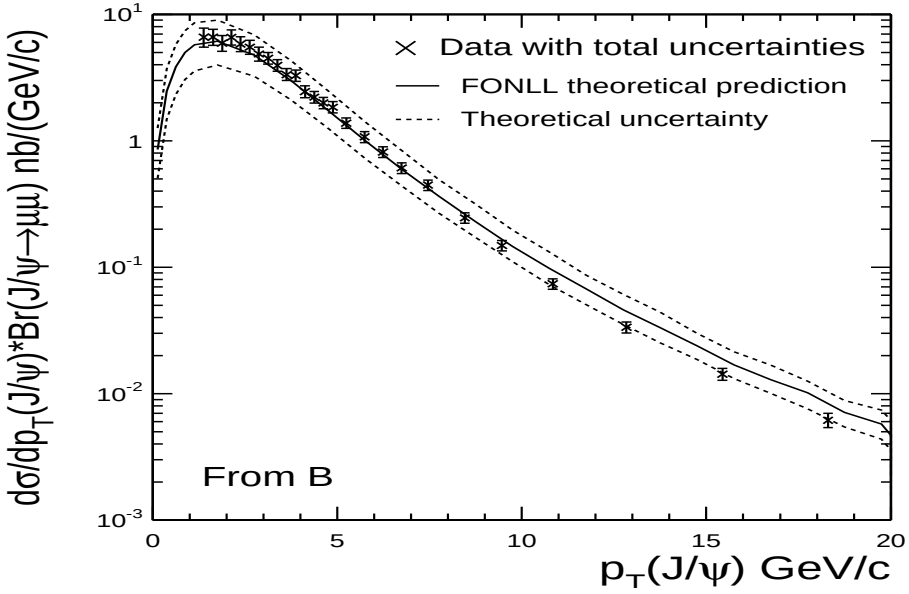
Inclusive x-section of J/ψ from H_b

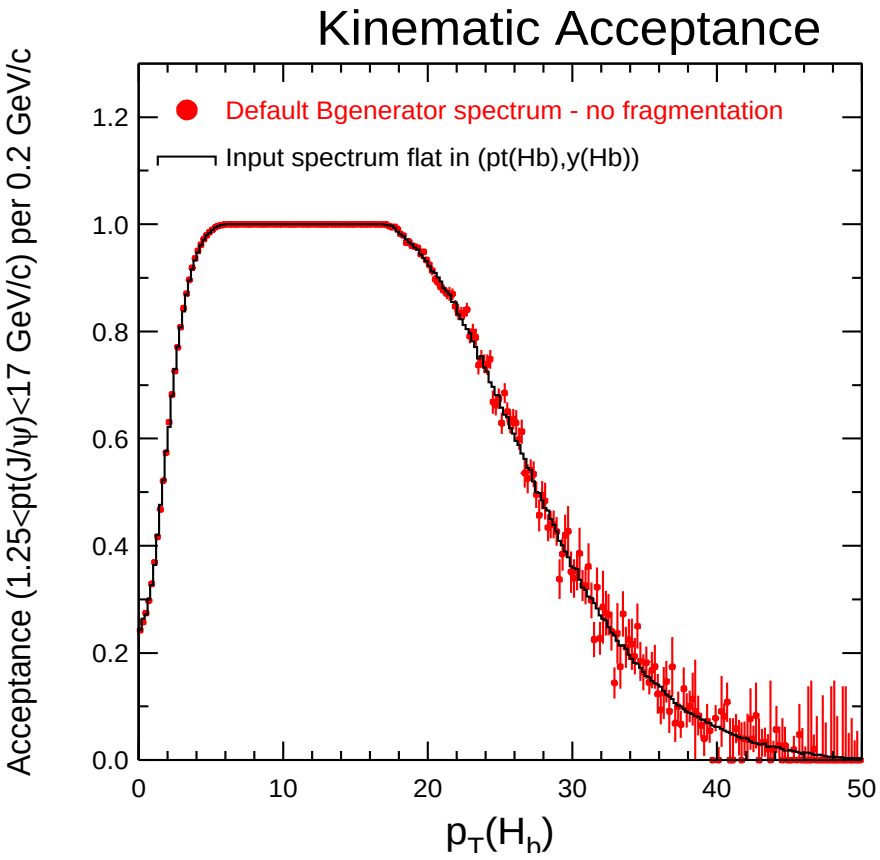
GOAL: We measure the spectrum of $J/\psi \rightarrow \mu\mu$ events from the inclusive decays of b-hadrons ($H_b = B^{\pm}, B^0, B_s, \Lambda_b$ ..etc) where $H_b \rightarrow J/\psi X$ and X is not reconstructed.



Can we extract the shape of the parent H_b distrubution? This is equivalent in MINOS to saying we measure the spectrum of μs from the CC interaction $\nu_\mu + N \rightarrow \mu X$ where $X = N' + n(\pi)$ is NOT reconstructed and we would like to extract the shape of the the parent E_ν^{true} using E_μ^{reco}.

Measurement of the total b-hadron cross-section

Since J/ψ with transverse momenta $<$ 2.0 GeV/c probe b-hadrons with transverse momenta down to 0 GeV/c and J/ψ with transverse momenta $\approx$ 17 GeV/c probe b-hadrons up to 40 GeV/c, the measurement of the differential cross-section using $1.25 < p_T(J/[y]) < 17.0$ GeV/c can be used to extract the total b-hadron cross-section as well as measure the shape of the differential cross-section as a function of $p_T(b-hadron)$



This is the equivalent plot to the CC(true)/CC(all) as a function of E_ν^{true} for MINOS.

Algorithim to extract $d\sigma/dp_T(H_b)$

- Count the observed number of b-hadrons in a given $p_T(H_b)$ bin

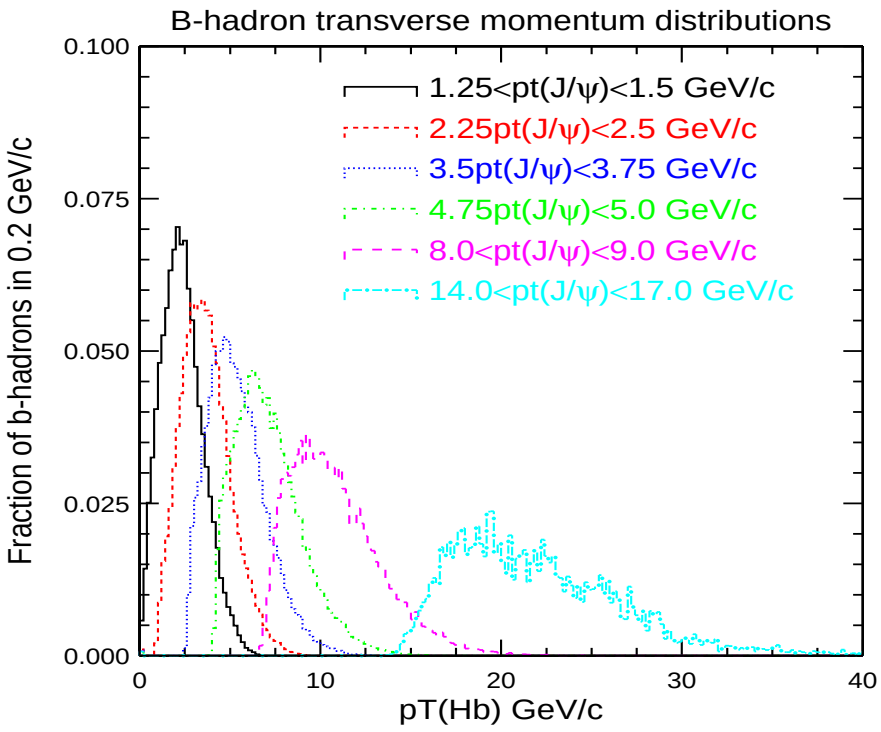
$$N_i^b = \sum_{j=1}^{N} w_{ij} N_j^{J/\psi}$$

w_{ij} is the fraction of b events in the i^{th} $p_T(H_b)$ from the j^{th} $p_T(J/\psi)$ bin obtained from MC.

- Correct the observed number of b-hadrons for the acceptance
- Propagate the errors on $N_j^{J/\psi}$:

$$\delta_{stat}(N_i^b) = \sqrt{\sum_{j=1}^{N} w_{ij} \delta_{stat}^2(N_j^{J/\psi})}$$

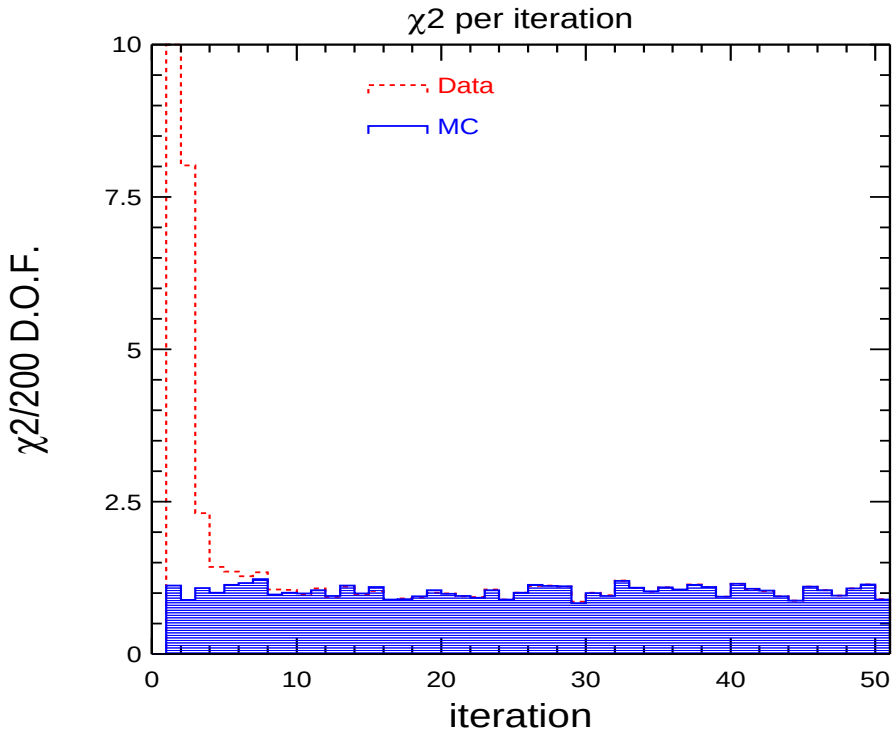
$$\delta_{syst}(N_i^b) = \sum_{j=1}^{N} w_{ij} \delta_{syst}(N_j^{J/\psi})$$



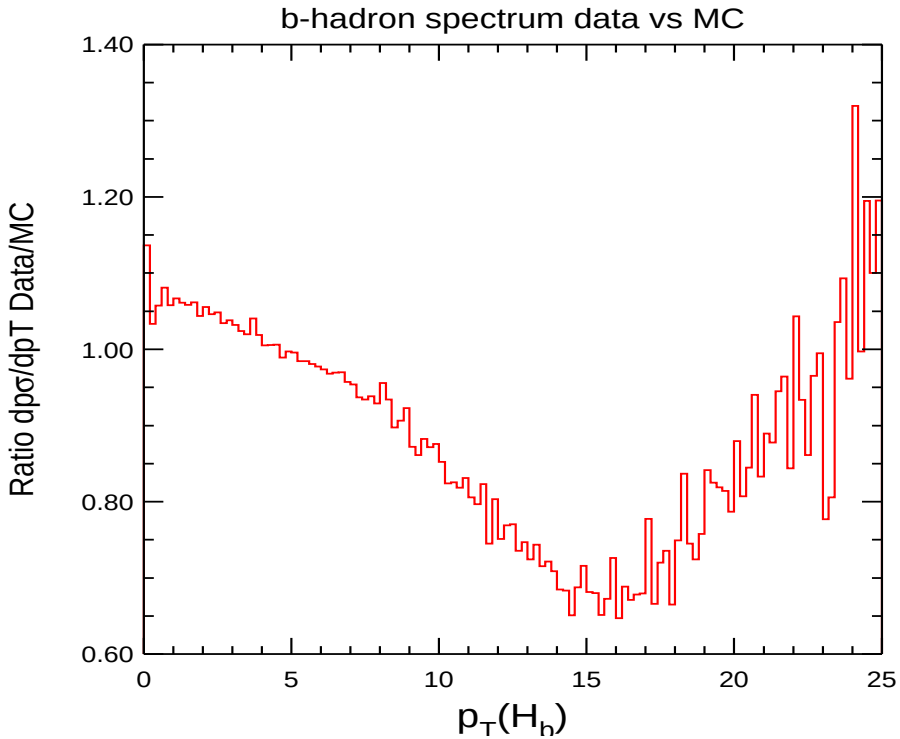
The histograms are equivalent to the MINOS reco-to-true matrix columns.

Iterating...

After a $d\sigma/dp_T(H_b)$ spectrum is obtained, the weights w_{ij} are recomputed using the new spectrum and the algorithim repeated. A χ^2 test is performed on the input and output spectra until no difference is seen: The MC (shown in blue) converges immediately and remains stable

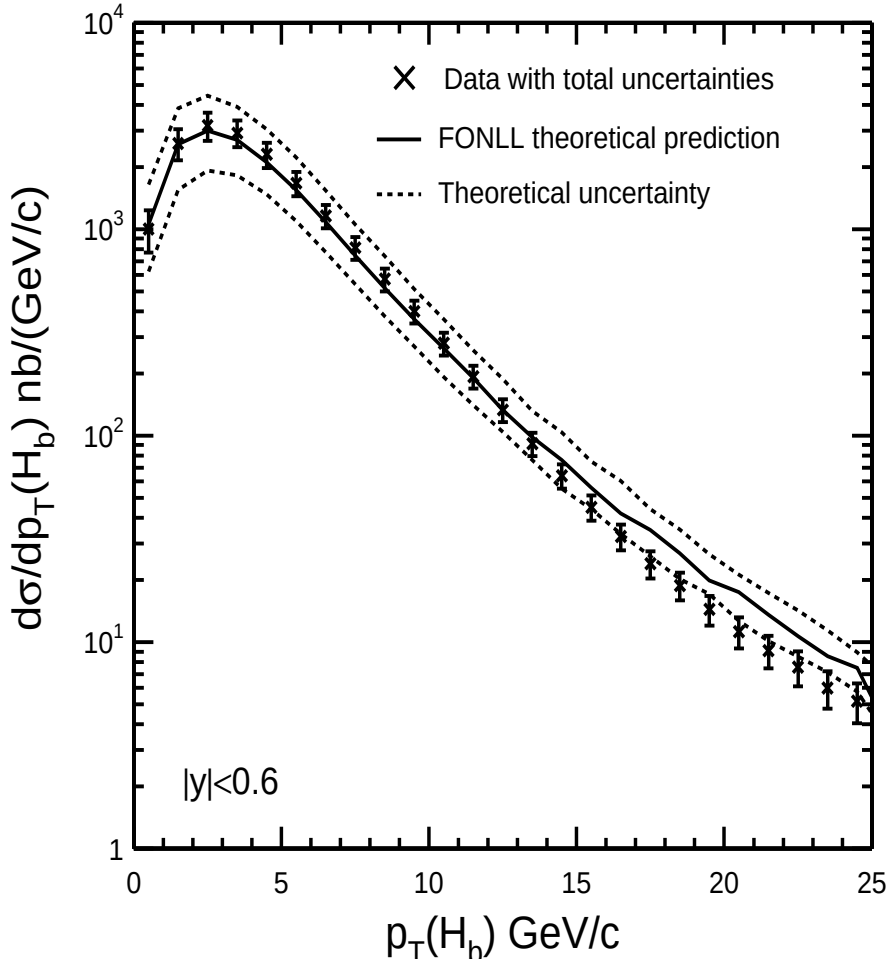


Run 50 iterations



After 9 iterations

The total central b-hadron cross-section



Is there a dependency on input shape?

2 MC samples are generated, sample 1 is used as data and a $d\sigma/dp_T(J/\psi)$ shape is obtained from a known realistic $d\sigma/dp_T(H_b)$ shape. Sample 2 is generated with a flat $d\sigma/dp_T(H_b)$ and used to extract the cross-section from sample 1