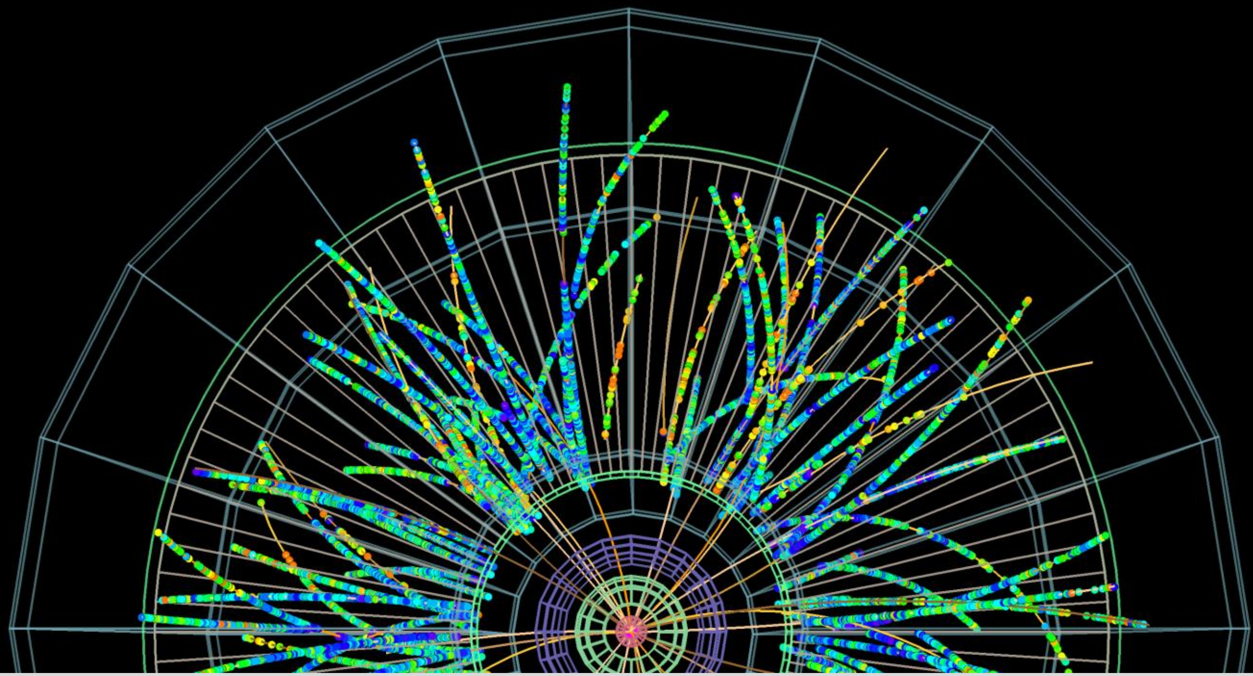

PERFORMANCE OF THE ALICE SECONDARY VERTEX B-TAGGING ALGORITHM

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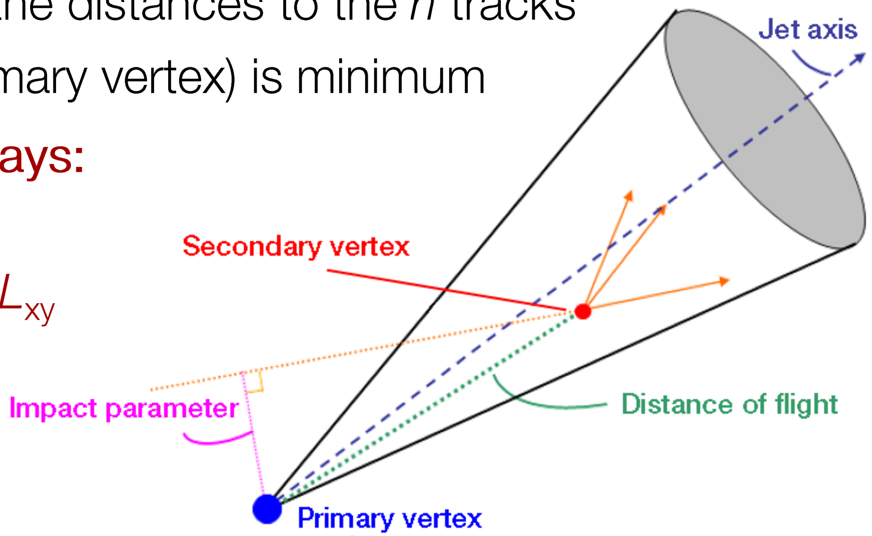
PROPERTIES OF b-JETS

b-jets

- Come from fragmentation of beauty quarks
- Allow studies of redistribution of the lost energy and possible modifications to b-quark fragmentation in the medium
- b-tagging algorithms exploit long lifetime ($c\tau$ ~500 μm) and large mass (~5 GeV/c^2) of B hadrons

Secondary vertices

- Calculated as the point for which the sum of the distances to the *n* tracks (approximated to linear in proximity of the primary vertex) is minimum
- Secondary vertices from beauty-hadron decays:
  - Large invariant mass
  - Large secondary vertex distance of flight L_{xy}



SECONDARY VERTEX RECONSTRUCTION

Jet reconstruction:

- FastJet Anti-k_T, R = 0.4
- $p_{T,\,track}$ > 0.15 GeV/c

Secondary vertex reconstruction:

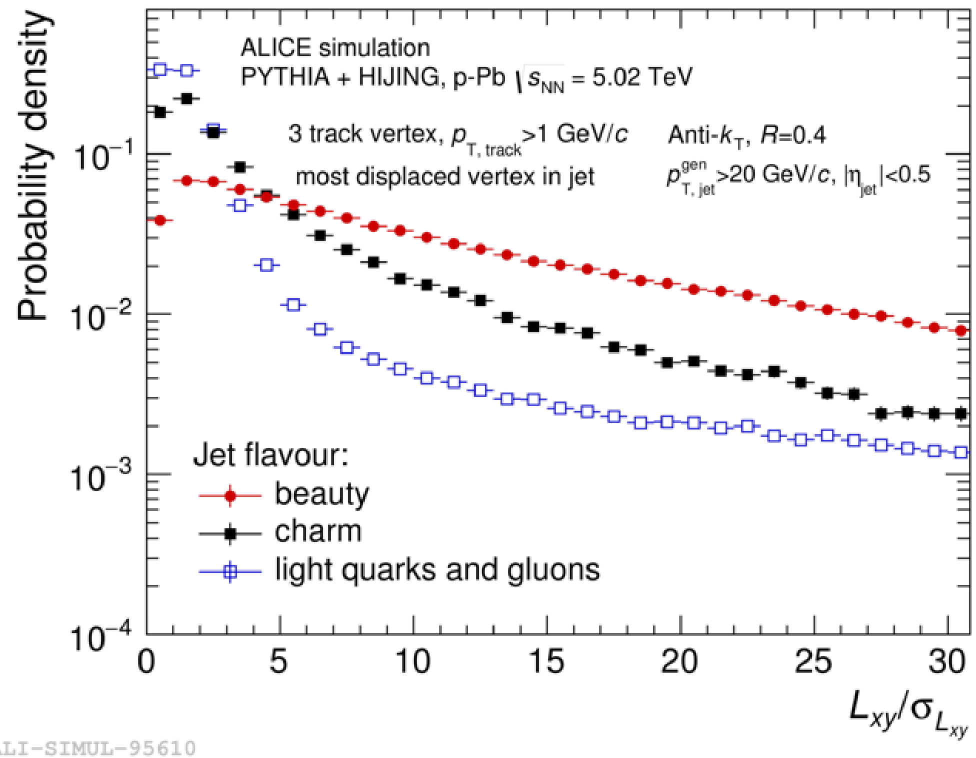
- Using 3 tracks
- Tracks in a jet $p_{T,\,prong}$ > 1 GeV/c

Discriminating variables for b-tagging:

- Significance of signed secondary vertex distance of flight L_{xy}/σ_{Lxy} in the transverse plane
- Secondary vertex dispersion,

$$\sigma_{vtx} = \sqrt{d_1^2 + d_2^2 + d_3^2}$$

where $d_{1,2,3}$ are the distances of tracks from secondary vertex

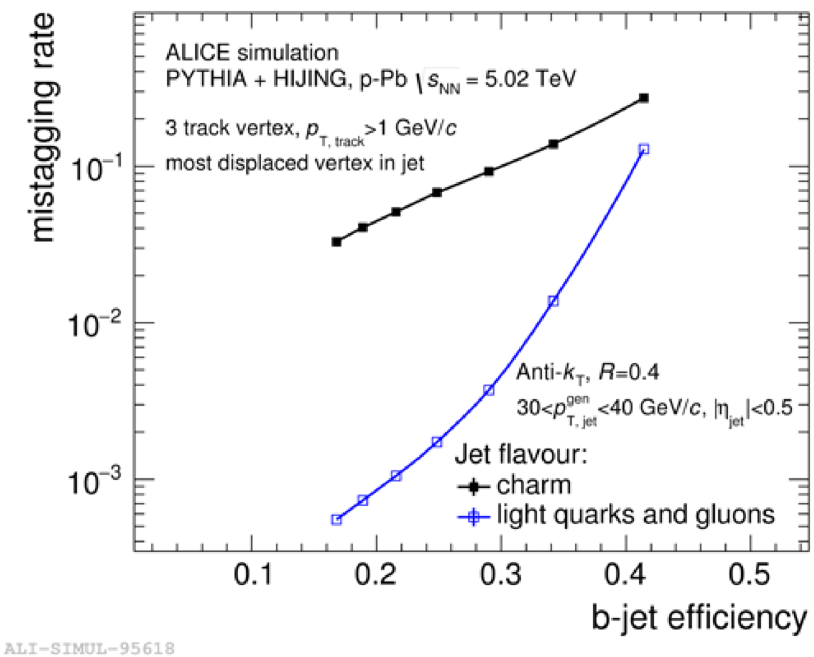


Discriminating variables exist to separate beauty jets from inclusive jets.

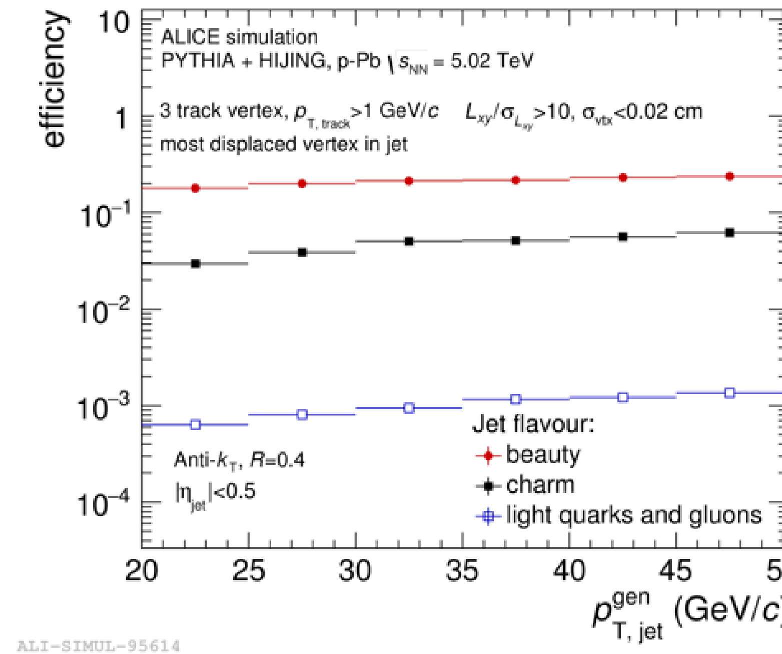
SECONDARY VERTEX ALGORITHM PERFORMANCE IN p-Pb COLLISIONS

- Tagging efficiency:

$$\varepsilon_b(p_T) = \frac{dN_b^{tagged} / dp_T}{dN_b / dp_T}$$

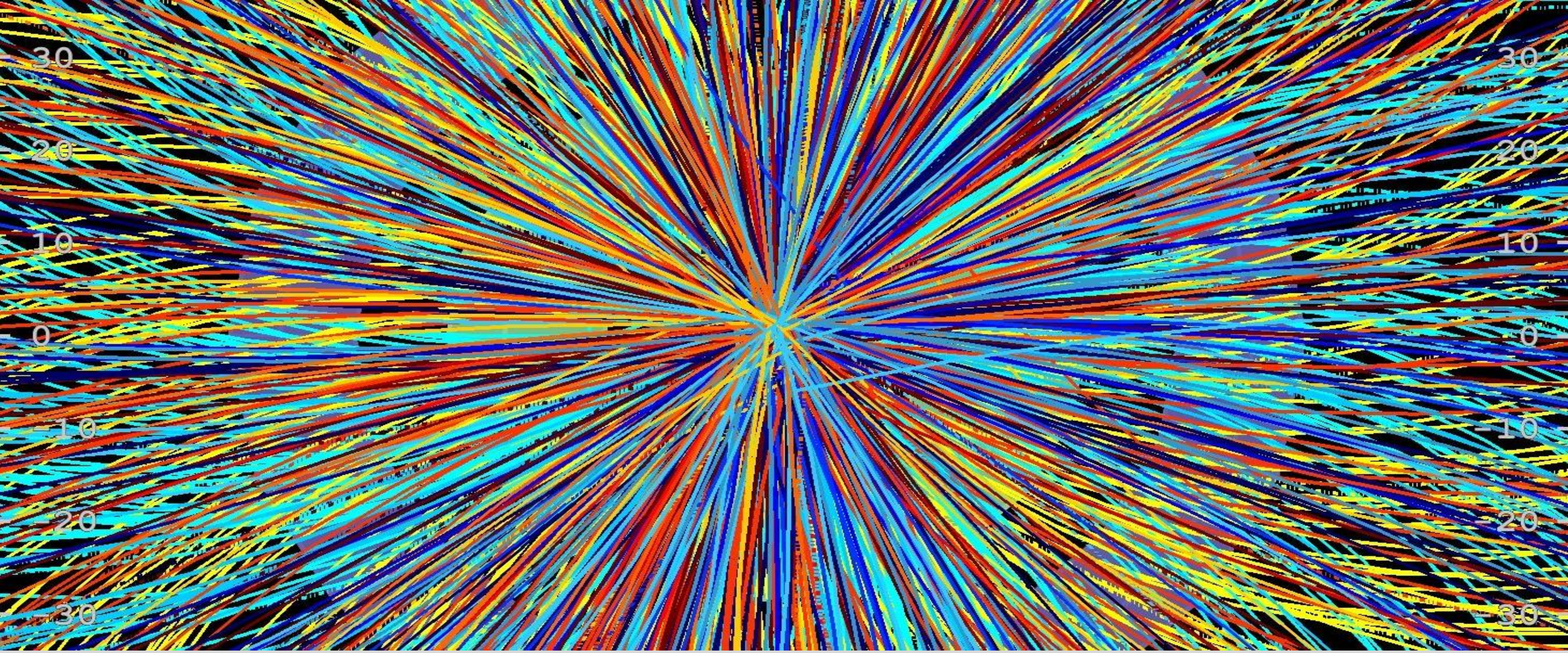


Tagging efficiency and mistagging rate with different cuts on L_{xy}/σ_{Lxy} of secondary vertex for 30 < $p_{T,\,jet}$ < 40 GeV/c.



(Mis)Tagging efficiencies of secondary vertex algorithm for L_{xy}/σ_{Lxy} > 10 and σ_{vtx} < 0.02 cm.

The goal is to find the working point (cuts used in further analysis) with high purity and reasonably high efficiency at the same time.

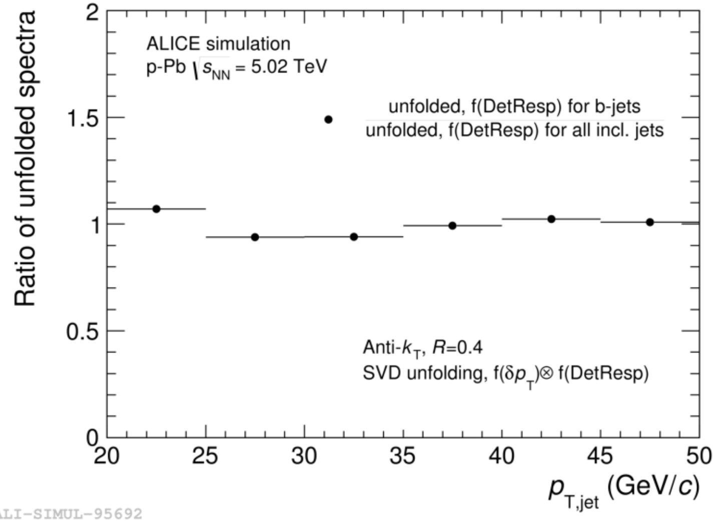


THANK YOU FOR YOUR ATTENTION

BACKUP SLIDES

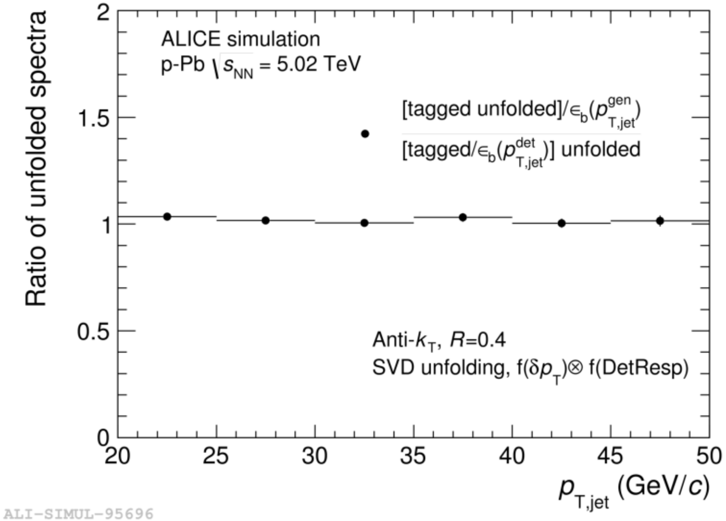
UNFOLDING CORRECTIONS IN p-Pb COLLISIONS

- MC b-jet p_T spectrum is unfolded with the combined matrix:
  - detector response
  - background fluctuations of jets
- Comparison of unfolding with response matrix for b-jets and for inclusive jets



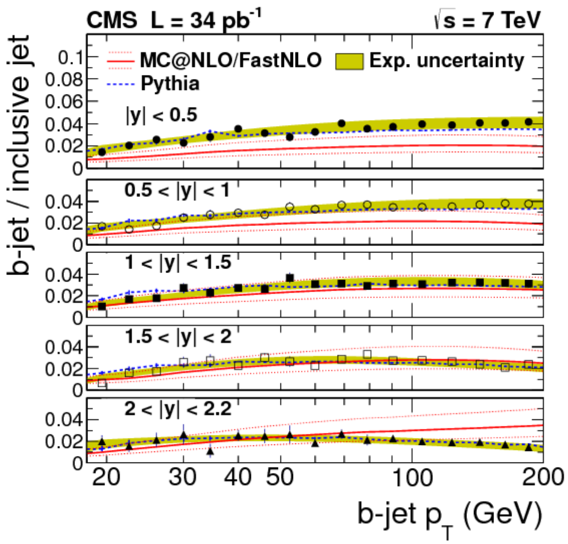
Same results when unfolding spectrum with detector response matrix of inclusive and b-jets

- Tagged spectrum should be:
  - Unfolded
  - Corrected for tagging efficiency and purity
- Estimation of systematic influence of the order of corrections

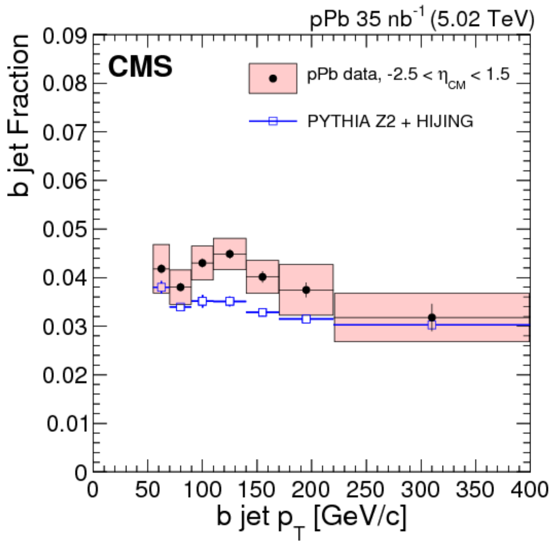


It was verified that the correction order does not give significant differences in the resulting spectrum

b-JET FRACTION IN p-Pb AND pp FROM CMS



b-jet fraction in pp collisions for different rapidity ranges for $20 < p_{T,\,jet} < 200$ GeV/c from CMS experiment

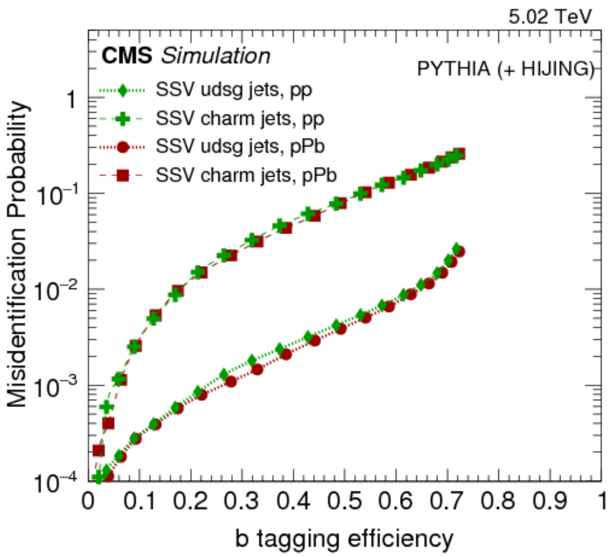


b-jet fraction in p-Pb collisions for different rapidity ranges for $50 < p_{T,\,jet} < 200$ GeV/c from CMS experiment

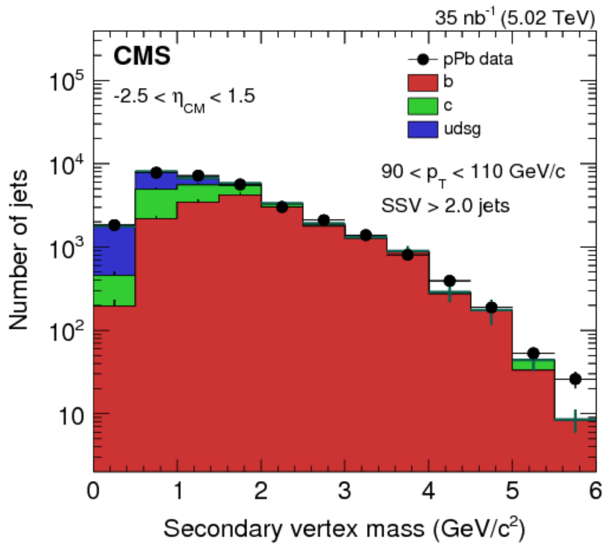
Inclusive b-jet production in pp collisions at $\sqrt{s}$ = 7 TeV, CMS Collaboration (Serguei Chatrchyan et al.) arXiv:1202.4617, JHEP 1204 (2012) 084.

Transverse momentum spectra of b-jets in pPb collisions at $\sqrt{s_{NN}}$ = 5.02 TeV, CMS Collaboration (Khachatryan, Vardan et al.), arXiv:1510.03373, CMS-HIN-14-007, CERN-PH-EP-2015-205.

PERFORMANCE OF b-TAGGING IN p-Pb AT CMS



Tagging efficiency and mistagging rate with different cuts on L_{xy}/σ_{Lxy} of secondary vertex in pp and p-Pb collisions.



Template fit to SSV tagged invariant mass distribution for $90 < p_{T,\,jet} < 110$ GeV/c.

Transverse momentum spectra of b-jets in pPb collisions at $\sqrt{s_{NN}} = 5.02$ TeV, CMS Collaboration (Khachatryan, Vardan et al.), arXiv:1510.03373, CMS-HIN-14-007, CERN-PH-EP-2015-205.

UNFOLDING CORRECTIONS, SVD

- Measured spectrum *m(x')* is a convolution of a true spectrum *t(x)* and detector response function *A(x;x')*:

$$m(x') = \int dx A(x;x')t(x)$$

- In practice one solves the discrete equation with the spectra as histograms and the response function as a matrix: $\boldsymbol{M}_m = \boldsymbol{A}_{m,t} \cdot \boldsymbol{T}_t$

- Given a detector response and background fluctuation matrix, the unfolding can be done with the combined matrix $C_{m,t}$. The measured spectrum M_m is the ”detector” spectrum D_d distorted by background fluctuations $B_{m,d}$: $\boldsymbol{M}_m = \boldsymbol{B}_{m,d} \cdot \boldsymbol{D}_d$
- The ”detector” spectrum D_d is the true spectrum distorted by detector effects $A_{d,t}$: $\boldsymbol{D}_d = \boldsymbol{A}_{d,t} \cdot \boldsymbol{T}_t$
- Thus, measured spectrum is:

$$\boldsymbol{M}_m = \boldsymbol{B}_{m,d} \cdot \boldsymbol{A}_{d,t} \cdot \boldsymbol{T}_t = \boldsymbol{C}_{m,t} \cdot \boldsymbol{T}_t$$

- Finding and inverse matrix is an ill-posed problem, since it is very sensitive to small perturbations of the data.
- Here we used SVD (singular value decomposition) as a main method for our results