HF jets analysis

23.06.2020 ALICE@IFJ meeting

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Outline

1. Progress in HF-jets analysis
   - efficiency & contamination corrections
   - closure test on MC
   - “Barlow test” – uncorrelated error under change of threshold

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    - **efficiency & contamination corrections**
    - closure test on MC
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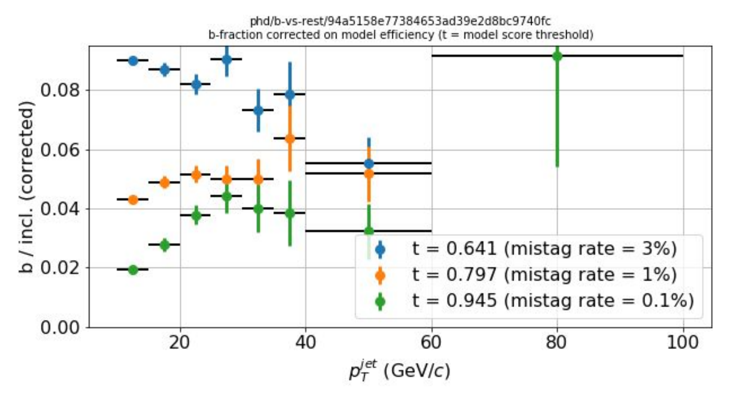
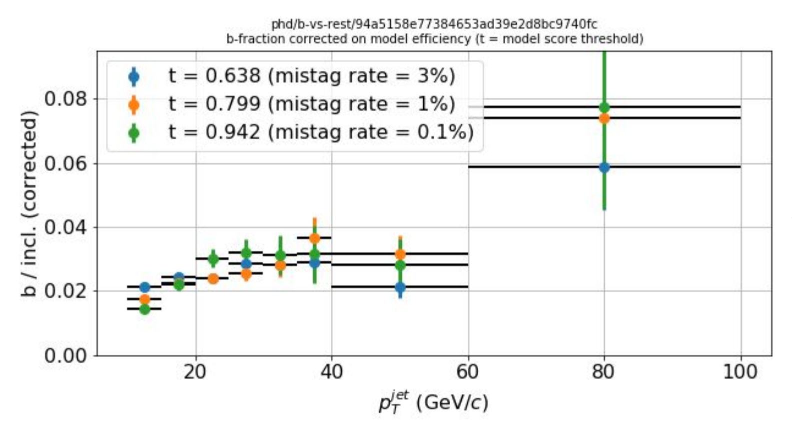
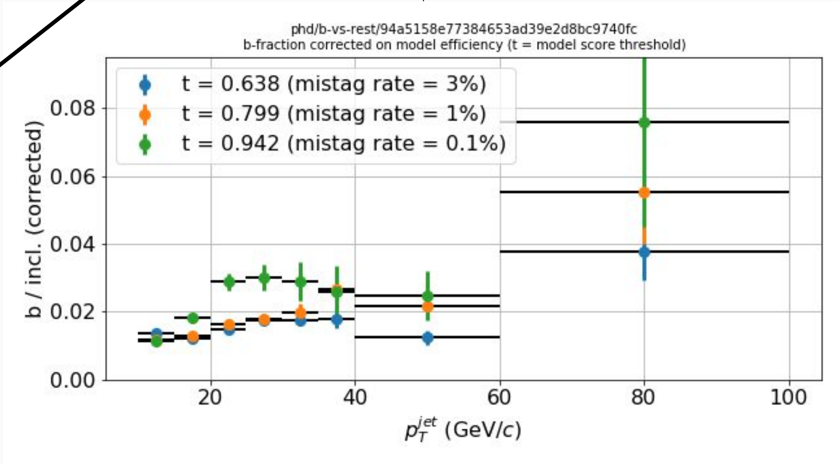
Reminder: problem source



Calculated corrections depend on number of assumed fraction of b-jets

here:
50% b **OR** 2% b **OR** 1% b





Reminder: suggestion to split correction

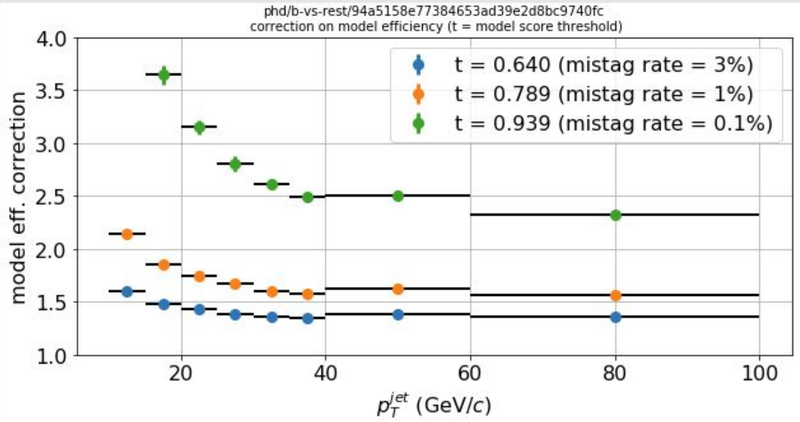
$$\text{total correction} = \frac{N_{MC}^{true\ b}}{N_{MC}^{b-tagged}} = \frac{TP+FN}{TP+FP}$$

$$\text{eff. correction} = \frac{N_{MC}^{true\ b}}{N_{MC}^{true\ \ b-tagged}} = \frac{TP+FN}{TP}$$

$$\text{contamination correction} = \frac{N_{MC}^{true\ tagged-b}}{N_{MC}^{b-tagged}} = \frac{TP}{TP+FP}$$

total correction = (eff. corr) x (contamination corr.)
but it’s still useful to judge if obtained corrections are reasonable and which factor is more significant

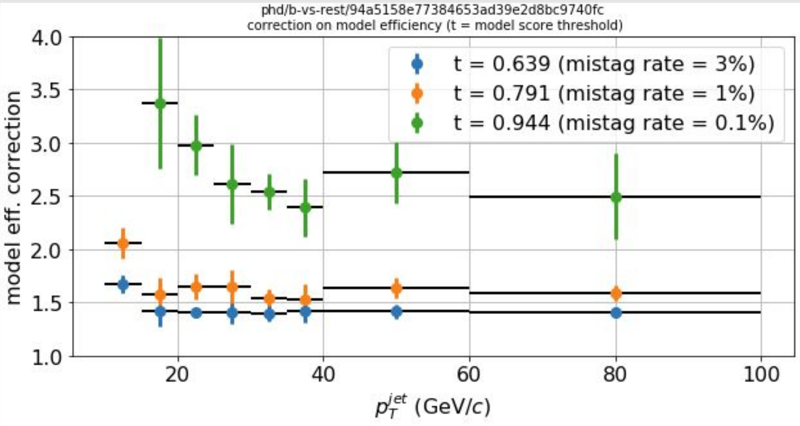
Correction factorized

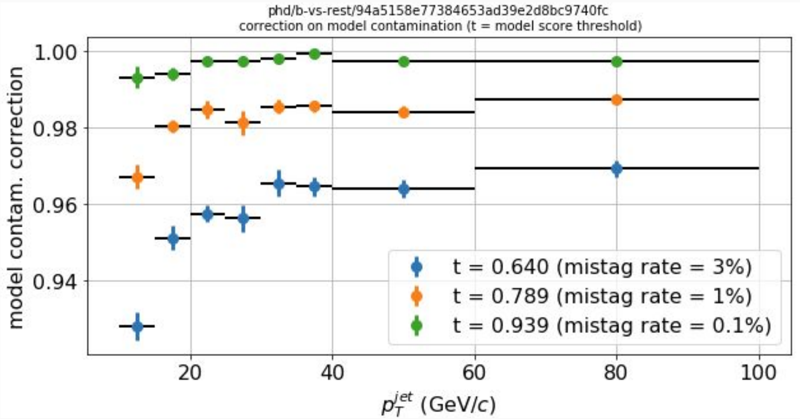


b-frac:

50% **1%**

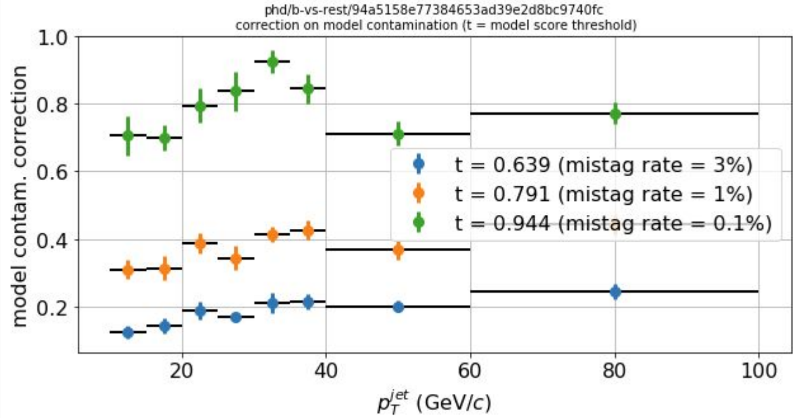
efficiency
correction
- similar for both
- higher errors for b-frac = 1%



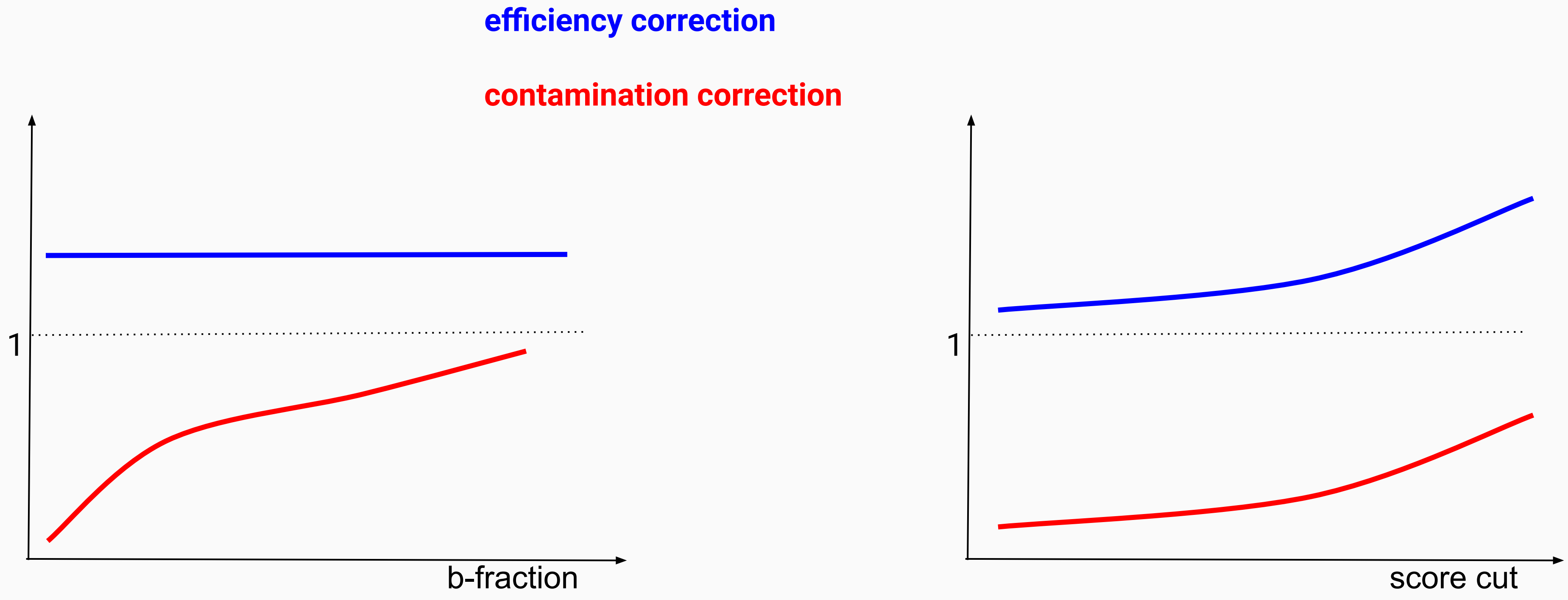


contamination
correction

- differ a lot
- similar magnitudes as those of eff. correction for mistag rate between 1% – 0.1%



Sketches of factorized corrections



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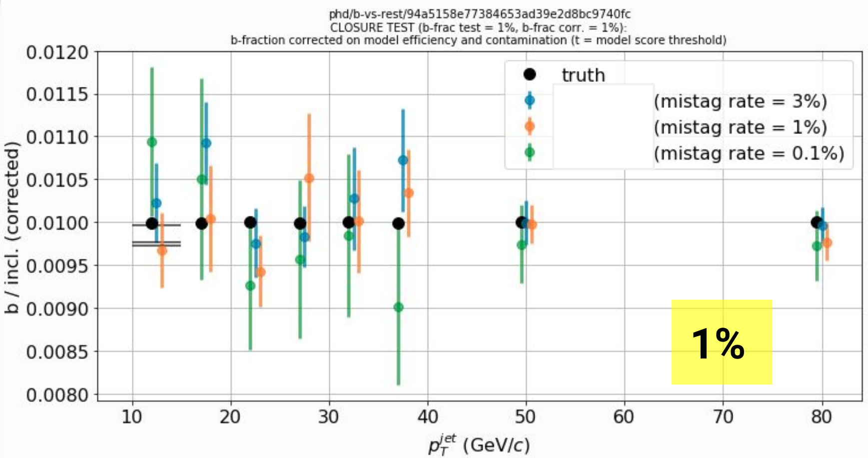
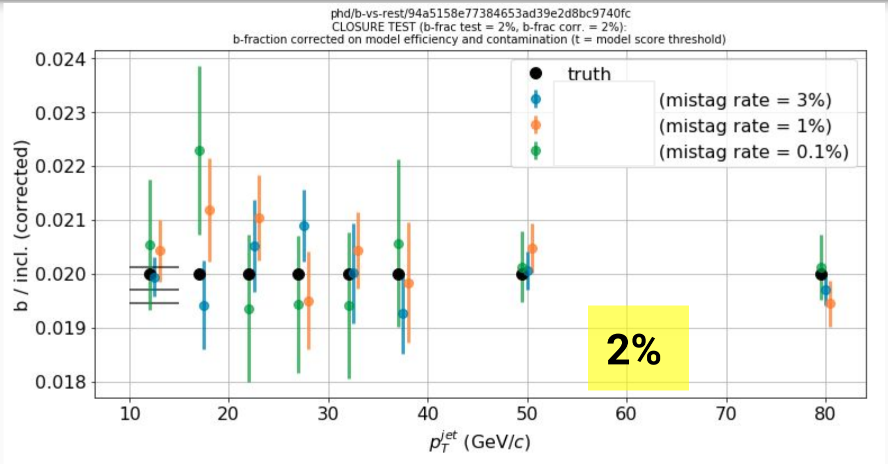
Closure test

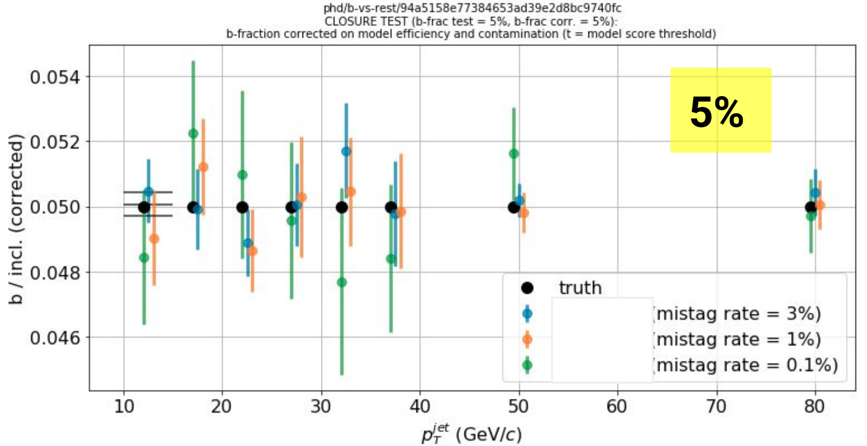
- two identically generated MC samples: test one (pseudo data) and second used to calculate corrections
- we want to reproduce true value in test sample
- relatively simple test, if it fails then we should worry

- 500k for both test ("pseudo-data") and corrections samples
- differences w.r.t. previous plots:
  - the fraction of b-jets is exactly the same in each pt bin
  - the threshold values are adjusted separately for each bin
  - 3 WPs considered: mistagging rate = 3%, 1%, 0.1%

Closure test



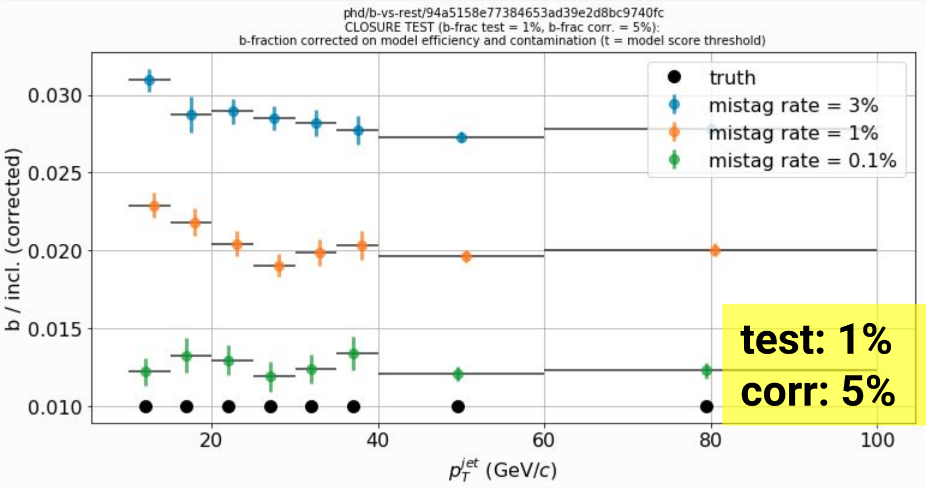


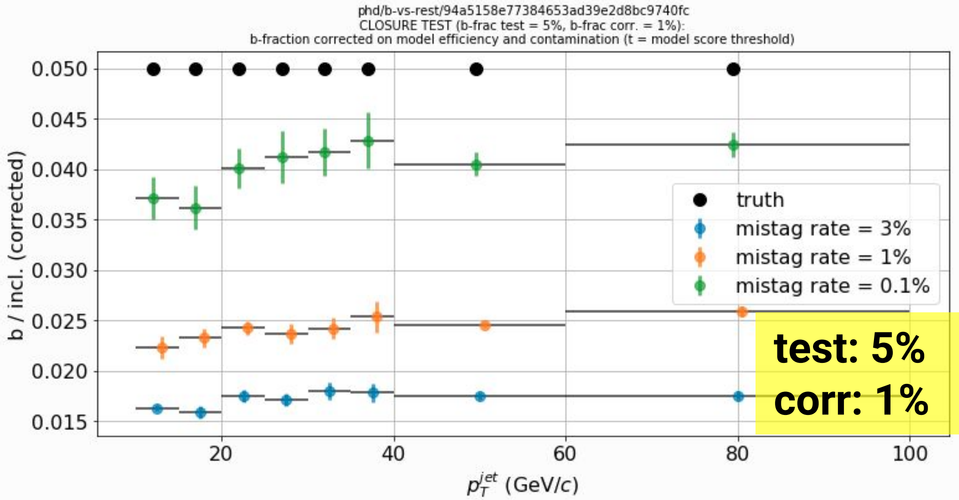


the errorbars include 2 sources:
- poissonian error from uncorrected ratio and
- correction uncertainty from bootstrap sampling
they give more less similar contribution

variation of roughly 5% (σ) between truth and 3 WPs

Closure test: wrong b-fraction





What if our assumed b-fraction is wrong?

- strong dependence on choice of WP
- purest sample is much closer to truth <-- eff. corr. does not change with b-fraction and contamination corr. is smallest for this WP

  this is strong argument against *high eff. / low purity WP*

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Barlow test

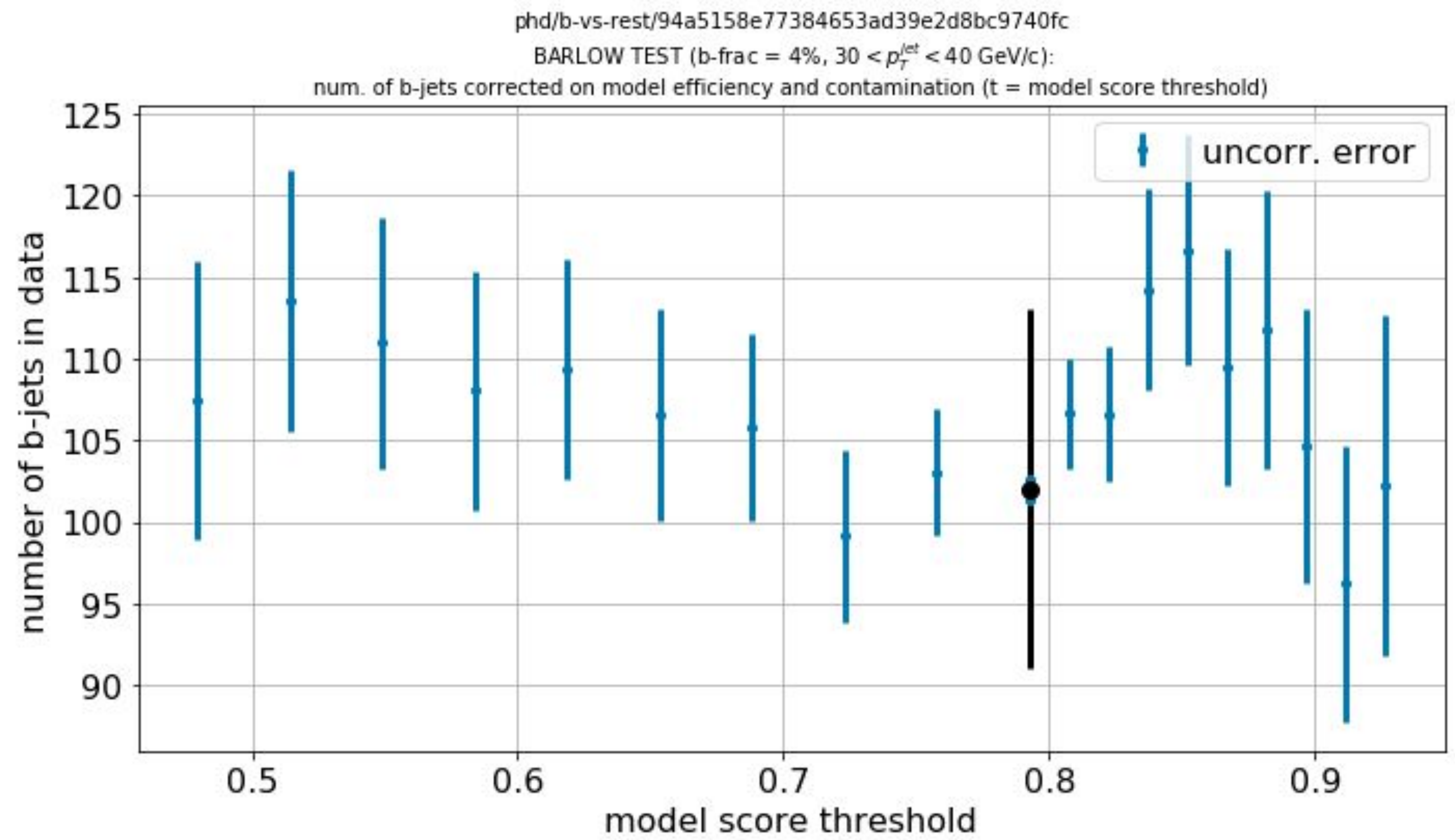
Test how much our main results changes under variation of the threshold value
WPs share data so uncorrelated errors will be used $\sqrt{\sigma^2 - \sigma_{ref}^2}$

Procedure (for single pT bin):

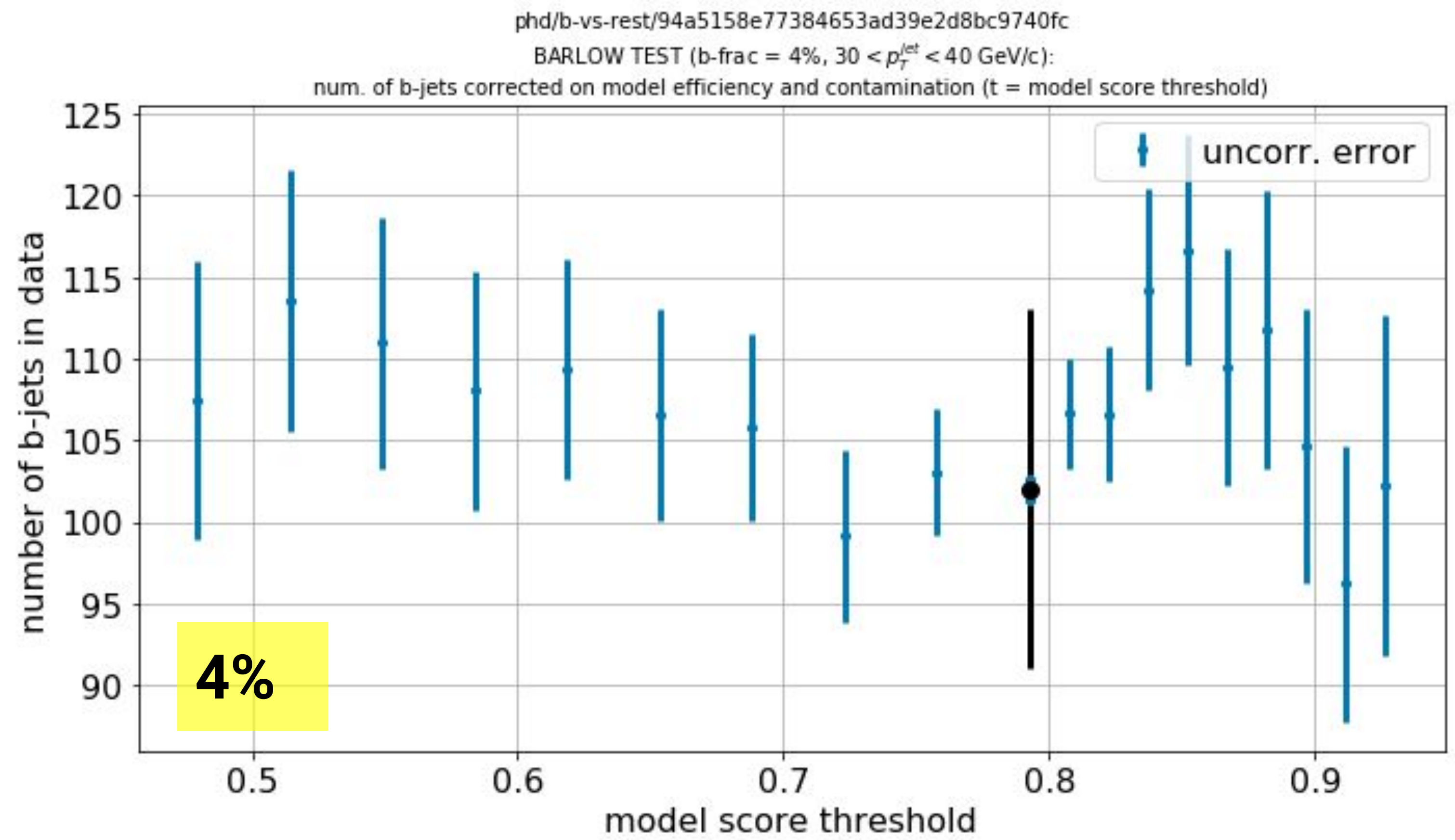
1. select reference WP (mistag. rate = 1%)
2. vary it by 20% of efficiency in both directions to get boundaries for considered thresholds range (similarly as in L_c analysis with BDT)
3. calculate value and sigma for 10 WPs between boundary and reference WP
4. subtract in quadrature

https://arxiv.org/pdf/hep-ex/0207026.pdf
https://indico.cern.ch/event/591374/contributions/2511753/attachments/1429002/2193943/01_PWA-Barlow.pdf

Barlow test

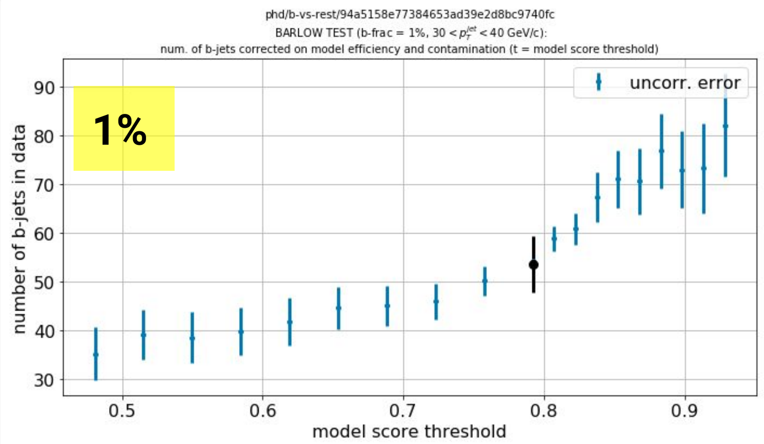

phd/b-vs-rest/94a5158e77384653ad39e2d8bc9740fc
BARLOW TEST (b-frac = 4%, 30 < p_T^{jet} < 40 GeV/c):
num. of b-jets corrected on model efficiency and contamination (t = model score threshold)
uncorr. error
number of b-jets in data
125
120
115
110
105
100
95
90
0.5
0.6
0.7
0.8
0.9
model score threshold

Barlow test



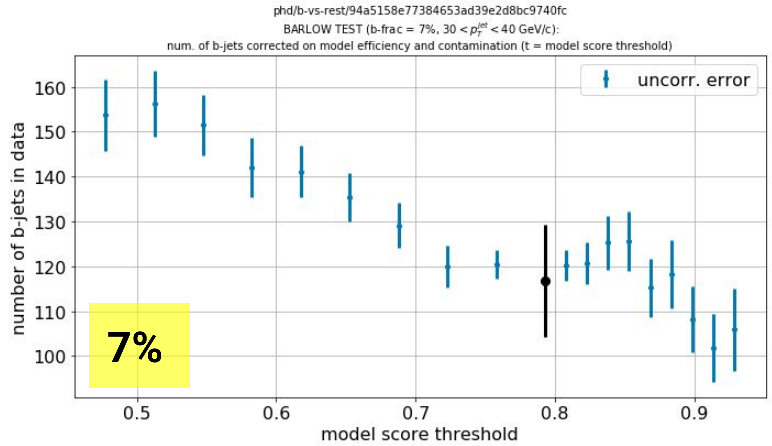
again, depends in assumed b-fraction ...

Barlow test

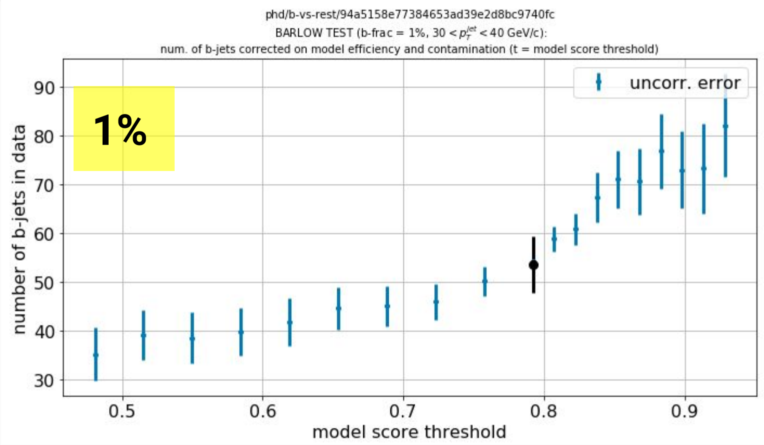


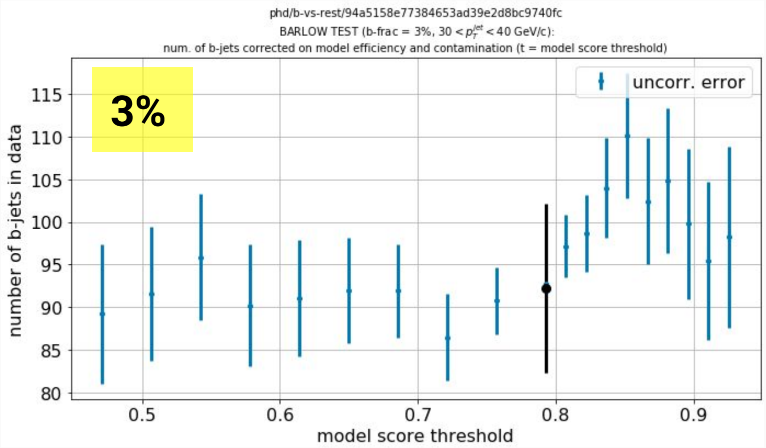
b-fraction
< far too small

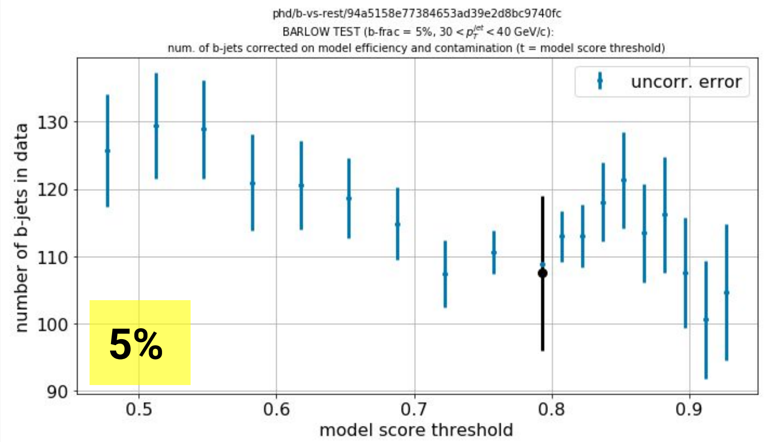
far too large >

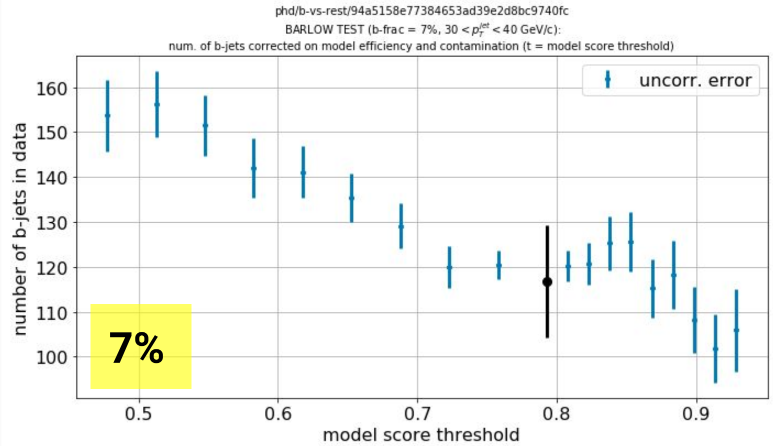


Barlow test

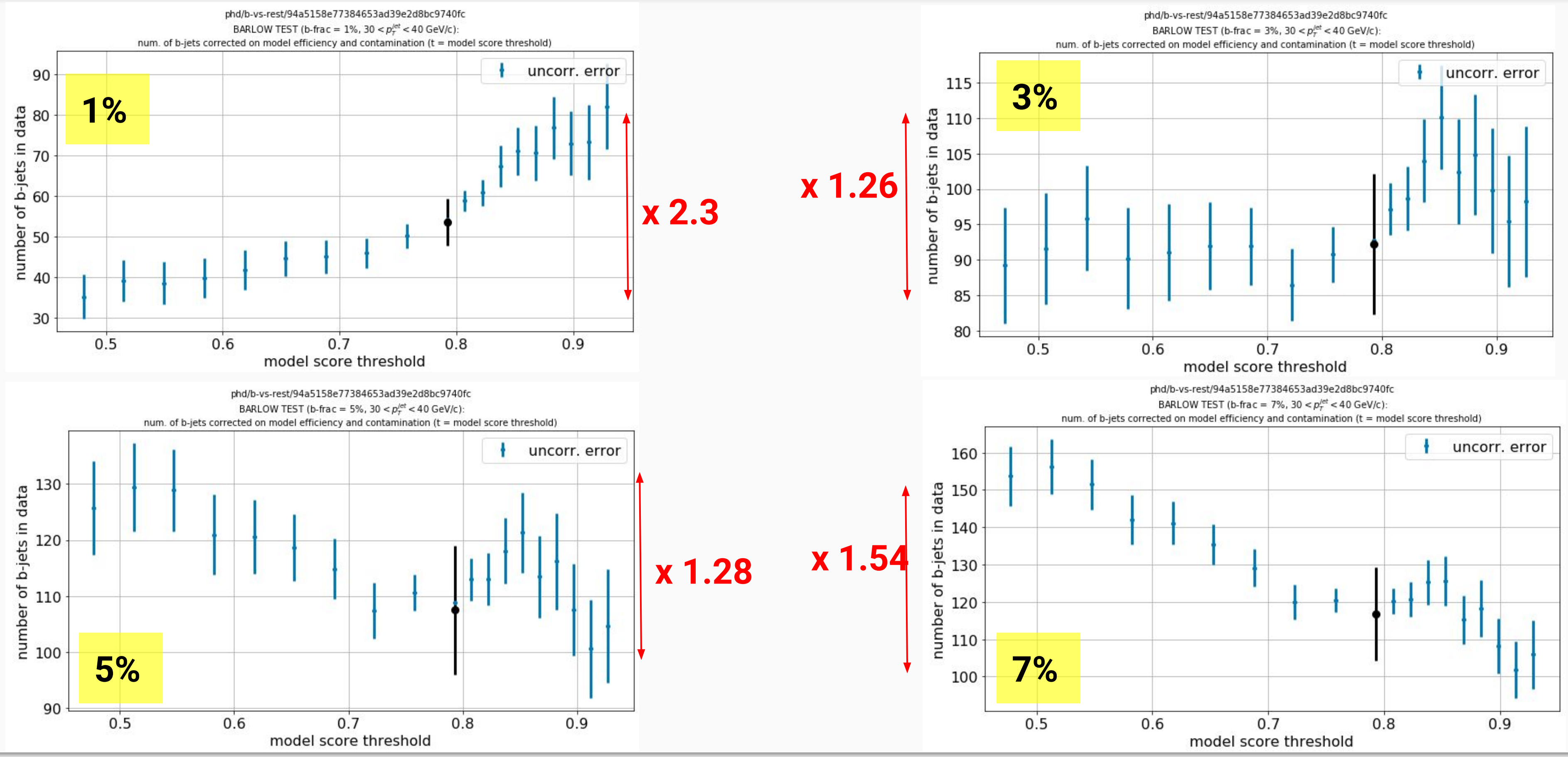

phd/b-vs-rest/94a5158e77384653ad39e2d8bc9740fc
BARLOW TEST (b-frac = 1%, $30 < p_T^{jet} < 40$ GeV/c):
num. of b-jets corrected on model efficiency and contamination (t = model score threshold)
uncorr. error
1%
number of b-jets in data
model score threshold
30
40
50
60
70
80
90
0.5
0.6
0.7
0.8
0.9


phd/b-vs-rest/94a5158e77384653ad39e2d8bc9740fc
BARLOW TEST (b-frac = 3%, $30 < p_T^{jet} < 40$ GeV/c):
num. of b-jets corrected on model efficiency and contamination (t = model score threshold)
uncorr. error
3%
number of b-jets in data
model score threshold
80
85
90
95
100
105
110
115
0.5
0.6
0.7
0.8
0.9


phd/b-vs-rest/94a5158e77384653ad39e2d8bc9740fc
BARLOW TEST (b-frac = 5%, $30 < p_T^{jet} < 40$ GeV/c):
num. of b-jets corrected on model efficiency and contamination (t = model score threshold)
uncorr. error
5%
number of b-jets in data
model score threshold
90
100
110
120
130
0.5
0.6
0.7
0.8
0.9


phd/b-vs-rest/94a5158e77384653ad39e2d8bc9740fc
BARLOW TEST (b-frac = 7%, $30 < p_T^{jet} < 40$ GeV/c):
num. of b-jets corrected on model efficiency and contamination (t = model score threshold)
uncorr. error
7%
number of b-jets in data
model score threshold
100
110
120
130
140
150
160
0.5
0.6
0.7
0.8
0.9

Barlow test


1%
phd/b-vs-rest/94a5158e77384653ad39e2d8bc9740fc
BARLOW TEST (b-frac = 1%, 30 < p_T^jet < 40 GeV/c):
num. of b-jets corrected on model efficiency and contamination (t = model score threshold)
uncorr. error
number of b-jets in data
model score threshold
x 2.3
3%
phd/b-vs-rest/94a5158e77384653ad39e2d8bc9740fc
BARLOW TEST (b-frac = 3%, 30 < p_T^jet < 40 GeV/c):
num. of b-jets corrected on model efficiency and contamination (t = model score threshold)
uncorr. error
number of b-jets in data
model score threshold
x 1.26
5%
phd/b-vs-rest/94a5158e77384653ad39e2d8bc9740fc
BARLOW TEST (b-frac = 5%, 30 < p_T^jet < 40 GeV/c):
num. of b-jets corrected on model efficiency and contamination (t = model score threshold)
uncorr. error
number of b-jets in data
model score threshold
x 1.28
7%
phd/b-vs-rest/94a5158e77384653ad39e2d8bc9740fc
BARLOW TEST (b-frac = 7%, 30 < p_T^jet < 40 GeV/c):
num. of b-jets corrected on model efficiency and contamination (t = model score threshold)
uncorr. error
number of b-jets in data
model score threshold
x 1.54

Barlow test

pT = 30-40 GeV/c: for b-fraction = 3−4% the variation by 20% of tagging efficiency fits within reference uncertainty (equal ~10% so not huge)

Test passed unless corrections are derived from invalid MC

https://arxiv.org/pdf/hep-ex/0207026.pdf
https://indico.cern.ch/event/591374/contributions/2511753/attachments/1429002/2193943/01_PWA-Barlow.pdf

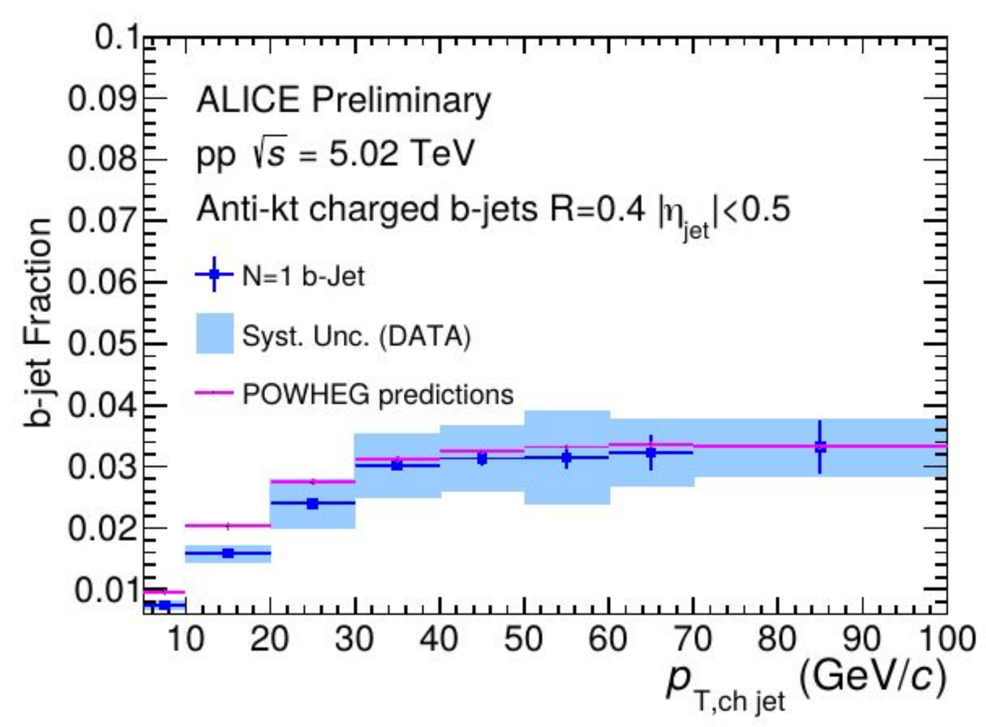
Next steps? (discussion)

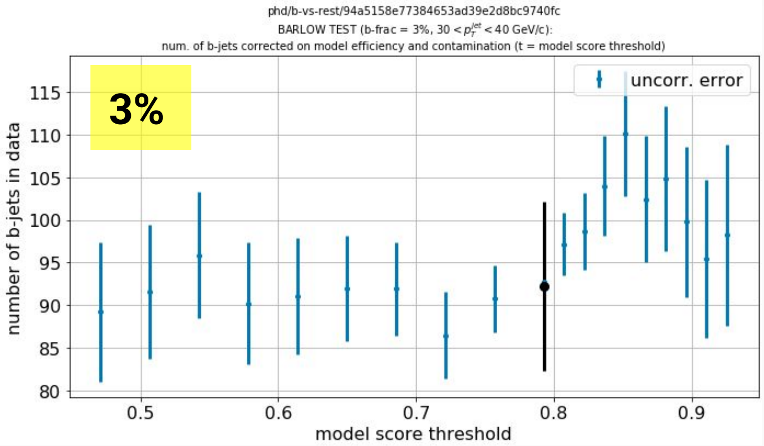
- data - MC diff <- 1.
- built x-section <- 2.   (response matrix etc)
- angular structure <- 3.
- OR more pp data <- 4.

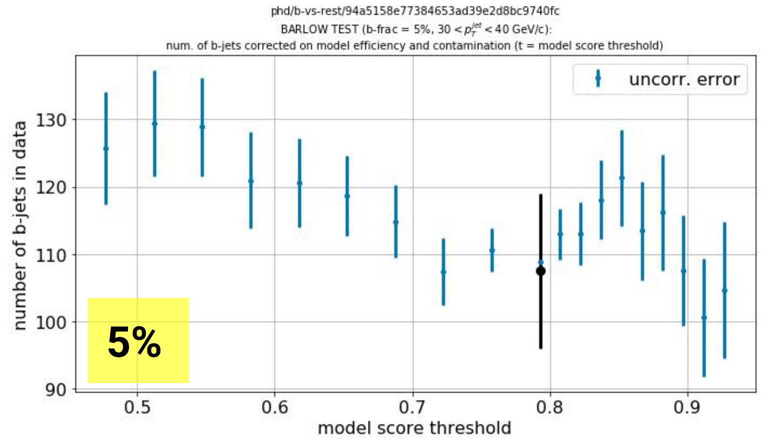
analysis note <- 0.   (BEFORE HOLIDAY)

Backup

Barlow test

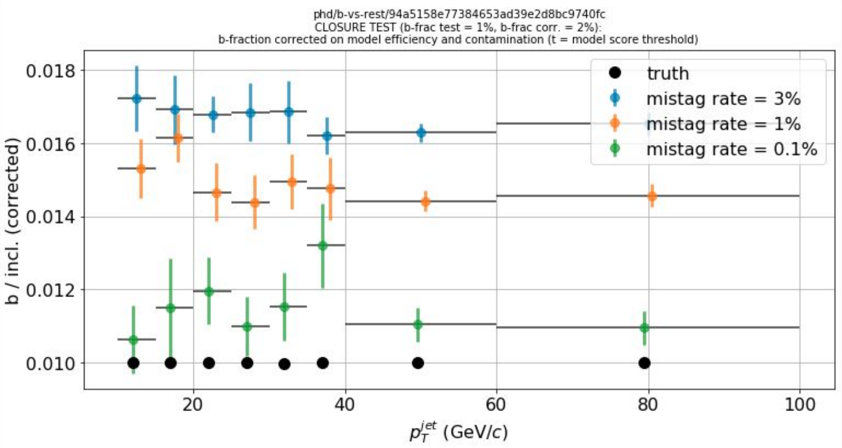


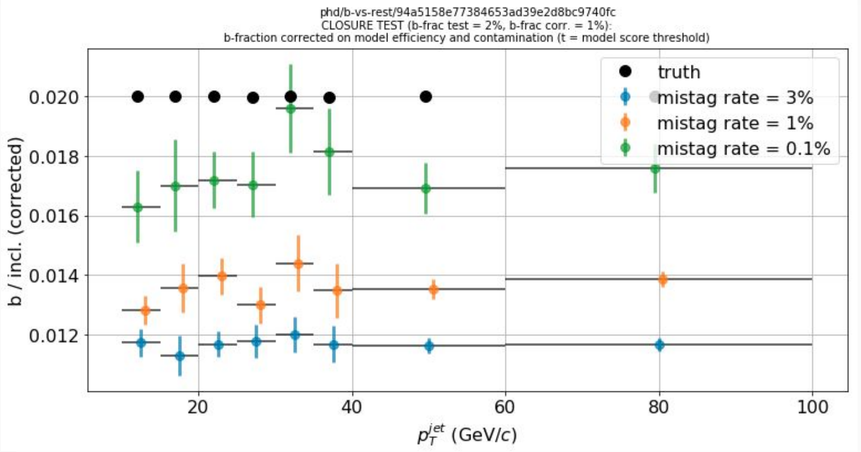


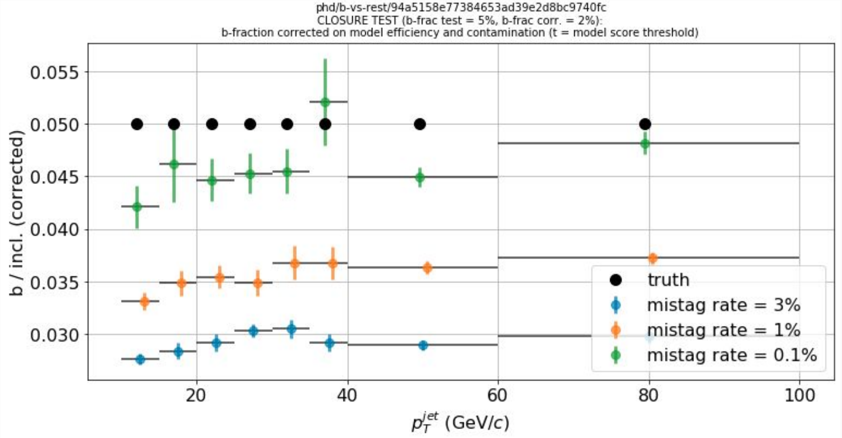


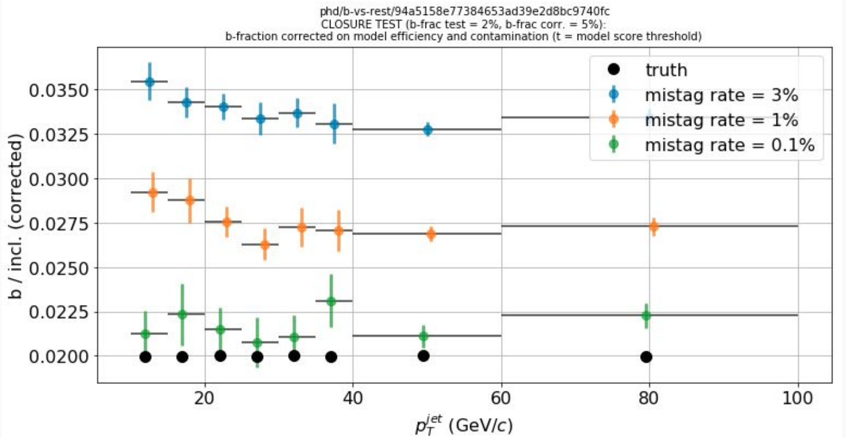
file:///home/sebbys/Downloads/apply_on_data-corrections-Copy1.html

Closure test: wrong b-fraction, realistic ~x2

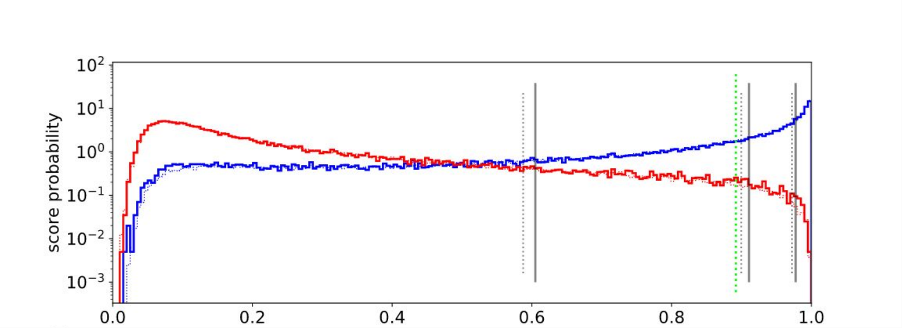


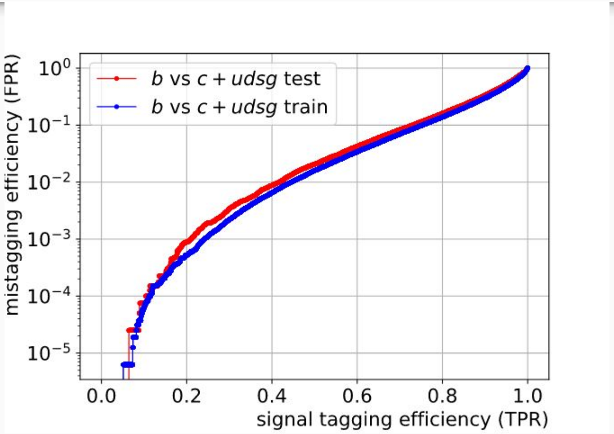


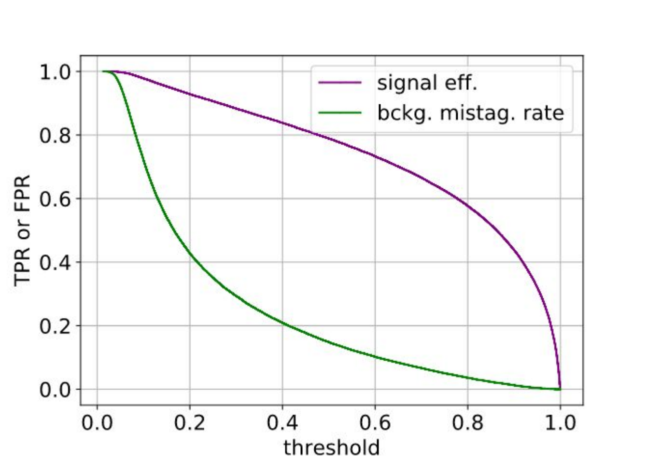




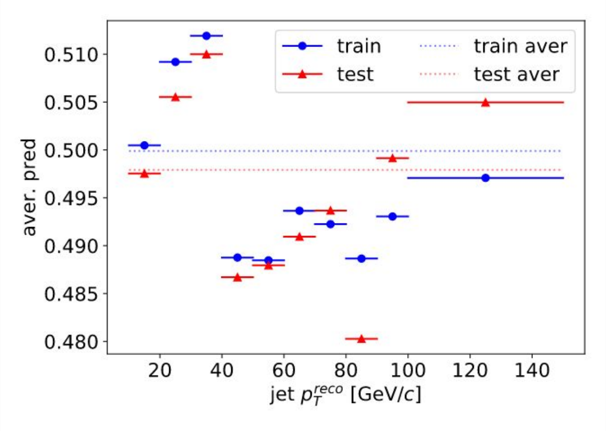
model with aligned pT distribution



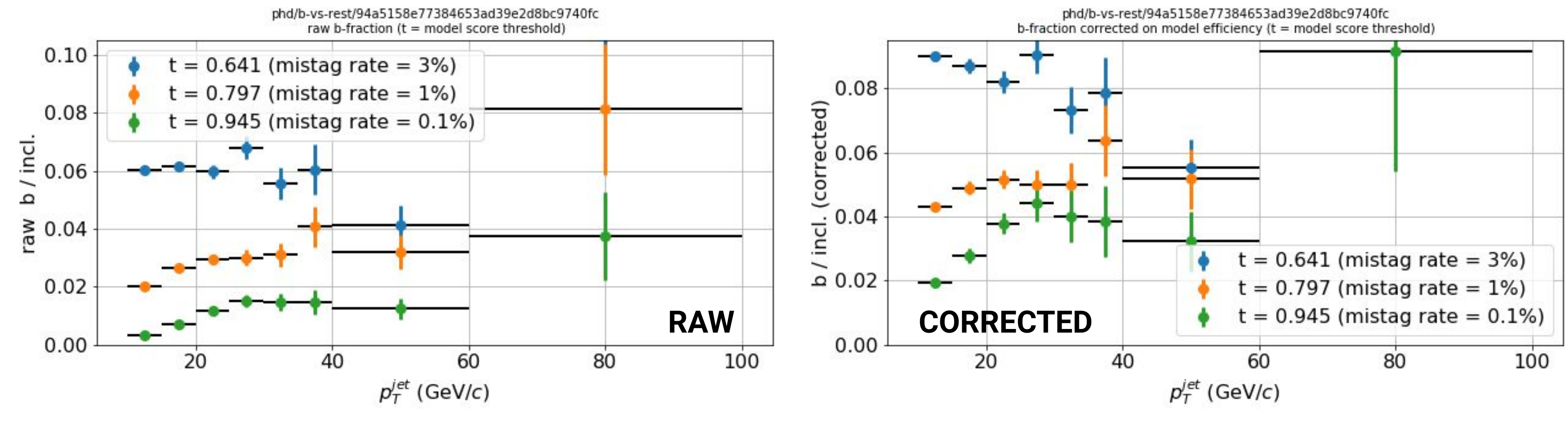




LINK TO PLOTS

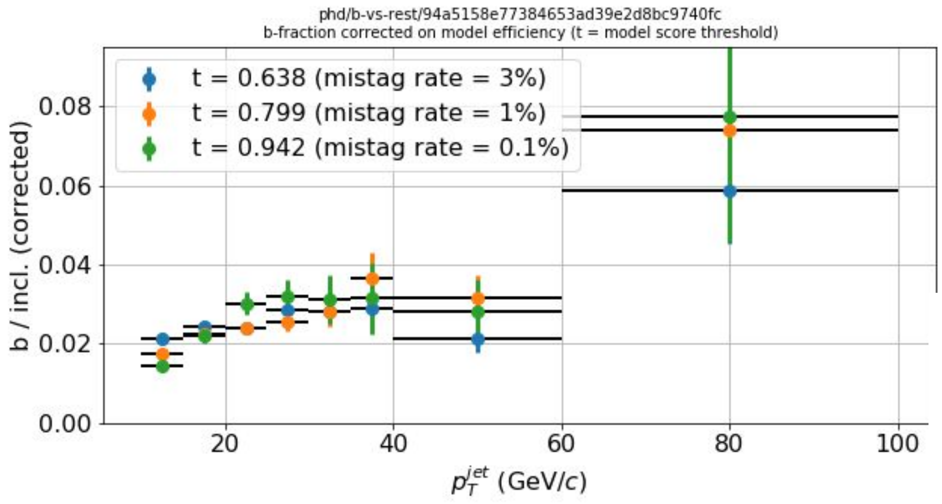


b-fraction (raw vs corrected)



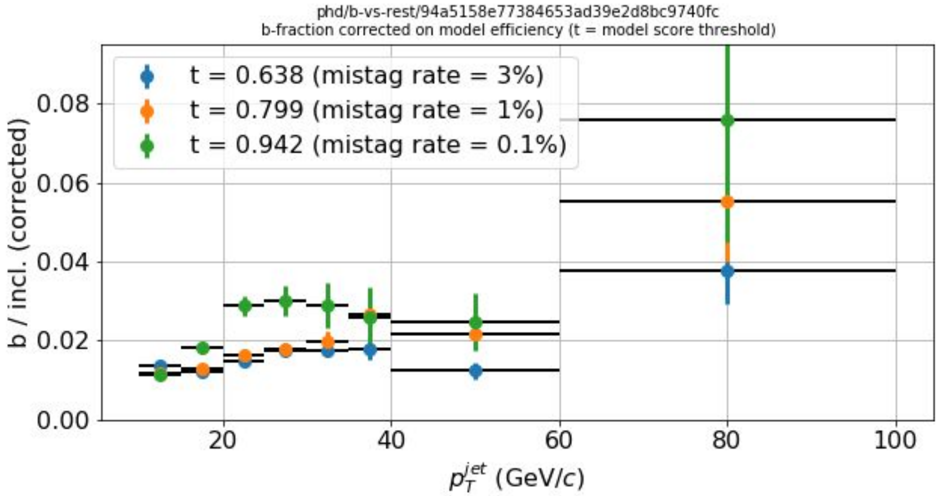
- the same ordering is observed in both raw and corrected b-fraction -- somehow the corrections are *too weak*
- results very stable across many models with changed hyperparameters / input vector

problem source (corrected b-fraction, different MC mix)



before for calculating the MC correction (not for training) I used:
50% b + 50% udsg + 5% c

here:
~90% udsg + ~10% c + 2% b **OR** 1% b



- *changes in MC mix change correction strength*
- *the method require using realistic MC mix (including pT dependence)*