

# Vertex Resolution and Flavour tagging performance of the New CLIC Detector

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# Outline

- ◆ Software and samples
- ◆ PV and SV resolution vs single-point resolution of the vertex detector
- ◆ Flavour tagging performance
  - Single-point resolution of the vertex detector
  - Conformal tracking
- ◆ Summary

# Software and samples

## 1. ILCSoft 23-08-2017

## 2. CLIC\_o3\_v13

## 3. Dijet samples at 500 GeV (20°-90°) -> at 10° performance severely degraded

- e+e- -> bb (80.000 events)
- e+e- -> cc (80.000 events)
- e+e- -> qq (q= uds) (80.000 events)

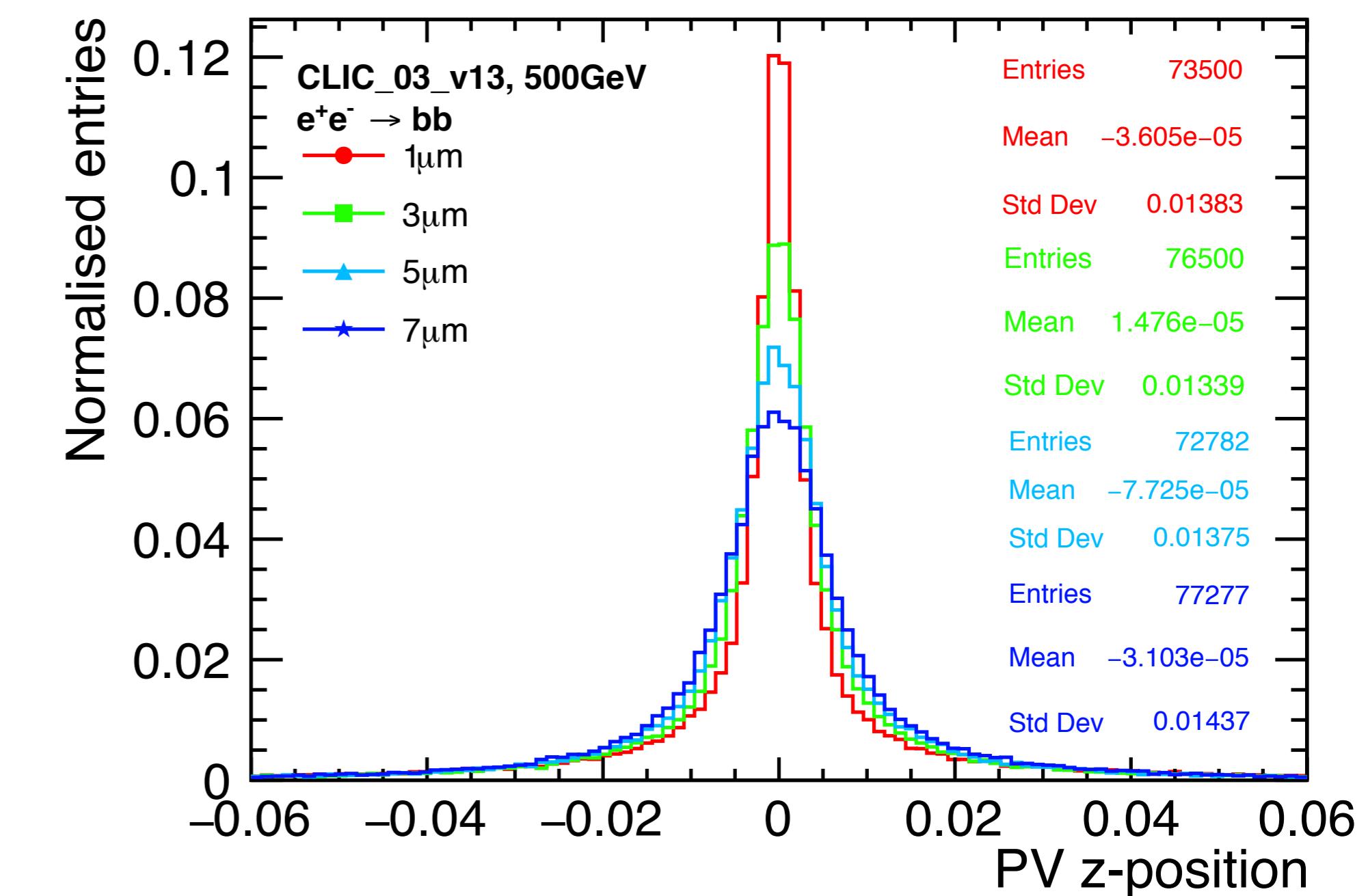
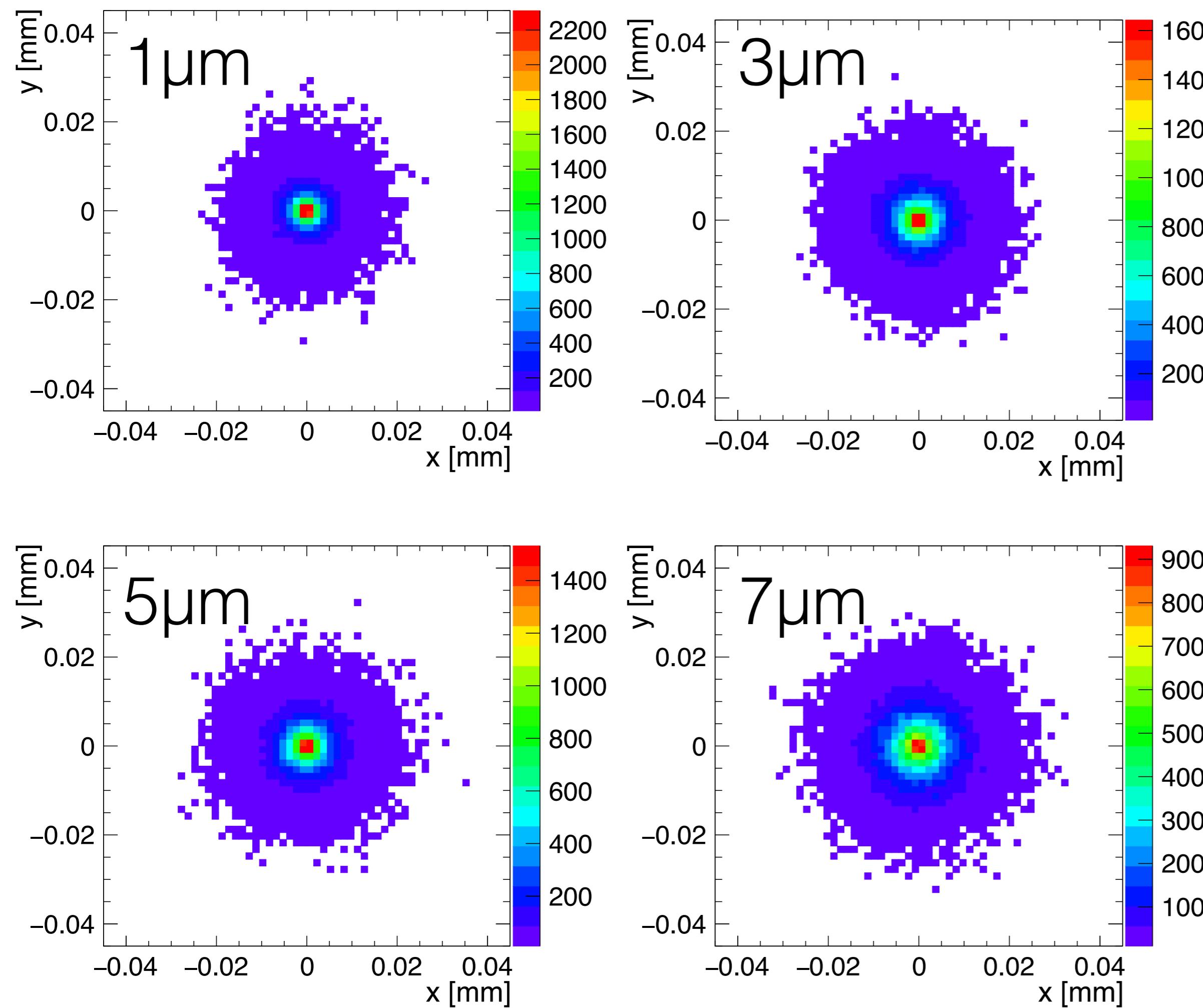
## 4. Single-point resolution

- The performance of the default value  $3\mu\text{m}$  is compared to the  $1\mu\text{m}$ ,  $5\mu\text{m}$  and  $7\mu\text{m}$  cases

## 5. Conformal tracking version included in the ILCSoft released of 23-08-2017

# Primary vertex resolution vs single-point resolution

- Primary vertex shape in the XY plane for 1 $\mu\text{m}$ , 3 $\mu\text{m}$ , 5 $\mu\text{m}$  and 7 $\mu\text{m}$  single-point resolution of the vertex detector (notice the number of entries for red colour)



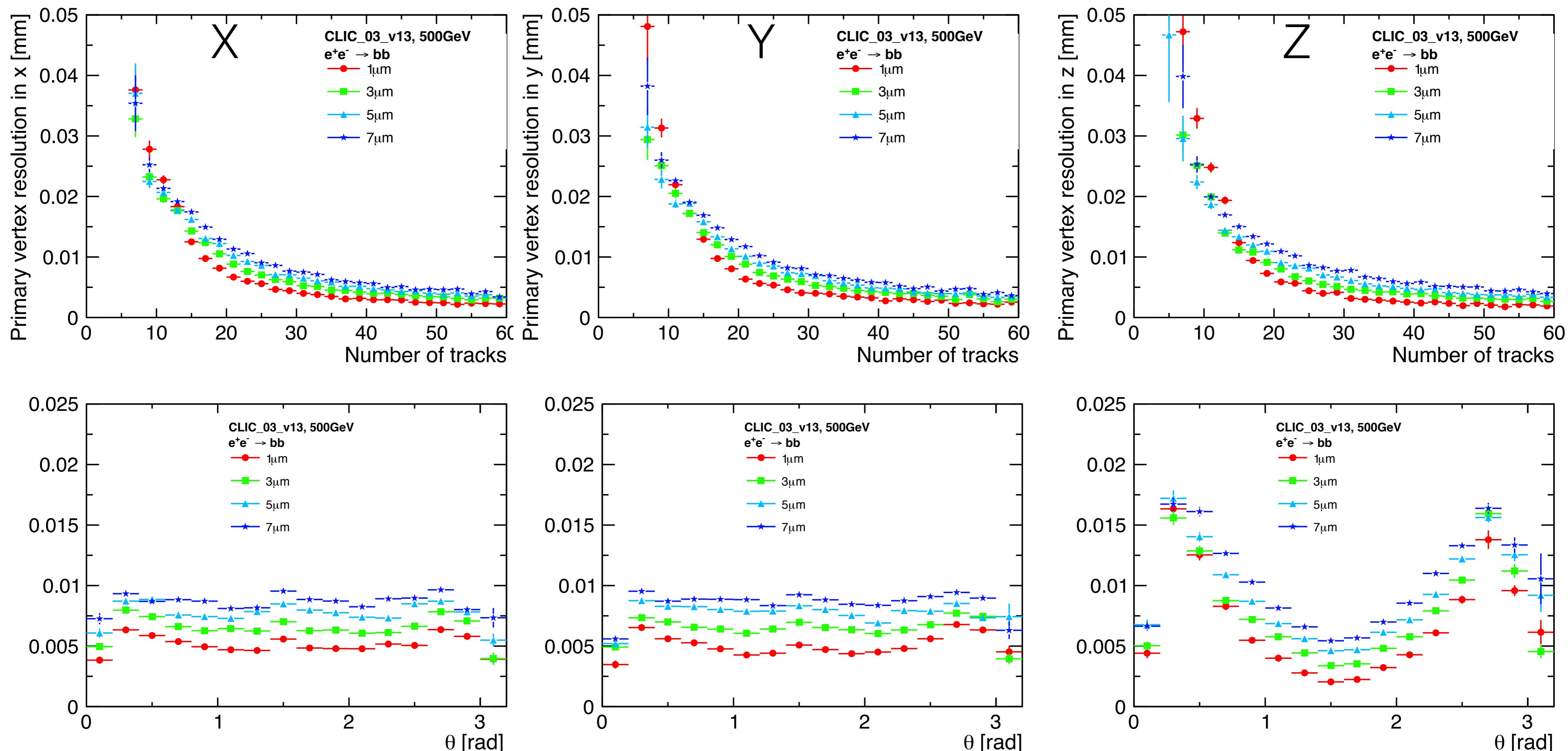
- z-position of the PV
- The standard deviation of the distribution varies between 13,4 $\mu\text{m}$  (best case) and 14,4 $\mu\text{m}$
- Higher single-point resolution wider distribution of the PV

# Primary vertex resolution vs single-point resolution

PV resolution below 10mm for 20 tracks or more

$\Theta$  = polar angle of particles associated to PV

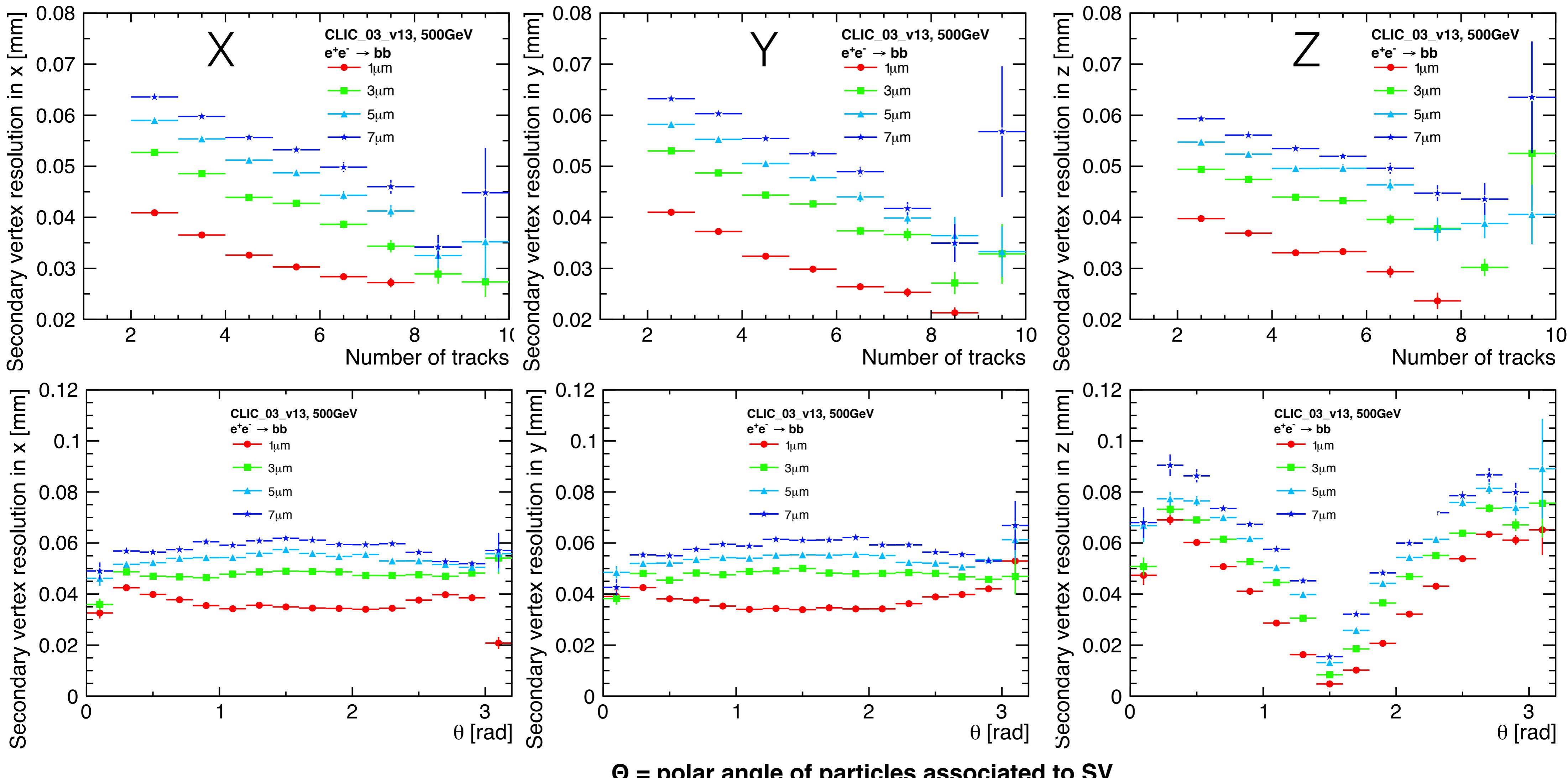
5 and 7 $\mu\text{m}$  single-point resolution still offer acceptable performance compared to the default case 3 $\mu\text{m}$



# Secondary vertex resolution vs single point resolution

Resolution for SV worse than PV as expected (being  $\sim 30\mu\text{m}$  in the best case)

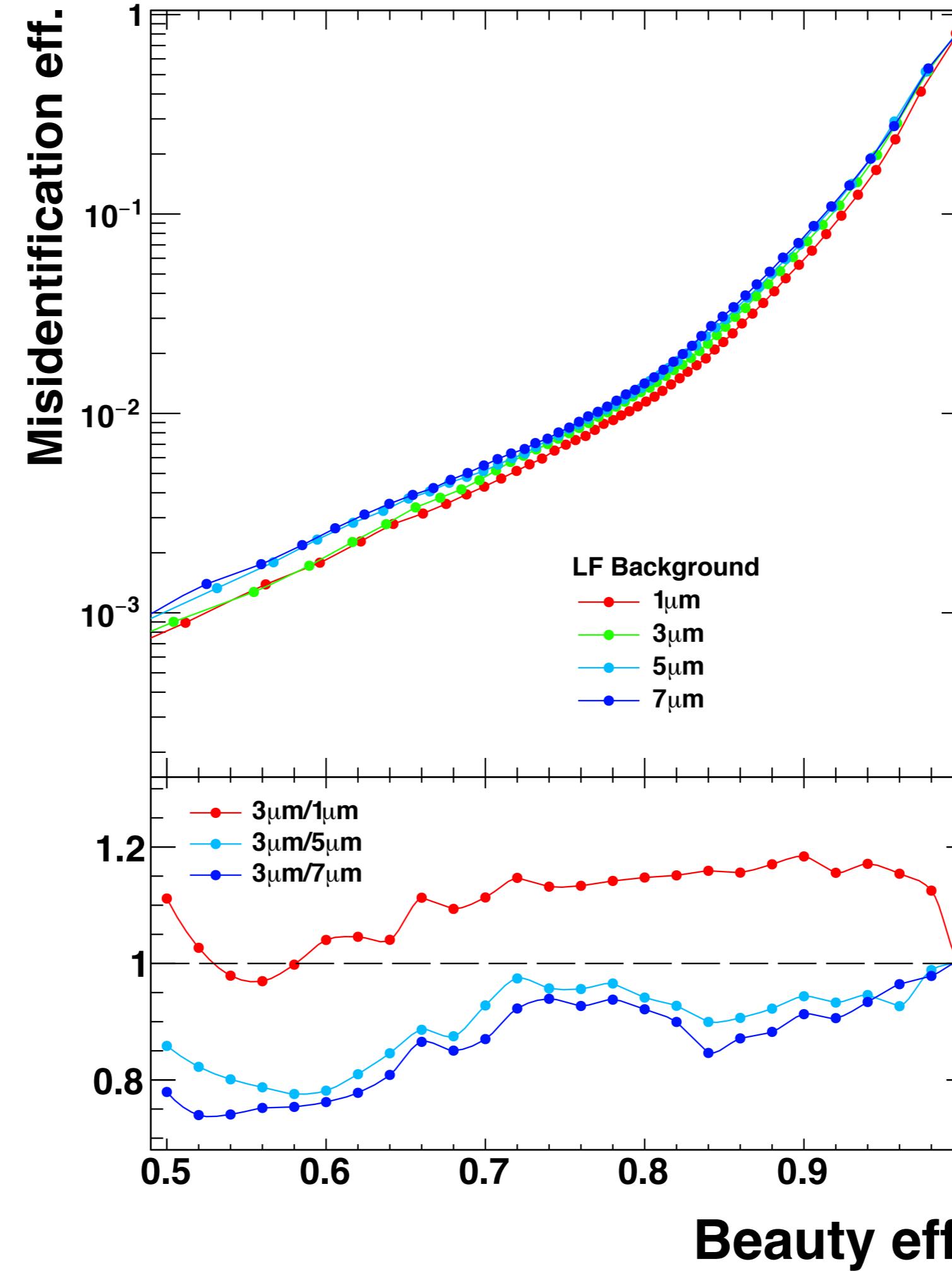
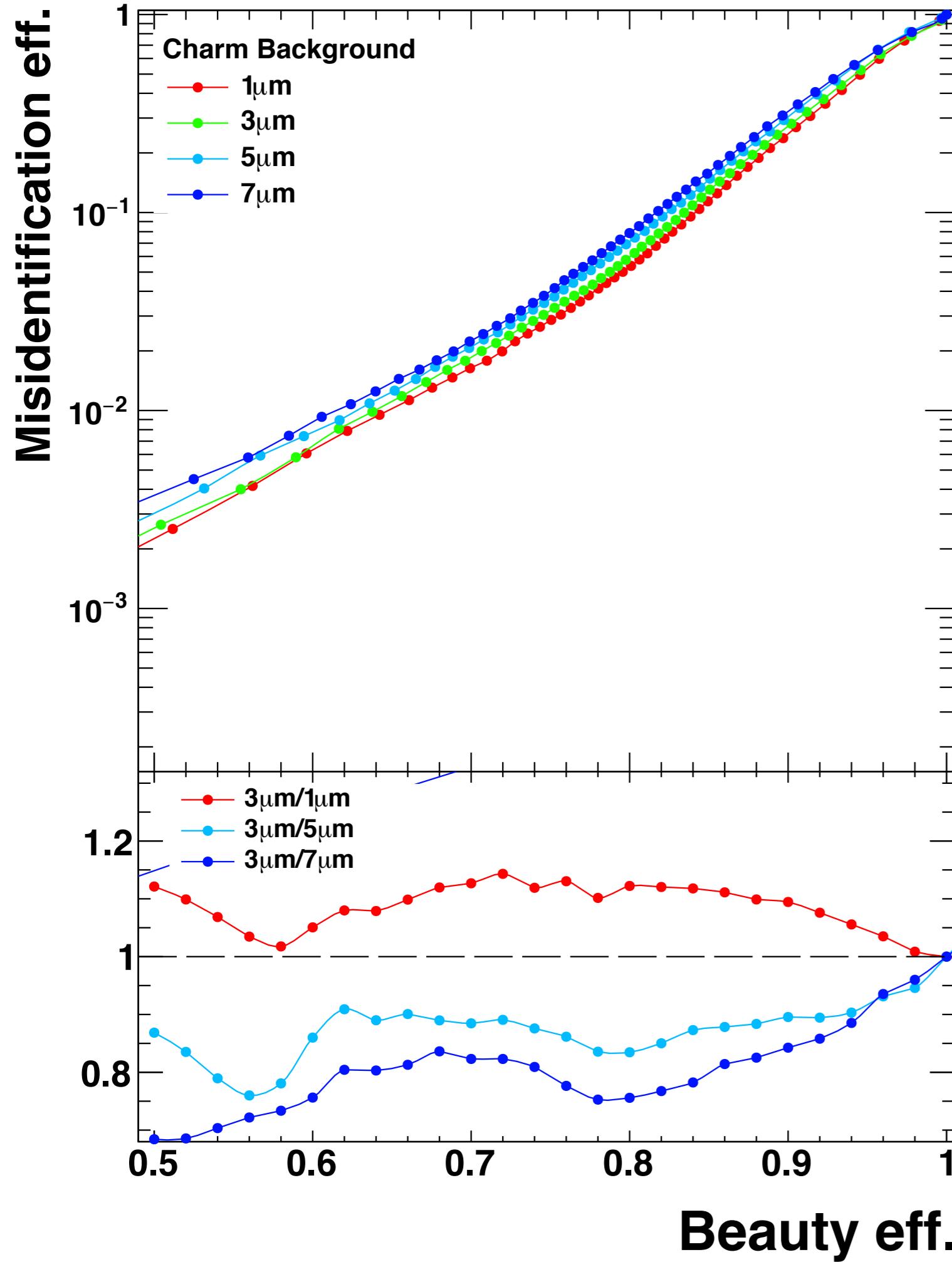
5 and 7 $\mu\text{m}$  single-point resolution offer generally a 10% and 20% worse SV resolution than the default case 3 $\mu\text{m}$



# Flavour tagging performance vs single-point resolution

b-tagging efficiency is compared for the different single-point resolution considered

Ratio plots (bottom part) are filled dividing the default case ( $3\mu\text{m}$ ) by the non-default cases



As expected, higher single-point resolution values performs worse.

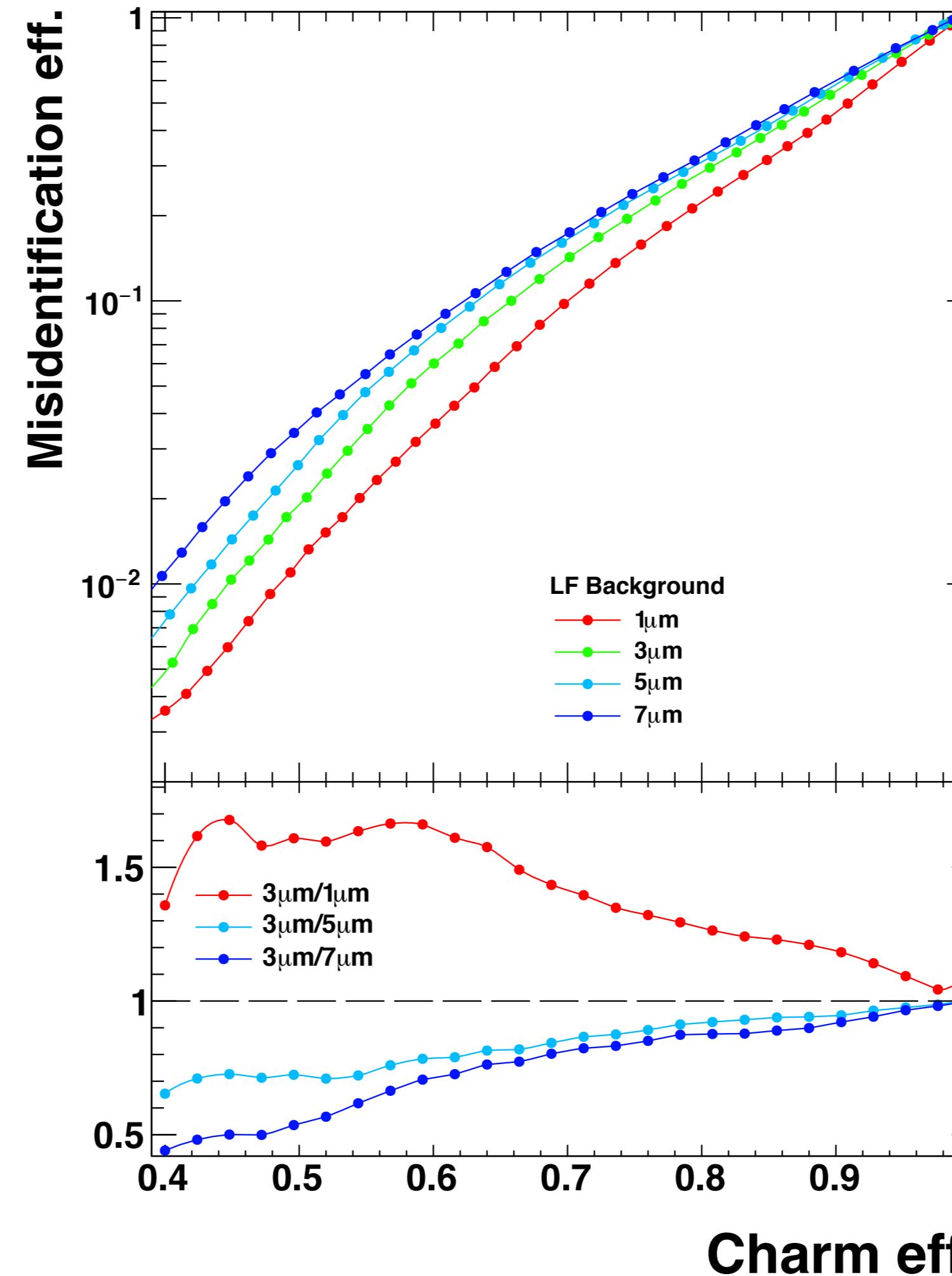
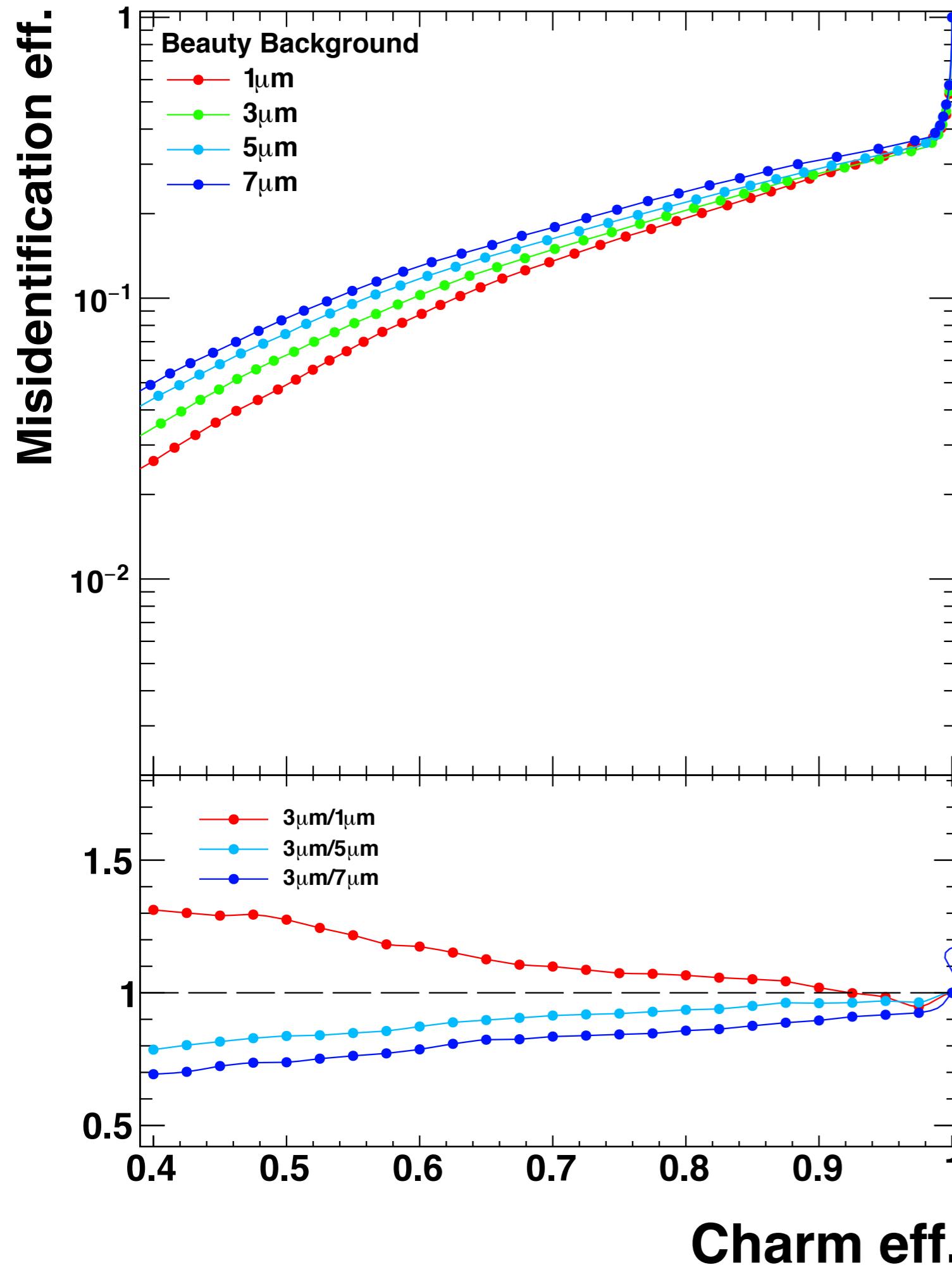
Miss-identification efficiency increases between 10% and 30% for  $>3\mu\text{m}$

Moving from 5 to 7 $\mu\text{m}$  doesn't lead to a dramatic degradation of the b-tagging performance

# Flavour tagging performance vs single-point resolution

c-tagging efficiency is compared for the different single-point resolution considered

Ratio plots (bottom part) are filled dividing the default case ( $3\mu\text{m}$ ) by the non-default cases



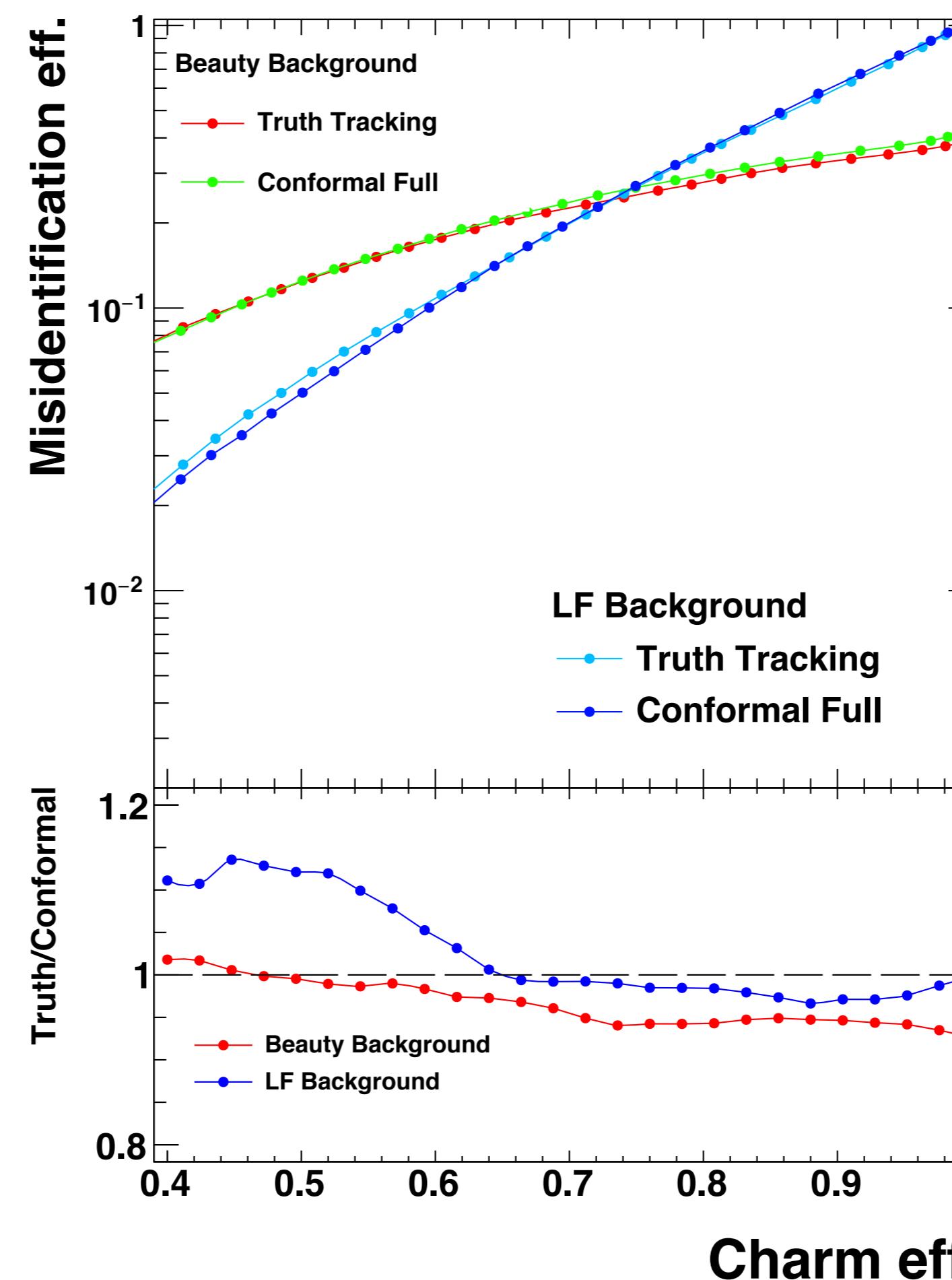
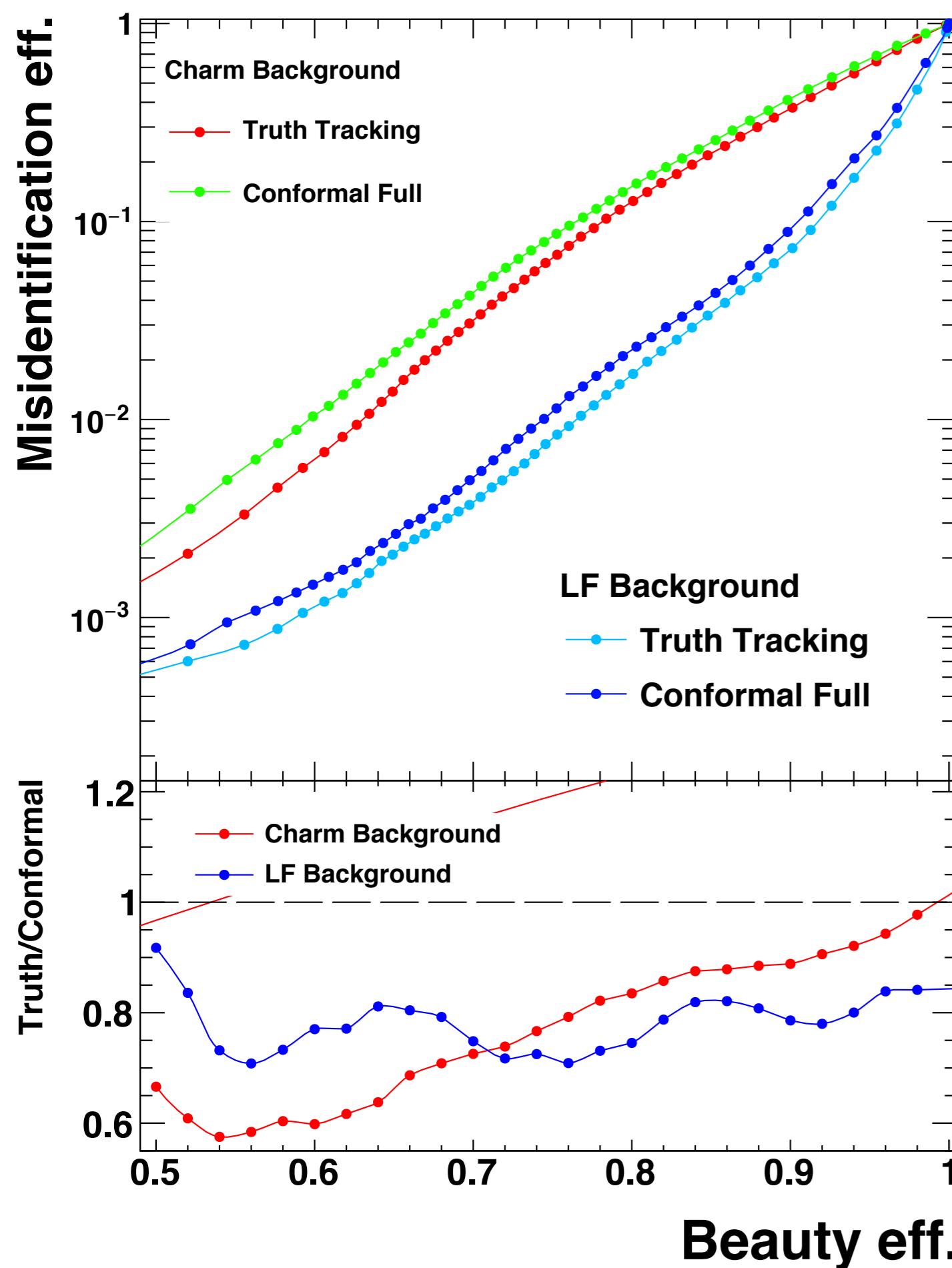
c-tagging efficiency is strongly dependent on the single-point resolution

Specially for c-jets miss-identified as LF-jets, where the miss-identification efficiency increases up to 50% for 5 $\mu\text{m}$  and 7 $\mu\text{m}$  compared to default

# Flavour tagging performance vs Conformal tracking

b-tagging and c-tagging efficiency is evaluated for the truth tracking and the realistic conformal tracking.

Ratio plots (bottom part) are filled with Truth/Conformal



**b-tagging efficiency:**  
With conformal tracking  
the miss-identification  
efficiency can be up 40%  
larger

**c-tagging efficiency:**  
Conformal tracking  
performs similar to truth  
tracking within a 10%  
variations of the miss-  
identification efficiency

# Summary

## PV and SV resolution

- PV resolution below 10mm even for a single-point resolution of  $7\mu\text{m}$
- SV resolution gets worse by a factor 10% and 20% for  $5\mu\text{m}$  and  $7\mu\text{m}$  respectively

## Flavour tagging performance

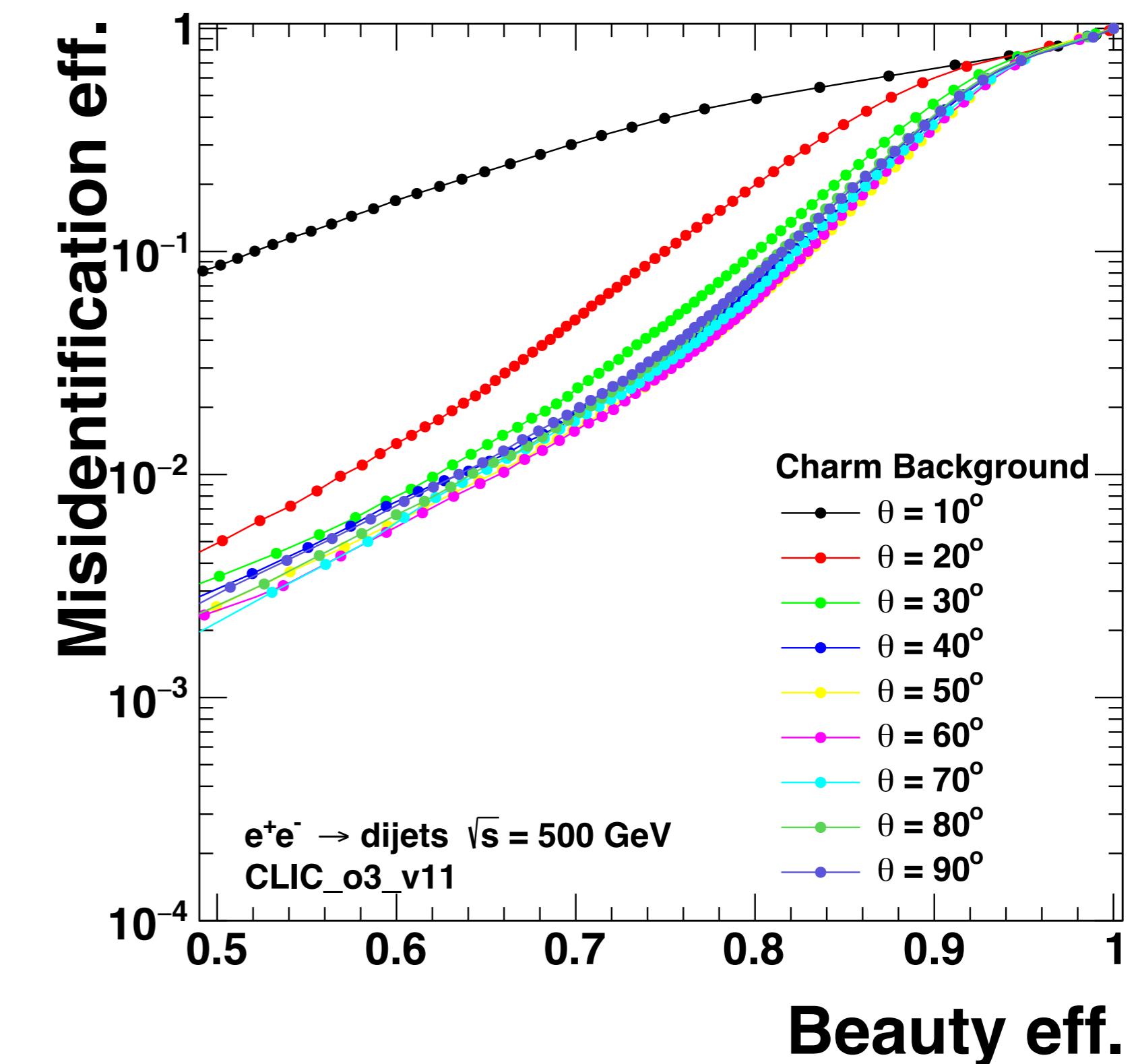
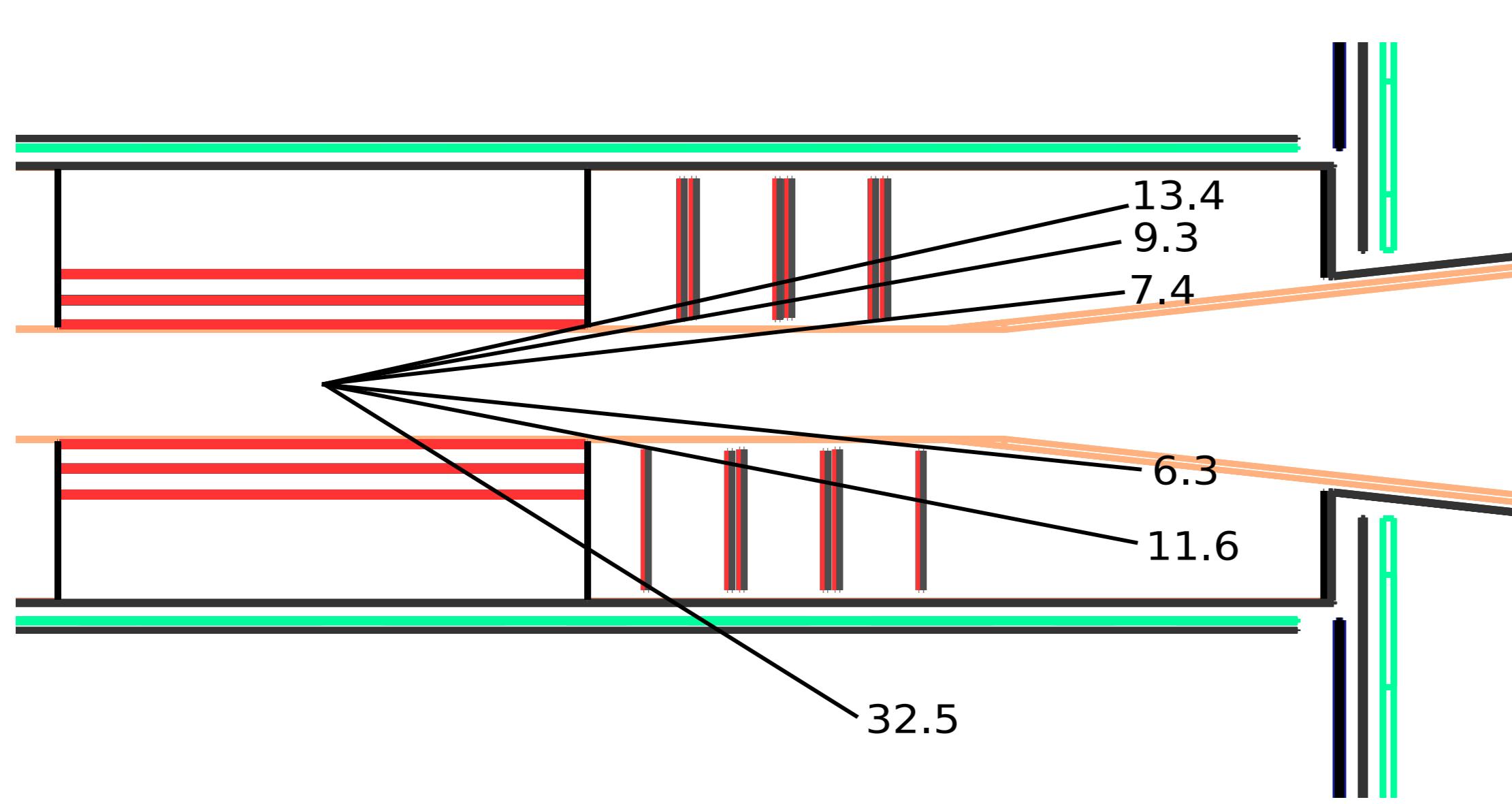
- The c-tagging is specially affected by the single-point resolution of the vertex detector. The miss-identification rate of c-jets as b(LF)-jets increases more than a 50% with  $7\mu\text{m}$  compared to the default value  $3\mu\text{m}$
- Conformal tracking leads to an increase of the miss-identification efficiency of b-jets up to 40% and performs similar to truth tracking for c-jets tagging (max diff. 13%) -> Improved conformal tracking version expected in the next ILCSoft release.

## Ongoing work

- Include number of soft leptons variables (nelectron and nmuon) coming from jets in the multivariate analysis for flavour tagging training, sizeable improvement expected.

# Polar-angle-10° issue

- At  $\theta=10^\circ$  tracks don't pass through all forward disks layers ( $12^\circ$  or more needed to recover reconstruction performance)



# Primary vertex resolution vs single point resolution

- For a single-point resolution of 1mm and 3mm the number of entries is significantly higher between 2 and 15 PV tracks
- It translates into a poorer reconstruction of the PV

