Tracking and flavour tagging status

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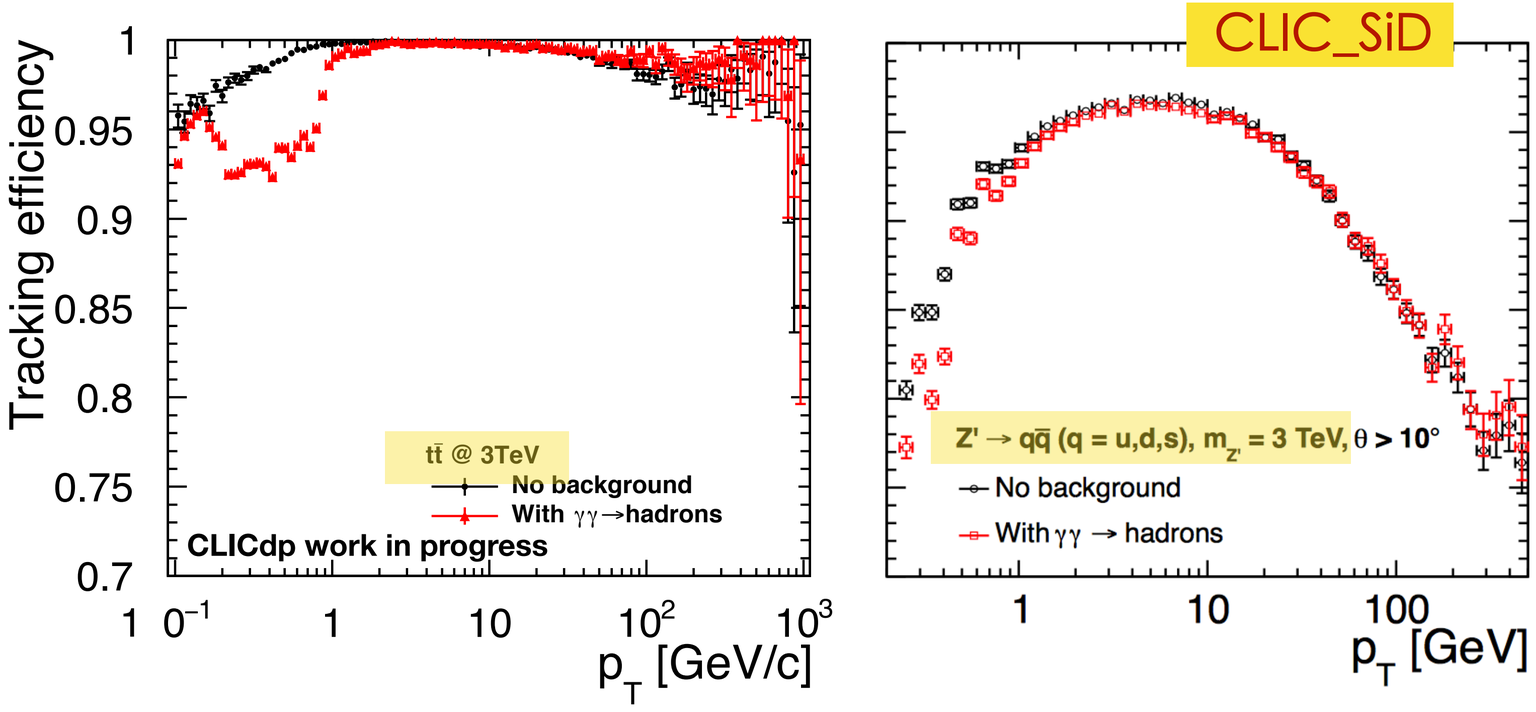
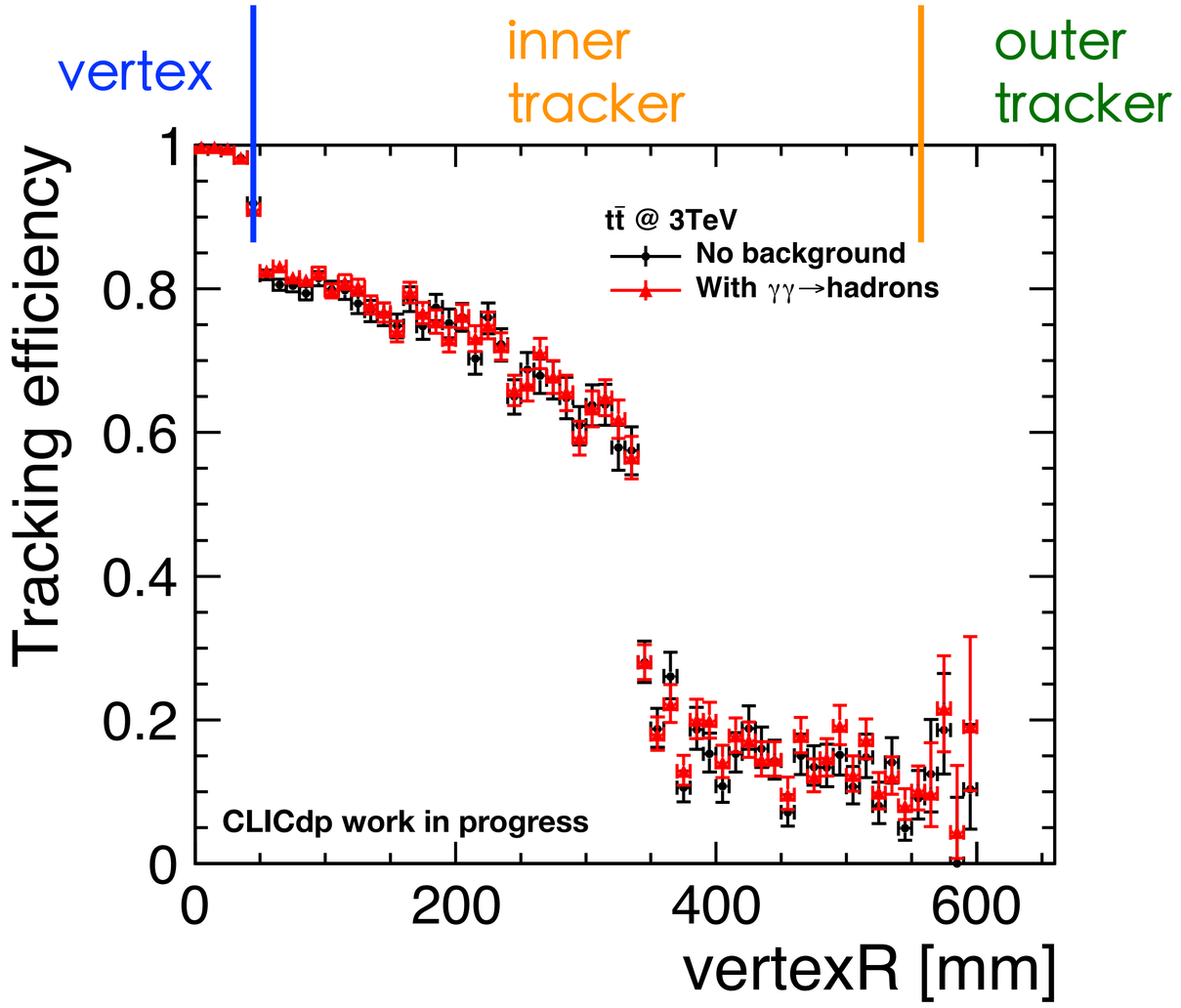
Tracking performance

- Updates since last optimisation meeting => most major issues with conformal tracking solved
- Performance over the p_T range better than for SiD, robust to background overlay



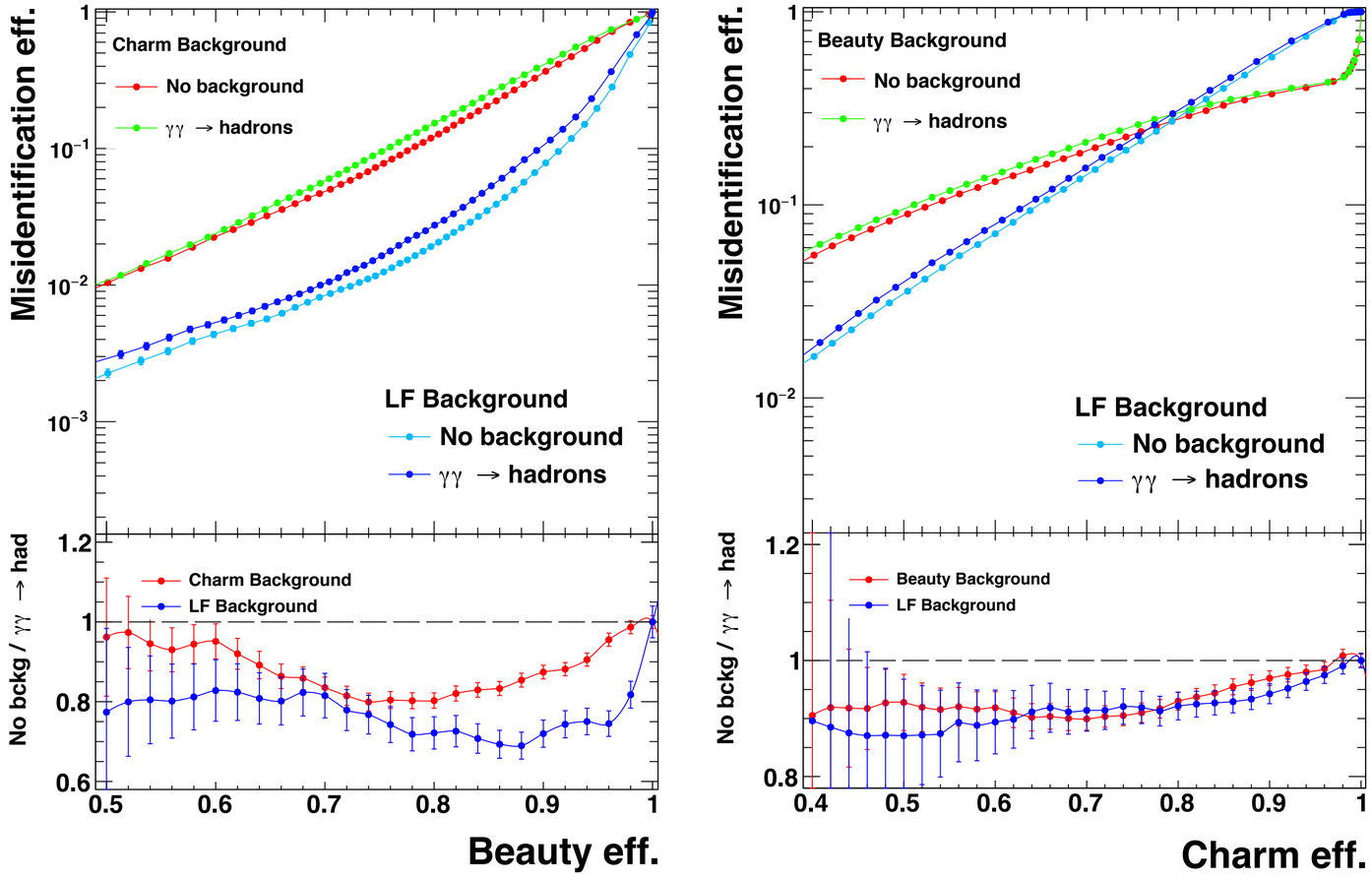
Tracking performance

- Big change was reconstruction strategy for displaced particles
  - Tracking works outwards-in from the tracker towards the vertex detector
  - Requirement on number of hits gives the drop at ~350 mm



Flavour tagging - with and without background

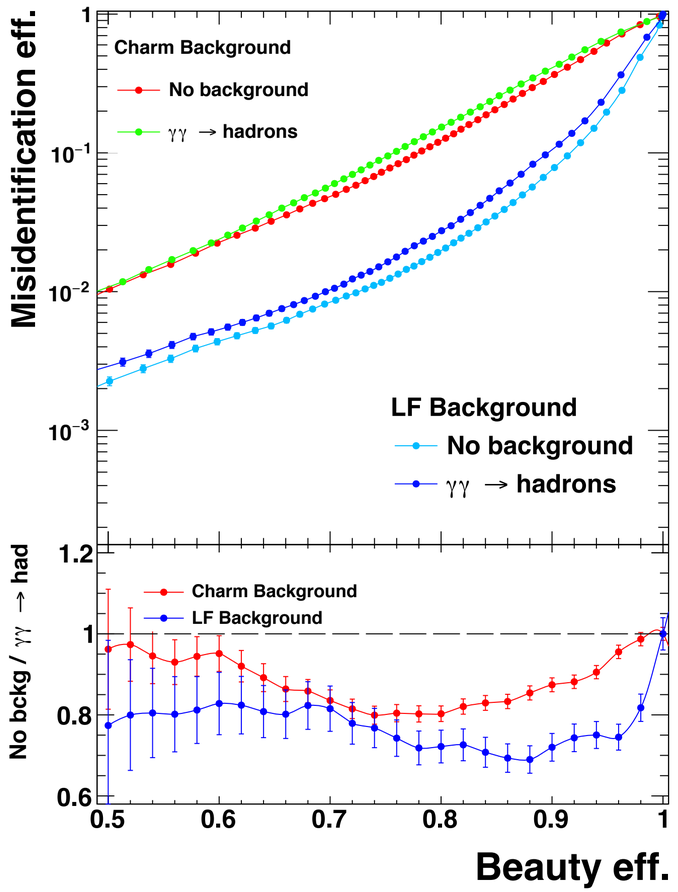
- Good first results with flavour tagging using the new detector model with realistic tracking
- Performance of the flavour tagging robust with background overlay!



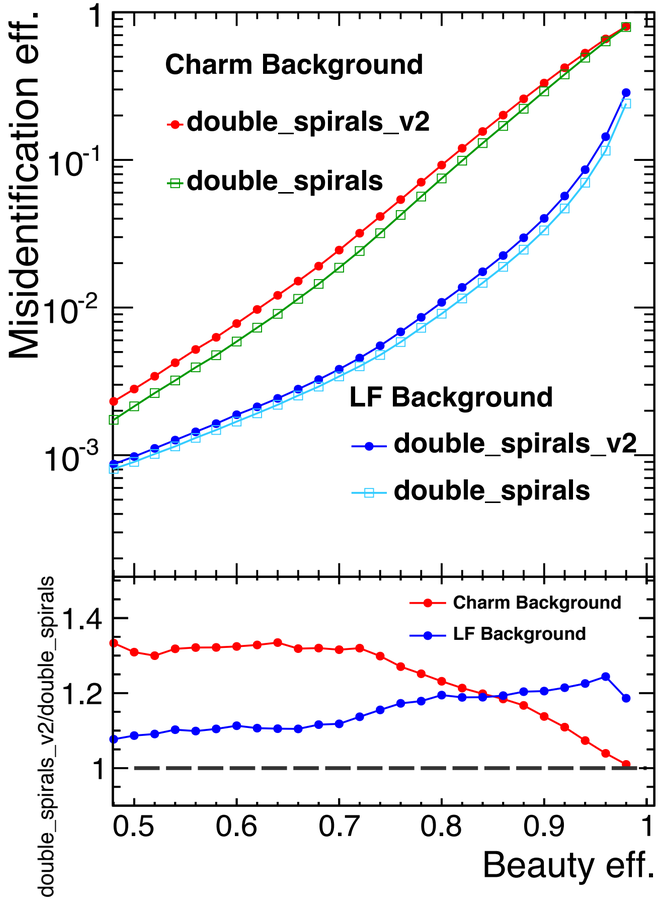
Flavour tagging - CDR-era comparison

- double_spirals_v2 most similar design to current CDR
- Beauty-tagging efficiency
  - Performance similar for charm background, mis-ID same for 70 % beauty efficiency
  - Slightly higher mis-ID for light flavour background

CLICdet



"CDR"



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- Charm-tagging efficiency
  - Better performance for beauty background
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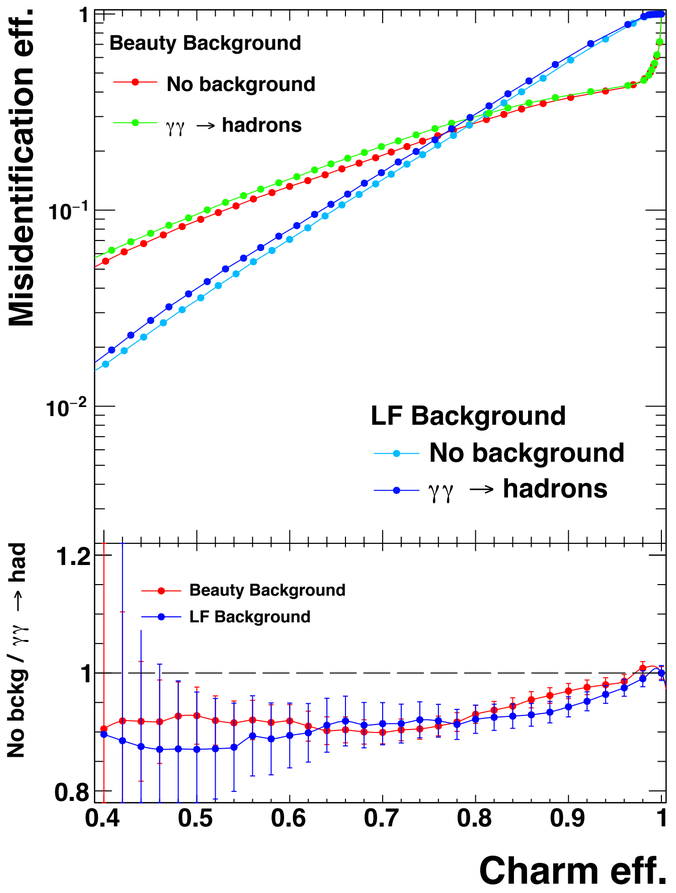

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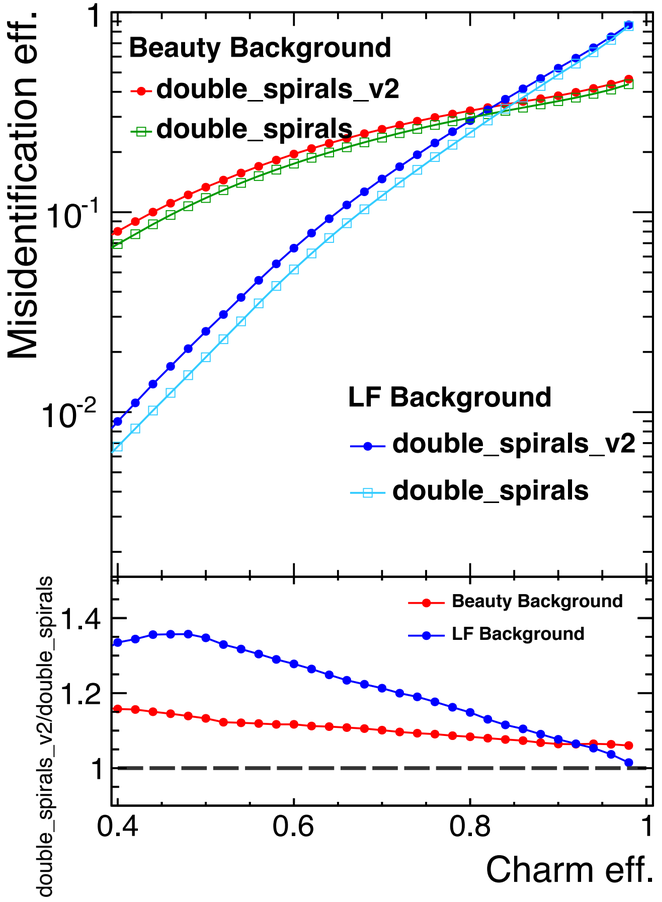


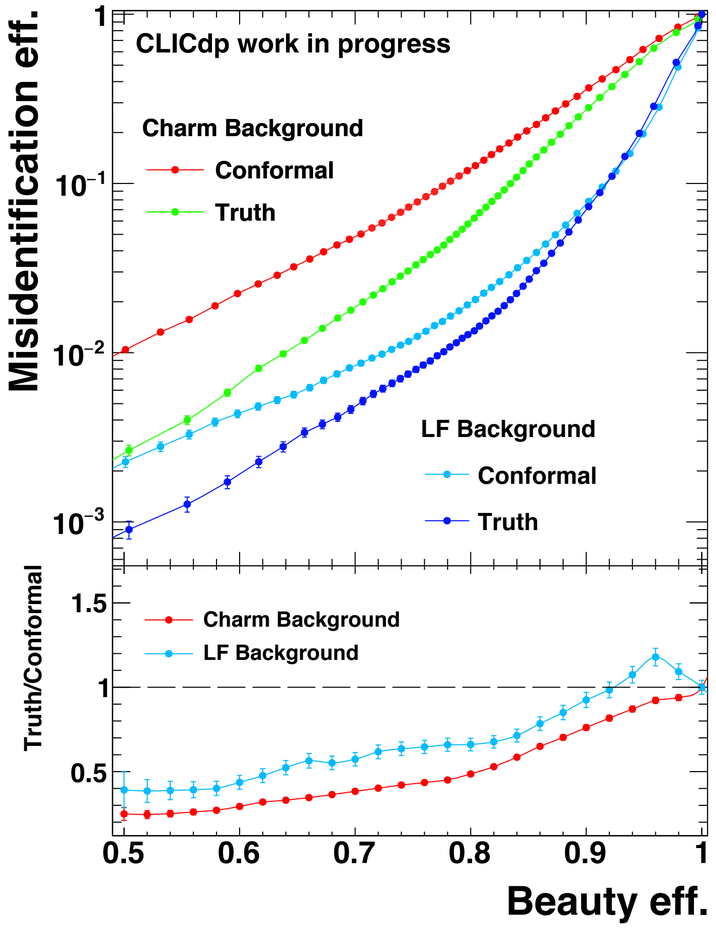
Summary of the good news

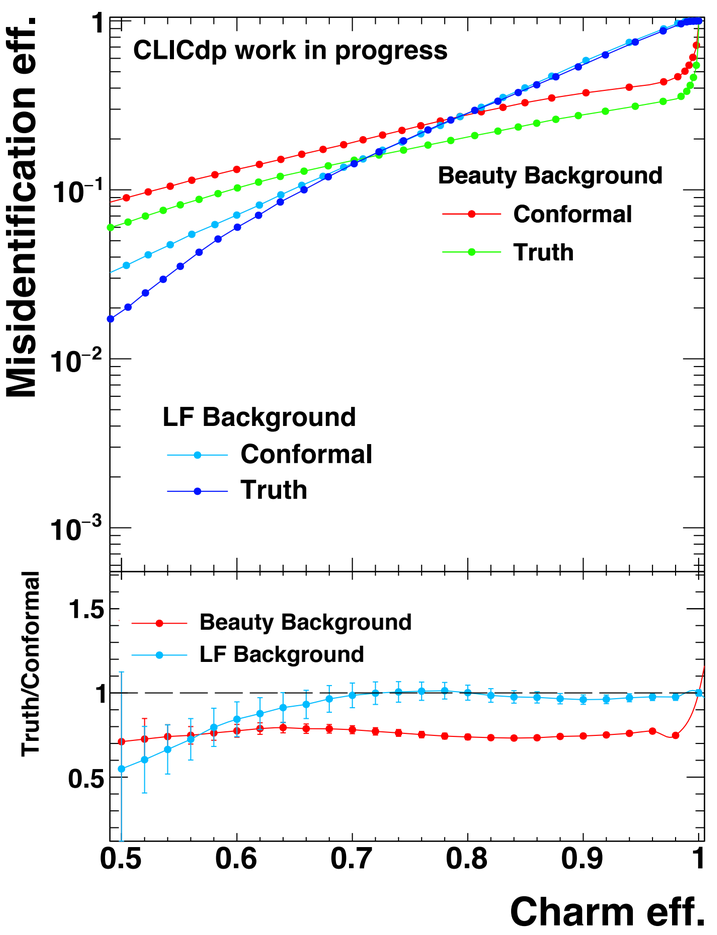
- Both tracking and flavour tagging performance look good, the full chain is working and has been tested on the grid with a wide variety of event types, both with and without backgrounds

- There is always a but…
  - Flavour tagging performance with cheated pattern recognition still shows some gain can be made from the tracking side

Flavour tagging room to improve

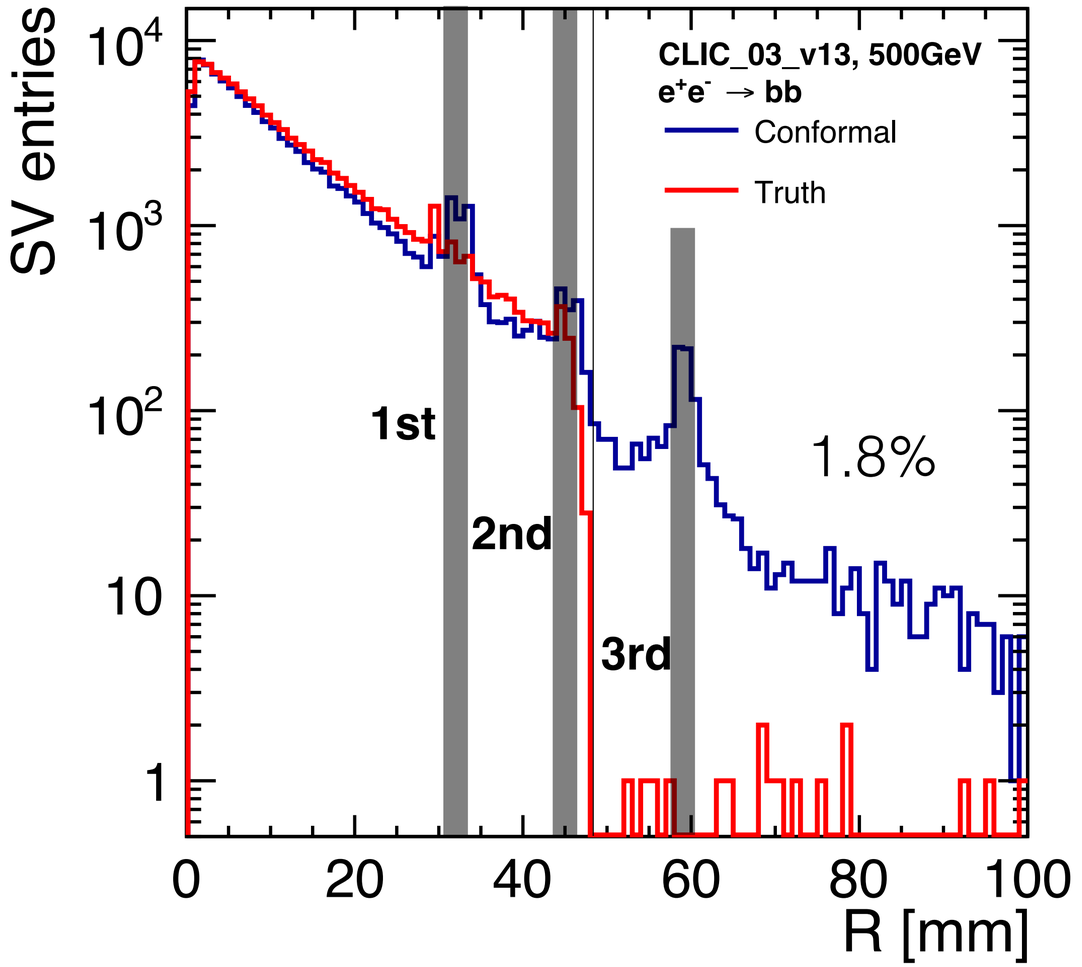
- Significant difference between Truth tracking and Conformal tracking
- Most pronounced for beauty tagging with charm background





Flavour tagging room to improve

- Now trying to search for differences between Conformal and Truth tracking that can give rise to this difference in flavour tagging
  - Number of secondary vertices lower in conformal tracking
- See several additional features which can be looked at
  - Drop off in secondary vertices with truth tracking (small effect)
  - Vertices from material interactions not treated differently



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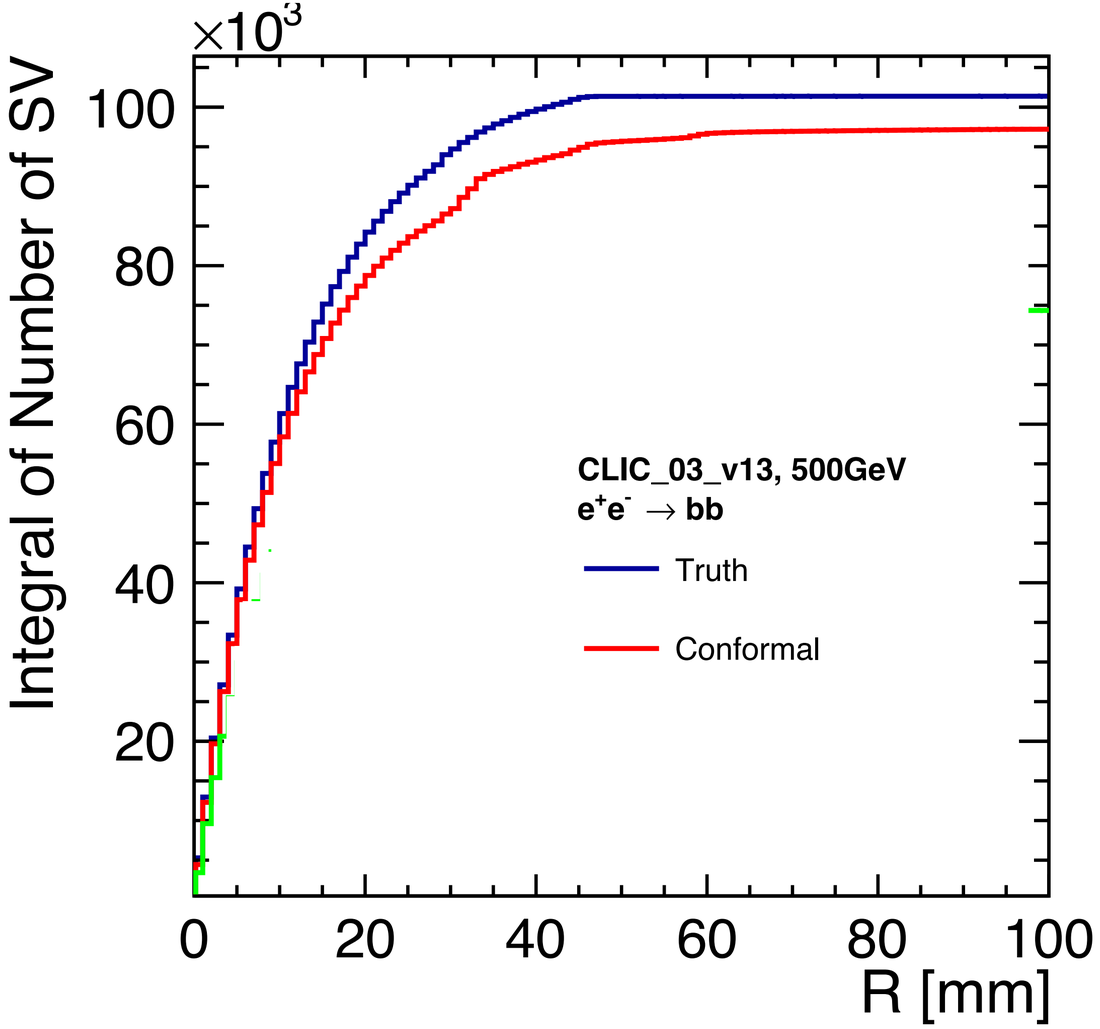
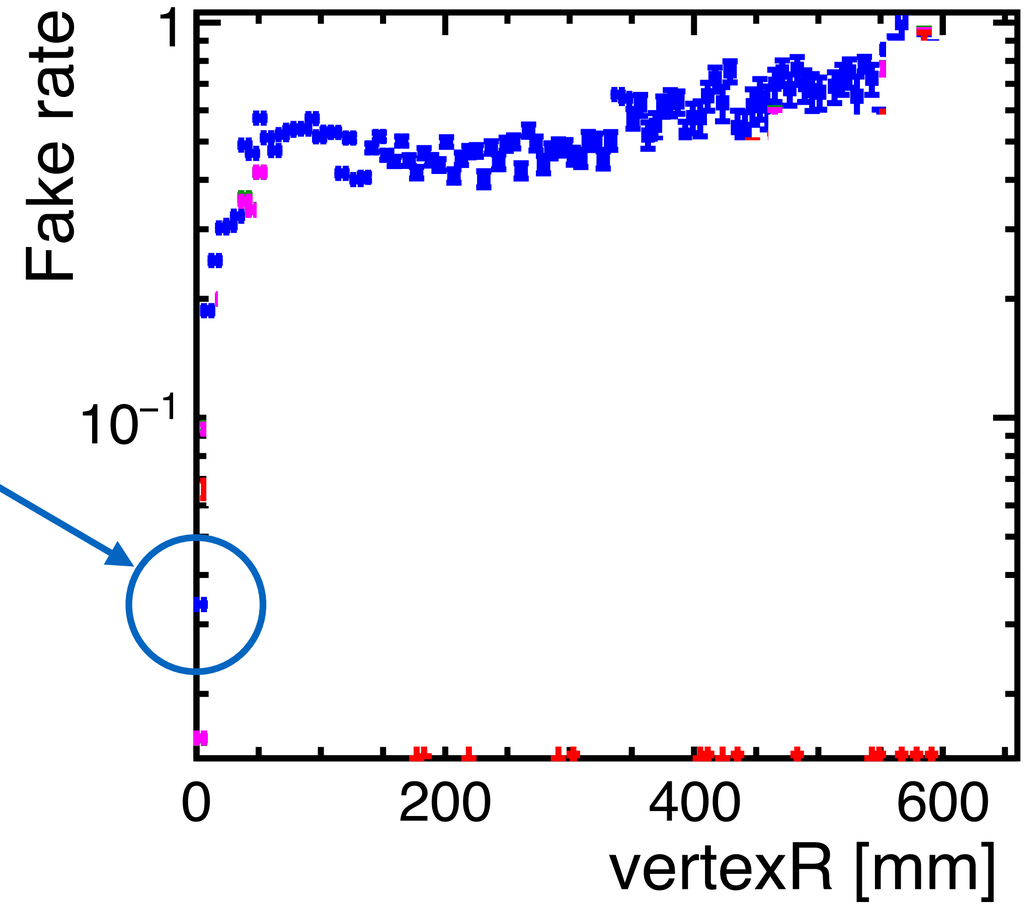


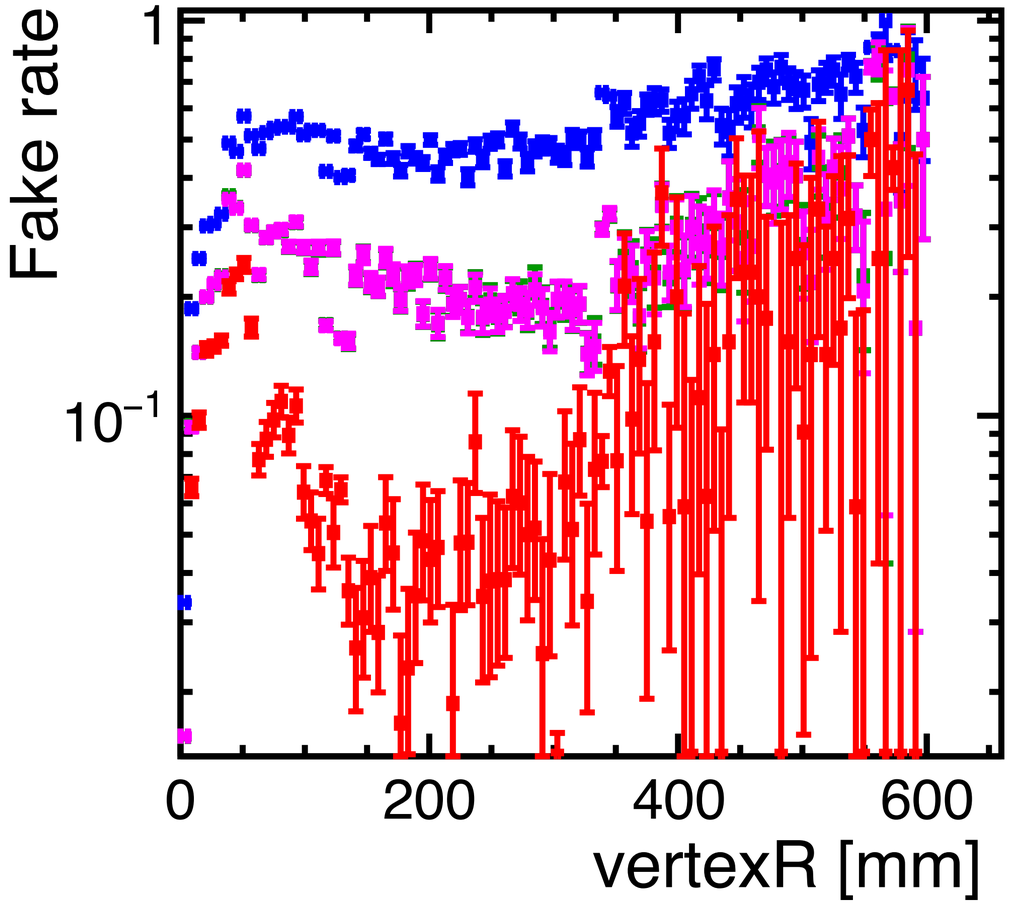
Fakes

- During flavour tagging studies started to look at the fake rate in 3 TeV bbbar events
  - Very few fakes at low r_{vertex}, then sharp increase
  - Fake rates for qqbar low
- Fakes coming from displaced track reconstruction
  - But keep in mind, tracker segmentation in the z-direction 1 - 10 mm
  - This is being investigated to understand where the fakes come from



Fakes - looking at z-segmentation

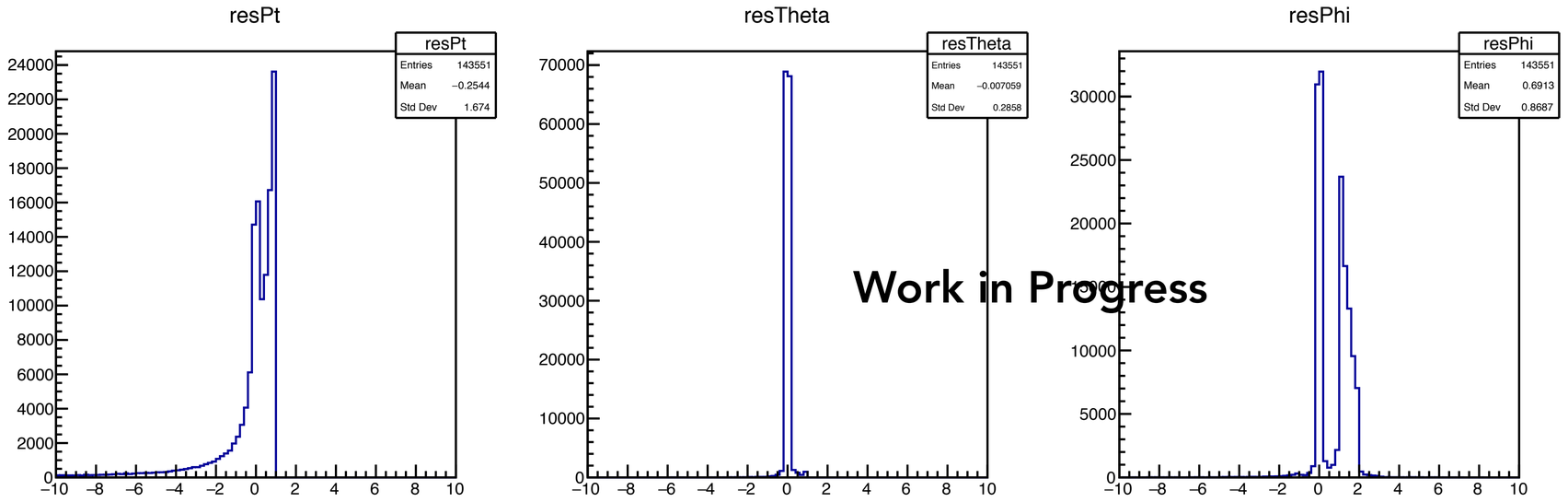
- **All: Vertex 3 μm × 3 μm**
- **Default configuration:**
  - **Inner tracker 7 μm × 300 μm**
  - **Outer tracker 7 μm × 1.5 - 3 mm**
- **Long pixel configuration:**
  - **Inner tracker 7 μm × 90 μm**
  - **Outer tracker 7 μm × 90 μm**
- **Extreme case: tracker 3 μm × 3 μm**



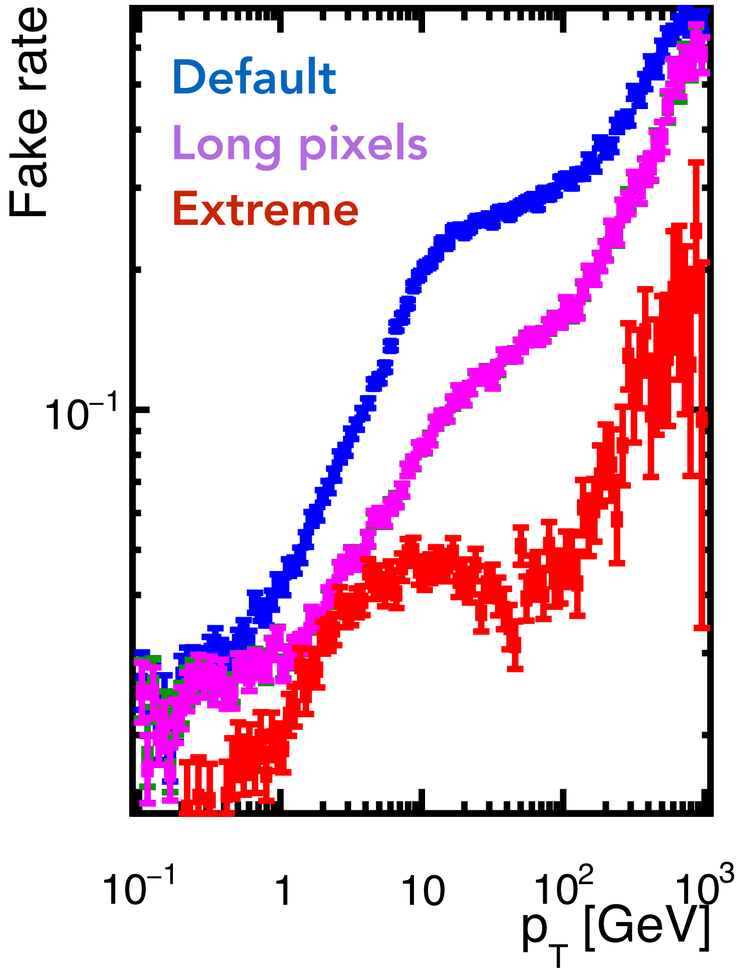
What is a fake?

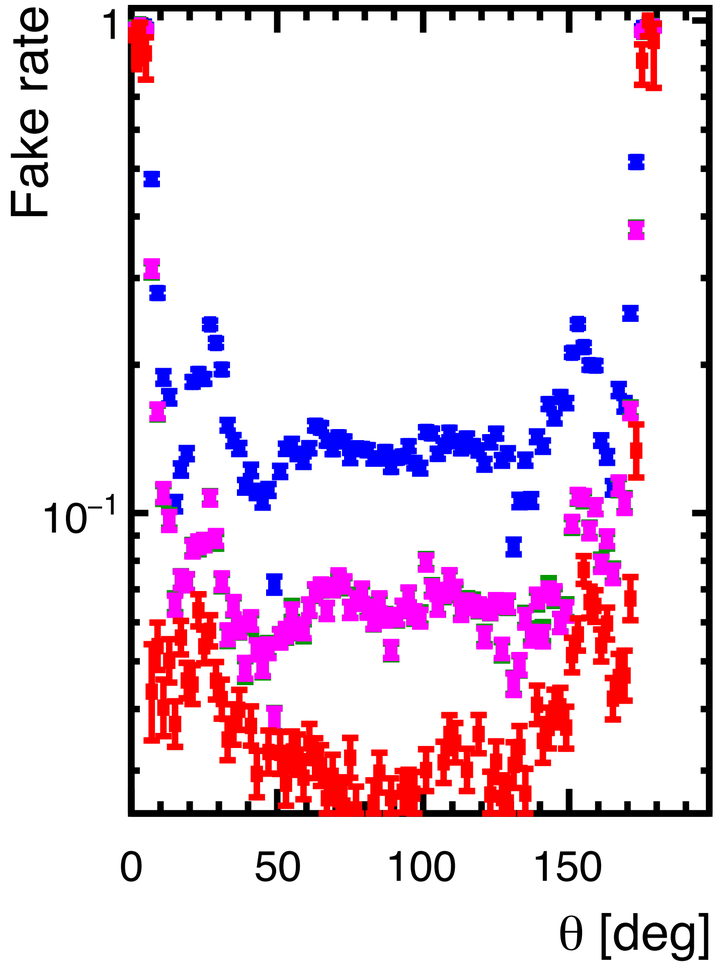
- Part of the ongoing discussion is how to define fakes
  - Currently hits with < 75 % of hits associated to the same MC particle

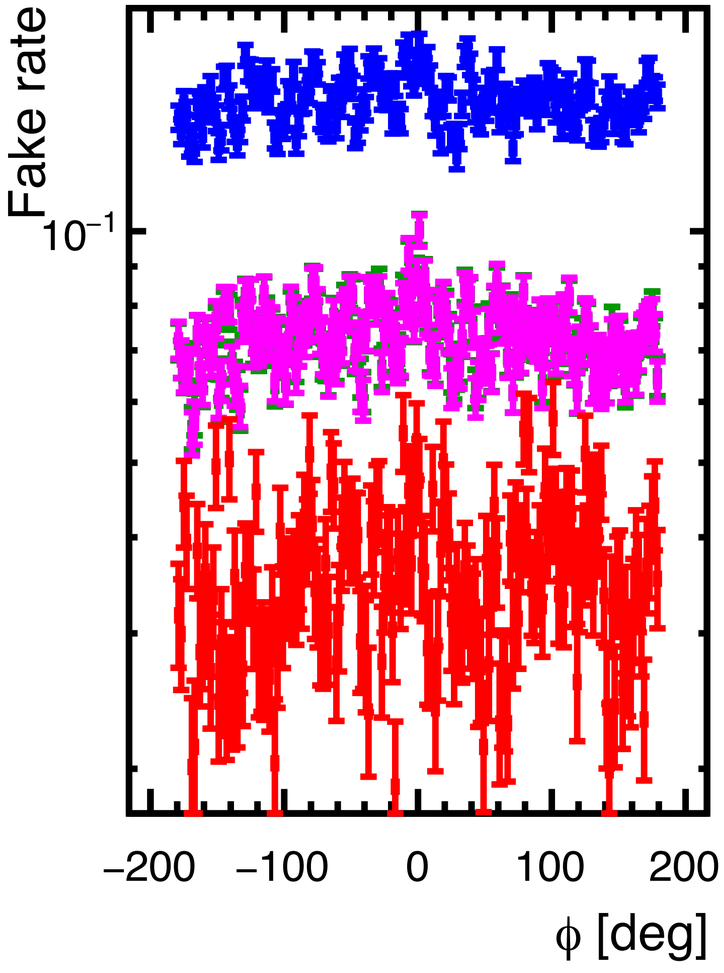
- However, many of these tracks still sit at the same θ, φ, p_T
  - Hits from parent particle/other daughters reduce the “purity”, but still good tracks



Fakes


Fake rate
Default
Long pixels
Extreme
10^{-1}
10^{-1}
1
10
10^2
10^3
p_T [GeV]


Fake rate
1
10^{-1}
0
50
100
150
θ [deg]


Fake rate
10^{-1}
−200
−100
0
100
200
ϕ [deg]

Summary

- Production of test samples over the Christmas period will be done with the current pattern recognition
  - Performance still broadly comparable with CDR
  - Robust to background overlay

- Investigation into what exactly gives better flavour tagging performance for truth tracking ongoing => can be applied in the future as a patch
  - Additionally should be possible to improve tagging by eg. ignoring secondary vertices next to material

- Potentially interesting to discuss a more segmented tracker for b-daughters => to be discussed at a later date