

# $b\bar{b}$ charge reconstruction in ILD

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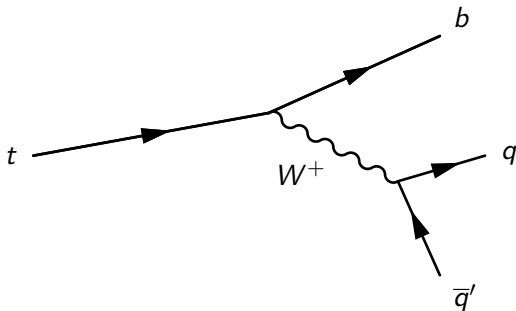
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# Channel

- Top's full hadronic decay channel (namely  $t\bar{t} \rightarrow b\bar{b}q\bar{q}'q\bar{q}'$ )
- 46% of the top decay



## TruthVertexFinder

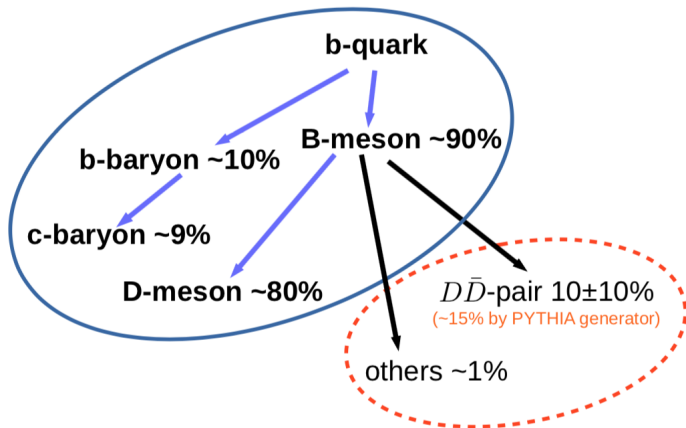


Figure: Illustration of the b-quark hadronization and decay modes. (Bilokin, 2017)

# Missing vertices

Possible reasons for missing vertices:

- Neutral decay vertex - the vertex cannot be reconstructed if it has no generated prongs.
- Generated soft b-hadrons - causes short flight path, which makes it difficult to distinguish b-hadron prongs from the other particles in b-jets.
- One prong decay vertex would possibly be lost if there were no other vertices reconstructed in a given b-jet.
- If b-hadrons were produced outside the VXD acceptance region.

We will focus on the missing prongs of the reconstructed vertices.

# Missing prongs

Possible reasons for missing prongs:

- No track info. (9.3%)
- No associated hits in the VXD or FTD (20.%)
- No reconstructed PFO (32%)
- Low generated momentum or offset (31%)
- Others (8%)

# Event Pre-selection

## Pre-selection conditions

- b-tag cut  
 $\text{Top1btag} > 0.8 \ \&\& \ \text{Top2btag} > 0.8$
- Chi2 cut  
 $\text{chiTopMass1} + \text{chiTopE1} + \text{chiPbstar1} < 30$   
 $\text{chiTopMass2} + \text{chiTopE2} + \text{chiPbstar2} < 30$
- Kinematic cut  
 $140 \text{ GeV} < \text{Top1mass} < 210 \text{ GeV}$   
 $140 \text{ GeV} < \text{Top2mass} < 210 \text{ GeV}$

## Precuts &amp; Generated

	Before vertex recovery	After vertex recovery
Event number	506773 (100%)	506773 (100%)
After b-tag cut	371410 (73.3%)	372884 (73.6%)
After kinematic cut	242100 (47.8%)	243046 (48.0%)
After chi2 cut	146479 (28.9%)	146990 (29.0%)

	Generated
Event number	491557
AFB(top)	0.324676
AFB(bottom)	0.341256

# Vertex charge cut (strict cut)

## Cuts

- $\text{Top1bcharge} * \text{Top2bcharge} < 0 \ \&\&$   
 $\text{Top1TotalKaonCharge} * \text{Top2TotalKaonCharge} < 0$



# Vertex charge cut (strict cut)

	Before vertex recovery	After vertex recovery
Number after cut	5113 (1.01%)	5469 (1.08%)
AFB(top)	0.280853 (86.5%)	0.296581 (91.3%)
AFB(bottom)	0.29337 (86.0%)	0.301518 (88.4%)

# Polar angle spectrum

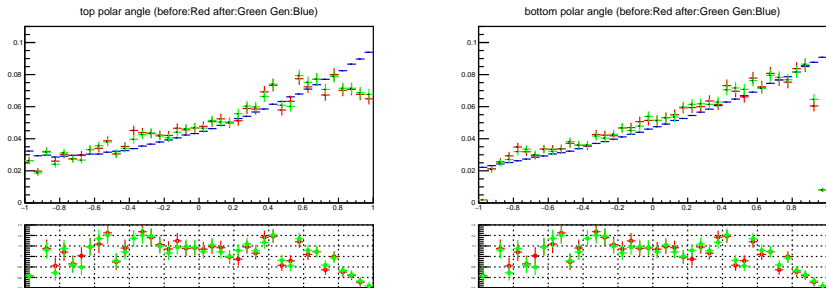


Figure: Top polar angle spectrum

# Polar angle spectrum

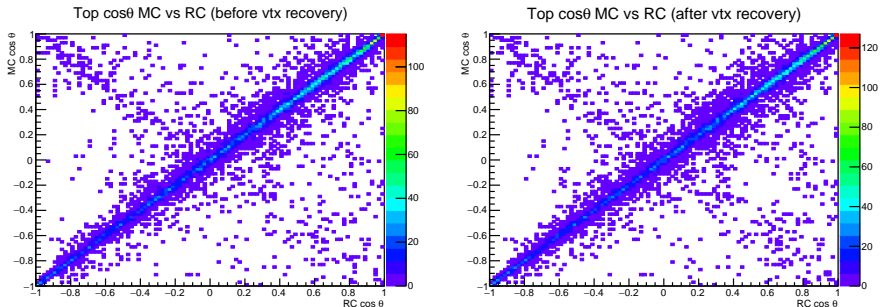


Figure: Top polar angle with MC and RC compared

# Vertex charge cut (non-strict cut)

## Cuts

- $\text{Top1bcharge} * \text{Top2bcharge} < 0$
- $\text{Top1TotalKaonCharge} * \text{Top2TotalKaonCharge} < 0$
- $\text{Top1bcharge} * \text{Top2TotalKaonCharge} < 0$
- $\text{Top2bcharge} * \text{Top1TotalKaonCharge} < 0$
- $\text{Top1bmomentum} > 30 \text{ GeV}$  and  $\text{LzF} > 2.6$

# Vertex charge cut (non-strict cut)

	Before vertex recovery	After vertex recovery
Number after cut	25527 (5.04%)	25254 (4.98%)
AFB(top)	0.276374 (14.8%)	0.280312 (13.7%)
AFB(bottom)	0.276492 (19.0%)	0.279718 (18.0%)

# Polar angle spectrum

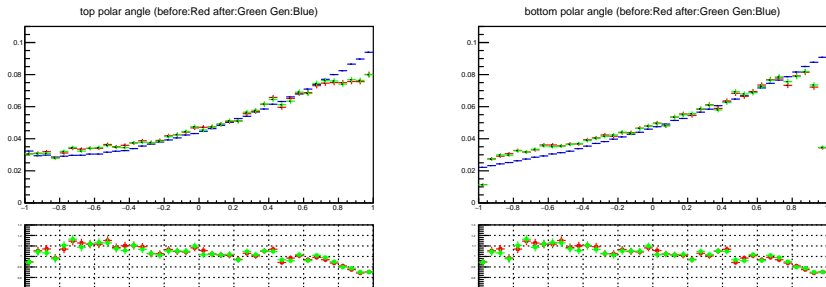


Figure: Top polar angle spectrum

# Polar angle spectrum

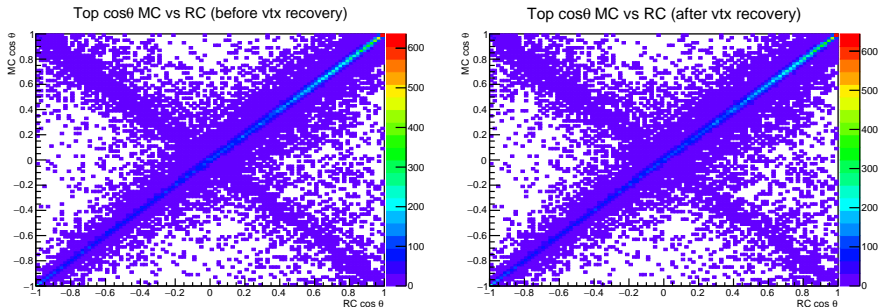


Figure: Top polar angle with MC and RC compared

# Vertex charge cut (vtx + kaon)

## Cuts

- $\text{Top1bcharge} * \text{Top2bcharge} < 0$
- $\text{Top1TotalKaonCharge} * \text{Top2TotalKaonCharge} < 0$
- $\text{Top1bcharge} * \text{Top2TotalKaonCharge} < 0$
- $\text{Top2bcharge} * \text{Top1TotalKaonCharge} < 0$
- $\text{Top1bmomentum} > 30 \text{ GeV}$  and  $\text{LzF} > 2.6$



## Vertex charge cut (vtx + kaon)

	Before vertex recovery	After vertex recovery
Number after cut	39008 (7.70%)	39811 (7.86%)
vtx1+vtx2	25527	25254
kaon1+kaon2	13481	14557
AFB(top)	0.277994 (14.4%)	0.281204 (13.4%)
AFB(bottom)	0.277200 (18.8%)	0.281053 (17.6%)

# Polar angle spectrum

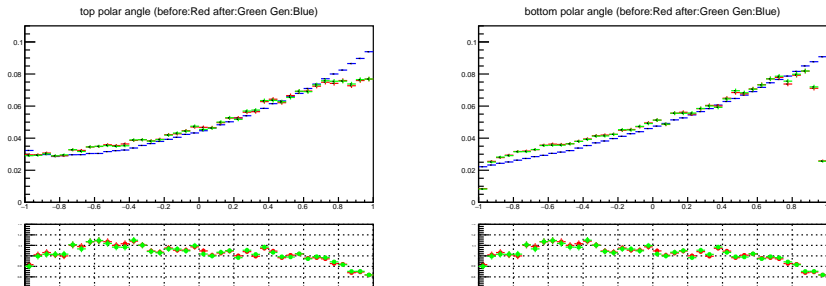


Figure: Top polar angle spectrum (normalized)

# Polar angle spectrum

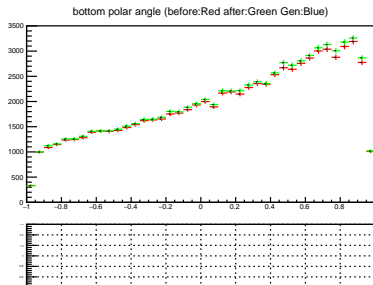
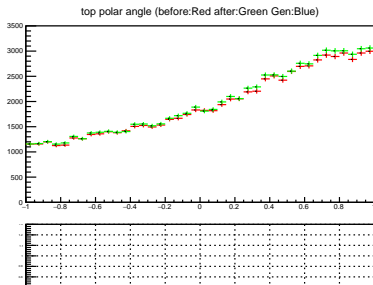
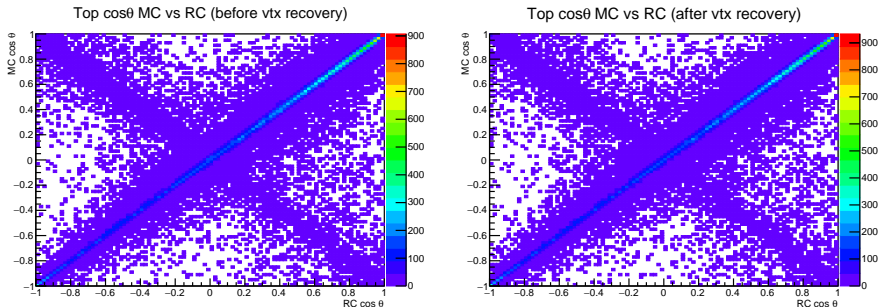


Figure: Top polar angle spectrum (not normalized)

# Polar angle spectrum



# Vertex charge cut (vtx + kaon + vtx1/kaon2)

## Cuts

- $\text{Top1bcharge} * \text{Top2bcharge} < 0$
- $\text{Top1TotalKaonCharge} * \text{Top2TotalKaonCharge} < 0$
- $\text{Top1bcharge} * \text{Top2TotalKaonCharge} < 0$
- $\text{Top2bcharge} * \text{Top1TotalKaonCharge} < 0$
- $\text{Top1bmomentum} > 30 \text{ GeV}$  and  $\text{LzF} > 2.6$

## Vertex charge cut (vtx + kaon + vtx1/kaon2)

	Before vertex recovery	After vertex recovery
Number after cut	44792 (8.84%)	45644 (9.01%)
vtx1+vtx2	25527	25254
kaon1+kaon2	13481	14557
vtx1+kaon2	5784	5833
AFB(top)	0.274871 (15.3%)	0.278525 (14.2%)
AFB(bottom)	0.271924 (20.3%)	0.275524 (19.3%)

# Polar angle spectrum

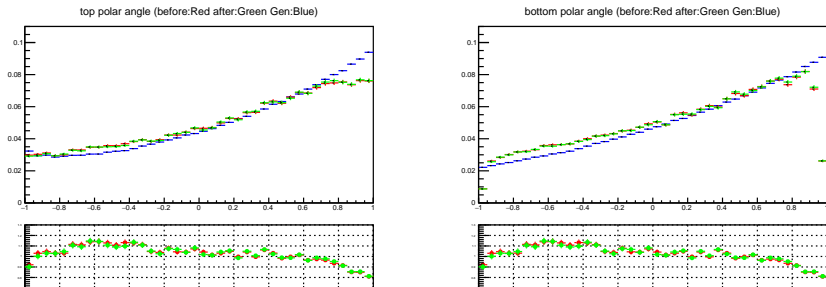


Figure: Top polar angle spectrum

# Polar angle spectrum

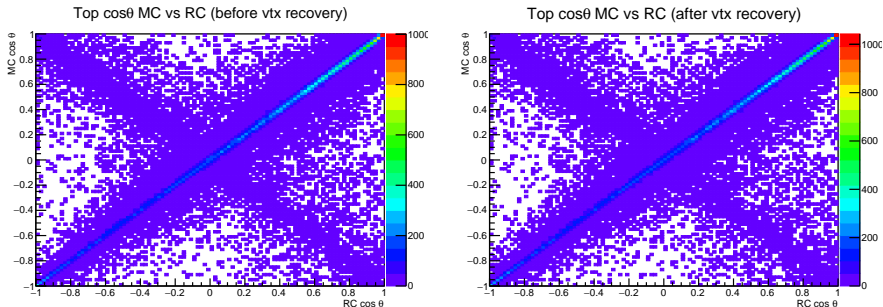


Figure: Top polar angle with MC and RC compared



# Vertex charge cut (vtx + kaon + vtx2/kaon1)

## Cuts

- $\text{Top1bcharge} * \text{Top2bcharge} < 0$
- $\text{Top1TotalKaonCharge} * \text{Top2TotalKaonCharge} < 0$
- $\text{Top1bcharge} * \text{Top2TotalKaonCharge} < 0$
- $\text{Top2bcharge} * \text{Top1TotalKaonCharge} < 0$
- $\text{Top1bmomentum} > 30 \text{ GeV}$  and  $\text{LzF} > 2.6$

## Vertex charge cut (vtx + kaon + vtx2/kaon1)

	Before vertex recovery	After vertex recovery
Number after cut	57866 (11.4%)	58365 (11.5%)
vtx1+vtx2	25527	25254
kaon1+kaon2	13481	14557
vtx1+kaon2	5784	5833
vtx2+kaon1	13074	12721
AFB(top)	0.274871 (15.3%)	0.278525 (14.2%)
AFB(bottom)	0.271924 (20.3%)	0.275524 (19.3%)

# Polar angle spectrum

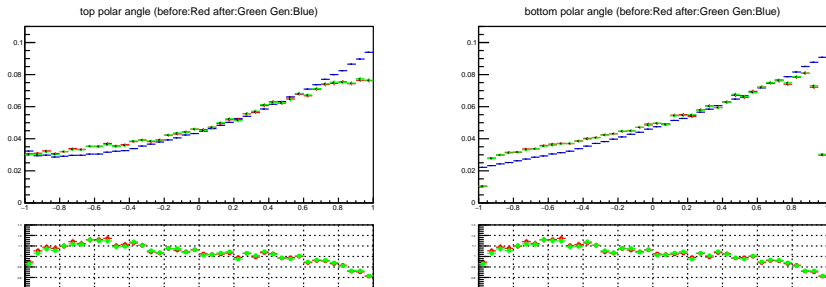


Figure: Top polar angle spectrum

# Polar angle spectrum

