Event Selection and Reconstruction

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Physics object and event selections

Primary vertex selection

3.2 Primary vertex selection

We require the events to have at least one primary vertex satisfying the following criteria:

- At least 4 degrees of freedom of the vertex reconstruction, n_{dof}
- The track impact parameter with respect to the beam spot on the z-axis, $|d_z|$, is smaller than 24 cm
- The track impact parameter with respect to the beam spot on the xy-plane, $|d_xy|$, is smaller than 2 cm

Lepton

Muon taken from the particle flow reconstruction should pass the following selection criteria:

- $p_{\mathrm{T}} > 30\,\mathrm{GeV}/c$
- $|\eta| < 2.4$
- Pass muon cut-based identification criteria of the **tight** working point as defined by the Muon POG [27]
- Have PF-based combined relative isolation value smaller than 0.15 in the tight working point defined by the Muon POG [27]

Electron

Electron taken from the particle flow reconstruction should pass the following selection criteria:

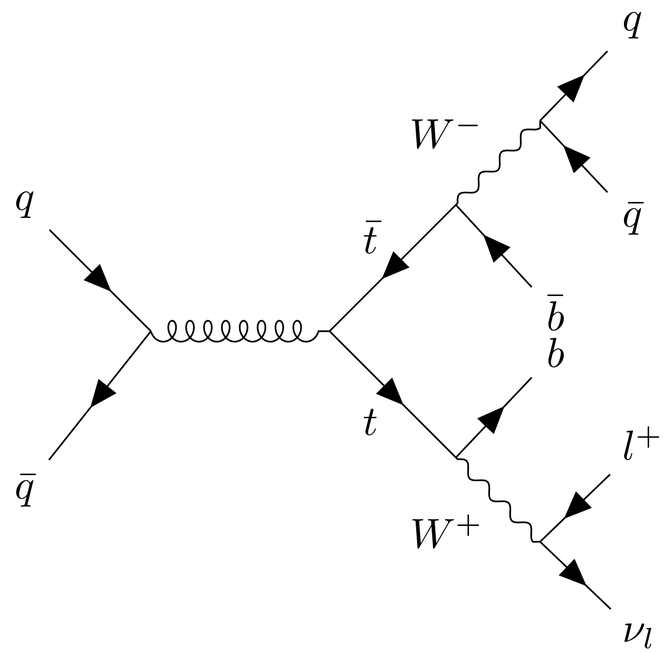
- $p_{\mathrm{T}} > 38\,\mathrm{GeV}/c$
- $|\eta| < 2.4 \notin [1.4442, 1.5660]$
- Pass electron cut-based identification criteria of the **tight** working point as defined by the EGamma POG [28].
- Pass the recommended impact parameter cut defined by the EGamma POG [28].

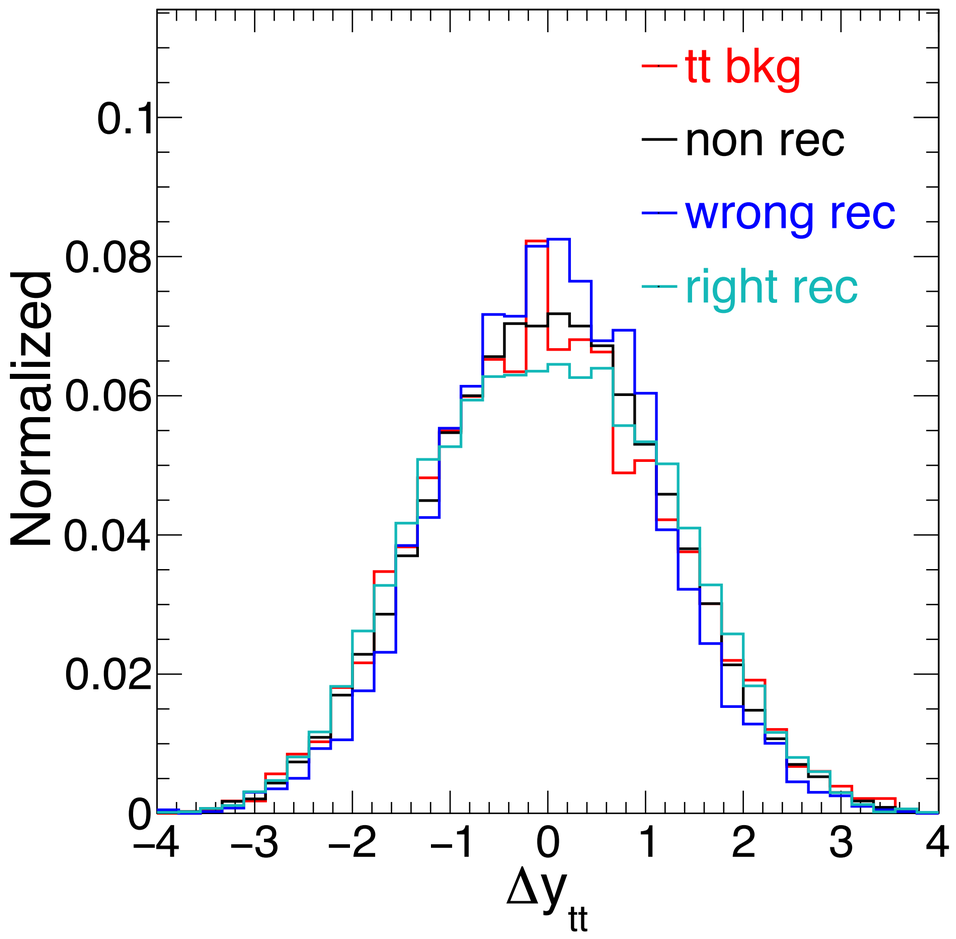
  Barrel: $d_Z \leq 0.10\,\mathrm{cm}$, $d_{xy} \leq 0.05\,\mathrm{cm}$. Endcap: $d_Z \leq 0.20\,\mathrm{cm}$, $d_{xy} \leq 0.10\,\mathrm{cm}$.

Jet

- $p_{\mathrm{T}} > 30\,\mathrm{GeV}/c$
- $|\eta| < 2.4$
- $\Delta R > 0.4$ with selected lepton
- 2016 samples should pass the **loose** jet ID [29]:
  - neutral hadron energy fraction < 0.99
  - neutral EM fraction < 0.99
  - charged EM fraction < 0.99
  - charged hadron fraction > 0
  - number of constituents > 1
  - charge multiplicity > 0
- 2017 and 2018 samples should pass the **tight** jet ID [29]:
  - neutral hadron energy fraction < 0.90
  - neutral EM fraction < 0.90
  - charged hadron fraction > 0
  - number of constituents > 1
  - charge multiplicity > 0

Event Reconstruction in Semileptonic channel

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non rec
wrong rec
right rec
Normalized
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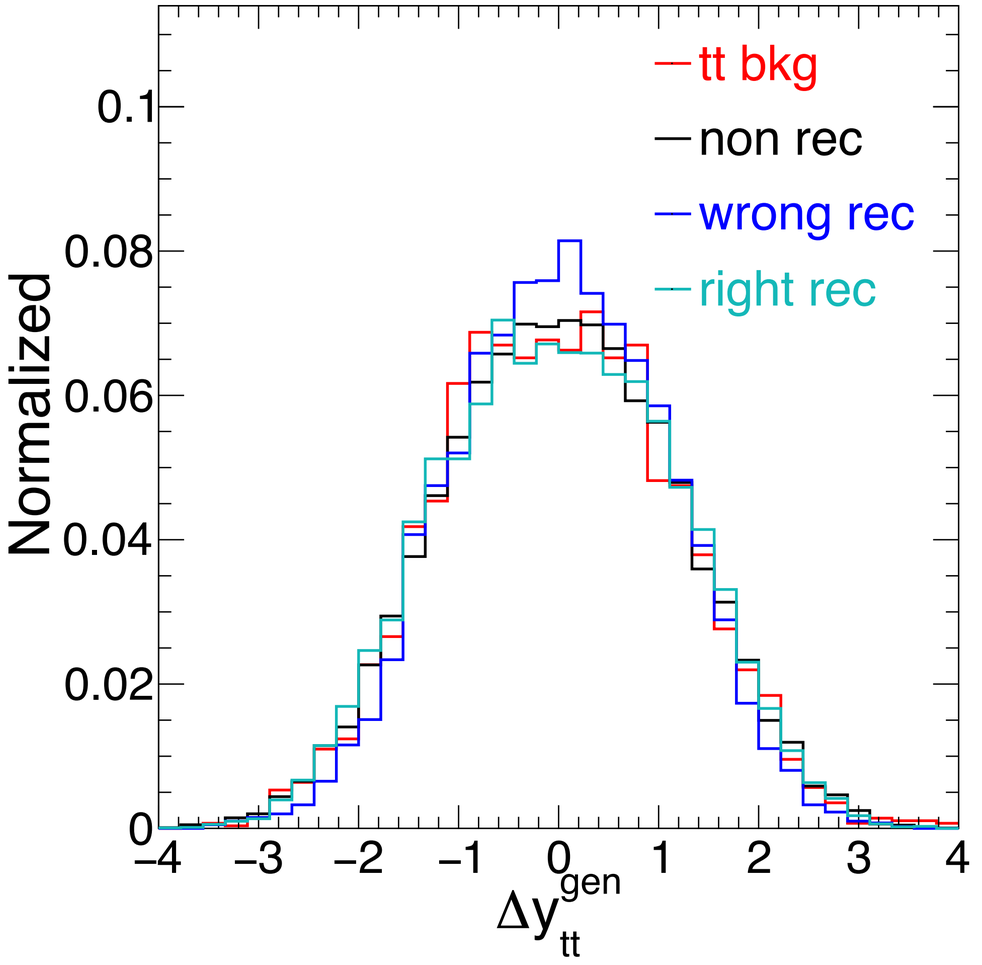
Δy_{tt}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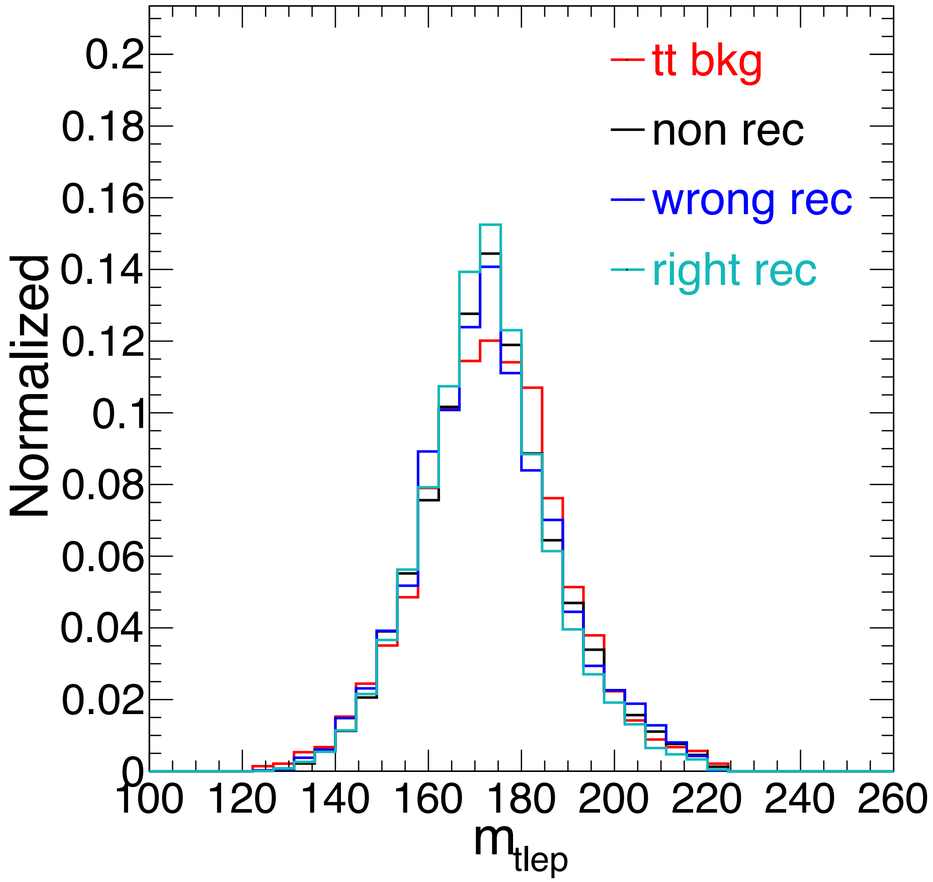
Δy_{tt}^{gen}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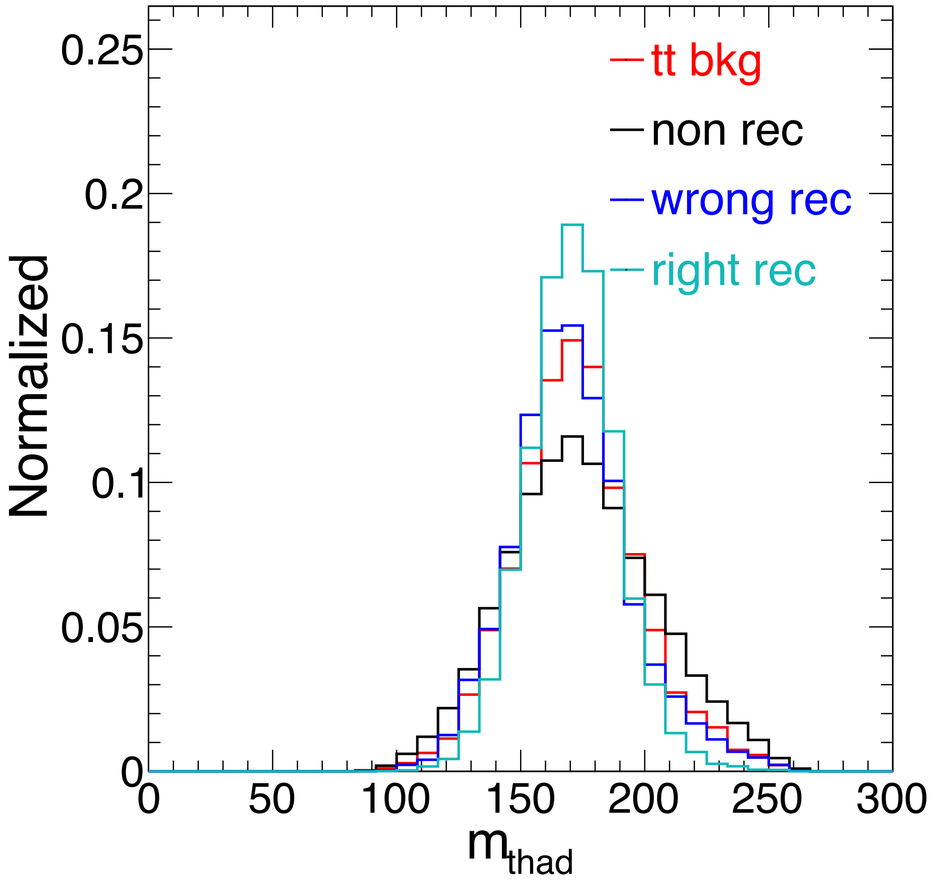
m_tlep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Normalized
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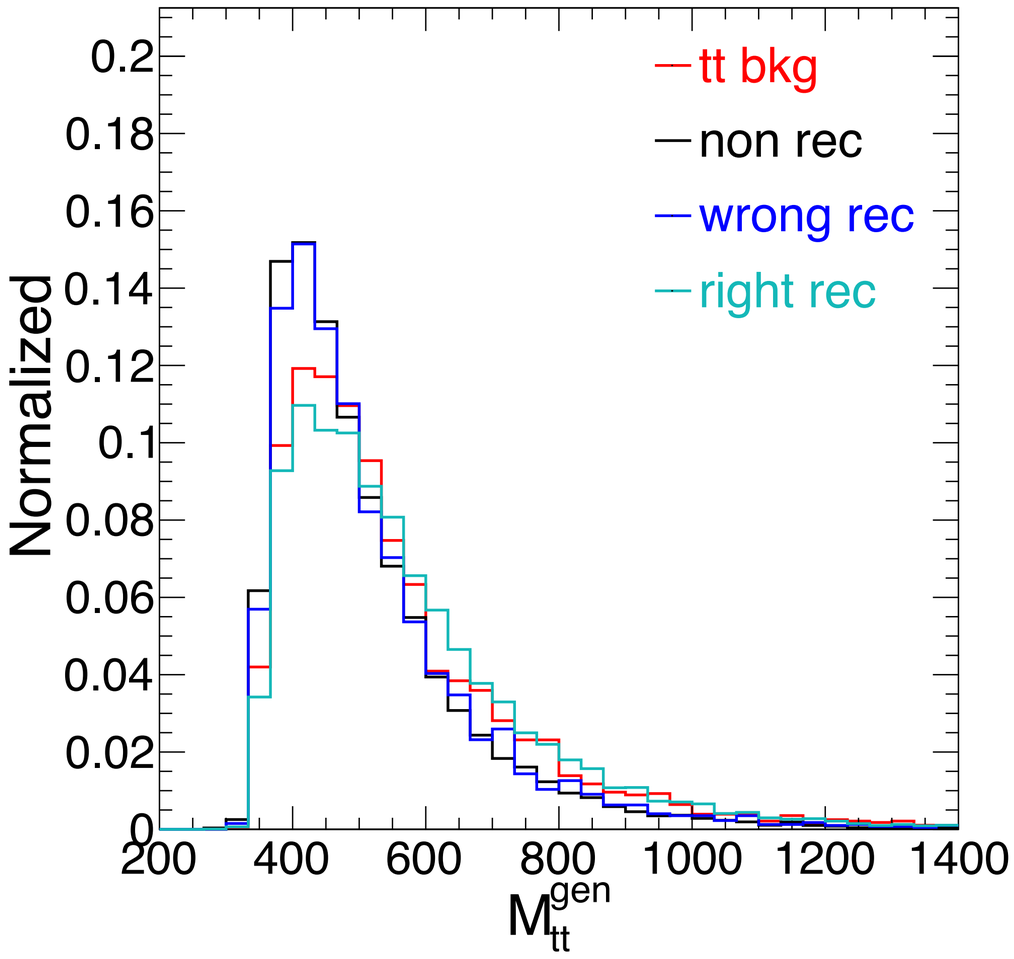
m_thad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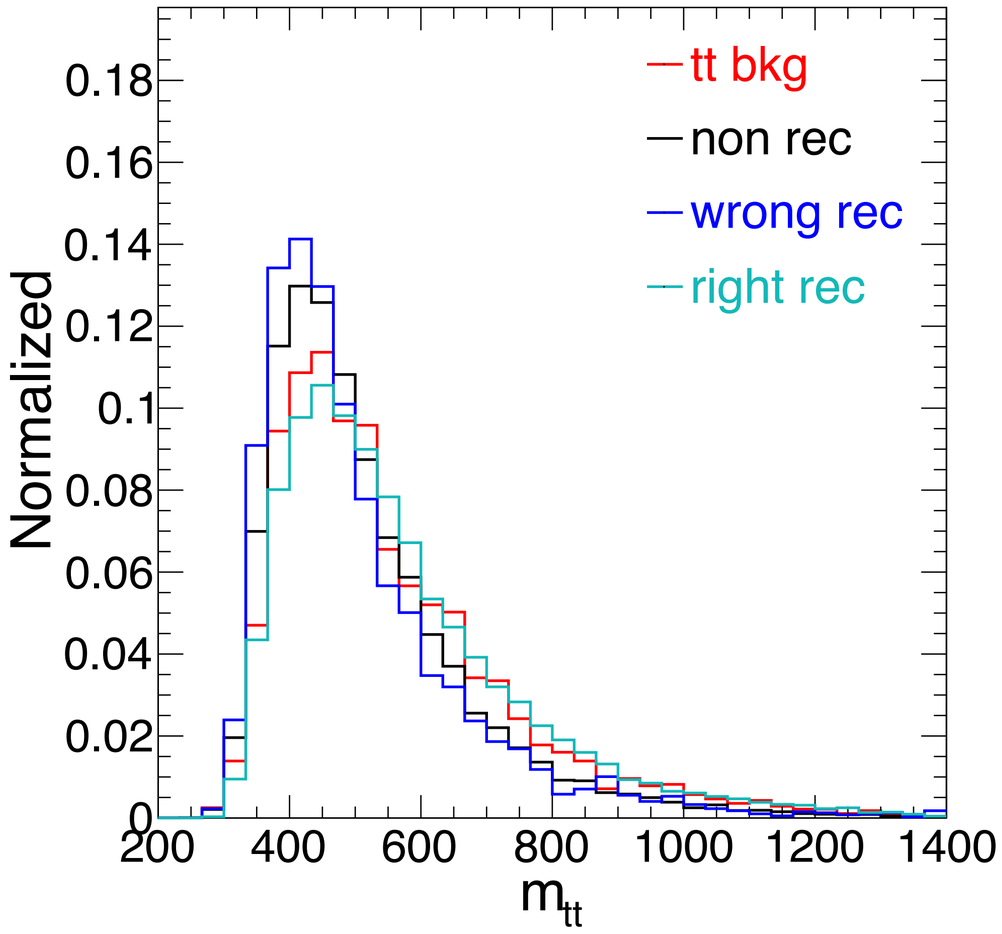
M_{tt}^{gen}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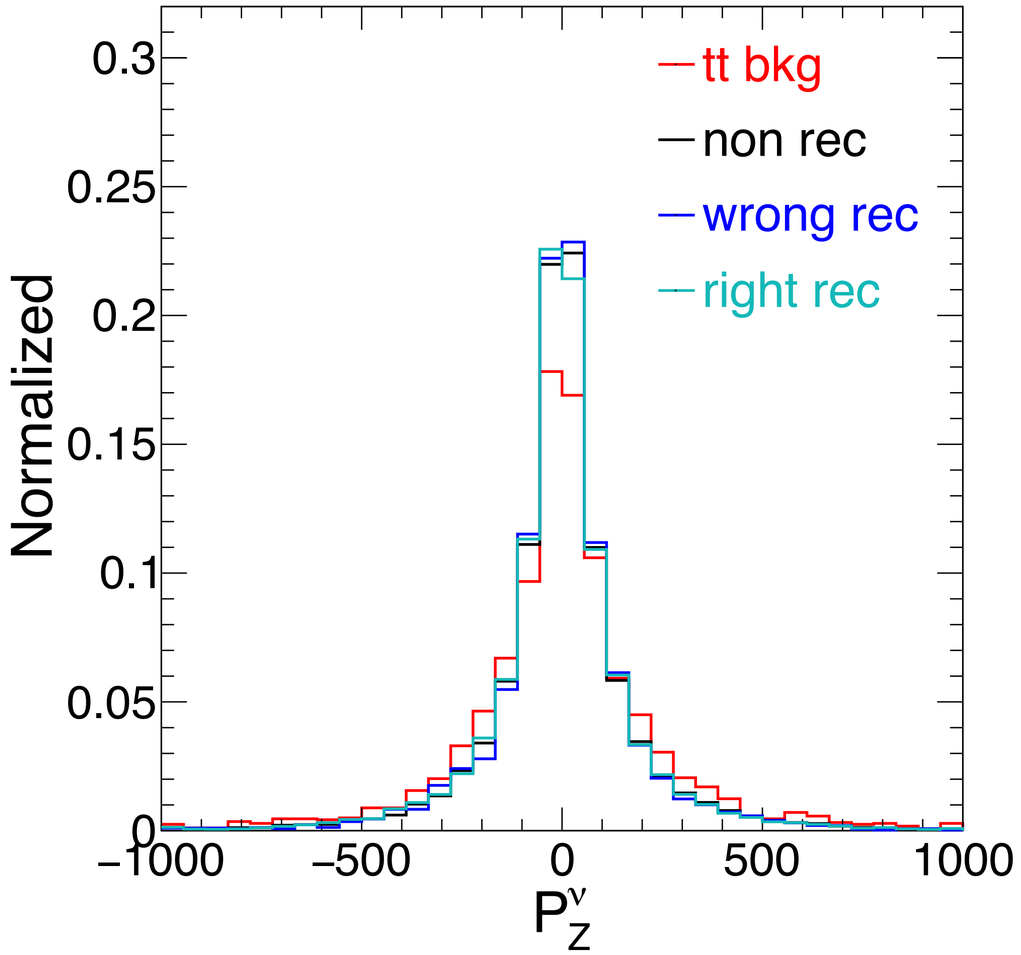
m_{tt}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wrong rec
right rec
Normalized
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−1000
−500
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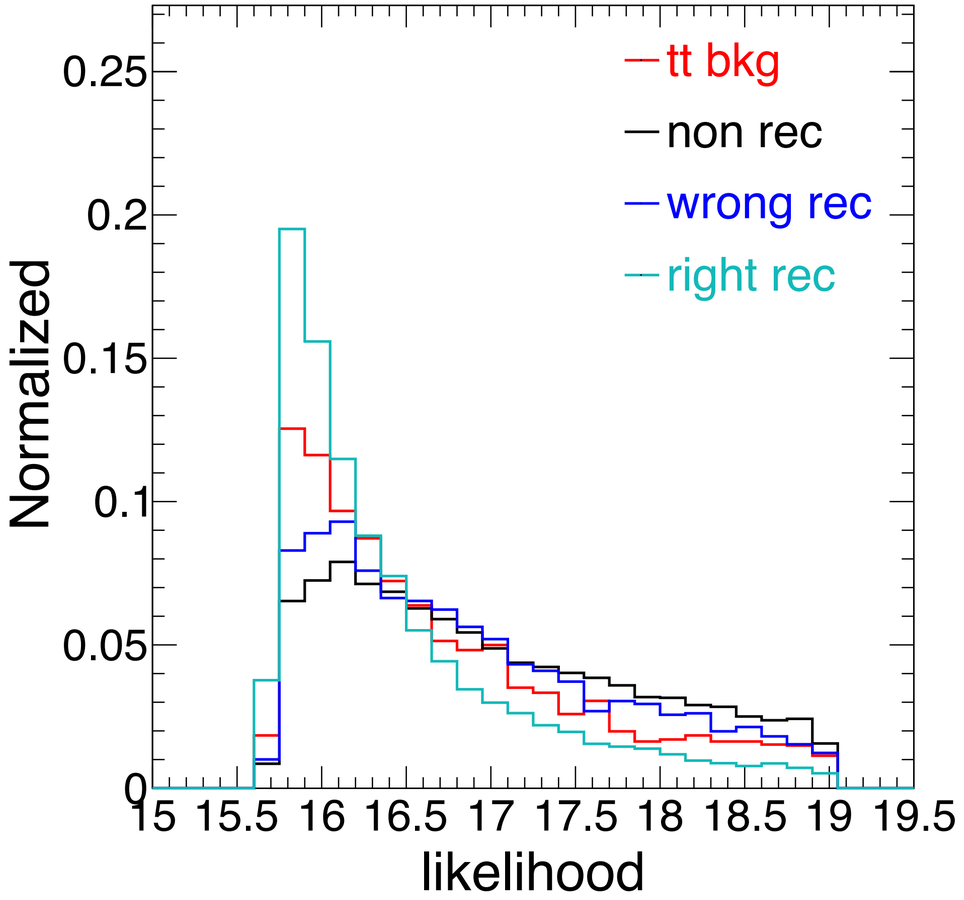
500
1000
P_z^ν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Normalized
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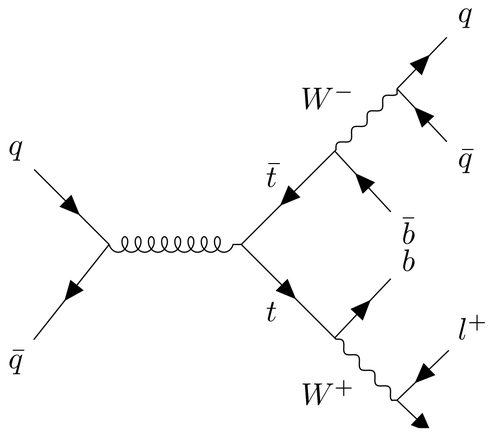
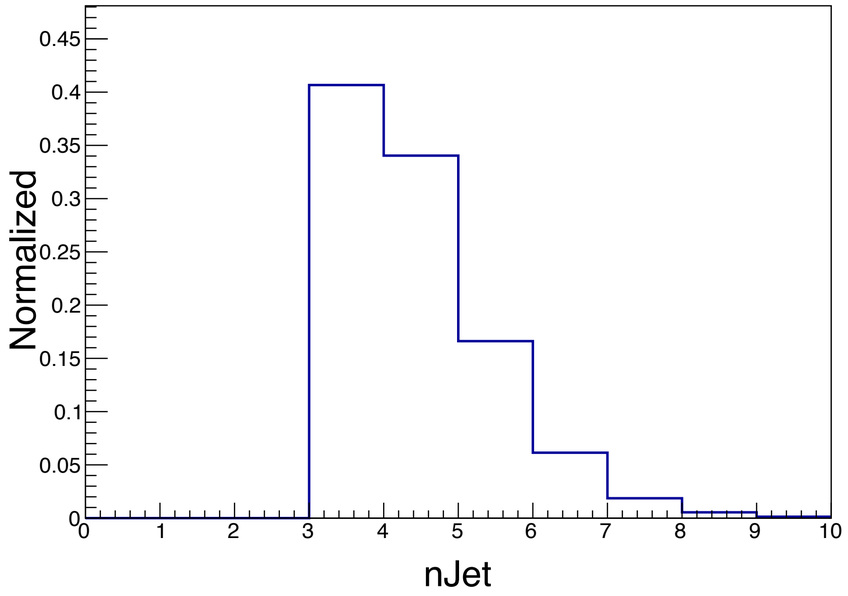
16.5
17
17.5
18
18.5
19
19.5
likelihood

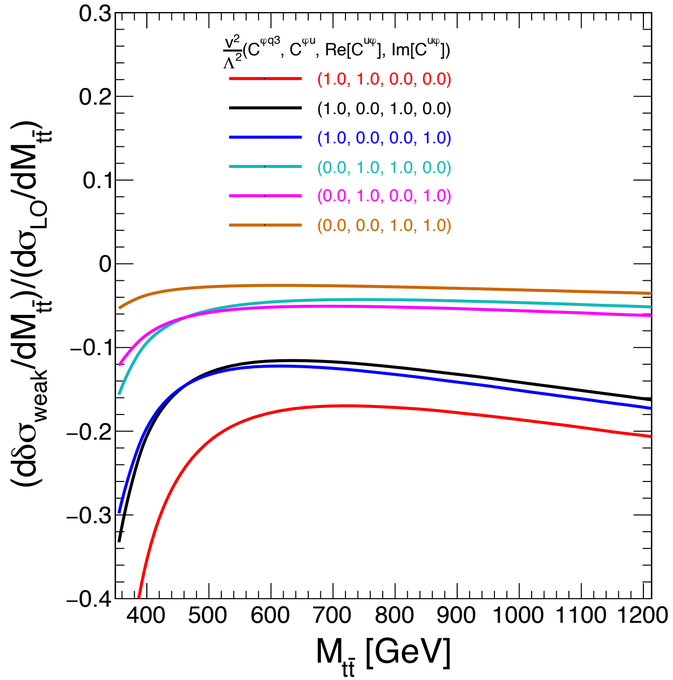
Reconstruction in 3 Jet Final State

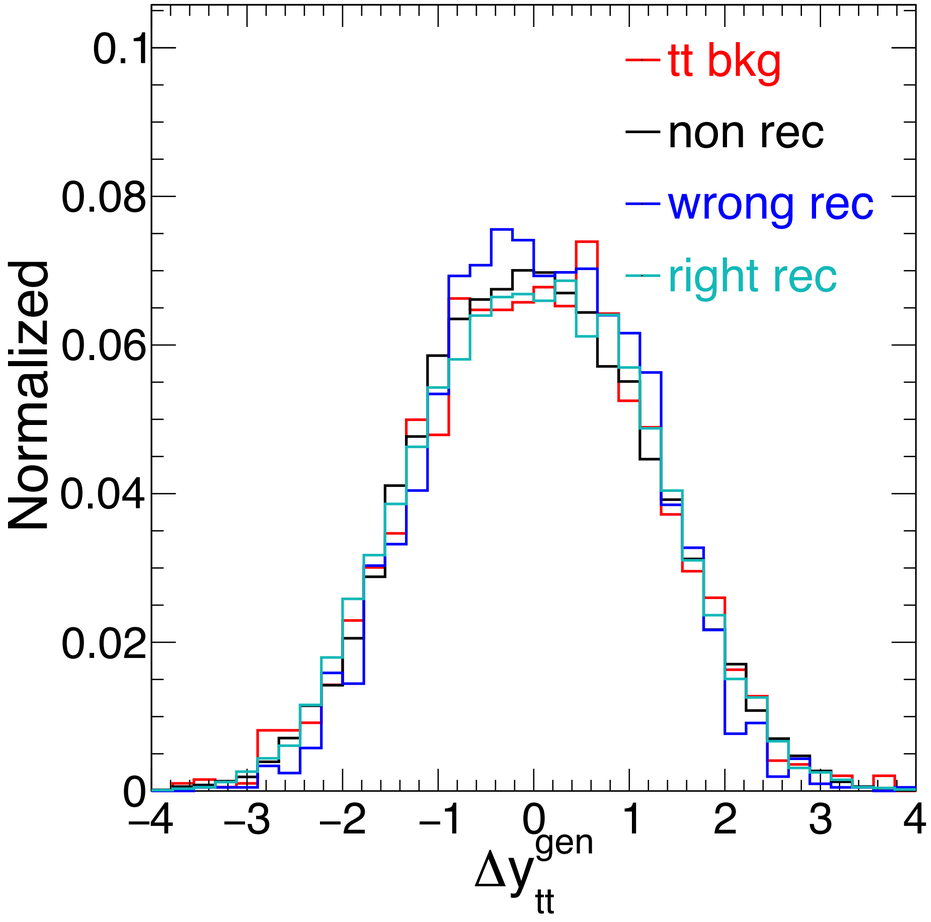
When only three jets are reconstructed, in 93% of the cases it is because a soft jet from W decay is out of acceptance: it is below the pT or η criteria for jets.

$$P_{w_{\text{had}}} = P_b + P_j$$








tt bkg
non rec
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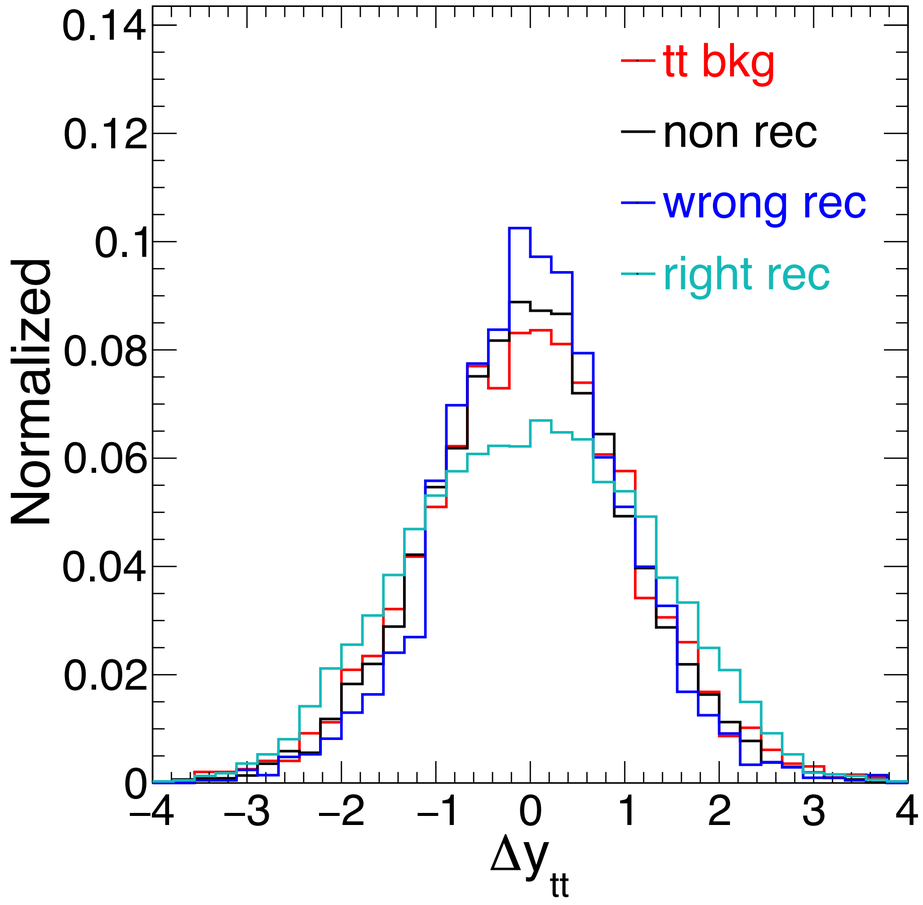
Δy_{tt}^{gen}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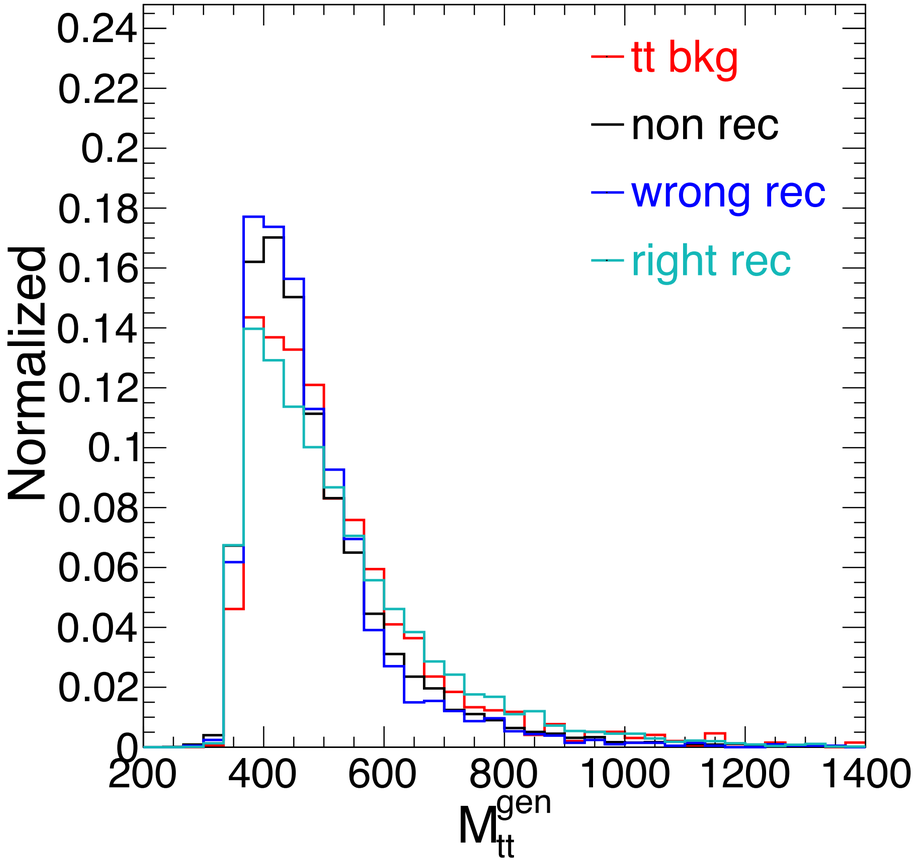
Δy_{tt}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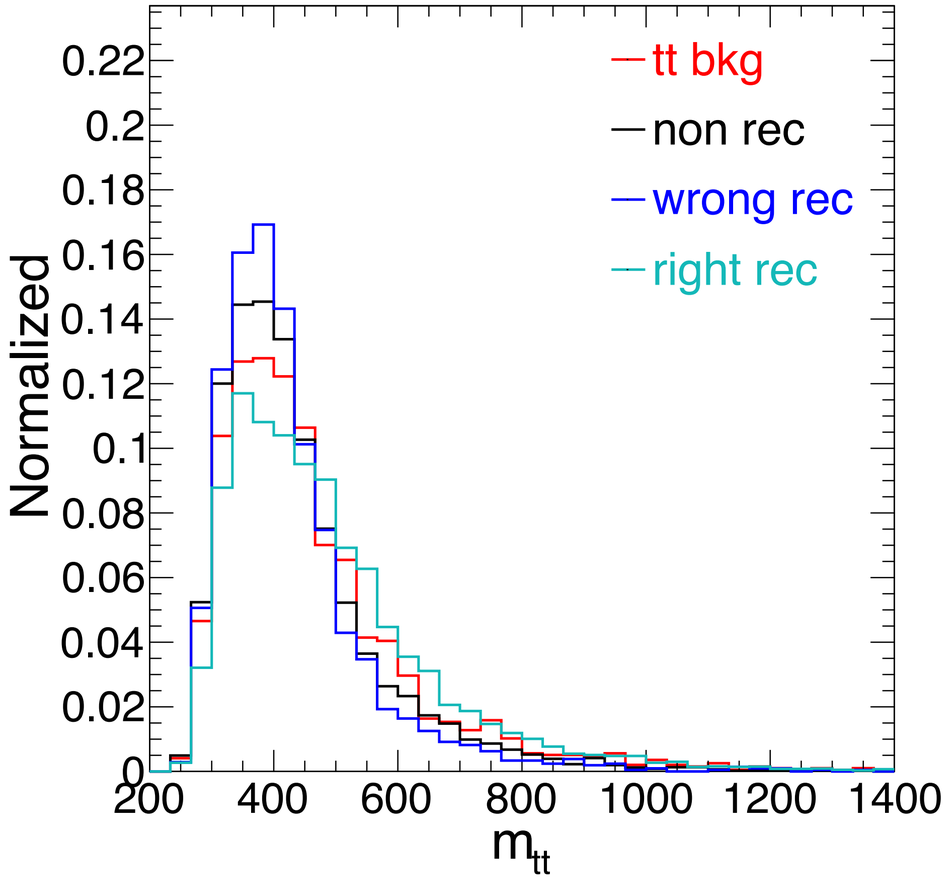
M_{tt}^{gen}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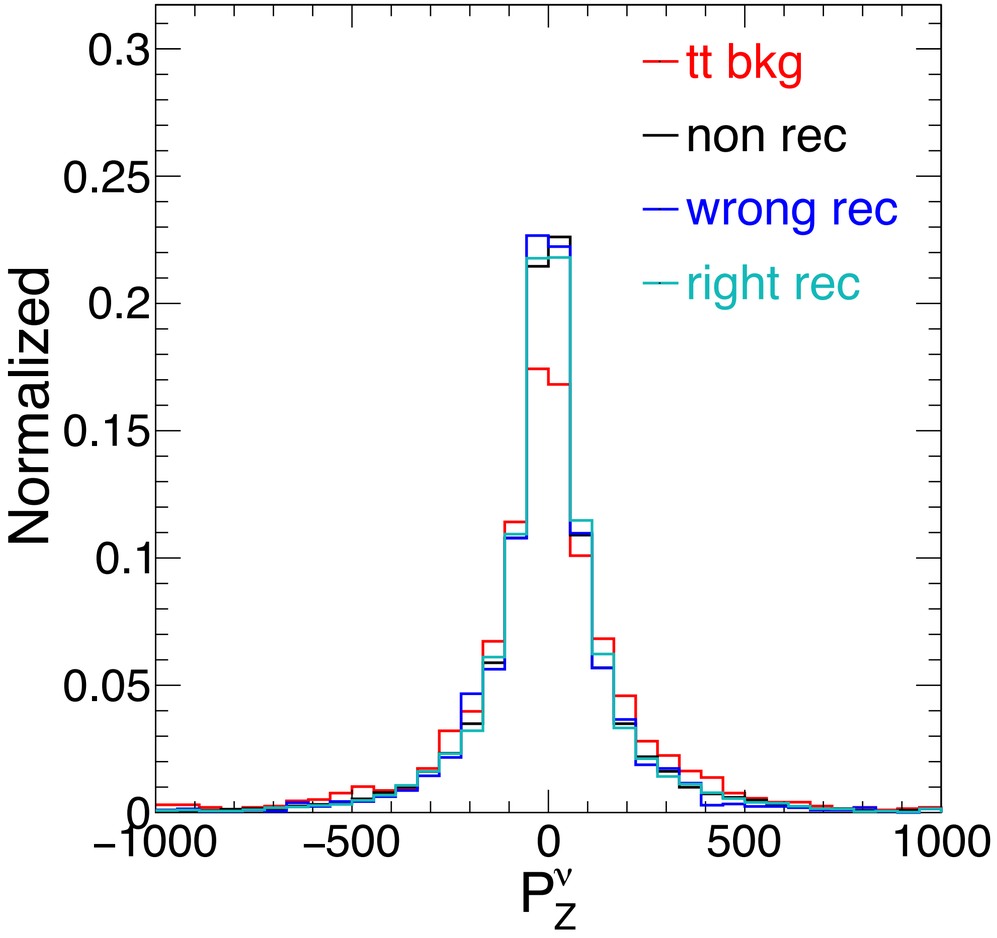
m_{tt}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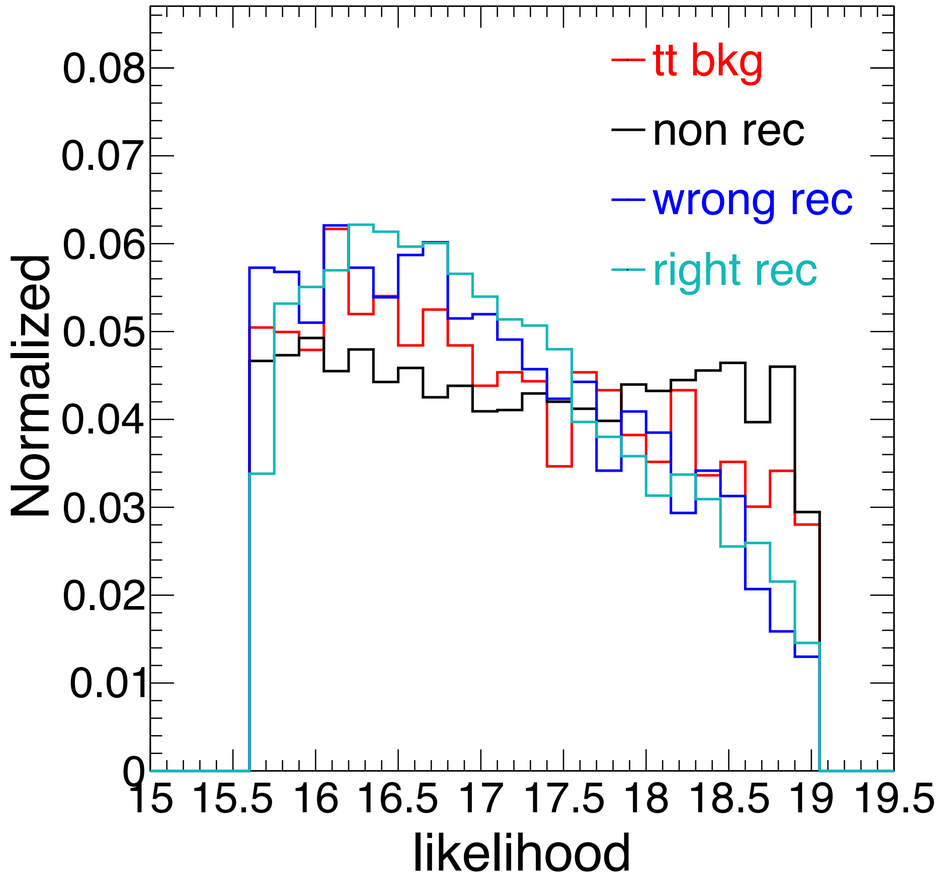
P_Z^ν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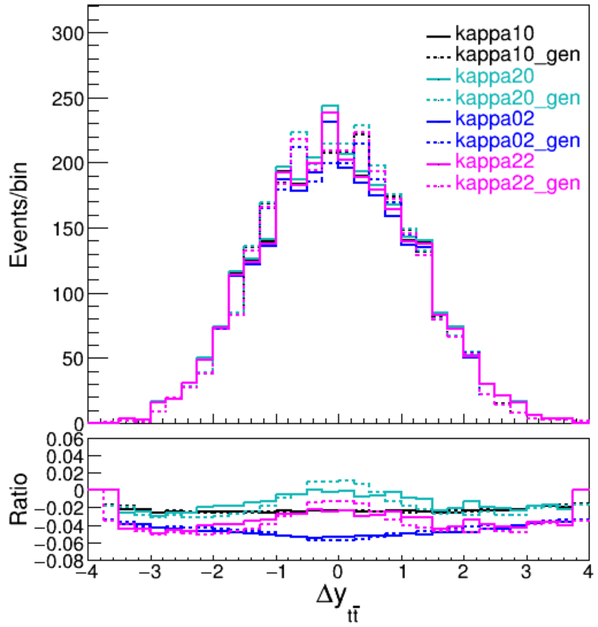
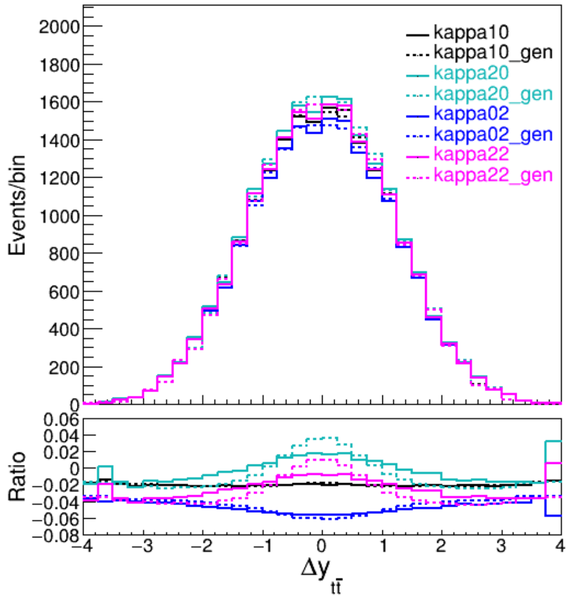
likelihood

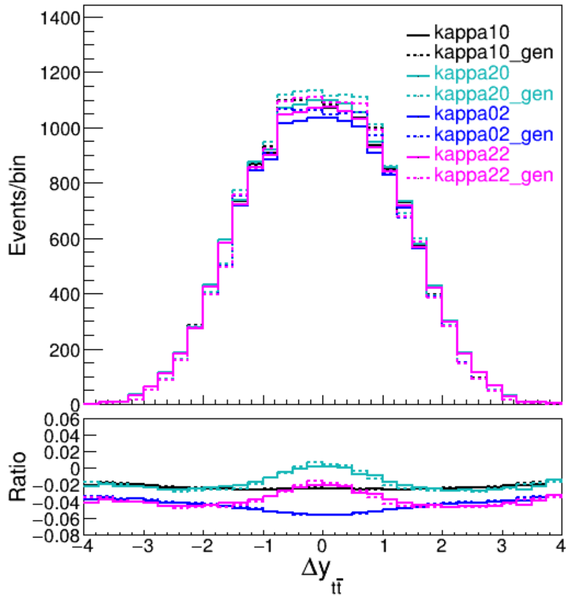
Background



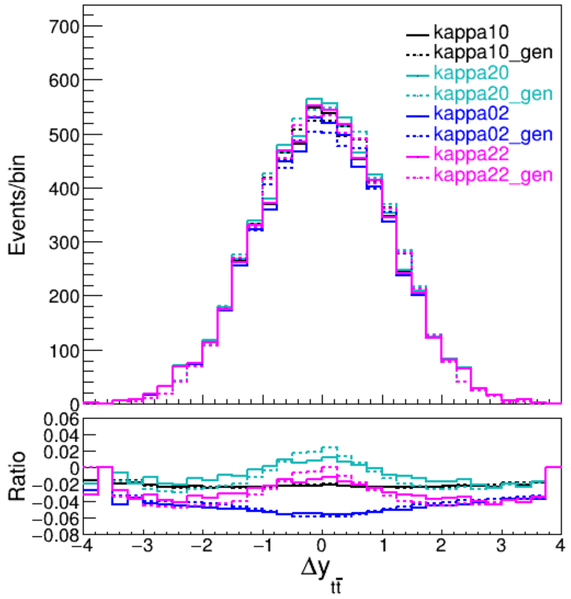
Nonrec



Right

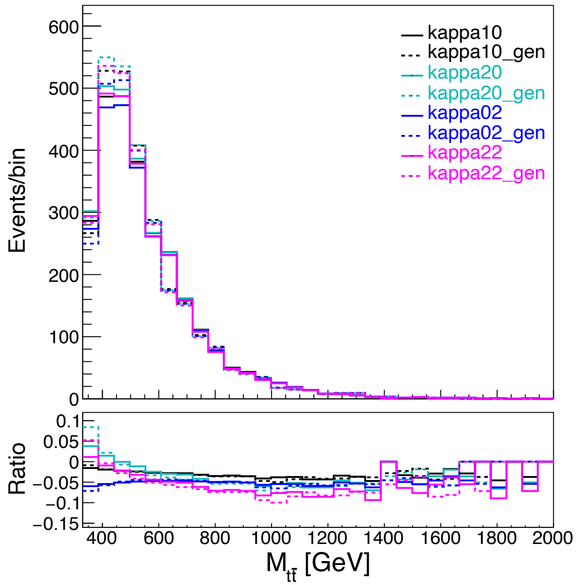


Wrong

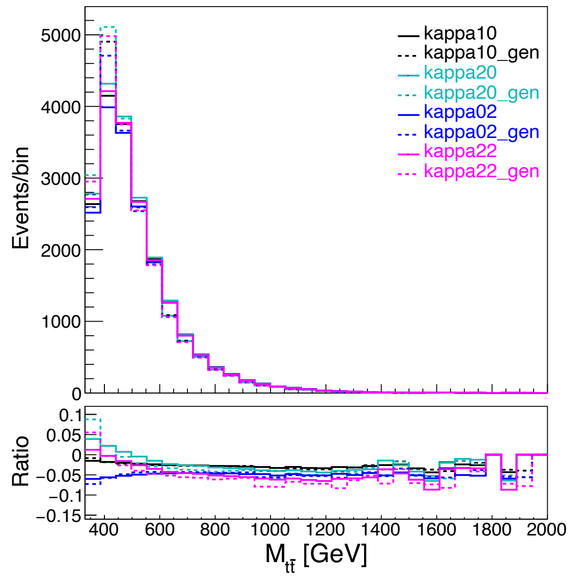


4Jets

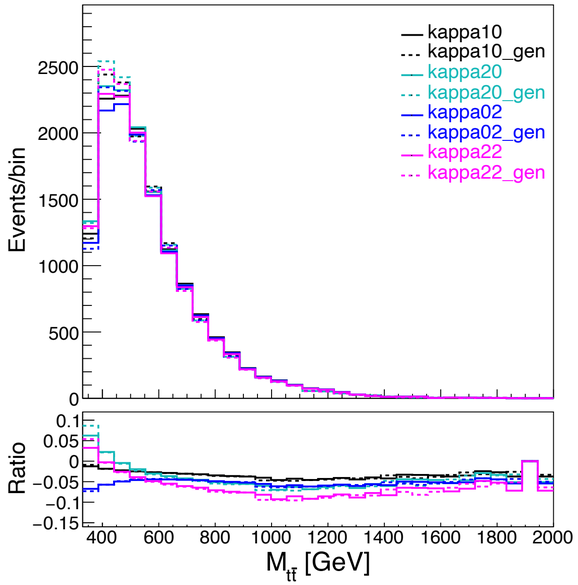
Background



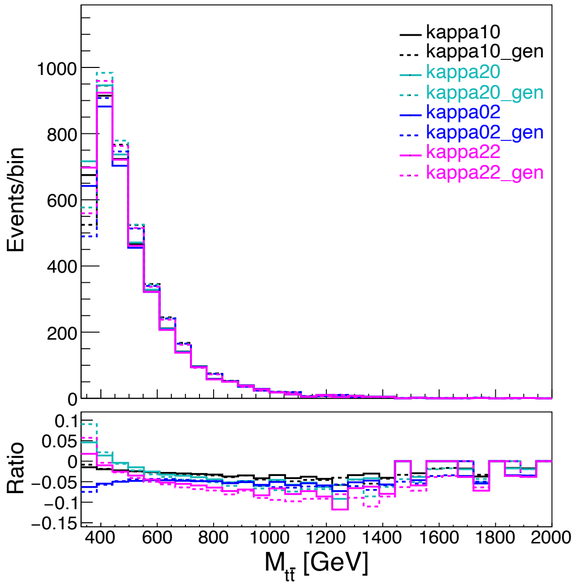
Nonrec



Right

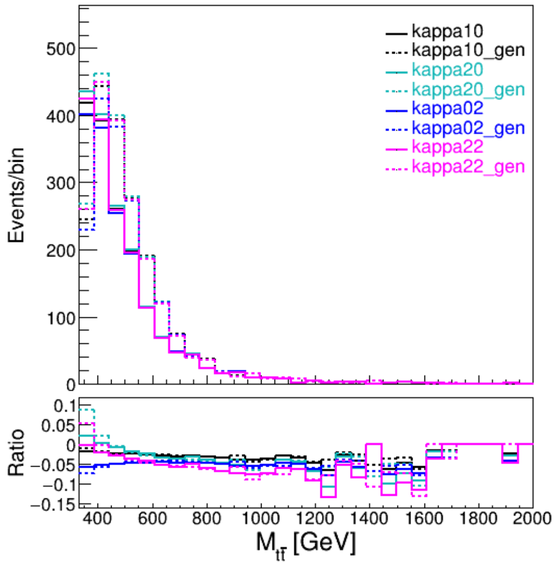


Wrong

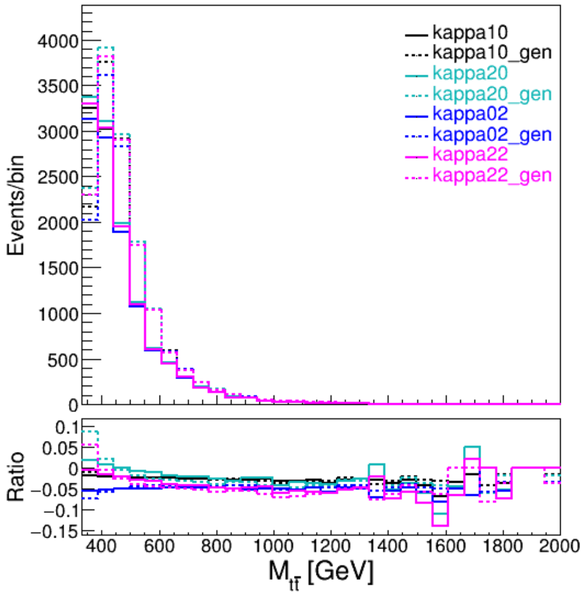


3Jets

Background



Nonrec



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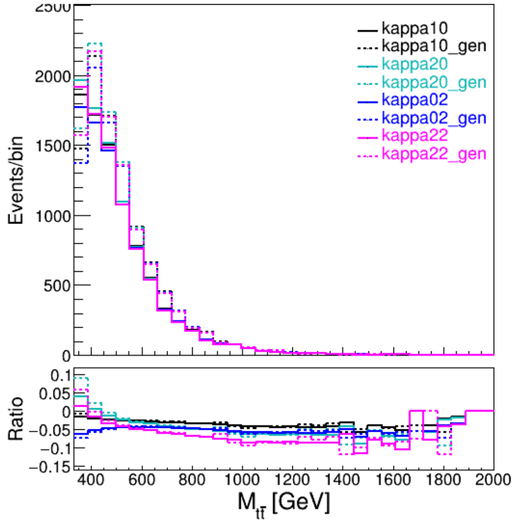

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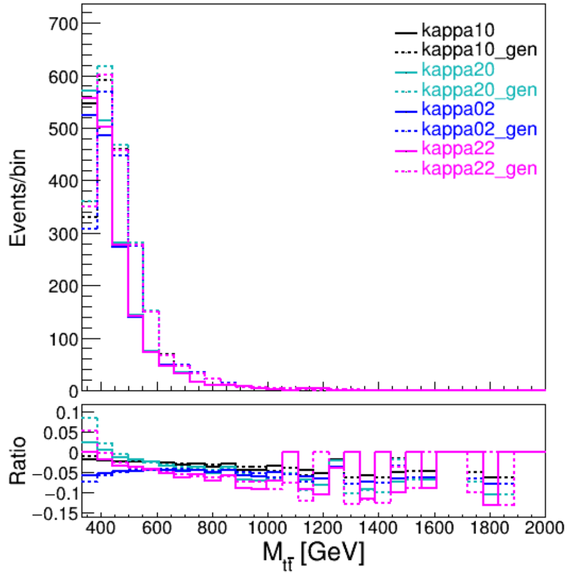

3Jets

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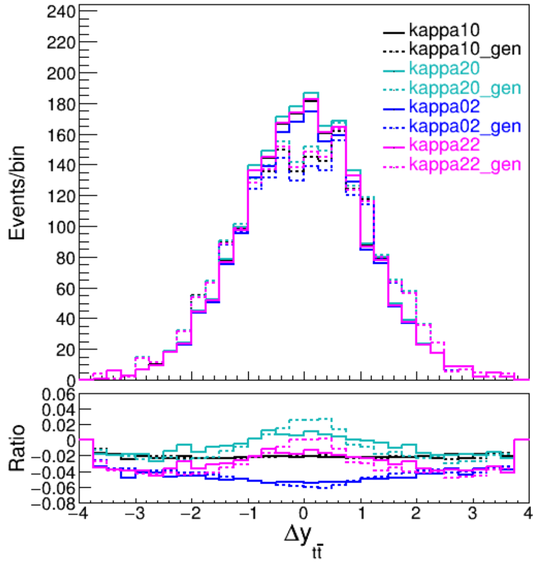

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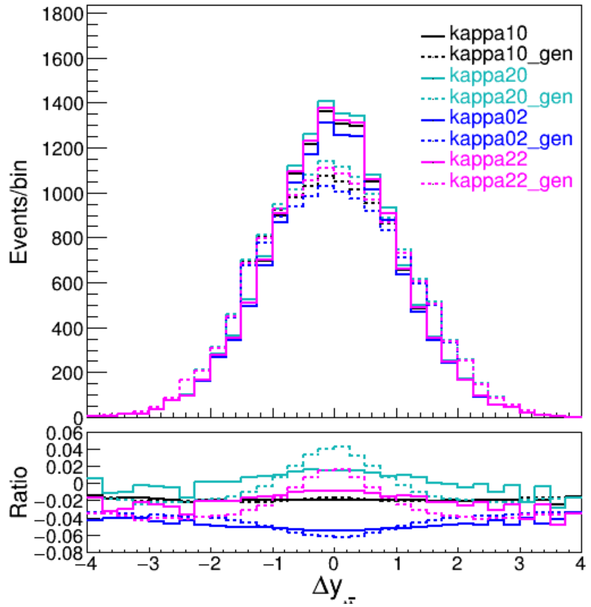

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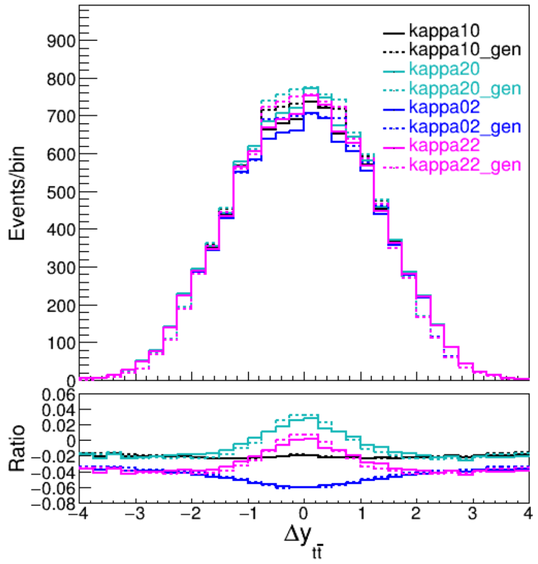

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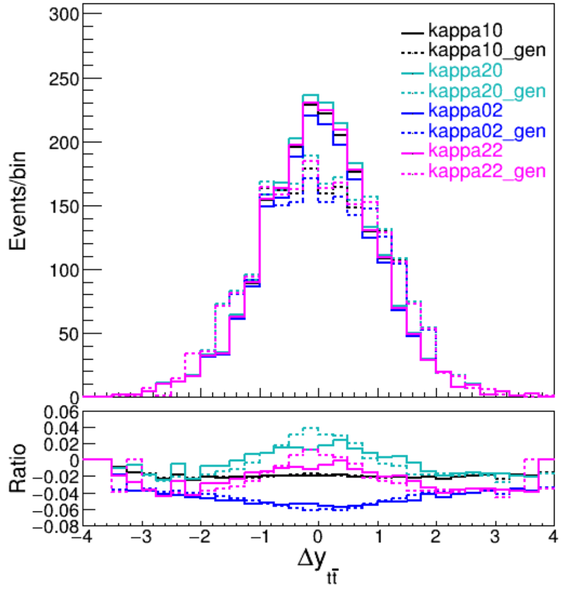

Efficiency

Efficiency of Reconstruction

Category	3Jets	>=4Jets
tt right	30%	31%
tt wrong	22%	20%
tt background	5%	5%
tt nonrec	43%	44%

EW in Dilepton channel