Outlook

- Update on “stub-like” tracks
  - reconstruction software release iLCSoft_2019-01-16

- Validation of release iLCSoft_2019-02-20
  - tracking performance (ttbar events @3TeV)
  - flavour tagging

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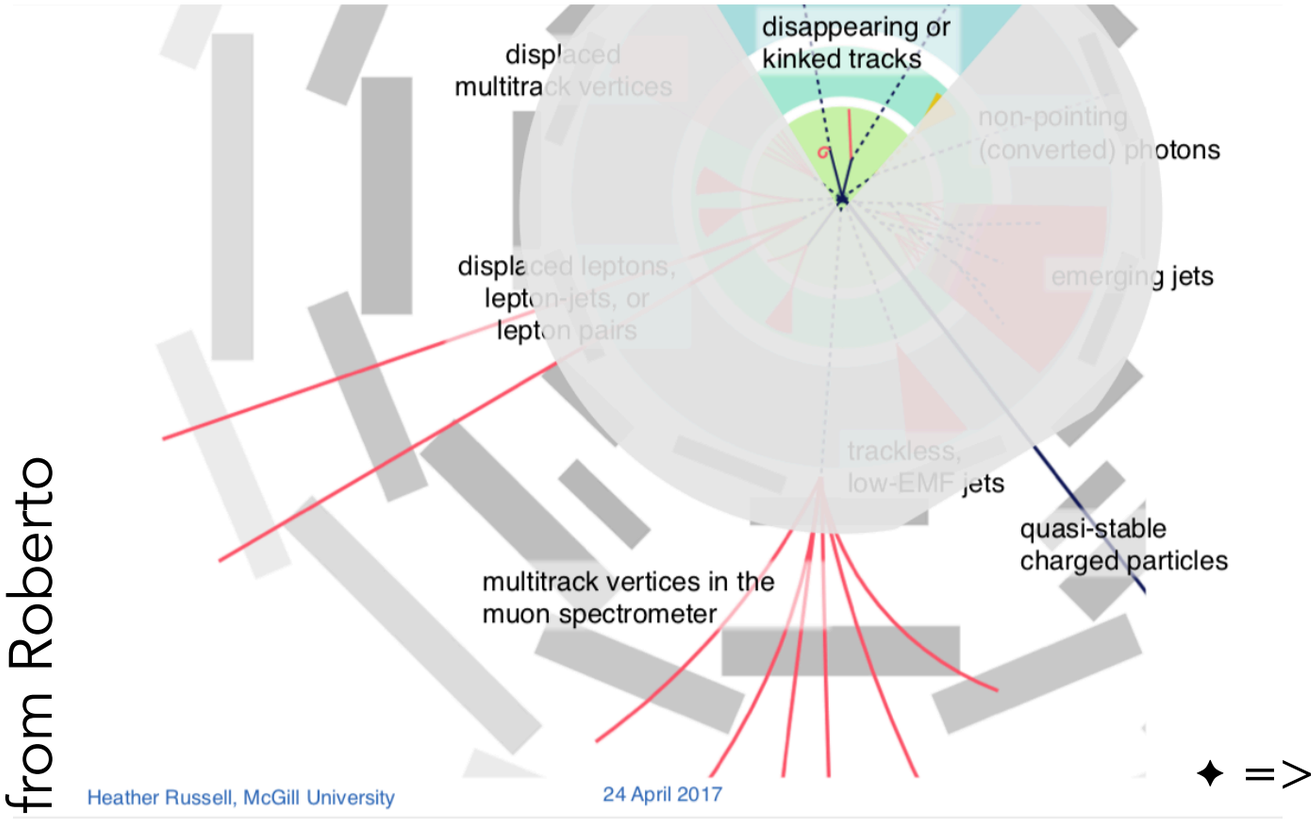
Stub tracks: theory and simulation

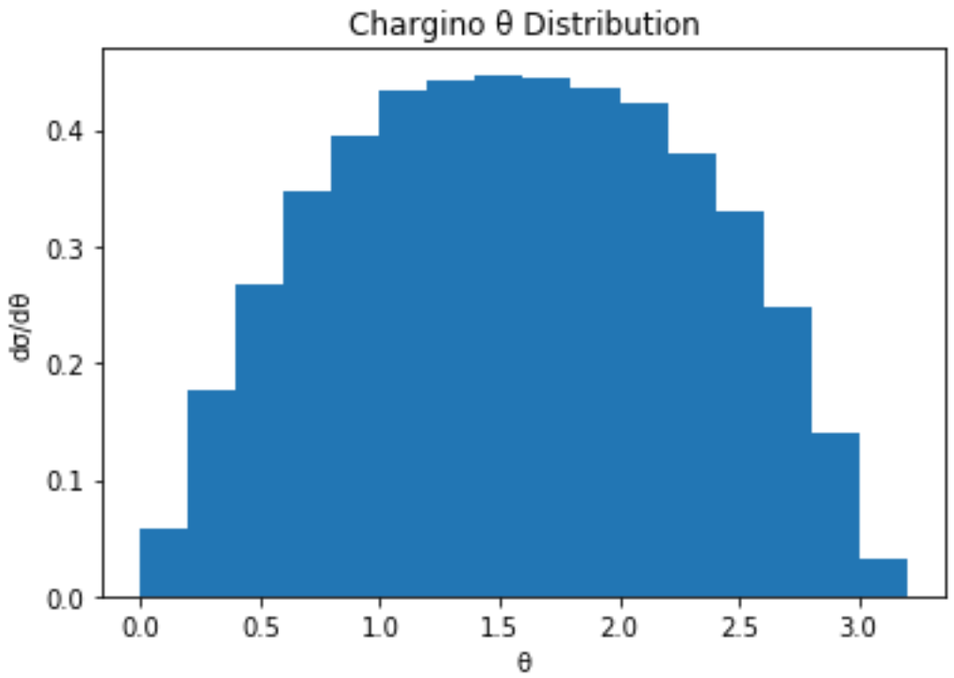
from last weeks

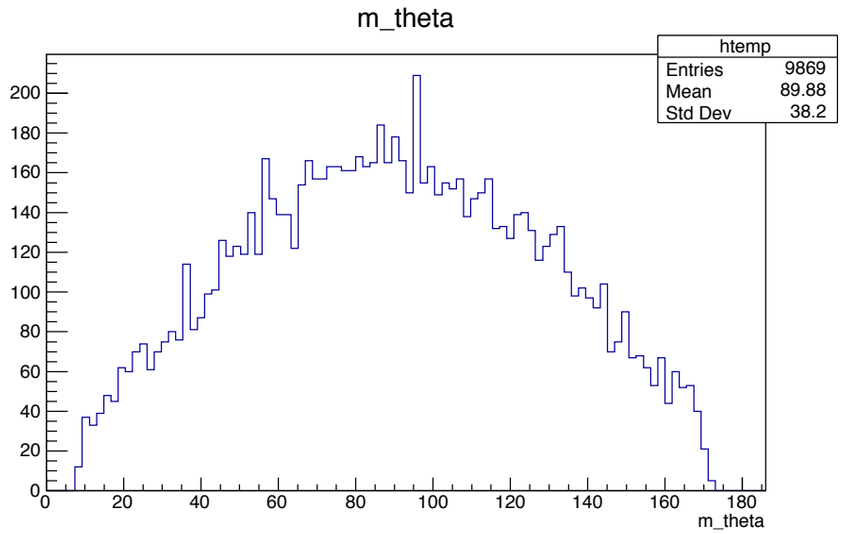


from Roberto

- e+e- @3 TeV => chargino energy E = 1.5 TeV
- chargino mass m = 1.050 TeV
- $p^2 = E^2 - m^2$ = 1.07 TeV
- => very straight and short tracks

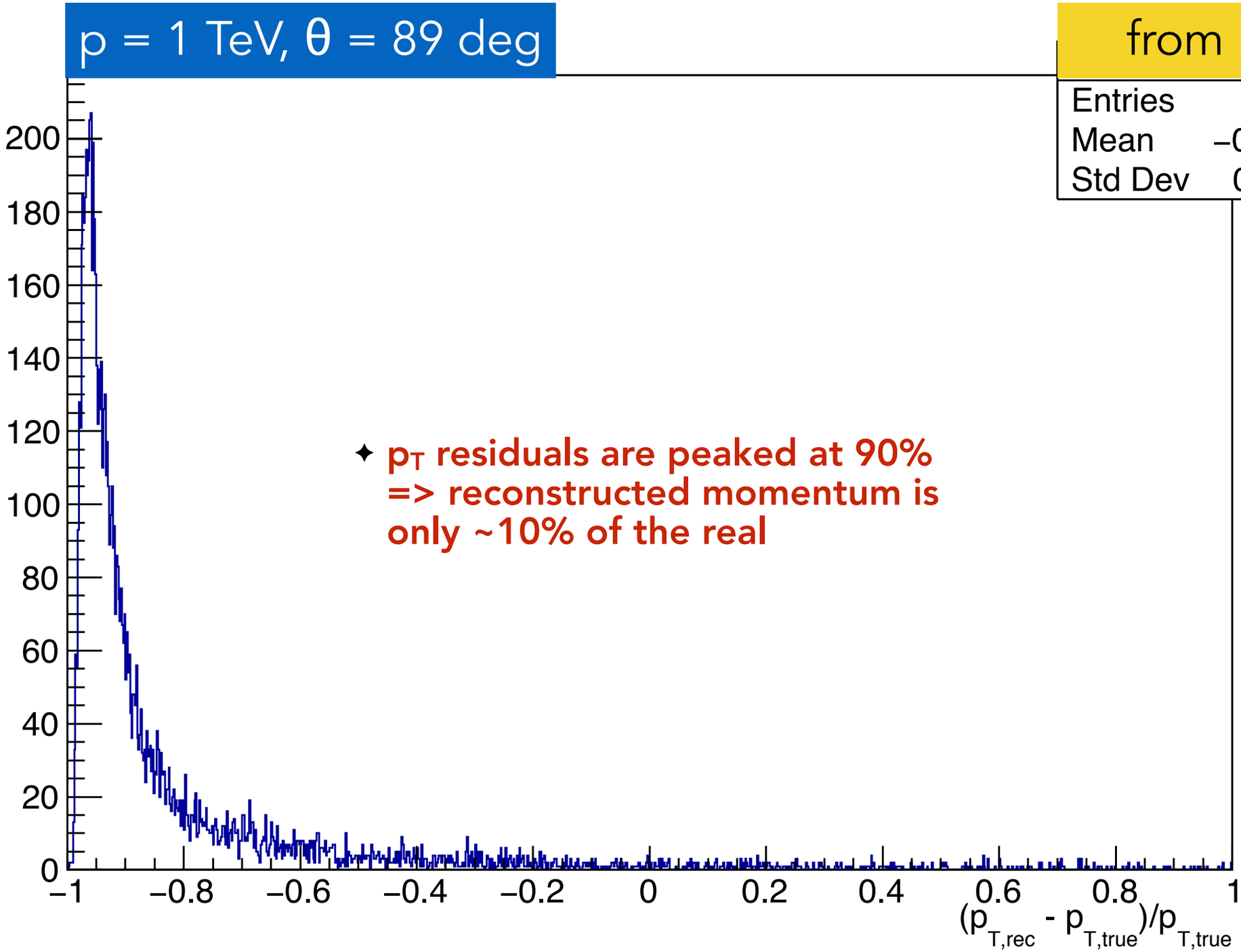
- => reduced the CLICdet to **only the vertex barrel**
- simulated **muons** with **p = 1 TeV and cos(theta)**:





Stub tracks: deeper investigation of momentum reconstruction

p = 1 TeV, θ = 89 deg



- p_T residuals are peaked at 90% => reconstructed momentum is only ~10% of the real

Sagitta's formula for momentum

- From equivalence between Lorentz force and circular motion:

$$mv_{\mathrm{T}}^2/R = qv_{\mathrm{T}}B => p_{\mathrm{T}} = qBR => p_{\mathrm{T}} = 0.3BR$$

p_T [GeV/c], B[T], R[m]

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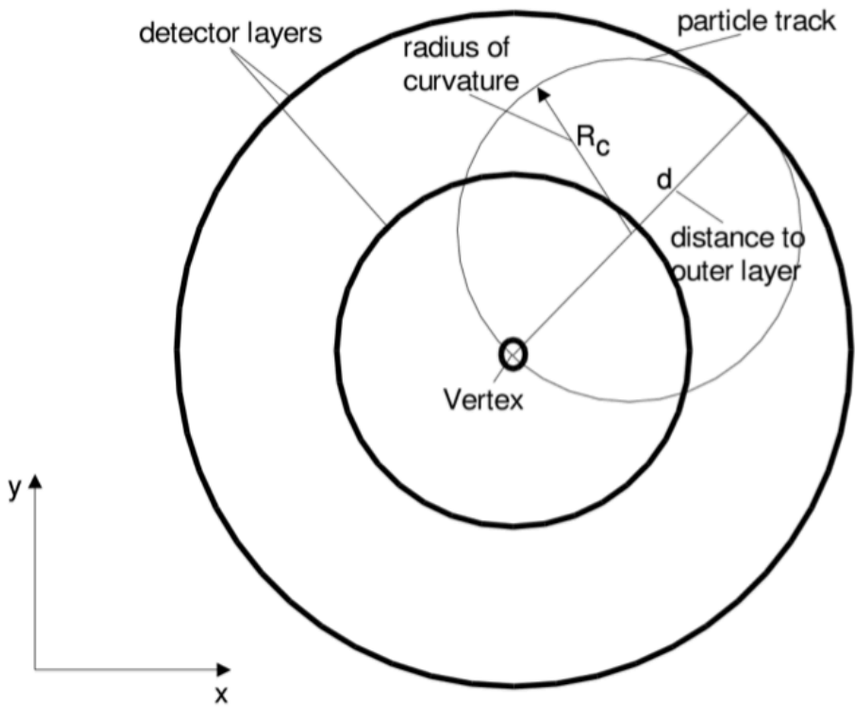
- R = R_c

Erica's thesis



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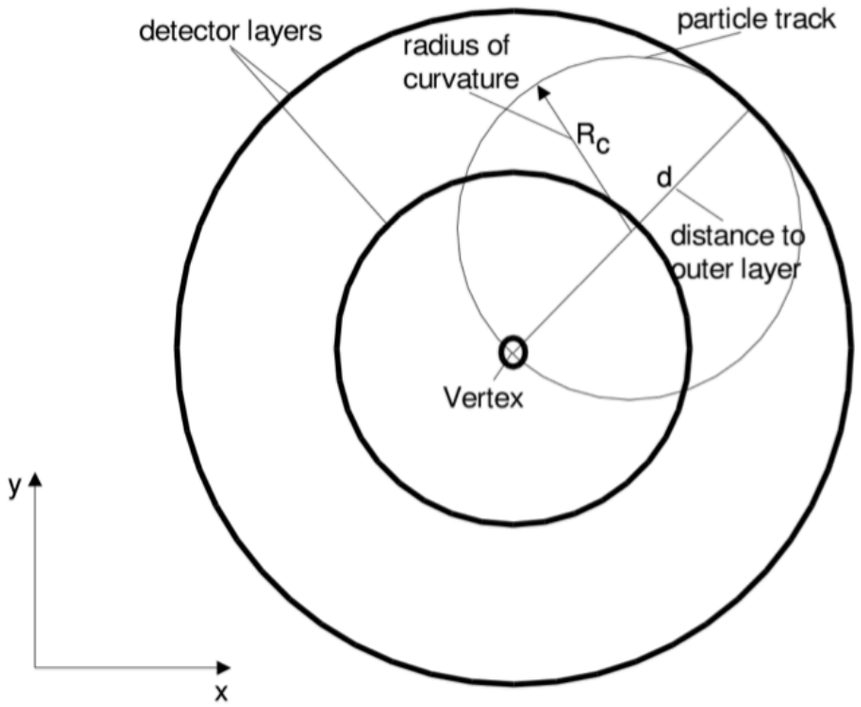

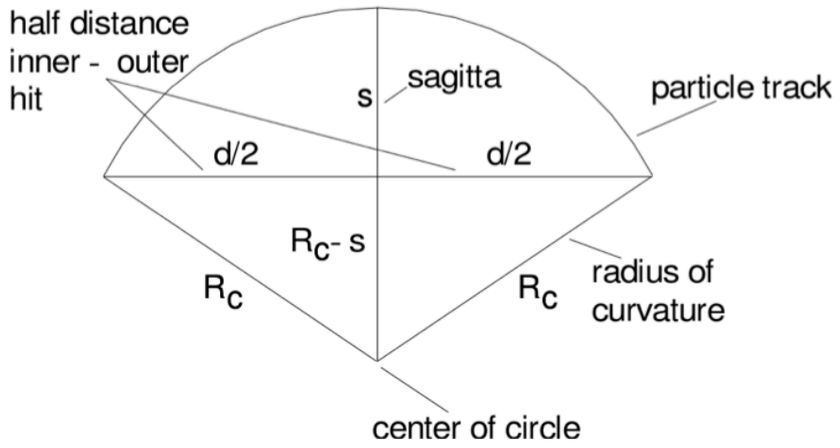

$$\left(\frac{d}{2}\right)^2 + (R_c - s)^2 = R_c^2$$

$$=> R_c = \frac{\left(\frac{d}{2}\right)^2 + s^2}{2s}$$

- for our stub tracks: d = 60 mm (3rd double layer)

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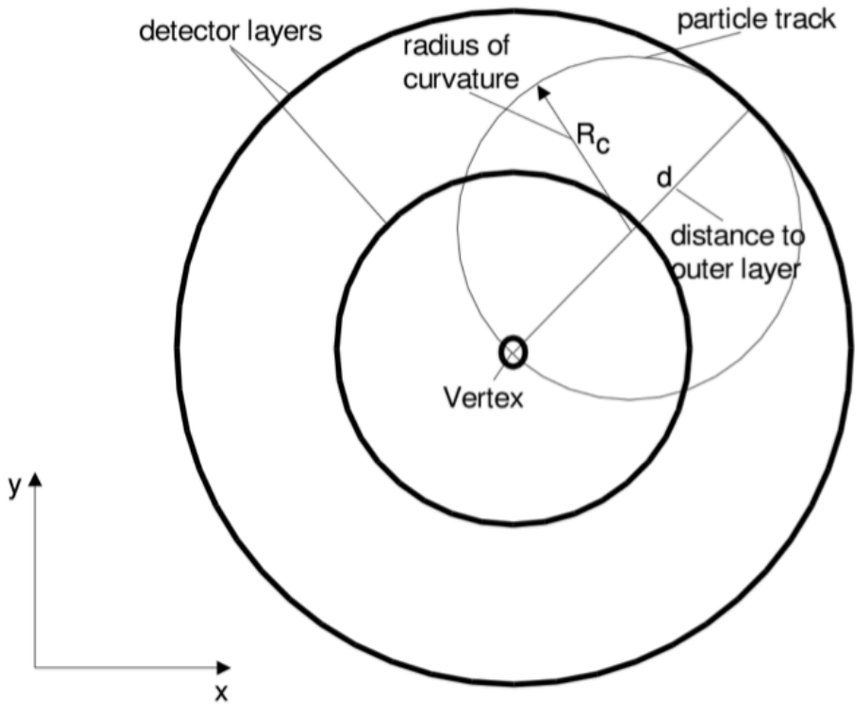

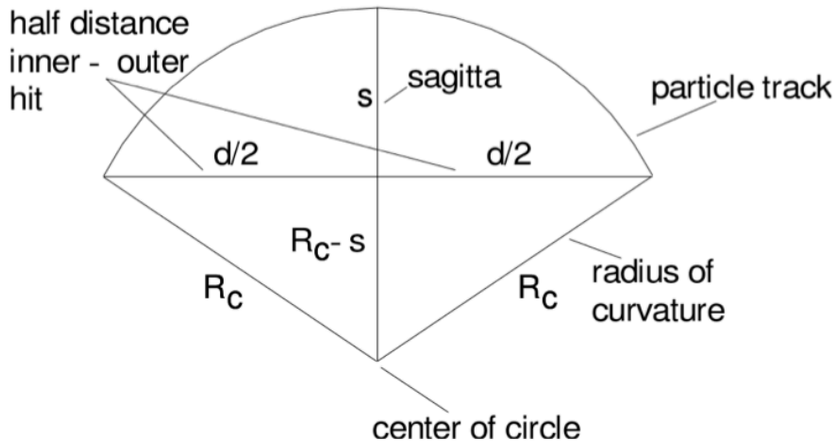

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- for our stub tracks: d = 60 mm (3rd double layer)

- We can calculate the max reconstructable p_T by setting the sagitta = spr of the middle layer/sqrt(2)
  - s = 3um/sqrt(2) => max p_T = ~250 GeV/c
  - s = 1um/sqrt(2) => max p_T = ~750 GeV/c

Sagitta's formula for momentum

- From equivalence between Lorentz force and circular motion:

$$mv_{\mathrm{T}}^2/R = qv_{\mathrm{T}}B => p_{\mathrm{T}} = qBR => p_{\mathrm{T}} = 0.3BR$$

p_T [GeV/c], B[T], R[m]

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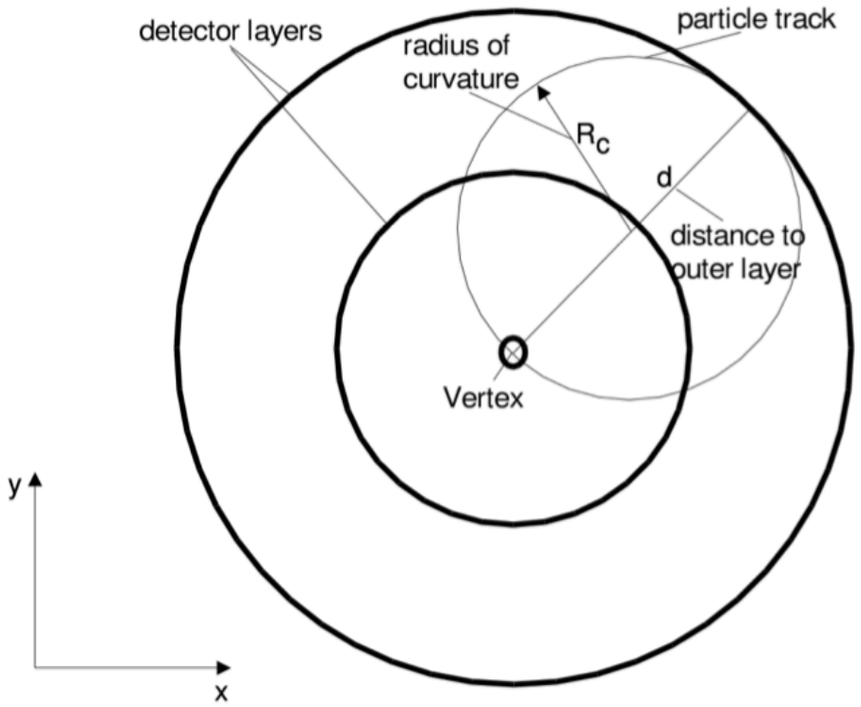

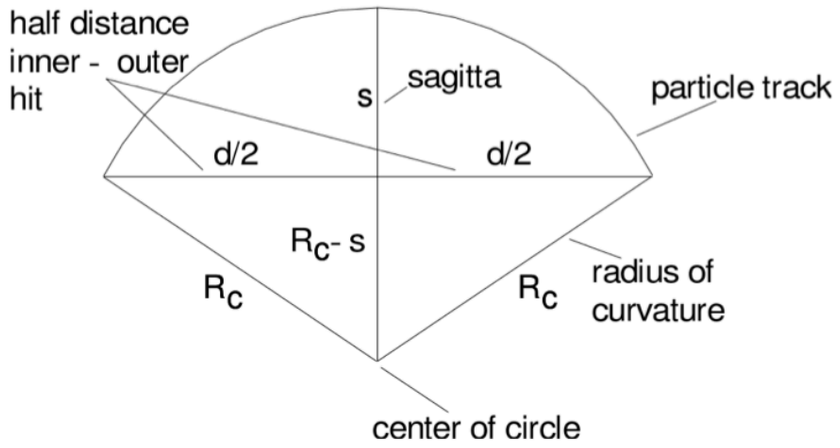

$$\left(\frac{d}{2}\right)^2 + (R_c - s)^2 = R_c^2$$

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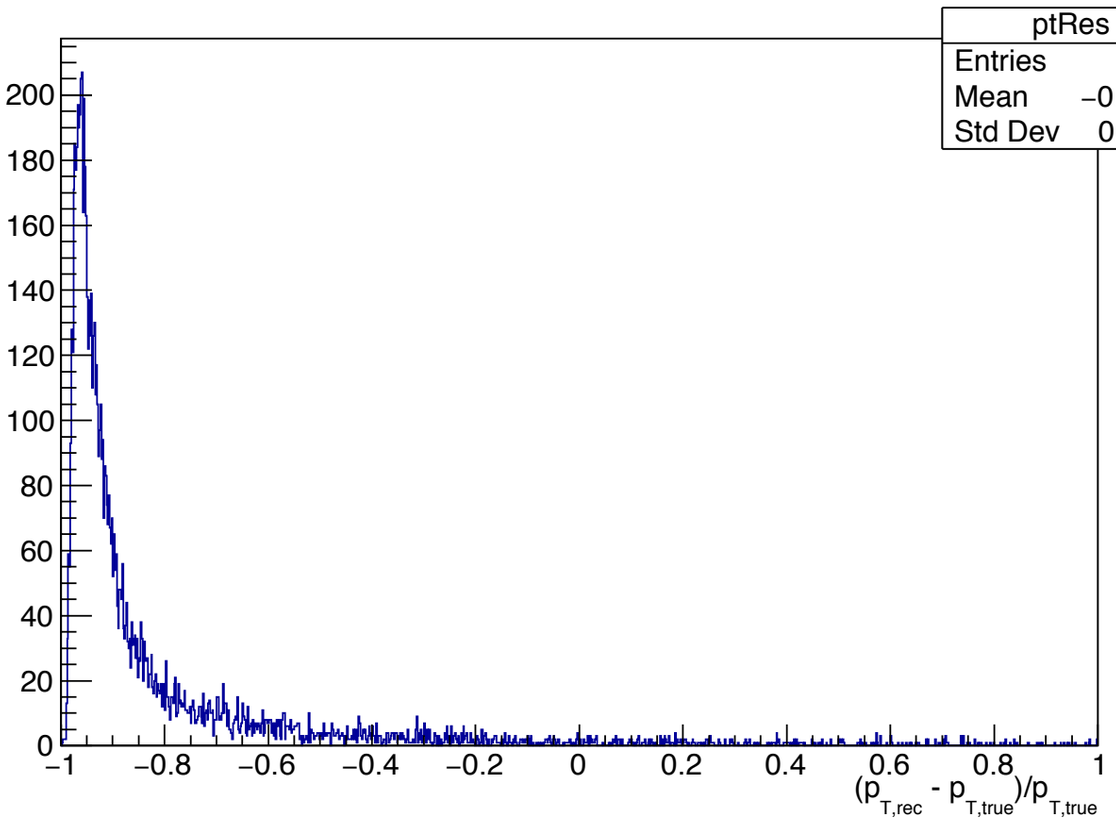
- We can calculate the max reconstructable p_T by setting the sagitta = spr of the middle layer/sqrt(2)
  - s = 3um/sqrt(2) => max p_T = ~250 GeV/c
  - s = 1um/sqrt(2) => max p_T = ~750 GeV/c

- If outermost layer is 2nd double layer (d = 44mm)
  - s = 3um/sqrt(2) => max p_T = ~110 GeV/c
  - s = 1um/sqrt(2) => max p_T = ~400 GeV/c

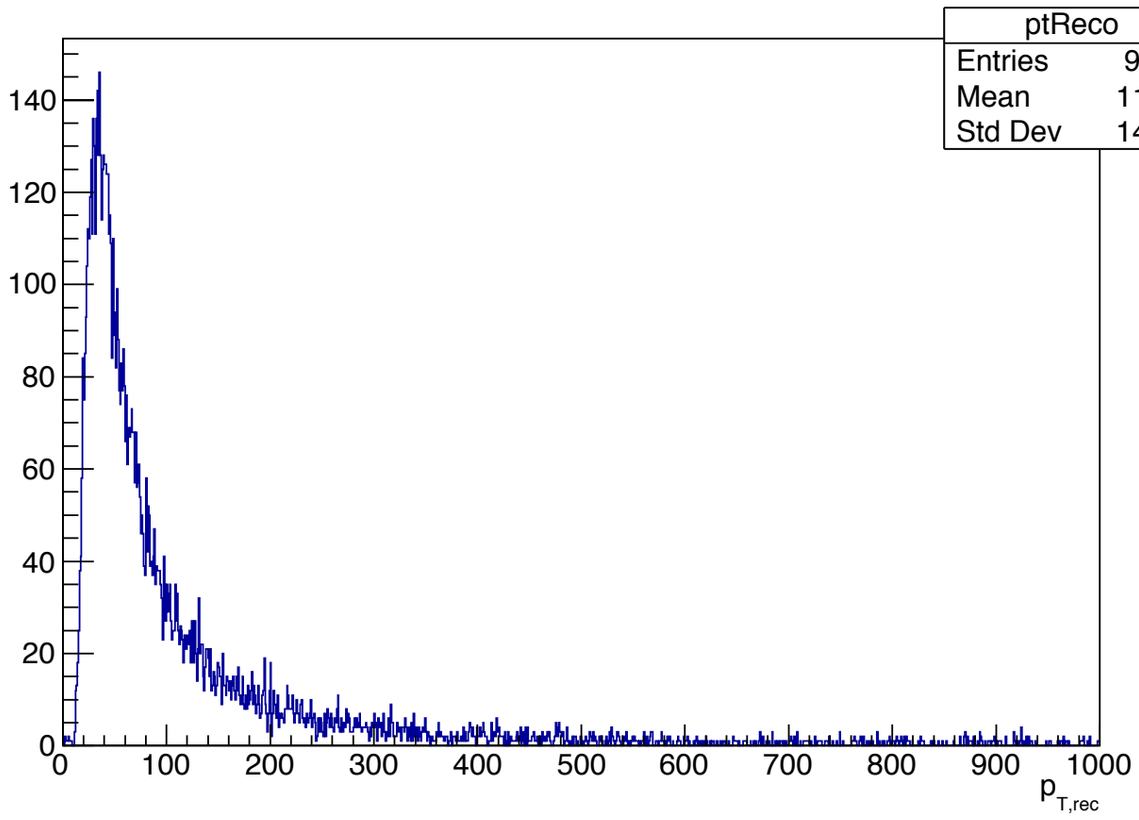
Stub tracks: deeper investigation of momentum reconstruction

p = 1 TeV, θ = 89 deg

p_T residual



p_T reco

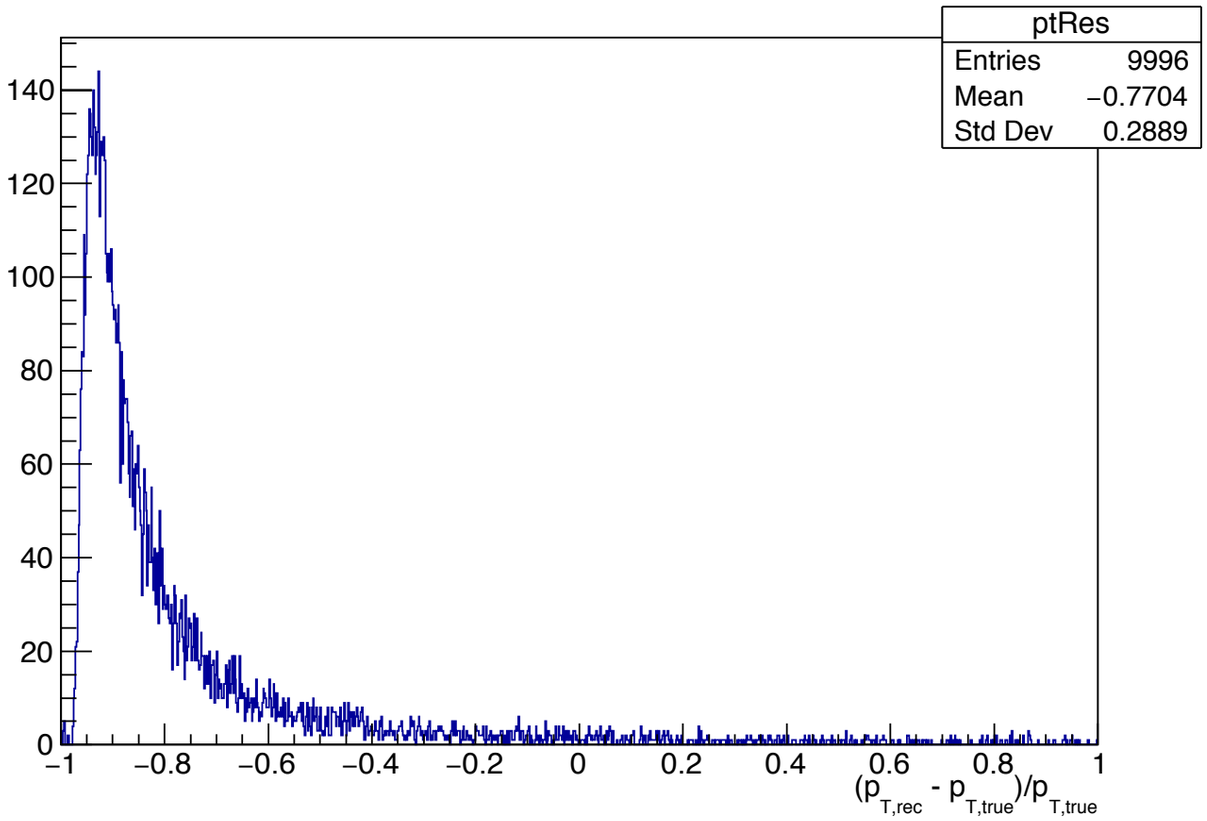


p_T @peak = 35.5 GeV

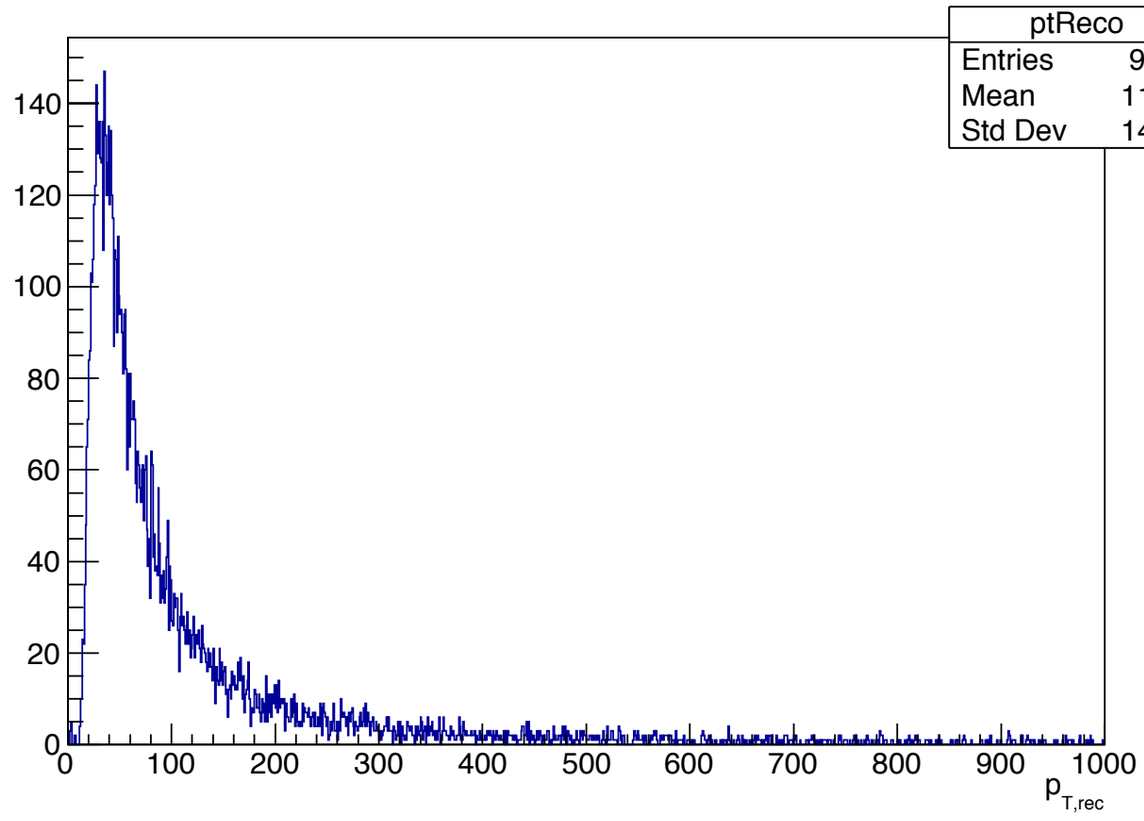
Stub tracks: deeper investigation of momentum reconstruction

p = 500 GeV, θ = 89 deg

p_T residual



p_T reco

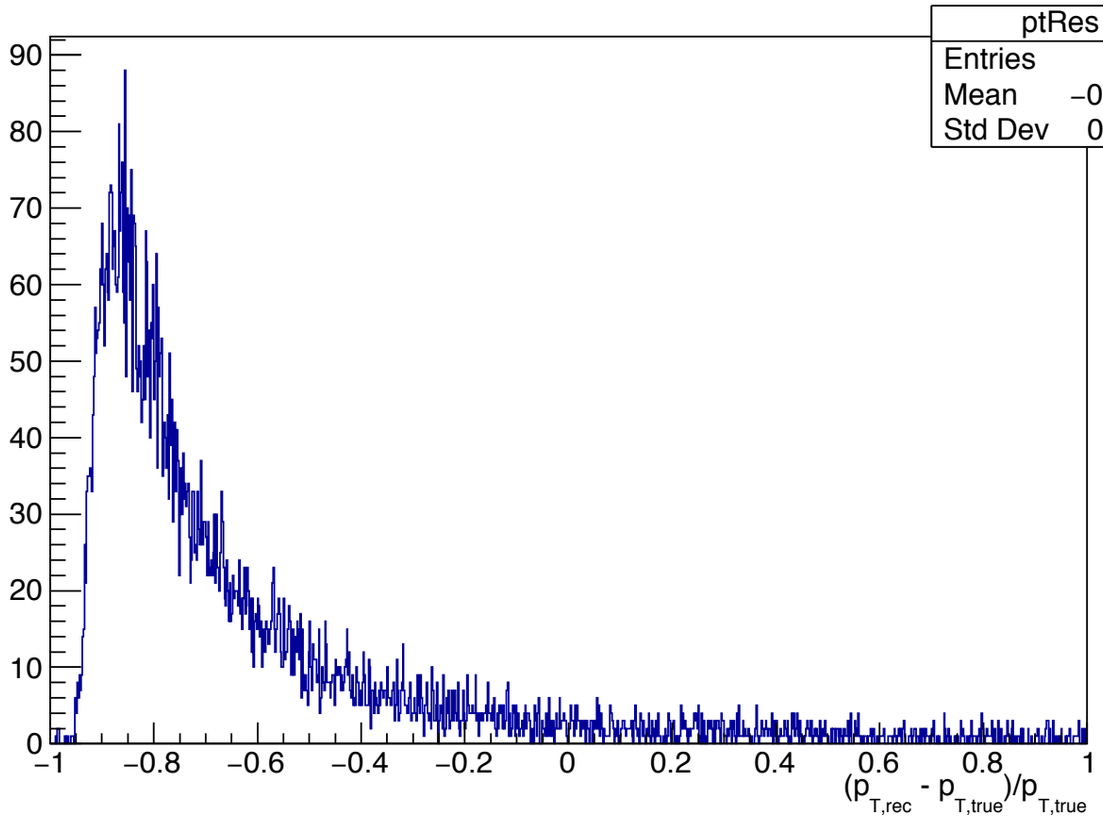


p_T @peak = 35.5 GeV

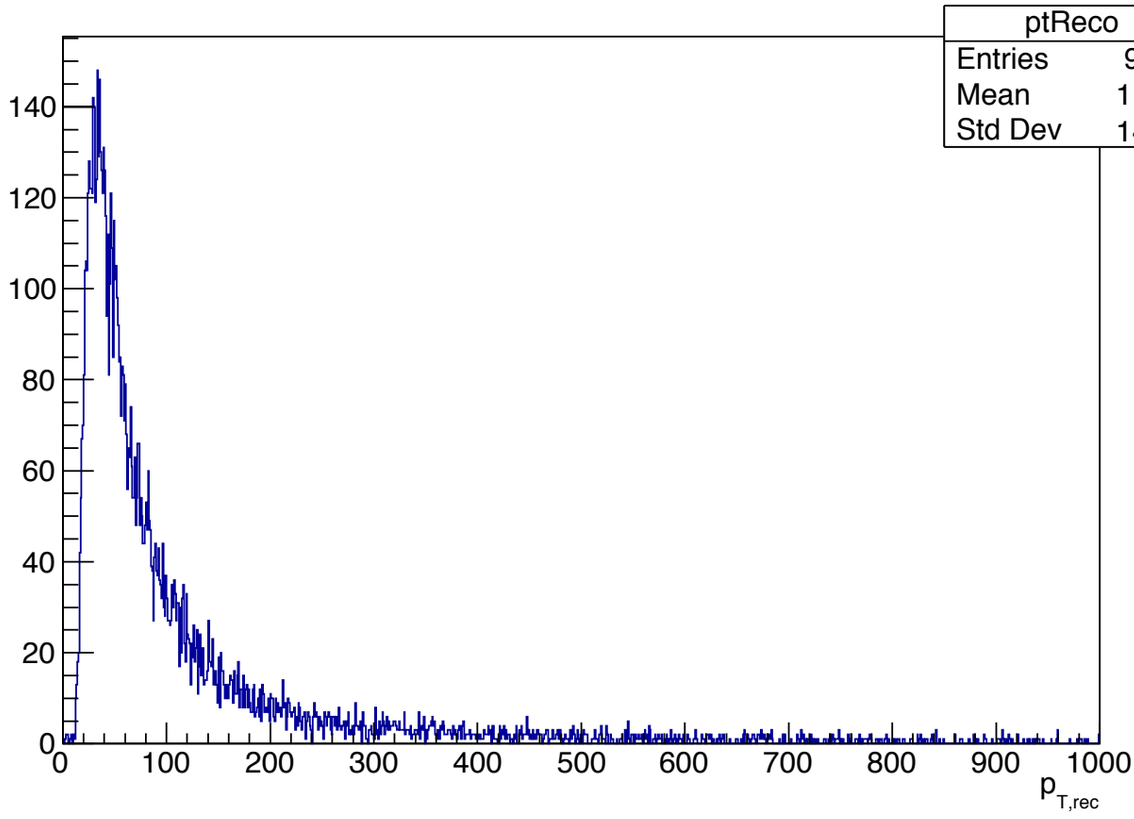
Stub tracks: deeper investigation of momentum reconstruction

p = 250 GeV, θ = 89 deg

p_T residual



p_T reco

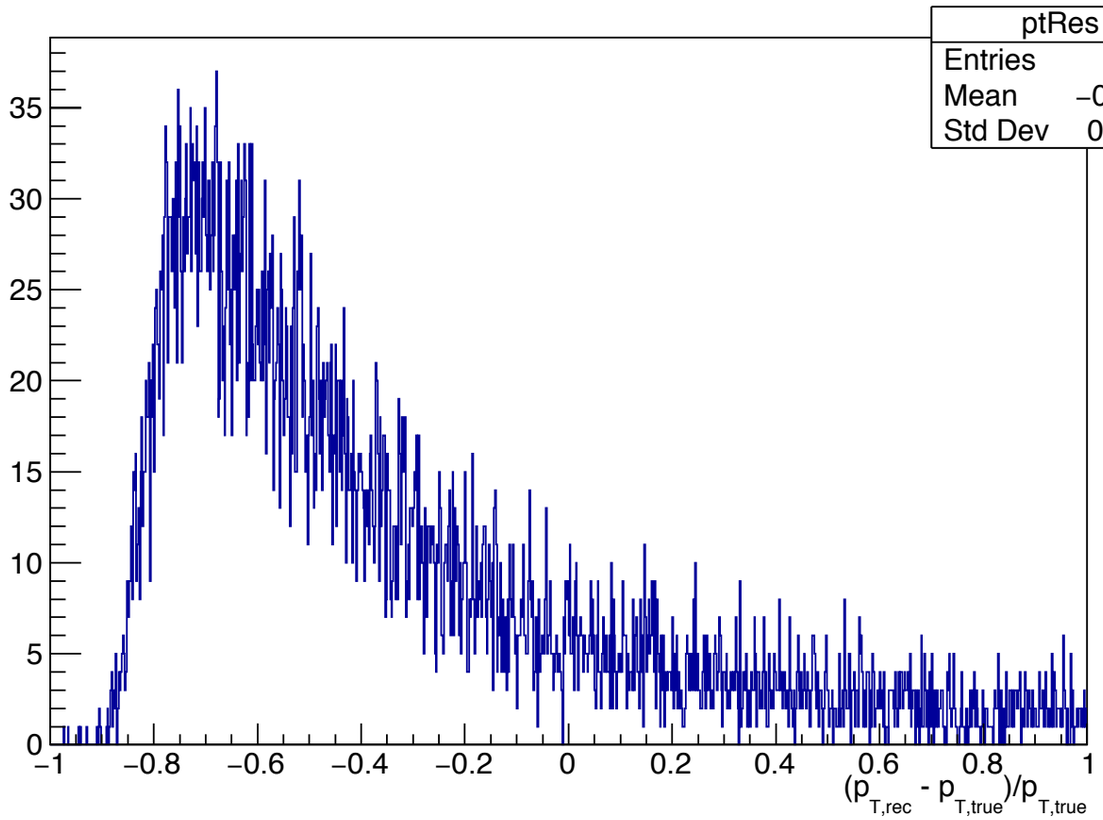


p_T @peak = 33.5 GeV

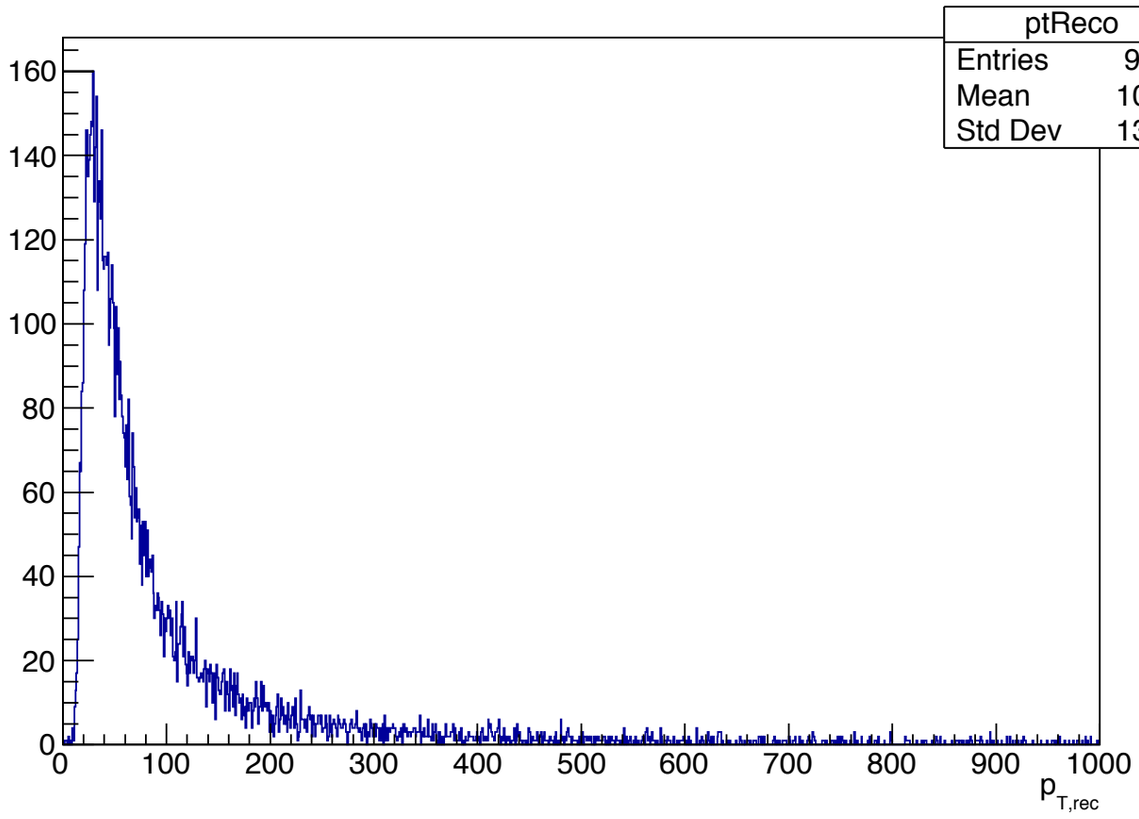
Stub tracks: deeper investigation of momentum reconstruction

p = 100 GeV, θ = 89 deg

p_T residual



p_T reco

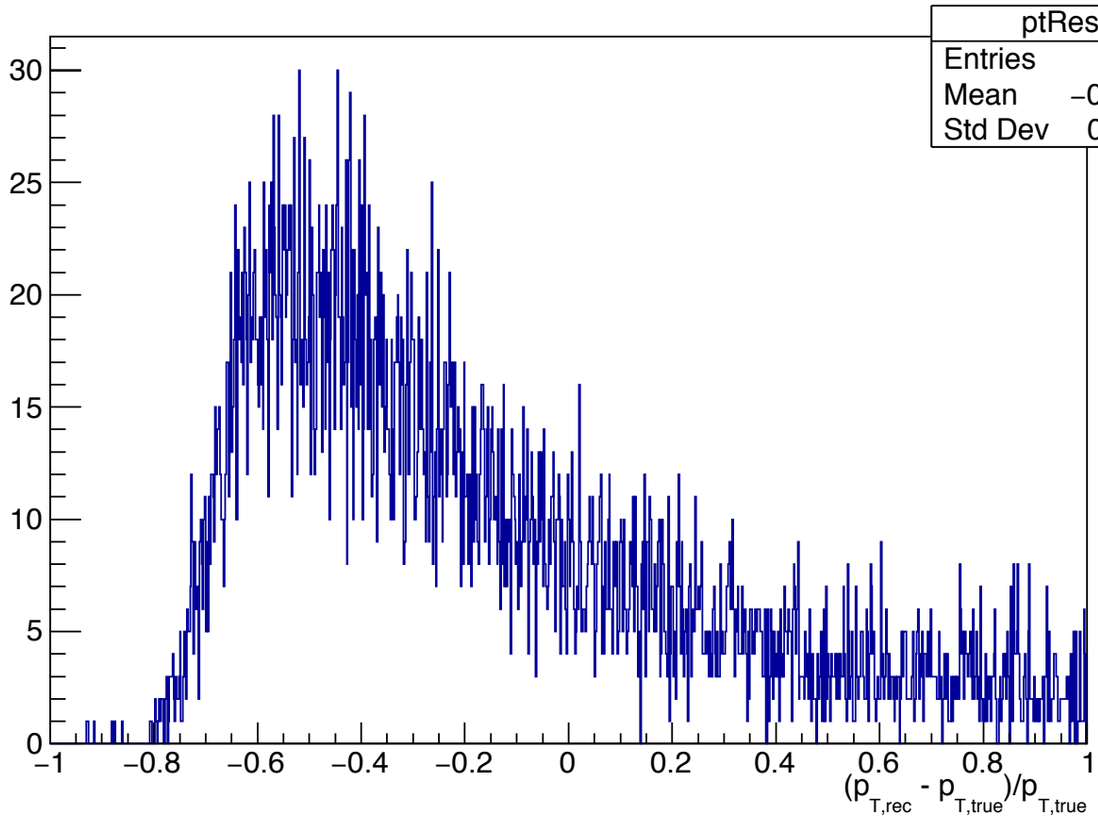


p_T @peak = 29.5 GeV

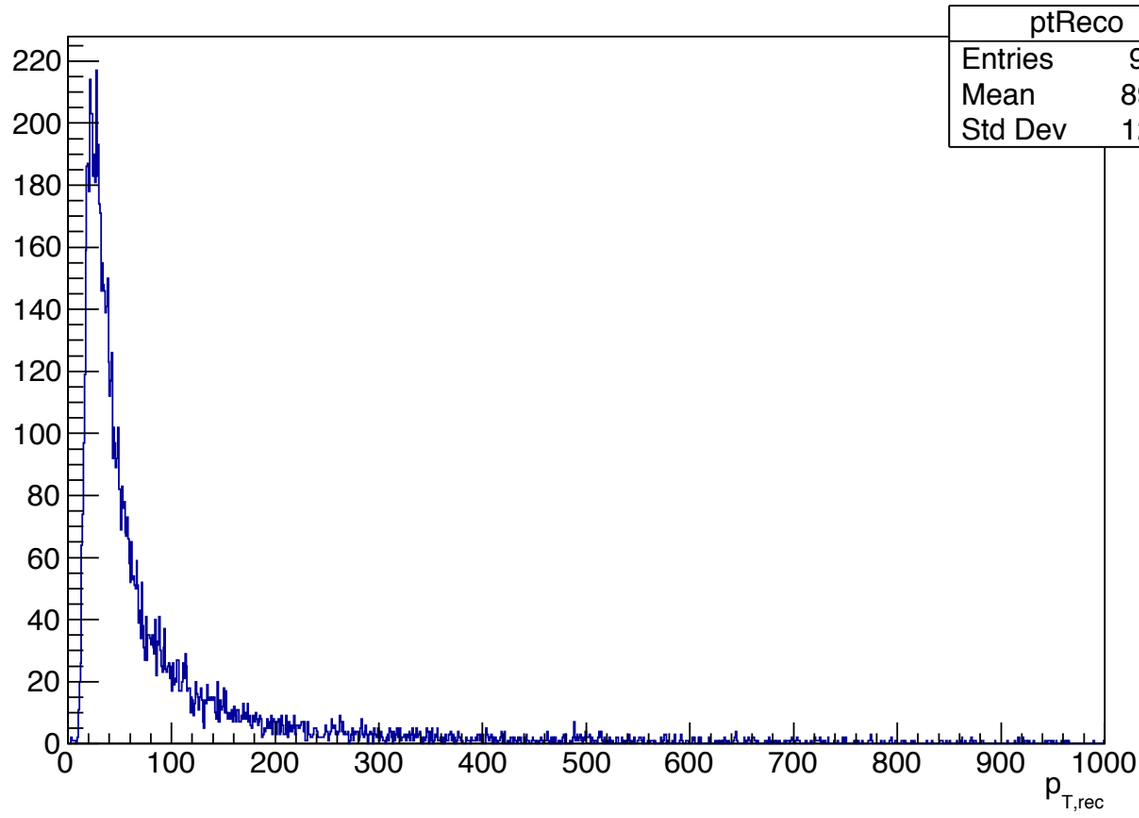
Stub tracks: deeper investigation of momentum reconstruction

p = 50 GeV, θ = 89 deg

p_T residual



p_T reco

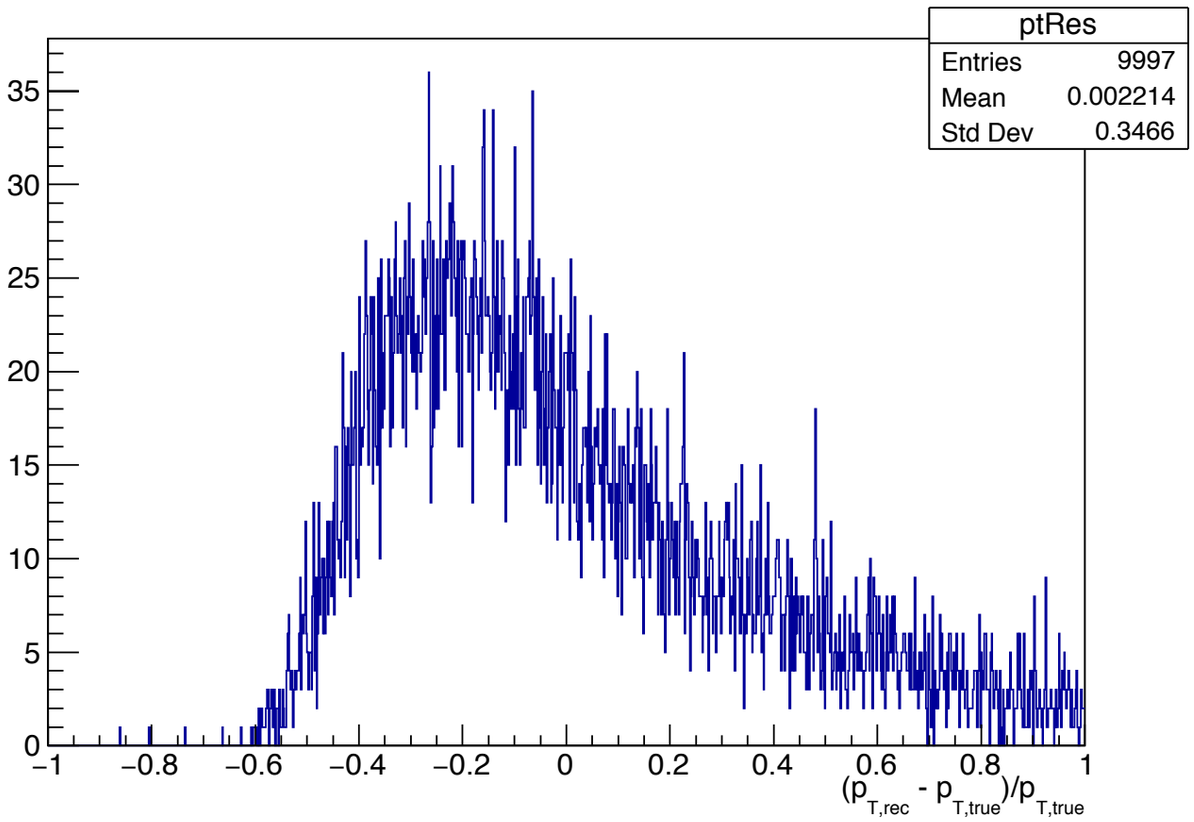


p_T @peak = 27.5 GeV

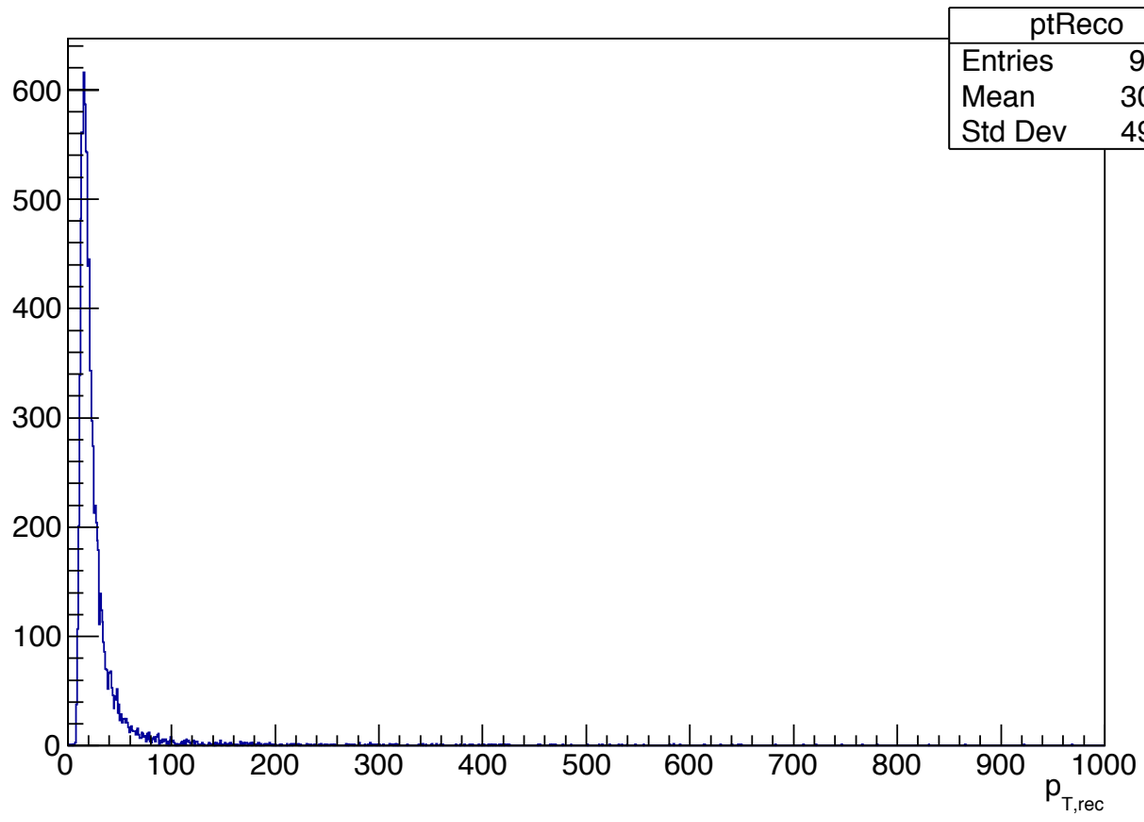
Stub tracks: deeper investigation of momentum reconstruction

p = 20 GeV, θ = 89 deg

p_T residual



p_T reco

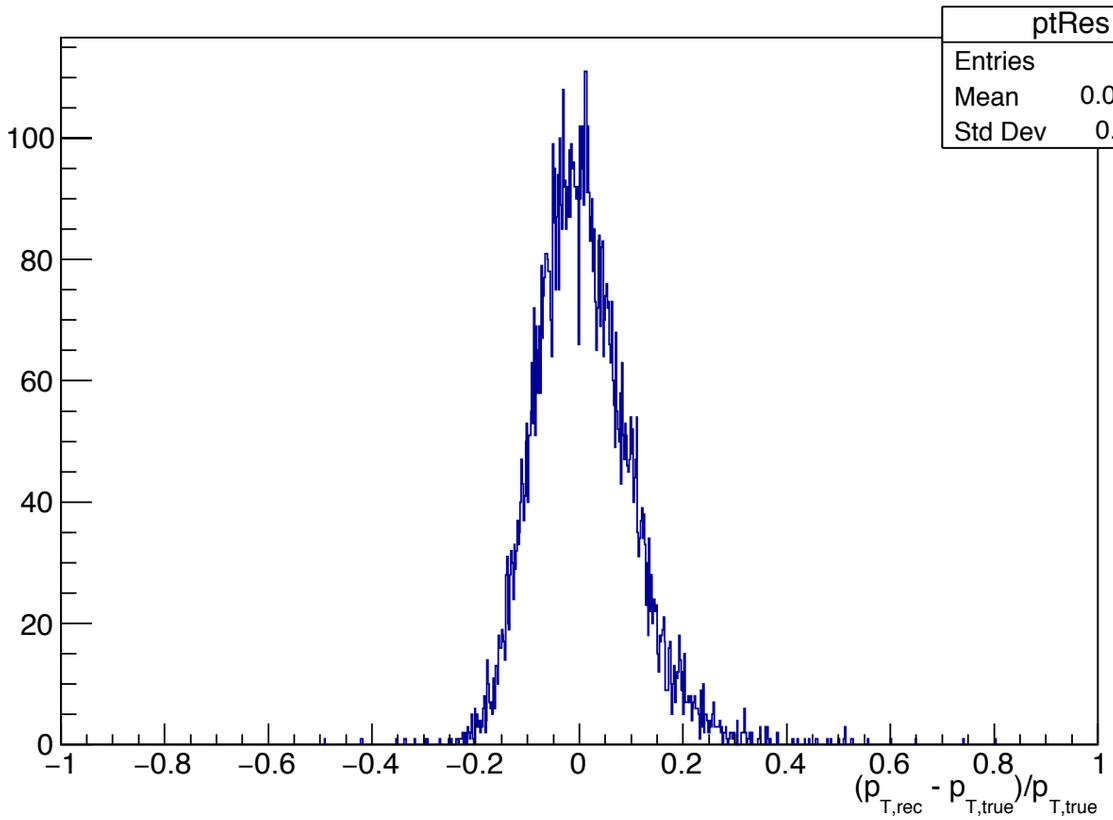


p_T @peak = 15.5 GeV

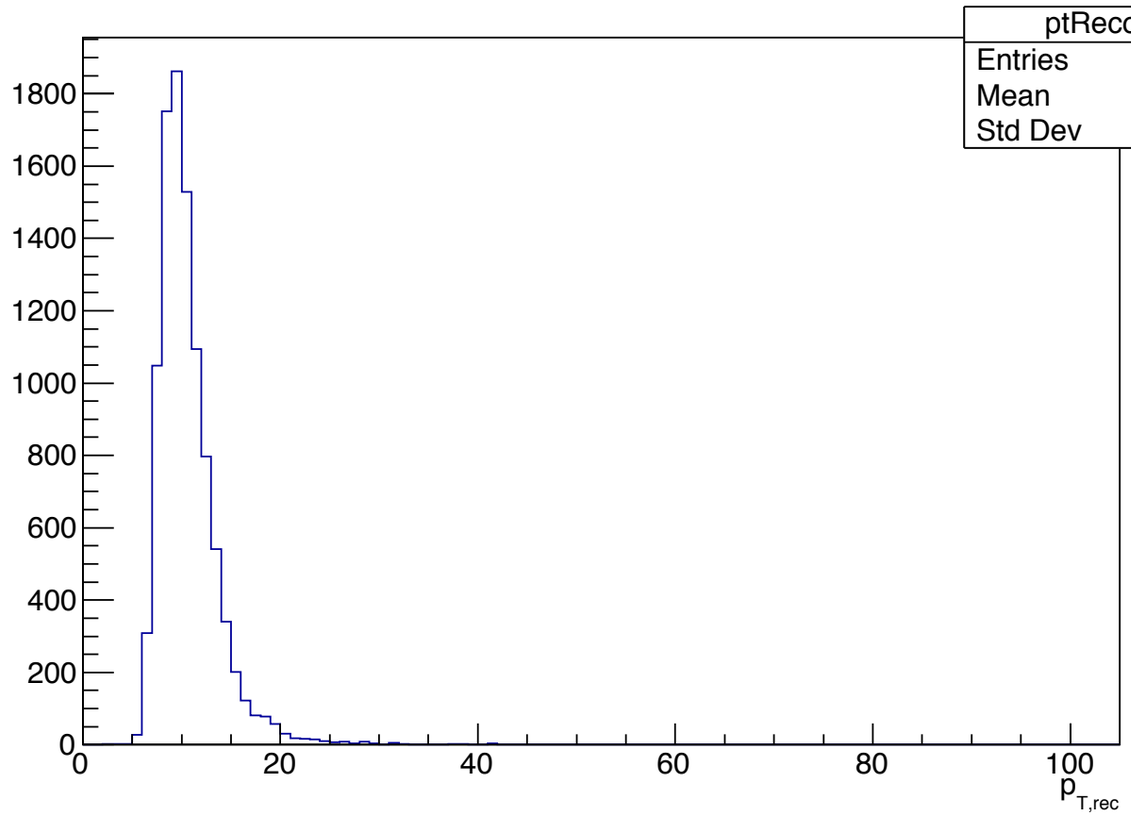
Stub tracks: deeper investigation of momentum reconstruction

p = 10 GeV, θ = 89 deg

p_T residual



p_T reco

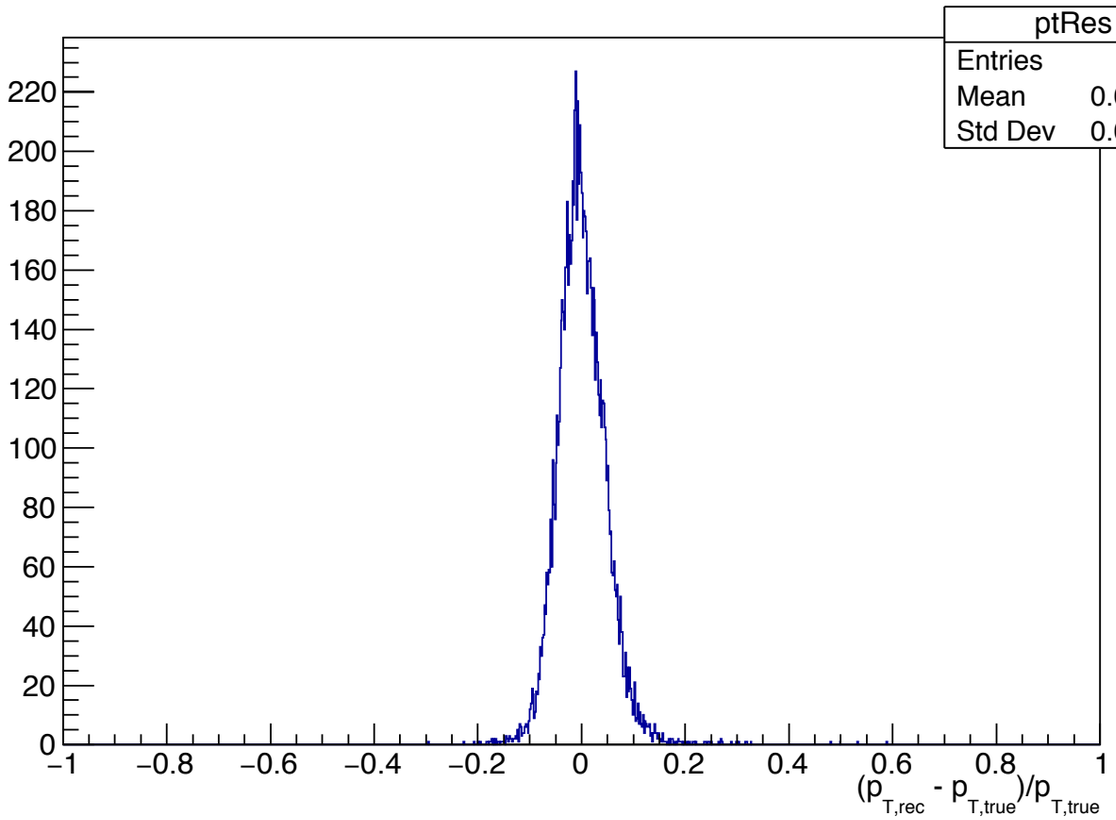


p_T @peak = 9.5 GeV

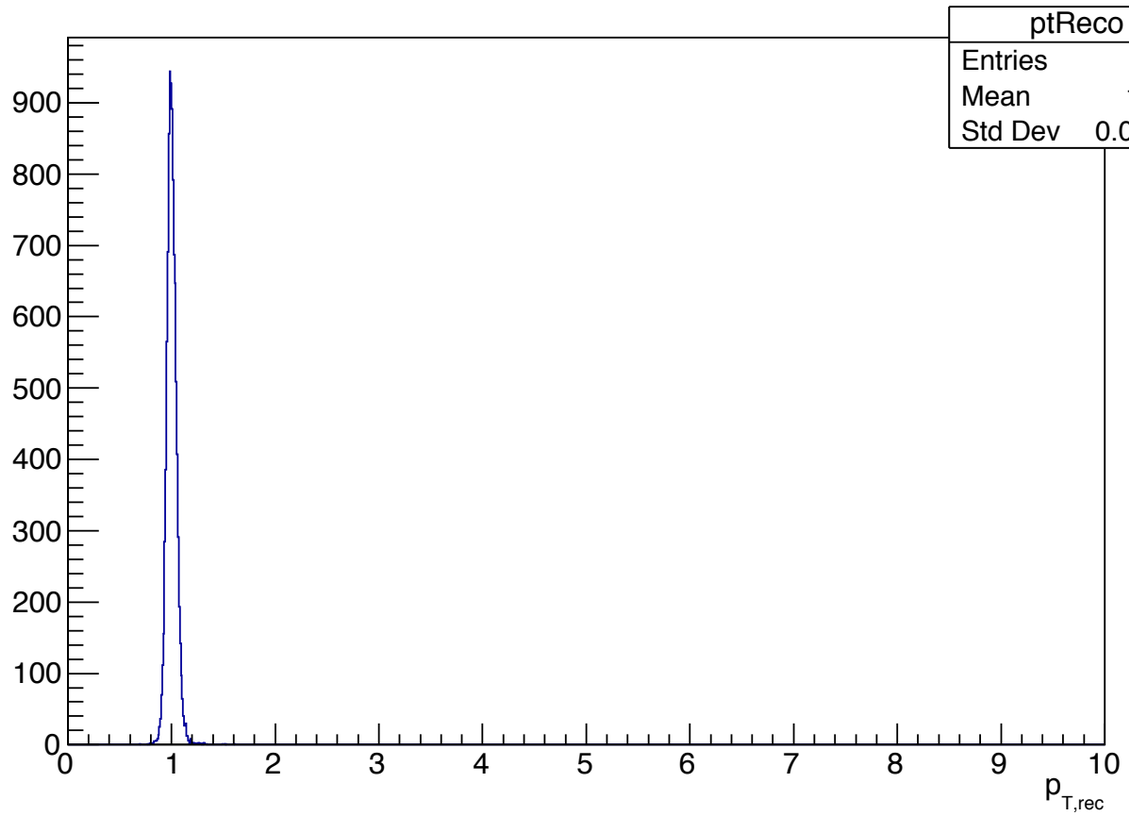
Stub tracks: deeper investigation of momentum reconstruction

p = 1 GeV, θ = 89 deg

p_T residual



p_T reco

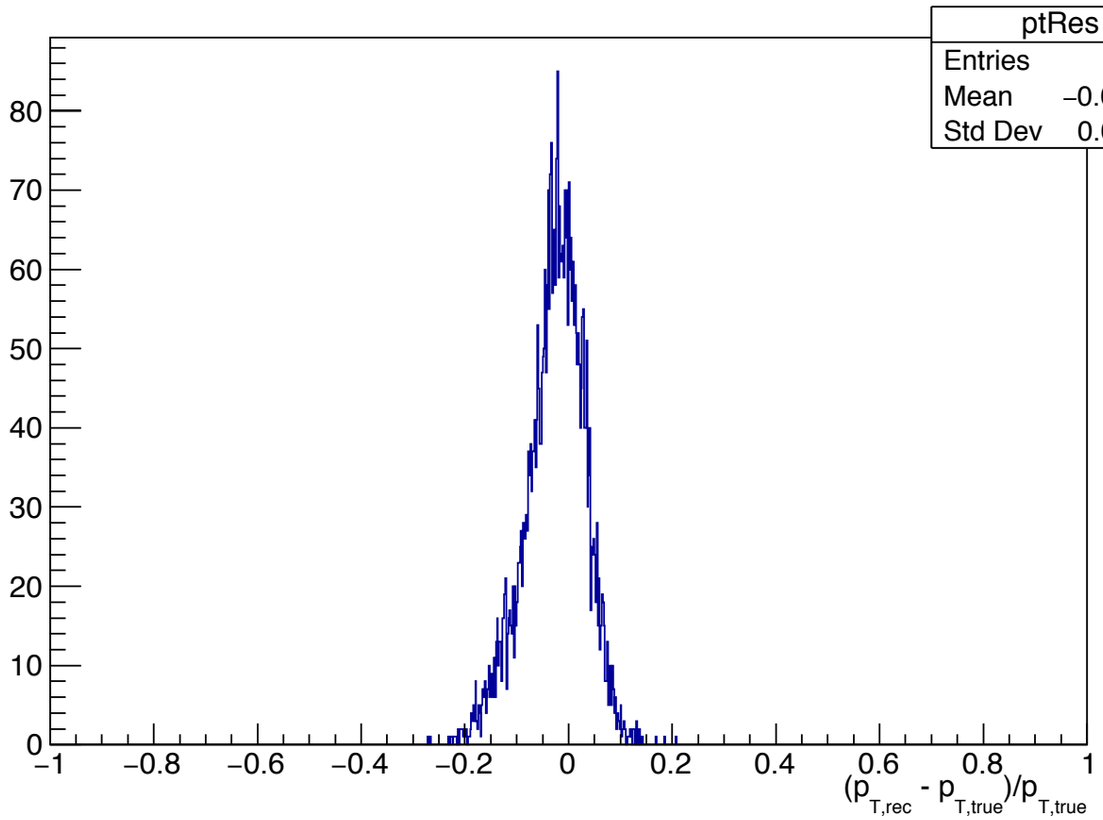


p_T @peak = 0.95 GeV

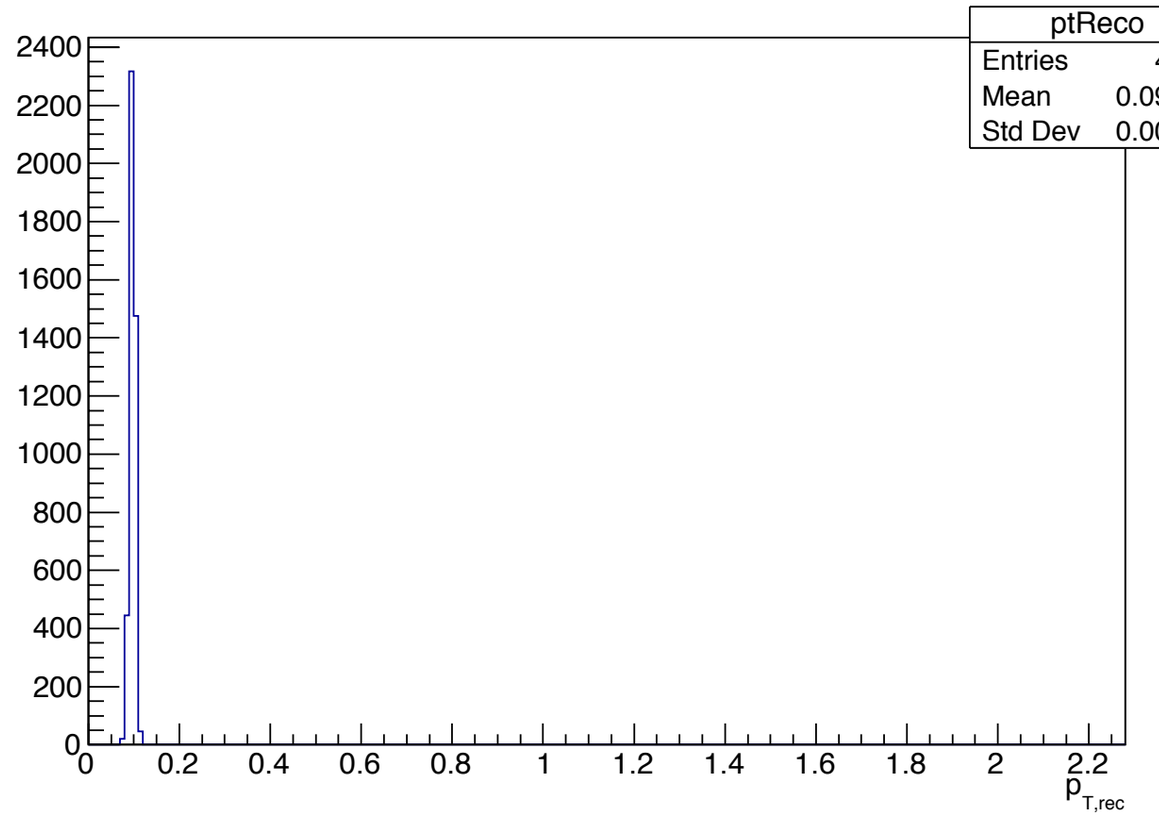
Stub tracks: deeper investigation of momentum reconstruction

p = 100 MeV, θ = 89 deg

p_T residual



p_T reco



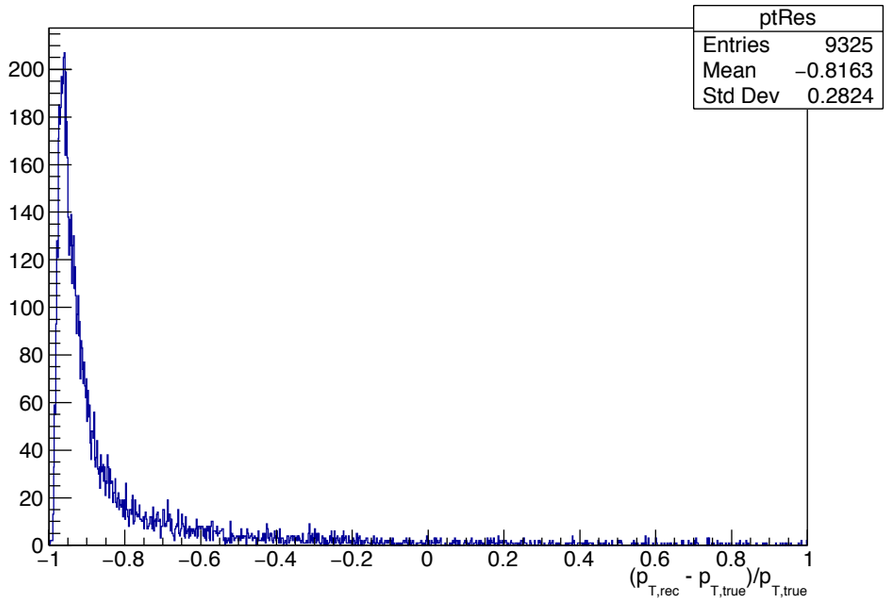
p_T @peak = 0.095 GeV

Stub tracks: deeper investigation of momentum reconstruction

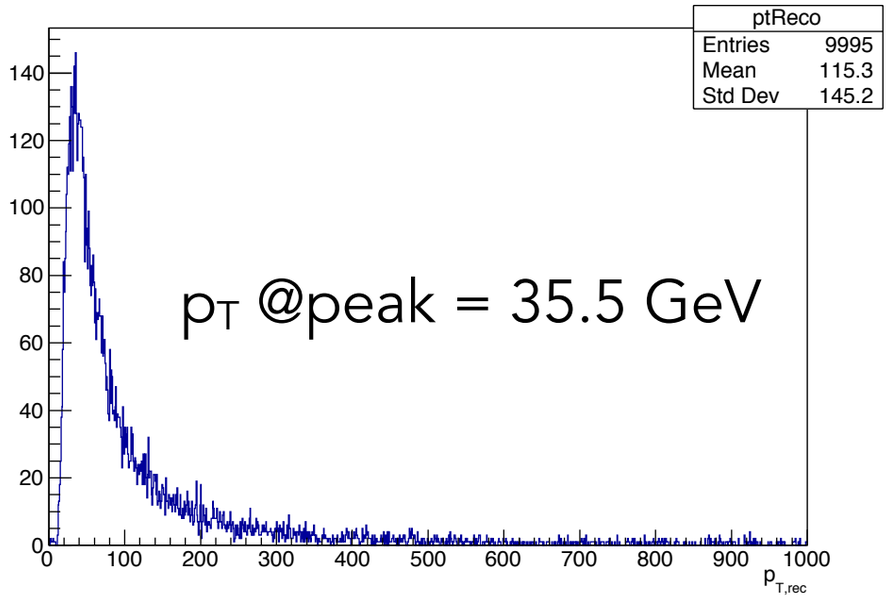
p = 1 TeV, θ = 89 deg

σ = 3 μm

p_T residual

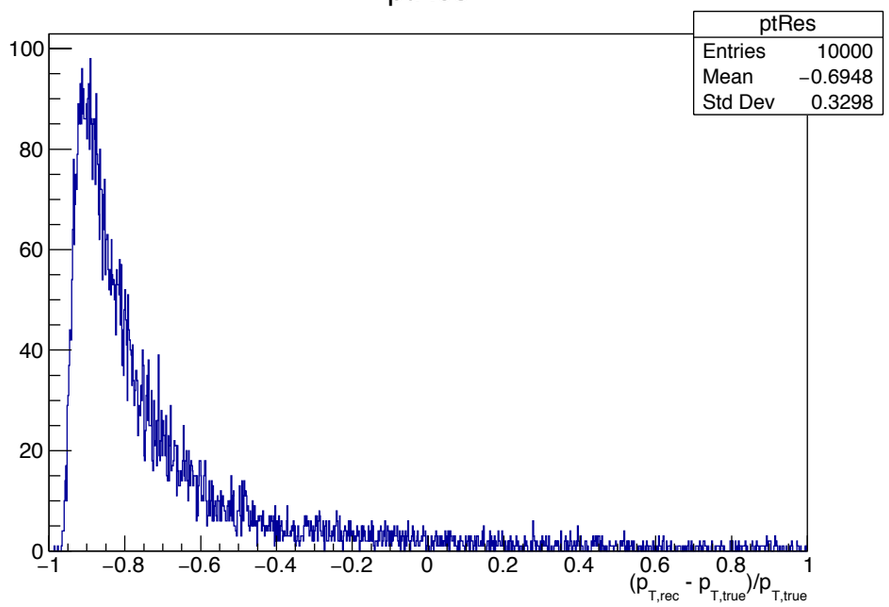


p_T reco

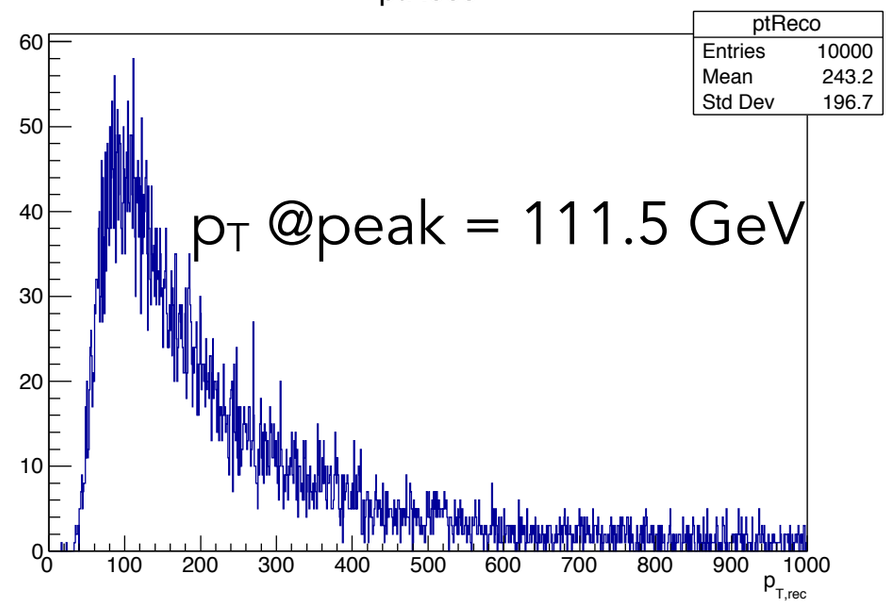


σ = 1 μm

ptRes



ptReco

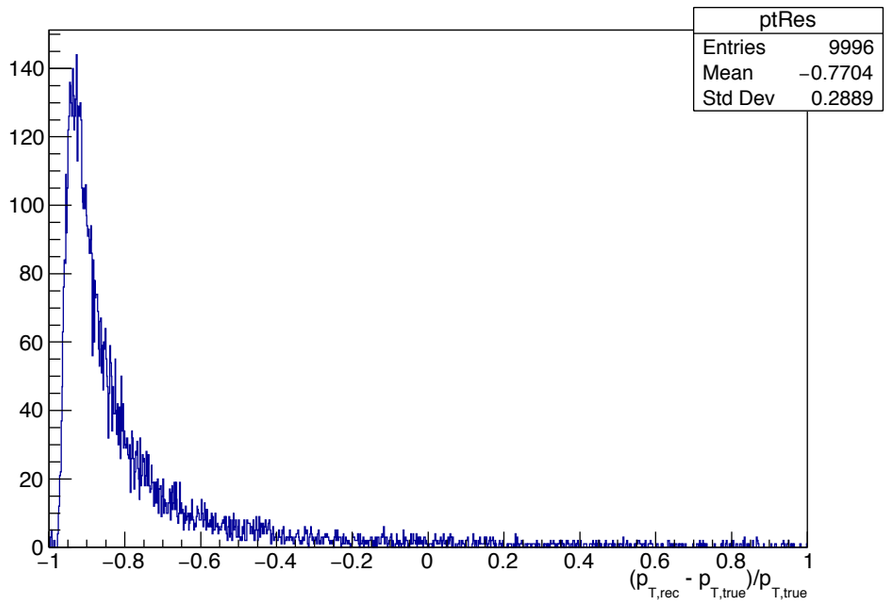


Stub tracks: deeper investigation of momentum reconstruction

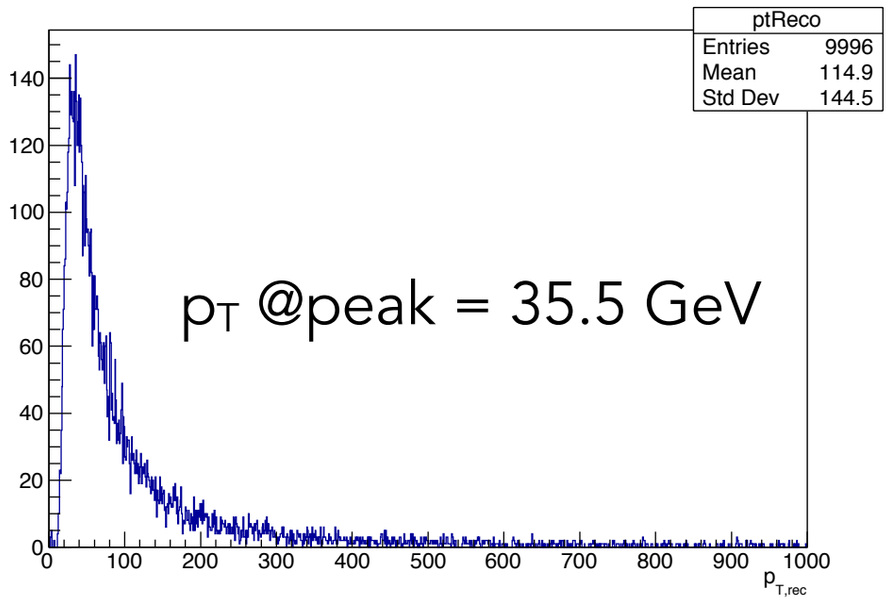
p = 500 GeV, θ = 89 deg

σ = 3 μm

p_T residual

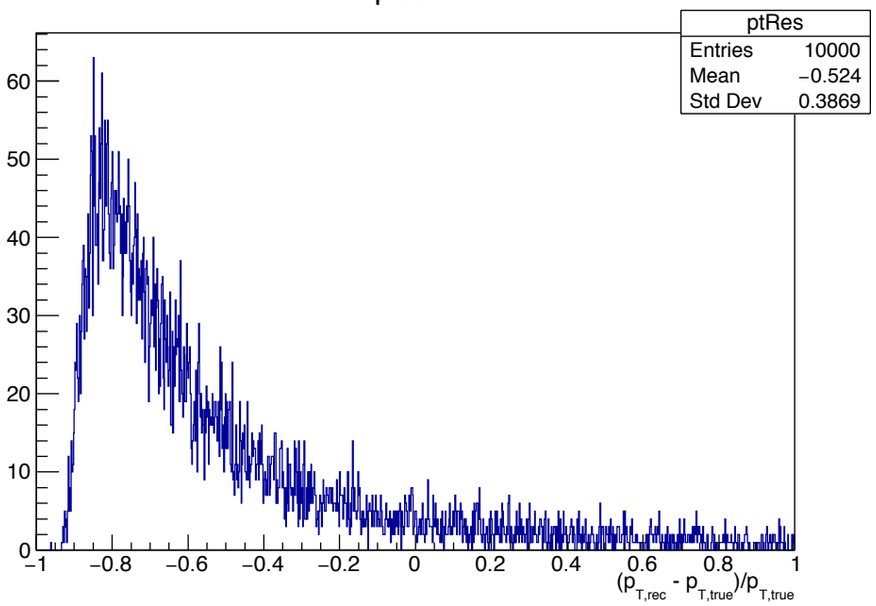


p_T reco

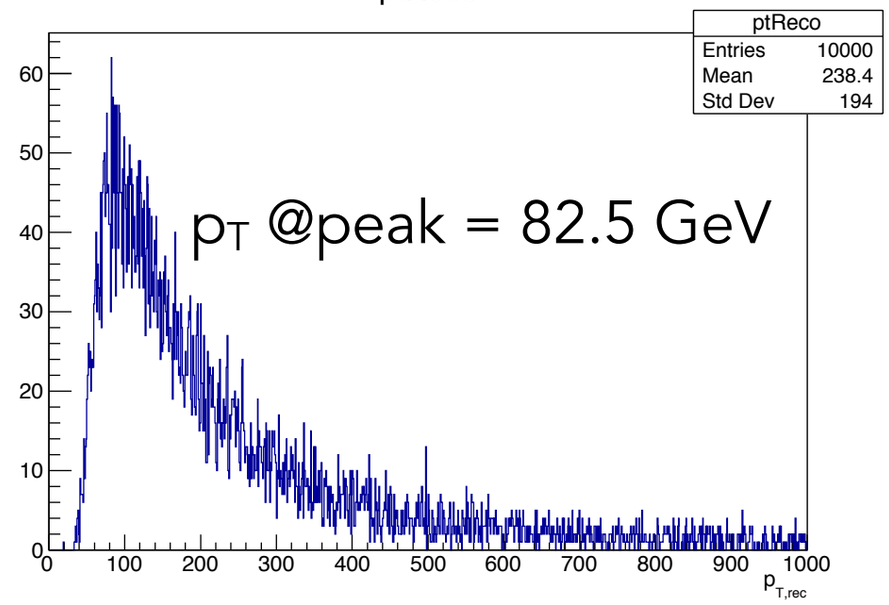


σ = 1 μm

ptRes



ptReco

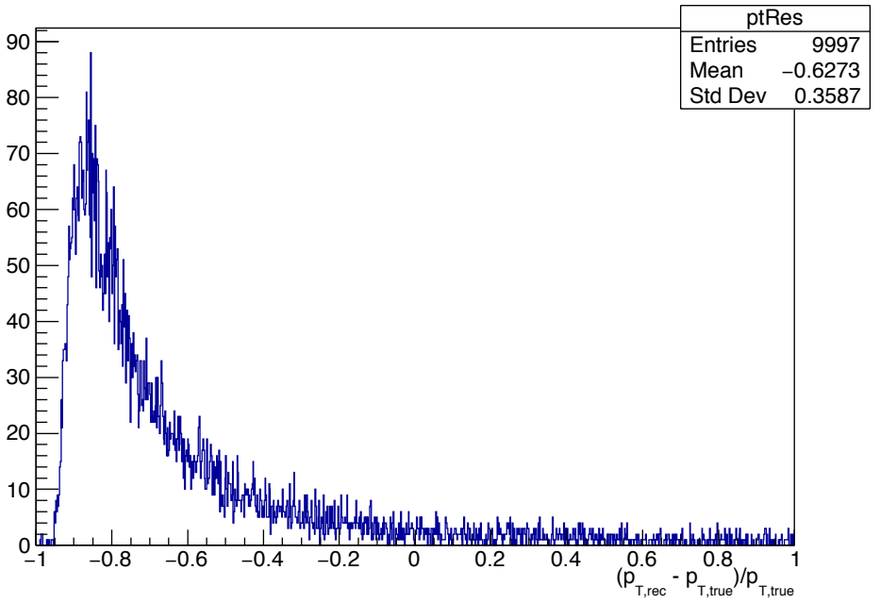


Stub tracks: deeper investigation of momentum reconstruction

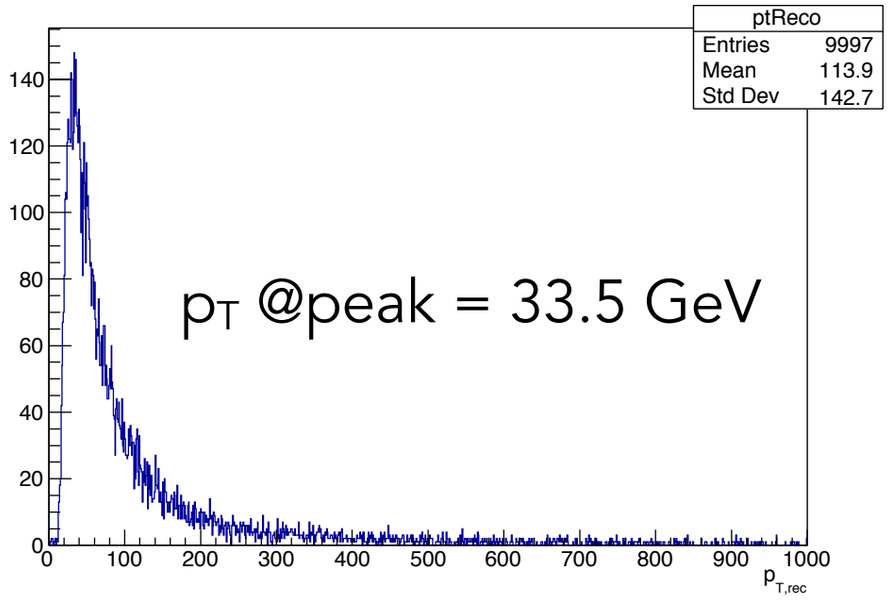
p = 250 GeV, θ = 89 deg

σ = 3 μm

p_T residual

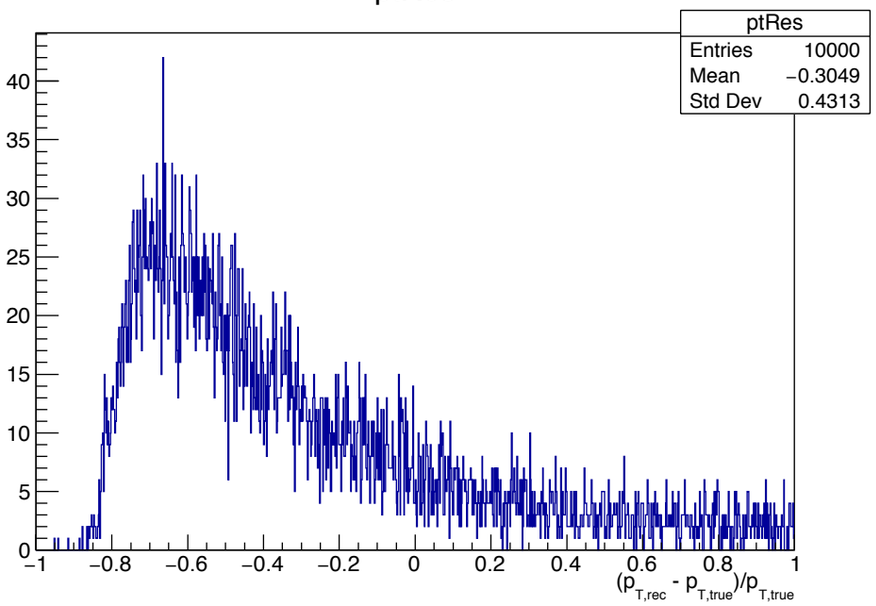


p_T reco

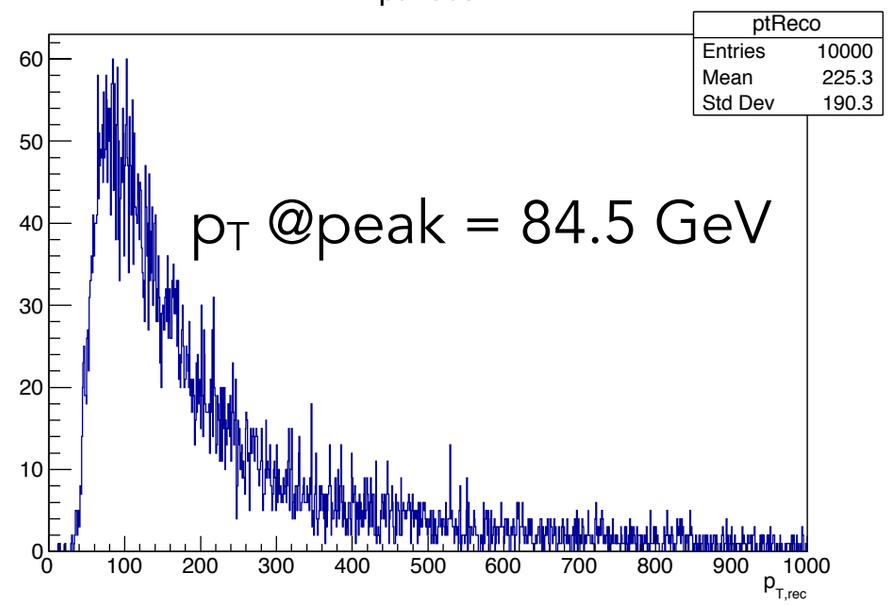


σ = 1 μm

ptRes



ptReco

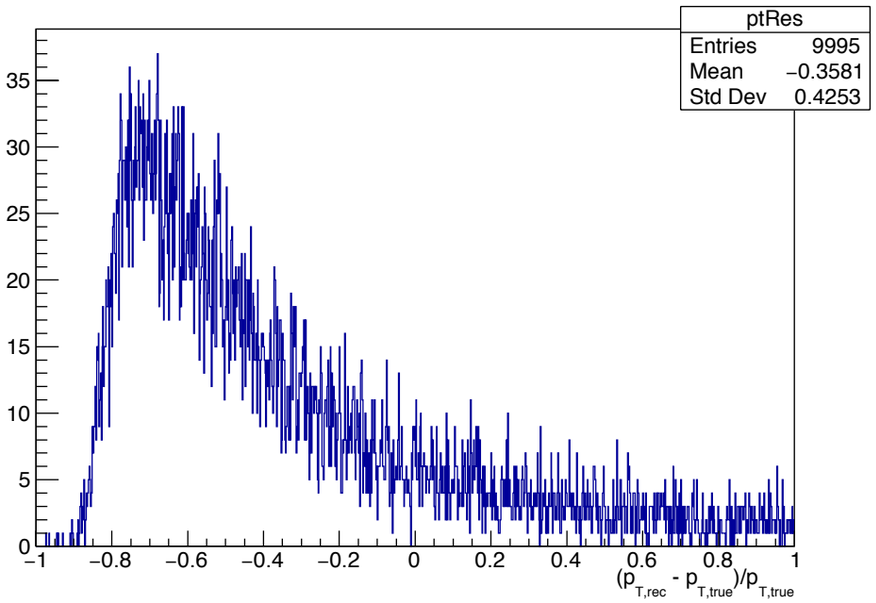


Stub tracks: deeper investigation of momentum reconstruction

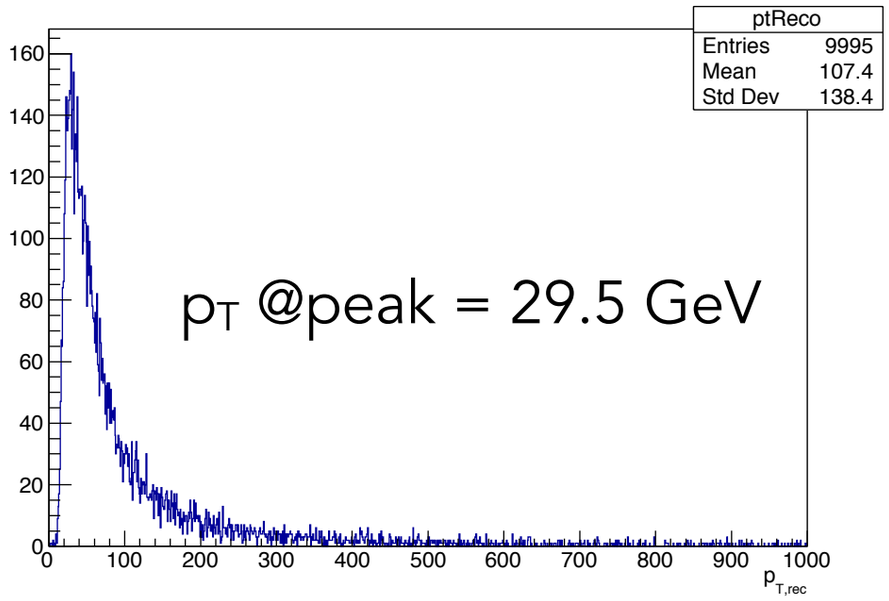
p = 100 GeV, θ = 89 deg

σ = 3 μm

p_T residual

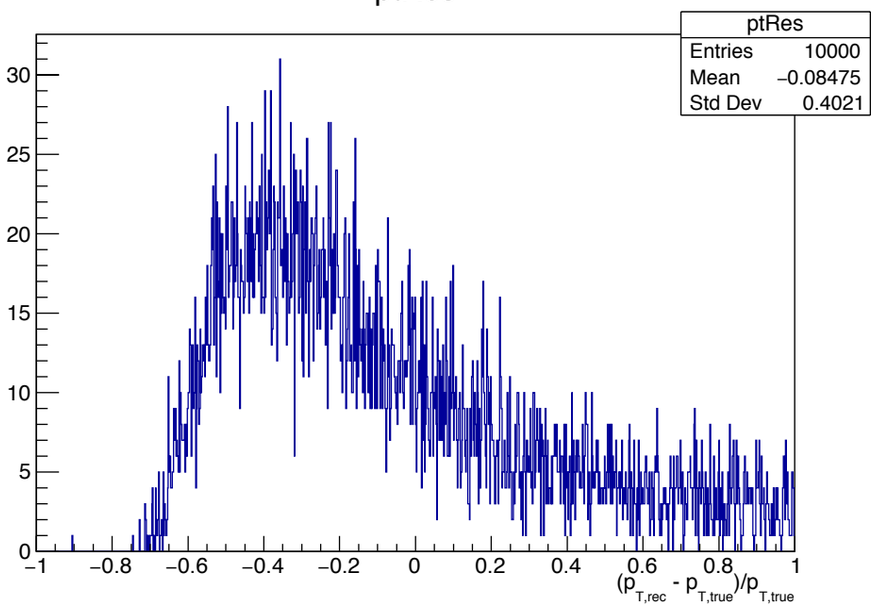


p_T reco

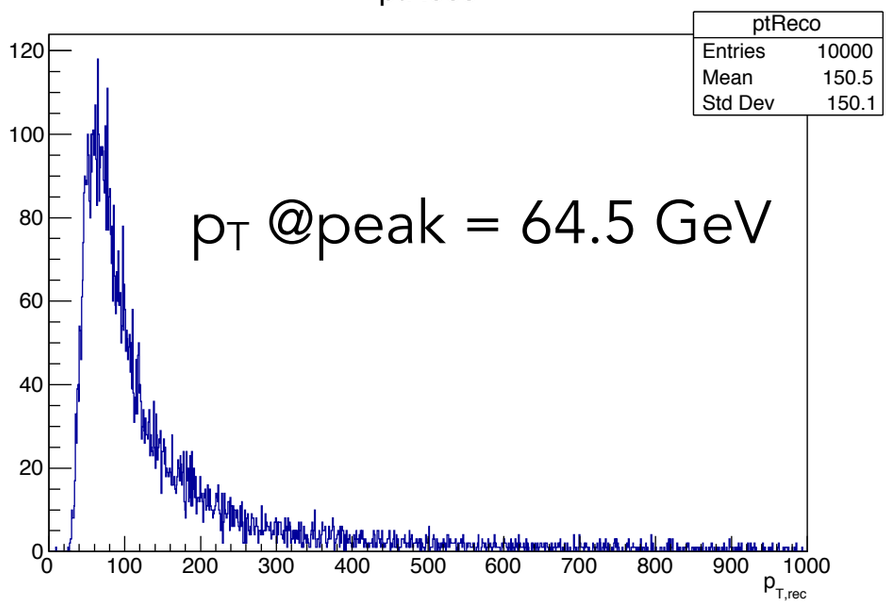


σ = 1 μm

ptRes



ptReco

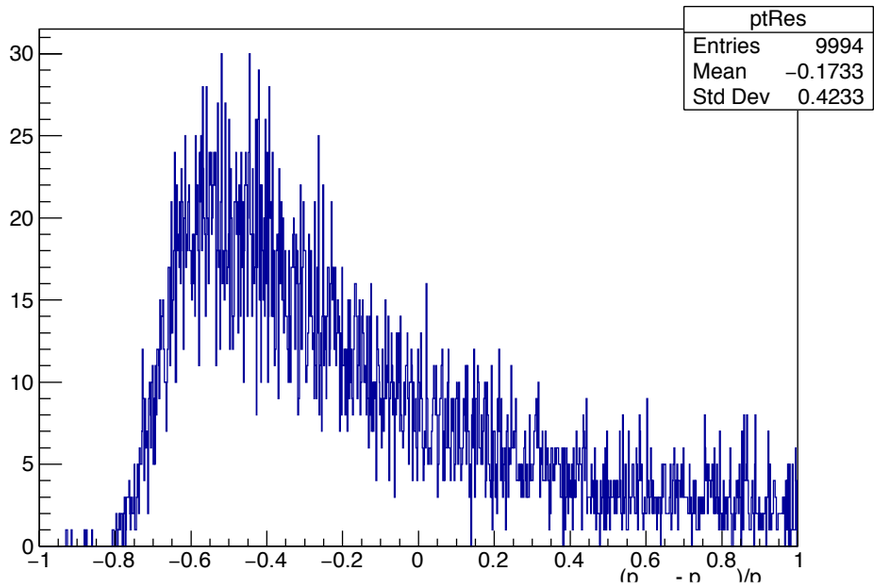


Stub tracks: deeper investigation of momentum reconstruction

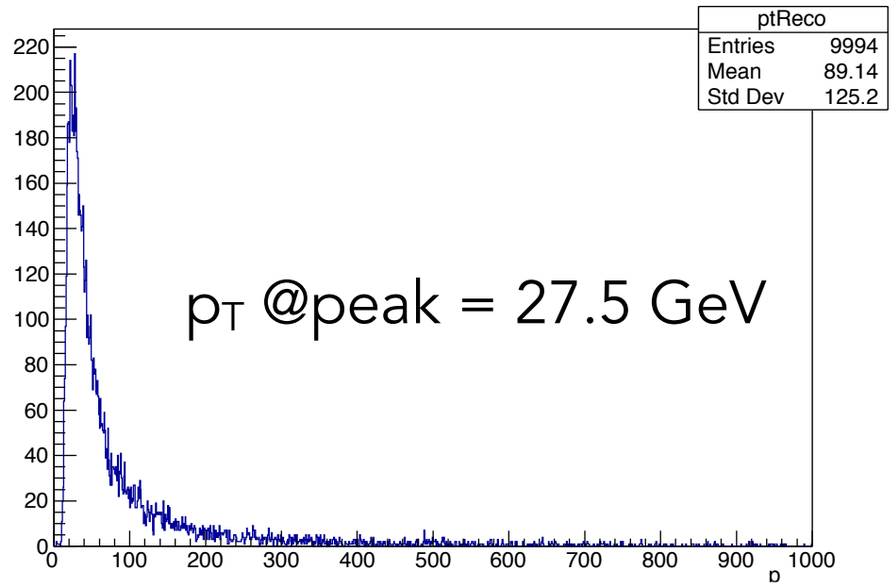
p = 50 GeV, θ = 89 deg

σ = 3 μm

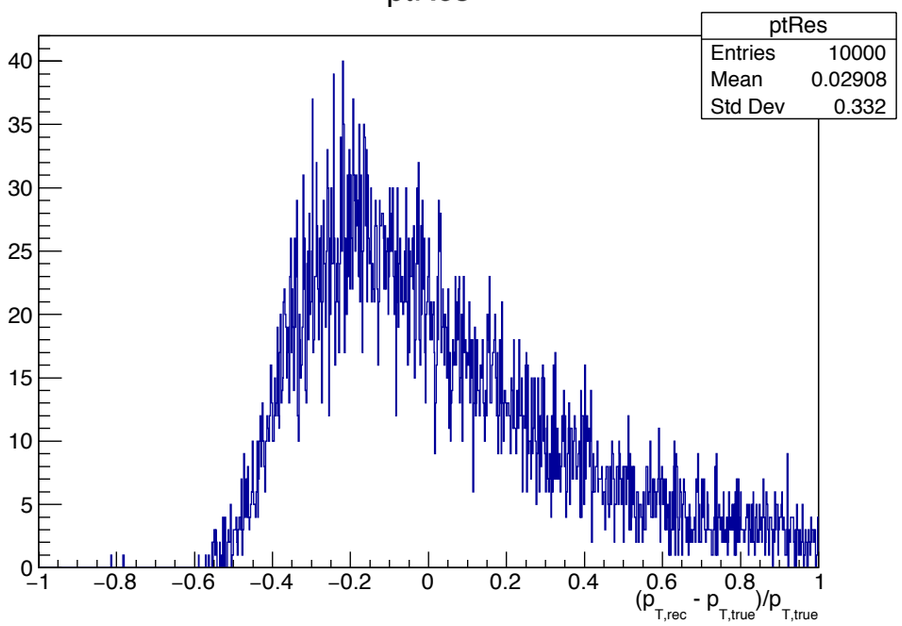
p_T residual



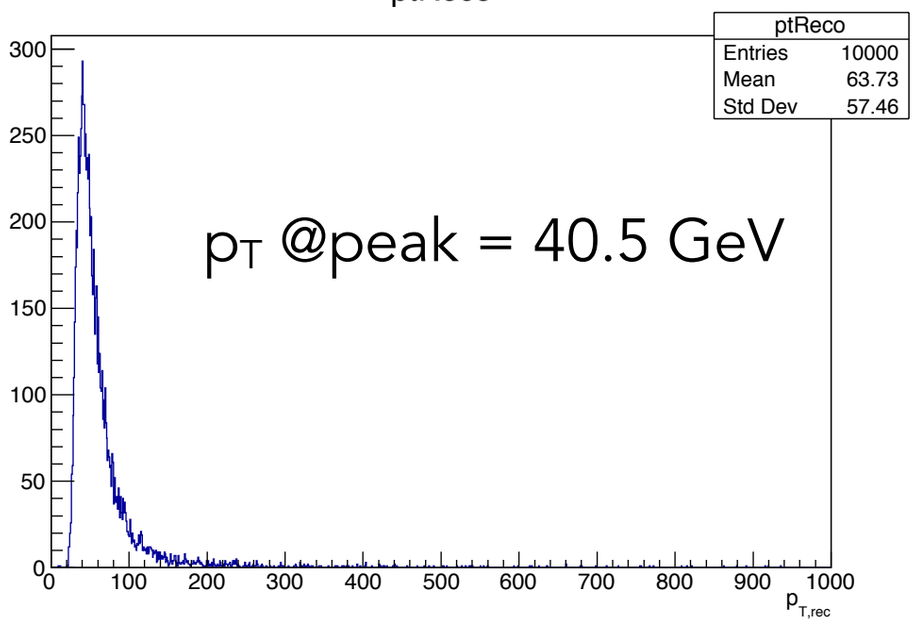
p_T reco



σ = 1 μm



p_T @peak = 40.5 GeV



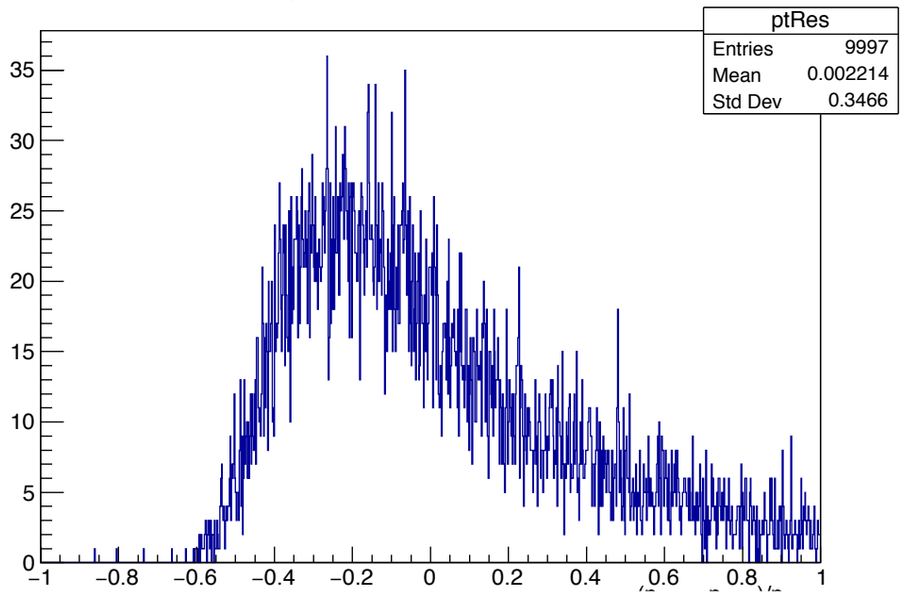
Stub tracks: deeper investigation of momentum reconstruction

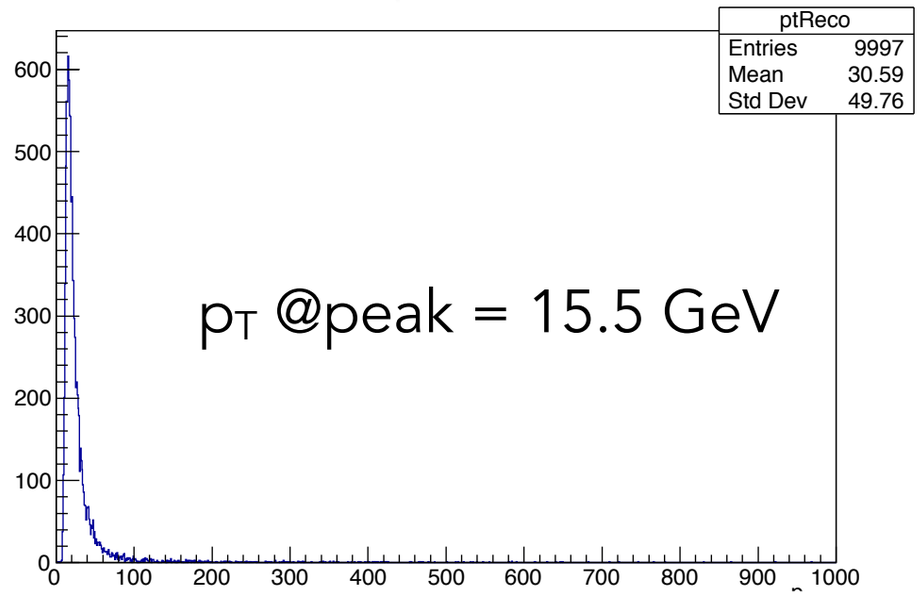
p = 20 GeV, θ = 89 deg

p_T residual

p_T reco

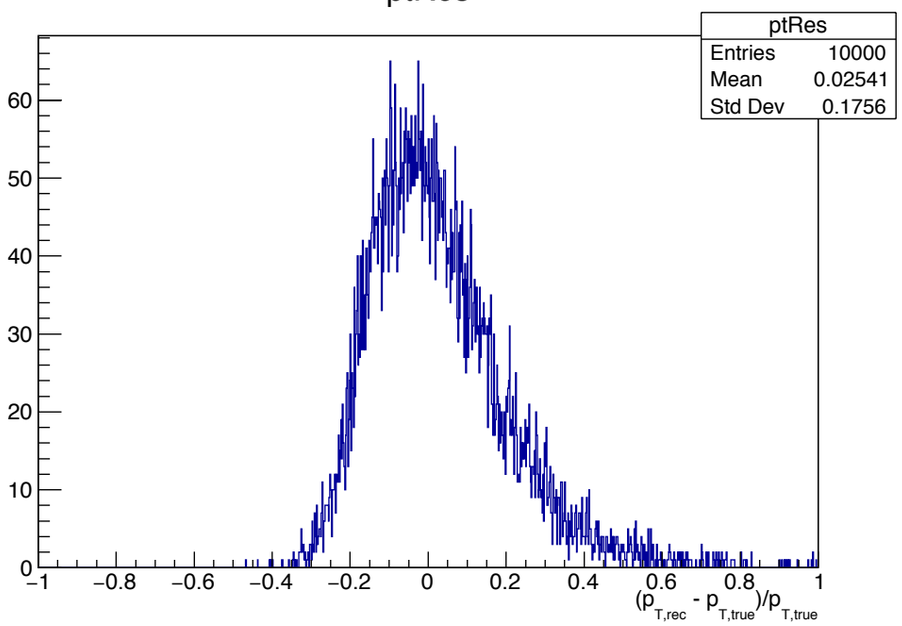
σ = 3 μm

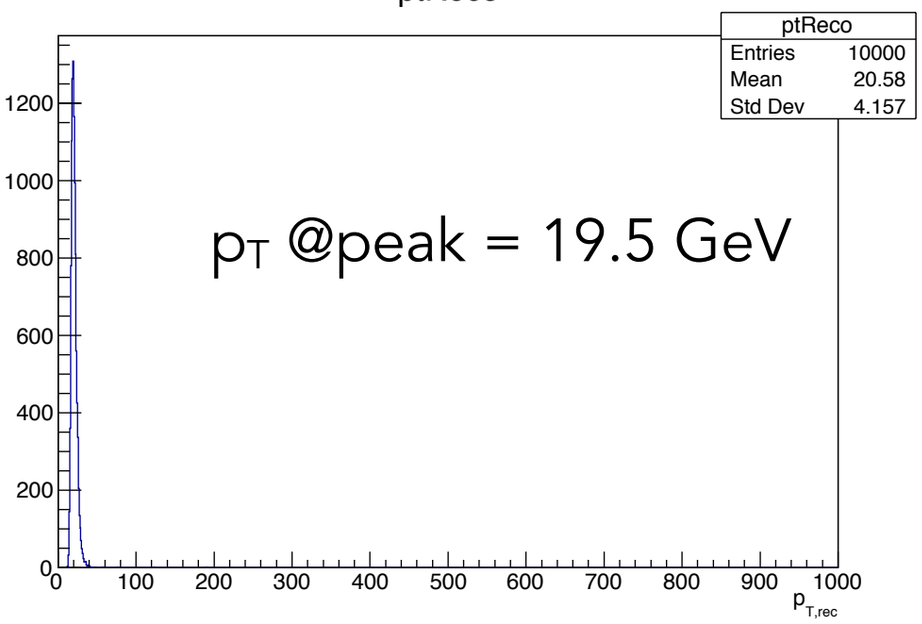




p_T @peak = 15.5 GeV

σ = 1 μm





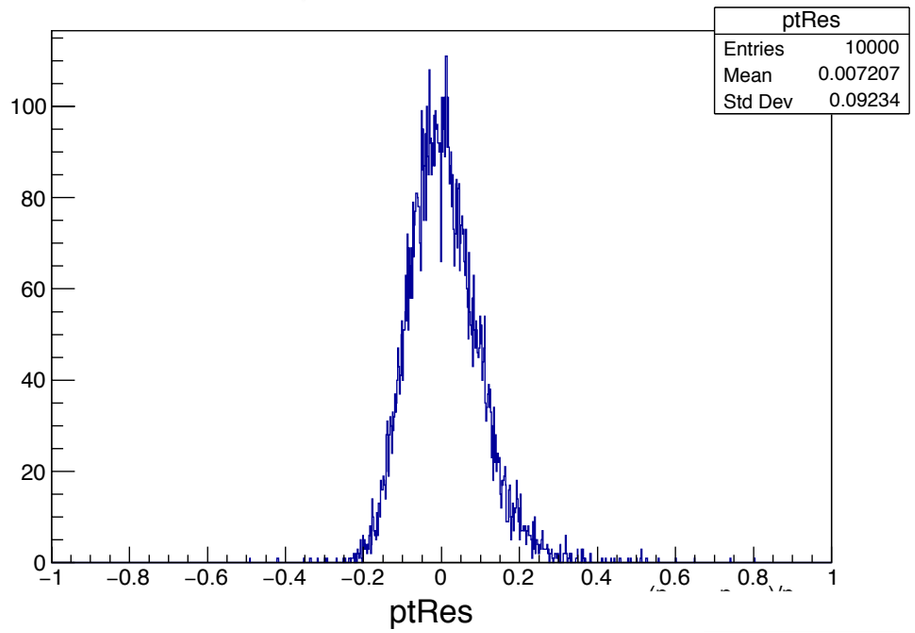
p_T @peak = 19.5 GeV

Stub tracks: deeper investigation of momentum reconstruction

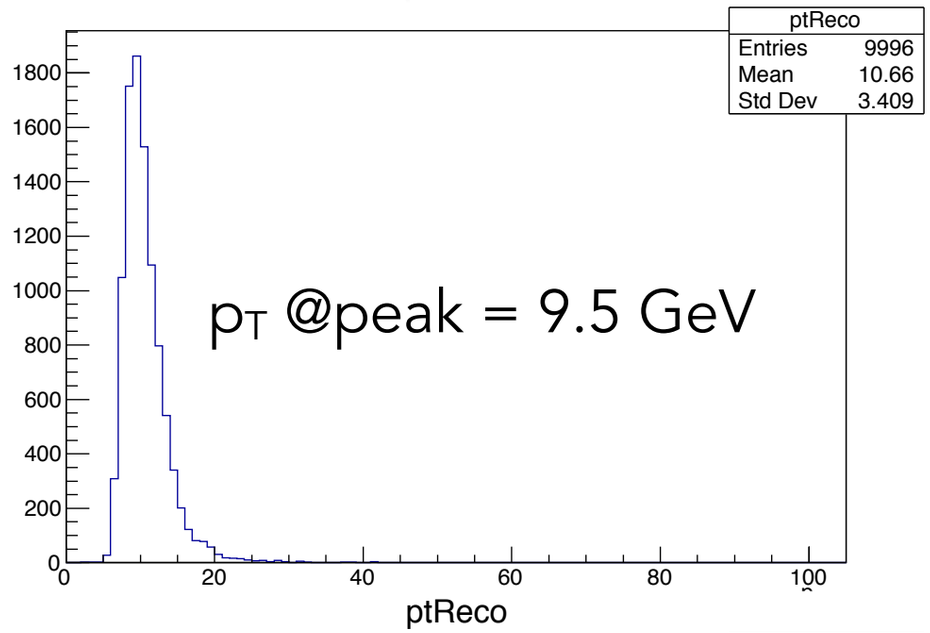
p = 10 GeV, θ = 89 deg

σ = 3 μm

p_T residual

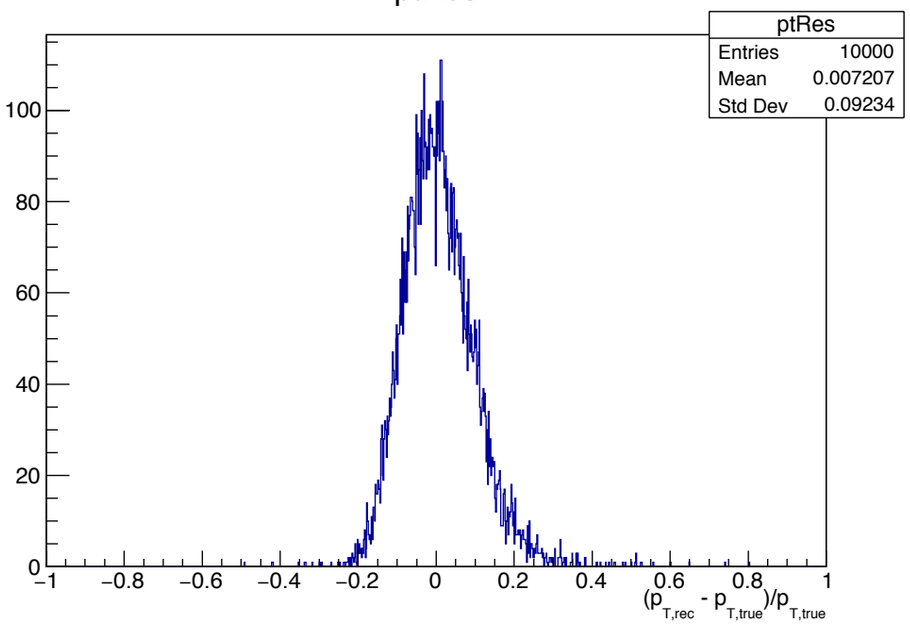


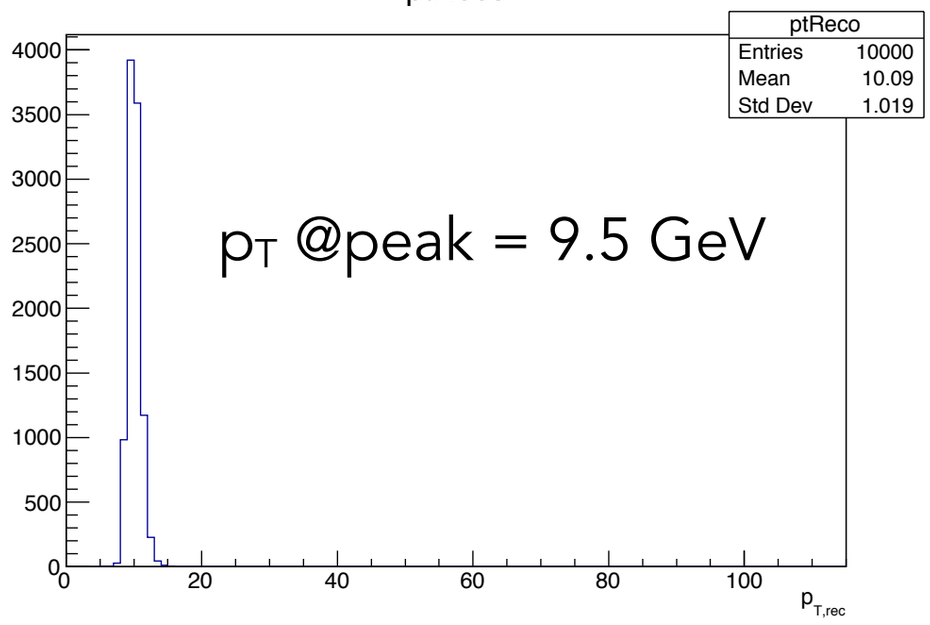
p_T reco



p_T @peak = 9.5 GeV

σ = 1 μm





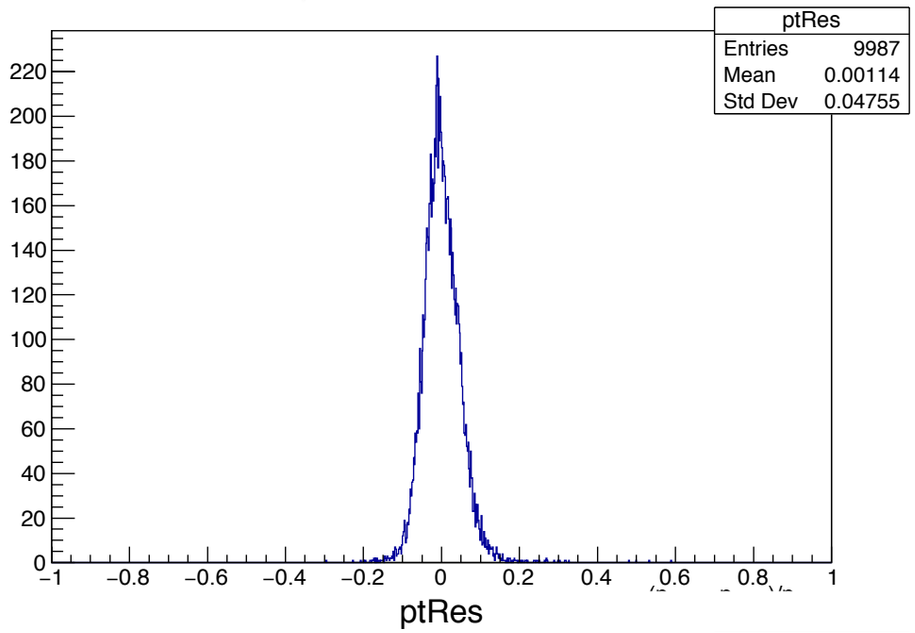
p_T @peak = 9.5 GeV

Stub tracks: deeper investigation of momentum reconstruction

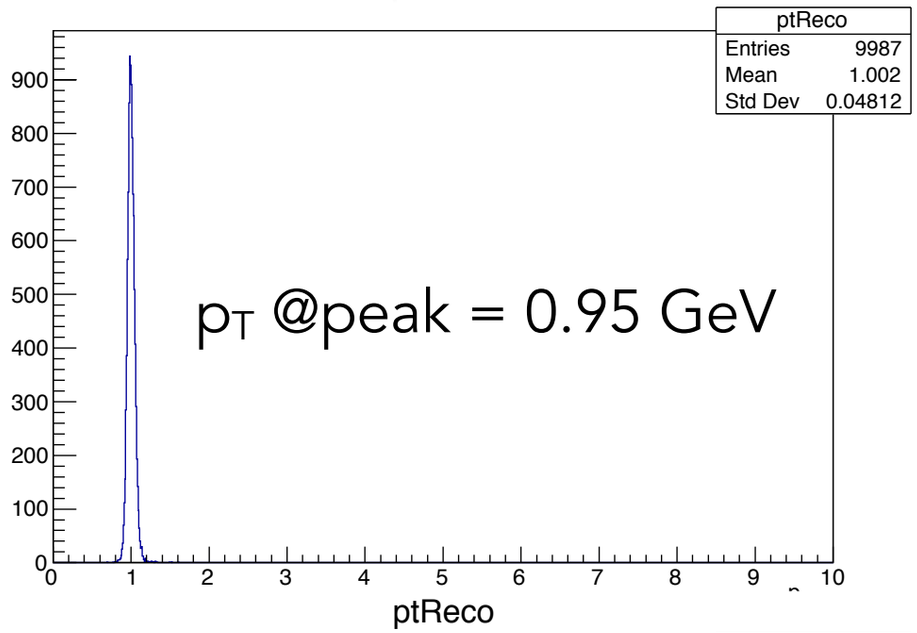
p = 1 GeV, θ = 89 deg

σ = 3 μm

p_T residual

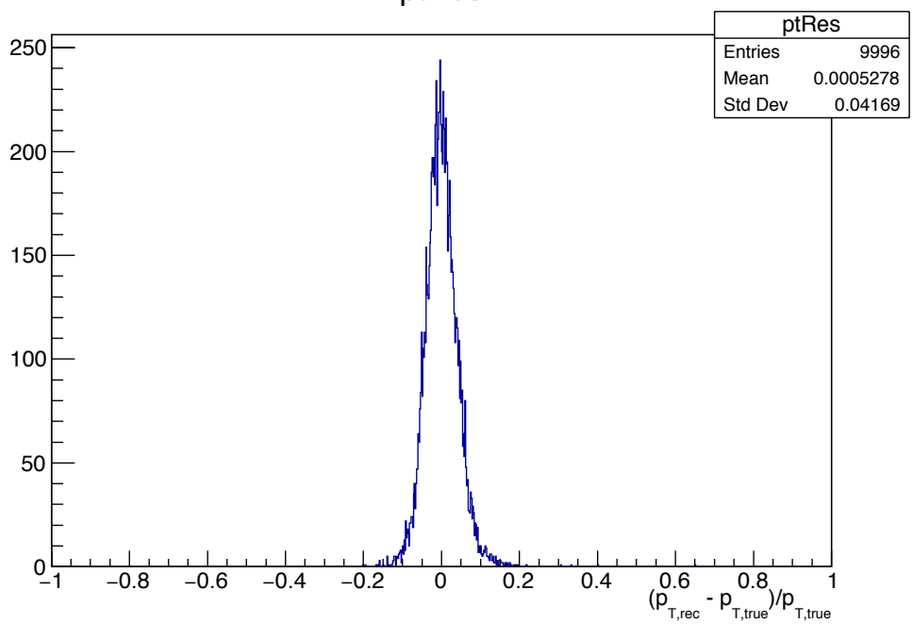


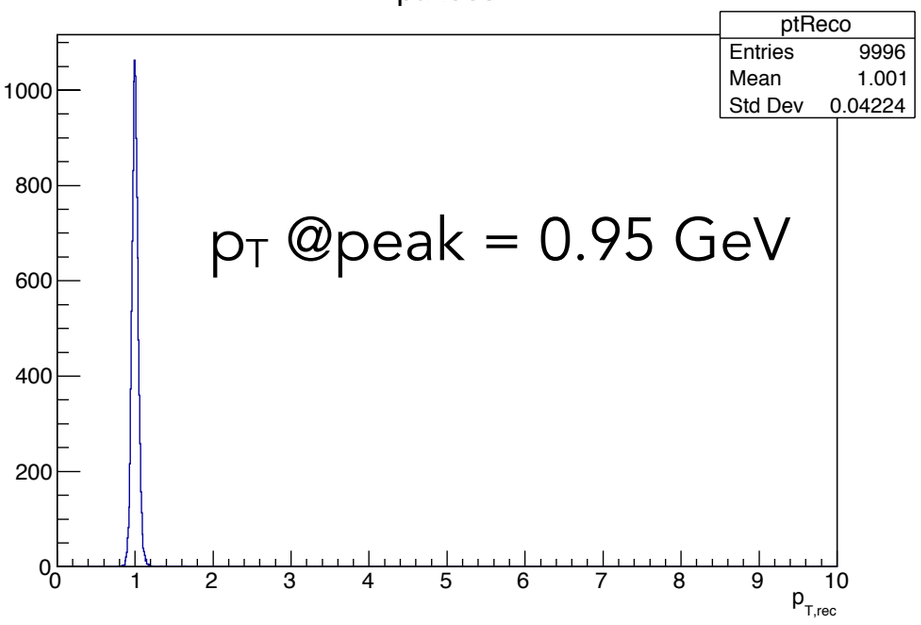
p_T reco



p_T @peak = 0.95 GeV

σ = 1 μm





p_T @peak = 0.95 GeV

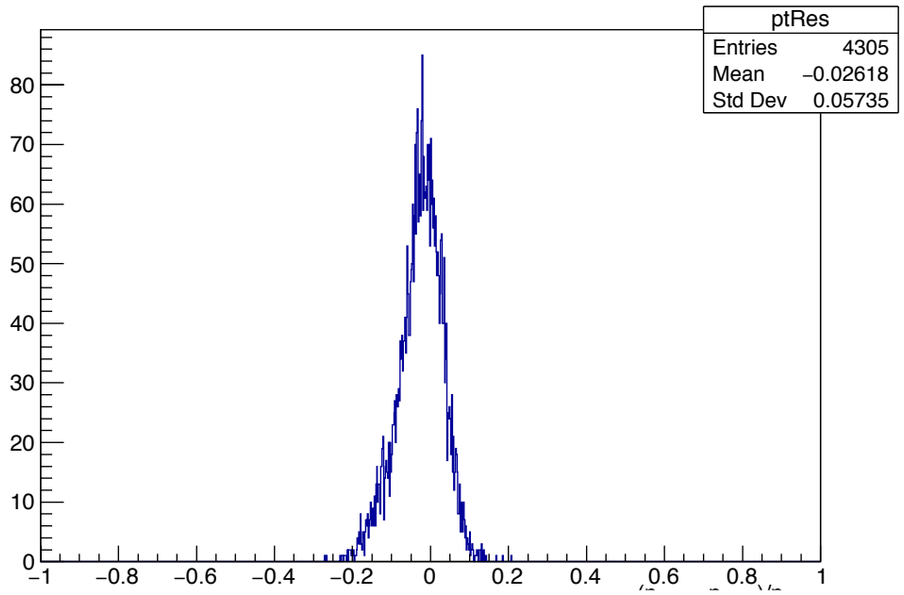
Stub tracks: deeper investigation of momentum reconstruction

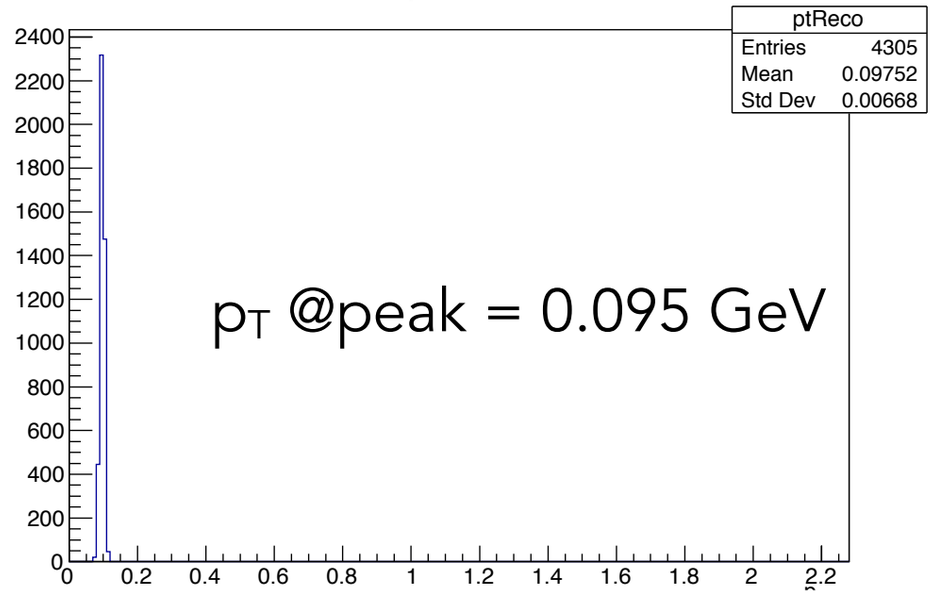
p = 100 MeV, θ = 89 deg

p_T residual

p_T reco

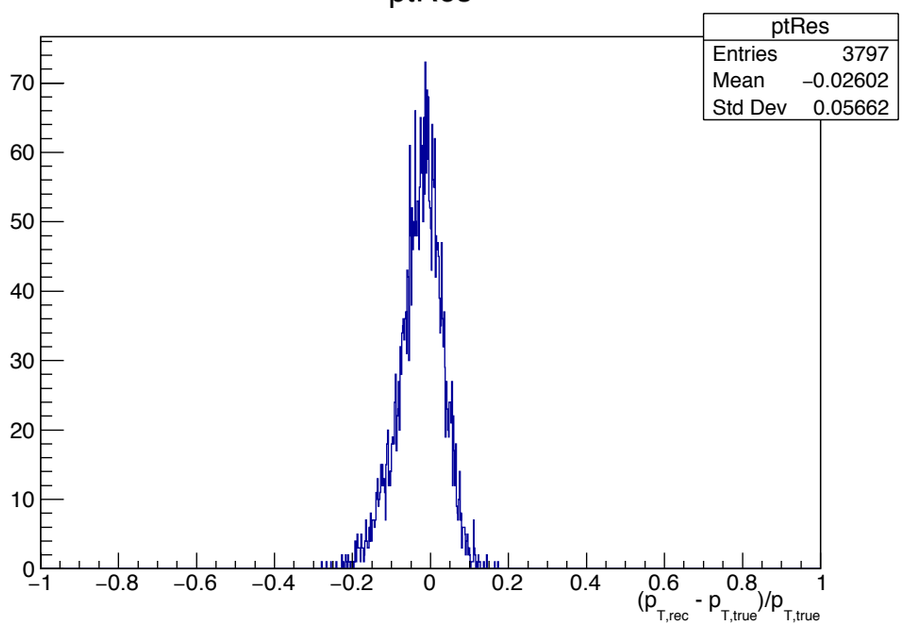
σ = 3 μm

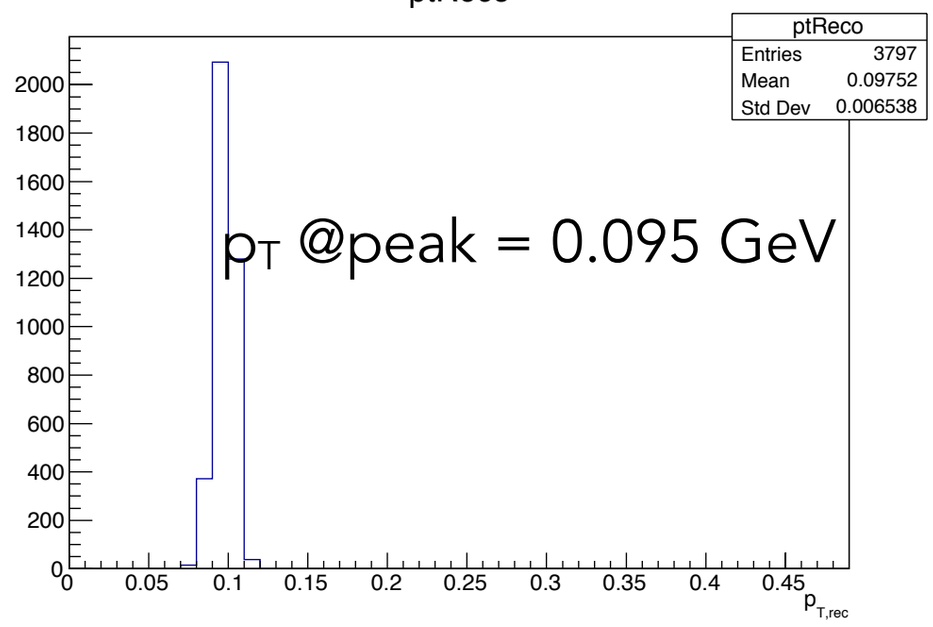




p_T @peak = 0.095 GeV

σ = 1 μm





p_T @peak = 0.095 GeV

Stub tracks p_T: conclusions

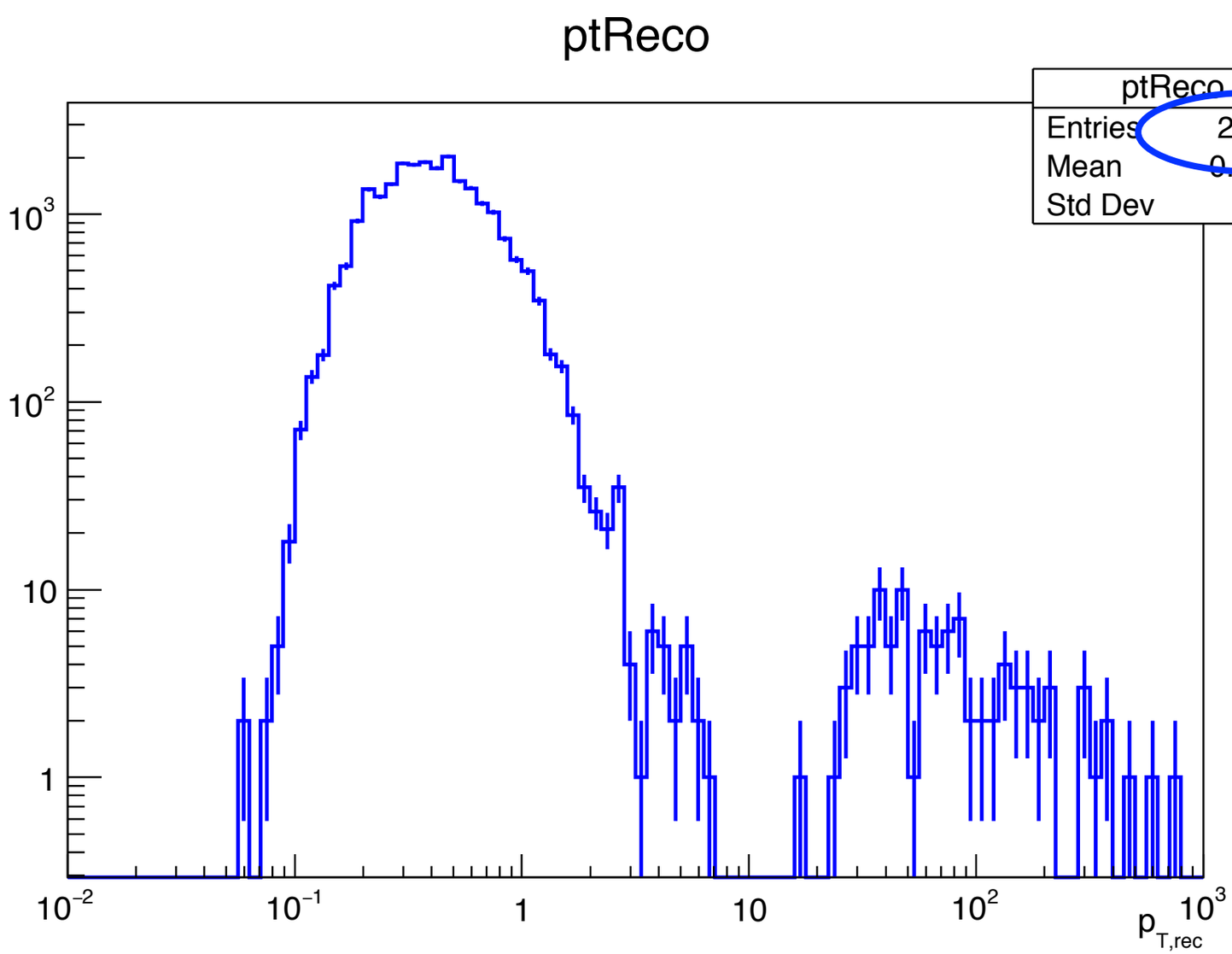
$$p_{\mathrm{T}} = 0.3B\frac{\left(\frac{d}{2}\right)^2 + s^2}{2s}$$

- There is a hard limit on the max reconstructable p_T
  - it depends on the dist from IP of the outermost hit => stub length
    - if last hit on outermost vertex layer (60mm): max p_T = 250 GeV/c
    - if last hit on intermediate vertex layer (44mm): max p_T = 110 GeV/c
  - it depends on the single point resolution; with σ = 1μm:
    - if last hit on outermost vertex layer (60mm): max p_T = 750 GeV/c
    - if last hit on intermediate vertex layer (44mm): max p_T = 400 GeV/c

- To reconstruct tracks with p_T 1 TeV
  - with σ = 3 μm, stub length should be at least 12 cm
  - with σ = 1 μm, stub length should be at least 7 cm

Stub tracks with γγ—>hadron overlay

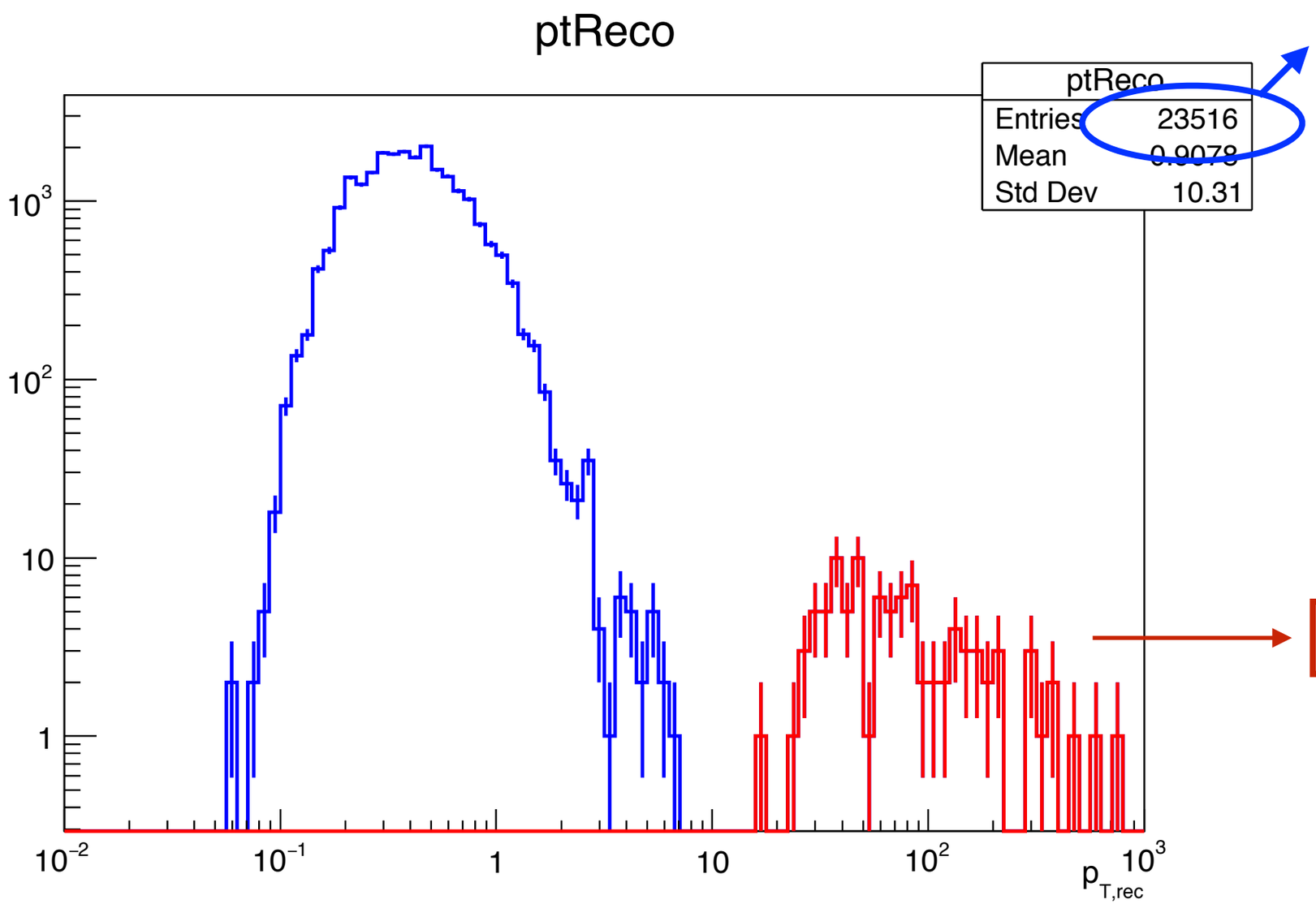
- 100 physics events: “short” muons with p = 1 TeV, θ = 89 deg
- Overlay of 30BX (10BX before the physics event, 20BX after)



- total nr tracks reconstructed by the tracking algorithm

Stub tracks with γγ—>hadron overlay

- 100 physics events: "short" muons with p = 1 TeV, θ = 89 deg
- Overlay of 30BX (10BX before the physics event, 20BX after)

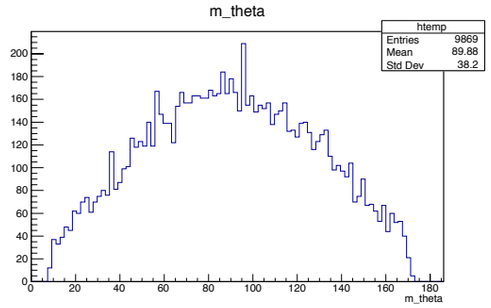


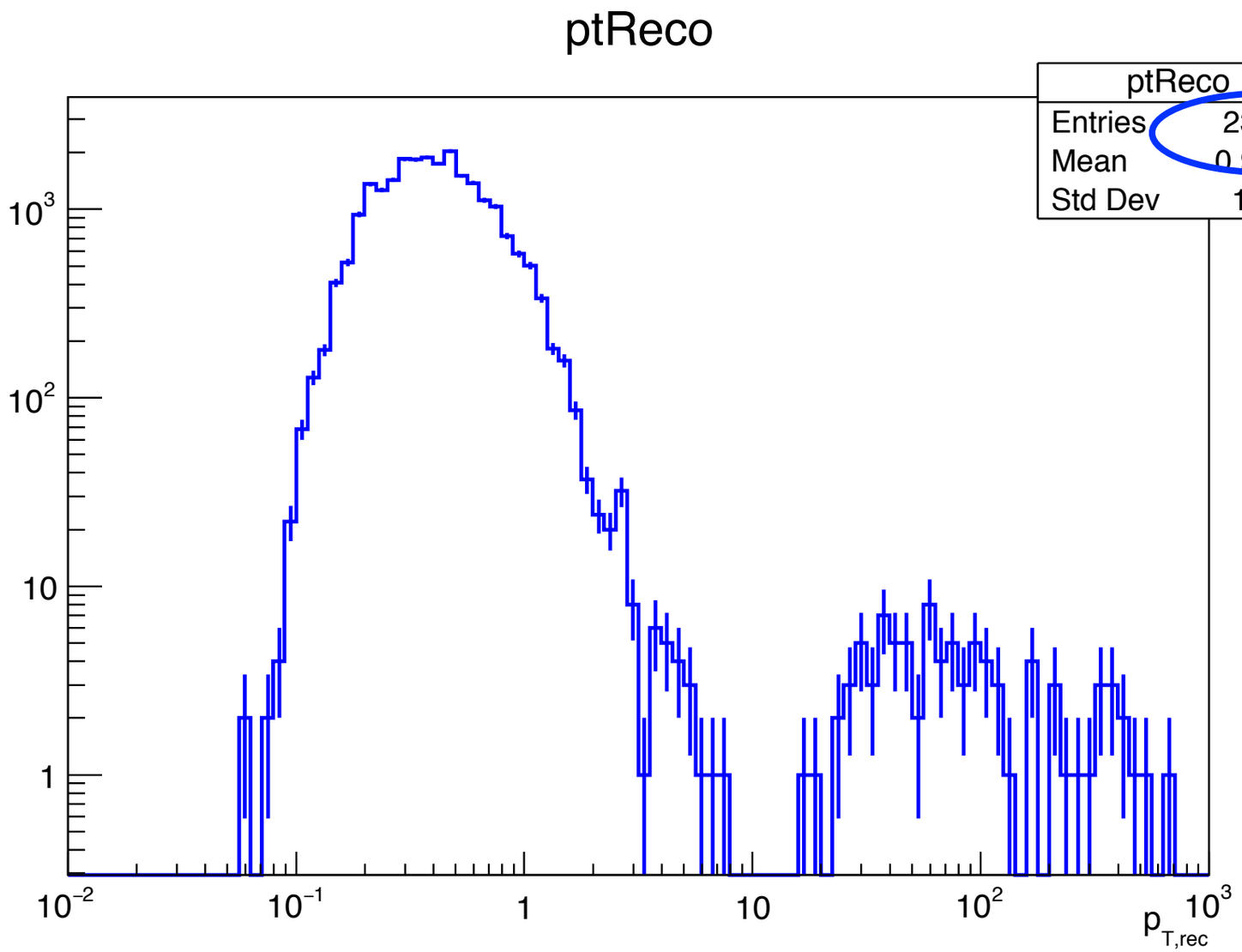
- total nr tracks reconstructed by the tracking algorithm

- the signal!

Stub tracks with γγ—>hadron overlay

- 100 physics events: “short” muons with p = 1 TeV, cosθ distribution -> more realistic
- Overlay of 30BX (10BX before the physics event, 20BX after)





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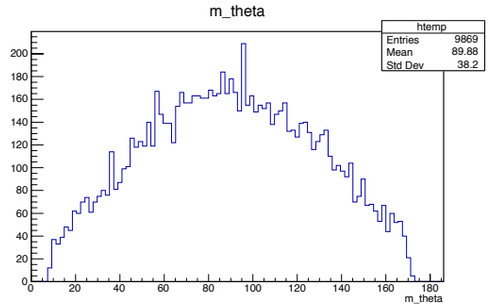
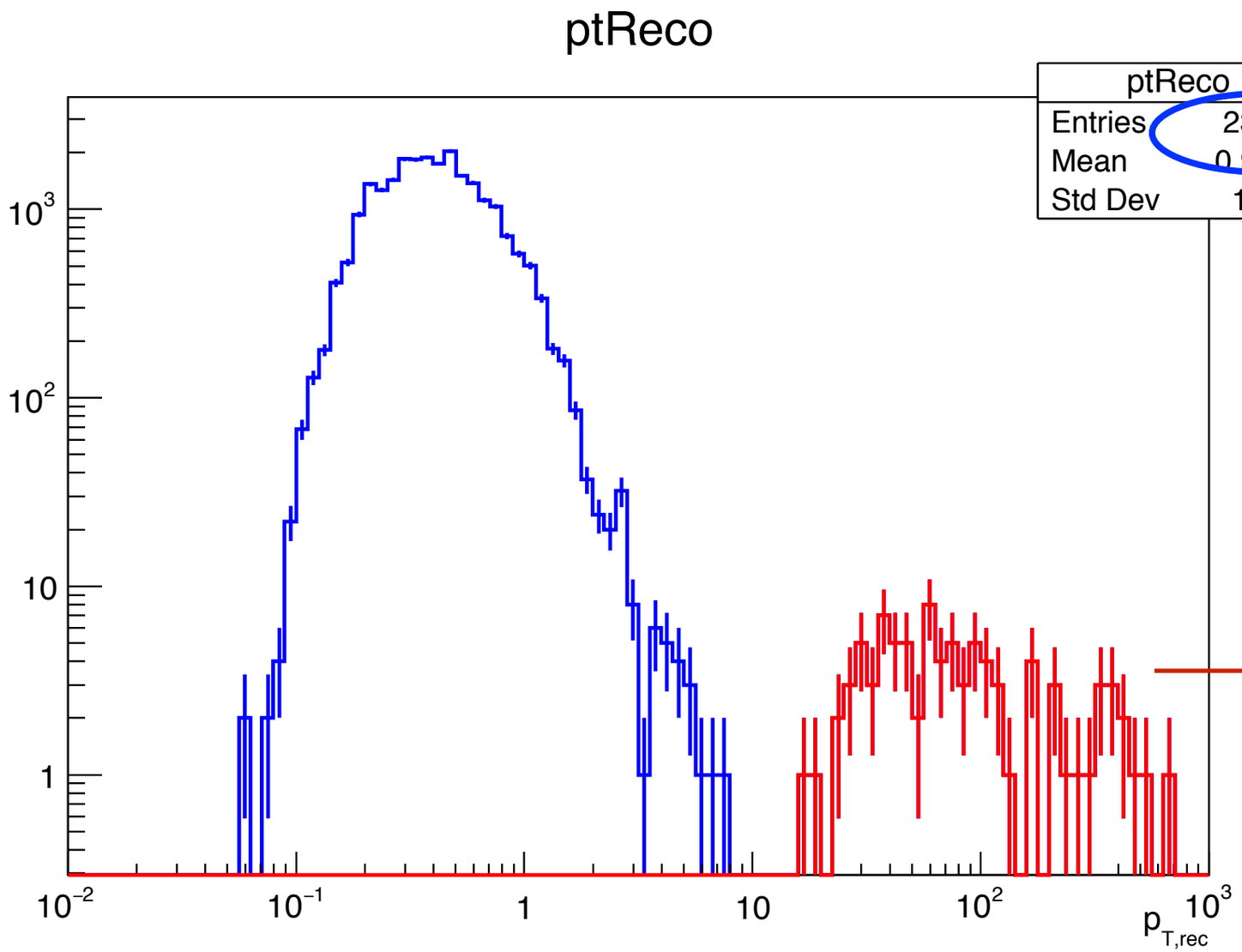




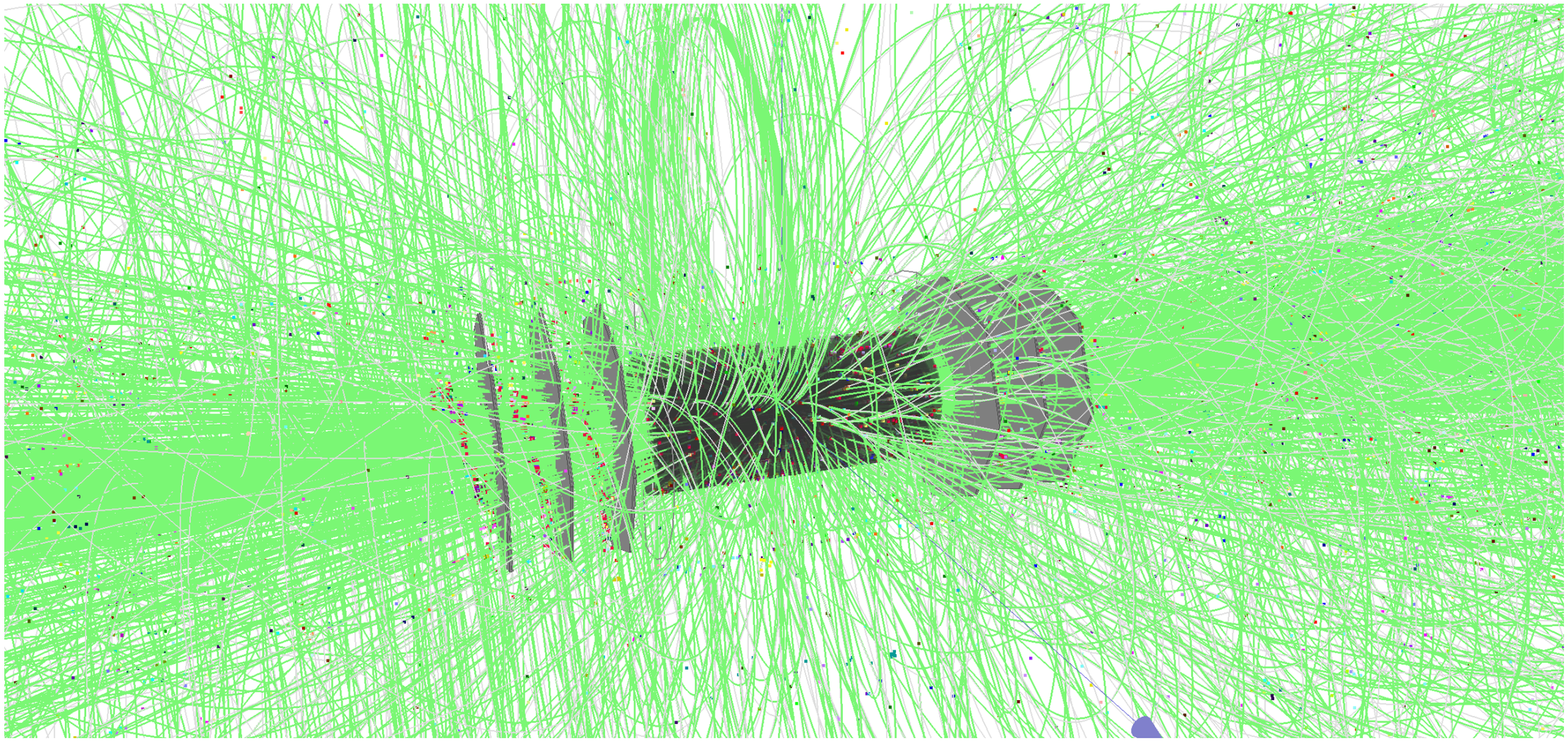
- total nr tracks reconstructed by the tracking algorithm

- the signal!

Stub tracks with γγ—>hadron overlay

- 100 physics events: “short” muons with p = 1 TeV, cosθ distribution -> more realistic
- Overlay of 30BX (10BX before the physics event, 20BX after)

- …this is how it looks like

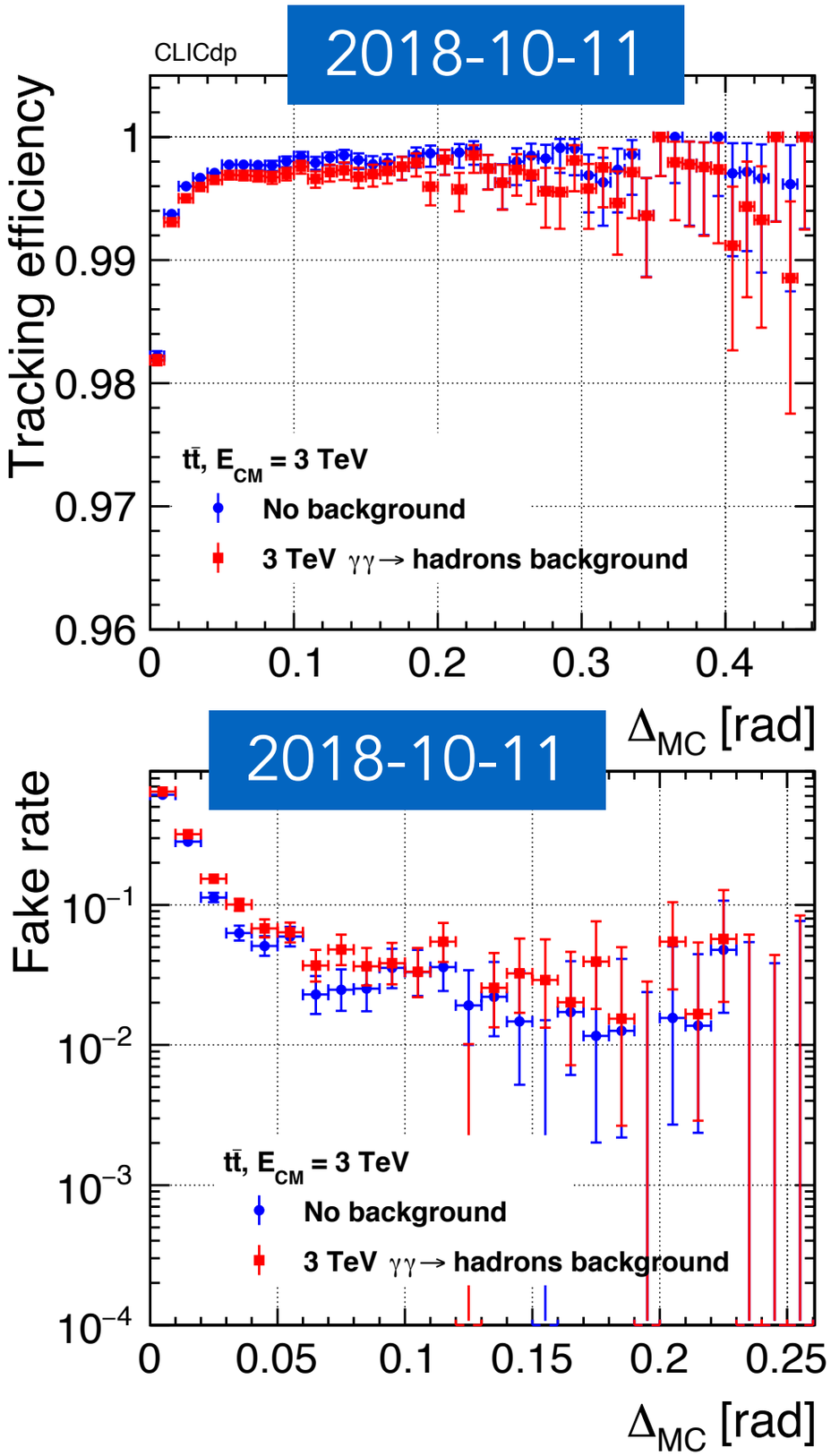


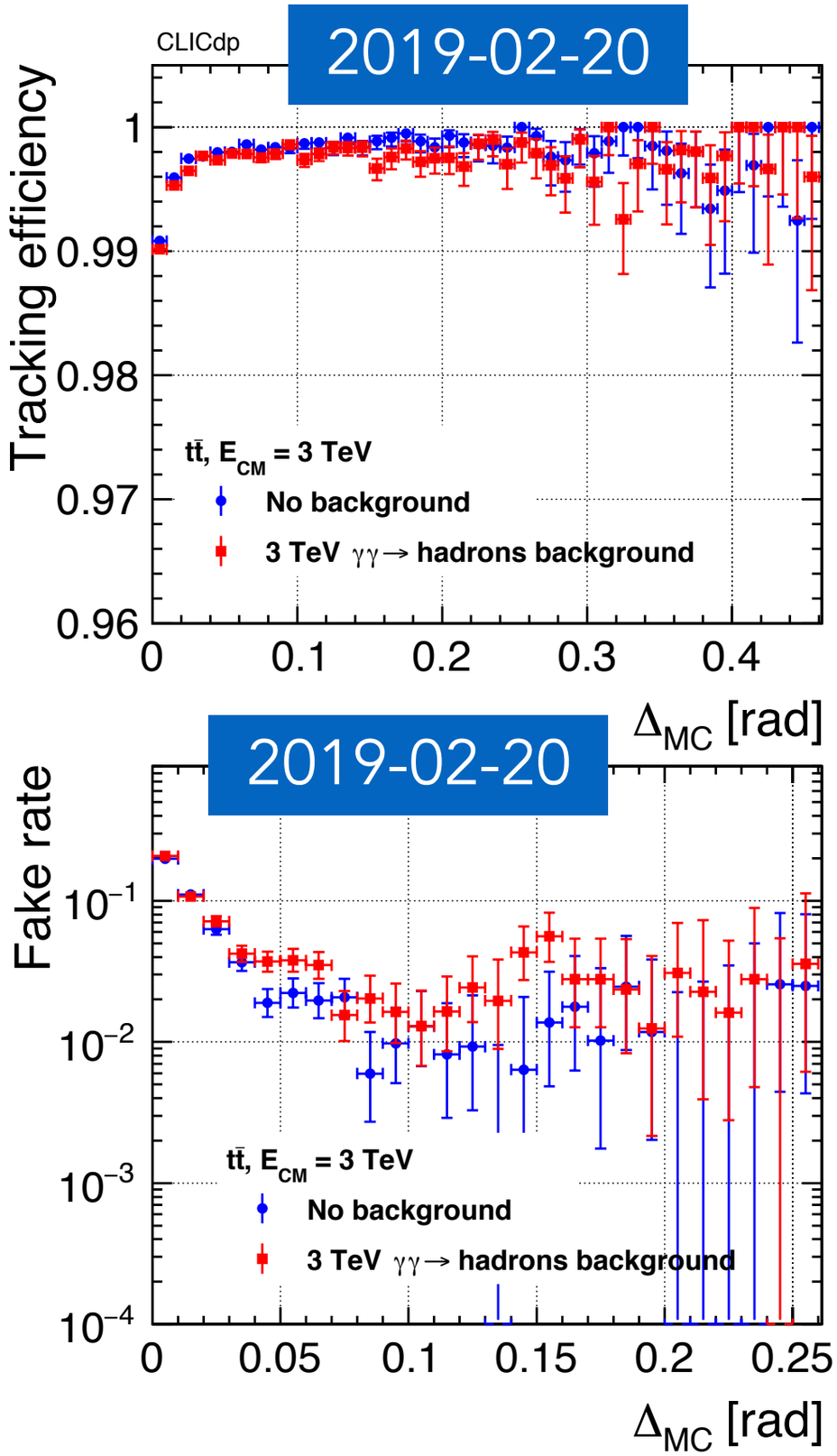
Outlook

- Update on “stub-like” tracks
  - reconstruction software release iLCSoft_2019-01-16

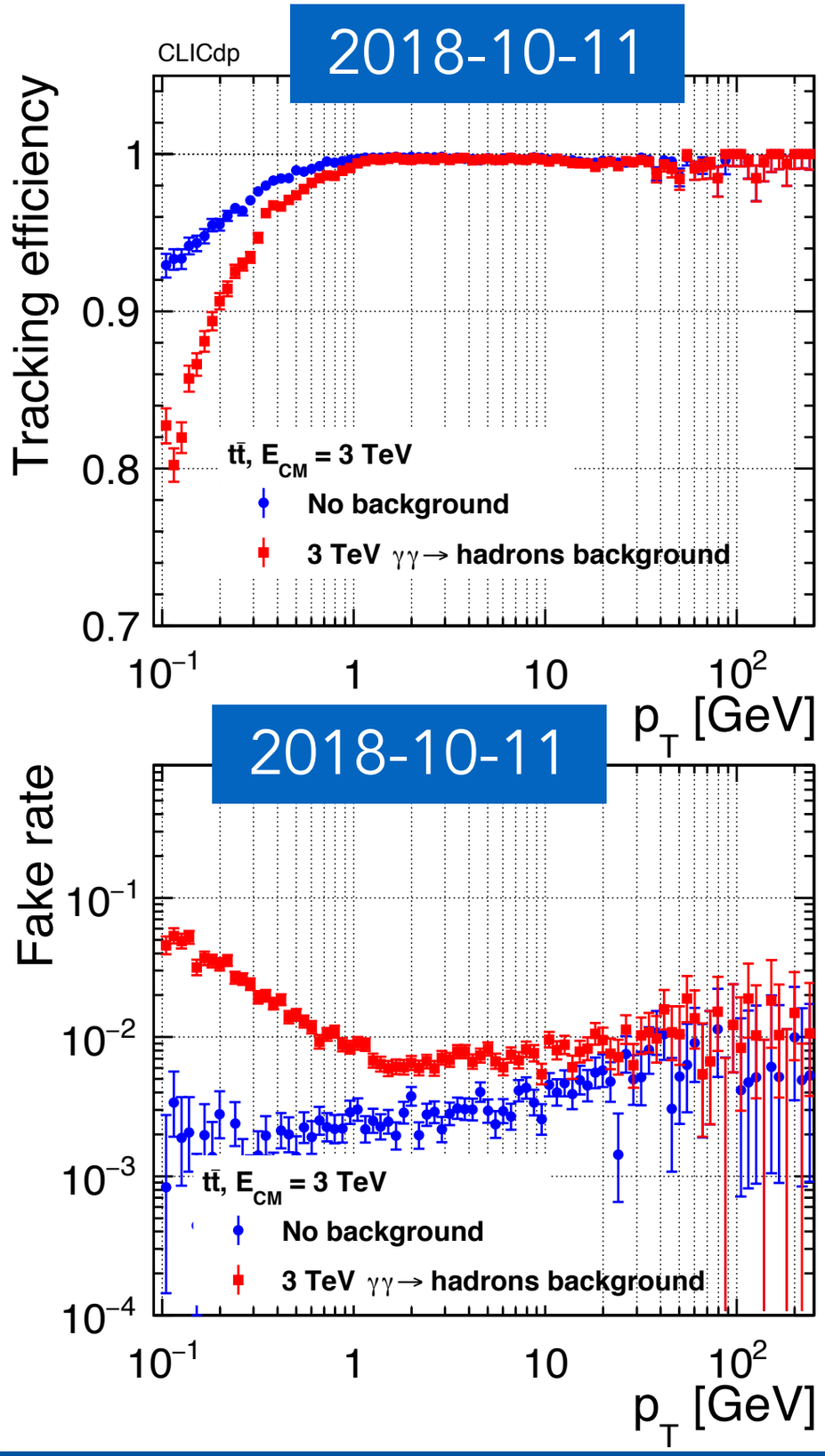
- Validation of release iLCSoft_2019-02-20
  - tracking performance (ttbar events @3TeV)
  - flavour tagging

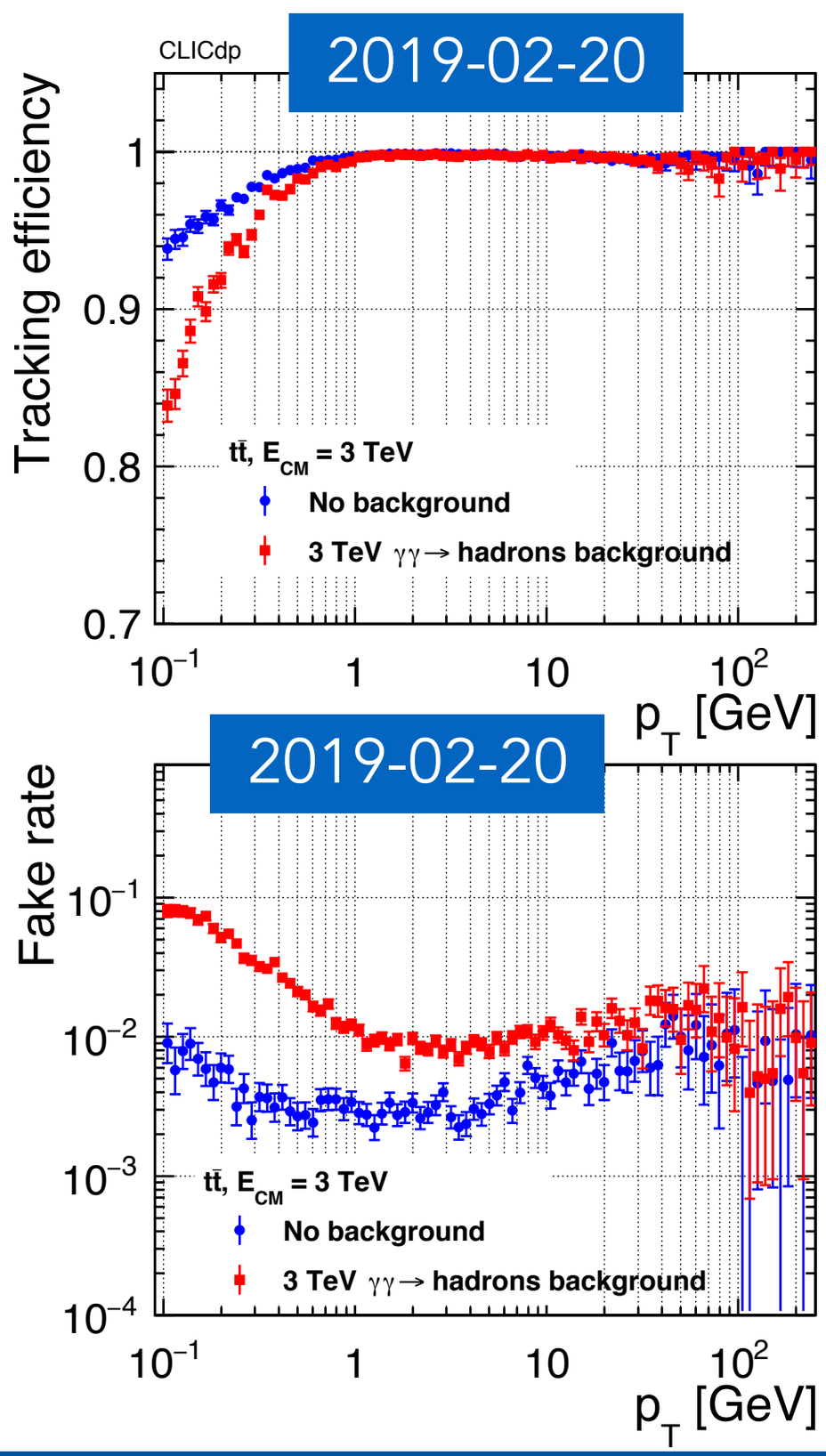
Tracking/ttbar/eff&fakes vs ΔMC



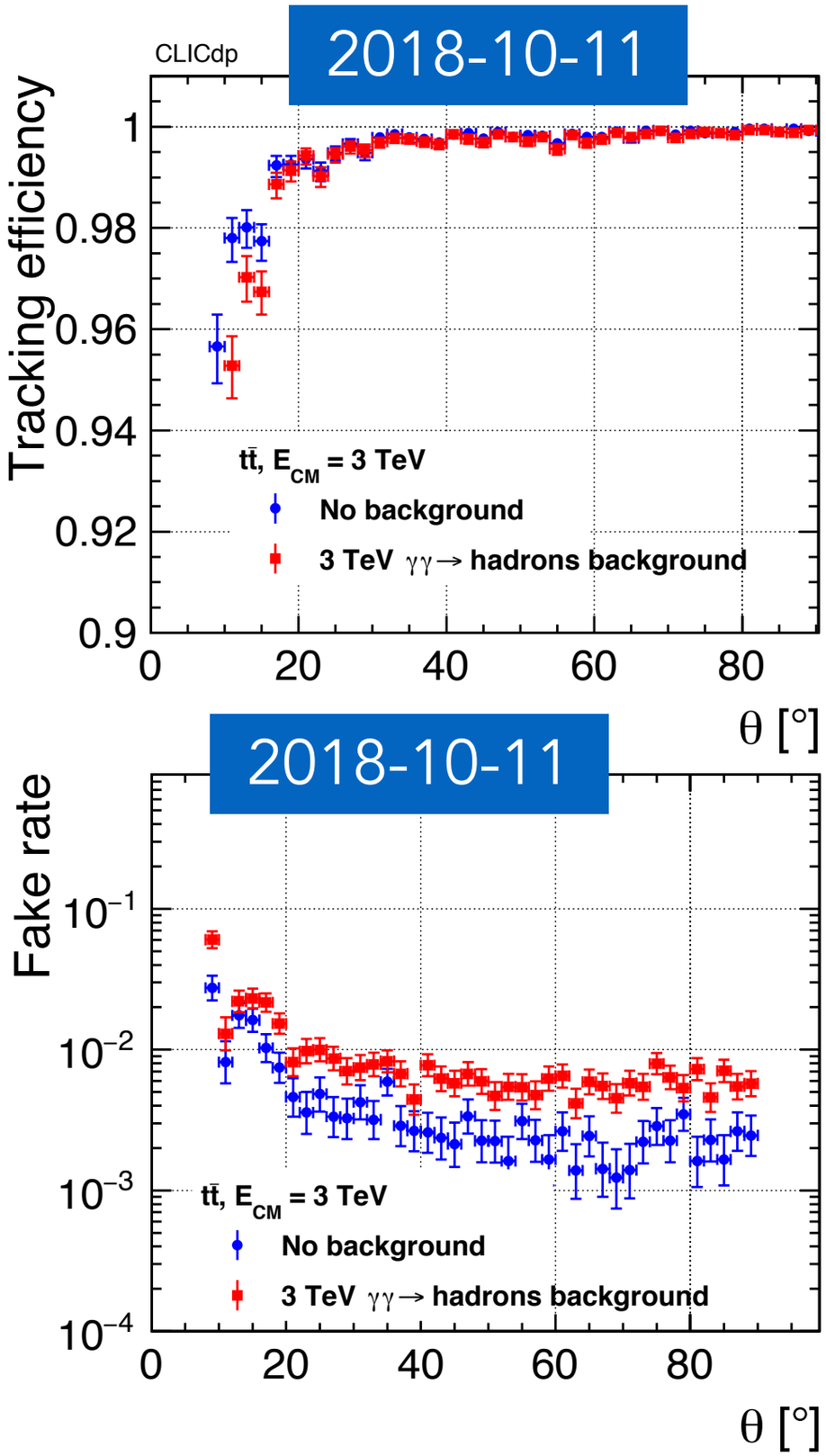


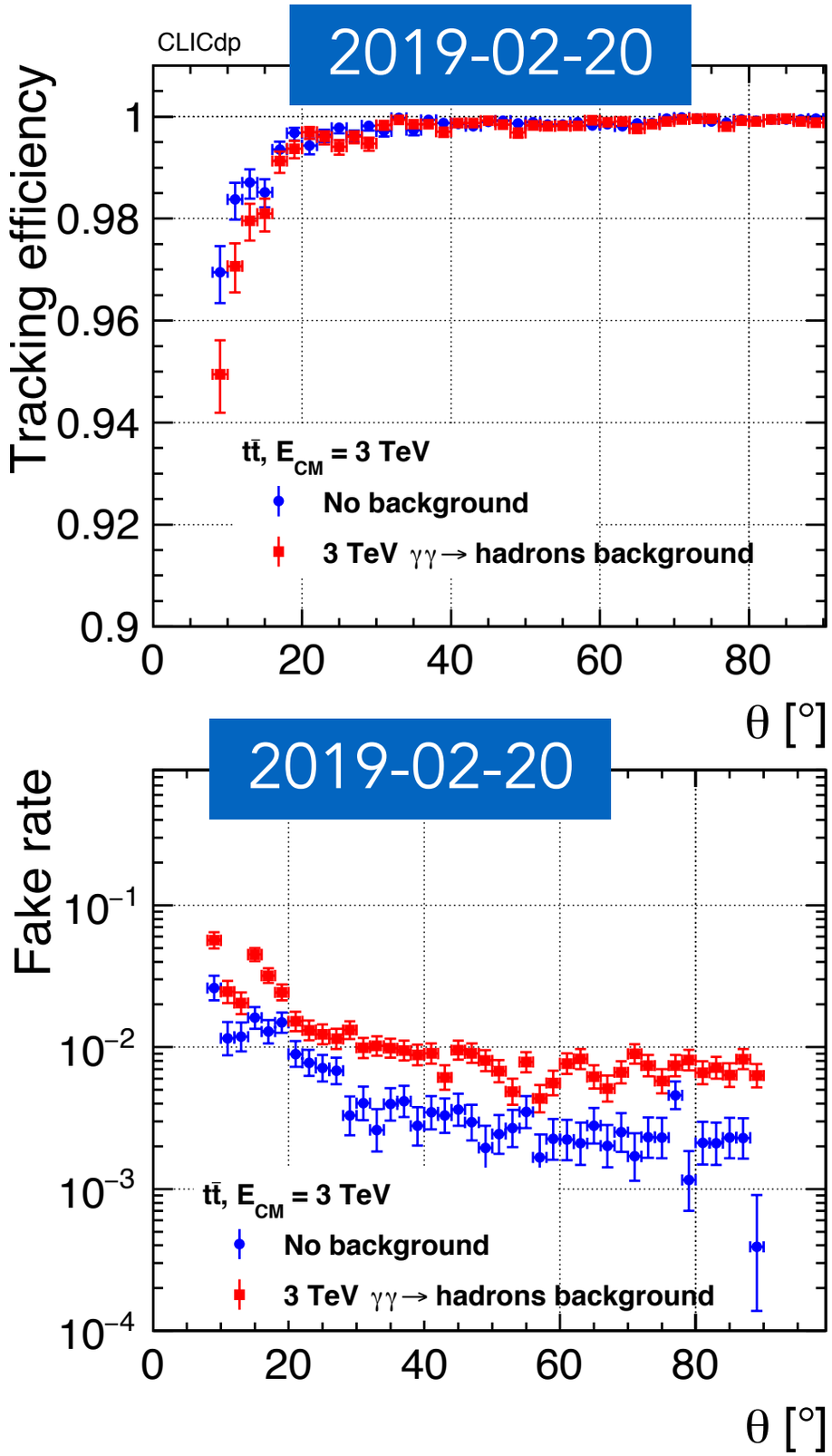
Tracking/ttbar/eff&fakes vs pT



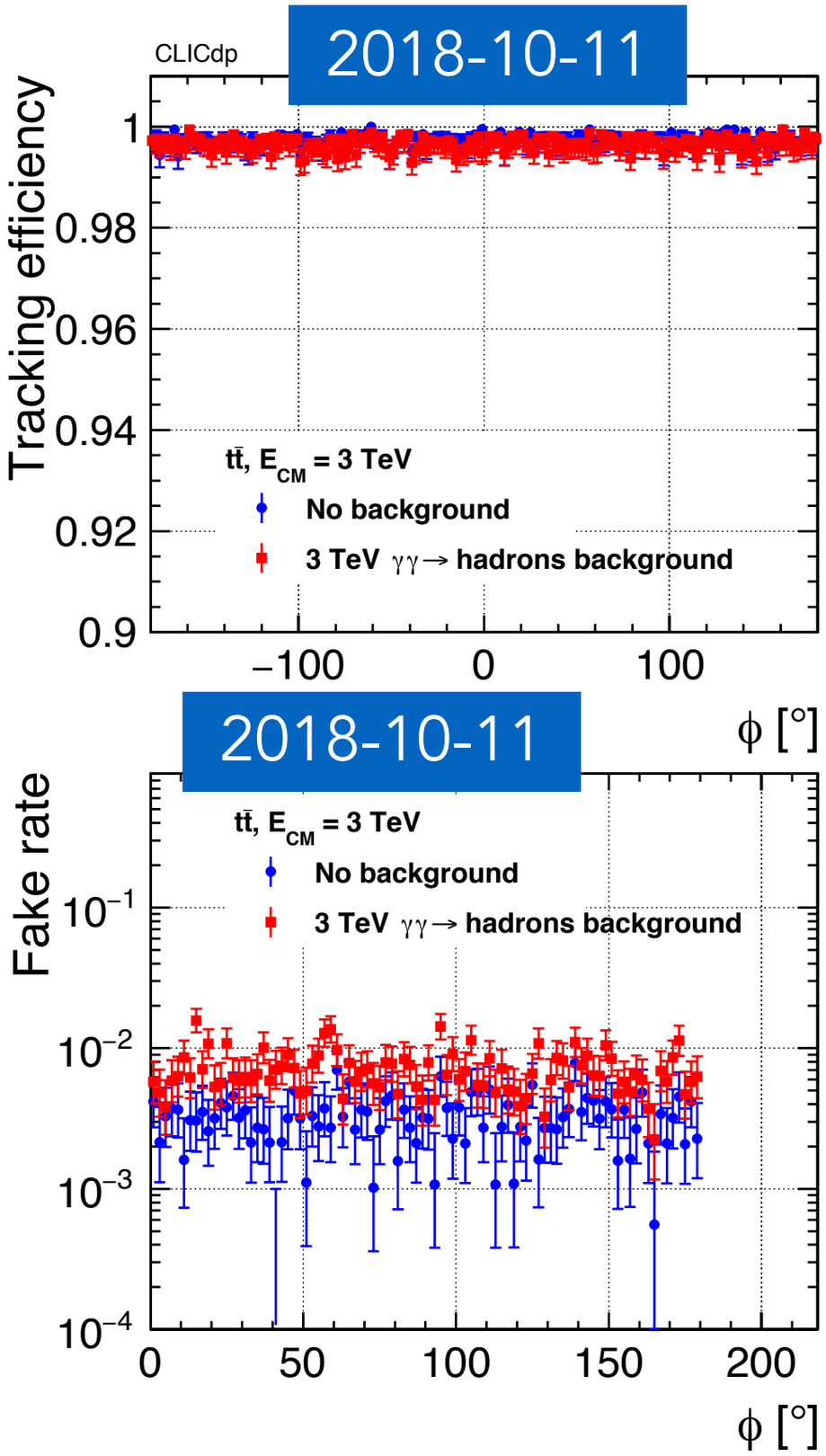


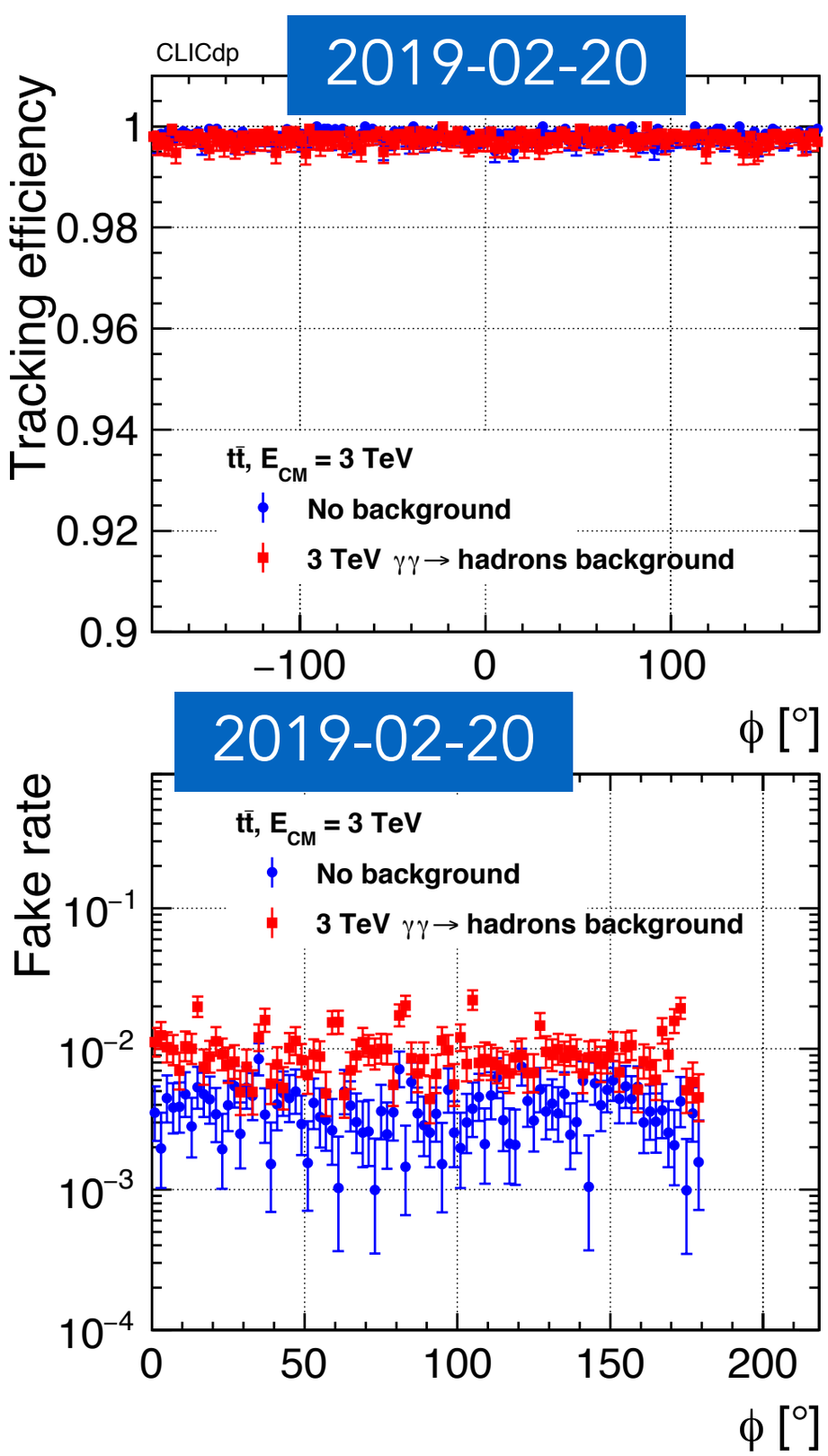
Tracking/ttbar/eff&fakes vs θ





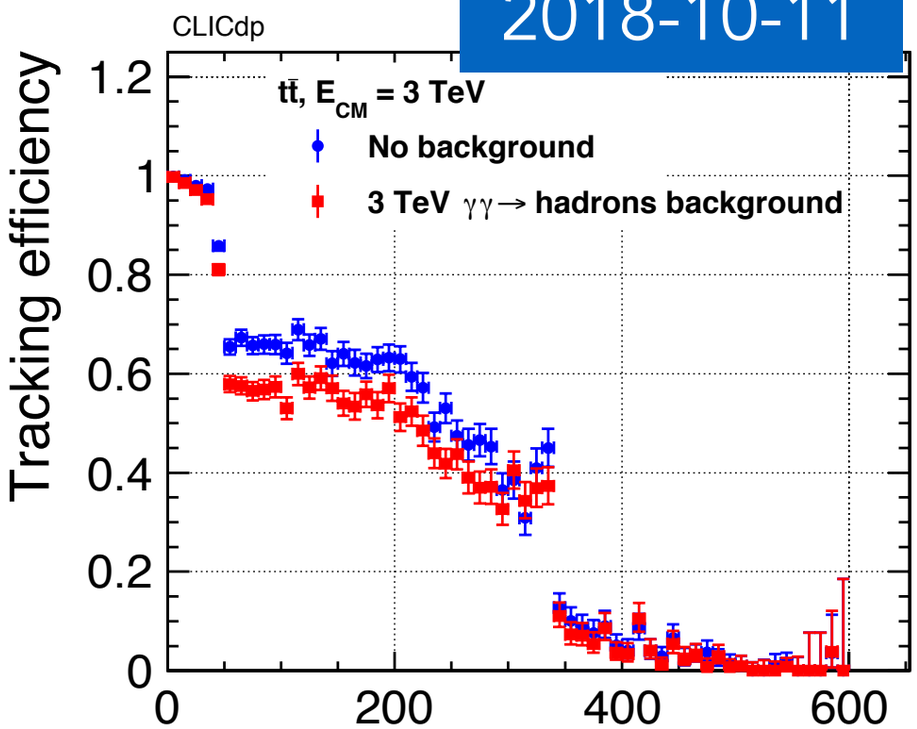
Tracking/ttbar/eff&fakes vs φ



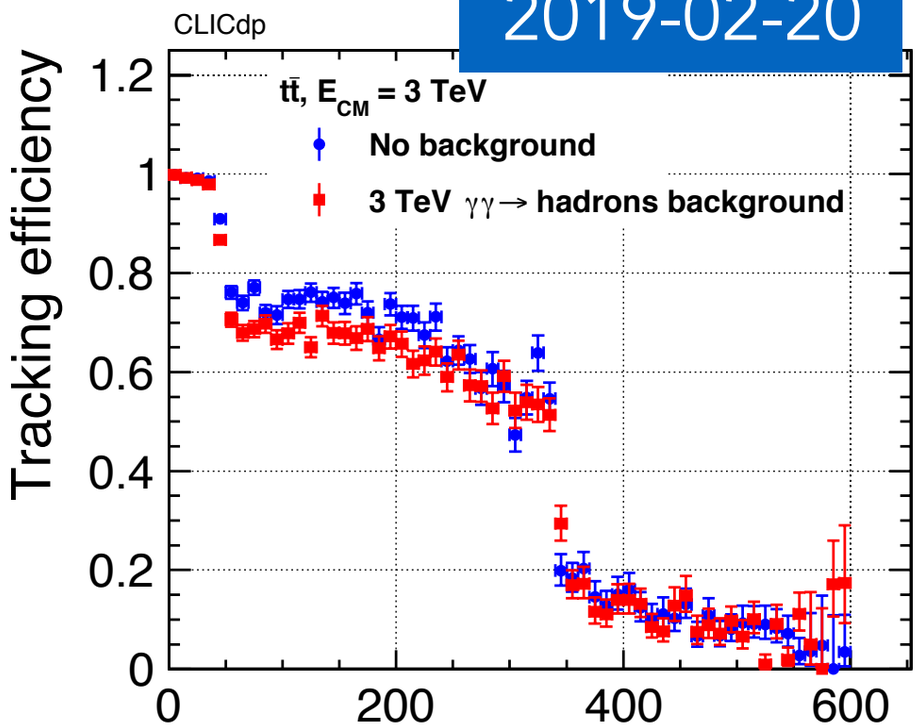


Tracking/ttbar/eff&fakes vs vertexR

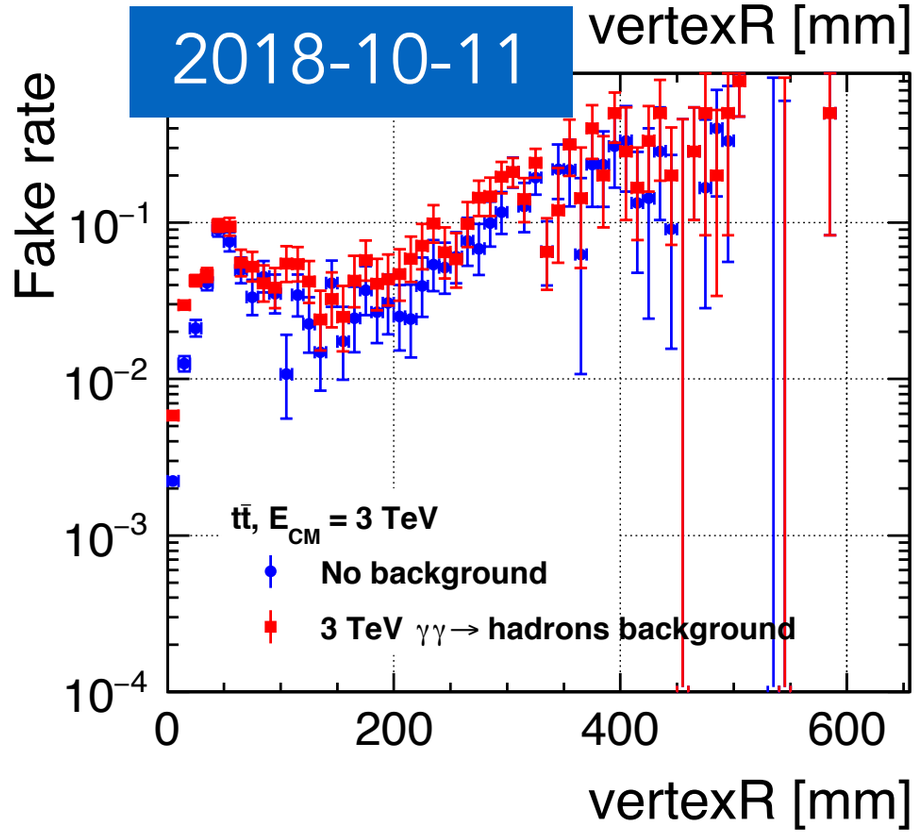
2018-10-11



2019-02-20



2018-10-11



2019-02-20