ALICE upgrade performance with ACTS

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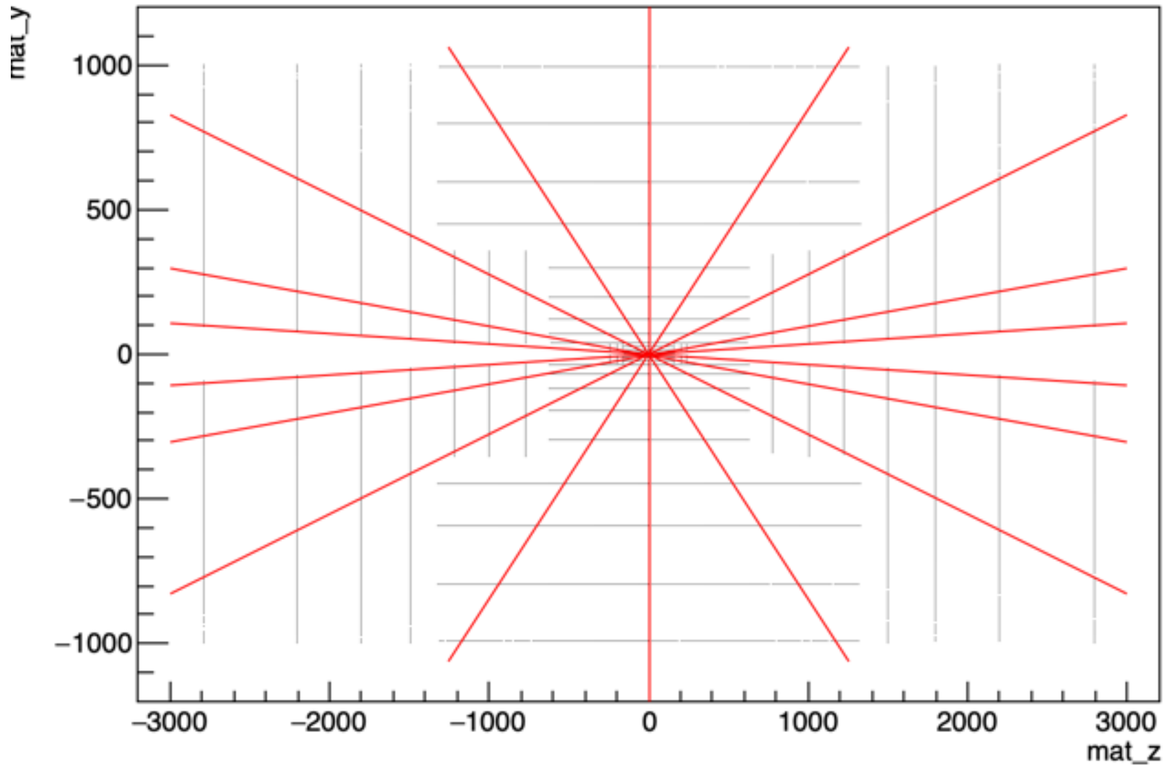
ALICE upgrade performance with ACTS



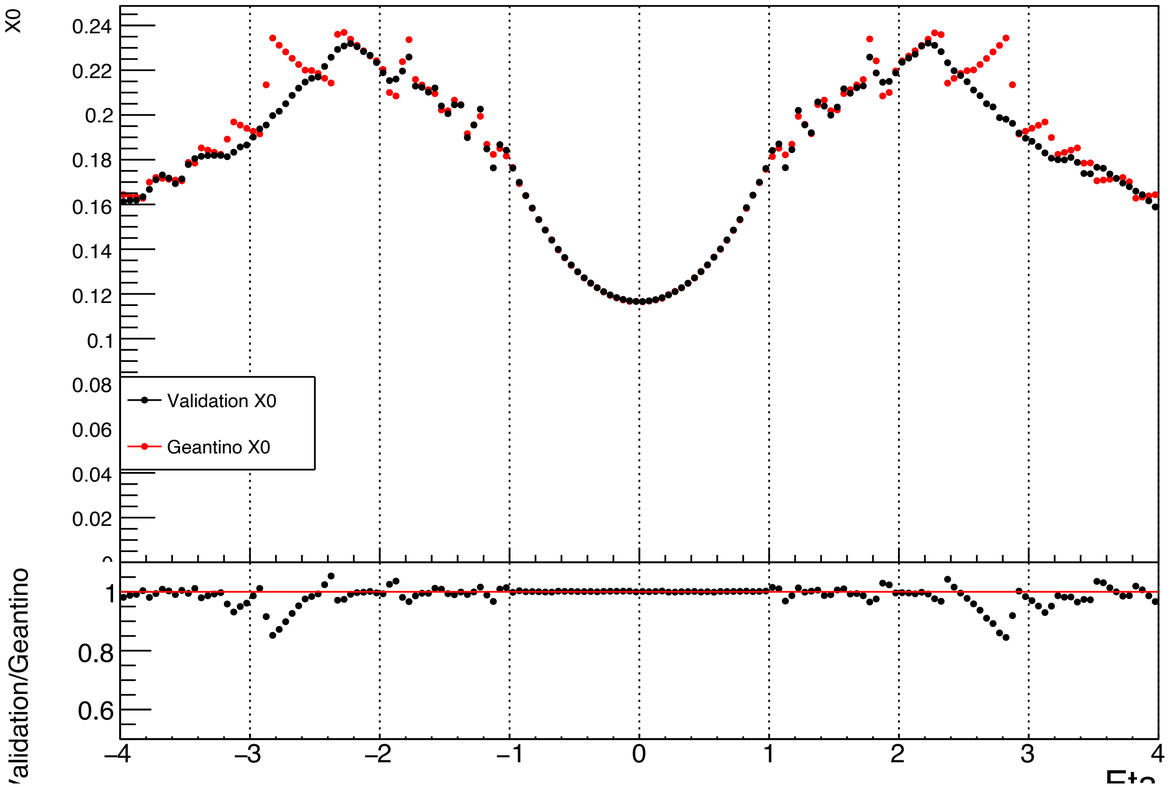
p_T = {0.5, 10.}
η = {0., 3.8}
ϕ = {−π;π}
PID = 211
B = 0.5 T
Material mapping = on

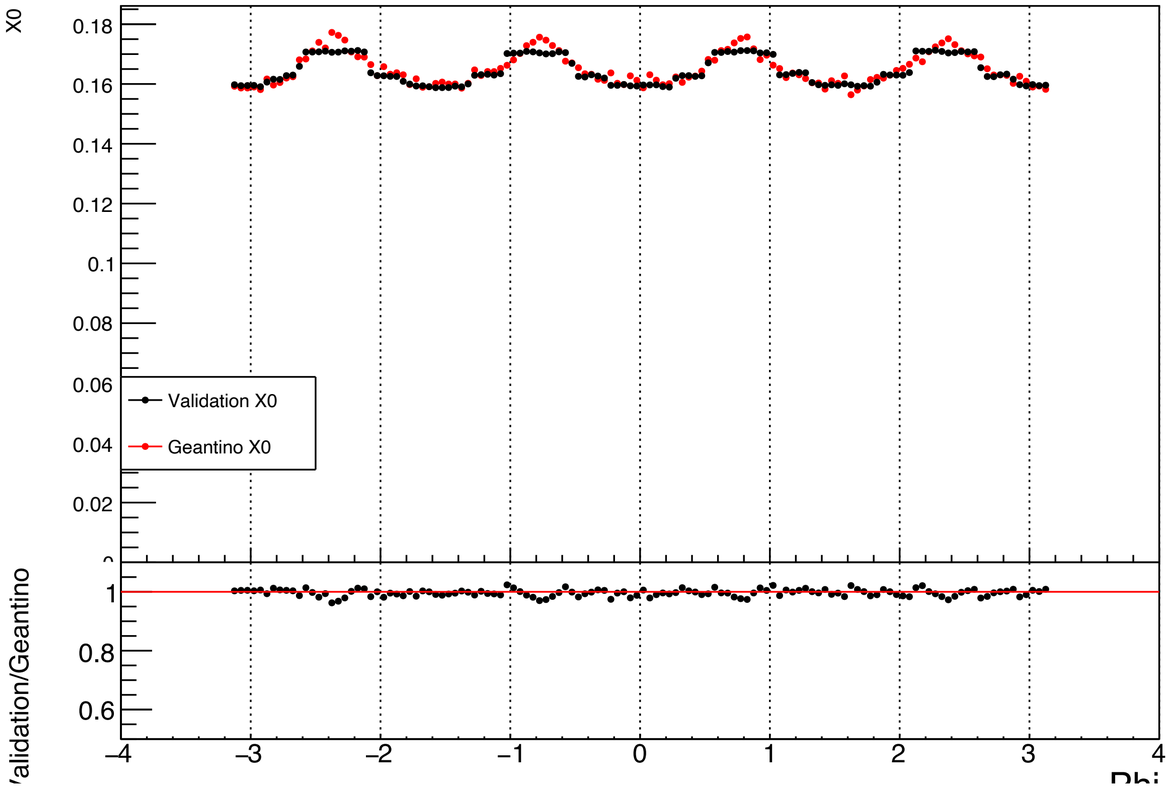
- Combined barrel and endcap layout
- Main interest: obtain performance plots in the transition and forward regions:
  1. Momentum resolution
  2. Impact parameter resolution
  3. Tracking efficiency
- Geometry implementation in TGeo, use the ACTS *TGeo examples:

  `ActsExampleFatrasTGeo`,

  `ActsExampleTruthTracksTGeo`
- Material mapping using the GDML (converted from TGeo)

Material validation after the fix in PR#873





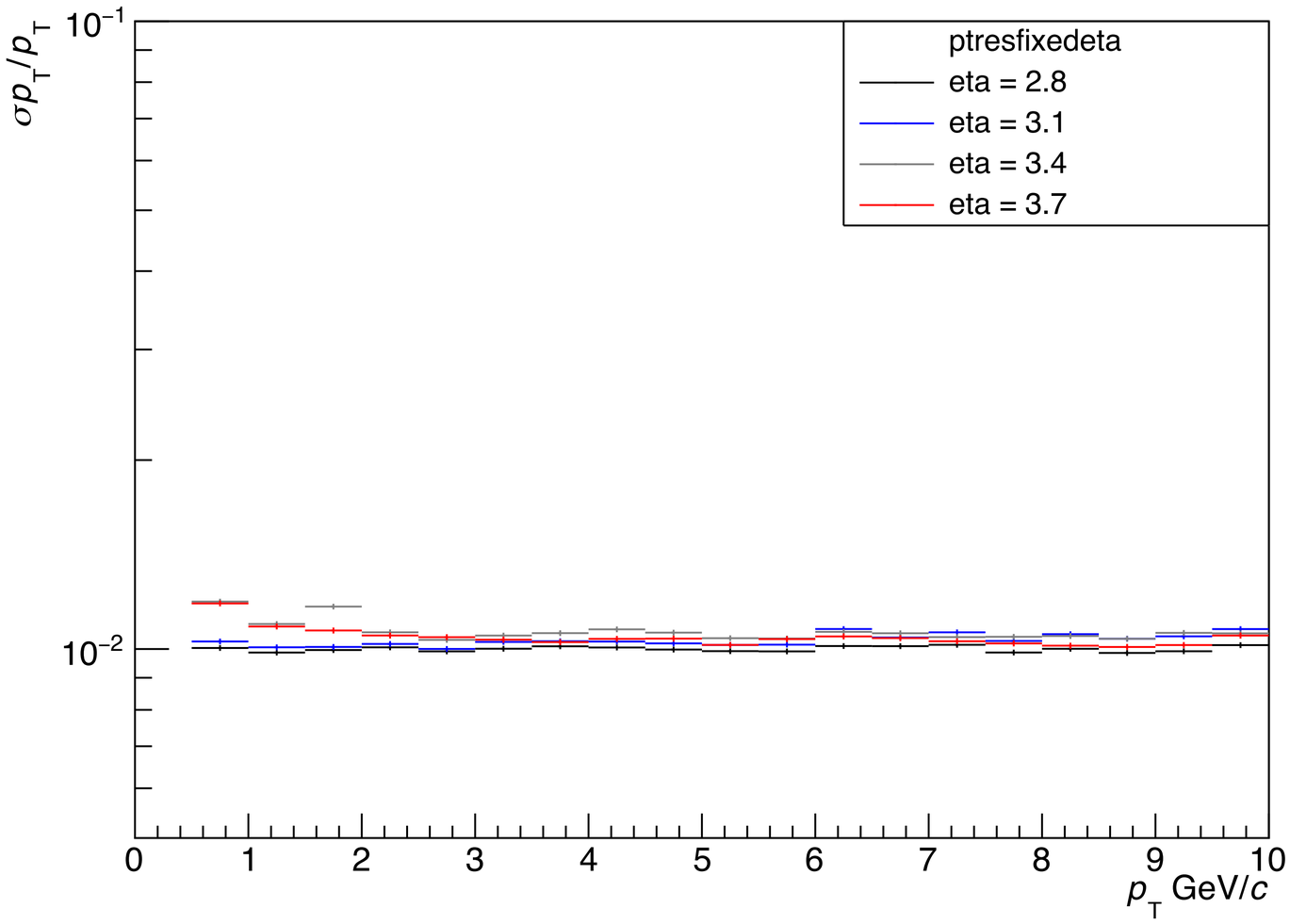
Example of the running configuration

```
./ActsExampleFatrasTGeo --response-file geom/tgeo-alice-o2.response \
    --events=25000 \
    --output-dir=data/gen/mat_on/gun_pions_phi-pi_pi_eta0_38_pt5 \
    --output-csv \
    --gen-phi-degree=-3.14159:3.14159 \
    --gen-eta=0:3.8 \
    --gen-mom-gev=5:5 --gen-mom-transverse \
    --gen-pdg=211 \
    --gen-nparticles=10 \
    --bf-constant-tesla="0:0:0.5" --mat-input-type file --mat-input-file material-maps.root


./ActsExampleTruthTracksTGeo --response-file geom/tgeo-alice-o2.response \
    --digi-config-file alice3-smearing-config.json \
    --input-dir=data/gen/mat_on/gun_pions_phi-pi_pi_eta0_38_pt5 \
    --input-root=1 \
    --bf-constant-tesla=0:0:0.5 \
    --output-dir output/mat_on/truthtrackstgeo_pions_phi-pi_pi_eta0_38_pt5_infl5000 \
    --mat-input-type file --mat-input-file material-maps.root \
    --fit-initial-variance-inflation=5000:5000:5000:5000:5000:5000
```

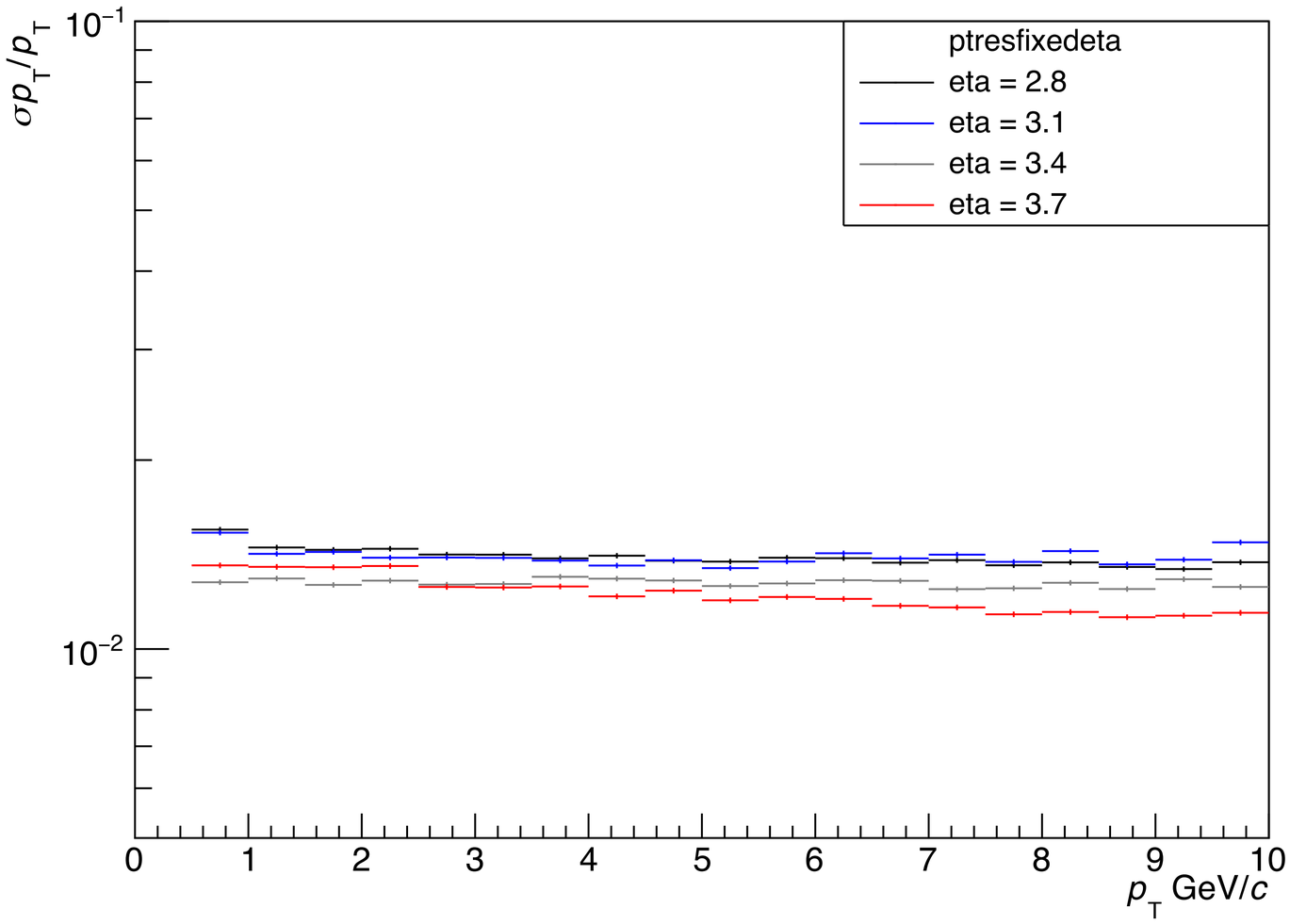
p_T resolution

Momentum resolution



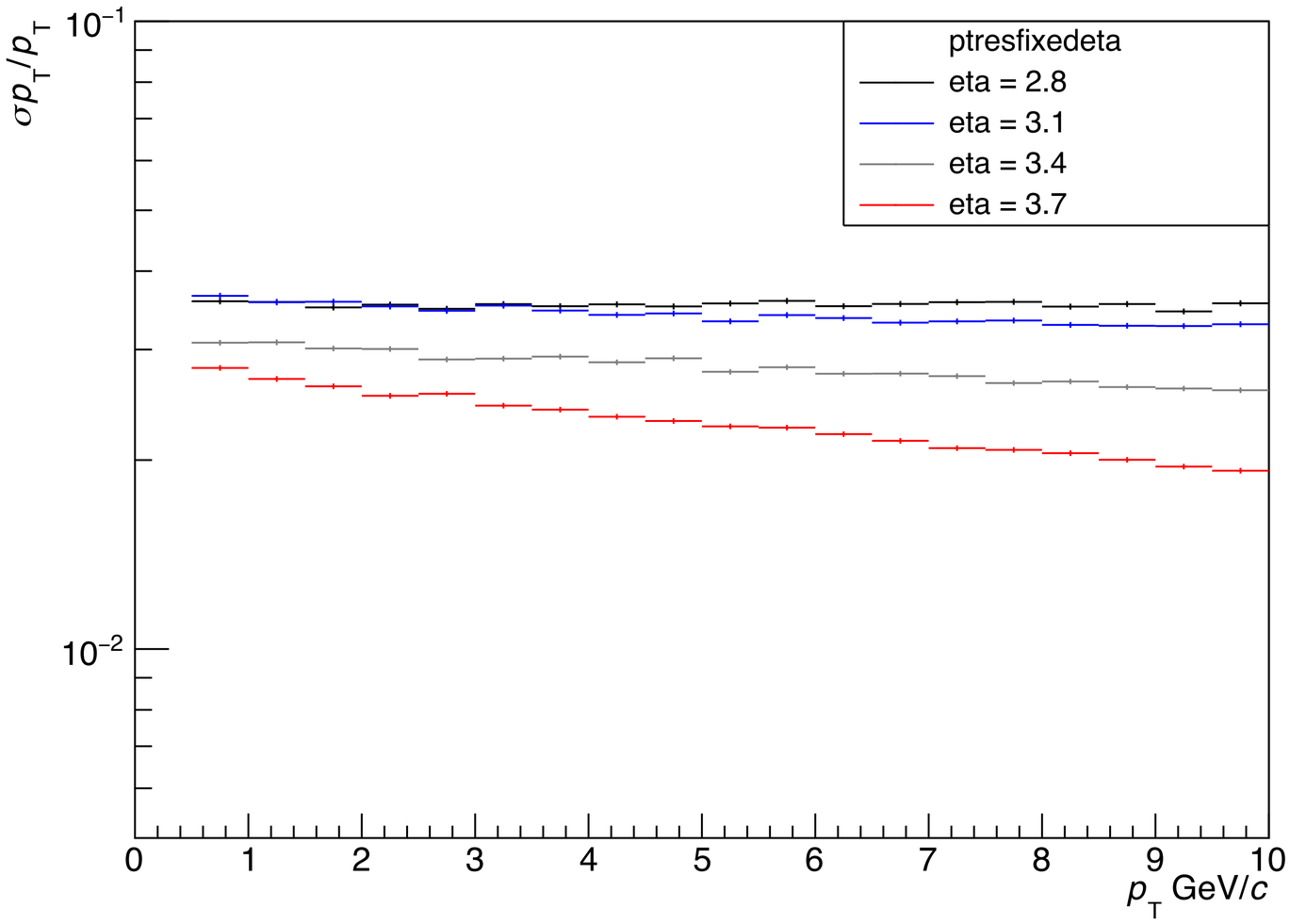
No seed covariance matrix inflation

Momentum resolution



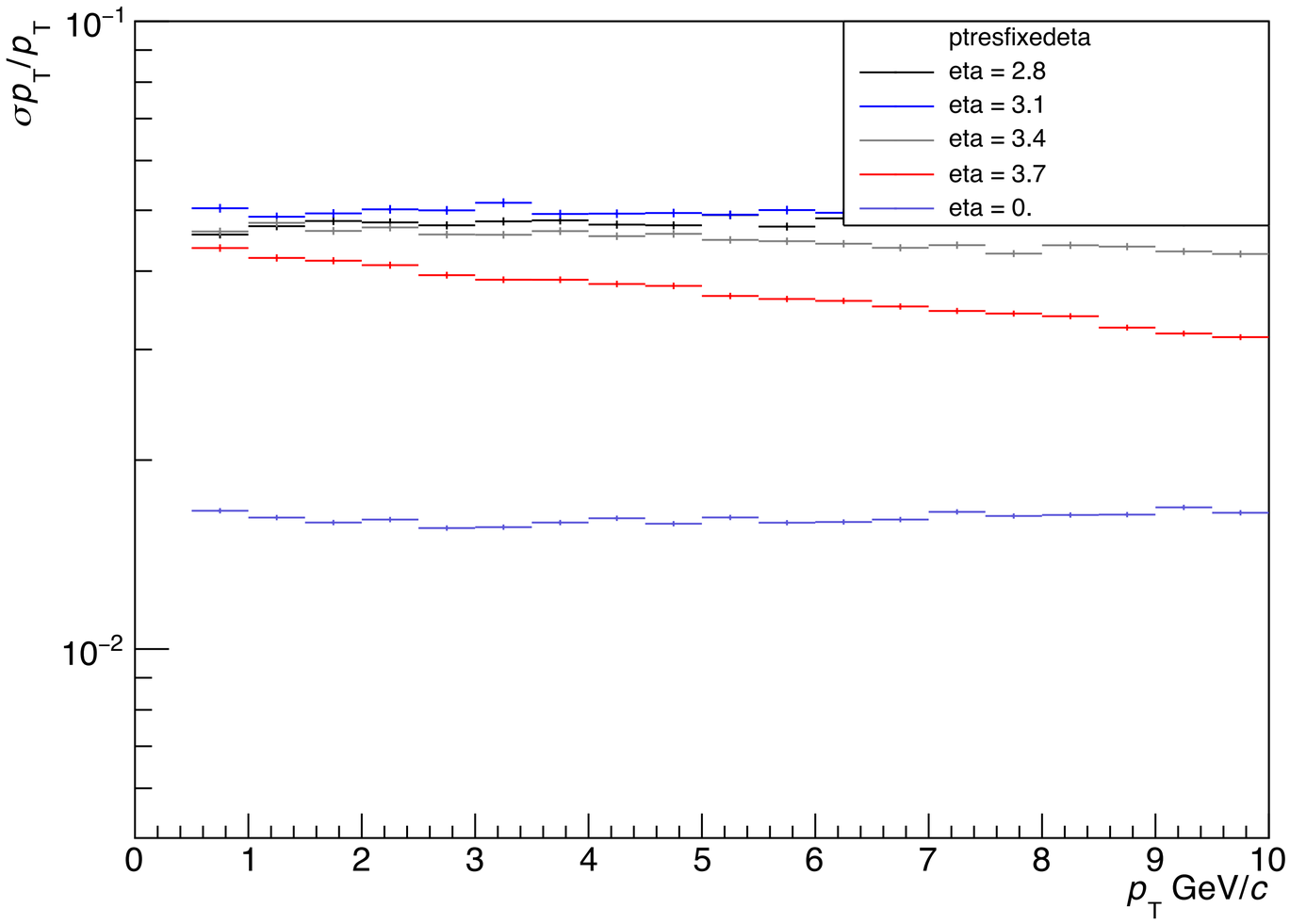
Seed covariance matrix inflation factor 10

Momentum resolution



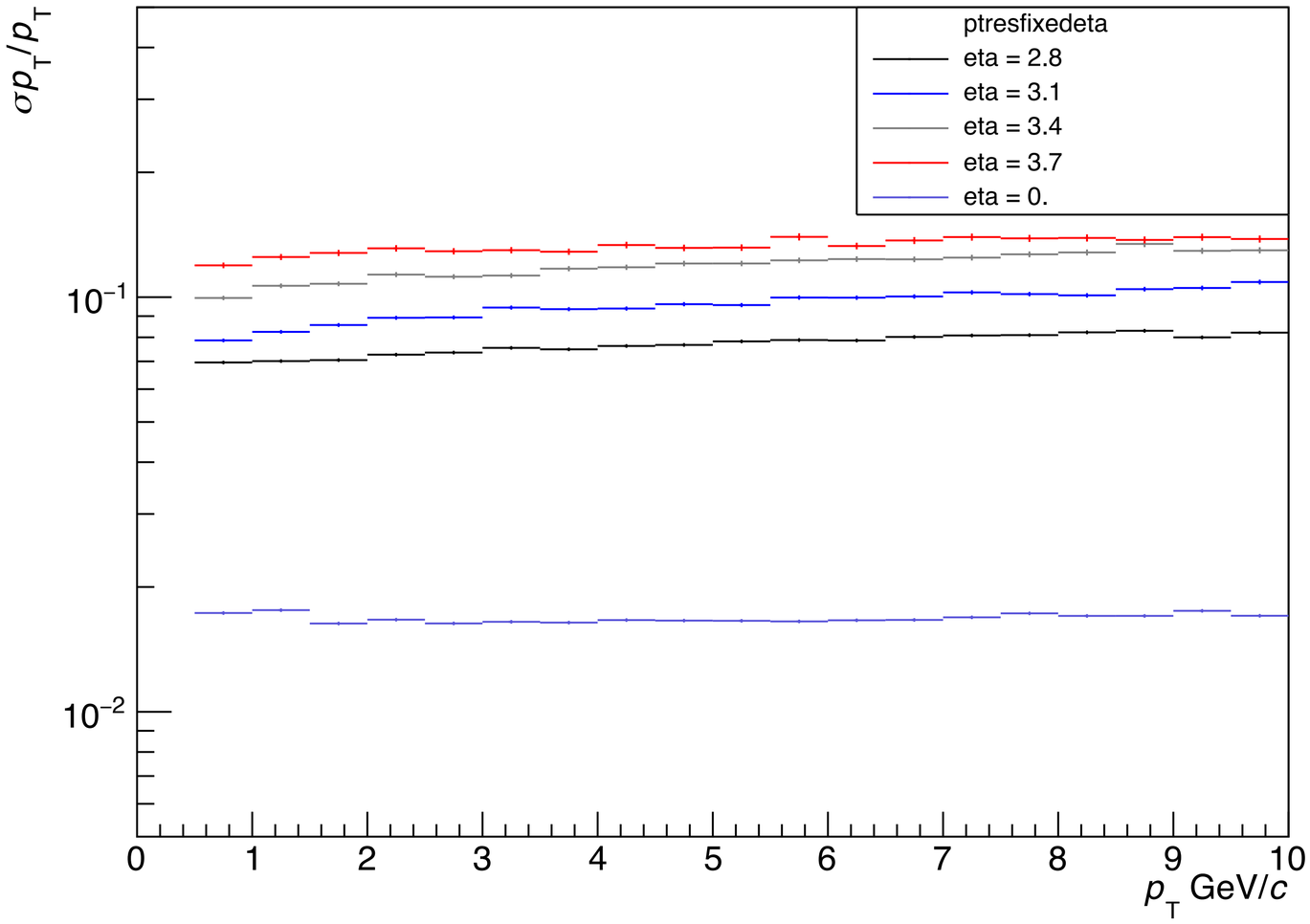
Seed covariance matrix inflation factor 50

Momentum resolution



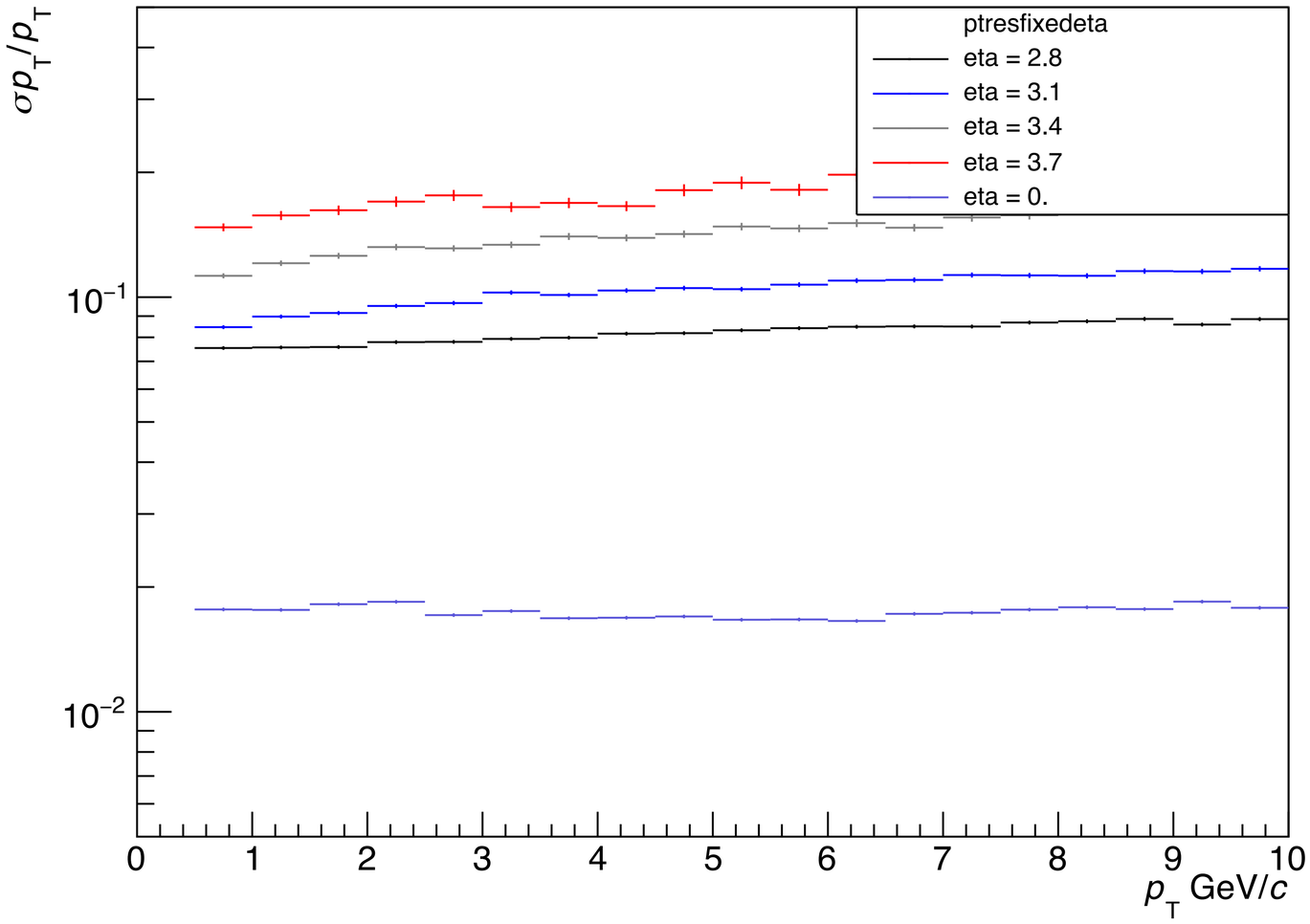
Seed covariance matrix inflation factor 100

Momentum resolution



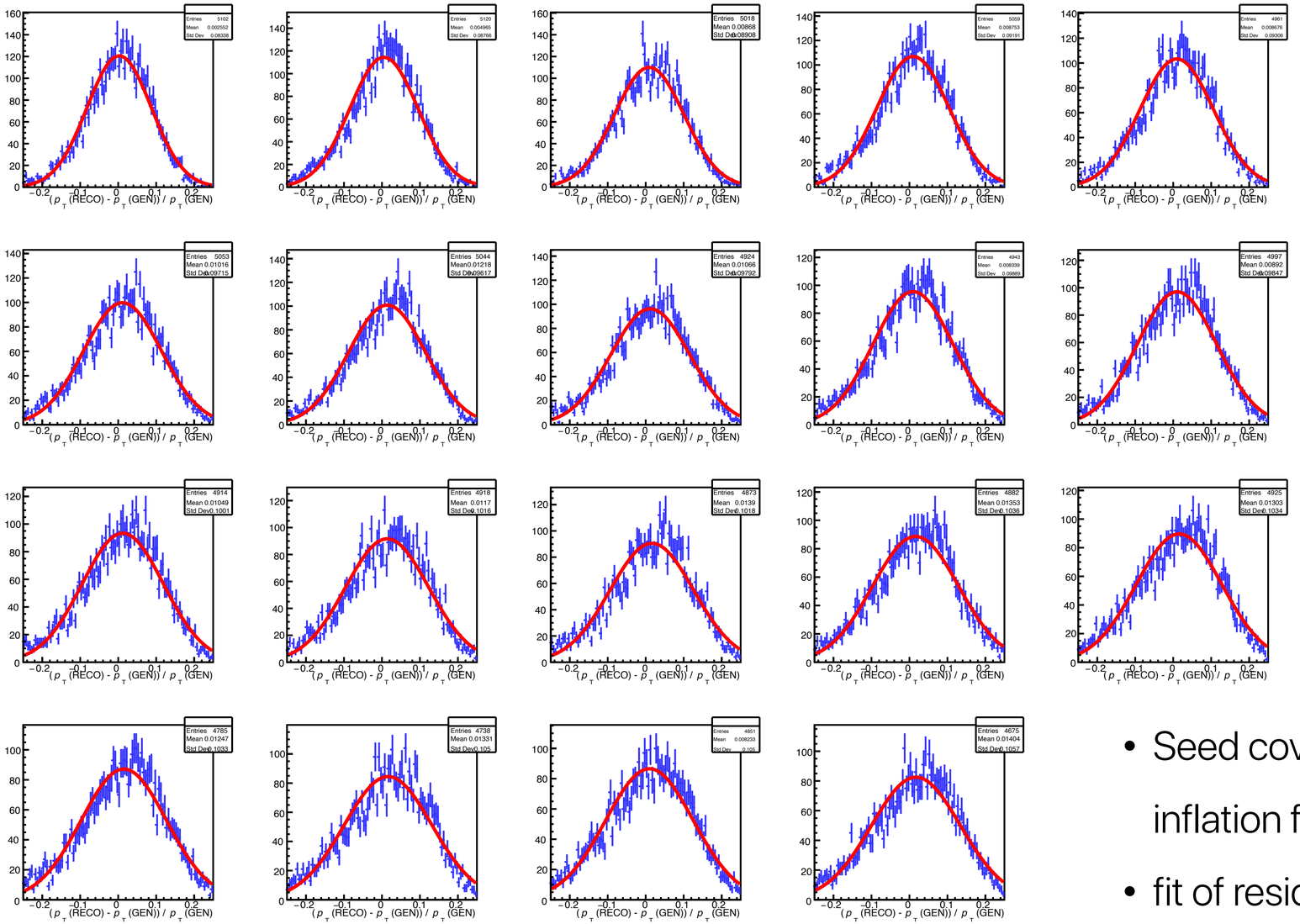
Seed covariance matrix inflation factor 1000

Momentum resolution



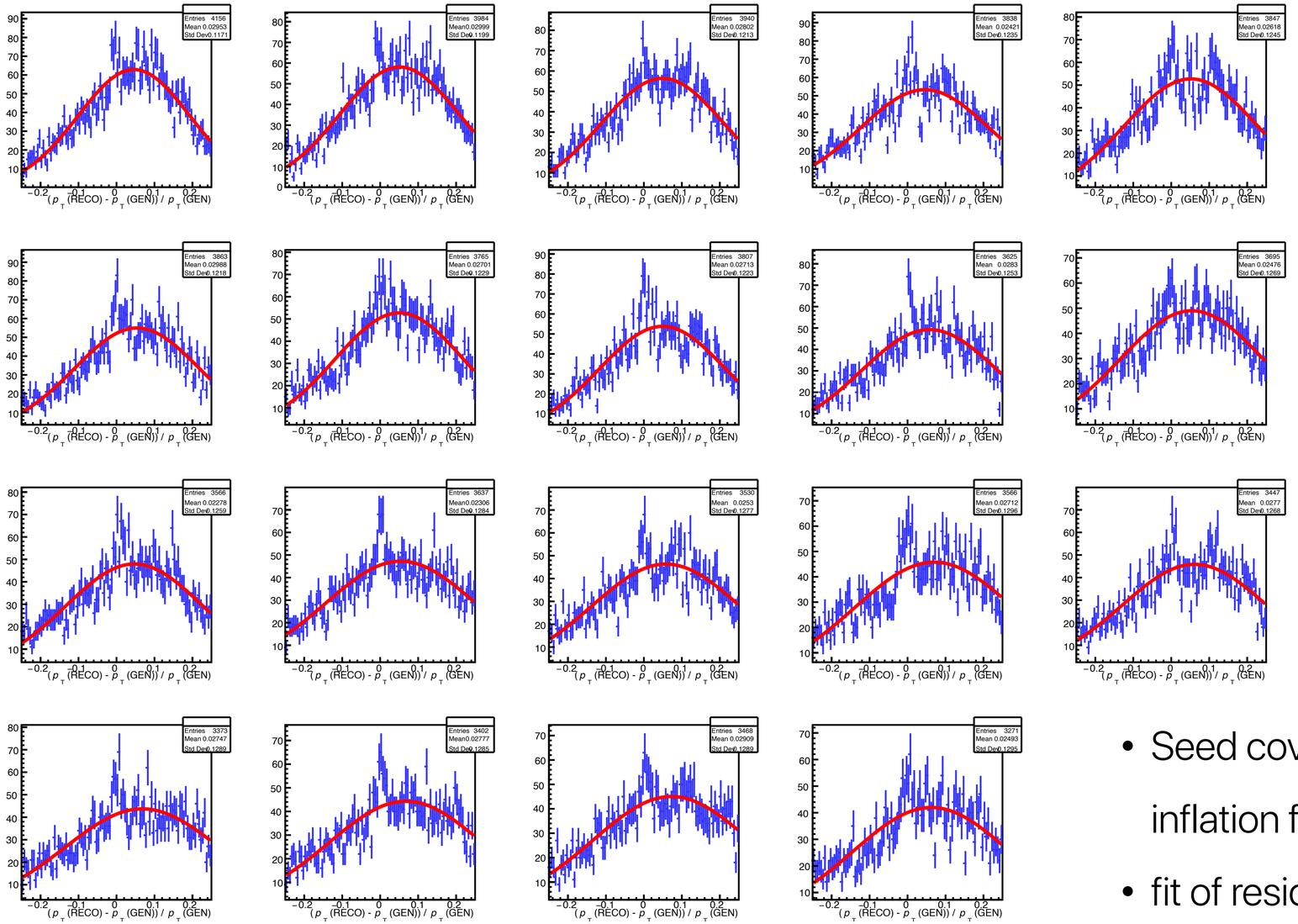
Seed covariance matrix inflation factor 5000

Momentum resolution



- Seed covariance matrix inflation factor 5000
- fit of residuals
- η = 3.1

Momentum resolution



- Seed covariance matrix inflation factor 5000
- fit of residuals
- η = 3.7

Pulls of the simulations used to produce the p_T resolution plot

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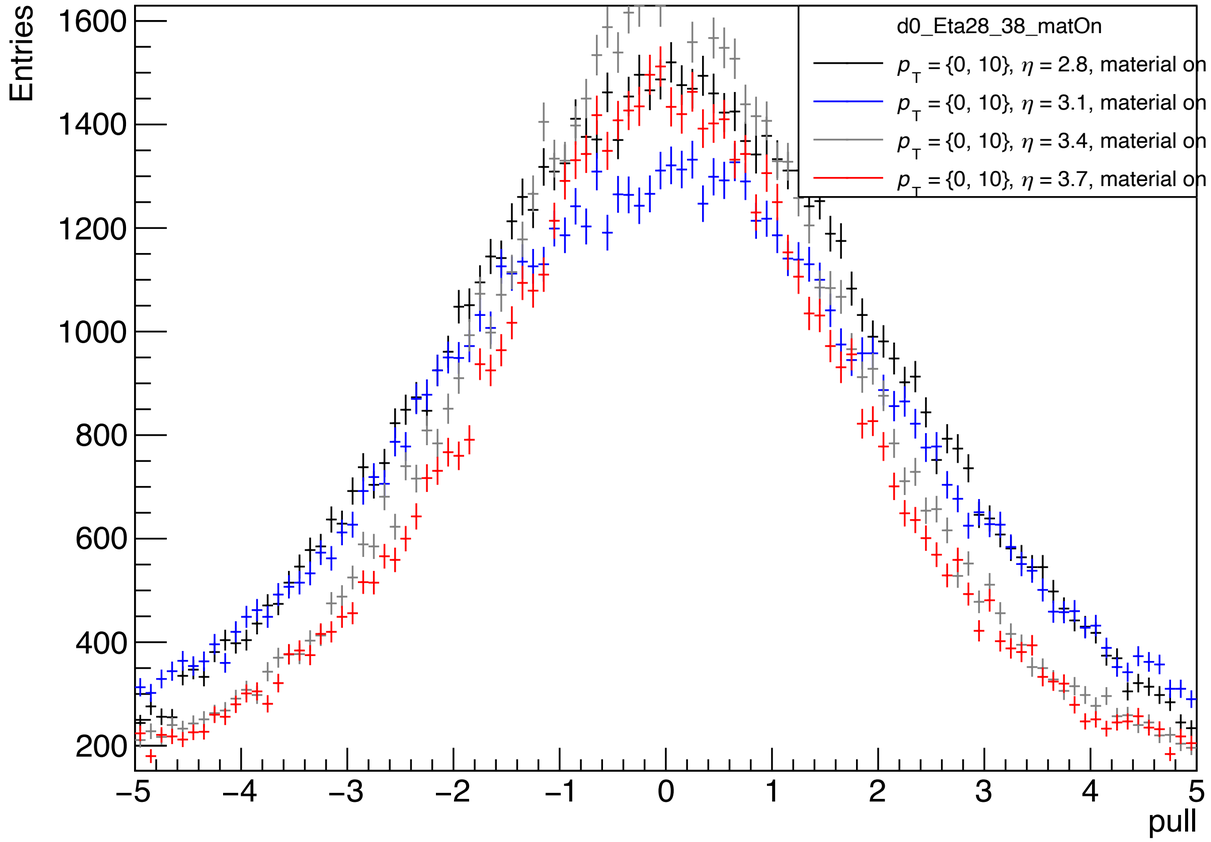
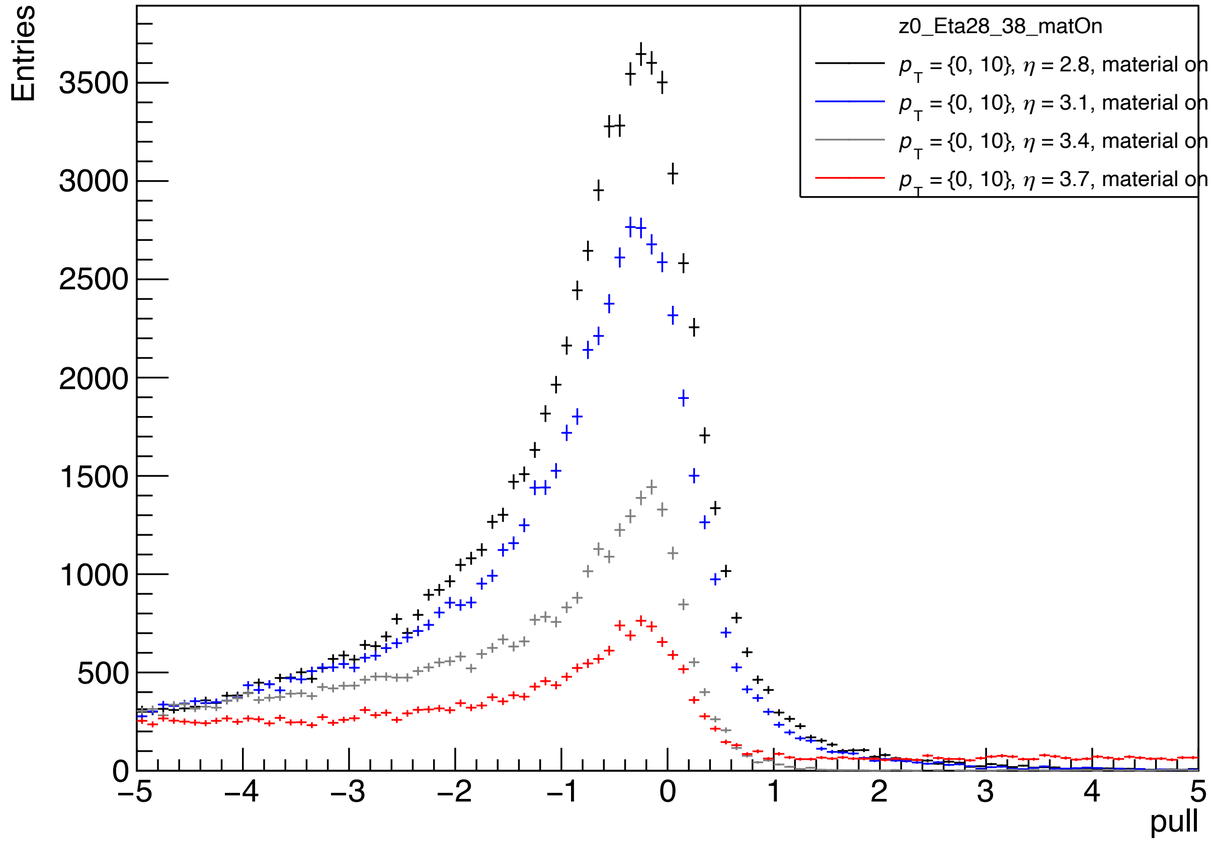
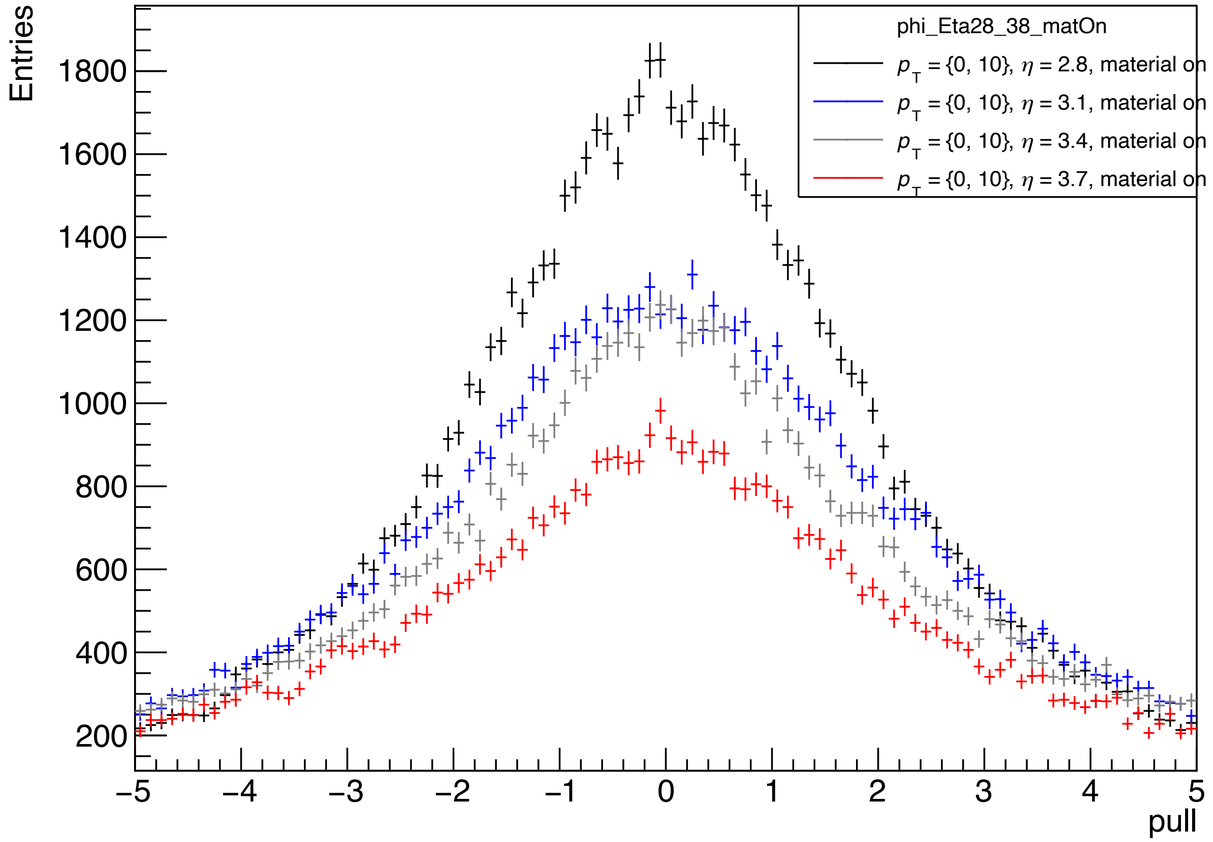


d0

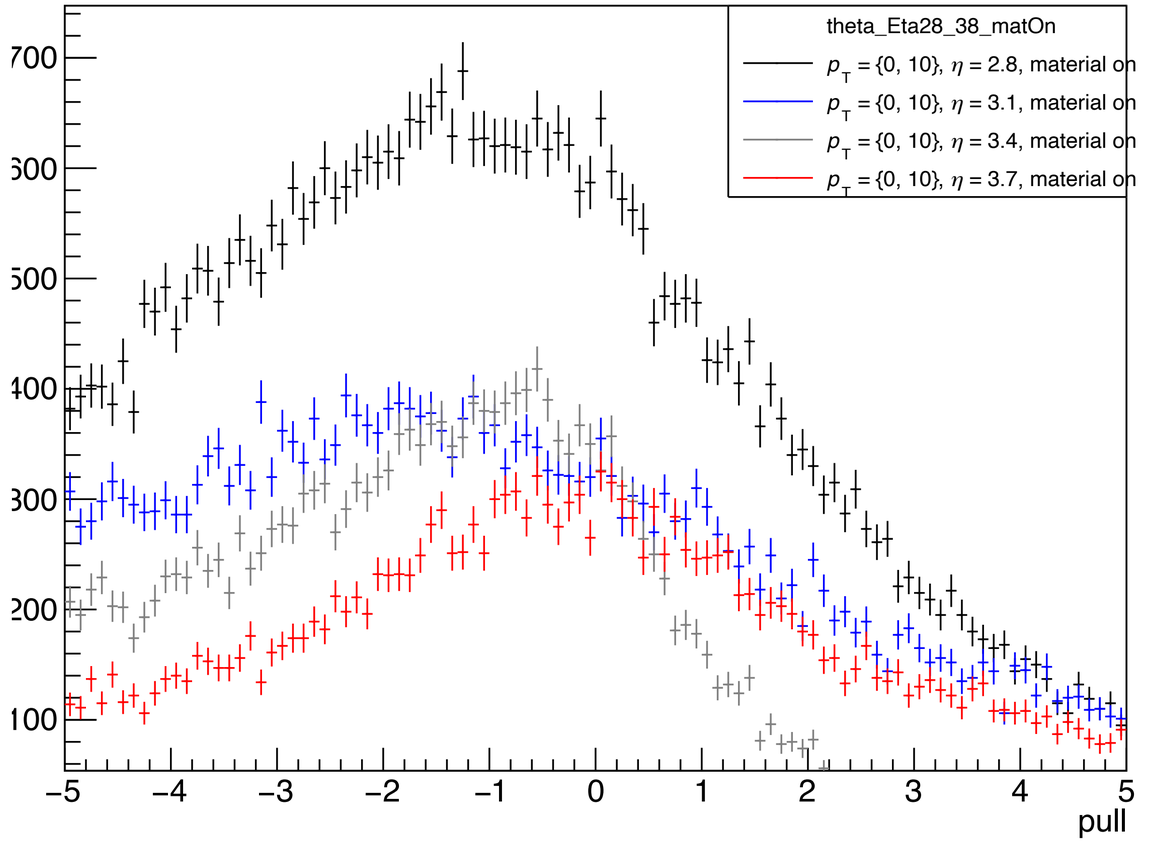


z0

Pulls of the simulations used to produce the p_T resolution plot

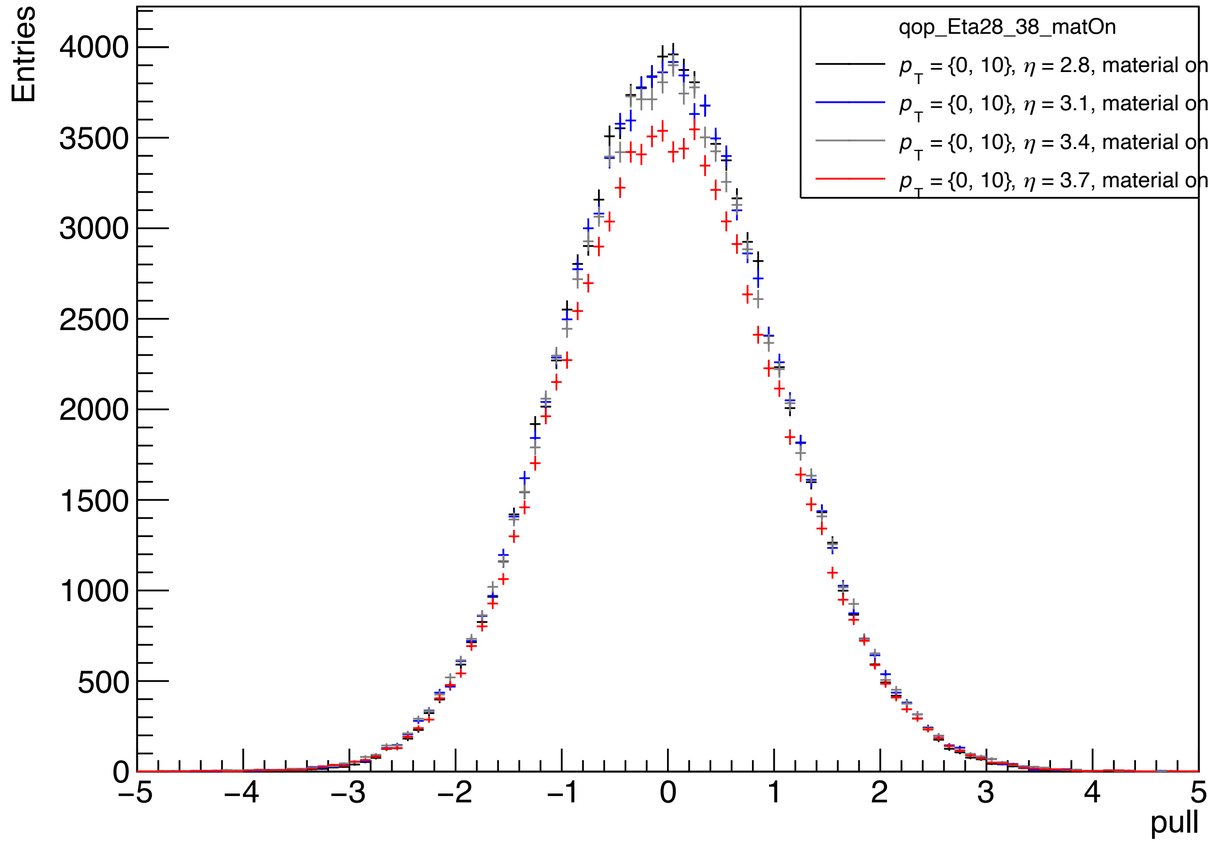


ϕ



θ

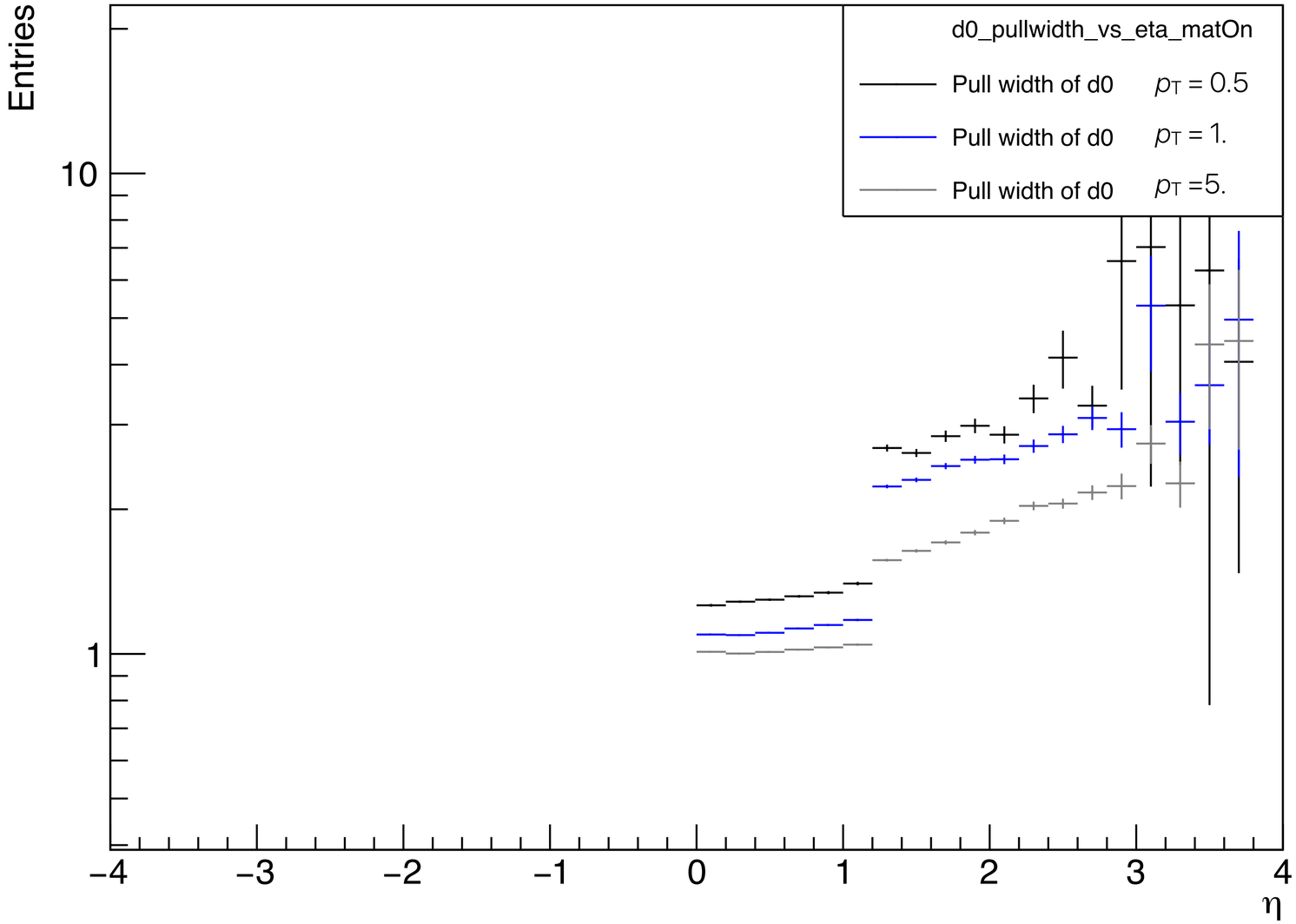
Pulls of the simulations used to produce the p_T resolution plot



q/p

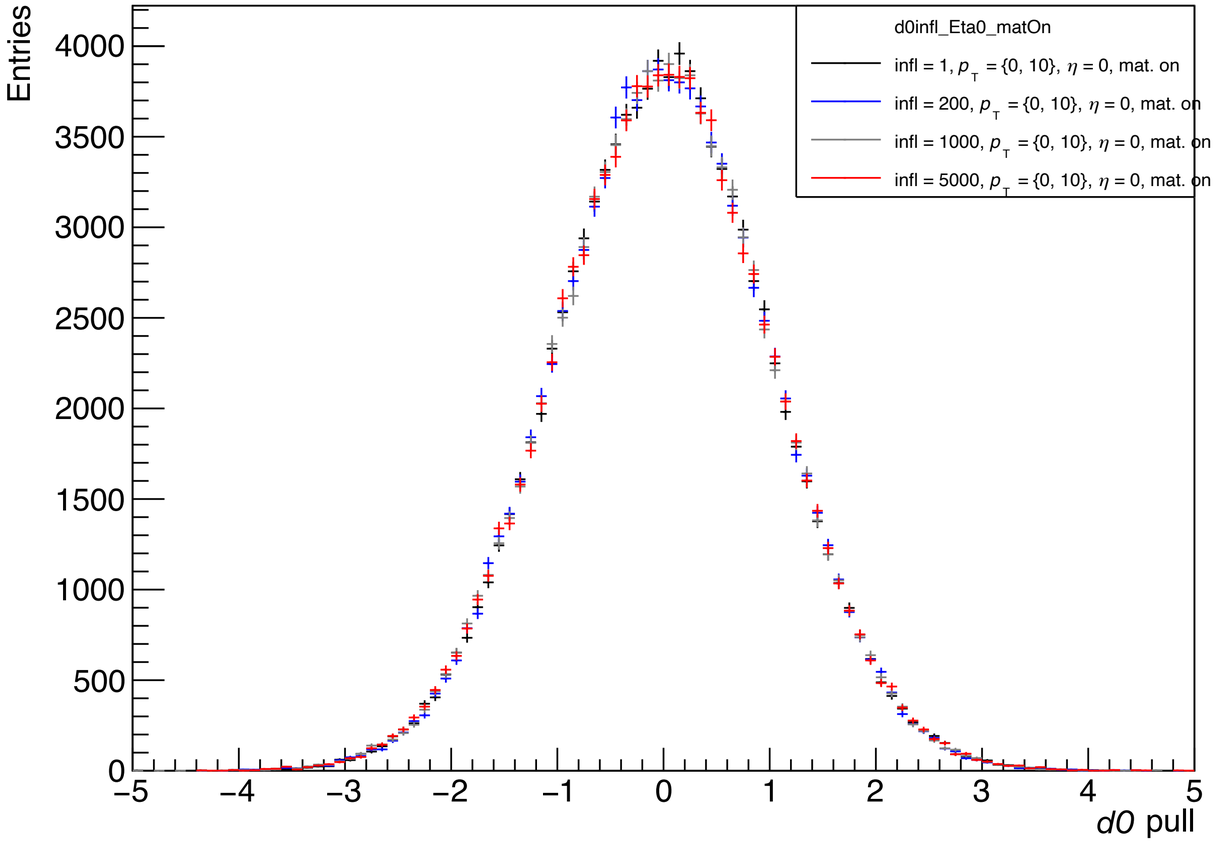
Pulls of the simulations used to produce the *d0* resolution plot

Pull width of the simulations used to produce the p_T resolution plot

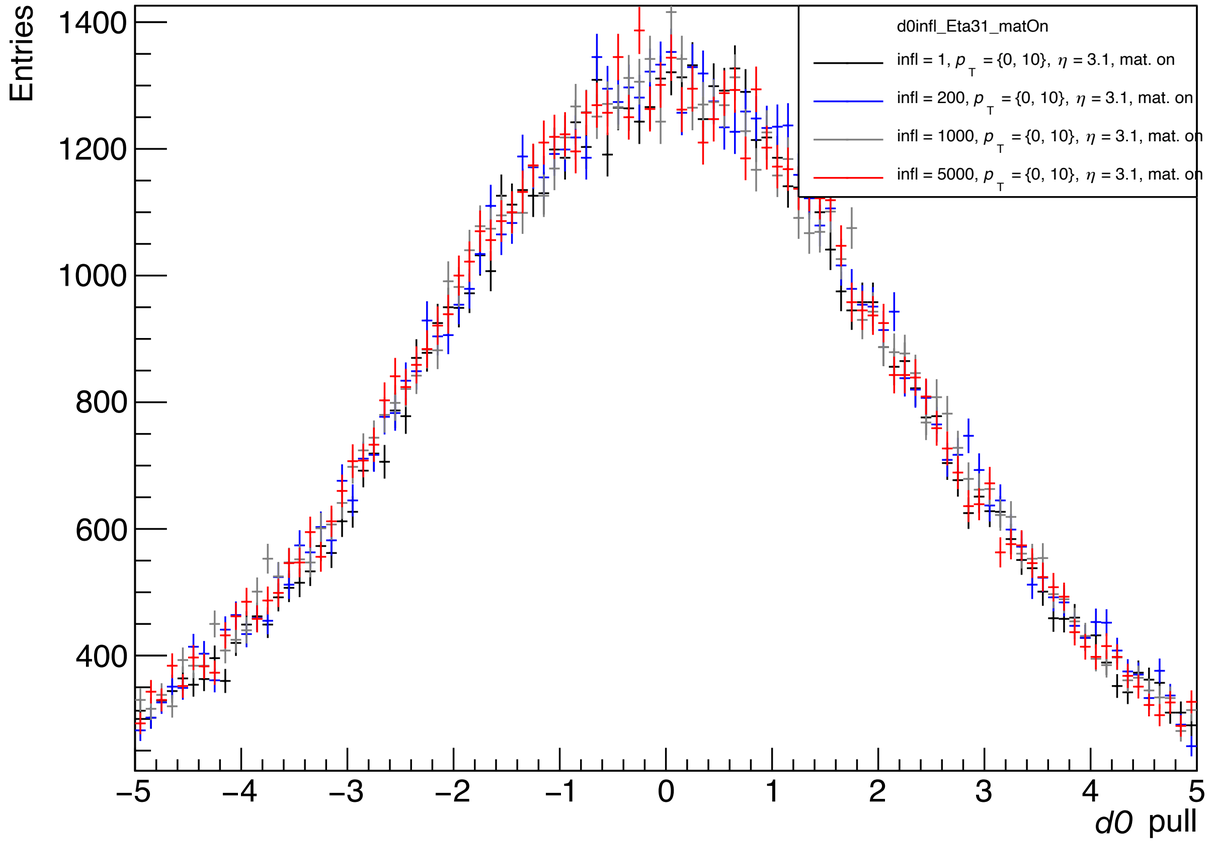


Pulls for different covariance matrix inflation factor

Pulls for different covariance matrix inflation factor : *d0*

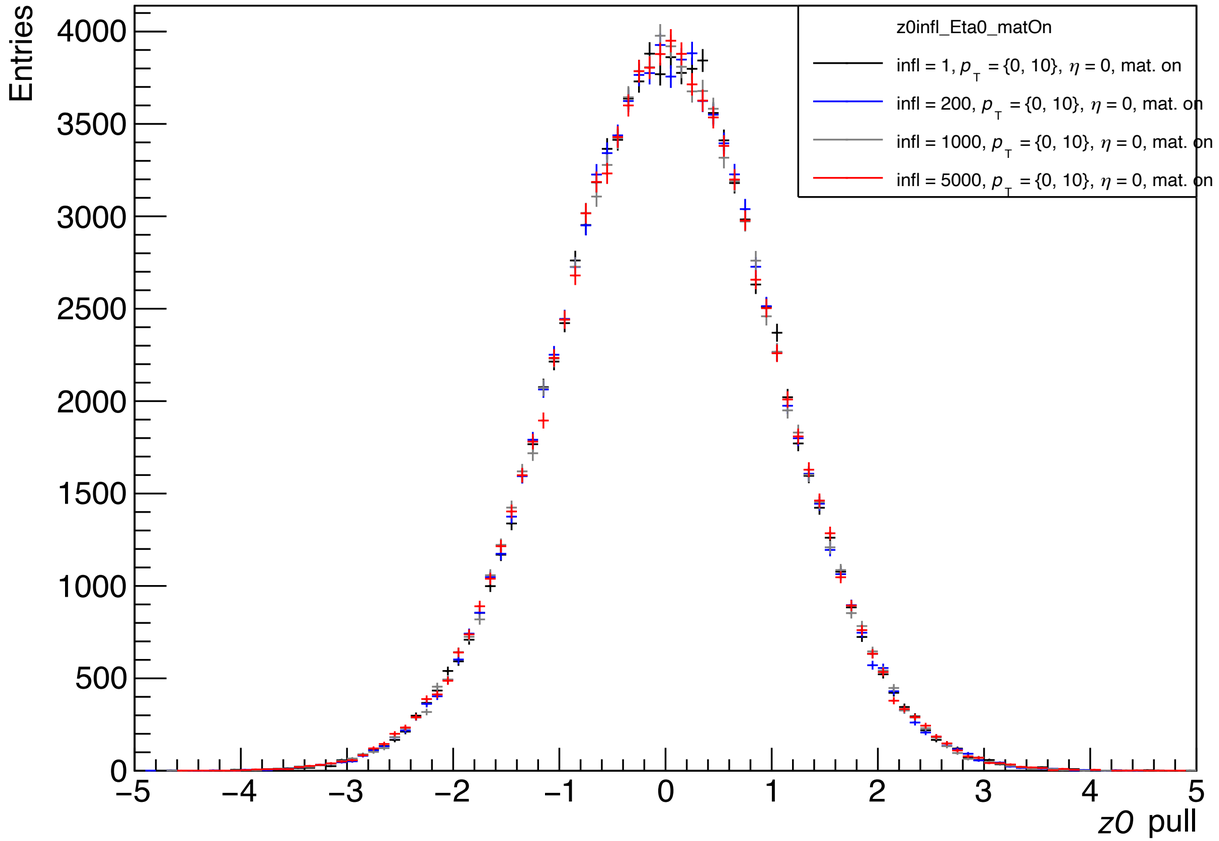


η = 0

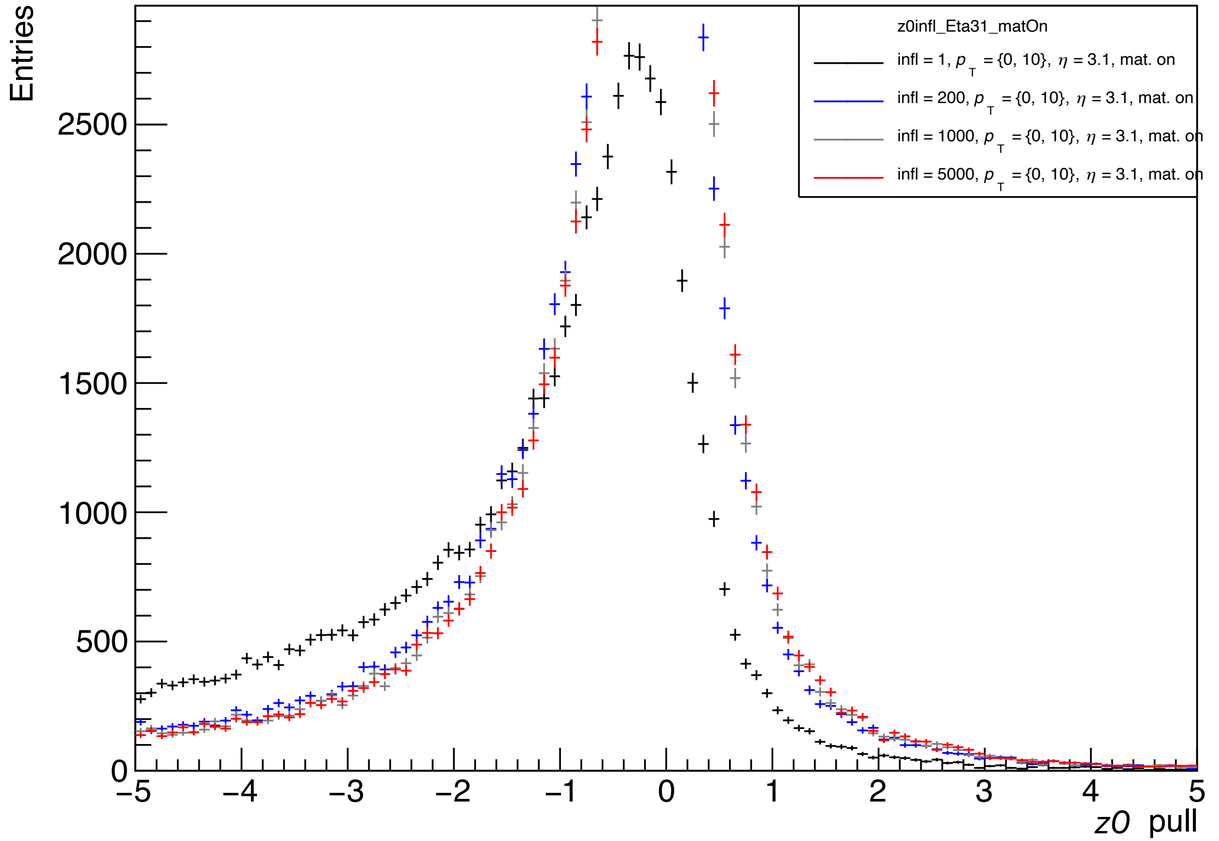


η = 3.1

Pulls for different covariance matrix inflation factor: *z0*

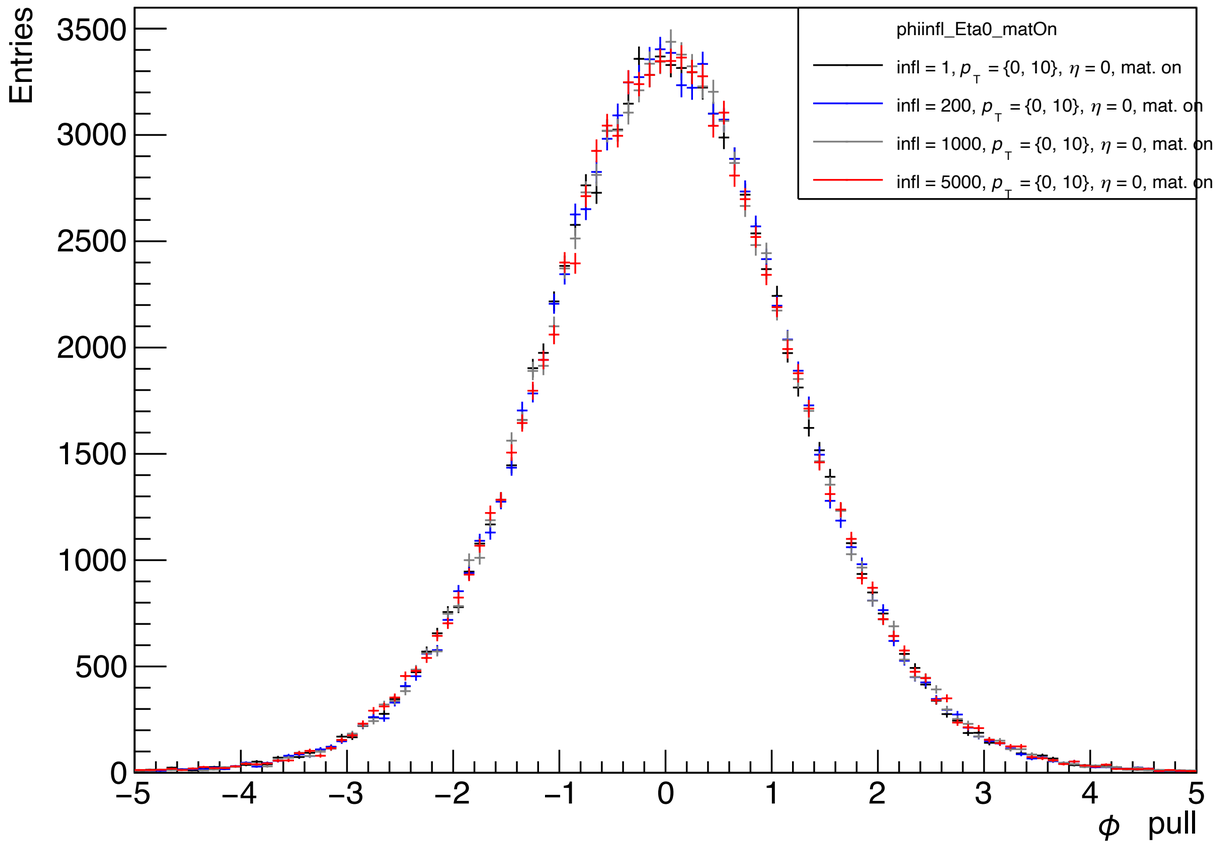


η = 0

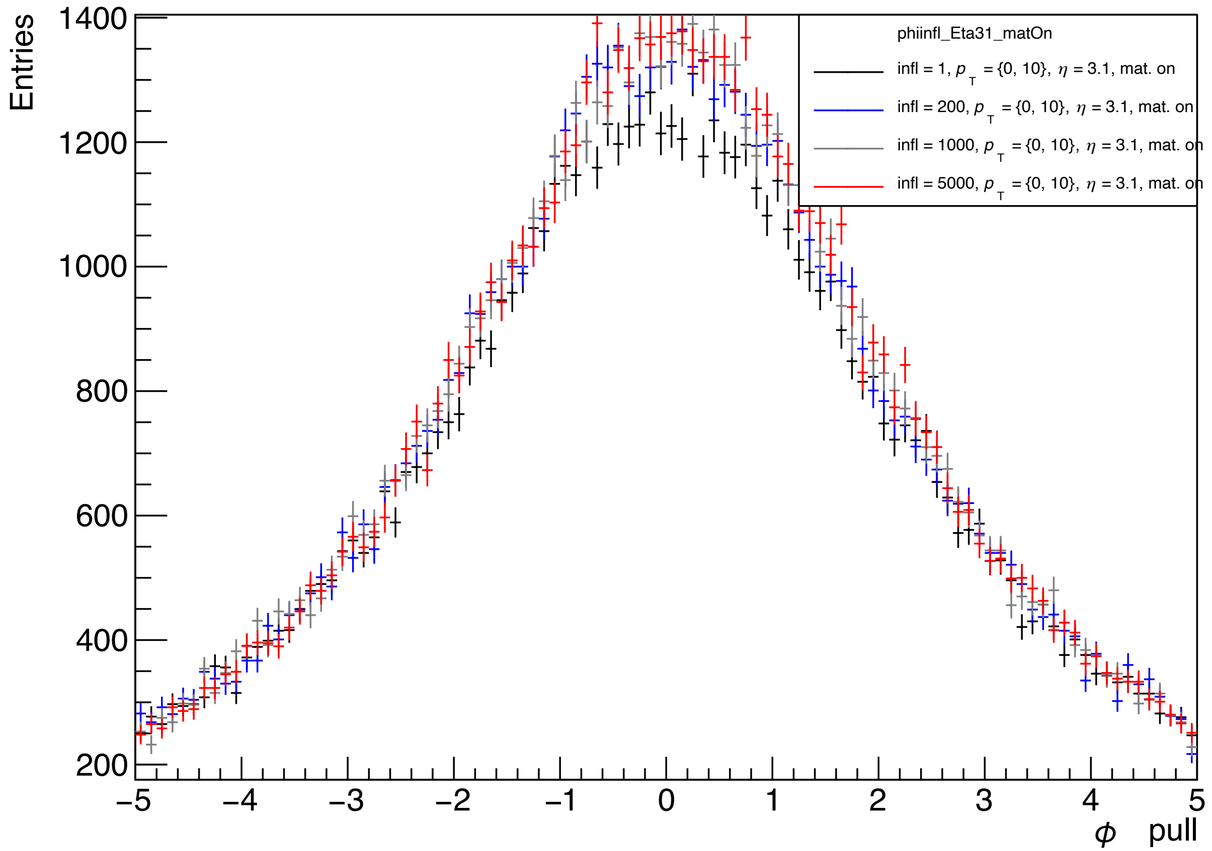


η = 3.1

Pulls for different covariance matrix inflation factor: ϕ

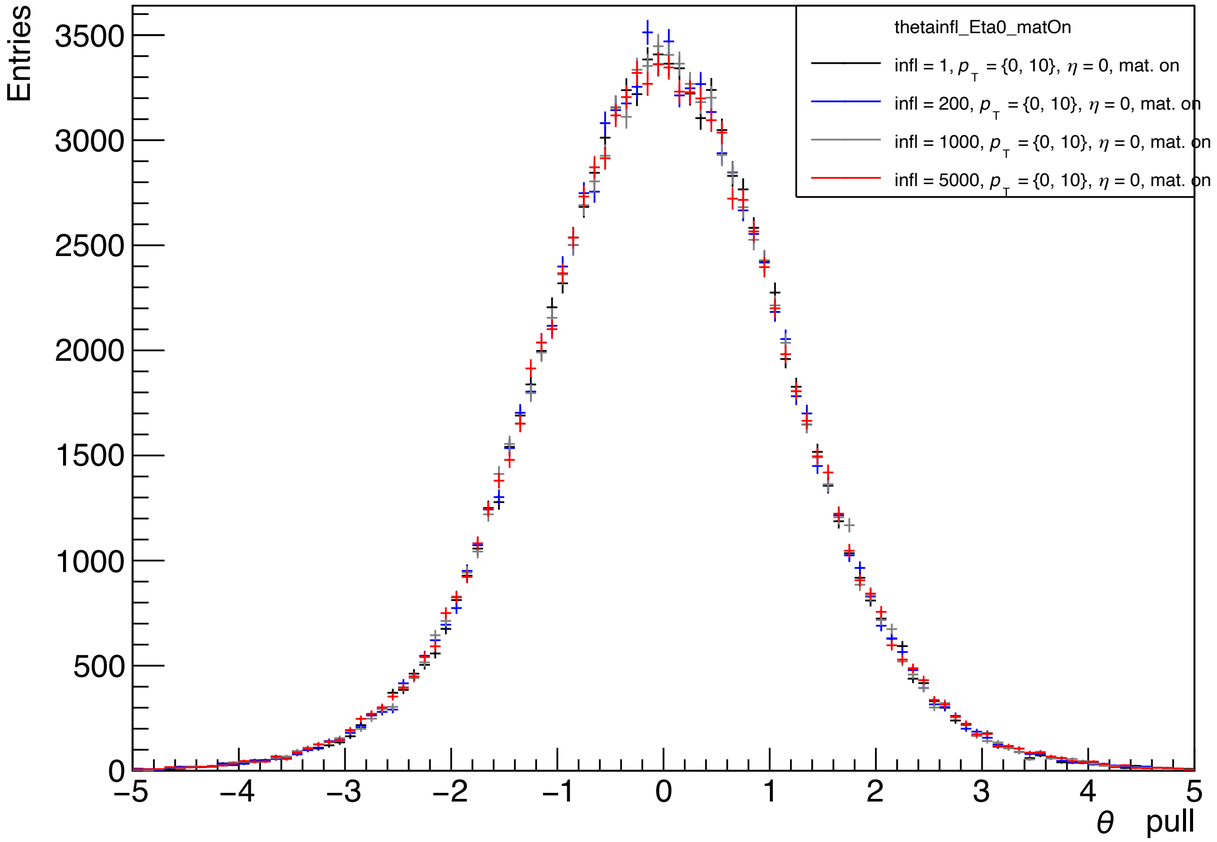


η = 0

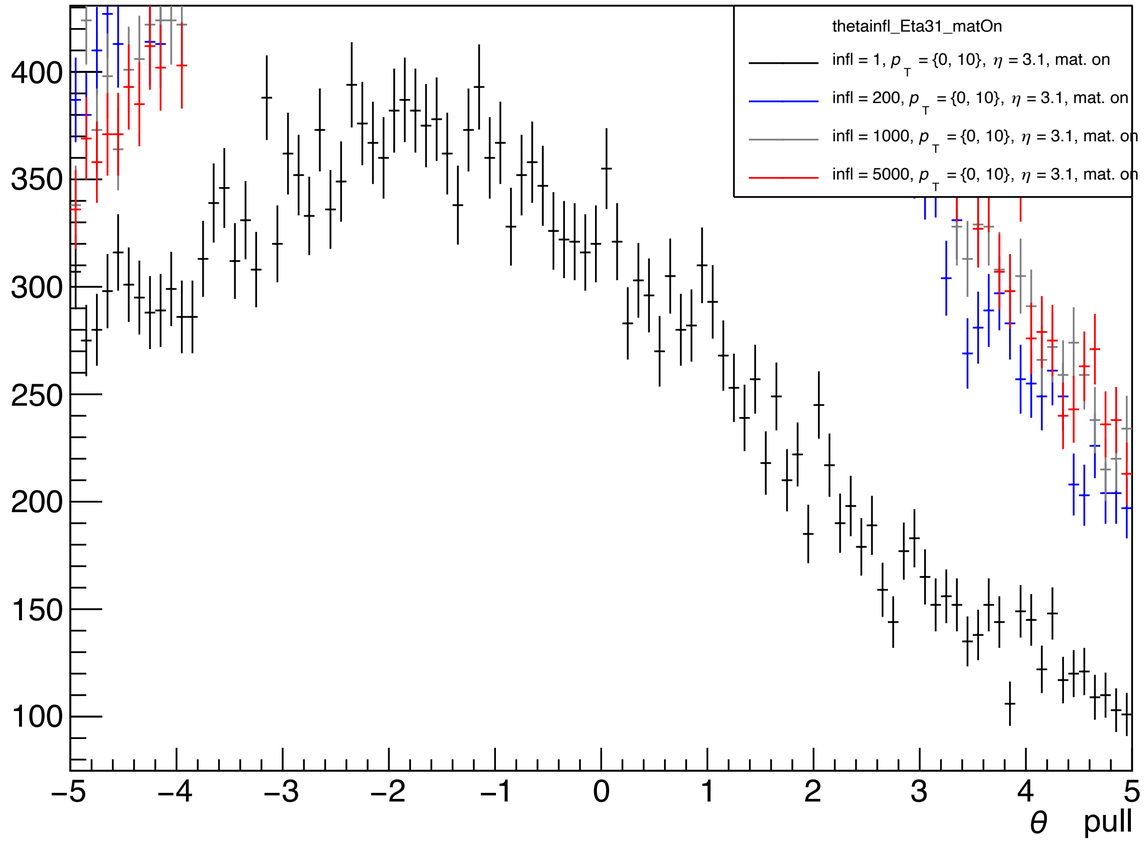


η = 3.1

Pulls for different covariance matrix inflation factor: θ

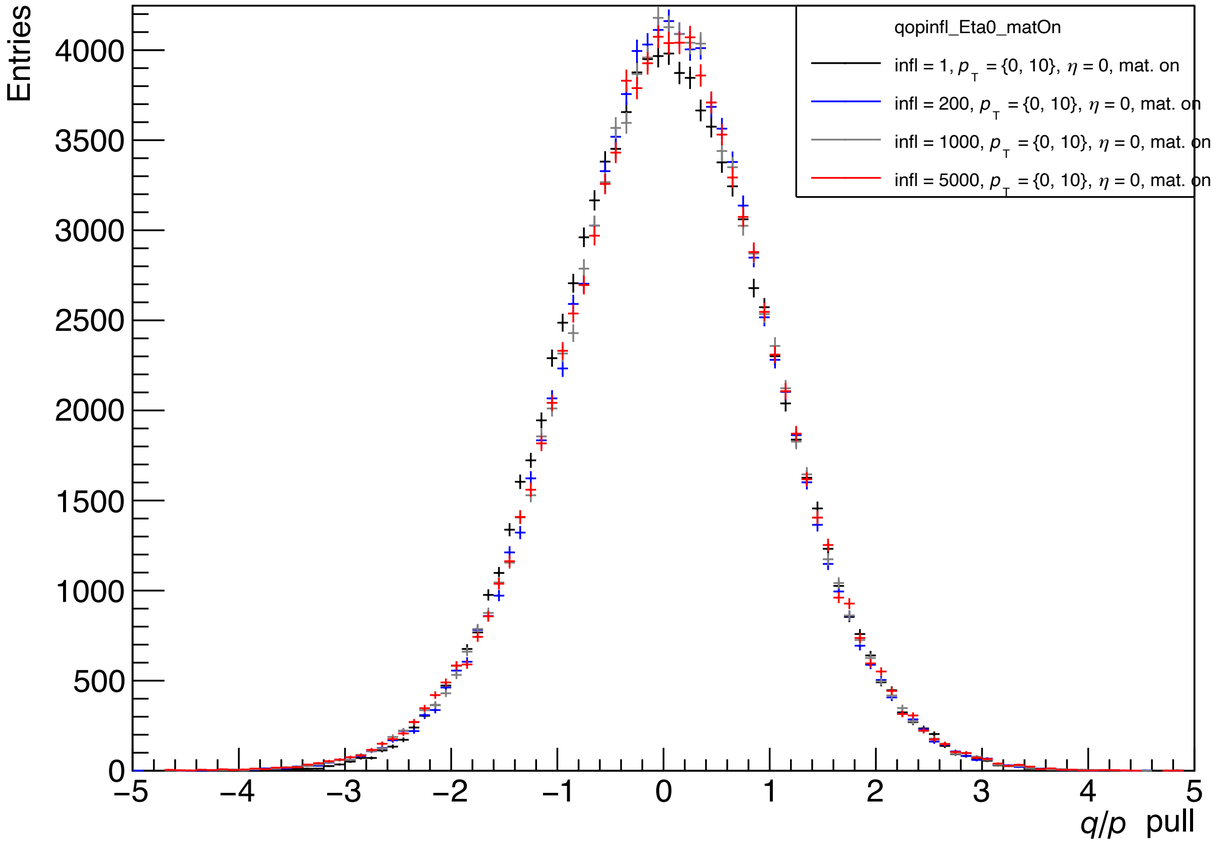


η = 0

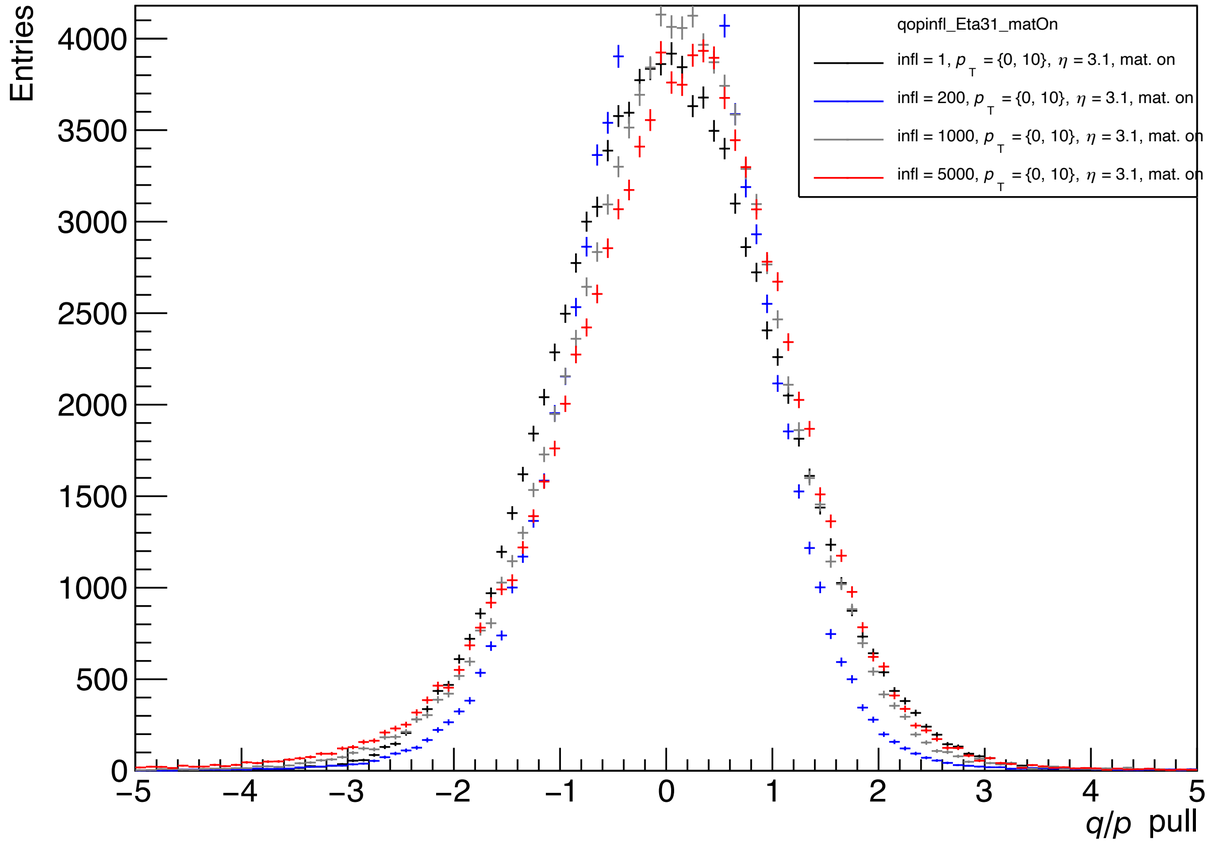


η = 3.1

Pulls for different covariance matrix inflation factor: *q/p*

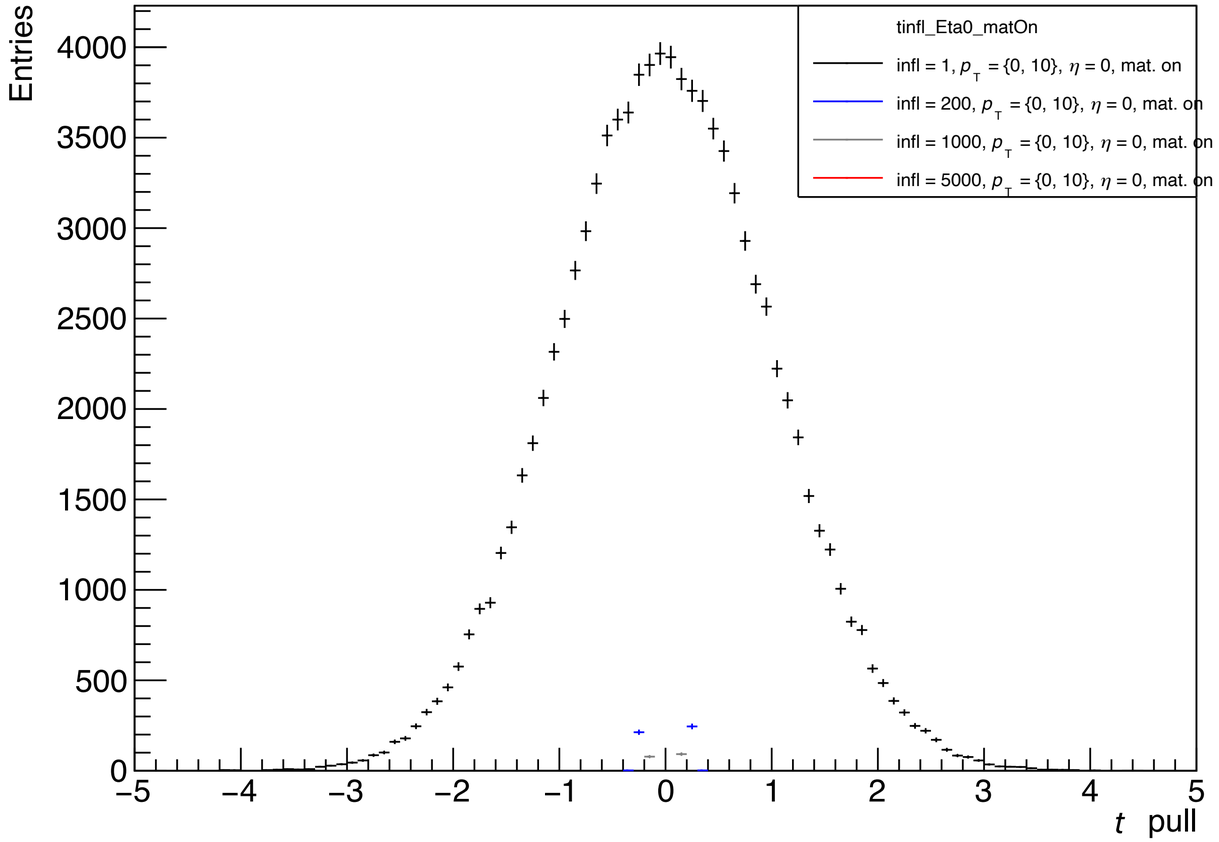


$\eta = 0$

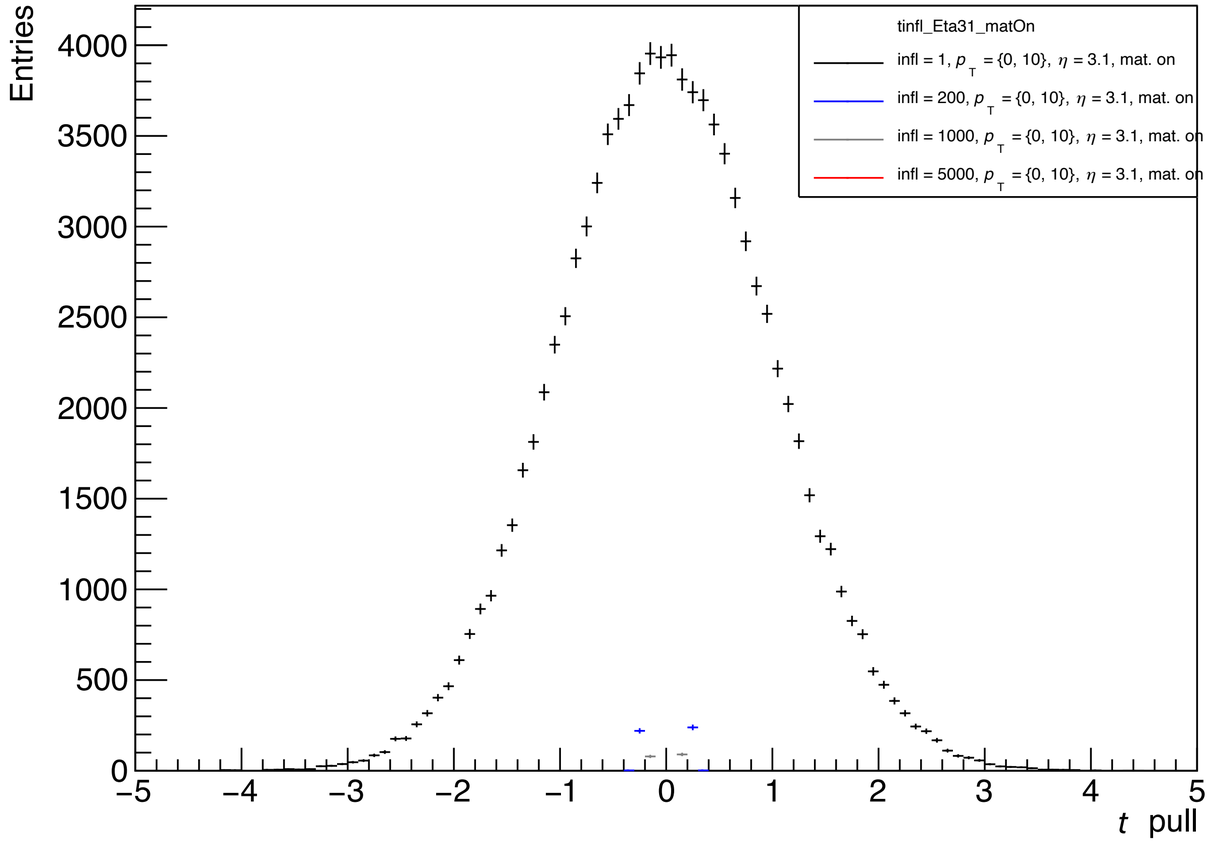


$\eta = 3.1$

Pulls for different covariance matrix inflation factor: *t*



$\eta = 0$

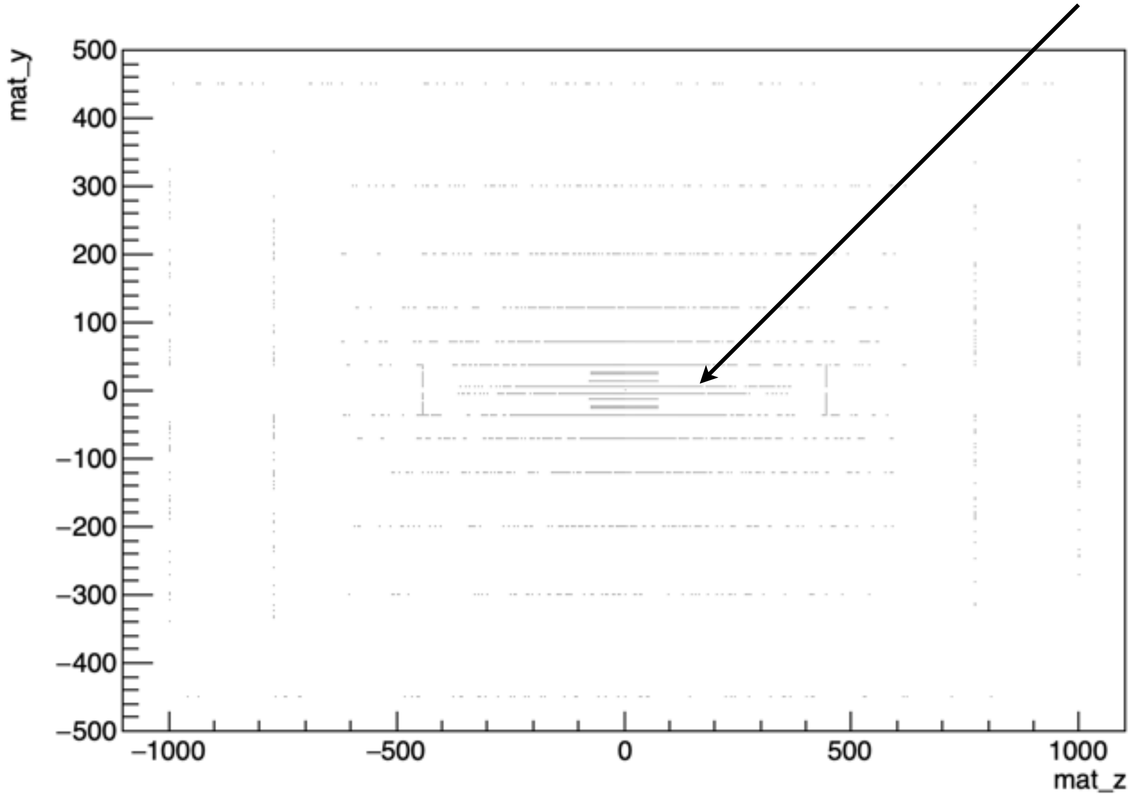


$\eta = 3.1$

Issue with TGeo -> GDML convertion

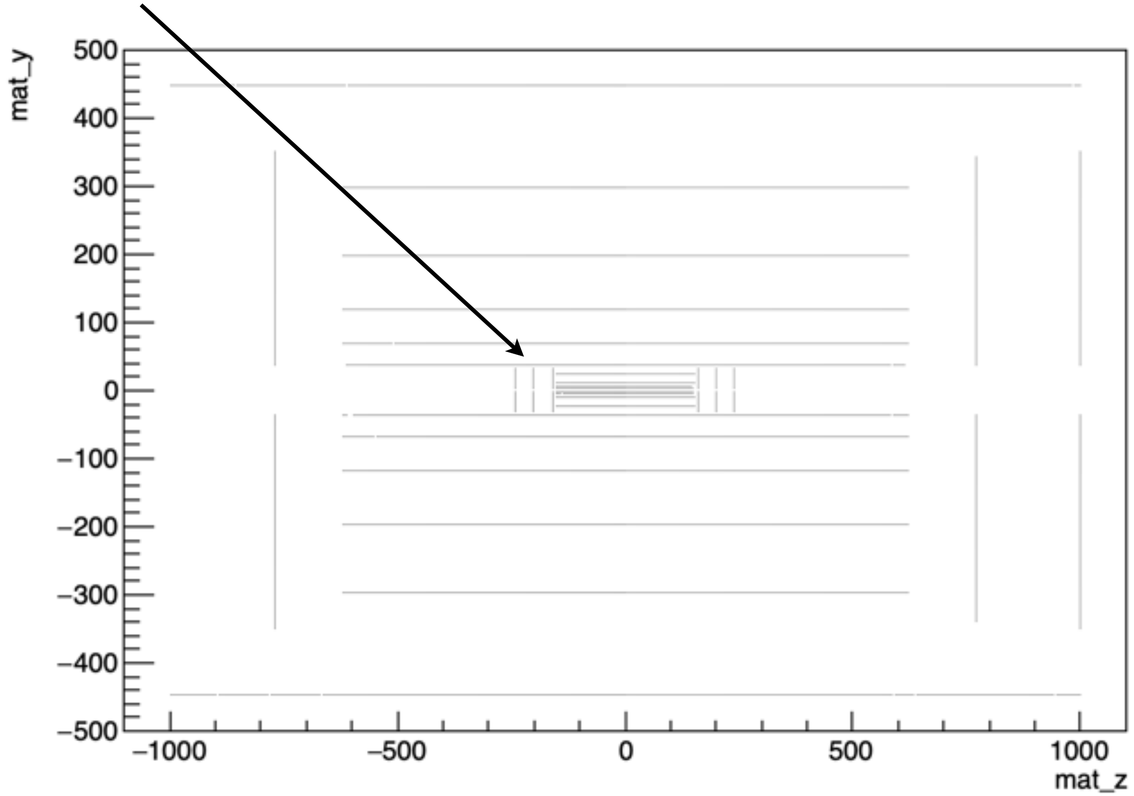
Issue with TGeo -> GDML convertion

Inner discs are missing



Geantino scan

Uses GDML input

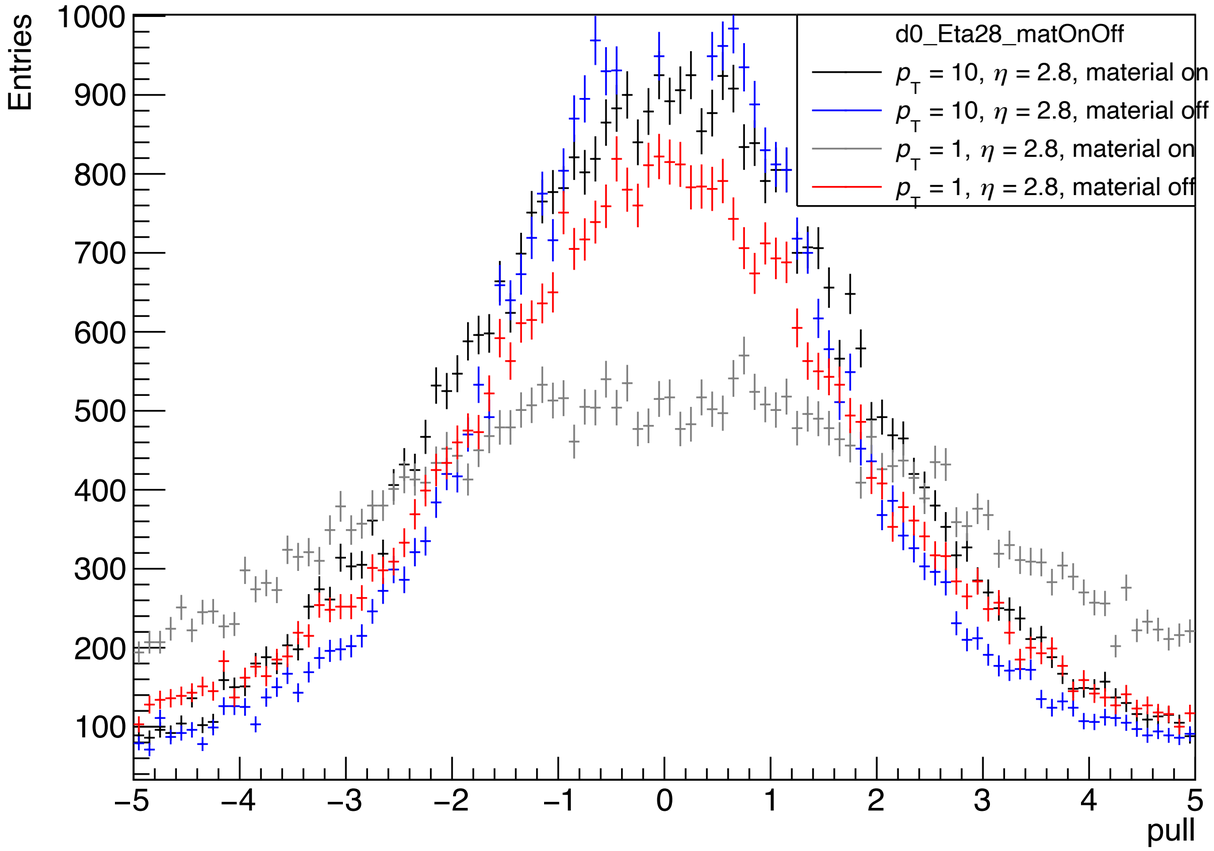


TGeo layout on which

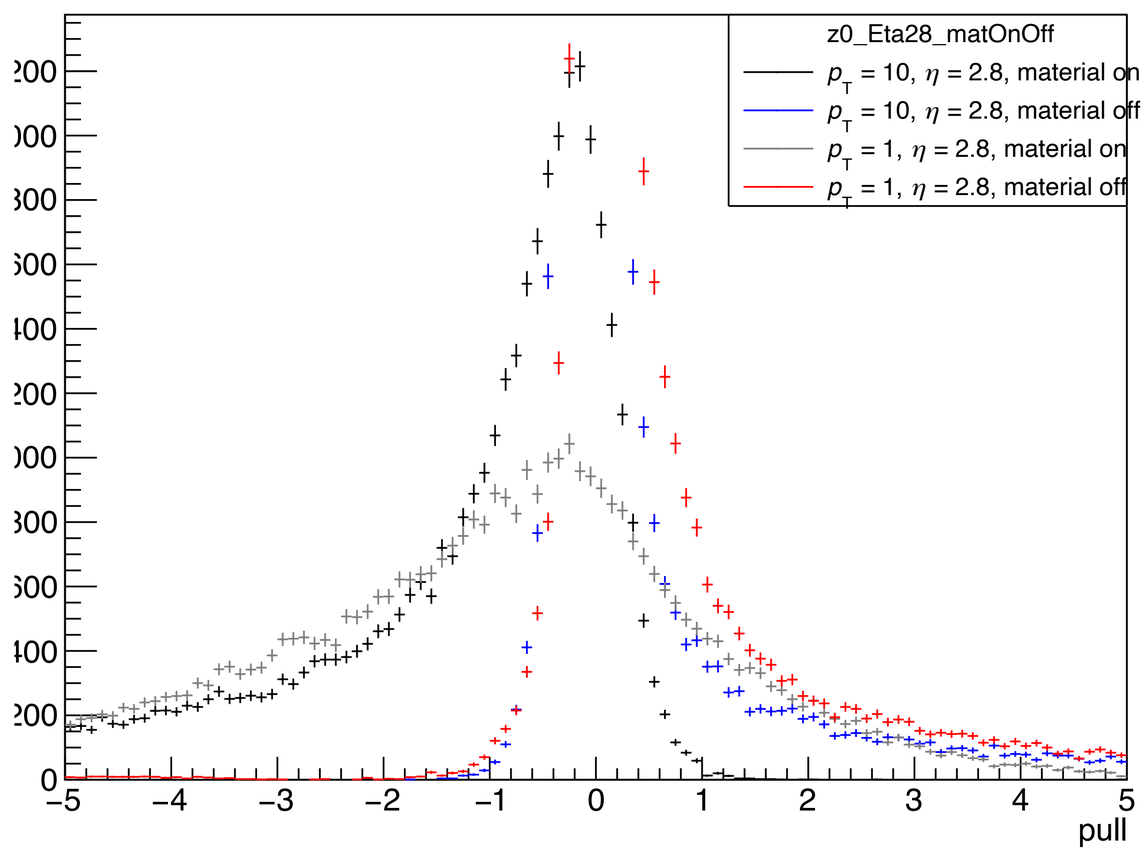
the material is mapped

Pulls fixed eta low and high p_T, material on/off

Pulls fixed eta low and high p_T

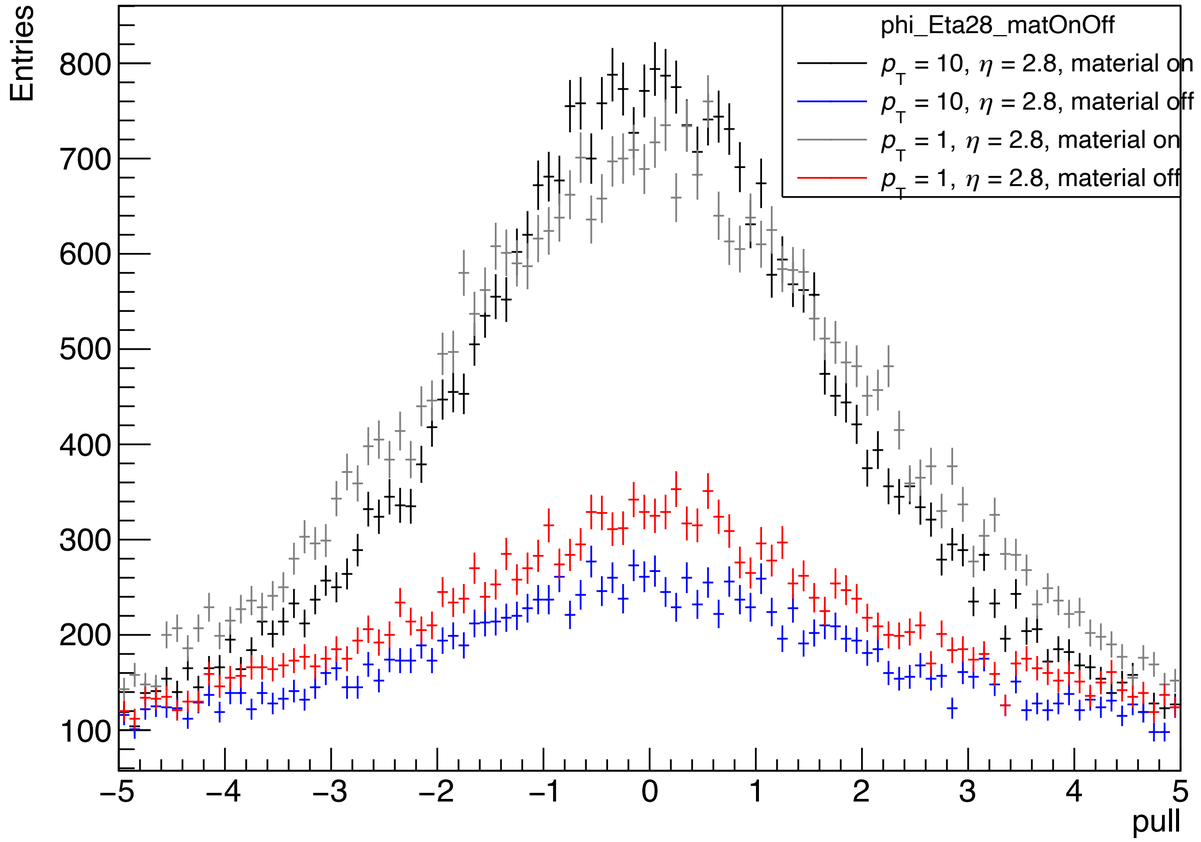


d0

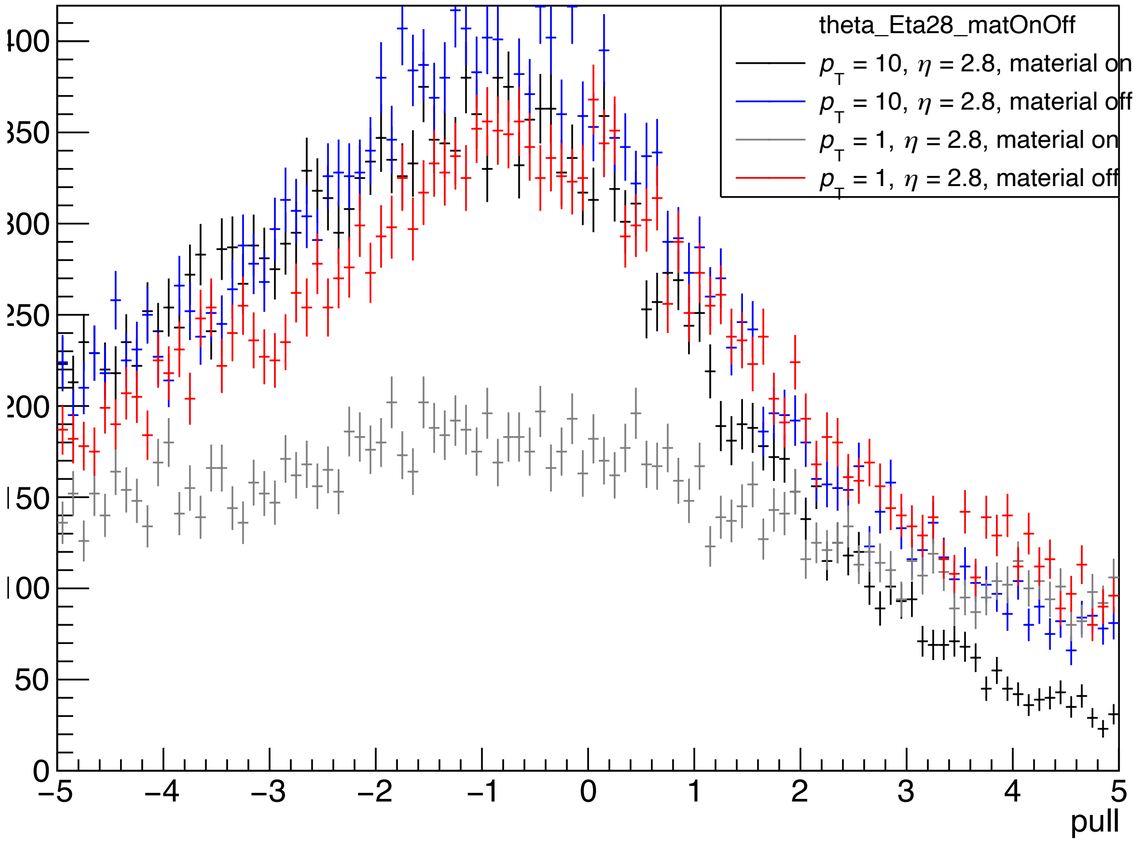


z0

Pulls fixed eta low and high p_T

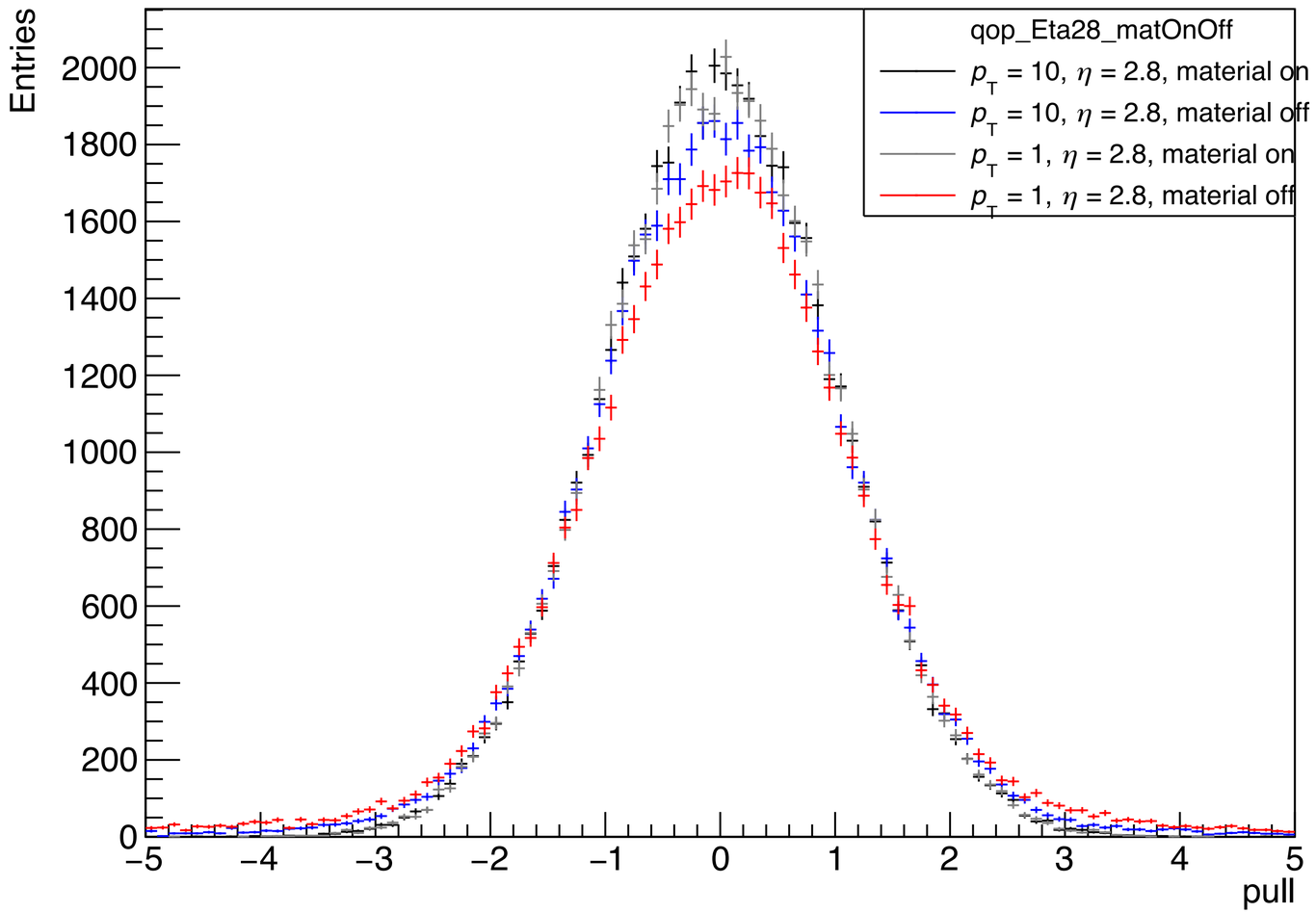


ϕ



θ

Pulls fixed eta low and high p_T



q/p

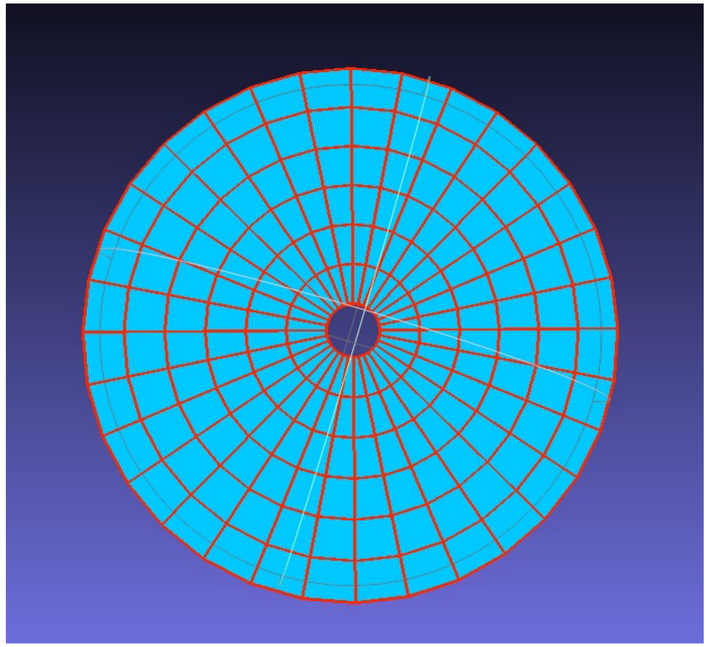
Summary / main questions

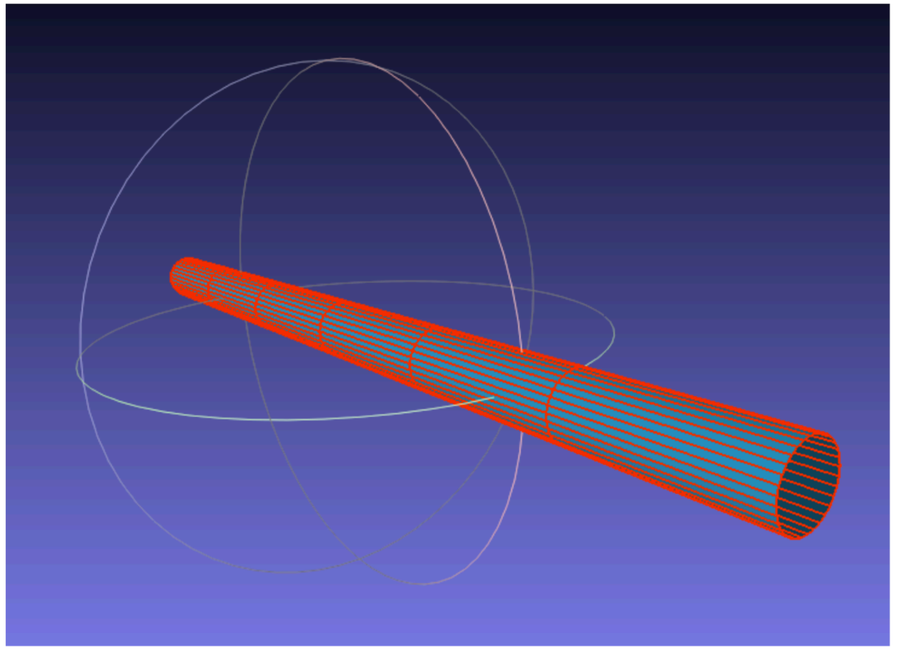
1. Many thanks to A. Salzburger, C. Allaire, X. Ai and the mattermost channel
2. With the current pulls at $2.8 < \eta < 3.8$ can we trust the performance?
3. Momentum resolution sensitivity on inflation factor
4. Inflation factor: some parameters sensitive, some not
5. Large inflation factor -> shifted residuals
6. Can we trust the *d0* resolution at large η if the pulls aren't good?
7. Pull degradation after including material mapping
8. Issues with material mapping: if some sufraces weren't present during Geantino, how it affects the performance

Backup

Disc splitting

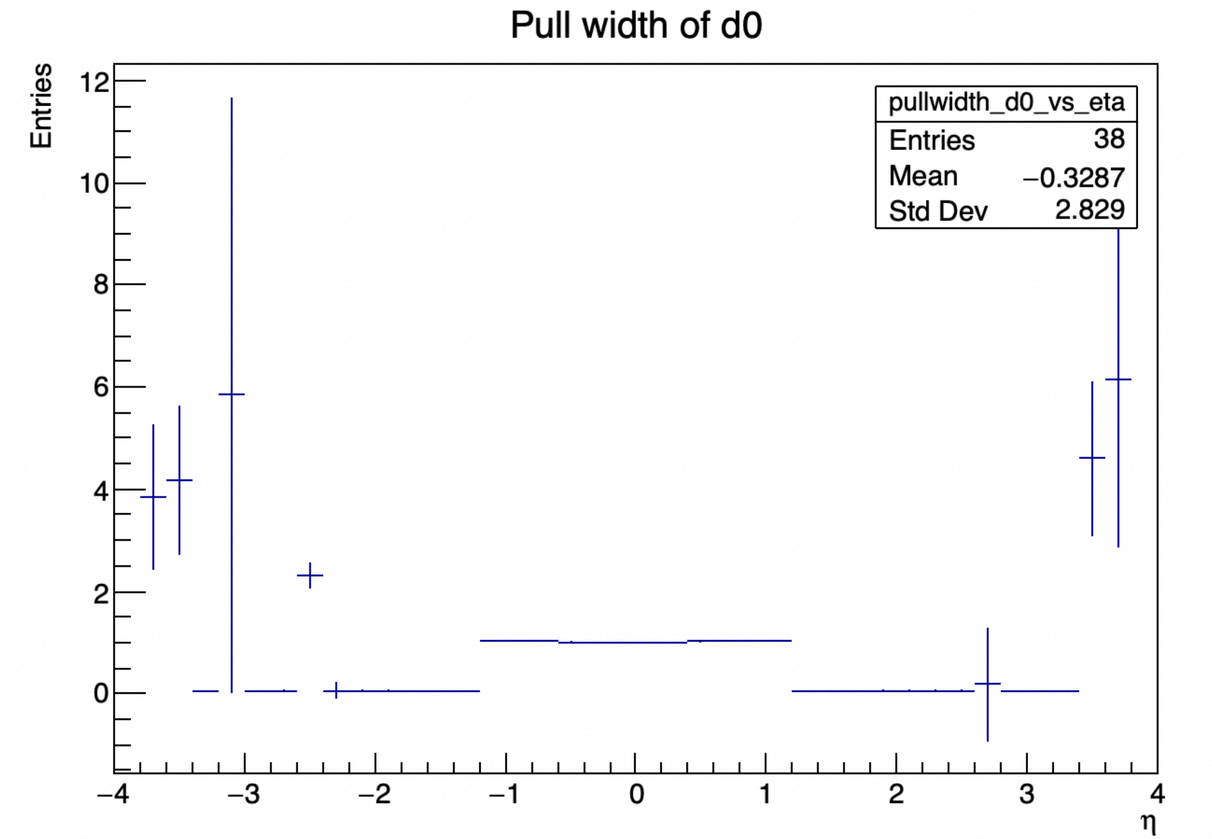
1. In the current ALICE3 geometry the endcaps are planar discs with no segmentation
2. ACTS interprets them as disc surfaces which automatically assigns spherical coordinates
3. When doing the smearing, it is done using the coordinates assigned ⇾ smearing in r and ϕ
4. Solution by ACTS experts to introduce disc element splitting in the ACTS geometry builder module ⇾ plane surfaces with trapezoid bounds



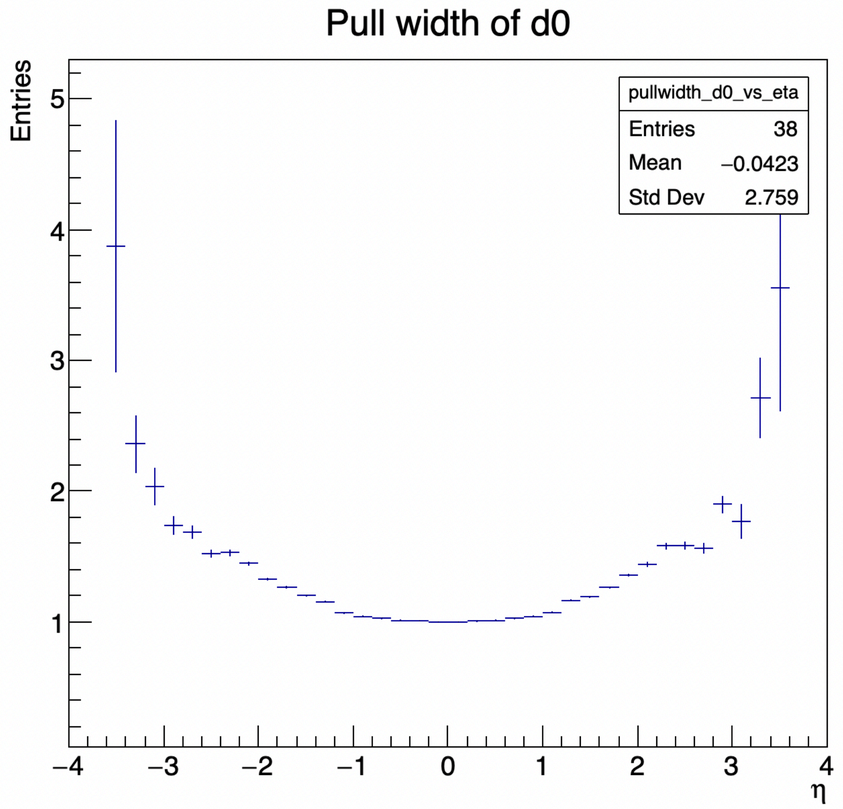


From PR#873

Current situation

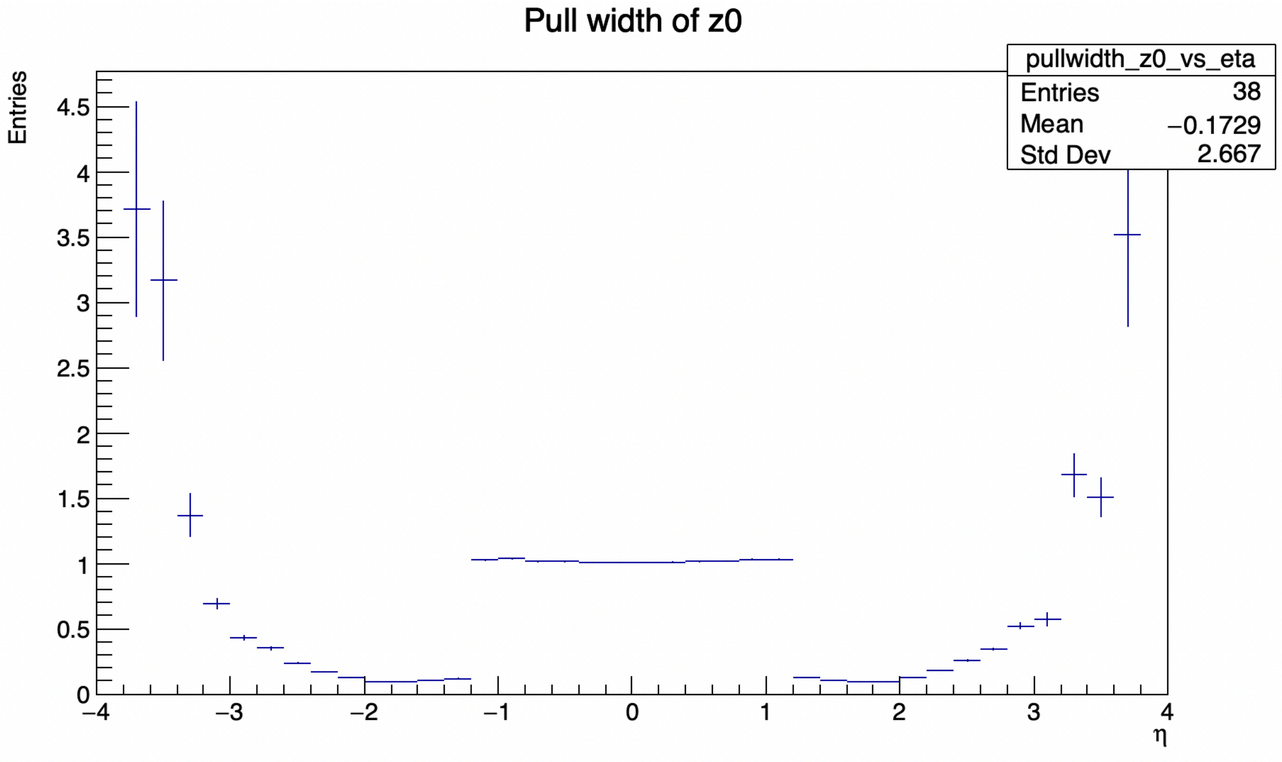


Before

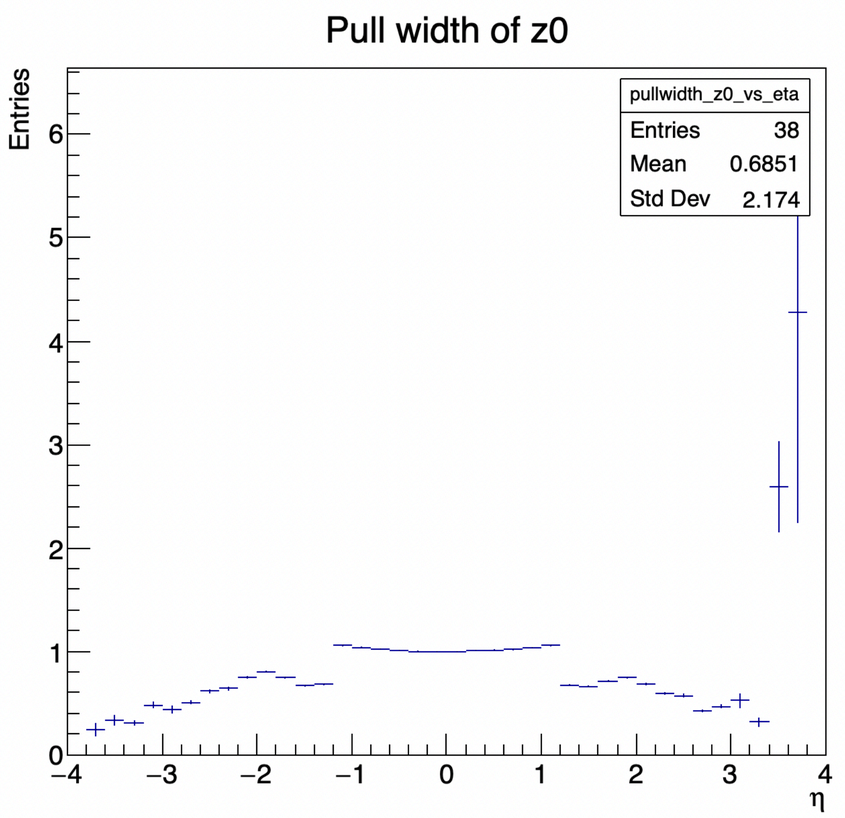


After

Current situation



Before



After