# Track refitting with Acts in Athena

Corentin Allaire
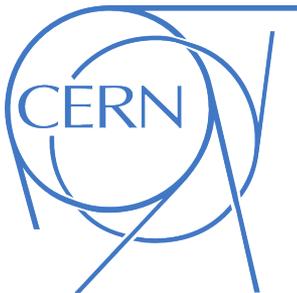
Introduction

- The Acts track fitting is being included into Athena (ATLAS software)

- For now due to the lack of digitisation we tested the fitting by refitting ATLAS tracks

- We use ATLAS track as input :
  - Extract the measurement from them
  - Convert them into Acts source link
  - Use the fitted track perigee parameter as initial parameter for the fitter

- Since the ATLAS tracks are validated against the truth track we can use them as reference

- The plots I will show are with 1000 ttbar events

Parameters comparison

- Comparison of the track parameters for Atlas and Acts

- Good agreement between the two

- Some small difference are observed which is expected.

$reco_{d_0}$

Entries : 1743	
Resolved	
Mean : 0.000738	
Std Dev : 0.976140	
Refitted	
Mean : 0.007626	
Std Dev : 1.033885	

$reco_{q/p}$

Entries : 1743	
Resolved	
Mean : 0.000010	
Std Dev : 0.000656	
Refitted	
Mean : 0.000013	
Std Dev : 0.000654	

$reco_{z_0}$

|	
Entries : 1743	
Resolved	
Mean : -7.185610	
Std Dev : 41.316364	
Refitted	
Mean : -7.083600	
Std Dev : 42.210802	
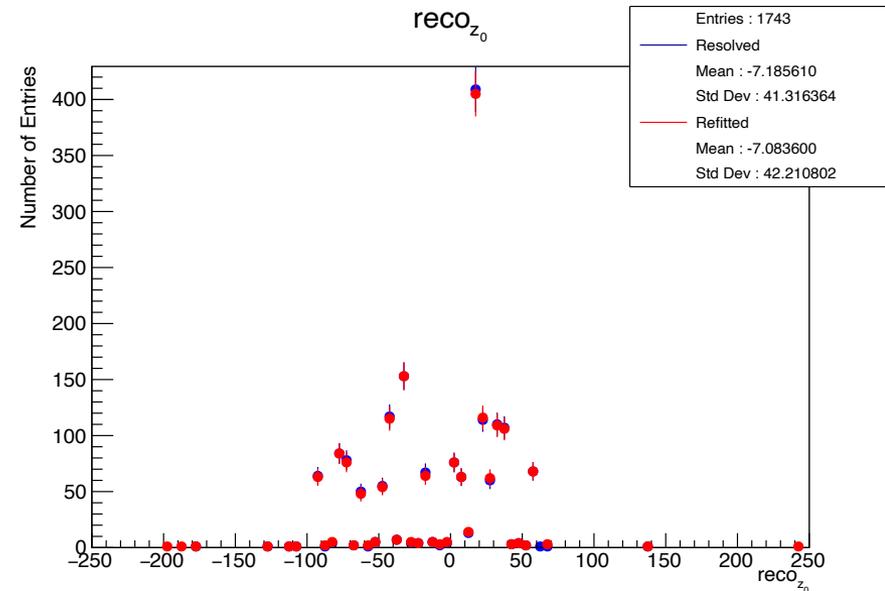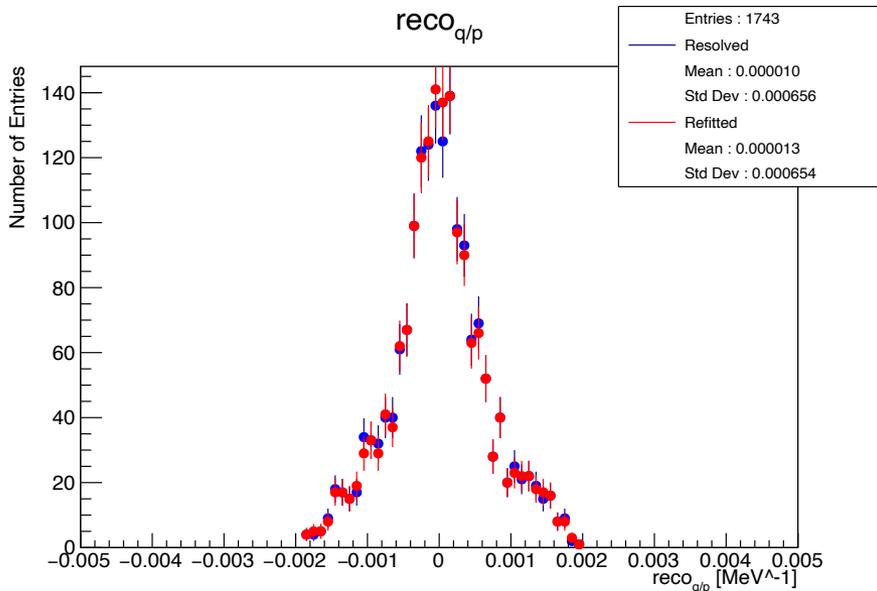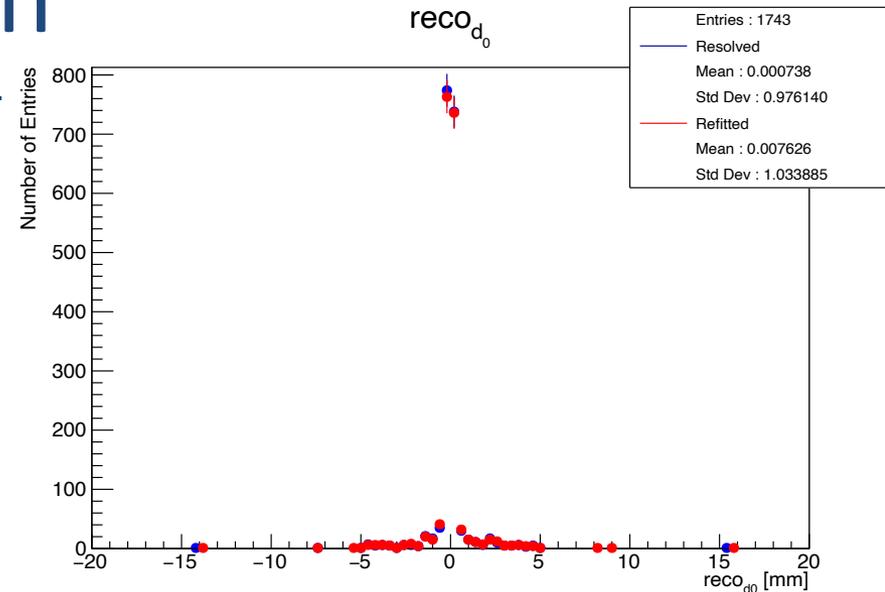
Parameters comparison

- Same comparison for phi and theta

- Similar agreement observed

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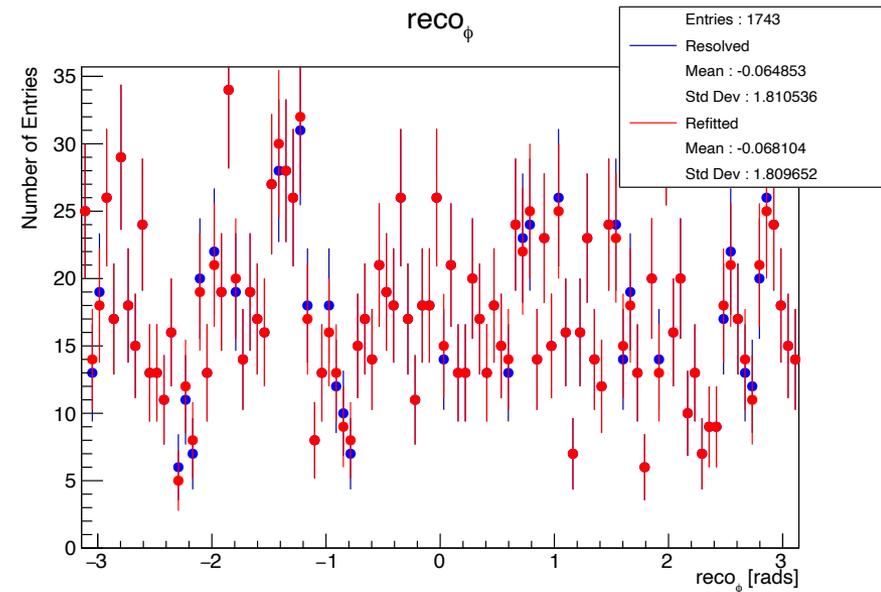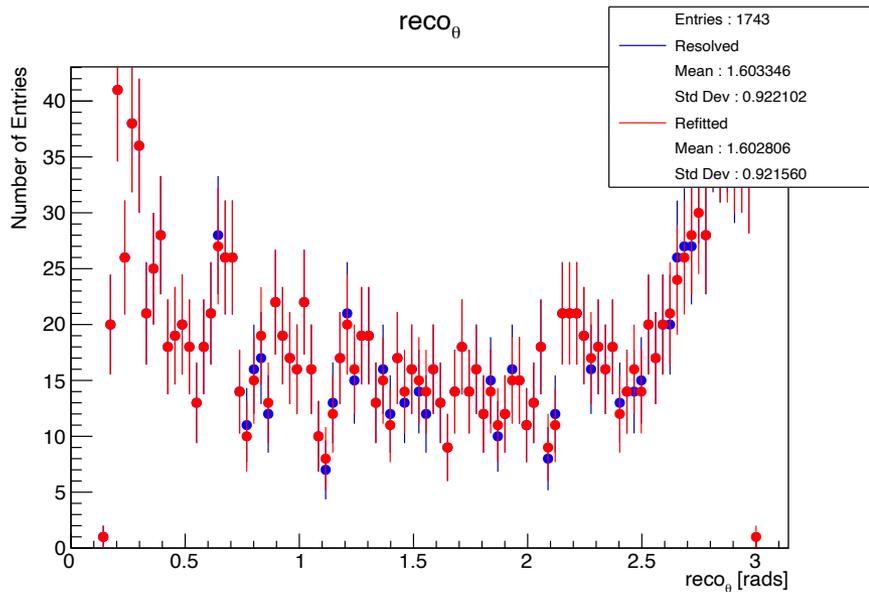
Pull comparison

- Comparison of the pull distribution for both Atlas and Acts

- Both are entered on 0 -> no bias

- The standard deviation is larger for the Acts

$(reco_{d_0} - truth_{d_0}) / \sigma(d_0)$

Entries : 1553
Resolved
Mean : -0.004373
Std Dev : 1.240634
Refitted
Mean : -0.003923
Std Dev : 1.900652

$(reco_{q/p_T} - truth_{q/p_T}) / \sigma(q/p_T)$

Entries : 1553
Resolved
Mean : -0.018417
Std Dev : 1.349083
Refitted
Mean : -0.032005
Std Dev : 1.827103

$(reco_{z_0} - truth_{z_0}) / \sigma(z_0)$

Entries : 1553
Resolved
Mean : -0.043565
Std Dev : 1.143733
Refitted
Mean : -0.018001
Std Dev : 1.449908
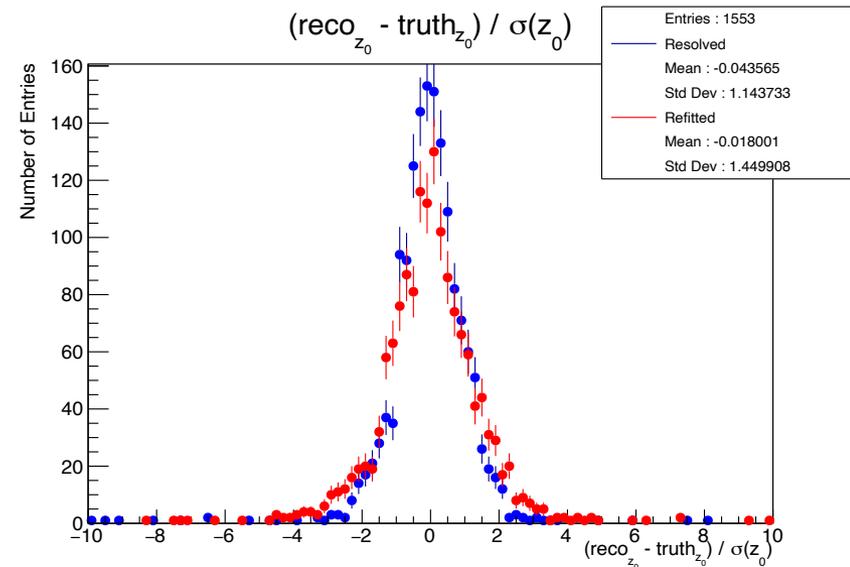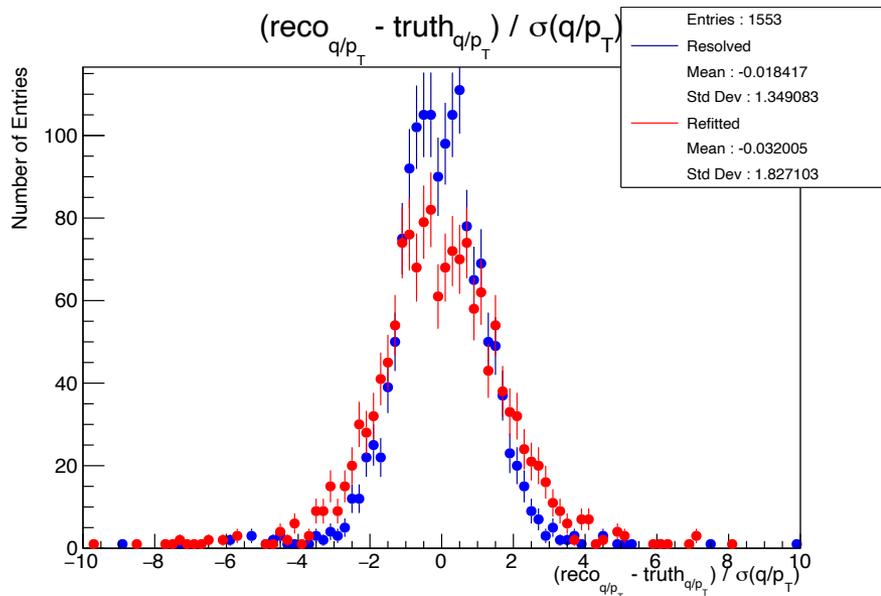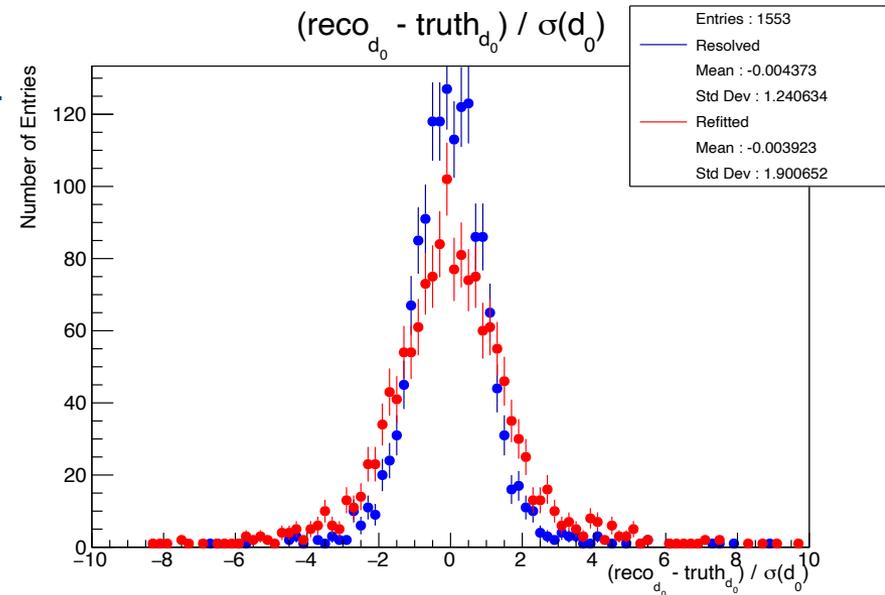
Resolution comparison

- Comparison of the Acts and ATLAS resolution : (ATLAS-Acts)/ATLAS

- Seem to pic at 0.3 instead of 0 (in general the Acts covariance element are 1/2 of the ATLAS one)

- The is also a tail for some of the distribution might be a material issue ? Only present at certain phi value (periodic)

Sigma_d0_diff

Sigma_d0_diff	
Entries	7155
Mean	0.3769
Std Dev	0.1468

Sigma_q_p_diff

Sigma_q_p_diff	
Entries	7155
Mean	0.3053
Std Dev	0.1058

Sigma_z0_diff

Sigma_z0_diff	
Entries	7155
Mean	0.2871
Std Dev	0.1891
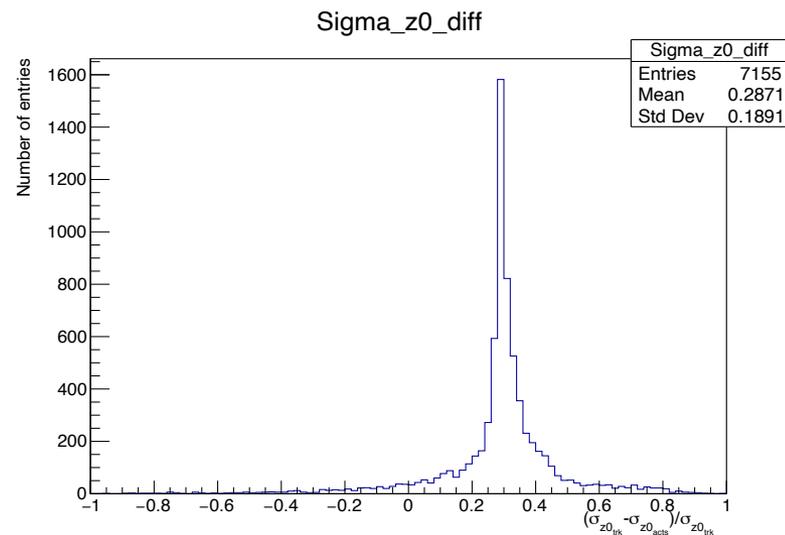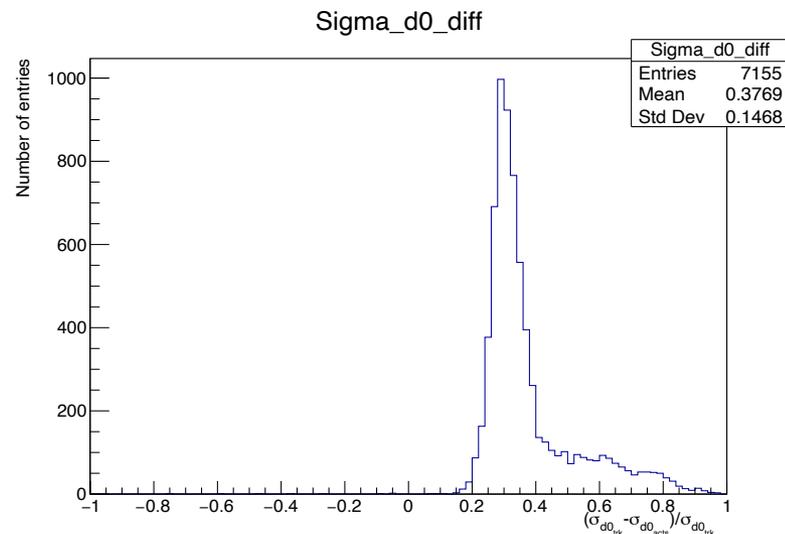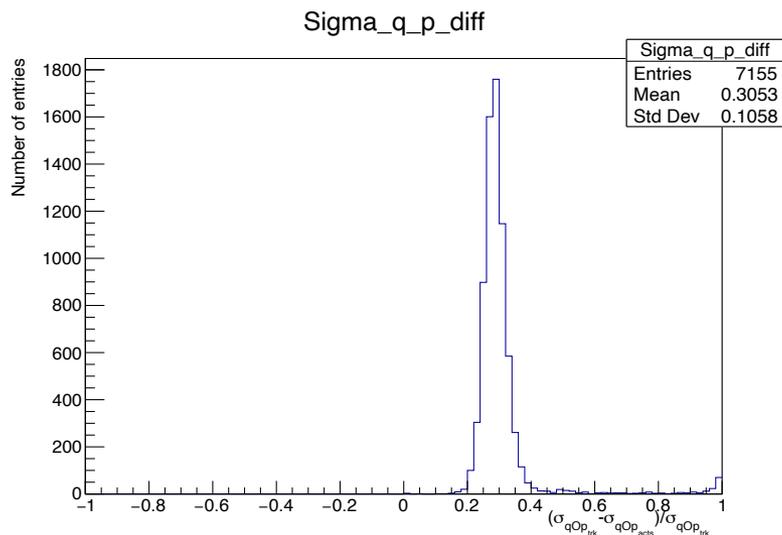
Resolution comparison

- This shift in covariance appear to be related to the initial parameter covariance.

- We use the fitter track parameter as input so the covariance is quite small

- If we multiply it by 20 the shift disappear

- Tail are still there but that is unrelated

Sigma_d0_diff

Sigma_d0_diff	
Entries	7155
Mean	0.1613
Std Dev	0.2401

Sigma_q_p_diff

Sigma_q_p_diff	
Entries	7155
Mean	0.03014
Std Dev	0.1758

Sigma_z0_diff

Sigma_z0_diff	
Entries	7155
Mean	0.05409
Std Dev	0.2548
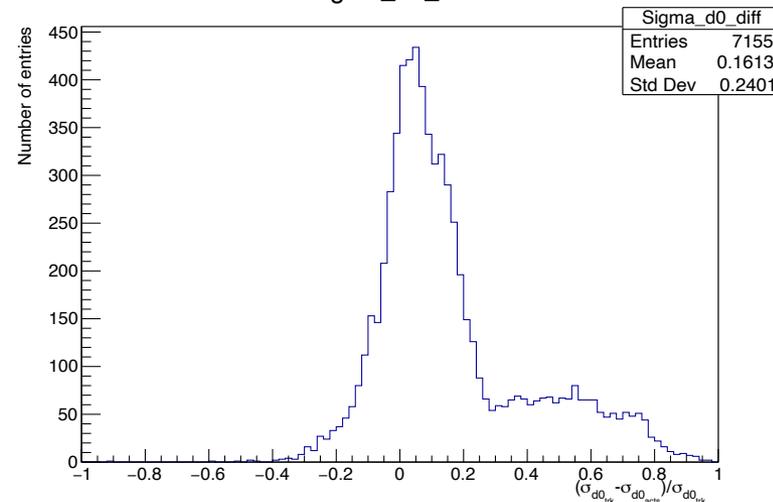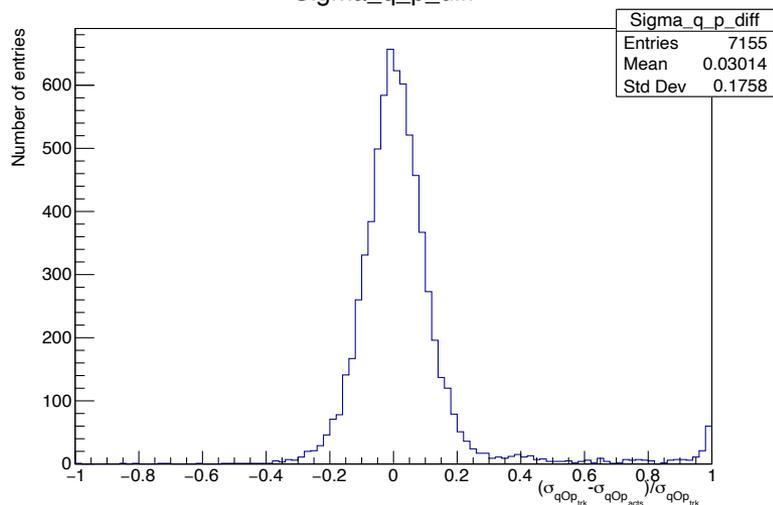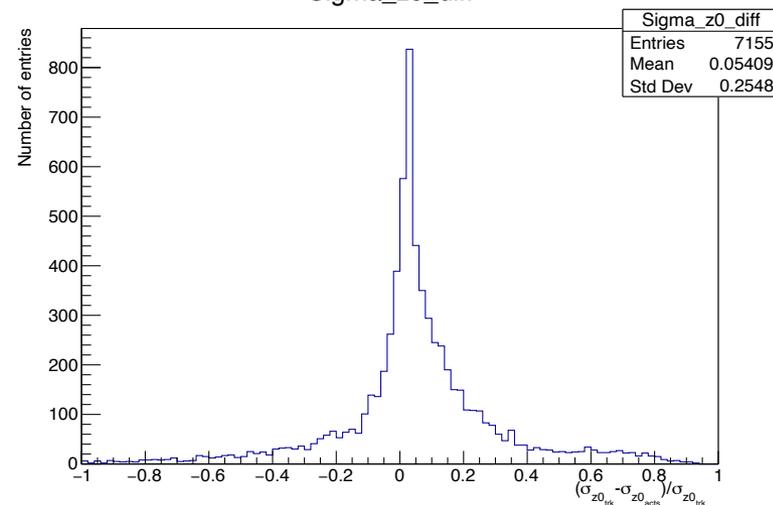
Summary

- There appear to be a correlation between the initial parameter covariance and resulting covariance

- I guess this occur when the initial and resulting covariance are of the same order of magnitude ?

- Is this expected ?

- In our case multiplying the initial covariance by 20 solver the issue.

- The larger that factor the smaller the shift between the resolution, with x20 we still have tiny shift of a couple of %

BACKUP

Acts track fitting workflow

- A tool was implemented to allow conversion between Atlas and Acts object (`ActsATLASConverterTool`)

- Performs the necessary unit conversion and can convert measurement and track parameter from Atlas to Acts and vice versa

- Use the resulting source link as input of the Acts KF

- The result of the fit is then used to create new Trk::Track on which we run the Atlas Track Summary Tool

- Some hacks are needed to get the store some information (like the nb of holes) and some other might be missing

```
ATLAS Track
   |
   v
Extract measurement
(including holes and
outliers)

Measurement set
   |
   v
Create Acts source links
(contain a link to the original
measurements)
   |
   v
Run the Acts KF using the
source links as input
   |
   v
Convert the fit result into a
Trk::Track.
Run the Atlas Track
Summary Tool
```