

# Reconstruction production with ITS/TPC/TRD

<https://alice.its.cern.ch/jira/browse/PWGPP-272>

<https://alice.its.cern.ch/jira/browse/PWGPP-221>

## Raw data filtering

TRD included in tracking to mitigate impact of space point distortion fluctuation

## reconstruction benchmark

- scan for different residual mis-calibration parameters
- With/Without TRD
  - Residual mis-calibration error scaling 1,  $\frac{1}{2}$ ,  $\frac{1}{4}$
  - validation of residual mis-calibration error

## Performance characterization:

- Track matching studies
- K0s invariant mass studies
  - selection of “best” reconstruction setting

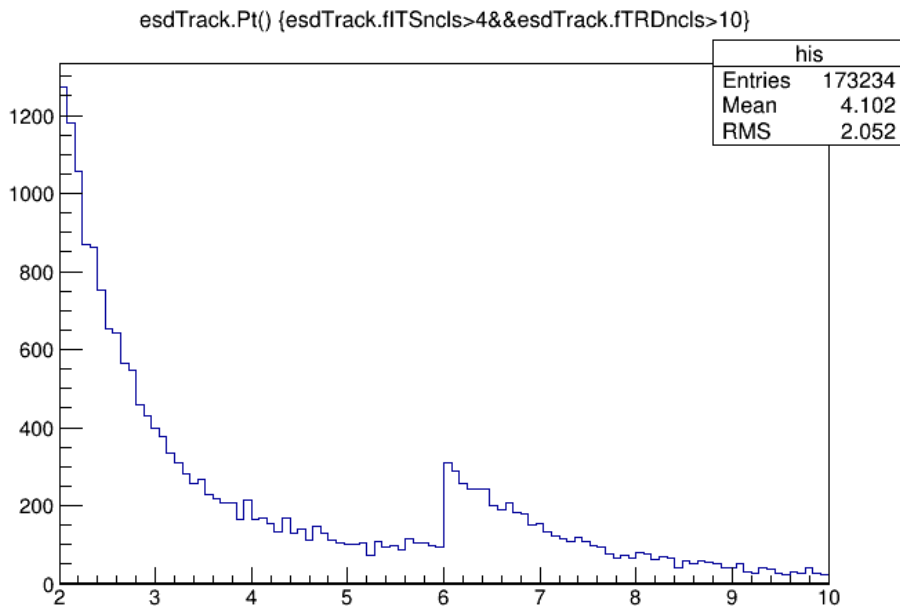
## Residual miscalibration

## Next steps

# Raw data filtering/skimming

## Offline trigger - LHC15n period

- Performance trigger
  - track -  $pt > 6$  GeV
  - V0s:
    - gamma candidate  $pt > 2$
    - Others  $pt > 4$
- Calibration trigger
  - $N_{spd}/N_{all} > 80\%$  - pile-up cleaning
  - $N_{spd} > 50\%$  - enhanced multiplicity to save CPU



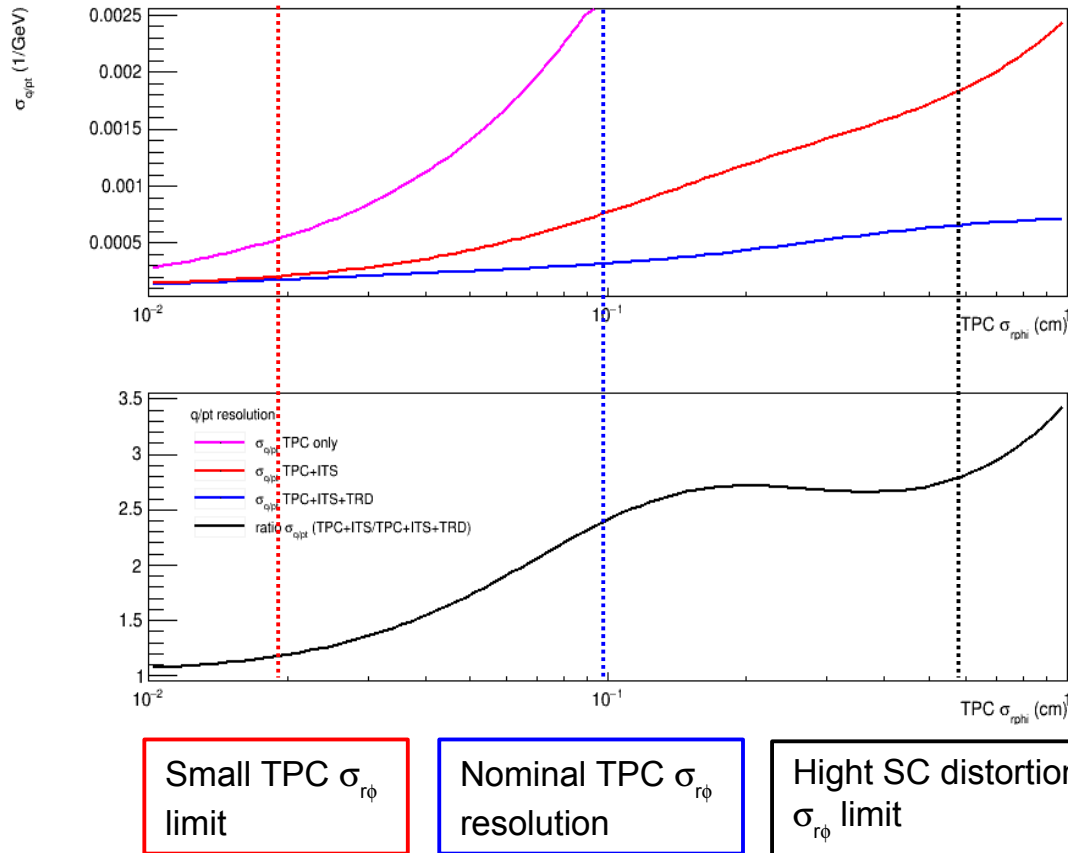
## 4 reconstruction setting

### Feedback time:

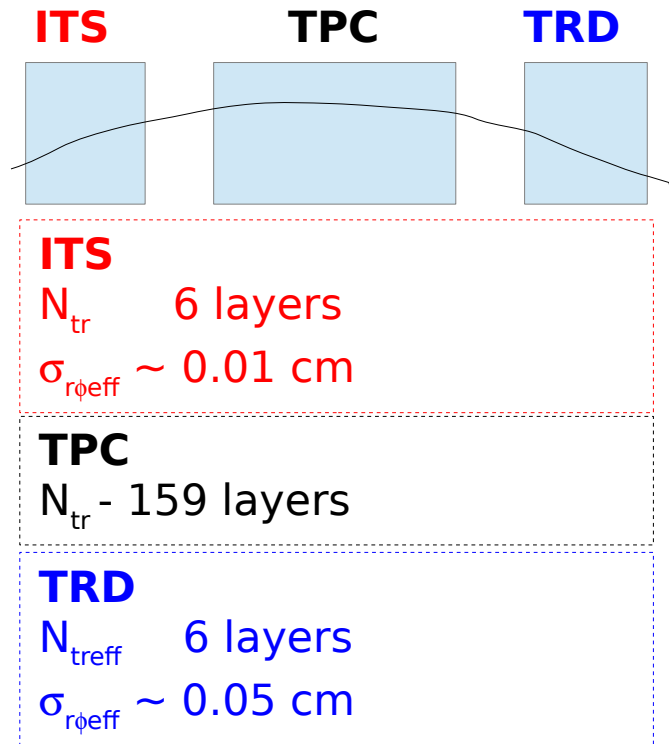
- Reconstruction within **2-4 hours**
  - 1400 cores
- Analysis, performance characterization - **5 minutes**
  - laptop

# TRD in reconstruction

# Combined $p_t$ resolution. Toy MC



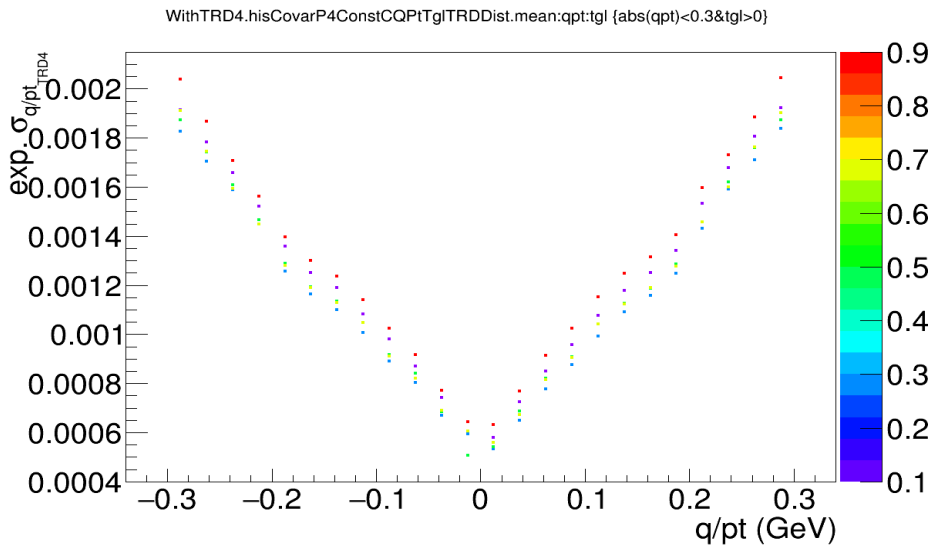
## Toy MC setup



## Combined $p_t$ resolution significantly better than TPC only

- High distortion limit -  $q/p_t$  resolution fully determined by ITS and TRD
- Close to TPC nominal resolution - linear scaling of  $q/p_t$  resolution as function of TPC  $\sigma_{r\phi}$

# Expected q/pt resolution (covariance matrix)

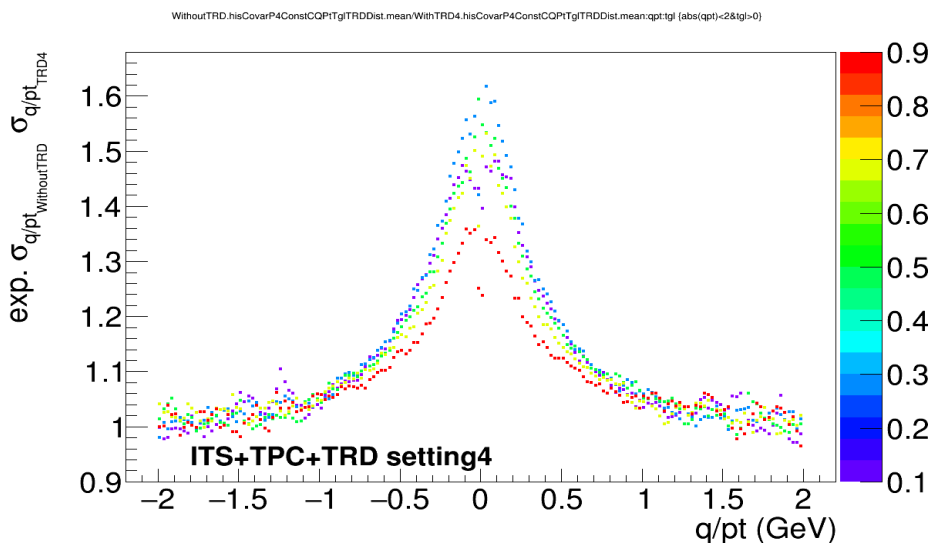


Expected  $1/pt$  resolution at 0.0004 GeV/c  
 $\rightarrow \sigma_{p_t}/p_t \sim 4\%$  at 100 GeV/c

Without/With TRD setting 4  
**1.3-1.6 improvement** at high  $pt$  ( $q/pt \sim 0$ )

color code - track inclination angle

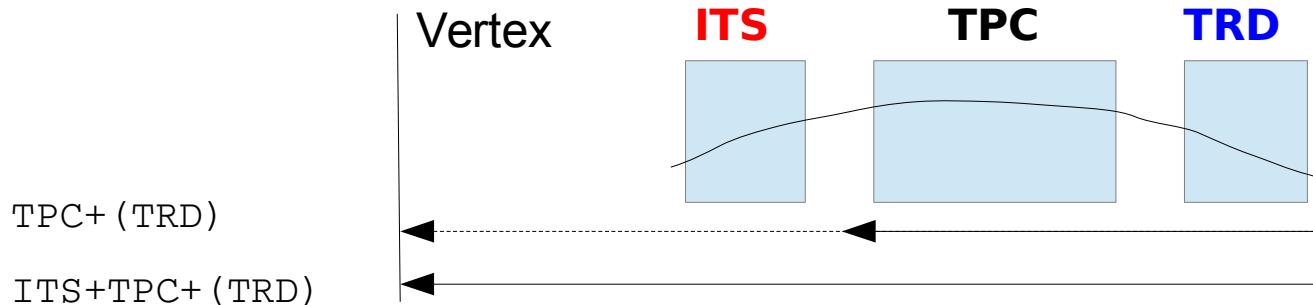
- $\sim 0$  full diffusion
- $\sim$  small outer radii (close to TRD)



# Track matching studies



# (TRD\_+TPC+ITS tracking benchamrk



## Residual histogram maps parameterization

- $\text{param}(\text{TPC}+(\text{TRD})) - \text{param}(\text{ITS}+\text{TPC}+(\text{TRD}))$

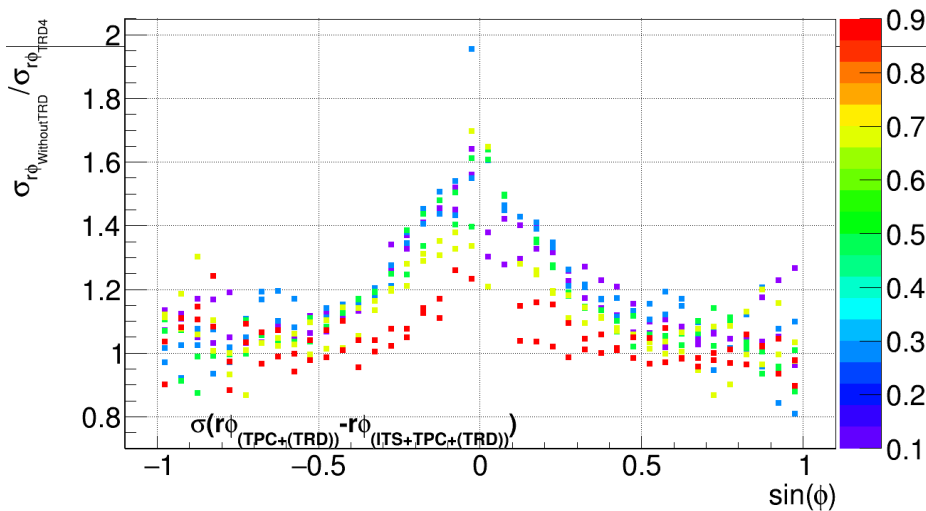
## Performance parameterization

- $\text{delta}(\text{rphi}, \text{phi}, \text{q/pt}): \text{q/pt}:\text{theta}:\text{mult}$
- $\text{pulls}(\text{rphi}, \text{phi}, \text{q/pt}): \text{q/pt}:\text{theta}:\text{mult}$
- matching eff.,  $\chi^2$ , NCI ...

## residual mis/calibration parameterization (maps)

- $\text{delta}(\text{rphi}, \text{phi}, \text{q/pt}): \text{phi}:\text{q/pt}:\text{theta}$
- matching eff.,  $\chi^2$ , Ncl ...

# Track matching $r\phi$



track(TPC+(TRD))-track(ITS+TPC+(TRD))

Without/With TRD setting 4

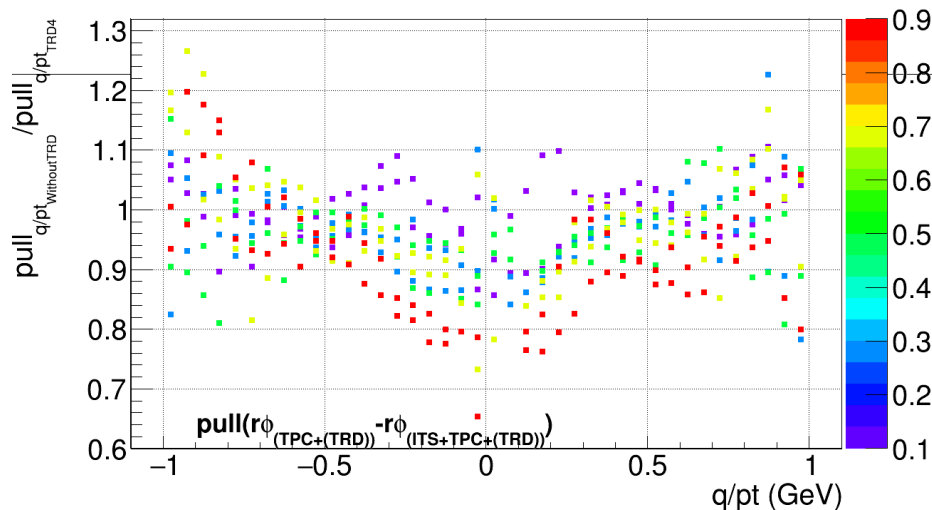
1.2-1.6 improvement at high pt ( $q/p_t \sim 0$ )

improvement described by covariance matrix (pull ratio)

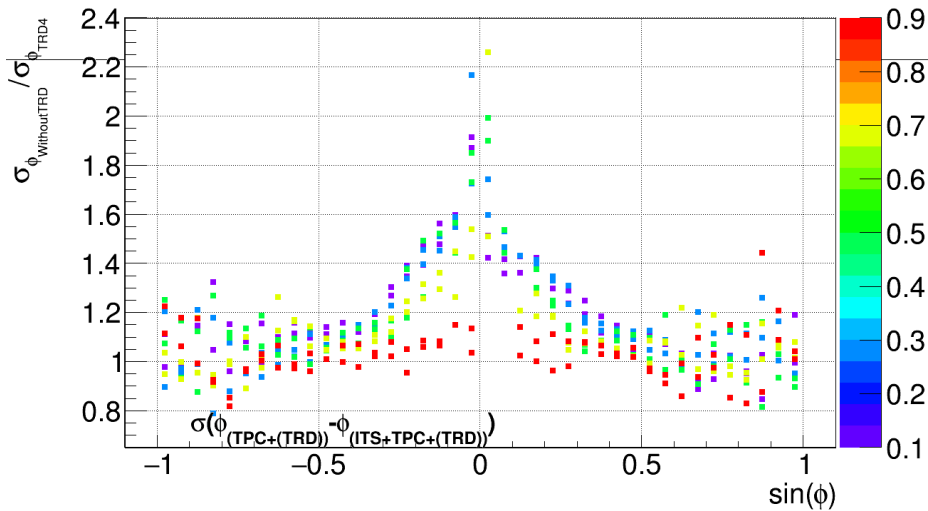
color code - track inclination angle

-  $\sim 0$  full diffusion

-  $\sim 1$  small diffusion close to TRD



# Track matching $r\phi$



track(TPC+(TRD))-track(ITS+TPC+(TRD))

Without/With TRD setting 4

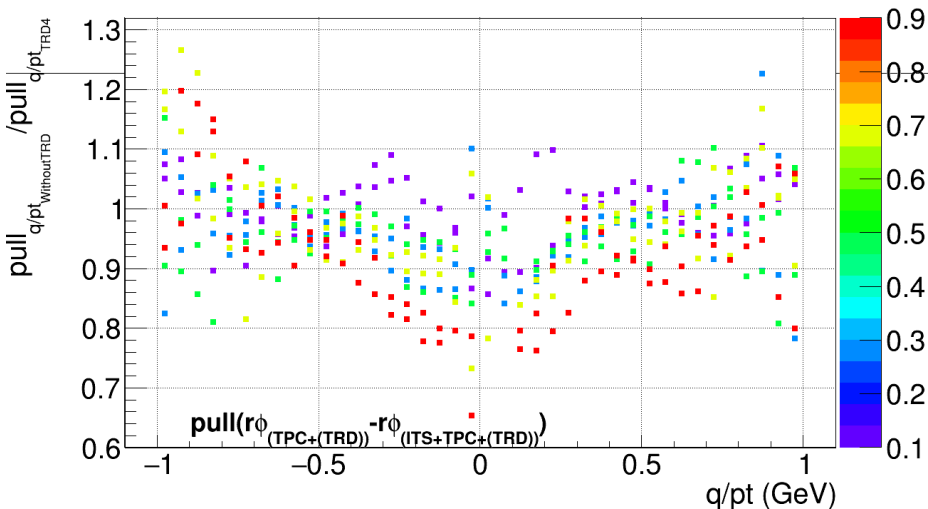
1.10-2 improvement at high pt ( $q/pt \sim 0$ )

improvement described by covariance matrix (pull ratio)

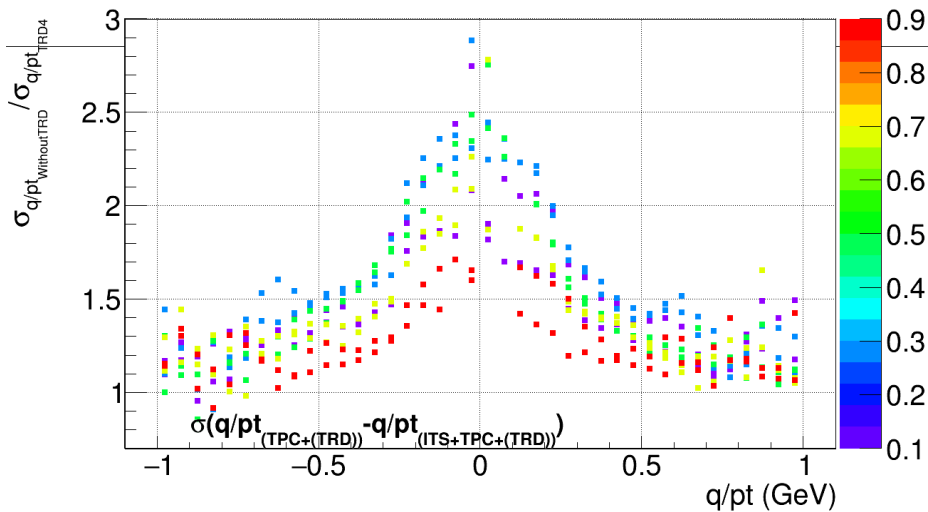
color code - track inclination angle

-  $\sim 0$ - full diffusion

-  $\sim 1$ - small diffusion (close to TRD)



# Track matching q/p<sub>t</sub>



track(TPC+(TRD))-track(ITS+TPC+(TRD))

Without/With TRD setting 4

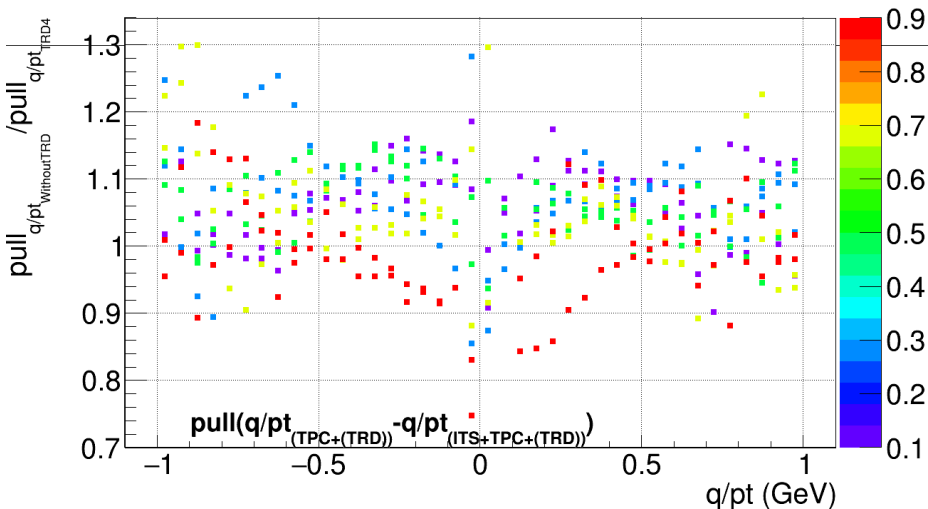
1.1-2.50 improvement at high pt ( $q/p_t \sim 0$ )

improvement described by covariance matrix (pull ratio)

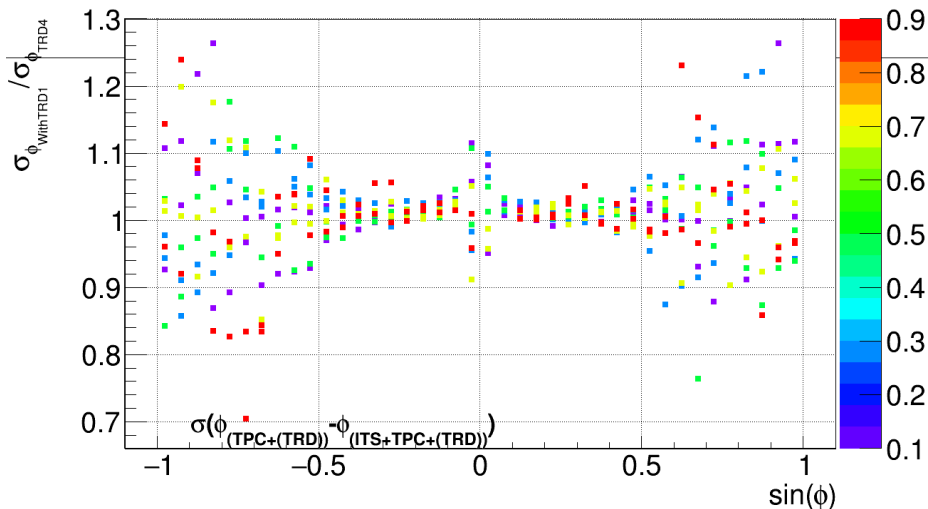
color code - track inclination angle

-  $\sim 0$  full diffusion

-  $\sim 1$  small diffusion close to TRD



# Track matching $\phi$



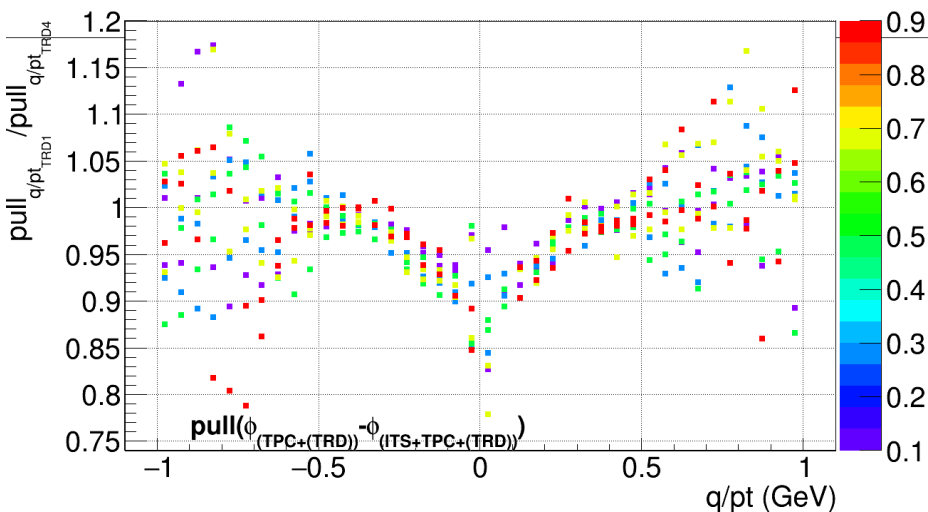
track(TPC+(TRD))-track(ITS+TPC+(TRD))

TRD setting1/setting 4

no improvement reducing estimated systematic mis-calibration error by factor 4

improvement 10% expected covariance matrix (pull ratio) not confirmed

→ mis-calibration error ~ setting 1-2



K0s inv. mass studies

## Comparison of resolution and bias for different reconstruction setting (see next slides)

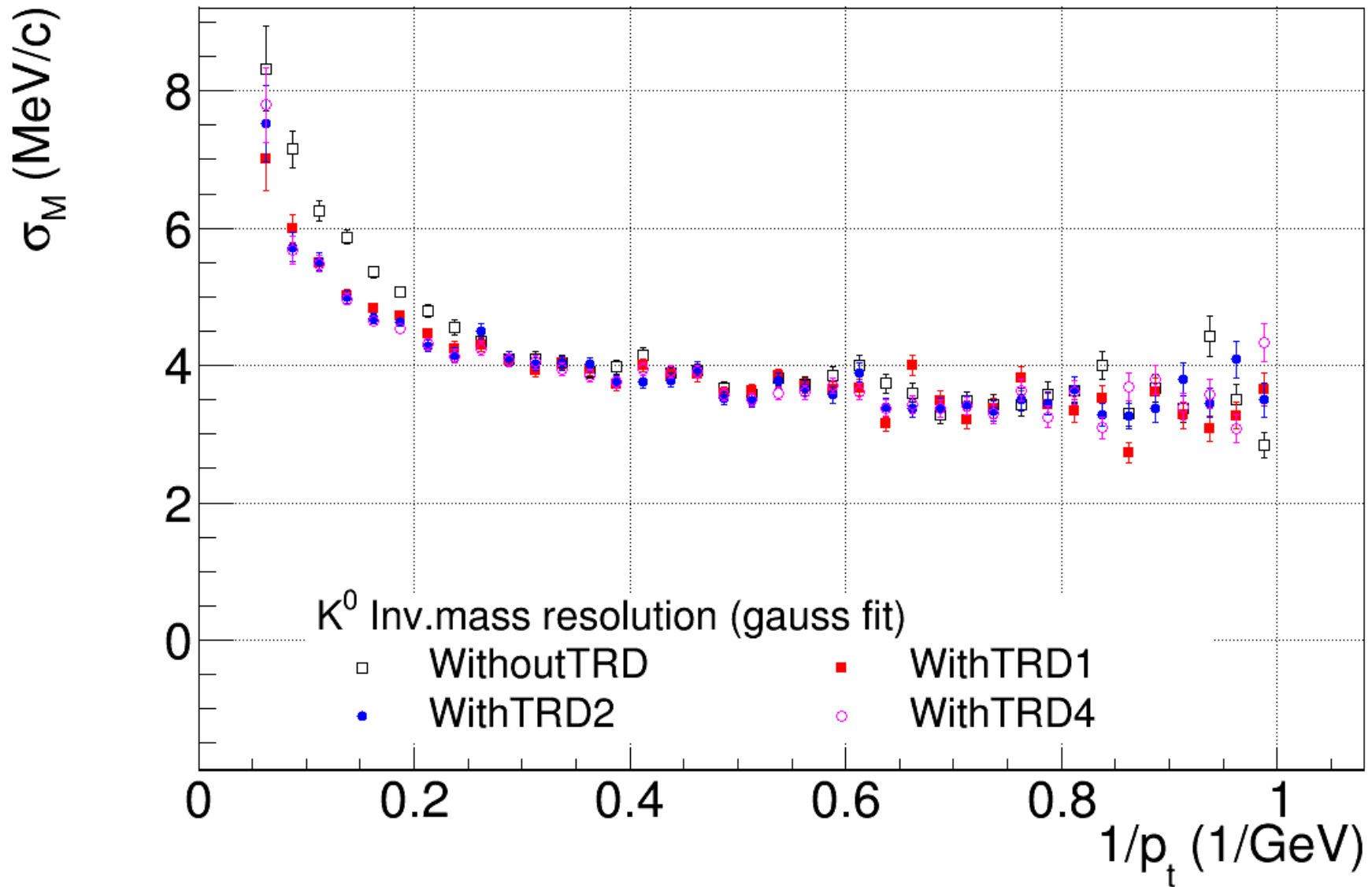
- Clear improvement for setting with TRD
- Not clear which setting of residual miscalibration error for this studies

## Improved mass/pt resolution at $pt > 3\text{GeV}$

- improvement pt dependent
- Statistic available only up to 20 GeV/c ( $\sim 50\%$  of LHC15n data)

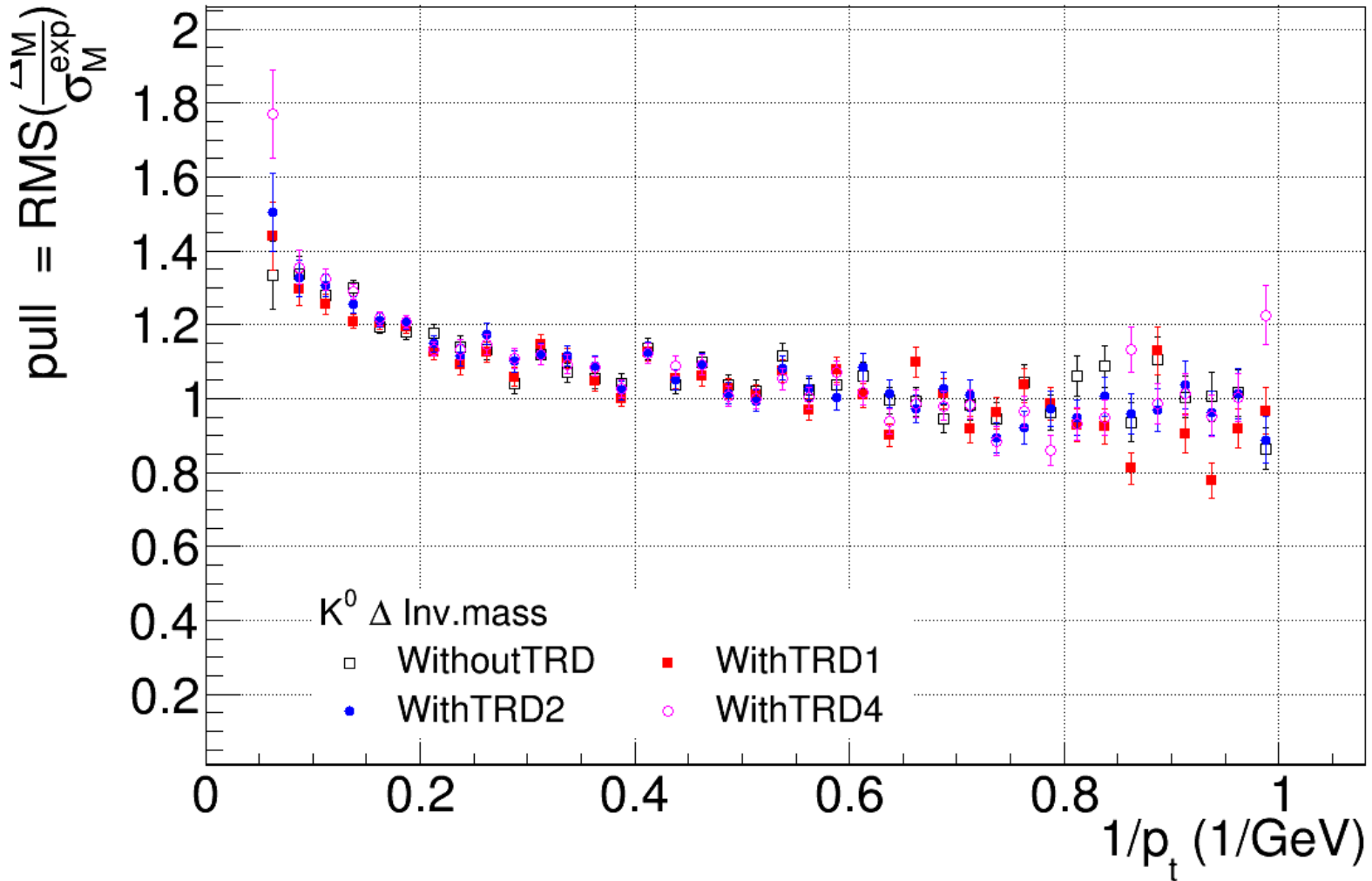
## Smaller inv. mass bias at for setting with TRD

# K<sup>0</sup> inv mass - RMS

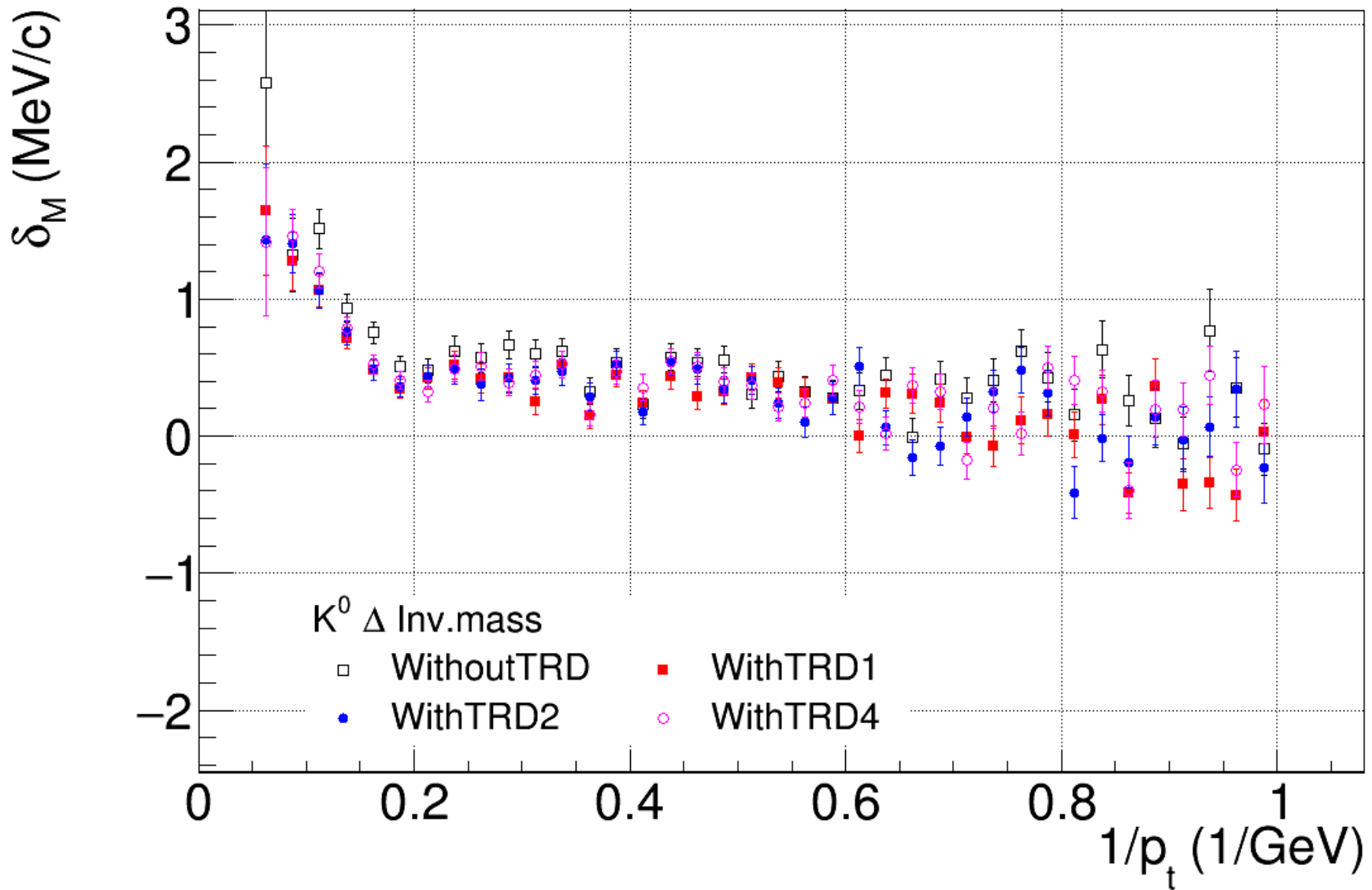




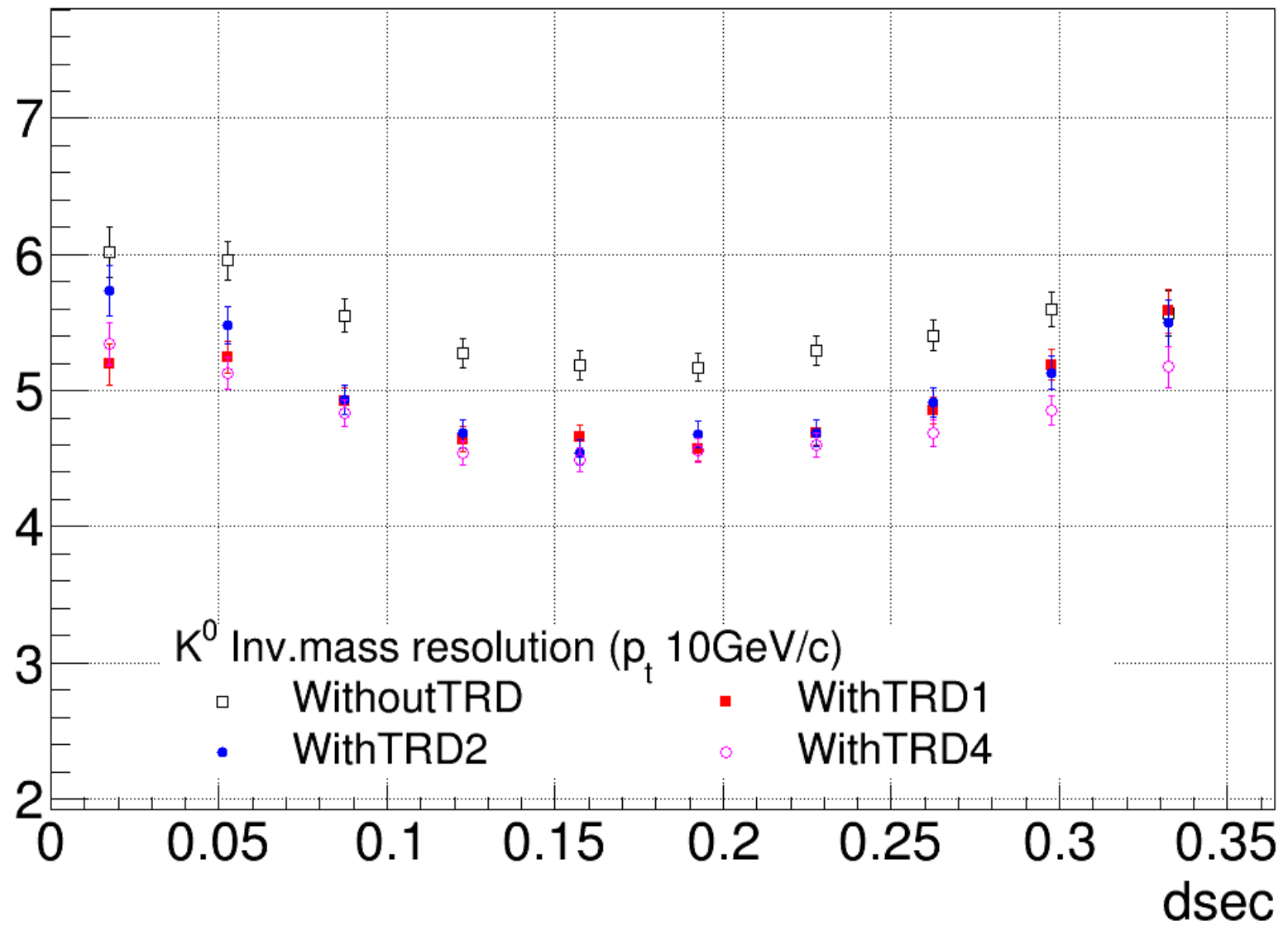
# K0 inv mass pulls

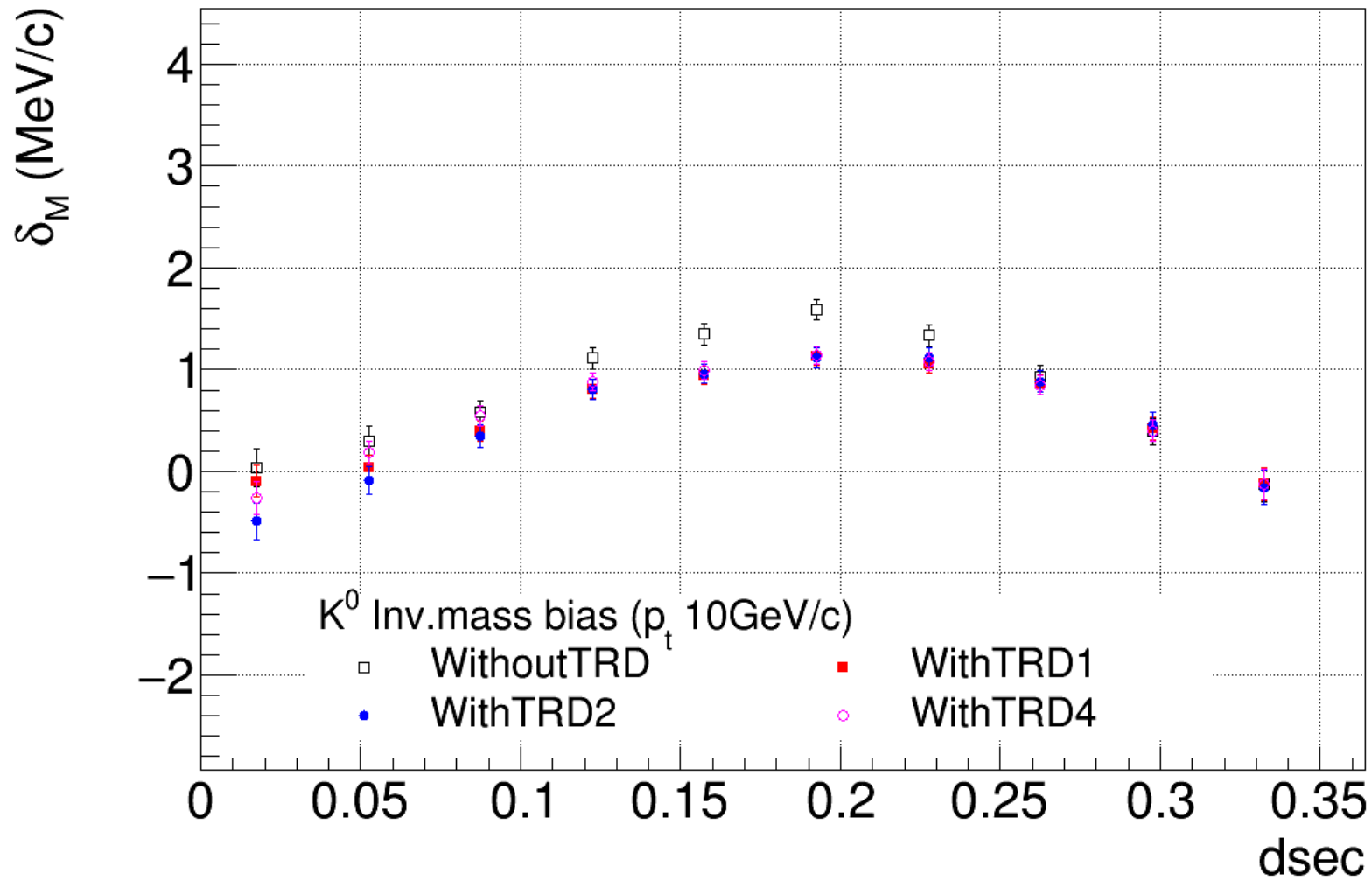


# K0 inv. mas bias



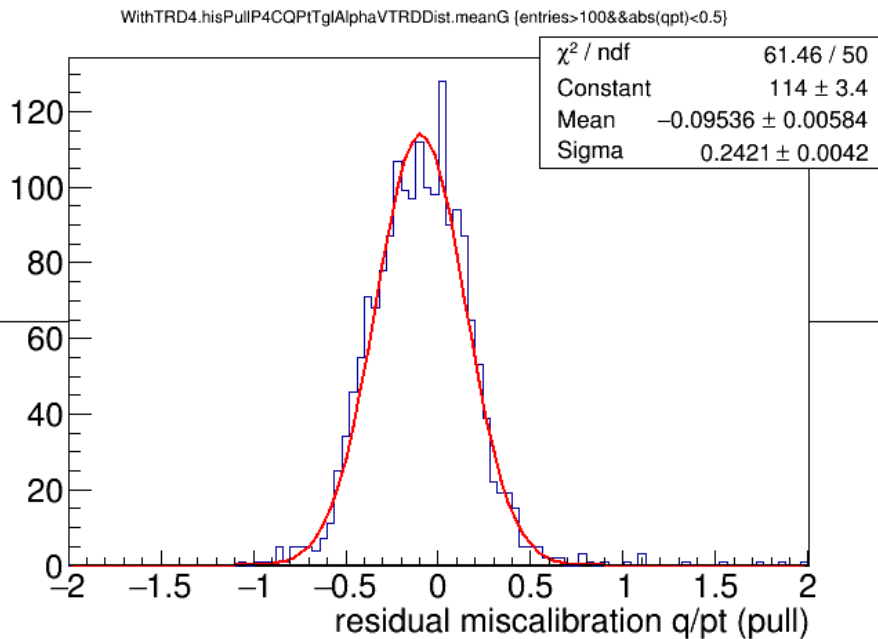
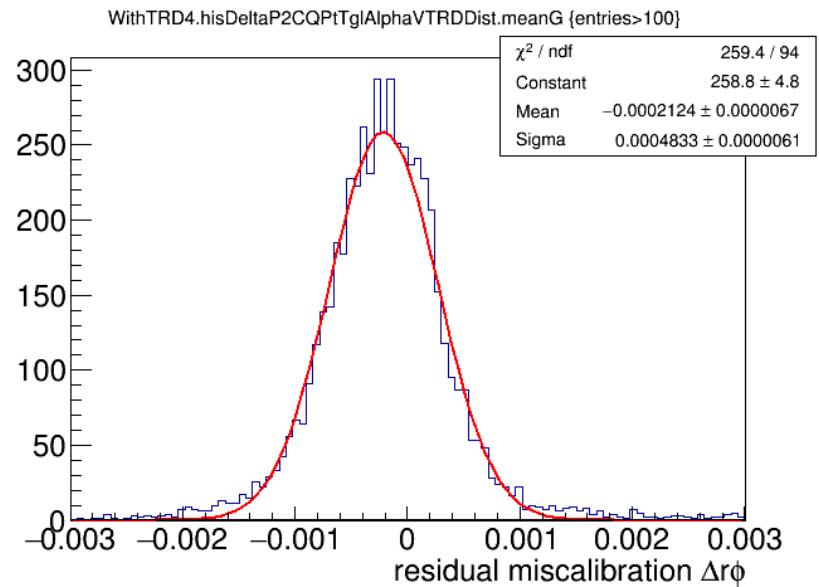
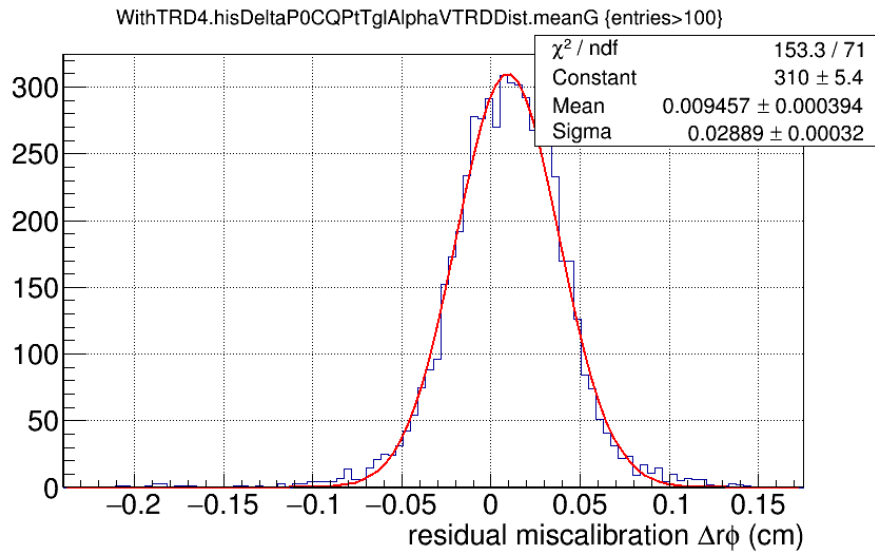
$\sigma_M$  (MeV/c)





# Residual miscalibration

# Example: Residual mis-calibration

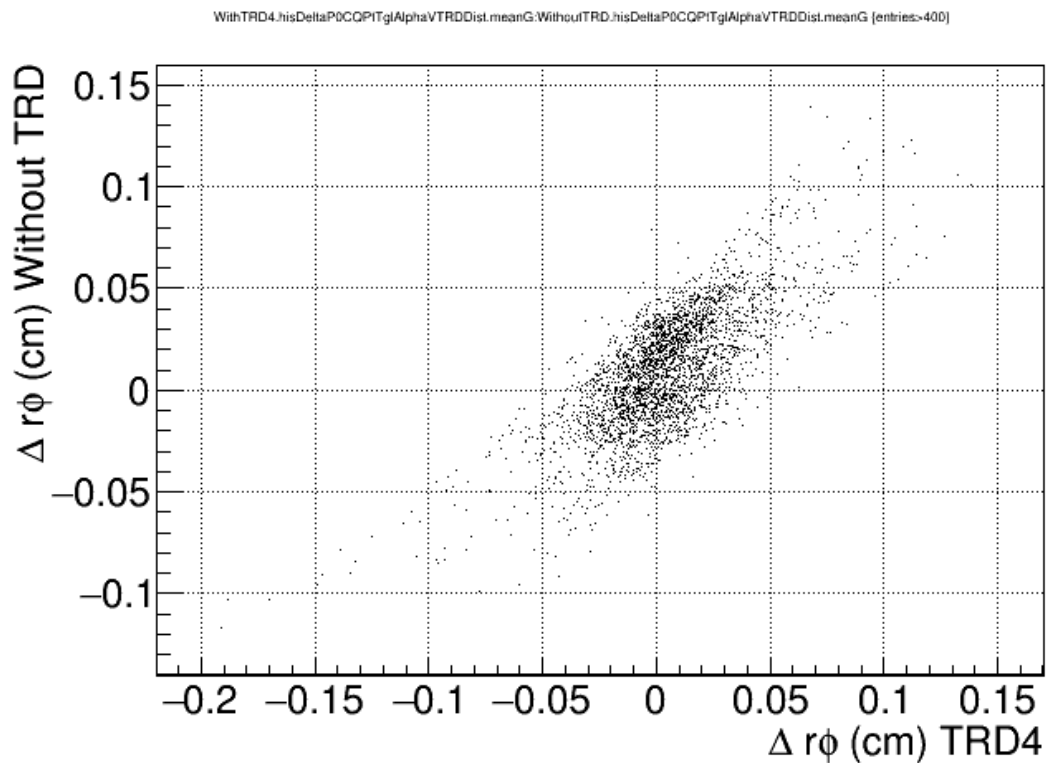


Residual mis-calibration

Histogram of mean bias in small  $\phi(90)$ ,  $\eta(10)$  and  $q/pt$  bins

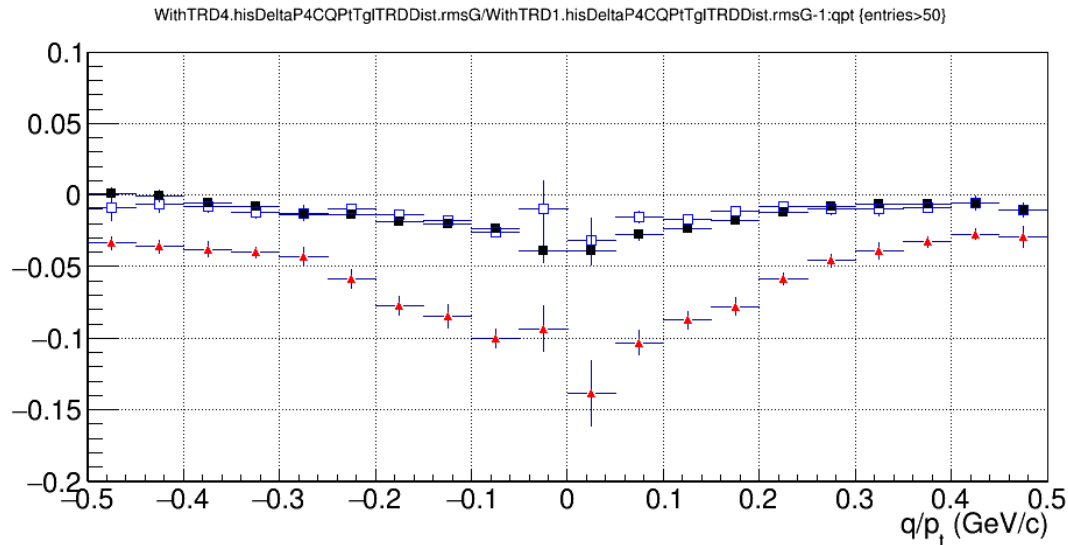
Residual mis-calibration  $< \sim 0.25 \sigma$  of intrinsic resolution

# Example: Reconstruction comparison



- Extrapolation for 2 different reconstruction scenarios
  - with/without TRD
  -

# Which setting to use



Using K0s not enough statistics to judge above 5 GeV (10 GeV/2)

RMS distribution of residuals favour setting 4

- **q/pt** 15 % improvement
- **$r\phi$ ,  $\phi$**   $\sim$  5 % improvement



# Conclusion

Significant improvement in tracking and V0 performance using the TRD in the track refit

Residual mis-calibration RMS pull  $< \sim 0.25$  at the vertex

- Confirmed by the inv. mass peak width
- Based on the track RMS residual distribution setup 4 preferable

To enable TRD in tracking extended studies of efficiency and dependencies on the IR to be provided

- Work in progress

improve matching efficiency and resolution at the TPC  
**sector boundaries** to reduce dead zones

- TPC only ITS track matching

reduce systematic errors of efficiency

increase fiducial volume

improve resolution at the sector edges

# Intinsic resolution