

# PWGPP-729: Electron bremsstrahlung correction + conditional PID momentum and position bias correction

Marian I Ivanov, Marian Ivanov, Benedict Heybeck

Mean energy loss correction and bremsstrahlung

Inter-detector matching and combined track properties

Conditional machine learning based correction of momenta and position bias (DCA, TOF)

- momentum bias
- TOF (space and time) and DCA residuals
- Optimally applicable in analysis

Similar conditional machine learning algorithm for the distortion correction -  $\Delta T_0$  as conditional variable

The loss of energy in the detector material could significantly affect the properties of the particles  
A considerable part of the energy lost during the propagation of the track from the production point to the outer detectors

## Consequences:

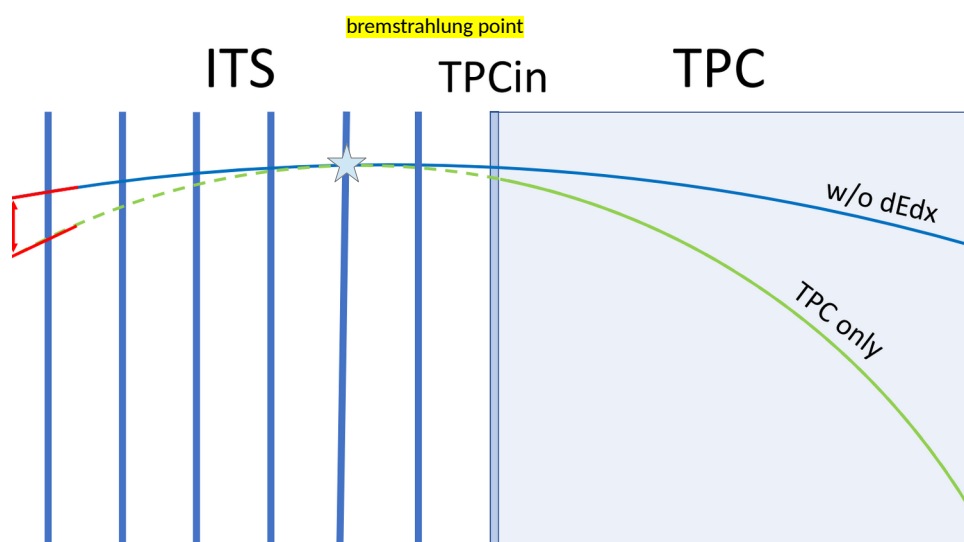
- momentum determination bias and particle extrapolation bias → deterioration of inter-detector matching (efficiency,  $\chi^2$  ...)

## Mean energy loss use to correct for the effect assuming particle identity known

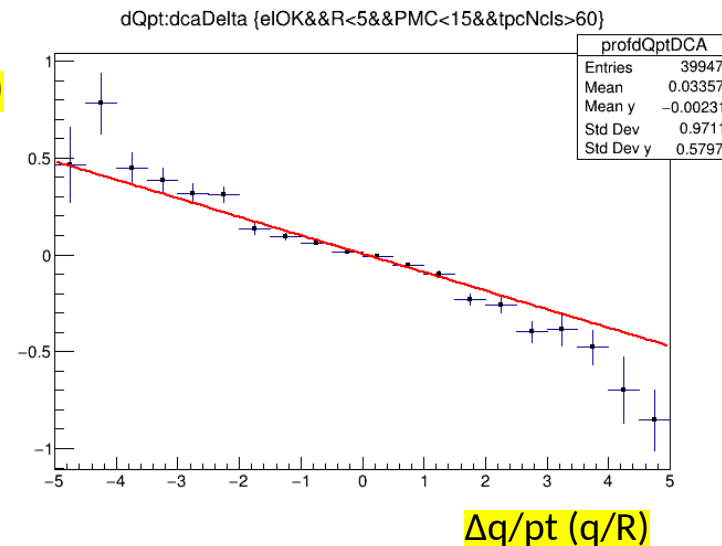
- In case of mis-identification the energy loss is biased
- In case of electron - mean energy loss not sufficient to correct for the bremstrahlung

## Goal:

- Prepare PID conditional modification of track properties (pt, DCA, TOF matching)



$\Delta DCA$  (cm)



TPC only tracks not sensitive to the bremstrahlung in the ITS material

Bremstrahlung probability in TPC is small

- impact negligible in comparison to bremstrahlung in service and ITS before TPC

Position and energy fraction of bremstrahlung not known

The DCA properties (position, angle +  $\Delta q/pt(ITS/TPC)$ ) depends on the bremstrahlung position and bremstrahlung loss

<https://pdg.lbl.gov/2018/reviews/rpp2018-rev-passage-particles-matter.pdf>

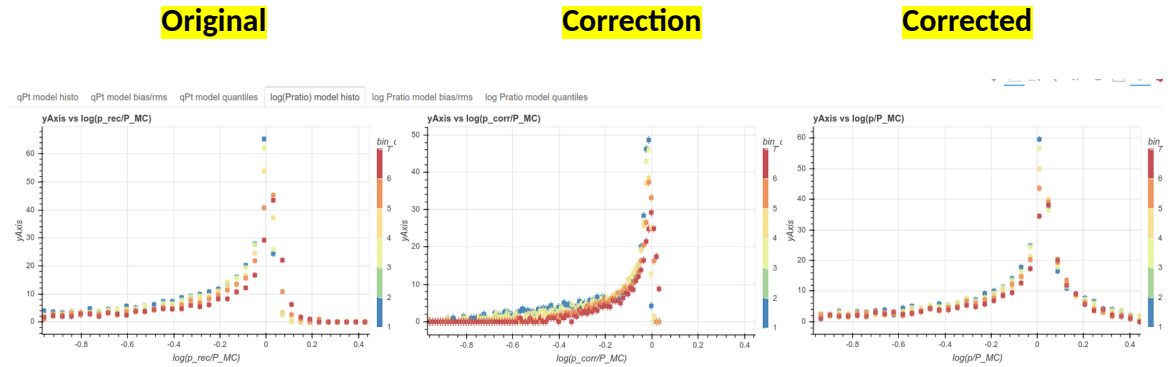
# Bremstrahlung and PID missindetification correction (Random Forest)

qPt correction - geometrical interpretation

$\log(\text{prec}/\text{ptrue})$ - fractional momentum loss

Input Variables:

- Geometrical: 'dcaDelta', 'phiDelta'
- PID and QA : "fPIDForTracking", 'tpcNcls'
- itsmask,
- qPt,tgl



[https://indico.cern.ch/event/1135398/contributions/4950038/subcontributions/391923/attachments/2493193/4282317/eLossBremstahlung\\_Corr.html](https://indico.cern.ch/event/1135398/contributions/4950038/subcontributions/391923/attachments/2493193/4282317/eLossBremstahlung_Corr.html)

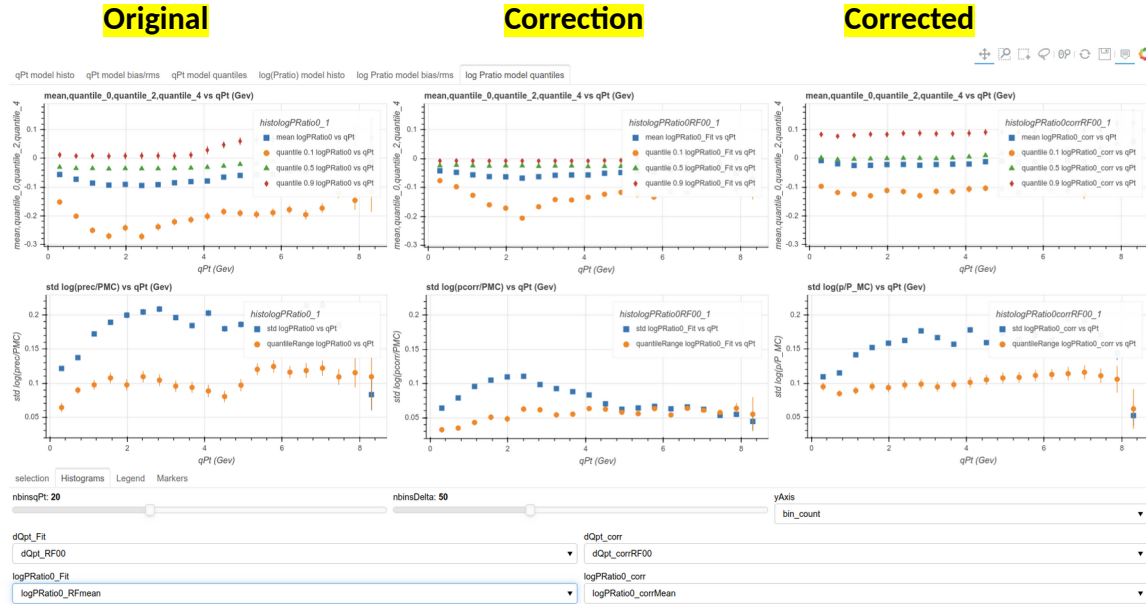
# Bremstrahlung and PID missidentification correction (Random Forest)

qPt correction - geometrical interpretation

$\log(\text{prec}/\text{ptrue})$ - fractional momentum loss

Input Variables:

- Geometrical: 'dcaDelta', 'phiDelta'
- PID and QA : "fPIDForTracking", 'tpcNcls'
- itsmask,
- qPt,tgl



[https://indico.cern.ch/event/1135398/contributions/4950038/subcontributions/391923/attachments/2493193/4282317/elessBremstahlung\\_Corr.html](https://indico.cern.ch/event/1135398/contributions/4950038/subcontributions/391923/attachments/2493193/4282317/elessBremstahlung_Corr.html)

## fractional momentum loss due brestrahlung: (time section: )

- corrected data significantly narrower using std nor and quantile norm
- normalization of the mean and median bias depends on the cost function used (square residual, abs residuals, weighted mean)

## Impact of PID miss-identification (cross at qPt~ 3) (time section: )

### Work in progress:

- more data needed - more flat in parameter space
- adding local error estimator of the correction to dashboard
- use also dQpt between ITS and TPC as additional constraint

[https://indico.cern.ch/event/1135398/contributions/4950038/subcontributions/391923/attachments/2493193/4282317/elossBremsstrahlung\\_Corr.html](https://indico.cern.ch/event/1135398/contributions/4950038/subcontributions/391923/attachments/2493193/4282317/elossBremsstrahlung_Corr.html)

[https://indico.cern.ch/event/1135398/contributions/4950038/subcontributions/391923/attachments/2493193/4282317/elossBremsstahlung\\_Corr.html](https://indico.cern.ch/event/1135398/contributions/4950038/subcontributions/391923/attachments/2493193/4282317/elossBremsstahlung_Corr.html)