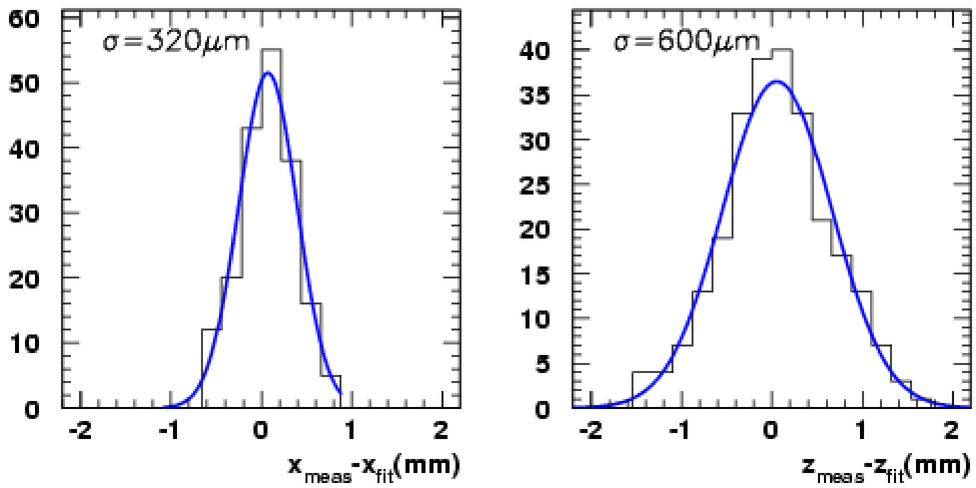
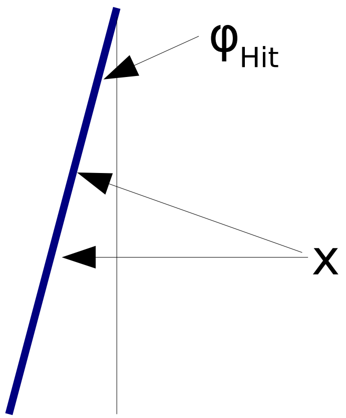
# Resolution

- How is the point resolution defined?
- The Hits are distributed following a Gaussian distribution around the particle trajectory,
  so $x_{Hit}-x_{Track}$ (resp. $z_{Hit}-z_{Track}$ ) follows a Gaussian distribution



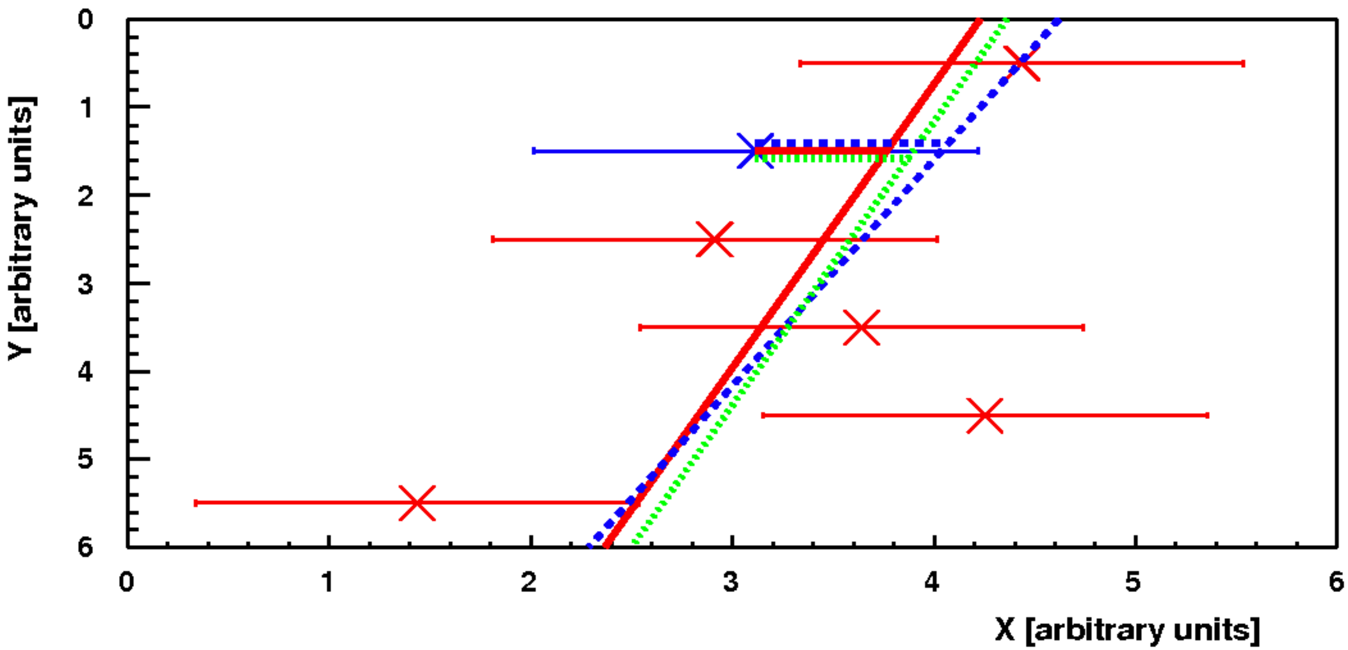

to be correct: this is true for track parallel to the Y axis, else the minimal distance has to be calculated using the track angle:

$$\Delta x_{corrected}=\Delta x\cos(\varphi_{hit}) \quad \text{,with } \varphi_{hit}=\sin^{-1}(\sin(\varphi_0)-y_{hit}\cdot C)$$

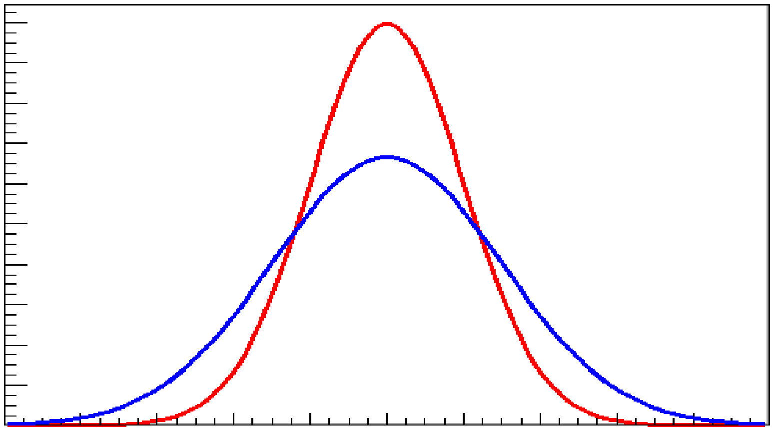
- The width σ of this distribution is the point resolution

# Resolution Calculation

- Often the true trajectory (green) is not known, but only the reconstructed track position. How to determine the resolution?
- The use of the "Geometric Mean Method" solves this problem:
- Distance: $\Delta x_{Hit}$ when the Hit in question is included in the track fit smaller than true distance, since the Hit "pulls" the track towards its position (red)
- Residual: $\Delta x_{Hit}$ when the Hit in question is **not** included in the track fit larger than the true distance, since other Hits "pull" the track away from the Hit in question (blue)



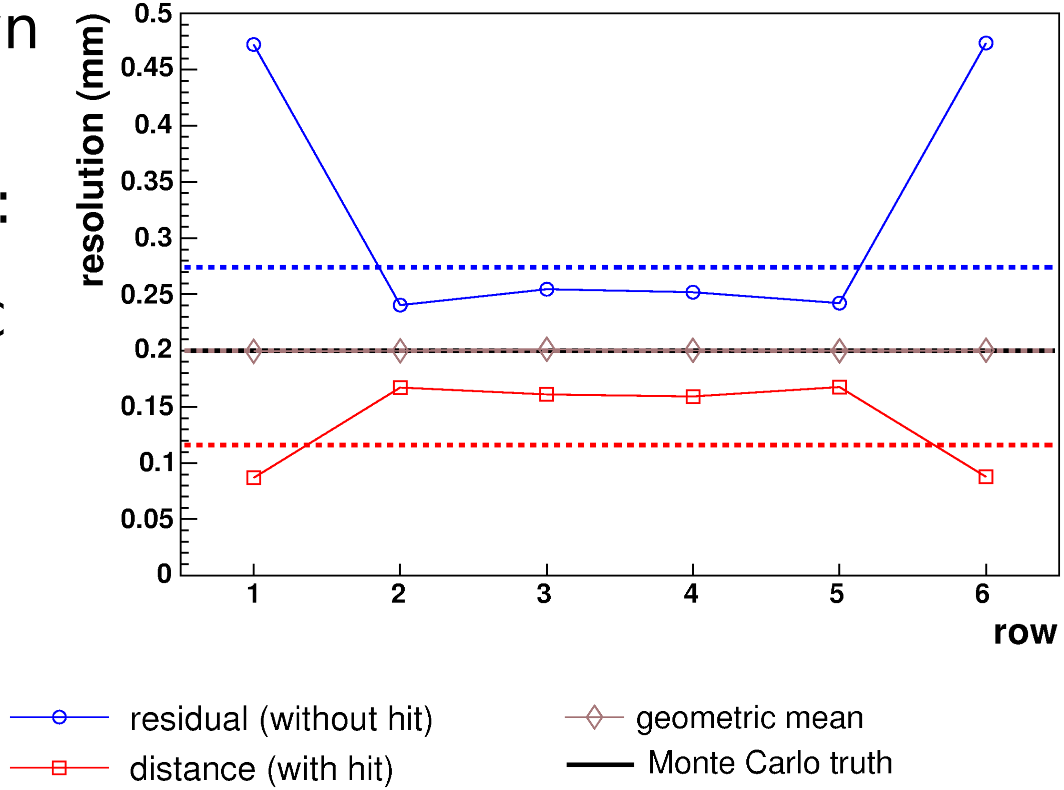
- Both the distance and the residual are Gaussian distributed. The width of the distance distribution is too narrow, the width of the residual distribution is too large.



- But the geometric mean of the widths of both distributions:

$$\sigma = \sqrt{\sigma_{distance} \cdot \sigma_{residual}}$$

  gives the right value as if the true trajectory would be known

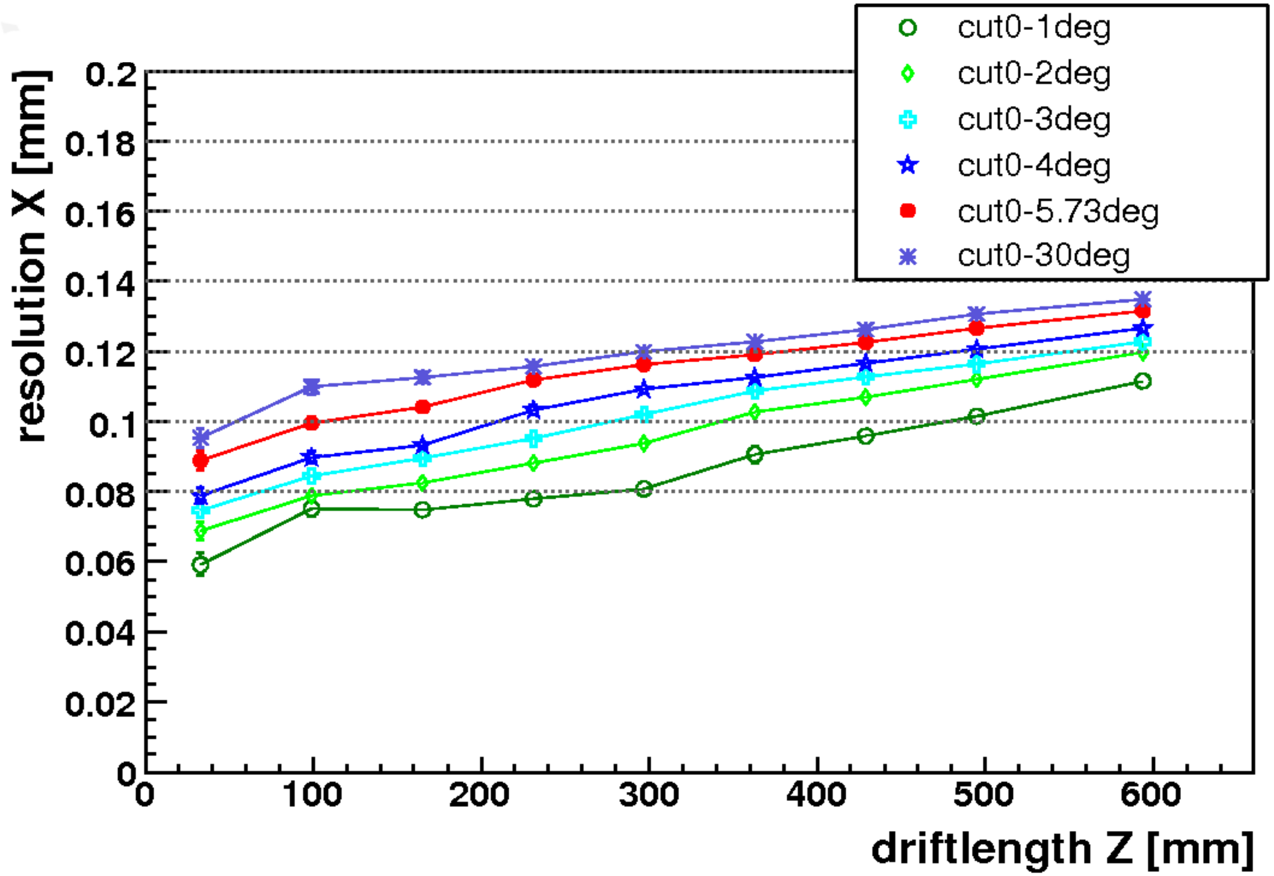



- This has been proven for straight tracks analytically:
  R. K. Carnegie et al., “Resolution studies of cosmic-ray tracks in a TPC with GEM readout”, Nucl. Instrum. Meth. A538, 372-383 (2005), physics/0402054.

- For curved tracks, a Monte Carlo Study has been done:

# Resolution Agreement

- To allow a comparison of the resolution results of different working groups, an agreement has been made:
- Resolution is calculated using the Geometric Mean Method
- Angle Cut: $\varphi<0.1$ rad (this is about 5.73°)

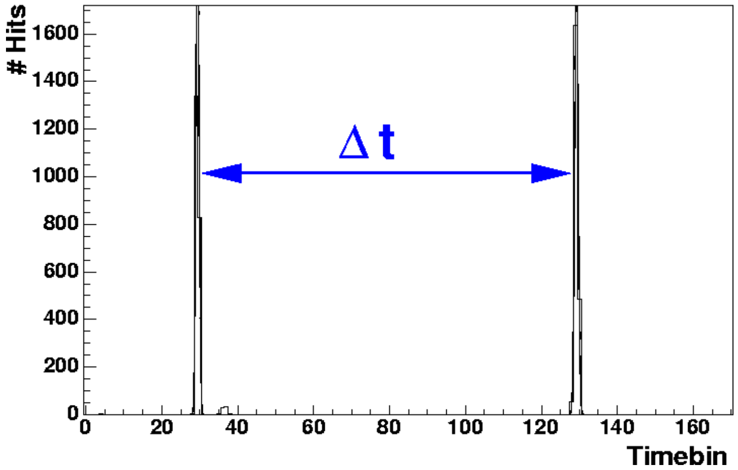


# Drift Velocity

- The drift velocity can be simulated with Magboltz for a given gas mixture and field
- Difficulties:
  - Pollutions ($H_20$) of the chamber gas change the drift velocity. They can be measured, but a system is not always available
- So it is better to measure the drift velocity

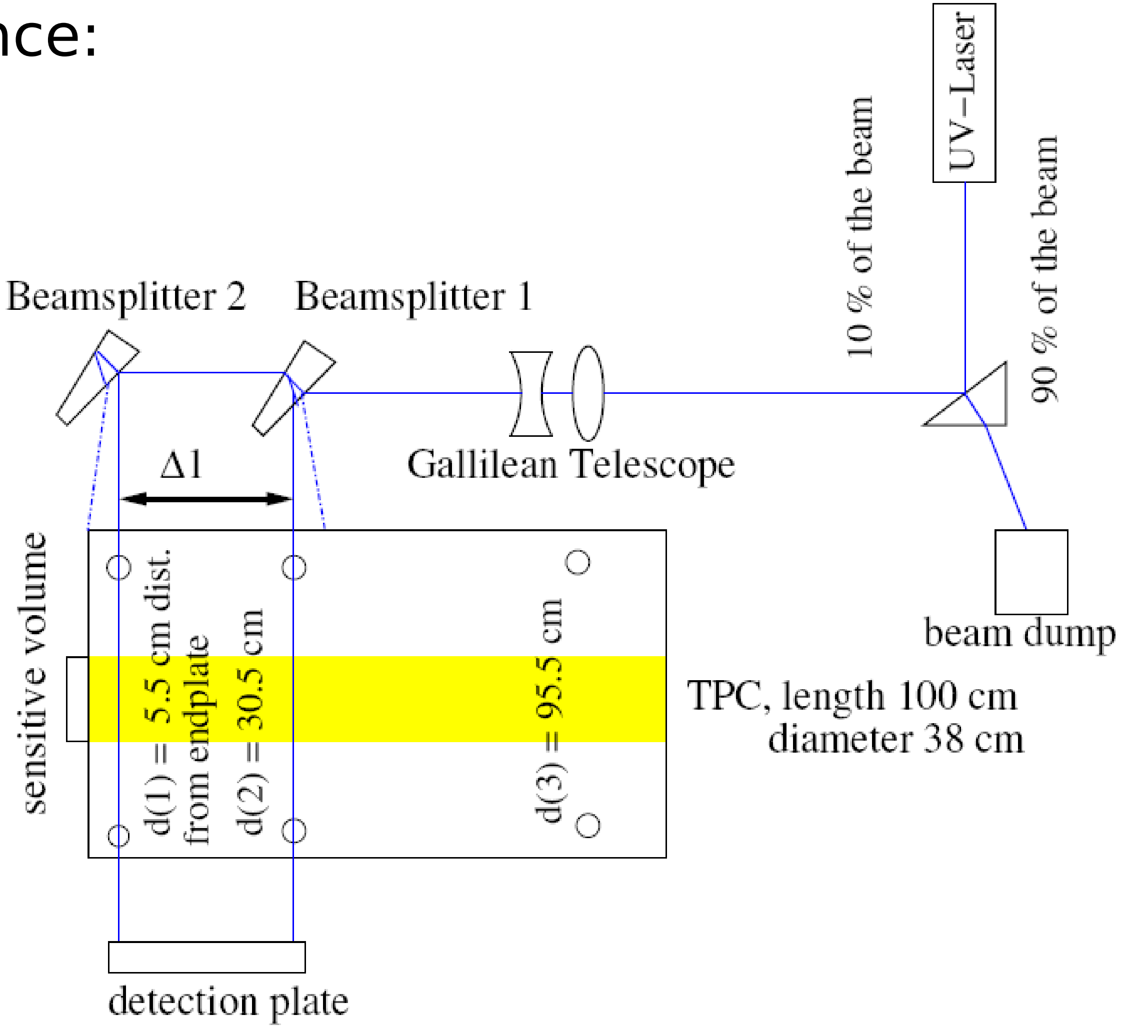
# Drift Velocity

- Use two laser beams perpendicular to the drift path with defined distance: $\Delta z_{\text{laser beams}}$
- Measure the time $\Delta t_{\text{laser beams}}$ between the arrival of the signals on the pad plane:




- Then the drift velocity is:

$$v_{Drift} = \frac{\Delta z_{laser\,beams}}{\Delta t_{laser\,beams}}$$



# Drift Velocity

- Get the drift velocity from a measured data set
- Plot the time slices of all Hits (that belong to tracks: to filter out noise)
- Search for the edge in Z (time slices) and calculate $t_{max}$ from this value
- The length $z_{chambermax}$ of the chamber is known
- Driftvelocity:

$$v_{Drift} = \frac{z_{chambermax}}{t_{max}}$$