Tracker alignment status

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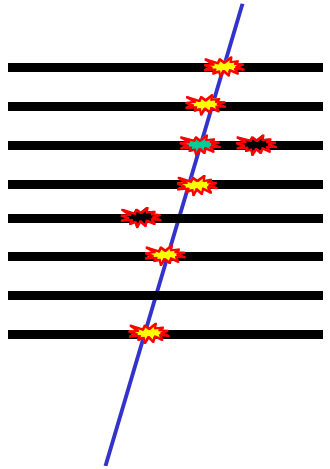
BFEM TKR Alignment

- **TKR alignment with BFEM.**
  - Objectives.
    - Examine and establish alignment procedure.
      - Comparison between data and MC.
    - Evaluate alignment precision.
      - Number of tracks required to achieve required precision.
  - Tracking.
    - Select clean tracks to avoid ambiguities.
      - Only layers with single cluster are used in the initial stage.
      - Five or more single-cluster layers in each view (X and Y).
    - Straight line fit.
      - Remove outliers.
      - Add a cluster from layers with two or more clusters.
      - Reject events if RMS is greater than 0.7 mm.



TKR Alignment Studies

- **Obtain alignment constants.**
  - Ultimate method.
    - Minimize χ^2 by adjusting SSD location and orientation.

$$\chi^2 = \sum\left(\frac{\delta x_i}{\sigma_x^i}\right)^2 + \sum\left(\frac{\delta y_i}{\sigma_y^i}\right)^2$$

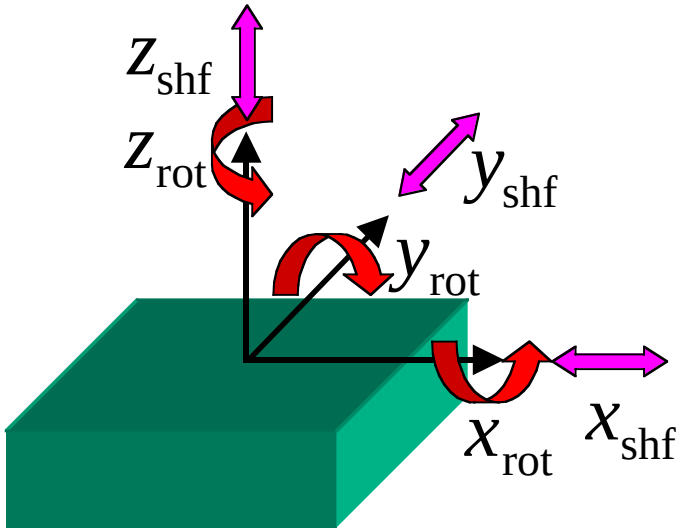
$$\delta x \equiv x_{hit} - x_{track} = -x_{shf} - z_{rot}y + \alpha_x(z_{shf} + y_{rot}x - x_{rot}y)$$

$$\delta y \equiv y_{hit} - y_{track} = -y_{shf} + z_{rot}x + \alpha_y(z_{shf} + y_{rot}x - x_{rot}y)$$

  - Simple method.
    - Understand systematics.

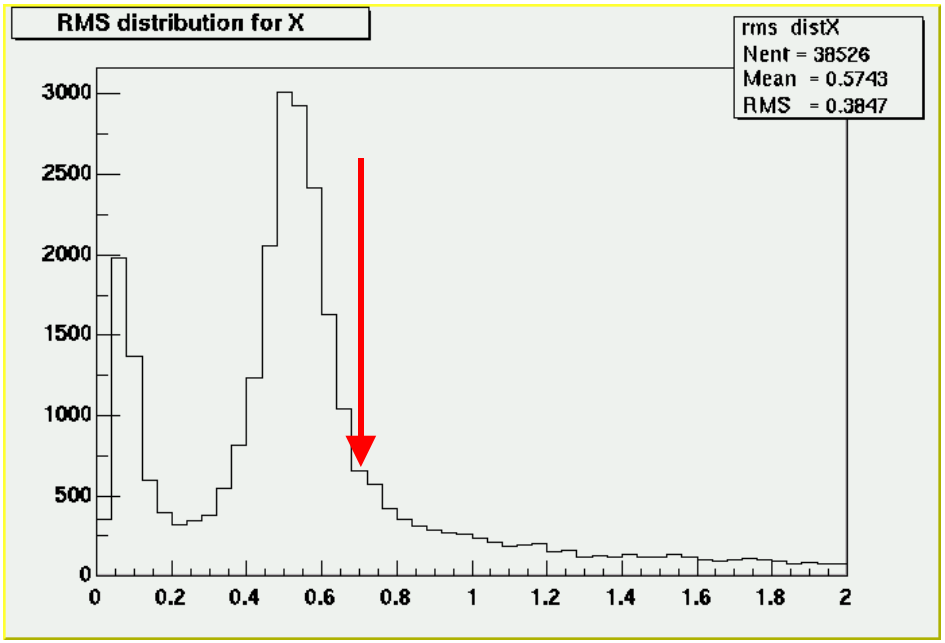
$$x_{shf} = -\langle \delta x \rangle$$

$$z_{rot} = -\frac{\sum \delta x_i y_i}{\sum y_i^2}$$

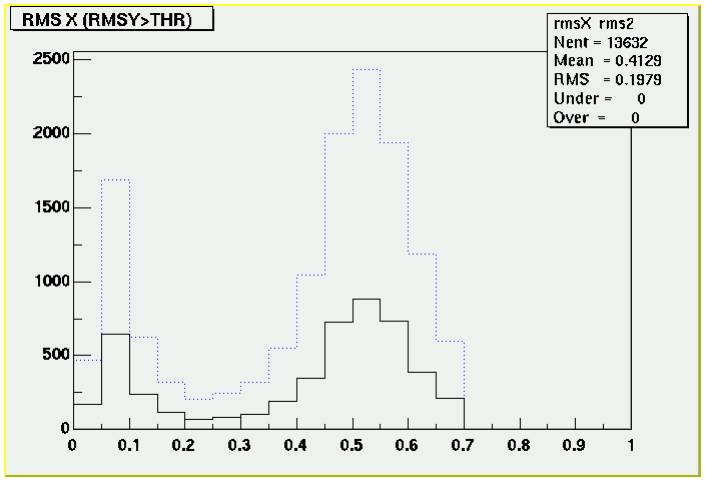


RMS Distribution

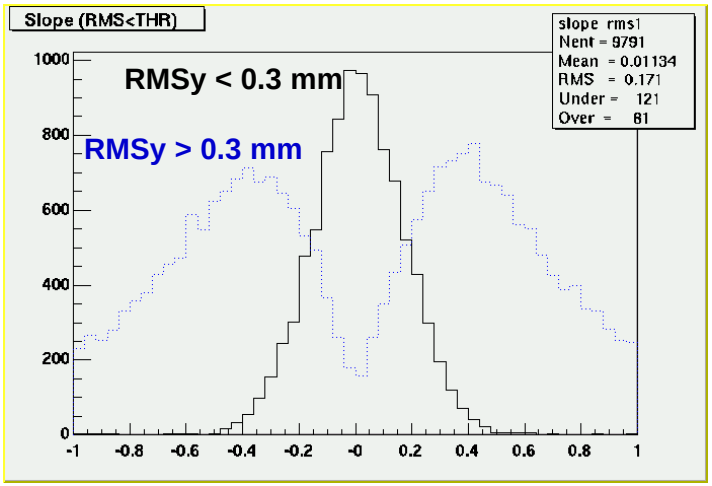
- **RMS distribution.**
  - Track is rejected if RMS > 0.7 mm
  - Two peak is observed.
  - No correlation with RMS in another projection. (RMS_x vs. RMS_y)
  - Strong correlation with track slope.



RMS (mm)



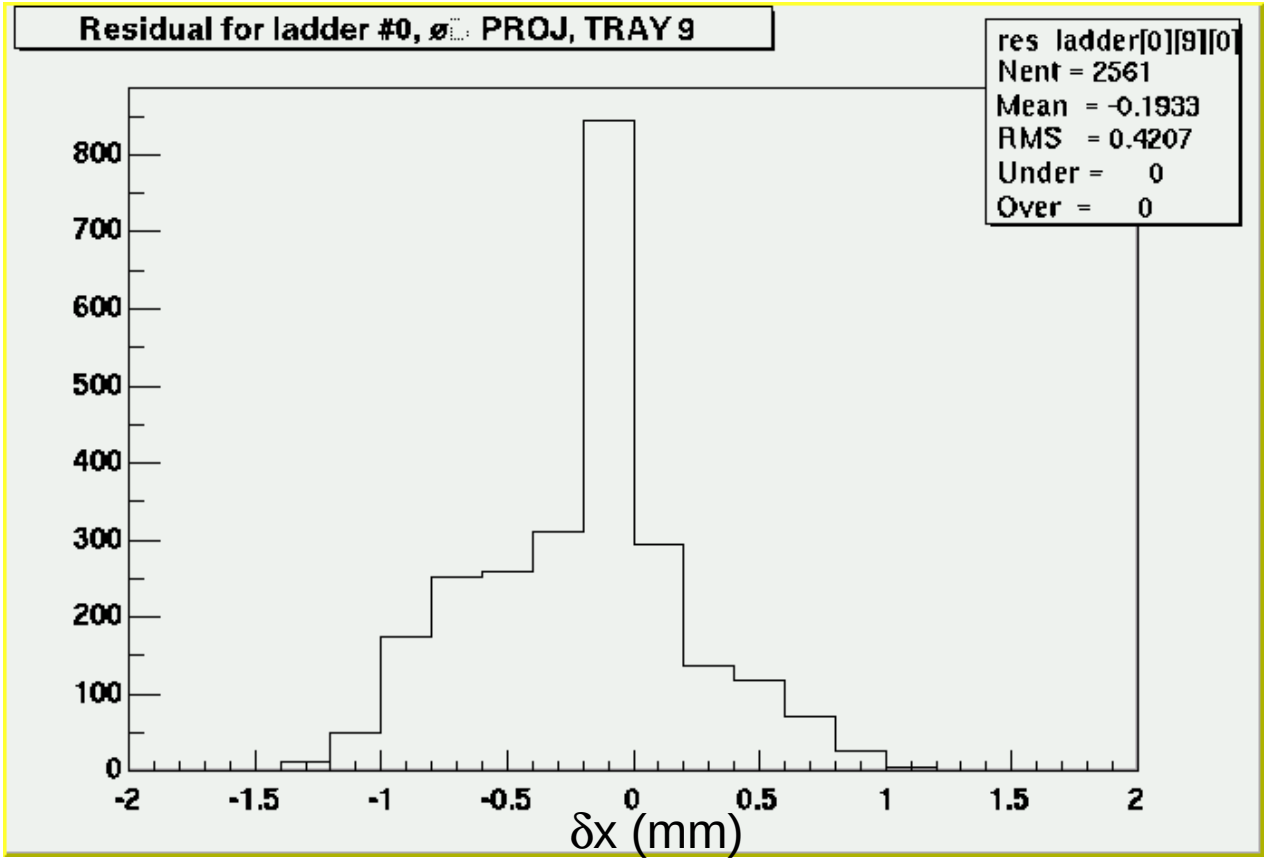
RMS (mm)



Track slope

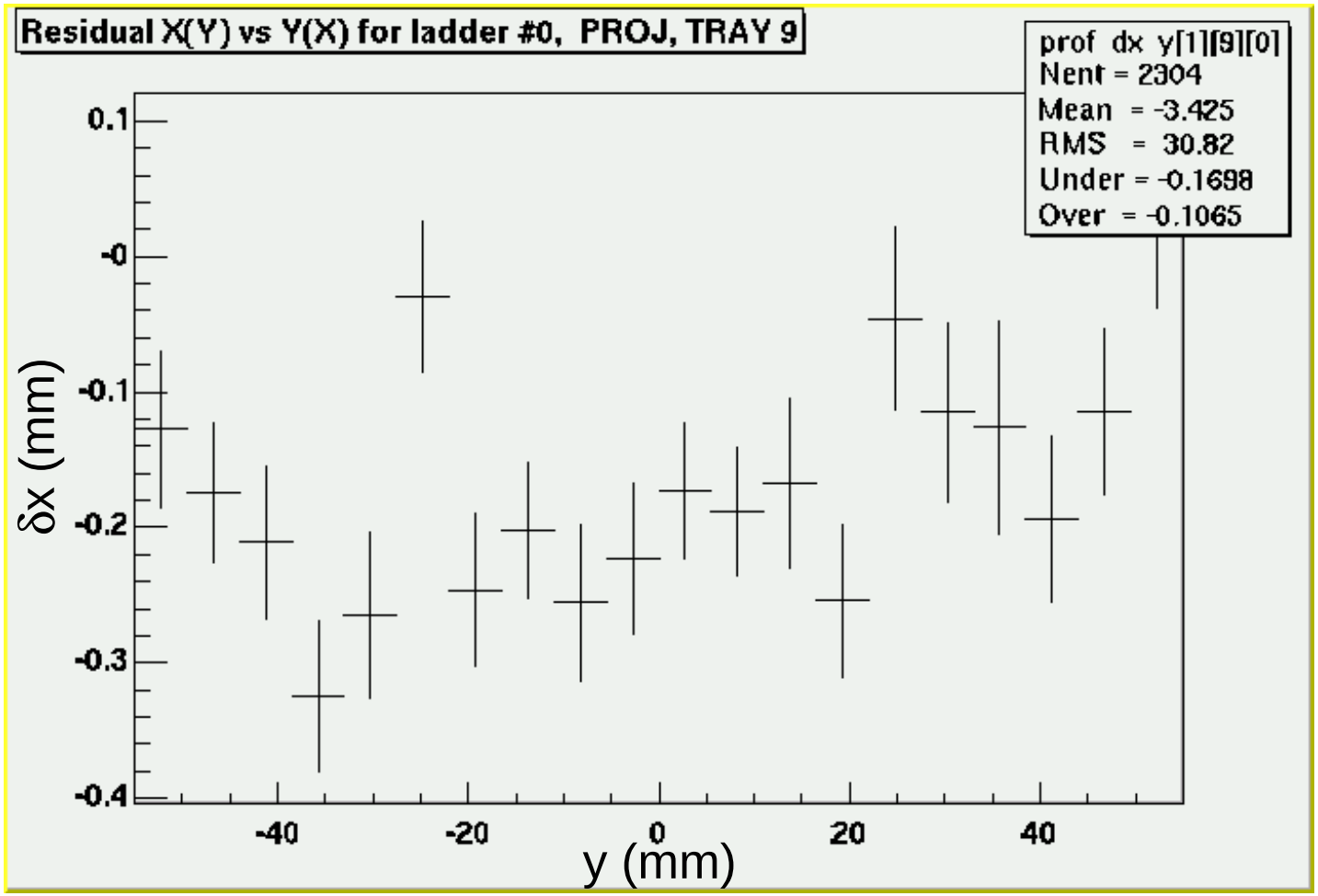
Residual

- **Large shifts (>100 μm) observed for some trays.**



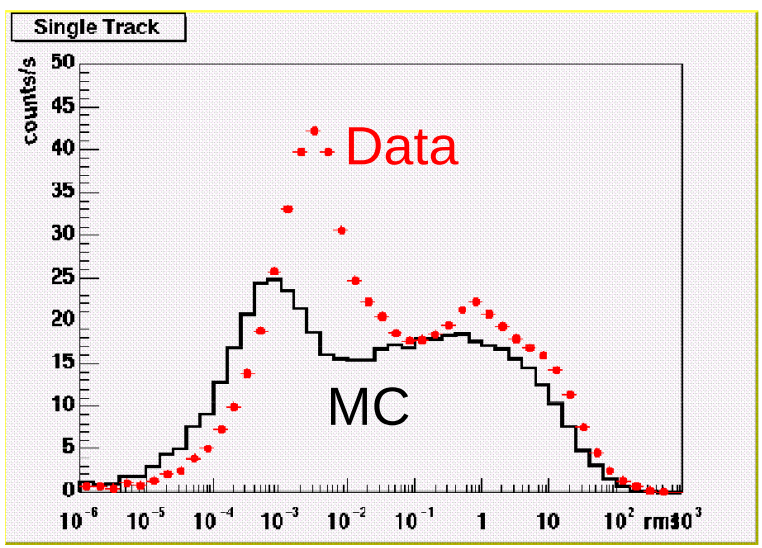
Rotation around Z

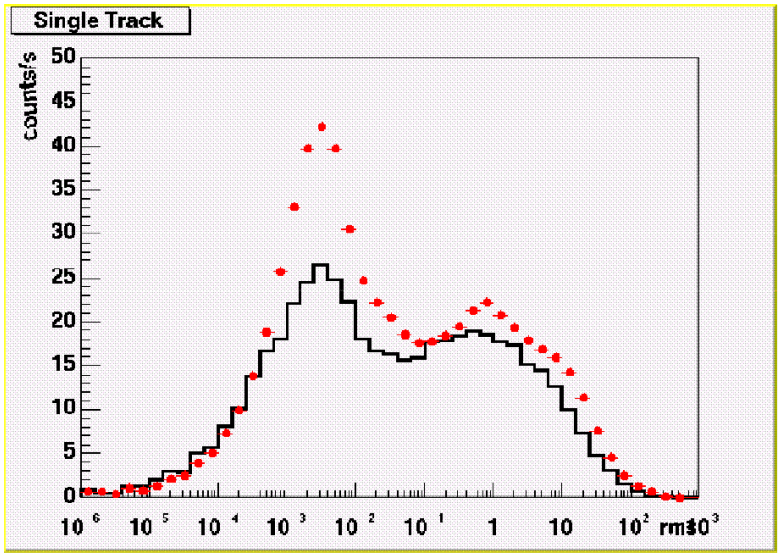
- **No visible rotation is observed.**



Misalignment in MC

- **Take into account measured shifts in BFEM MC.**
  - Peak positions in "χ^2" (normalized RMS) distributions match between data and MC.



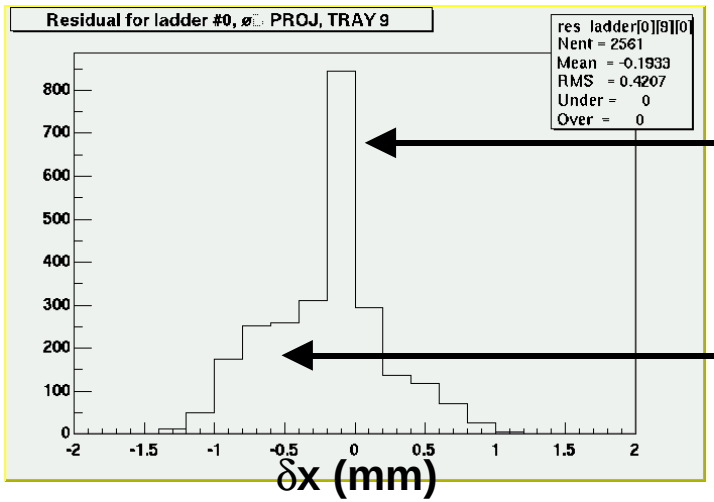


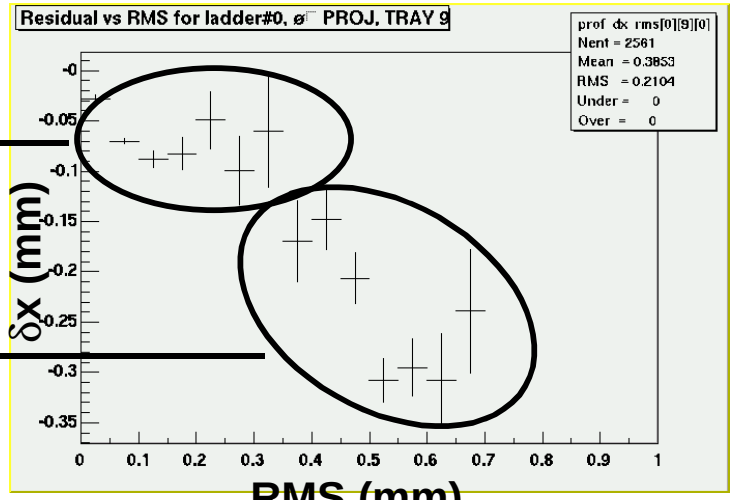
By Mizuno

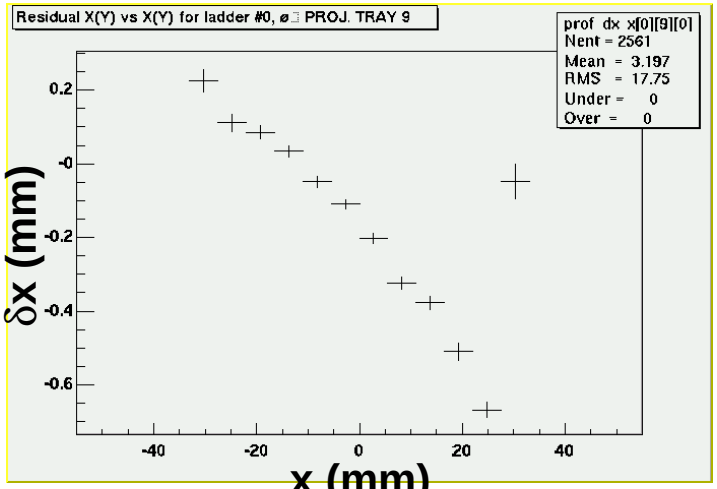
- **Looks good, but...**

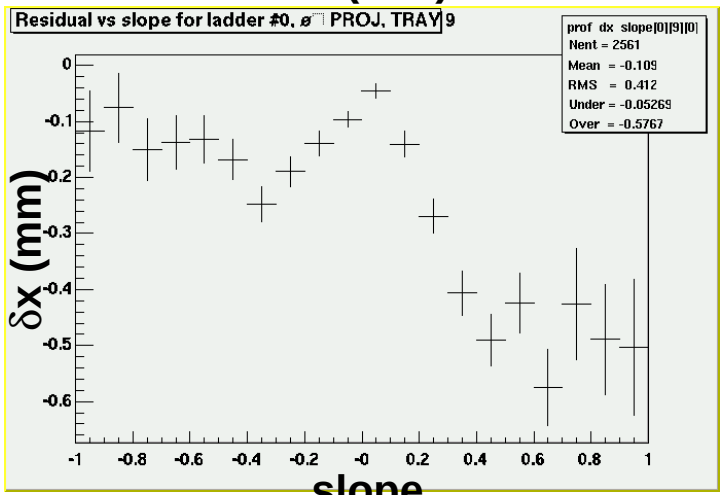
Further Studies

- **Some systematics observed.**









MC Results

- **MC gives similar systematics.**