



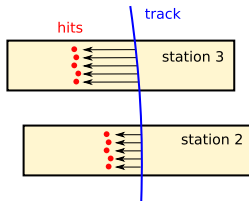
# Testing Alignment with Residuals-Differences

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- Plot difference of residuals on same track from different stations:

$(\text{station 3 track} - \text{station 3 hit}) - (\text{station 2 track} - \text{station 2 hit})$

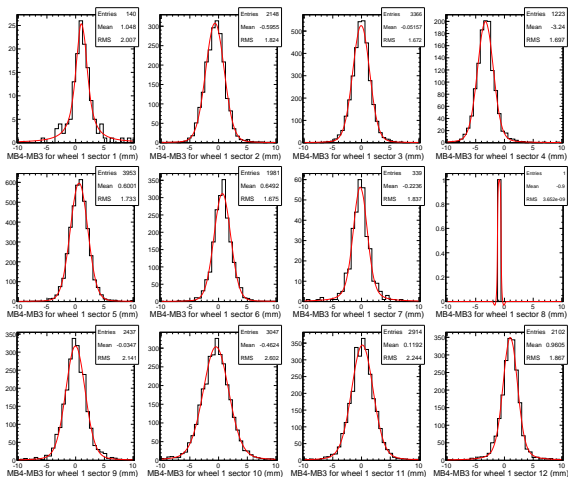
## Similarity to segment extrapolation

- Represents *relative* position of the chambers, not how either relates to the tracker (that part cancels)
- Introduces new information not used in alignment: higher precision in position ( $x$ ) differences and angle ( $\phi_y$ ) differences

## Differences from segment extrapolation

- Propagates with full CMSSW propagator, not a straight line
  - curvature of the track determined by tracker  $p_T$  measurement
- Can't be extended to tracks that don't point to tracker or 0 T data

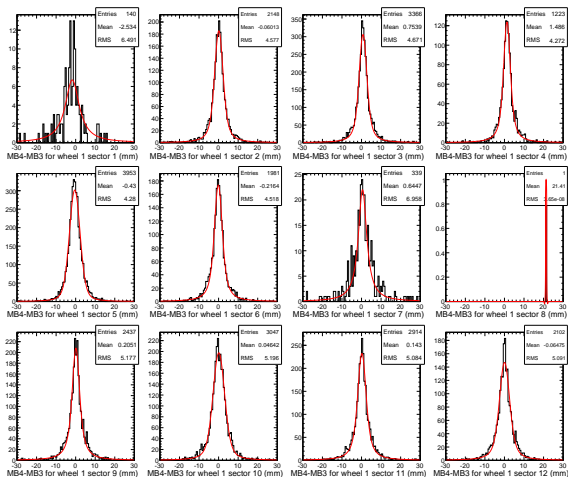
- ▶ Differences between stations 3 and 4 in wheel 1
- ▶ Distributions have tails: fit with Gaussian  $\otimes$  Lorentzian
  - ▶ doesn't matter: fit result (circles, next pages) are nearly equal to the mean (stars), usually overlapping



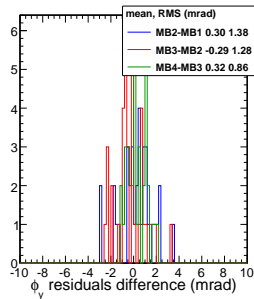
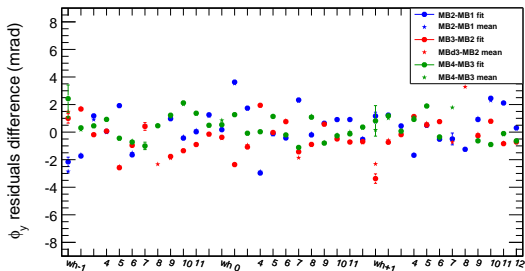
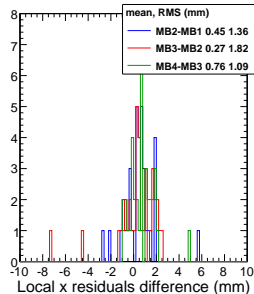
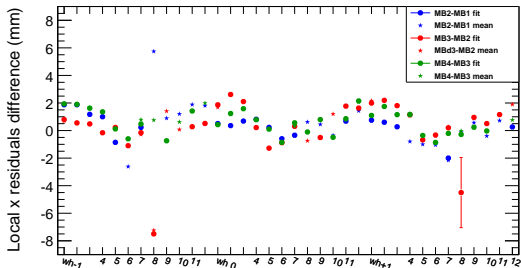
Chambers with too few tracks for alignment, such as sector 8, are excluded from the plots on the following pages

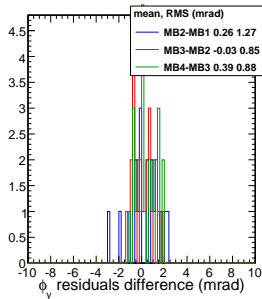
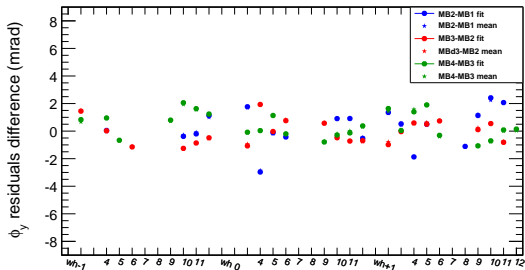
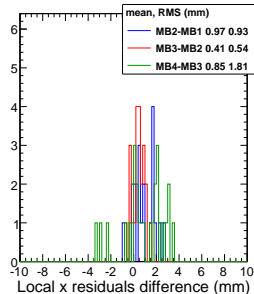
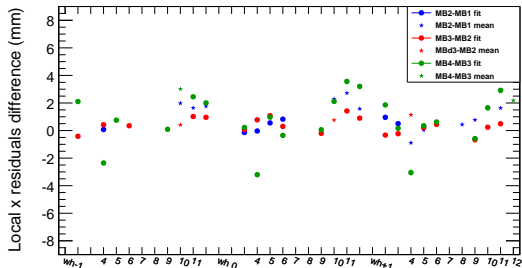


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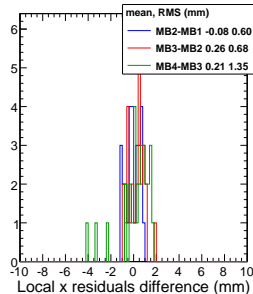
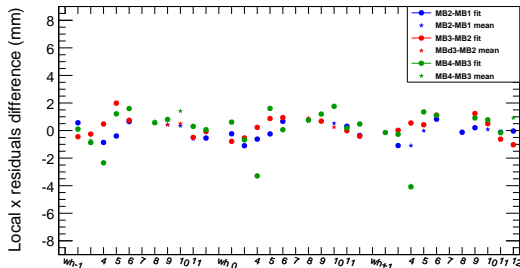
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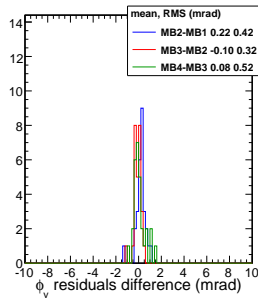
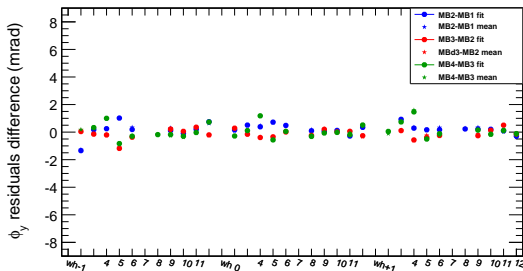


May 25 x

Jim Pivarski 7/10

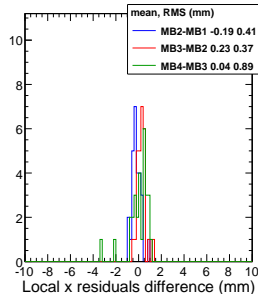
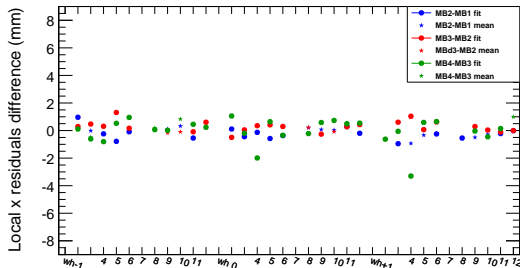


May 25  $\phi_y$

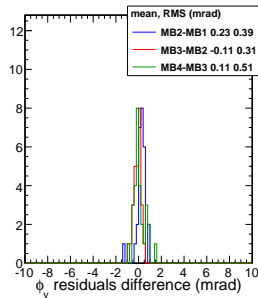
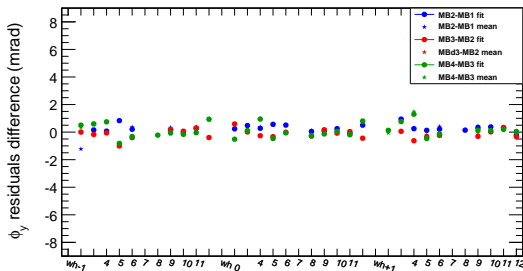


May 29  $x$

Jim Pivarski 8/10



May 29  $\phi_y$







- ▶ Chambers that were not included in a given alignment are not shown in the diagnostic:
  - ▶ CRAFT\_ALL\_V4: not globalMuon alignment, all chambers shown
  - ▶ CRAFT\_ALL\_V11: about half didn't pass the alignment criteria
  - ▶ May 25: wh-1 st2 sec8, wh+1 st2 sec2, wh+1 st3 sec8
  - ▶ May 29: wh-1 st2 sec8, wh+1 st2 sec2, wh+1 st3 sec8, wh-1 st1 sec12
- ▶ The first time  $\phi_y$  were corrected was after V11, so there are no V4-V11 differences in  $\phi_y$  (just a masking of unaligned chambers)
- ▶ DB-difference between May 25 and 29 in  $\phi_y$  has an RMS of 0.5 mrad; differences observed by tracks is also small
- ▶ DB-difference between May 25 and 29 in  $x$  has an RMS of 2.5 mm; track-based difference is significant (and favors May 29)
- ▶ Station 4, sector 4 chambers are often outliers in  $x$ , exactly as they were in the segment extrapolation plots. These are also the chambers with internal structure (10 mm discontinuity in residuals at  $x = 0$  through the middle of the chamber).



- ▶ Residuals differences, much like segment extrapolation, introduces new information, not used in alignment
- ▶ With the exception of station 4 sector 4 chambers, relative differences in May 29 (latest)  $x$  is  $400\ \mu\text{m}$
- ▶ Relative differences in  $\phi_y$  are 0.3–0.5 mrad