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# Stability measurement for SciFi module alignment on 2022 data

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Nils Breer

**30. August 2023**

TU Dortmund, AG Albrecht

## Dataset and motivation

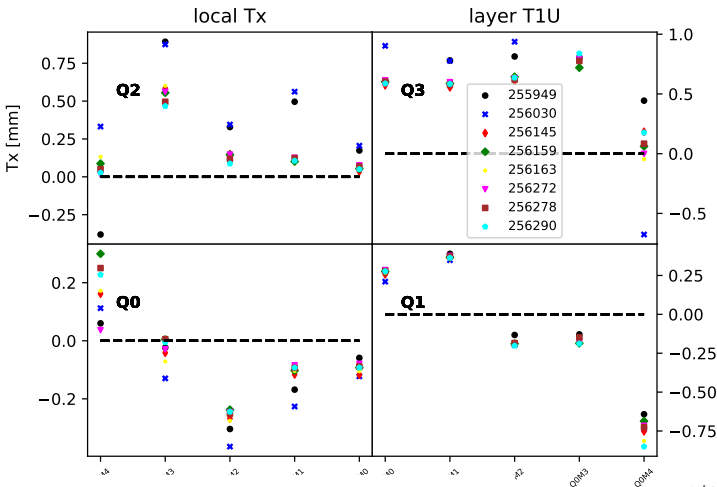
- **How much does the SciFi move between runs?**
- **Does magUp vs. magDown polarity impact the movement?**
- run an alignment for each of the runs on the list
- sort the runs in ascending run number
- compare the difference in module position for each run to the next
- where are the modules in the local frame in all runs?

## Procedure

- **Dataset** contains magUp and magDown samples from 2022 labeled as "good" from EMTF
  - Good: > 90% of datalinks are good
  - Includes runs from fills: 8489, 8491, 8496
- List of randomly chosen runs: 255949, 256030, 256145, 256159, 256163, 256272, 256278, 256290
- V10 Alignment from tag (loose tracking, half module alignment TxRz + Mats, back layer fixed) from conditions database

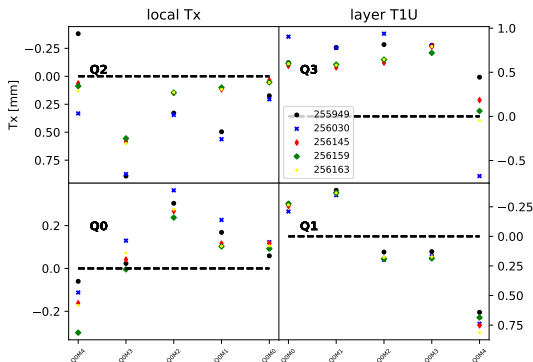
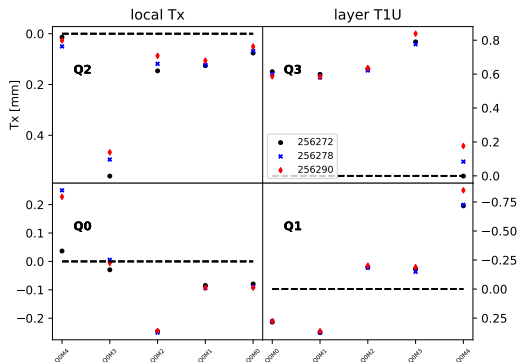
## Module Positions in local half module frame

- Runs 255949 + 256030 were from fill 8489
- Optimal fine timing implemented in 256145 (afterwards)
- Positions of other runs compatible (here: MU and MD mixed)



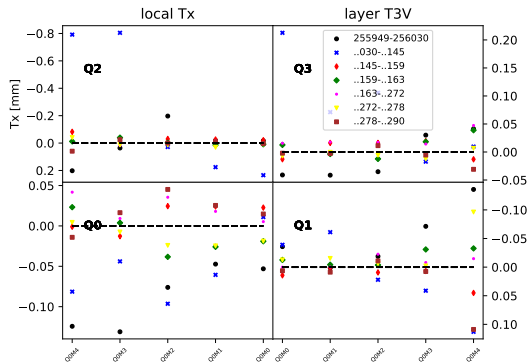
## Module positions: magUp and magDown in x-direction

- magUp (left) and magDown (right) runs are compatible respectively within  $100\mu\text{m}$
- black, blue: worse timing than other runs  $\rightarrow$  shifted modules



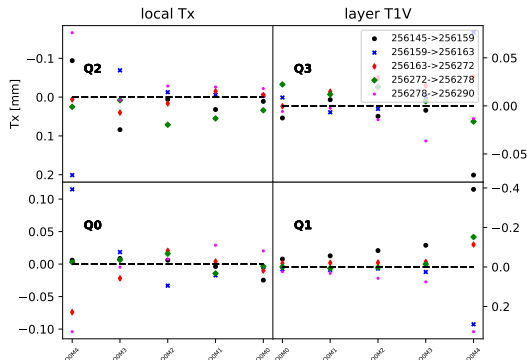
## Difference between runs: Tx

- Outer module (M4) more movement than inner modules ( $\approx 280$  hits in M4 vs 100k hits in M0)
  - Largest movement: T3VQ1M4
  - Timing changes: expect movement of at most  **$250\mu\text{m}$**  if enough statistics
  - largest movements/outliers (blue markers): T1V (-0.4mm), T3V(-0.8mm), T3X2 (-0.6mm)
- possible cause: lack of statistics



## Reduced dataset: removed pre timing update runs

- removed the first 2 runs from input list since they are from a fill without the optimal timing changes
- Without the fine timing changes the largest movement is at max around **200 $\mu$ m** at most outer modules
- M4, M5 often < 1000 events  $\rightarrow$  large movement
- M0-M3: movement at most around **150 $\mu$ m**



## Message

- Impactful changes like timing induces an observed movement up to 0.8mm in some cases
- The change in module position from run to run is at maximum **150 $\mu$ m** for the modules M0  $\rightarrow$  M3 in Tx
  - $\rightarrow$  only if there are no big changes between runs
- M4 moves at max **200 $\mu$ m** in this case
- there is no visible difference between magUp and magDown polarity



## Backup: MagUp and magDown only comparison

MagUp Tx and Tz module position comparisons

