Stability measurement for SciFi module alignment on 2022 data

Nils Breer

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TU Dortmund, AG Albrecht

Motivation and procedure

- **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?

Dataset and Alignment setup

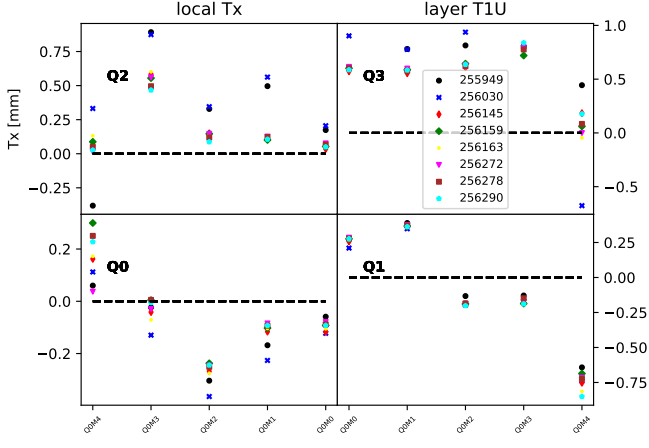
- Dataset contains magUp and magDown samples from 2022 labeled as ”good” from EMTF
- Good: > 90% of datalinks are good
- Includes runs from fills: 8489, 8491, 8496

List of randomly chosen runs: 255949, 256030, 256145, 256159, 256163, 256272, 256278, 256290

- V10 Alignment from tag (loose tracking, half module alignment TxTz + Mats, back layer fixed) from conditions database

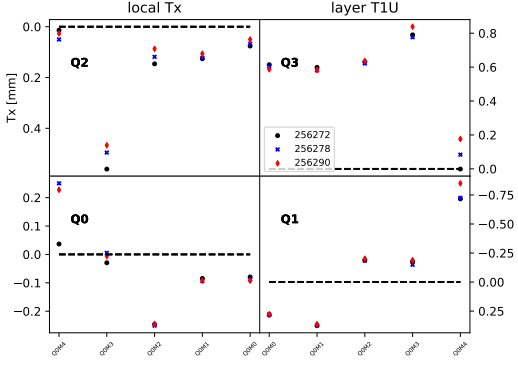
Module Positions in local half module frame

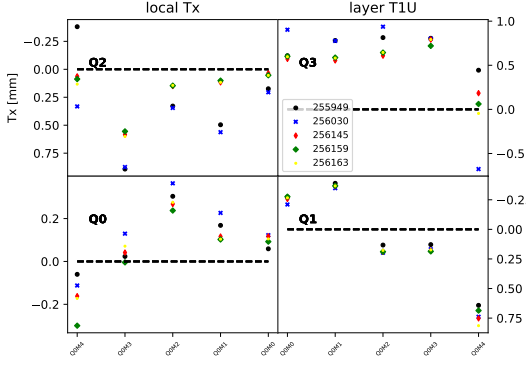
- Runs 255949 + 256030 were from fill 8489
- Optimal fine timing implemented in 256145 (afterwards)
- Positions of other runs compatible
- magUp: 256272, 256278, 256290
- magDown: 255949, 256030, 256145, 256159, 256163



Module positions: magUp and magDown in x-direction

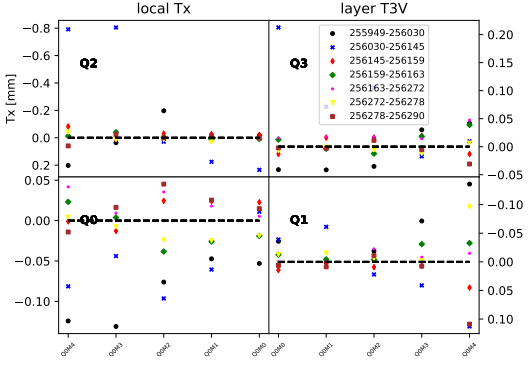
- magUp (left) and magDown (right) runs are compatible respectively within $100\mu m$
- black, blue: worse timing than other runs →shifted modules





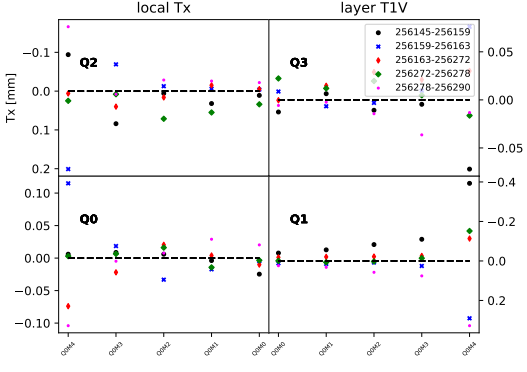
Difference between runs: Tx

- difference in module position between 2 runs
- Outer module (M4) more movement than inner modules (≈280 hits in M4 vs 100k hits in M0)
- 256030 to 256145 (blue markers) largest movement: fine timing changes, lack of statistics
- Timing changes: expect movement of at most $250\mu m$ if enough statistics
- largest movements/outliers (blue markers): T1VQ2M2 (-0.4mm), T3VQ2M3,4 (-0.8mm), T3X2M3,4 (-0.6mm)



Reduced dataset: removed pre timing update runs

- again: compare module positions of 2 runs but remove first 2 runs from input (different fine timing)
- Without the fine timing changes the largest movement is at max around **400μm** at most outer modules
- M4, M5 often < 1000 events (difficult for the alignment) →large movement,
- M0-M3: movement around **150μm**



Conclusion

- 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*μm*** for the modules M0 →M3 in Tx

→only if there are no big changes between runs

- M4 moves at max **400*μm*** in this case
- there is no visible difference between magUp and magDown polarity
- With good SciFi timing, variation of 200 ***μm*** expected.
- A possible choice of an automatic update would be if variations of > 200 ***μm*** occur.

Backup: MagUp and magDown only comparison

MagUp Tx and Tz module position comparisons