

# Alignment stability tests and joint constraint analysis

Nils Breer

24. Juli 2023

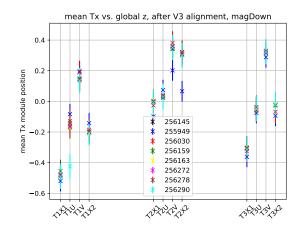
Faculty Physics



## **Alignment stability**

- How stable is the alignment over several runs/fills?
- difference in alignment quality between magnetUp and magnetDown?

MD: black, blue, red, green MU: yellow, magenta, brown, cyan





## **Config and run info**

#### Config used:

- V10 alignment tag
- DoF: TxTzRz
- surveyconstraints: data20221115dd4hep
- lagrange constraints: ["Tx", "Tz", "Rz", "BackLayerModules: FT/T3/X2/HL.\*. : Tx Tz Rx Rz"]

- runs labeled as Good from EMTF
- fill 8489: blue + red
- fill 8491: yellow + green + black
- fill 8496 magenta + brown + cyan

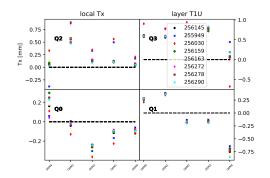
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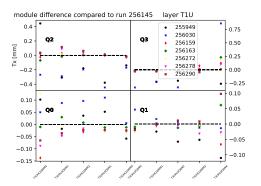


#### module x translation

10 iterations, converged

left plot: module position in comparison to nominal (maximum of 1mm in Tx is expected) right plot: module position compared to 256145





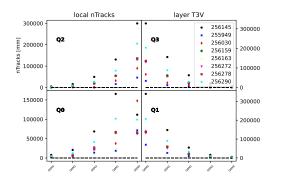
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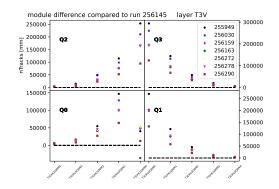


#### **nTracks**

10 iterations, converged

left plot: module position in comparison to nominal (maximum of 1mm in Tx is expected) right plot: module position compared to 256145

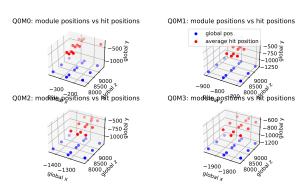




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- 256145, T3V low efficiency in O0M0
- module position vs. hit position being off →not all hits not registered in the module
- is this just a V10 alignment issue or still visible in v7/v8?
- Good news: MD and MU runs very comparable
- Module positions with 1 mm in Tx



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## Analysis of joint constraint errors and chi2

long modules not in geometry, half modules joined to mimic "banana shape"

combination of 2 Alignables  $\rightarrow$ how realistic are the errors?

Plan:

instead of 1 chi2 value calculated from Cov matrix

→ calculate chi2 value for each DoF separately run alignment with different errors and calculate chi2 again

→ tune errors to yield more or less chi2/dof = 1 at least make sure none really sticks out

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## Analysis of joint constraint errors and chi2

- Covariance matrix: 1/errors<sup>2</sup> diagonal
- $\chi^2 = (pA pB)^T \cdot \text{Cov} \cdot (pA pB)$
- pA, pB: Set of parameters for tophalfand bottomhalf modules
- initial errors: (Tx,Ty,Tz,Rx,Ry,Rz)0.001 0.001 0.001 0.0002 0.0002 0.0002

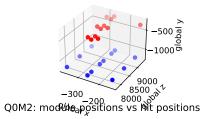
```
Total chisquare of survey constraints: 25974.1 / 1536
Total chi2 of joint constraints: 15100/768
chi2 values for each degree of freedom:
Tx_chi2: 7633.05/768
Ty_chi2: 1121.29/768
Tz_chi2: 2586.76/768
Rz_chi2: 3086.38/768
Ry_chi2: 0.0036795/768
Rz_chi2: 672.561/768
```

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### **Backup**

Q0M0: module positions vs hit positions



-500 ∑ -750 golb -1000b 9000 8500 8000 -1400-1300

Q0M1: module positions vs hit positions

