

Sensitivity Study of

$$B_d^0 \rightarrow K_1^0(1270)\mu^-\mu^+$$



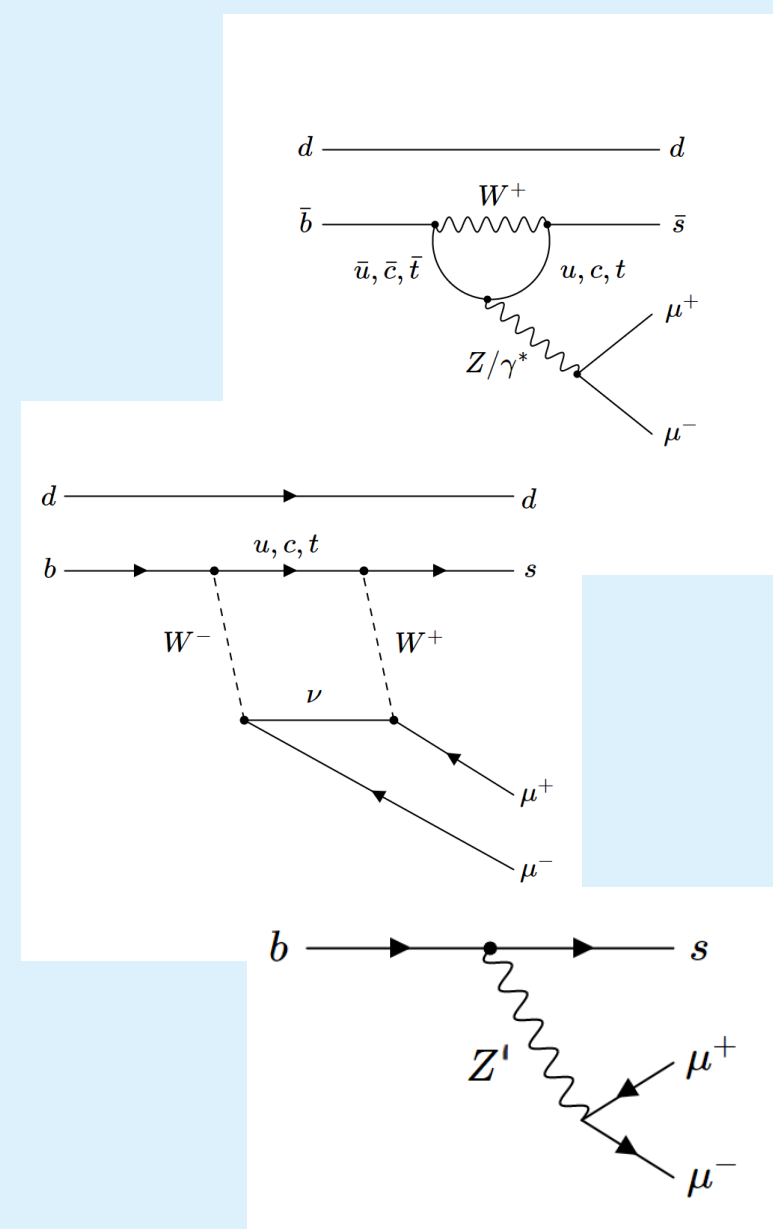
Motivation & Theory

- Weak interactions are exclusively of the vector – axial vector (V – A) type in SM, coupling to left handed particles (RH anti).
- No reason why BSM right handed weak interactions (V + A) shouldn't exist. Would be drowned out by SM contributions (V – A).
- Using a decay channel and an opposite parity channel can be sensitive since they have opposite signs in the amplitude.

$$B_d^0 \rightarrow K_1^0 \mu^- \mu^+$$

$$B_d^0 \rightarrow K^{*0} \mu^- \mu^+$$

- Flavour changing neutral currents, allowed in SM but prohibited at the tree level.
- Very rare process, properties are very well predicted by the SM – easy to find discrepancies.
- E.g. tension in lepton universality in $R_k = \frac{\mathcal{B}(B^+ \rightarrow K^+ \mu^+ \mu^-)}{\mathcal{B}(B^+ \rightarrow K^+ e^+ e^-)}$ parameters with 3.1σ [[arxiv:2103.11769](https://arxiv.org/abs/2103.11769)].

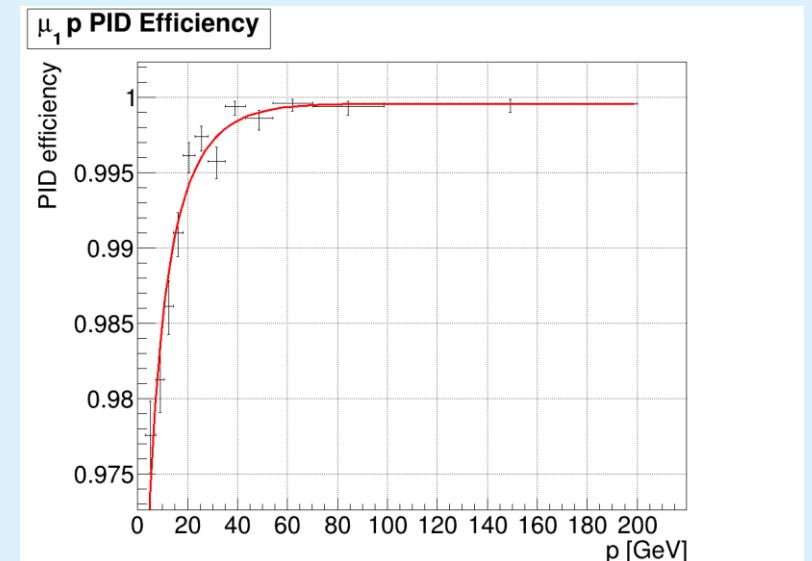
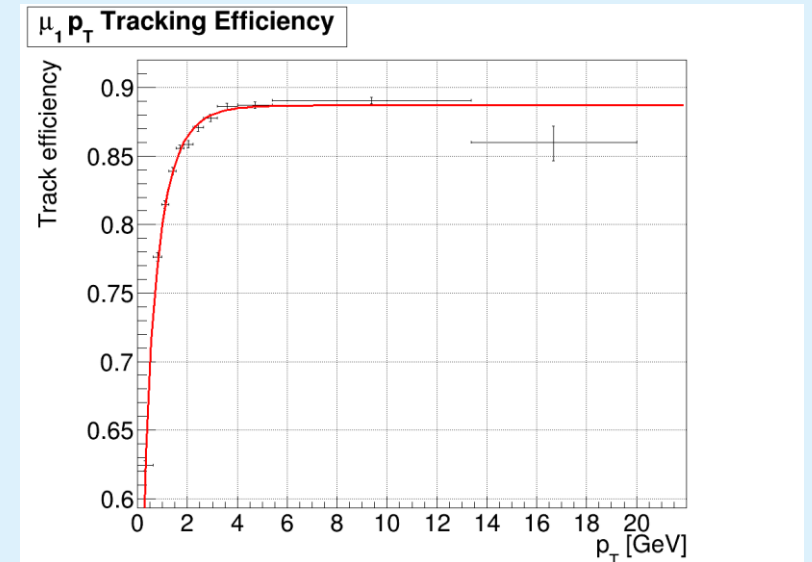
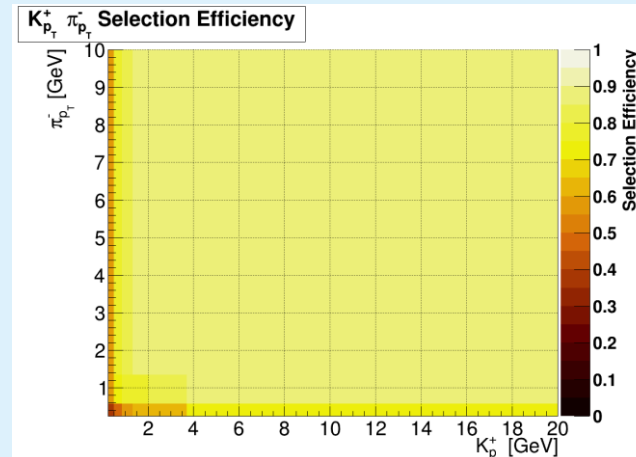
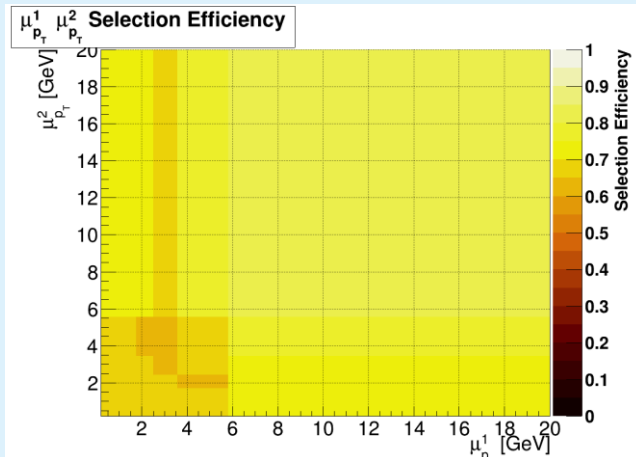


Efficiencies and Preliminary Selections

To estimate the number of K_1^0 decays found at LHCb need the detection efficiencies, broken down into a series of stages:

$$\varepsilon = \varepsilon_{Generated} \times \varepsilon_{Tracking} \times \varepsilon_{PID} \times \varepsilon_{Selections}$$

- Selections to reject various backgrounds e.g. refuse tracks where particles don't pass close enough to each other.
- Estimated using Monte Carlo data for the K^{*0} channel since they share similar final states, only difference is kinematics.

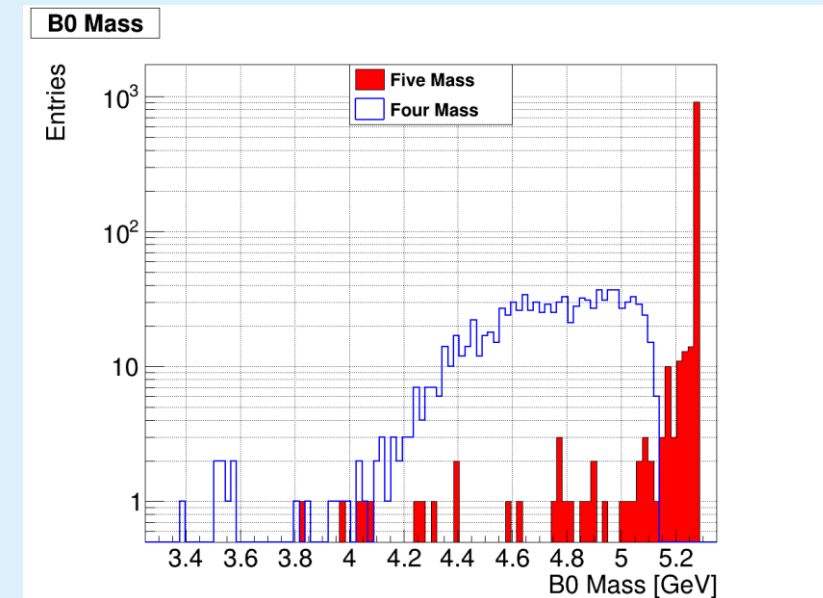


Results and Future Outlook

$$B_d^0 \rightarrow (K_1^0[1270] \rightarrow (K^{*0}[892] \rightarrow K^- \pi^+) \pi^0) (J/\psi \rightarrow \mu^- \mu^+)$$

13337 Events per fb^{-1} at LHCb (no selections)

- For contrast the K^{*0} channel had 5247 events without selections and a selection efficiency of $\sim 64\%$.
- K_1^0 selection efficiency will be lower due to the kinematics and the π^0 , but almost definitely significant.
- High luminosity pile-up, expecting lots of π^0 's.
- More selections need to be processed to reduce the background and improve the signal quality.
- Will with the π^0 (Five Mass) or without π^0 (Four Mass) be more significant for analysis.



Vertex Locator Alignment



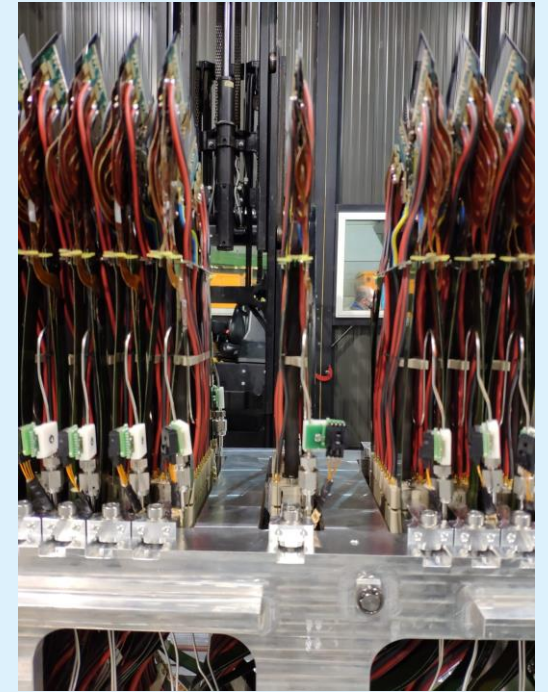
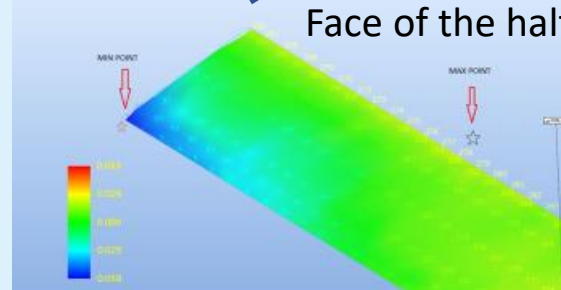
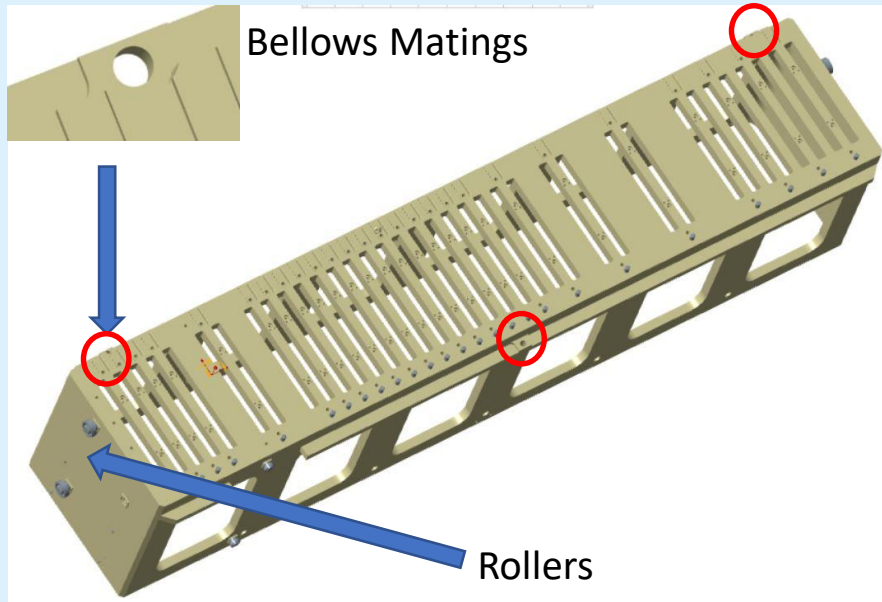
13/06/2022

James Brown

Slide 5

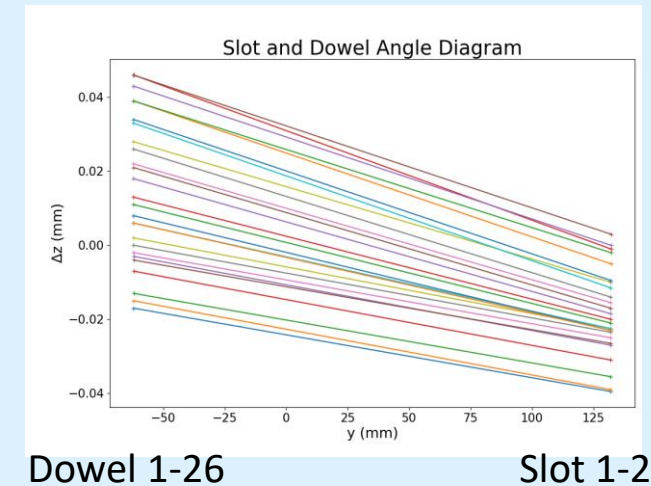


Base Alignment



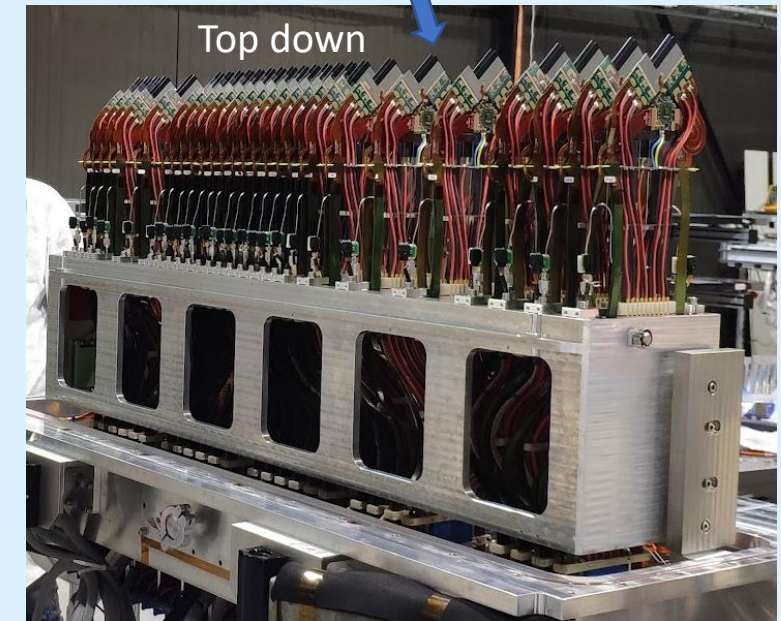
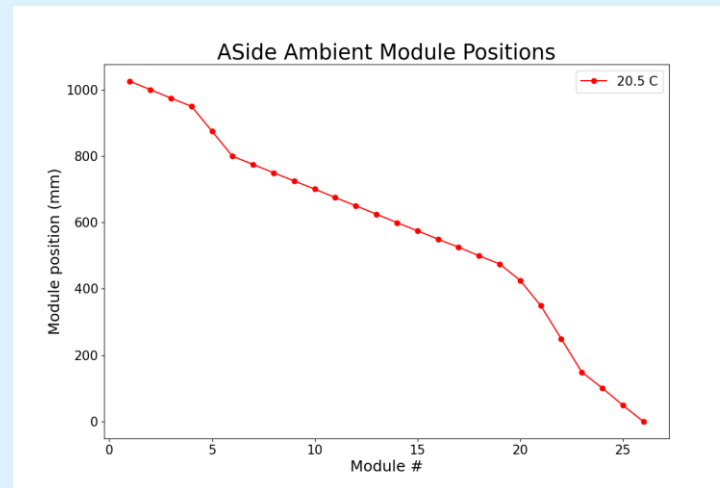
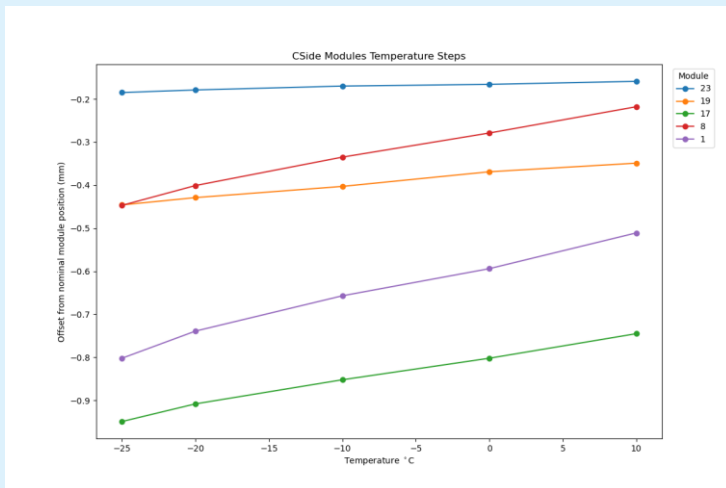
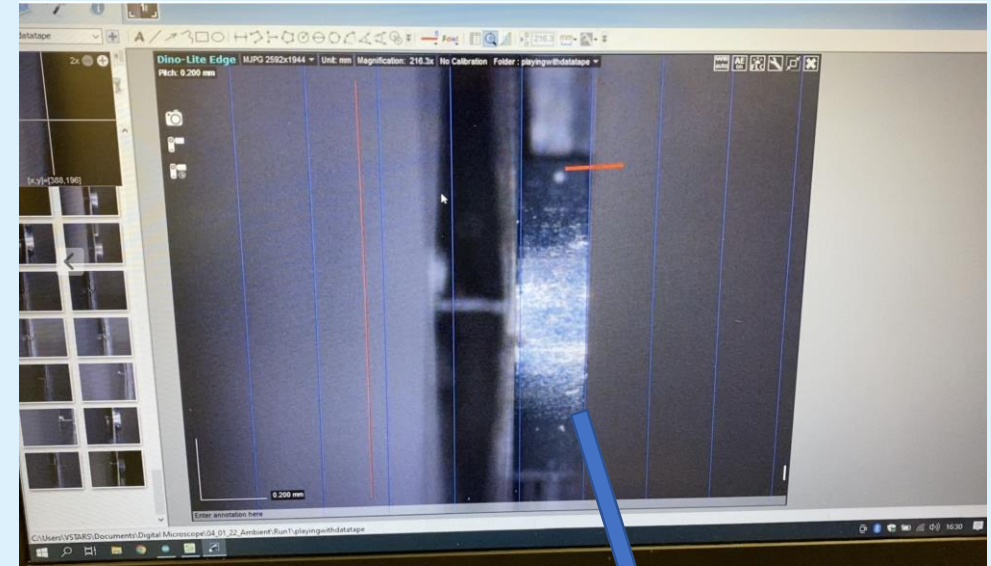
- Rollers and bellows matings affect the whole half.
- Rollers apply rotation over the extensions length.
- Bellows matings rotate the face of the half.

- Face of the half is not uniform, some points are higher than others.
- Individual modules will be locally rotated.



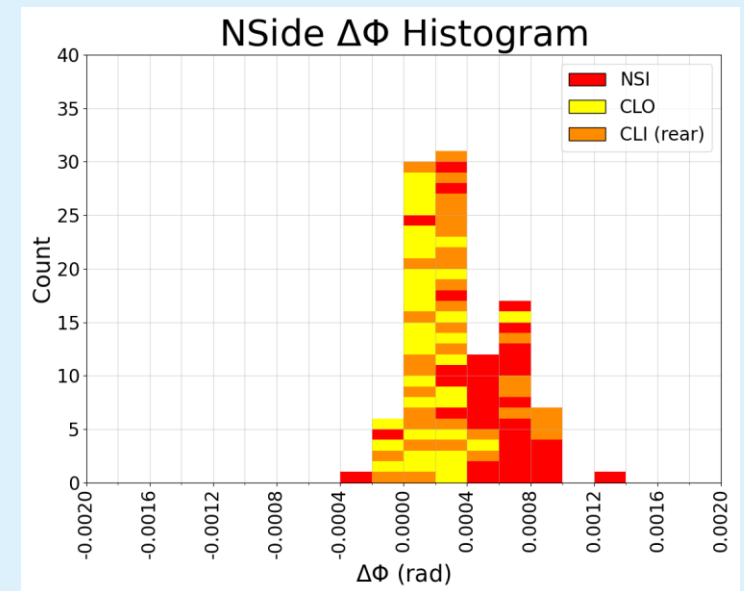
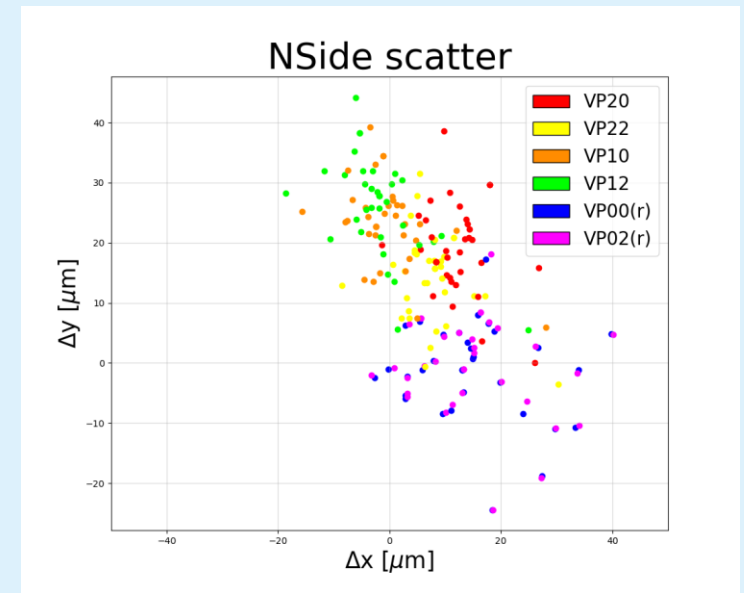
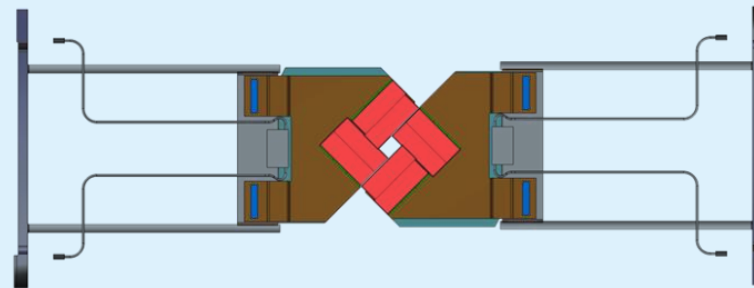
Temperature Variation

- Measurements of modules along the beampipe in is made using a microscope mounted to a rail.
- Measurements are done at ambient and with the VELOs cooling in operation across a variety of temperatures.
- Determine effects of the cooling on the module positions.



Tile Offset Alignment

- Tiles (pink sensors below) are glued onto the module and held in place.
- Temperature variations in the room etc cause glue to dry differently, tile to be offset.
- Measurements of markers on tiles are made using a digital microscope for their positions on each module.
- Offsets and rotations for each of the tiles is calculated using nominal positions.



Thank you for listening,
Questions?

