

Flip Mode Emittance Evolution: Beam Selection Testing

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- Continued testing the beam selection routines.
- Selected samples that have matched optics in the upstream tracker, to improve the cooling performance.
- Used FULL LH2 and NO ABSORBER 3, 4, 6 mm, 140 MeV/c, flip mode data.

Beam Selection

- The magnet issue led to an improperly matched beam into the downstream of the cooling channel, limiting the transmission
- Initial matching into the upstream tracker was determined by beamline design
- Selecting the correct initial beam parameters should allow us recover the cooling performance
- Procedure:
 - 1 Generate some data
 - 2 Find a function that describes the data (the parent)
 - 3 Find a function that describes the required distribution (the daughter)
 - 4 Randomly select events based on the ratio of probabilities between the parent and the daughter

For a given event x ,

$$\text{Prob. of Selection} = \frac{\text{Daughter}(x)}{\text{Parent}(x)} \times \text{Some Normalisation}$$

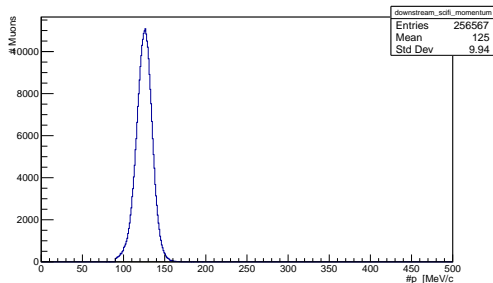
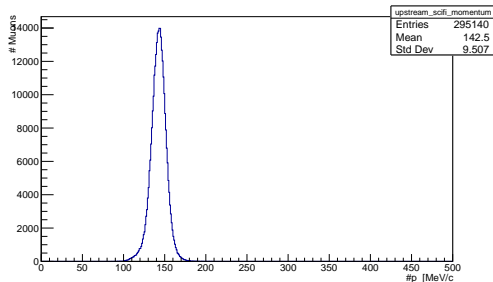
- Upstream

- 1 SP in both TOF0 and TOF1
- TOF01 consistent with muon peak
- TKU: $135 \text{ MeV}/c < \text{total momentum} < 145 \text{ MeV}/c$
- $\chi^2/\text{ndf} < 8$ TKU
- Diffuser radius cut: $r < 90 \text{ mm}$
- Fiducial cut: $r < 150 \text{ mm}$

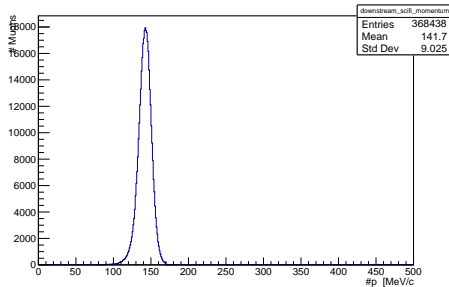
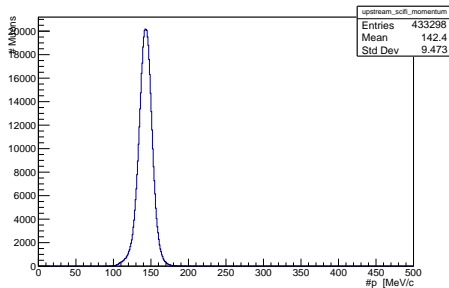
- Downstream

- TKD: $90 \text{ MeV}/c < \text{total momentum} < 170 \text{ MeV}/c$
- $\chi^2/\text{ndf} < 4$ TKD
- Fiducial cut: $r < 150 \text{ mm}$

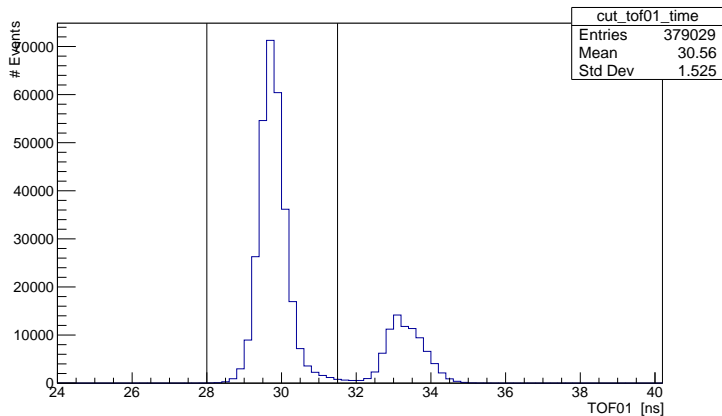
Full LH2 6 mm, Total Momentum



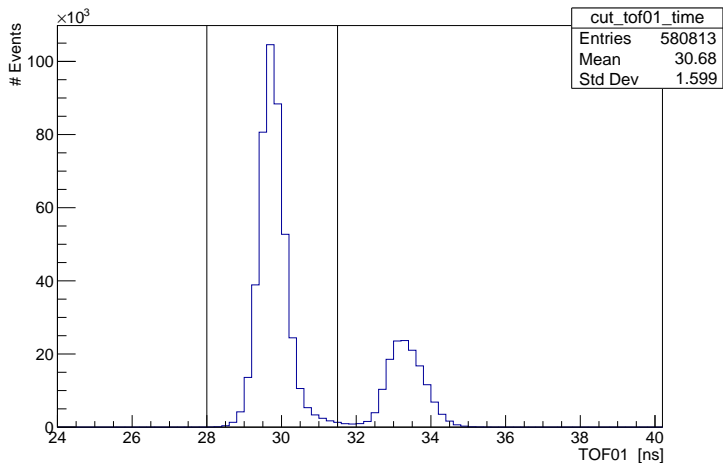
No absorber 6 mm, Total Momentum



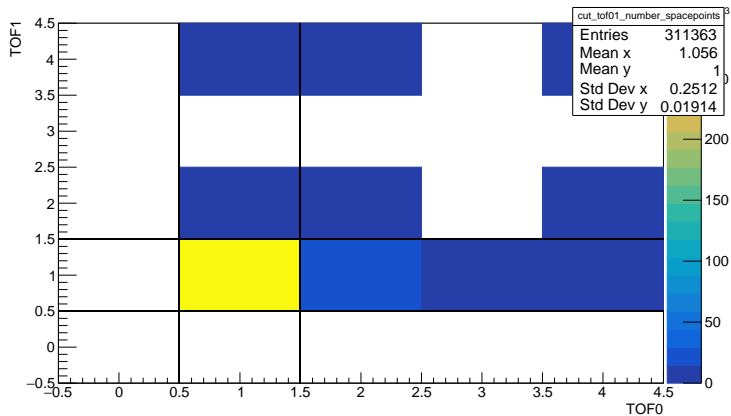
Full LH2 6 mm, TOF01 time



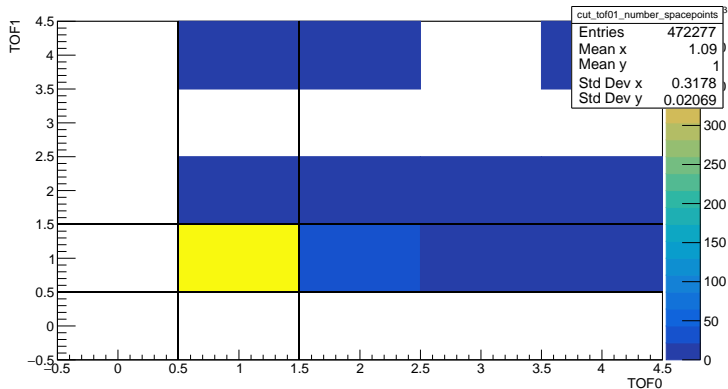
No absorber 6 mm, TOF01 time



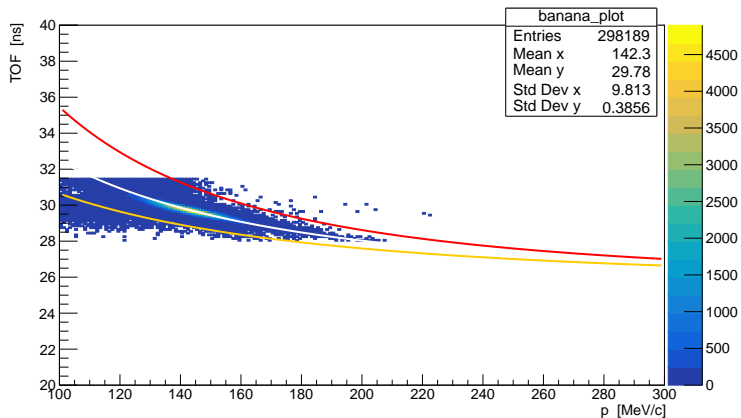
Full LH2 6 mm, TOF01 spacepoints



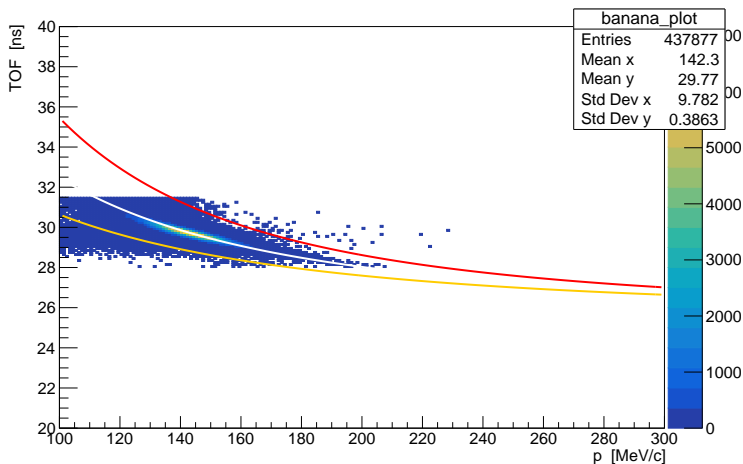
No absorber 6 mm, TOF01 spacepoints



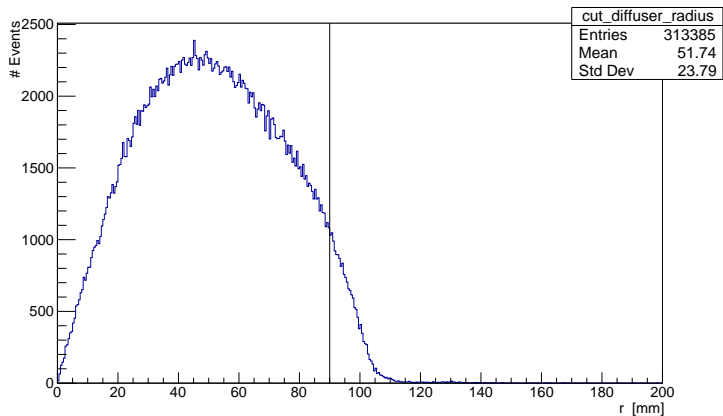
Full LH2 6 mm, Banana plot



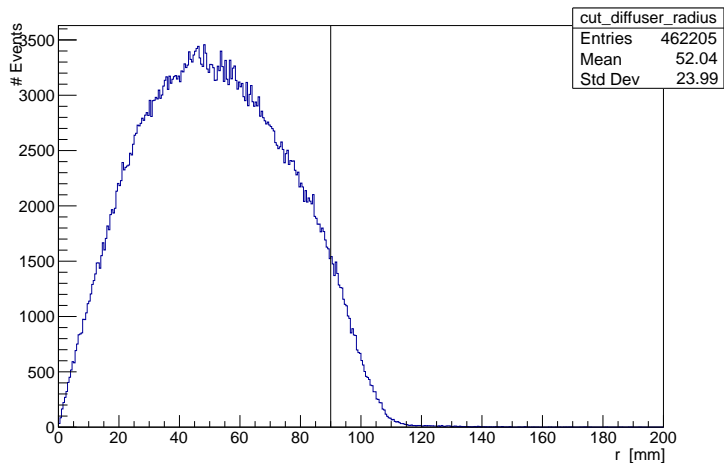
No absorber 6 mm, Banana plot



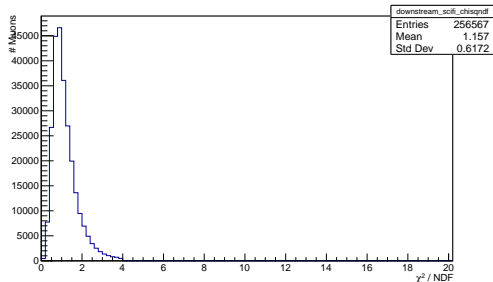
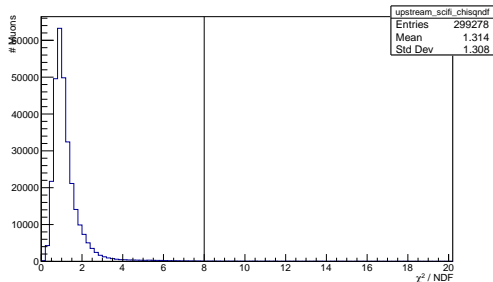
Full LH2 6 mm, Diffuser cut



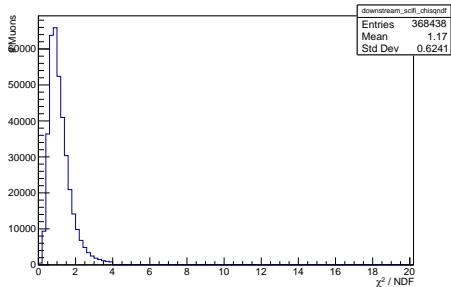
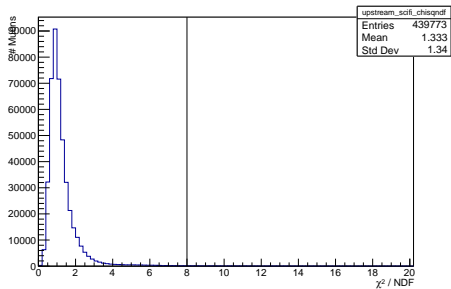
No absorber 6 mm, Diffuser cut



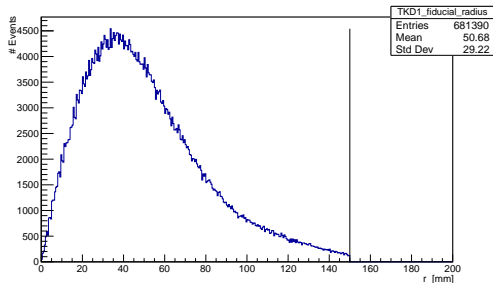
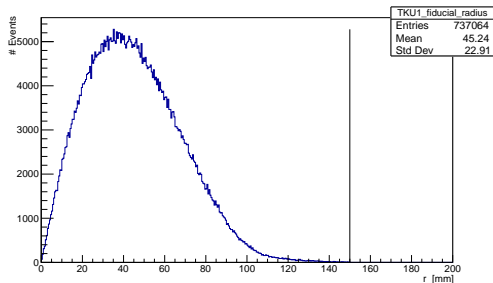
Full LH2 6 mm, chi2/ndf



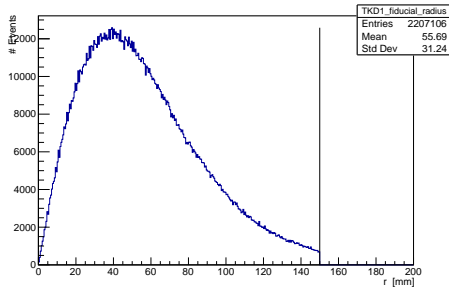
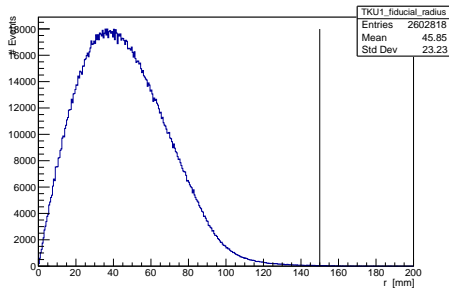
No absorber 6 mm, chi2/ndf



Full LH2 6 mm, Fiducial cut

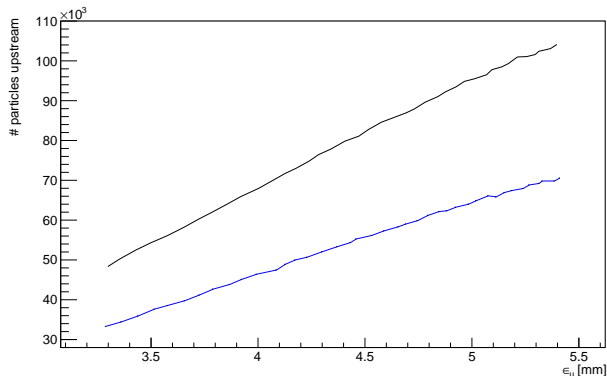


No absorber 6 mm, Fiducial cut

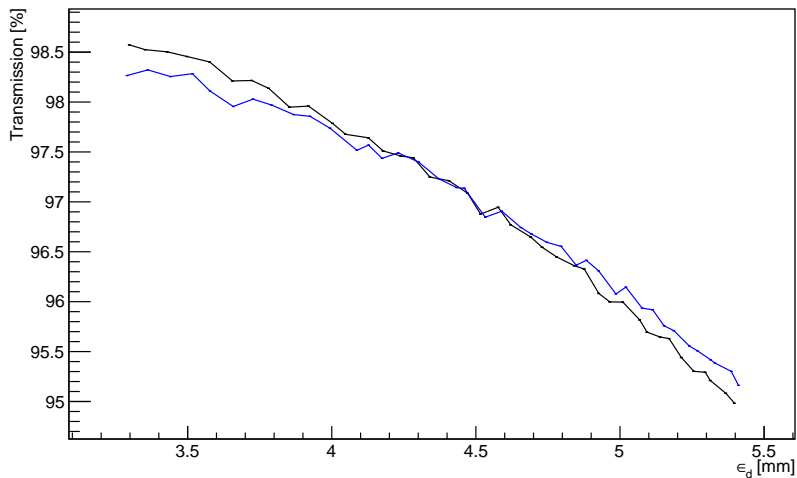


Selection

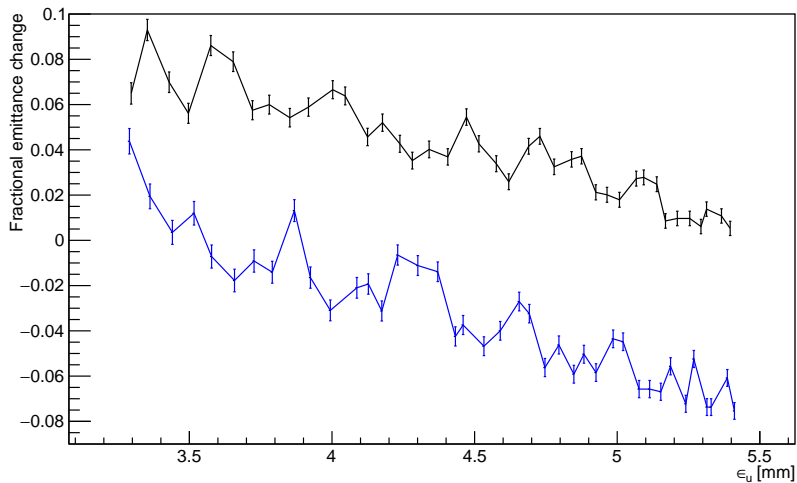
- Beam selection routine is applied to the samples that pass the cuts.
- Selection parameters: $\alpha = 0.0$, $\beta = 310.0\text{mm}$, $\epsilon = [3.5, 6.0]\text{mm}$, $L = 1.1$
- Black - No absorber
- Blue - Full LH2



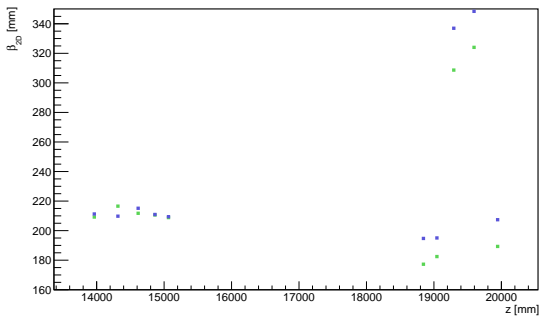
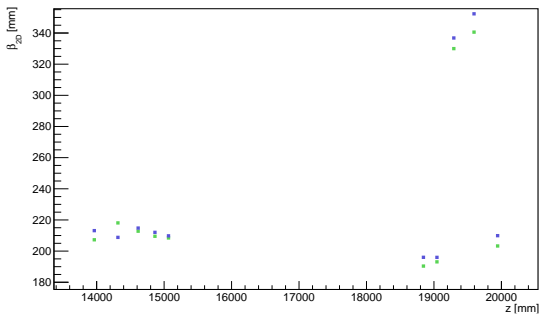
Transmission



Fractional emittance change - cooling

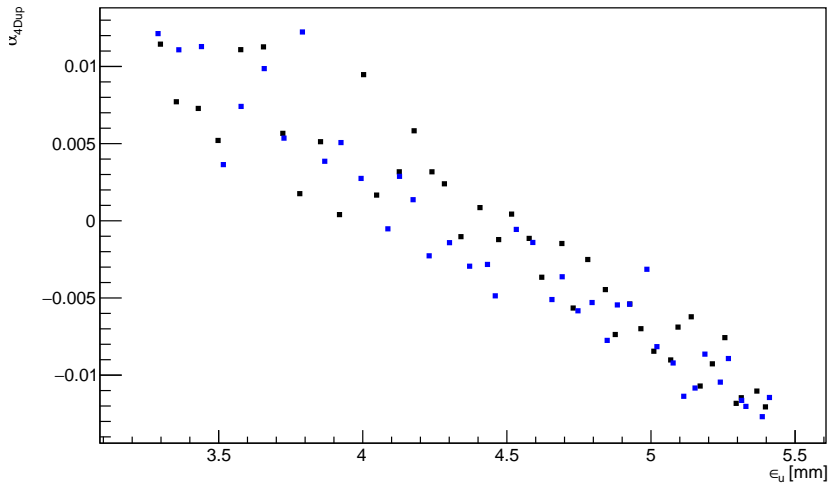


- Fluctuations in the emittance change large in comparison to statistical uncertainties.
- However, attempted to reduce the fluctuations by increasing the statistics: combined 4, 6 and 10 mm beams.
- This exercise revealed that the source of the anomaly is the a/symmetry of the daughter/selected beam.
- The higher the departure from a symmetric beam, the lower the cooling performance/higher the apparent emittance growth.
- Current efforts revolve around further constraining the selection routine to output symmetric daughter beams.

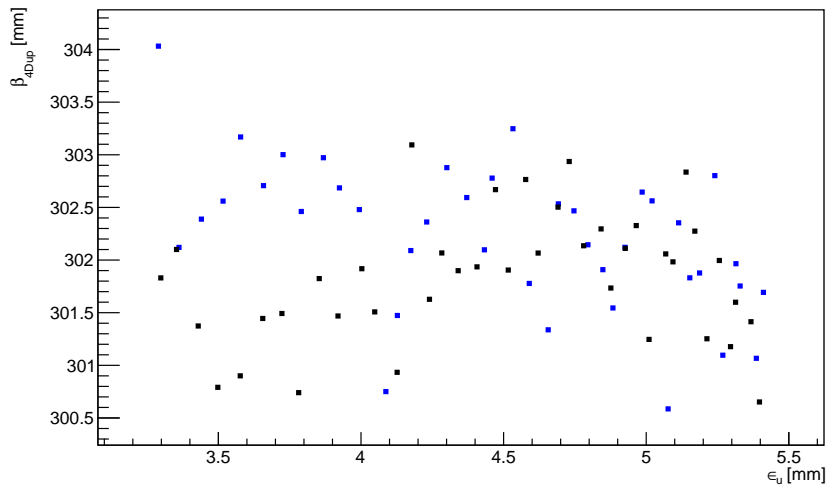


- Applied selection routine to the 6mm No absorber and Full LH2 beams.
- Presence of the absorber indicates cooling.
- Selection routine introduces a bias produced by the degree of asymmetry of the daughter beams.
- Next steps:
 - Need to find a fix to remove the selection bias.
 - Present m

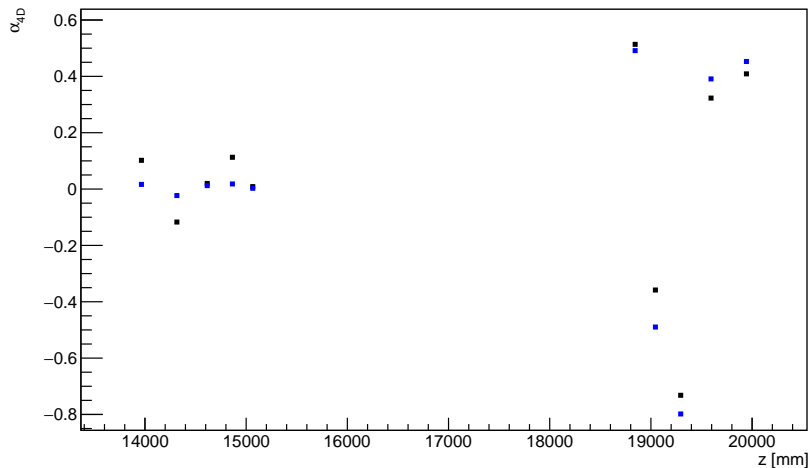
4D Alpha at TKU ref plane



4D Beta at TKU ref plane



Full LH2 4mm selected beam - alpha



Full LH2 4mm selected beam - beta

