Emittance Evolution Paper

- Response to referees
- Start with low level stuff improvements in detector recon/etc
- Work up to high level stuff

Drielsma Combined Fit

Exploit TOF0/TOF1 measurement to seed track fit – **DONE** The residuals between reconstructed track parameters show bias – **See below**

Simulated resolution plots to follow













Density of glue in tracker stations/effect of silicon (glass) beads

- Hunt to measure
- I have done a MC study to look at effect of adding Si
- Settled on "2 g/cm^3 and 20% Silicon in the glue"

Drielsma Den 2.0 Si 0.0







Drielsma Den 2.0 Si 0.2





Drielsma Den 2.0 Si 0.5





 χ^2 /D.o.F. in TKD

Drielsma Den 3.0 Si 0.0





χ²/D.o.F. in TKD

p(TKU) - p(TKD) [MeV/c]

20

40

0

Drielsma Den 3.0 Si 0.5





χ²/D.o.F. in TKD

Features in clusters

- Resolved





Check y-distribution and p-distribution at TKU; time shift in TOF distn

- NB: Systematic uncertainty owing to beam misalignment MC vs data has been added to the MC performance plots (see later)

- NB: Systematic uncertainty in the TKU and TKD field (i.e. momentum uncertainty) is included in the recon performance plots



Momentum at TKU Reference Plane [MeV/c]



Momentum at TKU Reference Plane [MeV/c]



Momentum at TKU Reference Plane [MeV/c]



y at TKD Reference Plane [mm]



y at TKU Reference Plane [mm]



y at TKU Reference Plane [mm]

Data: Mean: 4.51 ns RMS: 0.16 mm **MC:** Mean: 4.37 ns RMS: 0.16 mm



Energy loss across the absorber

- Discrepancy between data and MC, even for no absorber settings \rightarrow detector effect









P(TKU) - P(TKD) [MeV/c]

radius [mm]



P(TKU) - P(TKD) [MeV/c]

radius [mm]

TOF slab dt MC vs data

- discrepancy still remains
- data is much better behaved due to new calibration





Add optics MC plots



Data



Add banana plots

2017-2.7 4-140 None



2017-2.7 6-140 None



2017-2.7 10-140 None



Amplitude Resolution



Simulated 2017-2.7 4-140 IH2 empty Systematics tku_base

Simulated 2017-2.7 4-140 IH2 empty Systematics tku_base



4-140





Simulated 2017-2.7 6-140 IH2 empty Systematics tku_base











Simulated 2017-2.7 10-140 IH2 empty Systematics tku base



Inefficiency































Detector Systematics

Reminder that we correct for detector inefficiency and resolution by some matrix operations

Detector systematics are considered as systematic uncertainty on these corrections

Sources of detector systematic uncertainty

For MC

- None

For TKU

- 3 mm TKU Position offset
- 3 mrad TKU rotation offset
- 3 % increase in E1 scale
- 5 % increase in CC scale
- 3 % increase in E2 scale
- 50 % increase in TKU glue density For TKD
- 3 mm TKD Position offset
- 3 mrad TKD rotation offset
- 3 % increase in E1 scale
- 5 % increase in CC scale
- 3 % increase in E2 scale
- 50 % increase in TKD glue density

Performance Systematics

Add a new class of systematic uncertainty - "performance" systematic

- Say we underestimate the cooling channel performance due to e.g. underestimating the absorber thickness

- What effect does this have on the measured performance?

- In this case we underestimate the migration towards the beam core; i.e. we overestimate the number of events in high amplitude bins and underestimate the number of events in low amplitude bins

Can consider the number of events in each bin following such an underestimate

- but they are correlated

Instead consider the effect on migration between bins

- i.e. look at uncertainties on the migration matrix

Sources of systematic uncertainty on performance

For MC

- SSU M1 and M2 mispowered by 1 %
- FC mispowered by 1 %
- SSD M2 mispowered by 1 %
- beam offset by 3 mm in x, y and 3 MeV/c in px, py, pz
- absorber thickness increase from 0.0704 to 0.0728 For recon
- chi2 cut in TKD from 4 to 4.3
- fiducial radius in TKD from 150 to 148

Results

Nb: Correction on reconstructed MC yields MC truth



MC truth (all) Amplitude [mm]





Number



Number





 $\mathbf{R}_{\mathsf{Amp}}$

To Do

I think all of the "problems" are covered by systematic uncertainties

I need to work on presentation of the headline plots

I promised to add in

- fractional emittance vs z (MC, with data points)
- if Francois has it ready, some phase space density analysis