



FC Alignment



C. Rogers,
ASTeC Intense Beams Group
Rutherford Appleton Laboratory

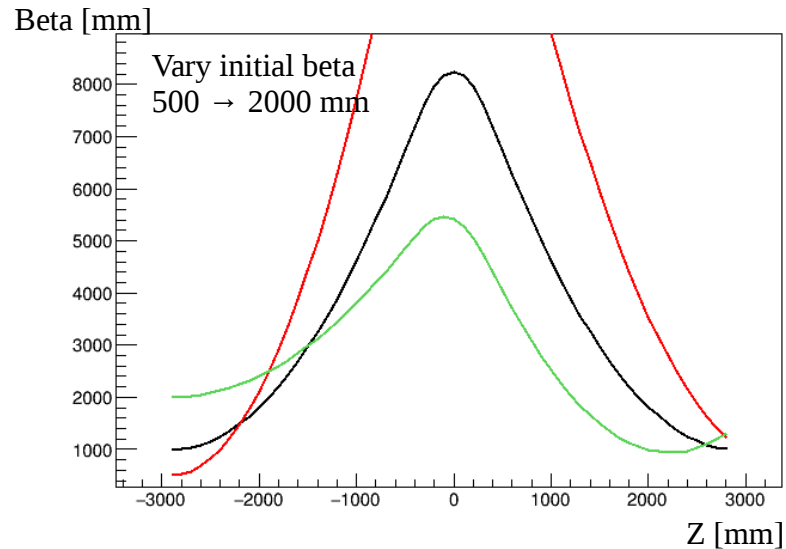
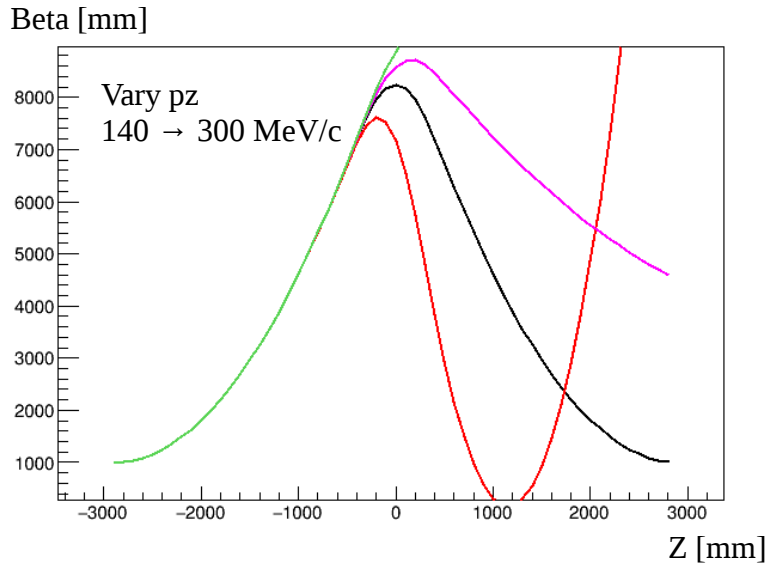


Transfer Matrix Measurement



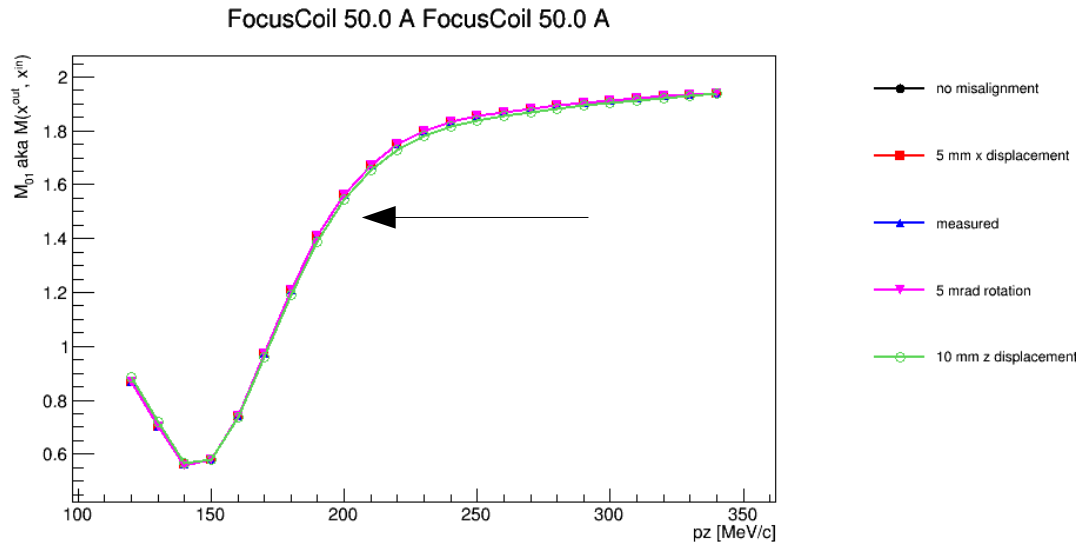
- Aim is to measure the transfer matrix
- This has never been directly measured as far as I can tell (from particle tracks)
- Use case: Focus coil alignment
 - Aim is to measure the transfer matrix
 - Fit to model of the magnet
 - Tweak focus coil until the model agrees with the data
- Look at analysis of data from run 8020

FC – solenoid mode



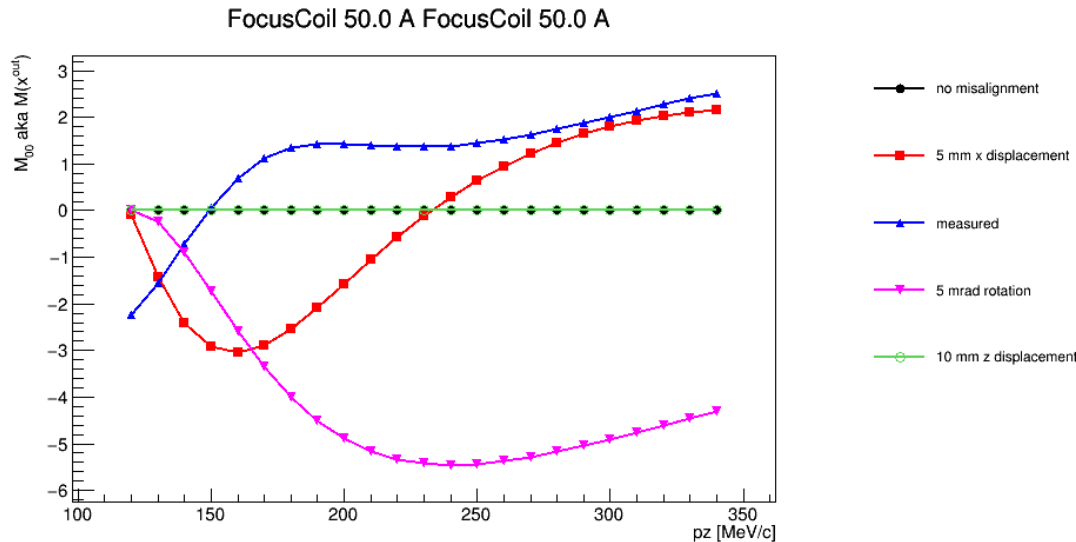
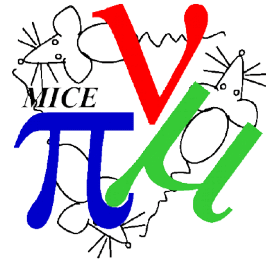
- Optimise for reasonable behaviour at 200 MeV/c and 1000 mm input beta
- Result FC = 46 A
 - Well, 50 A is probably fine
 - This is consistent with study Dec 2015

Focussing term (FC-solenoid)



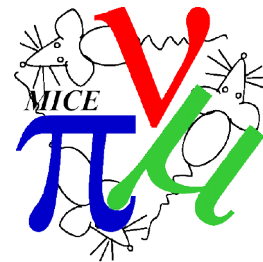
- Sample focussing term
 - This is x_{out} as a function of x_{in} assuming (y, p_x, p_y) are initially 0
 - Note little or no sensitivity to misalignment
 - If we run at higher current, equivalent to “shrinking” this plot (scaling p_z)

Dipole term (FC-solenoid)

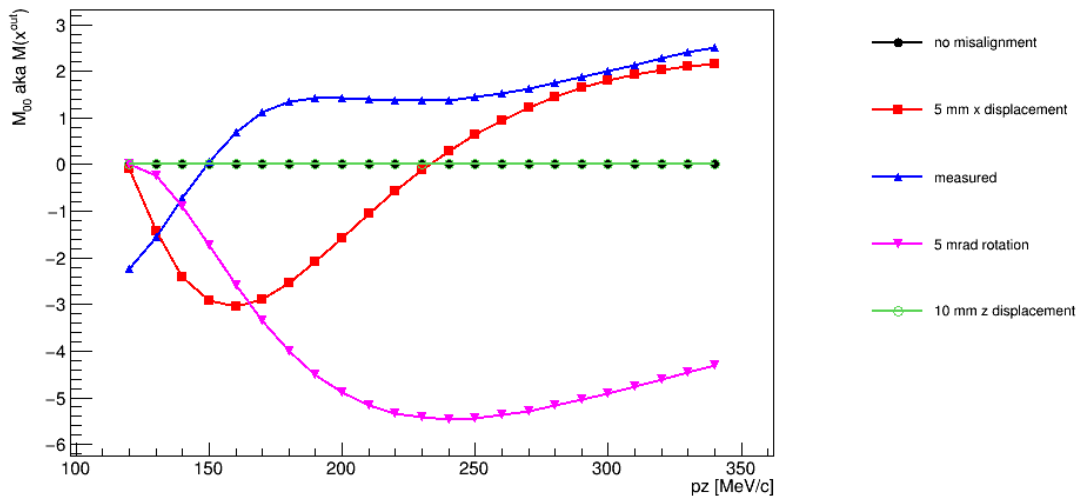


- Sample “dipole” term
 - This is the position x_{out} of a particle initially on-axis
 - These terms are the ones that give us alignment
- Even using a residual-based method, this still dictates the overall (mis)alignment signal that we want to measure

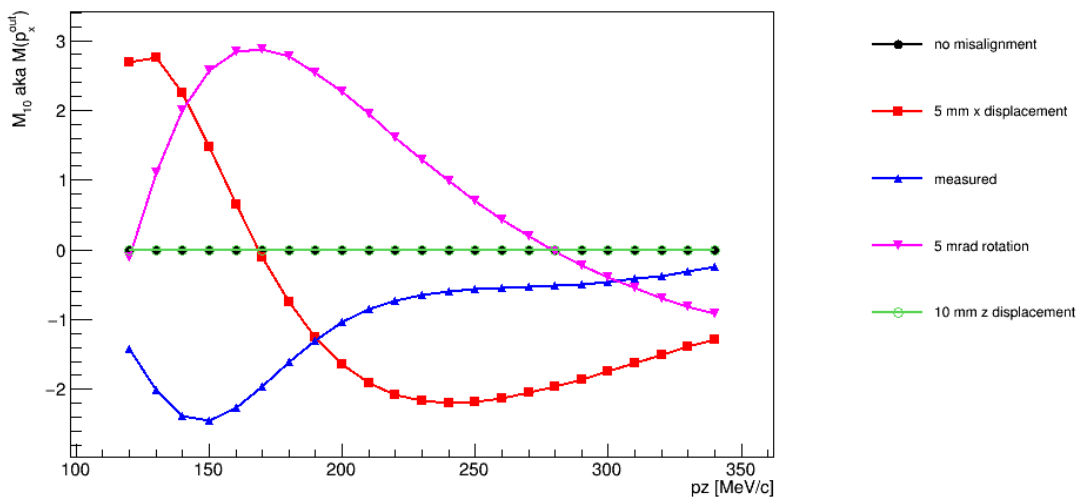
Expected signal (FC-solenoid)



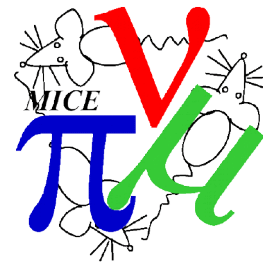
FocusCoil 50.0 A FocusCoil 50.0 A



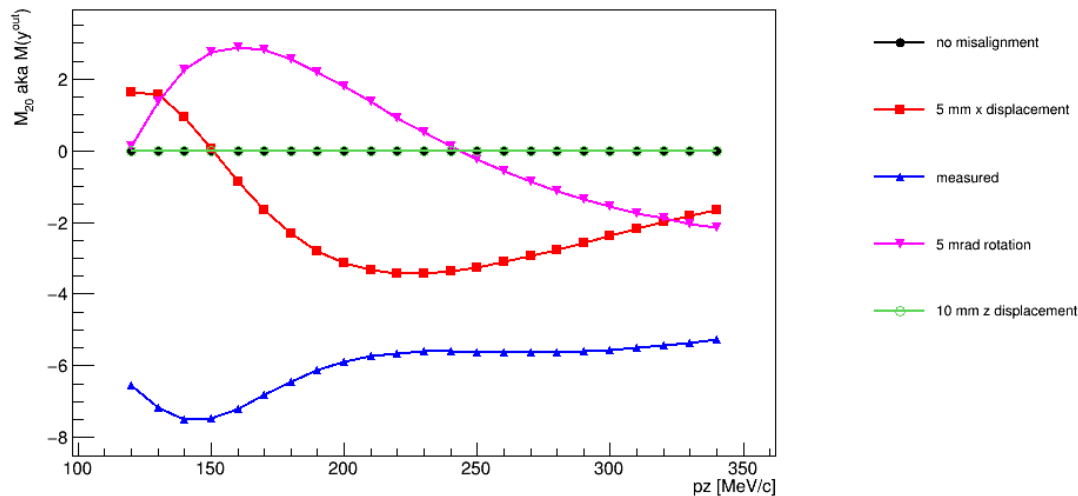
FocusCoil 50.0 A FocusCoil 50.0 A



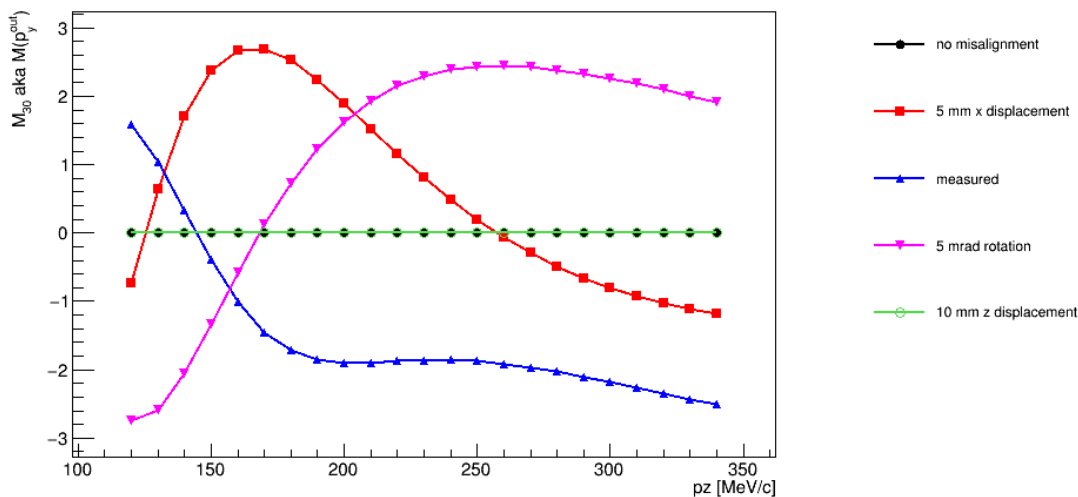
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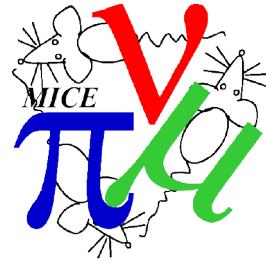
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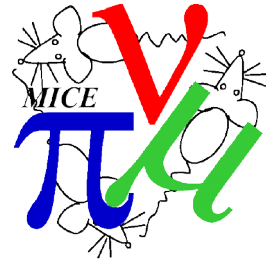
Cuts



- Cuts

- Require ≥ 5 track points per tracker
- Require exactly one track per tracker
- Require exactly one TOF0, TOF1, TOF2 space point
- Require TOF2 - TOF1 in range 30.5 - 32. ns
- Scraping cut: Require that events are well contained in downstream tracker (in projection from upstream tracker)
- Residual cut: Require that upstream tracks are consistent with downstream tracks

Cuts



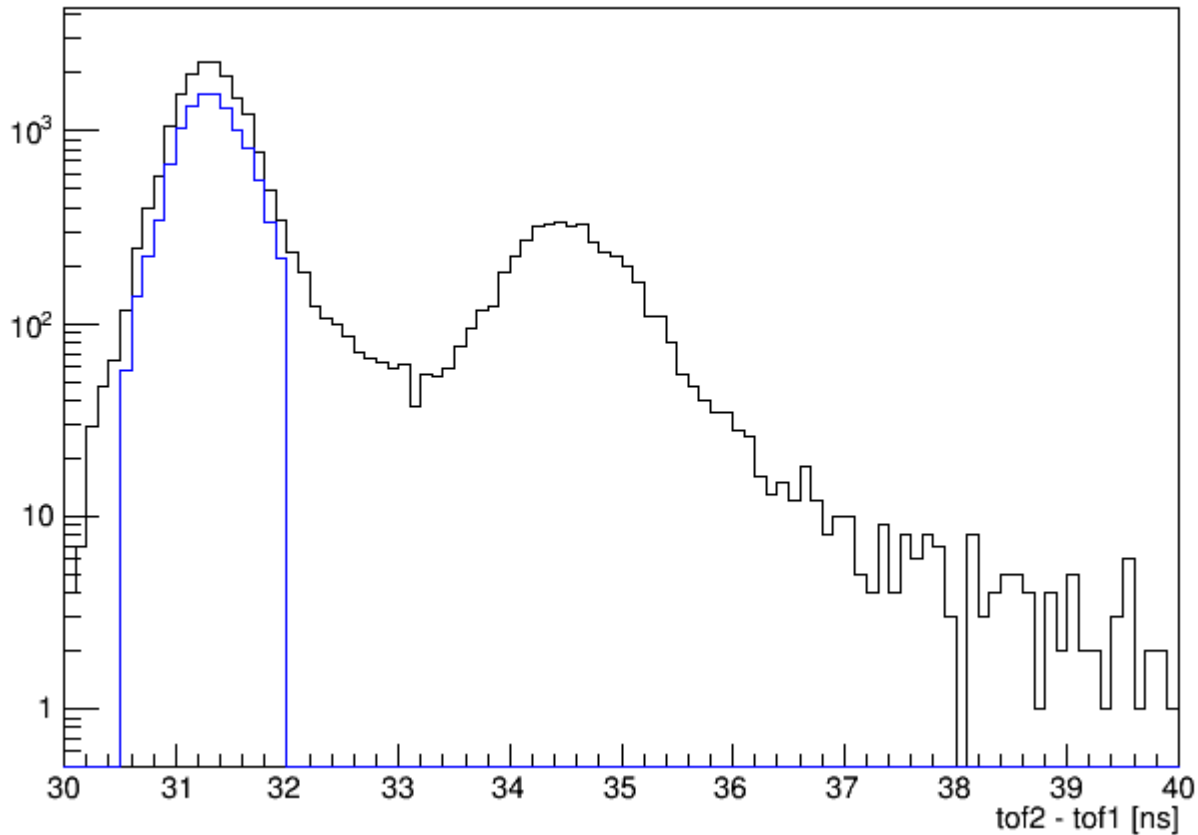
- Number of events accepted by each cut (run 8020):

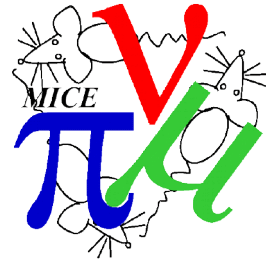
any_cut	11165
residual_cut	279153
scifi_track_points	35197
scifi_tracks	34875
scraping_cut	279384
tof12	268055
tof_0_sp	200378
tof_1_sp	261910
tof_2_sp	27400

TOF12

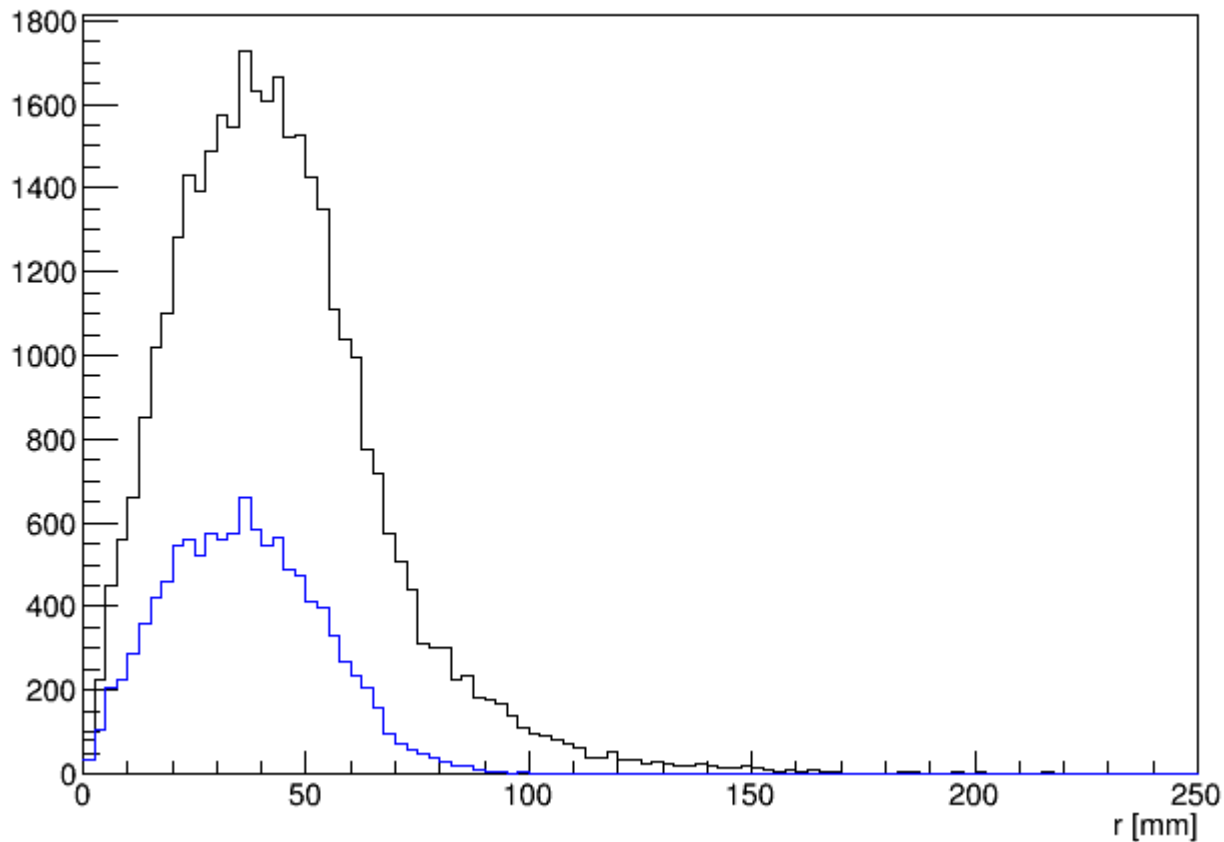


- Black are all events with TOF1 and TOF2 space point
- Blue events are events in cuts

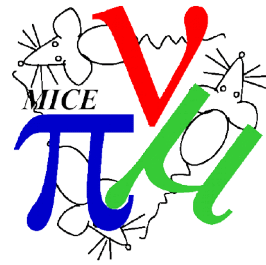




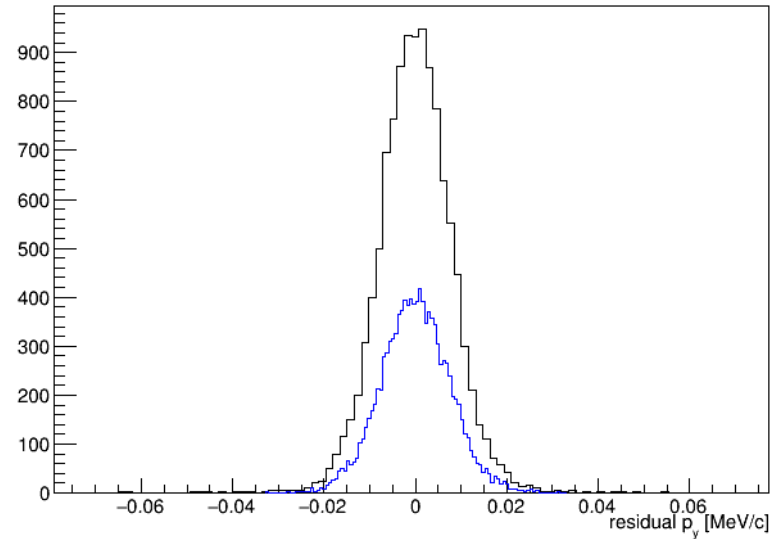
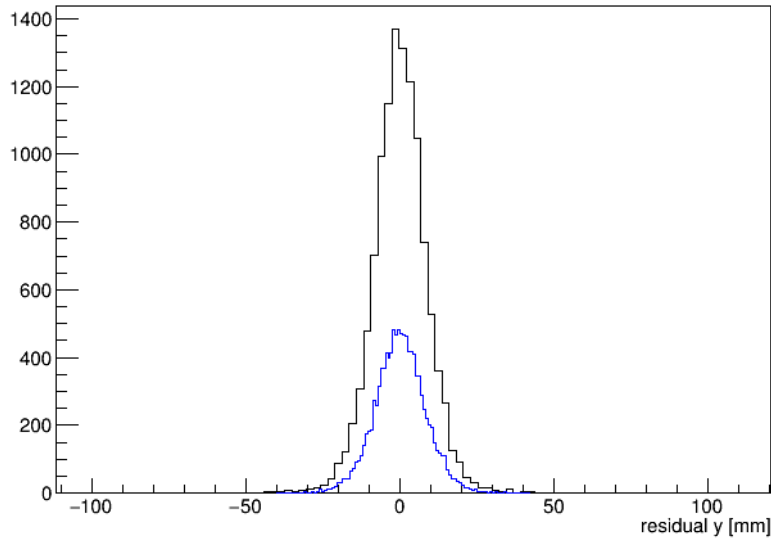
- Black events are all events with downstream tracker
- Blue events are events in cuts



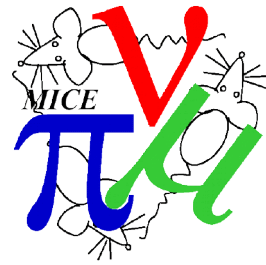
y residuals



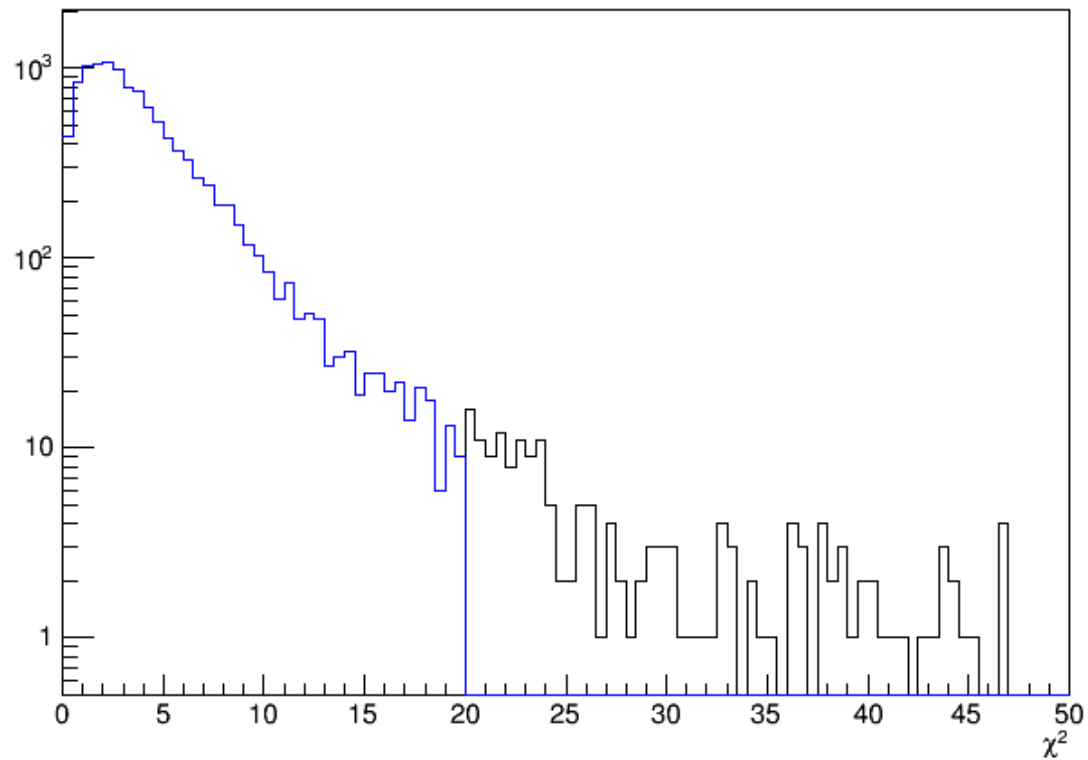
- Black events are all events with downstream tracker
- Blue events are events in cuts
- Residual is (Projected upstream) - (Measured downstream)



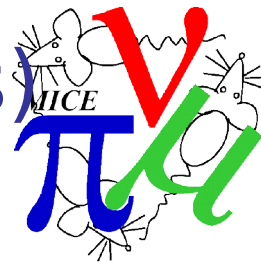
chi2



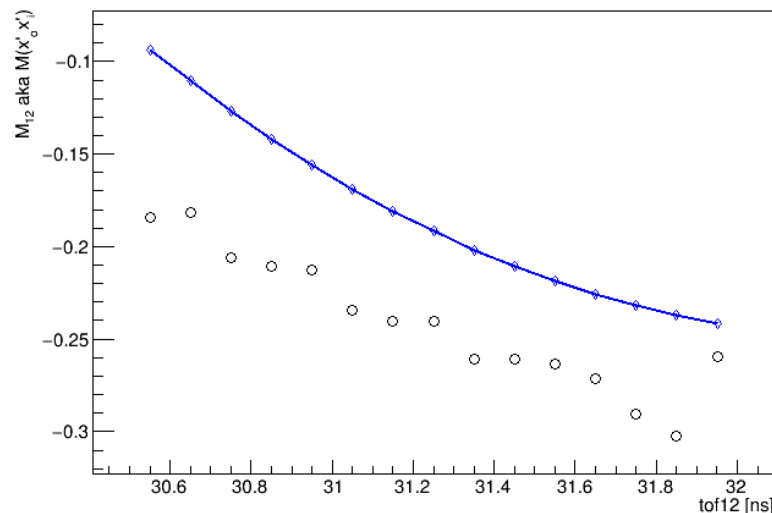
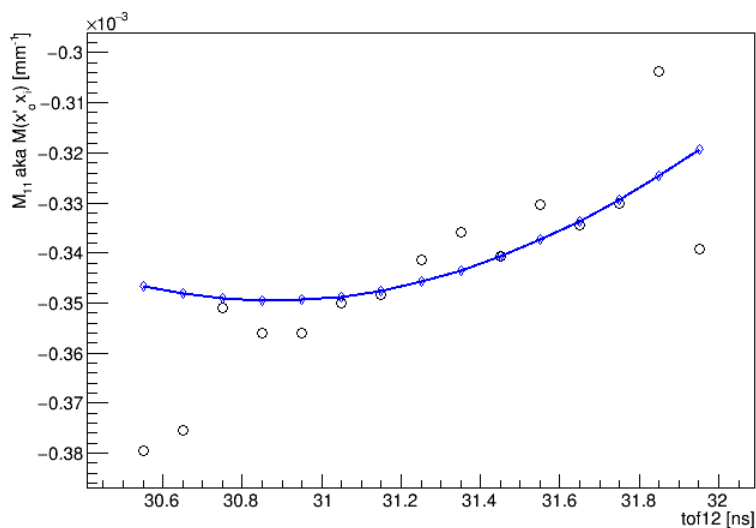
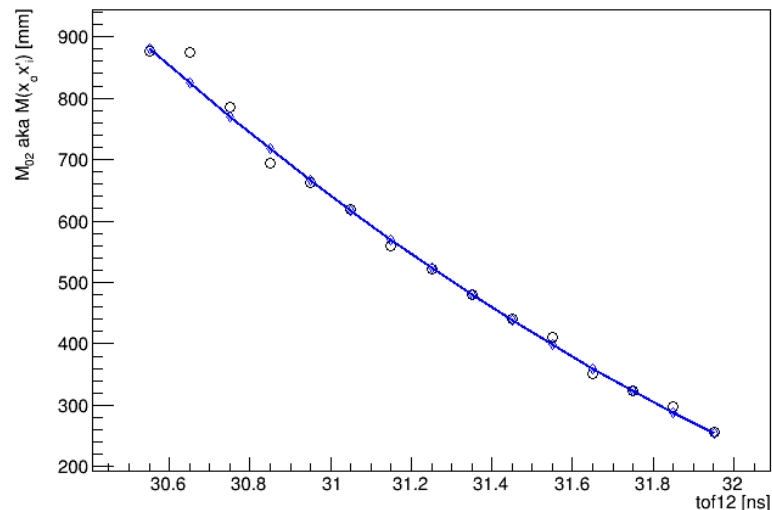
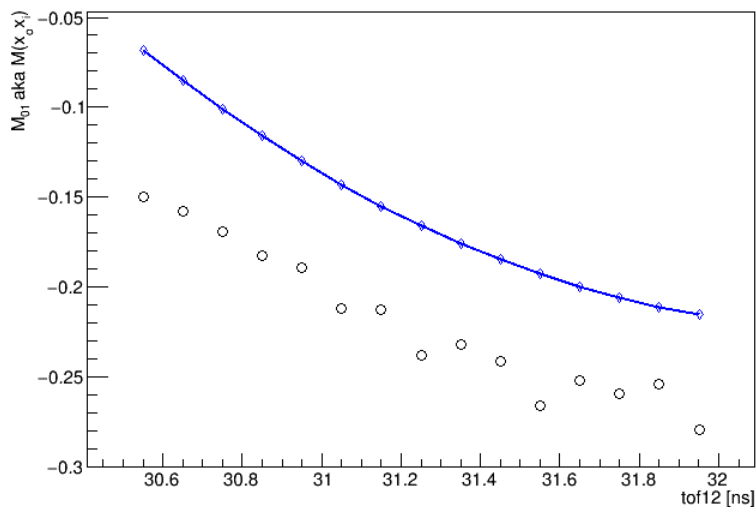
- Black events are all events with downstream tracker
- Blue events are events in cuts
- Cut at $\chi^2 = 20$ (4 d.o.f.)



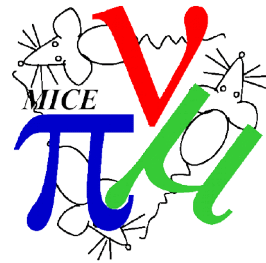
Matrix elements (focussing terms)



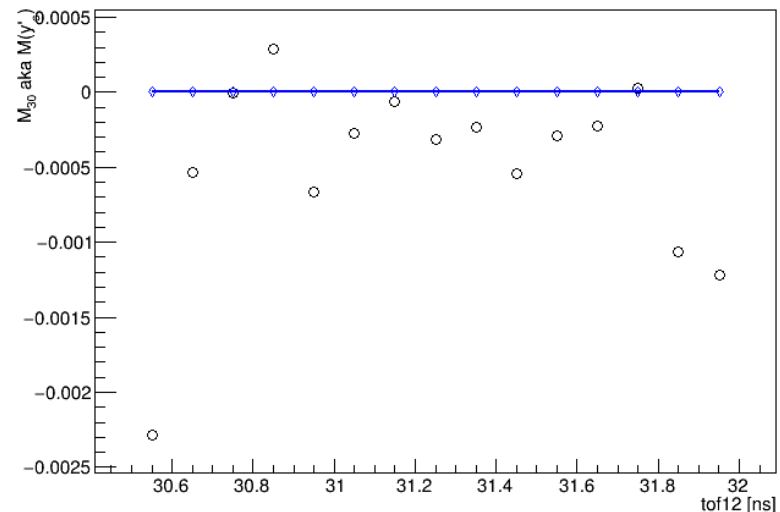
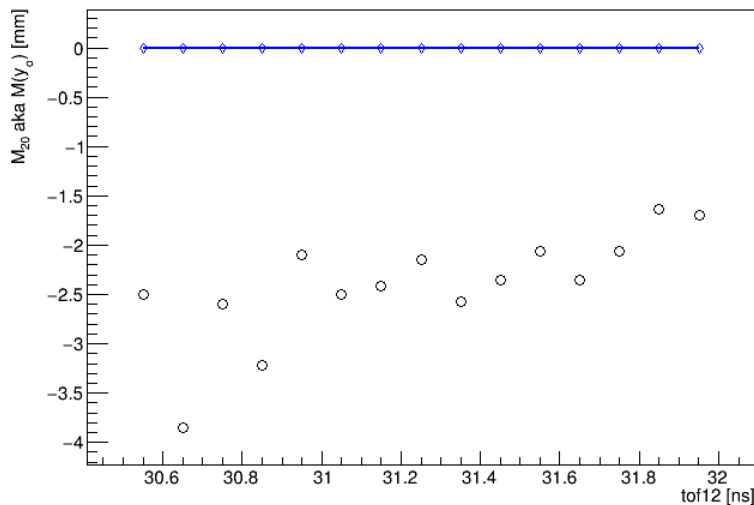
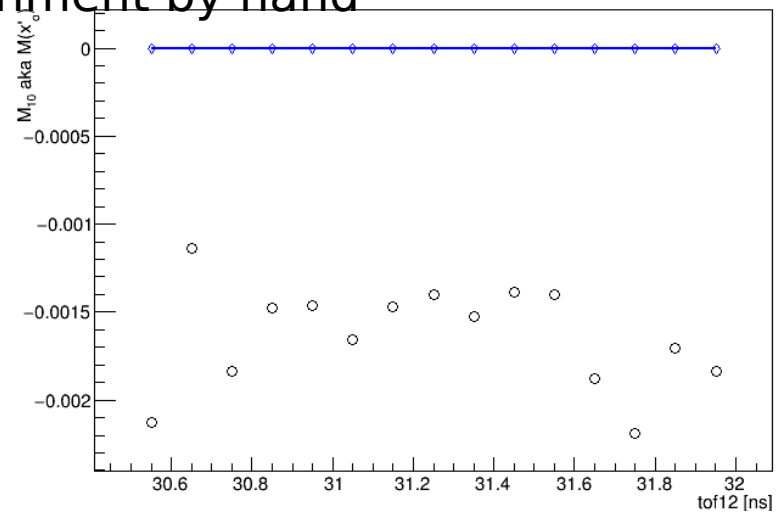
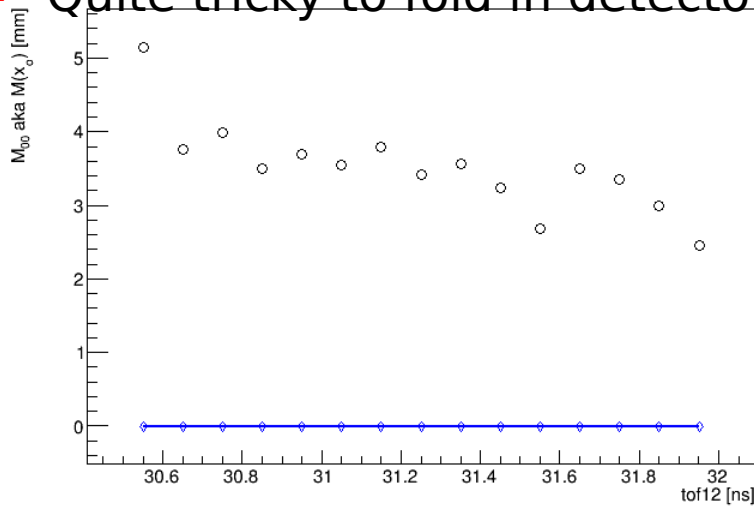
- Fitted FC current = 50.6 A \pm 1 A (black/blue is data/fit)



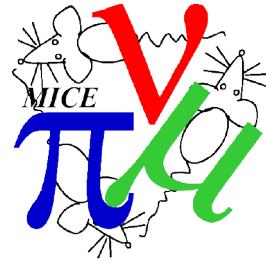
Matrix elements (dipole terms)



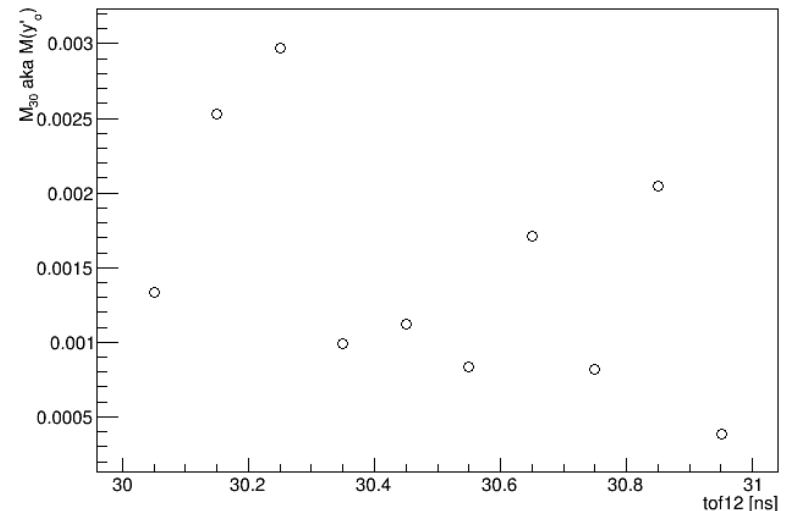
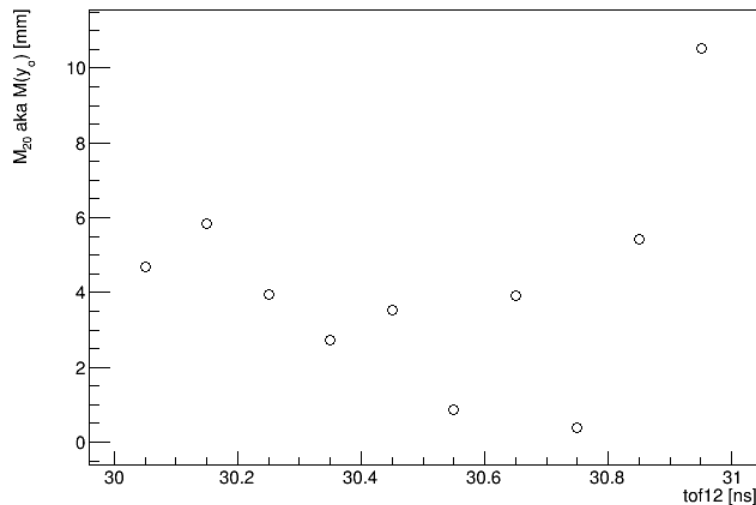
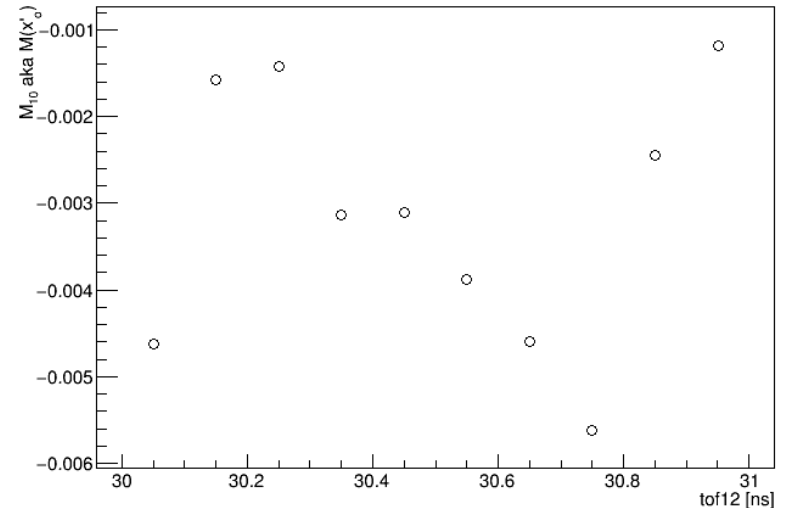
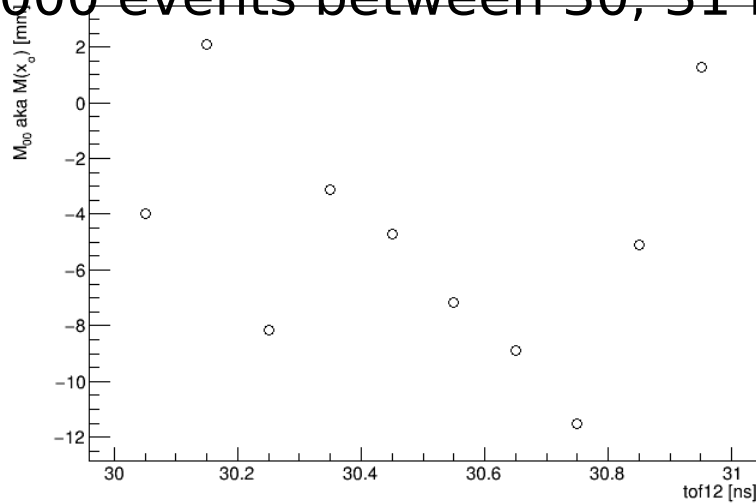
- Detector alignment is not included in the recon yet?
 - Quite tricky to fold in detector alignment by hand



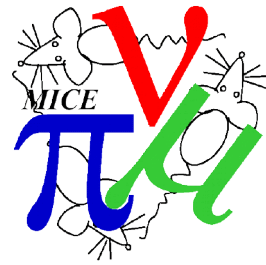
Straight tracks - run 8001



- Look at run 8001 to see how straight tracks look
- 7000 events between 30, 31 ns



Errors



- Systematic errors are at present dominant:
 - Effect of PRY not included
 - I haven't properly dealt with energy loss in the model
 - I need to tidy up bias due to detector resolution in TKU
 - There may be a bias due to scraping in the Focus coil region
 - In addition to scraping in the tracker region
- 8021 provides extra $\sim 25\%$ data

Friday running...



- Systematic errors are at present dominant:
 - Effect of PRY not included
 - I haven't properly dealt with energy loss in the model
 - I need to tidy up bias due to detector resolution in TKU
 - There may be a bias due to scraping in the Focus coil region
 - In addition to scraping in the tracker region
- My guess is the analysis would be best enhanced by sampling more of the “response curve” as in slide 6 and 7
 - So that means try 300 MeV/c