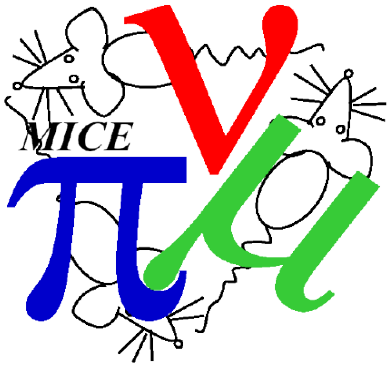
FC Alignment



C. Rogers,
ASTeC Intense Beams Group
Rutherford Appleton Laboratory

ASTeC

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, including misalignments
- Data was taken Thursday/Friday 14/15 July
  - 200 MeV/c beam: D2 = 94.9 A, run 8020 and 8021
  - 300 MeV/c beam: D2 = 104.8 A, run 8023 and 8024
  - 400 MeV/c beam: D2 = 170.0, run 8025
- Note dipole currents are not in ratio 2:3:4

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
- I show a few interesting plots for D2 = 94.9 A
  - other plots are available

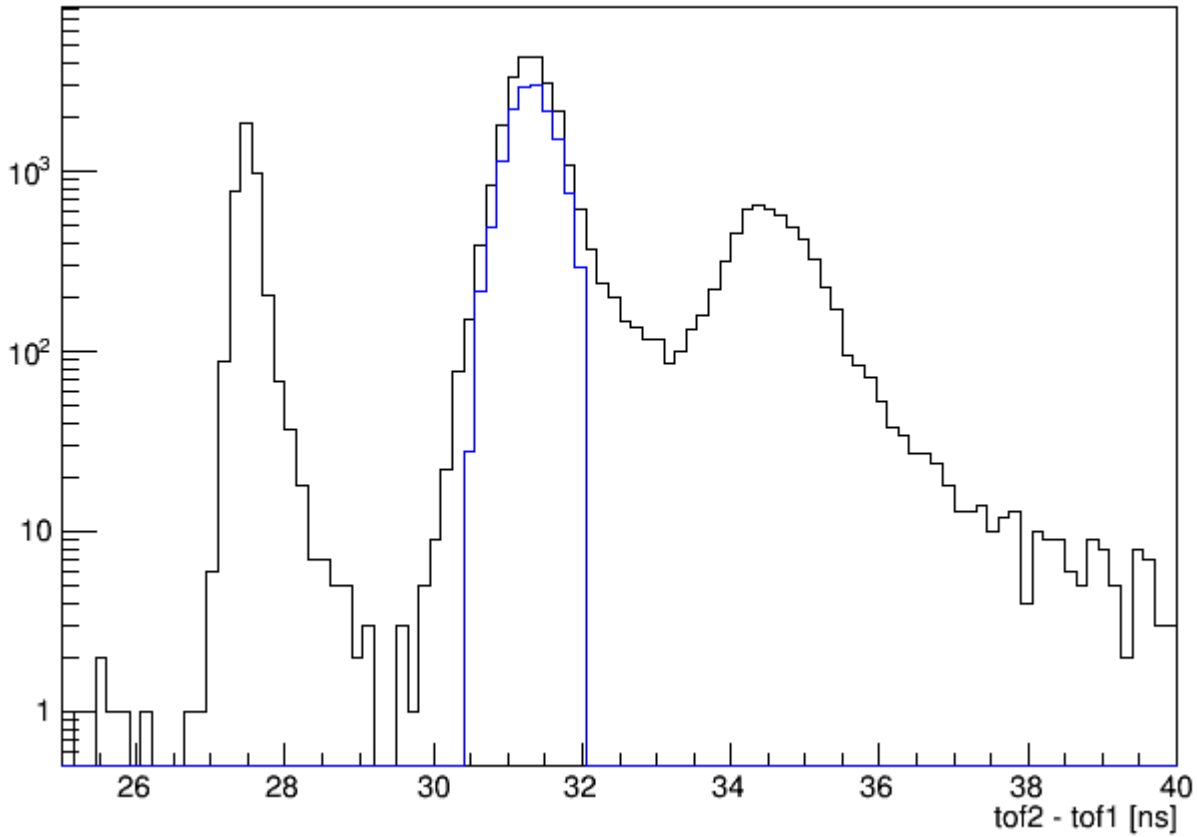
Cuts – D2 = 94.9

- Number of events surviving each cut
  - D2 = 94.9 A

any_cut	14676
residual_cut	361100
scifi_track_points	45603
scifi_tracks	45223
scraping_cut	361409
tof12	346900
tof_0_sp	261580
tof_1_sp	339827
tof_2_sp	35365

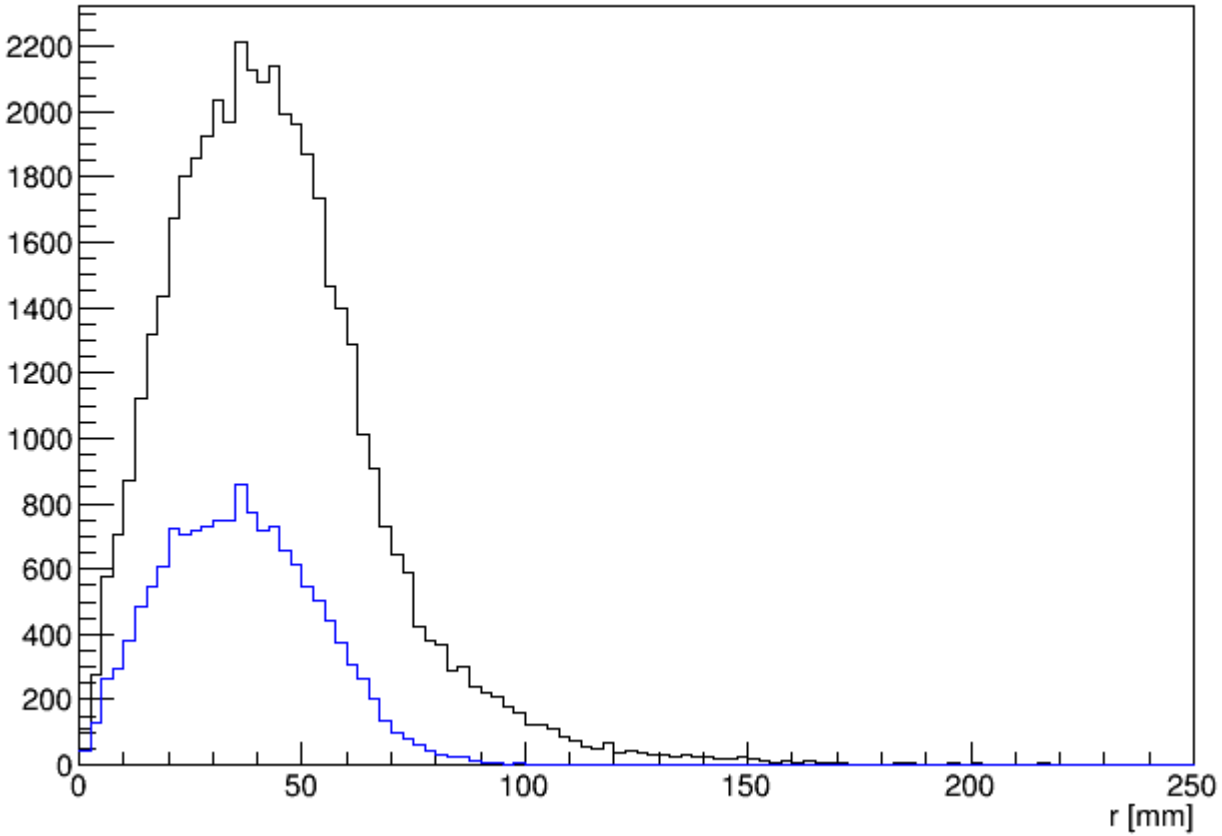
TOF12 – D2 = 94.9

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



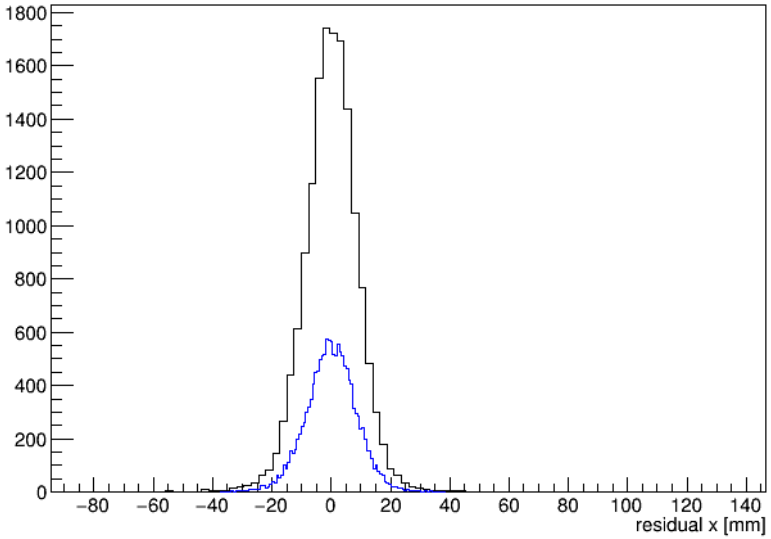
TKD – D2 = 94.9

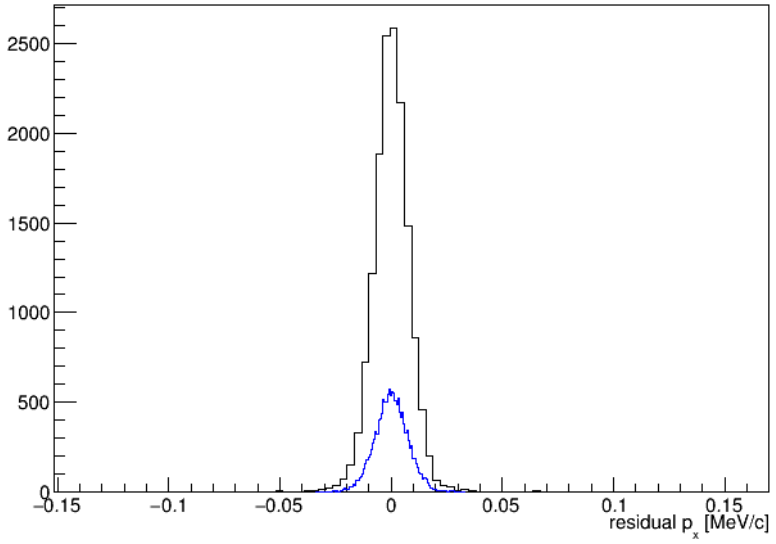
- Black events are all events with downstream tracker
- Blue events are events in cuts



X, x' residuals – D2 = 94.9

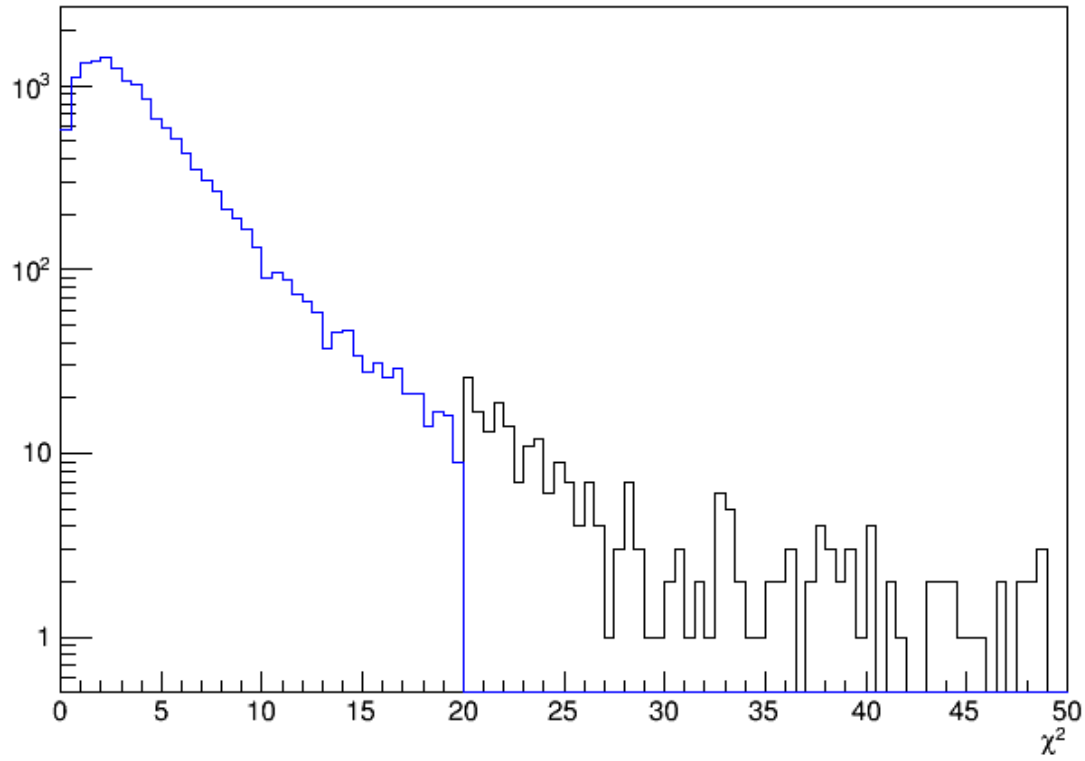
- Black events are all events with downstream tracker
- Blue events are events in cuts
- Residual is (Projected upstream) – (Measured downstream)





chi2 – D2 = 94.9

- Black events are all events with downstream tracker
- Blue events are events in cuts
- Cut at chi2 = 20 (4 d.o.f.)

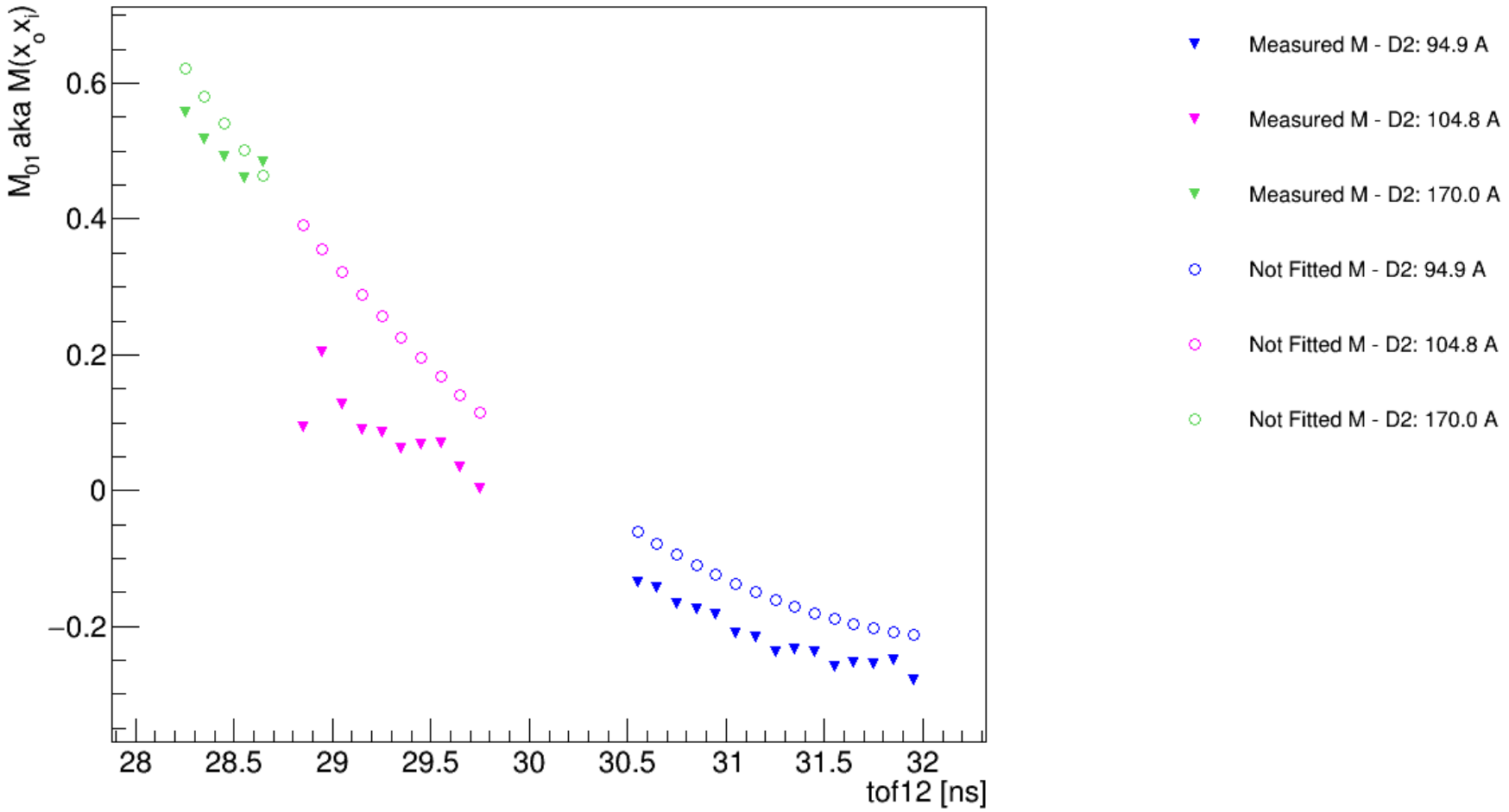


Matrix terms

- I now show matrix terms
  - Colored circles are measured TM terms (as a function of TOF12)
  - Blue triangles are calculated TM terms (assuming 50 A and perfect alignment)
- I don't show everything, but pull out some pertinent elements

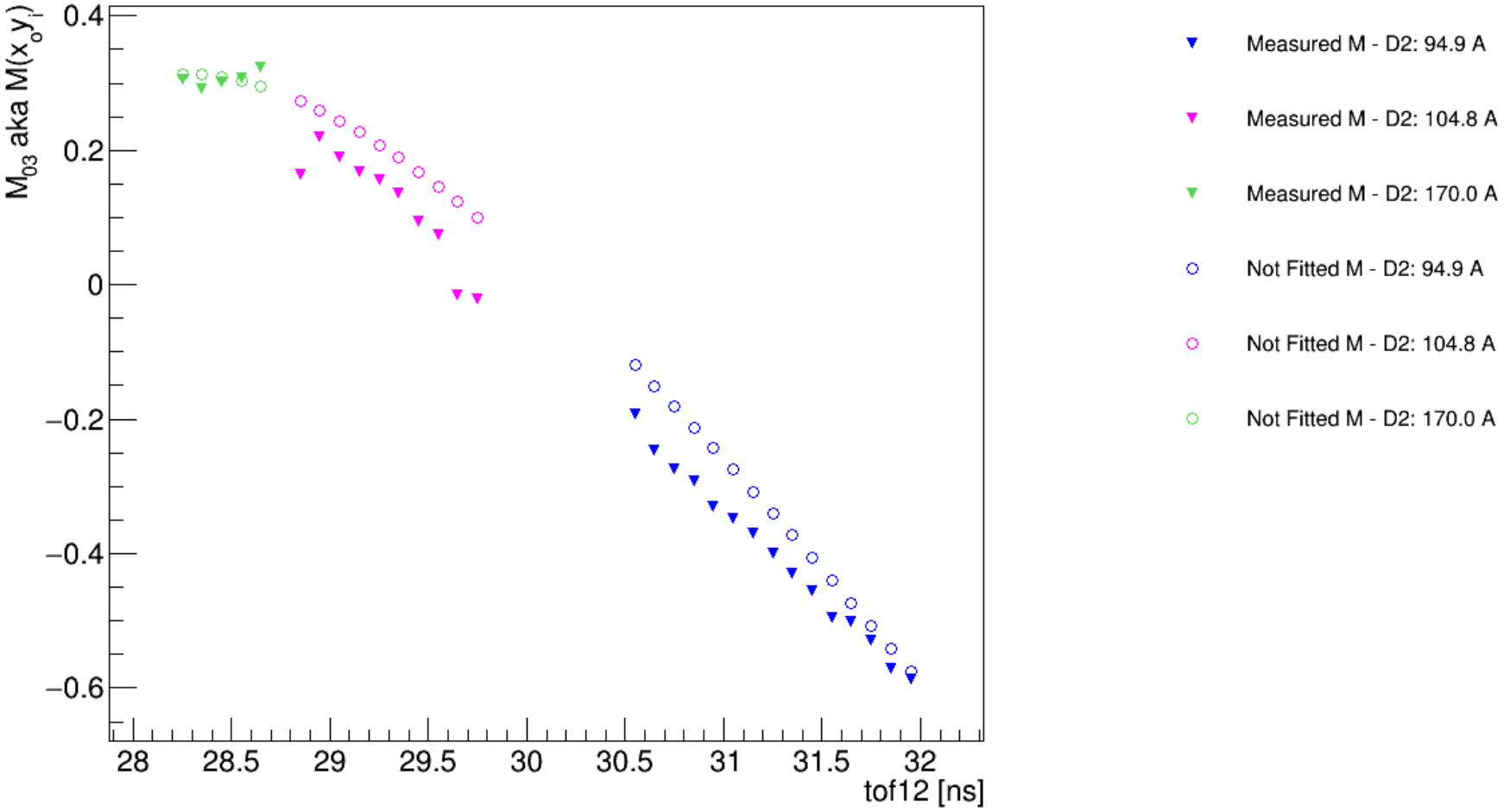
Focussing term - M01

- Coefficient coupling x upstream to x downstream



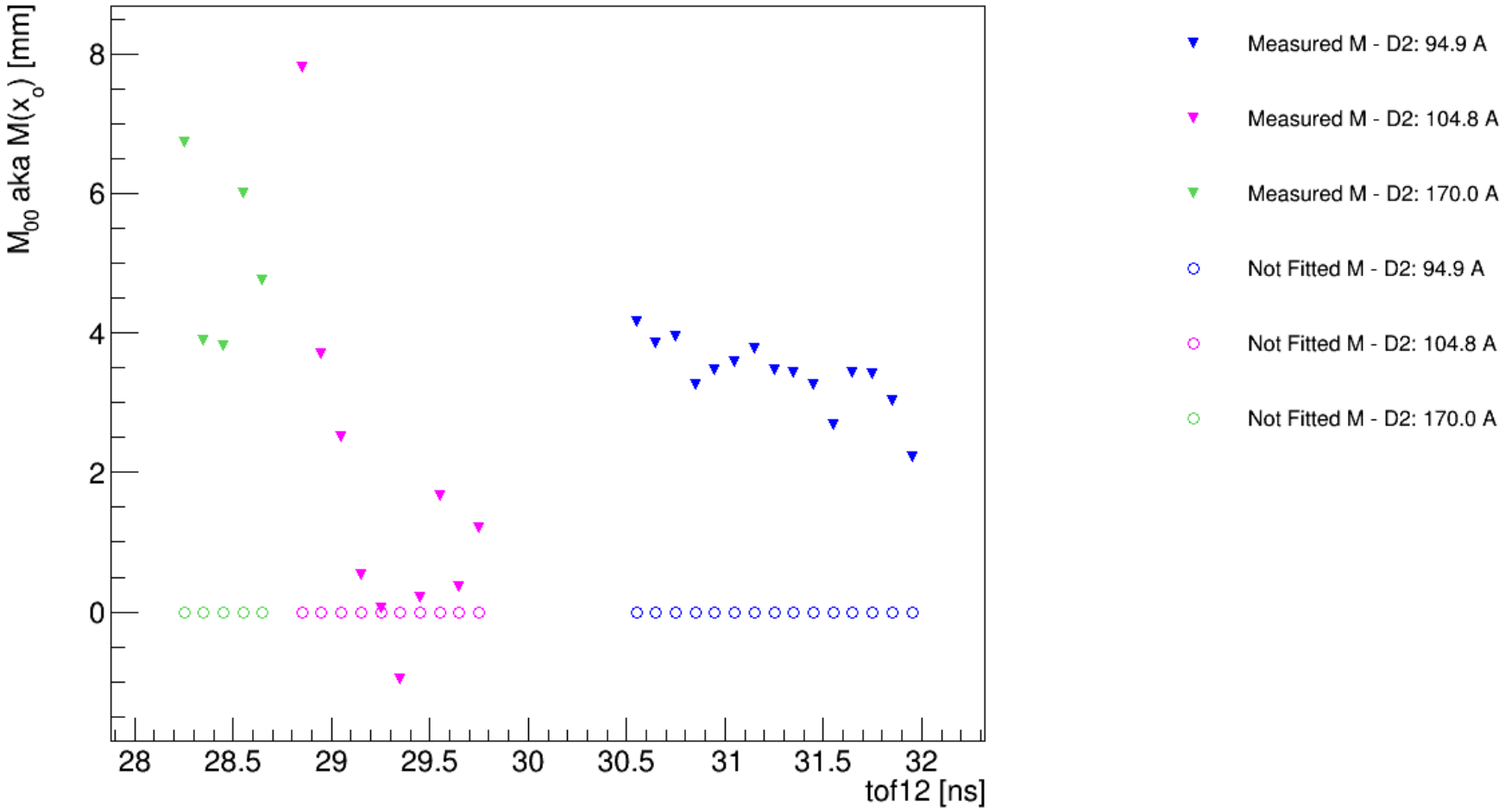
Focussing term - M03

- Rotation of beam about z axis



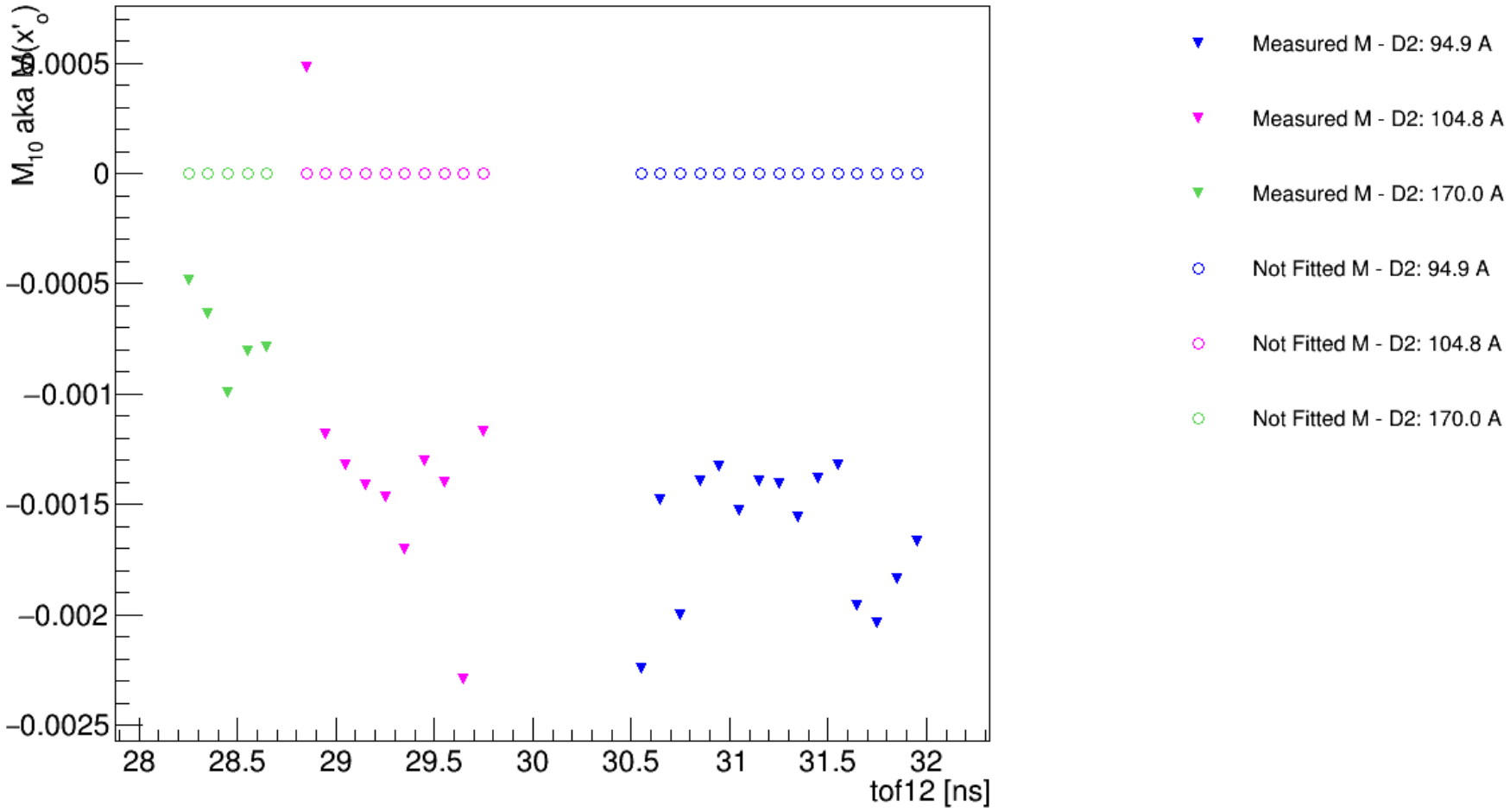
Dipole terms – x (M00)

- Detector alignment is not included in the recon yet



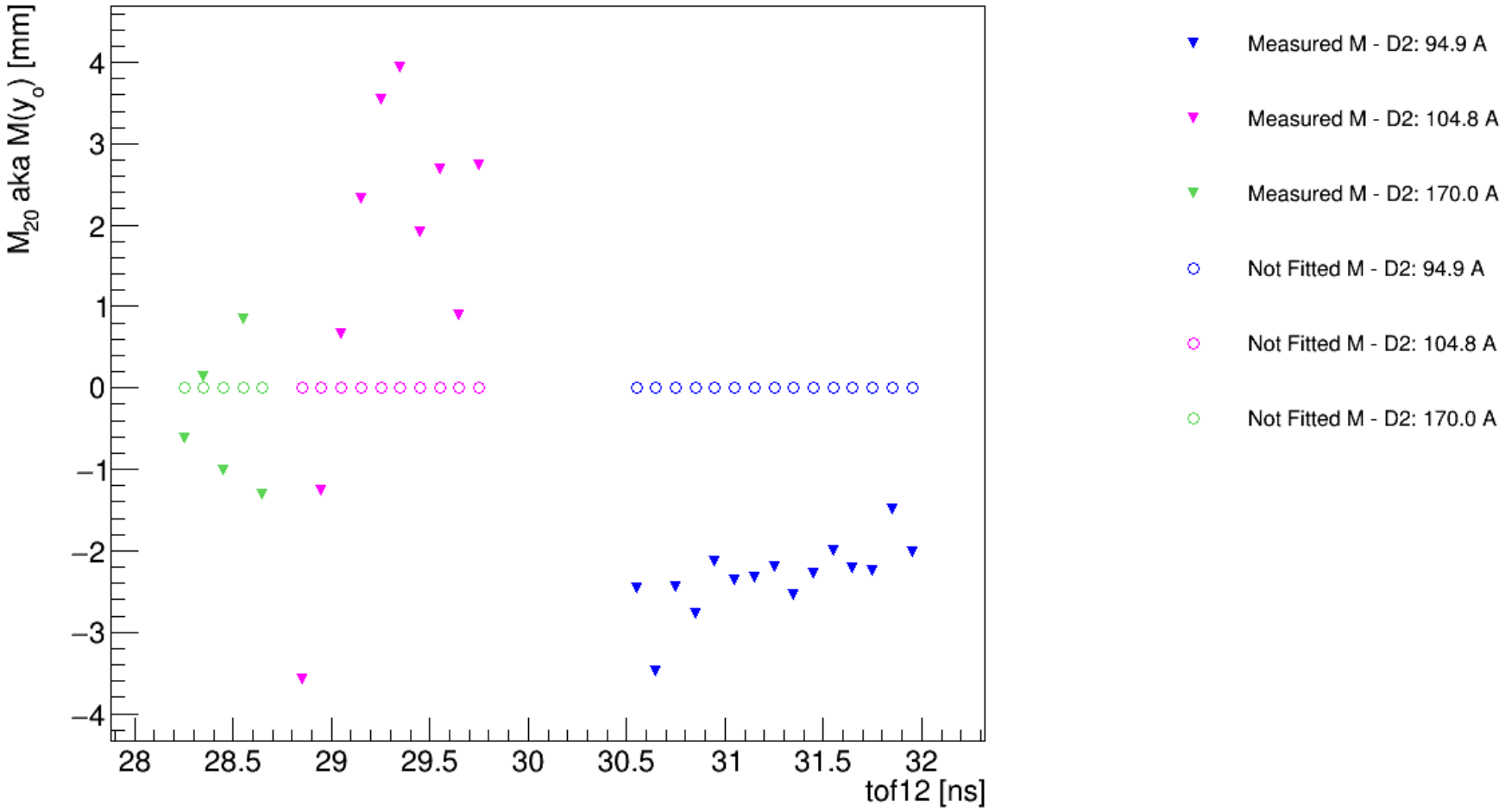
Dipole terms – x' (M10)

- Detector alignment is not included in the recon yet



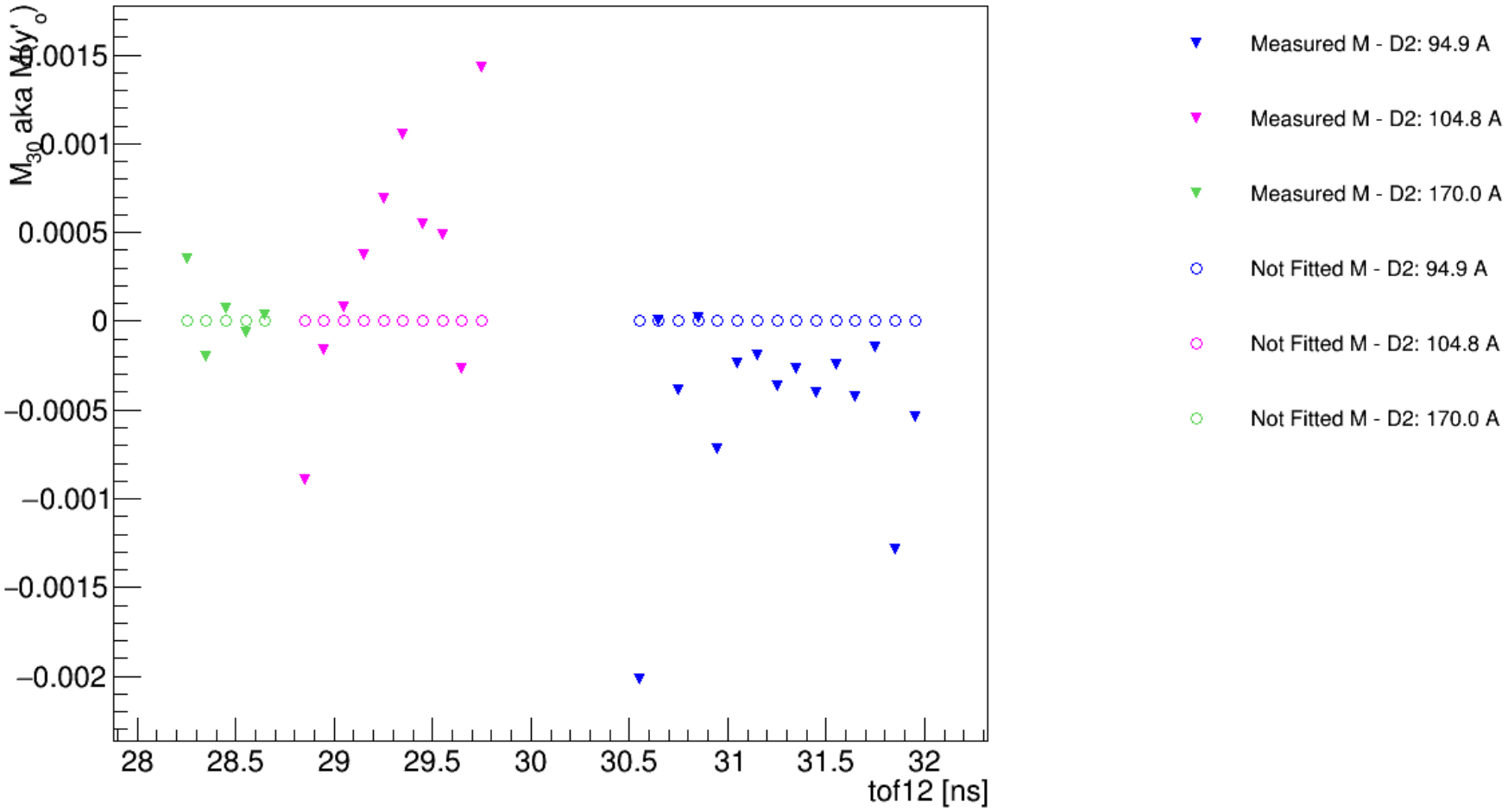
Dipole terms – y (M20)

- Detector alignment is not included in the recon yet



Dipole terms – y' (M30)

- Detector alignment is not included in the recon yet



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
- Estimate statistical errors
- Consider fixing “known” transfer matrix terms
  - Esp for straight tracks analysis
  - Or enforce some symmetries
- Bias due to detector resolution
- Bias due to scraping in FC region
- Include JHC cold dimensions/alignment
- Target Video Conference at end of August for first pass analysis complete