TKU EMITTANCE PAPER

AKA Run 7469 Analysis

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CM46

CONTENTS

- The run 7469 analysis “to do” list
  - Canonical momentum calculation – done.
  - Muon charge? Was wrong, but should now be correct
  - Improve cuts – remove “momentum loss” cut, replace with diffuser aperture cut
  - Investigate field placement
  - Origin of excess momentum loss between TOF1 and Tracker?

DIFFUSER APERTURE CUT

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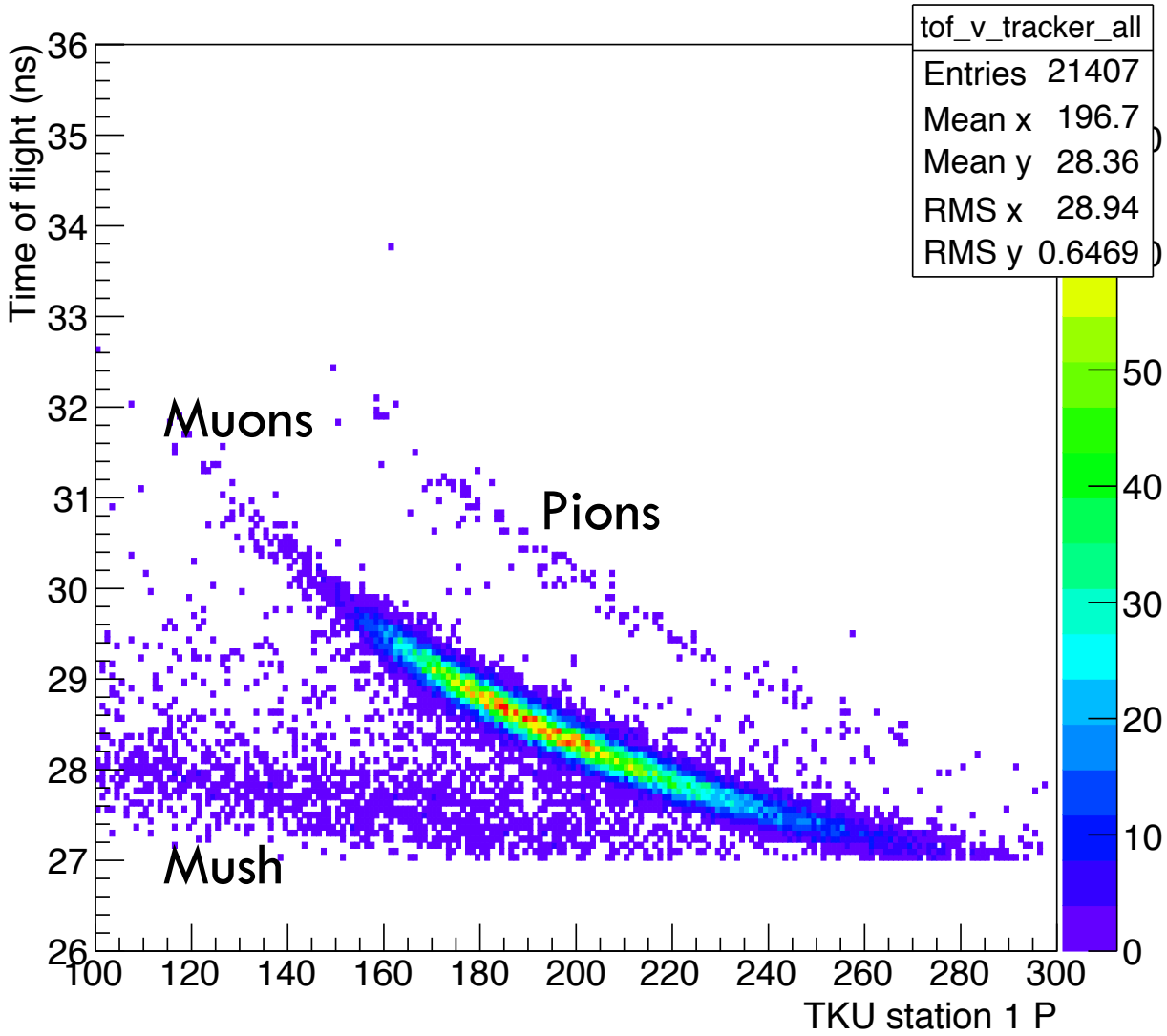
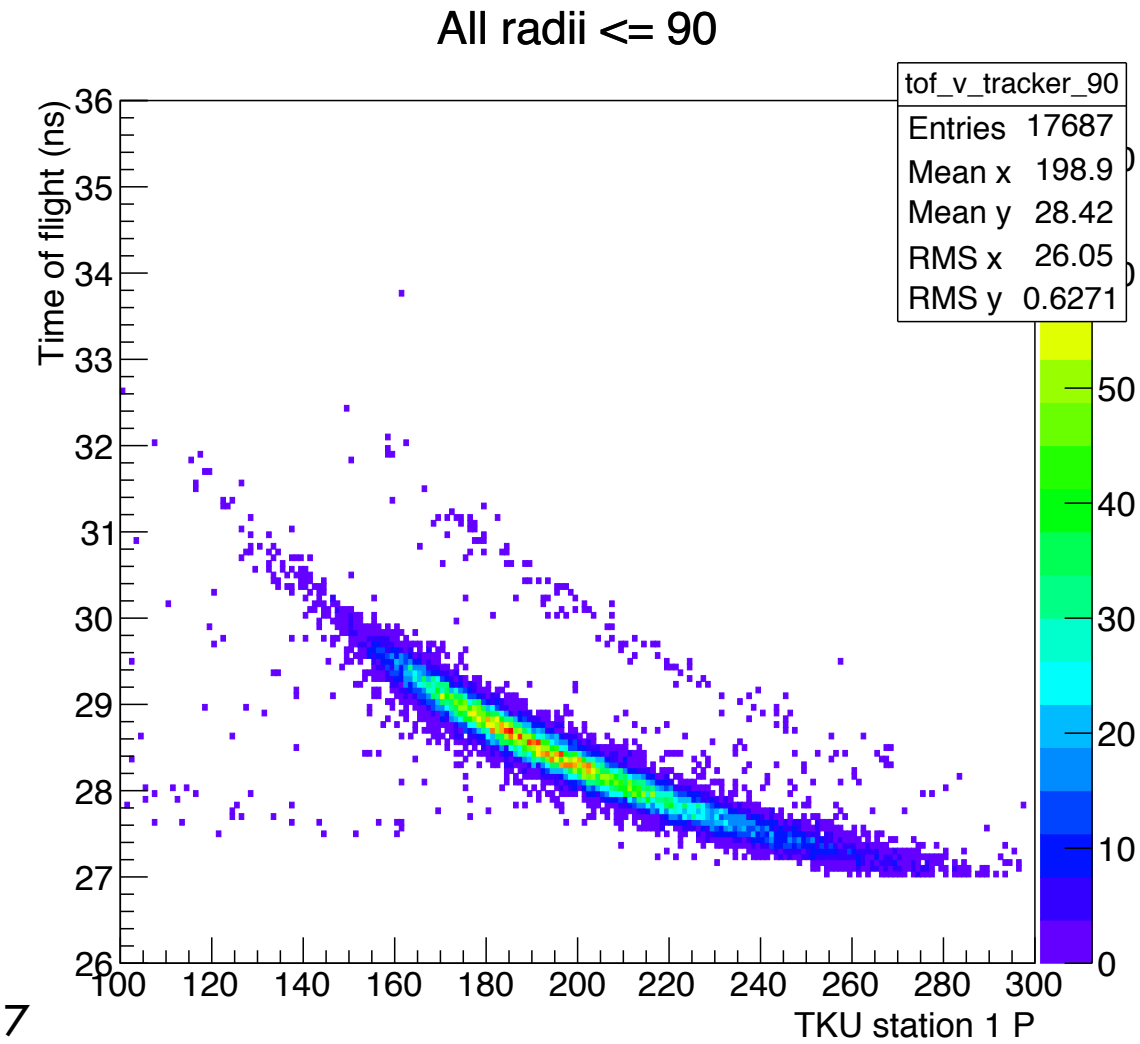
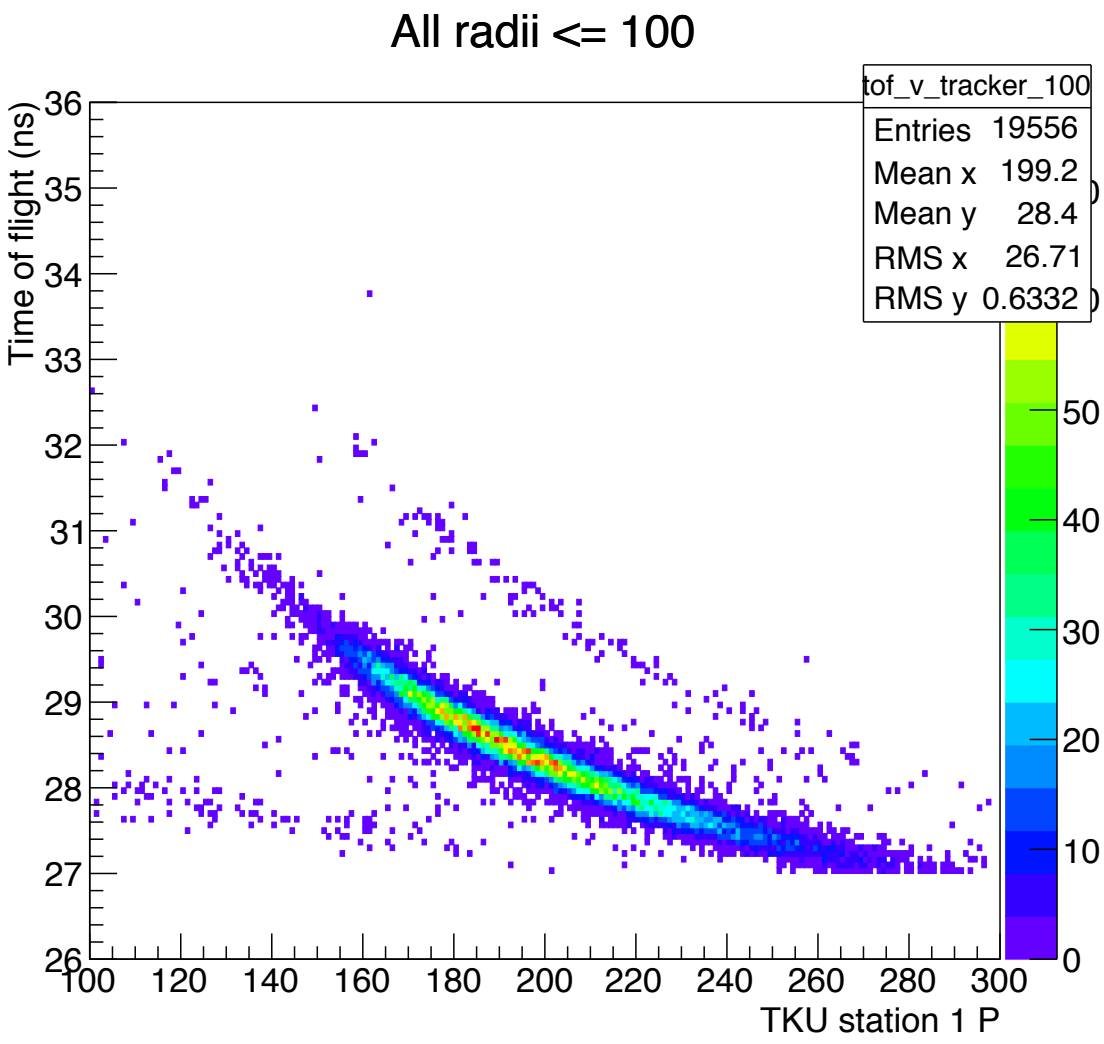
- Used to tidy up TOF vs Tracker distribution
- Claim: Particles in the lower "mush" have lost more momentum than expected from passing through the outside of the (open) diffuser
- At last CM, cut on ΔP between TOF1 and TKU
- Prefer to replace with a radial cut on muon position near diffuser
- Chris Rogers has done some tracking from TKU station 5 to TOF1, noting where they cross the diffuser (data only so far)



DIFFUSER APERTURE CUT





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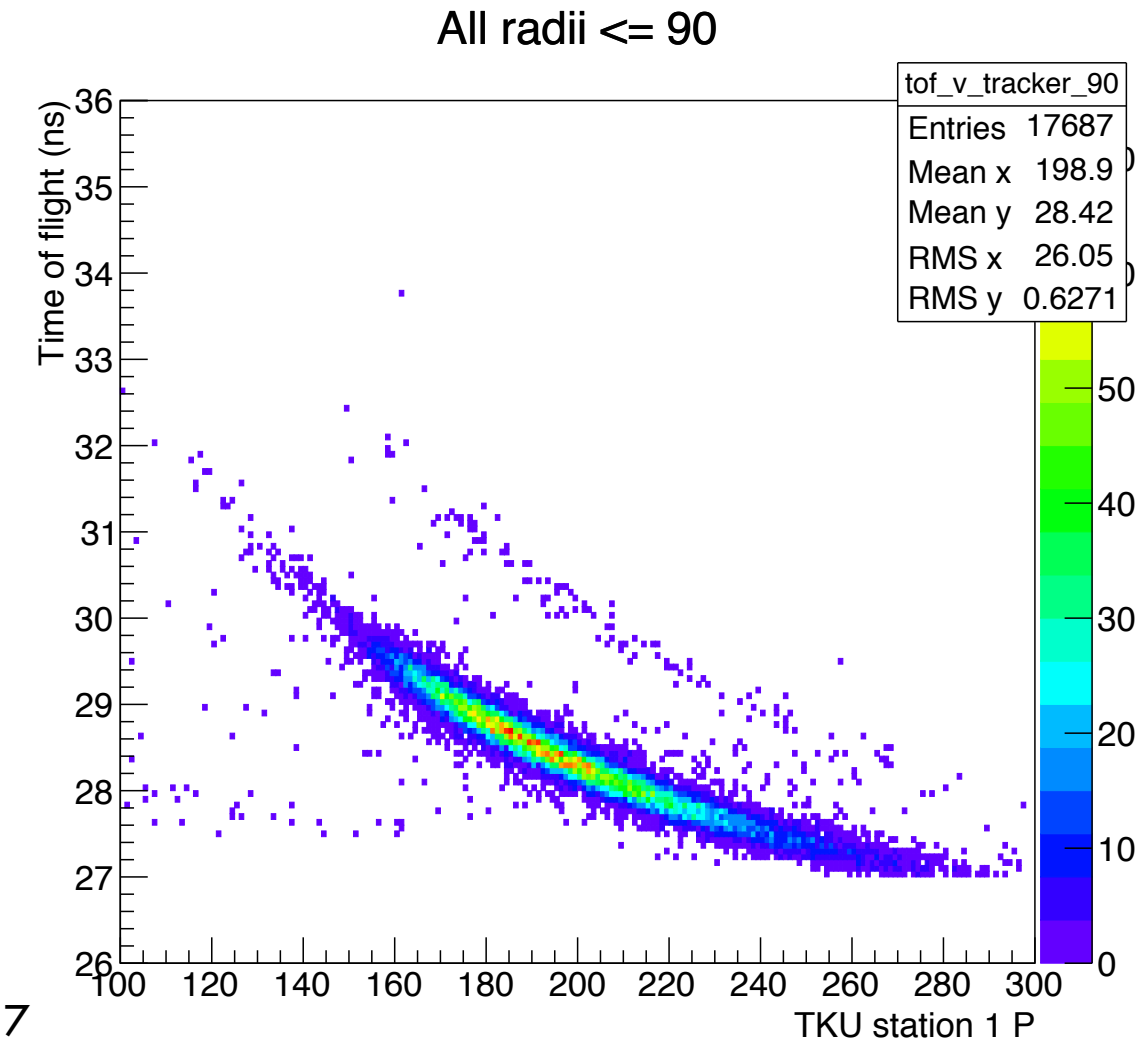
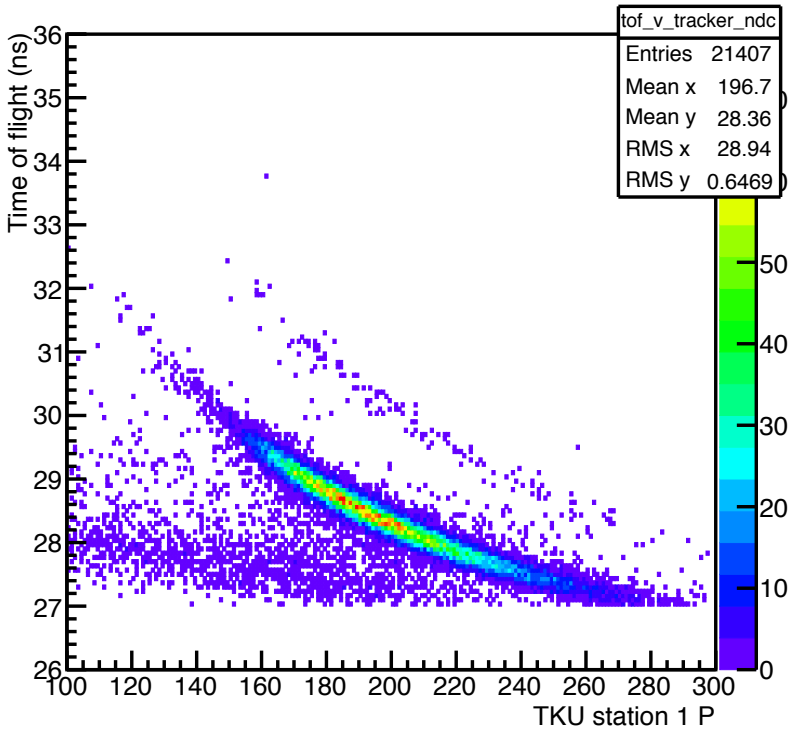


- Accept muons that cross the diffuser at a radius < 90mm
- What happens to plots of interest:
  - Without this cut, but with all "good detector" cuts
  - With good detector + good diffuser cut
  - With good detector + bad diffuser cut

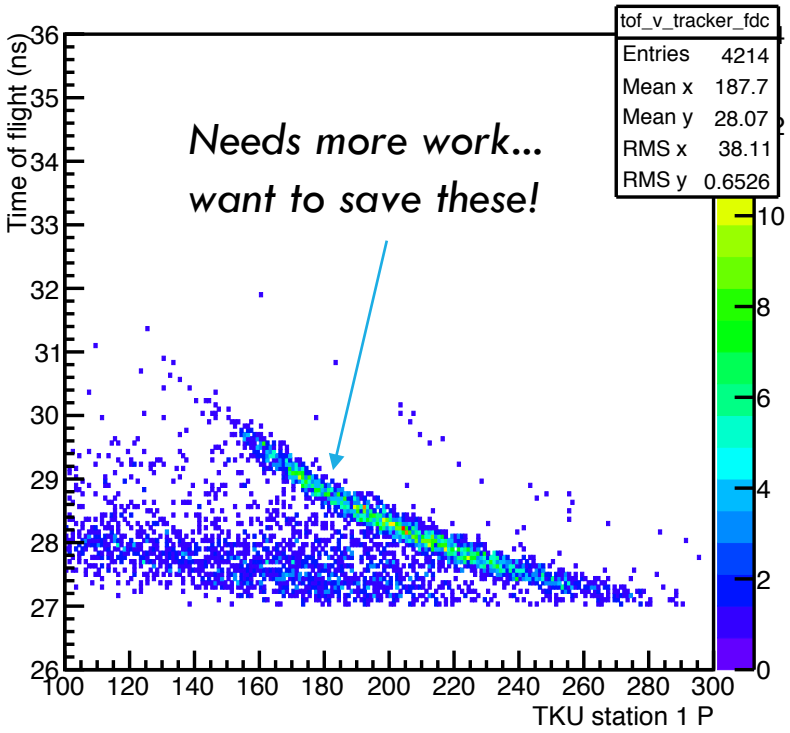
DIFFUSER APERTURE CUT

No diffuser cut



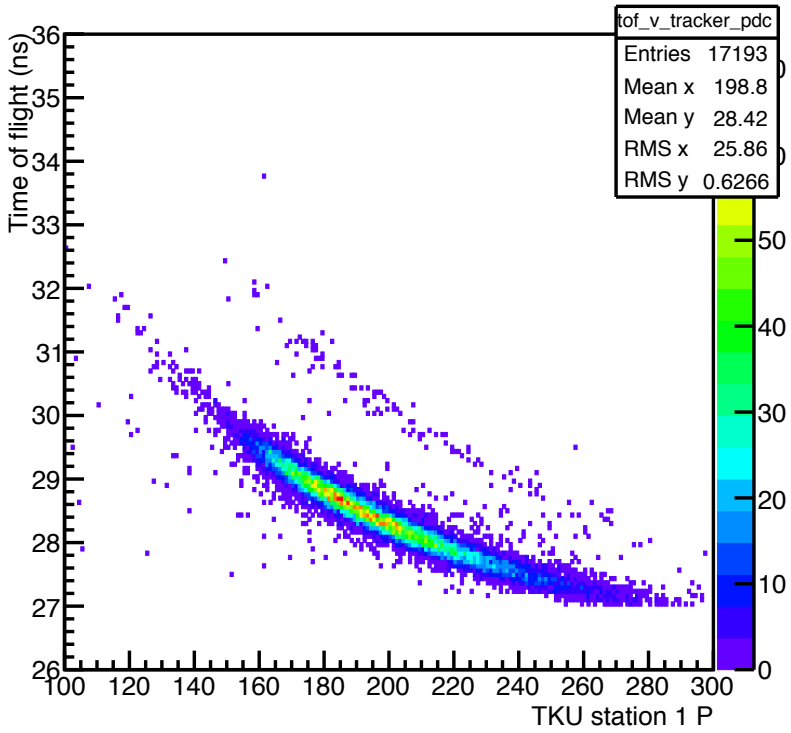
'Good detectors' only

Fail diffuser cut



'Good detectors'
&
Bad diffuser

Pass diffuser cut



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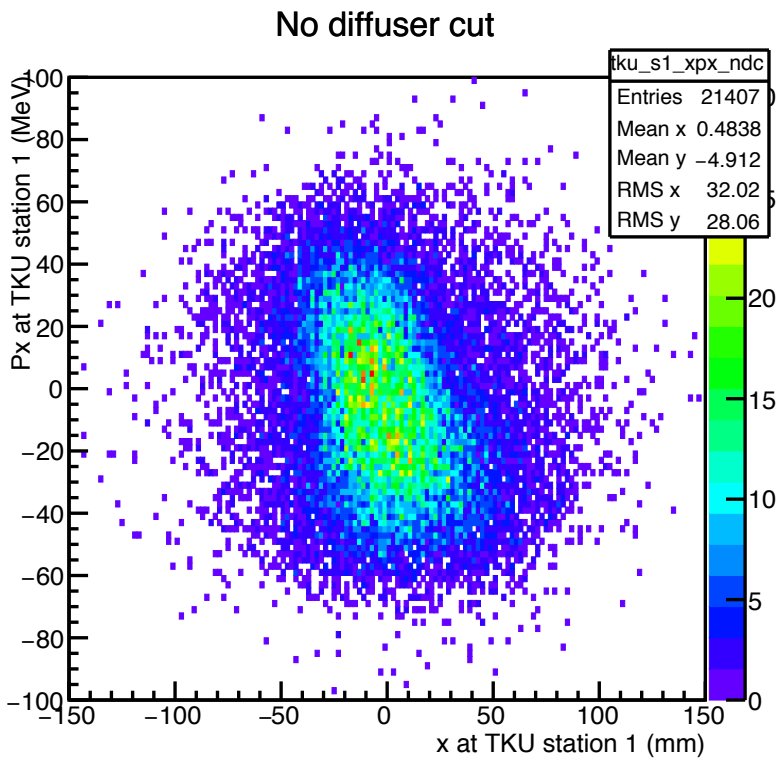
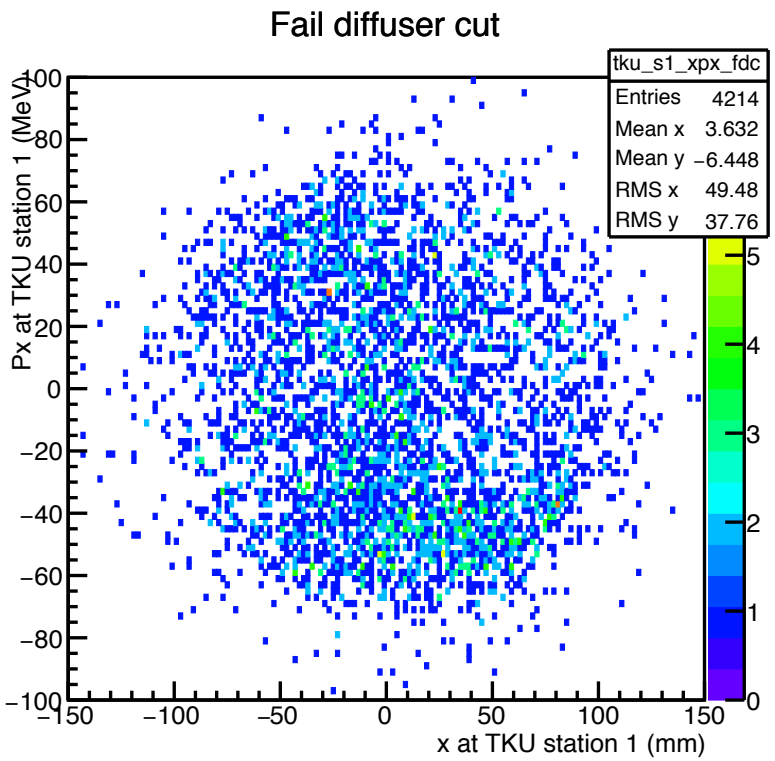
Good diffuser

DIFFUSER APERTURE CUT (X, PX)



'Good detectors' only



'Good detectors'
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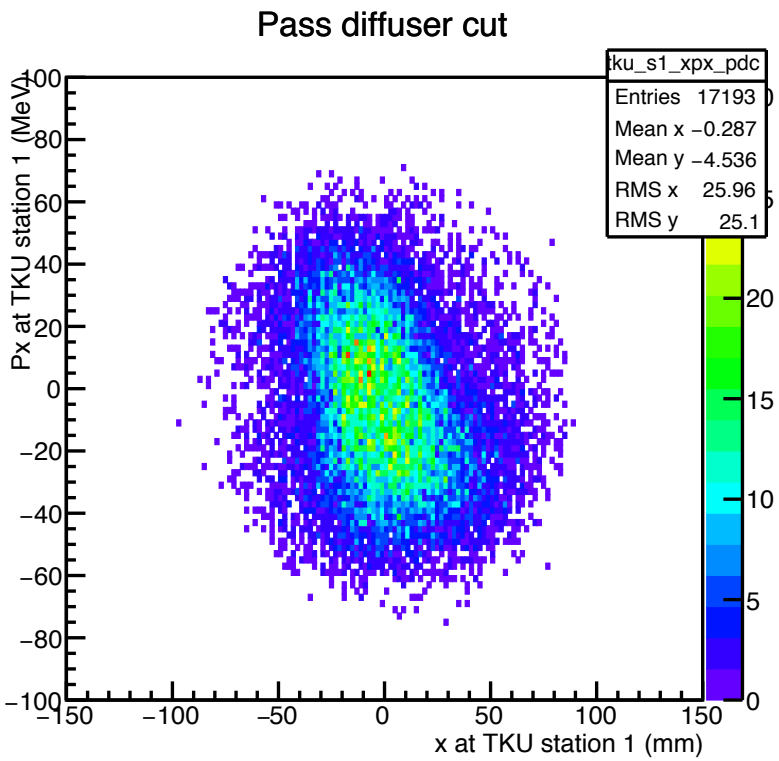
Bad diffuser



'Good detectors'
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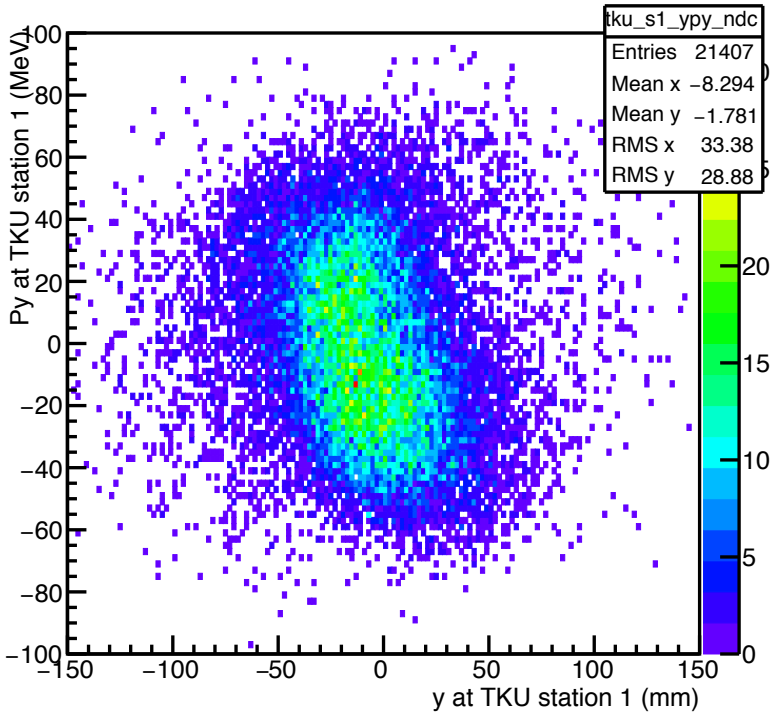
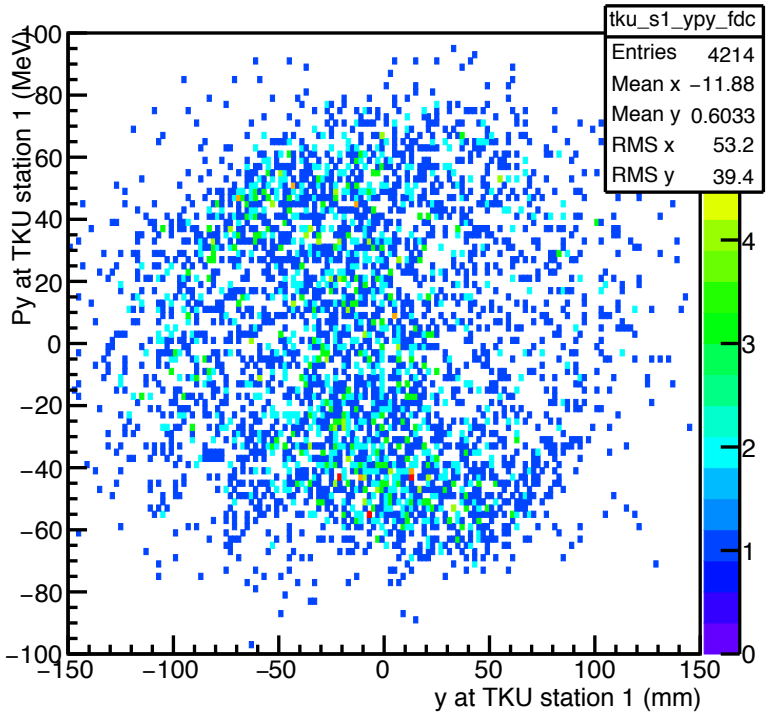
DIFFUSER APERTURE CUT (Y, PY)

No diffuser cut



'Good detectors' only

Fail diffuser cut



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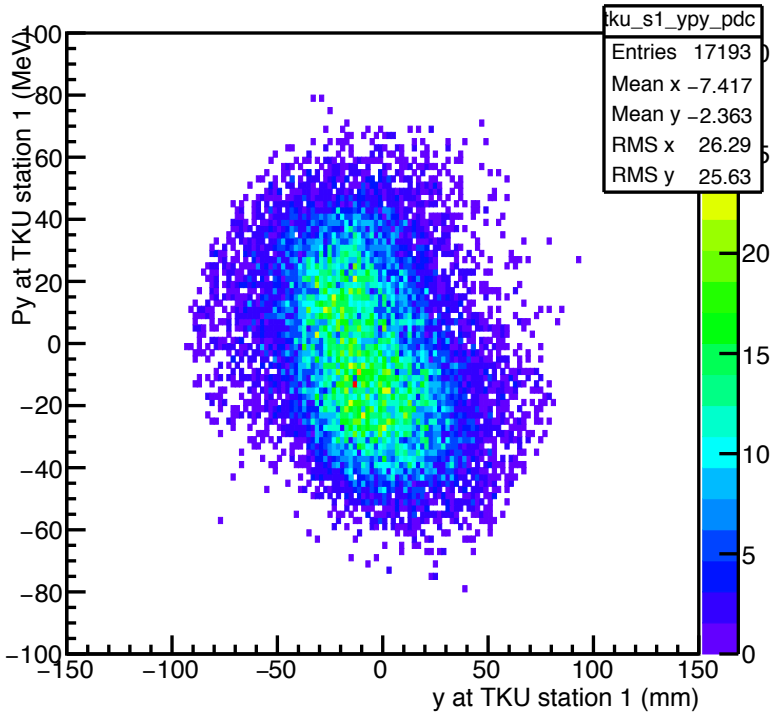

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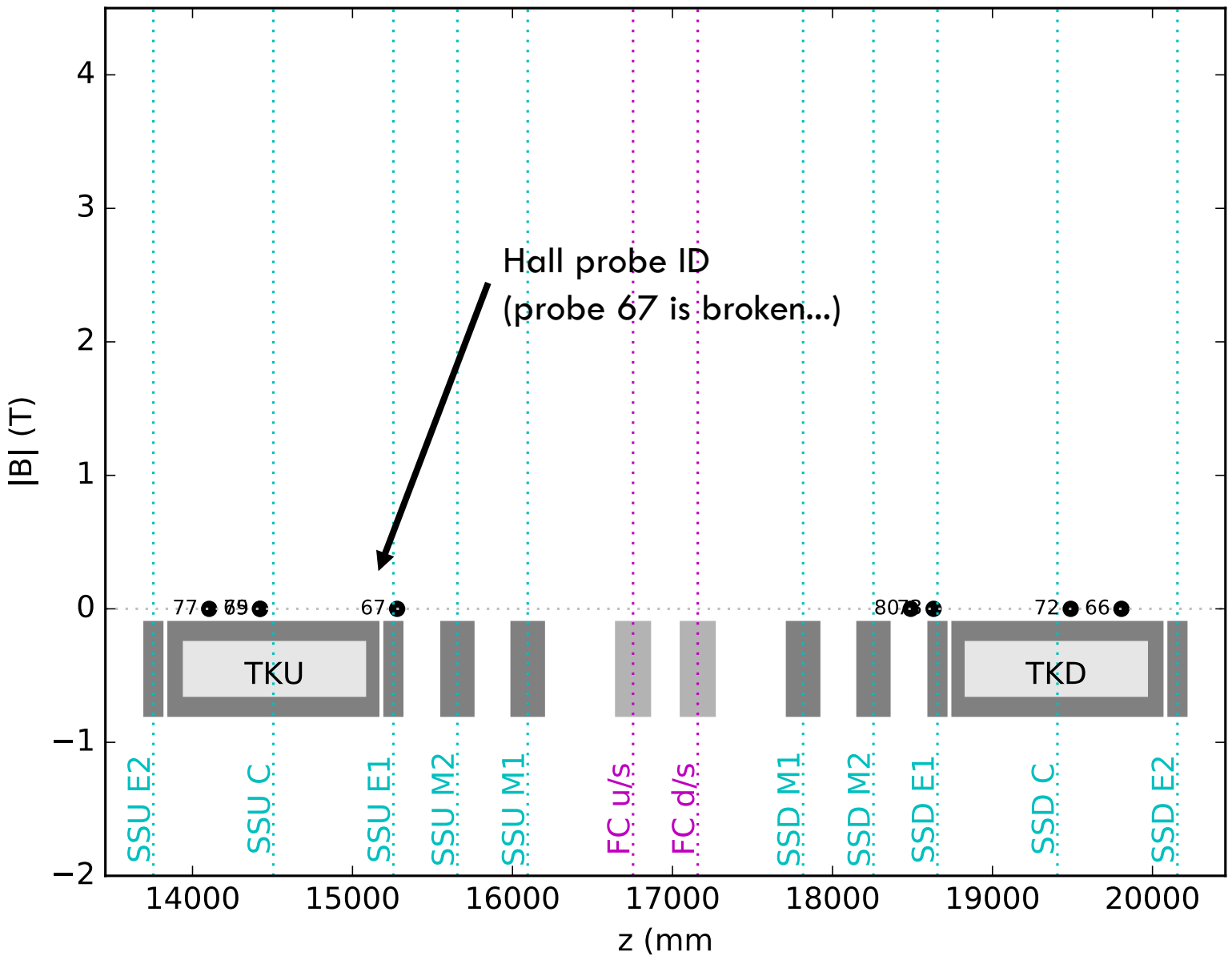
FIELDS & HALL PROBES



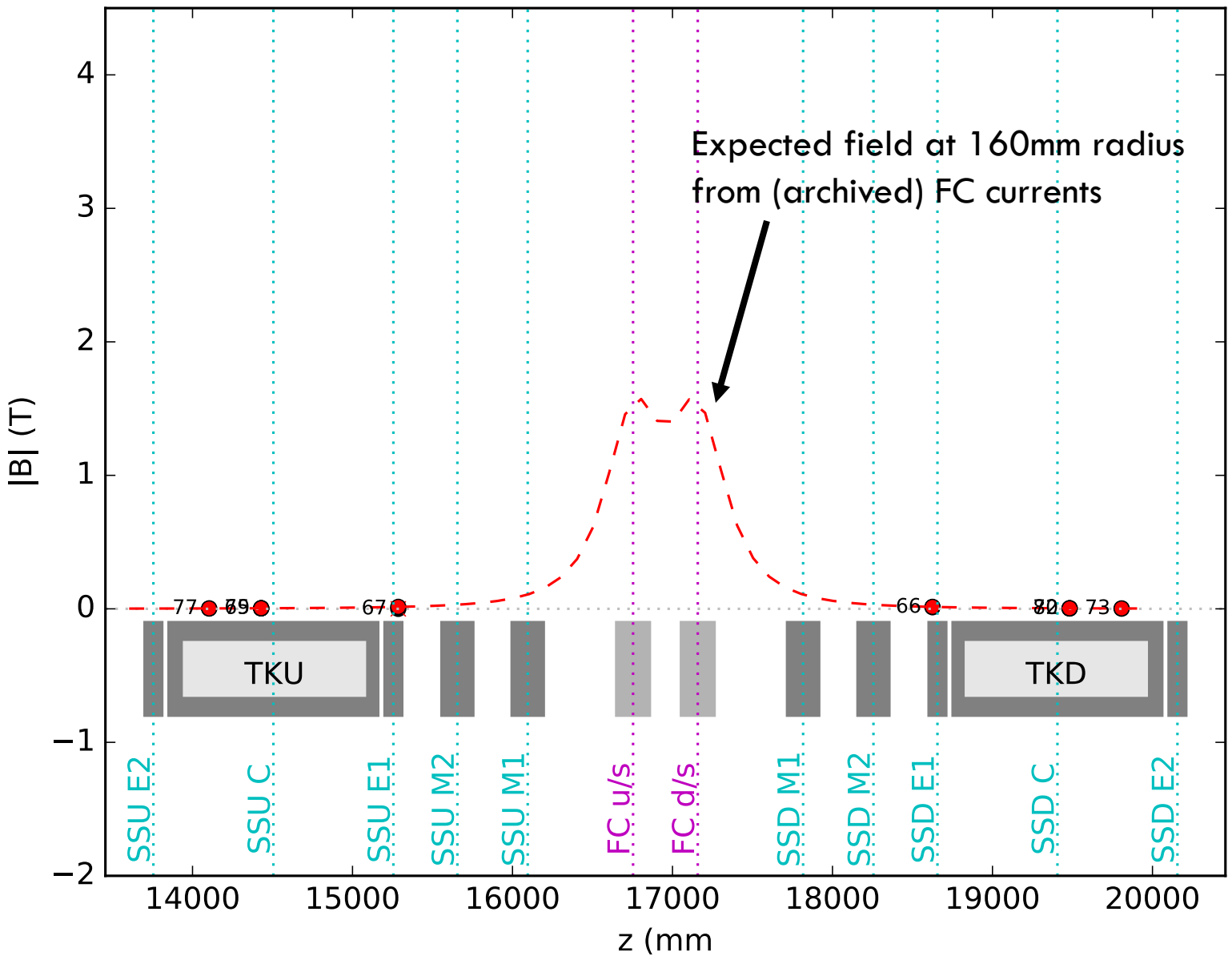
Following plots will look something like this:

- Grey boxes = coils positioned according to geometry. Lengths are Holger's cold dimensions
- Dotted cyan/magenta lines indicate coil centres
- TKU & TKD bounding boxes according to geometry

- Black dots = Hall probes at given position. All probes are at a radius of 160mm

- Red dots = expected field at given position

- Vertical axis: Total field measured by probes, or expected field at that position



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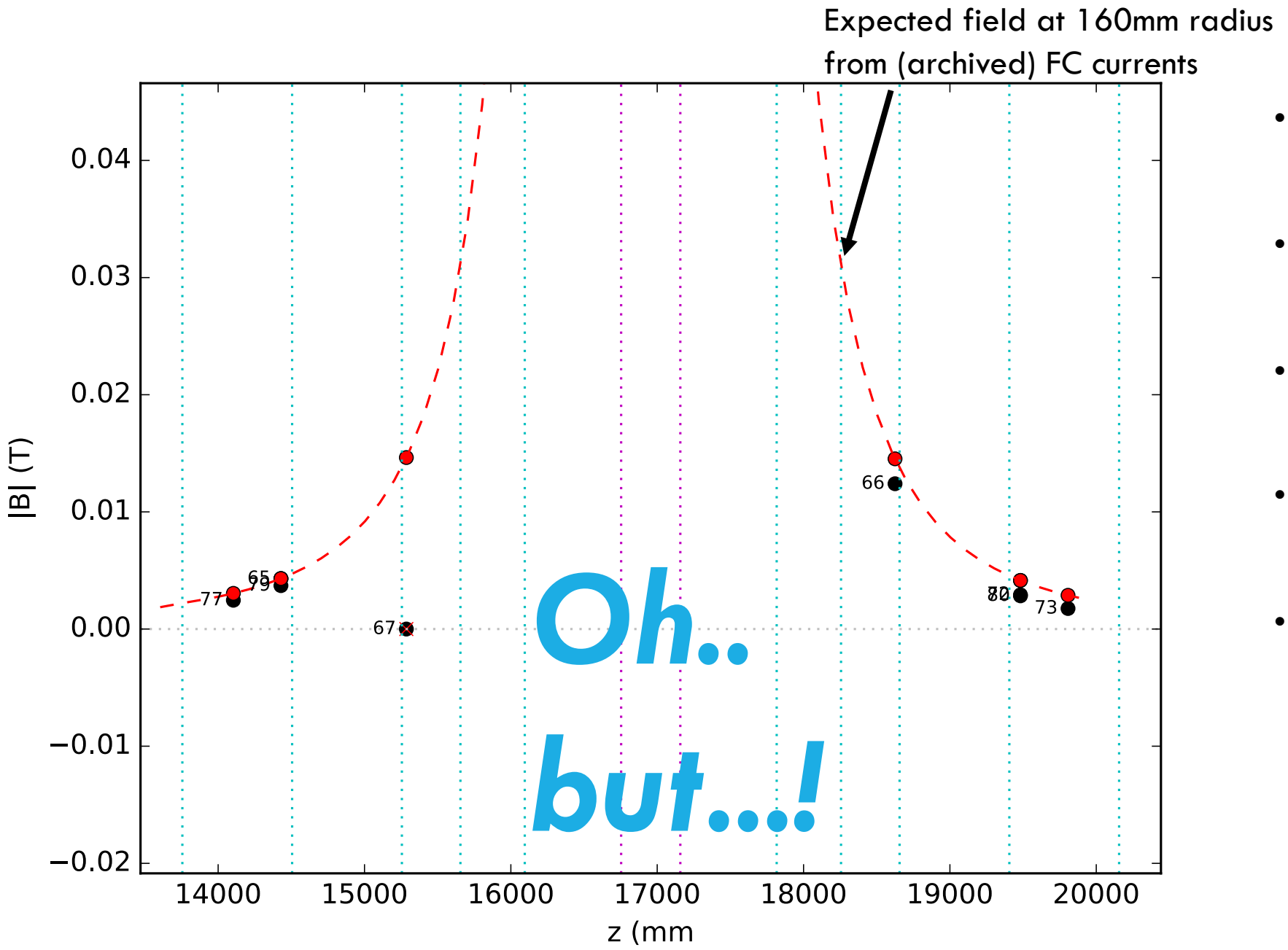

- Hall probe positions here are a simple (r, θ, z)
- Hall probes sit on the tracker frame
- Tracker frame sits in the magnet bores
- Bores != parallel with beam axis
- Calculate field isn't ***really*** at the same position as the probes are measuring
  - Some rotation & offset to apply
  - Started, but not finished...

TOF-TRACKER MOMENTUM LOSS

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- Lose more momentum than expected between TOF1 and TKU
- Two possible causes:
  - TKU momentum correction not included in SciFi Track::mom() function?
    - Need to talk to Adam
  - Incorrect "excess electron path length" used in TOF momentum reconstruction
    - These come from studies from Mark Rayner
    - Old G4BL simulation
    - Mean deviation from a straight line of electrons passing through Q789
    - An old (6, 200) mu+ simulation gives an 11mm excess
    - But this was a (3, 200) beam, and the excess is momentum dependent
    - **Look at more recent G4BL?**

Excess path length (mm)	Mean (P at TOF1 – P at TKU)
1	6.11
5	18.97
10	18.32
11	18.20
12	18.08
15	17.70
30	15.81
40	14.59
50	13.44
60	12.26

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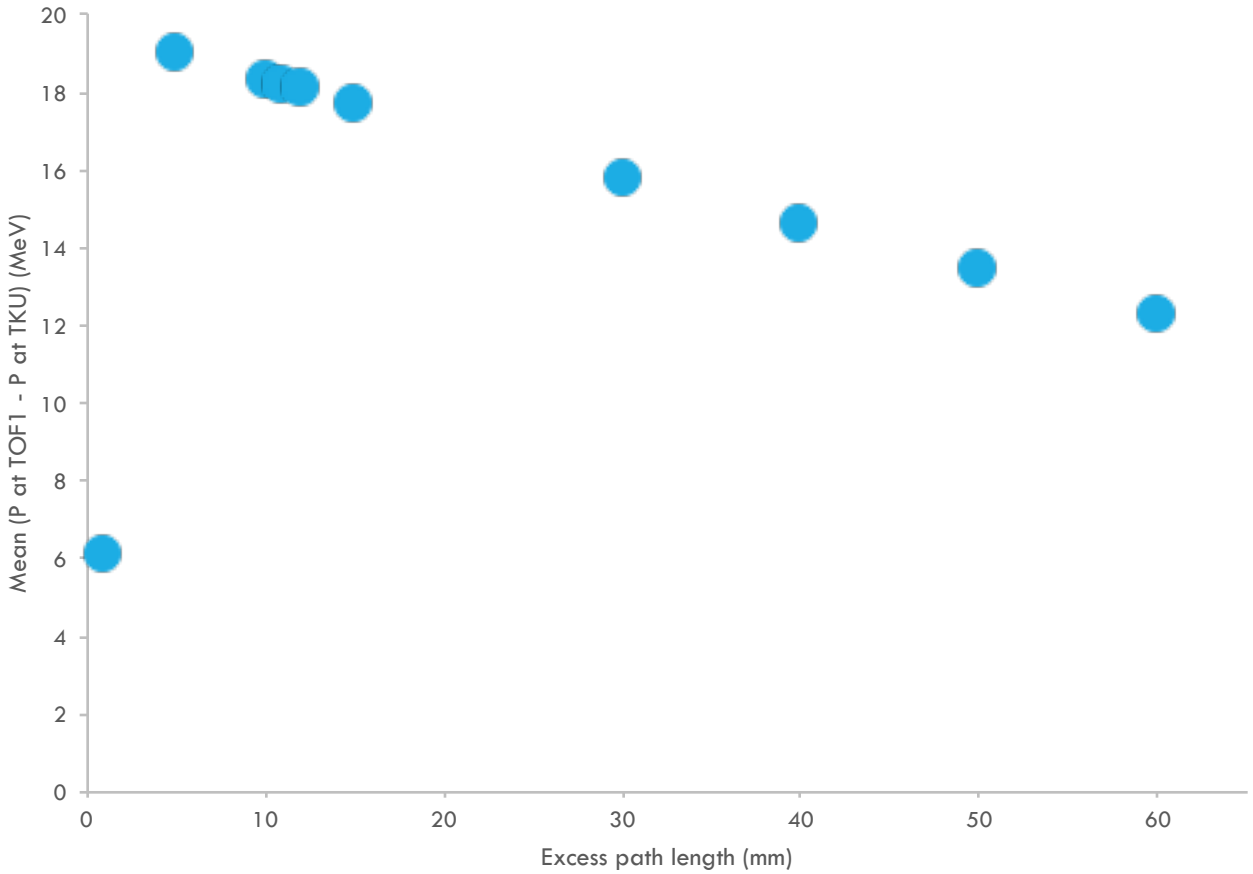

SUMMARY

- Diffuser cut requires:
  - Tracked MC, comparison with true particle positions at diffuser
  - Investigate why particles in the muon region might fail the cut (assume too tight)
- Field placement requires:
  - Understanding where probes are w.r.t. co-ordinates for calculating fields
  - Reading out fields assumed at tracker stations for extra cross-check (requested)
- TOF-TKU momentum loss requires:
  - Looking at a G4BL simulation to check excess electron path used
  - Apply TKU momentum correction if it's not included in SciFi Tracks – ideally, analysis user shouldn't have to apply corrections as they won't know enough to know ***what*** correction needs applying
- Tabulate final errors