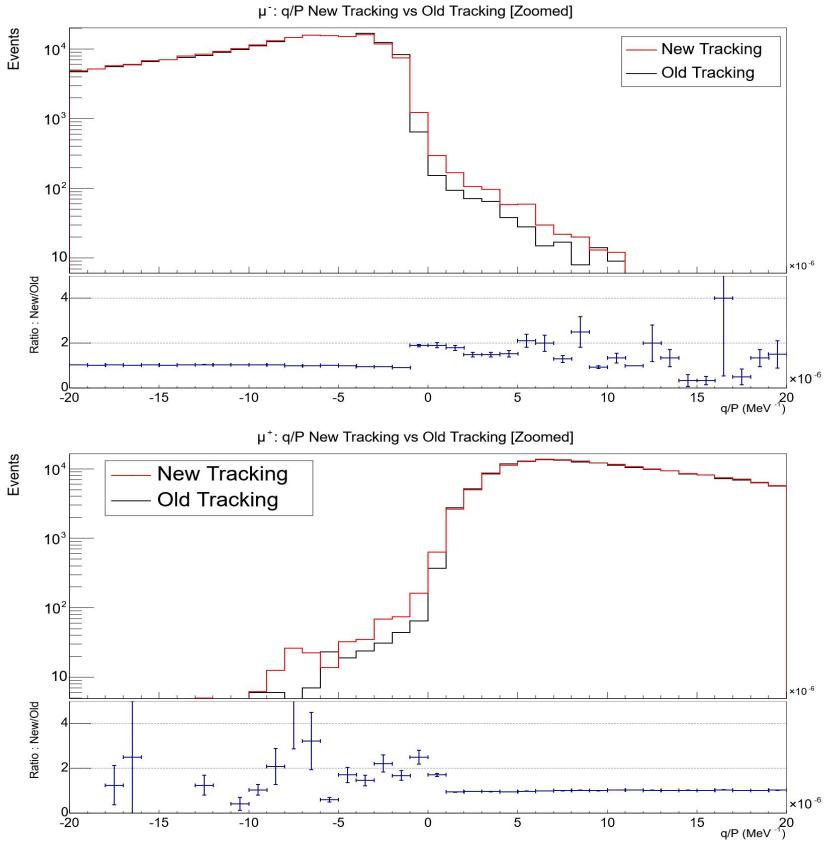
March Update

FASER Liverpool - March Meeting

Sinead Eley

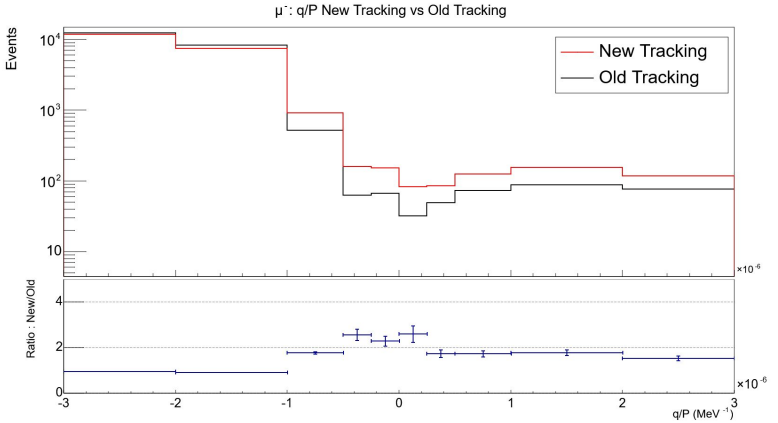
Alma 9 Validation

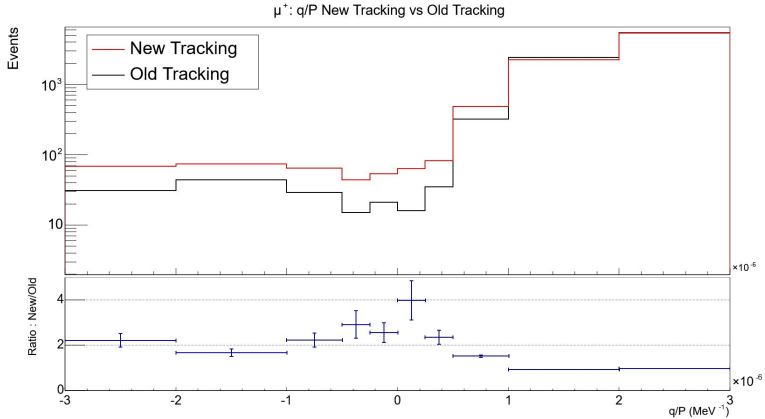
- Seeing slight differences between new and old tracking in charge misid
- Efficiencies look nice for both old and new tracking
- Looked at the q/p distribution to see whether can get to bottom of the differences in charge misidentification
- First looked at this zoomed in on area where most events are distributed
- We know lots of charge misid occur at high momentum
    - Have more bins in this region to look at how q/p is distributed



Alma 9 Validation

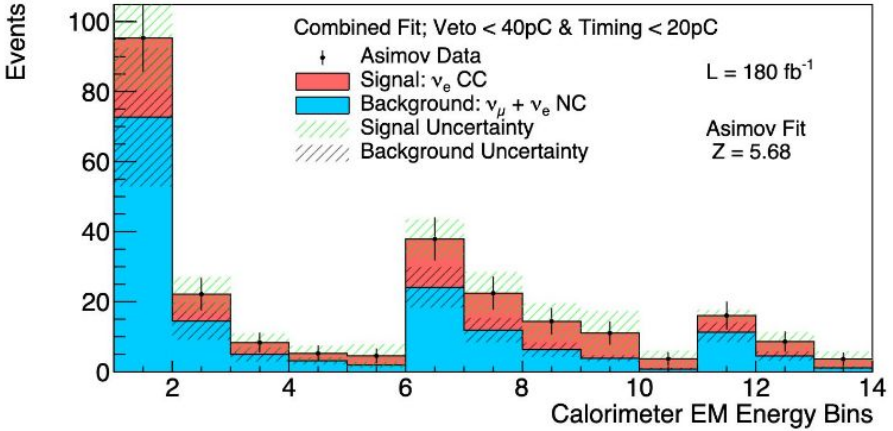
- At point where charge is correctly identified
  - Ratio of new to old events ~ 1
- At very high momentum there is a larger number of events in the new tracking sample than the old tracking sample
  - As the momentum decrease on the ‘charge mis id side’ there continues to be more events in the new tracking sample than in the old tracking sample
- Preparing slides that are an overview of work I’ve done on the validation
  - Useful for documentation/reference and thesis





ALPtrino

- Making progress looking at the background
- Currently looks as if we may get > 5 sigma of significance when using 3 regions (PS, Calo and Magnet)
  - Using Asimov Data to estimate
  - Lead shield region is yet to be included
  - John is working on adapting ATLAS unfolding code to ALPtrino analysis
- Background studies ongoing
  - Waiting for 2024 ntuples with new tracking
  - I'm working on neutral hadron and geometric muon backgrounds



Presented by Oscar (UoM)

ALPtrino Meeting 25/02/25

Alptrino : Neutral Hadron Background

- Idea is :
  - Most generated particles have conversion to electron/positron pair
    - Near veto/timing scintillator
    - Not background as muon would have to interact here
  - If muons create neutral hadrons
    - Won't interact
    - Background to the analysis
  - Expect this to be negligible
- Method here:
  - Study this using muon simulations
  - Have some large FLUKA muon samples
    - Also have some particle gun samples for neutral hadrons
      - Originally come from FLUKA muon samples
      - Used to specify type of neutral hadrons in Elec. Muon Nu analysis
  - Eli made some specific muon samples for studying neutral hadrons at cern
    - Currently waiting on these to be in a form that can be fed through calypso
  - Apply baseline cuts to samples

Neutral Hadron Background Cutflow

MC100067-69 & MC100074-76 [NH Particle Gun] $\approx 200\ \mathbf{fb}^{-1}$

Cut	Input	Pass	Eff	CumEff)
Select Neutral Hadrons	1080000.000	1080000.000	100.000%	100.000%
Calo Trigger (> 20 GeV in Calo)	1080000.000	22550.400	2.088%	2.088%
No Raw VetoNu Signal	22550.400	22227.300	98.567%	2.058%
No Raw Veto Signal	22227.300	12611.700	56.740%	1.168%
Raw Timing Signal < 20 pC	12611.700	11082.600	87.876%	1.026%
100 < Calo E < 2000 GeV	11082.600	1110.600	10.021%	0.103%

Hadron Type After Cuts

Hadron	Input	Pass	CumEff
Kl	1110.600	121.500	0.0113 %
Ks	1110.600	320.400	0.0297 %
Neutron	1110.600	683.100	0.0632 %
Lambda_0	1110.600	538.200	0.04983 %

MC20005[μ^-] & MC200006 [μ^-] - Fluka Muon Samples

Cut	Input	Pass	Eff	CumEff
Select Neutral Hadrons	180.000	0.114	0.063%	0.063%
Calo Trigger (20 GeV in Calo)	0.114	0.000	0.194%	0.000%
No Raw VetoNu Signal	0.000	0.000	0.000%	0.000%
No Raw Veto Signal	0.000	0.000	0.000%	0.000%
Raw Timing Signal 20 pC	0.000	0.000	0.000%	0.000%
100 Calo E 2000 GeV	0.000	0.000	0.000%	0.000%

ALPtrino: Geometric Muon Background

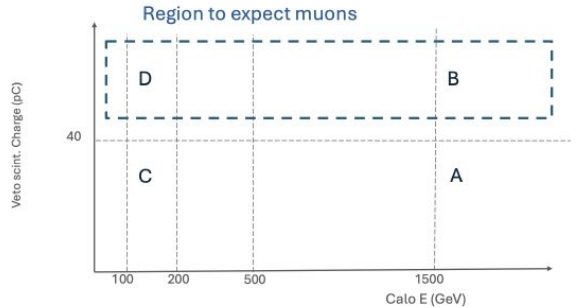
- Background can occur from muons coming into FASER at an angle, missing both veto detectors
- Looking at a data driven method (i.e. ABCD) to study this
- Several MC files
  - Underestimation of this type of background
  - Has low stats
- Lottie used ABCD method for geom. Muons in ALP analysis
  - Use a similar methodology but build upon and improve this

MC100084-85 (Large Angle Muon Samples for ALPs analysis - Particle Gun)

Cut	Input	Pass	Eff	CumEff
Calo Trigger (> 20 GeV in Calo)	72000000.000	77580.000	0.108%	0.108%
No Raw VetoNu Signal	77580.000	720.000	0.928%	0.001%
No Raw Veto Signal	720.000	360.000	50.000%	0.001%
Raw Timing Signal < 20 pC	360.000	0.000	0.000%	0.000%
100 < Calo E < 2000 GeV	0.000	0.000	0.000%	0.000%

MC200007- SND FLUKA Sample

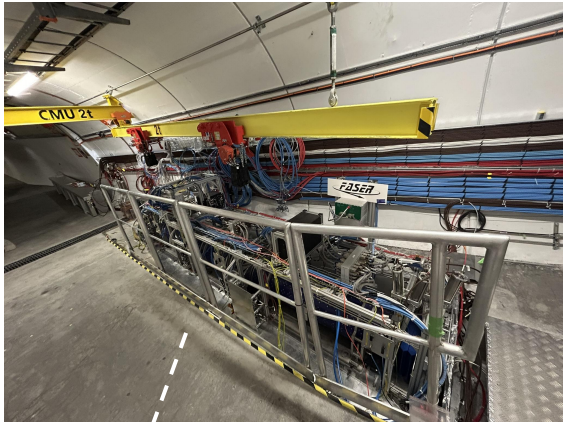
Cut	Input	Pass	Eff	CumEff
Calo Trigger (> 20 GeV in Calo)	180.000	0.005	0.003%	0.003%
No Raw VetoNu Signal	0.005	0.000	0.071%	0.000%
No Raw Veto Signal	0.000	0.000	0.000%	0.000%
Raw Timing Signal < 20 pC	0.000	0.000	0.000%	0.000%
100 < Calo E < 2000 GeV	0.000	0.000	0.000%	0.000%



Lottie's Method for ALPs Geom. Muon Bkg (taken from her thesis)

Summary

- Wrapping up validation tracking studies
  - Charge misid - appears to occur more in new tracking
  - Efficiencies and residuals look good
    - When comparing old tracking and new tracking this are near identical
  - Currently putting all this working together in some slides
- ALPtrino
  - NH background
    - Hopefully get Eli's samples very soon and can run over them
      - Larger stats than we currently have
  - Geom Background
    - Develop the ABCD method we will use for this and add to the RDF code
    - Apply to data when we are ready
- Other bits and bobs:
  - Regular run manager shifts aiming for ~ 1 month
  - Visited FASER earlier in the week



Visit to FASER on Wednesday