Alptrino Update

FASERLiv January 2026

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Recap : PS Fudge Factors

Recap of MC22 Study:

- Was unable to reproduce mc22 PS fudge factors calculated for the ALPs int note (2024)
  - Insufficient detail and code available from this study
- Found that difference between MC and data was likely to be < 20% quoted in the analysis
- Utilised a 4 bin approach (i.e. splitting events by the total momentum of the two lowest momentum tracks) to fit the data/mc
  - [0–75], [75–150], [150–225], [225) GeV
- Full results and method found here (last meeting) and in further detail here (alptrino meeting)

Updates for MC24 Approach:

- Use 3 bins (([0-75],[75-150],[>150] GeV)) instead of 4
  - New samples have lower stats that MC22 sample
  - Near impossible to get a decent fit for final momentum bin i.e. last two bins combined
- Improved fitting (?)
  - Using log likelihood method instead of chi-squared (default)
  - Use integral of function in bin rather than center of bin

Recap : PS Fudge Factors Approach

Select Photon Conversion Events

- Three good tracks
- Opposite charge for the two lower momentum tracks
- Calo E/p > 0.7

Extract MPV of Fit

For each momentum bin ([0-75],[75-150],[>150] GeV) :

- **Plot E Dep** for each layer of PS
- Apply **landau fit**
- **Extract MPV** of fit
- Plot **mean momentum vs MPV of fit**

Calculate Fudge Factor

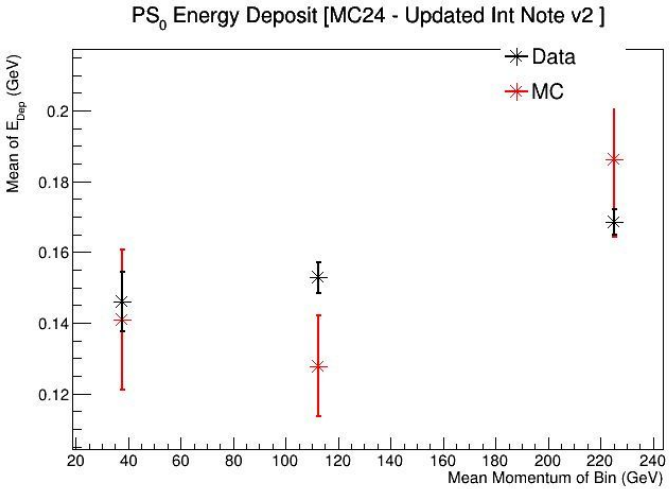
- Take **ratio (Data/MC)** for each energy distribution mean, in each momentum bin respectively
- **Fit ratios** with a horizontal fit
- **Extracted height** of fit to give fudge factor

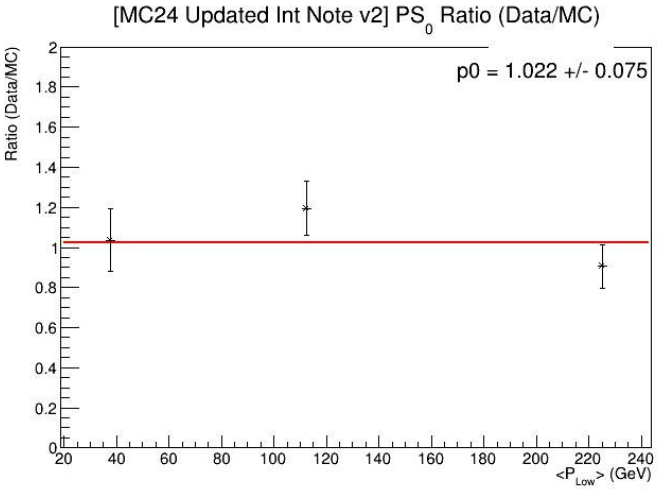
Samples

- MC24 PG Muon Samples (**MC100043/44**)
- 2022 & 2023 Data

MC 24 PS Fudge Factors: PS0

- Small difference between data and MC
- In TI12 studies see a difference of ~2%, in the test beam studies see a difference of ~ 5%





Test Beam (2024 MC)

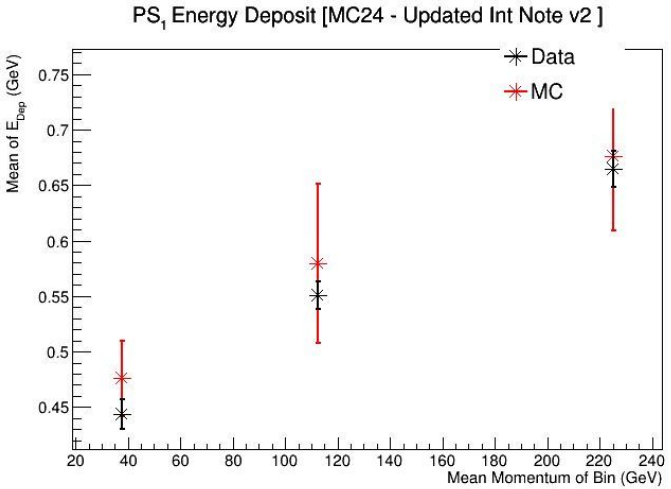
Variable	Correction factor
Preshower Layer 0	1.051 ± 0.061
Preshower Layer 1	0.977 ± 0.034
Preshower Ratio	1.036 ± 0.032

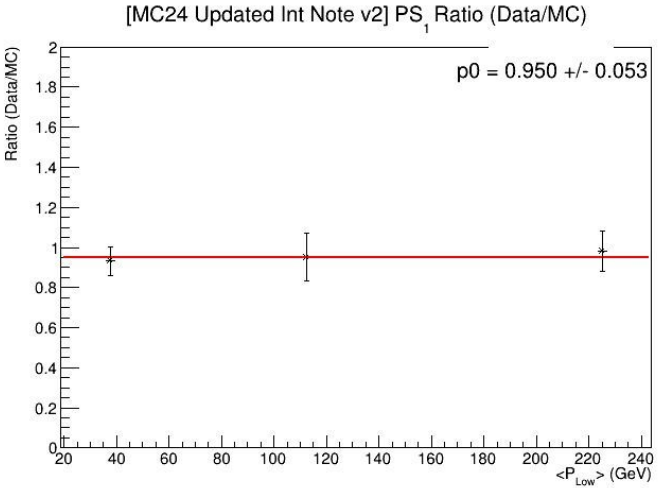
TI12 (2024 MC)

Variable	Correction factor
Preshower Layer 0	1.022 ± 0.075
Preshower Layer 1	0.950 ± 0.053
Preshower Ratio	0.914 ± 0.028

MC 24 PS Fudge Factors: PS1

- Generally good agreement between data and mc
  - Largest uncertainty arises from mc stats
- See a slightly larger difference in ti12 studies than in TB studies (5% vs 3 %)





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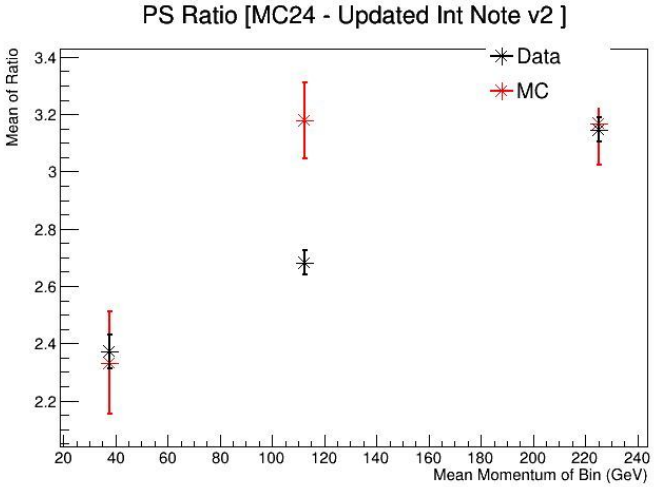
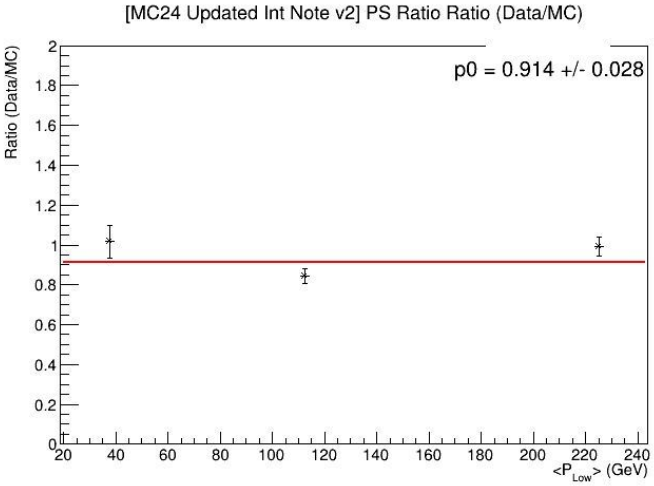
MC 24 PS Fudge Factors: PS Ratio

- Seems to be the largest difference between mc and data seen in the ti12 study
- Improving fit (i.e. using likelihood fit) doesn't seem to have too much of an impact
  - 0.901 vs 0.914 as data/mc ratio





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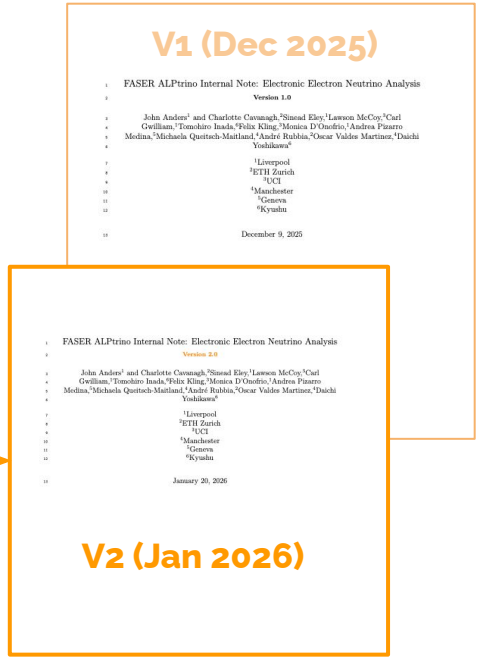
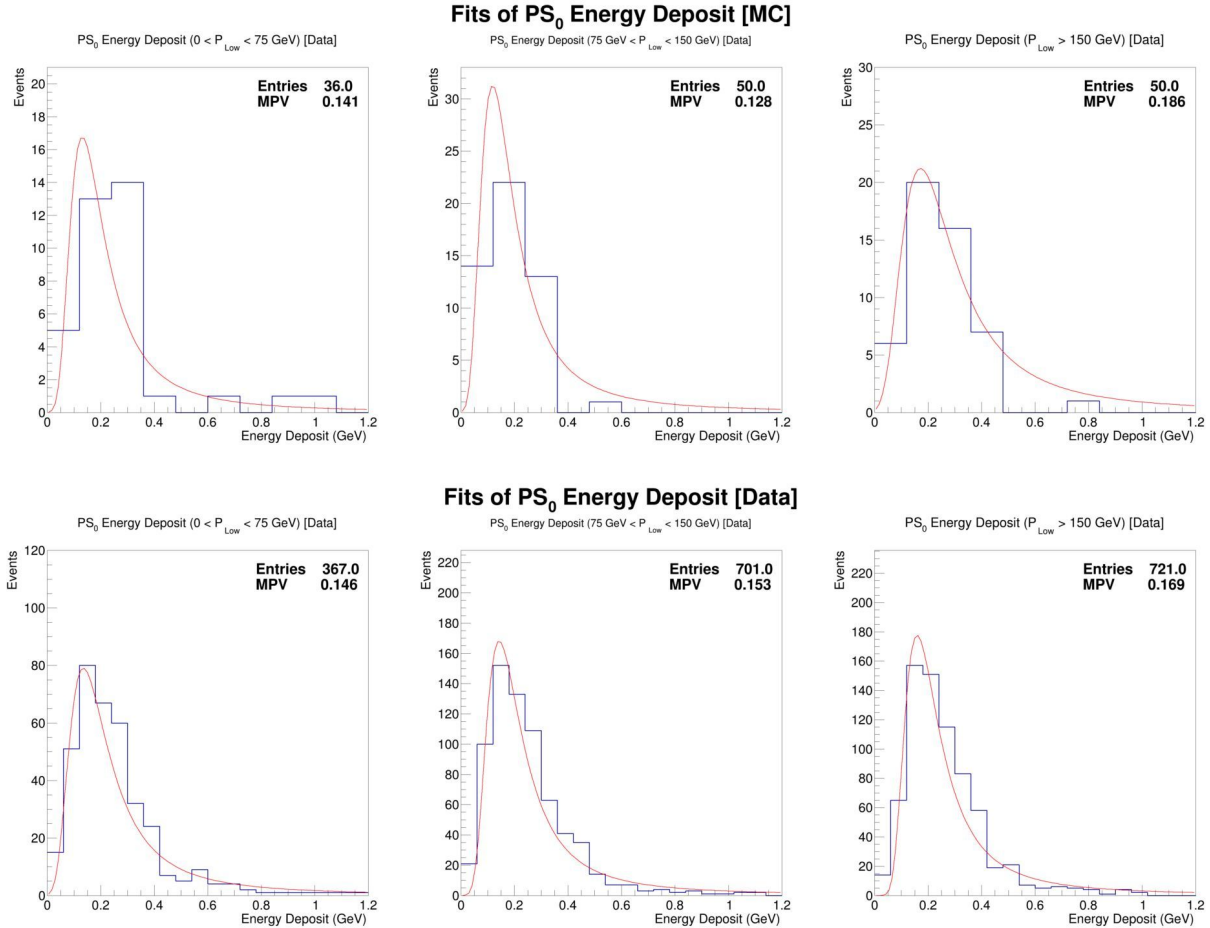
Summary

- ALPtrino note now circulated and comments been addressed
  - Version 2 circulated this week (can be found here)
- Concluded study on ps fudge factors using mc24 samples
  - Included in the updated note
- Analysis scripts cleaned up
  - Includes README for running each analysis
  - Will be pushed to main faser repo by the end of day
- Starting placement on monday at the Guardian
  - Full time on placement until April

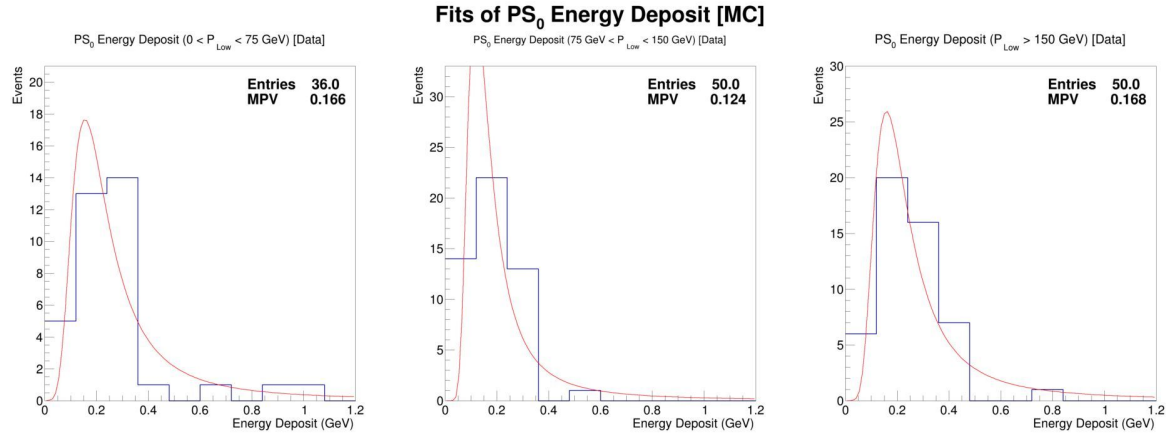


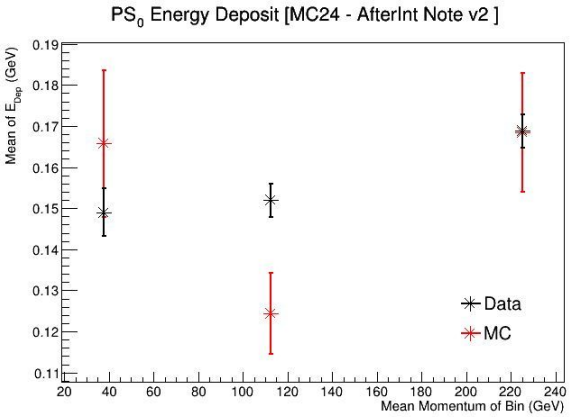
Back Up

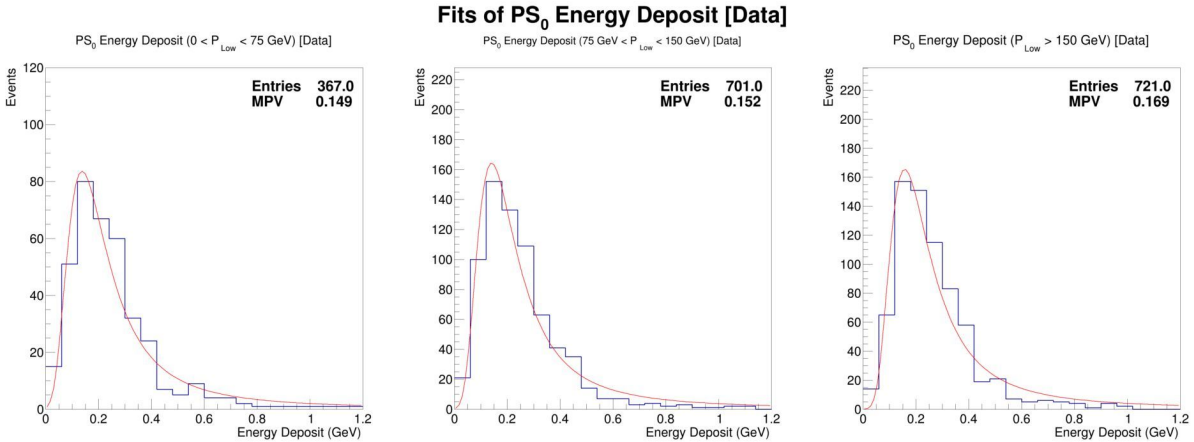
PS 0 - MC and Data Fits

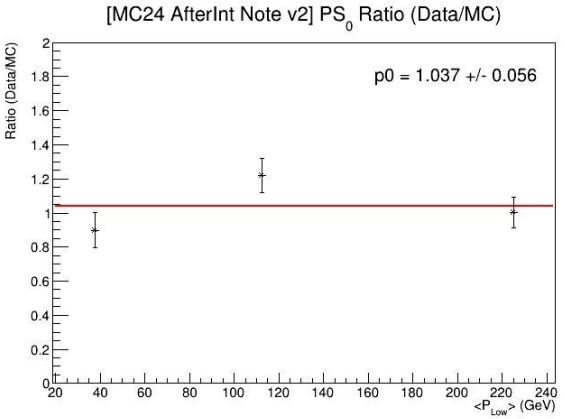


PS 0 - MC and Data Fits -> Improving Fits









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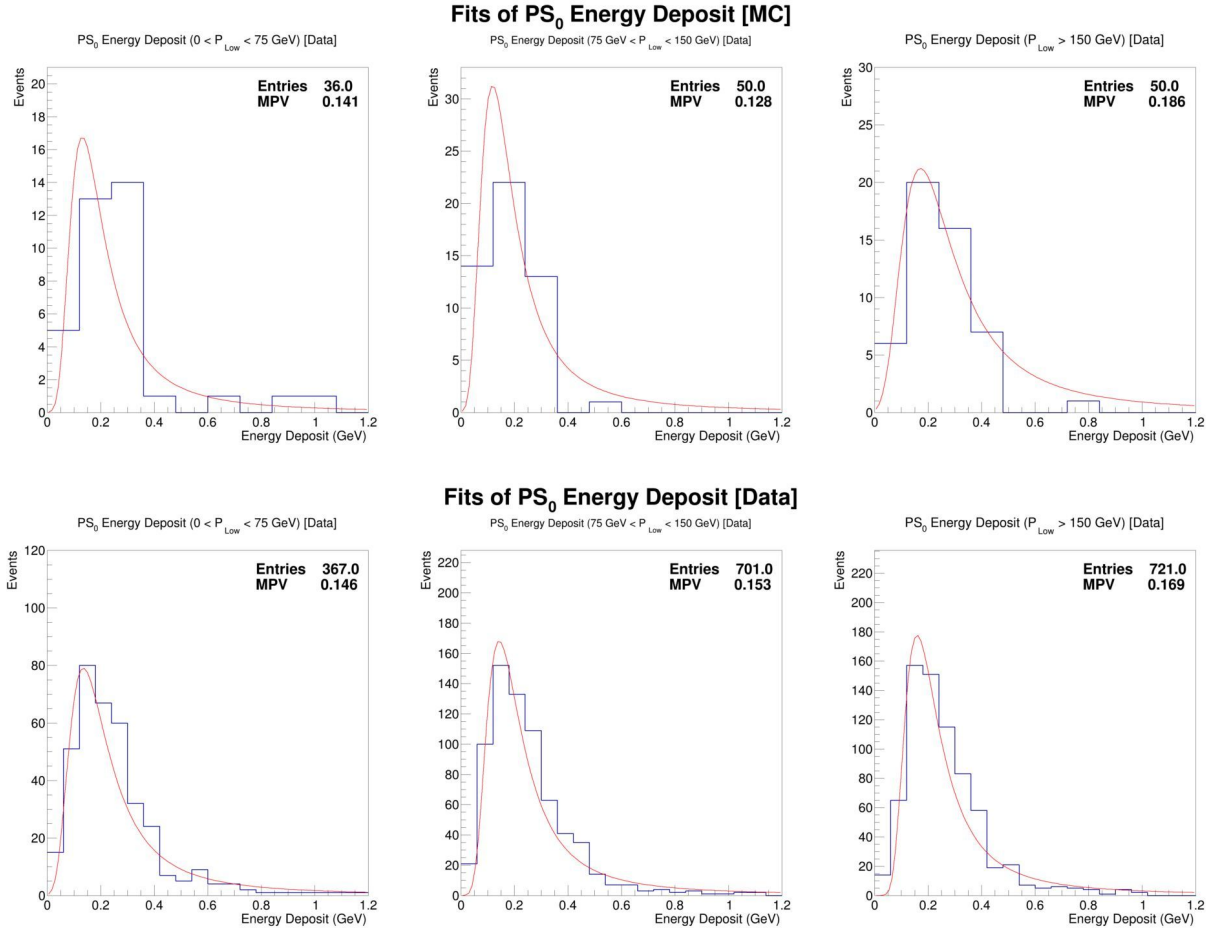
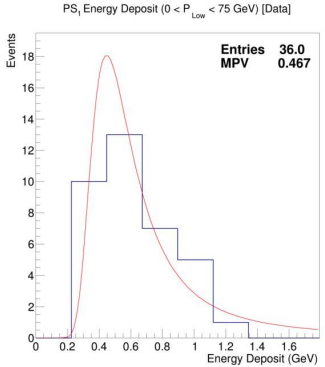
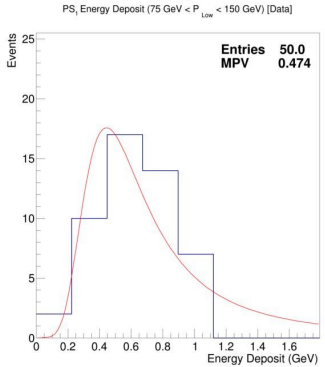
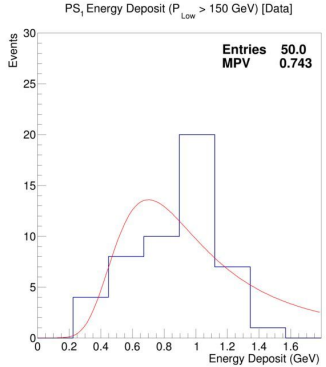


PS 1 - MC and Data Fits -> Improving Fits

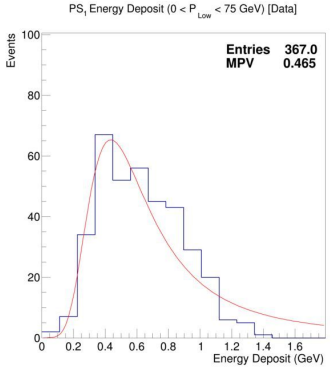
Fits of PS_1 Energy Deposit [MC]

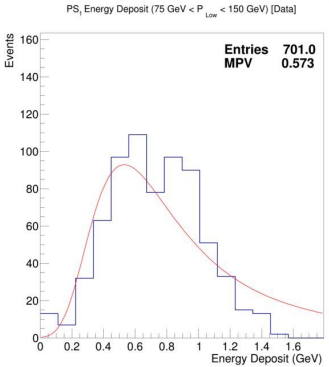


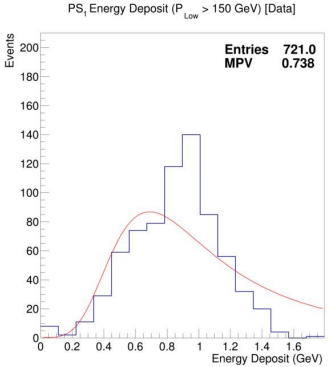


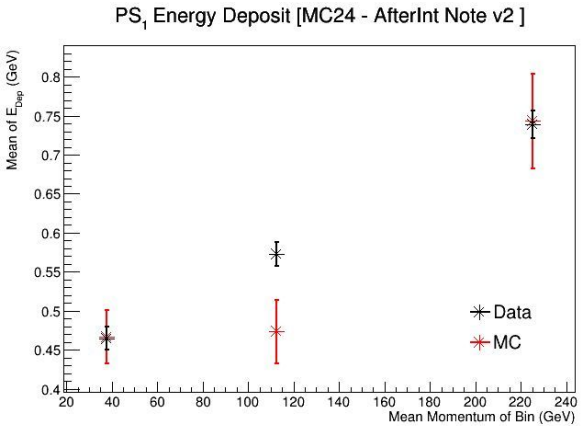


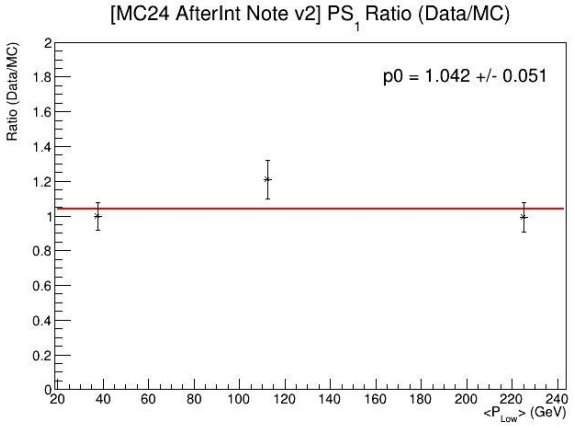
Fits of PS_1 Energy Deposit [Data]



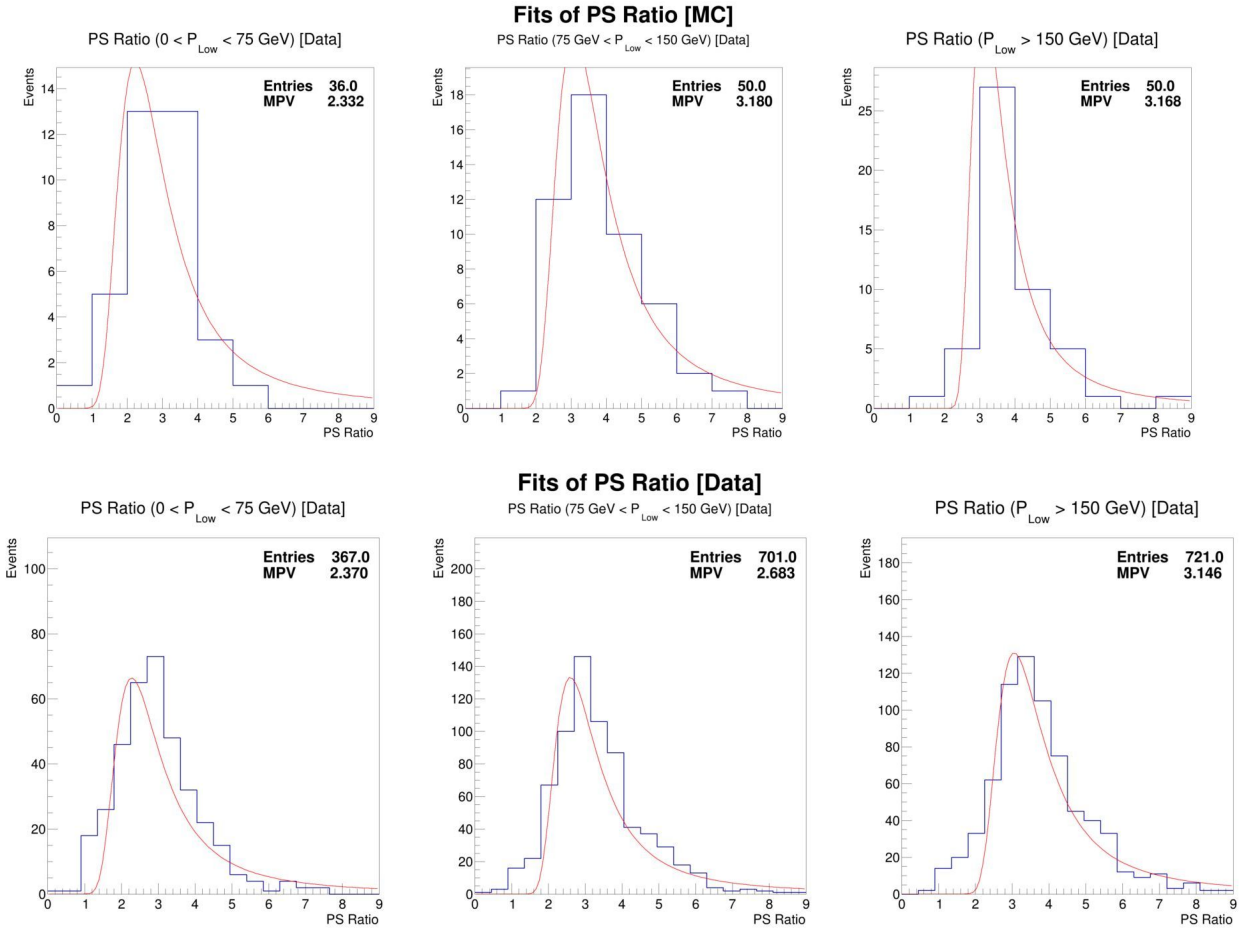




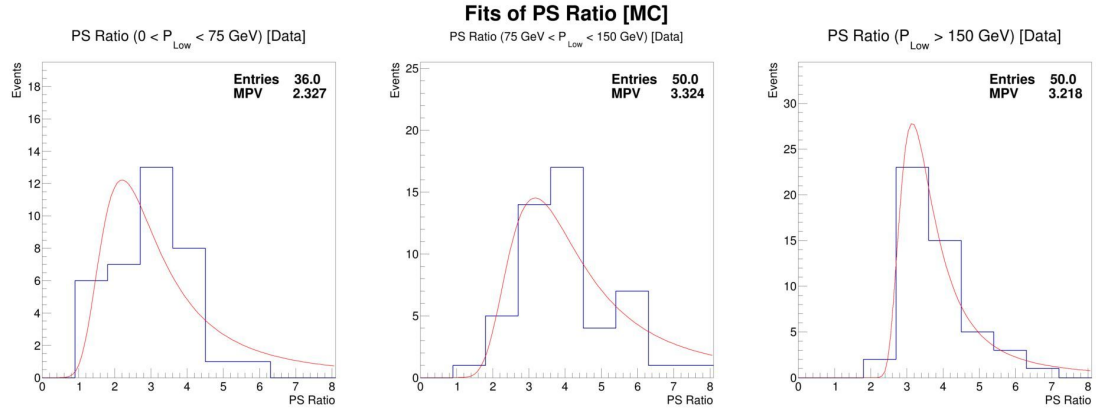


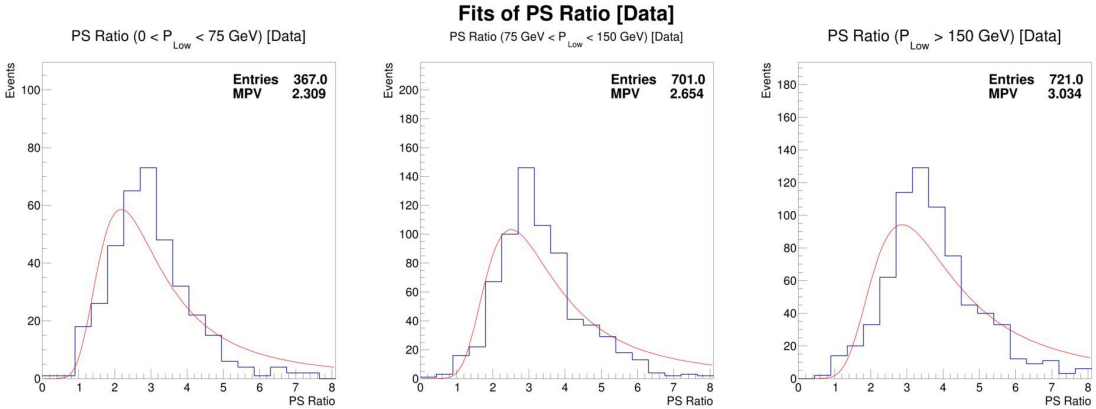


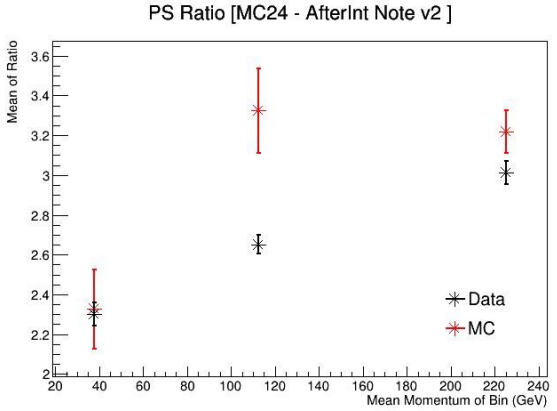
PS Ratio - MC and Data Fits

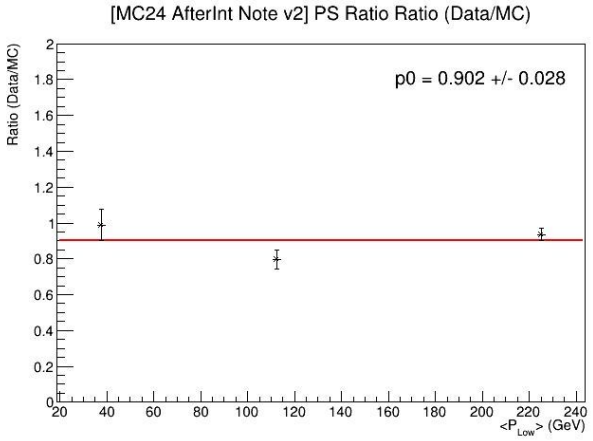


PS Ratio - MC and Data Fits -> Improving Fits



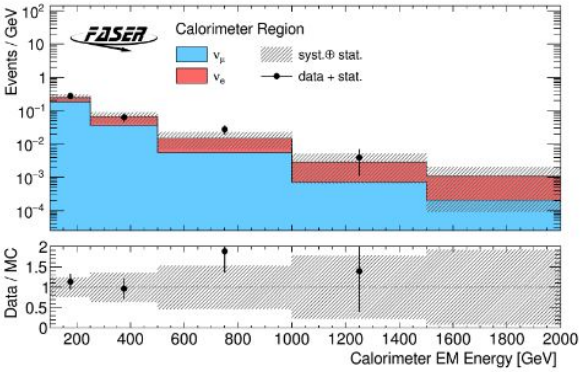


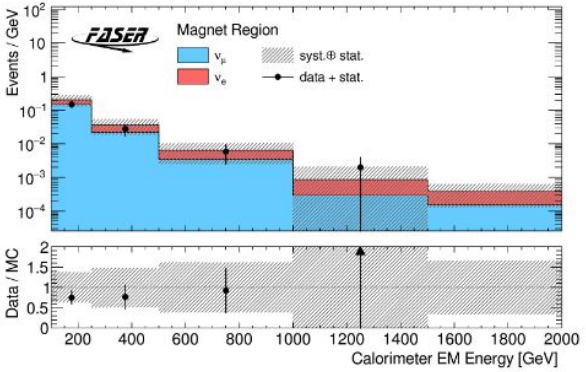




Overview of Analysis

- The ALP analysis has observed a significant selection of neutrinos in the control region (CR).
  - CR is now our region of interest
- Uses RDF framework
  - Used in A' (2023) and ALP (2024) analyses.
- Utilises predefined neutrino regions
  - Identified in the ALPs background analysis
- Targets 2022–2024 data,
  - Totaling ~ 177 fb^{-1}.
- Goal:
  - Detect electron neutrinos using the FASER electronic detector.
- Signal is CC Electron Neutrinos (with NC Electron and Muon neutrinos both contributing to the background)





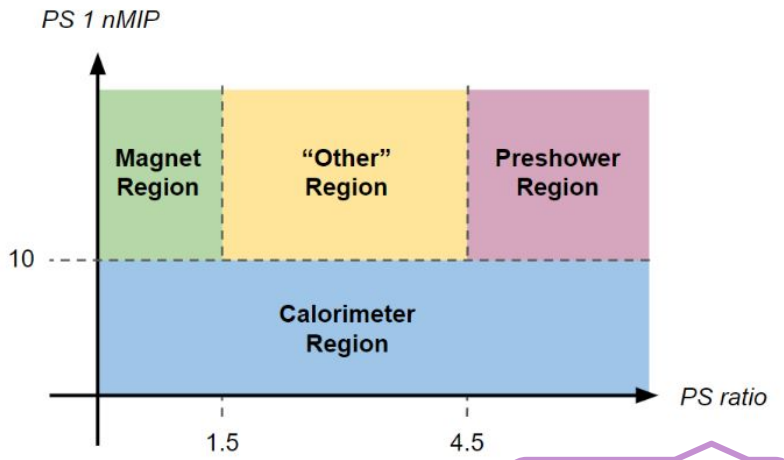
Baseline Cuts

- ➔ No signal in Veto or VetoNu
- ➔ Timing Signal < 40 pC

Overview of regions

- Utilising regions used for neutrino background in ALPs analysis
- Regions defined by PS ratio and PS1 nMIP (and utilising baseline cuts):
- **Magnet**:
  - PS1 nMIP >10
  - PS ratio < 1.5
- **Other**:
  - PS1 nMIP >10
  - PS ratio <4.5 & >1.5
- **PS**:
  - PS1 nMIP >10
  - PS ratio > 4.5
- **Calo**:
  - PS1 nMIP < 10

PS ratio
Ratio of MIPs in PS station 1 compared to station 10



PS1 nMIP
Number of MIPs in preshower station 1