FASER Liverpool
June Update

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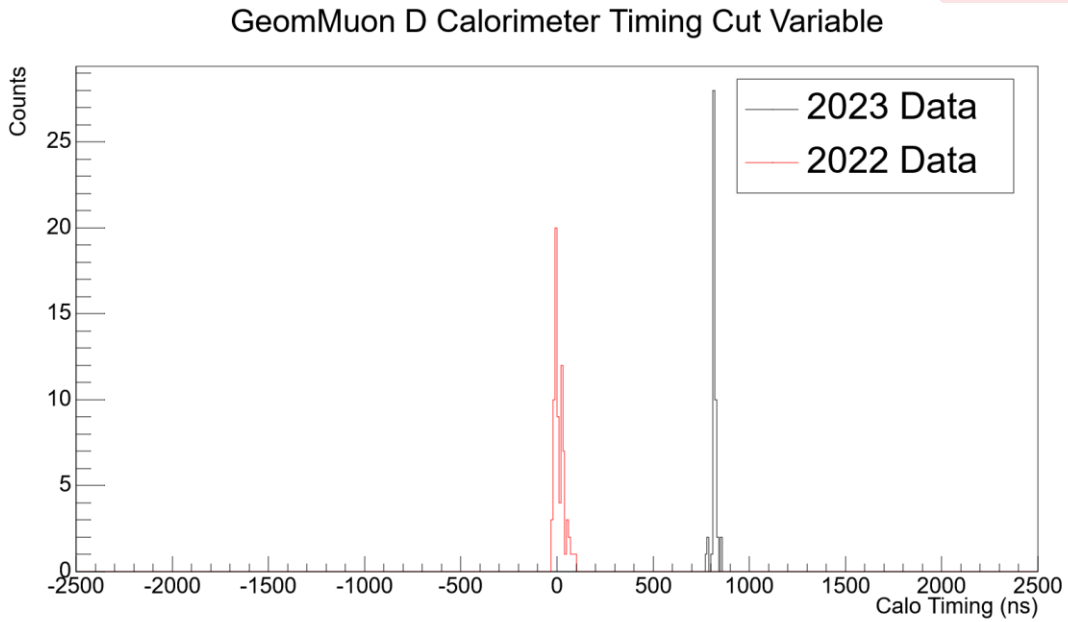
Calo Timing Cut

Recap:

- Cutting on the calorimeter local timing was studied for the ALPs analysis
- Can create a variable that shifts the calorimeter local time from ~ 800 ns to around 0
- Idea is that non-beam background occurs at a different timing than collision date –i.e. a cut can be applied to reduce this
- Previously saw that cutting on this for 2023 data resulted in no statistics

Issue

- Looked into this and noticed a difference in the 2022 and 2023 calorimeter timing with a shift applied
- Was not spotted in the cosmics analysis so far



Calo Timing Cut

Issue now fixed! ☺

- In 2023 we switched to have a narrower window for timing
  - Need to apply an extra 600ns shift to all 2023 data when applying this cut
- Cross checked with Brian's offsets json for 2023 (and updated code with these)
- Cut now works as expected on 2023 data!

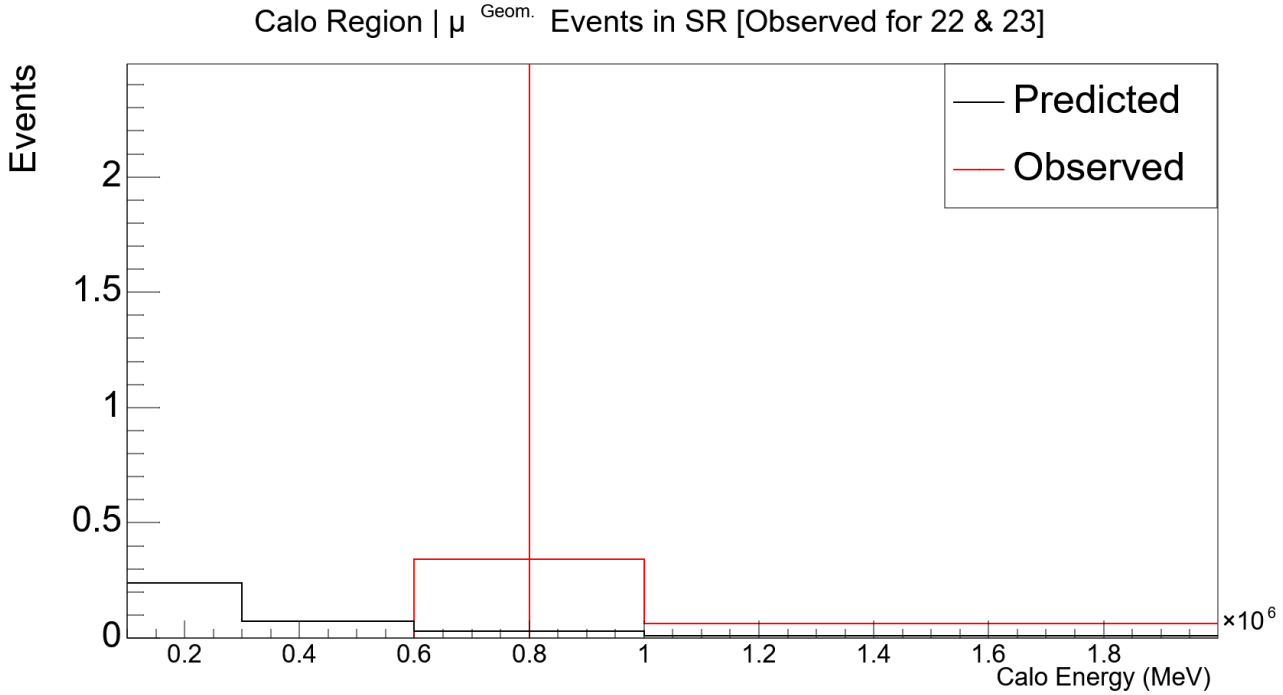
Geometric Muon

Recap

- Issue with method for calculating observed events
  - Now fixed this!
- Implementing calorimeter timing to remove cosmics/B1 background
  - Previously didn't have offsets for 2023 – now implemented
- Cross-checked data cuts with Lottie
  - A timing saturation cut was implemented in ALP's analysis
    - My code was previously missing this
    - Was not documented in either the ALP's int note or the paper
- Seems to be difference in calculated lumi from run list in int note compared to paper
  - Need to check the final run list for trackless 2022/23 data

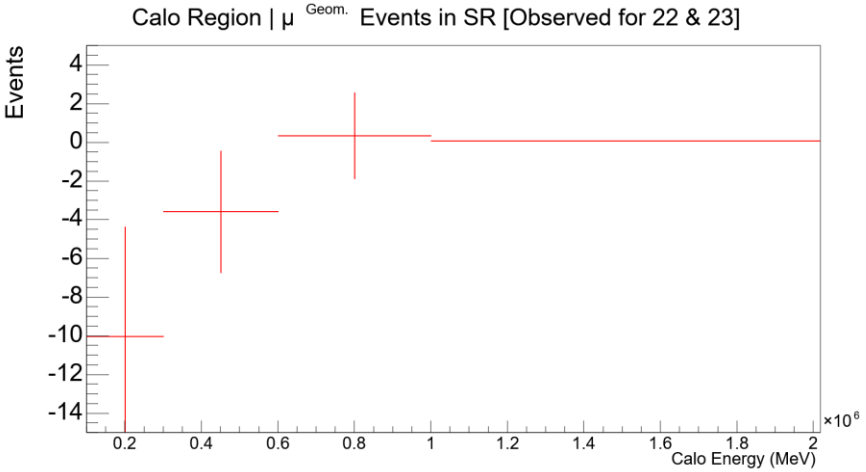
Geometric Muon

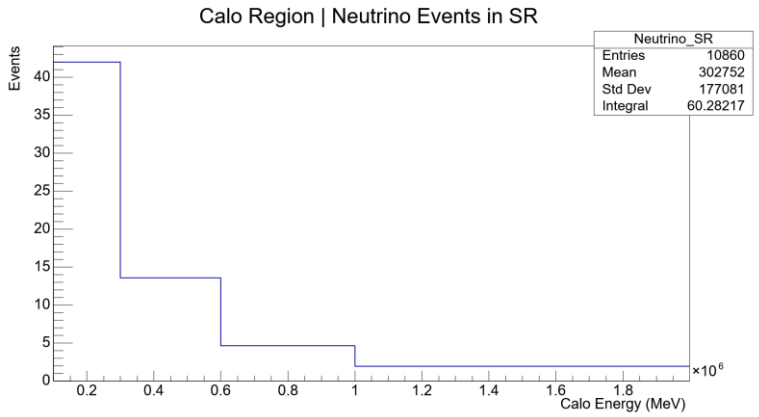
- Comparing to alps paper
  - See same number of neutrino MC events in SR (Calo)
  - Different number of data events (in process of checking this)
- Low number of events predicted in signal region
  - Less than 0.5 events observed per bin

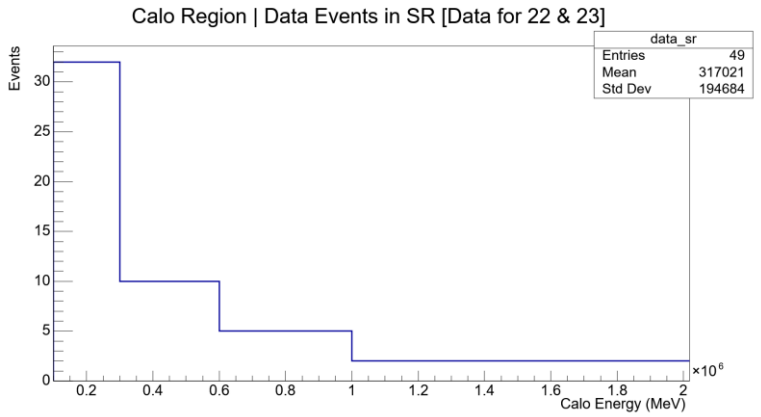


Geometric Muon – Observed Events

- Looking at which events pass signal region cuts
  - Subtract mc neutrino events to correct for signal
- 0 events are observed in first 2 bins
  - Number of neutrino MC events in these bins is higher than number of observed data events
- Low in final bins



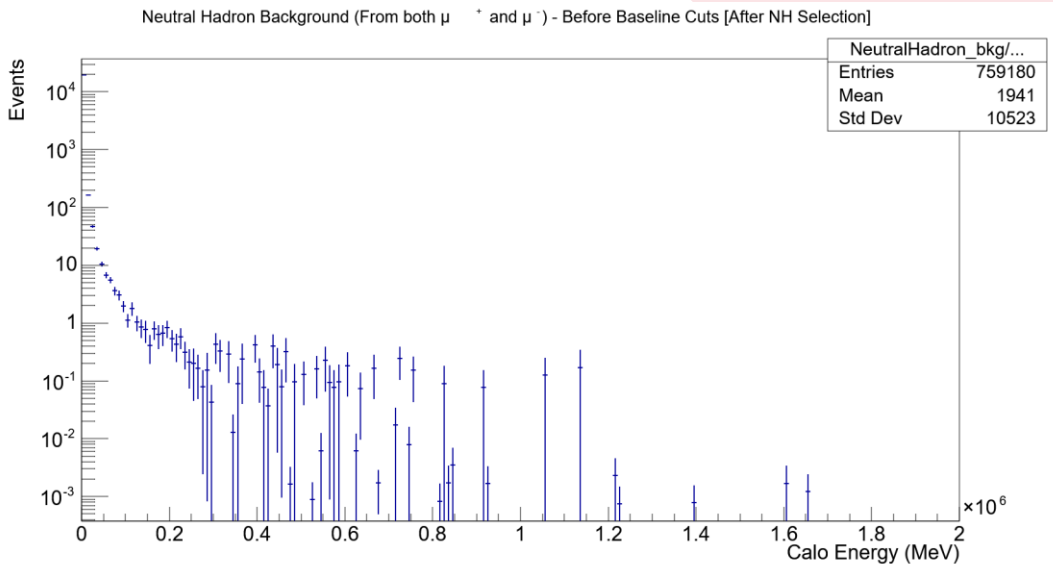


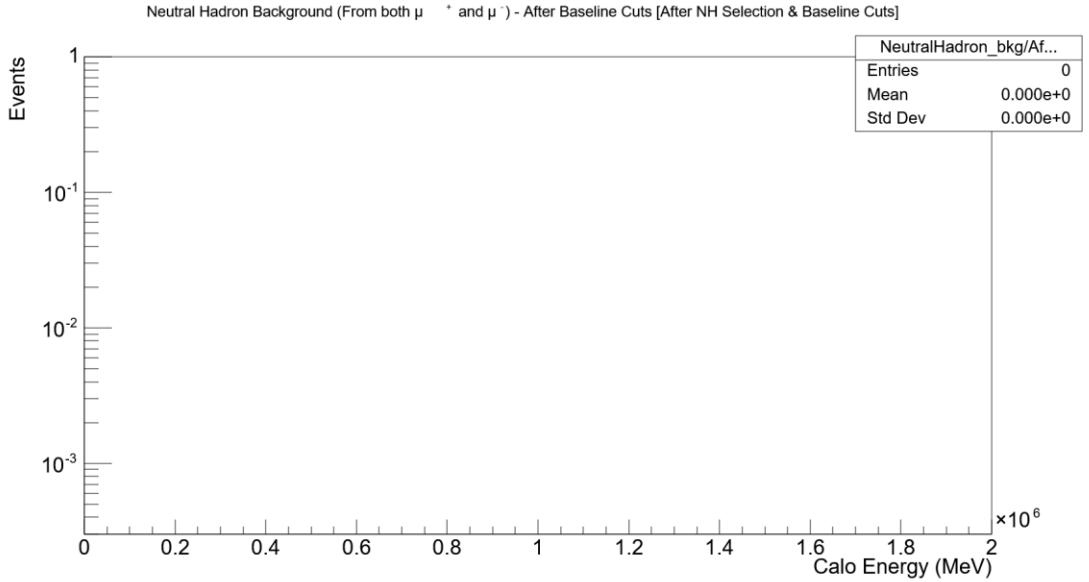


Neutral Hadrons

- Using NH specific samples created by Eli using the muon flux at FASER
- Process to analyse background from neutral hadrons:
  - Select neutral hadrons using pdg
  - Calo Trigger
  - No timing saturation
  - No raw vetonu signal
  - No veto signal
  - No timing signal
  - Calo E > 100 GeV

- Data currently passes cuts up until vetonu
  - Veto Nu cut removes remaining data





Summary

- Calo timing issue for 2023 now resolved
- Waiting on 2024 neutral hadron samples from Eli
- Implemented and cross checked data cuts for ABCD
  - Need to check run list compared to run list in int note