



UNIVERSITY OF
TORONTO

ν_e CCQE/CC1 π^+ Selection Studies

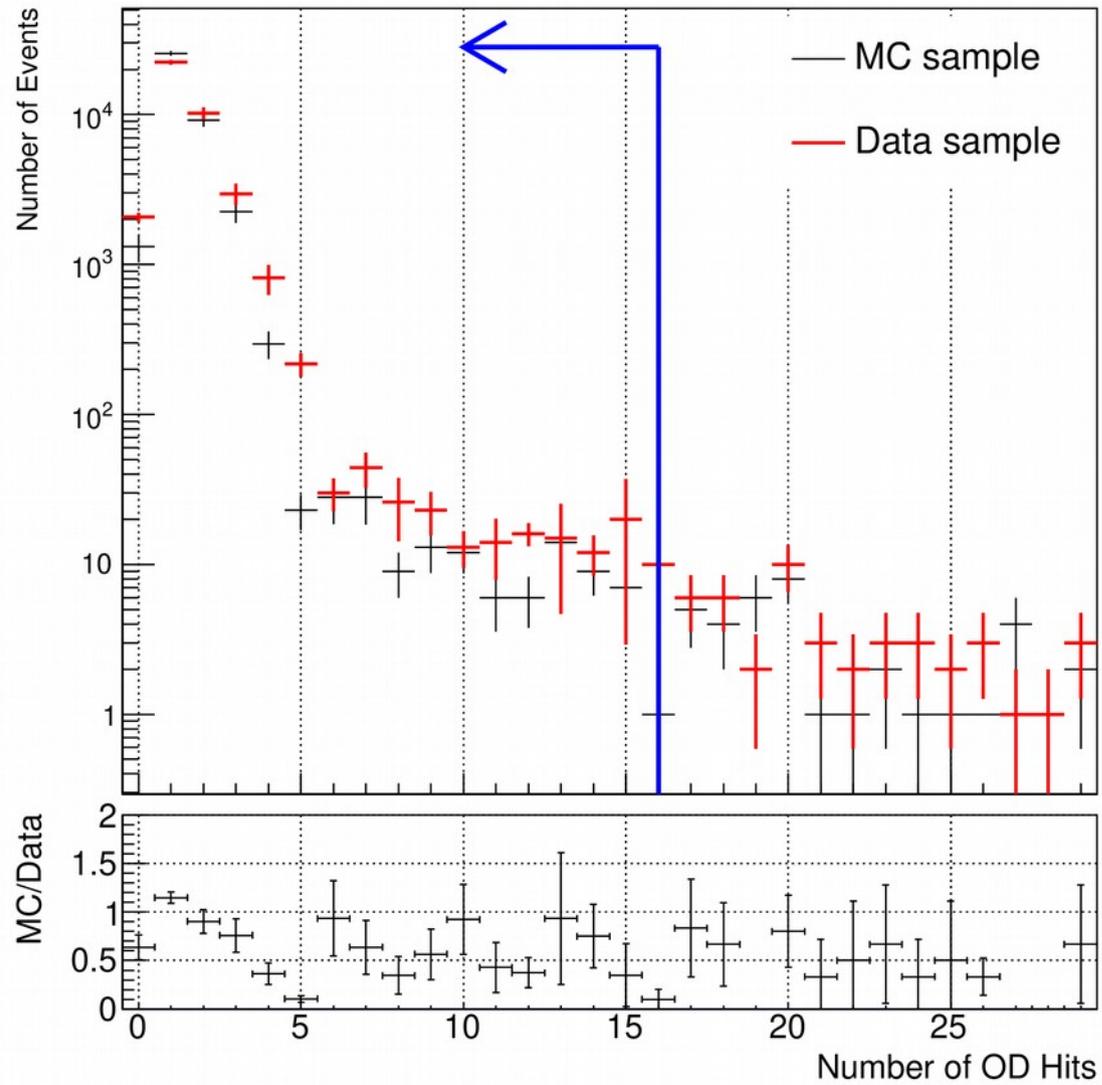
Trevor Towstego
 ν_e CCQE/CC1 π^+ Meeting
July 3, 2019

ν_e CC1 π^+ Hybrid Sample

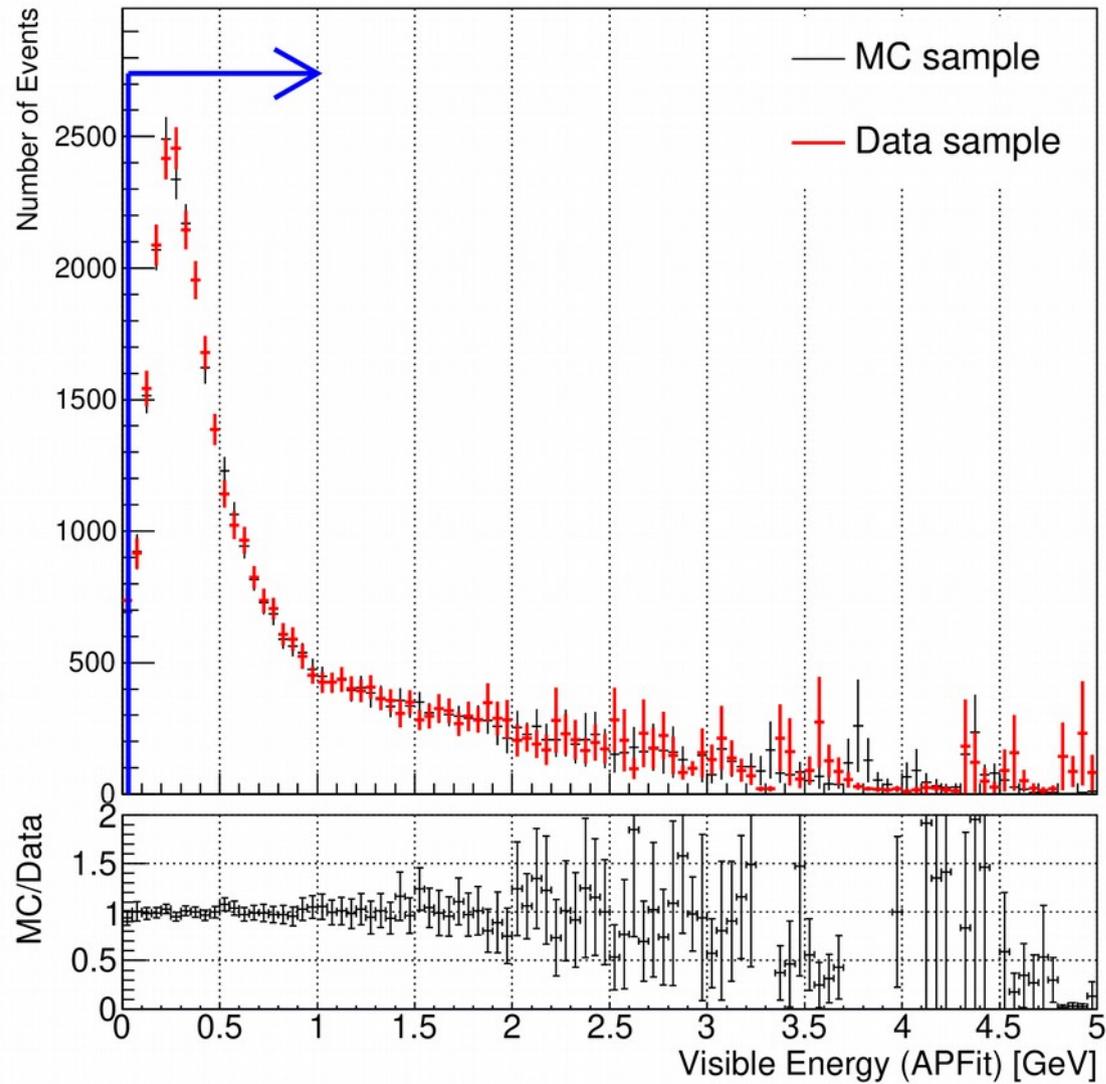
- Removed $E_{\text{vis}} > 50$ MeV cut from atmospheric e-like selection:
 - Cuts:
 - $n_{\text{hitac}} < 16 \ \&\& \ e_{\text{vis}} > 30$
 - $n_{\text{ring}} == 1 \ \&\& \ ip[0] == 2$
 - $n_{\text{mue}} == 0$
 - $a_{\text{good}} > 0.6$
 - $pi0_{\text{mass}}[0] < 100$
 - 6905 → **7438** selected e-like atmospheric data events
 - 9313 → **10033** selected e-like atmospheric MC events (equalized to 7438)
- Developed and applied basic APFit selection to hybrid sample
- Applied fitQun/BDT selection to updated hybrid sample
- Investigated efficiency discrepancy of BDT cut between oscillated T2K MC and hybrid sample
 - Still some work to be done

APFit Selection

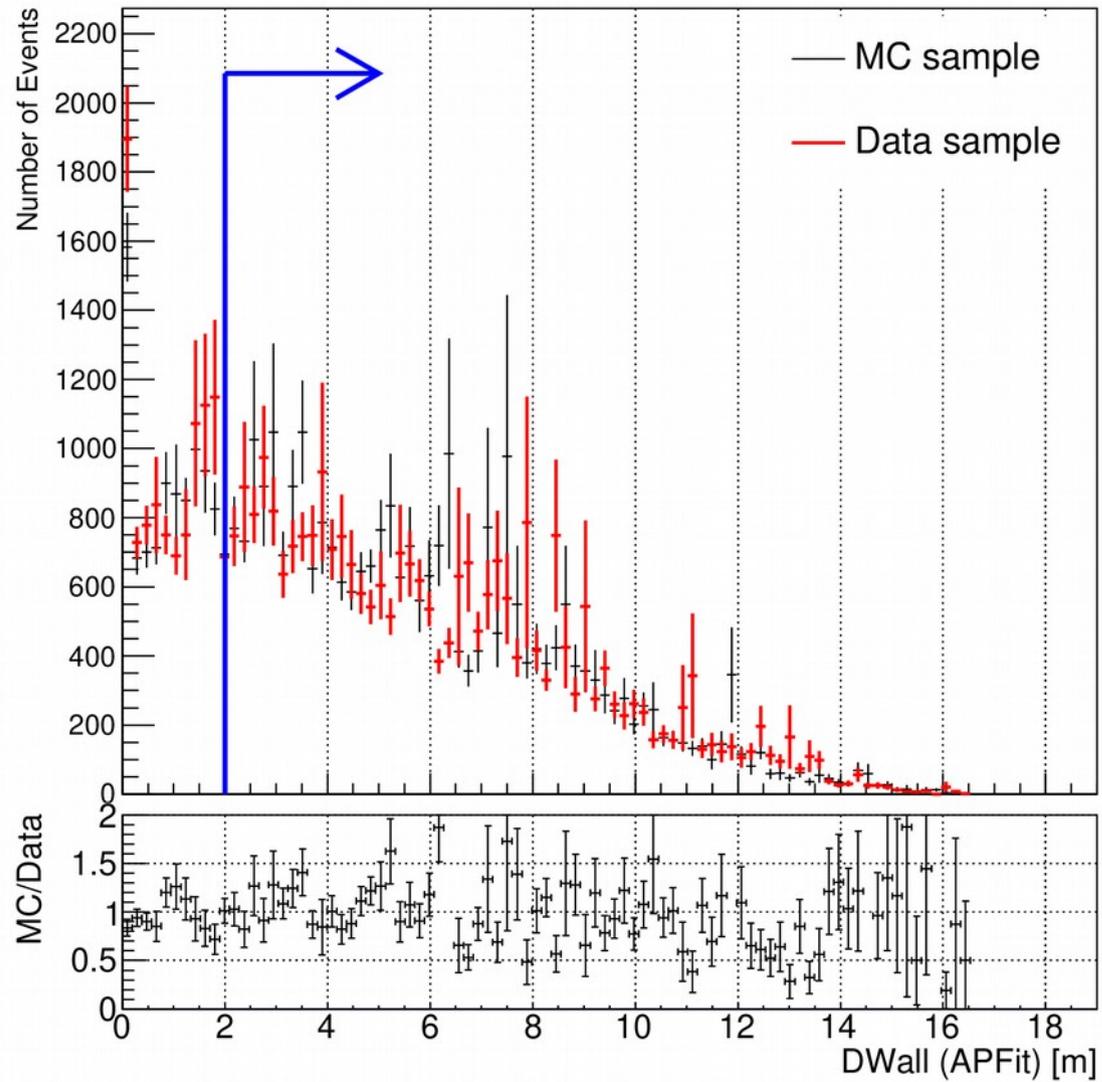
$n_{hitac} < 16$



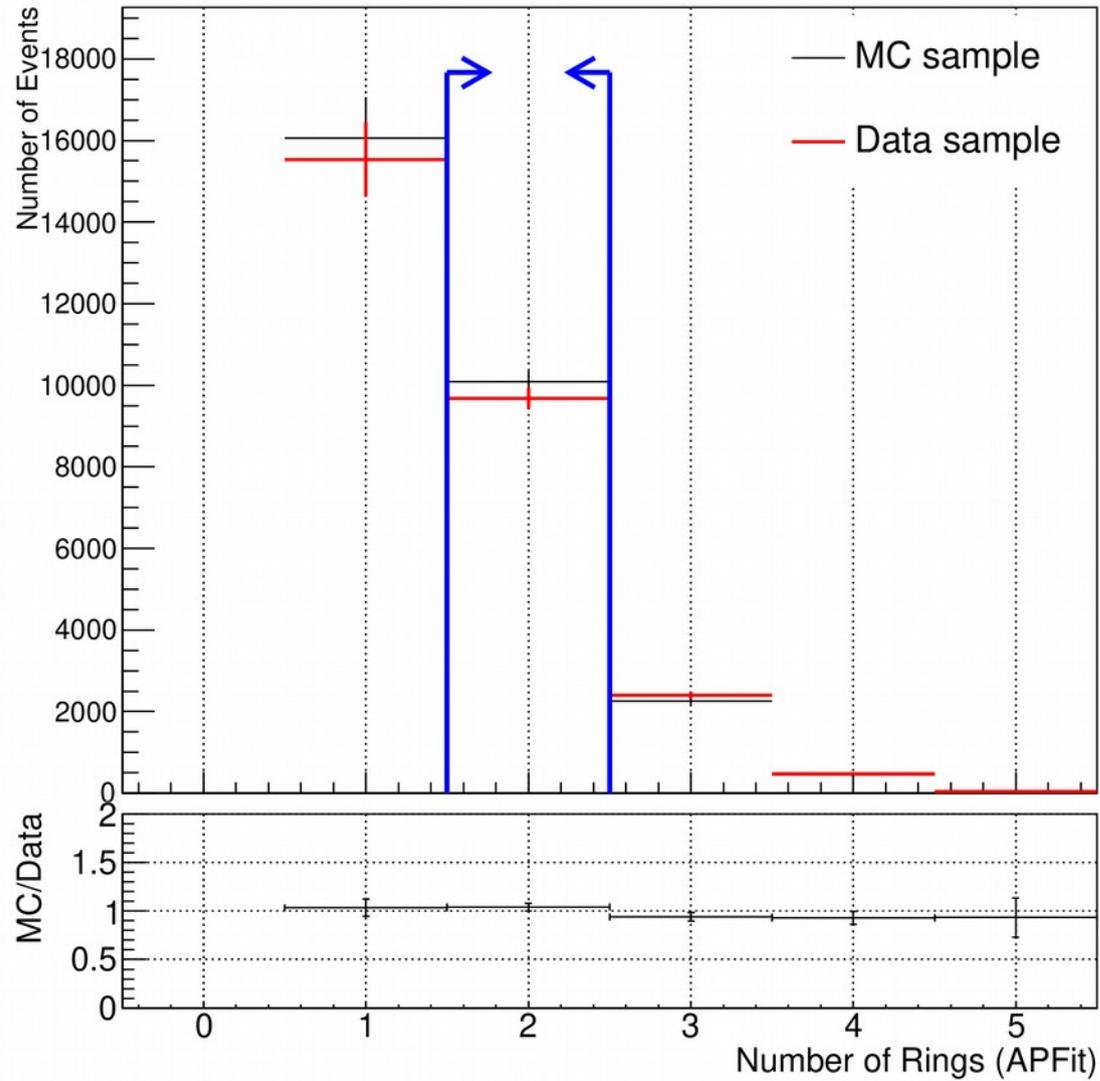
$$E_{\text{vis}} > 30 \text{ MeV}$$



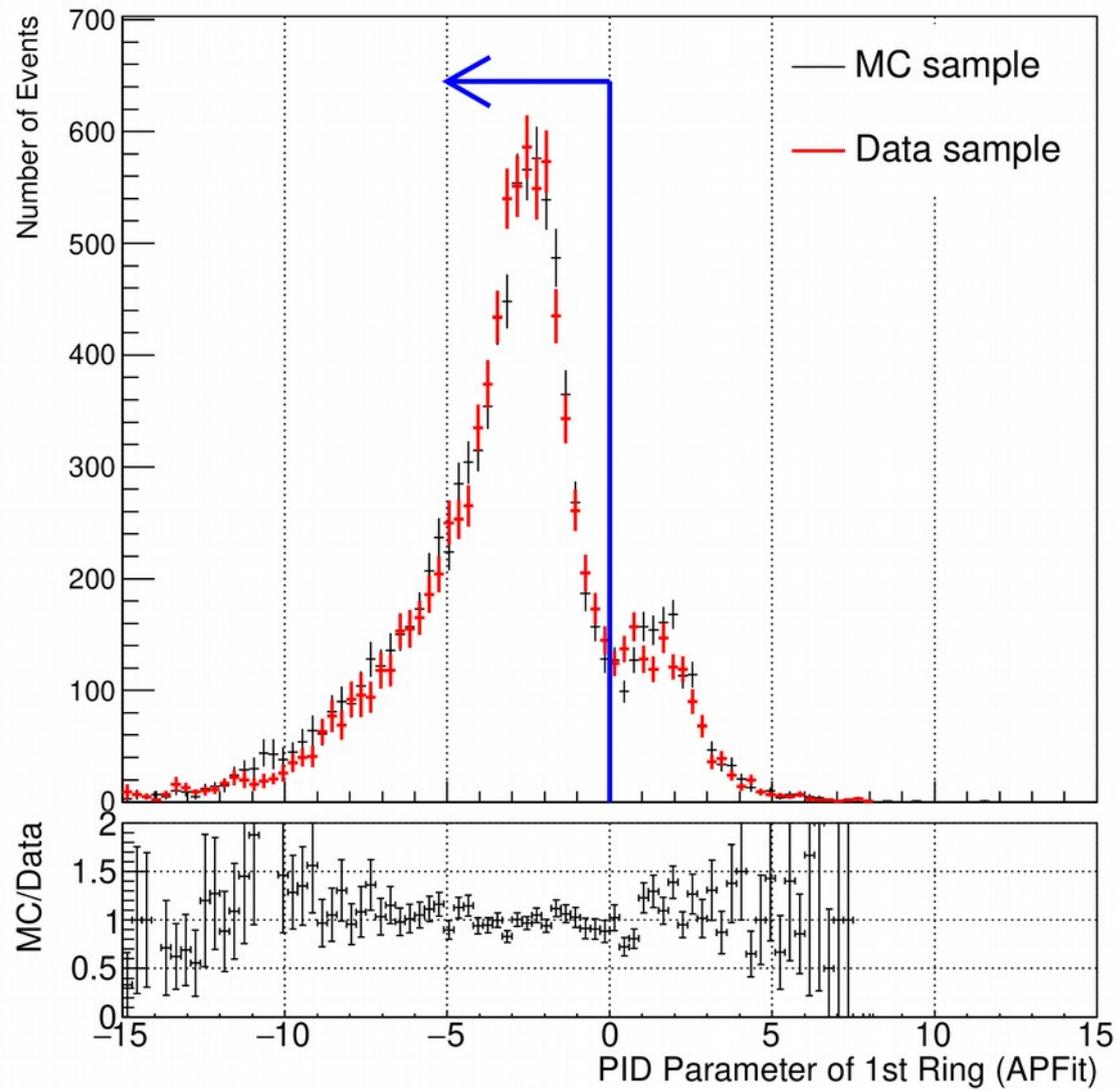
Wall > 200 cm



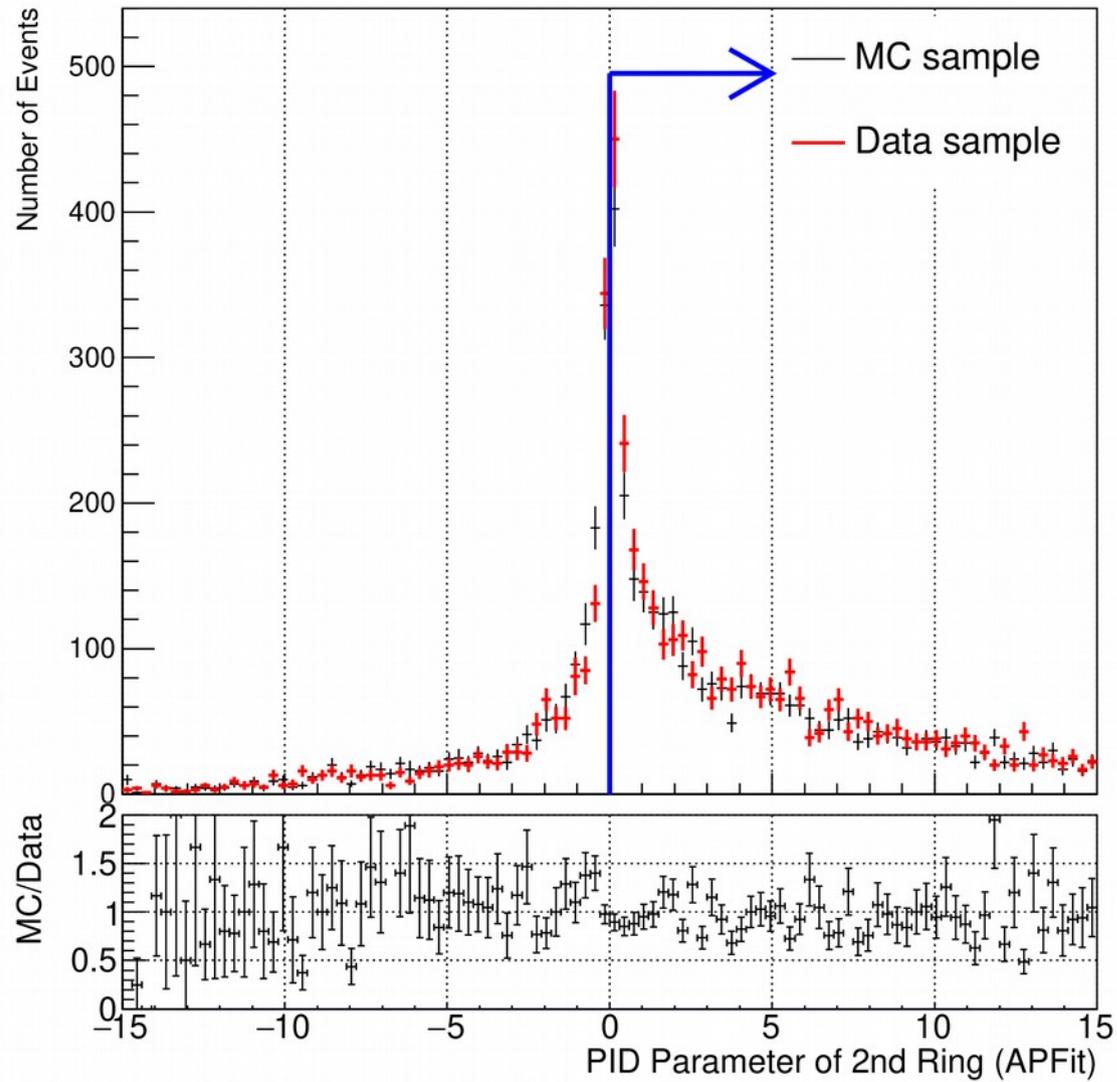
nring == 2



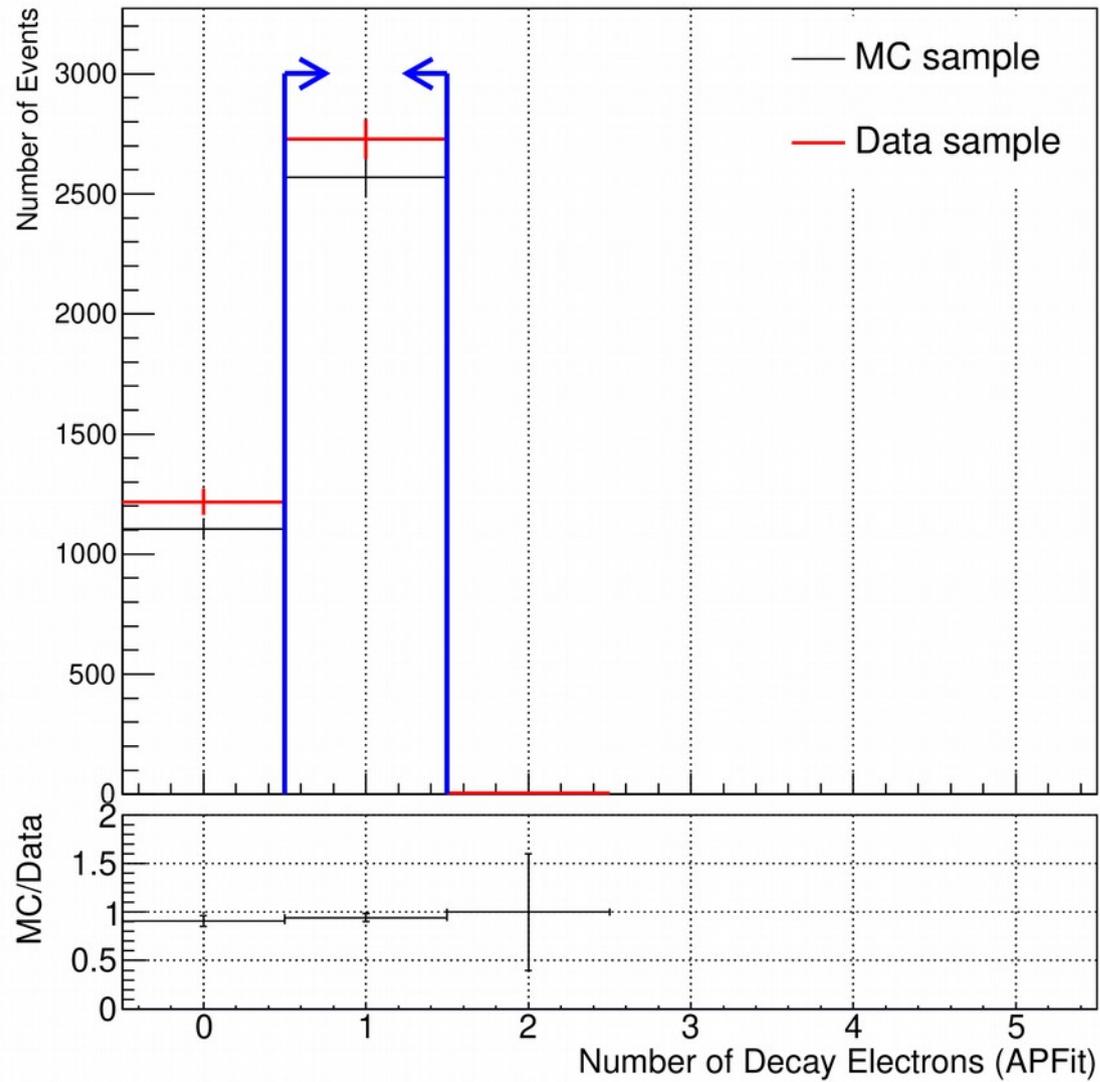
1st Ring e-like



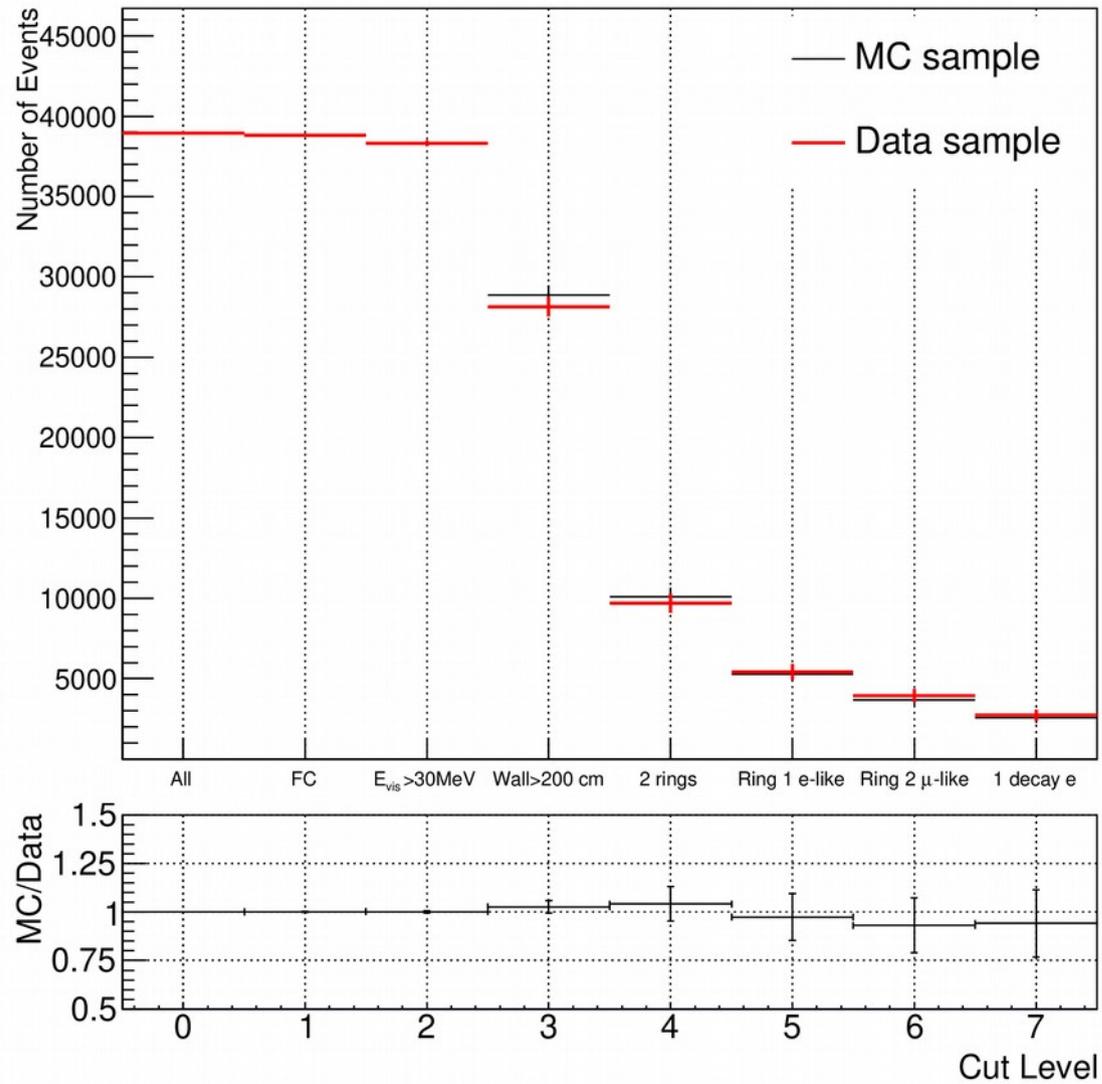
2nd Ring μ -like



1 decay electron

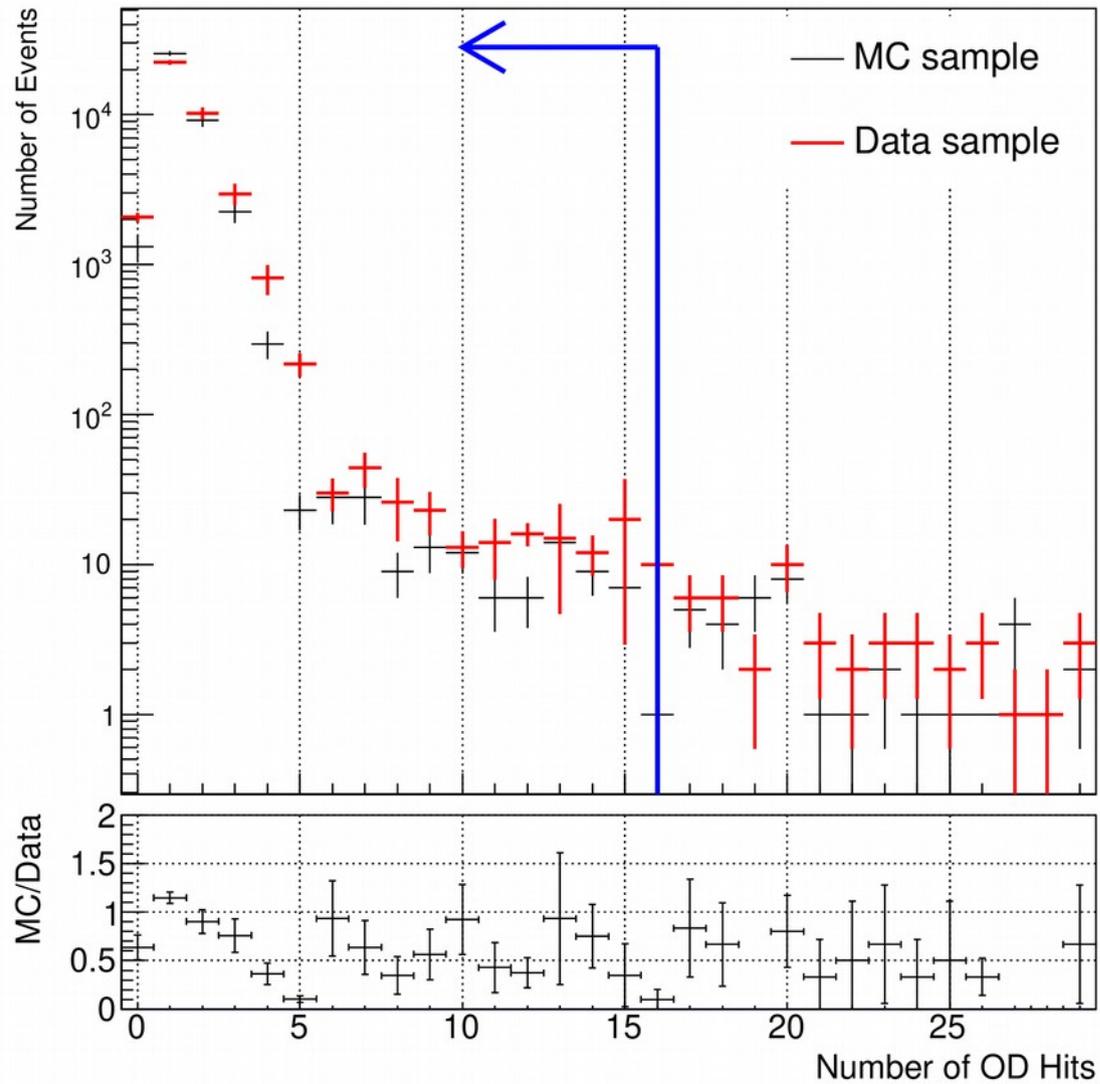


APFit Selection Cutflow

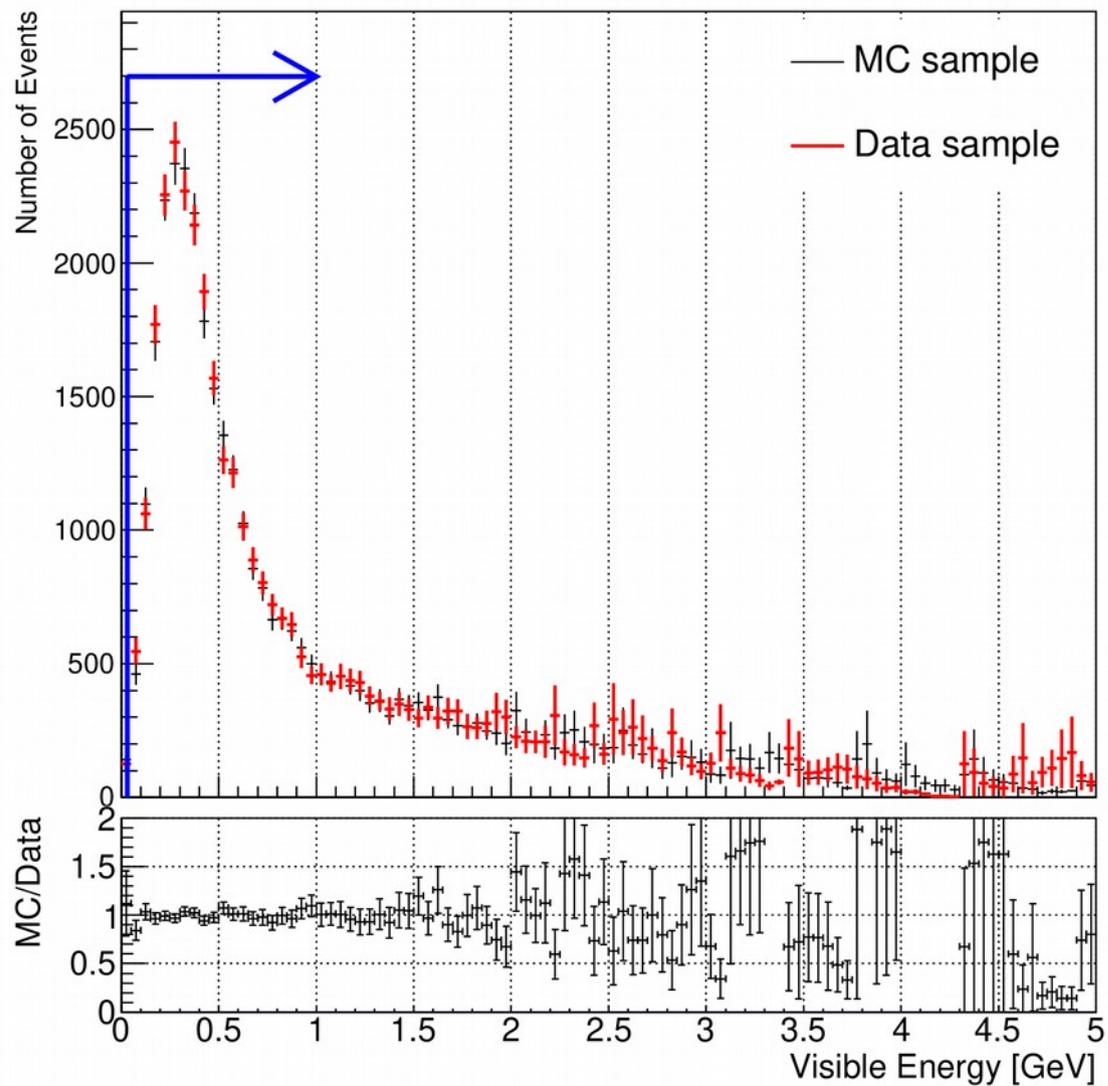


fiTQun Selection

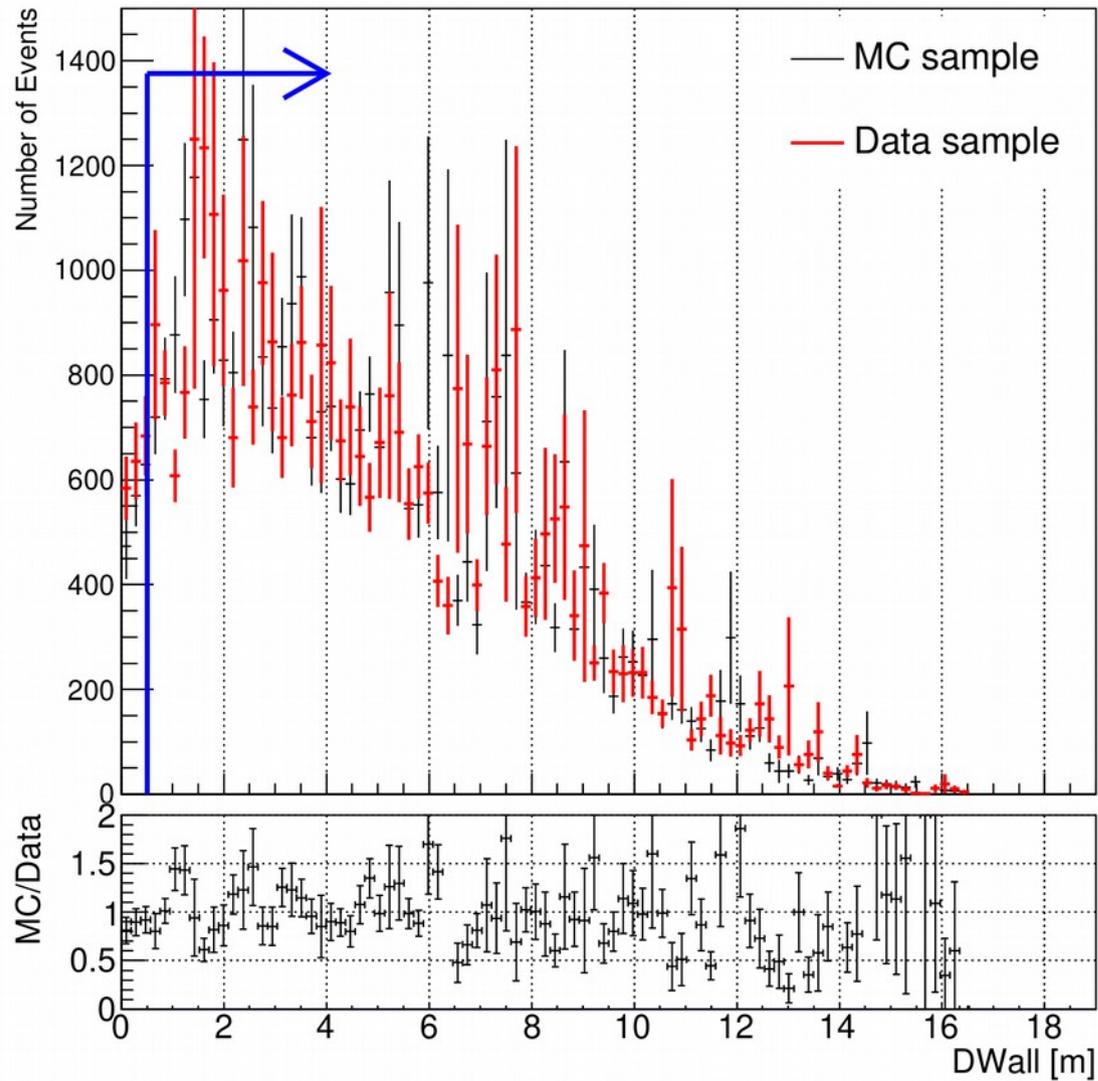
nhitac < 16



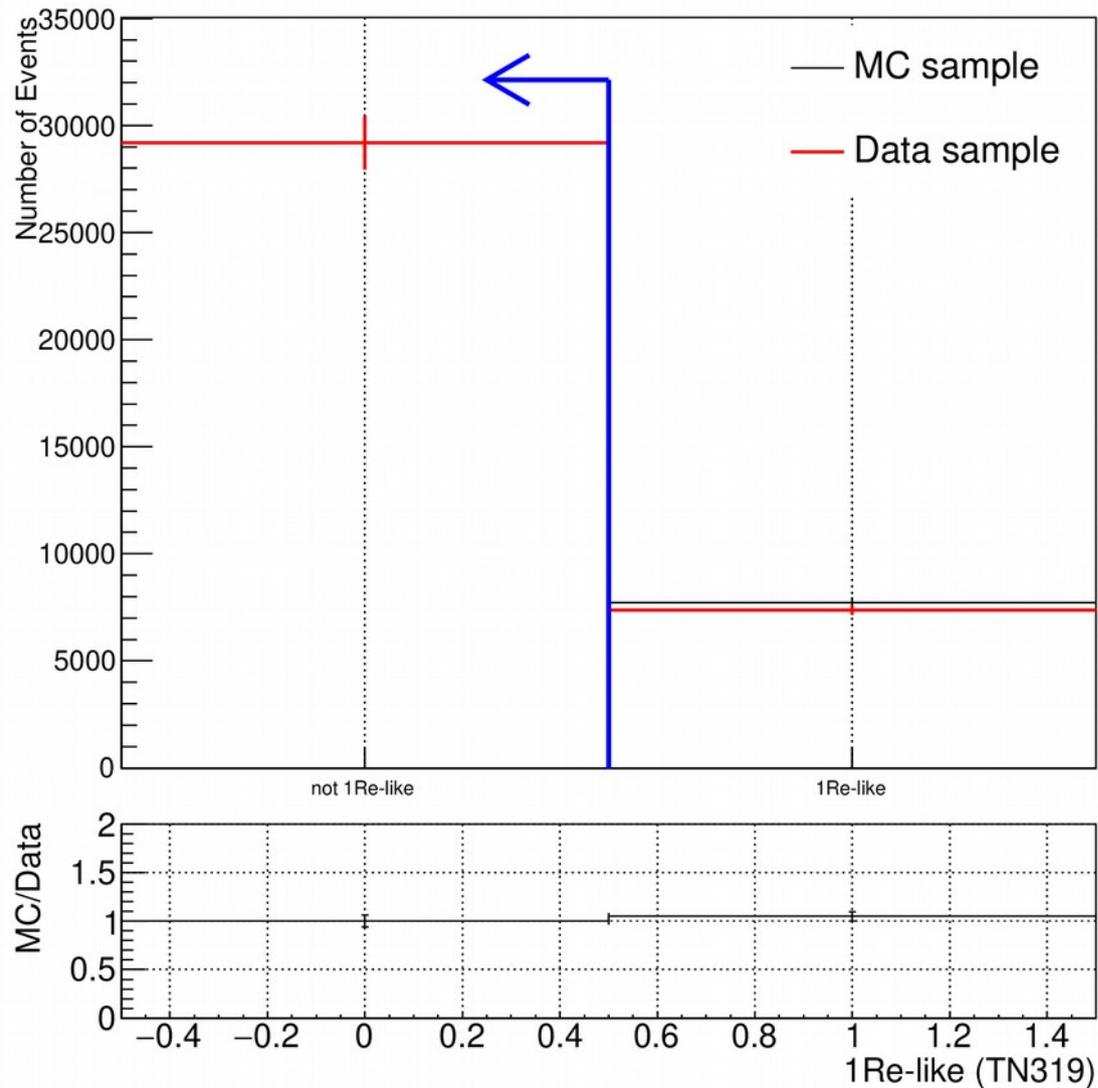
$$E_{\text{vis}} > 30 \text{ MeV}$$



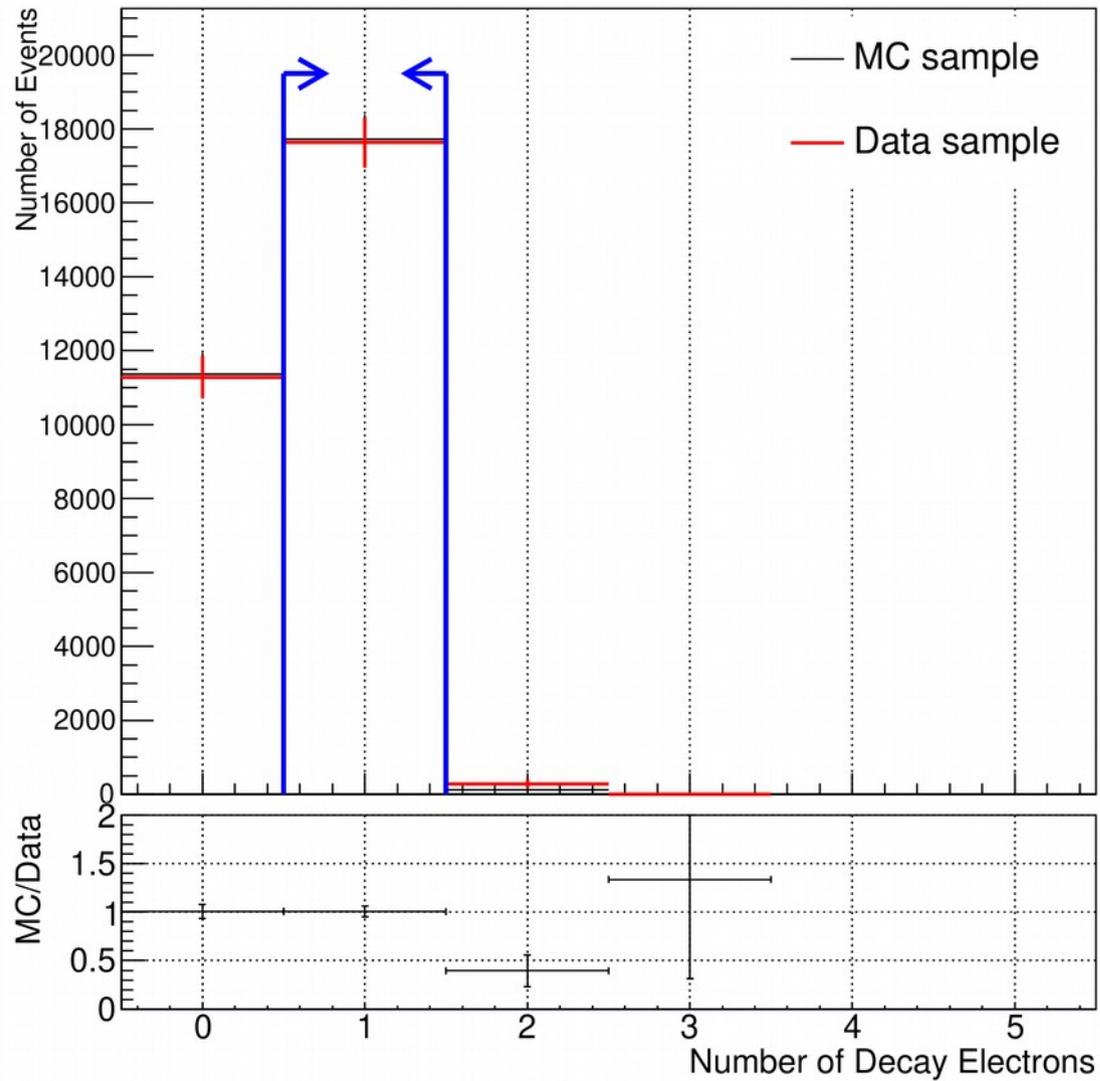
Wall > 50 cm



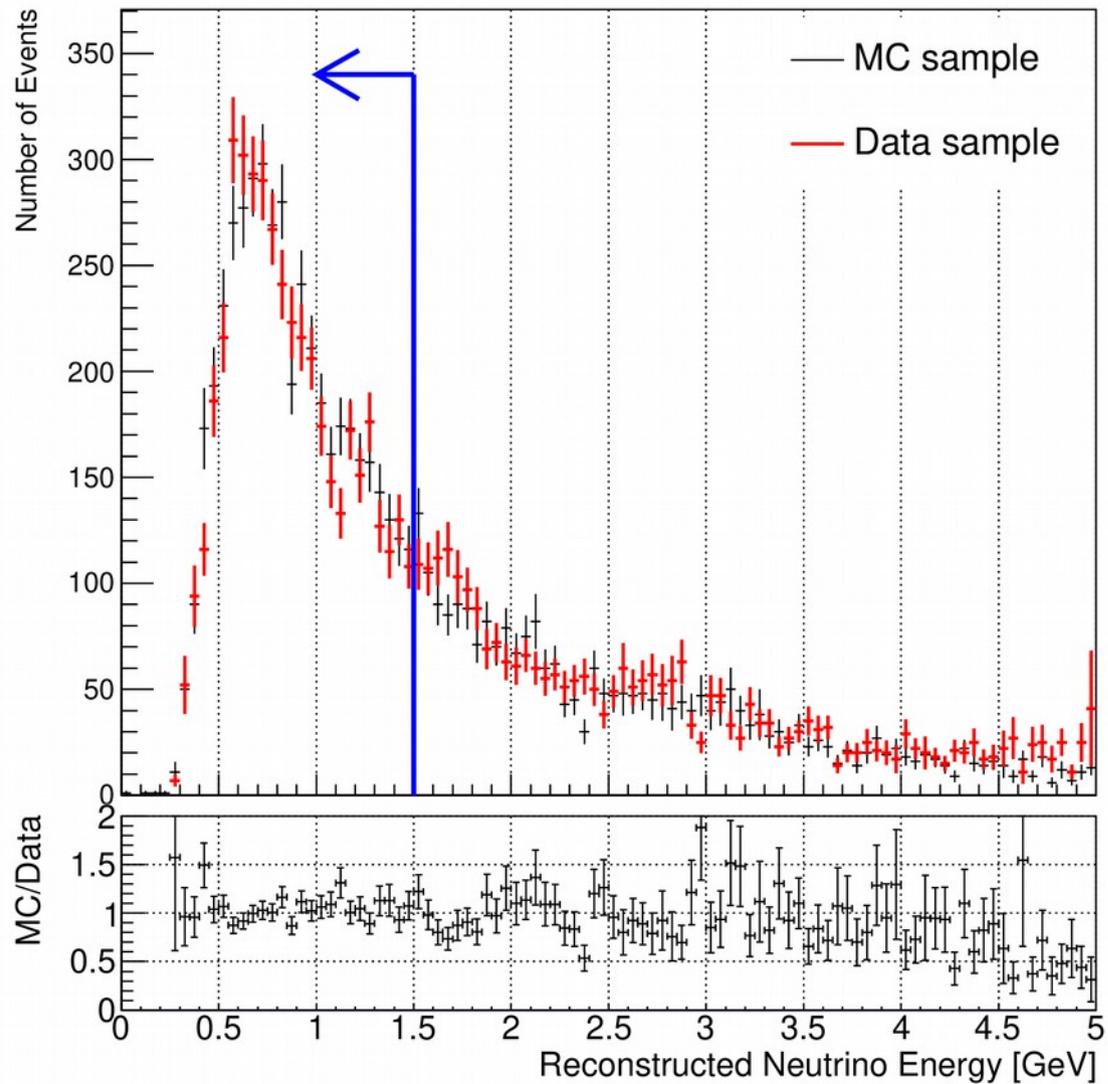
Not 1Re-like (TN319)



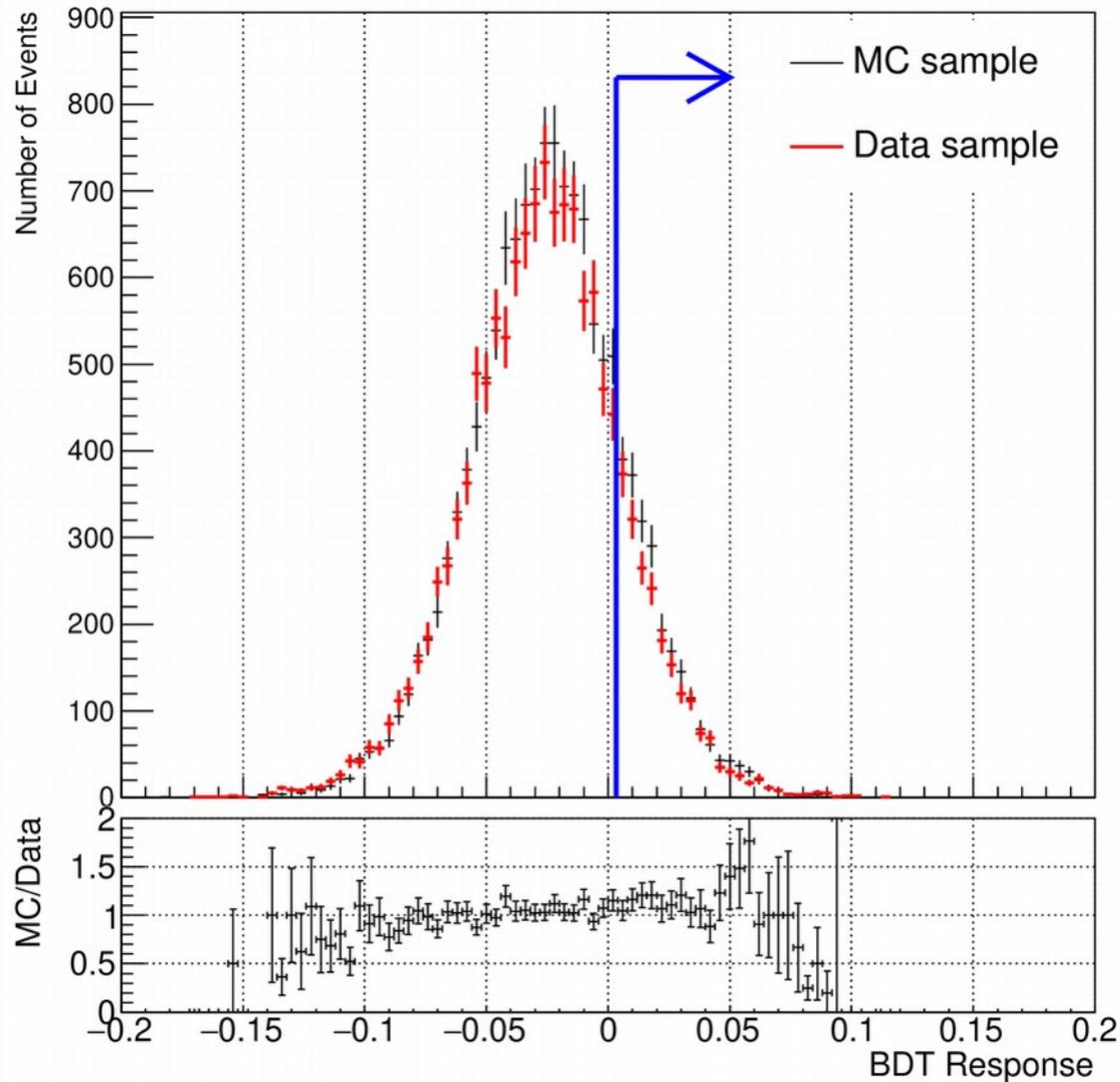
1 Decay Electron



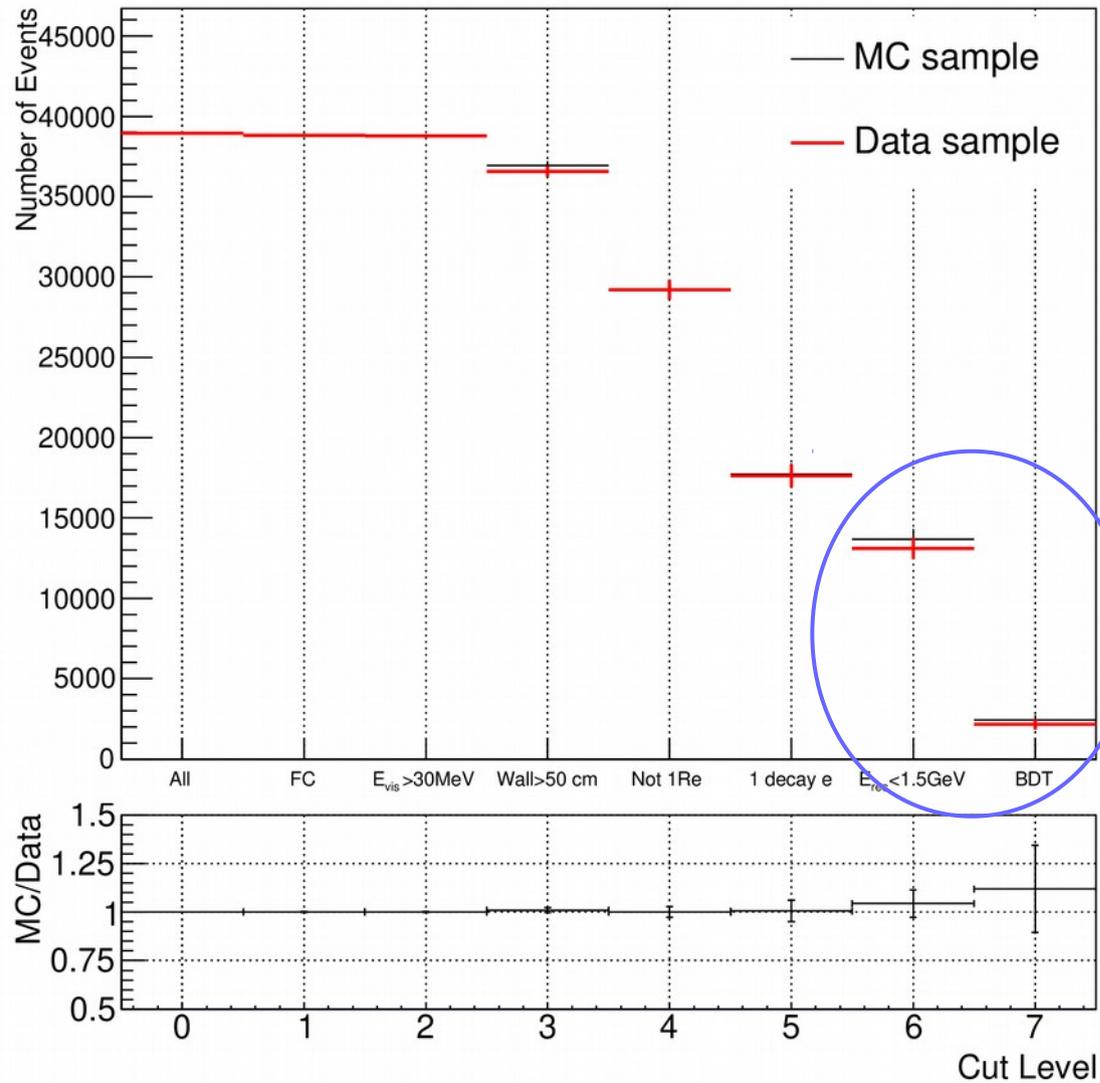
$$E_{\text{rec}} < 1.5 \text{ GeV}$$



BDT Response > 0.0034



Cut Flow



Greater efficiency loss than expected

Efficiency Discrepancy of BDT Cut

Sample:	Hybrid Sample	Oscillated T2K MC	Weight=1 T2K MC
BDT Cut Efficiency:	0.18	0.60	0.28

- Checked efficiency of BDT cut when T2K MC event weights are all set to 1, since hybrid sample events all have a weight of 1
 - Most of the discrepancy in efficiency is accounted for, but not all
- Possible reasons for remaining discrepancy:
 - Only half of $1e1\pi^+$ events are used in BDT evaluation for the T2K MC, so some statistical variation would be expected
 - Slightly different $1e1\pi^+$ definitions used in hybrid sample construction vs. BDT evaluation
 - Will change these definitions to be consistent to see if remaining discrepancy is accounted for
 - These should be consistent anyways, since we will be evaluating the systematics based on the hybrid sample

1e1 π^+ Definitions

T2K MC Evaluation

- Threshold momenta ($p_{CT}+30$ MeV/c):
 - π^\pm : 189 MeV/c
 - e: 30 MeV/c
- Requires 1 e and 1 π^\pm in primary stack

Hybrid Sample

- Threshold momenta:
 - π^+ : 175 MeV/c
 - e: 10 MeV/c
- Requires 1 e and 1 π^\pm in combined primary + secondary stack

Proposal:

- Adjust my definition:
 - to look at primary and secondary stacks
 - to only consider π^+ rather than both π^+ and π^- *** Perhaps different definitions for training/evaluation
- Adjust hybrid sample definition have visible thresholds consistent with mine

To Do

- Adjust $1e1\pi^+$ definitions to be consistent between my studies and the hybrid sample
 - Will need to re-produce hybrid samples with updated thresholds
 - Will need to re-train BDT on T2K-SK MC since signal definition is changing