



UNIVERSITY OF
TORONTO

ν_e CCQE/CC1 π^+ Selection Studies

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 ν_e CCQE/CC1 π^+ Meeting
August 14, 2019

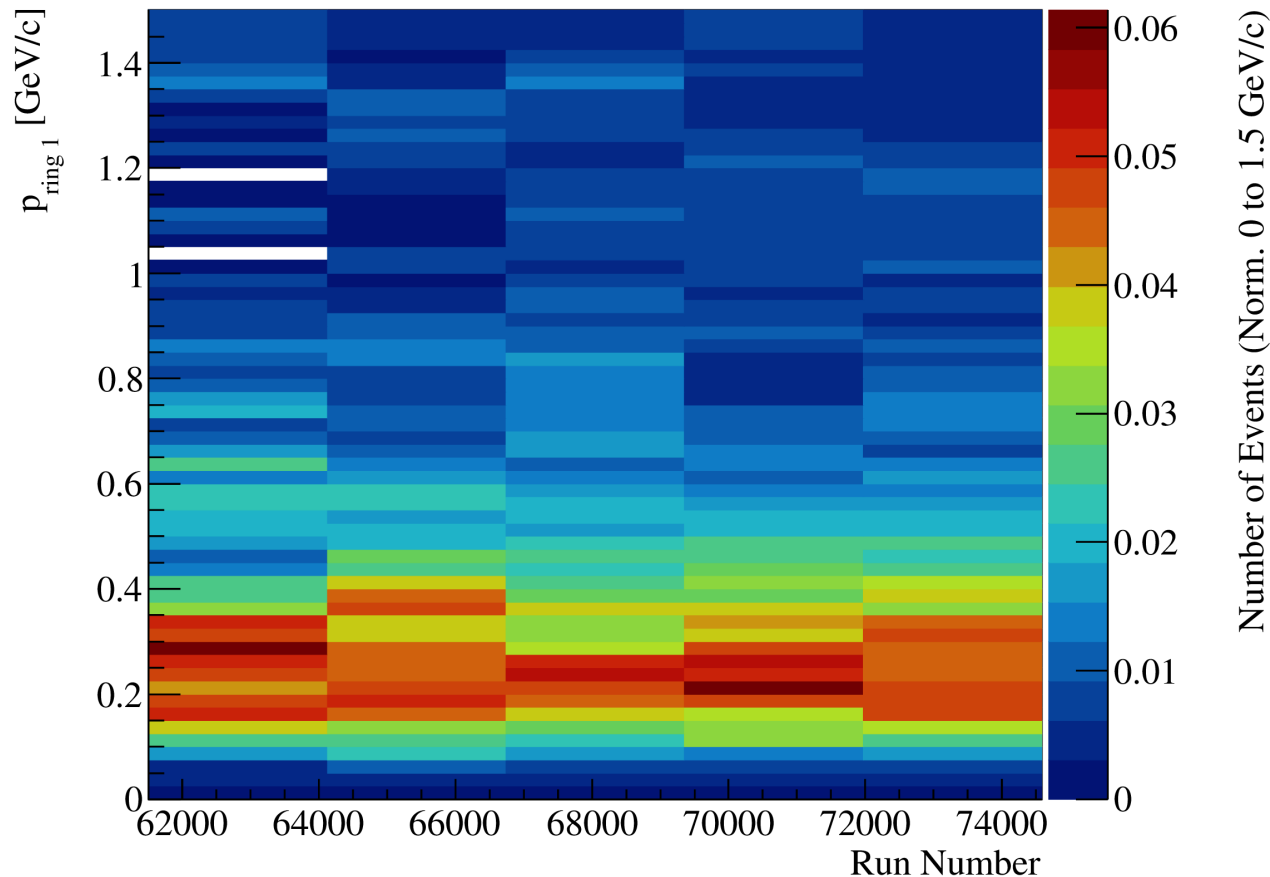
Running **fiTQun v4**

- fiTQun v4 has finished running on hybrid samples
 - Gain correction was turned off
- Checked to see if gain correction was applied correctly
 - Look at reconstructed momentum distribution as a function of SK run number

```
double SKTVarConsts::GetGainFact(int iRunTmp){  
    const double gainRef = 1.02681828571429; // April 2009 average  
  
    double tmp = 1.0;  
    // turn off gain correction (for hybrid epi+ sample)  
    /*  
    for (int i=1; i<nruns; i++) {  
        tmp = darkgain[i];  
        if (irun[i]<iRunTmp) continue;  
        else if (irun[i]>iRunTmp) { // interpolate  
            tmp = (darkgain[i-1]+darkgain[i])/2.;  
            break;  
        }  
        else break; // Run number matched  
    }  
  
    tmp/=gainRef;  
    */  
    return tmp;  
}
```

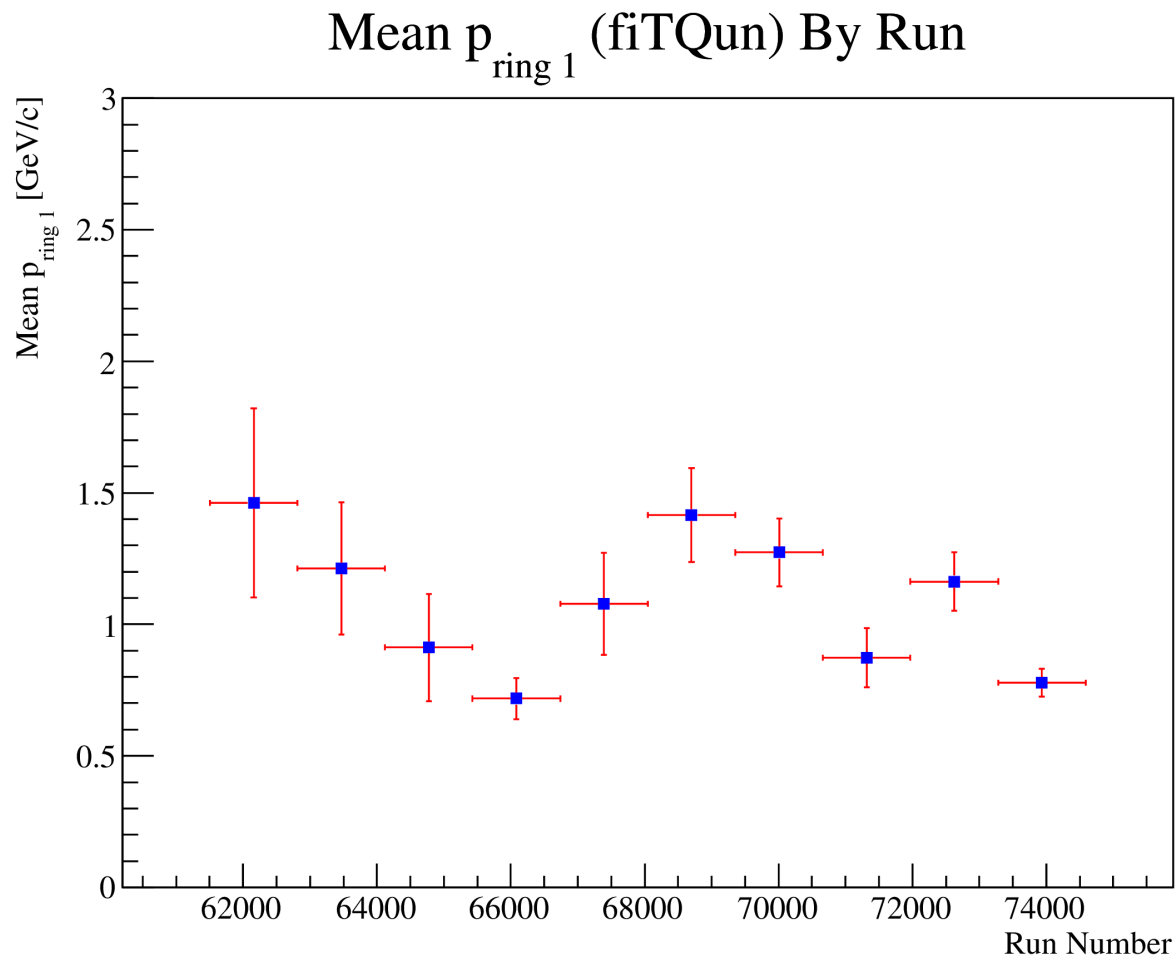
Gain Correction Check

$p_{\text{ring } 1}$ (fiTQun) vs. Run #: True FCFV Events (Data Sample)



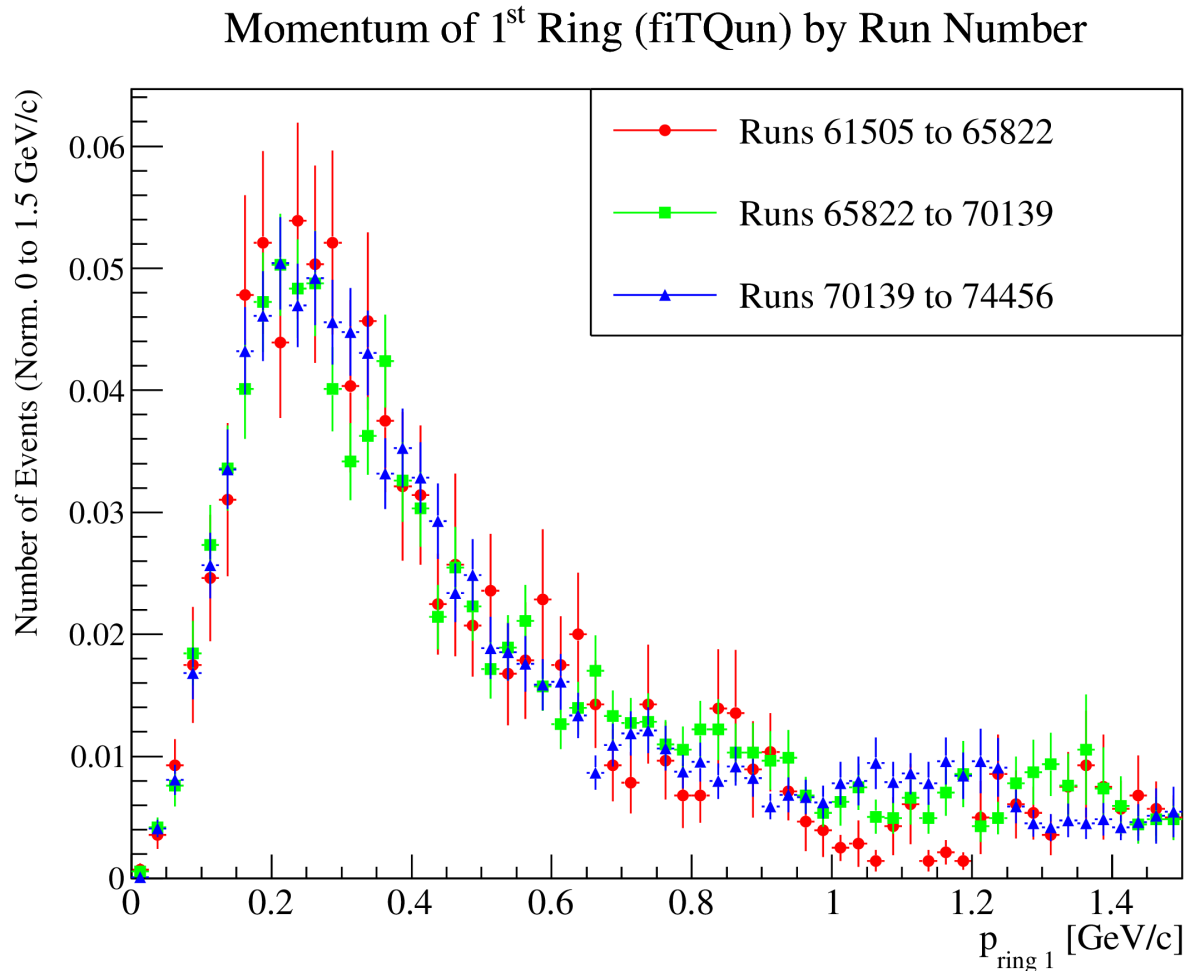
- Plotted reconstructed fiTQun momentum of 1st ring in multi-ring fitter
- Run numbers grouped into 5 bins
 - Events normalised for each run number bin
 - Only events between 0 and 1.5 GeV/c were included when calculating normalisation factor
 - That is, the integral of each run number bin from 0 to 1.5 GeV/c is 1

Gain Correction Check



- This plot shows the mean reconstructed momentum in each run number bin
 - Vertical error bars represent error of the mean (***now accounting for reuse rate of atm. e-like events***)
- Run numbers grouped into 10 bins

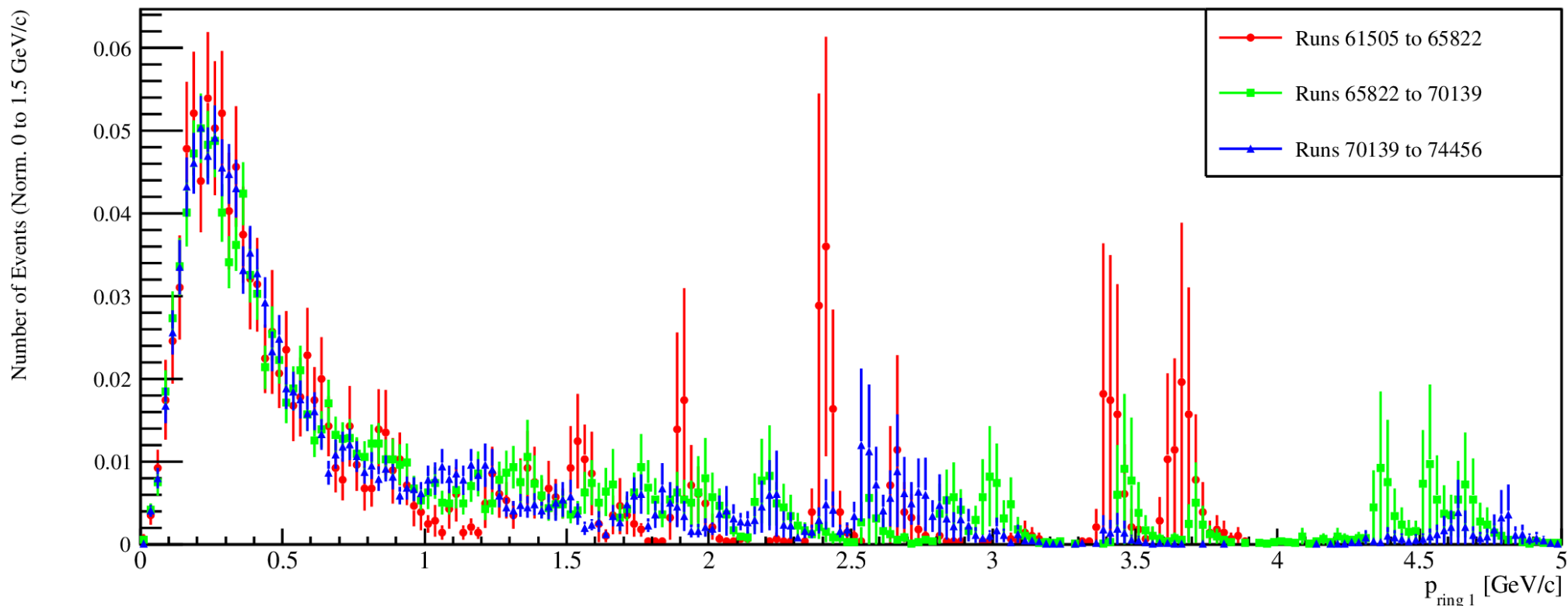
Gain Correction Check



- This plot shows the reconstructed momentum distribution
 - Different plots show 3 groups of runs
 - Each group of runs is normalised (again only between 0 and 1.5 GeV/c)
 - Vertical error bars show statistical error
 - ***Now accounting for reuse of atm. e-like events***

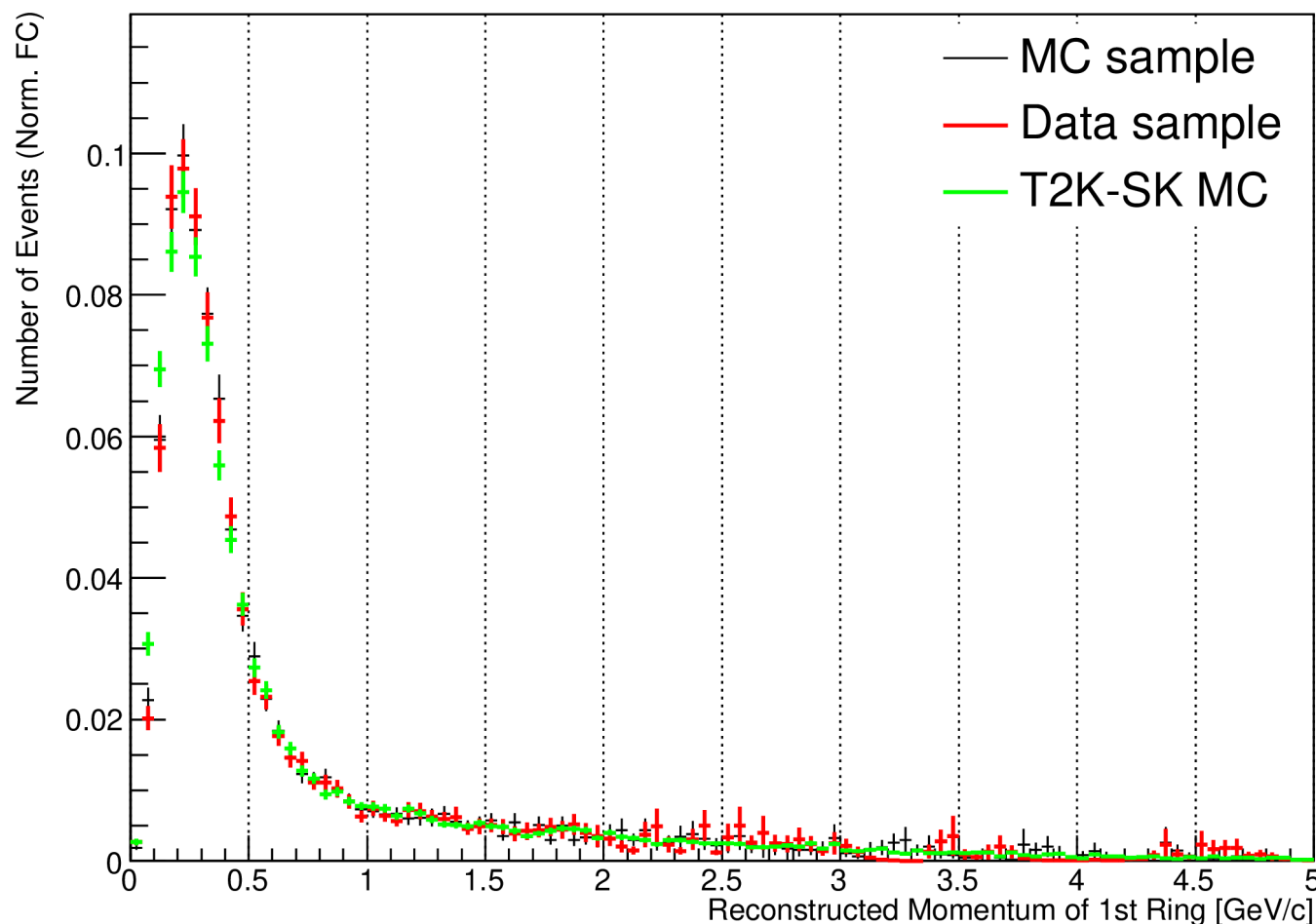
Gain Correction Check

Momentum of 1st Ring (fiTQun) by Run Number



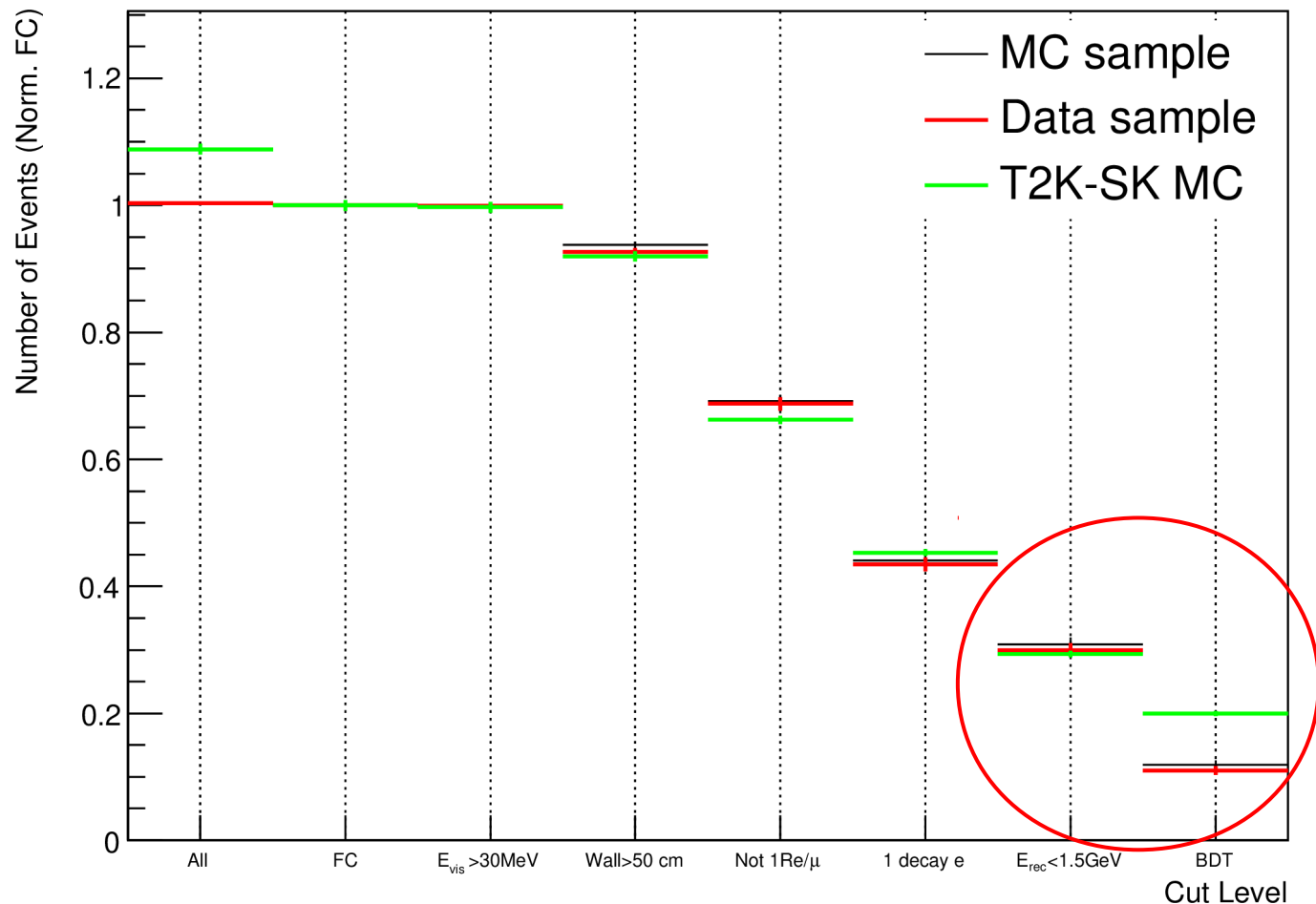
- This is the same plot as the previous slide, but the momentum range is extended to 5 GeV
- This would explain why the mean $p_{\text{ring } 1}$ value jumps around so much

Gain Correction Check



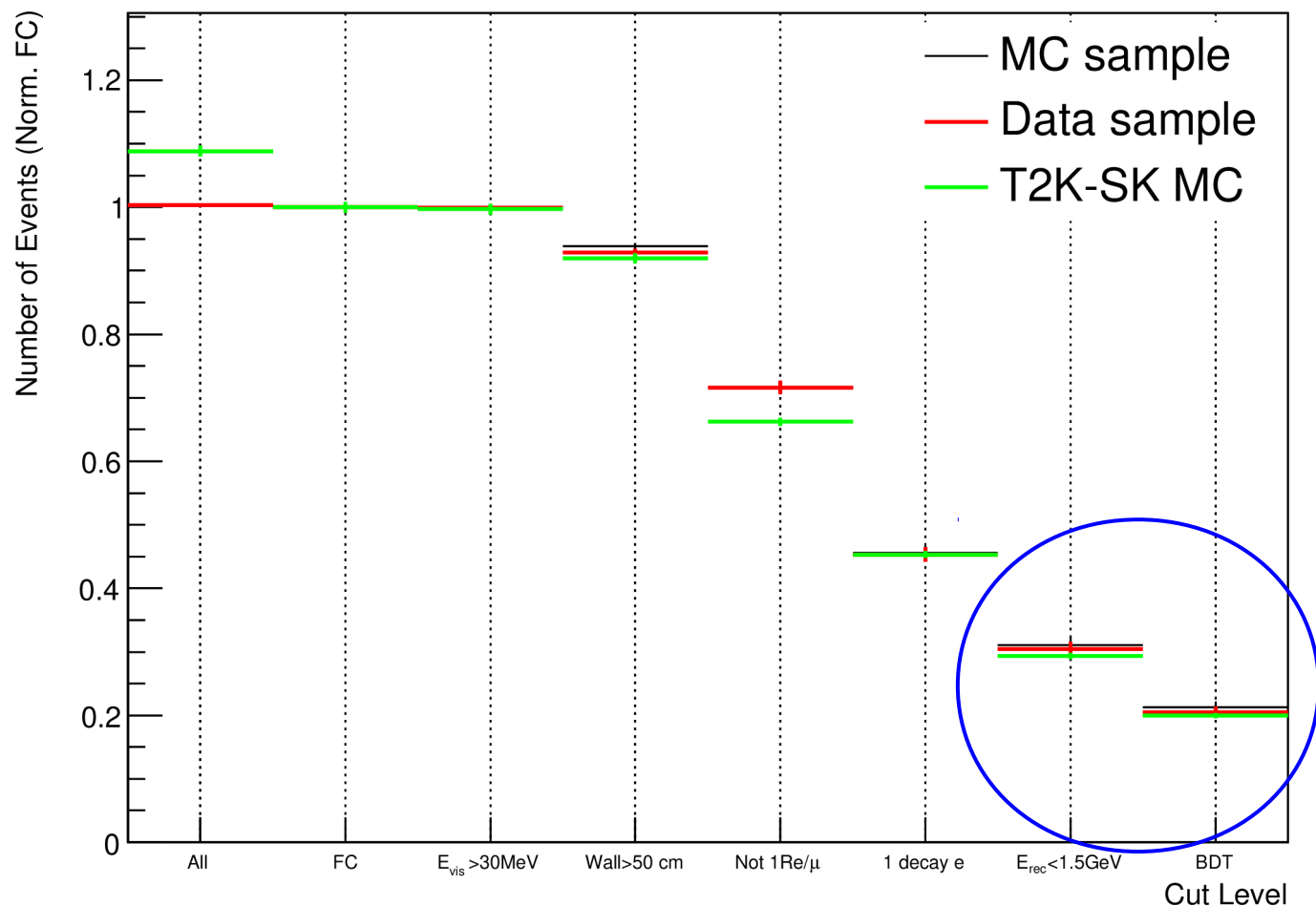
- Plot of the fiTQun reconstructed momentum of the 1st ring for the hybrid sample compared to the T2K-SK 14c MC
– After FCFV cuts

Hybrid Sample BDT Cut: **fiTQun v5**



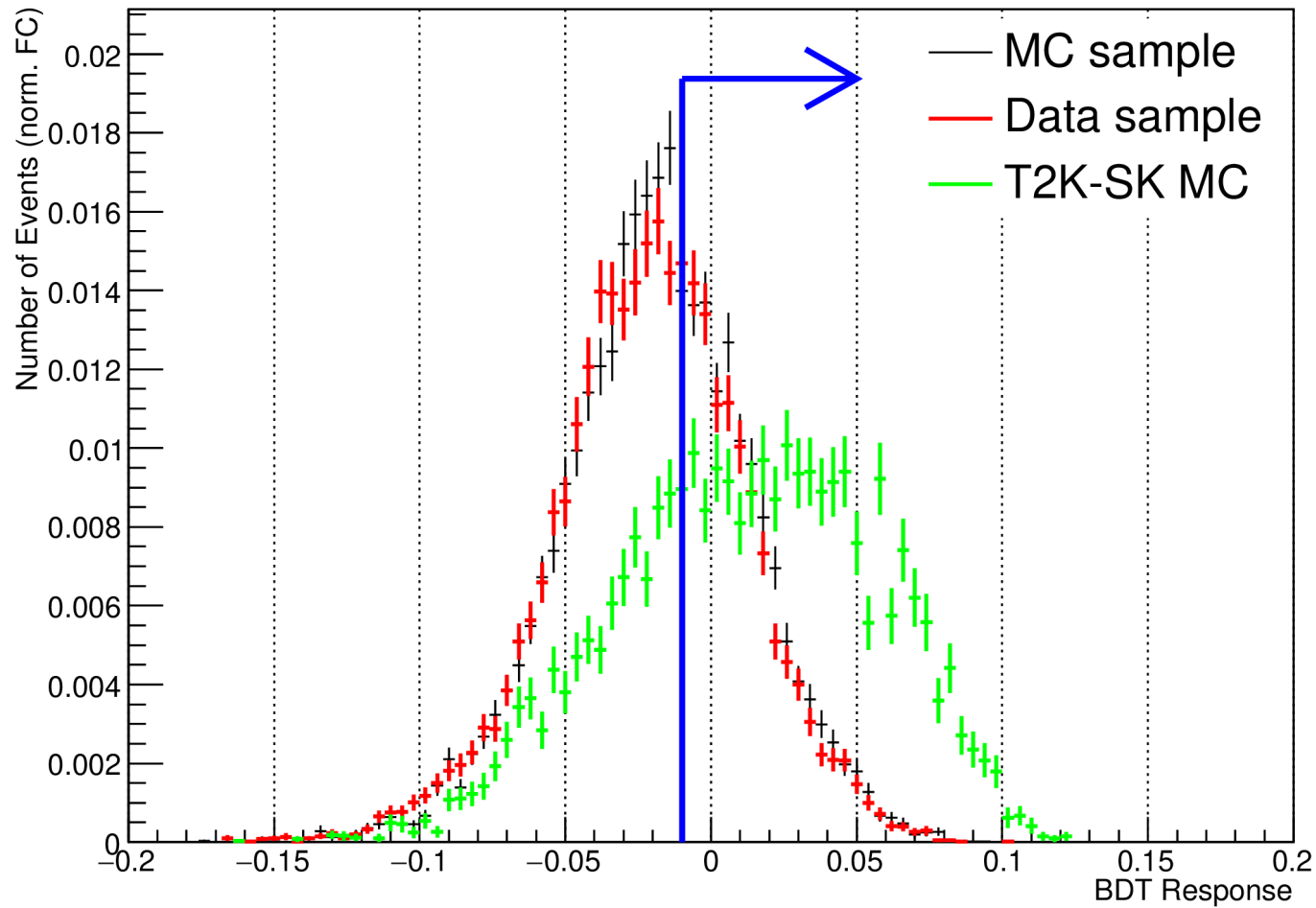
- Now oscillating hybrid sample
- T2K-SK events shown here are $1e1\pi^+$
 - Same final state definition used when constructing hybrid sample
- Can see efficiency discrepancy at BDT cut

Hybrid Sample BDT Cut: **fiTQun v4**

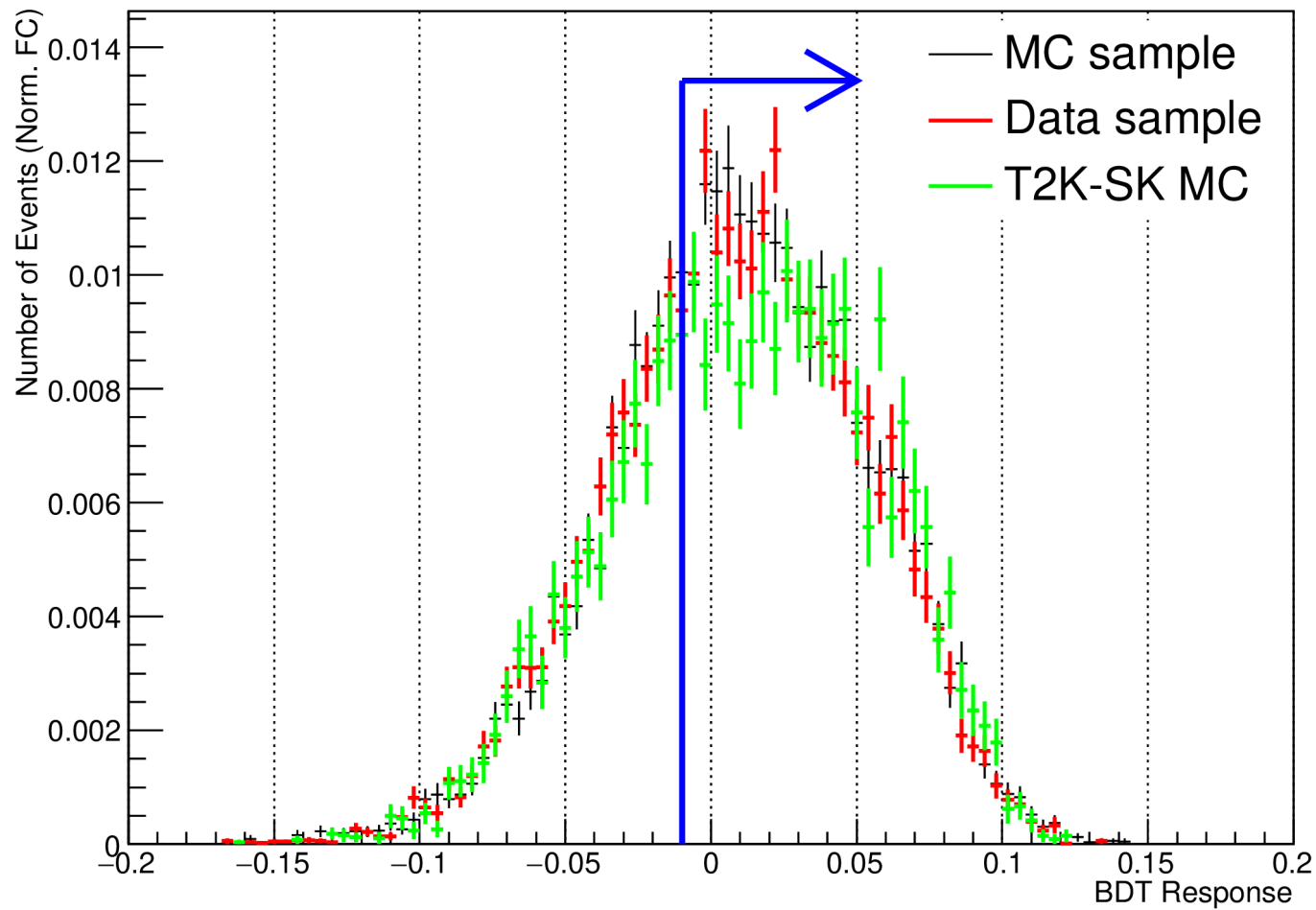


- With fiTQun v4 reconstruction, BDT cut discrepancy is gone!

BDT Response: **fiTQun v5**

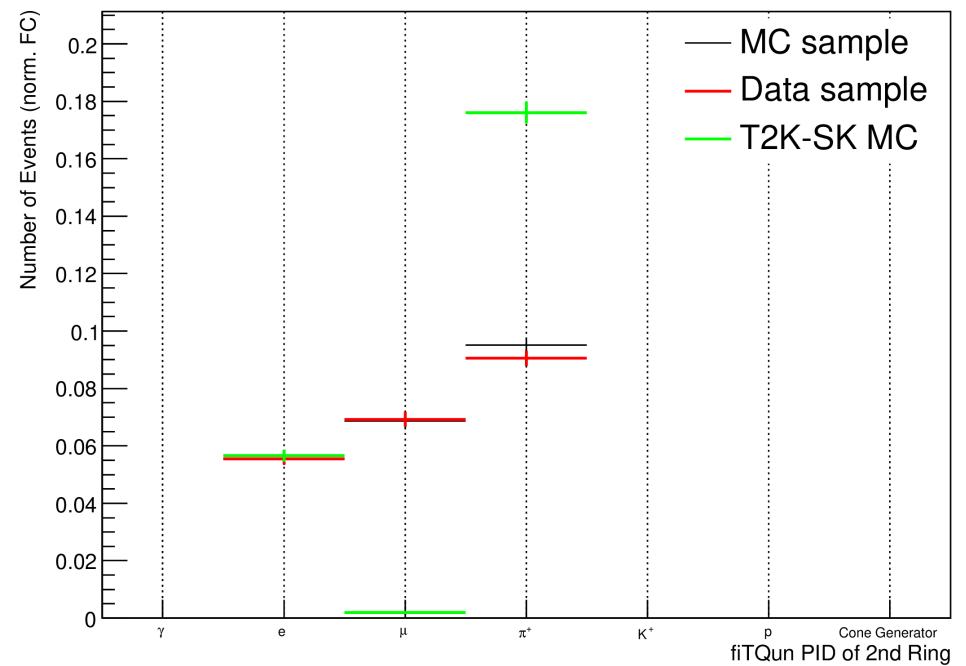
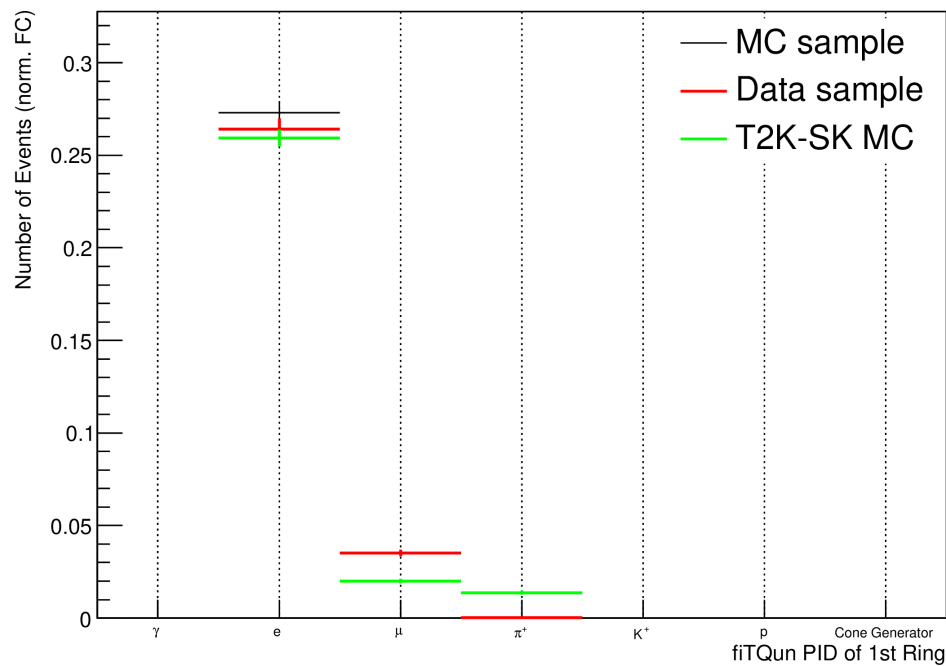


BDT Response: **fiTQun v4**



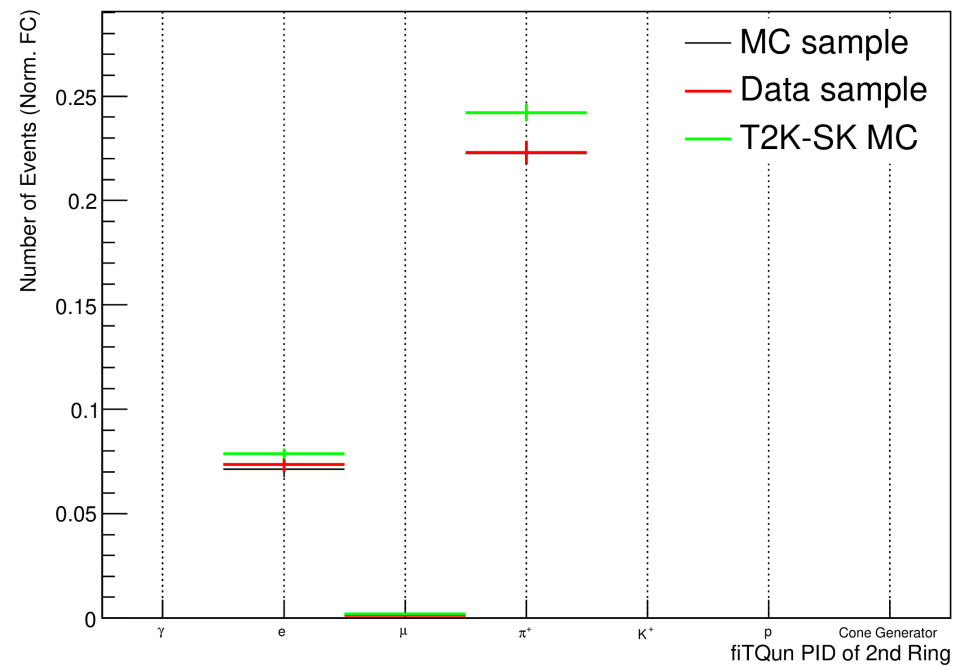
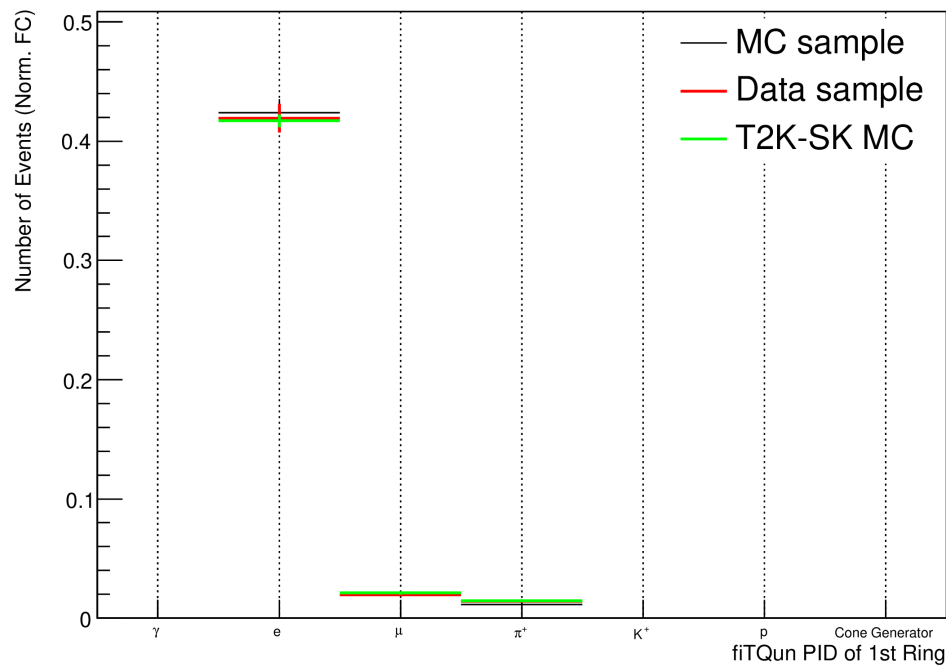
fiTQun PID of 1st and 2nd ring: **fiTQun v5**

events before BDT cut



fiTQun PID of 1st and 2nd ring: **fiTQun v4**

events before BDT cut



T2K Technical Note

T2K-TN-XXX

- I sent an email with the first draft of the hybrid ν_e CC1 π^+ technical note
- Please let me know if you have any comments!

Construction of Hybrid ν_e CC1 π^+ Samples for SK Detector Systematic Error Estimation

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August 12, 2019

Abstract

At T2K beam energies, CC1 π^\pm interactions are the second-most dominant interaction mode (after CCQE). To increase statistics at the far detector for ν_e appearance studies, a new 2-ring ν_e CC1 π^+ sample is being developed. Systematic uncertainties of this sample must therefore be studied. In order to estimate detector systematics at the Super-Kamiokande (SK) detector, hybrid ν_e CC1 π^+ samples will be used. These hybrid samples consist of atmospheric e -like rings (from either data or MC) merged with MC-generated π^+ rings. This technical note outlines the construction of these new hybrid samples and their potential to be used for systematic error estimation.

Backup