# Progress Update

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# Cedar Software Status

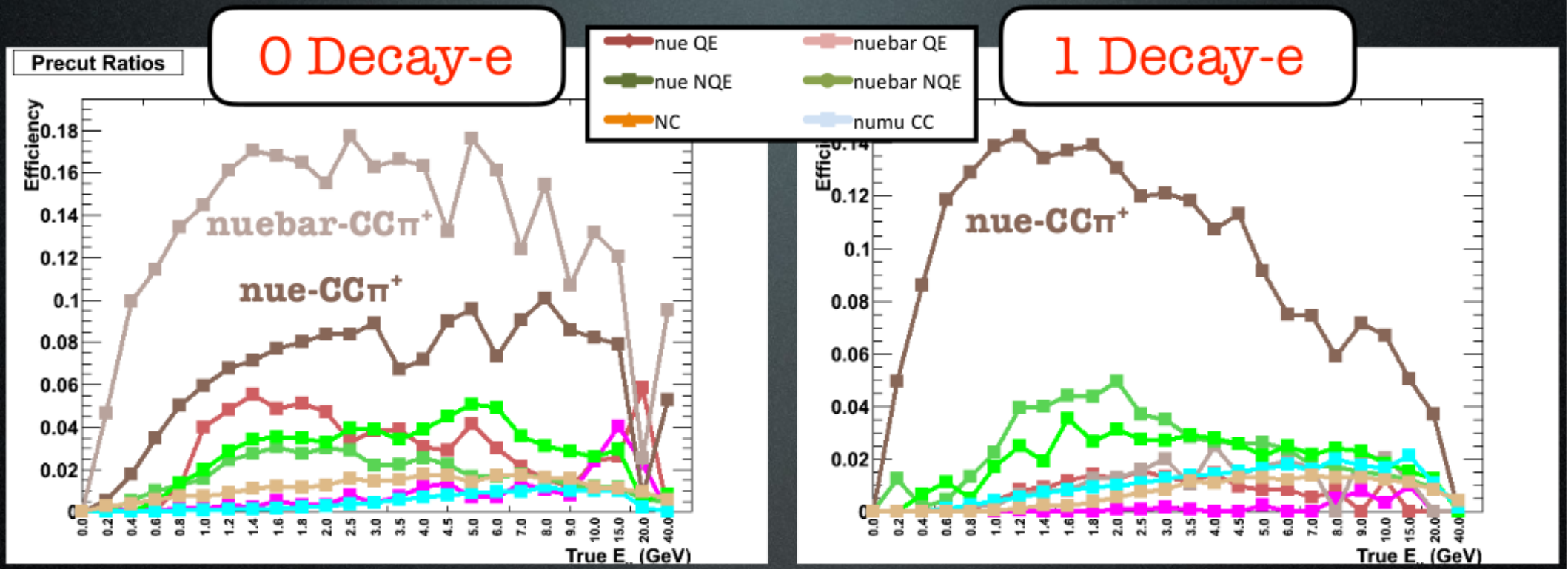
- Didn’t hear back from Mike regarding which version of SKDETSIM to use
  - I just installed the most recent version (v13p90)
- Planning to install these over the next month or so:
  - Geant4 9.4.4
  - Geant4 10.1.3
  - WCSim (NuPRISM analysis package)
  - WCSim (most recent NuPRISM branch using Geant4 10)
  - Root 5.28

# $\nu_e$ CC1$\pi^+$ Status

- Currently working on addressing comments from Mike and Roger at T2K-SK meeting in mid-August
  - Produce efficiency plots to compare with Mike's atmospheric SK efficiency plots (next slide)
  - Investigate requiring e-like ring to have higher energy
    - Mike did this for his SK studies
  - Plot exploratory histograms (from August) vs electron momentum
  - Divide cutflow table into more categories
    - Separate NC events by pion content to better understand backgrounds

# Mike's Efficiency Plots

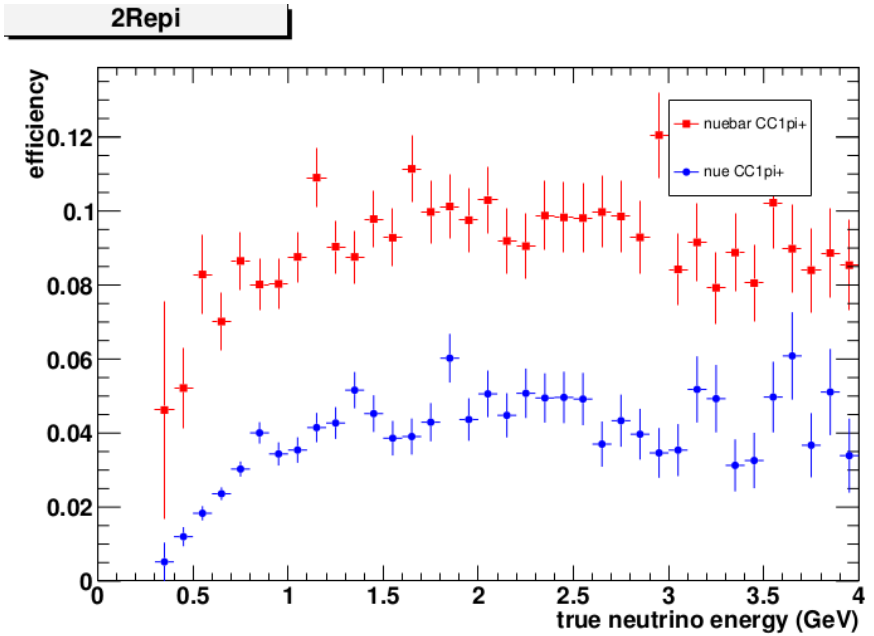
## 2-Ring Selection Results

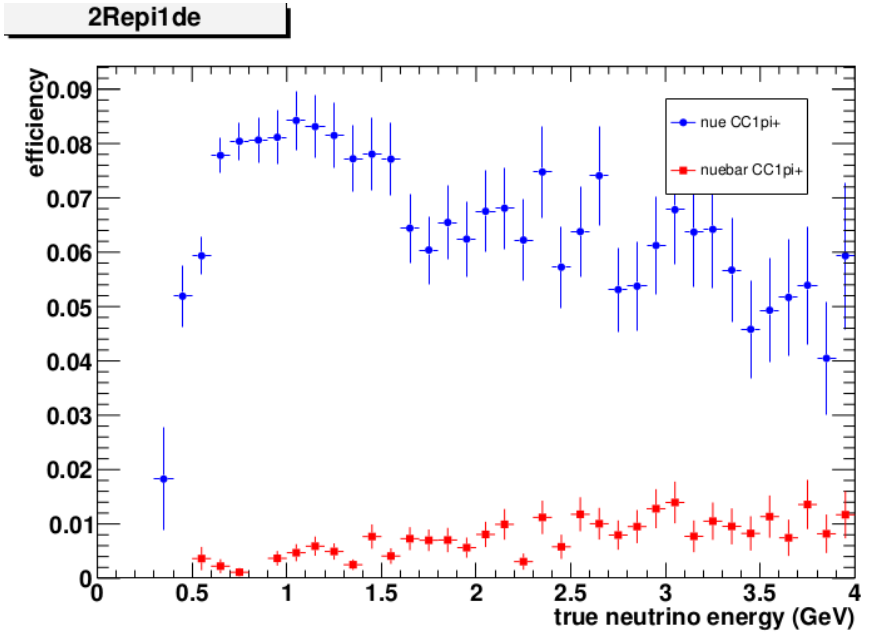



- "Efficiency" defined relative to all $CC\pi^+$ events (including below-Cherenkov $\pi^+$, absorption or charge exchange in the nucleus or water, etc.)

Not exactly sure what "efficiency" means for non-CC1$\pi^+$ events

# My Efficiency Plots (in progress)




Efficiency does seem to be lower than Mike's – different FCFV cuts?

| 2Reπ | |
|---|---|
| FCFV | evclass==1 && evis>30 && wall>200 |
| 2 rings | fqmrnring[0]==2 |
| eπ-like | (fqmrpid[0][0]==11 && fqmrpid[0][1]==211) \|\| (fqmrpid[0][0]==211 && fqmrpid[0][1]==11) |
| 0 decay e | fqnse==1 |

| 2Reπ1de | |
|---|---|
| FCFV | evclass==1 && evis>30 && wall>200 |
| 2 rings | fqmrnring[0]==2 |
| eπ-like | (fqmrpid[0][0]==11 && fqmrpid[0][1]==211) \|\| (fqmrpid[0][0]==211 && fqmrpid[0][1]==11) |
| 1 decay e | fqnse==2 |
| distance between sub-events | sqrt((fq1rpos[0][1][*]-fq1rpos[1][1][*])^2)<170 |

# Some other things...

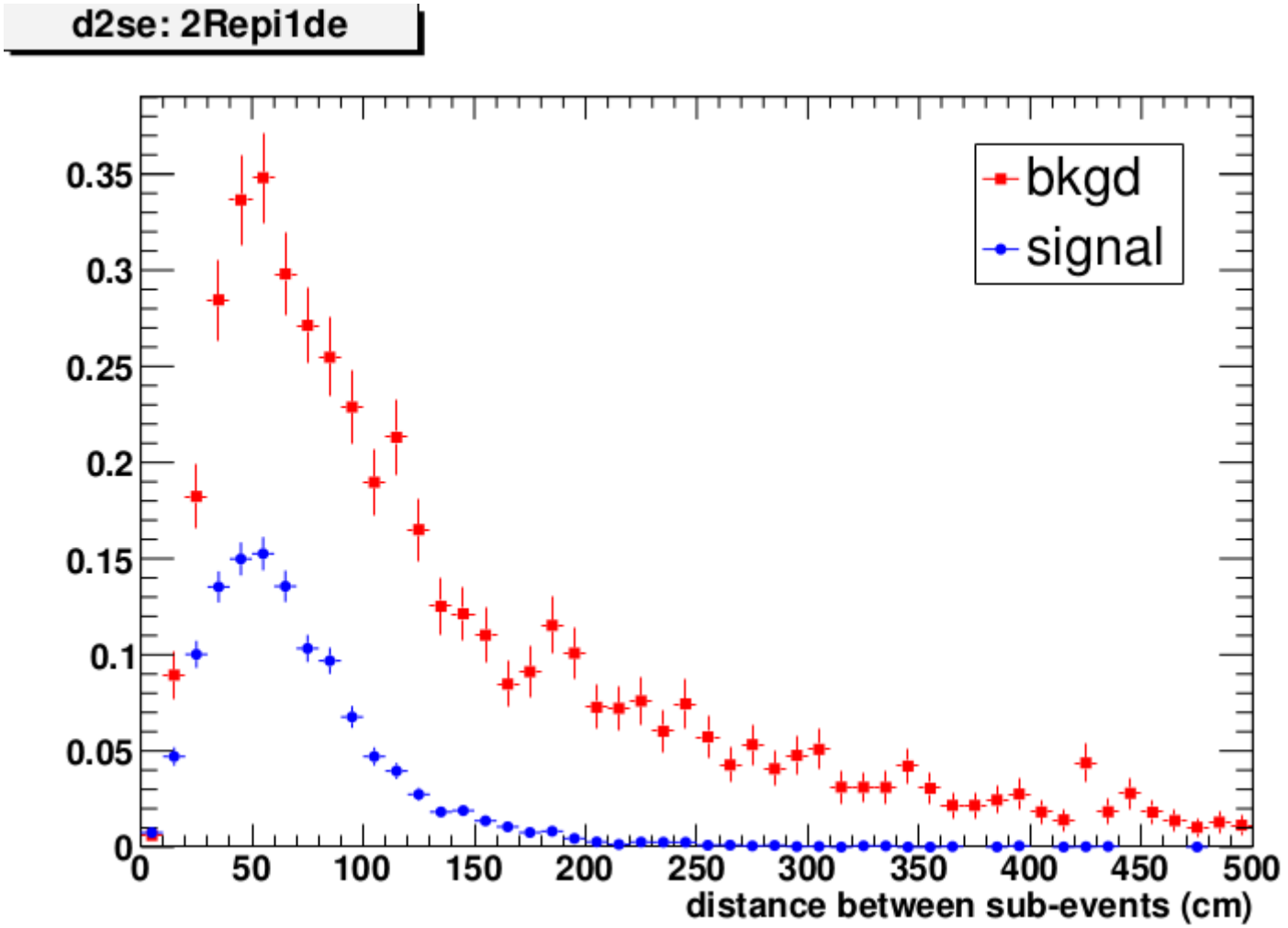
- I’ve heavily modified my code to be more friendly to changing/adding cuts
  - should also be more usable for something like a grid search
    - grid search will be done (to maximize FOM) once all potential cuts are identified
- Currently working on implementing remaining recommendations from T2K-SK meeting
- Mike also asked me to do a quick 8” PMT effective area simulation

# Backup

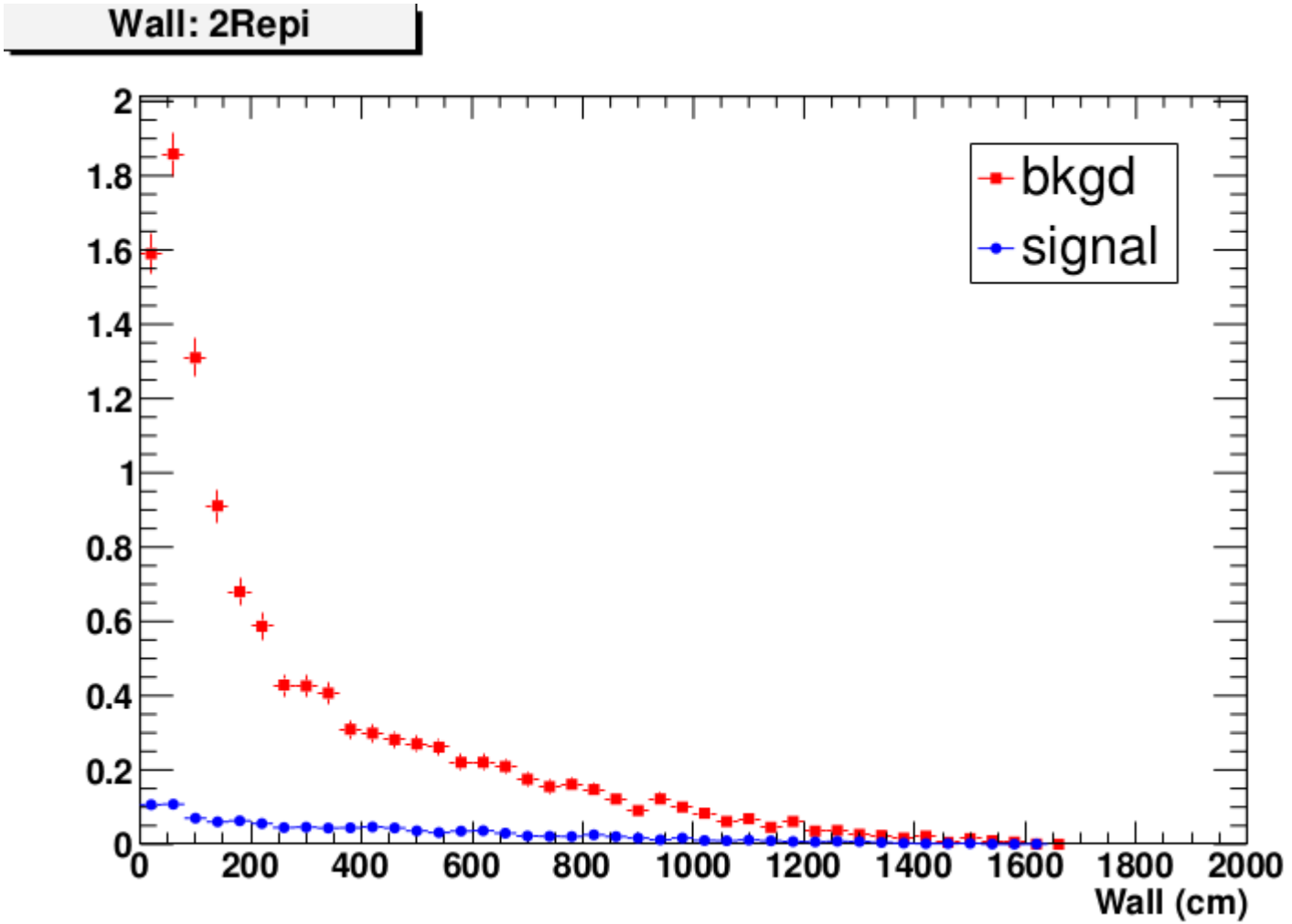
# Cut Exploration

- The following slides show some plots I made to investigate possible cuts to use for the 2Reπ and 2Reπ1de samples
- The 2Reπ sample only has the 2-ring, eπ-like, and 0de cuts applied
  - No FCFV cut
- The 2Reπ1de sample only has the 2-ring, eπ-like, and 1de cuts applied
  - No FCFV or d2se cuts
- “Signal” is all oscillated $\nu_e/\bar{\nu}_e$ CC events
- “Bkgd” is everything else

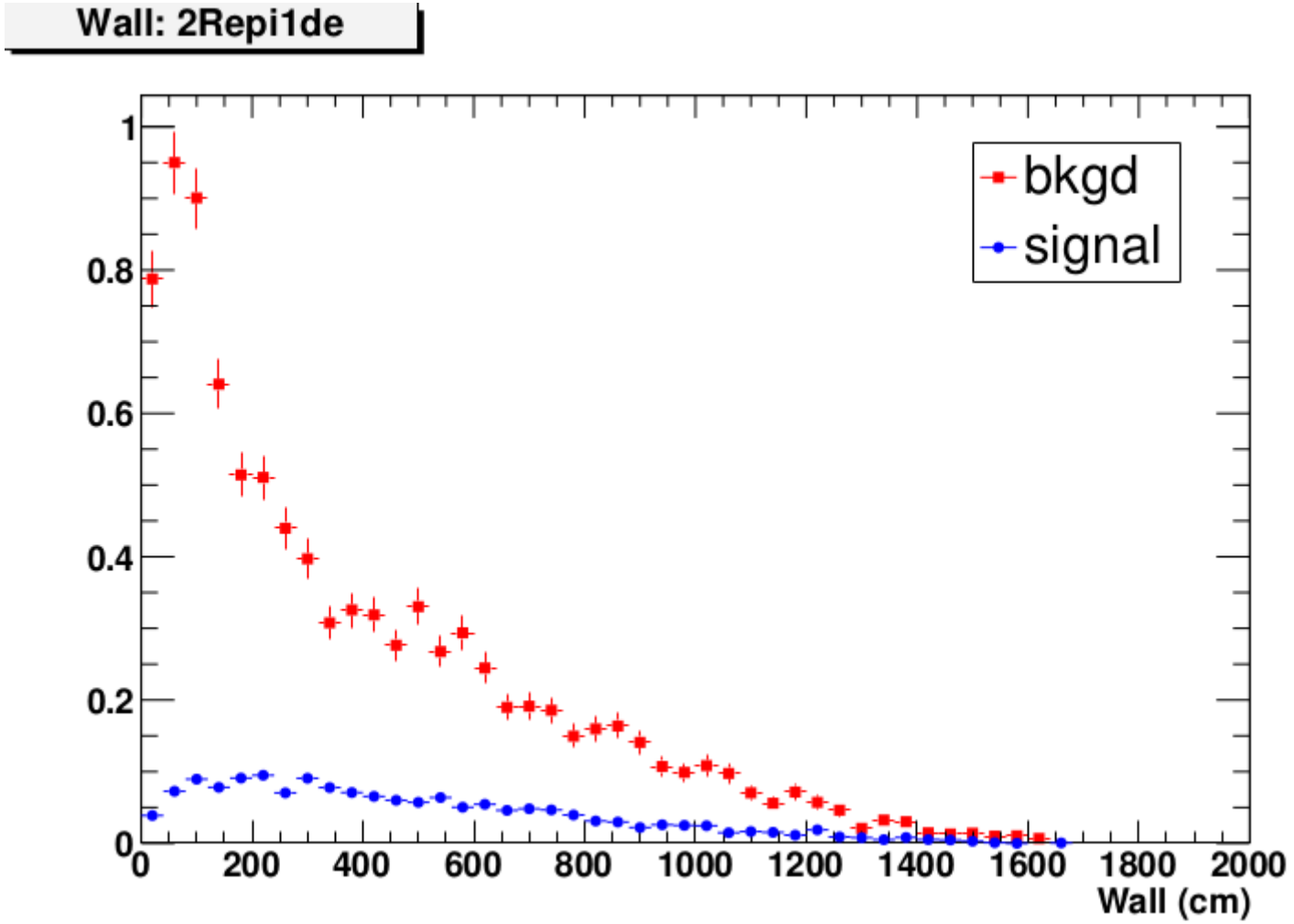
# Distance between sub-events (d2se)



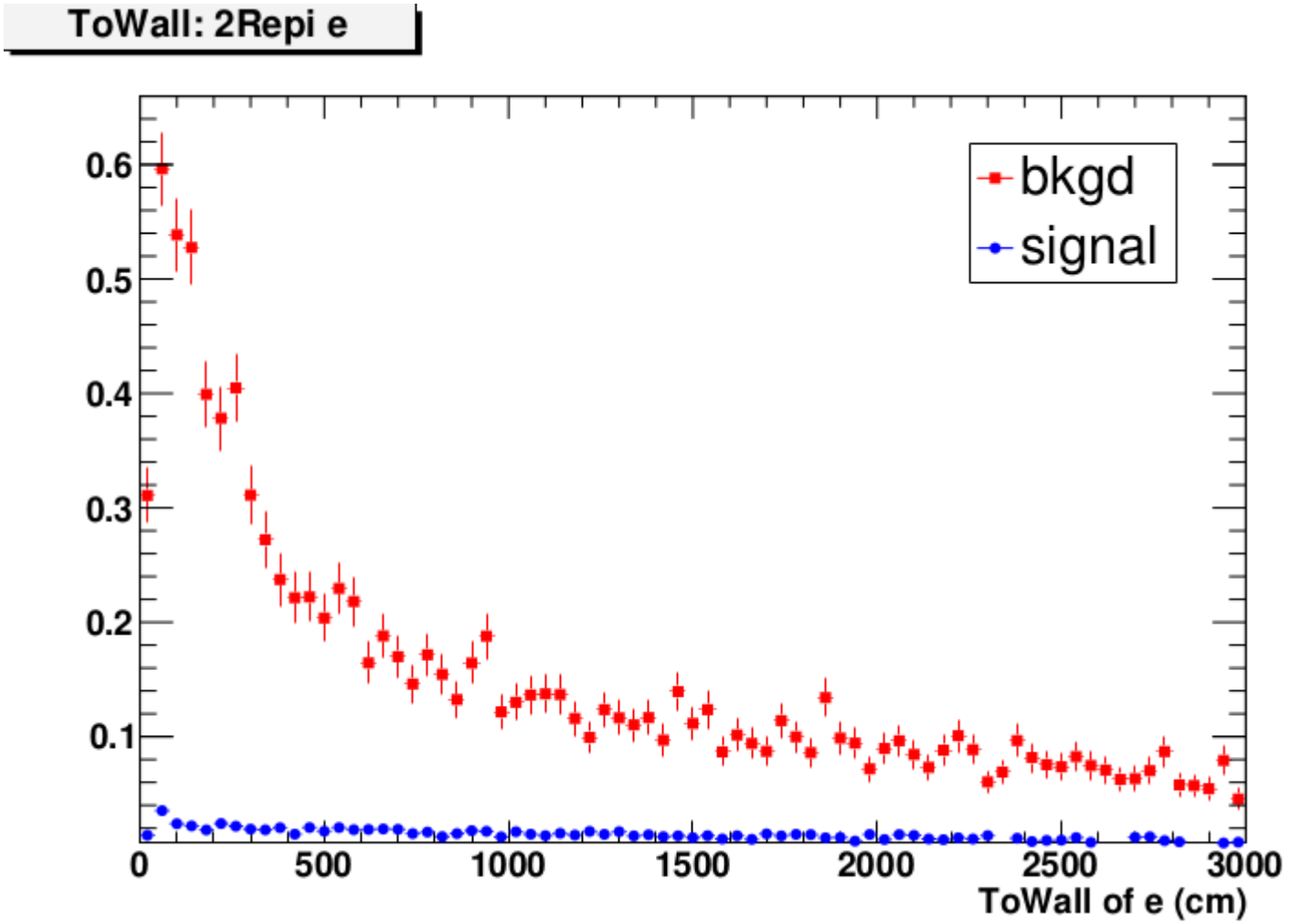
# Wall: 2Reπ


Wall: 2Repi
bkgd
signal
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Wall (cm)

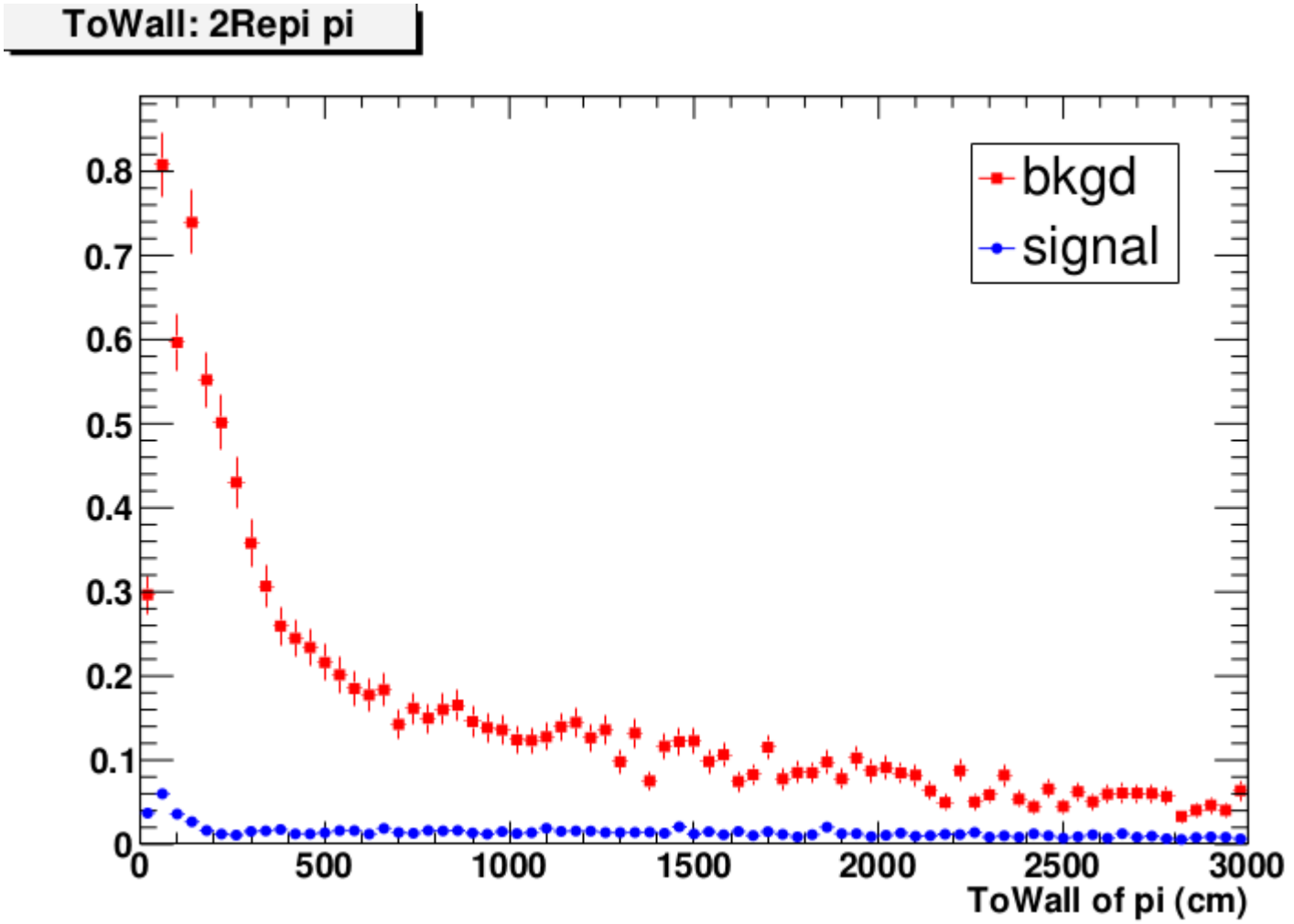
# Wall: 2Reπ1de



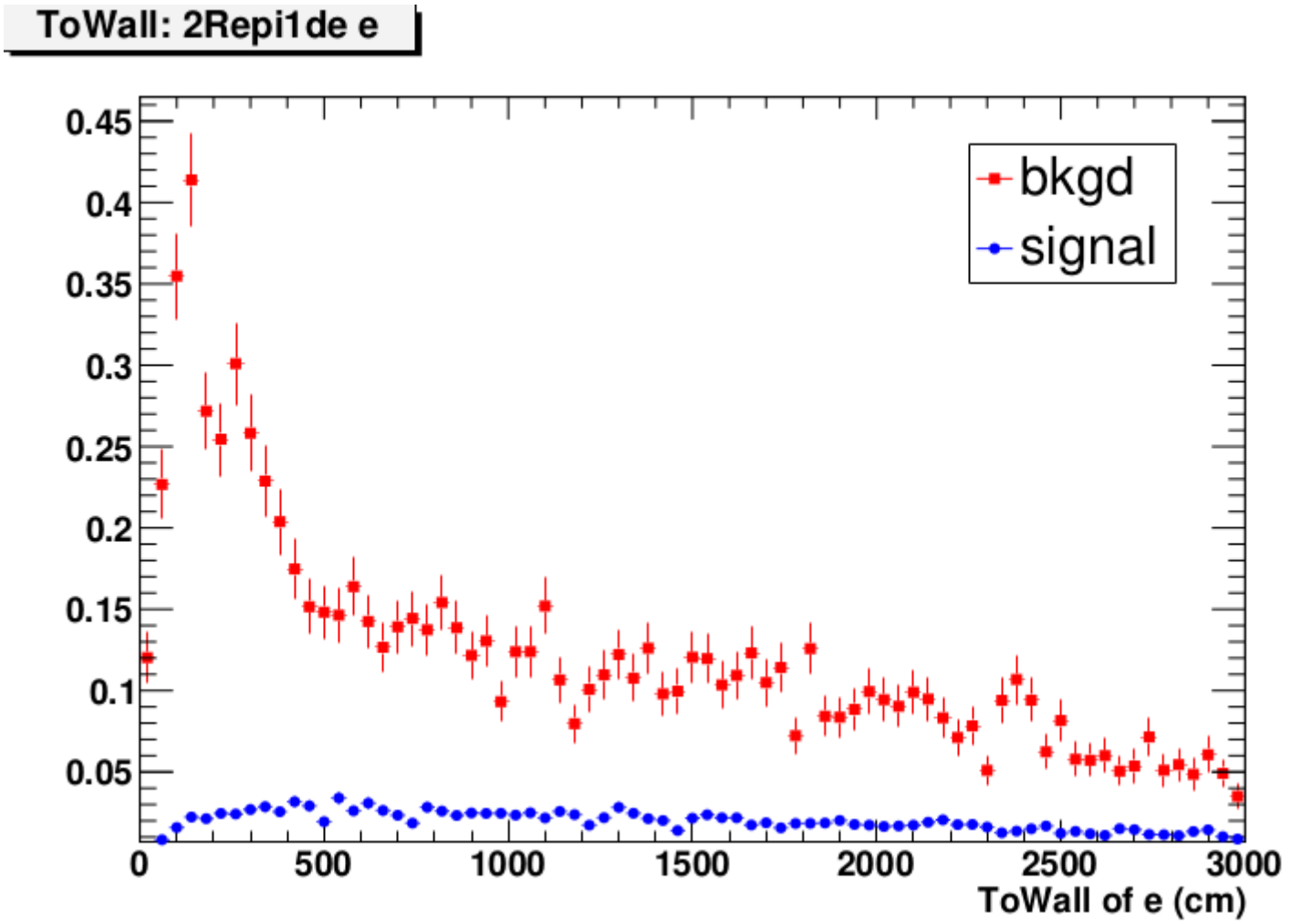
# e ToWall: 2Reπ



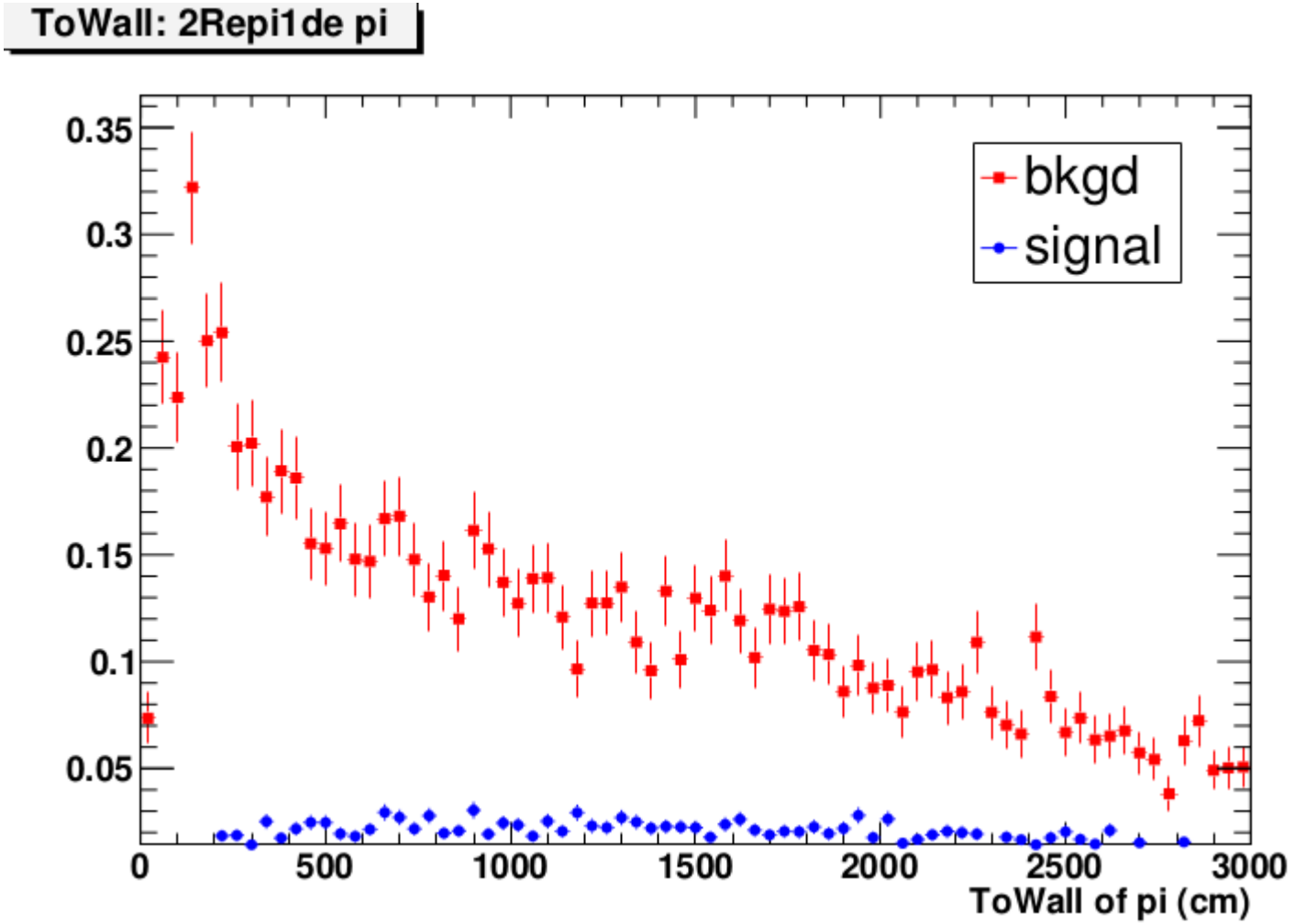
# π ToWall: 2Reπ



# e ToWall: 2Reπ1de



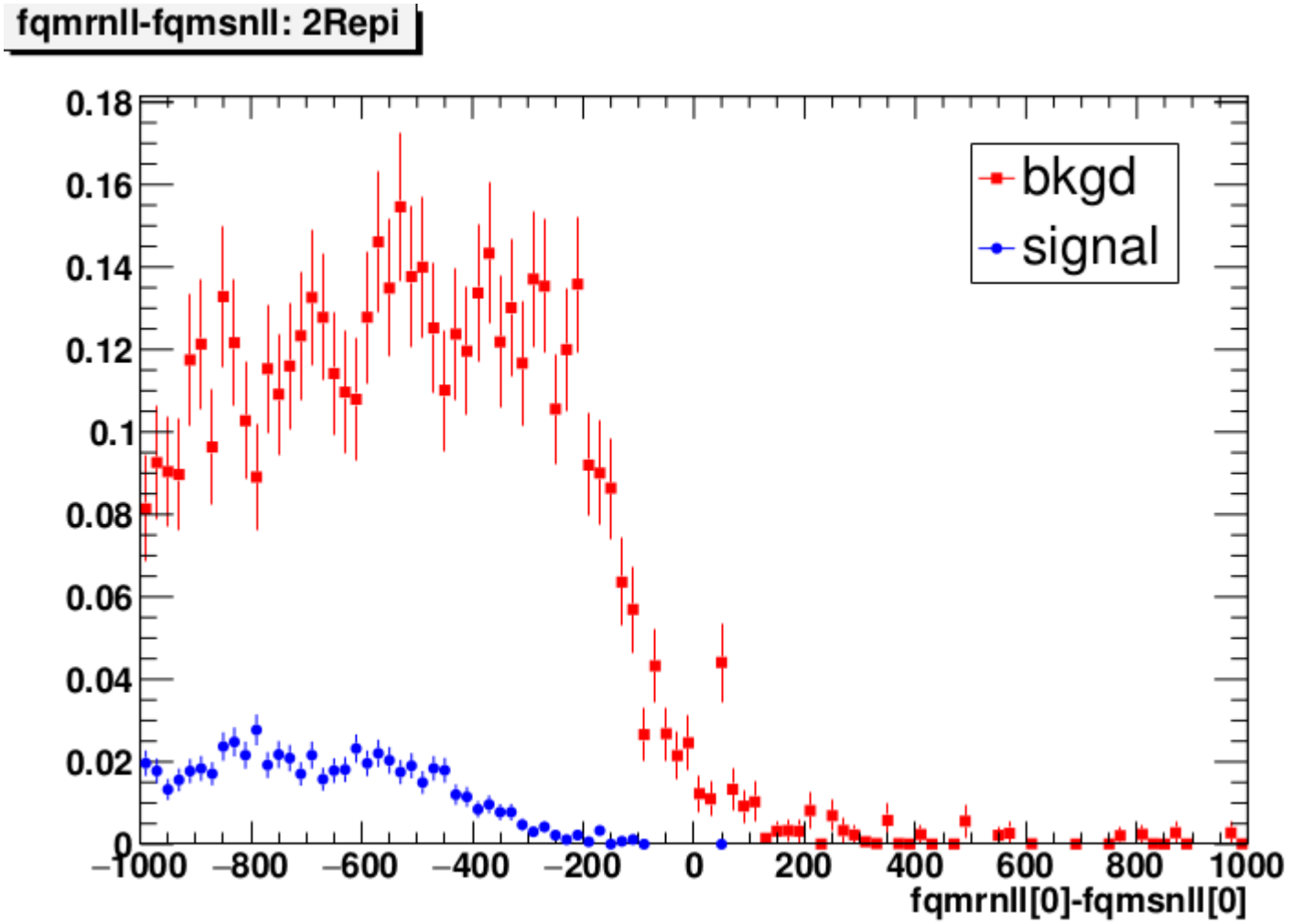
# π ToWall: 2Reπ1de



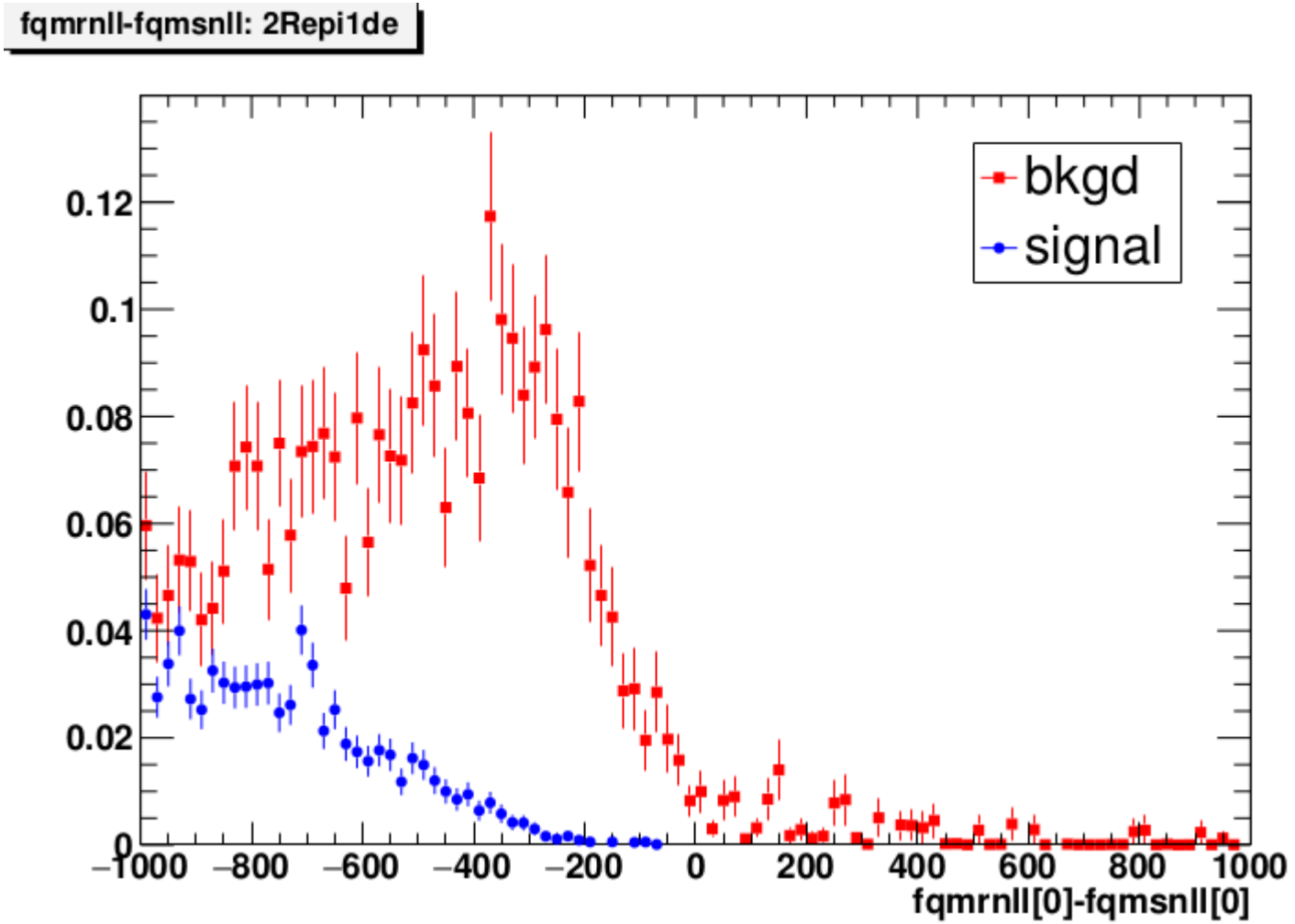
# Thoughts on Wall and ToWall

- Does FOM = S/sqrt(S+B) accurately measure Wall and ToWall cut performance?
  - Roger: should be fine for now
- Other MC files with OD events?
  - Roger: yes, but not sure where

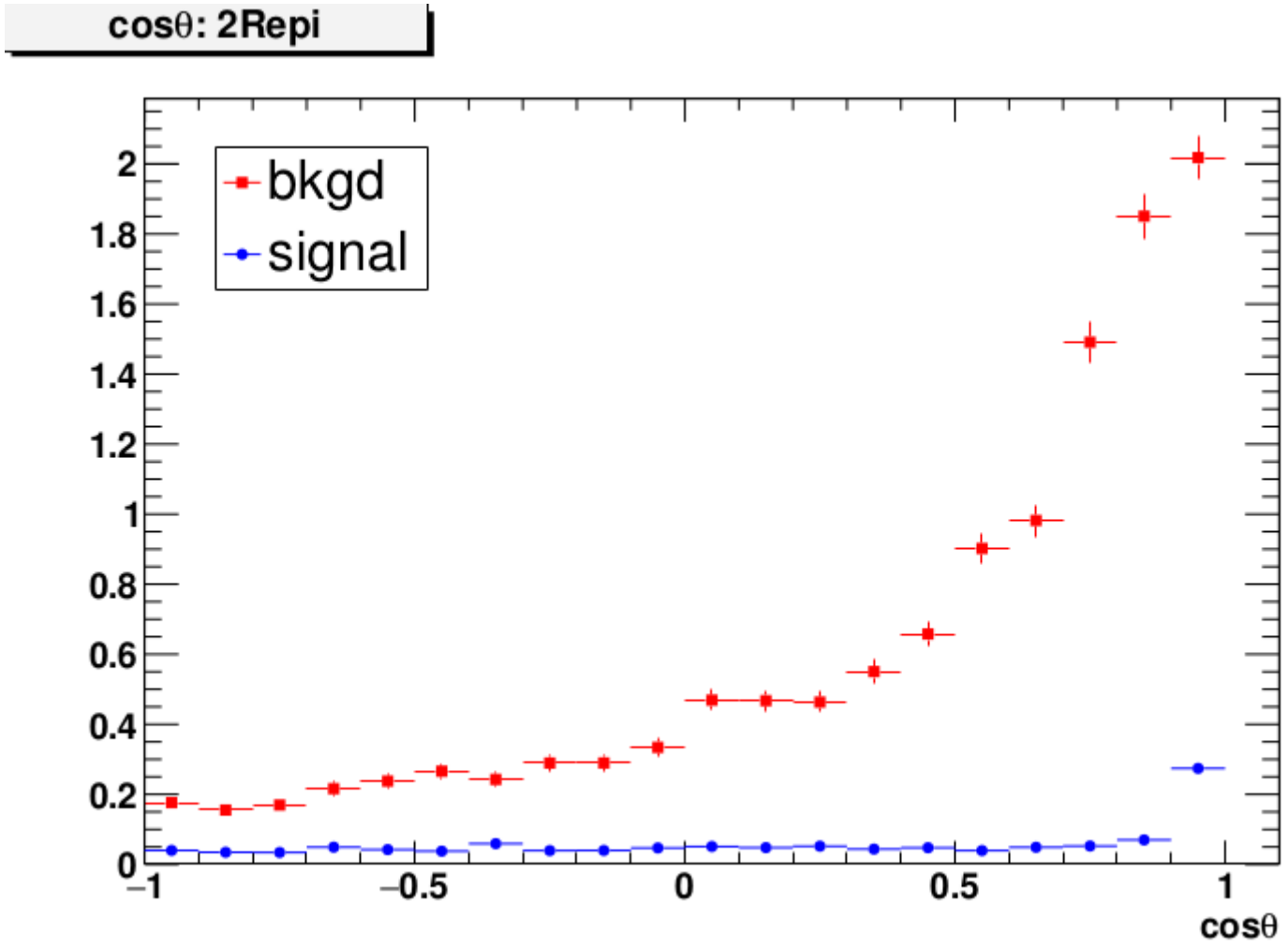
# MR vs MS fit: 2Reπ



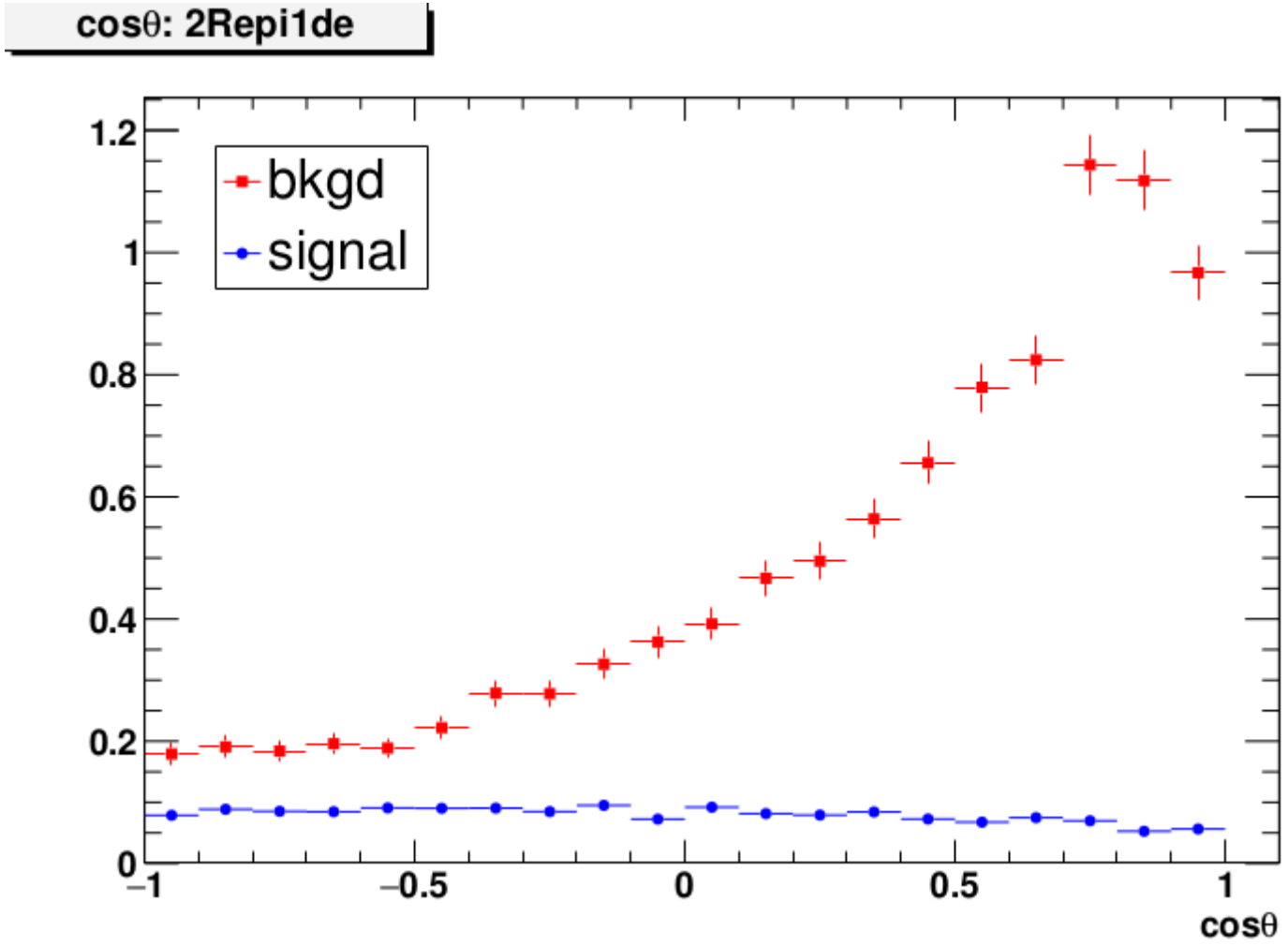
# MR vs MS fit: 2Reπ1de



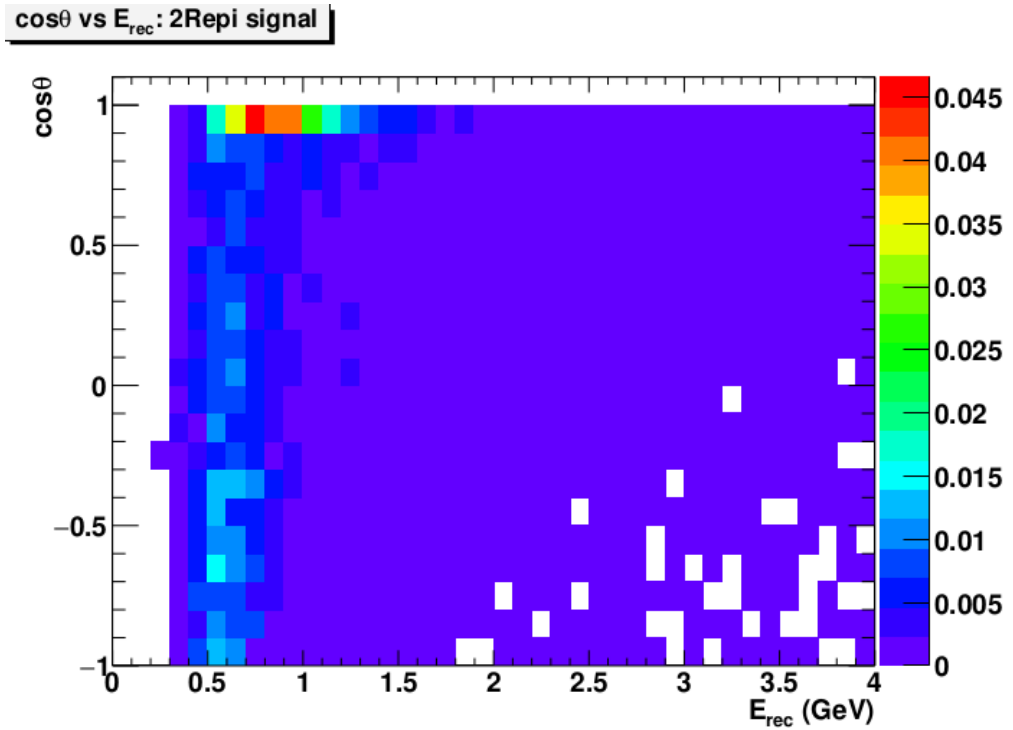
# $\cos\theta_{e\pi}$: 2Re$\pi$

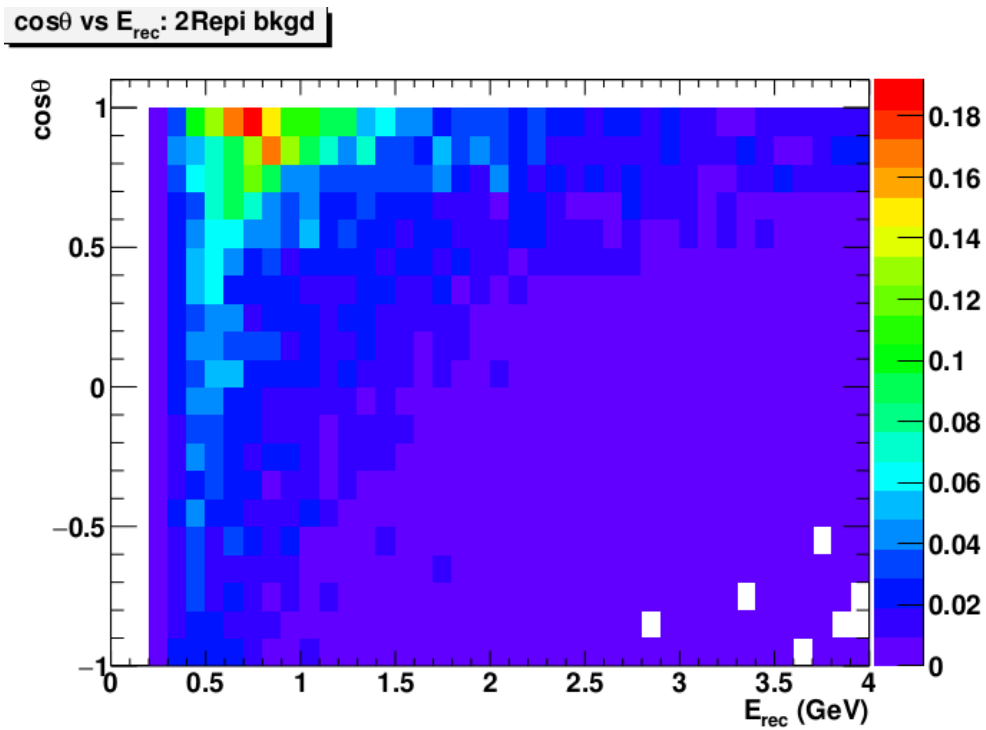


# $\cos\theta_{e\pi}$: 2Re$\pi$1de

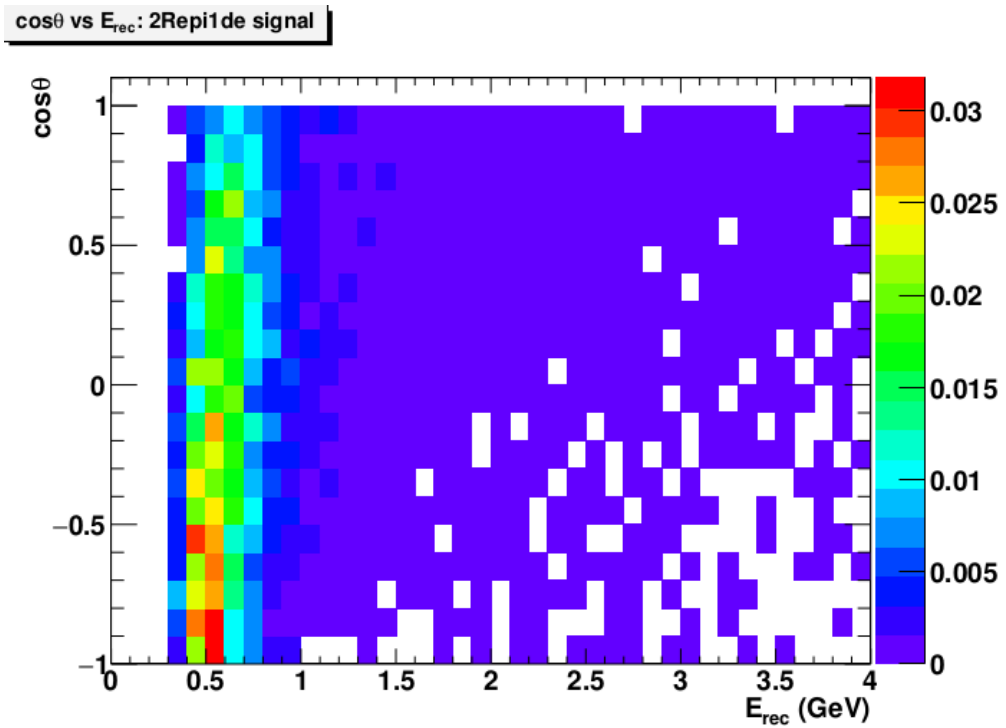


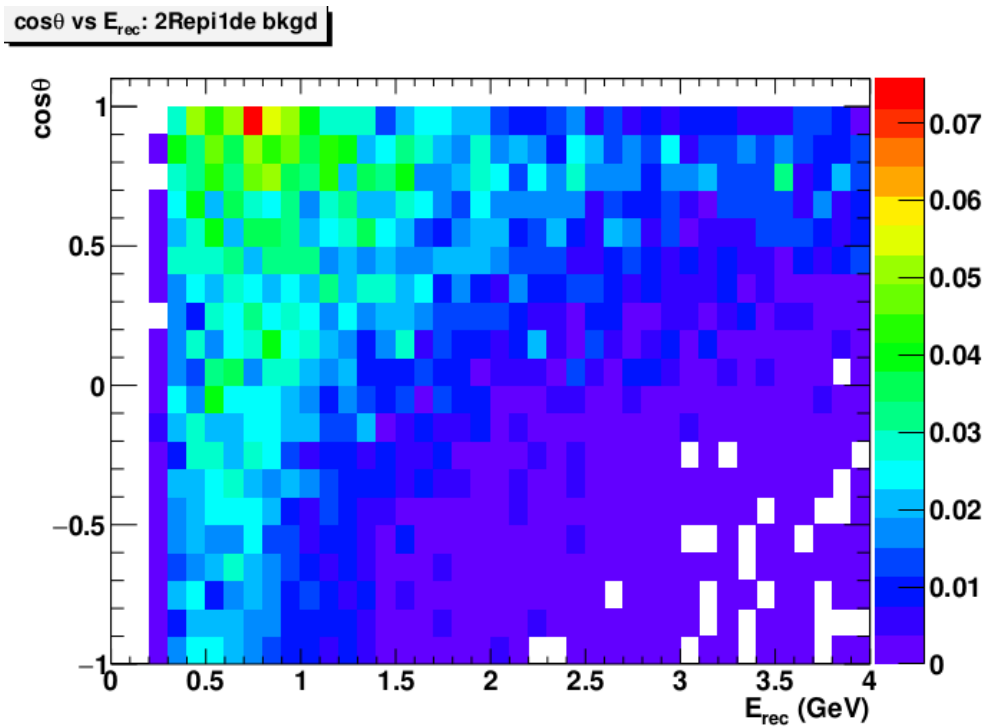
# $\cos\theta_{e\pi}$ vs $E_{rec}$: 2Re$\pi$



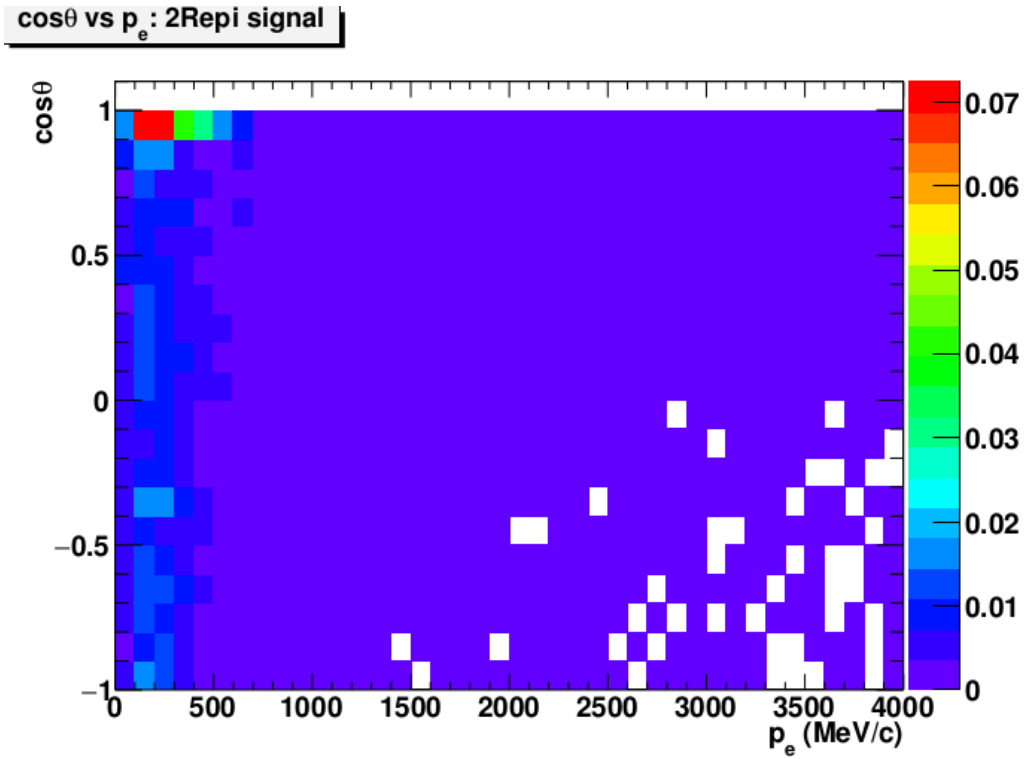



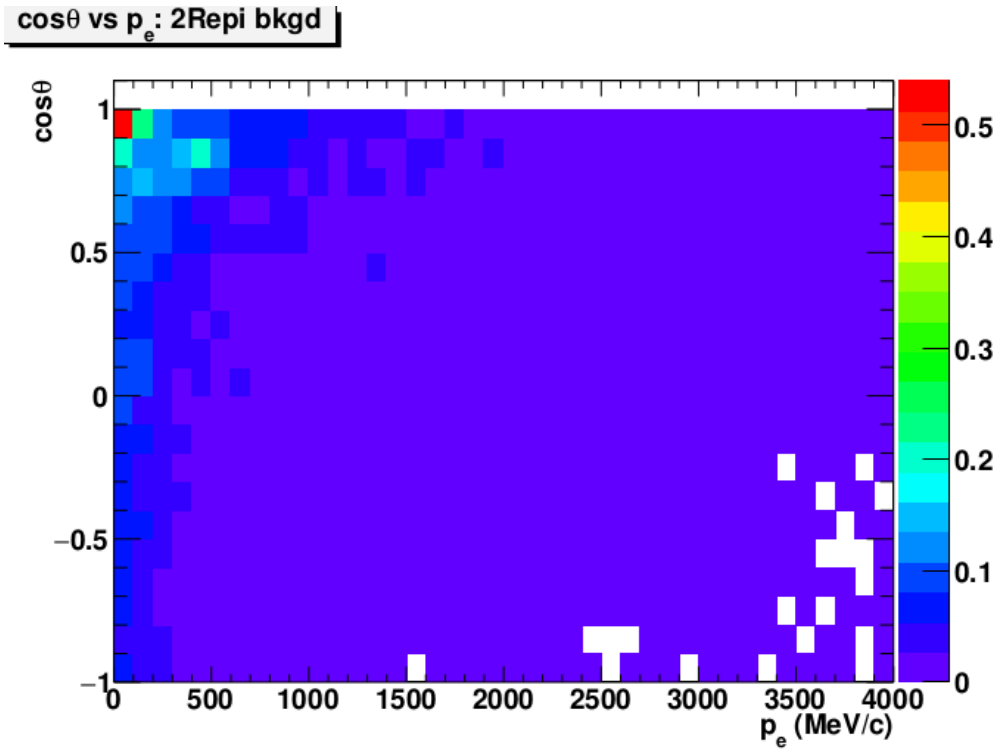
# $\cos\theta_{e\pi}$ vs $E_{rec}$: 2Re$\pi$1de



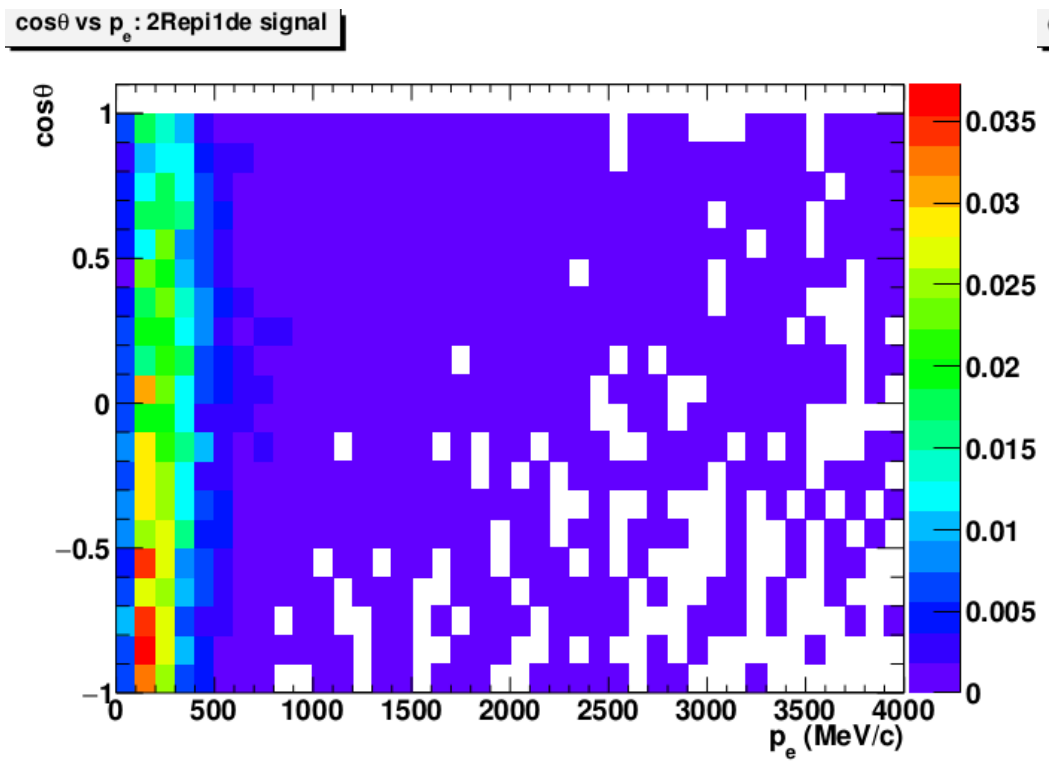



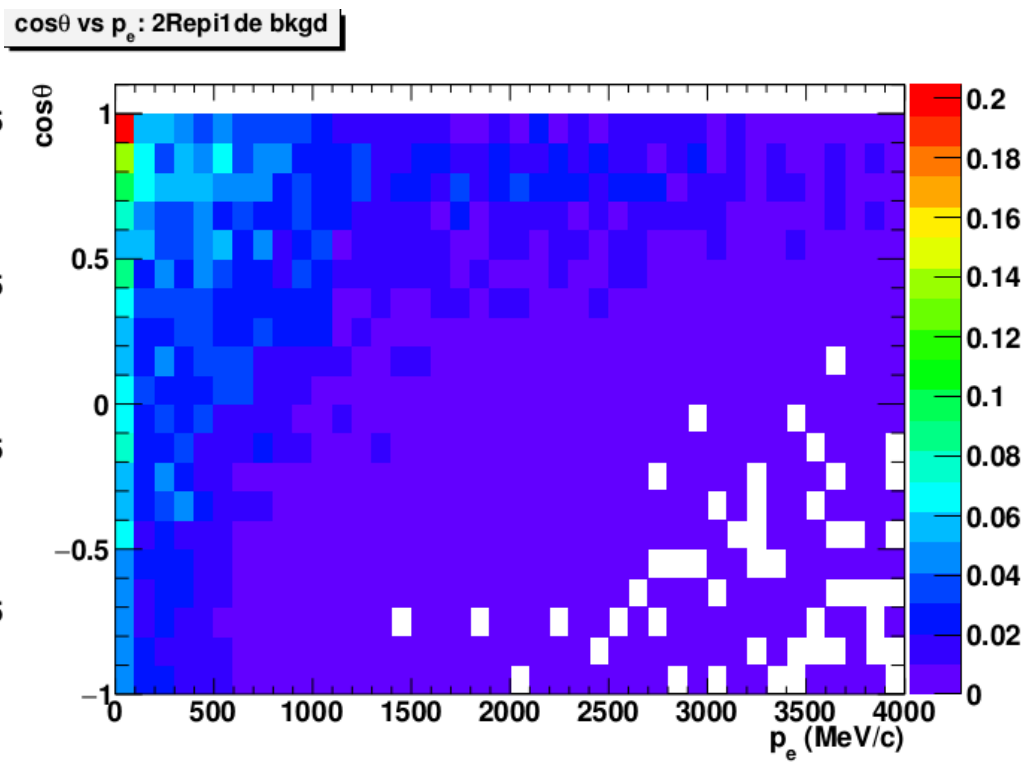
# $\cos\theta_{e\pi}$ vs $p_e$: 2Re$\pi$



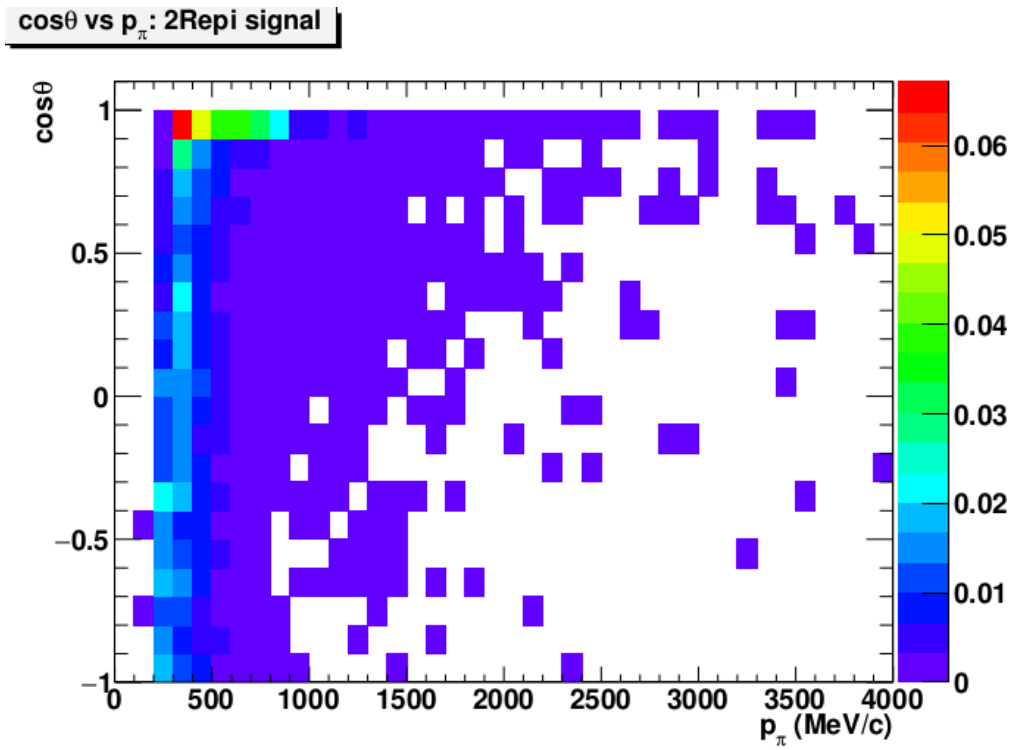



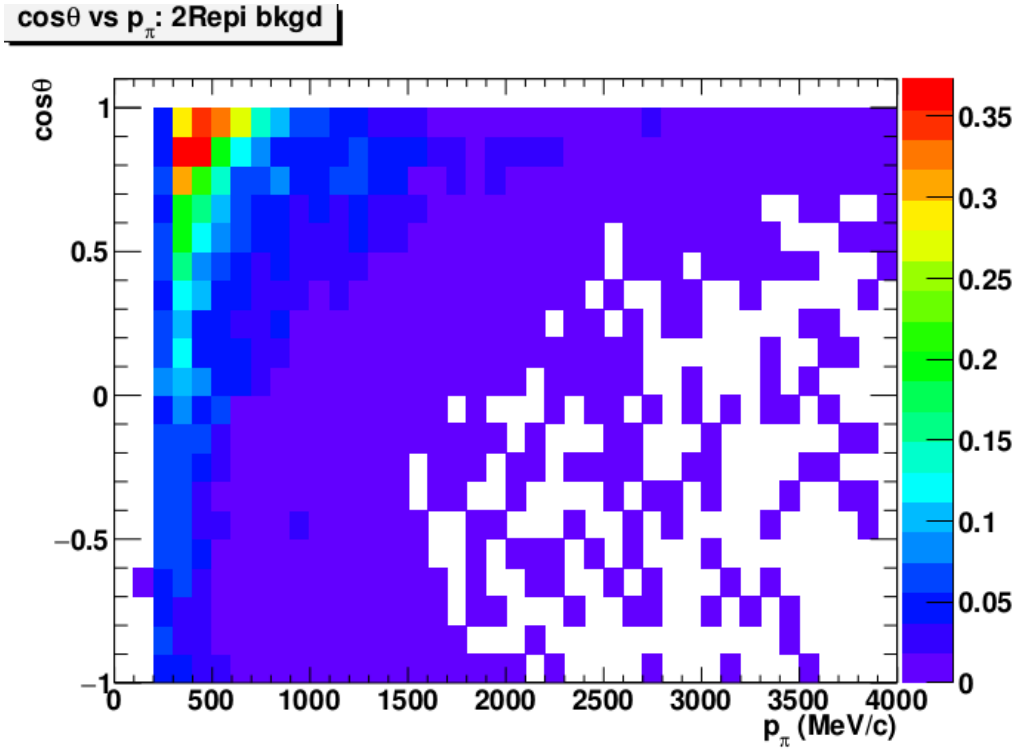
# $\cos\theta_{e\pi}$ vs $p_e$: 2Re$\pi$1de



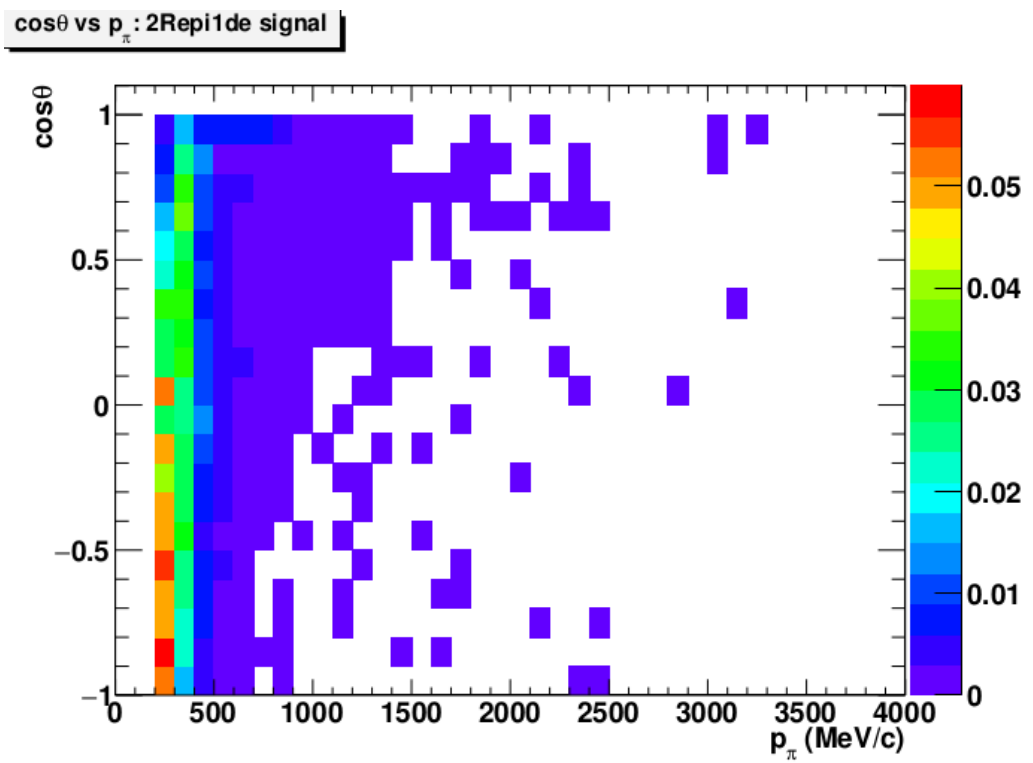



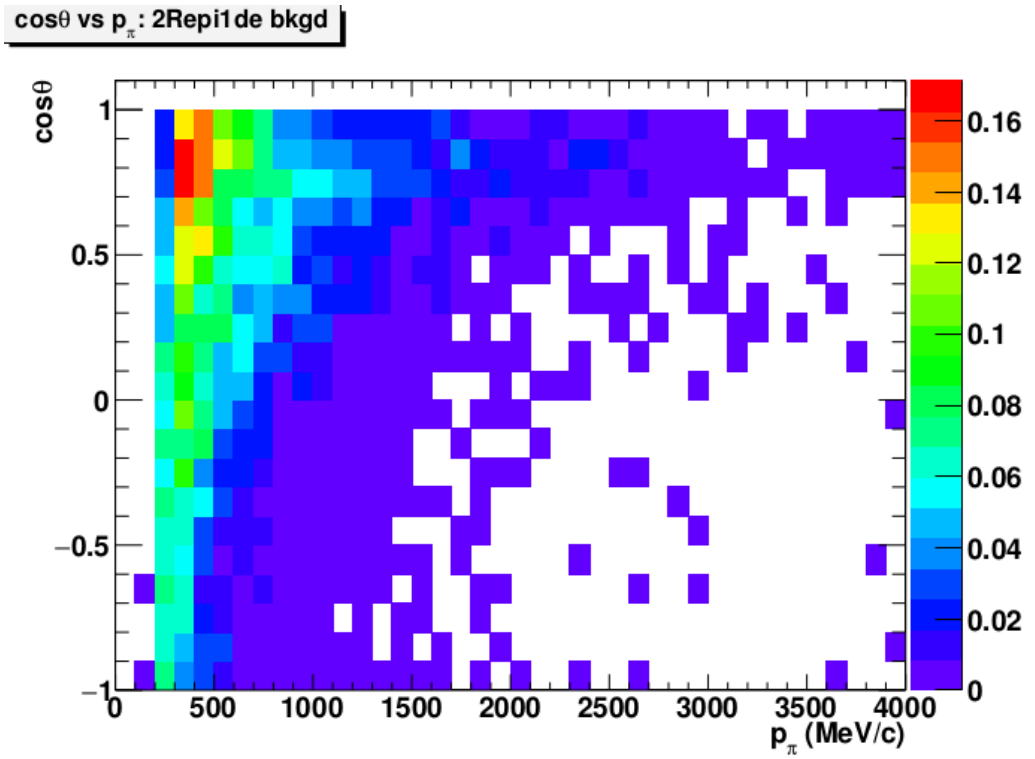
# $\cos\theta_{e\pi}$ vs $p_{\pi}$: 2Re$\pi$



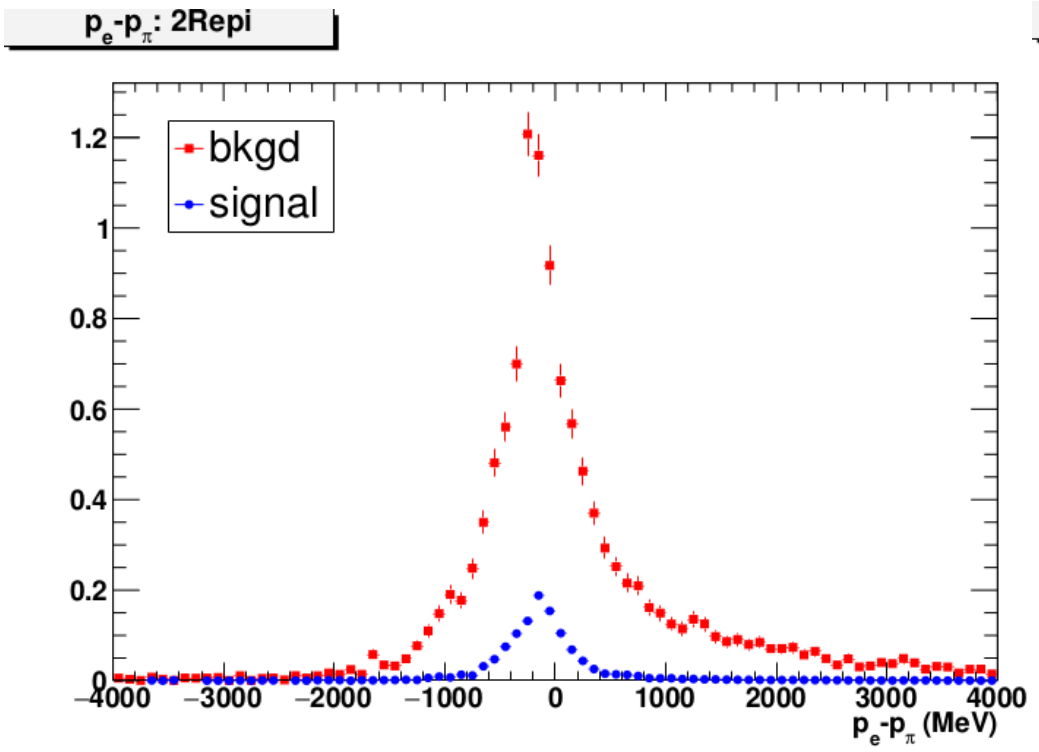



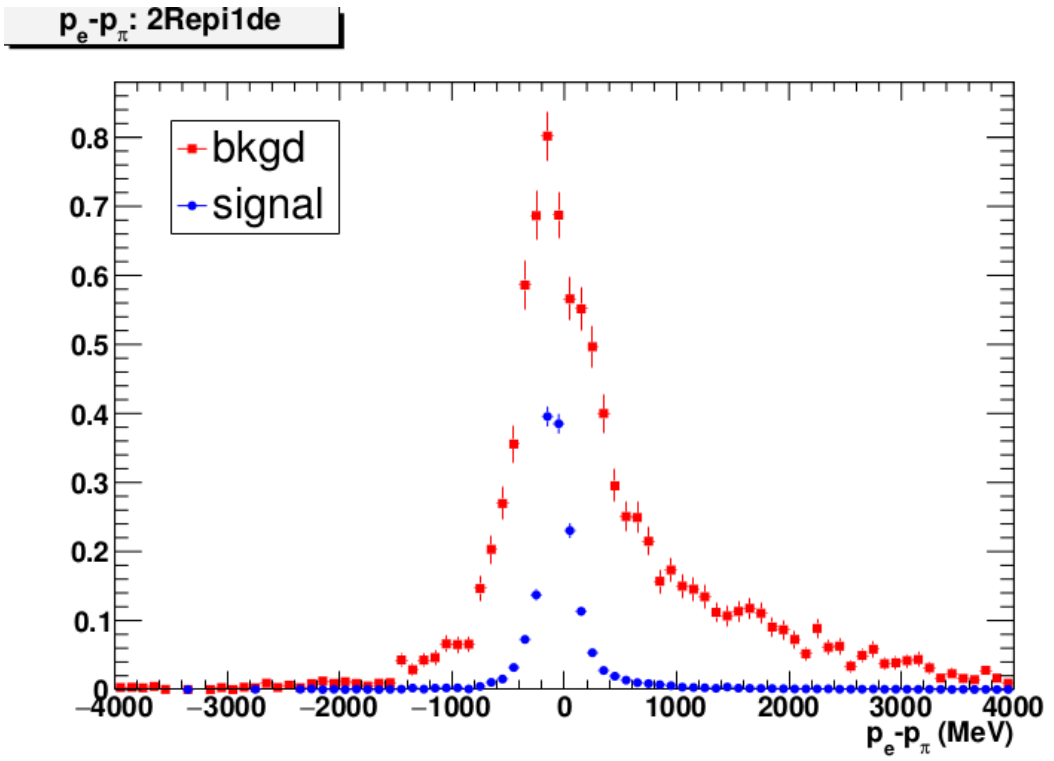
# $\cos\theta_{e\pi}$ vs $p_{\pi}$: 2Re$\pi$1de



# $p_e - p_\pi$


$p_e$-$p_\pi$: 2Repi
bkgd
signal
1.2
1
0.8
0.6
0.4
0.2
0
−4000
−3000
−2000
−1000
0
1000
2000
3000
4000
$p_e$-$p_\pi$ (MeV)


$p_e$-$p_\pi$: 2Repi1de
bkgd
signal
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
−4000
−3000
−2000
−1000
0
1000
2000
3000
4000
$p_e$-$p_\pi$ (MeV)