Pion/Kaon and Kaon/Pion mis-identifications studies using RICH

Inbending RGA 2018 data set

Gabriel Pecar

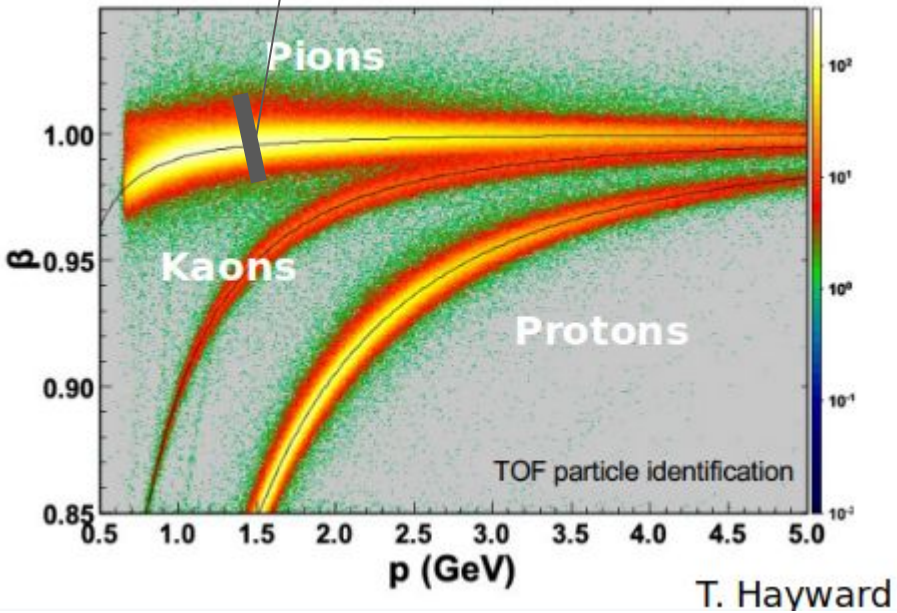
F. Benmokhtar & H. Avakian

Duquesne University

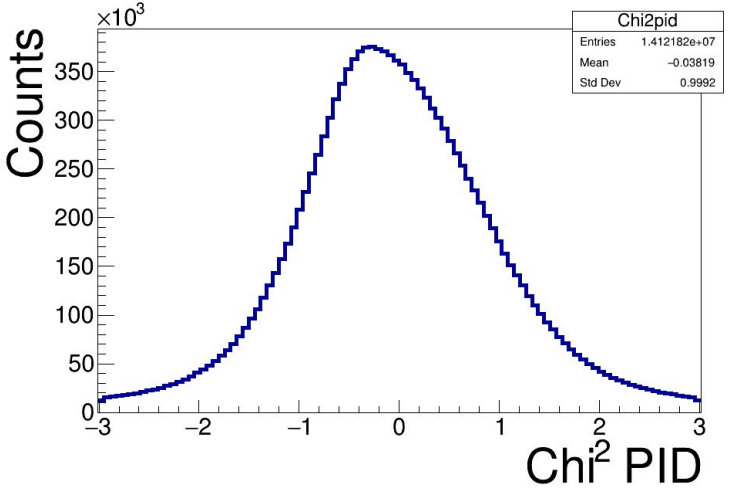
SULI

Reminder: **Particle ID from Time of Flight**

χ^2 PID – deviation from center line

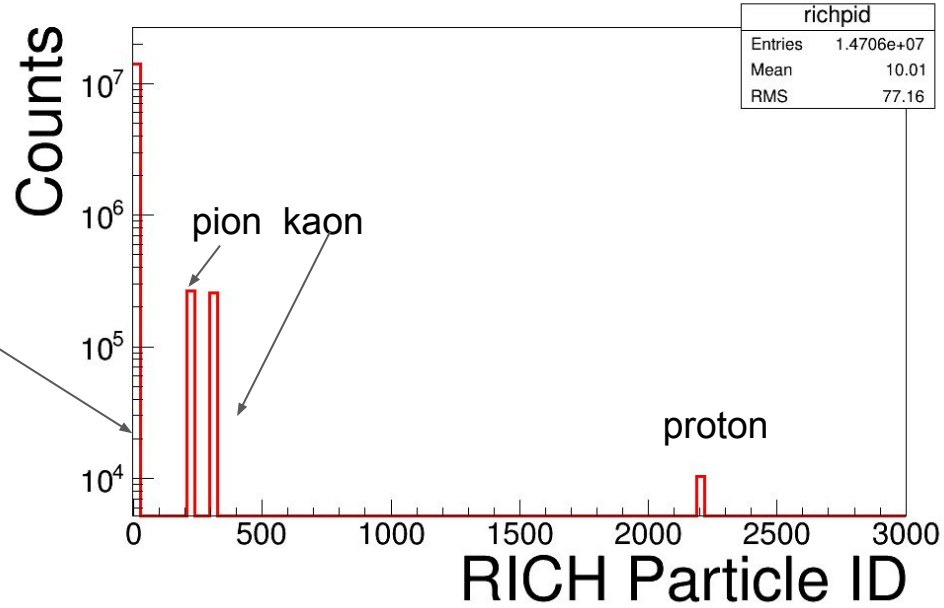


T. Hayward

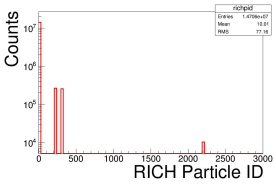


1- Pion/Kaon contamination ep→eKX with RICH

CLAS12 ET events that are not recorded in and/or not concerned with RICH. example: sec 5, 6, …

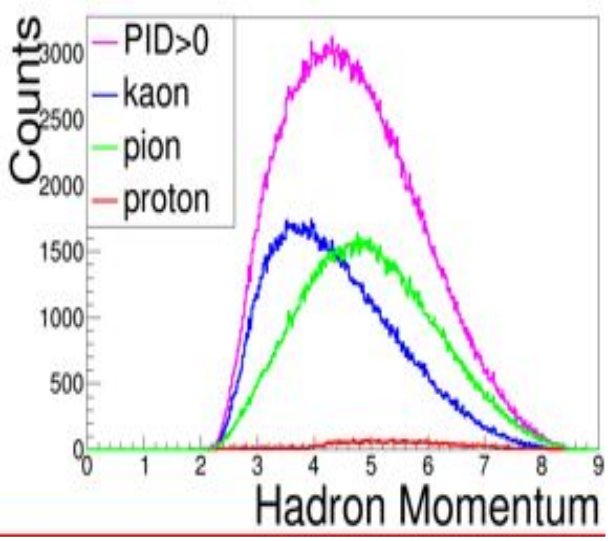


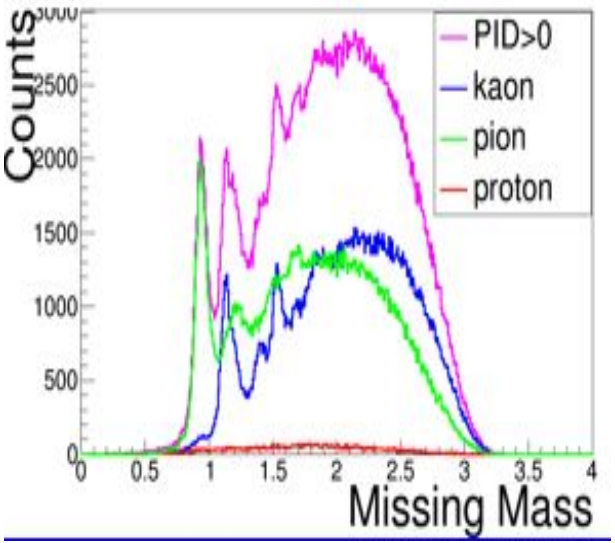
I- Pion-Kaon Contamination in ep → eKX channe

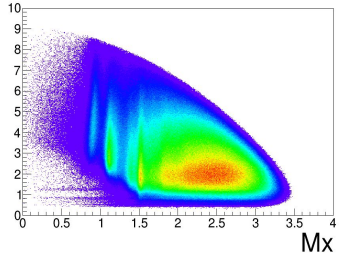


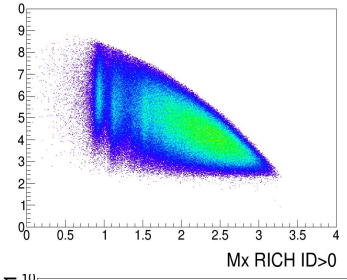
- RICH detector allows pion-kaon separation in the 3 to 8 GeV/c.
- Fall 2018 Inbending dataset (cooked by Marco Mirazita) can be studied for particle contamination. https://clasweb.jlab.org/wiki/index.php/2022_RICH_meetings

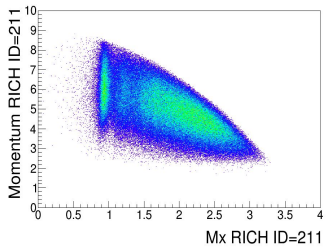
```
TCut pi = ("RICH_pid == 211");
TCut kaon = ("RICH_pid == 321");
TCut Kphi = ("p_phi>3.5 && p_phi<4.5");
TCut all = ("RICH_pid>0");
//TCut Ktheta = ("p_theta<13*3.14/180");
TCut Etheta = ("e_theta<0.2268");
TCut No = ("RICH_pid > 2000");
TCut proton = ("RICH_pid == 2212");
```

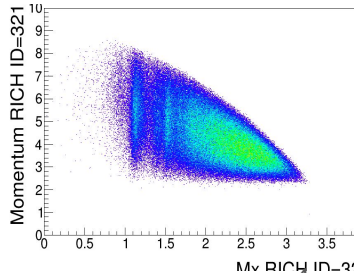






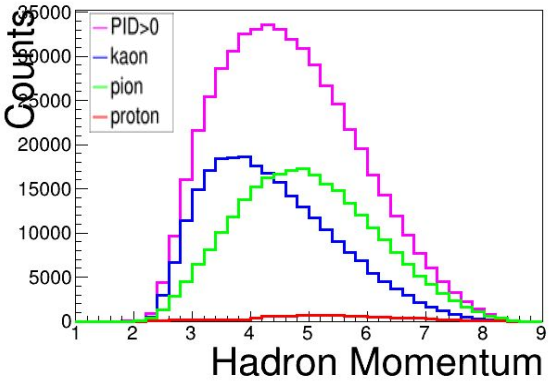


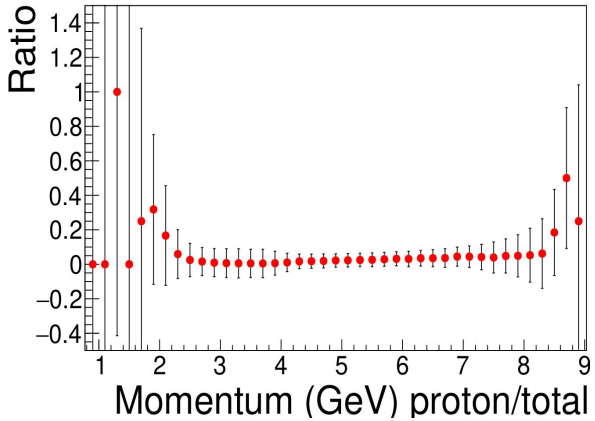


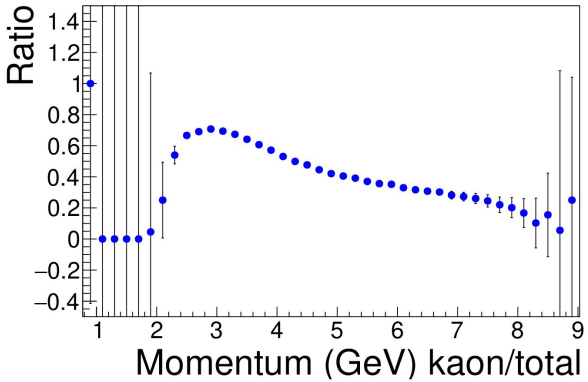


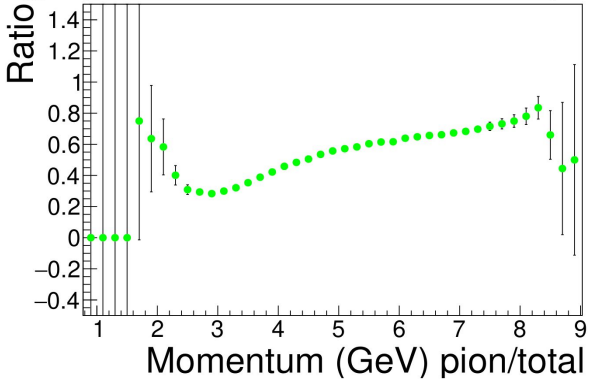
Hadron Momentum in ep → eKX channel

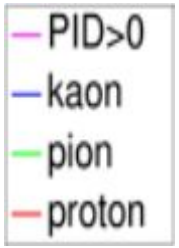
- Binning was refined to check for any sub-structures.
- Next step: Chi^2 PID analysis



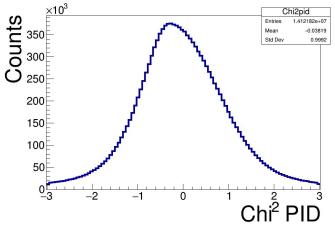


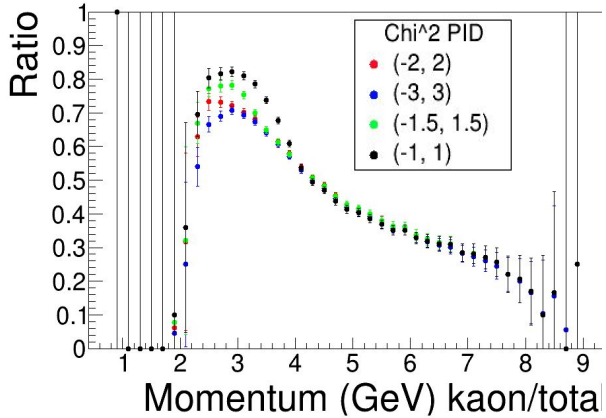


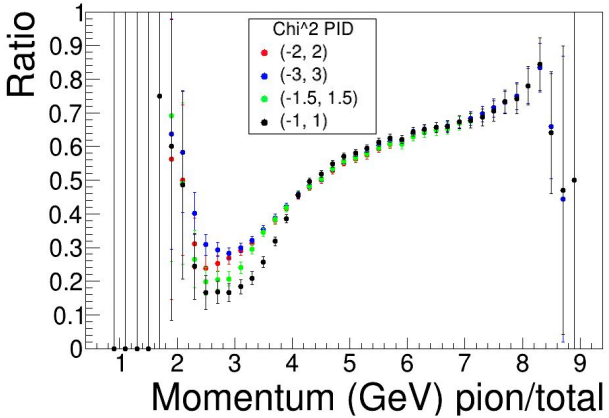


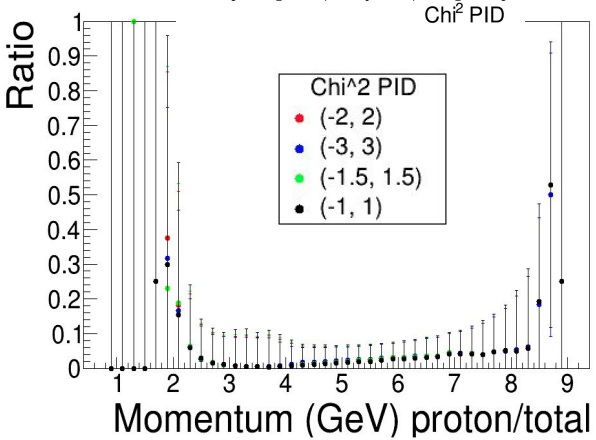


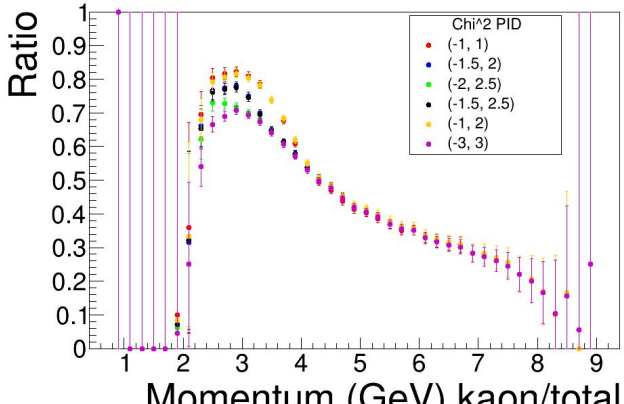
I- Kaon Data in ep → eKX channel, cont.
Chi2pi studies

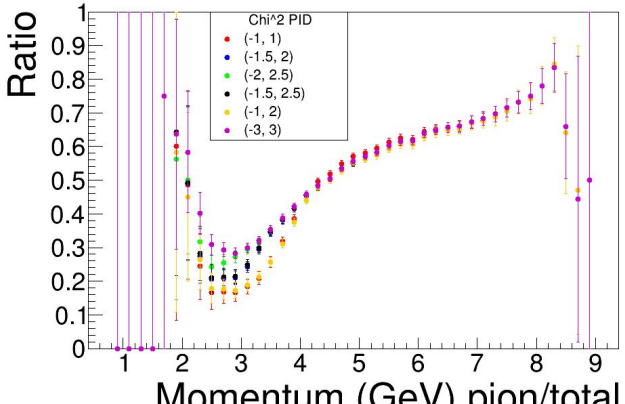


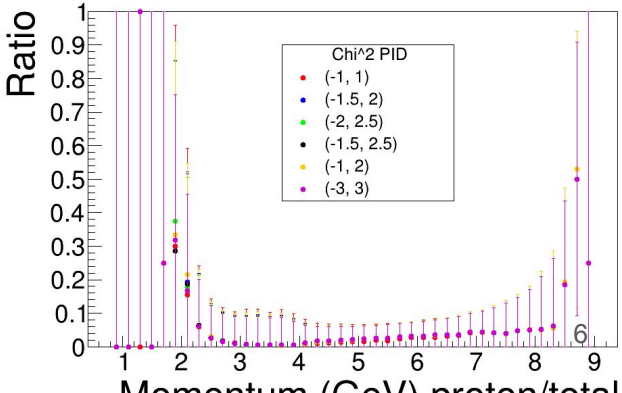




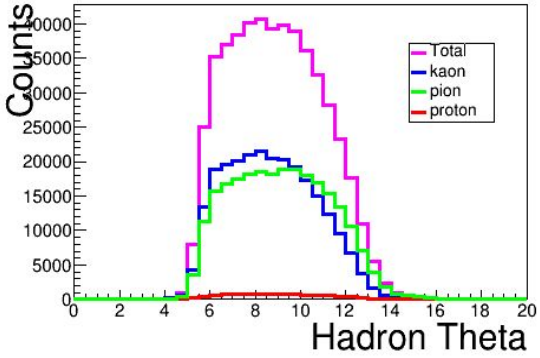


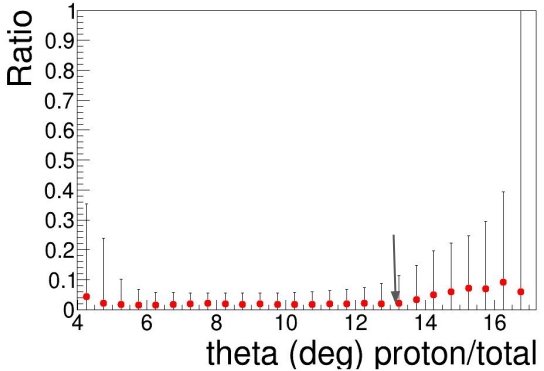


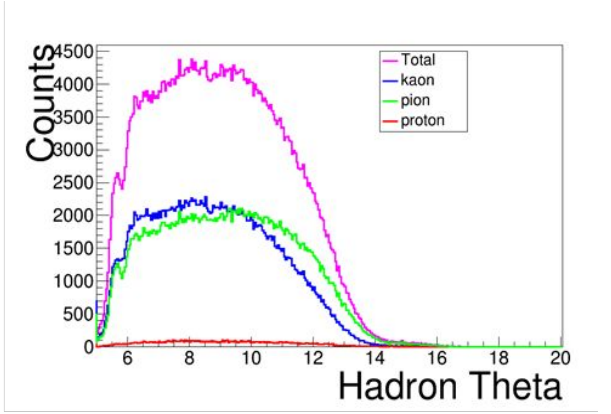


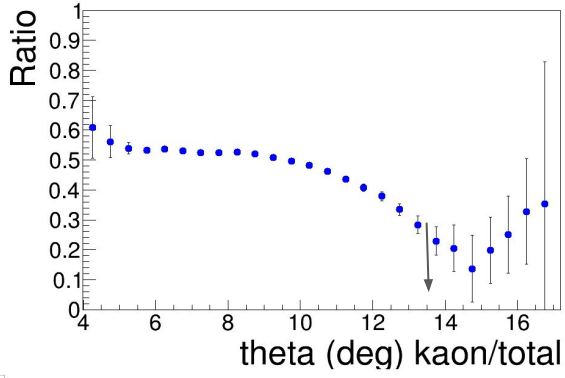


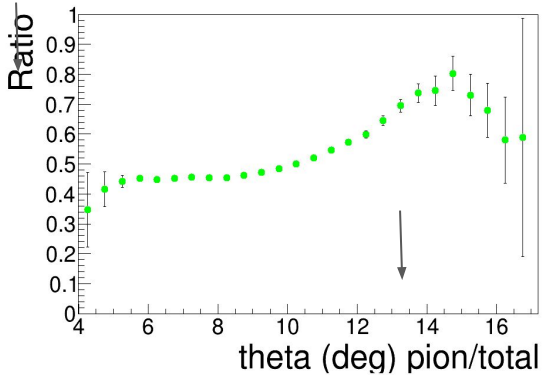
Theta Studies eKX







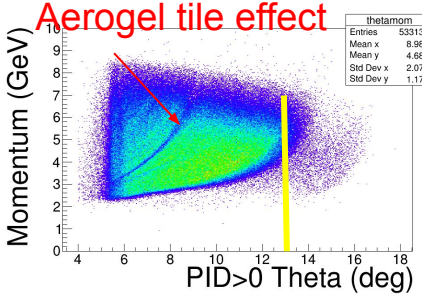


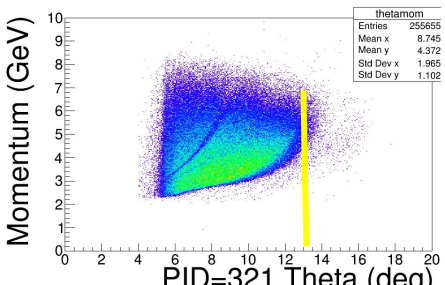


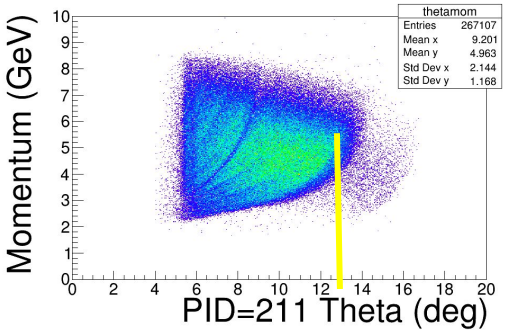
Study valid up to
~ 13.5 deg

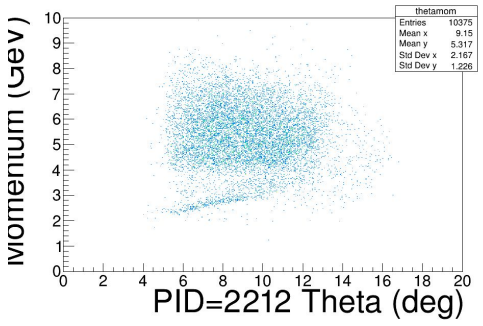
Momentum versus Angle study, no much data beyond 7 GeV/c

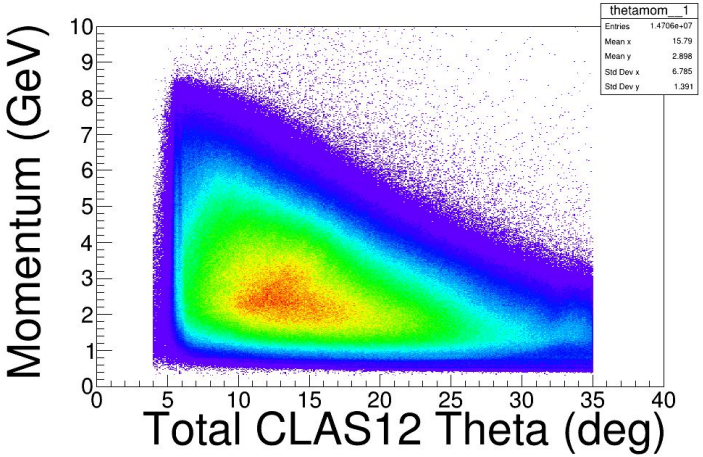
Aerogel tile effect

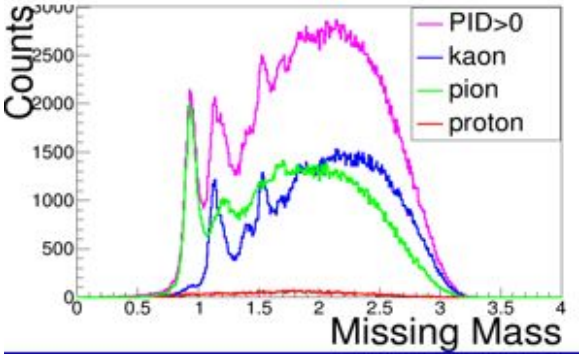


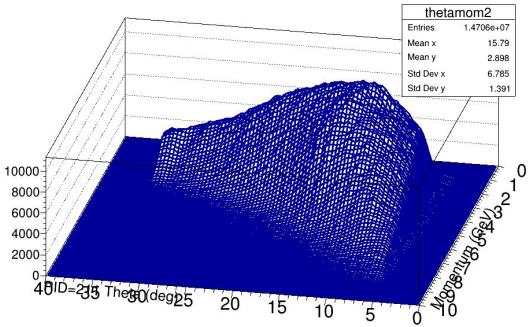










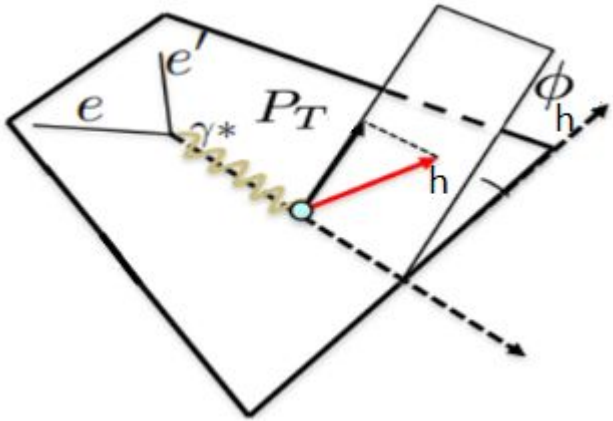


Clas12

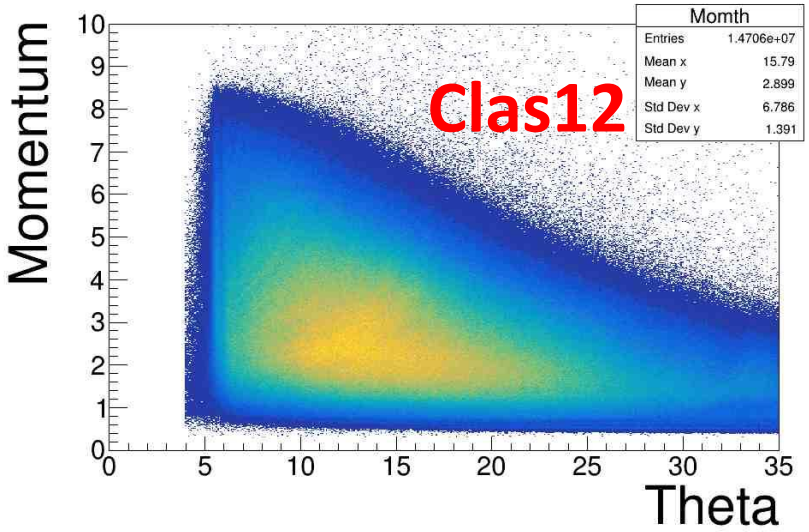
Single Spin Asymmetries in RICH Phase Space

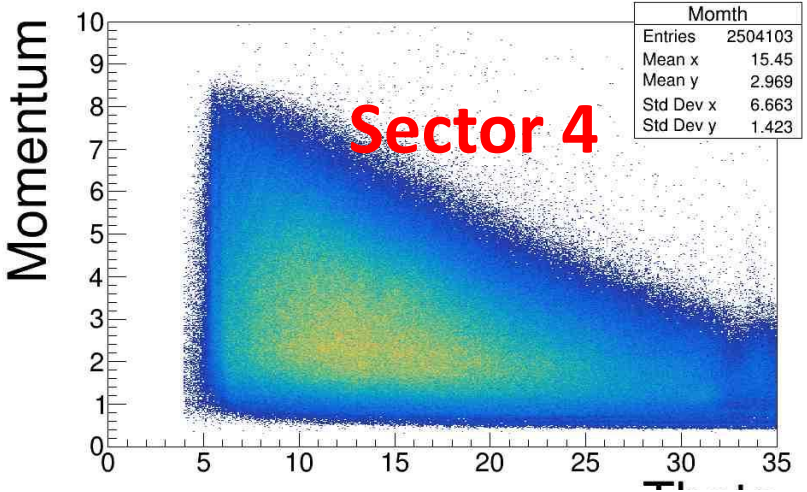
(Fatiha Benmokhtar and Zach Nickischer)

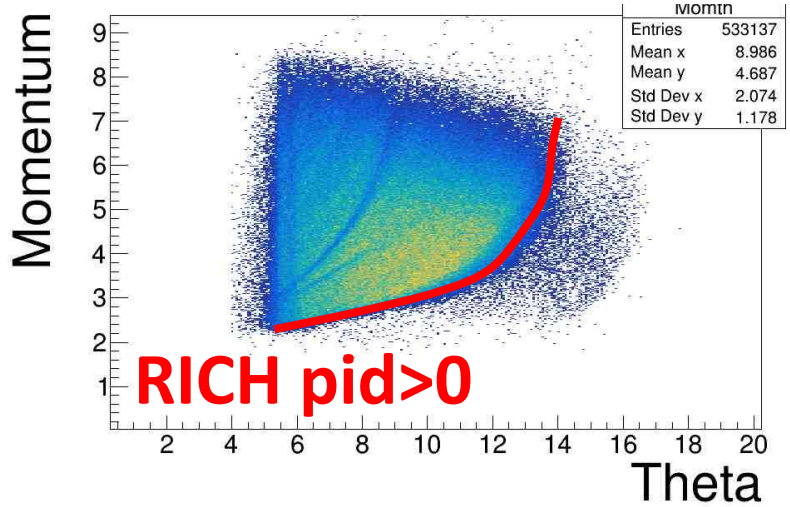
$$A(\phi_h)_{LU} = \frac{1}{p}\left(\frac{N^+ - N^-}{N^+ + N^-}\right)$$

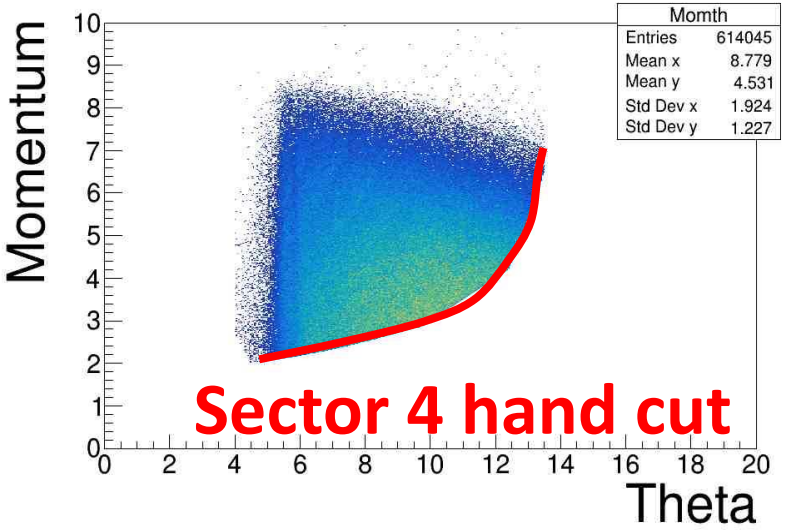


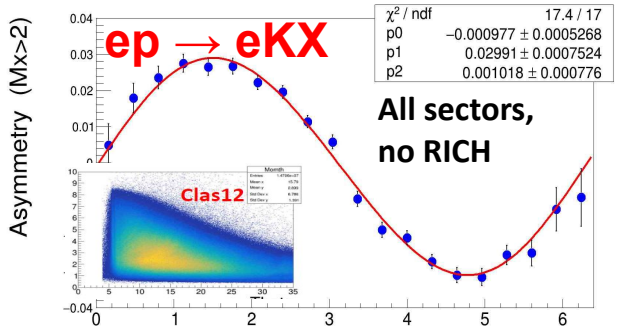
To be able to compare (Sector 4) and (Sector 4 with RICH) asymmetries for the ep→eKX channel, one has to study them in the same momentum/theta phase space.

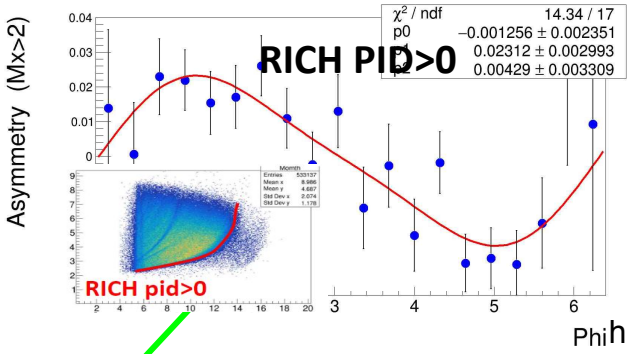

Momth
Entries 1.4706e+07
Mean x 15.79
Mean y 2.899
Std Dev x 6.786
Std Dev y 1.391
Clas12
Momentum
Theta

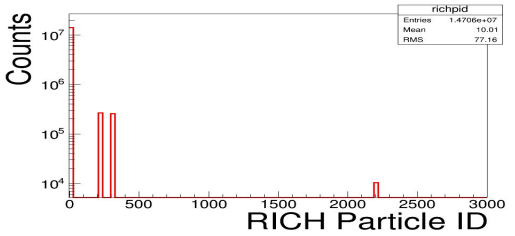

Momth
Entries 2504103
Mean x 15.45
Mean y 2.969
Std Dev x 6.663
Std Dev y 1.423
Sector 4
Momentum

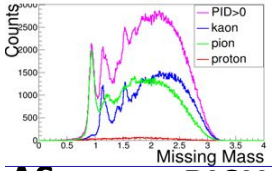

Momth
Entries 533137
Mean x 8.986
Mean y 4.687
Std Dev x 2.074
Std Dev y 1.178
RICH pid>0
Momentum
Theta

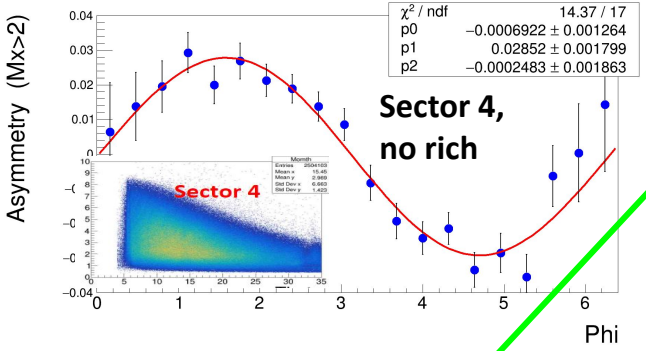

Momth
Entries 614045
Mean x 8.779
Mean y 4.531
Std Dev x 1.924
Std Dev y 1.227
Sector 4 hand cut
Momentum
Theta

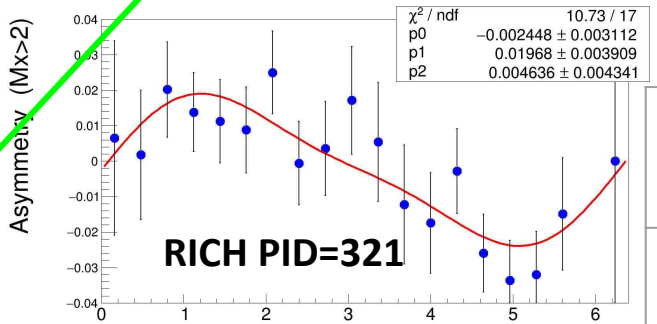


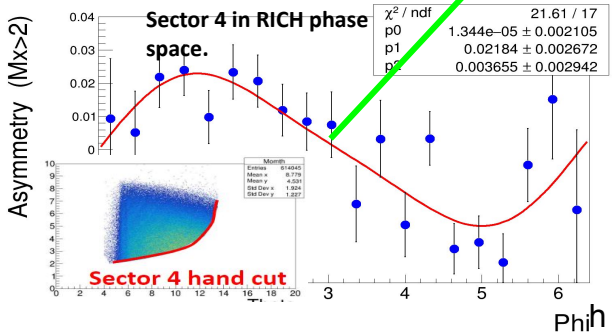


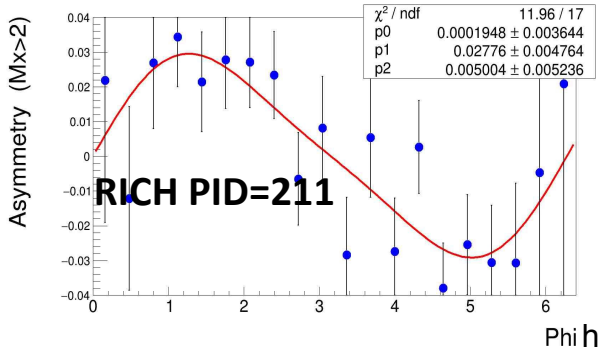










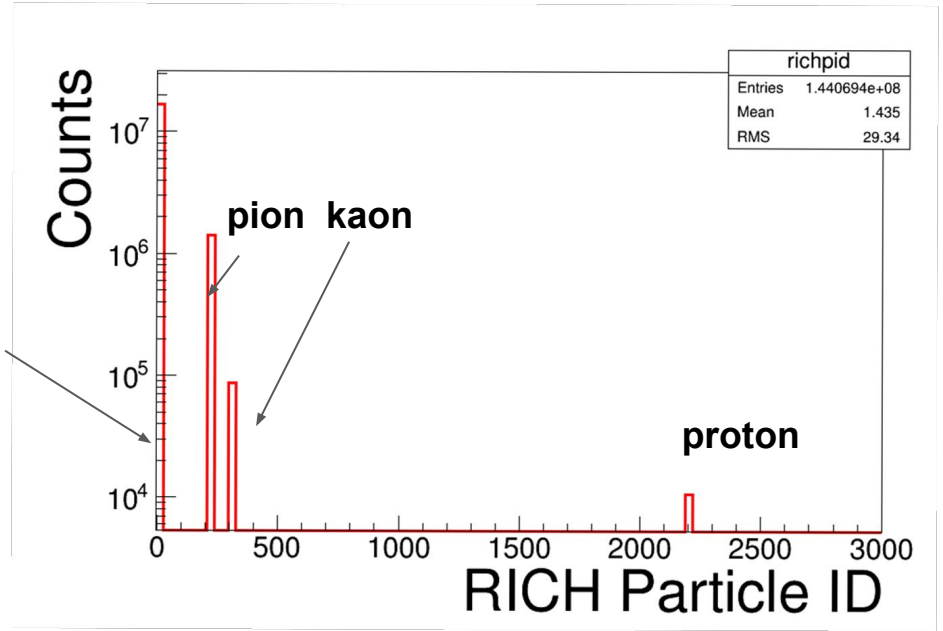


CLAS	RICH PID>0
0.02991 (0.0010)	0.02312 (0.00429)
0.02852 (0.00180) Sector 4	0.01968 (0.0039) PID=321
0.02184 (0.00267) Sector 4 in rich phase space	0.02776 (0.00500) PID=211

Cuts: Mx>2&&W>2&&p_theta &&p_p>2

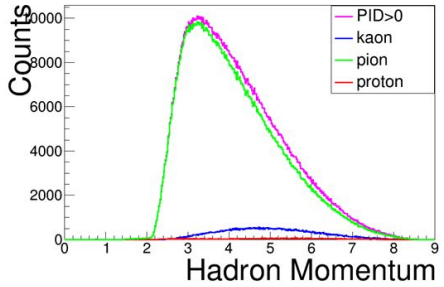
2- Kaon/Pion contamination ep→epiX

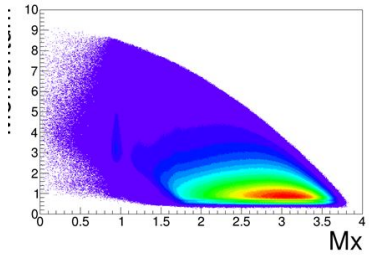
CLAS12 ET events that are not recorded in and/or not concerned with RICH. example: sec 5, 6, …

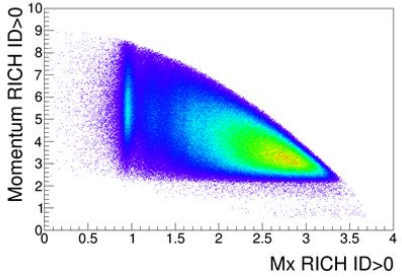


II- Pion Data in ep → epiX channel

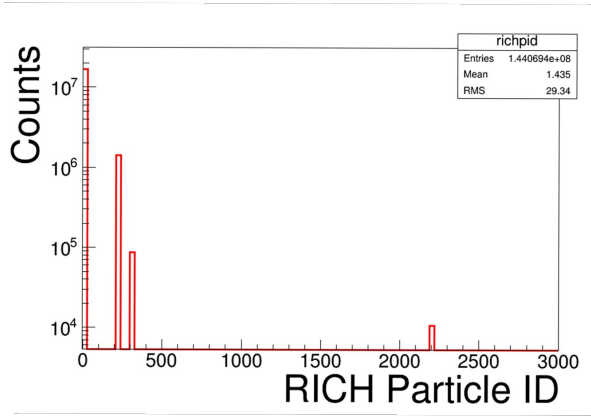
https://clasweb.jlab.org/wiki/index.php/2022_RICH_meetings

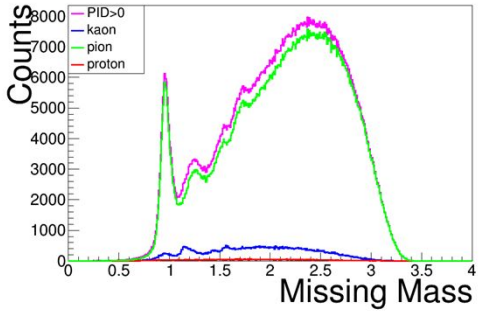


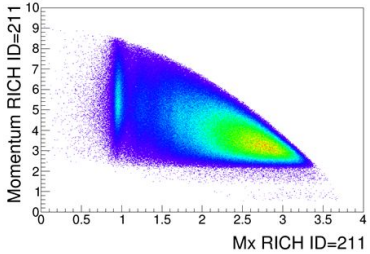


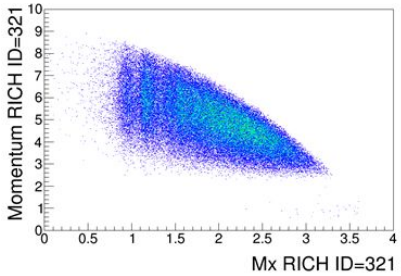


Total = PID>0



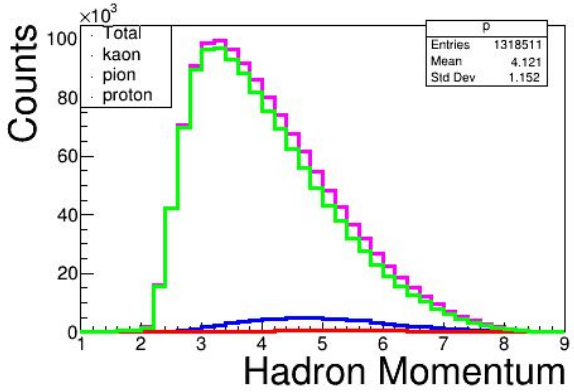


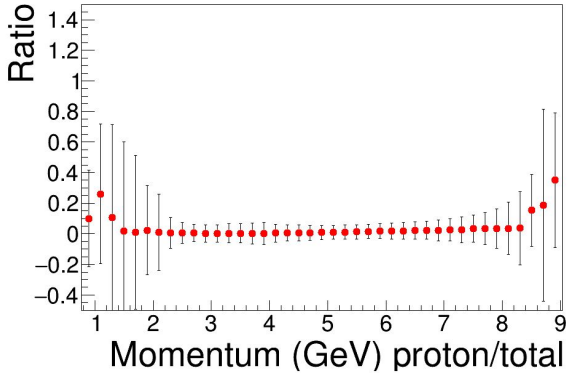


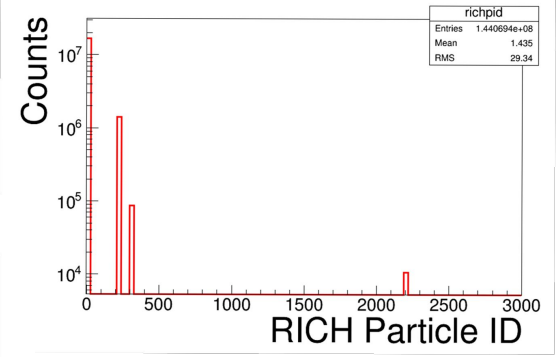


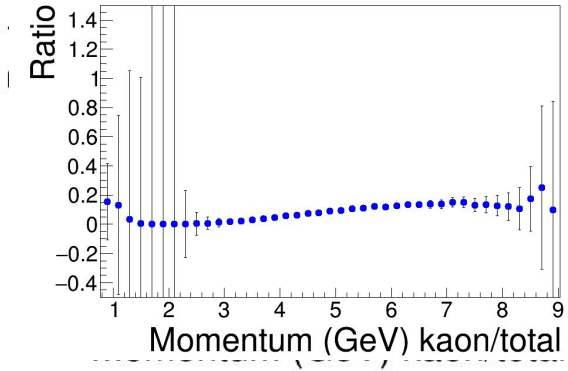
II - Pion Data in ep → epiX channel cont.

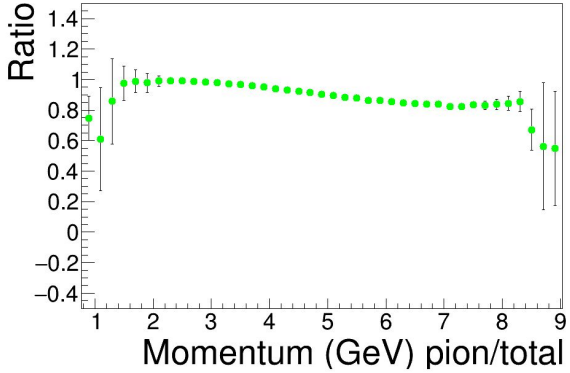
June 2022

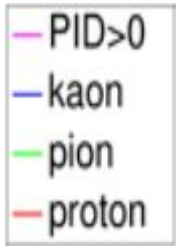




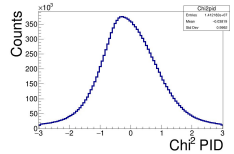


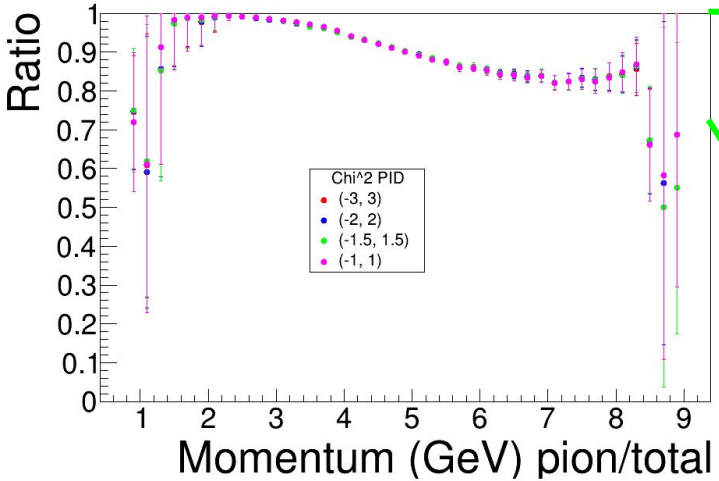




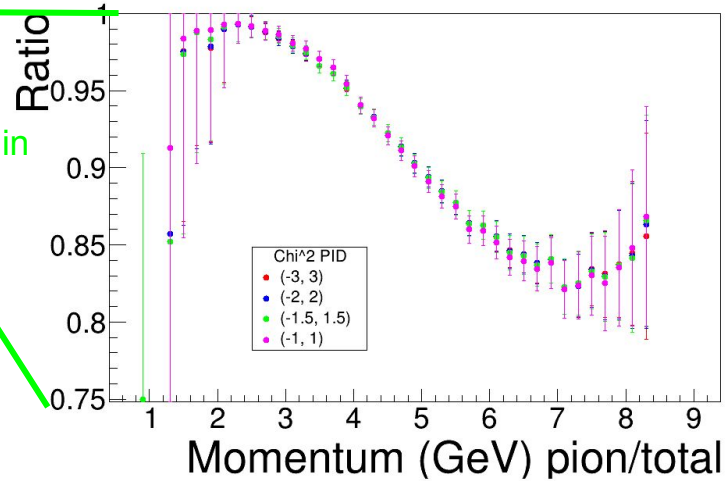


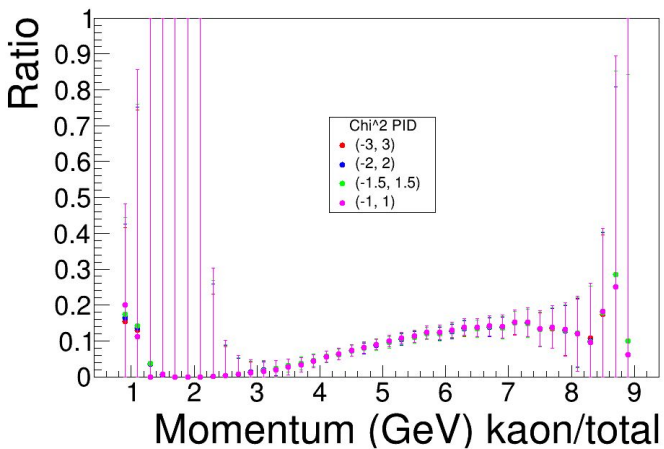
Pion Data in ep → epiX channel cont (Full data) .

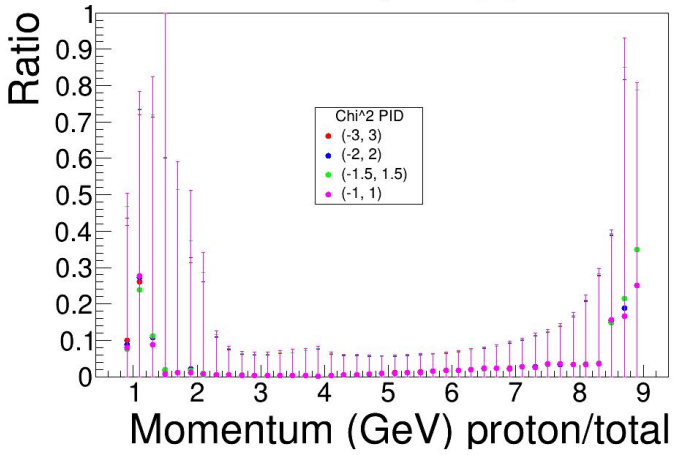




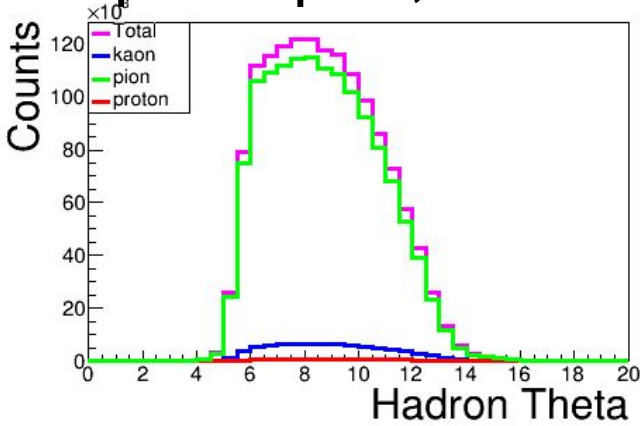
Zoom in

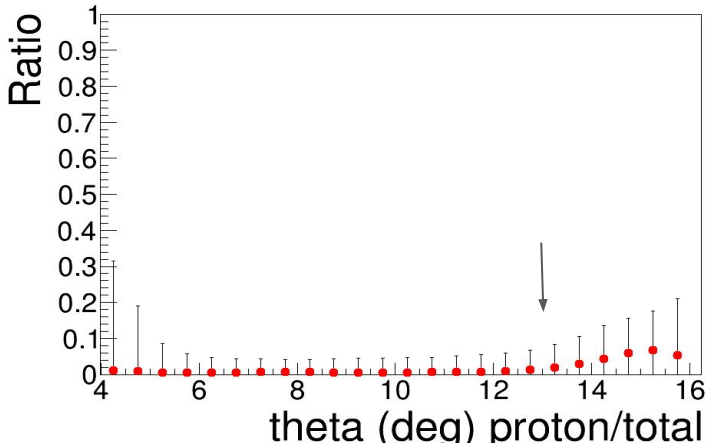


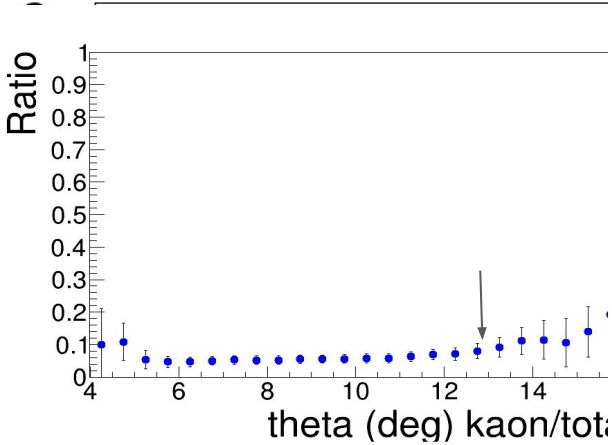


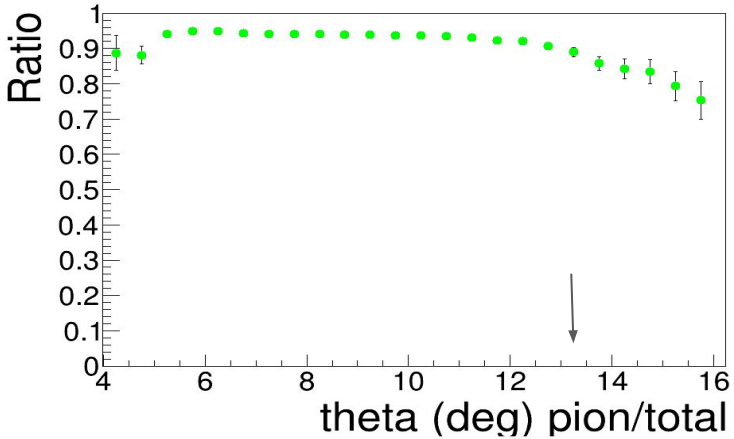


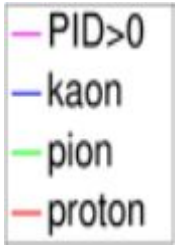
ep → epiX , theta analysis.



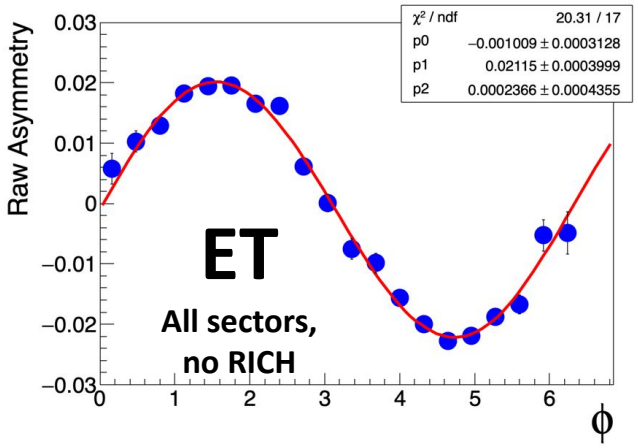


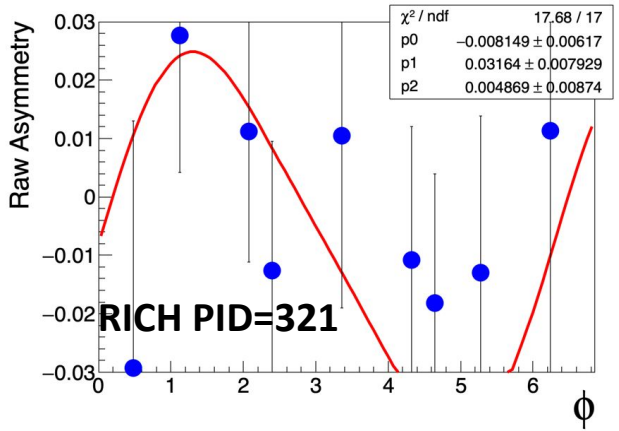


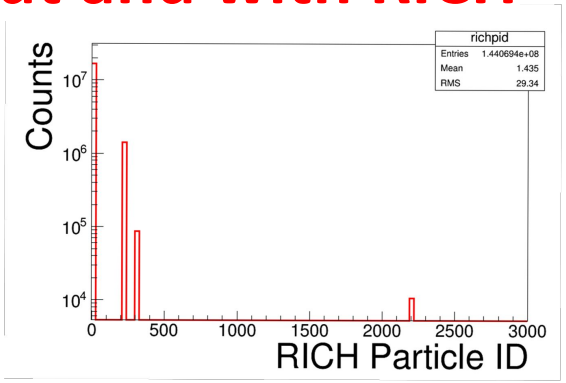


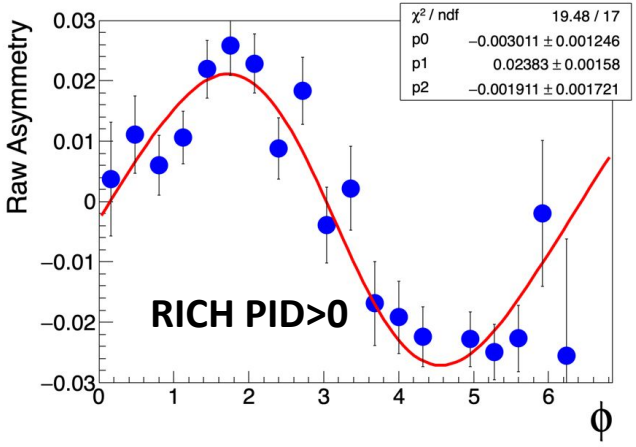


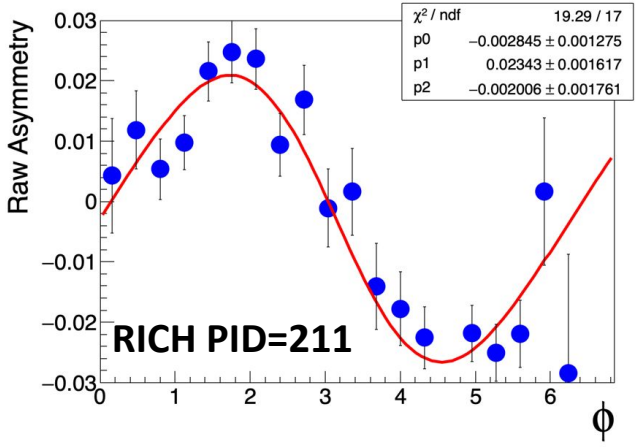
Asymmetries for ep–>epiX study without and with RICH











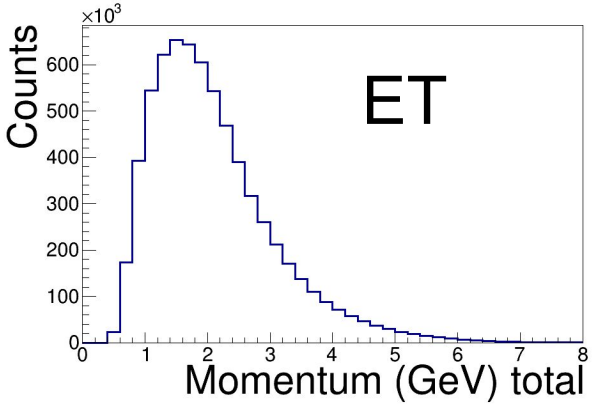
ET	PID=321
0.02115 (0.00039)	0.03164 (0.00793)
0.02383 (0.00158)	0.02343 (0.00162)
PID>0	PID=211

Cuts:

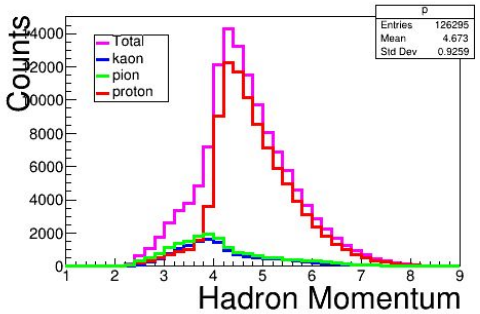
Mx>2&&p_theta<0.2530727
p_pi>2

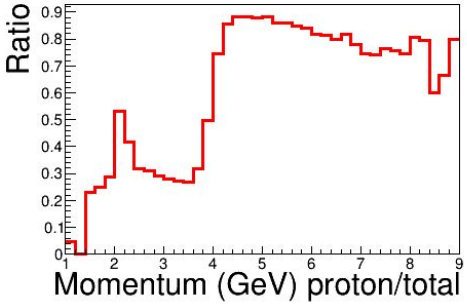
Thanks!

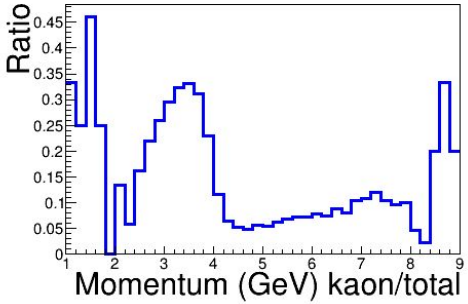
3- First look at ep→epX

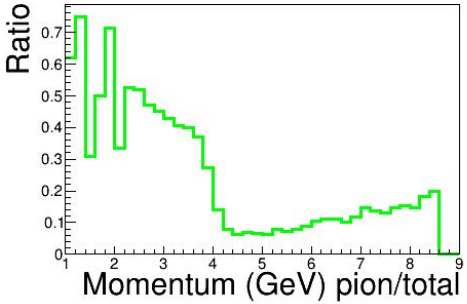


RICH





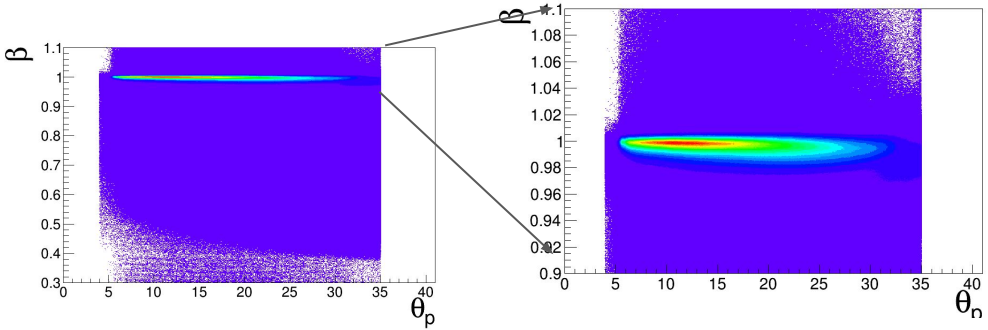


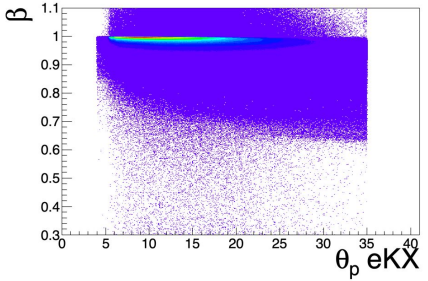


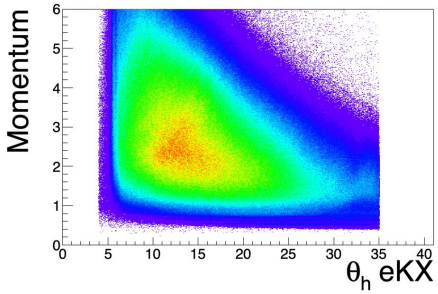
Definitely a problem with reconstruction/calib. →

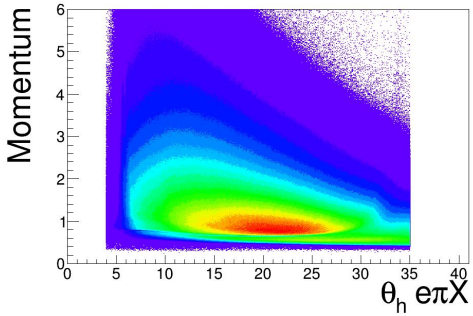
Answer: Study valid just up to 4GeV (From Marco)

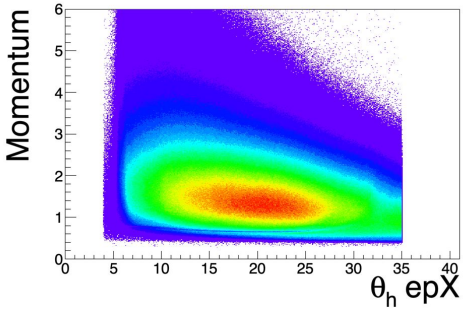
CLAS12 Beta and Momentum versus Angle study





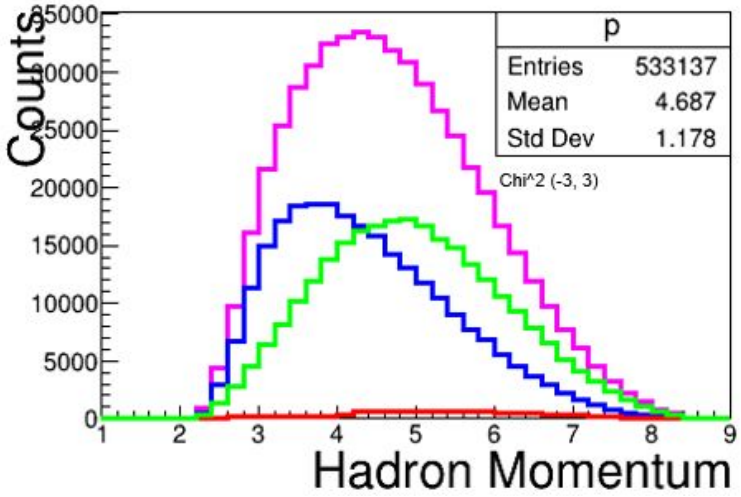




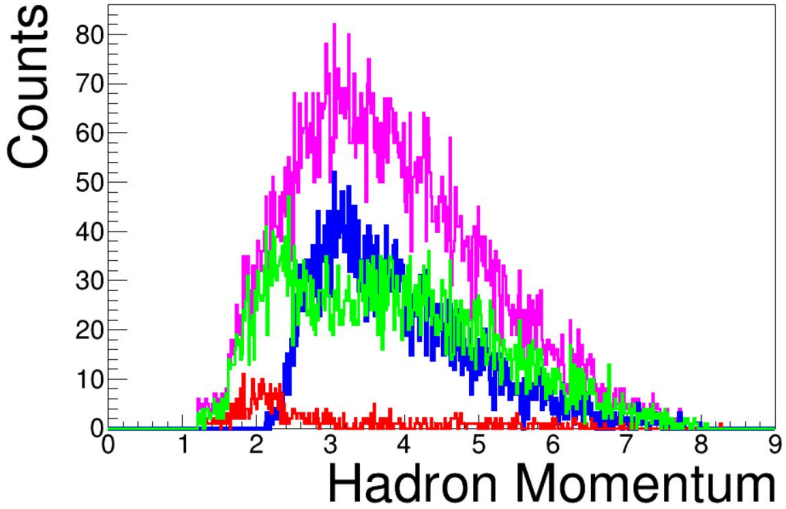


January versus August cooking (ep→eKX)

January (Marco)



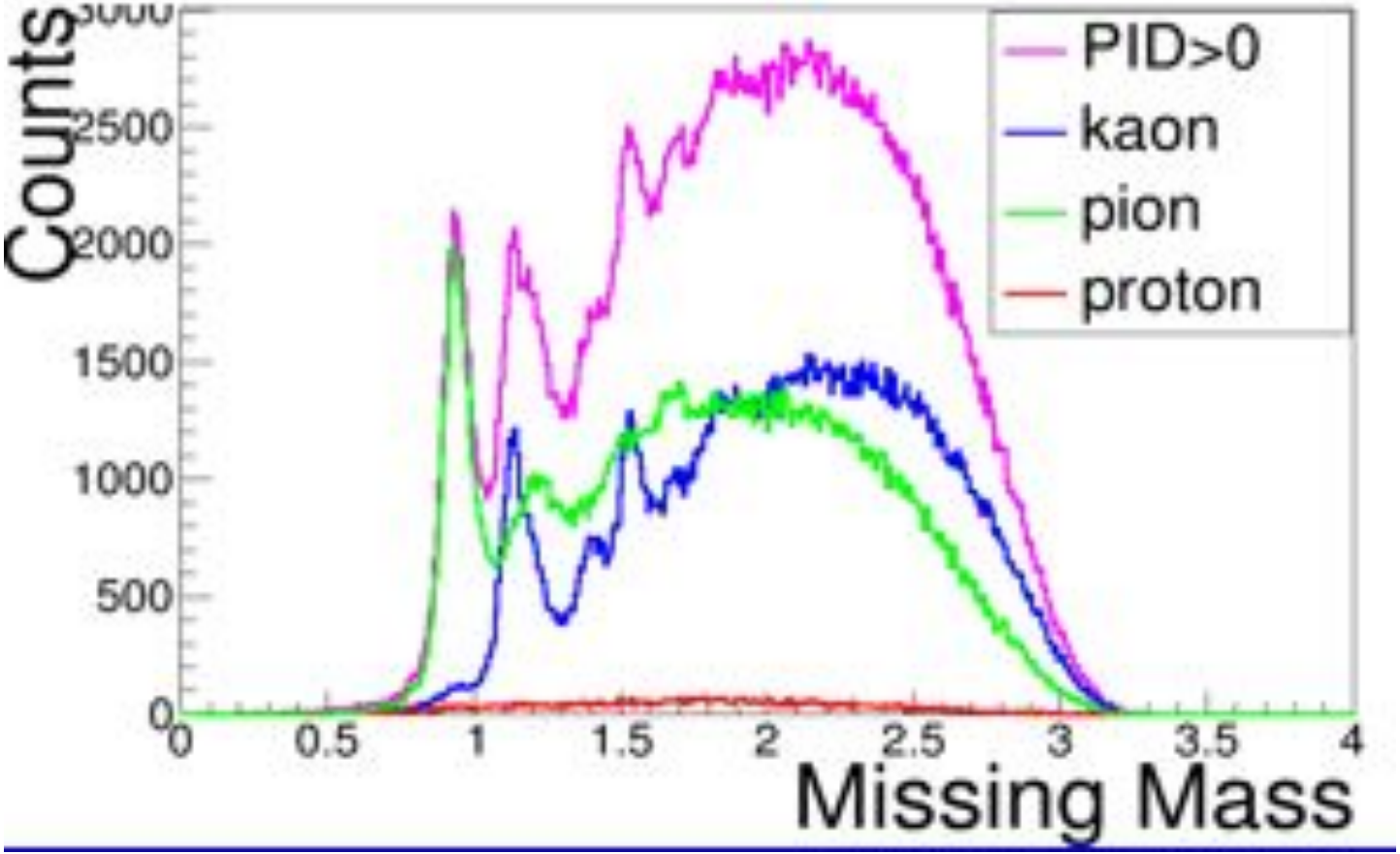
August (Marco/Connor)



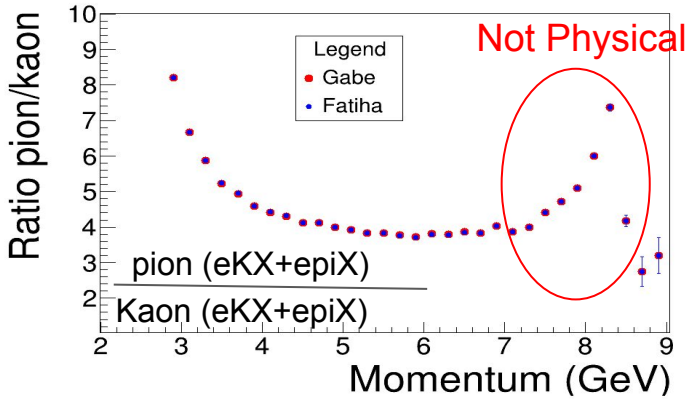
Is it possible that the programs Marco used in january were not correctly recovered? Marco's answer is: maybe it is the timetable that is read in the database. What do we do about that?

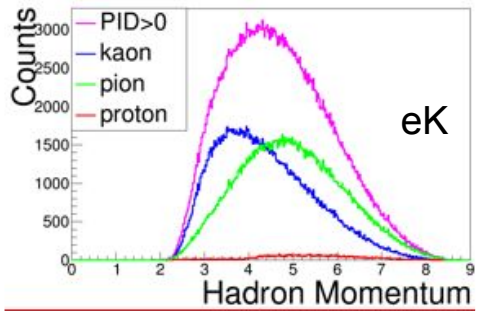
Next steps:

- Done: Redo integrated asymmetry with cut on W, target, etc.. Mx cut is already there. Momentum cut >2 for both kaon and pion data sets
- Done: Get the asymmetry for sector 4, without RICH IDs , make sure to take same phase space.
- …

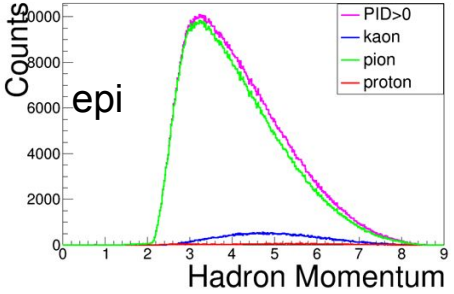

Counts
2500
2000
1500
1000
500
0
0
0.5
1
1.5
2
2.5
3
3.5
4
Missing Mass
PID>0
kaon
pion
proton

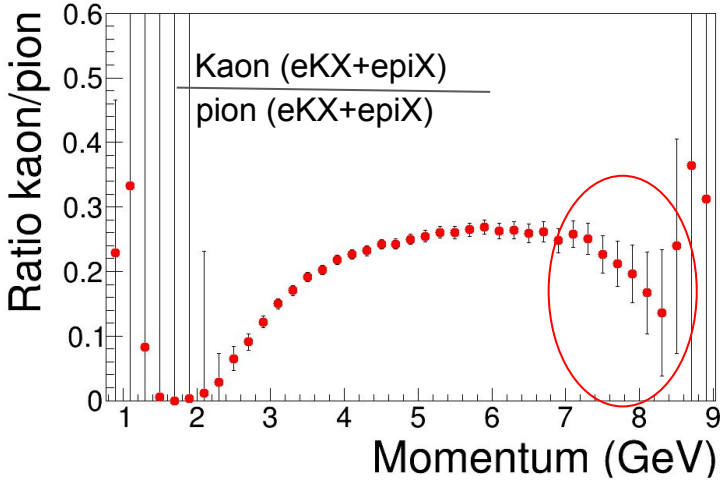
III- Total Pion/kaon and Total Kaon/pion study

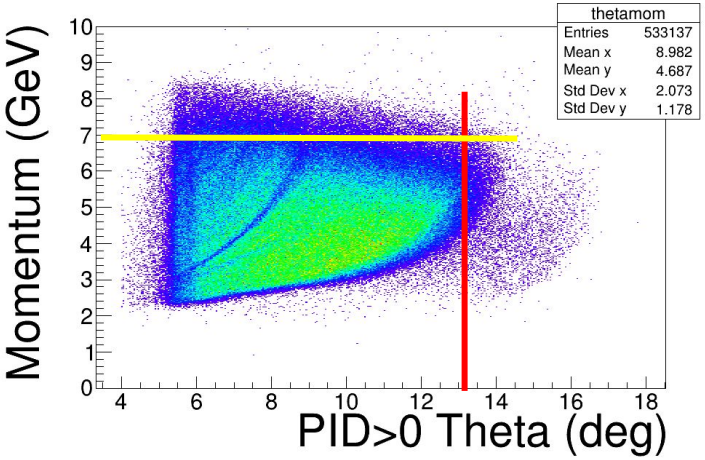




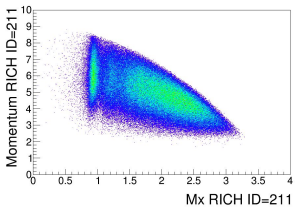
+

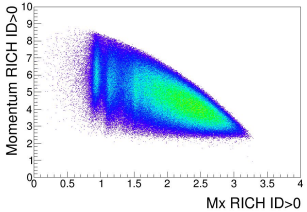


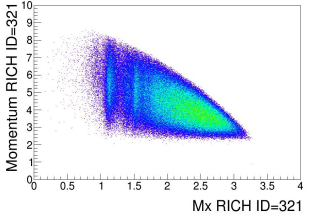


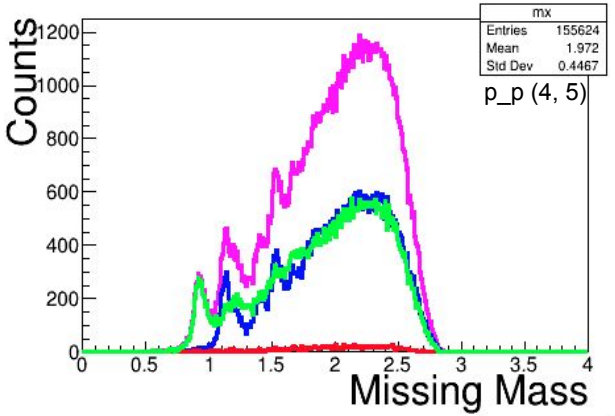


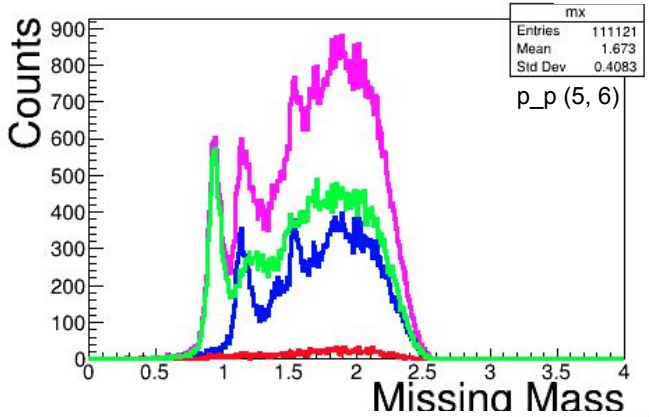
III - Kaon Mx Graphs

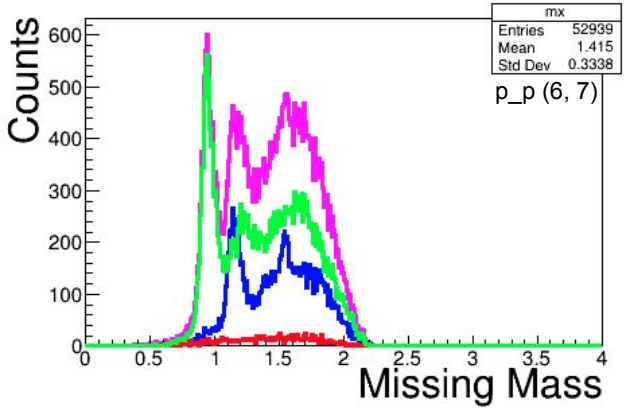


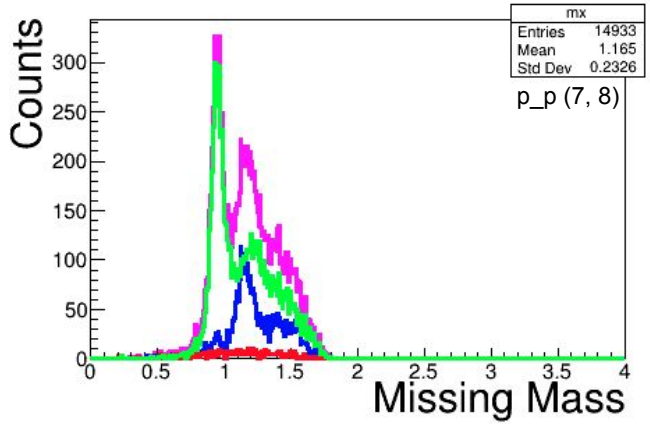




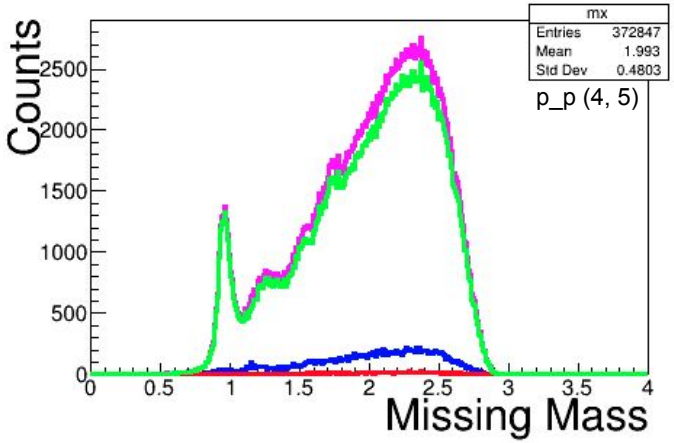


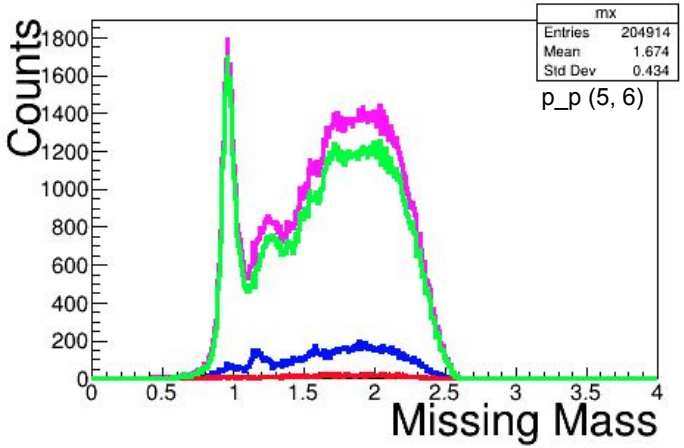


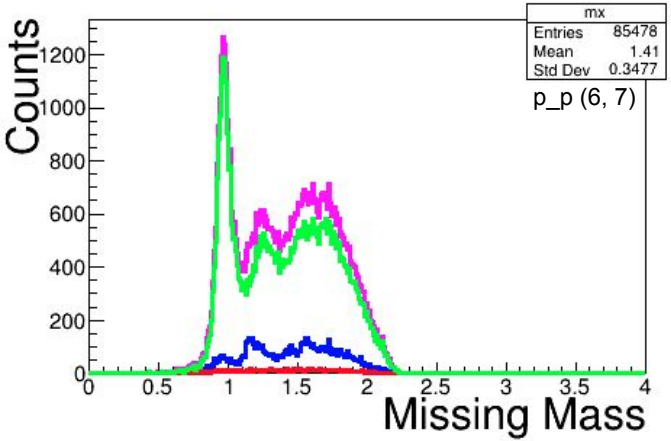


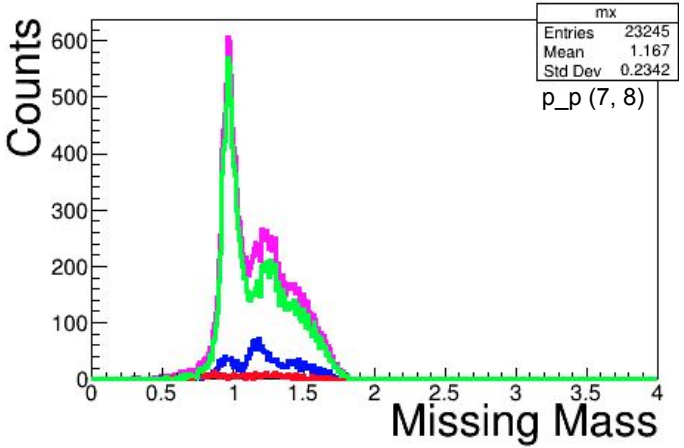


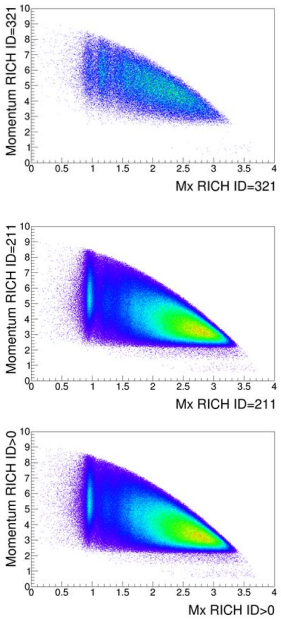
III - Pion Mx Graphs



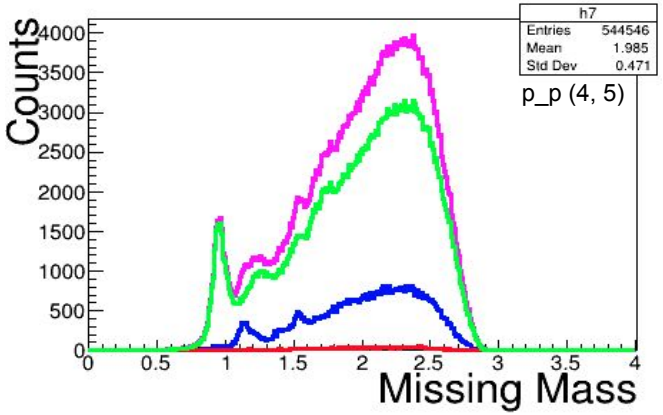


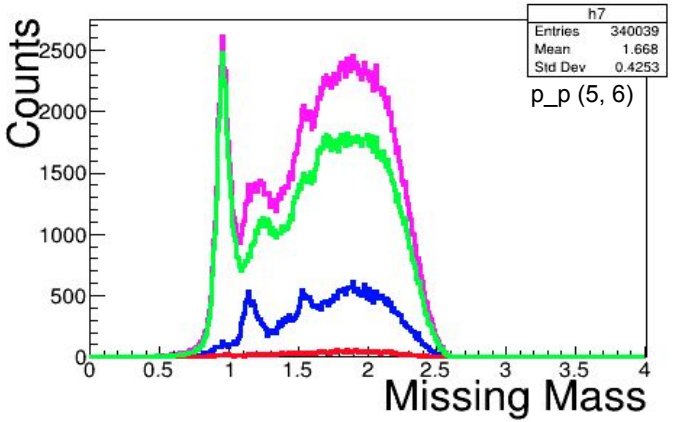


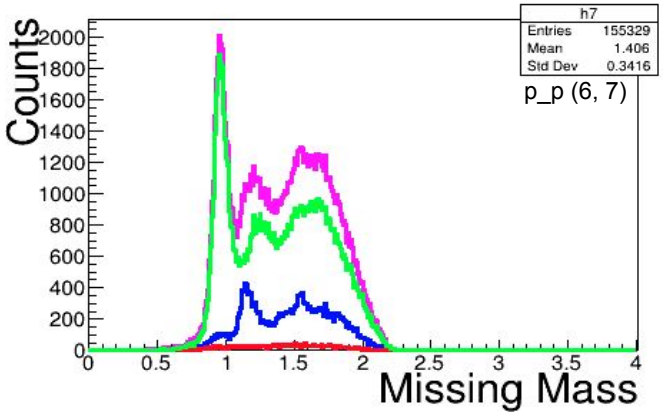


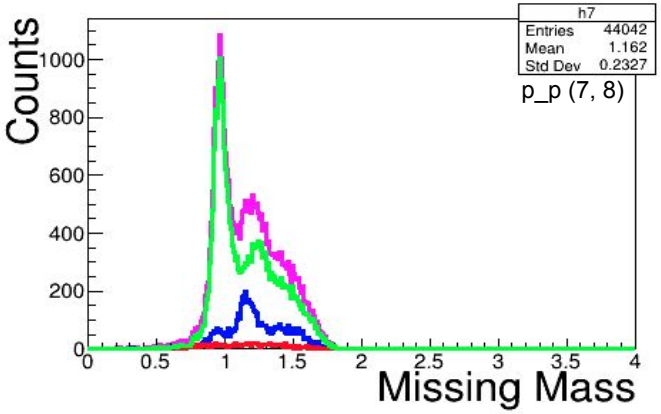


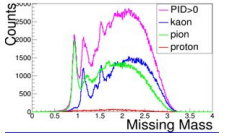
III - Total Mx Graphs

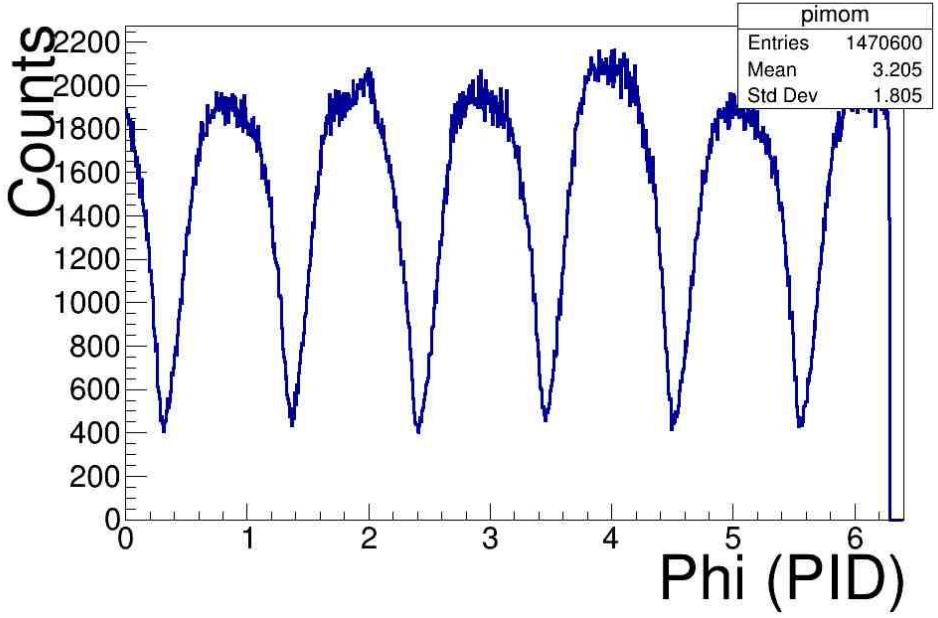


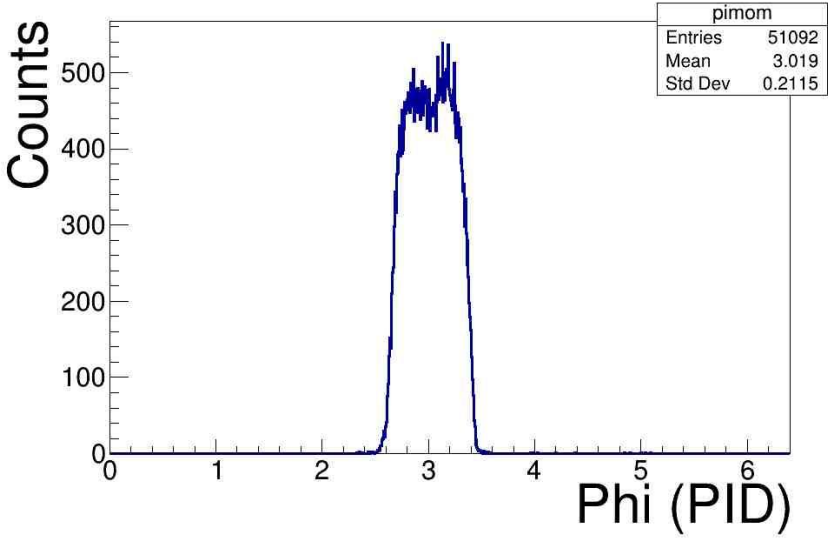






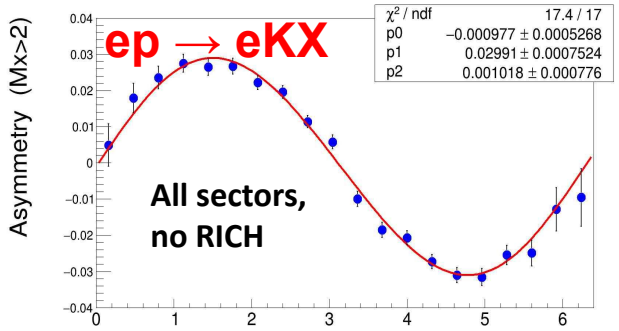

PID>0
kaon
pion
proton
Counts
Missing Mass

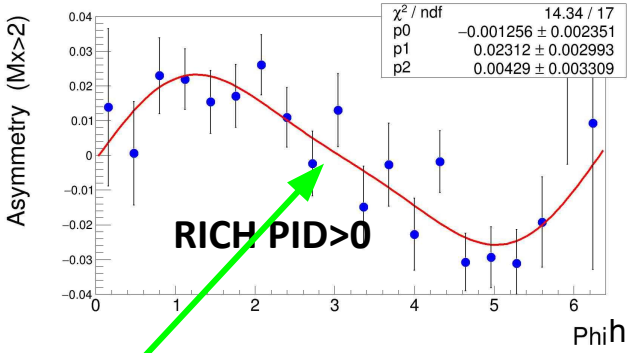

pimom
Entries 1470600
Mean 3.205
Std Dev 1.805
Counts
Phi (PID)

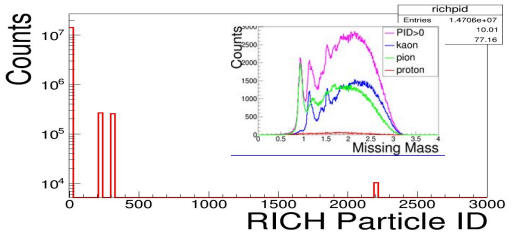

pimom
Entries 51092
Mean 3.019
Std Dev 0.2115
Counts
Phi (PID)

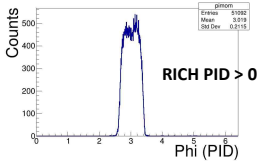
h

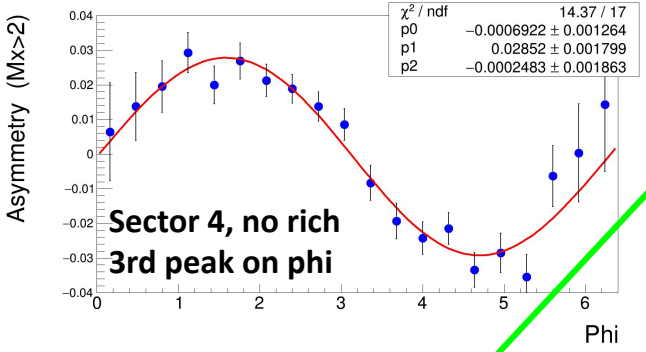
h

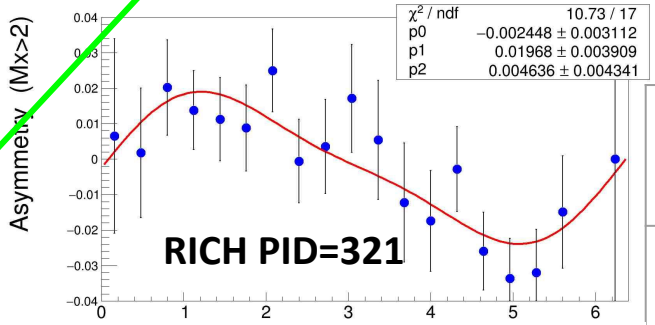


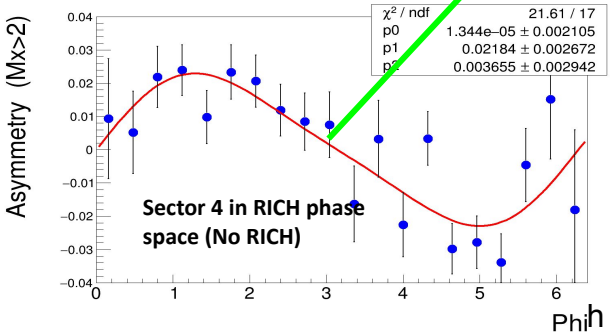


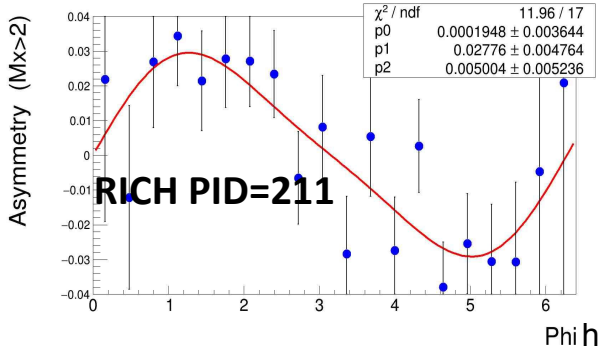












CLAS	RICH PID>0
0.02991 (0.0010)	0.02312 (0.00429)
0.02852 (0.00180) Sector 4	0.01968 (0.0039) PID=321
0.02184 (0.00267) Sector 4 in rich phase space	0.02776 (0.00500) PID=211

Cuts: Mx>2&&W>2&&p_theta &&p_p>2