Acceptance Cuts

Allowing good event selection

20/03/26

Acceptance criteria

HMS Specification	HMS Characteristic
Central Momentum	0.4 - 7.4 GeV/c
Momentum Acceptance	-8% - +8%
Momentum Resolution	0.1% - 0.15%
Rotational Angle Range	10.5° to 90° w.r.t. beamline
Horizontal Angle Acceptance	±32 mrad
Vertical Angle Acceptance	±85 mrad
Solid Angle Acceptance	8.1 msr
Horizontal Angle Resolution	0.8 mrad
Vertical Angle Resolution	1.0 mrad

| SHMS Specification	SHMS Characteristic
Central Momentum	2.0 - 11.0 GeV/c
Momentum Acceptance	-10% - +20% or +22%
Momentum Resolution	0.03% - 0.08%
Rotational Angle Range	5.5° - 40° w.r.t. beamline
Horizontal Angle Acceptance	±18 mrad
Vertical Angle Acceptance	±50 mrad
Solid Angle Acceptance	> 4 msr
Horizontal Angle Resolution	0.5-1.2 mrad
Vertical Angle Resolution	0.3-1.1 mrad

[1]

Acceptance cuts are the first cuts applied to the data.

These cuts give the angular and momentum acceptances (xptar, yptar, δ) at the target.

[1] S. A. Wood. Jefferson Lab Hall C Standard Equipment Manual (2023)
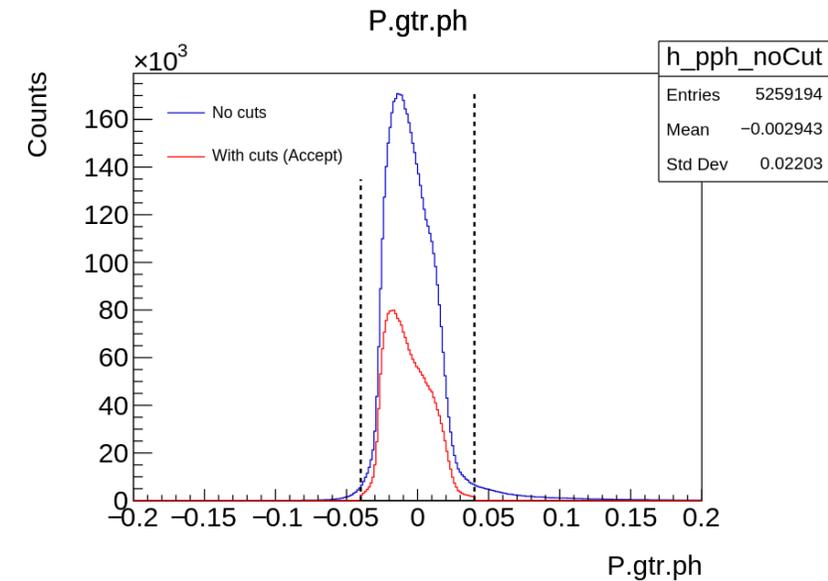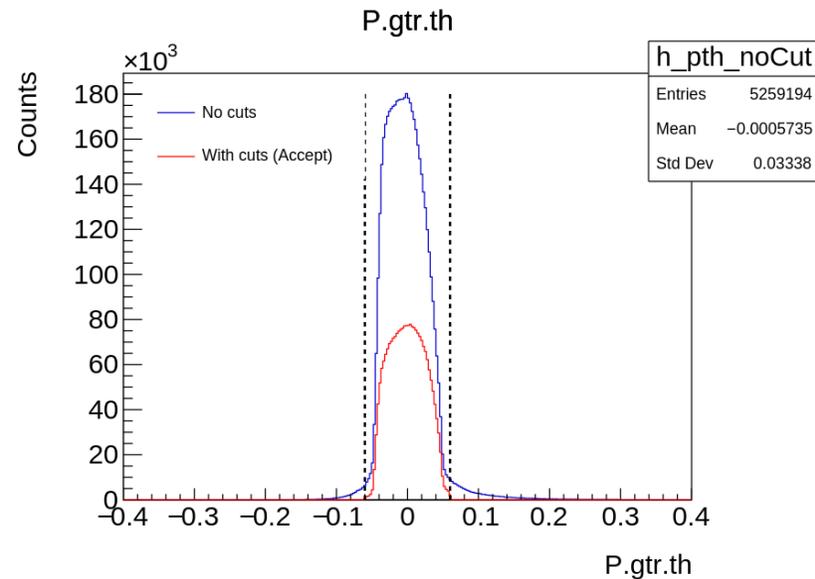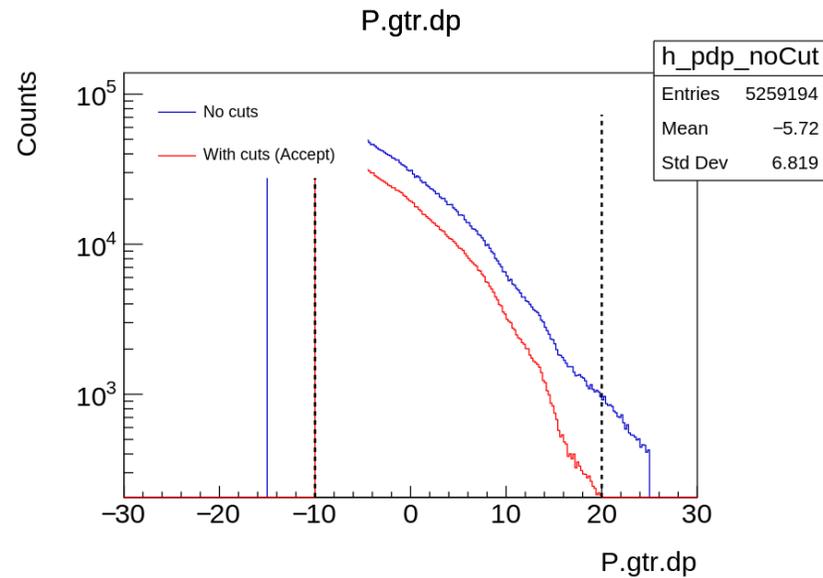
Acceptance cuts - HMS

H.hod.goodstarttime == 1
-8 < H.gtr.dp < 8 (%)
-0.08 < H.gtr.th < 0.08 (mrad)
-0.045 < H.gtr.ph < 0.045 (mrad)
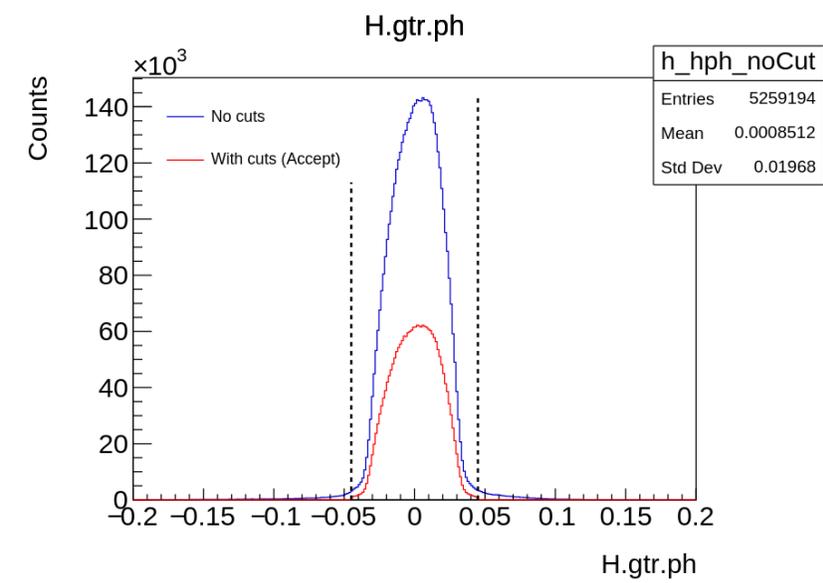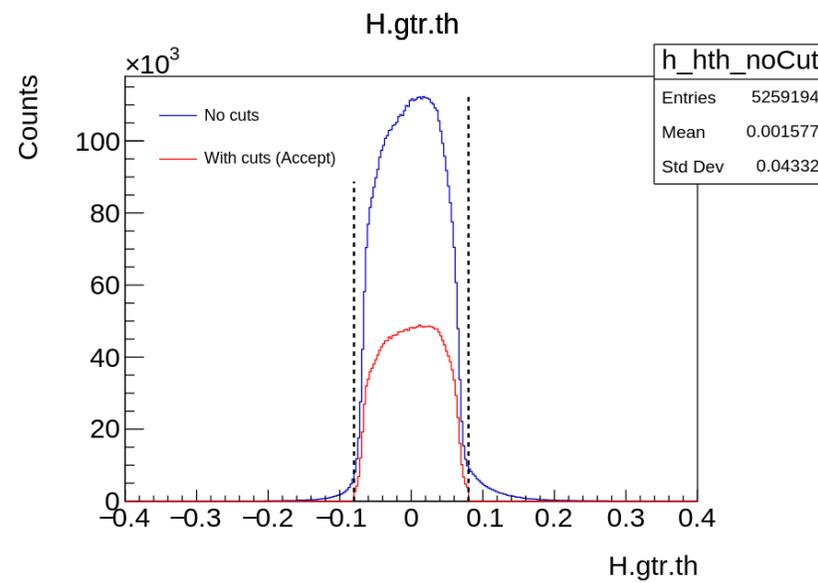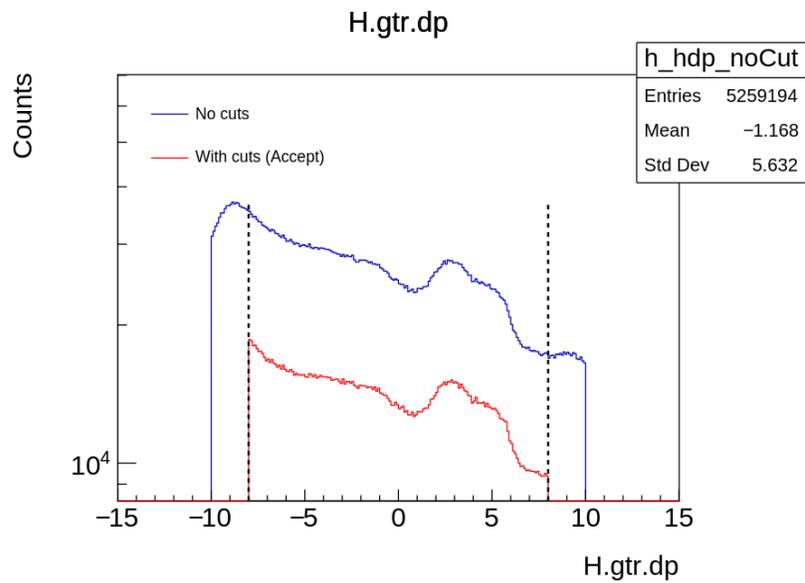
These were found in Vijay's thesis (p. 167)

Acceptance cuts - SHMS

P.hod.goodstarttime == 1
-10 < P.gtr.dp < 20 (%)
-0.06 < P.gtr.th < 0.06 (mrad)
-0.04 < P.gtr.ph < 0.04 (mrad)

Detector Cuts

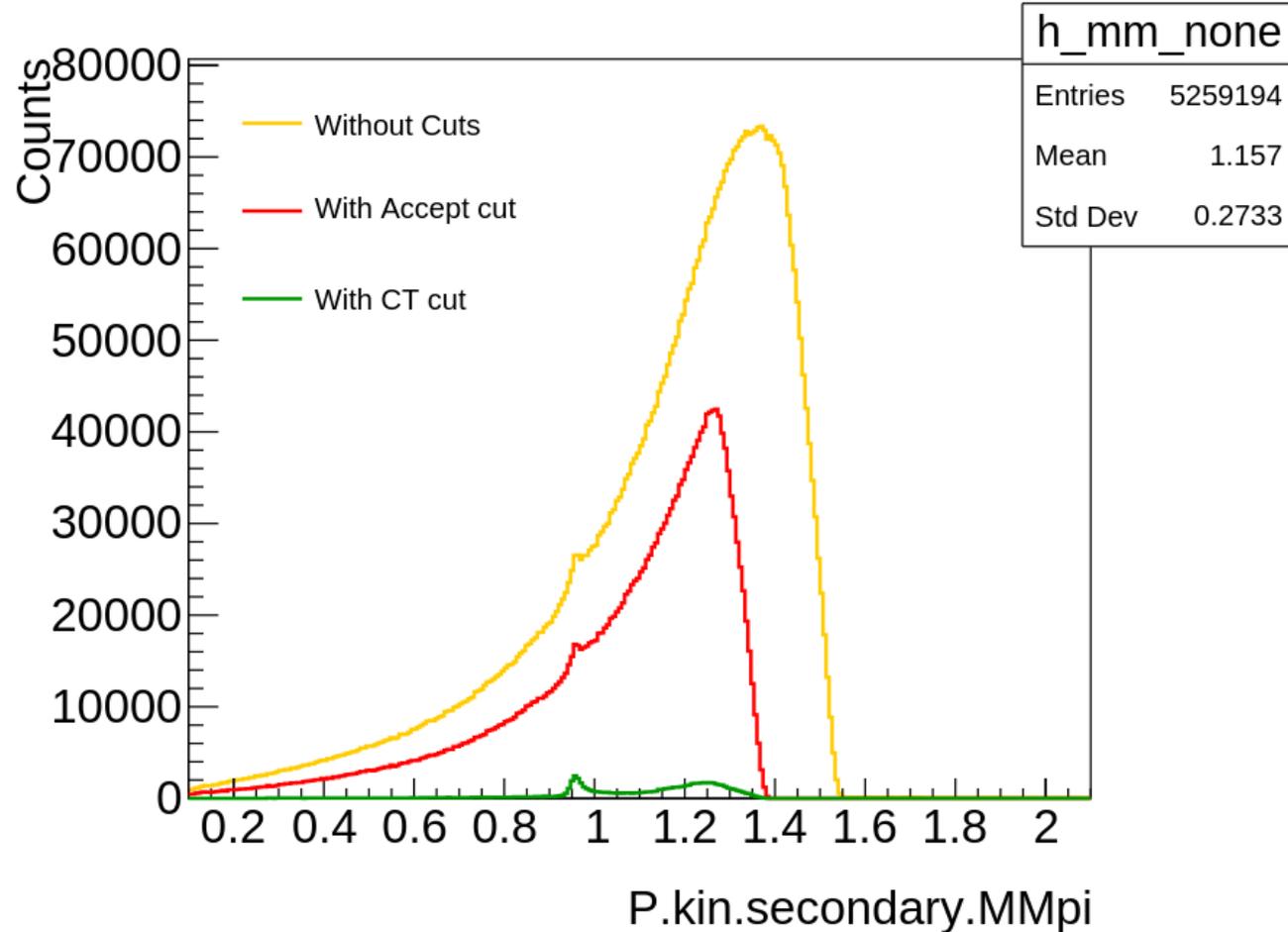Having another look at the HMS and SHMS cuts

20/03/26

Missing mass – accept + CT

Apply the cuts that remove most events first.

Acceptance makes delta0 resonance MM peak more narrow.

Missing Mass after each cut

h_mm_none	
Entries	5259194
Mean	1.157
Std Dev	0.2733

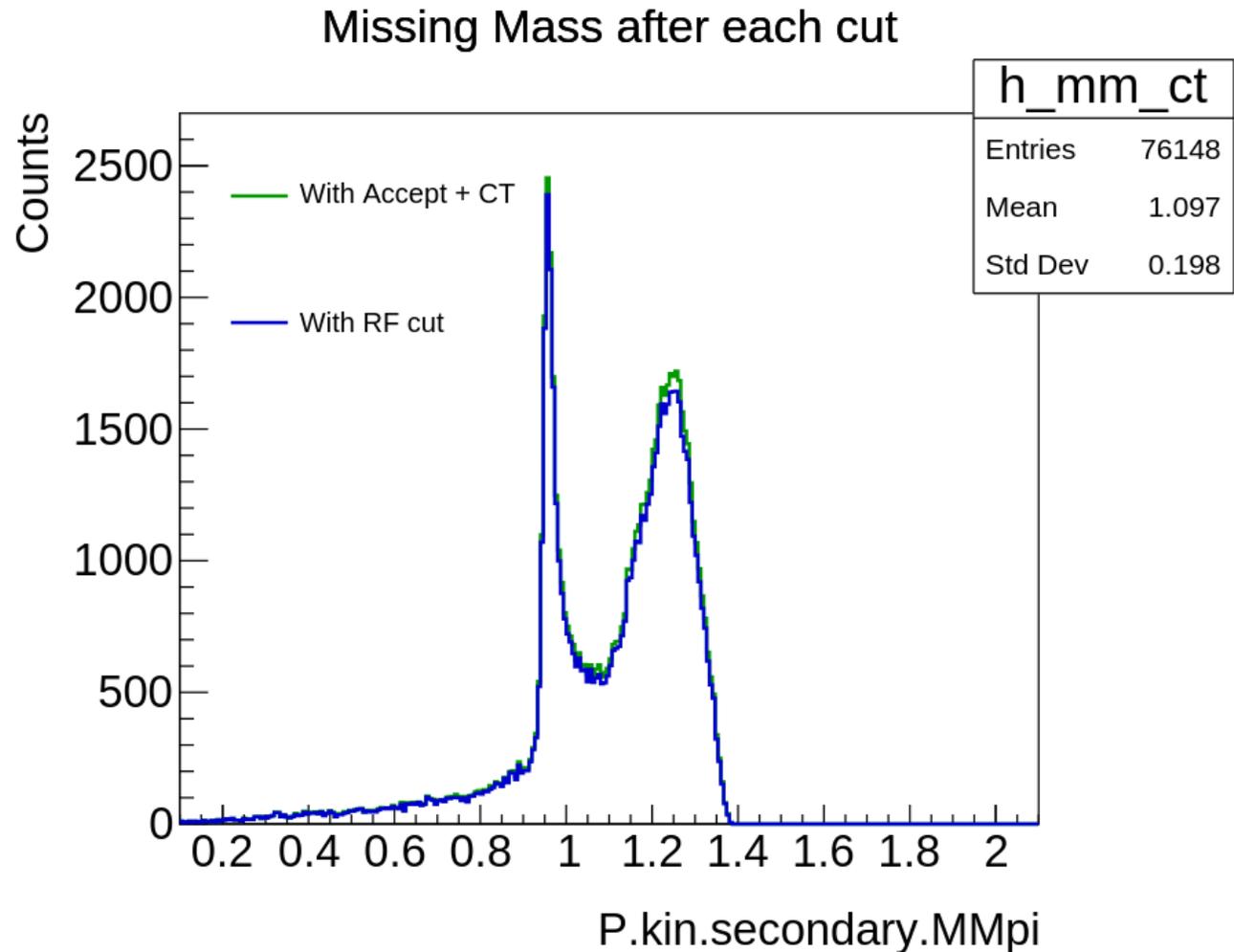Without Cuts
With Accept cut
With CT cut

P.kin.secondary.MMpi

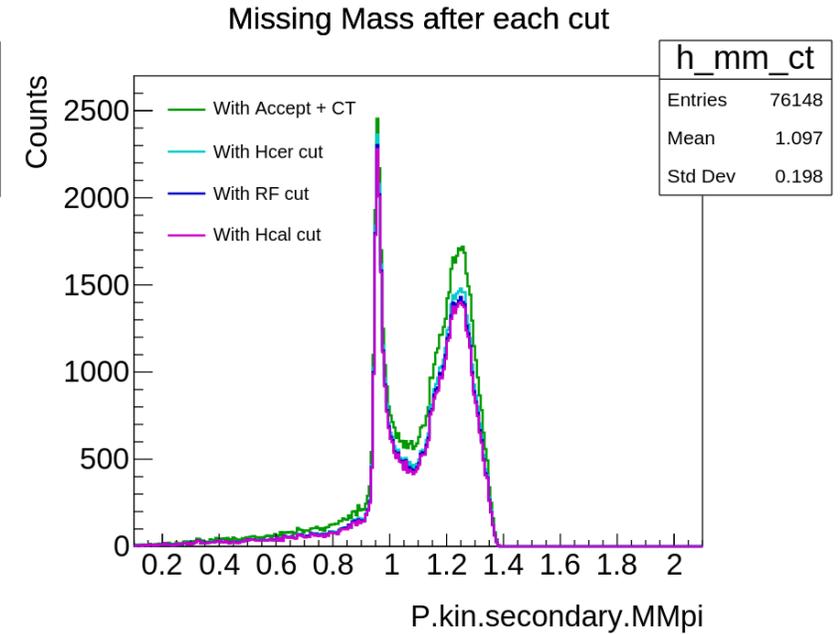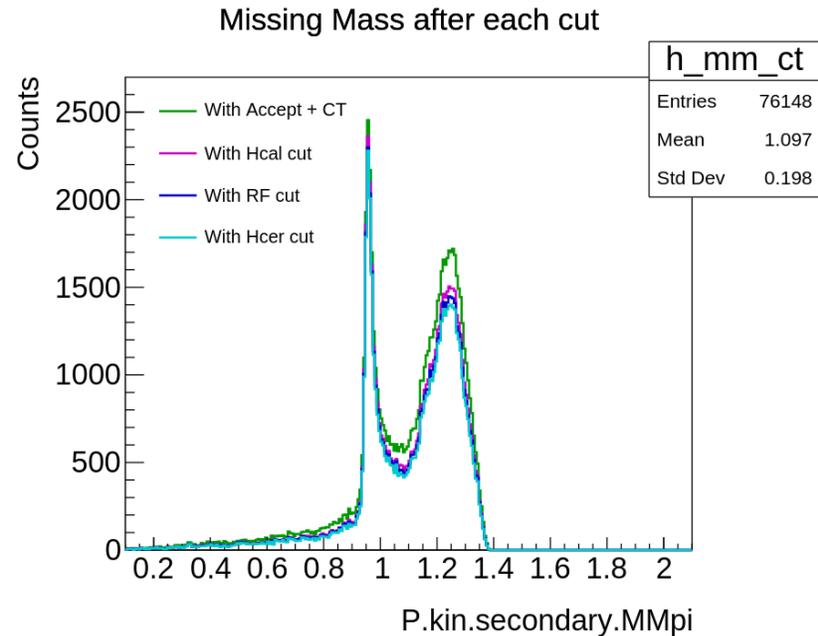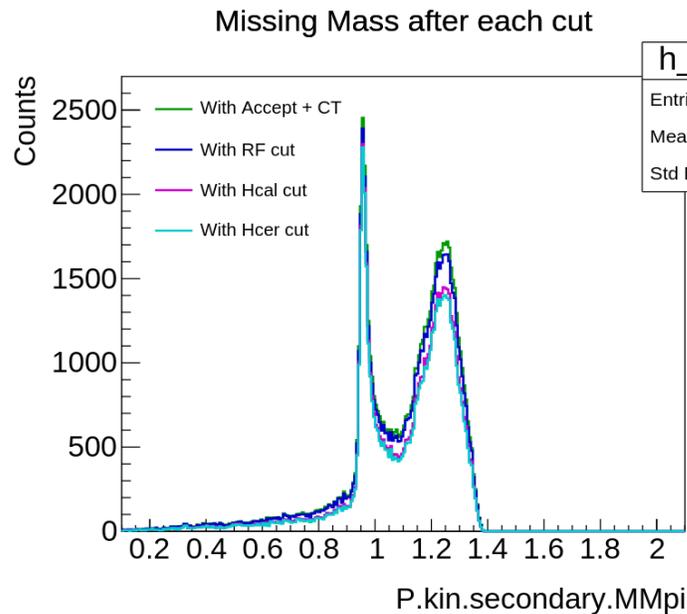# Missing mass – accept + timing

Now including the RF time cut.

Has very little effect.

Delta0 peak at ~1.23 GeV/c2?

Including HMS cuts

Most effective HMS cut is HCer, then HCal and then RF
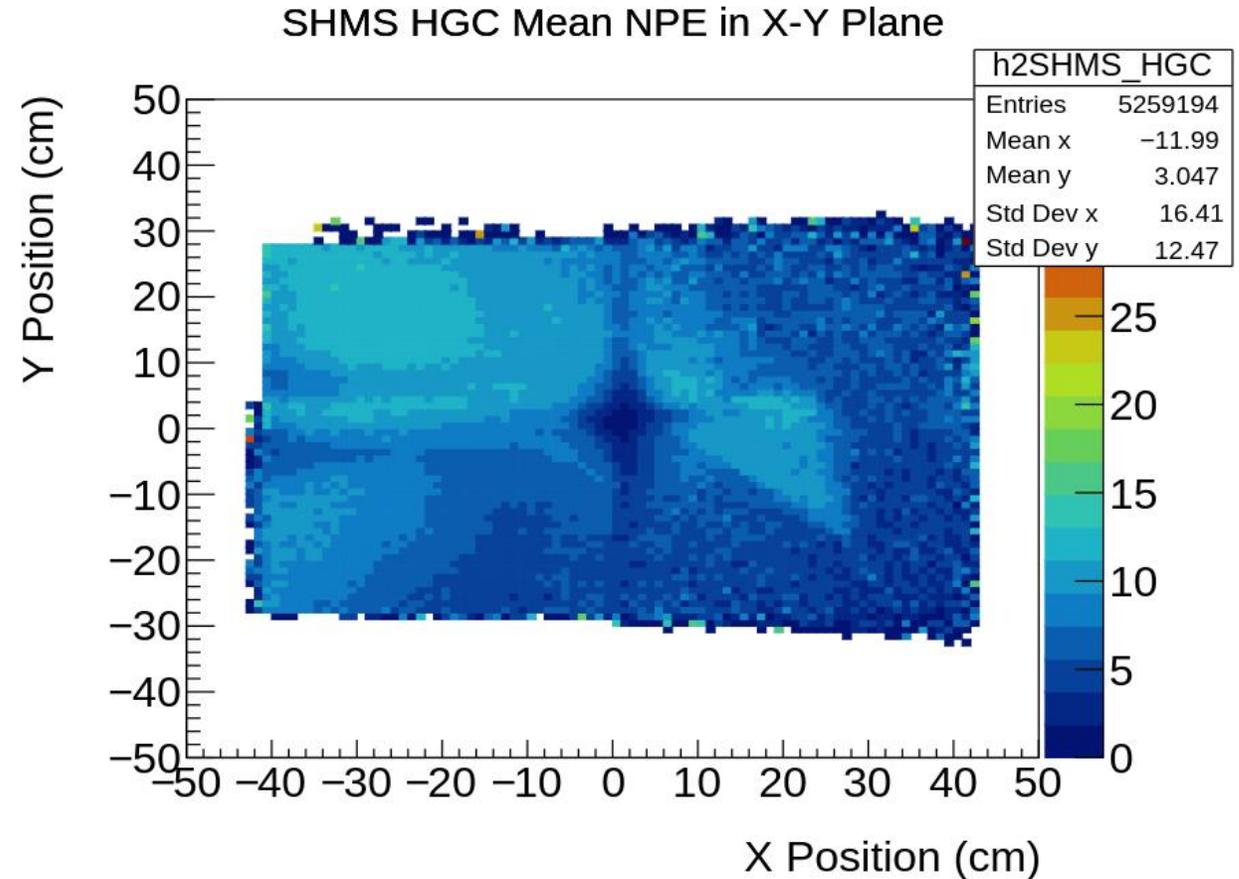
SHMS – Heavy Gas Cherenkov

Four curved mirrors that focus Cherenkov light onto four PMTs.

Middle of these has no photoelectrons.

1D cuts on HGC NPE insufficient as it is position dependent.

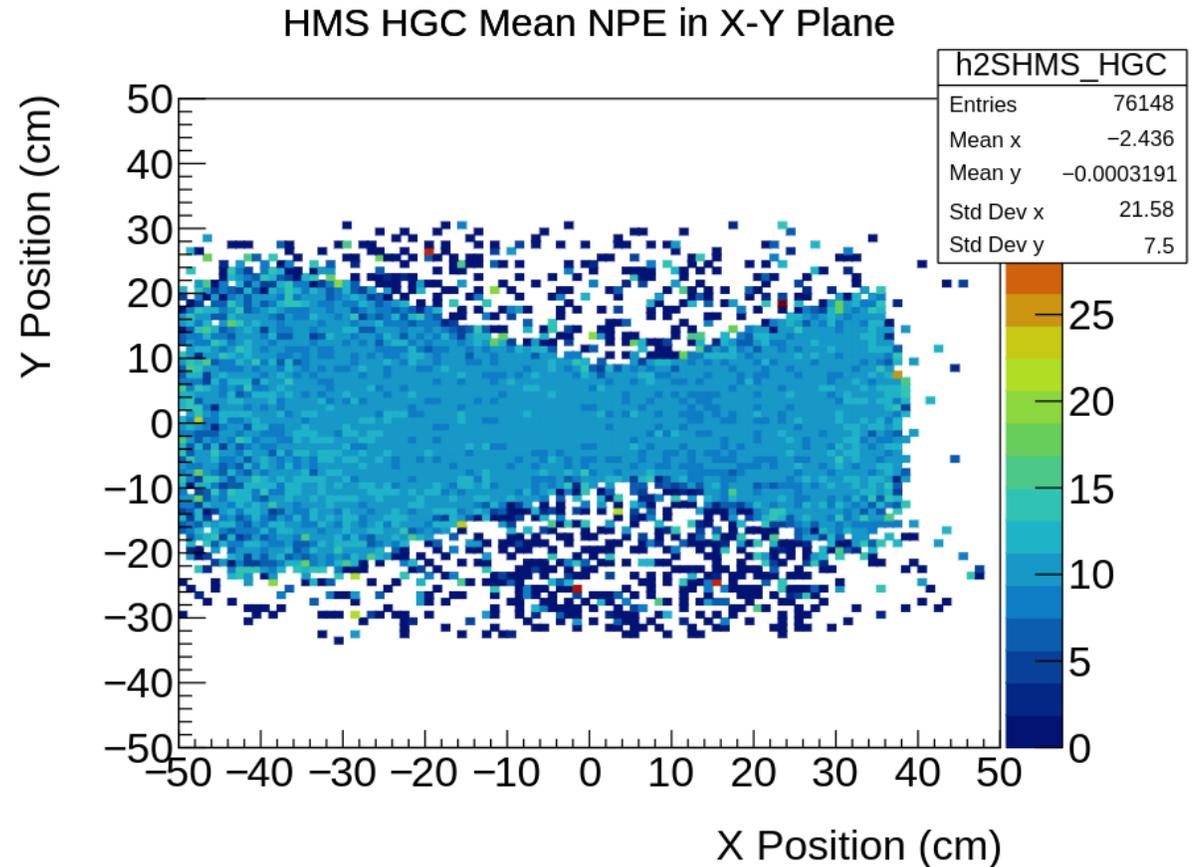**The same pion could produce different NPE depending on where it hits**
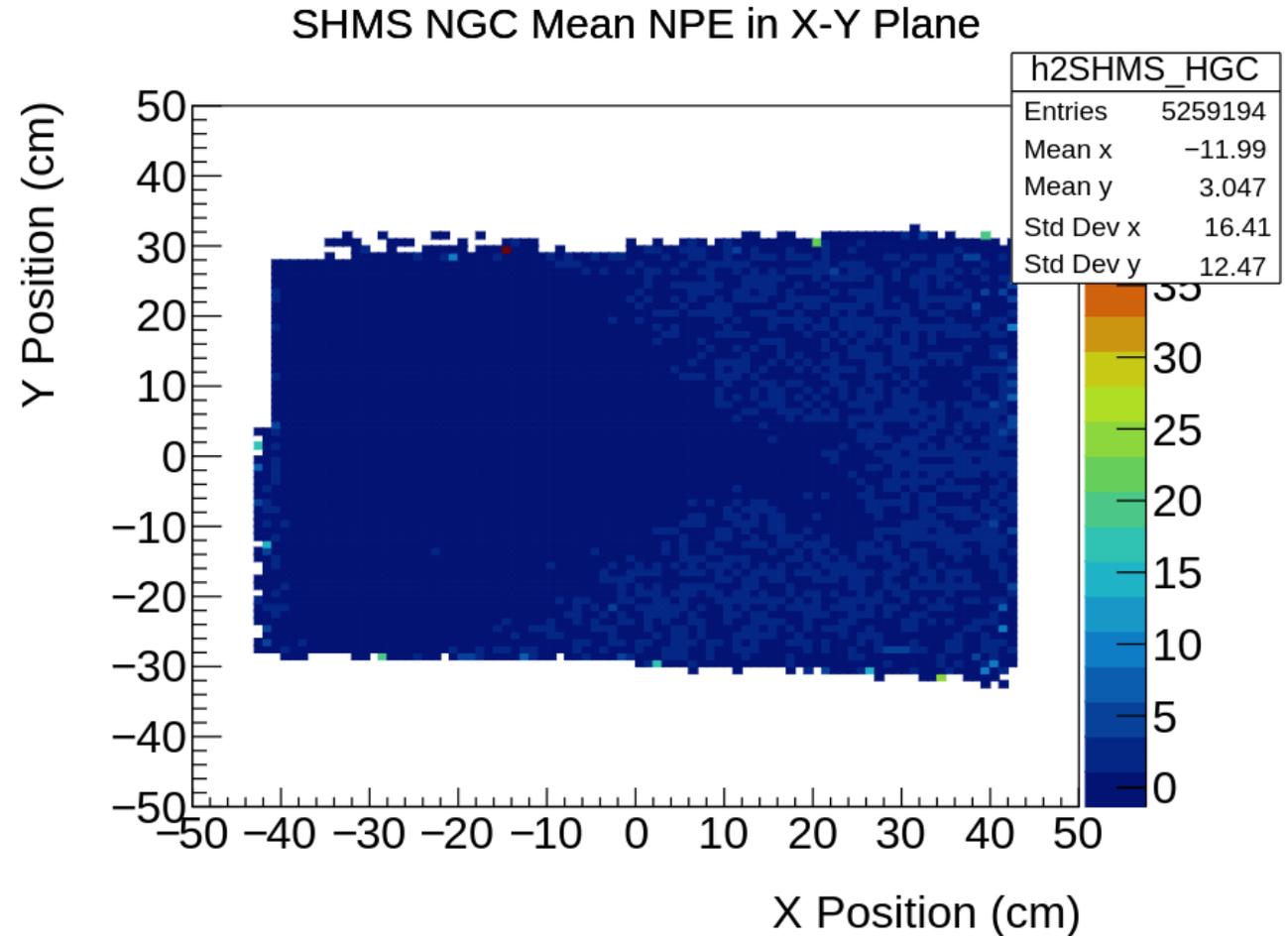
Set z max

HMS – Heavy Gas Cherenkov

Single large mirror system.

1D cut on HMS HGC NPE okay?

HMS HGC Mean NPE in X-Y Plane

h2SHMS_HGC	
Entries	76148
Mean x	−2.436
Mean y	−0.0003191
Std Dev x	21.58
Std Dev y	7.5

SHMS – Noble Gas Cherenkov

Need to look at pi- data to find the pi+ cut on the NGC

SHMS NGC Mean NPE in X-Y Plane

SHMS – Aerogel

Looks like the fiducial cut is already applied here.

So 1D cut is okay.

SHMS Aerogel Mean NPE in X-Y Plane
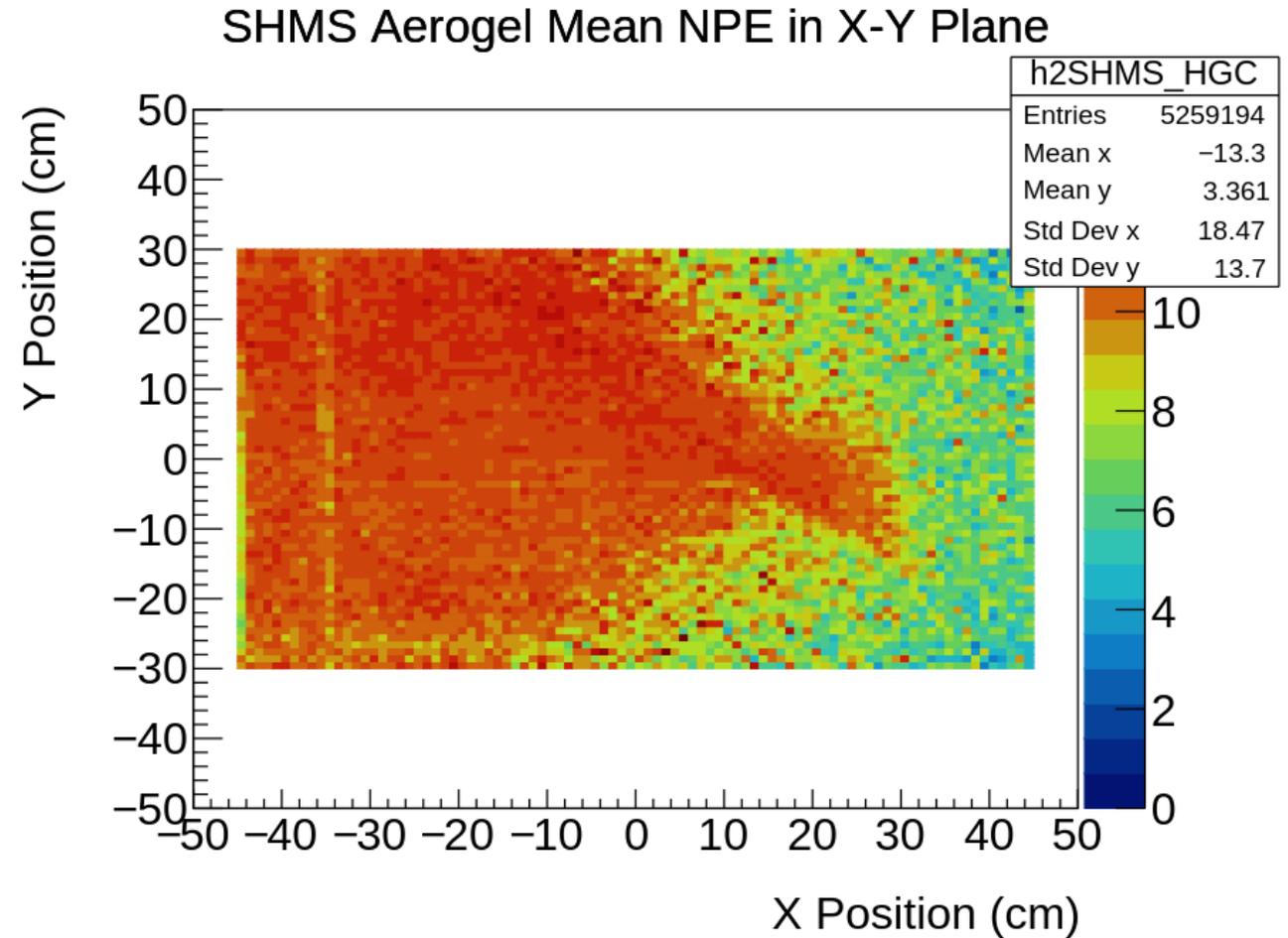
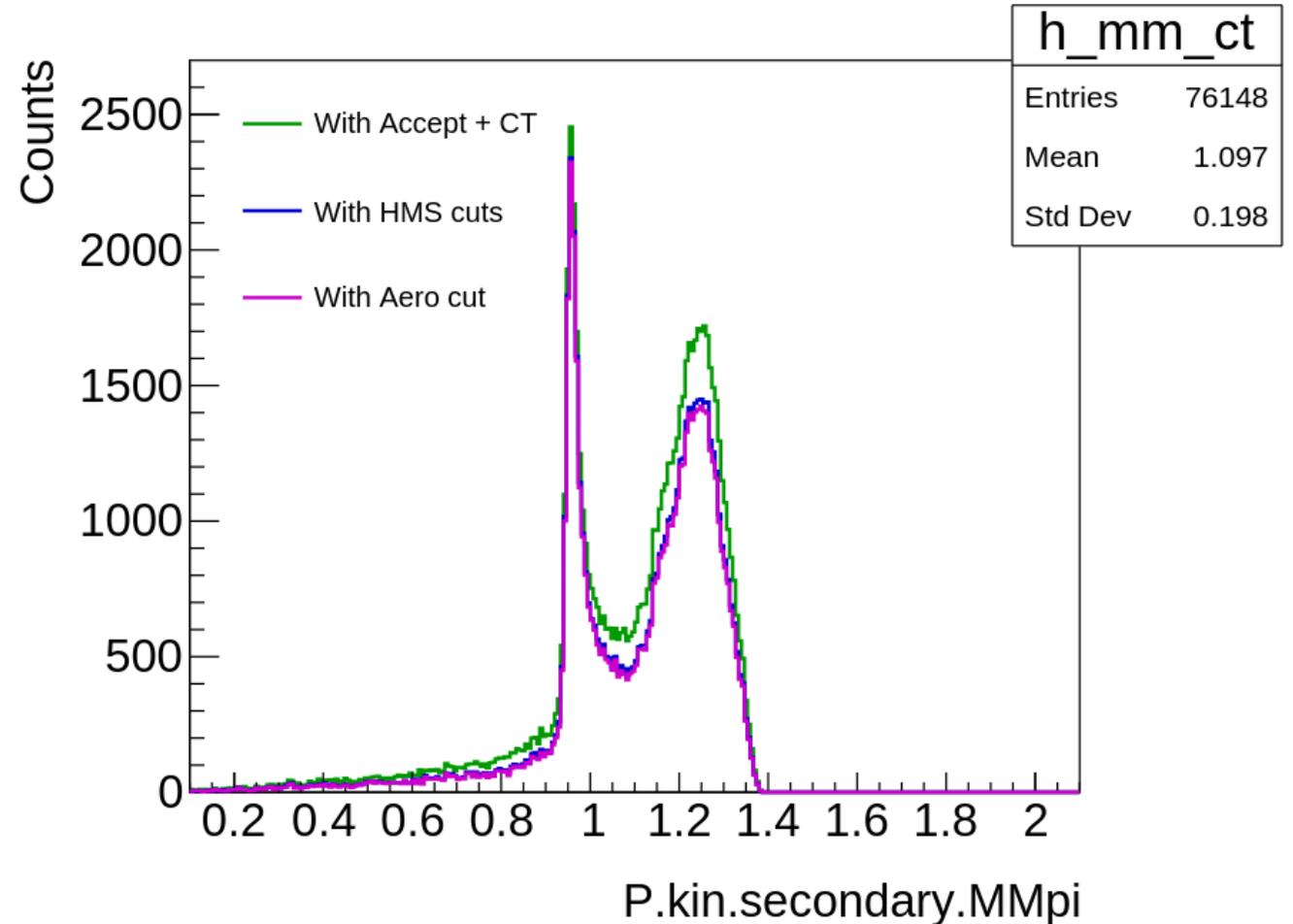**PAreo > 0.2 can then use this cut**

With SHMS aero

Aero cut has very little effect.

Look at with log scale to see clearer.

Next Steps

1. NGC has four mirrors too, with low light like in pi+ the inefficient region is not clear. Setting a z max value could make this clearer.

2. Apply the RF time cut and random subtraction. Log scale the counts in MM distribution to see cut effects clearer.

3. Look into the dummy target subtraction scaled by the integrated charge and efficiencies.

4. Extract the yield within a "generous" integration range.