

# Update to HCANA tracking

- Modified LeftRight method in THcDriftChamber.cxx
- Quick overview of tracking code
  - THcDC::Decode calls ProcessHits for each plane and then each chamber
  - THcDC::CoarseTrack
    - THcDriftChamber::FindSpacePoints
      - FindEasySpacePoints or FindHardSpacePoints
    - THcDriftChamber::CorrectHitTimes
    - THcDriftChamber::LeftRight
    - LinkStubs
    - TrackFit
- Made modifications to THcDriftChamber::LeftRight

# FindHardSpacePoint

- a. Loops through hits and determines pairs of hits in planes with angles greater than 17.5 degs between them. These are test pairs and stores the x and y position of pair
- b. Double loops through the test pairs to determine number of pair combinations.
  - a. Calculates  $d2 = (x_i - x_j)^2 + (y_i - y_j)^2$  from the two pairs (i,j).
  - b. If  $d2 < fSpacePointCriterion$  then fills combos structure with pair info and increments ncombos.
- c. Loops through ncombos
  - i. First combo is set as spacepoint which is loaded with hit info from combos.
  - ii. Next combo
    - A. Loops through previous space points
    - B. calculates  $d2 = (x_c - x_{sp})^2 + (y_c - y_{sp})^2$  between combos and spacepoint
    - C. if  $d2 < fSpacePointCriterion$  then adds combos hit info to that spacepoint which is not already in the spacepoint.
  - iii. if that combo is not already added to existing spacepoint then new spacepoint is made from the combo.
- d. If it found a spacepoint
  - a. For HMS-style chamber it would DestroyPoorSpacePoints if fRemove\_Sppt\_If\_One\_Yplane
  - b. Presently if HMS-style chamber calls SpacePointMultiWire()
  - c. Calls ChooseSingleHit this looks to see if two hits in the same plane. If two hits then rejects on with longer drift time.
  - d. calls SelectSpacePoints. Goes through the spacepoints and eliminates spacepoints that do not have  $n_{hits} > min\_hits$  and  $n_{combos} > min\_combos$  (exception for easyspacepoint)

# LeftRight

- a) Loops through spacepoints and determines the sign of the drift distance for each hit in the spacepoint by fitting the hits (FindStub). A hit which is in multiple spacepoints could have different sign.
- b) FindStub fits hits to find  $x$ ,  $y$ ,  $x'$  with fixed  $y' = 0$  and returns chi-squared
- c) If `stub_max_xpdiff < 100` ( by default `stub_max_xpdiff = 999`) then
  - a) check if difference between fitted  $x'$  and space point  $X * K$  is  $< \text{stub\_max\_xpdiff}$ .
  - b)  $K$  is from spectrometer optics. Hardcoded for HMS/SHMS.
  - c) If fails this cut , then LR combo is not used.
  - d) If fails this cut , then LR combo is stored in temporary array in case no LR combos pass the test.
- d) If `stub_max_xpdiff > 100`, then LR combo with smallest chi-squared is stored with spacepoint.

# LinkStub

1. Put all space points in a single list,  $N_{sp}$
2. Loop over all space points as seeds  $isp1=0, N_{sp}-1$ 
  1. Check if this space point is all ready in a track
  2. Set  $newtrack = 1$
  3. Loop over all succeeding space points  $isp2=isp+1, N_{sp}$ 
    1. Check if there is a stub-criterion match
    2. If  $newtrack=1$  , then create track with two spacepoints. Set  $newtrack=0$
    3. If  $Newtrack=0$ 
      1. either add to existing track
      2. or if there is another point in same chamber make a copy containing  $isp2$  rather than other point in same chamber

# SHMS Tracking parameters

Parameter	Code	Comment
pmin_hit = 4, 4	FindSpacePoints	
pmin_combos = 3, 3		
pspace_point_criterion = 1.2, 1.2	FindEasySpacePoints or FindHardSpacePoints	Used to determine pairs and the which combos to use in the spacepoint.
pxt_track_criterion = 100.0	LinkStub	
pyt_track_criterion = 20.0	LinkStub	
pxpt_track_criterion = 1.0	LinkStub	
pypt_track_criterion = 1.0	LinkStub	Not important since stub fit with yp=0
pSmallAngleApprox = 0	LeftRight	Fixes sign of LR for matching planes
Pstub_max_xpdiff=0.2	LeftRight	Set to >100 to do old behavior

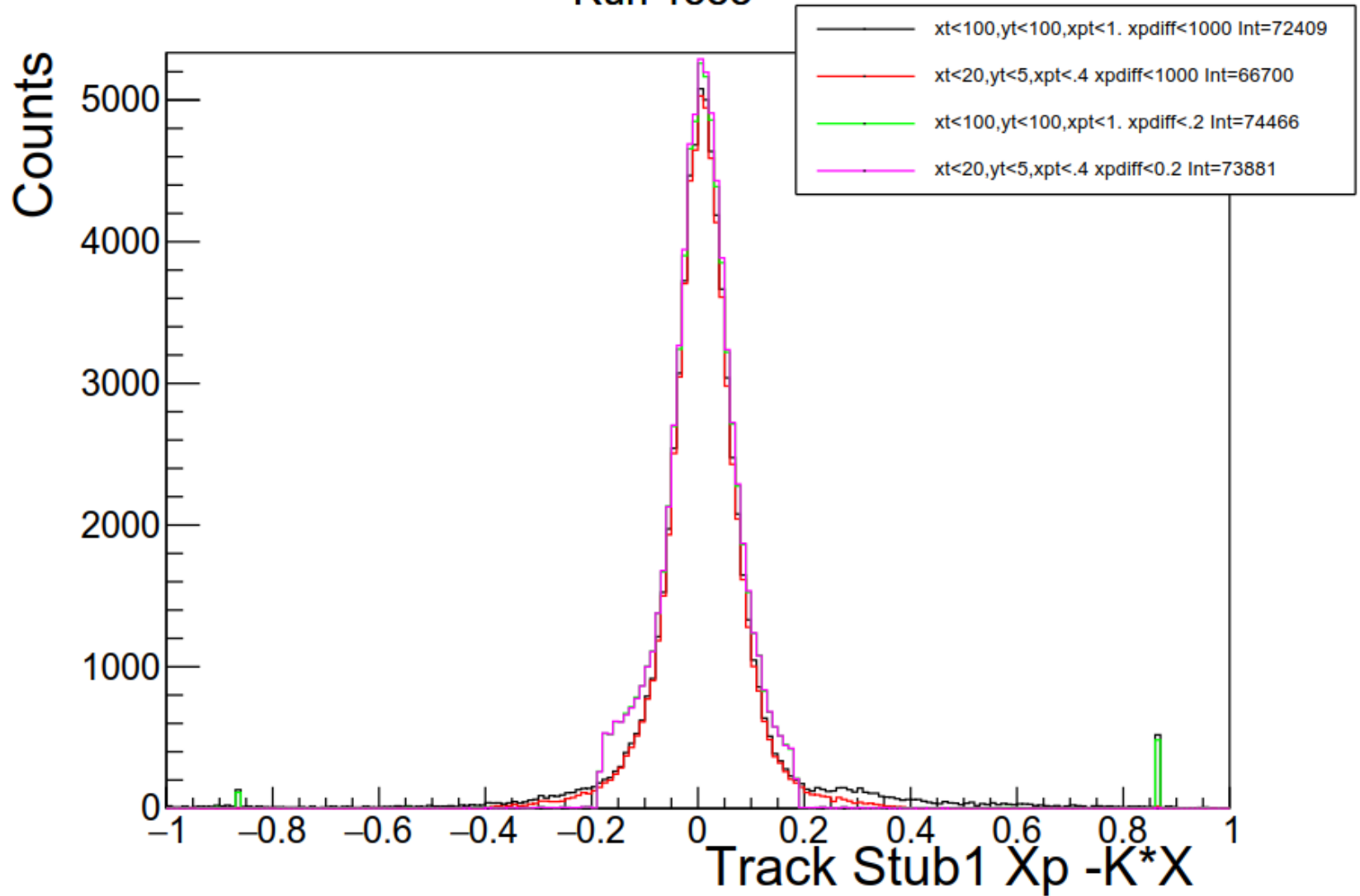
# Optimize tracking parameters

- Use SHMS run 1583 with 0.5% carbon at 25 deg and -1.6 GeV. Ebeam=2.2
- Rate of HODO = 2.7 kHz. P1X = 16 kHz
- Used pSmallAngleApprox = 0

Xt_track	Yt_track	Xpt_track	Stub_max_xpdiff	Track eff
100	100	1	1000	97.2%
100	100	1	0.2	99.3
20	5	0.4	1000	89.6
20	5	0.2	0.2	98.5

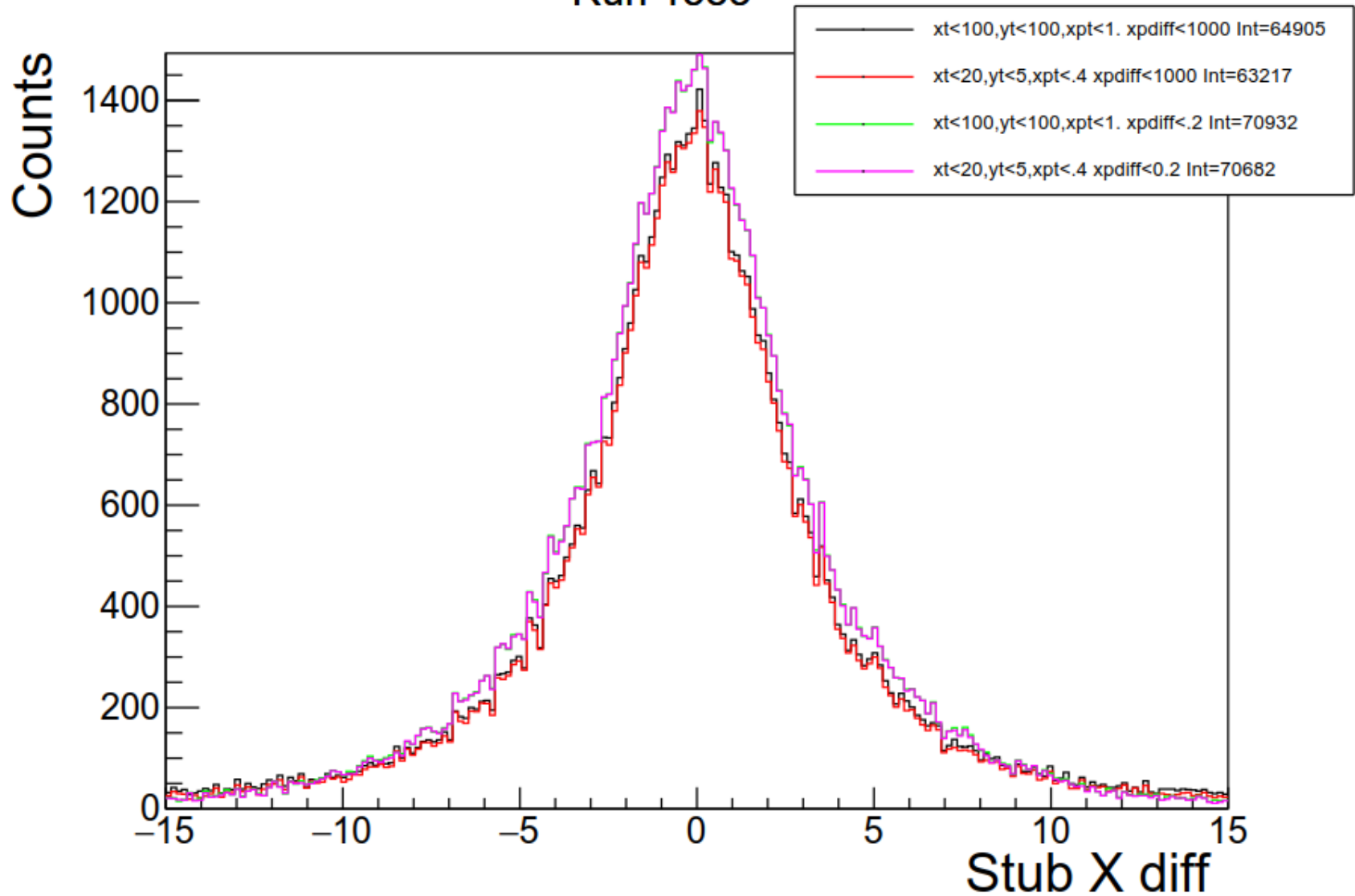
# For Stub $X_p - X^*K$

Run 1583



# Track Stub X difference

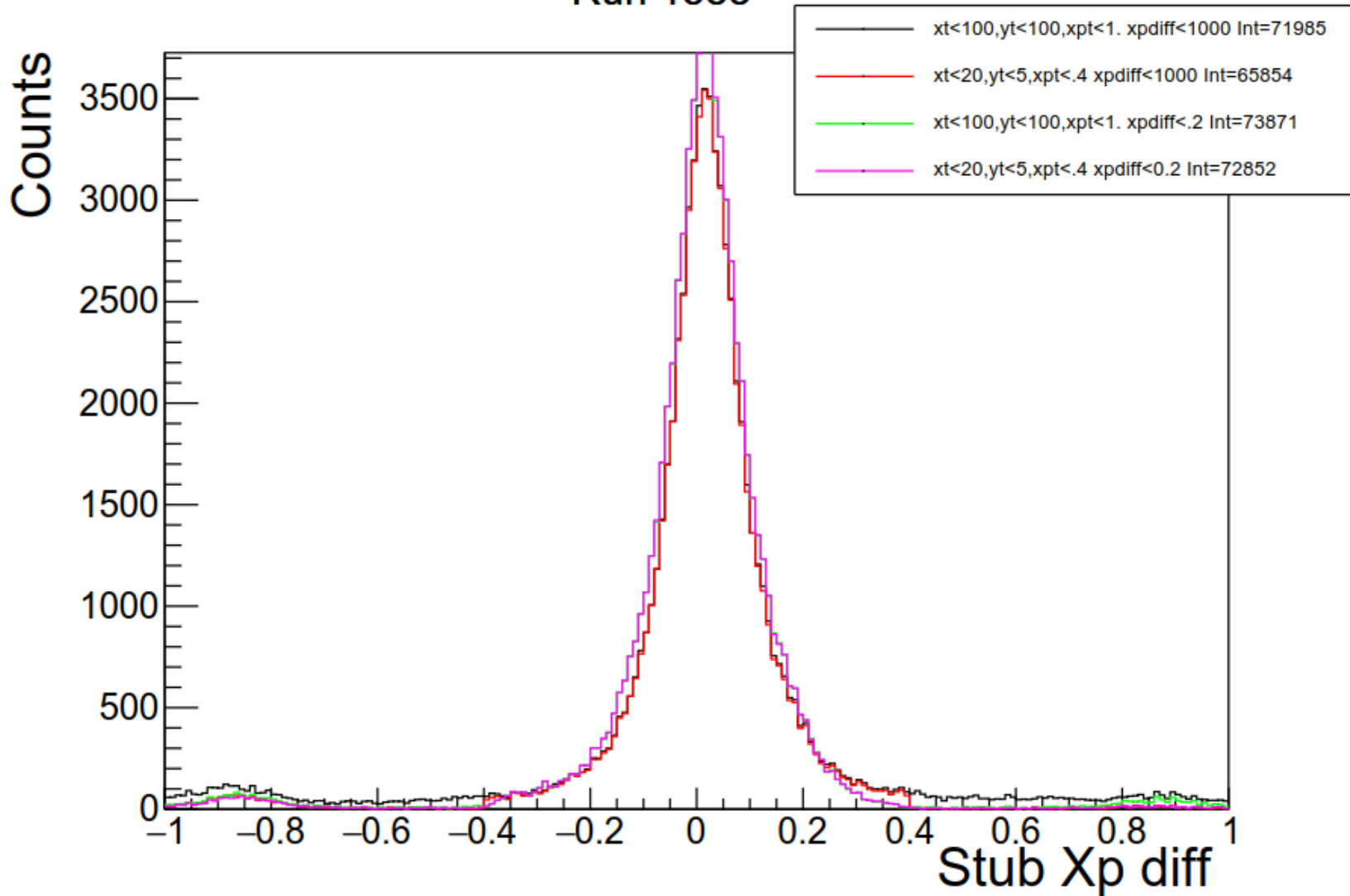
Run 1583





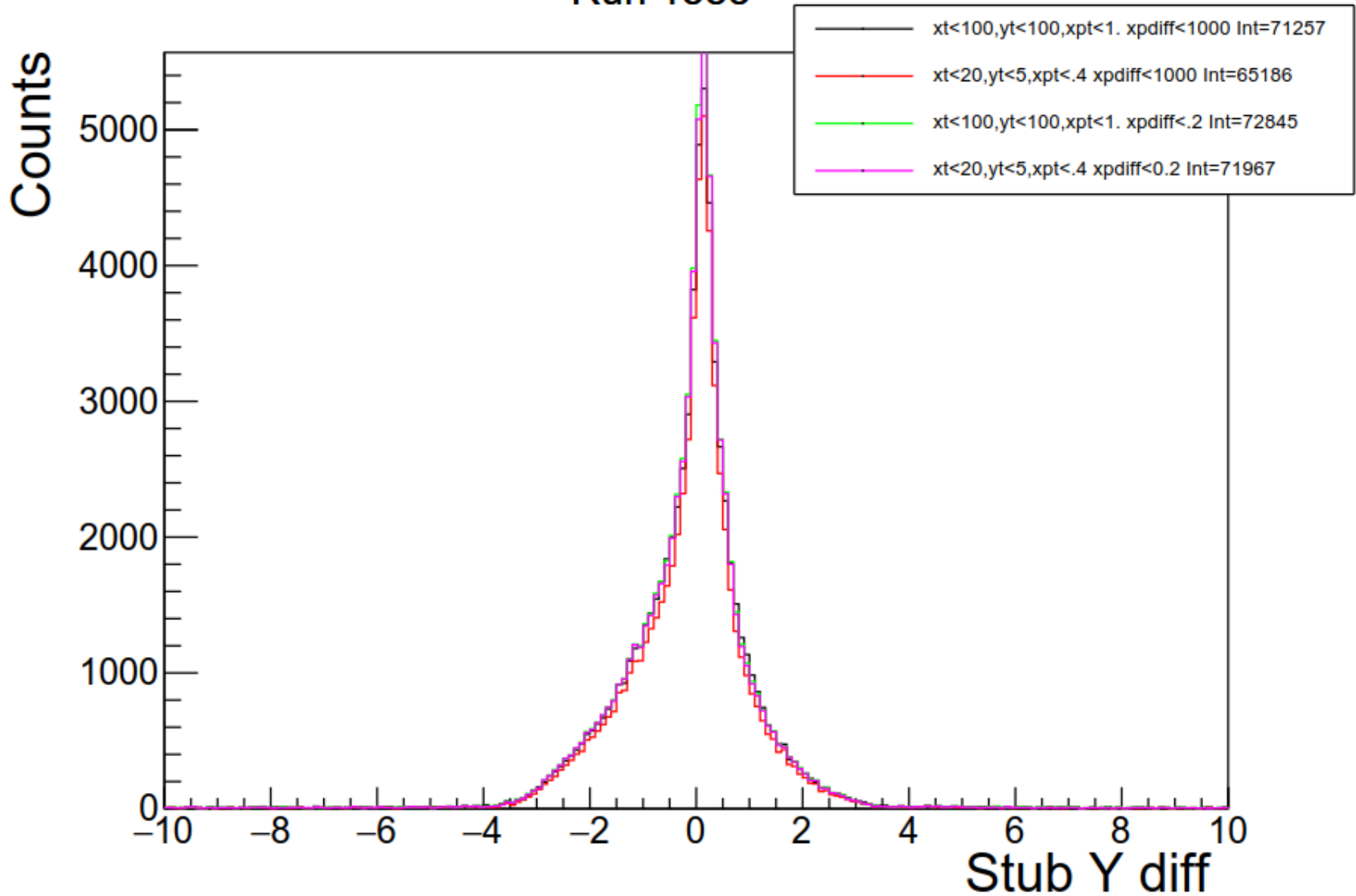
# Track Stub X' difference

Run 1583



# Track Stub Y difference

Run 1583



# Track Residuals

Run 1583

