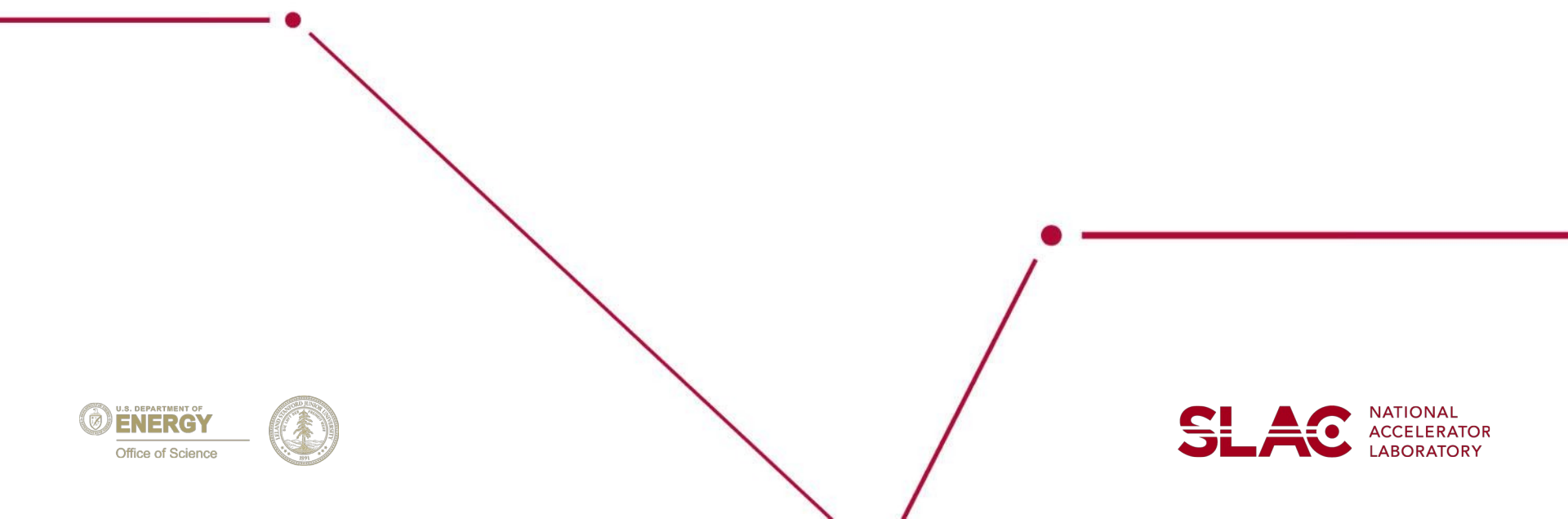# What was Moving in 2021?

Cameron Bravo (SLAC)

Introduction

- Showed evidence of movement of the SVT about 9 months ago

  - FEE peak momentum changes as a function of run number

  - Confirmed by further studies

- Focusing here on run 14770, a late high lumi physics run

  - Thanks to Nathan for making the FEE skims

  - Also looking at physics trigger

  - Mostly looking at alignment monitoring plots

  - Reminder that 14168 is an early low lumi FEE run

  - Only moving things in top in this talk

- First will show a different way of looking at the issue that arises in later runs

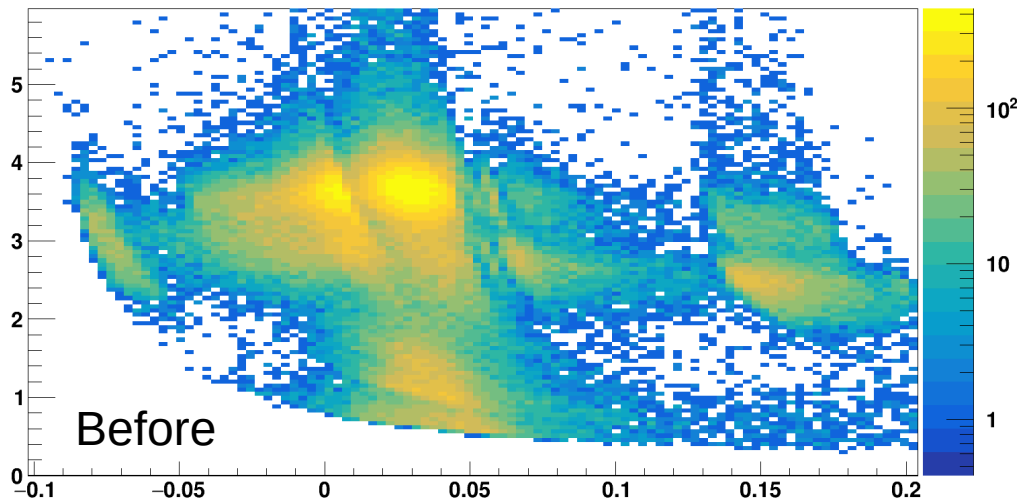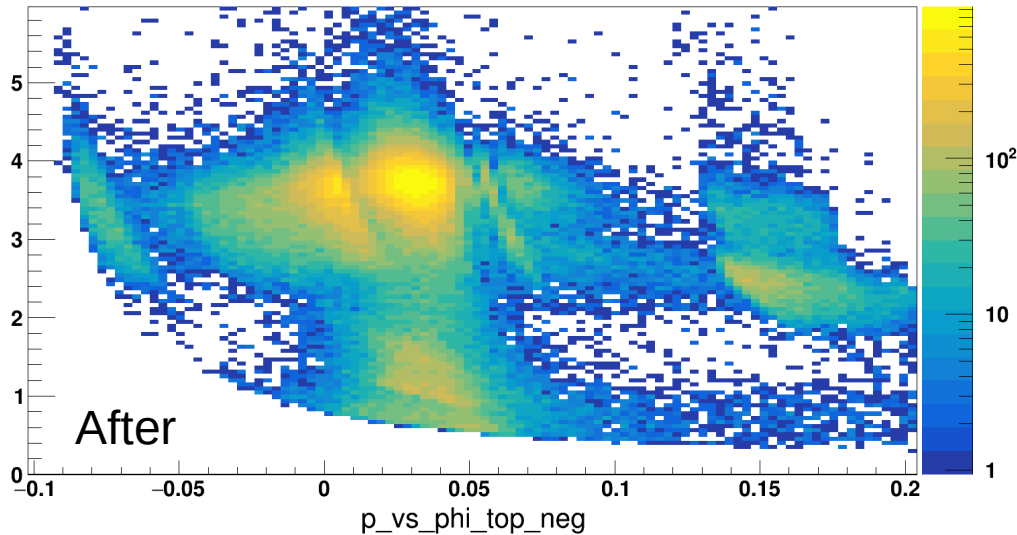- Investigate what is going on

- Align it

The Starting Point

p_vs_phi_top_neg

14168

p_vs_phi_top_neg

14770
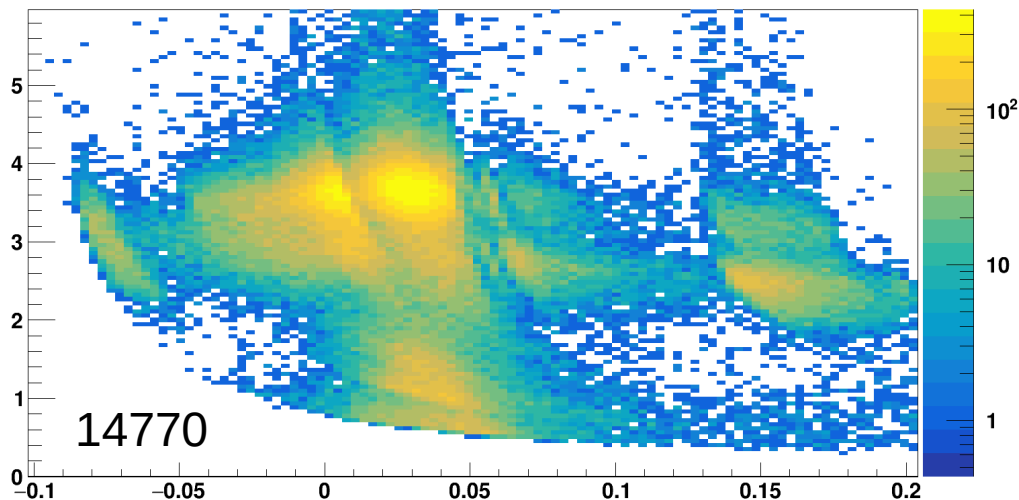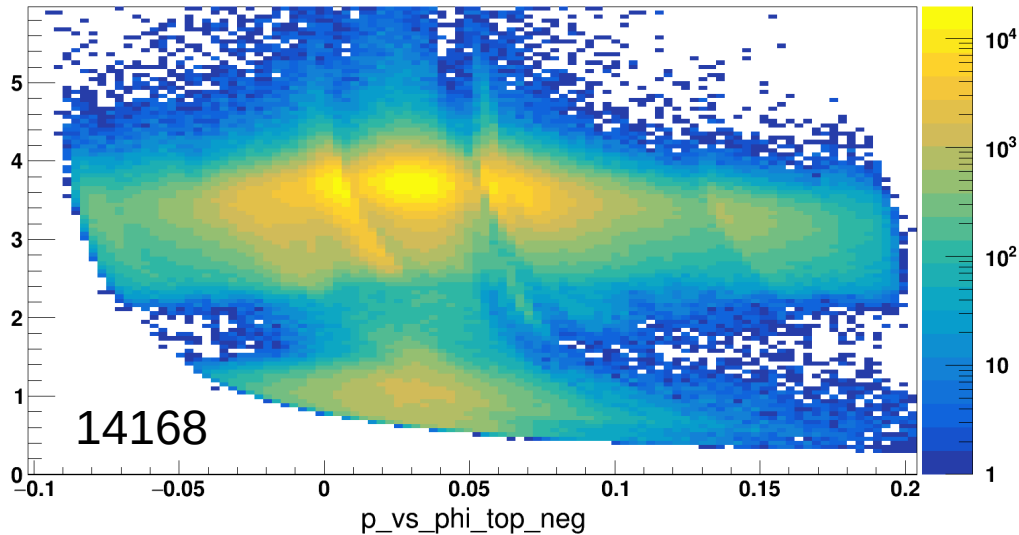
- Both plots are only FEE triggers

- Early run looks fine, as we have seen for a while now

- Later run has a clear bifurcation on the slot side

  - Bifurcation also appears a bit on hole side, but less apparent

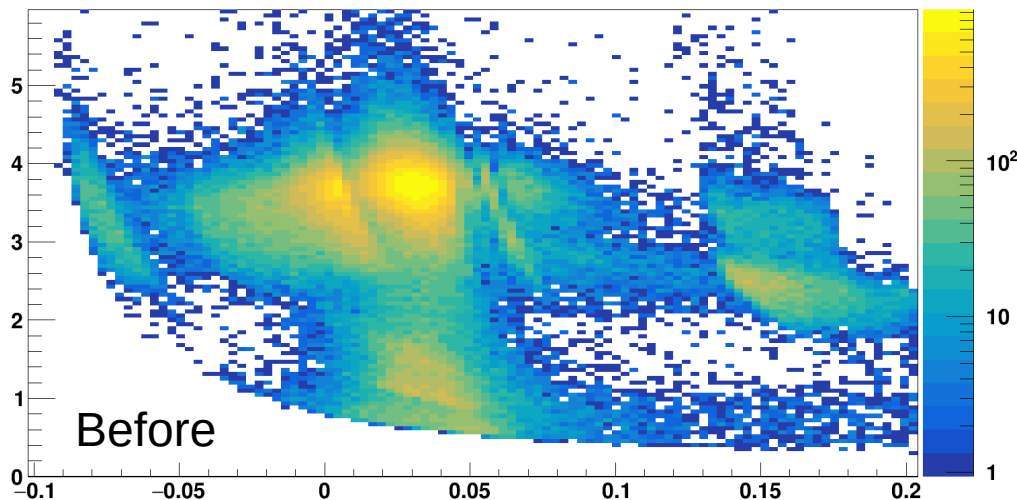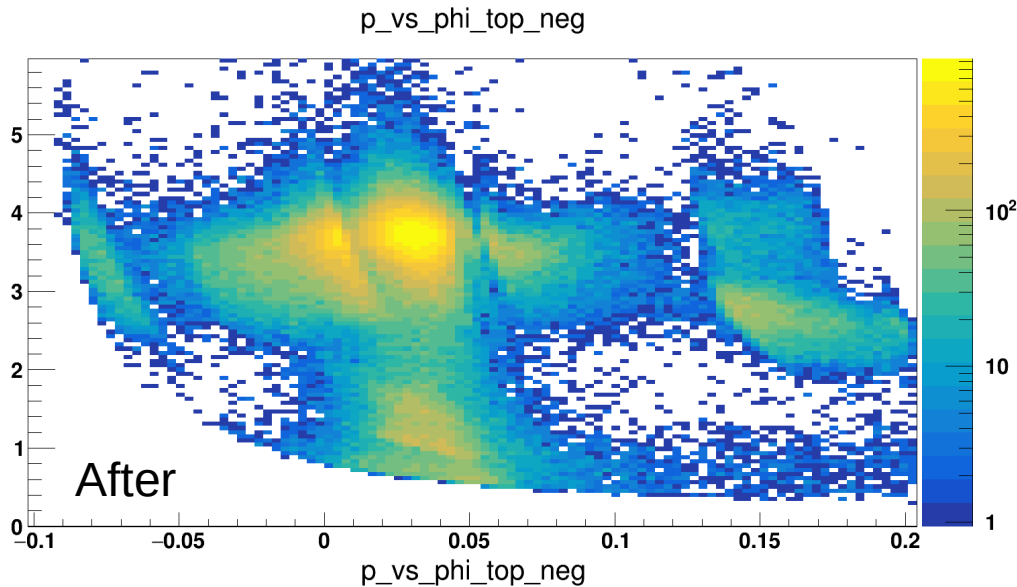- First lets try using millipede to fix it

First Try Millipede

- Use all triggers in 14770
  - Select tracks over 2 GeV
  - Use momentum constraint for FEEs

- Free layers 5 and 6 stereo in Rw and Tu

- Momentum resolution improves a bit, more tracks, chi2 improves a tad

- Does not fix issue

- Keep this since we do see some minor improvements anyway

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Try Something Different w/ Millipede

p_vs_phi_top_neg

After

p_vs_phi_top_neg

Before

- Use all triggers in 14770

  - Select tracks over 2 GeV

  - Use momentum constraint for FEEs

- Free layers 6 and 7 stereo slot in Rw and Tu

- Momentum resolution improves a hair, chi2 improves a tad

- Bifurcation starting to merge near the peak of the phase space

- Bifurcation further towards slot side gets a bit worse

- Keep this and try something else

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Last Try with Millipede

p_vs_phi_top_neg
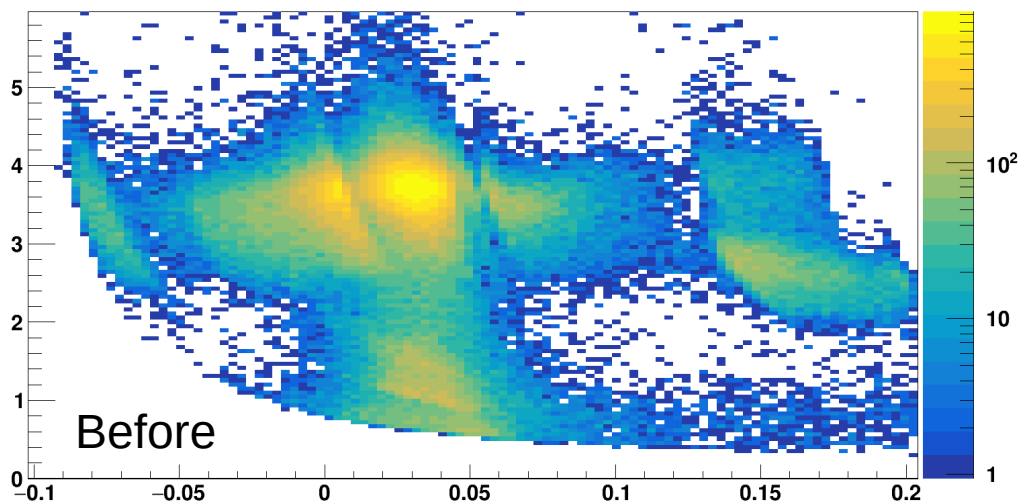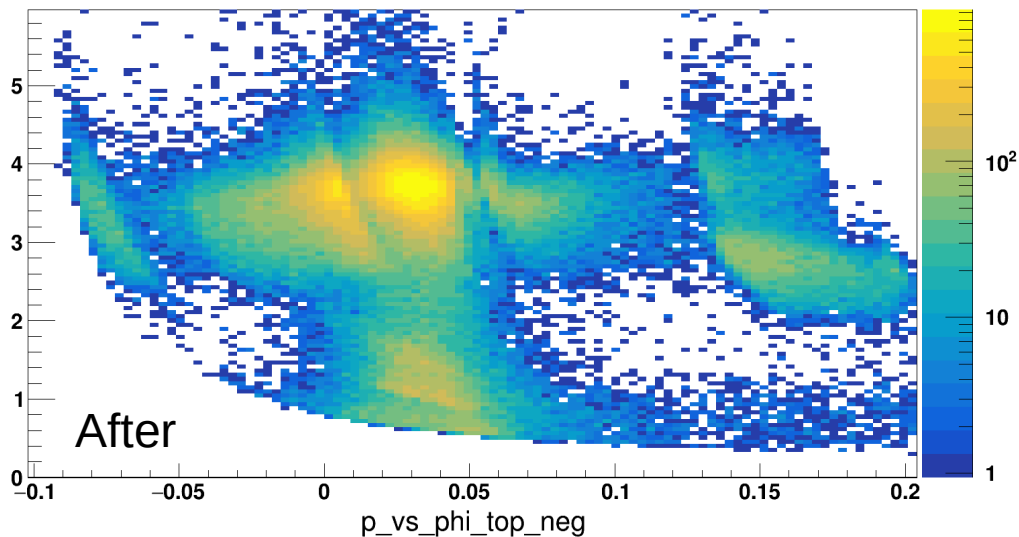
After
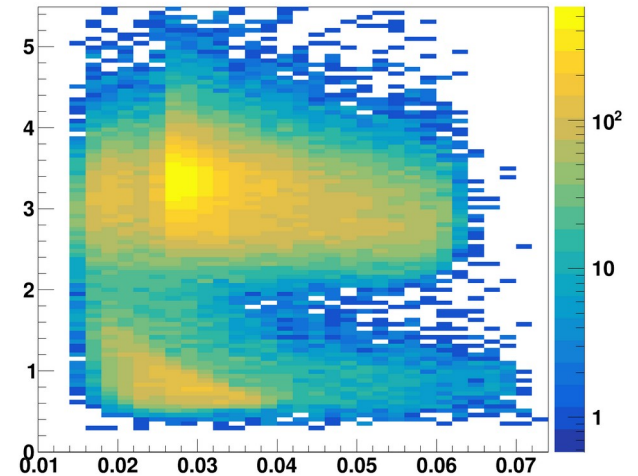
p_vs_phi_top_neg

Before

- Use only fee triggers in 14770

  - Select tracks over 2 GeV

  - Use momentum constraint

- Free layers 5, 6, and 7 stereo slot in Tu

- All movements up to this point have been really small, biggest is about 10 um

- Little difference

- Keep this, but we need to change the approach here, this doesn't seem to be getting us where we want to go
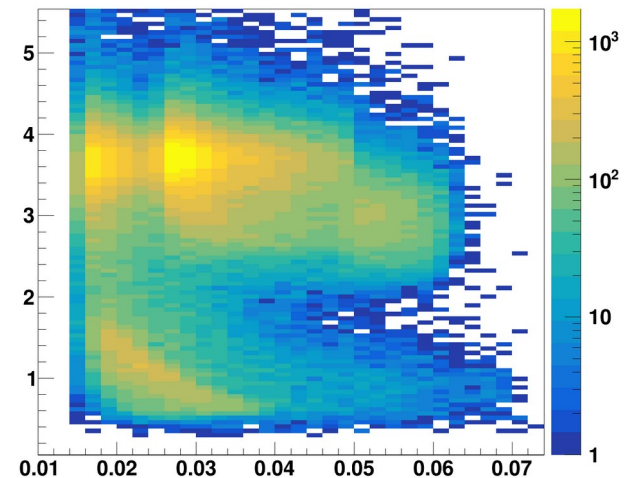
6

Removing Layer 7 from Reconstruction

p_vs_phi_top_neg
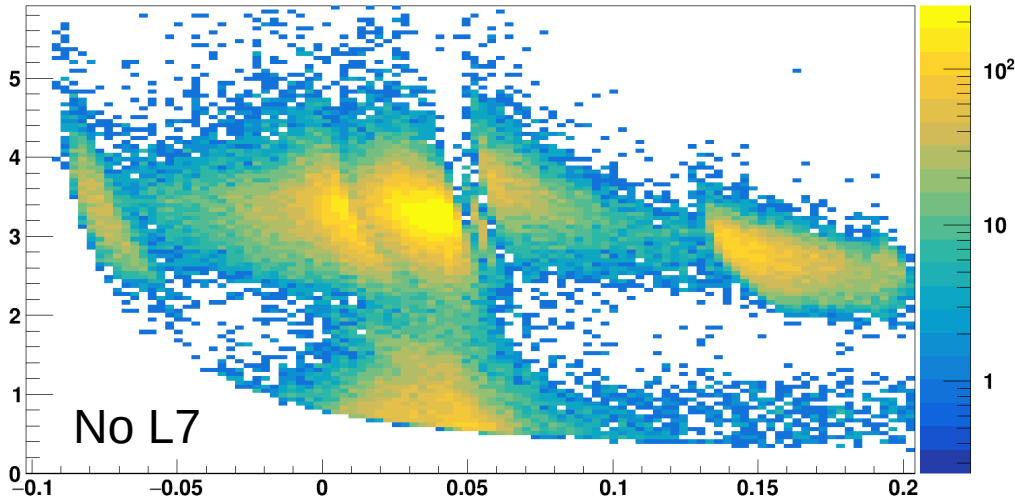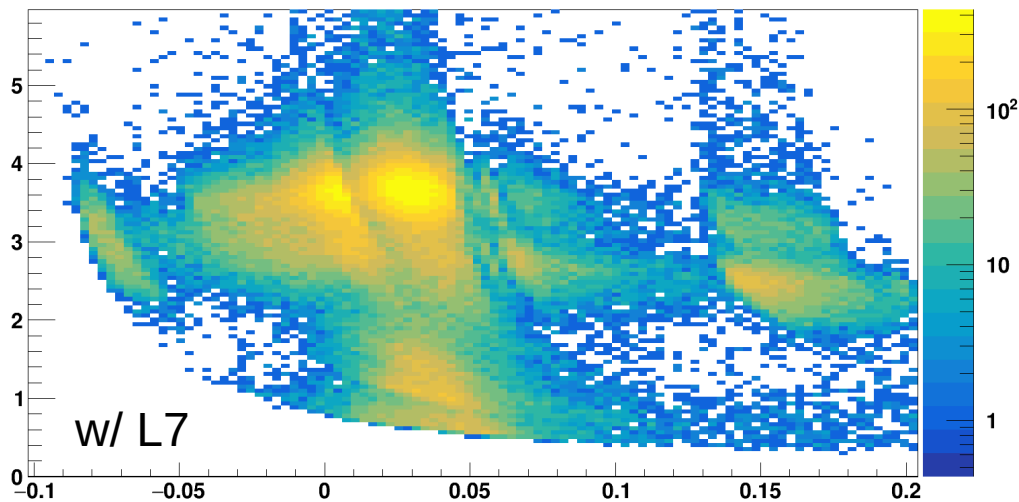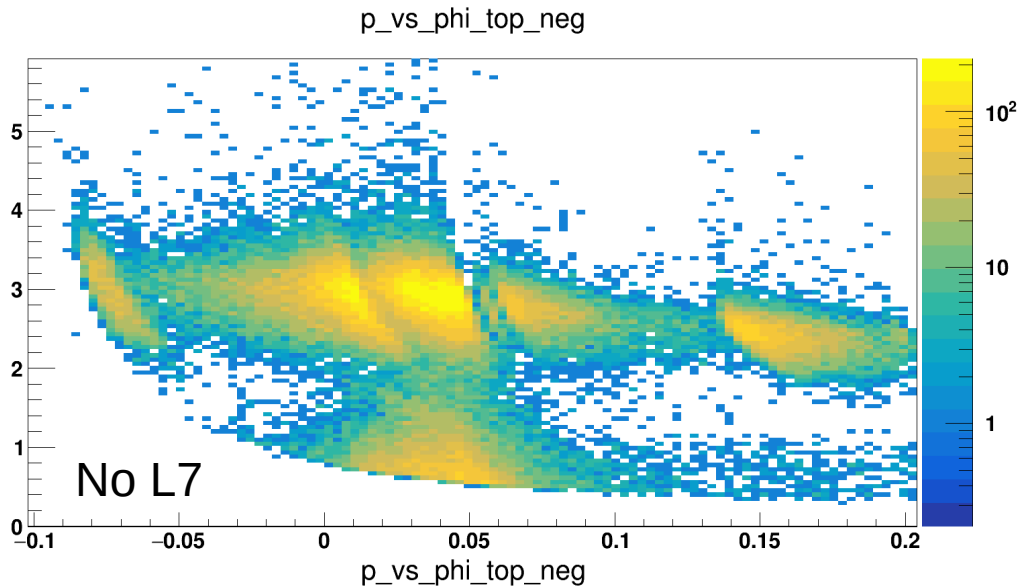
No L7

No L7   p_vs_tanLambda_top_neg

w/ L7   p_vs_tanLambda_top_neg

- Looking at momentum vs tan lambda we see the lower part of the bifurcation only at high tan lambda, this hints at L6 being the issue

- Removing layer 7 reveals something interesting

- Layer 6 stereo seems very misaligned, large Rw and even some Tu

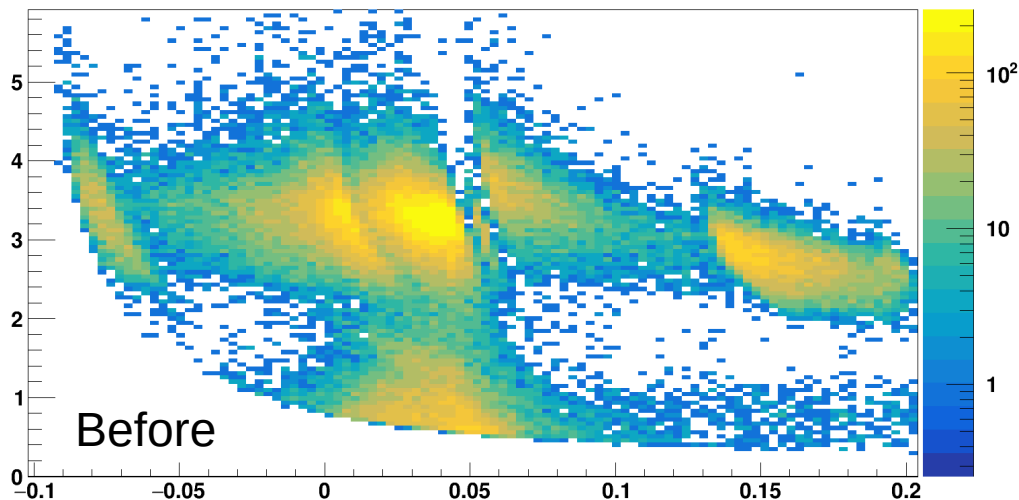- What did the detector we started with look like?

Pass1 v4 without Layer 7 top
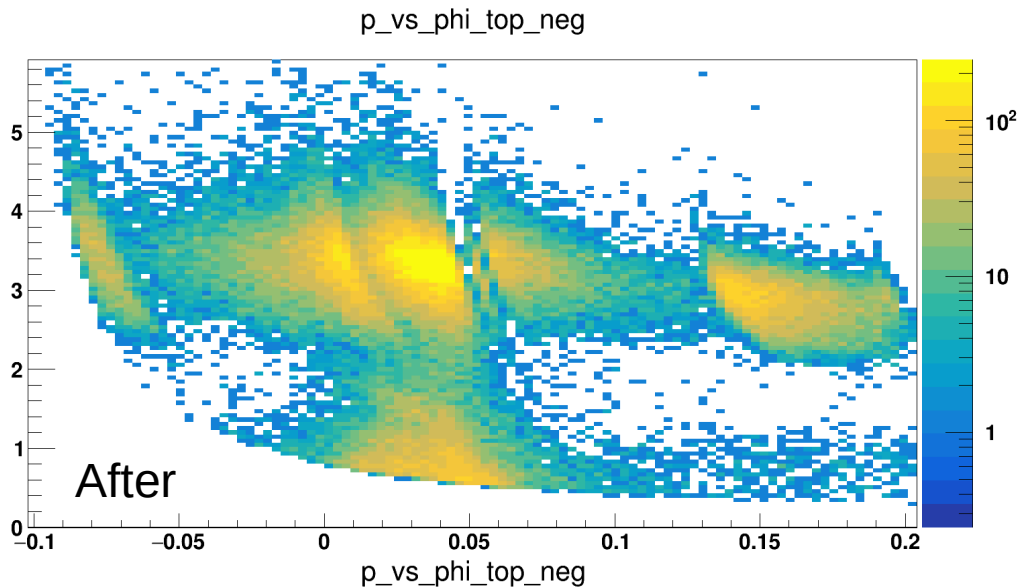

p_vs_phi_top_neg

No L7


p_vs_tanLambda_top_neg

No L7

p_vs_phi_top_neg

w/ L7
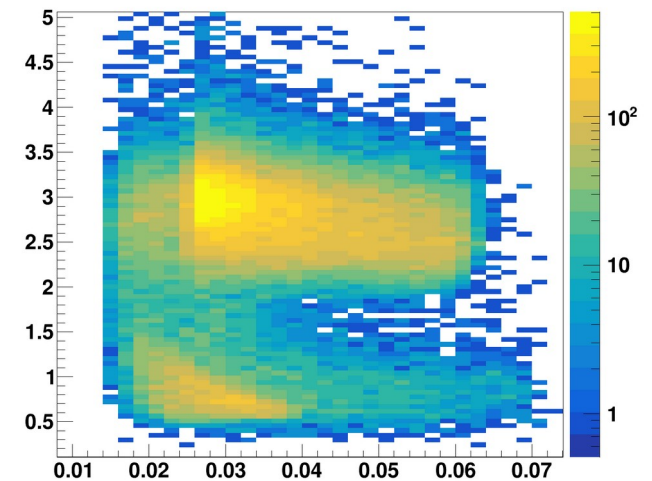
- We see a trend in p vs tan lambda

- Only see lower peak of momentum bifurcation

- See evidence of Rw in layer 6

- Let's try aligning FEEs w/o layer 7

Using Millipede without Layer 7

p_vs_phi_top_neg

After

p_vs_phi_top_neg

Before

- Use only fee triggers in 14770

  - Select tracks over 2 GeV

  - Use momentum constraint

- Free layers 5 and 6 stereo in Tu and L6 slot Rw

- Momentum scale improves

- Rw goes in correct direction, by eye it should have been maybe about 2x larger

  - Next detector just try 2x larger Rw

  - This Rw was largest movement yet, about 0.9 mrad, next is taking this to about 1.8 mrad

Comparing to where we started

p_vs_phi_top_neg

After

p_vs_phi_top_neg
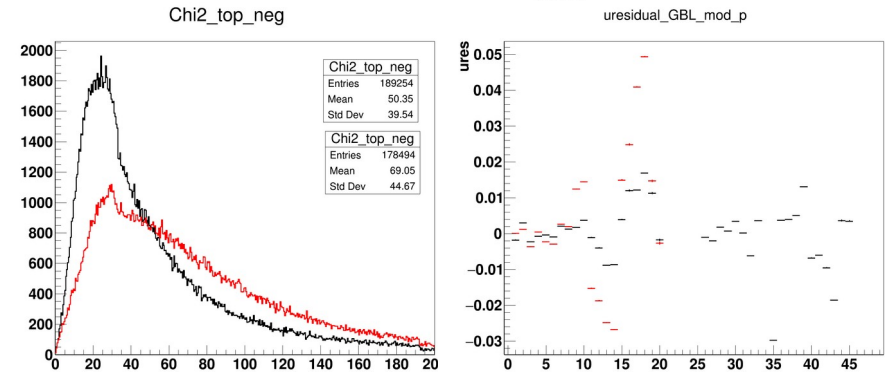

Before

After   p_vs_tanLambda_top_neg
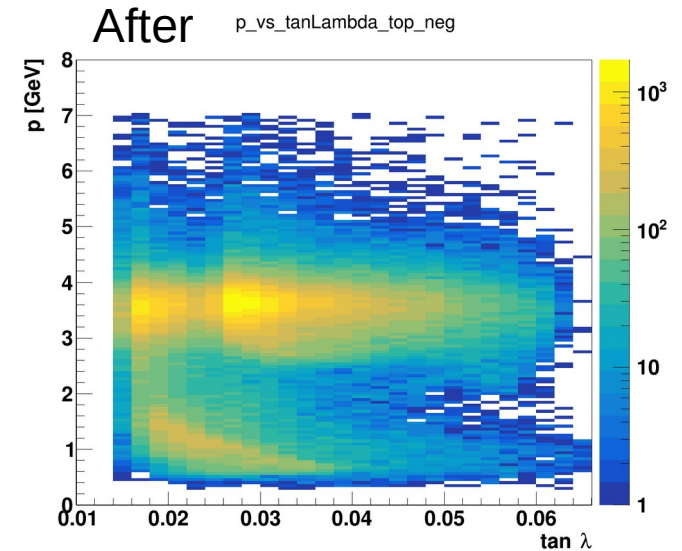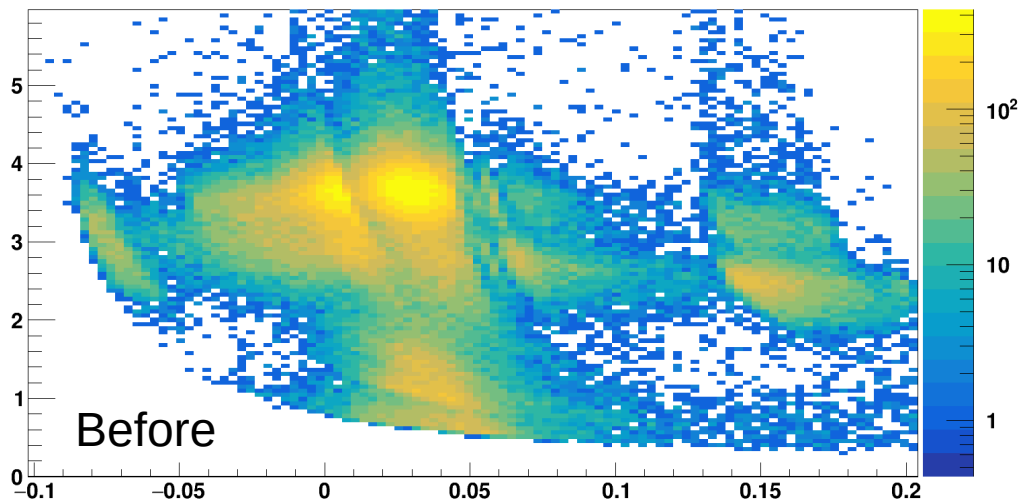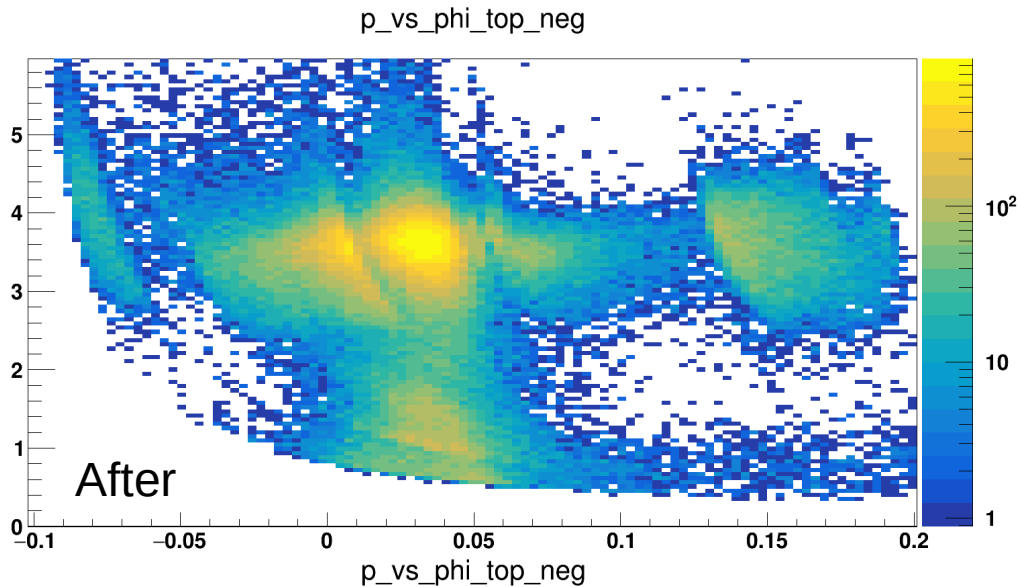
- High tan lambda momentum makes sense now

- Bifurcation is gone

- Generally looks like it does at the beginning of the run now

- Momentum resolution is about 7%

- Could probably achieve same thing only moving layer 6 stereo

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Iron this out with Millipede

p_vs_phi_top_neg

After

p_vs_phi_top_neg

Before

p_top_neg

Before
After

Chi2_top_neg

Chi2_top_neg	
Entries	189254
Mean	50.35
Std Dev	39.54

Chi2_top_neg	
Entries	178494
Mean	69.05
Std Dev	44.67

uresidual_GBL_mod_p
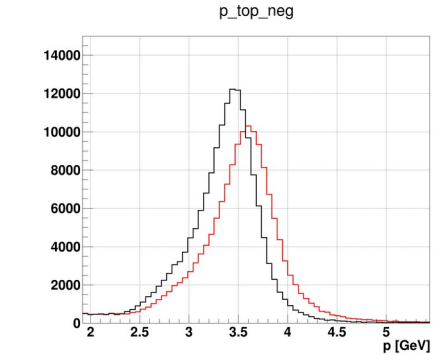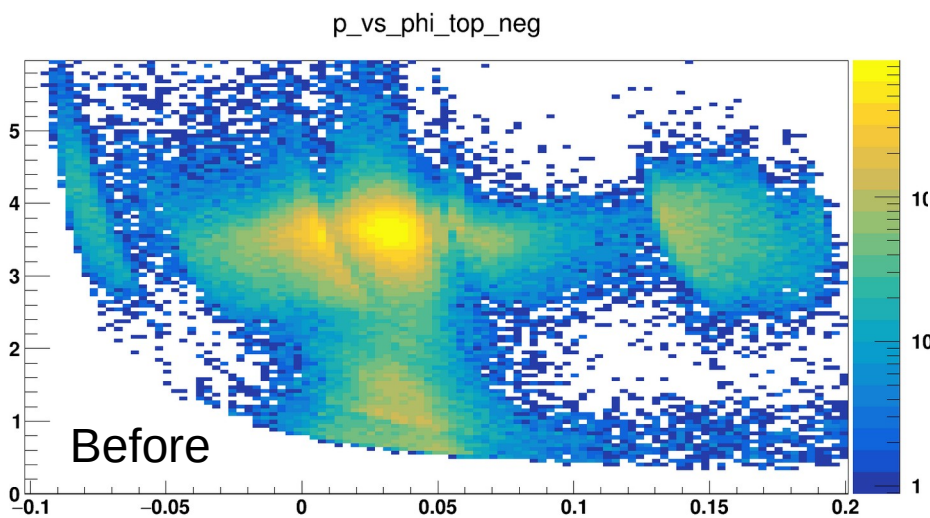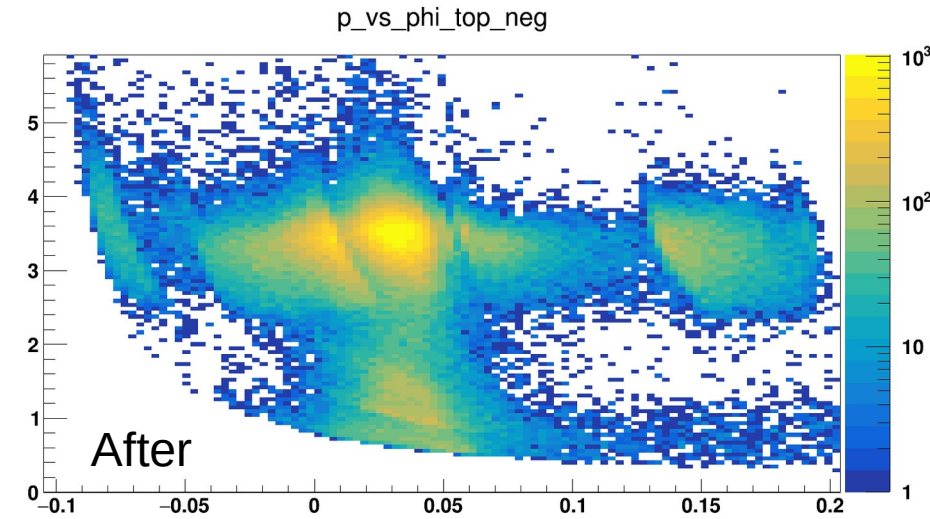
- Momentum scale is off (got worse even)
  - Strange because constraint is at 3.74 GeV
- Unbiased residuals look better
- Chi2 is better, and have more tracks

Discussion

- Layer 6 top stereo half module appears to move the most by far and is the cause of the momentum bifucation

  - Rw of nearly 2 mrad, which is ~400 um across the whole half module, pretty big

  - Rotates mostly around the hole side, meaning the slot side moves the most

- Almost have good geometry for run 14770, momentum scale needs some work still

- Can probably repeat fixing geometries at other run numbers if needed

  - Plan is to soon do 1% pass of 2021 with both new geometries and then use that to determine if we need any more and the run ranges we want to use

- Our software has been built and is available on s3df

  - Working on getting resources migrated and adding more to them

- Launched 100% pass of 2016 last night, pretty much done this morning, still reaping

  - hps-java 5.2.1

  - hpstr 1.2.0