

# Checks of 2x2 MINERvA with Beam

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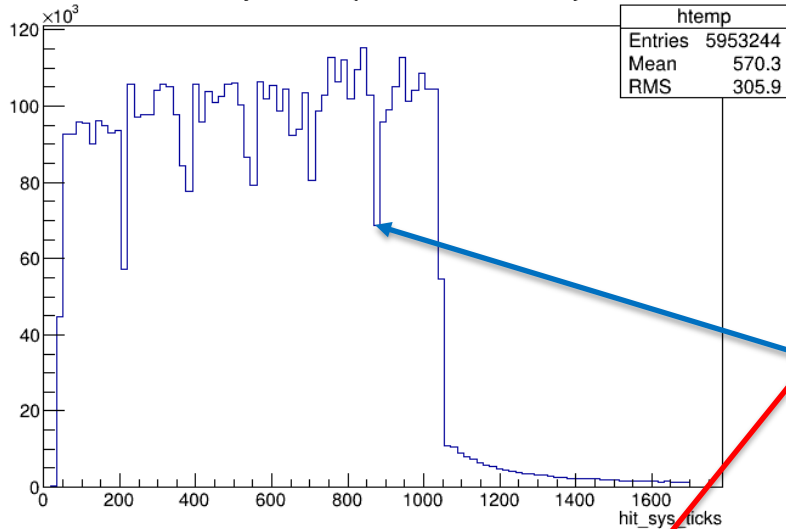




# Triggers & Gate

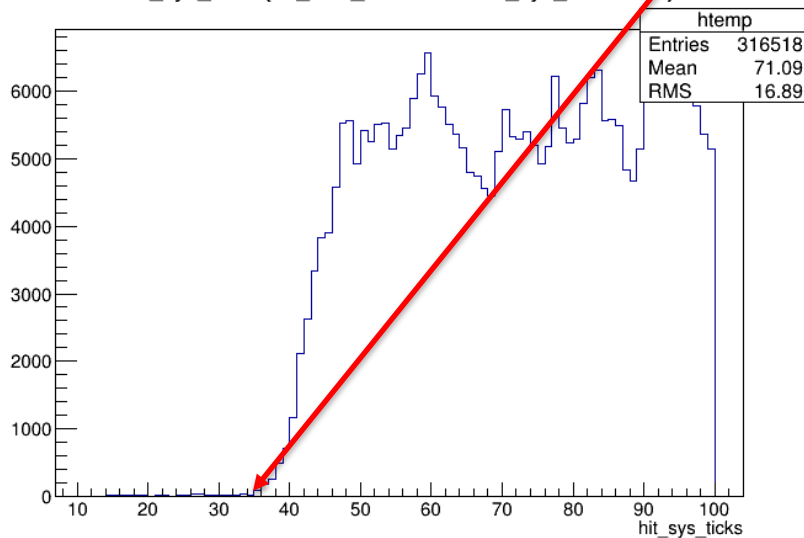


hit\_sys\_ticks {hit\_disc\_fired==1}



- MTM triggers on beam signal.
- Time of disc hits in clock counts
  - 1 clock count = 9.42ns
- 16  $\mu$ s gate which starts  $\sim$  400 ns before beam arrives. Tail is Michel electrons
- Plot same as MINERvA
- 6 Booster batches

hit\_sys\_ticks {hit\_disc\_fired==1&&hit\_sys\_ticks<100}





# DAQ



- The FEB PEDs are from MINERvA, Jul 2019, when MINERvA was stopped
- To understand the plots
  - DAQ reads out 5 -10 FEBs in a daisy chain, MINERvA had 59 chains
    - “The Sequencer”, the FGPA in the CROCE & the name given by Boris Baldin & Cristian Gingu, reads out a chain.
    - Event Builder & et puts the data on disk.
  - A module set (MS) is a unit of production consisting of 4 steel modules. The scintillator planes are read out by 2 chains, one east and one the west.
  - 2x2 MINERvA consists of 3 HCAL MS (4 scintillator planes), 2 ½ ECAL and 5 ½ tracker MS (8 scintillator planes)
  - The plots show this.
  - qhi is the most sensitive measure of pulse height.



# Module Sets



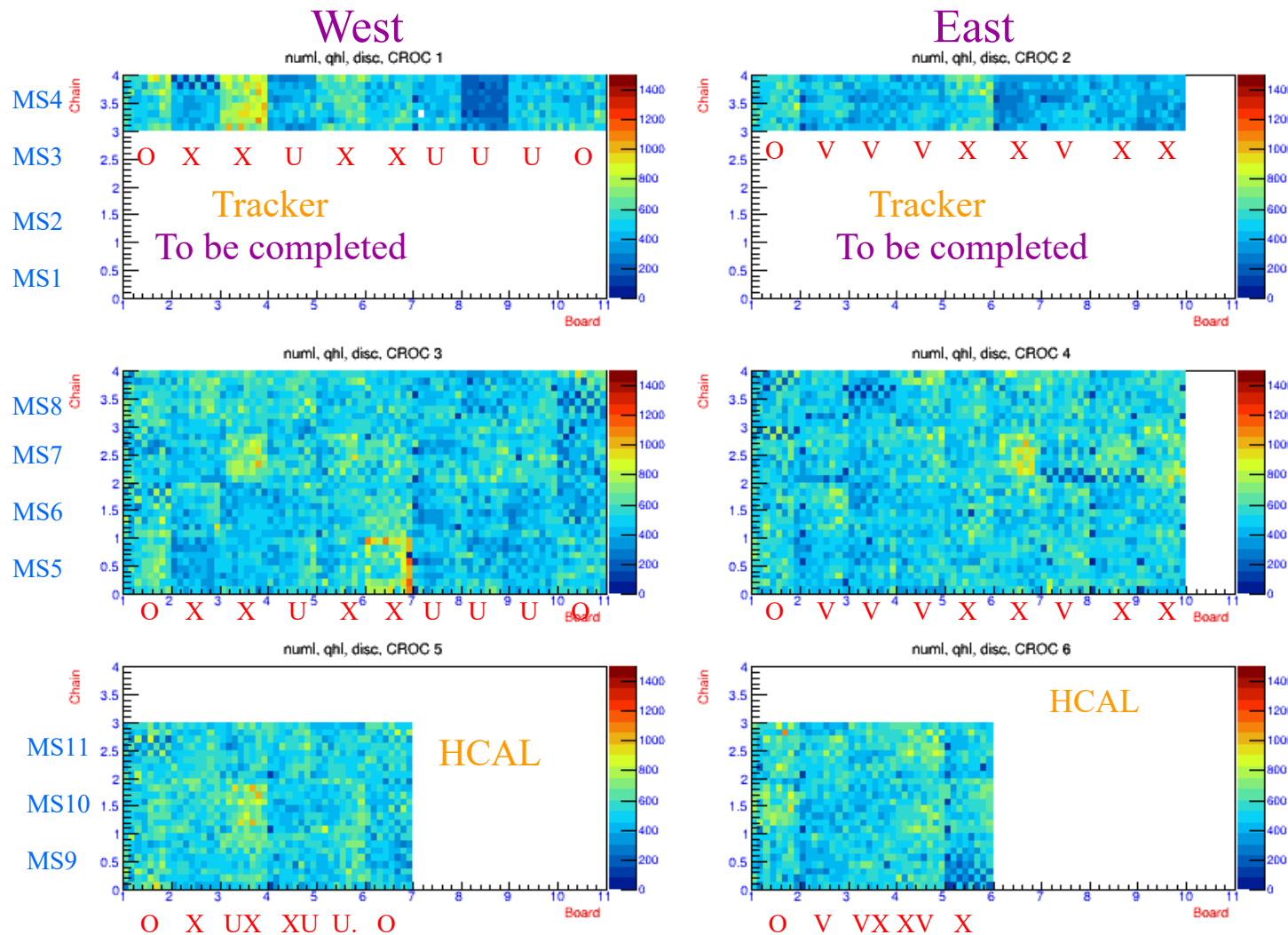
- MINERvA From above
- West side
- Left 3 are HCAL & the 4 on the right side are 2 ½ ECAL and 1 ½ tracker.
- FEB
- PMT
- Daisy Chain

Module Set, going up



# Ave Qhi for Pixel

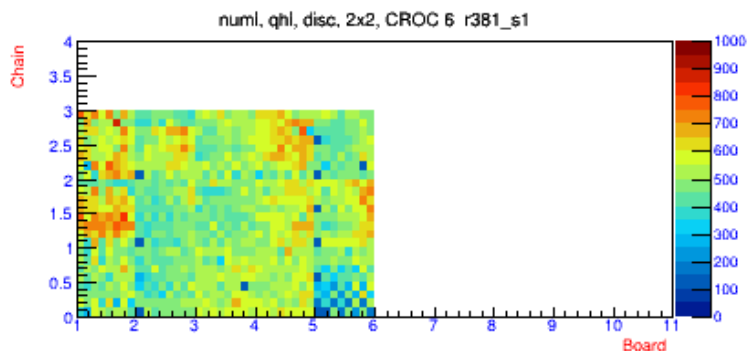
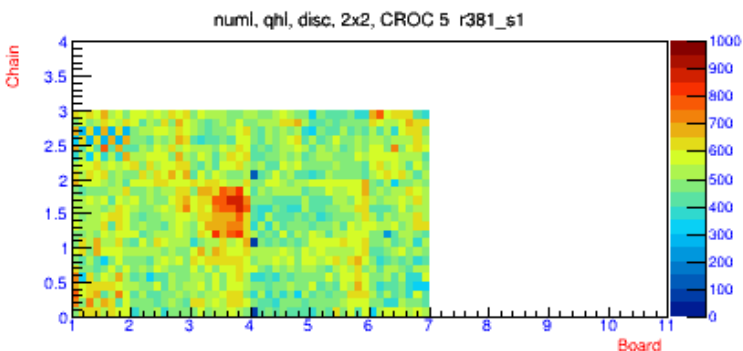
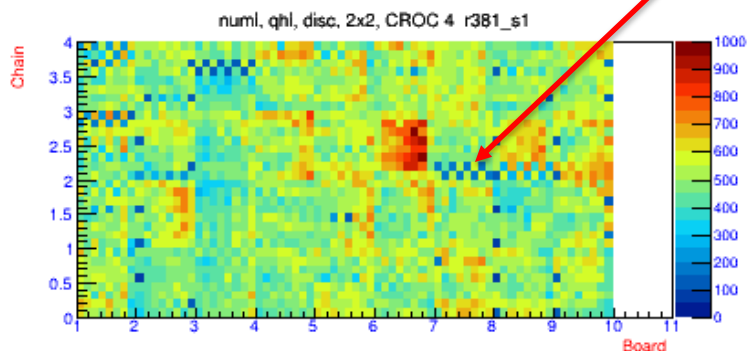
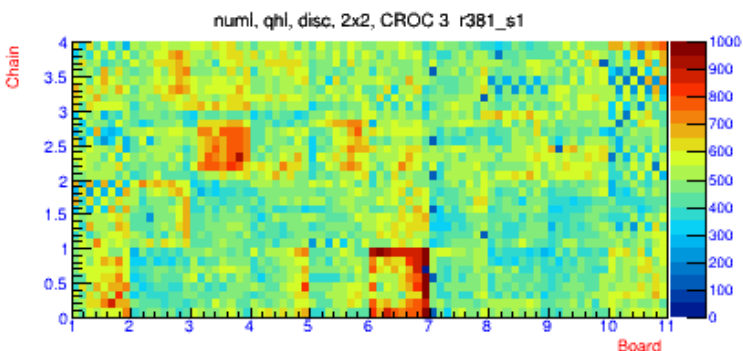
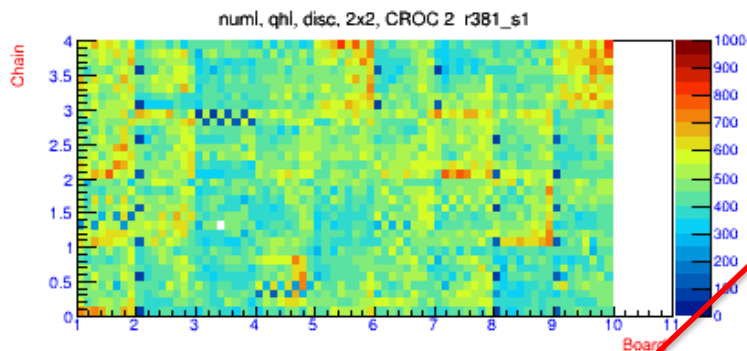
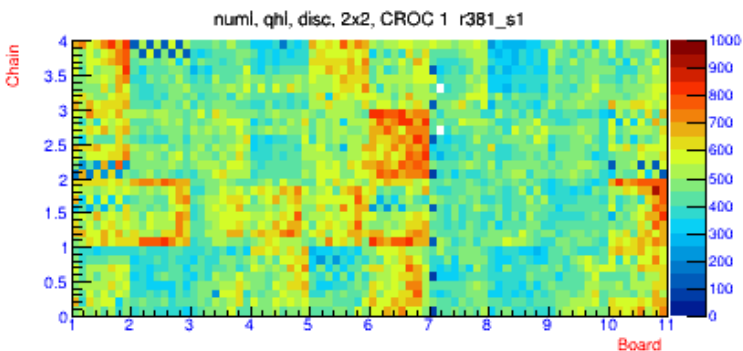
## Older plot, but shows geometry



- qhi for pixels, vs CROC, board & chain
- Plotted in MINERvA nearline
- Checker board pattern, cable not seeded
- O outer calorimer
- X x plane
- U u plane
- V v plane



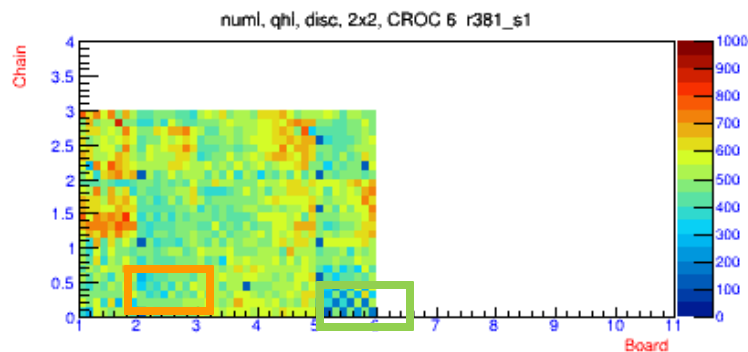
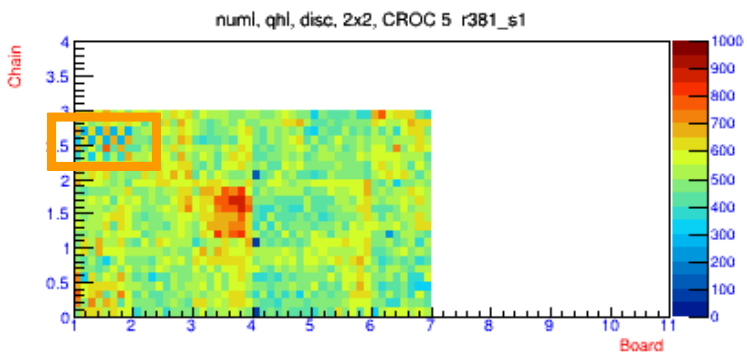
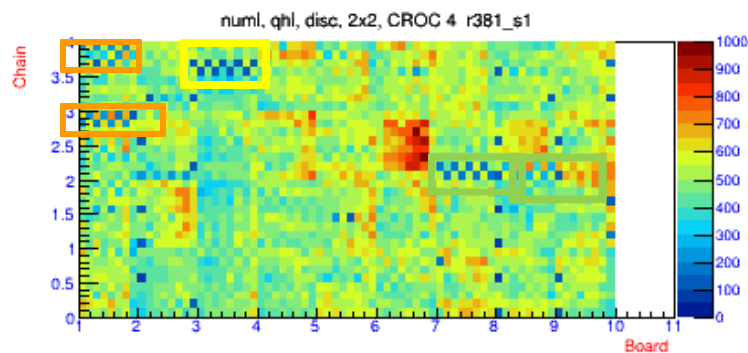
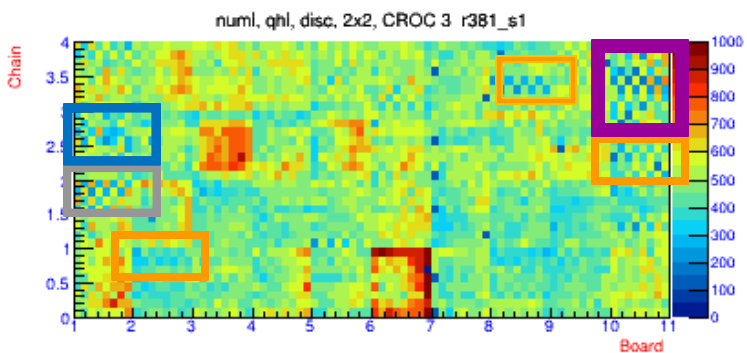
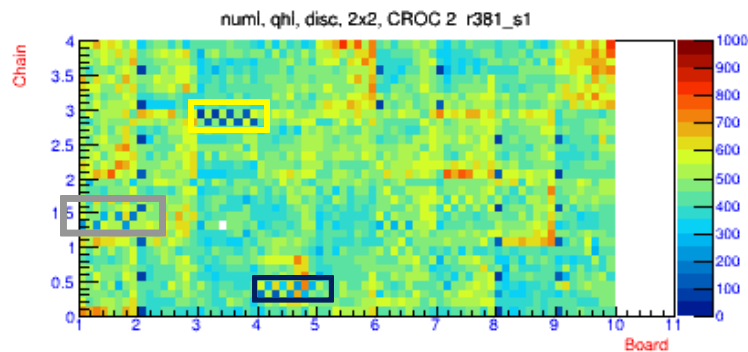
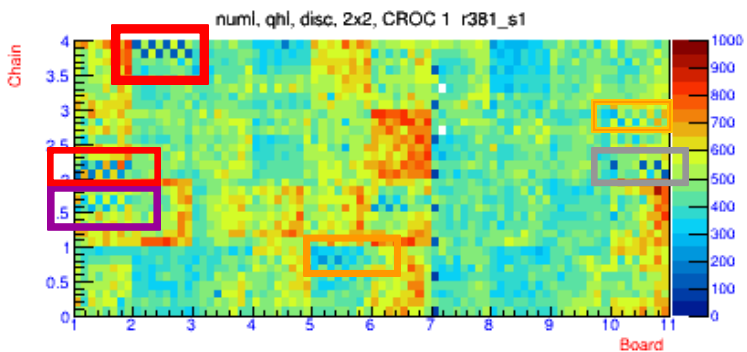
# Ave Qhi For Pixels



- After finishing assembly
- Cable not properly plugged in to a connect
- We see this in a variety of places



# Ave Qhi for Pixel Addressing the problem

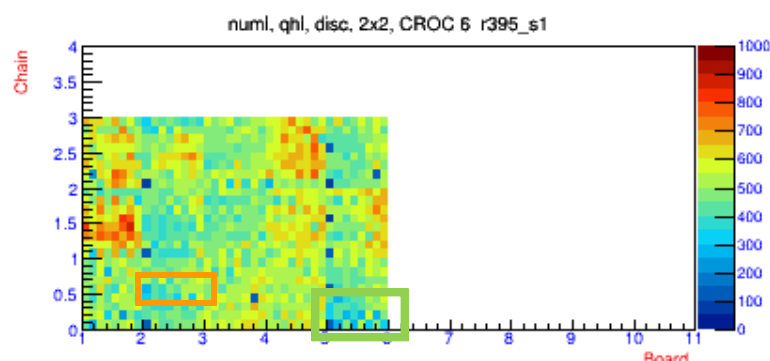
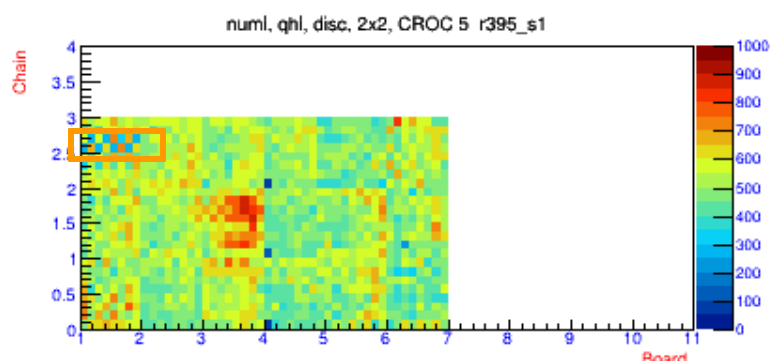
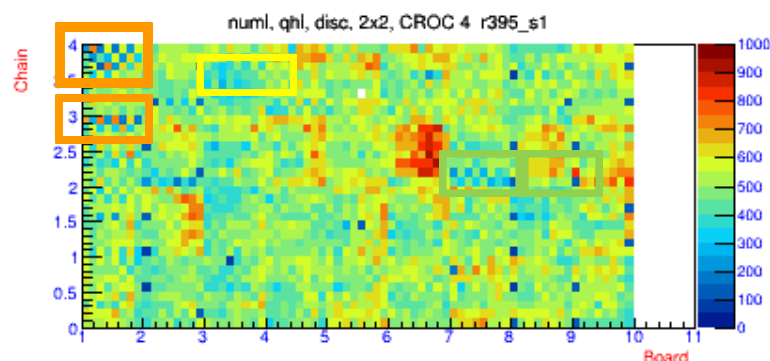
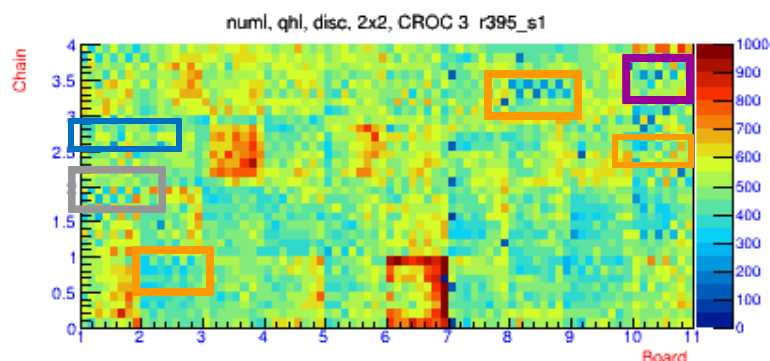
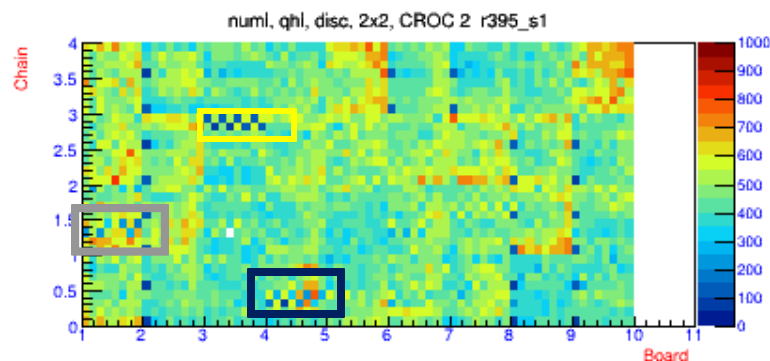
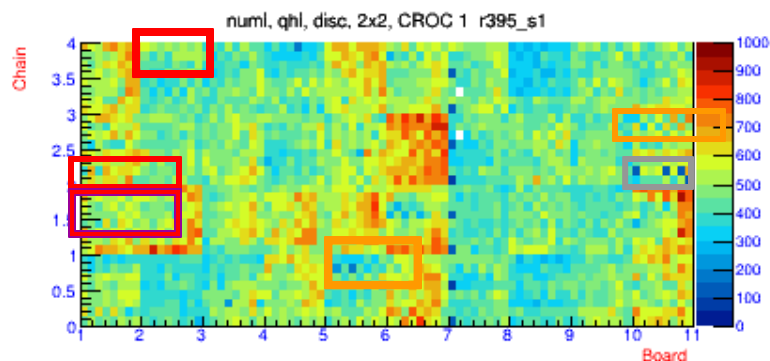


- Light Green, pushed on
- Red, not great connection
- Orange, nothing found
- Yellow, no cable
- Blue 7, loose @ PMT
- Dark Blue, maybe plugged into PMT
- Grey, unplugged at PMT
- Violet, unplugged at detector





# Ave Qhi After Fixing



- Light Green, pushed on
- Red, not great connection
- Orange, nothing found
- Yellow, no cable
- Blue 7, loose @ PMT
- Dark Blue, maybe plugged into PMT
- Grey, unplugged at PMT
- Violet, unplugged at detector





# Non fixed cables

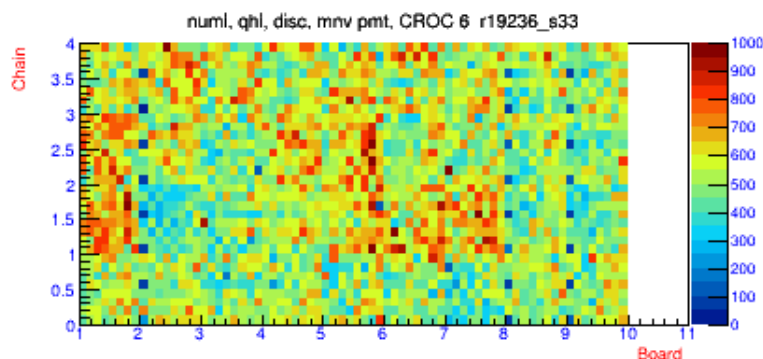
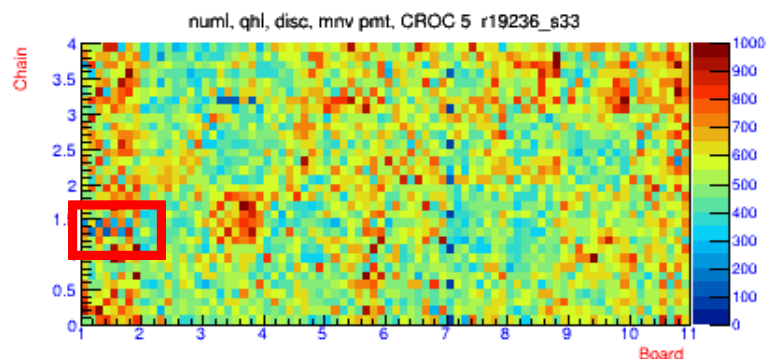
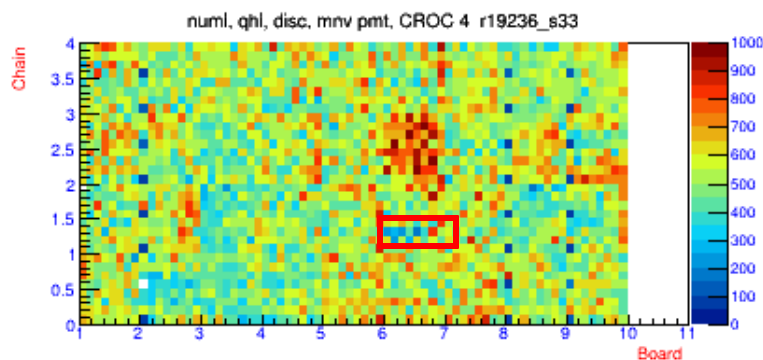
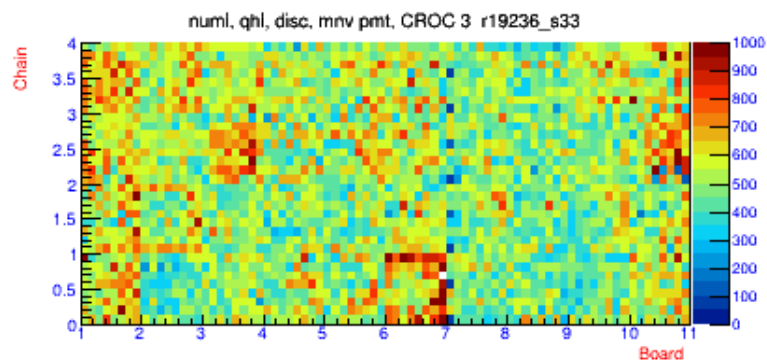
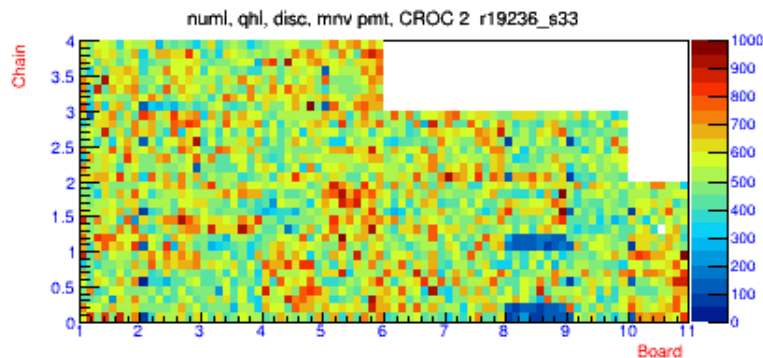
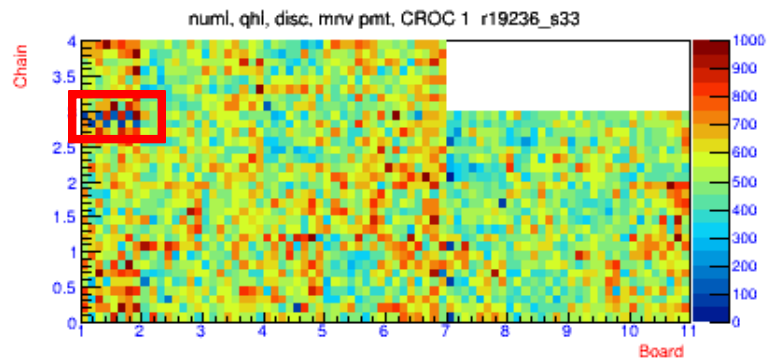


- MS WE Croc Chain BD cable action
- 1 W 1 0 5 1 nothing found
- 3 W 1 2 10 1 nothing found
- 3 W 1 2 5 5 one not looked at
- 3 E 2 2 3 1 Broken connector at detector
- 6 W 3 1 1 2 unplugged at PMT
- 5 W 3 0 2 1 nothing found
- 8 W 3 3 8 5 nothing found
- 8 E 4 3 1 1 nothing found
- 7 E 4 2 7 7 pushed on at detector – pushed at detector
- 7 E 4 2 1 2 nothing found
- 11 W 5 2 1 4 nothing found
- 11 E 6 0 5 7 pushed on at detector
- Could this be due to either the PMT box or the modules?



# MINERvA r19236

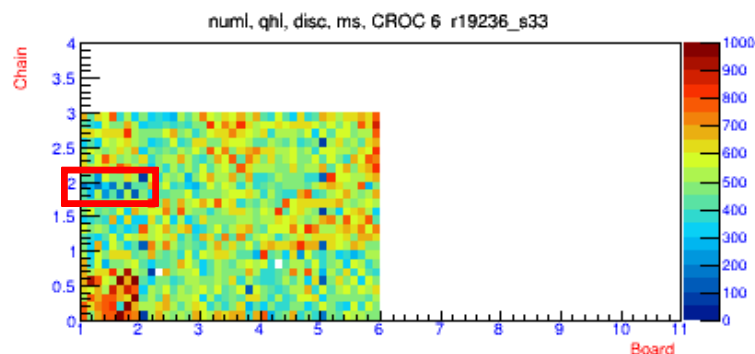
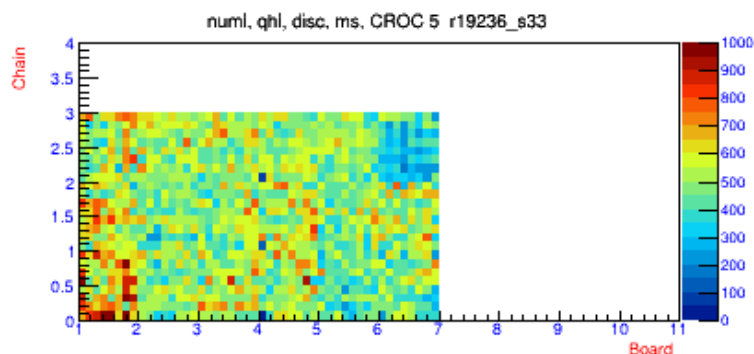
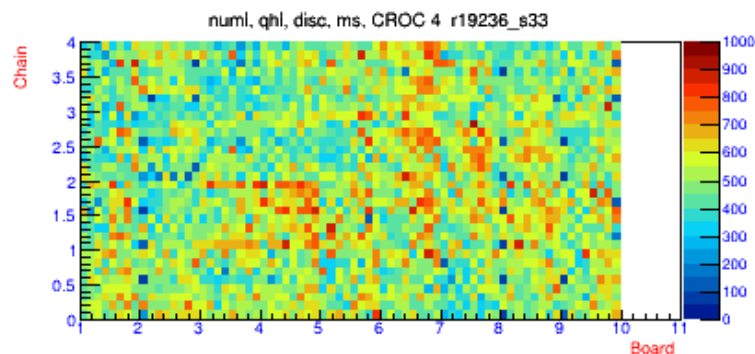
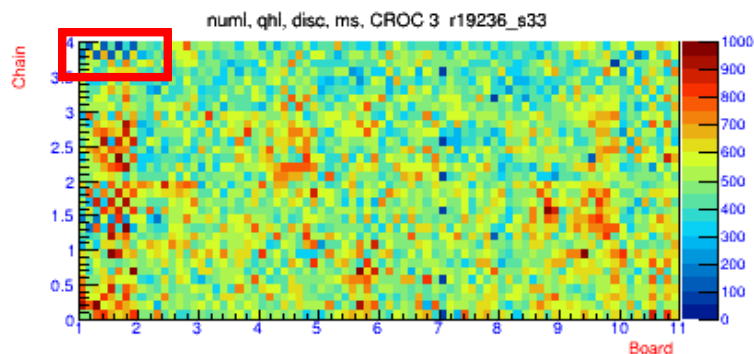
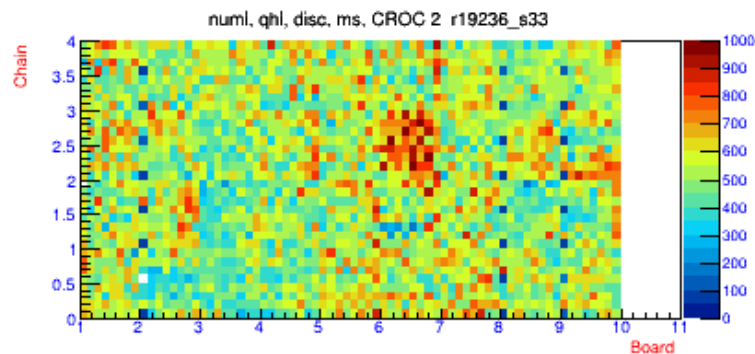
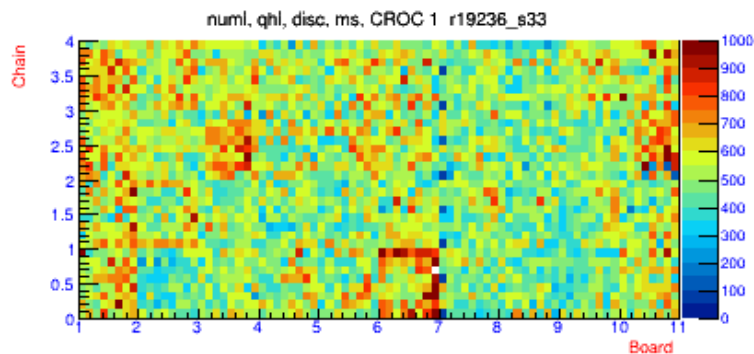
## Same CROCs, Match PMTs



- Same scale
- Matching PMTs
- We had to replace some PMTs, but none on the previous page
- Looks like cable problem is not a PMT problem
- Problem cables circled with box
- They do not match with problem cables in r395



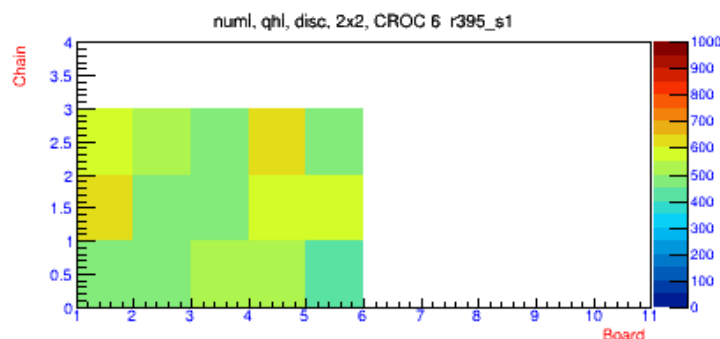
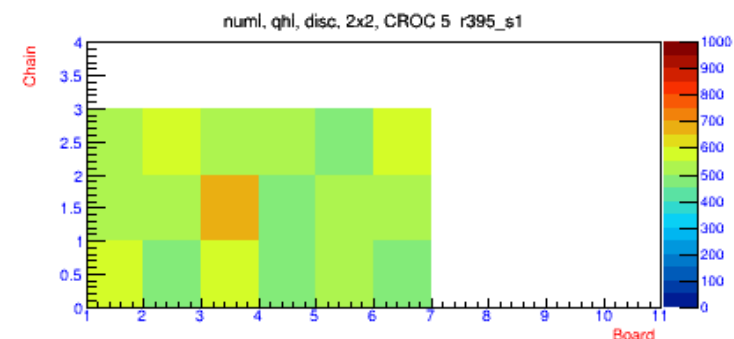
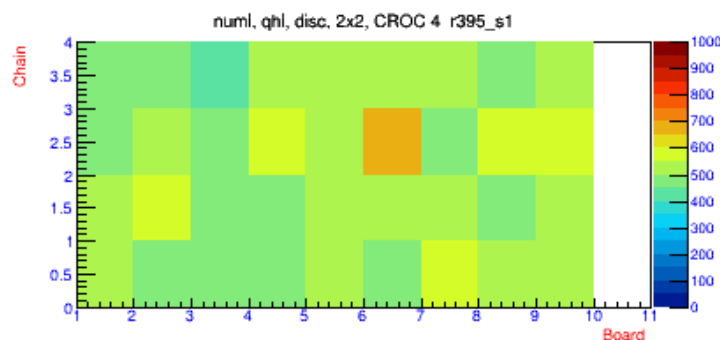
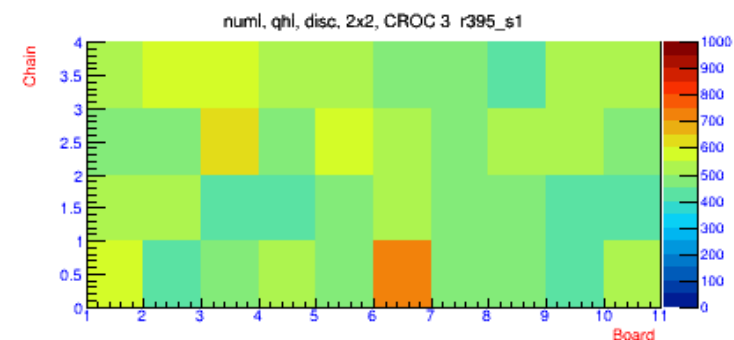
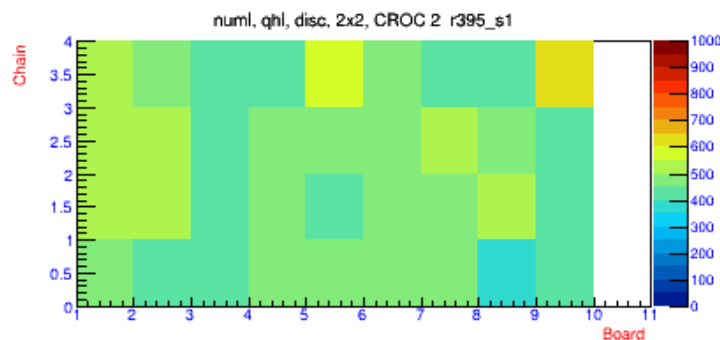
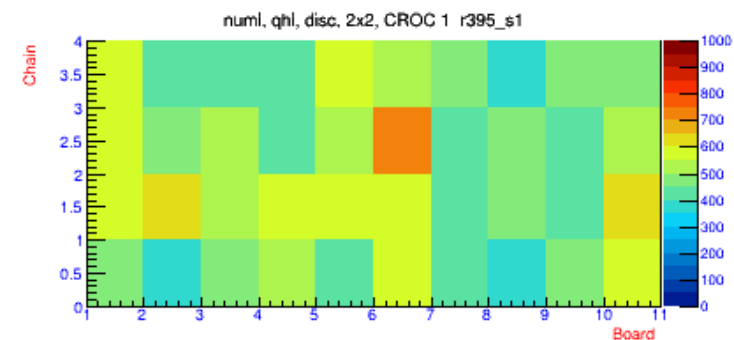
# MINERvA r29236 Match Module Sets



- Check if detector is the problem.
- Construct plot to put MINERvA module sets at same place for MINERvA 2x2
- Again, cable problem is not a module problem
- Our problem cables that we see in r395 are due to our assembly, not the PMT boxes or the detector



# Ave Qhi/PMT, 2x2



- Shows ave qhi/pmt
- Shows variation in gain of PMTs
- Boards 1, 10 & 6 for Chain 5. are outer calorimeter. They have square scintillator instead of triangles

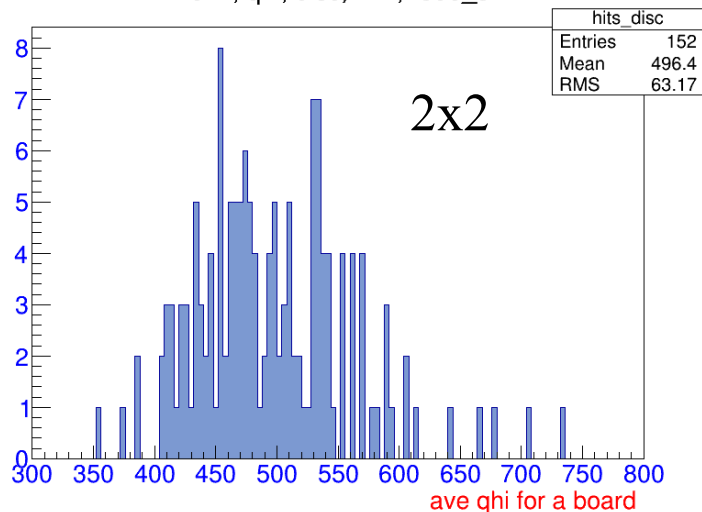


# Qhi board ave

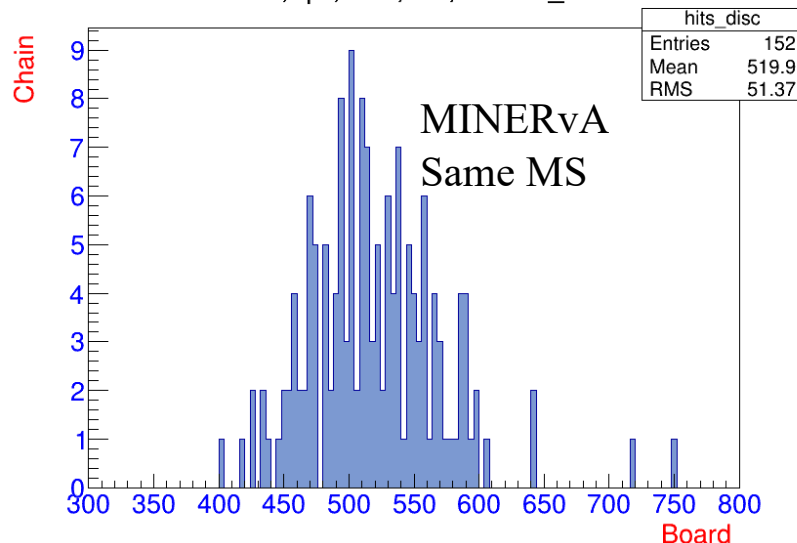
## 2x2, same PMT, same MS



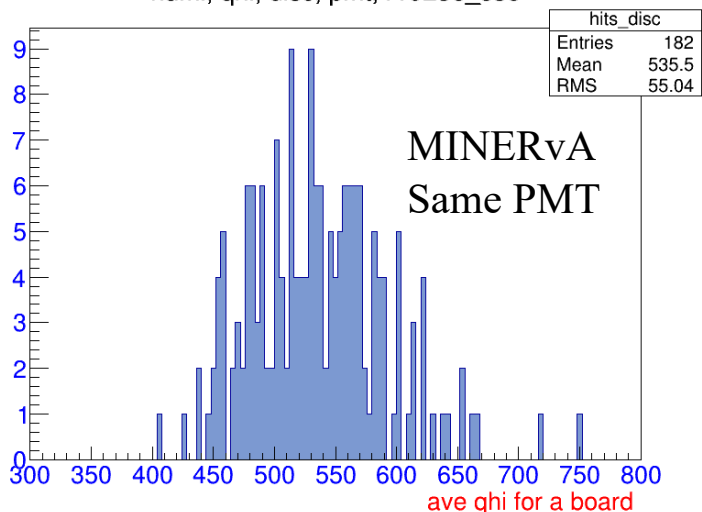
numi, qhi, disc, 2x2, r395\_s1



numi, qhi, disc, ms, r19236\_s33



numi, qhi, disc, pmt, r19236\_s33



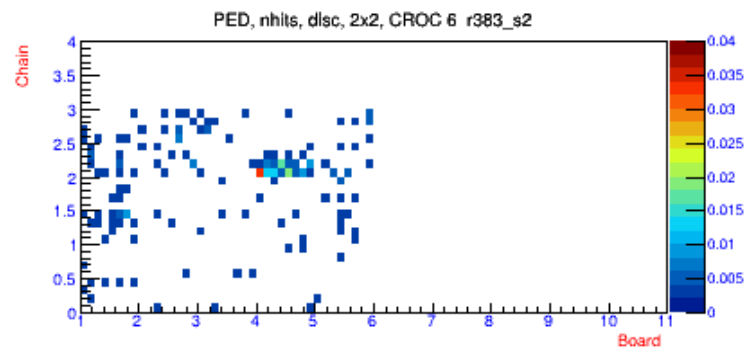
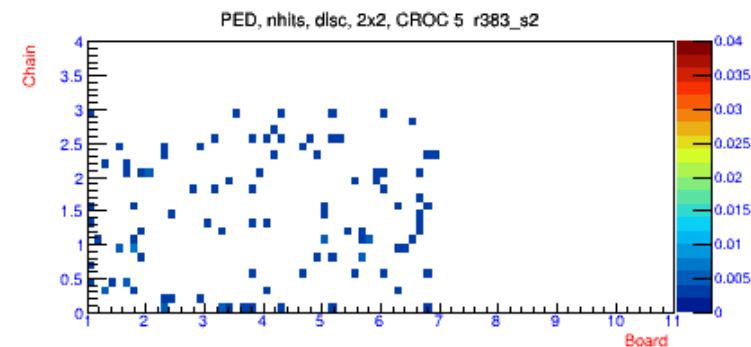
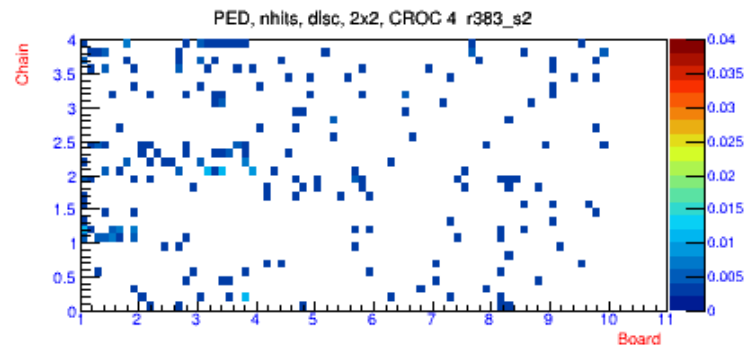
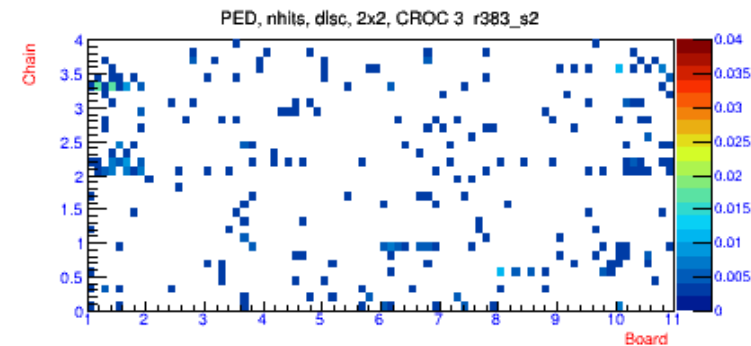
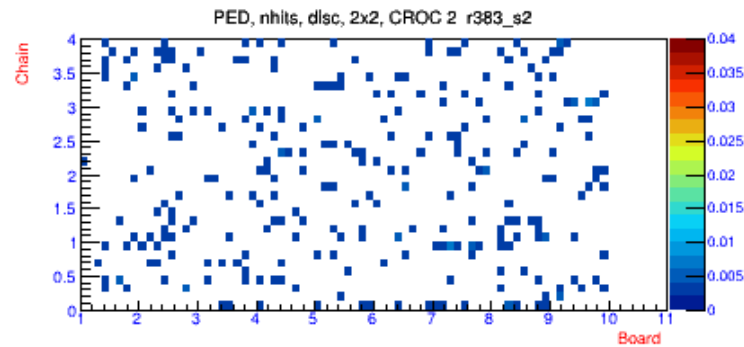
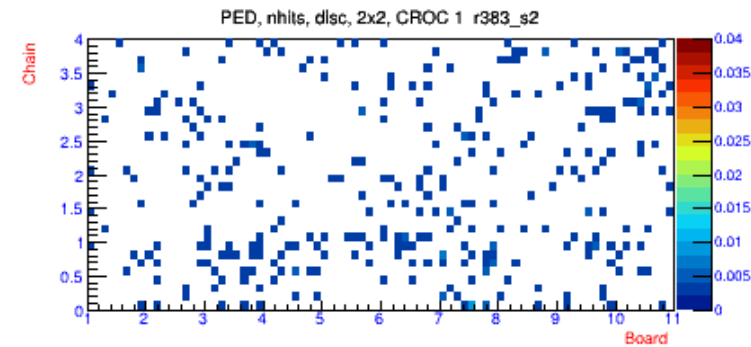
- Does not include outer HCAL calorimeter
- 2x2 = 496 av, 63 rms
- Ave of MINERvA plot = 528 av, 53 rms
- MINERvA HV determined by using RMS of LI pulse.
- The MINEvA ~ 4.5 years ago, maybe light ↓ ~ 1%/year.
- The beam is not centered at this same place on the detector so this could also be part of the difference.
- 2x2 has larger gain tubes or detector RMS, looks like tails
- The 2x2 looks similar to MINERvA with small change in the amount of light & slightly higher RMS



# PEDs, nhits



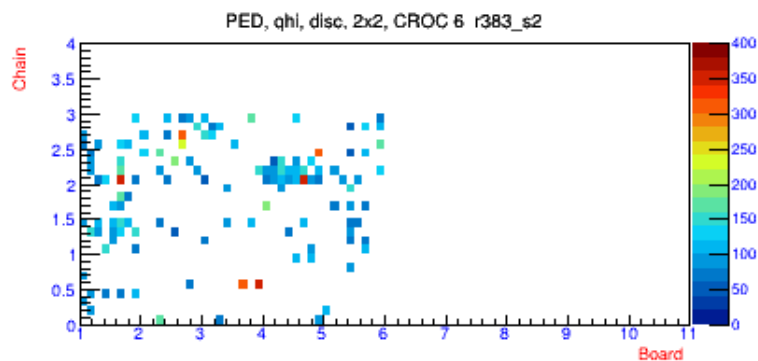
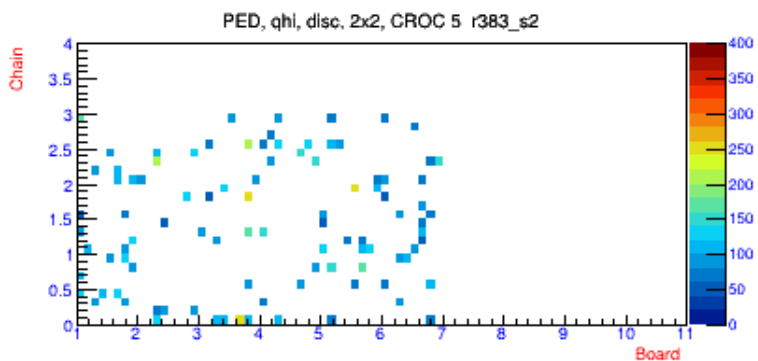
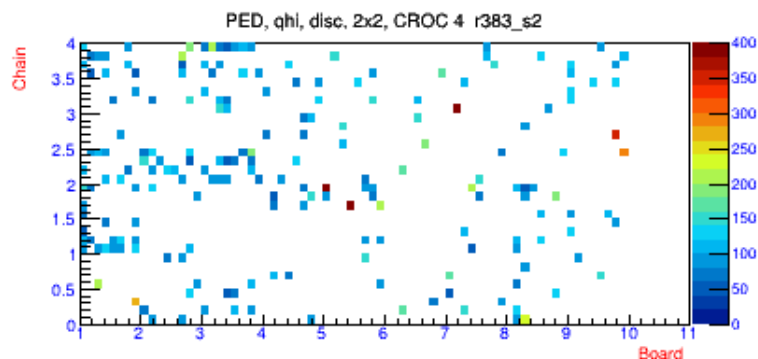
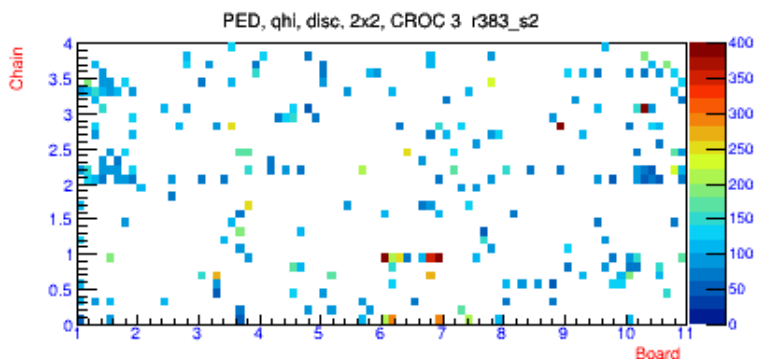
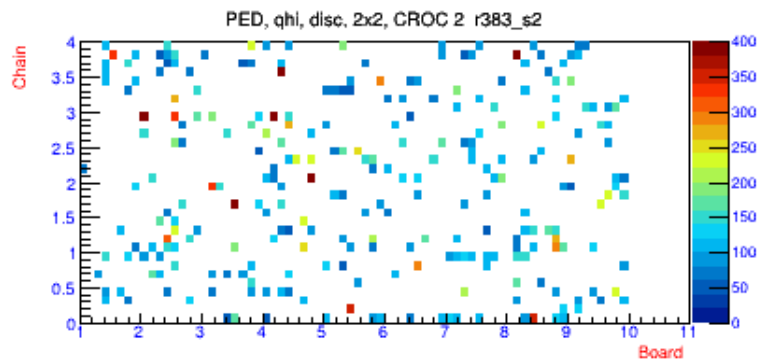
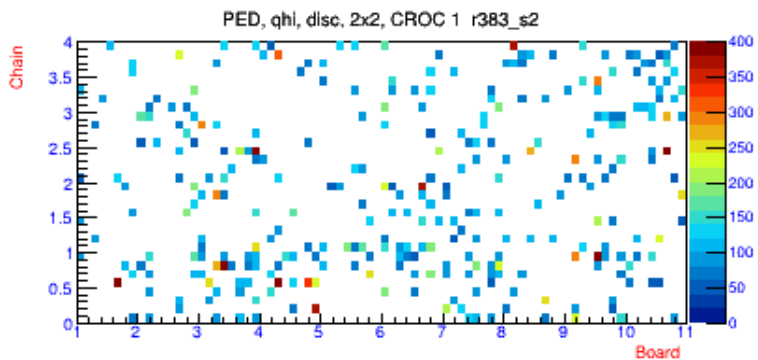
PED during light leak checking.  
Z axis changed from 0.25 to 0.04  
500 events







# Ped, qhi



Changed  
z axis to  
400  
instead of  
1500  
500  
events



# HV



- As stated before Cockcroft-Walton (CW) generator, designed by Sten Hanson for Quark Net, sets the HV of the PMTs. HV in configuration file.
- HV can become unstable. This was the major reason for replacing a PMT in MINERvA
- HV break down on or in the PMT or on PMT board? Some indications is it's in PMT
  - But CW can't generate much current, so a small breakdown causes a problem.
- I can look at this by going through all the DSTs and look at the all the PMT HVs
- The nearline program was stopping after every run. We were running the DAQ, but w was not making DSTs since it was such a pain.
- On Friday, I resubmitted the DST program and it is still running, the problem seems to have gone away.
- Nearline program is now using data files on local disk instead of using files on Blue Arc over the network. Looks like nearline over the network has problems.
- Looks like it will finish late this week, maybe beyond.
- So the HV issues will have to be presented next week.
- With the DAQ problem, making DSTs should be able to catch up.
- Numi, PED, or LI data work for this test.
- This is also a couple more tests I want to do, so I can try to show it at the same time