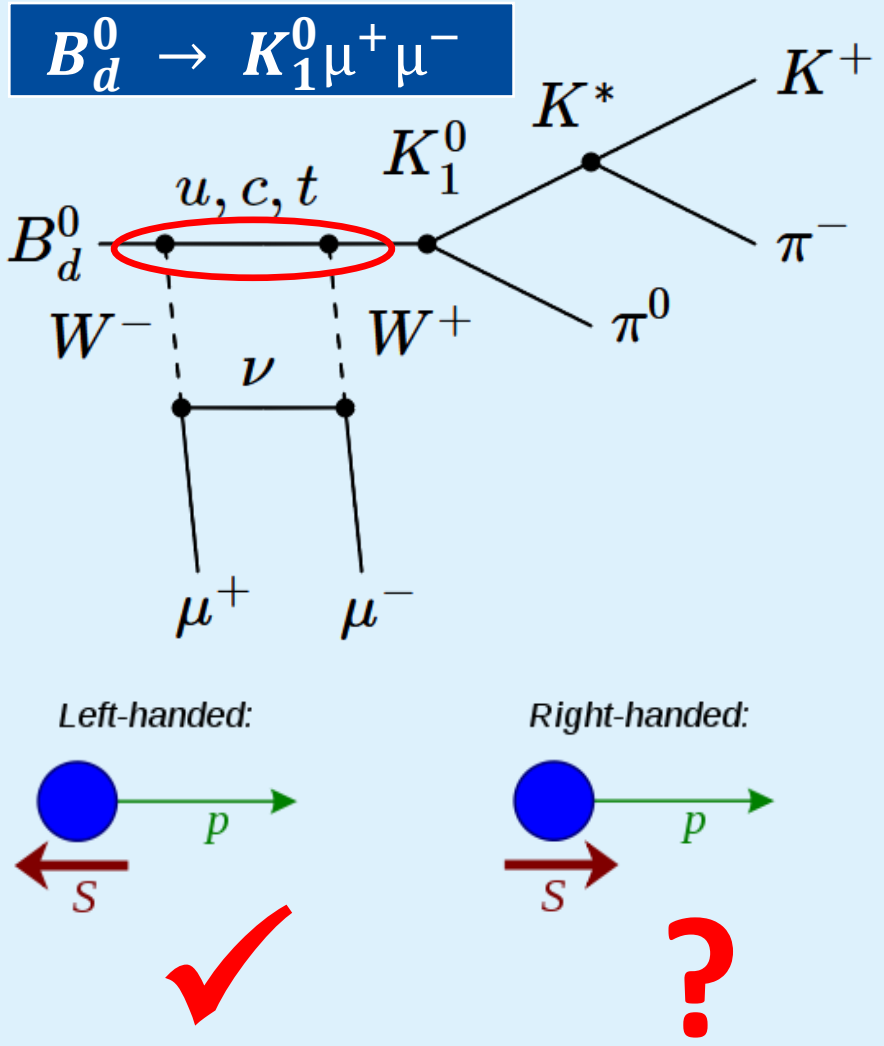
Liverpool Annual Meeting May 2023

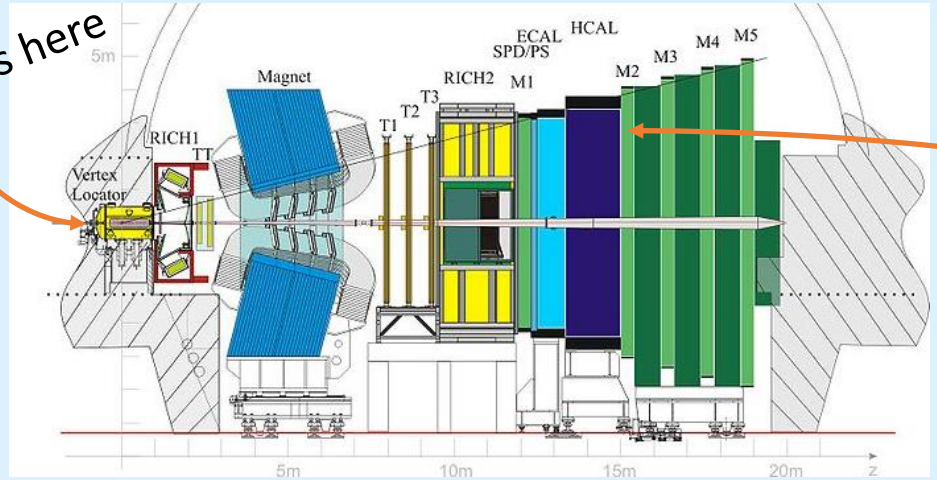
Analysis - Overview

- Standard model weak interactions are **exclusively left-handed**.
- Right-handed weak decays may exist but are ‘drowned out’.
- **Parity Doubling** - Comparing two channels with opposite parity states for accurate RH searches.
- Compare K_1^0 channel to the opposite parity K^{*0} channel to **accurately search for RH weak decays**.
- Also look at the R_K parameter and the possibility to search for CP violation.

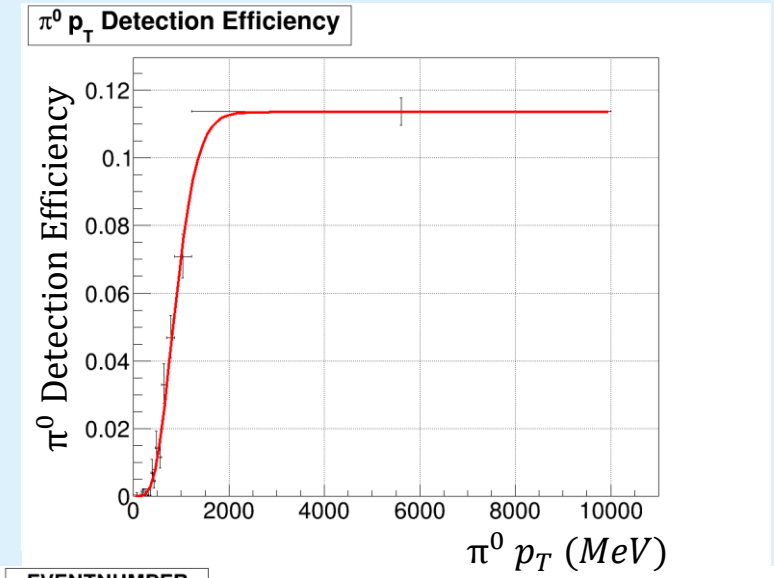


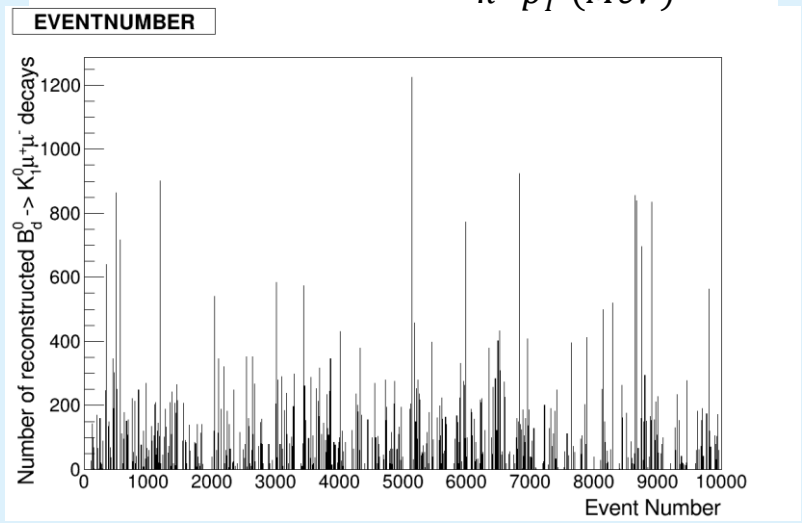
Analysis – The π^0 Problem

- π^0 makes reconstructing full decay incredibly difficult.
  - Very low track efficiency (avg. ~8%).
  - Little information about the π^0 is available.
  - Contributes many combinations, making finding the true decay accurately near impossible.



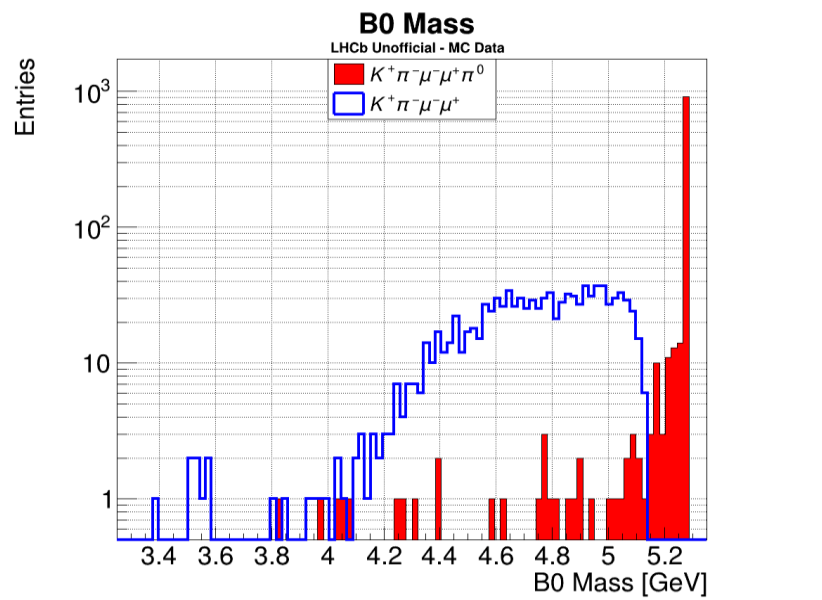
The only recognition of the π^0 is in HCAL, ~15m away!

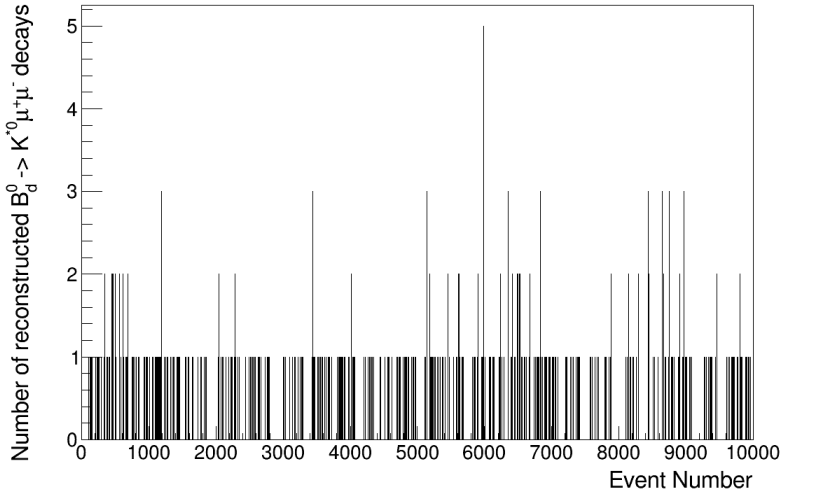




Analysis – The π^0 Solution

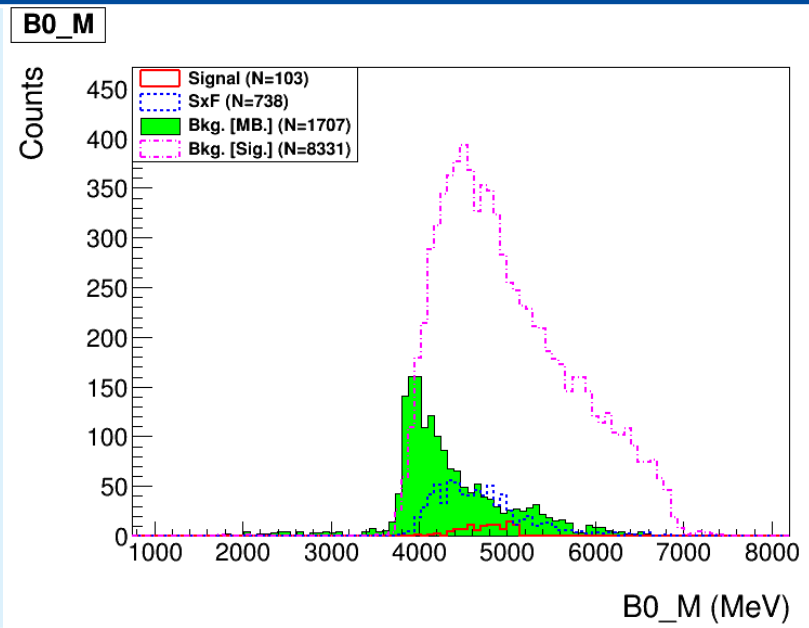
- Solution: Reconstruct as $B_d^0 \rightarrow K^{*0}\mu^+\mu^-$.
- The missing π^0 will carry some energy away.
- Reduced mass peak for the B0.
- Severely reduces the number of combinatorics to a manageable level.
- Much greater efficiency, many more events.



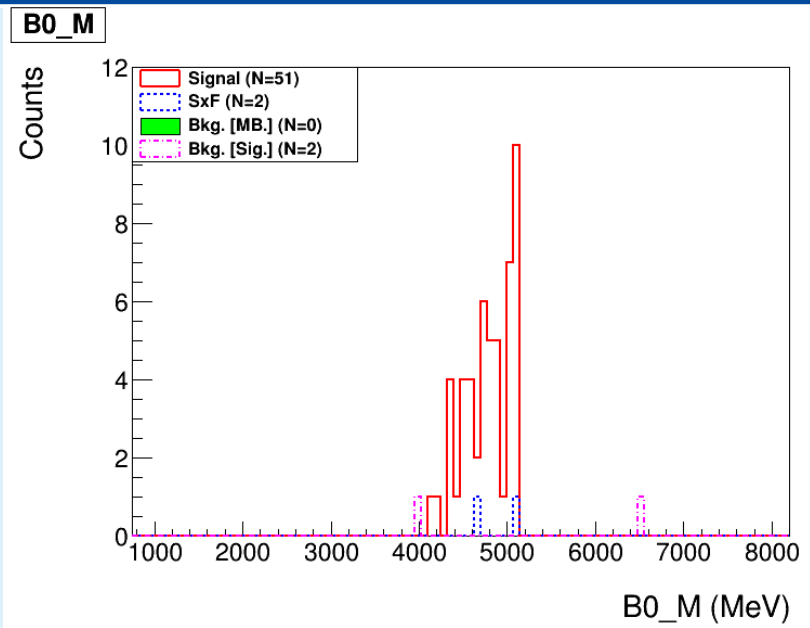


Analysis – Current Status

Currently working on re-selecting the Run1&2 data.
Example working plots that show the reduction of background:



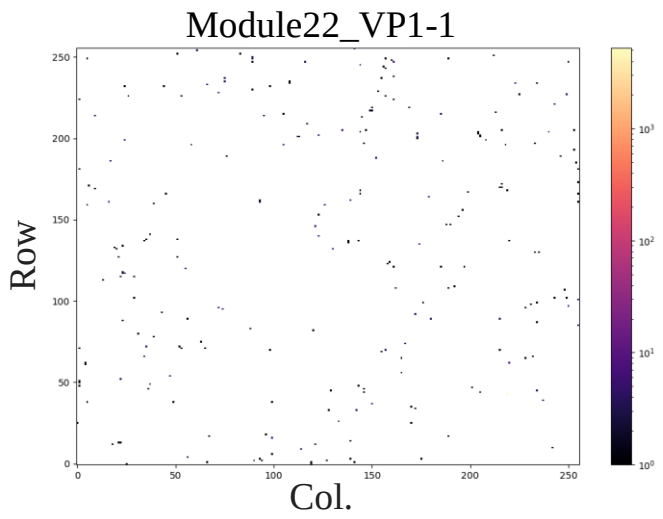
Apply selections



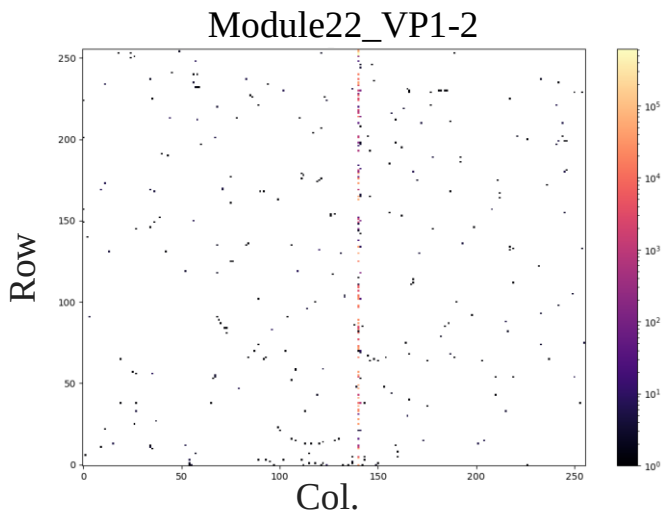
- Awaiting more background data to tune this further.
- Selections for upcoming Run3 data taking are ongoing.

Velo Noise Analysis - Overview

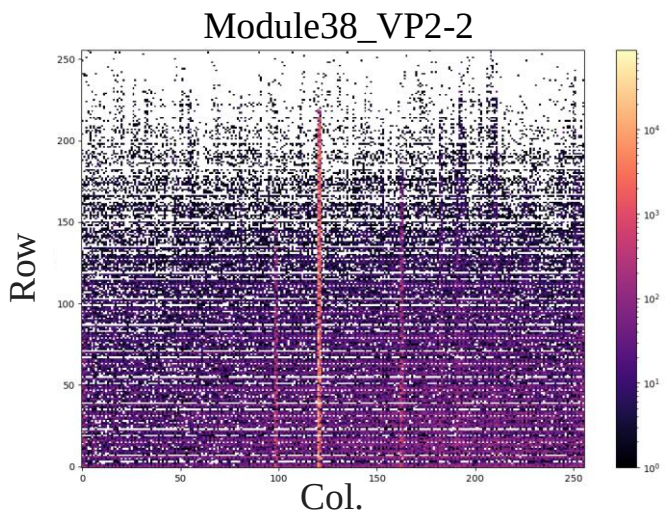
- Performing a study on the noise present in the VELO sensors.
- Data taken without beam (some ‘real’ hits coming from random decay).
- Various examples of pixel maps from this data (nEvents = 500 M):



Random Noise



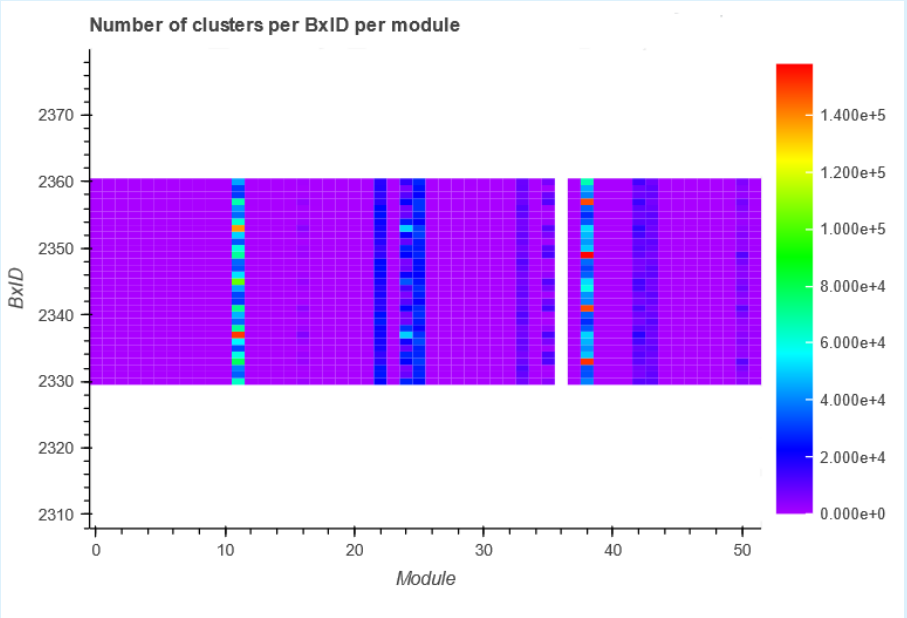
Noisy Column



Noisy Chip

Velo Noise Analysis – Current Status/Future

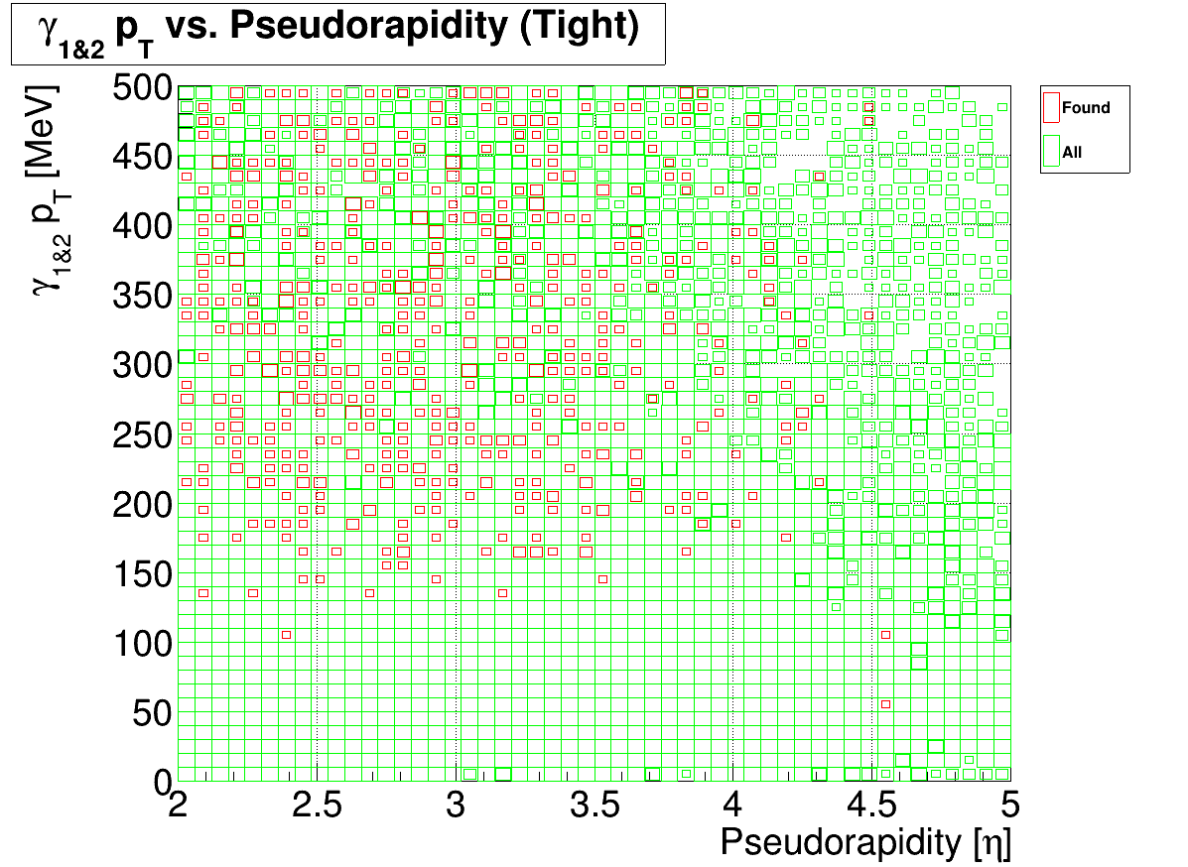
- The cut-off of 1 kHz per pixel, allows max data flow whilst removing the noisiest pixels that cause issues.
- Still some noisy pixels in chips that could be removed with more analysis.
- Investigate interesting observations as they appear.
- Study the effect of the beam on the noise (BE & BB).
- Implement a real time (live) monitor for the noise.
- Add system alerts for high noise.

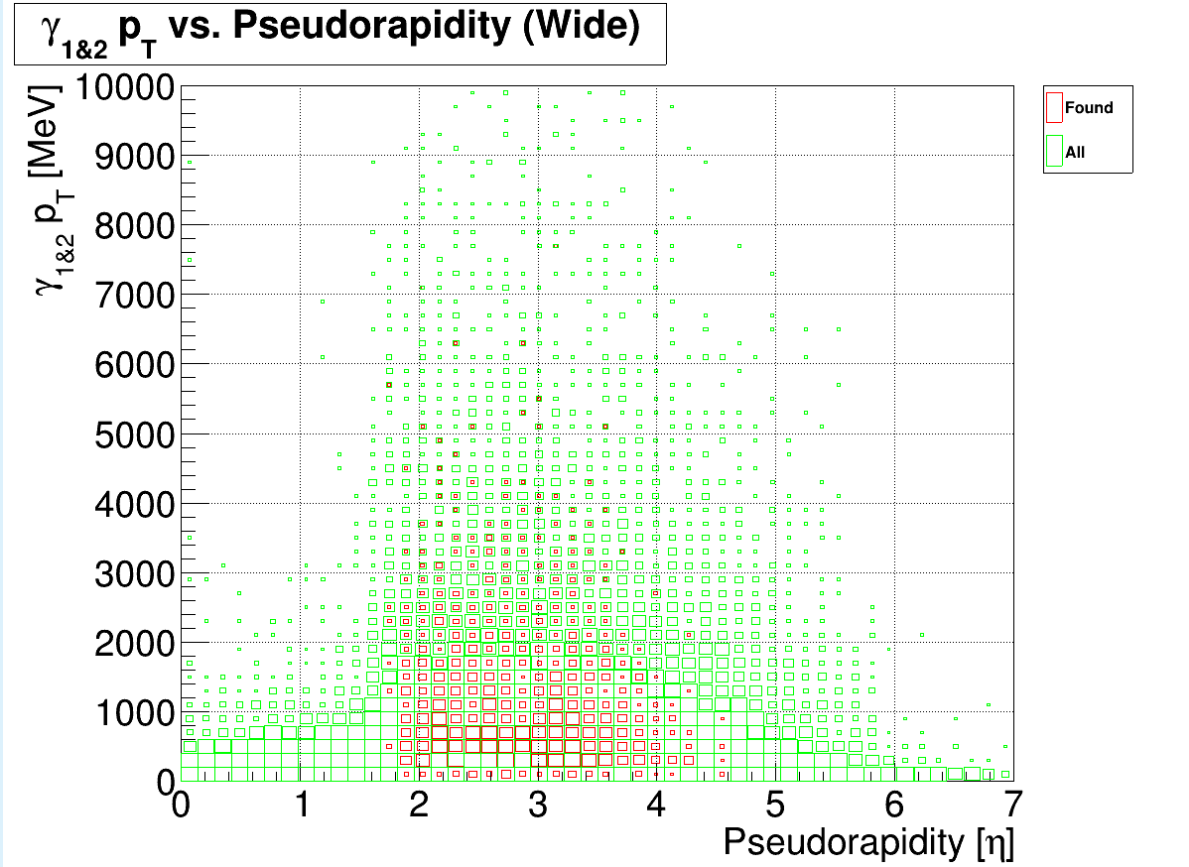


Thanks for Listening!

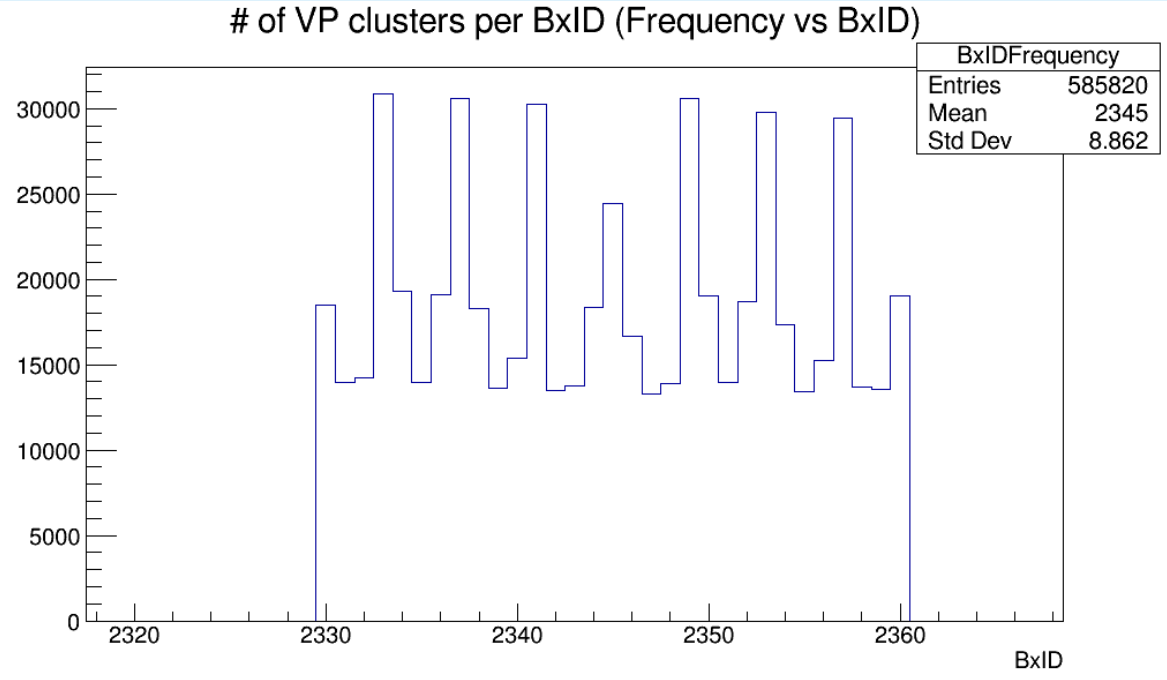
Backup - Analysis – The π^0 Problem

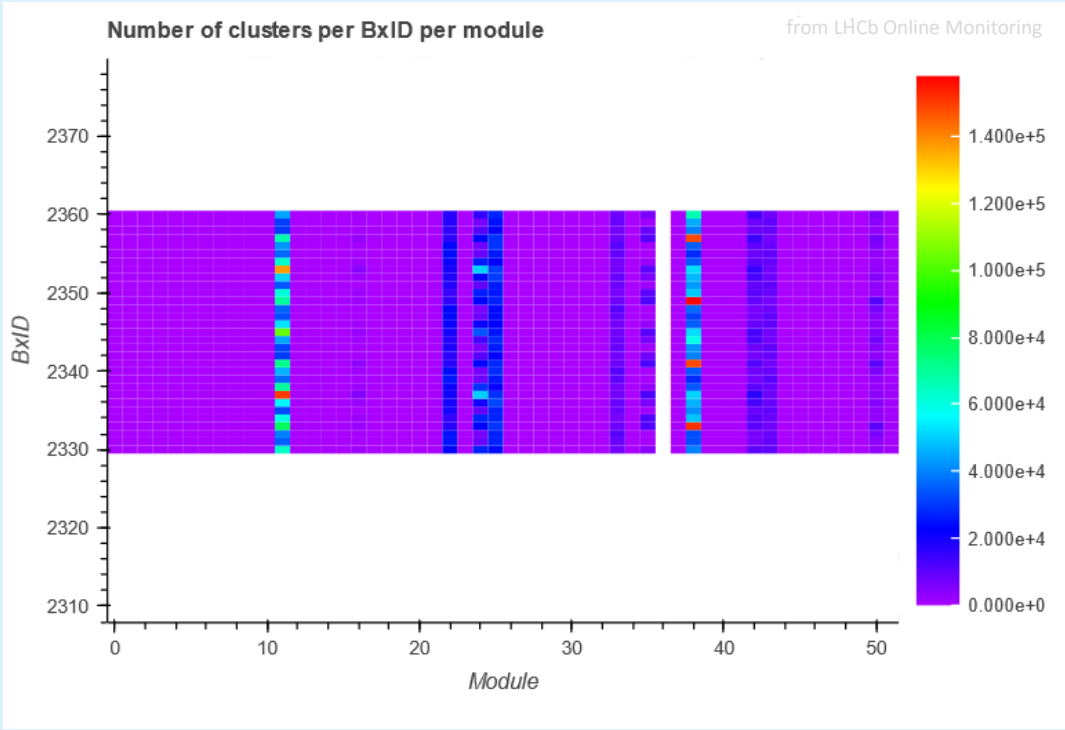
More pretty plots : Large loss of events to low energy photons and those outside acceptance.





Backup - Velo Noise Analysis





The number of clusters per bunch crossing (BxID) shows a peculiar recurring pattern. When the contributing clusters are divided to their respective modules it's clear that this is coming from chips that have been identified as noisy. The repeating nature of the pattern is likely due to the noisy pixel(s) firing at regular intervals.