UPDATE TO SN TRIGGERING

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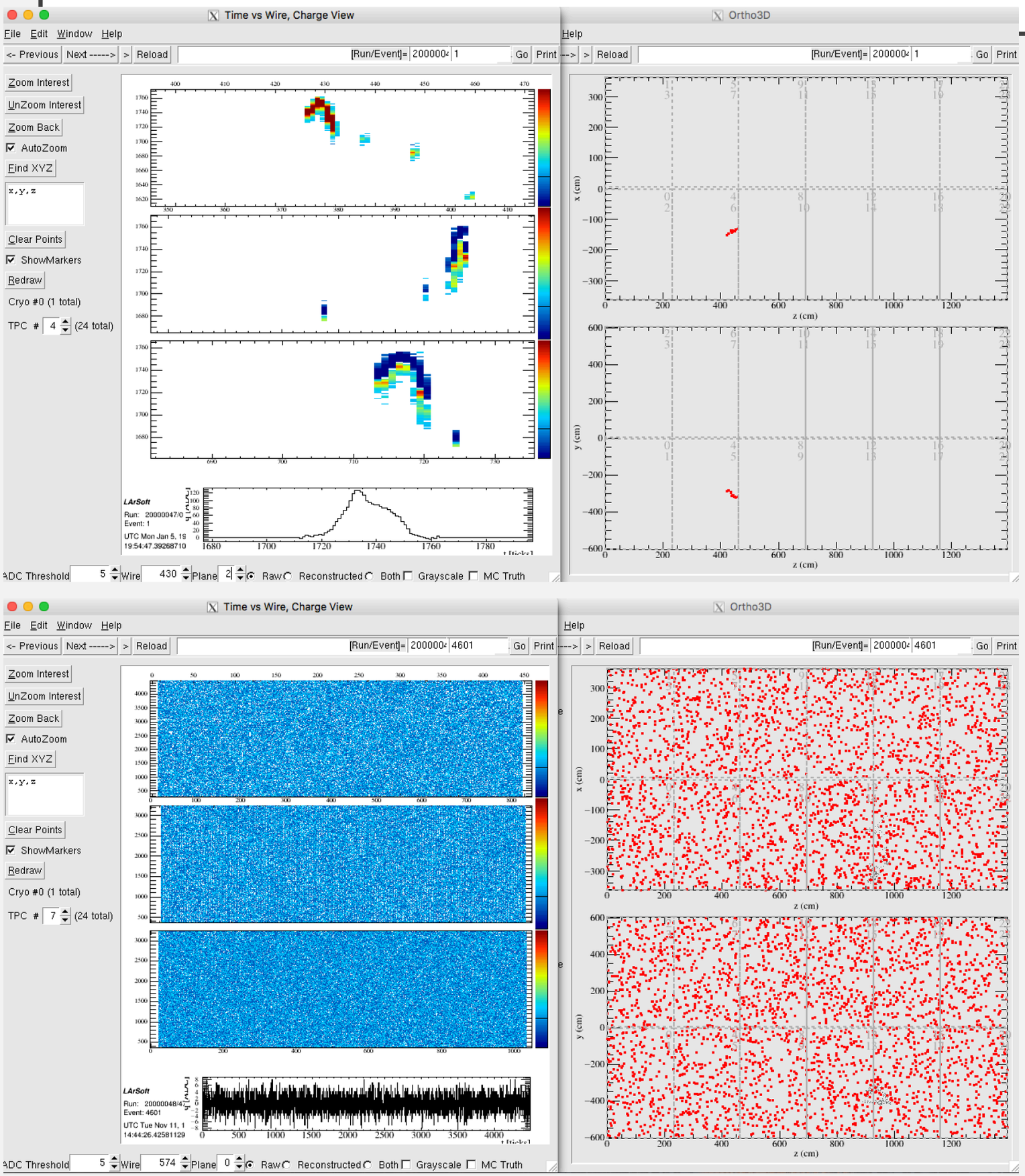
STATE OF SIMULATIONS

- Building on lots of the work done by other people;
  - Using the radiologicals which Jason is working are the key background, so they are really crucial in evaluating whether our triggers are feasible.
  - Using the time-profiled MARLEY events which Steven has been working on will mean that we can get some time-profiled triggering evaluations - unfortunately I haven't quite got this far yet.
- Want to simulate the prospect of triggering on the TPC information in the front end boards. Therefore need to use the raw::RawDigits (LArSoft speak for raw data sim).
  - This is after ZS && Comp are applied, so will want to study the effect of loosening things etc.
  - Need to find a way of evaluating whether a "hit" is present → FastHitFinder.
- Figure out which generator (MARLEY, Ar39, Ra…) a given hit was caused by, and make a vector of all of these hits. Loop through that vector and find the "hit occupancy"
  - Hit occupancy is defined as the number of hits within a given tick (time) && channel (space) region.

WHAT IS THE FAST HIT FINDER?

- Developed for the 35 ton – thanks to T. Blackburn, A. Booth, M. Stancari!
- Was initially designed for quickly looking at collection plane signals, but proved very helpful in calculating signal/noise ratios.
  - For collection planes it looks for two hits above a threshold. Calls this the time of the hit, and moves on. Doesn't work out hit width / hit integral.
  - For induction planes it looks for the "crossing point" (where ADC is 0) and calls that the time of the hit. Again, doesn't work out hit width / hit integral.
- At the collaboration meeting there was feedback about ways to improve this to make it more of a rolling sum from 0 in an effort to increase the sensitivity to some of the low charge hits.
  - I need to have a look at how easy this would be to code up though…

WHAT WE ARE UP AGAINST



- Top. A MARLEY generated event, notice that it goes over ~10 hits, which are highly concentrated in space and time
- Bottom. An event with Ar39 radiologicals, notice the insane number of hits! Luckily though it appears that they are largely isolated.
- Previous studies (+ new Georgia) have calculated various data rates depending on thresholds etc.

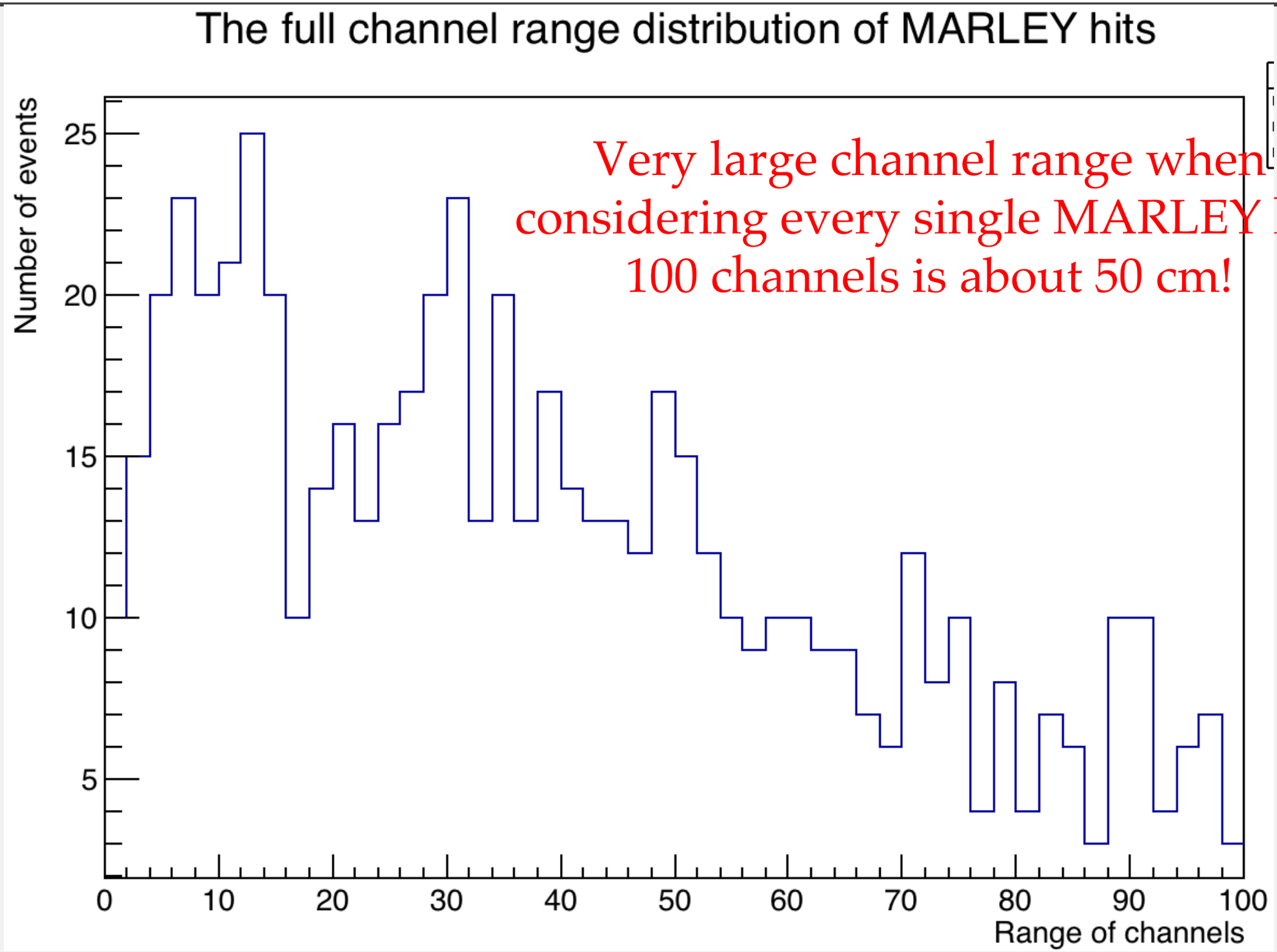
PLANNED WORK

- There is a sample of 10k MARLEY events with a time profile, plus radiologicals (not Ar42 – we should resim to add this) upon which I have ran the FastHitFinder with thresholds of 5, 10, 20, 30 ADC counts.
- I will then run my analysis script over these samples, and produce plots of;
  - Full Time / Channel range of MARLEY hits – similar to what Bruno has done.
  - Largest ”cluster” (group) of hits when using a time window of; 25, 50, 100, 200, All ticks.
  - Largest ”cluster” of hits when using a channel window of; 10, 20, 30, 50, All channels.
  - The number of “clusters” (above 3 hits for speed) for MARLEY && NotMARLEY when using windows of;
    - 25 ticks && 10 channels 50 ticks && 20 channels 100 ticks && 20 channels 100 ticks && 30 channels 200 ticks && 50 channels
    - The number of triggers issued when requiring a minimum of 5 or 10 hits within the window.
- I will then make some triggering efficiency plots showing all of these relationships.
- This will be done for both the induction and the collection planes.

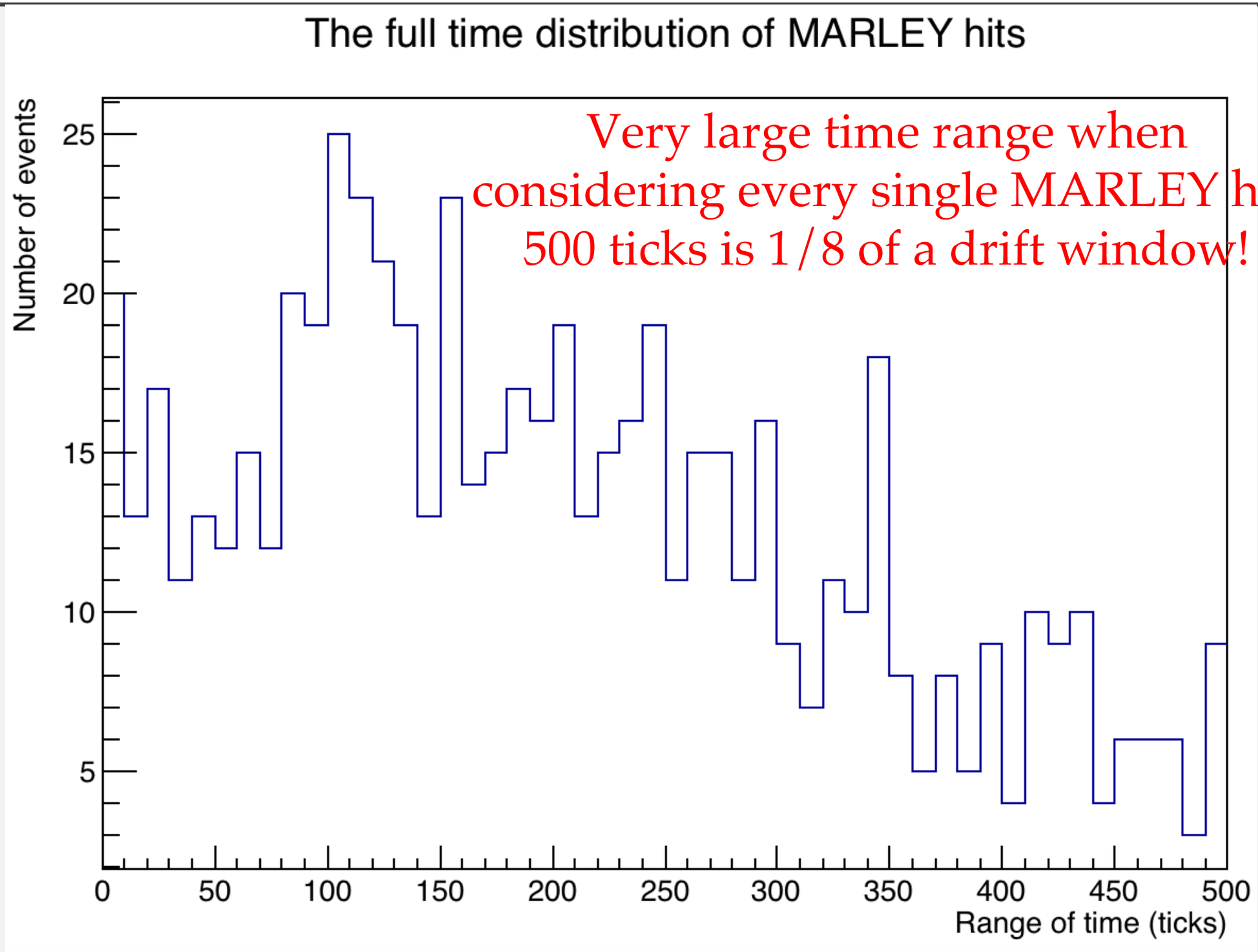
WHAT I HAVE SO FAR

- Unfortunately I didn't have time to make the triggering efficiency as a function of FastHit threshold and Triggering threshold for different Trigger windows plots.
- Will show, a previous run of 1000 events getting MARLEY only hits;
- The MARLEY chan / time range for Col planes at with a FH threshold of 5.
- The number of adjacent MARLEY hits for different channel windows
- The number of adjacent MARLEY hits for different time windows.

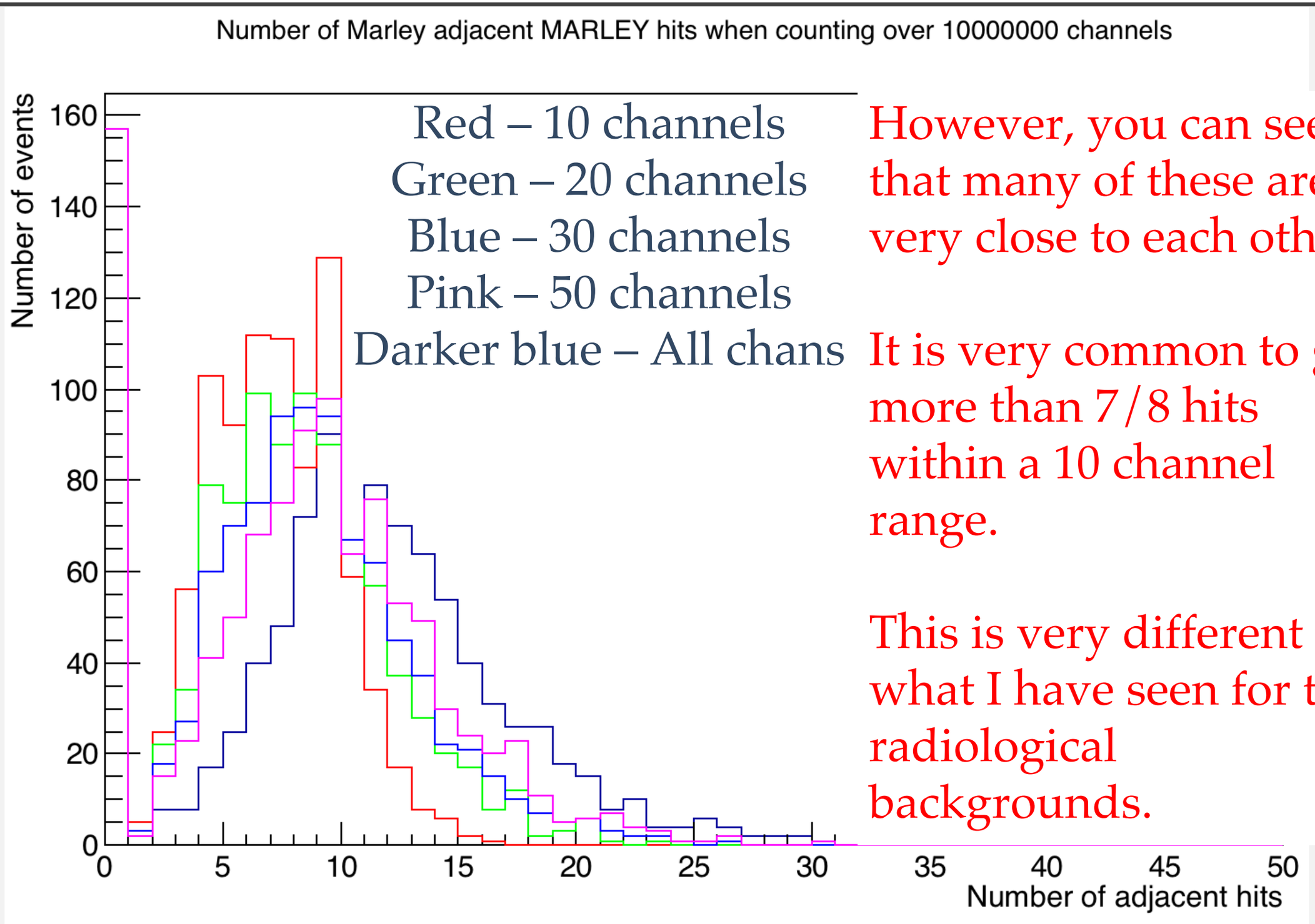
CHANNEL RANGE



TIME RANGE


The full time distribution of MARLEY hits
Number of events
25
20
15
10
5
0
50
100
150
200
250
300
350
400
450
500
Range of time (ticks)
Very large time range when considering every single MARLEY hit.
500 ticks is 1/8 of a drift window!

NUMBER OF ADJACENT HITS OVER CHANNEL RANGES



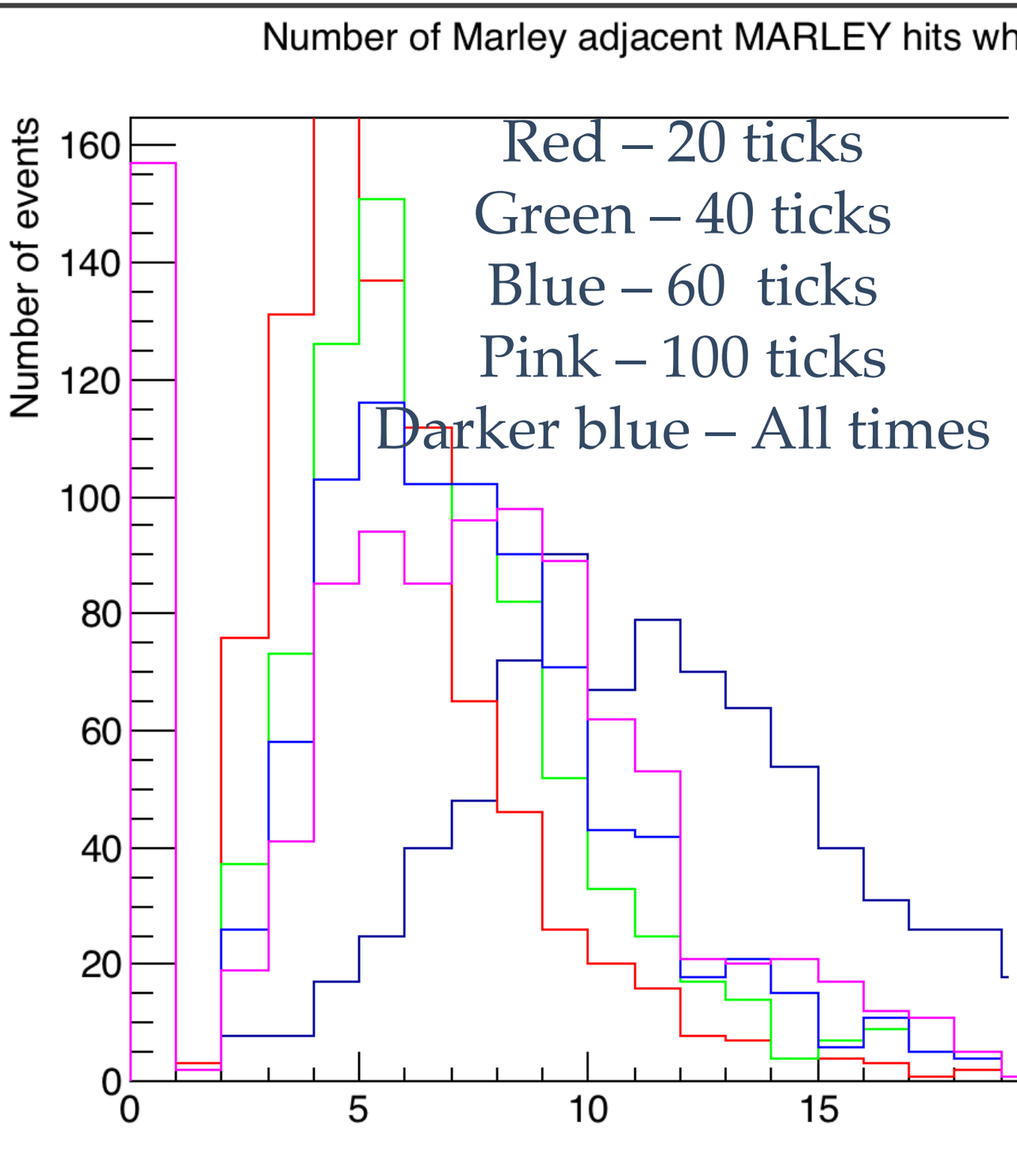
Red – 10 channels
Green – 20 channels
Blue – 30 channels
Pink – 50 channels
Darker blue – All chans

However, you can see that many of these are very close to each other.

It is very common to get more than 7/8 hits within a 10 channel range.

This is very different to what I have seen for the radiological backgrounds.

NUMBER OF ADJACENT HITS OVER TIME RANGES



Again, can see that many of the hits are correlated in time.

Whilst the plot indicates that 20 ticks may be too narrow a window (many ”clusters” have less than 5 hits). Once you begin having regions of around 100 ticks you start to get “clusters” of 7/8 hits. There is a tail of many many (>10) hits within such a small time window though.

CONCLUSION

- The entire distribution of MARLEY events is rather broad, however you can get a significant number of the hits by looking at very small windows
  - 20 / 30 channels and 50 / 100 ticks.
  - I have verified this running on the sample of 100 events.
- Though I haven't shown it here, from some TBrowser browsing I can see a significant effect of different FastHitFinder thresholds.
  - When using a threshold of 5 get a lot of radiological hits, but once this increases to 10 ADCs it dramatically decreases, whilst MARLEY occupancy is relatively constant.
- Making the relevant plots to show this shouldn't be hard / take too long, and hopefully I now have some time freed up to actually do it.

BACKUP SLIDES

NUMBER OF ADJACENT HITS (OLD WAY) - FASTHIT