Low energy hits in 2006

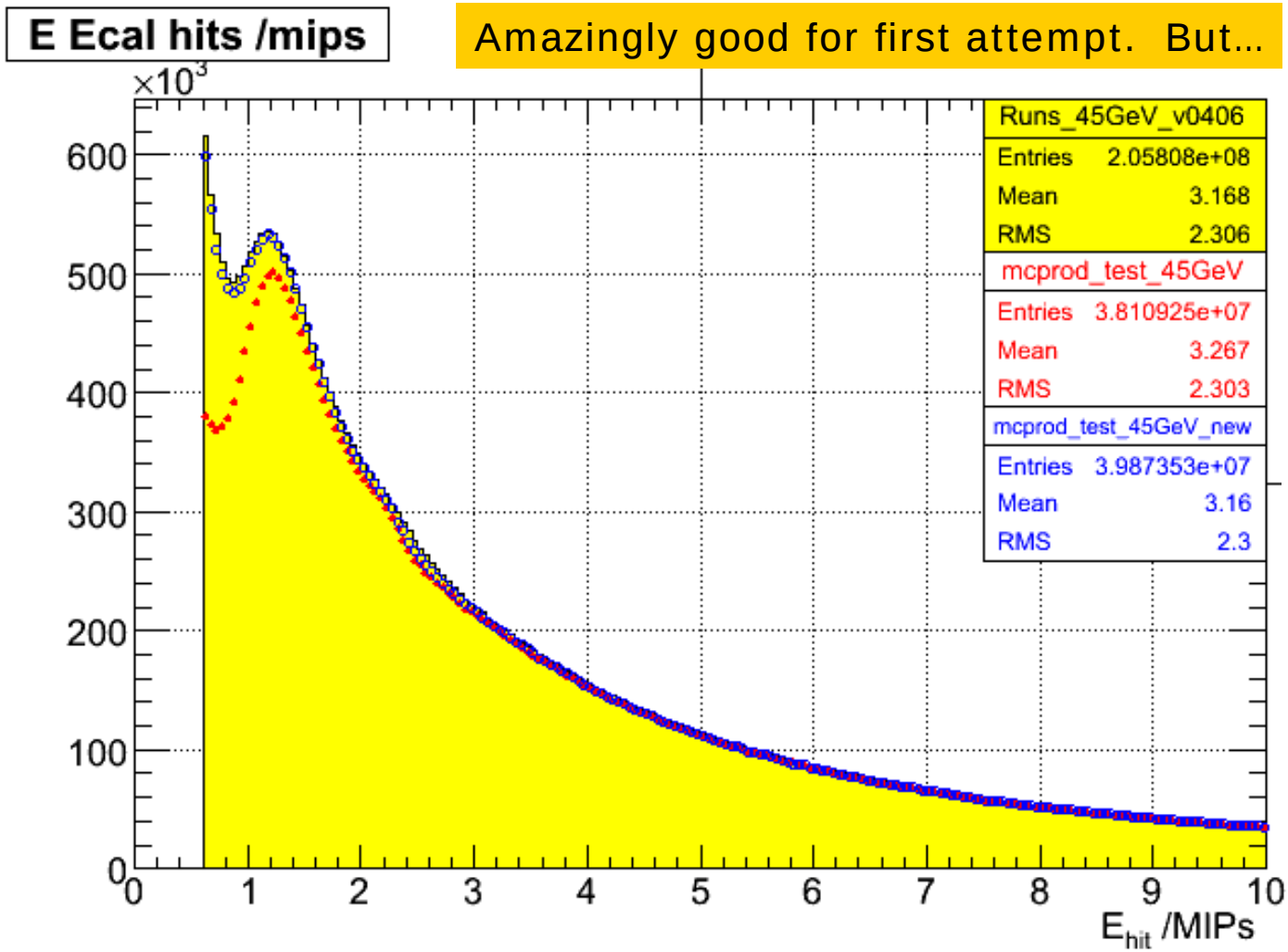
David Ward

- A few thoughts about the 2006 data.
- Focussing on the issue of the excess number of hits (largely low energy) seen in data at higher energies.
- Also an issue for 2007.
- n.b. related work has been reported by François Morisseau.

Low energy hits in 2006

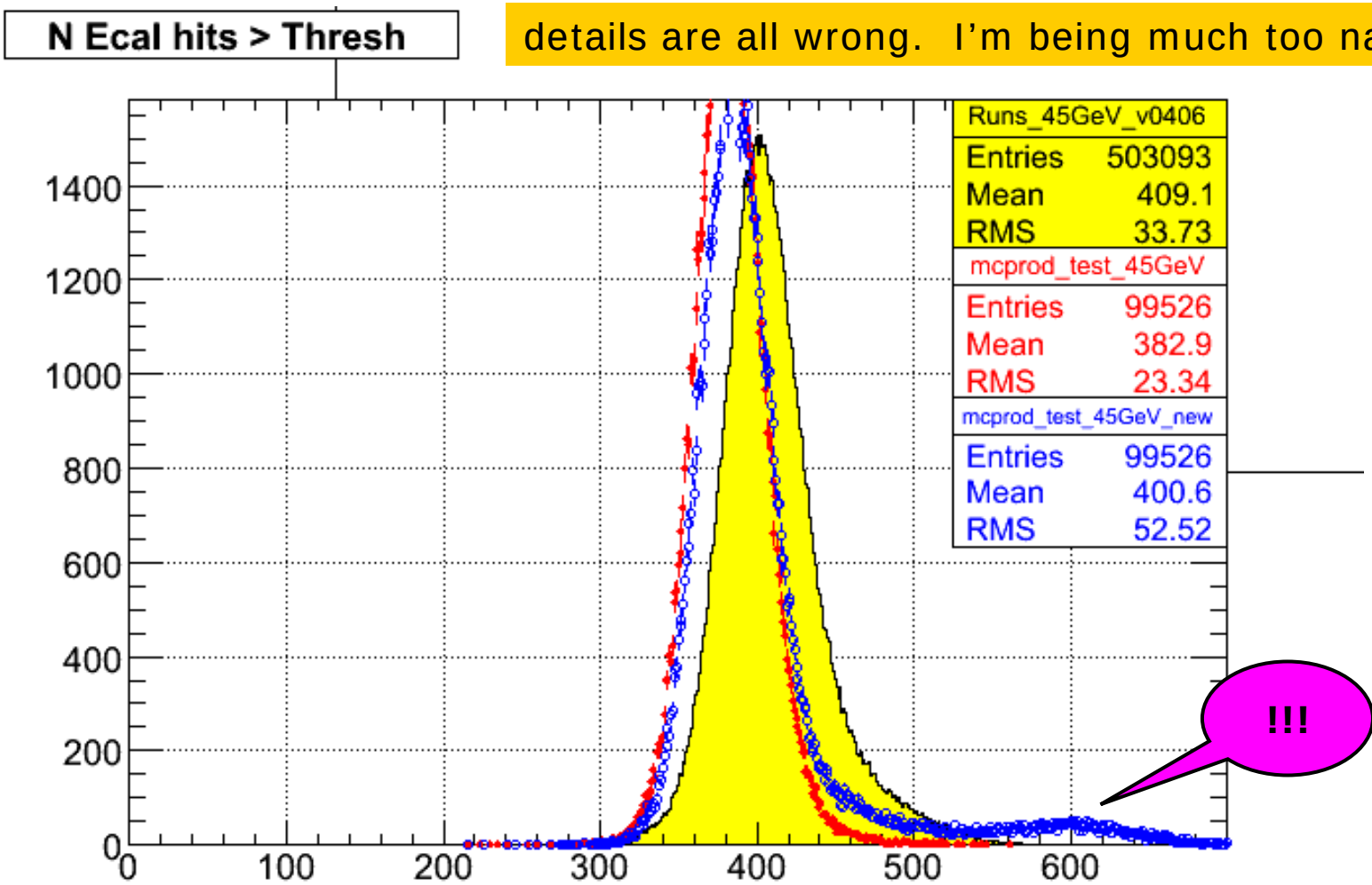
- Still worrying about the excess of low energy hits seen in data compared to MC.
  - Statement in the ECAL technical paper that in square events “about 1% of the guard ring energy is propagated into each border pixel (double in corner cells)”
  - Does this provide a means to simulate the effect?
- Tried a very naïve implementation:
  - Sum (all three – is this sensible?) guard ring hit energies for each wafer
  - Allocate 1% of this energy to each peripheral cell; 2% in the case of corner cells.
- Test at 45 GeV, where square event rates are greatest.

Hit energies



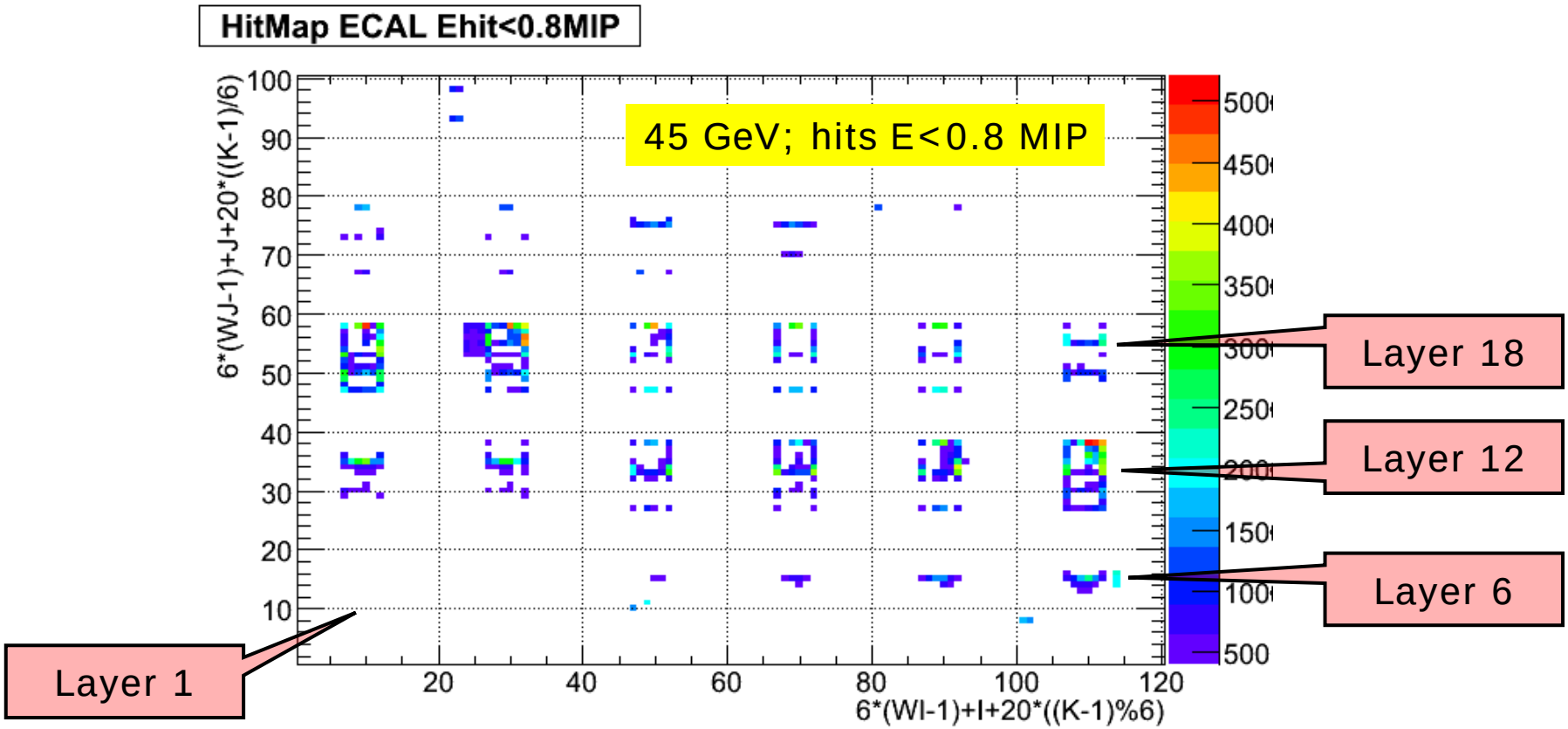
Number of hits

details are all wrong. I'm being much too naïve.



Method

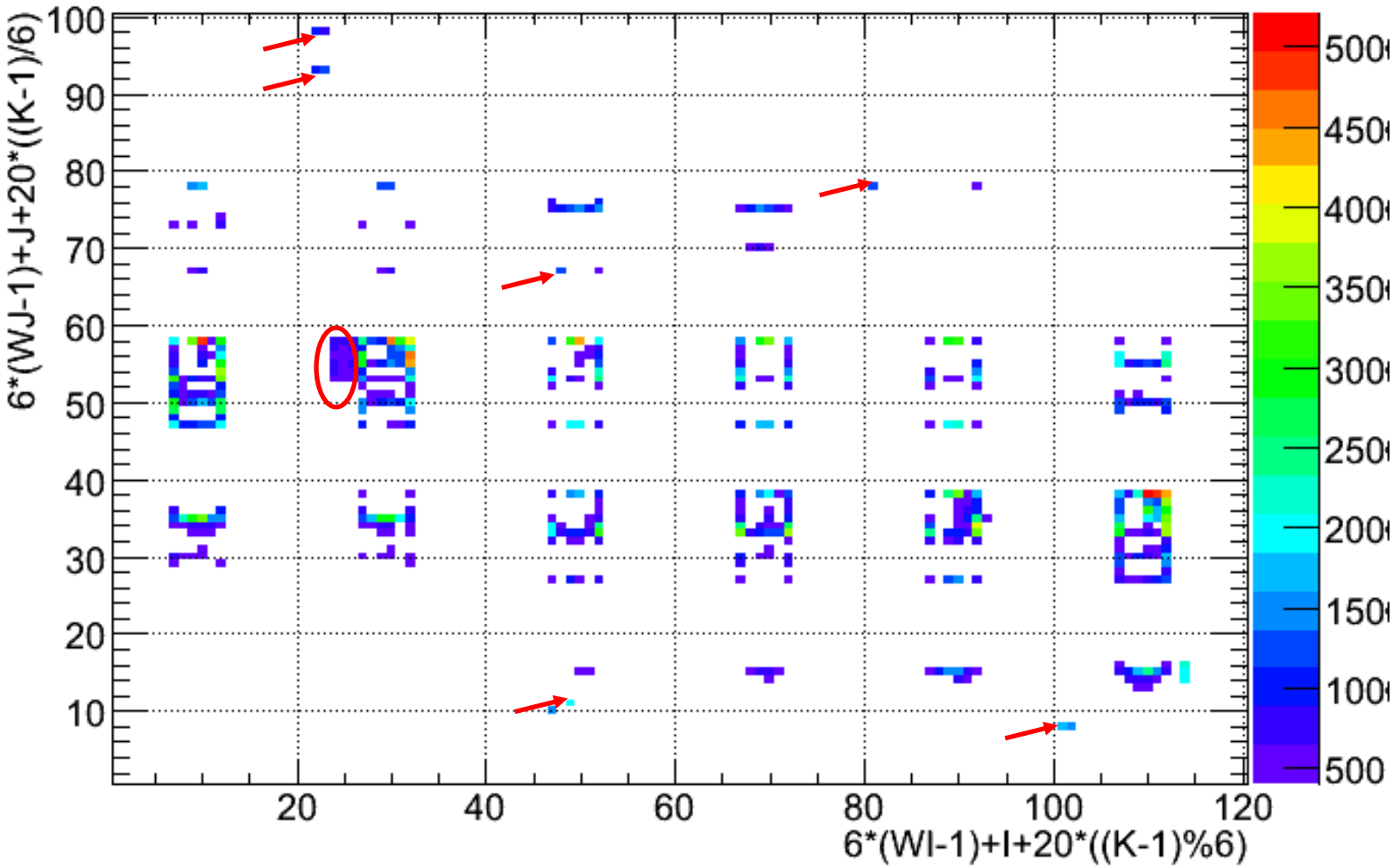
- Form a “hit map”, i.e. number of hits per cell.
- Compare data and MC – subtract normalised MC from data.
- Reveals location and frequency of noisy cells. A lot of structure!



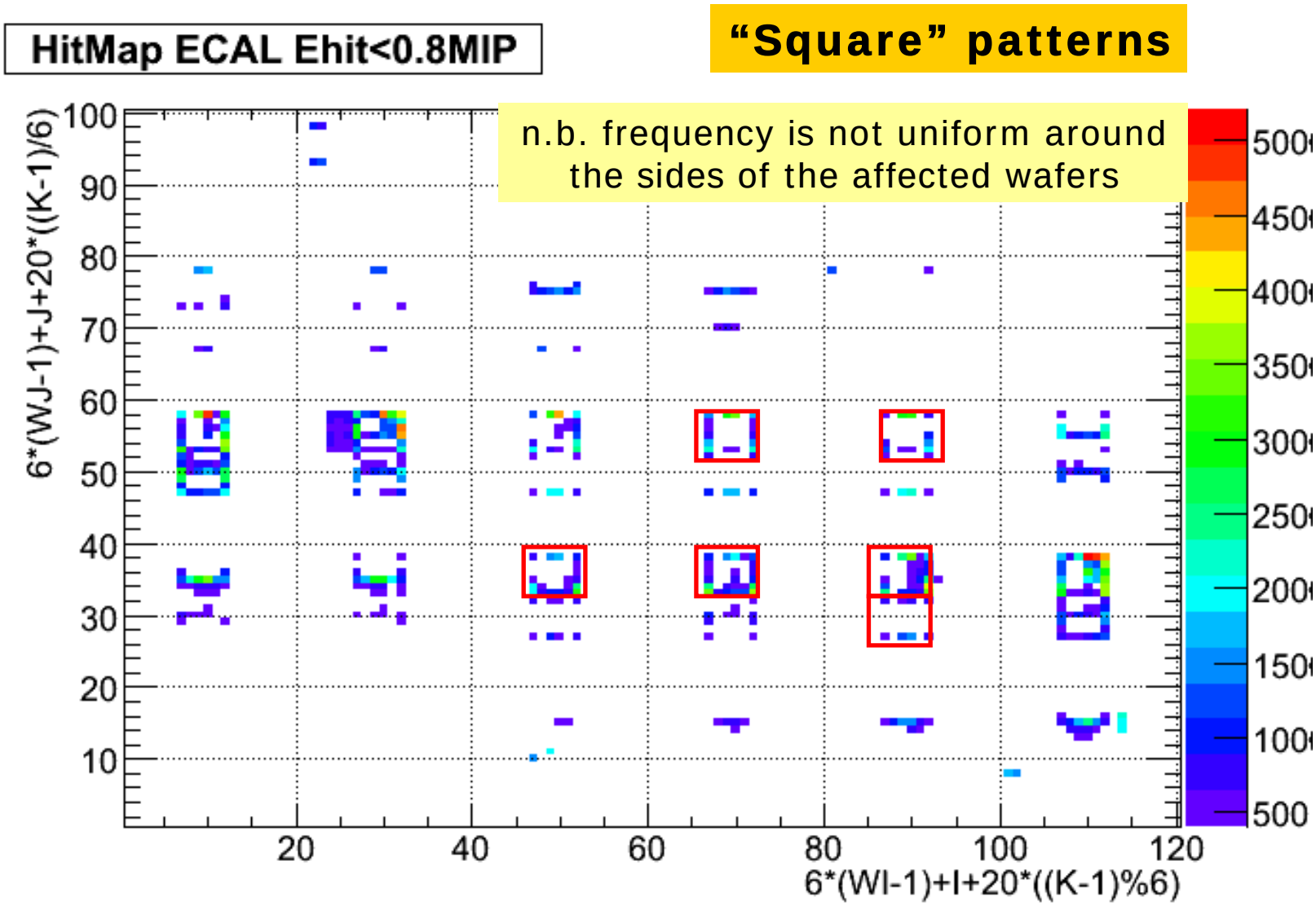
Data-MC Hitmap; 45 GeV; Ehit<0.8MIP

HitMap ECAL Ehit<0.8MIP

Noise. Simulated by Anne-Marie's code

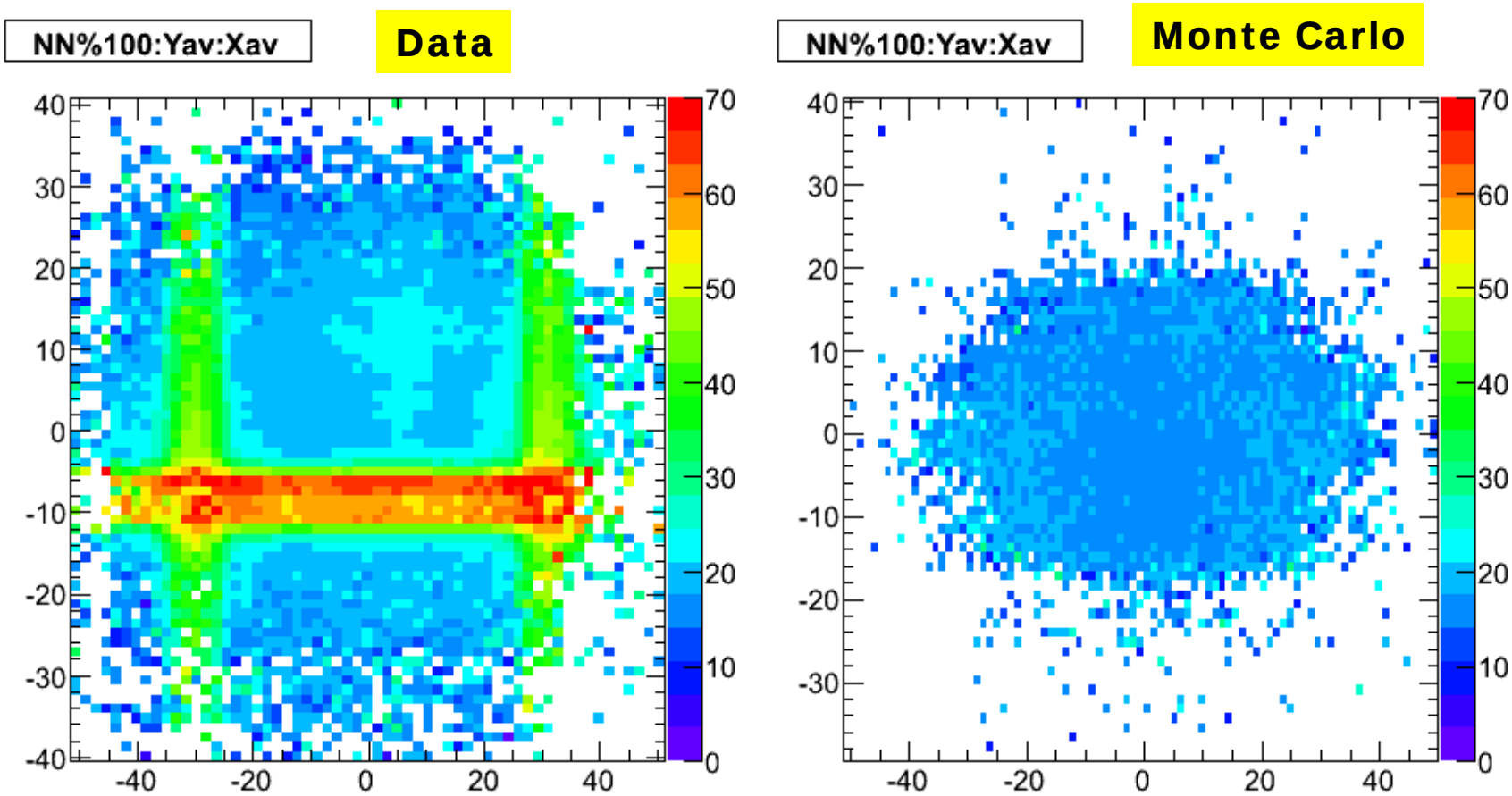


Data-MC Hitmap; 45 GeV; Ehit<0.8MIP

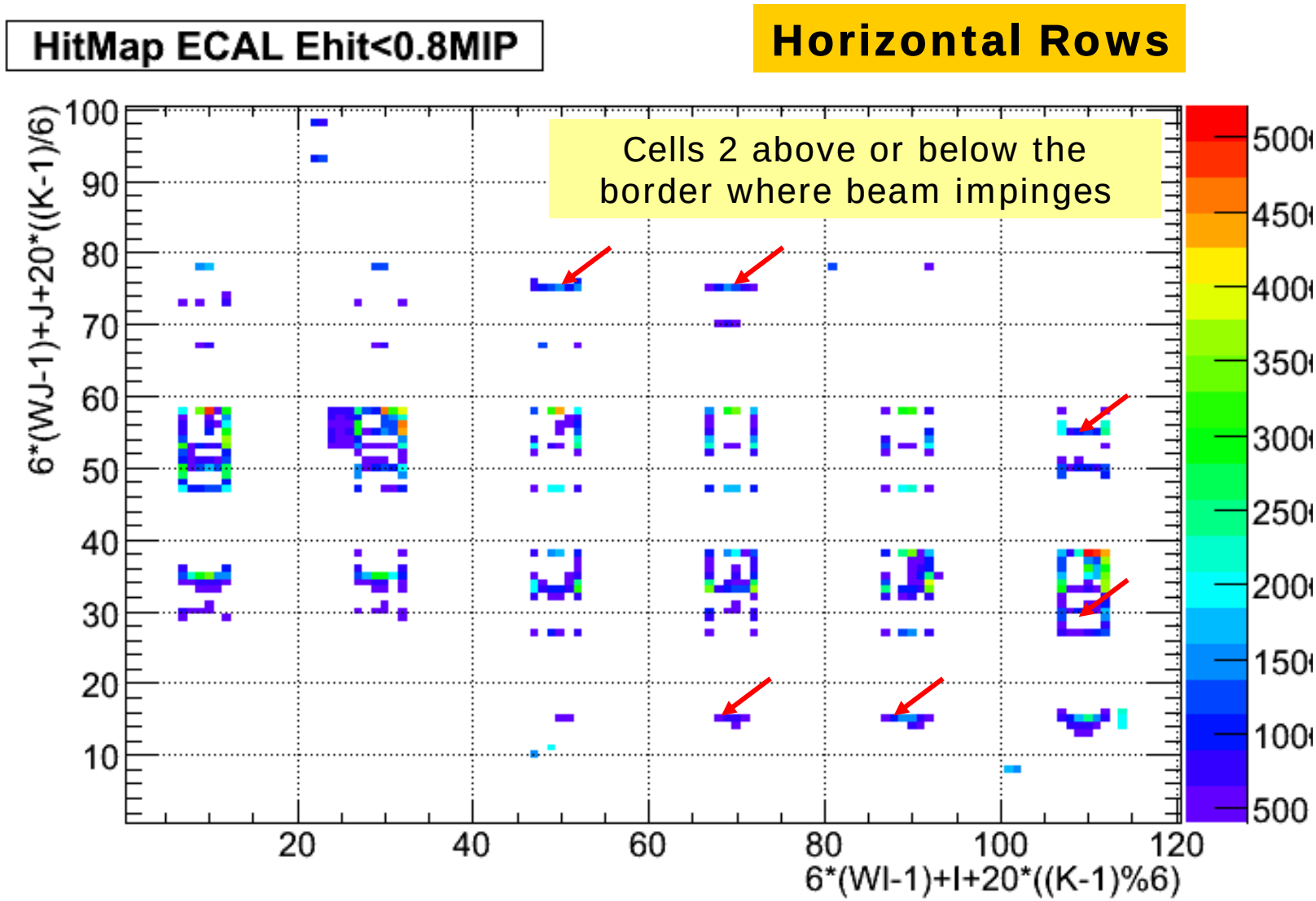


Square patterns

Excess of ~8 hits/event @ 45 GeV.
Clearly associated with crosstalk from guard rings.



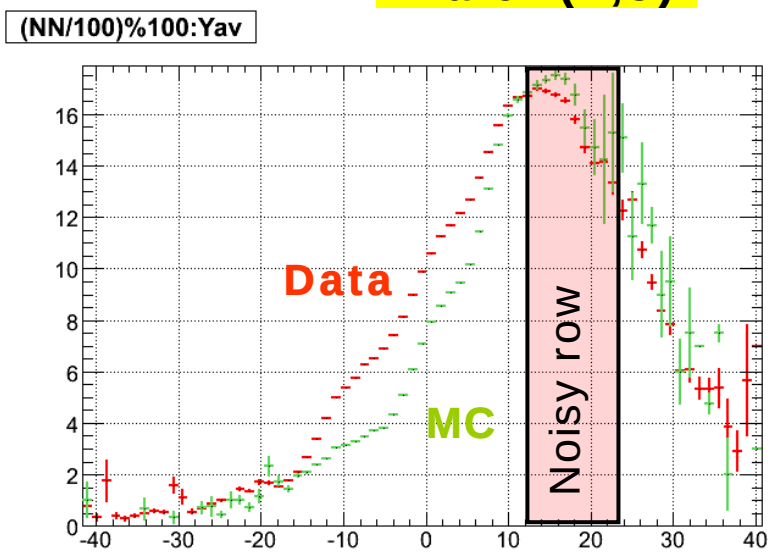
Data-MC Hitmap; 45 GeV; Ehit<0.8MIP



Horizontal rows

Excess ~3.4 hits/event @ 45 GeV (wafer (2,3) layers 5-8, 18,21,22)
Excess ~0.75 hits/event @ 45 GeV (wafer (2,2) layers 12-14, 18)
Excess associated with beam impinging one or two pads below/above the offending row – suggests this is a crosstalk effect again.

Wafer (2,3)



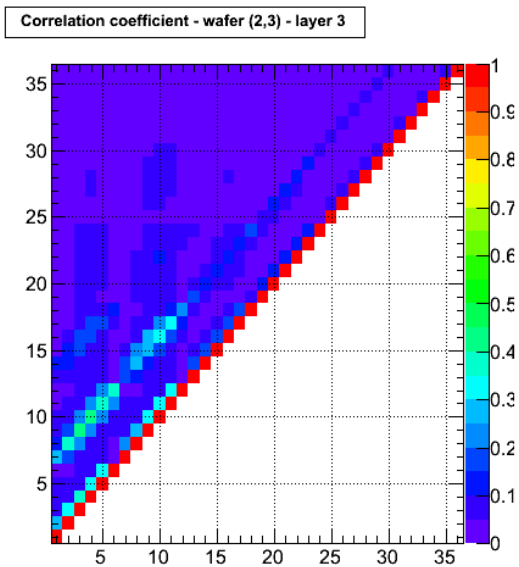
Wafer (2,2)

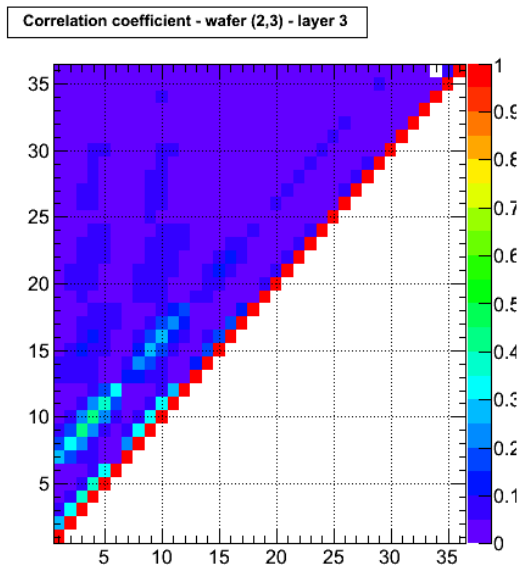
Correlation plots - method

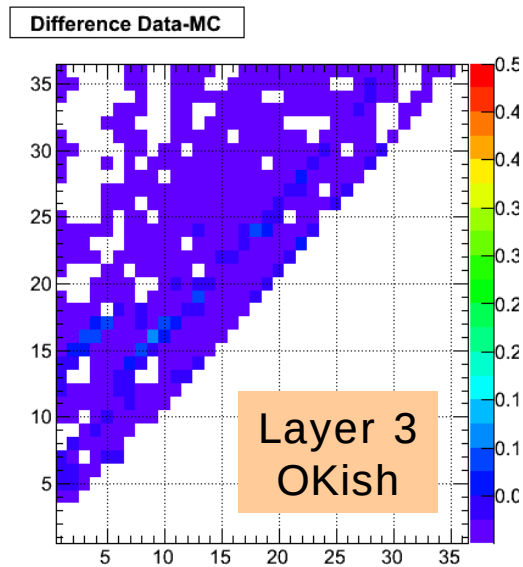
- Number correlations between cells in wafer(2,3) (i.e. middle wafer in top row).
- Shower-related correlations removed (hopefully) by subtracting MC from data.

31	32	33	34	35	36
25	26	27	28	29	30
19	20	21	22	23	24
13	14	15	16	17	18
7	8	9	10	11	12
1	2	3	4	5	6

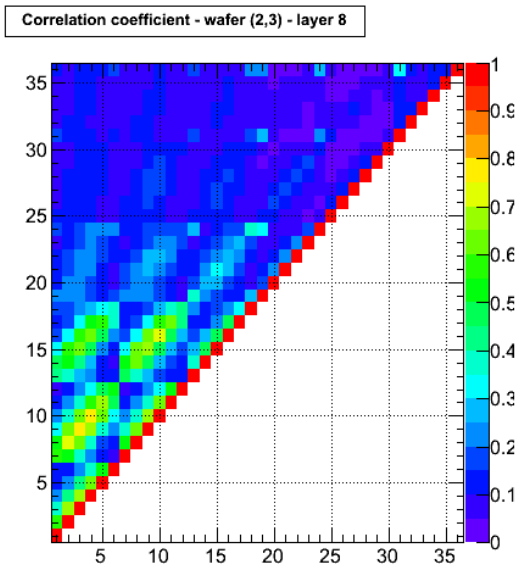
Cell numbering scheme

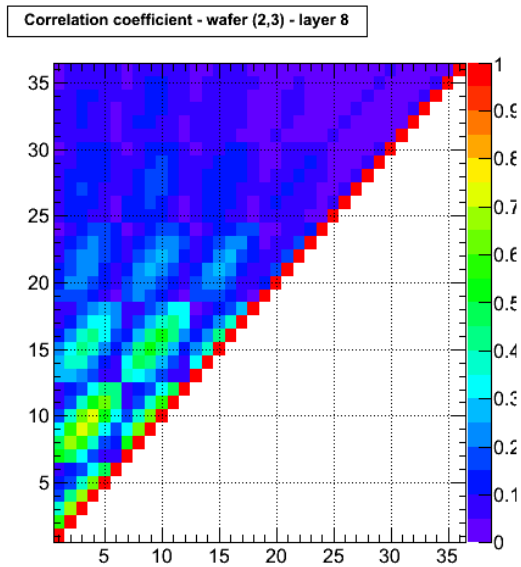


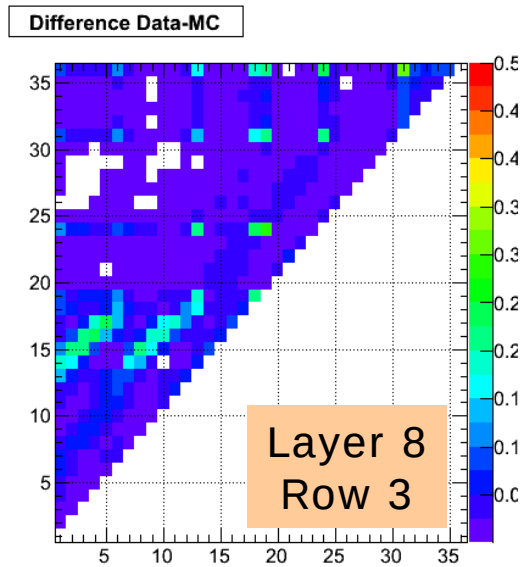


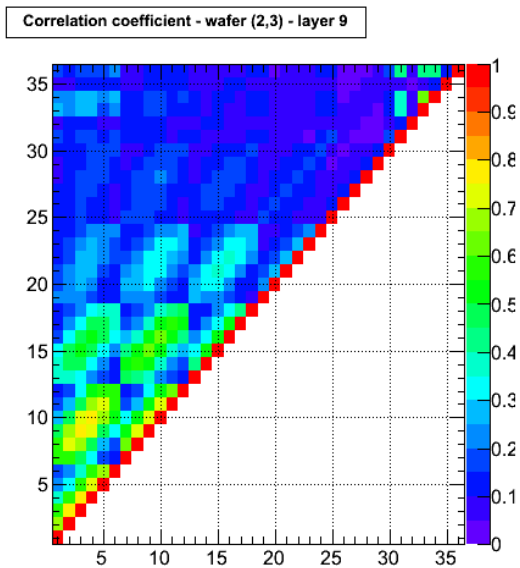


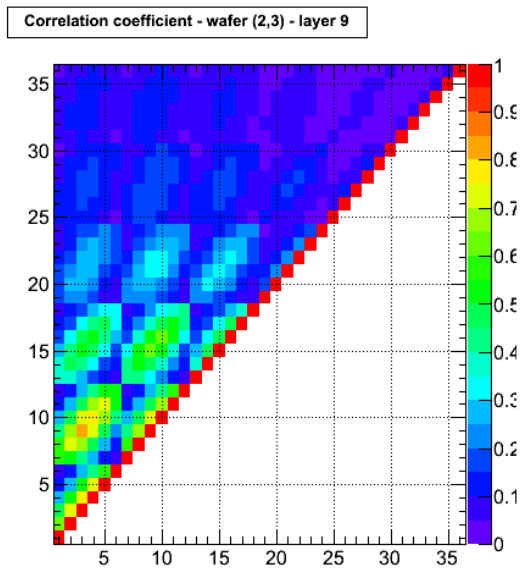
Correlation plots

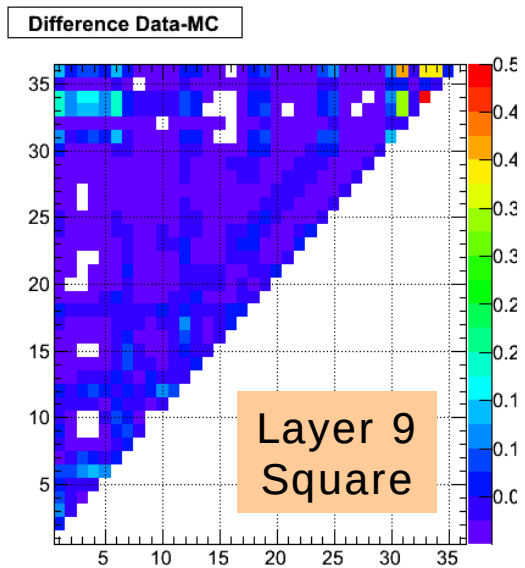








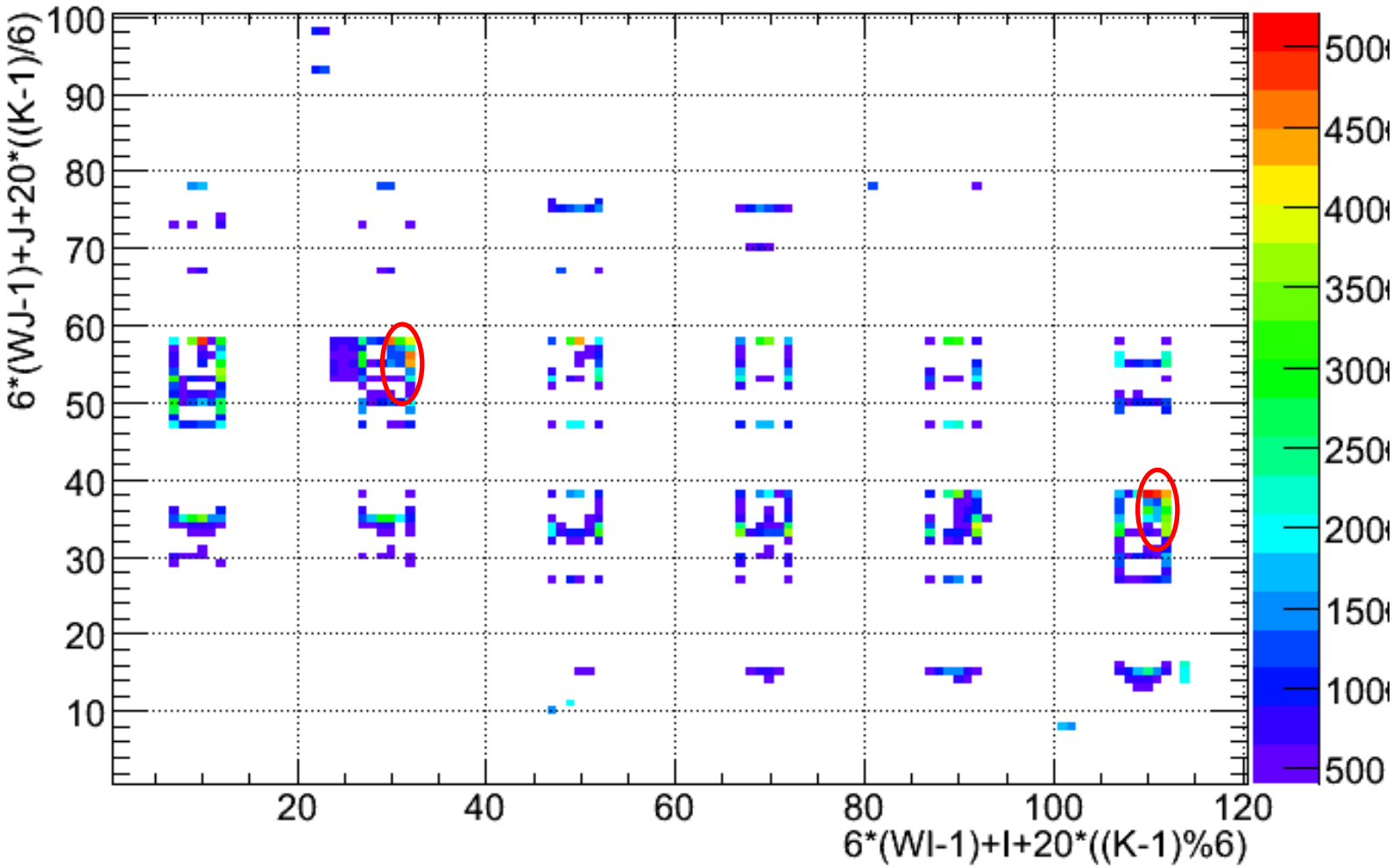




Data-MC Hitmap; 45 GeV; Ehit<0.8MIP

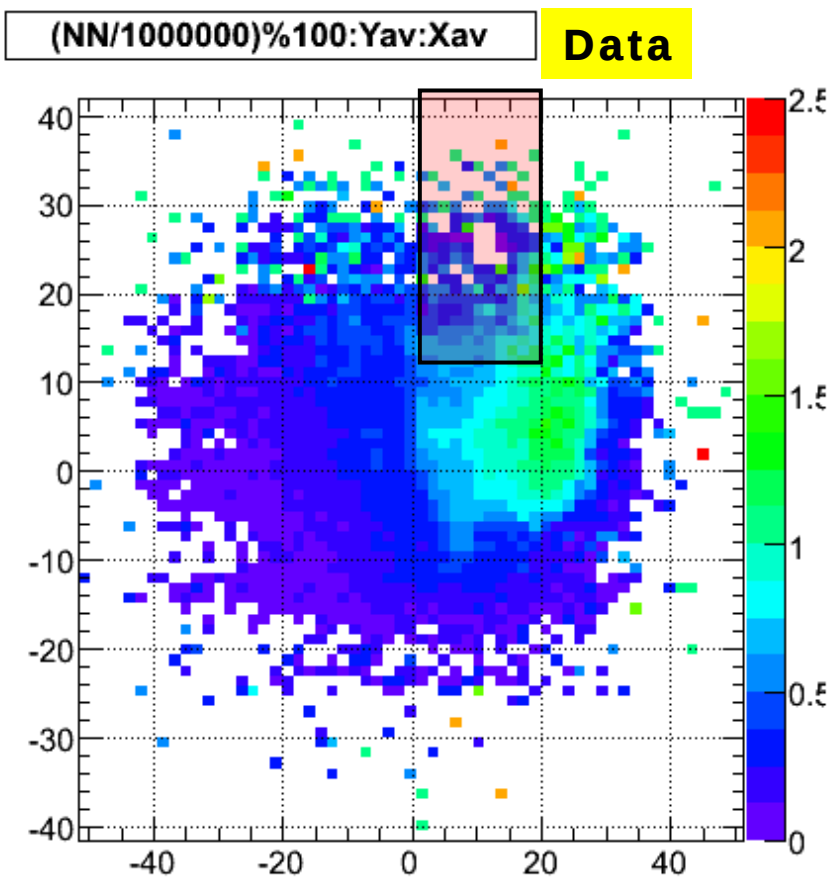
HitMap ECAL Ehit<0.8MIP

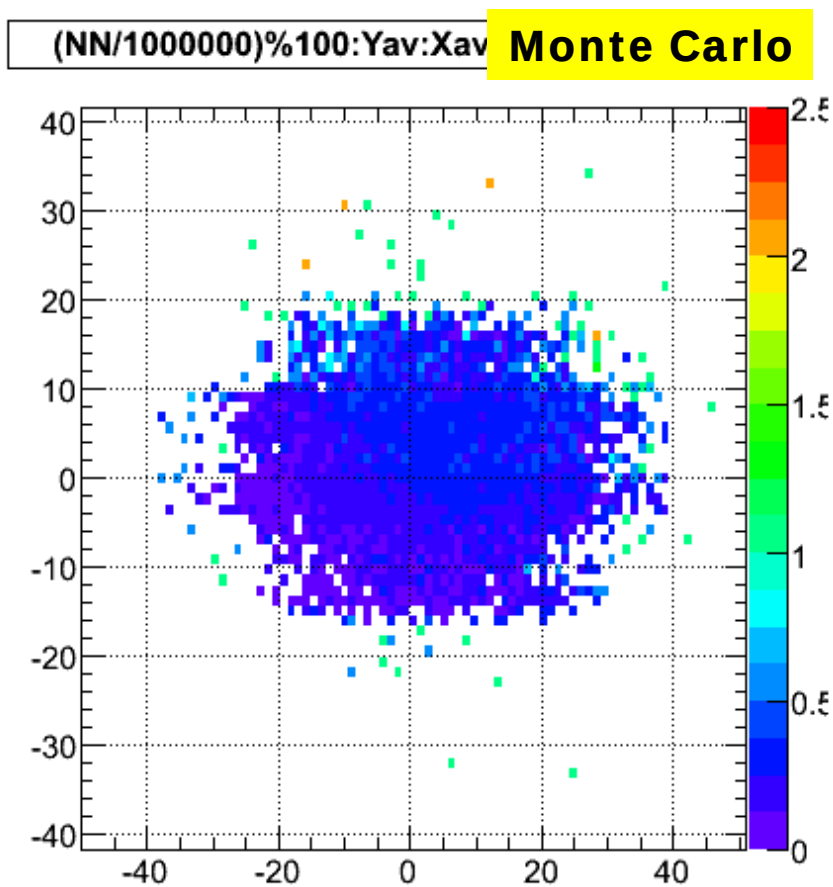
A couple of noisy quadrants of wafers



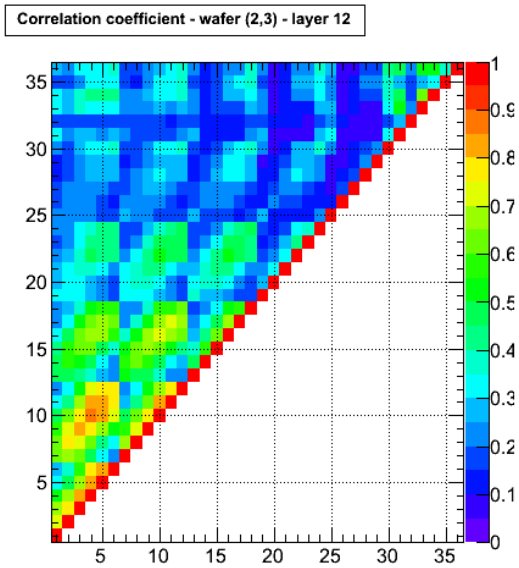
Noisy quadrants

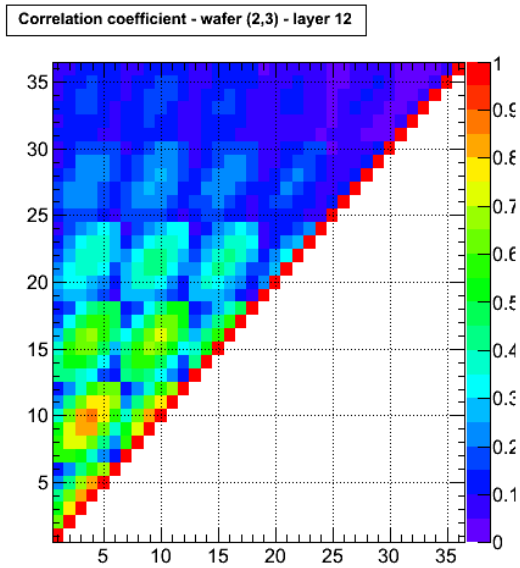
Excess of ~0.25 hits/event @ 45 GeV.
Beam tends to impact at lower right corner of wafer. Crosstalk?

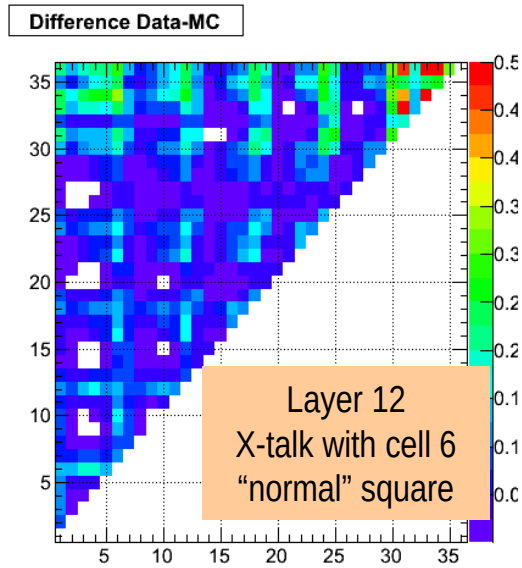


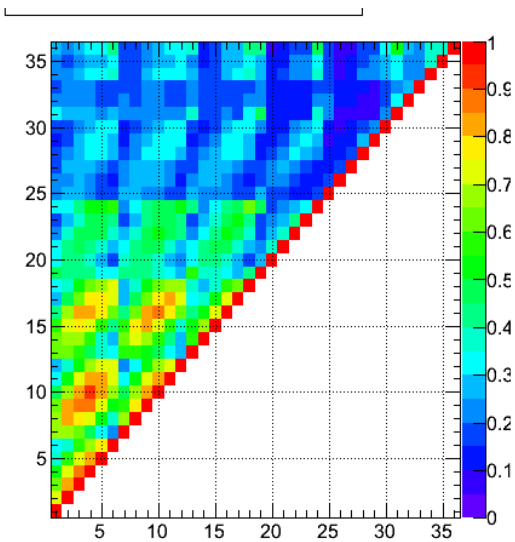


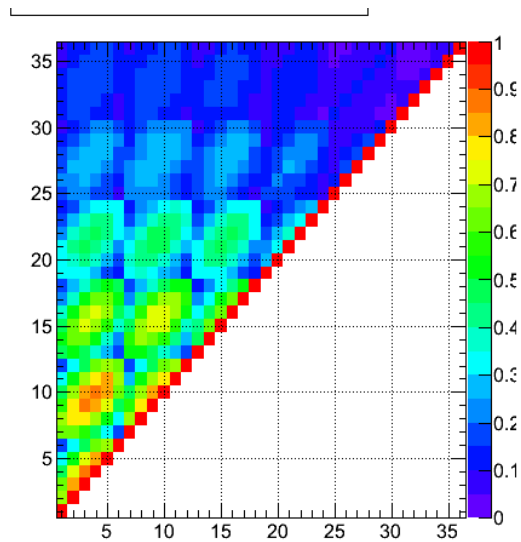
Correlation plots

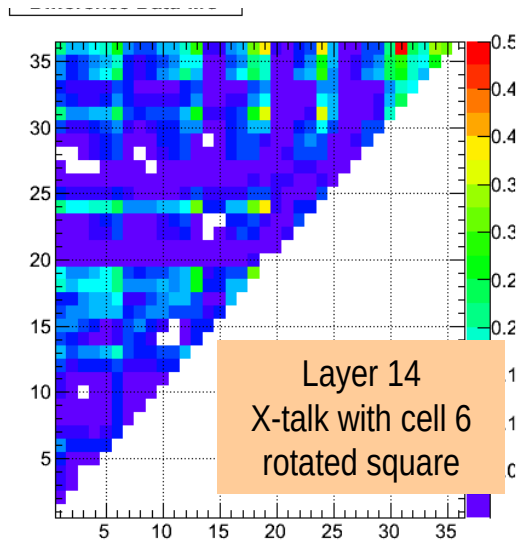








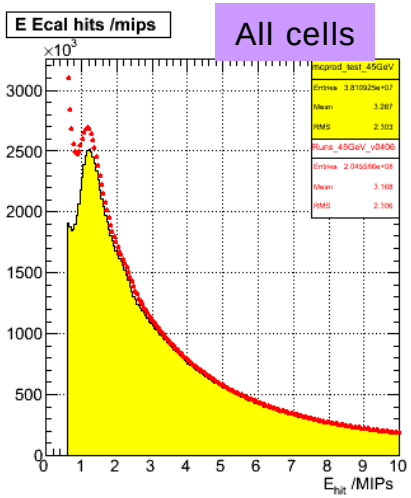


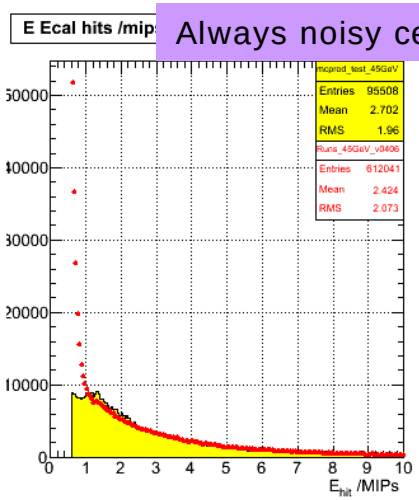


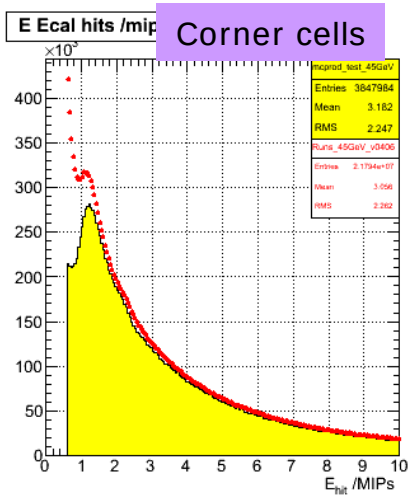
C

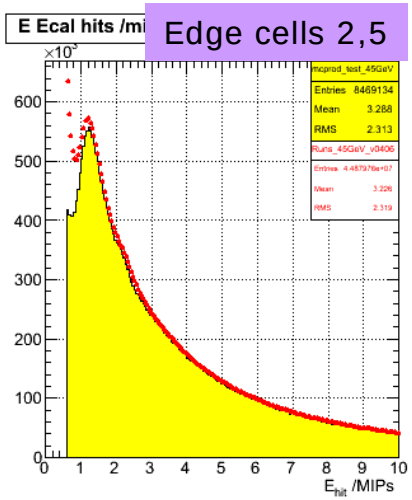
.5

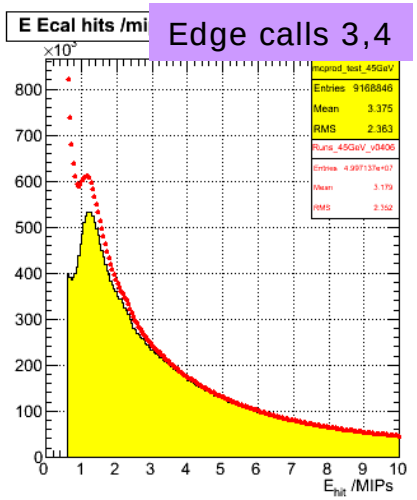
Summary – hit energies for different cell categories

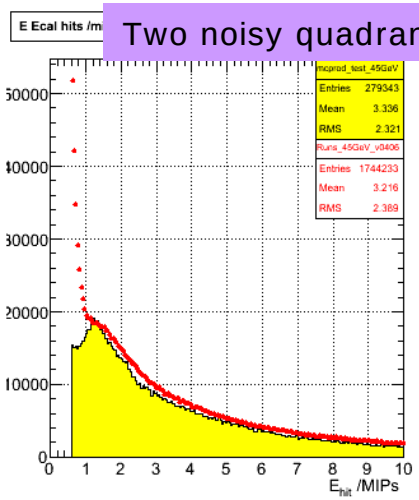


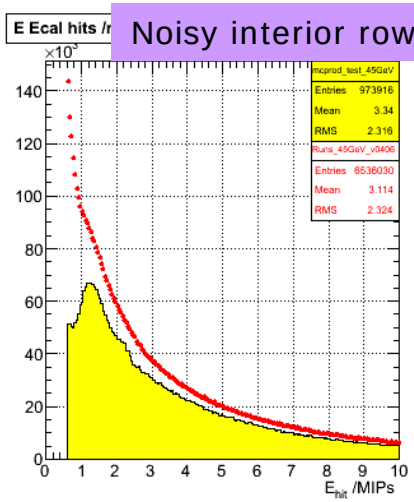


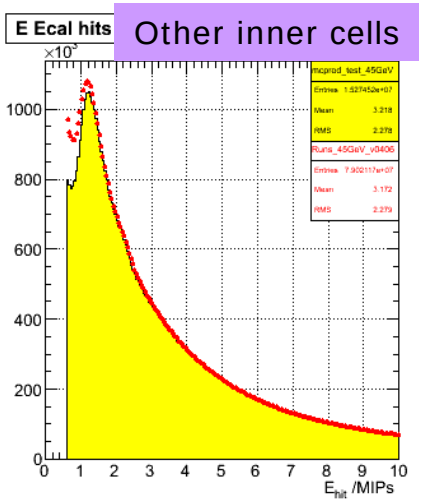




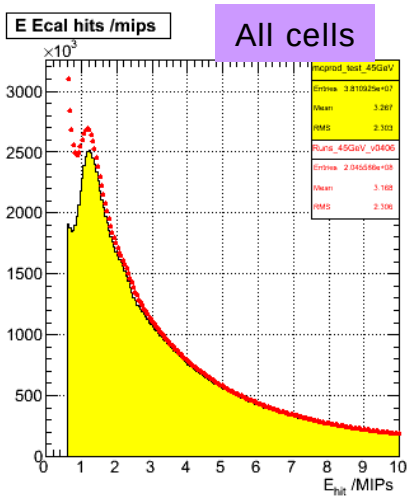


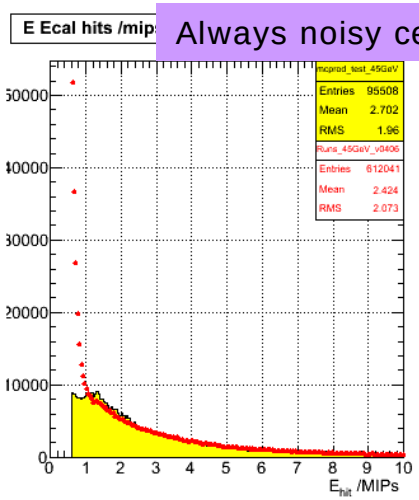


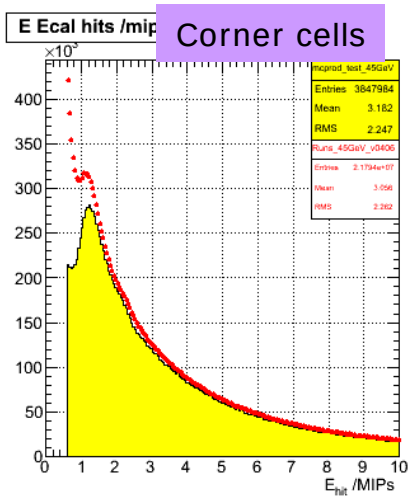


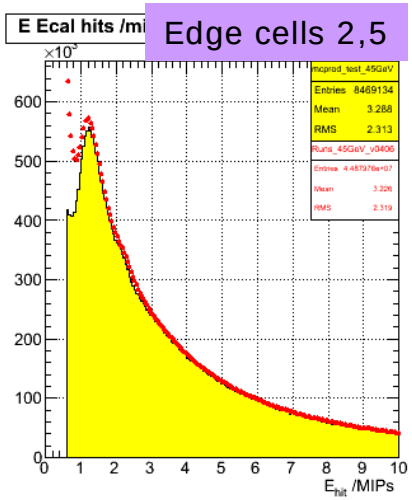


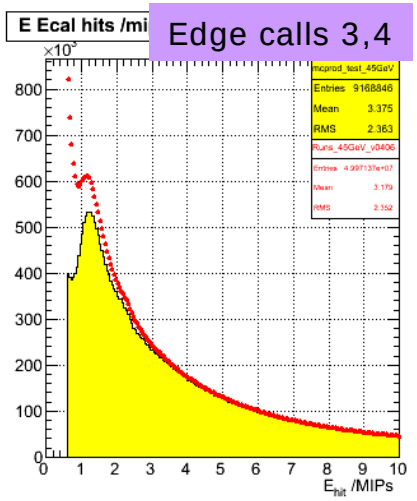
Similarly at 30 GeV

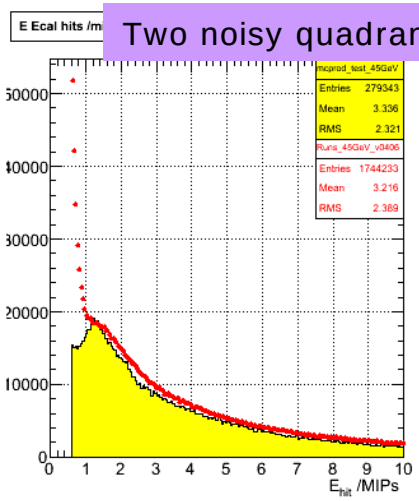


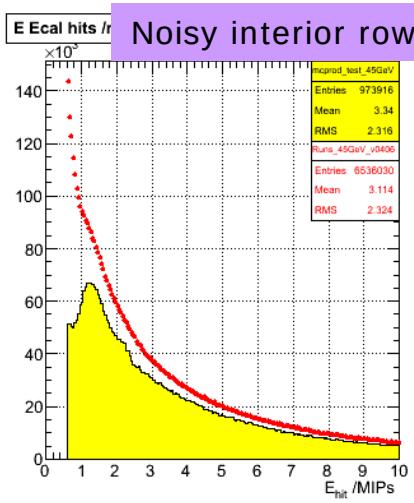


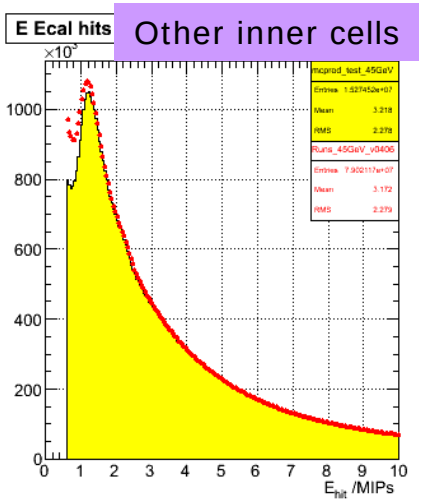






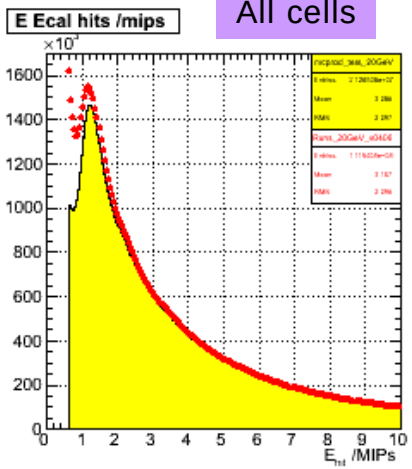




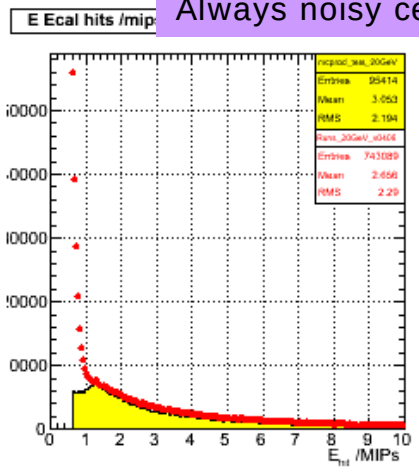


Similarly at 20 GeV

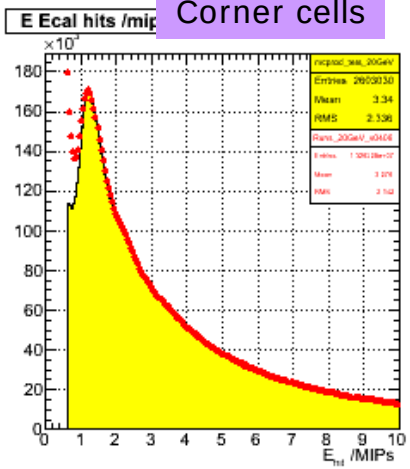
All cells



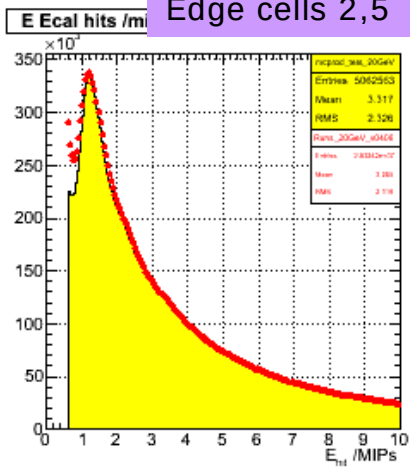
Always noisy cells



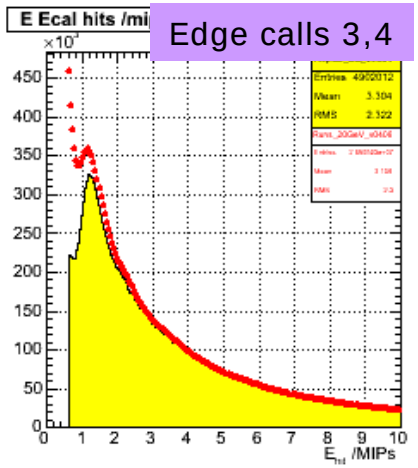
Corner cells



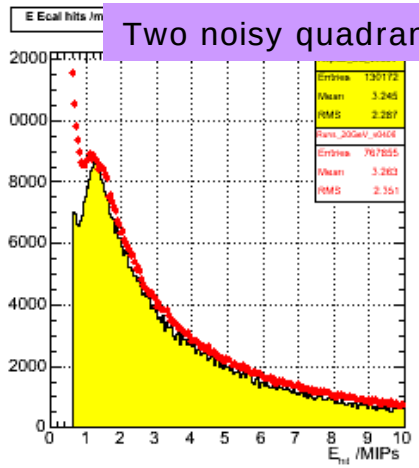
Edge cells 2,5



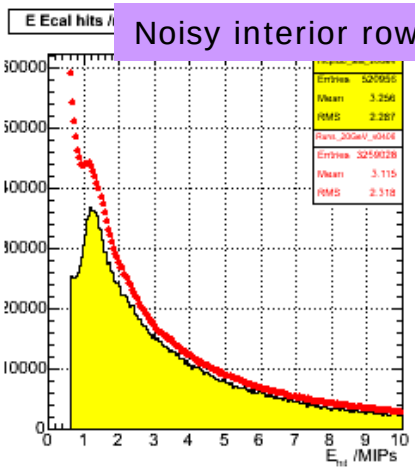
Edge calls 3,4



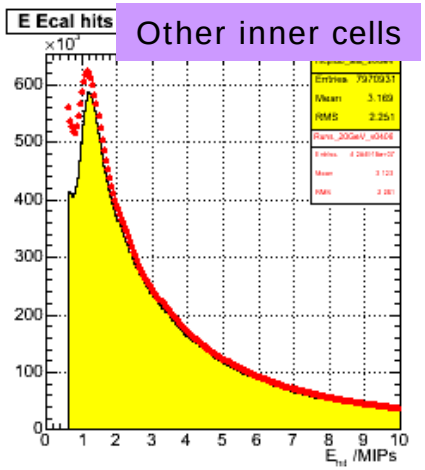
Two noisy quadrants



Noisy interior rows

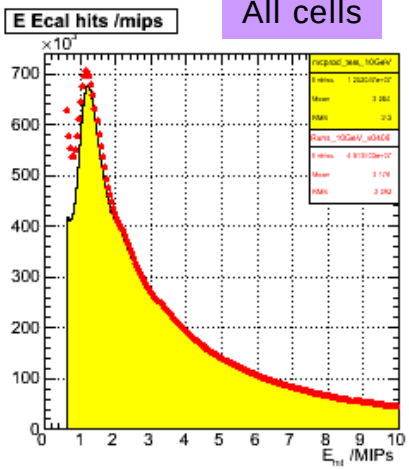


Other inner cells

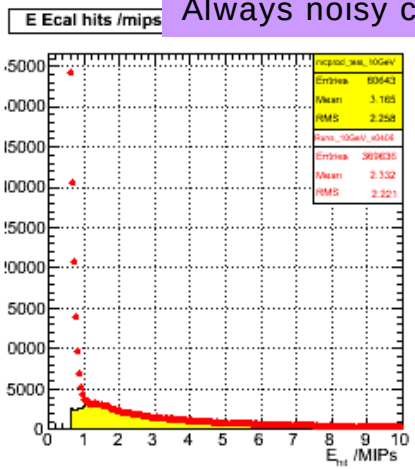


Similarly at 10 GeV

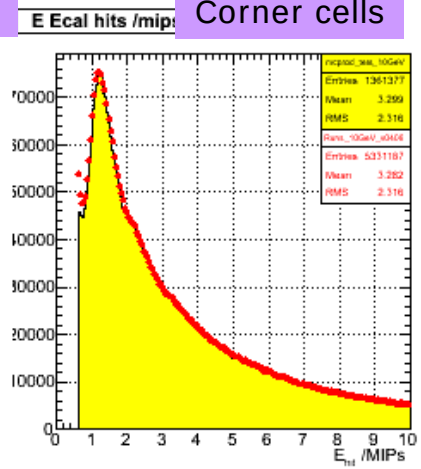
All cells



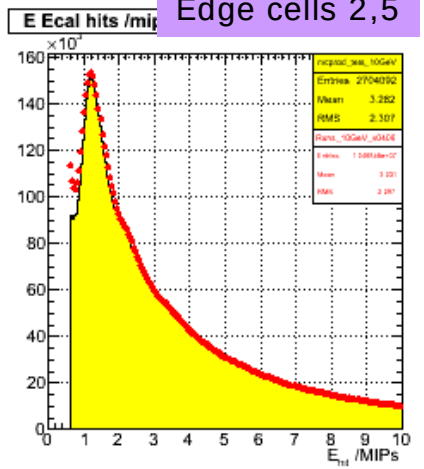
Always noisy cells



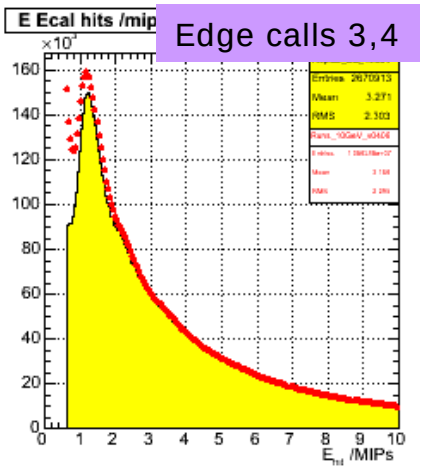
Corner cells



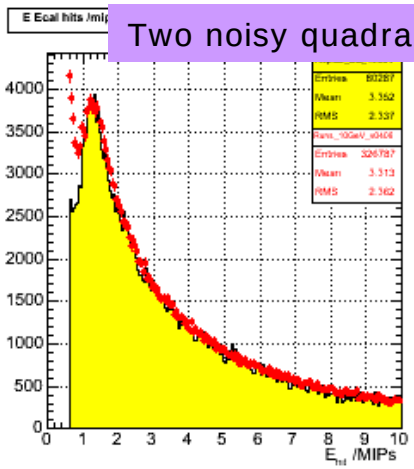
Edge cells 2,5



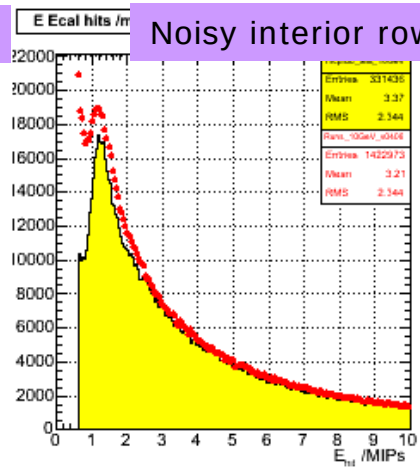
Edge calls 3,4



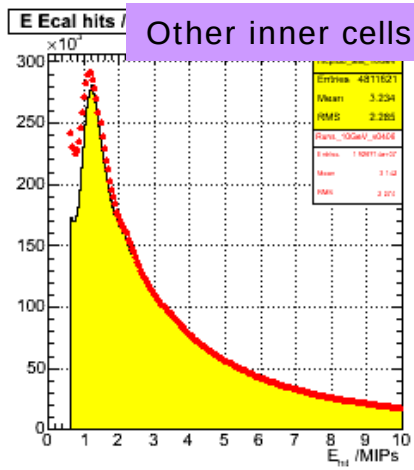
Two noisy quadrants



Noisy interior rows



Other inner cells



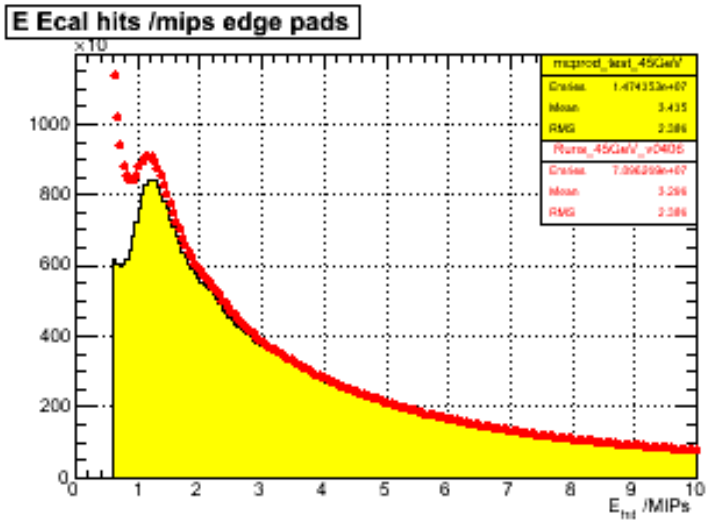
Low energy hits summary

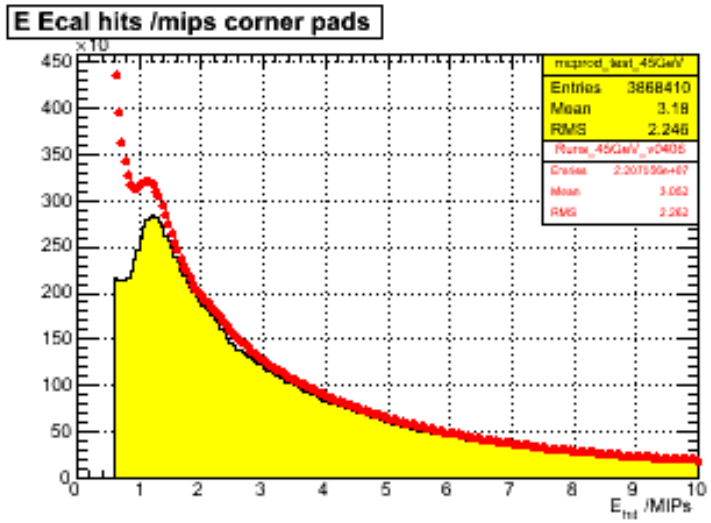
- At least four contributions:
- Noisy cells (seen in pedestal events, muons, etc). These are more or less simulated by Anne-Marie's code.
- Correlated noise in edge cells (square events; cross-talk with guard rings).
  - Some possibility to make progress with simulating these. But the pattern of crosstalk is complicated.
- Rows in wafer interior exhibiting noise.
  - Seems to correlated with hits in edge row two cells away.
- A couple of noisy quarter pads.
  - Appear to be associated with hits in a corner cell (but not the immediately adjacent corner).
- Complicated (but desirable?) to simulate this.

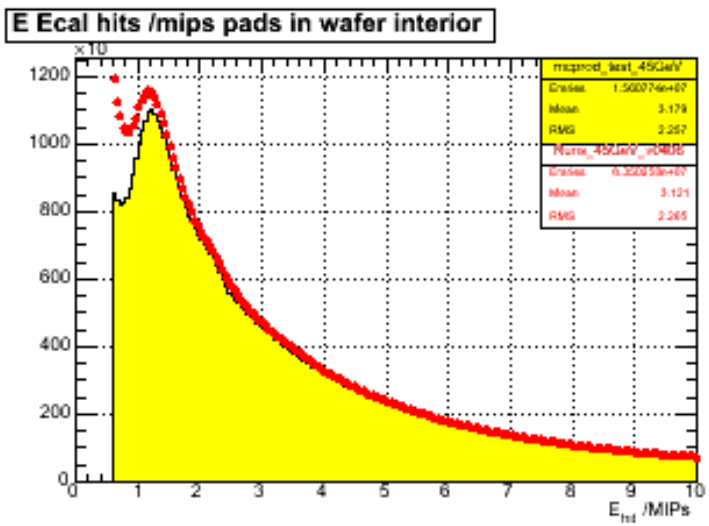
Spare slides

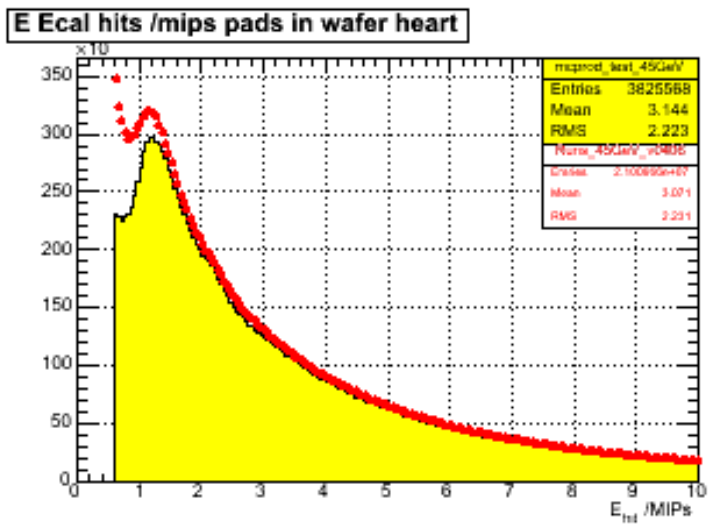
Showing dependence on beam energy,
and on hit energy.

Different pad types



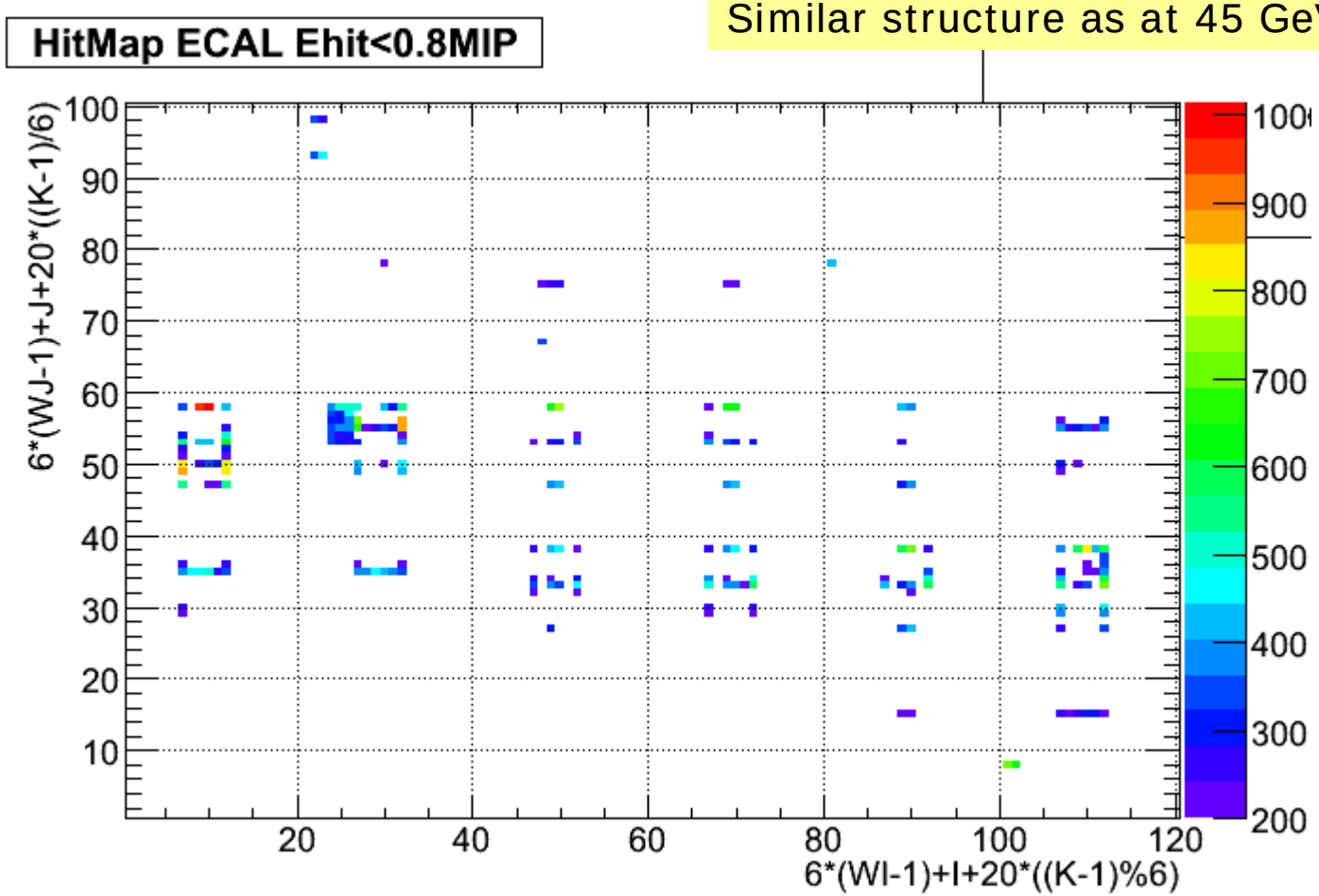






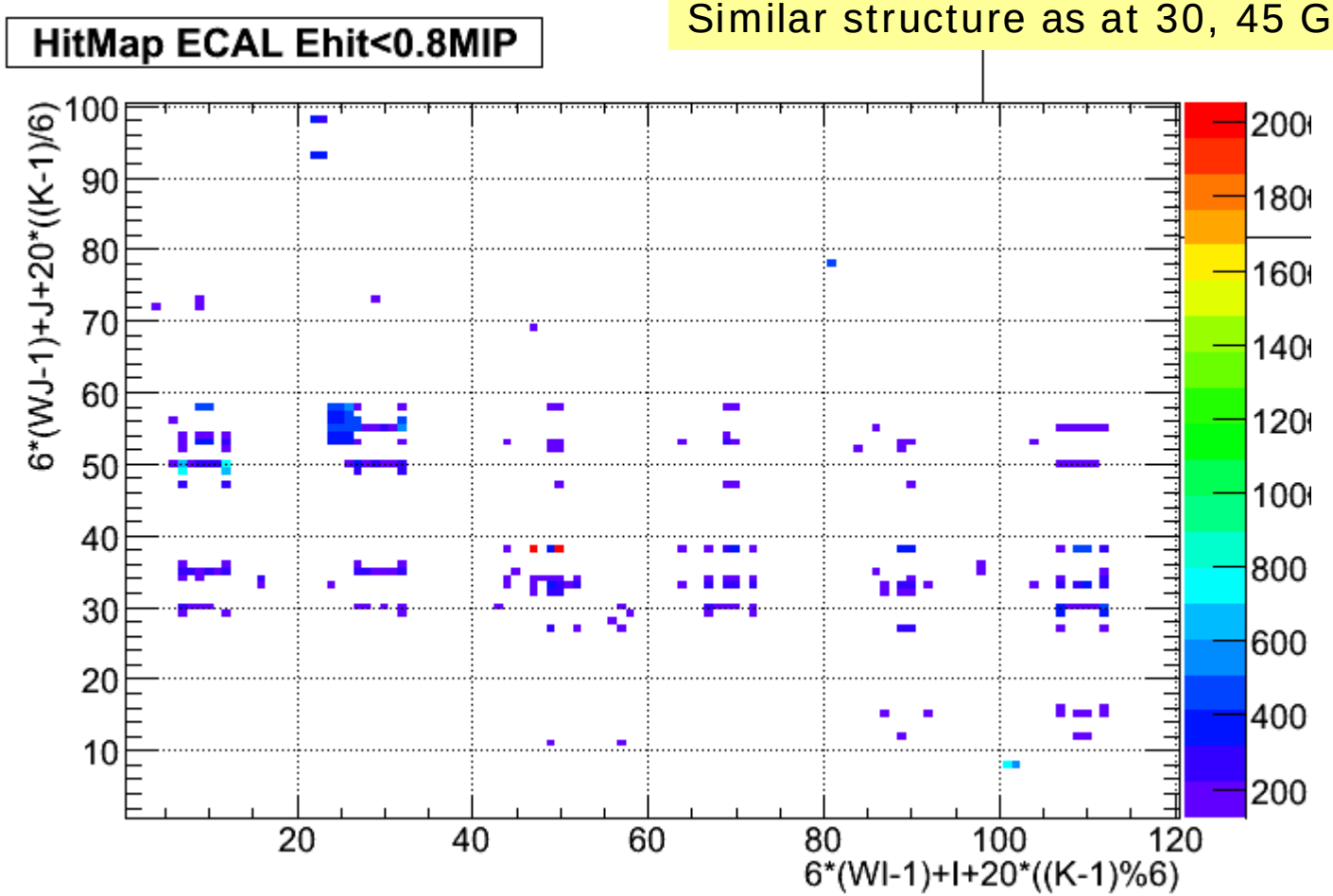
Data-MC Hitmap; 30 GeV; Ehit<0.8MIP

Similar structure as at 45 GeV



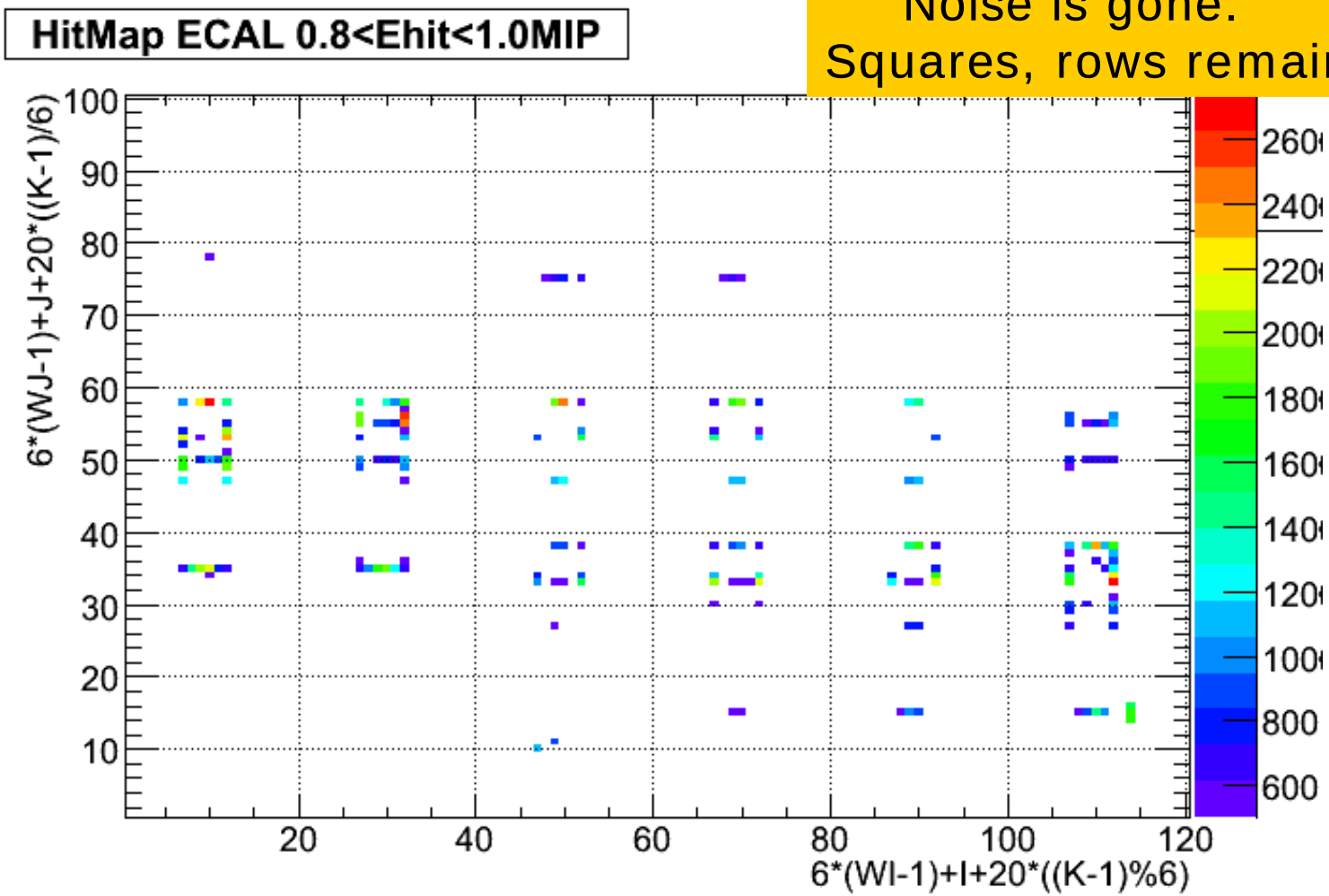
Data-MC Hitmap; 20 GeV; Ehit<0.8MIP

Similar structure as at 30, 45 GeV

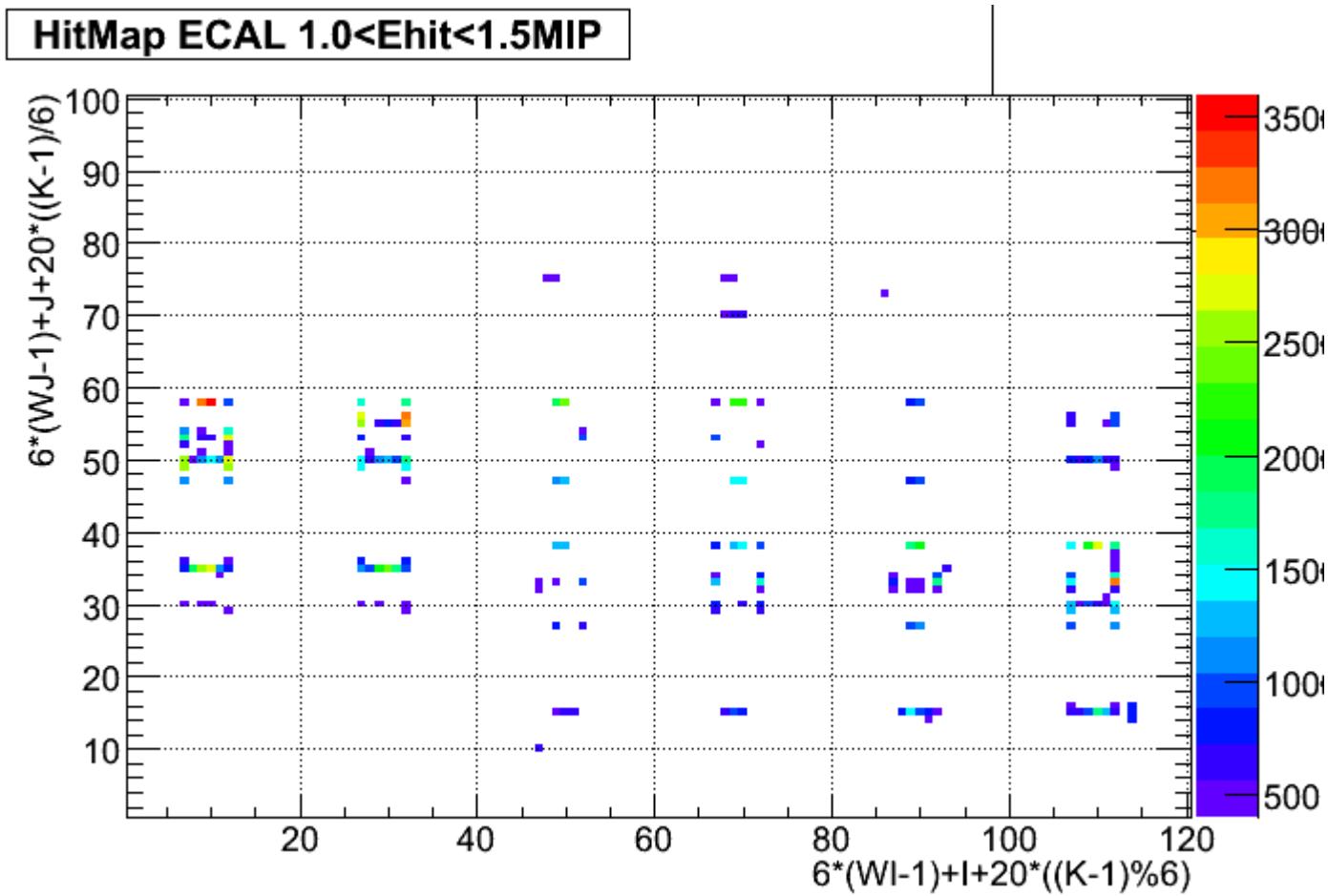


Data-MC Hitmap; 45 GeV; 0.8<Ehit<1.0MIP

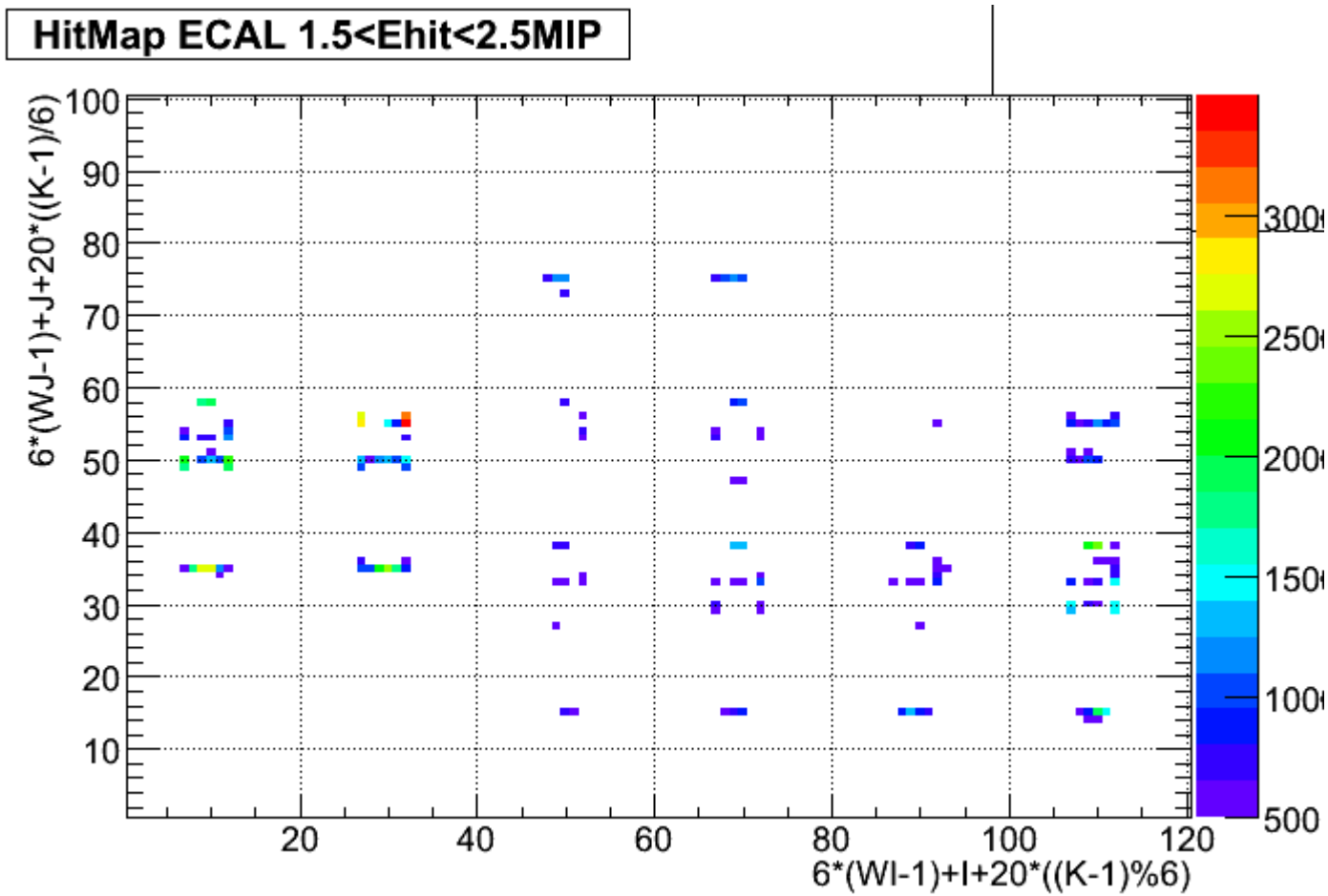
Noise is gone.
Squares, rows remain



Data-MC Hitmap; 45 GeV; 1.0<Ehit<1.5MIP



Data-MC Hitmap; 45 GeV; 1.5<Ehit<2.5MIP



Data-MC Hitmap; 45 GeV; Ehit>2.5MIP