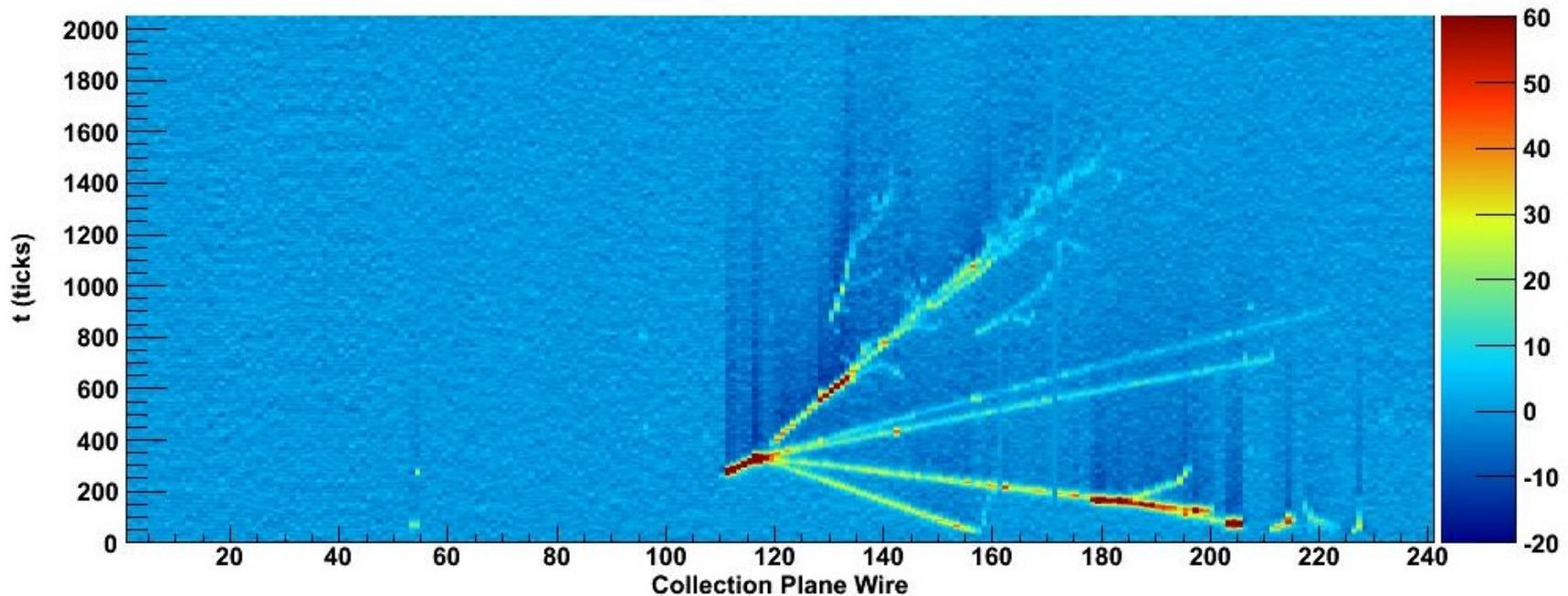


Characteristics of the PMT crosstalk

Gabriel Collin

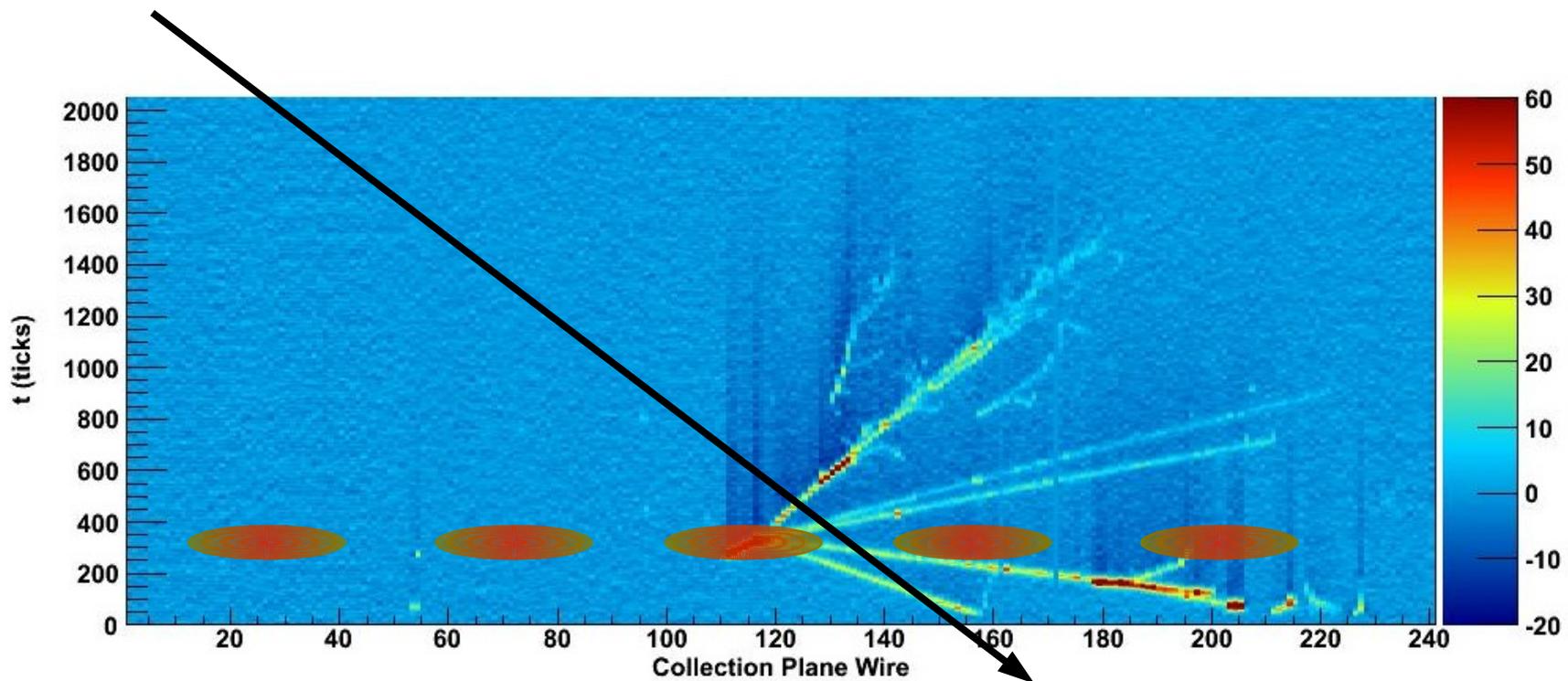
The danger

- Cosmic causes PMTs to dump noise on the wires while they read out an event



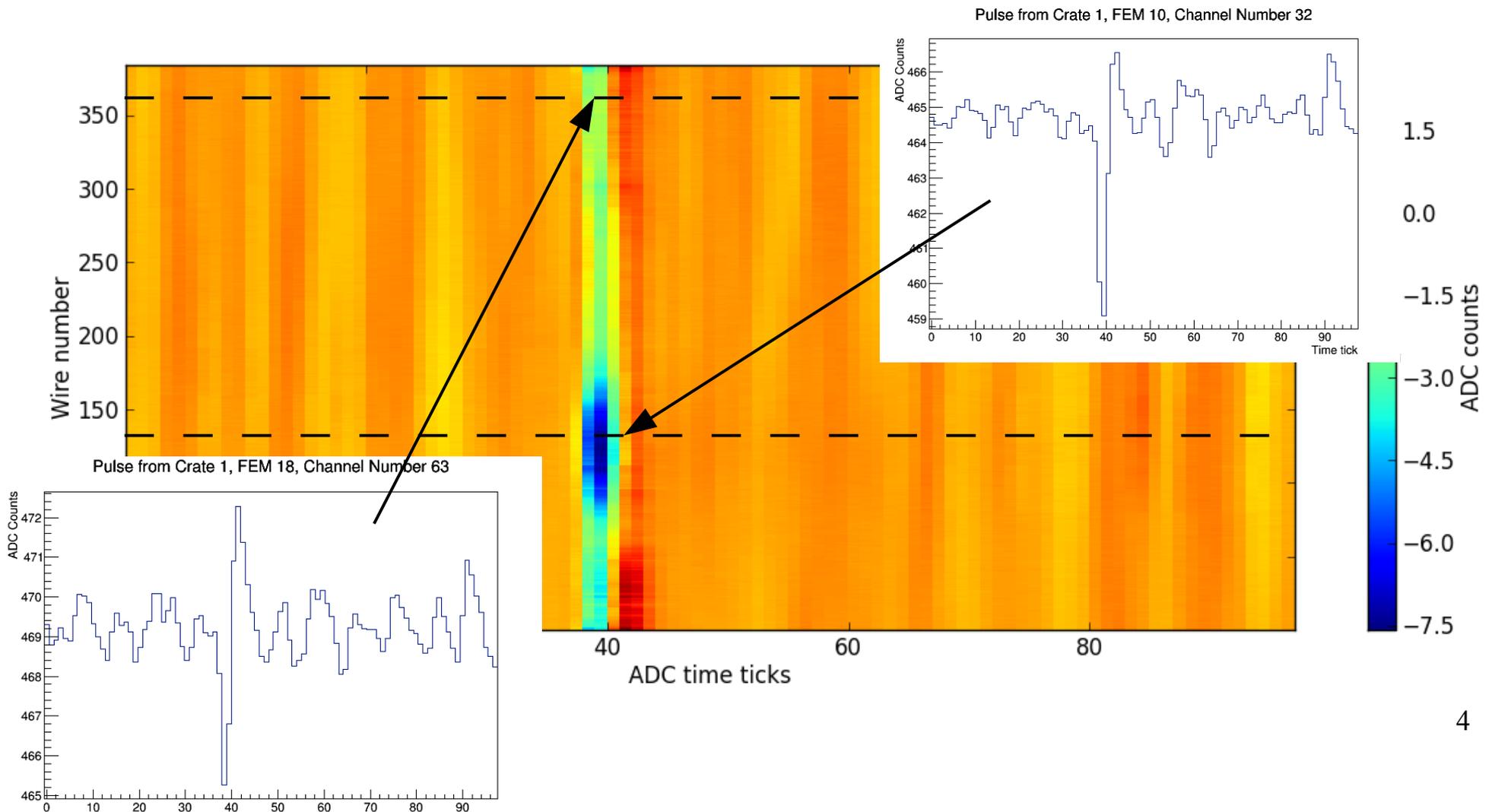
The danger

- Cosmic causes PMTs to dump noise on the wires while they read out an event



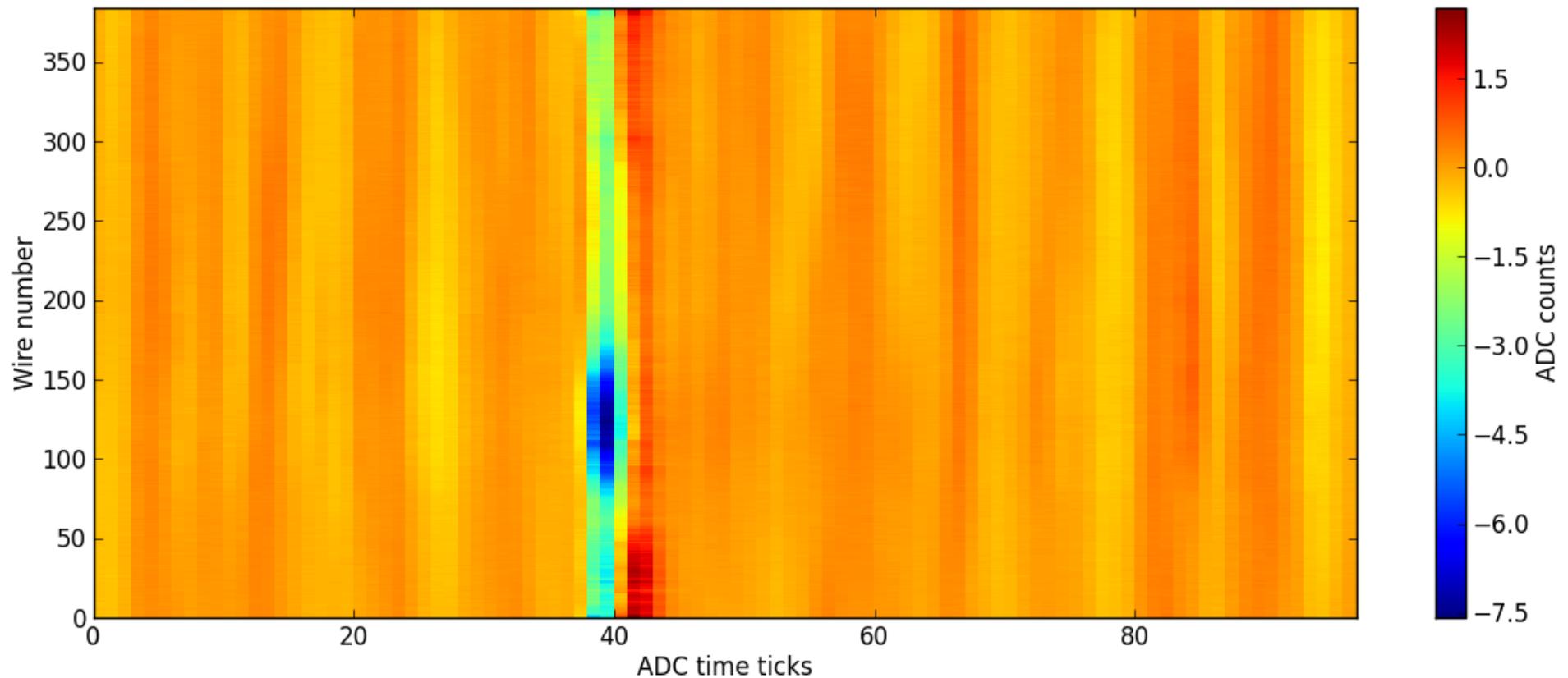
Photoelectrons

- 420 PE signal averaged over 50,000 events

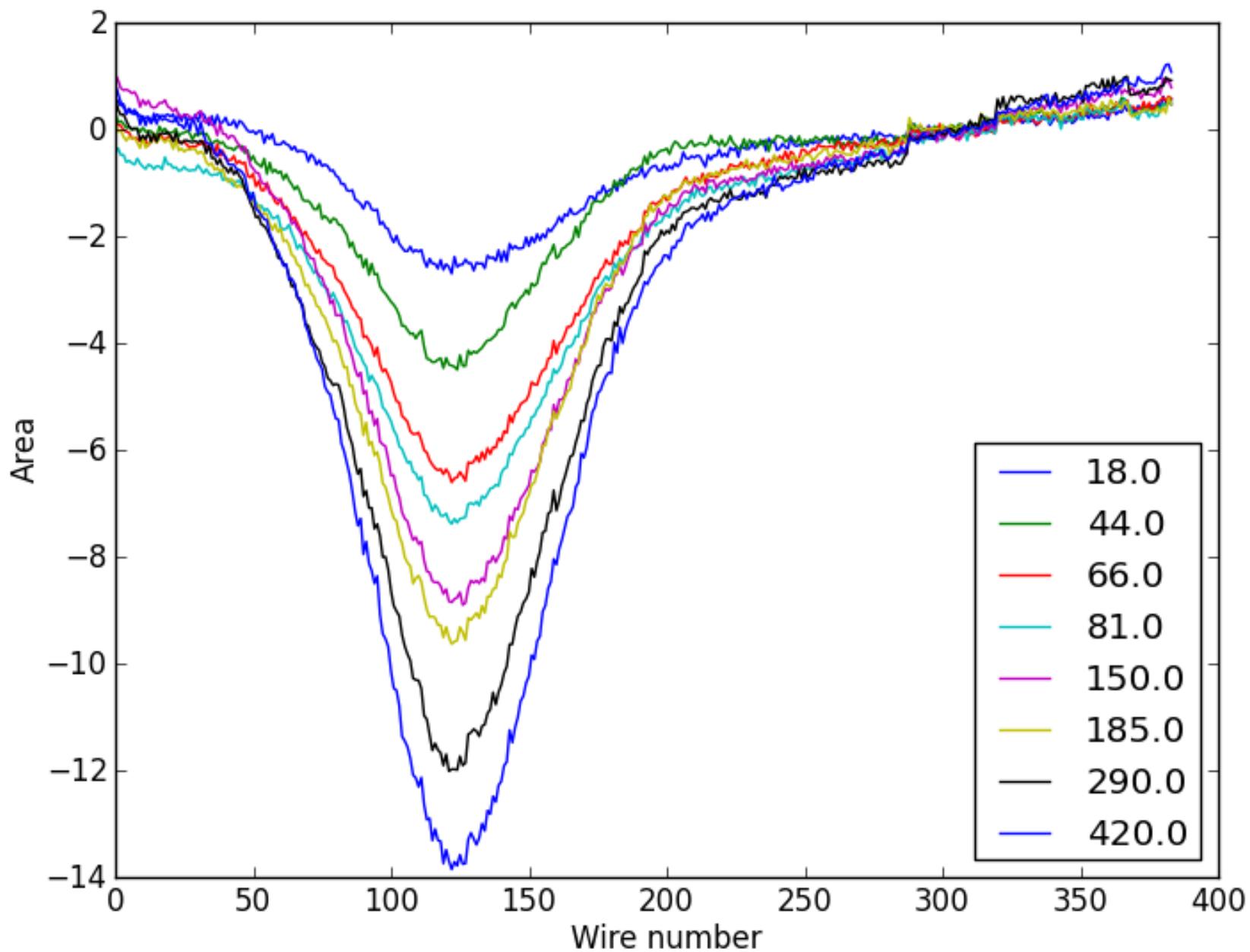


Photoelectrons

- 420 PE signal averaged over 50,000 events

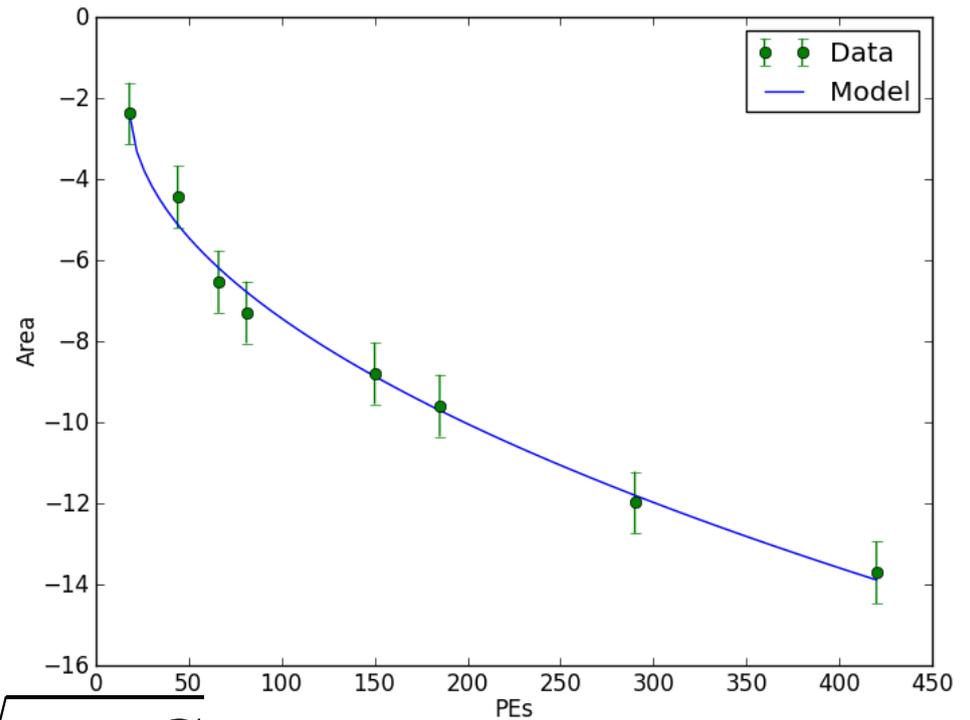
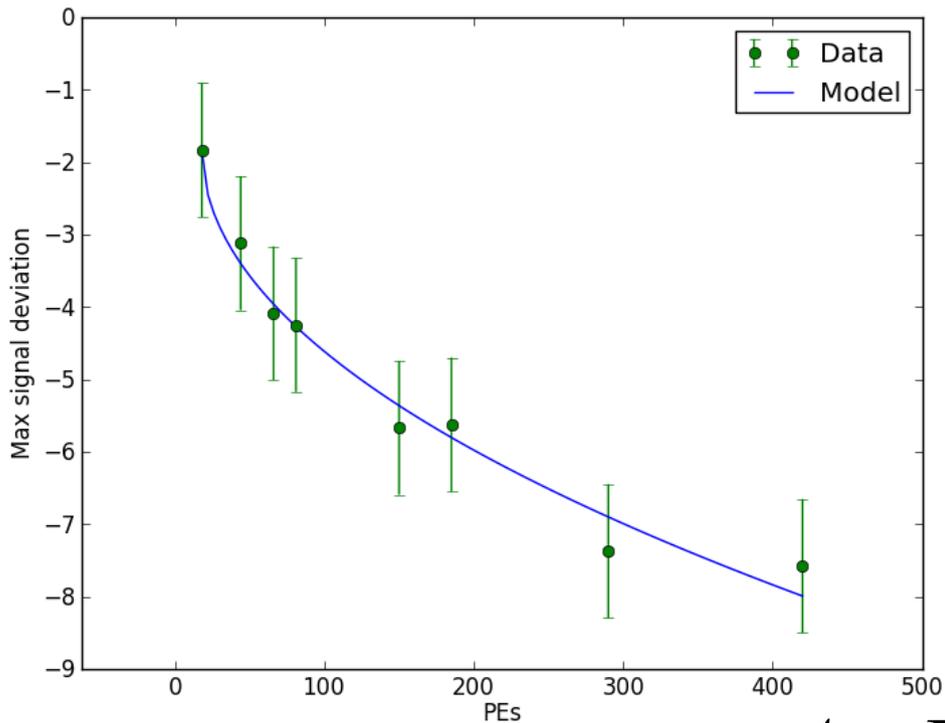


Photoelectrons



Photoelectrons

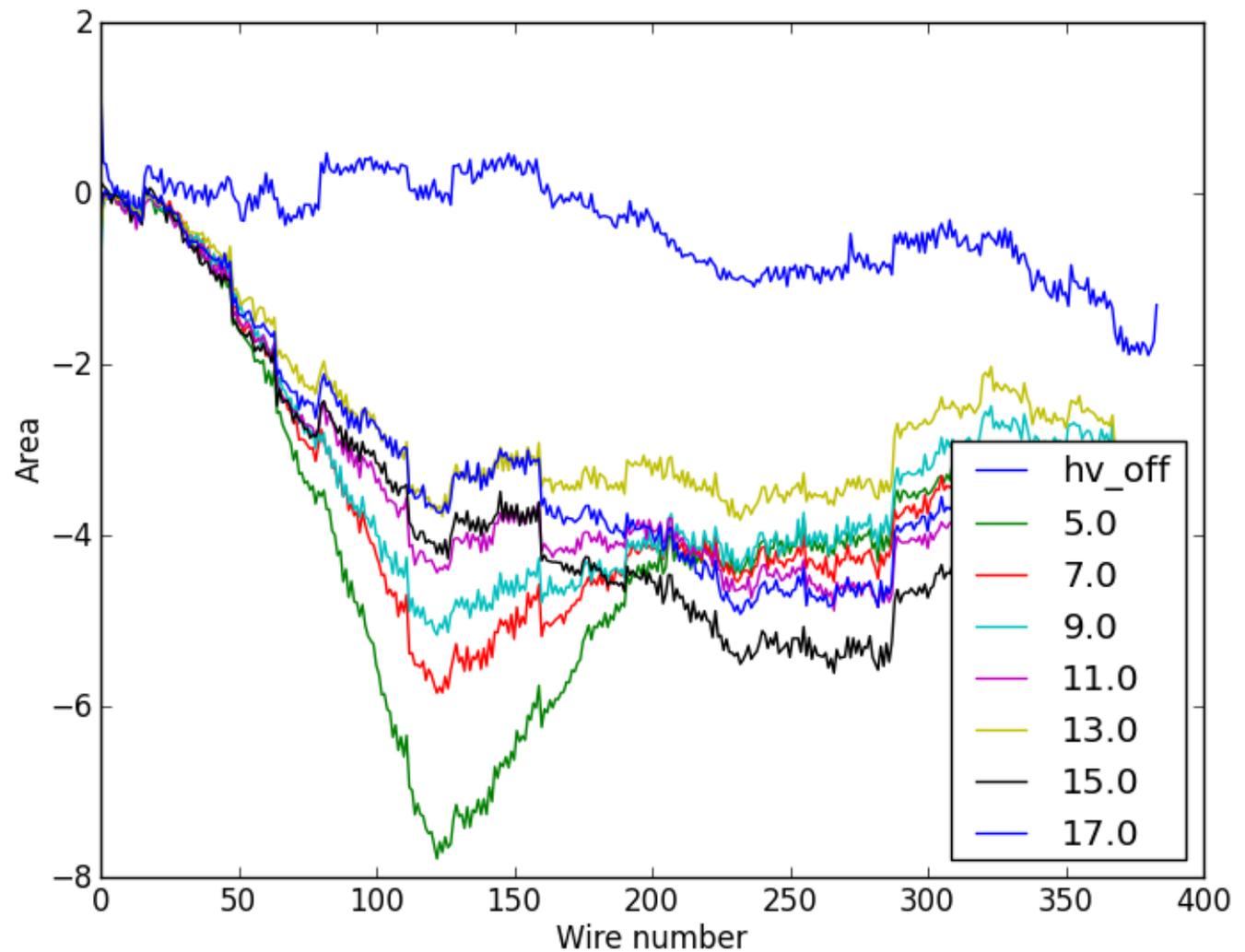
- Range of PEs over the expected cosmic spectrum
- Signal of ~4 ADC counts in area of interest
- No more than 10 counts at 1000 PEs



$$A + B \sqrt{x + C}$$

Distance

- Distribution pegged at wire 5



Signal pick-up vs distance

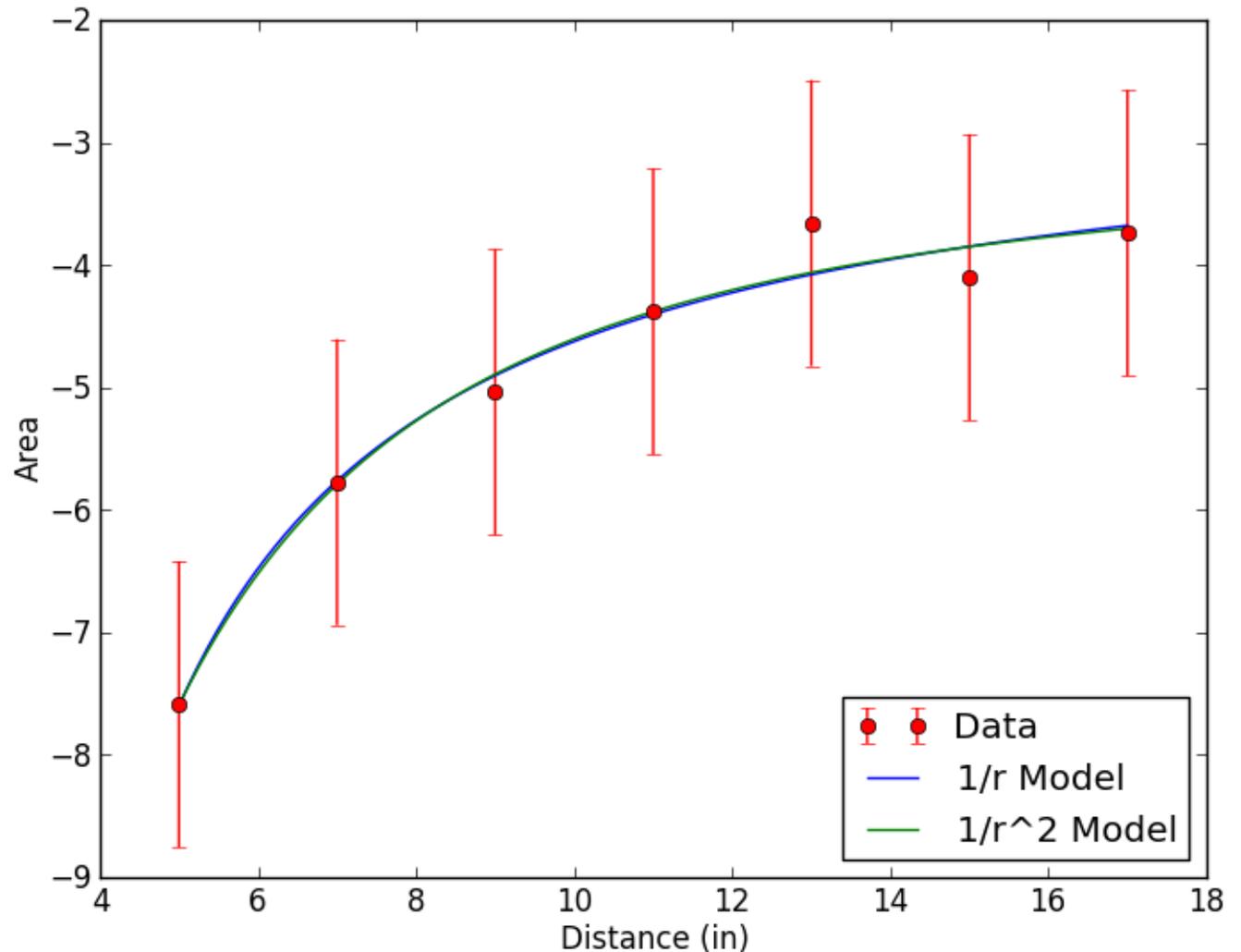
- 1/r offset:

1.4" +/- 1.2'

- 1/r² offset

-1.7" +/- 2"

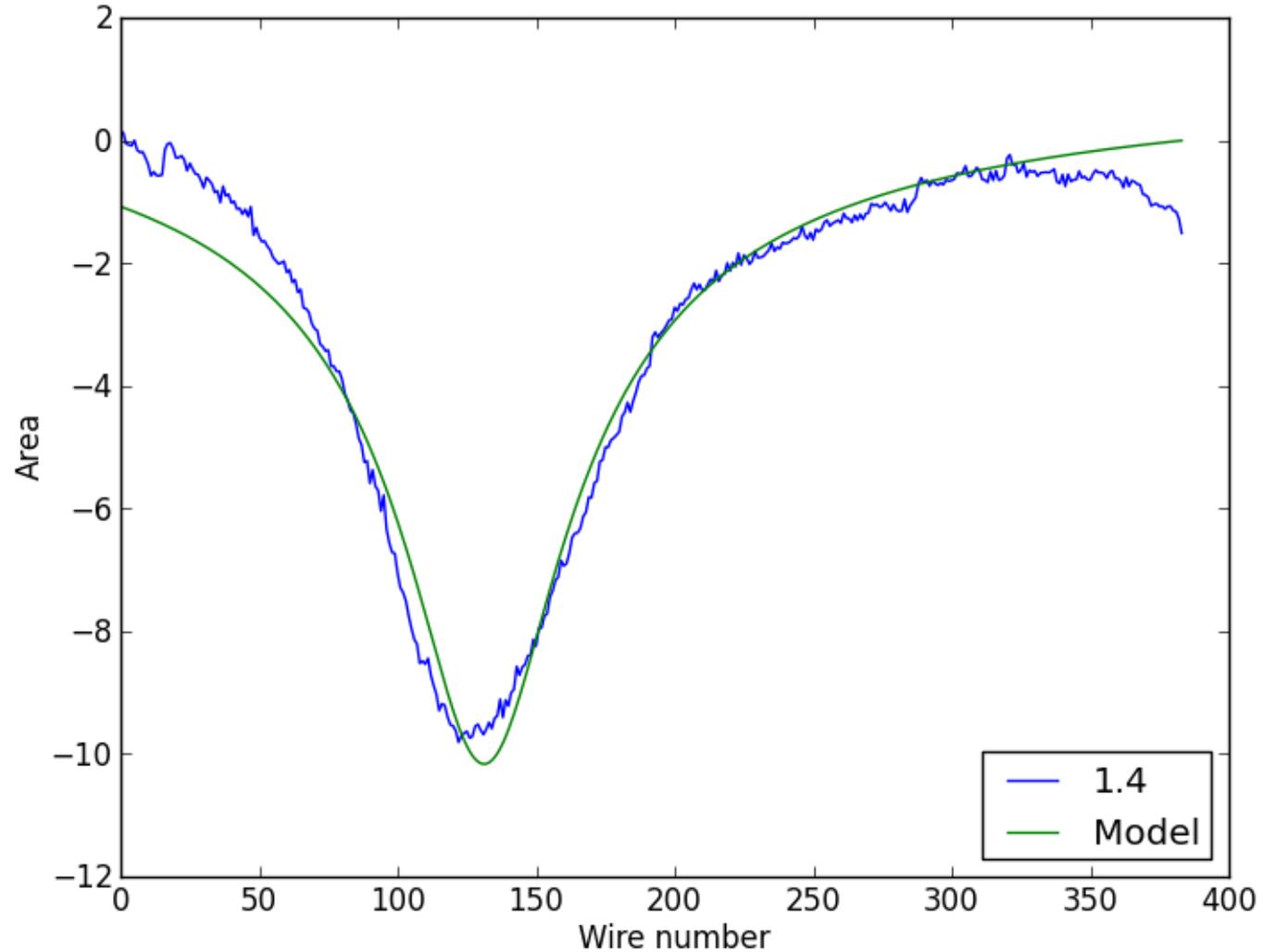
$$A + \frac{B}{(x - C)^n}$$



First dynode at -6.7 inches

Distance

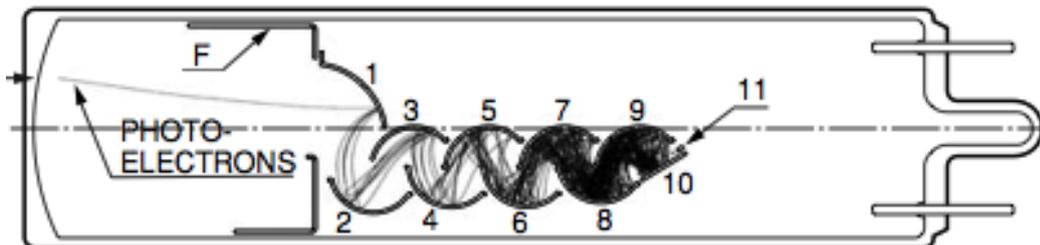
- Lorentzian fit
- Offset from wires:
 $C = 3.1'' \pm 0.08''$
- PMT located at $5''$



$$A + \frac{D}{\sqrt{C^2 + (0.11x + B)^2}}$$

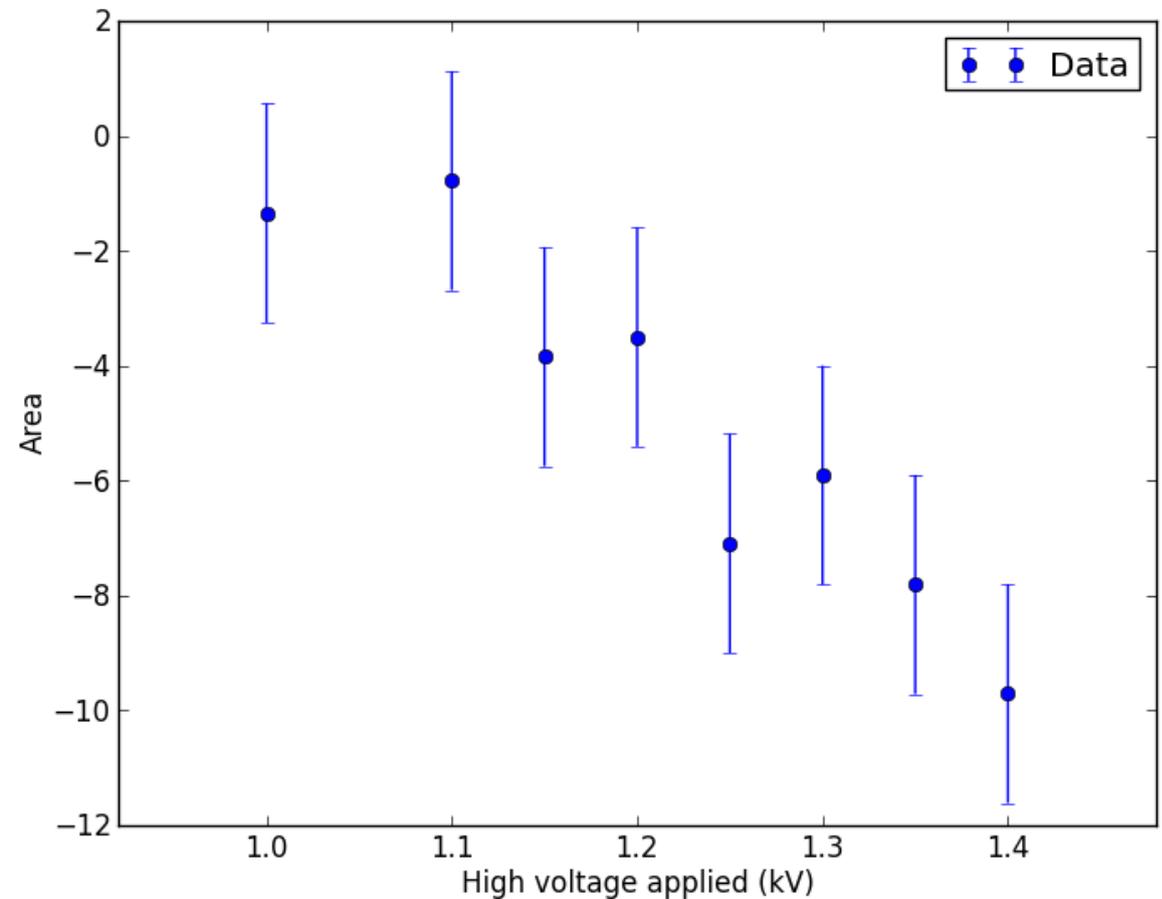
High voltage

- Effect should be generated at the place of highest current
 - If it is radiative
- The highest current in the PMT is in the gap between the last dynode and the anode.
- Thus the crosstalk signal should have some high power law dependence on the HV applied.



High voltage

- Linear with voltage
- Unexpected if signal caused by last dynode

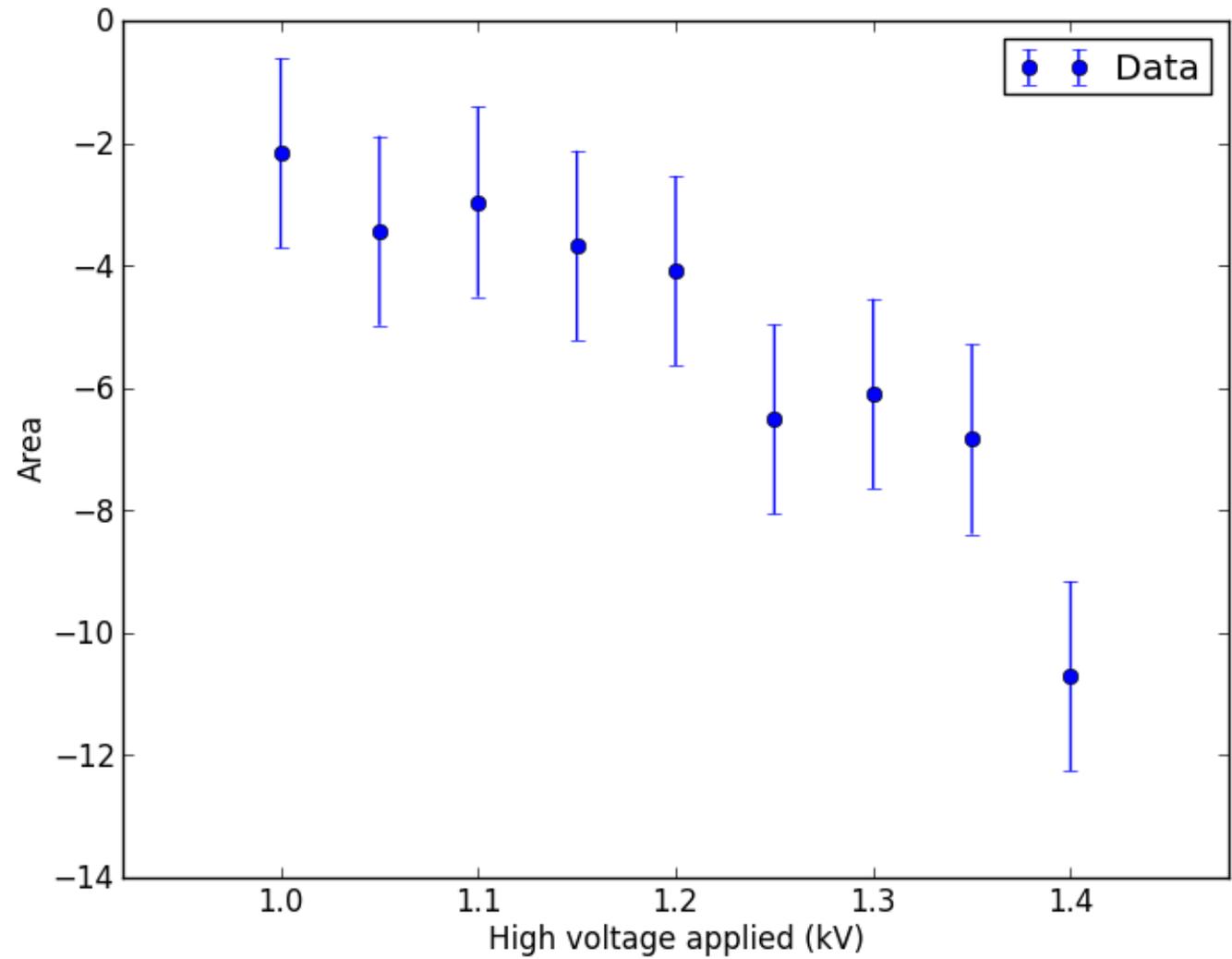


PMT pulse area

- Effect should be proportional to anode current
 - If it is due to the last dynode-anode gap.
- Thus effect should remain constant
 - If anode current is kept constant
- PMT pulse area was kept constant as HV and PE number were varied.

PMT pulse area

- Wire 123



Conclusions

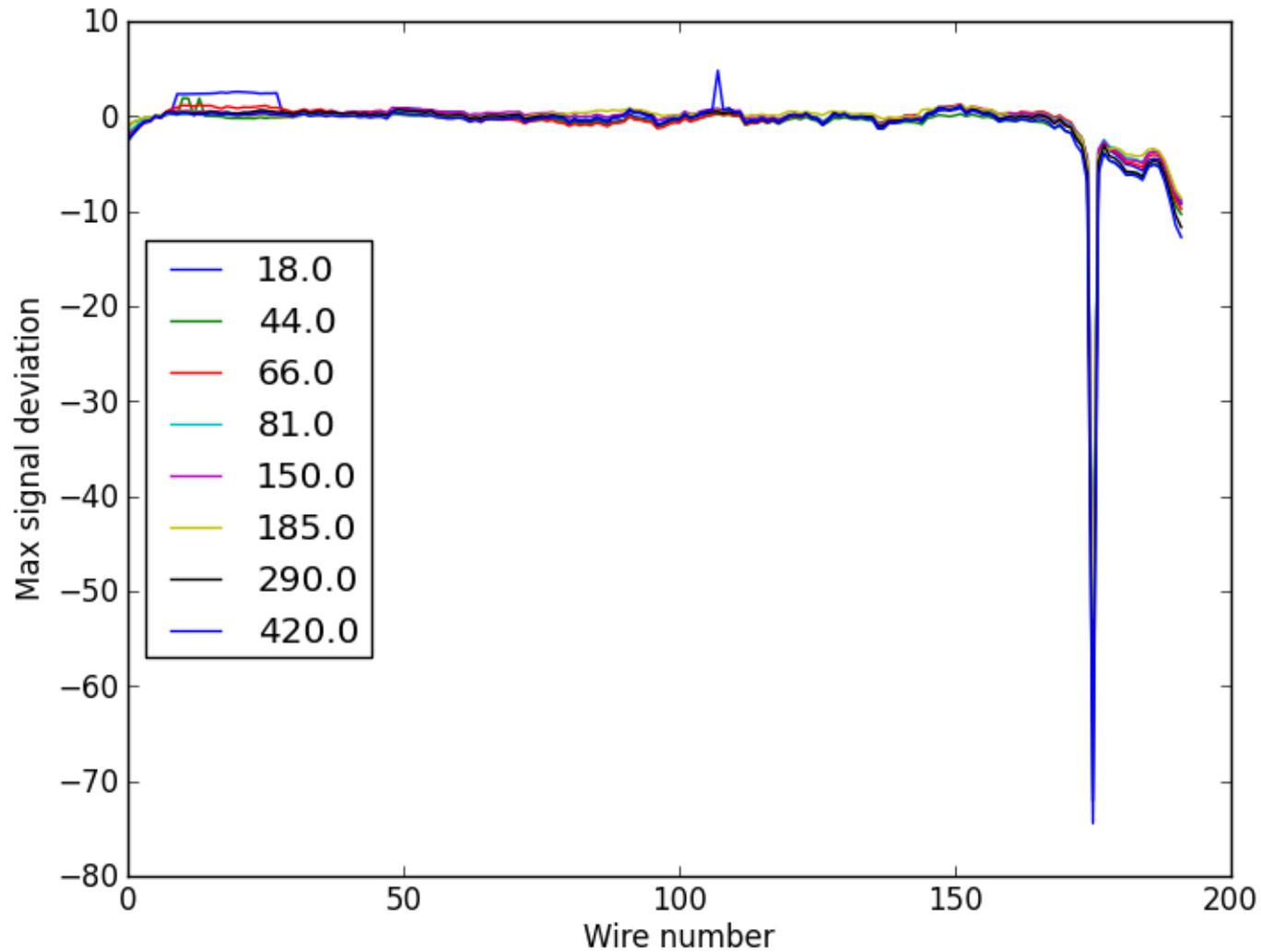
- Signal on TPC wires is observed
 - Correlated with the trigger
- Slight saturation effect observed with # of PEs
 - No greater than 10 ADC counts in present test conditions
- $1/r$ vs $1/r^2$ unclear
- Mu-metal shield reduces effect by a factor of 4
- 2"x3" hex mesh is a good shield
 - Attenuates signal as well as a solid plate
 - Removes signal entirely

Conclusions

- Still working to understand the details of the signal.
- Coordinating with the TPC and DAQ groups
 - Jen, Jonathon, Wes, Eric have been big helps
- Further tests using the Bo PMT in Sept can allow for a vertical slice test
 - VST being coordinated by DAQ and Online groups
 - Modifications can be safely made to the Bo PMT in order to narrow down the signal origin

Backup

PE data, U plane



PE data, V plane, no pegging

