

A Study of The Crosstalk in the Focusing DIRC Prototype

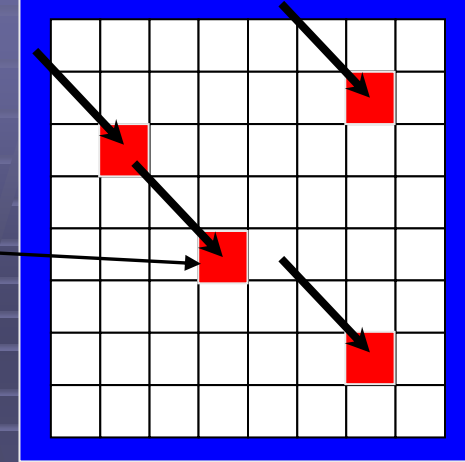
Jose Benitez

2/9/2006

Outline

- **Reminder:** There are two kinds of secondary signals induced by primary real photons:
 - Charge Sharing: occurs to nearest neighbor pads and very close in time with primary signal.
 - Crosstalk: occurs to nearest neighbors as well to far away pads; signals usually come later in time.
- In this talk only crosstalk signals will be studied using calibration data. We would like to know how we can
 - identify crosstalk signals,
 - quantify them and
 - possibly remove them.
- I will then show that this signals are present in beam data.

Consider calibration data where the MCPs are sprayed randomly with photons by the PILAS laser and take the point of view of a certain pad. Collect all events in which this “target” pad was hit and create 2D occupancy histogram which gives the probability that other pads will fire when the target pad is hit.

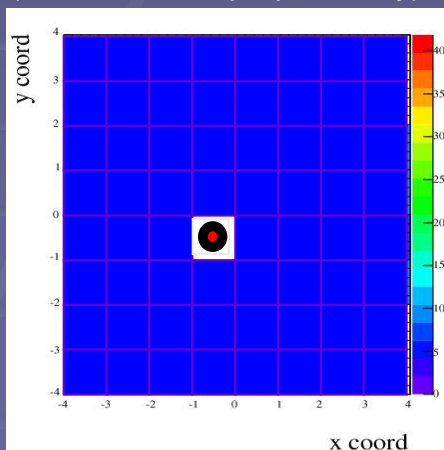


One Event In some Detector

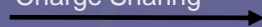
Every square bin represents one pad. The color scale gives the probability of a second hit when the target pad is hit. Target pad has been masked and labeled by a red filled circle.

Ideal Case

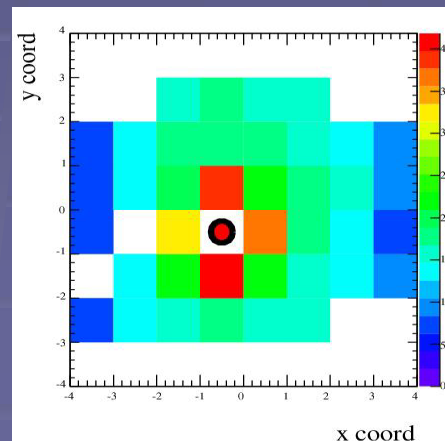
(For illustration purpose only)



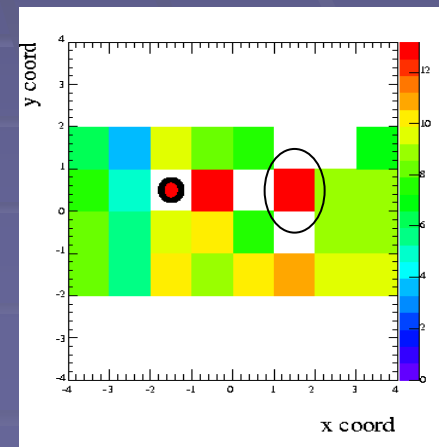
- Pads not read by TDC
- Position Dep. Efficiencies
- Charge Sharing



Real Case Without Crosstalk



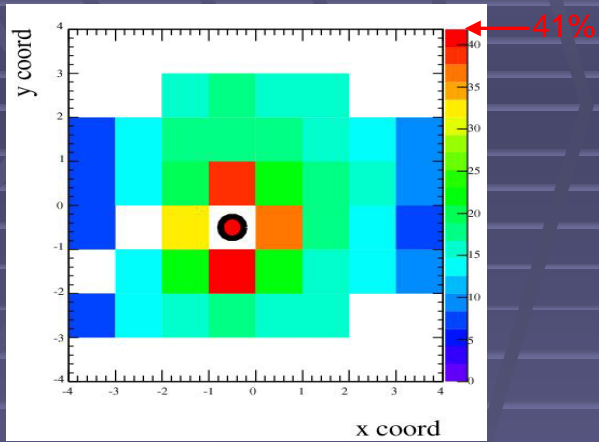
Real Case With Crosstalk



Which detectors are affected?

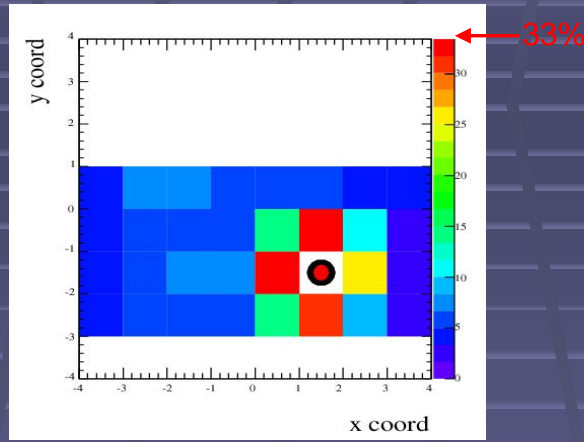
The Burle MCP's are *not* affected:

slot 4



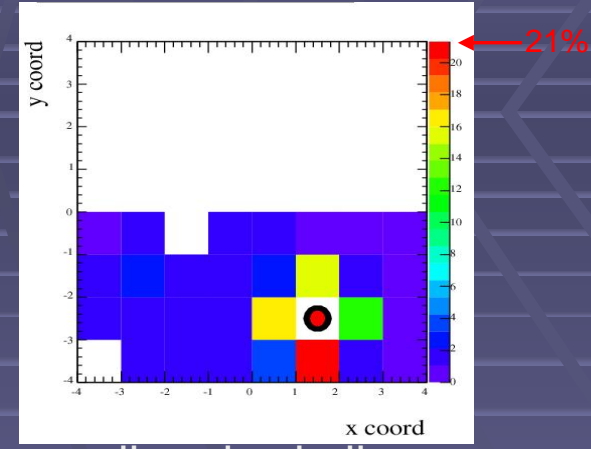
all pads similar

slot 5



all pads similar

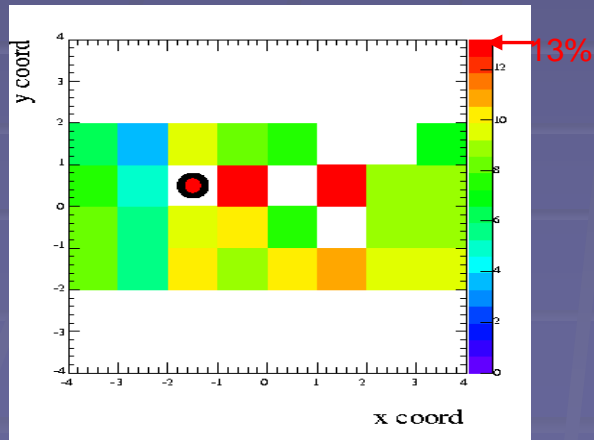
slot 6



all pads similar

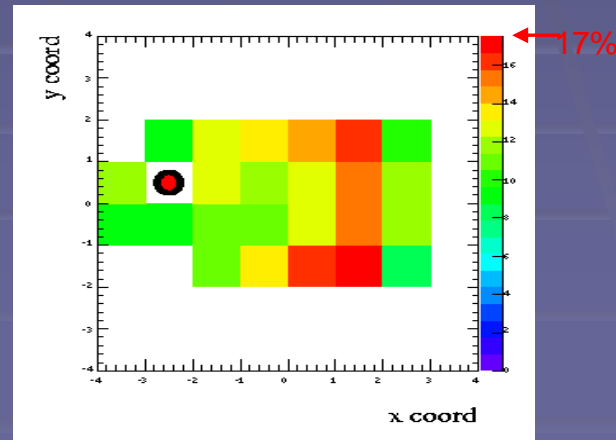
But the Hamamatsu PMTs are affected:

Slot 2



all pads similar

Slot 3

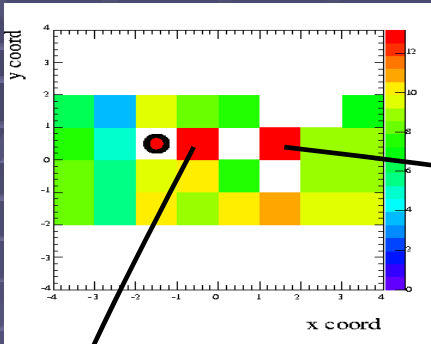


all pads similar

Note: This is PILAS data at 25% power

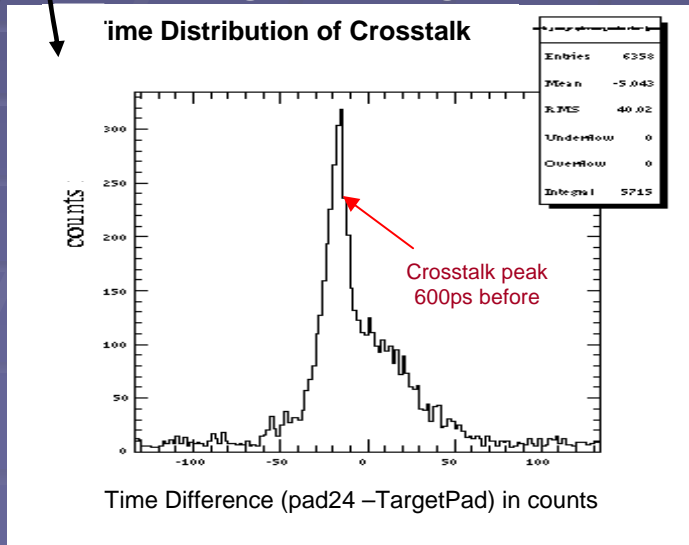
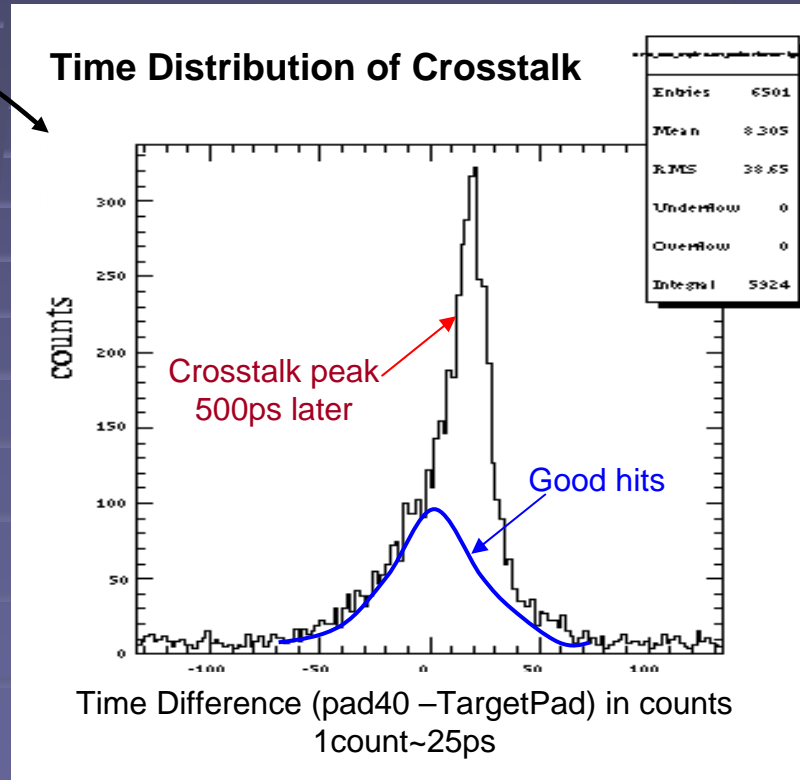
Can we identify crosstalk signals in the time distributions?

Slot 2 : Hamamatsu PMT



Consider the time distribution of the affected pad with respect to the target pad.

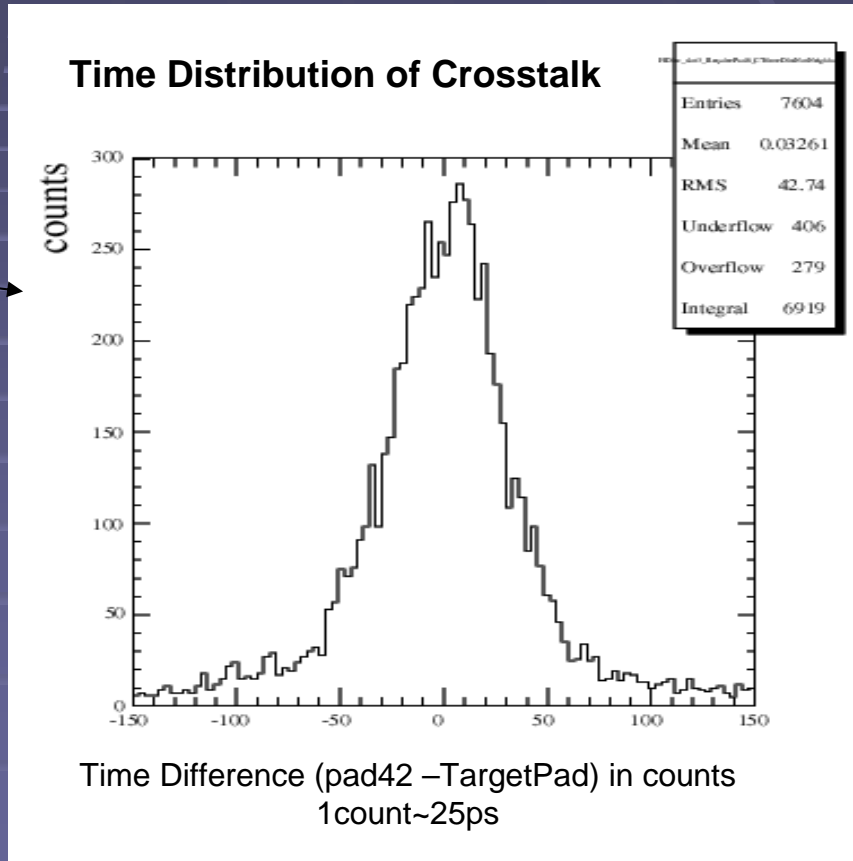
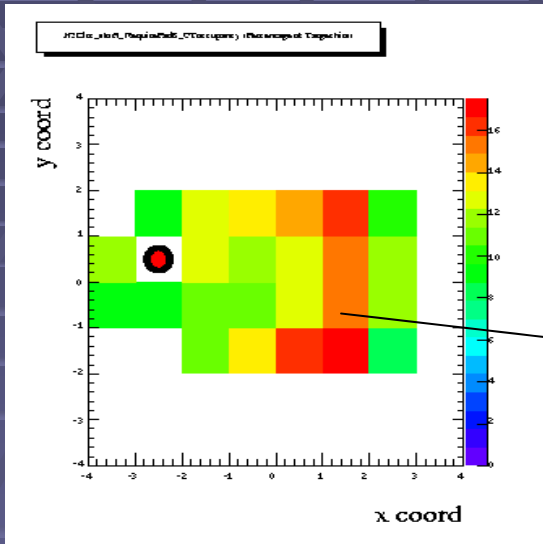
Crosstalk hiding in charge sharing pad



Note: This is PILAS data at 25% power

Slot 3: Hamamatsu PMT

In slot 3 the “crosstalk” hits don’t appear as a separate peak in time.



Note: This is PILAS data at 25% power

How does crosstalk depend on PILAS laser intensity?

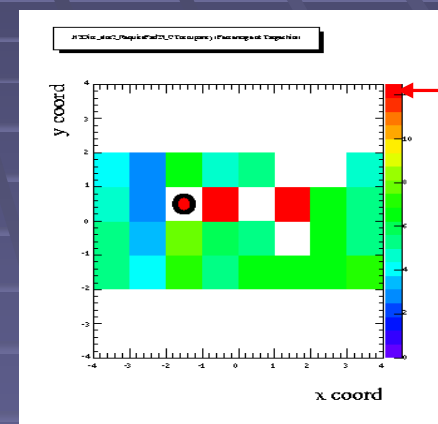
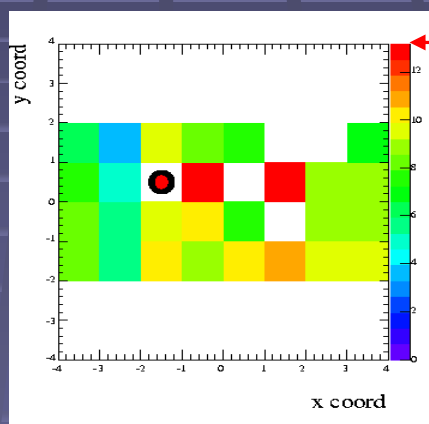
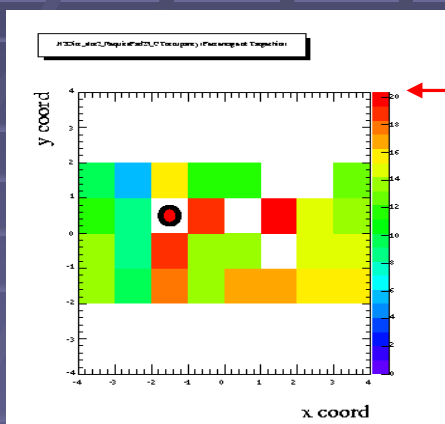
Hamamatsu PMTs

Laser Power: 60%

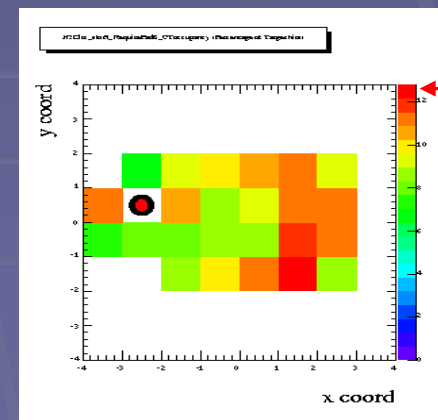
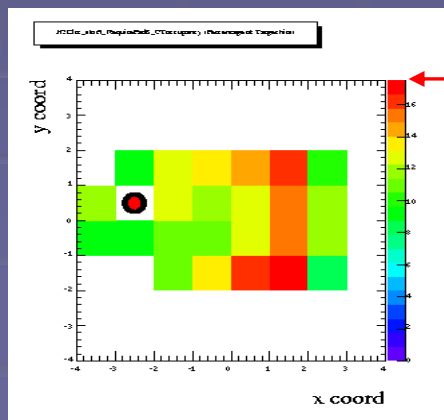
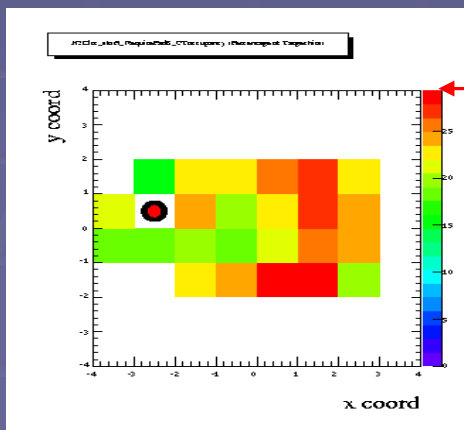
25%(nominal)

13%

Slot 2



Slot 3



Its useful to look at the hit multiplicities to know how "hot" a detector is.

LASER

60%

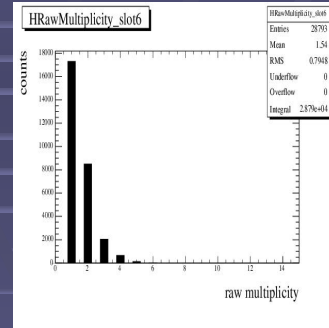
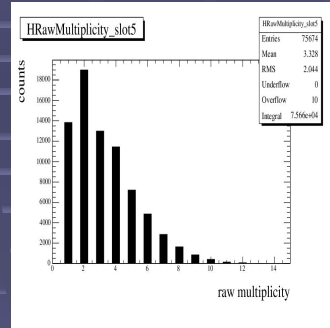
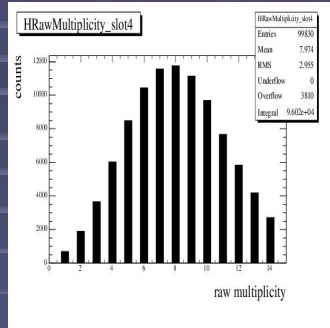
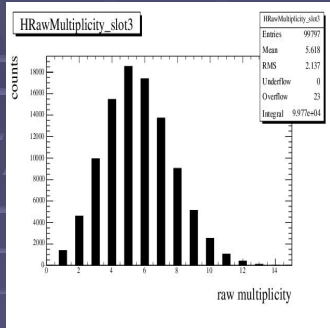
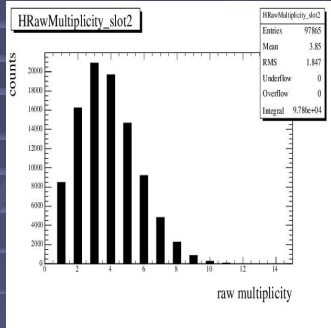
Slot: 2

3

4

5

6



Mean: 3.9

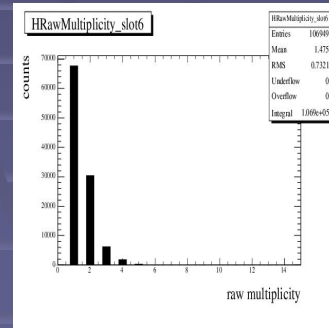
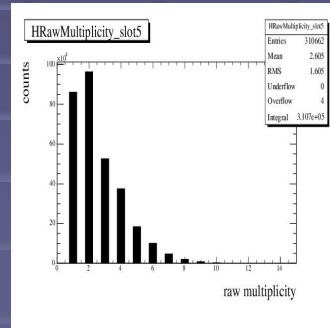
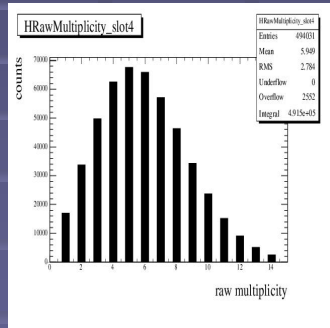
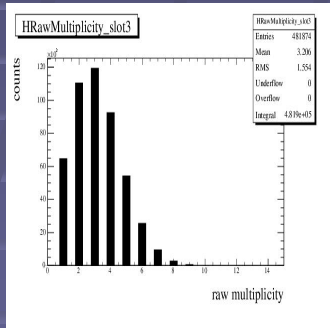
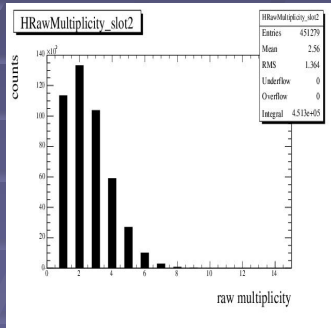
5.6

7.8

3.3

1.54

25%



Mean: 2.5

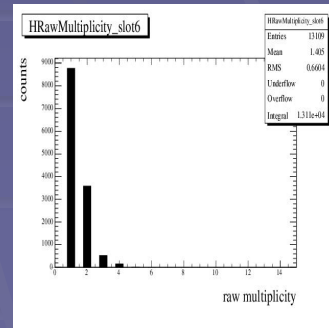
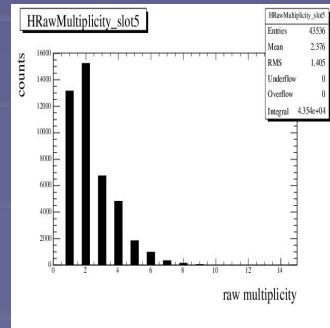
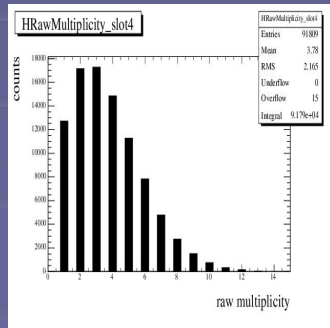
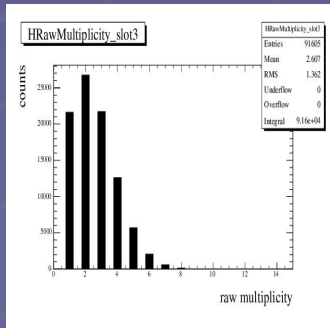
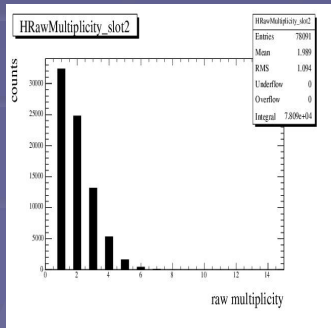
3.2

5.9

2.6

1.48

13%



Mean: 2

2.6

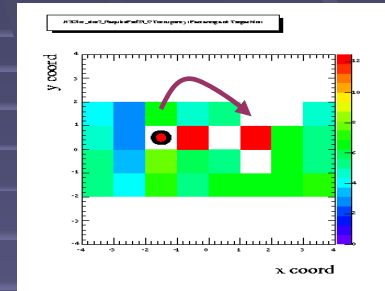
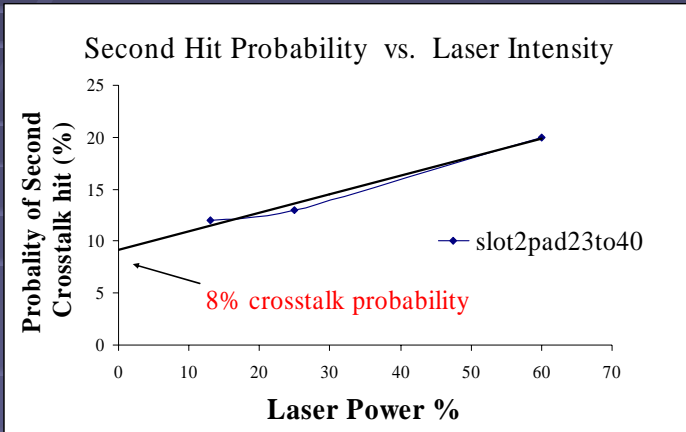
3.8

2.4

1.4

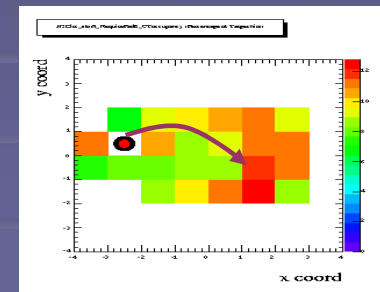
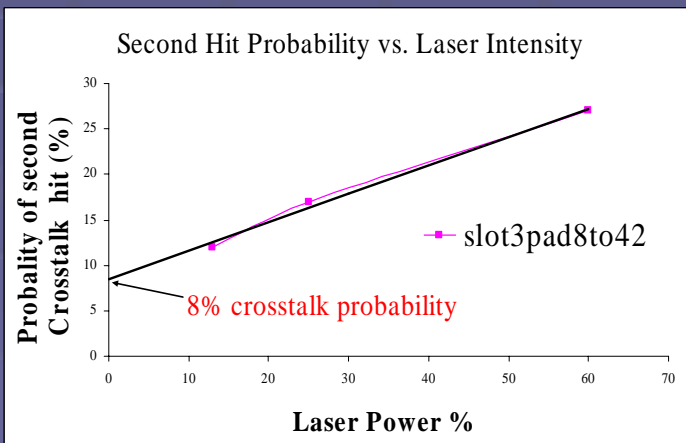
- In the above occupancy distributions there is a contribution from real laser photons. To find the actual crosstalk probability we need to extrapolate down to zero laser intensity.

Slot 2



8% is the probability that pad 23 will induce a signal on pad 40.

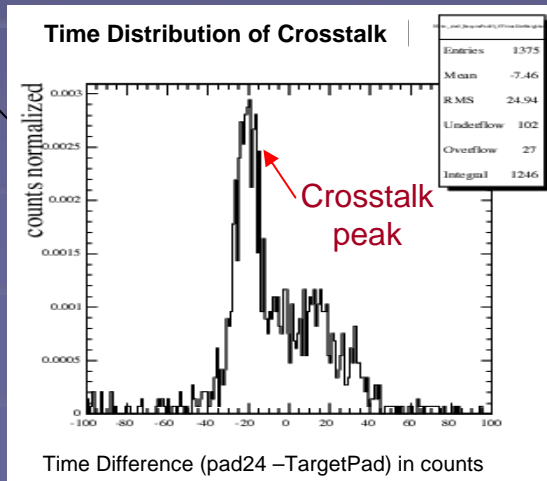
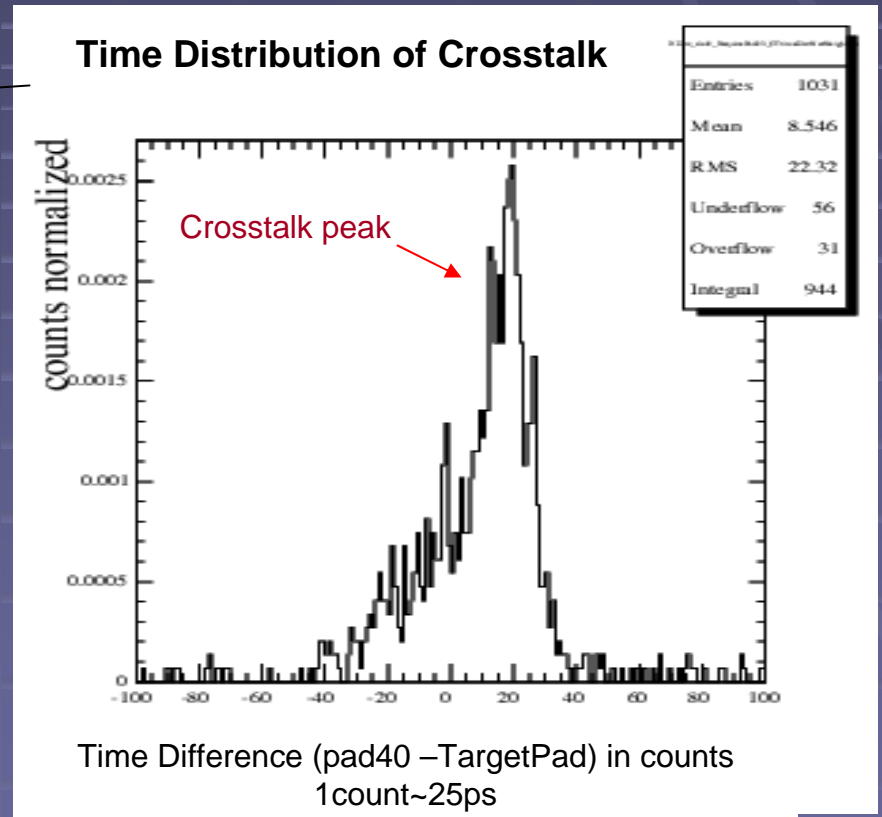
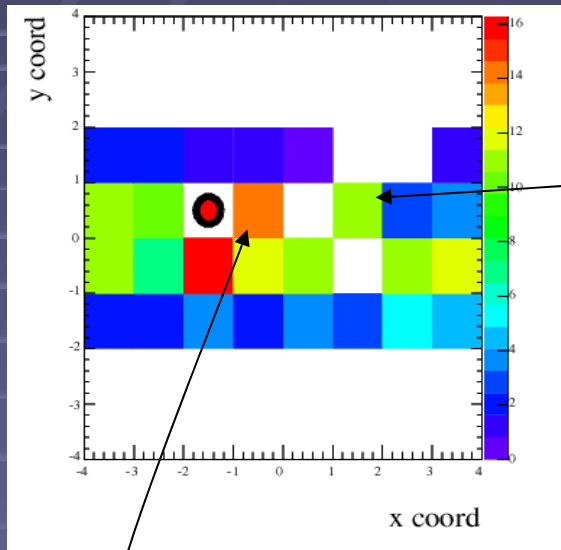
Slot 3



8% is the probability that pad 8 will induce a signal on pad 42

Are crosstalk signals present in the beam data?

November Beam Data:
Direct Photons in slot 2 Hamamatsu PMT



Conclusion

- The Burle MCPs (slots 4,5,6) have been found free of crosstalk.
- The Hamamatsu PMT's in slot 2 and slot 3 are suffering from crosstalk.
- The crosstalk appears to be one way: one pad affects another but the affected pad does not affect the first pad.
- Crosstalk signals have been found to be present in beam data.
- Crosstalk signals usually appear ~ 600 ps after the first signal. This makes removal of this signals very hard since the Cherenkov signals also come in this time scale.
- The above analysis does not yet allow for a determination of how much of our data is fake crosstalk signals. A new analysis technique is underway to make this determination.