Update on CERN/GE Source Measurements

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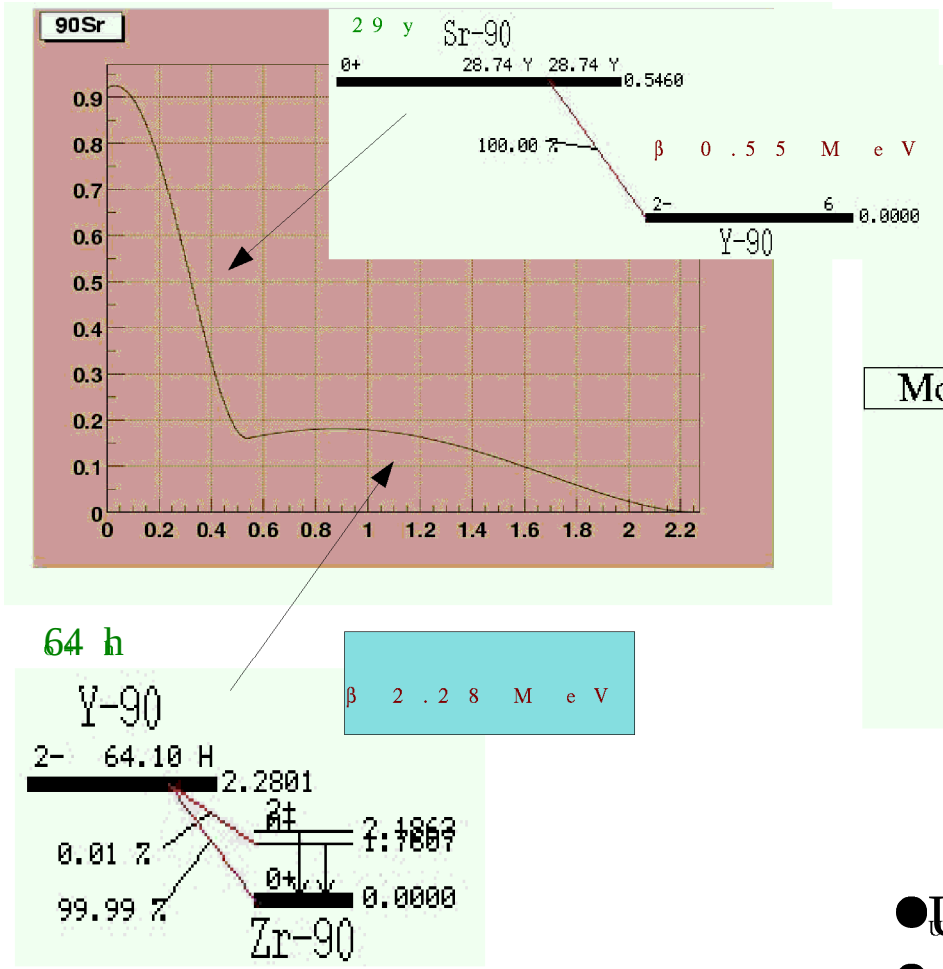
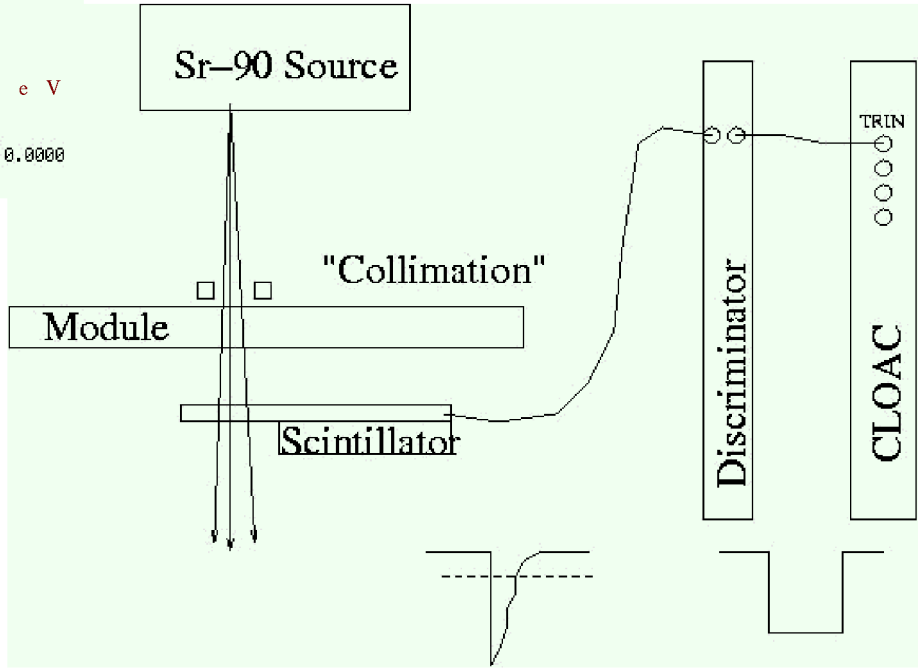
The CERN/GE Source Setup





~6% above MIP

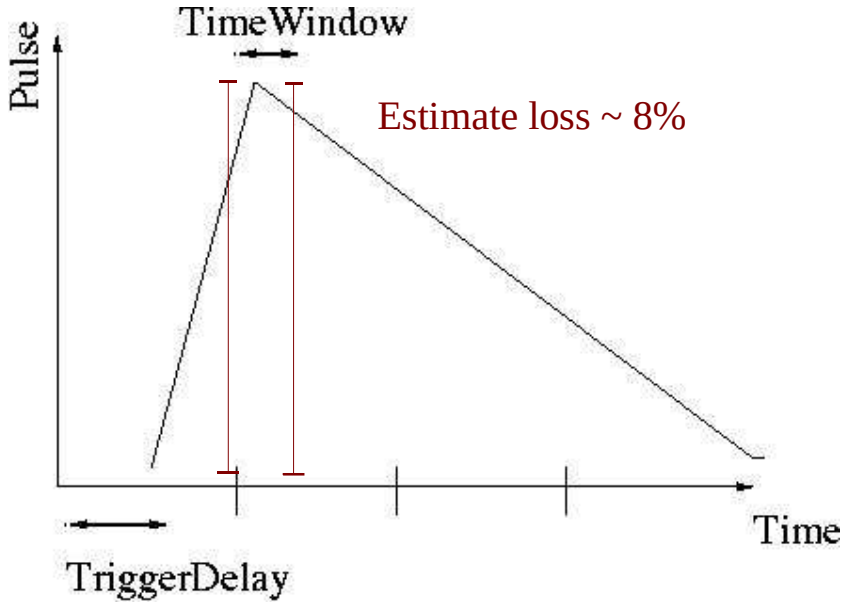
- Use TRIN feature of CLOAC
- Use BurstType "20" (External Trigger)
- Use Trigger Window Feature of CLOAC

The Timing

➔Choose Time Window 5 ns

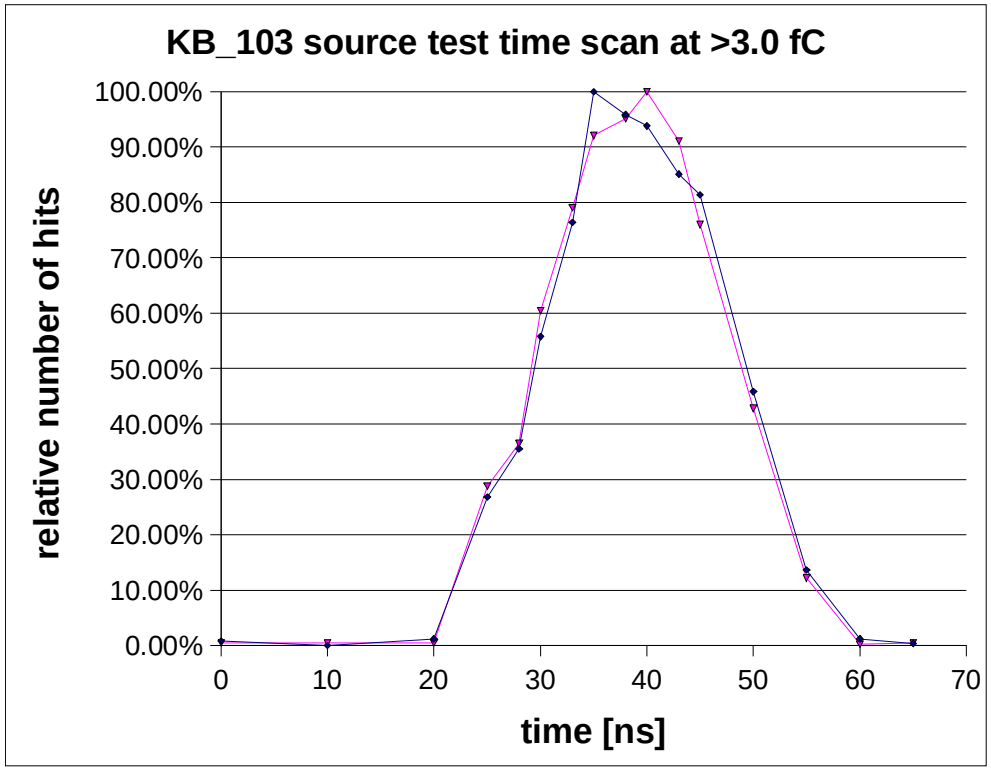
➔Optimize Window/Trigger Delay by counting hits above ~2 fC

➔Use LevelMode X1X for correct determination of noise

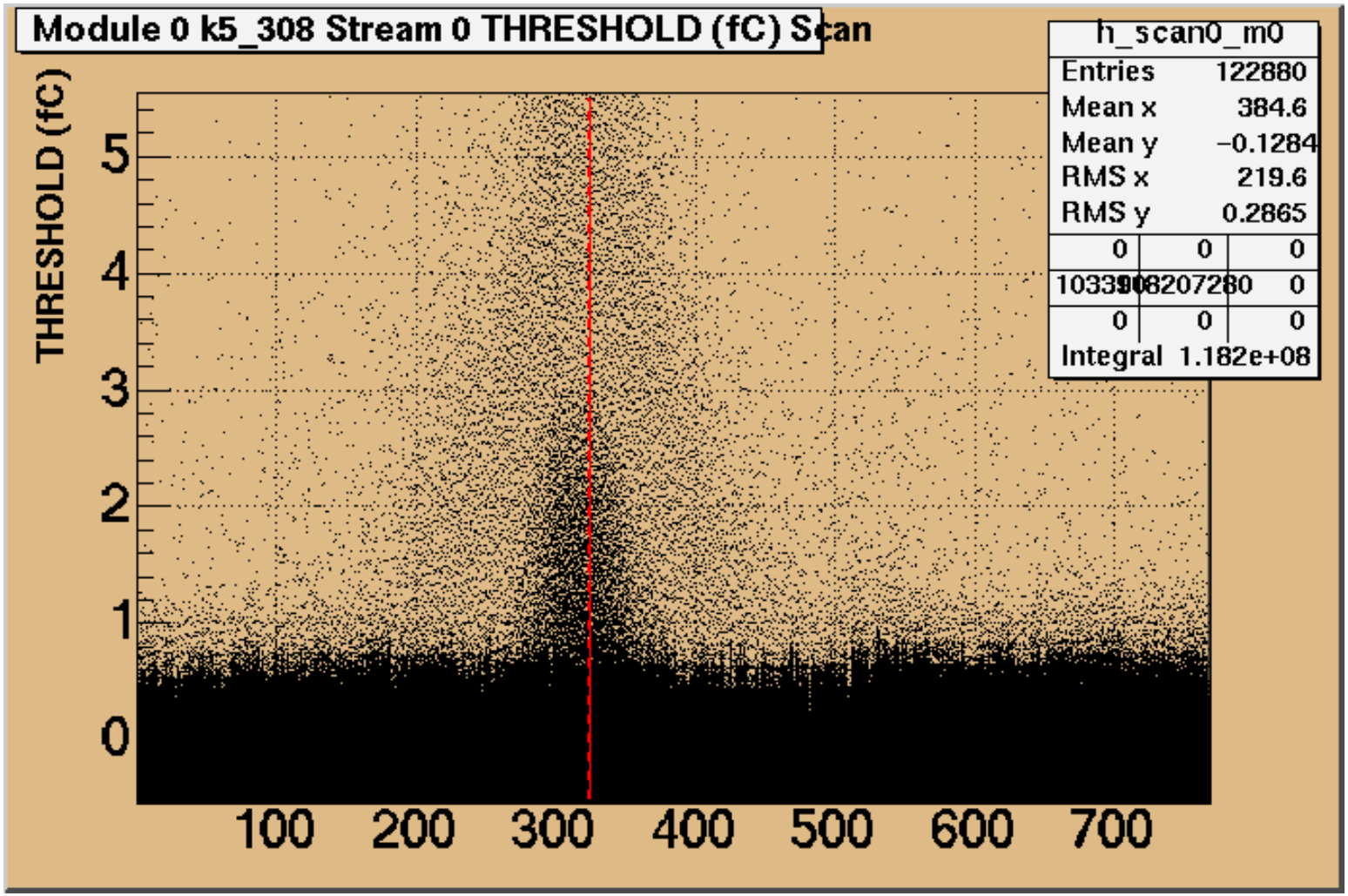


Module	BunchCrossing	WindowDelay
K5-303	123	7
K5-308*	124	12
K5-310*	124	12
K5-312*	124	12
kb-105	123	5
B044*	123	7

B044* courtesy by Janet Carter, Nobu Unno et al.

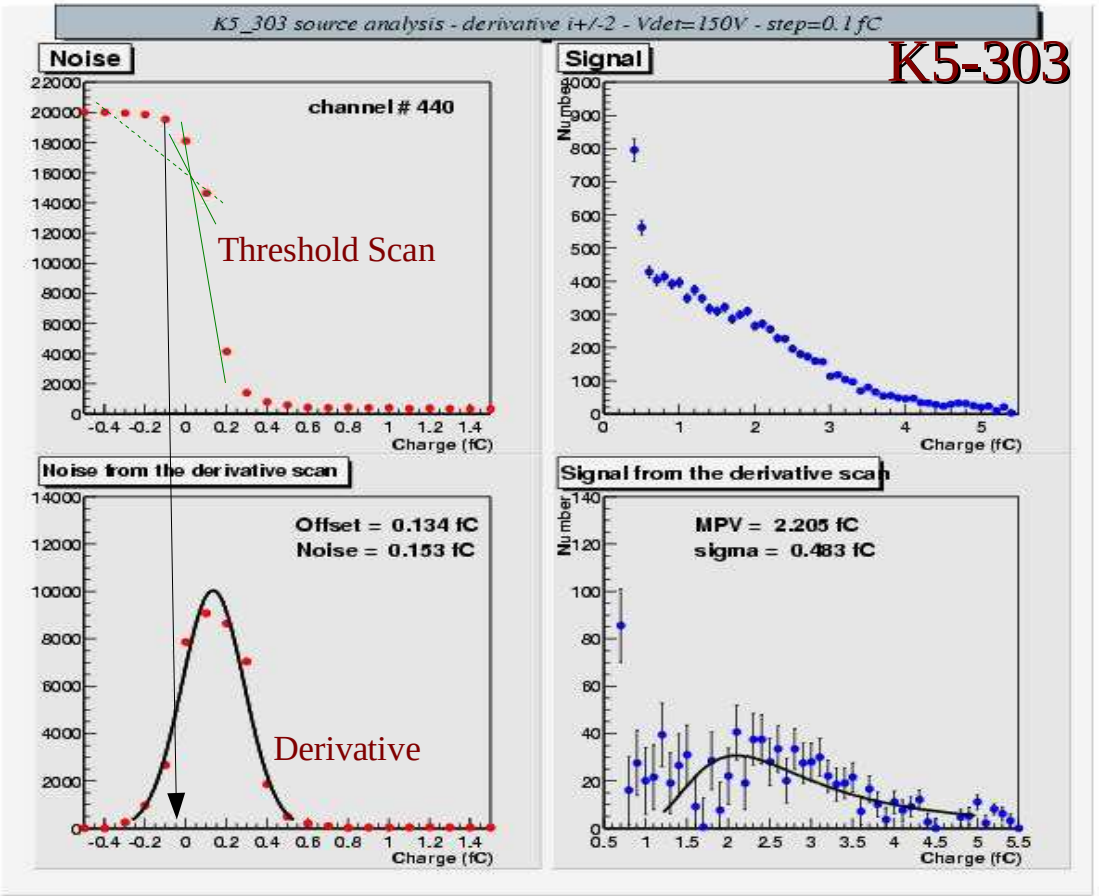


'Beam Profile'



- 0.5 ... 5.5 fC with 0.1 fC spacing
20000 triggers per point
1.... 11 channels summed in region of interest

The Method: Derivative of Threshold Scan



Goal: Recover the analog information from threshold scan -> S/N

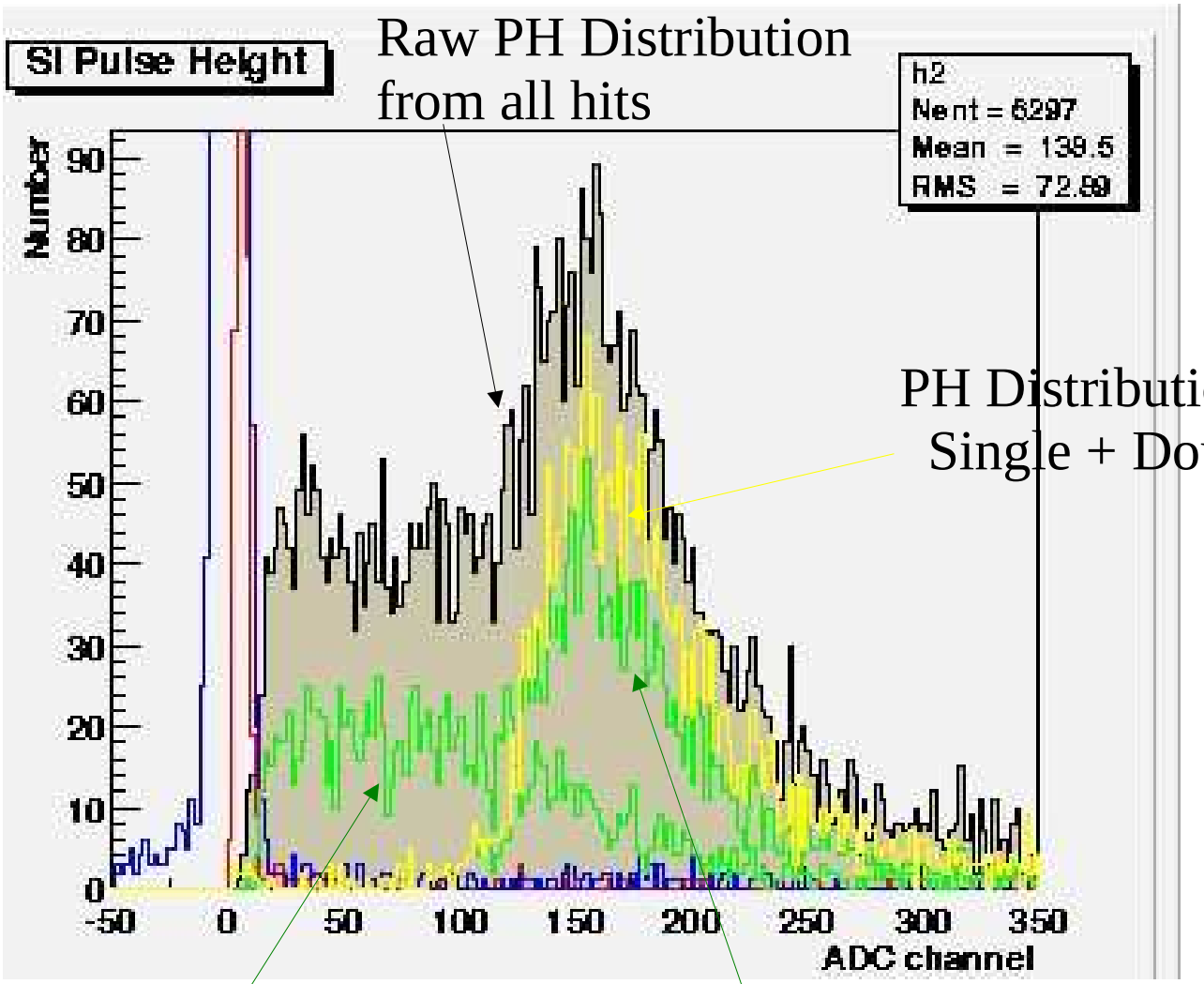
not as straightforward as it sounds (systematics of numerical finite derivative etc ...) numbers here on S/N, and absolute N and S still preliminary

.... but usable for "figure- of- merit" comparison of modules

second angle on standard perf. determinations (TB, electrical tests)

Source Pulse Height Expectation

CLEO Silicon, analog Readout
Sr-90 Source
private Comm.



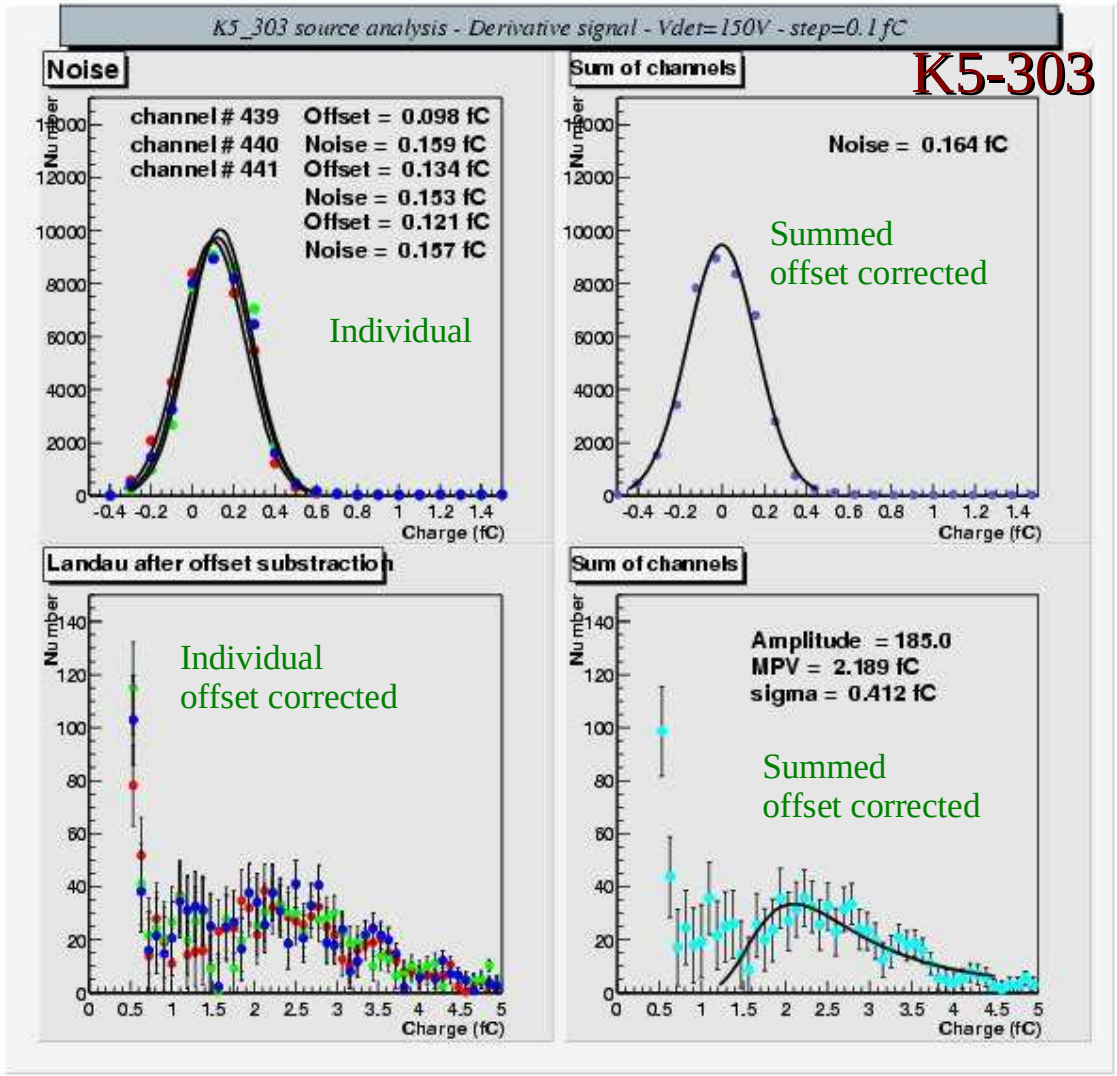
Raw PH Distribution from all hits

PH Distribution from Single + Double Hit Cluster

PH Distribution from Double Hits

PH Distribution from Single Hits

K5-303 (unirradiated)



- HV=150 V
- Sum 3 channels region

✔ Recover Gaussian Noise

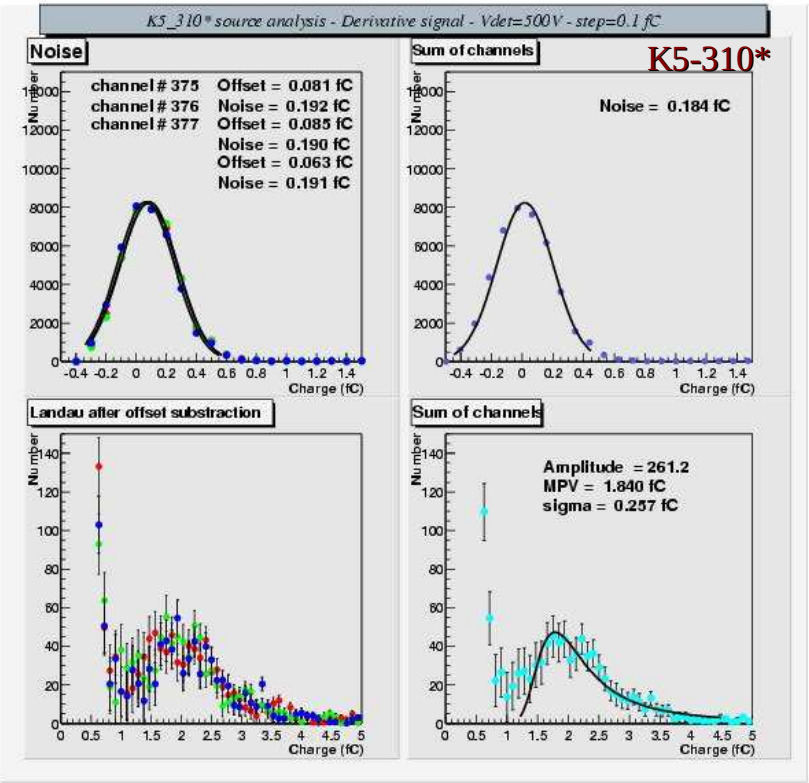
✔ Recover Landau (plus Charge Sharing Shoulder...)

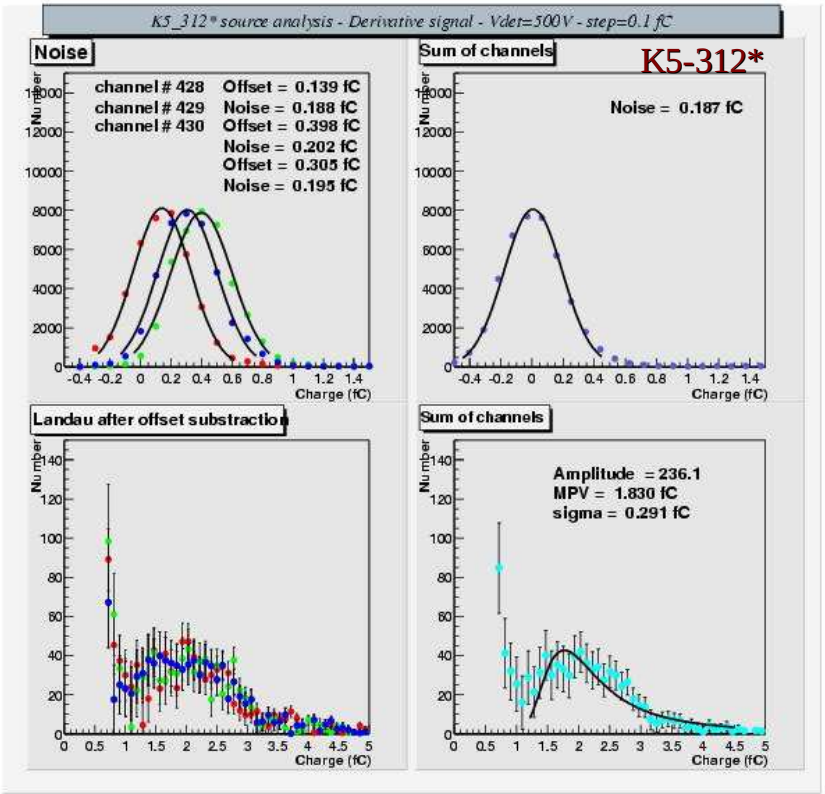
✘ but Noise Gaussians are not centered at 0 ... ???

-> subtract offsets

$S^{mp}/N \sim 13$

K5-310* and K5-312*



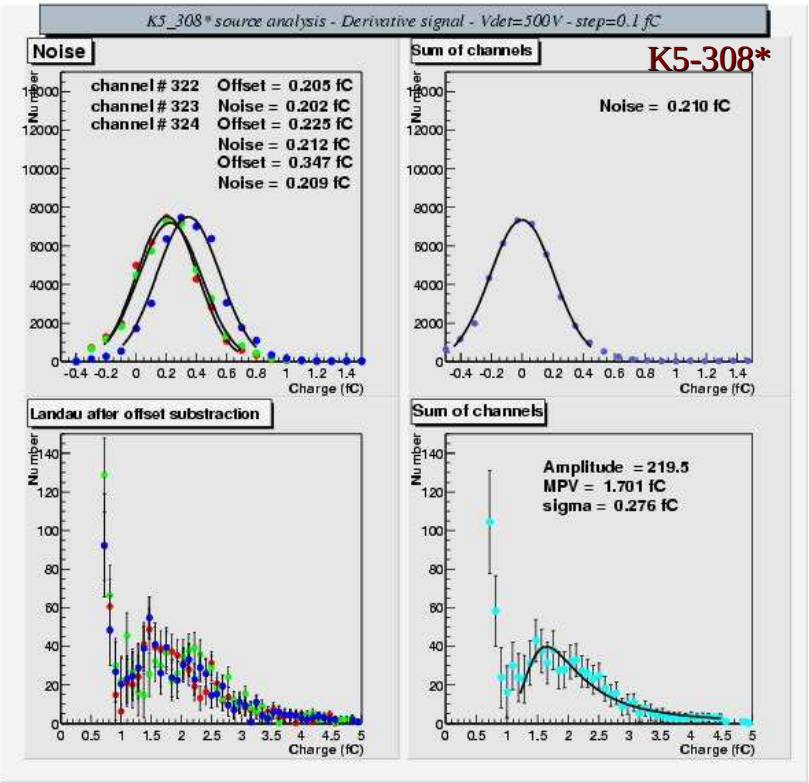


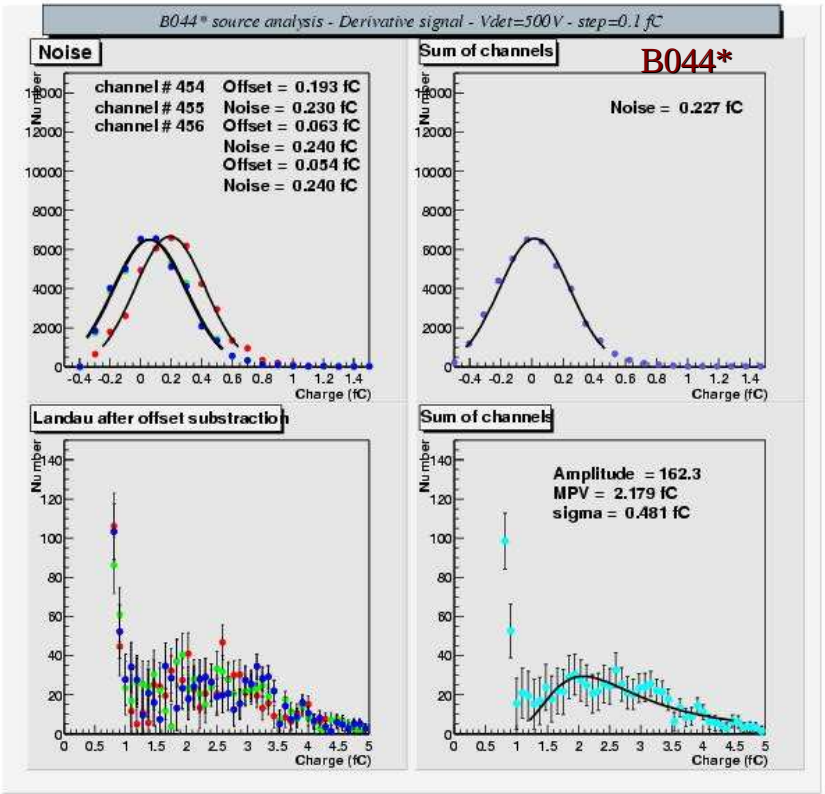
$S^{mp}/N \sim 10$ $S^{mp}/N \sim 10$

NB: modules have only seen 50% of nominal 10 yr LHC flux

- Noise Gaussians postions are fluctuating channel by channel 0.0...0.4 fC

K5-308* and Barrel B044*





✗

$S^{mp}/N \sim 8$

$S^{mp}/N \sim 9.5$

Barrel has slightly higher noise (0.21 fC vs 0.23 fC) but significantly higher signal (2.18 fC vs 1.70 fC)

Overview:

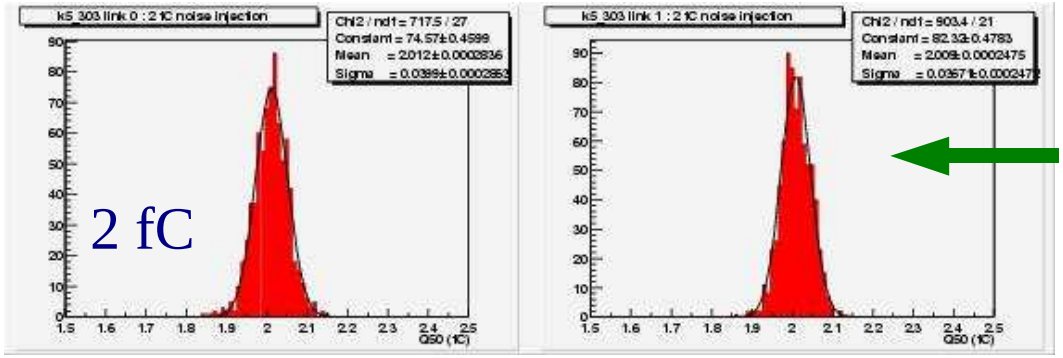
Module	Corrected Noise (fC)	Input Noise (ENC)	RC Noise (ENC)	Signal (fC)	S/N
303	0.19	1200	1300	2.6	13
310	0.20	1259	1800	2.0	10
312	0.21	1301	1830	2.0	10
308	0.23	1437	2140	1.9	8
B044	0.25	1554	2000	2.4	10

Handle numbers with care: Both S and N need further systematic study

- Unknown charge sharing in the source data
  -> use smaller channel region to reduce it <-> statistics
  -> use ntuple analysis a la test beam
- Threshold variation is taken out of noise determination via offset subtraction
  => worse for irradiated modules
  where do these offsets come from ?
- Noise determination assumes linearity of electronics down to 0 fC
  what happens below 0.5 fC ??

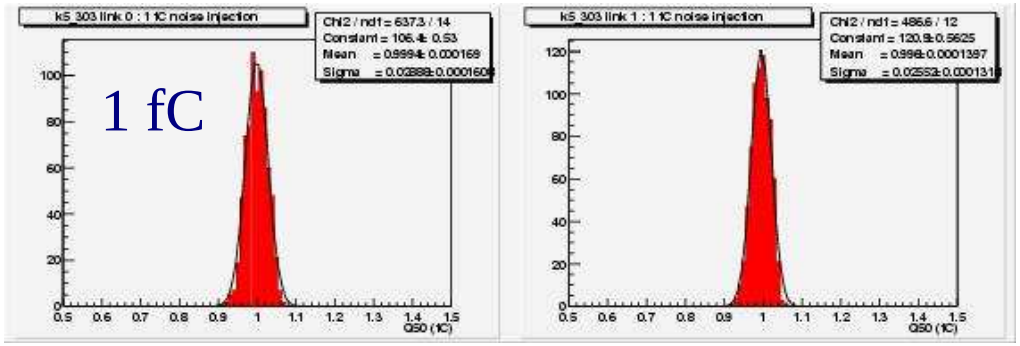
Nonlinearity?

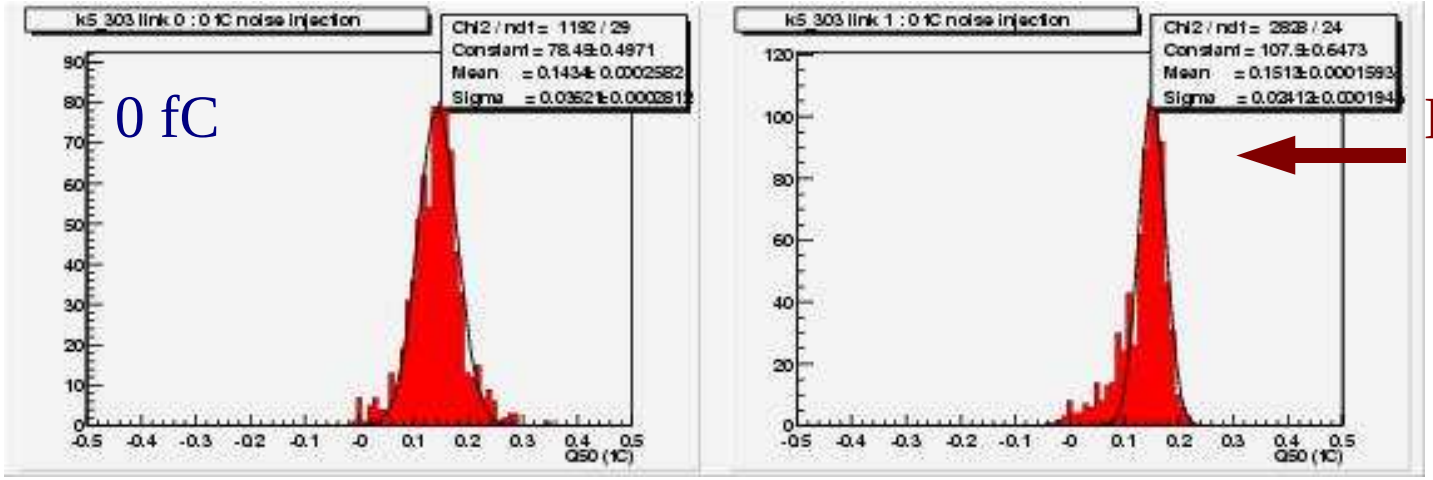
Threshold Spread:



Centered, σ=0.04 fC

Centered, σ=0.03 fC

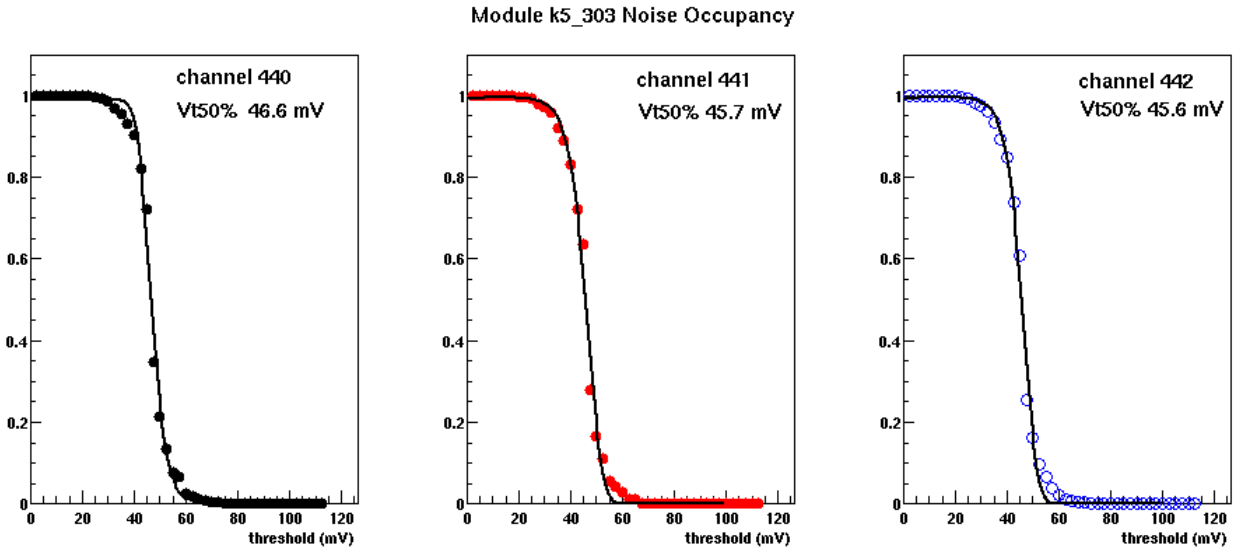


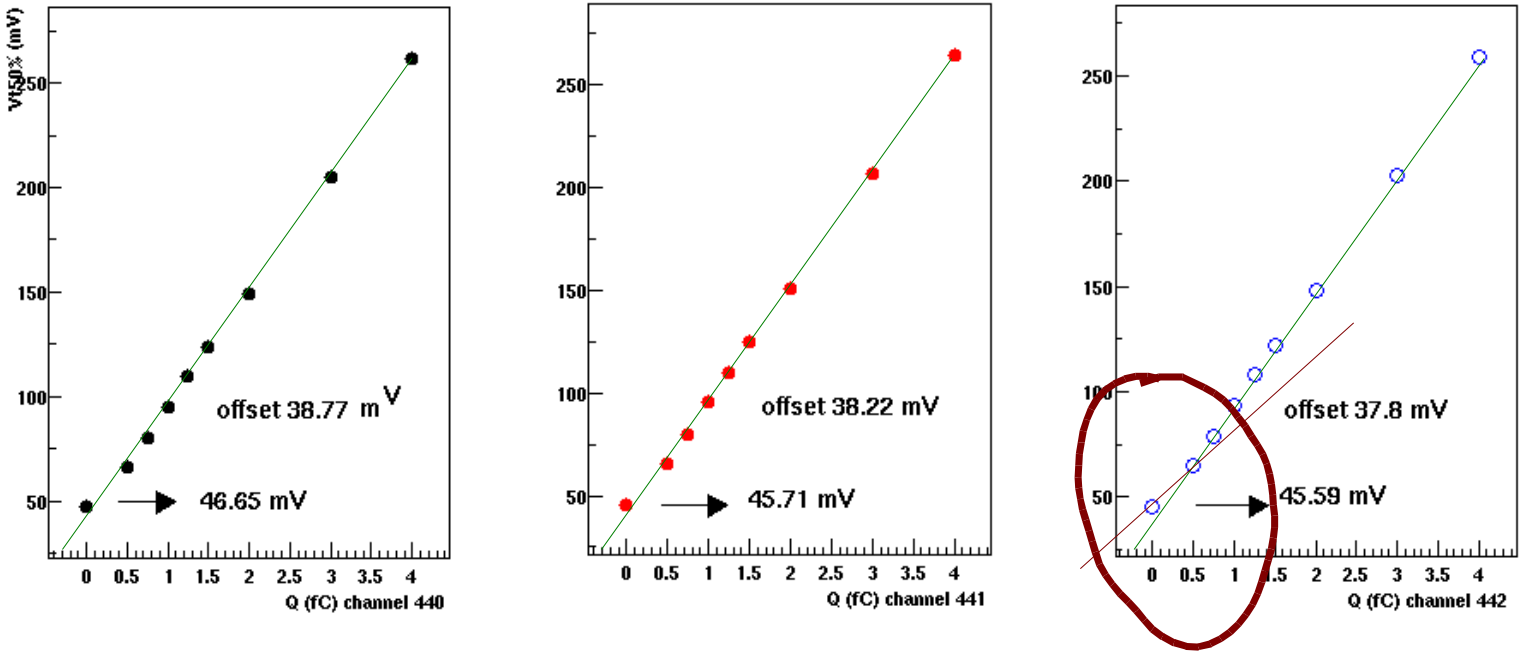


Not Centered, σ=0.04 fC

For K5-303, threshold offsets correspond to noise gaussian offsets ....

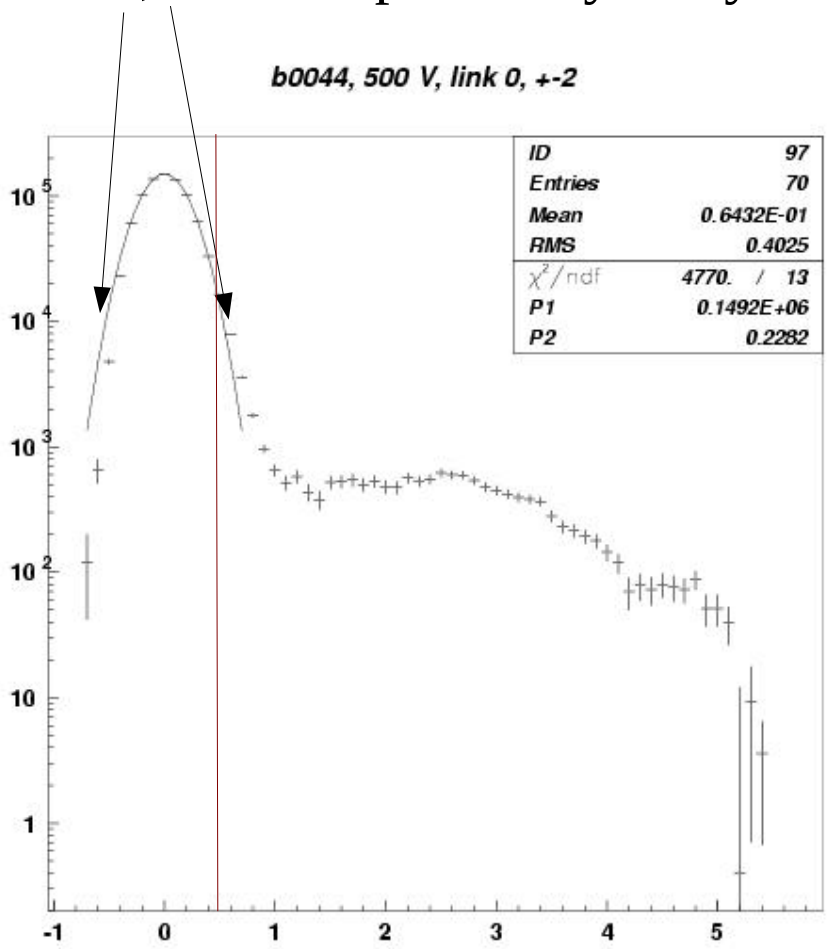
Nonlinearity?





Nonlinearity?

If true, could explain assymetry found in noise:



Re-scale 0....0.5 fC area with gain ratio -> increase noise

Further Work

- Charge Sharing -> What is the real Signal ?
- Non-Linearity ? Offsets ? -> What is the real Noise ?
- Energy Spectrum -> MonteCarlo Model
- Systematics from Derivative

....

➔ Alternative but non-trivial method for S/N estimation ....