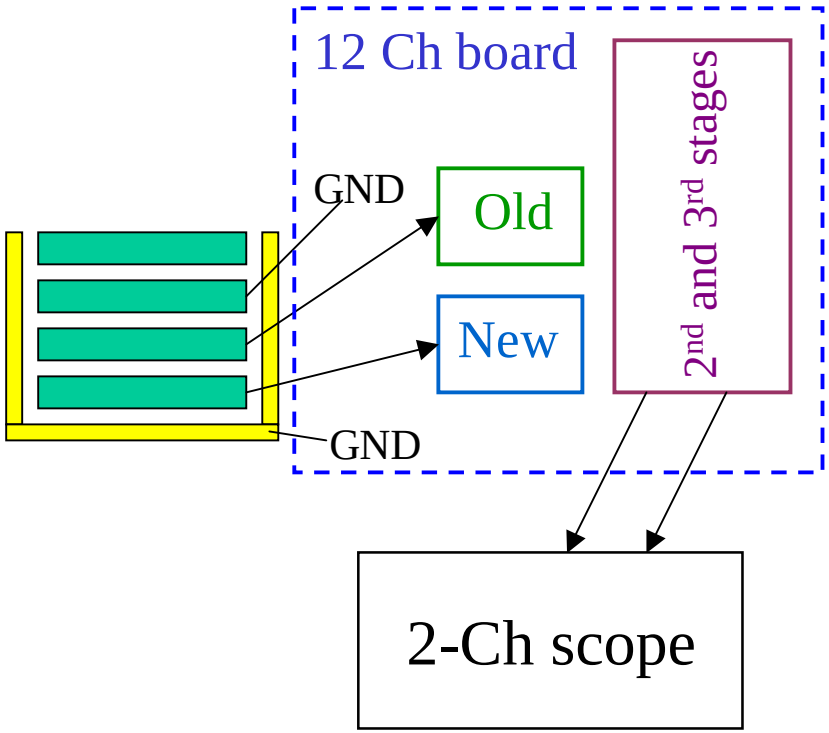
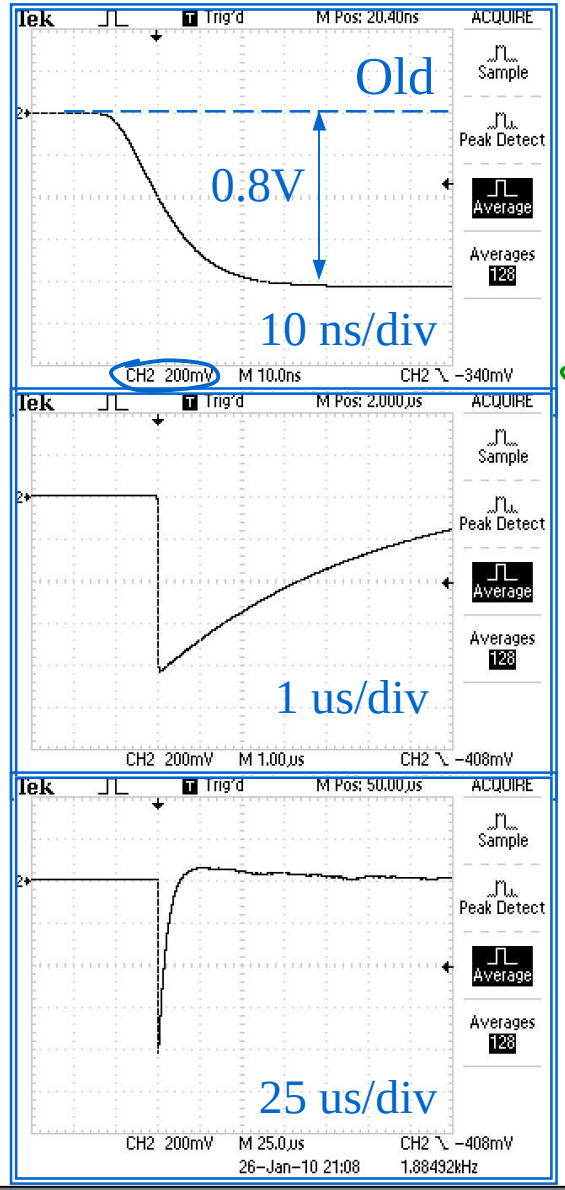
Experimental Setup

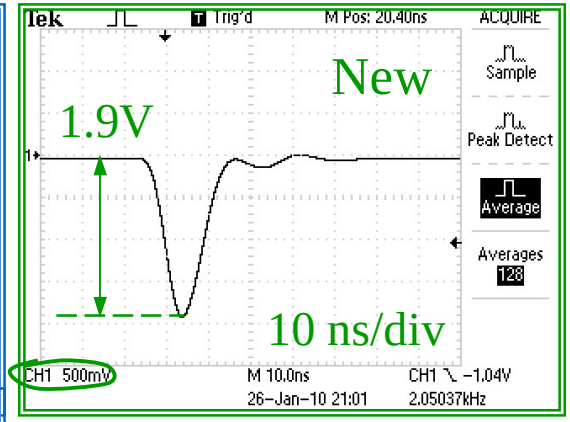
MAIN ELEMENTS:

- Very old BNL type detector with rad damage
- 12-channel RHIC-type preamplifier board with lowered 1st stage power to 6V
- Ch1 – new CurS PA
- Ch2 – old ChS PA
- Ch3 input grounded
- 1 Gs/s 100 MHz scope
- ^{239}Pu 5 MeV alpha source in the air (5-20mm), collimated d=1.2 mm or uncollimated d=12 mm spot
- Fast blue LED from a pulser
- Bias supply



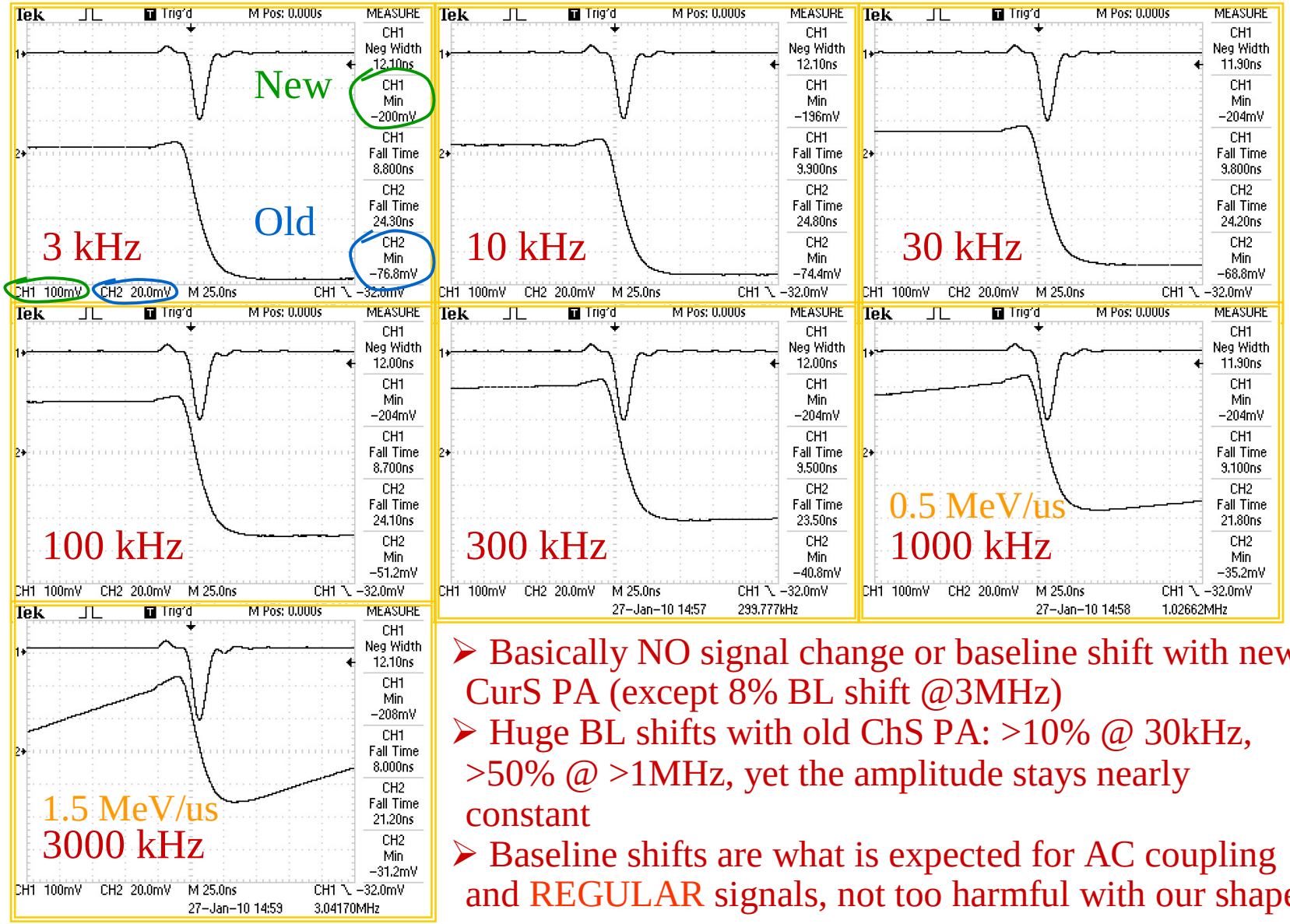
Signals – Comparison (5 MeV α, 2 kHz, 128 averages)





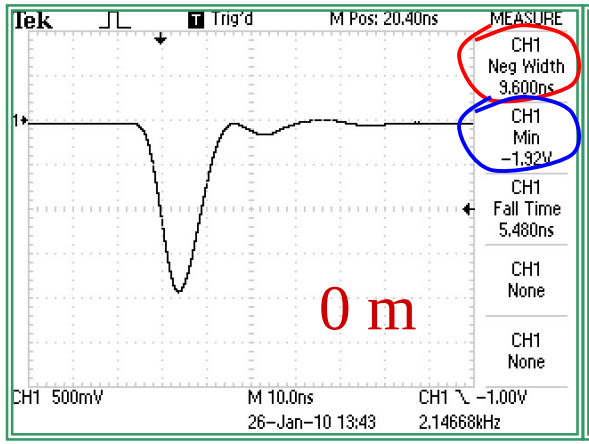
	Old	New
Amplitude @5MeV	0.8 V	1.9 V
Risetime	30 ns	5 ns
FWHM	3000 ns	10 ns
Total width with overshoot/ringing	150000 ns	50 ns

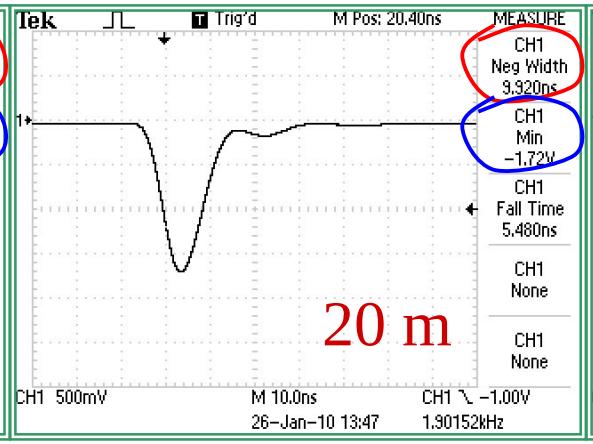
Baseline – Signals: LED, 500 kEv eqivalent

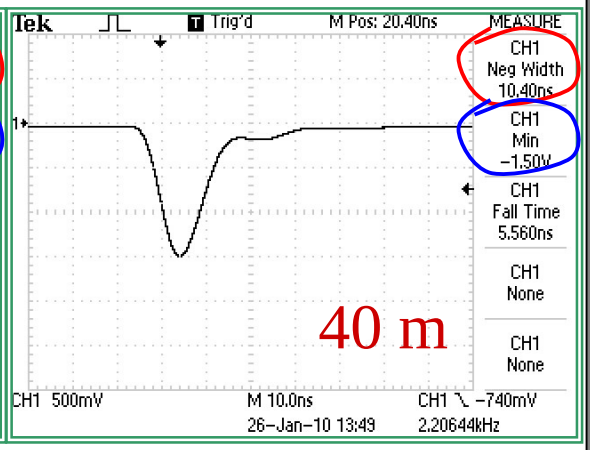


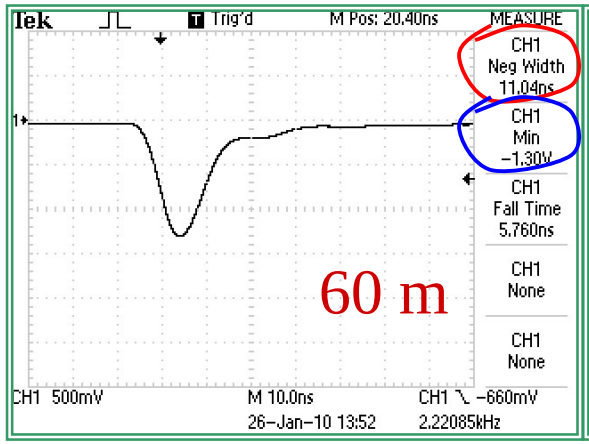
- Basically NO signal change or baseline shift with new CurS PA (except 8% BL shift @3MHz)
- Huge BL shifts with old ChS PA: >10% @ 30kHz, >50% @ >1MHz, yet the amplitude stays nearly constant
- Baseline shifts are what is expected for AC coupling and REGULAR signals, not too harmful with our shaper

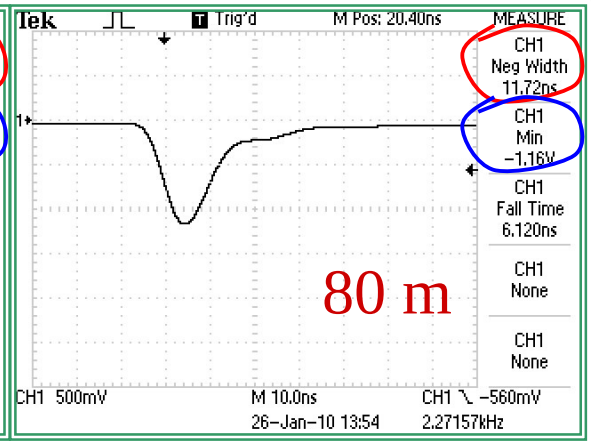
Cables – Thick 10 mm low loss low dispersion

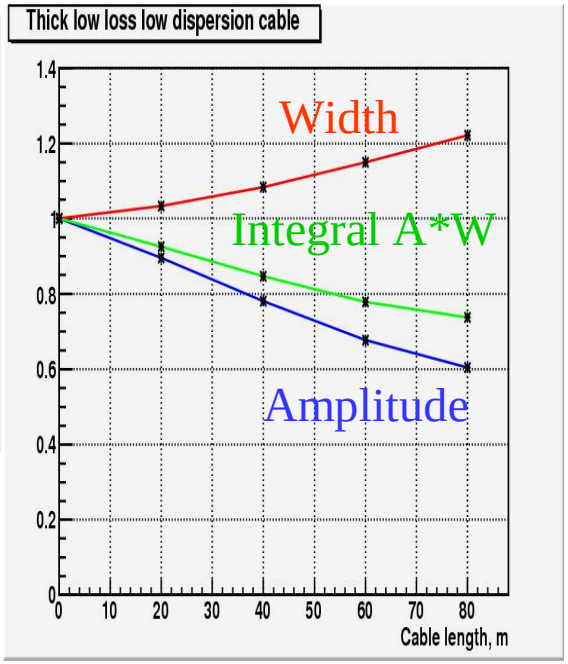










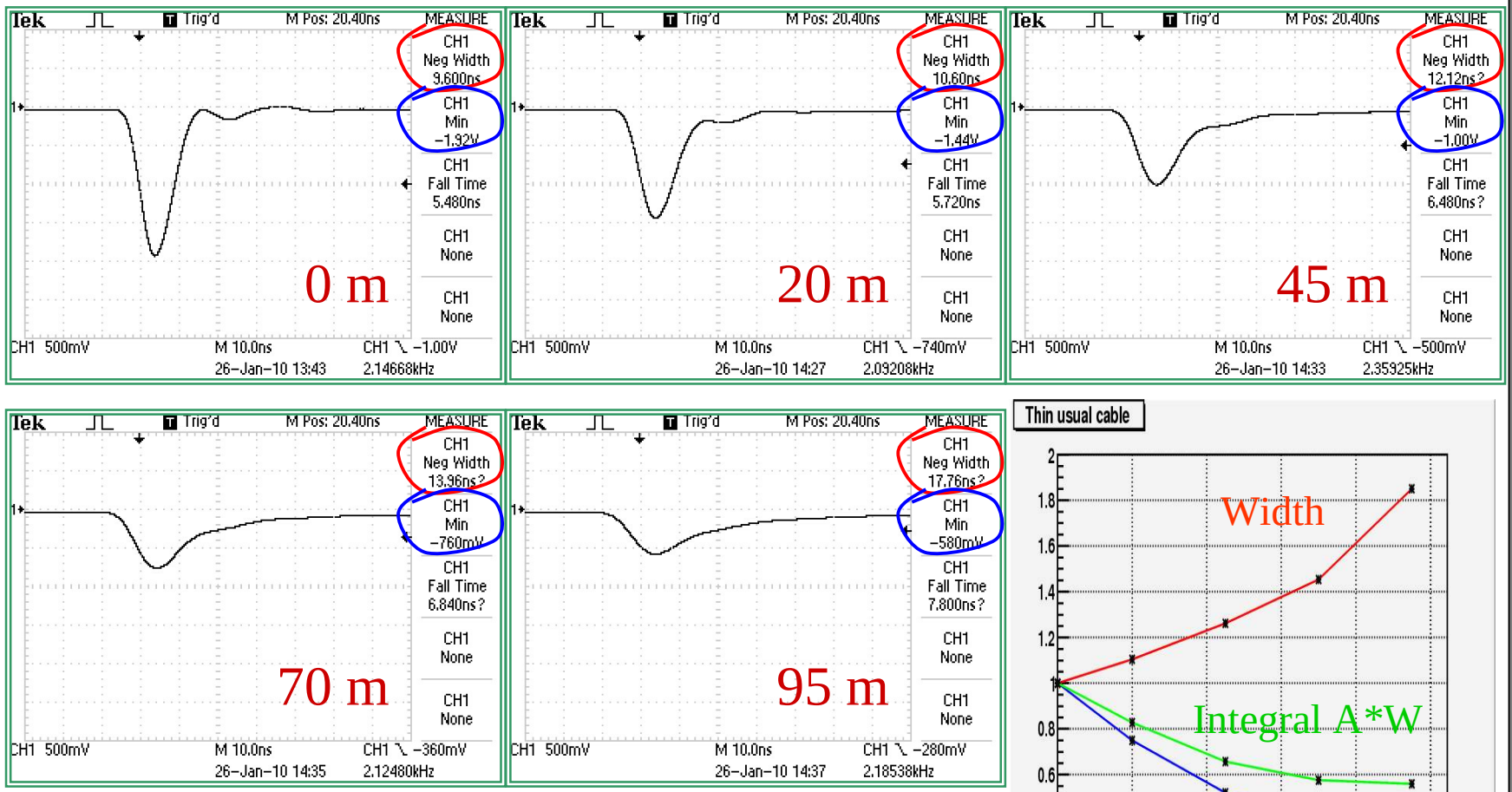


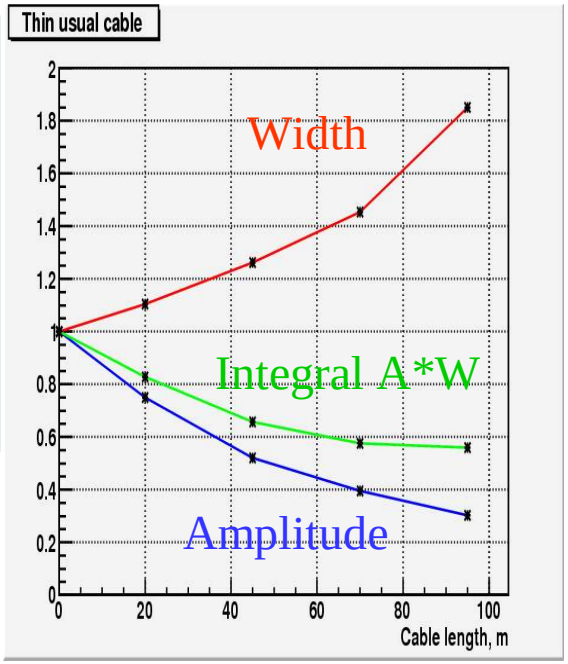
@100 m would be:

- Amplitude drop ~45% ; Width growth ~30%
- Integral drop ~30%

=> Both dispersion & loss, but tolerable

Cables – Thin 4.5 mm ususal cable

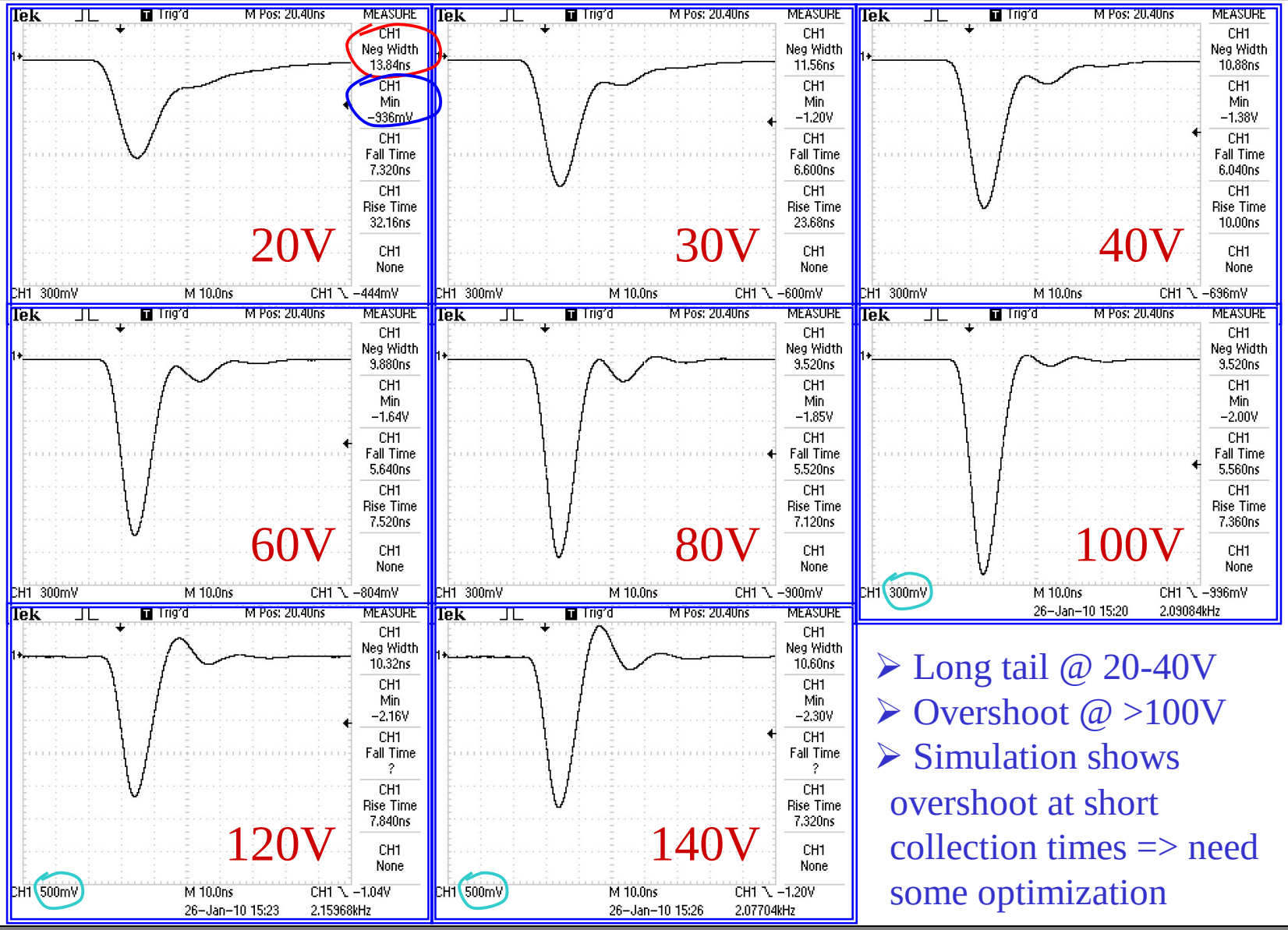




- Amplitude drop 3 times
- Width growth 2 times + long tail > 70 ns
- Integral drop ~45%

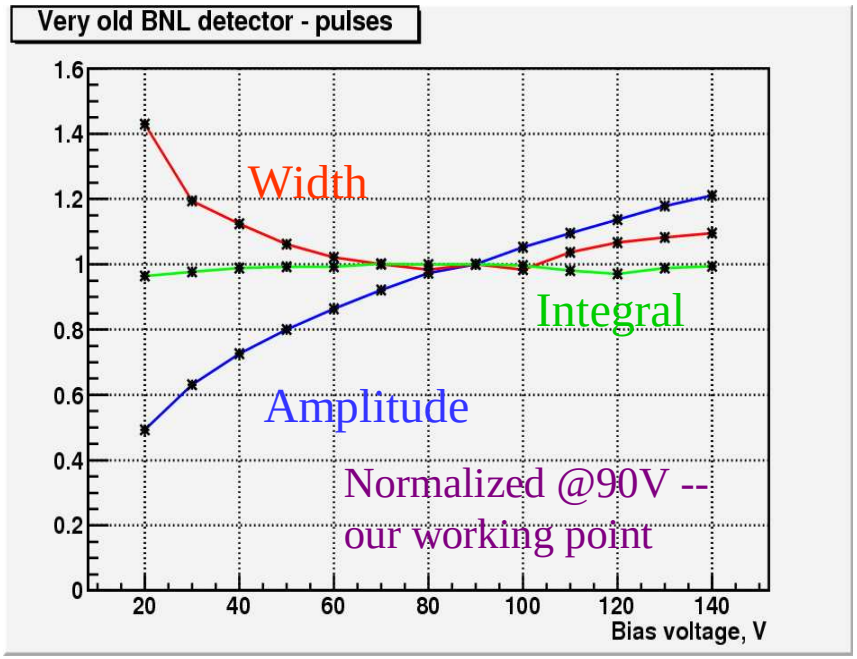
=> Large dispersion & loss; untolerable

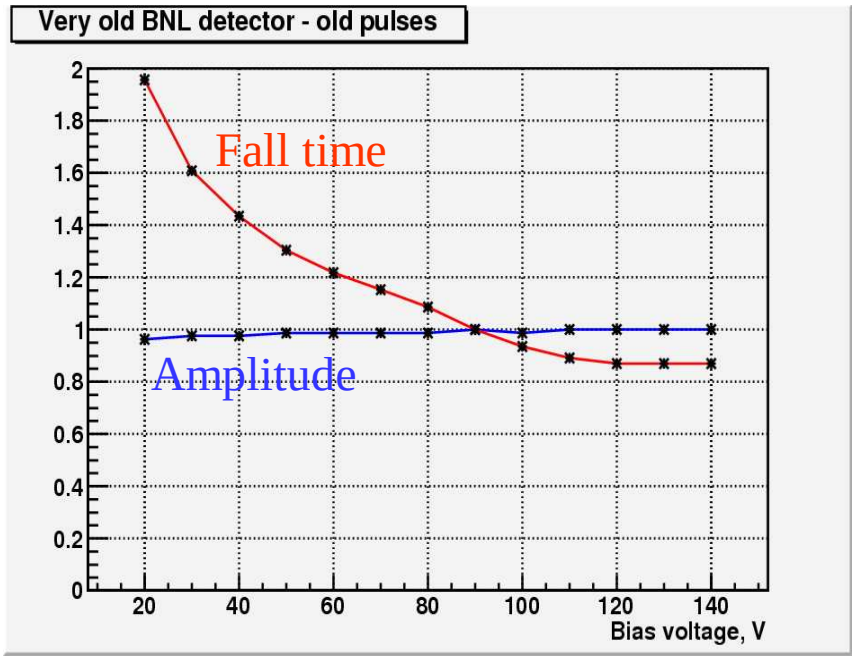
Bias voltage -- Signals



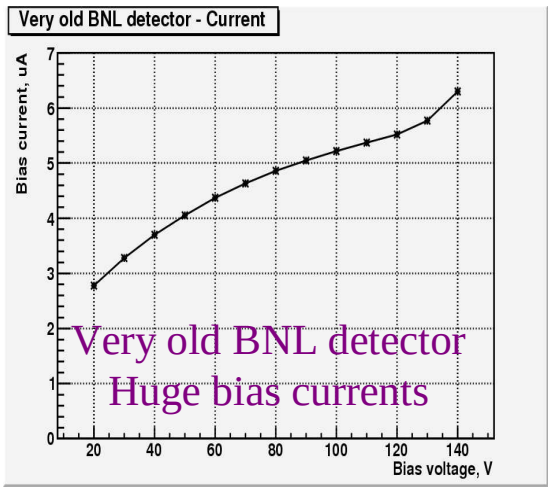
- Long tail @ 20-40V
- Overshoot @ >100V
- Simulation shows overshoot at short collection times => need some optimization

Bias voltage -- Dependencies

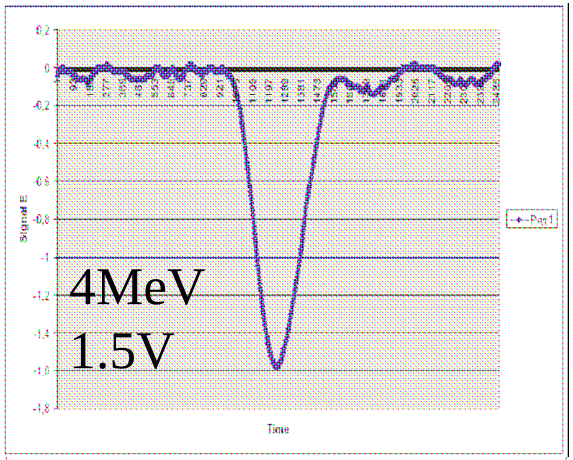


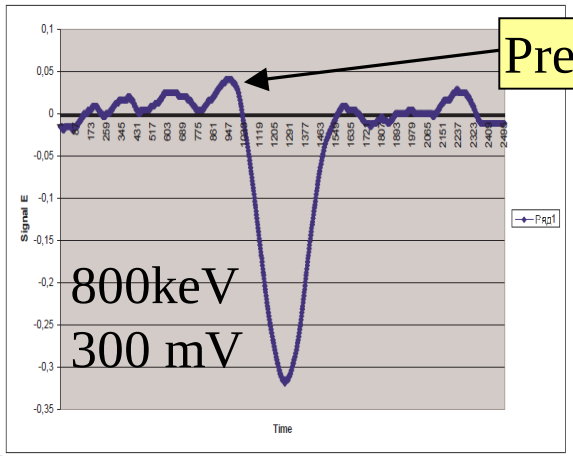


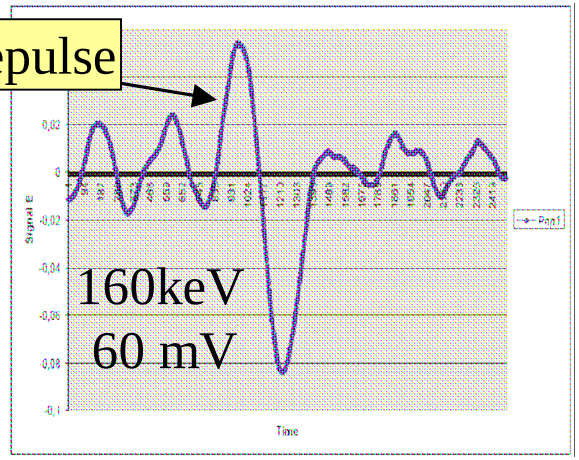
- Width mainly stops changing above 60V => defined by the amplifier response
- Amplitude growth doesn't saturate => the collection time continues decreasing, no saturation of the carrier velocity even at 140V => we need high bias voltages, even 150V is not enough for stable operation
- Integral conserves => a good measure
- OLD: fall time changes 15% 90V->140V, the same change in amplitude after shaper

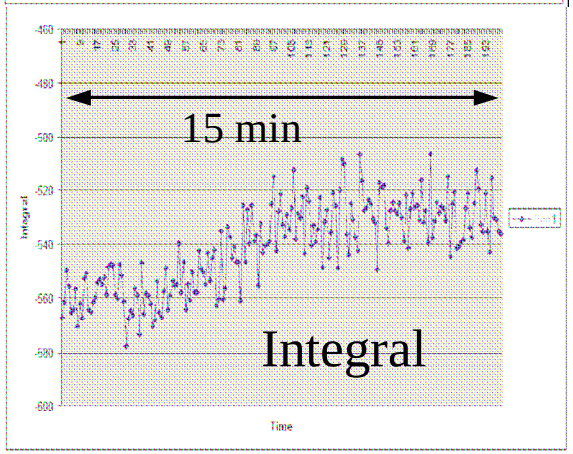


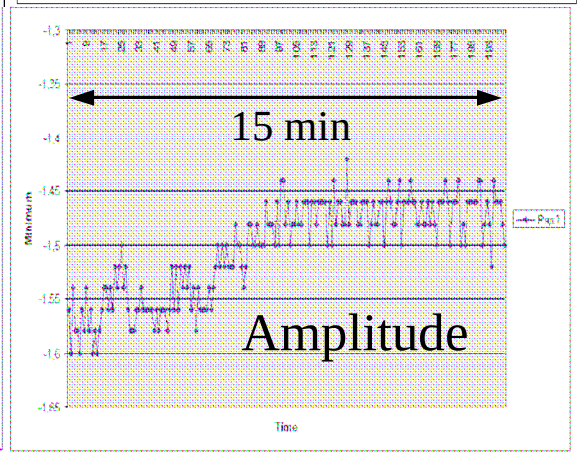
Noise Estimates – Procedure and problems







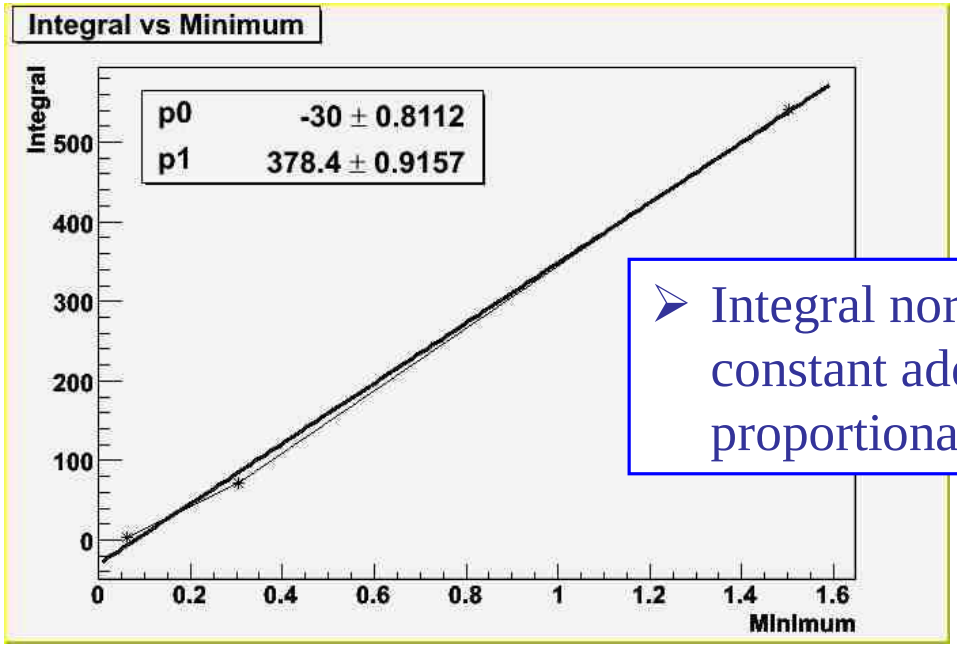




- 200 waveforms in 15 min
- LED amplitude drift
- Well correlated for amplitude and integral
- Positive prepulse – electrically induced by the LED power – nonproportional to the amplitude

- Amplitude – minimum value
- Integral -- sum of all points
- $RMS = 1/\sqrt{2} \cdot \sqrt{\sum_{i=1}^{n-1} (U_{i+1} - U_i)^2 / (N - 1)}$ -- cancels out slow drift

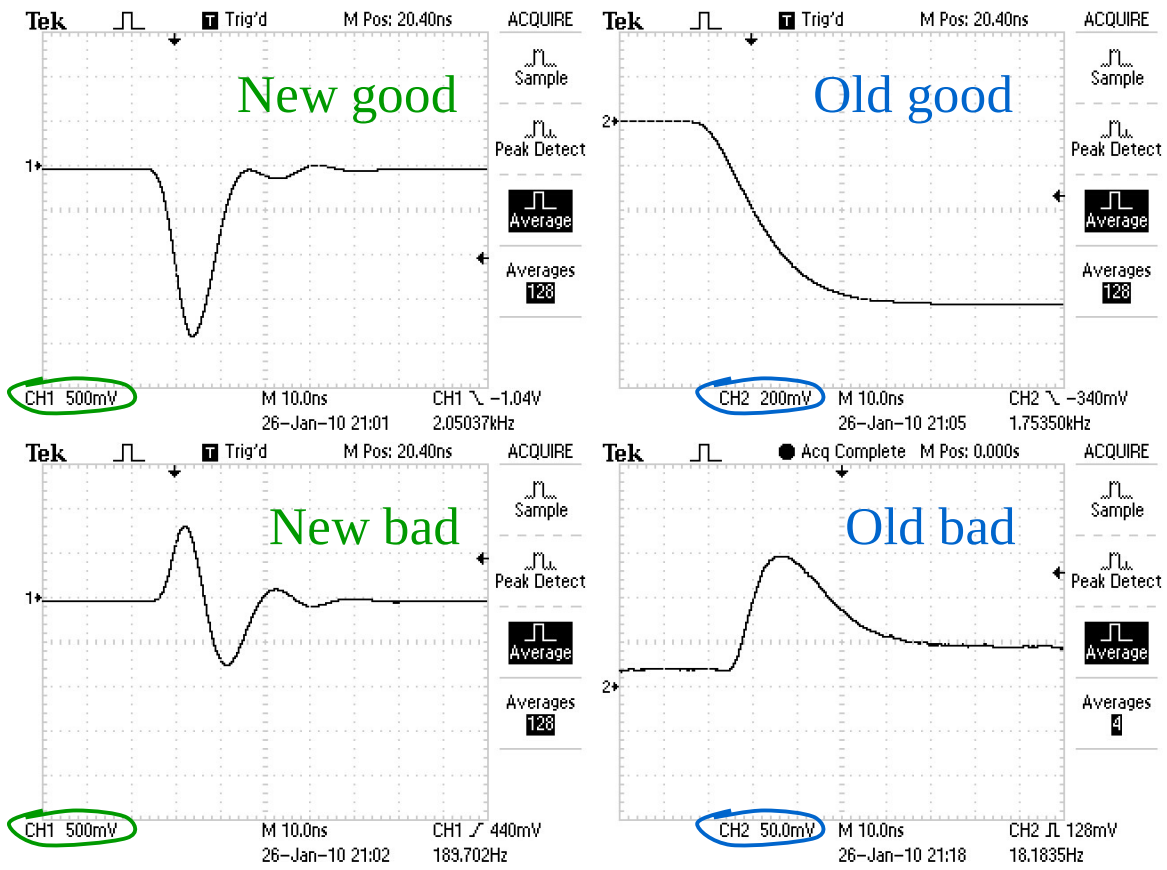
Noise estimates – Energy resolution



- Integral normalization: constant addition to make it proportional to the amplitude

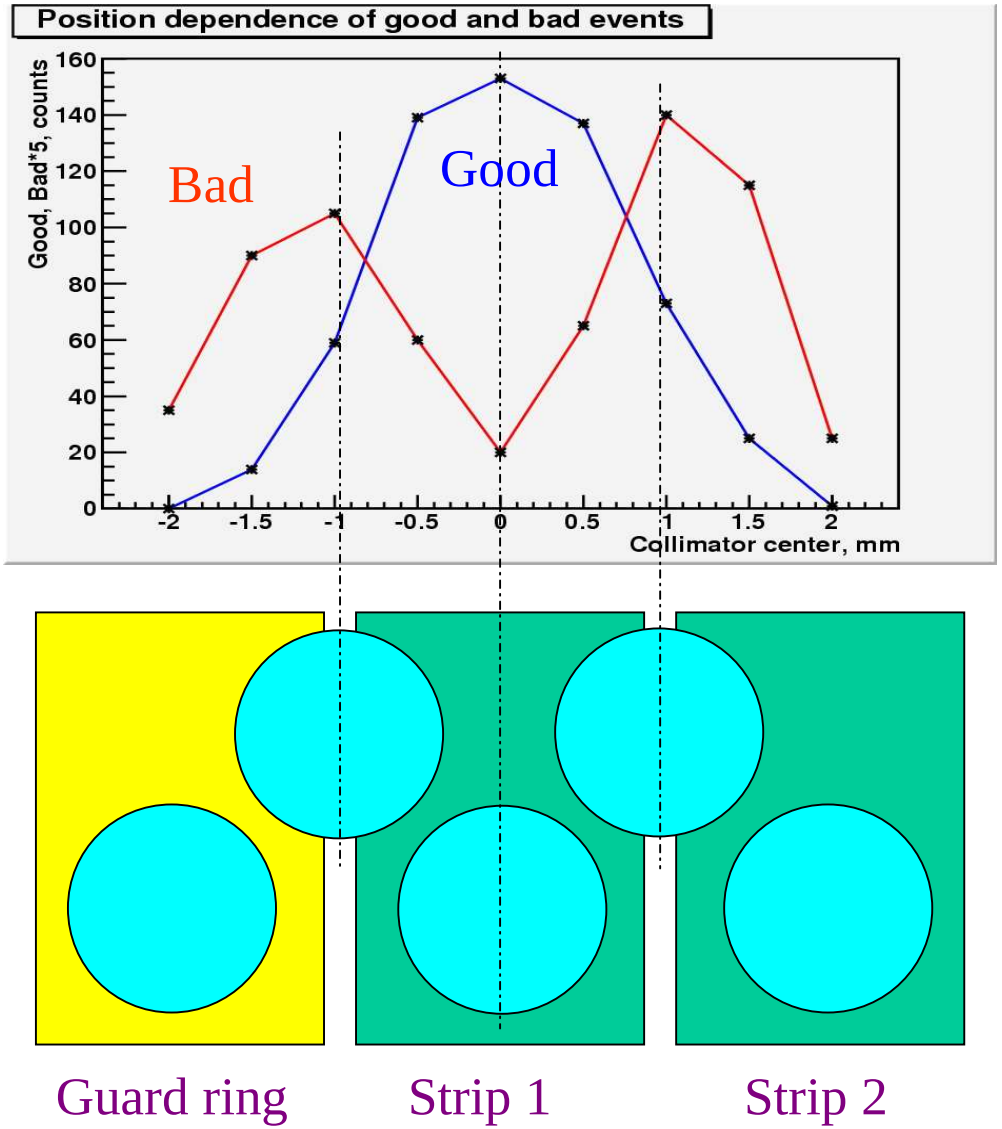
Amplitude	1.5 V	300 mV	60 mV
Energy equivalent	4 MeV	800 keV	160 keV
Integral RMS	63.6 keV	21.0 keV	12.4 keV
Amplitude RMS	49.0 keV	24.6 keV	24.6 keV

GOOD and BAD pulses (open alpha source)



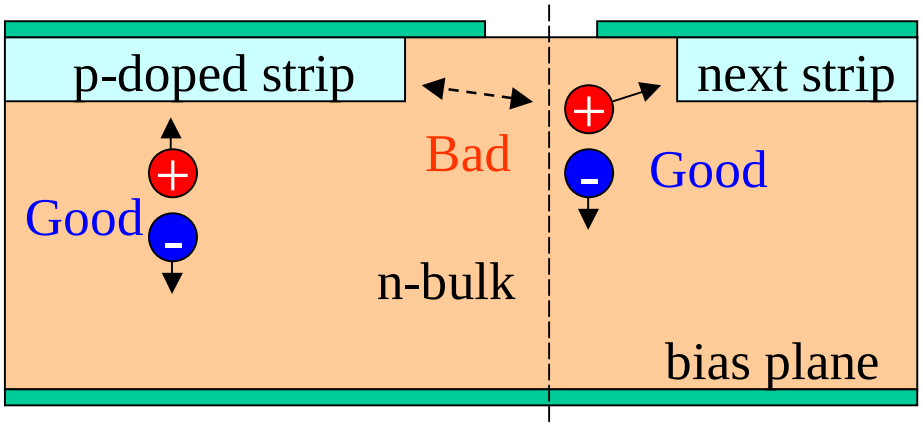
- Inverse current signals
- Present both in new and old PAs, about 15% of all pulses
- Small integral
- Old: inverted 15% of amplituede
- New: bipolar 30% of the same amplitude

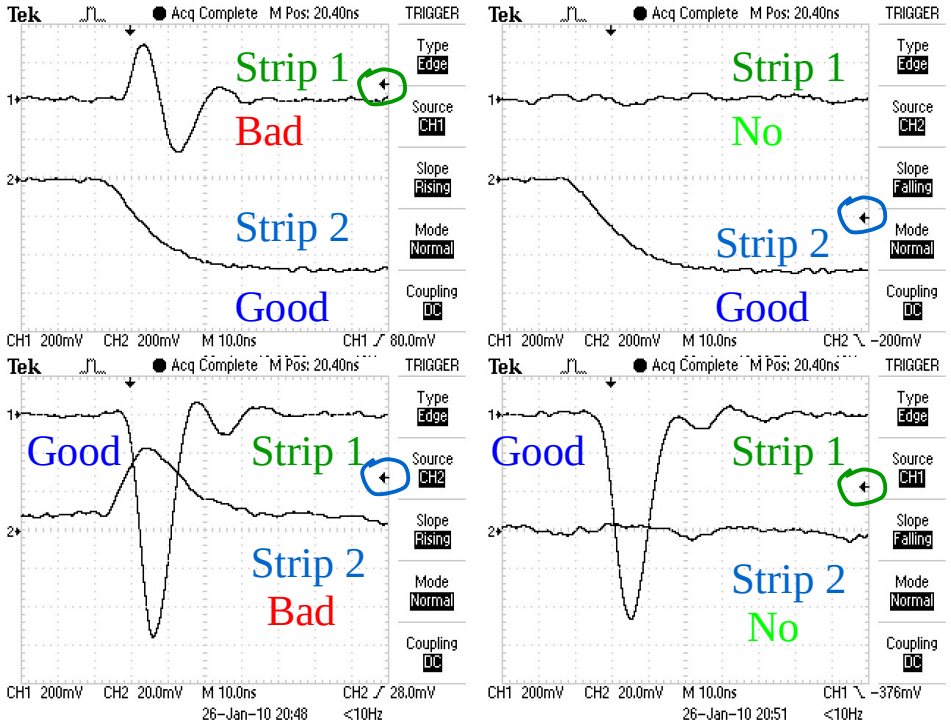
GOOD and BAD pulses – position of origin



- Moving 1.2 mm collimated source across the strips and counting events in 500s
- Looking at strip 1
- No events when source positioned at adjacent strip or guard ring – not a cross-talk
- Maximum of bad events when source positioned in between of the strips, no bad events at the center of the strip

GOOD and BAD pulses – hypothesis and proof





- Electrons always move to the bias plane, i.e. FROM strips
- Normally, holes drift TO strips
- If charge production happens in between the strips closer to the adjacent strip, the holes move TO the adjacent strip (good pulse in it), but FROM the strip under study; induced current in this case is inverted
- Proof (collimator between strips): there is ALWAYS a GOOD pulse in adjacent strip with a BAD pulse synchro, but not every good pulse in adjacent strip is followed by a bad one
- Rejection is possible by comparison of integral to amplitude (Int ~0)