University of Glasgow

Test of the NINO Card at Mainz

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Glasgow Photon Tagger at Mainz

Test prototype detector (similar to CDet) and **NINO card in large spectrometer environment**

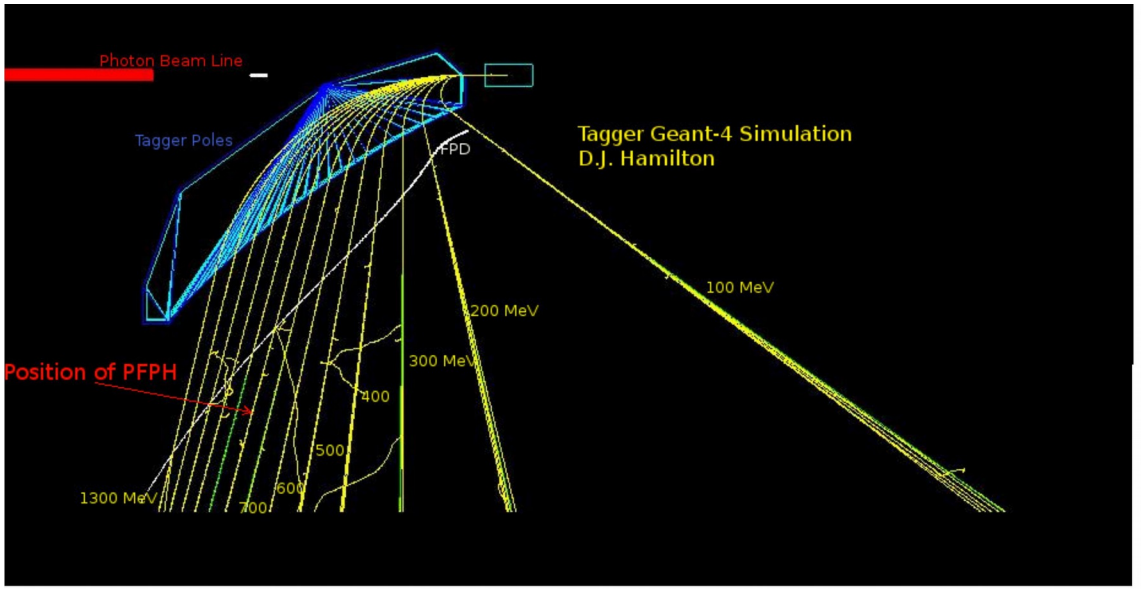
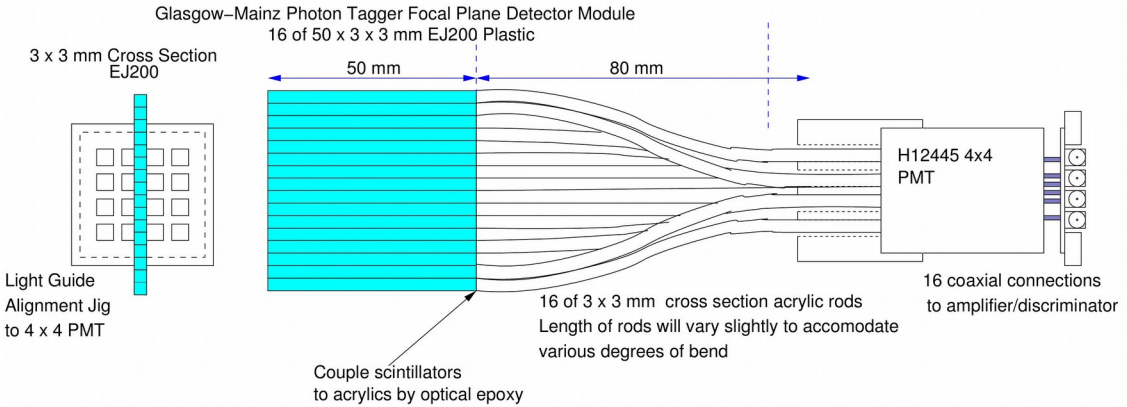


Figure 1: The Tagger dipole pole faces and positioning of the main FPH array (white). The red arrow shows the position of the PFPH for the test.



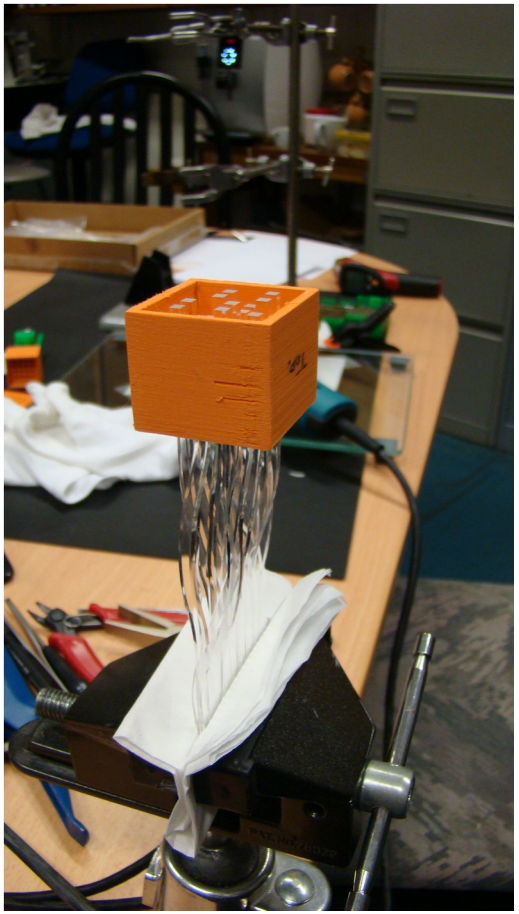
- 1557 MeV electron beam
  25 pA – 4 nA
- 10 mm Cu bremsstrahlung radiator
- Tagging spectrometer:
  ~100 ton room-temp. dipole,
  field setting ~1.89 T

- Detector
- 16 3x3x50 mm plastic scint. fibres
- Acrylic light guides
- 4x4 multi anode PMT (Hamamatsu H12445-200) similar to units used on CDet
- Detector placed on ~800 MeV/c exit trajectory

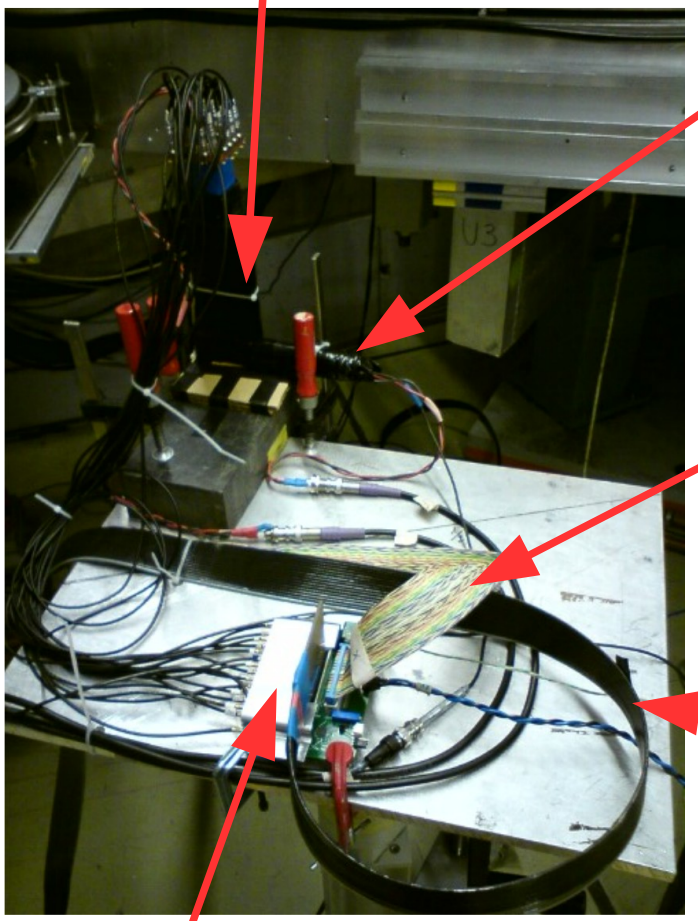
- Front-end electronics
  NINO amplifier/discriminator card, GRINCH version

Test Setup

Detector under Construction
Glasgow workshop



16-fibre prototype detector



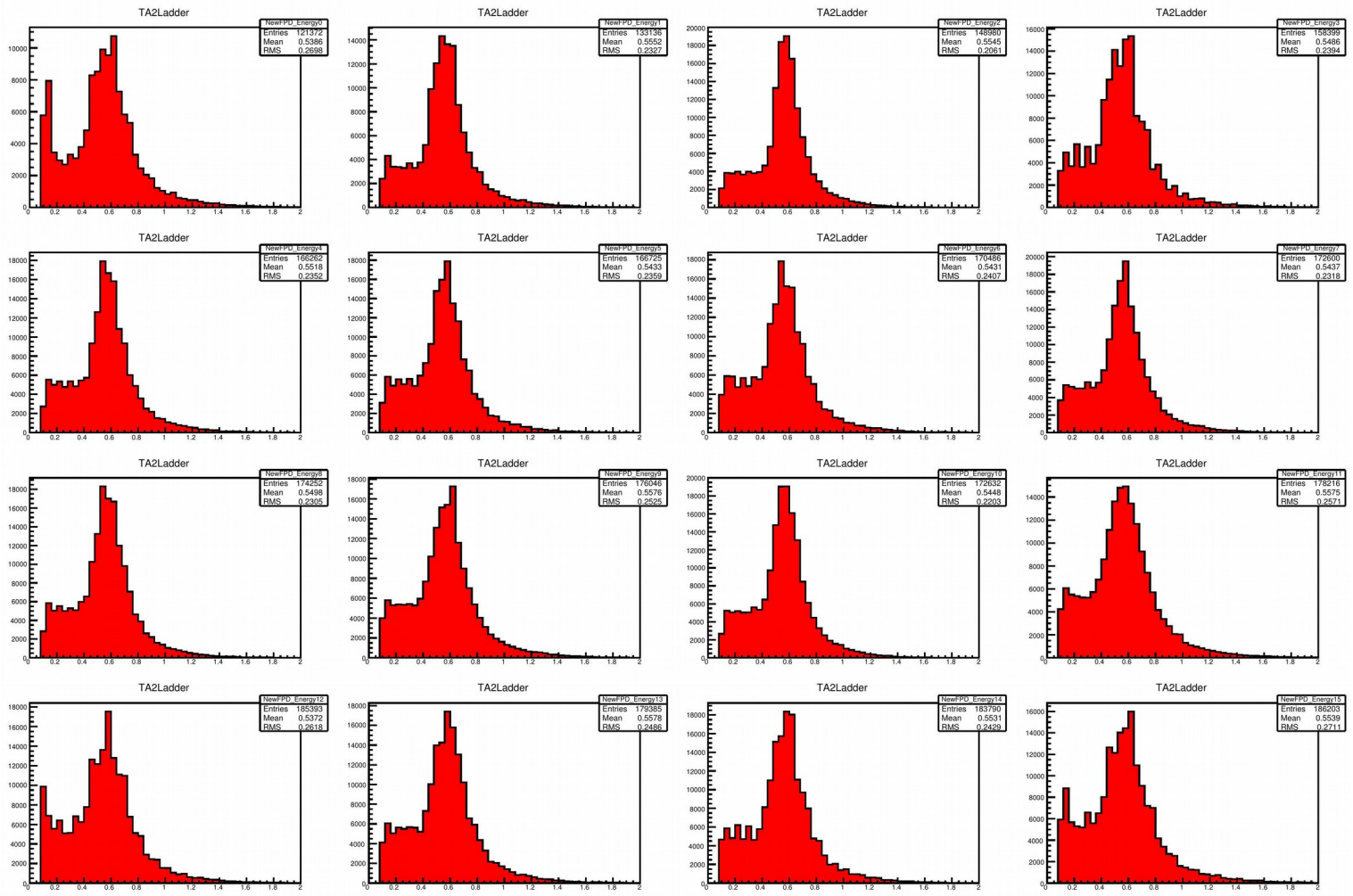
Paddle scintillator
Trigger DAQ
Provide time reference
ET9142 PMT (as for BigBite timing hodoscope)

LVDS cable to TDC
(CAEN V1290 25ps)
~15m cable length

Cable to QDC
(CAEN V792)
120m 50 ohm multi-way coax.

NINO card. Al shield fitted over front end amplifiers. LV “bench supply” power derived from central tagger DAQ system

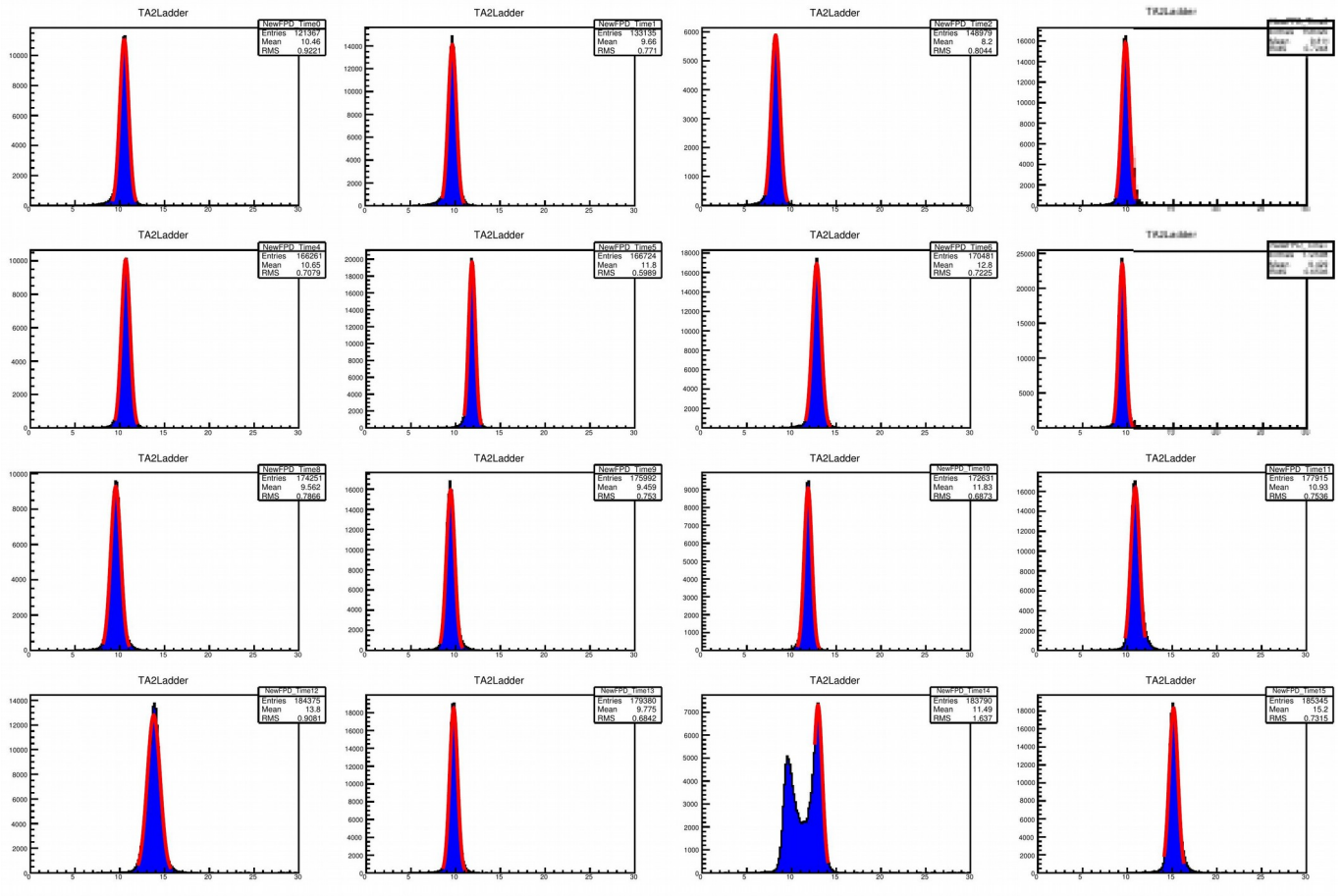
Pulse Height 3x3x50 mm Fibrers



Distributions normalised to put peak at 0.56 MeV

- Pulse height distributions ~800 MeV/c electrons
- Peak energy loss ~0.56 MeV
- X5 amplifier output from NINO card
- ~120 m 50 ohm coaxial delay cable
- CAEN V792 QDC, ~100 fC/channel

Timing



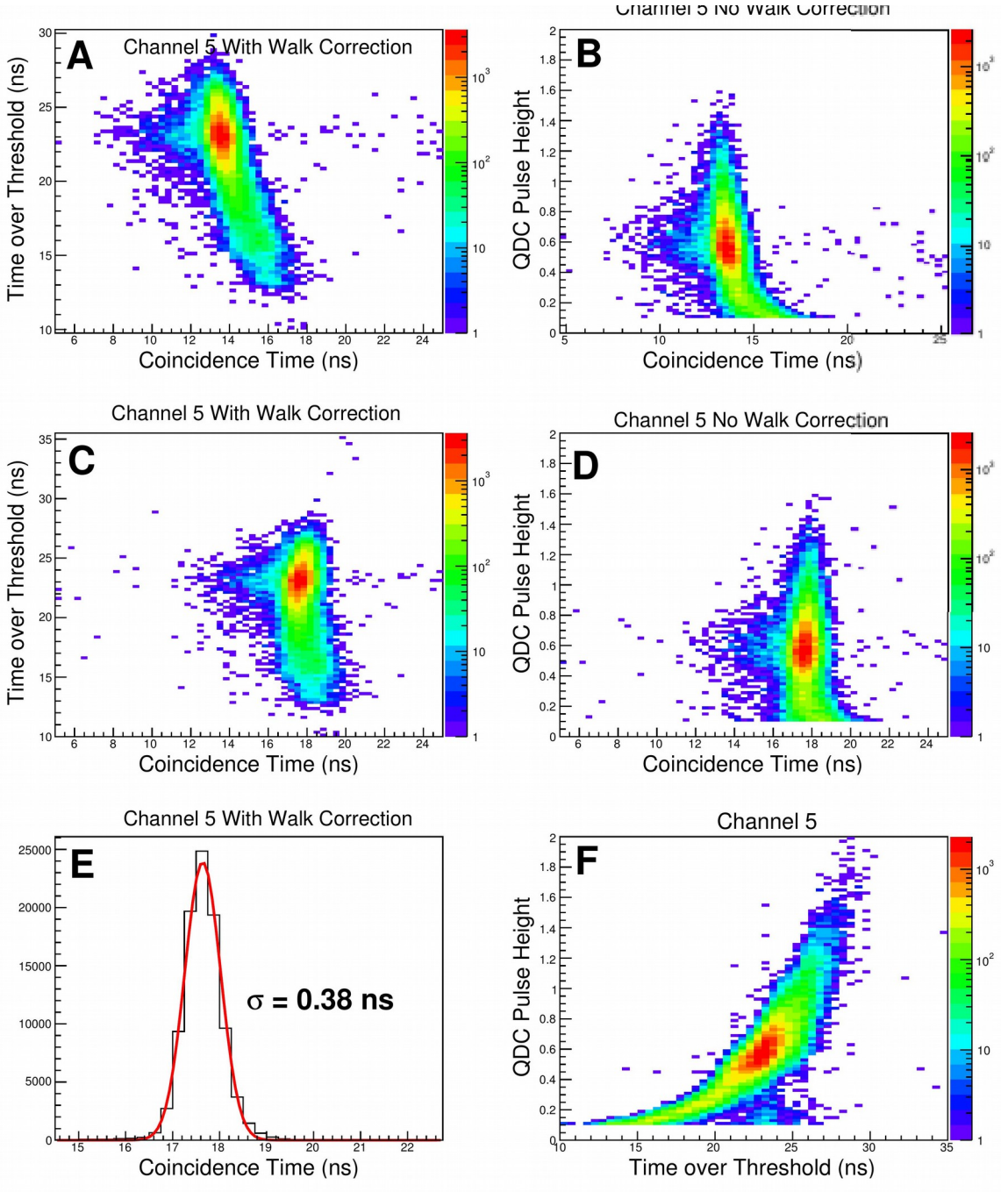
- Coincidence trigger paddle and plastic fibres
- Integration added before front end of NINO, glitch suppressed, clean triggering at HV -800V
- Noise immunity good
- Time-walk correction applied
  QDC (δT_1) and Time-over-threshold (δT_2)

- NINO card GRINCH version (high sensitivity)
- NINO retriggered on glitch at tail end of pulse
- Noise immunity good
- Add small amount of integration at MAPMT anode output card
- 47 – 200 pF to ground in parallel with 50 ohm NINO input impedance
  τ_{RC} = 2.5 – 10 ns

GF = relative gain factor
channels J = 0 - 15

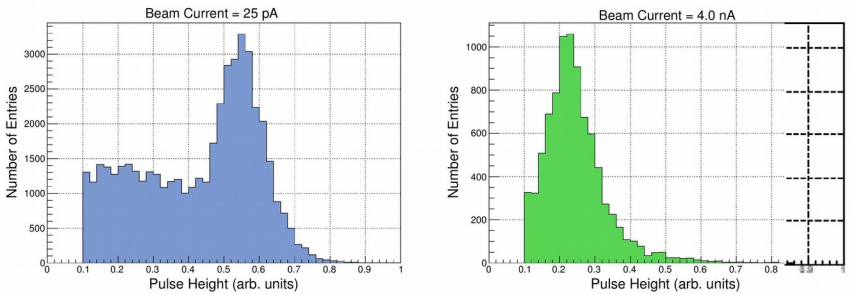
J	GF	δT_1	δT_2	J	GF	δT	δT_2
0	0.34	0.49	0.50	8	0.68	0.56	0.51
1	0.41	0.46	0.45	9	0.33	0.48	0.48
2	1.00	0.49	0.45	10	0.79	0.43	0.42
3	0.33	0.44	0.45	11	0.26	0.49	0.50
4	0.62	0.48	0.46	12	0.28	0.72	0.60
5	0.49	0.38	0.38	13	0.44	0.44	0.42
6	0.42	0.50	0.47	14	0.52	0.48	0.52
7	0.46	0.38	0.38	15	0.28	0.49	0.51

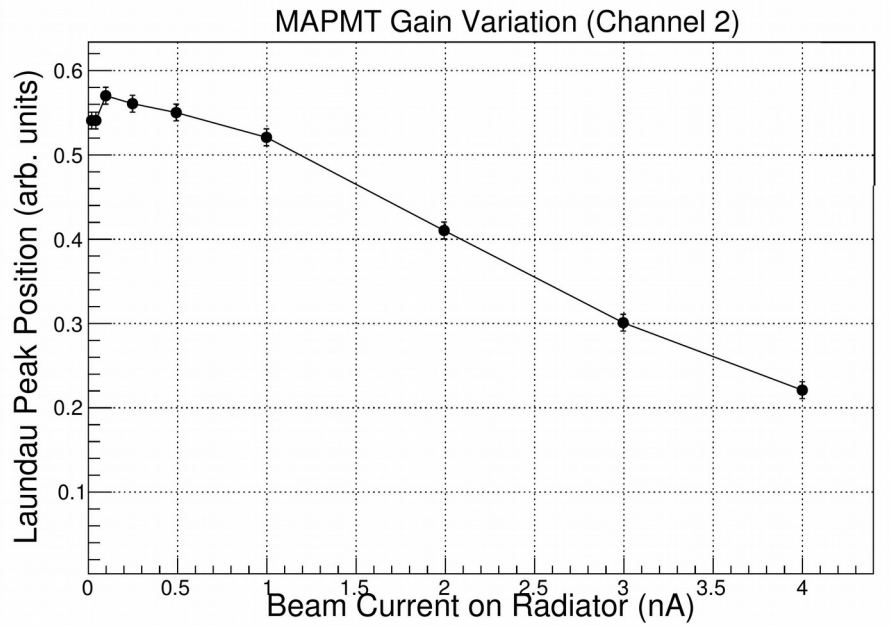
Walk Correction



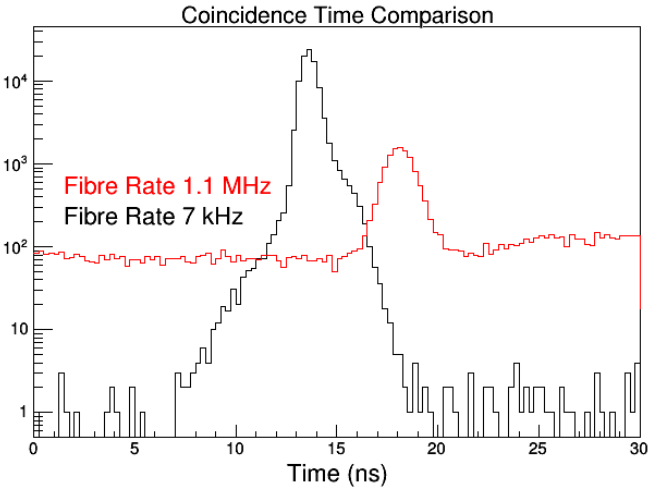
- Compare walk correction QDC information NINO time over threshold information
- 10 ns RC integration applied (channel 5)
- Damps glitch at tail of pulse
- Effectively increases threshold dynamic range
- Configure TDC to trigger also on trailing edge of LVDS pulse
- **Time over threshold works as well as use of QDC**

Rate Test





- Beam current varied from 25 pA to 4 nA
- Maximum rate through NINO card
  18 MHz at beam current of 4 nA
- MAPMT gain drops as anode current increases (as expected)
- MAPMT Current at 18 MHz
  ~18 mA...maximum Hamamatsu rating
- Rate-dependent shift in coincidence time common to all NINO channels
- At least partially due to trigger paddle



Conclusion & Outlook

- NINO card sensitivity can be reduced for plastic scintillator applications
- Addition of small degree of integration (τ = 2.5 – 10 ns) increases effective dynamic range of NINO threshold and suppresses sensitivity to glitch triggering
- NINO operated well in noisey electronic environment...random electronic noise observed at NINO amplifier outputs increased when tagger dipole energised, but did not trigger the discriminator.
- Hamamatsu multi-anode PMT continued to operate at pulse rate of 18 MHz where the estimated total anode current was around the absolute maximum rating ~18 μA.

- Further test scheduled for end of January at Mainz
- Addition of capacitor at NINO front end to be further investigated with CDet pattern NINO card. Direct soldering of 200 pF capacitor across input pins on card upsets the input impedance