BigBite Timing Hodoscope Update

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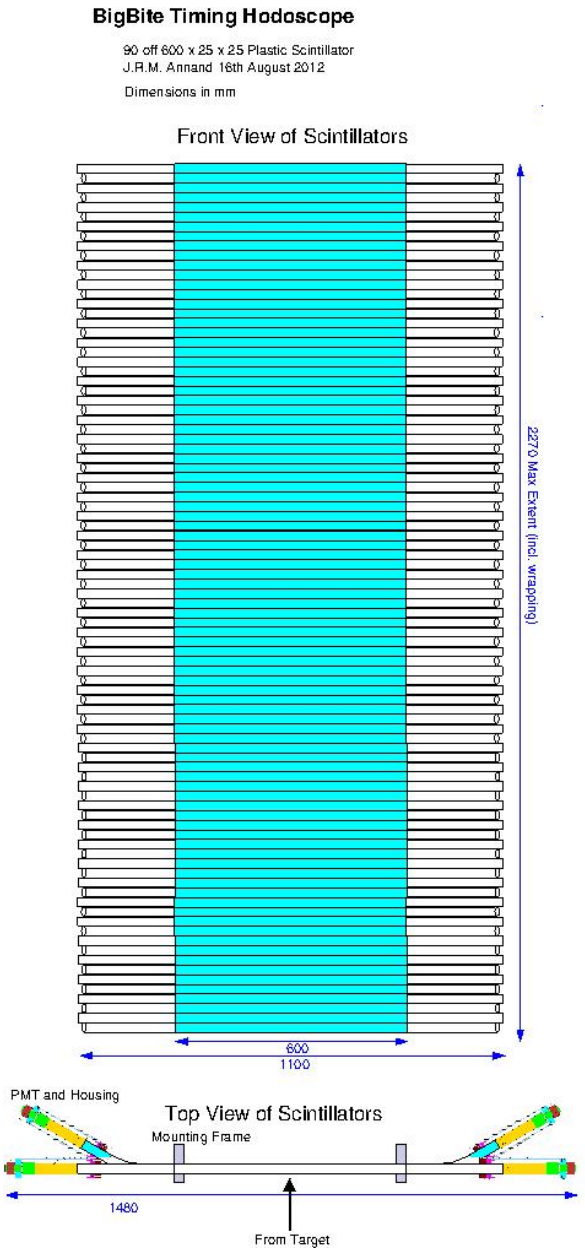
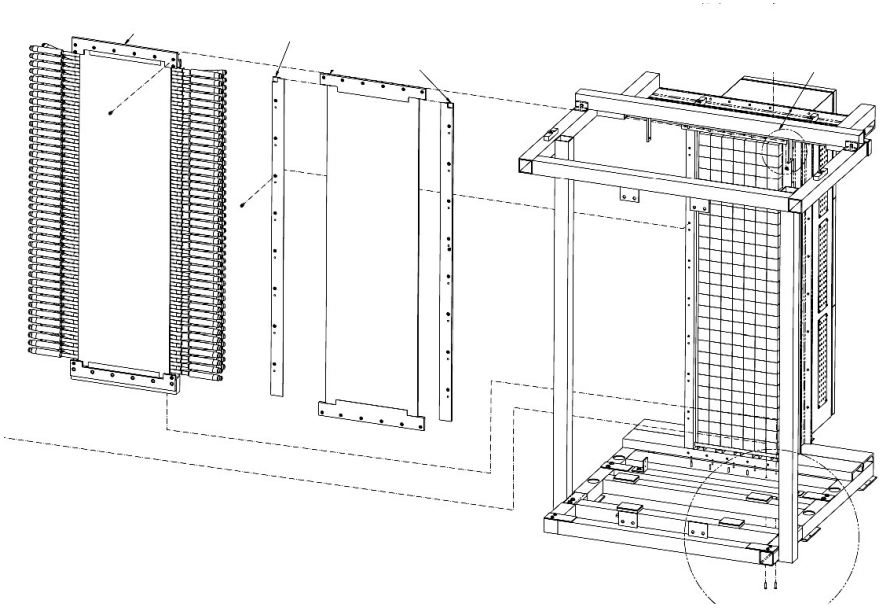
BB Timing Hodoscope

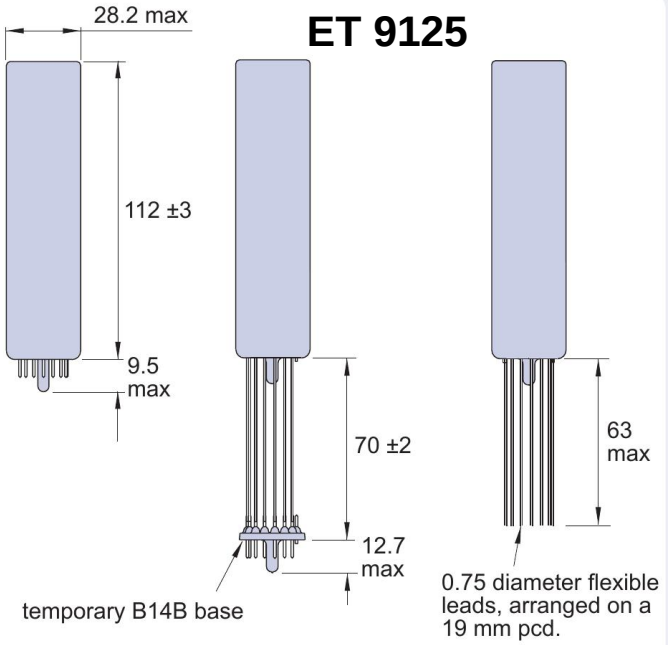


- 90 Bars EJ200 Scintillator
  600 x 25 x 25 mm
- PMT readout at each end
  via light guide
- Alternate straight and bent lightguide
  to fit PMT and housing
- ET9142 PMT + custom base
- NINO front-end amplifier/discriminator
- Hodoscope is strapped into main BB
  detector frame between preshower
  and shower Pb-Glass calorimeter

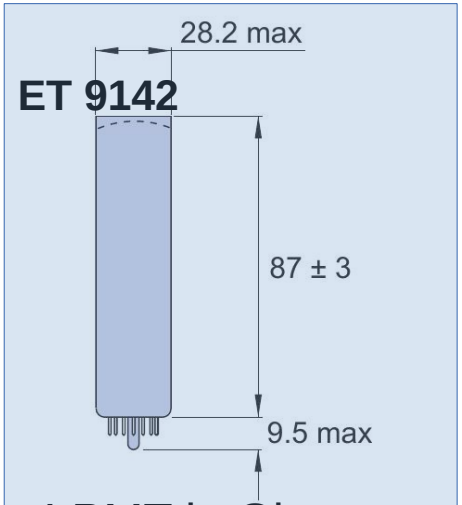


PMTs Tested on a Hodoscope bar

PMT Type	Rise Time (ns)	Transit Time (ns)	TT Jitter (ns)	QE @ 400 nm	Maximum Gain	PH Res (Cs137)	B-Field (Gauss)
ET 9125	4.5	33	4.0	28%	2.0×10^7	7.5	2.0
ET 9142	1.5	19	1.5	28%	1.0×10^7		2.4
H-11265	1.3	5.8	0.27	35/43%	1.3×10^6	3.1	75

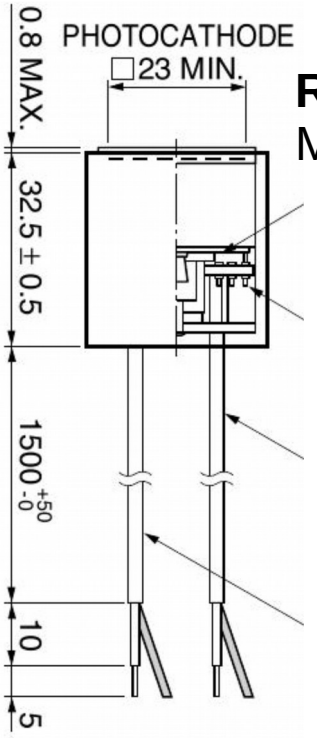


JLab have several thousand ET 9125 from BaBar DIRC



4 PMT in Glasgow For testing

200 9142 procured for hodoscope

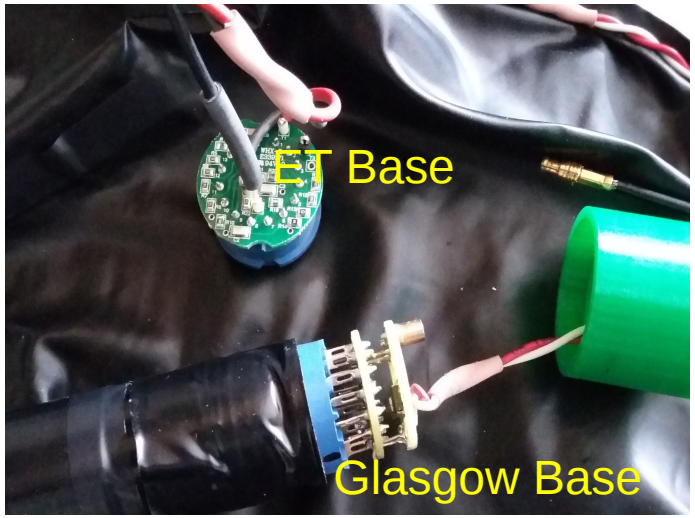


R-11265
Metal-can PMT

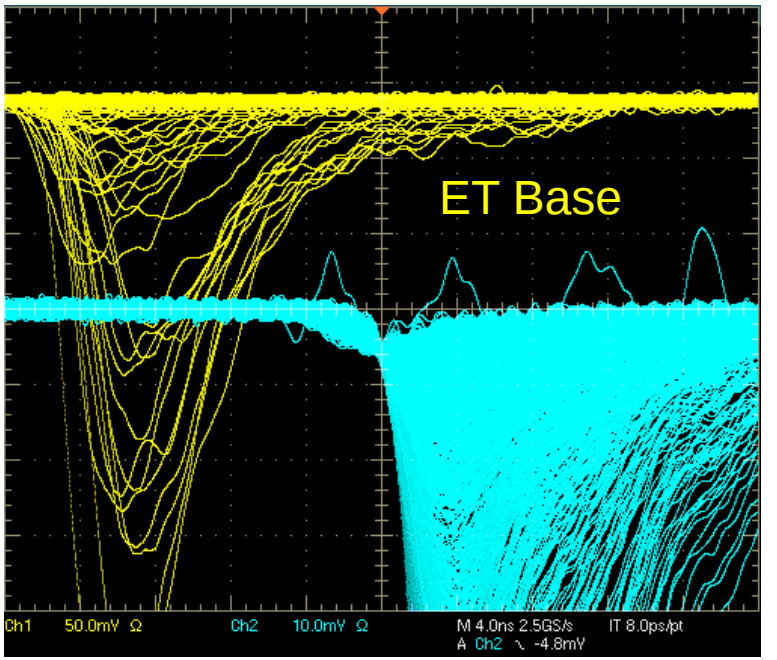
4 PMT in Glasgow Available for testing

ET 9142 a factor 4.5 cheaper than R-11265

Glasgow 9142 PMT Base

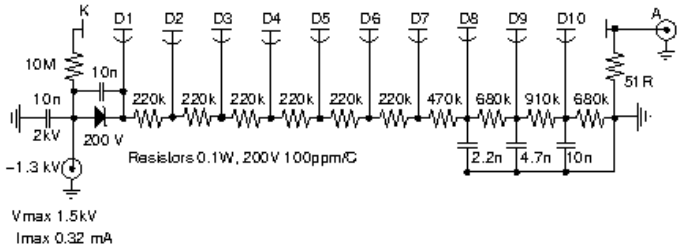


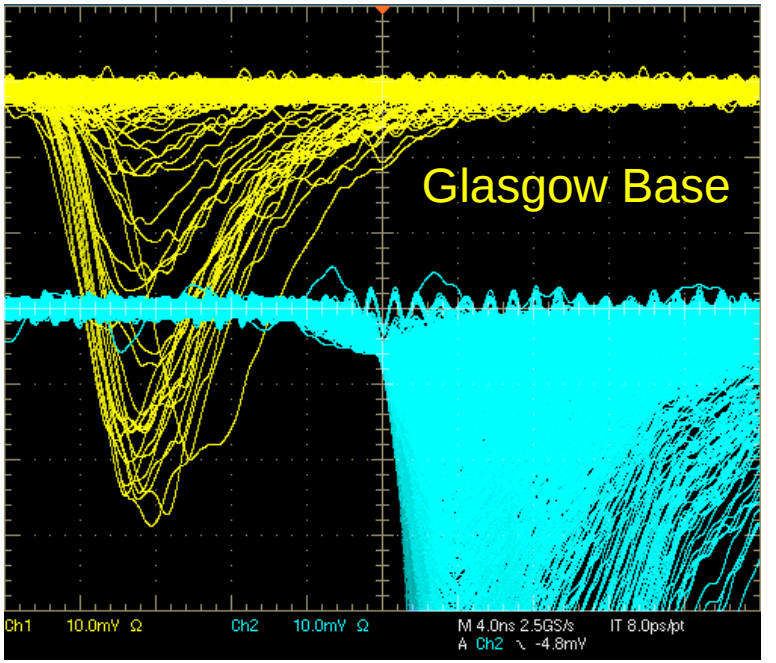
Glasgow base has MCX anode connector and BaBar-pattern HV connector



Voltage divider for ET9142SB 28mm PMT, Hall–A JLab.

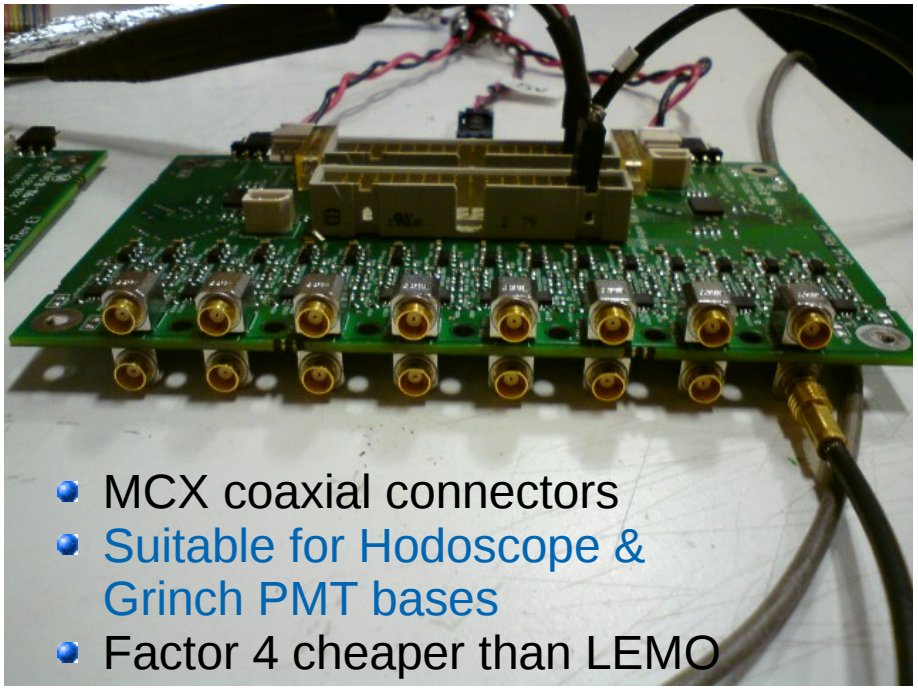
J.R.M.Annand 28th May 2014.
J.R.M.Annand 8th March 2016





- Custom base has low gain (NINO discriminator has high sensitivity)
- Good linearity over extended dynamic range
- Fast signal return to base line
- Cost about the same as ET version
- 200 Glasgow bases produced

Version G NINO Card

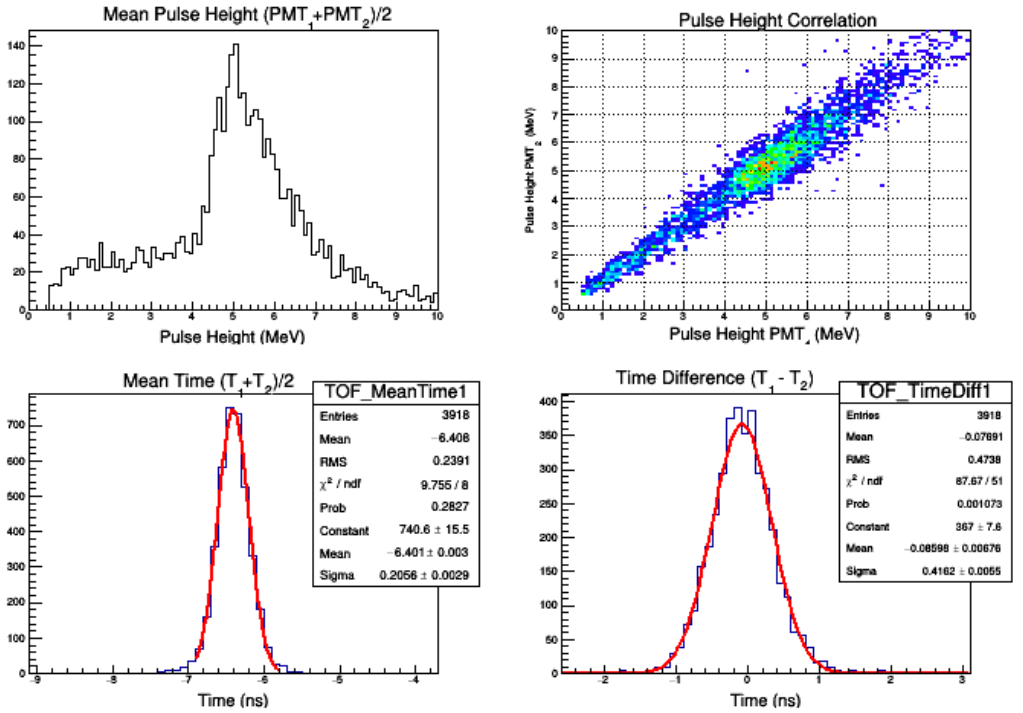


- Version G intended for GRINCH and BB Timing Hodoscope
- 110 cards (1760 channels) produced at Zott electronics
- Cards for GRINCH are now installed
- 2 BB hodoscope cards in JLab, the rest in Glasgow...will be tested and shipped this summer/fall
- 800 1.5 m MCX coaxial cables produced for GRINCH and Hodoscope
  Much cheaper than Lemo connectors (but less robust)

Hodoscope/NINO Time Resolution

Timing Resolution
R-11265 has the best timing resolution
ET9142 is slightly poorer (but much cheaper)
ET9125 (BaBar) has significantly poorer timing resolution

ET9142 offers acceptable performance and affordability

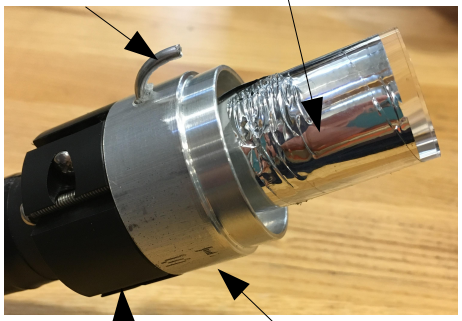


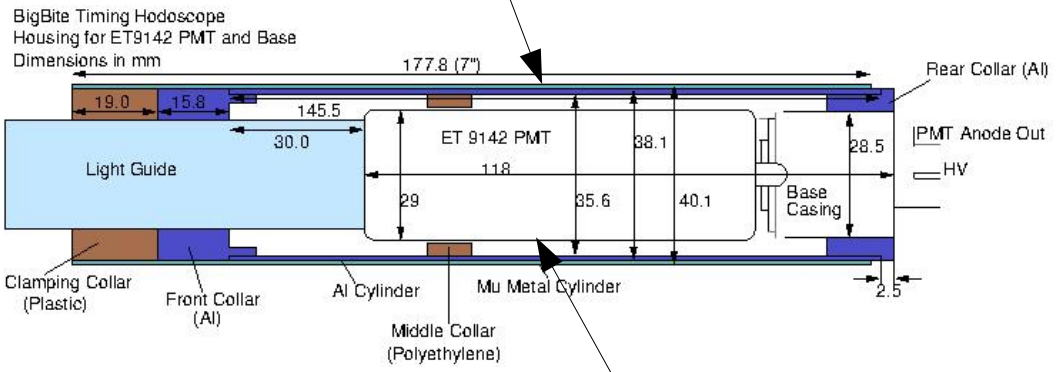
Time Histogram	ET-9125	R11265	ET-9142
PMT-1	0.5	0.20	0.30
PMT-2	0.6	0.21	0.30
Mean	0.44	0.14	0.21
Difference	0.80	0.28	0.42

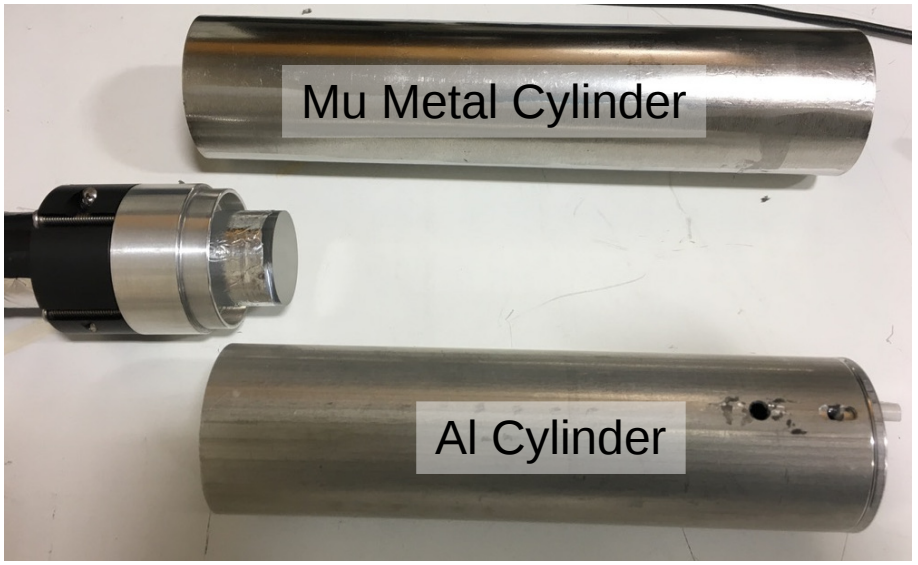
- Cosmic Ray Tests with ET 9142
- V1190A TDC configured to fire on leading and trailing edge of NINO LVDS pulse
- Time corrected for walk using time over threshold information

Time Resolution ~ 0.21/√2 = 0.15 ns

PMT Assembly







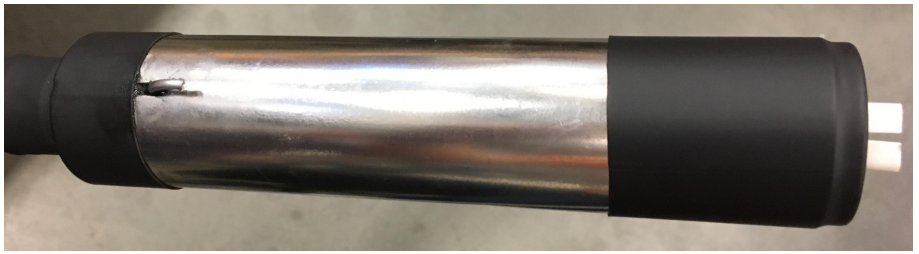
Estimate factor ~1000 suppression of longitudinal stray B field from dipole (~100 Gauss)
~ 0.1 Gauss at PMT cathode...~ 2% effect on PMT pulse height

Completed Sub-Assemblies

Al cans containing PMT & base

Front collars attached to clamps

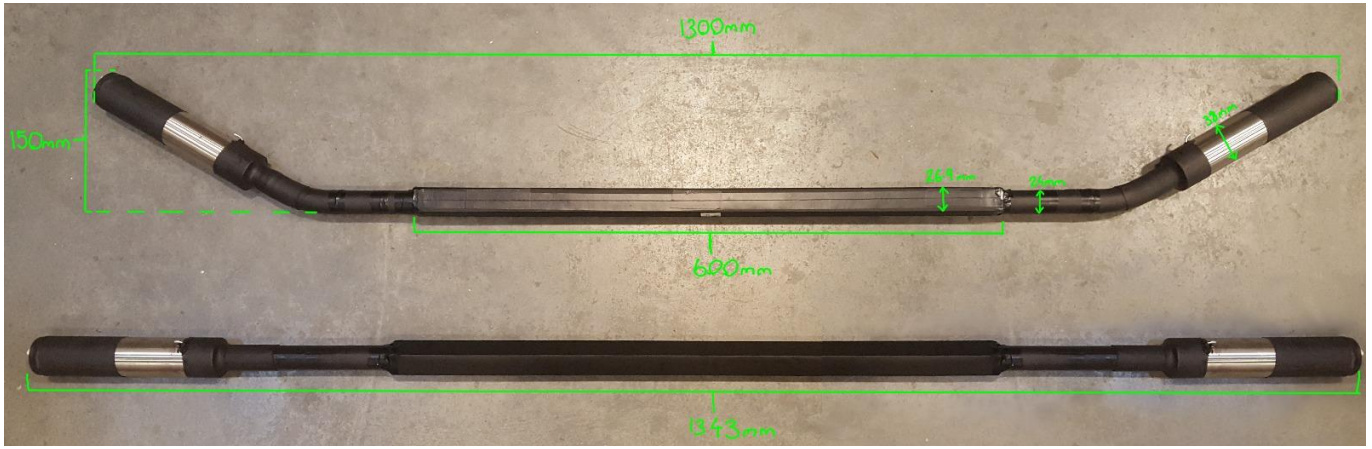
Heat shrink fitted to front & rear of PMT assembly



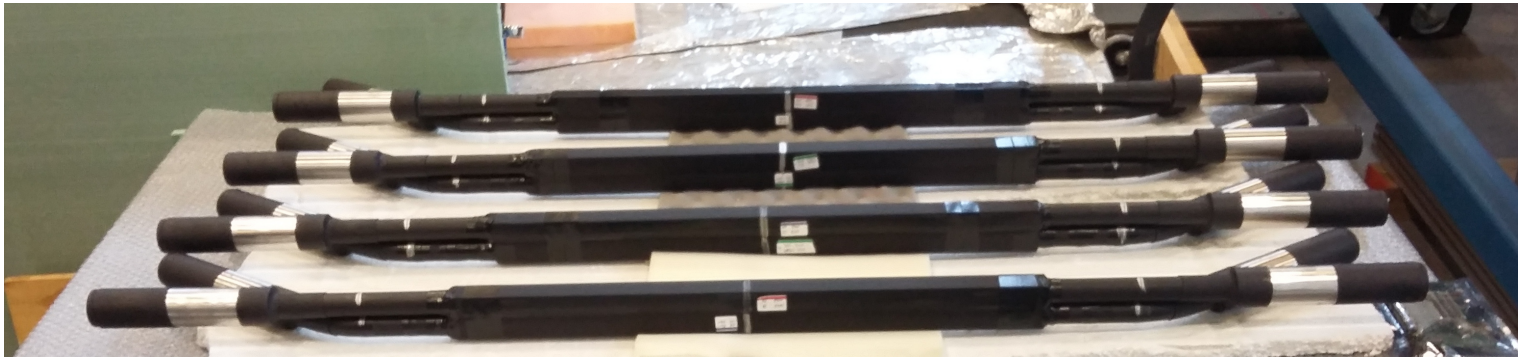
Heat shrink overlaps at rear

Completed Bars

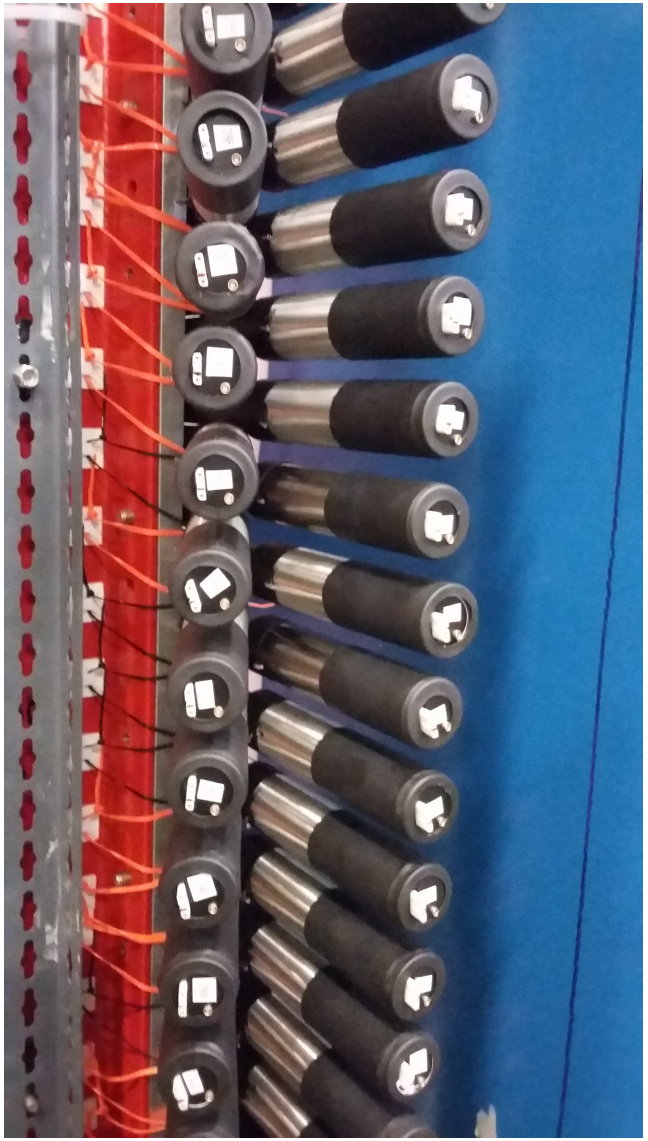
- 90 Hodoscope bars completely assembled ready to place in the BigBite detector stack
- 44 with curved light guide
- 46 with straight light guide

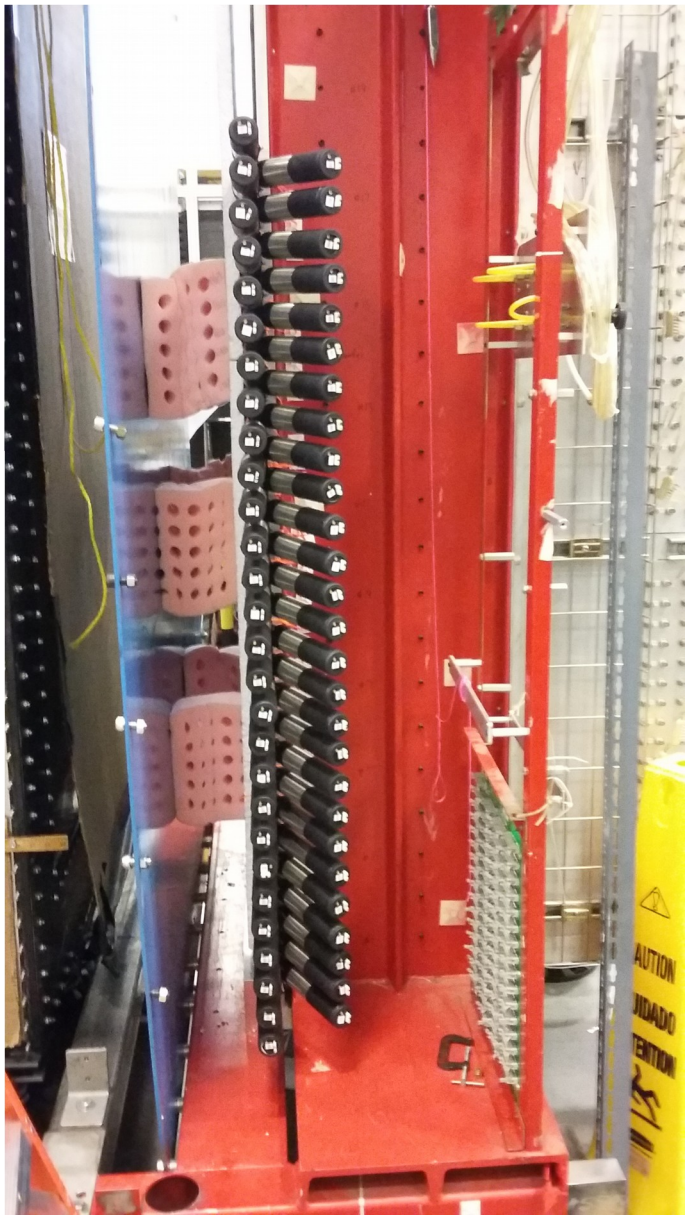


Work on best means to stack bars in BigBite frame, and hold them firmly in place, procedes

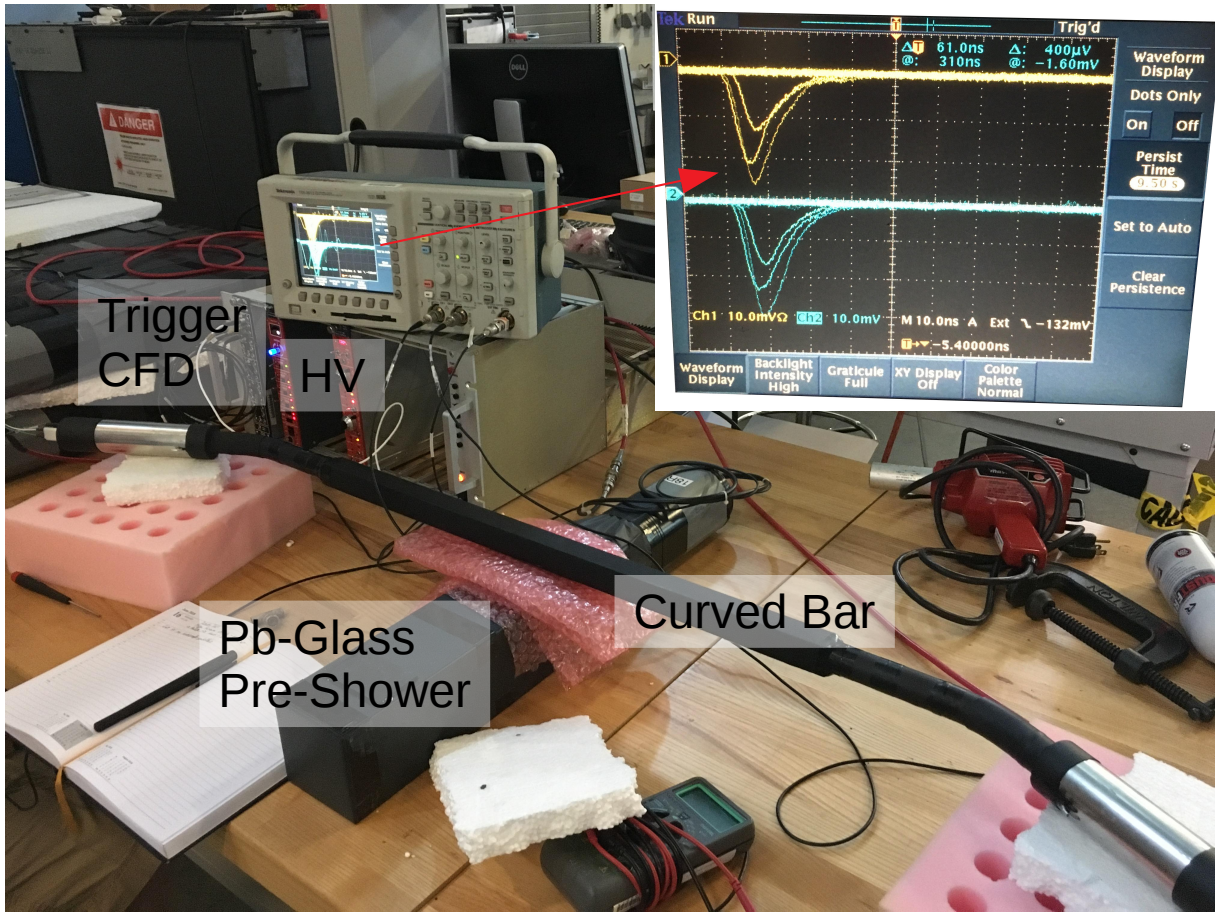


Trial Stacking



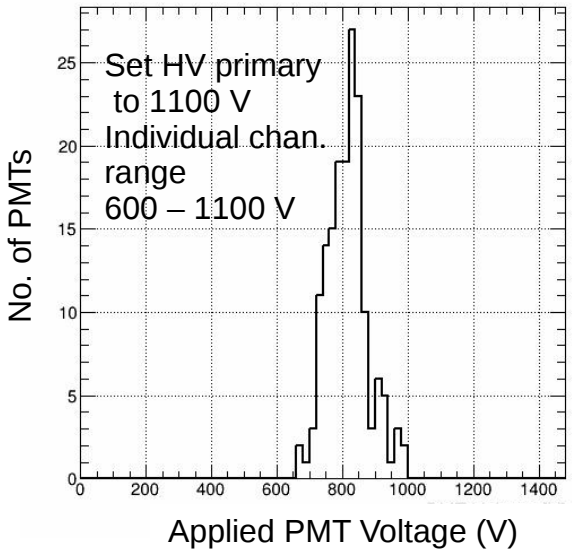


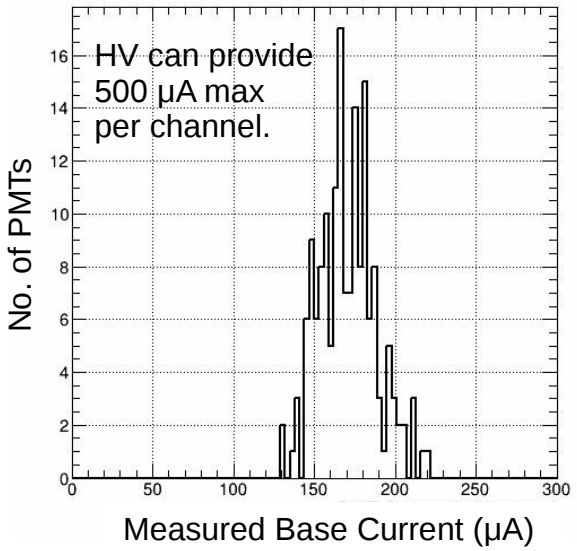
Preliminary Testing of Bars in TEDF

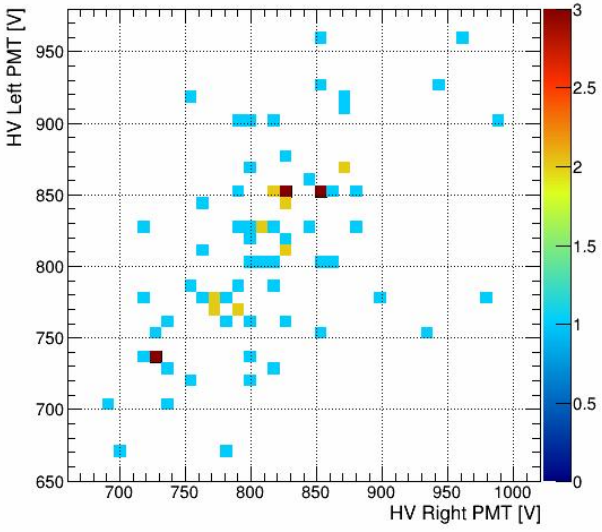


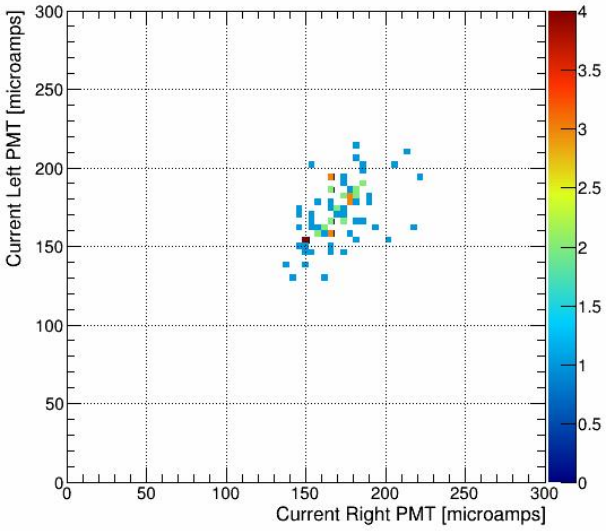
- All assembled bars tested with cosmic muons
- Pre-shower Pb-Glass counter, centered on bar, + CFD provides muon trigger
- Anode signals recorded on scope
- Ballpark HV setting... Equalize PMT gains Peak amplitude ~15 mV @ “maximum” in muon pulse-height distribution
- Check for light leaks using flash light

Gain Characteristics of 180 ET9142 PMTs







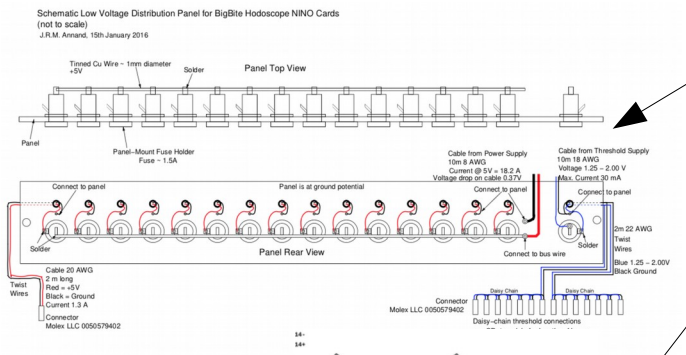


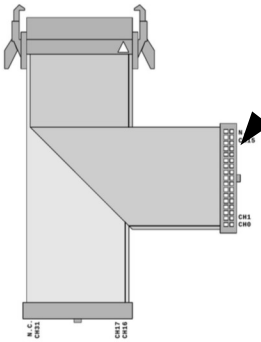
- PMT voltage setting as in slide 11
- Lowest gain PMTs from batch of 200 not used...but they work fine
- Where possible used 2 close PMT serial numbers on a bar
- PMT gains tended to be more similar on PMTs manufactured close in time

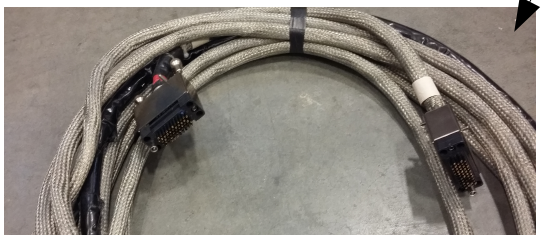
Equipment in JLab

- 90 assembled hodoscope bars, with PMT, base, case and magnetic shielding fitted
- Spare PMTs, bases and mechanical assembly parts. 4 bases returned to Glasgow to have MCX anode signal connector fitted
- 2 CAEN V1190A Multihit TDC (2 x 128 channels).One channel of each TDC needs to be reserved as a reference channel.
- 1 CAEN V792 QDC (32 channels) for pulse height calibration (1 to follow)
- 1 CAEN SY1527LC HV mainframe and 8, 48 channel A1932A HV distributers. Hodoscope requires 4 A1932A. The other 4 are available for other detectors. New US-pattern power cable required for mainframe.
- 1 AGILENT LV power supply for NINO card power supply
- 200 1.5m MCX co-ax cables for PMT → NINO
- 2 NINO cards for initial tests

Equipment to be Shipped from Glasgow

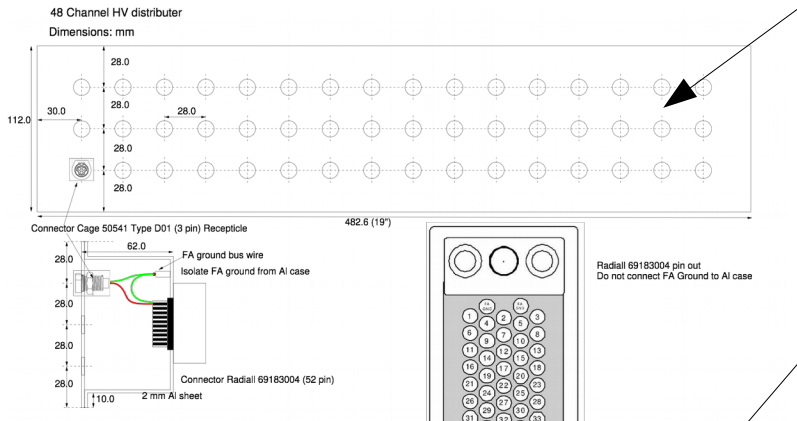


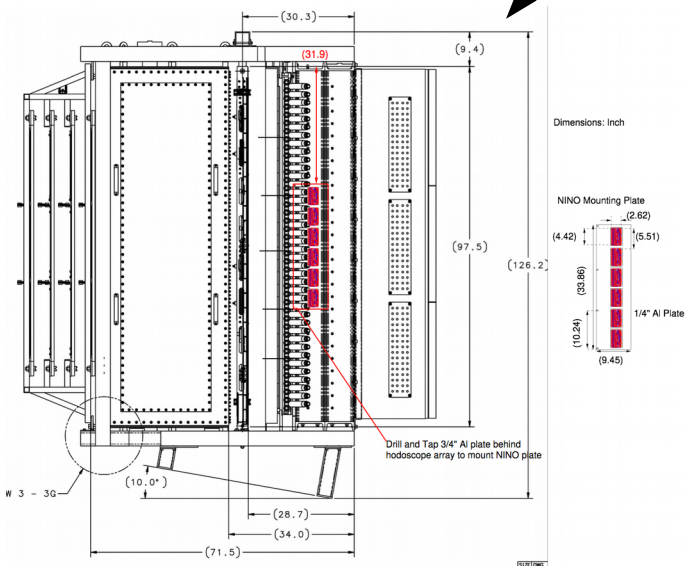




- 1 WIENER VME64x6023 crate
  21-slot, 6U, VME64X backplane, enet control
- 12 NINO cards (after they are tested)
- LV distribution panel, currently being manufactured
- 34-pair Robinson-Nugent to 17-pair IDC convertors ordered for connection of 17-pair flat ribbon cables to V1190A TDCs
- 4 60m 52-way HV cables to go from CAEN HV distributers to HV distribution panel on BigBite frame under procurement (existing cables too short)
- We also have a CAEN SY4527 HV mainframe which was procured for SBS...available for other SBS detectors

Other Items of Equipment





See talk by Eric Fuchey on layout

- HV distribution panels: convert multiway HV to individual HV cables. Procurement of 4 multiway and 180 individual HV connectors outstanding.
- Manufacture of HV cables from HV panels to PMT bases outstanding. Use same cable pattern as GRINCH. Connecter type non-standard in UK.
- Manufacture of mounts for NINO cards on BB frame outstanding (PMT → NINO cable 1.5 m long)
- Gas hosing into PMT housings
- Low current LV supply for NINO thresholds. On-board NINO-card potentiometers can also be used
- Slow control of LV and HV supplies. EPICS interface available for HV.
- 64 55m RG58 coaxial cables for analogue signals into QDC … suitable cables in ESB
- 24 30 m flat ribbon cables for NINO → TDC … NINO → LVDS-ECL converter → V1190A TDC. Suitable flat cable exists at JLab
- VMEbus controller SBC, CODA implementation of QDC and TDC readout, online display software. CODA system in Glasgow has suitable readout. SBC available at Jlab?

Hodoscope Outlook

- Hodoscope assembly at JLab by team from Glasgow & JLab summer students
  90 bars completed, tested
- Trial stacking of bars under way
- Liaise with JLab engineers for final stacking and mounting of bars
- Cabling to run from hodoscope NINO cards to readout electronics identified at JLab
- Manufacture of LV and HV distribution systems under way
- Layout of NINO cards/signal cables/panels on BB frame under way (E. Fuchey)

To do

- Set up of DAQ stand in JLab for cosmic-ray data taking
- Development of online display software using cosmic-ray data files

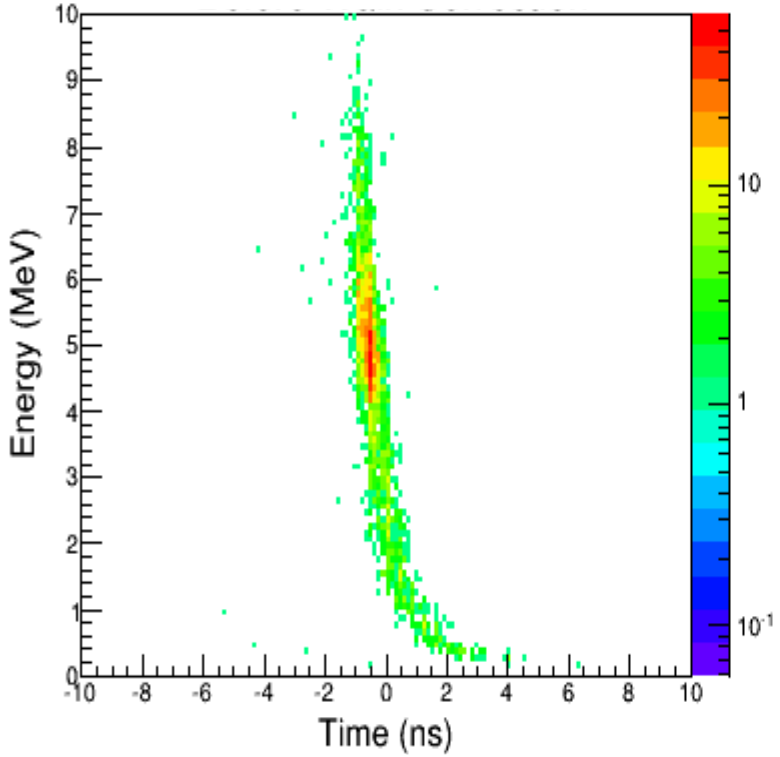
NINO:

- Testing of cards reserved for CDet to be completed before shipment
- Received delivery of further 130 cards (awaiting remainder)
- Available as spares/new cards
- Testing to be carried out. Small number require input connectors to be attached
- Several faulty cards to be repaired and tested

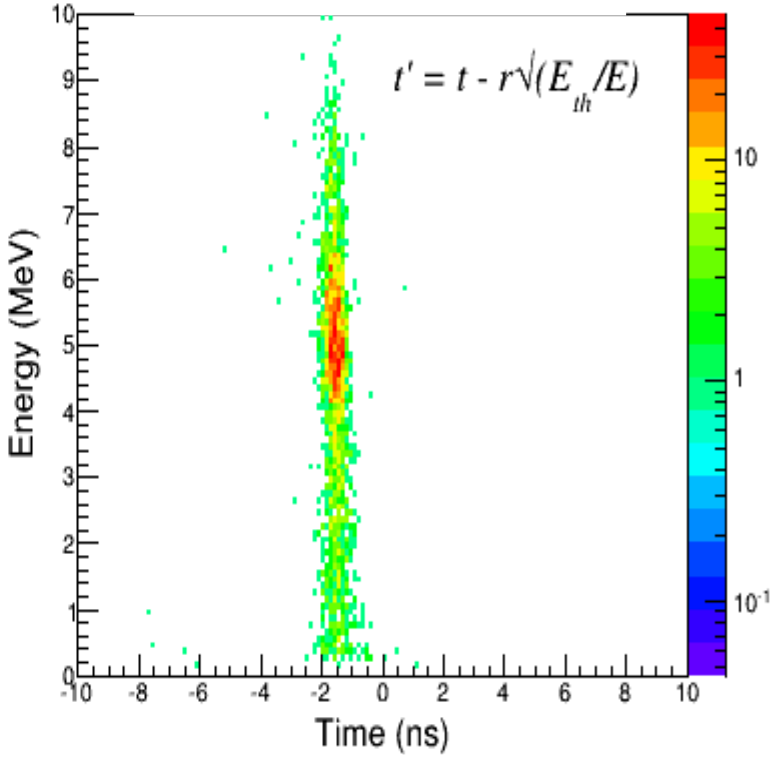
Thanks for your attention

Time-Walk Correction with NINO

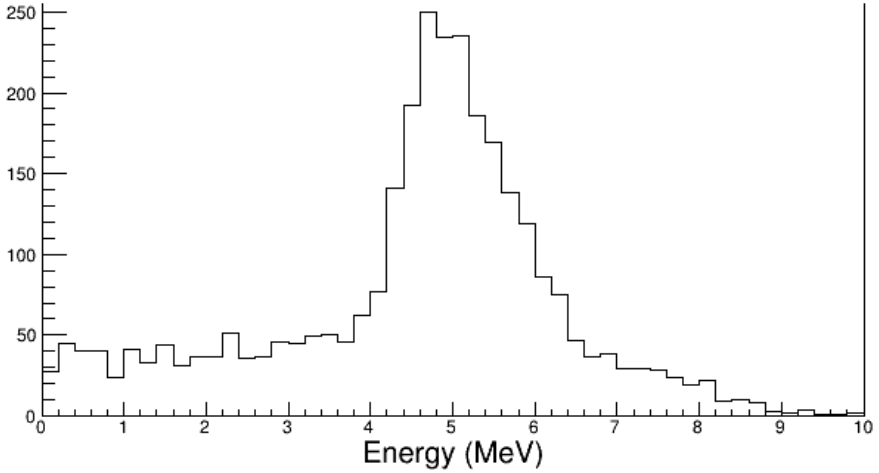
Before Walk Correction



After Walk Correction



Muon Pulse Height Spectrum Single Hodoscope PMT



Test made with R-11625 PMT

NINO is a leading edge discriminator
Time over threshold can also be used for walk correction