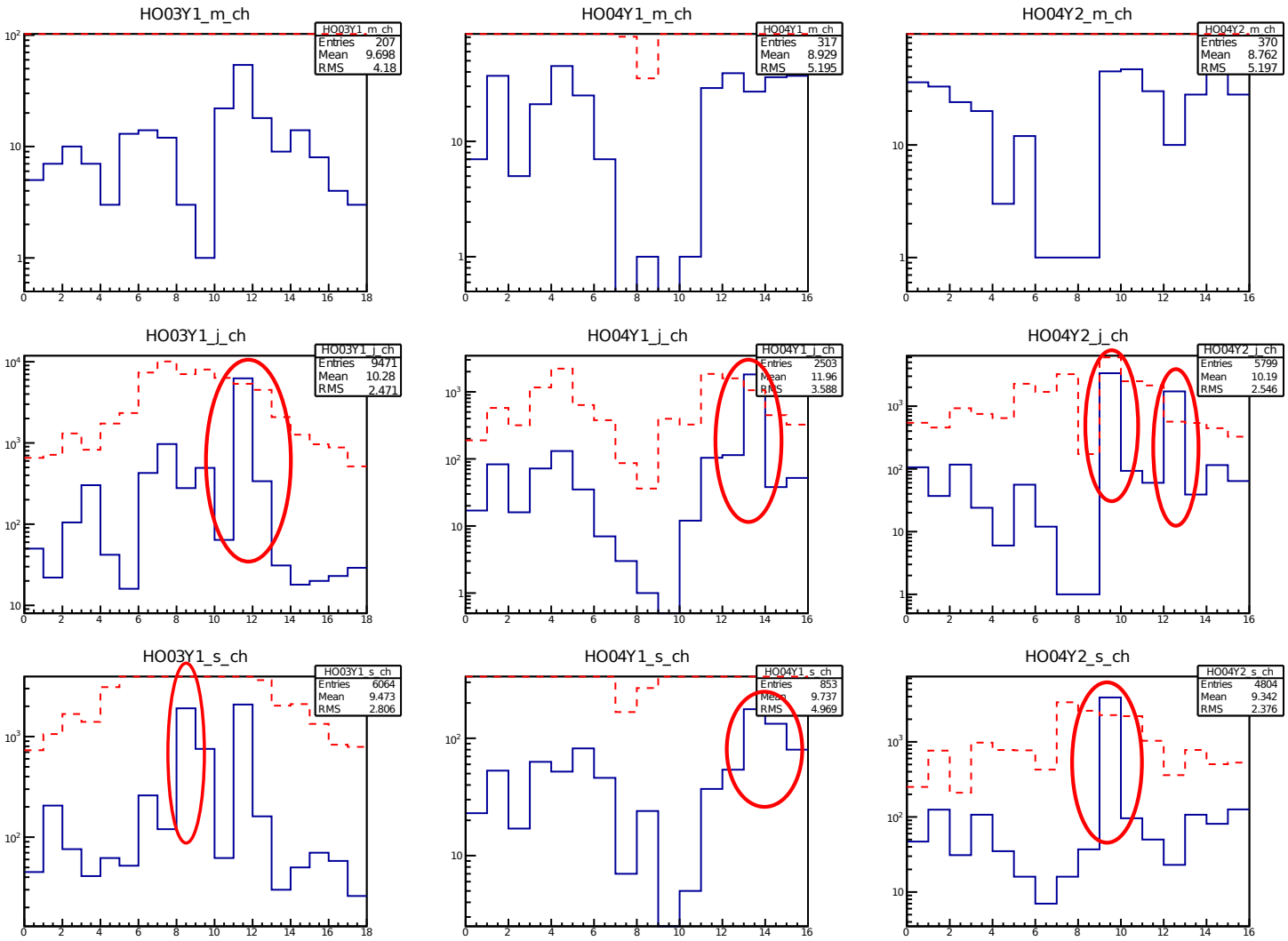
Summary of the work on triggers Q4 2016

Benjamin Moritz Veit

19. Dezember 2016

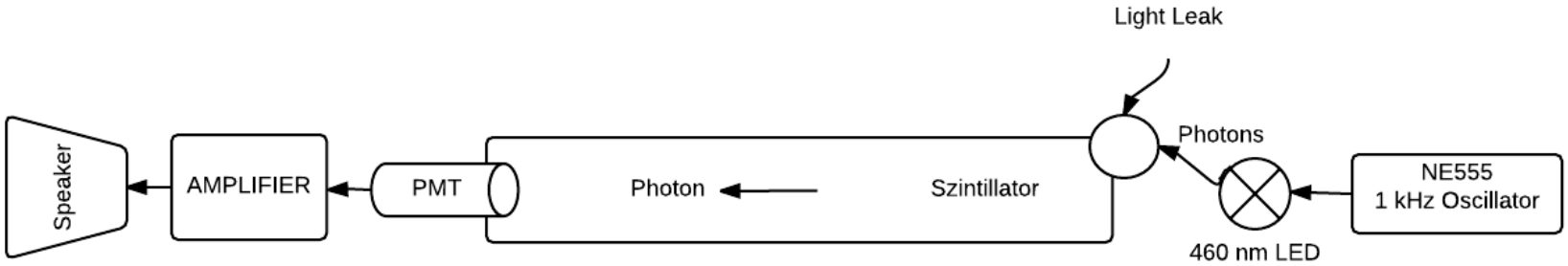
Light Leaks ?



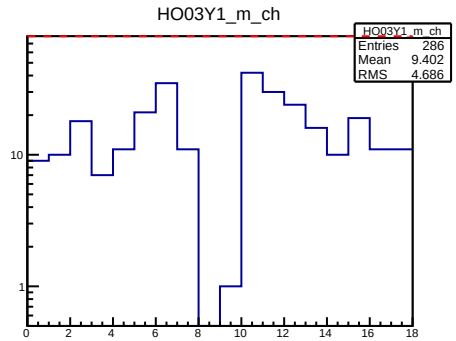
COOOL Plots taken with no Beam.

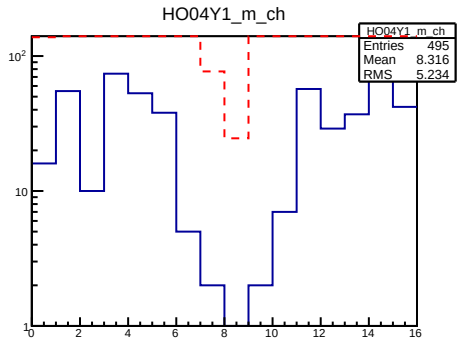
Finding Light Leaks

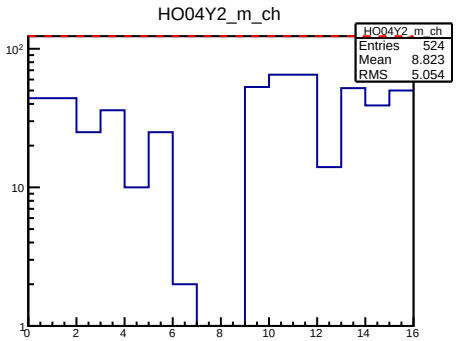
New methode by illuminating the scintillator slabs with a pulsed led (1 khz) and hearing the light leak by a speaker attached to the signal output of the PMT-Base.

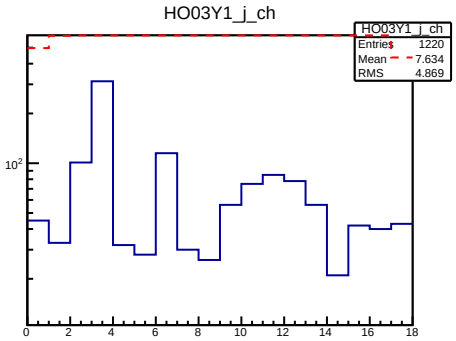


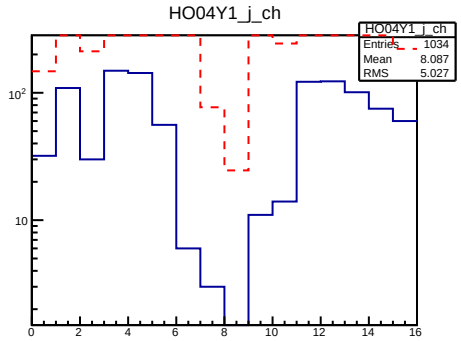
Light Leaks Fixed

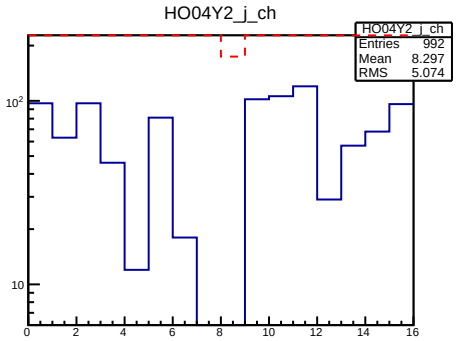


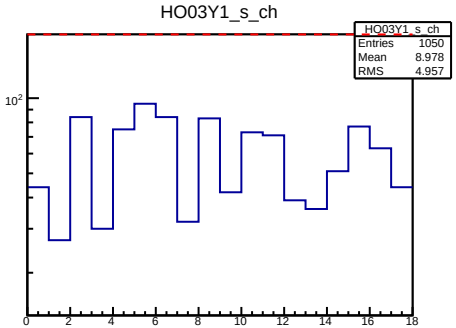


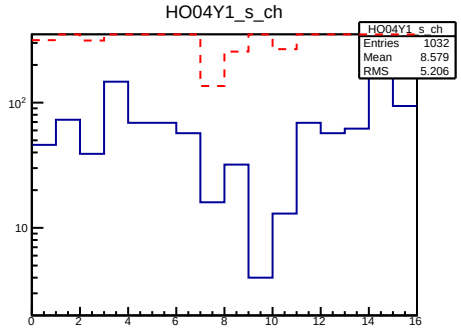


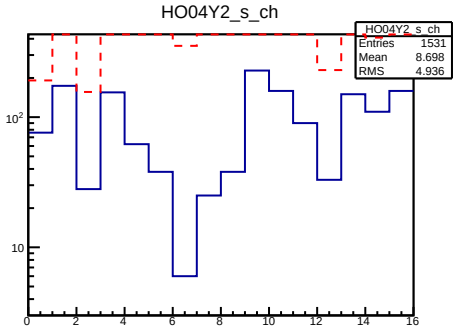












Finding Working Point

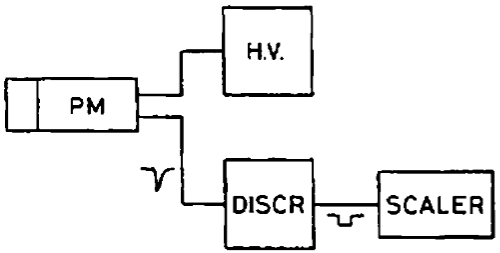


Fig. 9.17. Set-up for counter plateau measurement

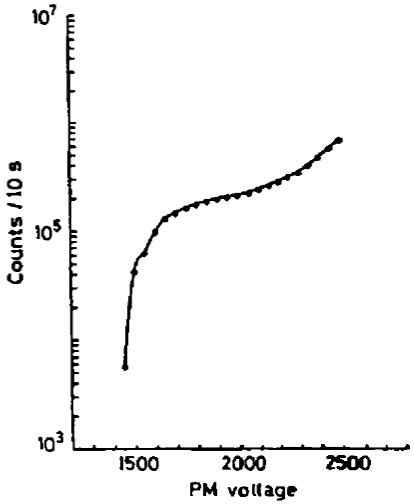
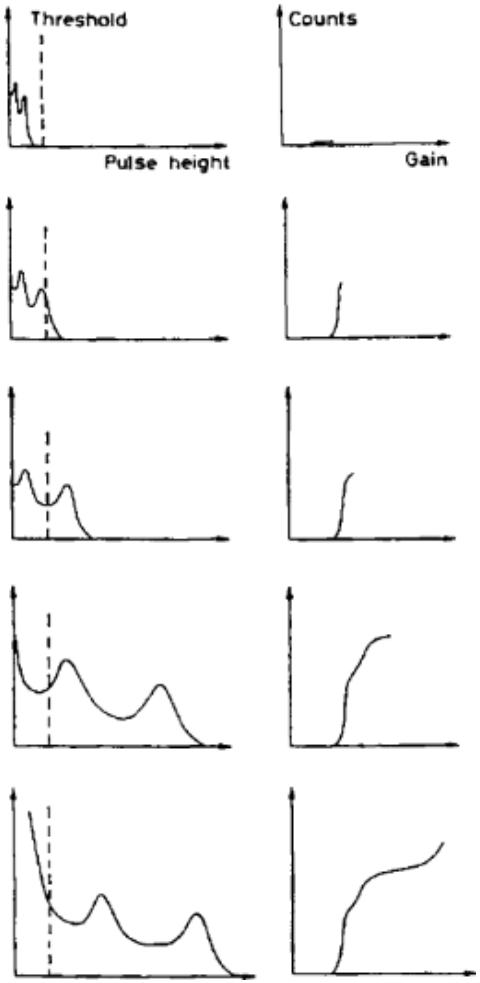
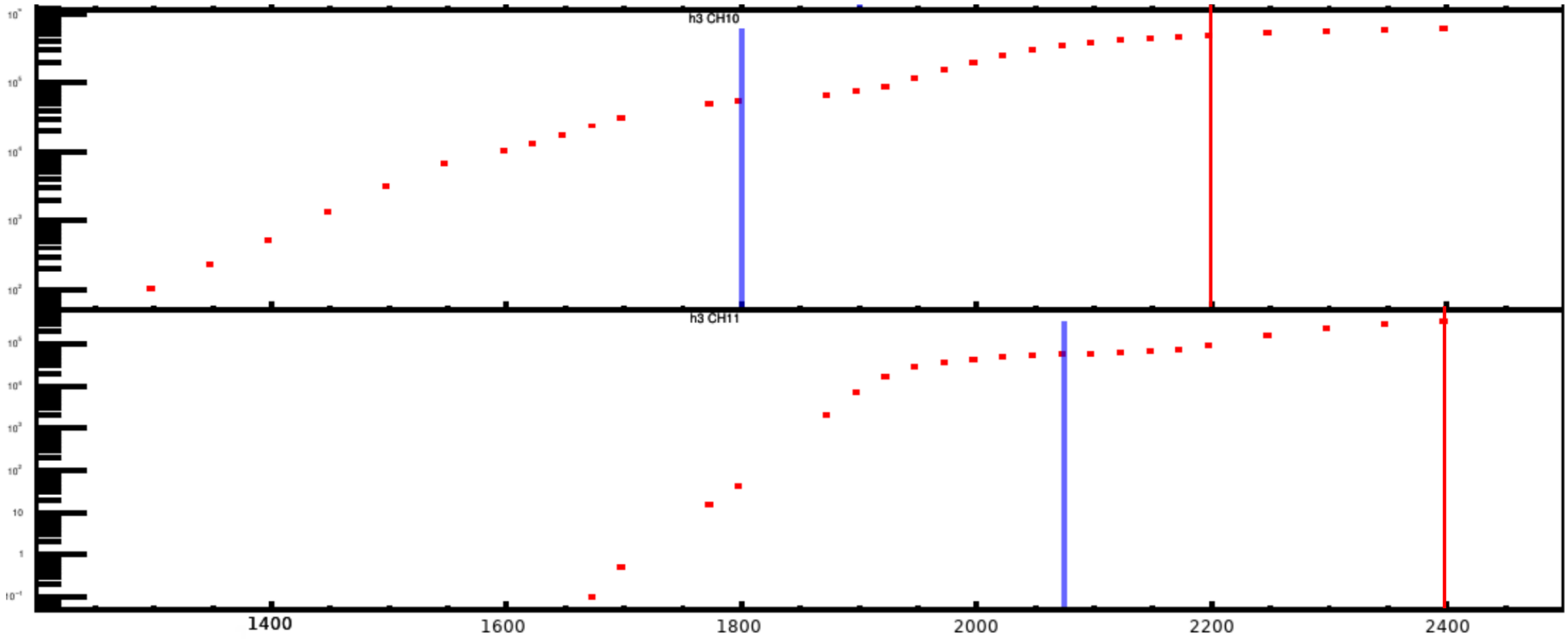


Fig. 9.18. Measured plateau curve for plastic scintillator detector shown in Fig. 9.16 using a ^{207}Bi source



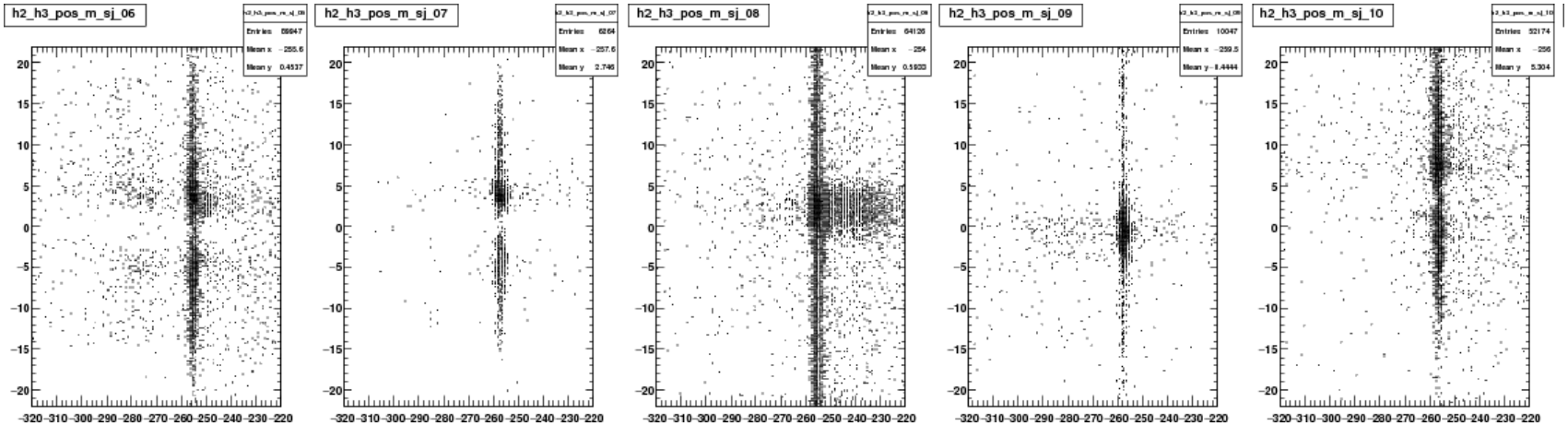
Source: William R. Leo, Techniques for Nuclear and Particle Physics Experiments.

Scaler Method Results

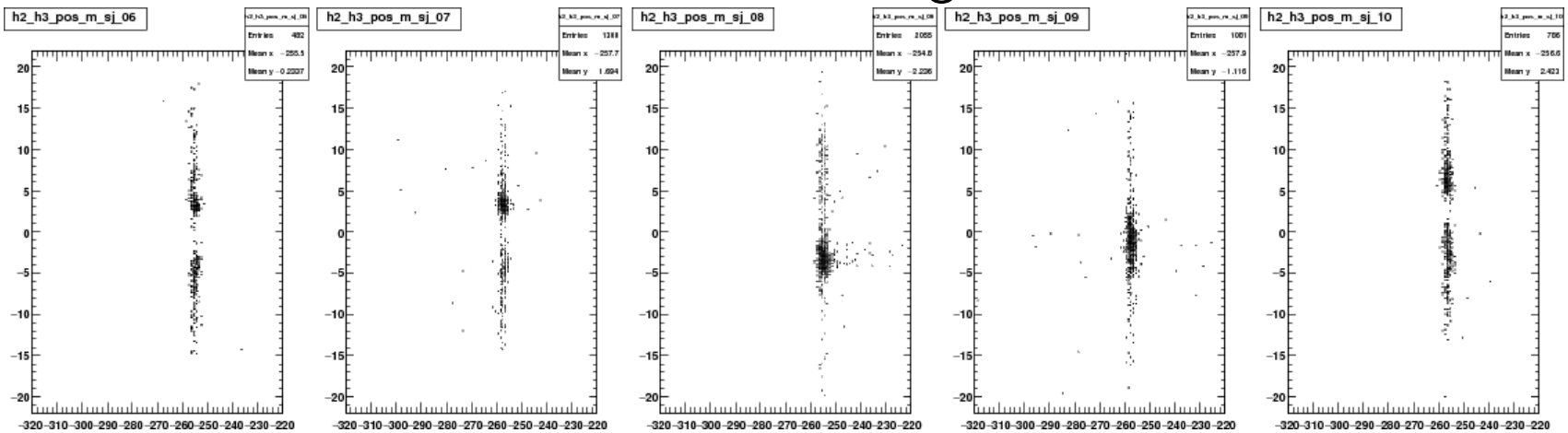


Pos. / Time Correlation

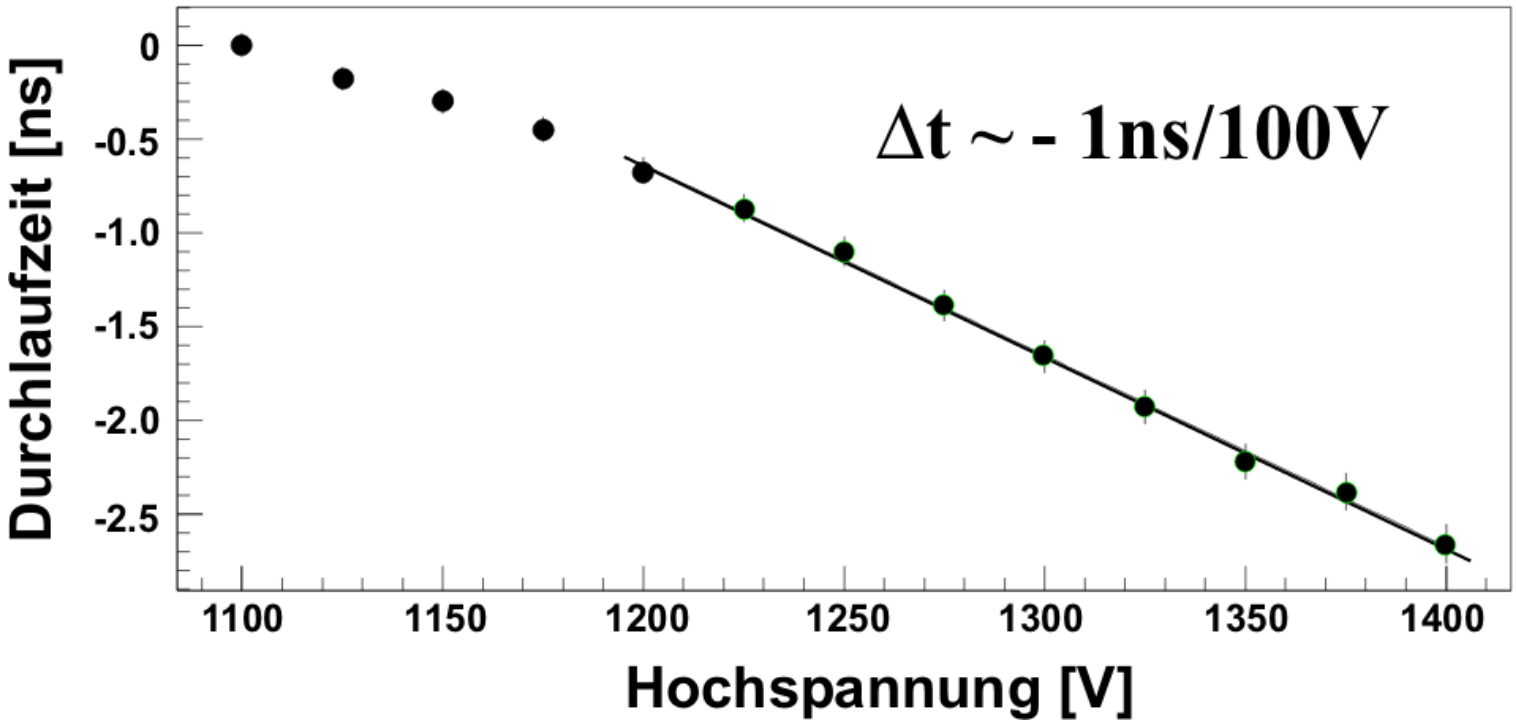
Old HV Settings:



New HV Settings:

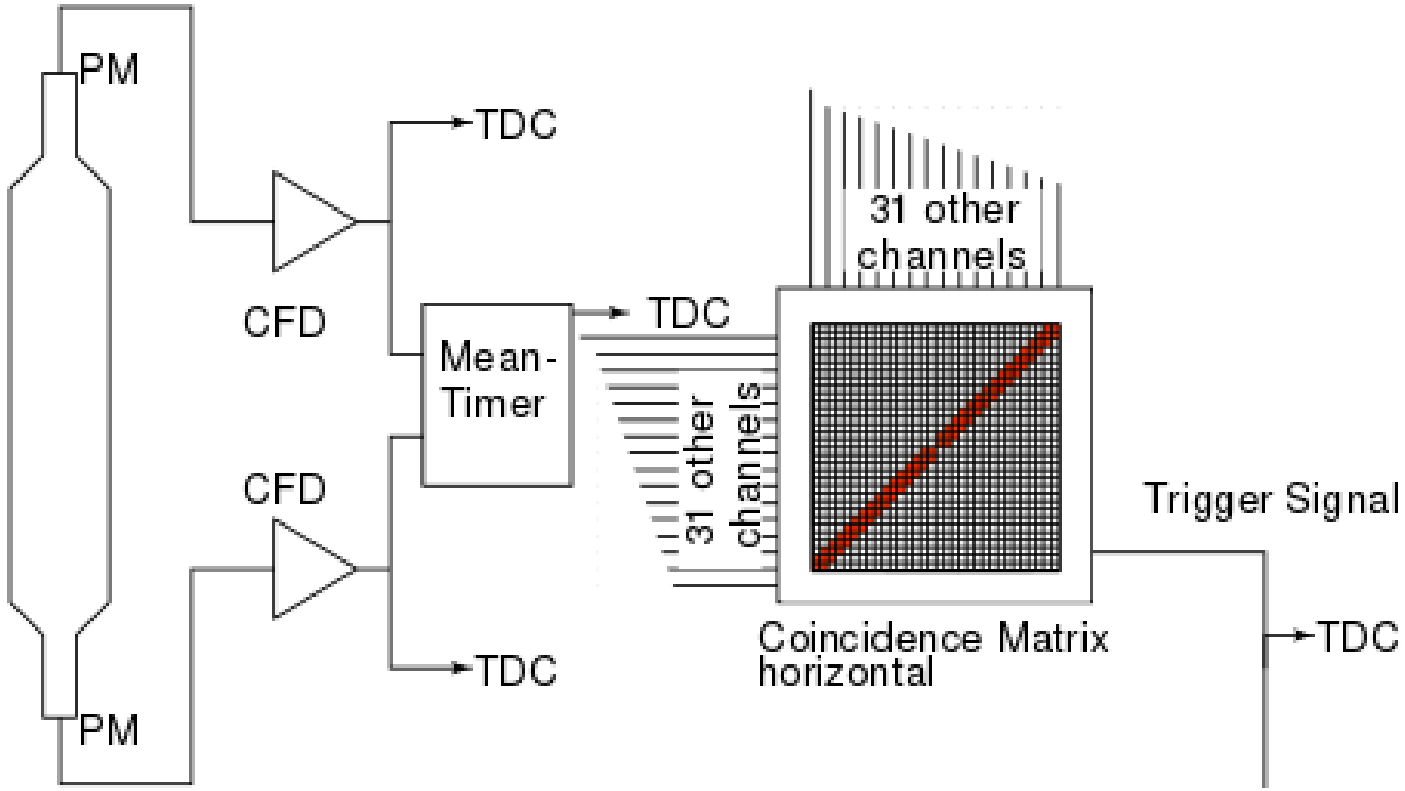


Transit Time vs. Voltage



Source: PHD Thesis Klaus Grimm: Aufbau eines Lichtauslesesystems für ein Bleifluorid-Kalorimeter zur Messung der Paritätsv erletzung in der elastischen Elektronenstreuung.

Trigger Detail



Trigger Matrix Detail

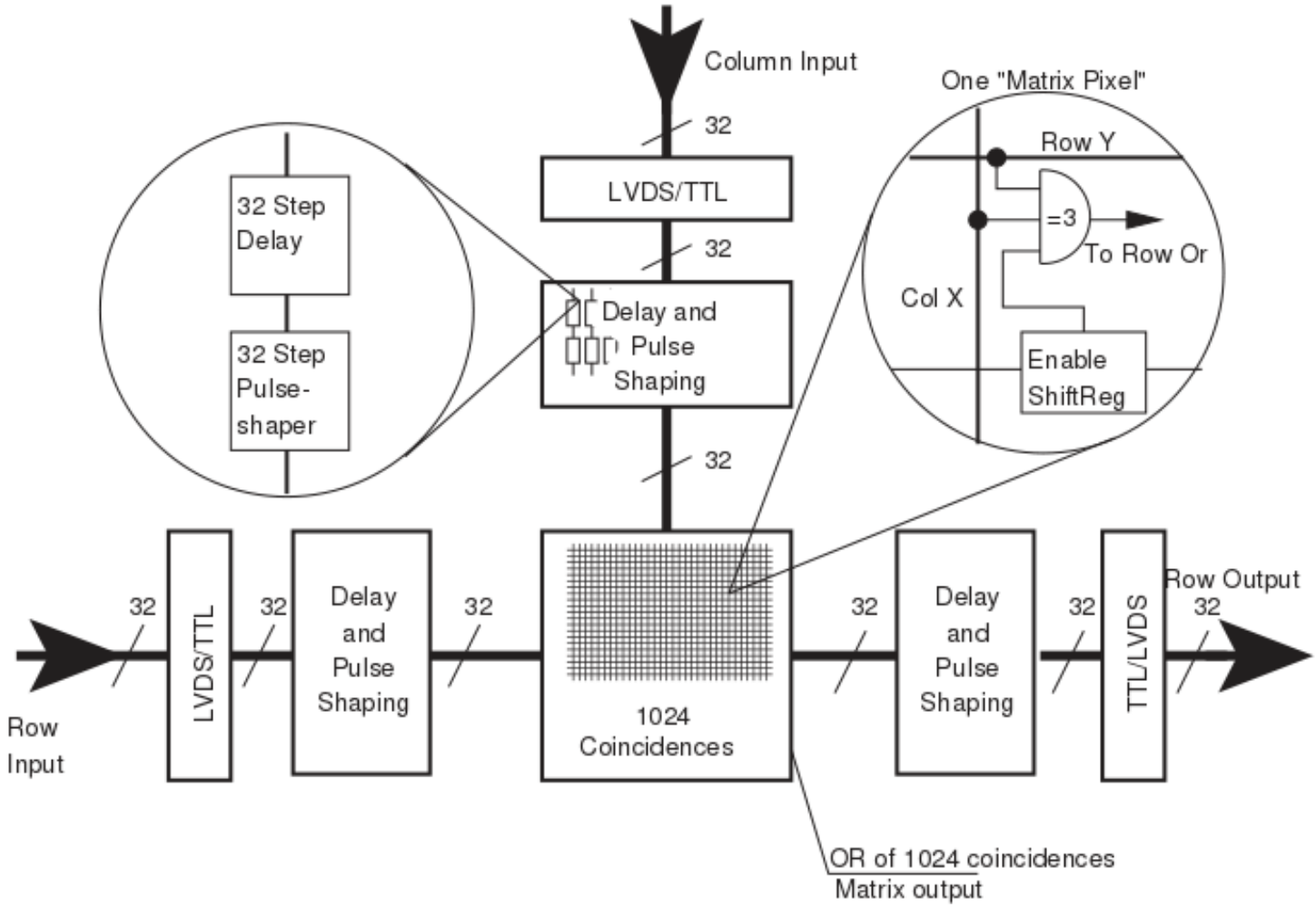
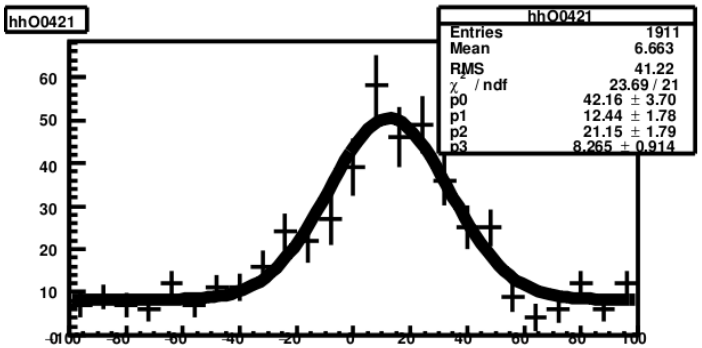


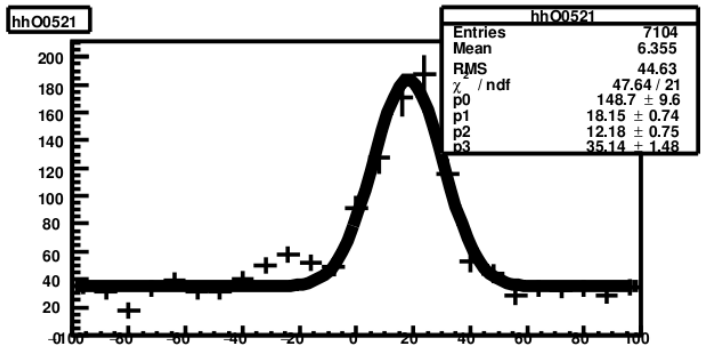
Fig. 13. Schematics of the matrix board.

Matrix Delay Scan

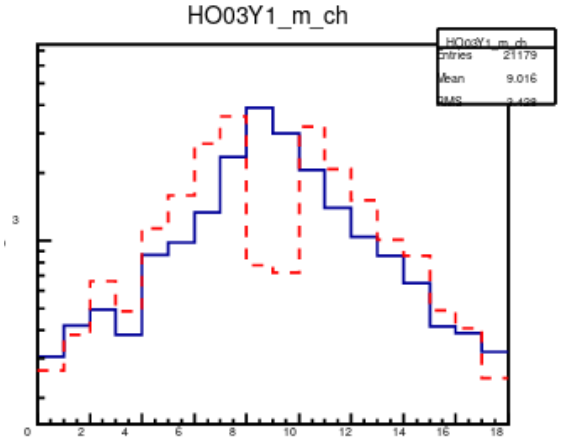
Fixing one Hodoscope in the middle of the delay range and stepping the delay of the second hodoscope by each spill (32Steps).

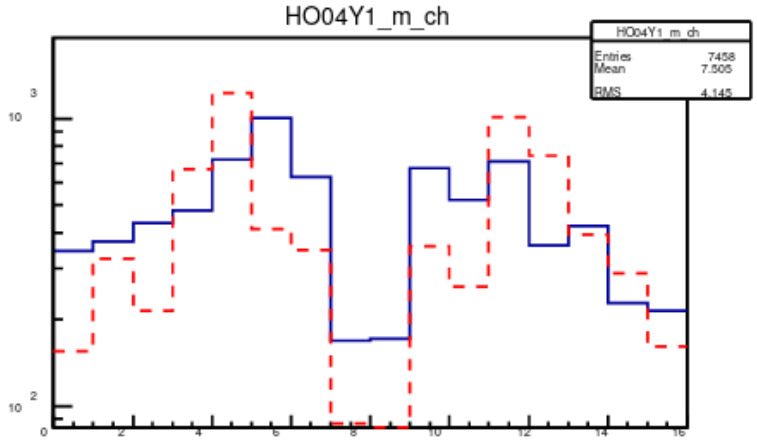
$\rightarrow$ Finding optimal delay setting by searching for the delay combination with maximum rate.

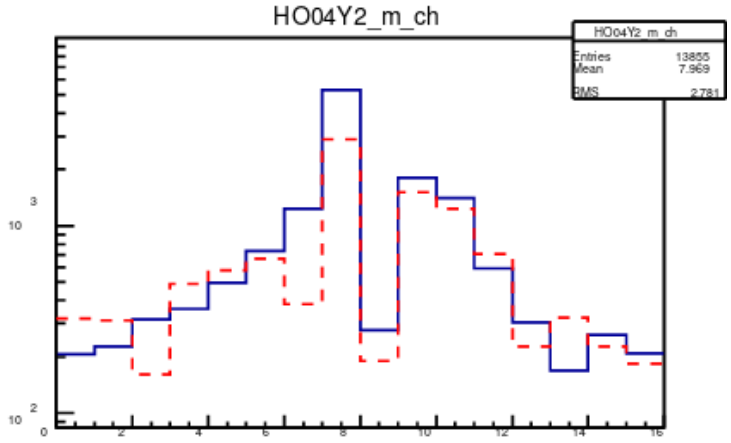




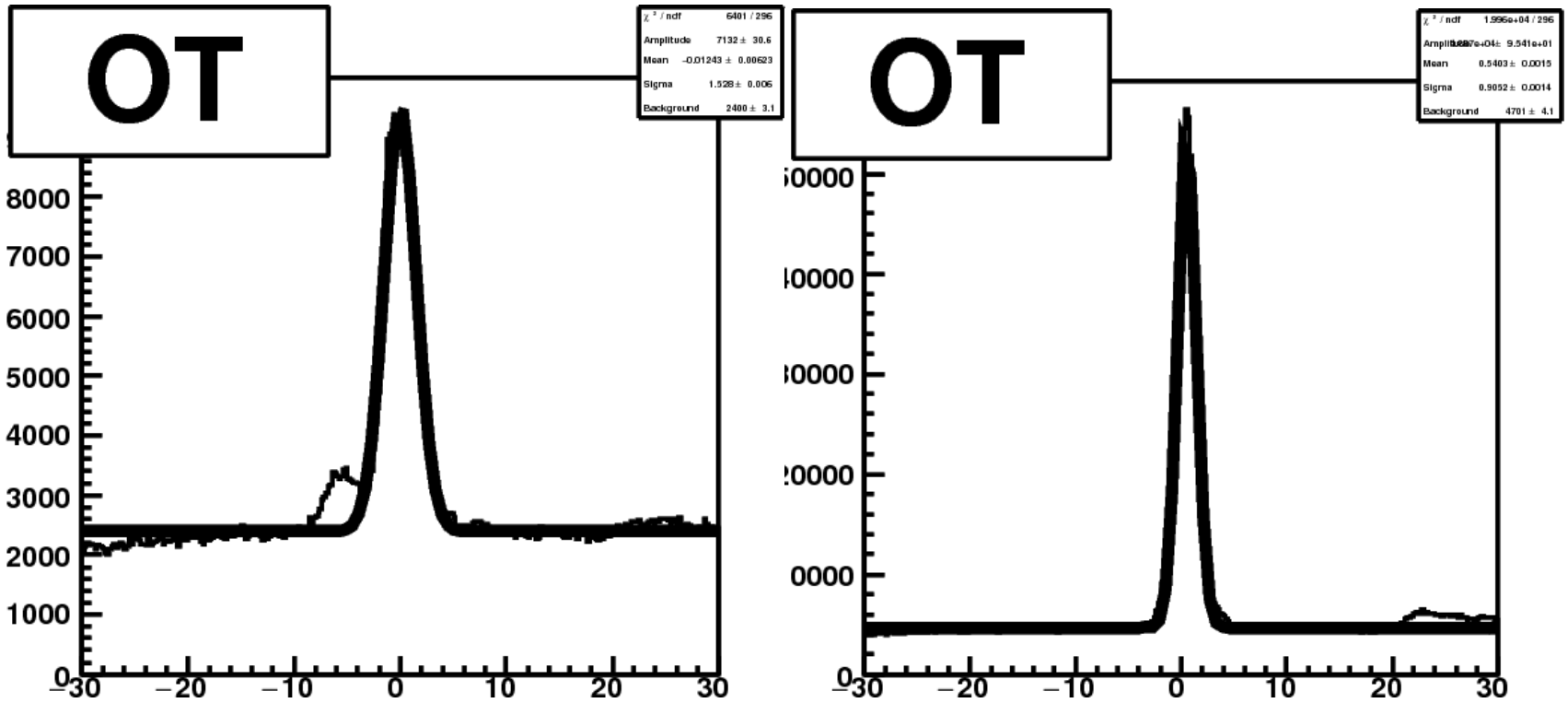
COOOL Spectra







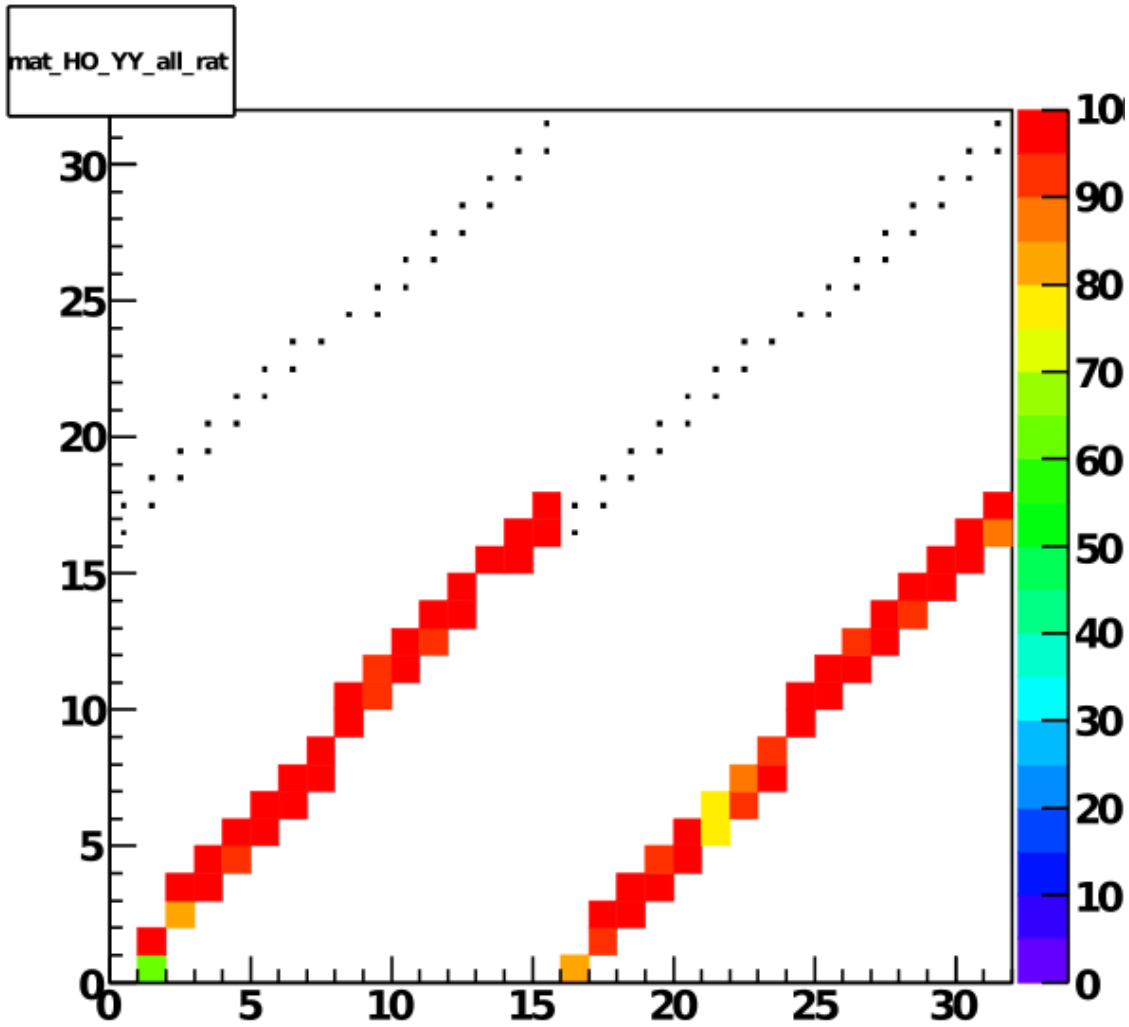
Timing Resolution



old sigma: 1.5 ns

new sigma: 0.9 ns

First Estimate of Outer Matrix Efficiencies



Antoine Comparisson 2012/2016

Table of efficiencies

Points hodoscope = true
"Inclusive" physics trigger

	MT	LT	OT	LAST	All
Z Vertex distribution	97 100	96 94	97 90	90 94	
ν	97 100	95 94	97 90	90 93	97 96
x_B	97 100	96 94	98 90	90 94	97 96
M_{K^0}	112 91	78 75	99 82	80 140	100 87
$E_{\rho^0}^{miss}$	96 96	101 96	105 90	104 72	97 95
$E_{\rho^0}^{miss}$ $Q \in]1,10[$	94 101	85 102	104 93	70 94	95 98

2016
2012

Improvement of the OT from 2012 to 2016

Lack of statistic for LAST in 2016

For any given trigger : Strong correlation (DIS variable)

Systematic 5% difference for LT

Higher statistics for 2012

Antoine Vidon

μ^+/μ^- comparison

Summary of Outer Investigation

- Improving grounding of the Outer Hodoscopes
- Fixing Light Leaks
- Found proper HV working points
- Do new matrix delay scan

- Improving timing resolution from 1.5 ns to 0.9 ns
- Improving Outer rate by factor 2+ (swap of cables in HO03) 3000 to 6000.
- Improving efficiency of the matrix

Outer Trigger in a much better shape now !

But still space to improve it for next year !

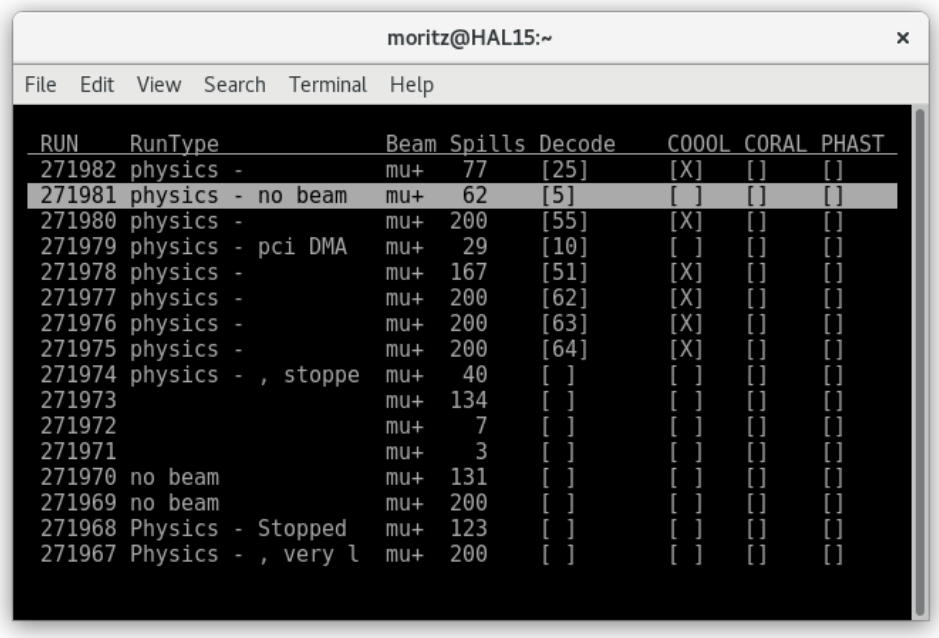
State of HV-Scan:

Hodoscope	PMT	Done	# Channels	Comment
HI5	XP2900	X	64	w/o target
HM4H	XP2900		64	
HM4V	XP2072B	X	40	w/o target
HM5H	XP2900		64	
HM5V	EMI9954B	X	40	w/o target
HL4	XP2900/XP2090/XP2020		32/16/16	
HL5	XP2900/XP2090/XP2020		32/16/16	
HO3	EMI9813KB	X	36	
HO4	EMI9813KB/XP2900	X	68	
H1	XP2900		64	scaler via gandalf
H2	9814KB		128	scaler via gandalf
Vbl	XP2020	X	4	partial done
VO	XP2020		32	only meantimer in db
VI1	XP2020		4	
VI2	XP2900		8	

New Program parameterchanger.py available

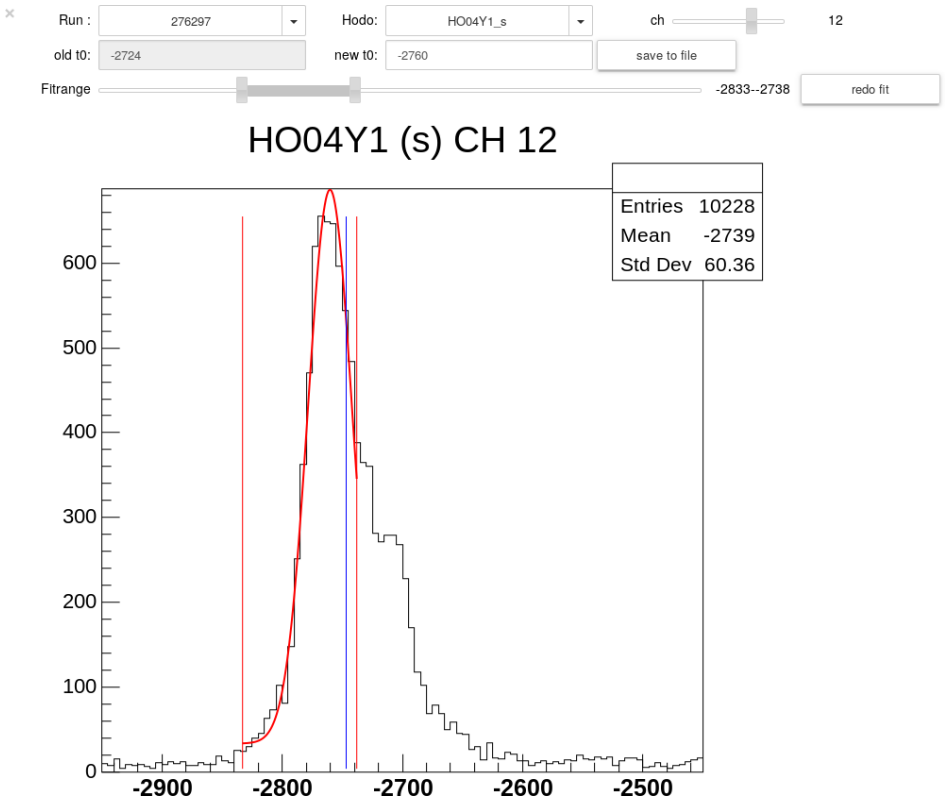
Can change any parameter (cmd line based or via DCS) per spill and over multiple runs. Save spill and run list as xml file for later analysis.

New Program for Data Decoding



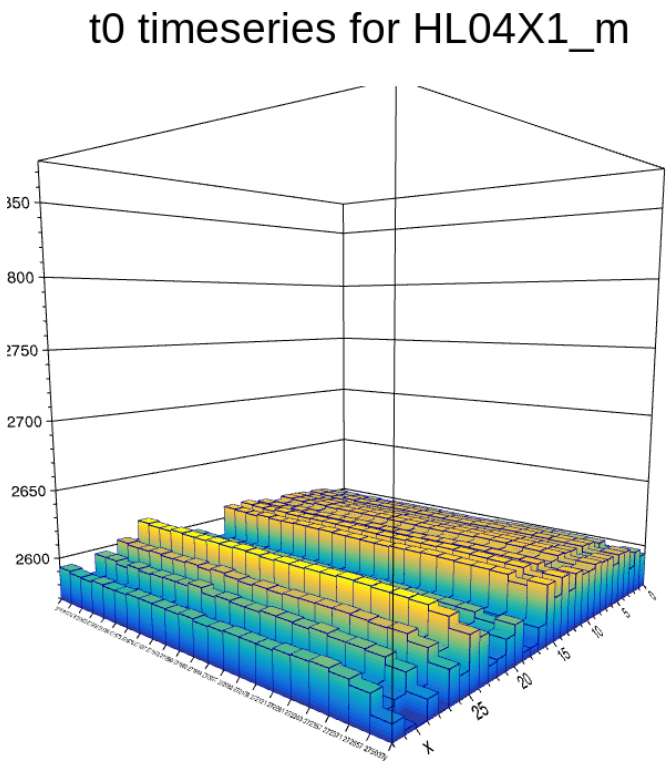
- Based on python and curse (cmd line program)
- useable on compass Domain or on lxplus
- Database integration
- Decode Files
- Run COOOL scripts
- Run PHAST scripts
- Results on eos directory
- Accessible via cernbox

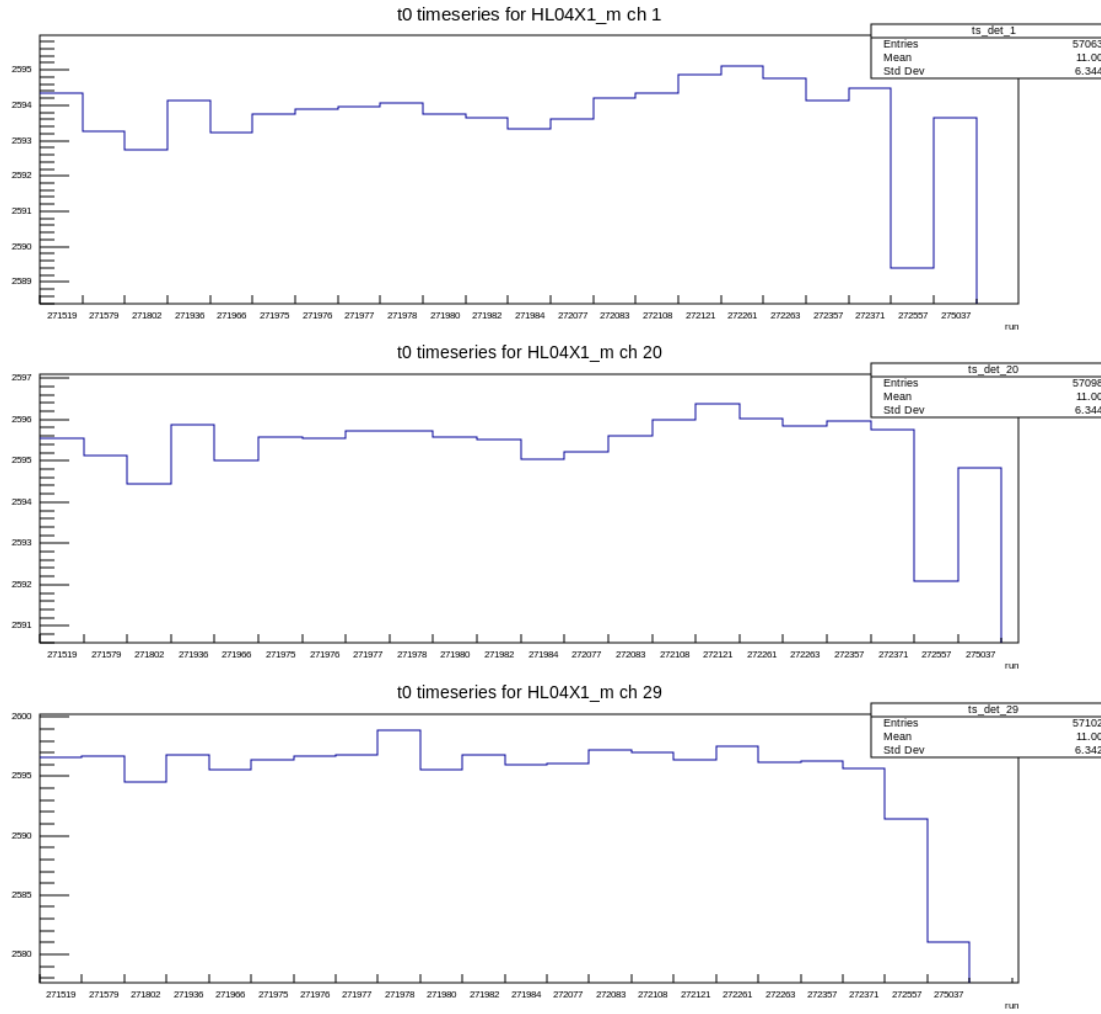
New Program for T0 Fit



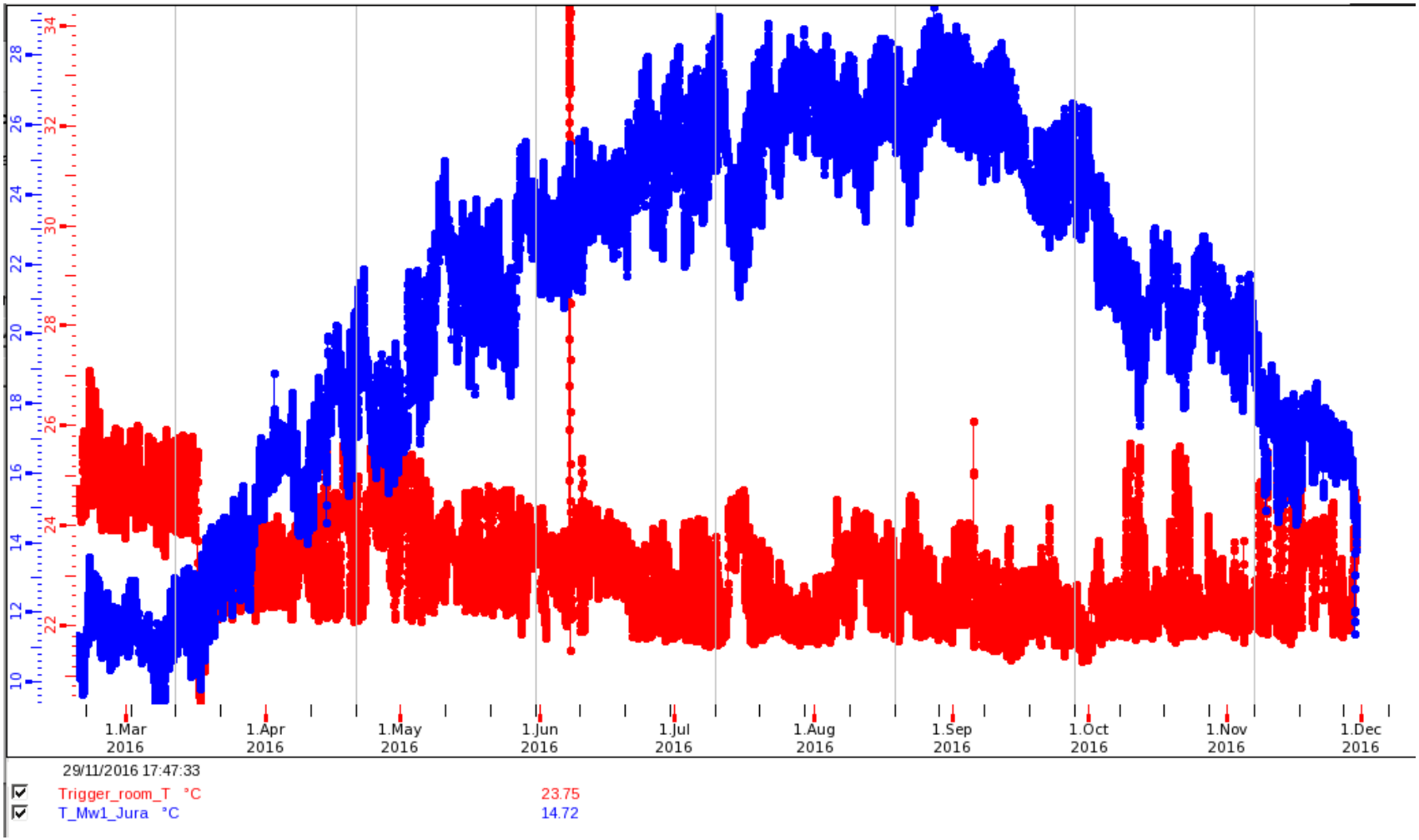
- Based on python and ROOT.
- Basically GUI for t0.C - Web jupyter application.
- Access to decoded data on eos.
- Usable over cernbox or SWAN.
- Still under development.

T0 long time stability



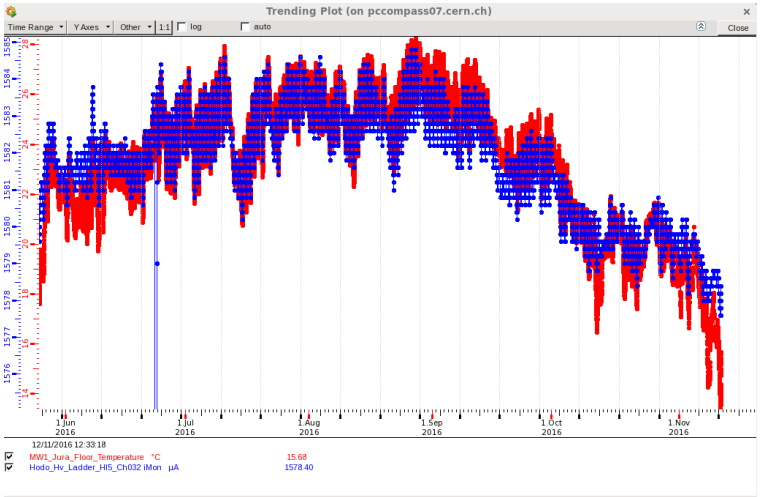


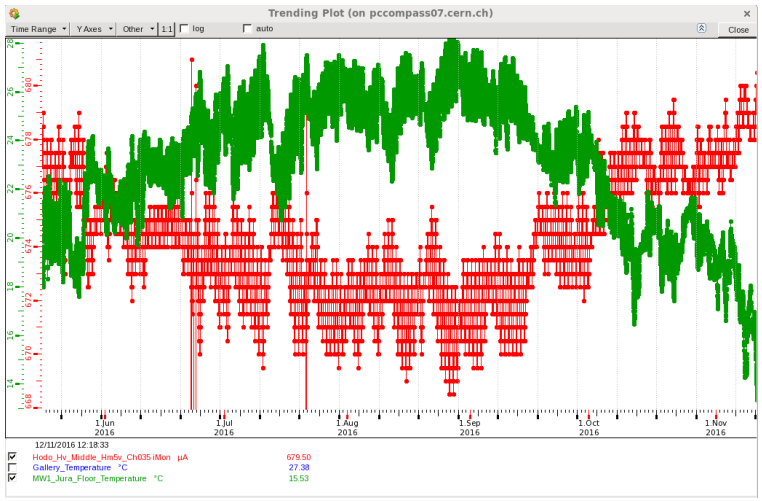
Temperature @ COMPASS

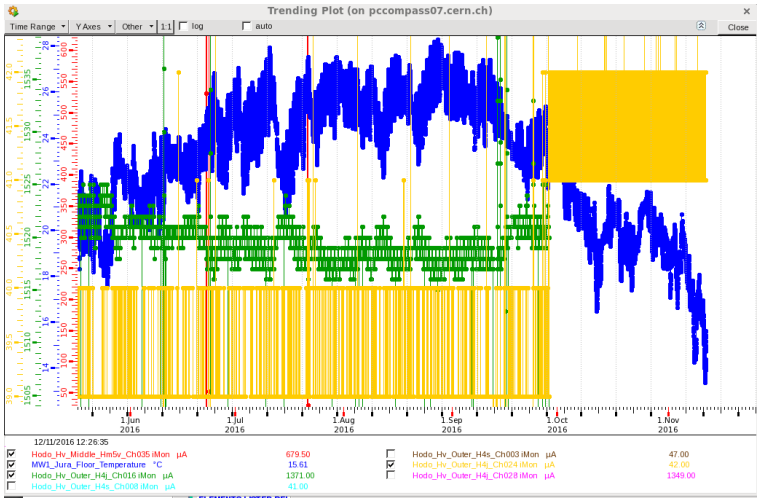


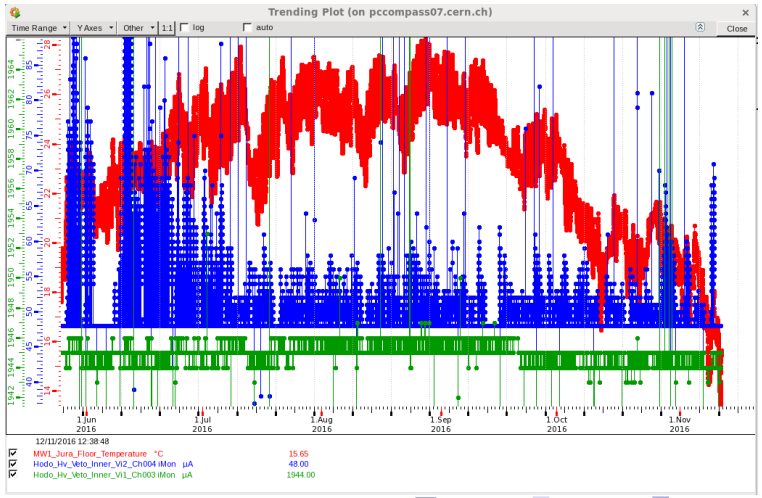
Temperature vs. Current of PMTs

Temperature dependency of PMT parameter ?

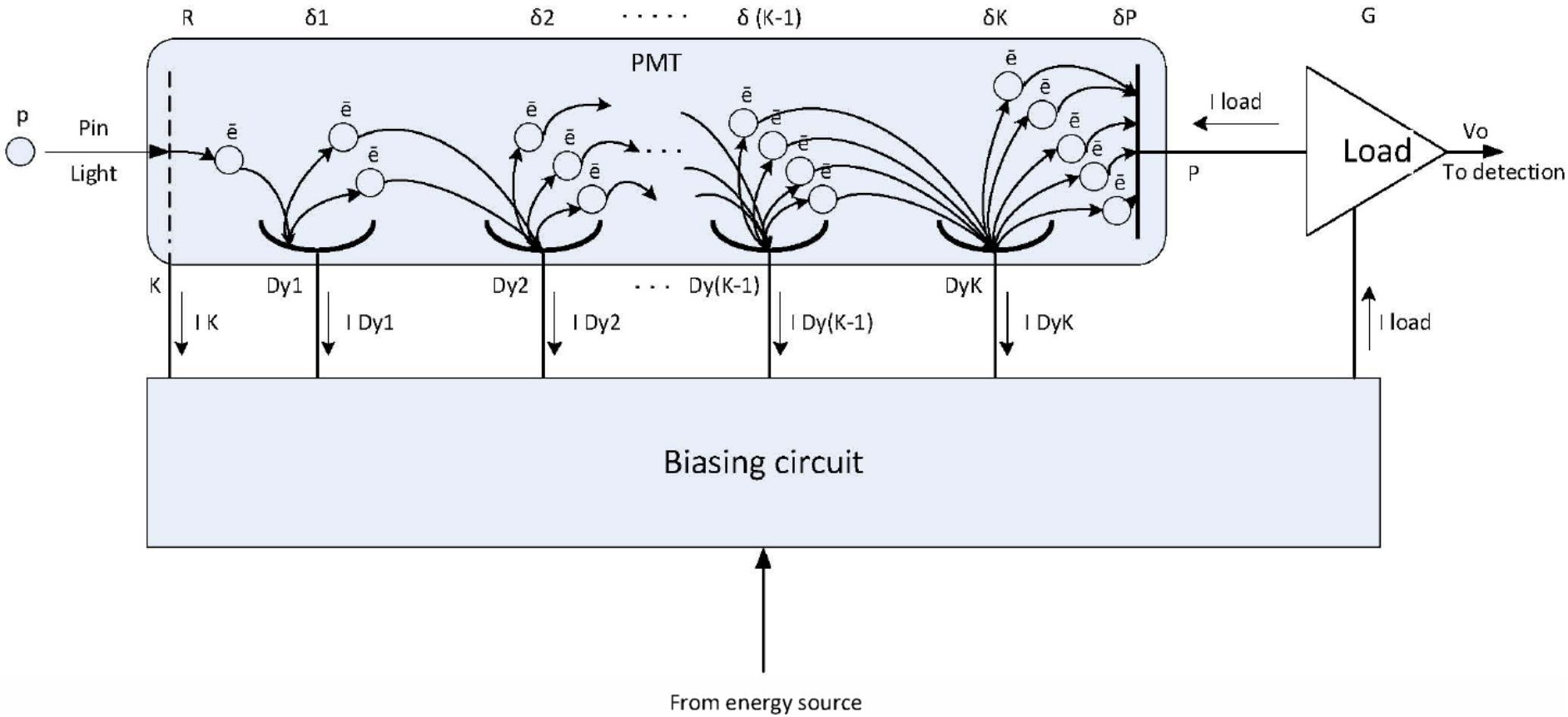




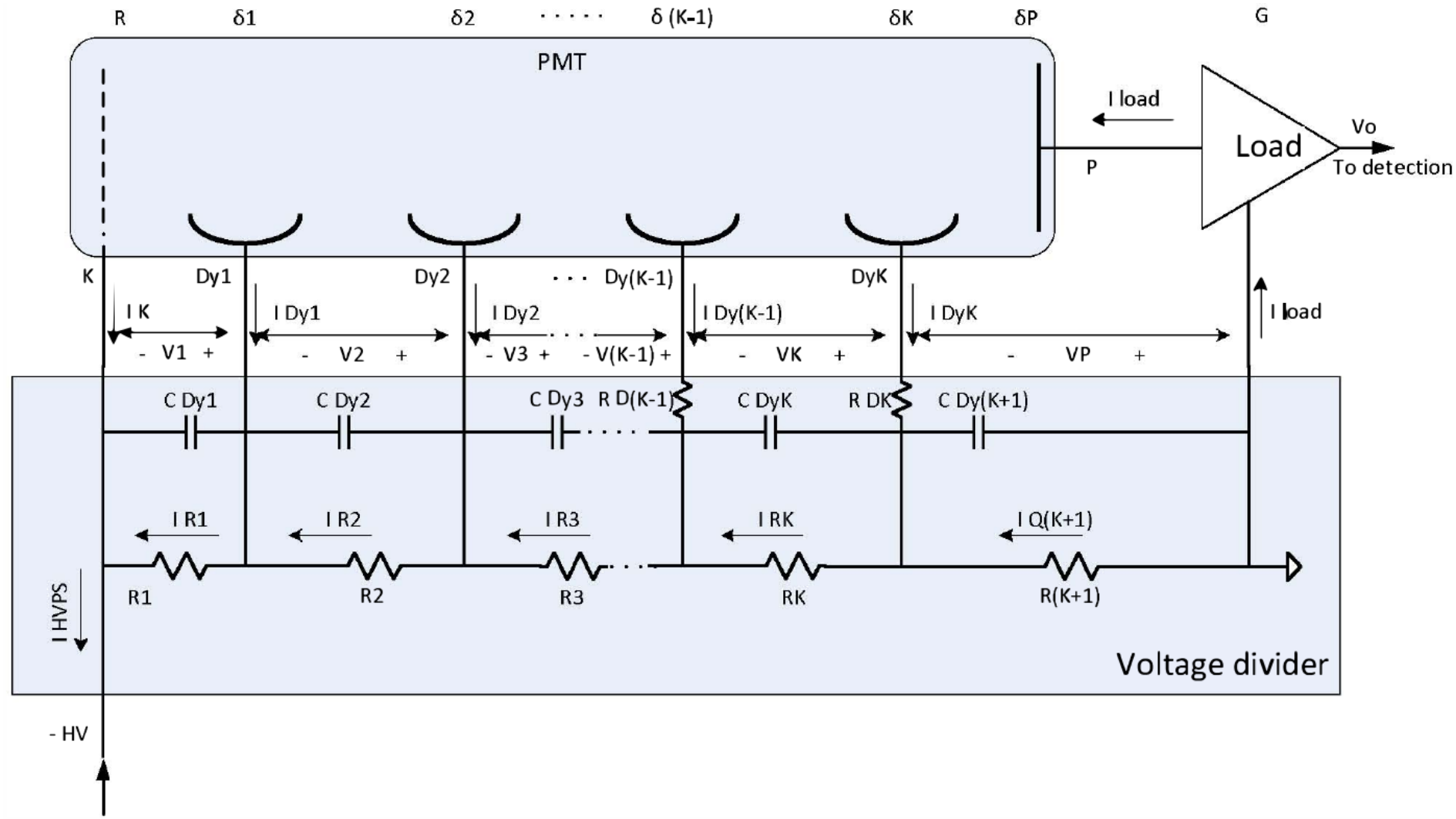




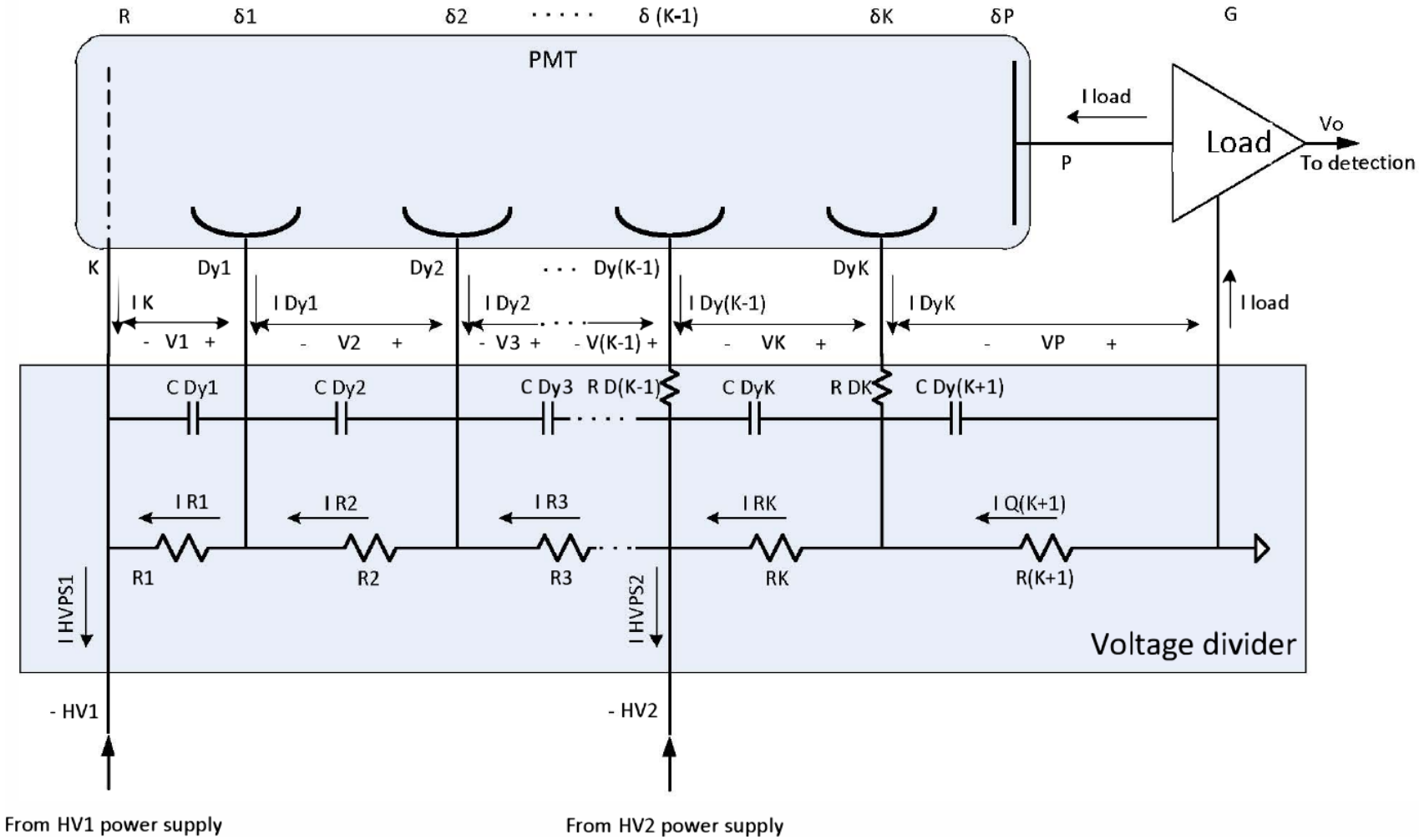
Function of PMT/Voltage Divider



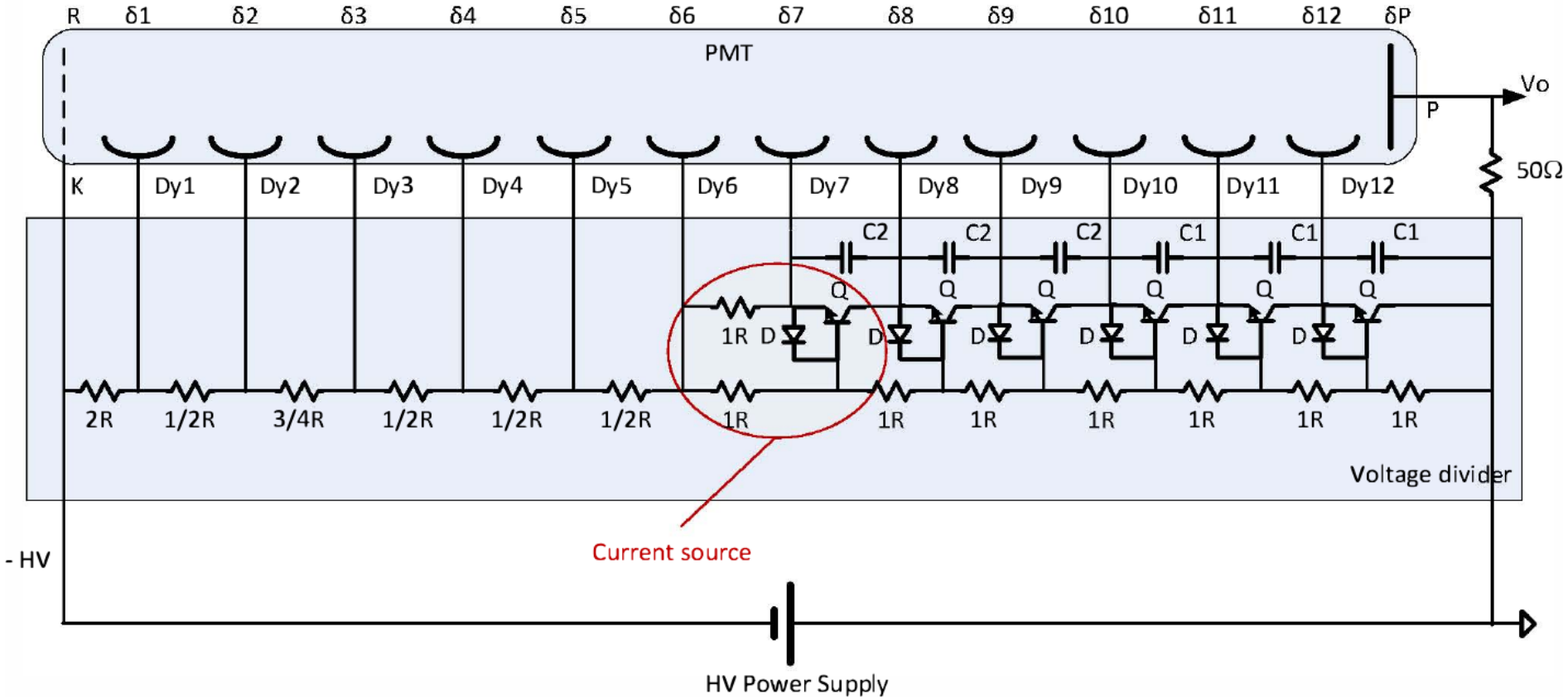
Resistor Voltage Divider



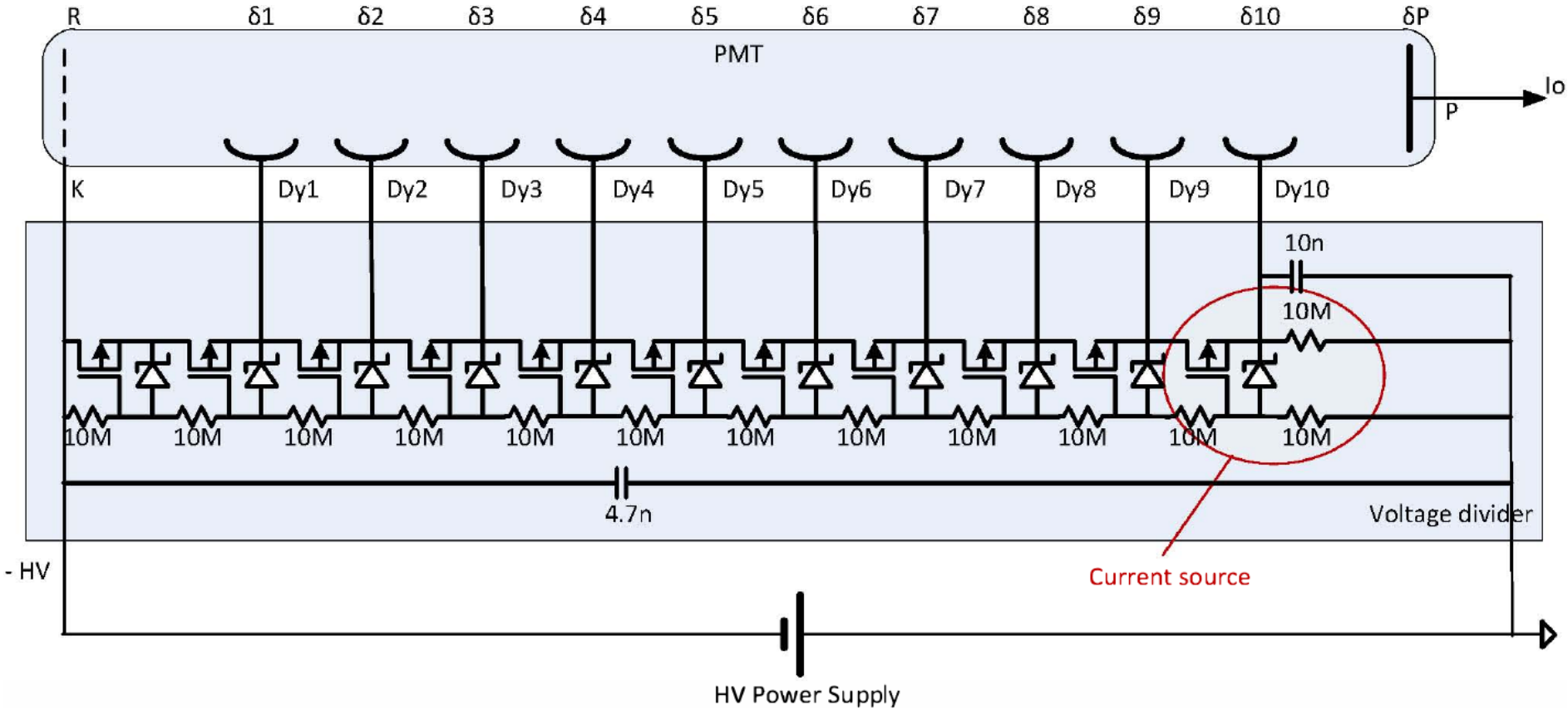
Boosted Resistor Voltage Divider



Semi Active Voltage Divider

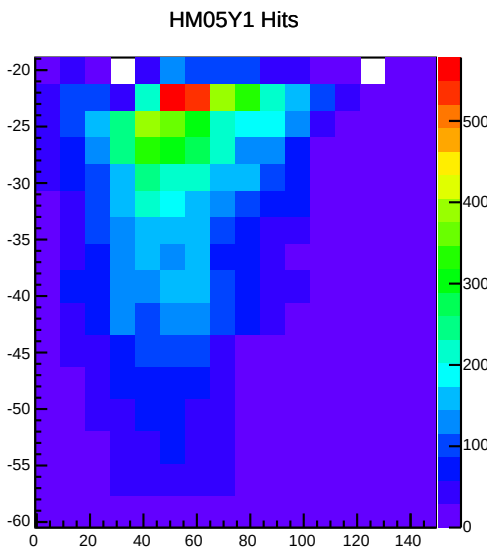


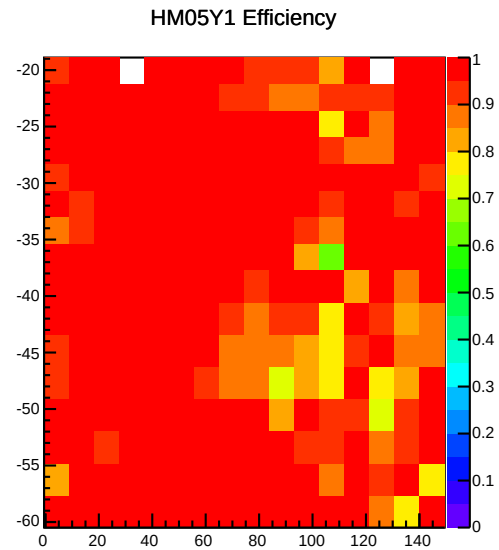
Active Voltage Divider

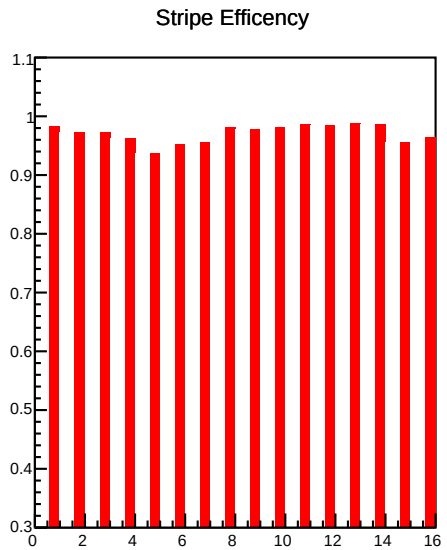


State of Efficiencies for 2016

- Enough statistic to do mu+/mu- separate
  $\rightarrow$ No major differences.
- With normal cuts no statistics in LAST.
- Still no hits in the middle slabs of Outer Hodoscopes, for HO04 also no hits in first and last slab.
- Diffuse inefficencies in middle hodoscopes.





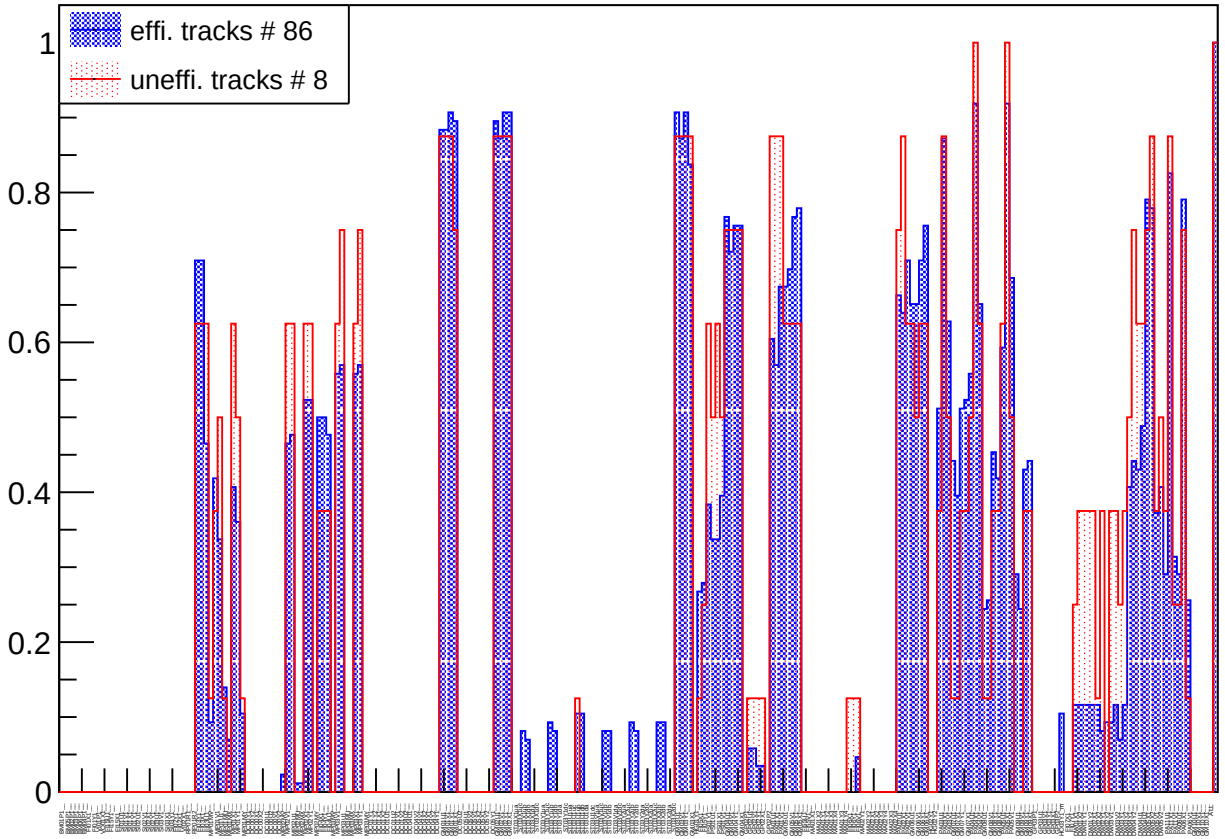


Investigation of Inefficencies of Middle Hodoscopes

Look at the bottom right quadrant of HM05Y1_d (x>115 cm, y<-40 cm)

Compare hits in tracking detectors of efficient and inefficient tracks.

Tracks with hits in detectors



Comparison of COOOL Plots with PHAST Efficiencies:]

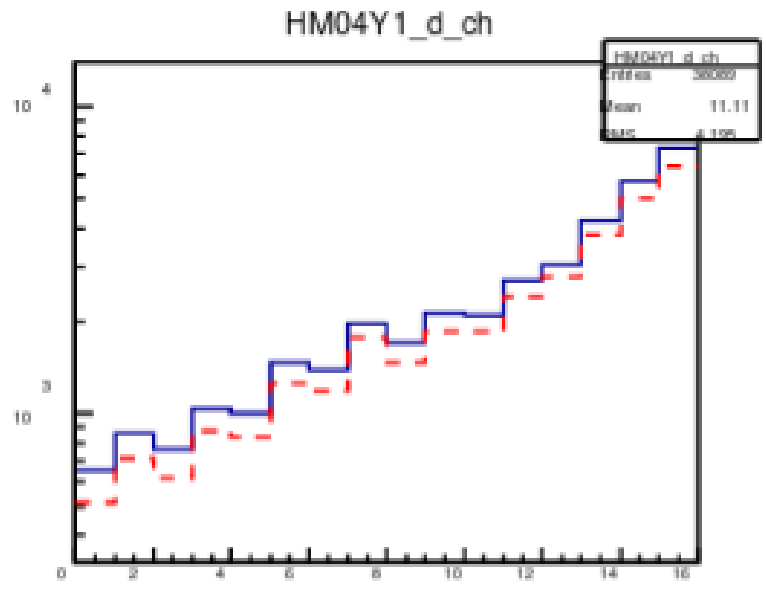
COOOL Plots from RUN276397
(mu+, 100E11 pot, 500 mm BE)

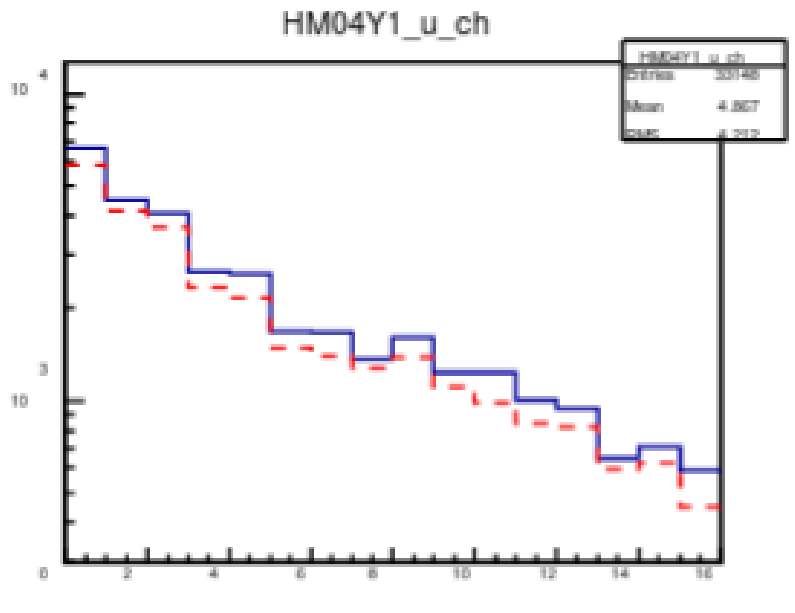
Prescaler setup for run 276396

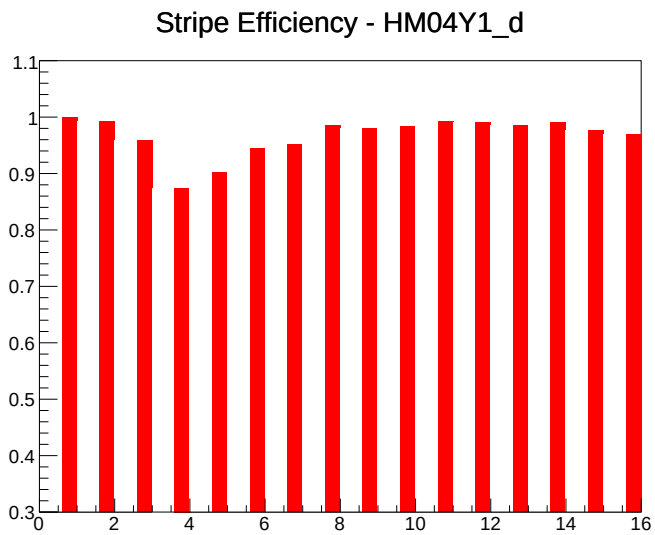
Trigger element	Short name	Division factor	In rate (1st spill)	Out rate (1st spill)
Tiger BT BKVeto	TigerDT0	0	24338425	0
Middle Trigger	MT	1	27810	27778
Ladder Trigger	LT	1	23096	23096
Outer Trigger	OT	1	17853	17853
Calorimeter Trigger	CT	1	12334	12334
Inner Veto	VI	1000	6895905	6896
Halo Trigger (H2 AND H4Outer)	Halo	50	1417810	28357
Beam Trigger	BT	8000	47211653	5902
ECAL0 trigger	ECAL0	0	0	0
LAS Trigger	LAST	1	11503	11503
True Random	TRand	1	16959	16959
Noise Random	NRand	0	1716965	0

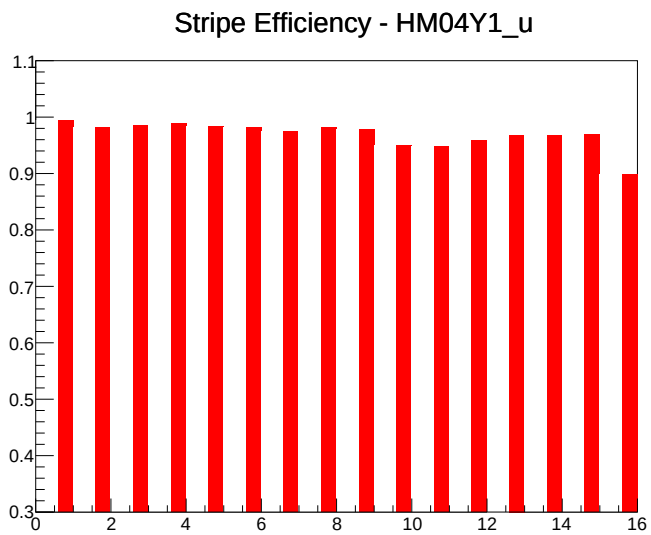
PHAST Effieciencies from RUNS:
274594,274699,274776,274889,274573,274788,274797
mu+/mu- from P7

State at the end of RUN2016 [HM04Y]

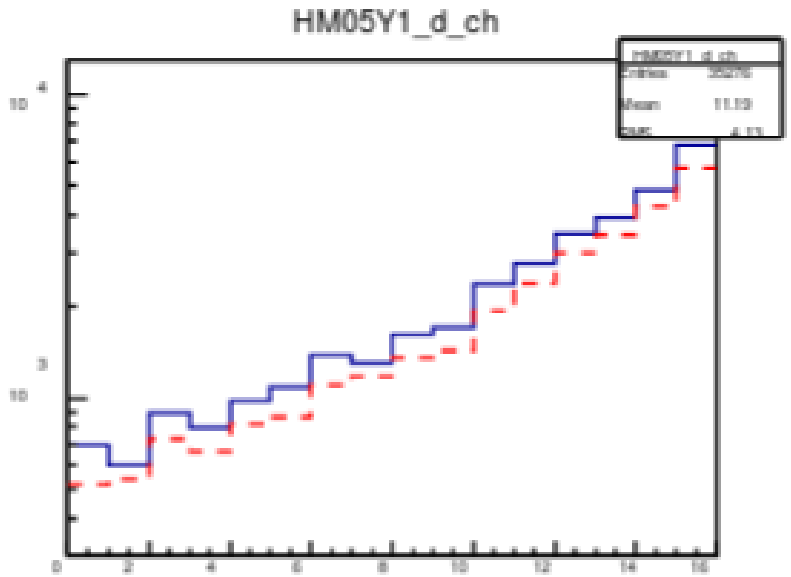


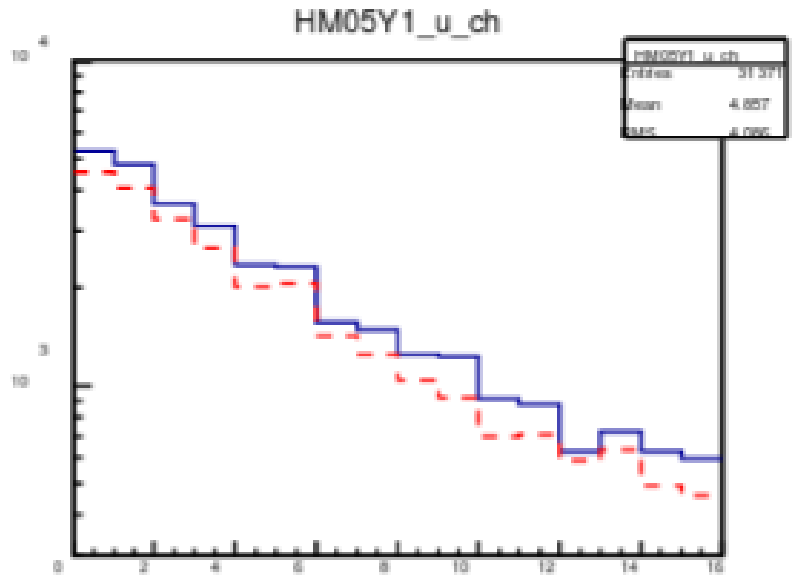


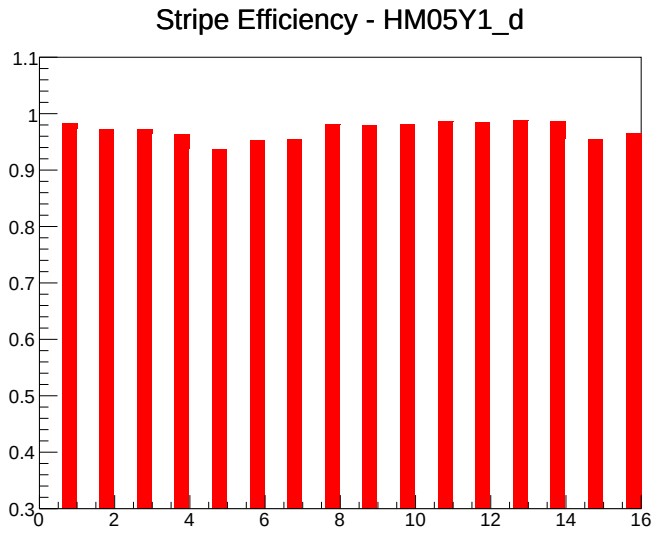


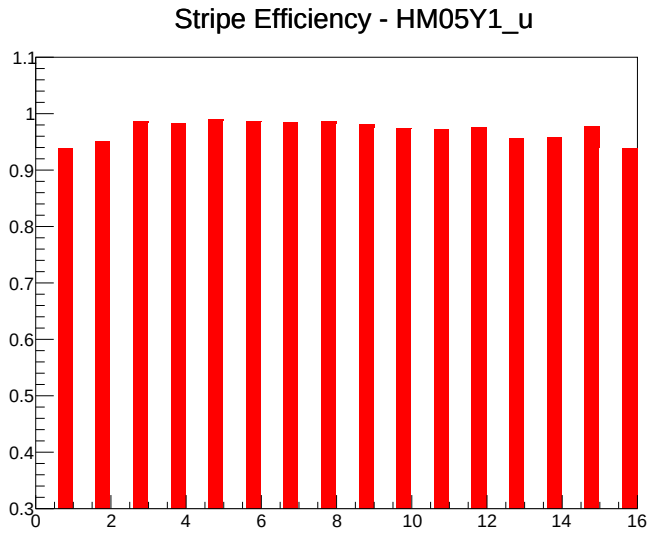


State at the end of RUN2016 [HM05Y]

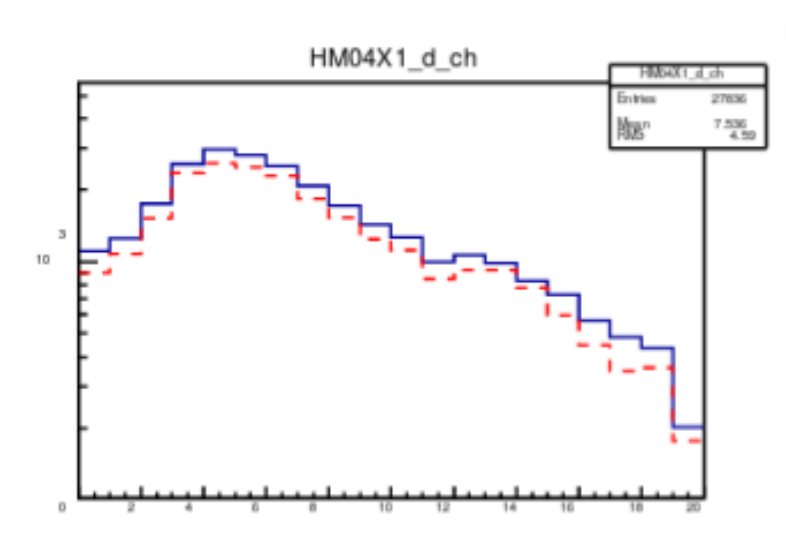


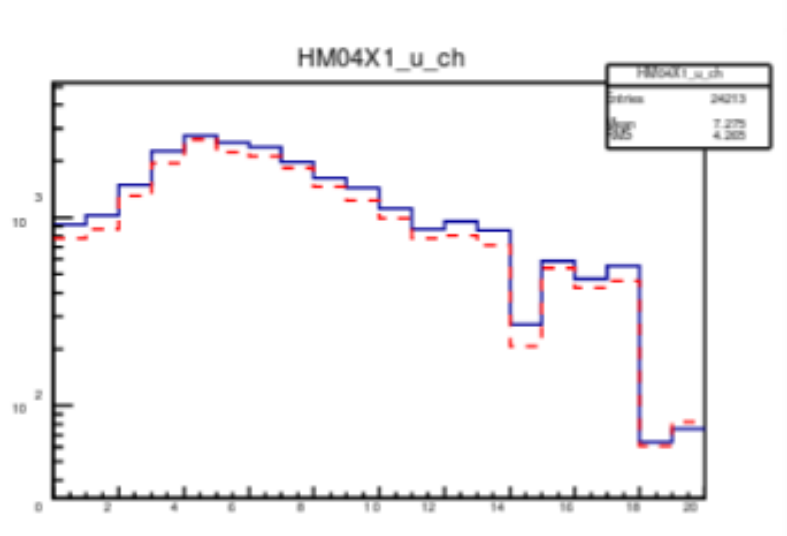


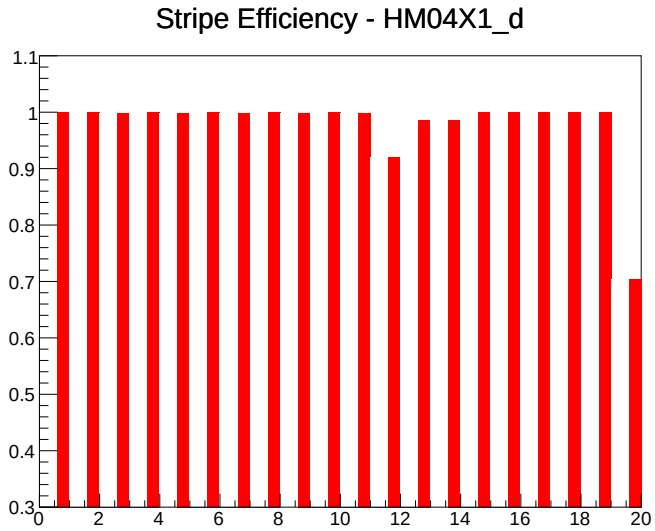


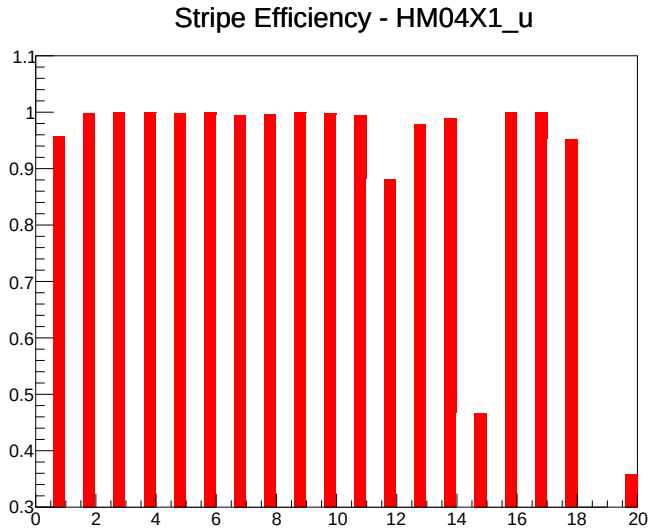


State at the end of RUN2016 [HM04X]

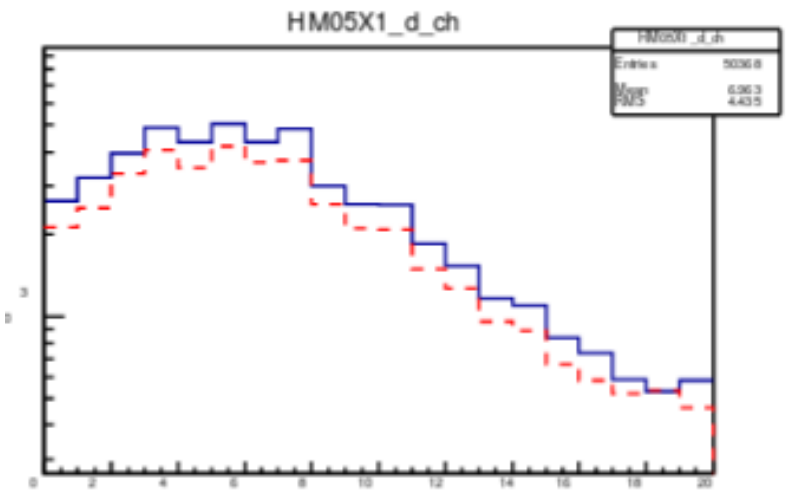


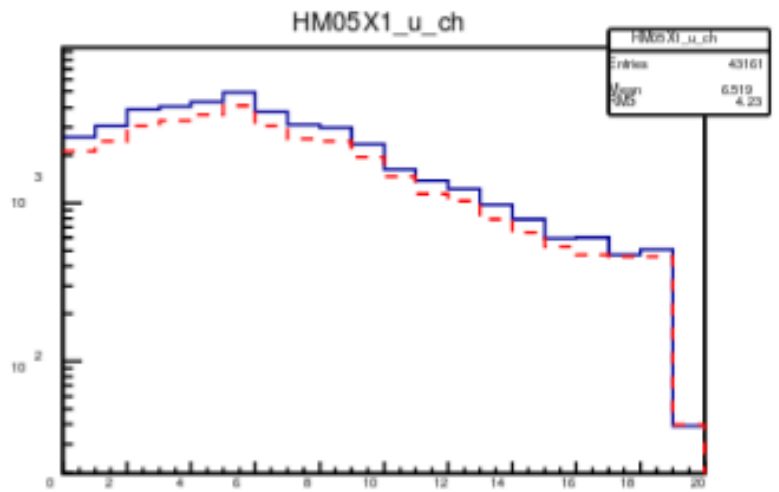


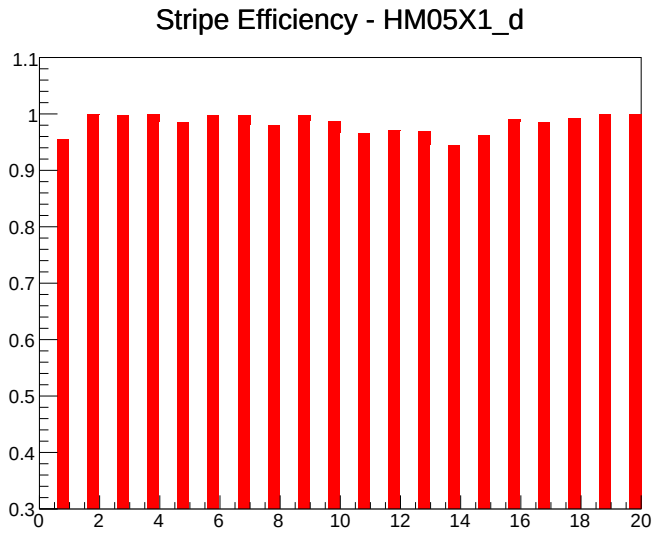


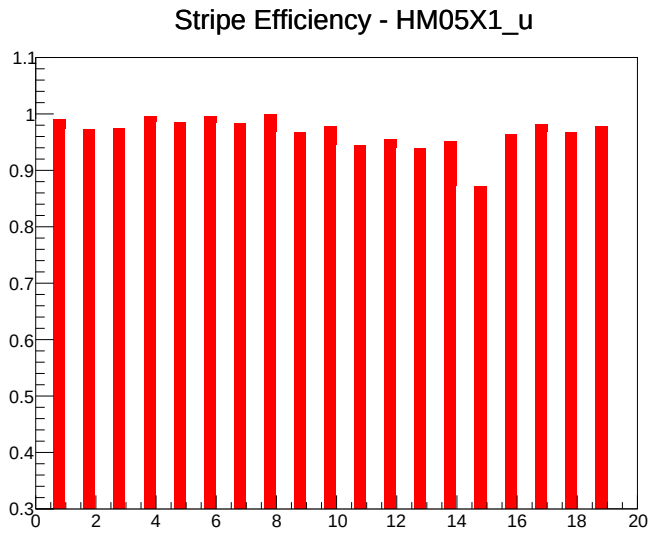


State at the end of RUN2016 [HM05X]

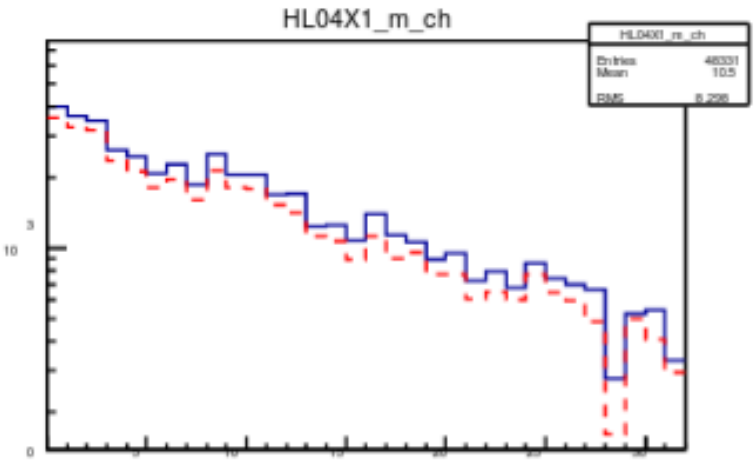


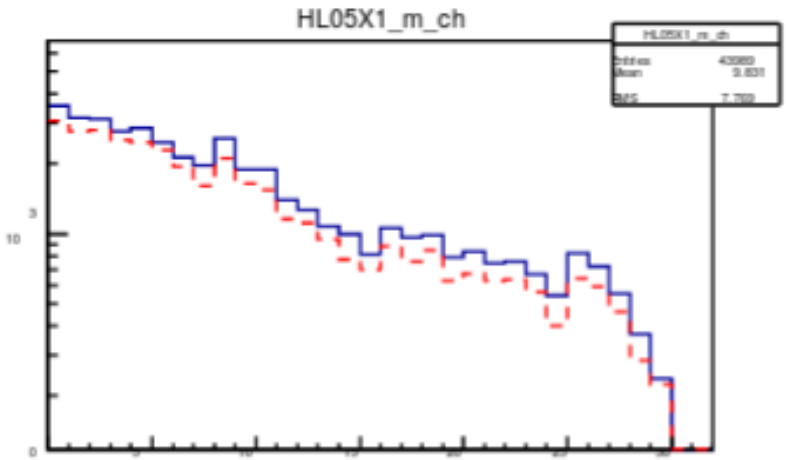


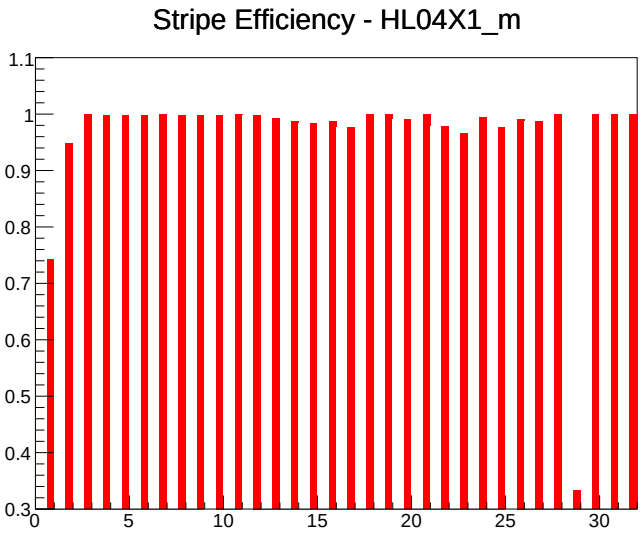


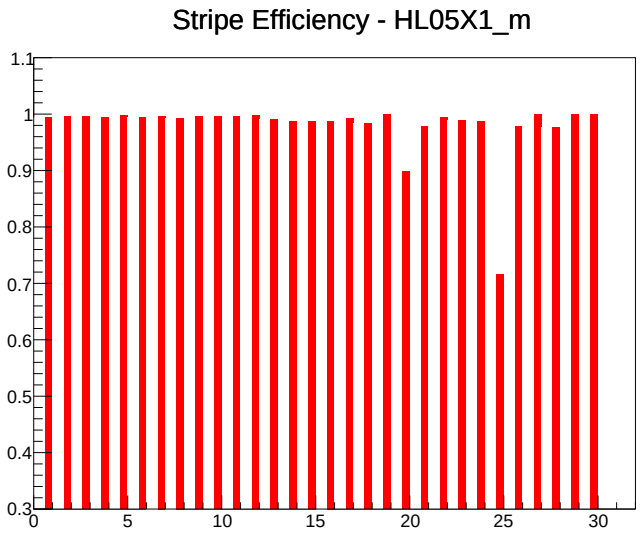


State at the end of RUN2016 [HL]

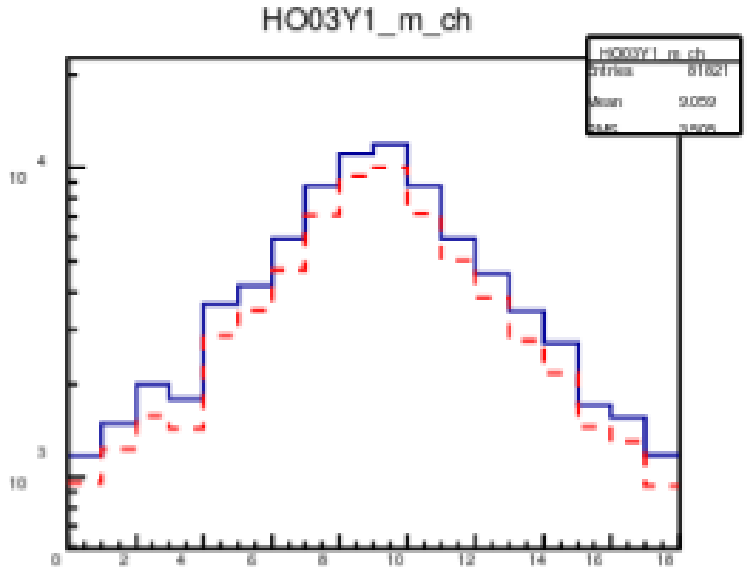




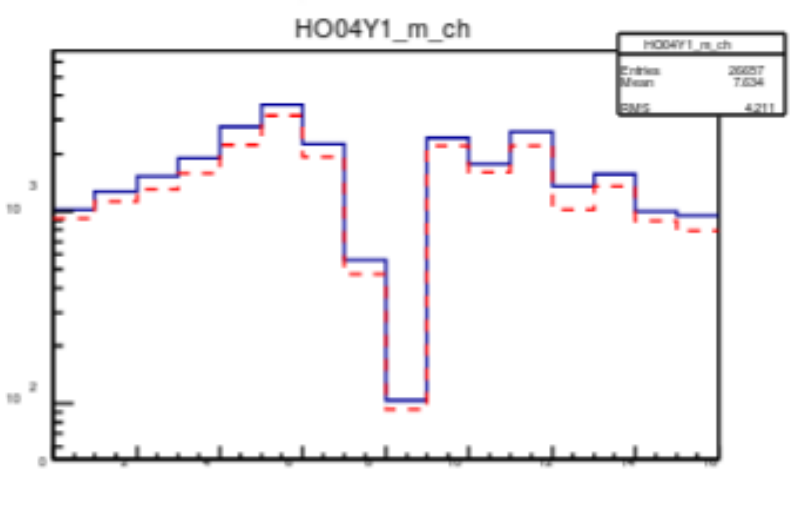


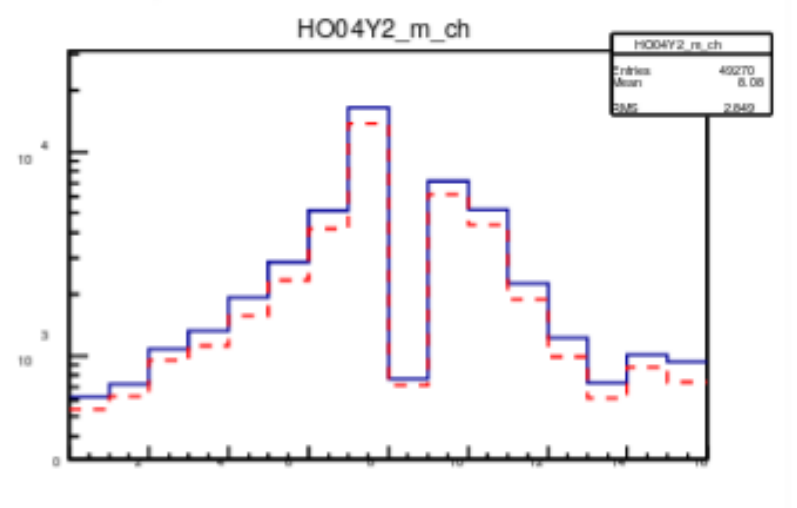


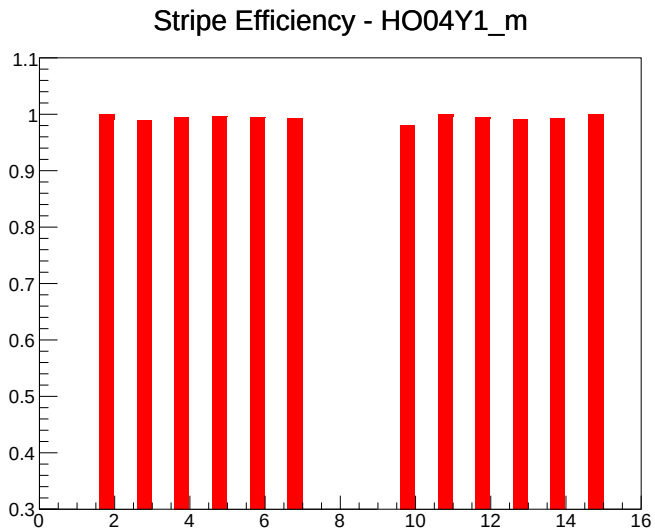
State at the end of RUN2016 [HO03]

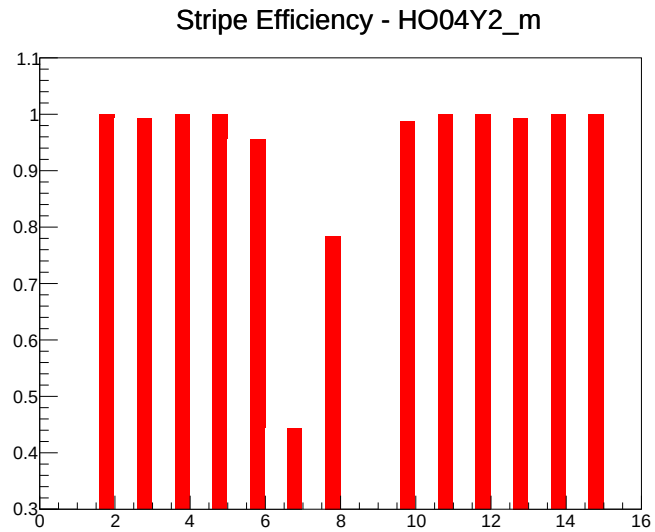


State at the end of RUN2016 [HO04]









Summary: State at the end of RUN2016 [HO04]

MIDDLE Horizontal

0 Channel defect

MIDDLE Vertical

5 Channel defect [4x XP2072, 1x EMI9954B]+ 2Channel strange

LADDER

3 Channel defect [3x XP2020] + 4 Channel strange

OUTER

1 Channel strange + fix inner part

Where is Channel 1+16 of HO4Y1/Y2 in PHAST ?

List of used PMTs and Spare parts:

Typ	Size	# used PMTs	# spare PMTs	# spare Bases	used in Hodo
XP2090	1.5"	32	33	3	HL4/HL5
XP2900	1"	352	12	100+	H1,HL4,HL5,HI4,HMV
EMI9813KB	2"	100	70+	128+	HO03,HO04
XP2072	1.5"	40	28	1	HM04V
9954B	2"	40	1	0	HM05V
XP2020	2"	80	43	100+ CERN Shieldings 0 Ladder 4 Veto	HL4/HL5/VI/Vo/Vbl/Vup/Vdn
9814KB	2"	128	7	8xI 10xA	H2

Planing for Exchange of Outer Bases

HO03

typ	used inner thread	used outer thread
active	4	1
resitor		31

HO04

typ	used inner thread	used outer thread
active	3	12
resitor	3	14

For Exchange: 45 external thread, 3 internal thread

Planing for Scaler Readout

- 15x LVDS Splitter (32ch each) (Thanks to Rainer)
- Need LV Powersupply 3,3V@3A for each Splitter
- 8x CATCH Scaler (32ch each)
- For LAST firmware modification for parallel readout of the scalers ?

Trigger system	Channels	Scaler/Splitter needed
Outer	100	4
Middle Vertical	80	4
Middle Horizontal	128	4
Ladder	128	4
LAST	192	via Gandalf ?
INNER	64	2
Vetos	52	via Gandalf ?
Summe	748	18

3 splitter and 10 scaler still needed

Plans For Changeover 2016/2017 I

- Proper isolation of PMTs and shieldings.
  - Kapton foil between μ-metall shielding and softirone-shielding.
  - Kapton tape between softirone shielding and frame holder.
  - investigation if signal ripple/reflections on long cables
- exchange of resistor bases against new transistor bases in Outer 3/4
- Decrease veto deadtime. Exchange of resistor bases against new transistor bases in VO/VI1/VbI (it is possible for XP2020?)
- HV-Scan of all Hodoscope channels to find the right working point.
- Find out temperature dependency of transition time for old Bases
- Include old Lecroy HV (256 channels) in DCS via DIM.
- Scan of discriminator thresholds and matrix gate length.
- New veto logics on Gandalf (work of John)
- split of all discriminator signals to equip each channel with a scaler

Plans For Changeover 2016/2017 II

- New spare bases for Ladder + Middle
- Add attempts for all physics trigger and delayed veto for all physics trigger to scaler (Request by Andrea)
- Make BeamKiller remote moveable