

# MAROC3 Update

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CLAS12 RICH R&D, 2013 May 3rd, ISS

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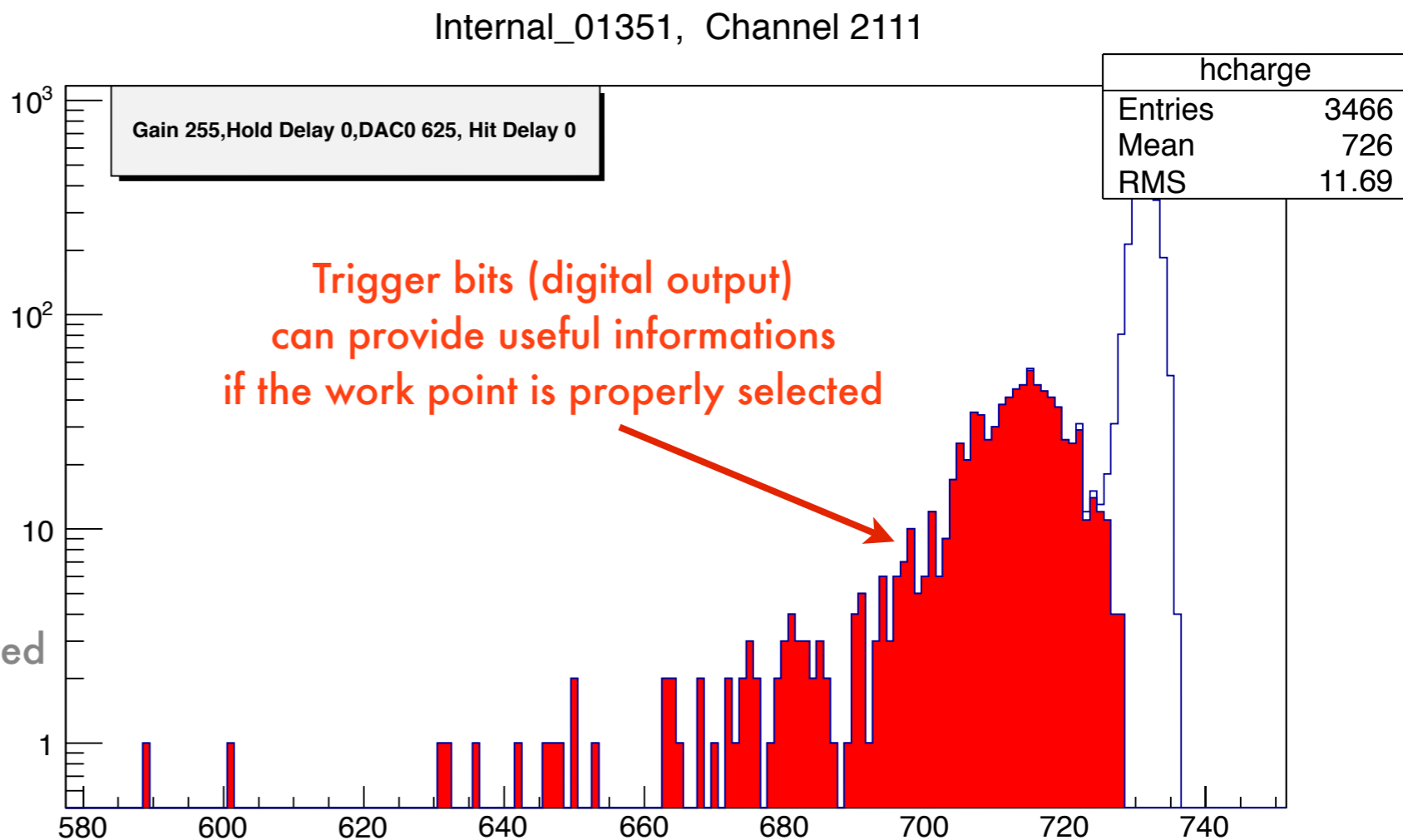
# This week

- Digital Readout
- Dark Current

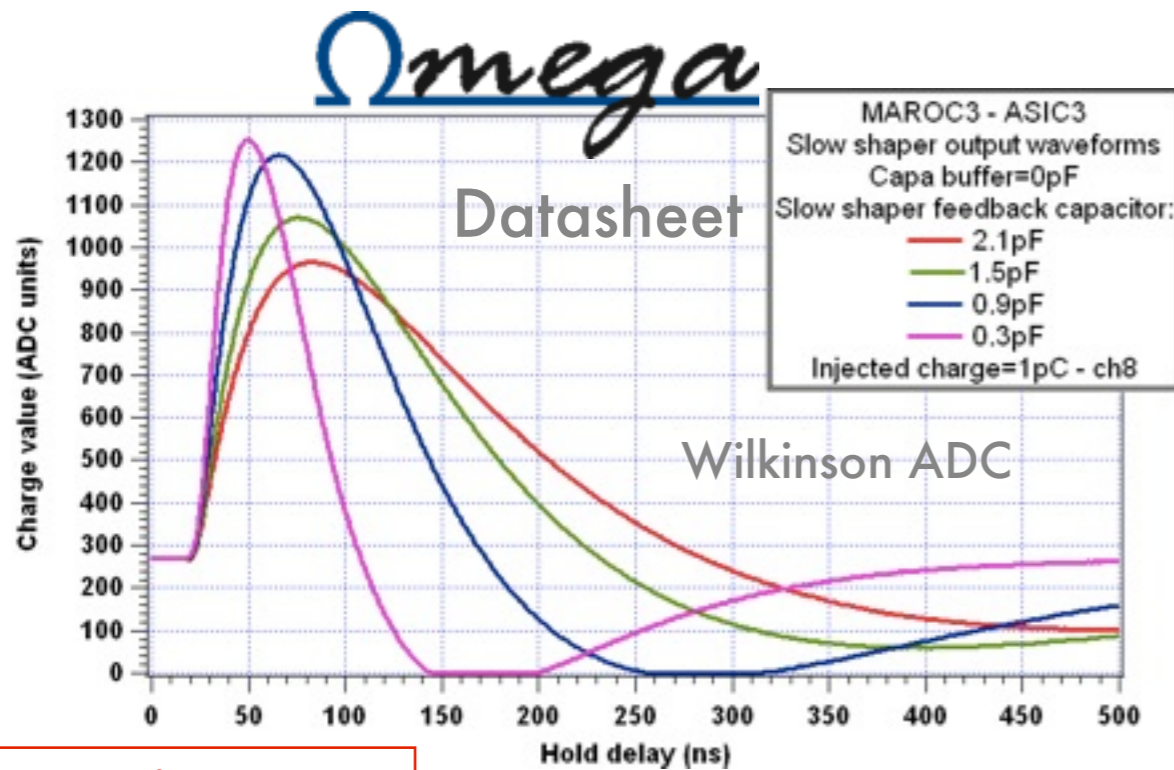
## Dark spectrum Internal Trigger

May 3rd, ISS.

SPE Waveform reconstruction more complicated  
(multiple gaussian fit,...)



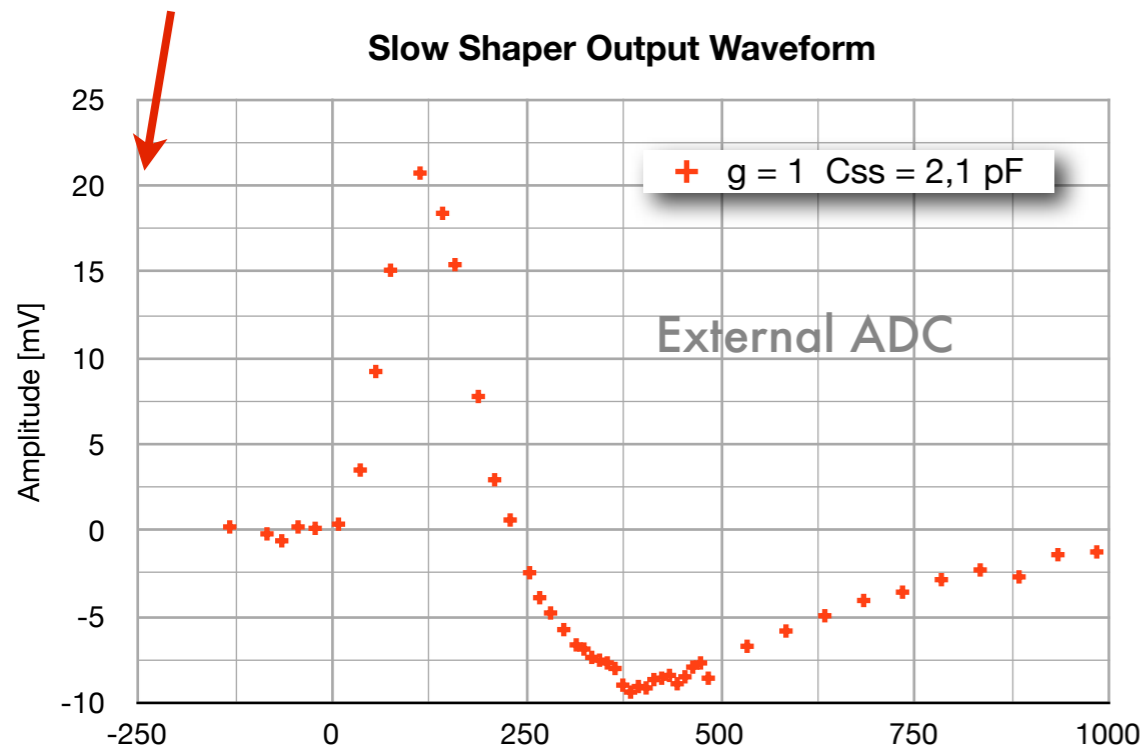
# ...ADC comparison



Datasheet

Wilkinson ADC

y-axis flipped and scaled to pedestal value



Right Polarity is negative

French guys inject +Q or flip the y axis

Test beam data are safe because RICH is intrinsically digital. Dynamic range reduced using undershoot (factor 3)

	Wilkinson	External	Unit	Ratio Ext/Wilk
VLow	800	0	mV	
VHigh	1800	3300	mV	
Range	1	3,3	Volt	3,3
bit	12	12		
LSB	244	806	$\mu$ Volt/ADC	
LSB	0,244	0,806	mV/ADC	
Typ DC level	300	750	ADC	2,5
Typ DC level	73	604	mV	
Typ RMS	2	3	ADC	1,5
Typ RMS	0,5	2,4	mV	
best hold	90	125	ns	
gain	1000	???	ADC/pC	

Injected charge 10 times smaller

100 fC vs 1 pC

# Digital Readout and Dark Current

MAROC provides **individual channel trigger signals**

They are sampled at 80 MHz, filtered and then registered at 40 MHz in a FIFO.

They are extracted with a MUX and added to data (1 event = 64 bit/maroc)

In order to select the sample to be included in the data there are 3 bit (software adjustable) for a maximum delay of 175 ns.

**EXTERNAL TRIGGER:** when the HOLD1 signal arrives at the board the event is readout and added to the dataflow.

**INTERNAL TRIGGER:** the FE FPGA rules on measurements, processing MAROC output and signaling a variation every 25 ns

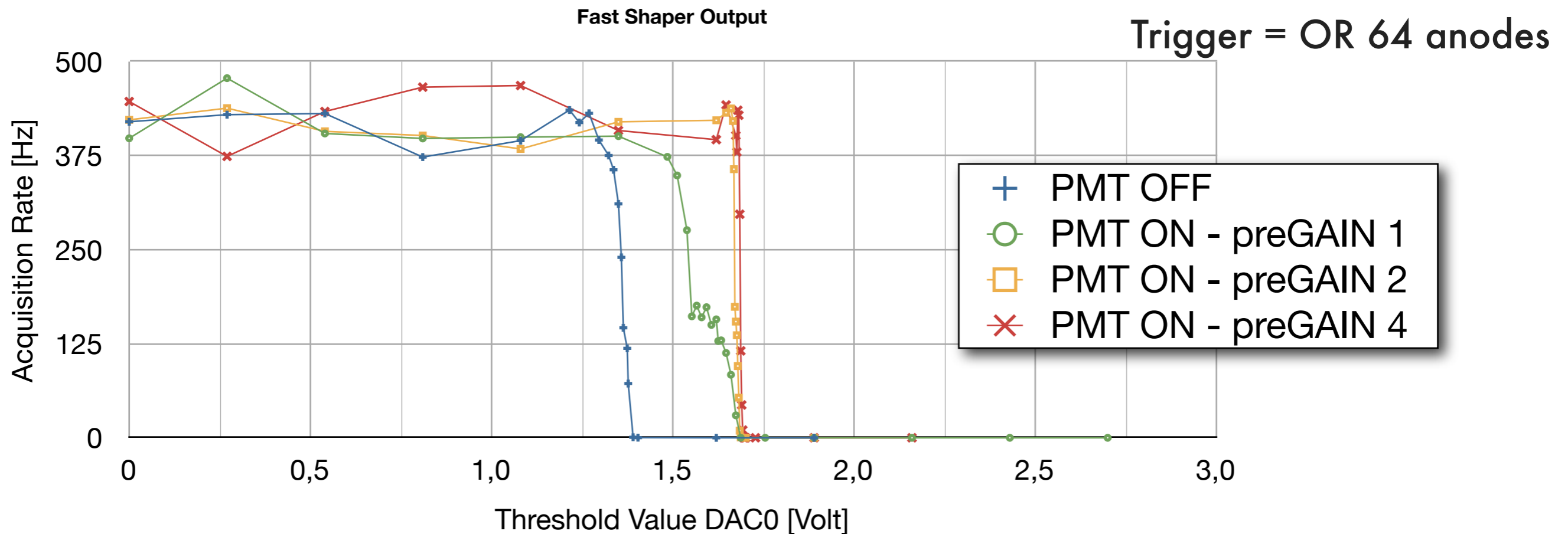
		Dark Current per PMT [Ampere]	Gain at 1000	SPE Amplified Charge [Coulomb]	SPE amplified Charge [pC]	Expected Rate SPE [kHz]	Typical period [micro sec]
ISS	AA2112	9,86E-09	3,280E+06	5,278E-13	0,5	18,7	54
MAINZ	CA4129	1,43E-09	3,250E+06	5,229E-13	0,5	2,7	366

## H8500 Dark Rate 0,5k÷20k Hz

Just because the probability depends on interval (cps x 10 ns) it is extremely difficult to see dark pulses in external trigger.

With **MAROC** we must work in **autotrigger mode** this is interesting because deals with MAROC **digital output properties**

# Trigger Efficiency Curves



## Fast Shaper output:

1. 50% blue curve defines DC level
2. Horizontal differences related to amplitude (thermal pe around 500 mV)

Green curve bump could be an estimation of the dark rate (...)

Green curve point 270 Hz, 1,6 Volt is the spectrum on slide 2

Yellow and Red curves are saturated (to be understood...)

# Dark Current at CERN

No data with internal trigger

We can use alignment runs  
excluding pmt on the beam

# Conclusion

- The work on digital readout is just started
- Charge injector instead of Laser +PMT (also useful for crosstalk study)
- DAC Threshold accurated enough at SPE
- Trigger bits reliable  $\Leftrightarrow$  work point calibration
- With a slightly faster readout should be possible to measure dark rate with MAROC-INFN electronics