RICH testbeam 2012

MaPMT R11265 vs MaPMT R7600

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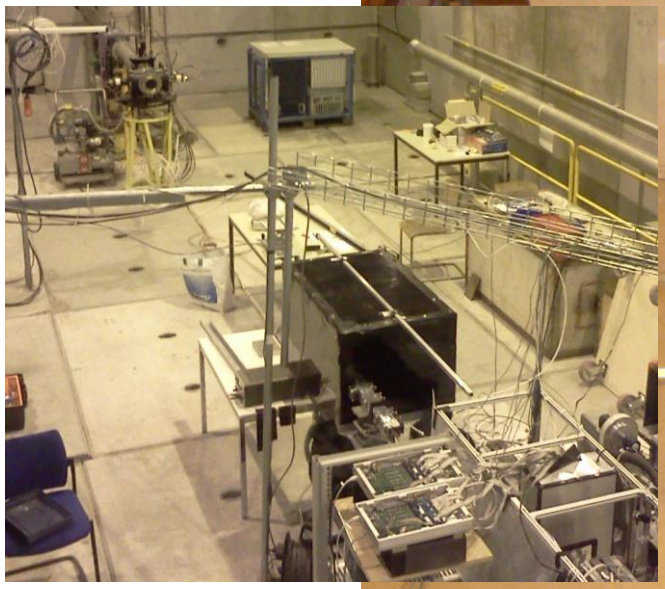
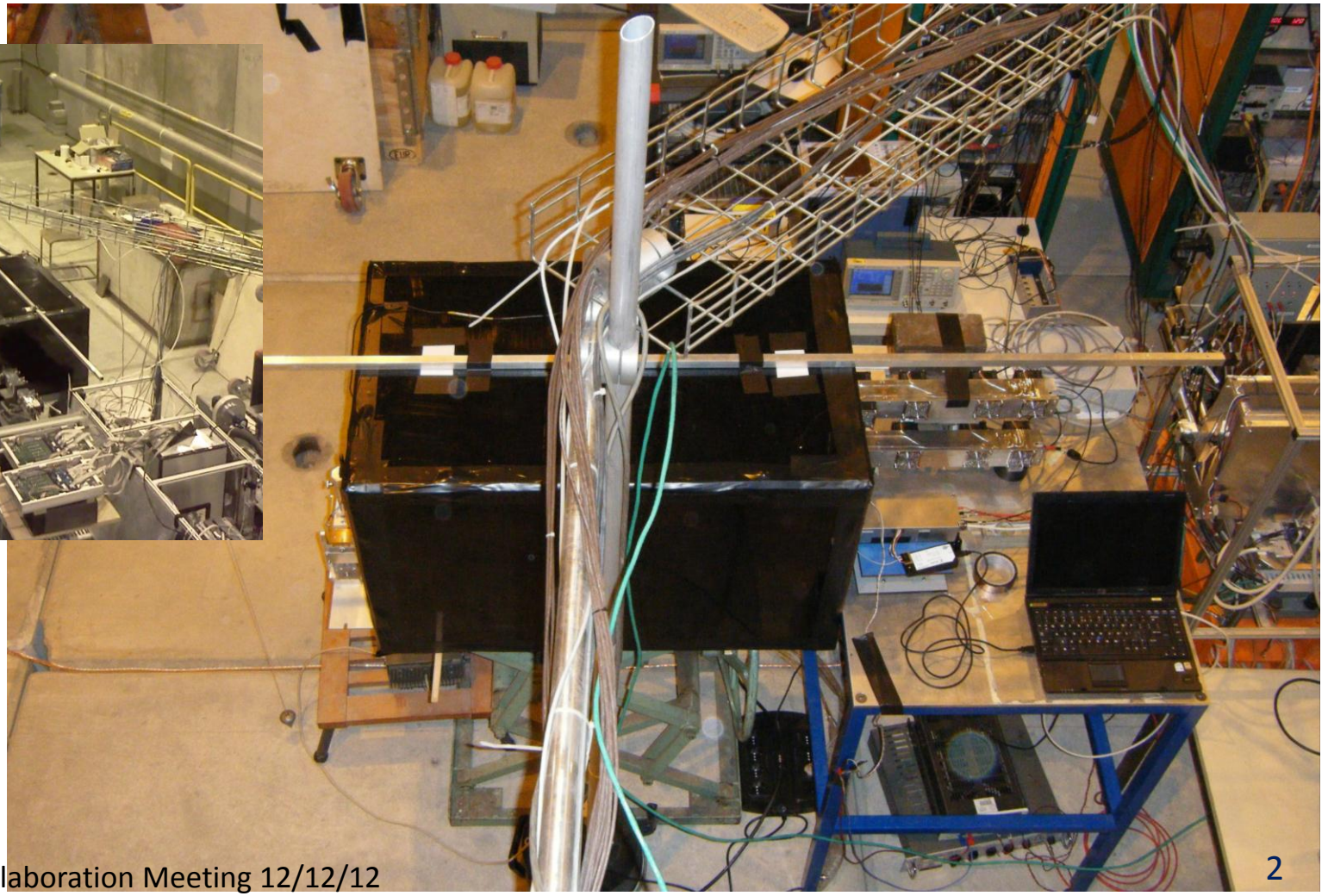
The Set-Up and Configuration

The configuration used is a **RICH in proximity focus** with **solid radiator** (aerogel or quarz) built in a light tight box (Made by **Roberto Mazza**).
Two scintillators are used in coincidence to generate the external trigger.



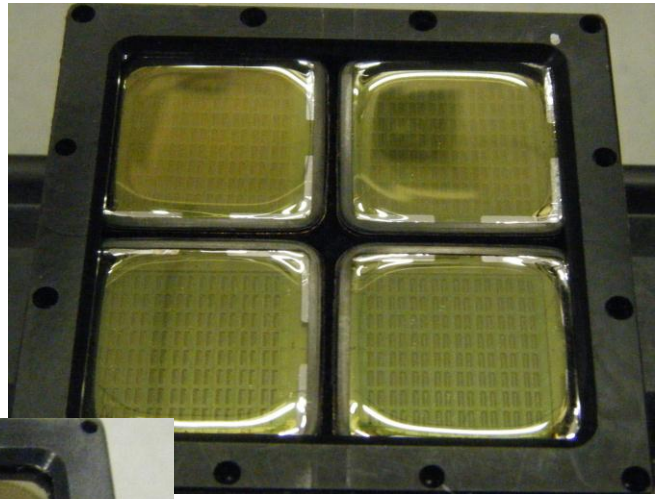


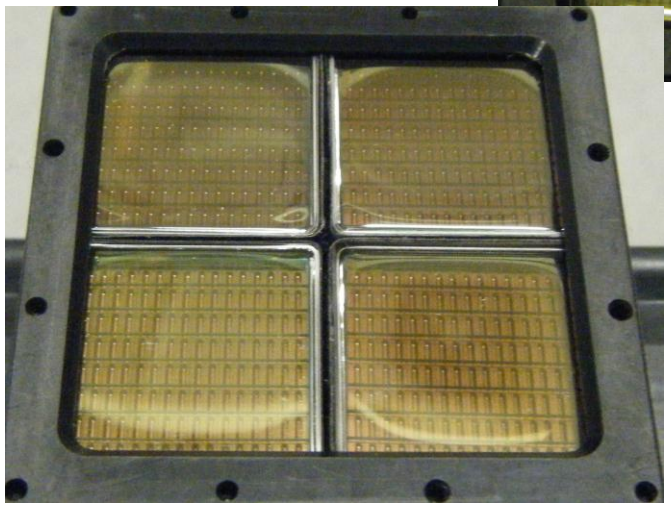
Read-Out: Uviscope 2x2

Uviscope is a read-out system designed for the photomultiplier Hamamatsu MaPMT R7600-M64. It's developed by the Italian Institute of Space Astrophysics and Cosmic Physics in Palermo (IASF Palermo - **Gaetano Agnetta** and **Francesco Russo**).

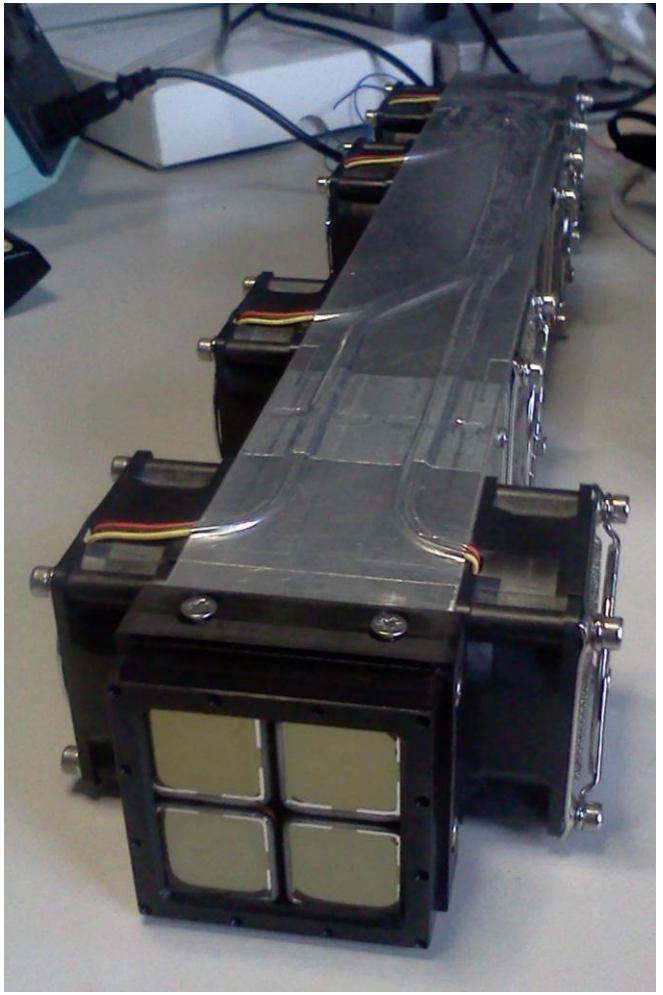
For the RICH testbeam we have two Uviscope 2x2:

4 MaPMTs
R7600-03-M64:
Window: UV glass
Cathode: Bialkali





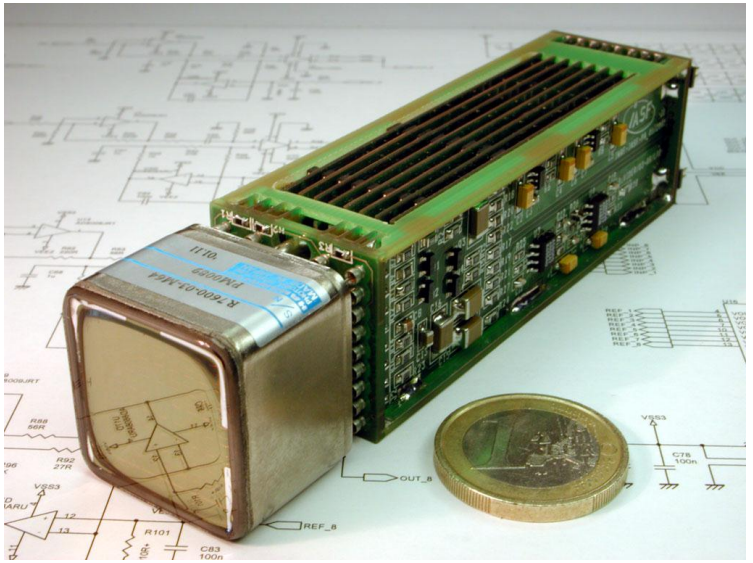
4 MaPMTs
R11265-103-M64:
Window: UV glass
Cathode: SuperBialkali



Febrick Readout

FEBrick (Front-End brick) is a read-out system designed as “single photoelectron detection” front-end for the photomultiplier Hamamatsu MaPMT R7600-M64.

The FEBrick system is developed by the Italian Institute of Space Astrophysics and Cosmic Physics in Palermo (IASF Palermo).



64 Single Photon Counting front-end channels for 64 anode outputs.
64 shaped outputs for digital sampling acquisition (up to 200MS/s);
7ns accuracy amplifier & discriminator chain for each channel;
Fast differential analog amplifier (fast charge integrator) for last dynode, fast ADC conversion and sampling acquisition;
Low power active high voltage divider, 5µA quiescent current;
Up to 1KVolt programmable high voltage, 0.5 Volt step;
HV and Last Dynode ADC converters and registers for continuous voltage output monitor;
64 independent channel with programmable threshold;
Internal temperature sensor register for continuous value output monitor;
Cross talk below 1%.

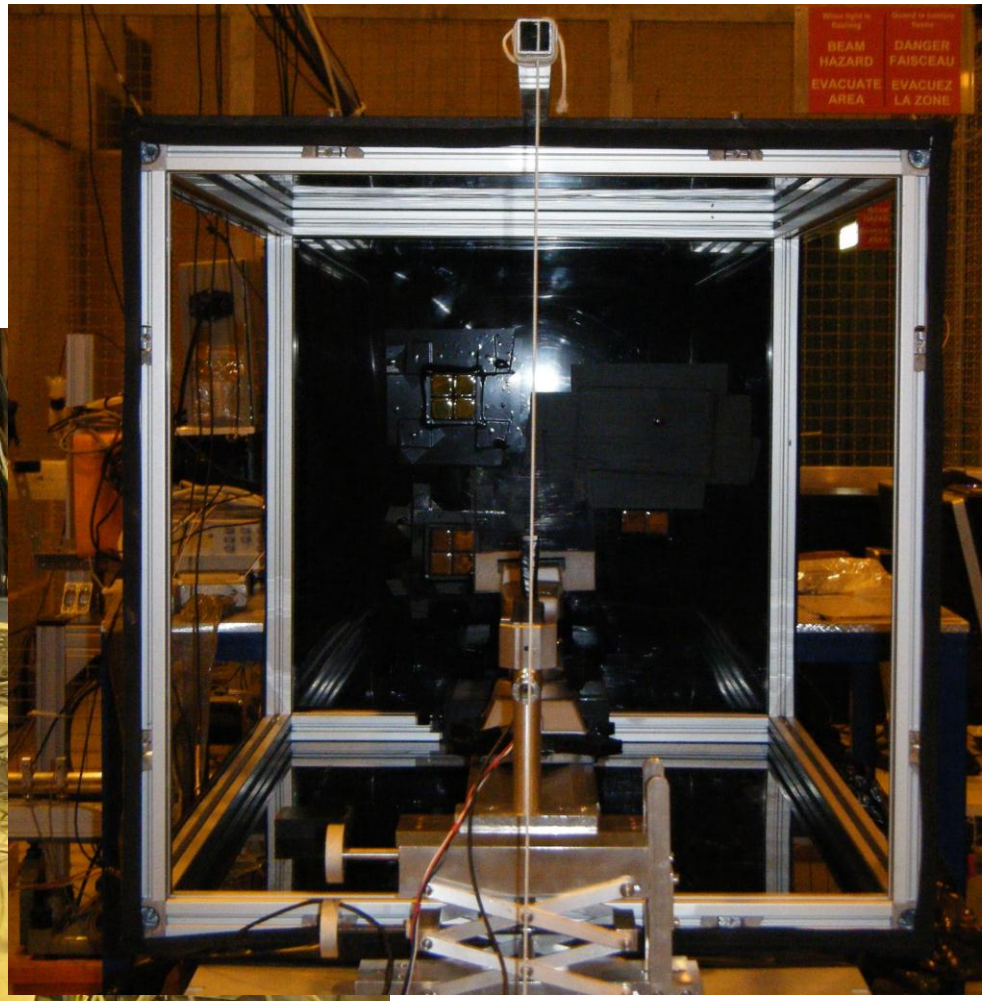
HAMAMATSU R11265 vs R7600

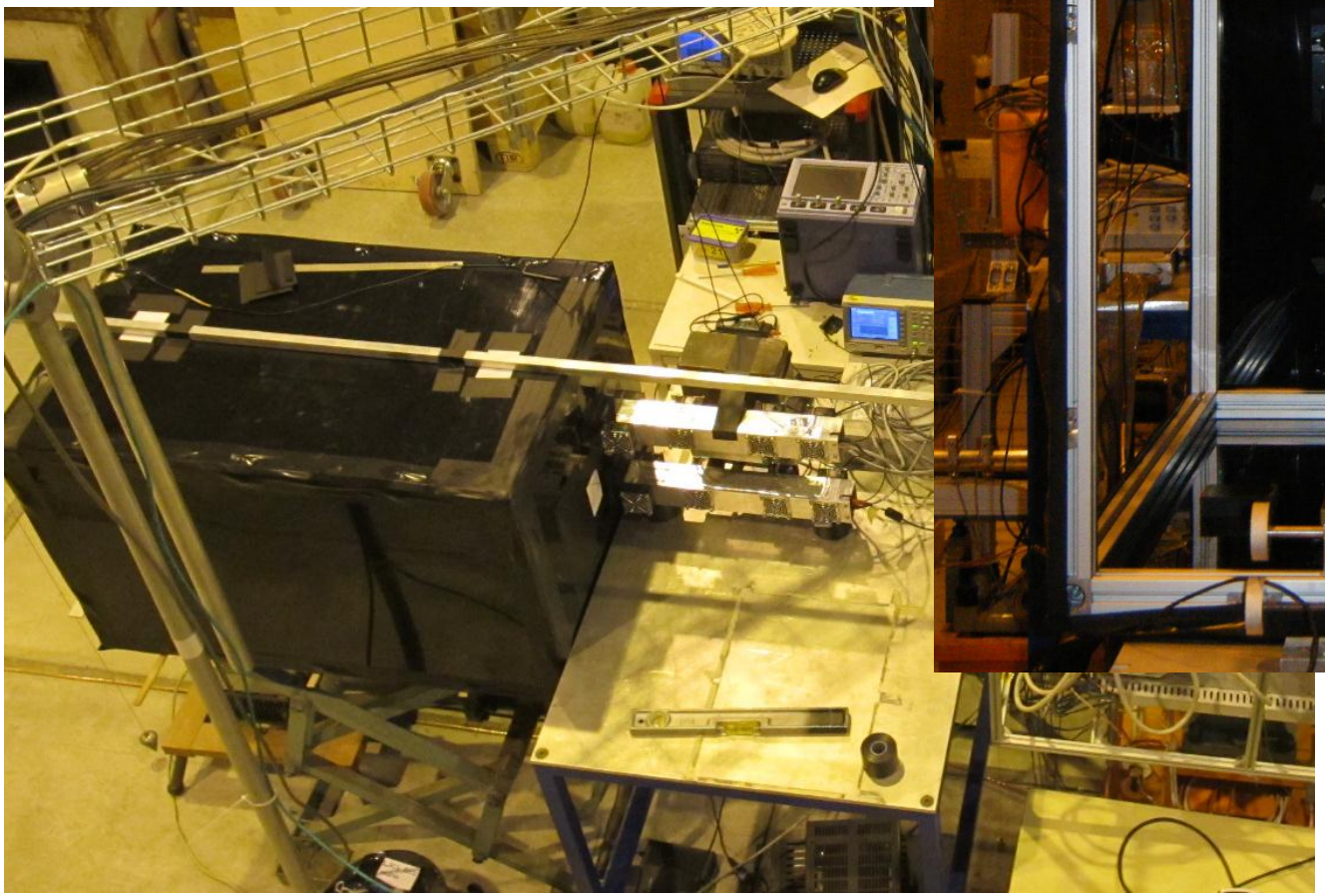
Comparison from Hamamatsu Data Sheets
The characteristics of R11265 are very close to those of R7600
The main difference is the improved active area

	R11265	**R7600**
Spectral Response Range	185-650 nm	185-650 nm
Window Material / Thickness	UV glass / 0.8 mm	UV glass / ND
Geometrical Dimensions	26.2 x 26.2 mm^2	25.7 x 25.7 mm^2
Photocathode Minimum Effective Area	23 x 23 mm^2 (>80%)	18.1 x 18.1 mm^2 (≈50%)
Number of Pixels / Dimensions	64 / 2.9 x 2.9 mm^2	64 / 2.0 x 2.0 mm^2
Photocathode Material	Super Bialkali	Bialkali
Number of Dynodes	12	12
Maximum Supply Voltage	1100 V	1000 V
Gain	1 x 10^6 at 1000V	0.6 x 10^6 at 800V
Anode Dark Current (Each anode)	0.4 nA	0.2 nA
Rise / Transit Time	0.6 / 5.1 ns	1.0 / 12 ns
Uniformity Between Each Anode	1 : 3	1 : 2.5

The 15 nov – 23 nov period activity

Comparison of the two matrix 2x2 of MaPMTs using only one configuration:
AEROGEL (n=1.03) radiator 10x10x1cm^3
Radius of ring 12cm
Every matrix 2x2 cover about 7% of the ring





The 15 nov – 23 nov period activity

The number of dark events (and electronic noise) are comparables

R11265: 3049 – 234 – 352 – 440 Hz

Sum of Acq Unit 0 Integration Channel Counters value: 3049 (RAW)
Acq Unit 0 Integration Channel Counters's values (RAW):

Items	(+00)	(+01)	(+02)	(+03)	(+04)	(+05)	(+06)	(+07)
(+00)	22	7	7	7	14	13	18	18
(+08)	16	3	7	10	10	5	11	7
(+16)	12	8	3	7	5	3	3	4
(+24)	9	3	8	8	7	6	4	3
(+32)	9	1	7	12	5	13	8	8
(+40)	9	8	9	8	16	8	7	4
(+48)	19	15	17	14	18	30	12	14
(+56)	81	18	19	257	793	814	440	88

Sum of Acq Unit 1 Integration Channel Counters value: 234 (RAW)
Acq Unit 1 Integration Channel Counters's values (RAW):

Items	(+00)	(+01)	(+02)	(+03)	(+04)	(+05)	(+06)	(+07)
(+00)	2	0	0	3	2	0	0	1
(+08)	5	2	5	3	1	5	2	7
(+16)	5	1	4	8	3	8	3	1
(+24)	6	4	2	2	4	2	1	1
(+32)	4	1	3	3	2	2	1	4
(+40)	7	3	4	4	1	2	1	3
(+48)	16	14	9	1	4	2	5	0
(+56)	27	13	3	0	1	1	0	0

Sum of Acq Unit 2 Integration Channel Counters value: 352 (RAW)
Acq Unit 2 Integration Channel Counters's values (RAW):

Items	(+00)	(+01)	(+02)	(+03)	(+04)	(+05)	(+06)	(+07)
(+00)	11	9	5	8	5	3	6	8
(+08)	8	10	4	5	1	5	4	6
(+16)	10	6	1	4	1	7	4	5
(+24)	5	2	4	0	5	4	7	7
(+32)	0	9	1	3	2	1	5	8
(+40)	2	2	3	5	10	5	5	4
(+48)	5	5	4	8	2	8	4	4
(+56)	23	7	10	13	8	4	9	3

Sum of Acq Unit 3 Integration Channel Counters value: 440 (RAW)
Acq Unit 3 Integration Channel Counters's values (RAW):

Items	(+00)	(+01)	(+02)	(+03)	(+04)	(+05)	(+06)	(+07)
(+00)	12	13	6	1	10	12	9	7
(+08)	19	9	6	2	0	5	7	5
(+16)	12	7	8	2	8	3	1	4
(+24)	10	7	5	4	3	6	2	6
(+32)	5	2	6	4	2	7	1	4
(+40)	2	6	8	5	4	6	1	9
(+48)	9	3	4	9	8	6	4	5
(+56)	24	11	12	12	20	13	8	9

R7600: 141 – 239 – 834 – 222 Hz

Sum of Acq Unit 0 Integration Channel Counters value: 141 (RAW)
Acq Unit 0 Integration Channel Counters's values (RAW):

Items	(+00)	(+01)	(+02)	(+03)	(+04)	(+05)	(+06)	(+07)
(+00)	7	3	4	1	2	2	1	4
(+08)	2	1	0	0	0	1	5	2
(+16)	1	1	3	1	2	1	2	3
(+24)	3	0	0	0	0	3	0	4
(+32)	3	0	0	0	1	0	1	3
(+40)	2	2	0	0	0	3	1	4
(+48)	0	0	0	0	2	2	1	6
(+56)	10	5	0	0	3	9	7	17

Sum of Acq Unit 1 Integration Channel Counters value: 239 (RAW)
Acq Unit 1 Integration Channel Counters's values (RAW):

Items	(+00)	(+01)	(+02)	(+03)	(+04)	(+05)	(+06)	(+07)
(+00)	6	11	2	4	3	3	2	7
(+08)	4	1	2	0	0	0	1	3
(+16)	6	2	0	0	0	1	1	5
(+24)	3	0	1	0	1	2	0	2
(+32)	18	5	0	0	1	2	0	1
(+40)	3	2	4	0	1	1	2	3
(+48)	11	6	3	1	3	6	3	1
(+56)	20	13	10	15	9	8	6	8

Sum of Acq Unit 2 Integration Channel Counters value: 834 (RAW)
Acq Unit 2 Integration Channel Counters's values (RAW):

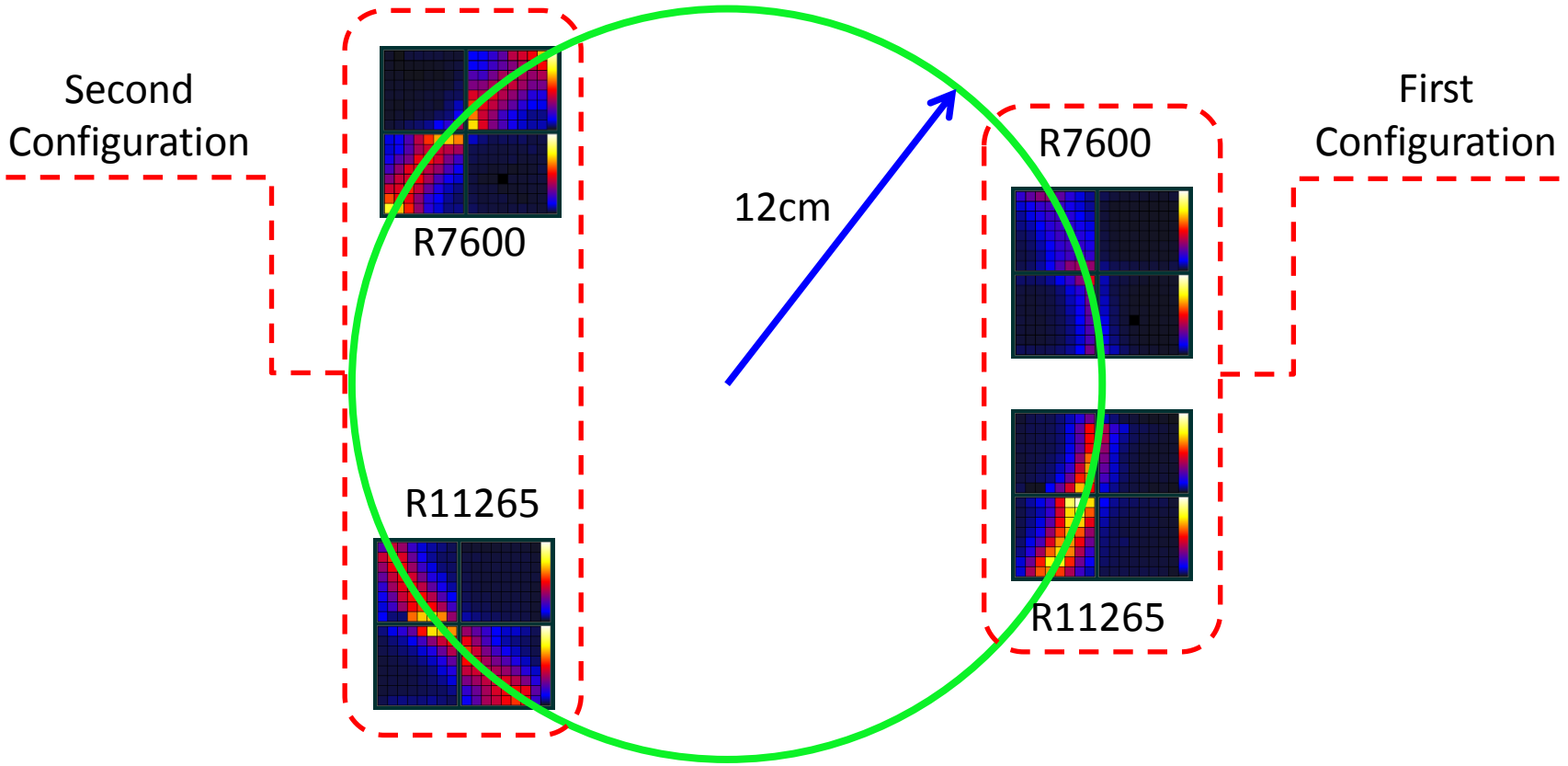
Items	(+00)	(+01)	(+02)	(+03)	(+04)	(+05)	(+06)	(+07)
(+00)	11	25	28	28	32	30	37	46
(+08)	10	20	6	4	6	7	17	31
(+16)	4	9	6	10	12	10	12	17
(+24)	6	5	7	6	11	8	9	4
(+32)	8	3	8	8	4	13	4	25
(+40)	5	8	7	7	8	5	6	8
(+48)	5	0	10	2	7	63	12	29
(+56)	16	4	5	13	12	18	16	21

Sum of Acq Unit 3 Integration Channel Counters value: 222 (RAW)
Acq Unit 3 Integration Channel Counters's values (RAW):

Items	(+00)	(+01)	(+02)	(+03)	(+04)	(+05)	(+06)	(+07)
(+00)	11	12	14	12	6	7	8	4
(+08)	7	2	10	2	3	1	4	5
(+16)	2	4	1	1	0	0	3	0
(+24)	4	2	0	2	2	3	1	3
(+32)	5	2	0	0	2	0	0	1
(+40)	5	4	1	2	1	0	0	2
(+48)	5	7	1	2	0	0	0	3
(+56)	9	7	3	6	6	2	4	6

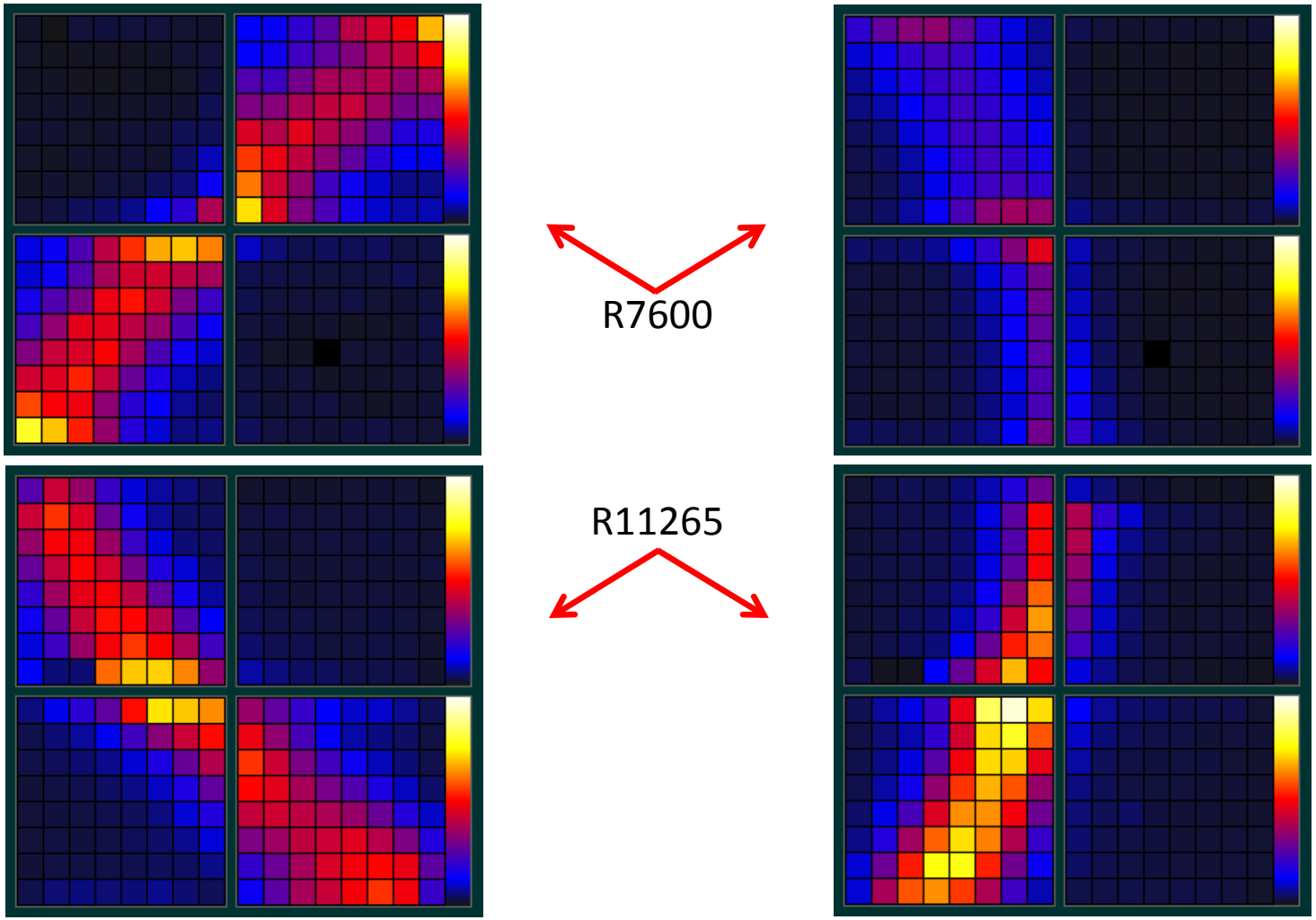
The 15 nov – 23 nov period activity

We use two simmetrical configurations without moving the box.
The only difference is the position of the PMT matrices.
In this way we can study the efficiency in Cherenkov ring detection in two different positions.



The 15 nov – 23 nov period activity

These are realtime screenshots taken in different instants.
Comparing the colors is not meaningful, because the color full scale is automatically adjusted to the total number of counts.
It is easy to notice the effect of the inactive area on the R7600.



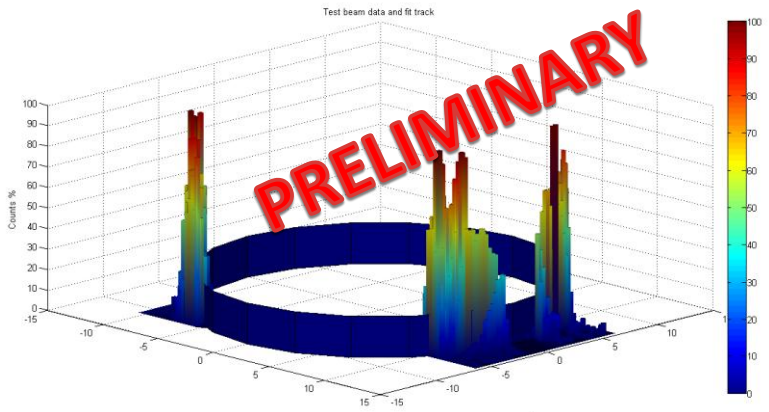
The 15 nov – 23 nov period activity

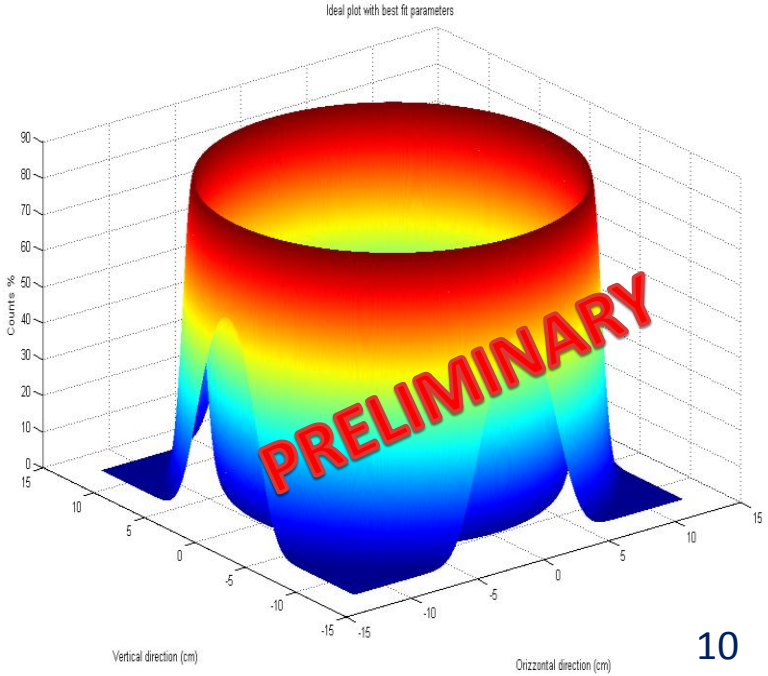
The offline analysis of triggered events has just started.
We want to compare the two PMTs studying for example:

- the PMT single photon efficiency;
- the single photon counting;
- the PMT effective area;
- the spatial resolution.

The analysis is done using the integration of all the data triggered in the four positions or studying single events in coincidence in the two matrices.

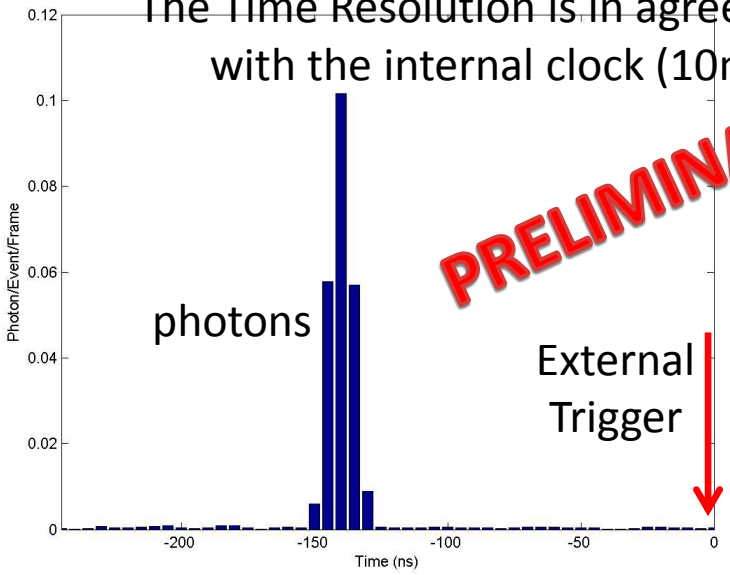
For example we try to do a circular and a Toroidal (Gaussian) Fit to extrapolate the ring resolution and the percentage of lost photons in different positions.

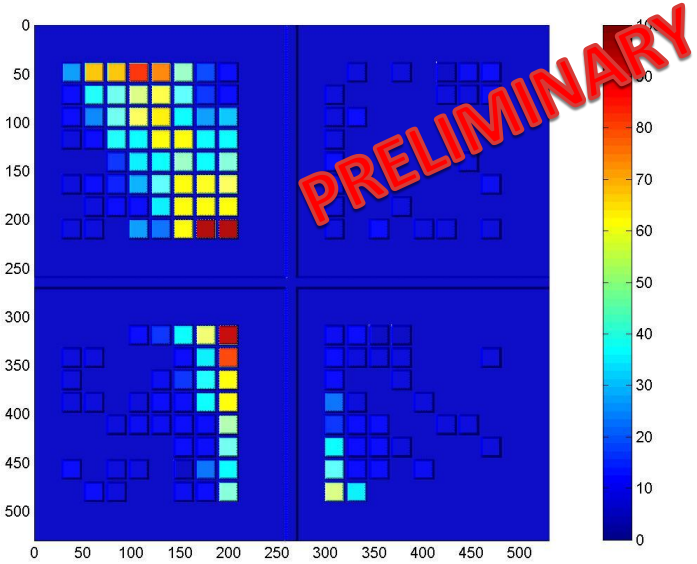


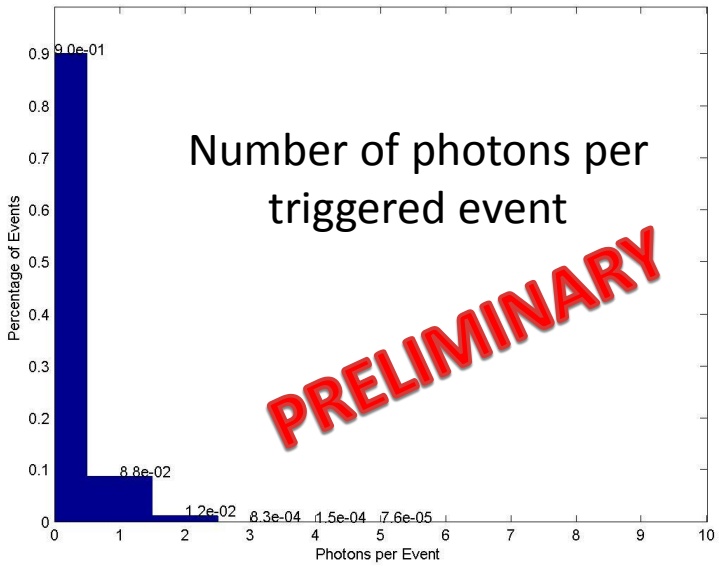


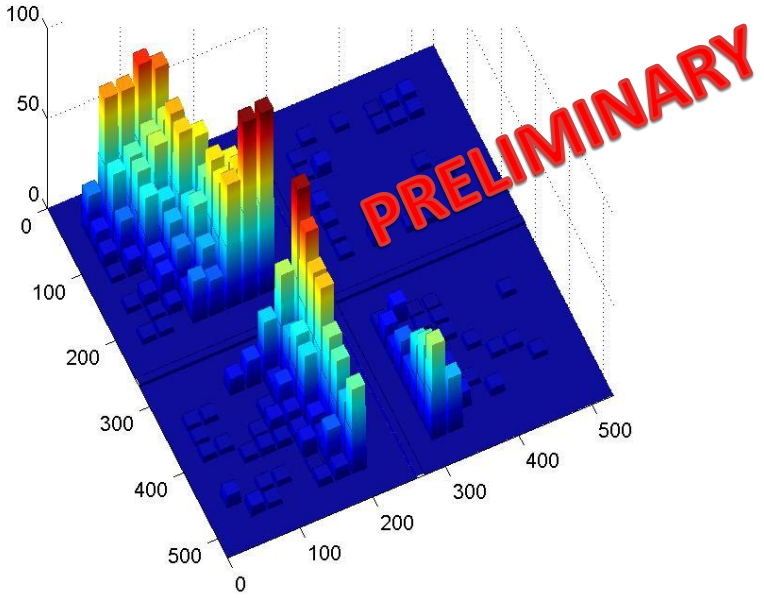
The 15 nov – 23 nov period activity – R7600

The Time Resolution is in agreement with the internal clock (10ns)



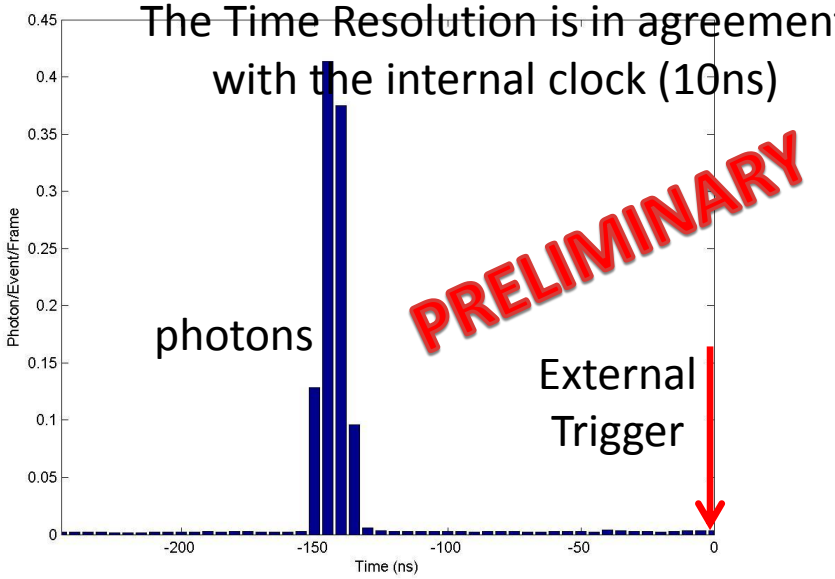


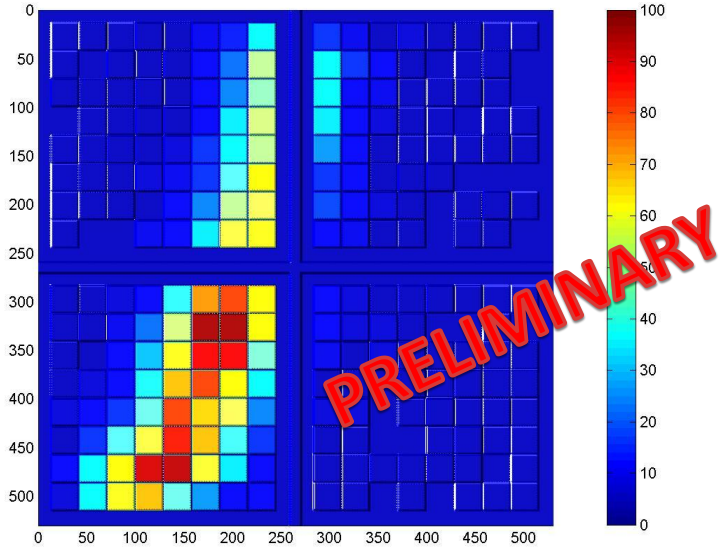




The 15 nov – 23 nov period activity – R11265

The Time Resolution is in agreement with the internal clock (10ns)





Number of photons per triggered event