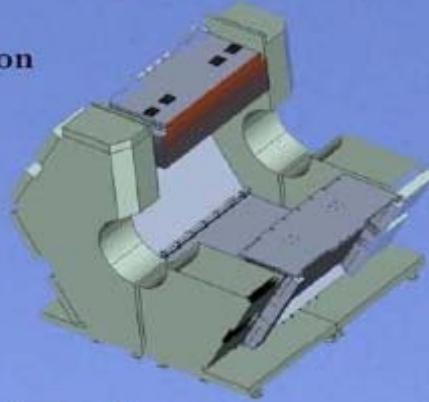




# Instrumentation for muon and $K_L^0$ identification at Super Flavor Factories

On the way to the construction  
of the hadronic calorimeter  
and muon detector (IFR)  
for SuperB spectrometer:



- research and development work on silicon photomultipliers and readout electronics;
- mechanical design of the IFR
- detector's response simulations;
- optimization of identification of pions and muons;
- fast data acquisition system;

Organizing Committee:

W. Baldini (INFN Ferrara) | R. Calabrese (INFN Ferrara) | M. Chruszcz (IFJ PAN) |  
W. Kucewicz (AGH) | T. Lesiak (IFJ PAN, chair) | B. Rachwał (WFM PK) |  
M. Stodulski (IFJ PAN) | C. Szklarz (IFJ PAN) | P. Romanowicz (WM PK) |  
T. Szymocha (CYFRONET) | M. Śnieżek (Perfect Travel) | J. Wlochczyński (IFJ)




Electronics parallel sessions summary

- Presentations reviewed and discussed

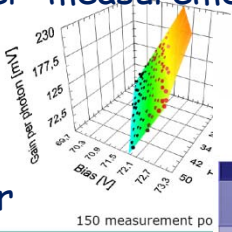
- "Thermal Stabilization of Silicon Photomultiplier measurement system for IFR" (Piotr Dorosz)


... "We can use few sample SiPMs, calculate a set of parameters and then use this parameters for larger group of SiPMs" ...



### Best Fit Function and 3D Model

Each point represents single measurement. Plane is determined from parameters a, b and c.





### Calculated Parameters

- $G(V, T) = aV + bT + c$

SiPM	a(V)	b(T)	c(°C, V)	c(K, V)	c(°C, V-V <sub>br</sub> )	Residue
Hamamatsu s10362-11-100U (696)	105,27	-5,9	-7261,05	-5736,13	18,51	0,074
Hamamatsu s10362-11-100U (698)	101,33	-5,44	-6983,45	-5499,50	28,48	0,057
Hamamatsu s10362-11-100U (699)	102,38	-5,52	-7058,30	-5552,31	38,70	0,078
Hamamatsu s10362-11-100U (700)	101,46	-5,45	-6991,27	-5503,31	39,84	0,091

- "SiPM test with thermal neutrons at the IRMM" ( A. Cotta Ramusino)

... Low energy neutron are not as harmless as one could think..

... Analysis on-going on the effects of shielding ...

... After a thermal neutron irradiation equivalent to 2 years of SuperB operation (with safety factor of 5) SiPM dark rate has increased and pile up effect occur -> constraints on shaping time of front end electronics

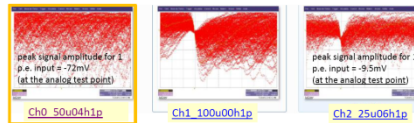
... pulse height for single p.e. remains constant

#### Summary:

- Reasons for the test at the IRMM'S GELINA facility (proposal originated by G. Cibinetto, INFN-FE)
- Overview of the electronic chain for the GEL
- SiPM signals picked up at the analog test point BEFORE irradiation
- SiPM signals picked up at the analog test point AFTER irradiation ( integrated fluence of abo
- preliminary conclusions

Amplified SiPM signals picked up at the analog test point of the modified ABCD board ( R.M. July 20<sup>th</sup> 2012)

Measurements performed AFTER the full irradiation

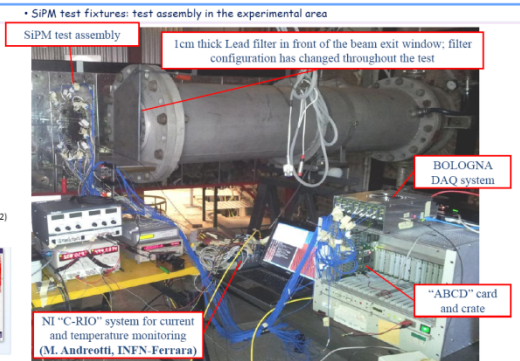


Hamamatsu MPPCs 1mm x 1mm

Note: Roberto Malagutti used different trigger settings and waveform accumulation and display settings than I used for previous waveforms but also in this plots the last waveform accumulated is drawn in yellow and by looking at it one can have a better idea of the effects of radiation on the single photon sensing devices under test

Note: Four devices were replaced with nominally equivalent ones at the beginning of the second week of irradiation so the FINAL WAVEFORMS AND THE INITIAL WAVEFORMS FOR 4 CHANNELS DO NOT REFER TO EXACTLY THE SAME DEVICE BUT TO EQUIVALENT ONES. The channels to which the replaced devices were connected were:  
 Channel 0 - Hamamatsu MPPCs 1mm x 1mm, 50u pitch  
 Channel 1 - Hamamatsu MPPCs 1mm x 1mm, 100u pitch  
 Channel 2 - Hamamatsu MPPCs 1mm x 1mm, 25u pitch  
 Channel 10 - Hamamatsu MPPCs 3mm x 3mm, 50u pitch

Overview of the electronic chain for the GELINA test



Angelo Cotta Ramusino - INFN-Ferrara Sept 2nd 2012

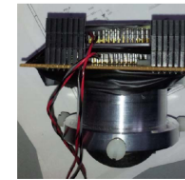


# Friday morning electronic I

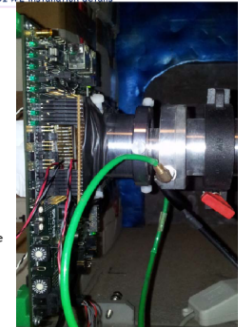
- "CLARO and RAPSODI ASICs irradiation at the CN facility of the INFN-LNL" (A. Cotta Ramusino, Bartłomiej Rachwał)

...No Single Event Effect, no Single Event Latchup, no permanent effects from total integrated dose Observed for the CLARO chip...

SuperB IFR electronics: preparing for irradiation tests  
 • ASIC irradiation test setup at LNL: RAPSODI #2 installation details



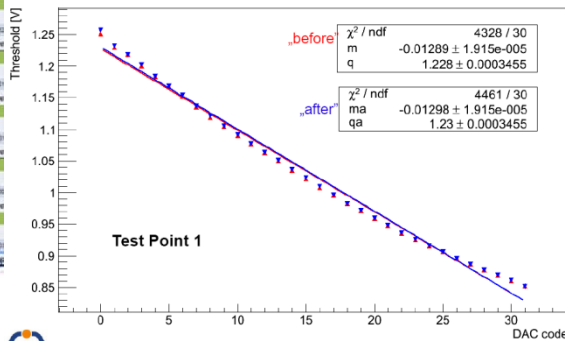
The stack of chips placed in front of the source and plugged onto the FPGA development board used as a neutron flux monitor



Angelo Cotta Ramusino, INFN Ferrara - Jun 21 2012

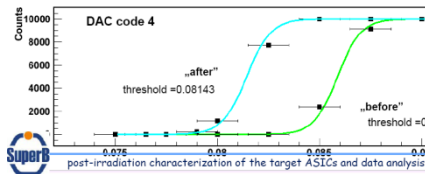
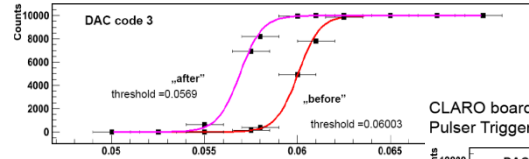
	DAC 3	DAC 4	DAC 8	DAC 16	
Channel A					
Burst 1E+4					
before	0.28033	after: 0.2805	before: 0.28143	after: 0.2797	
after	0.28033	after: 0.2805	before: 0.28143	after: 0.2797	
μIR ± 0.00218	0.279%	μIR ± 0.00247	-0.22%	μIR ± 0.00281	0.9%
μIR ± 0.00281	0.9%	μIR ± 0.00281	0.9%	μIR ± 0.00281	0.9%
Stages from linear fitting:	before: 0.02118 ± 0.00205	after: 0.02189 ± 0.00204	0.4%		
Threshold [μV]					
before	0.28033	after: 0.28146	before: 0.2797	after: 0.28178	
after	0.28033	after: 0.28146	before: 0.2797	after: 0.28178	
μIR ± 0.00226	0.7%	μIR ± 0.00287	1.4%	μIR ± 0.002	0.8%
μIR ± 0.00287	1.4%	μIR ± 0.00287	1.4%	μIR ± 0.002	0.8%
Stages from linear fitting:	before: 0.0212 ± 0.00201	after: 0.02189 ± 0.00202	1.4%		

CLARO board - Linear characterization  
 Threshold Voltage vs. DAC code

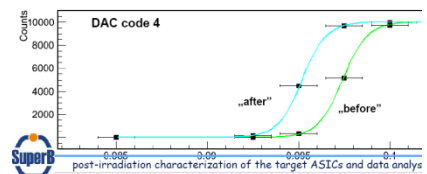
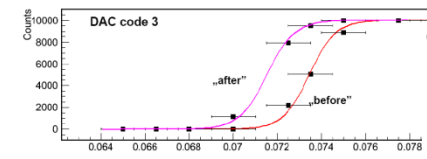


post-irradiation characterization of the target ASICs and data analysis by B. Rachwał

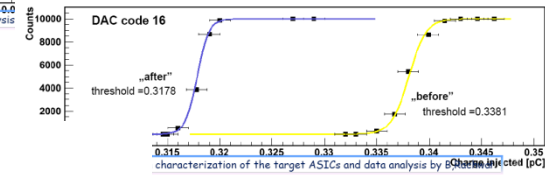
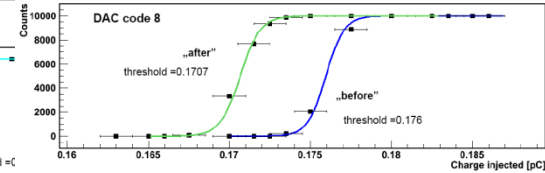
CLARO board - Channel A  
 Pulsar Trigger - Burst 1E+4



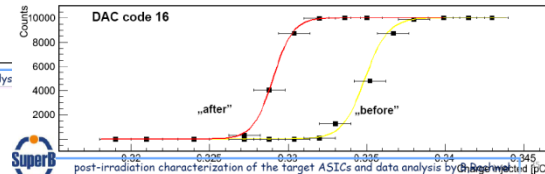
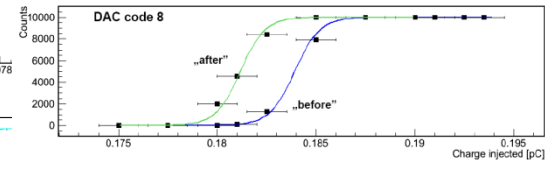
CLARO board - Channel C  
 Pulsar Trigger - Burst 1E+4



CLARO board - Channel A  
 Pulsar Trigger - Burst 1E+4



CLARO board - Channel C  
 Pulsar Trigger - Burst 1E+4



# Friday afternoon electronic II

- Visit to Wojciech's laboratory at AGH
- Presentations reviewed and discussed
  - "An idea of IFR ASIC front-end with gain stabilization" (Juliusz Godek & Jacek Kołodziej) discussion on proposal with remote participation of Gianluigi Pessina and Claudio Gotti



AKADEMIA GÓRNICZO-HUTNICZA  
IM. STANISŁAWA STASZICA W KRAKOWIE

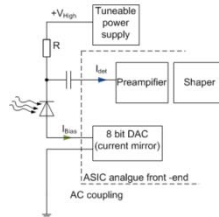


## An idea of IFR front-end ASIC with gain stabilization

Behalf of AGH  
Jacek Kołodziej

University of Science and Technology,  
Department of Electronics,  
Krakow 2012

### Gain stabilization with AC detector coupling



- ❑ The coupling capacitance at the input is decoupling of high voltage and makes first derivative.
- ❑ An 8-bit DAC must be added in parallel to each diode.
- ❑ Bias voltage circuit generator doesn't influent to signal path.

IFR SuperB, Krakow 2012

11



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IM. STANISŁAWA STASZICA W KRAKOWIE



## IFR front-end ASIC in UMC180 nm technology

Juliusz Godek  
on behalf of AGH

### Area comparision

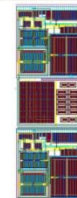


Katedra Elektroniki

Kraków 2012

89923 square um

the same scale



13237 square um

nology,

10

.. the thouroughly prepared proposal opens perspectives toward the usage of a technology node which lower costs provides higher density and rad tolerance but it has, like all new things some disadvantages w.r.t. to the technology considered so far for front end ASIC... to be discussed further

# Friday afternoon electronic II

- "Characterization of RAPSODI ASICs after Irradiation" (Mateusz Baszczyk)

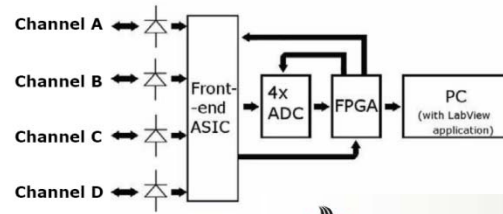


AGH UNIVERSITY OF SCIENCE  
AND TECHNOLOGY

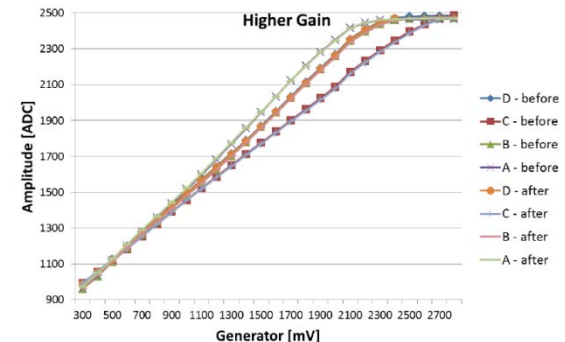
## Characterization of RAPSODI ASICs after Irradiation Tests

Mateusz Baszczyk, Piotr Dorosz  
On behalf of AGH University of Science and Technology

### System of Data Acquisition



### Linearity after Irradiation – RAPSODI #16



### Conclusions

- There are no difference between linearity and standard deviation for measurements before irradiation and after.
- Mean value points before and after irradiation do not exceed each other standard deviation error bars.
- There are no noticeable differences between measurements of RAPSODI #16 ( $1,32e+12$  neutrons/cm<sup>2</sup>) and RAPSODI #30 ( $3,3e+13$  neutrons/cm<sup>2</sup>).

## Electronics parallel sessions summary

- Saturday morning joint electronics/mechanics
- Saturday morning joint electronics/R&D

From these joint sessions good suggestions came regarding the subjects of:

- redundancy of SiPM
- machining of scintillating bars (grooves on top and bottom)

which have impact on the design of the detector electronics but could reduce the detector manufacturing time and improve the reliability of the overall system.

The topic of Quality Control (Q.C.) was addressed at the joint electronics/R&D session: three steps were identified:

- quick verification, by means of test systems based on RAPSODI #2 chips, of SiPM gain @ nominal operating conditions
- Q.C. of assembled detector element: spectrum from  $^{90}\text{Sr}$  source collected
- long term Q.C. of assembled module: cosmic ray spectrum acquired via the final readout chain while detector modules are in storage