PADME charged veto status

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SU "St. Kl. Ohridski"* and LNF-INFN

For the charged vetoes working group

08.03.2018

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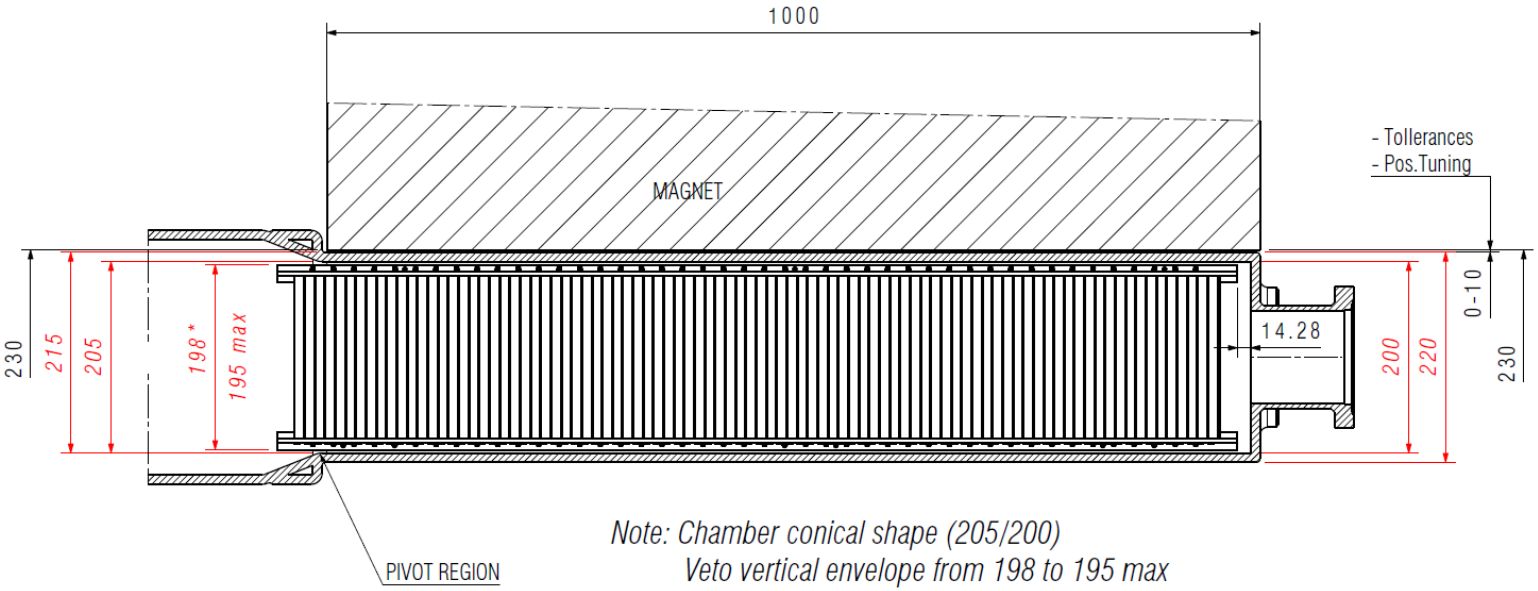
Towards completion of the detector

- E/P Veto
  - Mechanics
  - Scintillators
  - Cabling
  - SiPM FEE cards
- HEP Veto

Mechanics

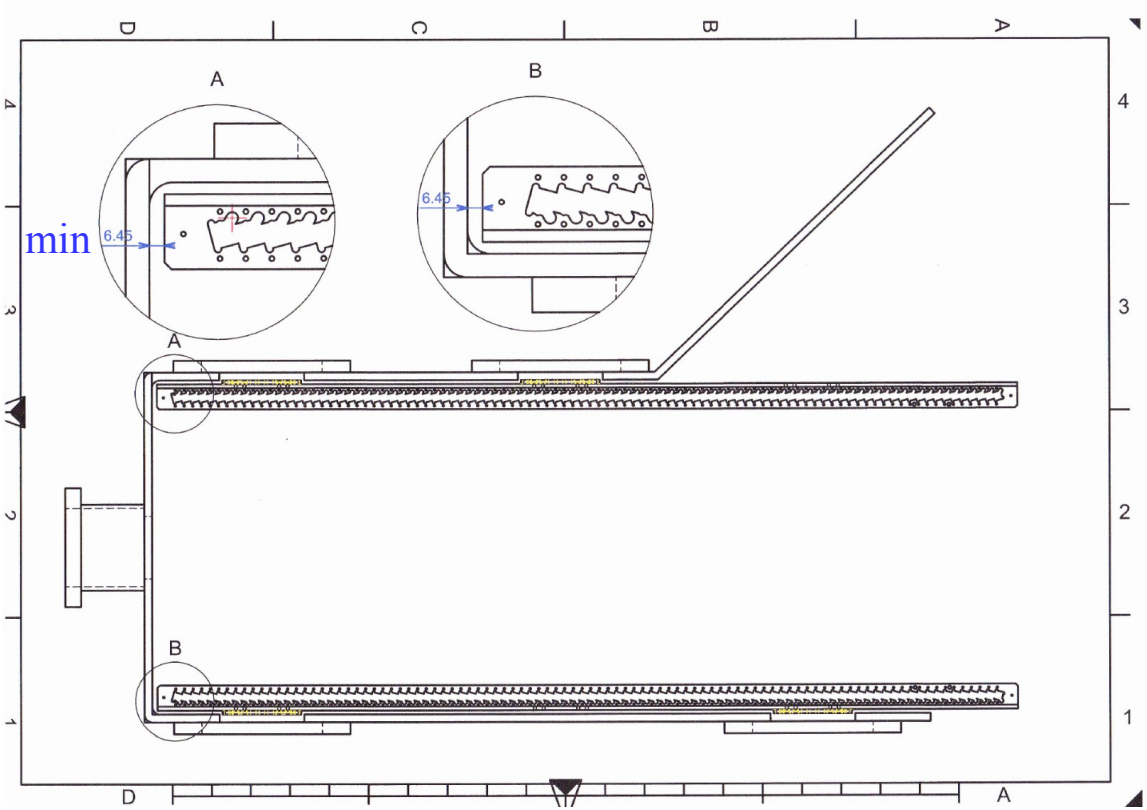
- Current design of the vacuum chamber (from Cesidio)



- Vertical size – at most 195 mm (a bit shorter than originally thought)
  - Chosen vertical size – 190 mm, to avoid difficulties during the installation inside the vacuum chamber and provide room for tolerances

Mechanics

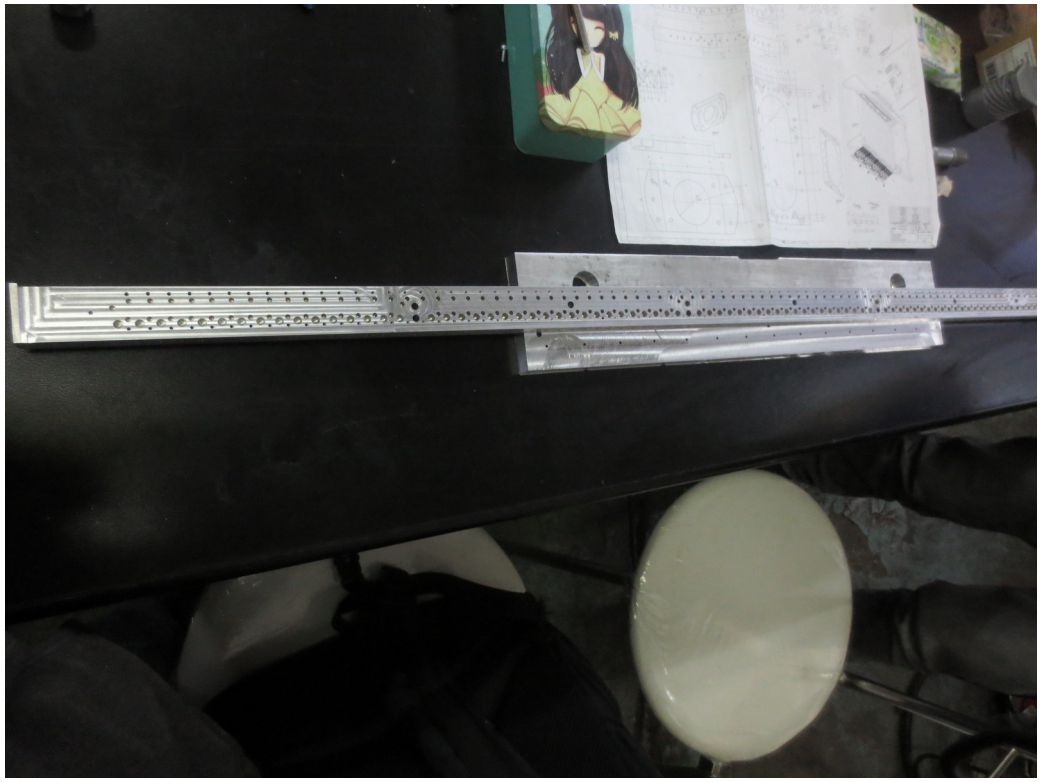
- Information from the producer



- The producer agreed to postpone the production of the back enclosing plates till the end. Now their width is fixed to 190 mm
- Distance to the front face of the vacuum chamber – 6.45 mm + X*11 mm, discussed with producer to allow for both 6.45 mm and 17.45 mm

Mechanics

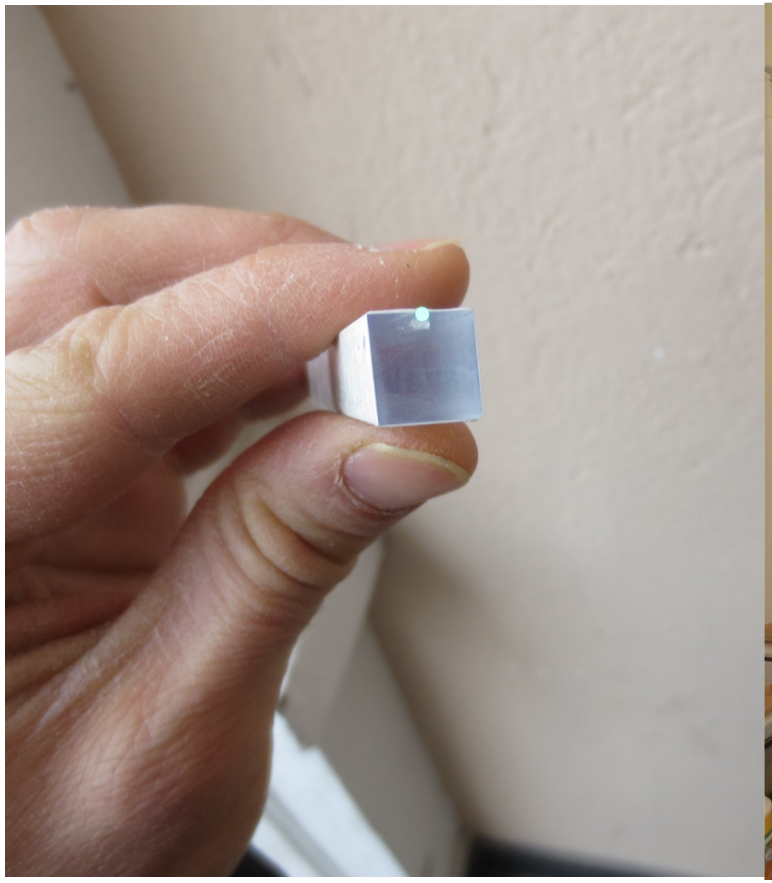
- The rails production steps seem to be completely defined



- The first rail should arrive this Friday. Production of all the remaining rails to follow quickly after
- All the consumables (screws, etc.) obtained
- Scintillator spacers are being 3D printed from PLA, with improved mechanical stability with respect to the prototype

Scintillators

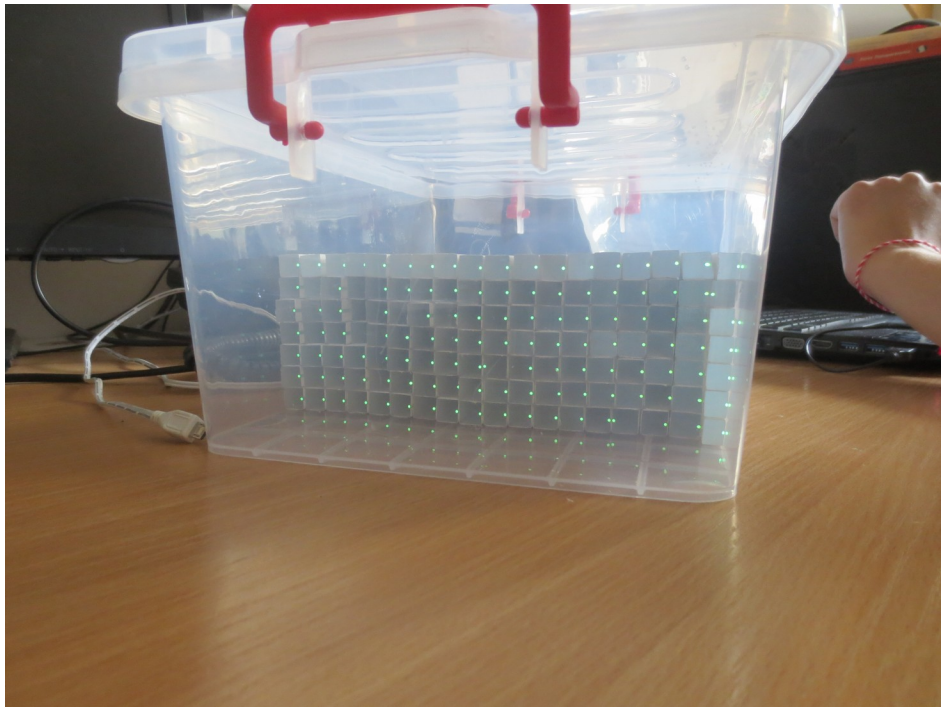
- Scintillators have to be machined to the final dimension
  - A little bit shorter than initial plans, however this is not critical



Scintillators

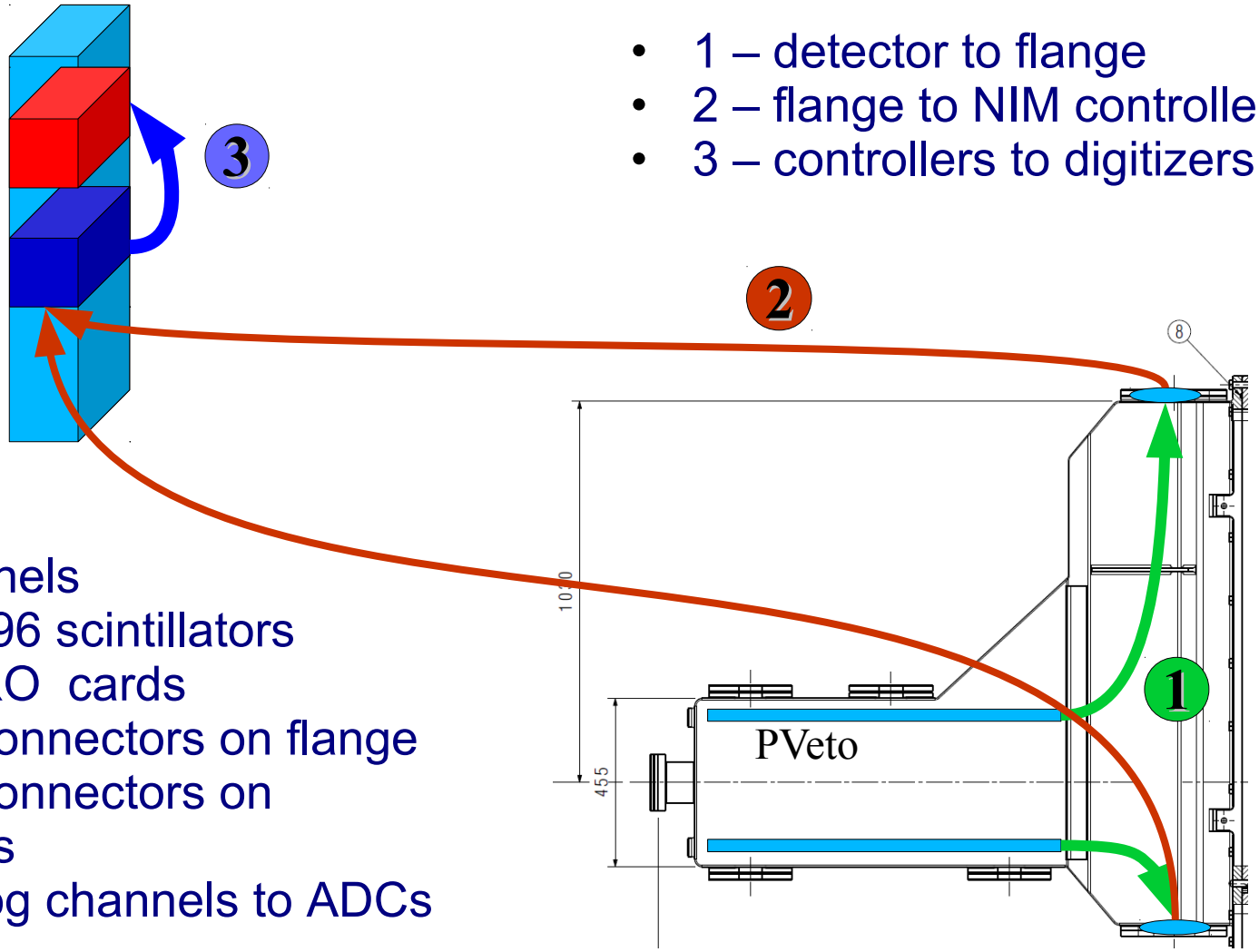
- A dedicated setup for scintillator cutting prepared (almost entirely by Simeon with the help of Svetoslav)
  - Allows the cutting of ~200 scintillators per one day!
  - Using a large part of his personal equipment

- Very good quality of the cut, grinding is not necessary
  - Sanding with sand-paper grade 2000 (water) and polishing on a glass plate with polishing powder



Cabling

- 1 – detector to flange
- 2 – flange to NIM controllers
- 3 – controllers to digitizers



- 192 channels
- 2 rails of 96 scintillators
- 24 + 24 RO cards
- 12 + 12 connectors on flange
- 12 + 12 connectors on controllers
- 192 analog channels to ADCs

Cabling

- 3. Controller → ADC cables (MCX → lemo)
  - ordered, production ongoing, 200 RG-174 cables
- 1. Cabling from FEE cards to the vacuum flange
  - Length should be fixed as soon as possible
  - Alpha-wire cable? (quite expensive, but certified for low outgassing)
  - Ordering/manufacturing?

- 2. Flange to controller cables – at least 5 m length necessary…
  - 12 signal cables, DB37 → DB37, twisted pairs, differential signals, 100 ohm impedance
  - 12 supply and control cables. Specific connection, twisted pairs with 100 ohm impedance seem appropriate
- Possible solutions for flange → controller cables
  - Flat multiwire twisted pair cable
  - CAT 6, S-SFTP cable, 4 twisted pairs each cable, 4 cables per 1 DB37 → DB37 cable

DB37 → DB37 cables

- Requirements
  - To preserve the signal quality so that there is no much degradation in the time resolution of the detector
  - The major criterion – the change in the time resolution of the system with the pulsed LED driver
- Cables under study

Options

Flat twisted pair

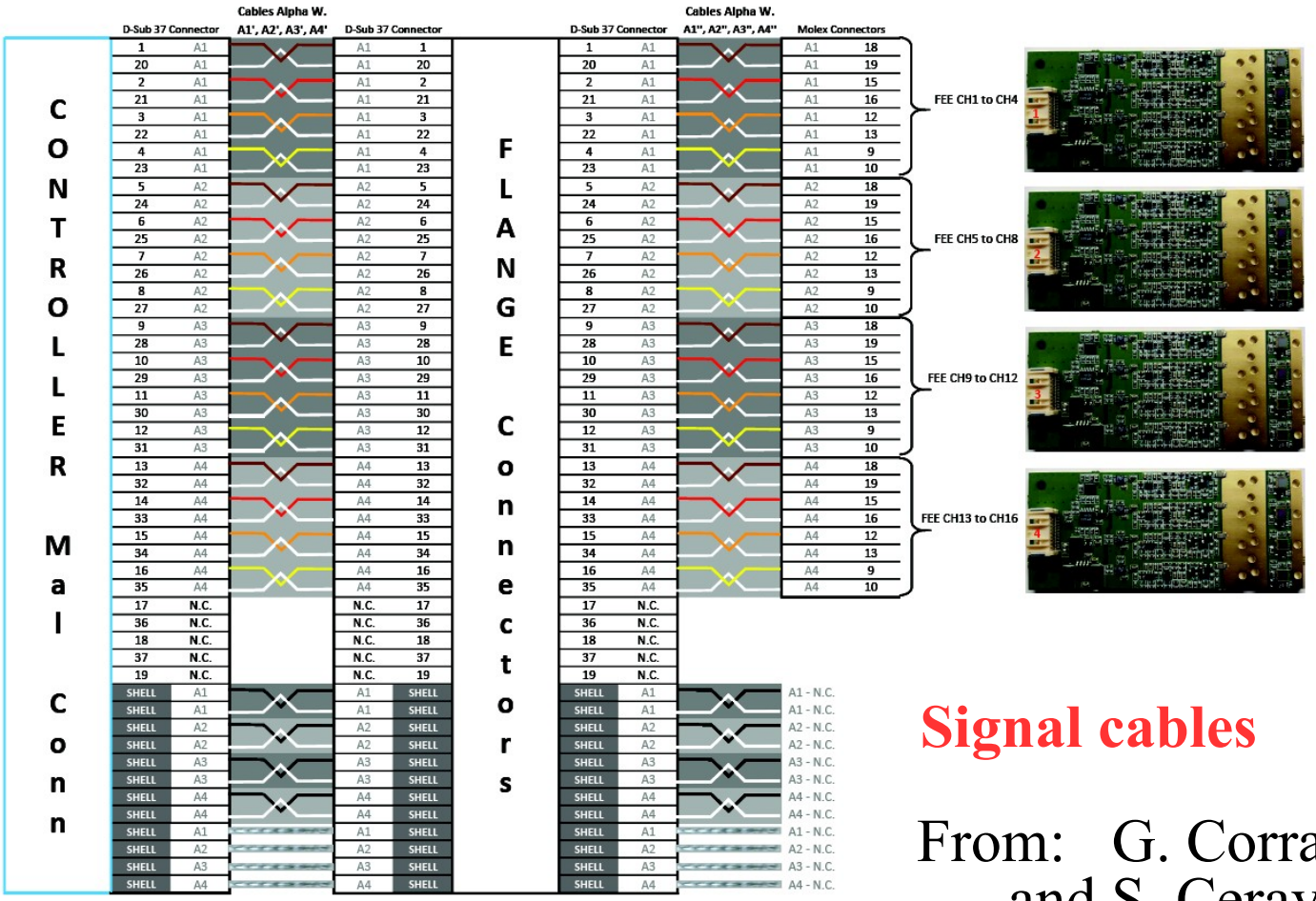
Fast production
No shielding

CAT 6, 250 MHz

Shielding
Bandwidth
Soldiering

Cabling scheme

- Cabling scheme agreed after few iterations – the DB37 → DB37 cables ensures one to one correspondence of the connected pins



Signal cables

From: G. Corradi and S. Ceravolo

Cabling scheme

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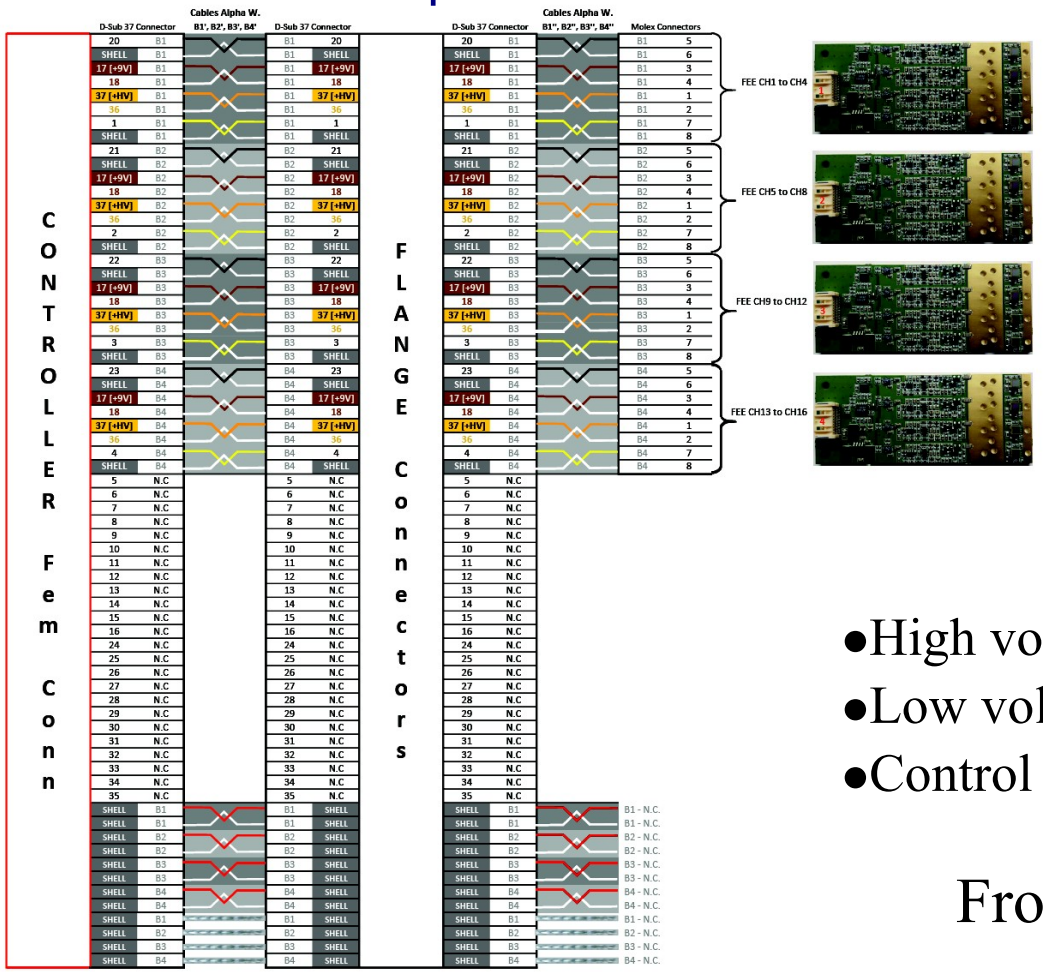


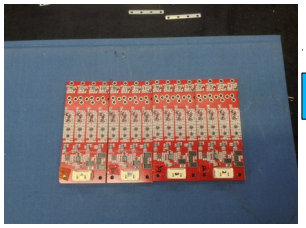
I/O & Control

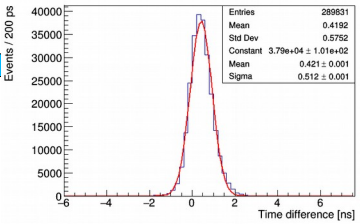
- High voltage
- Low voltage
- Control and monitoring

From: G. Corradi and S. Ceravolo

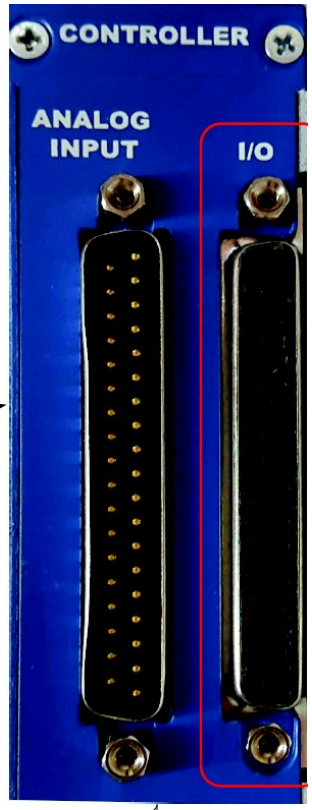
Cables – test

- Time resolution measurements





σ = 360 ps



5 m prototype cable

σ = ??? ps

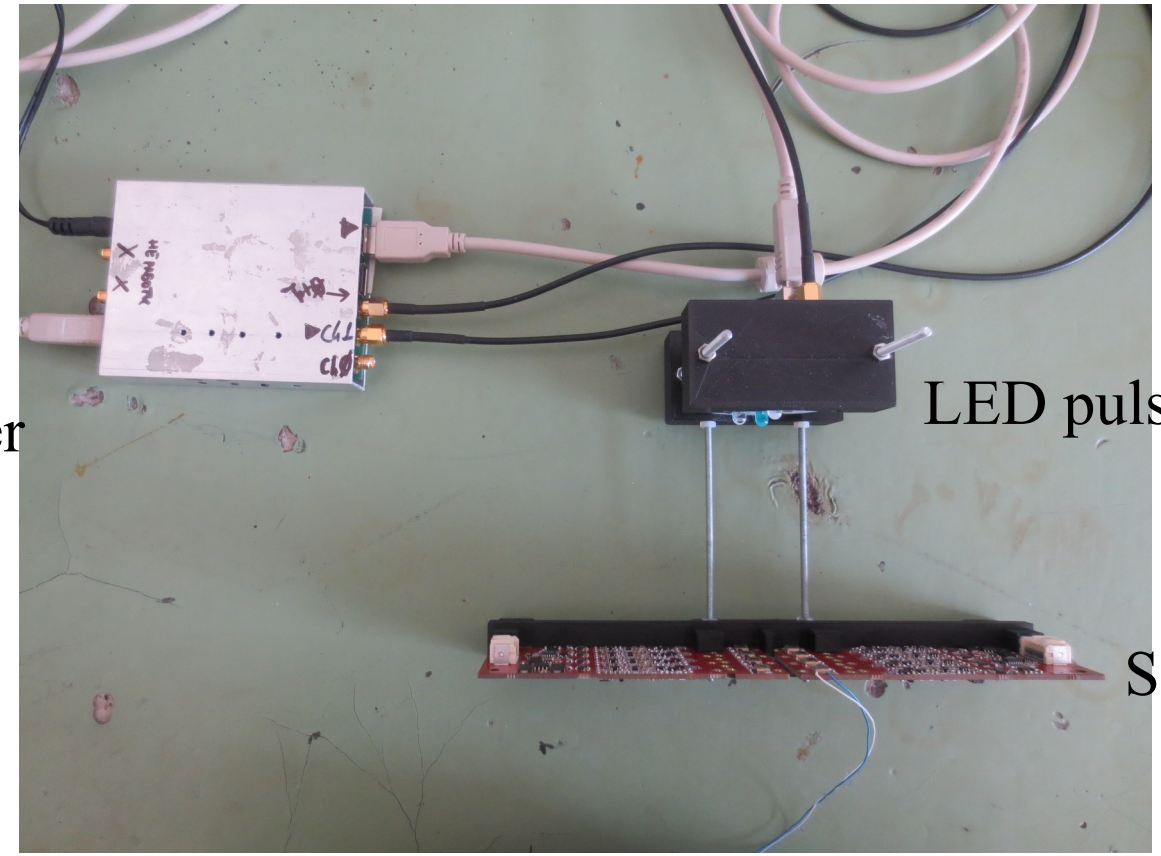
PC

V1751, 1 GS/s

scope

Cables – test setup

controller



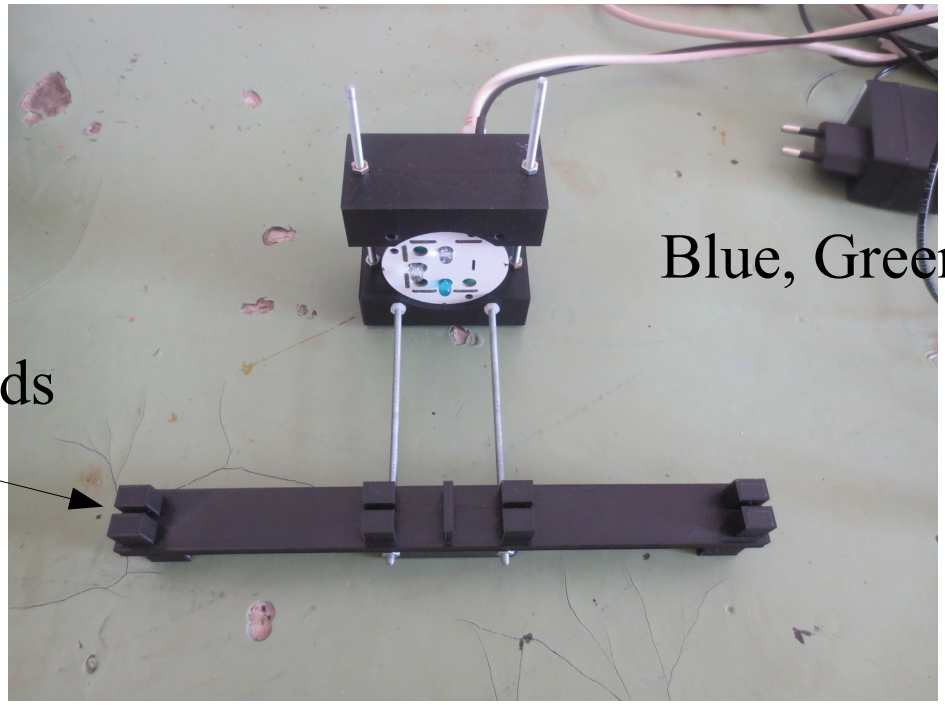
LED pulser

SiPM cards

- The tests will be done with the pulsed LED driver
- SiPM + LED pulser – in the back box used for scintillator tests
- **Quick check with the scope on the operation of the system, adjusting, verification**

SiPM FEE cards

- The tested prototype cards will be used to fix the type of the DB37 → DB37 cable



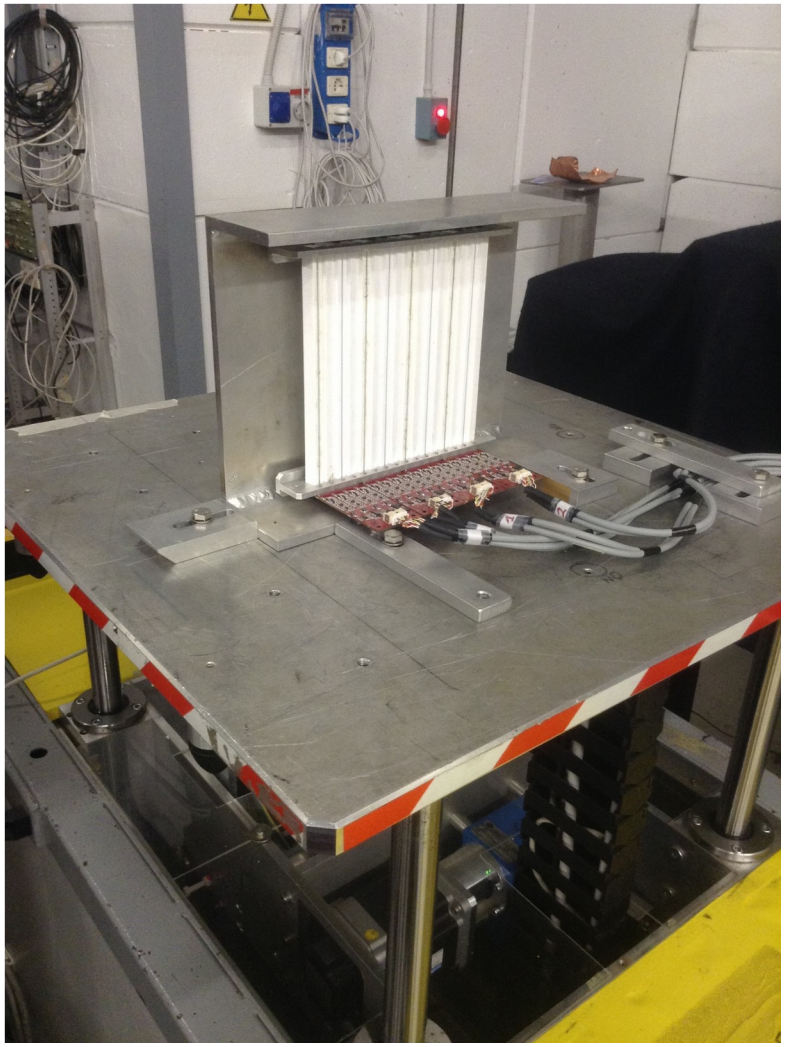
- Currently at Sofia: 3 controllers + 12 cards of the final production for the charged particle vetoes

SiPM cards

- Each card is calibrated to a specific controller (vice-versa)
- Test parameters
  - Pulsed LED driver
  - Stability of response – 15 min data taking and average charge and pulse amplitude history
  - Time resolution
- Each card with SiPMs showing less than 10% change in the average charge and with time resolution less than 500 ps is considered good for PADME
- Beginning of the tests – after cable type selection. Tentatively – next week
  - Selection of the best among the production
  - Actually there will be no time for modification for 2018 run in case some bad performance of all the production (very unlikely, extensive prototype tests)
  - The test will serve mostly as a characterization one

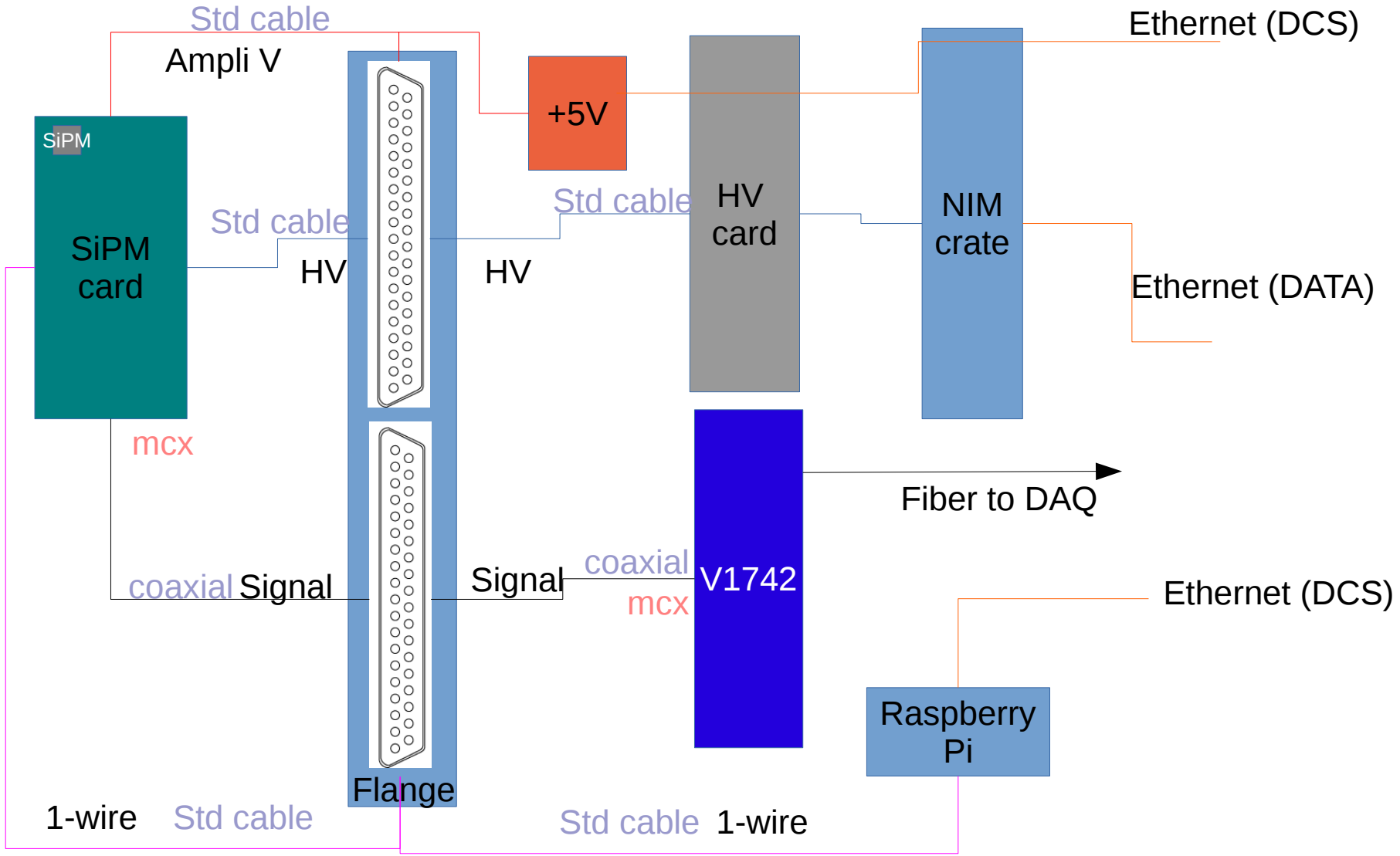
HEP Veto mechanics

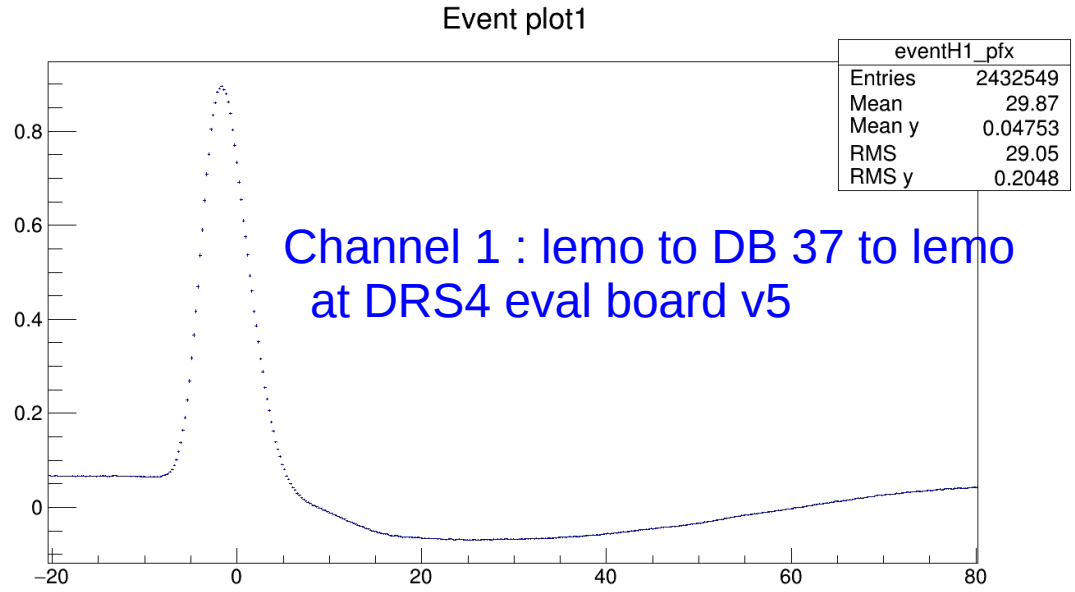
- The start-up detector will be the prototype for the testing of the scintillator and the SiPM readout, used in April 2017
  - 16 channels, possibility for double readout
- Design is universal – can be substituted with a new set of scintillators (cast) or SiPM cards upon their availability
  - Robustness
  - An already working backup solution
  - HEPVeto studies by Fabio Ferrarotto

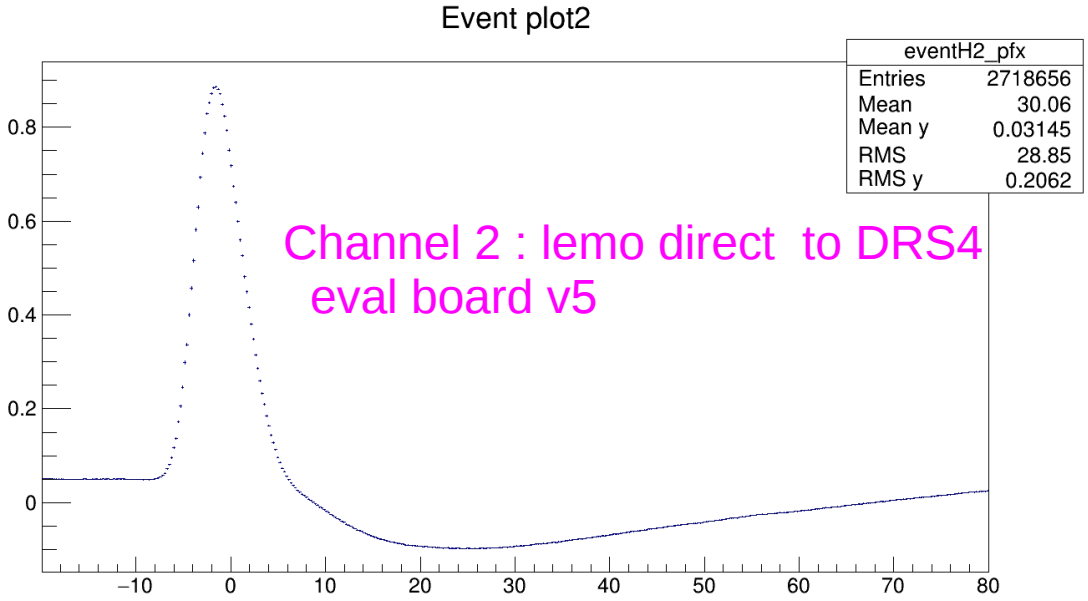


HEPVeto SiPM readout scheme

Schema adopted assuming 16 channels (bottom side r/out) → 4 ampli cards x 4 cards
Ampli Voltage (+5V) and GND on DB37 – *4 supplies (1/each card) with common GND*
4 1-wire serialized readout for temp sensors (1/card)







Signals from cosmics at Roma1 LABE

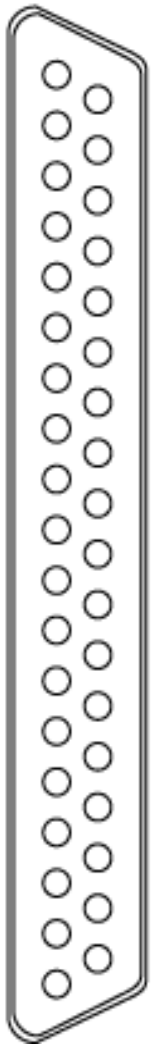
Signal shown reversed
Normalized profile plot of ~ 6K evts
5 GHz sampling with DRS4 eval bd v5
AND of ch 1 and ch 2
HV = +28 V to SenSL SiPM

Fast output signal (width < 10 ns)
~ 10% undershoot by amplifier

Signals are basically equal
Readout with coaxial to DB37 is OK

DB 37 Female

Ch 1 V	1	20	Ch 9 V
Ch 1 GND	2	21	Ch 9 GND
Ch 2 V	3	22	Ch 10 V
Ch 2 GND	4	23	Ch 10 GND
Ch 3 V	5	24	Ch 11 V
Ch 3 GND	6	25	Ch 11 GND
Ch 4 V	7	26	Ch 12 V
Ch 4 GND	8	27	Ch 12 GND
Ch 5 V	9	28	Ch 13 V
Ch 5 GND	10	29	Ch 13 GND
Ch 6 V	11	30	Ch 14 V
Ch 6 GND	12	31	Ch 14 GND
Ch 7 V	13	32	Ch 15 V
Ch 7 GND	14	33	Ch 15 GND
Ch 8 V	15	34	Ch 16 V
Ch 8 GND	16	35	Ch 16 GND
+5 V Amp 1	17	36	+5V Amp 3
GND Ampli	18	37	+5V Amp4
+5V Amp2	19		



DB 37 Female

SIgnal 1	1	20	SIgnal 9
Sgn 1 GND	2	21	Sgn 9 GND
Signal 2	3	22	Signal 10
Sgn 2 GND	4	23	Sgn 10 GND
Signal 3	5	24	Signal 11
Sgn 3 GND	6	25	Sgn 11 GND
Signal 4	7	26	Signal 12
Sgn 4 GND	8	27	Sgn 12 GND
Signal 5	9	28	Signal 13
Sgn 5 GND	10	29	Sgn 13 GND
Signal 6	11	30	Signal 14
Sgn 6 GND	12	31	Sgn 14 GND
Signal 7	13	32	Signal 15
Sgn 7 GND	14	33	Sgn 15 GND
Signal 8 V	15	34	Signal 16 V
Sgn 8 GND	16	35	Sgn 16 GND
-	17	36	-
Data 1-wire T	18	37	+3.3.V T
GND T	19		

2 DB-37 connectors could be enough

HEPVeto pieces

Must start placing orders now !

Flange : 2 DB37 possible ~ 1000 € (w/out supplemental order ? - Cesidio ?)

SenSL 20 6x6 mm^2 MicroFC-60035 : 75 €/each = 1500 € + IVA + sped
LV supply stabilized linear for + 5V amplifiers = ~ 300 € + IVA + sped
Minicircuit PSA-5454+ : OK - 20 arriving at Roma1 next
TCCH-80+ x 40 : 3.47 €/each = 139 € + IVA + sped
Mini RF RFX9503 x 40 quote 1.4 €/each = 56 € + IVA + sped
ThermaBridge IMS BG3-1206-DS : 300 min $0.83/each = $ 249.00+IVA+sp
Other electronic pieces for SiPM card : to be ordered at RS

MCX connectors 90 degrees x 20 : 2.85 €/each RS
MCX connectors straight to crimp cable x 40 : 2.98 €/each RS
Cables : to be ordered RG174 ? RS

HV Card : to be done by Corradi on our design
NIM Crate for HV : same as p/e Veto
SiPM card : finishing desig in LABE Roma 1
Cables : to be done at LNF ?

Conclusions (Towards completion)

Task	Main actor (help)	→ 4.03	5-11.03	12-18.03	19-25.03	26-31.03
Cutting of ~200 scintillators (one side)	Simeon (Venelin, Svetoslav)		8.03 DONE			
One side polishing	Simeon (Venelin, Svetoslav)			14.03		
200 ready (2 sides) scintillators	Simeon (Venelin, Svetoslav)			16.03		
CAT6 cable prototype (the rest are ready)	Mityo		6.03 DONE			
Test + definition of the cable type	Georgi + Ludmil (Venelin)		12.03			
Production of >= (12+12) cables	Mityo + …				24.03	
SiPM cards + controllers calibration	Gianni and Sergio					
SiPM timing tests	? (Bilyana, Nikolay, Dafina, Radoslav)					
HEPVeto detector part	Fabio (Venelin)					31.03
HEPVeto infrastructure	Fabio (Cesidio, Gianni)					Soon...

The time schedule is quite tight, however a lot of preparatory work already done