



EMC front-end Electronics

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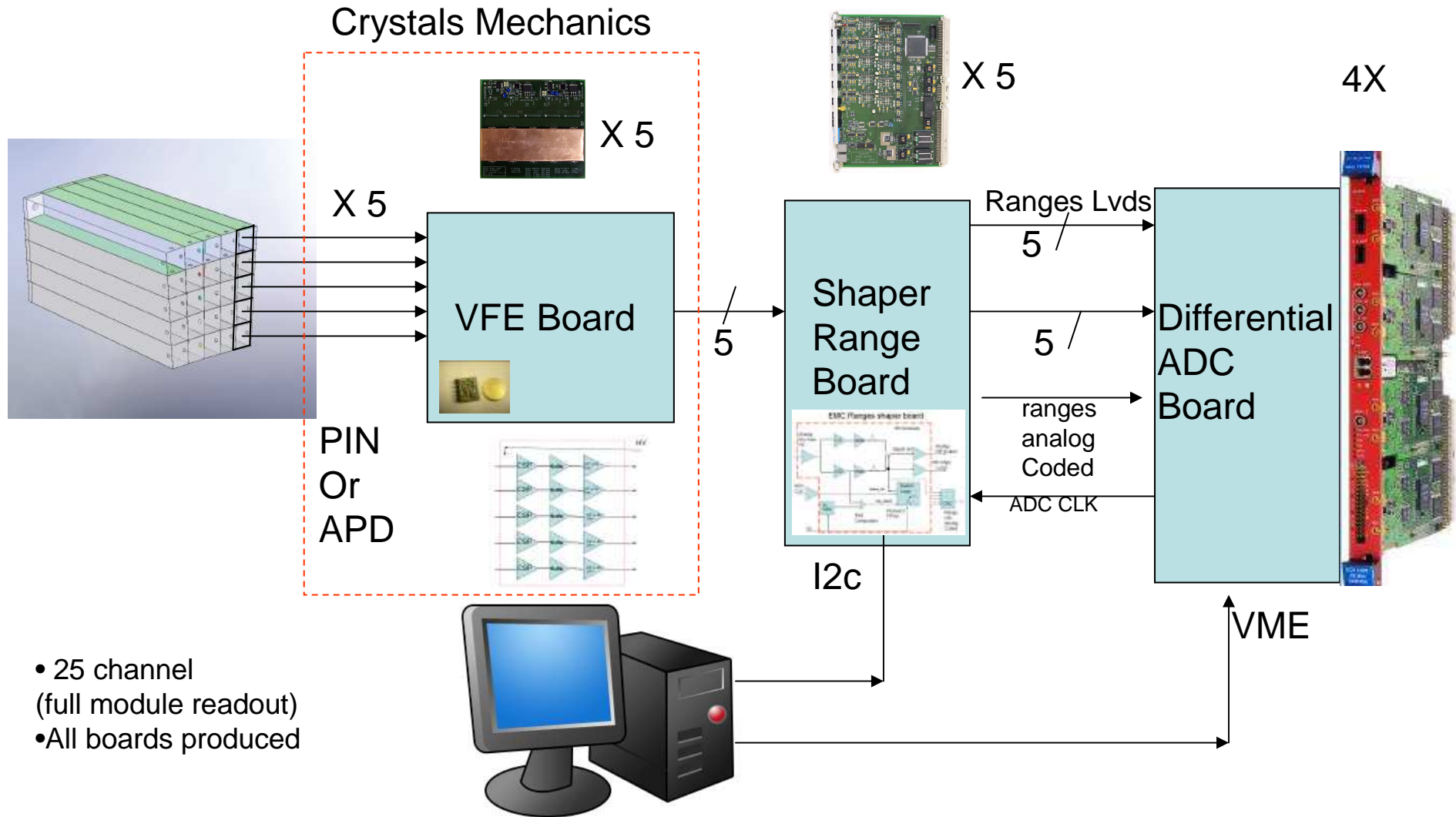
XV SuperB General Meeting – Caltech 14-17 December 2010

M.Bizzarri, A. Papi, A. Rossi (INFN Perugia)

V.Bocci, G. Chiodi, R. Lunadei, L. Recchia, D. Ruggieri, M. Vignati (INFN Roma)

P.Branchini, A. Budano (INFN Roma 3)

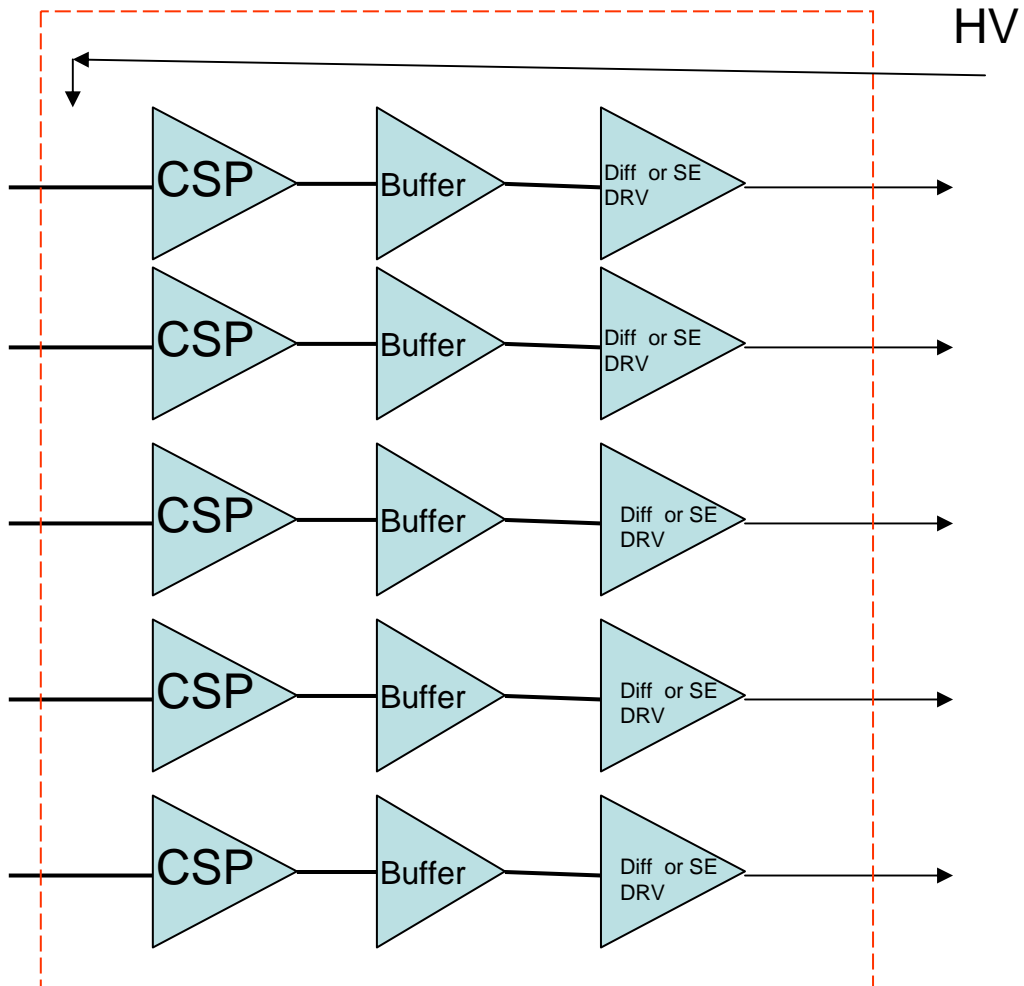
25 crystals tower readout electronics



- 25 channel (full module readout)
- All boards produced

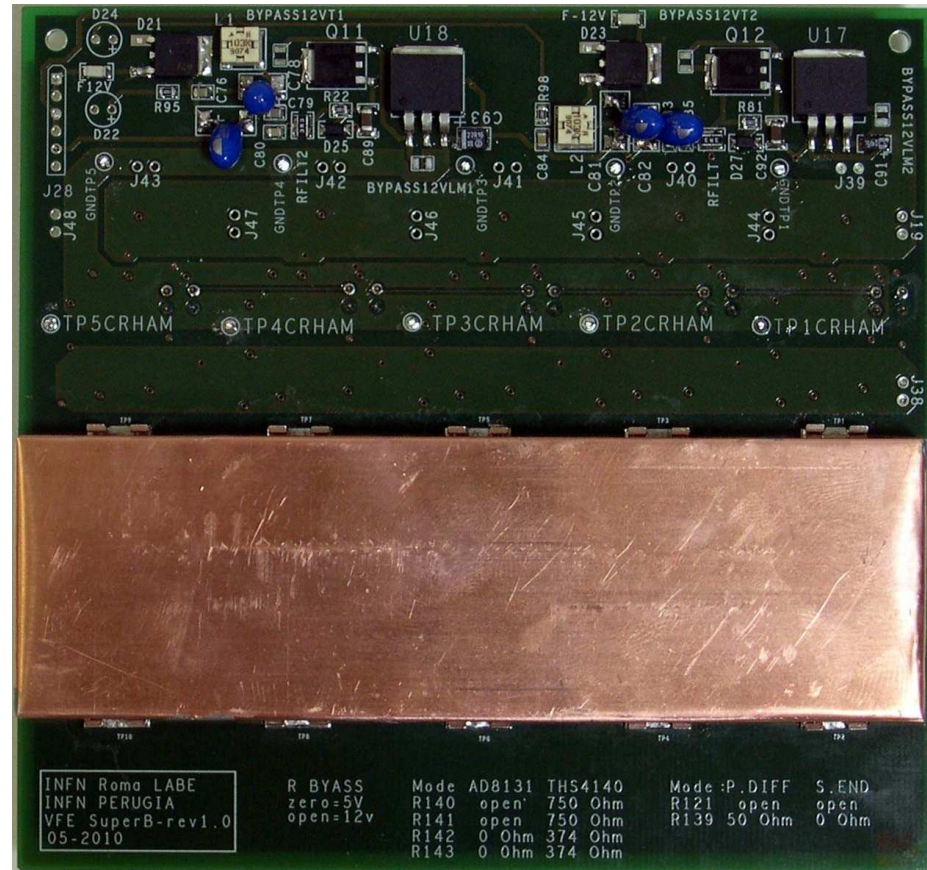
Very Front End Board

- EMC VFE Board
- 5 CSP Channels
- Enable to mount:
Cremat,
Hamamatsu,
Home Made CSP
- HV distribution

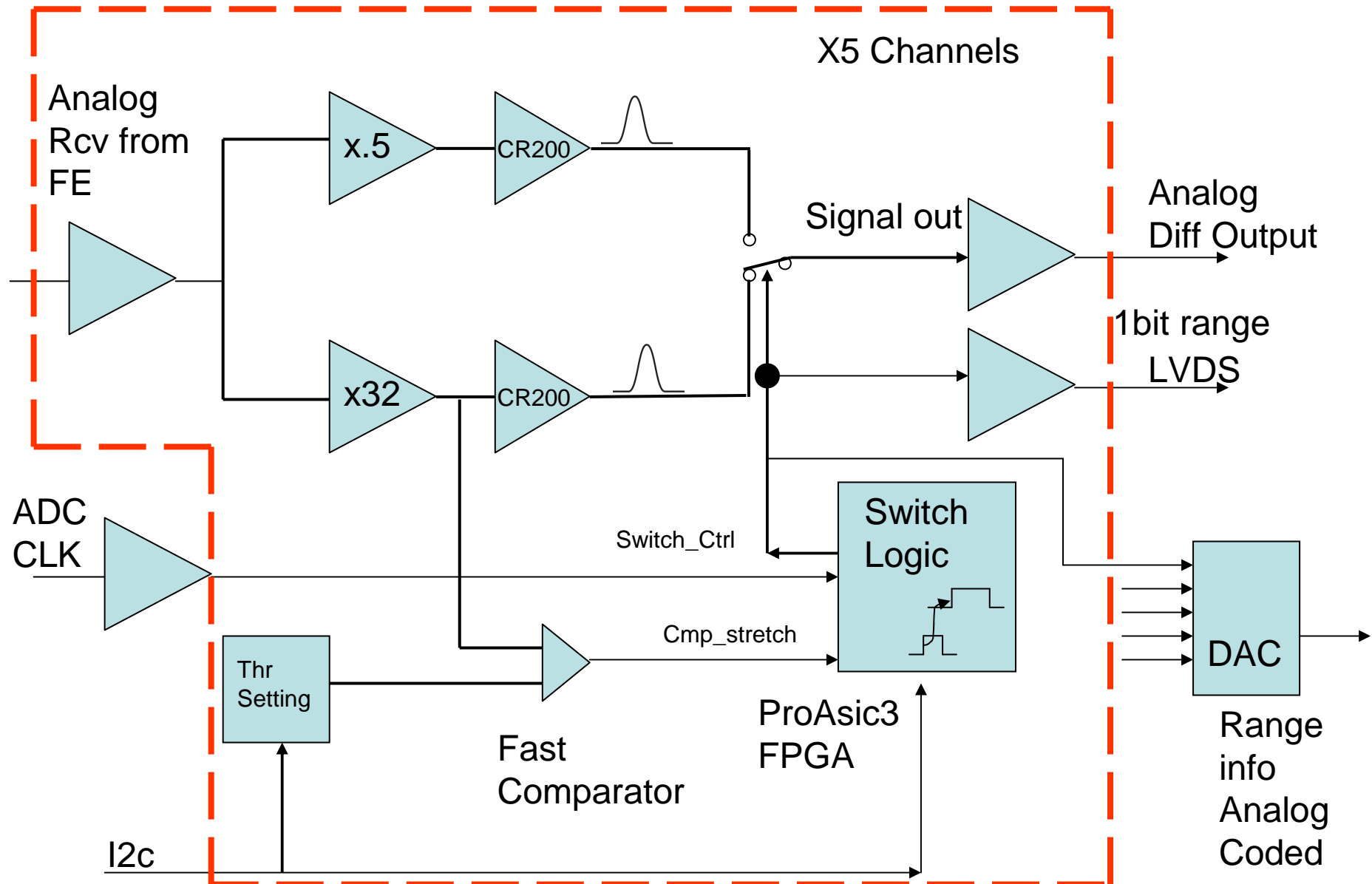


Very Front End Board

- EMC VFE Board
- 4 Layers
- 5 CSP Channels
- Enable to mount:
Cremat, Hamamatsu, Home Made CSP
- HV distribution
- Mounted on crystals
- Interface with EMC range Board

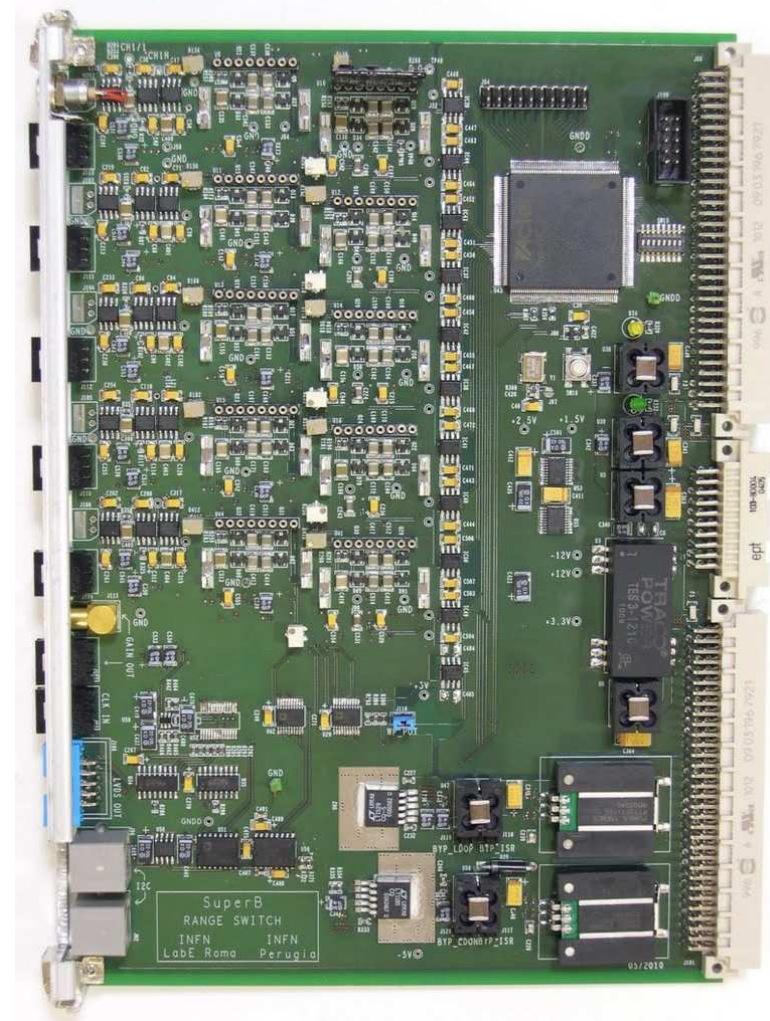


EMC Ranges shaper board

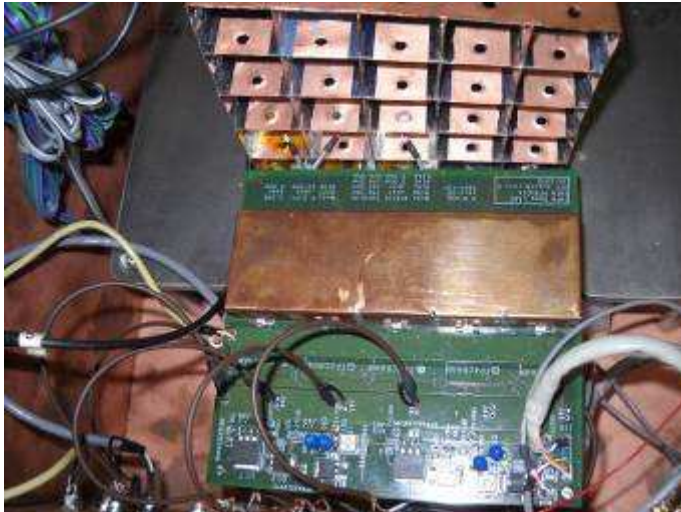


EMC Range Board

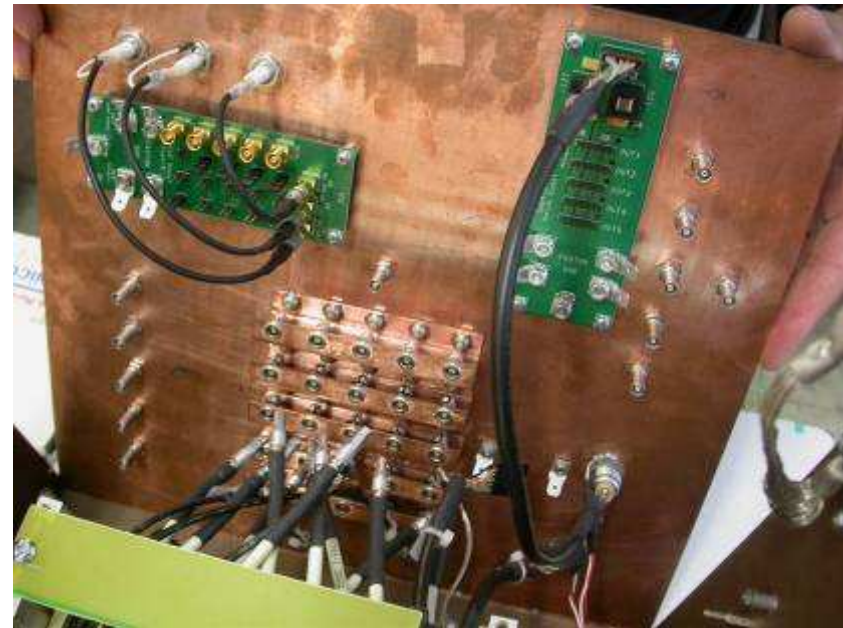
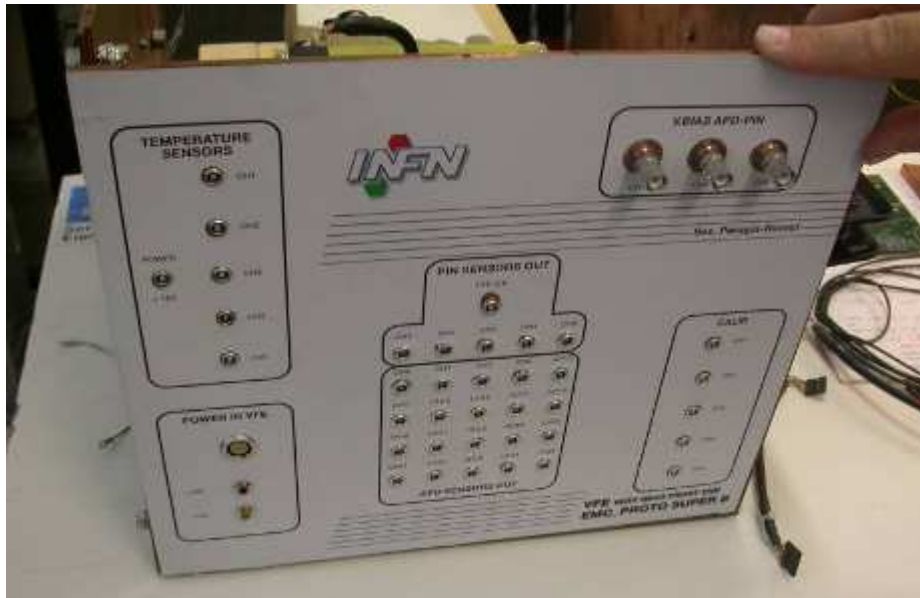
- EMC Range Board
- 8 Layers VME size
- 5 Channels Analog Differential input
- 5 Channels Analog Differential output
- 1 Main clock input
- Long line I2c control input
- Range info analog coded
- LvdS output for Range bit



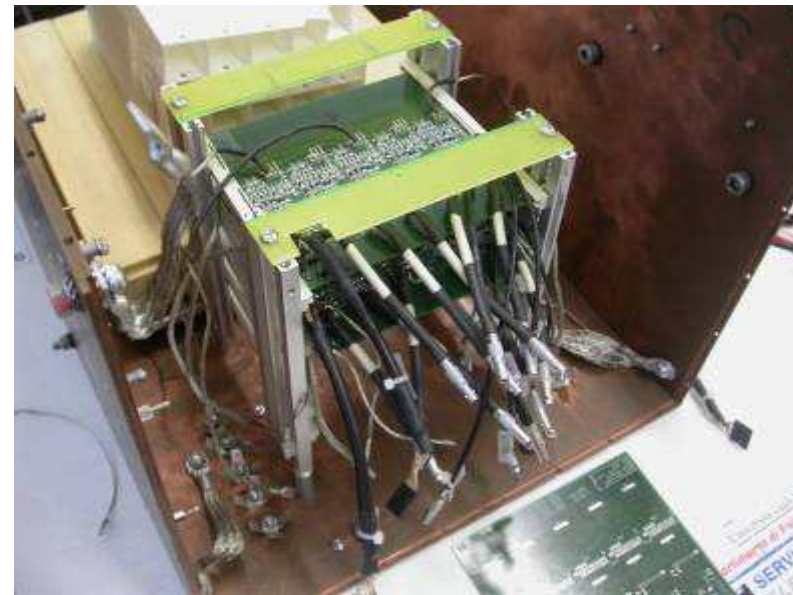
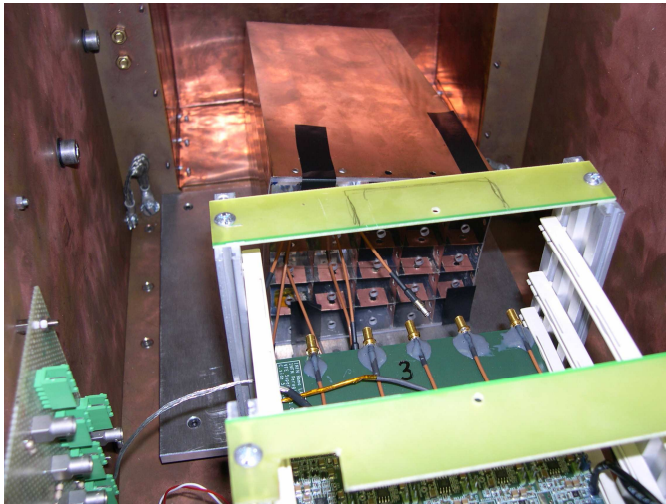
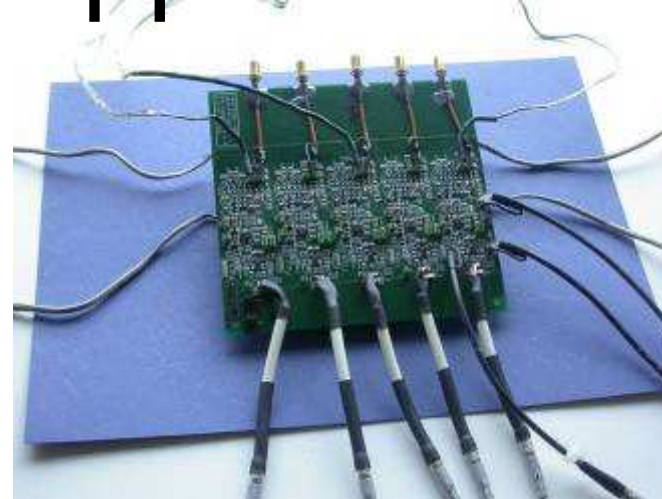
BTF setup



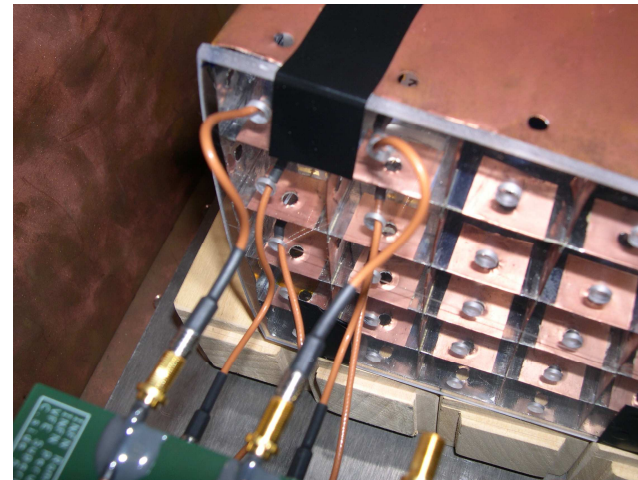
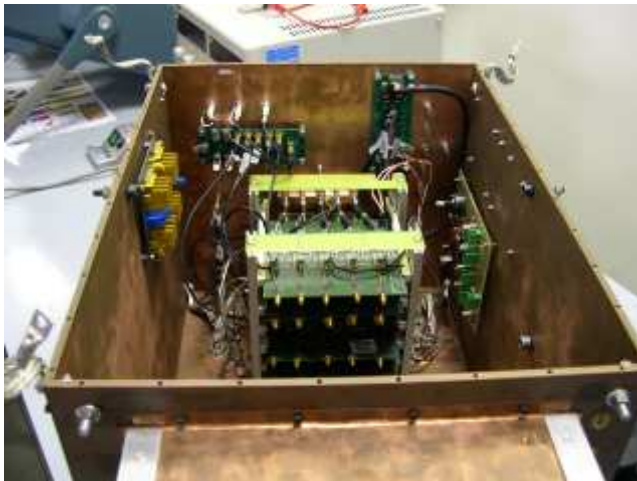
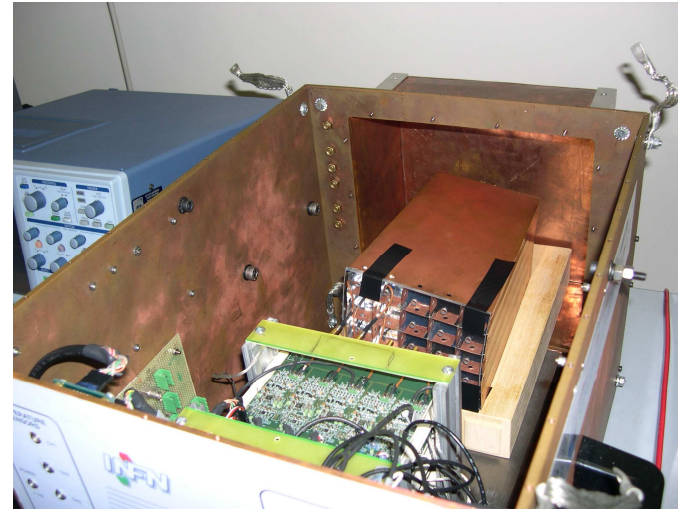
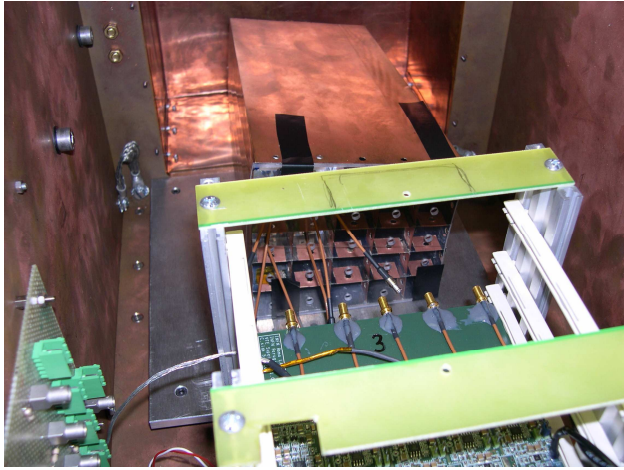
Front Panel Cabling



VFE inside the copper Box 1/2



VFE inside the copper Box 2/2

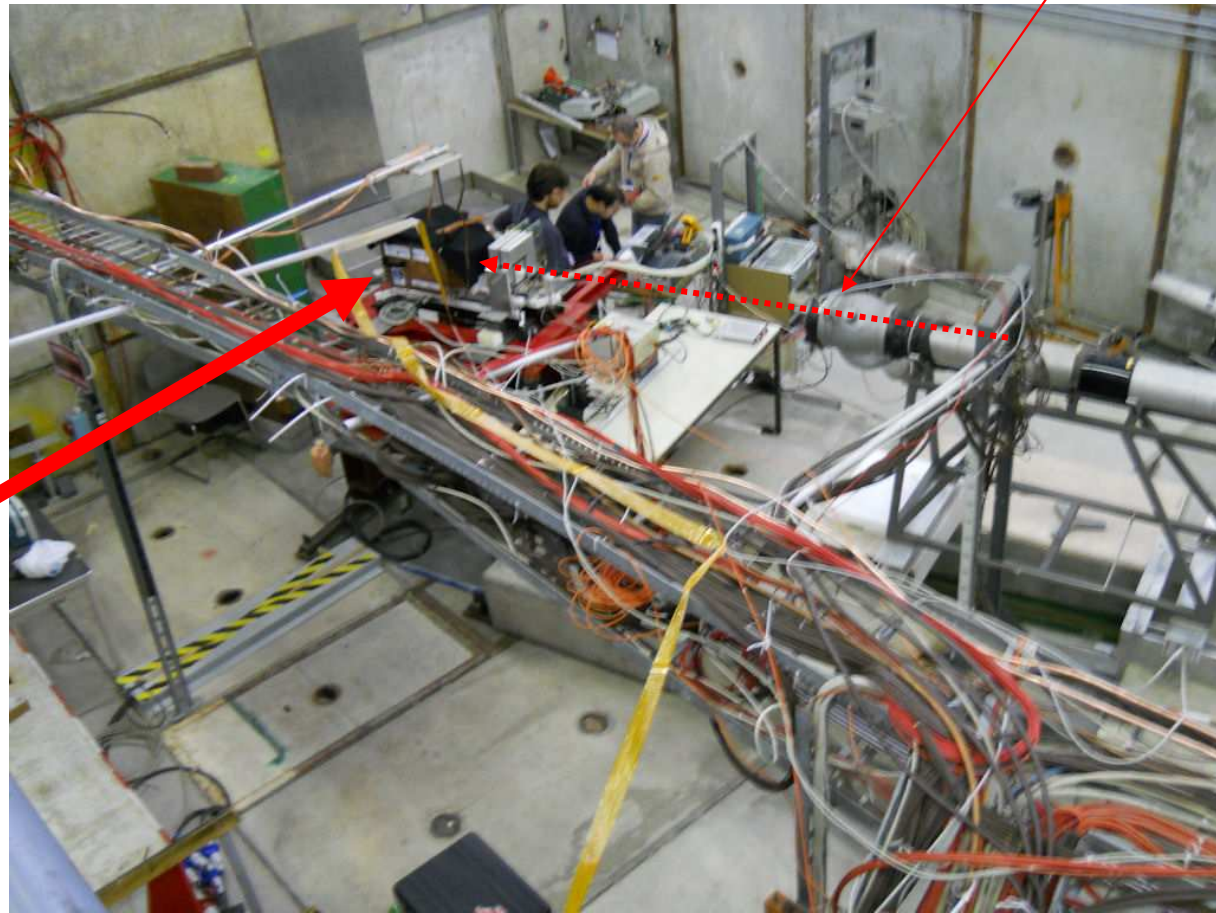


CERN test Beam 1/2

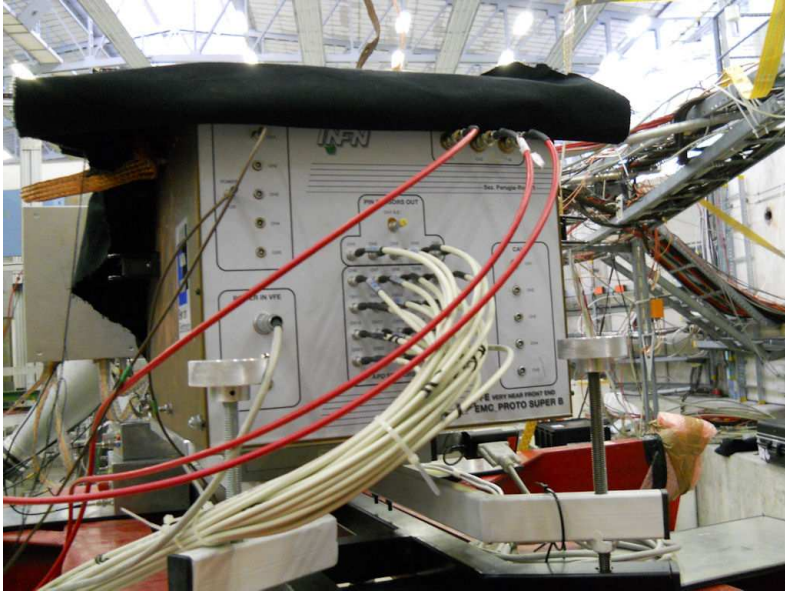
Beam



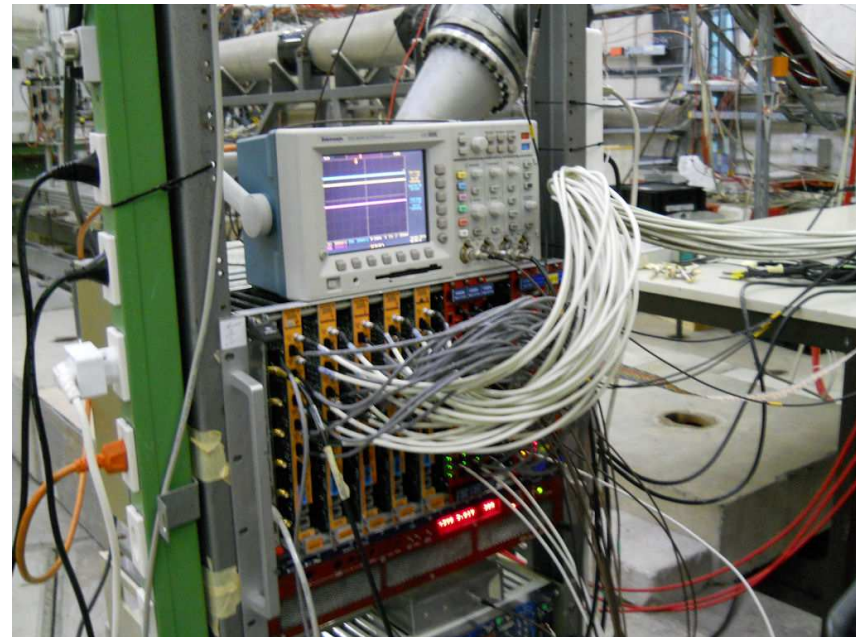
FE Box



CERN test beam 2/2



Front End Box

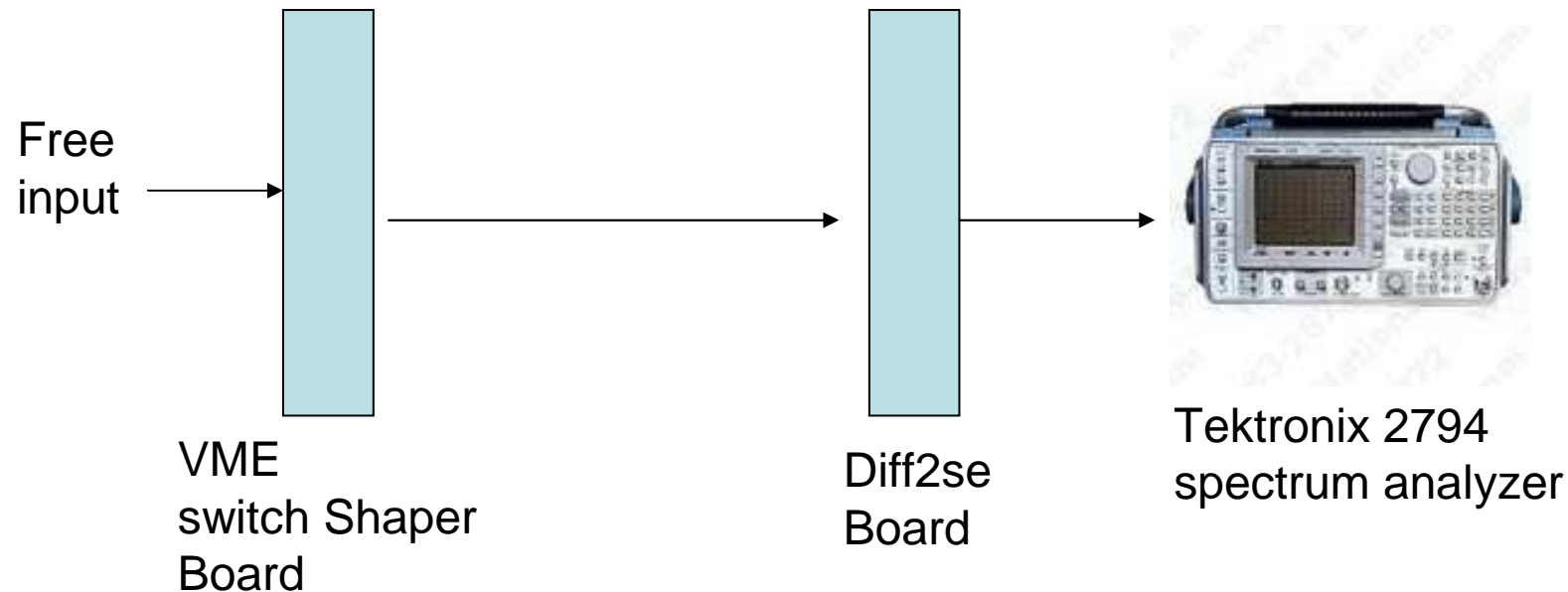


Shaper switch Boards

Noise Measurements using frequency domain approach

- The main source of electronic noise in the test beam was the shaper board.
- The approach to find ipotetic sources of noise in the time domain does not give enough information
- to exclude any specific source of noise the frequency domain approach is better

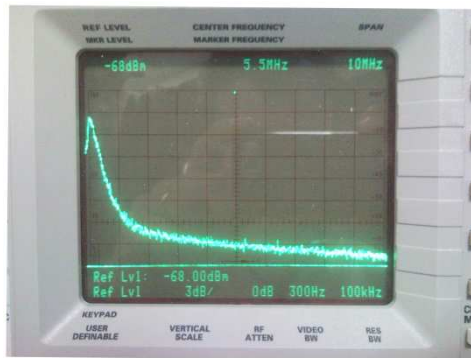
Frequency domain measurements



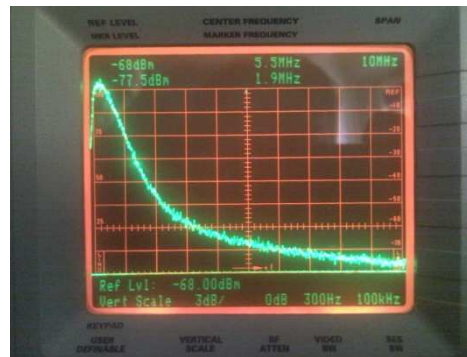
We use a tektronix 2794 spectrum analyzer to measure the noise of any shaper channel

As we know the noise spectrum depends from the shaping time we do not find any noise source with an heavy contribution.

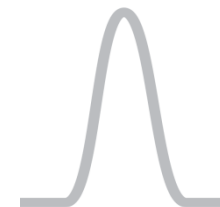
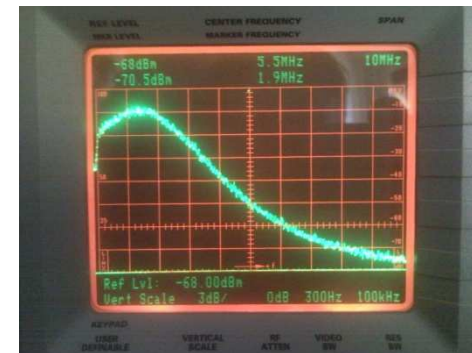
Power Spectrum 500 ns Shaper



Power Spectrum 250 ns Shaper

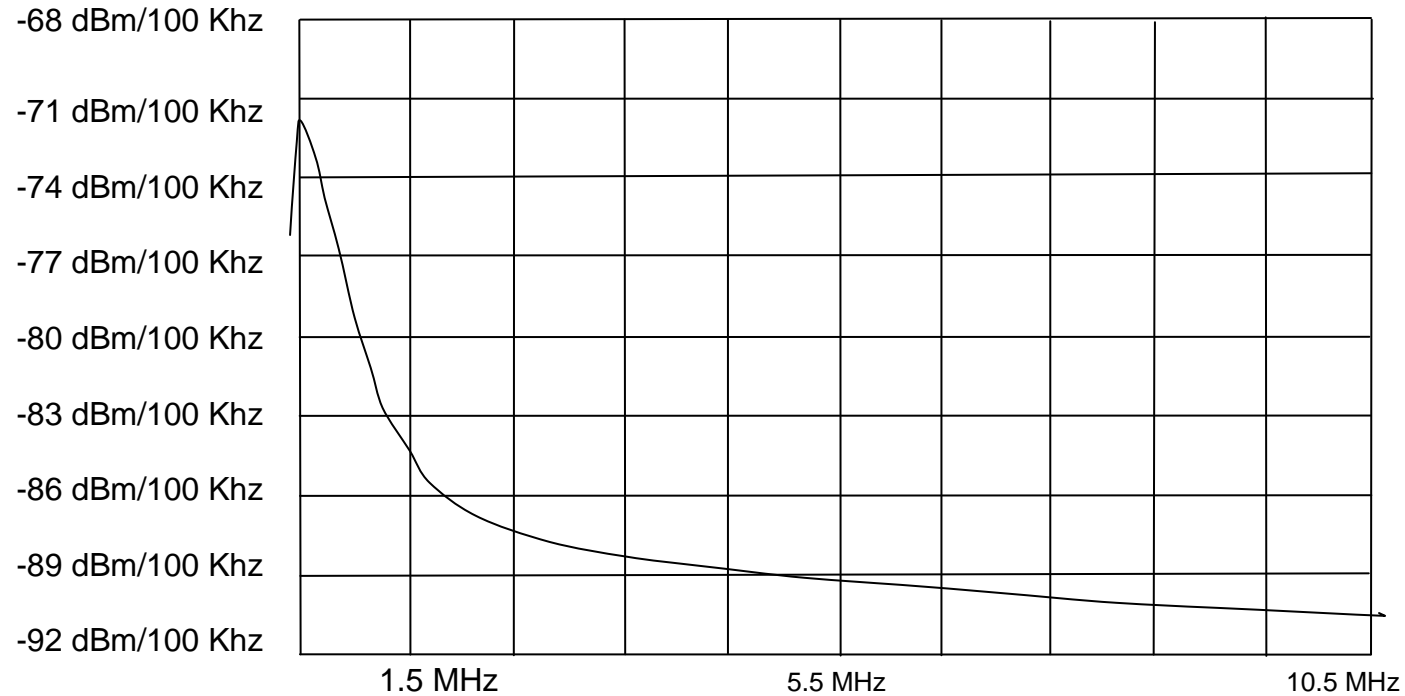


Power Spectrum 100 ns Shaper



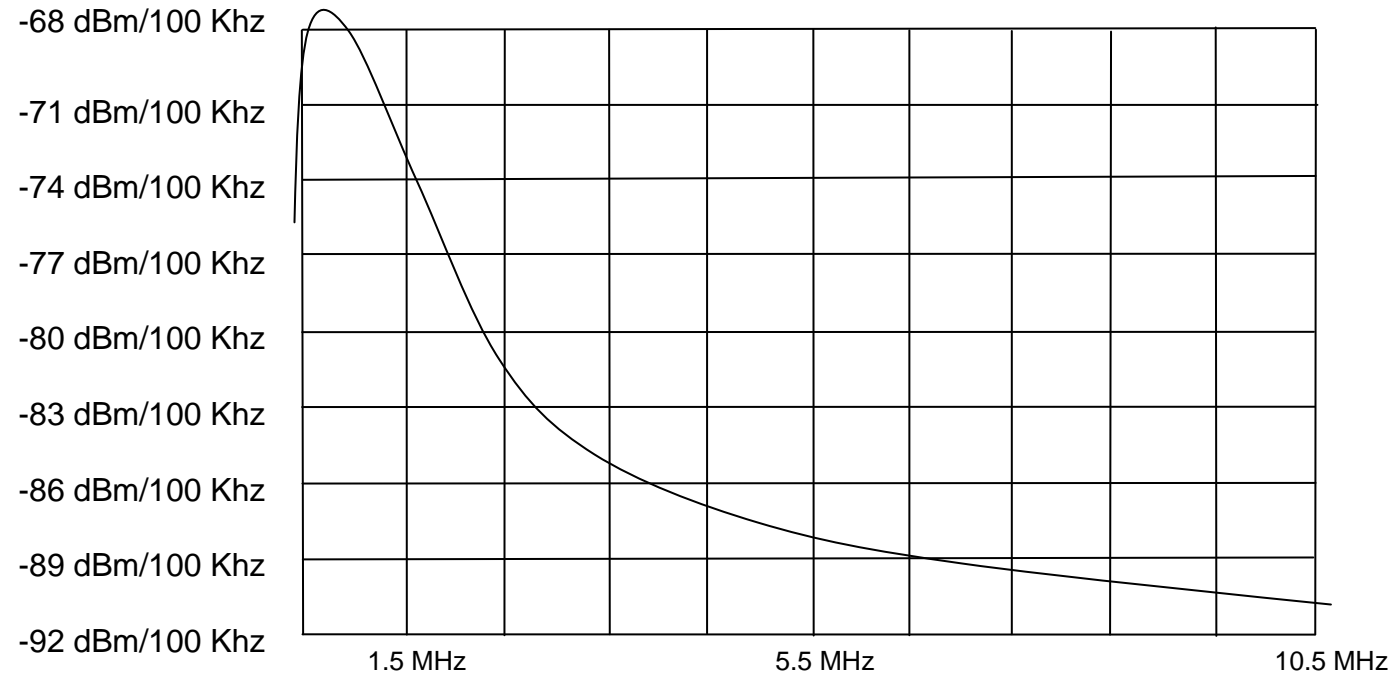
More noise

Power Spectrum 500 ns Shaper

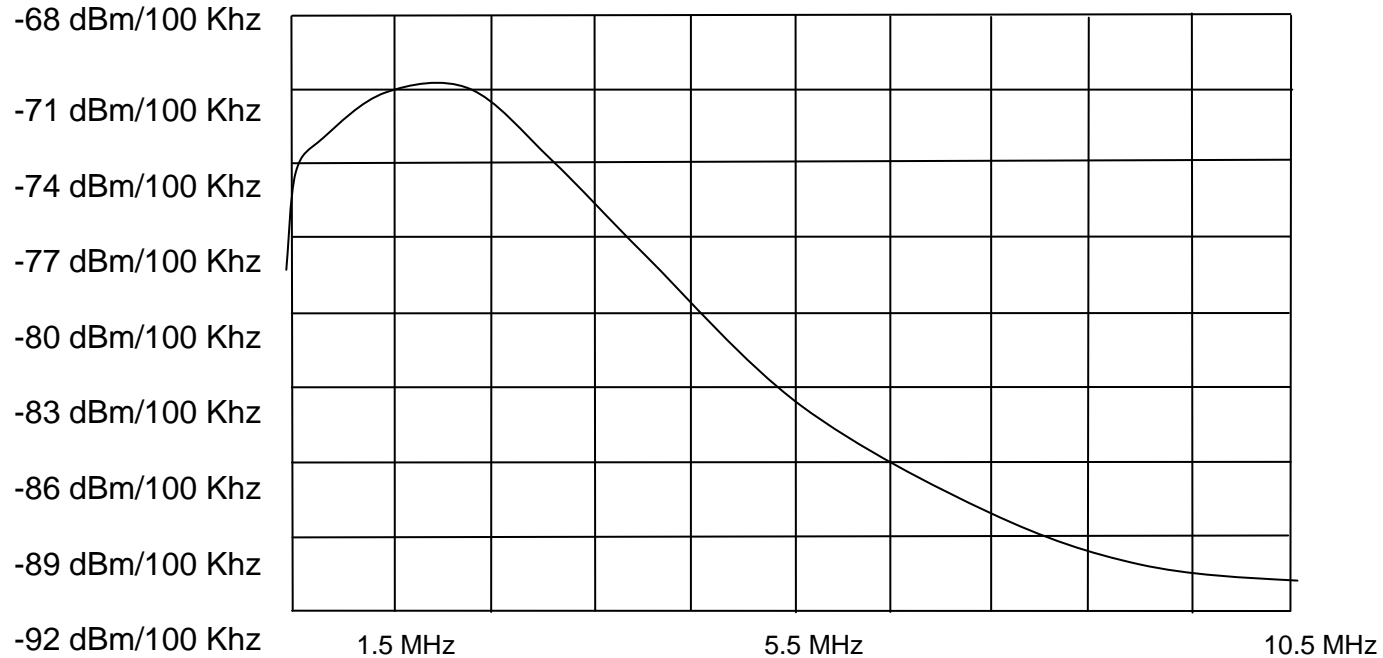


This is the shaping time used in LNF beam test

Power Spectrum 200 ns Shaper



Power Spectrum 100 ns Shaper

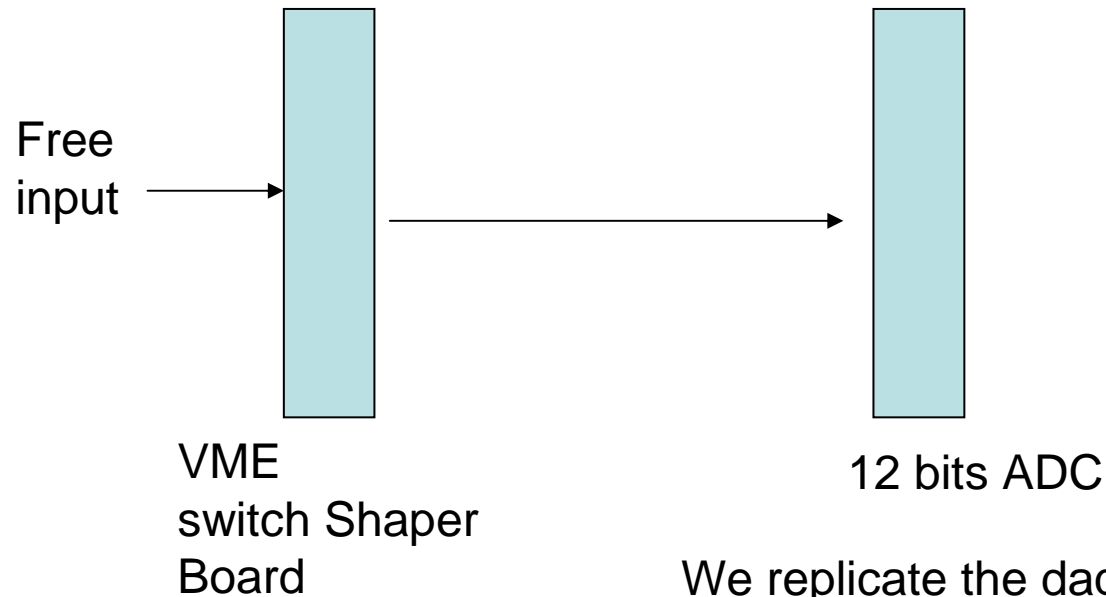


This is the shaping time used during the CERN test beam

We integrate the noise spectrum
and we have evaluated the noise
level in V_{eff}

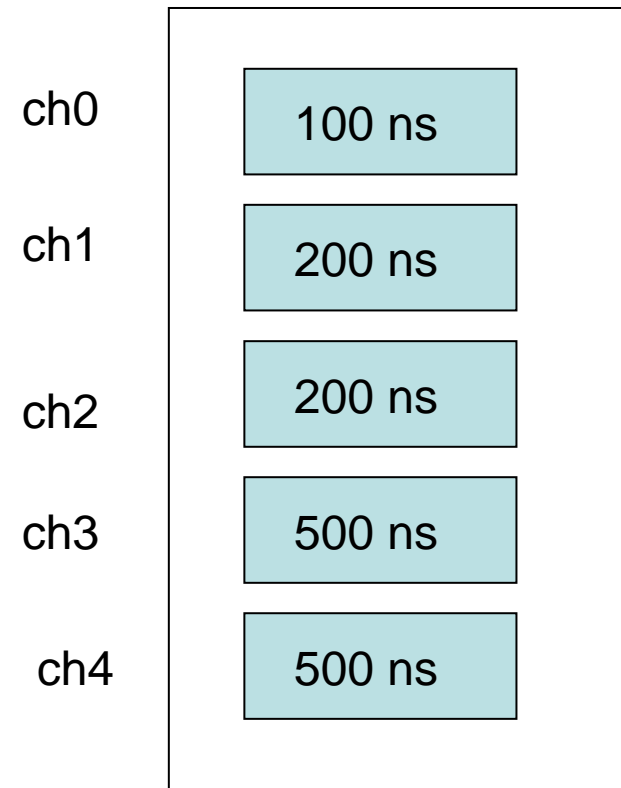
- **100ns -> 745 μV_{eff} (0.5-10.5 MHz)**
- **200 ns -> 565 μV_{eff} (0.5-3.5 MHz)**
- **500 ns -> 418 μV_{eff} (0.1-2.1 MHz)**

Frequency domain approach using the ADC and data analysis



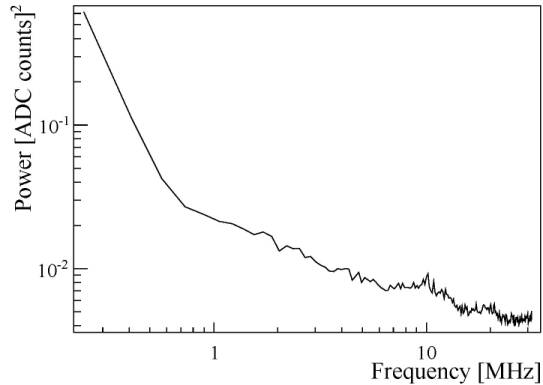
We replicate the daq setup at CERN in Rome

To evaluate the noise dependence from the shaping time we use a board with 5 different shaping time



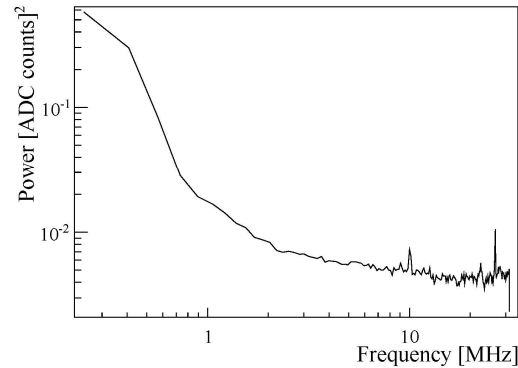
Frequency domain calculated from ADC data

Noise PS of crystal 4 in run 522



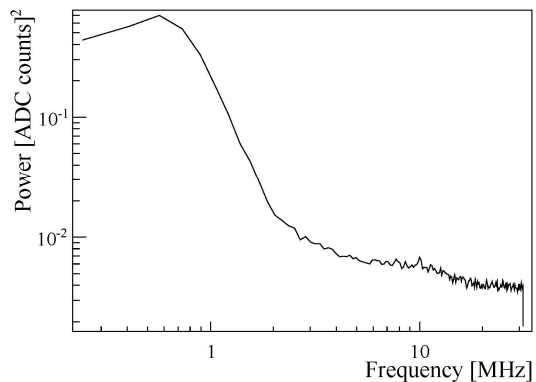
500 ns shaping time

Noise PS of crystal 2 in run 522



200 ns shaping time

Noise PS of crystal 0 in run 522



100 ns shaping time

ch0: 1.97878 -> 965.264 μ V
ch1: 1.7537 -> 855.464 μ V
ch2: 1.39712 -> 681.736 μ V
ch3: 1.29801 -> 633.424 μ V
ch4: 1.43141 -> 698.328 μ V

Equivalent noise measurements

Value with the spectrum analyzer

Ch 0 100ns -> 745 μ Veff(0.5-10.5 MHz)

Ch 2 200 ns -> 565 μ Veff (0.5-3.5 MHz)

Ch 3 500 ns -> 418 μ Veff (0.1-2.1 MHz)

Value using the daq system

100 ns ch0: 1.97878 -> 965.264 μ V

200 ns ch1: 1.7537 -> 855.464 μ V

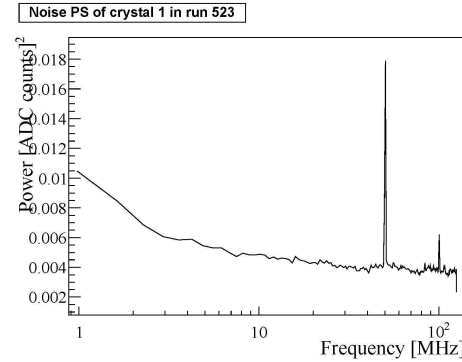
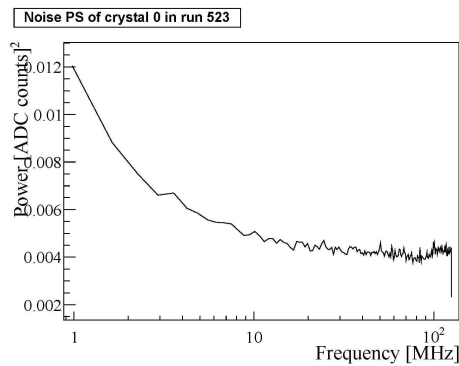
200 ns ch2: 1.39712 -> 681.736 μ V

500 ns ch3: 1.29801 -> 633.424 μ V

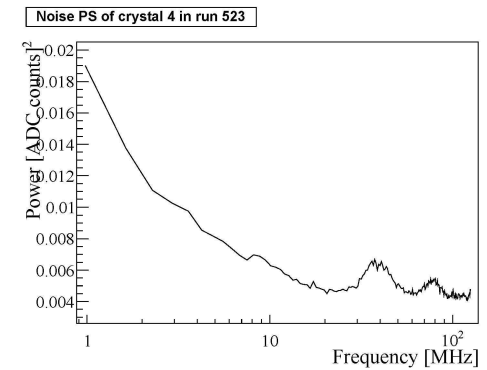
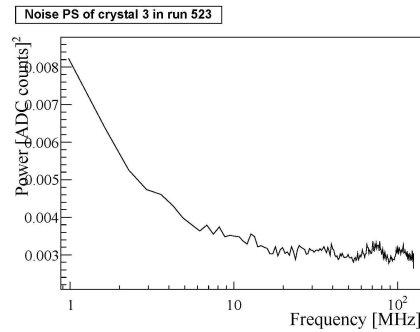
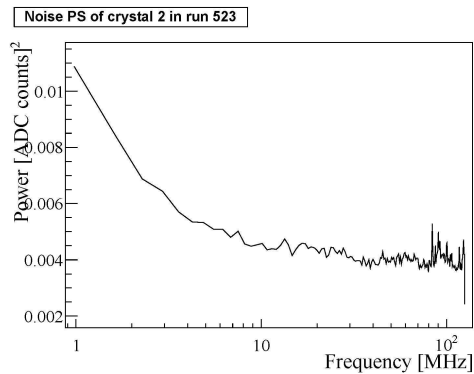
500 ns ch4: 1.43141 -> 698.328 μ V

The value from the daq analysis are full bandwidth (0-100 Mhz)
the value calculated from spectrum analyzer are in limited BW.

ADC without input



RMS [ADC]
ch0: 0.917437
ch1: 0.898957
ch2: 0.897097
ch3: 0.779097
ch4: 1.0034



Conclusions

- The electronics in the test beam perform well also if we reach the 25 channels target at the last minute.
- We evaluate shorter shaping time (100 ns) but the request of the experiment can be more tight and we have to manage more noise.
- The choice to split the fast signals (pre shaper) for trigger and slow signals for readout comes up.
- The frequency domain analysis does not show any contribution from interference frequencies.
- The noise level is well known and can be inserted in the simulation
- The rms value for the 100 ns shaper is consistent with 2.1 count (shap+ADC) and 1 count (ADC alone) shown from CERN data
- The rms value of the shaper board is better than shaper data sheet value.
- The use of 100 ns shaper respects the 500 ns shaper used in Frascati gives more noise
- We can learn from this how short shaping time gives more noise and we have to find action to reduce this noise.
- We use a 125 MHz BW ADC than integrate more noise if necessary have to postprocess data cutting the high frequency components.