ECL update

C. Cecchi for the ECL italian group

Outline

- BEAST preparation
  - Pure CsI + PMT
  - LYSO + APD
- TEST beam results LNF and Mainz (August 2015)
- Other activities
- Software

BEAST

Goals:

1. Protect Belle II: Ensure radiation levels safe before Belle roll-in
2. Measure individual beam background components
3. System tests (beam abort, VXD occupancy, cooling, mask control system)
4. Provide real-time feedback to SuperKEKB

Phase 1 Jan 2016

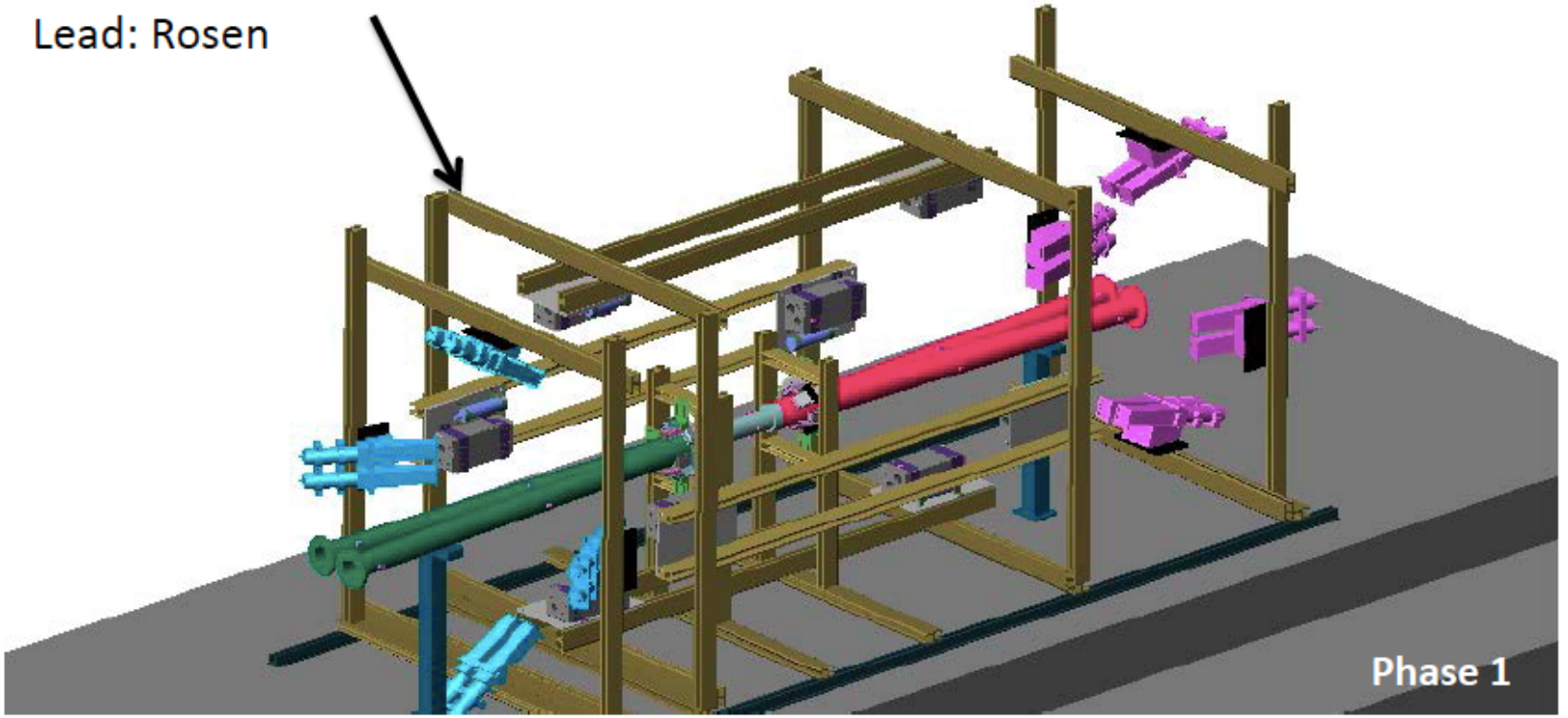
Scrubbing of beam pipe
No collisions, Belle will not roll in
Variety of subsystems on fiberglass support structure

Phase 2 Feb 2017

Belle rolled in
VXD BEAST
He-3 and TPC neutron detectors in VXD dock space

Phase 1: design

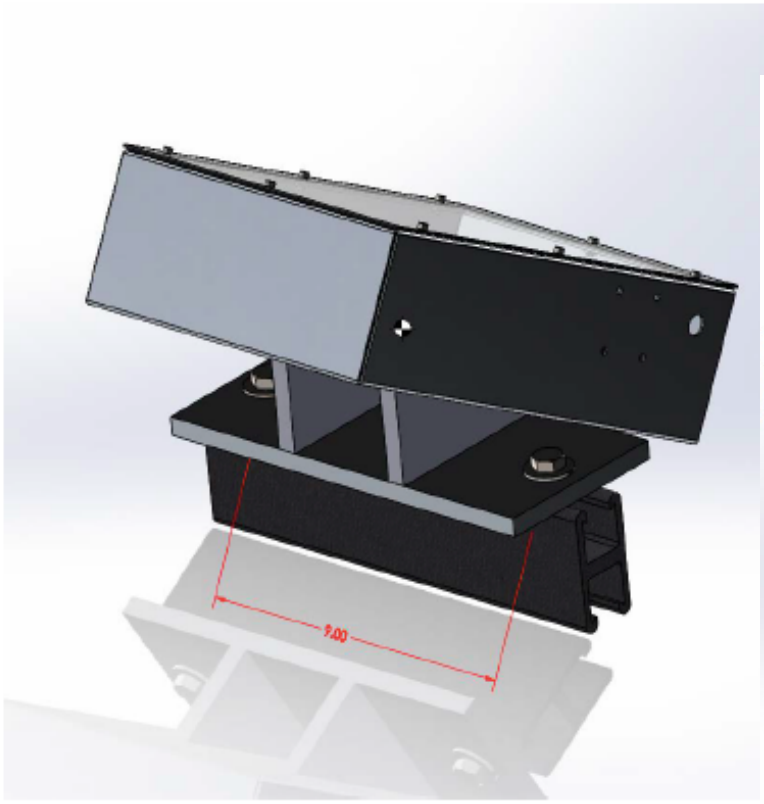
- Hawaii delivering phase 1 mechanical mounting structure
- Lead: Rosen

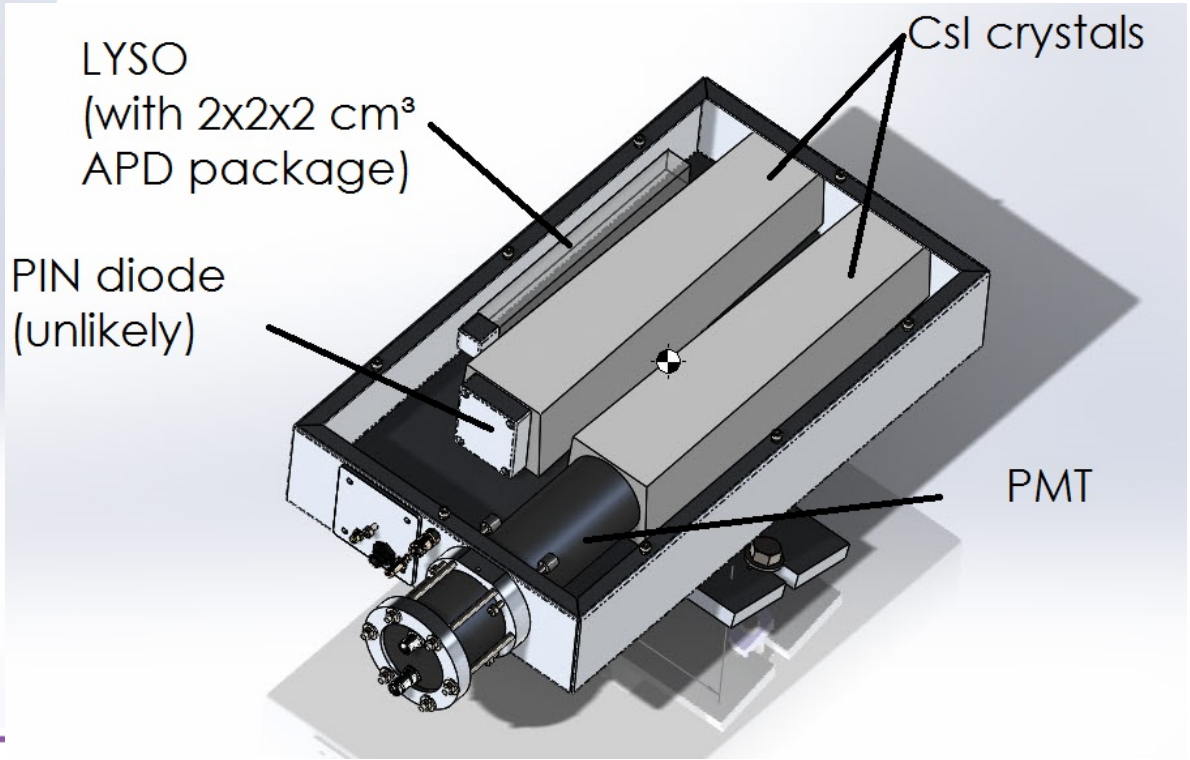


- Variety of detector systems on fiberglass support structure
- Some detectors (TPCs, He-3 tubes, PIN diodes) can be easily moved manually
- Full 3D CAD exists (Rosen). Also has been incorporated in the Belle II simulation (Jaegle).
- All parts procured, most assembly, to be used for “MiniBEAST” system test January 2015.
- Disassemble and ship to KEK August 2015.

Crystals: CsI + LYSO

Use 6 CsI pure + 6 CsI(Tl) + 6 LYSO for BCKG and dose measurement (validation simualtion)





Holder for pair of crystal, preliminary mechanical design by U. of Victoria.

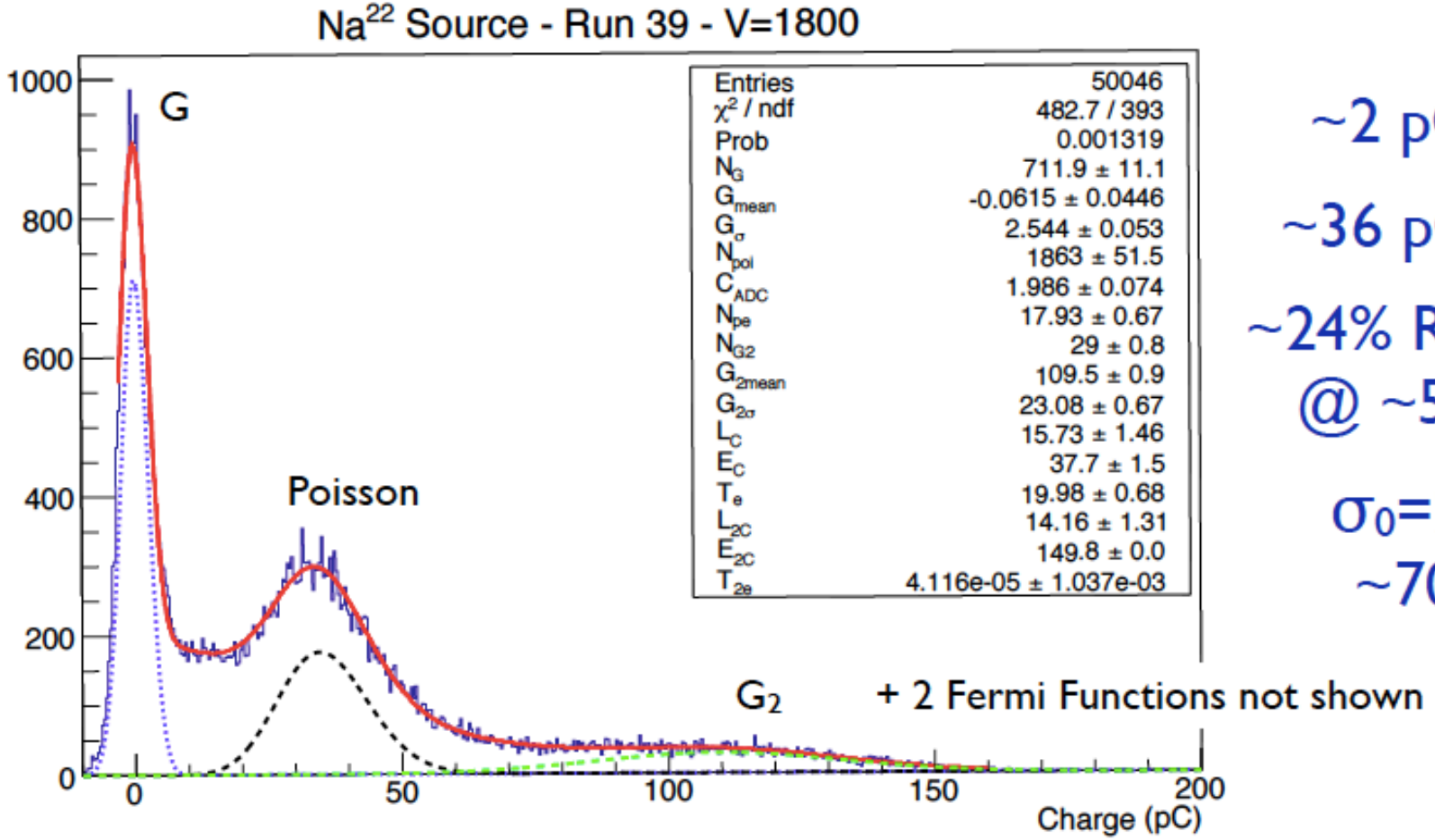
Study@LNF pure CsI + PMT

1 pure CsI (Optomaterials) 5x5x30 cm^3

1 PMT from RM3 (2262) 2", $G=10^7$, QE@310nm≈30%

Na^{22} source + CR data

Na^{22} Source - RUN 39



~2 pC/p.e.

~36 pC/MeV

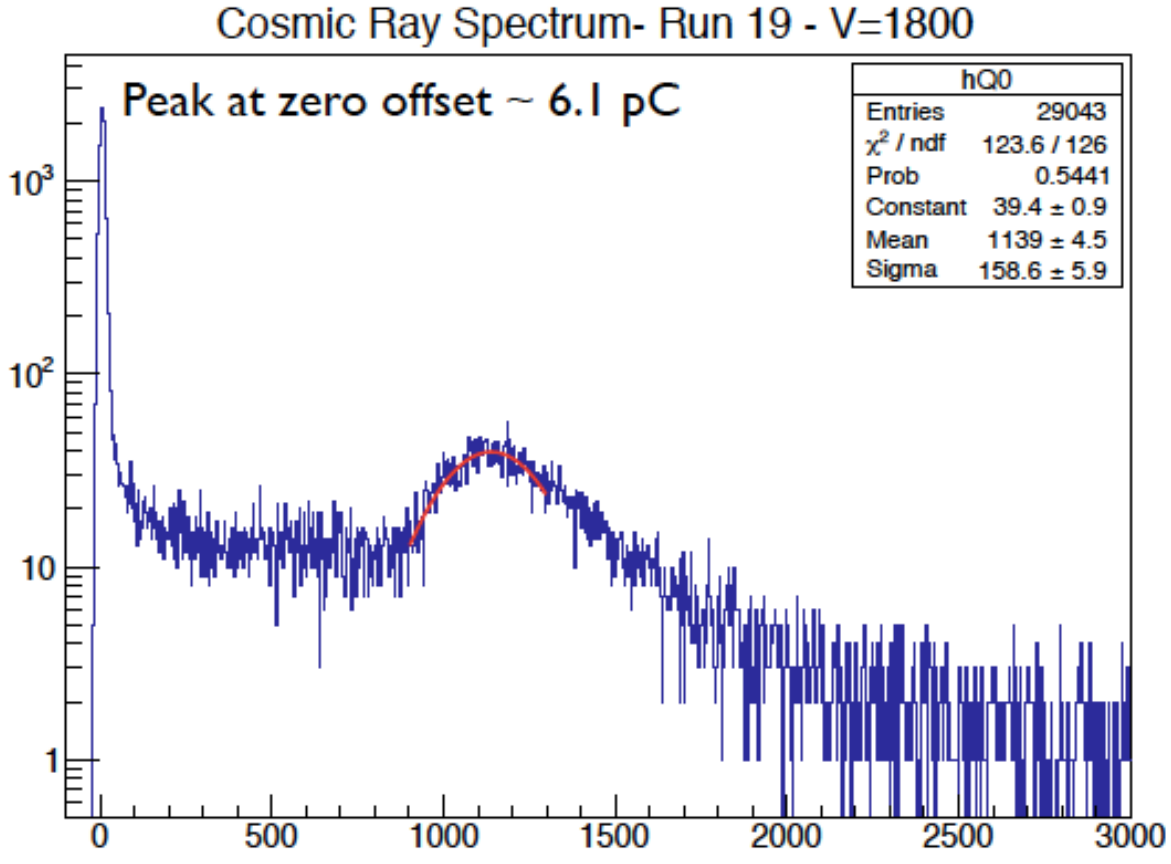
~24% Resolution @ ~511 KeV

σ_0=2.5 pC
~70 KeV

Fit Function*: $S(E) = N\frac{N_{p.e.}^{(E/C_{ADC})}\, e^{-N_{p.e.}}}{(E/C_{ADC})!} + \frac{L_C}{e^{(E-E_C)/T_e}+1}$ + 2 gaussians

(*) S. Baccaro, et al.NIM A385, (1997) 69-73

Cosmic Ray Data - RUN 20



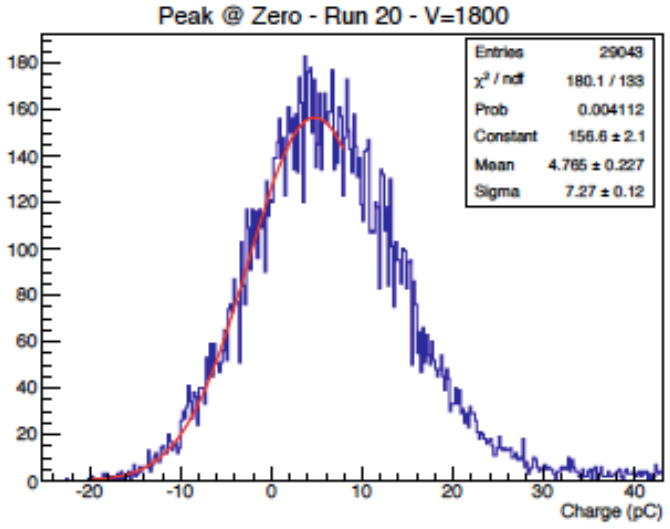
~2 pC/p.e.

~38 pC/MeV

~14% Resolution @ ~30 MeV

σ_0=7.3 pC

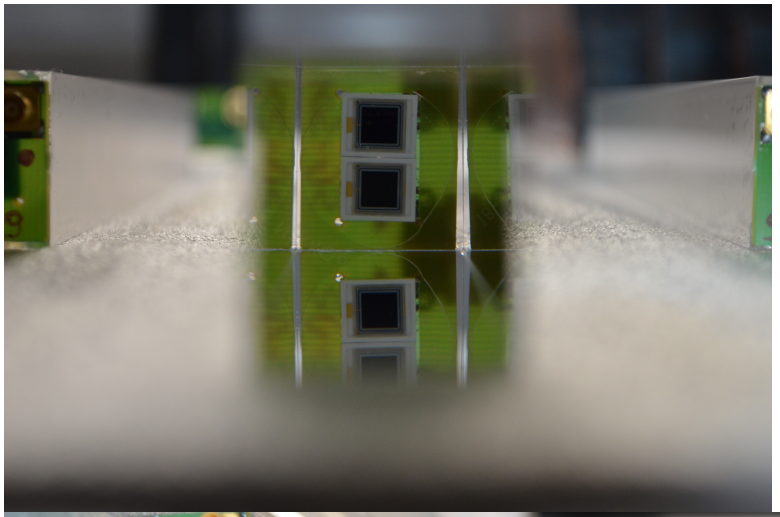
~190 KeV

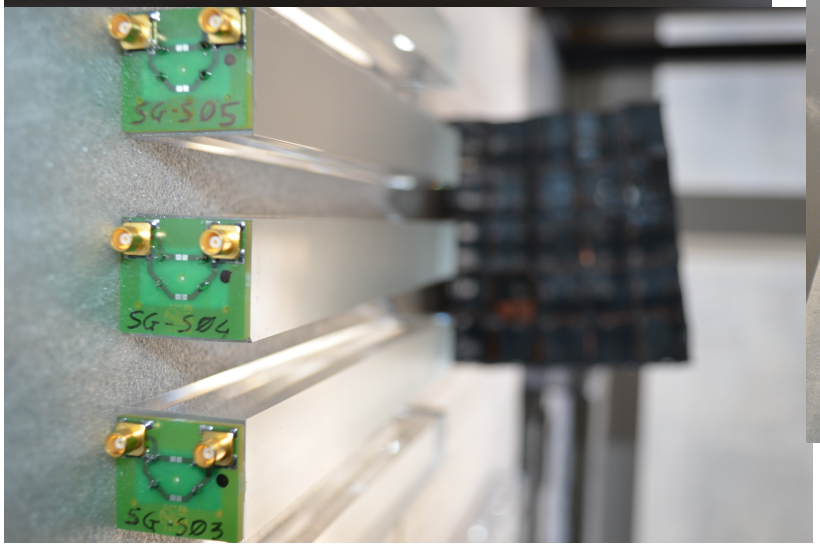


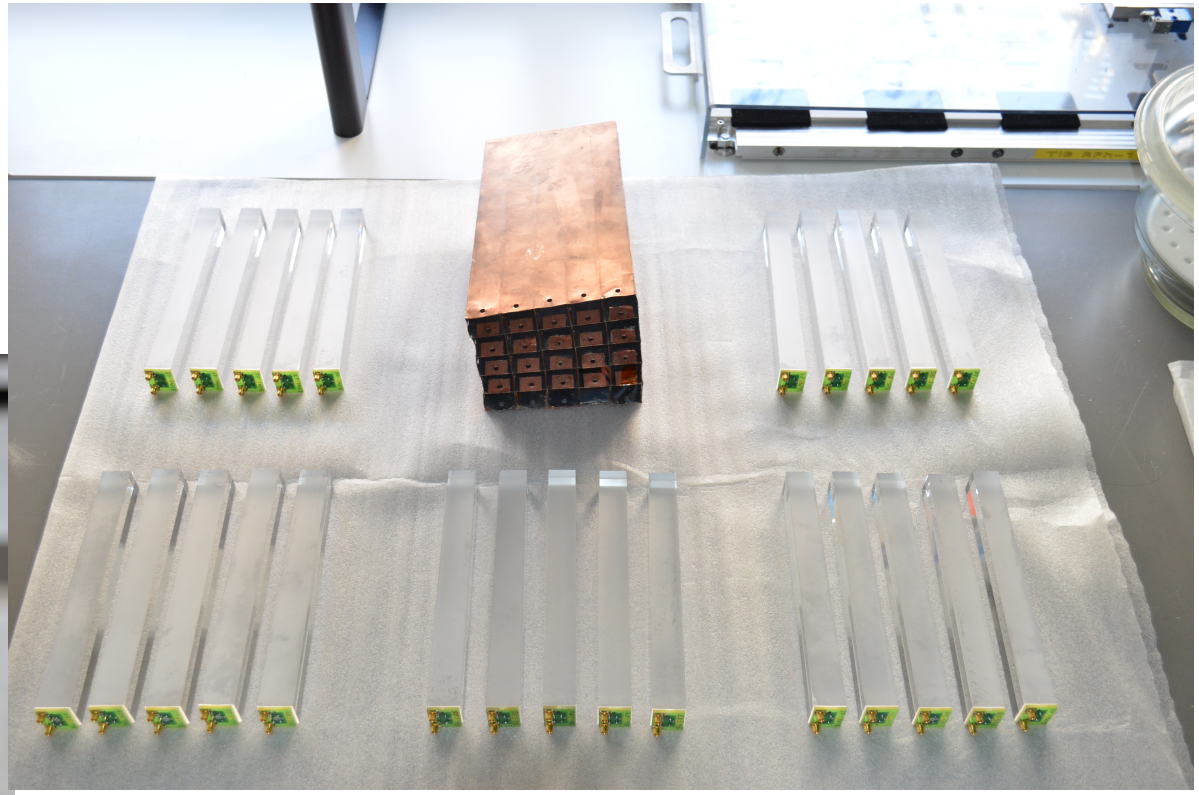
PG: Cecchi, Manoni, Rossi

LYSO crystals

LYSO crystals studied for the SuperB FWD calorimeter 2x2x20 cm^3 with APD readout

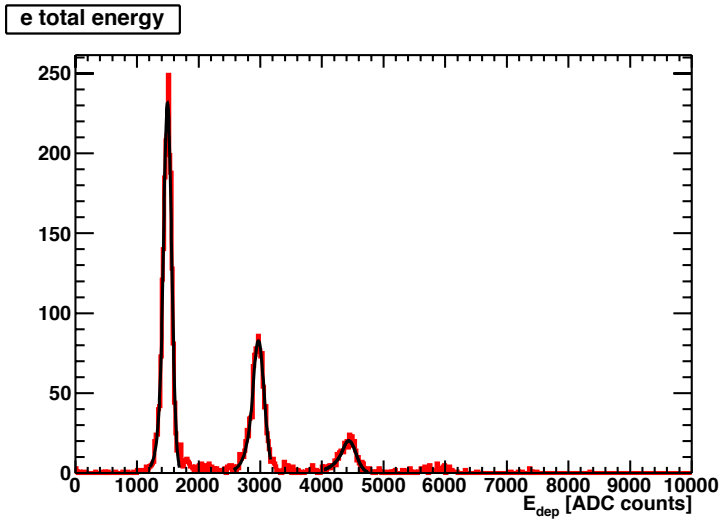


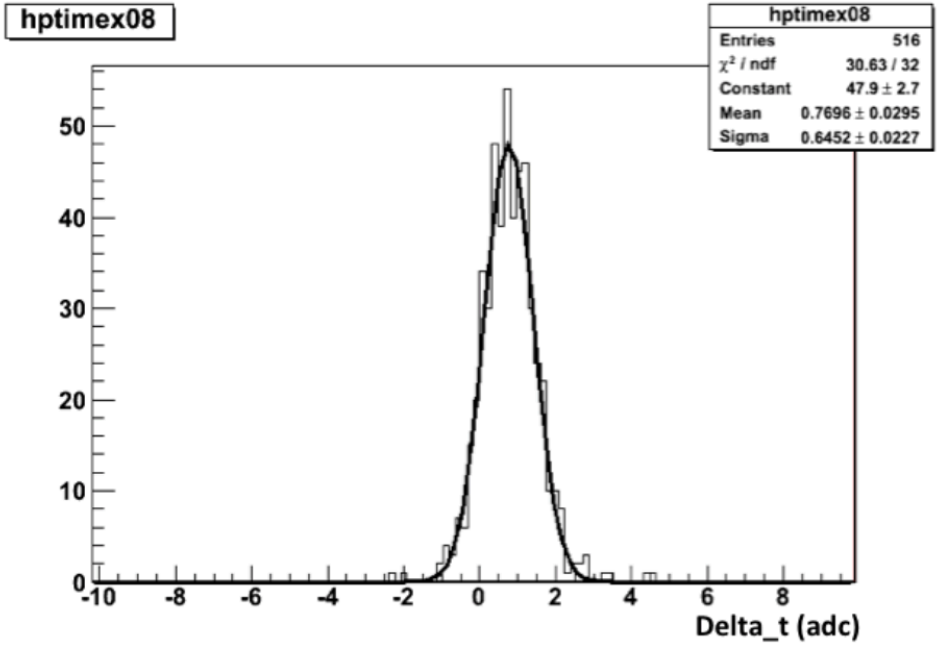


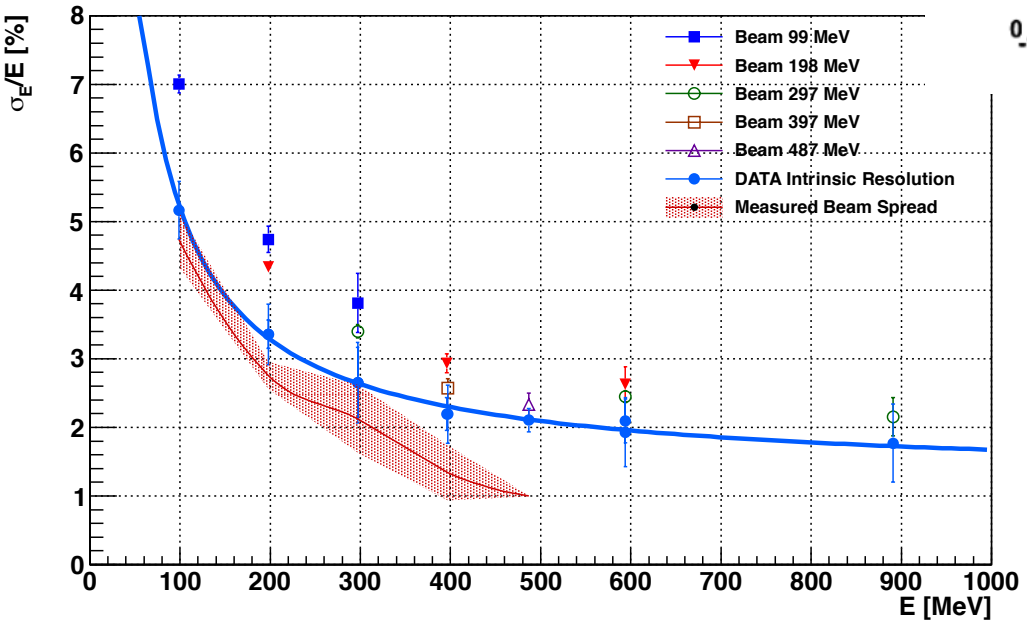


PG: Cecchi, Manoni, Rossi

LYSO performance

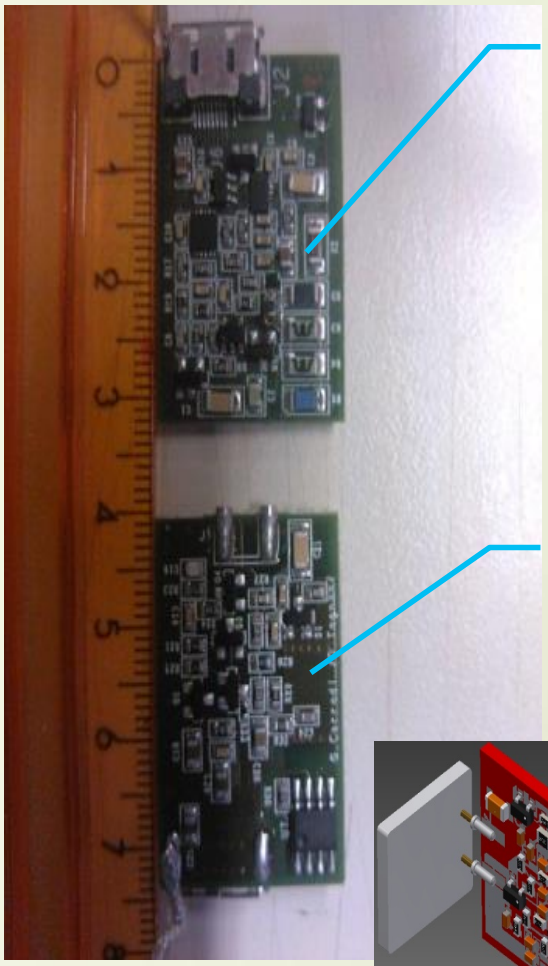






$$\sigma_{ris}^{cristallo\ 8} = \frac{\sigma_{gaus}}{\sqrt{2}} \cdot 4 \cdot \frac{ns}{conteggi\ di\ ADC} = (1.84 \pm 0.06) ns$$

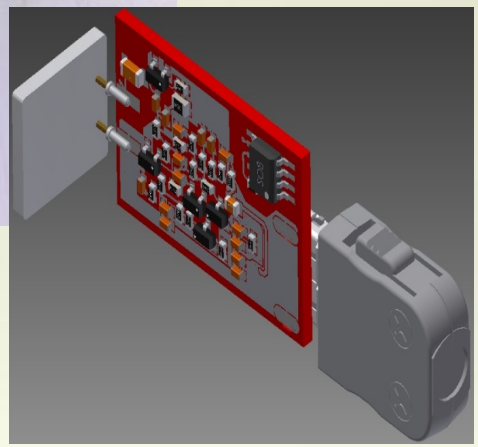
Front End.

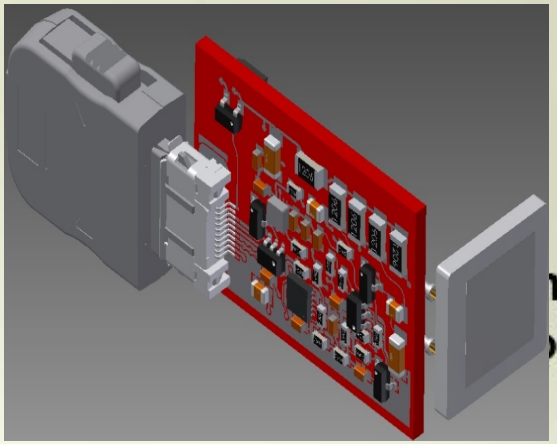


TOP side.
Detector linear voltage regulator

Charge pre-amp and detector Voltage regulator.

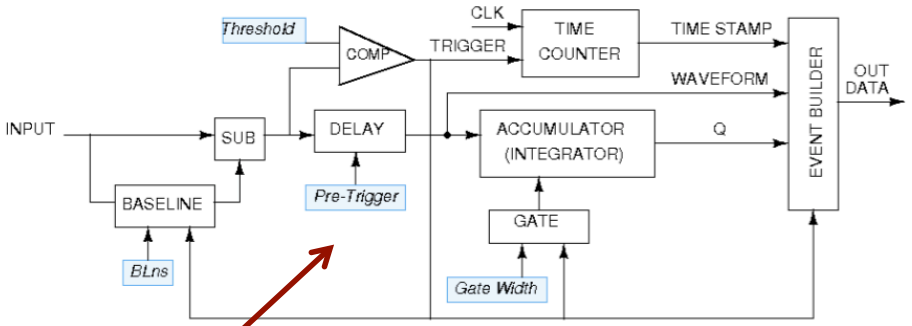
BOTTOM side.
Charge pre-amp.

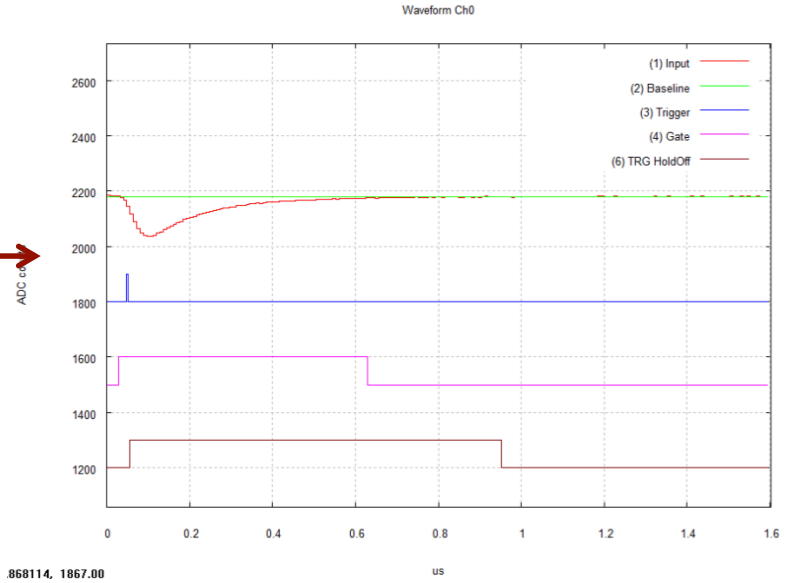




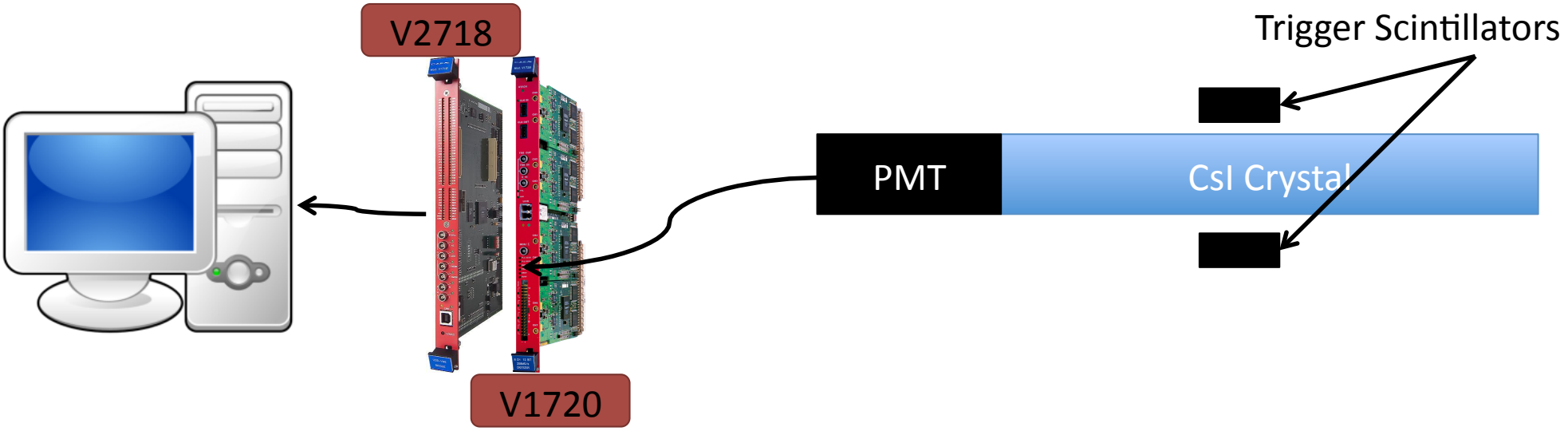
DAQ test

- Target: Test Caen V1720 readout capabilities
- V1720
  - Flash ADC 250MS/s
  - Two firmware possibility
    - "Oscilloscope mode"
      - N sampling for each channel (N can change)
    - "Digital Pulse Processing mode"
      - Only Amplitude and Time are saved
      - Need "ad hoc" configuration
      - To enhance time resolution a "Mixed mode" is possible
        - » Few sampling saved in order to refit offline to extract time info





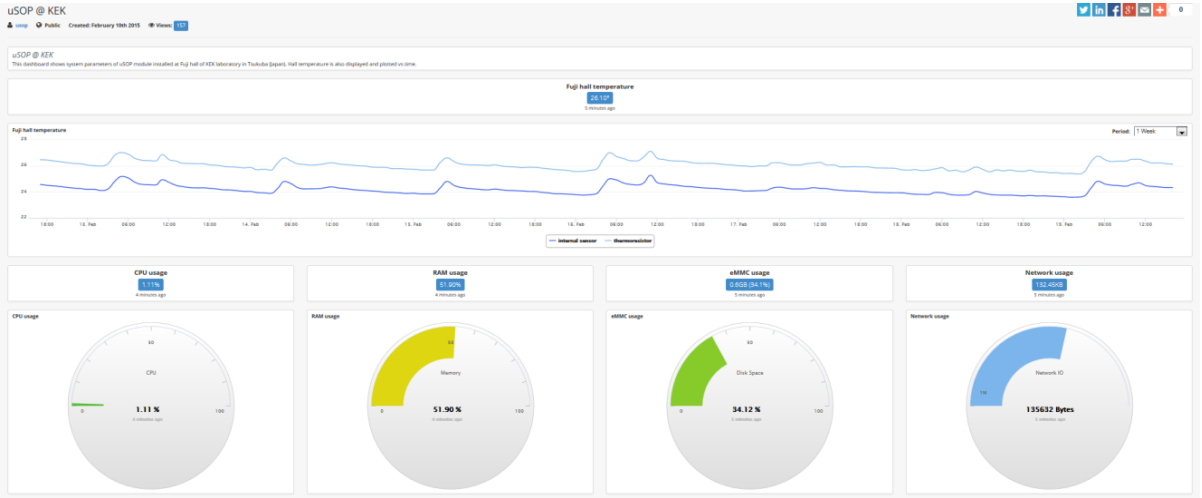
DAQ Test SetUp



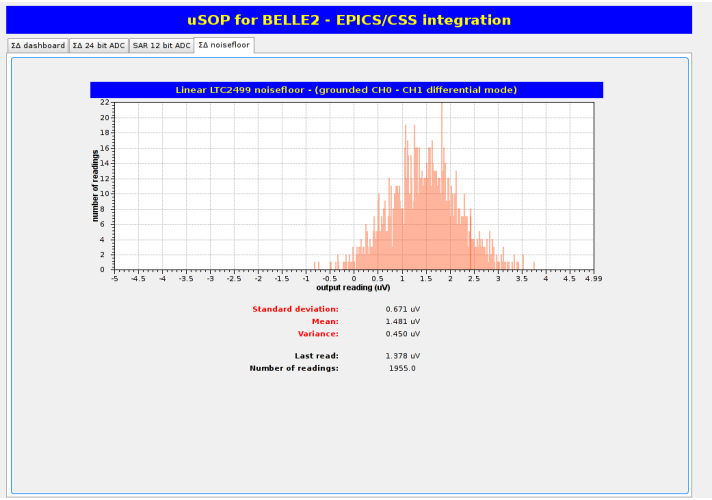
- To test the rate capabilities a random trigger with adjustable frequency will be used

NA: A. Aloisio, R. Giordano

Taking data @ Fuji Hall



(b) Temp in the Fuji Hall and uSOP system parameters – via web page



(a) 24-bit ADC noise floor: 600nV RMS – via EPICS and CSS

- uSOP is taking data in the Fuji Hall since the last B2GM (Feb. 2015)
- EPICS IOCs read/frame temperature data and ADC noise floor
- Data is also published on a web site for an easy and interactive real-time display:
  →→ try browsing the URL: http://bit.ly/1zGAtyL

NA: A. Aloisio, R. Giordano

uSOP @ BEAST

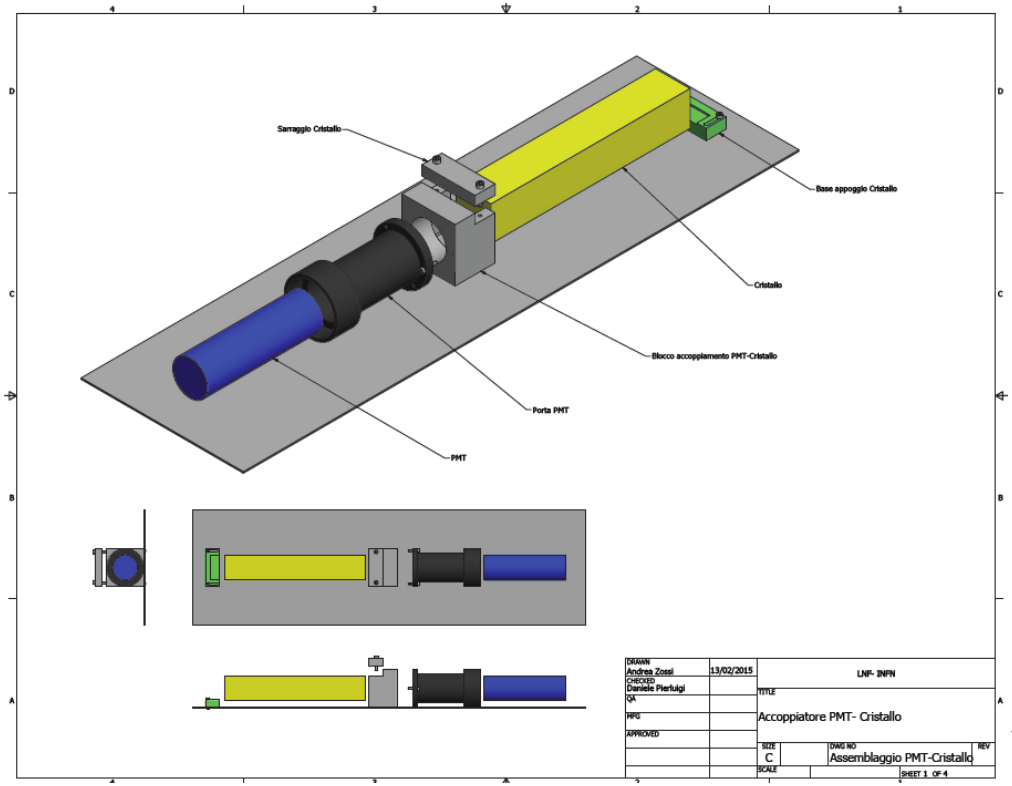
- uSOP can be deployed in the following applications:
  - Temp, Rel-Humidity acquisition
  - Current, voltage read-out
  - Dosimeter controllers handling via RS232, SPI, I2C, Ethernet
  - Pre-amplifier, HV supply programming and read-out
  - Virtually any slow-control, needing high resolution and low sampling rate (ADC noise floor: 600nV RMS @ 5Hz sampling rate)

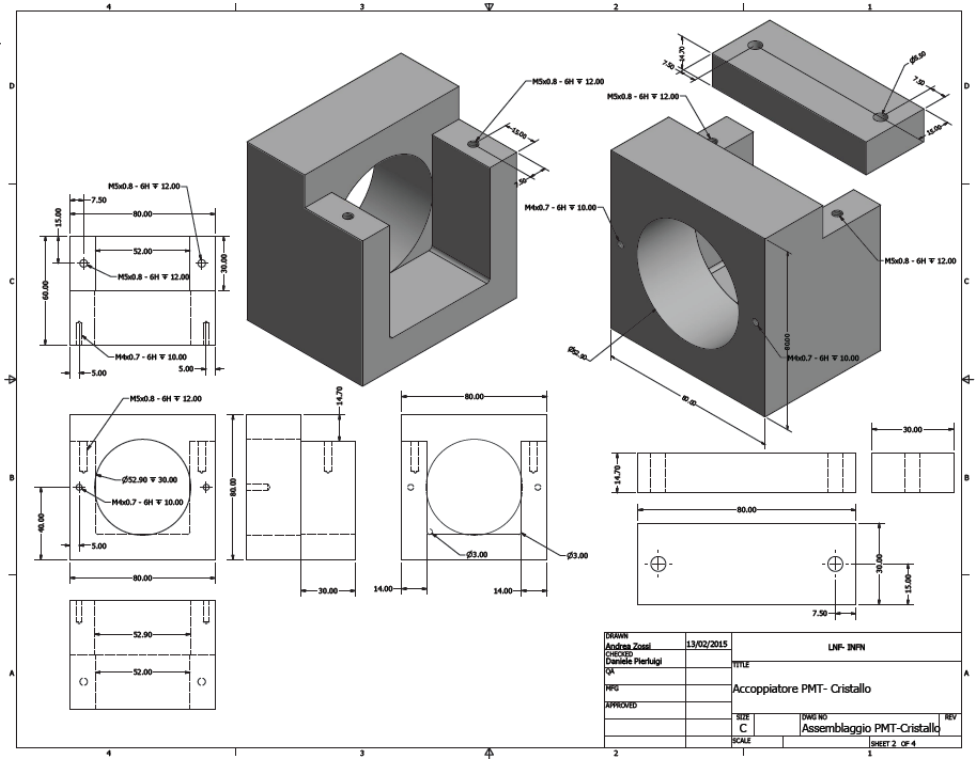
Sonde temperatura

Misura di temperatura:

- tre termistori SEMITEC 103-AT2
- 1 sonda RH VAISALA (71mm lungh.- 12 mm diam.)

Mechanics


Sarraggio Cristallo
Base appoggio Cristallo
Cristallo
Blocco accoppiamento PMT-Cristallo
Porta PMT
PMT
DRAWN Andrea Zossi 13/02/2015
CHECKED Daniele Pierluigi
QA
MFG
APPROVED
LNF- INFN
TITLE
Accoppiatore PMT- Cristallo
SIZE C
DWG NO Assemblaggio PMT-Cristallo
REV
SCALE
SHEET 1 OF 4


M5x0.8 - 6H ↧ 12.00
M4x0.7 - 6H ↧ 10.00
Ø52.90 ↧ 30.00
Ø3.00
DRAWN Andrea Zossi 13/02/2015
CHECKED Daniele Pierluigi
QA
MFG
APPROVED
LNF- INFN
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SIZE C
DWG NO Assemblaggio PMT-Cristallo
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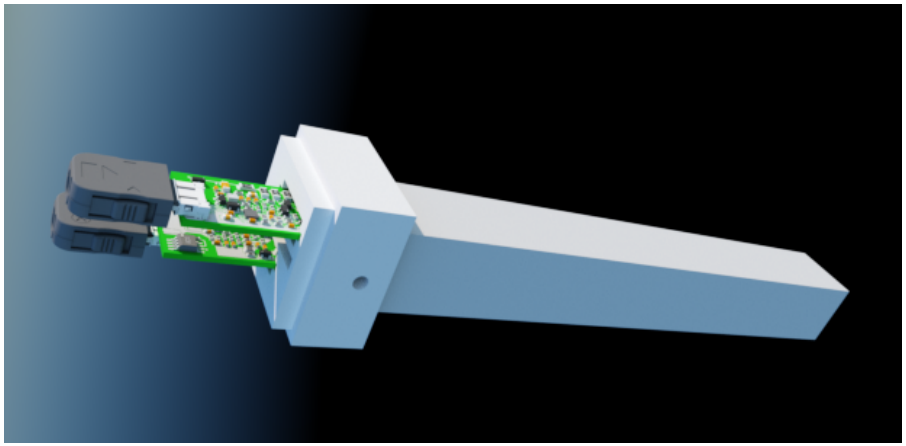
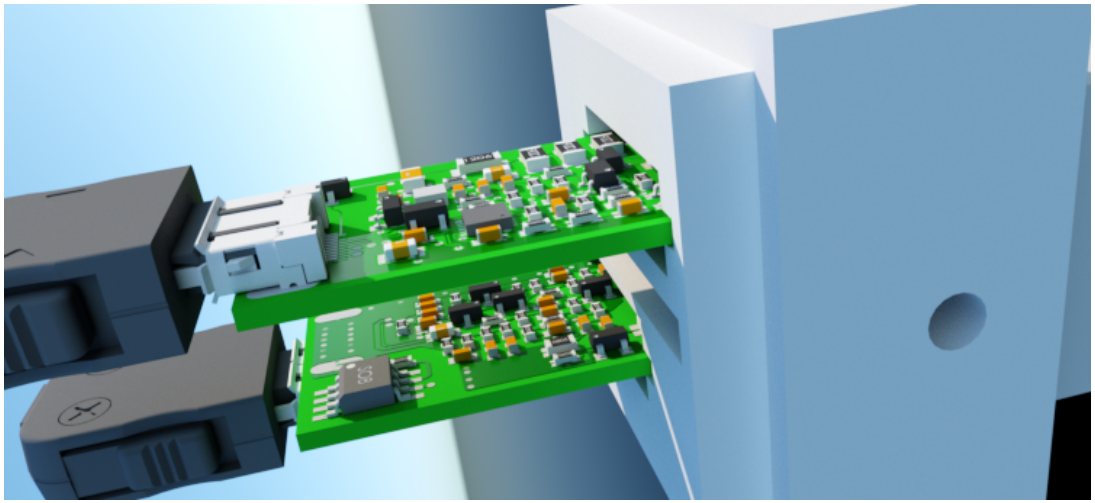
SHEET 2 OF 4

Mechanics



Some clamps will be designed to fix the crystals inside the box



Dose measurement

Crystals will be used for this purpose counting the number of hits vs Energy

Detailed study of the rate capability before saturation is ongoing and it is crucial because
→ Mc simulation gives a rate very high at very low energy (E<1 MeV). We should be able to count up to E≈10 MeV for crystals with high multiplicity and below for the others

Conclusions on BEAST

A lot of work in going on for this effort which involves all the ECL groups

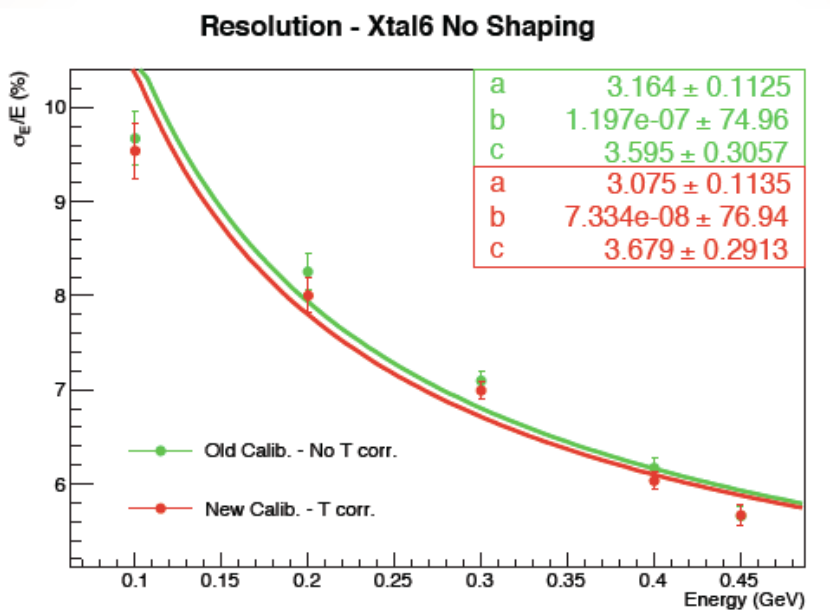
The goal of BEAST is of crucial importance for the understanding of the machine background of BelleII

Pure CsI + PMT and LYSO have very good performance for this measurements

Dose rate will also be measured using crystals

TEST BEAM 2014 @LNF

Matrix of 16 pure CsI crystals with LAAPD readout



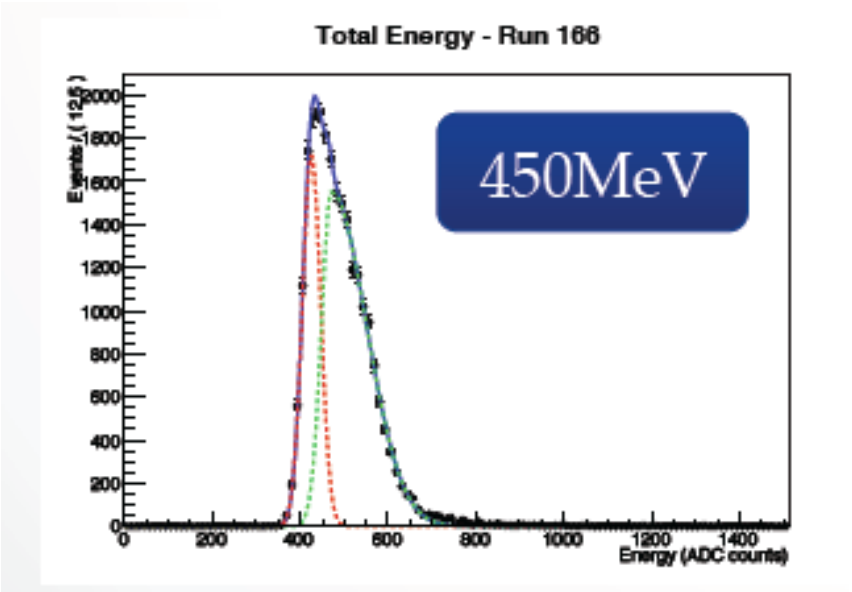
Resolution is not as good as expected but:
- Shaping is not yet applied
- a cloud of background photons of very low energy is present in the beam → it degrades the resolution

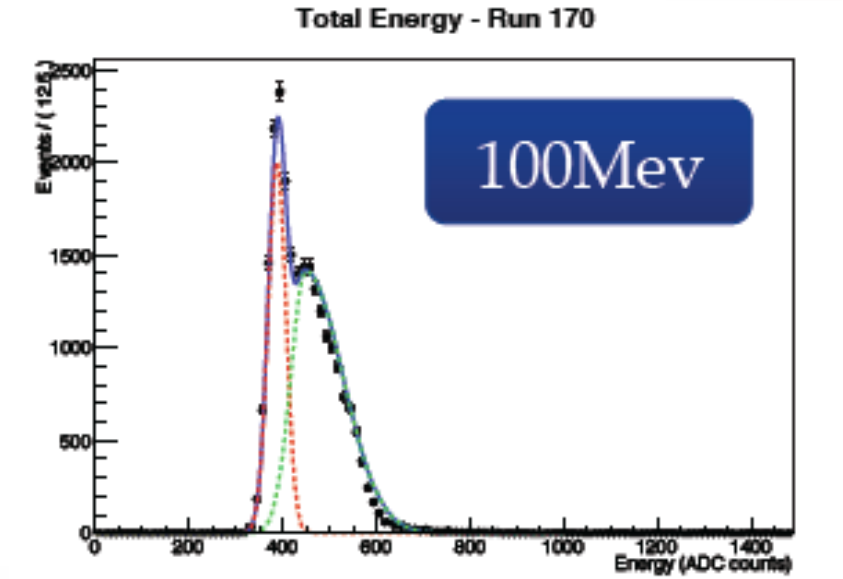
-Try to eliminate it

Background photons extraction

Isolate the photon distribution fitting the pedestal (no signal in the silicon sensors)

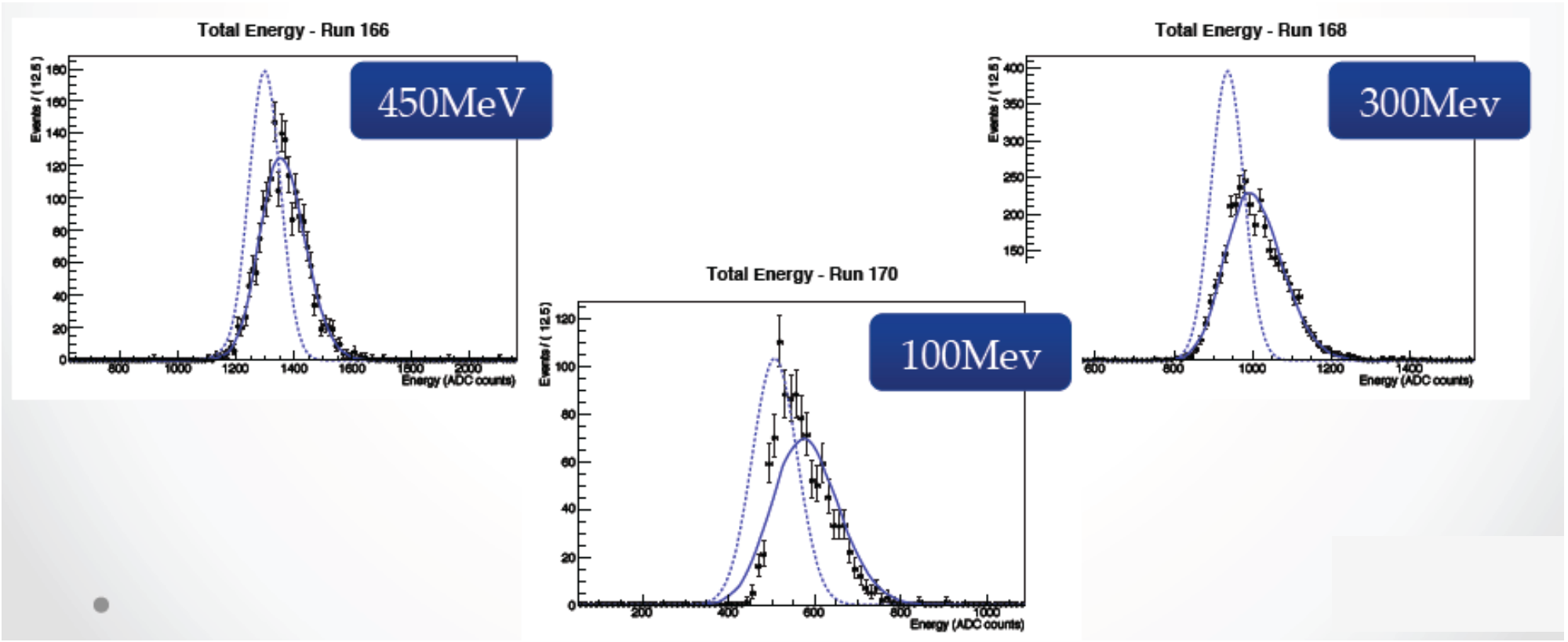
Fit the pedestal distribution with a gaussian and the photons distribution with a gaussian with different sigma left and right side



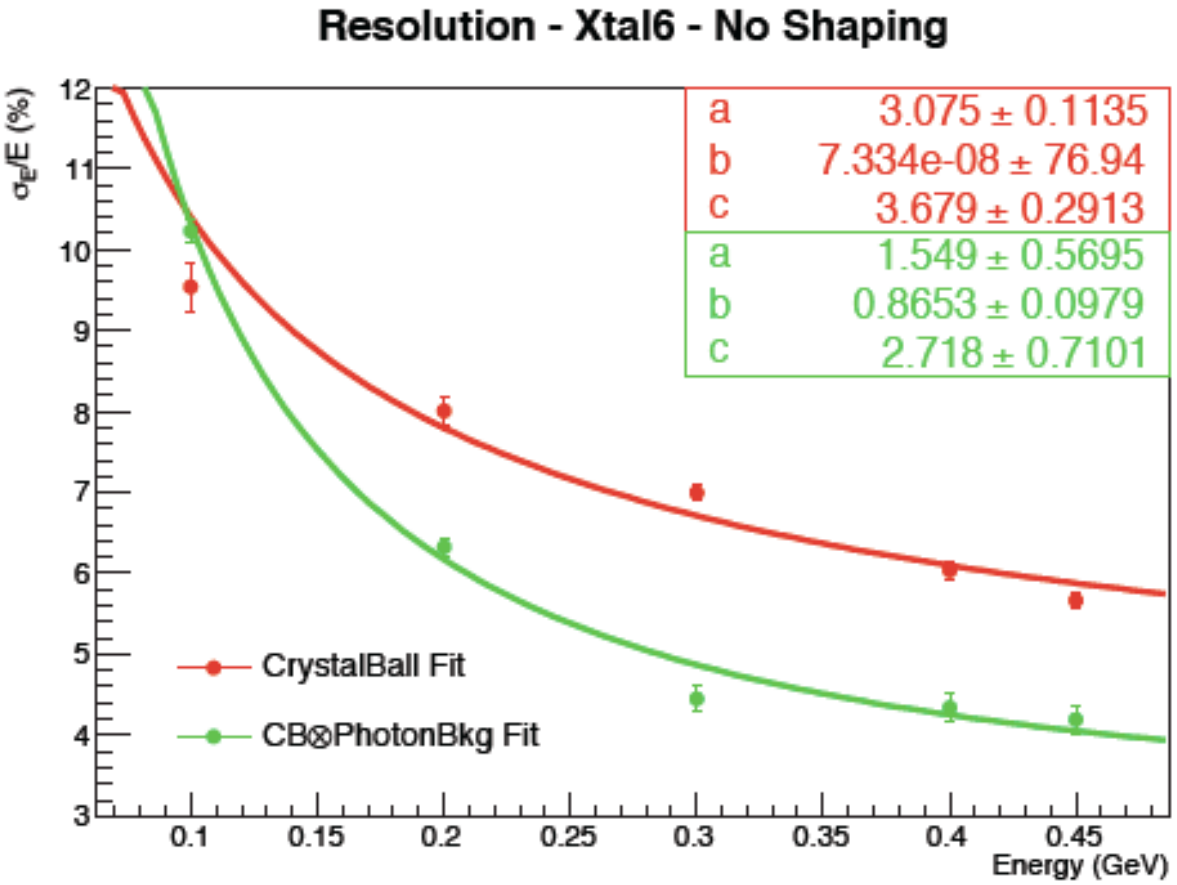


→ Extract the photons bkg shape → fit energy distribution with a convolution of CB + photon shape

Convoluted fit



Results

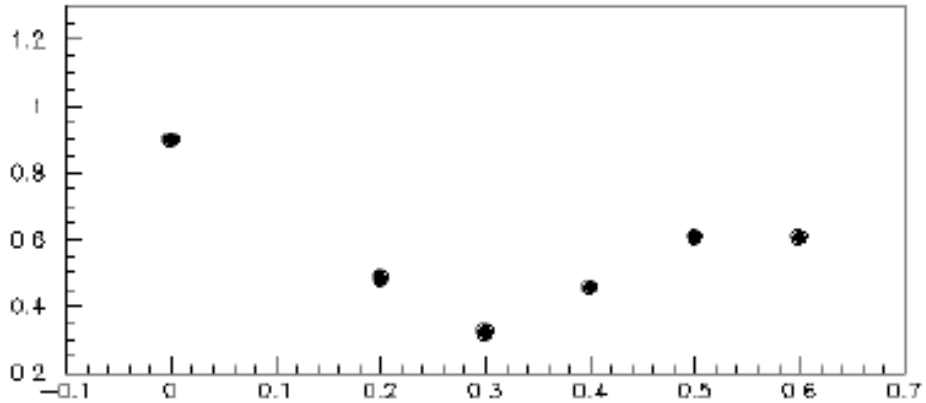


100 Mev????? Not yet understood

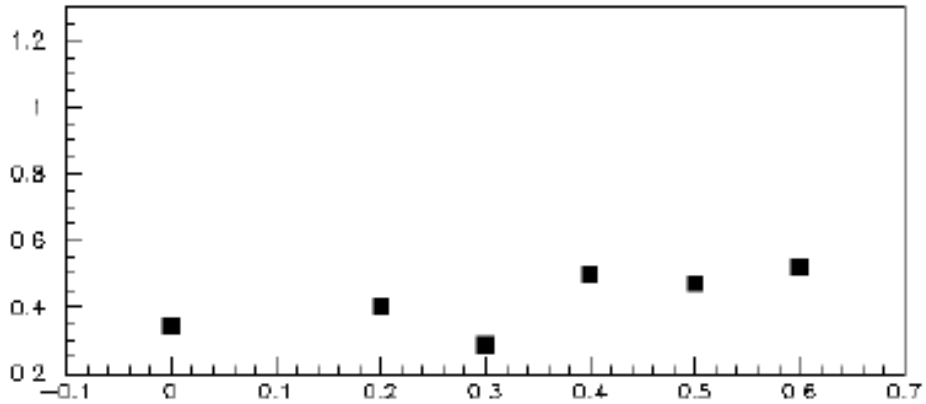
We decided to put the matrix in the beam at Mainz, tagged photons, very clean beam, beam energy spread < 1% (August 2015)

Many other activities are ongoing

Brickwall filter (CR CsI(Tl)



200 nsec (CR) filter

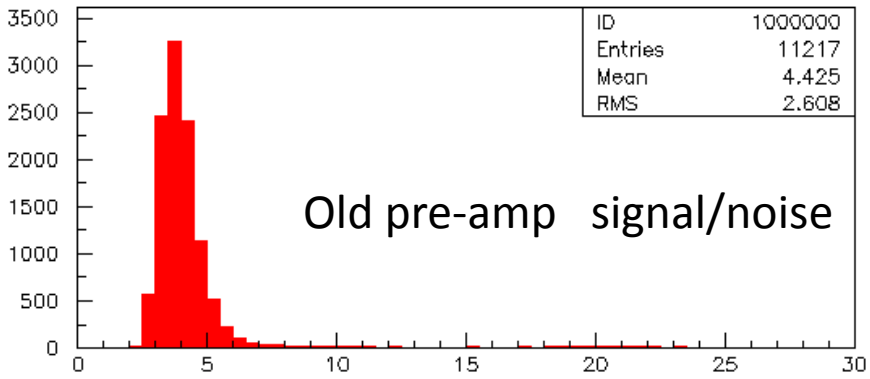


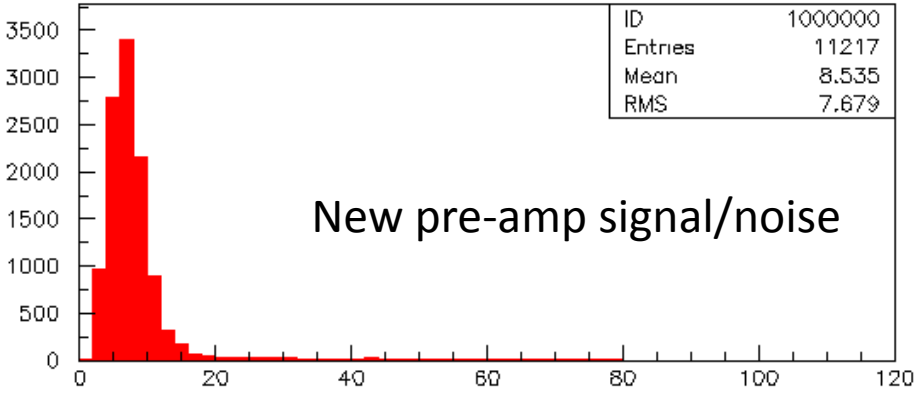
500 nsec (CR) filter

L'asse x mostra la frequenza di taglio in MHz; il punto a 0 riporta il valore senza il BW filter.

Many other activities are ongoing

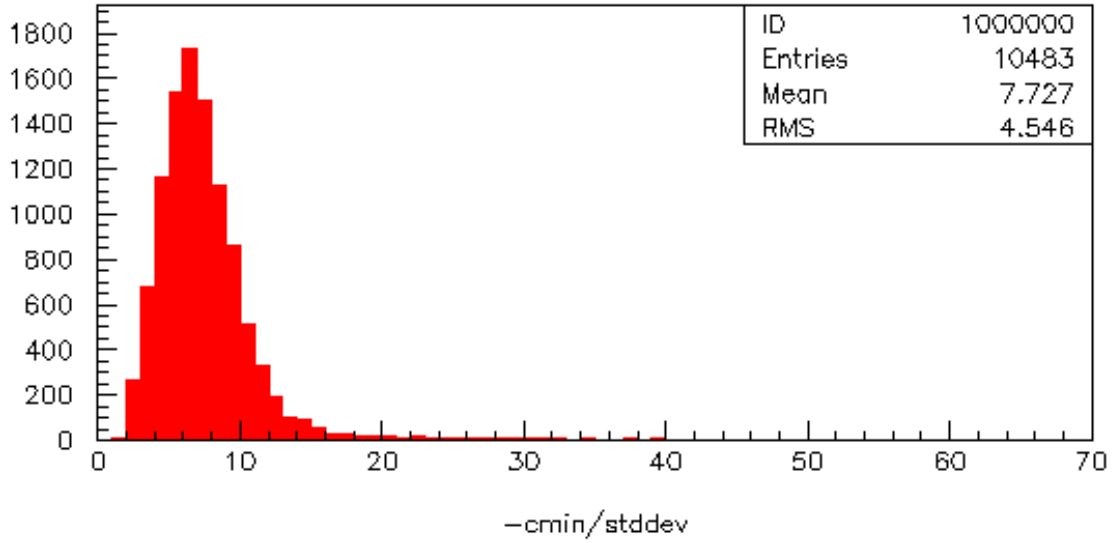
New preamp has been developed at RM3 to enhance S/N for pure CsI crystals



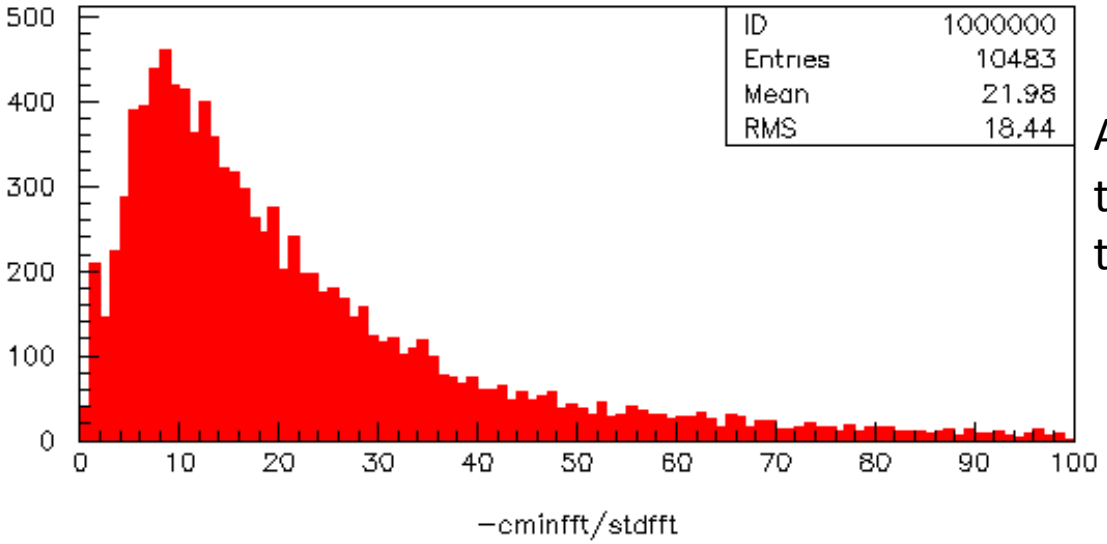


In our setup we gain on S/N a factor 2.6 without shaping. If we had a 12 mV peak (@Test Beam) from cosmic
this would bring our ENE down to 1.5 MeV Single APD no shaping.

What happens if I apply the 200 kHz cut?

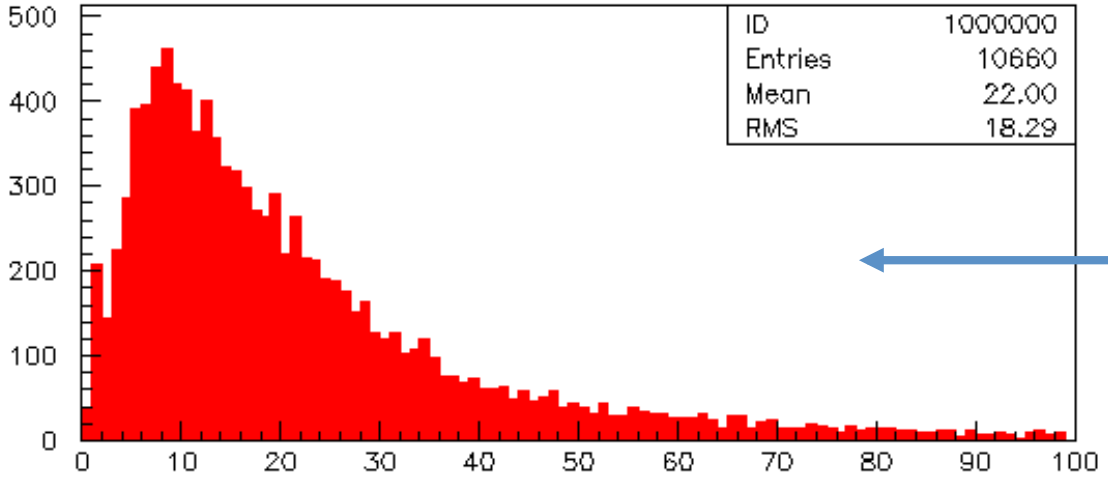


Brickwall filter sharp 200kHz cut

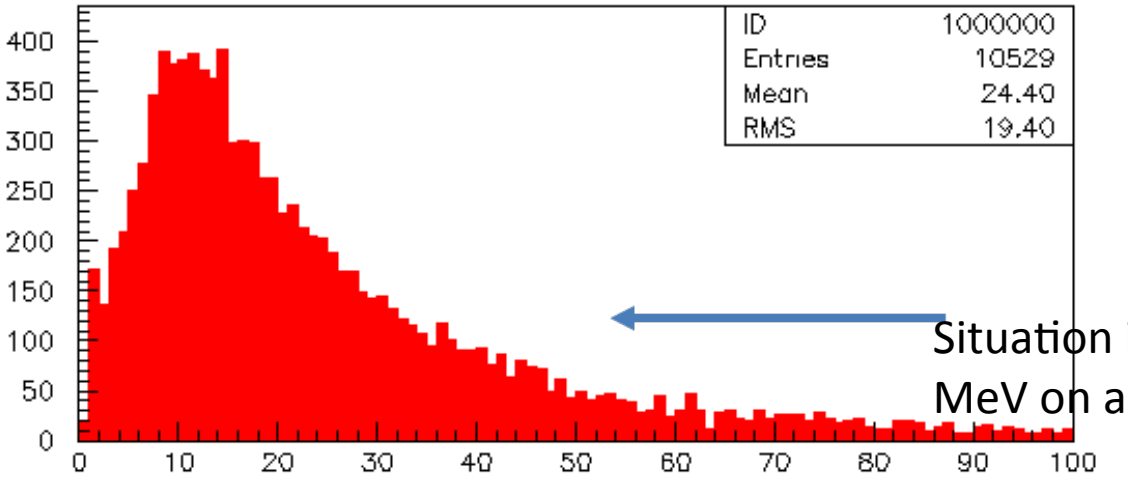


After 200 kHz cut we get a signal to noise ratio better than 20 (1.5 MeV single apd)

What about butterworth filter ?



Sharp cut on frequency (200 kHz)



$$\left|H(j\Omega)\right|^2 = \frac{1}{1+\left(\frac{\Omega}{\Omega_{-3dB}}\right)^{2N}}$$ N=2

Situation improves a little bit we are close to 1 MeV on a single APD!

Software

Intensive activity in the software is going on

→Many progress in the last two months

→Main goal: ECL software ready to start performance studies

→ some work still to be done, but we are approaching the result

Conclusions

- Activities on BEAST are proceeding very well
- Many other activities are continuing
  - Test beam analysis + new Mainz
  - Irradiation of APD's with neutrons
  - New preamp development
  - CR studies to improve S/N ratio
  - Software activities are progressing very well

Richieste

Mini BEAST

LNF + PG + NA + RM3 1 persona 3 keuro

→TOT. 12 Keuro

BEAST

LNF + PG + NA + RM3 1 m.u. 6 keuro

→TOT. 24 Keuro

TOTALE: 36 keuro richiesta sblocco del SJ

Su PG assegnato per installazioni varie
30Keuro+ 6 keuro aggiuntivi

MAINZ TEST BEAM

LNF + PG + NA + RM3 + RM1

2 persone 3 keuro

→TOT. 15 keuro

LNF

consumi cavi + meccanica	1 keuro
licenza firmware digitizer	1.7 keuro
inventario modulo di scaler	3.2 keuro

RM3

2.5 Keuro dati dal Direttore 2014 per lo sviluppo delle schede di FE

2.5 keuro avanzati rispetto alle richieste

→possono essere utilizzati ora per BEAST