EMC SUMMARY

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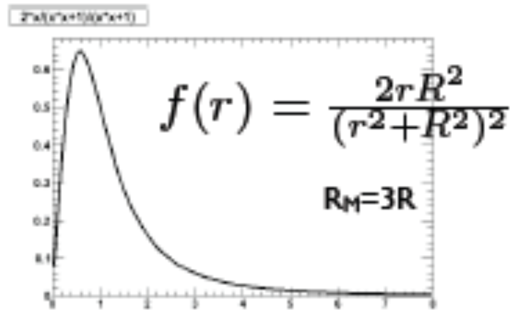
University of Perugia and INFN

SIMULATION

Chih-hsiang
Stefano Germani

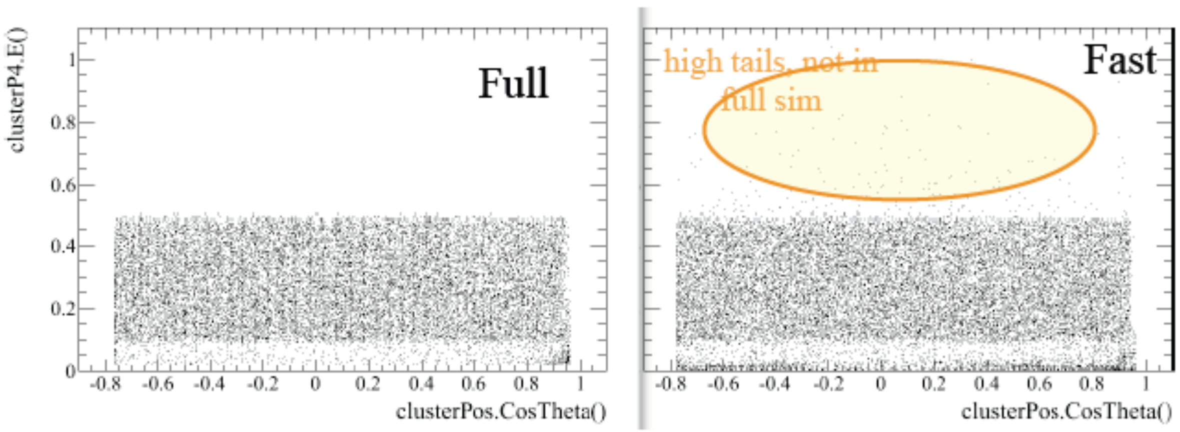
FAST SIM

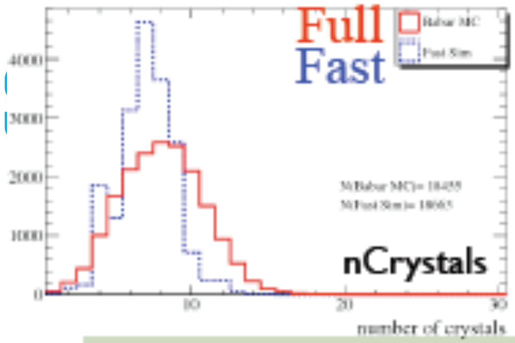
Geometry description in 3 xml files: Barrel cylinder, FWD cone, BCK disk
individual crystals are not simulated
EMC properties in a config xml file: segmentation, Molière radii, Energy fluctuations, Calibration parameters...

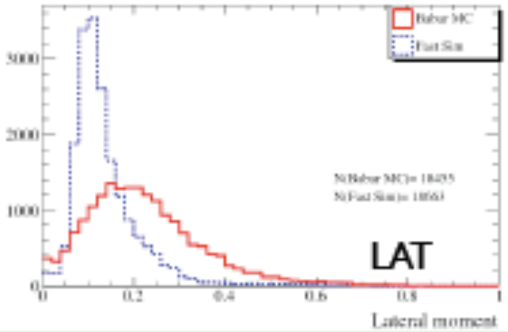


3 types of clusters are simulated:
- MIP straight line energy prop. path length
- EM showers
- Hadron showers fraction of energy to form an EM-like cluster the rest to form an irregular cluster

Comparison fast-full
with photons
100MeV → 500MeV

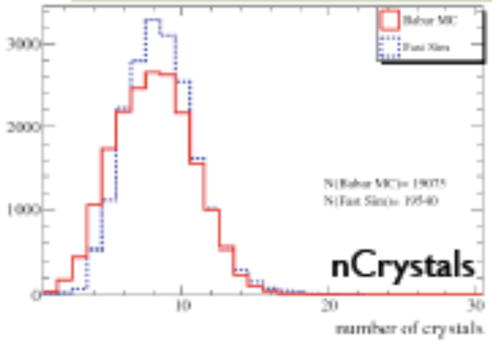


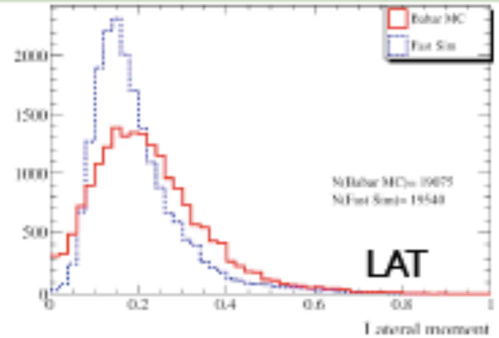




cluster generated from the smooth function + E digi fluctuations

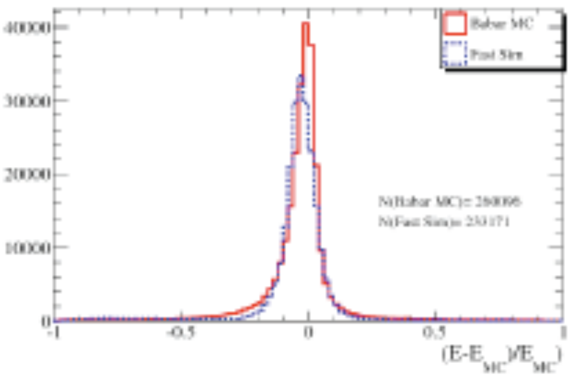
Generator : 100-500 MeV single γ; cut at E > 30 MeV

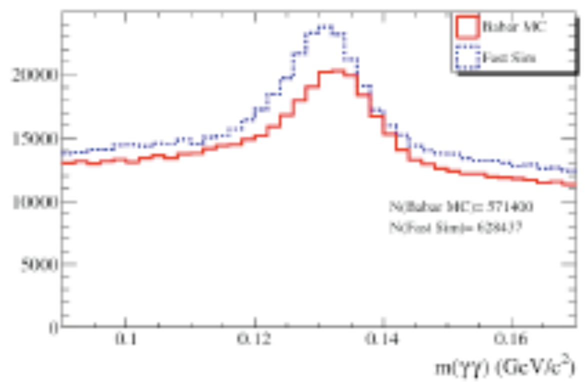


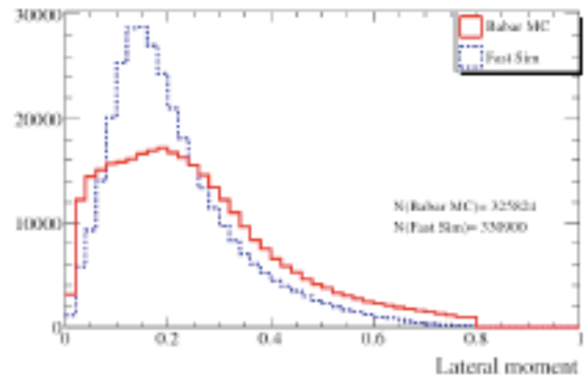


Add energies to cluster's digi and its neighboring digis, assuming 10% occupancy and energy distributed

$$f(E) \sim \exp(-(E-1\,\mathrm{MeV})/1\,\mathrm{MeV})$$





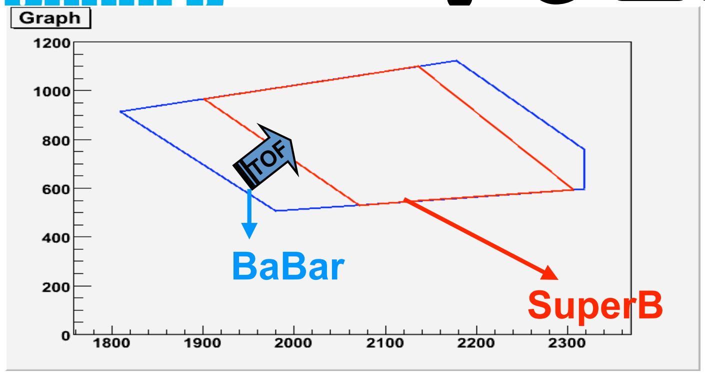


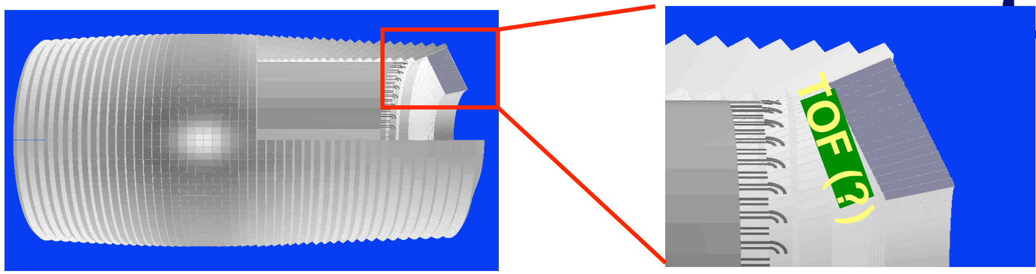
Reconstruct $\pi^0 \rightarrow \gamma\gamma$

Energy resolution shifted a little

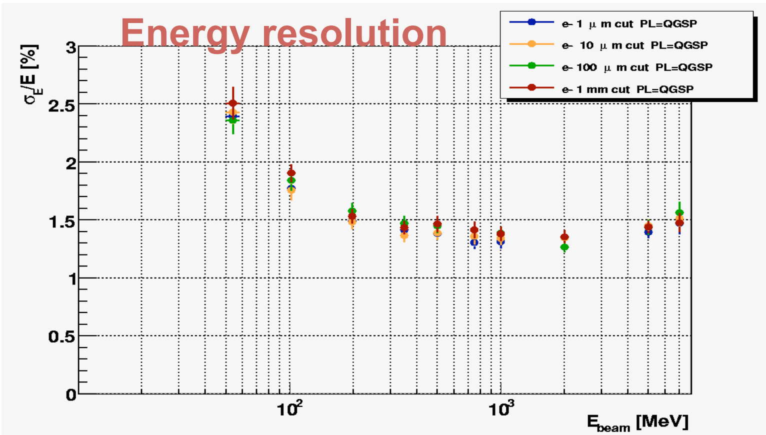
To many neutrals?

FULL G4 SIM

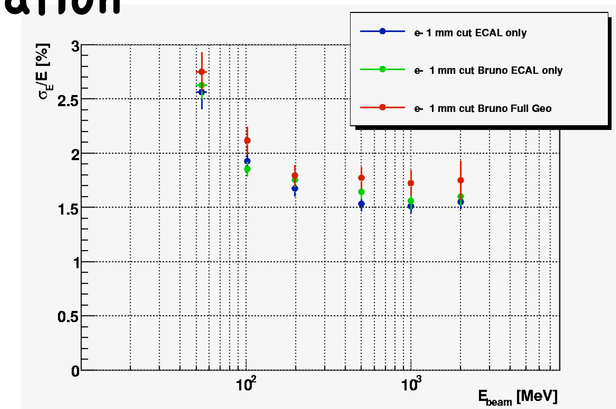




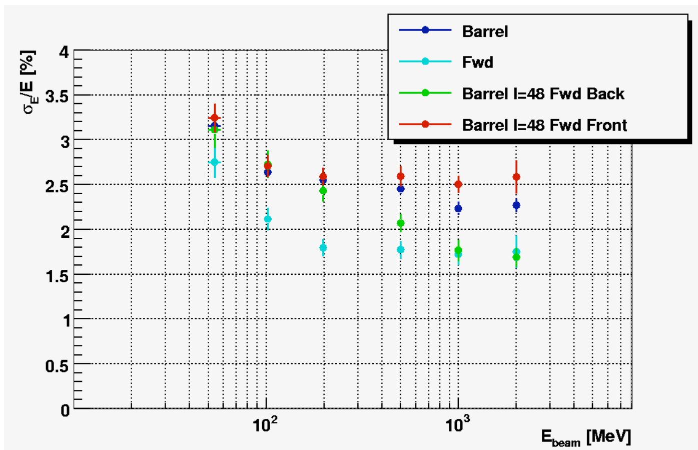
Treshold tuning: 1mm cut do not affect the resolution



Comparison Bruno with standalone simulation



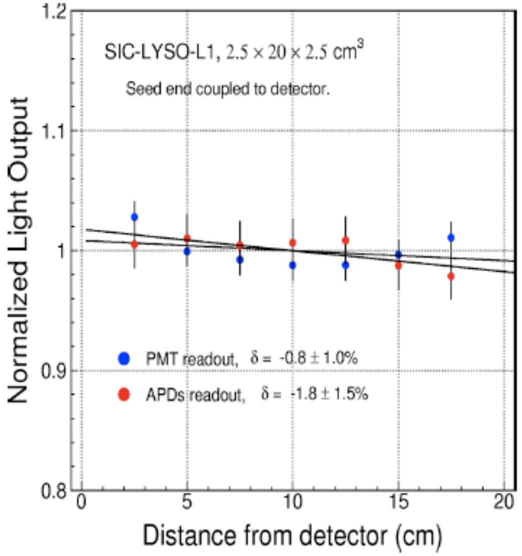
Start to investigate transition region between barrel and endcap

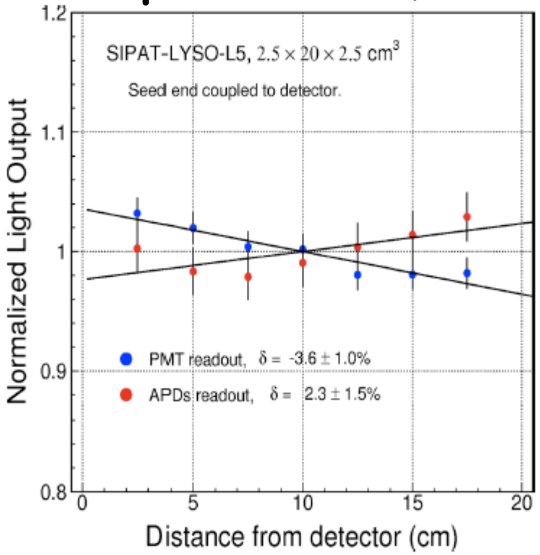


CRYSTAL STUDIES

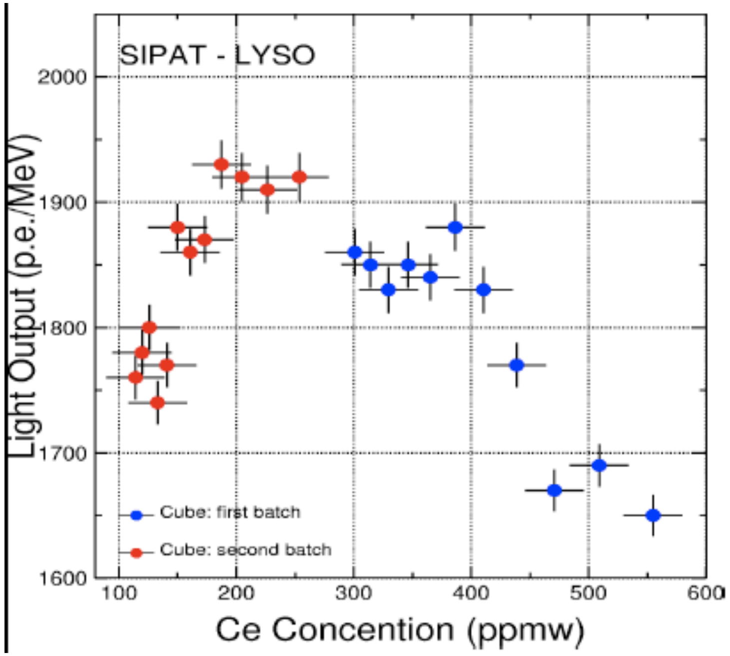
Ren-yuan Zhu

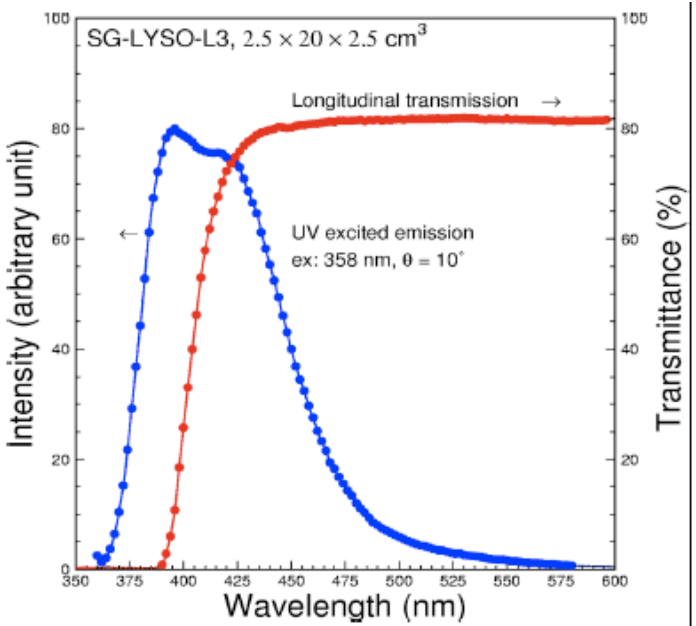
Large difference observed in LRU with PMT and ADP in one sample SYPAT LYSO (not observed in other SG-LYSO sample or BGO)



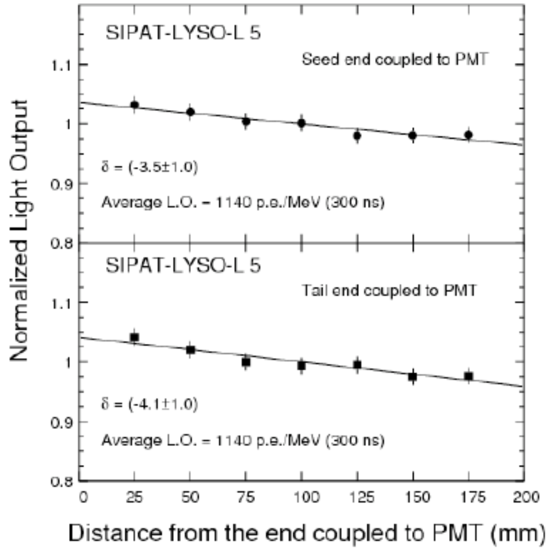


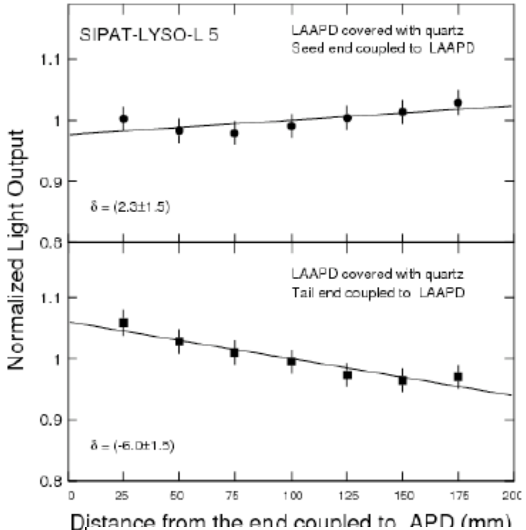
LO is a function of CE concentration is also a result of interplay between transmittance and emission





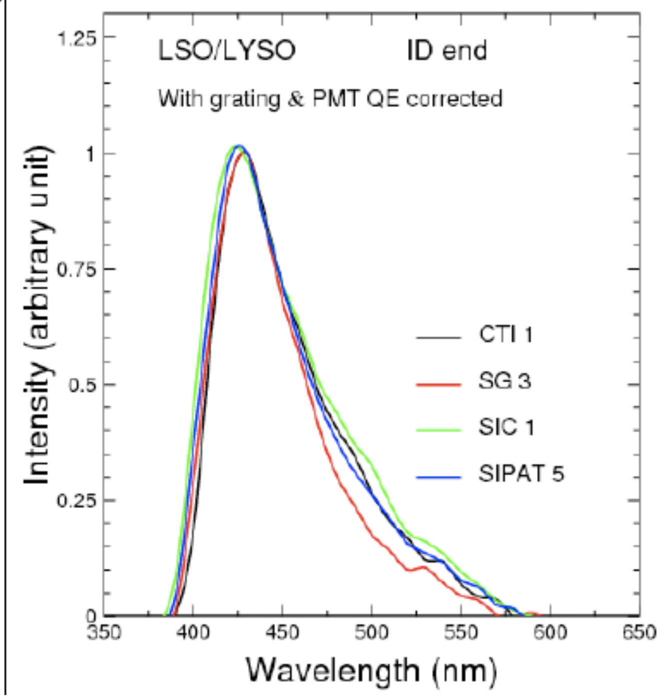
Ce doping optimized for the uniformity measured with PMT. Difference observed between PMT and APD.

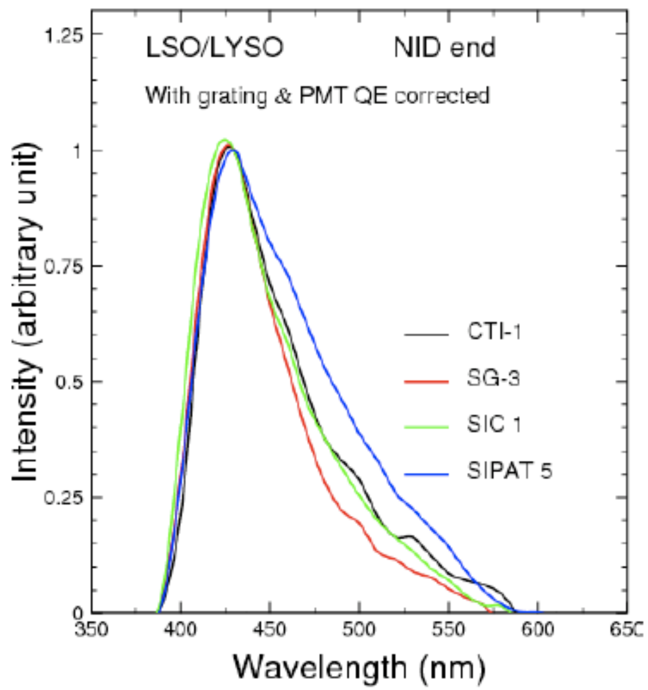




SIPAT-LYSO has an extra green emission component at the tail end wich could explaind the difference between APD and PMT

Contamination seems to be a little larger for SIPAT LYSO sample

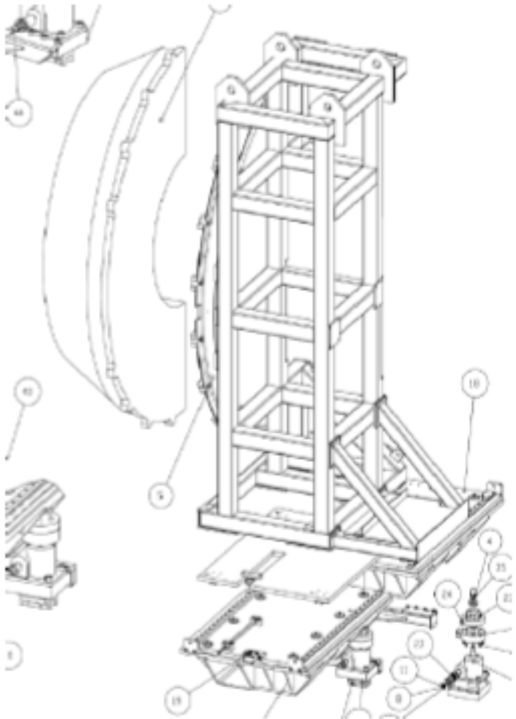




MECHANICS

Michel Lebeau

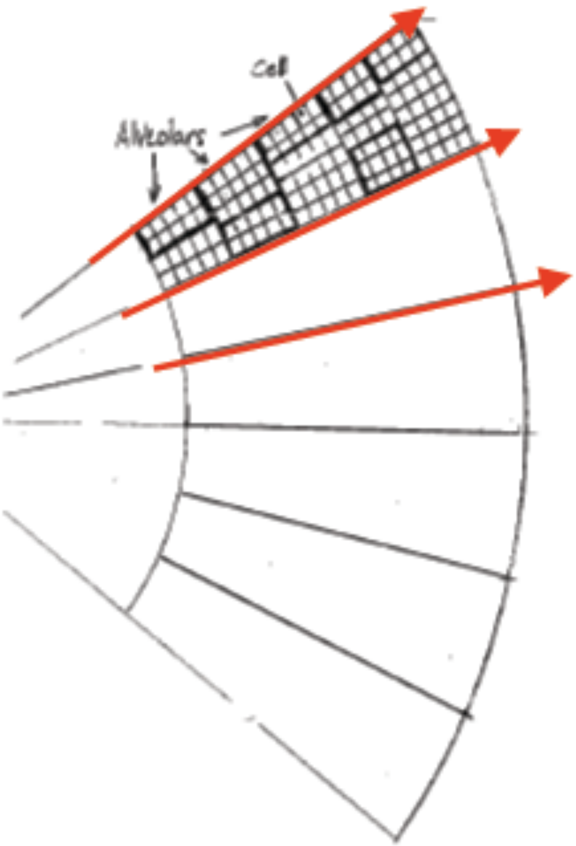
Re-use maximun of BaBar endcap installation tooling.
Create ad hoc interface for new design.



Tentative re-use of BaBar endcap support structure.
Different design concept
BaBar separate modular building blocks
SuperB one single alveolar structure
Possible re-use of back plates?

Structural design starting base inspired from previous structures (L3, BaBar, CMS)
Design progress will take information from BT specific tests defined for structural information, FEA, spaces for services and boundary imposed by integration.

LYSO is a brittle crystal with high Young module, LYSO mechanical properties are under study in Ancona on small samples 5x5x100mm3 (superB is 25x25x200mm3). Annealed and not annealed samples are under test.



- Rear part of cell walls results after module assembly in a kind of rigid **lattice**
- Radial (straight) connections can only go through modular splits given by some ϕ **symmetry**
- ϕ symmetry contributes to precision in the construction process by forming **assembly steps**

Number of 5x5 modules (Perugia geometry)
35 - 41- 45 - 53
Suggested evolution symmetry 2x3
36 - 42 - 48 - 54

Small changes in crystal dimensions

ELECTRONICS

Valerio Bocci
David Hitlin
Pasquale Lubrano

Main discussion was devoted to the choice between APD's and PD's

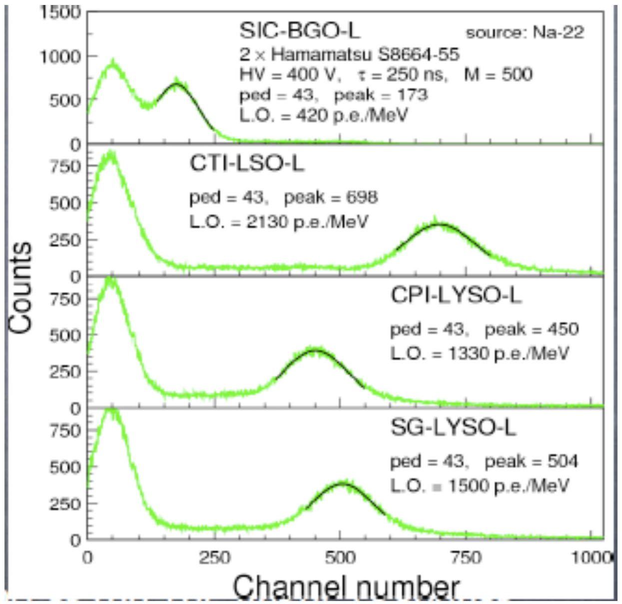
LYSO light yield very high → do we need amplification before the FE?

Size and cost of the device is not a real issue.

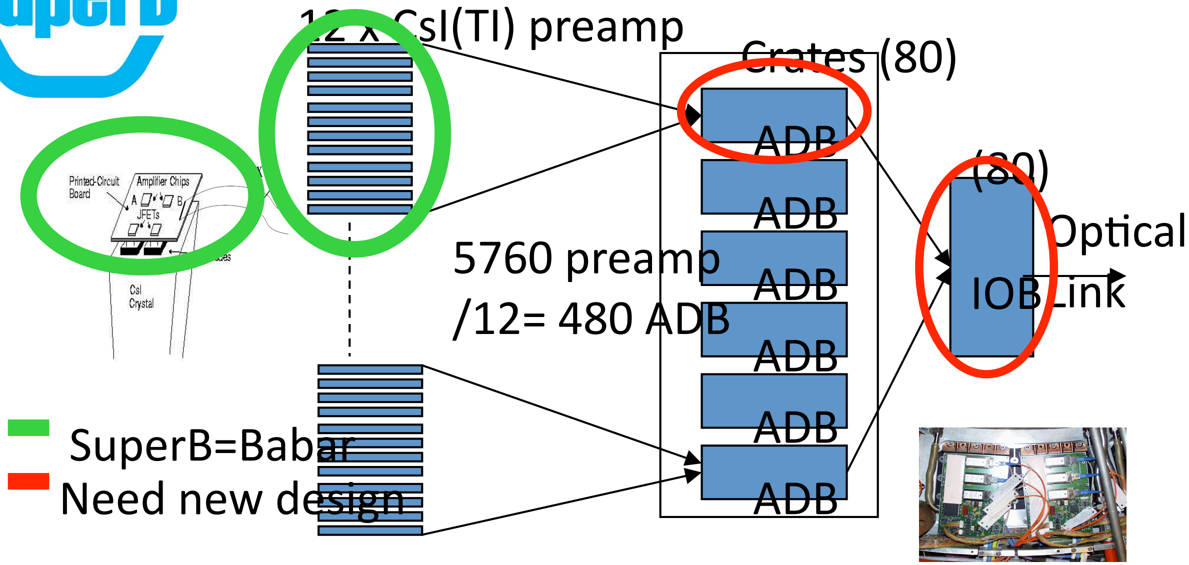
Pro: APD QE better match with LYSO scintillation spectrum
better S/N → linearization of the response with source calibration

Con: Gain stability → APD's very sensitive to applied voltage (CMS: $1/M\ dM/dV=3.15\%/V$). Very stable high voltage system (50 - 100 mV@380V), with calibration

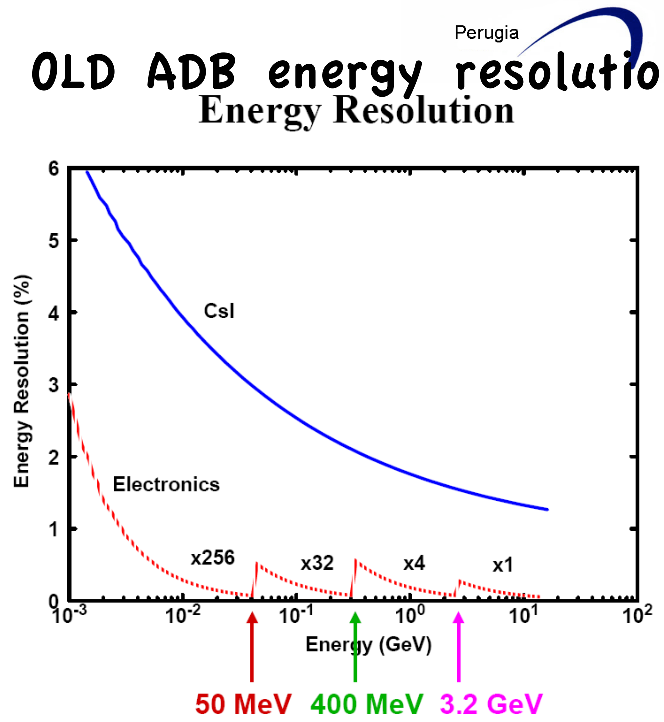
Temperature dependence → APD's temperature dependent gain ($1/M\ dM/dT=-2.4\%/C°$)



BARREL FE electronics

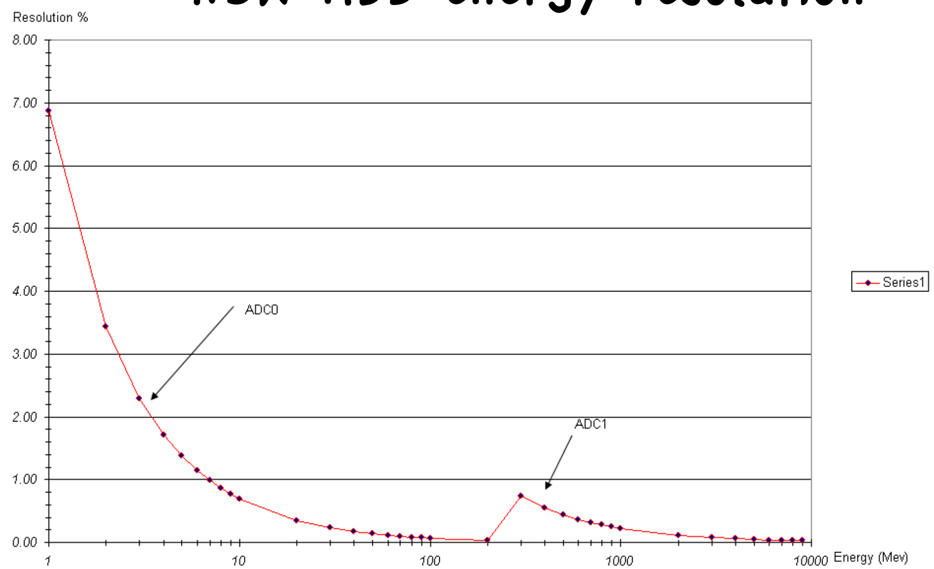


OLD ADB energy resolution



- Design new board
- Mechanical constraints: re-use of the crate structures
- use new ADC with more bits
- less power consumption
- reduce number of gain ranges x1 and x32
- Use the new superB ECS and FCTS interfaces

NEW ADB energy resolution



EMC endcap FE read out option

2 x APD (5x5mm) or

2 x PIN (10x10mm) or

1 x PIN (20x10mm) or

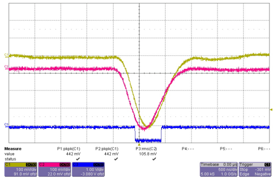
CSP + shaper

or

TIA

or

TA



Number of Lyso crystals =3600
(Number CsI(TI) Forward endcap babar x4)

We start to test Charge sensitive preamp at Beam Test Facility in Frascati

- Design a preamplifier for EMC FWD with a x1 and x32 output compatible with Barrel preamp
- Design a new ADB board compatible with the old mechanical structure
- Design a new IOB compatible with the new FCTS and ECS system

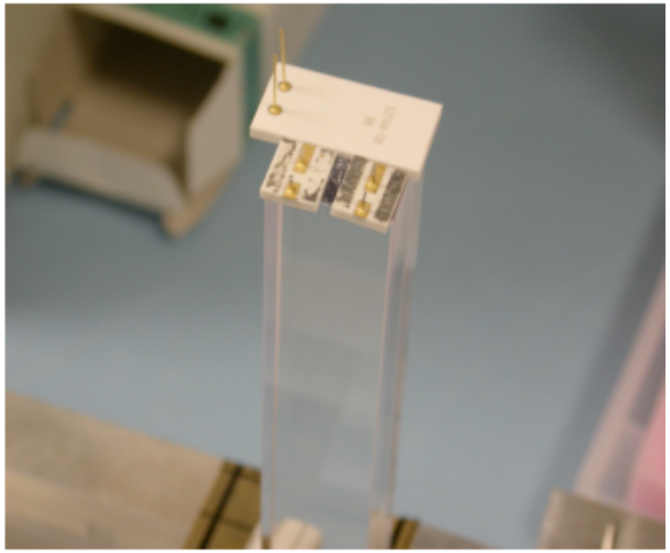
TEST BEAM

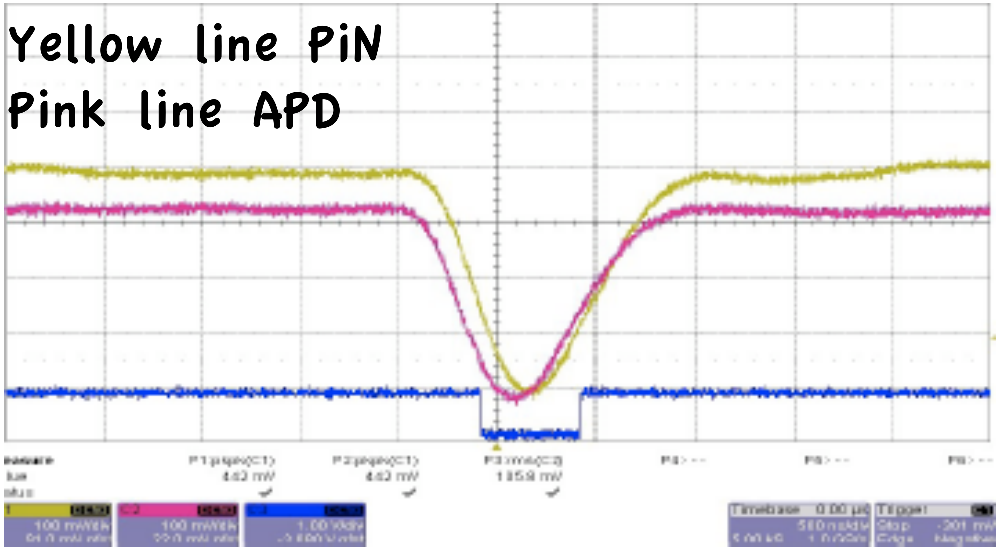
Claudia Cecchi
Alessandro Rossi

JUNE TB@BTF

1 LYSO crystal (2x2x20cm3) with two different readout

- 1 PiN photodiode S2744-08 (1x2cm2) read by CREMAT CSP CR110 (gain 1.4V/pC) + CREMAT shaper CR200, 250ns shaping time
- 2 APD S8664-55 (0.5x0.5cm2) read by CREMAT CSP CR110 (gain 0.15V/pC) + CREMAT shaper CR200, 250ns shaping time





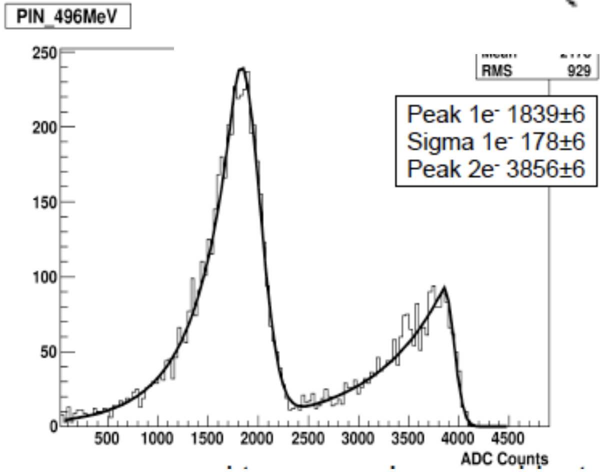
SuperB

$$f(x;\alpha,n,\bar{x},\sigma) = N \cdot \begin{cases} \exp\left(-\frac{(x-\bar{x})^2}{2\sigma^2}\right), & \text{for } \frac{x-\bar{x}}{\sigma} > -\alpha \\ A \cdot \left(B - \frac{x-\bar{x}}{\sigma}\right)^{-n}, & \text{for } \frac{x-\bar{x}}{\sigma} \leqslant -\alpha \end{cases}$$

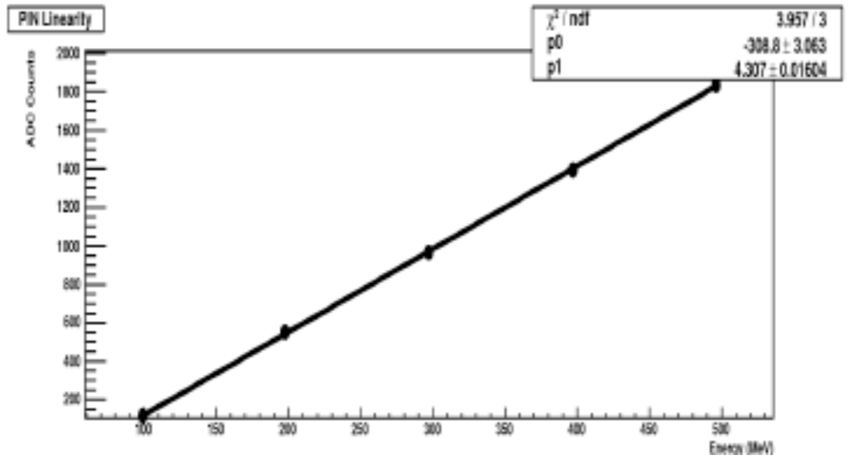
$$A = \left(\frac{n}{|\alpha|}\right)^n \cdot \exp\left(-\frac{|\alpha|^2}{2}\right)$$

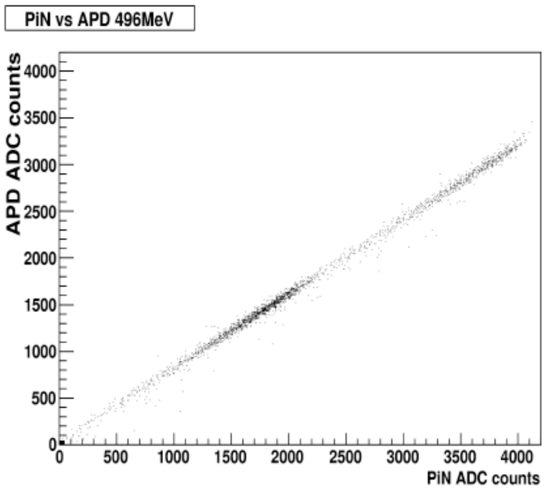
$$B = \frac{n}{|\alpha|} - |\alpha|$$

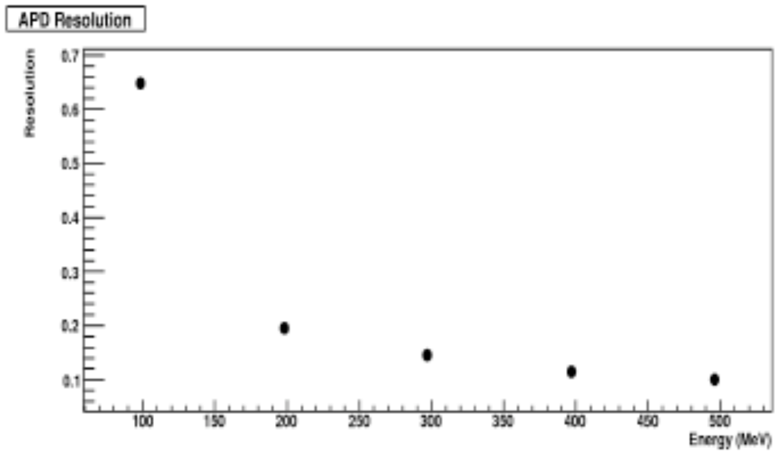
onale
cleare



1 e- and 2e- peaks are well separated







November 09 TB@BTF

Put under test matrix of 5x5 LYSO crystals + external ring of CsI crystals (CLEO)

Crystal procurement:

-8 crystals ordered at St. Gobain by INFN

-4 to be ordered by INFN

-13 will be ordered by Caltech

- finalizing dimensions
- CsI crystals for the external ring will be at Caltech by end of June

Electronics: 2 options

1) Rome and Perugia are working on a new readout with PD → 50 readout channels for November
2) Caltech has 50 channels available with APD's + CMS DAQ

Mechanics:

-Carbon fiber or glass fiber structure

- CAD drawing of the structure by June (INFN)
- visiting producer beginning of July
- delivery in October

Simulation: available, tested and running

BACKWARD CALORIMETER

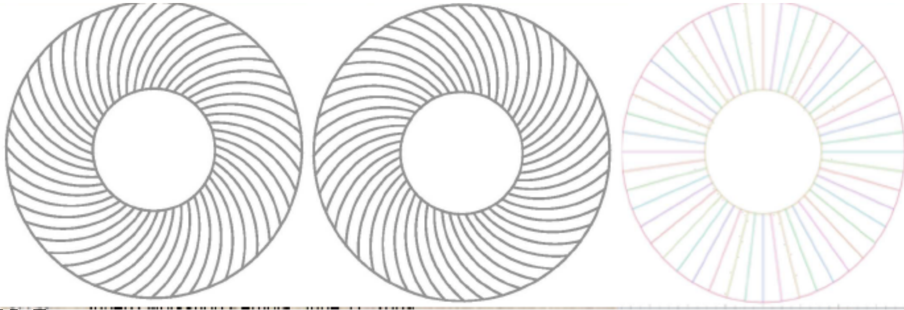
Gerald Eigen

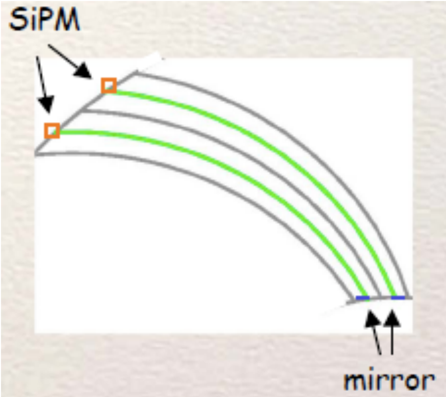
12 X0 Pb-scintillator sampling calorimeter

Original design was tiles 11520 readout channels but on average only 1-2 particles are expected in the BCKW → reduce segmentation (1152 ch) → use strips

3 different shapes of strips(3 mm thick):

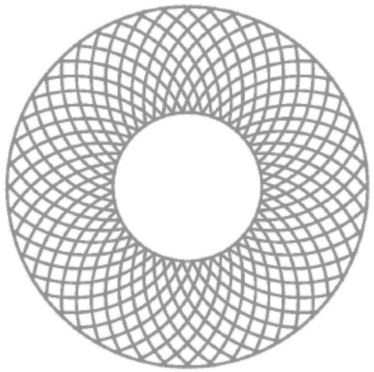
- Right-handed spiral
- Left-handed spiral
- Sector strips
- Alternate 3 types 8 times → 24 layers

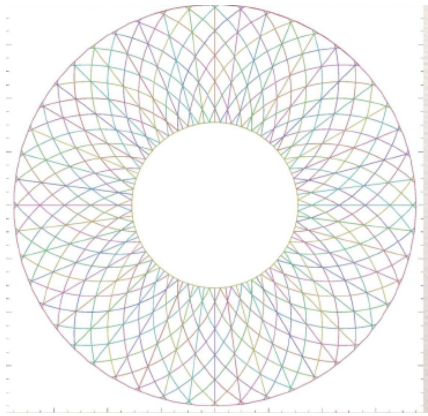




SiPM (MPPC) mounted on the outer edge
Mirror at the inner edge of the fibers

Superposition of different shapes → tile structure: resolution $\sigma_r \approx \sigma_\phi \approx 2.9$ cm (outer) 1.2 cm (inner)

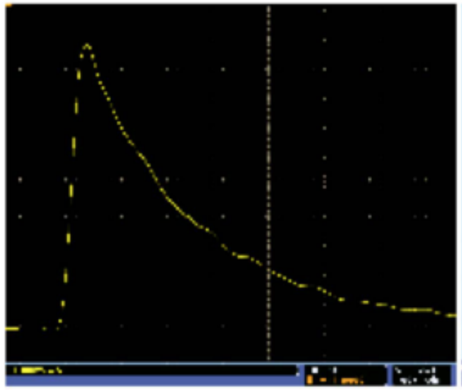




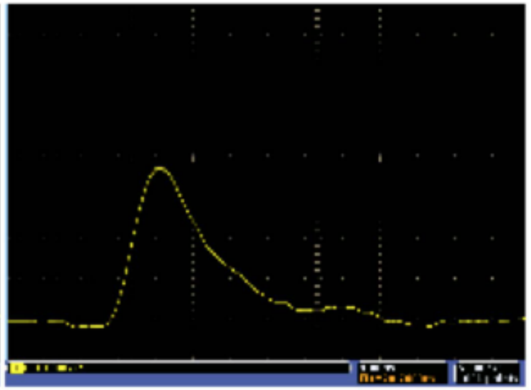
Adding sectors improve resolution by a factor of 2 σ_ϕ (relevant for track separation) around sector boundaries

R&D in Bergen

Start to study SiPM: study LED and source spectra from scintillator tiles



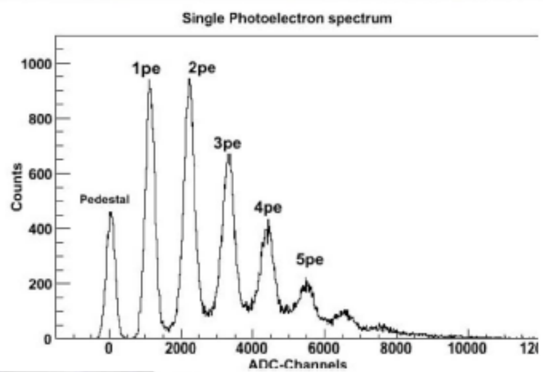
(a) MPPC 10362-33-050C, sample 341. X-axis: 10 ns. Y-axis: 1 mV

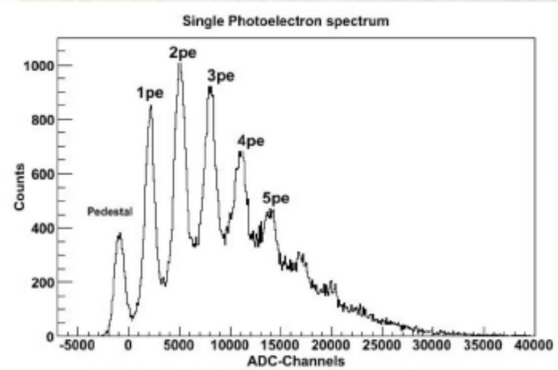


(b) MPPC 10362-11-025C, sample 7 4 ns. Y-axis: 1 mV

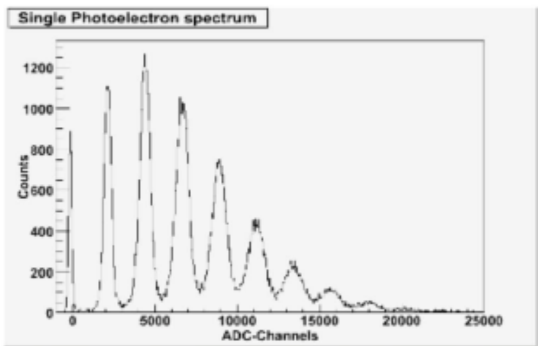
1x1mm2 faster response than 3x3mm2

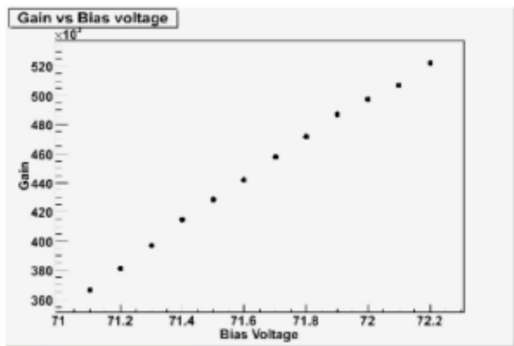
MPPC's 1x1mm2 narrower peaks than 3x3mm2





Gain and MIP measurement using SiPM





Start measurements with spiral strips, equipment for R&D available in Bergen

CONCLUSIONS

-Fast Sim and Full Sim are well on the way:

tuning of LYSO parameters is needed for Fast Sim

Basic studies with Full Sim have been done, more cpmplex studies have started (material in front of EMC, transition region between barrel and endcap)

-Crystals: many studies are underway in Caltech to study Ce concentration, LRU, and to improve the quality of the chinese production.

-Mechanics: first basic ideas for the whole structure have been proposed by the engineer. Geometry changed to have PHI symmetry, single big alveolar structure seems to be the optimal solution for our calorimeter

-Electronics: APD's vs PD pros and contras are under study. Discussion is still open, more after TB of November

-Test Beam

June: (1 LYSO crystal + PD and APD) first results have been shown. Good separation between 1 and 2 electrons, linearity is good, will come in next few weeks

November: crystals to be ordered funding is OK

electronics 50 channels with PD and APD's with electronics based on the one used for June

mechanics under study of for October

CONCLUSIONS cont'd

Backward calorimeter has a new design with much smaller segmentation, based on spiral strips with SiPM readout.

R&D is ongoing in Bergen, results with SiPM and tiles to study gain and MIP measurement.

Instrumentation is available, studies on strips are going to start.

Radiation hardness of SiPM is under study.