EMC SUMMARY

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FOR THE EMC GROUP

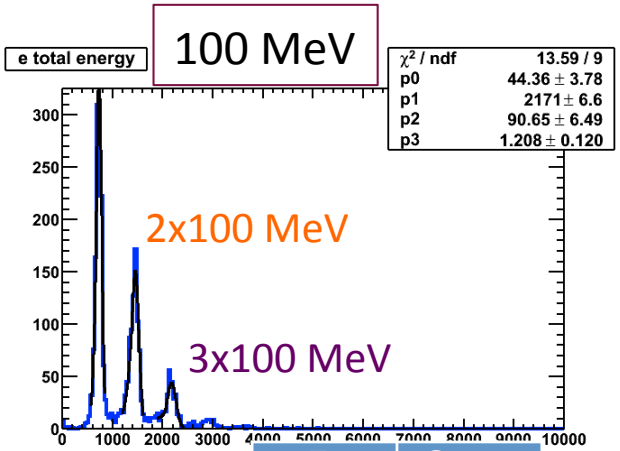
December 16th 20111

EMC SESSIONS

Report from SLAC visit – Electronics	Valerio Bocci (ROMA1)
Report from Beijing	Pasquale Lubrano (PG)
Test beam "final results"	Elisa Manoni (PG)
Background/radiation studies	Chih-hsiang Cheng (*Caltech*)
Pileup studies	Daniel Chao (*Caltech*)
Barrel performance, changes at SuperB	Wenfeng Wang (*University of Note Dame*)
Alternative options	Stefano Germani (*PG*)
Performance of EMC and physics related studies	Elisa Manoni (PG)
Radiation hardness tests	Riccardo Faccini (*ROMA1*)
Background/radiation estimates	Stefano Germani (*PG*)
Backward EMC	Gerald Eigen (*University of Bergen*)
The BGO alternative	Davide Pinci (*ROMA1*)
Roughening crystals results	RenYuan Zhu (Caltech) (NO TIME!)
TDR discussion	All

TEST BEAM (E. Manoni)

New: study of the Beam Spread @BTF from data (by S. GERMANI)

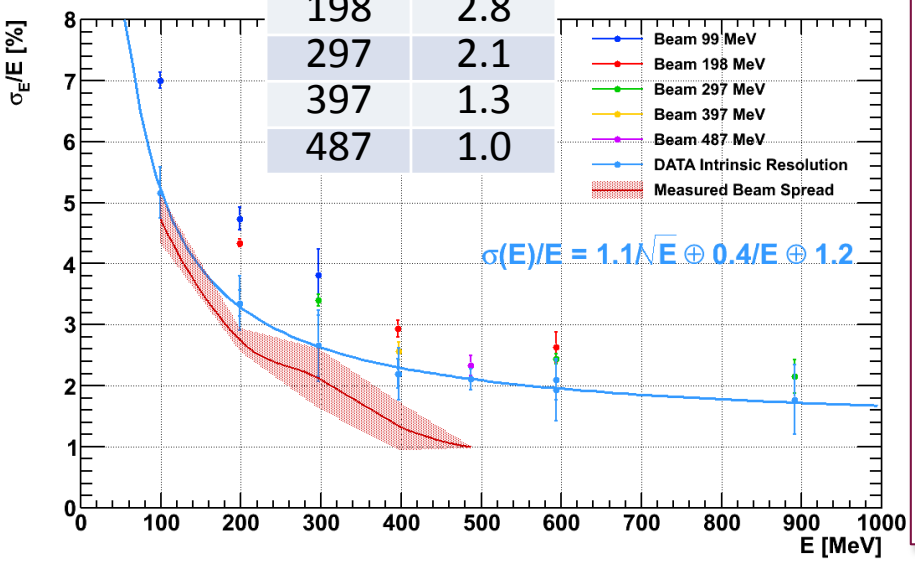


$\sigma_{TB} = \sigma_{EMC} \oplus \sigma_{BS}$

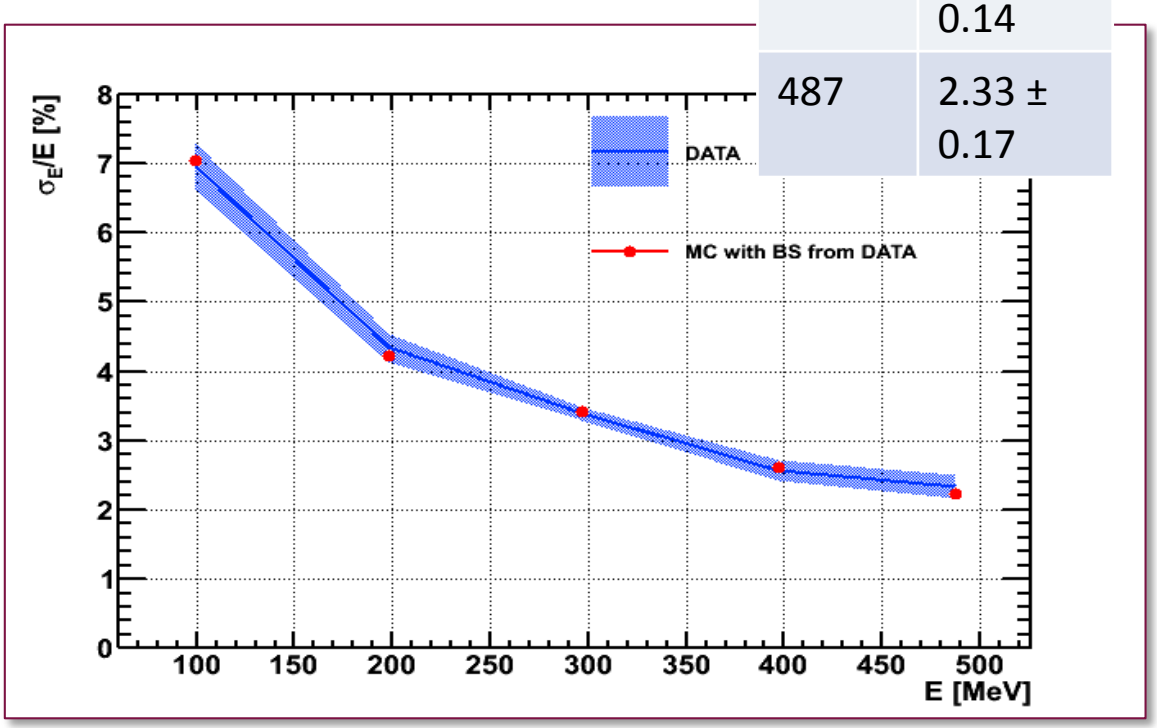
σ(100MeV +100MeV) = σ(200MeV) and so one for other energies/multiplicity

σ_{BS}(500 MeV) = 1%

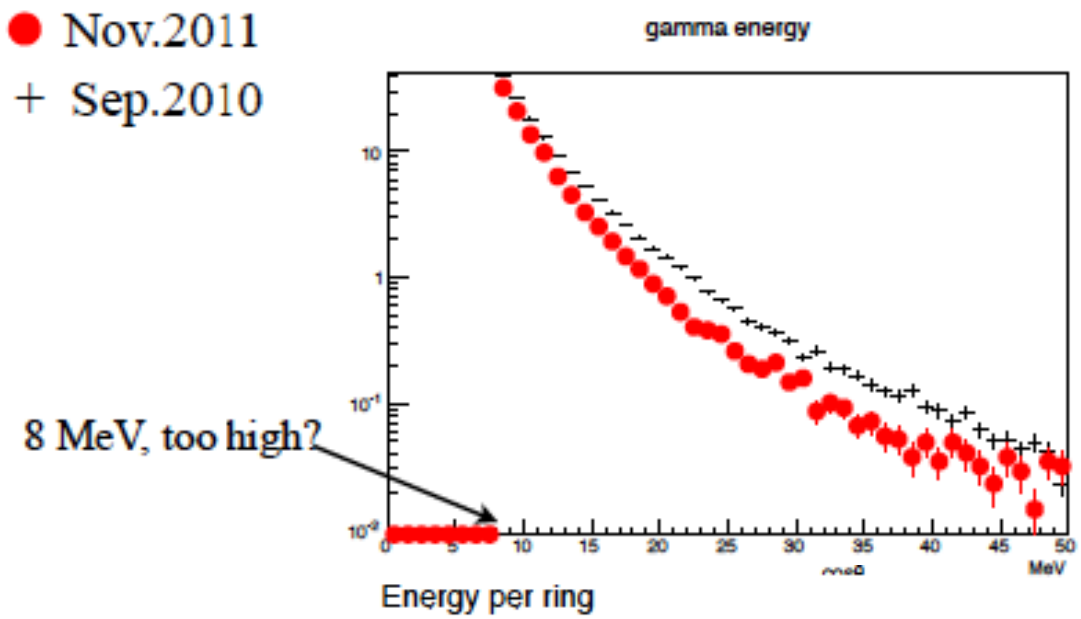
En [MeV]	Spread [%]
99	4.7
198	2.8
297	2.1
397	1.3
487	1.0



En (MeV)	σ(E)/E (%)
99	6.96 ± 034
198	4.34 ± 0.20
297	3.39 ± 0.10
397	2.57 ± 0.14
487	2.33 ± 0.17

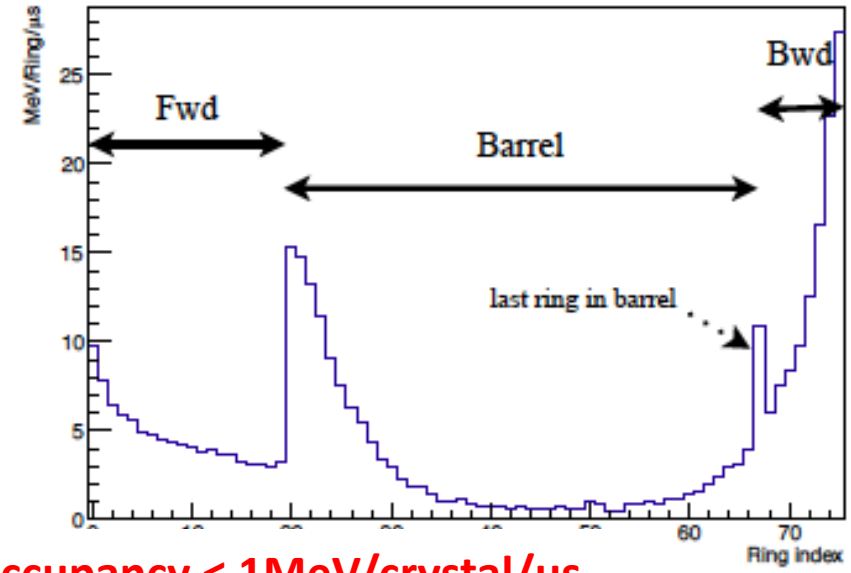


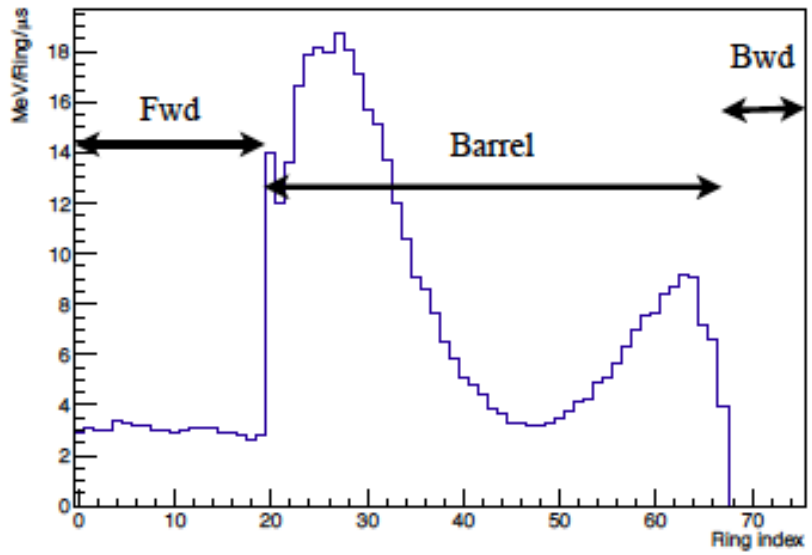
Background studies Fast and Full SIM (C. Hsiang – S. Germani)



Check the energy flux in the detector with Hits in fast sim and reconstruct clusters (with some cuts neutron kin.en. Thresh.= 0.1 MeV and sub-MeV for crystal energy

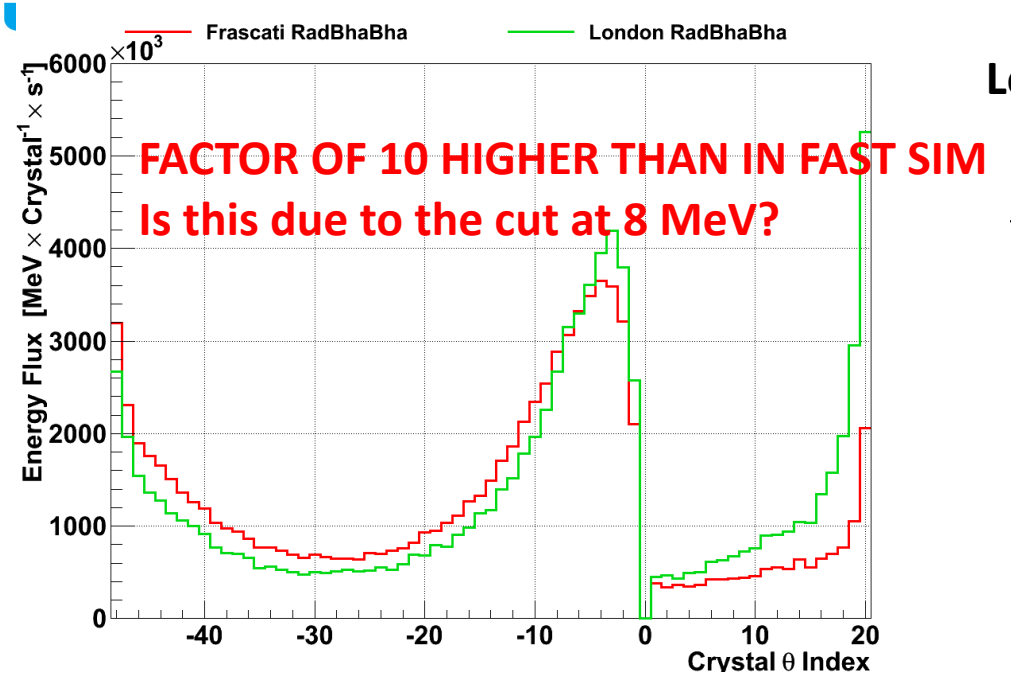
Why are there so few SimHits from neutrons in forward and backward endcaps? There are a lot of neutron entries in the background frame. Why don't they produce hits in the FastSim? Geometry mismatch? The "layers" in the FastSim not dense enough?



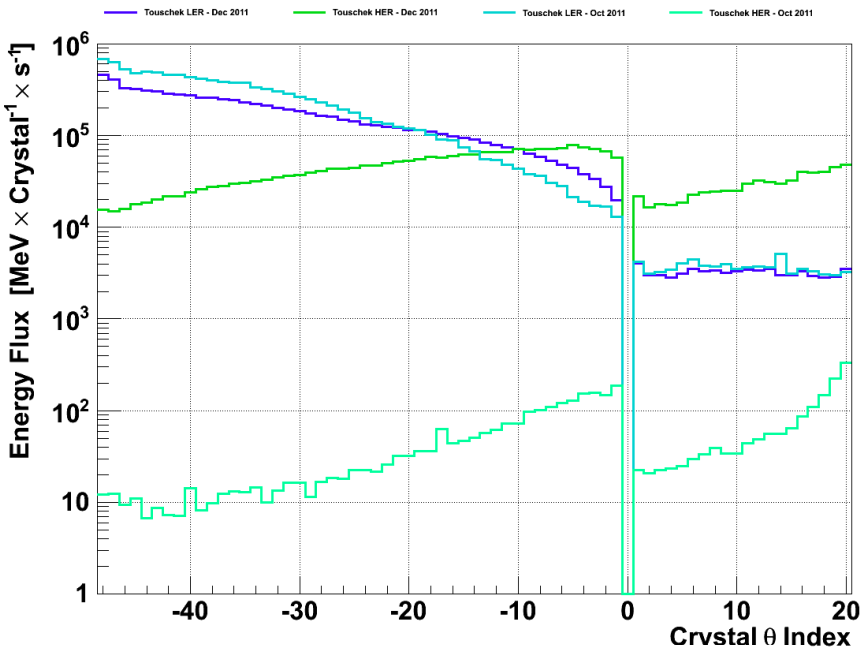


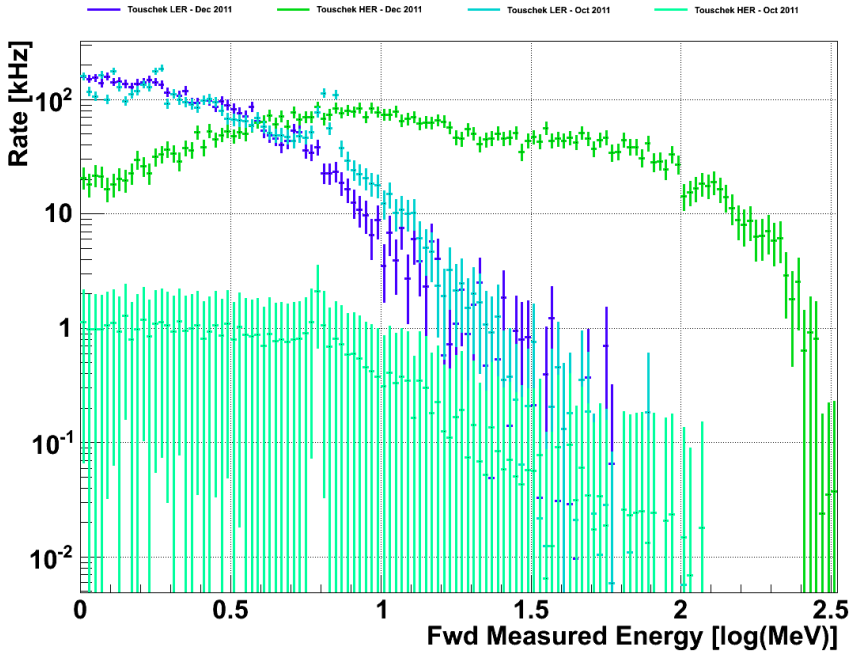
Occupancy < 1MeV/crystal/us

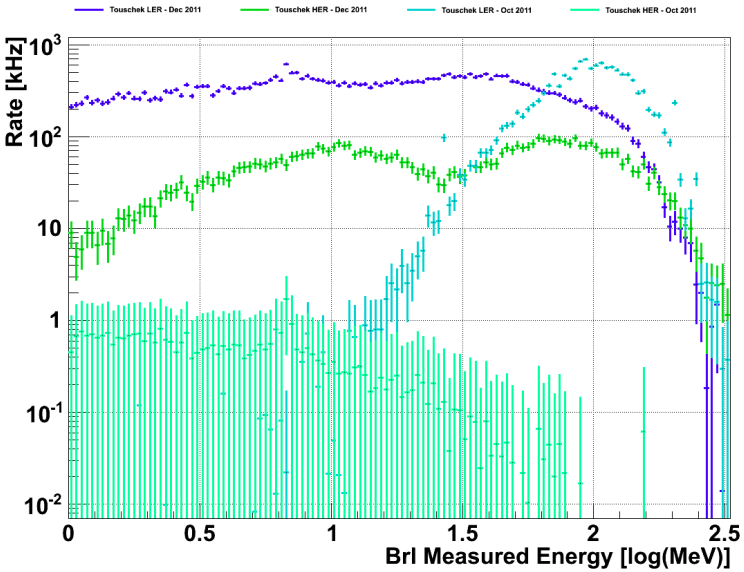
Background studies Fast and Full SIM (C. Hsiang – S. Germani)

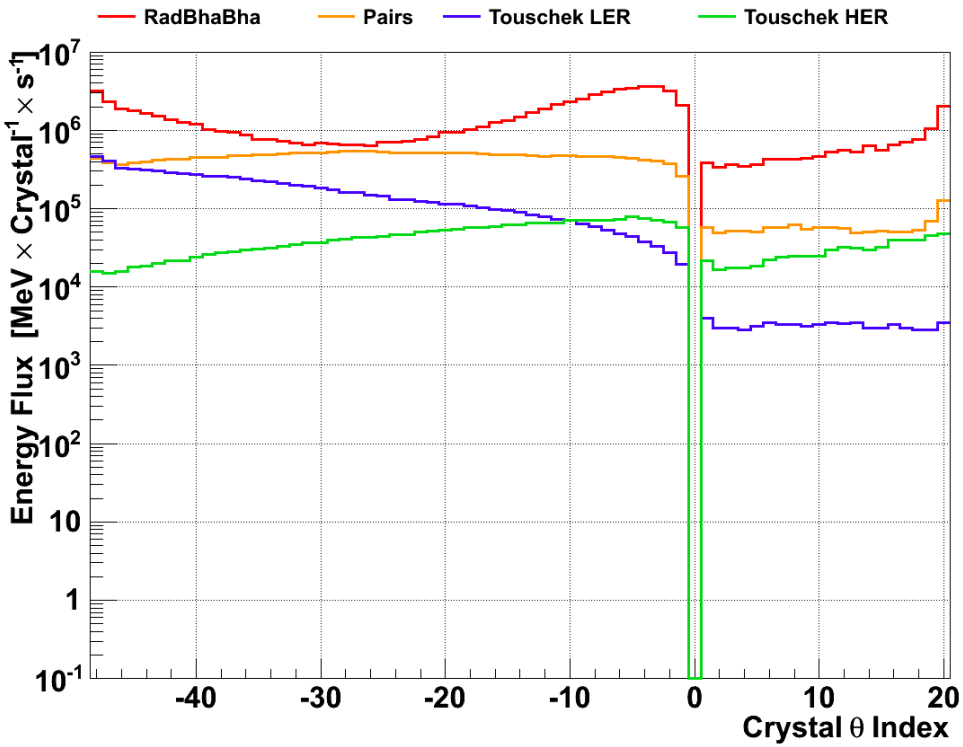


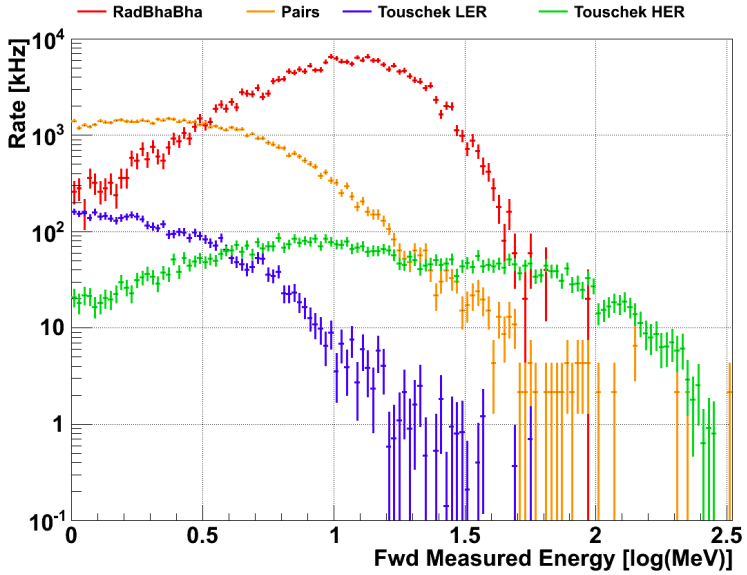
London SIM had beam pipe too large

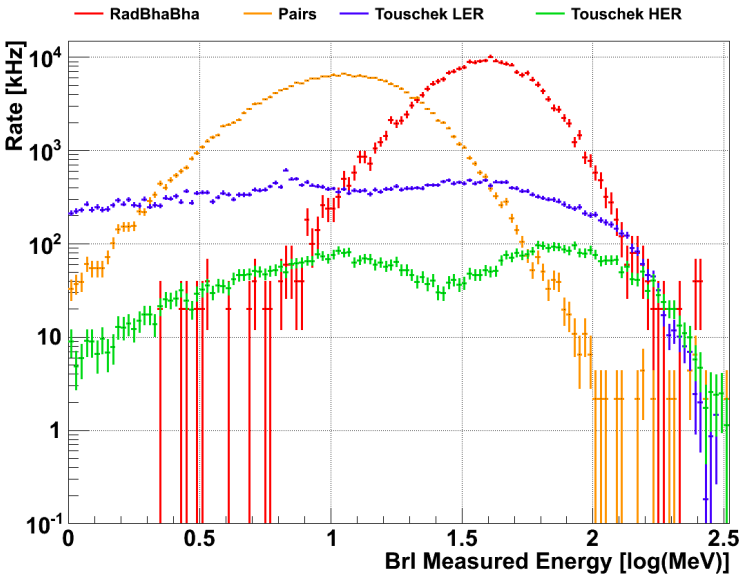








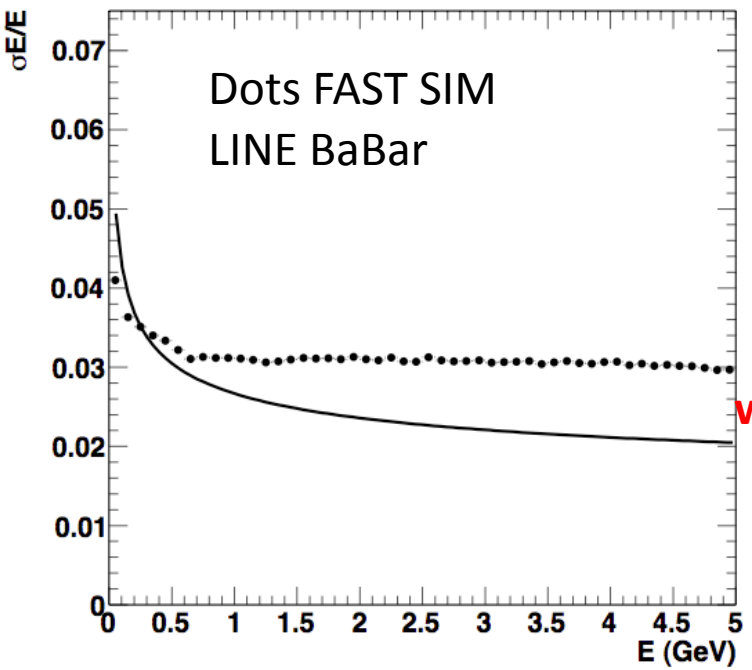




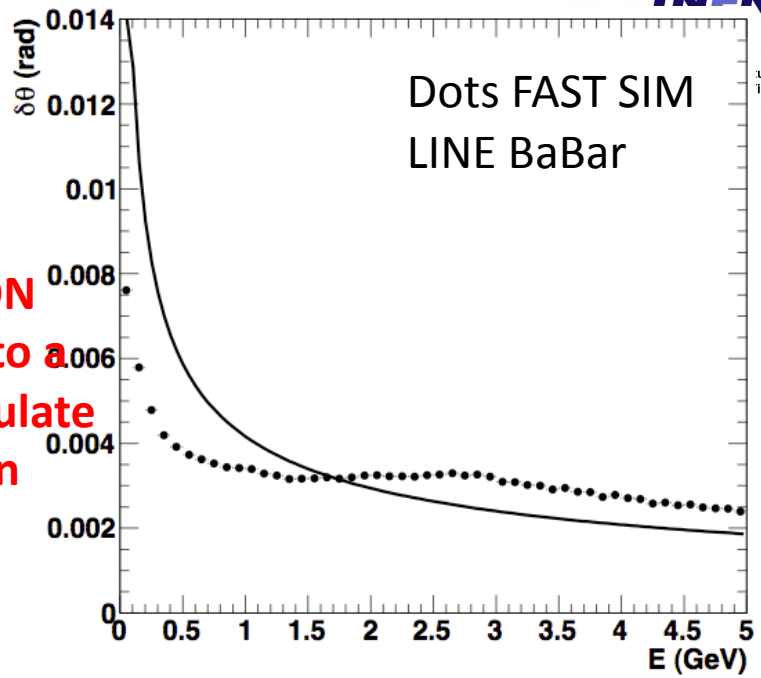
RAD Bhabha is the main BKG source but there is also a dependence on energy and on where events hit the calorimeter

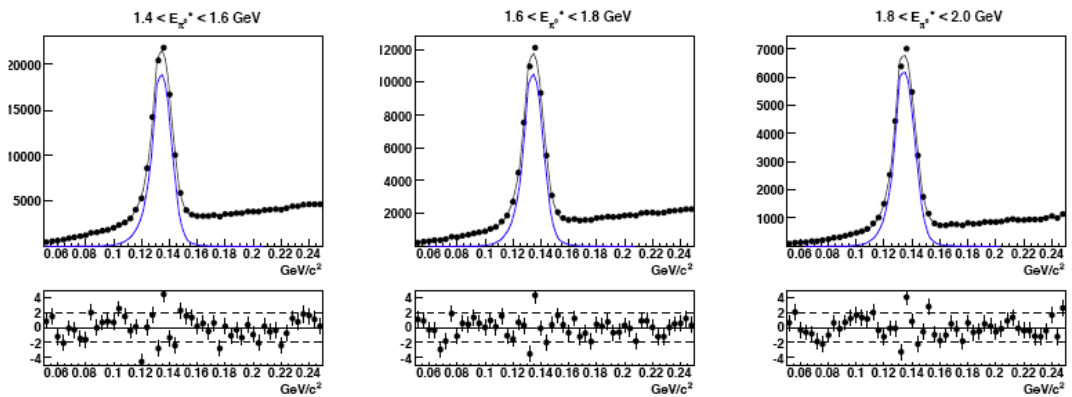
In particular:
PAIRS low energy region and central Barrel
TOUSCHEK high energy bckw barrel and Fwd

Barrel FAST SIM studies (W. F. Wang)

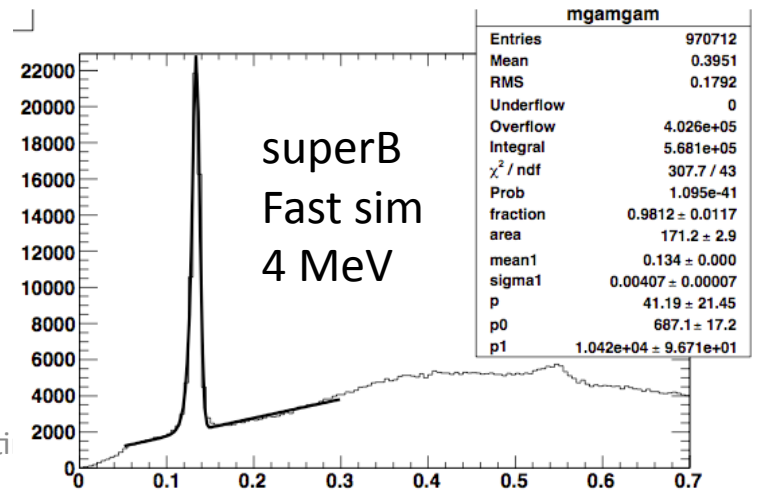


UNDER INVESTIGATION
Should be due to a way used to calculate the resolution





5.9 – 6.7 MeV resolution
No change observed after 10% LY due to 1Krad total dose

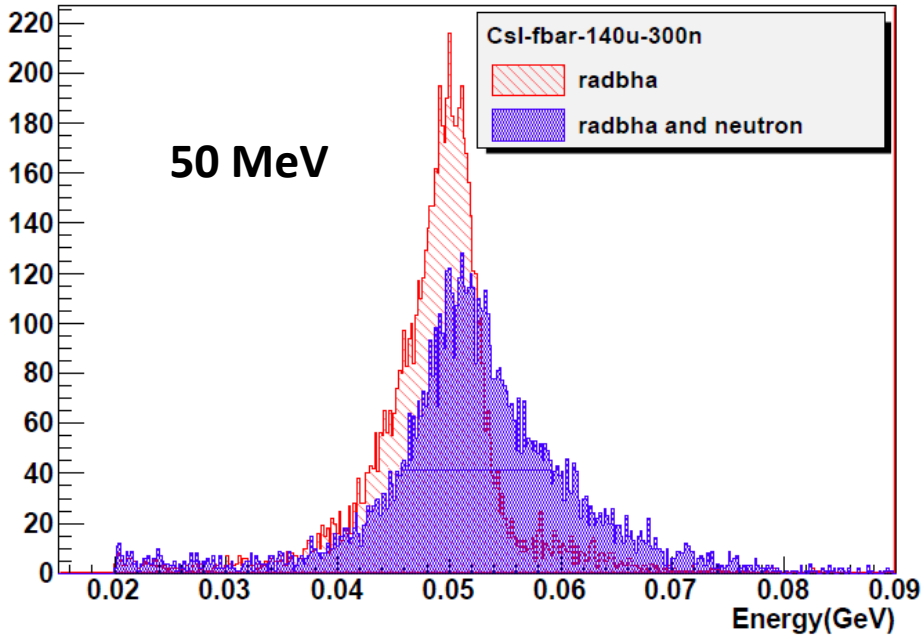


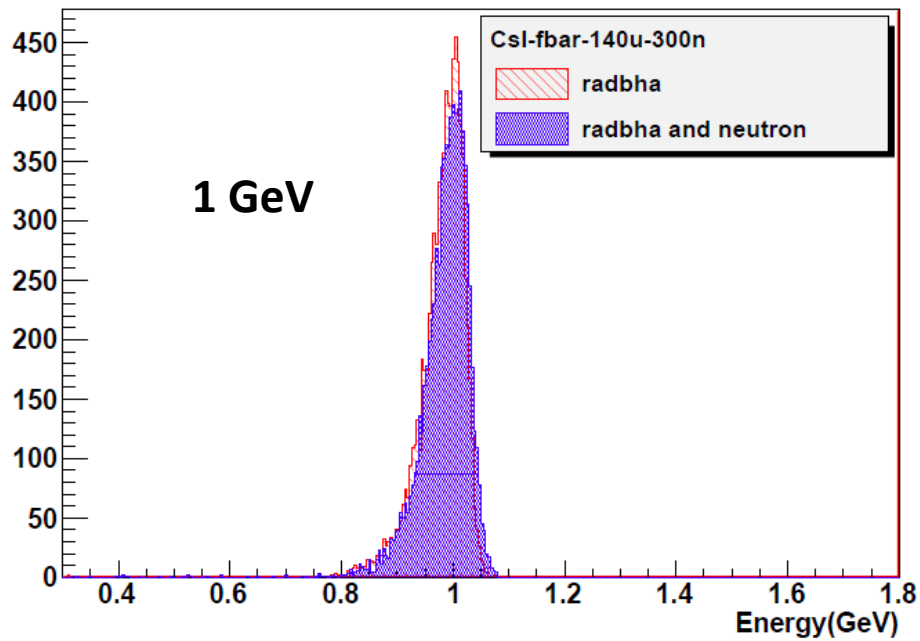
superB 1Krad/year → changes expected under study
Safety factor of 5 not included in EMC analysis!

FAST SIM: pile up studies (D. Chao)

Degradation of resolution due to pile-up radBhabha and slow neutrons
What's the effect of new preamps on Bckg?

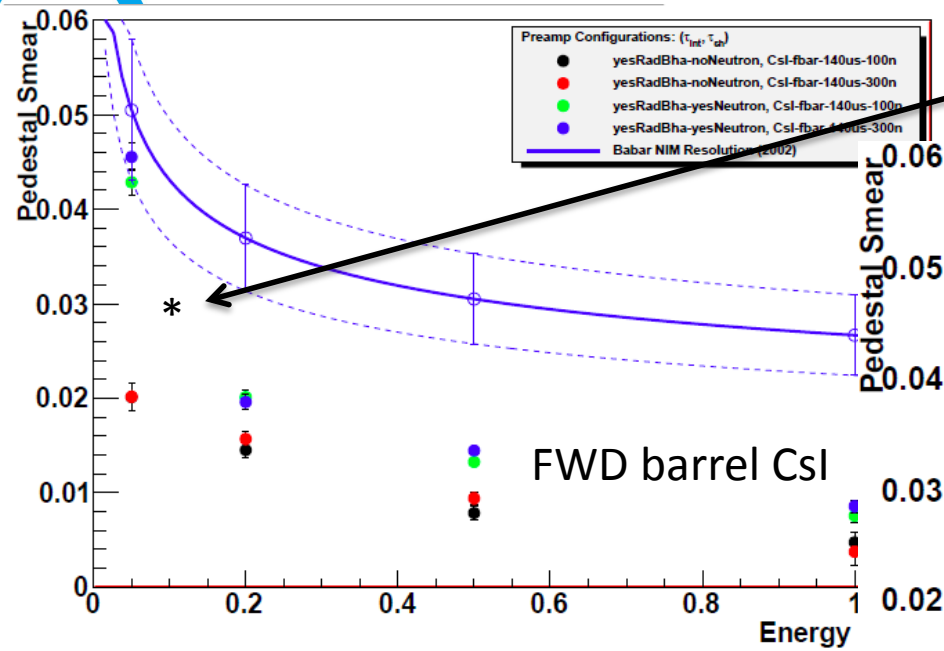
Energy distribution are generated and studied with and without background →
Pileup smearing is the difference in quadrature of the two resolutions to be compared to BaBar performance.

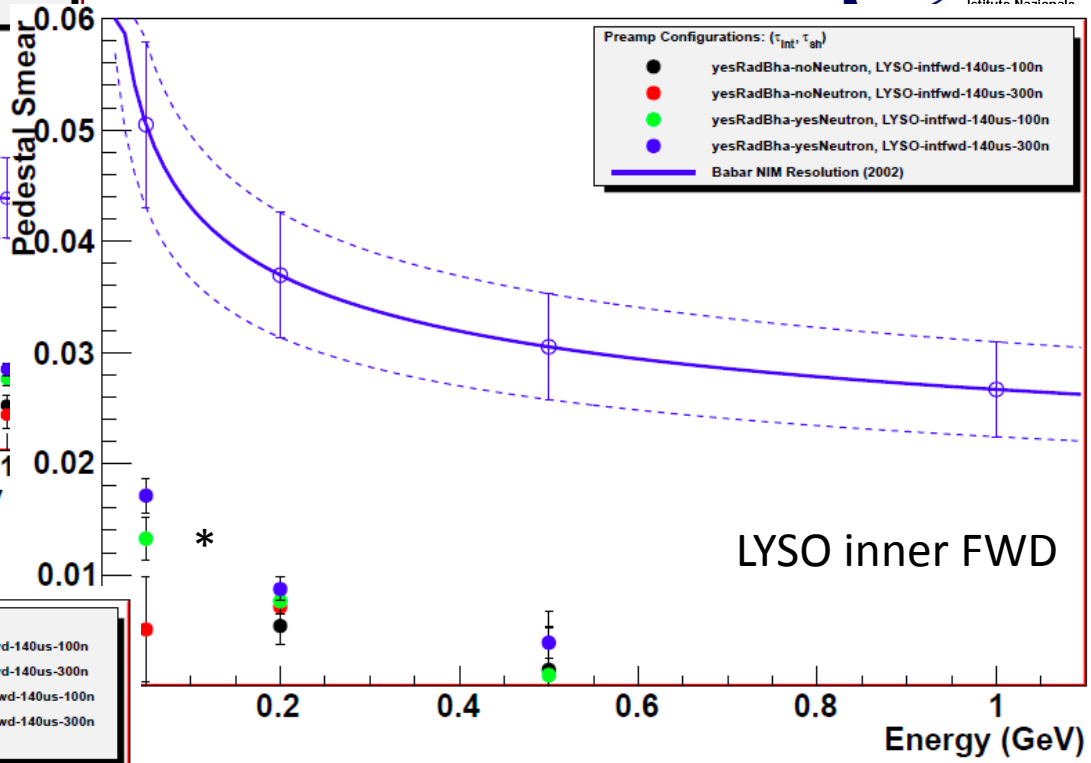


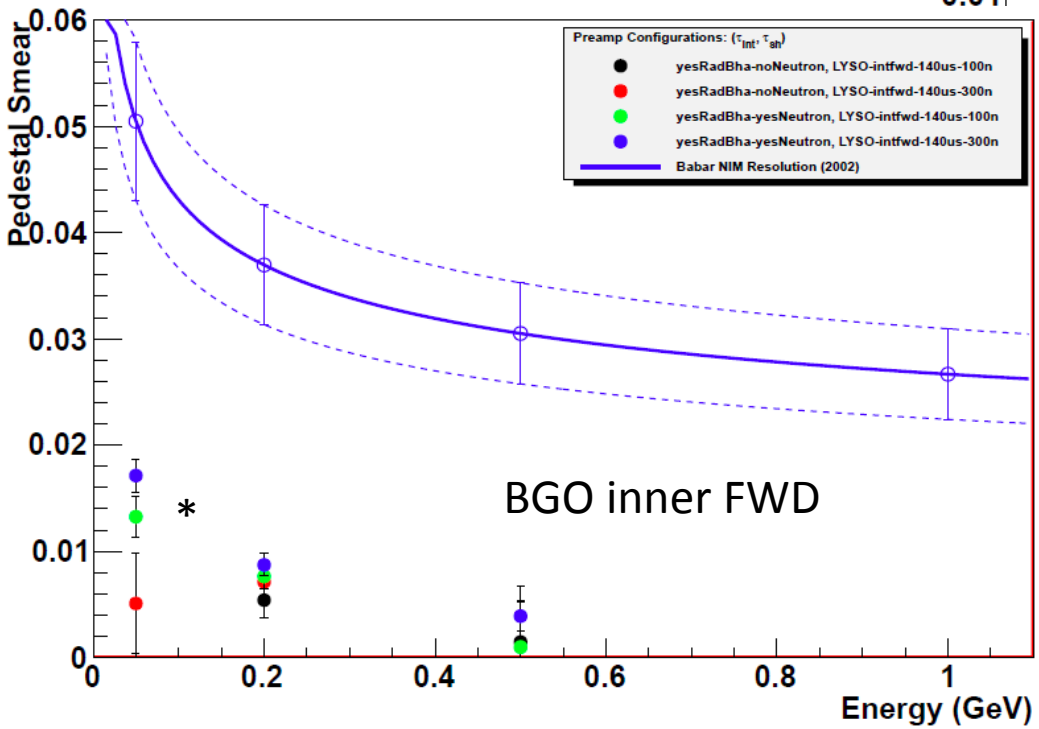


Neutron background has important effect for the barrel at low energies

Extrapolation to 100 MeV gives 3MeV from pileup contribution.



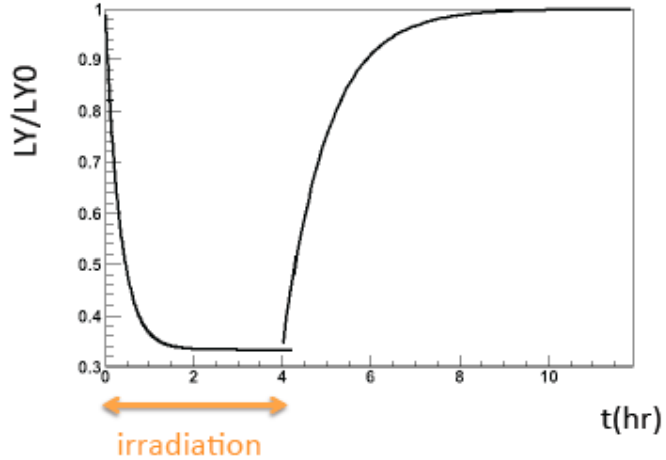


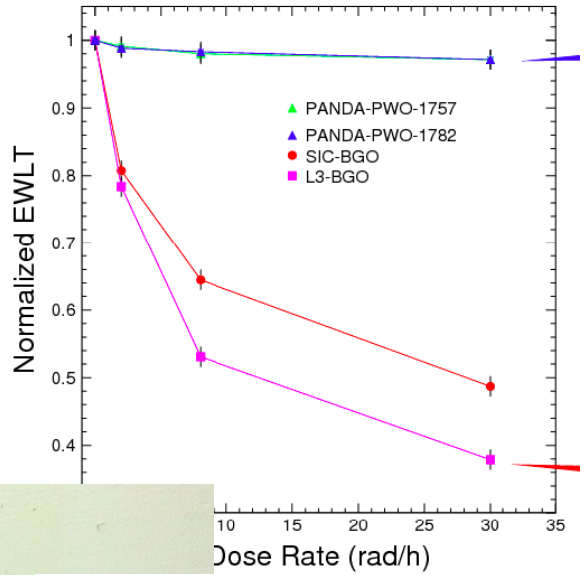


The smearing has no effect in the FWD

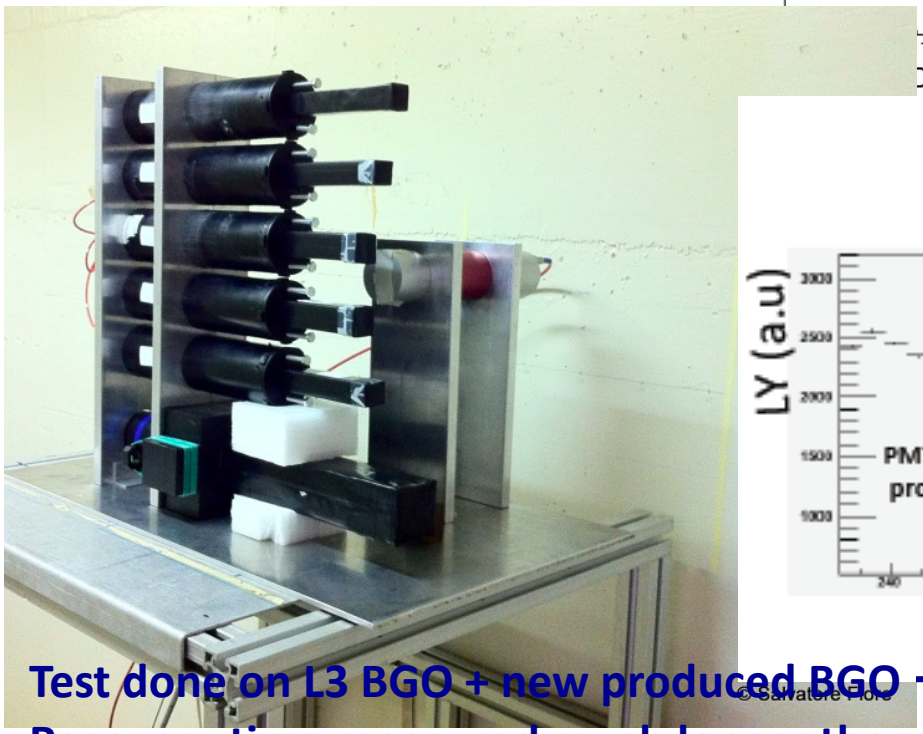
Dependence on pulse shape is under study.

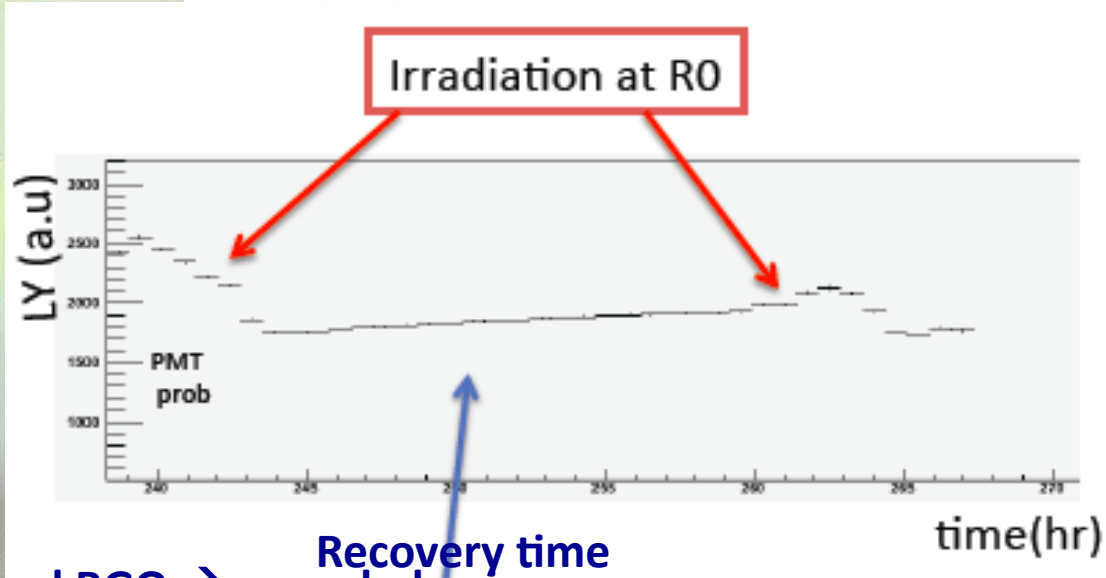
Alternatives: BGO rad hardness (R. Faccini)





Measure the properties of BGO (and other crystals) for the dose expected @superB.
Assumptions: 3Krad/year or 0.5 rad/hr
Verify the stability of LYSO and CsI





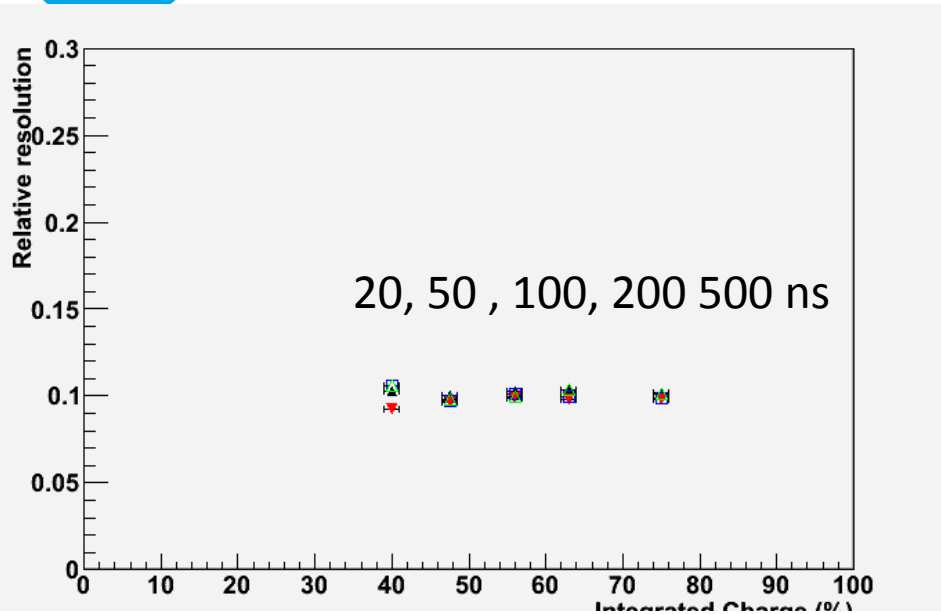
Test done on L3 BGO + new produced BGO → same behavior

Recovery time measured much longer than expected from literature 10hr (1hr) → measure again with a different strategy

With 8rad/hr drop of about 40%, verify that saturation has been reached

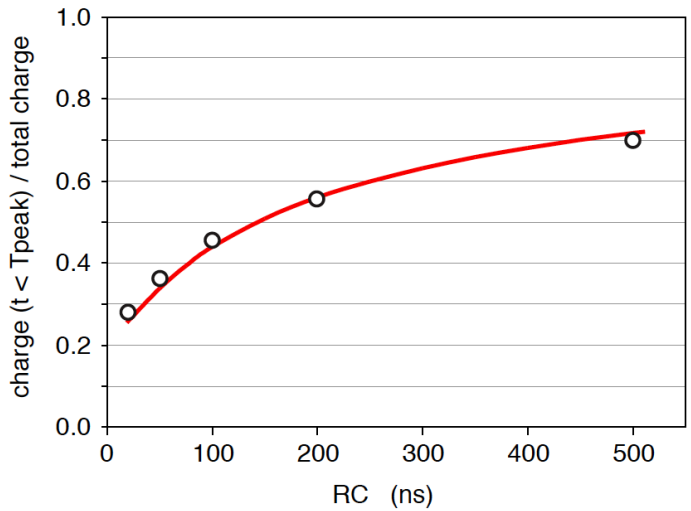
Alternatives: BGO lab measurements (D. Pinci)

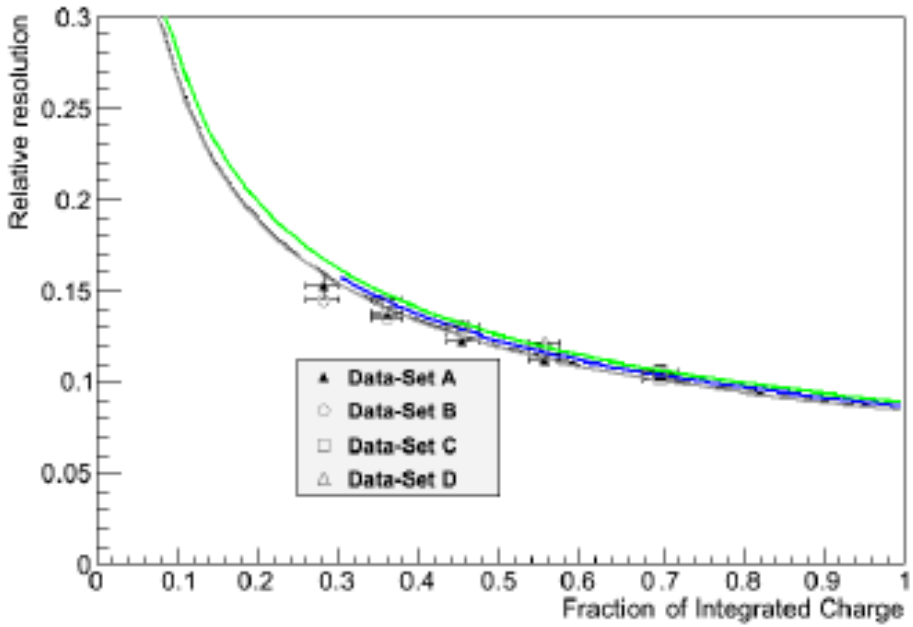
BGO crystal irradiated with ^{137}Cs source and study resolution as function of integration time.



From the resolution the number of p.e./MeV is derived of about 150

This gives a contribution of about 1% to the resolution in the stat.term

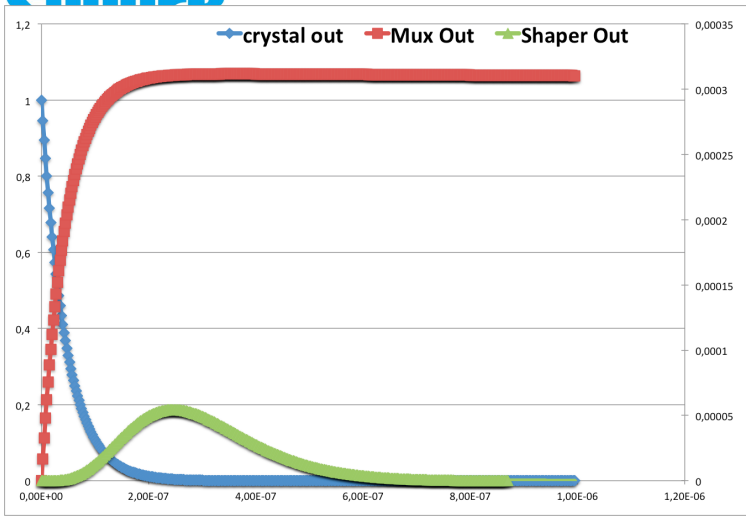


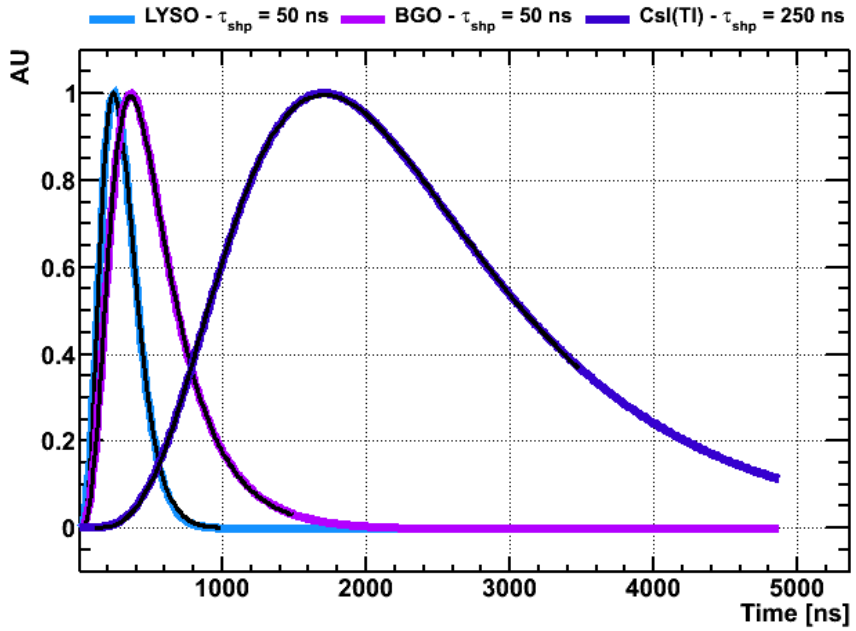


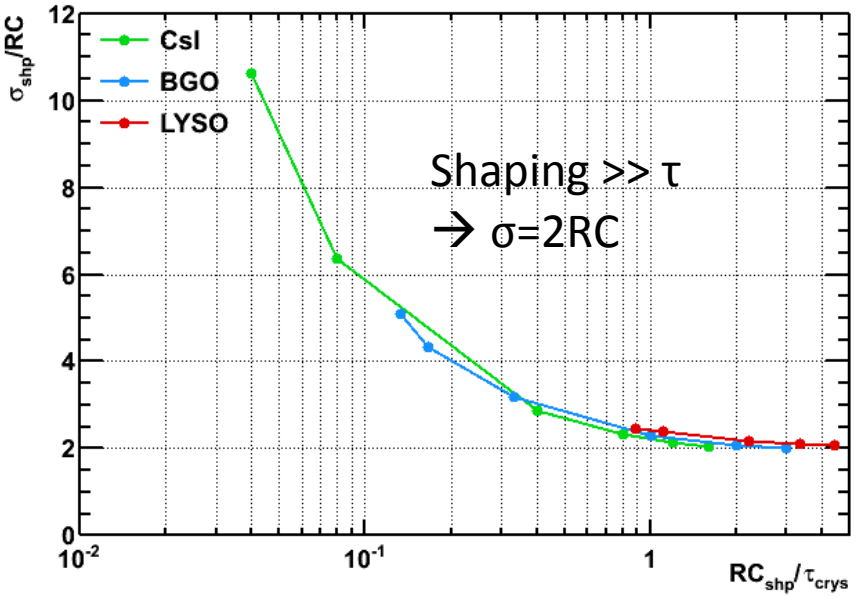
$$\frac{\sigma_A}{A} = \frac{\sigma_0}{\sqrt{f}}$$

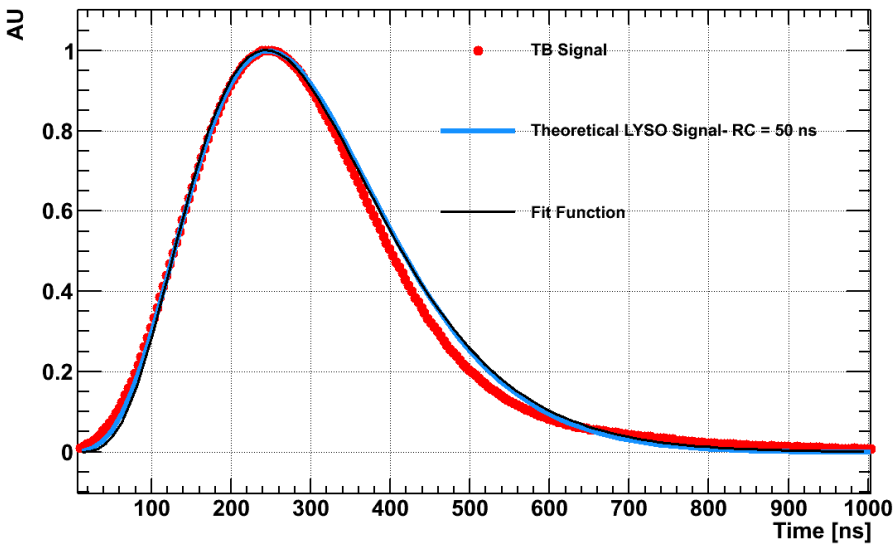
σ_0 = 8.5% - 9.0%

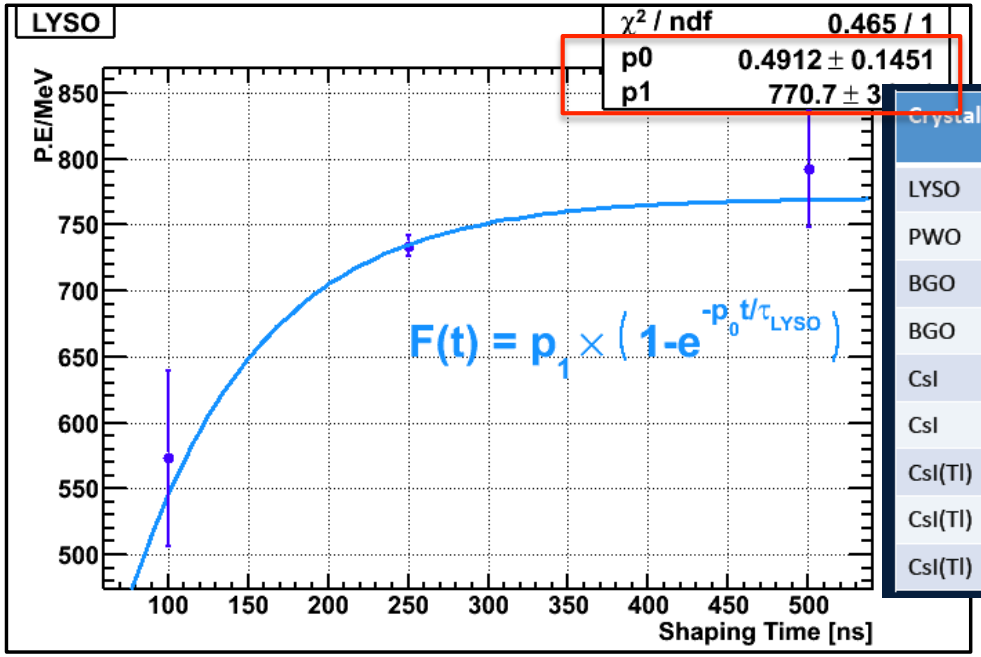
Alternatives: simulation studies (S. Germani)





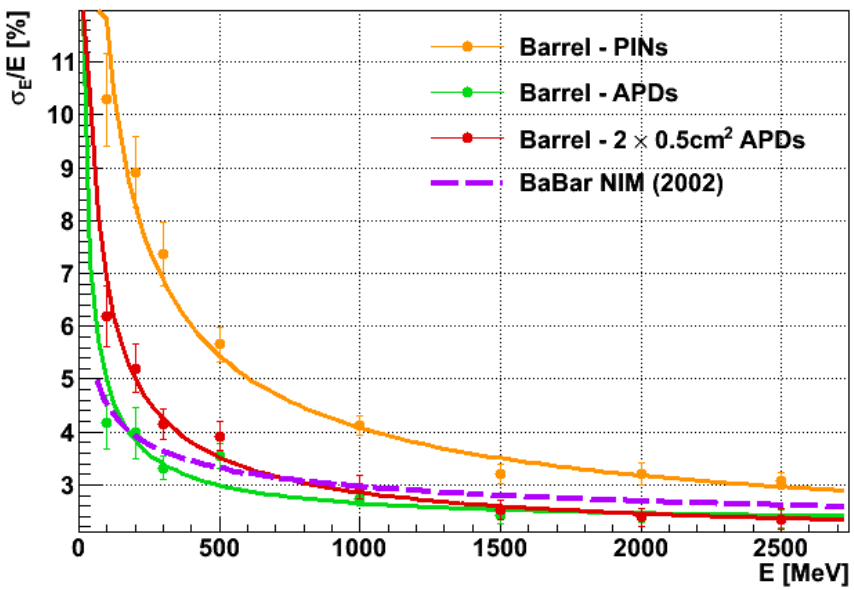


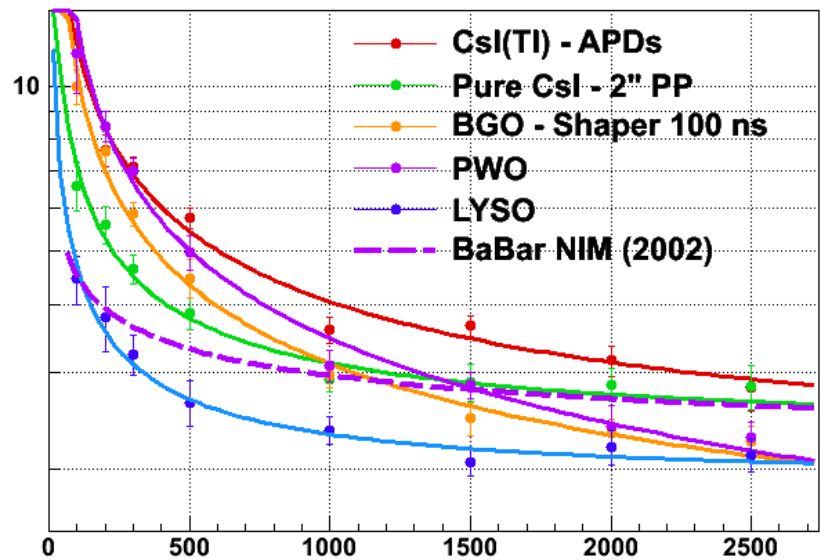




Perugia

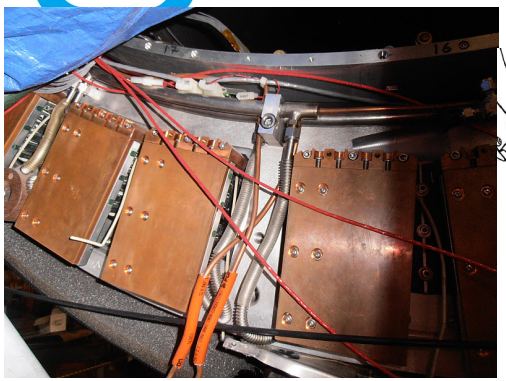
Crystal	Sensor	Sensor Area	Gain	Shaping Time	Integrated Fraction	Effective pe/MeV	SN/SN(BTF)
LYSO	APD	0.5 cm2	50	100 ns	711 %	530	**16**
PWO	APD	2 cm2	50	100ns	81 %	28	**0.86**
BGO	APD	0.5 cm2	50	200 ns	28 %	64	**3.9**
BGO	APD	0.5 cm2	50	100 ns	15 %	35	**2.1**
CsI	PP	10 cm2	180	100 ns	81 %	29	**3.2**
CsI	PP	20 cm2	180	100 ns	81 %	58	**6.4**
CsI(Tl)	PIN	4 cm2	1	500 ns	21 %	1550	**0.95**
CsI(Tl)	APD	4 cm2	50	500 ns	21 %	1550	**48**
CsI(Tl)	APD	0.5 cm2	50	500 ns	21 %	190	**6**

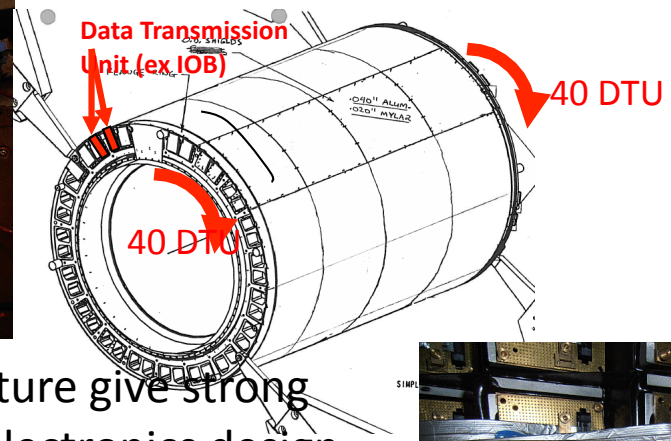


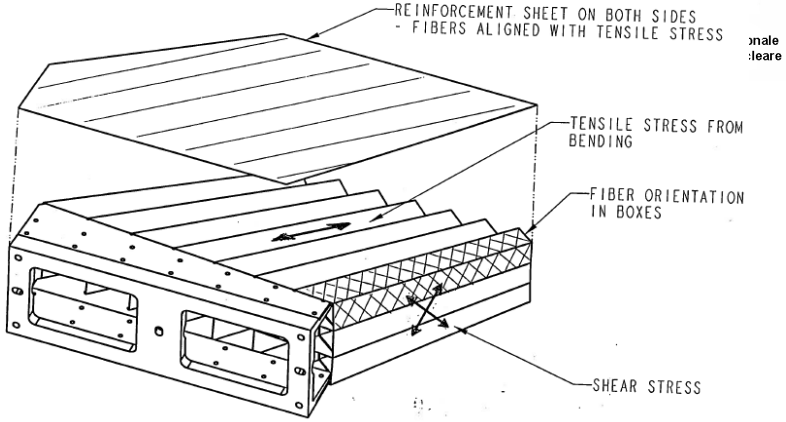


SLAC visit: consideration for FEE (V. Bocci)

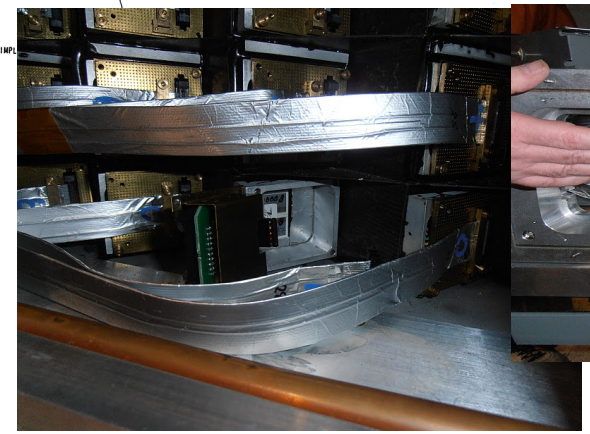
FE electronics for the BARREL

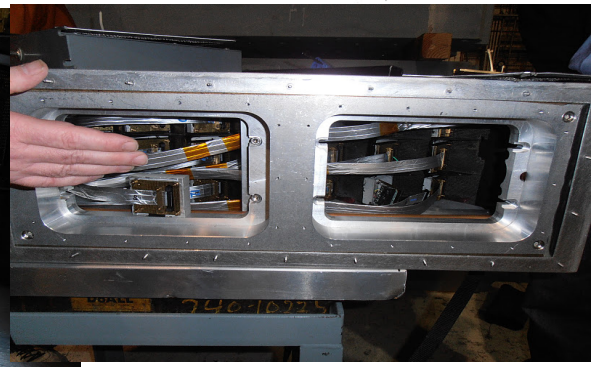






- The Mechanical structure give strong physical constraint to electronics design

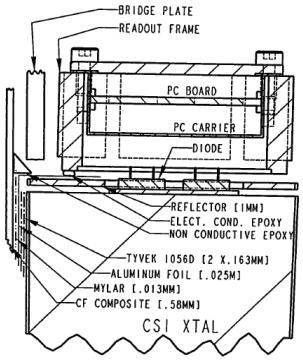




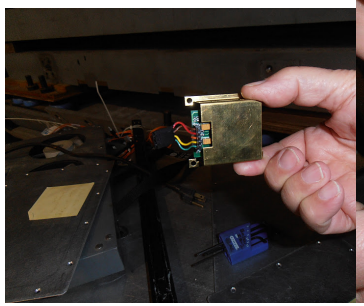
- **It is impossible without risking to destroy the assembly to substitute the PIN diodes.**

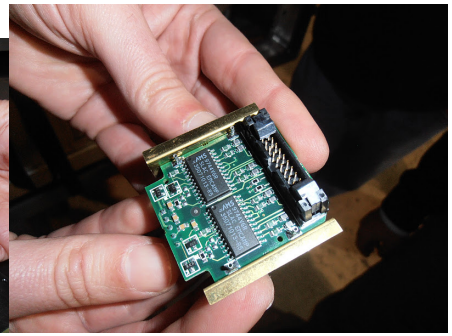
- **The substitution of the Preamplifier it is not trivial but feasible (order 1 yr man pwr)**

- New Preamp,New (Digitizer + trigger sum),New Data Transmission



21 modules, 21 preamps board inside the two windows of the box





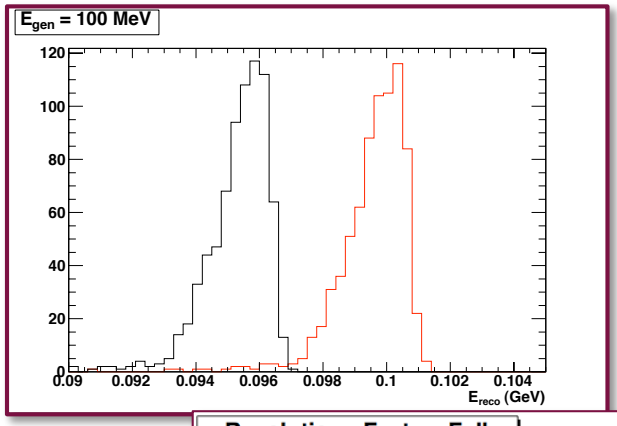
Performance of EMC alternatives: Physics studies (E. Manoni)

Quantify the impact of different EMC resolutions on physics

$$\frac{\sigma(E)}{E} = \frac{a}{\sqrt{E}} \oplus \frac{b}{E} \oplus c$$

Parameters from full sim

Calibration →



Single photons
Event generated

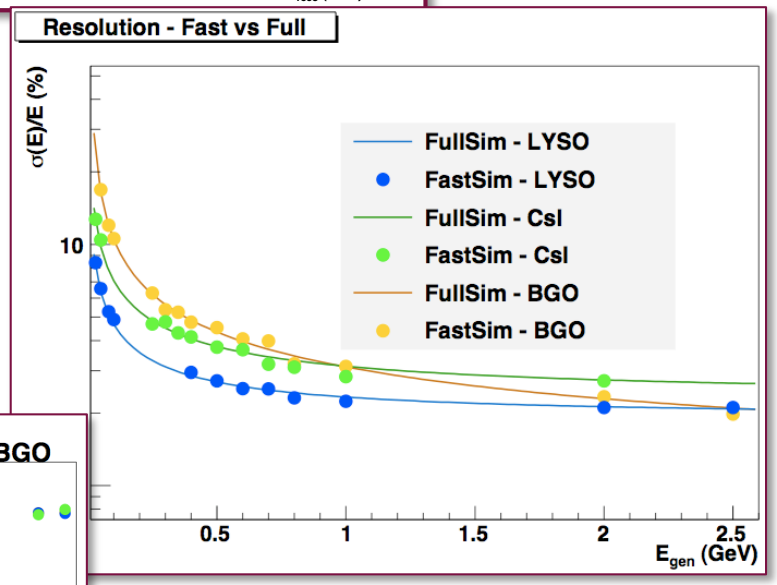
Compare expected resolution with intrinsic one and apply the smearing as

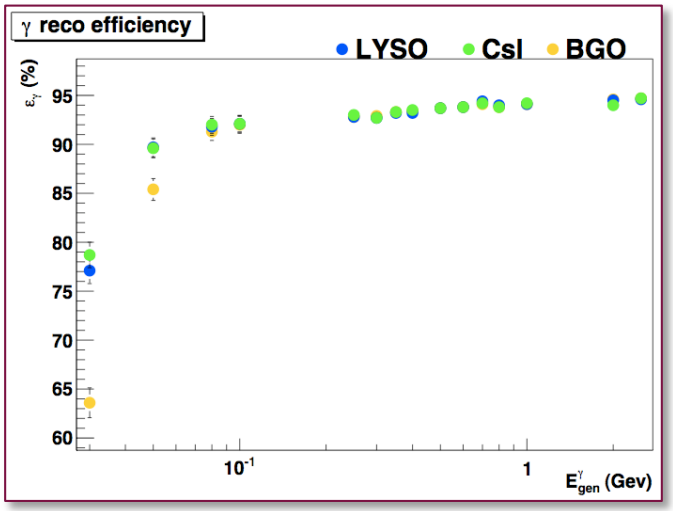
if (σ_{exp}>σ_{intr}) {

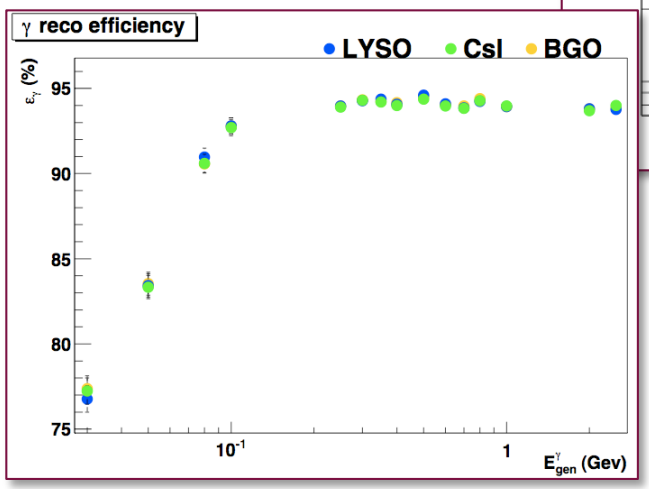
σ=sqrt(σ_{exp}^2-σ_{intr}^2);

generate a random number (δE) with CB distribution

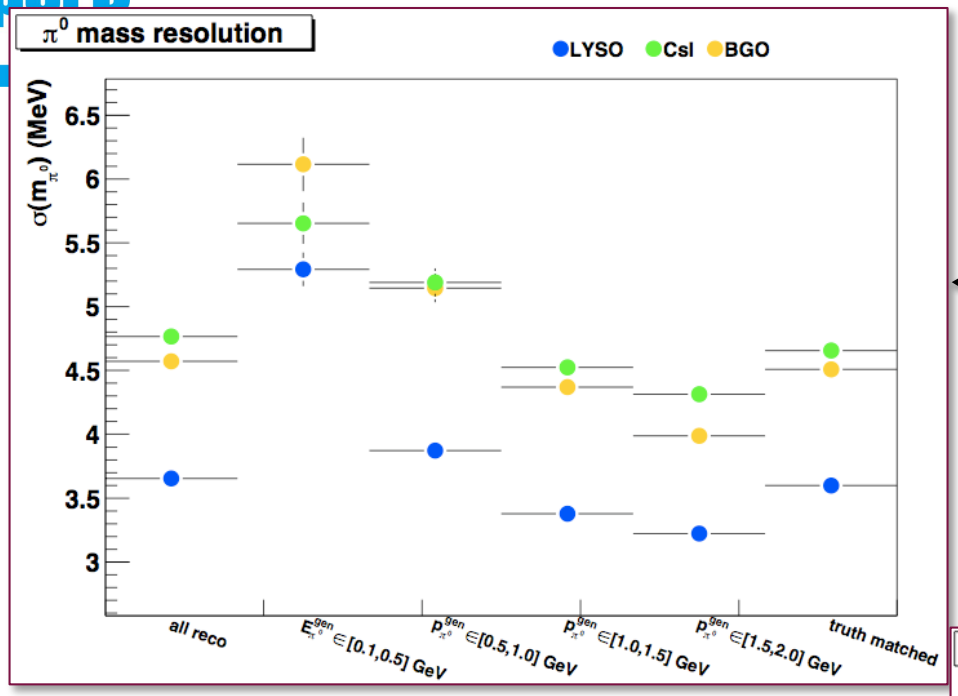
scale energy: E_{reco} = E x (1+δE)





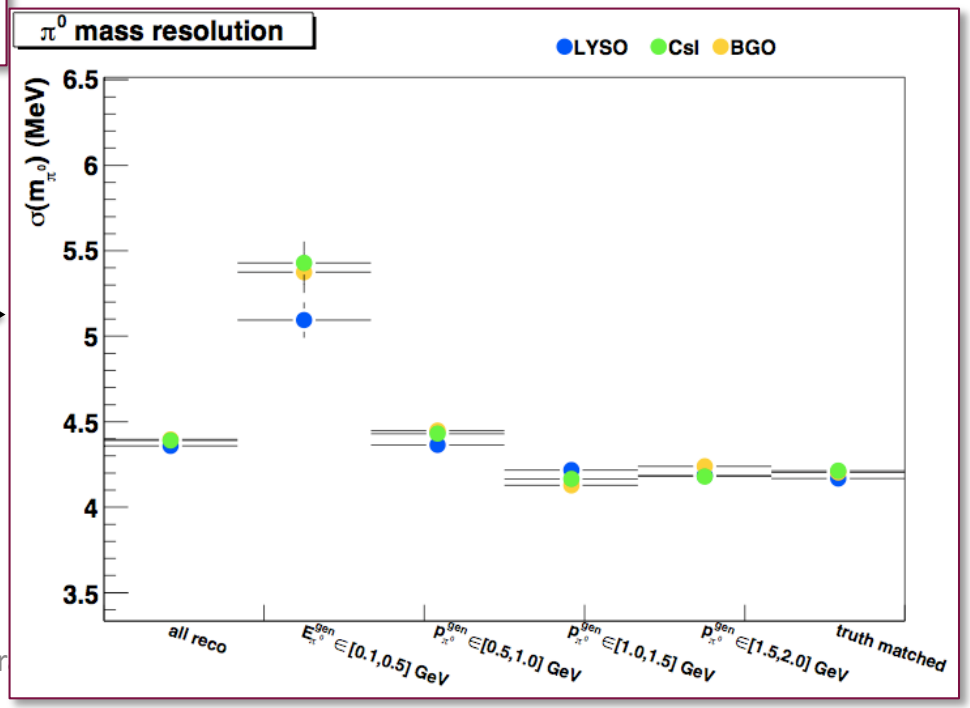


In Barrel + FWD the background will give the main effect and there is no difference between options

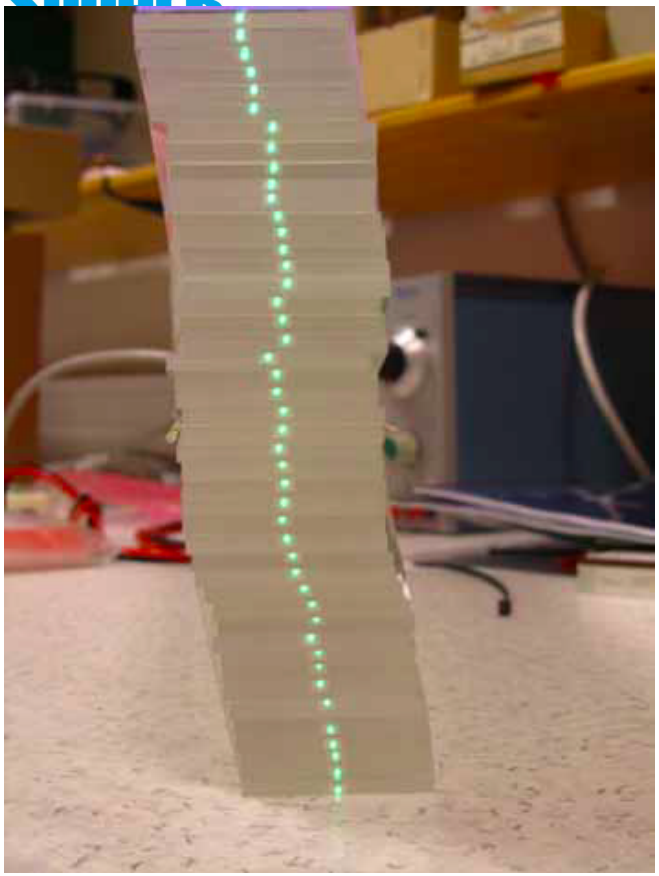


FWD

FWD + BARREL



Backward Calorimeter (G. Eigen)

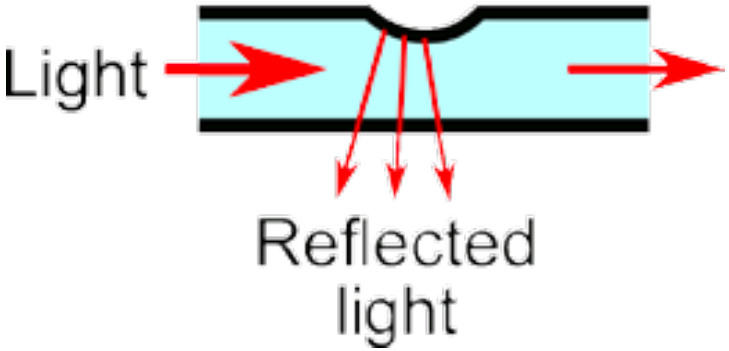


Prototype: 48 sector strips ready
spiral strips (96) to be done (where?)

Strips are not uniform in LY uniformity will be restored with
black dots into the with reflectors, should work also for spiral strips

New SiPM could be used which shows better performances
Notched fibers can be used to reduce PiN diodes and calibration boards

Test needed



TDR status (ALL)

Writing is ongoing

some parts are not yet there but all the sections have been assigned

The only difficult part could be the one related to
ALTERNATIVES TO LYSO

We should decide how to proceed on it

Conclusions

An impressive amount of work has been carried out since the last meeting!

Many presentations during this week (we really need to have 4 sessions for EMC at the next meeting

TB results show agreement between data and MC and confirm the excellent performance expected with the LYSO calorimeter
(it will be very interesting to close the loop verifying at the BTF our new model for the beam spread, measuring events with more than 1 electron, some time has been allocated on March 2012)

Full SIM- fast SIM need some more understanding

Many effort have been dedicated to the study of the ALTERNATIVES to LYSO: try to uniform the starting points of the different studies in order to have comparable results: this will start just after Christmas stop, meeting between people working on it have to be planned to have a complete and CONSISTENT sets of results to be discussed in the EMC groups

→ 3 alternatives will be described in the TDR

Open Issues – EMC

	Answered by TDR?
▸ Shipping/refurbishing of barrel	
▸ Does it need to be disassembled for shipping (no, in baseline)?	unknown
▸ Do we need to change preamps (this is baseline)?	yes
▸ Do we need to change PIN diodes (this is not baseline)?	yes
▸ Optimal shaping time?	yes
▸ Add row of crystals in backward end?	no
▸ Backward EMC beam test	no
▸ Does backward EMC capture beampipe (this is baseline)?	no
▸ Can backward EMC do TOF?	no
▸ What should we include in TDR for alternative forward technology?	yes
▸ Which alternative forward strategy if can't afford baseline LYSO design?	no

December 2011 Frank Porter, Frascati SuperB Collaboration Meeting 1