Attività per

EMC superB Perugia

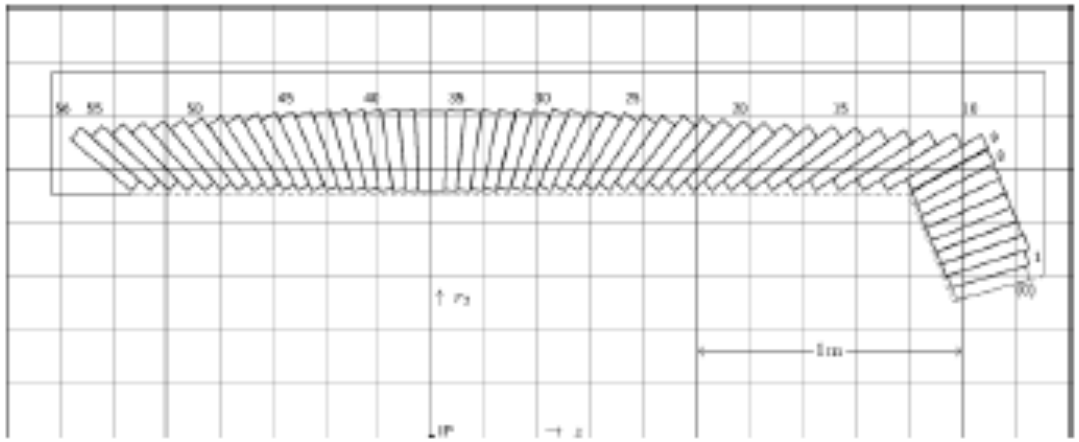
Riunione referee

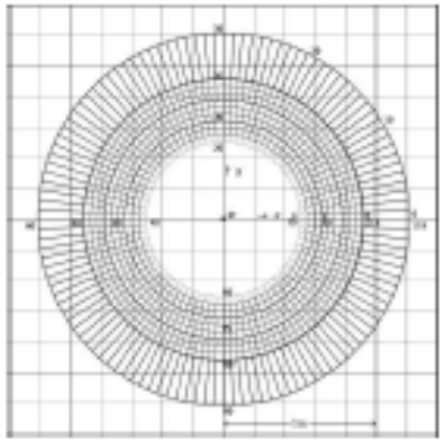
Milano 8 Settembre 2008

Claudia Cecchi

STATUS OF EMC

Measure energy and direction of e, γ
Detect neutral hadrons
Separate e, γ





BaBar Barrel

5760 CsI(Tl)

Crystals

-Barrel can be reused, retain geometry and PD read-out
-Forward endcap to be replaced due to radiation damage, CsI too slow at superB rate ⇒ LSO
- Backward Endcap hermeticity important for inclusive decays and decays with neutral energy
- Veto detector possibility Lead/Scintillator fibers

NEW approach scintillator tiles

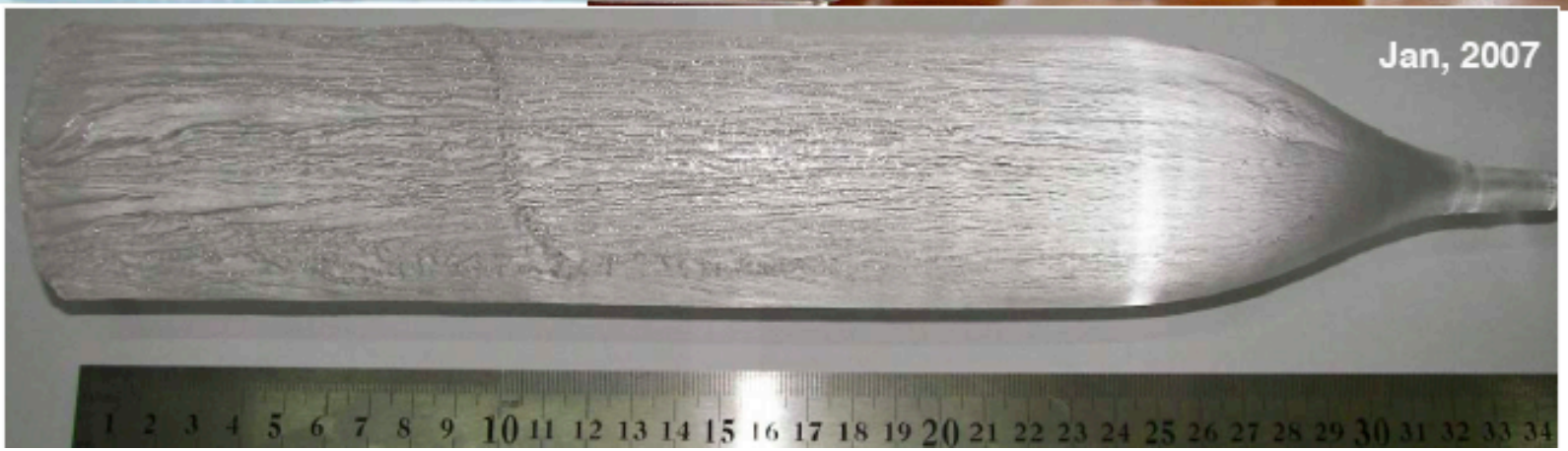
EMC Forward as well as backward should be
- FAST
- small Molière Radius and RL
- radiation hard

Mass-produced Crystals (new, for PDG)

Crystal	NaI(Tl)	CsI(Tl)	CsI	BaF_2	BGO	PWO(Y)	LSO(Ce)	GSO(Ce)
Density (g/cm^3)	3.67	4.51	4.51	4.89	7.13	8.3	7.40	6.71
Melting Point (°C)	651	621	621	1280	1050	1123	2050	1950
Radiation Length (cm)	2.59	1.86	1.86	2.03	1.12	0.89	1.14	1.38
Molière Radius (cm)	4.13	3.57	3.57	3.10	2.23	2.00	2.07	2.23
Interaction Length (cm)	42.9	39.3	39.3	30.7	22.8	20.7	20.9	22.2
Refractive Index [a]	1.85	1.79	1.95	1.50	2.15	2.20	1.82	1.85
Hygroscopicity	Yes	Slight	Slight	No	No	No	No	No
Luminescence [b] (nm) (at peak)	410	550	420 310	300 220	480	425 420	402	440
Decay Time [b] (ns)	230	1250	30 6	630 0.9	300	30 10	40	60
Light Yield [b,c] (%)	100	165	3.6 1.1	36 3.4	21	0.29 .083	83	30
d(LY)/dT [b] (%/ °C)	-0.2	0.3	-1.3	-1.3	-0.9	-2.7	-0.2	-0.1
Experiment	Crystal Ball	CLEO BaBar BELLE BES III	KTeV	TAPS (L*) (GEM)	L3 BELLE PANDA?	CMS ALICE PrimEx PANDA?	-	-

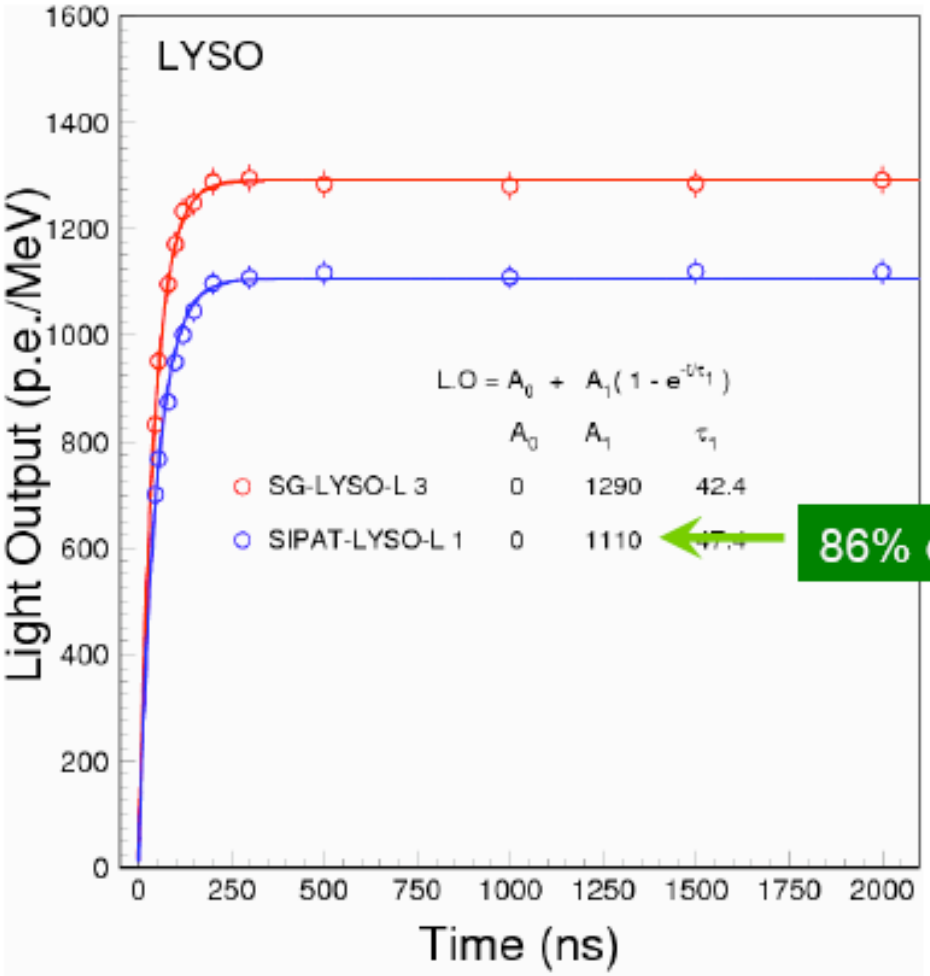
Progress of LSO/LYSO Growth

Started 2001, invested >$1M
Significant Progress in last year

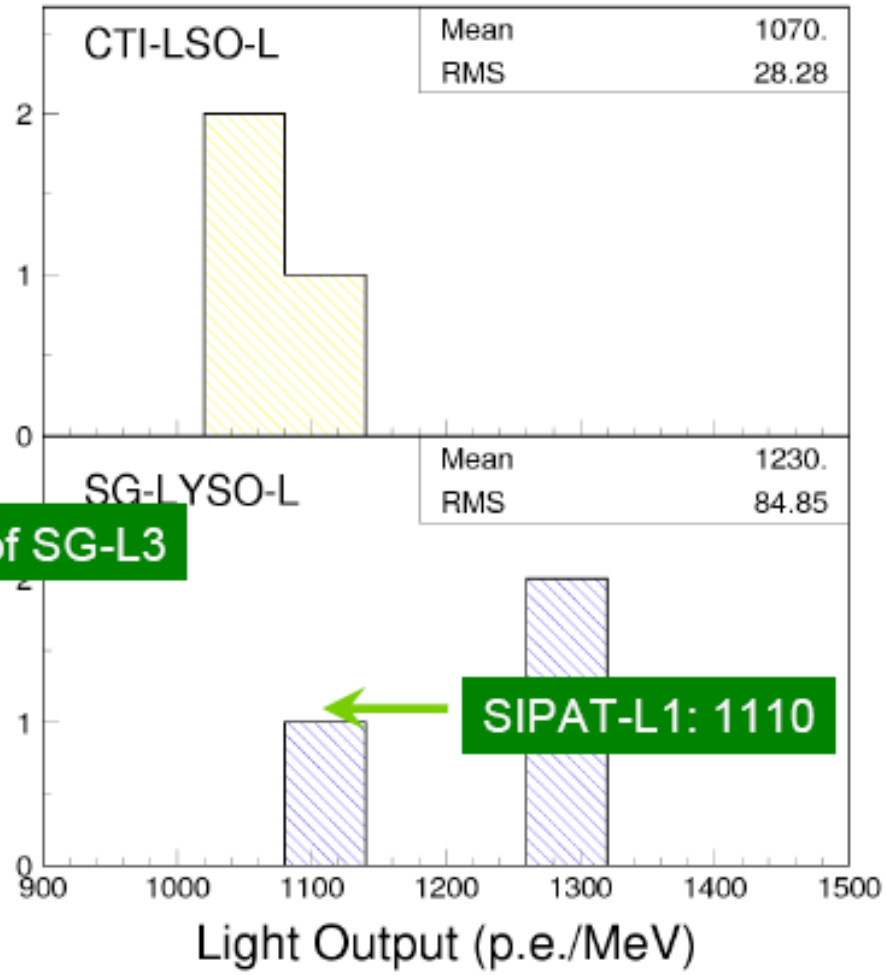


Light Output and Decay Kinetics

Compatible with the first batch large size samples from CTI and Saint-Gobain, and is 86% of the 'best' samples

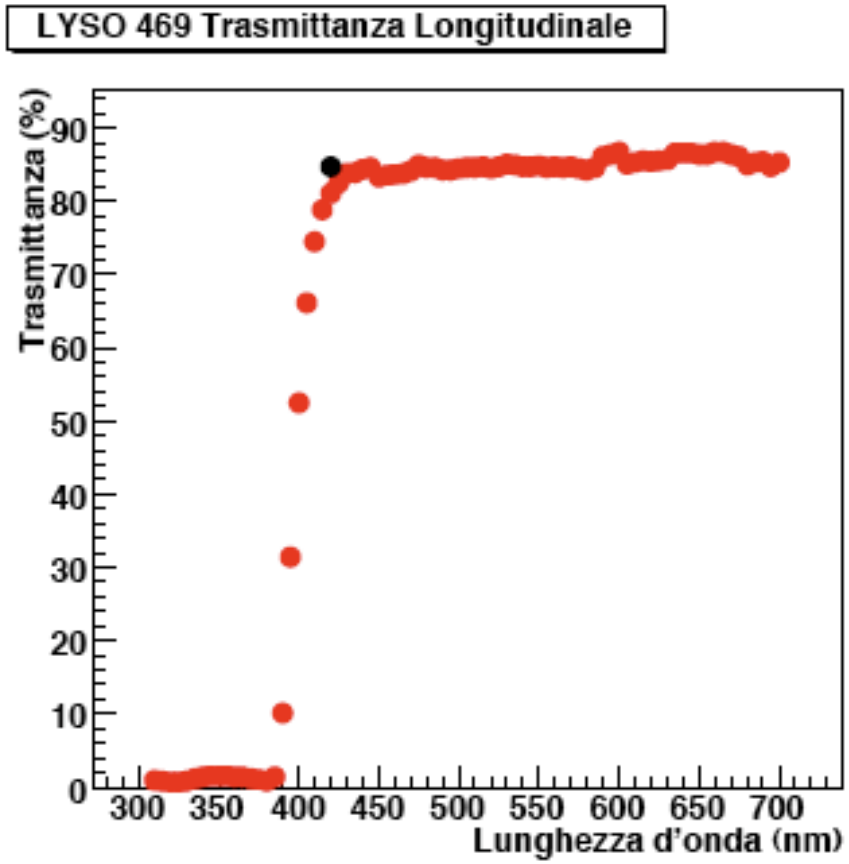


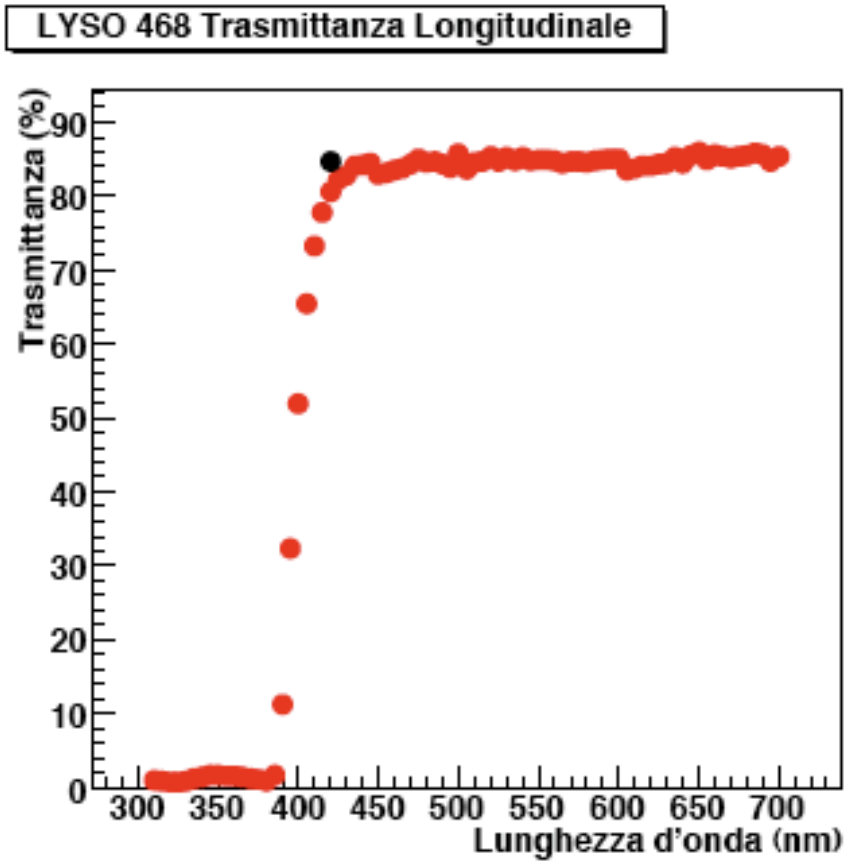
86% of SG-L3



SIPAT-L1: 1110

Crystals measurements in Perugia

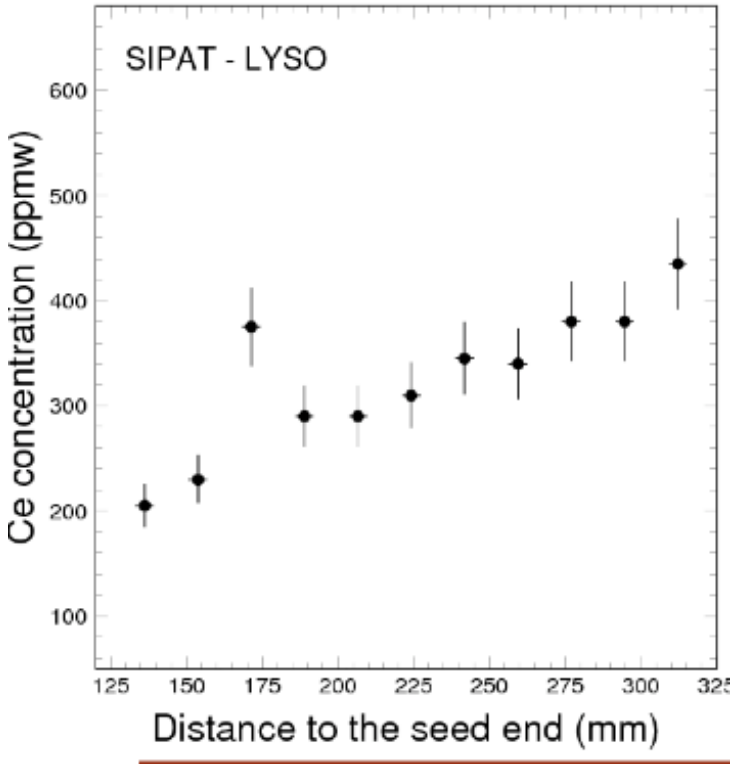




Black point is the maximum value of transmittance theoretically reachable

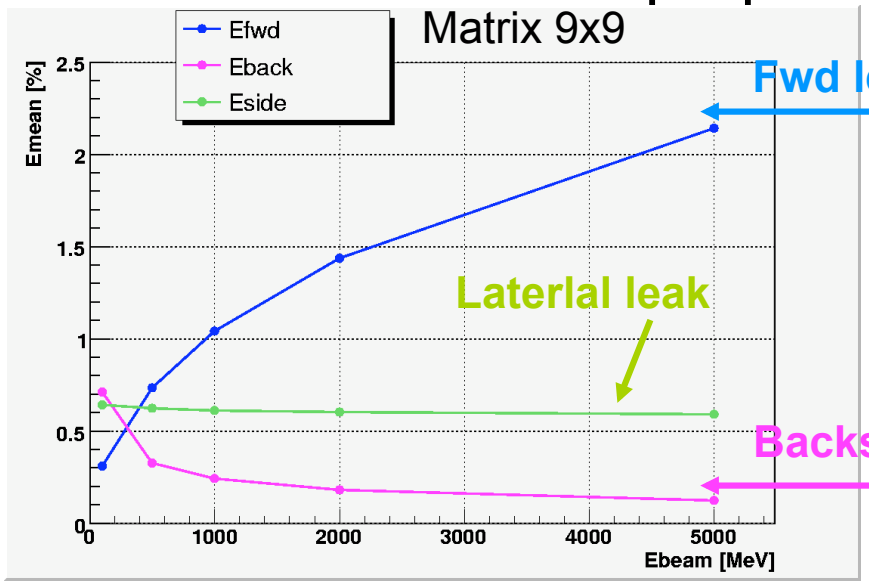
Two main points still under discussion:

1) Uniformity of Ce doping to be better understood

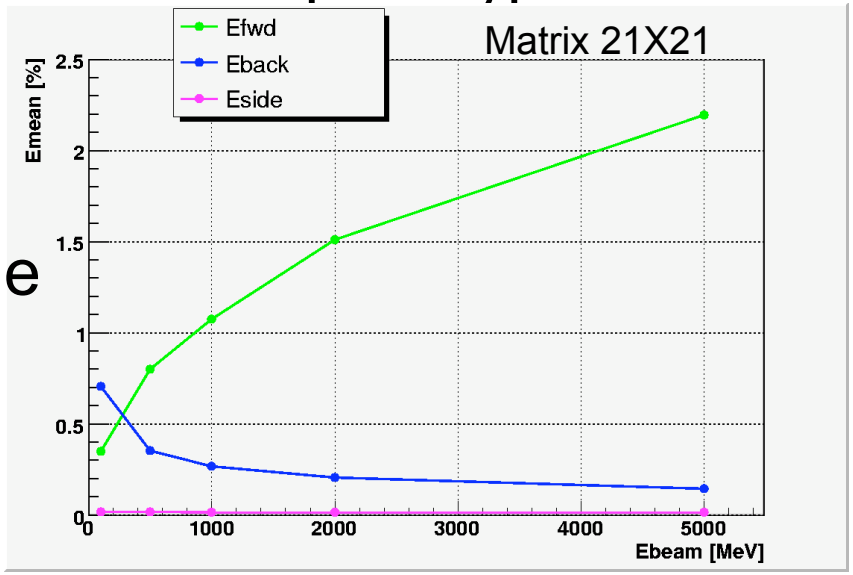


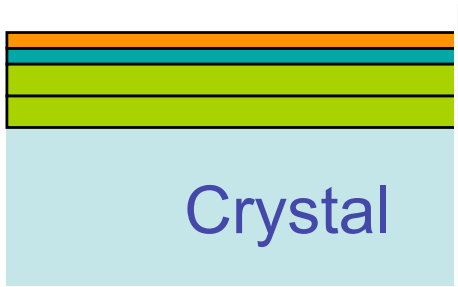
2) Is this possible to cut two crystal form one boule?

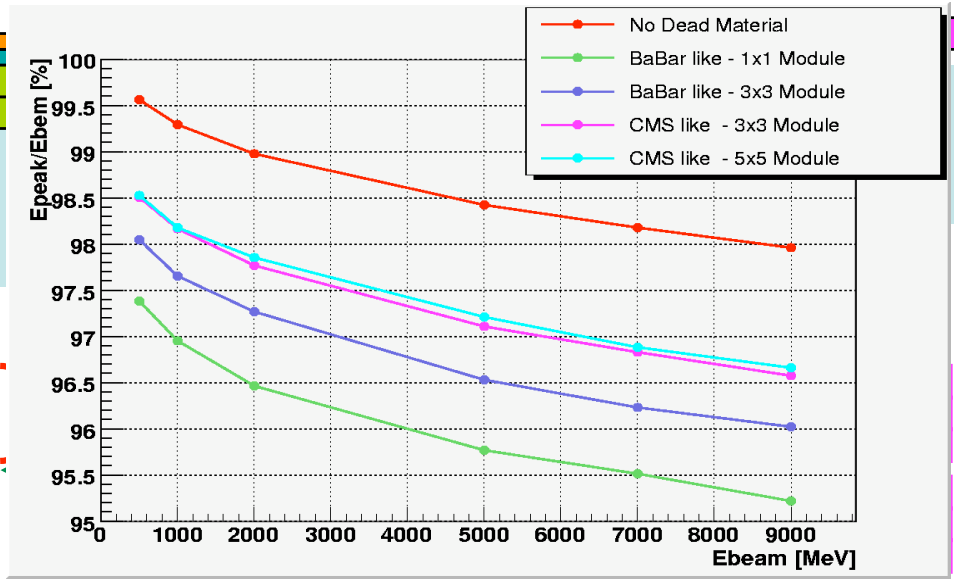
Geant4 simulation: preparation of beam test prototype 2009

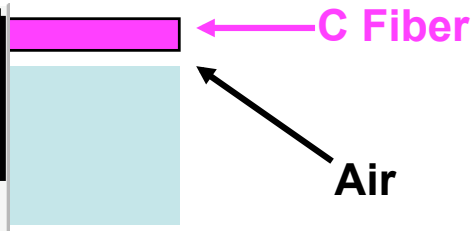


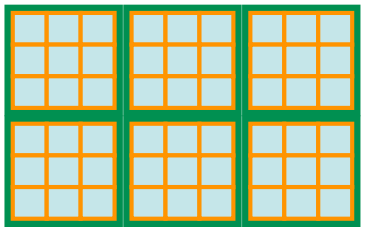
leakage







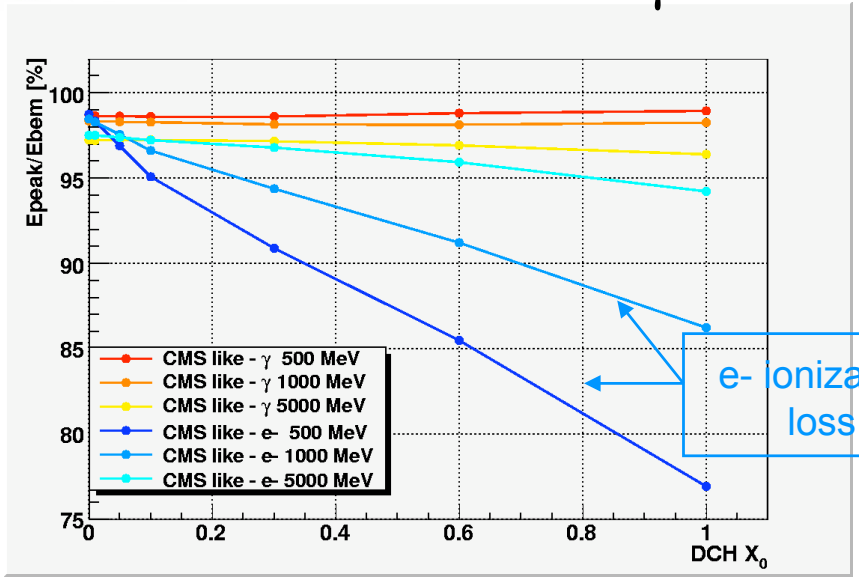




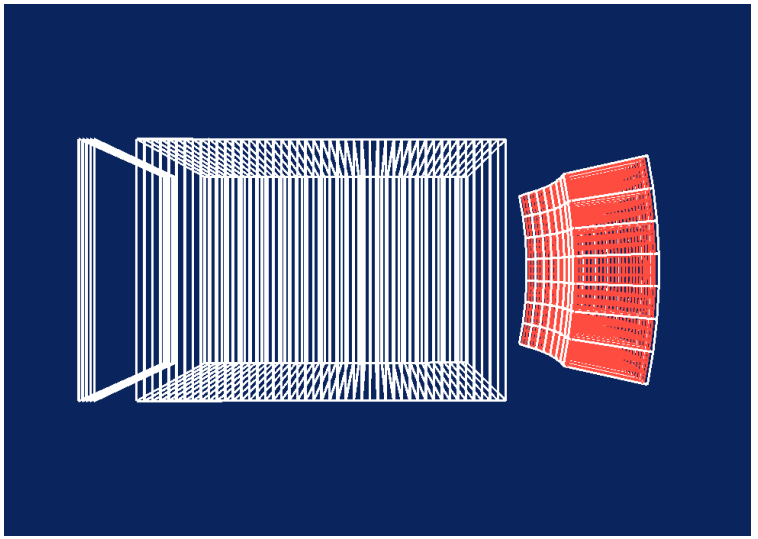
3x3 Module

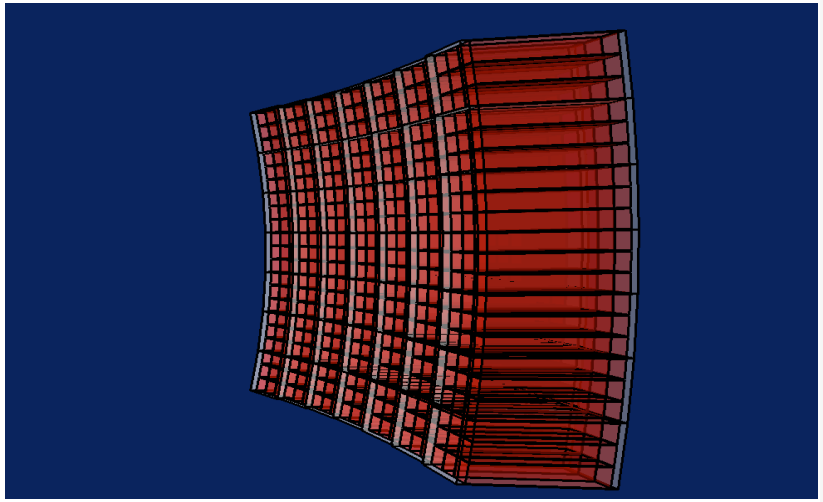
Air

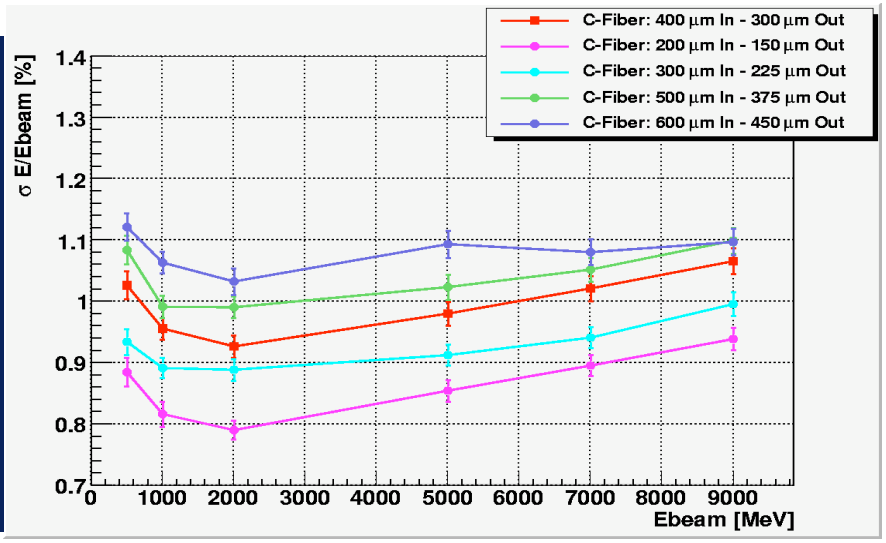
e- and γ beam on SVT + DCH



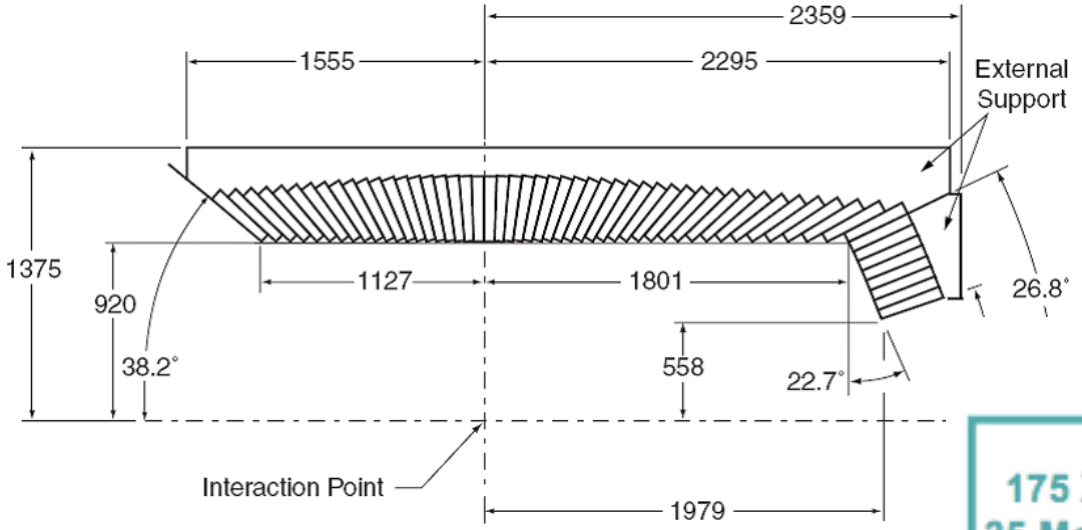
e- Ionization loss

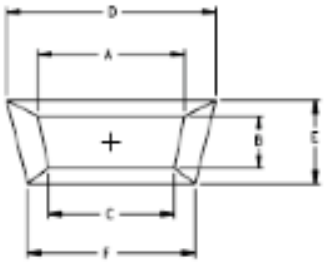


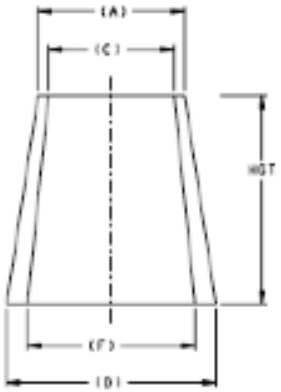




geometry in the simulation







Xtals dimensions:
Back < 2.63 cm
Front > 2.3 cm

175 Xtals
35 Modules

205 Xtals
41 Modules

235 Xtals
45 Modules

265 Xtals
53 Modules

Ring	A	B	C	D	E	F
1	19.48	23.12	18.72	21.37	25.65	20.52
2	20.26	23.12	19.50	22.23	25.65	21.38
3	21.04	23.12	20.28	23.09	25.65	22.25
4	21.82	23.12	21.05	23.96	25.65	23.11
5	22.60	23.12	21.83	24.82	25.65	23.97
6	19.92	23.12	19.27	21.95	25.65	21.22
7	20.59	23.12	19.94	22.68	25.65	21.96
8	21.25	23.12	20.60	23.42	25.65	22.70
9	21.92	23.12	21.27	24.16	25.65	23.43
10	22.58	23.12	21.93	24.89	25.65	24.17
11	20.25	23.12	19.68	22.38	25.65	21.75
12	20.83	23.12	20.26	23.02	25.65	22.39
13	21.41	23.12	20.84	23.66	25.65	23.03
14	21.99	23.12	21.42	24.31	25.65	23.67
15	22.57	23.12	22.00	24.95	25.65	24.32
16	20.51	23.12	20.00	22.71	25.65	22.15
17	21.02	23.12	20.52	23.28	25.65	22.72
18	21.54	23.12	21.03	23.85	25.65	23.29
19	22.05	23.12	21.55	24.42	25.65	23.86
20	22.57	23.12	22.06	24.99	25.65	24.43

mechanical properties of LYSO

(in collaboration with D. Rinaldi Università Politecnica delle Marche)

Test to measure elastic properties along cut direction.

Non destructive measurement of the elastic module

1) Via ultrasounds qualitative investigation of crystals
   high anisotropy has been observed
2) Quantitative measurements with
   Laser vibrometer for Laser Doppler Vibrometry (LDV)
   Hammer with charge amplifier

Measurement of the velocity of the propagation of the perturbation induced by the hammer along the longitudinal dimension of the crystal

$$v = \sqrt{\frac{E}{\rho}}$$

4200m/s --> 131 ±12 GPa

Destructive test are ongoing in these days to study to study resistance to stress and breaking points.

mechanical structure for EMC

(in collaboration with Roma1: F. Ferroni C. Gargiulo)

It is very important in the simulation of the geometry to take into account the gap between crystals that has to be filled with the structure.

Deformation of the structure < gap between edge of the crystal and structure itself

It is possible to build CFC structure 300um thick

If structure is 1/10 mm → tolerance 1/100 mm

Same or even better tolerance between modules (5x5 crystals) related also to the positioning of the module on the structure.

Geometry now takes into account 400um between crystals and 400um between modules, could be too tight, under study

If APD will be used to read crystals, a study for the thermal control is necessary (cooling system), what about FE electronics in terms of space?

Project and design for the module of the beam test: better to have it of the same dimension as in the whole calorimeter (5x5), it can be used as prototype.

First design of the forward EMC has been produced in Perugia: starting point for C. Gargiulo to start a study for a possible mechanical structure.

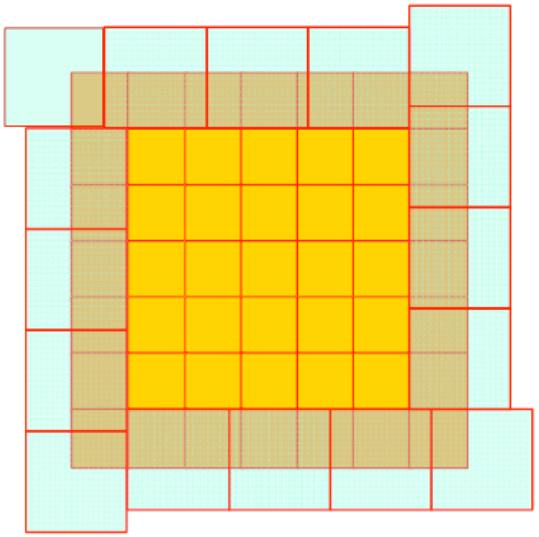
We are working for the first modification to be applied to the version 0 geometry.

TEST BEAM program:

- Put under particle beam 5x5 (7x7) matrix of LSO crystals eventually surrounded by CsI crystals
- Study different material configuration
- Different readout systems APD, PMT, PD
-Linearity, energy resolution…

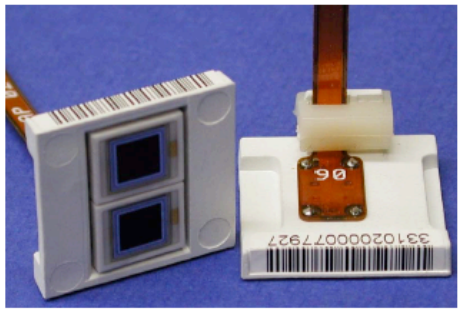
Beam line available:
CERN, DESY, LNF
with different energy ranges
Electrons, positrons,
tagged photons
High energy 0.5 - 7 GeV
Low energy 50 - 750 MeV

5x5 Projective LYSO array with CsI(Tl) surround



A 7x7 array is best, but it can be approximated by a 5x5 array surrounded by CsI(Tl) to catch the outer few percent of shower

16 spare *BABAR* CsI(Tl) crystals may be available



CMS APD readout module
2 @ 5mmx5mm APD
(10x10mm APDs are now available)

From J.A. Bevan Example Quotes

- 1) Non projective geometry: 9 crystals of 2.5x2.5x20cm:
  - All sides polished, LYSO
  - Cost for 9 crystals = 31 Kє
  - Timescale for delivery = 8 weeks
  - Timescale / cost for 49 crystals (est) = 16 weeks (4 months) / 167 Kє
- 2) Projective geometry outlined previously:
  - Cost for 9 crystals = 55.5Kє
  - Timescale for delivery = 4 months
  - Timescale / cost for 49 crystals (est) = ? 8 months / ? 111Kє

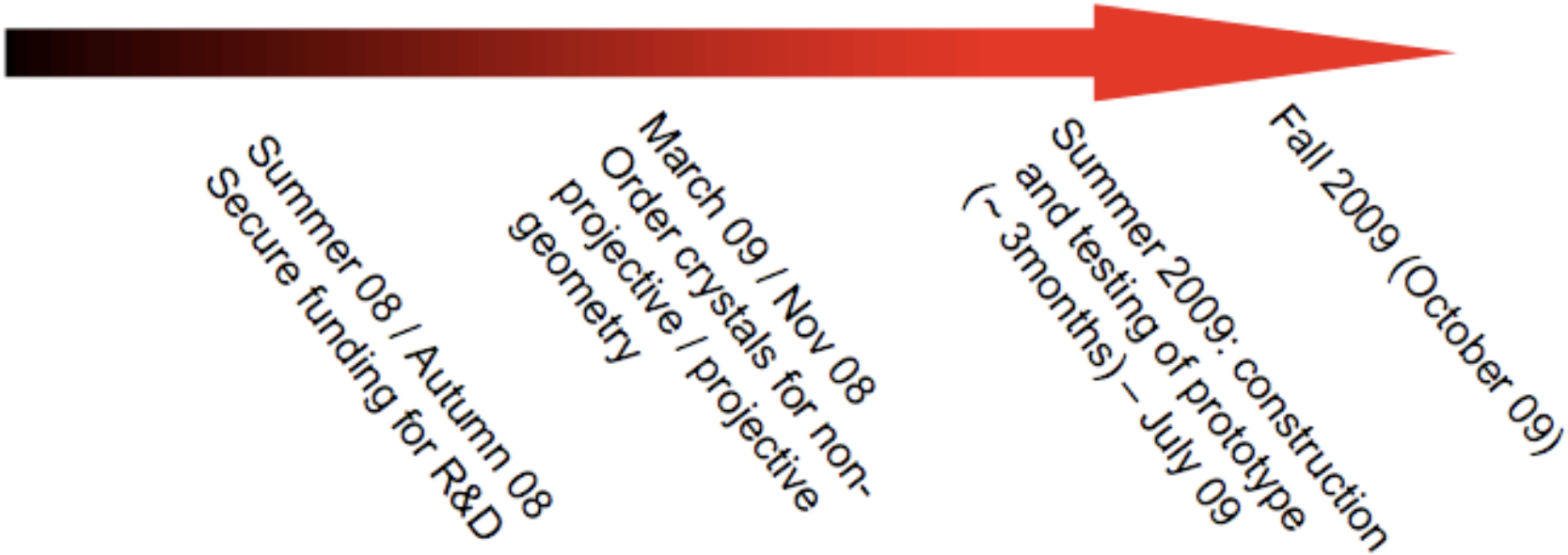
Quotes were aquired from Saint Gobain and SIPAT, and exclude tax and shipping. SIPAT were O(10% more expensive)

NOTE: The goal is to build a 5x5 or 7x7 array of crystals, this layout was investigated in a failed attempt to exploit a funding opportunity.

From J.A. Bevan

Timescales (very rough)

- Aim to have a test-beam ~ fall 2009
  - Working backward, we would need to acquire funding for R&D soon.



- Also means we should start to design the calorimeter prototype in the next 6-9 months.
- Timescale is more relaxed if we don't want tapered crystals.

Perugia INFN Istituto Nazionale di Fisica Nucleare

SuperB

Persone conivolte:		
	C. Cecchi	30%
	P. Lubrano	30%
	E. Manoni	100%
	F. Ferroni (Roma1)	30%
	C. Gargiulo (Roma1)	10%

SJ 30keuro sbloccato in CSN1 30 Giugno per acquisto cristalli

Richieste 2009:

Cristalli	5.5 Keuro/cristallo (-30 SJ 2008)
APD	800 euro/canale (available from USA)
Preamp./shaper	350 euro/canale
DAQ	16 Keuro
Struttura meccanica	32 Keuro

USA and GB are trying to get money for TB, at the moment the situation is not clear

Perugia

INFN

Istituto Nazionale di Fisica Nucleare

ISTITUTO NAZIONALE DI FISICA NUCLEARE
Preventivo per l'anno 2009

Struttura
Perugia

CODICE	SIGLA	COMMISSIONE
	P-SUPERB	CSN I
Resp. Loc.: Claudia Cecchi		

SuperB

PREVENTIVO LOCALE DI SPESA (In K€)

Capitolo	*Descrizione*	Parziali		Totale	
		Richiesta	SJ	Richieste	SJ
interno	riunioni di collaborazione	1.50		**1.50**	0.00
estero	Missioni CERN per test beam (2 settimane x 2 persone) (1mu/FTE)	4.00			
	Riunioni di collaborazione all'estero + workshop superB (1 mu/FTE)	7.00		**11.00**	0.00
consumo	Struttura meccanica cristalli per test beam	32.00			
	DAQ per test beam	16.00			
	25 preamplificatori/shaper (350 euro/channel)	9.00			
	20 cristalli per test beam (5.5 Keuro/cristallo)	110.00			
	metabolismo	2.00		**169.00**	0.00
seminari					
trasporti					
pubblicazioni					
manutenzione-HW					
calcolo					
manutenzione					
linee-dati					
inventario					
apparati					
licenze-sw					
	Totale P-SUPERB Perugia.DTZ			**181.50**	

Riunione re
8 Settembre

Mod. EC/EN 2

(a cura del responsabile locale)