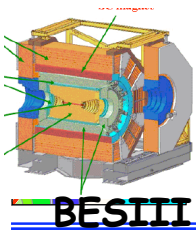




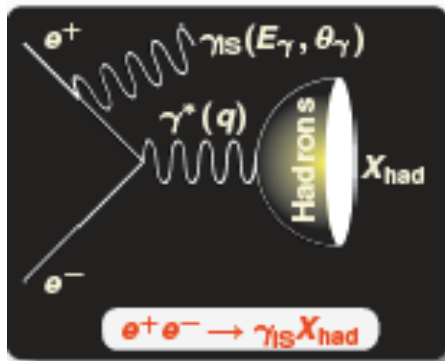
BESIII Italian Collaboration

R. Baldini Ferroli, M. Bertani, A. Calcaterra, A. Zallo, M. Anelli (LNF)
F. Coccetti (Centro Fermi/LNF)
S. Pacetti (PG)

M. Destefanis, M. Greco, L. Fava, M. Maggiora, S. Spataro (TO)
S. Stucci, laureanda gruppo collegato CS



Initial State Radiation: physics motivations



- © Existing results, mainly from BABAR (ISR) show interesting and unexpected behaviors especially at threshold for $e^+e^- \rightarrow p\bar{p}$, $e^+e^- \rightarrow \Lambda\bar{\Lambda}$
- © Only one measurement by FENICE (energy scan) for $e^+e^- \rightarrow n\bar{n}$, now SND confirms FENICE

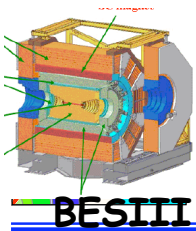
Physical limits in reaching threshold of many of these channels via energy scan (stable hadrons produced at rest cannot be detected)

The ISR technique provides a unique tool to access threshold regions working at higher resonances:

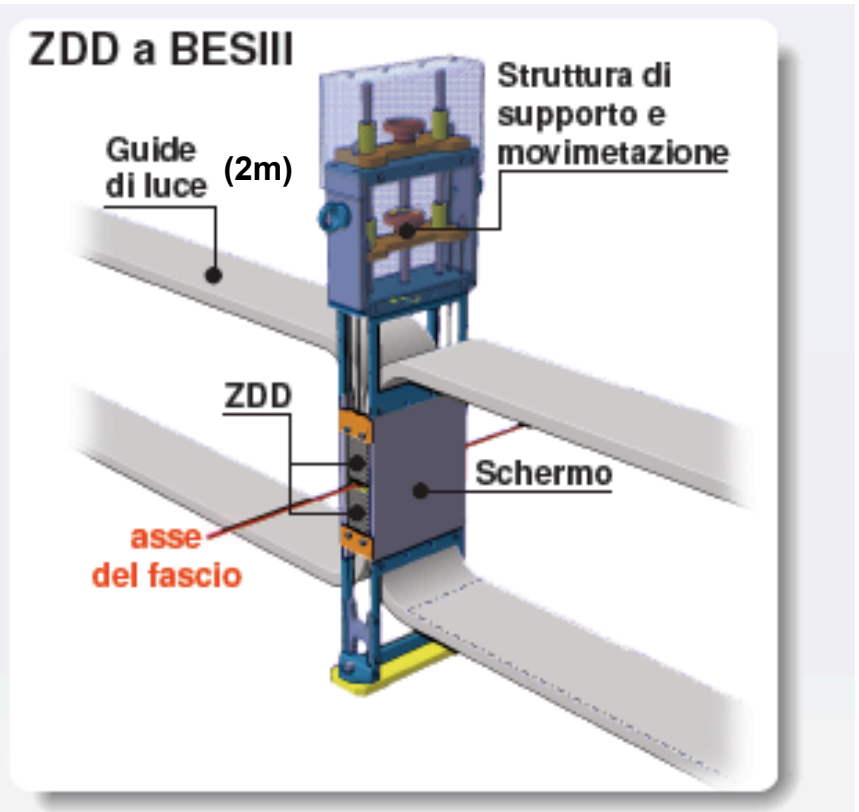
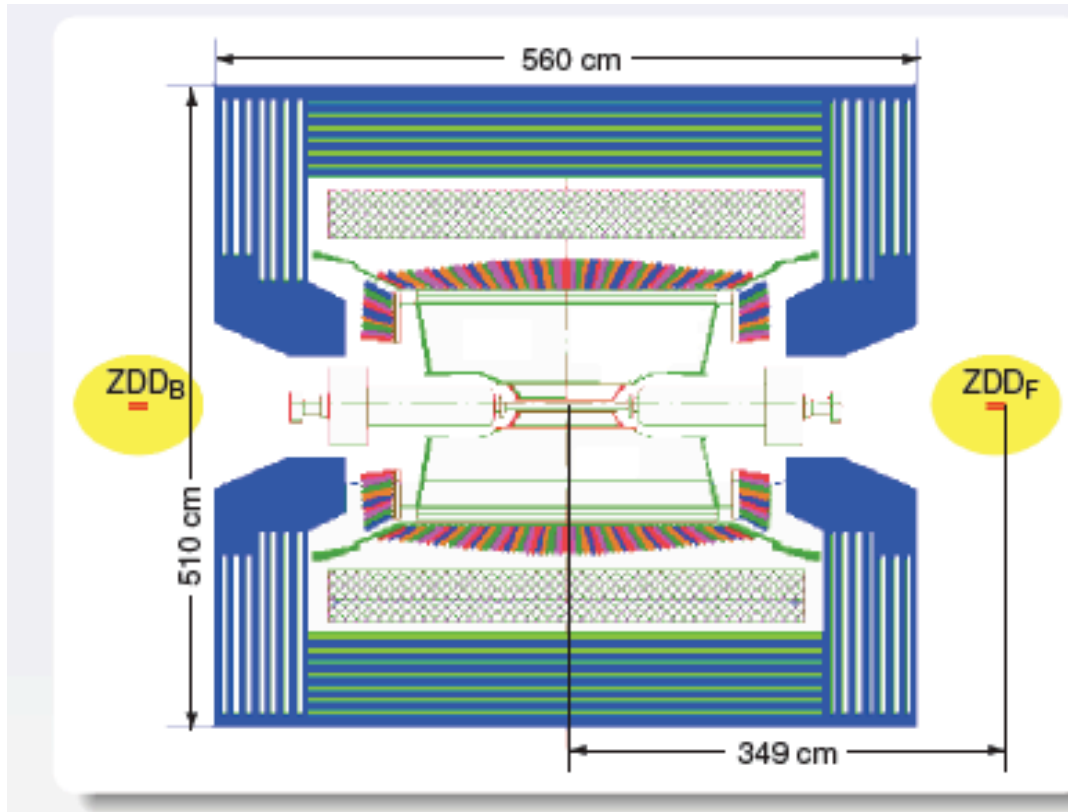
- all energies (q^2) at the same time $\rightarrow$ better control on systematics
- detect ISR photon $\rightarrow$ full X_{had} angular coverage

A Zero Degree radiative photon tagger **has just been installed** at 3.5m from IP

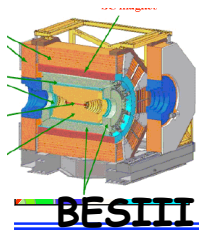
- to detect ISR photons peaked at small angle
- to suppress background from π^0 and γ_{FS}



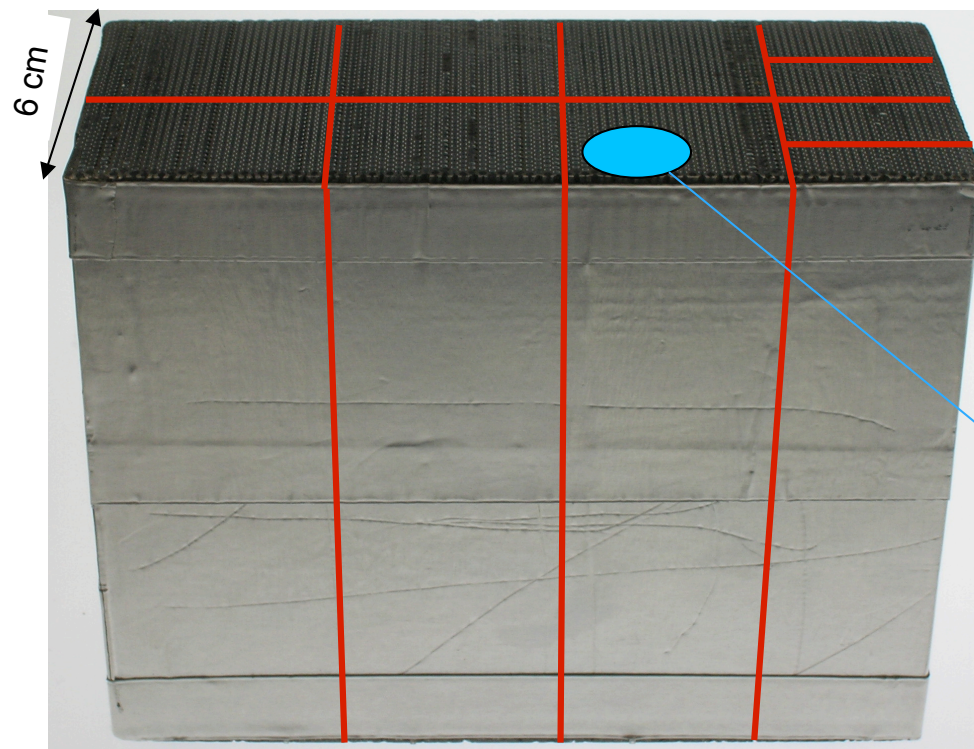
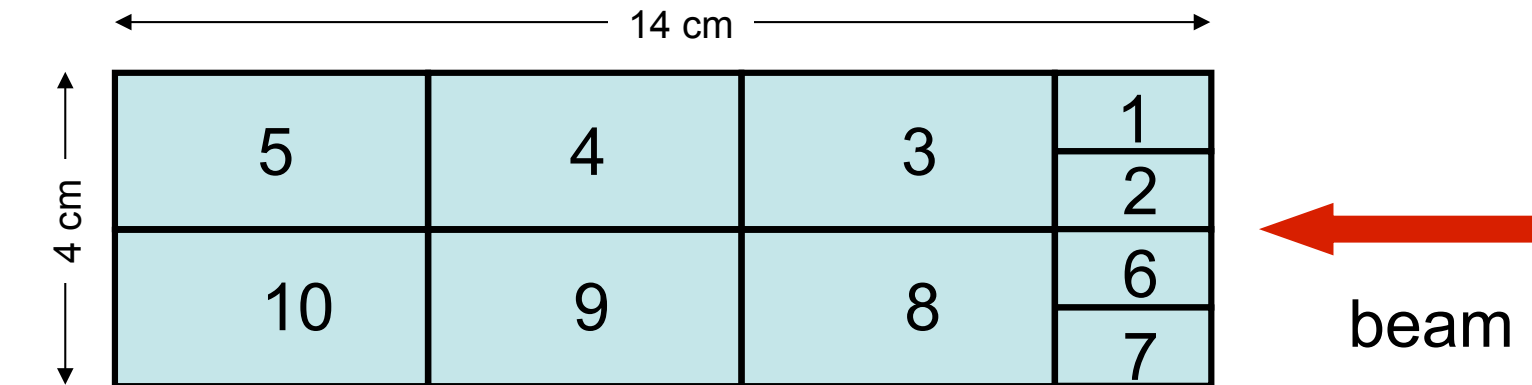
BESIII and Zero Degree Detector



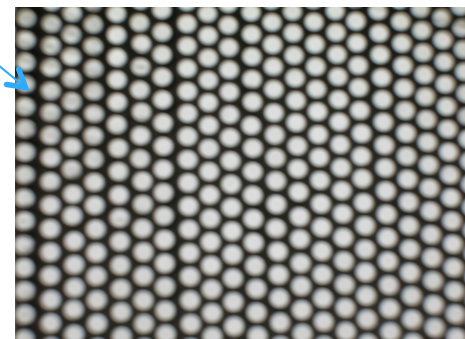
ZDD: Pb/Sci.Fi Array, scintillating material 60% of total (in volume), two modules (up and down the beam) dimensions: $14 \times 4 \times 6 \text{ cm}^3$

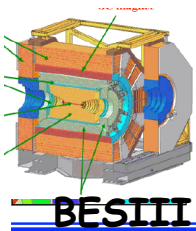


ZDD segmentation (one/two module)



Each sector is sent to a PM, sectors 1&2 (6&7) are sent to the same PM





ZDD: milestones raggiunte

© **2009:** Prime idee e studi, proposta alla collaborazione BESIII

© **2010:**

© R&D con campione SciFi tagliato da prototipo esp. P326/NA62

© Giugno: summer BESIII coll.meeting: approvata proposta SciFi per ZDD, una sola stazione per lasciare un LUMI monitor dall'altra parte dell'IP

© settembre, CSN1 : approvata ufficialmente sigla BESIII Italia e finanziato ZDD per il 2011, chiesto anticipo al 2010 del 50% per poter iniziare approvvigionamento

© 2 moduli (up and down) tagliati dal prototipo P326

© **2011:**

© Fresatura dei due moduli

© Struttura meccanica: disegno/progetto e costruzione

© realizzazione guide di luce: bundles di fibre chiare lunghe 2m

© approvvigionamento PM Hamamatsu e moduli elettronica CAEN

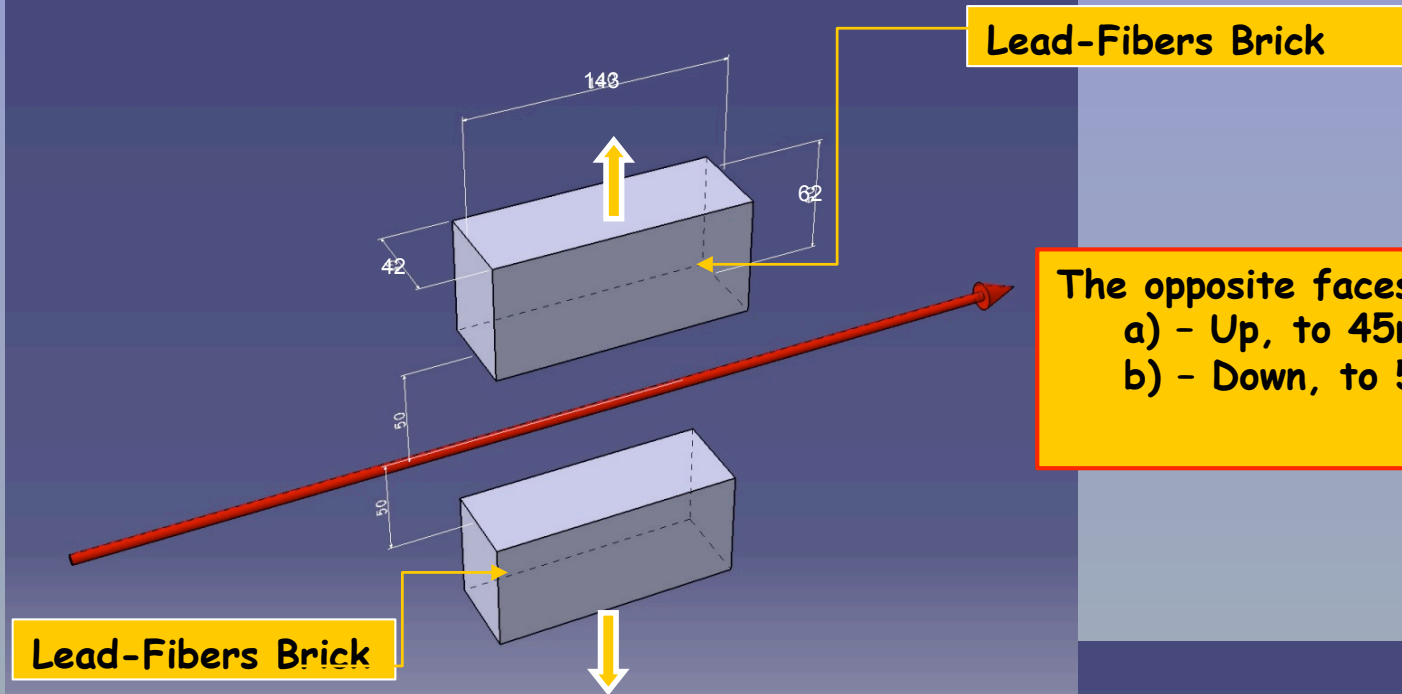
© Front End Electronics: progetto e realizzazione a LNF

© maggio-giugno: test con raggi cosmici e BTF

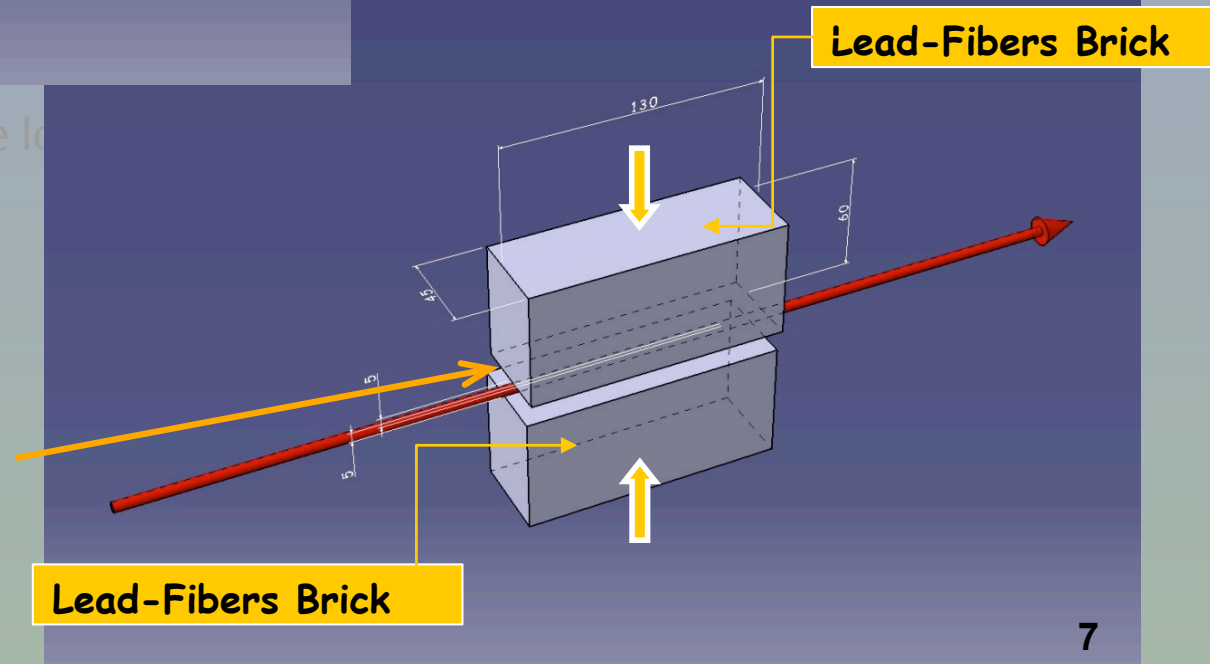
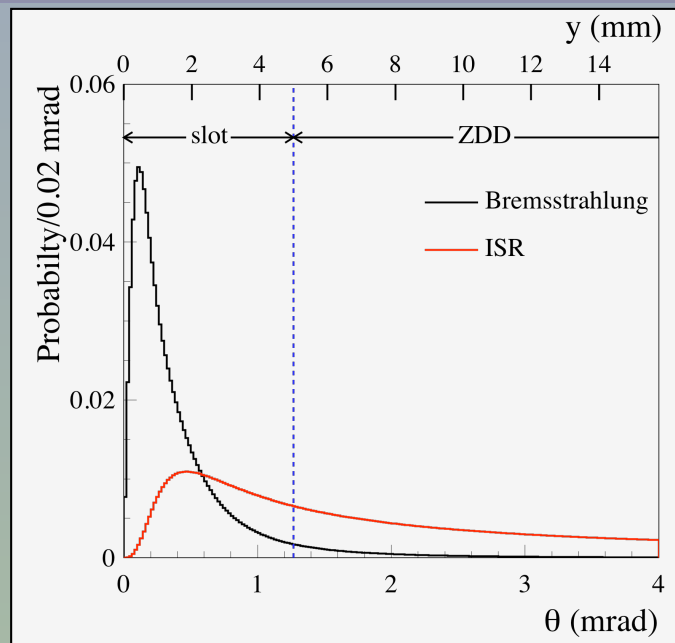
© luglio: spedizione a IHEP

© **Agosto: installazione a BEPCII !**

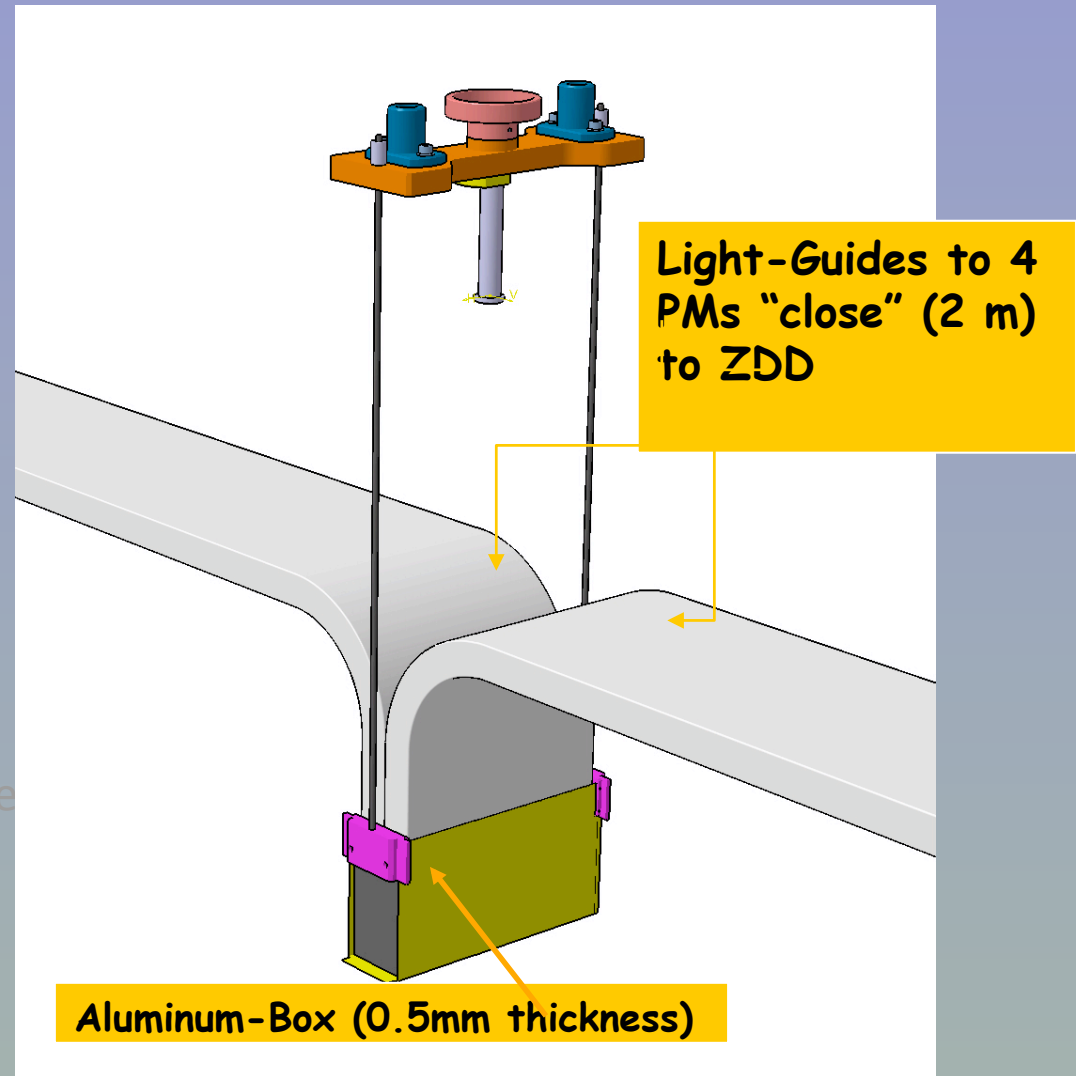
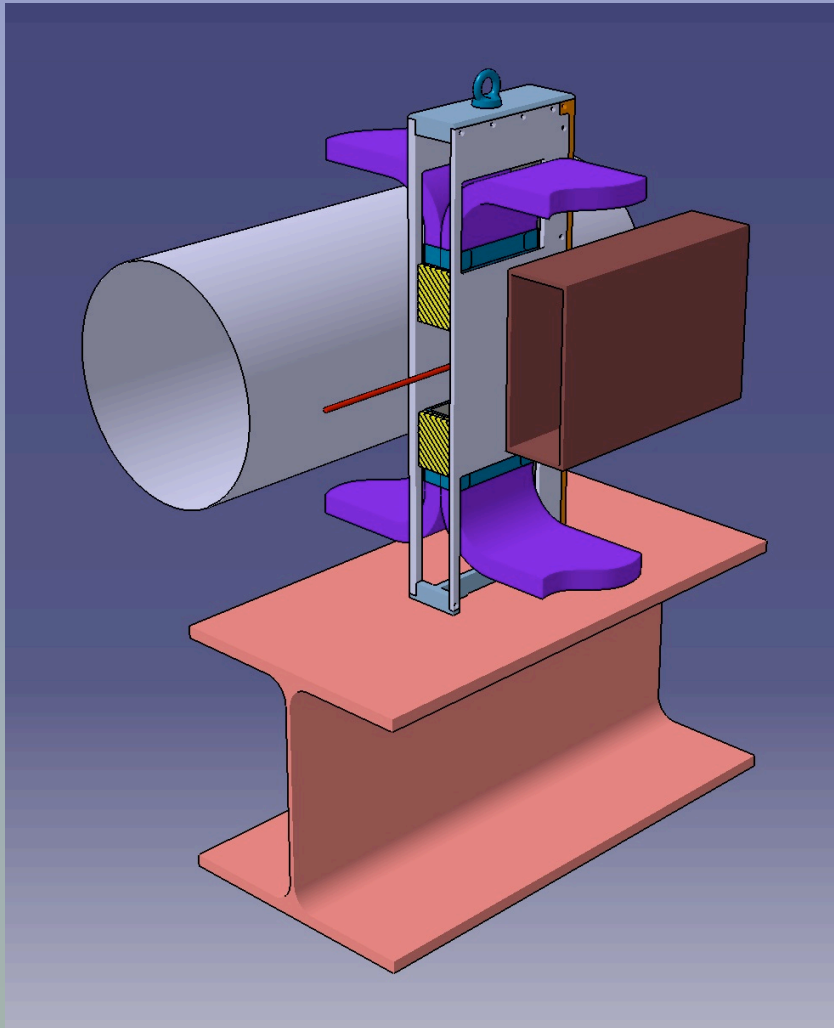
(design by D.Orecchini)

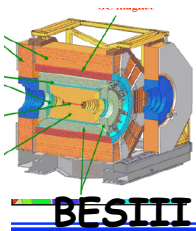


The opposite faces of the two bricks lift:
a) - Up, to 45mm from the beam;
b) - Down, to 5mm from the beam.



(design by D.Orecchini)

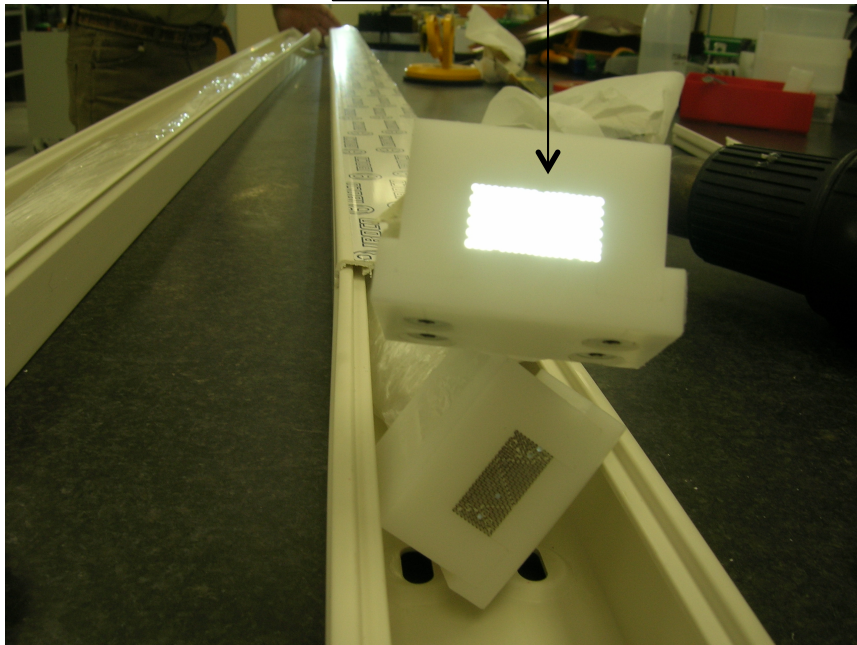


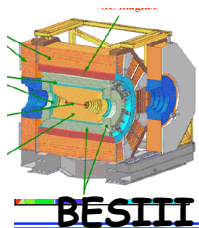


Bundles production (clear fibers)

(SSE, resp. M.Anelli)

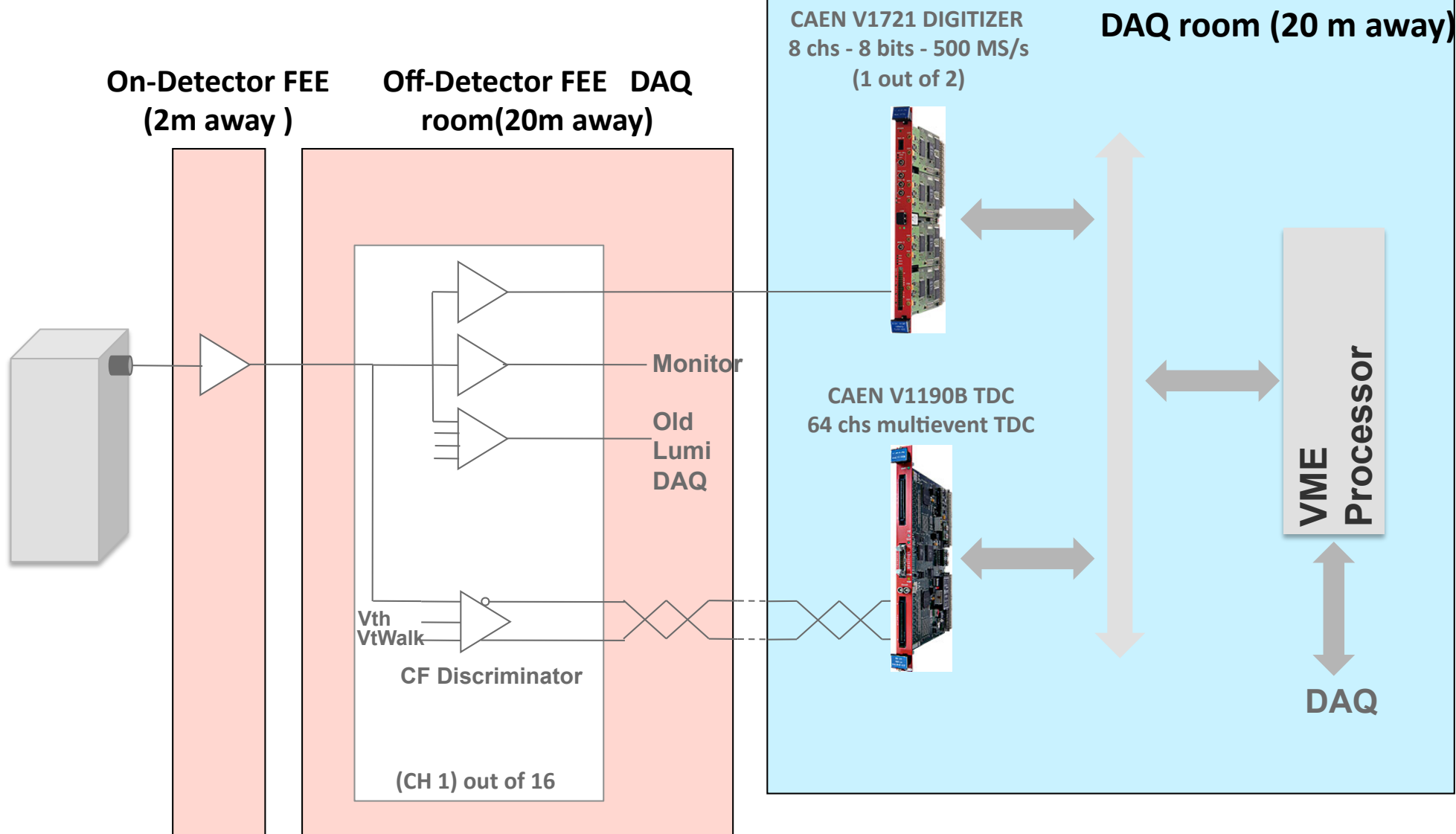
for each module:
 $6 \times (2 \times 4 \times 200) \text{ cm}^3 + 4 \times (1 \times 2 \times 200) \text{ cm}^3$
8PM

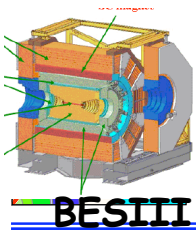




Front End Electronics

(by G.Felici, LNF-SEA)





BTF test beam

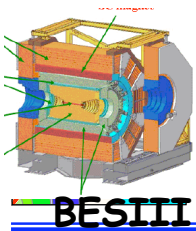
(may 16-22 2011)



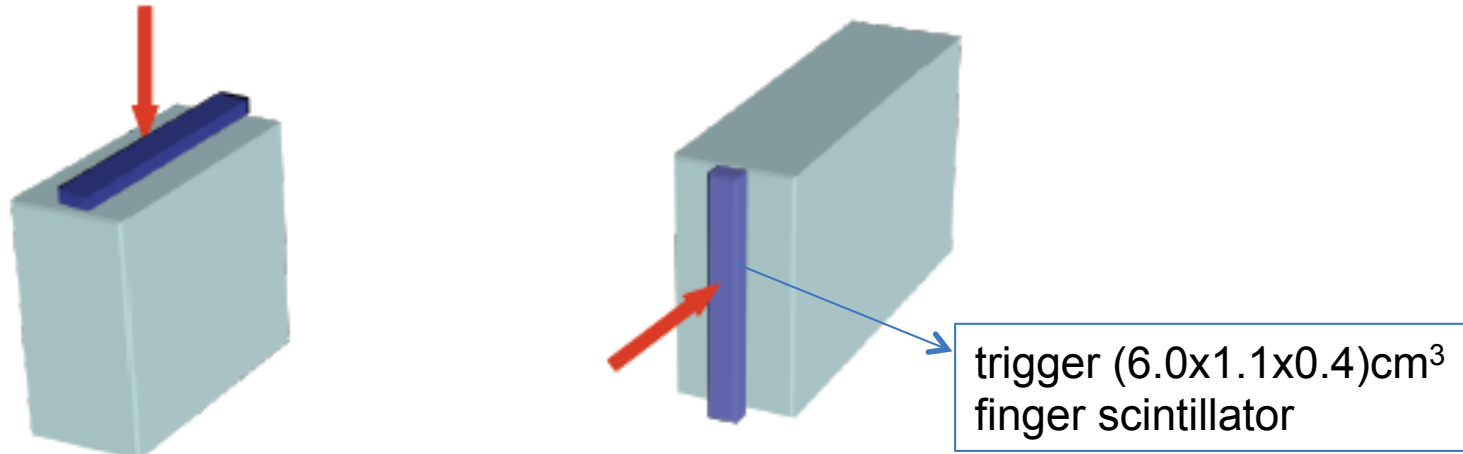
One (out of two) ZDD module tested at BTF
with 450, ~300, ~200 MeV e^- bunches ($N_{e^-}=1,2,3$)
Final Pb-scifi ZDD module, bundles guides,
PM's, TDC, at the moment not FADC but ADC
caen V V792N

Small scintillator ($60 \times 11 \times 4$) mm³ used to trigger
and select electrons impact point

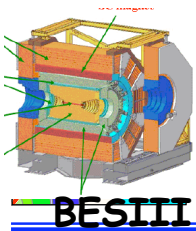




Cosmic rays and Beam Test Facility

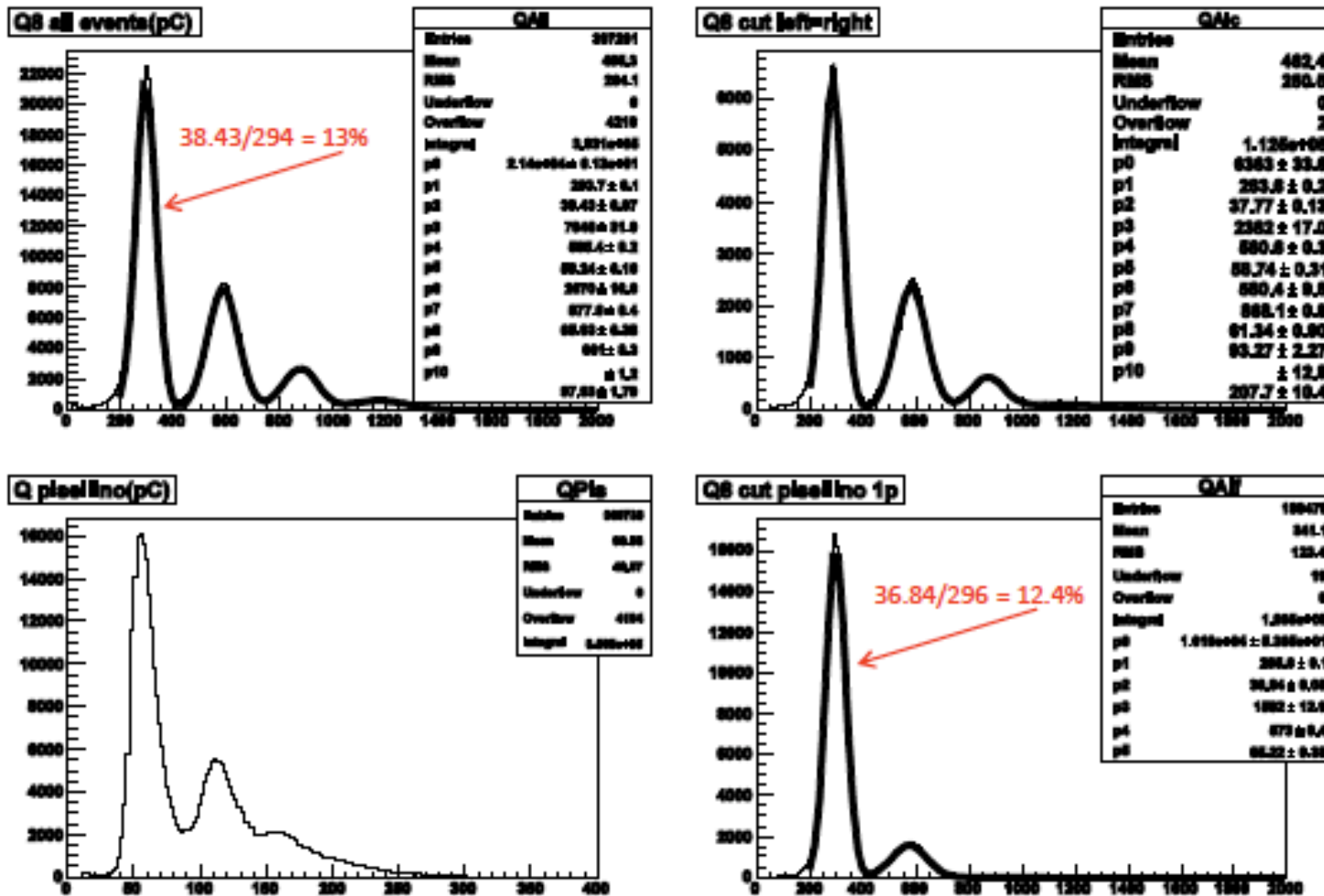


- From cosmic ray data set compute a set of correction factors for PM equalisation
- Read back the BTF data applying individual factors to the 8 channels
- Recompute the the sums of left, right collected charge

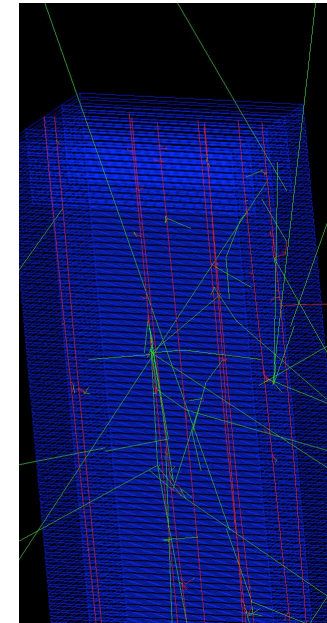
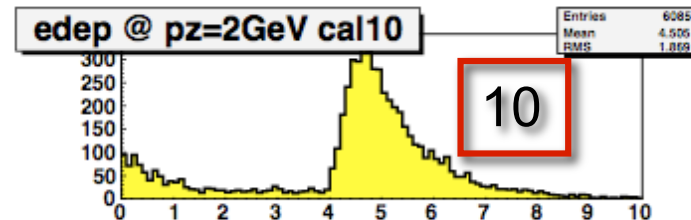
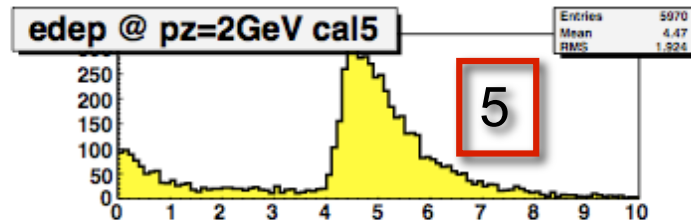
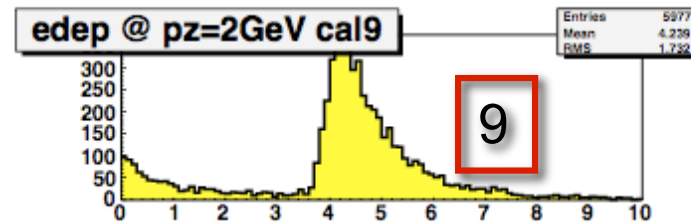
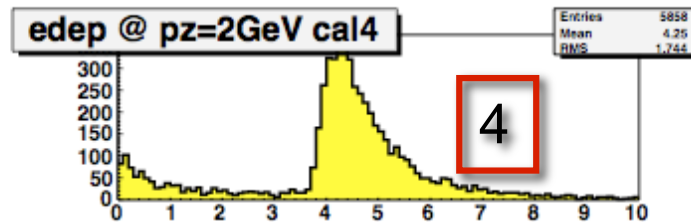
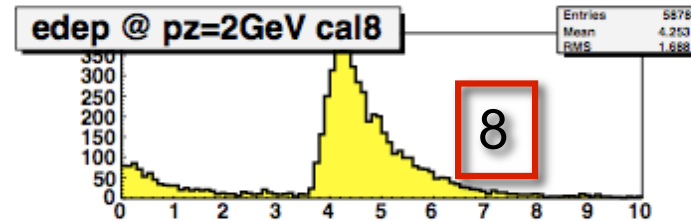
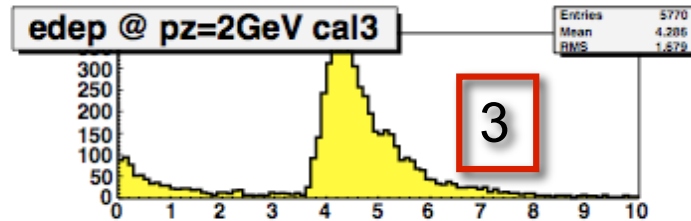
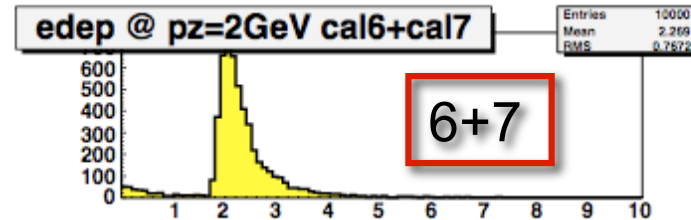
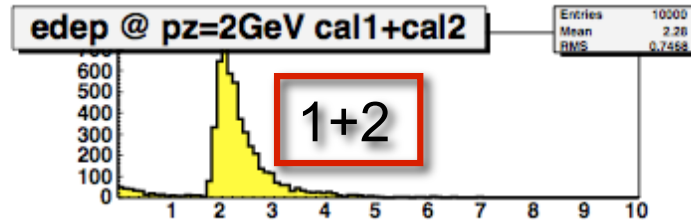
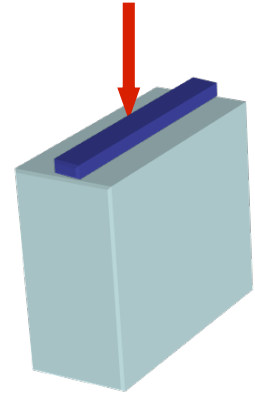


BTF data

Run 4, 450 MeV, corrected data

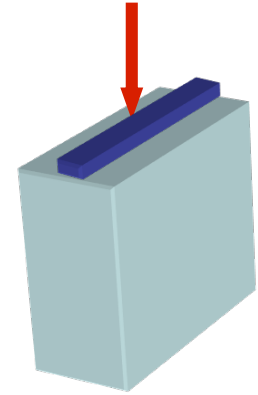


Geant MC: Cosmic rays (1)

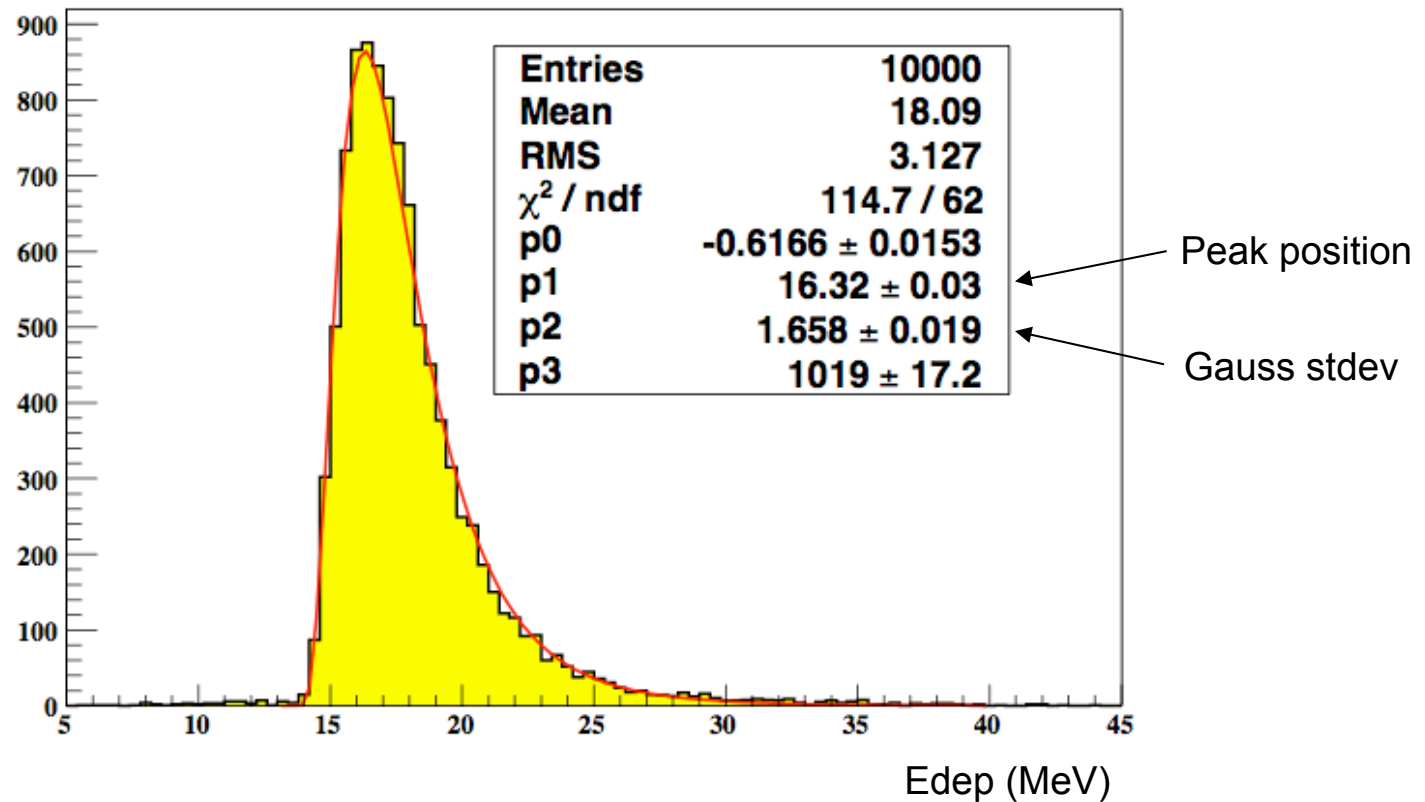


The histograms represent the deposited energy by the muons into the 8 RO sectors (slide 2). The peak position is in agreement with the prediction for a mip traversing the material. The initial part of the distributions is due to the energy loss by the delta rays produced by the muon when it pass through the neighbour sector of the same layer.

Geant MC: Cosmic rays (2)

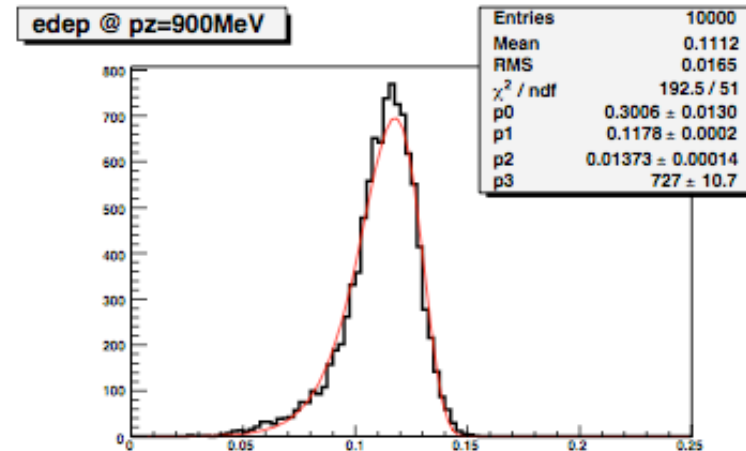
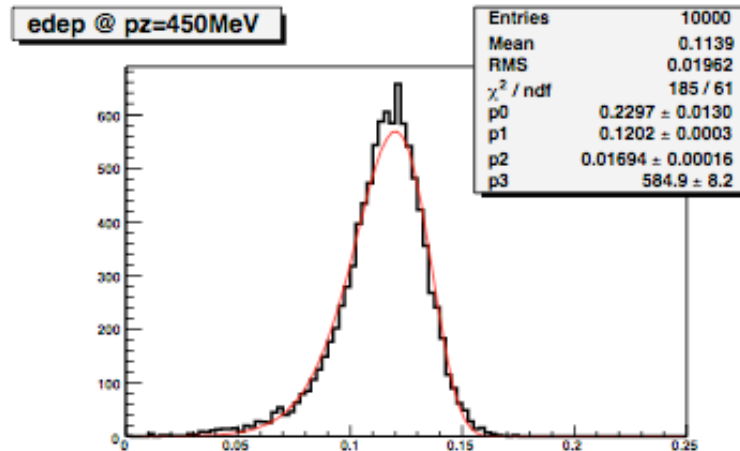
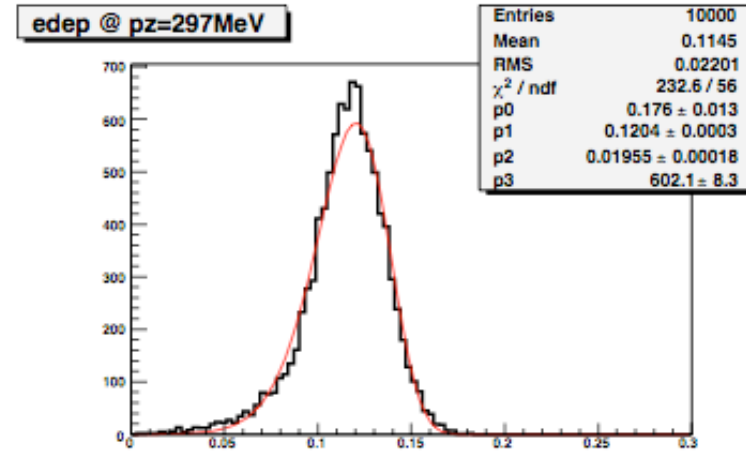
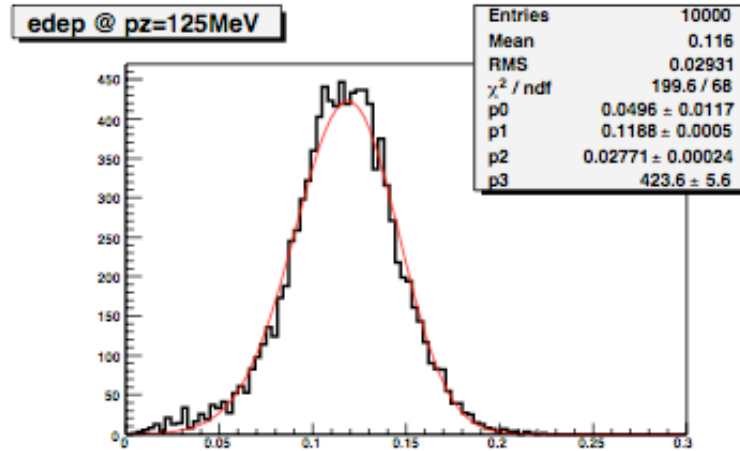
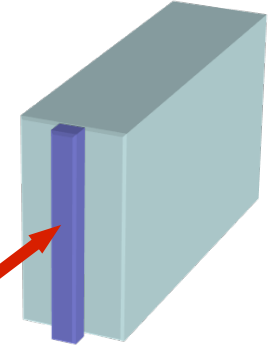


muon edep @ pz=2GeV large trigger area - test beam



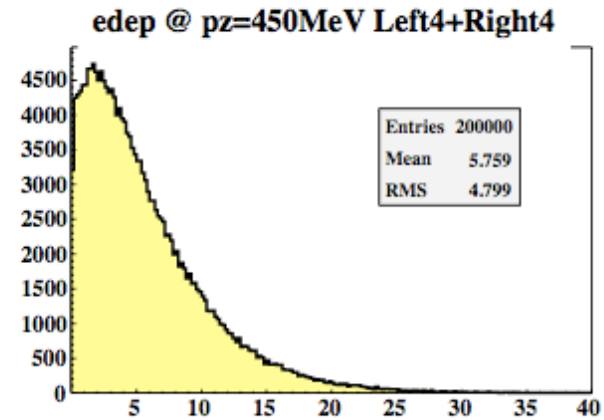
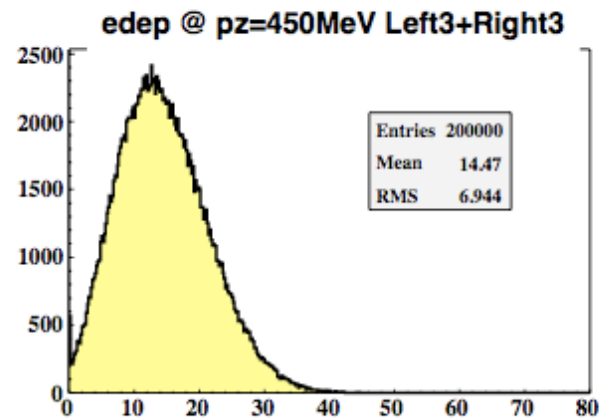
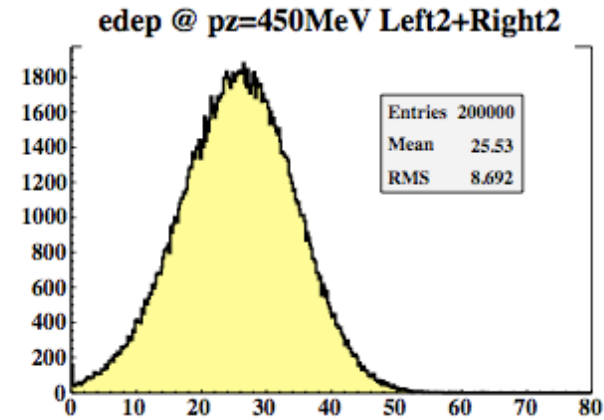
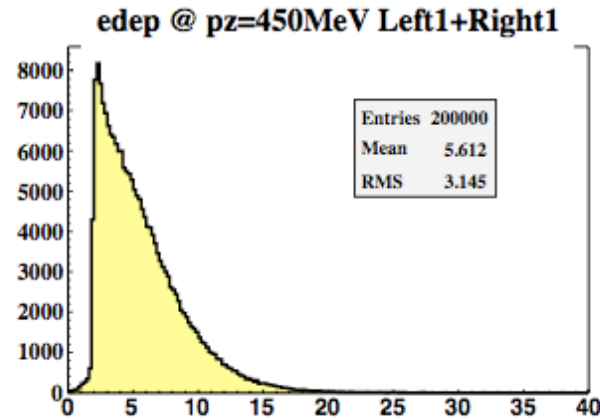
The histogram represents the total deposited energy by the muons (sum over all 8 sectors). The MC data are fitted with the standard log gaussian distribution.

BTF Geant



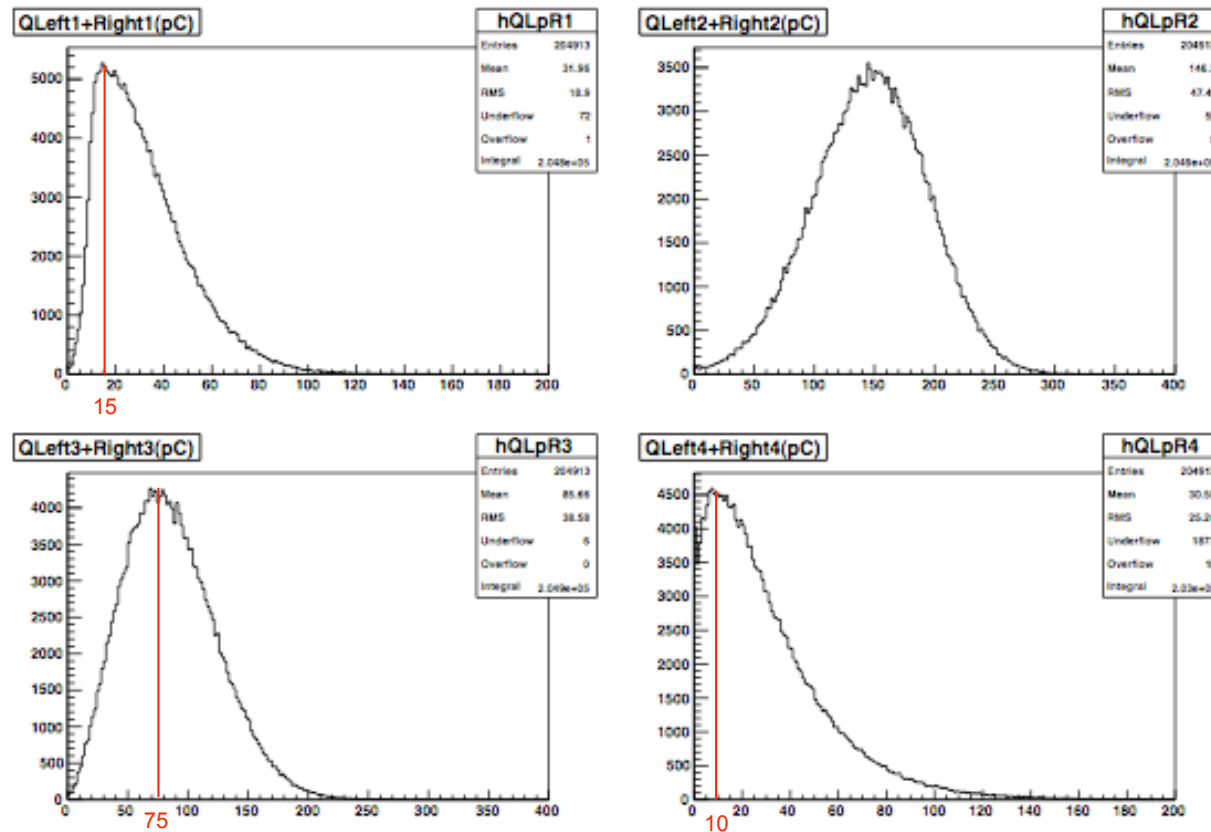
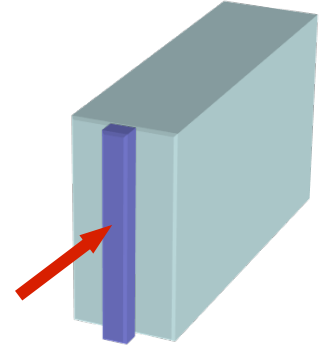
The 4 histograms represent the total deposited energy (sum over all 10 sectors) by the beam electrons, normalized to the beam energy, for the 4 analyzed energy. The data are fitted with the standard log gaussian distribution.

BTF Geant @ 450MeV



The 4 histograms represent the deposited energy per layer (e.g. 3+8 sectors) at the beam energy 450MeV

BTF TB data @ 450MeV



The 4 histograms represent the deposited energy per layer (e.g. 3+8 sectors) measured during the test beam (run 4) with 450MeV beam energy.

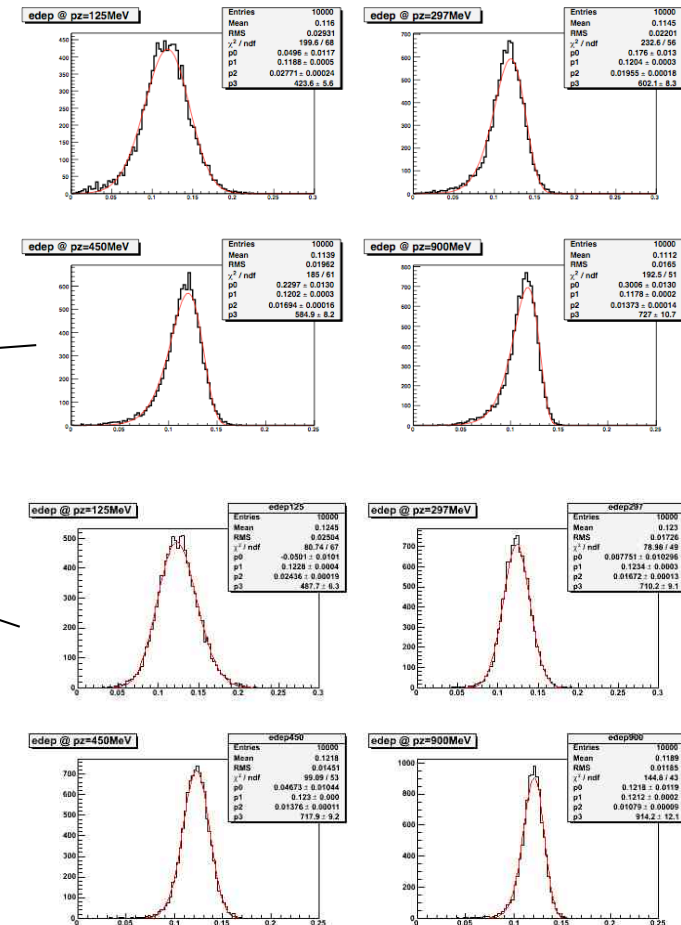
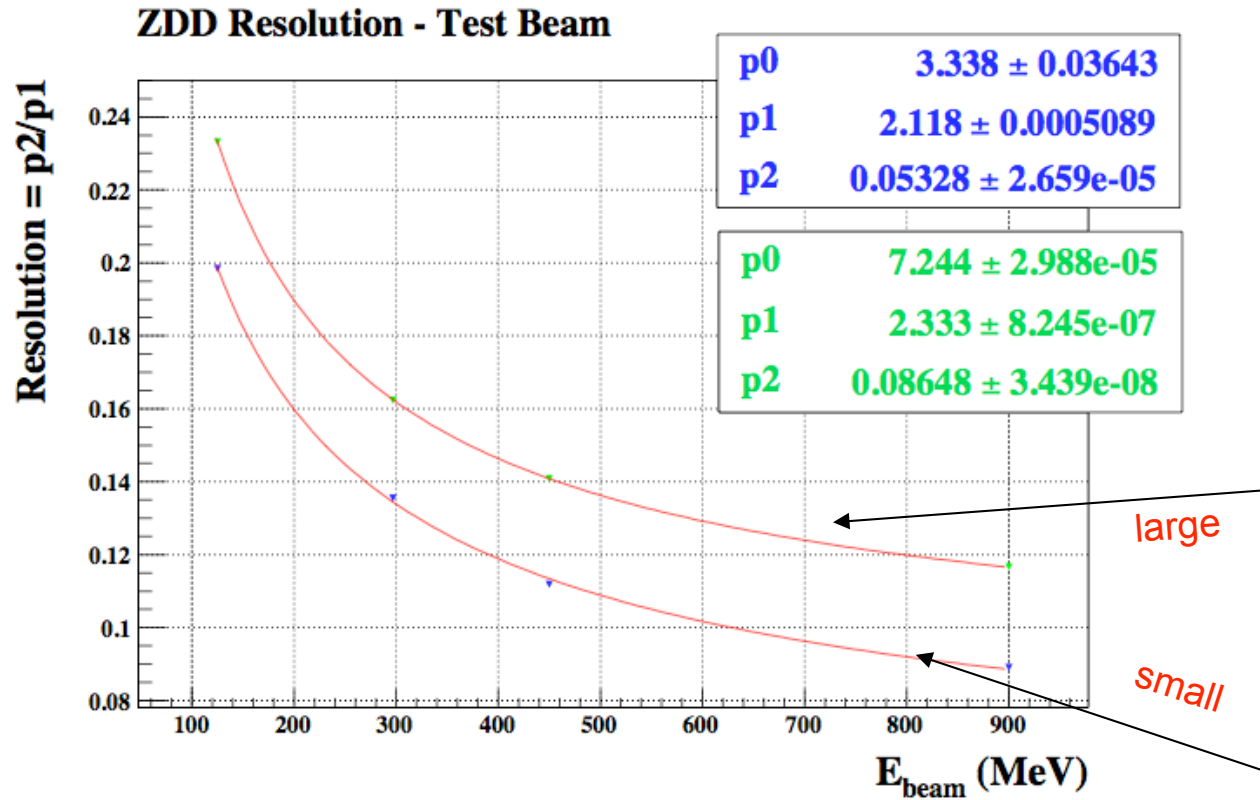
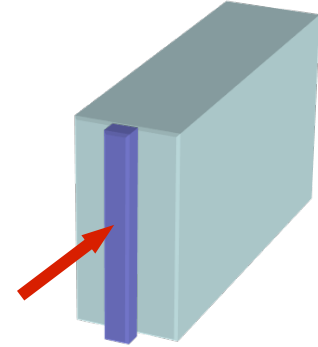
Comparison data-MC @ 450MeV

The shape of the distributions data and MC are very similar. The initial part of the MC distribution of the layer1 is steeper then the data one. This is still under study.

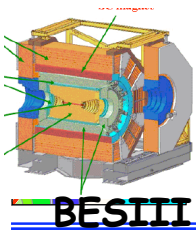
The ratio between the peak position of the data distribution and the MC distribution gives the scale factor and equalization factor. The $\langle R \rangle$ is in agreement with the formula $\langle n_{pe}/MeV \rangle * G * 1.6 * 10^{-19}$ when $\langle n_{pe}/MeV \rangle = 5$ and $G = 5 * 10^6$.

Layer	Peak (pC)	Peak MC (MeV)	R (pC/MeV)
1	15	2.2	6.8
2	146.3	25.5	5.54
3	75	12.7	5.91
4	10	1.8	5.56

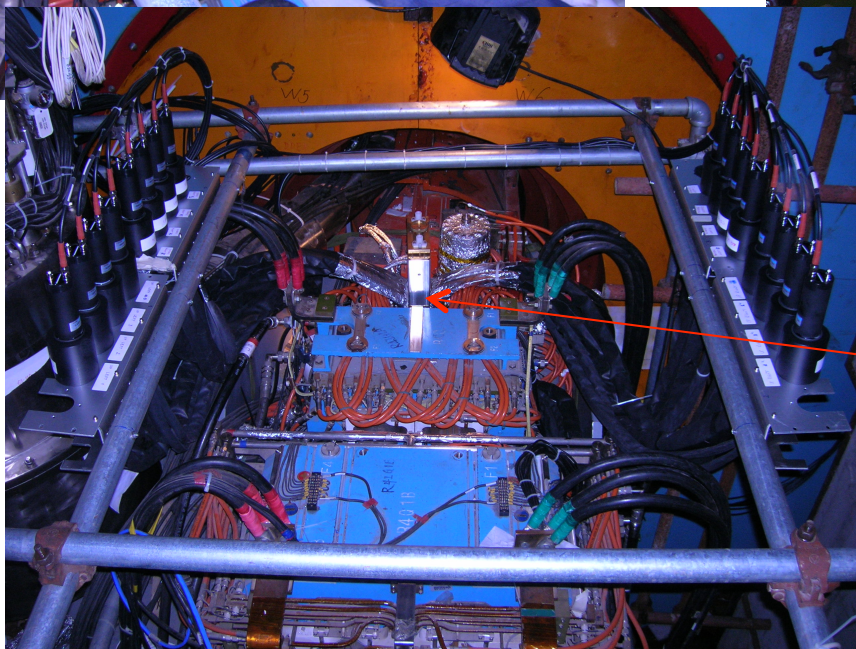
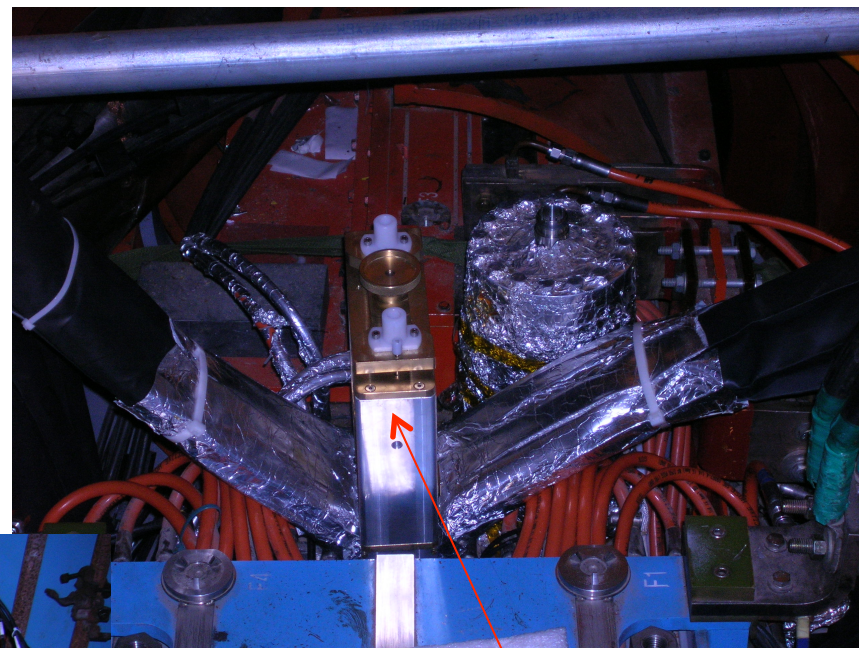
BTF Geant

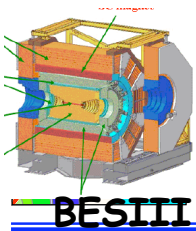


The energy resolution has been computed for two different trigger area: large (1.1x6.0) and small (1.1x0.5). In both cases the beam centre is the geometrical centre of the calorimeter. In large configuration the beam is uniform instead in the small configuration the beam is Gaussian.



August Installation at BEPCII





Installazione di Agosto a BEPCII

In 10 giorni a IHEP la stazione ZDD e` stata installata con successo nella zona superaffollata di BEPCII !

- ZDD con la sua struttura meccanica e` posizionata
- I Bundle di guide di luce sono collegati ai PM nel patch pannel e cablati
- Tutte le box di FEE sono installate e collegate, sia near (2m) che far (20m)
- Tutti i canali sono stati accesi e controllati sia prima che dopo la FEE

Al 2 di settembre: ZDD posizionato su BEPCII e funzionante!

- lavori in corso: setup daq con raggi cosmici

RICHIESTE FINANZIARIE 2012



BESIII Italia nel 2012

sezioni coinvolte: LNF (3.0 FTE), Torino (2.3 FTE), **PG/Dot1 (Simone Pacetti)**

impegno LNF: ZDD, analisi fattori di forma barioni

impegno Torino : analisi fattori di forma barioni, analisi dei segnali da ZDD, farm di calcolo

Composizione del gruppo LNF:

<i>R.Baldini Ferroli</i>	<i>0%</i>
<i>M. Bertani (resp. naz. e LNF)</i>	<i>100%</i>
<i>A. Calcaterra (resp. ZDD)</i>	<i>100%</i>
<i>F. Coccetti (ass. Centro Fermi)</i>	<i>100%</i>
<i>A.Zallo</i>	<i>0%</i>

<i>TOT</i>	<i>3.0 FTE</i>

Composizione del gruppo TO:

<i>M. Destefanis</i>	<i>30%</i>
<i>M. Greco</i>	<i>50%</i>
<i>L. Fava</i>	<i>50%</i>
<i>M. Maggiore (resp. TO)</i>	<i>50%</i>
<i>S. Spataro</i>	<i>50%</i>

<i>TOT</i>	<i>2.3 FTE</i>



Richieste finanziarie per il 2012 @LNF

	Richieste (K€)
Missioni estere	56.5
Missioni interne	4.0
<i>Consumo</i> <i>prelievo magazzino centrale e metalli</i>	5.0
<i>Apparati tot</i>	80
<i>scheda elettronica(splitter e disc) custom LNF</i>	6.0
<i>guide di luce, fibre da 1mm diametro</i>	15.0
<i>strutture meccaniche ZDD</i>	7.0
<i>PM Hamamatsu H10826 SEL 24(16+4+4) PM</i>	32.0
<i>alimentaz. 24ch HV (SY1527)</i>	6.0
<i>Elettronica ZDD (2FADC)</i>	14.0
trasporti	6.0
Totale LNF	151.5



Richieste finanziarie per il 2012 @TO / PG

TORINO	Richieste(K€)
Missioni estere	50.5
Missioni interne	9.0
Mat. Consumo	4.5
<i>nastri LTO per storage dati LNF+TO</i>	2.0
<i>metabolismo</i>	2.5
Inventario	1.5
<i>rack 19" per farm</i>	
Totale TO	65.5

Perugia/ DOT1	Richieste(K€)
Missioni estere (2meeting in Cina, 1 turno)	6.0
Missioni interne (4 a LNF, 1 a To)	2.0
Totale PG	8.0

Dettagli richieste Missioni Estere, 2012



- partecipazione alle riunioni di collaborazione, IB meeting, discussione analisi dati e simulazioni, discussione pubblicazioni e release risultati per conferenza
LNF=TO : 2meeting/anno x (7d in Cina + viaggio + fee) x 3p = 11.0 K€
PG/dot1: 2meeting/anno x (7d in Cina + viaggio + fee) x 1p = 3.6 K€
- partecipazione a BESIII Physics Workshop: discussione analisi dati e simulazioni, discussione pubblicazione e release risultati per conferenze
LNF=TO: 2meeting/anno x (7d in Cina + viaggio + fee) x 3p = 11.0 K€
- partecipazione Working group europeo fattori di forma (D/NL):
LNF=TO: 2meeting/anno x (3d in D/NL + viaggio + fee) x 3p = 6.5 K€
- partecipazione meeting BESIII-EU NL):
LNF=TO: 3meeting/anno x (3d in D/NL + viaggio + fee) x 2p = 4.5 K€
- turni di presa dati: Token turni richiesto da BESIII: 10turni/persona
LNF: 1periodo/persona/anno x (10d in Cina + viaggio) x 4p = 9.0 K€
TO: 1periodo/persona/anno x (10d in Cina + viaggio) x 5p = 11.5 K€
PG/dot1: 1 periodo/anno x (10d in Cina + viaggio) x 1p = 2.2 K€
- lavoro fuori sede di un PostDoc/Ricercatore @ IHEP: sviluppo sw ricostruzione, analisi e simulazione
TO: 2periodi/anno x (15d + viaggio) x 1p = 6.0
- attività installazione ZDD @ IHEP:
 - LNF: attività installazione e messa in opera ZDD sul posto:
2sett/anno x (15d + viaggio) x 3p = 8.5 K€
 - LNF: commissioning ZDD all'inizio della presa dati sul posto:
2sett/anno x (15d + viaggio) x 2p = 6.0 K€

Dettagli richieste Missioni Interne 2012



- riunioni di coordinamento software/fisica TO<->LNF:
analisi dati canali $e^+e^- \rightarrow p \bar{p}$, $e^+e^- \rightarrow n \bar{n}$,
sviluppo codice simulazioni
LNF: 1 riunioni/anno x (3d + viaggio) x 4pp = 2.5 K€
TO: 4 riunioni/anno x (3d + viaggio) x 2pp = 5.5 K€
PG/dot1: 1 meeting a To, 4 a LNF = 2.0 K€
- partecipazione alle riunioni CSN1
LNF: 1riunioni/anno x (2d + viaggio) x 2pp = 1.5 K€
TO: 1riunioni/anno x (2d + viaggio) x 2pp = 1.5 K€
- lavoro fuori sede di un PostDoc/Ricercatore di TO @ LNF:
sviluppo sw ricostruzione, analisi e simulazione
TO:2periodi/anno x (5d + viaggio) x 1p = 2.0 K€

Dettagli richieste CON. / INV. LNF 2012



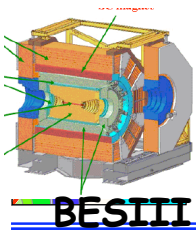
GUIDE DI LUCE in fibra plastica, L=2 m per portare segnale a PM
ditta Luceat (BS) : fibra plastica non rivestita da 1mm: Prezzo 0,39 Euro/m
Necessari 14 Km di fibra/modulo, 2 moduli = 28Km → **15K€**

PM Hamamtsu H10826 SEL
24 PM → **32K€**

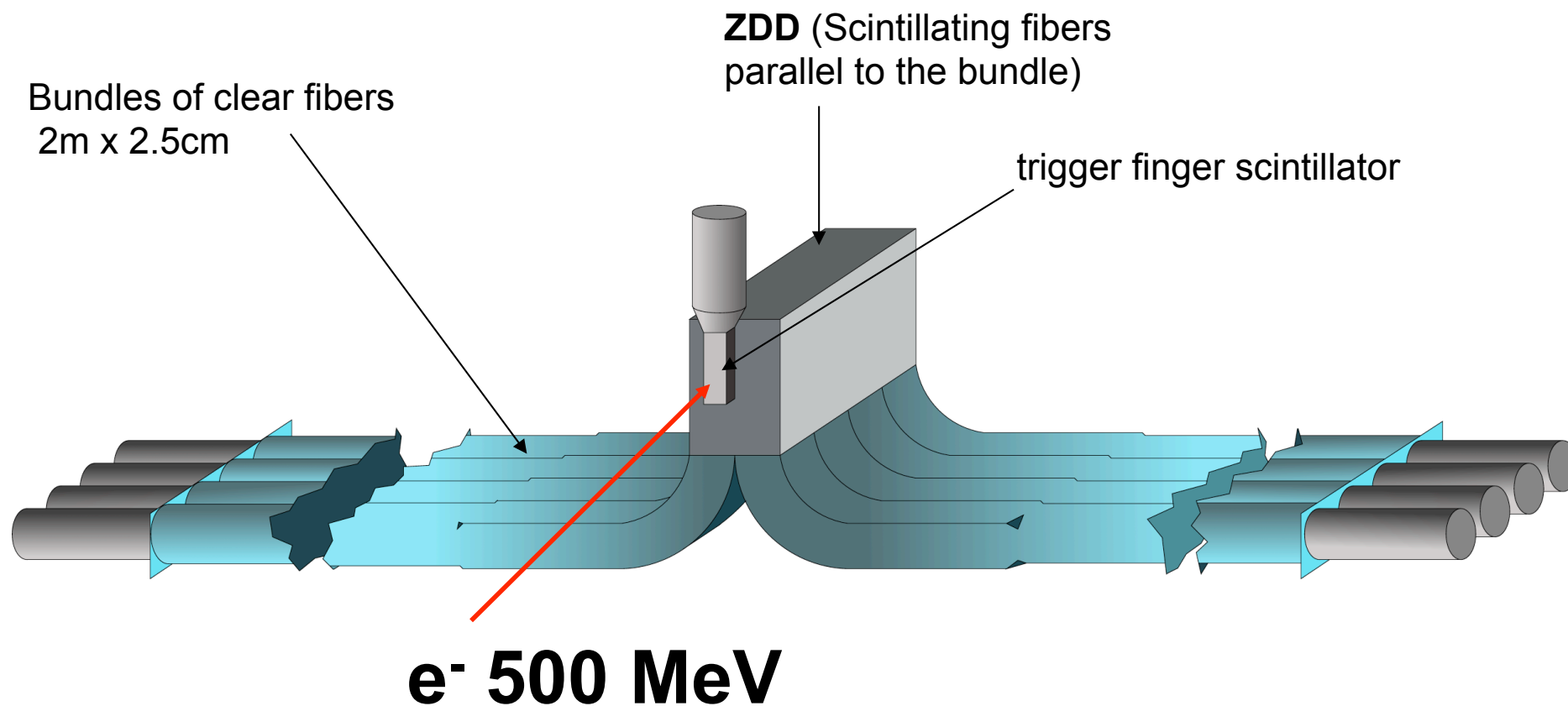
ALIMENTAZIONE PM
SY252LC PowerSupply system → 6.0K€

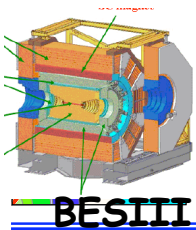
ELETTRONICA ZDD (CAEN)
1 Crate VME =3.0
1 CPU = 2.2
2FADC V1721 - 8 Ch. 8 bit 500 MS/s, 5700 *2+IVA= 14 K€

spares

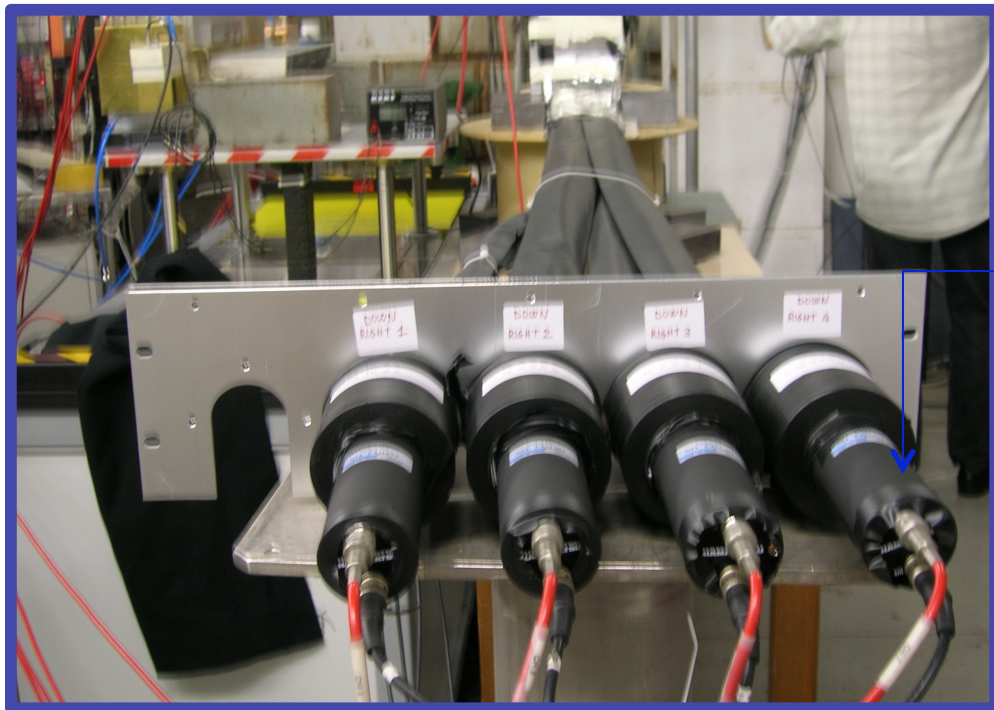


BTF Test beam setup



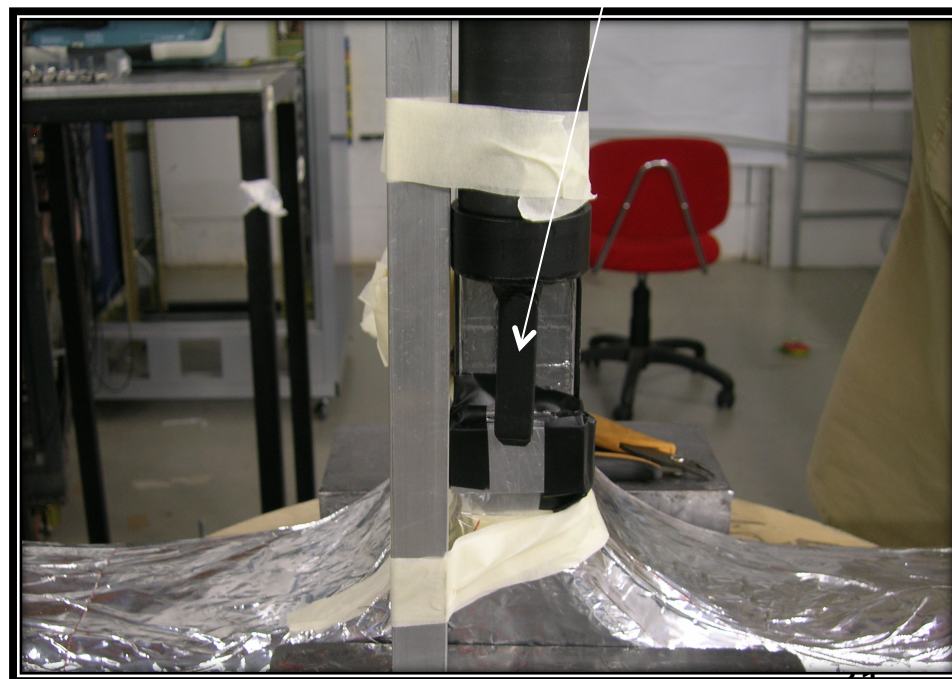


BTF test beam



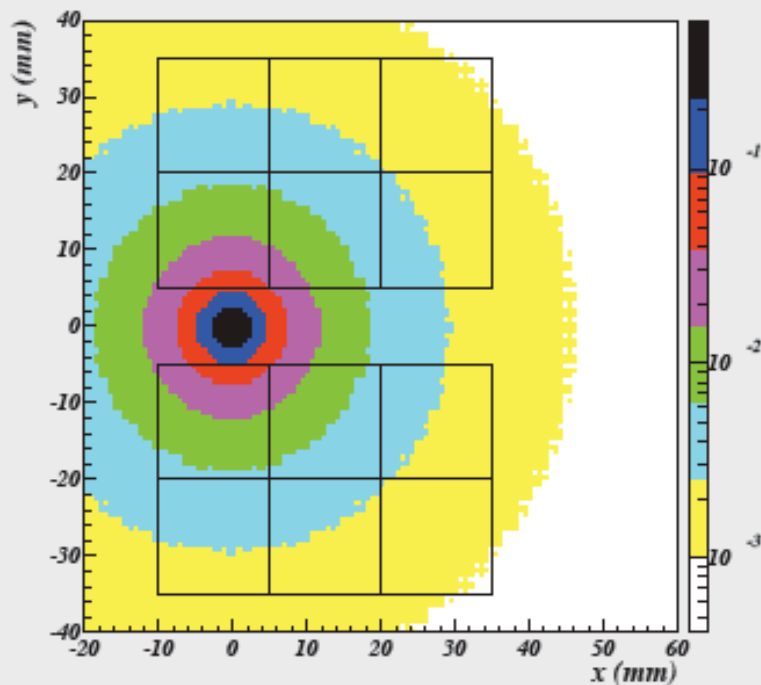
Hamamatsu H10826 SEL

trigger finger scintillator
((60x11x4) mm³)



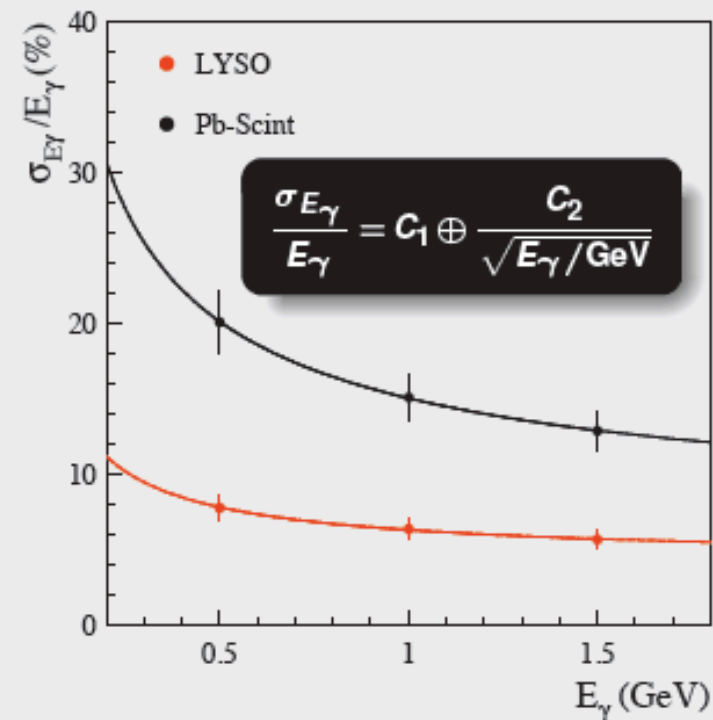
Energy resolution, the ISR case

ISR angular distribution on ZDD

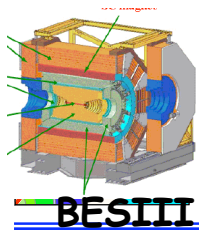


E_γ (GeV)	LYSO $\sigma_{E_\gamma}/E_\gamma$	Pb-Scint $\sigma_{E_\gamma}/E_\gamma$
1.5	5.7%	12.9 %
1.0	6.4%	15.1 %
0.5	7.8%	20.1 %

Energy resolution for ISR

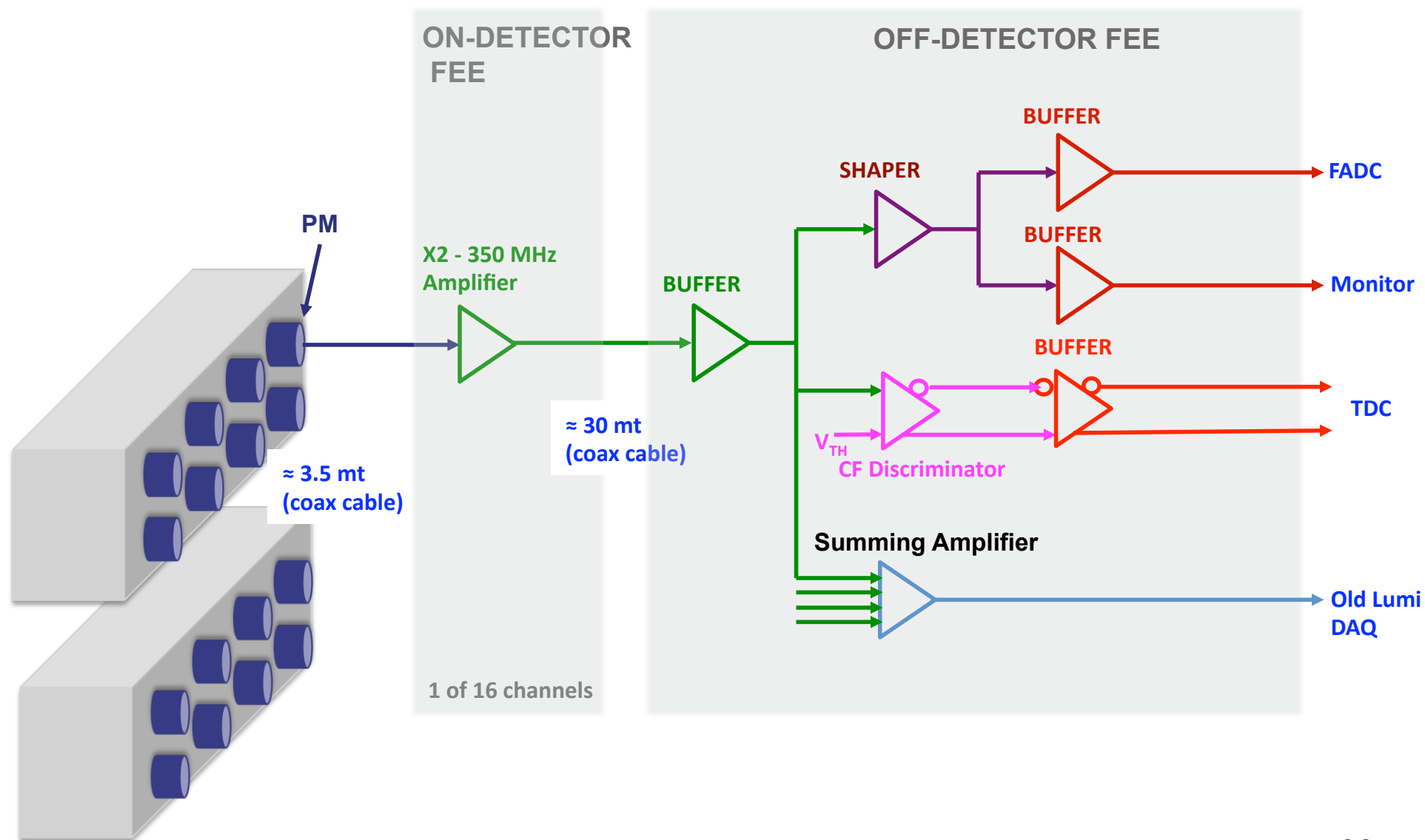


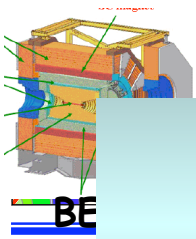
	LYSO	Pb-Scint
C_1	4.3%	6.9 %
C_2	4.6%	13.4 %



Front End Electronics

(by G.Felici, LNF-SEA)





Front-End electronics

- Close to the detector (~2m away) a mechanical structure holds:
 - 16 PMs (8 up, 8 dw) and fiber bundles
 - cables: analog OUT (16 x 3 = 48)
 - discriminators OUT (16), PM power IN (16)
- ~20 kgs of electronics