Stato di SuperB

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Commissione Scientifica Nazionale 1

Pisa, 16 settembre 2008

Reviews summary

INFN Internation Review Comm

- John Dainton – UK/Daresbury, chair
- Jacques Lefrancois – F/Orsay
- Antonio Masiero – I/Padova
- Rolf Heuer – D/ Desy
- Daniel Schulte – CERN
- Abe Seiden – USA/UCSC
- Young-Kee Kim – USA/FNAL
- Hiroaki Aihara – Japan/Tokyo

+ Tatsuya Nakada (RECFA)
+ Steve Myers – accel expert

Report released May 2008

recommend strongly continuation of work for 10^{36} cm^{-2} s^{-1} asymmetric e^+e^- collider

DOE Particle Physics Project Prioritization Panel (P5)

Report released May 2008

Recommend significant US Participation in offshore flavour factory in the intermediate funding scenario

RECFA Committee

- Tatsuya Nakada
- Yanis Karyotakis
- Frank Linde
- Bernhard Spaan

SuperB presented twice at ECFA

Presentation fall 08 to CERN strategy group

- chair Steinar Stapnes

Mini Machine Advisory Commitee

- Klaus Balewski (DESY)
- John Corlett (LBNL)
- Jonathan Dorfan (SLAC, Chair)
- Tom Himel (SLAC/ DESY)
- Claudio Pellegrini (UCLA)
- Daniel Schulte (CERN)
- Ferdi Willeke (BNL)
- Andy Wolski (Liverpool)
- Frank Zimmermann (CERN)

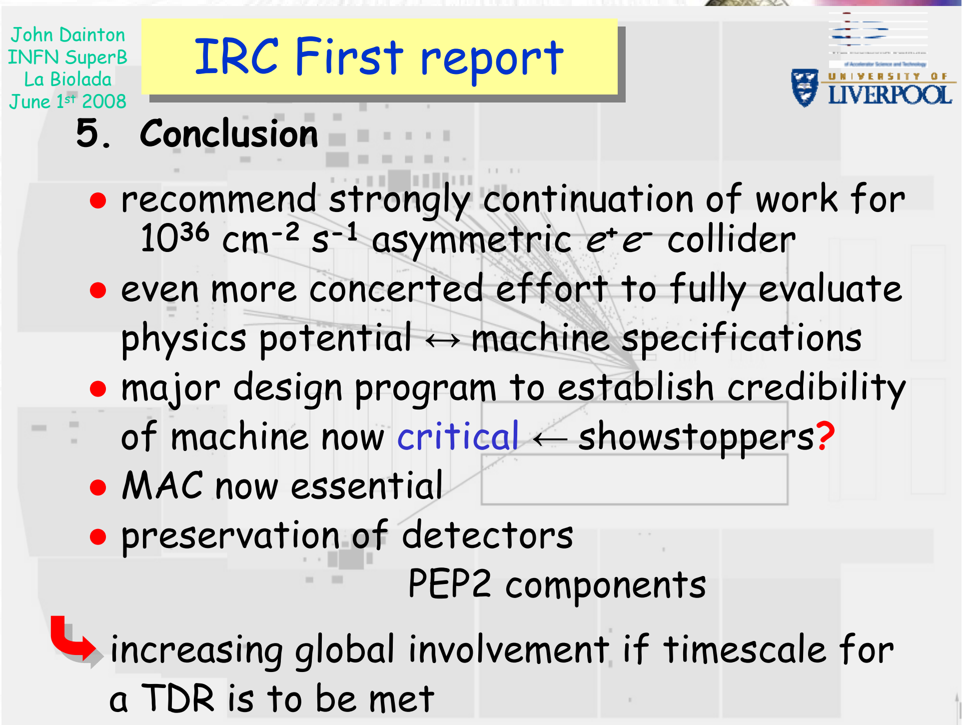
First meeting in July 08

No glaring showstoppers

Form a management structure

Comments on reviews

- Link to meetings and reports:
  http://www.pi.infn.it/SuperB/reviews
- Dainton committee →
- Mini MAC



- Very exciting project -- Committee is exhilarated by the challenge
- Physics requirement of 10**36 cm-2 sec-1 or 75 ab-1/5yr is very demanding
- Committee considers the SINGLE MOST ESSENTIAL ingredient for moving forward is the formation of a sanctioned management structure which formally incorporates a dedicated machine design team. The team members must have the strong support of their home institutions to work on the design. The team needs a designated leader, who is as close to full time as is possible
- The Committee sees no glaring showstoppers wrt achieving the design performance. However, in several key areas, more work is needed before the design can be blessed

Europa

- Processo di review di ECFA in corso. Report atteso per ottobre. Indicazioni positive
- Iniziata interazione con CERN Strategy Group
  - Necessaria per accedere ai finanziamenti europei
  - Iniziata una discussione sul coinvolgimento del CERN
    - Delicata, ma molto importante
    - Ci sono indicazioni di un interesse a supportare il progetto

America

- P5 report ha iniziato un processo positivo
- Indicazioni positive da parte del DOE sulla possibilita' di finanziare le attività dei gruppi americani
- Accesso a R&D money

Struttura di management

- Lavoro in corso tra SuperB e il management dell'INFN per definire la struttura di governance del progetto
  - Deve garantire la presenza dei partner internazionali
    - Evoluzione dell'attuale Steering Committee
  - Deve dipendere direttamente dal management INFN
  - Suddivisione
    - Acceleratore
    - Detector
    - Infrastrutture locali
    - Computing
  - Supervisione tecnica attraverso degli advisory committee (per ora esiste solo il Machine Advisory Committee)
  - Oversight da parte delle funding agencies attraverso uno specifico comitato
  - Struttura funzionale alla preparazione del TDR
- Ormai nelle fasi finali, si dovrebbe concludere in autunno
  - Importante per poter passare all'organizzazione del lavoro per il TDR
  - Ruoli definiti per le persone, sia italiani che stranieri

Coinvolgimento internazionale

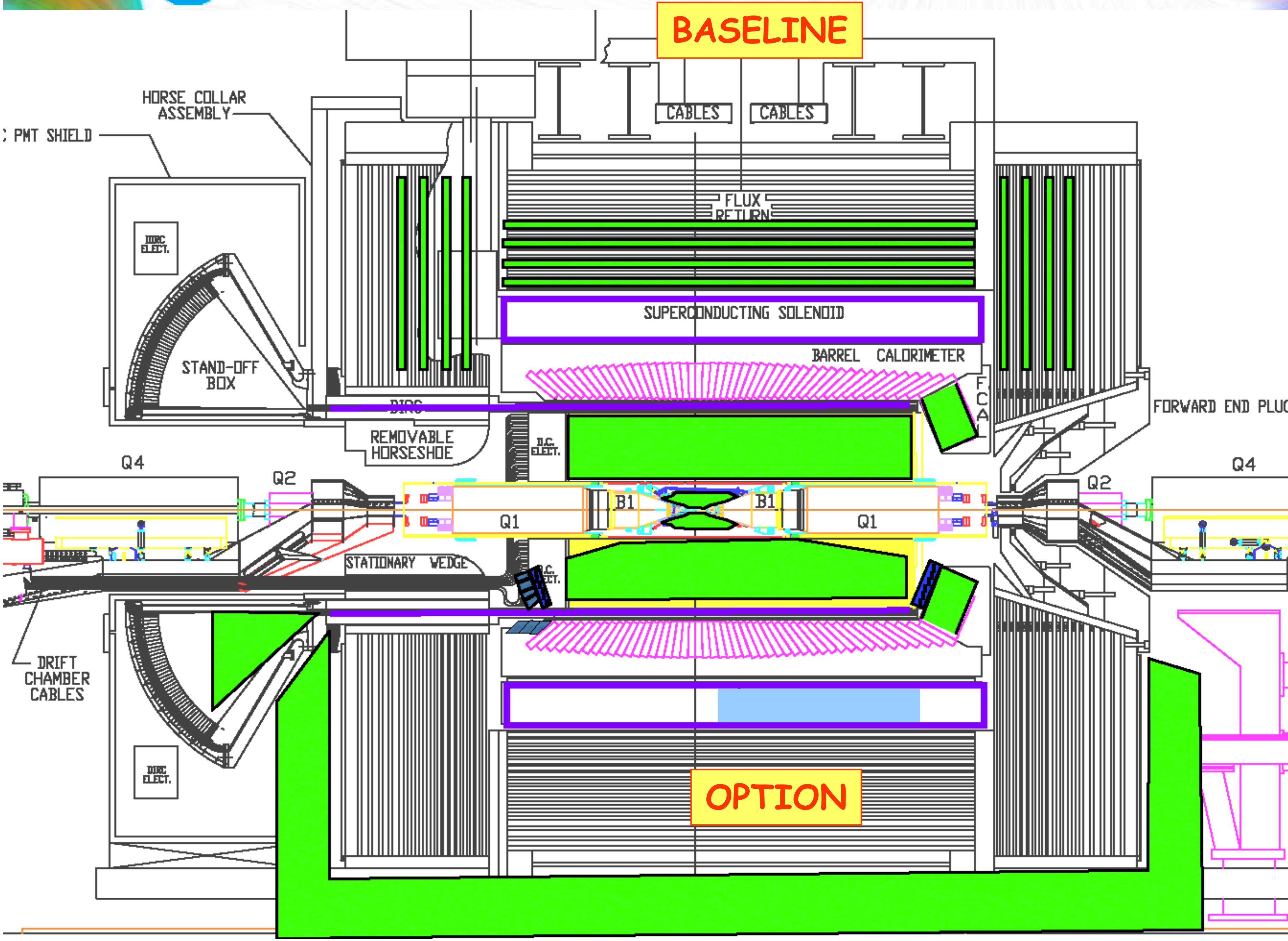
- La partecipazione si sta allargando. La quantità di manpower è ancora piccola, ma in crescita
- Acceleratore:
  - LNF, Orsay, Triumph, SLAC, BINP, UK/Cockcroft, ...
- Detector

System	Institutions
SVT	PI, PV-BG, TO, MI, TS, BO, PG, RM3, QMC (U of London), (Barcelona/Valencia)
DCH	LNF, NA, (Canada)
PID	SLAC, BINP , Cincinnati, Ljubljana, PD, LAL
EMC	Bergen, Caltech, Edinburgh, McGill, PG, RM1
IFR	FE, PD, RM1, (Ohio, Liverpool)
Trigger/DAQ	SLAC, Caltech, NA, BO
Computing	PD, FE, TO, BO, RM2, PI, PG, LNF, LBNL
Electronics	LAL, SLAC, Caltech

Subsystem conveners

- MDI/Backgrounds – Paoloni/Biagini
- SVT – Rizzo
- DCH – Finocchiaro
- PID – Leith
- EMC – Hitlin
- IFR – Calabrese
- Electronics/Trigger/DAQ – Breton/Dubois-Felsmann
- Computing – Morandin

Detector Layout – Reuse parts of Babar



PEP-II & Babar components

- SuperB dipende criticamente sulla disponibilità dei componenti di PEP-II e Babar e sulla volontà del DOE di darceli.
- PEP-II
  - Di proprietà del DOE. Ci sono piani di riuso molto parziale di alcuni componenti del Low energy ring per PEP-X
  - Inviata lettera Presid INFN → Direttore SLAC richiedendo formalmente la disponibilità del materiale (specificato in una lista)
  - La disponibilità permane, ovviamente andrà formalmente fatto l'accounting

Babar components

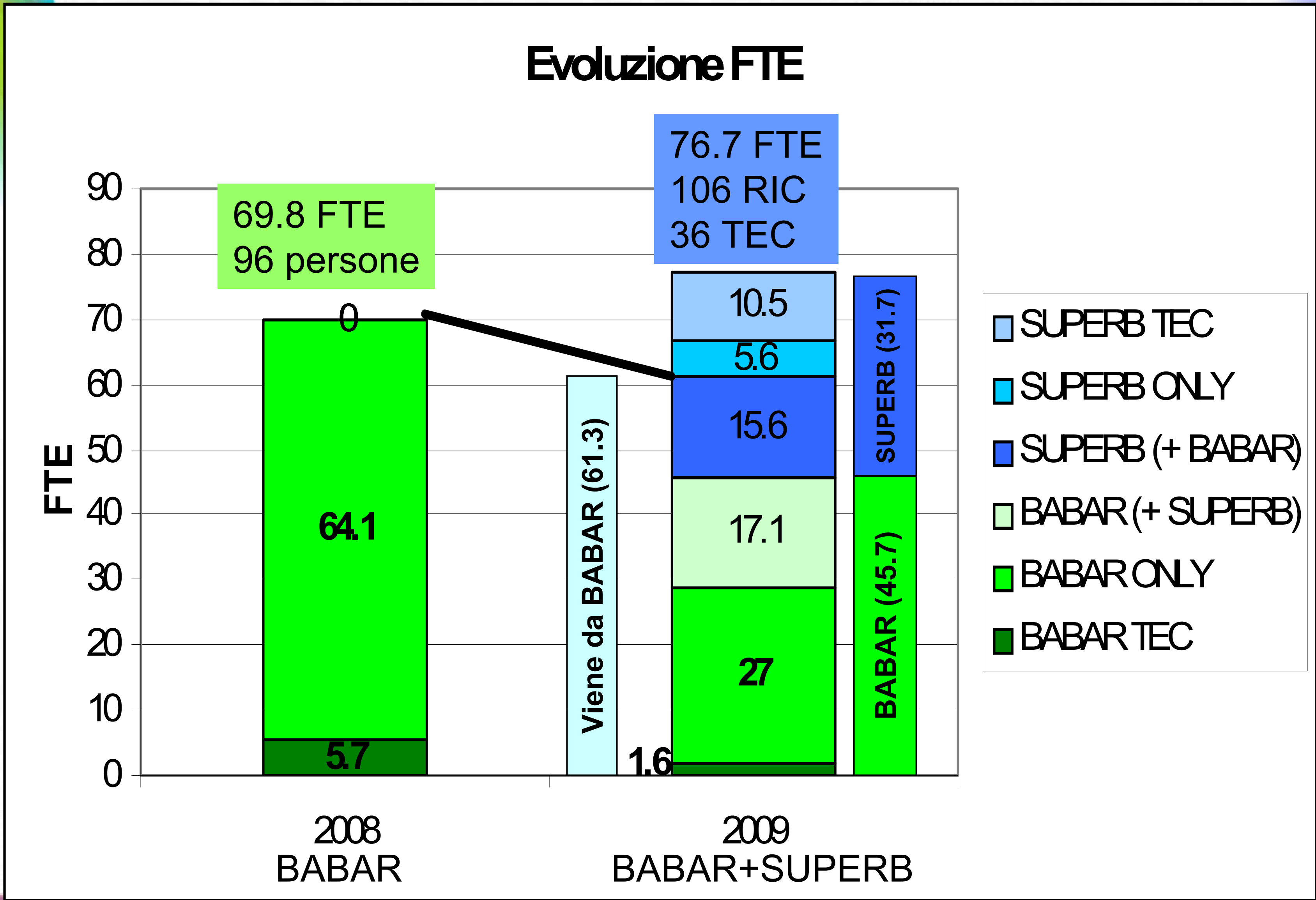
- Babar appartiene alla collaborazione (con un certo share)
- Farne il dismantling costa circa \$15M, che le F.A. non hanno intenzione di pagare
- Il DOE paga, ma vuole che la proprietà del rivelatore venga trasferita
- Questo processo si interseca con il riutilizzo dei componenti di Babar per SuperB:
  - Dopo il trasferimento la collaborazione perde formalmente il controllo, e SLAC può (potrebbe) fare quello che vuole
  - Dopo il trasferimento il valore del contributo in kind a SuperB (ordine di \$45M) verrebbe accreditato al DOE, senza possibilità di riconoscimento agli altri partners che hanno pagato per la costruzione
    - Germania, Francia, UK per calorimetro e DIRC
    - tutti per il magnete, che è fondo comune

Transfer of ownership

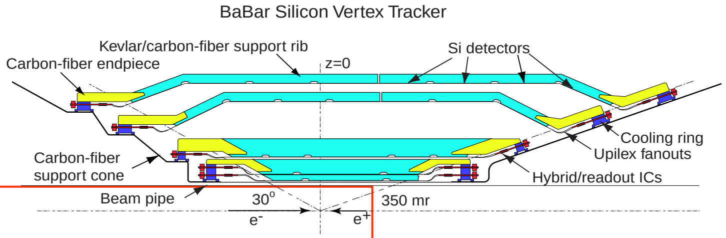
- La data della transfer of ownership è importante
  - Vorremmo che fosse dopo che il progetto SuperB esiste ed ha fatto i suoi accordi con SLAC e la collaborazione.
  - Si pensava intorno a fine 2009
- All'ultimo IFC, SLAC ha proposto invece Marzo 2009.
  - Motivazione principale: pensionamento delle persone esperte sull'installazione di Babar rischia di far aumentare i costi di ingegnerizzazione ed allungare i tempi
  - IFC è stato colto di sorpresa e non ha potuto prendere una decisione → Nominato sottocomitato per esaminare il problema ed arrivare con una proposta per ottobre (INFN: R. Calabrese)
- La partecipazione di SuperB allo smontaggio di Babar è importante:
  - Engineering necessario per poter trasportare le cose e rimontarle a SuperB
  - Non siamo ben preparati ad oggi. Con la fine della costruzione di LHC alcuni ingegneri saranno disponibili per questa attività a partire dall'autunno

Attività italiane 2009

- Attività finalizzate alla preparazione del technical design report
  - R&D dei rivelatori
  - Sviluppo di prototipi per finalizzare il design
  - Engineering preliminare rivelatori
  - Engineering smontaggio e trasporto Babar (e PEP-II)
- Manpower
  - Parte della comunità Babar
  - Forze nuove interessate (ma con percentuali piccole)
    - Attenzione a non danneggiare gli esperimenti LHC in questa fase di startup
  - Forte coinvolgimento di ingegneri (liberi da LHC)

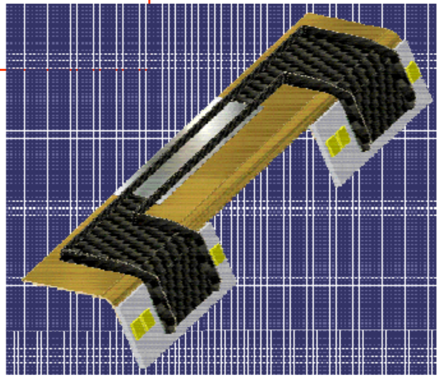

Evoluzione FTE
69.8 FTE
96 persone
76.7 FTE
106 RIC
36 TEC
FTE
90
80
70
60
50
40
30
20
10
0
0
64.1
5.7
Viene da BABAR (61.3)
1.6
10.5
5.6
15.6
17.1
27
SUPERB (31.7)
BABAR (45.7)
SUPERB TEC
SUPERB ONLY
SUPERB (+ BABAR)
BABAR (+ SUPERB)
BABAR ONLY
BABAR TEC
2008
BABAR
2009
BABAR+SUPERB

SVT - Layer 0 Options



G.Rizzo

- The BaBar SVT technology is adequate for R > 3cm: use design similar to BaBar SVT
- Layer0 is subject to large backround and needs to be extremely thin: > 5MHz/cm2, 1MRad/yr, < 0.5%X0

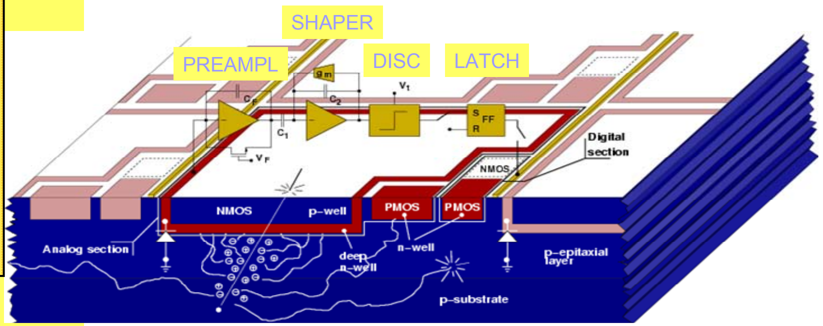


Striplets option: mature technology, not so robust against background.

- Marginal with background rate higher than ~ 5 MHz/cm^2
- Moderate R&D needed on module interconnection/mechanics/FE chip (FSSR2)

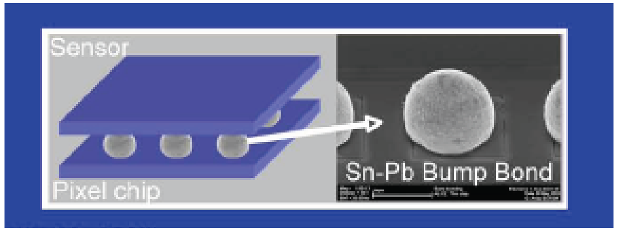
CMOS MAPS option

- new & challenging technology:
- can provide the required thickness
- existing devices are too slow
- Extensive R&D ongoing (SLIM5-Collaboration) on 3-well devices 50x50um^2



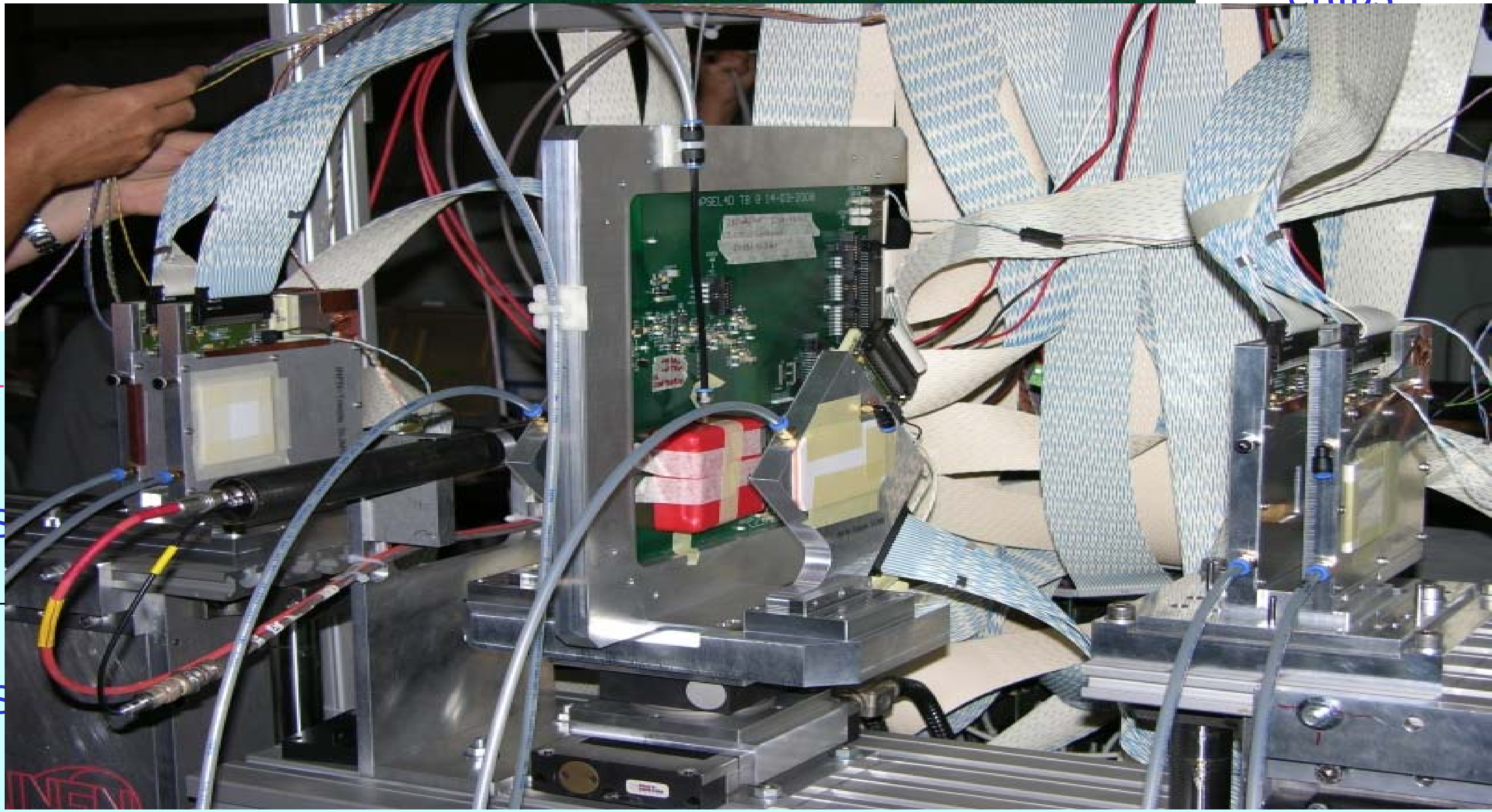
Hybrid Pixel Option: tends to be too thick.

- An example: Alice hybrid pixel module ~ 1% X0
- Possible material reduction with the latest technology improvements
- Viable option, although marginal



Beam test

- Beam test started last week @ CERN (T9). Main goals:
  - DNW MAPS matrix resolution & efficiency
  - chips

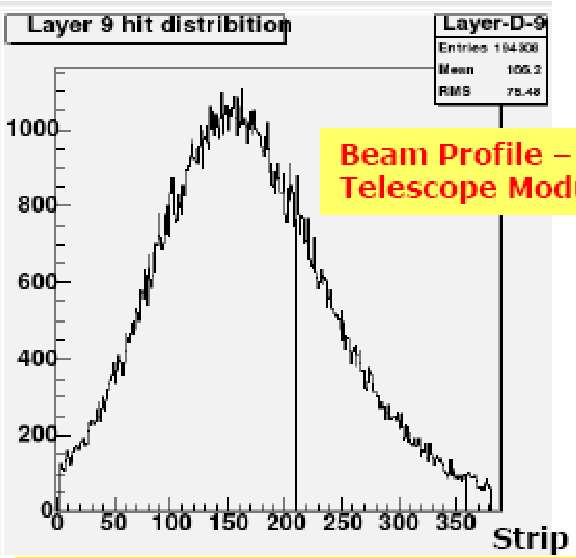


T-1

S

S

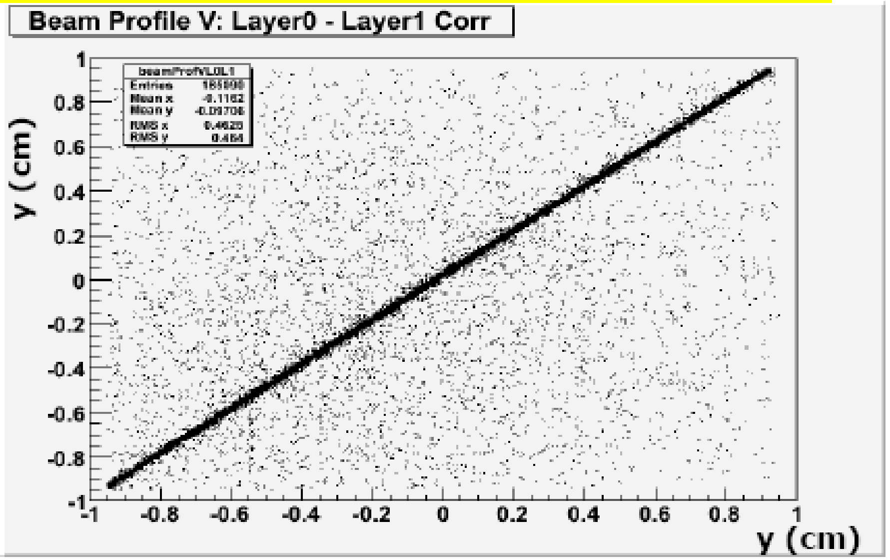
m



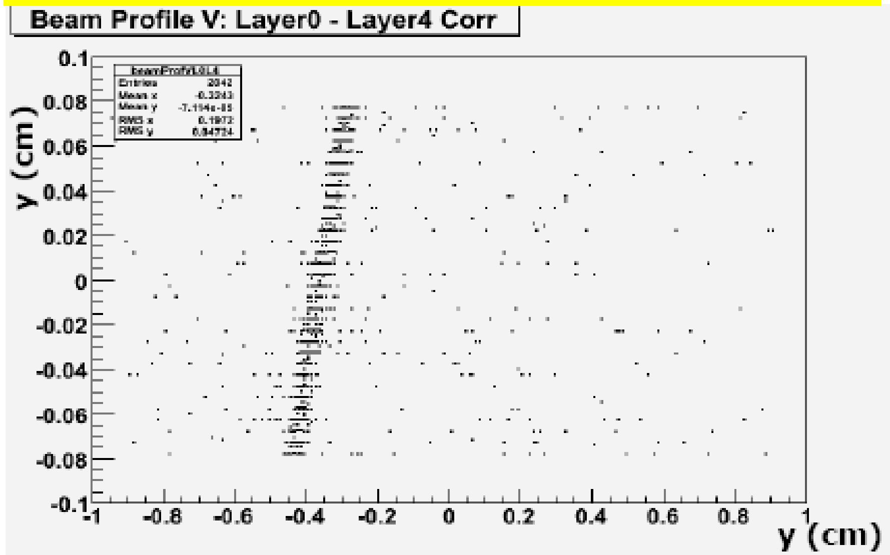
Beam Profile –
Telescope Module

A first look to the CERN beam test data (still in progress)

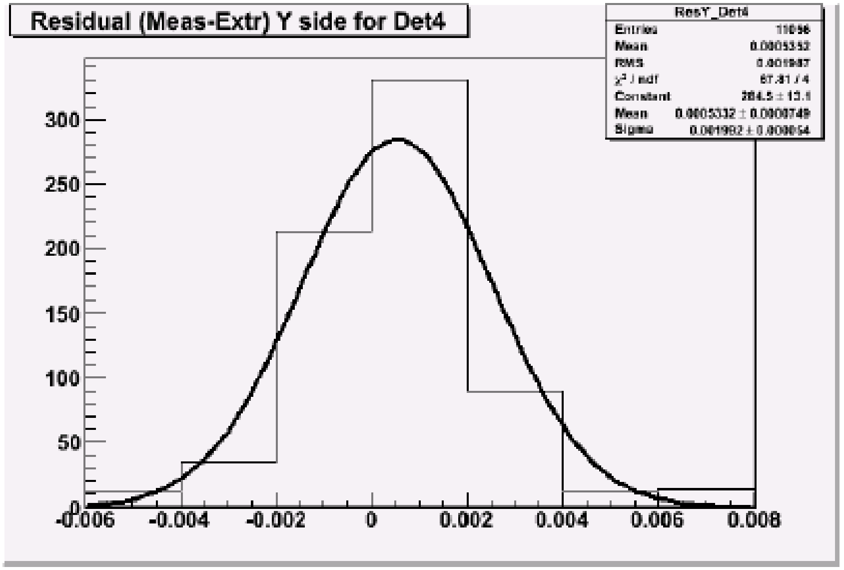
Y hit correlation Telescope T2 vs T1

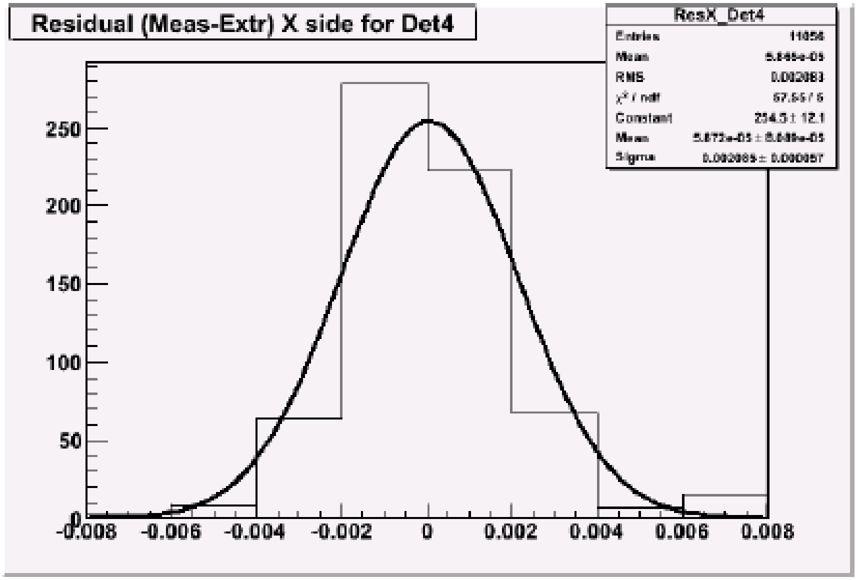


Y hit correlation MAPS vs Telescope T1



Resolution and efficiency of APSEL4D from preliminary beam test data

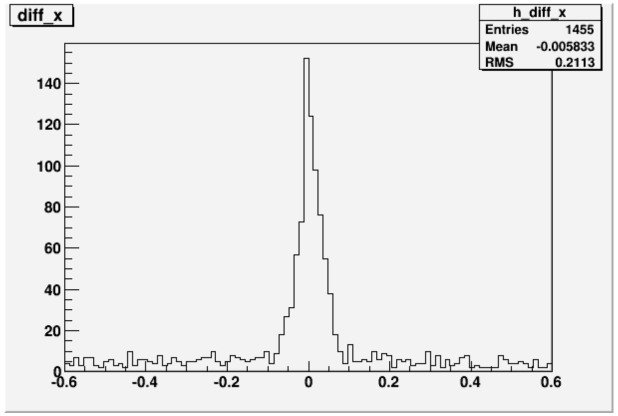




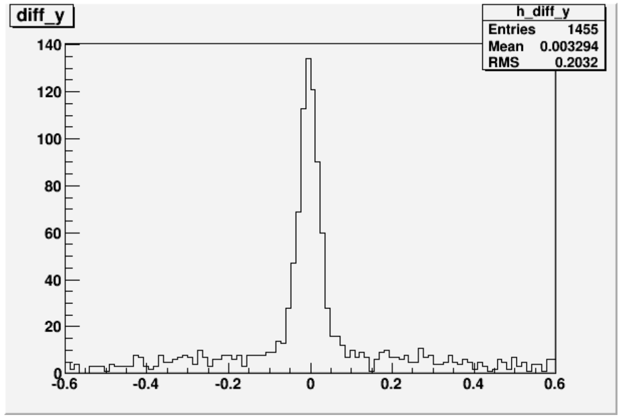
- Resolution < 18 μm (50 μm x 50 μm pixels)
- Efficiency plateau between 80% and 90%

Slim5 TB: Tracce da AM

- Risultati (molto) preliminari da test beam di Slim5
- Tracce ricostruite offline in buona correlazione con le "road" osservate dalla memoria associativa online
- Eventi a trigger AM
- 200 um di risoluzione sulle intercette delle tracce al primo piano del telescopio

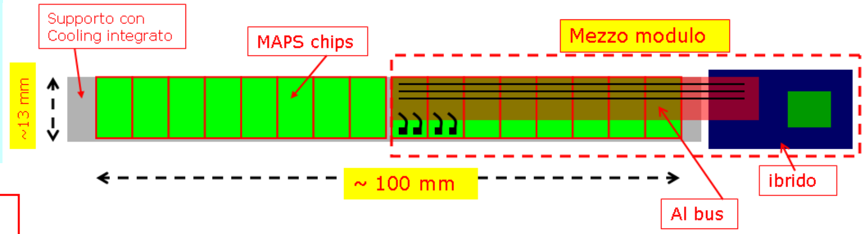


X(tr_offline)-X(tr_AM)



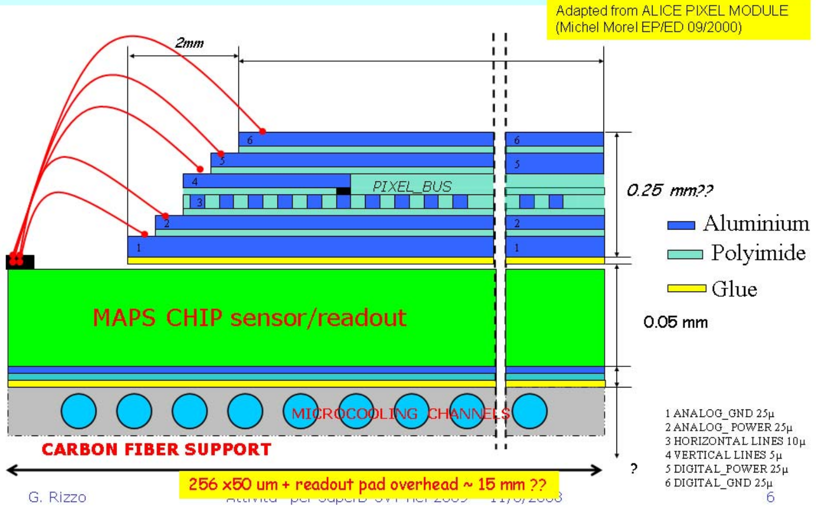
Y(tr_offline)-Y(tr_AM)

Sviluppo di modulo multichip MAPS: dimostrazione di fattibilita' per Layer0



- Modulo prototipo di dimensioni ridotte ma con funzionalita' elettriche e supporto meccanico/cooling vicino alle specifiche per SuperB
  - 2-3 chips MAPS ~ 128x128 area chip ~ 60 mm2 di cui 40 mm2 attivi (architettura data driven tipo APSEL4D-SLIM5)
    - PV/BG, PI, BO, Roma III
  - connessi su un bus multistrato (stile ALICE pixel bus) (MI, TS)
  - Ibrido "intelligente" con FPGA (→ ASIC in futuro se necesario per rad. Hardness) per implementare buffer locali (in attesa LV1 trigger), smistamento dati verso DAQ. In prospettiva simile sviluppo per ibrido con FSSR2 per striplets e layer esterni. (MI, TS)
  - Montati su supporto meccanico sottile in fibra di carbonio con cooling integrato con microcanali. (PI)
- Realizzazione delle varie componenti nel 2009, inizio assemblaggio e test fine 2009. Preparazione testbeam nel 2010.

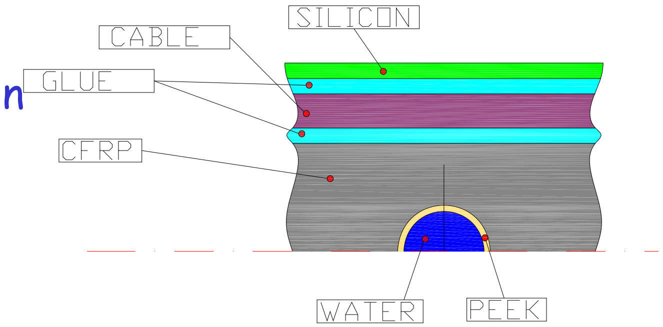
PIXEL BUS + MAPS CHIP+Support CROSS SECTION

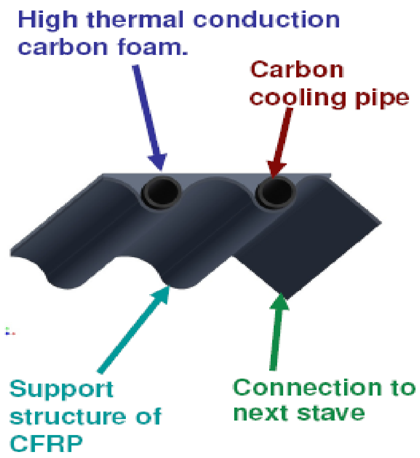


- Assemblaggio meccanico del modulo/saldatura (PI)
- Test termici lab termofluido. (PI)
- Test elettrici: catena d'acquisizione SLIM5 - modificata (BO,PI)
- Danno da radiazione MAPS (PV)

Supporto meccanico per Layer0

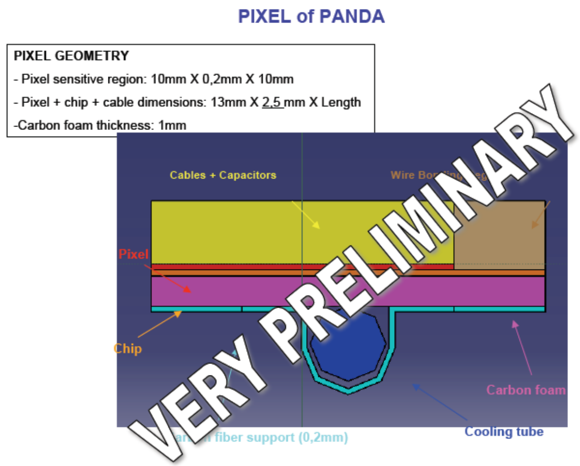
- Realizzazione del supporto per prototipo modulo MAPS. Struttura con cooling integrato (monofase) realizzato con microcanali in fibra di carbonio (D ~ 300 μm).
- Design delle flange di interfaccia per moduli Layer0 Continuazione delle attivita' di SLIM5 (PI)





- Valutazione di sistema di cooling evaporativo per Layer0. Design simile a quello proposto per upgrade <u>Pixel Detector di ATLAS</u>: canali in fibra di carbonio (D ~ 4mm), schiuma conduttiva di carbonio per il sostegno dei moduli, struttura meccanica in laminato composito di fibre di carbonio. (MI)

- Studio supporto e cooling per pixel con struttura a fibra di carbonio e schiuma conduttiva simile a quello in corso di elaborazione per PANDA (TO)



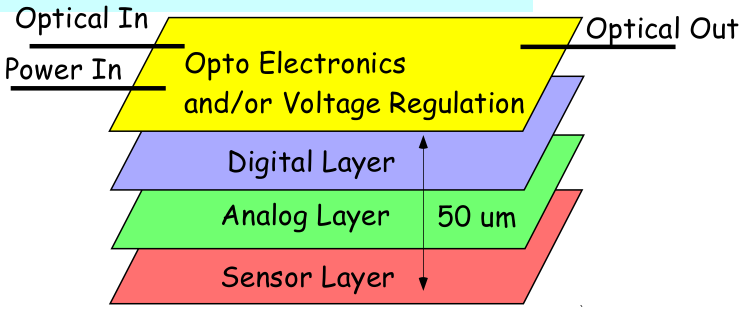
Attivita' 2009 per SVT - P-SuperB

Sezioni: Bologna, Milano, Pavia, Pisa, Roma III, Torino, Trieste

- Attivita' finalizzate alla stesura del TDR in 2-3 anni
- R&D sulle 3 opzioni per Layer 0:
  - CMOS MAPS per dimostrazione fattibilita' di modulo multichip con specifiche SuperB (tutte le sezioni coinvolte)
  - Pixel ibridi: indagine sulla possibile riduzione del pitch in chip esistenti (PV) e del materiale supporto/cooling (MI,TO, PI) per target Layer0-SuperB
  - Continuazione attivita' Striplets (TS)
- Layer esterni: valutazione chip lettura FSSR2 (PV,TS) e "ibrido intelligente" (TS)
  - Interesse di gruppi non italiani al design dei layer esterni
- Meccanica: Layer0 (PI,TO, MI), supporto di SVT (PI,TO), beam-pipe. (PI)
- Simulazione: background, fast simulation per ottimizzazione layout SVT (PI)

Altre Attivita' del Gruppo SVT - I

- Il gruppo SVT e' coinvolto in altri progetti di R&D su pixel sottili che investigano nuove tecnologie di integrazione verticale (Vertical Scale Integration) VIPIX (GRV dal 2009) - PRIN2007



Physicist's Dream

- Non c'e' sovrapposizione con le attivita' di P-SuperB finalizzate alla realizzazione di un Layer0 con tecnologie piu' convenzionali.
- Le nuove tecnologie potrebbero essere molto utili per applicazioni in SuperB ma non sono ancora mature per essere proposte per il TDR.

Progetto VIPIX – Vertically Integrated PIXel – GR V

- Durata: triennale - Sezioni : BO, PI, PG, PV/BG, RM3, TN(PD), TO, TS ~ 17 FTE
- Scopo: sviluppare sistemi a pixel per tracciatori sottili basati su tecnologie innovative di integrazione verticale (Vertical Scale Integration)
  - Si realizzeranno chip su 2 layer con Tecnologia Chartered – Tezzaron 130 nm
    1. CMOS MAPS in VSI (layer con sensore + analogico/layer con digitale)
    2. chip di front-end in VSI (layer analogico/layer con digitale) da connettere a pixel su substrato ad alta resistivita' con bump bonding

Altre Attivita' del Gruppo SVT - II

<u>Progetto PRIN2007 GIORGI:</u>

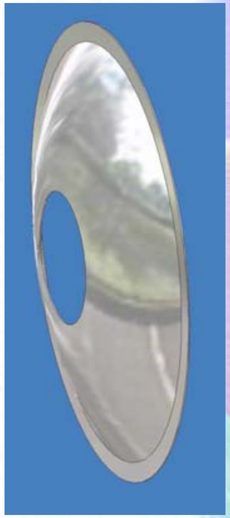
- Titolo: Sistemi a pixel per tracciatori sottili basati su tecnologie microelettroniche ad alta densita'.
- Durata: biennale - Sezioni coinvolte: BO, PI, PV, BG, TS
- Nel progetto, sottomesso prima della definizione delle attivita' P-SuperB e VIPIX, (Nov. 2007) ci si proponeva di
  1. investigare le tecnologie innovaticve di integrazione verticale con sensori ad alta resistivita'
  2. Sviluppo di tecnologie piu' convenzionali per realizzare un modulo multichip con CMOS MAPS tradizionali (matrice 128x128 ST 130 nm, specifiche vicine a quelle attuali di SuperB): architettura di lettura matrice grande, cooling, DAQ.
- Progetto approvato in Agosto 2008 con notevole riduzione del budget.
- Ridefinizione delle finalita':
  1. integrazione verticale tra rivelatori a pixel su substrato ad alta resistivita' e chip di front end (ulteriore riduzione del materiale rispetto al punto 2 di VIPIX.
  2. Parte del budget puo' essere utilizzato per realizzare la matrice MAPS di grandi dimensioni integrando il finanziamento INFN – P-SuperB per la realizzazione del modulo prototipo pixel. Di fatto cancelliamo il finanziamento per cooling e DAQ previsto nel PRIN che viene mantenuto in SuperB.

LNF

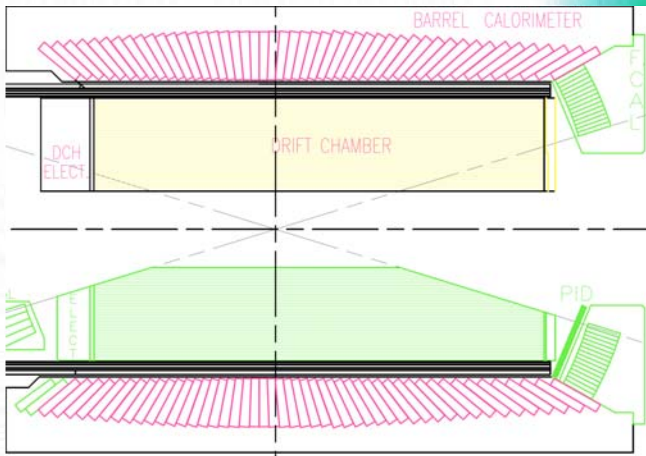
Drift Chamber

G. Finocchiaro

Build on *BABAR* drift chamber concept: no major R&D effort needed, but:



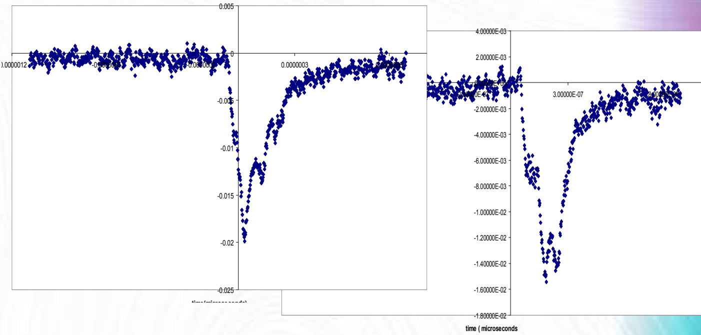
- Lighter structure, all in Carbon Fiber (CF)
  - Preliminary studies show dome-shaped CF end-plates with X_0 ~2% seem achievable (compare 13-26% in BABAR DCH)
- Design faster, lighter electronics (possibly taking into account detectors being considered now to be installed behind backward end-plates)
- To control expected increase in occupancy:
  - studying faster gas mixtures
  - considering smaller cells
    - optimization studies need simulation tools being made available on Summer '08
  - Tapered shape of end-plates
    - alternative solutions being explored



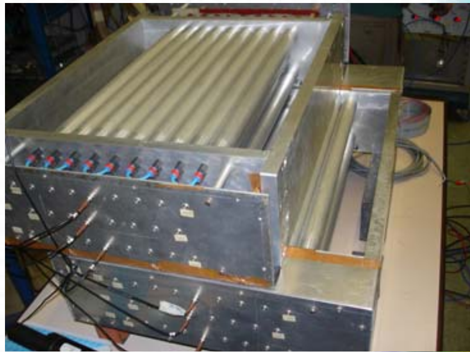
- Need to test all new solutions on small prototypes

Re-commissioning of DCH prototype

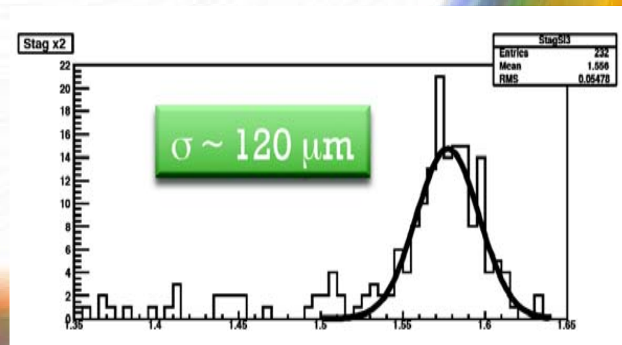
- Started re-commissioning of small DCH prototype
  - Wires OK
  - Electronics OK
  - Gas tightness OK
- Read out few channels
  - Signals look good
  - Need more electronics to read out all
    - underway
- Can easily replace bolted end plates with new ones with different cell geometries



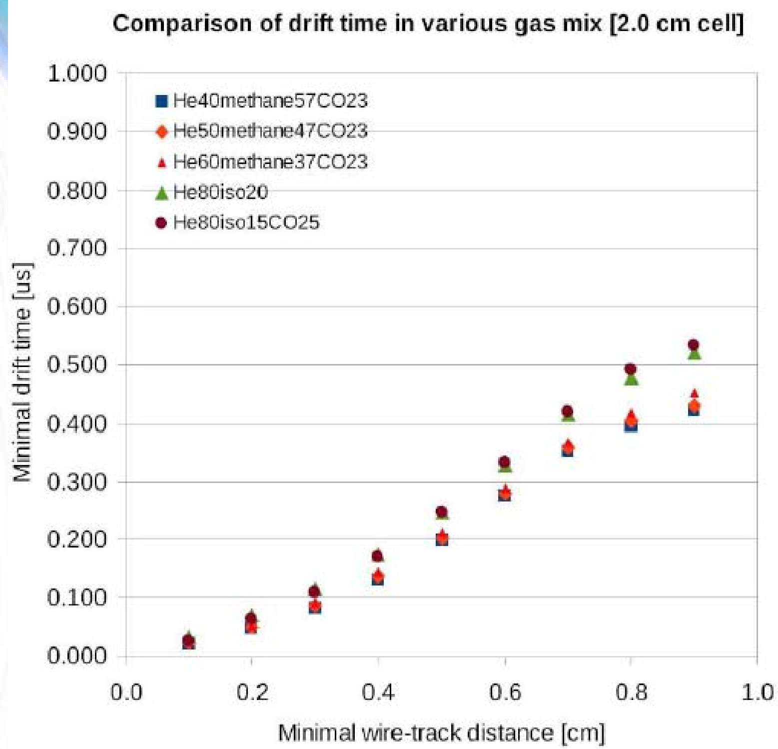
Re-commissioning of precision tracker

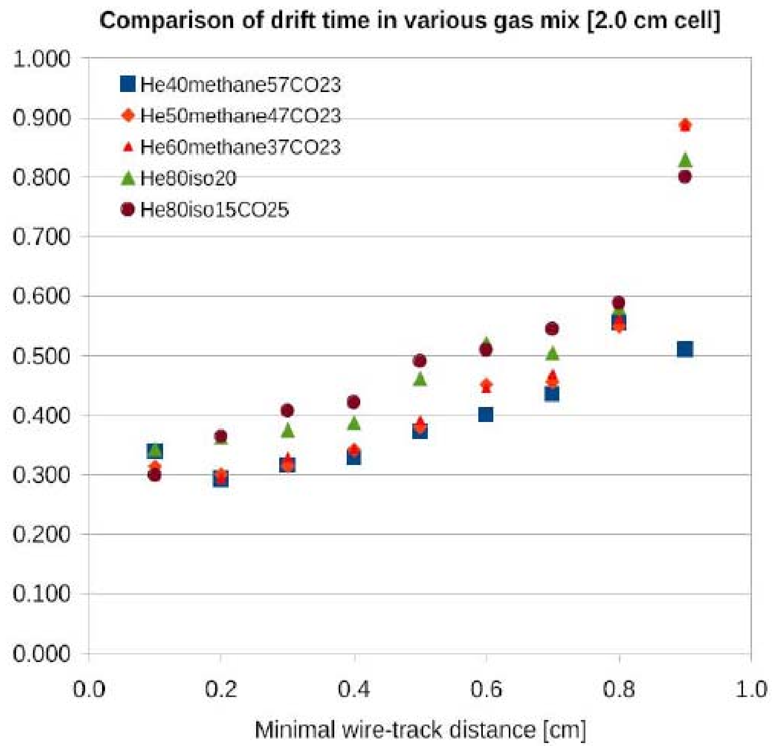


- First pass with coarse space-time relations
  ➔ achieved resolution of 120 μm
- on-board electronics for all 52 channels being designed, to be ready after Summer



Garfield simulations





t_{min} and $t_{90\%}$ in various gas mixtures
(standard BABAR cell)

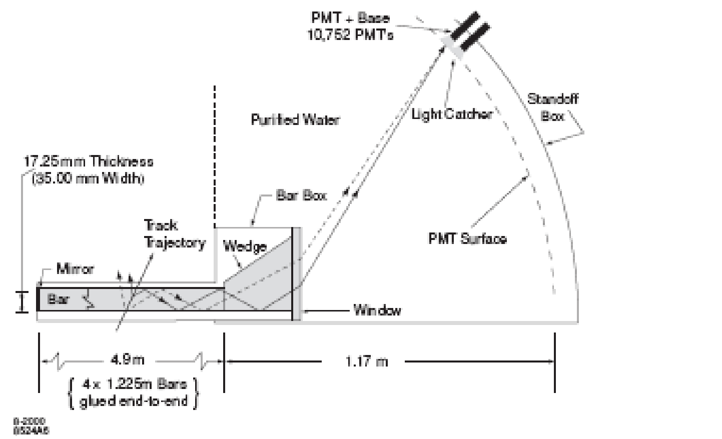
Drift Chamber TDR plan

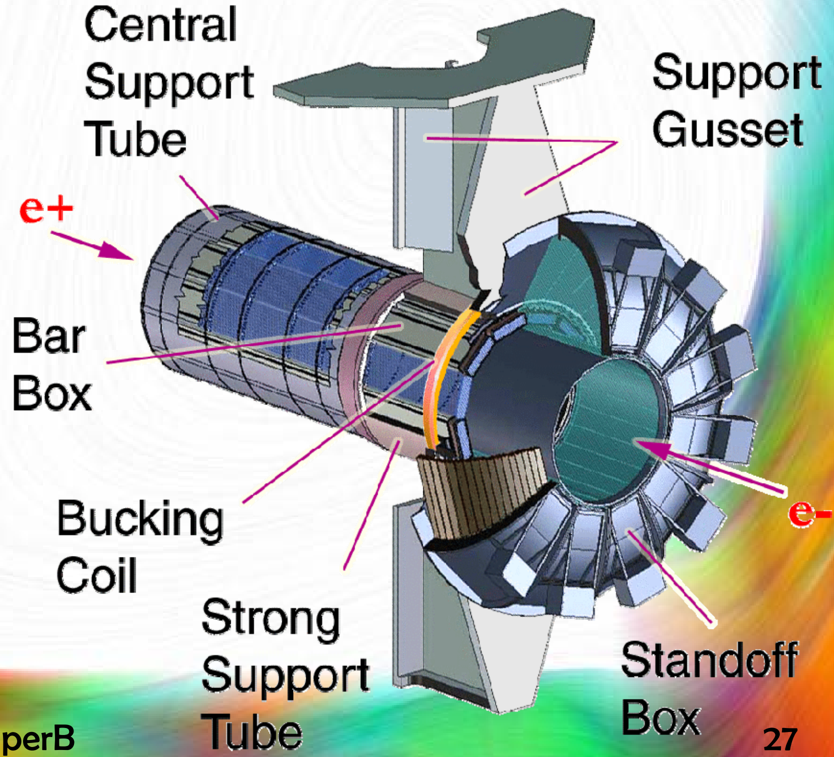
- ✓ New gas mixture
  - → Garfield studies have started
- ✓ New cell structure
  - → re-starting studies as soon as the needed fast- and full- simulation tools are made available later this year
- ✓ Studies with prototypes
  - → preparation work (external tracker, drift chamber prototype) well advanced. Can start whenever results from above two points are ready
- ✓ Define mechanical structure
  - → Interplay with other detectors (length, offset, shape) from simulation
  - → Once geometry outlined, make detailed FEA calculations (mechanical engineers and designers available at LNF)
- ✓ Electronics design
  - → Based on BABAR design, with necessary modifications
  - → presently understanding requirements, then start design

PID

D. Leith

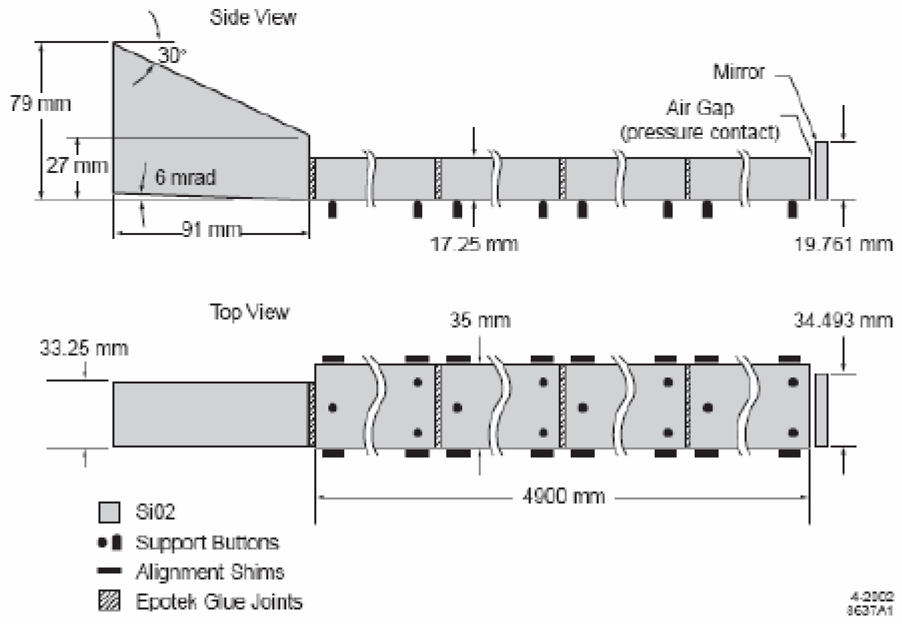
- Main issues:
  - replacement of readout for barrel DIRC
  - forward PID system: if, and what.
- Progress in many areas:
  - Time of flight
  - Aerogel
  - Electronics design
- Who:
  - SLAC, BINP , Cincinnati , Ljubljana , Padua , Hawaii
  - System with large overlap with Belle – need to be resolved some time
  - More groups are needed



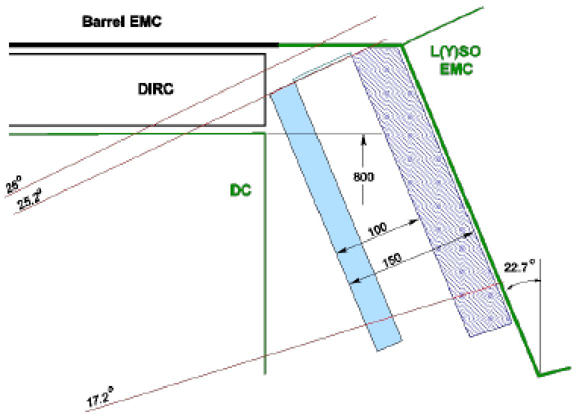


PID

Barrel PID
Reuse Babar quartz bars with compact readout



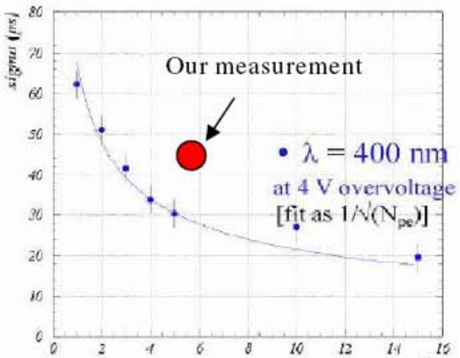
Forward PID



- With LSO the front of the endcap calorimeter could be moved back for about 12 cm
- Full scale Drift Chamber
- There is a space for 15 cm thick FARICH

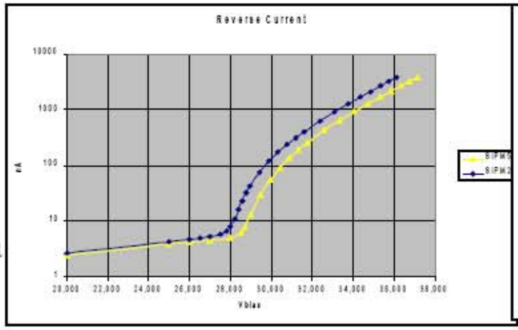
Confronto tra SiPM IRST e MPPC Hamamtsu

- Reverse current. SiPM peggiore del MPPC di 2 ordini di grandezza.
- Gain. Confrontabile: ~10^6
- Signal shape. l'MPPC mostra una forma esponenziale semplice, mentre il SiPM mostra un impulso stretto ed ampio, con fronti assai più ripidi, a cui segue l'esponenziale. La carica totale dei due impulsi è comparabile.
- Dark rate. comparabile (~1 MHz), ma l'MPPC mostra un rate di afterpulses e crosstalk ottico significativamente più alto rispetto al SiPM
- Time resolution. i fronti più ripidi del SiPM consentono un time resolution decisamente migliore rispetto al MPPC: ~50 ps contro 140 ps.

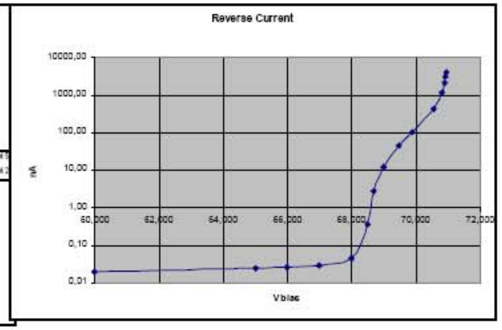


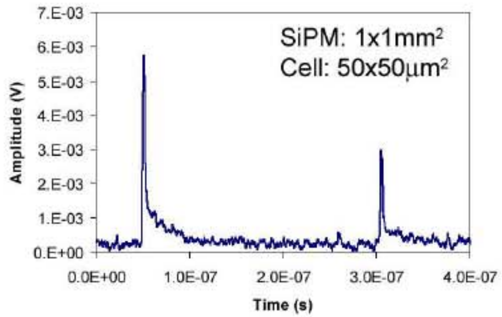
20 ps at 15 photoelectrons
[G. Collazuol et al., VCI 2007, to be published in NIM A.]

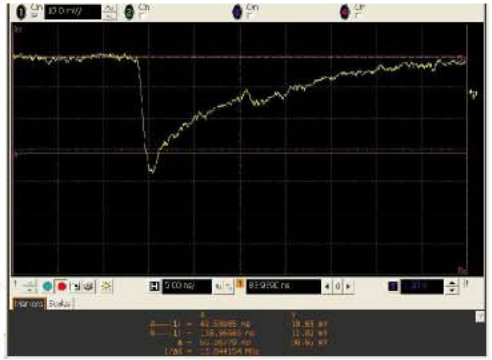
SiPM-IRST

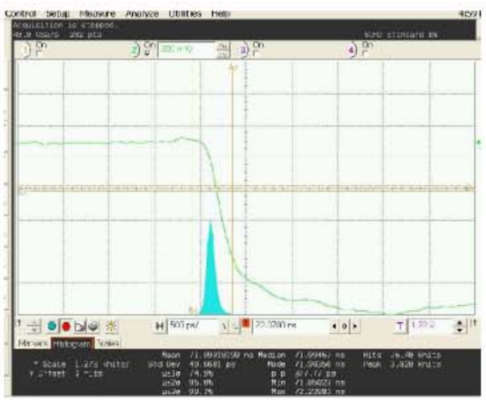


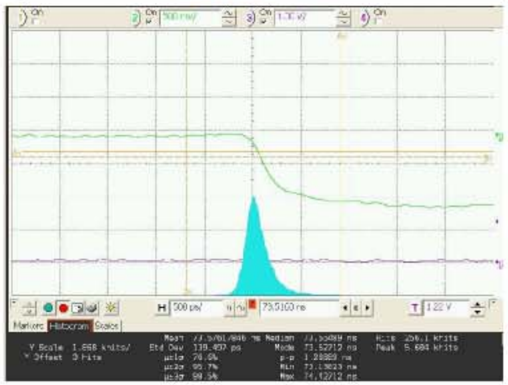
MPPC-Hamamtsu









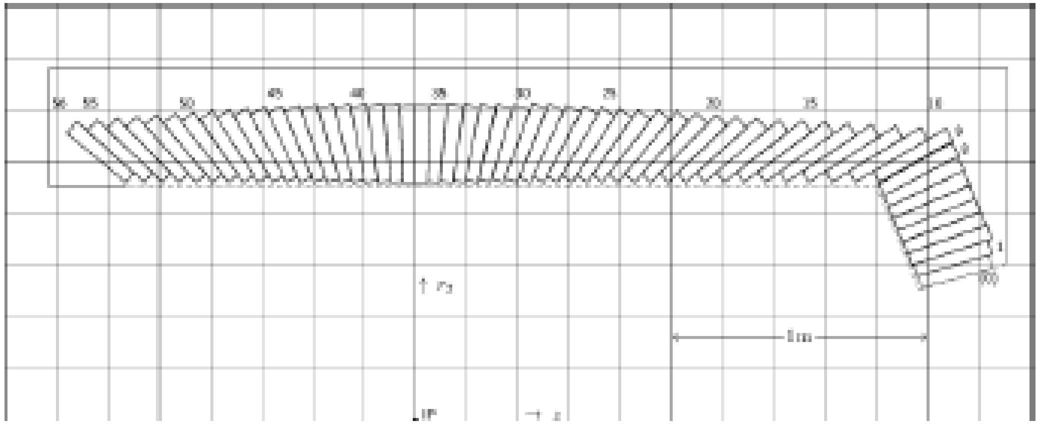
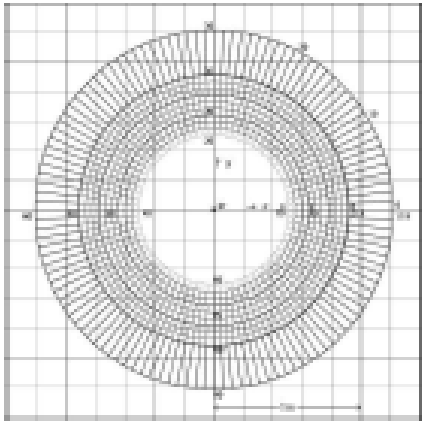


Attivita' previste nel 2009

- Completamento studio delle proprieta' temporali dei vari photodetectors, in particolare SiPM con superficie piu' ampia, mediante test su banco con laser
- Misure di efficienza con banco ottico e monocromatore
- Misure di risoluzione TOF di rivelatori ottici (SiPM e MCP-PMT) accoppiati a radiatori di quarzo, effettuate in laboratorio con laser e cosmici e su fascio a FNAL (gia avviati accordi preliminari con Jerry Va'vra per test congiunti)
- Inizio progetto del Forward PID di SuperB con rivelatori TOF in vista della scrittura del TDR
- Possibile coinvolgimento nella simulazione del Forward PID
- Possibile coinvolgimento nell'ingegnerizzazione del nuovo DIRC

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 $\Rightarrow$ LSO
- Backward Endcap hermeticity important for inclusive decays and decays with neutral energy
- Veto detector possibility Lead/Scintillator fibers

NEW approach scintillator tiles

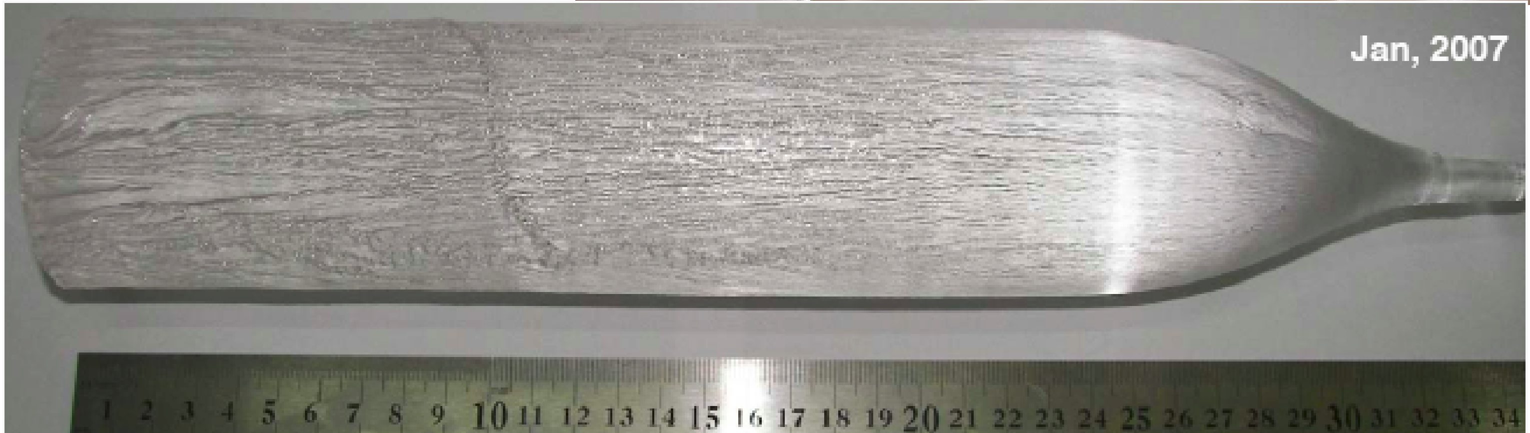
EMC Forward as well as backward should be
- FAST
- small Molière Radius and RL
- radiation hard

Mass-produced Crystals (new, for PDG)

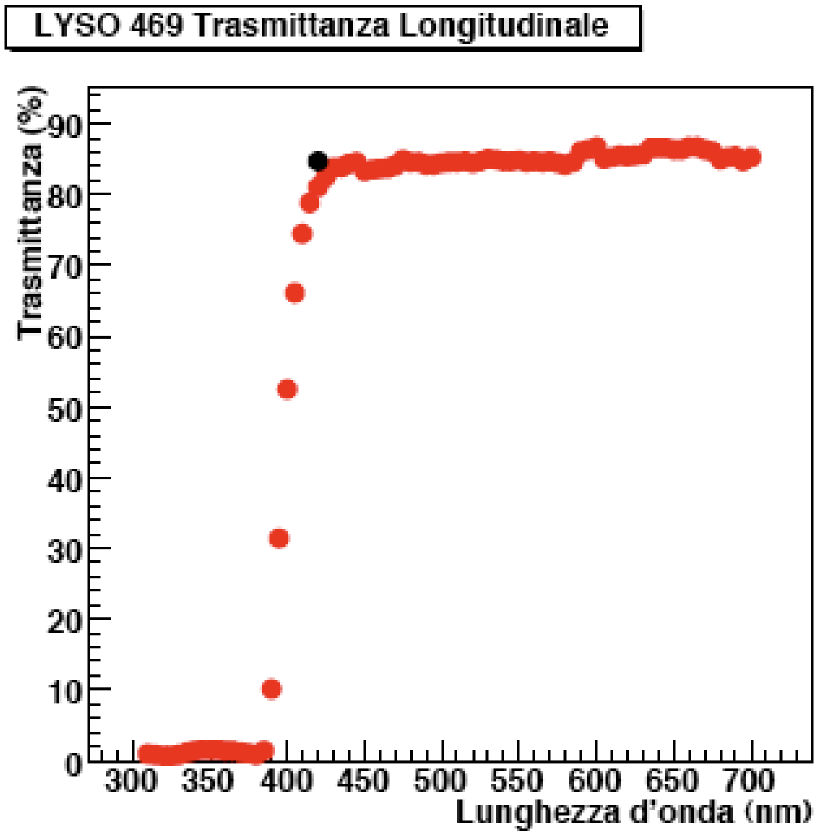
Crystal	NaI(Tl)	CsI(Tl)	CsI	BaF_2	BGO	PWO(Y)	LSO(Ce)	GSO(Ce)
Density (g/cm^3)	3.67	4.51	4.51	4.89	7.13	8.3	7.40	6.71
Melting Point (°C)	651	621	621	1280	1050	1123	2050	1950
Radiation Length (cm)	2.59	1.86	1.86	2.03	1.12	0.89	1.14	1.38
Molière Radius (cm)	4.13	3.57	3.57	3.10	2.23	2.00	2.07	2.23
Interaction 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?	-	-

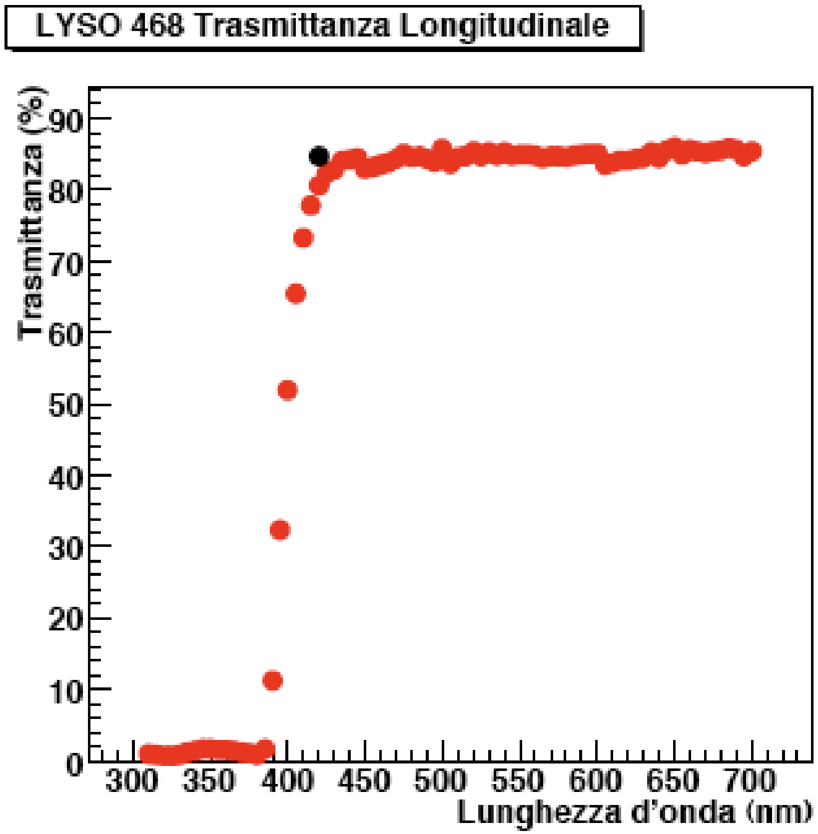
Progress of LSO/LYSO Growth

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



Crystals measurements in Perugia

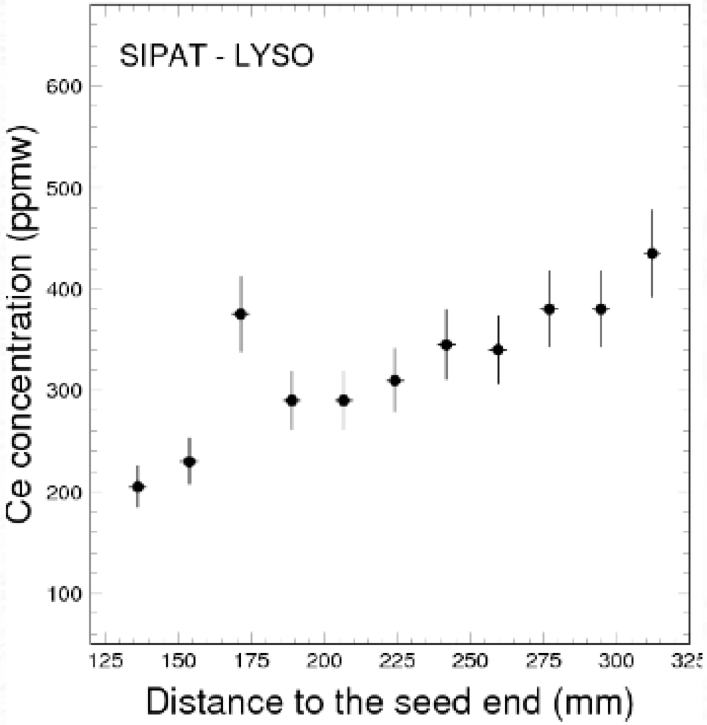




Black point is the maximum value of transmittance theoretically reachable

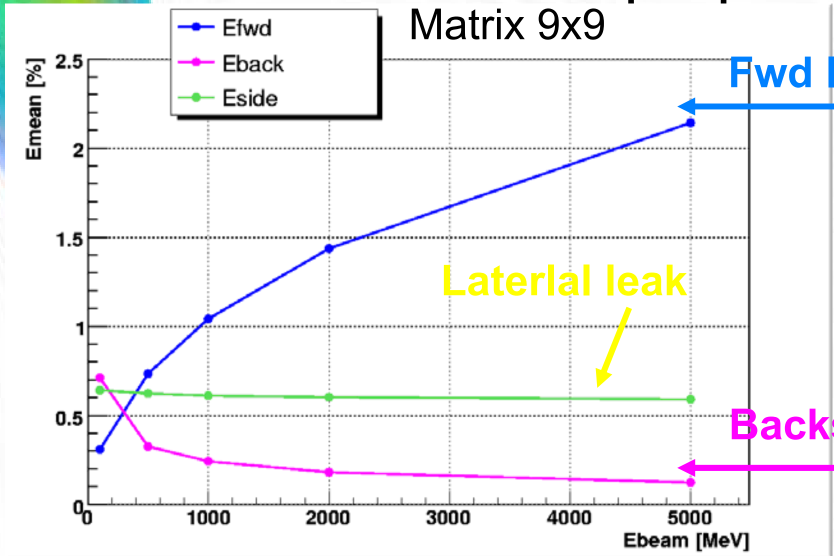
Two main points still under discussion:

1) Uniformity of Ce doping to be better understood

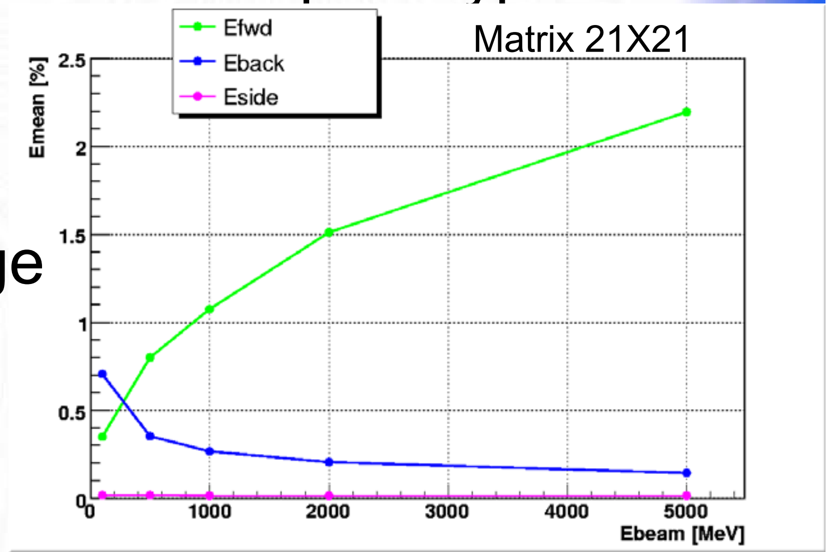


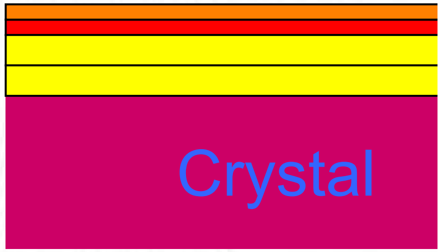
2) Is this possible to cut two crystal form one boule?

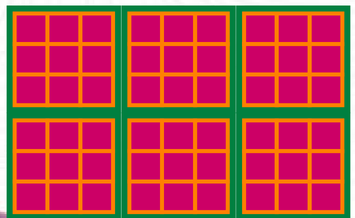
Geant4 simulation: preparation of beam test prototype 2009

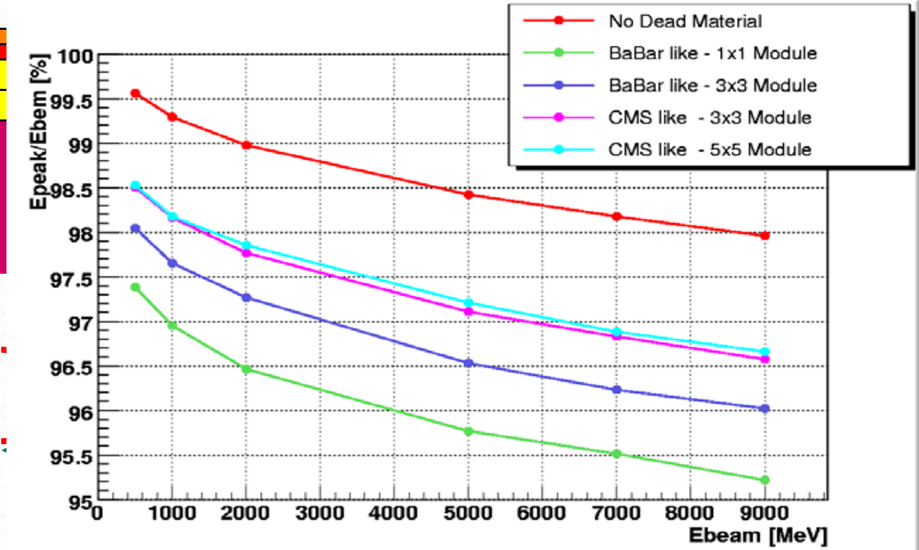


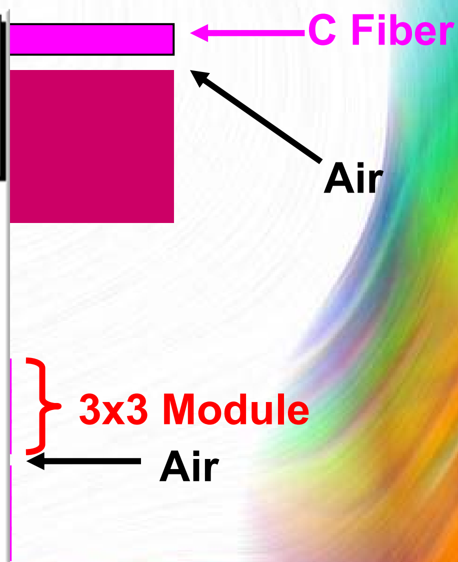
leakage











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.

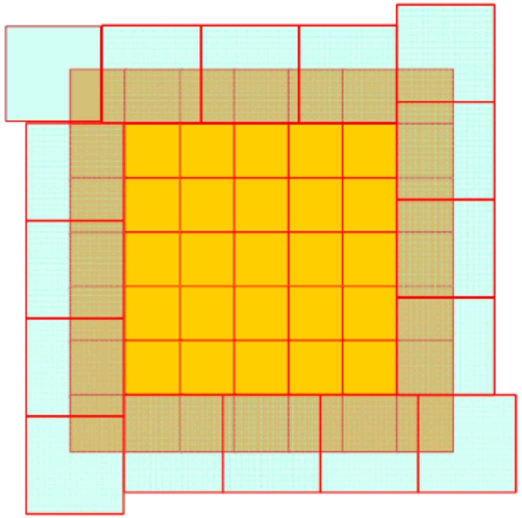
Geometry now takes into account 400um between crystals and 400um between modules, could be too tight, under study

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…

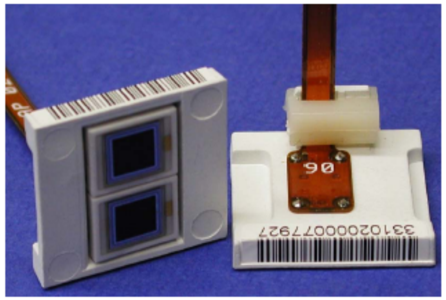
Beam line available:
CERN, DESY, LNF
with different energy ranges
Electrons, positrons,
tagged photons
High energy 0.5 - 7 GeV
Low energy 50 - 750 MeV

5x5 Projective LYSO array with CsI(Tl) surround



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

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



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

From J.A. Bevan

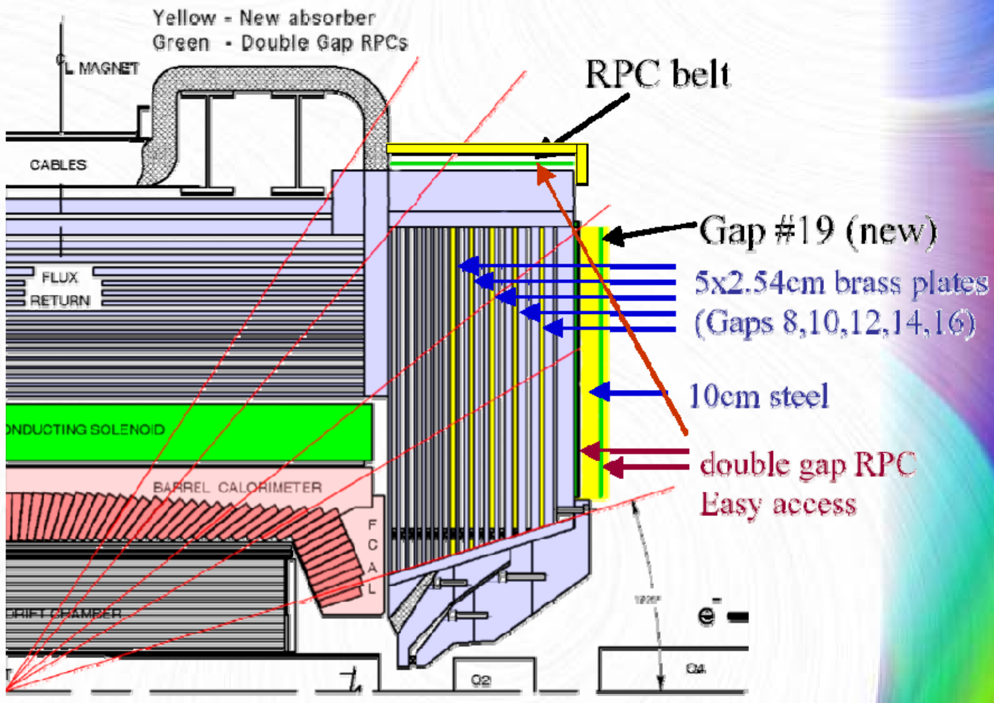
Timescales (very rough)

- 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.

The IFR for Super B

- The muon detector is build in the magnet flux return.
- It will be composed by one hexagonal barrel and 2 endcaps like in Babar.
- Plan to reuse BaBar iron structure



- Backgrounds will be problematic for gas detectors - rates O(100 Hz/cm^2)

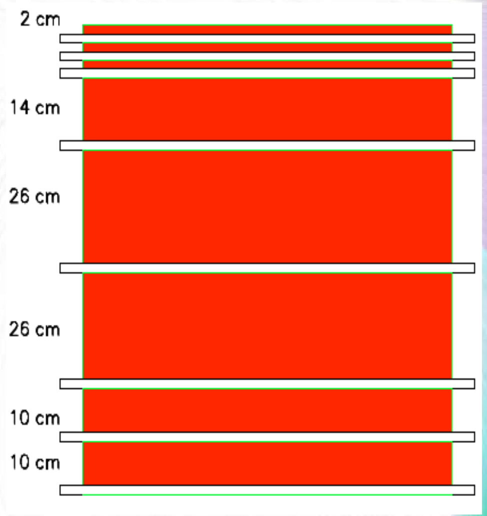
→Use scintillation bars with WLS fiber

IFR requirements for Super B

- Add iron to BaBar stack to improve μ ID:

  ➔ 8 detection layers should be enough

- Keep longitudinal segmentation in front of stack to retain K_L ID capability.

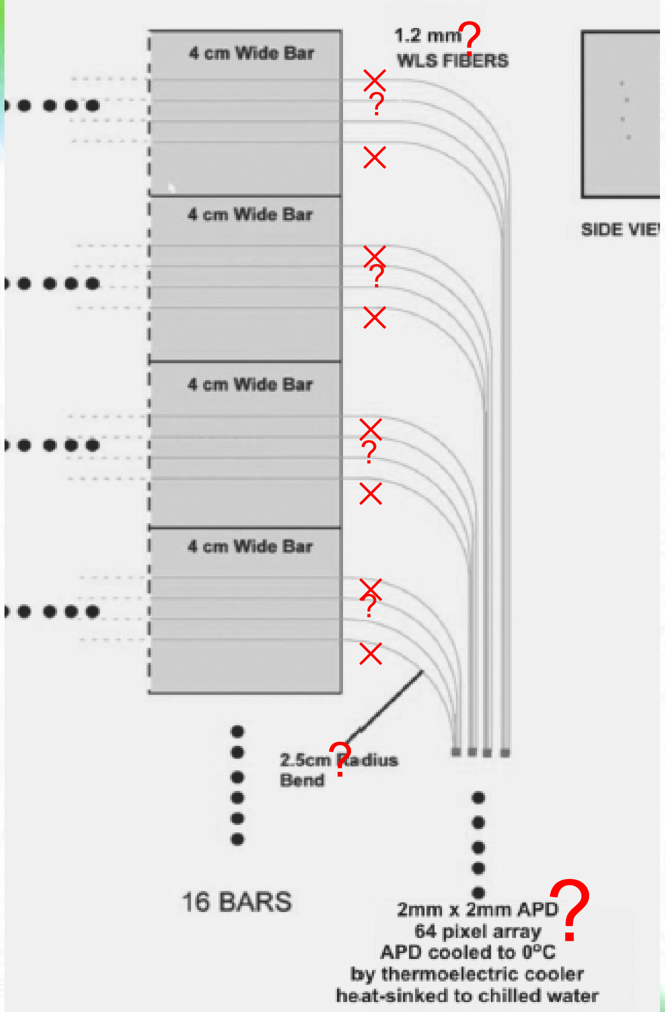


A possible layer configuration

Need to optimize:

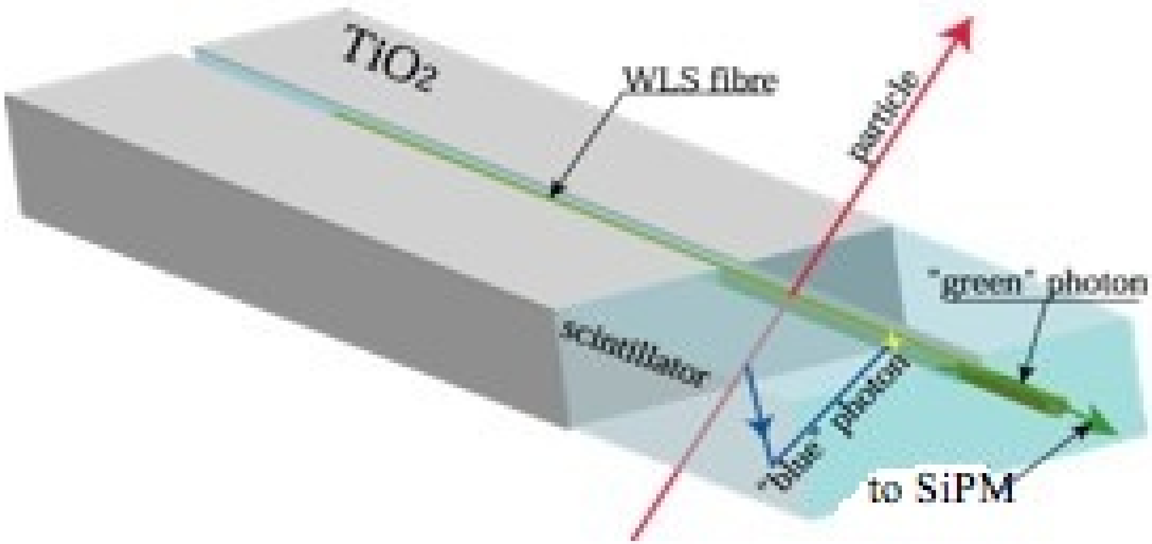
- Scintillation bars geometry
- Number of active layers
- Where and how much iron we need to add

Evolution from CDR

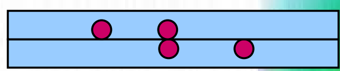


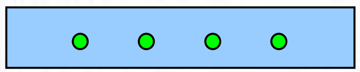
- Some of the questions that we need to answer for TDR
  - Number of fibers per scintillation bar: may be only one or two.
  - WLS fiber diameter (1 mm), shape decay time, …
  - Use Geiger Mode APDs instead of APDs
  - What is the best mechanical design
  - What electronics
  - Read one or two side of the scintillator

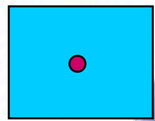
The scintillator bars

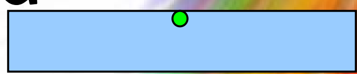


- In contact with FNAL-NICADD facility
- Various candidates:









- We have some spares from Minos and Itasca company that we are using for R&D
- In 2009 we need to make our own prototype.

The WLS fibers

- Kuraray Y11-300 Φ=1.0 mm, round, double cladding
    - Trapping efficiency = 5.4%
    - Attenuation Length ~ 3.5m
    - Emission peak: 476 nm

- Possible alternatives:
  - Different diameter/dopant concentration: increase the light yield
  - Square shape: higher trapping efficiency (~+30%)

  - Bicron BCF-92 fibers (round multiclad):
    - Trapping efficiency = 5.6%
    - Attenuation Length ~ 3.5m
    - Emission peak: 492 nm
    - Decay time: 2.7 ns (Y11-200 is ≈10ns), faster → better time resolution

Fiber readout: APDs vs Geiger mode APDs

- **APD:**
  - For BaBar R&D was considered the model RMD #S0223:
    - G>1000
    - QE=65% (>530 nm)
    - 5ns risetime
    - High bias voltage (1850V) → difficult to stabilize
    - G very sensitive to V and T variations

$$\begin{cases} \dfrac{\Delta G}{G} = 75 \cdot \dfrac{\Delta V}{V} \\ \dfrac{\Delta G}{G} = 17 \cdot \dfrac{\Delta T}{T} \end{cases}$$

  - Hamamatsu APDs have lower gain (few 100), bias voltage 400- 500 V

Geiger mode APDs:

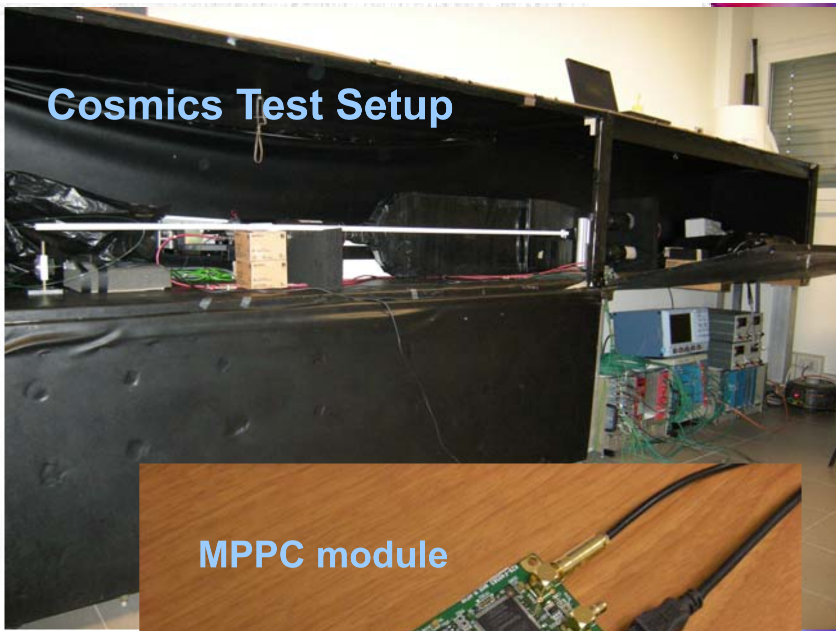
- **MPPC (Hamamatsu), SiPM (FBK- IRST)**
    - G >10^5
    - DE ≈ 40% (530nm) (DE = Q.E x Fill factor x Avalanche probability)
    - ~ 1ns risetime
    - ≈ 10 times less sensitive to V and T variations

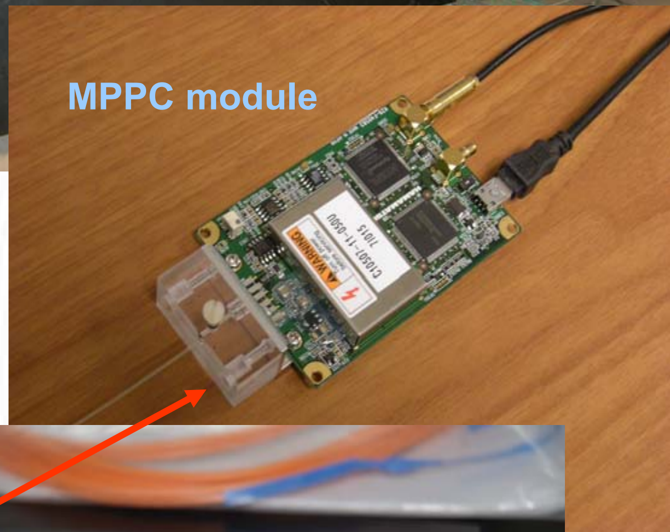
$$\begin{cases} \dfrac{\Delta G}{G} = 7 \cdot \dfrac{\Delta V}{V} \\ \dfrac{\Delta G}{G} = 1.3 \cdot \dfrac{\Delta T}{T} \end{cases}$$

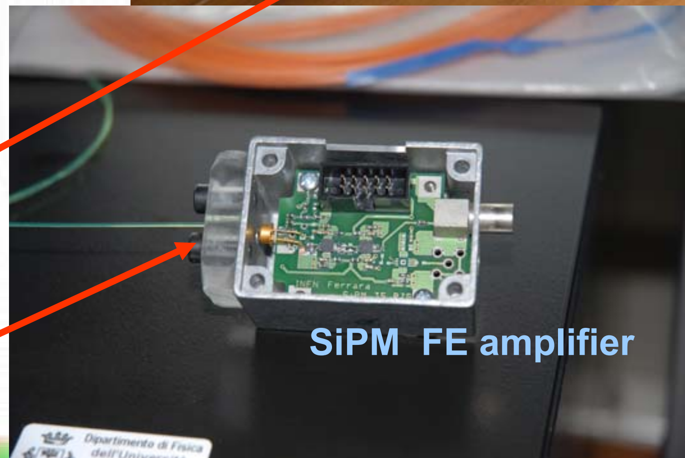
    - Low bias voltage (30-70V)
    - Dark current rate @ room temperature : 100s of kHz thr = 0.5 phe; 10s of kHz if thr = 1.5 phe

Cosmic ray test setup

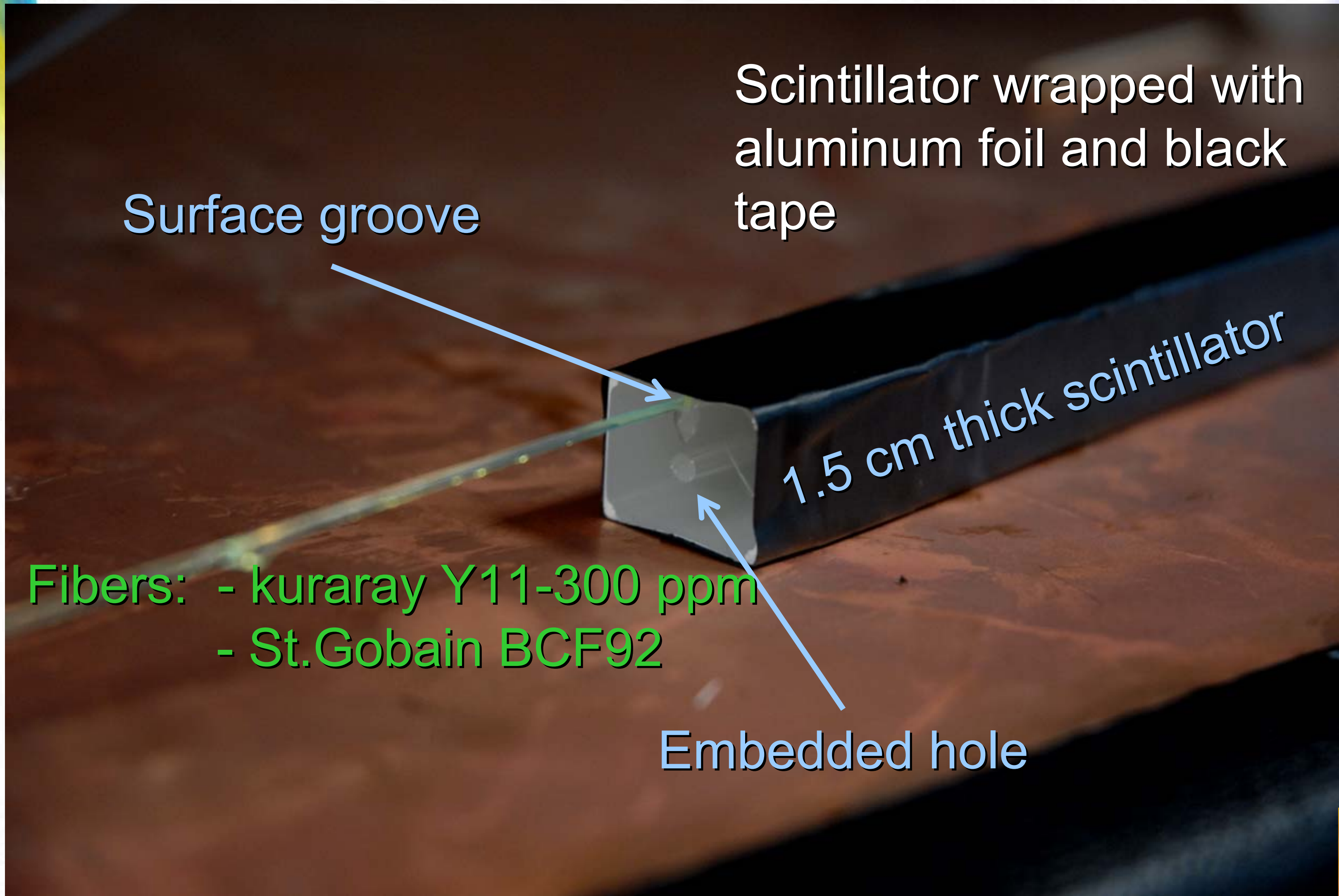
- **Tests with cosmics**
- **scintillator: 1.5cmx2.0cm, with one embedded hole (one fiber)**
- **Same scintillator with a surface groove**
- **WLS fibers: Saint Gobain BCF92, and kuraray Y11 – 300ppm**
- **$\phi = 1$mm, ≈ 4m long**
- **Fibers Readout:**
  1. MPPC *"plug and play"* module (Hamamatsu), 1.2mm active area
  2. SiPM with custom FE amplifiers





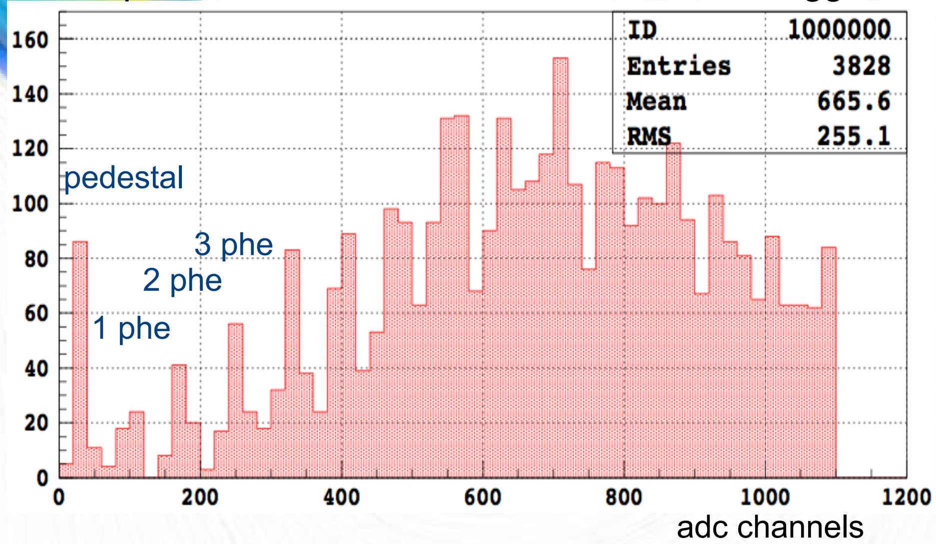


Bar prototype

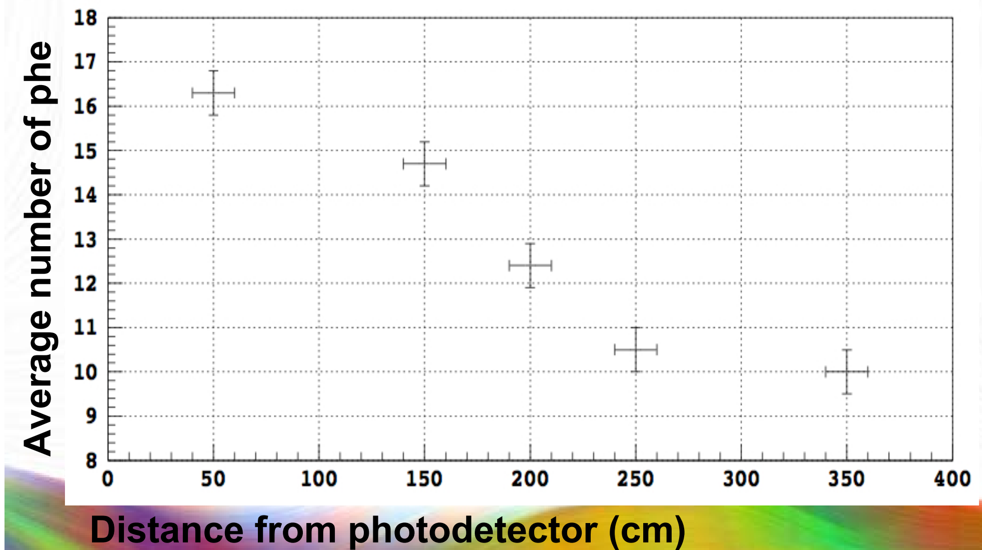


Light Yield fiber: Saint-Gobain

ADC spectrum for MPPC 350 cm far from the trigger

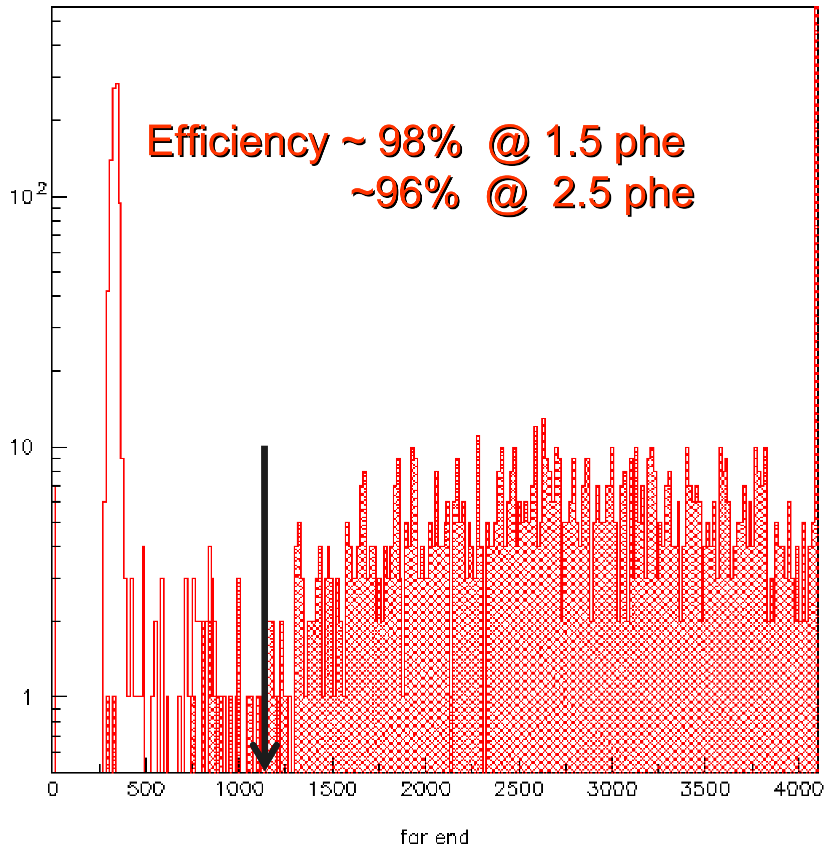


Average number of phe:
~ 9 at maximum distance

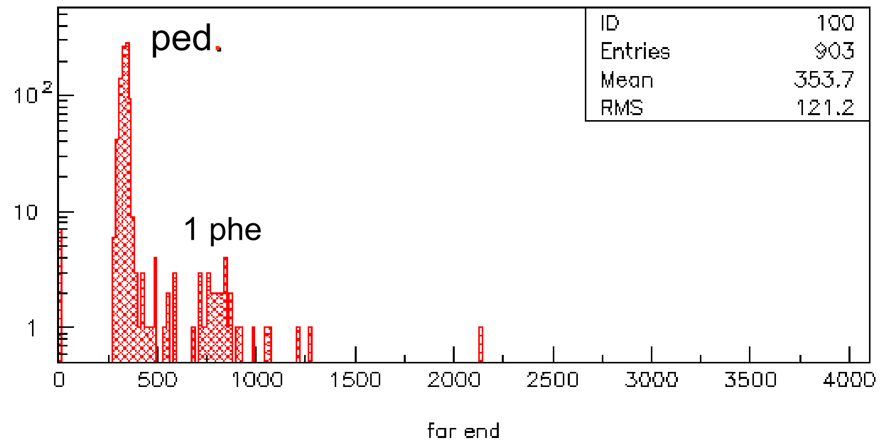


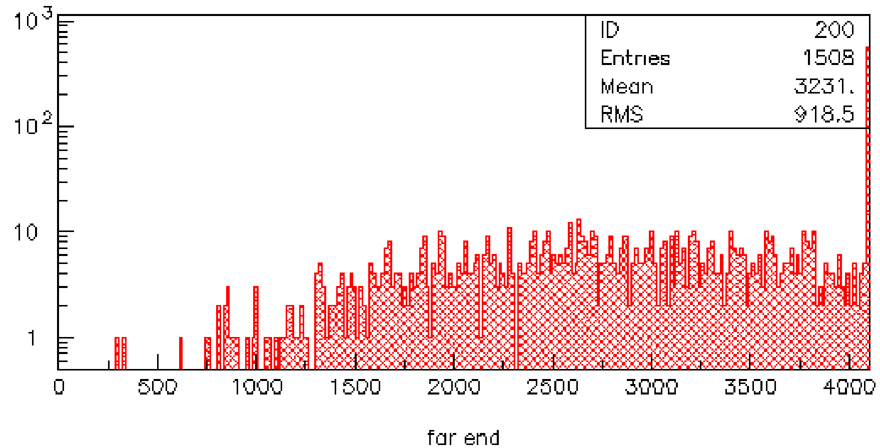
Detection efficiency:
- ~96% @ 1.5 phe
- ~94% @ 2.5 phe

Light yield Fiber: Kuraray



ADC spectrum 350 cm far from the trigger

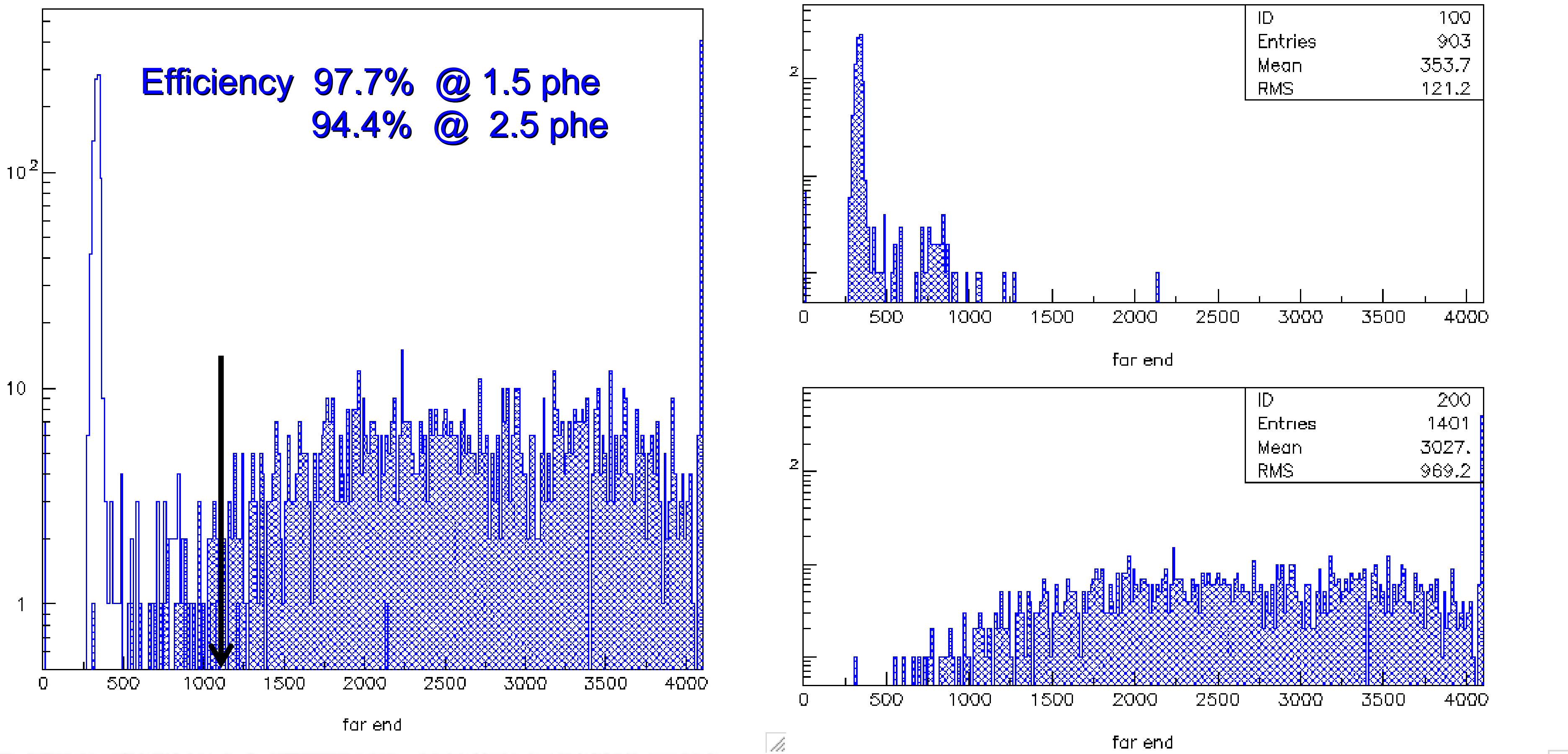




Separate plots for pedestal and signal

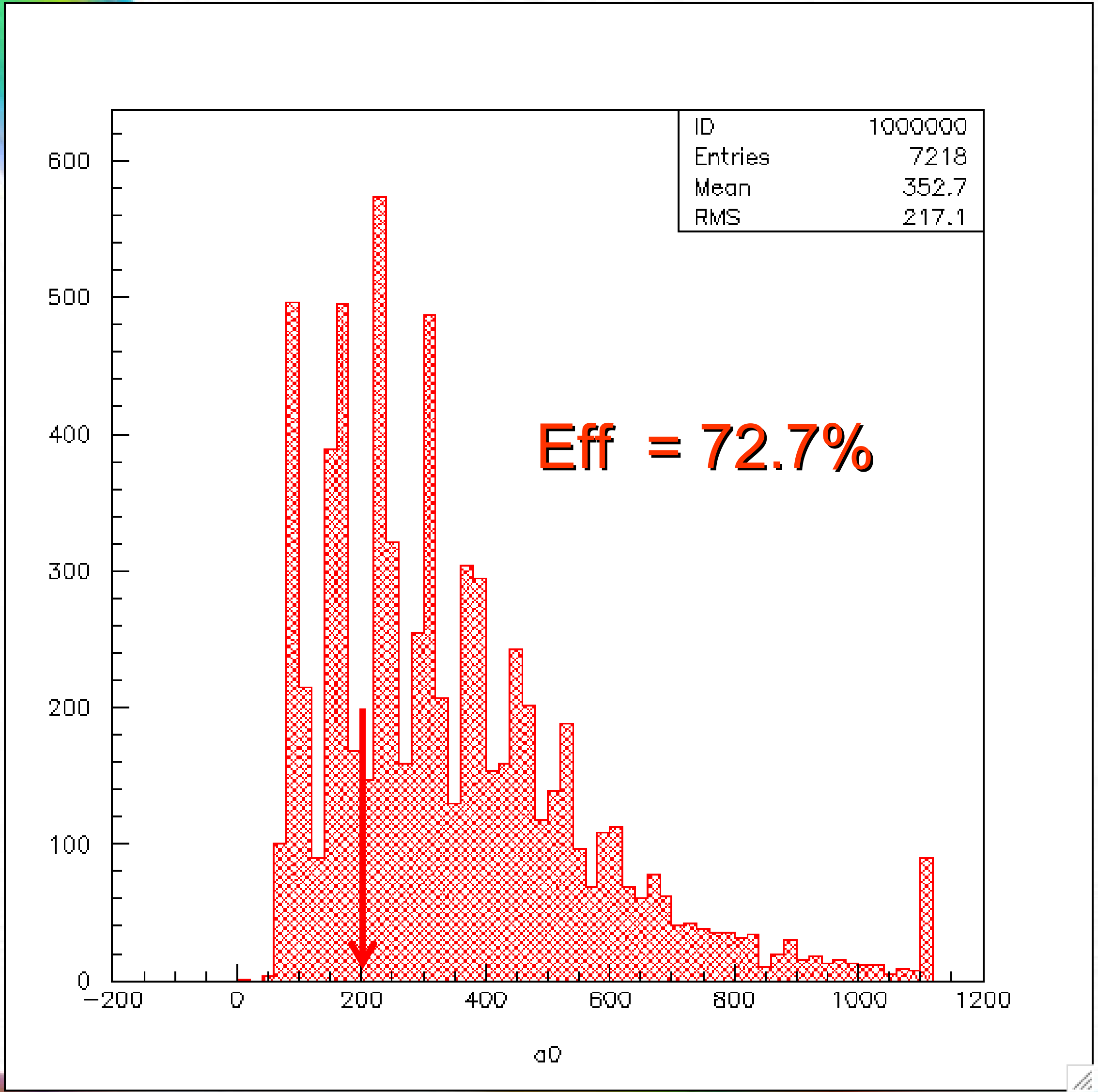
ADC spectra for a kuraray Y11-300 fiber about 4 m long in an embedded hole

Light yield fiber kuraray



ADC spectra for a kuraray Y11-300 fiber about 4 m long in a surface groove

Thinner scintillator



- 1.0 cm scintillator and Saint-Gobain fiber on a surface groove
- Low light yield at the far end (~ 4 m)
- Detection efficiency less that 73% @ 1.5 phe
- With only one fiber at least 1.5 cm scintillator is needed

Efficiency studies status

Kuraray fibers give little more light wich translates into an efficiency a few % higher

The fiber placed in a surface groove (instead of the embedded hole) gives an efficiency just about 1-2 % lower

•**Fnal 1cm thick** scintillator with a **single fiber** shows an efficiency > 99% taking the sum/OR of both ends. Reading the far end alone anyway, the eff. is <90% (e.g. in case of a broken SiPM..)

• with **2 fibers** readout (on separate grooves) efficiency is always better than 98%, the mechanics is somehow complicated. For the moment this measurement has been done by summing up the signals of two single SiPM

•Measurements with two fibers in the same groove and 2x2 mm^2 SiPM will be done soon (we have now the SiPM, we need some mechanics for the optical coupling)

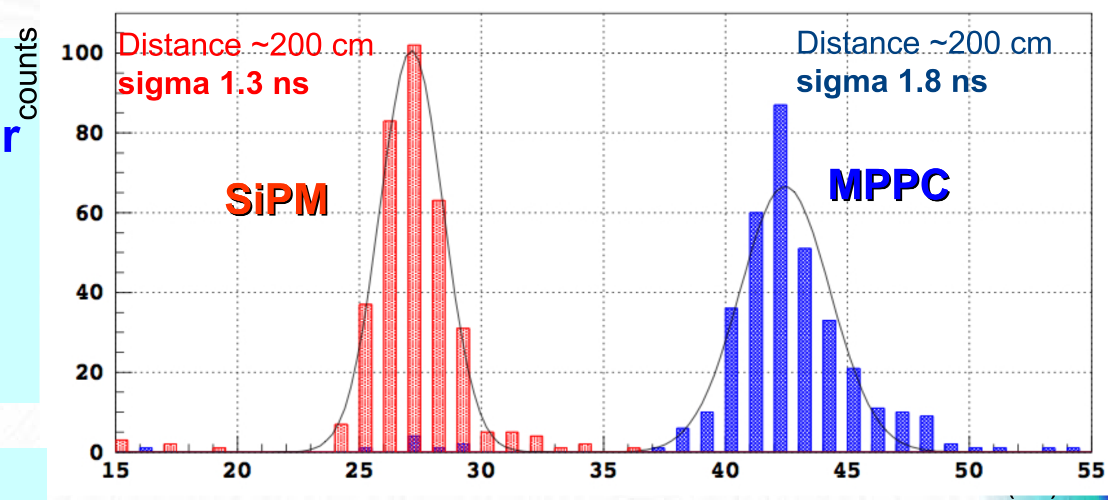
Time resolution first results

- For these first measurements **no constant fraction discriminator** was used because we wanted to understand how the time resolution depends on the strength of the signal

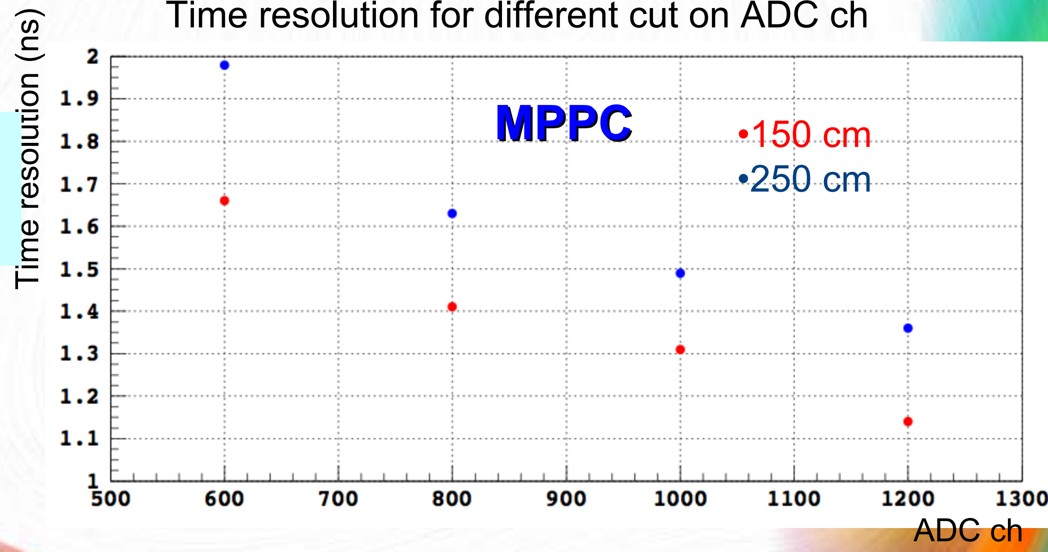
- 15 cm scintillators has been used in the trigger

- Time measured with respect to the trigger signal (common start)

- A single hit TDC was used

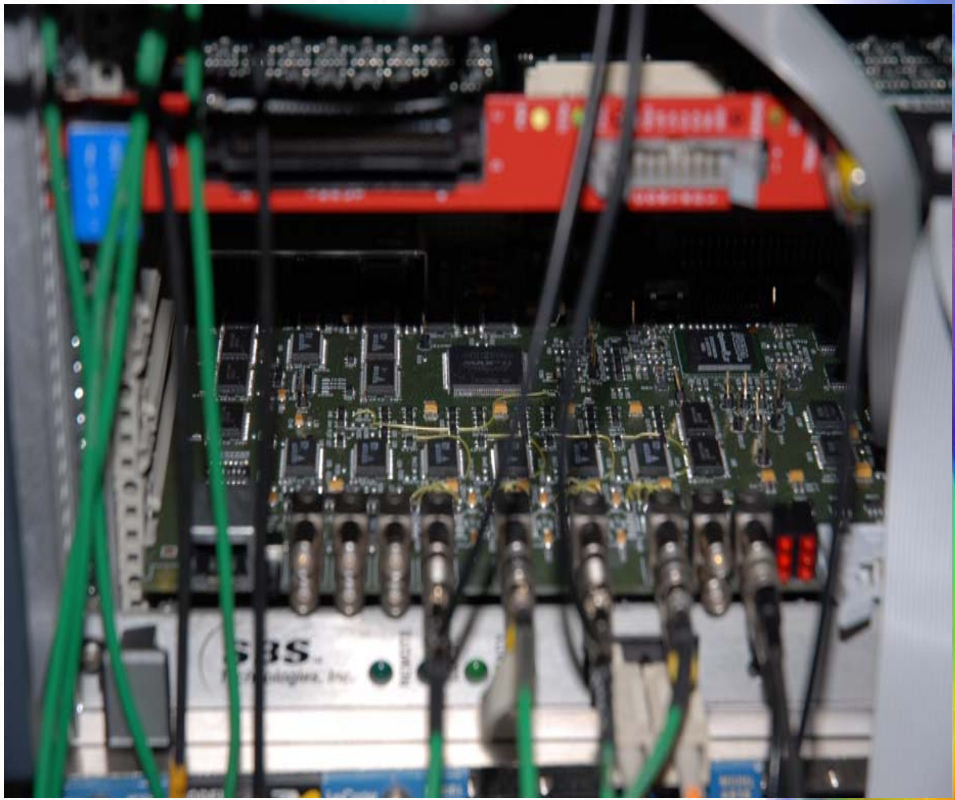


Time resolution for different cut on ADC ch

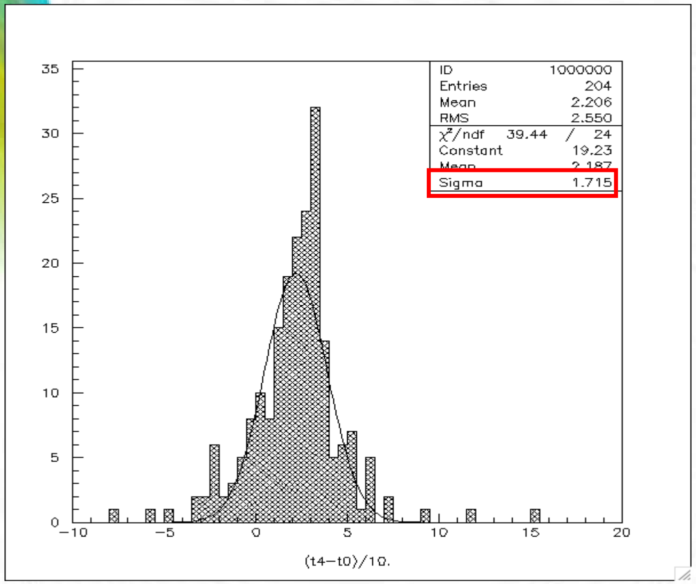


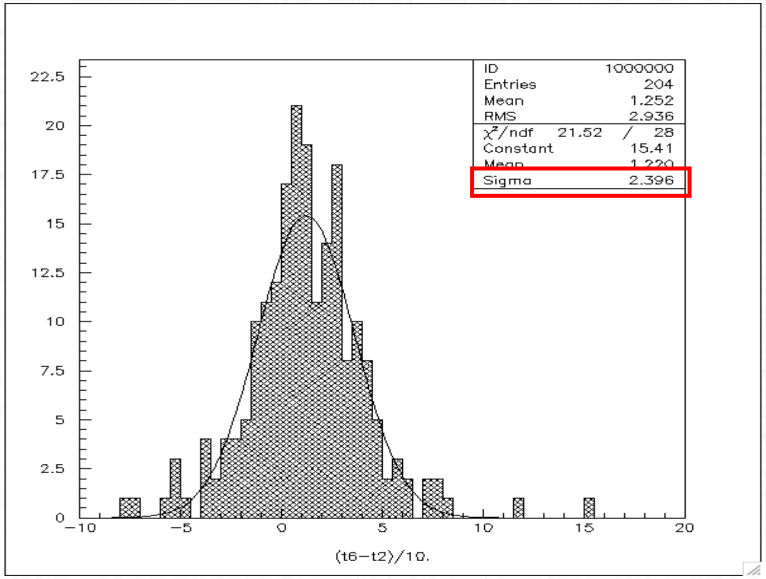
Time resolution studies update

- time resolution studies are ongoing using fast discriminator board with programmable thresholds
- for each input the board provides outputs at different thresholds
- The idea is to use a high (2.5 p.e.) threshold to reduce noise and a lower threshold to have precise timing
- 5 cm scintillators has been used in the trigger to have a precise time reference
- A Multi-hit TDC (caen 1190A) is now used
- SiPM signal shows multiple hits, not easy to deal with….



So what we get is…..





- Time distributions (especially at high thresholds) show peaks due to the shape of the signal

- fitting the main peak only we obtain better that 1 ns resolution ….

- The first peak gives the correct time, we are working on algorithms to extract that information from all kinds of signals…

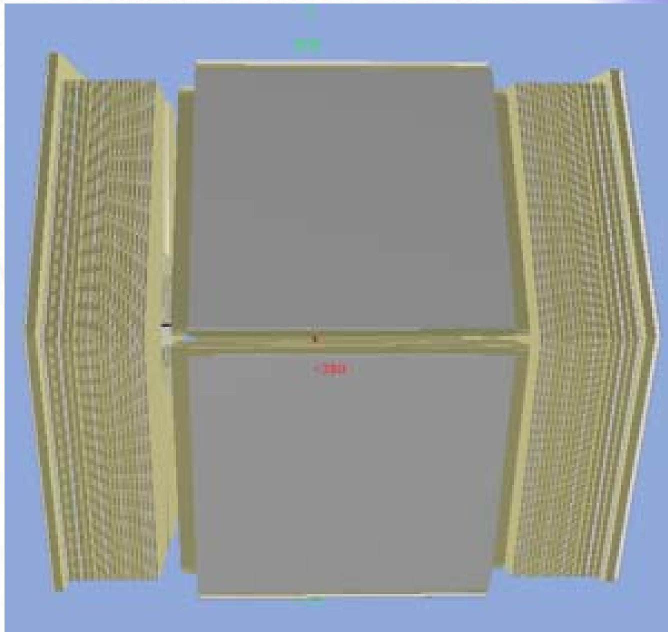
- Signal shape doesn't depend on bias voltage, possible temperature effects will be investigated

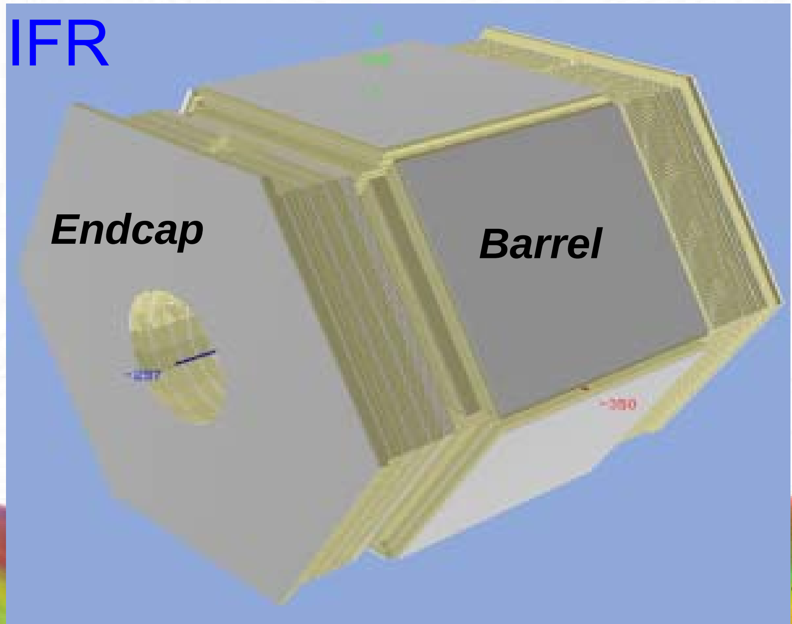
Simulazioni MC dell'IFR e dell'intero rivelatore

- Si utilizzano GEANT4 ed programmi Monte Carlo (Pravda) per la simulazione del rivelatore e dei fondi macchina, utilizzando in parte tool sviluppati per BaBar

- La geometria del rivelatore e' gia' stata implementata schematicamente

- Si sta lavorando sulla simulazione dell'intero rivelatore necessaria per il preciso dimensionamento e l'ottimizzazione dell'IFR





- Una volta inserita la segmentazione dei layer attivi verranno fatti studi approfonditi per ottimizzare le dimensioni delle singole celle

SuperB IFR path to TDR

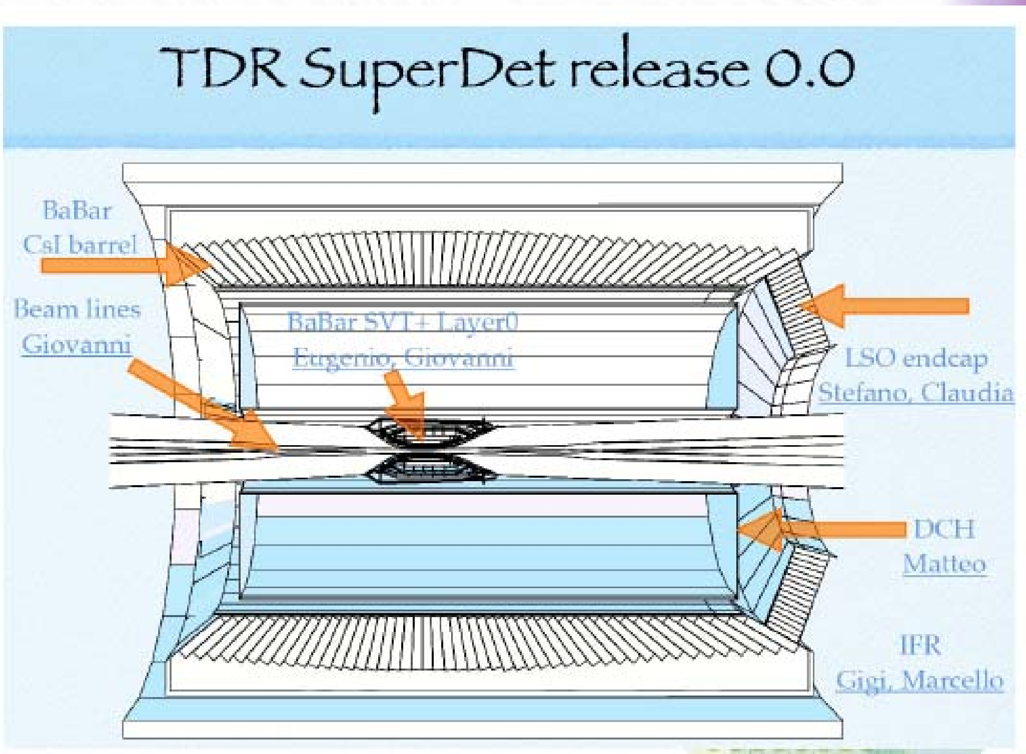
For the TDR:

- Simulation → requested detector performance
- Detector Design
  - Scintillator
  - Fiber
  - Photodetector: time resolution, afterpulses, noise, radiation hardness
  - Electronics + DAQ
  - Preliminary Detector Layout, including preliminary mechanics/detector integration (Summer/Fall09)
- Prototype Design → Construction (starting Fall09)
- Prototype Beam Test (Spring 2010)
- Final Layout for TDR (Summer/Fall 2010)

Computing

- La stesura del TDR richiede tools di simulazione

- Simulazione veloce per studi di fisica ed ottimizzazione del rivelatore
  - Sviluppato un tool che è evoluto da cosa era disponibile in Babar. Beta release
- Simulazione completa GEANT4-based per lo studio dei fondi di macchina e delle prestazioni di rivelatore
  - Disponibile la prima versione



Produzione, gestione e analisi dei dati prodotti

- Lo schema non è ancora ben definito nei dettagli, ma si prevede al momento:
  - per simulazione veloce:
    - molti "piccoli" run su risorse loclali, alcuni run globali di riferimento per studiare i fondi di fisica
      - ~ 10 run x 2.5 TB --> 25 TB netti
  - per simulazione Geant4:
    - simulazioni background: qualche TB dati complessivamente
    - simulazioni estese performance rivelatore:
      - 1000 run x 10^6 eventi --> 25 TB netti
  - CPU locali per piccoli run, GRID e farm ex-BaBar a Padova per produzione e analisi grandi run

altre attività

- Dovremo consolidare l'infrastruttura per i servizi collaborativi e i tool di sviluppo
  - al momento distribuita fra i siti dove c'è attività di supporto
    - Ferrara: user DB (LDAP), documentazione (MediaWiki, Invenio)
    - Padova: repository del codice (SVN), archivio package (RPM)
    - Pisa: sito Web della collaborazione (Drupal)
  - con utilizzo di servizi centrali ove possibile:
    - Gestione meeting: Indico (LNF); mailing list: Sympa (CNAF); sito pubblico: Joomla (CNAF)

Milestones

Descrizione	Data completamento
COMP - installazione server e configurazione di produzione dei servizi collaborativi	31-03-2009
SVT - Realizzazione e caratterizzazione prototipo di supporto meccanico modulo Layer0.	30-10-2009
SVT - Sottomissione della matrice CMOS MAPS per il prototipo di modulo multichip per Layer0.	31-12-2009
DCH - Realizzazione di un prototipo di camera a deriva e presa dati in cosmici.	30-06-2009
DCH - Ottimizzazione della cella e della miscela di gas per SuperB.	31-12-2009
EMC - Acquisizione dei cristalli per il calorimetro del test beam	30-06-2009
IFR - Definizione della configurazione del prototipo del rivelatore	30-10-2009
COMP - completamento prima versione della full simulation del rivelatore SuperB	30-06-2009
COMP - versione completa della simulazione veloce disponibile per gli studi del TDR a tutti i collaboratori	30-06-2009

Conclusioni

Verbale

BACKUP

Manpower SuperB 2009

Sigla aperta solo se ci sono 2 FTE in sezione

21.2 + 10.5 FTE

sezione	Ricercatori		Tecnologi		Tot. Pers.	FTE	FTE / PERS.
BO.DTZ	0.8 fte	5 pers.	0.2 fte	1 pers.	6	1	0.167
FE	3 fte	7 pers.	1.2 fte	4 pers.	11	4.2	0.382
LNF	2 fte	7 pers.	0 fte	pers.	7	2	0.286
MI	2 fte	5 pers.	1.1 fte	3 pers.	8	3.1	0.388
NA.DTZ	0.7 fte	4 pers.	0.2 fte	1 pers.	5	0.9	0.18
PD	2.7 fte	6 pers.	0.8 fte	3 pers.	9	3.5	0.389
PG.DTZ	1.1 fte	3 pers.	0 fte	pers.	3	1.1	0.367
PI	4.5 fte	11 pers.	1.8 fte	4 pers.	15	6.3	0.42
PV	0.3 fte	1 pers.	2.7 fte	6 pers.	7	3	0.429
RM1.DTZ	1 fte	6 pers.	0.3 fte	2 pers.	8	1.3	0.163
RM3.DTZ	0 fte	pers.	0.3 fte	1 pers.	1	0.3	0.3
TO	1 fte	5 pers.	1.5 fte	7 pers.	12	2.5	0.208
TS	2.1 fte	4 pers.	0.4 fte	1 pers.	5	2.5	0.5
TOTALE	21.2 fte	64 pers.	10.5 fte	33 pers.	97	31.7	0.327

BABAR

sezione	Ricercatori		Tecnologi		Tot. Pers.	FTE	FTE / PERS.
BA	2 fte	3 pers.	0 fte	pers.	3	2	0.667
FE	7.1 fte	13 pers.	0 fte	pers.	13	7.1	0.546
GE	4.9 fte	7 pers.	0 fte	pers.	7	4.9	0.7
LNF	5.9 fte	11 pers.	0 fte	pers.	11	5.9	0.536
MI	2.1 fte	5 pers.	0 fte	pers.	5	2.1	0.42
NA	2.1 fte	3 pers.	0 fte	pers.	3	2.1	0.7
PD	5.4 fte	10 pers.	1 fte	1 pers.	11	6.4	0.582
PG	1.3 fte	2 pers.	0 fte	pers.	2	1.3	0.65
PI	5.5 fte	14 pers.	0.6 fte	2 pers.	16	6.1	0.381
RM1	3.5 fte	6 pers.	0 fte	pers.	6	3.5	0.583
TO	2.2 fte	3 pers.	0 fte	pers.	3	2.2	0.733
TS	2.1 fte	4 pers.	0 fte	pers.	4	2.1	0.525
TOTALE	44.1 fte	81 pers.	1.6 fte	3 pers.	84	45.7	0.544

44.1 + 1.6 FTE

Sommario Richieste

	interno		estero		consumo		trasporti		calc		inventari		TOTALI	
BO.DTZ	2		7		2						20		**31**	
FE	10.5		48		59						7		**124.5**	
LNF	8		27		21.5						10		**66.5**	
MI	6		21		46.5	15					10		**83.5**	**15**
NA.DTZ	6		12		9						20		**47**	
PD	12		64		52		4				87	3	**219**	**3**
PG.DTZ	4		11		169								**184**	
PI	19.5		161		155.5						70		**406**	
PV	8		26.5		27								**61.5**	
RM1.DTZ	2.5		9		7	15					3		**21.5**	**15**
RM3.DTZ	2		3		1								**6**	
TO	11.5		32		12						4.5		**60**	
TS	8		20		40.5				3		17		**88.5**	
Totali	**100**		**441.5**		**602**	*30*	**4**		**3**		**248.5**	*3*	***1,399.00***	***33***

Confronto con Babar 2008

		Int	Est	Cons	Trasp	Calcolo	INV	**Totale**
BABAR 2009	Richieste	65.5	460.5	262				**788**
	SJ		80	20	20			**120**
SuperB 2009	Richieste	100	441.5	602	4	3	248.5	**1399**
	SJ			30			3	**33**
BABAR+ SUPERB	Richieste	165.5	902	864	4	3	248.5	**2187**
	SJ	0	80	50	20	0	3	**153**

		Int	Est	Cons	Trasp	Calcolo	INV	**Totale**
BABAR 2008	Richieste	159.7	1456.27	836.5			384.5	**2836.97**
	SJ			50				**50**

- Richieste inferiori all'anno scorso
- Assegnazioni Babar nel 2008: 1300+350(ant 2007)
- Forte riduzione di missioni per la fine del run