Detector Geometry Working Group activities and preliminary results

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Document from F.Forti and B. Ratclif

The SuperB detector as described in the Conceptual Design Report has a number of options not yet defined that have a large impact on the overal detector geometry. As the MC simulation tools for the detector are rapidly maturing, we believe it is timely to set up a Detector Geometry Working Group (DGWG) to study the physics tradeoffs of the open CDR detector options with the goal of being able to finalize the global geometry and define the subsystems of the SuperB detector within a relatively short time frame, between six months and a year. The DGWG main task will be to examine critically the open questions detailed below and provide to the proto-technical board the information necessary to make the relevant decisions.

Do we need a forward PID (eventually backward) ?

Do we need a backward EMC ?

The ammount of absorber on the IFR ?

Internal geometry of SVT / Space between SVT and DCH

Use golden channles to optimise the detector geometry

	H^+ high tanβ	Minimal FV	Non-Minimal FV (1-3)	Non-Minimal FV (2-3)	NP Z-penguins	Right-Handed currents
$\mathcal{B}(B \to X_s\gamma)$		X		O		O
$A_{CP}(B \to X_s\gamma)$				X		O
$\mathcal{B}(B \to \tau\nu)$	X-CKM					
$\mathcal{B}(B \to X_s l^+ l^-)$				O	O	O
$\mathcal{B}(B \to K\nu\overline{\nu})$				O	X	
$S(K_S\pi^0\gamma)$						X
β			X-CKM			X

+ $\tau \to \mu\gamma$

Disussion on adding a golden channel for charm physics
(results at the end of this meeting)

X The GOLDEN channel for the given scenario

O Not the GOLDEN channel for the given scenario but can show experimentally measurable deviations from SM.

Vertex perfromances

$Br(B \rightarrow X_s \gamma)$

Recoil physics optimisation

$A_{CP}(B \rightarrow X_s \gamma)$

$Br(B \rightarrow \tau \nu)$

K_s opimisation

$Br(B \rightarrow X_s \ell\ell)$

K_L veto

$Br(B \rightarrow X_s \nu \nu)$

K/π PID

$S(K_s \pi^0 \gamma)$

μ PID and μ/π sepration

β

Calorimeter coverage

$\tau \rightarrow \mu \gamma$

PID coverage

These are the golden modes for physics and also challenging ones from detector point of view !

	People (22/jan/09)	Detector options	Optimization studies	Physics benchmarks	Items needing development
SVT	D. Brown, N. Neri, D. Roberts, G. Simi		internal geometry, radius of outer layer	$B \rightarrow Ks\pi^0/Ks\pi^0\gamma$, beta, Recoil, (tagging)	▪ dE/dx ▪ endcap PID response ▪ PID selectors ▪ tuning of EMC response ▪ hadron shower sim. ▪ Flavour tagging ▪ Tag vertex
DCH	M. Rama, G. Finocchiaro		longer DCH replacing forw. PID, inner radius	tracking performance, dE/dx	
PID	A. Stocchi, L. Burm, N. Arnaud, A. Perez, A. Berdyugin, B. Meadows, F. Renga E. Manoni	forward PID yes/no, backward PID yes/no	angular and momentum coverage range, needed PID performance, #rad. length (impact on endcap EMC performance)	$B \rightarrow (d,s)\ l^+l^-$, Recoil, tagging	
EMC	C. Cheng, E. Manoni	backward EMC yes/no	angular coverage of forw/back endcaps, needed performance, degradation due to endcap PID	$B \rightarrow Ks\pi^0/Ks\pi^0\gamma$, $B \rightarrow$ tau nu, $b \rightarrow s\gamma$, $B \rightarrow K$ nu nubar Recoil, tagging	
IFR	G. Cibinetto, M. Rotondo		amount and distribution of absorber	beta, Recoil, tagging	
			Other: position of IR vertex		

Monday 16 February 2009 16:00->*18:30*

Parallel V - detector geometry group

16:00	SVT studies (10')	Nicola Neri (*Universita' di Pisa & INFN*)
16:10	Study of deltaT in B->Kspi0 (10')	Gabriele Simi (*UMD College Park, MD*)
16:20	μ/π separation using TOF in DIRC (10')	Brian Meadows (*University of Cincinnati*)
16:30	Physics case of forw. PID (20')	Achille Stocchi, Leonid Burmistrov (*LAL*)
16:50	Breco in FastSim. Impact of PID (15')	Elisa Manoni (*PG*)
17:05	Endcap EMC - plans (20')	Chih-hsiang Cheng (*Caltech*) , Elisa Manoni (*PG*)
17:25	IFR optimization strategy (10')	Gianluigi Cibinetto (*FE*) , Marcello Rotondo (*INFN Padova*)
17:35	AFit (15')	Adrian Bevan (*Queen Mary, U. London*)

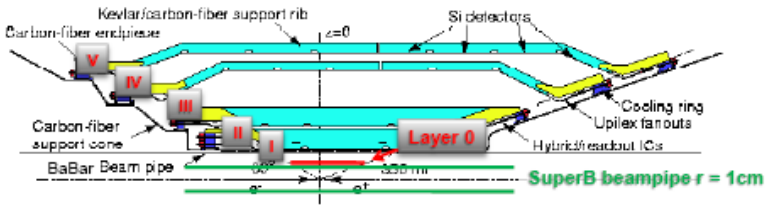
+ two phone meetings on March

Detector configurations for DGWG studies

Set of reference detector configurations in FastSim to test the performances of the benchmark channels

SVT

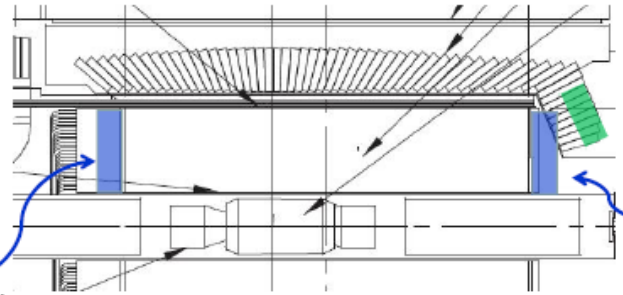
Example: do we want 6 layers?



Or can we live without layer-II given the presence of L0?

The fine-tuning of the SVT internal geometry will be studied separately.

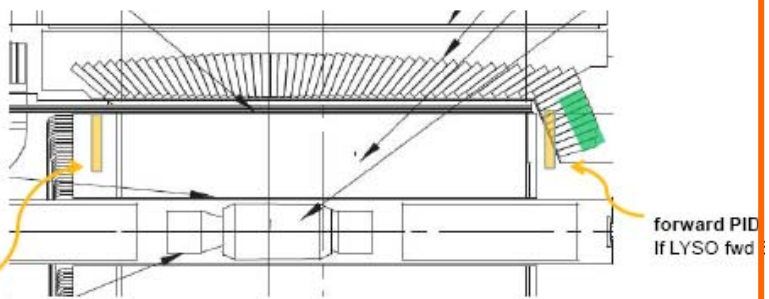
DCH



extended DCH
If LYSO fwd EMC
and NO fwd PID

extended DCH
f NO bwd EMC/PID
nd the DCH electronics
pace is reduced w.r.t. Babar

PID

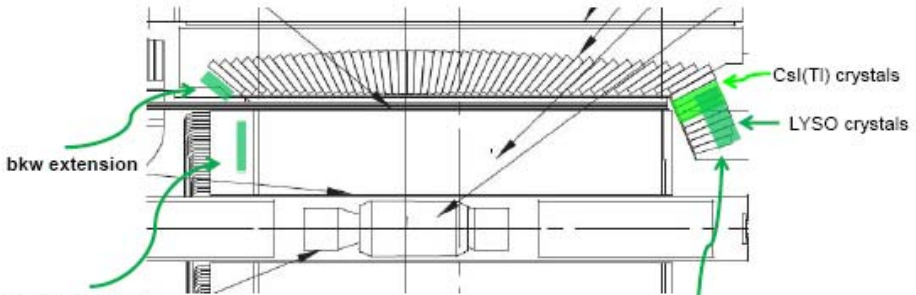


forward PID
If LYSO fwd

backward PID
If NO bwd EMC
and the DCH electronics
space is reduced w.r.t. Babar

We're not considering it as a major option

EMC



CsI(Tl) crystals

LYSO crystals

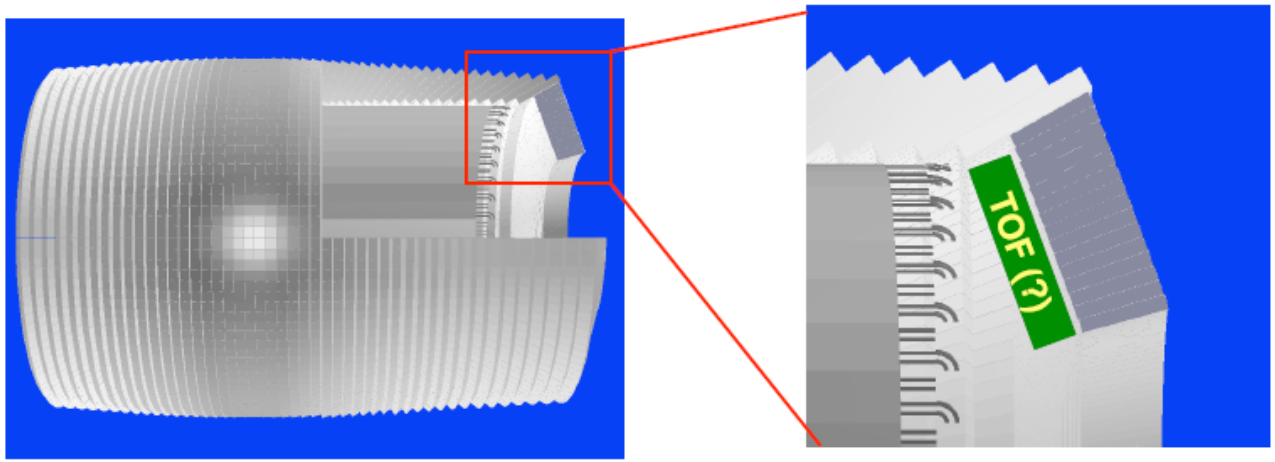
bkw extension

backward EMC
If DCH electronics
space is reduced w.r.t. Babar

bwd EMC could be used as pion/kaon PID device (TOF) to some extent? Need evaluation

forward EMC
If all LYSO: additional space available
if CsI+LYSO: NO additional space available

C. Cecchi



Potential problems to this solution

- **LYSO not back of 10cm → bigger volume (+10% cost!), alignment edge barrel/endcap could present problem of performance**
- **material in front of EMC if PID**

At the meeting it was decided that this Point should be studied

This table is a starting point for discussion

	SVT	DCH	PID	EMC	IFR
0	5 layers+L0	"babar"	DIRC	fwd LYSO	baseline
1	5 layers+L0	"babar"+bwd+fwd	DIRC	fwd LYSO	baseline
2	5 layers+L0	"babar"+bwd	DIRC+fwd	fwd LYSO	baseline
3	5 layers+L0	"babar"+fwd	DIRC	fwd LYSO+bwd	baseline
4	5 layers+L0	"babar"	DIRC+fwd	fwd LYSO+bwd	baseline
5	5 layers+L0	"babar"	DIRC	fwd CsI+LYSO+bwd	baseline

"babar" DCH: inner radius close to the outer SVT radius
SVT: what options? Discussion today
EMC: discussion today (likely involving PID and DCH as well)

Some work really started in the group (we show few examples..)

1) A lot in learning how to use and help in improving FastSim

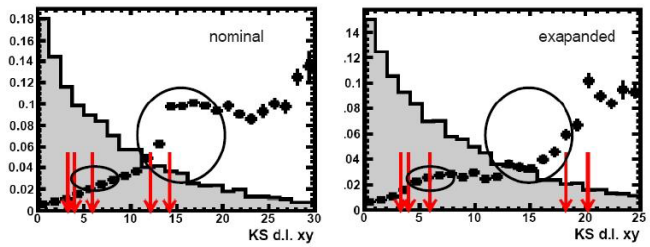
+ selektors (many talks @ this meetings)
+ new algortims (not specif to this group)
+ preliminary work on geom. optimisation
+ implementation of tools (like Breco)

B→Ksπ⁰ : Ks f.l. resolution vs. SVT geometry

N. Neri, G. Simi

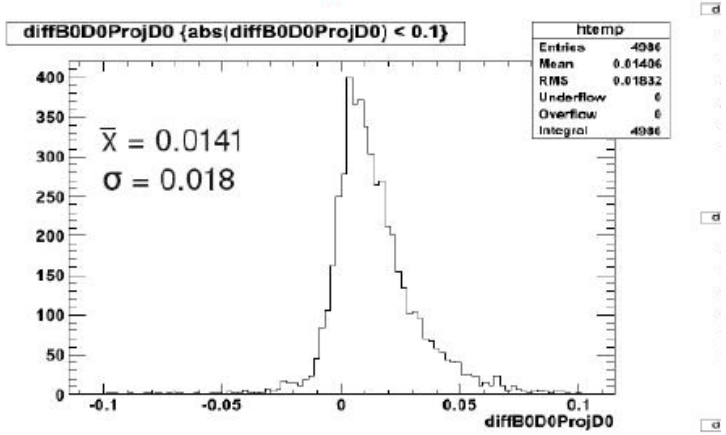
Filling the gap between SVT and DCH

- Expand L4 and L5 up to maximum allowed:
  - Layer 4: 12.2->17.4
  - Layer 5: 14.2->20.2 (DCH S.T. is at 21.3cm)



how the Ks decay length changes by 'expanding' the external SVT layers?

Vertex difference along D0 momentum



- Separation along momentum is bigger than resolution
- Average 3.5σ away
- Vertices are separable

D. Brown, A.Suzuki

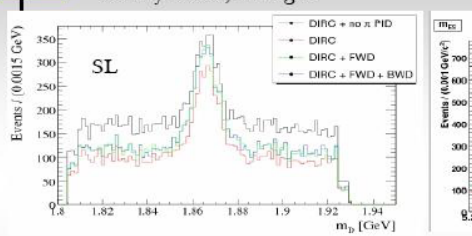
first studies of BReco vs. PID

E. Manoni/F.Renga

SuperB workshop Orsay

PID devices geometry (II)

π VeryLoose, K Tight



HAD RECONSTRUCTION	signal region m_{ES}>5.27GeV/c²	sideband: m_{ES}<5.26GeV/c²
K PID + Dirc	5140	5514
K PID + π PID + Dirc	5023	5005
K PID + π PID + Dirc + Fw TOF	5969	6273
K PID + π PID + Dirc + Fw TOF + BW TOF	6045	6386

elisa manoni

2) Preliminary results on sensitivity
[relevant for the disucssions here]
(see talk of F. Renga on Kνν)

FastSim vs. BaBar Full Sim.

- Tag Reconstruction & Preselection efficiency:

K* ν ν BOBO

	FAST	FULL
SL	0.0193	0.0200
HAD	0.0045	0.0033

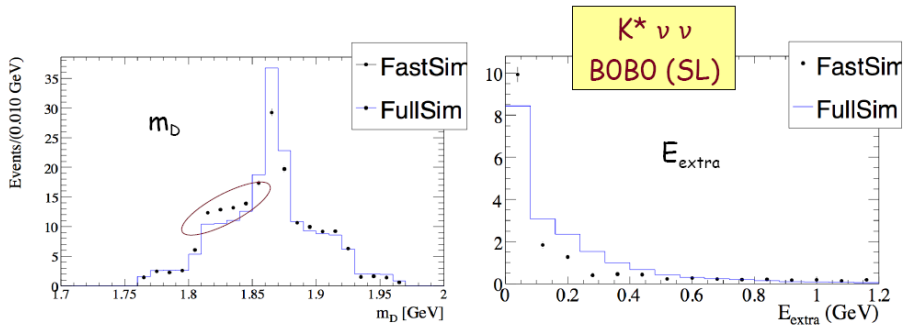
- Tag + Signal Reconstruction & Preselection efficiency:

	FAST	FULL
SL	0.00175	0.00188
HAD	0.00036	0.00053

Agreement at 10% level in the SL analysis

Discrepancy in the HAD analysis due to difficulties in reproducing the BaBar analysis strategy

FastSim vs. Full Sim.



Some discrepancy in mD spectrum (high tails in FastSim)

Underestimated Production of low energy EMC deposits

FastSim is good enough for comparing different configurations (i.e. relative changes)

Not yet mature for absolute estimate of performances

Some preliminary results

- Baseline – SL:
  - 25% improvement in S/sqrt(B) for neutral B;
  - 35% improvement in S/sqrt(B) for charged B;
- Baseline – HAD:
  - 10% improvement in S/sqrt(B) for neutral B;
  - 20% improvement in S/sqrt(B) for charged B;

Hopefully few of these studies will be ready for Perugia SuperB meeting evaluating the impact of the different detector configurations

It has been asked to think on the backgrounds we need to be simulated.

→ In our case is also important if we want to simulate several detector configuarations

As far as the B physics group is concerned, Breco sample could be used as our generic MC