Third Workshop on Theory, Phenomenology and Experiments in Heavy Flavour Physics

SuperB Update

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INFN & Universita' di Pisa

Round Table July 6, 2010

Overview

Toward TDR completion.

Better understanding of:

- Machine parameters and flexibility .
- Physics with Polarization.
- Detector Geometry and requirements.

Process:

- Increase the size of the collaboration with new entries as Poland.
- Mou’ s.
- Close to the startup.

Progress report before TDR

Super*B*

Progress Reports

The Physics

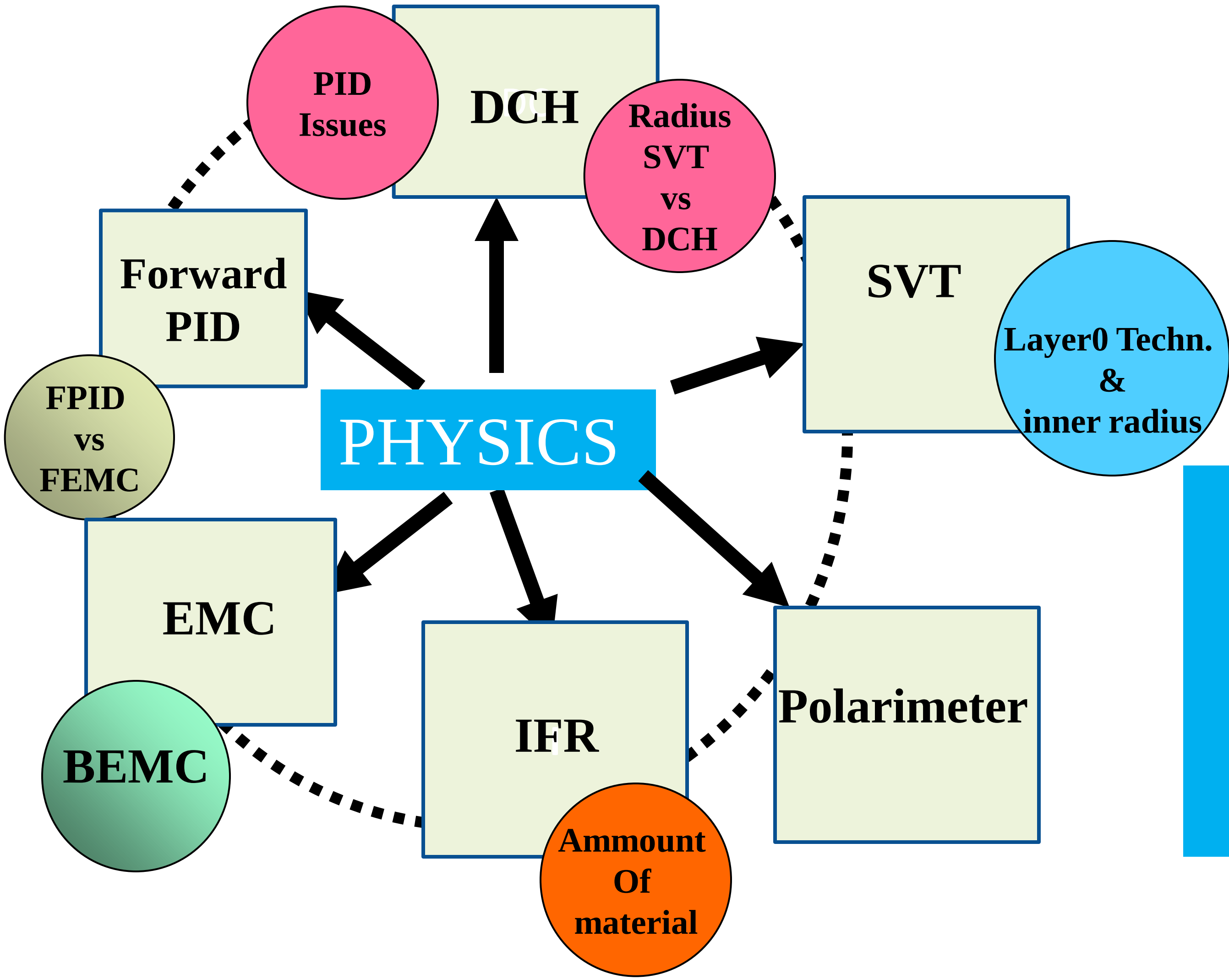
Accelerator

Detector

Computing

- http://mailman.fe.infn.it/superbwiki/index.php/SuperB_white_paper

From White Paper a sharper view on Detector and Machine



Impact of Geometry on sensitivity
+
Background related issues
B→K νν, B→τν
+ Polarimetry for
τ →μ γ

PID/EMC Material

IFR Optimisation

Interest of running @ threshold

B. Meadow et al.

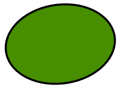
PHYSICS

500 fb-1 at *ψ(3770)*

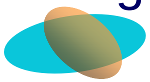
Decays of *ψ(3770)* → D^0D^0 produce coherent *(C=-1)* pairs of D^0's. Quantum correlations in their subsequent decays allow measurements of strong phases

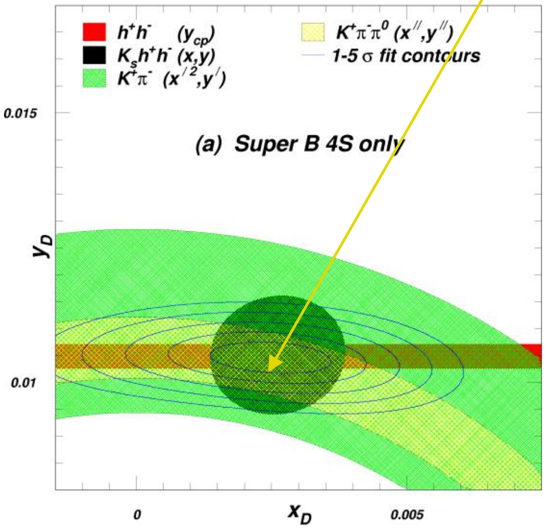
- Required for improved measurement of CKM γ
- Also required for D^0 mixing studies

- Dalitz plot model uncertainty shrinks

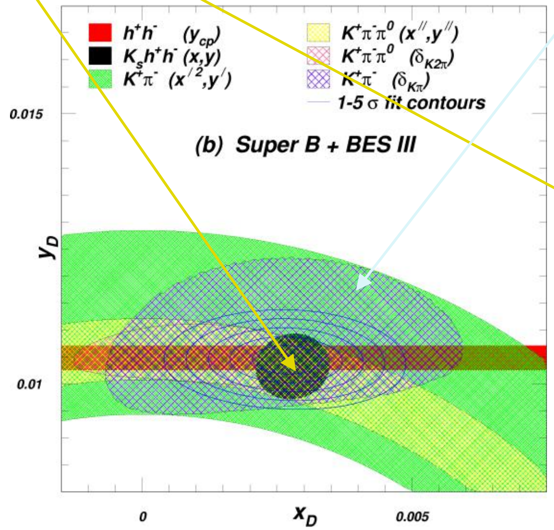


- Information on overall strong phase is added

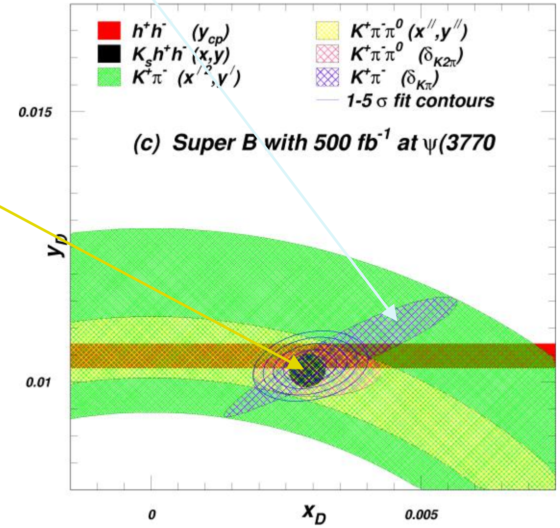




Fit	$x \times 10^3$	$y \times 10^3$	$\delta^\circ_{K+\pi-}$	$\delta^\circ_{K+\pi-\pi^0}$
(b)	$xxx^{+0.72}_{-0.75}$	$xxx \pm 0.19$	$xxx^{+3.7}_{-3.4}$	$xxx^{+4.6}_{-4.5}$
Stat.	(0.18)	(0.11)	(1.3)	(2.9)



Fit	$x \times 10^3$	$y \times 10^3$	$\delta^\circ_{K+\pi-}$	$\delta^\circ_{K+\pi-\pi^0}$
(c)	$xxx \pm 0.42$	$xxx \pm 0.17$	$xxx \pm 2.2$	$xxx^{+3.3}_{-3.4}$
Stat.	(0.18)	(0.11)	(1.3)	(2.7)



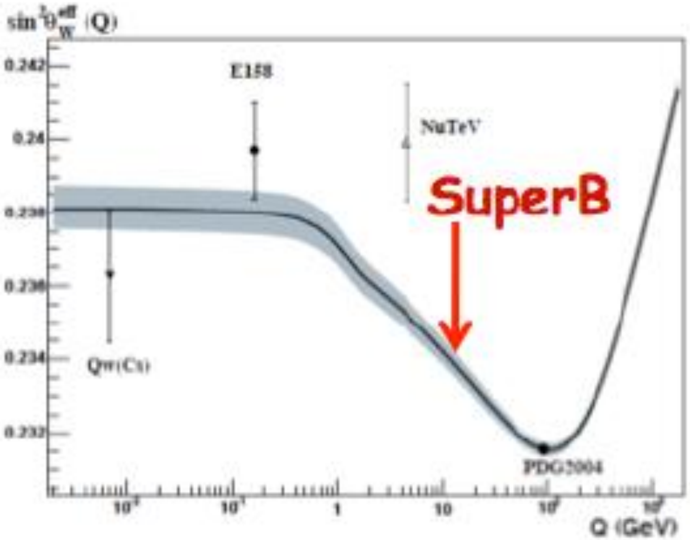
Fit	$x \times 10^3$	$y \times 10^3$	$\delta^\circ_{K+\pi-}$	$\delta^\circ_{K+\pi-\pi^0}$
(d)	$xxx \pm 0.20$	$xxx \pm 0.12$	$xxx \pm 1.0$	$xxx \pm 1.1$
Stat.	(0.17)	(0.10)	(0.9)	(1.1)

Uncertainty in x_D improves more than that of y_D

Electroweak measurement @ SuperB
POLARIZATION NEEDED

M.Roney et al.

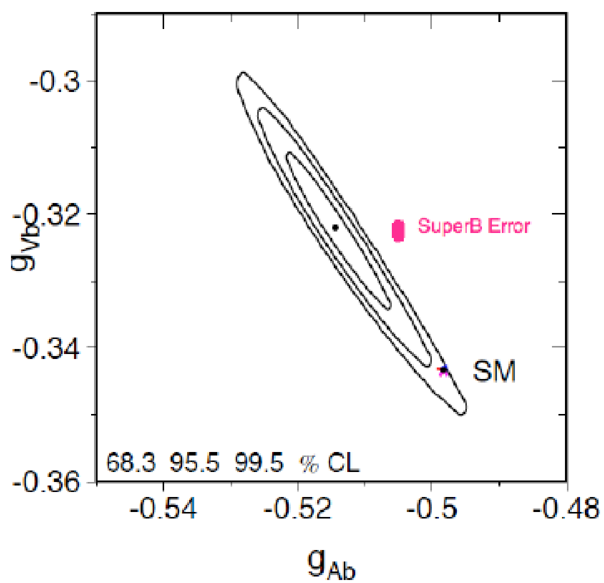
PHYSICS



$$A_{LR} = \frac{\sigma(P)-\sigma(-P)}{\sigma(P)+\sigma(-P)} = \frac{16}{\sqrt{2}} \left(\frac{G_F q^2}{4\pi\alpha}\right) \left(\frac{g_A^e\, g_V^b}{Q_b}\right) P$$

- Measurable for all $B^0\,\bar{B}^0$ and $B^+\,B^-$ final states, both resonant and continuum.
- **All** QCD corrections included in the **single** form factor that cancels in the asymmetry.
- Very clean measurement, no **large** theoretical corrections (in progress...)

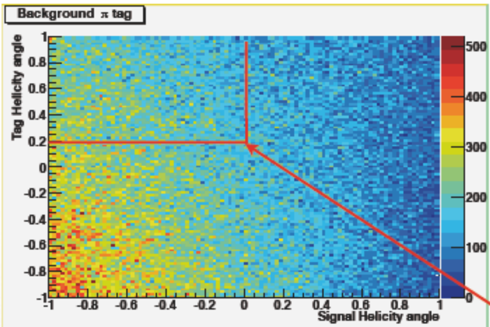
$\Rightarrow$ Excellent opportunity to measure g_V & $\sin^2\theta_W$ at SuperB with polarized beams!!

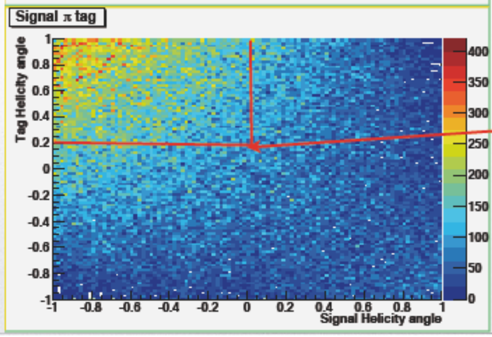


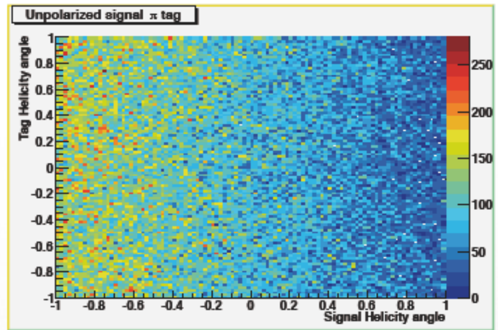
0.5% polarization syst.
0.3% stat. error
→ 0.0021

Important point :
The L-R luminosity asymmetry has to be very well controlled.
Possibly done using monitoring using Bhabhas. Thought needed

Polarized beam and tag on leptons and on hadrons ($\tau \rightarrow \pi \nu$ / $\tau \rightarrow \rho \nu$) reduces irreducible background!



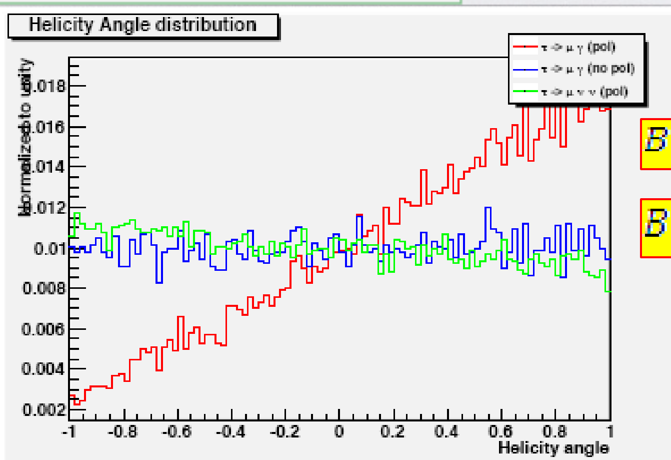




75 ab^{-1}

A.Cervelli, A.Lusiani, M.A.G., B.Oberhof, E.Paoloni

Applying a rectangular cut
eff. on signal ~40-45%
bkg retained ~ 10-15%



$B(\tau \rightarrow \mu\gamma)$ $2 \times 10-9$

$B(\tau \rightarrow e\gamma)$ $2 \times 10-9$

→

$B(\tau \rightarrow \mu\gamma)$ $1 \times 10-9$

$B(\tau \rightarrow e\gamma)$ $1 \times 10-9$

Sensitivity improves at least by a factor 2.
Equivalent to a factor 4 increase in luminosity.

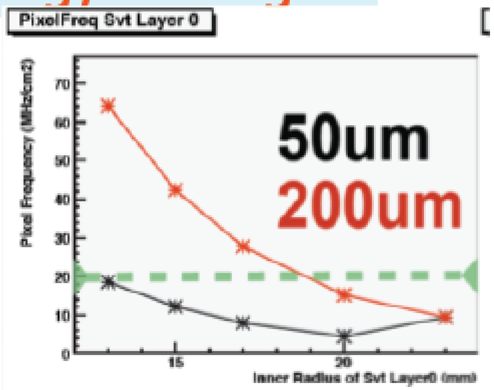
Understanding background

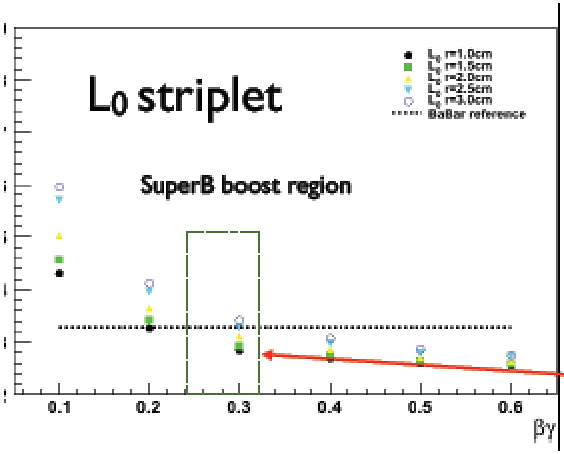
Layer0 radius & technology vs bkg.

E.Paoloni et al

Update on background:

- Hit rate vs Layer0 radius from pairs production depends strongly on sensor thickness:
  - on thick sensor larger cluster width for low momentum tracks with large crossing angle
- Large difference for thin pixels (50 um) and striplets (200 um)
- Hybrid pixel with 200 um sensor will be like striplets, unless thinner sensor can be used

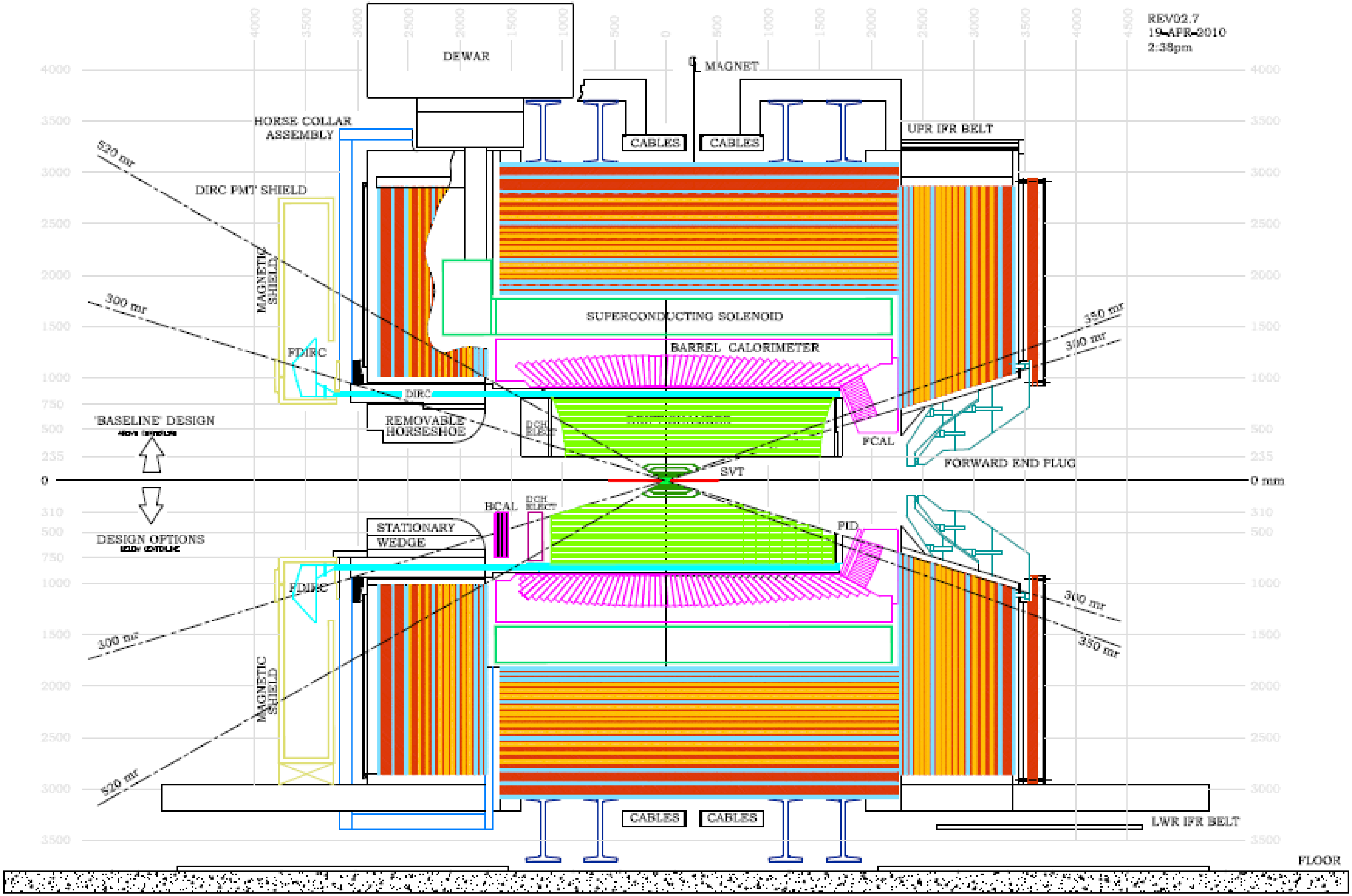




Sustainable background hit rate (radius) depends on technology: striplets vs pixel area and readout chip.

- Development of thin pixel chip readout architecture continue: data push and triggered with target 100MHz/cm2 (safety x5 included) with timestamp 100 ns. → R~1.3cm
  - Still to demonstrate: scaling to large matrix, rad hardness for MAPS.
- Assumed 100MHz/cm2 hard limit for striplets (~ 10% occupancy in 100 ns, area~10^{-2} cm^{-2}) → R~2 cm
  - performance similar to BaBar and thin pixel at lower radius. No margin left!

SuperB Detector (with options)



Outstanding Geometry Issues

6 Layer SVT	LO Striplets @ 1.6cm if background is acceptable as default. MAPS Option . Retain 5 Layer outer detector.
SVT – DCH transition radius	~> than 20 cm determined by beam element cryostats to allow easy installation
Backward EMC	Inexpensive Veto device bringing 8-10% sensitivity improvements for B→$\tau\ \nu$. Low momentum PID via TOF? Technical Issues?
Forward PID	Physics gains about 5% in B→K(*)$\nu\nu$. Somewhat larger gains for higher multiplicities Open technical options/interactions with EMC
Absorber in IFR	Optimized layout. Plan to reuse yoke. Still need to resolve engineering questions.

Parameters

		Base Line		Low Emittance		High Current		Tau/Charm (prelim.)	
Parameter	Units	HER (e+)	LER (e-)	HER (e+)	LER (e-)	HER (e+)	LER (e-)	HER (e+)	LER (e-)
LUMINOSITY	$cm^{-2}\ s^{-1}$	1.00E+36		1.00E+36		1.00E+36		1.00E+35	
Energy	GeV	6.7	4.18	6.7	4.18	6.7	4.18	2.58	1.61
Circumference	m	1258.4		1258.4		1258.4		1258.4	
X-Angle (full)	mrad	66		66		66		66	
Piwinski angle	rad	22.88	18.60	32.36	26.30	14.43	11.74	8.80	7.15
β_x @ IP	cm	2.6	3.2	2.6	3.2	5.06	6.22	6.76	8.32
β_y @ IP	cm	0.0253	0.0205	0.0179	0.0145	0.0292	0.0237	0.0658	0.0533
Coupling (full current)	%	0.25	0.25	0.25	0.25	0.5	0.5	0.25	0.25
ε_x (without IBS)	nm	1.97	1.82	1.00	0.91	1.97	1.82	1.97	1.82
ε_x (with IBS)	nm	2.00	2.46	1.00	1.23	2.00	2.46	5.20	6.4
ε_y	pm	5	6.15	2.5	3.075	10	12.3	13	16
σ_x @ IP	μm	7.211	6.872	5.090	6.274	10.060	12.370	18.749	23.076
σ_y @ IP	μm	0.036	0.036	0.021	0.021	0.054	0.054	0.092	0.092
Σ_x	μm	11.433		8.085		15.944		29.732	
Σ_y	μm	0.050		0.030		0.076		0.131	
σ_L (0 current)	mm	4.69	4.29	4.73	4.34	4.03	3.65	4.75	4.36
σ_L (full current)	mm	5	5	5	5	4.4	4.4	5	5
Beam current	mA	1892	2447	1460	1888	3094	4000	1365	1766
Buckets distance	#	2		2		1		1	
Ion gap	%	2		2		2		2	
RF frequency	Hz	4.76E+08		4.76E+08		4.76E+08		4.76E+08	
Harmonic number		1998		1998		1998		1998	
Number of bunches		978		978		1956		1956	
N. Particle/bunch		5.08E+10	6.56E+10	3.92E+10	5.06E+10	4.15E+10	5.36E+10	1.83E+10	2.37E+10
Tune shift x		0.0021	0.0033	0.0017	0.0025	0.0044	0.0067	0.0052	0.0080
Tune shift y		0.0970	0.0971	0.0891	0.0892	0.0684	0.0687	0.0909	0.0910
Long. damping time	msec	13.4	20.3	13.4	20.3	13.4	20.3	26.8	40.6
Energy Loss/turn	MeV	2.11	0.865	2.11	0.865	2.11	0.865	0.4	0.166
σ_E (full current)	dE/E	6.43E-04	7.34E-04	6.43E-04	7.34E-04	6.43E-04	7.34E-04	6.94E-04	7.34E-04
CM σ_E	dE/E	5.00E-04		5.00E-04		5.00E-04		5.26E-04	
Total lifetime	min	4.23	4.48	3.05	3.00	7.08	7.73	11.41	6.79
Total RF Power	MW	17.08		12.72		30.48		3.11	

Tau/charm threshold running at 10^{35}

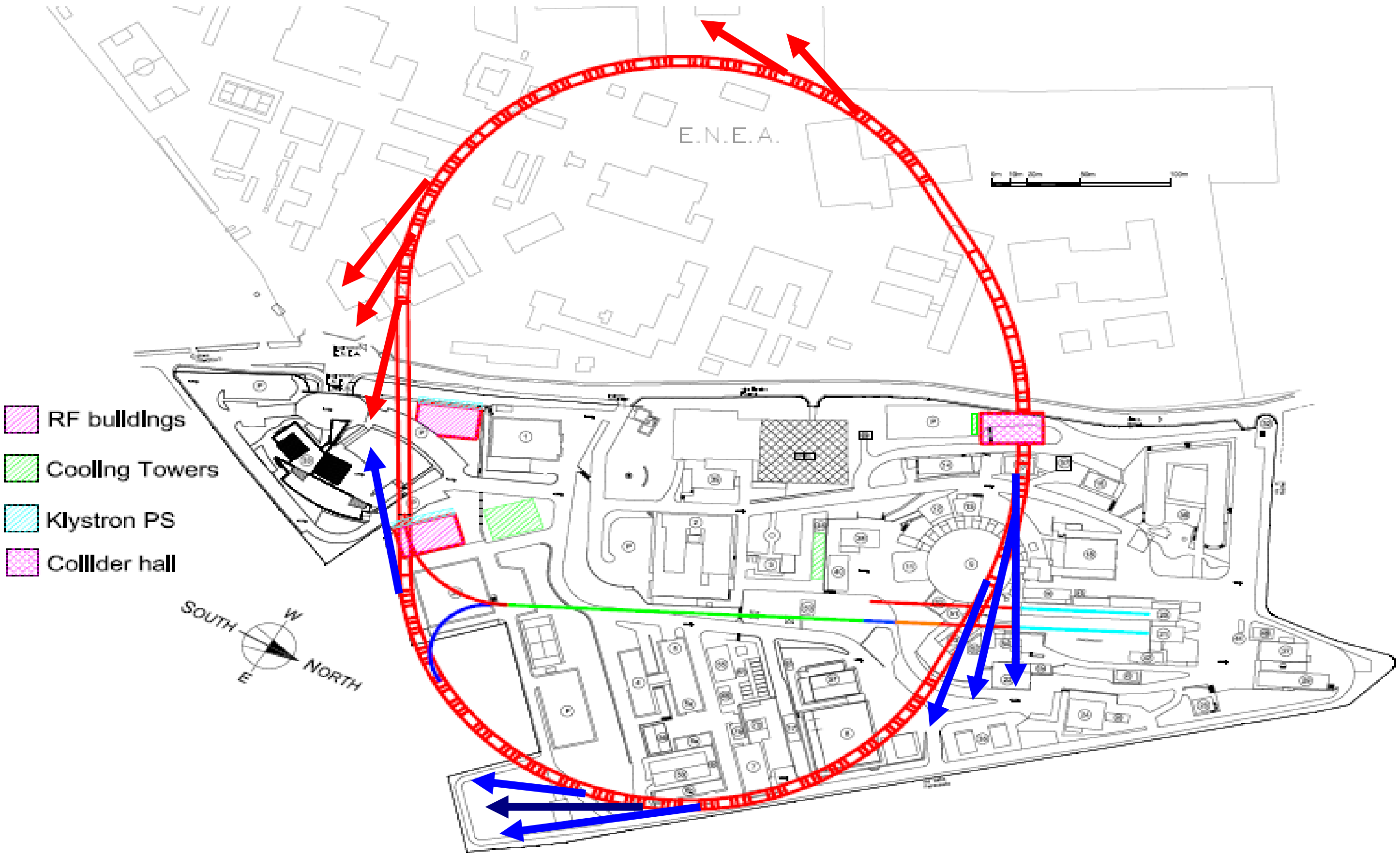
Baseline + other 2 options:
- **Lower y-emittance**
- **Higher currents (twice bunches)**

Baseline:
- **Higher emittance due to IBS**
- **Asymmetric beam currents**

RF power includes SR and HOM

J.Seeman

Machine layout with Synch Radiation Beam Lines



INFN
SLAC
In2p3+Cea
BINP
Poland
UK

Polarization is understood and fesible!

Parameter flexibility allows 10^{36} peak lumi without stressing limits!

Where we are

- TDR on the final path: a white paper TDR-like ready.
- MOU's with France, USA and Russia in operation.
- MOU with Canada in final step.
- Further developments on
  - Physics
  - Detector
  - accelerator

Toward green light

- The project is the first “flagship project” of the new national research plan
- The project has been mentioned as a reciprocity condition in a russian italian agreement on ignitor (nuclear fusion)

PNR on newspapers

Mer 14/04/2010 | Il Sole 24 ORE | Estratto da pag. 25

Innovazione. Più spazio all'industria

Gelmini aggiorna il piano nazionale

Eugenio Bruno
ROMA

Un acceleratore di particelle complementare a quello del Cern di Ginevra. Un network dei laboratori di nanotecnologia. Una «fabbrica del futuro» per rilanciare il manifatturiero. Uno studio approfondito nell'epigenetica. Sono alcuni dei «progetti bandiera» che il ministro dell'Istruzione Maristella Gelmini punta a inserire tra le priorità del programma nazionale della ricerca (Pnr) 2010-2012.

La lista degli interventi su cui il Miur vuole dirottare le prime risorse che il Pnr intercetterà contiene 14 voci. Fermo restando che da qui alla sua ufficializzazione potrebbe anche subire delle modifiche, l'elenco si presenta estremamente variegato. Alle azioni sulla formazione nel campo del nucleare, sull'approfondimento dei rapporti tra invecchiamento e Dna e alle misure per l'agroalimentare e i beni culturali – anticipati dallo stesso ministro al Sole 24 Ore il 26 marzo scorso – si è aggiunto

Gli interventi

Progetto	Settore	Valore stimato (milioni)
Super B Factory	Fisica	680
Cosmo - Skymed II generation	Aerospazio	N.D.
Epigenomica	Medicina	N.D.
3N - Network nazionale delle nanotecnologie	Industria	300
Ritmare - Ricerca ita. per il mare	Industria	795
Sintonia - Sistema integrato di telecomunicazioni	Aerospazio	671
Ipi - Invecchiamento e pop. isolate	Medicina	90
Agro Alimentare	Agricoltura	100
L'ambito nucleare	Energia	53,5
Recupero e rilancio della Villa dei Papiri	Beni cluturali	20
Elettra-Fermi-Eurofel	Industria	191
Astri - Astrofisica con specchi a tecnologia replicante italiana	Aerospazio	8
Controllo delle crisi nei sistemi complessi socio-economici	Economica	30
La fabbrica del futuro	Industria	30

ra: «Cosmo-Skymed II generation», «Sintonia» e «Astri». Con i primi due orientati a potenziare i metodi di osservazione della terra dallo spazio e il terzo che, quasi fosse un controcampo, si concentra sull'osser-

Se ne dovrebbe sapere di più tra fine aprile e i primi di maggio quando ministri e governatori si siederanno allo stesso tavolo. Dopodiché il Pnr sarà pronto per andare a Palazzo Chigi, prima, e al Cipe, poi.

Comunicato stampa del 26 Aprile 2010 - Miur

Ministero dell'Istruzione, dell'Università e della Ricerca

Ministero

Istruzione

Ufficio Stampa

Roma, 26 Aprile 2010

RICERCA, VERTICE ITALIA-RUSSIA, GELMINI FIRMA ACCORDO SU RICERCA NUCLEARE

Oggi, il ministro Mariastella Gelmini, in occasione del vertice italo-russo di Lesmo, ha firmato una dichiarazione d'intenti tra il MIUR e il Ministero della ricerca scientifica russo per la realizzazione di due importanti progetti per la promozione della ricerca nel settore della fusione nucleare.

L'intesa riguarda i programmi di ricerca denominati "IGNITOR" e "SUPER B". Il programma "IGNITOR" prevede la realizzazione in Russia di un innovativo reattore sperimentale a fusione nucleare che verrà utilizzato come fonte di energia.

Il programma "SUPER B" riguarda la realizzazione in Italia di un acceleratore di particelle di nuova generazione che consentirà una più alta intensità di collisioni tra particelle, permettendo la produzione di "quark pesanti".

START

- A formal commitment with INFN for the project with the declaration of some available budget in the current year is expected
- This commitment will set the start of the project

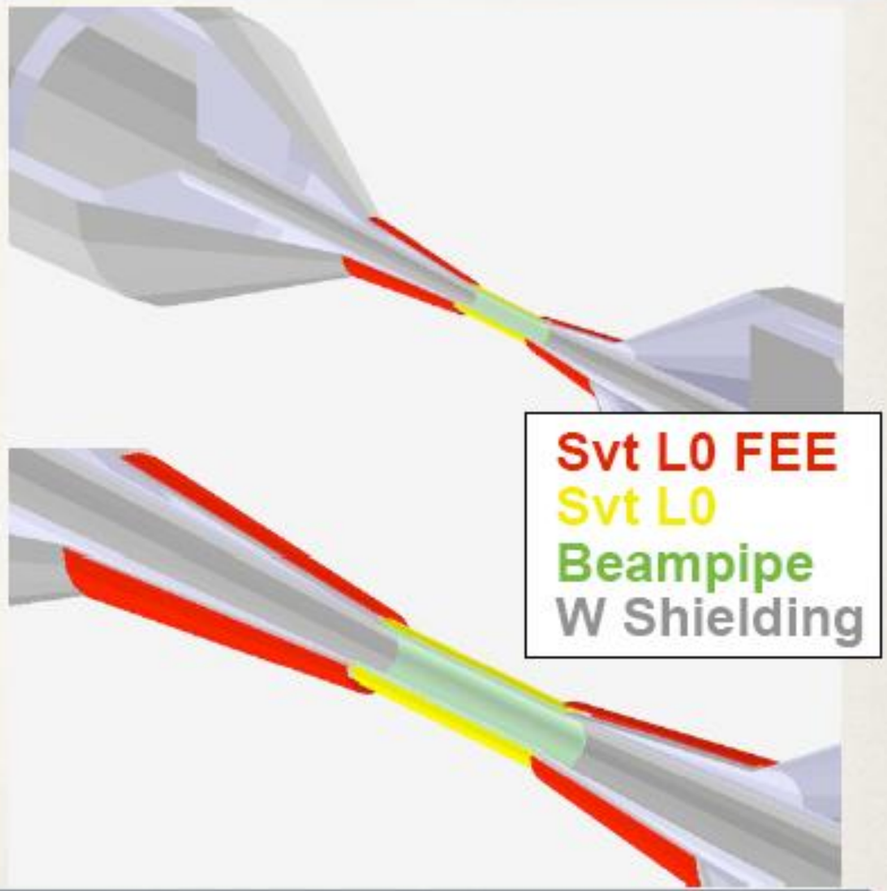
Backup

Understanding background

E.Paoloni et al

L0 electronics position

- Additional 2 volumes
  - Cones around IR tungsten shielding close to L0
  - 1mm of Si at 2mm from shields (radiation probes)
- Sensitive volumes: additional BrnRootHits list dumped by RooEvt object



Understanding Budget

A satisfactory full simulation of different Background sources allows the design of interaction region:
The geometry of the detector has now more solid justification.

Budget has been revisited from CDR and breakdown ready (WBS).

WBS	Item	M&S KEuro	Rep. Val. Keuro
1.	SuperB (no Light lines, no running-operation costs)	~ 250000	150000
2.	SuperB detector	~ 51000	48922

Present Budget must be revisited with final transport costs of reusable components and currency rates.