Stato del Progetto SuperB

Francesco Forti, INFN e Università, Pisa

Presentazione in Sezione, 23 giugno 2008

Sommario

- SuperB CDR presentato nel Marzo 2007
- Sottoposto ad una review internazionale (Dainton Committee, nominata dall'INFN).
  - International Review Report presentato al workshop dell'Elba
  - Molto positivo
  - Updates:
    - Fisica: Valencia Workshop in January
    - Acceleratore: risultati del test su Dafne
- Attività sul rivelatore
- Apertura della sigla in CSN1

The SuperB Process

www.pi.infn.it/SuperB

(Courtesy of M. Biagini)

International Reviews

INFN IRC Members

- 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

Also participating in last meeting

+ Tatsuya Nakada in representation of RECFA
+ Steve Myers – accel expert

RECFA Committee setup

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

Will join us for the SuperB workshop

- SuperB presented already twice at ECFA

P5 presentation made in February

IRC meetings

- First meeting Nov 12-13, 2007
- Second meeting April 29-30, 2008
  - Update on physics and detector
  - Update on accelerator
  - Focus on the results from the Frascati tests of Crab Waist principle
- The written Report presented at the SuperB workshop in Elba.
- Very positive!

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

Slides available at:
https://agenda.infn.it/conferenceDisplay.py?confId=163
https://agenda.infn.it/conferenceDisplay.py?confId=501
Report at
https://agenda.infn.it/materialDisplay.py?contribId=101&sessionId=39&materialId=paper&confId=347

Sharpening the arguments on the Physics Reach of *SuperB*

Physics Retreat in Valencia Jan.7-15,2008

Following informal suggestions of IRC.

Update on physics (potential discovery of New Physics with a 75 ab^{-1} in 5 years) for B, Charm, Tau's and new Spectroscopy .

Examine carefully the potential benefits of running at 4GeV c.m.s. Energy and of the Polarization.

Organize the preparation of the simulation tools to evaluate the correct experimental sensitivity to the most relevant physics channels

The report is now in the final editing stage.

Draft at https://agenda.infn.it/materialDisplay.py?materialId=1&confId=501

Proceedings
of
Super*B* Workshop VI

New Physics
at the
Super Flavour Factory

Valencia, Spain
January 7-15, 2008

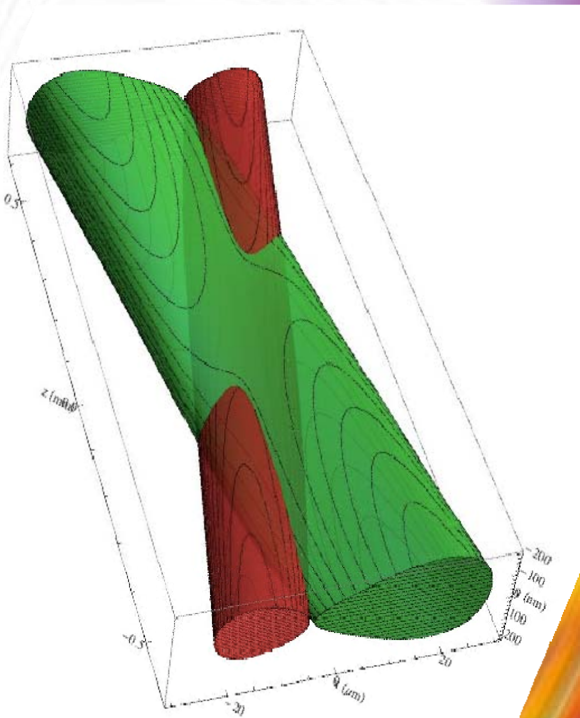
Machine Parameters (slightly different from CDR)

Parameter (Baseline)	LER	HER
Particle type	e^+	e^-
Energy (GeV)	4	7
Luminosity ($cm^{-2}s^{-1}$)	1.0×10^{36}	
Circumference (m)	1800	
Number of bunches	1251	
Particles/bunch $\times 10^{10}$	5.52	
Beam current (A)	1.85	
β_y (mm)	0.22	0.385
β_x (mm)	35	20
ϵ_y (pm-rad)	7	4
ϵ_x (nm-rad)	2.8	1.6
$\sigma_y{}^*$ (nm)	39	
$\sigma_x{}^*$ (μm)	9.9	5.66
Bunch length (mm)	5	
RF Power (MW)	17	

150m needed for Polarization

Circumference in CDR was 2200 m

LEB HEB



Asymmetric bunch size to optimize beam lifetime (Toushek effect)

SuperB parameters with higher Wall Power

PARAMETER	Nominal LER (e+)	Nominal HER (e-)	Upgrade LER (e+)	Upgrade HER (e-)
Energy (GeV)	4	7	4	7
Luminosity x 10^{36}	1.0		2.0	
Circumference (m)	1800	1800		
Revolution frequency (MHz)	0.167			
Eff. long. polarization (%)	0	80		
RF frequency (MHz)	476			
Momentum spread ($x10^{-4}$)	7.9	5.6	9.0	8.0
Momentum compaction ($x10^{-4}$)	3.2	3.8	3.2	3.8
Rf Voltage (MV)	5	8.3	8	11.8
Energy loss/turn (MeV)	1.16	1.94	1.78	2.81
Number of bunches	1251			
Particles per bunch ($x10^{10}$)	5.52			
Beam current (A)	1.85			
Beta y* (mm)	0.22	0.39	0.16	0.27
Beta x* (mm)	35	20		
Emit y (pm-rad)	7	4	3.5	2
Emit x (nm-rad)	2.8	1.6	1.4	0.8
Sigma y* (microns)	0.039	0.039	0.0233	0.0233
Sigma x* (microns)	9.9	5.66	7	4
Bunch length (mm)	5		4.3	
Full Crossing angle (mrad)	48			
Wigglers (#) 20 meters each	0	0	2	2
Damping time (trans/long)(ms)	40/20	40/20	28/14	28/14
Luminosity lifetime (min)	6.7		3.35	
Touschek lifetime (min)	13	20	6.9	10.3
Effective beam lifetime (min)	4.5	5.1	2.3	2.5
Injection rate pps ($x10^{11}$) (100%)	2.6	2.3	5.1	4.6
Tune shift y (from formula)	0.15		0.20	
Tune shift x (from formula)	0.0043	0.0025	0.0059	0.0034
RF Power (MW)	17		25	

Doubling currents with a factor 2 in Wall power we can double the luminosity

DAΦNE test summary

- Crab sextupoles are working very nicely
- Good agreement with simulation
- Luminosity of about 1.6×10^{32} reached
  - Probably a pessimistic estimate
- No “hard to fix” problems found so far, but many more than desired
- A lot of “single pieces” are working very nicely, need to put all together at the same time
- Commissioning rate slower than we hoped
  - Need to increase current to old values

ISTITUTO NAZIONALE DI FISICA NUCLEARE

Laboratori Nazionali di Frascati

(DRAFT) MEMO for SuperB Steering Committee

INFN/code-08/?
4 Aprile 2008
SuperB-A1-Note

PRELIMINARY RESULTS FROM DAΦNE UPGRADE AS A PROOF OF PRINCIPLE OF NEW CONCEPTS FOR *SuperB*

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Simona Bettoni
CERN CH-1211, Geneva 23, Switzerland
Marco Schioppa
INFN-Gruppo di Cosenza, Arcavacata di Rende (Cosenza), I-87036, Italy
D. Alesini, M. Biagini, C. Biscari, R .Boni, M. Boscolo, F. Bossi, B. Buonomo, A. Clozza, G. Delle Monache, T. Demma, E. Di Pasquale, G. Di Pirro, A. Drago, A. Gallo, A. Ghigo, S. Guiducci, C. Ligi, F. Marcellini, G. Mazzitelli, C. Milardi, F. Murtas, L. Pellegrino, M. Preger, L. Quintieri, P. Raimondi, R. Ricci, U. Rotundo, C. Sanelli, M. Serio, F. Sgamma, B. Spataro, A. Stecchi, A. Stella, S. Tomassini, C. Vaccarezza, M. Zobov
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KEK, Ibaraki 305-0801, Japan
N. Arnaud, D. Breton, P. Roudeau, A. Stocchi, A. Variola, B. F. Viaud

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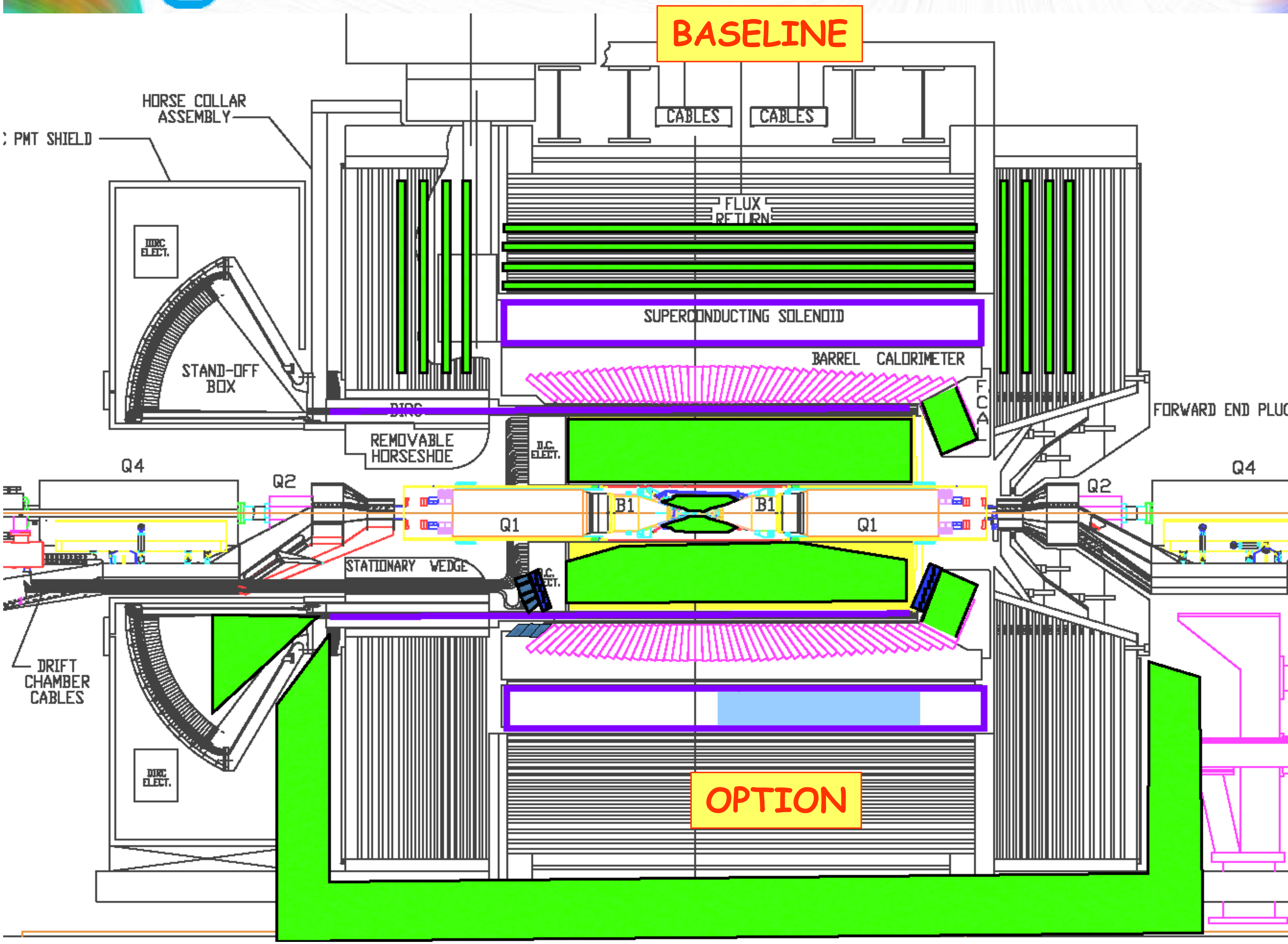
SuperB Detector

- Babar and Belle designs have proven to be very effective for B-Factory physics
  - Follow the same ideas for SuperB detector
- A SuperB detector is possible with today's technology. Main issues:
  - Machine backgrounds – somewhat larger than in Babar/Belle
  - Beam energy asymmetry – a bit smaller
  - Strong interaction with machine design
- Try to reuse parts of Babar as much as possible
  - Quartz bars of the DIRC
  - Barrel EMC CsI(Tl) crystal and mechanical structure
  - Superconducting coil and flux return yoke.
- Moderate R&D and engineering required
  - Small beam pipe technology
  - Thin silicon pixel detector for first layer
  - Drift chamber CF mechanical structure, gas and cell size
  - Photon detection for DIRC quartz bars
  - Forward PID system (TOF or focusing RICH)
  - Forward calorimeter crystals (LSO)
  - Minos-style scintillator for Instrumented flux return
  - Electronics and trigger
  - Computing – large data amount

Prepare Technical Design Report in 2-3 years

Detector Layout – Reuse parts of Babar



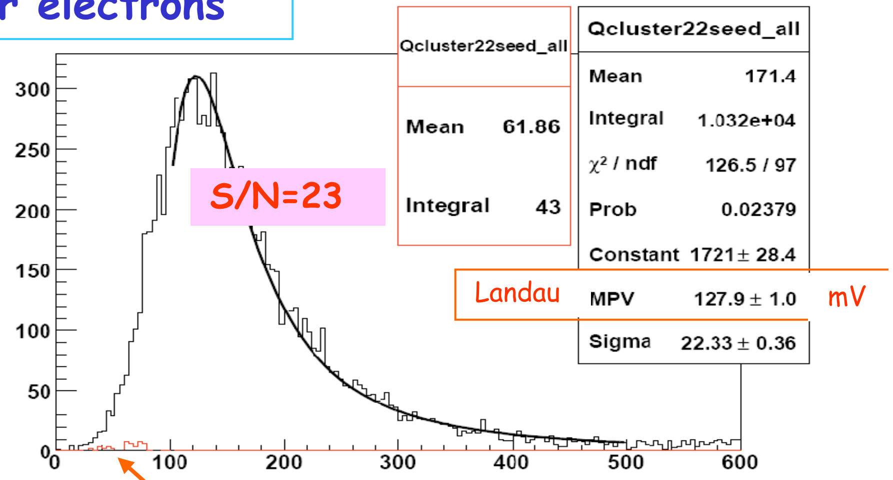
SVT Main activities in the last year

G. Rizzo

Basic CMOS MAPS R&D (most challenging option for the Layer0):

- Optimization of the Deep NWell MAPS pixel
  - S/N up to 25 with power consumption reduced (~30 uW/ch)
- Fast redout architecture (sparsification and timestamp) implemented in a 4k pixel matrix. Preliminary test encouraging. Good sensitivity to e- from Sr90 and to γ from Fe55 source

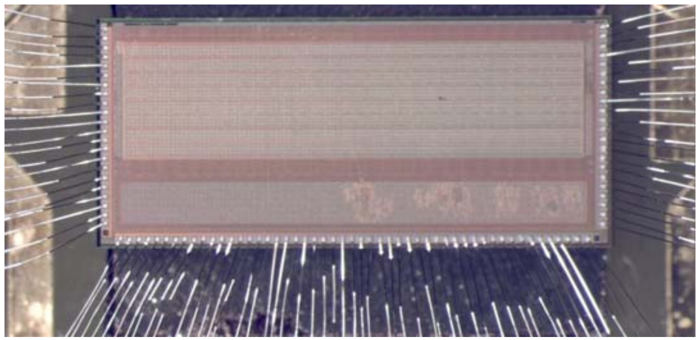
^{90}Sr electrons



Noise events

Cluster signal (mV)

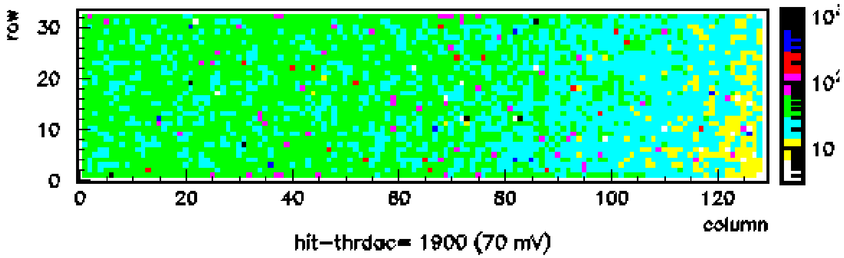
APSEL4D - 32x128 pixels
50 µm pixel pitch



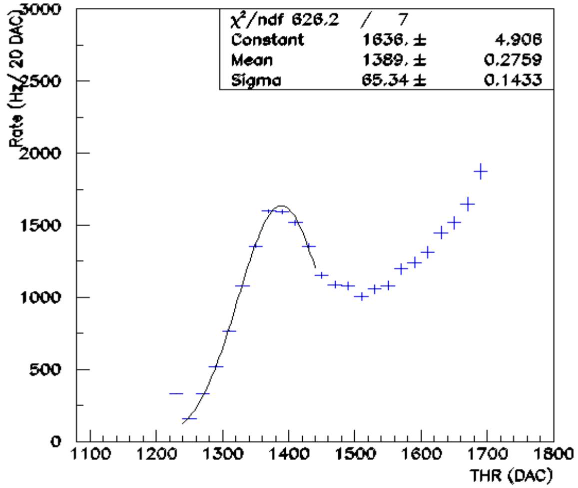
APSEL4D – Sr90 test

Fired pixel map with threshodl @ ½ MIP

Good uniformity (the source was positioned on the left side of the matrix)



APSEL4D - Fe55
5.9 keV calibration peak



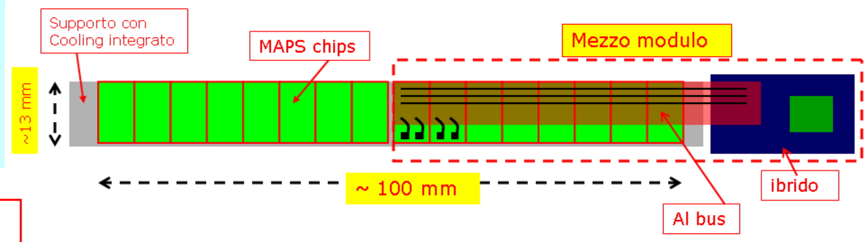
Attivita' 2009 in GRI per SVT-SuperB

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

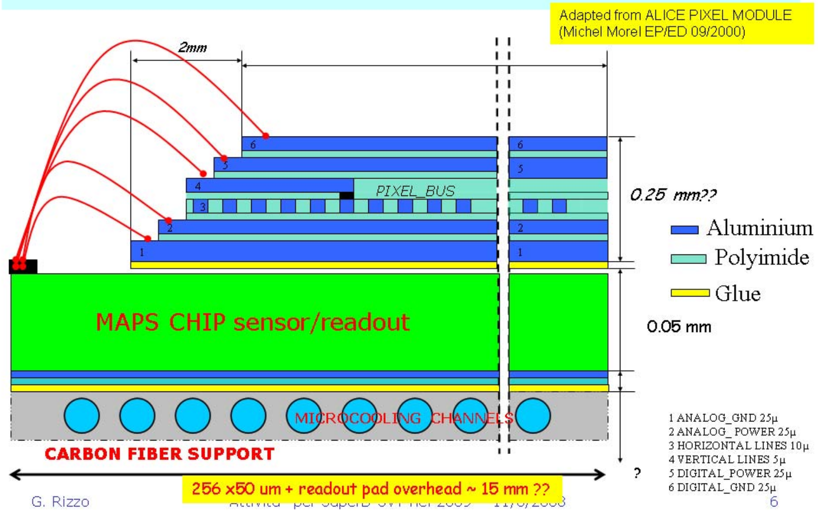
- Attivita' finalizzate alla stesura del TDR in 2-3 anni
- R&D sulle 3 opzioni per Layer 0:
  - CMOS MAPS per dimostrazione fattibilita' di modulo multichip con specifiche SuperB (~tutte le sezioni coinvolte)
  - Pixel ibridi: indagine sulla possibile riduzione del pitch in chip esistenti (PV) e del materiale supporto/cooling (MI,TO) 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, supporto di SVT, beam-pipe. (PI,TO, MI)
- Simulazione: background, fast simulation per ottimizzazione layout SVT (PI)

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 tipo APSEL4D)
  - PV/BG, PI, BO, interesse 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 in fibra di carbonio con cooling integrato con microcanali.
- Realizzazione delle varie componenti nel 2009, inizio assemblaggio e test in lab fine 2009. Possibile 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 con EDRO modificata (BO,PI)
- Danno da radiazione MAPS (PV)

Meccanica per SVT

- Realizzazione supporto in fibra di carbonio con cooling integrato con microcanali (monofase) per prototipo modulo MAPS (PI)
- Valutazione di sistema di cooling bifase per Layer0 (MI)
- Studio supporto e cooling per pixel ibridi con struttura a fibra di carbonio e schiuma conduttiva (TO)
- Design delle flange di interfaccia per moduli Layer0 (PI)
- Design del supporto meccanico di SVT in stretta interazione con il design della zona d'interazione (M. Sullivan-in corso di definizione) (PI, TO)
- Design della beam pipe (PI)

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 meeting timescale
  - Tapered shape of end-plates
    - alternative solutions being presented at this meeting
- Eventually, need to test all new solutions on small prototypes

Drift Chamber

Achievements:

- In last months, preparation work for tests with drift chamber prototypes was done
  - External tracking telescope made available
    - Extrapolated accuracy O(100micron)
    - Readout electronics (on-board discriminators) being designed now
  - Mechanical structure and electronics of small drift chamber prototype ready (from KLOE)

Groups involved:

- The *BABAR* LNF group as of now
- Electronics engineers (2, part-time) expressed interest starting from 2009

Drift Chamber

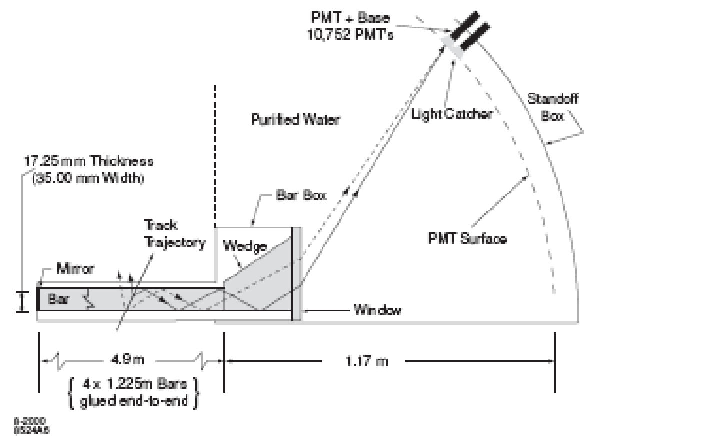
Perspective for TDR: decisions to be taken

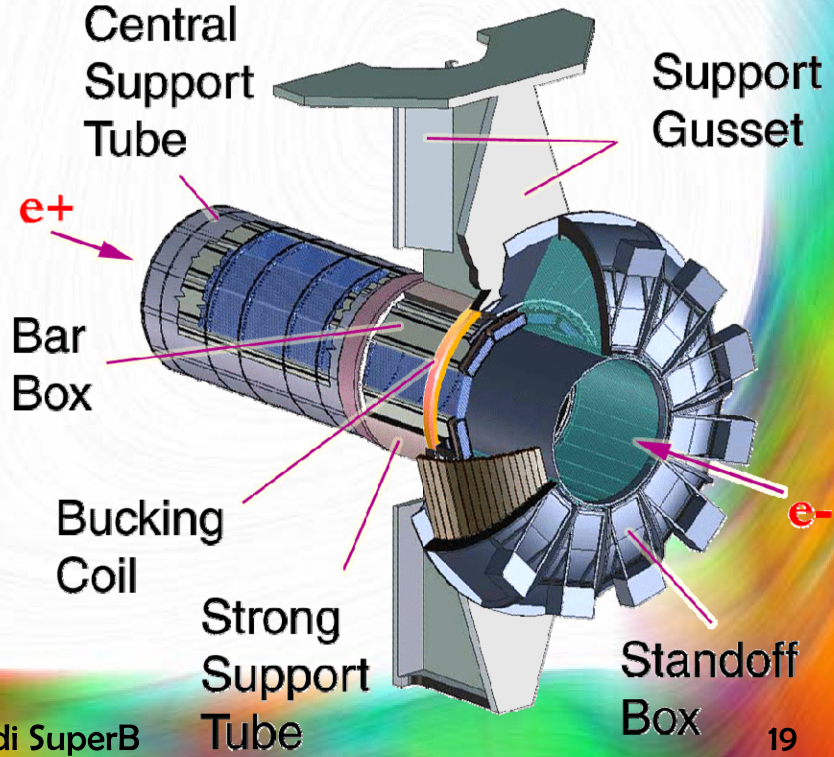
- New cell structure
  - attack this problem with newly available simulation tools (next months)
  - test new cell and gas mixtures with prototypes (~1 year from now)
- Define mechanical structure
  - simulation
  - Interplay with other detectors (length, offset, shape)
  - Once geometry outlined, make detailed FEA calculations
- Electronics design
  - Actual work starting next year
  - Understand requirements meanwhile

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 TDR path

- Forward PID ?
  - Physics case
  - Effect on other systems
- If yes, what technology ?
  - TOF, Focusing Aerogel
  - Design of system
  - Technical work on detectors
  - Beam tests
  - engineering
- Barrel changes from Babar
  - Small SOB choice
  - Optical coupling of bars to photo-detector
  - Wedge or no wedge ?
  - Choice of photodetector
  - Prototyping and beam tests
  - Engineering
- Disassembly, transport, reinstallation and commissionin
  - Lots of engineering
- Sotware, Electronics

Attivita' a Padova sul PID e richieste per il 2009

- Attivita' gia' svolta nel 2008: caratterizzazione preliminare di MPPC e SiPM con particolare attenzione alle caratteristiche temporali (vedi un esempio nella slide successiva)
- Attivita' prevista per il resto del 2008: continuazione caratterizzazione fotodetectors (i 2 MCPPMT in arrivo a luglio per ritardo costruzione), accoppiamento con radiatore di quarzo e misure risoluzione TOF; inizio coinvolgimento ingegnere su nuova meccanica DIRC
- Attivita' prevista per il 2009: completamento dello studio delle proprieta' temporali dei vari fotodetector, in particolare SiPM con superficie piu' ampia, continuazione misure di risoluzione TOF con cosmici e su fascio (accordi preliminari con Jerry Va'vra per test comuni al FNAL); continuazione ingegnerizzazione meccanica DIRC

Electromagnetic calorimeter

D. Hitlin

- The *BABAR* CsI(Tl) barrel calorimeter, should, with minor modifications, be an adequate device for Super*B*
  - Add two or three rings of crystals to extend rear coverage
  - Shorten effective integration time of the digital filter
  - Effect of lack of projectivity due to displacement of the IP is an issue for study
- Most effort has gone into identifying appropriate technology for the front and rear endcaps. Leading candidates:
  - Front endcap: LYSO with APD readout
  - Rear endcap (primarily a missing energy veto): Lead (0.5 X_0) with scintillating tiles and fiber + SiPM readout
- Monte Carlo studies for design of forward endcap are well-advanced
- Confronting design concepts with physics benchmarks is next

Bergen, Caltech, Edinburgh, McGill, Perugia, QMC (U of London)

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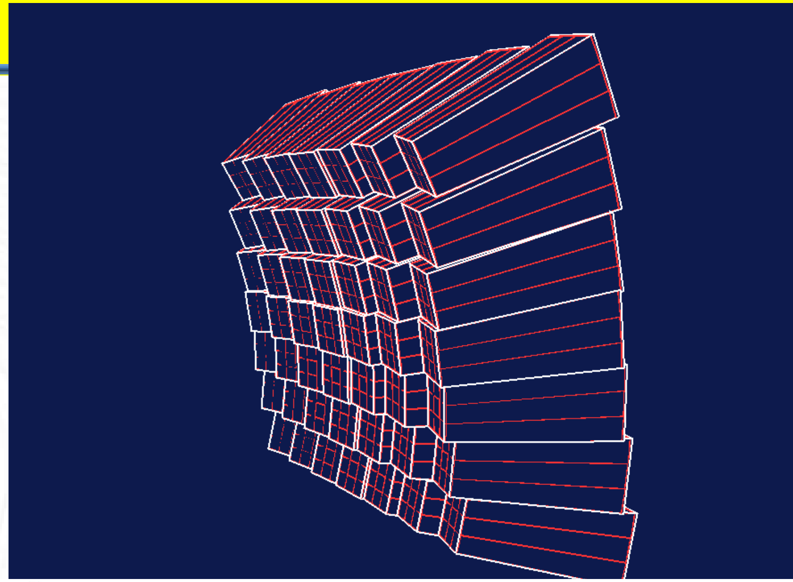
Forward Endcap

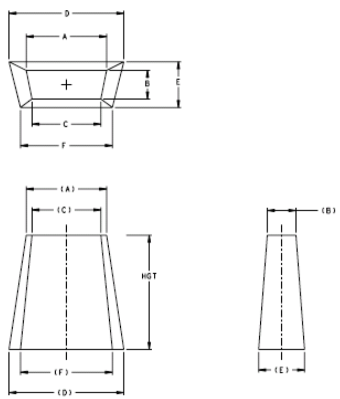
- Geometry
  - Front crystal face in the range of one Molière radius: ~25mm
    - Constraint: maximize crystal yield/boule
- Beam test provides focus
  - Optimize crystal quality
  - Ascertain mechanical properties of LYSO
  - Devise readout and electronics chain
  - Calibration and system issues
  - Monte Carlo and analysis tools



Xtals Dimensions: Back <2.5 cm

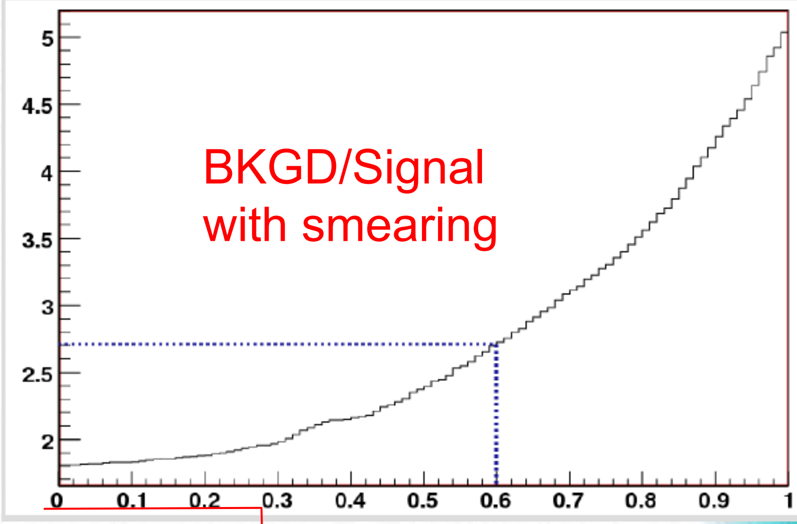
Rule: minimum allowed number of crysrtals multiple of 5

Group	Ring	A	B	C	D	E	F
165 Xtals 33 Modules	1	20.65	22.03	19.88	22.65	24.43	21.79
	2	21.44	22.03	20.66	23.52	24.43	22.66
	3	22.23	22.03	21.45	24.39	24.43	23.53
180 Xtals 36 Modules	4	21.08	22.03	20.37	23.18	24.43	22.39
	5	21.80	22.03	21.09	23.98	24.43	23.19
	6	22.52	22.03	21.81	24.77	24.43	23.99
200 Xtals 40 Modules	7	20.89	22.03	20.25	23.02	24.43	22.31
	8	21.54	22.03	20.90	23.74	24.43	23.03
	9	22.19	22.03	21.55	24.46	24.43	23.75
235 Xtals 45 Modules	10	21.23	22.03	20.64	23.44	24.43	22.78
	11	21.84	22.03	21.24	24.11	24.43	23.45
	12	22.44	22.03	21.85	24.78	24.43	24.12
265 Xtals 53 Modules	13	21.06	22.03	20.52	23.29	24.43	22.68
	14	21.62	22.03	21.07	23.90	24.43	23.30
	15	22.17	22.03	21.63	24.51	24.43	23.91
250 Xtals 50 Modules	16	21.34	22.03	20.83	23.63	24.43	23.06
	17	21.86	22.03	21.35	24.21	24.43	23.64
	18	22.38	22.03	21.87	24.78	24.43	24.21
270 Xtals 54 Modules	19	21.19	22.03	20.72	23.48	24.43	22.96
	20	21.67	22.03	21.20	24.02	24.43	23.49
	21	22.15	22.03	21.68	24.55	24.43	24.02



Rear Endcap

- Many of the main physics objectives of Super$B$ use missing energy signatures
- Improving backward calorimeter coverage, and thus overall hermeticity,
  can pay large dividends in signal/background
- Only modest energy resolution is required



Backward polar angle coverage (radians)

- The drift chamber electronics and DIRC tunnel provide severe constraints
- A scintillating tile design provides adequate flexibility ~10K SiPM channels

zur

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SuperB-IFR: detection efficiency

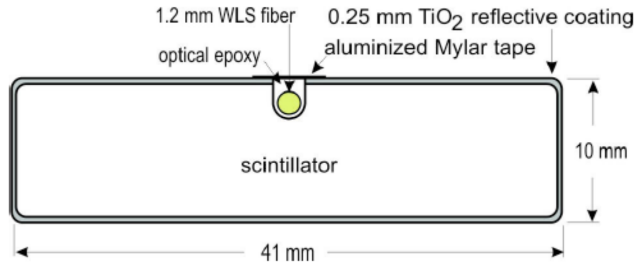
Present baseline configuration:

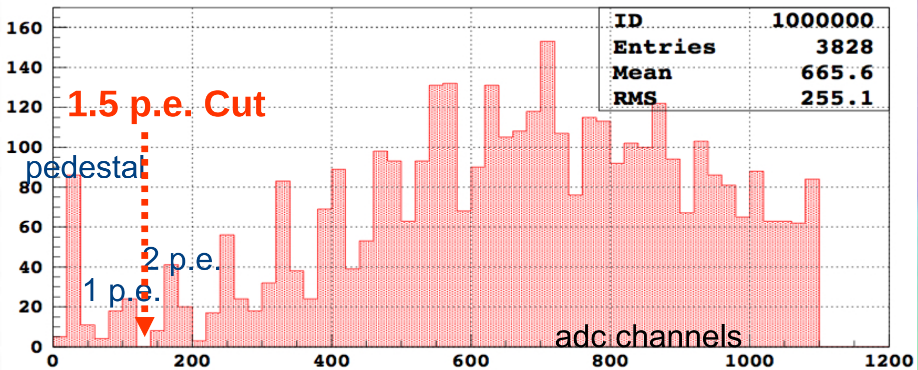
scintillator: 1.5cm thick with embedded hole
Fiber: One Saint-Gobain BCF- 92 1.0 mm diameter
Readout: Geiger mode APDs from Hamamatsu and IRST-FBK

- Average number of p.e.: ~ 9 at maximum distance (~4m)
- Efficiency better that 95%

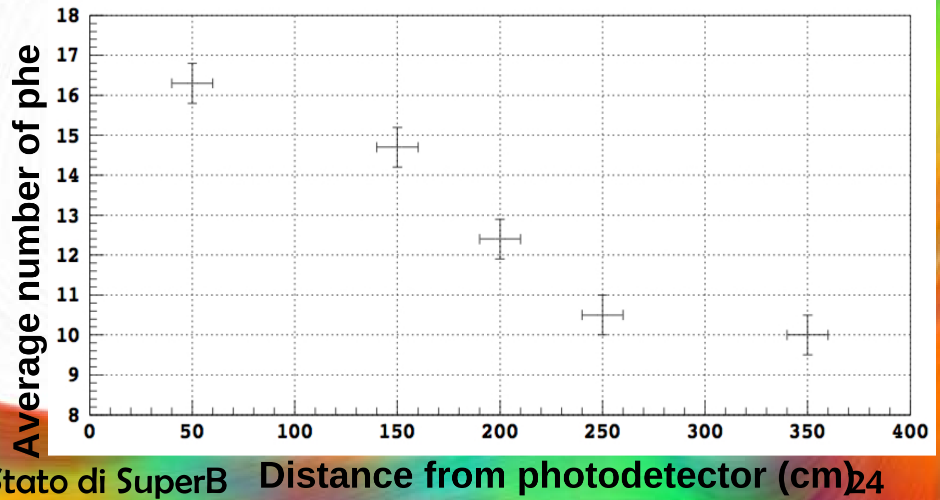
Fiber Kuraray T11- 300 ppm shows higher light yield but slower time response

Tests on scintillator with surface groove instead of embedded hole are under way





ADC spectrum for MPPC fiber 350 cm long

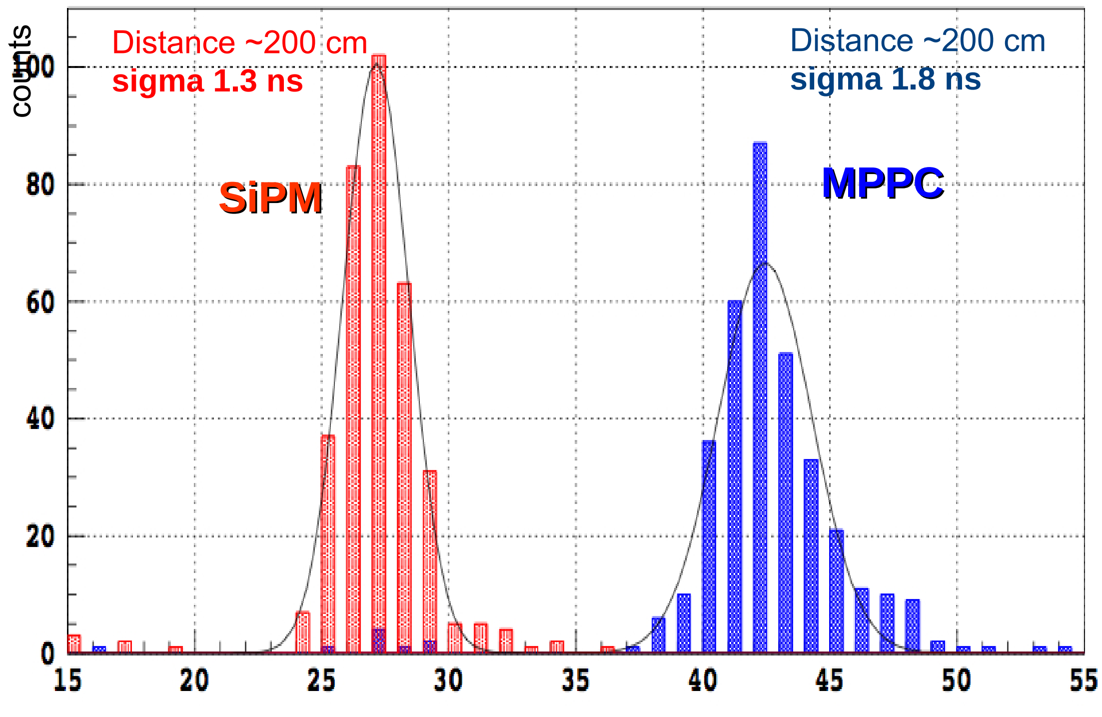


SuperB-IFR: time resolution

1.5cm thick scintillator + Saint-Gobain BCF- 92 fiber 1.0 mm diameter

The trigger scintillator is 15cm long so we expect a contribution of about 0.8ns due to that

The time resolution is < 2 ns and is better with SiPM (IRST- FBK) than with MPPC (Hamamatsu)



Time resolution studies are under way:
- kuraray vs Saint-Gobain fibers
- precise study of SiPM time response
- use of a fast discriminator board

SuperB IFR group institutions and activities

At present:

Ferrara INFN-University

Padova INFN-University

Roma1 INFN-University

Additional forces would be very helpful, in particular in the area of simulation

For the TDR:

Establish the baseline layout of the detector (R&D on scintillator, fiber, SiPM, electronics,…+ simulations)

Build and test a prototype (end 2009/beginning 2010)

Detector organization

Rough institutional roll call May

System	Institutions
SVT	PI, PV-BG, TO, MI, TS, BO, (PG, RM3)
DCH	LNF
PID	SLAC, BINP , Cincinnati, Ljubljana, PD, Hawaii.
EMC	Bergen, Caltech, Edinburgh, McGill, Perugia, QMC (U of London)
IFR	FE, PD, RM1
Trigger/DAQ	SLAC, Caltech
Computing	PD, FE, TO, BO, RM2, PI, PG, LNF
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

In Italia

- Attività SuperB finanziata fino ad ora nel budget di Babar + NTA + qualcosa su Dot.
- Verrà proposta l'apertura della sigla PSuperB nel 2009.
- Motivazione:
  - Ricevuta approvazione scientifica
  - Interesse di forze nuove non parte di Babar
  - Ramp up delle attività in preparazione del TDR

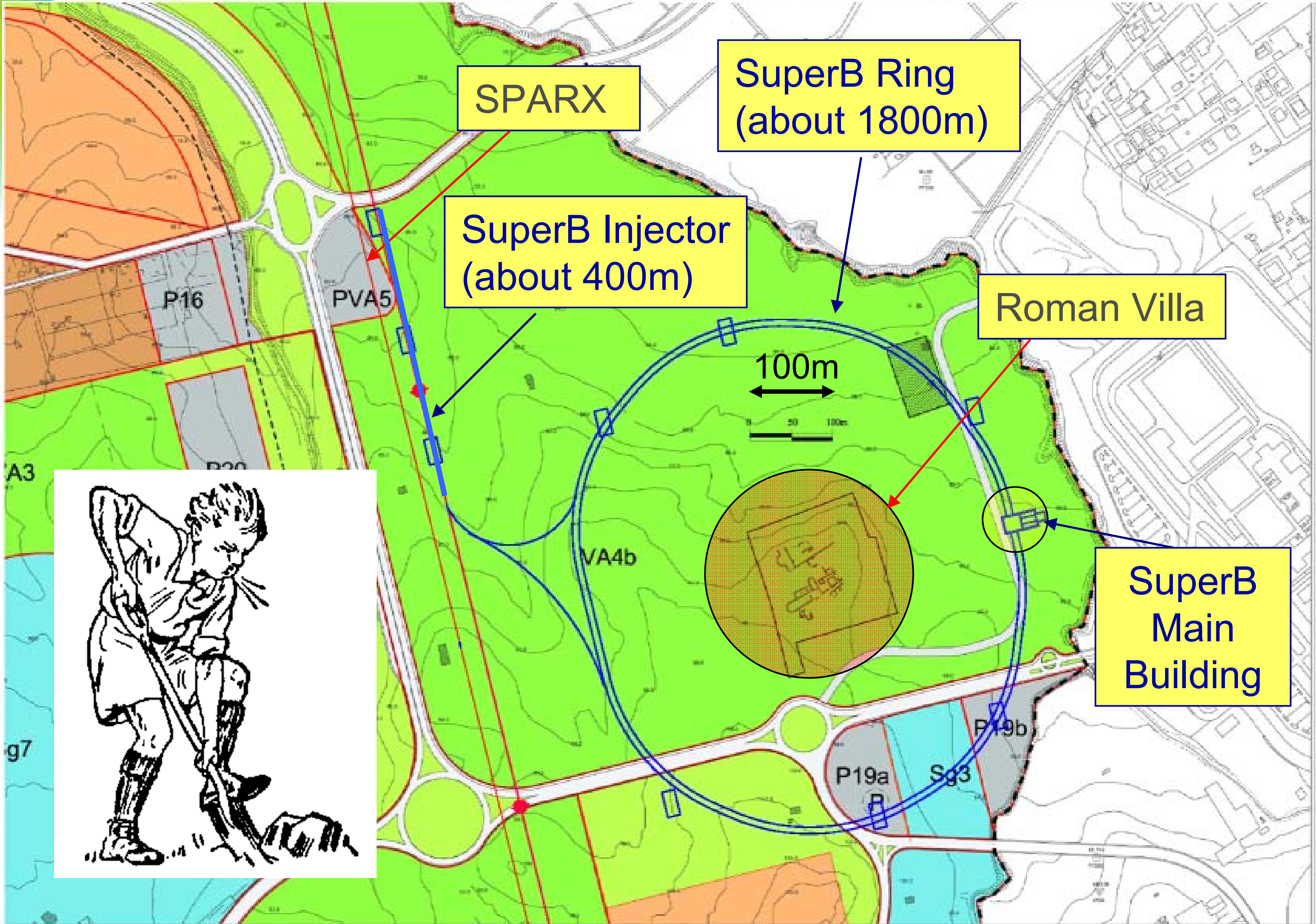
Manpower e soldi

- Le sedi sono ancora nella fase di definizione delle percentuali
- Prima stima su SuperB (solo Gruppo I):
  - Circa 29 FTE (ric+tec) di cui
    - circa 10 FTE provengono da fuori Babar
- Richieste finanziarie per il 2009
  - Totale di circa 850kEuro (esclusi metabolismi)
    - SVT 420
    - DCH 40
    - PID 20
    - EMC 200
    - IFR 95
    - COMP 70
- Il costo totale per l'INFN in CSN I sarebbe intorno a 20 M su 5 anni.

Next steps

- CDR Phase is substantially over.
- The SuperB community is ready to start the organization towards the preparation of a Technical Design Report, building the technical structure for the machine and detector project :
  - Collect resources for the machine design.
  - Organize the project group for site and infrastructure.
  - Organize the detector community for the next steps.
  - Build the s/w tools for machine & detector optimization, for physics.

SuperB Footprint



BACKUP

Funding model

- The SuperB budget model still needs to be fully developed. It is based on the following elements (all being negotiated)
  - Italian government ad hoc contribution
  - Regione Lazio contribution for infrastructure
  - INFN regular budget
  - EU contribution
  - In-kind contribution (PEP-II + Babar elements)
  - Partner countries contributions
- Clearly the SuperB project is inherently international and will need to be managed internationally
  - Through a dedicated Project Office

Accelerator and site costs

WBS	Item	EDIA mm	Labor mm	M\&S kEuro	Rep.Val. kEuro
1	**Accelerator**	**5429**	**3497**	**191166**	**126330**
1.1	Project management	2112	96	1800	0
1.2	Magnet and support system	666	1199	28965	25380
1.3	Vacuum system	620	520	27600	14200
1.4	RF system	272	304	22300	60000
1.5	Interaction region	370	478	10950	0
1.6	Controls, Diagnostics, Feedback	963	648	12951	8750
1.7	Injection and transport systems	426	252	86600	18000

WBS	Item	EDIA mm	Labor mm	M\&S kEuro	Rep.Val. kEuro
2.0	**Site**	**1424**	**1660**	**105700**	**0**
2.1	Site Utilities	820	1040	31700	0
2.2	Tunnel and Support Buildings	604	620	74000	0

Note: site cost estimate not as detailed as other estimates.

Detector cost

WBS	Item	EDIA mm	Labor mm	M\&S kEuro	Rep.Val. kEuro
1	**SuperB detector**	**3391**	**1873**	**40747**	**46471**
1.0	**Interaction region**	**10**	**4**	**210**	**0**
1.1	**Tracker (SVT + L0 MAPS)**	**248**	**348**	**5615**	**0**
1.1.1	**SVT**	**142**	**317**	**4380**	**0**
1.1.2	***L0 Striplet option***	***23***	***33***	***324***	***0***
1.1.3	**L0 MAPS option**	**106**	**32**	**1235**	**0**
1.2	**DCH**	**113**	**104**	**2862**	**0**
1.3	**PID (DIRC Pixilated PMTs + TOF)**	**110**	**222**	**7953**	**6728**
1.3.1	**DIRC barrel - Pixilated PMTs**	**78**	**152**	**4527**	**6728**
1.3.1	***DIRC barrel - Focusing DIRC***	***92***	***179***	***6959***	***6728***
1.3.2	**Forward TOF**	**32**	**70**	**3426**	**0**
1.4	**EMC**	**136**	**222**	**10095**	**30120**
1.4.1	**Barrel EMC**	**20**	**5**	**171**	**30120**
1.4.2	**Forward EMC**	73	152	6828	0
1.4.3	**Backward EMC**	42	65	3096	0
1.5	**IFR (scintillator)**	**56**	**54**	**1268**	**0**
1.6	**Magnet**	**87**	**47**	**1545**	**9623**
1.7	**Electronics**	**286**	**213**	**5565**	**0**
1.8	**Online computing**	**1272**	**34**	**1624**	**0**
1.9	**Installation and integration**	**353**	**624**	**3830**	**0**
1.A	**Project Management**	**720**	**0**	**180**	**0**

Note: options in italics are not summed. We chose to sum the options we considered most likely/necessary.

Schedule

- Overall schedule dominated by:
  - Site construction
  - PEP-II/Babar disassembly, transport, and reassembly
- We consider possible to reach the commissioning phase after 5 years from To.

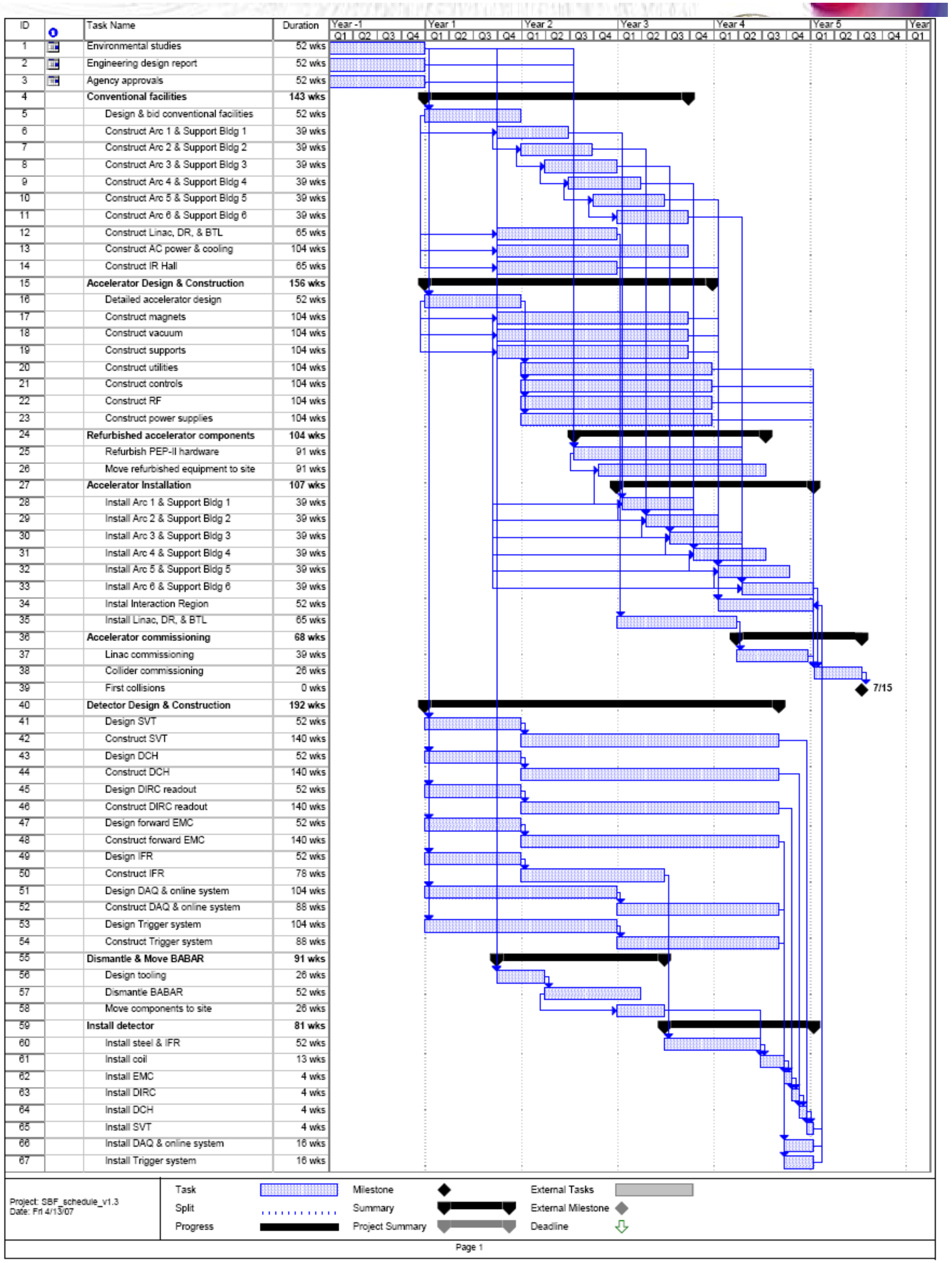


Figure 5-1. *Overall schedule for the construction of the SuperB project.*

B Physics Comparison 10ab^{-1} with 75 ab^{-1}

Mode	Sensitivity		
	Current	Expected (10 ab^{-1})	Expected (75 ab^{-1})
$\mathcal{B}(B \to X_s\gamma)$	7%	5%	3%
$A_{CP}(B \to X_s\gamma)$	0.037	0.01	0.004–0.005
$\mathcal{B}(B^+ \to \tau^+\nu)$	30%	10%	3–4%
$\mathcal{B}(B^+ \to \mu^+\nu)$	not measured	20%	5–6%
$\mathcal{B}(B \to X_s l^+l^-)$	23%	15%	4–6%
$A_{\rm FB}(B \to X_s l^+l^-)_{s_0}$	not measured	30%	4–6%
$\mathcal{B}(B \to K\nu\overline{\nu})$	not measured	not measured	16–20%
$S(K_S^0\pi^0\gamma)$	0.24	0.08	0.02–0.03

$B \to X_S\gamma$ *and* $B \to X_S\ell^+\ell^-$ not deeply investigated in the CDR

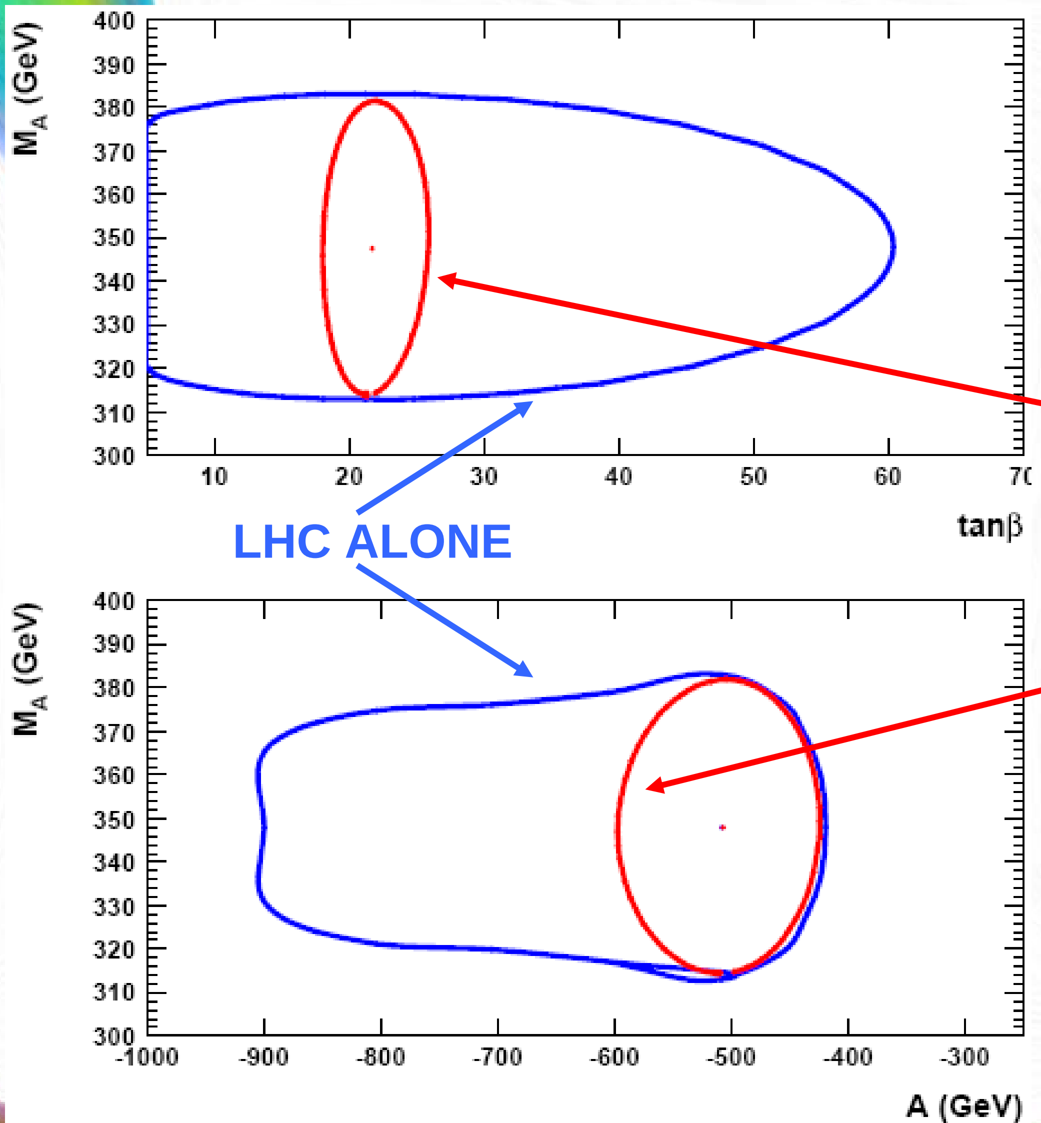
In CDR all comparisons for 50 ab^{-1}

Scenario selectivity

- Golden modes in different New Physics scenarios.
- A “X" indicates the golden channel of a given scenario.
- An “O" marks modes which are not the “golden" one of a given scenario but can still display a measurable deviation from the Standard Model.
- The label CKM denotes golden modes which require the high-precision determination of the CKM parameters achievable at SuperB.

	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			O

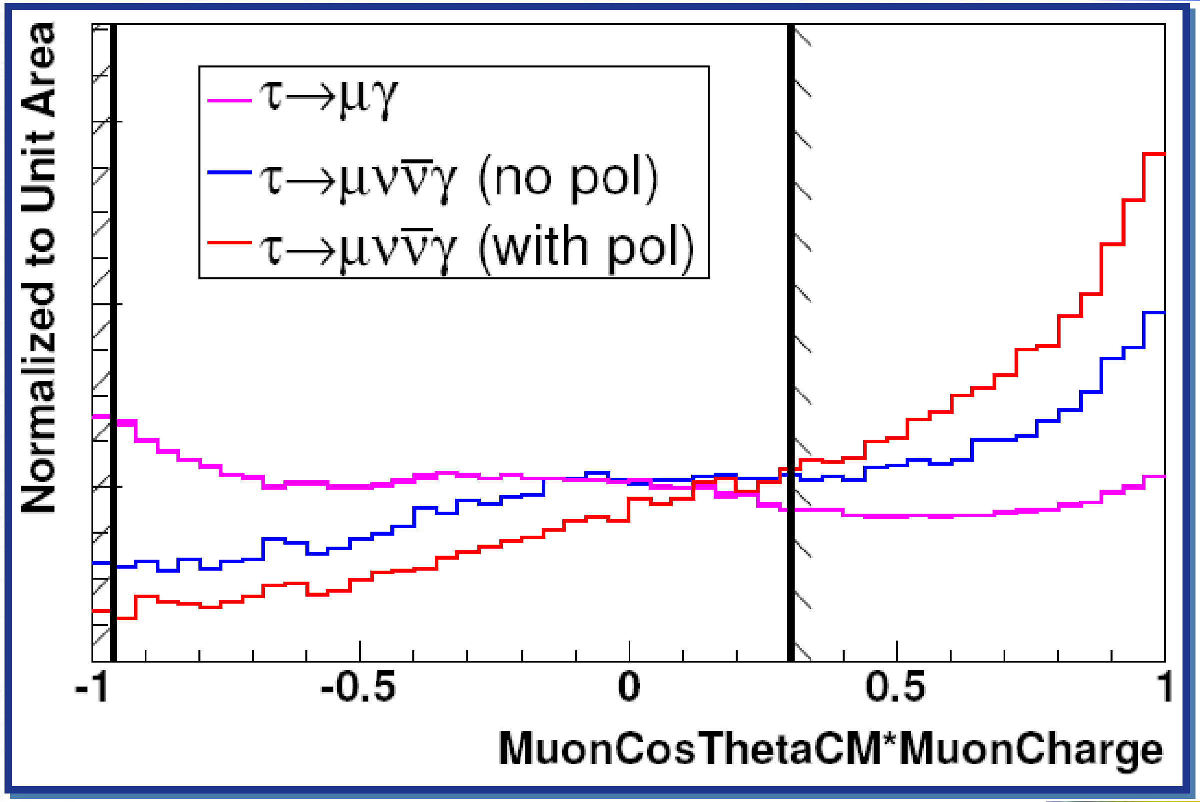
Complementarity of low energy measurements and LHC energy frontier



SUSY parameters constraints

TAU LFV (use of polarization)

- Understanding possible uses of polarization just beginning
- Powerful tool:
  - discriminate background from angular distributions
  - CPV,
  - T-odd observables
  - EDM
  - helicity structure
  - g-2



Process	Expected 90%CL upper limited	4σ Discovery Reach
$\mathcal{B}(\tau \to \mu \gamma)$	2×10^{-9}	5×10^{-9}
$\mathcal{B}(\tau \to \mu \mu \mu)$	2×10^{-10}	8.8×10^{-10}

CPV in Charm

CP violation can be studied in high statistics as:

1. Indirect in the mixing
2. Direct in the decay

With very high statistics at Υ_{4S} together with tau and B physics

BUT time dependent analysis is needed for CP violation in the interference mixing-decay, for it runs at *charm threshold* production are needed in asymmetric factory mode .

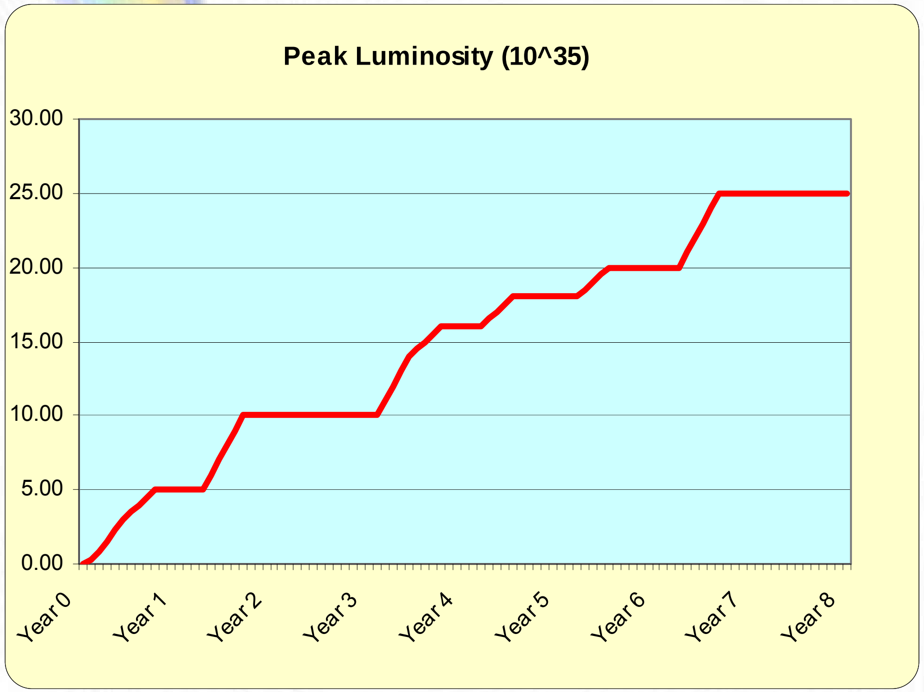
$D^0 \to K^+K^-$ and $D^0 \to \pi^+\pi^-$ can be studied with time dependent analysis and ϕ_f can be extracted.

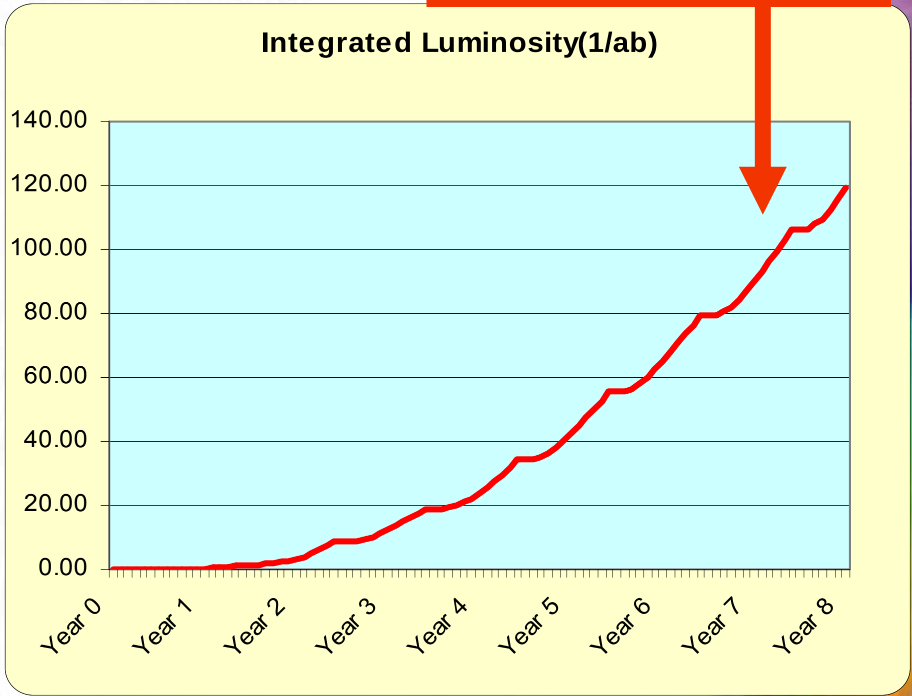
Running options

- Dedicated runs at the tau/charm threshold feasible
- Electron polarization scheme is very important
  - Expected ≥ 80% polarization
  - Polarized electron source
  - Electron spin manipulation to provide longitudinal polarization @ IP

SuperB expected LUMI

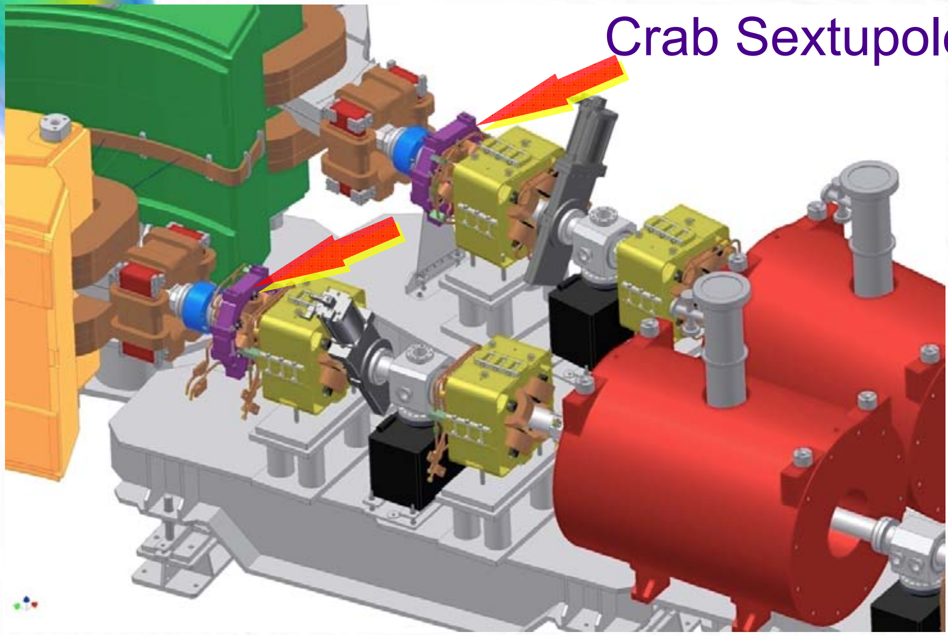
>80ab-1 in 7th year

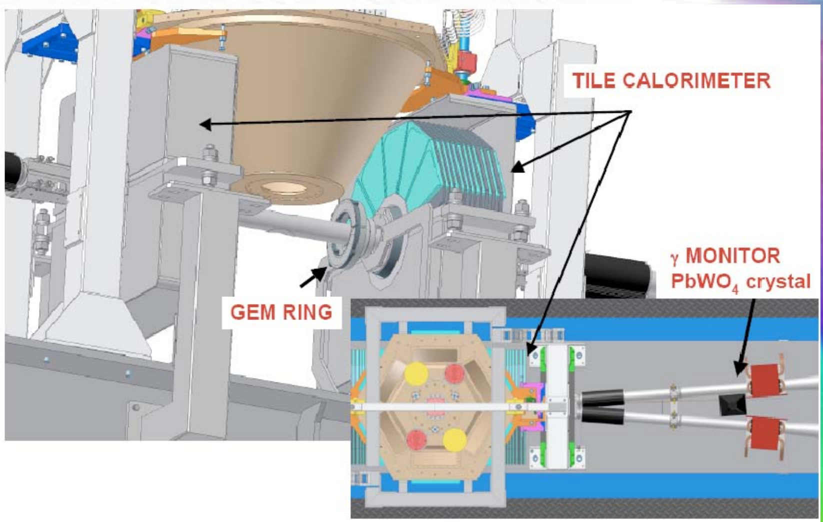




After 7th year integrated Luminosity can grow at rate of ~40 ab^{-1}/year

DAΦNE Crab Waist Exp.



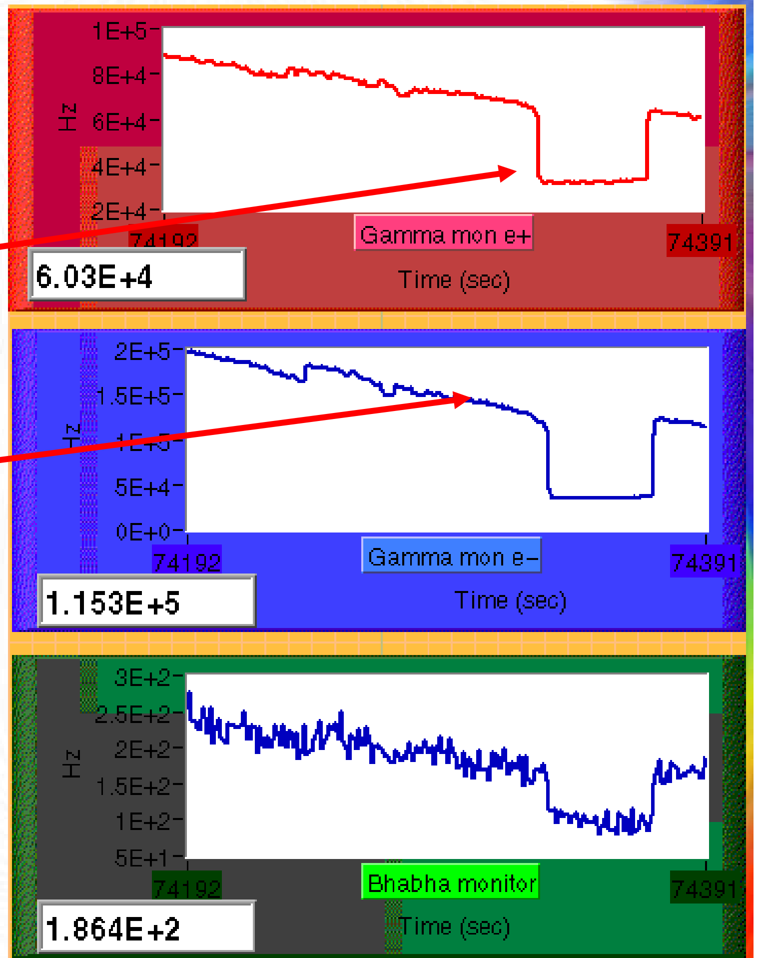


- Tests still ongoing in Frascati
- Small angle EMC as luminosity monitor
- Beam crabbing made by 2 pairs of Sextupoles

Effect of crab sextupoles on luminosity

A huge work on machine optimization has been done and is still in progress in term of feedbacks systems tuning, background minimization and tuning of the machine luminosity

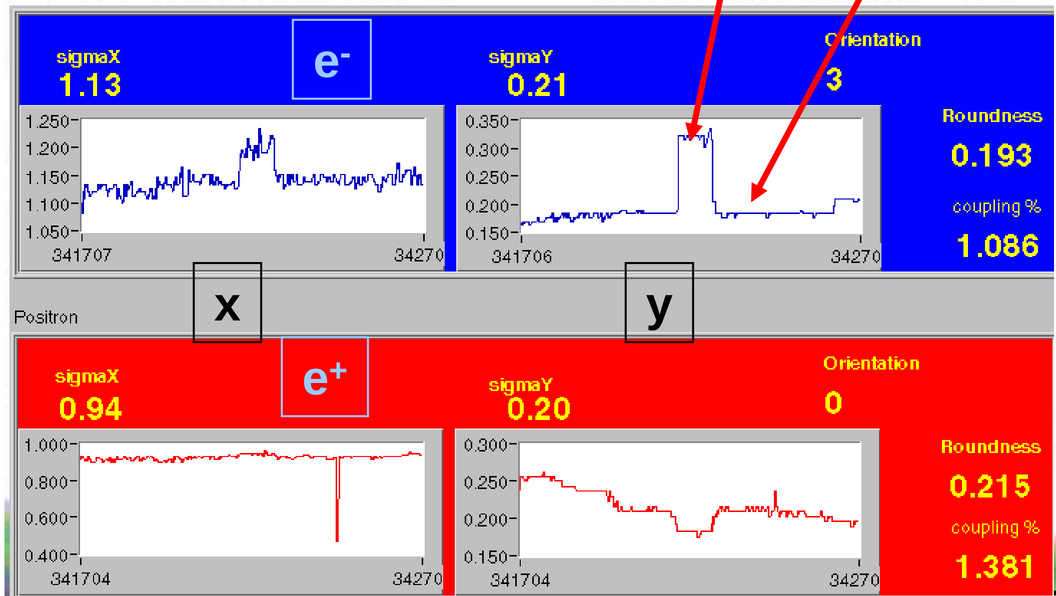
LUMINOMETERS



Crab OFF

Crab ON

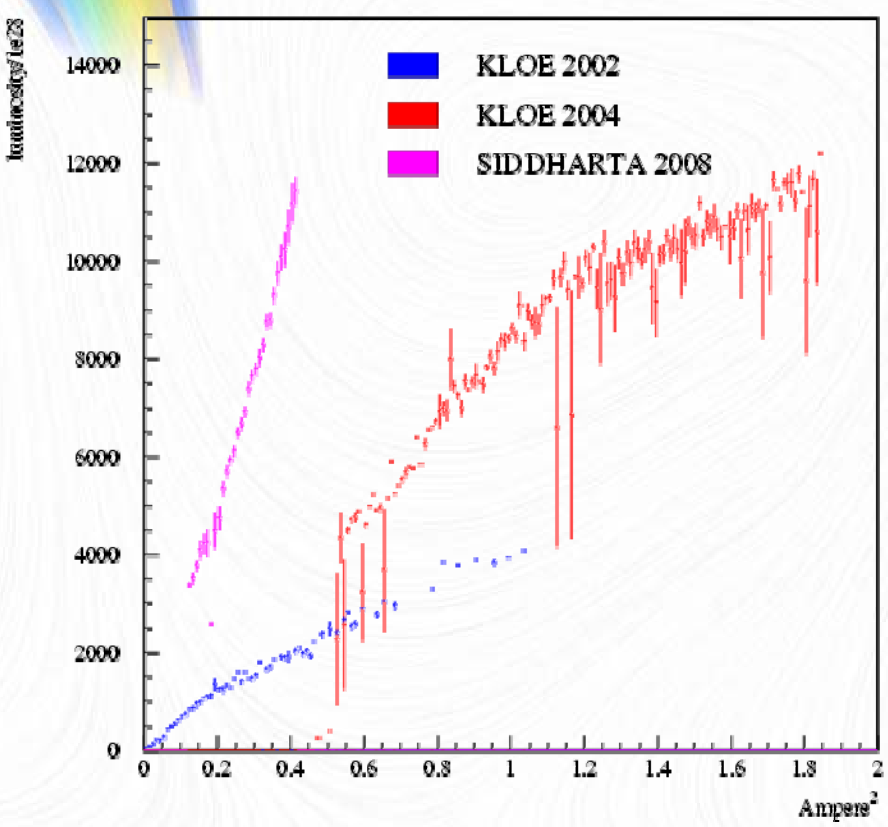
Transverse beam dimensions at the Synchrotron Light Monitor



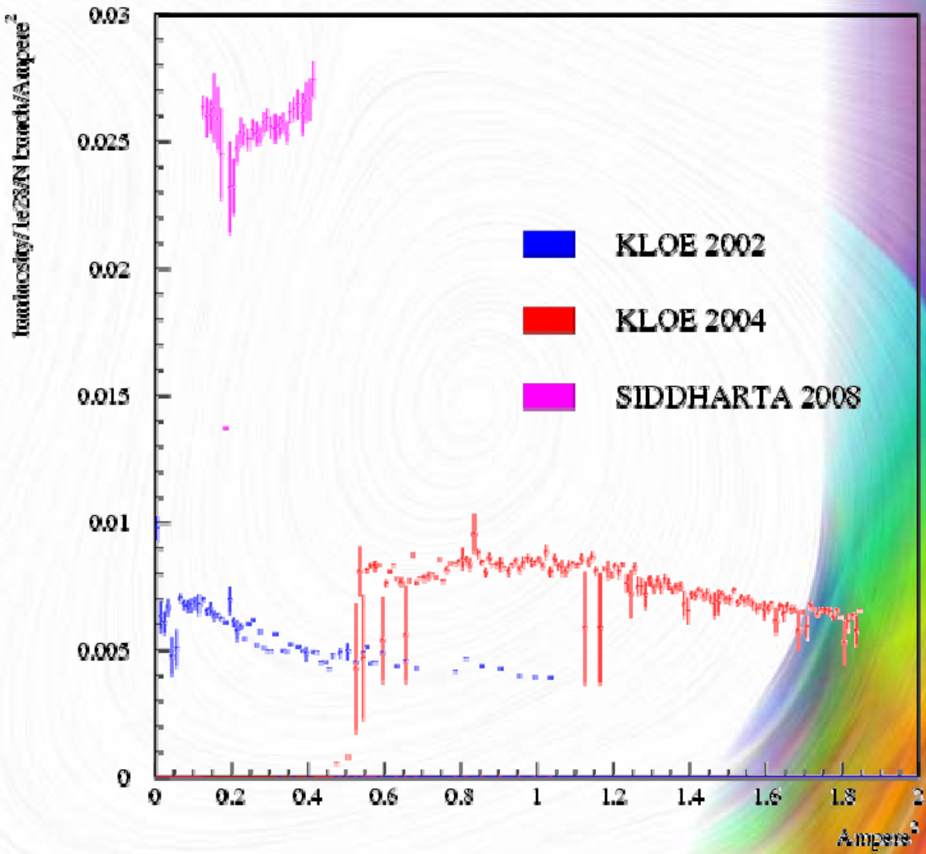
Blow-up in beam sizes and decrease in Bhabha rates observed when crab sexts for one ring OFF (other ring ON)

Lumi and specific lumi

Luminosity vs I^+I^-



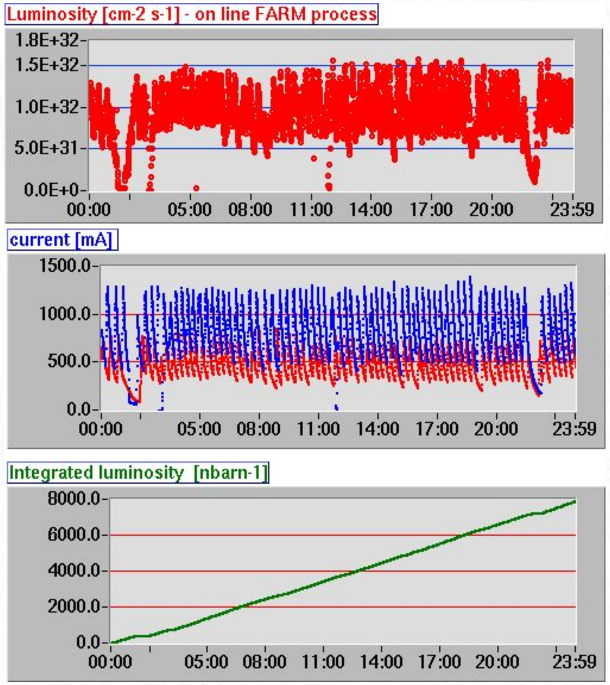
Specific L vs I^+I^-



Best days

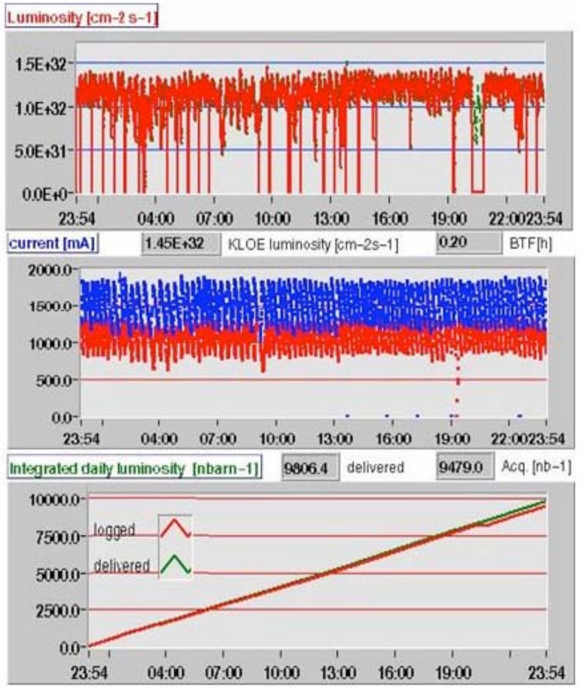
- Reached same lumi as before, but with much smaller currents

SIDDHARTA 2008



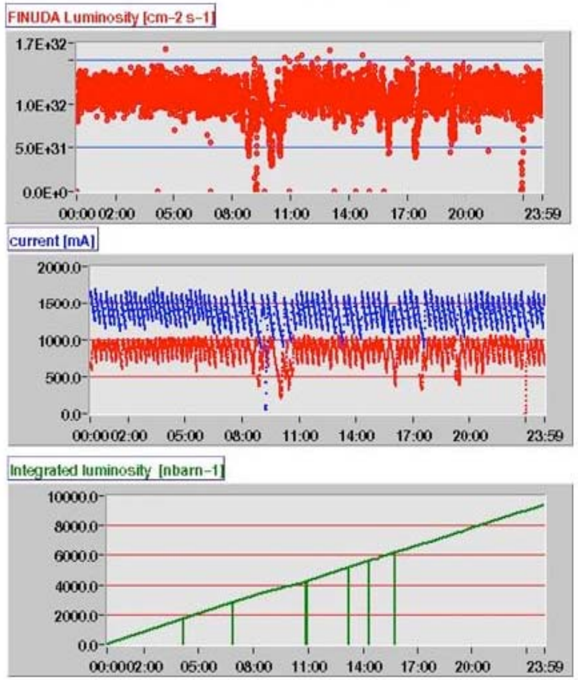
90 bunches, β_y^*= 0.9 cm, β_x^* = 0.26 m

KLOE 2002



111 bunches, β_y^*= 1.8 cm, β_x^*= 1.5 m

FINUDA 2004



106 bunches, β_y^*= 1.9 cm, β_x^*= 2.0 m