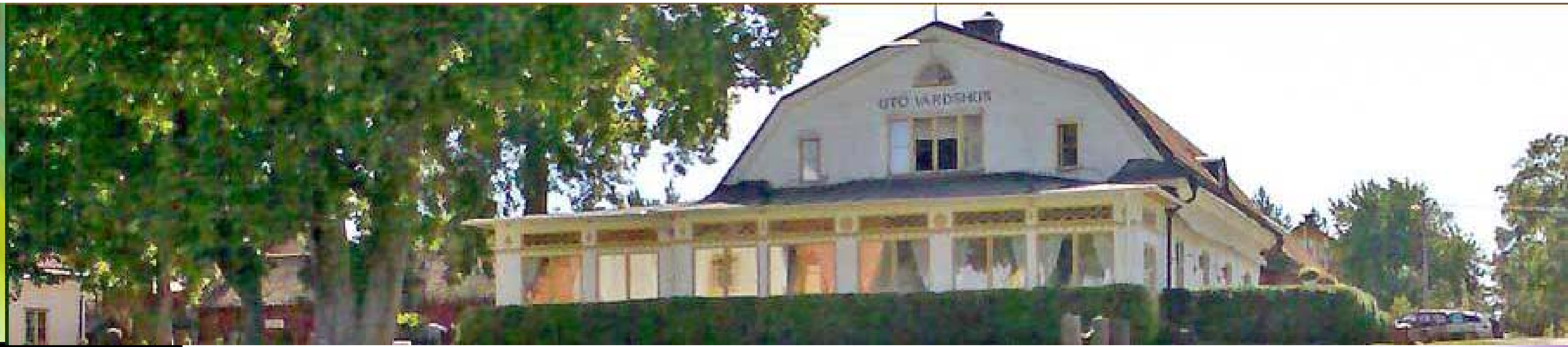


Status of SuperB

Francesco Forti, INFN e Università, Pisa

Vertex 2008 Conference

Utö Island, Sweden

July 29, 2008

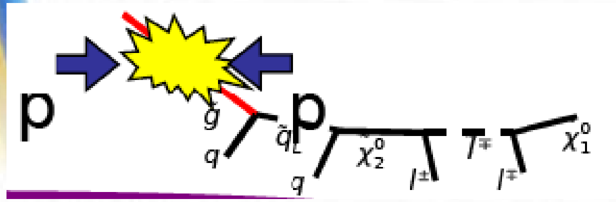
INFN

Outline

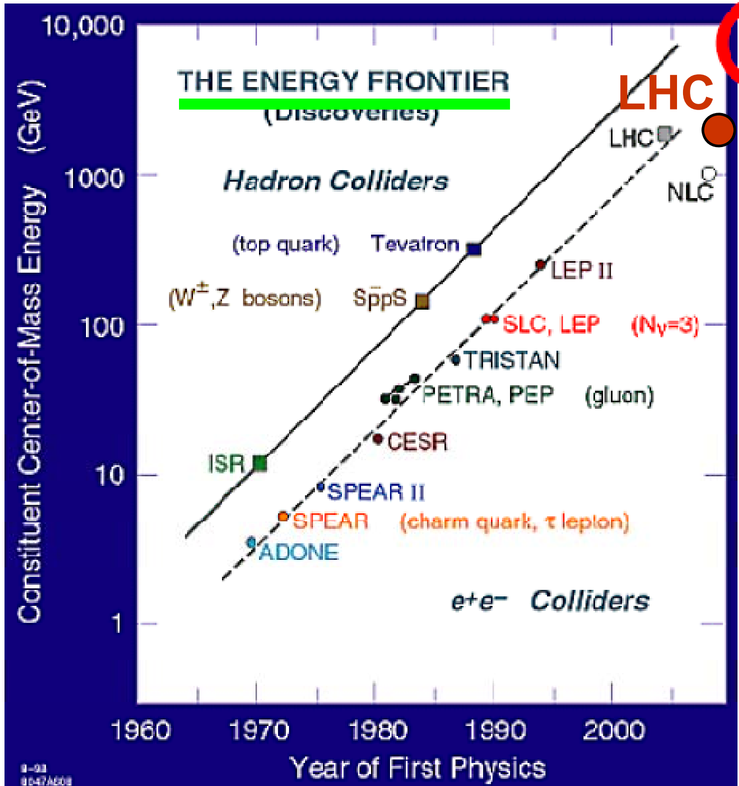
- SuperB Physics Motivation
- The SuperB Accelerator in a nutshell
  - Results of Frascati Tests
- The SuperB Detector
  - The Vertex Detector
  - LayerZero R&D – CMOS MAPS
- The SuperB Approval Process

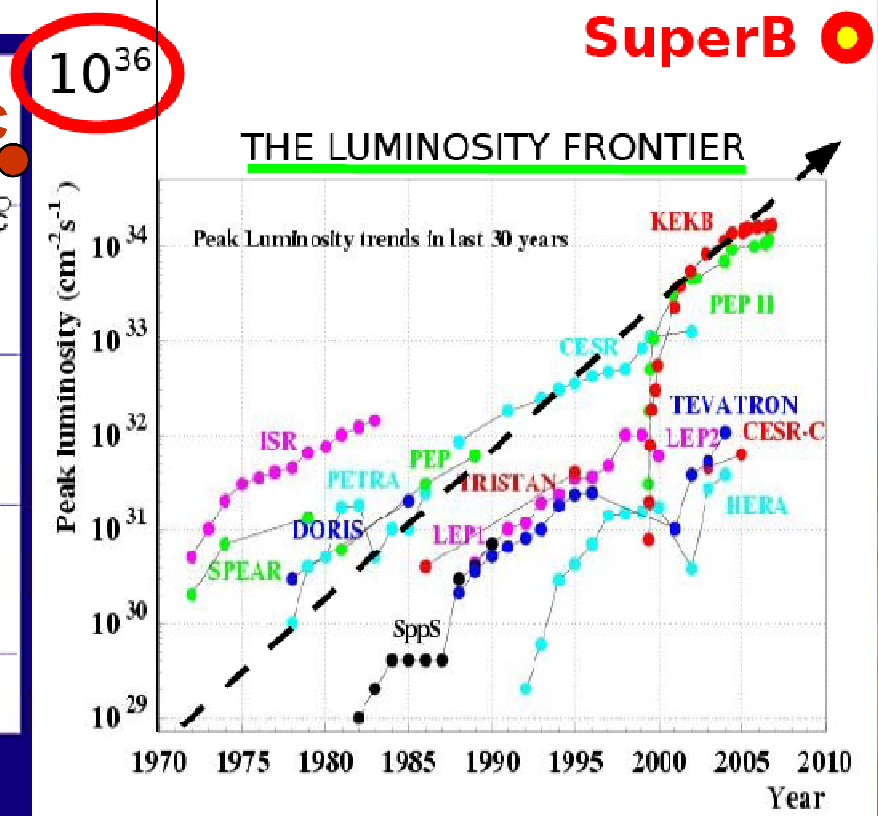
Exploration of two frontiers

Relativistic path



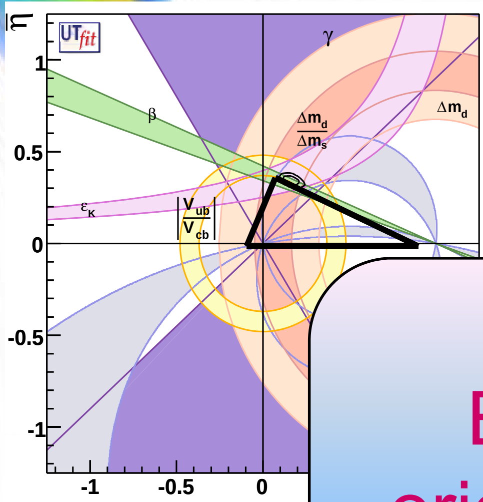
Quantum path



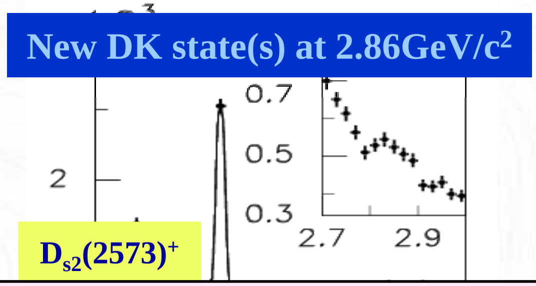


(Some) Results from B-Factories

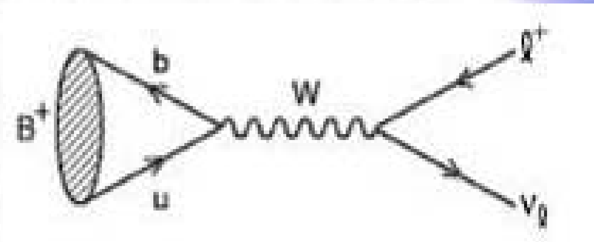
Unitarity Triangle precision measurements

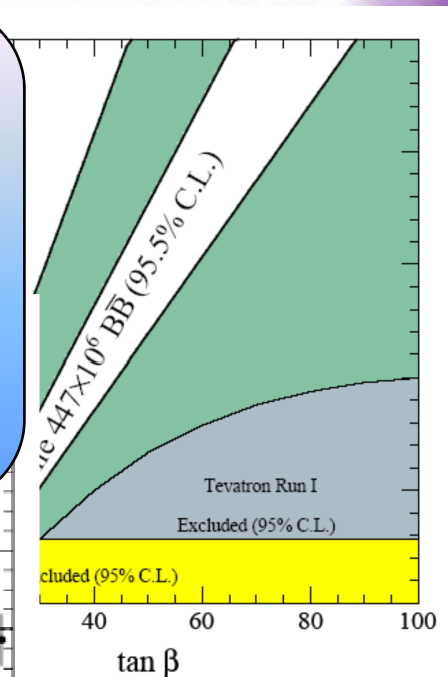


Spectroscopy of new, unexpected states



B→τν setting limits on MSSM parameters





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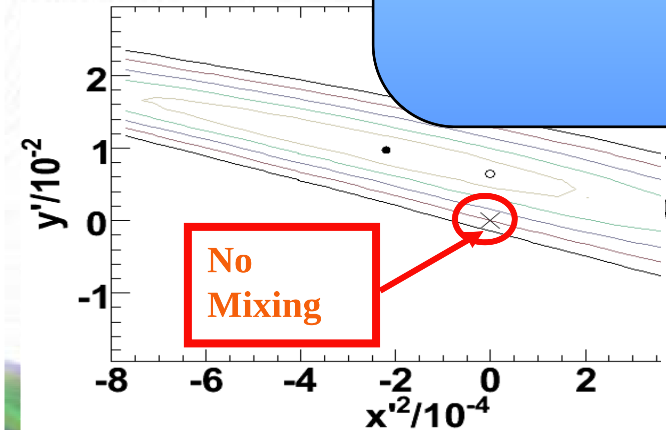
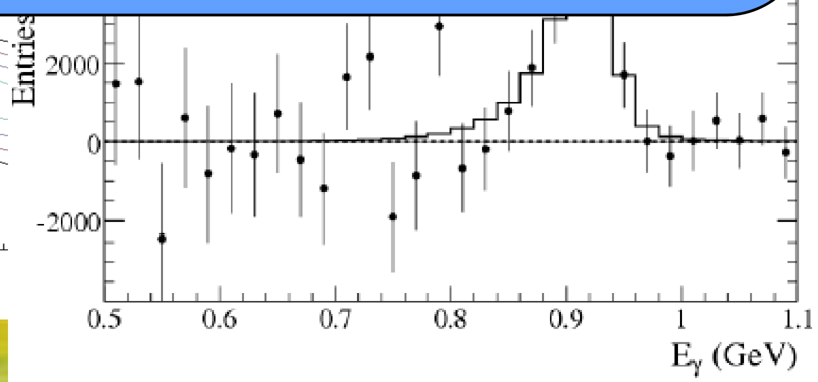
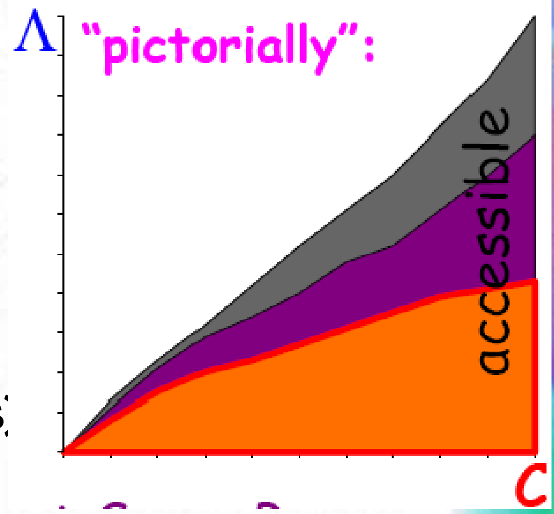




Extend well beyond the originally envisaged physics program.

Power of Intensity

- Precision measurements in the flavour sector are sensitive to New Physics (NP)
  - Intereference effects in known processes
  - SM Rare or forbidden decays
- NP effects are controlled by
  - NP scale: Λ
  - Effective couplings: C
    - Different coupling intensity (different interactions)
    - Differente patterns (e.g. because of simmetries)



- With 5-10x10^{10} bb, cc, ττ pairs (50-100 ab^{-1}) one can:

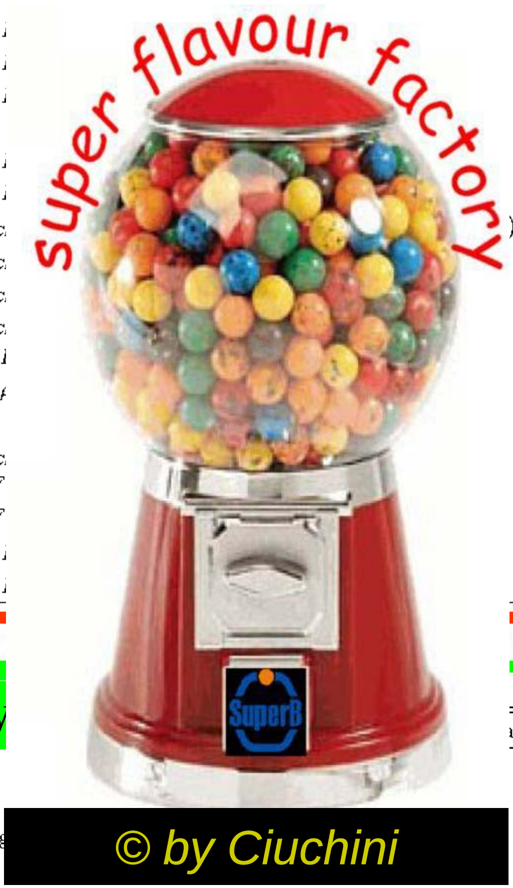
LHC finds NP(Λ)	LHC does not find NP(Λ)
• Determine detailed structure of couplings of NP	• Look for indirect NP signals • Connect them to models
• Look for heavier startes • Study NP flavour structure	• Exclude regions in parameters space

Some channels, such as the LFV decays of τ are unambiguous signals of NP

B Physics @ Y(4S)

	ab^{-1})	Super$B$ (75 ab^{-1})
in(2β) ($J/\psi K^0$)	0.018	0.005 (†)
os(2β) ($J/\psi K^{*0}$)	0.30	0.05
in(2β) (Dh^0)	0.10	0.02
os(2β) (Dh^0)	0.20	0.04
$S(J/\psi\, \pi^0)$	0.10	0.02
$S(D^+D^-)$	0.20	0.03
$S(\phi K^0)$	0.13	0.02 (∗)
$S(\eta' K^0)$	0.05	0.01 (∗)
$S(K_S^0 K_S^0 K_S^0)$	0.15	0.02 (∗)
$S(K_S^0 \pi^0)$	0.15	0.02 (∗)
$S(\omega K_S^0)$	0.17	0.03 (∗)
$S(f_0 K_S^0)$	0.12	0.02 (∗)
γ ($B \to DK$, $D \to CP$ eigenstates)	$\sim 15^\circ$	2.5°
γ ($B \to DK$, $D \to$ suppressed states)	$\sim 12^\circ$	2.0°
γ ($B \to DK$, $D \to$ multibody states)	$\sim 9^\circ$	1.5°
γ ($B \to DK$, combined)	$\sim 6^\circ$	1–2°
α ($B \to \pi\pi$)	$\sim 16^\circ$	3°
α ($B \to \rho\rho$)	$\sim 7^\circ$	1–2° (∗)
α ($B \to \rho\pi$)	$\sim 12^\circ$	2°
α (combined)	$\sim 6^\circ$	1–2° (∗)
$2\beta+\gamma$ ($D^{(*)\pm}\pi^\mp$, $D^\pm K_S^0 \pi^\mp$)	20°	5°

Observable	B Factories (2 ab^{-1})	Super$B$ (75 ab^{-1})
$\lvert V_{cb}\rvert$ (exclusive)	4% (∗)	1.0% (∗)
$\lvert V_{cb}\rvert$ (inclusive)	1% (∗)	0.5% (∗)
$\lvert V_{ub}\rvert$ (exclusive)	8% (∗)	3.0% (∗)
$\lvert V_{ub}\rvert$ (inclusive)	8% (∗)	2.0% (∗)
$\mathcal{B}($		
$\mathcal{B}($		
$\mathcal{B}($		
$\mathcal{B}($		
$\mathcal{B}($		
A_C		
A_C		
A_C		
A_C		
$S($		
$S($		)
A_C		
A^F		
A^F		
$\mathcal{B}($		
$\mathcal{B}($		



Charm mixing and CP

Mode	Observable	$\Upsilon(4S)$ (75 ab^{-1})	$\psi(3770)$ (300 fb^{-1})
$D^0 \to K^+\pi^-$	x'^2	3×10^{-5}	
	y'	7×10^{-4}	
$D^0 \to K^+K^-$	y_{CP}	5×10^{-4}	
$D^0 \to K_S^0\pi^+\pi^-$	x	4.9×10^{-4}	
	y	3.5×10^{-4}	
	$\lvert q/p\rvert$	3×10^{-2}	
	ϕ	2°	
$\psi(3770) \to D^0\overline{D}^0$	x^2		$(1-2) \times 10^{-5}$
	y		$(1-2) \times 10^{-3}$
	$\cos\delta$		$(0.01-0.02)$

Charm FCNC

	Sensitivity
$D^0 \to e^+e^-$, $D^0 \to \mu^+\mu^-$	1×10^{-8}
$D^0 \to \pi^0 e^+e^-$, $D^0 \to \pi^0\mu^+\mu^-$	2×10^{-8}
$D^0 \to \eta e^+e^-$, $D^0 \to \eta\mu^+\mu^-$	3×10^{-8}
$D^0 \to K_S^0 e^+e^-$, $D^0 \to K_S^0\mu^+\mu^-$	3×10^{-8}
$D^+ \to \pi^+ e^+e^-$, $D^+ \to \pi^+\mu^+\mu^-$	1×10^{-8}
$D^0 \to e^\pm\mu^\mp$	1×10^{-8}
$D^+ \to \pi^+ e^\pm\mu^\mp$	1×10^{-8}
$D^0 \to \pi^0 e^\pm\mu^\mp$	2×10^{-8}
$D^0 \to \eta e^\pm\mu^\mp$	3×10^{-8}
$D^0 \to K_S^0 e^\pm\mu^\mp$	3×10^{-8}
$D^+ \to \pi^- e^+e^+$, $D^+ \to K^- e^+e^+$	1×10^{-8}
$D^+ \to \pi^-\mu^+\mu^+$, $D^+ \to K^-\mu^+\mu^+$	1×10^{-8}
$D^+ \to \pi^- e^\pm\mu^\mp$, $D^+ \to K^- e^\pm\mu^\mp$	1×10^{-8}

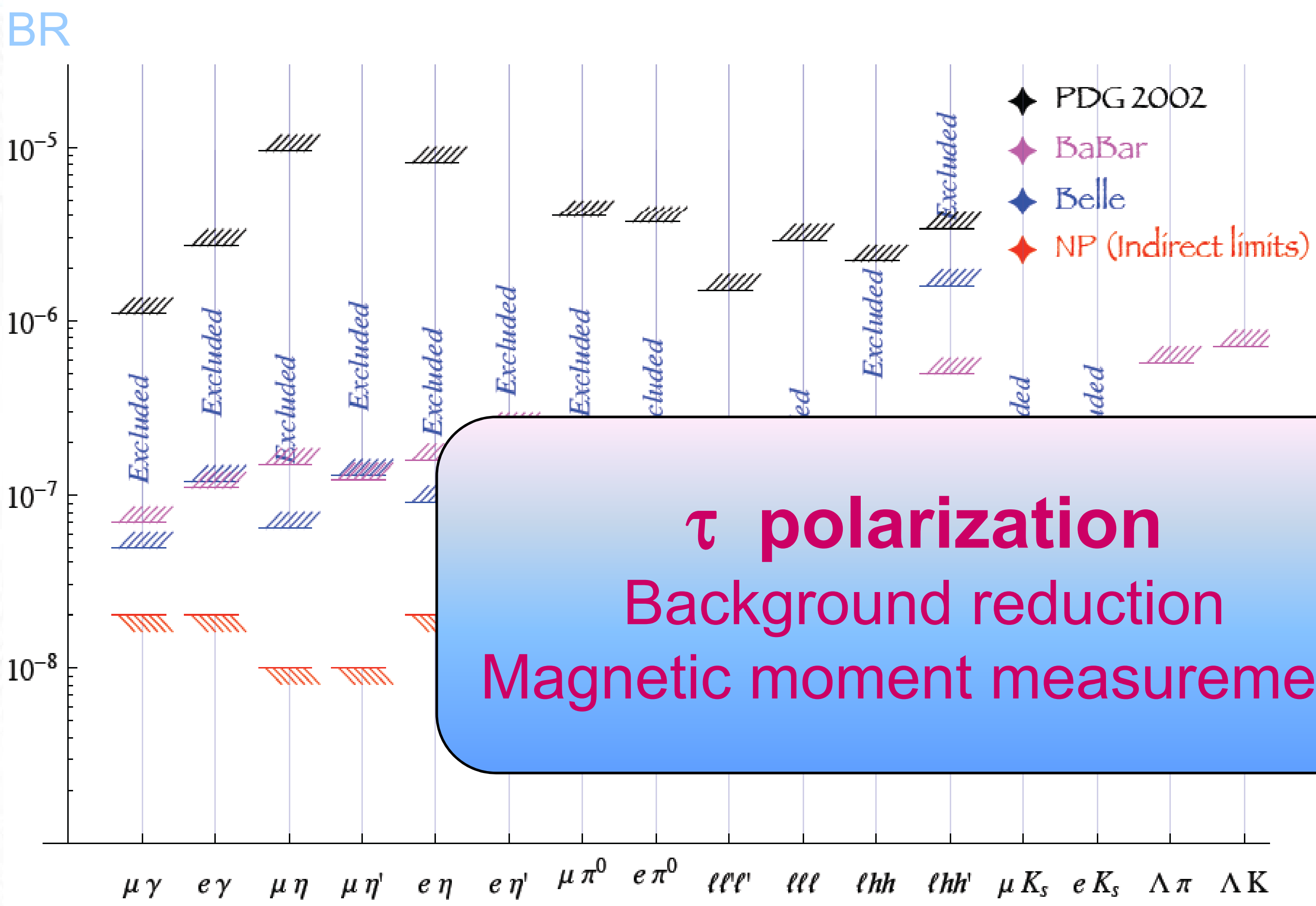
τ Physics

	Sensitivity
$\mathcal{B}(\tau \to \mu\gamma)$	2×10^{-9}
$\mathcal{B}(\tau \to e\gamma)$	2×10^{-9}
$\mathcal{B}(\tau \to \mu\mu\mu)$	2×10^{-10}
$\mathcal{B}(\tau \to eee)$	2×10^{-10}
$\mathcal{B}(\tau \to \mu\eta)$	4×10^{-10}
$\mathcal{B}(\tau \to e\eta)$	6×10^{-10}
$\mathcal{B}(\tau \to \ell K_S^0)$	2×10^{-10}

B_s Phy

		ab^{-1}
$\Delta\Gamma$		
Γ		
β_s from ang		
A_{SL}^s		
A_{CH}	0.004	0.004
$\mathcal{B}(B_s \to \mu^+\mu^-)$	-	$< 8 \times 10^{-9}$
$\lvert V_{td}/V_{ts}\rvert$	0.08	0.017
$\mathcal{B}(B_s \to \gamma\gamma)$	38%	7%
β_s from $J/\psi\phi$	10°	3°
β_s from $B_s \to K^0\bar{K}^0$	24°	11°

Lepton flavour violation in τ decay



τ polarization

Background reduction

Magnetic moment measurement

SuperB Sensitivity (75 ab^{-1})

Process	Sensitivity
$\mathcal{B}(\tau \to \mu\gamma)$	2×10^{-9}
$\mathcal{B}(\tau \to e\gamma)$	2×10^{-9}
$\mathcal{B}(\tau \to \mu\mu\mu)$	2×10^{-10}
$(\tau \to eee)$	2×10^{-10}
$(\tau \to \mu\eta)$	4×10^{-10}
$(\tau \to e\eta)$	6×10^{-10}
$(\tau \to \ell K^0_S)$	2×10^{-10}

Very high luminosity

Ways to increase luminosity by two order of magnitude:

KEKB:

- High currents
- Small damping time
- Short bunches
- Crab cavities for head-on collisions

- Large RF power
- High order modes
- High backgrounds

SuperB:

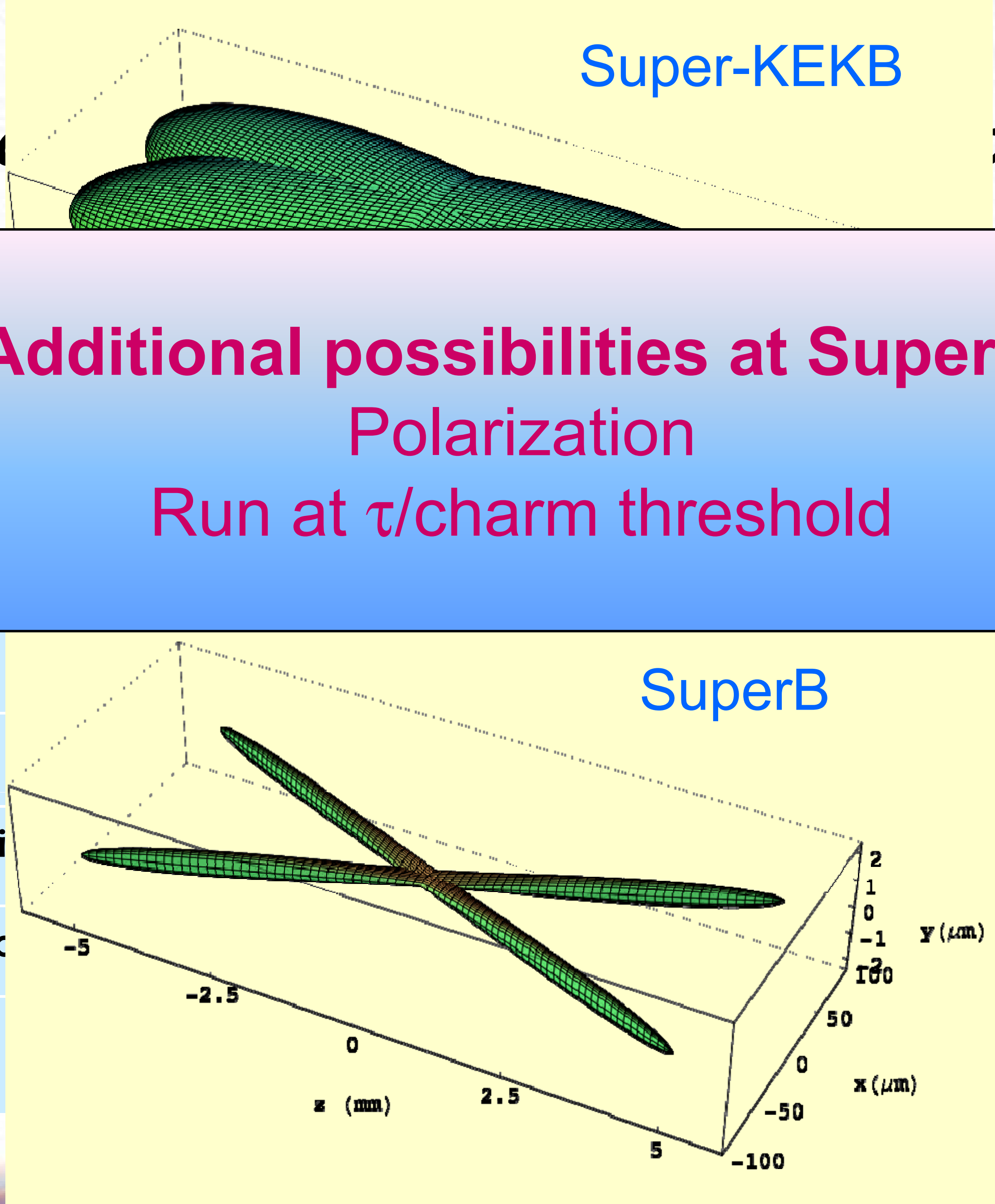
- Very small emi
- Small β^* at IP
- Large Piwinski
- Crab waist tec
- Currents similar to present ones

- Small collision area
- c crossing
- esonances
- backgrounds

Reuse many PEP-II components

Comp… …er-KEKB

	B
E	
L	
B	
β_y^*	.
β_x^*	o.
Crossi	o 0.
RF po	o 90
Tune	/0.3



Additional possibilities at SuperB:

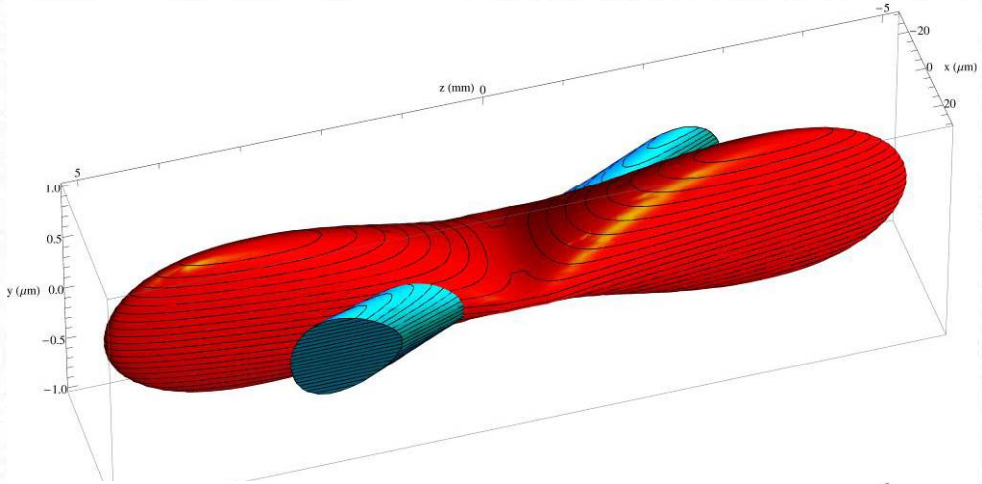
Polarization

Run at τ/charm threshold

Crab waist illustration

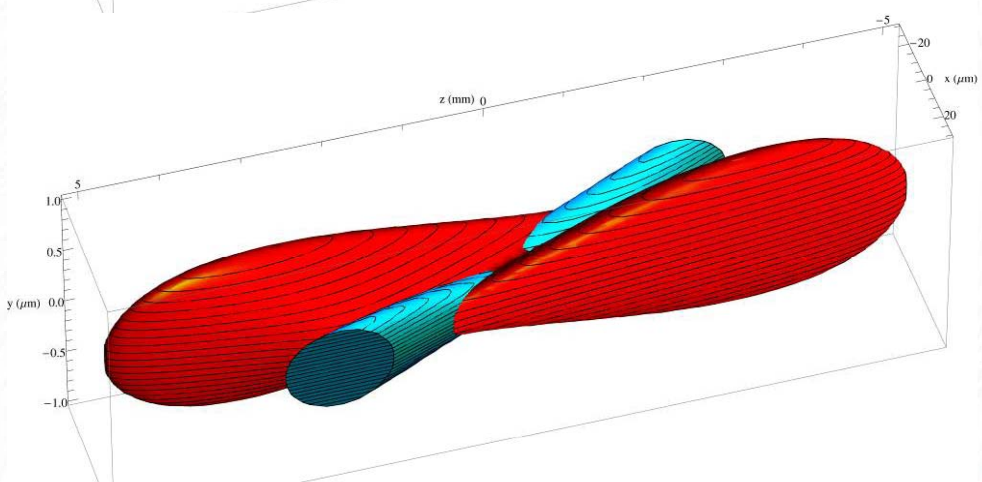
Crab sextupoles OFF

waist line is orthogonal to the axis of one bunch



Crab sextupoles ON

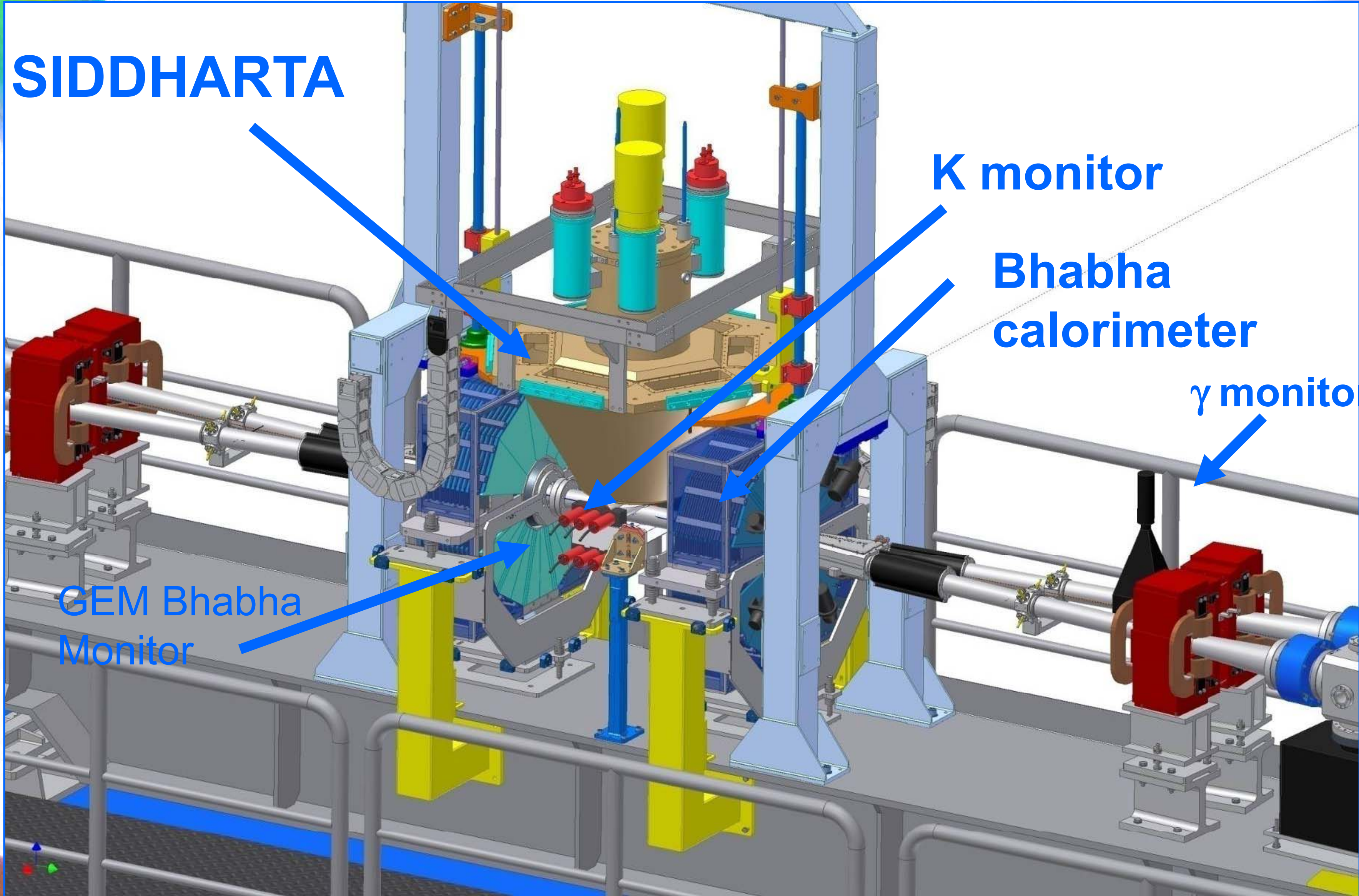
waist moves to the axis of other beam



All particles from both beams collide in the minimum β_y region:

- net luminosity gain
- removal of dangerous synchrotron-betatron resonances

DAΦNE Crab Waist test

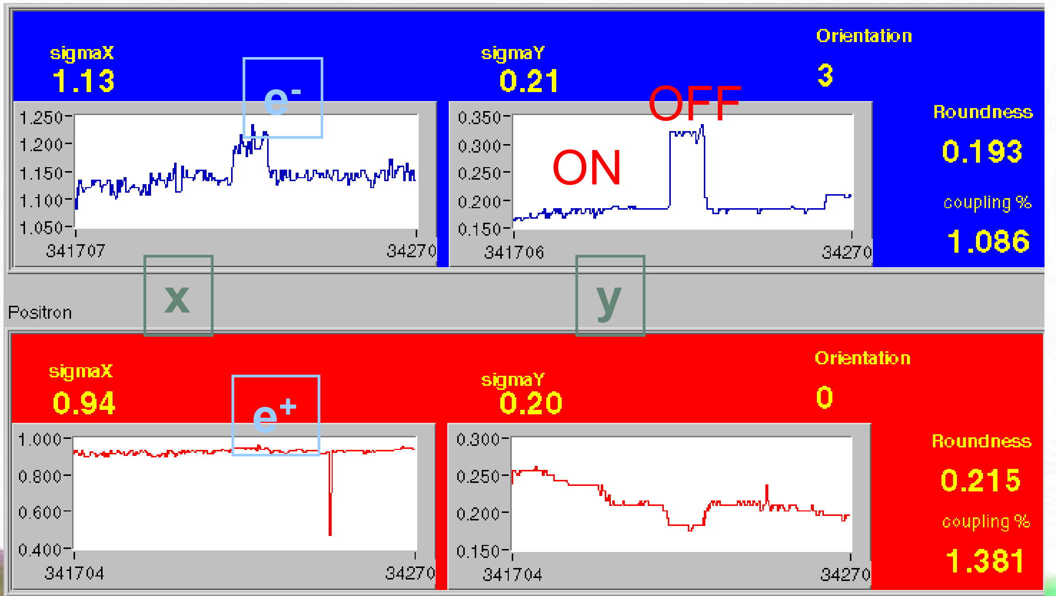


Crab sextupoles effects

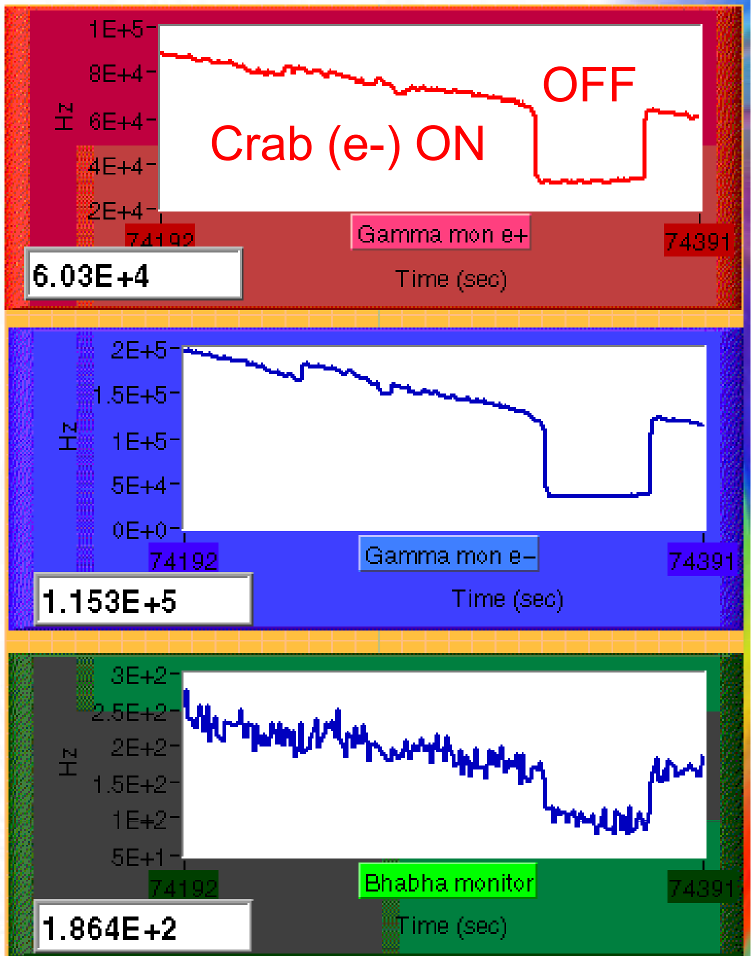
Effect on luminosity:
Turning off the crab sextupoles the luminosity drops by a factor 2-3, recoverable by turning them on again

Effect on beam dimension:
Turning off the crab sextupoles the beam dimension increases because of couplings induced by the crossing angle

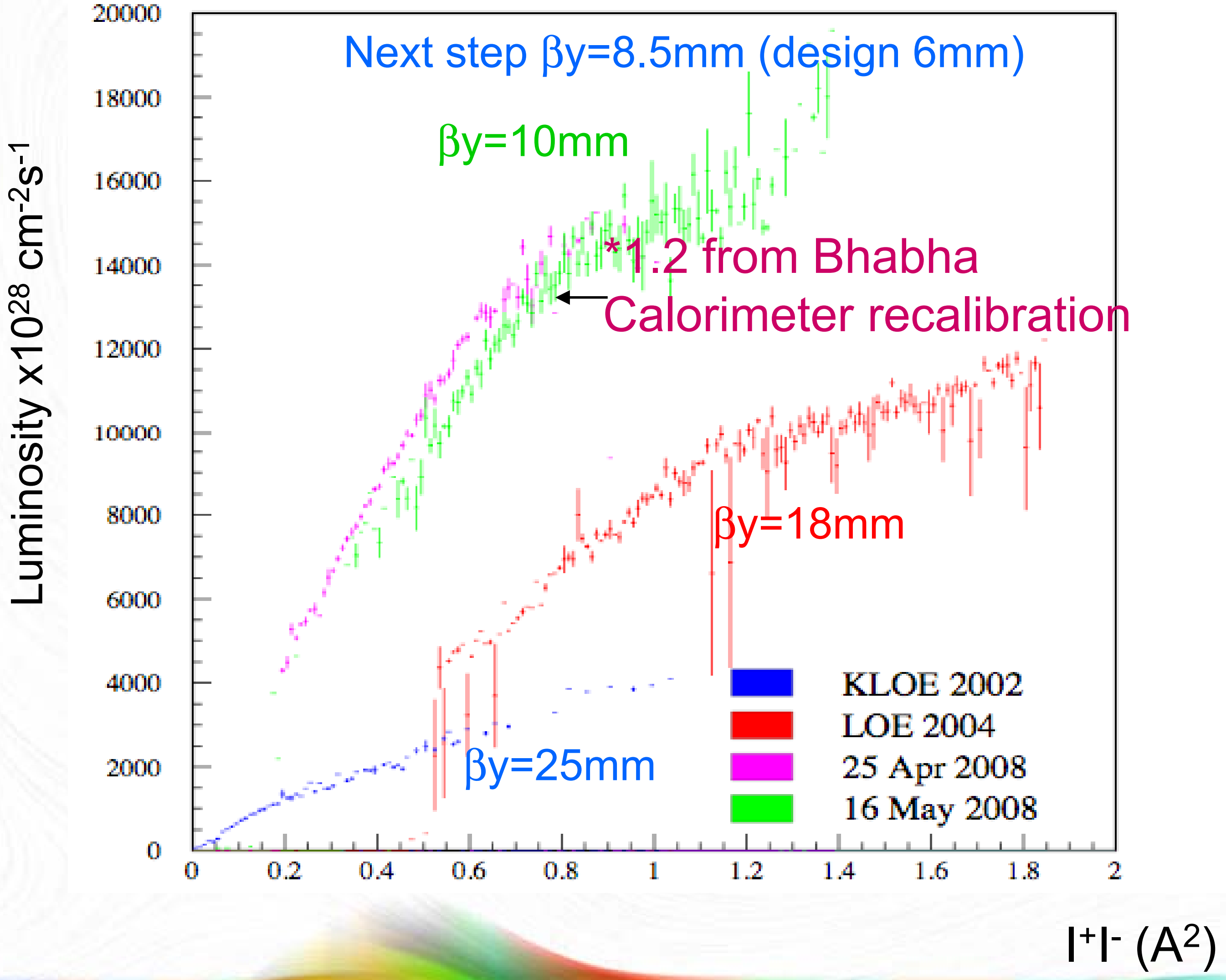
Transverse beam dimension at the Synchrotron Light Monitor



LUMINOMETERS

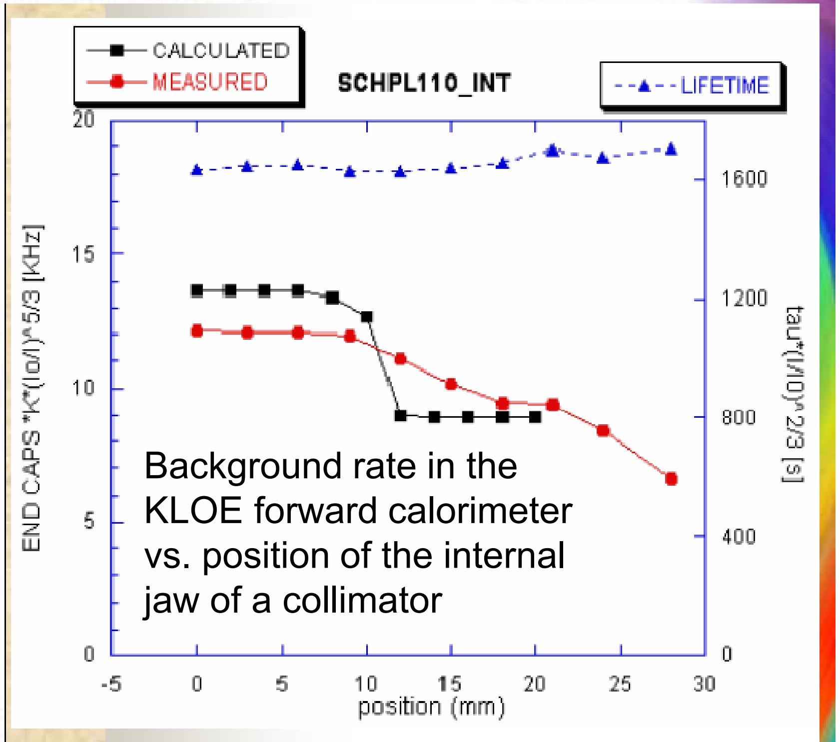


Luminosity vs current product



Summary of DaΦne tests

- Only electrons: I^{-}= 1.79A in 95 bunches
- Only positrons: I^{+}= 1.15A in 120 bunches
- Both beams, interacting: I-=1.2A, I+=1.1A in 95 bunches
- Peak Luminosity ≈$2.6x10^{32}cm^{-2}s^{-1}$
- Integrated luminosity
  - per day: ≈9.6 pb^{-1}
  - per hour: ≈ 0.6pb^{-1} (KLOE record 0.44pb-1)
- Crab sextupoles work as designed
- Beam parameters and backgrounds are as expected from simulation → validation of simulation tools



Further improvements are in the pipeline:

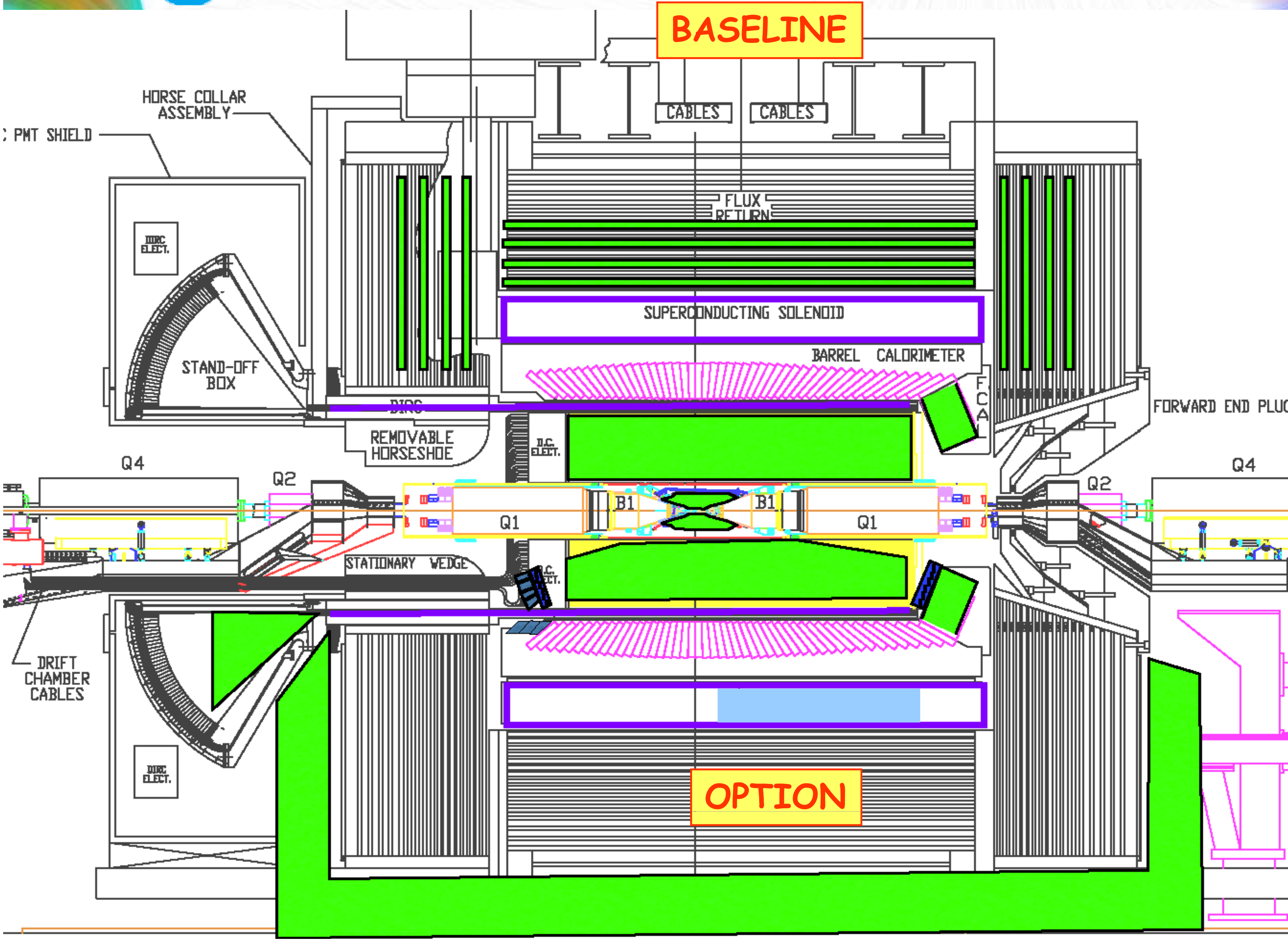
$4x10^{32}cm^{-2}s^{-1}$ and 20 pb^{-1}/day → KLOE ROLL-IN

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

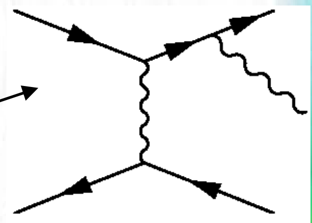
Detector Layout – Reuse parts of Babar

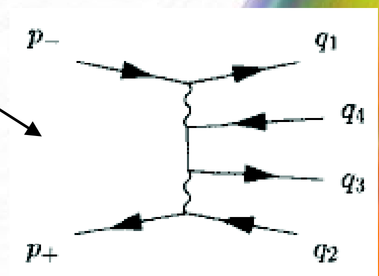


Background

- To be treated with care, but not a huge problem
- Sources: different from PEP-II/Babar
  - Beam-gas: ok because of low current
  - SR fan: can be shielded
  - Touschek

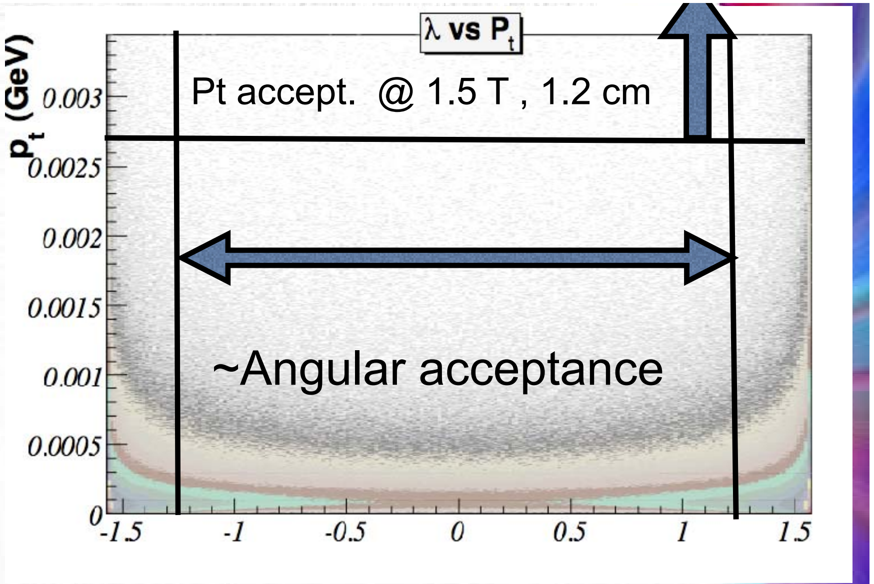
	Cross section	Evt/bunch xing	Rate
Radiative Bhabha	~340 mbarn (Eγ/Ebeam > 1%)	~680	0.3THz
e^+e^- pair production	~7.3 mbarn	~15	7GHz
Elastic Bhabha	$O(10^{-5})$ mbarn (Det. acceptance)	~20/Million	10KHz
$\Upsilon(4S)$	$O(10^{-6})$ mbarn	~2/million	1 KHz





Background rates

- Pair production
  - Low P_t make magnetic shielding effective
  - Issue for first layer of SVT
  - Rate 15MHz/cm² @ 1.2cm
    5MHz/cm² @ 1.5cm

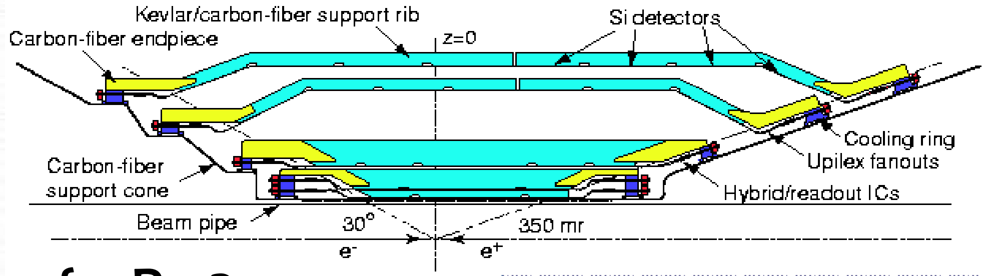


- Radiative Bhabhas
  - Beamline and shielding design are paramount
  - Showering and backscattering extends to large radius
  - Rate 100kHz/cm² @ R=1.2 cm

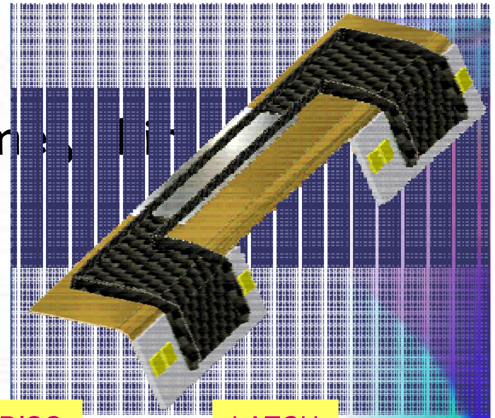
- Touschek Background
  - Produced all along the ring, depending on emittance and bunch volume
  - Beam optics and collimator setting essential in controlling this background
  - Rate <10 kHz/cm² @ R=1.2 cm

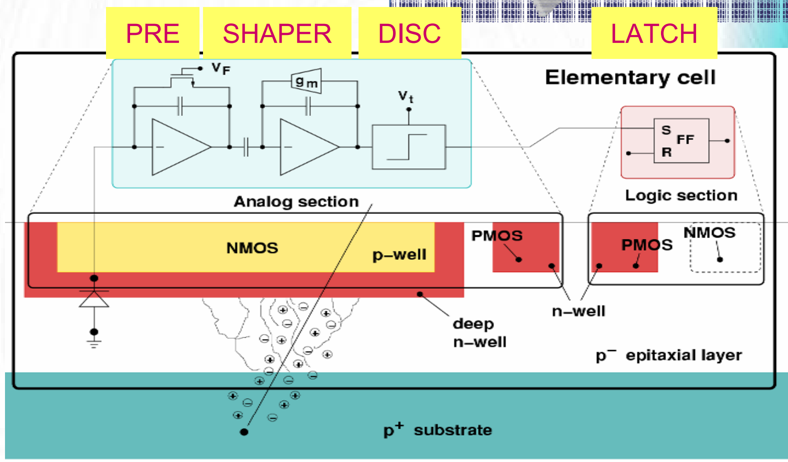
Layer	Flux (Hz/cm2)	X(cm)	Y(cm)	Area (cm2)	time resolution	Occupancy
Pixel @ 1.2cm	15.0E+6	0.005	0.005	0.000025	100.0E-9	3.8E-05
Pixel @ 1.5cm	5.0E+6	0.005	0.005	0.000025	100.0E-9	1.3E-05
Striplets @ 1.2cm	15.0E+6	1.8	0.005	0.009	100.0E-9	1.4E-02
Striplets @ 1.5cm	5.0E+6	1.8	0.005	0.009	100.0E-9	4.5E-03
Strip Layer N	10.0E+3	10	0.01	0.1	100.0E-9	1.0E-04

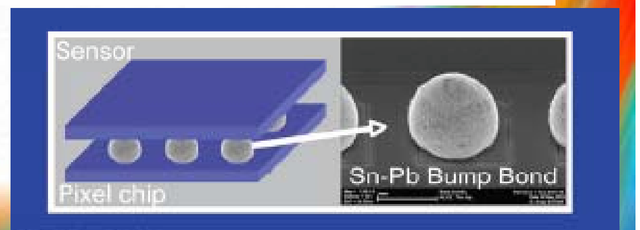
Silicon Vertex Tracker



- 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 extrem
  – More than 5MHz/cm², 1MRad/yr, < 0.5%X_0
  – Striplets option: mature technology, not so robust against background.
    - Marginal with background rate higher than ~ 5 MHz/cm²
    - 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 on 3-well devices 50x50um²
  – Hybrid Pixel Option: tends to be too thick.
    - An example: Alice hybrid pixel module ~ 1% X_0
    - Possible material reduction with the latest technology improvements
    - Viable option, although marginal





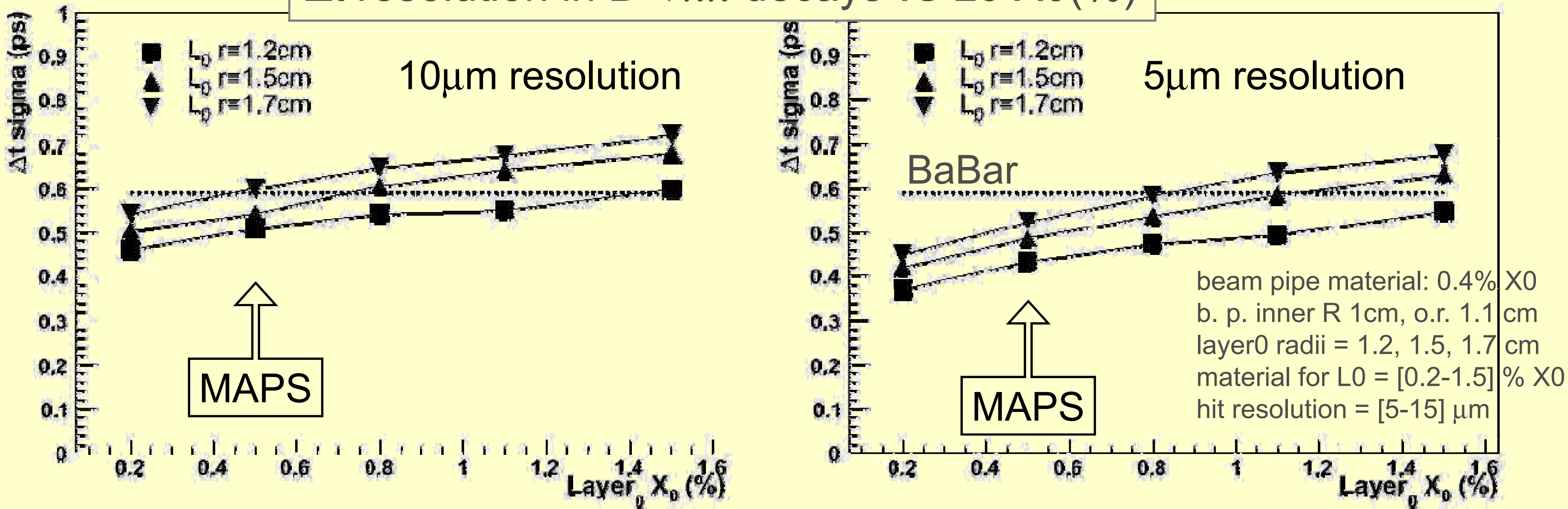


Radius, thickness, resolution

- Technological solutions depend critically on L_0 radius, thickness, resolution
- Fast simulation studies for various decays have been performed
- A full, more detailed reassessment is needed for the TDR.

- MAPS low mass solution would leave more flexibility for radius (ie background) and resolution
- Hybrid pixels will force to use the smallest radius and/or better resolution
- Striplets (same MAPS material) require larger radius, performance marginal

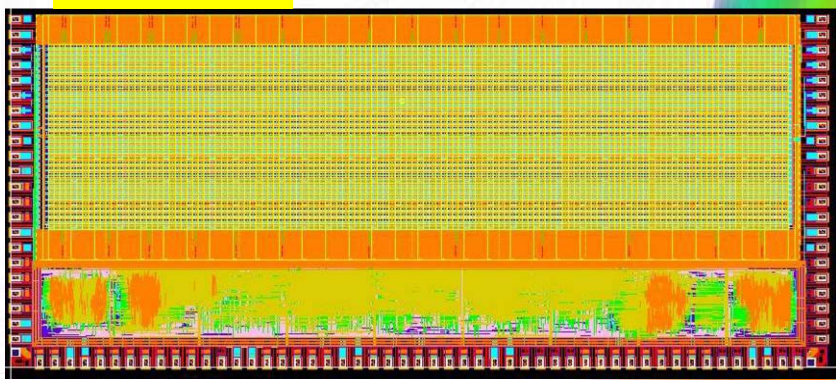
Δt resolution in B→ππ decays *vs* L0 X0(%)



MAPS R&D

- Proof of principle (APSEL0-2)
  - first prototypes realized in 130 nm triple well ST-Micro CMOS process
- APSEL3
  - 32x8 matrix with sparsified readout
  - Pixel cell optimization (50x50 um^2)
    - Increase S/N (15→30)
    - reduce power dissipation x2
- APSEL4D
  - 4K(32x128) pixel matrix with data driven sparsified readout and timestamp
  - Pixel cell & matrix implemented with full custom design and layout
  - Sparsifying logic synthetized in std-cell from VHDL model
  - Periphery inlcudes a “dummy matrix” used as digital matrix emulator
- Test Beam foreseen in Sep 2008
  - Prototype MAPS module + striplets

APSEL4D sub 11/2007- rec 3/2008



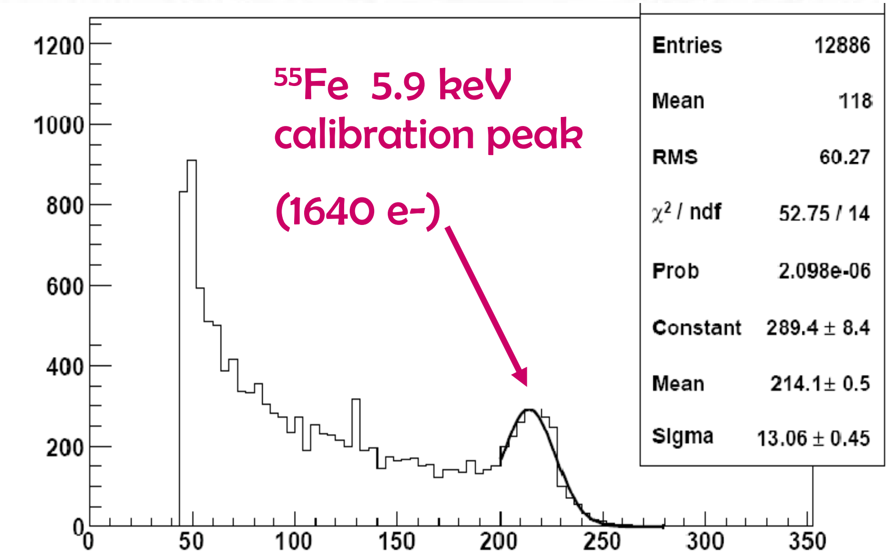
32x128 4k pixel matrix for beam test

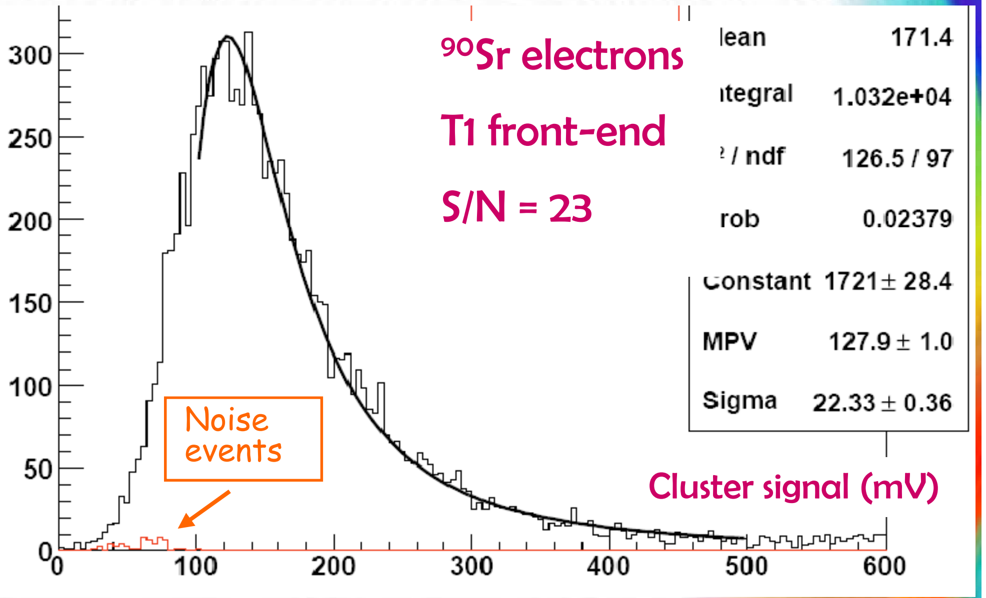
APSEL3 Chip Results

- Substantial redesign of the pixel cell in the APSEL3 chips with improved S/N and reduced power consumption (30 uW/ch)
- Major source of digital crosstalk reduced inserting a metal shield between digital lines and sensor
- But some digital crosstalk still present in the APSEL3 series, not fully understood.

Results obtained on 3x3 matrix with full analog readout

Front-end	ENC (e-)	Gain (mv/fC)	S/N (MIP)
T1	40-52	860	19-23
T2	27-36	1000	27-33

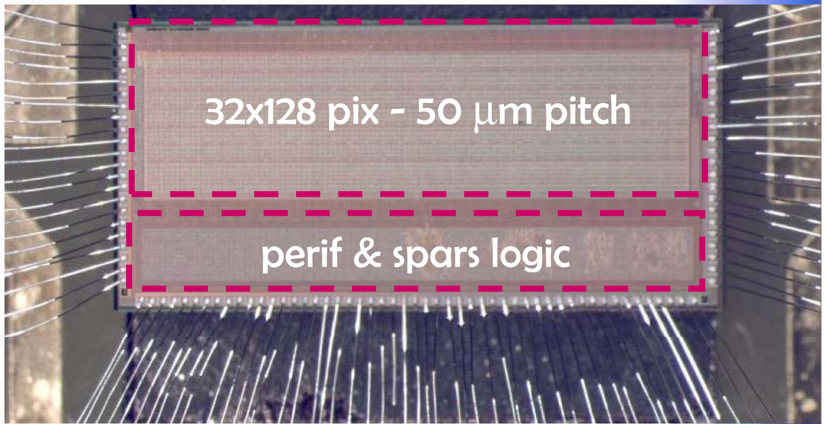


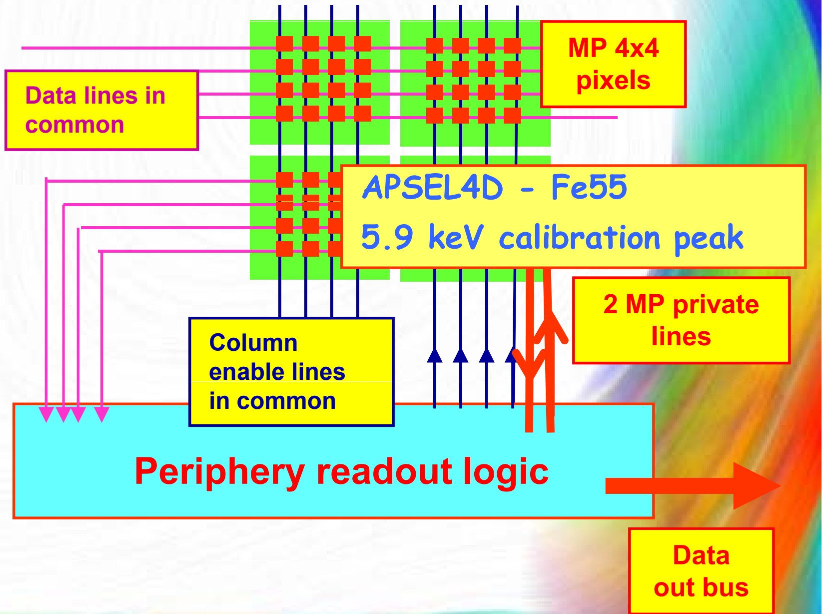


Most Probable Signal for MIP = 980e-

APSEL4D

- Matrix subdivided in MacroPixel (MP=4x4) with point to point connection to the periphery readout logic:
  - Register hit MP & store timestamp
  - Enable MP readout
  - Receive, sparsify, format data to output bus
- Data driven architecture
  - Interface to Associative memory trigger boards (CDF style)
  - Useful for Bhabha rejection trigger
- Readout tests
  - All readout functionality tested with dummy matrix.
    - Dummy pixels can be set and correctly readout, with the right timestamp associated.
  - The readout is working properly even with 100% occupancy.
  - Three clocks are used: the BCO clock, used for the timestamp counter, a faster readout clock, and a slow control clock.
  - Test performed with RDCLK up to 50 MHz

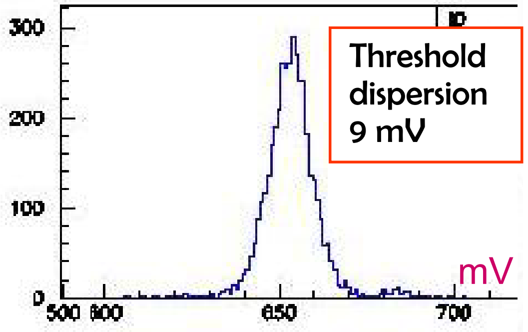




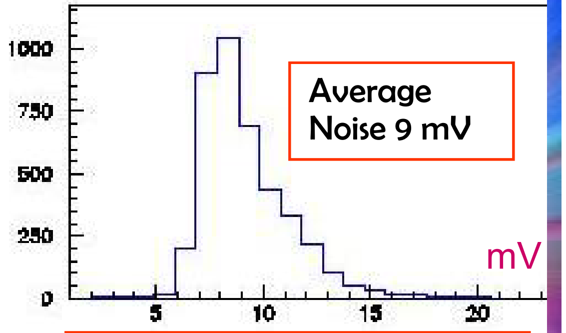
APSEL4D Results

- Noise and threshold from threshold scans
  - –Threshold dispersion inside one chip: 9mV(65e-)
  - – <Noise> across chips: 10.5 mV (75e-) with 20% dispersion
- Calibration peak (^{55}Fe)
  - –Obtained by differentiating the integral spectrum
  - –<Gain> = 860 mV/fC ± 5%

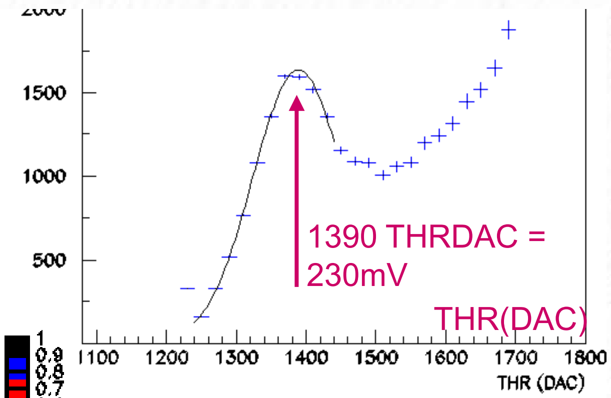
Offset distribution



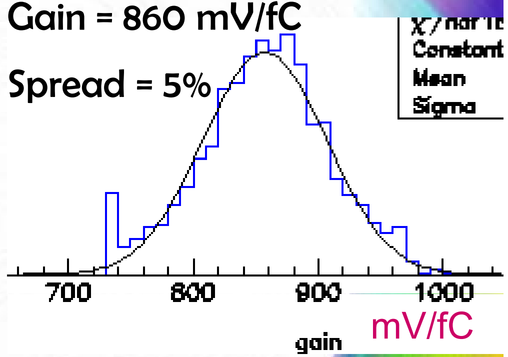
Noise distribution

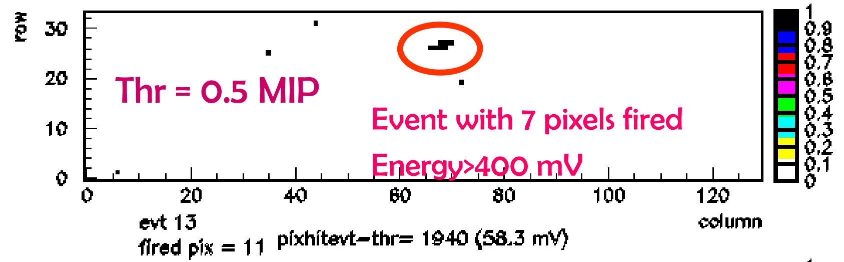


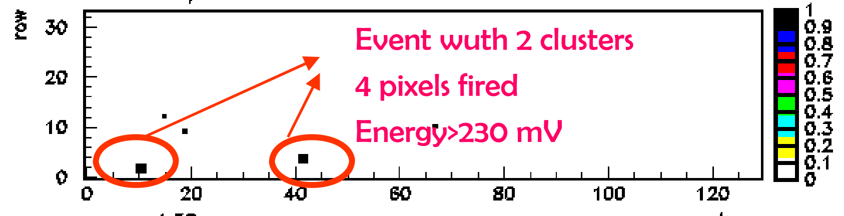
^{55}Fe peak (all pixels in matrix)



Gain distribution (all pixels in matrix)





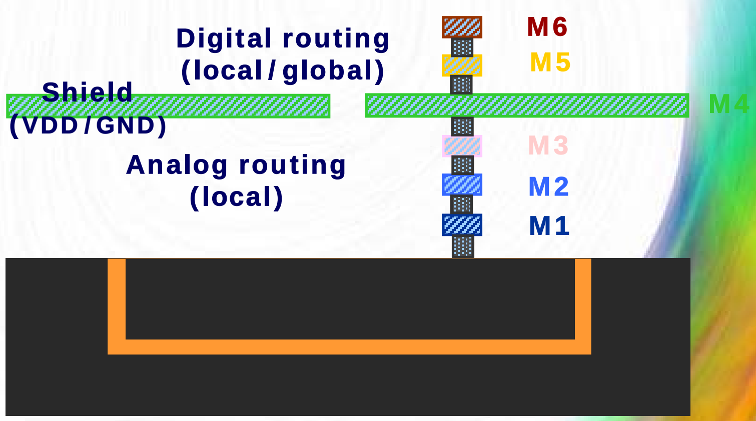


- MIP results (^{90}Sr) (still ongoing)
  - –Clusters clearly visible
  - –Landau MPV ~ 130 mV
    - measured with analog information on small matrix

Issues

- Digital to analog crosstalk
  - Metal shield implemented in the last pixel cell layout effective in reducing the digital crosstalk
  - New effects are visible in APSEL4D: currently under investigation.
  - By reducing the digital voltage from 1.2 to 1 V we are able to keep this effect at an acceptable level (~ 3 x Noise) still being able to operate the matrix and the readout.
  - Results shown have been obtained with the reduced digital voltage.

- Architecture scalability (4k → 64K or more)
  - To be demonstrated
- Radiation hardness
  - Irradiation program
  - Expected dose around 2-3 MRad/yr
- Mechanical issues
  - sensor thinning
  - module design
  - low mass cooling

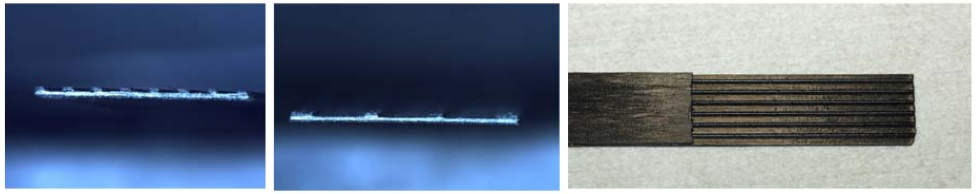


Thin Mechanics/Cooling R&D for Layer0

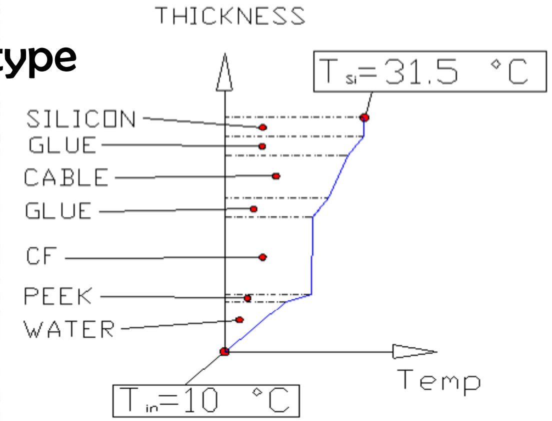
Design of a pixel module with integrated cooling and low material (< 1% X0)

- Crucial for a low material Layer 0 design with both MAPS & Hybrid Pixel options
- Development of support structures with cooling microchannel integrated in the Carbon Fiber/Ceramics support
  - The total thickness of the support structure + cooling fluid + peek + glue is: 0.35 % X_0
  - Consistent with the requirements
- Thermal simulation of the prototype module in progress: $2W/cm^2$ benchmark
  - Testbench for thermoidraulic measurements in preparation.

N.7 channels N.3 channels Slat support showing internal stucture

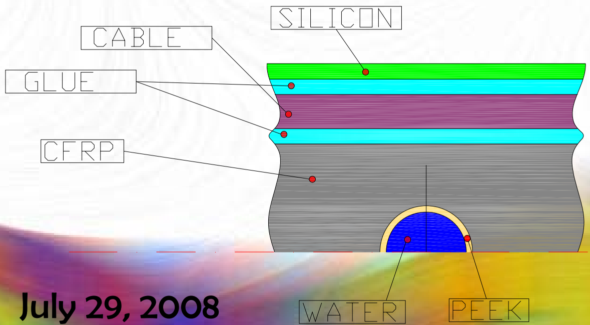


Carbon Fiber Prototype module



	Thermal Conductivity, K (watt/mK)	Thermal Gradient (K)	Resistance (K/watt)
Silicon	124	0.009	0.005
Epoxy Glue	0.28	3.57	2.04
Cable	Average between Al & Kapton	4.4	2.51
CFRP	20	0.2	0.114
PEEK	0.25	5.94	3.4
WATER	0.58	3.7	2.123

The total gradient is about 21.5 °C

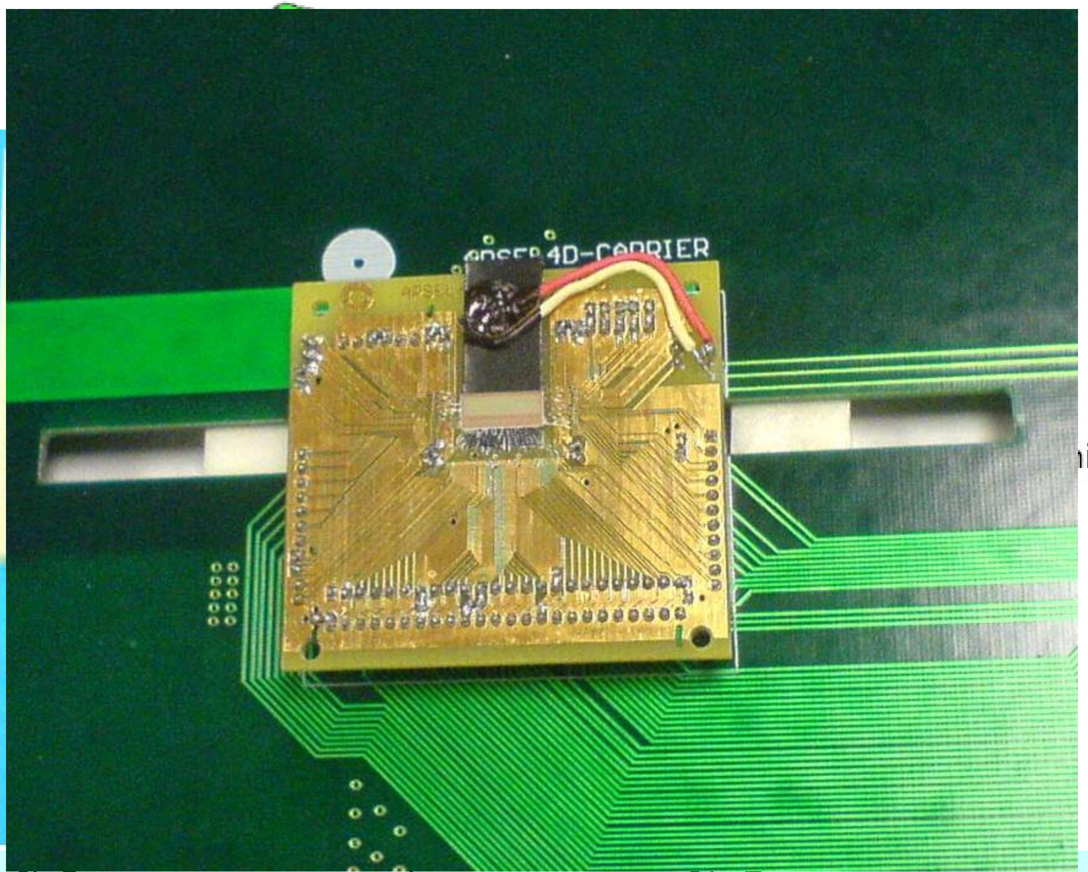


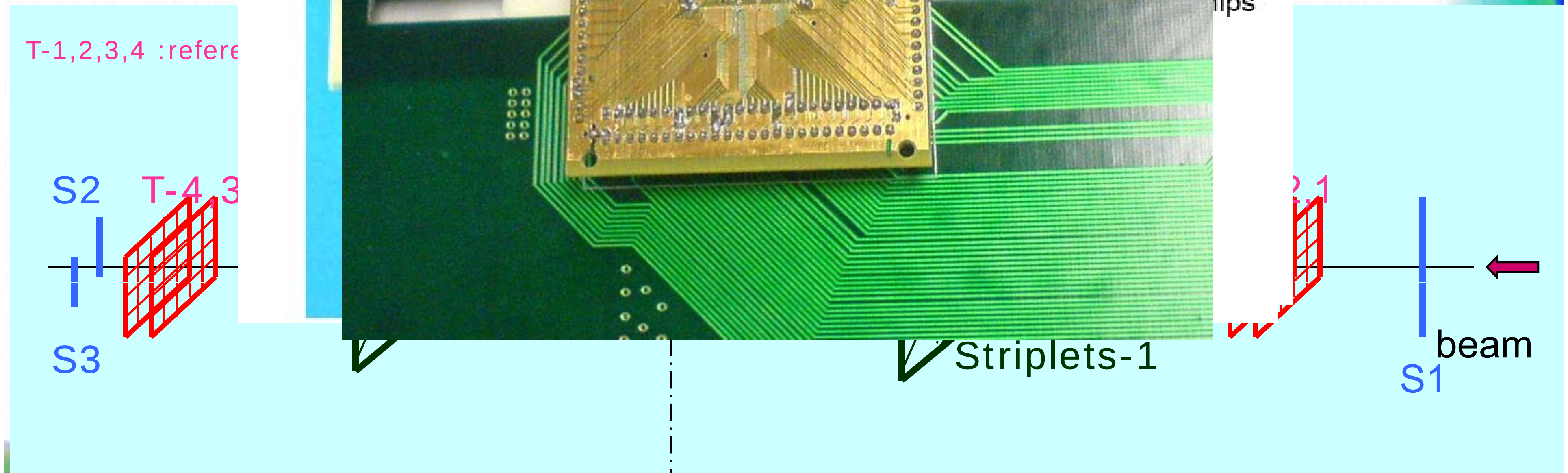
Thermal simulation of module

Beam test

- Beam test in Sept. 2008 @ CERN (T9) main goals:
  - D
  - T
  - D ... ?
    A
  - N ... LAS-
    c

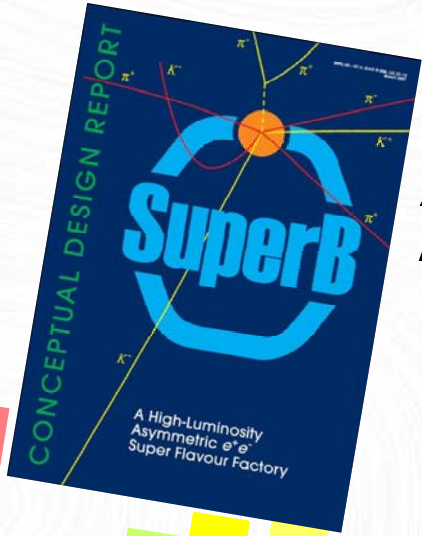
...ips





The SuperB Process

www.pi.infn.it/SuperB



2005
- 4 – 2th Joint Japan-US SuperB-Factory Workshop, Hawaii, US
- 9 – International SuperB Study Group formed
- 11 – 1st SuperB Workshop, LNF, Italy
- International SuperB Steering Committee established

2006
- 3 – 2nd SuperB Workshop, LNF, Italy
- 4 – SuperB meeting, Daresbury,UK
- 6 – 3rd SuperB Workshop, SLAC, US
- 9 – 1st Accelerator retreat, SLAC, US
- 11 – 4th SuperB Workshop, Villa Mondragone, Italy
- 12 – CDR writing started

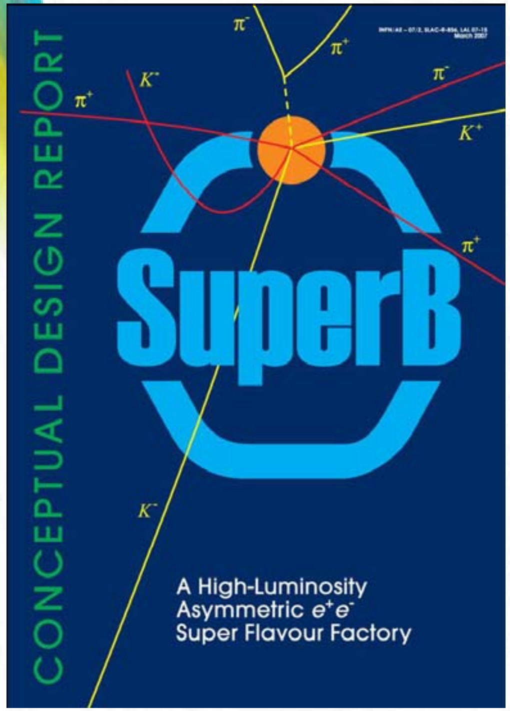
2007
- 3 – CDR published
- 5 – CDR presented to INFN Management
- 5 – 5th SuperB Workshop in Paris, France
- 7 – International Review Committee setup
- 7 – CDR presented to ECFA
- 9 – 2th Accelerator retreat, SLAC, US
- 11 – 1st IRC meeting, LNF, Italy
- 12 – Accelerator test started at DAΦNE, LNF, Italy

2008
- 1 – Physics retreat at Valencia, Spain
- 2 – Detector R&D workshop, SLAC,US
- 3 – 2nd Meeting with ECFA
- 4 – ICFA08 Workshop at BINP, Russia
- 4 – 2nd IRC meeting, Rome, Italy
- 6 – SuperB Meeting in Elba, Italy – IRC REPORT
- 7 – Mini MAC
- CERN strategy group presentation

Month

(Courtesy of M. Biagini)

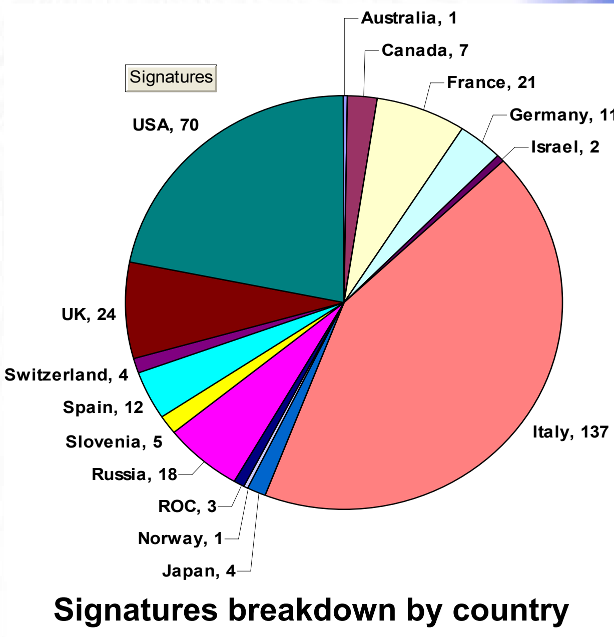
Conceptual Design Report



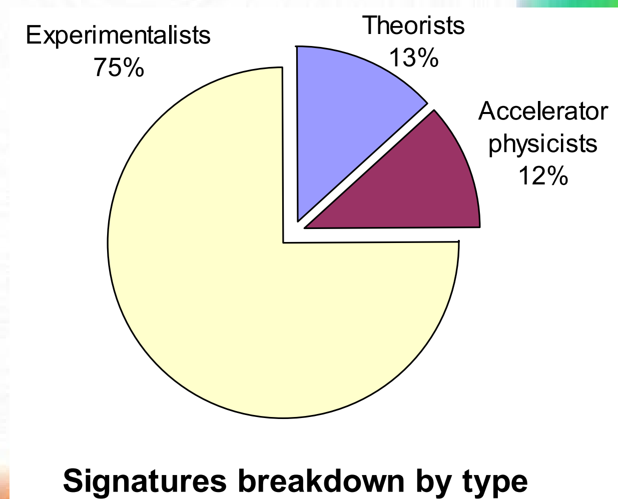
CDR signers

Support and interest
3/2007

320 signers
85 institutions
174 Babar members
65 non Babar exper



Signatures breakdown by country



Signatures breakdown by type

- **SuperB is an intrinsically internation project.**
- **Strong interest and participation from several countries, both for detector and for accelarator::**
  - LNF, SLAC, BINP, LAL, UK, ...
- **INFN proposed site in the di Tor Vergata Campus, near Frascati.**
  Synergy with SPARX 2 GeV FEL in construction

Reviews

INFN International 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


ST1

Slide 31

ST1 Let's start from this google map. It is two years old and let's consider the overlap with the area planning map.
Here there is a roman villa
The sport City designed by the architect Santiago de Calatrava for the next World swimming championship.
The university Campus, the CNR and finally the area available for the SPARX & SuperB project
Sandro Tomassini, 5/29/2008

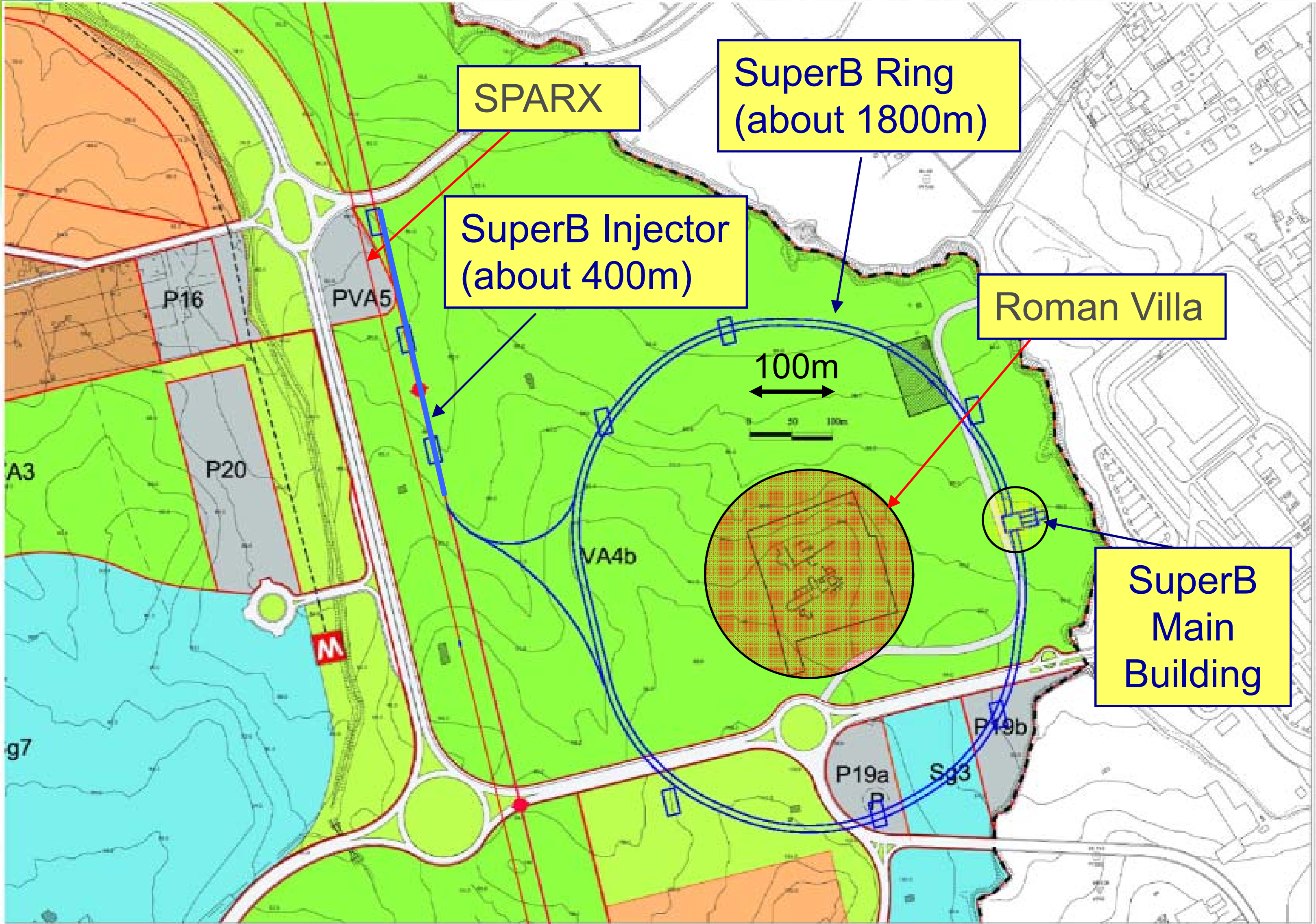
Next steps

- CDR phase is substancially over
- The SuperB community is ready to start the preparation of a Technical Design Report
- Project Funding
- SuperB Project Office
- MOU for the Design Team (end 2008/ beginning 2009)
- Begin negotiation for construction MOU's, after government approval (mid 2009)

- 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

BACKUP

SuperB Footprint



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 T0.

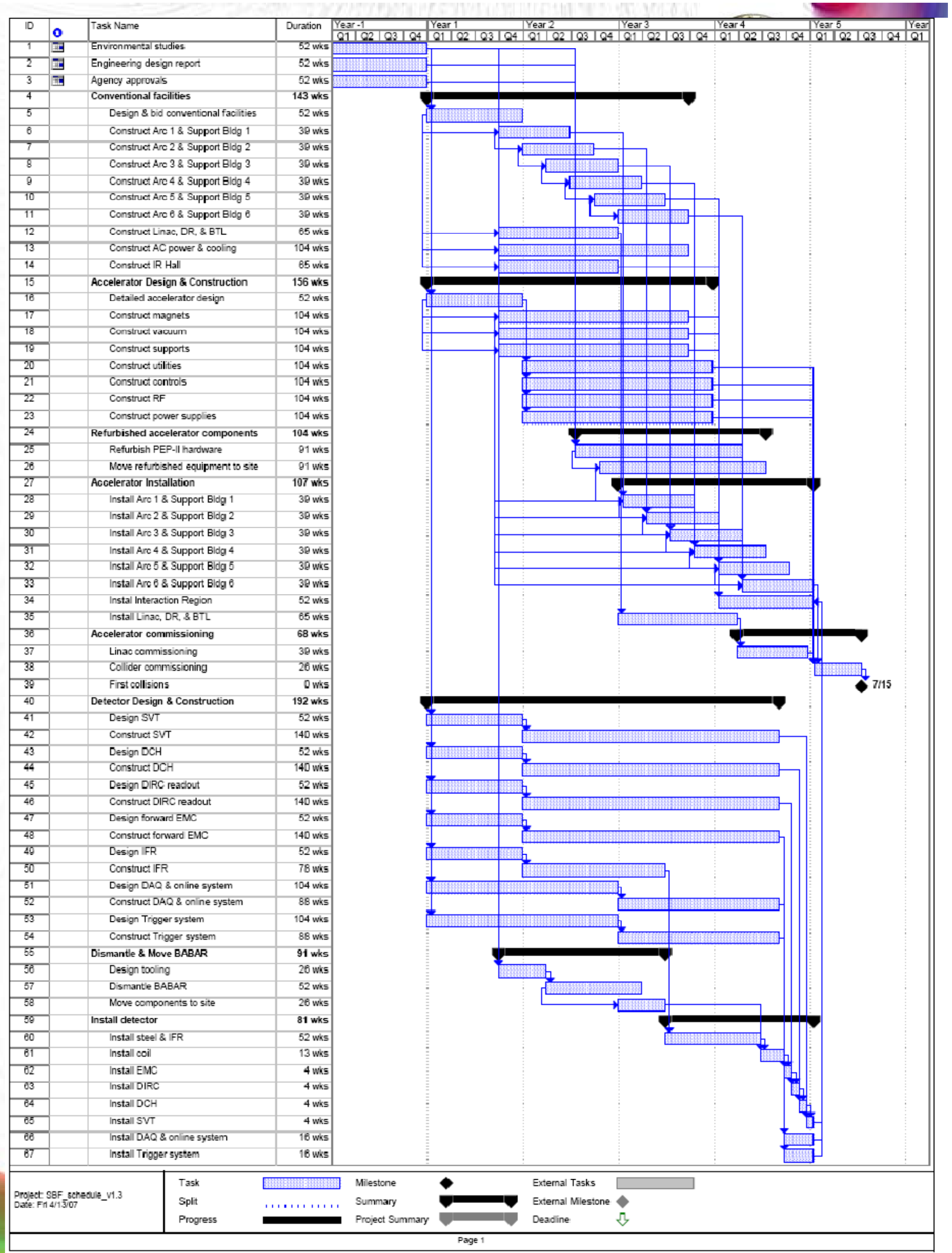


Figure 5-1. *Overall schedule for the construction of the SuperB project.*

Updated SuperB parameters

PARAMETER	Nominal LER (e+)	Nominal HER (e-)	Upgrade LER (e+)	Upgrade HER (e-)	Ultimate LER (e+)	Ultimate HER (e-)
Energy (GeV)	4	7	4	7	4	7
Luminosity x 10^{36}	1.0		2.0		4.0	
Circumference (m)	1800	1800				
Revolution frequency (MHz)	0.167					
Eff. long. polarization (%)	0	80				
RF frequency (MHz)	476					
Momentum spread ($\times 10^{-4}$)	7.9	5.6	9.0	8.0		
Momentum compaction ($\times 10^{-4}$)	3.2	3.8	3.2	3.8		
Rf Voltage (MV)	5	8.3	8	11.8	17.5	27
Energy loss/turn (MeV)	1.16	1.94	1.78	2.81		
Number of bunches	1251				2502	
Particles per bunch ($\times 10^{10}$)	5.52				6.78	
Beam current (A)	1.85				3.69	
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)	20	40	38	20		
Effective beam lifetime (min)	5.0	5.7	3.1	2.9		
Injection rate pps ($\times 10^{11}$) (100%)	2.6	2.3	5.1	4.6	10	9.1
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		58.2	

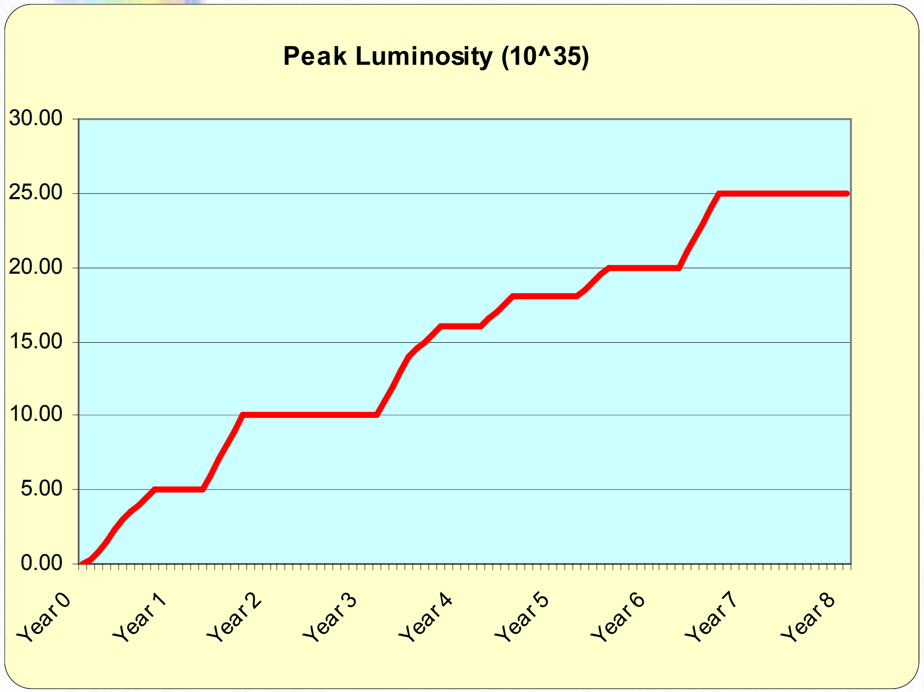
150 m needed for polarization

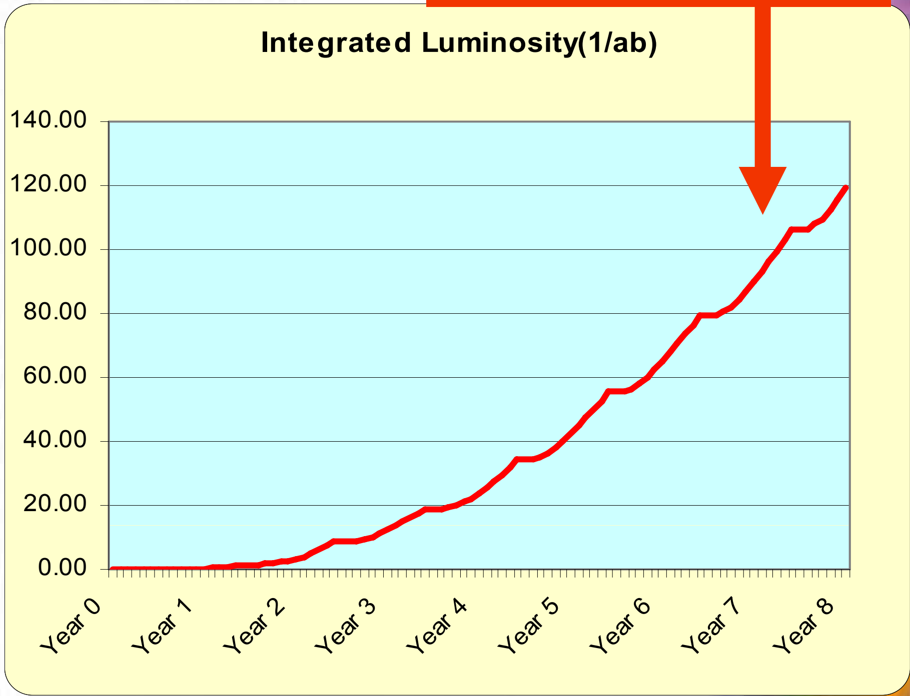
Circumference in CDR was 2200 m

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

SuperB expected LUMI

>80ab-1 in 7th year





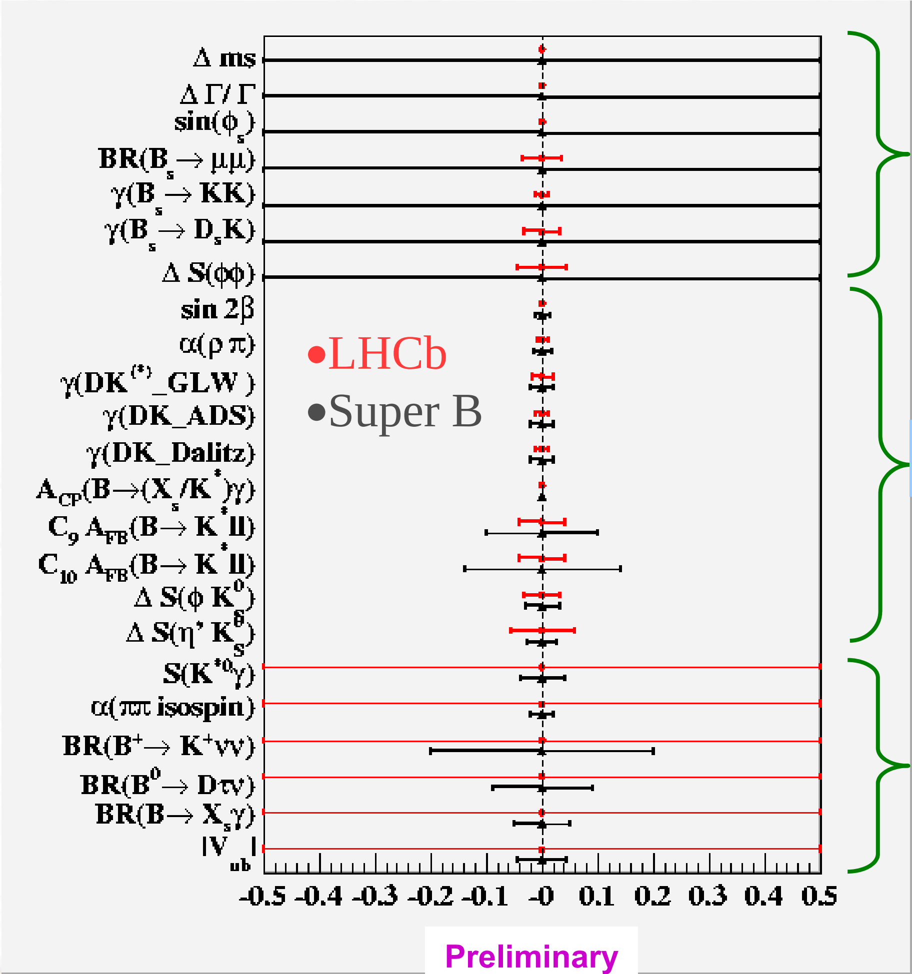
After 7th year integrated Luminosity can grow at rate of ~40 ab^{-1}/year

SuperB and Super LHCb:

- SuperB cannot compete with LHCb on B_s physics.
  - Only time integrated measurements
- Similar sensitivity for many common channels
  - SuperB extrapolation based on Babar/Belle experience
- Unique opportunity for channels with neutrals, ν, inclusive measurements
  - Not accessible at hadronic machines.

Sensitivity Comparison ~2020

S-LHCb 100 fb^{-1} vs SuperB 50 ab^{-1}



B_s time dependent analysis only accessible to LHCB

Common

No IP, Neutrals, ν, only accessible to SuperB

CDF an important player, too.

Links

- SuperB Site: www.pi.infn.it/SuperB/
- CDR: www.pi.infn.it/SuperB/CDR
  - Update on Physics (Valencia workshop proceedings):
    https://agenda.infn.it/materialDisplay.py?materialId=1&confId=501
  - Dafne results preliminary report
    https://agenda.infn.it/materialDisplay.py?materialId=0&confId=501
- IRC Meetings and report:
  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
- Mini MAC
  - Slides available at:

SLIM5-Silicon detectors with Low Interactions with Material

G. Batignani[1,2], S. Bettarini[1,2], F. Bosi[1,2], G. Calderini[1,2], R. Cenci[1,2], M. Dell'Orso[1,2], F. Forti[1,2], P.Giannetti[1,2] , M. A. Giorgi[1,2], A. Lusiani[2,3], G. Marchiori[1,2], F. Morsani[2], N. Neri[2], E. Paoloni[1,2], G. Rizzo[1,2] , J. Walsh[2]

C. Andreoli[4,5], E. Pozzati[4,5],L. Ratti[4,5], V. Speziali[4,5], M. Manghisoni[5,6], V. Re[5,6], G. Traversi[5,6], L.Gaioni[4,5]

L. Bosisio[7], G. Giacomini[7], L. Lanceri[7], I. Rachevskaia[7], L. Vitale[7],

M. Bruschi[8], B. Giacobbe[8],A. Gabrielli[8], N. Semprini[8], R. Spighi[8], M. Villa[8], A. Zoccoli[8],

D. Gamba[9], G. Giraudo[9], P. Mereu[9],

G.F. Dalla Betta[10] , G. Soncini[10] , G. Fontana[10] , L. Pancheri[10] , G. Verzellesi[11]

[1]Università degli Studi di Pisa, [2]INFN Pisa, [3]Scuola Normale Superiore di Pisa,

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