The SuperB Project

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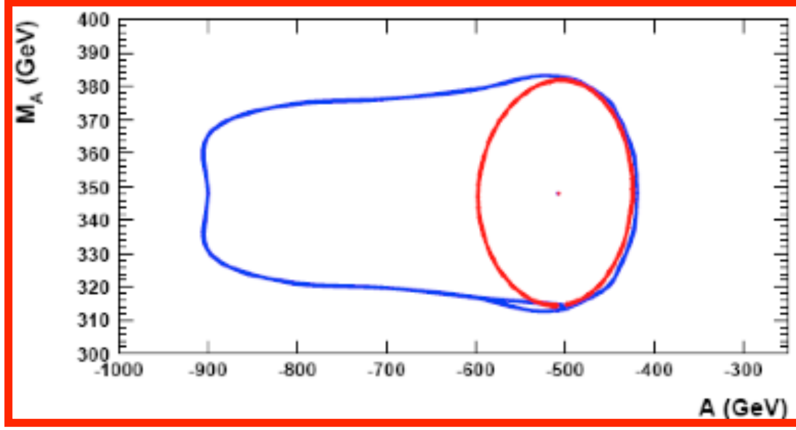
Overview

- Goals of the project
- Accelerator
- Detector
- Project status

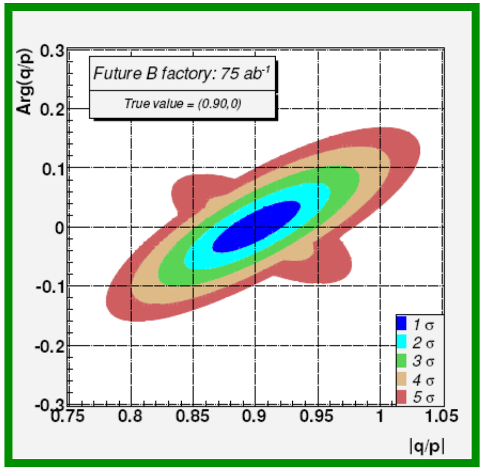
Physics Goals of the project

Overview of the goals

- Test new physics with precision EW measurements in the flavour sector



- High luminosity Flavor (charm/tau/…) factory

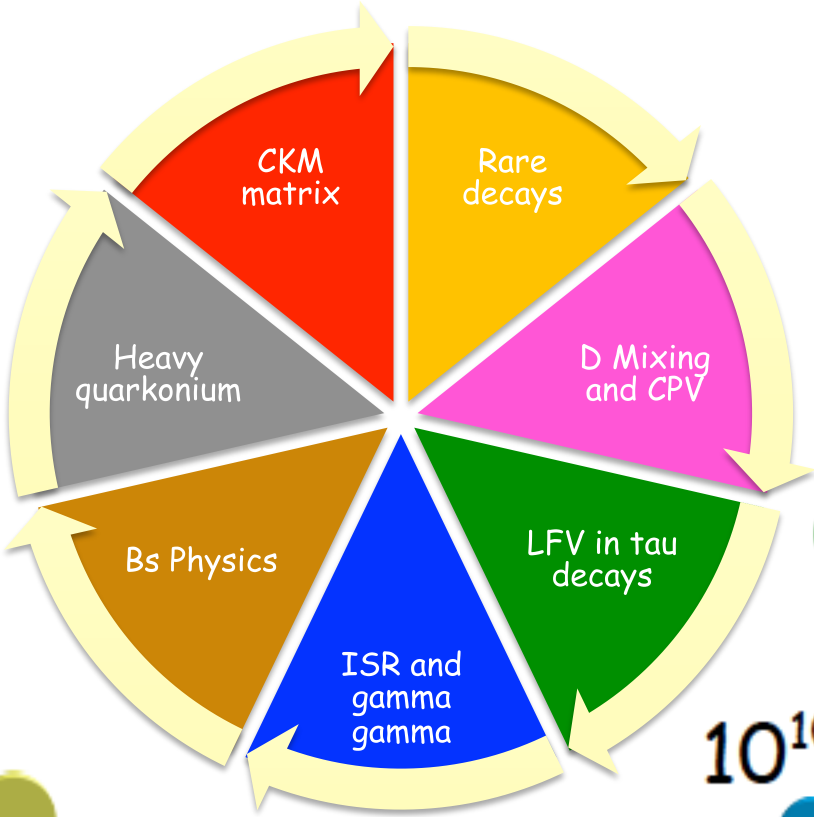


- 3-10 Synchrotron radiation lines

A different story

Not a single flagship analysis

$10^{10}\ B\bar{B}$



$10^{9}\ D\bar{D}$

$10^{10}\ B_s\bar{B}_s$

$10^{10}\ \tau^+\tau^-$

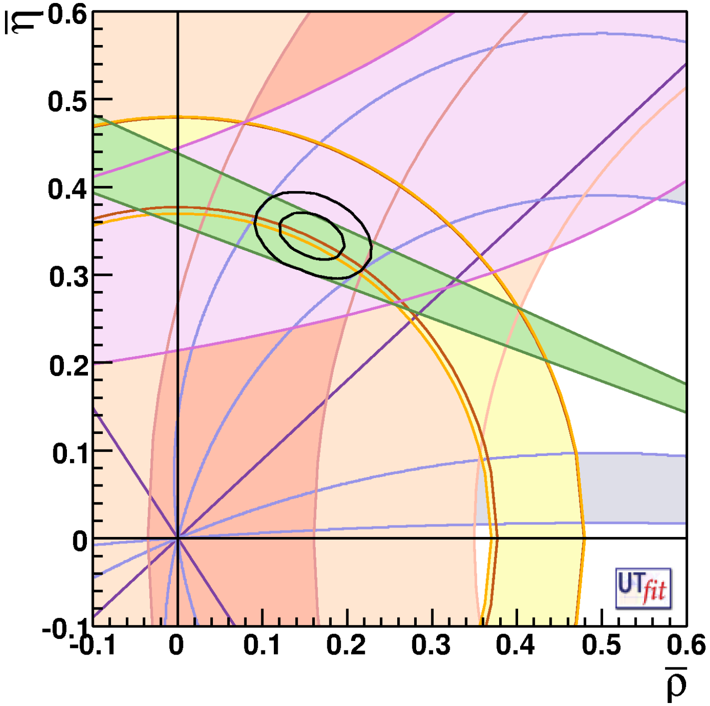
B_D PHYSICS

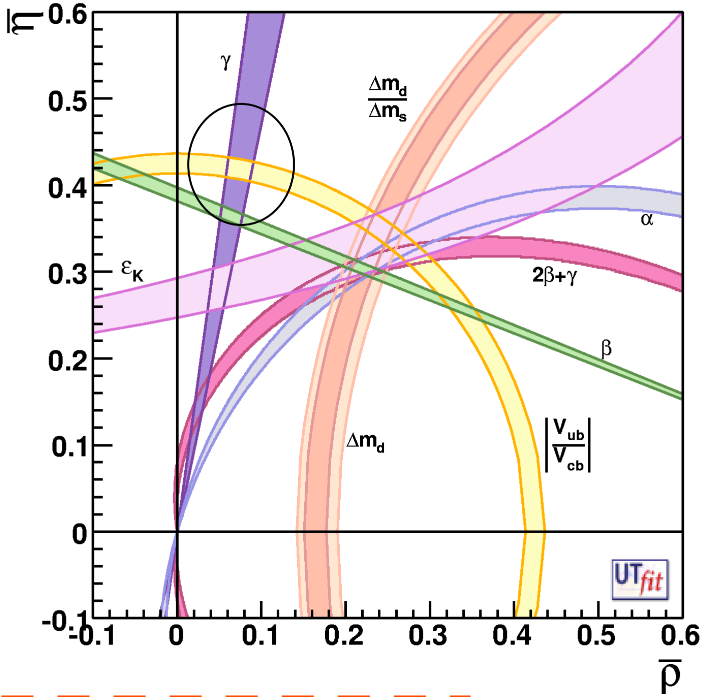
- CP violation (CKM)

- Rare Decays

CKM- Matrix

Today





<u>SuperB improvements:</u>

- $\sin 2\beta$
- α in $B \to \pi\pi, \rho\pi, \rho\rho$
- γ with input from threshold running
- Reduced exp error on $|V_{ub}|$

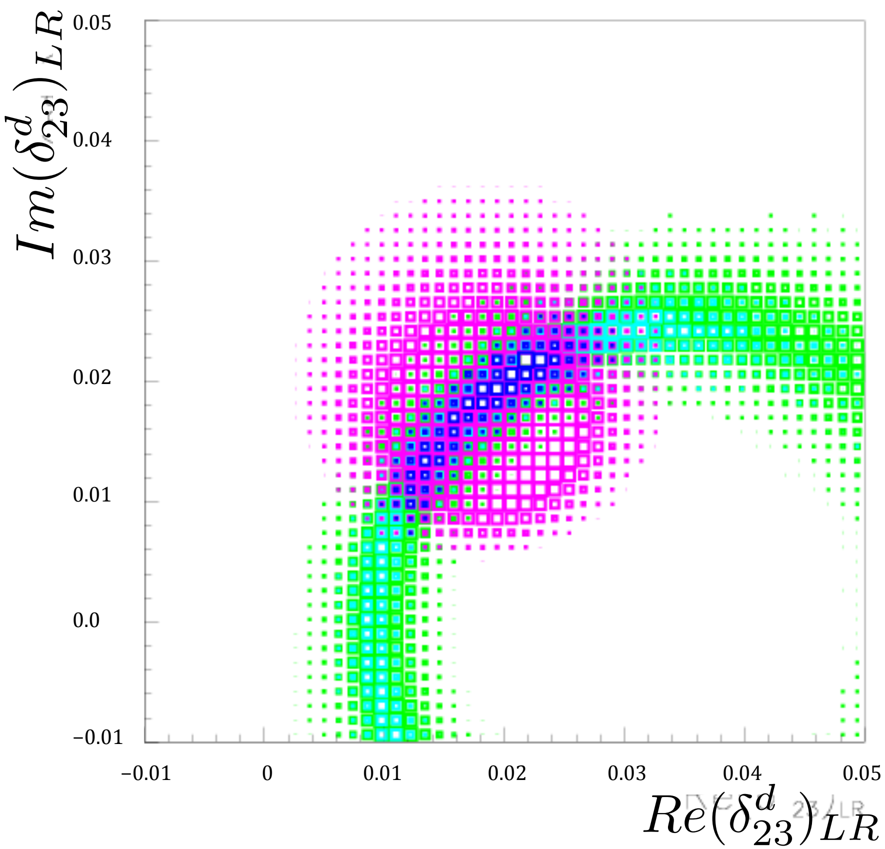
<u>Lattice improvements</u>

… and sCKM-matrix

- e.g. MSSM with generic squark mass matrices.
- Use Mass insertion approximation $m_{\tilde{q}}$ $m_{\tilde{g}}$ with to constrain couplings:

$$(\delta^q_{ij})_{AB} = \frac{(\Delta_{ij})^q_{AB}}{m^2_{\tilde{q}}}$$

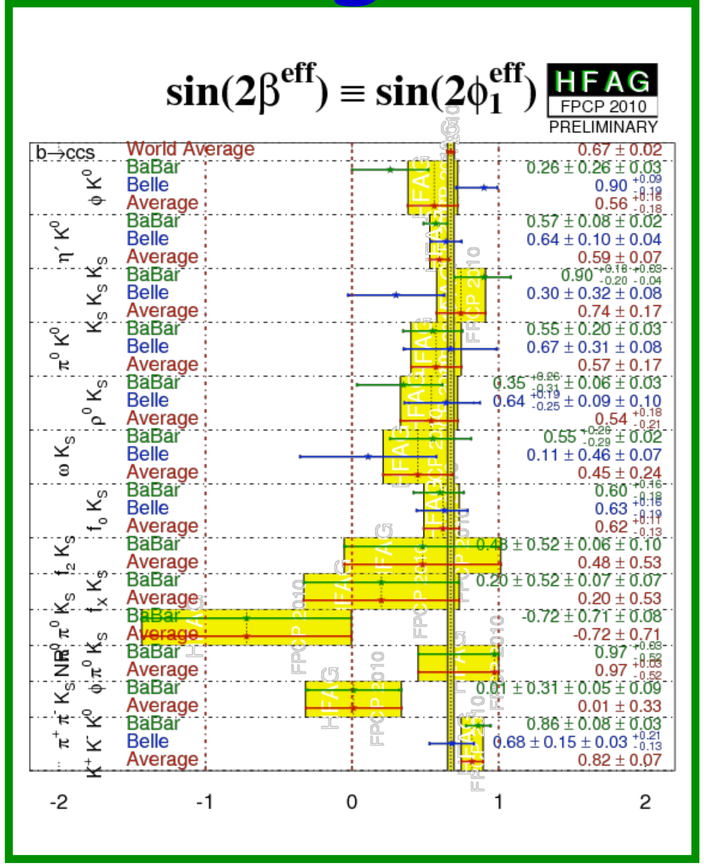
- Can constrain the δ^d_{ij}'s using
  - $\mathcal{B}(B \to X_s\gamma)$ (green)
  - $\mathcal{B}(B \to X_s\ell^+\ell^-)$ (cyan)
  - $\mathcal{A}_{CP}(B \to X_s\gamma)$ (magenta)



e.g. see Hall et al., Nucl. Phys. B **267** 415-432 (1986)
Ciuchini et al., hep-ph/0212397

➔ Rare decays

Penguins and new physics



NOW

IMPROVEMENT WITH SuperB

Mode	Current Precision			Predicted Precision ($75\,{\rm ab}^{-1}$)		
	Stat.	Syst.	ΔS^f (Th.)	Stat.	Syst.	ΔS^f (Th.)
$J/\psi K^0_S$	0.022	0.010	0 ± 0.01	0.002	0.005	0 ± 0.001
$\eta' K^0_S$	0.08	0.02	0.015 ± 0.015	0.006	0.005	0.015 ± 0.015
$\phi K^0_S \pi^0$	0.28	0.01	–	0.020	0.010	–
$f_0 K^0_S$	0.18	0.04	0 ± 0.02	0.012	0.003	0 ± 0.02
$K^0_S K^0_S K^0_S$	0.19	0.03	0.02 ± 0.01	0.015	0.020	0.02 ± 0.01
ϕK^0_S	0.26	0.03	0.03 ± 0.02	0.020	0.005	0.03 ± 0.02
$\pi^0 K^0_S$	0.20	0.03	0.09 ± 0.07	0.015	0.015	0.09 ± 0.07
ωK^0_S	0.28	0.02	0.1 ± 0.1	0.020	0.005	0.1 ± 0.1
$K^+K^-K^0_S$	0.08	0.03	0.05 ± 0.05	0.006	0.005	0.05 ± 0.05
$\pi^0\pi^0 K^0_S$	0.71	0.08	–	0.038	0.045	–
ρK^0_S	0.28	0.07	-0.13 ± 0.16	0.020	0.017	-0.13 ± 0.16
$J/\psi \pi^0$	0.21	0.04	–	0.016	0.005	–
$D^{*+}D^{*-}$	0.16	0.03	–	0.012	0.017	–
D^+D^-	0.36	0.05	–	0.027	0.008	–

Requirements from B_d physics

- Time-dependent measurements:
  - Asymmetric beams
  - Vertexing (improved due to reduced boost)
  - PID
- Rare decays
  - High luminosity
  - Hermeticity
  - Low backgrounds

TAU PHYSICS

- Lepton flavor violation
- CP Violation
- Moments: electric dipole and g-2
- Precision $|V_{us}|$ measurements

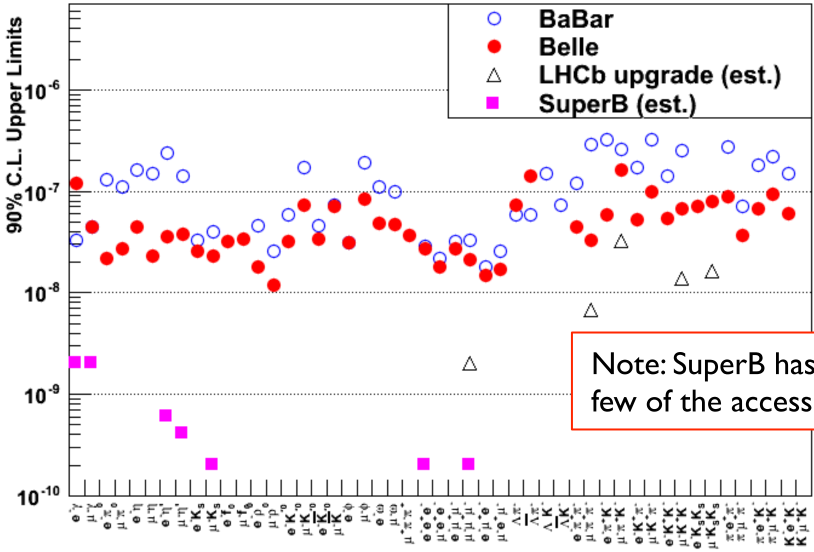
Lepton Flavour Violation (LFV)

- ν mixing leads to a low level of charged LFV ($B \sim 10^{-54}$).
  - Enhancements to observable levels are possible with new physics scenarios.
  - Searching for transitions from 3rd generation to 2nd and 1st, i.e.

$$\tau \longrightarrow \mu \qquad \text{and} \qquad \tau \longrightarrow e$$

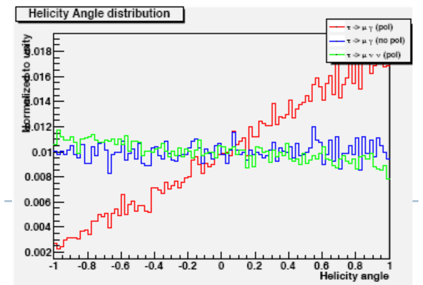
➢Two orders of magnitude improvement at SuperB over current limits.

➢Hadron machines are not competitive with e^+e^- machines for this.



Note: SuperB has only evaluated a few of the accessible modes.

- N.B. e^- beam polarisation helps suppress background.



Signal (with pol)
Signal (no pol)
background

Other τ measurements

- CPV

  → expect sensitivity at 10^{-5} level ($\tau^{\pm} \rightarrow K_s \pi^{\pm} \nu$)
  - RPV SUSY and multi-Higgs non-SUSY models
  - SM CPV $o(10^{-12})$
- Electric dipole moment

  → expect sensitivity @ 10^{-19} e cm level
  - SM expectation $\sim 10^{-22}$ ecm
- g-2

  → Expect sensitivity @$\Delta\alpha_{\tau} \sim 10^{-6}$ level
  - possible for SUSY models

Require beam polarization

Requirements from τ physics

- High luminosity
- Beam polarization

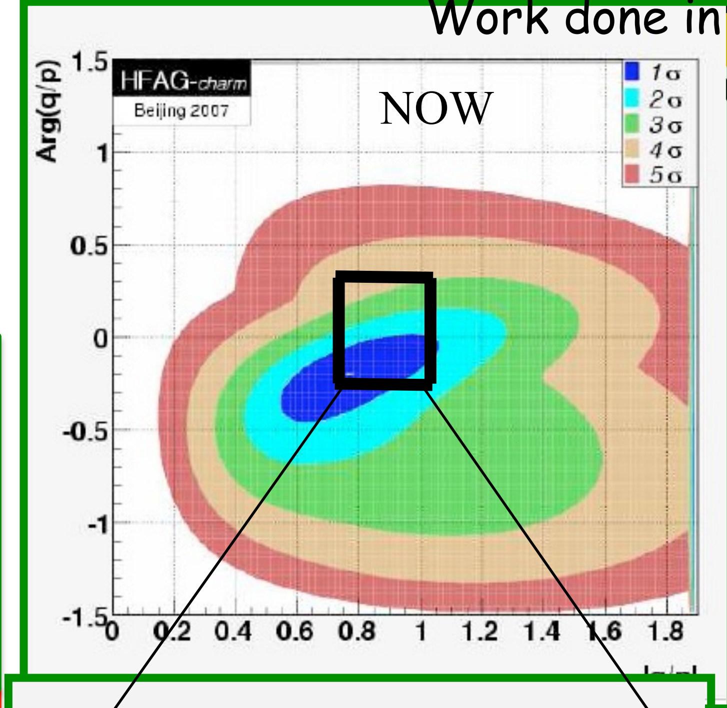
CHARM PHYSICS

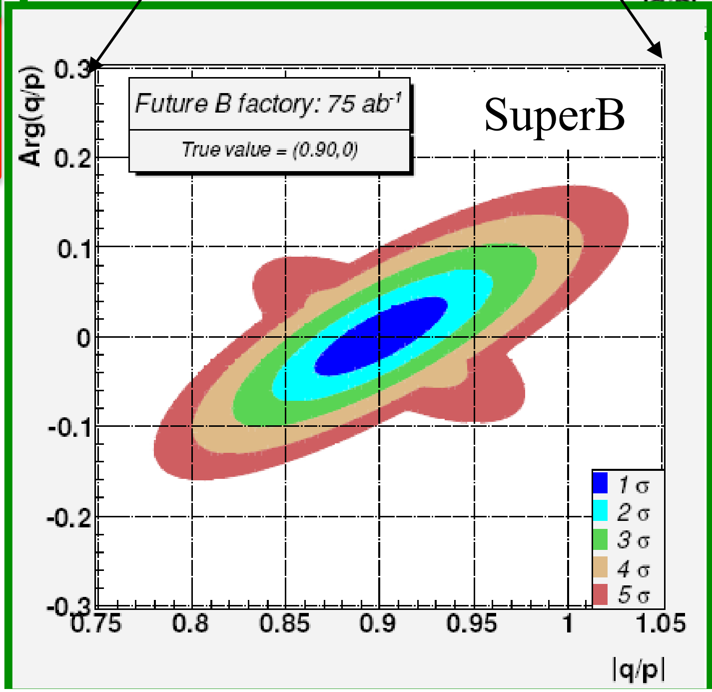
- CP violation
- Charm Threshold Physics
- Exotic charmonium spectroscopy

CP Violation in charm

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}	
$D^0 \to K^0_S\pi^+\pi^-$	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		$(1-2) \times 10^{-3}$
	$\cos\delta$		$(0.01-0.02)$

Work done in Valencia



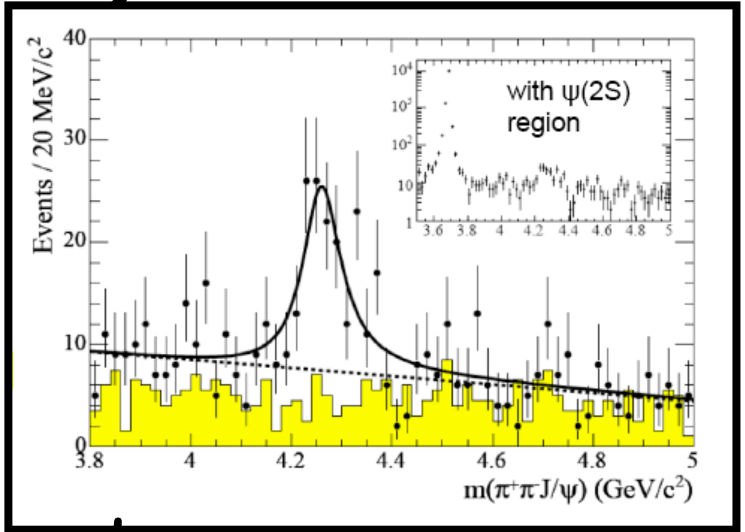


Charm Threshold physics

+ Measurements of phases needed for a precision measurement of γ

Exotic Spectroscopy (future)

- Low statistics
- Huge number of missing modes to study
- Energy scan required



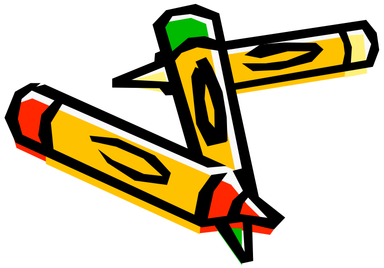
B decays	J/ψππ	J/ψω	J/ψγ	J/ψφ	J/ψη	ψ(2S)ππ	ψ(2S)ω	ψ(2S)γ	χcγ	pp	ΛΛ	ΛcΛc	DD	DD*	D*D*	Ds(*)Ds(*)	γγ
X(3872)	S	S	S	N/A	N/S	N/A	N/A	S	N/S	M/F	M/F	N/A	N/A	S	N/A	N/A	N/S
X,Y (3940)	M/F	S	N/S	N/A	N/A	N/A	N/A	M/F	N/A	M/F	M/F	N/A	M/F	N/S	N/A	N	N
Z(3940)	M/F	M/F	N/S	N/A	N/A	N/A	N/A	M/F	N/A	M/F	M/F	N/A	M/F	M/F	N/A	N	N
Y(4140)	M/F	M/F	N	S	N/A	N	N/A	N	N/A	M/F	M/F	N/A	M/F	N	N	N	N
X(4160)	M/F	M/F	N	M/F	N/A	N	N/A	N	N/A	M/F	M/F	N/A	M/F	N	N	N	N
Y(4260)	S	N/A	N/A	N/A	M/F	N	N/A	N/A	N	M/F	M/F	N/A	N	N	N	N	N/A
X(4350)	M/F	M/F	N	M/F	N/A	N	N	N	N/A	M/F	M/F	N/A	N	N	N	N	N
Y(4350)	M/F	N/A	N/A	N/A	M/F	N	N/A	N/A	N	M/F	M/F	N/A	N	N	N	N	N/A
Y(4660)	N	N/A	N/A	N/A	M/F	N	N/A	N/A	N	M/F	M/F	M/F	N	N	N	N	N/A

Requirements from charm physics

- High luminosity
- Scan energy from charm threshold (3.5 GeV) to $\Upsilon(4S)$

ABOVE $\Upsilon(4S)$ PHYSICS

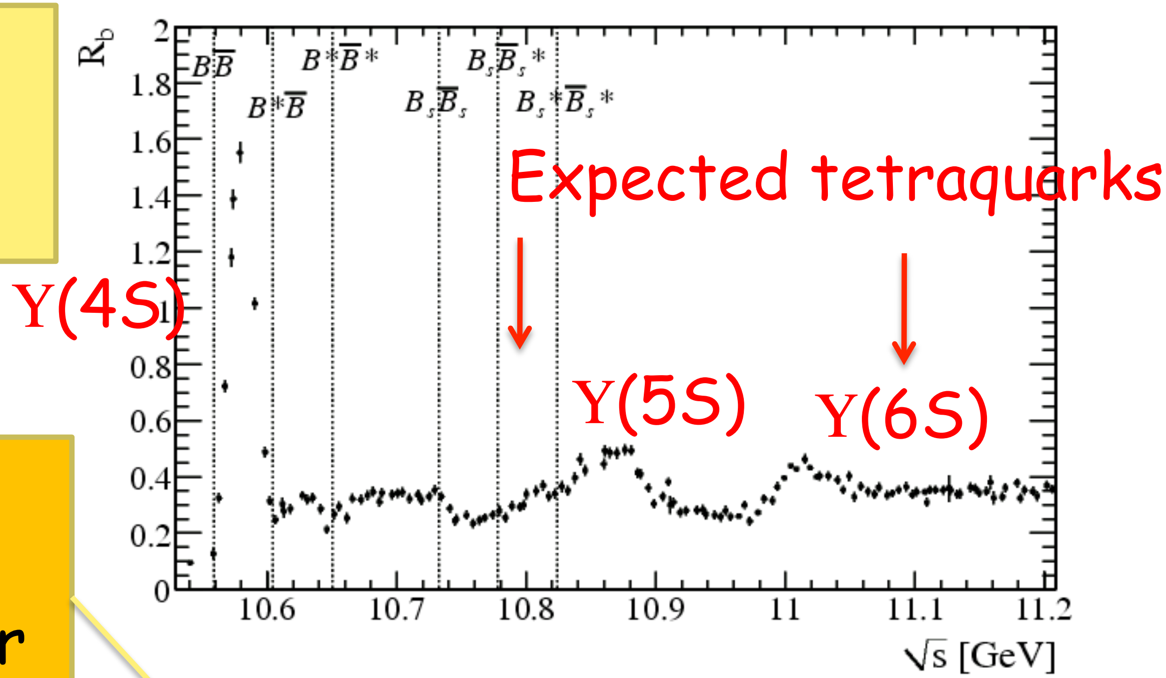
- Exotic Bottomonium
- Bs Physics



Scan between $\Upsilon(4S)$ and $\Lambda_b\Lambda_b$

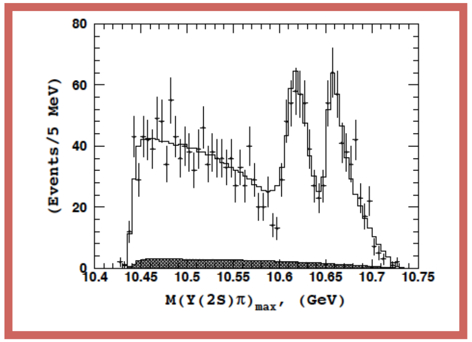
Inclusive scan did not show effects

Exclusive analyses requires larger luminosity



E.g. Belle at $\Upsilon(5S)$

$\Upsilon(5S) \rightarrow Z_b^+\pi^- \rightarrow \Upsilon(2S)\pi^+\pi^-$



B_s physics

- Can cleanly measure A^s_{SL} using 5S data

$$A^s_{SL} = \frac{\mathcal{B}(B_s \to \overline{B}_s \to X^-\ell^+\nu_\ell) - \mathcal{B}(\overline{B}_s \to B_s \to X^-\ell^+\nu_\ell)}{\mathcal{B}(B_s \to \overline{B}_s \to X^-\ell^+\nu_\ell) + \mathcal{B}(\overline{B}_s \to B_s \to X^-\ell^+\nu_\ell)} = \frac{1-|q/p|^4}{1-|q/p|^4}$$

$$\sigma(A^s_{SL}) \sim 0.004 \text{ with a few } ab^{-1}$$

- CPV in mixing measurements impossible, but $\Delta\Gamma s \neq 0$ allows for untagged time-dependent measurements of Re(λ)

$$R(\Delta t) = \mathcal{N}\frac{e^{-|\Delta t|/\tau(B_s)}}{2\tau(B_s)}\left[\cosh\left(\frac{\Delta\Gamma_s \Delta t}{2}\right) - \frac{2\,\Re(\lambda_f)}{1+|\lambda_f|^2}\sinh\left(\frac{\Delta\Gamma_s \Delta t}{2}\right)\right]$$

  - Modes difficult for LHCb can be studied

- SuperB can also study rare decays with many neutral particles, such as $B_s \to \gamma\gamma$, which can be enhanced by SUSY.

Bs summary

Observable	1 ab^{-1}	30 ab^{-1}
$\Delta\Gamma$	0.16 ps^{-1}	0.03 ps^{-1}
Γ	0.07 ps^{-1}	0.01 ps^{-1}
A^s_{SL}	0.006	0.004
A_{CH}	0.004	0.004
$\mathcal{B}(B_s \to \mu^+\mu^-)$	-	$< 8 \times 10^{-9}$
$\|V_{td}/V_{ts}\|$	0.08	0.017
$\mathcal{B}(B_s \to \gamma\gamma)$	38%	7%
β_s (angular analysis)	20°	8°
β_s $(J/\psi\phi)$	10°	3°
β_s $(K^0\bar{K}^0)$	24°	11°

Requirements from above Υ(4S) physics

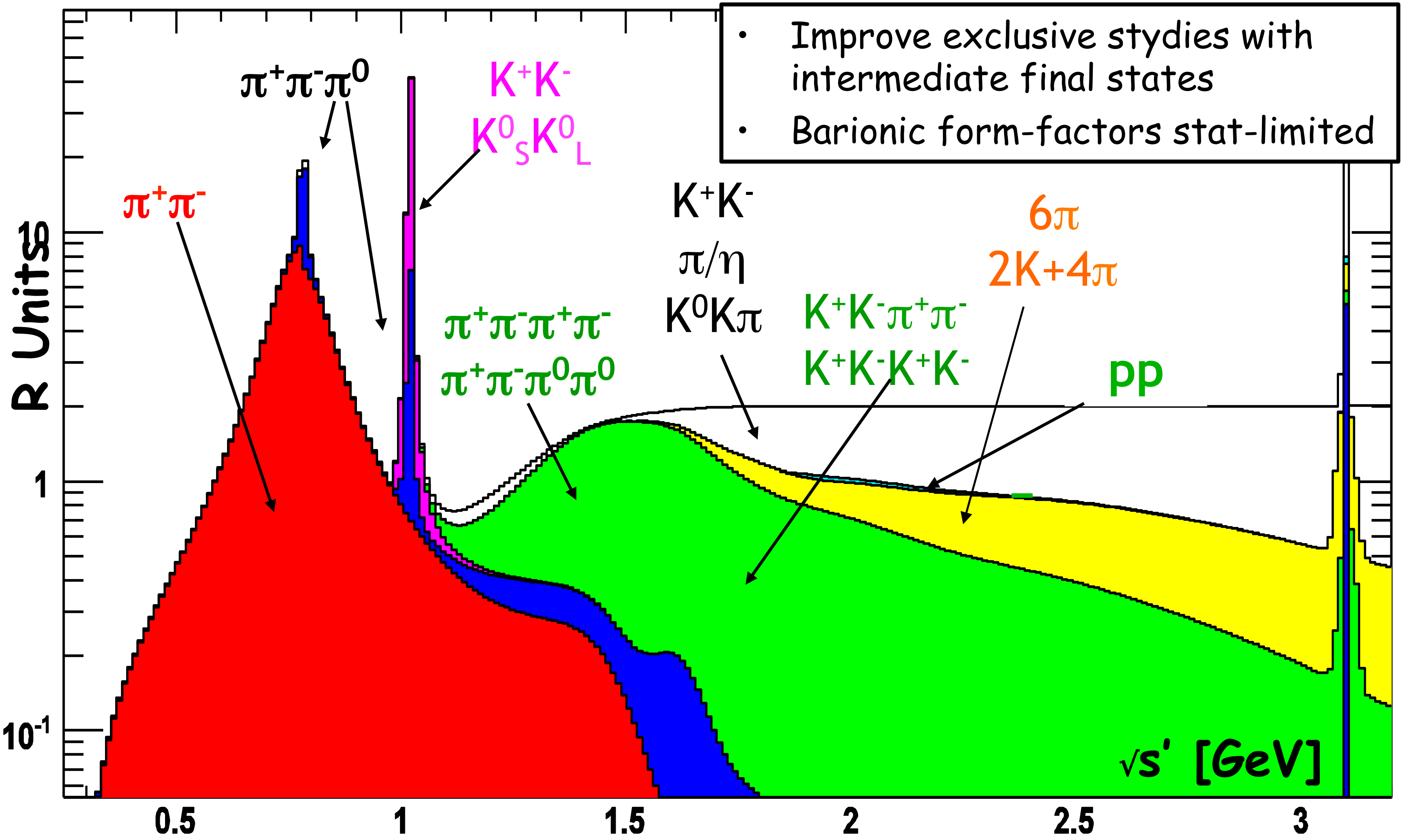
- High luminosity @ Υ(5S)
- Scan energy from Υ(4S) to 11 GeV

OTHER PHYSICS

- ISR
- γγ physics
- Electroweak physics
- Direct searches for exotics (light higgs, dark forces, invisible Y decays)

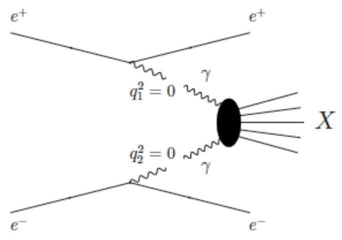
$e^+e^- \rightarrow \gamma_{ISR} X_{light}$

- Improve exclusive stydies with intermediate final states
- Barionic form-factors stat-limited



Critical region for δa_μ

Critical region for $\Delta\alpha_{had}$

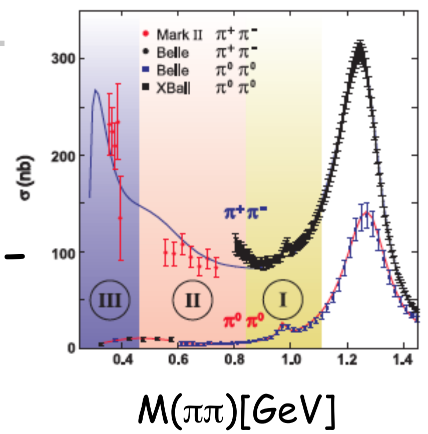


γγ physics

- Study of resonances γγ width
- Measurement of form factors
- Search for new states with C=+ (e.g. hybrids with X=ηπ)

Would profit from lowering the minimal triggered invariant mass

e+e- → e+e-π+π-

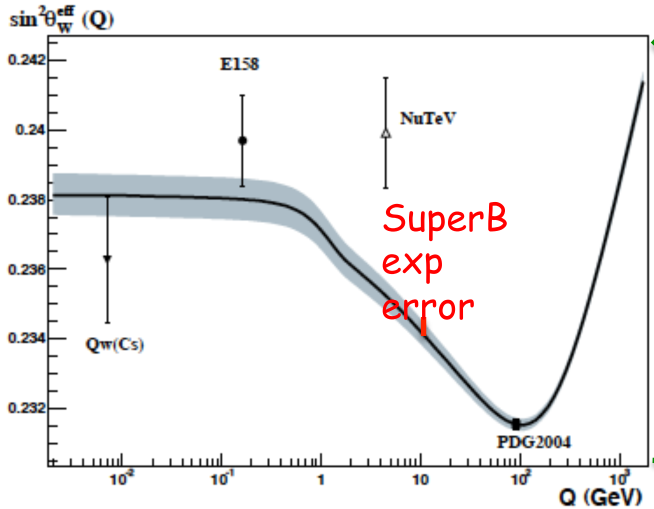


O. Vives
M. Roney

Electroweak

- Inconsistencies among $\sin^2\theta_W$ measurements at LEP could be further investigated with precise $A_{LR}(f)$, $A_{pol}(\tau)$ measurements at SuperB

Note:
$\sin^2\theta_W(b)=$
$0.281+/-0.016$



- Without polarization measurement dominated by measurements of g_A(=-0.5 in SM). Second order sensitivity to $\sin^2\theta_W$ → polarization is critical

Light higgs

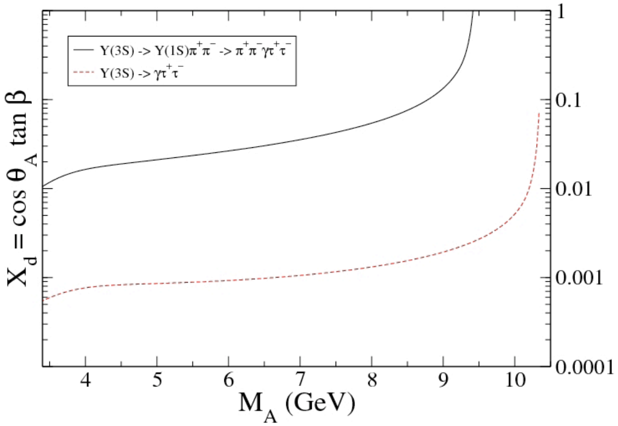
- ❑ There are models (eg NMSSM) where LEP cannot exclude completely CP-odd Higgs with $m_A<2m_B$

$$\Upsilon(nS) \rightarrow A\,\gamma \rightarrow \tau\tau\,\gamma$$

$$R_{\tau/\ell} = \frac{\Gamma_{\Upsilon(nS)\rightarrow\gamma_s\tau\tau}}{\Gamma^{(em)}_{\ell\ell}} = \frac{B_{\tau\tau} - B_{\ell\ell}}{B_{\ell\ell}} = \frac{B_{\tau\tau}}{B_{\ell\ell}} - 1$$

- ❑ Two approaches:
  - ◆ Search for deviations from lepton universality in Υ decays
    - ☹ Dominated by systematics
  - ◆ Search for monochromatic photon
    - ☹ Large background from $e^+e^- \rightarrow \tau\tau\gamma$
    - ☺ Use cascade $\Upsilon(3S)\rightarrow\Upsilon(1S)\pi\pi\rightarrow A\gamma\,\pi\pi$

5 σ Discovery limit on X in Y->γττ



Dark matter searches

DM

Dominant mode $\Upsilon(3S)\rightarrow \Upsilon(1S)\pi\pi\rightarrow \chi\chi\pi\pi \rightarrow$

THE STANDARD MODEL

$$BR(\Upsilon(1S)\rightarrow \nu\bar{\nu}) = \frac{N_\nu G_F^2}{48\pi}\left|1-\frac{4}{3}\sin^2\theta_W\right|^2 \frac{f_{\Upsilon(1S)}^2 M_{\Upsilon(1S)}^3}{\Gamma_{\Upsilon(1S)}}$$

$$BR(\Upsilon(1S)\rightarrow \nu\bar{\nu}) = (1.03\pm 0.04)\times 10^{-5}$$

LOW-MASS DARK MATTER

Fayet, McElrath, Yeghiyan, ...

Most recently, Yeghiyan calculated from an effective theory that:

$$BR(\Upsilon(1S)\rightarrow \phi\bar{\phi}) = \frac{C_3^2}{\Lambda_H^4}\frac{f_{\Upsilon(1S)}^2}{48\pi\Gamma_{\Upsilon(1S)}}\left|M_{\Upsilon(1S)}^2-4m_\phi^2\right|^{3/2}$$

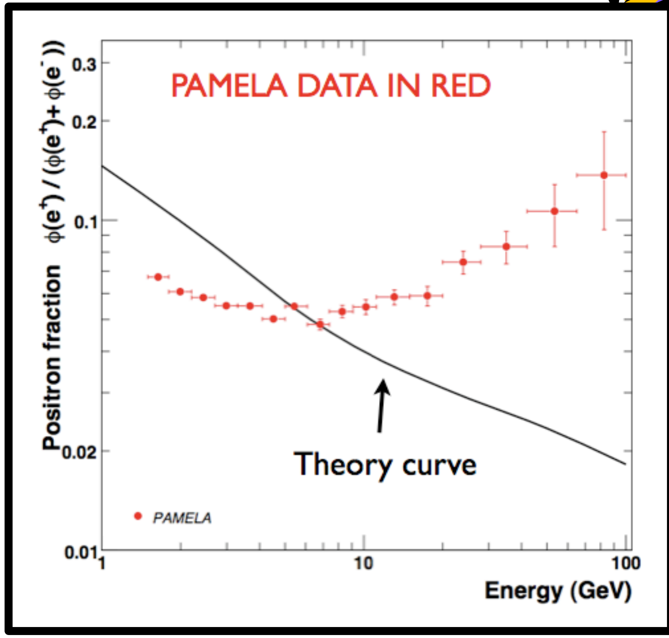
where the production of the dark matter is mediated by heavy degrees of freedom whose mass scale is Λ_H and where C_3 is the (real-valued) Wilson coefficient for the term in the effective theory that leads to this final state.

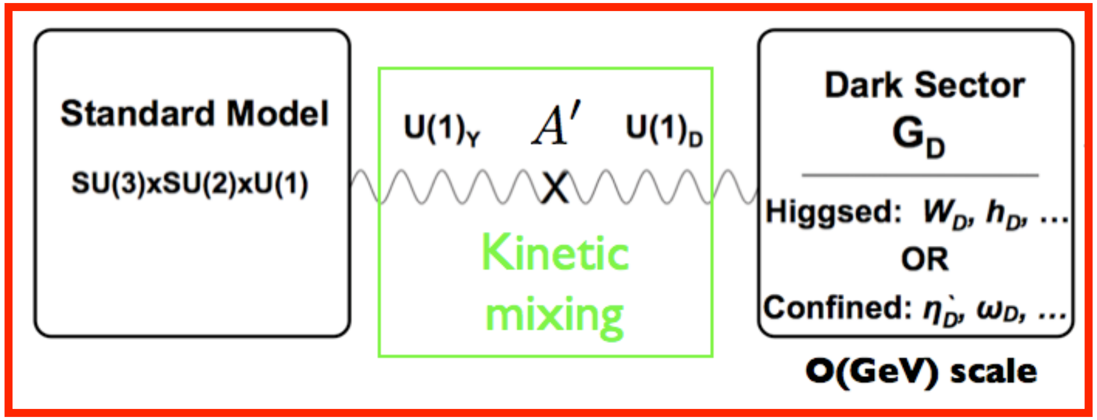
Search for Dark Forces

Results from Pamela/Fermi: excess of positrons of astrophysical origin

➔ Due to particles decaying into e^+e^- with $m<2m_p$?

➔ "Dark" gauge sector

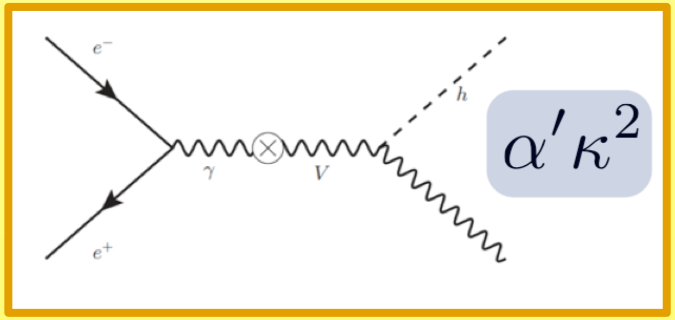




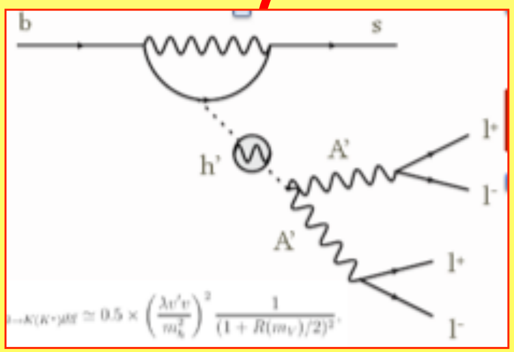
Sensitivity to dark forces

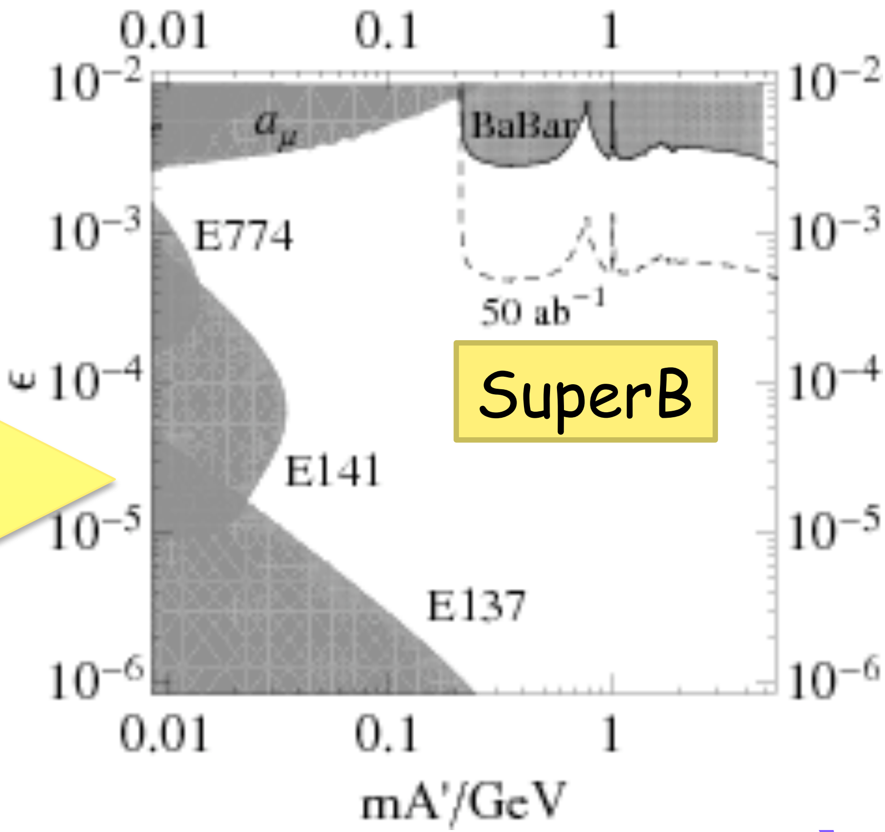
Discovery modes:

- Direct production



- B decays





Requirements from "other" physics

- High luminosity
- Customed triggers

Requirements and competitors

Requirements	Competitors
High luminosity @ $\Upsilon(4S)$ Asymmetric beams Good vertex resolution	Belle II (sligtly lower lumi, starting earlier) LHCb (limited number of channels accessible)
polarization	nobody
Energy scan	BES III (up to 4 GeV) Panda (ppbar@threshold) –much lower stat/ only conventional J^{CP}

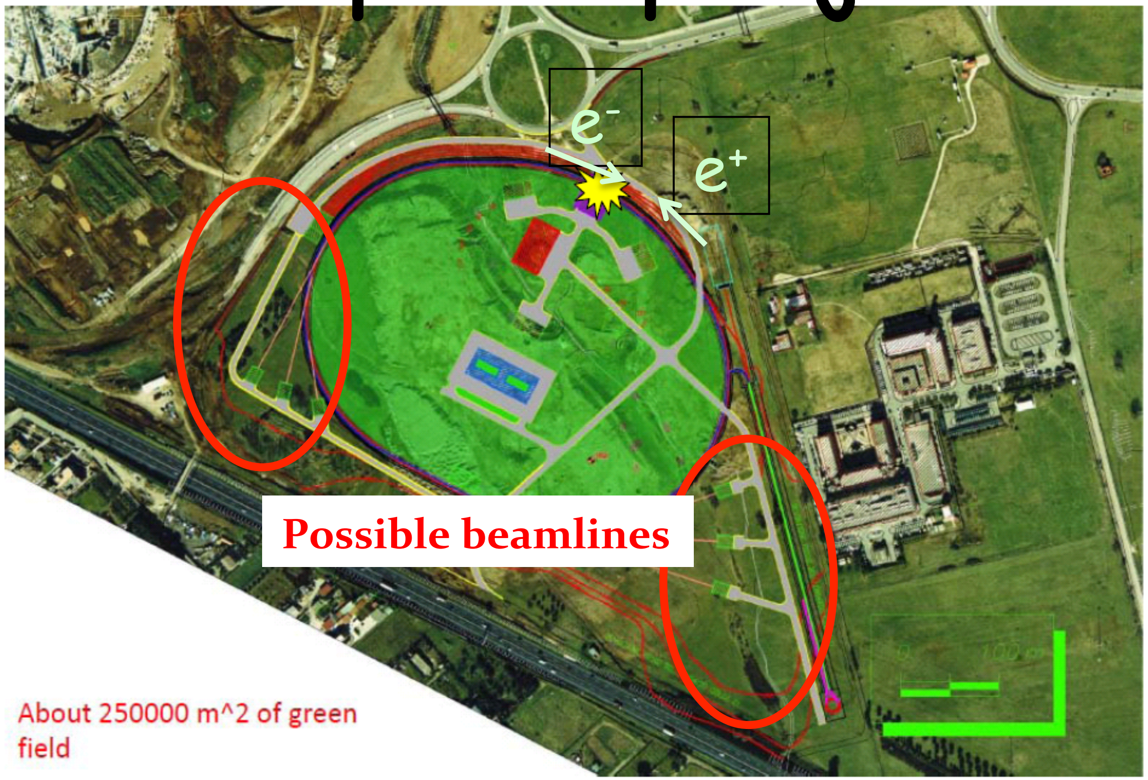
Accelerator design

SuperB main features

- Goal: maximal luminosity , low wall power

- 2 rings (~4 GeV and ~7 GeV) with flexible design
- Ultra low emittance optics: 7x4 pm vertical emittance
- Beam currents: comparable to present Factories
- Crab-waist and low PA scheme used to maximize luminosity and minimize beam size blow-up
- No “emittance” wigglers used (save power)
- Design based on recycling PEP-II hardware (save costs)
- Longitudinal polarization for electrons in the HER
- Possibility to push the cm energy to the τ-charm threshold with a luminosity of 10^{35} cm^{-2} s^{-1}

The SuperB project



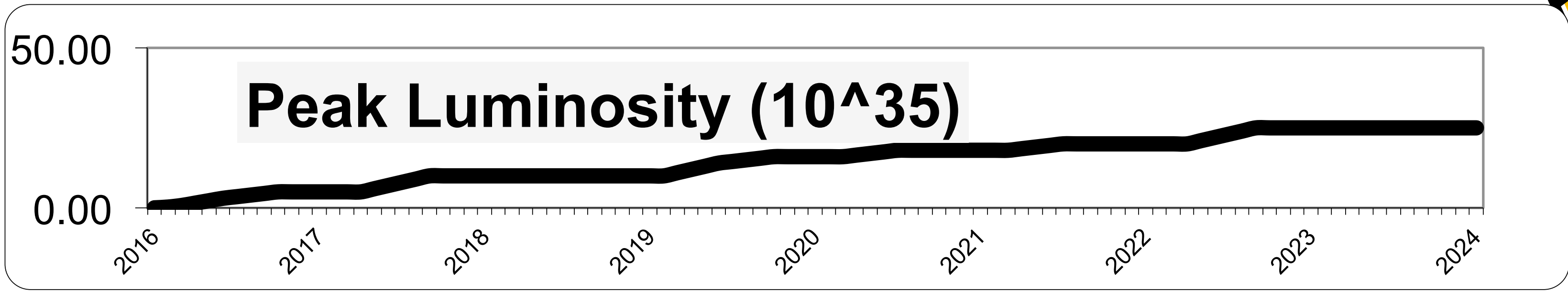
e^+e^- machine in TorVergata (Rome)

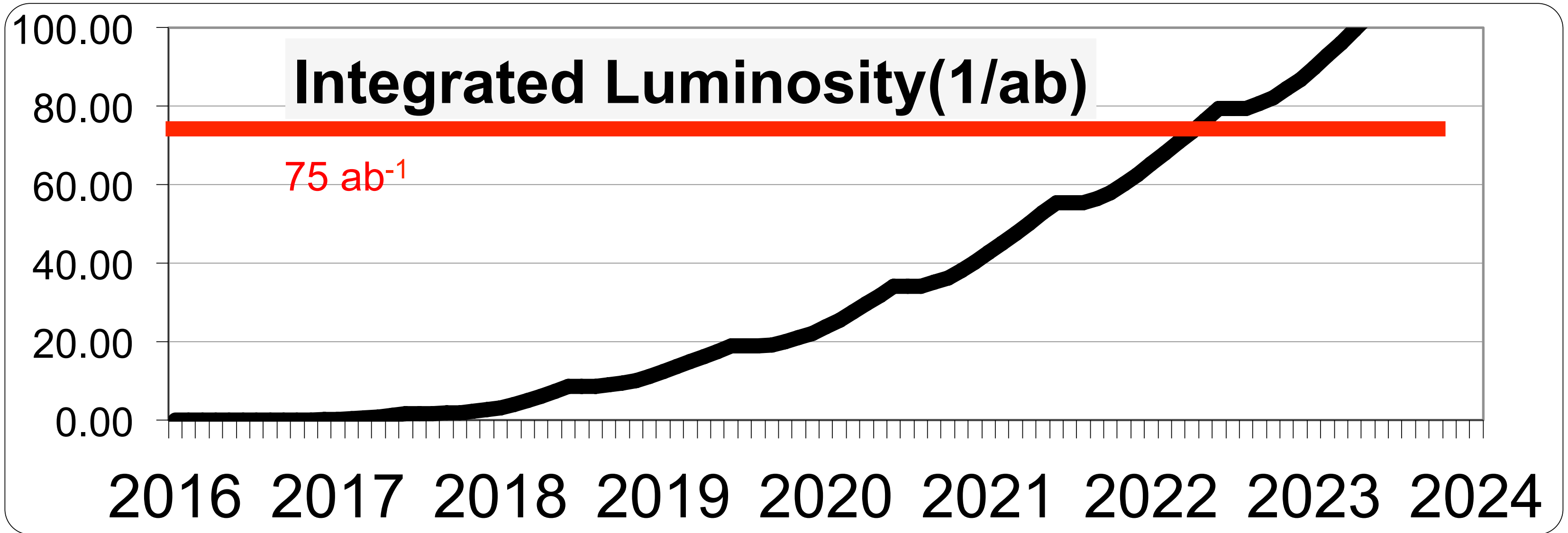
E_{CM}=4-12 GeV

Accelerator Parameters

	PEP-II (SLAC)	SuperB (Italy)	SuperKEKB (KEK)
Luminosity (10^{30} cm^{-2}s^{-1})	12069 (design: 3000)	1.0×10^6	8×10^5
Injection energy (GeV)	2.5–12	$e^-/e^+: 4.2/6.7$	$e^-/e^+: 7/4$
Transverse emittance ($10^{-9}\pi$ rad-m)	e^-: 48 (H), 1.5 (V) e^+: 24 (H), 1.5 (V)	e^-: 2.5 (H), 0.006 (V) e^+: 2.0 (H), 0.005 (V)	5 (H), 3 (V)
β^*, amplitude function at interaction point (m)	e^-: 0.50 (H), 0.012 (V) e^+: 0.50 (H), 0.012 (V)	e^-: 0.032 (H), 0.00021 (V) e^+: 0.026 (H), 0.00025 (V)	e^-: 0.025 (H), 3×10^{-4} (V) e^+: 0.032 (H), 2.7×10^{-4} (V)
Beam-beam tune shift per crossing (units 10^{-4})	e^-: 703 (H), 498 (V) e^+: 510 (H), 727 (V)	20 (H), 950 (V)	e^-: 12 (H), 807 (V) e^+: 28 (H), 893 (V)
RF frequency (MHz)	476	476	508.887
Particles per bunch (units 10^{10})	e^-/e^+: 5.2/8.0	e^-/e^+: 5.1/6.5	e^-/e^+: 6.53/9.04
Bunches per ring per species	1732	978	2500
Average beam current per species (mA)	e^-/e^+: 1960/3026	e^-/e^+: 1900/2400	e^-/e^+: 2600/3600

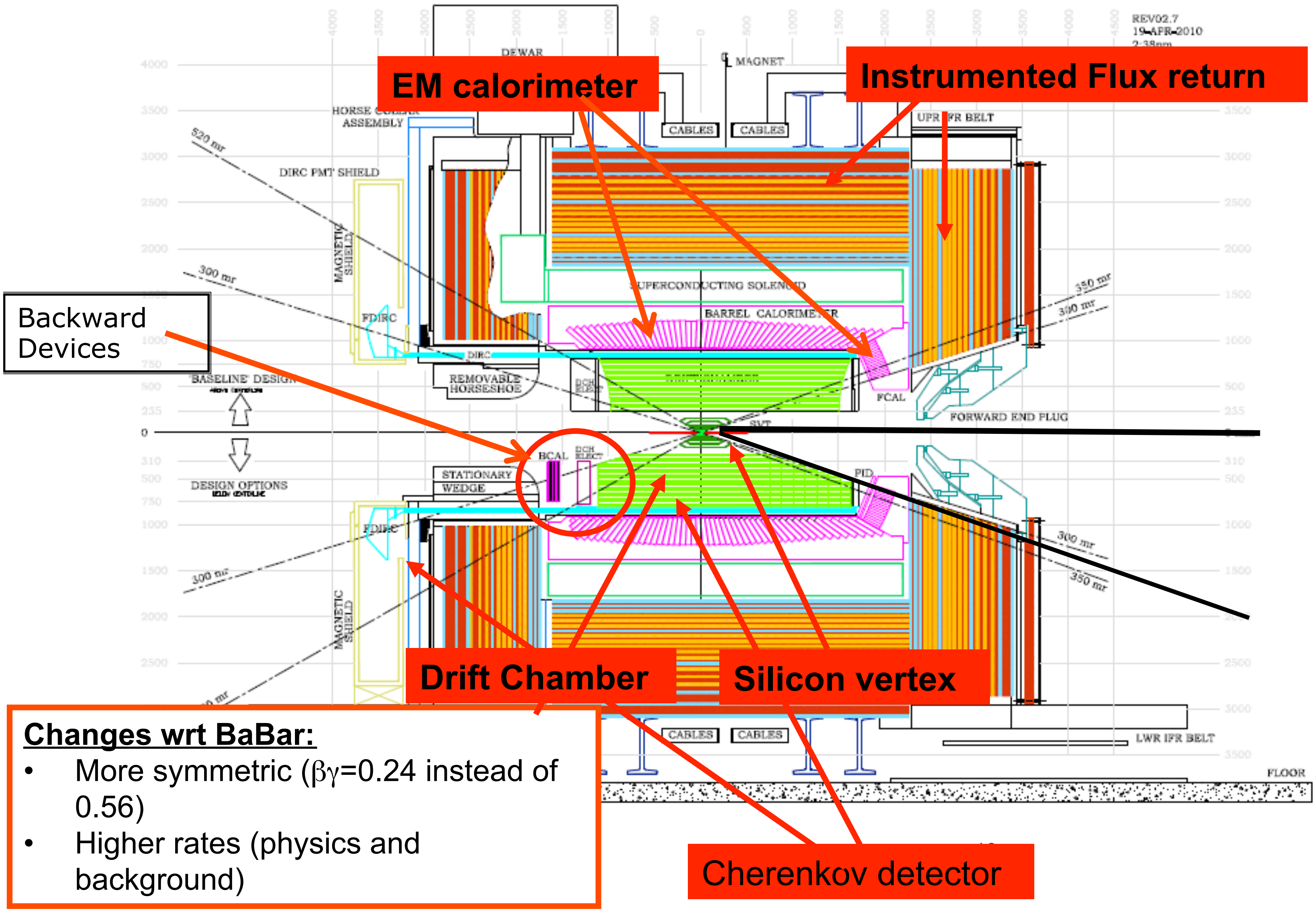
SuperB Luminosity model





Detector

Detector Design (with *fewer* options)



Changes wrt BaBar:

- More symmetric ($\beta\gamma$=0.24 instead of 0.56)
- Higher rates (physics and background)

Detector Coordinators – B.Ratcliff, F. Forti
Technical Coordinator – W.Wisnieswki

- SVT – G. Rizzo
- DCH – G. Finocchiaro, M.Roney
- PID – N.Arnaud, J.Va'vra
- EMC – F.Porter, C.Cecchi
- IFR – R.Calabrese
- Magnet – W.Wisniewski
- Electronics, Trigger, DAQ – D. Breton, U. Marconi
- Online/DAQ – S.Luitz
- Offline SW –
  - Simulation coordinator – D.Brown
  - Fast simulation – M. Rama
  - Full Simulation – F. Bianchi
- Background simulation – M.Boscolo, E.Paoloni
- Machine Detector Interface –
  - Rad monitor –
  - Lumi monitor –
  - Polarimeter –

Detector Geometry Working Group
Chairs : M.Rama, A.Stocchi

Forward Task Force
Chair H.Jawahery

Backward Task Force
Chair W. Wisniewski

Mechanical integration team
F. Raffaelli

To be created:
Central electronics team

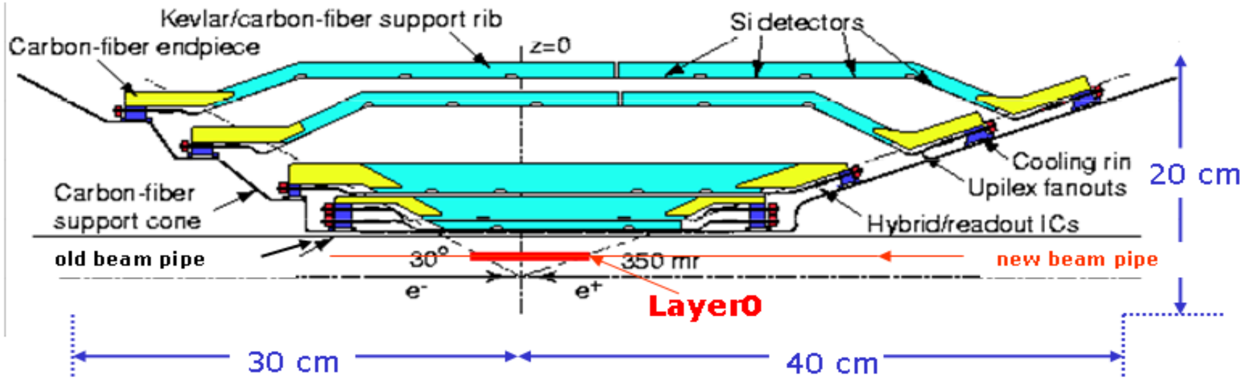
System	Institutions
SVT	Bologna, Milano, Pavia, Pisa, Rome3, Torino, Trieste, Trento, LBNL, Queen Mary, RAL, Strasbourg, Bari
DCH	LNF, McGill, Montreal, TRIUMF, UBC, Victoria, Lecce
PID	SLAC, BINP, (Hawaii), Cincinnati, Bari, Padova, Maryland, LAL, LPNHE
EMC	Bergen, Caltech, Perugia, Rome1, Napoli
IFR	Ferrara, Padova, Krakow, Bologna
ETD	SLAC, Caltech, Napoli, Bologna, LAL, Padova, Rome3
Computing	Padova, Ferrara, Torino, Bari, Bologna, Rome2, Pisa, Perugia, LNF, LBNL, Napoli, SLAC
Magnet/ Integration	SLAC, LNF, Pisa, Genova
Backgrounds/MDI	SLAC, Pisa, LNF, LNS, Cagliari, Ohio State
TBD	(Valencia, Barcelona, Annecy, Tel Aviv, Liverpool, Kiev, ITEP, Riverside, Kansas, Livermore, Louisville, Notre Dame,Ohio State, Princeton, Southern Methodist, South Carolina, Austin, Utah ,Grenoble ,Strasbourg

SVT (Silicon Detector) - Generality

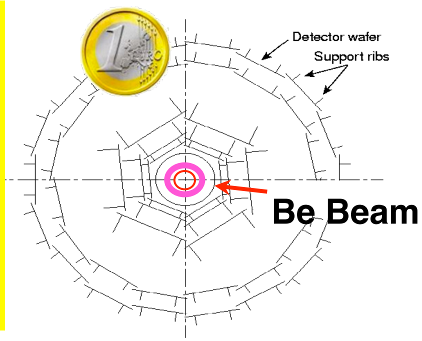
Layer 0 very close
To the beam pipe ADDED

BaBar SVT

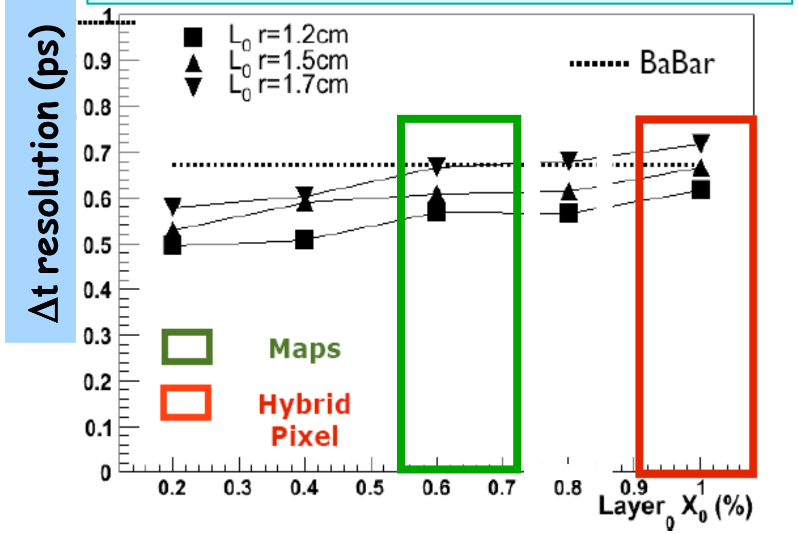
Layer	Radius
0	1.2-1.5 cm
1	3.3 cm
2	4.0 cm
3	5.9 cm
4	9.1 to 12.7 cm
5	11.4 to 14.6 cm



Based on BaBar SVT: 5 layers silicon strip modules + Layer0 at small radius to improve vertex resolution and compensate the reduced SuperB boost w.r.t. PEPII



$B \to \pi\pi$, $\beta\gamma=0.28$, hit resolution =10 μm

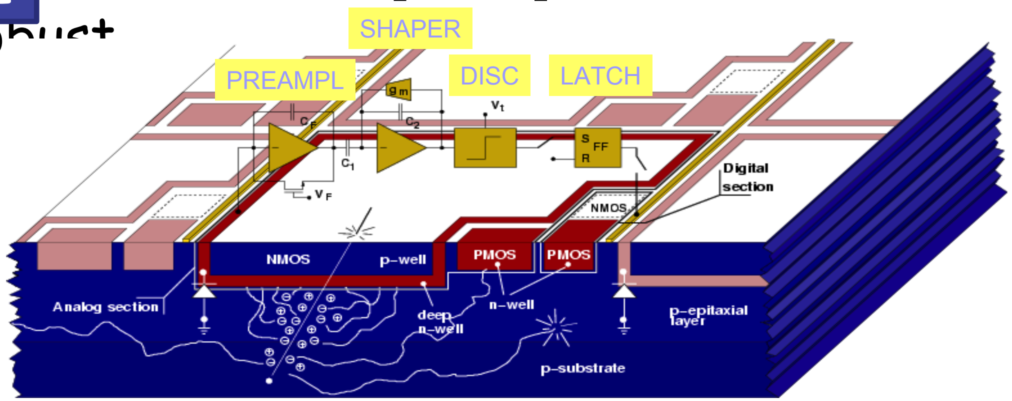


- Physics performance and background levels set stringent requirements on Layer0:
  - R~1.5 cm, material budget < 1% X_0,,
  - Hit resolution 10-15 μm in both coordinates
  - Track rate > 5MHz/cm² (with large cluster too!), TID > 3MRad/yr
- Several options under study for Layer0

SVT Layer 0 - technology options

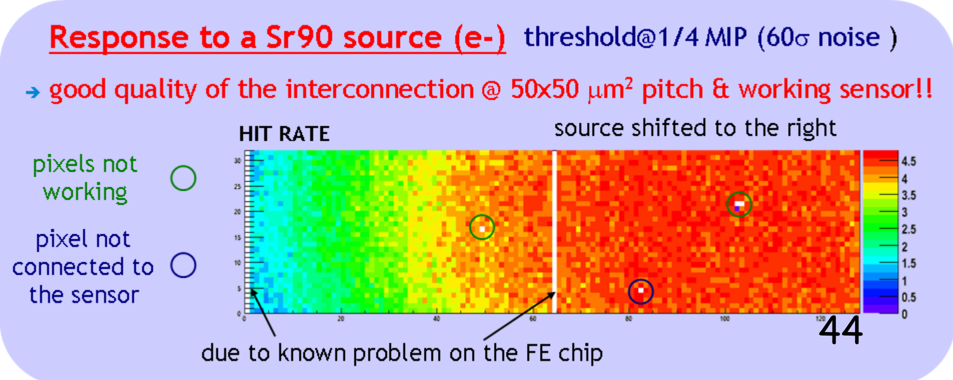
- Ordered by increasing complexity:
  - Striplets **BASELINE**
    → Mature technology, not so robust against bkg occupancy
  - Hybrid pixels
    → Viable, although marginal in term of material budget
  - CMOS MAPS
    → New & challenging technology: fast readout needed (high rate)
  - Thin pixels with vertical integration
    → Reduction of material and improved performance

CMOS MAPS with in pixel sparsification



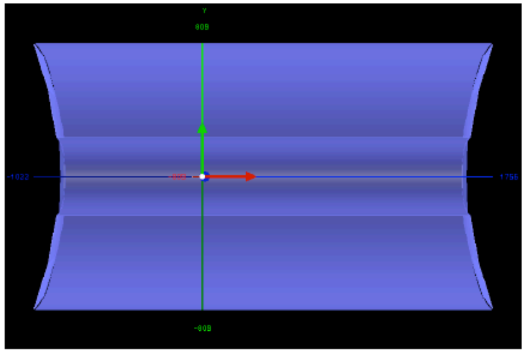
Test of a hybrid pixel matrix with 50×50 μm² pitch

- Several pixel R&D activities
  - Performances: efficiency, hit resolution
  - Radiation hardness
  - Readout architecture
  - Power, cooling

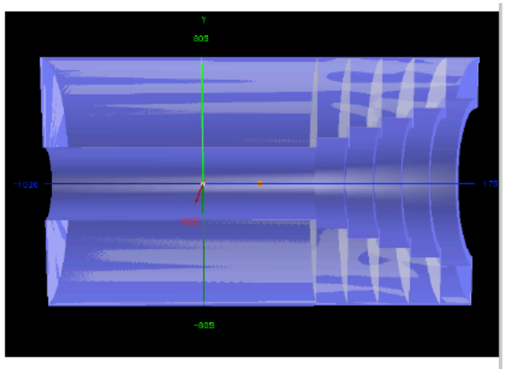


Drift CHamber (DCH)

- Large volume gas (BaBar: He 80% / Isobutane 20%) tracking system providing measurement of charged particle mom. and ionization energy loss for particle identification
- Primary device to measure speed of particles having momenta below ~700 MeV/c
- About 40 layers of centimetre-sized cells strung approximately parallel to the beamline with subset of layers strung at a small stereo angle in order to provide measurements along the beam axis
- Momentum resolution of ~0.4% for tracks with p_t = 1 GeV/c
- Overall geometry
  - Outer radius constrained to 809 mm by the DIRC quartz bars
  - Nominal BaBar inner radius (236 mm) used until Final Focus cooling finalized
  - Chamber length of 2764 mm (will depend on forward PID and backward EMC)



(a) Spherical endplates design.

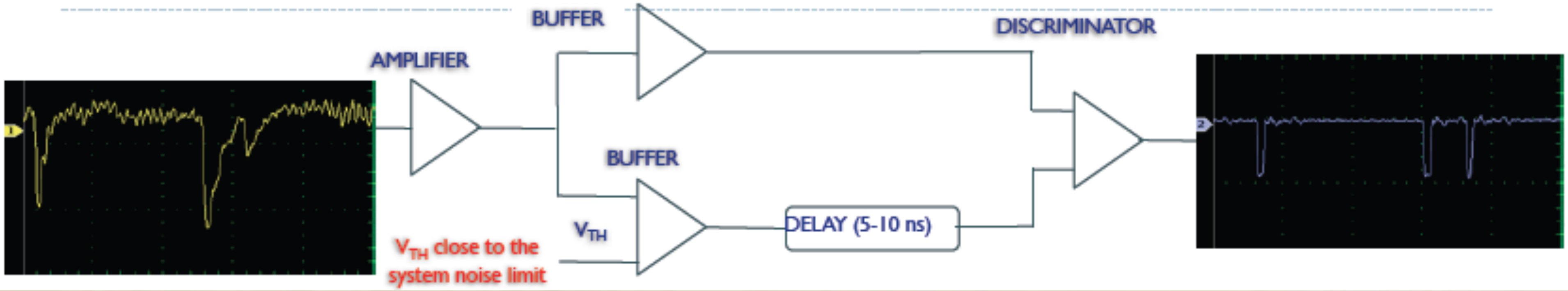


(b) Stepped endplates design.

R&D on cluster counting

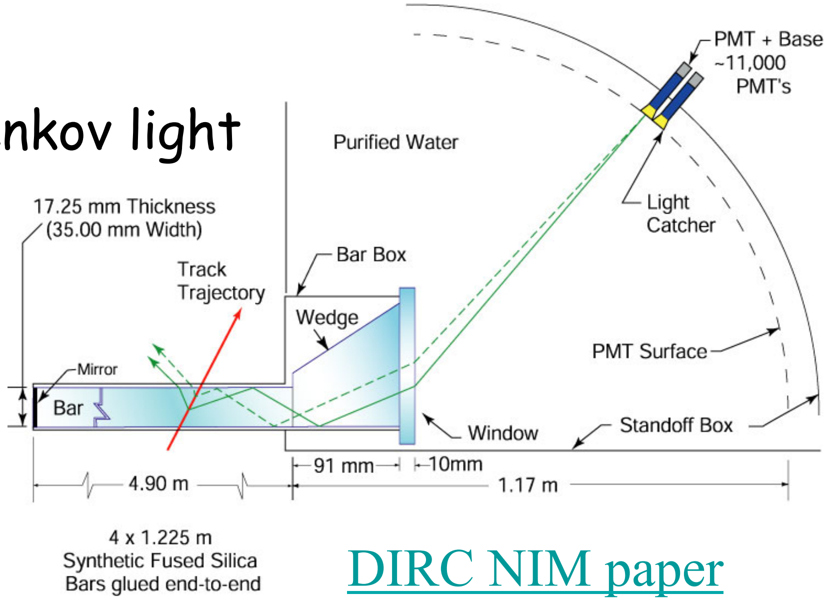
- Kaon-pion separation achieved by counting the number of released clusters
  - a more direct measurable rather than the integral energy
  - need time resolution to resolve clusters

Local derivative method



The Focusing DIRC (FDIRC)

- Based on the successful BaBar DIRC:
  - Detector of Internally Reflected Cherenkov light [SLAC-PUB-5946]



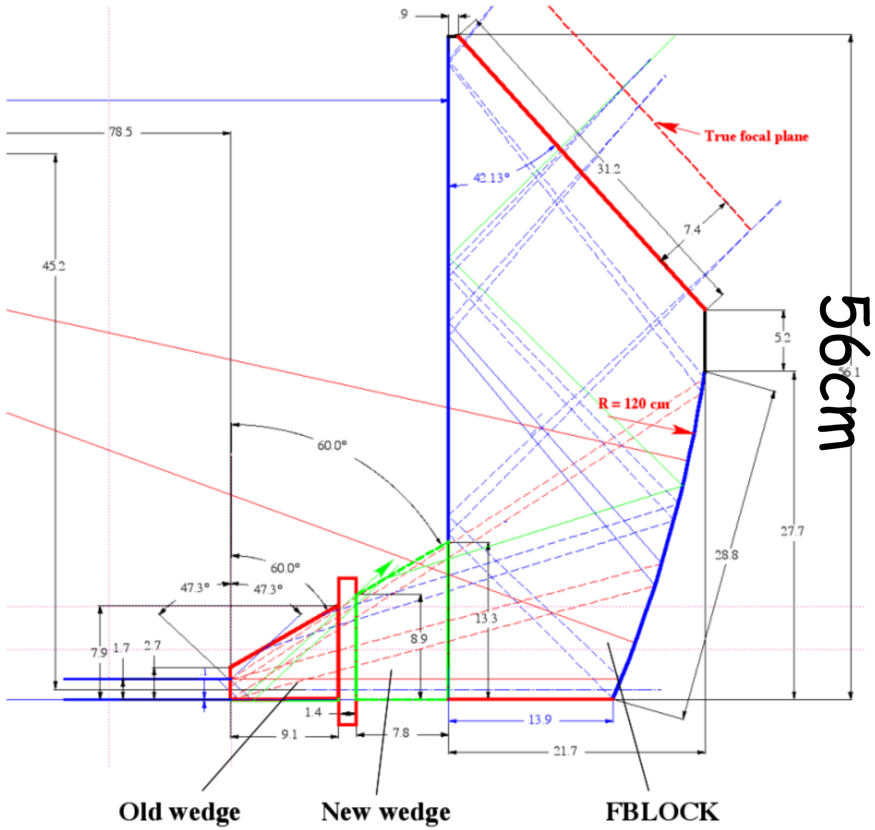
DIRC NIM paper
[A583 (2007) 281-357]

- Main PID detector for the SuperB barrel
  - K/π separation up to 3-4 GeV/c
  - Performance close to that of the BaBar DIRC

- To cope with high luminosity (10^{36} $cm^{-2}s^{-1}$) & high background
  - Complete redesign of the photon camera [SLAC-PUB-14282]: true 3D imaging using:
    - 25× smaller volume of the photon camera
    - 10× better timing resolution to detect single photons
    - Optical design is based entirely on Fused Silica glass
      → Avoid water or oil as optical media

FDIRC - photon camera (12 in total)

- Photon camera design (FBLOCK)
  - Initial design by ray-tracing [SLAC-PUB-13763]
  - Experience from the 1rst FDIRC prototype [SLAC-PUB-12236]
  - Geant4 model now [SLAC-PUB-14282]



- Main optical components
  - New wedge
    → Old bar box wedge not long enough
  - Cylindrical mirror to remove bar thickness
  - Double-folded mirror optics to provide access to detectors

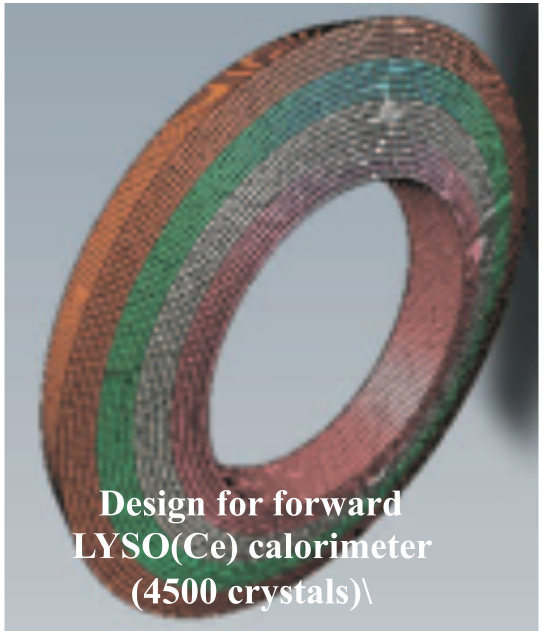
- Photon detectors: highly pixilated H-8500 MaPMTs
  - Total number of detectors per FBLOCK: 48
  - Total number of detectors: 576 (12 FBLOCKs)
  - Total number of pixels: 576 × 32 = 18,432

The ElectroMagnetic Calorimeter (EMC)

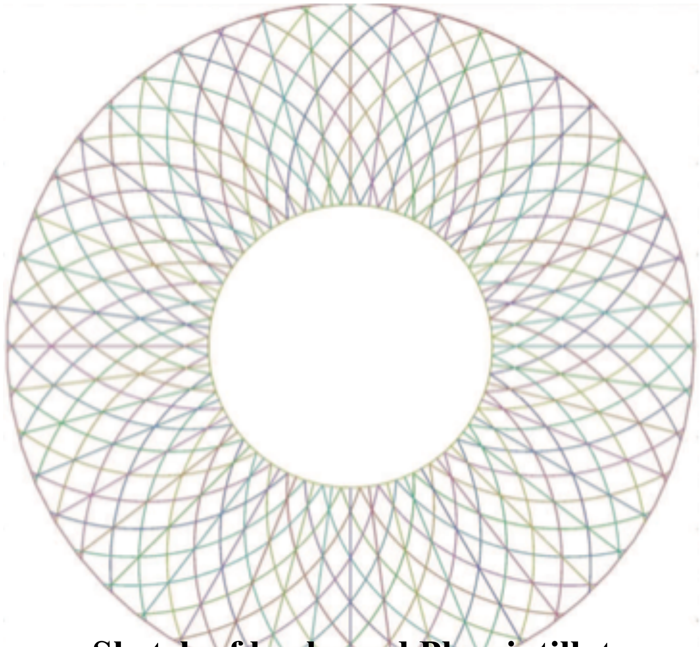
- System to measure electrons and photons, assist in particle identification
- Three components
  - Barrel EMC: CsI(Tl) crystals with PiN diode readout
  - Forward EMC: LYSO(Ce) crystals with APD readout
  - Backward EMC: Pb scintillator with WLS fiber to SiPM/MPPC readout [*option*]
- Groups: Bergen, Caltech, Perugia, Rome

  → New groups welcome to join!

CsI(Tl) barrel calorimeter (5760 crystals)



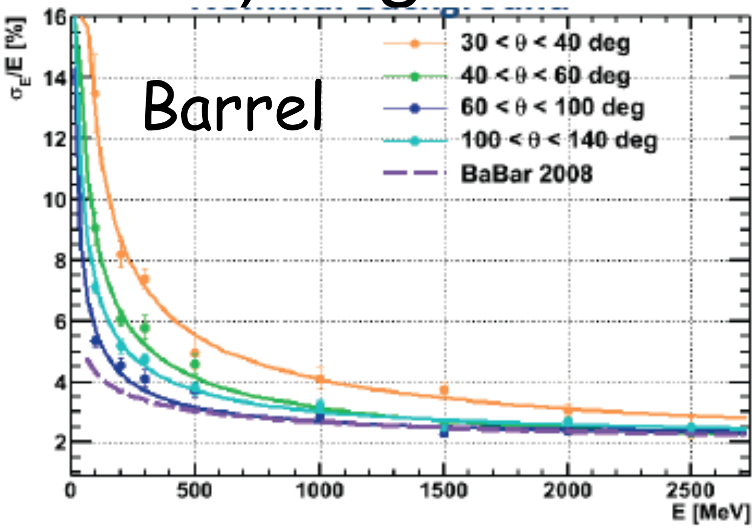
Design for forward LYSO(Ce) calorimeter (4500 crystals)\

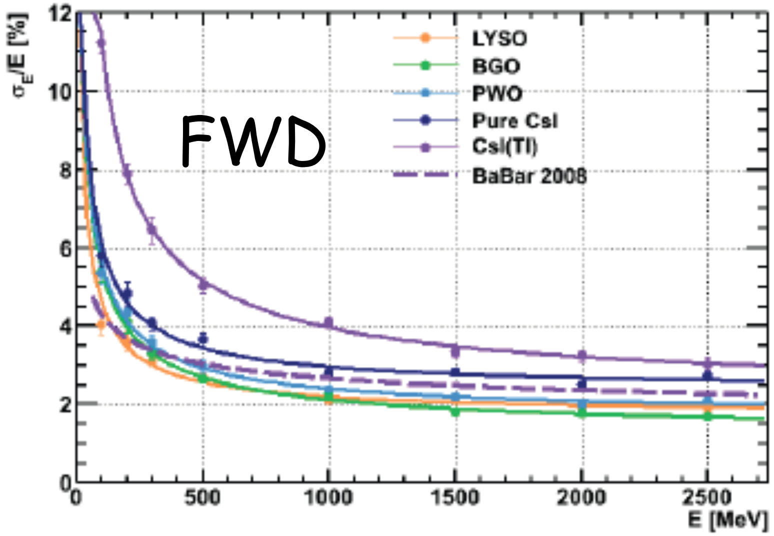


Sketch of backward Pb-scintillator calorimeter, showing both radial and logarithmic spiral strips (24 Pb-scint layers, 48 strips/layer, total 1152 scintillator strips)

Background issues

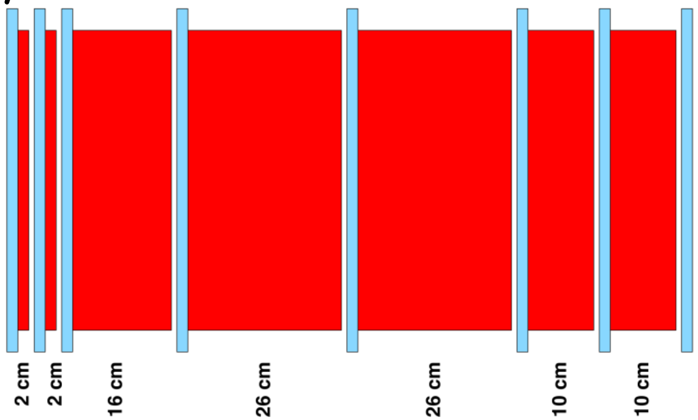
- High background (rad bhabha) is critical
- Best solution for FWD is LYSO → very expensive (10M€), searching for alternative
- Also barrel (where CsI(TI) cannot be replaced) might suffer



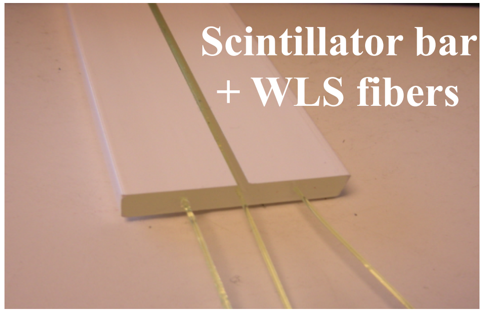


Instrumented Flux Return (IFR)

- Built in the magnet flux return
  → One hexagonal barrel and two endcaps
- Scintillator as active material to cope with high flux of particles: hottest region up to few 100 Hz/cm^2
- 82 cm or 92 cm of Iron interleaved by 8-9 active layers
  → Under study with simulations/testbeam
- Fine longitudinal segmentation in front of the stack for K_L ID (together with the EMC)
- Plan to reuse BaBar flux return
  → Add some mechanical constraints:
  gap dimensions, amount of iron, accessibility

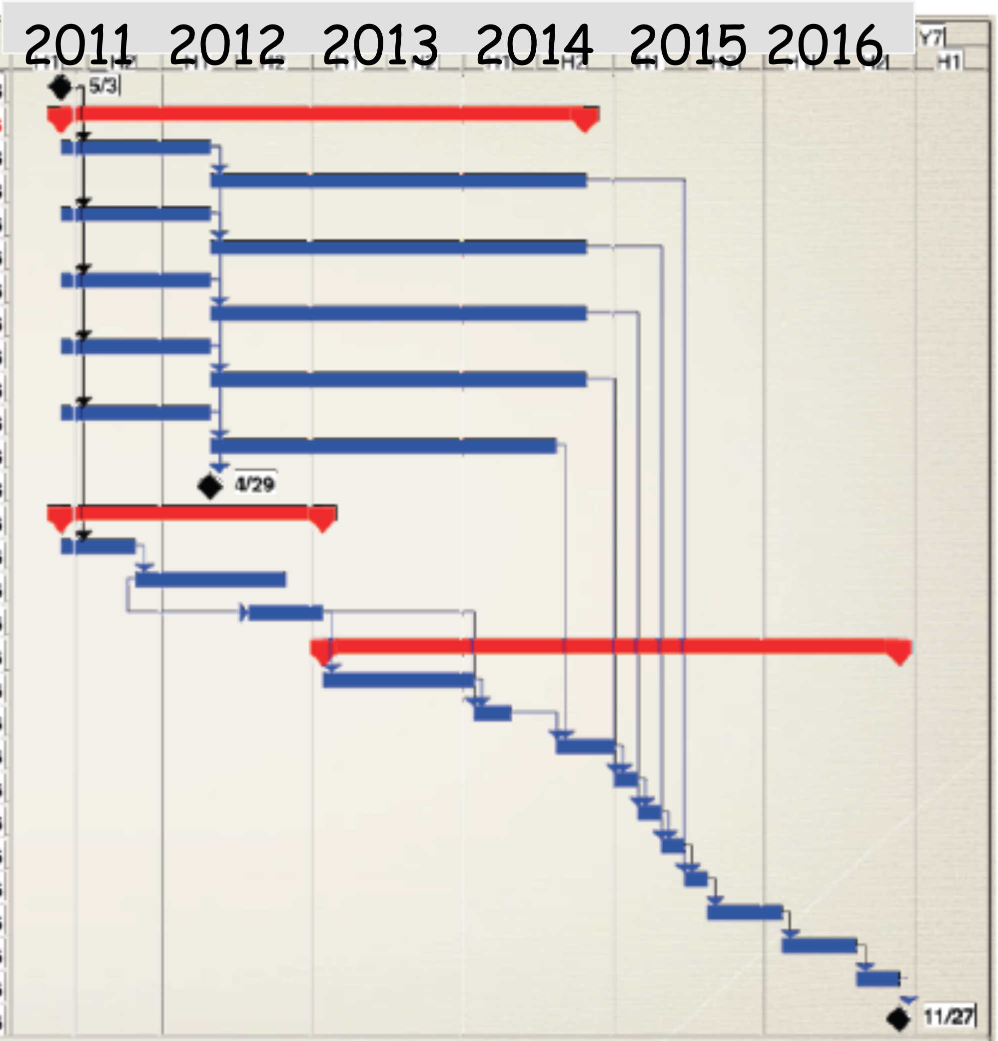


- 4-meter long extruded scintillator bars readout through 3 WLS fibers and SiPM
- Two readout options under study
  - Time readout for the barrel (two coordinates read by the same bar)
  - Binary readout for the endcaps (two layers of orthogonal bars)



Detector Schedule Piano Triennale

ID	Task Name	Duration
1	Approval	0 wks
2	Detector Design & Construction	182 wks
3	Design SVT	52 wks
4	Construct SVT	130 wks
5	Design DCH	52 wks
6	Construct DCH	130 wks
7	Design PID	52 wks
8	Construct PID	130 wks
9	Design forward EMC	52 wks
10	Construct forward EMC	130 wks
11	Design IFR	52 wks
12	Construct IFR	120 wks
13	Detector Technical Design Report	0 wks
14	Dismantle & Move Babar	91 wks
15	Design Tooling	26 wks
16	Dismantle Babar	52 wks
17	Component transportation	26 wks
18	Detector Installation & Commissioning	200 wks
19	Installation steel	52 wks
20	Installation magnet	13 wks
21	Installation IFR	20 wks
22	Installation EMC	8 wks
23	Installation PID	8 wks
24	Installation DCH	8 wks
25	Installation SVT	8 wks
26	Commissioning	26 wks
27	Cosmic Ray test	26 wks
28	Commissioning on beam	15 wks
29	Detector ready for collision	0 wks



Project: SBF_schedule_v1.2
Date: Fri 6/4/10

Task | Milestone | External Tasks
Split | Summary | External Milestone

Project status

Status of the project

- SuperB has been approved within the new italian research plan.
- Reasearch plan endorsed by "CIPE" (the institution responsible for infrastructure long term plans)
- A financial allocation of 250 Million Euros from the italian government in about five years approved for the "superb flavour factory"
- Site established in May 2011
- Cabibbo Lab has been created
- **Currently:**
  - Finalizing machine design and project organization
  - Building the international collaboration on the detector
  - Aiming at writing both the TDRs by 2012

Key milestones

- Site choice Summer 2011
- Start civil engineering early 2012
- Machine end Detector TDR spring 2012
- Start machine installation Early 2013
- First collisions Beg 2016

Summary

SuperB is a Super-Flavour-Factory

- Produces huge numbers of B_d, B_s, D, τ, $\gamma\gamma$, and continuum events
- Searches for impact of new physics in flavour decays but not only

SuperB presents unique characteristics:

- Luminosity
- Beam polarization
- Energy scan potentialities

White Papers:

- Detector arXiv:1007.4241
- Accelerator arXiv:1009.6178
- Physics arXiv:1008.1541

Challenges:
machine
detector
schedule …