Status of the Super Flavor Factory Super$B$

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Discrete 08
Valencia
December 13, 2008

Is there a motivation to continue e^+e^- flavor physics studies with a Super B factory beyond the *BABAR*/Belle/(LHC*b*) era ?

- Yes – provided that new measurements have sensitivity to New Physics in b, c and τ decay

What size data sample is required to provide this sensitivity ?

- 50-75 ab^{-1} (*BABAR*+Belle total sample is <2 ab^{-1})

What luminosity is required to gather a sample of this size in five years ?

- At least 10^{36} cm^{-2}s^{-1}

Can a practical asymmetric collider with this luminosity be built ?

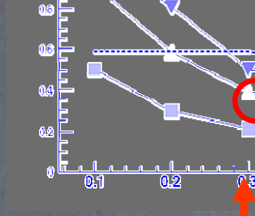
- Yes, using an innovative new approach: a low emittance collider, based on concepts developed for the ILC damping rings, and employing a new type of final focus – a “crabbed waist”. The machine is called Super*B*

Can a detector be built that can withstand the machine backgrounds ?

- Yes. The beam currents are less than those at PEP-II and KEKB

In this era of increasing energy prices, can you pay the power bill ?

- Yes. The wallplug power, 17MW, is less than half that of KEKB (65MW) and comparable to that of PEP-II



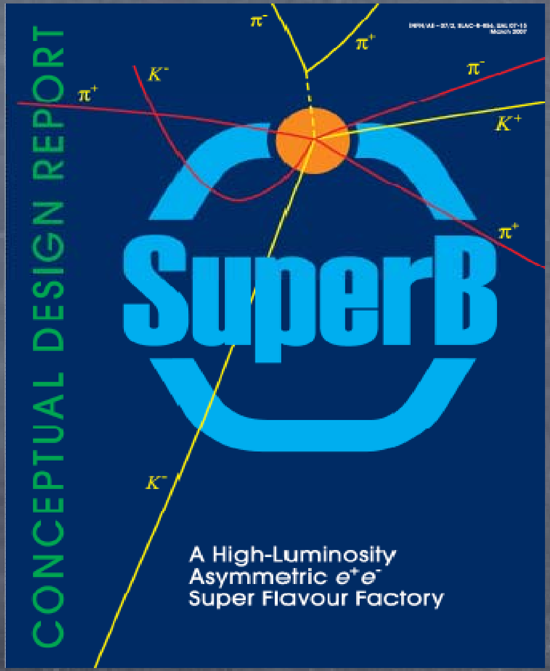
- uper$B$ is a Super Flavor Factory with very high initial luminosity, 0^{36}, which can be upgraded to 4×10^{36} in a straightforward manner
- t is asymmetric : 4 on 7 GeV
- lost of the ring magnets can re reused from PEP-II, as can the RF systems, any vacuum components, linac and injection components – as well as $BABAR$ as asis for an upgraded detector
- he high energy beam can be linearly polarized to ~85% , using the SLC laser
  - This is particularly important for confronting New Physics in τ decays
- he primary E_{CM} will be the $\Upsilon(4S)$, but Super$B$ can run elsewhere in the Υ re d in the charm & tau threshold regions as well, with a luminosity above 10^{35}
  - One month at the $\psi(3770)$, for example, yields 10x the total data sample that will be produced by BEPCII
- uper$B$ will be built on the campus of the Rome II University at Tor Vergat
  - There is an FEL already in early stages of construction on the site
  - Tunneling will continue to dig the Super$B$ tunnel, funded by Regione Lazio
- me scales
  - (Successful) conclusion of the European Roadmap process (INFN, ECFA, CERN Strategy Group) by early 2009, followed by INFN✹Ministry
  - TDR effort is beginning: construction 5 years : luminosity in 2015/16

There are two proposals on the market

- SuperKEKB, an high current upgrade of KEKB (next talk)
- Super$B$, a new low emittance collider, with a luminosity of >10^{36}, to be built at Rome II University “Tor Vergata”, using many PEP-II components

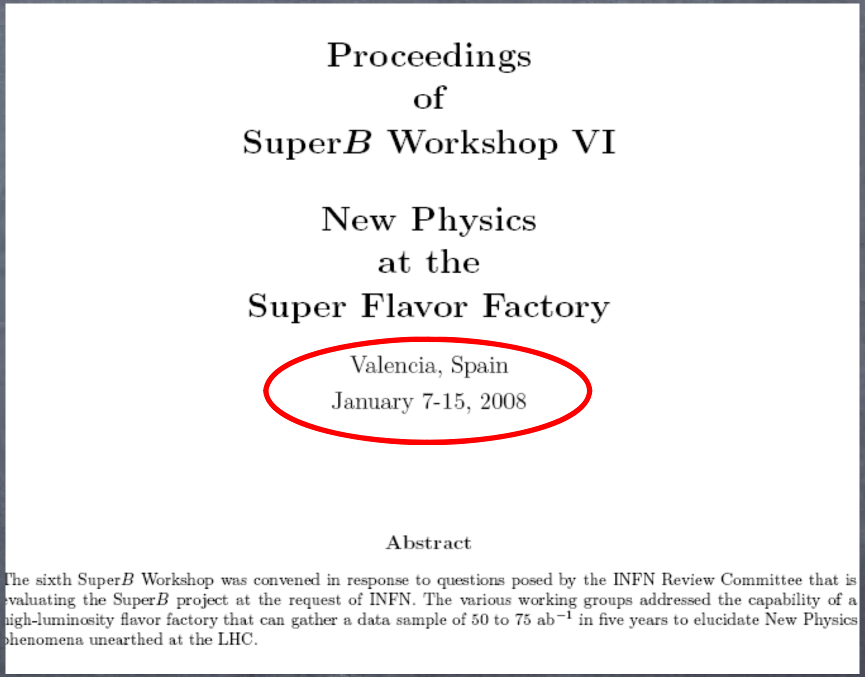
- This talk will concern Super$B$

320 signers
80 institutions


CONCEPTUAL DESIGN REPORT

SuperB

A High-Luminosity
Asymmetric e^+e^-
Super Flavour Factory


Proceedings
of
Super$B$ Workshop VI

New Physics
at the
Super Flavor Factory

Valencia, Spain
January 7-15, 2008

Abstract

The sixth Super$B$ Workshop was convened in response to questions posed by the INFN Review Committee that is evaluating the Super$B$ project at the request of INFN. The various working groups addressed the capability of a high-luminosity flavor factory that can gather a data sample of 50 to 75 ab^{-1} in five years to elucidate New Physics phenomena unearthed at the LHC.

- Super$B$ TDR Kickoff Meeting in Orsay – Feb 15-18
- Super$B$ Physics Workshop at Warwick – April 14-17

➢ If new particles are discovered at LHC we are able to study t
flavor structure of the New Physics

➢ If the New Physics scale is beyond the reach of the LHC,
explore the New Physics scale

More specifically

Are there new CP-violating phases in b,c or τ decay ?

Are there CPT and T-violating interactions observable in coheren
$B\overline{B}$ production?

Are there new right-handed currents ?

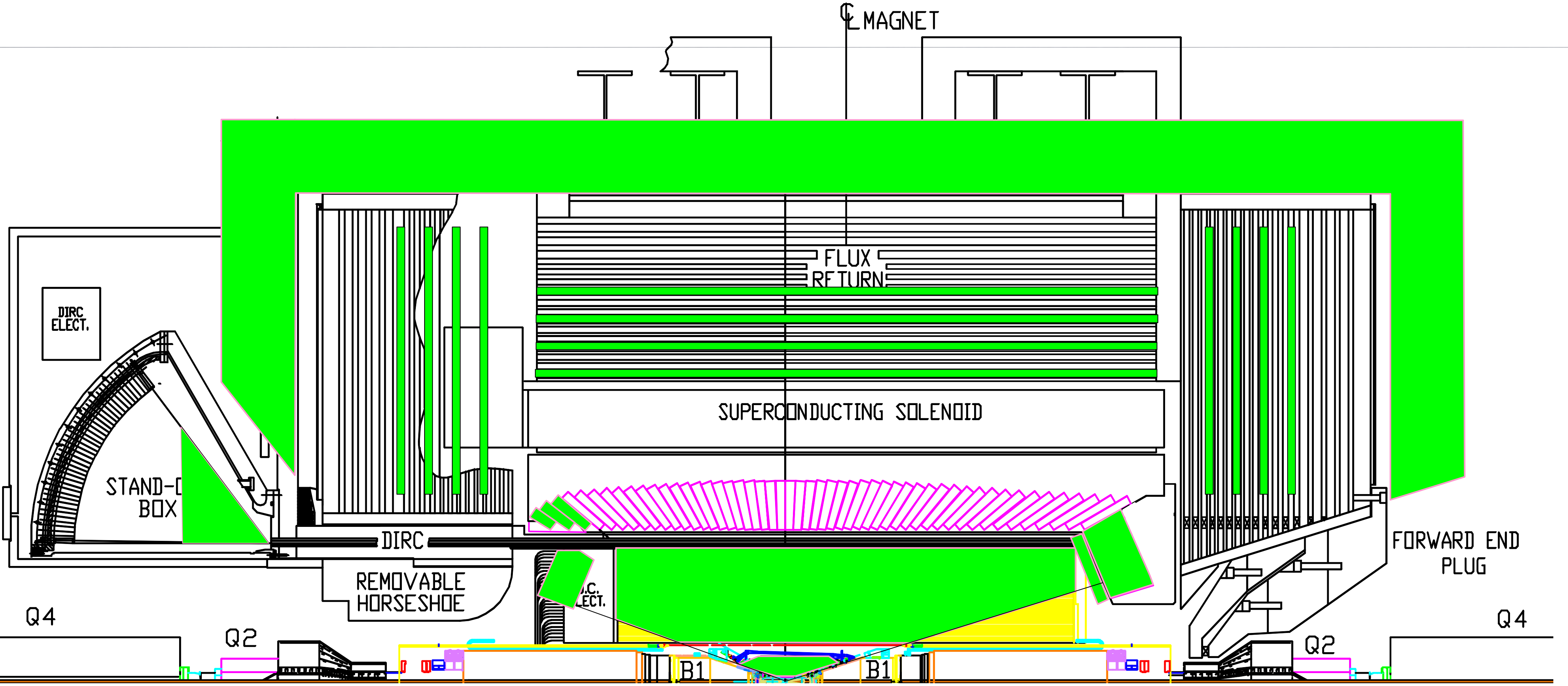
Are there new loop contributions to flavor-changing neutral curr

Are there new Higgs fields ?

Is there charged lepton flavor violation (LFV) ?

Is there new flavor symmetry that elucidates the CKM hierarchy

With these primary physics requirements, we are actively explor
the design of a detector that can address these questions in a 10



raightforward R&D on Super*B* upgrade components is underway

&D for a detector that can function in the SuperKEKB environment,
much more difficult problem, is also underway

	0.10	0.02
	0.20	0.04
	0.10	0.02
	0.20	0.03
	0.13	0.02 (∗)
	0.05	0.01 (∗)
	0.15	0.02 (∗)
	0.15	0.02 (∗)
	0.17	0.03 (∗)
	0.12	0.02 (∗)
CP eigenstates)	∼ 15°	2.5°
suppressed states)	∼ 12°	2.0°
multibody states)	∼ 9°	1.5°
bined)	∼ 6°	1–2°
	∼ 16°	3°
	∼ 7°	1–2° (∗)
	∼ 12°	2°
	∼ 6°	1–2° (∗)
$D^{\pm}K^0_s\pi^{\mp}$)	20°	5°

$\lvert V_{ub}\rvert$ (inclusive)	8% (∗)	2.0% (∗)
$\mathcal{B}(B\to\tau\nu)$	20%	4% (†)
$\mathcal{B}(B\to\mu\nu)$	visible	5%
$\mathcal{B}(B\to D\tau\nu)$	10%	2%
$\mathcal{B}(B\to\rho\gamma)$	15%	3% (†)
$\mathcal{B}(B\to\omega\gamma)$	30%	5%
$A_{CP}(B\to K^*\gamma)$	0.007 (†)	0.004 († ∗)
$A_{CP}(B\to\rho\gamma)$	∼ 0.20	0.05
$A_{CP}(b\to s\gamma)$	0.012 (†)	0.004 (†)
$A_{CP}(b\to(s+d)\gamma)$	0.03	0.006 (†)
$S(K^0_s\pi^0\gamma)$	0.15	0.02 (∗)
$S(\rho^0\gamma)$	possible	0.10
$A_{CP}(B\to K^*\ell\ell)$	7%	1%
$A^{FB}(B\to K^*\ell\ell)s_0$	25%	9%
$A^{FB}(B\to X_s\ell\ell)s_0$	35%	5%
$\mathcal{B}(B\to K\nu\bar{\nu})$	visible	20%
$\mathcal{B}(B\to\pi\nu\bar{\nu})$	–	possible

		(75 ab)
$D^0\to K^+\pi^-$	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	
	y	
	$\cos\delta$	

sics

	Sensitivity
$\mu\gamma)$	2×10^{-9}
$e\gamma)$	2×10^{-9}
$\mu\mu\mu)$	2×10^{-10}
$eee)$	2×10^{-10}
$\mu\eta)$	4×10^{-10}

B_s Physics: $\Upsilon(5S)$

Observable	Error with 1 ab^{-1}	Error with 30 ab^{-1}
$\Delta\Gamma$	0.16 ps^{-1}	0.03 ps^{-1}
Γ	0.07 ps^{-1}	0.01 ps^{-1}
β_s from angular analysis	20°	8°
$A^s_{\rm SL}$	0.006	0.004
$A_{\rm CH}$	0.004	0.004
$\mathcal{B}(B_s\to\mu^+\mu^-)$	-	$< 8\times10^{-9}$
$\lvert V_{td}/V_{ts}\rvert$	0.08	0.017
$\mathcal{B}(B_s\to\gamma\gamma)$	38%	7%
β_s from $J/\psi\phi$	10°	3°

Charm FCNC

$D^0\to e^+e^-$, $D^0\to\mu^+\mu^-$

$D^0\to\pi^0e^+e^-$, $D^0\to\pi^0\mu^+\mu^-$

$D^0\to\eta e^+e^-$, $D^0\to\eta\mu^+\mu^-$

$D^0\to K^0_Se^+e^-$, $D^0\to K^0_S\mu^+\mu^-$

$D^+\to\pi^+e^+e^-$, $D^+\to\pi^+\mu^+\mu^-$

$D^0\to e^{\pm}\mu^{\mp}$

$D^+\to\pi^+e^{\pm}\mu^{\mp}$

$D^0\to\pi^0e^{\pm}\mu^{\mp}$

$D^0\to\eta e^{\pm}\mu^{\mp}$

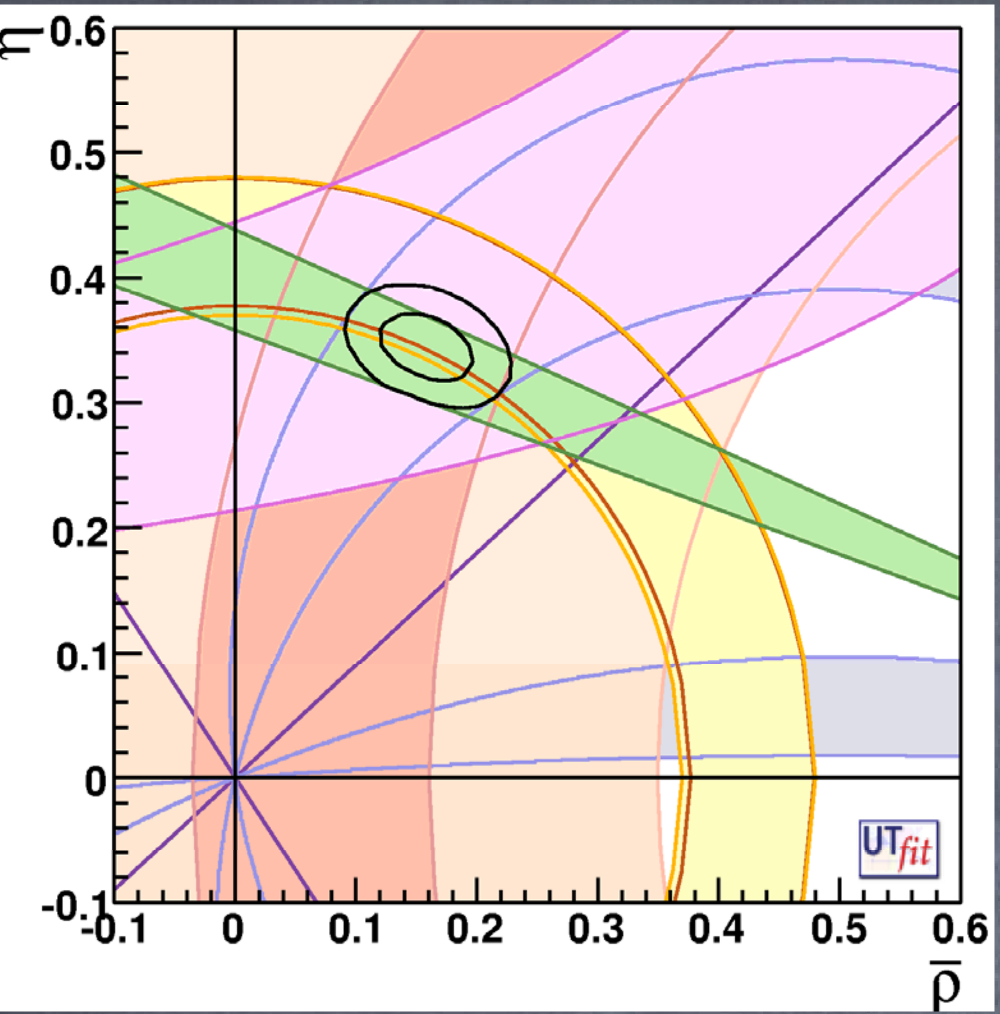
$D^0\to K^0_Se^{\pm}\mu^{\mp}$

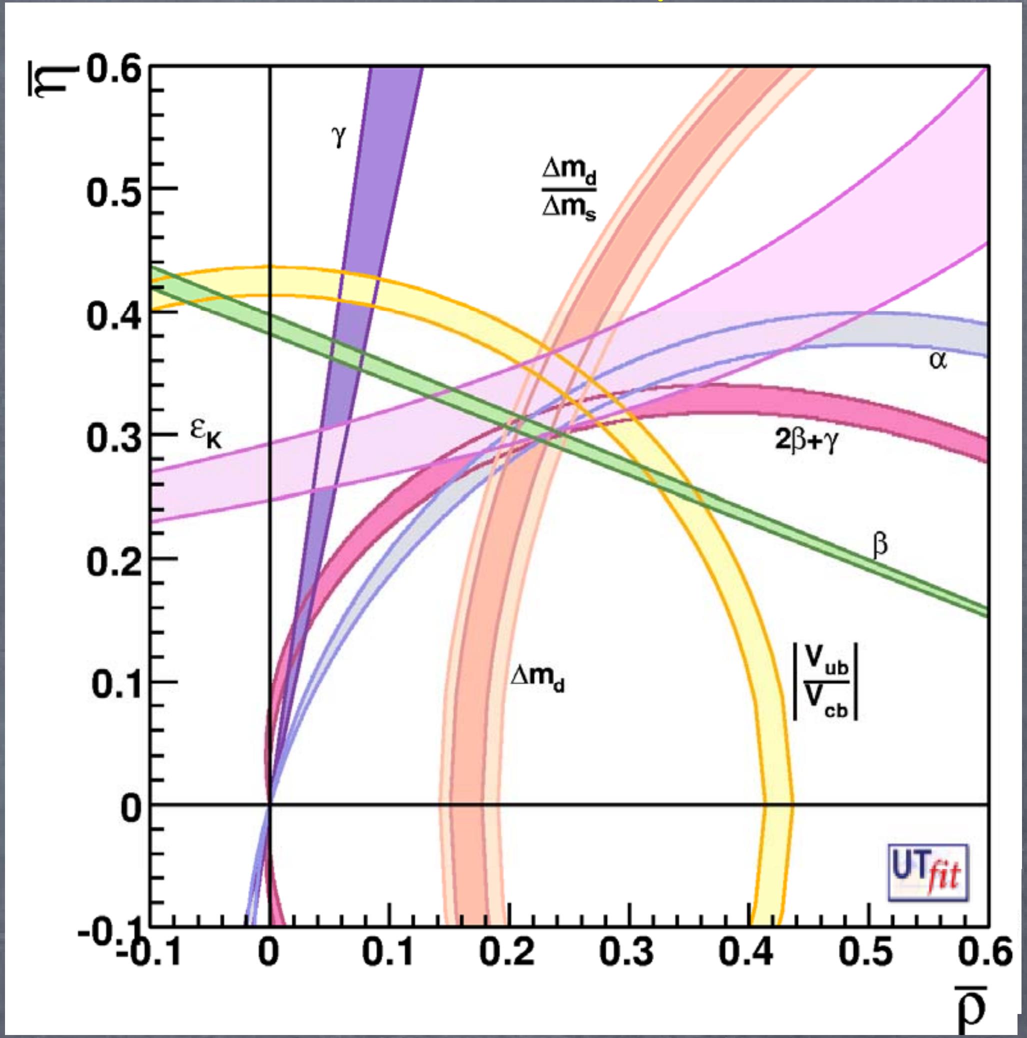
$D^+\to\pi^-e^+e^+$, $D^+\to K^-e^+e^+$

$D^+\to\pi^-\mu^+\mu^+$, $D^+\to K^-\mu^+\mu^+$

$D^+\to\pi^-e^{\pm}\mu^{\mp}$, $D^+\to K^-e^{\pm}\mu^{\mp}$

Today

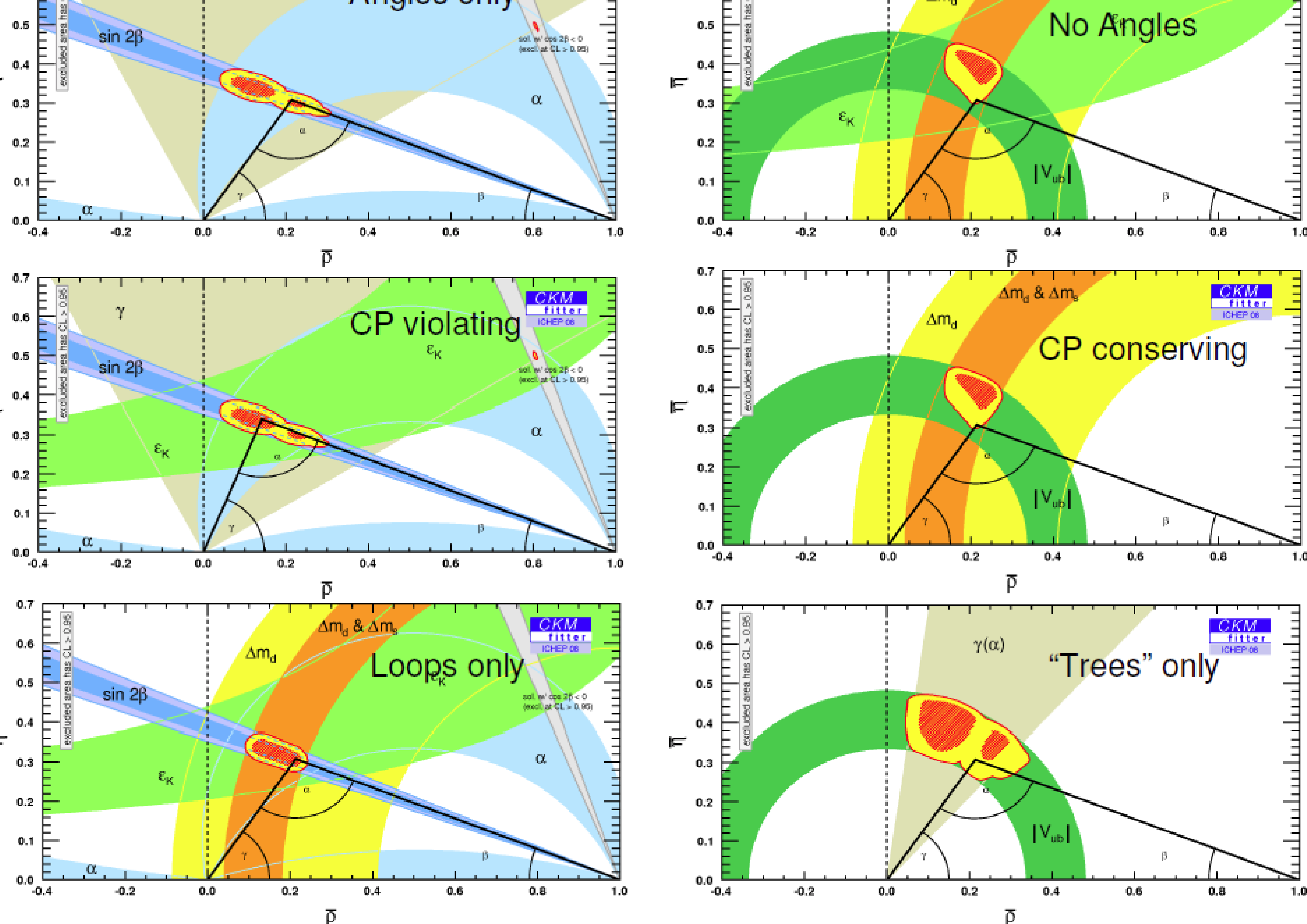




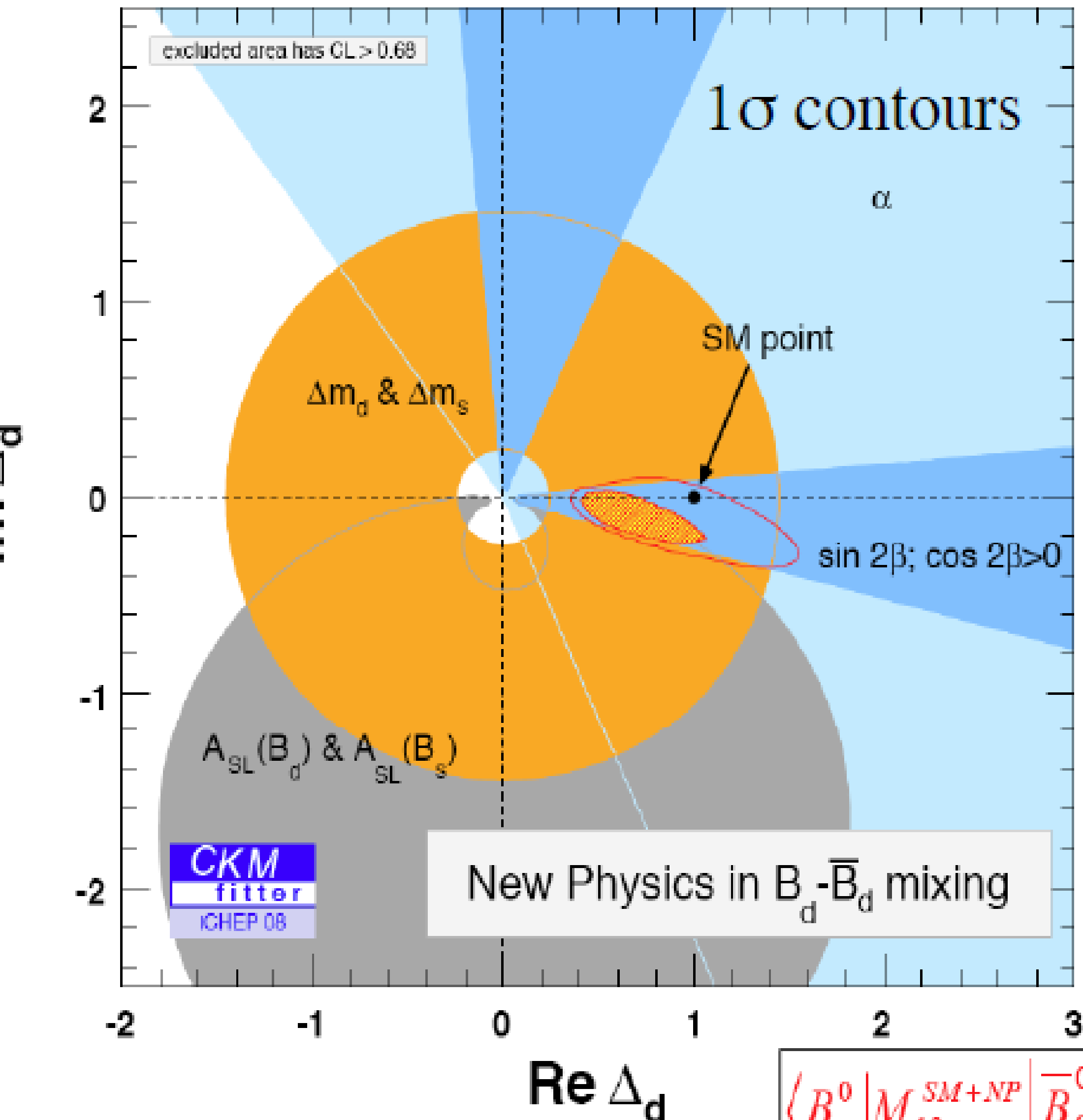
$\rho = 0.163 \pm 0.028$
$\eta = 0.344 \pm 0.016$

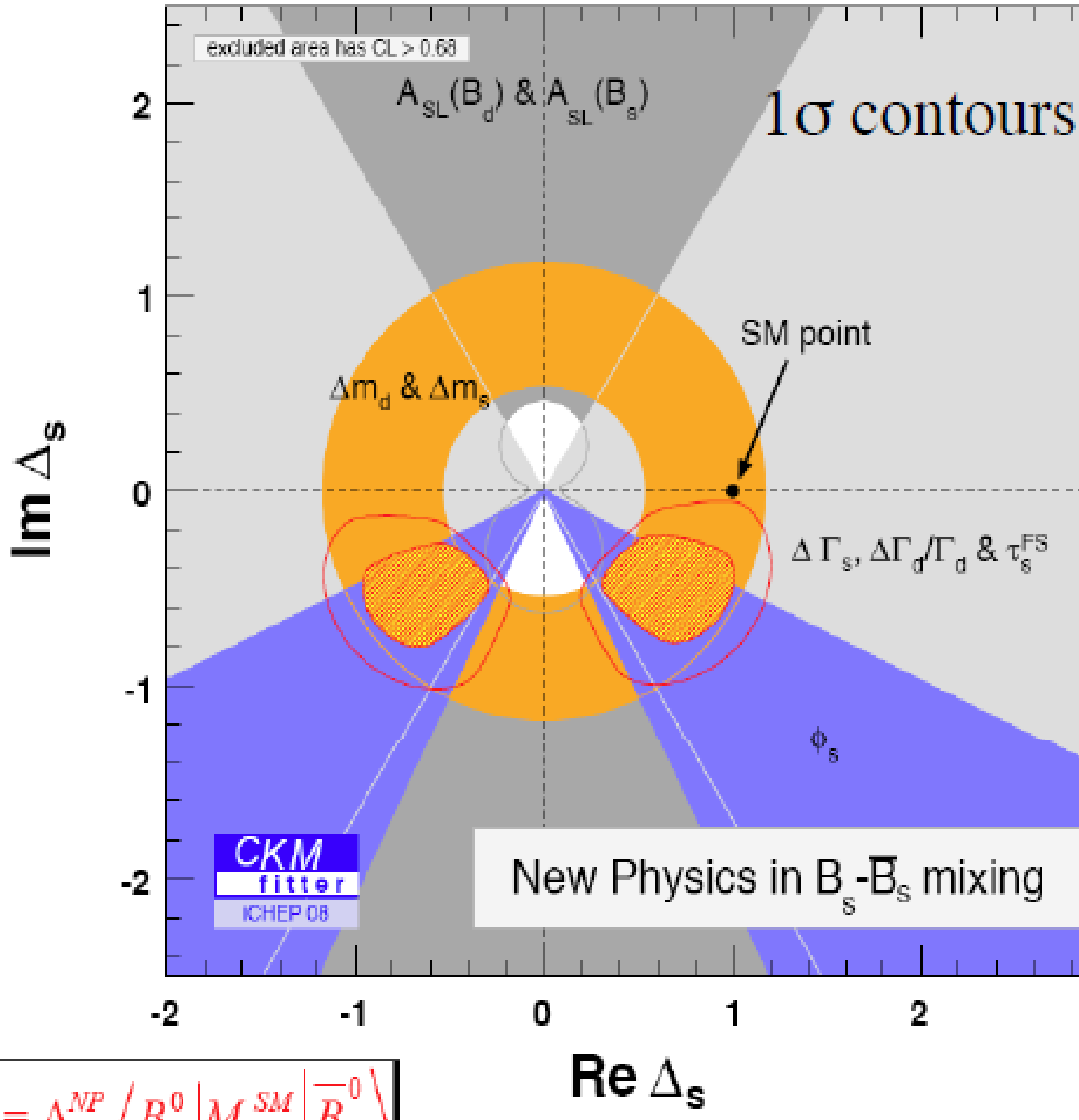
$\rho = \quad \pm 0.0028$
$\eta = \quad \pm 0.0024$

Improving the precision of Unitarity Triangle measurements, long with reducing theoretical uncertainties, can provide evidenc for New Physics


Angles only
sin 2β
α
γ
β
sol. w/ cos 2β < 0
(excl. at CL > 0.95)
excluded area has CL > 0.95
No Angles
ε_K
$|V_{ub}|$
Δm_d
Δm_d & Δm_s
CP violating
CP conserving
Loops only
"Trees" only
γ(α)
CKM fitter
ICHEP 08
$\bar{\rho}$
$\bar{\eta}$
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0
0.1
0.3
0.5
0.7

New Physics Constraints in Loops





$$\left\langle B_q^0 \middle| M_{12}^{SM+NP} \middle| \overline{B}_q^0 \right\rangle \equiv \Delta_q^{NP} \cdot \left\langle B_q^0 \middle| M_{12}^{SM} \middle| \overline{B}_q^0 \right\rangle$$

Agreement with SM at 1-2σ level

Largest deviations in β_s and B→τν

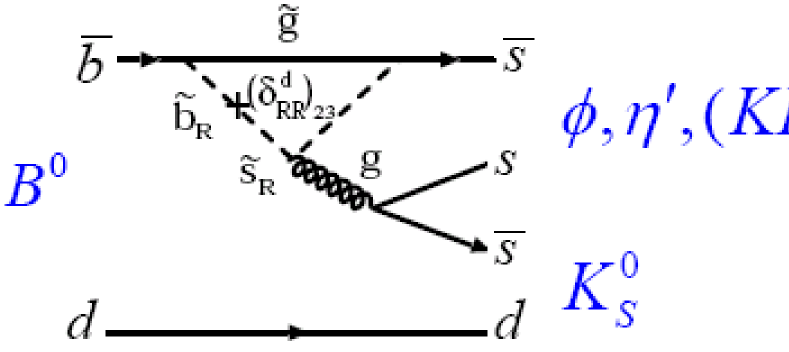
$$
\begin{matrix}
m^2_{\tilde d_L} & m_d(A_d-\mu\tan\beta) & (\Delta^d_{12})_{LL} & (\Delta^d_{12})_{LR} & (\Delta^d_{13})_{LL} & (\Delta^d_{13})_{LR} \\
 & m^2_{\tilde d_R} & (\Delta^d_{12})_{RL} & (\Delta^d_{12})_{RR} & (\Delta^d_{13})_{RL} & (\Delta^d_{13})_{RR} \\
 & & m^2_{\tilde s_L} & m_s(A_s-\mu\tan\beta) & (\Delta^d_{23})_{LL} & (\Delta^d_{23})_{LR} \\
 & & & m^2_{\tilde s_R} & (\Delta^d_{23})_{RL} & (\Delta^d_{23})_{RR} \\
 & & & & m^2_{\tilde b_L} & m_b(A_b-\mu\tan\beta) \\
 & & & & & m^2_{\tilde b_R}
\end{matrix}
$$

LHC

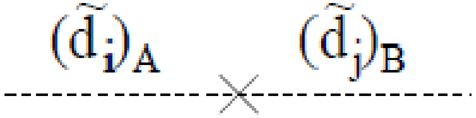
Supe

ssuming all Δ's small and squarks nearly degenerate, we can use mass insertion pproximation (MIA):

$$(\delta^d_{ij})_{AB} = \frac{(\Delta^d_{ij})_{AB}}{\tilde m^2}$$



ith new Feynman rule:

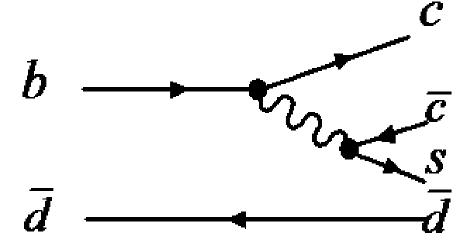


$$\longrightarrow (\Delta^d_{ij})_{AB} = \tilde m^2 (\delta^d_{ij})_{AB}$$

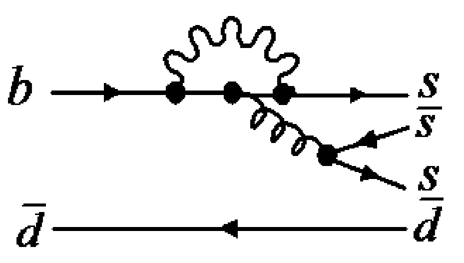
In the Standard Model we expect the same value for "sin2β" in $b ® \; c\bar{c}s, b ® \; c\bar{c}d, b ® \; s\bar{s}s, b ® \; d\bar{d}s$ modes, but different SUSY models can produce different asymmetries

Since the penguin modes have branching fractions one or two orders of magnitude less than tree modes, a great deal of luminosity is required to make these measurements to meaningful precision

$B^0 \to J/\psi K_S^0$

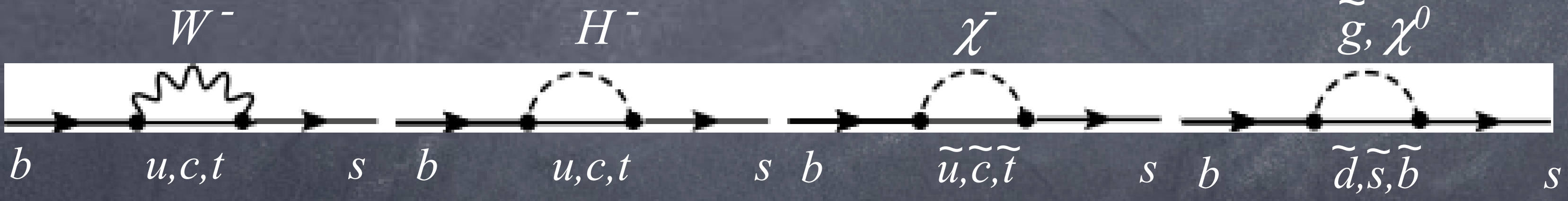


$B^0 \to \phi K_S^0$



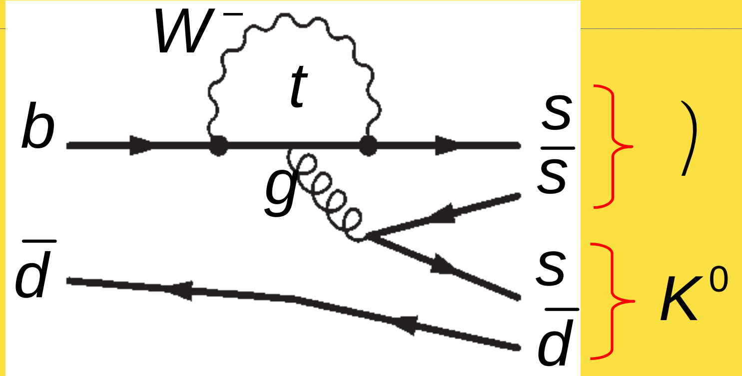
$$\lambda_{tree} = \frac{q}{p}\frac{\bar{A}}{A} = \eta \frac{V_{tb}^* V_{td}}{V_{tb} V_{td}^*} \frac{V_{cb} V_{cs}^*}{V_{cb}^* V_{cs}} = (-1)e^{-2i\beta}$$

$$\lambda_{penguin} = \frac{q}{p}\frac{\bar{A}}{A} = \eta \frac{V_{tb}^* V_{td}}{V_{tb} V_{td}^*} \frac{V_{tb} V_{ts}^*}{V_{tb}^* V_{ts}} = (-1)e^{-2i\beta}$$

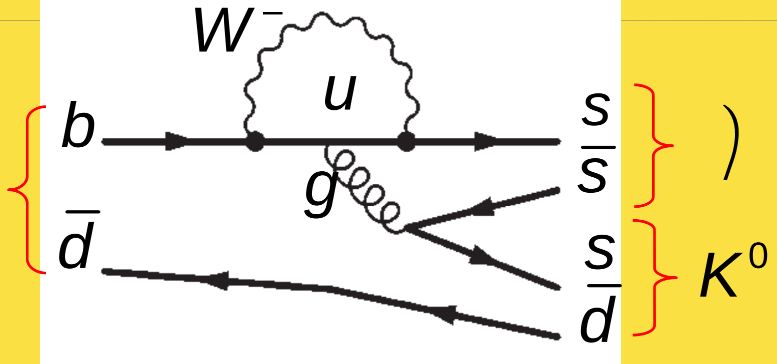


$$\lambda = e^{i(2\beta+\phi^{\text{SUSY}})} \left|\frac{\bar{A}}{A}\right| \Rightarrow S_{\phi K} = \sin(2\beta+\phi^{\text{SUSY}})$$

$\propto V_{tb}V_{ts}^{*} \sim \lambda^{2}$



$\propto V_{ub}V_{us}^{*} \sim \lambda^{4}R_{u}e^{-i\gamma}$



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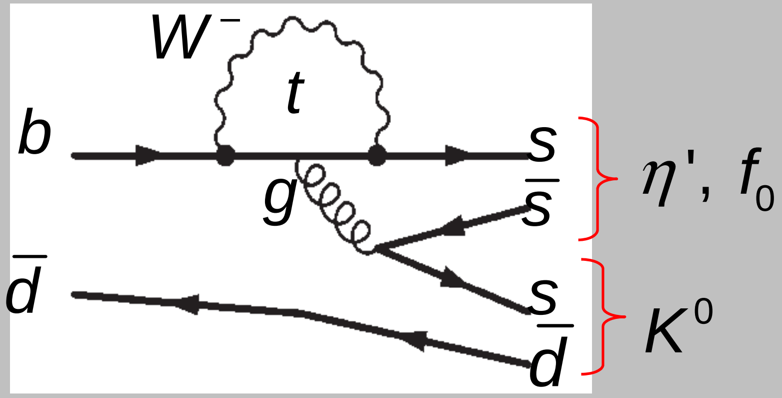
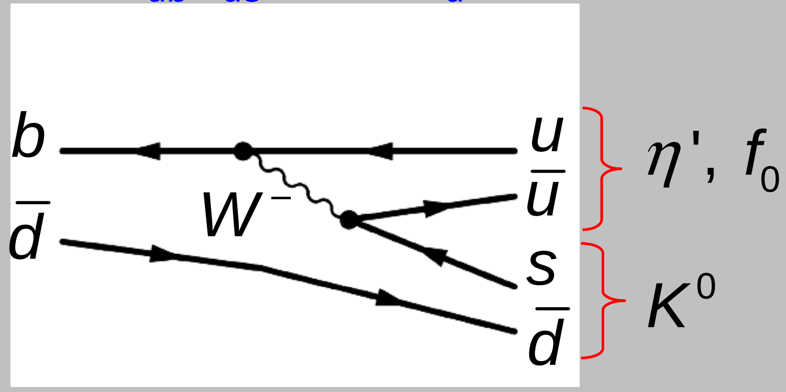
$\propto V_{tb}V_{ts}^{*} \sim \lambda^{2}$



$\propto V_{ub}V_{us}^{*} \sim \lambda^{4}R_{u}e^{-i\gamma}$



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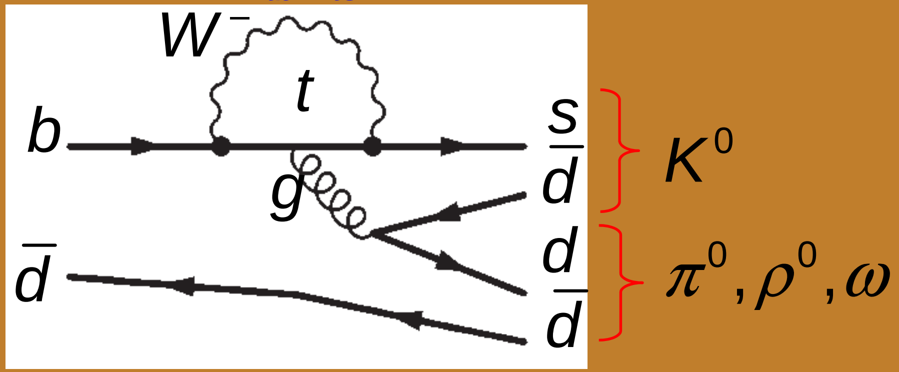
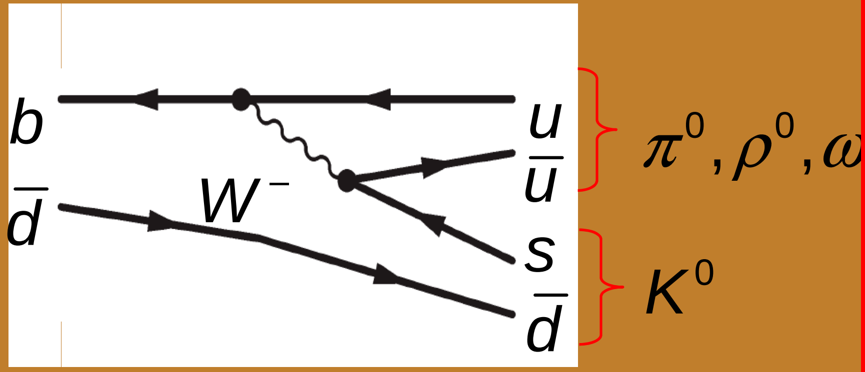
$\propto V_{tb}V_{ts}^{*} \sim \lambda^{2}$



$\propto V_{ub}V_{us}^{*} \sim \lambda^{4}R_{u}e^{-i\gamma}$



20

$J/\psi K_S^0$ 440 x10^{-6}

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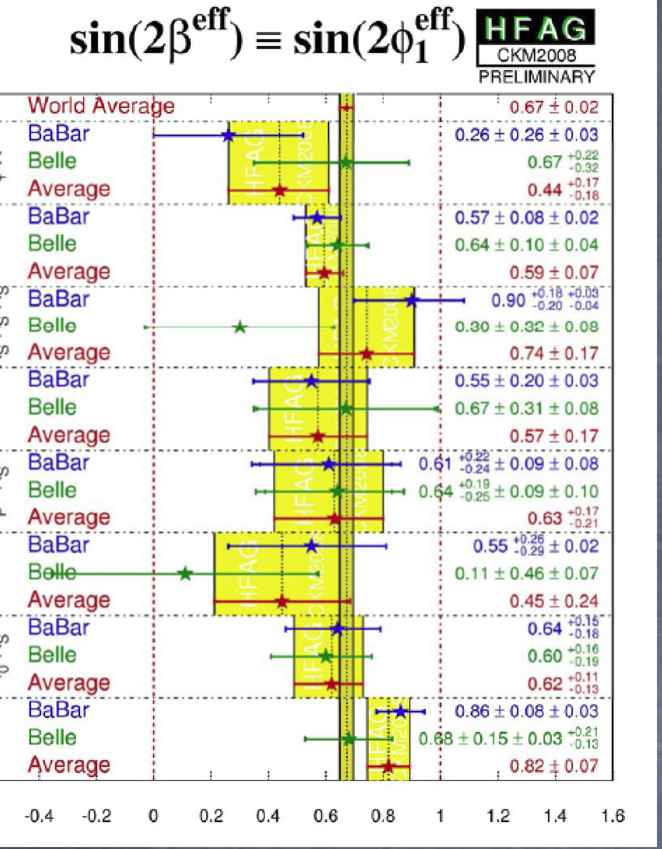
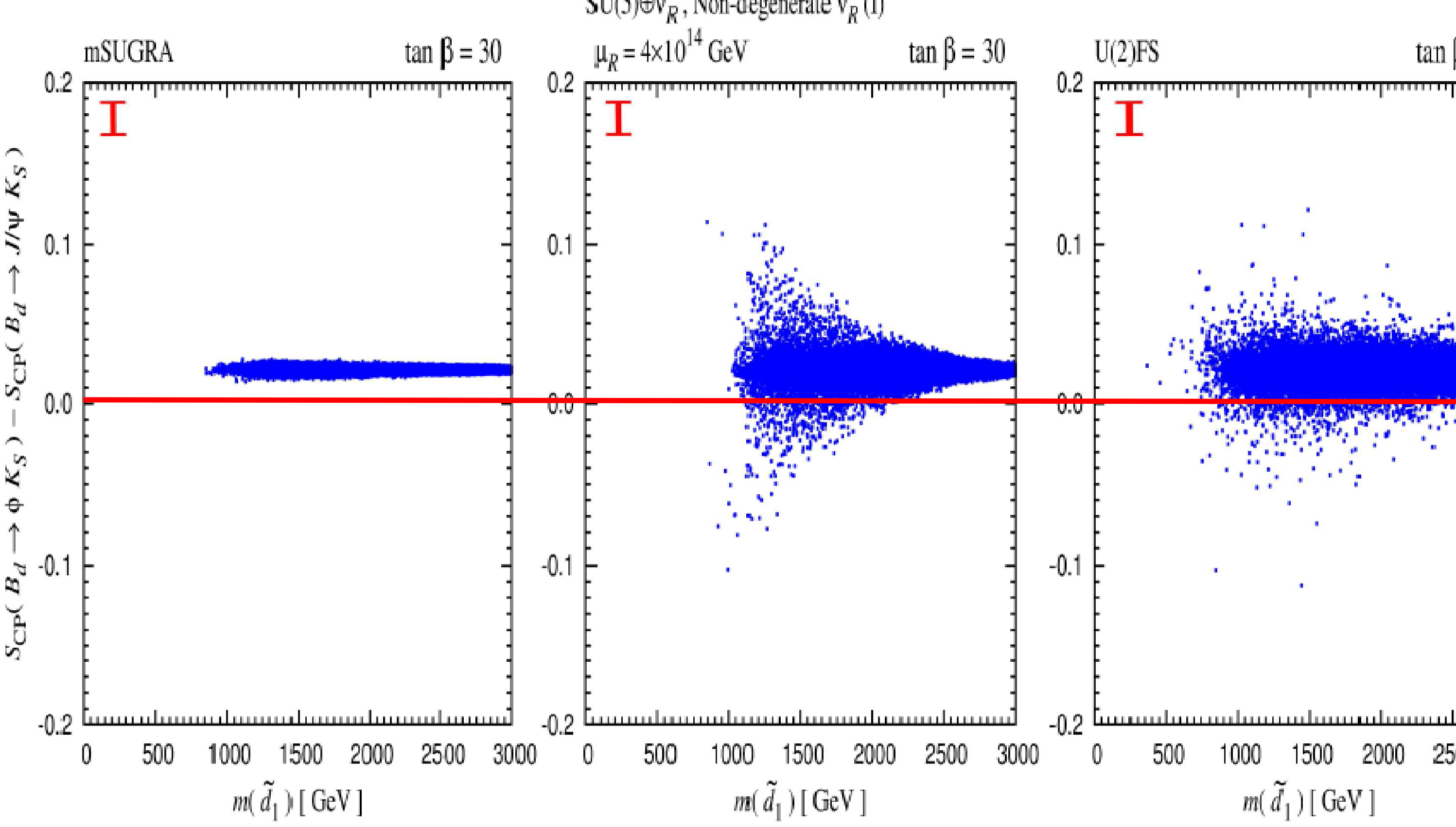
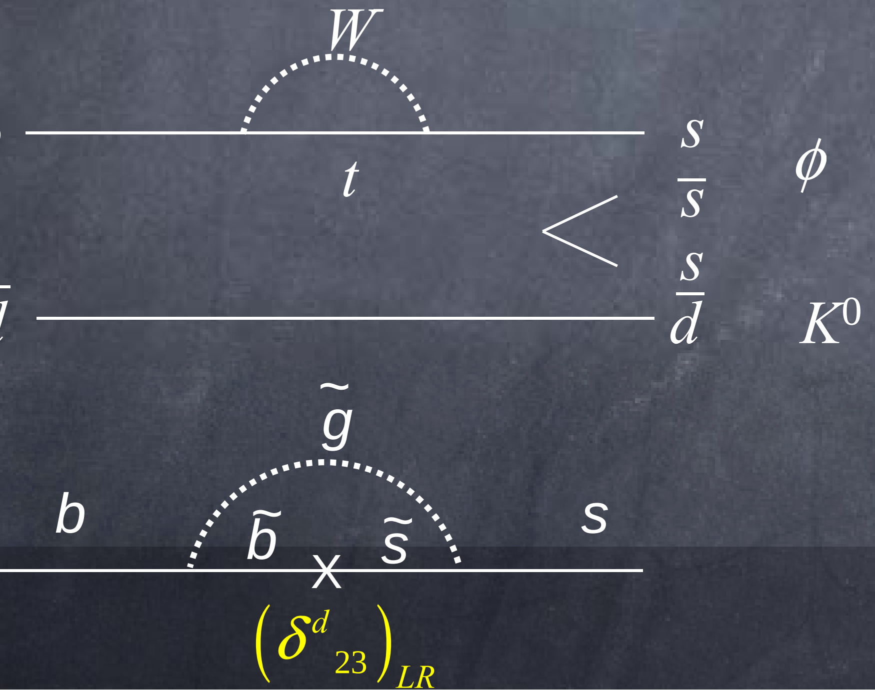




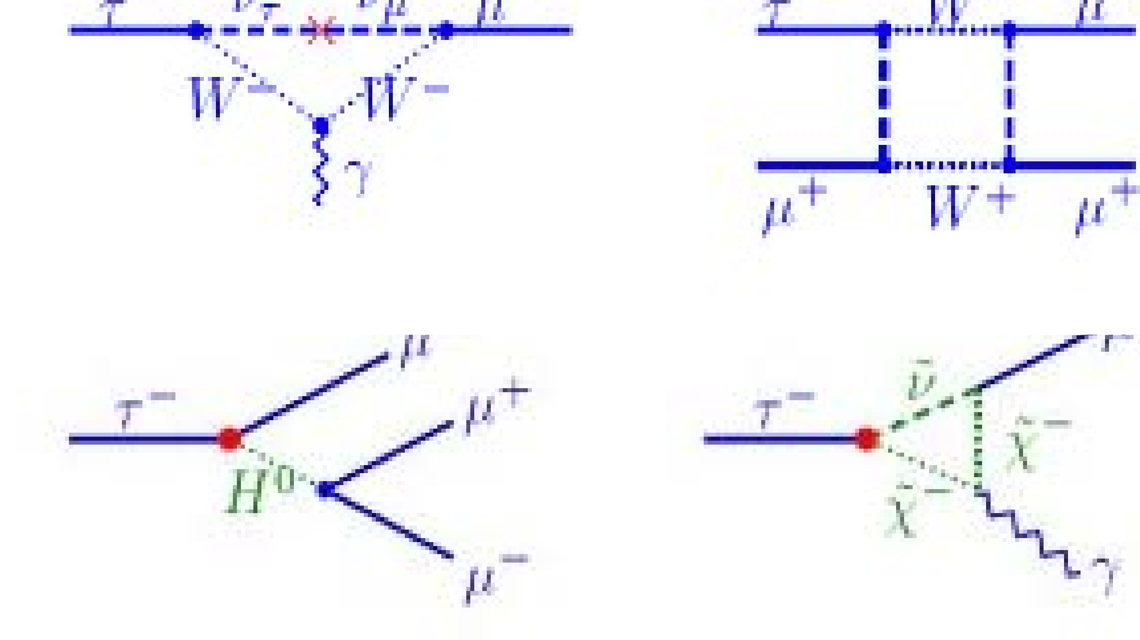


Many channels can show effects in the range ΔS~(0.0

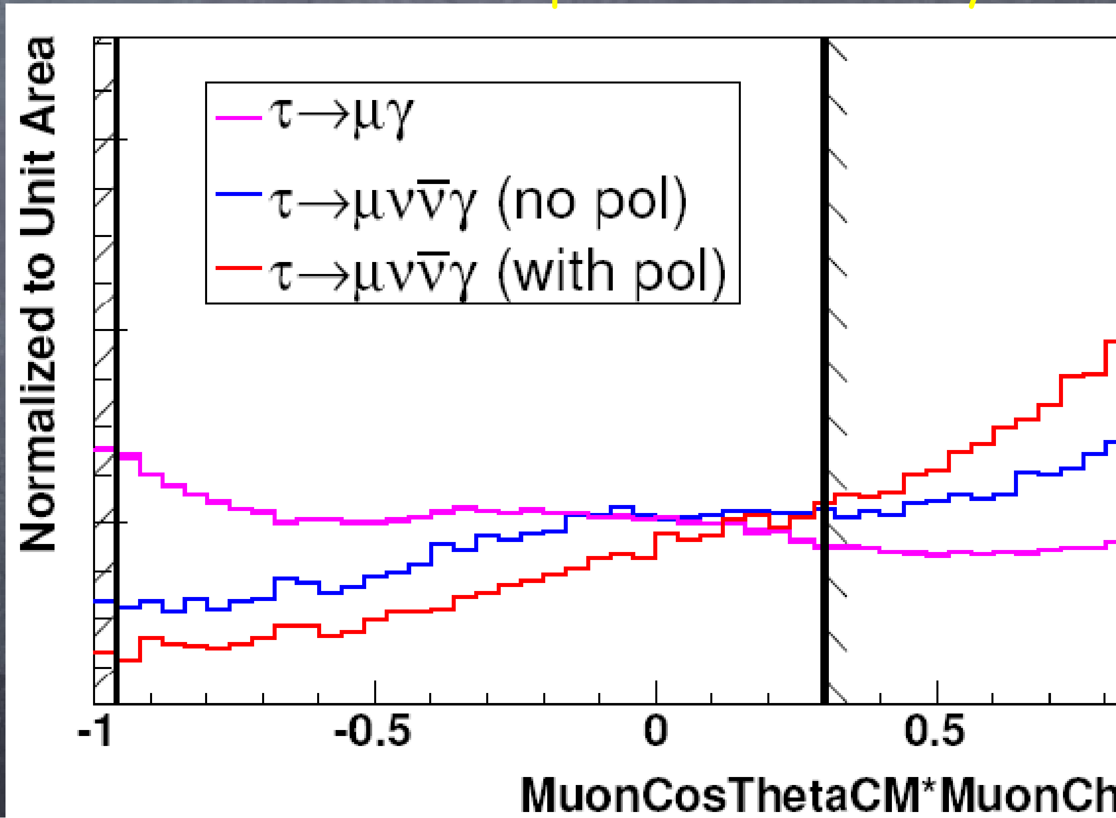
Observable	B Factories (2 ab^{-1})	Super$B$ 75 ab^{-1}
$S(\phi K^0)$	0.13	0.02 $(*)$
$S(\eta' K^0)$	0.05	0.01 $(*)$
$S(K^0_S K^0_S K^0_S)$	0.15	0.02 $(*)$
$S(K^0_S \pi^0)$	0.15	0.02 $(*)$
$S(\omega K^0_S)$	0.17	0.03 $(*)$
$S(f_0 K^0_S)$	0.12	0.02 $(*)$

epton Flavor Violation

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}
$\mathcal{B}(\tau \to eee)$	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}



polarized e- beam: reduced background,
improved sensitivity

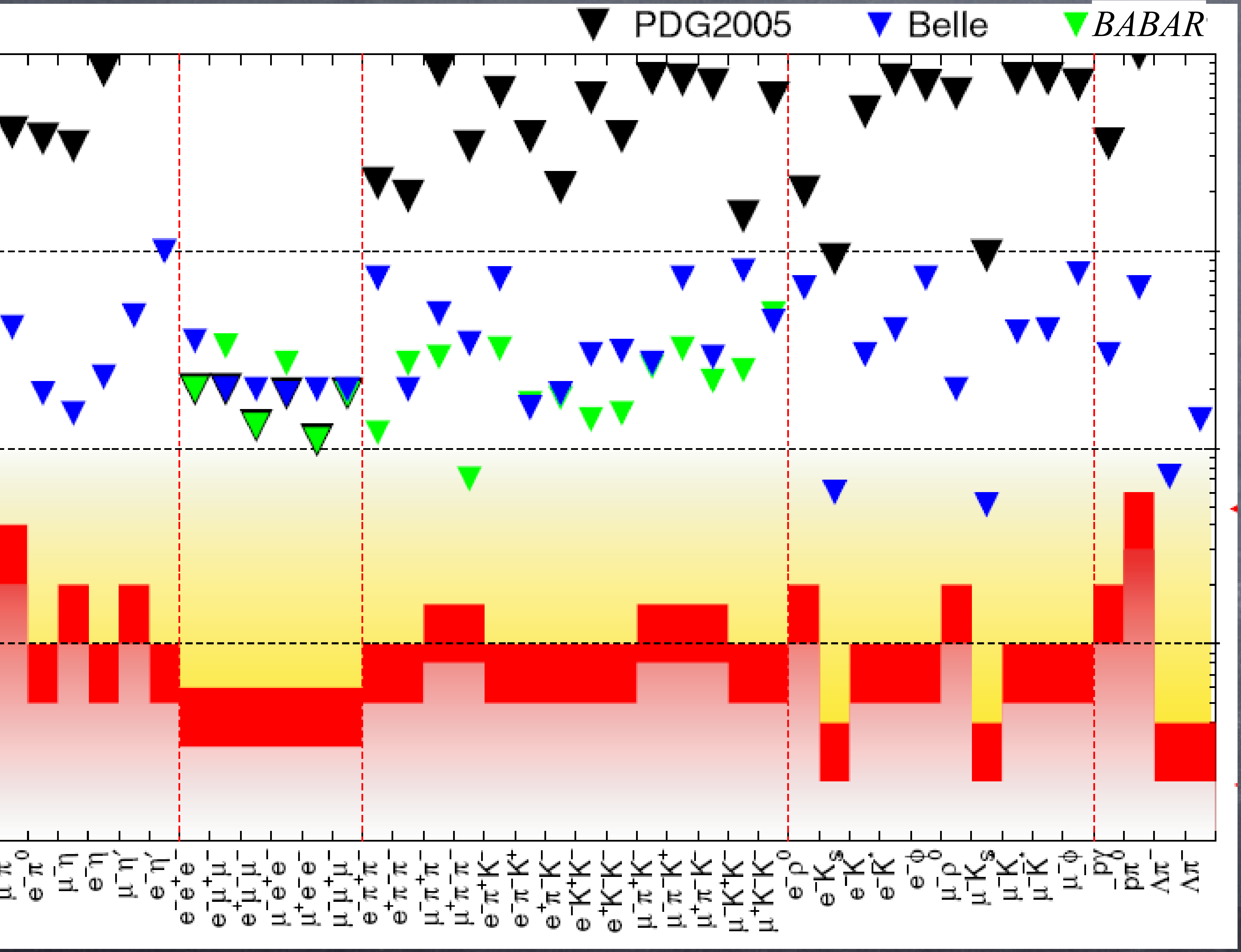


y important order of magnitude

10^{-8} ✸ 10^{-9}

Complimentarity with μ ✸ $e\,\gamma$

er$B$ sensitivity directly confronts many New Physics moc



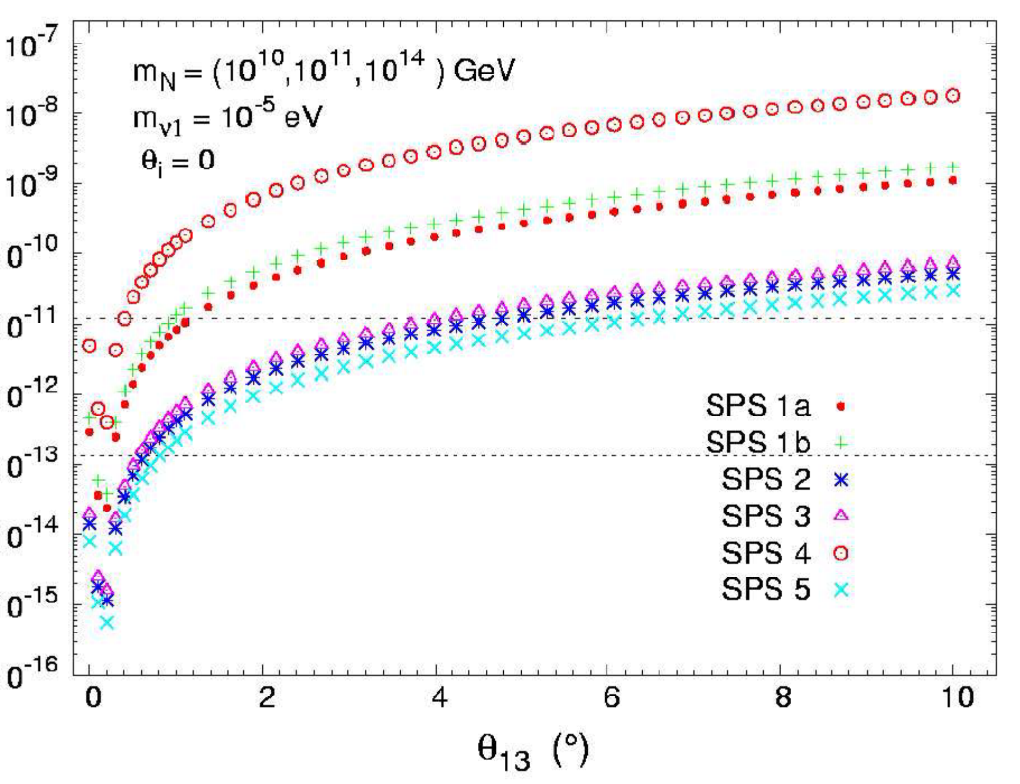
Super$B$
sensitivit
For 75 ab

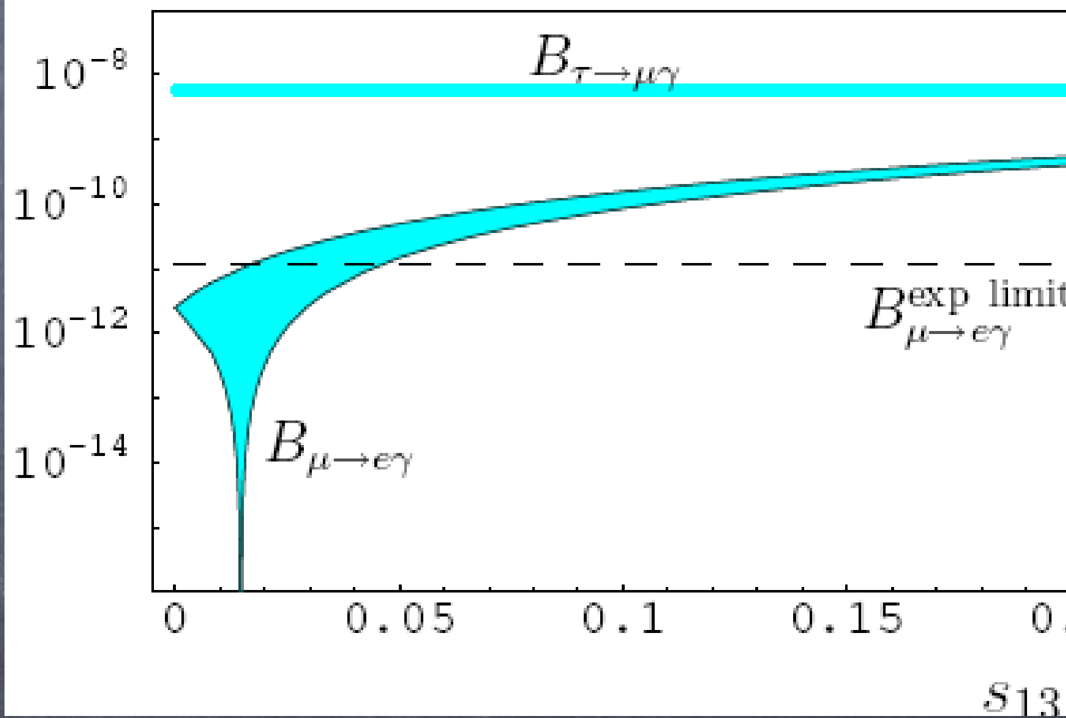
Process	S
$\mathcal{B}(\tau \to \mu\,\gamma)$	2
$\mathcal{B}(\tau \to e\,\gamma)$	2
$\mathcal{B}(\tau \to \mu\,\mu\,\mu)$	2
$\mathcal{B}(\tau \to eee)$	2
$\mathcal{B}(\tau \to \mu\eta)$	4
$\mathcal{B}(\tau \to e\eta)$	6
$\mathcal{B}(\tau \to \ell K^0_S)$	2

LFV

	1a	1b	2	3	4	5	90% UL	5σ dis
$\mathcal{B}(\tau\to\mu\gamma)\times10^{-9}$	4.2	7.9	0.18	0.26	97	0.019	2	5
$\mathcal{B}(\tau\to3\mu)\times10^{-12}$	9.4	18	0.41	0.59	220	0.043	200	880

$$10\text{ab}^{-1}:75\text{ab}^{-1}\Rightarrow\sqrt{\frac{75}{10}}\text{ for }\mathcal{B}(\tau\to\mu\gamma),\ 7.5\text{ for }\mathcal{B}(\tau\to\ell\ell\ell)$$

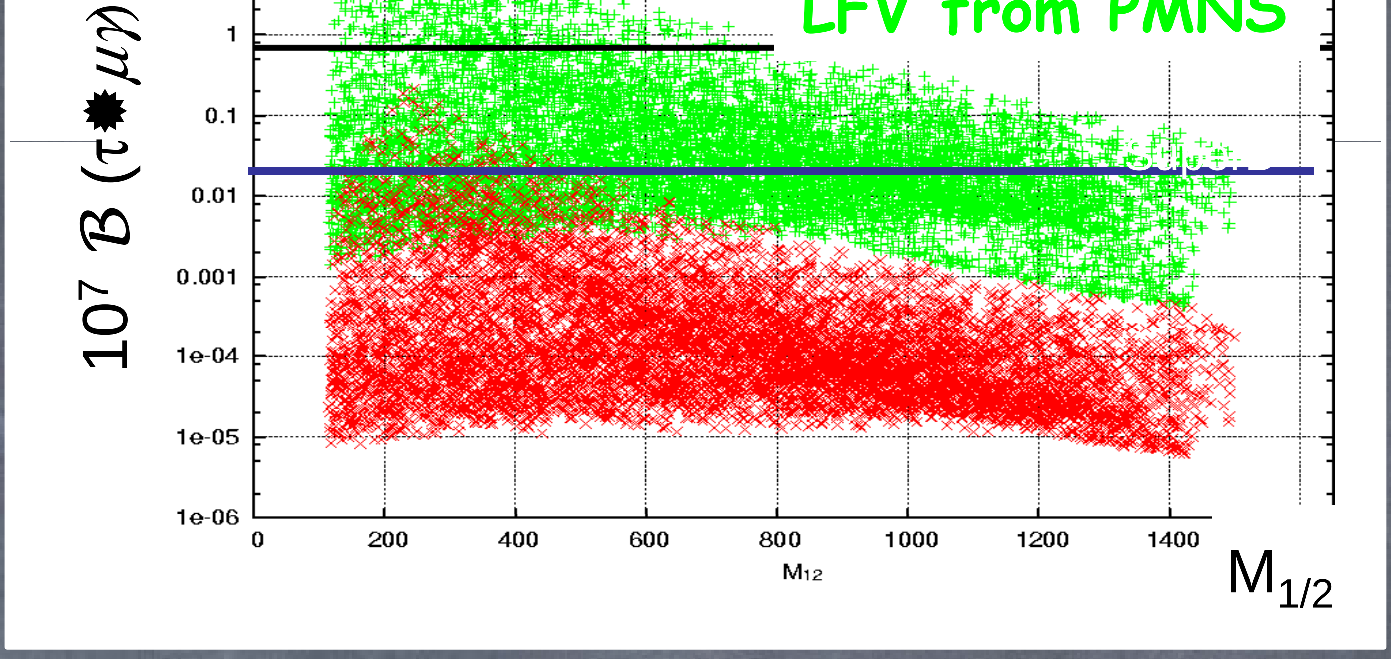




SSM : μ✸$e\gamma$ vanishes at all SPS points

MVF-NP extensions : μ✸$e\gamma$ vanishes as
τ✸$\mu\gamma$is independent of s_{13}

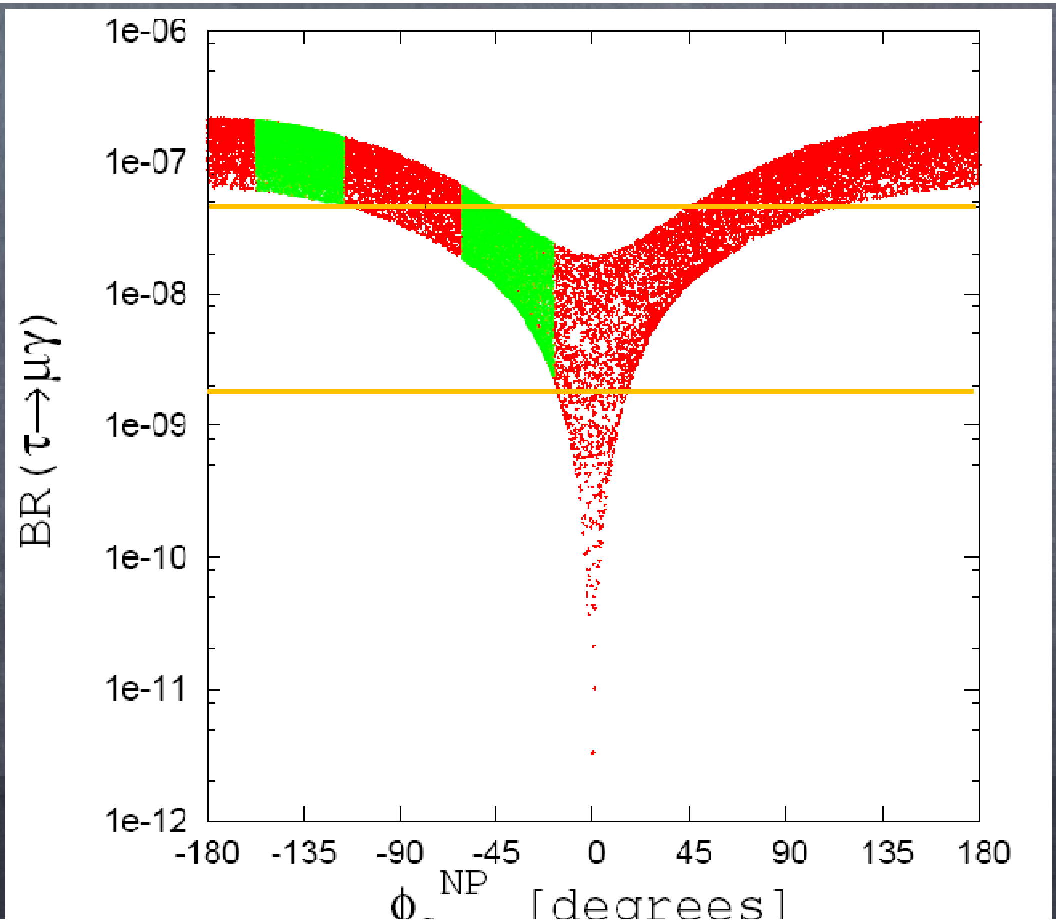
SO(10) MSSM



now

Super

SUSY GUT



now

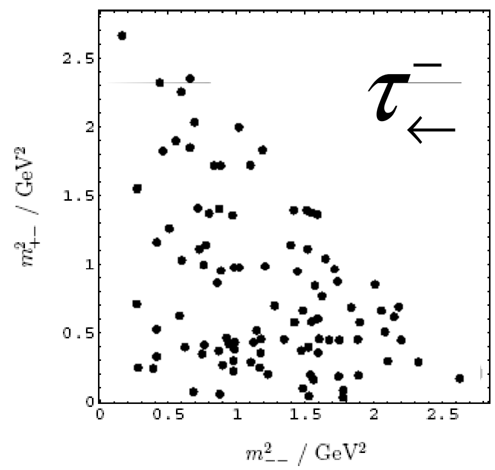
Super$B$

🟥 Allowed by Δm_s

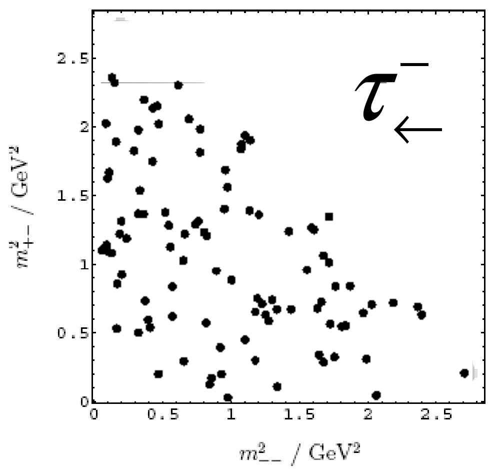
🟩 From B_s phase

J.K.Parry, H.-H. Z
hep-ph/0710.544

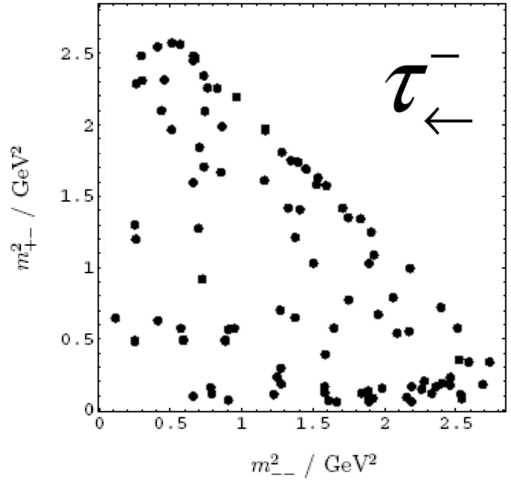
$^{(LL)}$ (left)



$d^2\Gamma_V^{(LL)(RR)}$ (right)

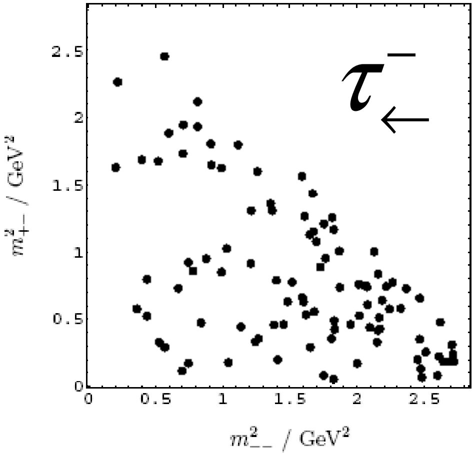


$d^2\Gamma^{(LR)}_{\mathrm{rad}}$

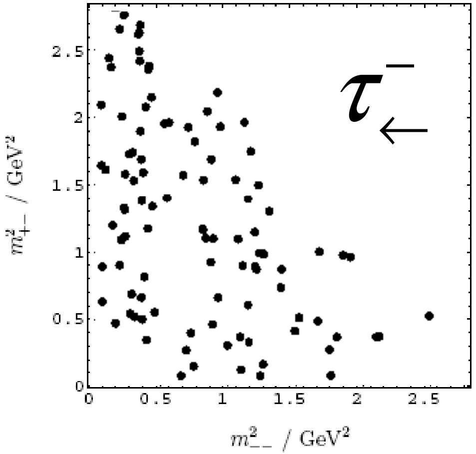


Flipping the helicity of the po
electron beam allows us to
determine the chiral structure
of dimension 6 four fermion
lepton flavor-violating interac

$)^{(LL)}|$ (left)

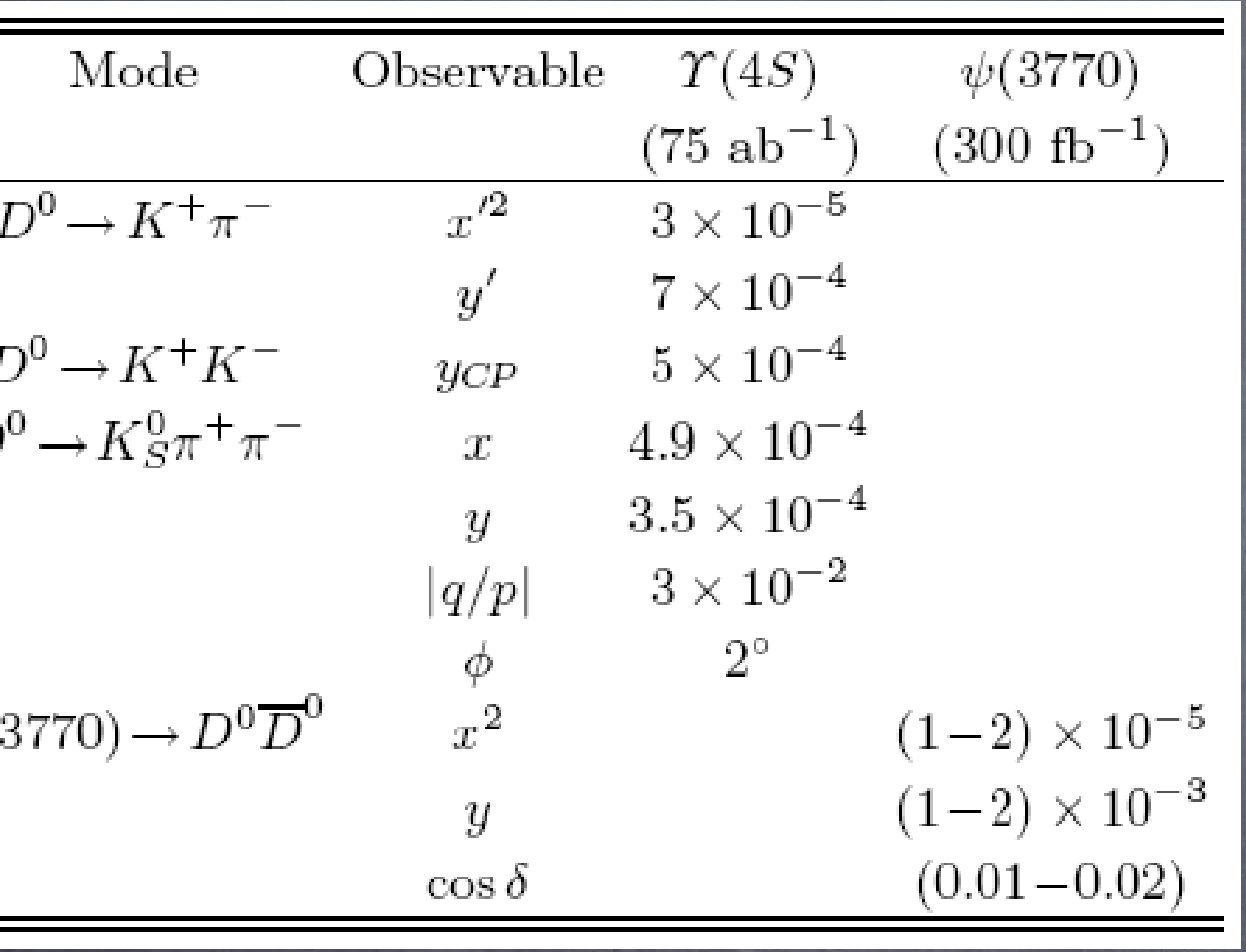


$|d^2\Gamma_{\mathrm{mix}}^{(LL)(RR)}|$ (right)

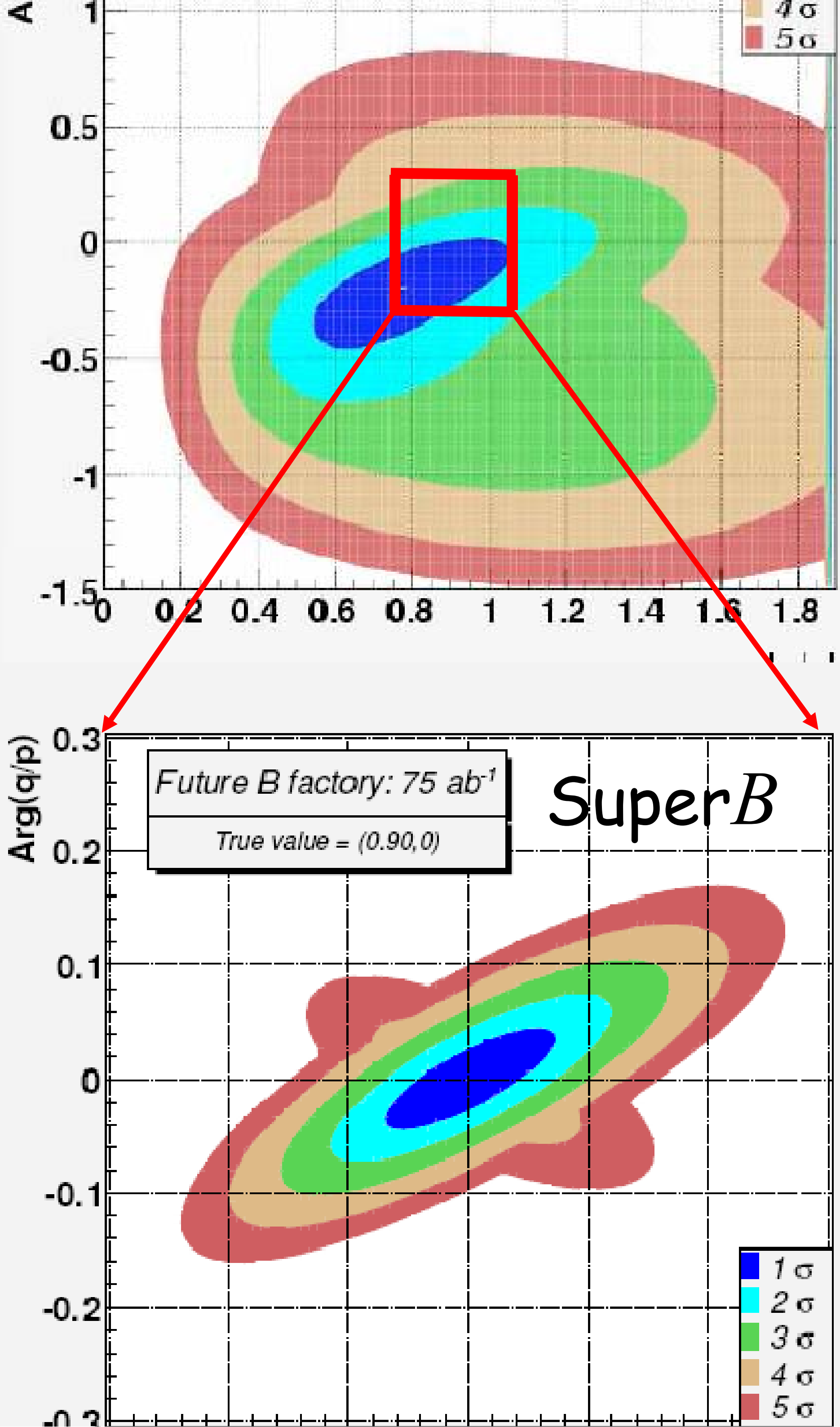


Dassinger, Feldmann, Mannel, and
JHEP 0710:039,2007;

[See also Matsuzaki and Sanda
arXiv:0711.0792 [hep-ph]



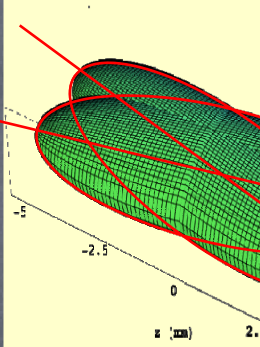
Mode	Observable	$\Upsilon(4S)$ (75 ab^{-1})	$\psi(3770)$ (300 fb^{-1})
$D^0 \to K^+\pi^-$	x'^2	3×10^{-5}	
	y'	7×10^{-4}	
$D^0 \to K^+K^-$	y_{CP}	5×10^{-4}	
$^0 \to K^0_S\pi^+\pi^-$	x	4.9×10^{-4}	
	y	3.5×10^{-4}	
	$\lvert q/p \rvert$	3×10^{-2}	
	ϕ	2°	
$3770) \to D^0\overline{D}^0$	x^2		$(1-2) \times 10^{-5}$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

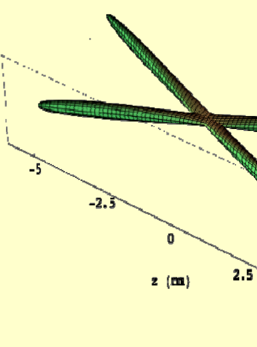


	$_d$ Unitarity	CPV	Rare B decay	Other signals
SUGRA moderate tan β)	-	-	-	-
SUGRA arge tan β)	B_d mixing	-	$B \to (D)^* \tau\nu$ $b \to s l^+ l^-$	$B_s \to \mu\mu$ B_s mixing
JSY GUT with ν_R	-	$B \to \phi K_S$ $B \to K^* \gamma$	-	B_s mixing τ LFV, n EDM
ffective SUSY	B_d mixing	$B \to \phi K_S$	$A_{CP}(b \to s\gamma)$ $b \to s l^+ l^-$	B_s mixing
K graviton xchange	-	-	$b \to s l^+ l^-$	-
plit fermions in rge extra mensions	B_d mixing	-	$b \to s l^+ l^-$	$K^0 \bar{K}^0$ mixing $D^0 \bar{D}^0$ mixing
ulk fermions in arped extra mensions	B_d mixing	$B \to \phi K_S$	$b \to s l^+ l^-$	B_s mixing $D^0 \bar{D}^0$ mixing
niversal extra mensions	-	-	$b \to s l^+ l^-$ $b \to s\gamma$	$K \to \pi\nu\nu$

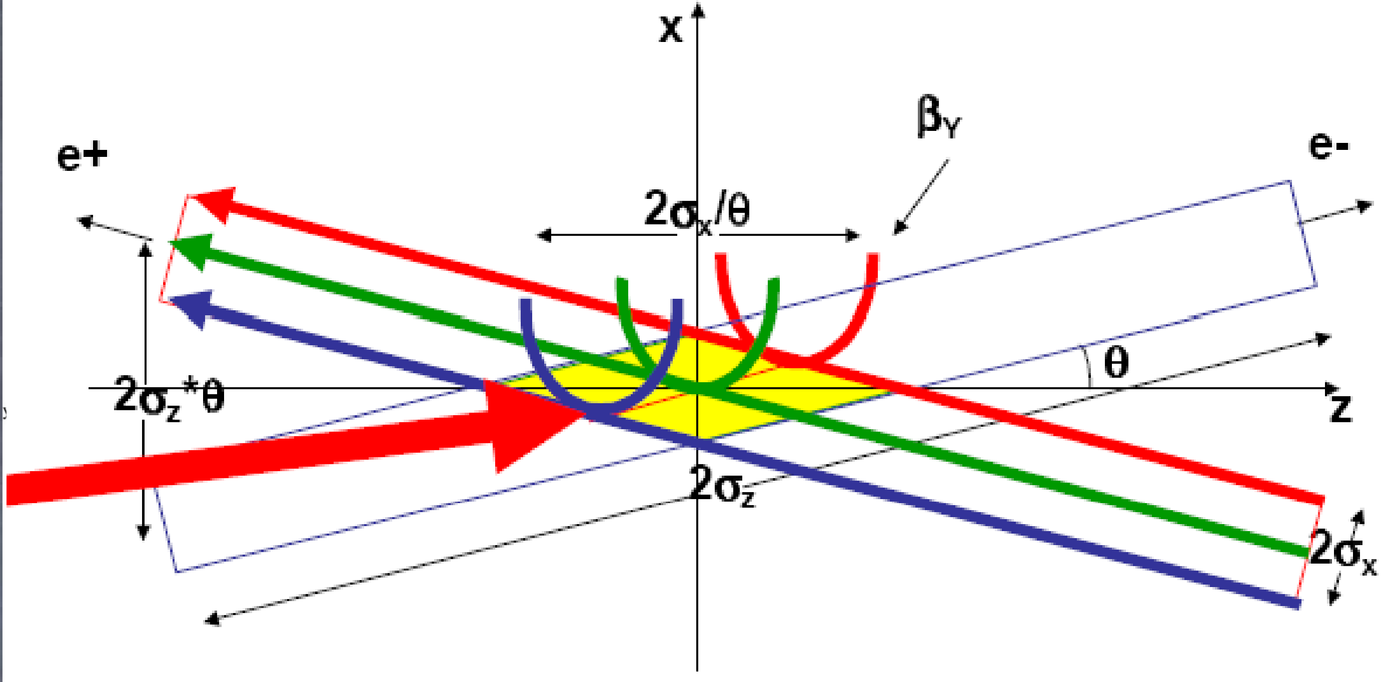
ER	LER (e+)	HER (e-)	LER (e+)	HER (e-)	LER (e+)	HER (e-)	LER (e+)	HER (e-)
eV)	4	7	4	7	4	7	3.5	8
y x 10^{36}	1.0		2.0		4.0		0.8 (0.4)	
ence (m)	1800	1800					3016	
frequency (MHz)	0.167							
olarization (%)	0	80						
ncy (MHz)	476							
n spread (x10^{-4})	7.9	5.6	9.0	8.0				
n compaction (x10^{-4})	3.2	3.8	3.2	3.8				
(MV)	5	8.3	8	11.8	17.5	27		
s/turn (MeV)	1.16	1.94	1.78	2.81				
bunches	1251				2502		5018	
er bunch (x10^{10})	5.52				6.78		11.8	5.1
ent (A)	1.85				3.69		9.4	4.1
m)	0.22	0.39	0.16	0.27			3	
m)	35	20					200	
-rad)	7	4	3.5	2			45	
-rad)	2.8	1.6	1.4	0.8			9 (24)	
microns)	0.039	0.039	0.0233	0.0233			0.367	
microns)	9.9	5.66	7	4			42	
gth (mm)	5		4.3				3	
ng angle (mrad)	48						30	
#) 20 meters each	0	0	2	2				
ime (trans/long)(ms)	40/20	40/20	28/14	28/14				
y lifetime (min)	6.7		3.35					
ifetime (min)	20	40	38	20				
eam lifetime (min)	5.0	5.7	3.1	2.9				
ate pps (x10^{11}) (100%)	2.6	2.3	5.1	4.6	10	9.1		
y (from formula)	0.15		0.20				0.43	
x (from formula)	0.0043	0.0025	0.0059	0.0034			0.36	
(MW)	17		25		58.2		65	

IP beam dis
for KI

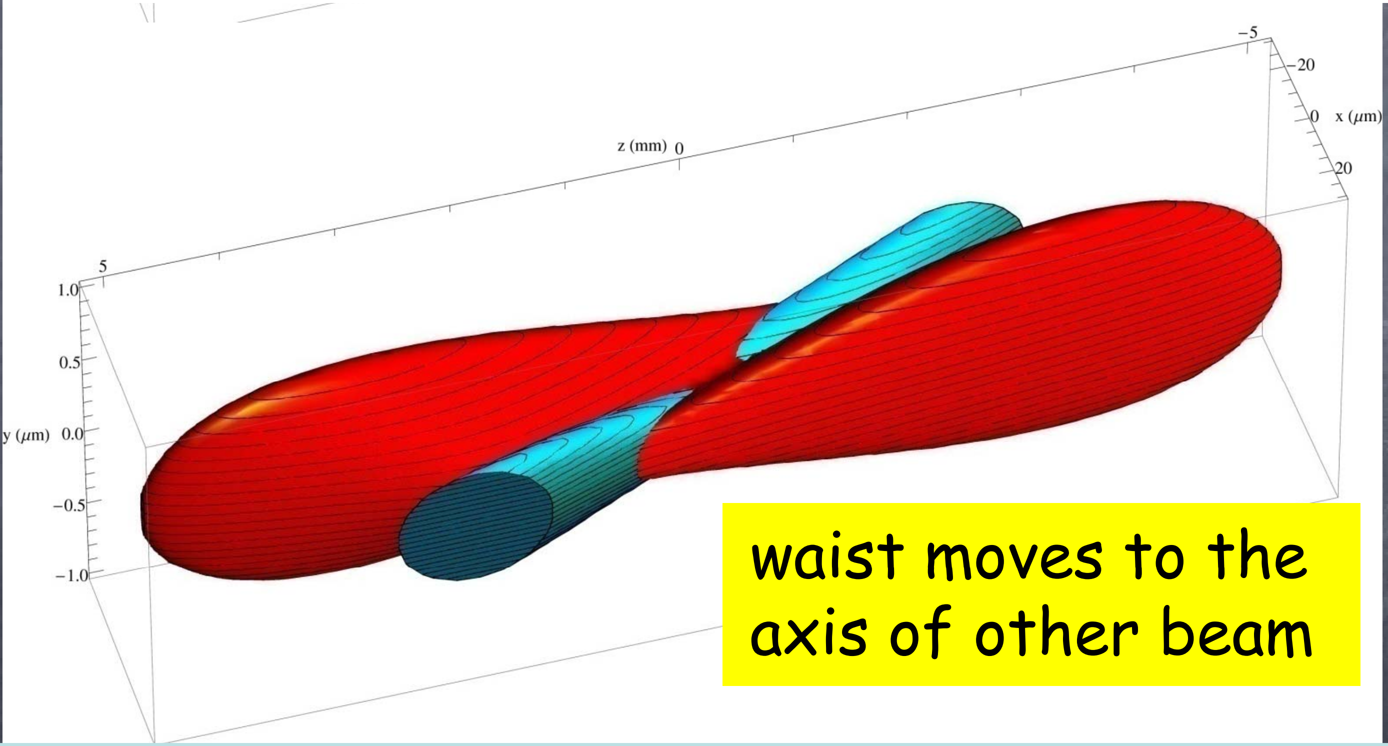




IP beam dis
for Su
*(without tra
condit*



Crab sextu
OFF



waist moves to the axis of other beam

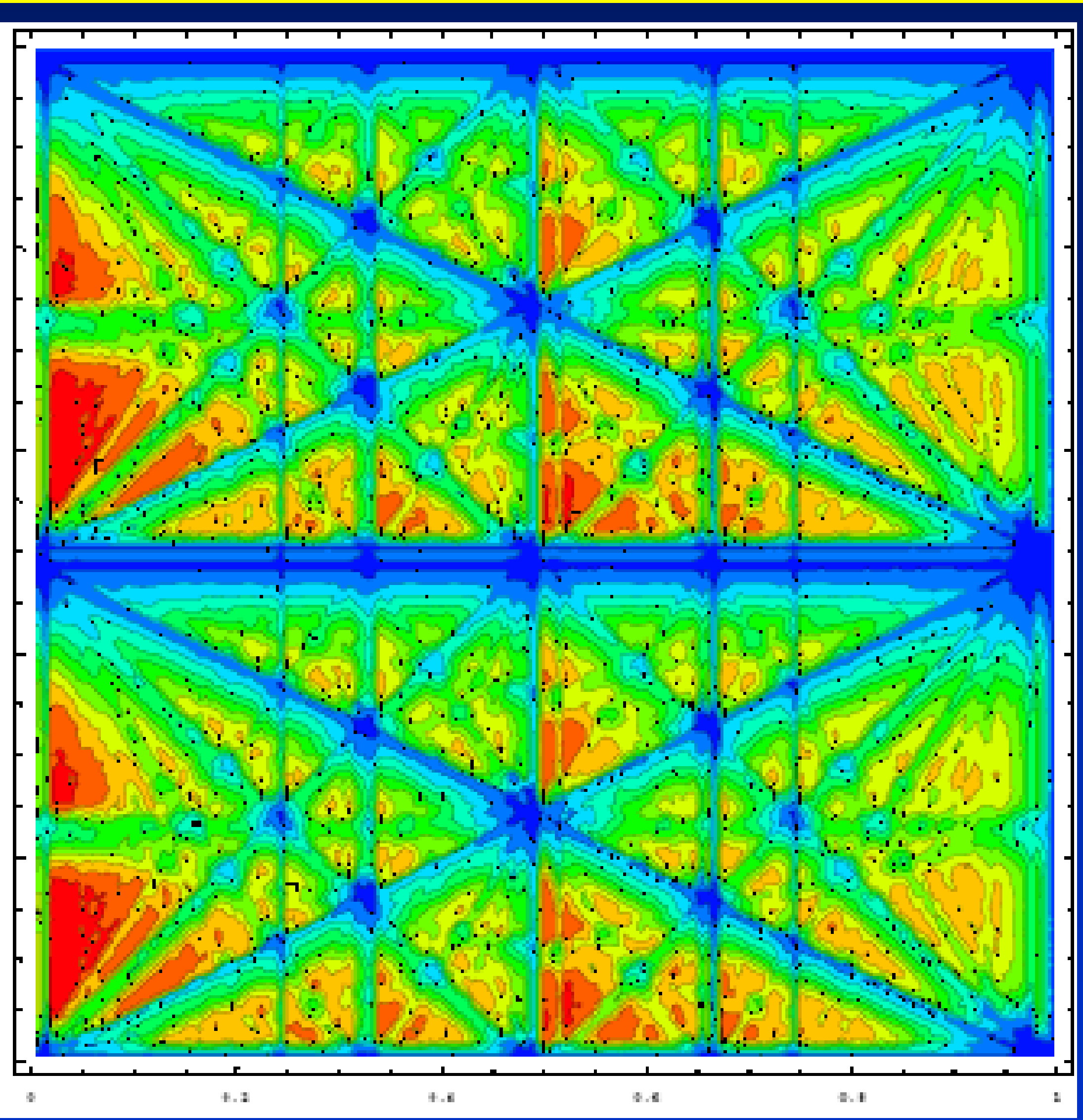
Crab sextu
ON

All particles from both beams collide in the minimum β_y region, with a net luminosity gain

E.

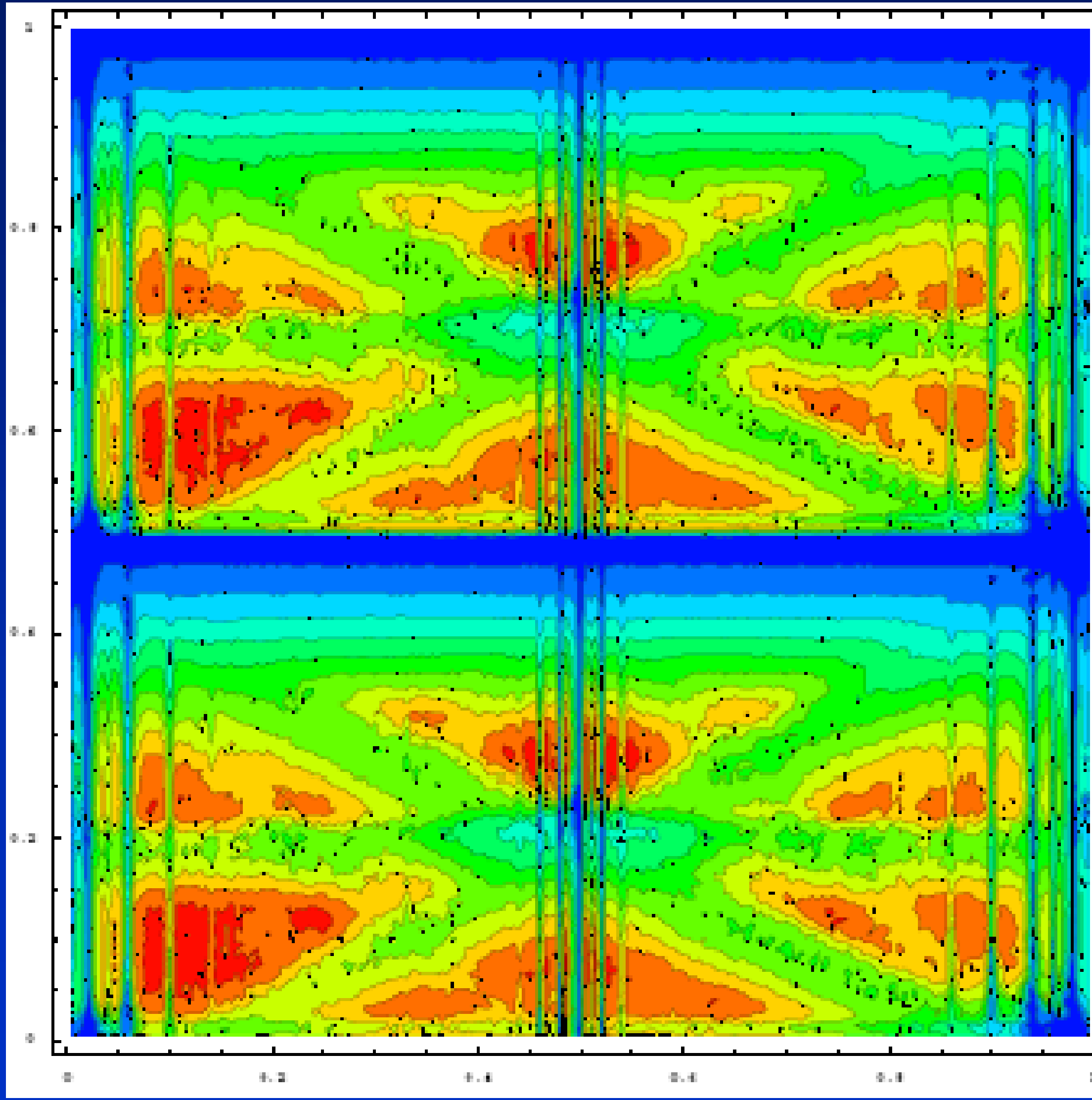
D.Shatilov's (BINP), ICFA08 Workshop

Much higher luminosity!



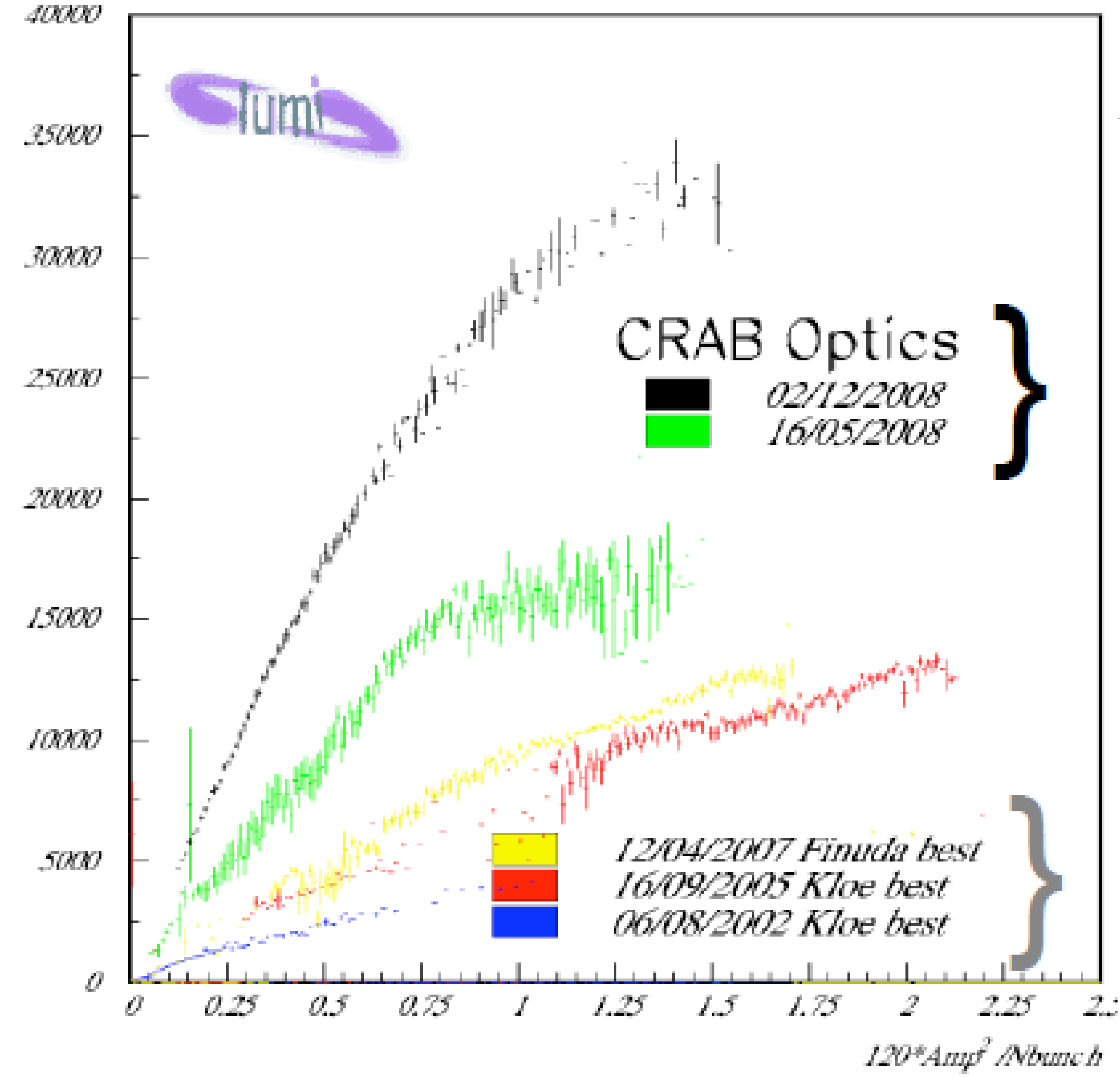
Typical case (KEKB, DAΦNE):

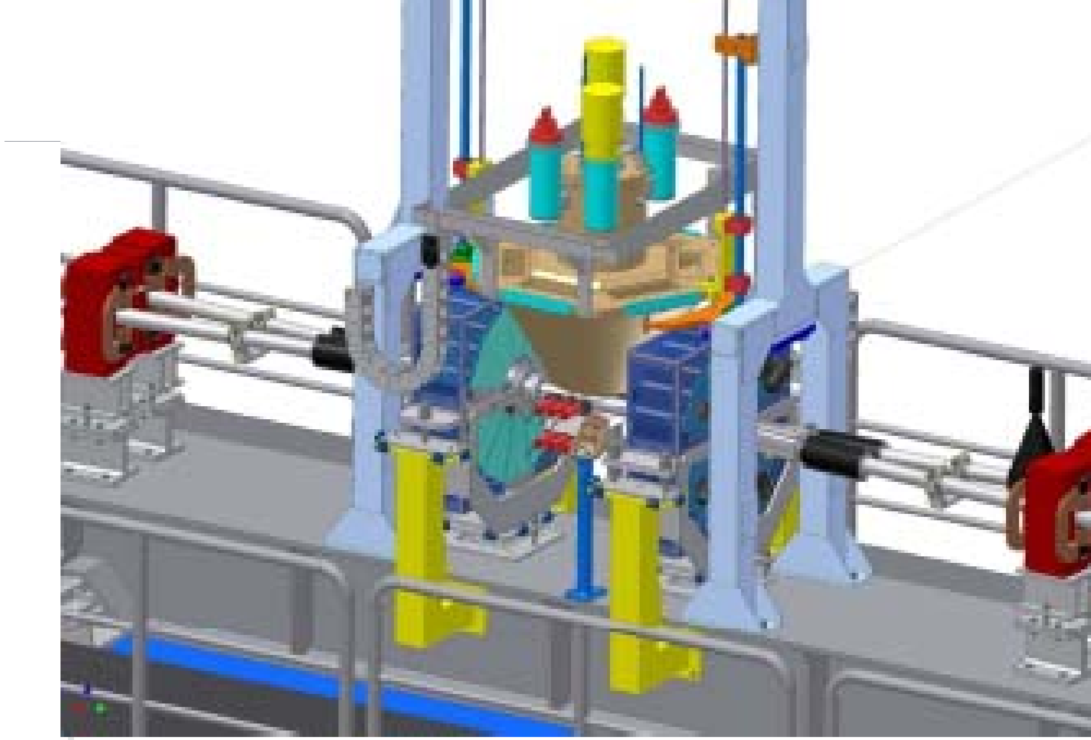
1. low Piwinski angle $\Phi < 1$
2. β_y comparable with σ_z

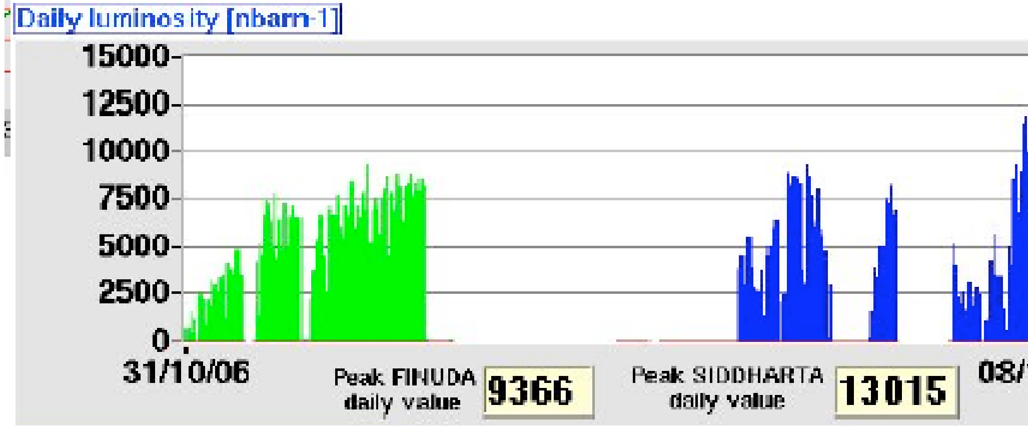


Crab Waist On:

1. large Piwinski angle $\Phi >> 1$
2. β_y comparable with σ_x/θ







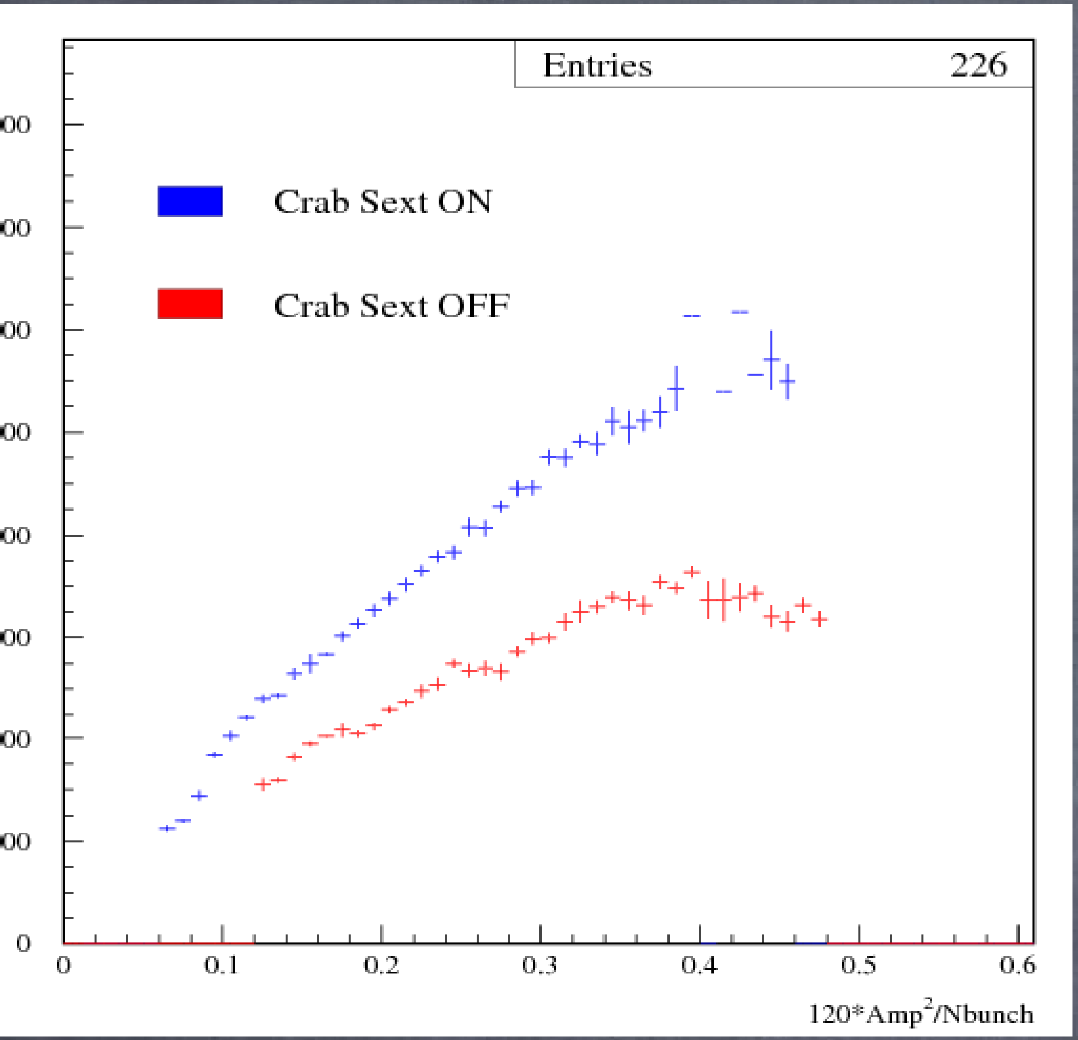
New collision scheme works and CW sextupoles are effective in controlling transverse beam blow-up and increasing luminosity:

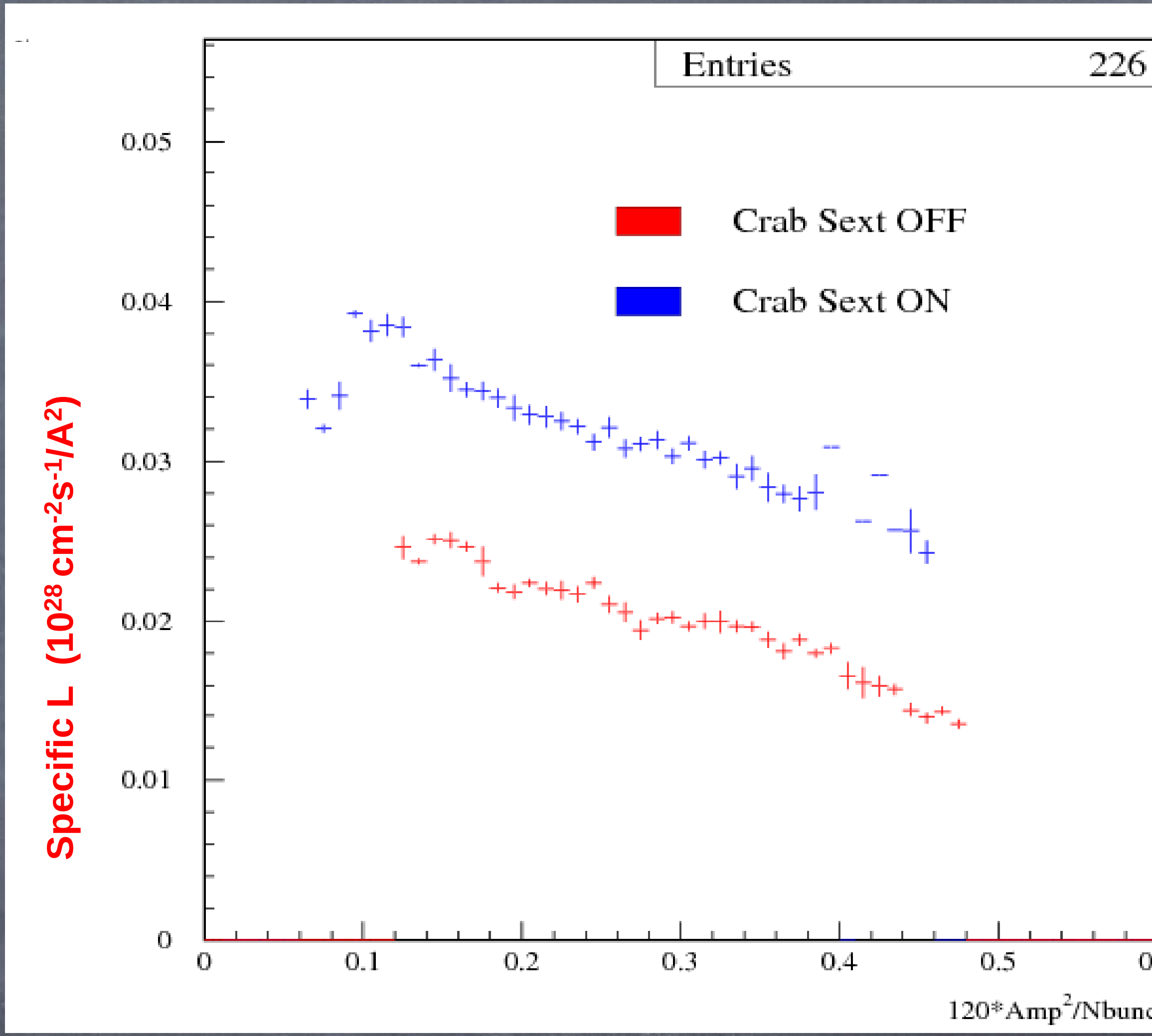
$L_{peak} = 1.6\ cm^{-2}s^{-1}$, $\int L_{day} = 10.\ pb^{-1}$ **(KLOE 2003)**

$L_{peak} = 4\ cm^{-2}s^{-1}$, $\int L_{day} = 12.8\ pb^{-1}$ **(NOW)**

uminosity

Specific Luminosity

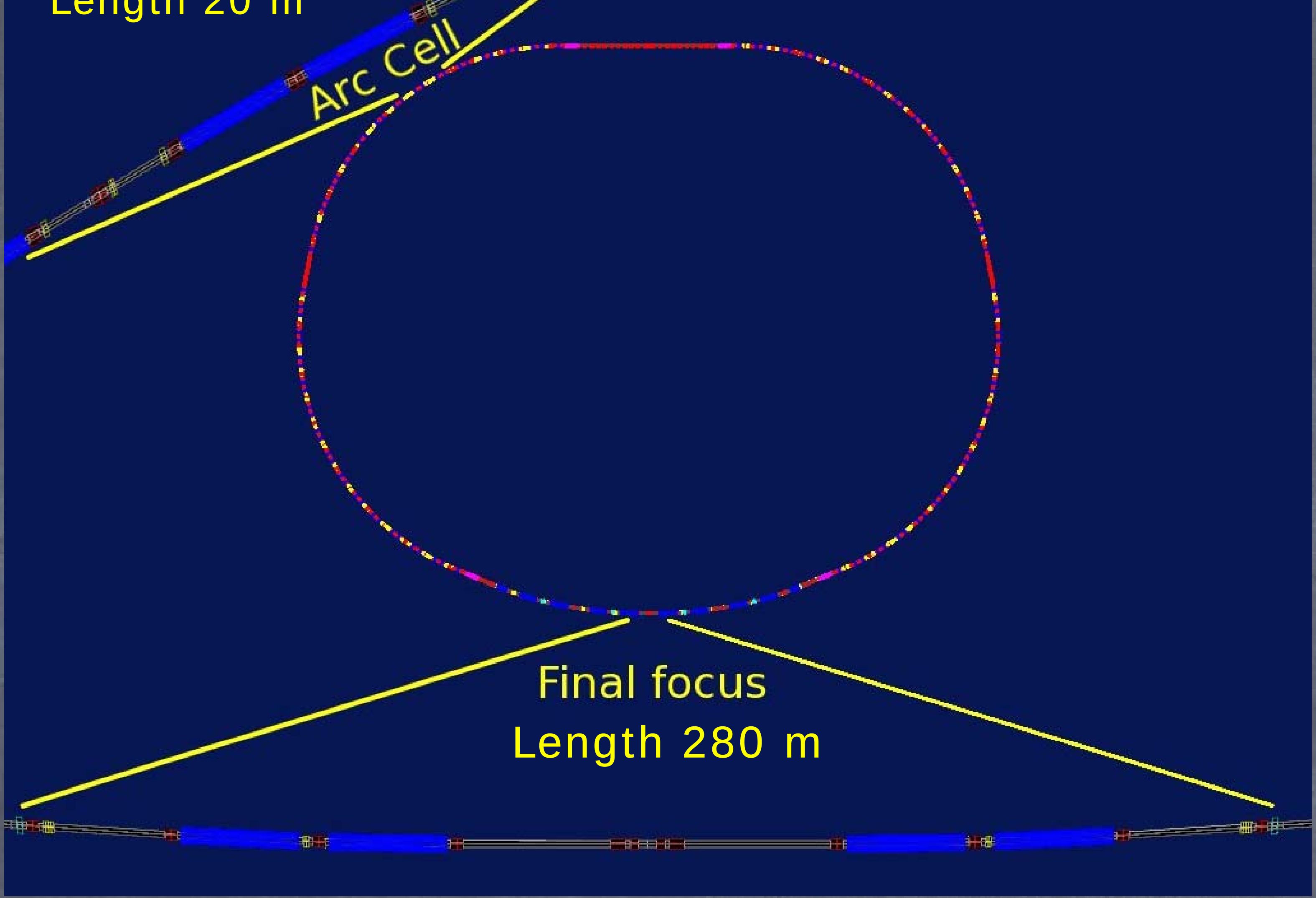




95 bunches

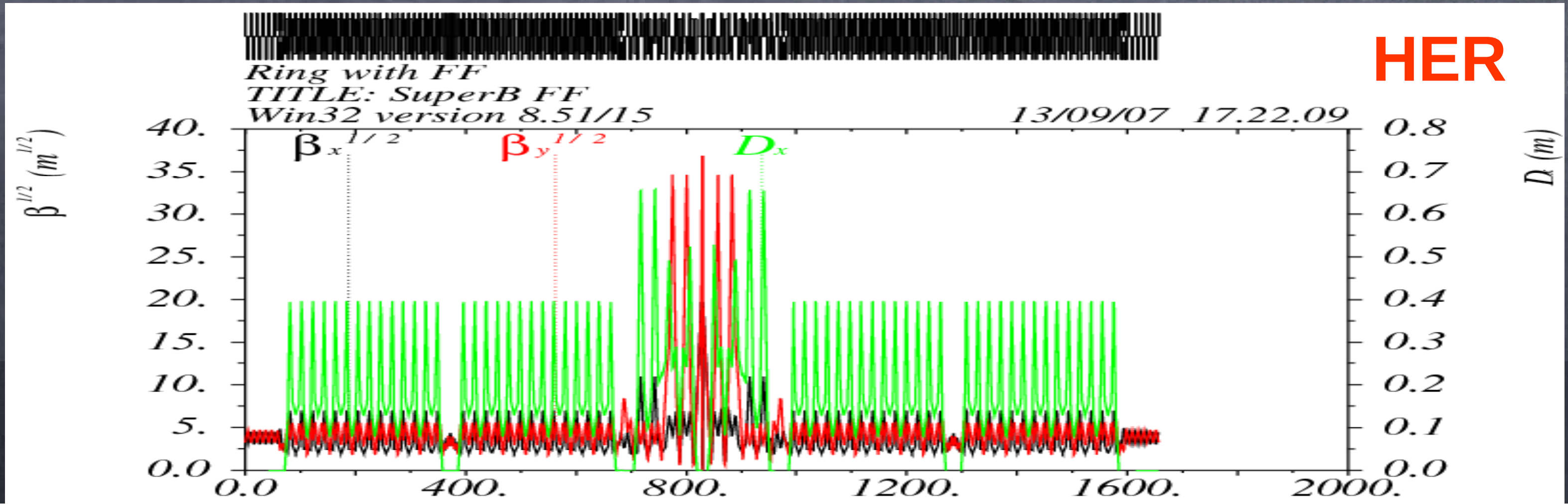
July 2008

$$L_{sp} = \frac{N_b \, L_{peak}}{I^+ I^-} \; [cm^{-2} s^{-1} / A^2]$$



~1800 m

nb:
polarizat
insertion
modeled
this vers



Either beam can be polarized

The LER would be less expensive, the HER technically easier

- The HER (e^-) is the choice

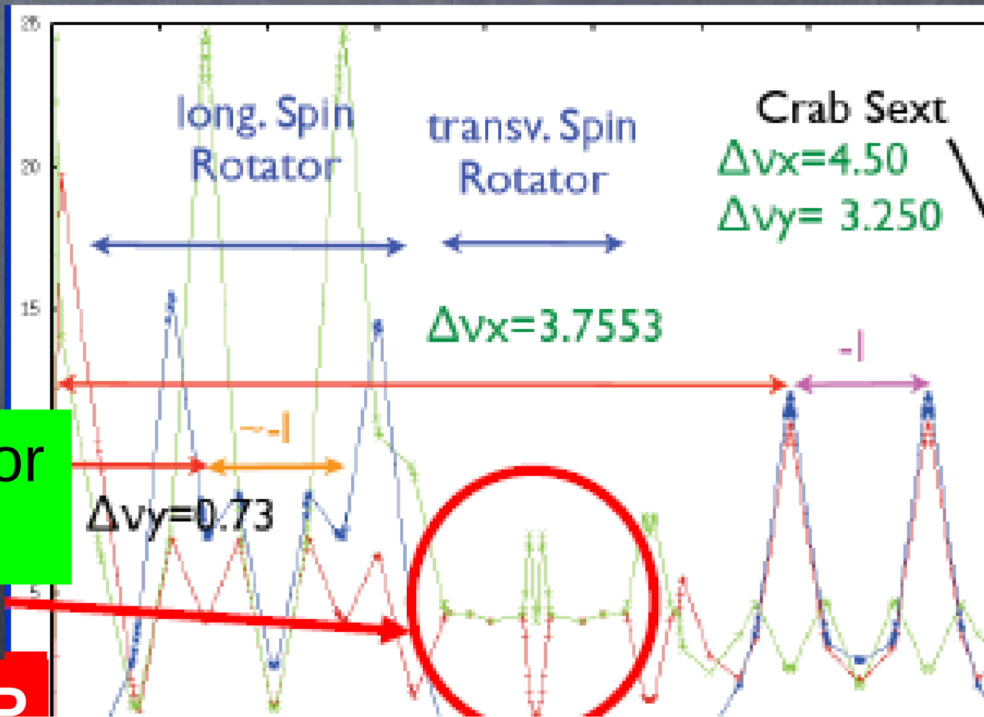
he longitudinally polarized electron source will be either the SLC source or a very similar design

he beam polarization must be vertical in the ring, longitudinal at the collision point

Several spin rotation schemes are possible

- Solenoids appear to be a better choice, as vertical bends cause troublesome vertical emittance growth
- Longitudinal polarization at the IP: (87% at injection)x(97% in ring) = 85% effective net polarization

Integration of the polarization section with the lattice optics is in progress



Half IR with spin rotator (Wienands, Wittmer)

Dipoles

g (m)	0.45	5.4
P HER	-	194
P LER	194	-
perB HER	-	130
perB LER	224	18
perB Total	224	148
eded	30	0

Quadrupoles

L_{mag} (m)	0.56	0.73	0.43	0.7
PEP HER	202	82	-	-
PEP LER	-	-	353	-
SuperB HER	165	108	-	2
SuperB LER	88	108	165	2
SuperB Total	253	216	165	4
Needed	51	134	0	4

Sextupoles

ag (m)	0.25	0.5
EP HER/LER	188	-
uperB HER/LER	372	4
eeded	184	4

+ RF (cavities, klystrons, ..

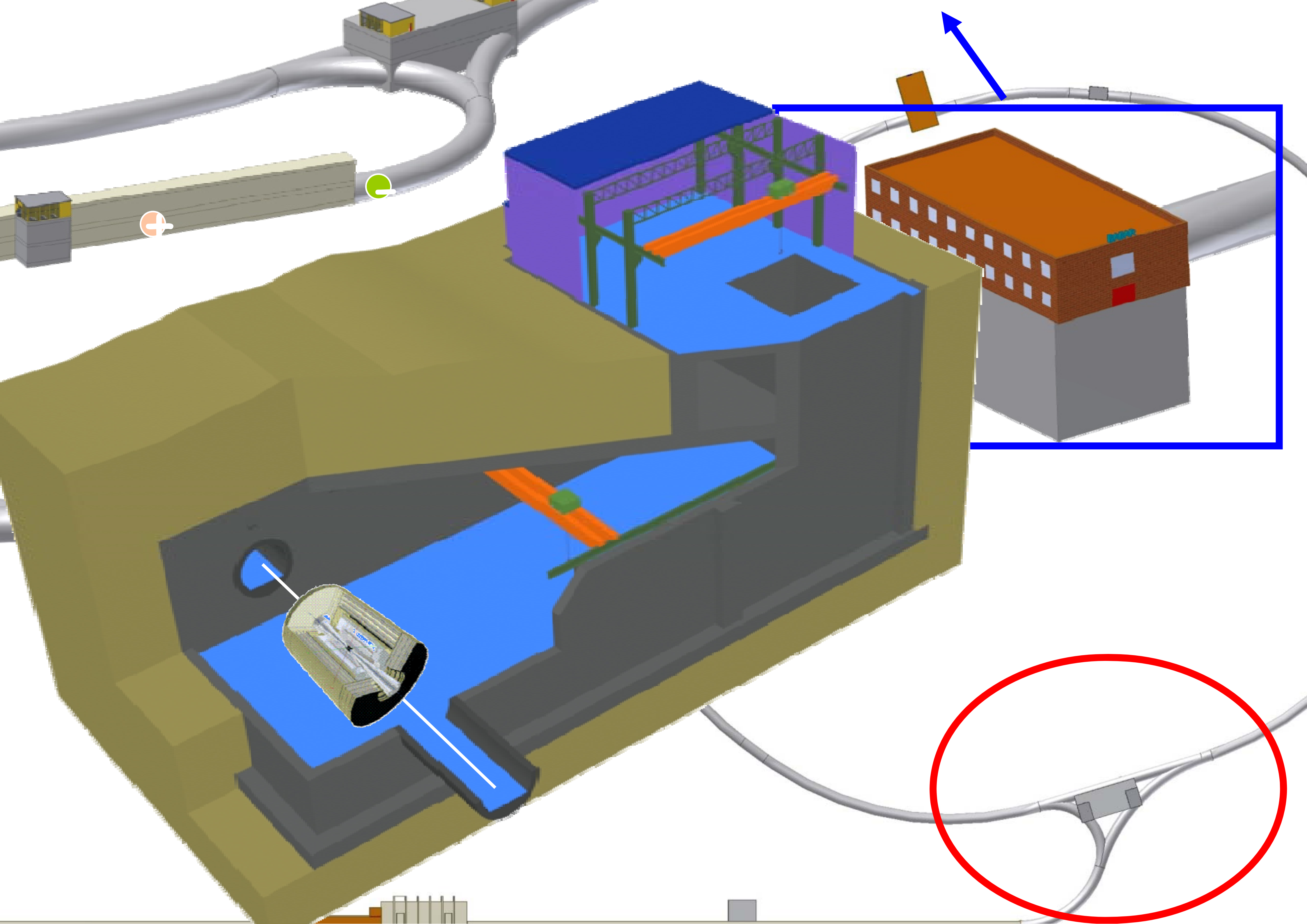
+ vacuum components

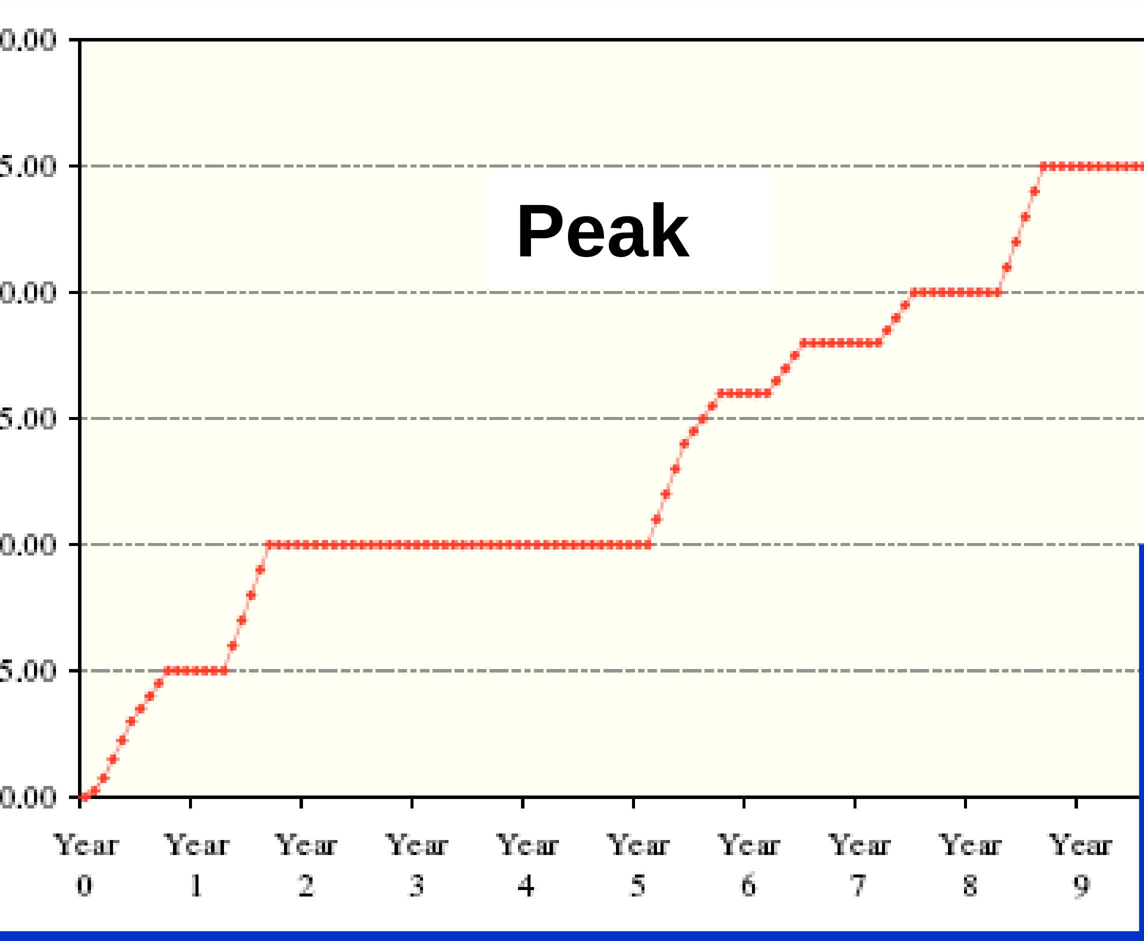
+ accelerator expertise

+ *BABAR*

- The 3.1 GeV PEP-II low energy ring (LER) stored 3.2A in 1722 bu with 4 ns spacing and 23 nm-rad emittance with few electron clou instability issues
- Low emittance lattices (few nm-rad horizontal and few pm-rad vertical emittance) have been designed for the ILC damping rings PETRA-3, NSLC-II and PEP-X
- Very low emittance has been achieved in the ATF test ring for I
- Luminosity enhancement using the crabbed waist technique has b demonstrated at DAϕNE
- There have been spin manipulation tests at BINP
- A laser gun with high e^- polarization was in routine use at SLC
- Both PEP-II (head on) and KEKB (crossing angle) successfully use asymmetric interaction regions
- Both PEP-II and KEKB successfully used continuous injection

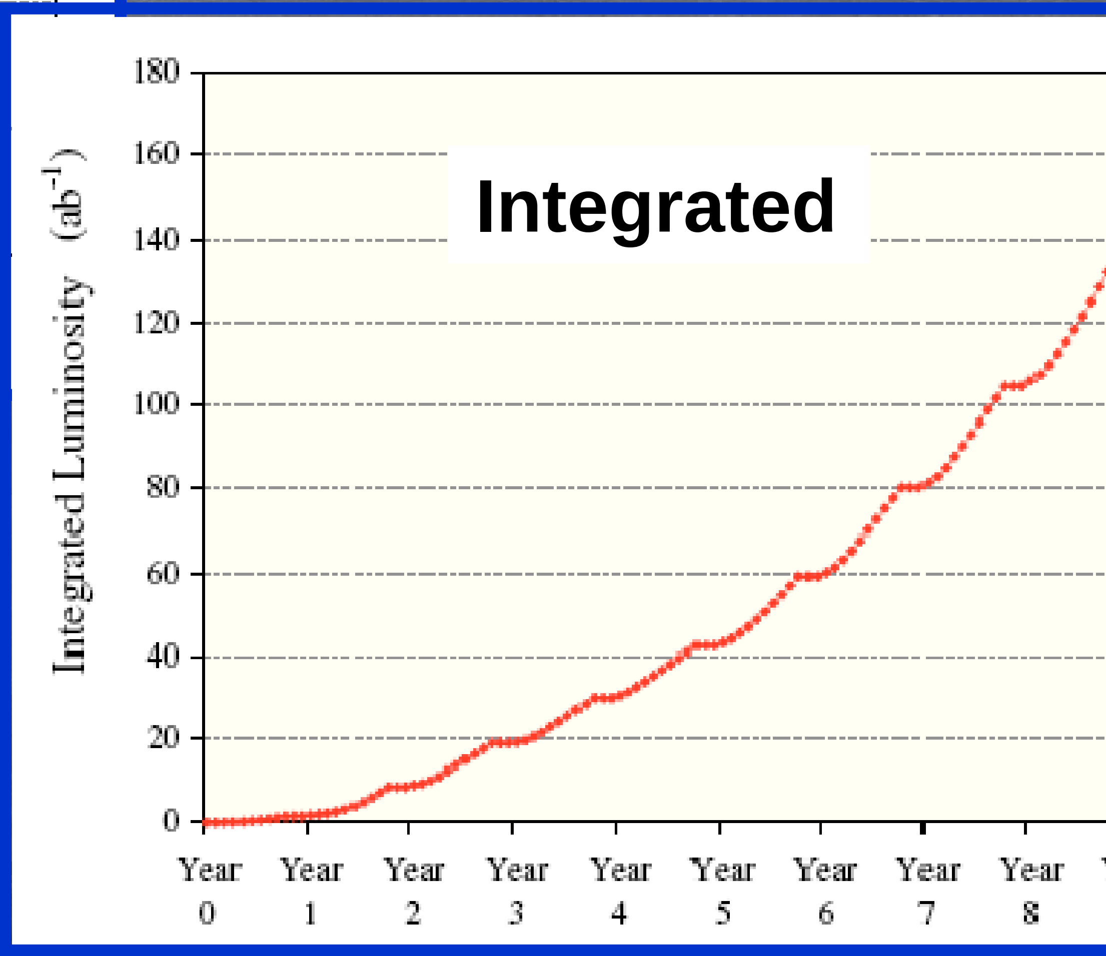

Due Torri
Google





Peak luminosity can be upgraded to at least $2.5x10^{36}$ (conservatively

160 ab^{-1} in ten years
~100 x combined
BABAR+Belle data sample



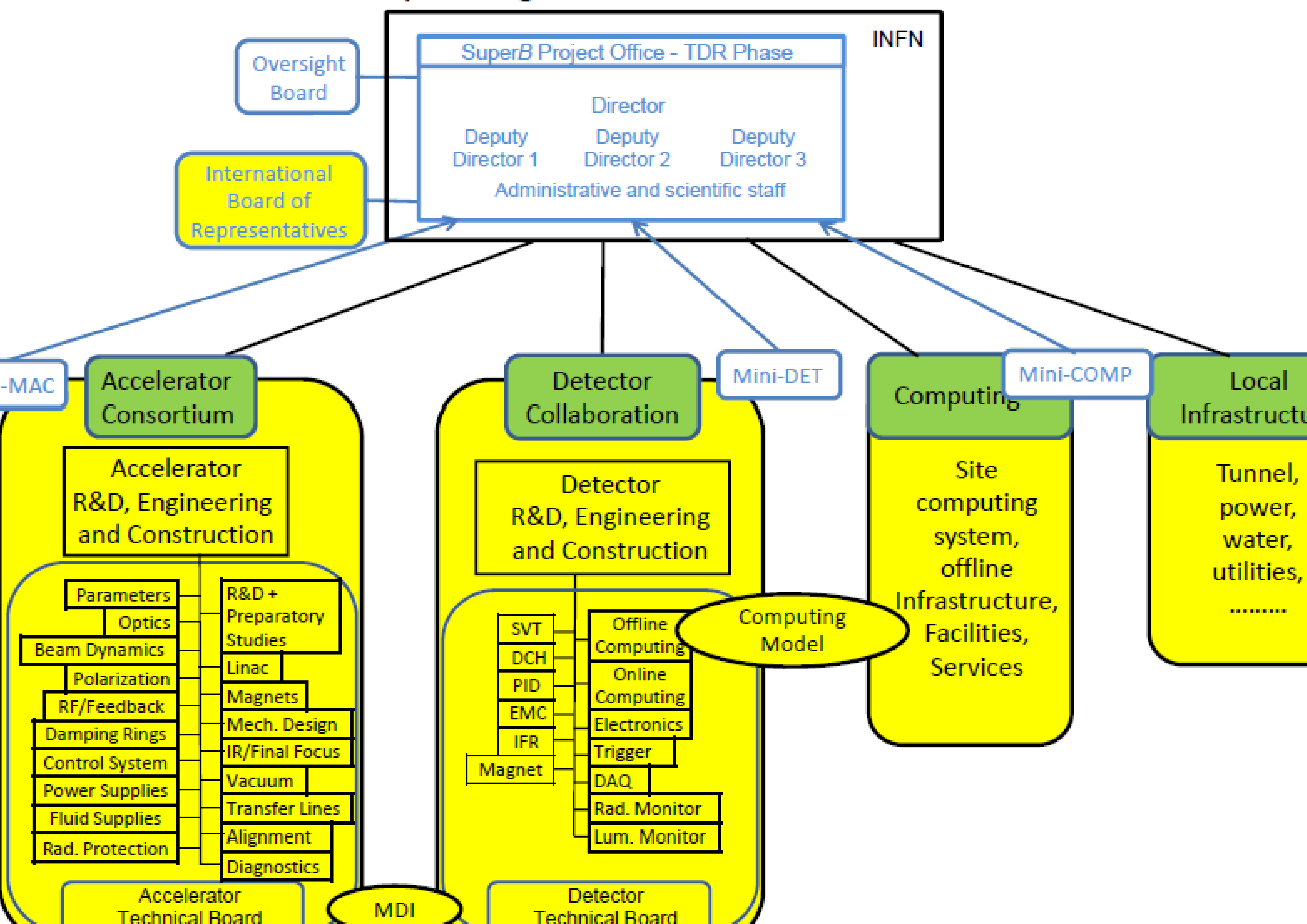
From the Super*B* CDR

	EDIA [my]	Labor [my]	M&S [k€]	Net replacement value [k€]
Accelerator	452	291	191,166	126,33
Site (Lazio region)	119	138	105,700	
Detector	283	156	40,747	46,47

Costs are presented “ILC-style”, with replacement value for reusable PEP-II/ *BaBar* components

Value of reusable items from PEP-II and *BaBar*

Disassembly, crating, refurbishment and shipping costs are included in columns to the left


INFN
SuperB Project Office - TDR Phase
Director
Deputy Director 1
Deputy Director 2
Deputy Director 3
Administrative and scientific staff
Oversight Board
International Board of Representatives
-MAC
Accelerator Consortium
Accelerator R&D, Engineering and Construction
Parameters
Optics
Beam Dynamics
Polarization
RF/Feedback
Damping Rings
Control System
Power Supplies
Fluid Supplies
Rad. Protection
R&D + Preparatory Studies
Linac
Magnets
Mech. Design
IR/Final Focus
Vacuum
Transfer Lines
Alignment
Diagnostics
Accelerator Technical Board
MDI
Detector Collaboration
Mini-DET
Detector R&D, Engineering and Construction
SVT
DCH
PID
EMC
IFR
Magnet
Offline Computing
Online Computing
Electronics
Trigger
DAQ
Rad. Monitor
Lum. Monitor
Computing Model
Detector Technical Board
Computing
Mini-COMP
Site computing system, offline Infrastructure, Facilities, Services
Local Infrastructu
Tunnel, power, water, utilities, ...

NFN commissioned an International Review Committee, for the CDR, chair
y John Dainton to report on the physics objectives the detector concept an
ne machine

H. Aihara (Tokyo), J. Dainton (Liverpool) , R. Heuer (DESY), Y.-K, Kim (Fermilab), J. Lefrancois (Orsay), A. Masiero (Padova), S. Myers(CERN), D. Schulte (CERN), A. Seiden (UC Santa Cruz)

- The report, issued in May, was strongly positive. Excerpts:

“……….. the step change in luminosity which Super*B* brings, makes possible measurements that are crucial to our comprehension of the physics which is behind the Standard Model. In some cases, for example if dynamic issues are at a multi-Te energy scale, measurements at Super*B* may provide the only window on this physi

“There are issues which arise because of the huge luminosity at Super*B* and the need improve detector performance in the face of the experimental challenge of precisio measurements. R&D is already underway where appropriate, and, given the timesc foreseen by the Super*B* collaboration, it is important to maintain, and where possib to accelerate, this work to a conclusion, so as to enable the appropriate decisions fo the experiment to be taken in a timely fashion.”

“The importance of taking forward the design of the Super*B* machine expeditiously requires a growing investment in the accelerator physics and engineering R&D wo This growth in both scope and volume of in-depth evaluation requires the oversigh an expert Machine Advisory Committee (MAC).”

n response to the Dainton report, INFN commissioned a Machine Advisory
ommittee, chaired by Jonathan Dorfan

laus Balewski (DESY), John Corlett (LBNL), Jonathan Dorfan (SLAC, Chair),
om Himel (SLAC/on sabbatical at DESY), Claudio Pellegrini (UCLA),
aniel Schulte (CERN), Ferdi Willeke (BNL), Andy Wolski (Liverpool),
rank Zimmermann (CERN)

rom the closeout:

y exciting project - Committee is exhilarated by the challenge"

ginative and ambitious design - Committee endorses the design approach. Design does
exibility to either raise the luminosity or compensate for surprises"

mittee considers the SINGLE MOST ESSENTIAL ingredient for moving forward
the formation of a sanctioned management structure which formally incorporates a dedic
achine design team"

Committee sees no glaring showstoppers wrt achieving the design performance. Howe
veral key areas, more work is needed before the design can be blessed"

Committee, in consultation with the Super*B* team, established a list of topics that are es
r the team to address before the Mini-MAC will be in a position to state with confidenc
e machine can achieve its physics goals. It is the Committee's opinion that these items c
ioritized in such a way that the machine feasibility can be judged six months from now"

ocal food is excellent"

- After a presentation to ECFA, a Super$B$ subcommittee chaired by Tatsuya Nakada was formed
  - The report was presented at RECFA meeting on Nov. 28
  - ECFA recommends proceeding to TDR phase

- Presentation to CERN Strategy Group is anticipated in Decembe

- If thus milestone is passed successfully, next step is to formally seek funding from the Italian ministry and the EU

- INFN has formally requested the PEP-II and $BABAR$ components from SLAC and DOE
  - Approval will be contingent on European funding decisions

High statistics flavor physics at an e^+e^- collider will likely provide informatio
crucial to the understanding of new physics found at LHC

- The data sample needed is in the range 50-75 ab^{-1}
- Super$B$, with an initial luminosity of 10^{36} cm^{-2}s^{-1} can provide such a sampl the canonical five years
  - The low emittance crabbed waist design of Super$B$ allows
    - Very high luminosity with a power bill less than existing machines
    - Detector backgrounds that can be coped with using existing technology
    - A longitudinally polarized electron beam that facilitates measurem of or searches for, ♦ EDM, CPV and anomalous moment
    - The capability of running at lower center-of-mass energies

The achievable levels of sensitivity in rare b, c and ♦ decays allow substantia coverage in the parameter space of new physics

There is, of course, overlap with the programs of LHC flavor experiments su as LHCb, but the e^+e^- environment makes possible a substantial number of ur and important physics objectives, especially in those areas most sensitive to physics, such as LFV, FCNC, decays involving (multi) neutrals, $D^0\bar{D}^0$ mixing and CPV, ...

We are working towards a turn-on date of 2015 or 2016