Prospects at Future B Factories

CKM 2012

G. Finocchiaro INFN-LNF

Outline

- Actors: the Super Flavour Factory (SFF) experiments

- (Main) plot: the quest for New Physics
  - Mixing and mixing-related *CPV* in *B* decays
    - at the $\Upsilon(4S)$ resonance
    - at the $\Upsilon(5S)$ resonance
  - Comparison with reach at LHC(b)

Preamble: Where we are, where we're going

- Today's flavour physics landscape defined by BABAR, Belle, Tevatron, and evolving with LHC
  - Triumph of the CKM paradigm at the current precision level
    - with some hints of tension
  - Indirect constraints on NP

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LHC finds NP

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➡ constrain couplings and flavour structure

➡ search for still heavier states

◉ If incompatible with present data

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LHC does not find NP

◉ Some model-dependent direct searches at LHC found nothing to date

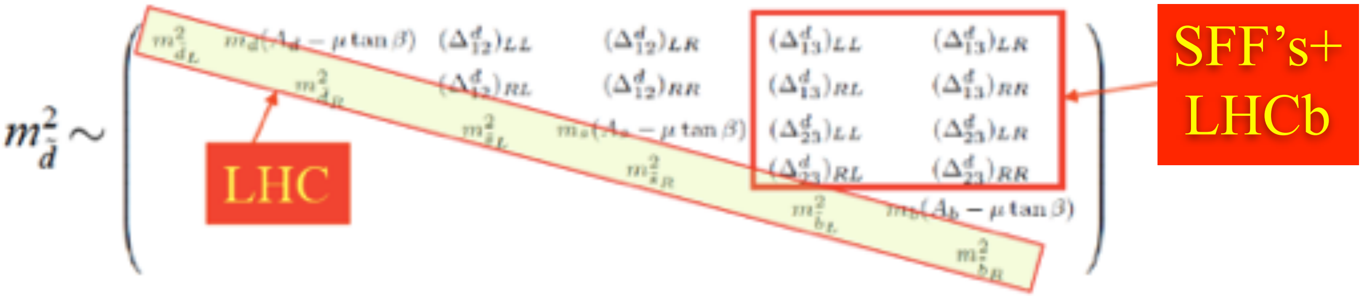
◉ SFFs can indirectly explore energy scales higher than those accessible at LHC

➡ constrain the many available models

➡ exclude regions in the (vast) parameter space

Squark mass matrices and Λ_{NP}

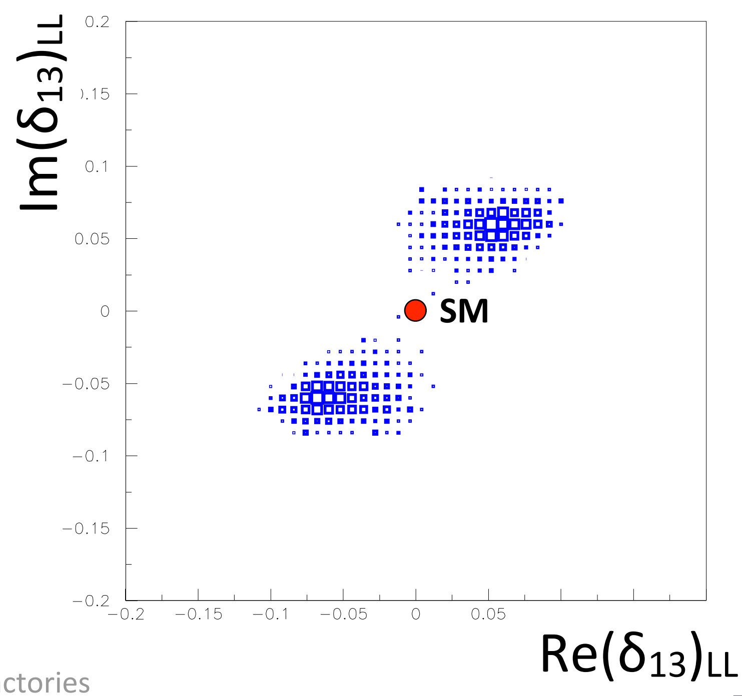
- Example: the MSSM with generic squark mass matrices in the mass-insertion approximation with $m_{\tilde{q}} \sim m_{\tilde{g}}$ to constrain the couplings



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

- In several NP scenarios the "high p_T" experiments will probe the diagonal elements of mixing matrices.
- Flavour experiments are sensitive to off-diagonal elements.
  - in specific NP models, to mass scales higher than LHC
- Example:

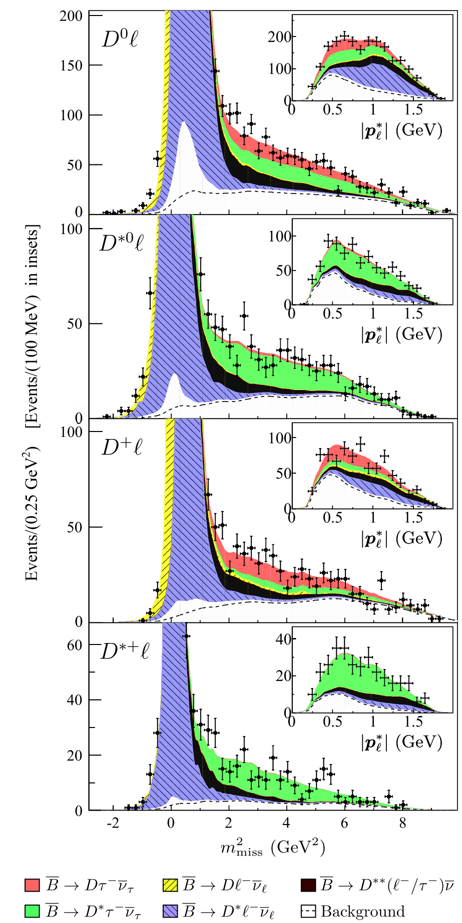
  constraints on the $Im(\delta_{13})_{LL}$ - $Re(\delta_{13})_{LL}$ plane from measurements of $\beta, \Delta m_d$ and a_{SL} at SuperB



The power of precision data: $B \rightarrow D^{(*)}\tau\nu$

BABAR
PRL **109**, 101802 (2012)

- A recent example of how well precision "low energy" measurements can constrain NP models
  - $B \rightarrow D^{(*)}\tau\nu$ decays reconstructed in 4 different modes and normalized to $B \rightarrow D^{(*)}\ell\nu$ to reduce syst. errors: final measured value is R($D^{(*)}$)
  - No value of tanβ /m_{H+} in the type II 2HDM is compatible with both D and D^* measurements
    ➜ the data rule out the model at 99.8%CL



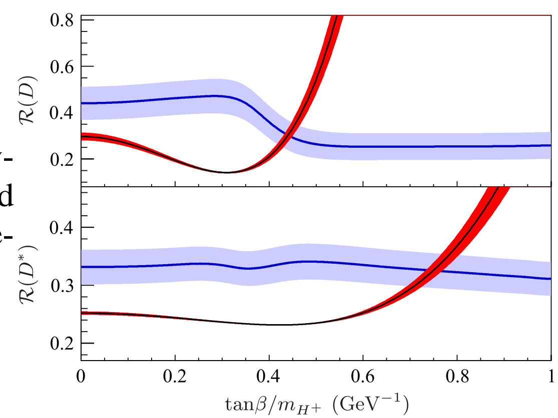


FIG. 2 (color online). Comparison of the results of this analysis (light gray, blue) with predictions that include a charged Higgs boson of type II 2HDM (dark gray, red). The SM corresponds to $\tan\beta/m_{H^+} = 0$.

Hunting for NP at a Super B Factory

- We DO NOT know what New Physics is out there
  - many NP models on the market
  - many non predicted parameters, including the NP mass scale Λ_{NP}
- Precision measurements sensitive to loop diagrams can probe relatively high energy scales
  - e.g., m_{Higgs} from EW data, or m_{top} from B mixing
- As shown by the *B* factories, a *huge* number of measurements can be performed in the clean $e^+e^- \to \Upsilon(4S) \to BB$ environment
- Most are statistics-limited, and worth to be studied with large (x100) data samples
  - large control samples can further reduce systematic and theoretical uncertainties
- Very rare modes will become accessible

Hunting for NP at a Super B Factory

Observable/mode	charged Higgs high $\tan\beta$	MFV NP low $\tan\beta$	non-MFV NP 2-3 sector	NP in Z penguins	Right-handed currents	LHT	SUSY					
							AC	RVV2	AKM	δLL	FBMSSM	GUT-CMM
$\tau \to \mu\gamma$							***	***	*	***	***	***
$\tau \to \ell\ell\ell$						***						?
$B \to \tau\nu, \mu\nu$	***(CKM)											
$B \to K^{(*)+}\nu\bar{\nu}$			*	***			*	*	*	*	*	?
S in $B \to K_S^0\pi^0\gamma$			**		***							
S in other penguin modes			***(CKM)		***		***	**	*	***	***	?
$A_{CP}(B \to X_s\gamma)$			***		**		*	*	*	***	***	?
$BR(B \to X_s\gamma)$		*	**		*							**
$BR(B \to X_s\ell\ell)$			**	*	*							?
$B \to K^{(*)}\ell\ell$ (FB Asym)							*	*	*	***	***	?
a_{sl}^s			***			***						***
Charm mixing							***	*	*	*	*	
CPV in Charm	**									***		

- Example (from arXiv:1109.5028): golden matrix of observables which can be measured at Super*B*
  - the more the ***'s the larger the expected deviation from SM
- Detailed study of the patterns of deviations from the SM is crucial to isolate the correct NP model (if any)

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$\tau \to \mu\gamma$							★★★	★★★	★	★★★	★★★	★★★
$\tau \to \ell\ell\ell$						★★★						?
$B \to \tau\nu, \mu\nu$	★★★(CKM)											
$B \to K^{(*)+}\nu\overline{\nu}$			★	★★★			★	★	★	★	★	?
S in $B \to K^0_S\pi^0\gamma$			★★		★★★							
S in other penguin modes			★★★(CKM)		★★★		★★★	★★	★	★★★	★★★	?
$A_{CP}(B \to X_s\gamma)$			★★★		★★		★	★	★	★★★	★★★	?
$BR(B \to X_s\gamma)$		★	★★		★							★★
$BR(B \to X_s\ell\ell)$			★★	★	★							?
$B \to K^{(*)}\ell\ell$ (FB Asym)							★	★	★	★★★	★★★	?
a^s_{sl}			★★★			★★★						★★★
Charm mixing							★★★	★	★	★	★	
CPV in Charm	★★									★★★		

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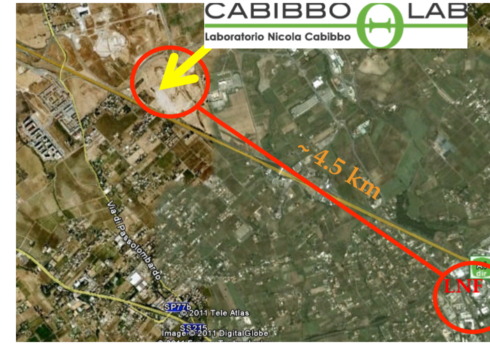
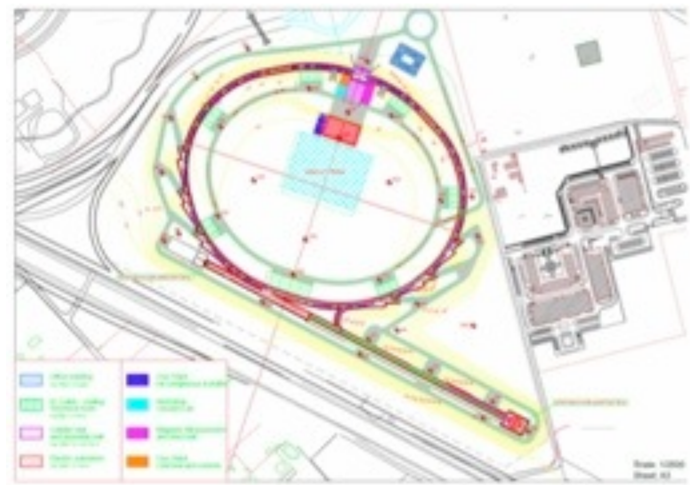
The Future B Factories

SuperB at the Nicola Cabibbo Lab in Tor Vergata



- Super*B* is a 2 rings, asymmetric energies (e^- @ 4.18, e^+ @ 6.7 GeV) collider with:
  - large Piwinski angle and “crab waist” collision scheme
  - ultra low emittance lattices – ideas taken from ILC design
  - target luminosity of 10^{36} cm^{-2} s^{-1} at the Υ(4S)
    - headroom for higher $\mathcal{L}$
    - $\int \mathcal{L} dt = 75 ab^{-1}$ in 5 years
  - 80% longitudinally polarized electron beam
  - possibility to run at τ/cc threshold with $\mathcal{L}$ = 10^{35} cm^{-2} s^{-1}
  - Linac can share beam with an X-FEL

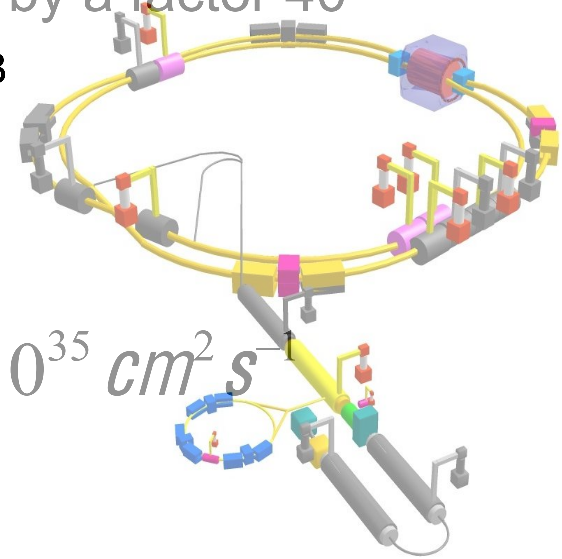


- Design criteria:
  - Minimize building costs
  - Minimize running costs (wall-plug power and water consumption)
  - Reuse of some PEP-II B-Factory hardware (RF)

SuperKEKB

Upgrade of the world's highest Luminosity collider by a factor 40

"Nano-Beam" scheme of Pantaleo Raimondi for SuperB

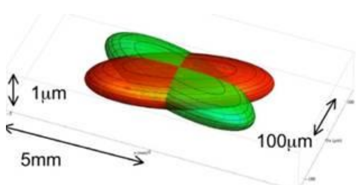


~x2 in beam current

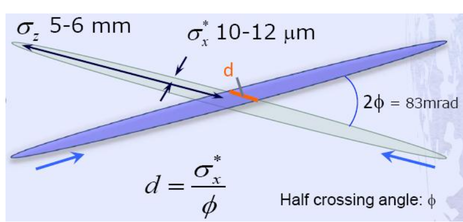
$$L = \frac{\gamma_{\pm}}{2er_e}\left(1+\frac{\sigma_y^*}{\sigma_x^*}\right)\left(\frac{I_{\pm}\xi_{\pm y}}{\beta_y^*}\right)\left(\frac{R_L}{R_y}\right) = 8\times10^{35}\ cm^{2}\ s^{-1}$$

Vertical beta function reduction (5.9→0.3 mm) gives x20

Beam Energies 8.0/3.5→7.0/4.0



KEKB



(Vertical beam size ~ 60 nm)

Increase in LER energy improves lifetime (reduced Touschek scattering)
Decrease in HER energy reduces Synchrotron power requirements

SuperB & SuperKEKB Parameters

Table 1: SuperB and SuperKEKB Main Parameters

Parameter	SuperB		SuperKEKB	
	HER (e^+)	LER (e^-)	HER (e^-)	LER (e^+)
Luminosity ($cm^{-2}s^{-1}$)	10^{36}		$8x10^{35}$	
C (m)	1200 m	1200 m	3016	3016
E (GeV)	6.7	4.18	7.007	4
Crossing angle (mrad)	60		83	
Piwinski angle	20.8	16.9	19.3	24.6
I (mA)	1900	2440	2600	3600
$\varepsilon_{x/y}$ (nm/pm) (with IBS)	2/5	2.5/6.2	4.6/11.5	3.2/8.6
IP $\sigma_{x/y}$ (μm/nm)	7.2/36	8.9/36	10.7/62	10.1/48
σ_l (mm)	5	5	5	6
N. bunches	978		2500	
Part/bunch ($x10^{10}$)	5.1	6.6	6.5	9.04
σ_E/E ($x10^{-4}$)	6.4	7.3	6.5	8.14
bb tune shift (x/y)	0.0026/0.107	0.004/0.107	0.0012/0.081	0.0028/0.088
Beam losses (MeV)	2.1	0.86	2.4	1.9
Total beam lifetime (s)	254	269	332	346
Polarization (%)	0	80	0	0
RF (MHz)	476		508.9	

M. Biagini
IPAC 2012

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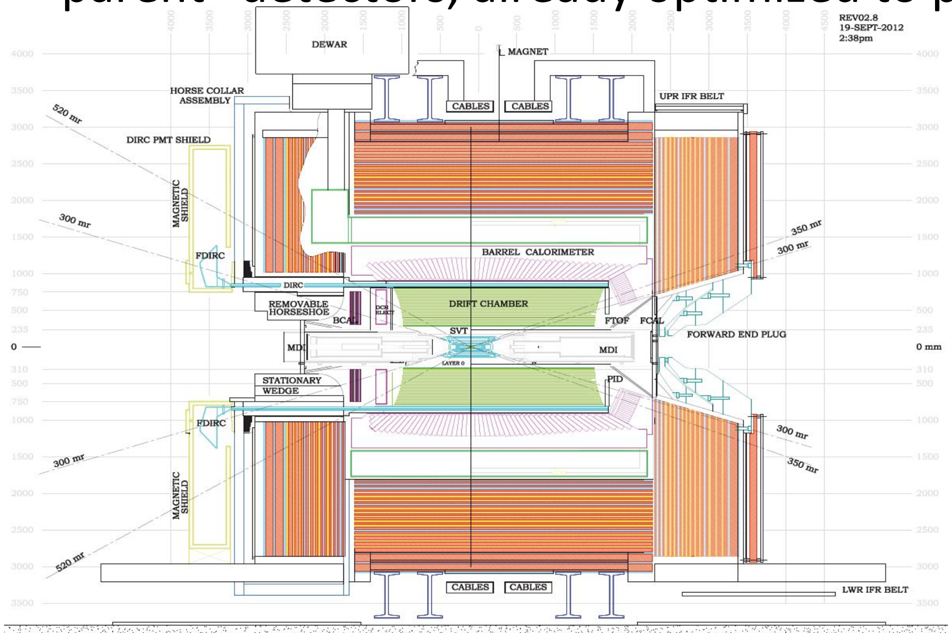
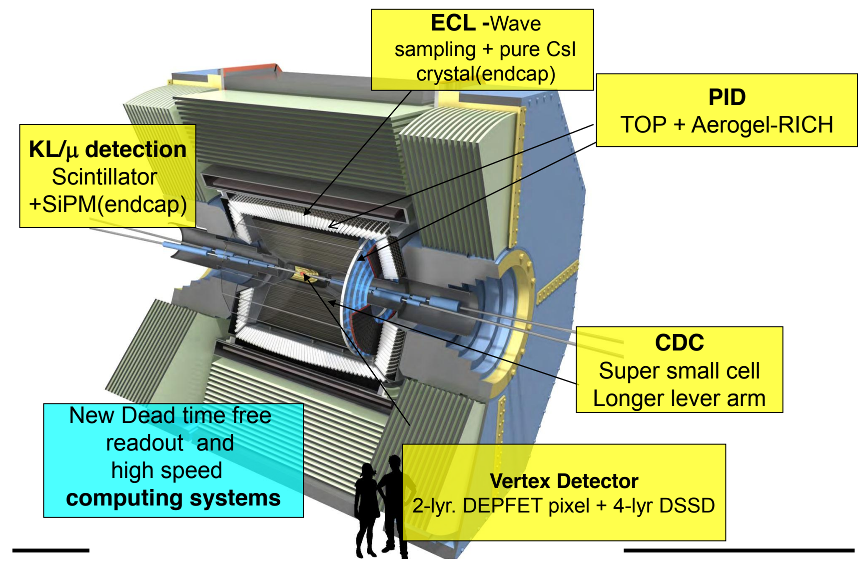
IPAC 2012

5-year int. Lumi ab^{-1}	75 (in 2023)	50 (in 2021)

The Super Detectors

- Both SuperB and Belle II are based on the design and reuse of parts of their "parent" detectors, already optimized to perform high precision *B* physics



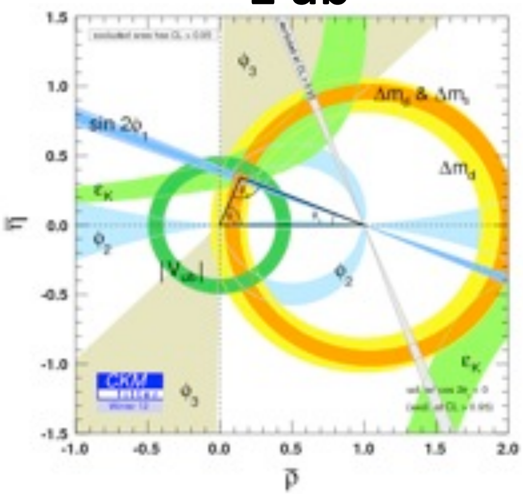


- Main differences to cope with expected increase in trigger rates and occupancies
  - Luminosity-related backgrounds carefully studied by both experiments
- ...and reduction of the CM boost
  - Belle: 3.5/8GeV → Belle II: 4/7GeV; BaBar: 9/3.1GeV → SuperB: 4.18/6.77GeV
- In principle, better performances than BaBar and Belle, in a harsher environment

Mixing-related CKM measurements

Success of CKM, stresses in the UT

~1 ab^{-1}



- The CKM matrix is the dominant source of CPV

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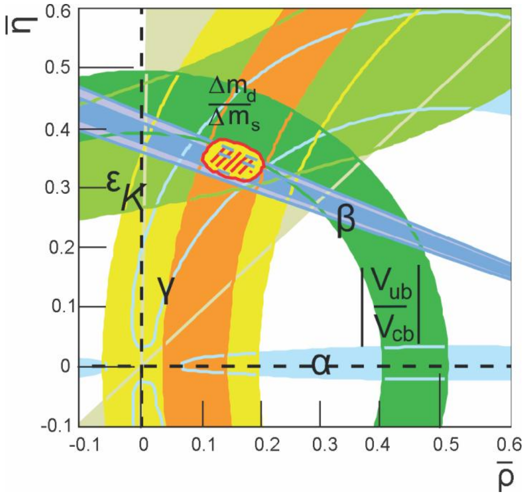

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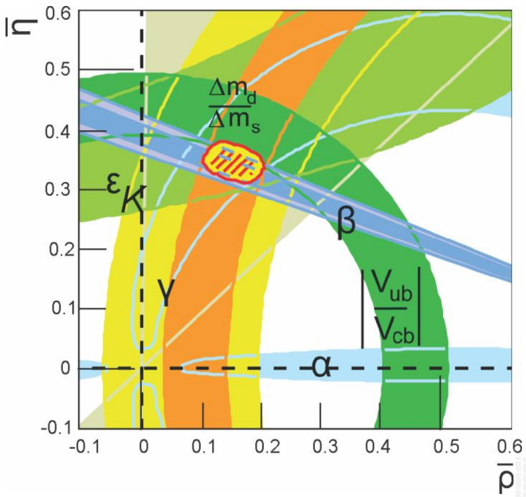

- The CKM matrix is the dominant source of CPV
- There are some tensions in the current measurements

C. Tarantino, ICHEP 2012

From the UTA (excluding its exp. constraint) → Prediction

	Prediction	Measurement	Pull
$\sin 2\beta$	0.81±0.05	0.680±0.023	2.4 ←
γ	68°±3°	76°±11°	<1
α	88°±4°	91°±6°	<1
$\lvert V_{cb}\rvert \cdot 10^3$	42.3±0.9	41.0±1.0	<1
$\lvert V_{ub}\rvert \cdot 10^3$	3.62±0.14	3.82±0.56	<1
$\varepsilon_K \cdot 10^3$	1.96±0.20	2.23±0.01	1.4 ←
$BR(B\to \tau\nu)\cdot 10^4$	0.82±0.08	1.67±0.30	-2.7 ←

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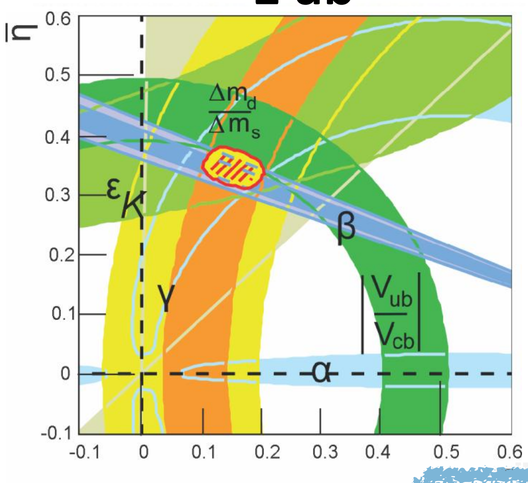

- The CKM matrix is the dominant source of CPV
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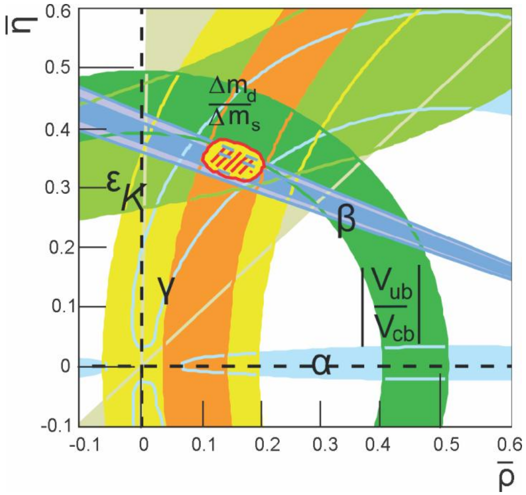
D. Derkach, CKM 2012

	Prediction	Measurement	Pull, σ
α, °	(87.8±3.7)	(90.6±6.8)	<1
sin(2β)	(0.75±0.05)	(0.679±0.024)	-1,4
γ , °	(68.8±3.4)	(72.2±9.2)	<1
V_{ub}, 10^{-3}	(3.63±0.13)	(3.8±0.6)	<1
V_{cb}, 10^{-3}	(42.3±0.9)	(41.±1.)	<1
ε_K, 10^{-3}	(1.96±0.2)	(2.229±0.010)	+1.3
Δm_s, ps^{-1}	(17.5±1.3)	(17.69±0.08)	<1
B(B→τν), 10^{-4}	(0.822±0.008)	(0.99±0.25)	<1
β_s, rad*	(0.01876±0.0008)	(0.01±0.05)	
B(B_s→ll), 10^{-9}*	(3.47±0.27)	<4.5	

CKM at 1%

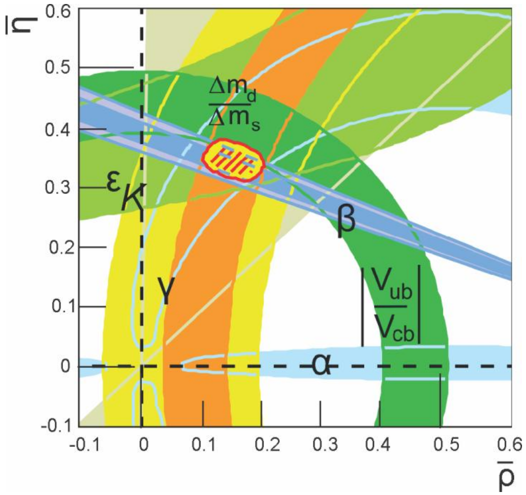
~1 ab^{-1}



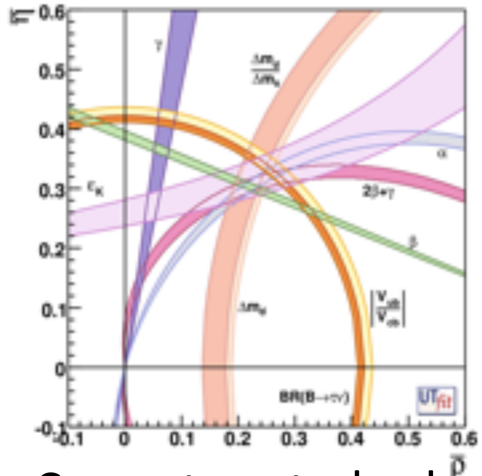
$\bar{\eta}$
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
$\bar{\rho}$
$\frac{\Delta m_d}{\Delta m_s}$
ε_K
β
γ
$\left|\frac{V_{ub}}{V_{cb}}\right|$
α

CKM at 1%

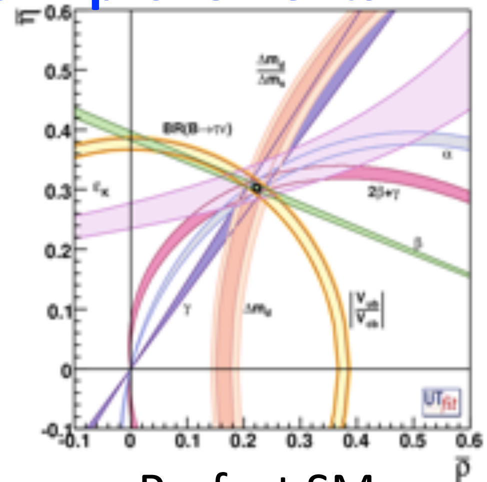
~1 ab^{-1}



~75 ab^{-1}+lattice improvements



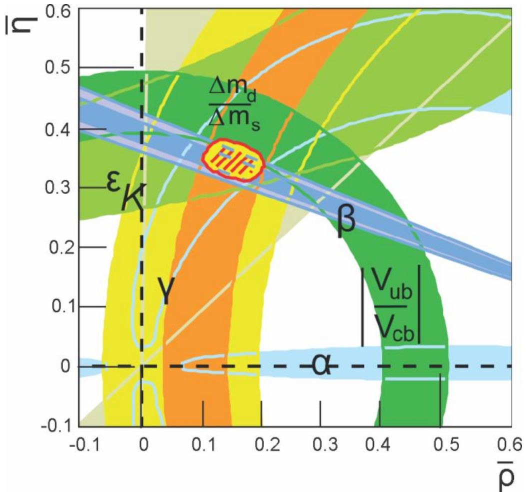
Current central values

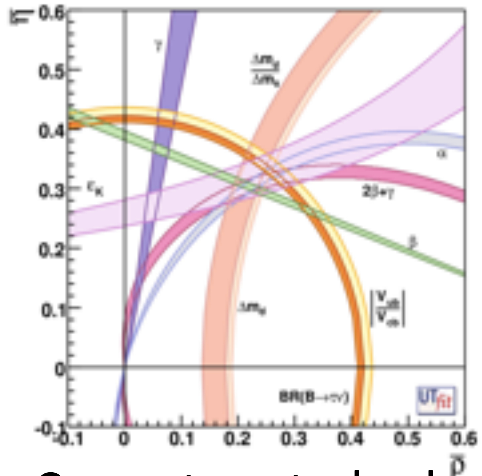


Perfect SM

CKM at 1%

~1 ab^{-1} | **~75 ab^{-1}+lattice improvements**





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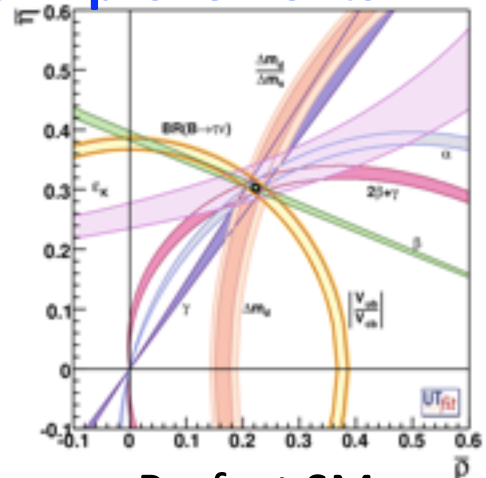


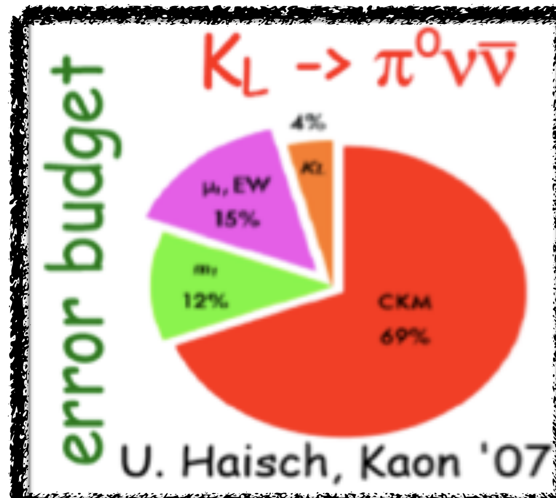
Perfect SM

Generalized UT fits:
CKM at 1% in the presence of NP!

	today	SuperB
$\bar\rho$	0.187±0.056	±0.005
$\bar\eta$	0.370±0.036	±0.005

- crucial for many NP searches with flavour (not only in the B sector!)

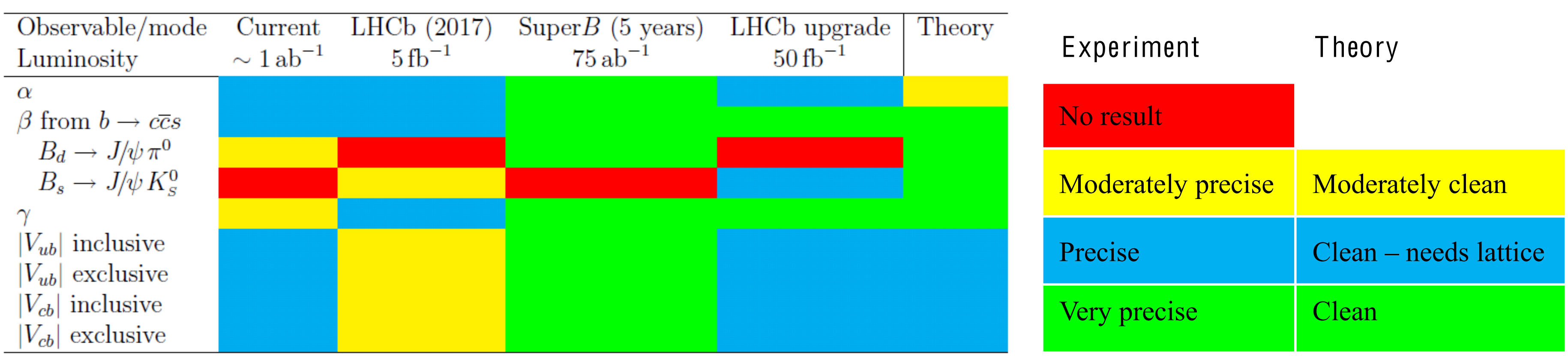
Marco Ciuchini   4th SuperB Collaboration Meeting – La Biodola – 31/5/2012



Future B Factories & LHCb

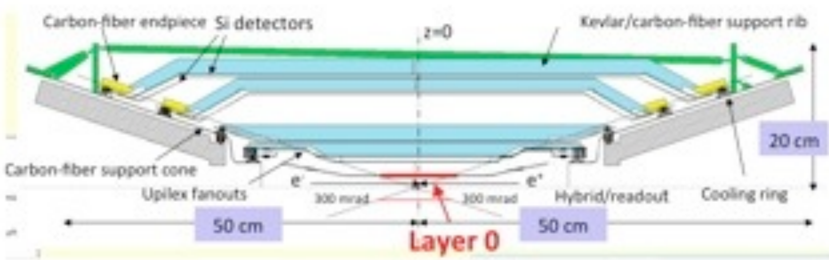
General comments:

- The SFF reach estimates with 75 (50) ab^{-1} are based (unless otherwise noted) on *B*-factory analyses already performed, and are therefore quite sound
- Generally, better control of systematic uncertainties at e^+e^- colliders
  - well-defined initial state, hermetic “4π” detector; modes with neutral particles and missing energy (much) better reconstructed
- On the other hand, SFF’s have little (no) handle on B_s TD measurements
- Complementarity with LHC in general and LHCb in particular



Vertexing @high $\mathscr{L}$ - example: SuperB

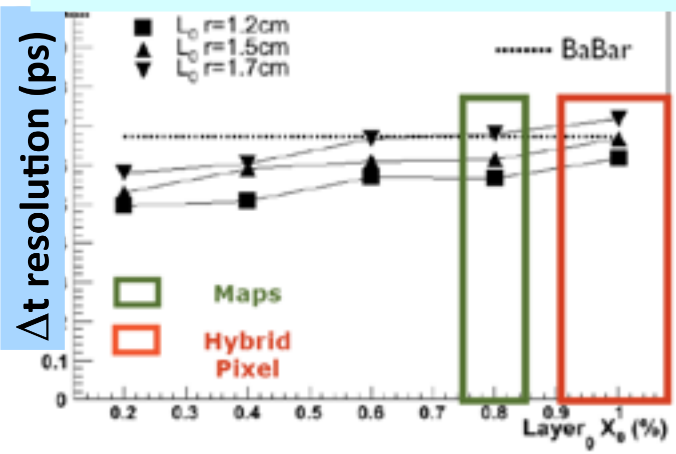
- VTX detector similar to BaBar. However:

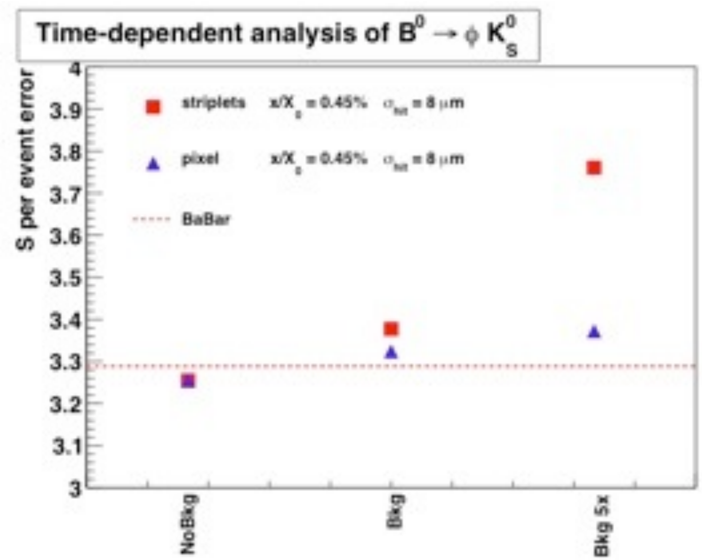


1) reduced beam energy asymmetry (7x4 GeV vs. 9x3.1 GeV) requires an <u>improved vertex resolution</u> (~factor 2)
   - Layer0 very close to IP (@1.5 cm) with low material budget (<1% X_0) and fine granularity (50 μm pitch)
   - Layer0 area 100 cm^2

2) <u>bkg levels</u> depend steeply on radius
   - Layer0 needs to be fast and rad hard hit rate 20 MHz/cm^2, TID 3 MRad/yr, eq. neutron fluence 5 x 10^{12} n/cm^2/yr
   - x5 safety factor to be inlcuded!

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

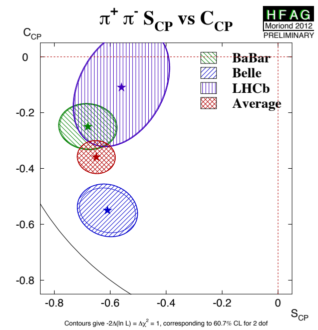


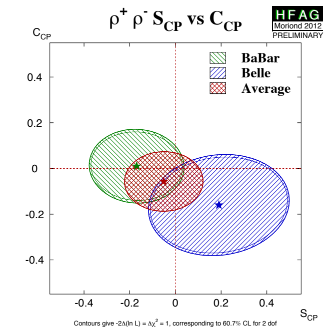


Layer0 technology can impact the per-event error on *S* by up to 12% (25% more luminosity needed to reach a given sensitivity)

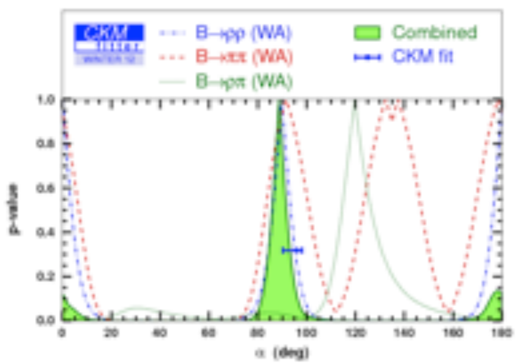
Measurement of $\alpha \equiv \arg[V_{td}V^*_{tb}/V_{ud}V^*_{ub}]$

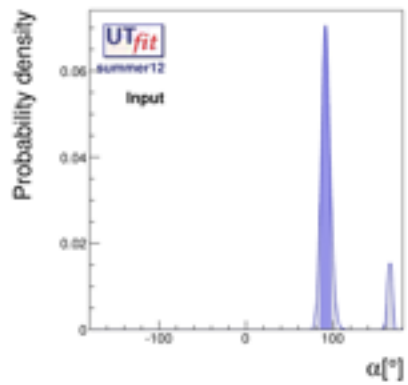
- Combined use of $B \to \pi\pi, \rho\rho, \rho\pi, a_1\pi$ decays allows constraining penguin contributions and reduce ambiguities (isospin analysis)



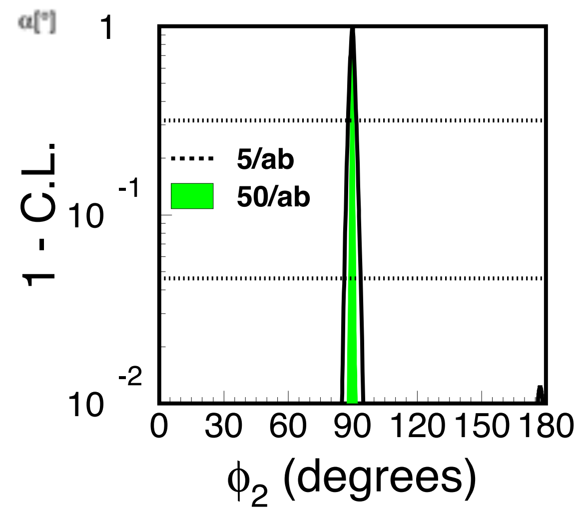


- WA combination to date:
  - $\delta\alpha \cong (5\text{-}6)^{\circ}$



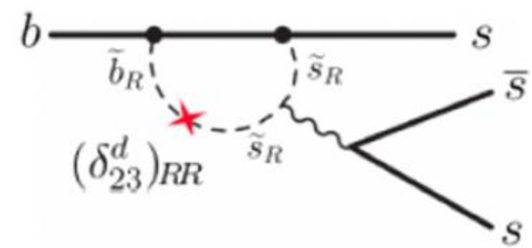


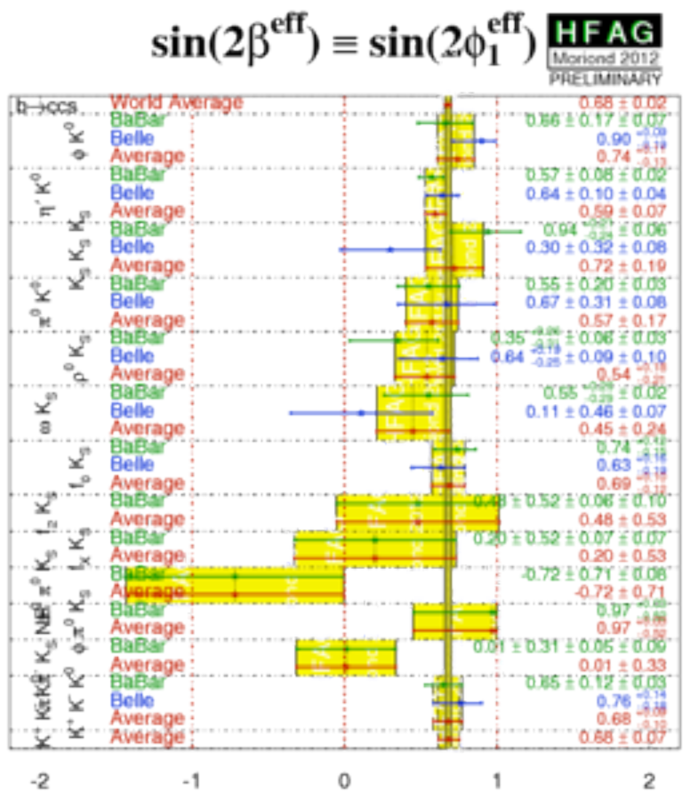
- Belle II reach with $50ab^{-1}$: $\delta\alpha \leq 1^{\circ}$
  - Similar for SuperB
- LHCb: $\delta\alpha \sim 5^{\circ}$; sLHCb: $\delta\alpha \sim 1^{\circ}$
- Theoretical error: $\delta\alpha \sim 1^{\circ}$ [SU(2) symmetry breaking]



Search for NP in s-penguin modes

- In the SM the same value for "sin2β" is expected for the *b→ccs, b→ccd, b→sss b→dds* modes, but different BSM contributions can produce different asymmetries
  - *b→sss* modes (with different degrees) show the best experimental and theoretical sensitivity





- The statistical uncertainty in many of the *b→sss* modes with 50-75 ab^{-1} will be comparable to the present precision for *B→J/ψK^0* , providing mass insertion scale sensitivity approaching 1 TeV at standard coupling
- Some of the systematics on the measurement of (S_f - $S_{J/\psi K^0}$) and (C_f - $C_{J/\psi K^0}$) are common to the charmless mode and the reference one, and will be at least reduced in the difference

Summary on α & β

Mode	Current Precision			Predicted Precision ($75\,\mathrm{ab}^{-1}$)		
	Stat.	Syst.	ΔS^f (Th.)	Stat.	Syst.	ΔS^f (Th.)
$J/\psi K_S^0$	0.022	0.010	0 ± 0.01	0.002	0.005	0 ± 0.001
$\eta' K_S^0$	0.08	0.02	0.015 ± 0.015	0.006	0.005	
$f_0 K_S^0$	0.18	0.04	0 ± 0.02	0.012	0.003	
$K_S^0 K_S^0 K_S^0$	0.19	0.03	0.02 ± 0.01	0.015	0.020	TBD
ϕK_S^0	0.26	0.03	0.03 ± 0.02	0.020	0.005	
$J/\psi \pi^0$	0.21	0.04	–	0.016	0.005	–

"SuperB Progress report- Physics"
arXiv:1008.1541v1

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Important to constrain penguin contributions in J/ψ K^0 (along with other SU(n) related channels, see R.Fleischer's talk on 29/09)

Summary on α & β

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Observable/mode	Current now	LHCb (2017)	Super$B$ (2021)	Belle II (2021)	LHCb upgrade (10 years of running)	theory now
		5 fb^{-1}	75 ab^{-1}	50 ab^{-1}	50 fb^{-1}	
α from $u\bar{u}d$	6.1°	5° [a]	1°	1°	[b]	1 – 2°
β from $c\bar{c}s$ (S)	0.8° (0.020)	0.5° (0.008)	0.1° (0.002)	0.3° (0.007)	0.2° (0.003)	clean
S from $B_d \to J/\psi \pi^0$	0.21		0.014	0.021 (est.)		clean

From: "The impact of SuperB on flavour physics"
arXiv:1109.5028 [hep-ex]

$B \to K_S \pi^0 \gamma$

- Mixing-induced CPV *in* $b \to s\gamma$ suppressed *in the SM* because the photons carry opposite polarisations if from *b* or anti-*b* decays
  - $S_{K_S\pi^0\gamma} \propto m_s/m_b \sin 2\beta \approx$ -0.02÷-0.04 (up to ±0.1 including hadr. corrections)
  - Possibly much larger, e.g. in SUSY LR-symmetric models

			$K_S^0\pi^0\gamma$ (including $K^*(892)\gamma$)		
BABAR	[314]	467M	$-0.17 \pm 0.26 \pm 0.03$	$-0.19 \pm 0.14 \pm 0.03$	0.04
Belle	[315]	535M	$-0.10 \pm 0.31 \pm 0.07$	$0.20 \pm 0.20 \pm 0.06$	0.08
Average			-0.15 ± 0.20	-0.07 ± 0.12	0.05

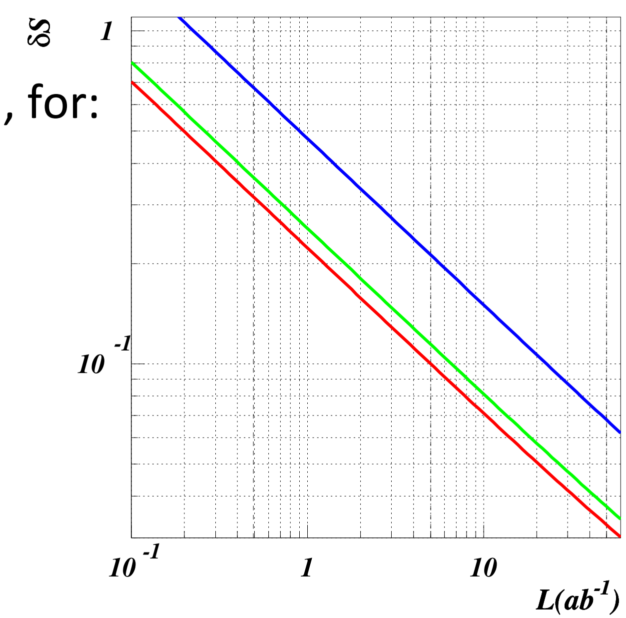
HFAG average of BABAR & Belle measurements

Belle II estimate of error on $S_{K_S\pi^0\gamma}$ vs. integrated lumi, for:

$B \to K_S\pi^0\gamma$ (all modes)

$B \to K^*\gamma$ only

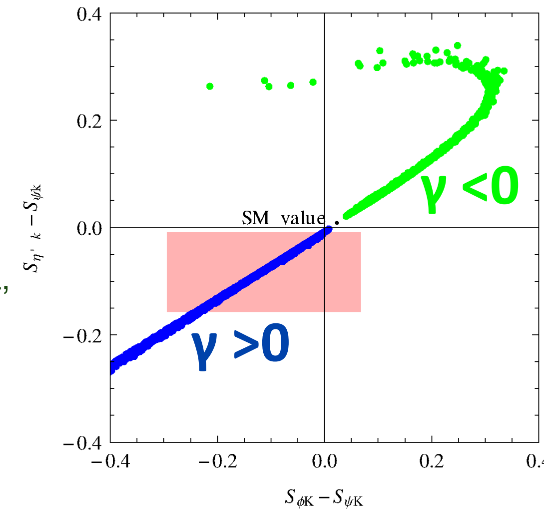
$B \to K_S\pi^0\gamma$ (all but $B \to K^*\gamma$)



Correlations Among Observables

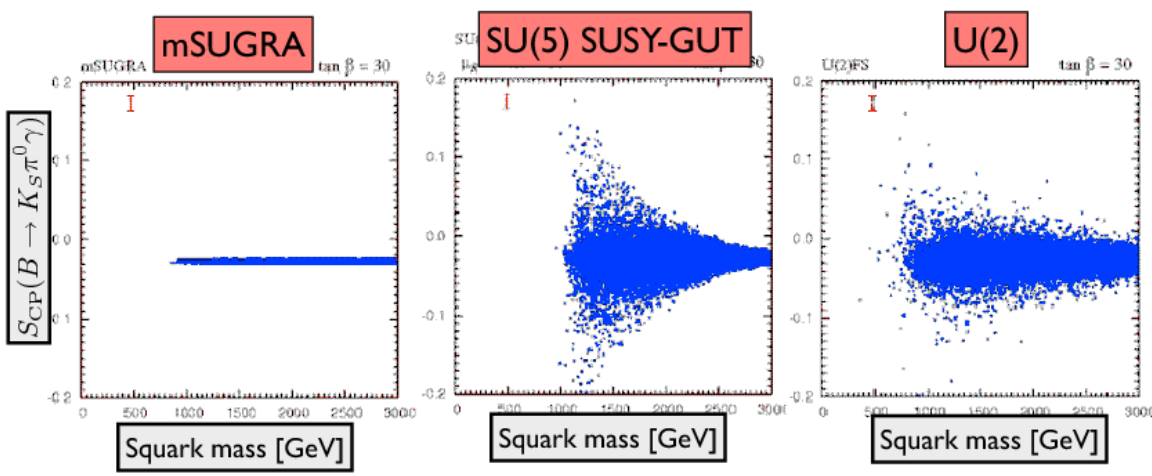
- Very powerful tool to challenge NP models against experimental data
- Example 1: ($S_{\phi K_S}$-$S_{\psi K_S}$) *vs.* ($S_{\eta' K_S}$-$S_{\psi K_S}$) in a U(2)^3 model (weakly coupled 3rd generation, consistent with other exptl data e.g. on ε_K, Δm)

Barbieri, Campli, Isidori, Sala, Straub 1108.5125 [hep-ph]



- Example 2: $S_{K_S\pi^0\gamma}$ vs. squark mass in different models

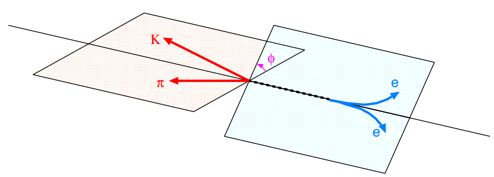
Goto, Okada, Shindou, Tanaka, 0711.2935 [hep-ph]

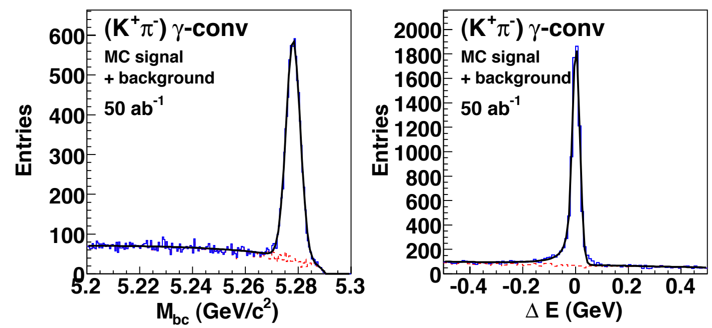


More Ideas with BIG Samples

A.G. Akeroyd at al.
arXiv:1002.5012 [hep-ex]

- Measure the photon polarization in $B \to K_S \pi^0 \gamma$ using $\gamma \to e^+e^-$ conversions in the detector material
- The distribution of the angle φ (plane of e^+e^- pair WRT K^* plane) depends on the polarization amplitudes A_L and A_R: $1 + \xi(E_e, q^2)\frac{|A_R||A_L|}{|A_R|^2 + |A_L|^2}[\cos(2\phi + \delta)]$
- ξ~0.1 an efficiency factor, conversion efficiency ~3%





- Belle II sensitivity study: analysis efficiency with the current Belle tracking code (unable to measure the e^+e^- opening angle but only the vertex position) is ~0.36%
  - 2σ effect with 50ab^{-1} in the case of maximal RH currents
  - it should be possible to optimize the code to allow the opening angle measurement and increase the efficiency ➜ 4σ effect

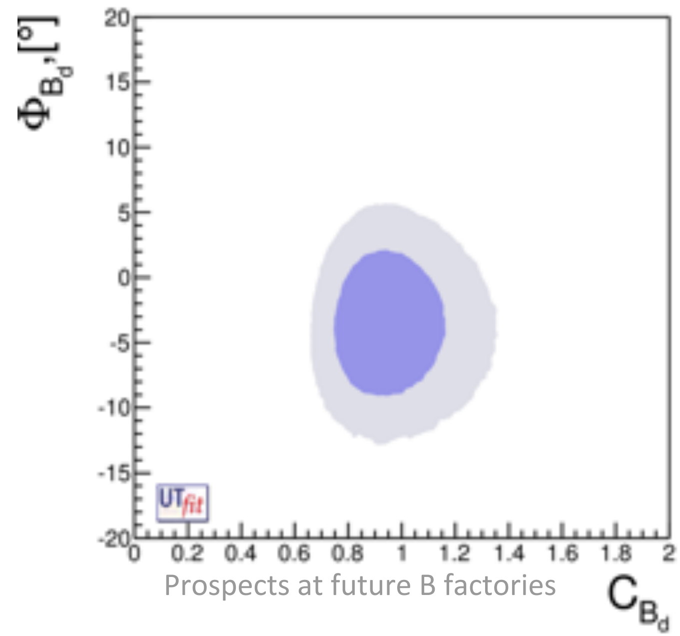
CP Violation in Mixing

- Single best *published* measurement in dilepton events (BABAR, PRL96 (2006), 251802, 211fb^{-1})

$$A_{T/CP} = \frac{P(\overline{B}^0 \to B^0) - P(B^0 \to \overline{B}^0)}{P(\overline{B}^0 \to B^0) + P(B^0 \to \overline{B}^0)} = \frac{N^{++} - N^{--}}{N^{++} + N^{--}} = \frac{1 - |q/p|^4}{1 + |q/p|^4}.$$

$$|q/p| - 1 = (-0.8 \pm 2.7(\text{stat.}) \pm 1.9(\text{syst.})) \times 10^{-3},$$

- Relevant in NP searches. BSM contributions parameterized as NP amplitude +phase
  - compatible with SM with current experimental errors; very important to improve precision



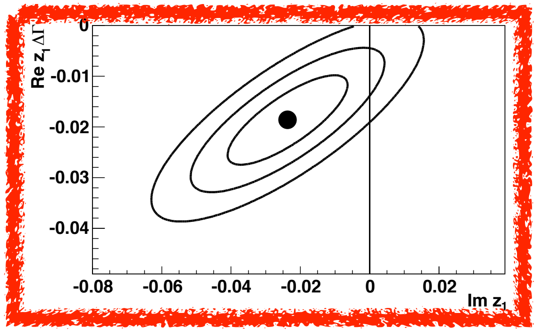
CPT Violation in B→dileptons

- Single best measurement in dilepton events (BABAR, PRL96 (2006), 251802, 211fb^{-1})

$$A_{CPT/CP}(|\Delta t|) = \frac{P(B^0 \to B^0) - P(\overline{B}^0 \to \overline{B}^0)}{P(B^0 \to B^0) + P(\overline{B}^0 \to \overline{B}^0)} = \frac{N^{+-}(\Delta t > 0) - N^{+-}(\Delta t < 0)}{N^{+-}(\Delta t > 0) + N^{+-}(\Delta t < 0)}$$

$$\begin{aligned} \mathrm{Im}\, z &= (-13.9 \pm 7.3(\mathrm{stat.}) \pm 3.2(\mathrm{syst.})) \times 10^{-3}, \\ \Delta\Gamma \times \mathrm{Re}\, z &= (-7.1 \pm 3.9(\mathrm{stat.}) \pm 2.0(\mathrm{syst.})) \times 10^{-3}\,\mathrm{ps}^{-1}. \end{aligned}$$

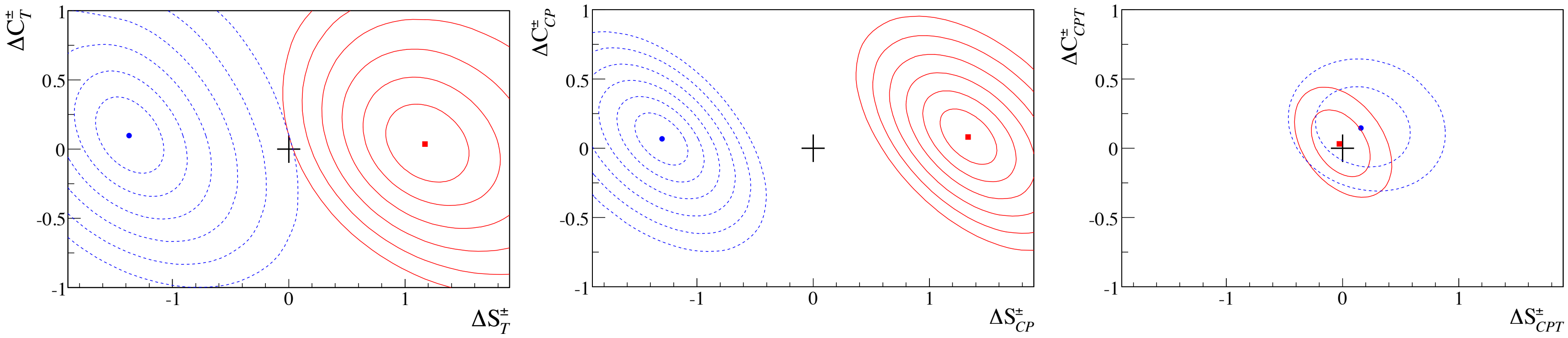
- Same data are binned to study sidereal time dependence of z (PRL100, 131802 (2008))
  - z=z0+z1cos(Ωt+φ) with Ω=2π/sidereal day
  - significance for z1≠0 (CPT and Lorentz violation) is 2.8σ



- Main systematics:
  - detector charge asymmetry (A_{CP}); PDF modeling, vertex detector alignment (A_{CPT})
- Important to improve precision tests of CPT and Lorentz invariance conservation with 50-75ab^{-1} at the future B factories

(CP)(T) Violation in $J/\psi K^0$ decays

see R. Cowan's talk in this session

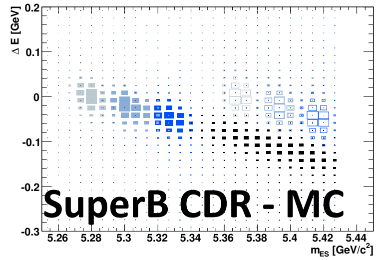


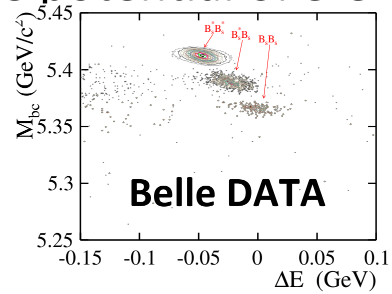
- A simultaneous test of CP, T and CPT violation without a-priori assumptions
- We can test CPT invariance in the B system with unprecedented precision at the super B factories
  - Systematic uncertainties will dominate
  - fortunately, a few are data-driven...

Systematic source	ΔS^+_{CPT}	ΔS^-_{CPT}	ΔC^+_{CPT}	ΔC^-_{CPT}
Interaction region	0.015	0.024	0.023	0.026
Flavor misID probabilities	0.018	0.008	0.009	0.009
Δt resolution	0.062	0.033	0.051	0.072
$J/\psi K^0_L$ background	0.046	0.021	0.029	0.015
Background fractions and *CP* content	0.024	0.020	0.024	0.016
$m_{\rm ES}$ parameterization	0.011	0.002	0.005	0.002
Γ_d and Δm_d	0.004	0.001	0.002	0.003
CP violation for flavor ID categories	0.026	0.010	0.007	0.005
Fit bias	0.018	0.026	0.007	0.021
$\Delta\Gamma_d/\Gamma_d$	0.003	0.002	0.002	0.001
PDF normalization	0.019	0.015	0.007	0.004
Total	0.092	0.058	0.067	0.083

B_s Physics at the Υ(5S)

- Cannot resolve the rapid B_s oscillation frequency
- However, CLEO and Belle have demonstrated the potential of e^+e^- machines at the Υ(5S)





see S. Esen's talk in previous session

- Expected precision from MC studies at the Υ(5S).

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}
$A^s_{\rm SL}$	0.006	0.004
$A_{\rm CH}$	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°

- In general not competitive with hadronic experiments, with some exceptions
  - A^s_{SL} , A_{CH}
  - $B_s \to \gamma\gamma$, $B_s \to K^0K^0$
  - Absolute measurement of branching fractions can be of use to LHCb

Conclusions

- Signals of New Physics can be observed at the energy frontier LHC experiments
- A variety of measurements with high sensitivity to New Physics will be needed to relate such signals to particular NP models
- The future SuperB and SuperKEKB flavour factories have the experimental sensitivity to perform high precision measurements and will play a key role in deciphering the code of NP, in a complementary way with other existing and planned facilities