The SuperB Physics Case

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- Introduction
- Indirect searches for NP
- SuperB physics goals
- Conclusions

INTRODUCTION

- Main physics goals for the next ten years:
  - Identify the mechanism of EW and flavour symmetry breaking
  - Identify NP that stabilizes EW scale
  - Identify Dark Matter (candidates)
  - Write down the NP Lagrangian and determine its parameters

DIRECT SEARCHES

- The TeVatron and (mainly) LHC will cover direct searches of new particles up to the TeV scale
- In the next five years, we might have NP signals and info on a few combinations of new particle masses (depending on decay chains, mass spectrum, etc.)
- We might have indications of (WIMP) DM

DIRECT SEARCHES II

- Naturalness requires new degrees of freedom to stabilize the EW scale, mainly by canceling loop contributions of 3rd family
- Limits on new coloured particles and Higgs imply %-‰ fine-tuning in simplified models
- Expect hierarchical spectrums with only a few light particles or more fine-tuned spectrums close to (or above) the TeV

BEYOND DIRECT SEARCHES

- How to go from
    - (possible) direct detection of a few new particles
    - (possible) direct detection of DM (candidate)
    - (possible) direct detection of the Higgs or whatever else unitarizes WW scattering

to the NP Lagrangian?

- Need to complete the spectrum and to determine couplings, just as in the SM

NP SEEN FROM BELOW

- At energies « M_W, physics is described by an effective Lagrangian:

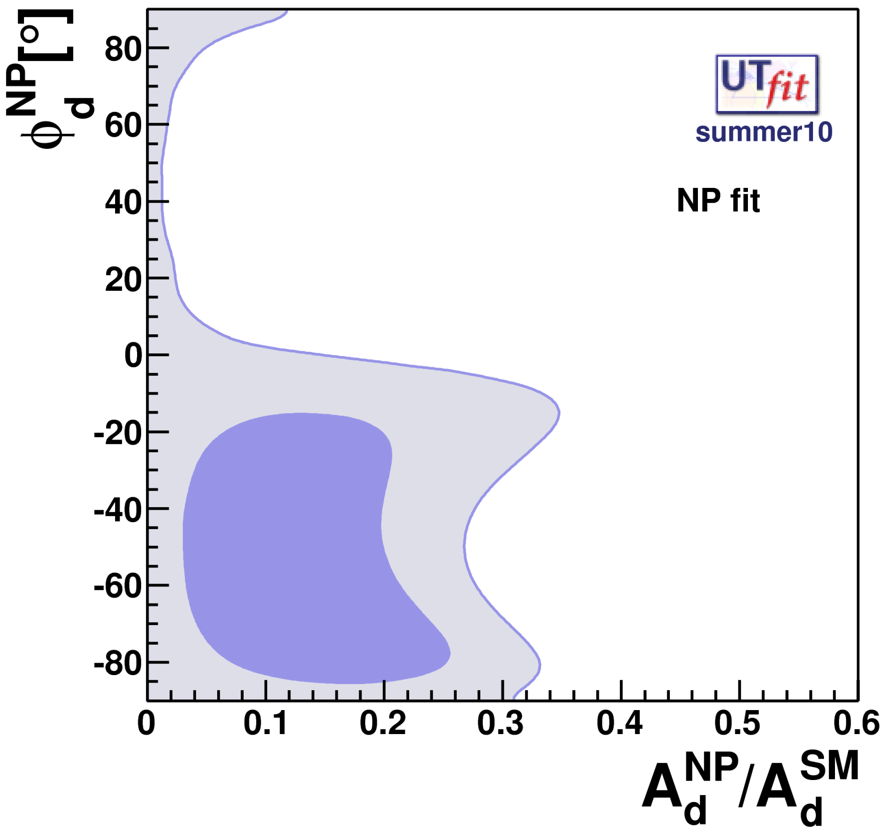
$$\mathcal{L}_{\rm eff} = \overbrace{\mathcal{L}^{\rm n_f=5}_{\rm QCD} + \mathcal{L}^{\rm n_f=5}_{\rm QED} + \mathcal{L}^{\rm n_f=5}_{\rm mass}}^{\text{Accidental symm. (no FCNC, no CPV)}} + \overbrace{\mathcal{L}^{\rm SM}_{D=6}(V_{\rm CKM}, U_{\rm PMNS})}^{\text{Violates accidental sym.}} + \underbrace{\mathcal{L}^{\rm NP}_{D=6}(M_{\rm NP}, V_{\rm CKM}, U_{\rm PMNS})}_{\text{Generated by any NP relevant to the hierarchy problem (even if MFV)}} + \underbrace{\mathcal{L}^{\rm NP}_{D=6}(M_{\rm NP}, V_{\rm NP}, U_{\rm NP})}_{\text{Generated by non-MFV NP}} + \dots$$

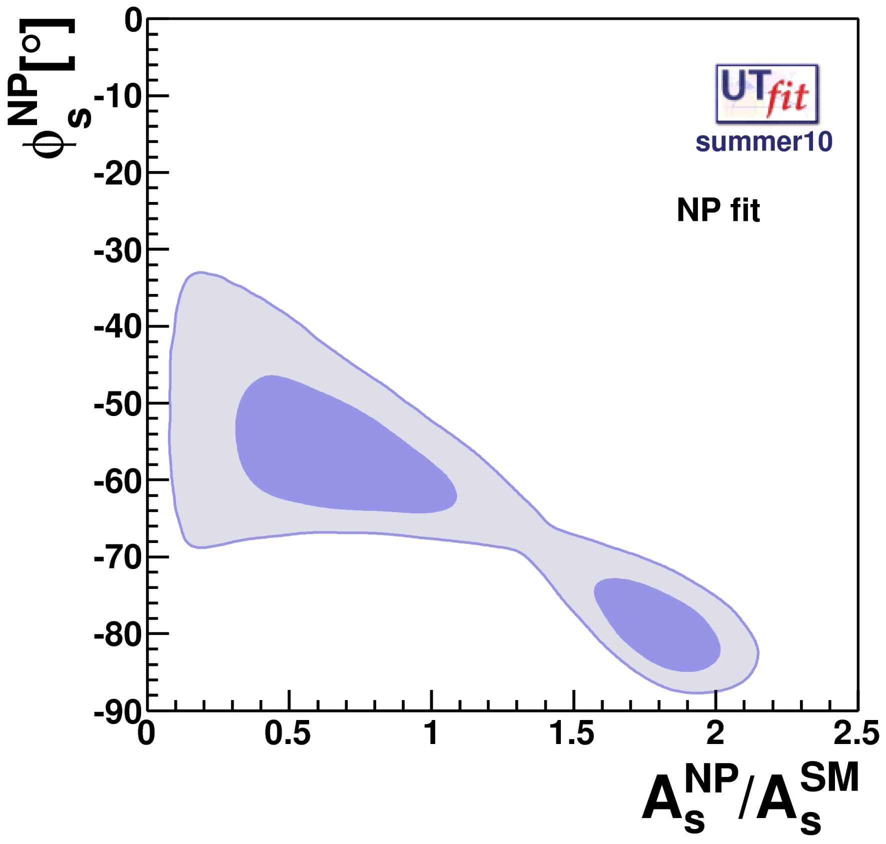
- For any FCNC or CPV process, one has in general

$$\begin{aligned}\mathcal{H}_{\rm eff} &= \frac{\alpha_W}{M_W^2} K_{\rm SM} \left\{ \left(f\left(\frac{m_t^2}{m_W^2}\right) + \frac{m_W^2}{m_{\rm NP}^2} f'\left(\frac{m_{t'}^2}{m_{\rm NP}^2}\right)\right) Q_{\rm SM} + \frac{m_W^2}{m_{\rm NP}^2} f''\left(\frac{m_{t'}^2}{m_{\rm NP}^2}\right) Q_{\rm NP} \right\} \\ &+ \frac{\alpha_s}{M_{\rm NP}^2} K_{\rm NP} f_{\rm NP} Q_{\rm NP} + \frac{\alpha_{\rm NP}}{M_{\rm NP}^2} K_{\rm NP} f'_{\rm NP} Q_{\rm NP}\end{aligned}$$

- To extract M_{NP} and/or K_{NP} need to:
  - Measure the relevant process
  - Extract H_{eff} from the measurement
    - Matrix elements: Lattice QCD, HQE
  - Subtract the SM contribution
    - CKM in the presence of NP, top mass

- What are the requirements to probe NP within the LHC reach ($M_{NP} \lesssim 1$ TeV) ?
  - Consider the worst-case scenario: CMFV (no new flavour violation, no parametric enhancement)
  - Present sensitivity on CMFV from UTfit is around 300 GeV, with present exp & theory errors
- Need a factor of three in mass:
  - One order of magnitude in the Wilson coefficient
  - Theory uncertainties at the percent
  - Two orders of magnitude more statistics in experimental measurements
- Need a Super Flavour Factory





Of course, things might be much more interesting than CMFV… (see also MEG…)

SuperB/Flavour physics goals

- Being able to determine the flavour structure of whatever NP seen at the LHC
- Being able to derive info on the full spectrum of NP if LHC only sees part of it
- Being able to cover indirectly the region of NP masses just above the LHC reach, pushing the indirect bound on Λ as high as possible

How do we get there - I

- A few % error on CKM parameters in the generalized UTA;
- Determining NP contributions to $\Delta F=2$ and $\Delta F=1$ transitions in all sectors (K, B_d, B_s, D) at the few percent level;
- Improving Lepton Flavour Violation and Lepton Universality bounds by more than one order of magnitude

How do we get there - II

- CKM parameters in the presence of loop-mediated NP: $V_{cb,ub}^{incl,excl}$, $\gamma(B \rightarrow DK)$
- NP contributions to $\Delta F=2$ amplitudes: $\beta(b \rightarrow ccs)$, $\beta_s(b \rightarrow ccs)$, $D^0 \rightarrow KK, K\pi, K\pi\pi$, $A_{SL}^{d,s}$, $(\Delta\Gamma/\Gamma)_{d,s}$

How do we get there - III

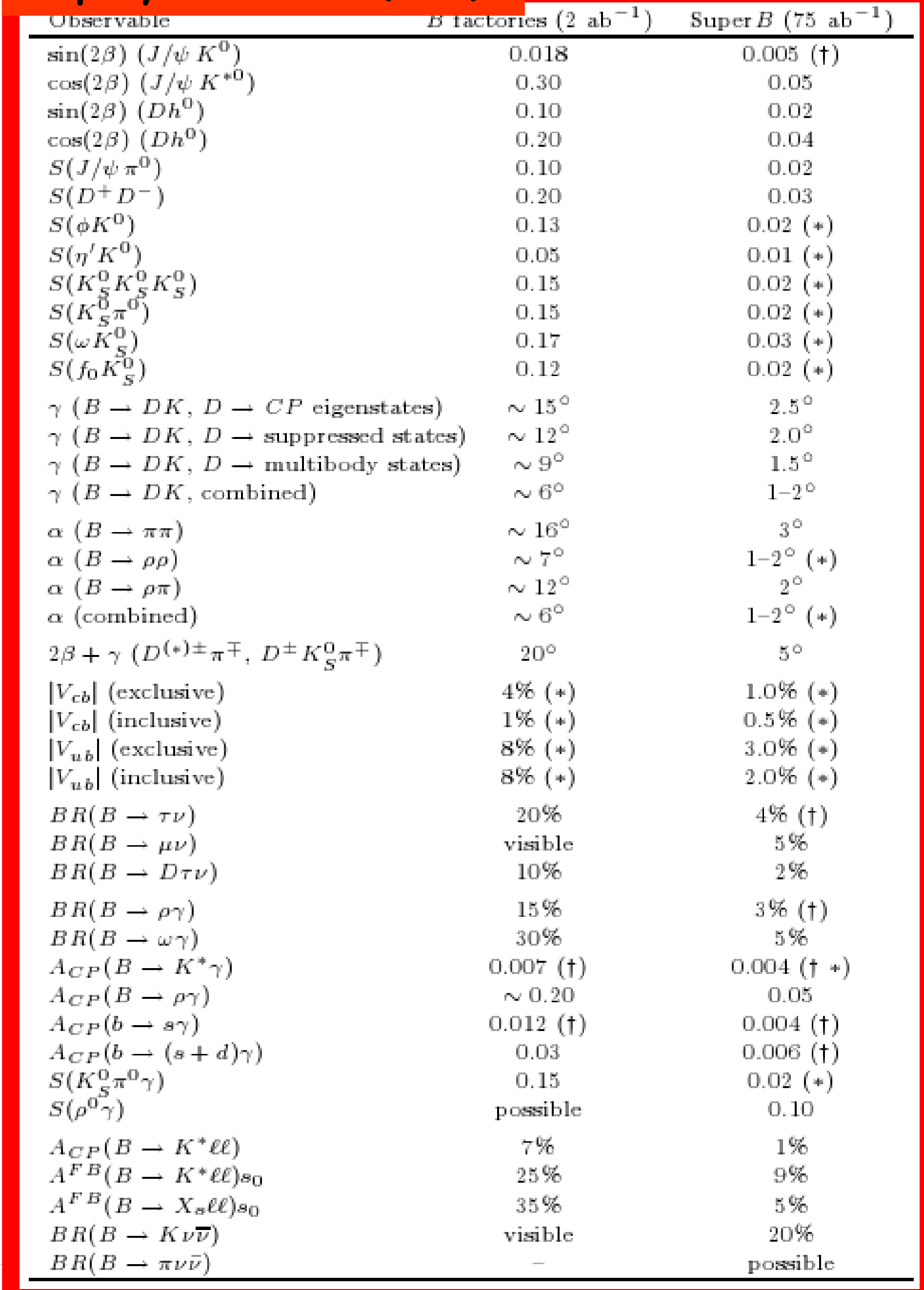
- NP contributions to $\Delta F=1$ amplitudes:
  - $b\to s$: $\beta(B\to K_S\phi, K_S K_S K_S, \ldots)$, $\beta_s(B_s\to\phi\phi)$, $B_s\to K^{*0}K^{*0}$ (penguins), $B\to K^{(*)}\pi$ (penguins & ewp), $B\to K\nu\nu$ (ewp), $B\to X_s\gamma$ $(B\to K^*\gamma)$ (BR&ACP) (photon peng), $B\to X_s ll$ $(B\to K^{(*)}\mu\mu)$ (BR&AFB) (photon & ewp), $\beta(B\to K_s\pi^0\gamma)$, $\beta_s(B_s\to\phi\gamma)$ (RH ops), $B_s\to\mu\mu$ (scalar peng)
  - $b\to d$: $\alpha(B\to\pi\pi,\rho\pi,\rho\rho)$ (ewp), $B\to X_d\gamma$ (BR&ACP) (photon peng), $B\to X_d ll$ (BR&AFB) (photon & ewp), $S(B\to\rho^0\gamma)$ (RH ops)
  - $s\to d$: $K_L\to\pi^0\nu\nu$, $K^+\to\pi^+\nu\nu$ (ewp), $K_L\to\pi^0 ll$ (photon & ewp)

How do we get there - IV

- LFV: τ→μγ, τ→eγ, μ→eγ (photon peng), τ→μll, τ→ell, μ→eee, μ↔e (photon, ewp & boxes), τ→μη, τ→eη (photon, ewp, boxes & Higgs)
- Lepton Universality: K→eν/K→μν, B→τν/B→μν (Higgs)
- Charged current scalar interactions: B→τν (Higgs)

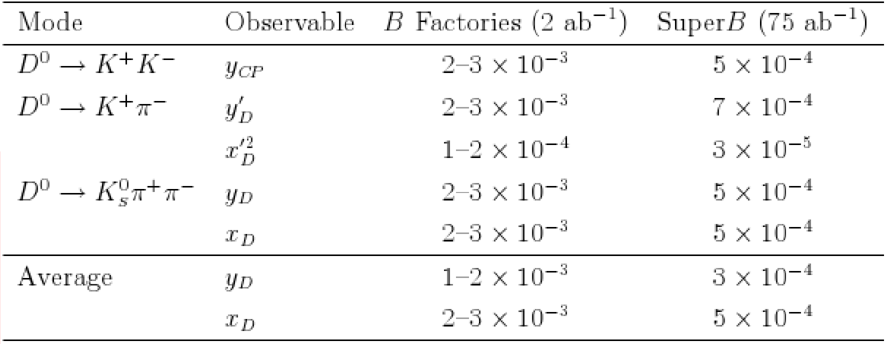
SuperB flavour reach...

B physics @$\Upsilon(4S)$

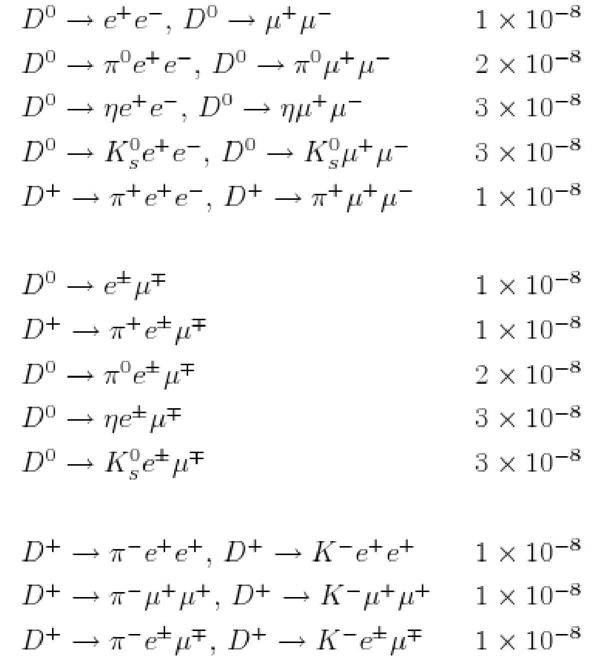


Observable	B factories (2 ab^{-1})	Super$B$ (75 ab^{-1})
$\sin(2\beta)$ $(J/\psi\, K^0)$	0.018	0.005 (†)
$\cos(2\beta)$ $(J/\psi\, K^{*0})$	0.30	0.05
$\sin(2\beta)$ (Dh^0)	0.10	0.02
$\cos(2\beta)$ (Dh^0)	0.20	0.04
$S(J/\psi\, \pi^0)$	0.10	0.02
$S(D^+D^-)$	0.20	0.03
$S(\phi K^0)$	0.13	0.02 (∗)
$S(\eta' K^0)$	0.05	0.01 (∗)
$S(K^0_S K^0_S K^0_S)$	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 (∗)
γ $(B \to DK,\ D \to CP$ eigenstates)	$\sim 15^\circ$	2.5°
γ $(B \to DK,\ D \to$ suppressed states)	$\sim 12^\circ$	2.0°
γ $(B \to DK,\ D \to$ multibody states)	$\sim 9^\circ$	1.5°
γ $(B \to DK$, combined)	$\sim 6^\circ$	1–2°
α $(B \to \pi\pi)$	$\sim 16^\circ$	3°
α $(B \to \rho\rho)$	$\sim 7^\circ$	1–2° (∗)
α $(B \to \rho\pi)$	$\sim 12^\circ$	2°
α (combined)	$\sim 6^\circ$	1–2° (∗)
$2\beta + \gamma$ $(D^{(*)\pm}\pi^\mp,\ D^\pm K^0_S \pi^\mp)$	20°	5°
$\lvert V_{cb}\rvert$ (exclusive)	4% (∗)	1.0% (∗)
$\lvert V_{cb}\rvert$ (inclusive)	1% (∗)	0.5% (∗)
$\lvert V_{ub}\rvert$ (exclusive)	8% (∗)	3.0% (∗)
$\lvert V_{ub}\rvert$ (inclusive)	8% (∗)	2.0% (∗)
$BR(B \to \tau\nu)$	20%	4% (†)
$BR(B \to \mu\nu)$	visible	5%
$BR(B \to D\tau\nu)$	10%	2%
$BR(B \to \rho\gamma)$	15%	3% (†)
$BR(B \to \omega\gamma)$	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%
$BR(B \to K\nu\overline{\nu})$	visible	20%
$BR(B \to \pi\nu\bar{\nu})$	–	possible

Charm physics

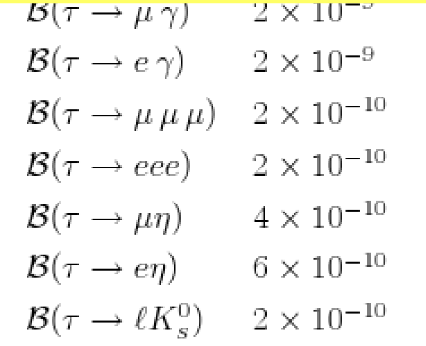


Mode	Observable	B Factories (2 ab^{-1})	Super$B$ (75 ab^{-1})
$D^0 \to K^+K^-$	y_{CP}	2–3×10^{-3}	5×10^{-4}
$D^0 \to K^+\pi^-$	y'_D	2–3×10^{-3}	7×10^{-4}
	x'^2_D	1–2×10^{-4}	3×10^{-5}
$D^0 \to K^0_S\pi^+\pi^-$	y_D	2–3×10^{-3}	5×10^{-4}
	x_D	2–3×10^{-3}	5×10^{-4}
Average	y_D	1–2×10^{-3}	3×10^{-4}
	x_D	2–3×10^{-3}	5×10^{-4}



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

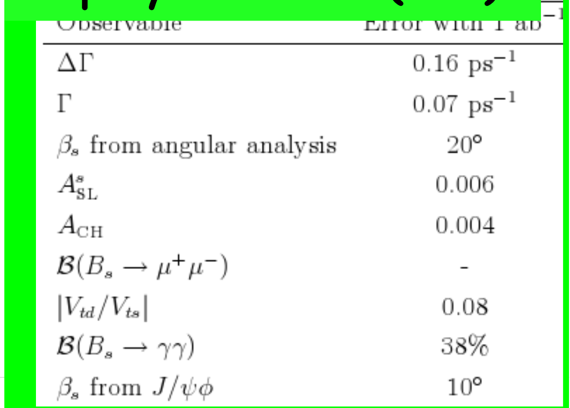
τ physics



$\mathcal{B}(\tau \to \mu\,\gamma)$	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}
$\mathcal{B}(\tau \to \ell K^0_s)$	2×10^{-10}

+ τ FC physics (CPV, ...)

B physics @$\Upsilon(5S)$



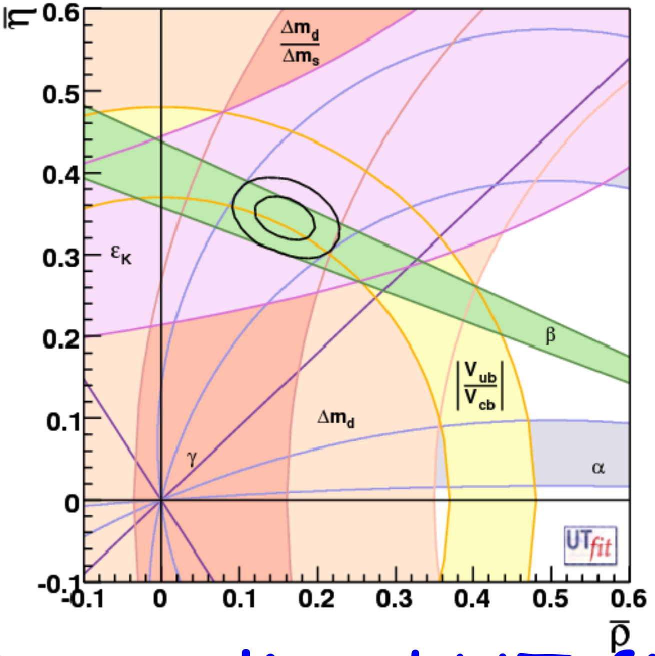
Observable	Error with 1 ab^{-1}
$\Delta\Gamma$	$0.16\ \mathrm{ps}^{-1}$
Γ	$0.07\ \mathrm{ps}^{-1}$
β_s from angular analysis	$20°$
A^s_{SL}	0.006
A_{CH}	0.004
$\mathcal{B}(B_s \to \mu^+\mu^-)$	-
$\lvert V_{td}/V_{ts}\rvert$	0.08
$\mathcal{B}(B_s \to \gamma\gamma)$	38%
β_s from $J/\psi\phi$	$10°$

...and required theoretical efforts

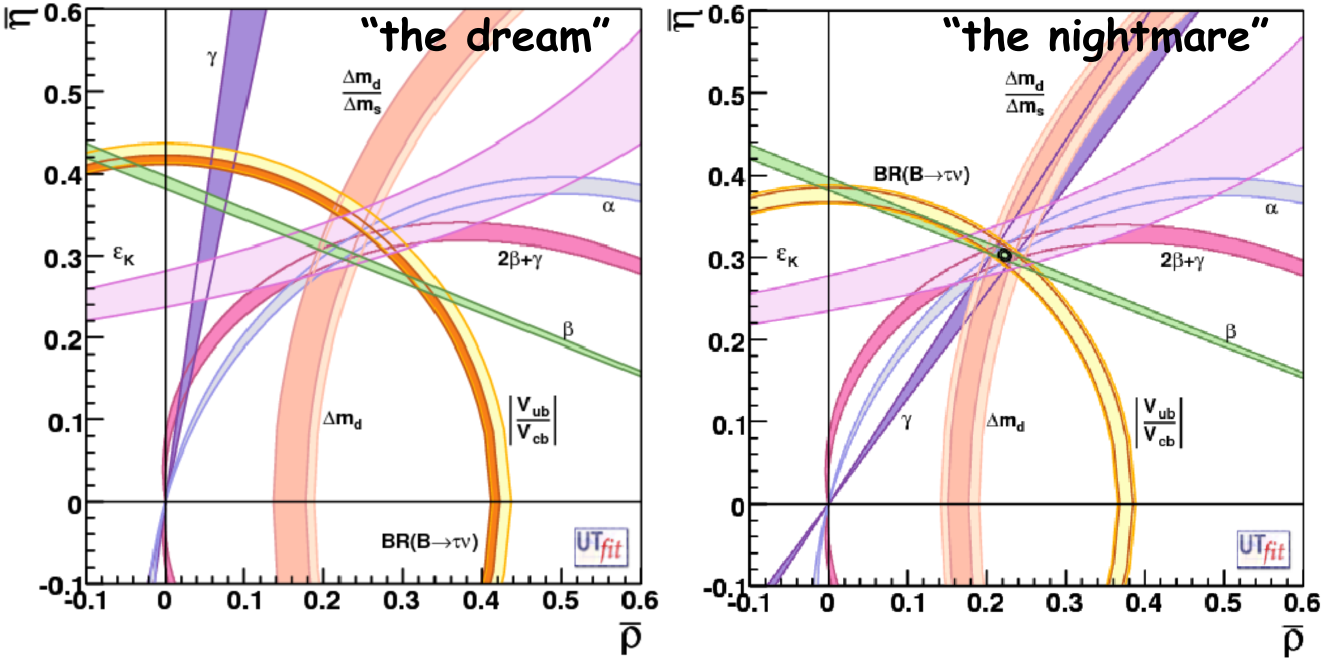
no theory improvements needed	$\beta(J/\psi\ K)$, $\gamma(DK)$, α, lepton FV & UV, CPV in $B \to X\gamma$, D and τ decays, zero of FB asymmetry $B \to X_s l^+ l^-$	SM already known with the required accuracy
improved lattice QCD	meson mixing , $B \to D(*) l\nu$, $B \to \pi(\rho) l\nu$, $B \to K^*\gamma$, $B \to \rho\gamma$, $B \to l\nu$, $B_s \to \mu\mu$	target error: ~1-2% Feasible (see SuperB CDR)
improved OPE+HQE	$B \to X_{u,c} l\nu$	target error: ~2-3% Feasible getting exp. rid of annihilation & shape function (see arXiv:0810.1312)
improved QCDF or SCET or flavour symmetries or data driven methods	S's from TD A_{CP} in b -> s transitions	target error: ~2-3% need either breakthrough in computing power corrections or data-driven approaches (Dalitz analyses particularly favourable)

The basic step: CKM matrix at the %

Today



With a SuperB



Generalized UT fits:

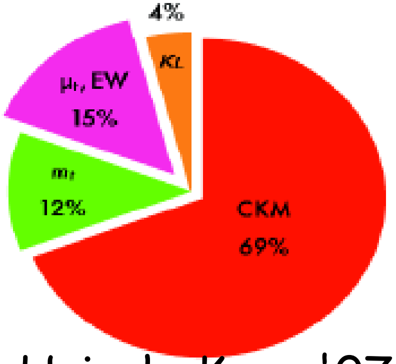
CKM at % in the presence of NP!

	today	SuperB
$\bar\rho$	0.177±0.044	±0.005
$\bar\eta$	0.360±0.031	±0.005

Will detect deviations from the SM at the level of 3% in C_{Bd} and of 0.5° in ϕ_{Bd}

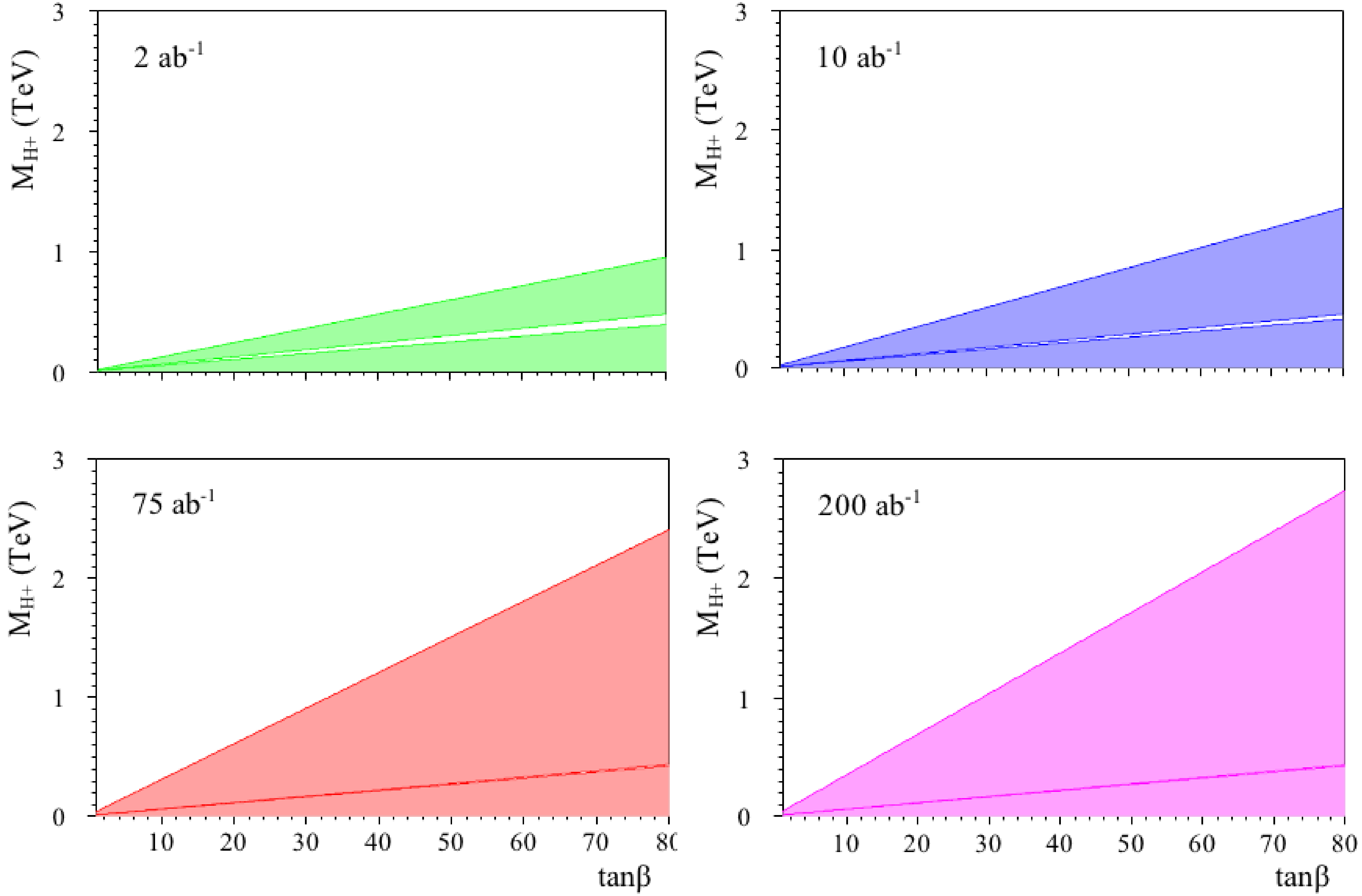
$K_L \to \pi^0 \nu \bar\nu$

error budget



U. Haisch, Kaon '07

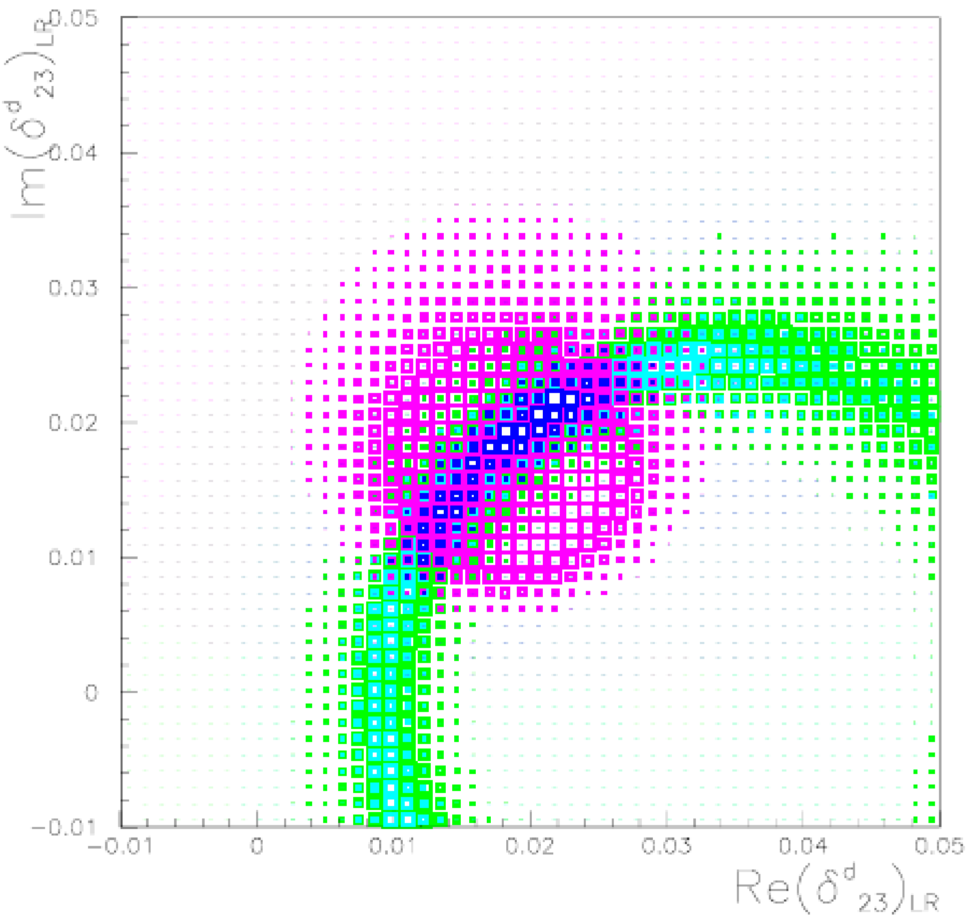
Constraints on 2HDMII from B→lν

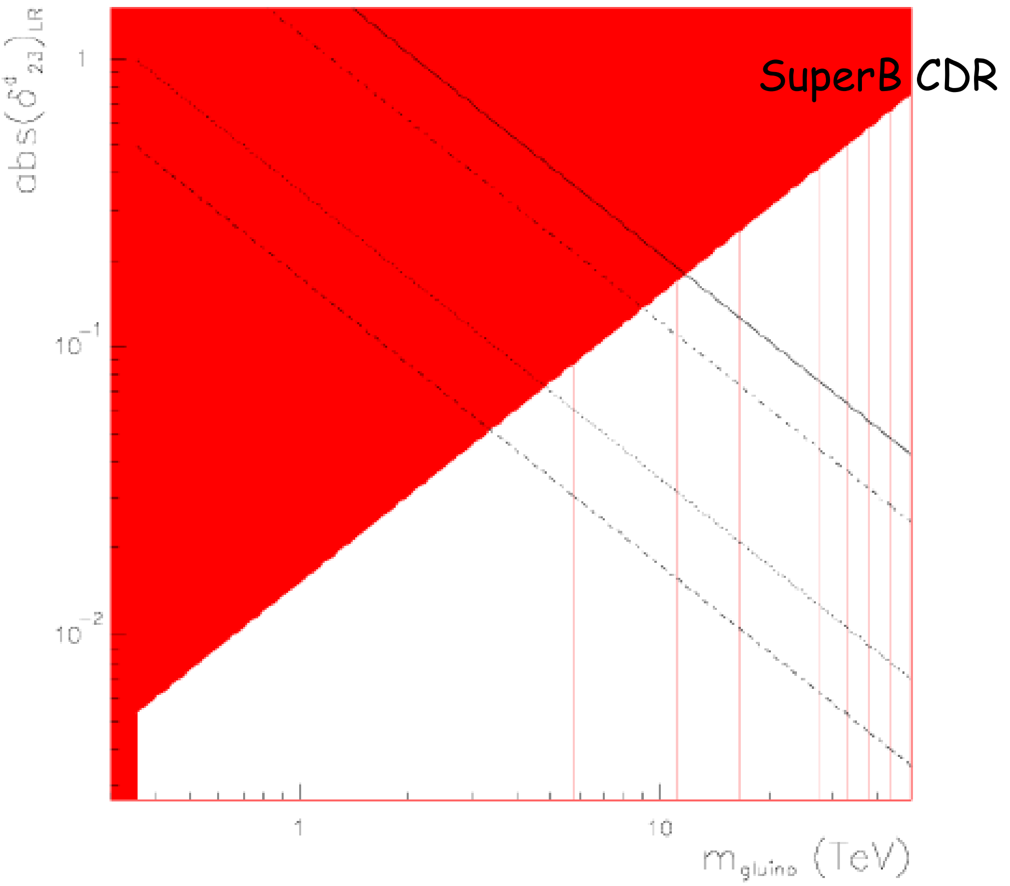


Reconstructing L_{SUSY}

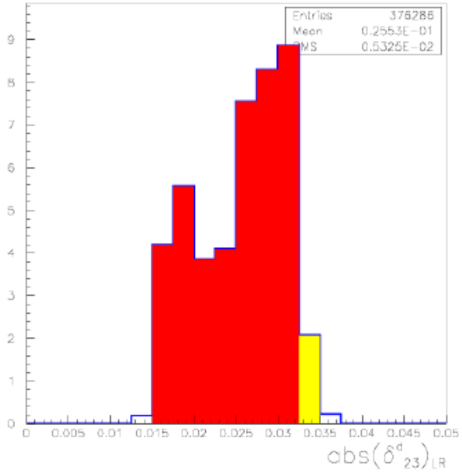
$$m^2_{\tilde{d}} = \begin{pmatrix} (m^2_{11})_{LL} & (\Delta^d_{12})_{LL} & (\Delta^d_{13})_{LL} & (\Delta^d_{11})_{LR} & (\Delta^d_{12})_{LR} & (\Delta^d_{13})_{LR} \\ (\Delta^d_{12})^*_{LL} & (m^2_{22})_{LL} & (\Delta^d_{23})_{LL} & (\Delta^d_{21})_{LR} & (\Delta^d_{22})_{LR} & (\Delta^d_{23})_{LR} \\ (\Delta^d_{13})^*_{LL} & (\Delta^d_{23})^*_{LL} & (m^2_{33})_{LL} & (\Delta^d_{31})_{LR} & (\Delta^d_{32})_{LR} & (\Delta^d_{33})_{LR} \\ (\Delta^d_{11})^*_{LR} & (\Delta^d_{21})^*_{LR} & (\Delta^d_{31})^*_{LR} & (m^2_{11})_{RR} & (\Delta^d_{12})_{RR} & (\Delta^d_{13})_{RR} \\ (\Delta^d_{12})^*_{LR} & (\Delta^d_{22})^*_{LR} & (\Delta^d_{32})^*_{LR} & (\Delta^d_{12})^*_{RR} & (m^2_{22})_{RR} & (\Delta^d_{23})_{RR} \\ (\Delta^d_{13})^*_{LR} & (\Delta^d_{23})^*_{LR} & (\Delta^d_{33})^*_{LR} & (\Delta^d_{13})^*_{RR} & (\Delta^d_{23})^*_{RR} & (m^2_{33})_{RR} \end{pmatrix}$$

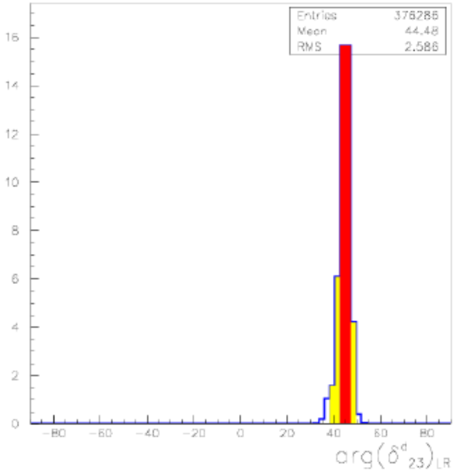
(Some of the) Diagonal sfermion masses will be measured @ LHC; off-diagonal terms to be determined from flavour (relevant parameters: $(\delta^d_{ij})_{AB} = (\Delta^d_{ij})_{AB}/(m_{ii})_{AA}(m_{jj})_{BB}$)





Reconstructing $(\delta^d_{23})_{LR}=0.028\ e^{i\pi/4}$ for m_{SUSY}=1TeV





Lepton Flavour Violation

- For slepton masses in the LHC range LFV becomes extremely interesting!
- In SUSY-GUTs:
  - can identify the neutrino Yukawa flavour structure (CKM or PMNS) by studying μ & τ;
  - interesting correlations with $b\to s$ transitions
- Interesting correlations also in MFV case:

$B(\tau\to\mu\gamma):B(\tau\to e\gamma):B(\mu\to e\gamma) \sim \lambda^{-6}:\lambda^{-4}:1 \sim 10^4:500:1$ ← **LFV from CKM**

$B(\tau\to\mu\gamma):B(\tau\to e\gamma):B(\mu\to e\gamma) \sim [500-10]:1:1$ ← **LFV from PMNS**

Isidori, 4th SuperB workshop

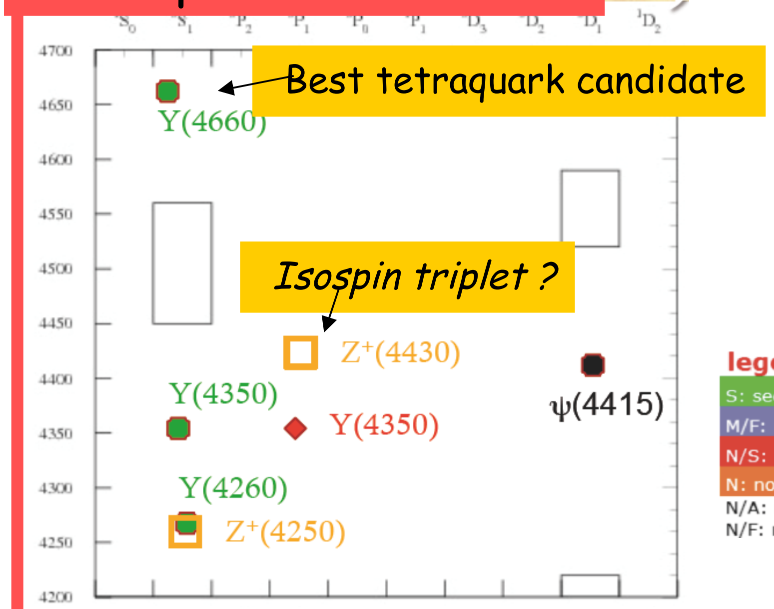
Spectroscopy + other physics

R. Faccini et al.

Building a new spectroscopy – strong interplay experiment-theory

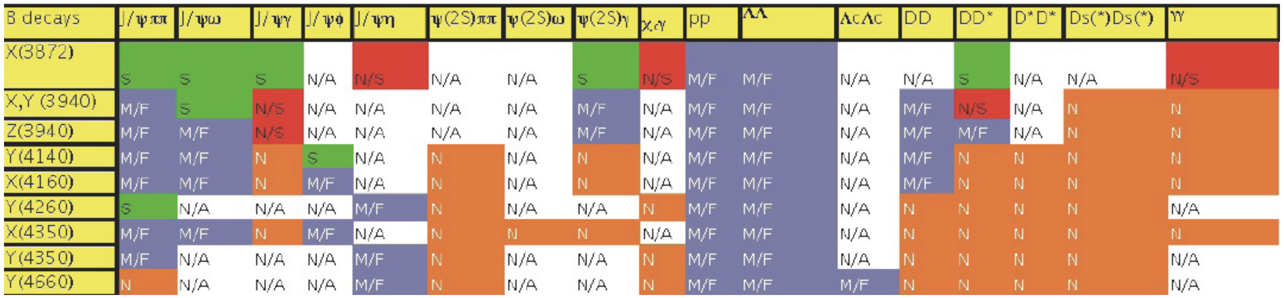
Light mesons, charmonomium,
bottonomium

Example : charmonium



Best tetraquark candidate

Isospin triplet ?

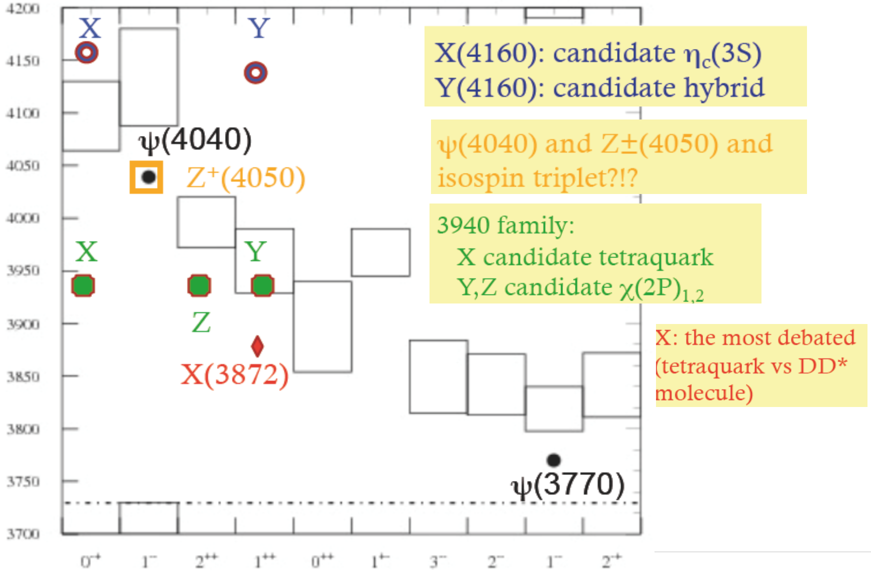


B decays	J/ψππ	J/ψω	J/ψγ	J/ψφ	J/ψη	ψ(2S)ππ	ψ(2S)ω	ψ(2S)γ	χcγ	pp	ΛΛ	ΛcΛc	DD	DD*	D*D*	Ds(*)Ds(*)	γγ
X(3872)	S	S	S	N/A	N/S	N/A	N/A	S	N/S	M/F	M/F	N/A	N/A	S	N/A	N/A	N/S
X,Y (3940)	M/F	S	N/S	N/A	N/A	N/A	N/A	M/F	N/A	M/F	M/F	N/A	M/F	N/S	N/A	N	N
Z(3940)	M/F	M/F	N/S	N/A	N/A	N/A	N/A	M/F	N/A	M/F	M/F	N/A	M/F	M/F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

legenda

- S: seen
- M/F: missing fit
- N/S: not seen
- N: not searched
- N/A: not applicable
- N/F: not feasible

Many of such a table are now constantly updated and show that **much higher statistics is needed to study the new spectroscopy and clarify the picture**



X(4160): candidate $\eta_c(3S)$
Y(4160): candidate hybrid

ψ(4040) and Z±(4050) and isospin triplet?!?

3940 family:
X candidate tetraquark
Y,Z candidate $\chi(2P)_{1,2}$

X: the most debated (tetraquark vs DD* molecule)

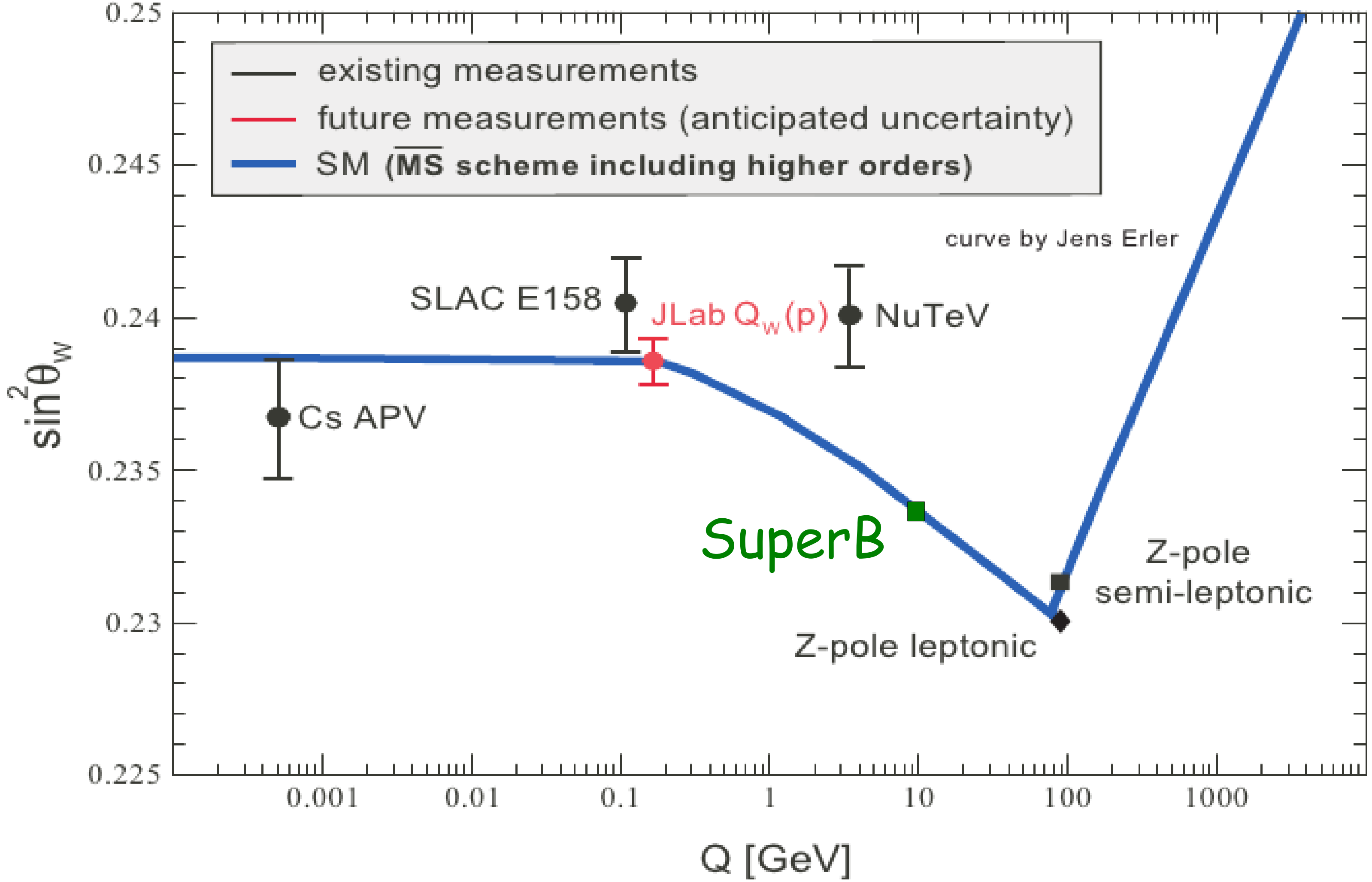
OTHER TOPICS IN SPECTROSCOPY

- Light scalar nonet is a tetraquark ? Y(2175) another tetraquark
- Bottonomium : five narrow resonances still missing
- U(5S,6S) results ? → Interest of scanning between U(4S) and $\Lambda_B\Lambda_B$

OTHER PHYSICS

- Light Higgs U(nS)→ Aγ → ττγ
- Dark Matter in light Upsilon decays U(1S)→νν
- Dark forces

Polarization allows to measure LR asymmetries, giving an interesting contribution to EWP:



CONCLUSIONS

- SuperB will allow us to study flavour properties of NP at the TeV scale:
    - Ensure determination of flavour structure of whatever NP seen at the LHC
    - Ensure sensitivity to moderately fine-tuned NP above the LHC reach

with full complementarity with other experiments (LHC(b), MEG, NA62, ...)

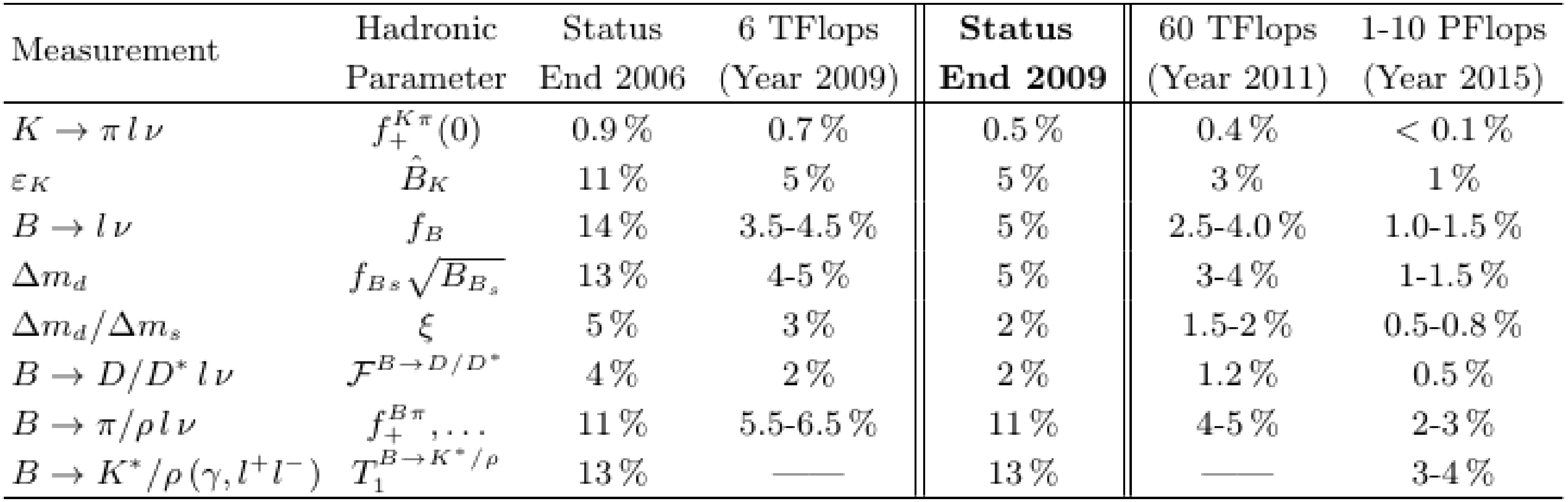
CONCLUSIONS II

- In addition to flavour studies, SuperB offers a unique opportunity for:
    - QCD spectroscopy
    - EW precision physics
    - Dark Matter searches
    - direct light Higgs boson searches
    - dark forces

BACKUP SLIDES

Theory keeps up...

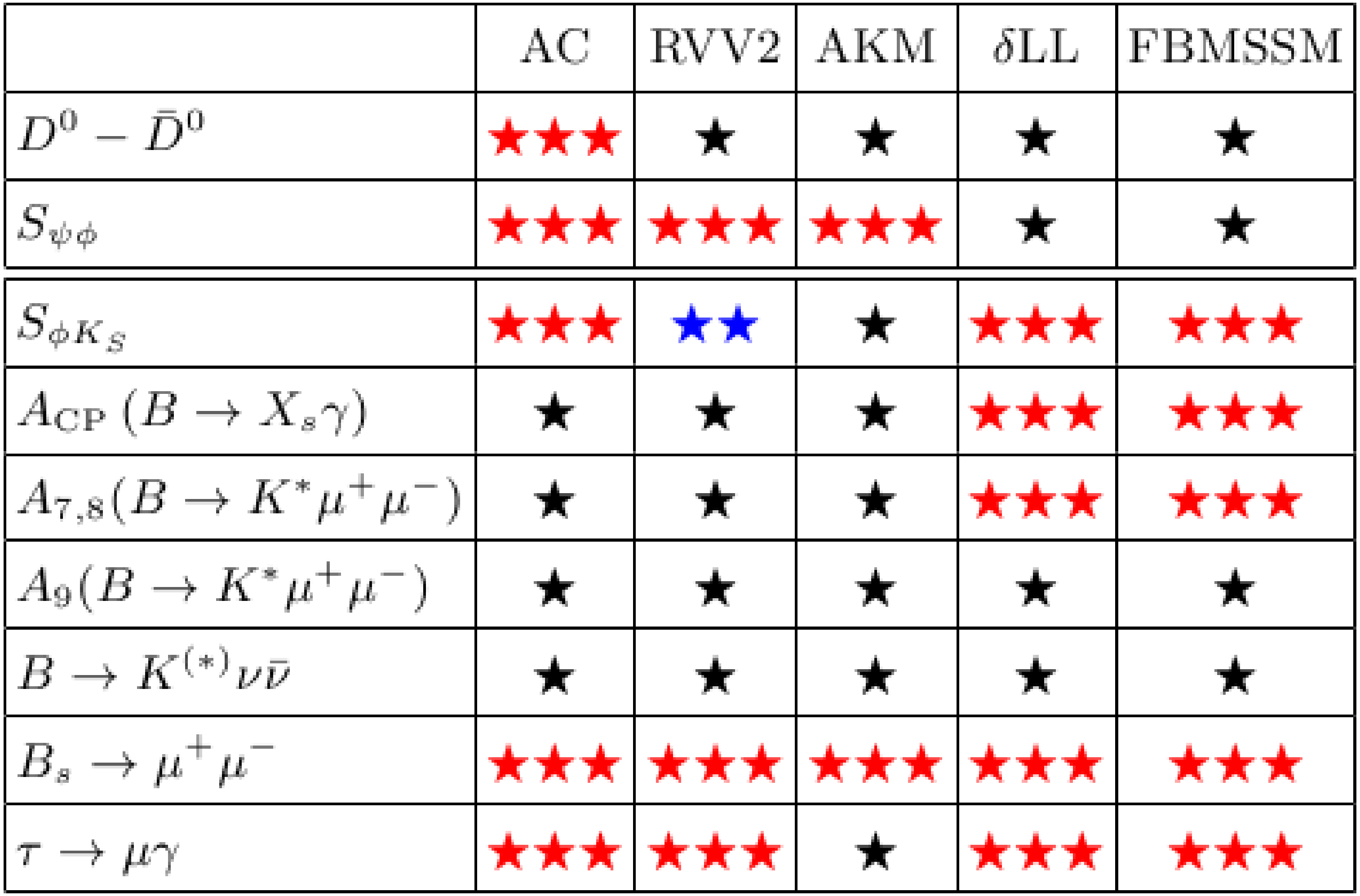
- lattice QCD can reach the O(1%) precision goal in time
- some progress for inclusive techniques for SL B decays
- non-leptonic B decays are more problematic



Measurement	Hadronic Parameter	Status End 2006	6 TFlops (Year 2009)	**Status End 2009**	60 TFlops (Year 2011)	1-10 PFlops (Year 2015)
$K \to \pi\, l\, \nu$	$f_+^{K\pi}(0)$	0.9 %	0.7 %	0.5 %	0.4 %	< 0.1 %
ε_K	$\hat{B}_K$	11 %	5 %	5 %	3 %	1 %
$B \to l\, \nu$	f_B	14 %	3.5-4.5 %	5 %	2.5-4.0 %	1.0-1.5 %
Δm_d	$f_{Bs}\sqrt{B_{B_s}}$	13 %	4-5 %	5 %	3-4 %	1-1.5 %
$\Delta m_d/\Delta m_s$	ξ	5 %	3 %	2 %	1.5-2 %	0.5-0.8 %
$B \to D/D^*\, l\, \nu$	$\mathcal{F}^{B\to D/D^*}$	4 %	2 %	2 %	1.2 %	0.5 %
$B \to \pi/\rho\, l\, \nu$	$f_+^{B\pi}, \ldots$	11 %	5.5-6.5 %	11 %	4-5 %	2-3 %
$B \to K^*/\rho\, (\gamma, l^+ l^-)$	$T_1^{B\to K^*/\rho}$	13 %	——	13 %	——	3-4 %

V. Lubicz, 4th SuperB Workshop and SuperB white paper

W. Altmannshofer et al., 0909.1333



	AC	RVV2	AKM	δLL	FBMSSM
$D^0 - \bar{D}^0$	★★★	★	★	★	★
$S_{\psi\phi}$	★★★	★★★	★★★	★	★
$S_{\phi K_S}$	★★★	★★	★	★★★	★★★
$A_{\rm CP}\,(B \to X_s\gamma)$	★	★	★	★★★	★★★
$A_{7,8}(B \to K^*\mu^+\mu^-)$	★	★	★	★★★	★★★
$A_9(B \to K^*\mu^+\mu^-)$	★	★	★	★	★
$B \to K^{(*)}\nu\bar{\nu}$	★	★	★	★	★
$B_s \to \mu^+\mu^-$	★★★	★★★	★★★	★★★	★★★
$\tau \to \mu\gamma$	★★★	★★★	★	★★★	★★★

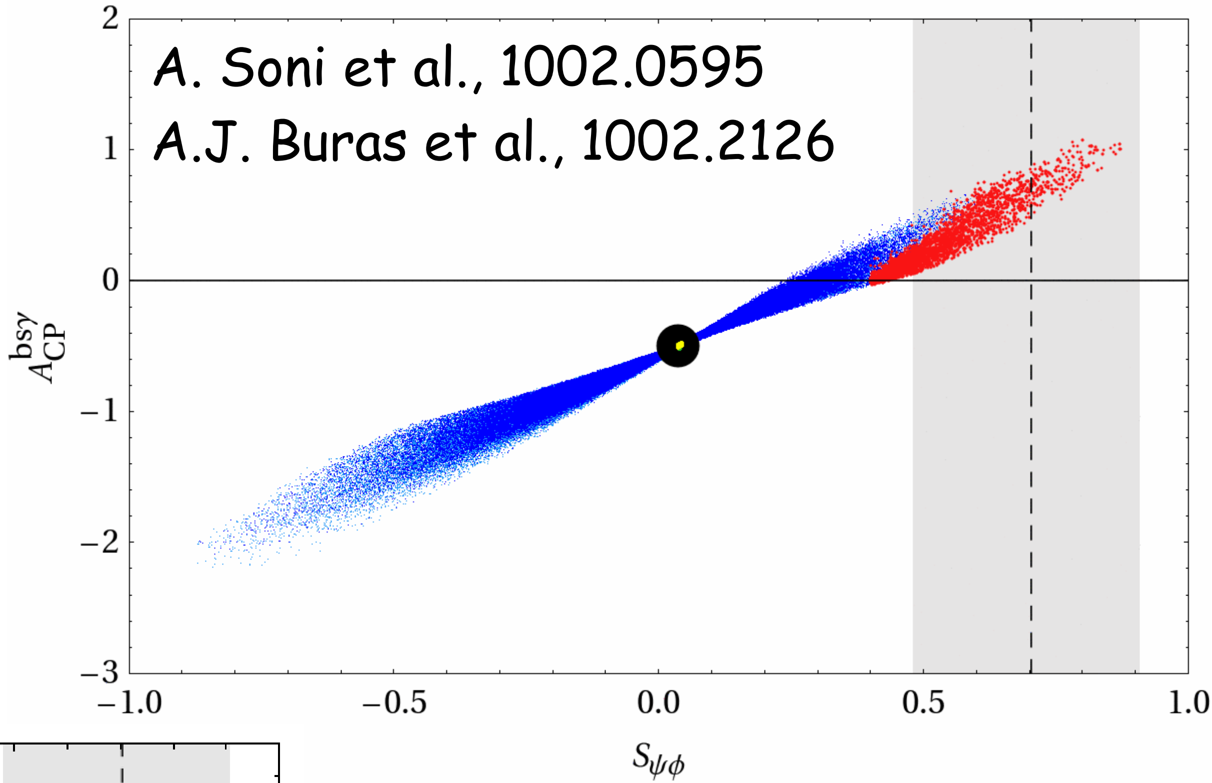
AC / RVV2,AKM: abelian / non-abelian flavour models

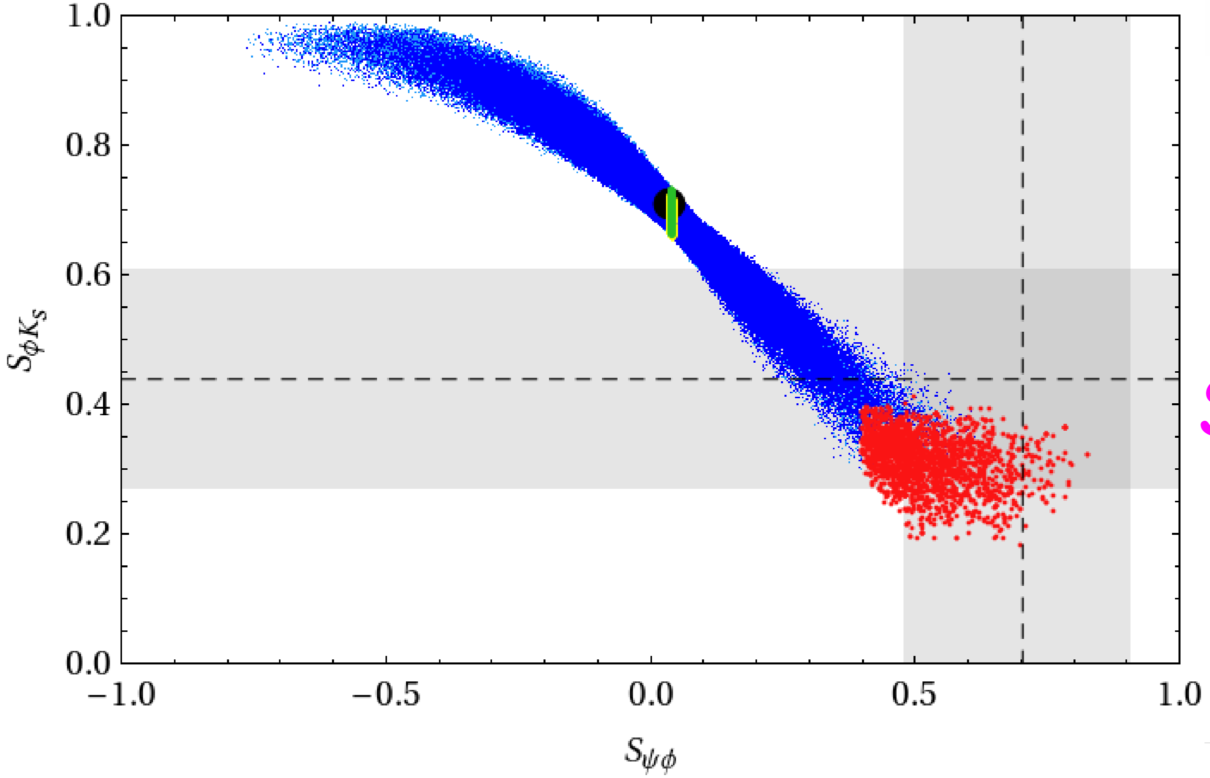
δLL: CKM-like new LH currents + 2↔3 NP CPV phase

FBMSSM: universal SSB terms + CPV phases

4th generation

- allows for a heavier Higgs
- allows for large CPV in Bs mixing
- testable at the LHC

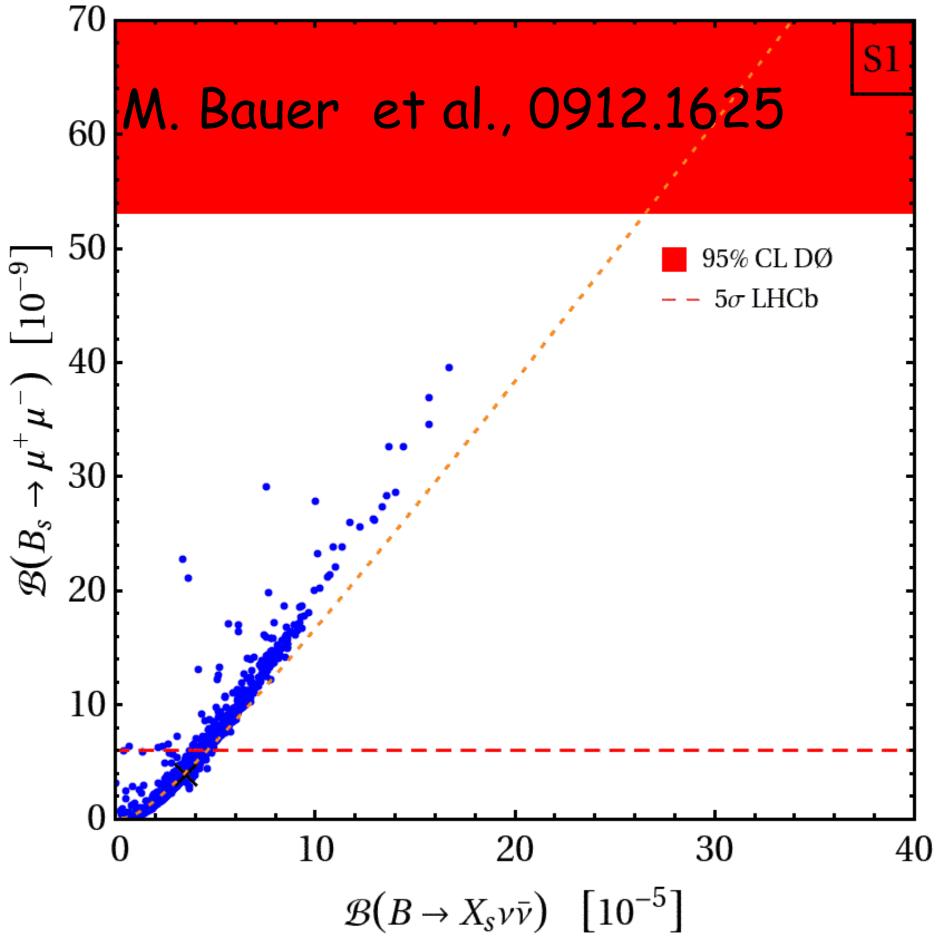


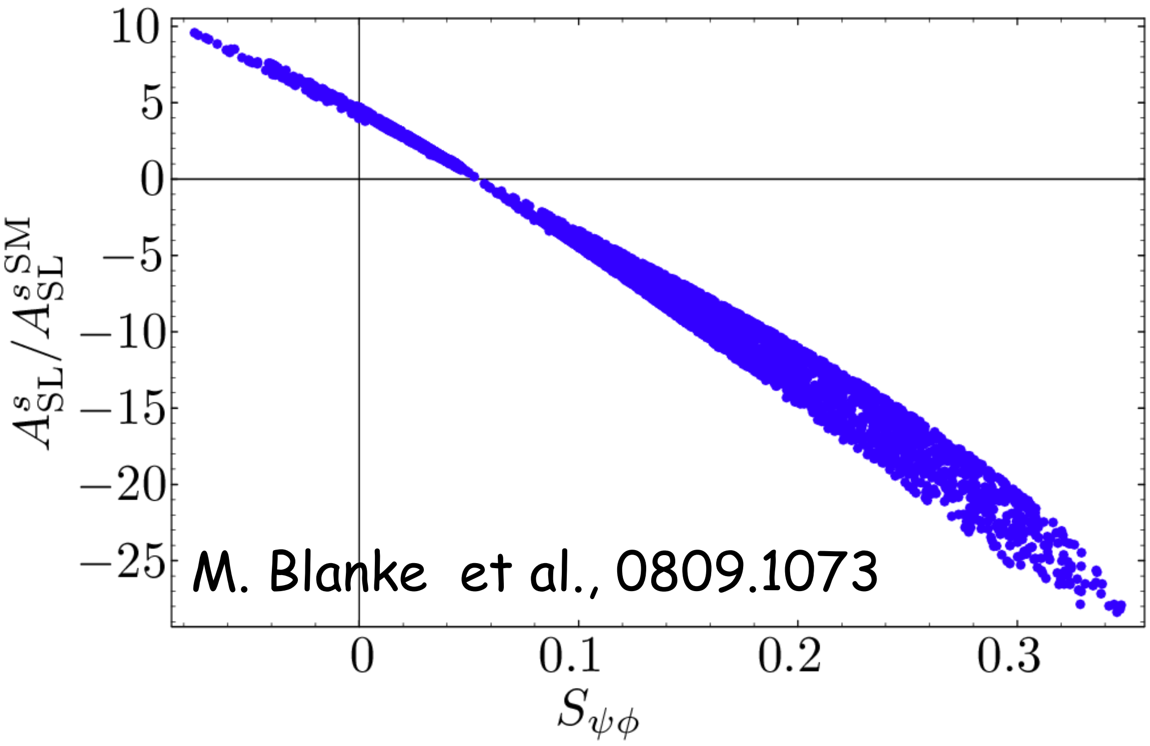


Extremely interesting implications also for SuperB phenomenology

R-S models

- flavour in extra-dim. is severely constrained by ε_K
- large B/Bs effect are still possible


M. Bauer et al., 0912.1625

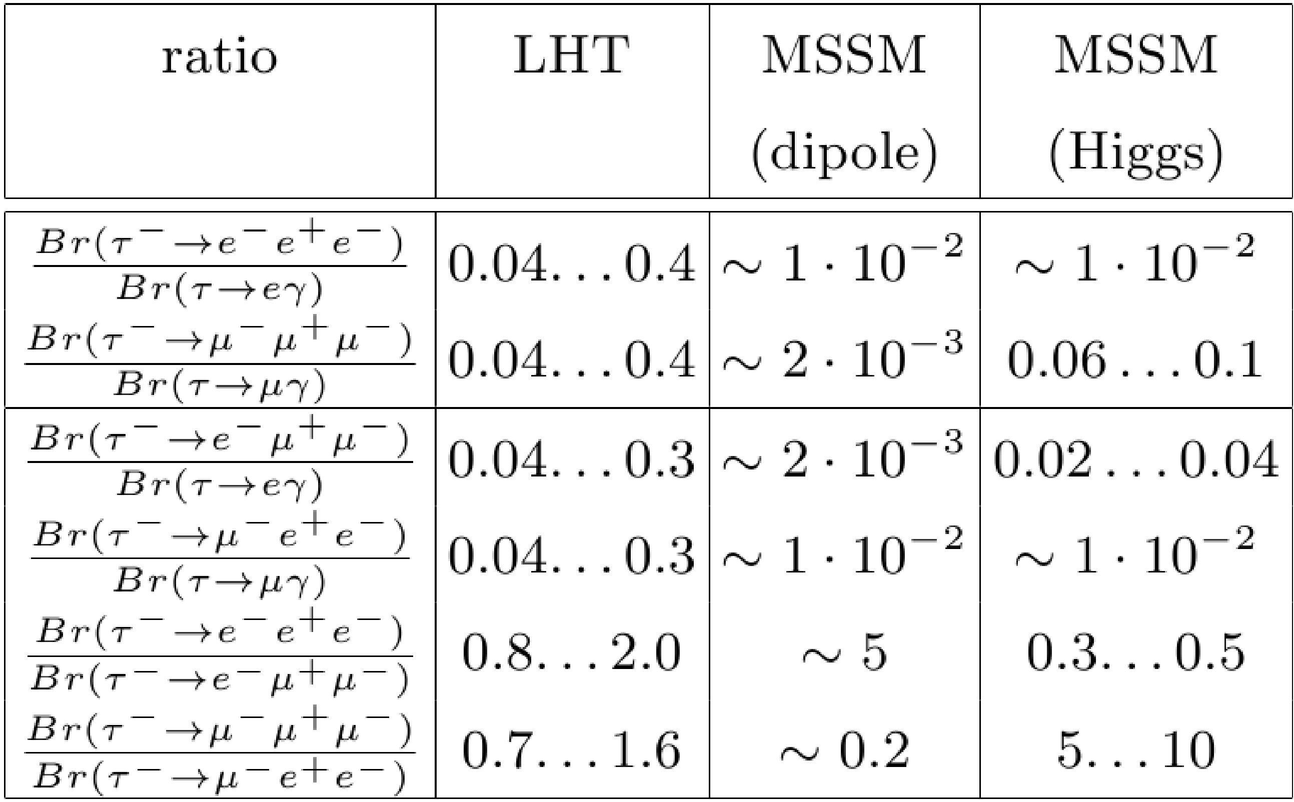

M. Blanke et al., 0809.1073

there are R-S models where effects in B(s) are confined to the mixing amplitudes

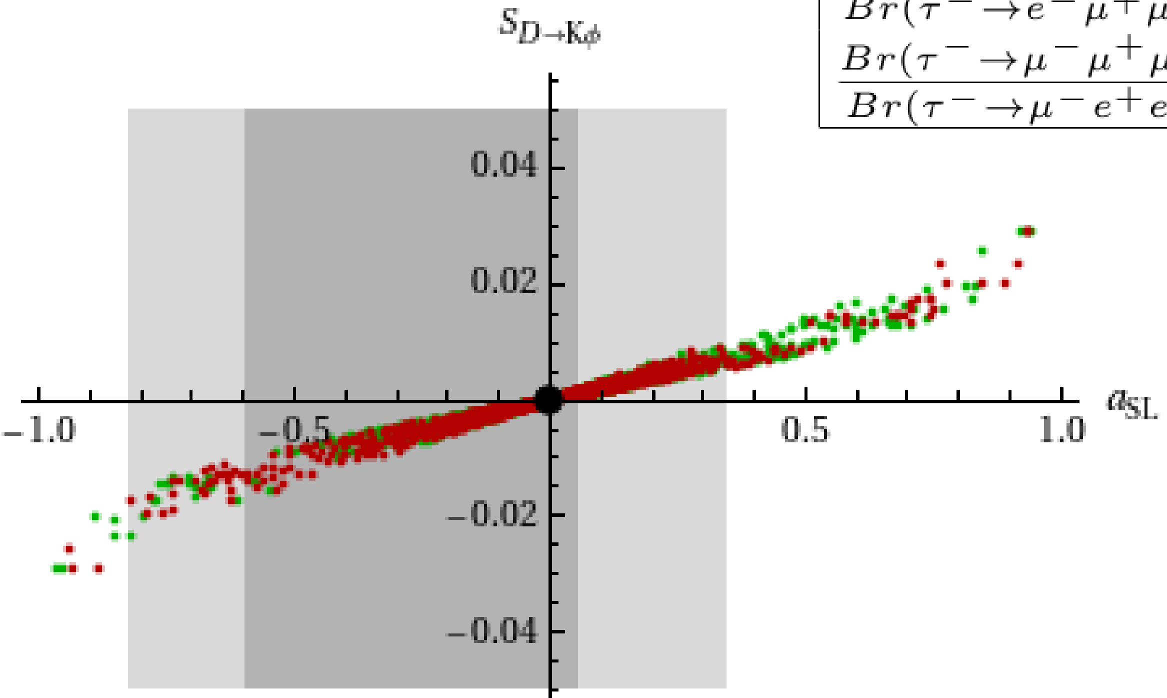
M. Blanke et al., 0906.5454

LHT model

- LFV: τ → μγ vs τ → ℓℓℓ
- semileptonic asymmetries

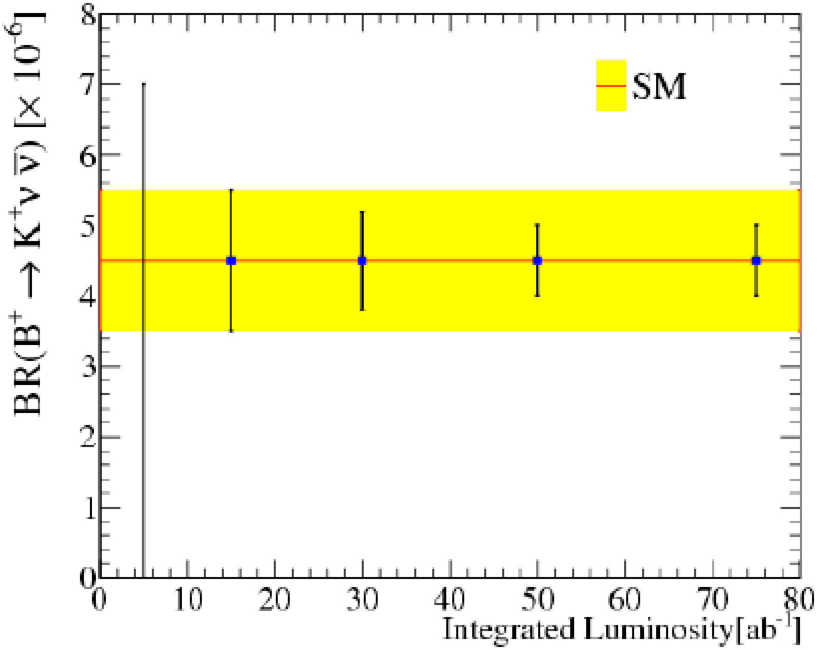


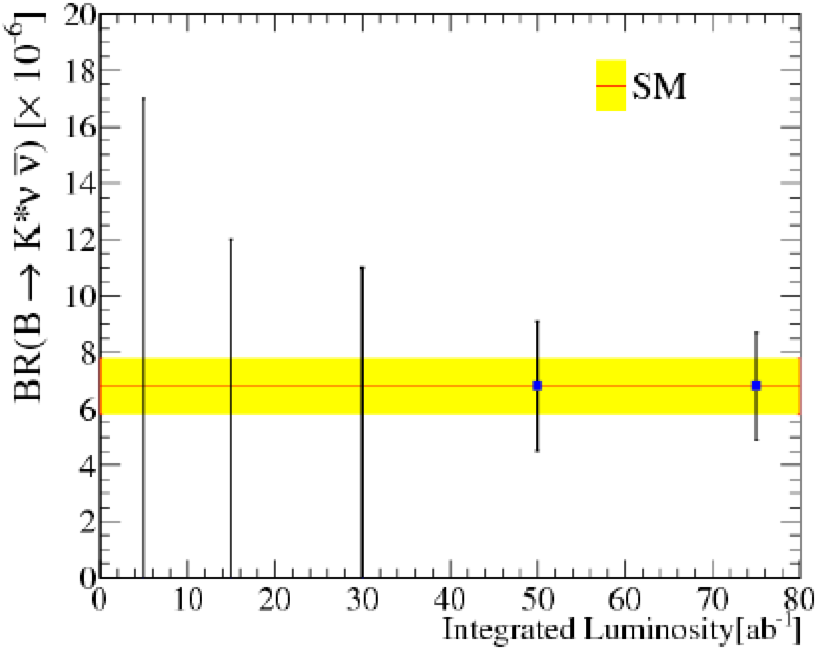
ratio	LHT	MSSM (dipole)	MSSM (Higgs)
$\frac{Br(\tau^-\to e^-e^+e^-)}{Br(\tau\to e\gamma)}$	$0.04\ldots0.4$	$\sim 1\cdot10^{-2}$	$\sim 1\cdot10^{-2}$
$\frac{Br(\tau^-\to\mu^-\mu^+\mu^-)}{Br(\tau\to\mu\gamma)}$	$0.04\ldots0.4$	$\sim 2\cdot10^{-3}$	$0.06\ldots0.1$
$\frac{Br(\tau^-\to e^-\mu^+\mu^-)}{Br(\tau\to e\gamma)}$	$0.04\ldots0.3$	$\sim 2\cdot10^{-3}$	$0.02\ldots0.04$
$\frac{Br(\tau^-\to\mu^-e^+e^-)}{Br(\tau\to\mu\gamma)}$	$0.04\ldots0.3$	$\sim 1\cdot10^{-2}$	$\sim 1\cdot10^{-2}$
$\frac{Br(\tau^-\to e^-e^+e^-)}{Br(\tau^-\to e^-\mu^+\mu^-)}$	$0.8\ldots2.0$	~ 5	$0.3\ldots0.5$
$\frac{Br(\tau^-\to\mu^-\mu^+\mu^-)}{Br(\tau^-\to\mu^-e^+e^-)}$	$0.7\ldots1.6$	~ 0.2	$5\ldots10$

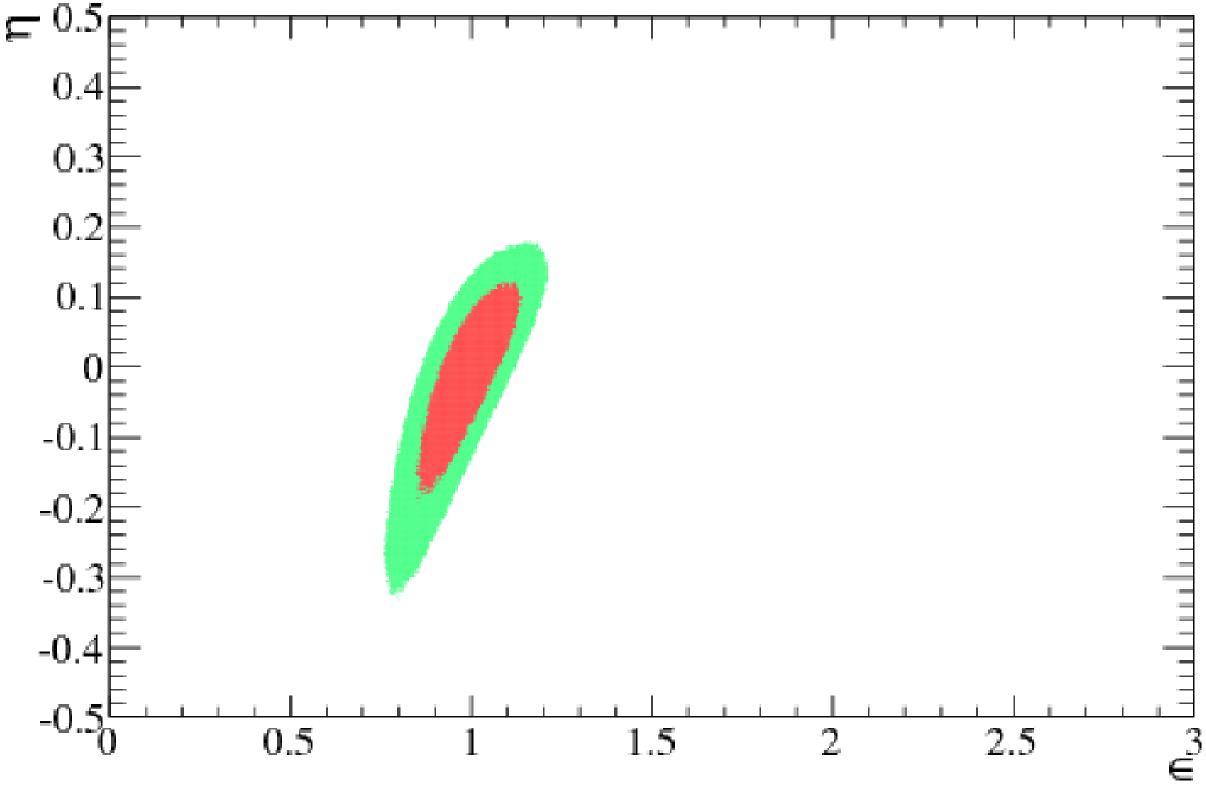


I.I. Bigi et al., 0904.1545

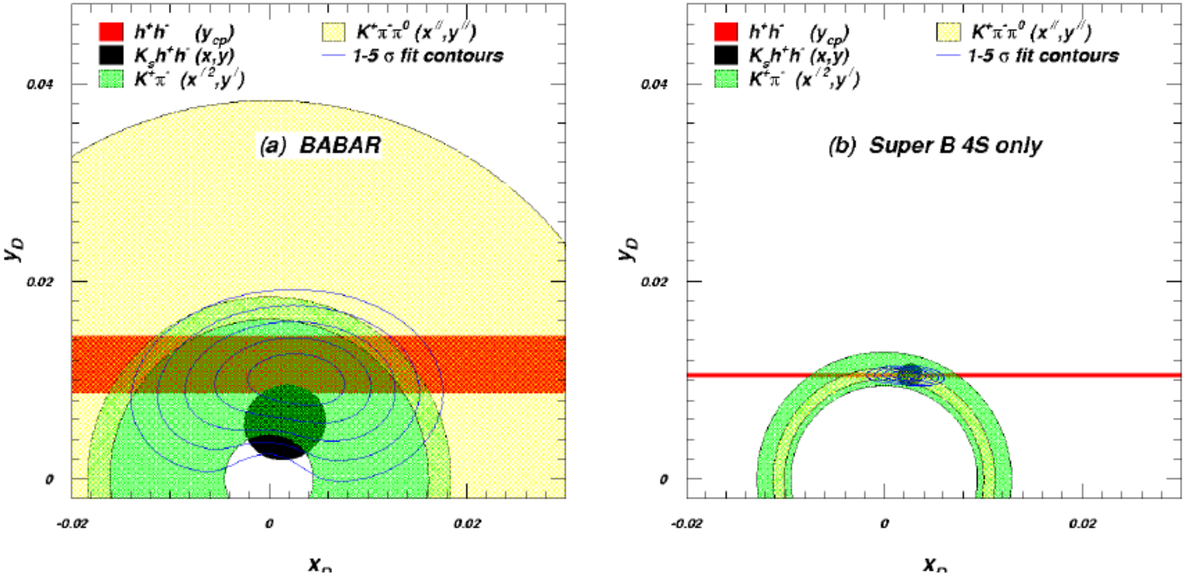
Recently: large and correlated CPV effects in D mixing


BR($B^+ \to K^+\nu\bar{\nu}$) [× 10^{-6}]
SM
Integrated Luminosity[ab^{-1}]
0
1
2
3
4
5
6
7
8
0
10
20
30
40
50
60
70
80


BR($B \to K^*\nu\bar{\nu}$) [× 10^{-6}]
SM
Integrated Luminosity[ab^{-1}]
0
2
4
6
8
10
12
14
16
18
20
0
10
20
30
40
50
60
70
80


η
ε
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
0
0.5
1
1.5
2
2.5
3

Charm mixing



Fit	$x \times 10^3$	$y \times 10^3$	$\delta^{\circ}_{K^+\pi^-}$	$\delta^{\circ}_{K^+\pi^-\pi^0}$
(a)	$3.01^{+3.12}_{-3.39}$	$10.10^{+1.69}_{-1.72}$	$41.3^{+22.0}_{-24.0}$	43.8 ± 26.4
Stat.	(2.76)	(1.36)	(18.8)	(22.4)
(b)	$xxx^{+0.72}_{-0.75}$	$xxx \pm 0.19$	$xxx^{+3.7}_{-3.4}$	$xxx^{+4.6}_{-4.5}$
Stat.	(0.18)	(0.11)	(1.3)	(2.9)
(c)	$xxx \pm 0.42$	$xxx \pm 0.17$	$xxx \pm 2.2$	$xxx^{+3.3}_{-3.4}$
Stat.	(0.18)	(0.11)	(1.3)	(2.7)
(d)	$xxx \pm 0.20$	$xxx \pm 0.12$	$xxx \pm 1.0$	$xxx \pm 1.1$
Stat.	(0.17)	(0.10)	(0.9)	(1.1)

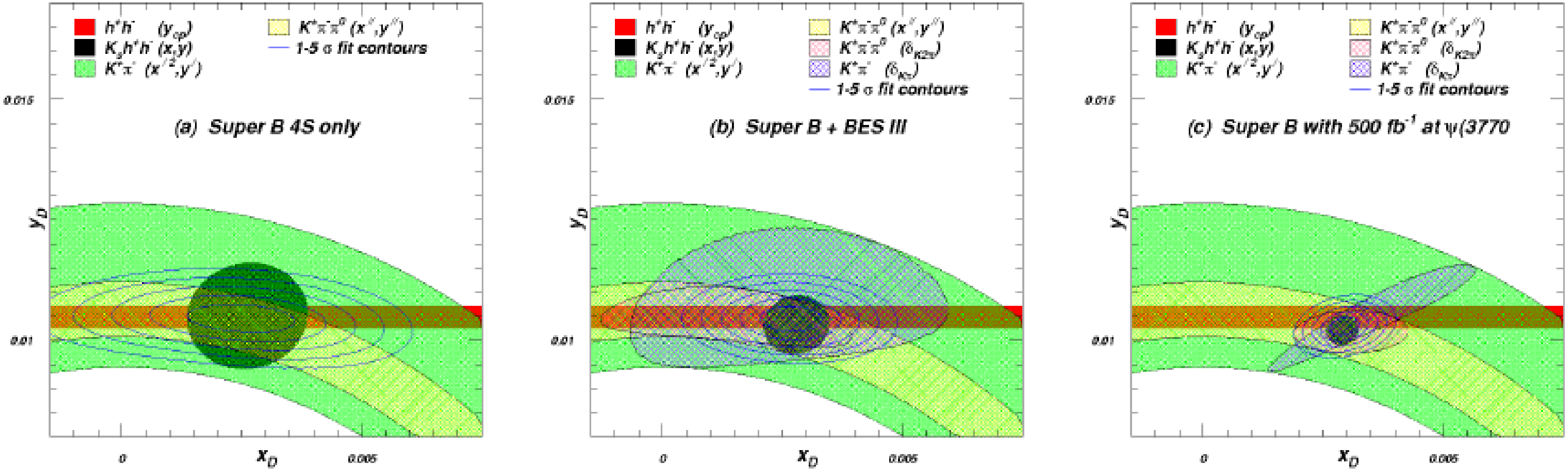
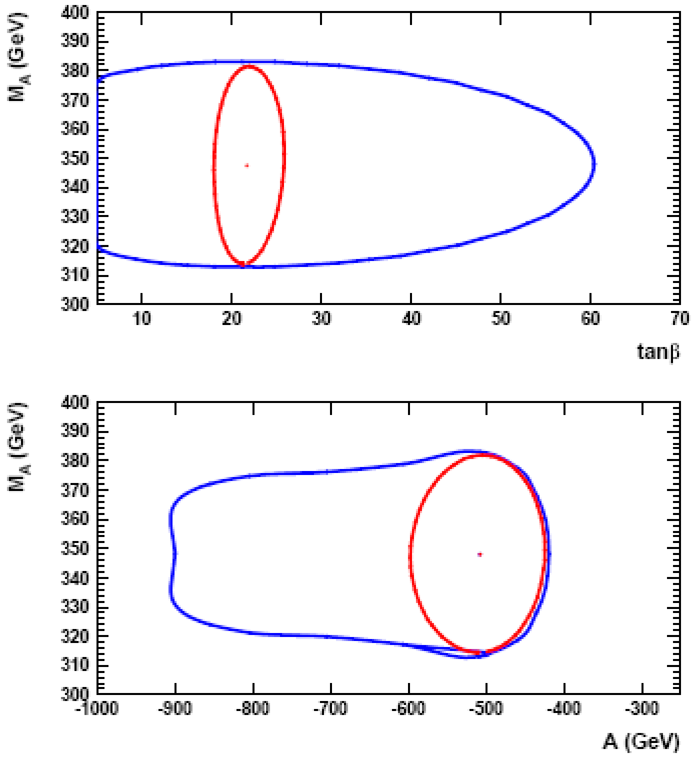


TABLE II: Golden modes in different New Physics scenarios. A "X" indicates the golden channel of a given scenario. An "O" marks modes which are not the "golden" one of a given scenario but can still display a measurable deviation from the Standard Model. The label *CKM* denotes golden modes which require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

	H^+ high $\tan\beta$	Minimal FV	Non-Minimal FV (1-3)	Non-Minimal FV (2-3)	NP Z-penguins	Right-Handed currents
$\mathcal{B}(B \to X_s\gamma)$		X		O		O
$A_{CP}(B \to X_s\gamma)$				X		O
$\mathcal{B}(B \to \tau\nu)$	X-CKM					
$\mathcal{B}(B \to X_s l^+l^-)$				O	O	O
$\mathcal{B}(B \to K\nu\overline{\nu})$				O	X	
$S(K_S\pi^0\gamma)$						X
β			X-CKM			O

	SPS1a	SPS4	SPS5
$\mathcal{R}(B \to X_s\gamma)$	0.919 ± 0.038	0.248	0.848 ± 0.081
$\mathcal{R}(B \to \tau\nu)$	0.968 ± 0.007	0.436	0.997 ± 0.003
$\mathcal{R}(B \to X_s l^+l^-)$	0.916 ± 0.004	0.917	0.995 ± 0.002
$\mathcal{R}(B \to K\nu\overline{\nu})$	0.967 ± 0.001	0.972	0.994 ± 0.001
$\mathcal{B}(B_d \to \mu^+\mu^-)/10^{-10}$	1.631 ± 0.038	16.9	1.979 ± 0.012
$\mathcal{R}(\Delta m_s)$	1.050 ± 0.001	1.029	1.029 ± 0.001
$\mathcal{B}(B_s \to \mu^+\mu^-)/10^{-9}$	2.824 ± 0.063	29.3	3.427 ± 0.018
$\mathcal{R}(K \to \pi^0\nu\overline{\nu})$	0.973 ± 0.001	0.977	0.994 ± 0.001



Proceedings of Superb VI,
arXiv:0810.1312