WG-A: Phenomenology

- Our task: discussing SuperB physics goal in terms of new physics signals search
- Currently we are exploring the following models:

(A) MSSM

(B) SUSY-GUTs (together with MSSM, could be simply SUSY)

(C) Little Higgs model (LHT)

(D) Extra-Dimension model

(E) CKM analysis

(F) Model independent/Effective theory approach

** new since CDR*

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- Our task: discussing SuperB physics goal in terms of new physics signals search
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SUSY: Shimizu, Jager, Nardecchia

(A) MSSM

(B) SUSY-GUTs (together with MSSM, could be simply SUSY)

(C) Little Higgs model (LHT)

LHT: Blanke, Duling

(D) Extra-Dimension model

(E) CKM analysis

ED: Gemmler

(F) Model independent/Effective theory approach

Model Indep.: Bona, (non)MFV: Zupan, Vives

ince CDR

New activity I: Benchmark

- SUSY Benchmark point for flavour (started in Valencia meeting):
  (i) The SPS (snowmass point and slope) are useful to see a correlation between collider (high PT) and flavour experiments.
  (ii) But current points are not necessarily favorable for flavour.
  (iii) Furthermore, some of the points look already been excluded by e.g. $B \to X_s\gamma$ or new $g-2$.

$$\begin{aligned} \text{SPS1}a: &\quad m_0 = 100\text{GeV}, \quad m_{1/2} = 250\text{GeV}, \\ &\quad A_0 = -100\text{GeV}, \quad \tan\beta = 10, \quad \mu > 0 \\ \text{SPS4}: &\quad m_0 = 400\text{GeV}, \quad m_{1/2} = 300\text{GeV}, \\ &\quad A_0 = 0, \quad \tan\beta = 50, \quad \mu > 0, \\ \text{SPS5}: &\quad m_0 = 150\text{GeV}, \quad m_{1/2} = 300\text{GeV}, \\ &\quad A_0 = -1000, \quad \tan\beta = 5, \quad \mu > 0. \end{aligned} \tag{7}$$

	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

- For TDR:
  (i) Can we find a *nice point* which represents a physics goal of Super flavour factory (non-MFV? non-mSUGRA type)?

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	$A_0 = -100\text{GeV}$, $\tan\beta = 10$, $\mu > 0$	
SPS4 :	$m_0 = 400\text{GeV}$, $m_{1/2} = 300\text{GeV}$,	
	$A_0 = 0$, $\tan\beta = 50$, $\mu > 0$,	
SPS5 :	$m_0 = 150\text{GeV}$, $m_{1/2} = 300\text{GeV}$,	
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$\mathcal{R}($			
$\mathcal{B}($			
$\mathcal{R}($			

Tools is provided.
A *mini-working* proposed.
Activity will start soon...

- For TDR:
  (i) Can we find a *nice point* wh[...]
  Super flavour factory (non-MF[...]

New activity II: MSSM+ specific soft ~~SUSY~~ model

- Importance to have specific models:

(i) Enable to predict the mass insertion parameter

e.g. Hierarchy model: $\delta_{23} \approx V_{ts}$ (talk M.Nardecchia)

e.g. mSUGRA, Gauge mediation etc...(talk S. Jager)

(ii) Enable to see the correlations to the other experiments (Bs mixing, lepton sector, high P_T etc)

e.g. SUSY SU(5): Bs mixing vs $\tau \to \mu\gamma$ (talk Y. Shimizu)

- TDR:

(i) Study the impact of Super Flavour Factory on those theoretically motivated models.

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- TDR:

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  theoretically motivated […]

Discussions about new theoretical ideas at the meetings.

New activity III: new physics in new observable

- Studying further physics potential is always important!

Observable	B Factories (2 ab^{-1})	Super$B$ (7
$\sin(2\beta)$ $(J/\psi\, K^0)$	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
α $(B \to \pi\pi)$	$\sim 16^\circ$	
α $(B \to \rho\rho)$	$\sim 7^\circ$	
α $(B \to \rho\pi)$	$\sim 12^\circ$	
α (combined)	$\sim 6^\circ$	
γ $(B \to DK$, $D \to CP$ eigenstates)	$\sim 15^\circ$	
γ $(B \to DK$, $D \to$ suppressed states)	$\sim 12^\circ$	
γ $(B \to DK$, $D \to$ multibody states)	$\sim 9^\circ$	
γ $(B \to DK$, combined)	$\sim 6^\circ$	

Observable	B Factories (2 ab^{-1})	Super$B$ (75 ab
$\mathcal{B}(B \to \tau\nu)$	20%	4% (†)
$\mathcal{B}(B \to \mu\nu)$		
$\mathcal{B}(B \to D\tau\nu)$		
$\mathcal{B}(B \to \rho\gamma)$		
$\mathcal{B}(B \to \omega\gamma)$		
1 $A_{CP}(B \to K^*\gamma)$		
$A_{CP}(B \to \rho\gamma)$	~ 0.20	0.05
1 $A_{CP}(b \to s\gamma)$	0.012 (†)	0.004 (†)
$A_{CP}(b \to (s+d)\gamma)$	0.03	0.006 (†)
$S(K_S^0\pi^0\gamma)$	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

$S(\phi K^0)$	0.13	0.02 (∗)
$S(\eta' K^0)$	0.05	0.01 (∗)
$S(K_S^0 K_S^0 K_S^0$	0.15	0.02 (∗)
$S(K_S^0\pi^0)$	0.15	0.02 (∗)
$S(\omega K_S^0)$	0.17	0.03 (∗)
$S(f_0 K_S^0)$	0.12	0.02 (∗)

1.0% (∗)
0.5% (∗)
3.0% (∗)
2.0% (∗)

New activity III: searching more physics cases

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		1.0% (∗)
		0.5% (∗)
		3.0% (∗)
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As more precise sensitivity study becomes available, re-evaluations of the physics case must be done.

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As ... stu... ev... case must be done.

To make this activity a more public effort, we will open a web-site to list the up-to-date information of the sensitivity study of the SuperB golden-channels.