

# Workshop *Code* & *closeout* Discussion

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*conveners and the local organizers*

# Many codes

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- Some very specialized:

*SuperISO, SUSY\_Flavour, CKMfitter*

- Some are more statistic frameworks

*GammaCombo, myFitter, BAT, EOS, SUSYFit*

Thank you for the nice overview from all groups.  
This was extremely helpful and we will summarize  
your ideas & codes in the coming B2TIP meeting.

# Golden modes

<https://belle2.cc.kek.jp/~twiki/bin/view/Public/B2TIPGoldenModes>

Group	Observables	Mode	SM or CKM Fit Expectation	Belle 2014	Babar 2014	Belle II 5/ab	Belle II 50/ab	LHCb 2014	LHCb 8/fb	LHCb 50/fb
<a href="#">φ<sub>1</sub>/φ<sub>2</sub> WG page</a>	sin(2φ <sub>1</sub> )	$B \rightarrow J/\psi K_S$		$0.667 \pm 0.023 \pm 0.012(1.4^\circ)$		0.7°	0.4°		1.6°	0.6°
	S	$B \rightarrow \phi K_S^0$		$0.90^{+0.09}_{-0.19}$		0.053	0.018		0.2	0.04
		$B \rightarrow \eta' K_S^0$		$0.68 \pm 0.07 \pm 0.03$		0.028	0.011			
		$B \rightarrow K_S^0 K_S^0 K_S^0$		$0.30 \pm 0.32 \pm 0.08$		0.100	0.033			
	φ <sub>2</sub>	$B \rightarrow \pi\pi, B \rightarrow \rho\pi, B \rightarrow \rho\rho$		$(85 \pm 4)^\circ$ (Belle + Babar)		2°	1°			
<a href="#">φ<sub>3</sub> WG page</a>	φ <sub>3</sub>	$B \rightarrow D^{(*)} K^{(*)}$		$(68 \pm 14)^\circ$		6°	1.5°			
<a href="#">Hadronic B WG page</a>	A	$B \rightarrow K_S^0 \pi^0$		$-0.05 \pm 0.1 \pm 0.05$		0.07	0.04			
<a href="#">Semileptonic &amp; Leptonic WG page</a>	$V_{cb}[10^{-3}]$ inclusive	$B \rightarrow X_c \ell \nu$		$41.6(1 \pm 0.024_{fit})$		1.2%				
	$V_{cb}[10^{-3}]$ exclusive	$B \rightarrow D^* \ell \nu$		$37.5(1 \pm 0.030_{exp} \pm 0.027_{th})$		1.8%	1.4%			
	$V_{ub}[10^{-3}]$ inclusive	$B \rightarrow X_u \ell \nu$		$4.47(1 \pm 0.060_{exp} \pm 0.025_{th})$		3.4%	3.0%			
	$V_{ub}[10^{-3}]$ exclusive	$B \rightarrow \pi \ell \nu$ (Hadronic tag)		$3.52(1 \pm 0.95_{fit})$		4.4%	2.3%			
	$\mathcal{B}[10^{-6}]$	$B \rightarrow \tau \nu$ (Hadronic tag)		$96(1 \pm 0.26)$		10%	5%			
	$\mathcal{B}[10^{-6}]$	$B \rightarrow \mu \nu$				20%	7%			
	$\mathcal{R}$	$B \rightarrow D^* \tau \nu$ (Hadronic tag)			$0.440(1 \pm 0.165)$	5.6%	3.4%			
	$\mathcal{R}$	$B \rightarrow D^* \tau \nu$ (Hadronic tag)			$0.332(1 \pm 0.090)$	4.4%	2.3%			
<a href="#">Radiative &amp; Electroweak WG page</a>	$\mathcal{B}[10^{-4}]$	$B \rightarrow X_s \gamma$ (inclusive)		$3.45(1 \pm 0.043 \pm 0.116)$		7%	6%			
	$A_{CP}$	$B \rightarrow X_{s+d} \gamma$		$2.2 \pm 4.4 \pm 0.8$		1	0.5			
	S	$B \rightarrow K_S^0 \pi^0 \gamma$		$-0.10 \pm 0.31 \pm 0.07$		0.11	0.035			
	S	$B \rightarrow \rho \gamma$		$-0.83 \pm 0.65 \pm 0.18$		0.23	0.07			
	$\mathcal{B}[10^{-6}]$	$B \rightarrow K \nu \bar{\nu}$		< 40						
	$\mathcal{B}[10^{-6}]$	$B \rightarrow K^* \nu \bar{\nu}$		< 55						
	$C_7/C_9$	$B \rightarrow X_s \ell^+ \ell^-$		20%		10%	5%			
	$\mathcal{B}[10^{-6}]$	$B_s \rightarrow \gamma \gamma$		< 8.7		0.3	-			
	$\mathcal{B}[10^{-3}]$	$B_s \rightarrow \tau \tau$		-		< 2	-			
<a href="#">Charm WG page</a>	$\mathcal{B}[10^{-3}]$	$D_s \rightarrow \mu \nu$		$5.31(1 \pm 0.053 \pm 0.038)$		2.9%	0.9%			
	$\mathcal{B}[10^{-3}]$	$D_s \rightarrow \tau \nu$		$5.70(1 \pm 0.037 \pm 0.054)$		3.5%	2.3%			
	$\mathcal{B}[10^{-6}]$	$D^0 \rightarrow \gamma \gamma$		< 1.5		30%	25%			
	$A_{CP}[10^{-4}]$	$D^0 \rightarrow K^+ K^-$		$-32 \pm 21 \pm 9$		11	6			
	$A_{CP}[10^{-2}]$	$D^0 \rightarrow \pi^0 \pi^0$		$0.03 \pm 0.64 \pm 0.10$		0.29	0.09			
	$A_{CP}[10^{-2}]$	$D^0 \rightarrow K_S^0 \pi^0$		$-0.21 \pm 0.16 \pm 0.09$		0.08	0.03			
	$A_T$			$-0.03 \pm 0.21 \pm 0.08$		0.1	0.03			
	$x[10^{-2}]$	$D^0 \rightarrow K_S^0 \pi^+ \pi^-$		$0.56 \pm 0.19^{+0.07}_{-0.13}$		0.14	0.11			
	$y[10^{-2}]$	$D^0 \rightarrow K_S^0 \pi^+ \pi^-$		$0.30 \pm 0.15^{+0.05}_{-0.08}$		0.08	0.05			
	abs(q/p)	$D^0 \rightarrow K_S^0 \pi^+ \pi^-$		$0.90^{+0.16+0.08}_{-0.15-0.06}$		0.10	0.07			
	φ	$D^0 \rightarrow K_S^0 \pi^+ \pi^-$		$-6 \pm 11^{+4}_{-5}$		6°	4°			

# Global fits for new physics

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- First are the golden modes sufficient to perform a global search for new physics, be it model dependent or independent?
- What is needed to do such global fits: bare minimum is experimental cross correlations / common Nuisance parameter sources. Fit value, likelihood or chi2 contours?
  - In what forum should such fits occur? Inside Belle II, in collaboration with theorists?
    - *We as experimentalists are good at measuring things. We are also happy to do interpretations, but our foremost task is to measure things right.*
- If you are working on a global fit, it's interesting for us to know what the ultimate precision / limit of a model is, assuming the SM or NP.

For us it would be interesting to collect such results, so that they can be shown to illustrate the Belle II potential.