Model-independent NP-Fits in $\Delta B=2$ and $\Delta B=1$ Transitions

Heiko Lacker on behalf of the CKMfitter group
CKM workshop, San Diego, 18.03.2005

CONTENT

1) NP-Fits in $\Delta B=2$ Transitions
2) NP-Fits in $\Delta B=1$ Transitions
   (model-independent framework)
   * $B \rightarrow \pi\pi$
   * $B \rightarrow \phi K$

The following is based on hep-ph/0406184
(accepted for publication in EPJ C)

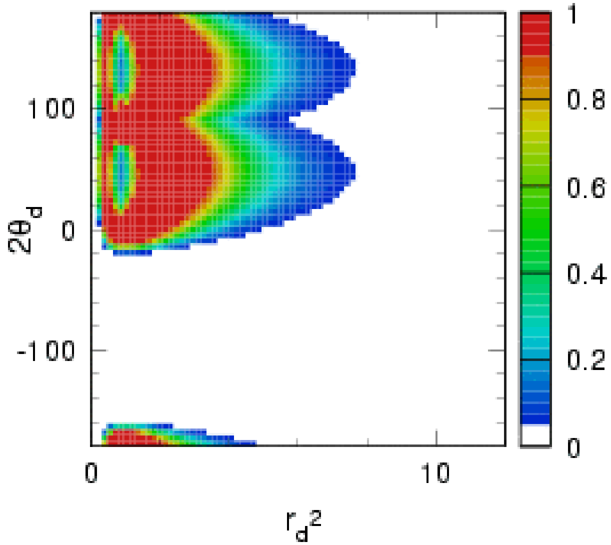
Note: Numerical input values are still those of Winter 2004
Will be updated soon

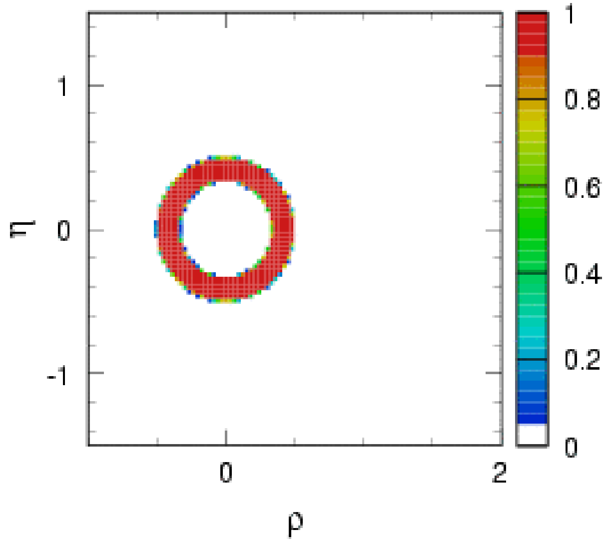
NEW PHYSICS IN ΔB=2 TRANSITIONS ?

$$r_d^2 \exp(2\theta_d) = \frac{\langle B^0 | H_{eff}^{full} | \bar{B}^0 \rangle}{\langle B^0 | H_{eff}^{SM} | \bar{B}^0 \rangle}$$

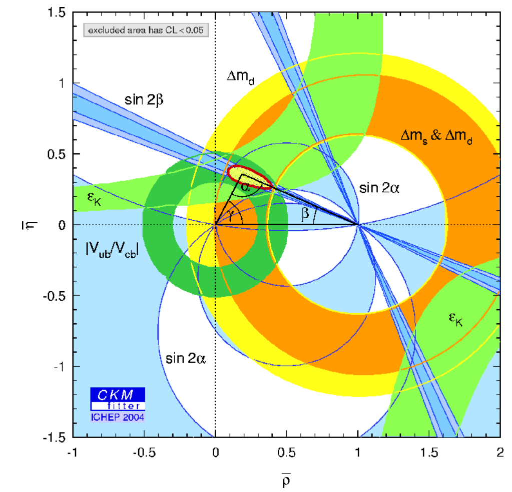
CONSTRAINT	SM & NP DEPENDENCE	REMARKS
$B \to X_{u,c}\, l\, \nu$	$\|V_{ub}\|, \|V_{cb}\|$	
$B \to D^{(*)0} K^+$	$\tan\gamma$	**Dalitz plot**
$B \to D^{(\pm)0} \pi^\mp$	$\sin(2\beta + 2\theta_d + \gamma)$	**SU(3) ! (Caution)**
$B \to \rho\rho$	$2\beta + 2\theta_d + 2\gamma$	**Isospin analysis**
$B \to J/\Psi\, K^0$	$\sin(2\beta + 2\theta_d)$	**CP(t) asymmetry**
$B \to J/\Psi\, K^{*0}$	$\cos(2\beta + 2\theta_d)$	**CP(t) & angular analysis (data only prefer > 0)**
Δm_d	$\Delta m_d^{SM} r_d^2$	
A_{SL}	$-\Re\left(\frac{\Gamma_{12}}{M_{12}}\right)^{SM} \frac{\sin 2\theta_d}{r_d^2} + \Im\left(\frac{\Gamma_{12}}{M_{12}}\right)^{SM} \frac{\cos 2\theta_d}{r_d^2}$	

NEW PHYSICS IN ΔB=2 TRANSITIONS ?





SM CKM-fit:

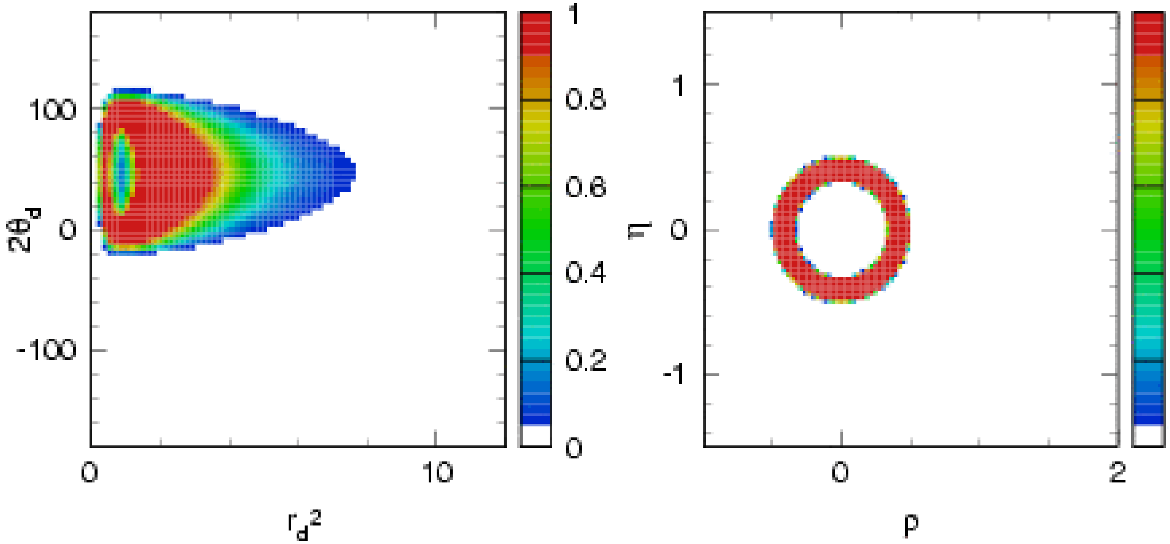


$$B \to X_{u,c}\, l\, \nu \qquad |V_{ub}|, |V_{cb}|$$

$$\Delta m_d \qquad \Delta m_d^{SM}\, r_d^2$$

$$B \to J/\Psi\, K^0 \qquad \sin(2\beta + 2\theta_d)$$

NEW PHYSICS IN ΔB=2 TRANSITIONS ?



Importance of resolving ambiguity:
Fleischer & Matias;
Fleischer, Isidori & Matias

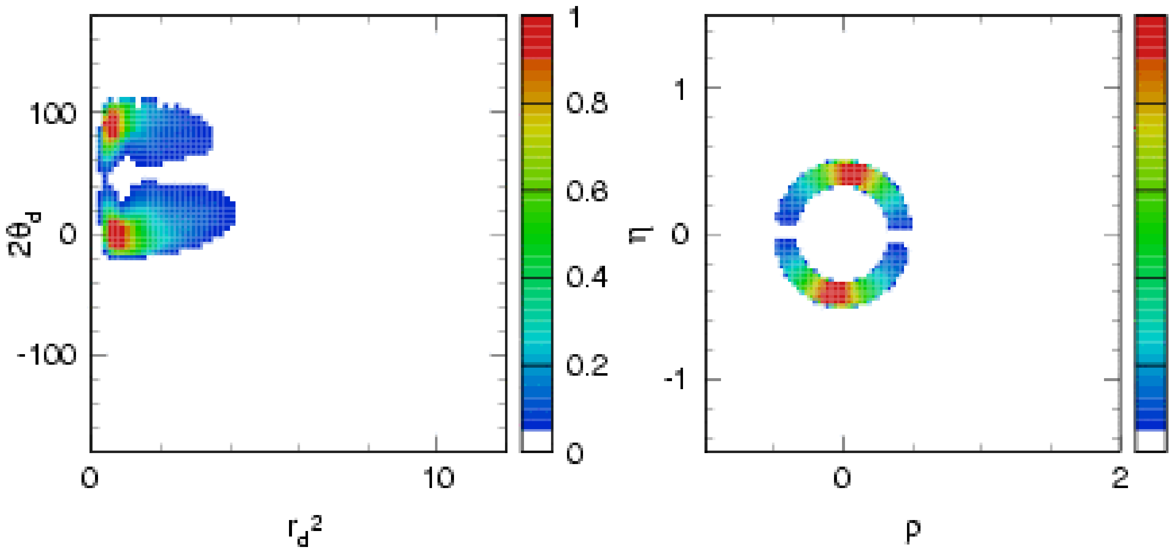
$2\theta_d = \pi$ excluded

=> F_{tt}(MFV) < 0 excluded

$B \to X_{u,c}\, l\, \nu$	$\lvert V_{ub}\rvert, \lvert V_{cb}\rvert$
Δm_d	$\Delta m_d^{SM}\, r_d^2$
$B \to J/\Psi\, K^0$	$\sin(2\beta + 2\theta_d)$
$B \to J/\Psi\, K^{*0}$	$\cos(2\beta + 2\theta_d)$

Assume here 'cos2β'> 0
(as prefered by data)
Not settled yet.

NEW PHYSICS IN ΔB=2 TRANSITIONS ?



$B \to X_{u,c} l \nu$	$\lvert V_{ub}\rvert, \lvert V_{cb}\rvert$
Δm_d	$\Delta m_d^{SM} r_d^2$
$B \to J/\Psi K^0$	$\sin(2\beta + 2\theta_d)$
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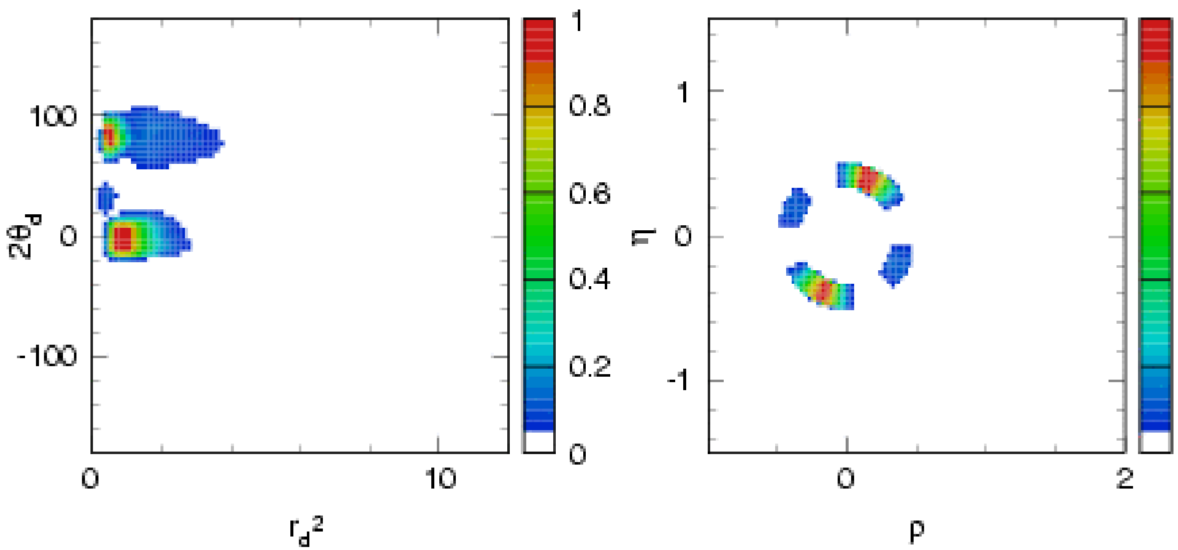
$B \to D^{(*)0} K^+$	$\tan\gamma$

NEW PHYSICS IN ΔB=2 TRANSITIONS ?



$B \to X_{u,c} l \nu$	$\lvert V_{ub}\rvert, \lvert V_{cb}\rvert$
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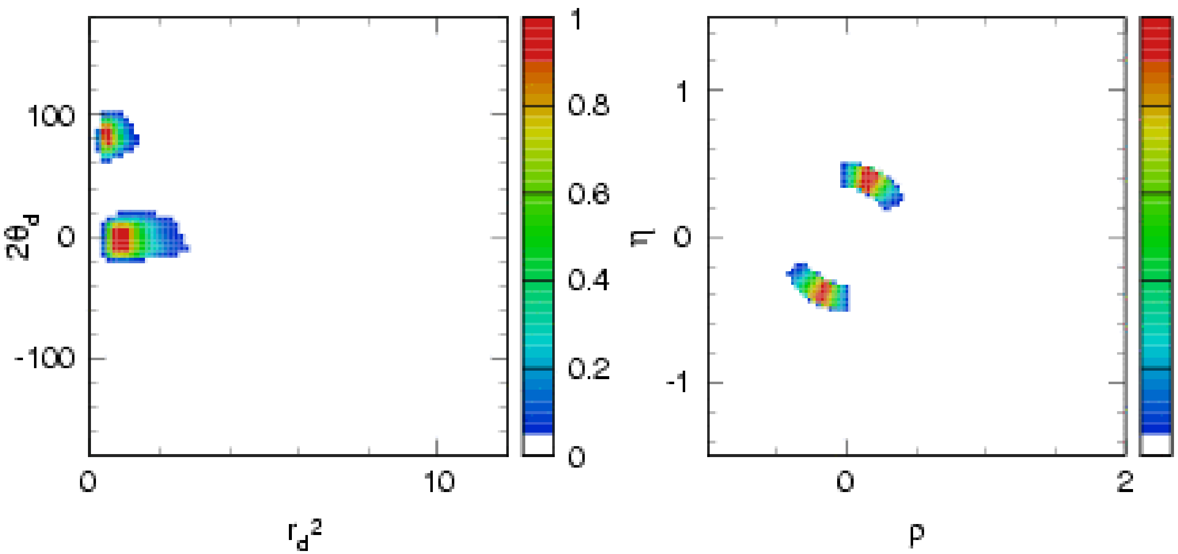
$B \to D^{(*)0} K^+$	$\tan\gamma$
$B \to \rho\rho$	$2\beta + 2\theta_d + 2\gamma$

Isospin analysis
Assume ΔI=3/2 amplitude being standard

NEW PHYSICS IN ΔB=2 TRANSITIONS ?



$B \to X_{u,c} l \nu$	$\|V_{ub}\|, \|V_{cb}\|$
Δm_d	$\Delta m_d^{SM} r_d^2$
$B \to J/\Psi K^0$	$\sin(2\beta + 2\theta_d)$
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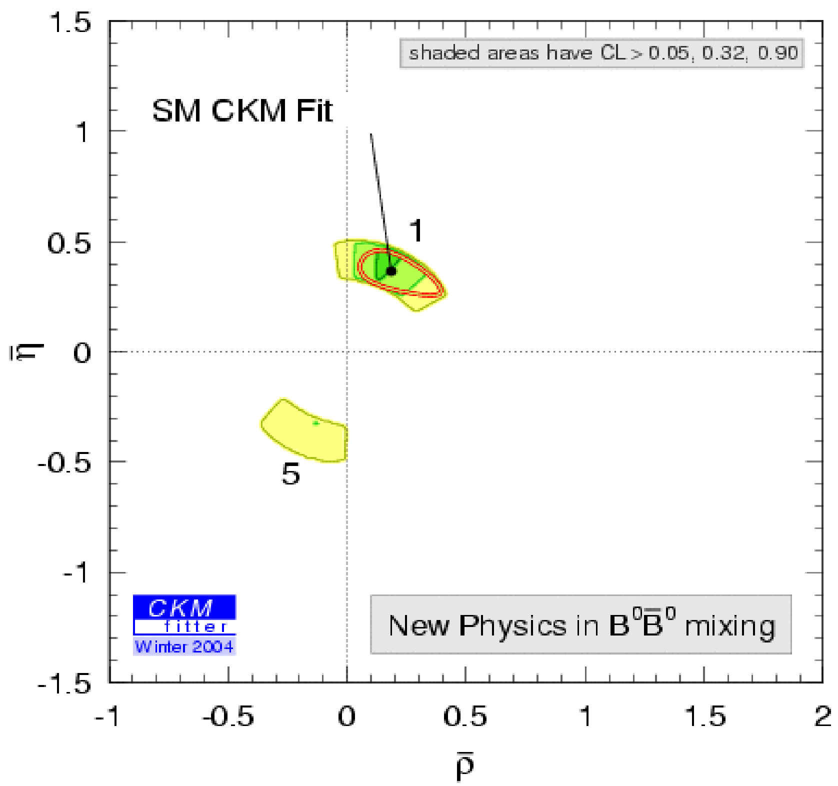
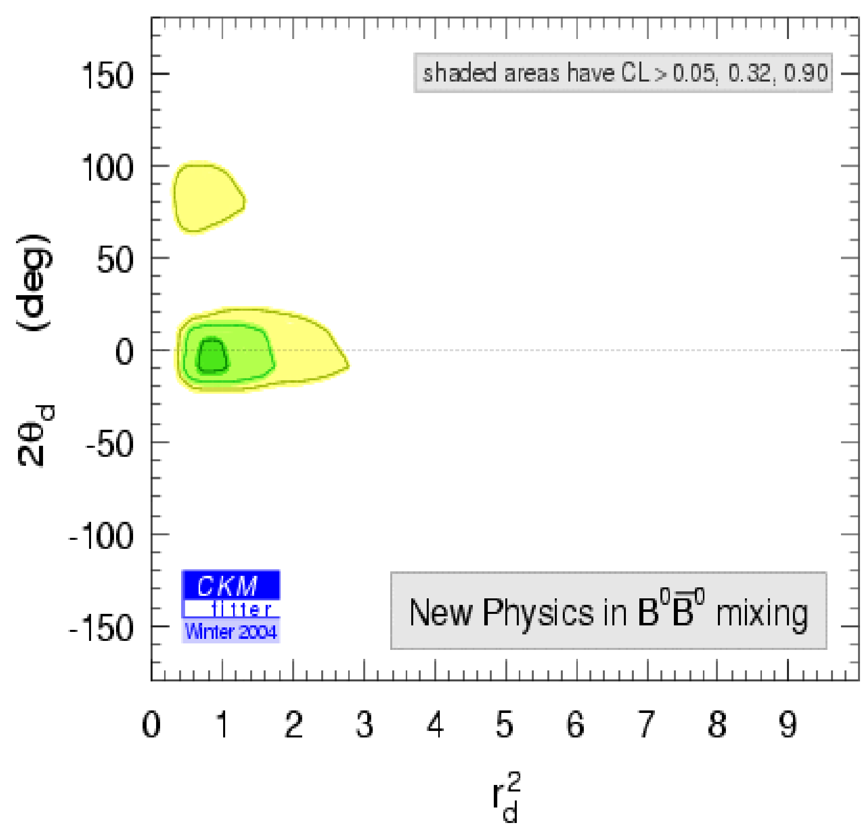
$B \to D^{(*)0} K^+$	$\tan\gamma$
$B \to \rho\rho$	$2\beta + 2\theta_d + 2\gamma$
$B \to D^{(\pm)0} \pi^{\mp}$	$\sin(2\beta + 2\theta_d + \gamma)$

SU(3) ! (Caution)

NEW PHYSICS IN ΔB=2 TRANSITIONS ?

Non-SM solution can be excluded by adding A$_{SL}$: $A_{SL} = -0.007 \pm 0.013$





Parameter space significantly reduced by year 2004 data
(with necessary caveats wrt $\sin(2\beta + 2\theta_d + \gamma)$ **&** $\cos(2\beta + 2\theta_d)$**)**
Nevertheless: Large NP contributions still possible
However: Approaching Finetuning scenario !?
ΔB=2 fit provide constraints on ρ and η consistent with ε_K

NEW PHYSICS IN B->PP DECAYS ?

$B \to \pi^+ \pi^-$ **versus** $B \to K^0 \pi^{+-}$

IDEA: **ΔB=2 fit constrains** $\gamma, 2\beta + 2\theta_d$

Probe for NP in $B \to \pi\pi$ **by comparing** $P_{\pi\pi}^{+-}$ **with** $P_{K\pi}^{0+}$

Inputs: $\gamma, 2\beta + 2\theta_d$ $\quad S_{\pi\pi}^{+-}, C_{\pi\pi}^{+-}$ $\quad BF(\pi^+\pi^-), BF(\pi^{+-}\pi^0), BF(\pi^0\pi^0)$

$BF(K^0\pi^{+-})$

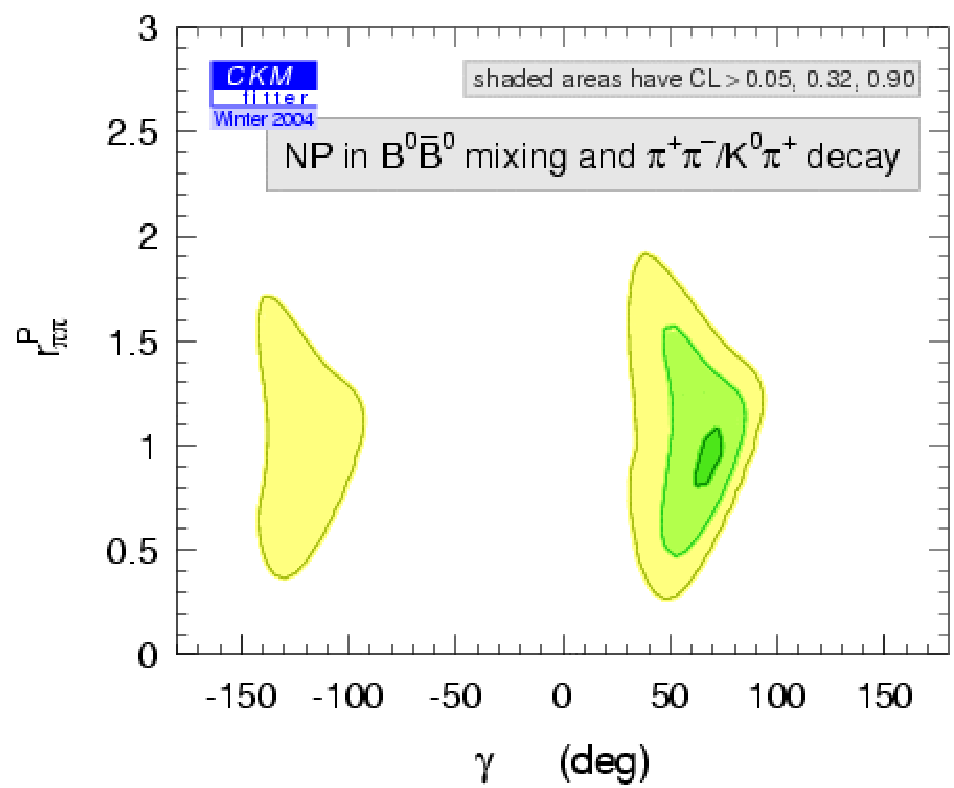
Constrain: $$r_{\pi\pi}^P = \sqrt{\frac{\tau_{B^+}}{\tau_{B^0}} \frac{PS\left|V_{cs} V_{cb}^* P_{\pi\pi}^{+-}\right|^2}{BF(K^0\pi^+)}}$$

$$A(B^0 \to \pi\pi) = V_{ud} V_{ub}^* T_{\pi\pi}^{+-} + V_{cd} V_{cb}^* P_{\pi\pi}^{+-}$$

SM: $$r_{\pi\pi}^P = O(1)$$

$$r_{\pi\pi}^P \equiv 1$$

if SU(3) exact
no Annih./Exch.
no EW Peng.



Deviation from 1 larger than O(30%):

Hint of non-standard contributions

NEW PHYSICS IN B->VP DECAYS ?

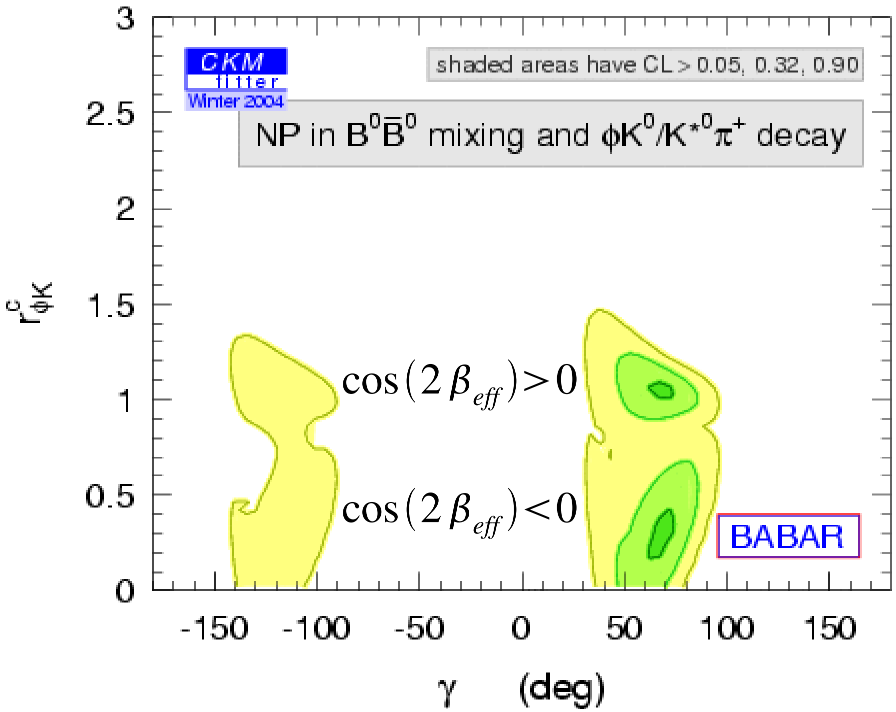
$B \to \phi K^0$ **versus** $B \to K^{*0} \pi^+$

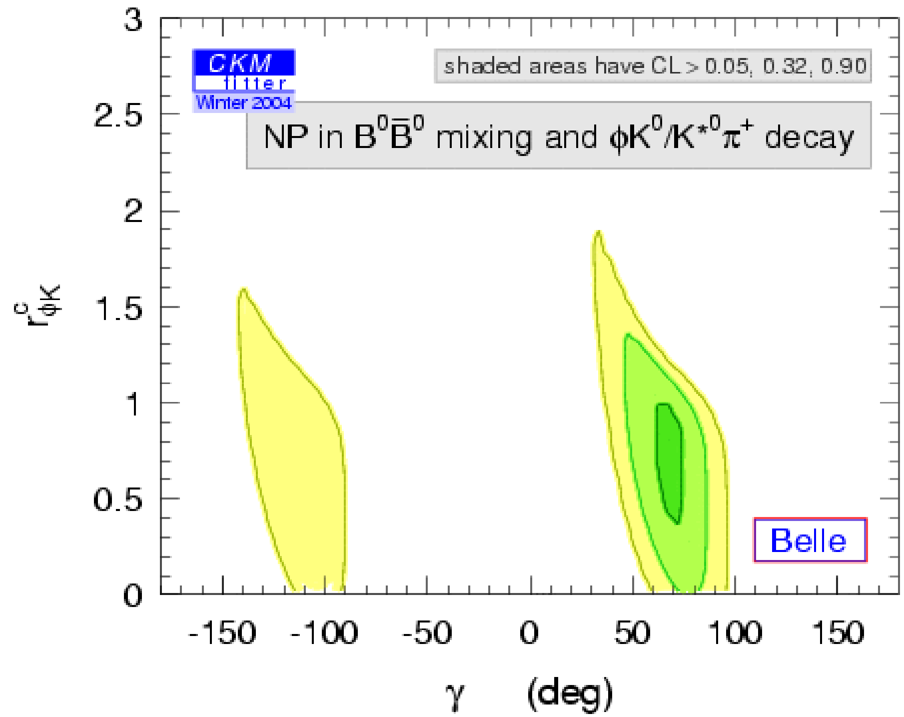
Inputs: $\gamma, 2\beta + 2\theta_d$ $\quad S_{\phi K}, C_{\phi K}$ $\quad BF(\phi K^0)$ $\quad BF(K^{*0}\pi^{+-})$

Constrain: $r^c_{\phi K} = \sqrt{\frac{\tau_{B^+}}{\tau_{B^0}} \frac{PS |V_{cs} V^*_{cb} P^c_{\phi K}|^2}{BF(K^{*0}\pi^+)}}$ $\quad r^{u/c}_{\phi K} = \frac{|P^u_{\phi K}|}{|P^c_{\phi K}|}$ $\quad A(B^0 \to \phi K^0) = V_{us} V^*_{ub} P^u_{\phi K} + V_{cs} V^*_{cb} P^c_{\phi K}$

SM: $r^c_{\phi K} \approx O(1)$ **if SU(3) exact**
no Annih./Exch.
no EW Penguins

Deviation: ***Hint of non-standard short-distance EW Penguins***





NEW PHYSICS IN B->VP DECAYS ?

$$B \to \phi K^0 \quad \textbf{versus} \quad B \to K^{*0}\pi^+$$

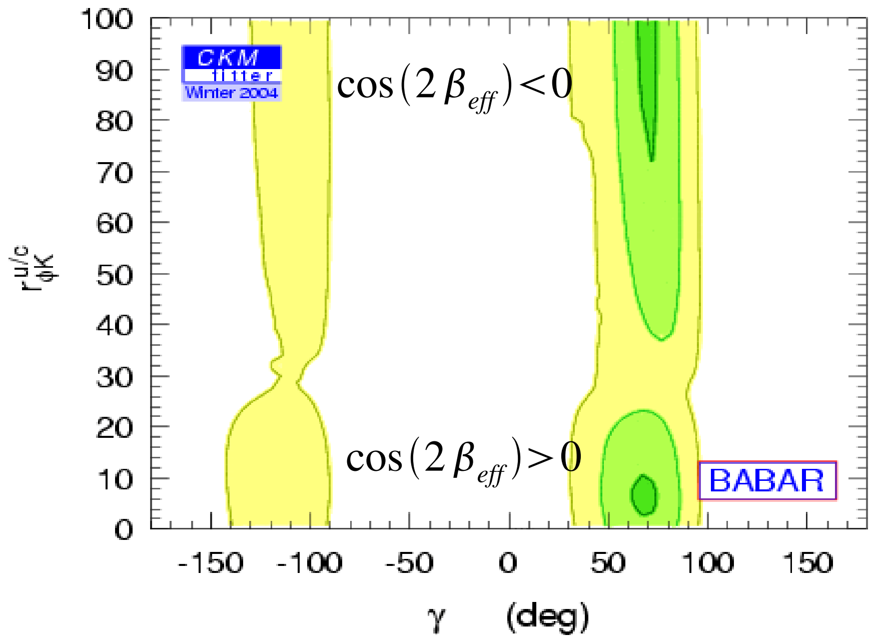
Inputs: $\gamma, 2\beta + 2\theta_d \quad S_{\phi K}, C_{\phi K} \quad BF(\phi K^0) \quad BF(K^{*0}\pi^{+-})$

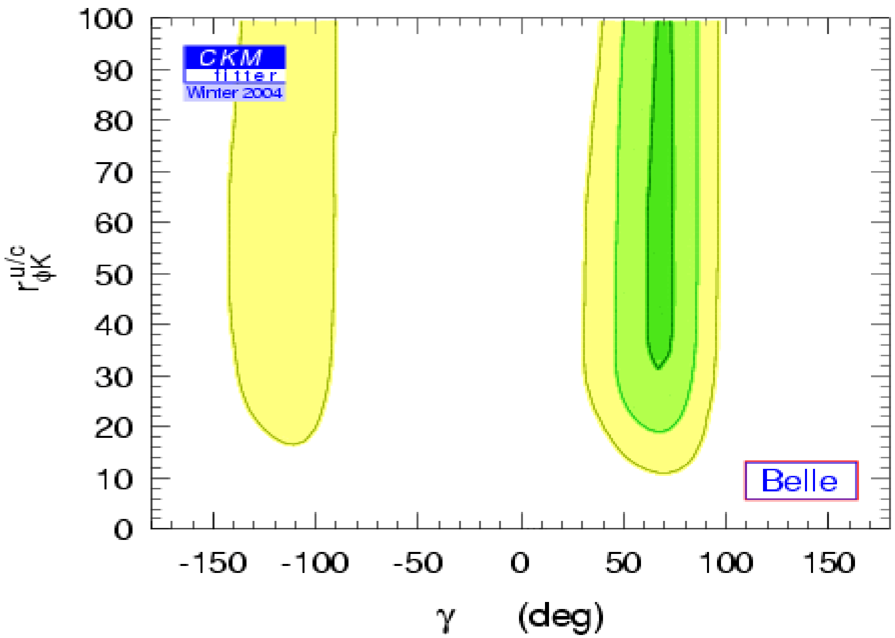
Constrain: $r^c_{\phi K} = \sqrt{\frac{\tau_{B^+}}{\tau_{B^0}} \frac{PS\left|V_{cs}V^*_{cb}P^c_{\phi K}\right|^2}{BF(K^{*0}\pi^+)}}$ $\quad r^{u/c}_{\phi K} = \frac{\left|P^u_{\phi K}\right|}{\left|P^c_{\phi K}\right|}$ $\quad A(B^0 \to \phi K^0) = V_{us}V^*_{ub}P^u_{\phi K} + V_{cs}V^*_{cb}P^c_{\phi K}$

SM: $r^{u/c}_{\phi K} \approx O(1) \quad r^{u/c}_{\phi K} \approx O(10)$ **possible (Grossman, Ligeti, Nir, Quinn)**

If NP competes with SM: $r^{u/c}_{\phi K} = O(1/\lambda^2)$

Deviation: ***Hint of non-standard long-distance EW or gluonic Penguins***

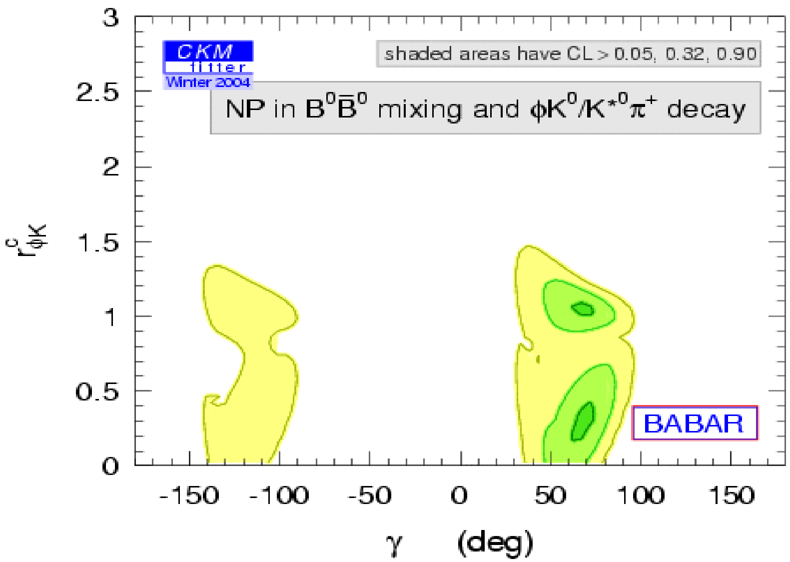


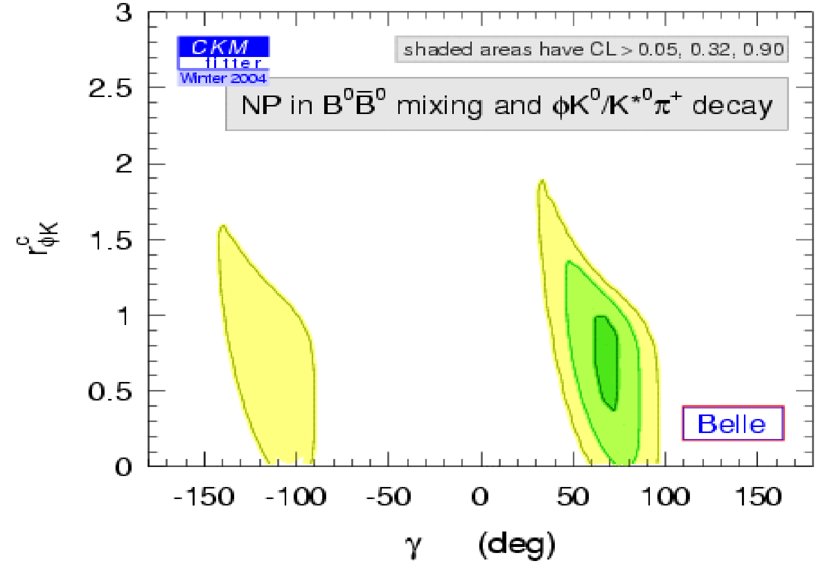


NEW PHYSICS IN B->VP DECAYS ?

$$B \to \phi K^0 \quad \textbf{versus} \quad B \to K^{*0} \pi^+$$

$$r^c_{\phi K} = \sqrt{\frac{\tau_{B^+}}{\tau_{B^0}} \frac{PS \left| V_{cs} V^*_{cb} P^c_{\phi K} \right|^2}{BF\left(K^{*0}\pi^+\right)}}$$





At the time when the large deviation in $S_{\phi K}$ was observed by Belle:

Hint of non-standard gluonic Penguins rather than non-standard EW Penguins

$$r^u_{\phi K} = \frac{\left|P^u_{\phi K}\right|}{\left|P^c_{\phi K}\right|}$$