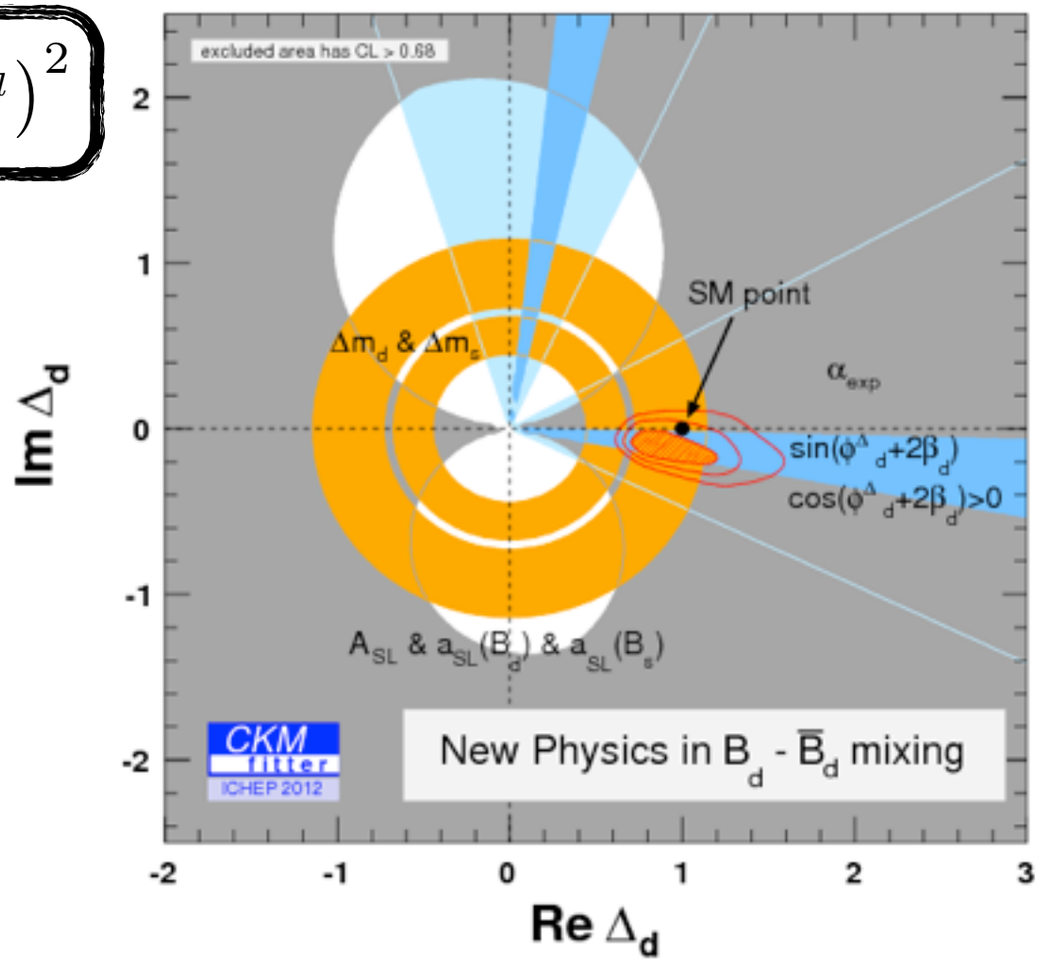
NP in B mixing

$$M_{12} = M_{12}^{\rm SM}\Delta_d\,, \quad \Delta_d = \left(r_d e^{i\theta_d}\right)^2$$

$$\Delta m_d = r_d^2 (\Delta m_d)^{\rm SM}$$

$$S_{\psi K_S}^{(B)} = \sin(2\beta + 2\theta_d)$$

$$a_{SL}^{(d)} = \Re\left(\frac{\Gamma_{12}}{M_{12}}\right)^{\rm SM}\frac{\sin\theta_d}{r_d^2} + \Im\left(\frac{\Gamma_{12}}{M_{12}}\right)^{\rm SM}\frac{\cos 2\theta_d}{r_d^2}$$



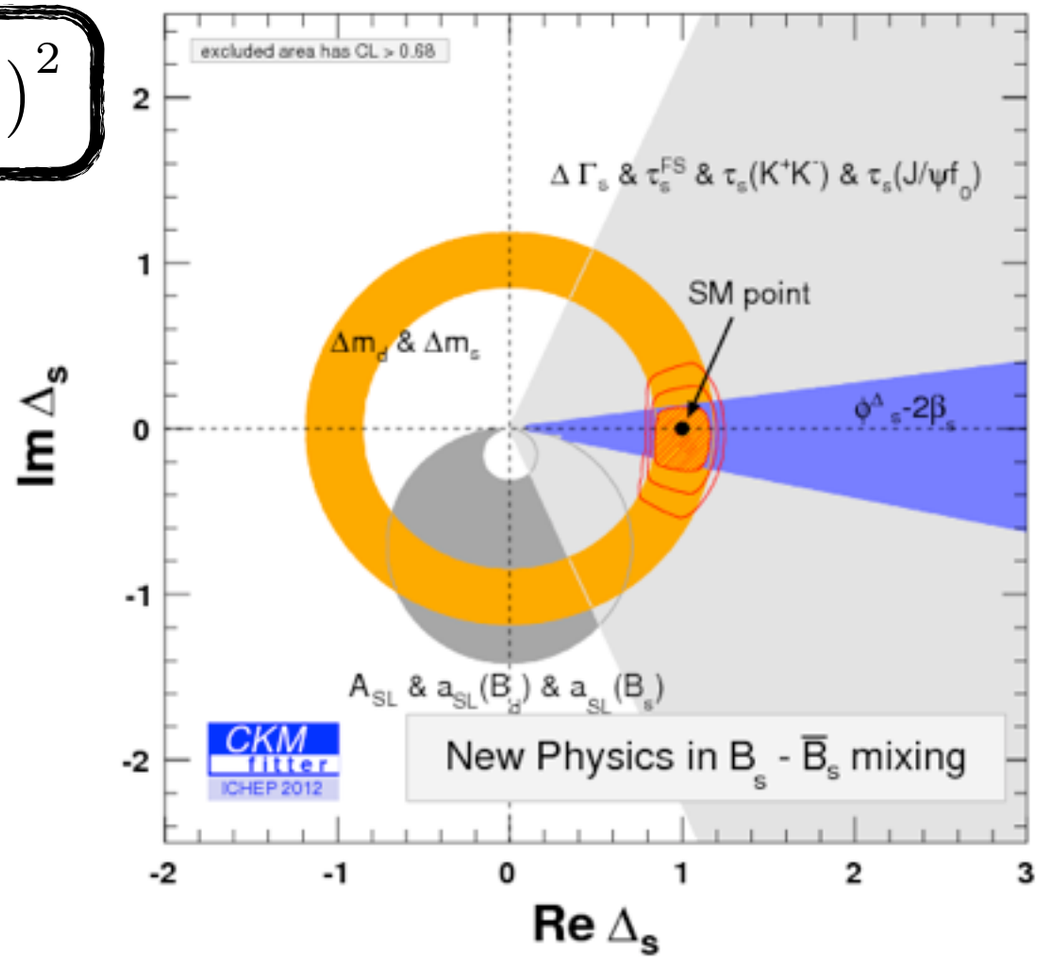
NP in B mixing

$$M_{12} = M_{12}^{\rm SM}\Delta_s\,, \quad \Delta_s = \left(r_s e^{i\theta_s}\right)^2$$

$$\Delta m_s = r_s^2 (\Delta m_s)^{\rm SM}$$

$$S_{\psi\phi}^{(B_s)} = \sin(2\beta_s + 2\theta_s)$$

$$a_{SL}^{(s)} = \Re\left(\frac{\Gamma_{12}}{M_{12}}\right)^{\rm SM}\frac{\sin\theta_s}{r_s^2} + \Im\left(\frac{\Gamma_{12}}{M_{12}}\right)^{\rm SM}\frac{\cos 2\theta_s}{r_s^2}$$



NP in ΔF=2

$$\mathcal{L}_{\Delta F=2} = \frac{z_{sd}}{\Lambda_{\rm NP}^2}(\overline{d_L}\gamma_\mu s_L)^2 + \frac{z_{cu}}{\Lambda_{\rm NP}^2}(\overline{c_L}\gamma_\mu u_L)^2 + \frac{z_{bd}}{\Lambda_{\rm NP}^2}(\overline{d_L}\gamma_\mu b_L)^2 + \frac{z_{bs}}{\Lambda_{\rm NP}^2}(\overline{s_L}\gamma_\mu b_L)^2.$$

CPC NP

$$\begin{aligned}
\Delta m_K/m_K &\sim 7.0\times10^{-15},\\
\Delta m_D/m_D &\sim 8.7\times10^{-15},\\
\Delta m_B/m_B &\sim 6.3\times10^{-14},\\
\Delta m_{B_s}/m_{B_s} &\sim 2.1\times10^{-12},
\end{aligned}
\Rightarrow \Lambda_{\rm NP} \gtrsim \begin{cases}
\sqrt{z_{sd}}\,1\times10^3\ \text{TeV} & \Delta m_K\\
\sqrt{z_{cu}}\,1\times10^3\ \text{TeV} & \Delta m_D\\
\sqrt{z_{bd}}\,4\times10^2\ \text{TeV} & \Delta m_B\\
\sqrt{z_{bs}}\,7\times10^1\ \text{TeV} & \Delta m_{B_s}
\end{cases}$$

CPV NP

$$\begin{aligned}
\epsilon_K &\sim 2.3\times10^{-3},\\
A_\Gamma/y_{\rm CP} &\lesssim 0.2,\\
S_{\psi K_S} &= 0.67\pm0.02,\\
S_{\psi\phi} &\lesssim 1.
\end{aligned}
\Rightarrow \Lambda_{\rm NP} \gtrsim \begin{cases}
\sqrt{z_{sd}}\,2\times10^4\ \text{TeV} & \epsilon_K\\
\sqrt{z_{cu}}\,3\times10^3\ \text{TeV} & A_\Gamma\\
\sqrt{z_{bd}}\,8\times10^2\ \text{TeV} & S_{\psi K}\\
\sqrt{z_{bs}}\,7\times10^1\ \text{TeV} & S_{\psi\phi}
\end{cases}$$

NP in ΔF=2

$$\mathcal{L}_{\Delta F=2} = \frac{z_{sd}}{\Lambda_{\rm NP}^2}(\overline{d_L}\gamma_\mu s_L)^2 + \frac{z_{cu}}{\Lambda_{\rm NP}^2}(\overline{c_L}\gamma_\mu u_L)^2 + \frac{z_{bd}}{\Lambda_{\rm NP}^2}(\overline{d_L}\gamma_\mu b_L)^2 + \frac{z_{bs}}{\Lambda_{\rm NP}^2}(\overline{s_L}\gamma_\mu b_L)^2.$$

CPC NP

$$\begin{aligned}
\Delta m_K/m_K &\sim 7.0\times10^{-15},\\
\Delta m_D/m_D &\sim 8.7\times10^{-15},\\
\Delta m_B/m_B &\sim 6.3\times10^{-14},\\
\Delta m_{B_s}/m_{B_s} &\sim 2.1\times10^{-12},
\end{aligned}
\Rightarrow
\begin{aligned}
z_{sd} &\lesssim 8\times10^{-7}\,(\Lambda_{\rm NP}/{\rm TeV})^2,\\
z_{cu} &\lesssim 5\times10^{-7}\,(\Lambda_{\rm NP}/{\rm TeV})^2,\\
z_{bd} &\lesssim 5\times10^{-6}\,(\Lambda_{\rm NP}/{\rm TeV})^2,\\
z_{bs} &\lesssim 2\times10^{-4}\,(\Lambda_{\rm NP}/{\rm TeV})^2,
\end{aligned}$$

CPV NP

$$\begin{aligned}
\epsilon_K &\sim 2.3\times10^{-3},\\
A_\Gamma/y_{\rm CP} &\lesssim 0.2,\\
S_{\psi K_S} &= 0.67\pm0.02,\\
S_{\psi\phi} &\lesssim 1.
\end{aligned}
\Rightarrow
\begin{aligned}
z^I_{sd} &\lesssim 6\times10^{-9}\,(\Lambda_{\rm NP}/{\rm TeV})^2,\\
z^I_{cu} &\lesssim 1\times10^{-7}\,(\Lambda_{\rm NP}/{\rm TeV})^2,\\
z^I_{bd} &\lesssim 1\times10^{-6}\,(\Lambda_{\rm NP}/{\rm TeV})^2,\\
z^I_{bs} &\lesssim 2\times10^{-4}\,(\Lambda_{\rm NP}/{\rm TeV})^2.
\end{aligned}$$

NP in ΔF=2

$$\mathcal{L}_{\Delta F=2} = \frac{z_{sd}}{\Lambda_{\rm NP}^2}(\overline{d_L}\gamma_\mu s_L)^2 + \frac{z_{cu}}{\Lambda_{\rm NP}^2}(\overline{c_L}\gamma_\mu u_L)^2 + \frac{z_{bd}}{\Lambda_{\rm NP}^2}(\overline{d_L}\gamma_\mu b_L)^2 + \frac{z_{bs}}{\Lambda_{\rm NP}^2}(\overline{s_L}\gamma_\mu b_L)^2.$$

SM (Λ_{SM}~v)

$$\Im(z_{sd}^{\rm SM}) \sim \frac{\lambda_t^2}{64\pi^2}|V_{td}V_{ts}^*|^2 \sim 10^{-10}$$

$$\Re(z_{sd}^{\rm SM}) \sim \frac{\lambda_c^2}{64\pi^2}|V_{cd}V_{cs}^*|^2 \sim 5\times 10^{-9}$$

$$|z_{bd}^{\rm SM}| \sim \frac{\lambda_t^2}{64\pi^2}|V_{td}V_{tb}^*|^2 \sim 9\times 10^{-8}$$

$$|z_{bs}^{\rm SM}| \sim \frac{\lambda_t^2}{64\pi^2}|V_{ts}V_{tb}^*|^2 \sim 3\times 10^{-6}$$

$$\begin{aligned}
z_{sd} &\lesssim 8\times 10^{-7}\,(\Lambda_{\rm NP}/{\rm TeV})^2,\\
z_{cu} &\lesssim 5\times 10^{-7}\,(\Lambda_{\rm NP}/{\rm TeV})^2,\\
z_{bd} &\lesssim 5\times 10^{-6}\,(\Lambda_{\rm NP}/{\rm TeV})^2,\\
z_{bs} &\lesssim 2\times 10^{-4}\,(\Lambda_{\rm NP}/{\rm TeV})^2,
\end{aligned}$$

$$\begin{aligned}
z^I_{sd} &\lesssim 6\times 10^{-9}\,(\Lambda_{\rm NP}/{\rm TeV})^2,\\
z^I_{cu} &\lesssim 1\times 10^{-7}\,(\Lambda_{\rm NP}/{\rm TeV})^2,\\
z^I_{bd} &\lesssim 1\times 10^{-6}\,(\Lambda_{\rm NP}/{\rm TeV})^2,\\
z^I_{bs} &\lesssim 2\times 10^{-4}\,(\Lambda_{\rm NP}/{\rm TeV})^2.
\end{aligned}$$

NP in ΔF=1

$$\mathcal{L}_{\Delta F=1} = y_{sd}\frac{v^2}{\Lambda_{NP}^2}\frac{g}{c_W}\bar{d}_L \not{Z} s_L + y_{cu}\frac{v^2}{\Lambda_{NP}^2}\frac{g}{c_W}\bar{u}_L \not{Z} c_L + y_{bd}\frac{v^2}{\Lambda_{NP}^2}\frac{g}{c_W}\bar{d}_L \not{Z} b_L + y_{bs}\frac{v^2}{\Lambda_{NP}^2}\frac{g}{c_W}\bar{s}_L \not{Z} b_L$$

SM (Λ_{SM}~v)

$$|y_{sd}^{\rm SM}| \sim \frac{\lambda_t^2}{64\pi^2}|V_{td}V_{ts}^*| \sim 5\times 10^{-7}$$
$$|y_{bd}^{\rm SM}| \sim \frac{\lambda_t^2}{64\pi^2}|V_{td}V_{tb}^*| \sim 10^{-5}$$
$$|y_{bs}^{\rm SM}| \sim \frac{\lambda_t^2}{64\pi^2}|V_{ts}V_{tb}^*| \sim 6\times 10^{-5}$$

$$\Rightarrow$$

$$\mathcal{B}(K^+ \to \pi^+ \nu\bar{\nu}) \sim 8\times 10^{-11}\,,$$
$$\mathcal{B}(B_d \to \mu^+\mu^-) \sim 10^{-10}\,,$$
$$\mathcal{B}(B_s \to \mu^+\mu^-) \sim 4\times 10^{-9}\,.$$