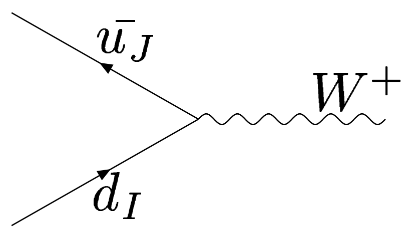
Plan:

- Why we should the exact informations about Cabbibo-Kobayashi-Maskawa matrix (V_{CKM})?
- V_{CKM} – the only source of CP and flavour violation?
- Classification of SM extensions.
- CP and flavour violation in Standarod Model and its extensions.
- Description of the experimental quantities in SM and its extensions.
- How to distinguish between models?Possibility of experimental excluding models.
- Bounds on new models following from present and future experimental data.
- The examples of the models - 2HDM(II) i MSSM.

The motivations for precise finding the Cabbibo-Kobayashi-Maskawa matrix elements (V_{CKM})

- the V_{CKM} matrix describes CP violation and flavour violation



$\sim V_{IJ}$

- this is the only source of CP violation and flavour violation in Standard Model (SM)

- CP violation is nessesery in bariogenesis theories

- in SM CP violation is too small to explain $\frac{n_{barion}}{n_{foton}} \sim 10^{-9}$

Cabbibo-Kobayashi-Maskawa (V_{CKM}) matrix

$$V_{CKM} = \begin{bmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{bmatrix} \quad (1)$$

For 3 generations of quarks this matrix is parametrized by 3 angles and the phase δ. In SM that phase is the only source of CP violation.

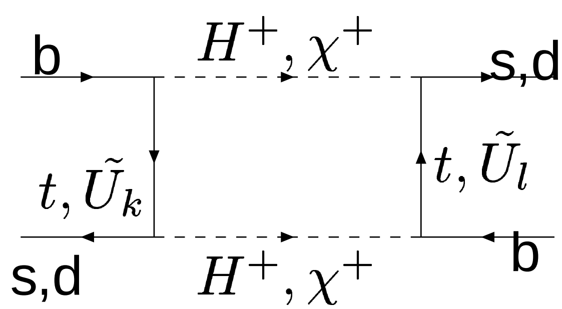
The V_{CKM} elements are found experimentally. They are determined from the tree or loop level processes.

V_{ij}	value	process
$\|V_{us}\|$	0.2205 ± 0.0018	$K^+ \to \pi^0 e^+ \nu_e$
$\|V_{cb}\|$	0.041 ± 0.002	$B \to X_c^* l \bar{\nu}_l$
$\|V_{ub}\|$	0.00349 ± 0.00076	$B \to X_u^* l \bar{\nu}_l$

$|V_{td}|$ i $|V_{ts}|$ - are determined from the loop-level processes.

How we can classify the extensions of Standard Model with respect on sources CP violation :

1. V_{CKM} matrix is the only one source of CP violation and flavour violation: then the enchancement of CP violated efects arrive by the new particles which give rise to the amplitudes of FCNC (*flavour changing neutral current*) processes.



Example: 2HDM or SUSY models

That efects are especially important in quark b physic $B^0_{s,d} - \bar{B^0}_{s,d}$, rare decays B mesons, because in vertices stand Yukawa constants of top or bottom (which is large for $\tan\beta >> 1$).

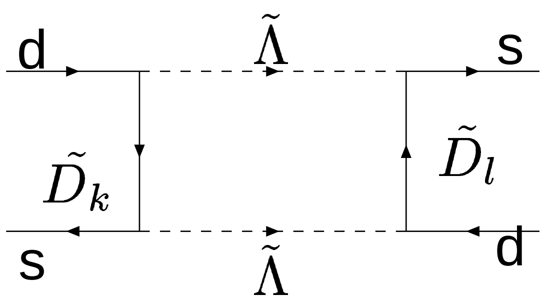
Processes with b quark are experimentally researched. (e.g. $B_s \to X_s\gamma$ /CLEO/, $B \to \Psi K_S$ /BELLE, BaBar/, $B \to l\bar{l}$ /CLEO/)

How we can classify ...(cont.)

2. New sources (except V_{CKM} matrix) of CP and flavour violation – sfermion mass matrices ($u \to \widetilde{U}_L, \widetilde{U}_R$)

$$\mathcal{M}_D^2 = \begin{bmatrix} \left(\mathcal{M}_D^2\right)_{LL} & \left(\mathcal{M}_D^2\right)_{LR} \\ \left(\mathcal{M}_D^2\right)_{RL} & \left(\mathcal{M}_D^2\right)_{RR} \end{bmatrix}, \qquad (2)$$

$\left(\mathcal{M}_D^2\right)_{XY}$ $X, Y = L, R \to 3 \times 3$ matrices.



$\sim (\alpha_S)^2$

Flavour changing - in vertices: quark–squark–gluino.

Rare processes description by H_{eff}

We consider processes with $\Delta F = 2$, because we will use them to find some V_{CKM} matrix elements – V_{td} i V_{ts} (neutral kaons mixing and neutral B^0 mesons mixing).

The examples of the theories above M_W scale: Standard Model(SM), 2-Higgs Doublet Model (2HDM), Minimal Supersymmetric Standard Model (MSSM).

Effective description up to M_W scale by effective Hamiltionian:

$$H_{eff} = \Sigma_i C_i Q^i. \tag{3}$$

It allow us to take into account QCD correction.

C_i – Wilson coeffitiens calculated in 'full theory',
Q^i – local operators built on fermionic fields .

All possible (8) operators dimension 6, which give rise to H_{eff} z $\Delta F = 2$

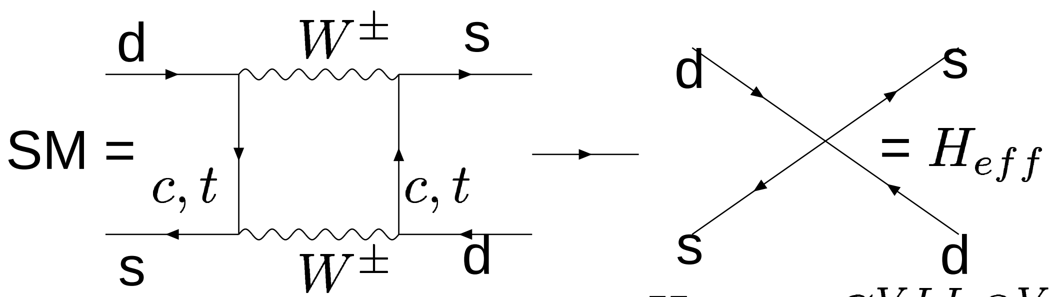
$$
\begin{aligned}
Q^{\mathrm{VLL}} &= (\bar{d}_J \gamma_\mu P_L d_I)(\bar{d}_J \gamma^\mu P_L d_I), \\
Q_1^{\mathrm{LR}} &= (\bar{d}_J \gamma_\mu P_L d_I)(\bar{d}_J \gamma^\mu P_R d_I), \\
Q_2^{\mathrm{LR}} &= (\bar{d}_J P_L d_I)(\bar{d}_J P_R d_I), \\
Q_1^{\mathrm{SLL}} &= (\bar{d}_J P_L d_I)(\bar{d}_J P_L d_I), \\
Q_2^{\mathrm{SLL}} &= (\bar{d}_J \sigma_{\mu\nu} P_L d_I)(\bar{d}_J \sigma^{\mu\nu} P_L d_I), \\
+L \leftrightarrow R, &
\end{aligned}
\tag{4}
$$

I, J - flavour indeces.

Connection of H_{eff} matrix elements with measurables quantities

$$2\mathrm{Im}\langle \bar{K^0}|H_{eff}|K^0\rangle\ M_{K^0} = \varepsilon_K, \qquad (5)$$

$$2\mathrm{Re}\langle \bar{B^0}|H_{eff}|B^0\rangle = \Delta M_{d,s}. \qquad (6)$$



$$H_{eff} = C^{VLL}Q^{VLL}$$

Contribution to kaons mixing in 'full theory'(SM) and 'effective theory'.

The matrix elements Q^x between hadronic states (data from lattice calculations):

$$\langle \bar{K^0} | Q^{VLL} | K^0 \rangle = \frac{8}{3} M_{K^0}^2 f_K^2 \hat{B}_K,$$
$$\langle \bar{B^0} | Q^{VLL} | B^0 \rangle = \frac{8}{3} \hat{B}_{B_d} F_{B_d}^2 M_{B^0}^2 \qquad (7)$$

$\hat{B}_K$ = 0.85± 0.15,
$\sqrt{\hat{B}_{B_d}} F_{B_d}$= 230 MeV $\pm$ 40 MeV,
$\sqrt{\hat{B}_{B_s}} F_{B_s}$ = 265 MeV $\pm$ 40 MeV.

Remark: still large uncertainties!

The classification of models with V_{CKM} as the only source CP violation

One can classify such models on H_{eff} level . It is convenient from phenomenological point of view.

1. The models 'similar to Standard Model' (the MFV model– Minimal Flavour Violation) .
   $H_{eff}^{SM} = C^{VLL}Q^{\mathrm{VLL}}$
   In MFV we can factorize in H_{eff} the elements of V_{CKM}. The contribution from t i $W^{\pm}$ to H_{eff} one can write as:

$$H_{\mathrm{eff}}^{\Delta \mathrm{F}=2} = \frac{G_F^2 M_W^2}{16\pi^2} \lambda_t^2 \sum_i \tilde{C}_i(\mu) Q_i \tag{8}$$

where

$$\begin{aligned} \lambda_t &= V_{ts}V_{td}^* \;\; \mathrm{dla} \;\; K^0 - \bar{K}^0 \\ \lambda_t &= V_{td}V_{tb}^* \;\; \mathrm{dla} \;\; B_d^0 - \bar{B}_d^0 \\ \lambda_t &= V_{ts}V_{tb}^* \;\; \mathrm{dla} \;\; B_s^0 - \bar{B}_s^0 \end{aligned} \tag{9}$$

$\tilde{C}_i$ are real.

The classification of models ...(cont.)

2. GMFV model (Generalized Minimal Flavour Violation).
   Possible contributions from all 8 operators with $\Delta F = 2$

   Because V_{CKM} is in models (1.,2.) the only source of CP and flavour violation, in H_{eff} one can factorize the V_{CKM} matrix elements from the Wilson coefficients like in Standard Model.

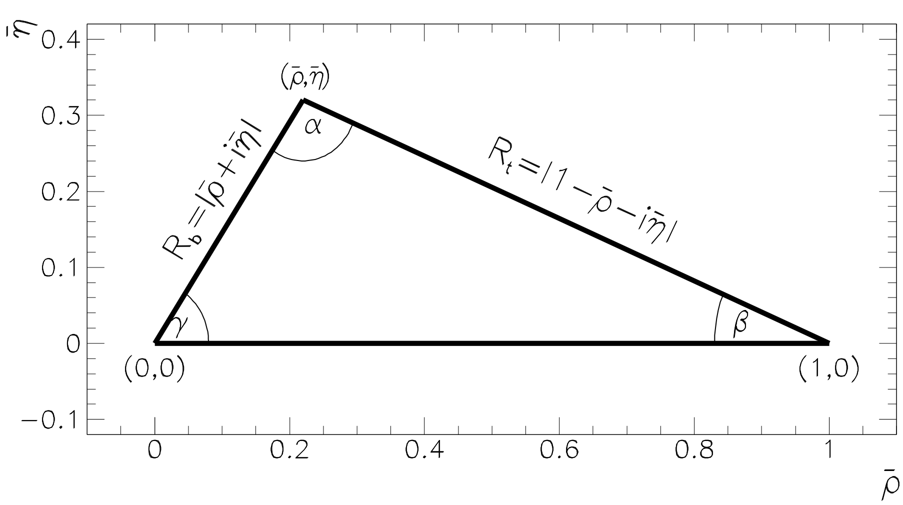
   In SM the contributions to $\tilde{C}_i$ dla $K^0 - \bar{K}^0$, $B_d^0 - \bar{B}_d^0$ i $B_s^0 - \bar{B}_s^0$ are the same (they are given by one function common for all that processes), similar in MFV.
   This is no longer true in GMFV.

Wolfenstein parametrization

$$V_{CKM} = \left[\begin{array}{ccc} 1-\lambda^2/2 & \lambda & A\lambda^3(\varrho - i\eta) \\ -\lambda & 1-\lambda^2/2 & A\lambda^2 \\ A\lambda^3(1-\varrho-i\eta) & \lambda^2/2 & 1 \end{array} \right] \quad (10)$$

Wolfenstein parameters: λ, A, $\bar{\varrho}$, $\bar{\eta}$, where A i λ are found from tree-level processes.
One of orthogonality relation

$$V_{ud}V_{ub}^* + V_{cd}V_{cb}^* + V_{td}V_{tb}^* = 0. \quad (11)$$



Unitarity triangle.

$$R_b \equiv \frac{|V_{ud}V_{ub}^*|}{|V_{cd}V_{cb}^*|} = \sqrt{\bar{\varrho}^2 + \bar{\eta}^2} = (1 - \frac{\lambda^2}{2})\frac{1}{\lambda}\left|\frac{V_{ub}}{V_{cb}}\right| \quad (12)$$

$$R_t \equiv \frac{|V_{td}V_{tb}^*|}{|V_{cd}V_{cb}^*|} = \sqrt{(1-\bar{\varrho})^2 + \bar{\eta}^2} = \frac{1}{\lambda}\left|\frac{V_{td}}{V_{cb}}\right| \quad (13)$$

The formula for $\Delta M_{d,s}$ i ε_K in Standard Model:

- masses differences of neutral mesons B:

$$\Delta M_q = \frac{G_{\rm F}^2 M_W^2}{6\pi^2} M_{B_q}\eta_B \hat{B}_{B_q} F_{B_q}^2 |V_{tq}|^2 S_0(x_t), \quad q = d, s \quad (14)$$

where $S_0(x_t)$ with $x_t = m_t^2/M_W^2$ is function deriving from diagram $(t, W^{\pm})$ (in SM) $S_0(x_t) \approx 2.38 \pm 0.11$ for $\bar{m}_t(m_t) = (166 \pm 5)$ GeV.

$\Delta M_s/\Delta M_d$ i ΔM_d

– $\Delta M_d = (0.487 \pm 0.009)/ps$ - uncertainties, from $\sqrt{\hat{B}_{B_d}} F_{B_d}$
– $\Delta M_s \geq 15.0/ps$ ($\frac{\Delta M_s}{\Delta M_d} \geq 30$),
$\xi = \frac{\sqrt{\hat{B}_{B_s}} F_{B_s}}{\sqrt{\hat{B}_{B_d}} F_{B_d}} = 1.15 \pm 0.06$
- we do not know ΔM_s, just upper bound

- ε_K describing CP violating in the neutral kaon system:

$$\bar{\eta}\left[(1-\bar{\varrho})A^2\eta_2 S_0(x_t) + P_c(\varepsilon)\right] A^2 \hat{B}_K = 0.204 \tag{15}$$

$\mathbf{sin2}\beta$ measured in $B_d^0(\bar{B}_d^0) \to \psi K_S$ decay

$sin2\beta$ is found from measurement of the CP violated asymmetry ($a_{\psi K_{\rm S}}$) in $B_d^0(\bar{B}_d^0) \to \psi K_S$ decay.
Asymmetry:
$a_f = \frac{A(i\to f)-A(\bar{i}\to\bar{f})}{A(i\to f)+A(\bar{i}\to\bar{f})}$.

Why $B_d^0(\bar{B}_d^0) \to \psi K_S$ measures the $sin2\beta$?

The amplitude of that proces is composed on three amplitudes:

- $B_d^0 - \bar{B_d^0}$ mixing ($\sim |V_{td}V_{tb}^*|^2$),
- $B_d^0(\bar{B}_d^0) \to \psi K_S$ decay, which is real, if we neglect any loop-diagram (double Cabbibo-suppressed),
- $K^0 - \bar{K^0}$ mixing, which is real.

β angle (exactly $sin2\beta$) is the phase of the amplitude $B_d^0 - \bar{B}_d^0$ mixing.

Why $B_d^0(\bar{B}_d^0) \to \psi K_S$ measures the $sin2\beta$?

Experimental results:

$$a_{\psi K_\mathrm{S}} = \begin{cases} 0.59 \pm 0.14 \pm 0.05 & \text{(BaBar)} \\ 0.99 \pm 0.14 \pm 0.06 & \text{(Belle)} \\ 0.79^{+0.41}_{-0.44} & \text{(CDF)} \\ 0.84^{+0.82}_{-1.04} \pm 0.16 & \text{(ALEPH)} \end{cases} \tag{16}$$

The grand average is

$$a_{\psi K_\mathrm{S}} = 0.79 \pm 0.10\ , \tag{17}$$

but in view of the fact that BaBar and Belle results are not fully consistent with each other we believe that a better description of the present situation is $a_{\psi K_\mathrm{S}} = 0.80 \pm 0.20$.

Unitarity triangle in GMFV i MFV models

There are 3 processes, in which we will determine V_{CKM} elements – it is convenient to define separate function for each proces:

$$\begin{aligned} F_{tt}^d &= S_0(x_t)[1+f_d] \qquad (\text{for } \ \varepsilon_\mathrm{K}), \\ F_{tt}^s &= S_0(x_t)[1+f_s] \qquad (\text{for } \ \Delta \mathrm{M_d}), \\ F_{tt}^\varepsilon &= S_0(x_t)[1+f_\varepsilon] \qquad (\text{for } \ \Delta \mathrm{M_s}) \end{aligned} \tag{18}$$

in SM: $f_d = f_s = f_\varepsilon = 0$, $F_{tt}^d = F_{tt}^s = F_{tt}^\varepsilon = S_0(x_t)$

In MFV is $F_{tt}^d = F_{tt}^s = F_{tt}^\varepsilon$.

The formula for ε_K in GMFV:

$$\bar{\eta}\left[(1-\bar{\varrho})A^2\eta_2 F_{tt}^\varepsilon + P_c(\varepsilon)\right] A^2 \hat{B}_K = 0.204 \tag{19}$$

The formula for ΔM_q in GMFV:

$$\Delta M_q = \frac{G_\mathrm{F}^2 M_W^2}{6\pi^2} M_{B_q} \eta_B \hat{B}_{B_q} F_{B_q}^2 |V_{tq}|^2 F_{tt}^q, \qquad q = d, s \tag{20}$$

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As in SM, we can determine R_t in 2 ways: from ΔM_d and $\Delta M_d/\Delta M_s$:

$$R_t = 1.084\,\frac{R_0}{A}\frac{1}{\sqrt{F_{tt}^d}} \qquad (21)$$

$$R_0 \equiv \sqrt{\frac{\Delta M_d}{0.487/\mathrm{ps}}}\left[\frac{230\ \mathrm{MeV}}{\sqrt{\hat{B}_{B_d}}F_{B_d}}\right]\sqrt{\frac{0.55}{\eta_B}}$$

and

$$R_t = 0.819\,\xi\sqrt{\frac{\Delta M_d}{0.487/\mathrm{ps}}}\sqrt{\frac{15/\mathrm{ps}}{\Delta M_s}}\sqrt{R_{sd}}\ , \qquad (22)$$

$$R_{sd} = \frac{1+f_s}{1+f_d} \qquad (23)$$

In MFV $R_{sd}=1$ (R_t found from $\Delta M_d/\Delta M_s$ does not depend on parameters of model).

How to distinguish between GMFV and MFV models:

The question: how one can check experimentaly, if MFV are still valid, or no?:

- if the experimentaly value $\sin 2\beta$ will be small (smaller then 0.42), then MFV models are excluded.
  In the MFV models there exists an *absolute* lower bound on $\sin 2\beta$ that follows from the interplay of ΔM_d and ε and depends mainly on V_{cb}, V_{ub} and the non-perturbative parameters $\hat{B}_K$, $F_{B_d}\sqrt{\hat{B}_{B_d}}$ entering the analysis of the unitarity triangle. Lower bound on $\sin 2\beta$ obtained by scanning independently all relevant input parameters reads $(\sin 2\beta)_{\min} = 0.42$,

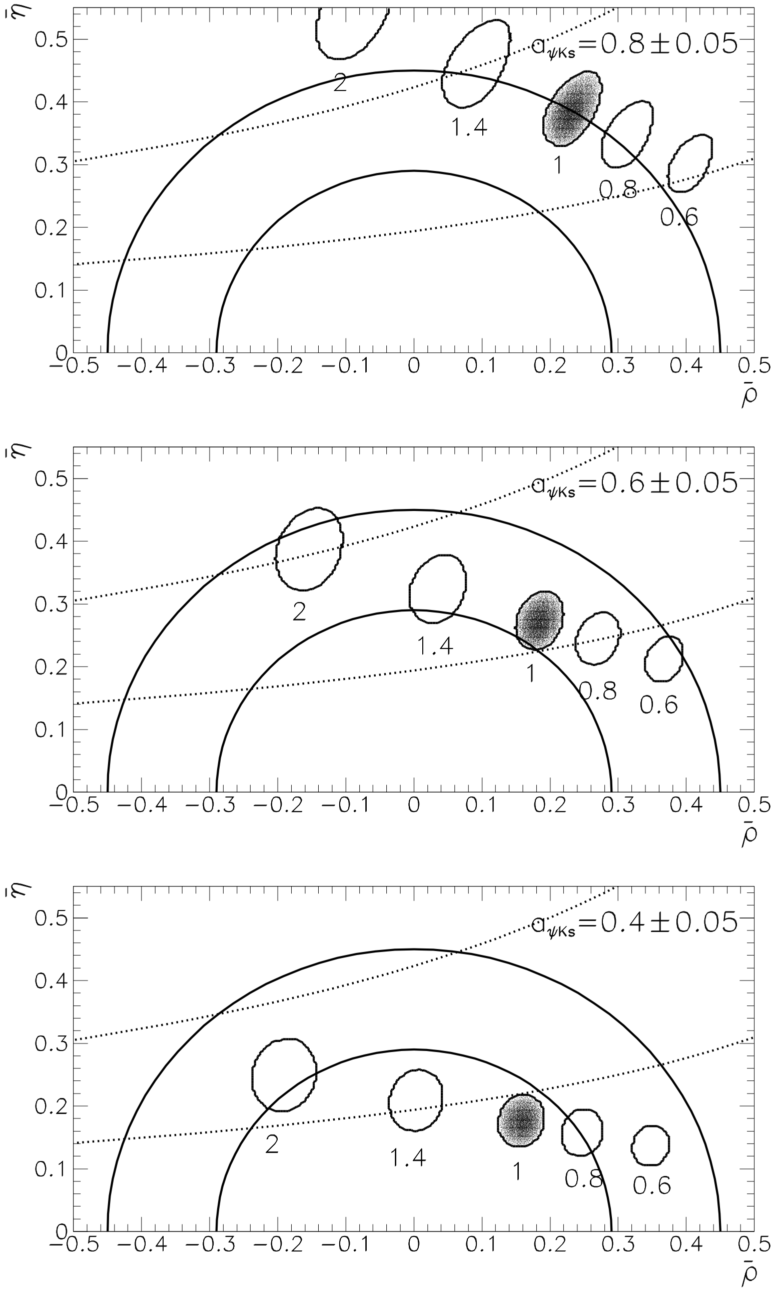
- if the experimentaly value $\sin 2\beta$ will be above this bound , then we analize the correlations between $\Delta M_d/\Delta M_s$, $\sin 2\beta$ and another quantities like ε_K or γ.

- ’strategy A’: if we will know experimentally value for $\Delta M_d/\Delta M_s$, then for any R_{sd} we know R_t - so we can find $\sin 2\beta$ (and we can compare with experimental results):

$$R_t \sim \frac{1}{\sqrt{\Delta M_s/\Delta M_d}}\sqrt{R_{sd}} \tag{24}$$

$R_t, R_b \rightarrow \sin 2\beta$

- ’strategy B’: if we will know experimentally value for $\Delta M_d/\Delta M_s$ and $sin2\beta$, we can find the value of the γ angle (from $B \rightarrow \pi K$)



Ranges of $(\bar{\rho}, \bar{\eta})$ allowed in 1σ for $\Delta M_s = (18.0 \pm 0.5)/ps$, three values of $a_{\psi K_S}$ and different values of R_{sd} (marked in the figures). Black spots correspond to $R_{sd} = 1$. Dotted lines show the constraint from ε_K, for $1 + f_\varepsilon = 1$.

The question: how one in concrete model find bounds on $F_{tt}^{d,s,\varepsilon}$ function?.

- from fitting the formula (20) to the measured (in the near future) value of ΔM_s. This determines $1 + f_s$ (or F_{tt}^{s}):

$$1 + f_s = 0.80 \left[\frac{2.38}{S_0(x_t)}\right] \left[\frac{265\ \mathrm{MeV}}{\sqrt{\hat{B}_{B_s}} F_{B_s}}\right]^2 \left[\frac{0.55}{\eta_B}\right] \left[\frac{0.041}{|V_{ts}|}\right]^2 \left[\frac{\Delta \ldots}{15 \ldots}\right.$$

scanning over uncertainties gives

$$0.52 \left[\frac{\Delta M_s}{15/ps}\right] < 1 + f_s < 1.29 \left[\frac{\Delta M_s}{15/ps}\right] \qquad (26)$$

(at present this gives $1 + f_s > 0.52$.)

next, there are bounds on R_t coming from unitarity of V_{CKM} matrix

$$1 - R_b < R_t < 1 + R_b \qquad (27)$$

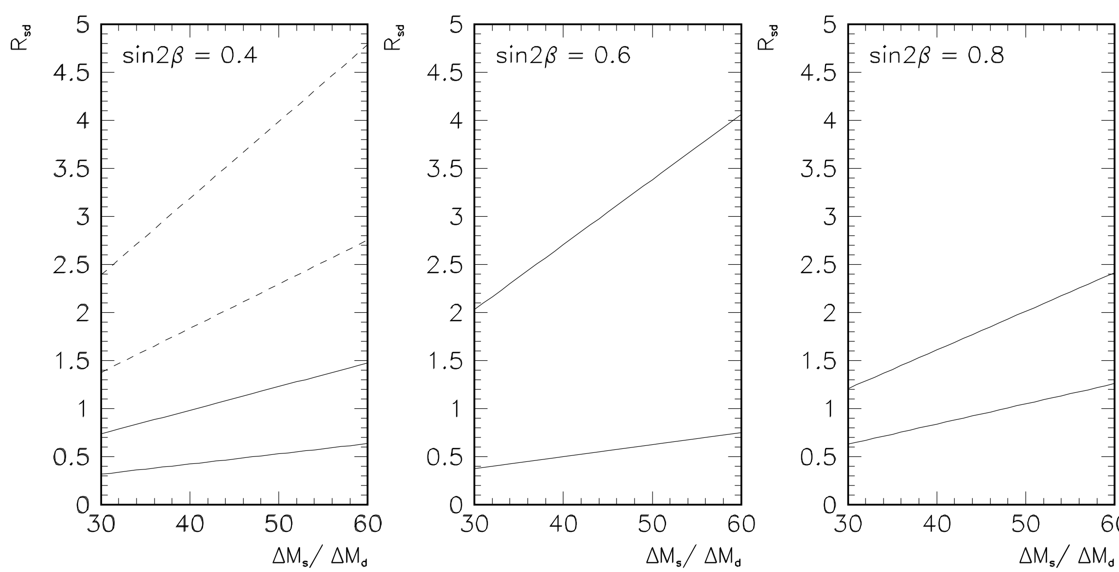
it gives $0.54 < R_t < 1.46$. This can be used to constrain either $1 + f_d$ or R_{sd}:

$$0.20 < 1 + f_d < 4.24 \tag{28}$$

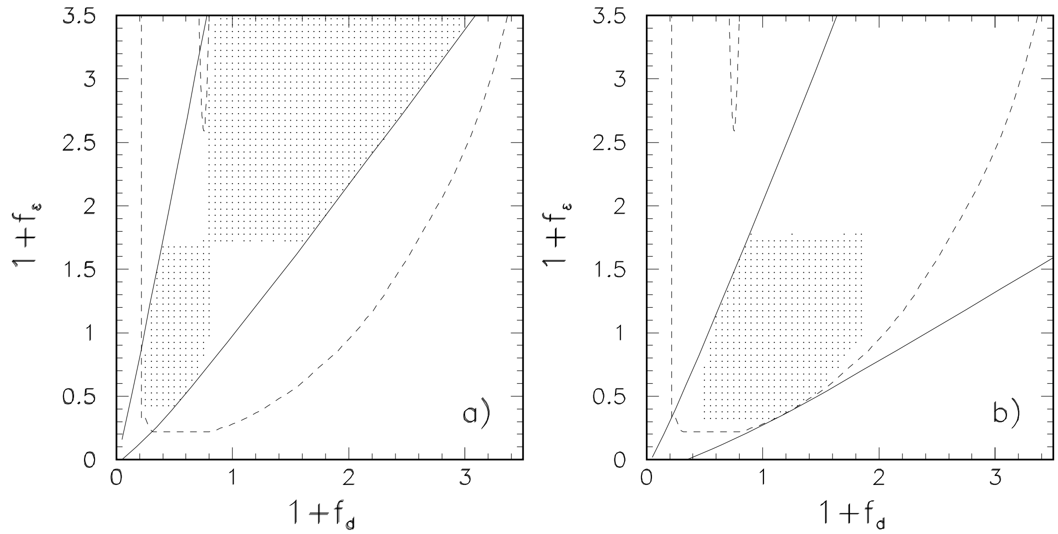
and

$$0.29 \left[\frac{\Delta M_s}{15/ps}\right] < R_{sd} < 2.73 \left[\frac{\Delta M_s}{15/ps}\right]. \tag{29}$$

- from measurement of $sin2\beta$ i R_b we can get more stringent constraint on R_{sd}
(if we know $sin2\beta$ i R_b, then we know R_t).



- if we make use on experimental result on ε_K, we can corelate F_{tt}^{ε} with F_{tt}^{d}.



Allowed ranges of $1 + f_d$ and $1 + f_\varepsilon$.

- ΔM_d, ε and R_b allow the region delimited by the dashed lines.
- Regions between the solid lines are allowed by ΔM_d, ε and $\sin 2\beta = 0.4$ (panel a) and $\sin 2\beta = 0.8$ (panel b).
- Dotted regions are allowed by ΔM_d, ε and R_b for $\sin 2\beta = 0.4$ and 0.8 in panels a) and b), respectively.

The examples of GMFV models

1. 2HDM(II) with large $\tan\beta$

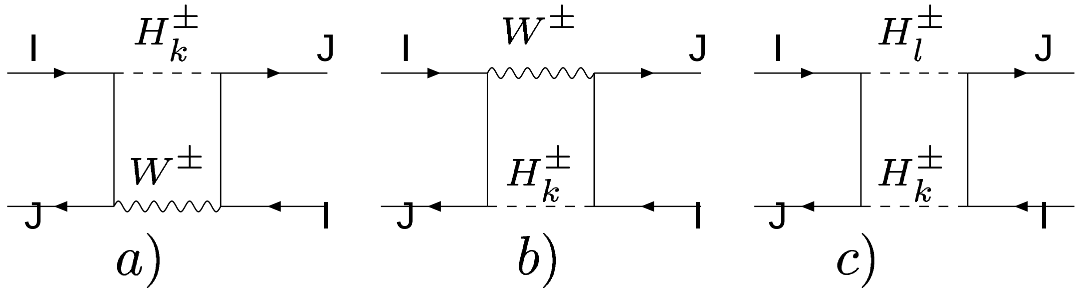
   tree-lewel coupling of charged Higgs scalar ($H_k^+ \equiv (H^+, G^+)$) to quarks:

$$L_{\rm int} = H_k^+ \bar{u}_A V_{AI} (a_L^{AIk} P_L + a_R^{AIk} P_R) d_I + {\rm Hc.} \quad (30)$$

where

$$a_L^{AIk} = \frac{e}{\sqrt{2} s_W} \frac{m_{u_A}}{M_W} \times \begin{cases} \cot\bar{\beta} & \text{for } \ k = 1 \\ 1 & \text{for } \ k = 2 \end{cases} \quad (31)$$

$$a_R^{AIk} = \frac{e}{\sqrt{2} s_W} \frac{m_{d_I}}{M_W} \times \begin{cases} \tan\bar{\beta} & \text{for } \ k = 1 \\ -1 & \text{for } \ k = 2 \end{cases} \quad (32)$$



Box diagrams in extended Higgs sector

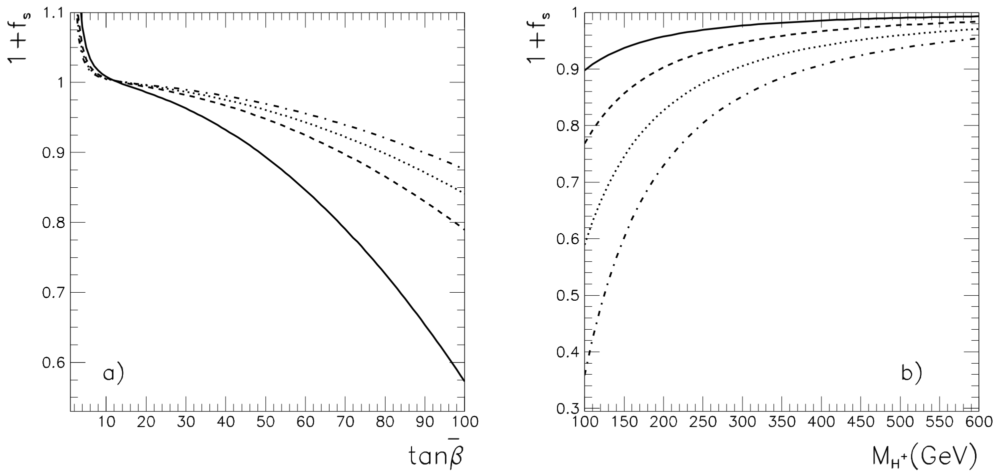
dominant contributions to Wilson coefficients:
diagram with $W^{\pm}H^{\mp}$:

$$\delta^{(+)}C_2^{\mathrm{LR}} \sim -\frac{8}{3}\frac{m_{d_I}m_{d_J}}{m_t^2}\tan^2\bar{\beta}$$

diagram with $H^{\pm}H^{\mp}$:

$$\delta^{(+)}C_2^{\mathrm{LR}} \sim -\frac{4}{3}\frac{m_{d_I}m_{d_J}}{M_W^2}\tan^2\bar{\beta} \qquad (33)$$

It is clear that for large $\tan\bar{\beta}$ the biggest contribution appears in $\delta^{(+)}C_2^{\mathrm{LR}}$. It is of the opposite sign than the contribution of the $tW^{\pm}$ box diagram and can be significant only for the $\bar{B}_s^0$-B_s^0 (similar contributions to $\delta^{(+)}C_2^{LR}$ for $\bar{B}_d^0$-B_d^0 and $\bar{K}^0$-K^0 transitions are suppressed by factors m_d/m_s and m_d/m_b,respectively.



$1 + f_s$ in the 2HDM(II): a) as a function of $\tan\beta$ for $M_{H^+} =$ (from below) 150, 250, 300 and 350 GeV and b) as a function of M_{H^+} for $\tan\beta =$ (from above) 40, 60, 80 and 100.

The computation of the $b \to s\gamma$ rate together with the experimental result for this process $BR(B \to X_s\gamma) = (3.03 \pm 0.40 \pm 0.26) \times 10^{-4}$ set the bound $M_{H^+} \gtrsim 350$ GeV . This means that in the 2HDM(II) for the still allowed range of charged Higgs boson masses the decrease of $1 + f_s$ can be very small. Consequently, the SM analysis of the unitarity triangle based on ε, ΔM_d and ΔM_s is practically unchanged in the 2HDM(II) for large $\tan\beta \lesssim 50$.

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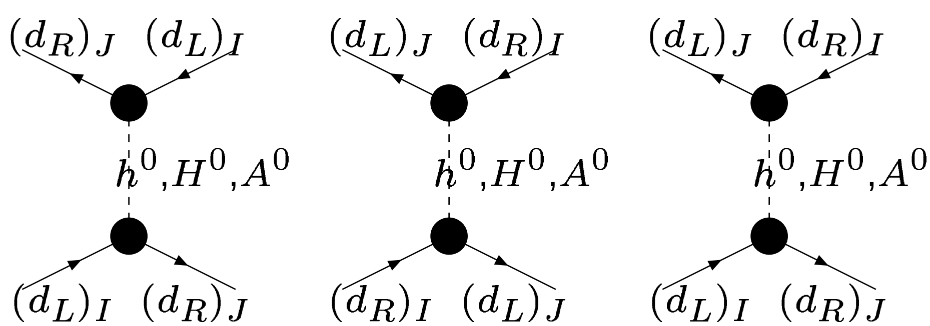
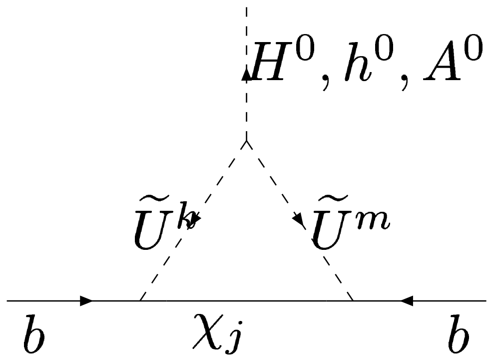
2. MSSM with large $\tan\beta$, heavy sparticles and light Higgs sector

- in the limit of heavy sparticles (which is practically realized already for $M_{\text{sparticles}} \gtrsim 500$ GeV) the one loop diagrams involving charginos and stops are negligible.
- one loop diagrams with charged Higgs and top quark can give large ($\sim \tan^2\beta$) contributions (the bound on M_{H^+} from $b \to s\gamma$ is much weaker)
- two loop corrections, deriving from one loop corrections to down quarks with neutral Higgs couplings (double penguin diagram), can be very large ($\sim \tan^4\beta$)





One-loop correction to the $\bar{b}b$-neutral Higgs vertex in MSSM (contribution charginos and stops in loop), proportional to $\tan\beta^2$.
Such kind of effects does not vanish with very heavy sparticles.

Identic diagrams give rise to $B \to \bar{l}l$ amplitude, so very strong efects which was expected in that proces can be partially limited by neutral$B$ meson mixing.

The contributions of diagrams (from previous figure) to Wilson coefficients:

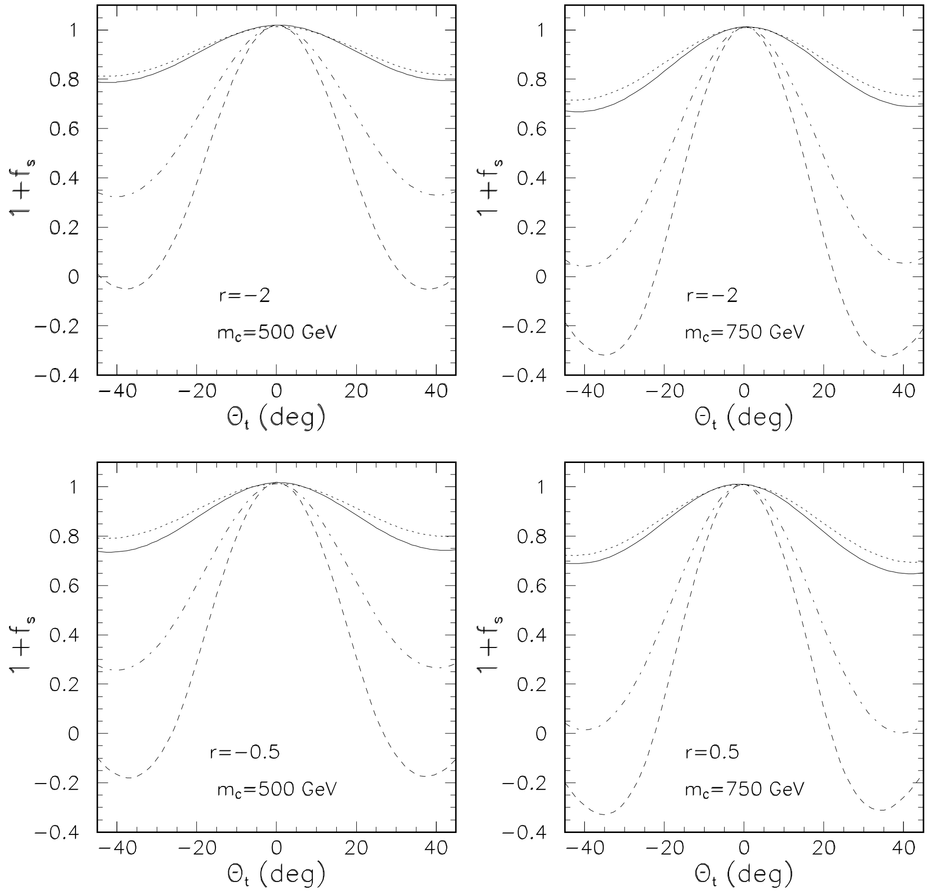
$$\delta^{(0)} C_1^{\mathrm{SLL}} = -\frac{\alpha_{EM}}{4\pi s_W^2}\frac{m_t^4}{M_W^4} m_{d_J}^2 X_{tC}^2 \tan^4\bar\beta \ \mathcal{F}_-$$

$$\delta^{(0)} C_1^{\mathrm{SRR}} = -\frac{\alpha_{EM}}{4\pi s_W^2}\frac{m_t^4}{M_W^4} m_{d_I}^2 X_{tC}^2 \tan^4\bar\beta \ \mathcal{F}_- \qquad (34)$$

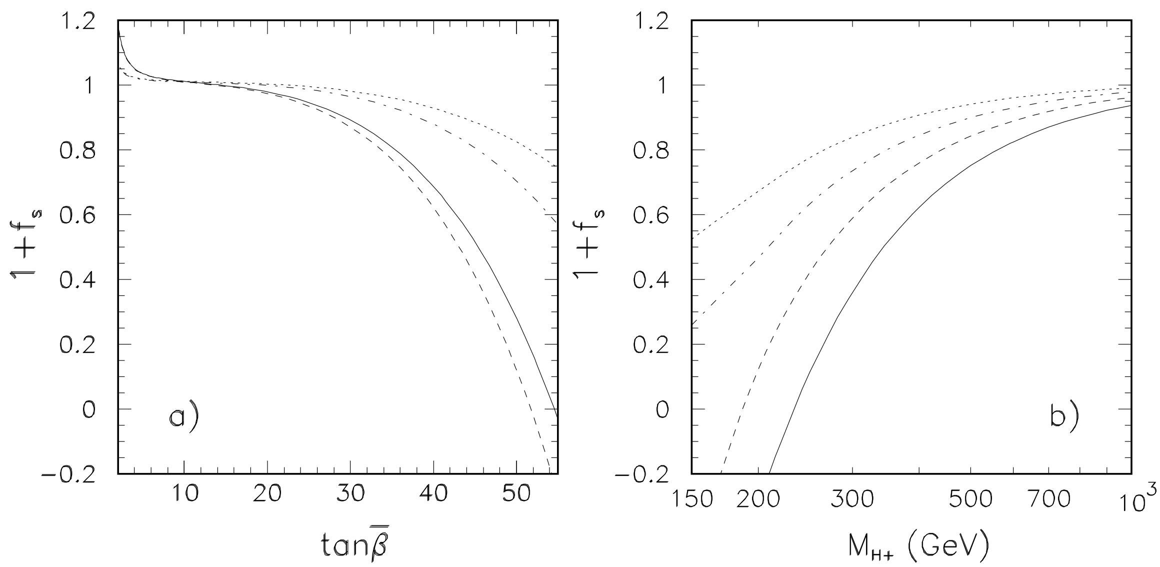
$$\delta^{(0)} C_2^{\mathrm{LR}} = -\frac{\alpha_{EM}}{2\pi s_W^2}\frac{m_t^4}{M_W^4} m_{d_J} m_{d_I} X_{tC}^2 \tan^4\bar\beta \ \mathcal{F}_+ \ .$$

where $X_{tC} = \sum_{j=1}^{2} Z_+^{2j} Z_-^{2j} \frac{A_t}{m_{C_j}} H_2(x_1^{t/C_j}, x_2^{t/C_j})$, $x_i^{t/C_j} = M_{\tilde t_i}^2 / m_{C_j}^2$, $i = 1,2$, $j = 1,2$,

$$\mathcal{F}_\mp \equiv \left[\frac{\cos^2\bar\alpha}{M_H^2} + \frac{\sin^2\bar\alpha}{M_h^2} \mp \frac{\sin^2\bar\beta}{M_A^2}\right] \qquad (35)$$



$1 + f_s$ in the MSSM as a function of the mixing angle of the top squarks for different lighter chargino masses and compositions ($r \equiv M_2/\mu$). Solid, dashed, dotted and dot-dashed lines correspond to stop masses (in GeV) (500,650), (500,850), (700,850) and (700,1000), respectively.



$1 + f_s$ in the MSSM for lighter chargino mass 750 GeV, $r \equiv M_2/\mu = -0.5$ and stop masses (in GeV) (500,850), (700,1000), (500,850) and (600,1100) (solid, dashed, dotted and dot-dashed lines, respectively) as a function of a) $\tan\bar{\beta}$ and b) M_{H^+}. In panel a) solid and dashed (dotted and dot-dashed) lines correspond to $M_{H^+} = 200\ (600)$ GeV, and in panel a) solid and dashed (dotted and dot-dashed) lines correspond to $\tan\bar{\beta} = 50\ (35)$.

Conclusions:

- Classification of SM extensions .
- Analysis of the role of new dimension six four-fermion $|\Delta F| = 2$ operators in models with minimal flavour violation (MFV and GMFV).
- Formulae for the mass differences ΔM_s, ΔM_d and the CP violation parameter ε (parametrization by three real functions F_{tt}^s, F_{tt}^d and F_{tt}^ε, respectively).
- We have proposed a few simple strategies involving the ratio $\Delta M_s/\Delta M_d$, $\sin 2\beta$ and the angle γ that allow to search for the effects of the new operators.
- The present experimental and theoretical uncertainties allow for sizable contributions of new operators to $\Delta M_{s,d}$ and ε.
- As an example we have analyzed the role of new operators in the MSSM with large

$\tan\bar{\beta} = v_2/v_1$ in the limit of heavy sparticles, investigating in particular the impact of the extended Higgs sector on the unitarity triangle. The largest effects of new contributions for large $\tan\bar{\beta}$ are seen in ΔM_s.