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Flavour observables
SPheno 3.0 $\Leftrightarrow$ Master Code

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Overview

Observables contained in both programs

- $b \to s\gamma$, $b \to s l^+ l^-$, $B_s^0 \to \mu^+\mu^-$, $B_u^+ \to \tau^+\nu$
- ΔM_{B_s}, ΔM_{B_d}

Observables in Master Code only

- $B_d^0 \to \mu^+\mu^-$ †
- $K^0 \to \pi\nu\nu$ †, $K^+ \to \mu^+\nu$
- ΔM_K †

Observables in SPheno only

- $b \to s\nu\nu$

† also in SPheno implemented, but still in the testing phase

Generalities

SPheno

input	via SLHA2 interface, includes also SM values
output	values for the observables
calc. currently	Wilson coefficients either at 160 GeV (for $b \to s\gamma$, hep-ph/0612166)
	or at m_Z; include all mixing effects, complete formula, running masses
calc. future	calculate Wilson coefficients at M_{SUSY} + running to m_Z

Master Code

input	SUSY parameters via SLHA2 interface
	all SM values hard-coded, e.g. $m_b^{\overline{MS}}(m_Z) = 3$ GeV, also SM observables
	no check if consistent with the other part of the master code
output	mostely ratios SUSY/SM (theory)
	only $B_q \to \mu^+\mu^-$ values for the observables
calculation	Wilson coefficients either at 160 GeVm_t or m_Z
	use running SUSY masses at M_{SUSY} without check
	simplfications like masses of first two generations are equal to $M_{\tilde{Q}}$ and $M_{\tilde{L}}$
	several approximate formulae which however should give correct results
	for most of parameter space

$b \to s\gamma$, $b \to s l^+ l^-$, $B_u^+ \to \tau^+ \nu$

- $b \to s\gamma$

  SPheno: SM NLO + SUSY LO at M_Z (T. Hurth, E. Lunghi and W. P., hep-ph/0312260)
  or SM NNLO + SUSY LO at 160 GeV (E.Lunghi, J.Matias, hep-ph/0612166)
  calculate C_7, C_7', C_8, C_8' including all SUSY contributions

  Master Code: SM NNLO fixed at $3.15 \cdot 10^{-4}$
  + H^+ at m_Z (?) using $m_{H^+}(M_{SUSY})$ + SUSY χ^+, $\tilde{g}$ at $Q = m_{\tilde{t}_1}$
  calculate C_7, C_8

  agreement within 10% after adjusting SM input (BR, Yukawas, Wilson coefficients)

- $b \to s l^+ l^-$ similar situation as $b \to s\gamma$, Master code: $BR_{SM} = 1.55 \cdot 10^{-6}$

- $B_u^+ \to \tau^+ \nu$

  differences up to a factor of 2, source, problem with m_τ resumation ?

  SPheno $M_{H^+}(m_Z)$

  Master Code $M_{H^+}(M_{SUSY})$

  agreement within a few per-cent once masses are adjusted

$B_q \to \mu^+\mu^-$, ΔM_{B_q} $(q = d, s)$

- ΔM_{B_q}: agreement within 10-20 % after Higgs mass adjustment as in $B_u^+ \to \tau^+\nu$,
- $B_q \to \mu^+\mu^-$ differences up to order of magnitude (in both directions) after Higgs mass adjustment
  Master Code: $BR(B_s \to \mu^+\mu^-)_{SM} = 3.46 \cdot 10^{-9}$, $BR(B_d \to \mu^+\mu^-)_{SM} = 2 \cdot 10^{-10}$

Some differences due to

- Master code assumes $m_{H^0} = m_{A^0}$ only justified if $m_{A^0} \gtrsim 300$ GeV
- full calculation (SPheno) versus approximations (Master Code)

but this is not complete story, still investigating
complication: different operator basis