Inclusive semileptonic charmless B-decays in SUSY

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Abstract: We study the semileptonic decays $B \to X_s e^+ e^-$, $B \to X_s \mu^+ \mu^-$ in generic supersymmetric extensions of the Standard Model. SUSY effects are parameterized using the mass insertion approximation formalism and differences with MSSM results are pointed out. Constraints on SUSY contributions coming from other processes (*e.g.* $b \to s\gamma$) are taken into account. Chargino and gluino contributions to photon and Z-mediated decays are computed and non-perturbative corrections are considered. We find that the integrated branching ratios and the asymmetries can be strongly modified. Moreover, the behavior of the differential Forward-Backward asymmetry remarkably changes with respect to the Standard Model expectation.

Keywords: rare semileptonic Beauty decays SUSY.

1. Introduction

One of the features of a general low energy supersymmetric (SUSY) extension of the Standard Model (SM) is the presence of a huge number of new parameters. FCNC and CP violating phenomena constrain strongly a big part of the new parameter space. However there is still room for significant departures from the SM expectations in this interesting class of physical processes. It is interesting to check all these possibilities on the available data and on those processes that are going to be studied in the next future. In this way it is possible to indicate where new physics effects can be revealed as well as to establish criteria for model building.

In this work we want to investigate the relevance of new physics effects in the semileptonic inclusive decay $B \to X_s l^+ l^-$. This decay is quite suppressed in the Standard Model; however, new B-factories should reach the precision requested by the SM prediction [1] and an estimate of all possible new contributions to this process is compelling.

Because of the presence of so many unknown parameters (in particular in the scalar mass matrices) which enter in a quite complicated way in the determination of the mass eigenstates and of the various mixing matrices it is very useful to adopt the so-called "Mass Insertion Approximation"(MIA) [8]. In this framework one chooses a basis for fermion and sfermion states in which all the couplings of these particles to neutral gauginos are flavor diagonal. Flavor changes in the squark sector are provided by the non-diagonality of the sfermion propagators. The pattern of flavor change is then given by the ratios

$$(\delta^f_{ij})_{AB} = \frac{(m^{\tilde{f}}_{ij})^2_{AB}}{M^2_{sq}} \ , \qquad (1.1)$$

where $(m^{\tilde{f}}_{ij})^2_{AB}$ are the off-diagonal elements of the $\tilde{f} = \tilde{u}, \tilde{d}$ mass squared matrix that mixes flavor i, j for both left- and right-handed scalars (A, B =Left, Right), M_{sq} is the average squark mass (see *e.g.* [9]). The sfermion propagators are expanded in terms of the δs and the contribution of the first two terms of this expansion are considered. The genuine SUSY contributions to the Wilson coefficients will be simply proportional to the various δs and a keen analysis of the different Feynman diagrams involved will allow us to isolate the few insertions really relevant for a given process. In this way we see that only a small

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number of the new parameters is involved and a general SUSY analysis is made possible. The hypothesis regarding the smallness of the δs and so the reliability of the approximation can then be checked *a posteriori*.

We consider all the possible contributions to charmless semileptonic B decays coming from chargino-quark-squark and gluino-quark-squark interactions and we analyze both Z-boson and photon mediated decays. Contributions coming from penguin and box diagrams are taken into account; moreover, corrections to the MIA results due to a light $\tilde{t}_R$ are considered. A direct comparison between the SUSY and the SM contributions to the Wilson coefficients is performed. Once the constraints on mass insertions are established, we find that in generic SUSY models there si still enough room in order to see large deviations from the SM expectations for branching ratios and asymmetries. For our final computation of physical observables we consider NLO order QCD evolution of the coefficients and non-perturbative corrections ($O(1/m_b^2)$, $O(1/m_c^2)$,..), each in its proper range of the dilepton invariant mass.

2. General framework

The effective Hamiltonian for the decay $B \to X_s l^+ l^-$ in the SM and in the MSSM is given by (neglecting the small contribution proportional to $K_{us}^* K_{ub}$)

$$\mathcal{H}_{\rm eff} = -\frac{4G_F}{\sqrt{2}} K_{ts}^* K_{tb} \sum_{i=1}^{10} C_i(\mu) Q_i \qquad (2.1)$$

where

$$\begin{aligned}
Q_1 &= \bar{s}_{L\alpha}\gamma_\mu b_{L\alpha} \bar{c}_{L\beta}\gamma^\mu c_{L\beta}, \\
Q_2 &= \bar{s}_{L\alpha}\gamma_\mu b_{L\beta} \bar{c}_{L\beta}\gamma^\mu c_{L\alpha}, \\
Q_3 &= \bar{s}_{L\alpha}\gamma_\mu b_{L\alpha} \sum_{q=u,..,b} \bar{q}_{L\beta}\gamma^\mu q_{L\beta}, \\
Q_4 &= \bar{s}_{L\alpha}\gamma_\mu b_{L\beta} \sum_{q=u,..,b} \bar{q}_{L\beta}\gamma^\mu q_{L\alpha}, \\
Q_5 &= \bar{s}_{L\alpha}\gamma_\mu b_{L\alpha} \sum_{q=u,..,b} \bar{q}_{R\beta}\gamma^\mu q_{R\beta}, \\
Q_6 &= \bar{s}_{L\alpha}\gamma_\mu b_{L\beta} \sum_{q=u,..,b} \bar{q}_{R\beta}\gamma^\mu q_{R\alpha}, \\
Q_7 &= \frac{e}{16\pi^2} m_b \bar{s}_L \sigma^{\mu\nu} b_R F_{\mu\nu}, \\
Q_8 &= \frac{g_s}{16\pi^2} m_b \bar{s}_L T^a \sigma^{\mu\nu} b_R G^a_{\mu\nu}, \\
Q_9 &= (\bar{s}_L\gamma_\mu b_L)\bar{l}\gamma^\mu l, \\
Q_{10} &= (\bar{s}_L\gamma_\mu b_L)\bar{l}\gamma^\mu\gamma_5 l \ , \qquad (2.2)
\end{aligned}$$

K is the CKM-matrix and $q_{L(R)} = (1 \mp \gamma_5)/2\, q$. This Hamiltonian is known at next-to-leading order both in the SM [2, 3] and in the MSSM [5, 6]. With these definitions the differential branching ratio and the forward-backward asymmetry can be written as

$$\begin{aligned}
R(s) &\equiv \frac{1}{\Gamma(B \to X_c e\nu)} \frac{{\rm d}\,\Gamma(B \to X_s l^+ l^-)}{{\rm d}s} \\
&= \frac{\alpha^2}{4\pi^2} \left|\frac{K_{ts}}{K_{cb}}\right| \frac{(1-s)^2}{f(z)k(z)} \Big[(1+2s) \left(|\tilde{C}_9^{\rm eff}(s)|^2 + \right. \\
&\left. |\tilde{C}_{10}|^2 \right) + 4(1+\frac{2}{s})|C_7|^2 + 12{\rm Re}\left[C_7 \tilde{C}_9^{\rm eff}(s) \right] \Big]
\end{aligned}$$

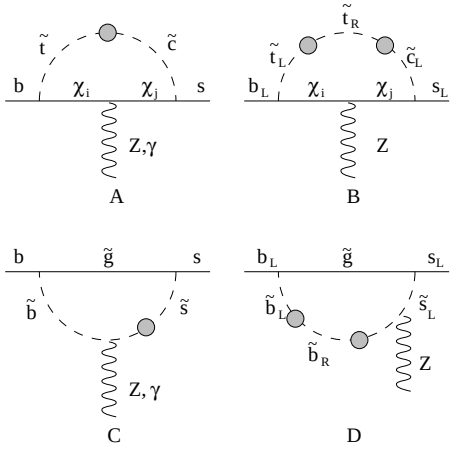

Figure 1: *Some of the relevant Feynman diagrams for $b \to s l^+ l^-$. Bubbles indicate Mass Insertions. Diagrams A,B are based on chargino interaction. Diagrams C,D consider gluino interactions.*

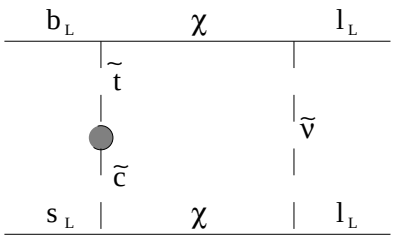

Figure 2: *Relevant box diagram for $b \to s l^+ l^-$. Bubble indicates Mass Insertion.*

$$A_{FB}(s) \equiv \frac{\displaystyle\int_{-1}^{1} \mathrm{d}c\, \frac{\mathrm{d}^2\Gamma}{\mathrm{d}c\,\mathrm{d}s}\,\mathrm{Sgn}(c)}{\displaystyle\int_{-1}^{1} \mathrm{d}c\, \frac{\mathrm{d}^2\Gamma}{\mathrm{d}c\,\mathrm{d}s}} = -\frac{3\mathrm{Re}\left[\tilde{C}_{10}\left(s\ \tilde{C}_9^{\mathrm{eff}}(s) + 2C_7\right)\right]}{\left[\cdots\right]}$$

where $\left[\cdots\right]$ is the part of $R(s)$ in square brackets, $\tilde{C}_i = \frac{\alpha}{4\pi}C_i$, $s = (p_{l^+} + p_{l^-})^2/m_b^2$, $c = \cos\theta$, θ is the angle between the positively charged lepton and the B flight direction in the rest frame of the dilepton system, $f(z)$ and $k(z)$ are the phase space factor and the QCD correction factor ($z = m_c/m_b$) that enter $\Gamma(B \to X_c e\nu)$ and can be found in ref. [3, 12]. $\tilde{C}_9^{\mathrm{eff}}(s)$ include all the contributions of the operators $Q_1 - Q_6$ and Q_8 and its complete definition for the SM and MSSM can be found again in refs. [2, 3, 5].

In the literature the energy asymmetry is also considered [5] but it is easy to show that these two kind of asymmetries are completely equivalent; in fact a configuration in the dilepton c.m.s. in which l^+ is scattered in the forward direction kinematically implies $E_{l^+} < E_{l^-}$ in the B rest frame (see for instance ref. [4]).

It is worth underlying that integrating the differential asymmetry given in eq. (2.3) we do not obtain the global Foward–Backward asymmetry which is by definition:

$$\frac{N(l^+_{\rightarrow}) - N(l^+_{\leftarrow})}{N(l^+_{\rightarrow}) + N(l^+_{\leftarrow})} = \frac{\displaystyle\int_{-1}^{1}\mathrm{d}c\int\mathrm{d}s\,\frac{\mathrm{d}^2\Gamma}{\mathrm{d}c\,\mathrm{d}s}\,\mathrm{Sgn}(c)}{\displaystyle\int_{-1}^{1}\mathrm{d}c\int\mathrm{d}s\,\frac{\mathrm{d}^2\Gamma}{\mathrm{d}c\,\mathrm{d}s}} \tag{2.3}$$

where $l^+_{\rightarrow}$ and $l^+_{\leftarrow}$ stand respectevely for leptons scattered in the forward and backward direction. To this extent it is useful to introduce the following quantity

$$\overline{A}_{FB}(s) \equiv \frac{\displaystyle\int_{-1}^{1} \mathrm{d}c\, \frac{\mathrm{d}^2\Gamma}{\mathrm{d}c\,\mathrm{d}s}\,\mathrm{Sgn}(c)}{\displaystyle\int_{-1}^{1}\mathrm{d}c\int\mathrm{d}s\,\frac{\mathrm{d}^2\Gamma}{\mathrm{d}c\,\mathrm{d}s}}$$

$$= \frac{-3\mathrm{Re}\left[\tilde{C}_{10}\left(s\ \tilde{C}_9^{\mathrm{eff}}(s) + 2C_7\right)\right](1-s)^2}{\displaystyle\int\mathrm{d}s\left[\cdots\right](1-s)^2} \tag{2.4}$$

whose integrated value is given by eq. (2.3).

All the effects coming from the mass insertion approximation can be included in the previous formulae writing the coefficients C_7, $\tilde{C}_9^{\mathrm{eff}}(s)$, $\tilde{C}_{10}$ as

$$\begin{aligned} C_7 &= C_7^{SM} + C_7^{Diag} + C_7^{MI}, \\ \tilde{C}_9^{\mathrm{eff}}(s) &= (\tilde{C}_9^{\mathrm{eff}}(s))^{SM} + (\tilde{C}_9^{\mathrm{eff}})^{Diag} + (\tilde{C}_9^{\mathrm{eff}})^{MI}, \\ \tilde{C}_{10} &= \tilde{C}_{10}^{SM} + \tilde{C}_{10}^{Diag} + \tilde{C}_{10}^{MI} \end{aligned} \tag{2.5}$$

where all the contributions are evaluated at the M_B scale and the various C_i^{Diag} summarize all the contributions coming from graphs including sparticles in the limit in which we neglect all the mass insertion contributions (they would be the only SUSY diagrams if the scalar mass matrices were diagonalized by the same rotations as those needed by the fermions). The explicit expressions for C_i^{Diag} can be found in ref. [5].

We find that the most general low-energy SUSY lagrangian can also modify (with respect to the SM) the matching coefficients of the operators

$$\begin{aligned} Q'_7 &= \frac{e}{8\pi^2} m_b \bar{s}_R \sigma^{\mu\nu} b_L F_{\mu\nu}, \\ Q'_9 &= (\bar{s}_R\gamma_\mu b_R)\bar{l}\gamma^\mu l, \\ Q'_{10} &= (\bar{s}_R\gamma_\mu b_R)\bar{l}\gamma^\mu\gamma_5 l. \end{aligned} \tag{2.6}$$

However the contribution of these operators is negligible and so they are not considered in the final discussion of physical quantities.

Finally the value of the physical constants we use is reported in table 1.

m_t	173.8 GeV
m_b	4.8 GeV
m_c	1.3 GeV
m_s	125 MeV
M_B	5.27 GeV
$\alpha_s(m_Z)$	.119
$1/\alpha_{el}(m_Z)$	128.9
$\sin^2\theta_W$	.2334

Table 1: Central values of physical constants used in the phenomenological analysis

3. Constraints on mass insertions

In order to establish how large the SUSY contribution to $B \to X_s l^+ l^-$ can be, one can compare,

coefficient per coefficient, the MI results with the SM ones taking into account possible constraints on the δs coming from other processes.

The most relevant δs interested in the determination of the Wilson coefficients C_7, C_9 and C_{10} are $(\delta^u_{23})_{LL}$, $(\delta^u_{23})_{LR}$, $(\delta^u_{33})_{RL}$, $(\delta^d_{23})_{LL}$ and $(\delta^d_{23})_{LR}$.

- Vaccum stability arguments regarding the absence of color and charge breaking minima and of directions unbounded from below in the potential [11] give

$$(\delta^u_{i3})_{LR} \leq m_t \frac{\sqrt{2M^2_{\tilde{u}} + M^2_{\tilde{l}}}}{M^2_{sq}} \simeq \sqrt{3}\frac{m_t}{M_{sq}}. \tag{3.1}$$

  For $M_{sq} \leq 300$GeV this is not an effective constraint on the mass insertions.

- A constraint on $(\delta^{d,u}_{23})_{LL}$ can come from the possible measure of ΔM_{B_s}; in fact the gluino–box contribution to ΔM_{B_s} is proportional to $(\delta^d_{23})^2_{LL}$ (see ref. [10]). Assuming

$$\Delta M_{B_s} < 30 \text{ ps}^{-1} \tag{3.2}$$

  we find

$$(\delta^d_{23})_{LL} < 0.5\ . \tag{3.3}$$

  Moreover the LL u- and d- squark mass matrices are related by a CKM rotation

$$(M^d_{sq})^2_{LL} = K^\dagger (M^u_{sq})^2_{LL} K \tag{3.4}$$

  so that the limit (3.3) is valid for the up sector too:

$$(\delta^u_{23})_{LL} < 0.5\ . \tag{3.5}$$

- A constraint comes from the measure of $B \to X_s\gamma$. The branching ratio of this process depends almost completely on the Wilson coefficients C_7 and C'_7 which are dominated by the gluino penguin diagrams involving $(\delta^d_{23})_{LR \text{ or } RL}$. The most recent CLEO estimate of the branching ratio for $B \to X_s\,\gamma$ is [7]

$$\text{B}_{exp} = (3.15 \pm 0.35 \pm 0.32 \pm 0.26) \cdot 10^{-4}\ . \tag{3.6}$$

  where the first error is statistical, the second is systematic and the third comes from the model dependence of the signal. The limits given at 95% C.L. are [7]:

$$2.0\ 10^{-4} < \text{B}_{exp} < 4.5\ 10^{-4}. \tag{3.7}$$

  We can define a $C^{\text{eff}}_7(M_B)$ as

$$(C^{\text{eff}}_7(M_B))^2 = \frac{B_{exp}(B \to s\ \gamma)}{\left(\frac{K_{ts}K_{tb}}{K_{cb}}\right)^2 \frac{6\alpha F}{\pi g(z)}} \tag{3.8}$$

  where F can be found in ref. [13]. Considering the limits in eq. (3.7) we find

$$0.250 < |C^{\text{eff}}_7(M_B)| < 0.445. \tag{3.9}$$

  In a general SUSY theory $|C^{\text{eff}}_7(M_B)|^2 = |C_7(M_B)|^2 + |C'_7(M_B)|^2$ and the constraint given in eq. (3.9) should be shared between the two coefficients. However in order to get the maximum SUSY contribution, we observe that in physical observables we are interested in C'_7 does not interfere with C_7, the C'_7C_9 term is suppressed by a factor m_s/m_b with respect to the C_7C_9 one and $C'_7C'_9$ is numerically negligible (in fact C'_9 is much smaller than C_9). For these reasons we choose to fill the constraint of eq. (3.9) with $C_7(M_B)$ alone (note that $(\delta^d_{23})_{LR}$ and $(\delta^d_{23})_{RL}$ are independent parameters).

  The bounds (3.9) are referred to the coefficient evaluated at the M_B scale while we are interested to the limits at the much higher matching scale. After the RG evolution has been performed we find

$$\begin{cases} -0.39 < C_7(M_W) < -0.099 \\ 0.66 < C_7(M_W) < 0.95 \end{cases} \tag{3.10}$$

  For M_{sq} lower than 1000 GeV, the MIA contribution alone with a suitable choice of δs, can always fit the experimental constraints.

  Thus, since we are interested in computing the maximum enhancement (suppression) SUSY can provide, we can choose the total $C^{eff}_7(M_B)$ anywhere inside the allowed region given in eq. (3.9) still remaining consistent with the MIA.

  The limit we get for $(\delta^d_{23})_{LR}$ from eq. (3.10) is of order 10^{-2} and this rules out gluino Z–penguins contributions to C_9 and C_{10}.

- Finally a comment on the δs coming in graphs with a double MI is in order.

  Given the constraints on $(\delta^d_{23})_{RL}$ one can see that the gluino-penguins with a double MI give negligible contributions to the final results even if $(\delta^d_{33})_{RL}$ is of order $\mathcal{O}(1)$.

  A $(\delta^u_{33})_{RL}$ of order $\mathcal{O}(1)$, can give rise to light or negative squark mass eigenstates. In any case the numerical value of these contributions is not particularly important for the determination of physical observables. Since we want to provide a model independent analysis we prefer not to consider in our final computation these double insertion graphs.

4. Results

The results of the calculations of the Wilson coefficients are presented in figs. 3-4. In the plots we sum all contributions coming from different graphs proportional to a common mass insertion (the actual values of the coefficients are obtained multiplying the points in the plots by the MI).

With $\mu \simeq -160$, $M_{gl} \simeq M_{sq} \simeq 250$GeV, $M_{\tilde{t}_R} \simeq 70$ GeV, $M_{\tilde{\nu}} \simeq 50$GeV, $\tan\beta \simeq 2$ one gets

$$\begin{cases} C_9^{MI}(M_B) = -1.2(\delta^u_{23})_{LL} + 0.69(\delta^u_{23})_{LR} - \\ \qquad\qquad 0.51(\delta^d_{23})_{LL} \\ C_{10}^{MI}(M_B) = 1.75(\delta^u_{23})_{LL} - 8.25(\delta^u_{23})_{LR} \end{cases} \tag{4.1}$$

According to the discussion of section 3 we find that, for diagrams involving charginos, the various contributions enhance the SM prediction in the most efficient way choosing $(\delta^u_{23})_{LR} = 0.9$, $(\delta^u_{23})_{LR} = -0.5$. C_9 receives a very small contribution also from gluino penguins.

The extremal values of C_9 and C_{10}, obtained with the above choice of δs are:

$$\begin{cases} C_9^{MI}(M_B) = \pm 1.5 \\ C_{10}^{MI}(M_B) = \mp 8.4 \end{cases} \tag{4.2}$$

The relative sign between C_9^{MI} and C_{10}^{MI} is fixed, as they are proportional to the same δs.

In order to numerically compare eq. (4.2) with the respective SM results we note that the minimum value of $\left(C_9^{\rm eff}(s)\right)^{SM}(M_B)$ is about 4.3 while $C_{10}^{SM} = -4.6$. Thus, from eq. (4.2) one deduces that SM expectations for the observables are enhanced when $C_9^{MI}(M_b)$ is positive. Moreover the big value of $C_{10}^{MI}(M_B)$ implies that the final total coefficient $C_{10}(M_B)$ can have a different sign with respect to the SM estimate. As a consequence of this, the sign of asymmetries can be the opposite of the one calculated in the SM.

The diagonal contributions to C_9, C_{10} introduced in sec.2, and computed in the same range of the parameters are

$$\begin{cases} C_9^{diag}(M_B) = -0.35 \\ C_{10}^{diag}(M_B) = -0.27 \end{cases} \tag{4.3}$$

The sign and the value of the coefficient C_7 has a great importance too. In fact the integral of the BR is dominated by the $|C_7|^2/s$ and C_7C_9 term for low values of s. In the SM the interference between O_7 and O_9 is destructive and this behavior can be easily modifed in the general class of models we are dealing with.

We find the maximum enhancement of the BR and A_{FB} with $C_7^{eff} = 0.445$ and of $\overline{A}_{FB}$ with $C_7^{eff} = 0.250$ while $C_9^{MI} = 1.5$ and $C_{10}^{MI} = -8.4$. It is important to note that with such choices the behavior of the asymmetries in the low s region of the spectrum is greatly modified: the coefficients of the operators Q_7 and Q_9 sum up instead of cancel each other in such a way that the asymmetries are never negative.

We compute, in addition, the best enhancement compatible with the condition of keeping the SM sign of C_7^{eff}, that is with $C_7^{eff} = -0.445$ for the BR and $C_7^{eff} = -0.250$ for asymmetries with the same values of C_9^{MI} and C_{10}^{MI}.

The most negative value for the asymmetries corresponds to $C_7^{eff} = -0.250$, $C_9^{MI} = -1.5$ and $C_{10}^{MI} = 8.2$. The strongest suppression of the SM result for the branching ratio is instead obtained for $C_7^{eff} = -0.445$ and with δs such that C_{10}^{MI} complitely annihilates C_{10}^{SM}. This implies $(\delta^u_{23})_{LR} = -0.5$ and $(\delta^u_{23})_{LL} = 0.5$ in eq. (4.1) so that $C_9^{MI} = -1.5$.

The plots of $BR(s)$, $A_{FB}(s)$ and $\overline{A}_{FB}(s)$ are drawn in figs.5-6. Here both SM and SUSY results are shown. The discontinuity in the A_{FB} plot at $s = 0.7$ corresponds to the point at which we have stopped the corrections $O(1/m_b^2)$. In

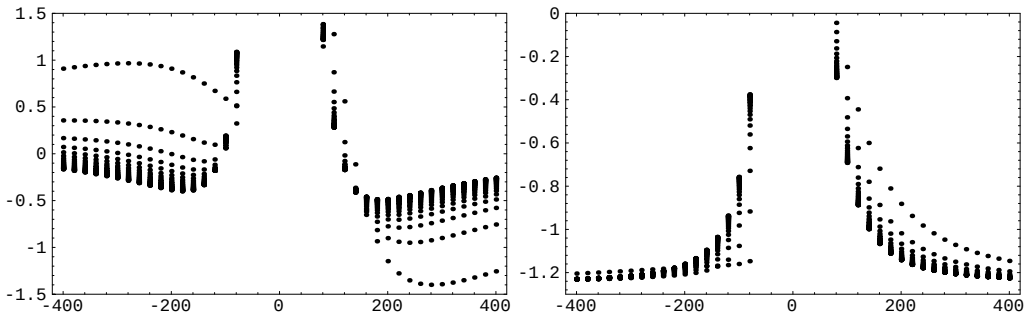

Figure 3: $(\delta^u_{23})_{LR}$ *(left) and* $(\delta^u_{23})_{LL}$ *(right) contributions to* C_9 *coming from chargino diagrams as functions of* μ *(expressed in GeV).* M_{sq} *is fixed to 250 GeV while* $\tan\beta$ *varies between 2 and 50.*

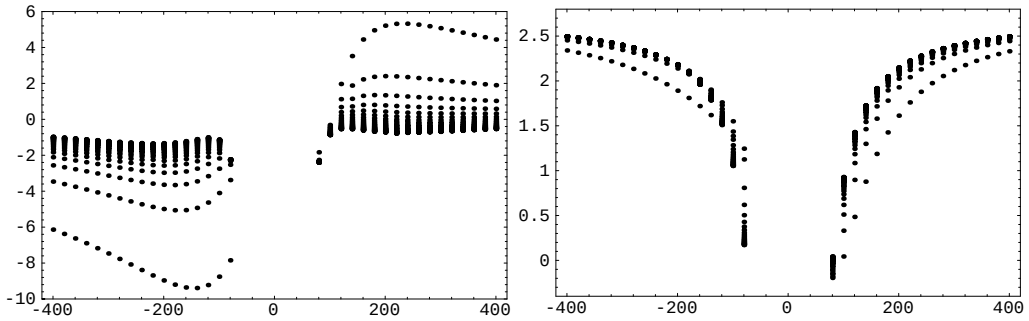

Figure 4: $(\delta^u_{23})_{LR}$ *(left) and* $(\delta^u_{23})_{LL}$ *(right) contributions to* C_{10} *coming from chargino diagrams as functions of* μ *(expressed in GeV).* M_{sq} *is fixed to 250 GeV while* $\tan\beta$ *varies between 2 and 50.*

fact a model independent description of the differential asymmetry in the region $0.7 < s < 0.93$ beyond the parton model one still lacks. Further the peak wich occur at $s = (2m_c/m_b)^2 \simeq 0.3$ is due to the perturbative remnant of the $c\bar{c}$ resonance.

The integrated BRs and asymmetries for the decays $B \to X_s e^+ e^-$ and $B \to X_s \mu^+ \mu^-$ in the SM case and in the SUSY one (with the above choices of the parameters) are summarized in tab.2. There we computed the total perturbative contributions without the resonances; these occur in the intermediate range of the spectrum (J/ψ at 3.1 GeV ($s = 0.42$) and ψ' at 3.7 GeV ($s = 0.59$) plus others at higher energies). However it is possible to exclude the resonant regions from the experimental analysis by opportune cuts and to correct the effects of their tails in the remaining part of the spectrum.

The results of tab. 2 must be compared with the experimental best limit which reads [14]

$$BR_{exp} < 5.8\ 10^{-5}. \tag{4.4}$$

A comment on the Constrained MSSM prediction for the observables we have computed is now necessary. An analysis on the subject is presented in ref. [5]. In this paper the authors show that the effect of CMSSM on the integrated BRs, considering only contributions to C_9 and C_{10}, varies between a depression up to 10% and an enhancement of few percents relative to the corresponding SM values. The asymmetries get even

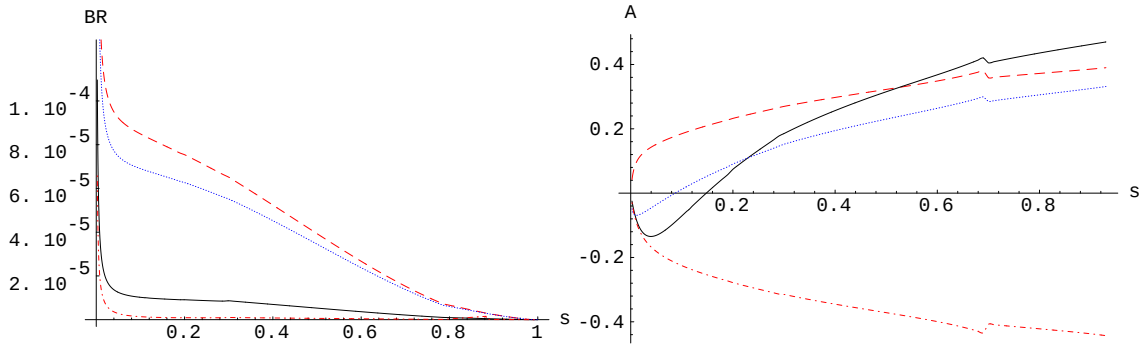

Figure 5: *Differential branching ratio [left] and forward–backward asymmetry (A_{FB}) [right] for the decay $B \to X_s l^+ l^-$. The solid line corresponds to the SM expectation; the dashed and dotted–dashed lines correspond respectively to the SUSY best enhancement and depression; the dotted line is the maximum enhancement obtained without changing the sign of C_7.*

	SM	SUSY maximal	SUSY minimal
$BR(e)$	$8.6\,10^{-6}$	$4.8\,10^{-5}$	$2.8\,10^{-6}$
$A_{FB}(e)$	0.23	0.28	-0.32
$\overline{A}_{FB}(e)$	0.077	0.21	-0.21
$BR(\mu)$	$5.8\,10^{-6}$	$4.2\,10^{-5}$	$1.0\,10^{-6}$
$A_{FB}(\mu)$	0.23	0.28	-0.32
$\overline{A}_{FB}(\mu)$	0.11	0.22	-0.28

Table 2: *Integrated BR, A_{FB} and $\overline{A}_{FB}$ in the SM and in a general SUSY extension of the SM for the decays $B \to X_s e^+ e^-$ and $B \to X_s \mu^+ \mu^-$. The second and third columns are the extremal values we obtain with a positive C_7^{eff} while the fourth one is the $C_7^{eff} < 0$ case. The actual numerical inputs for the various coefficients can be found in the text. The BR is just the integral of $R(s)$ multiplied by the BR of the semileptonic dominant B decay ($BR(B \to X_c e \nu) = 0.105$).*

smaller corrections. On the other hand a direct computation of $C_7^{MSSM}(M_W)$ yields [5]

$$-0.59 < C_7^{MSSM}(M_W) < +0.49 \qquad \text{large } \tan\beta,$$
$$-0.26 < C_7^{MSSM}(M_W) < -0.20 \qquad \text{low } \tan\beta.$$

It is worth observing that the limits given in eq. (3.10) exclude the possibility that CMSSM could drive a positive value for $C_7^{eff}(M_B)$. For what concerns the negative interval of values of $C_7^{eff}(M_B)$ we see that it can be accommodated both in the CMSSM and in our framework.

Looking at figs 5-6 and table 2 we see that the differences between SM and SUSY predictions can be remarkable. Moreover a sufficiently precise measure of BRs, A_{FB}s and $\overline{A}_{FB}$s can either discriminate between the CMSSM and more general SUSY models or give new constraints on mass insertions. Both these kind of informations can be very useful for model building.

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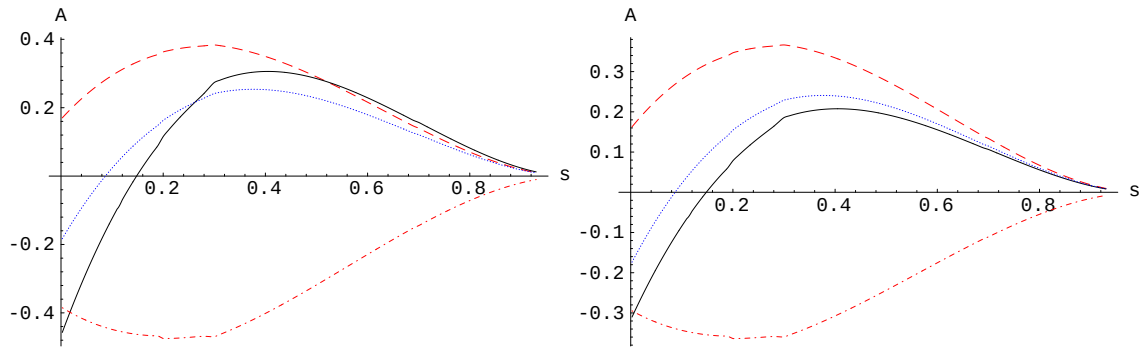

Figure 6: *Forward–Backward asymmetry ($\overline{A}_{FB}$) for the decays $B \to X_s\mu^+\mu^-$ [left] and $B \to X_s e^+e^-$ [right] The solid line corresponds to the SM expectation; the dashed and dotted–dashed lines correspond respectively to the SUSY best enhancement and depression; the dotted line is the maximum enhancement obtained without changing the sign of C_7.*

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