A comparative study on $B \to K^*\ell^+\ell^-$ and $B \to K_0^*(1430)\ell^+\ell^-$ decays in the Supersymmetric Models

V. Bashiry[1]*, M. Bayar[2]†, K. Azizi[3]‡,

[1] Engineering Faculty, Cyprus International University,

Via Mersin 10, Turkey

[2] Department of Physics, Kocaeli University, 41380 Izmit, Turkey

[3] Physics Division, Faculty of Arts and Sciences, Doğuş University,

Acıbadem-Kadıköy, 34722 Istanbul, Turkey

Abstract

In this paper, we compare the branching ratio and rate difference of electron channel to muon channel of $B \to K_0^*(1430)\ell^+\ell^-$ and $B \to K^*\ell^+\ell^-$ decays, where $K_0^*(1430)$ is the p–wave scalar meson, in the supersymmetric models. MSSM with R parity is considered since considerable deviation from the standard model predictions can be obtained in $B \to X_s\ell^-\ell^+$. Taking C_{Q1} and C_{Q2} about one which is consistent with the $B \to K^*\mu^+\mu^-$ rate at low dileptonic invariant mass region($1 \leq q^2 \leq 6\text{GeV}^2$). It is found that, firstly, the $B \to K_0^*(1430)\ell^+\ell^-$ ($\ell = \mu, \tau$) decay is measurable at LHC, secondly, in comparison with $B \to K^*\ell^+\ell^-$ decay a greater deviation in the $B \to K_0^*(1430)\ell^+\ell^-$ decay can be seen. Measurement of these observables for the semileptonic rare $B \to K_0^*(1430)\ell^+\ell^-$, in particular, at low q^2 region can give valuable information about the nature of interactions within Standard Model or beyond.

PACS numbers: 12.60.-i, 12.60.Jv, 13.25.Hw

*e-mail: bashiry@ciu.edu.tr

†e-mail: melahat.bayar@kocaeli.edu.tr

‡e-mail: kazizi@dogus.edu.tr

1 Introduction

The Standard Model (SM) is in perfect agreement with all confirmed collider data, but there is a missing ingredient. The SM is not regarded as a full theory, since it can not address some issues i.e., gauge and fermion mass hierarchy, matter- antimatter asymmetry, number of generations, the nature of the dark matter, the unification of fundamental forces and so on. For these reasons, the SM can be considered as an effective theory of some fundamental theory at low energy.

Supersymmetry (SUSY) is regarded as the most plausible extension of the SM in order to shed light on some of the issues as mentioned above [1]. It is an essential ingredient in string theory and the most-favoured candidate for unifying all the known interactions including gravity. It would help stabilize the hierarchy of mass scales between m_W and the Planck mass, by canceling the quadratic divergences in the radiative corrections to the mass-squared of the Higgs boson [2].

Two types of study can be conducted to explore supersymmetric particles (sparticles). In the direct search, the center of mass energy of colliding particles has to be increased to produce SUSY particles at the TeV scale, and hence be accessible to the Large Hadron Collider(LHC). On the other hand, we can indirectly investigate SUSY effects. The sparticles can contribute to the quantum loop. As a result, flavor changing neutral current (FCNC) transition induced by quantum loop level can be considered as a good tool for studying the possible effects of sparticles (there are many studies in this regard, for the most recent studies see Ref. [3] and the references therein).

The FCNC processes induced by $b \to s(d)$ transitions are forbidden in SM at tree level [4, 5]. However, they can provide the most sensitive and stringiest test for the SM at one loop level. Despite smallness of the branching ratios of FCNC decays, quite intriguing results have been obtained in ongoing experiments. The inclusive $B \to X_s \ell^+ \ell^-$ decay is observed in BaBaR [6] and Belle collaborations. Also these collaborations measured exclusive modes $B \to K \ell^+ \ell^-$ [7–9] and $B \to K^* \ell^+ \ell^-$ [10]. The experimental results on these decays are in good agreement with theoretical estimations [11–19] which can be used to constrain new physics (NP) effects.

There is another class of rare decays induced by $b \to s$ transition, such as $B \to K_{02}^*(1430)\ell^+\ell^-$ in which B meson decays into p–wave scalar meson. The decays $B \to K_2^*(1430)\ell^+\ell^-$ and $B \to K_0^*(1430)\ell^+\ell^-$ are studied in [20–22].Transition form factors of these decays in the framework of light front quark model [23] and 3–point QCD sum rules are estimated in [24], [25] and [21], respectively.

In the present work we investigate the possible effects of sparticles on the branching ratio of $B \to K_0^*(1430)\ell^+\ell^-$ decay.

The paper is organized as follows: In section 2, we calculate the decay amplitude of the $B \to K_0^*(1430)\ell^+\ell^-$ decay within SUSY models. Section 3 is devoted to the numerical analysis and discussion of the considered decay and our conclusions.

2 Decay amplitude of the $B \to K_0^*(1430)\ell^+\ell^-$ decay in the SUSY models

The exclusive $B \to K_0^*(1430)\ell^+\ell^-$ decay is described at quark level by $b \to s\ell^+\ell^-$ transition. The effective Hamiltonian, that is used to describe the $b \to s\ell^+\ell^-$ transition in SUSY models (see, for example, Ref. [26]), is:

$$
\mathcal{H}_{eff} = \frac{G_F \alpha V_{tb} V_{ts}^*}{2\sqrt{2}\pi} \Big[C_9^{eff}(m_b)\bar{s}\gamma_\mu(1-\gamma_5)b\,\bar{\ell}\gamma^\mu\ell + C_{10}(m_b)\bar{s}\gamma_\mu(1-\gamma_5)b\,\bar{\ell}\gamma^\mu\gamma_5\ell
$$
$$
- 2m_b C_7(m_b)\frac{1}{q^2}\bar{s}i\sigma_{\mu\nu}q^\nu(1+\gamma_5)b\,\bar{\ell}\gamma^\mu\ell + C_{Q_1}\bar{s}(1+\gamma_5)b \to \bar{}ell\ell + C_{Q_2}\bar{s}(1+\gamma_5)b\,\bar{\ell}\gamma_5\ell \Big] ,
$$
(1)

SUSY introduces several additional classes of contributions: I. gluino, down-type squark loop, II. chargino, up-type squark loop, III. chargino, up-type squark loop, (Higgs field attaching to charginos) and IV. neutralino down-type squark loop[27] accordingly. The neutral Higgs couplings SUSY contributions are mainly involved via the terms proportional with $C_{Q_{1,2}}$. These additional terms with respect to the SM come from the neutral Higgs bosons (NHBs) exchange diagrams, whose manifest forms and corresponding Wilson coefficients can be found in[28–32]. The effects of new scalar and pseudoscalar type interactions on physical observables come through the terms which are proportional to the mass of final state leptons. The effects of the other contributions come through the modification of known SM Wilson coefficients. The Wilson coefficients C_7, C_9^{eff} and C_{10} are already exist in the SM. $C_9^{eff}(\hat{s}) = C_9 + Y(\hat{s})$, where $Y(\hat{s}) = Y_{\text{pert}}(\hat{s}) + Y_{\text{LD}}$ contains both the perturbative part $Y_{\text{pert}}(\hat{s})$ and long-distance part $Y_{\text{LD}}(\hat{s})$ (see Ref. [11–13]). The explicit expressions of C_7, C_9^{per} and C_{10} in the SM can be found in [4]. Y_{LD} is usually parameterized by using Breit–Wigner ansatz,

$$
Y_{\text{LD}} = \frac{3\pi}{\alpha^2}C^{(0)}\sum_{V_i=\psi(1s)\cdots\psi(6s)} \text{æ}_i \frac{\Gamma(V_i \to \ell^+\ell^-)m_{V_i}}{m_{V_i}^2 - q^2 - im_{V_i}\Gamma_{V_i}} ,
$$

where α is the fine structure constant and $C^{(0)} = 0.362$.

The phenomenological factors æ_i for the $B \to K(K^*)\ell^+\ell^-$ decay can be determined from the condition that they should reproduce correct branching ratio relation

$$
\mathcal{B}(B \to J/\psi K(K^*) \to K(K^*)\ell^+\ell^-) = \mathcal{B}(B \to J/\psi K(K^*))\mathcal{B}(J/\psi \to \ell^+\ell^-) ,
$$

the right–hand side is determined from experiments. Using the experimental values of the branching ratios for the $B \to V_i K(K^*)$ and $V_i \to \ell^+\ell^-$ decays, for the lowest two J/ψ and ψ' resonances, the factor æ takes the values: $\text{æ}_1 = 2.7$, $\text{æ}_2 = 3.51$ (for K meson), and $\text{æ}_1 = 1.65$, $\text{æ}_2 = 2.36$ (for K^* meson). The values of æ_i used for higher resonances are usually the average of the values obtained for the J/ψ and ψ' resonances. In order to determine the branching ratio for the $B \to K_0^*(1430)\ell^+\ell^-$ decay with the inclusion of long distance effects, the measured branching ratio of $B \to K_0^*(1430)\psi$ is necessary. However,

the mentioned decay has not been measured yet. Therefore, we assume that the values of $æ_i$ are in the order of one. In accordance, we chose $æ_1 = 1$ and $æ_2 = 2$ and performed numerical calculations with these values.

The Wilson coefficients in the framework of the SUSY can be different from the their SM values. While the SUSY effects on C_7, which is proportional to the product of the top and bottom Yukawa coupling constant, $m_t m_b \tan\beta / \sin^2\beta$, is sizable for large $\tan\beta$. There are no such effects in the calculation of C_9 and C_{10}[27].

One has to sandwich Eq. (1) between initial meson state $B(p)$ and final meson state $K_0^*(1430)(p')$ in order to obtain the amplitude for the $B \to K_0^*(1430)\ell^+\ell^-$ decay. Thus, the matrix elements $\langle K_0^* |\bar{s}\gamma_\mu(1-\gamma_5)| B\rangle$ and $\langle K_0^* |\bar{s}i\sigma_{\mu\nu}q^\mu(1+\gamma_5)| B\rangle$ are needed. These matrix elements are parameterized in terms of the form factors as follows:

$$\langle K_0^*(1430)(p') |\bar{s}\gamma_\mu\gamma_5 b| B(p)\rangle = f_+(q^2)\mathcal{P}_\mu + f_-(q^2)q_\mu , \tag{2}$$

$$\langle K_0^*(1430)(p') |\bar{s}i\sigma_{\mu\nu}q^\nu\gamma_5 b| B(p)\rangle = \frac{f_T(q^2)}{m_B + m_{K_0^*}}[\mathcal{P}_\mu q^2 - (m_B^2 - m_{K_0^*}^2)q_\mu] , \tag{3}$$

where $\mathcal{P}_\mu = (p + p')_\mu$ and $q_\mu = (p - p')_\mu$. By multiplying both sides of Eq. (2) with q^μ the expression in terms of form factors for $\langle K_0^*(1430)(p') |\bar{s}\gamma_5 b| B(p)\rangle$ can be obtained.

$$\langle K_0^*(1430)(p') |\bar{s}\gamma_5 b| B(p)\rangle = -\frac{1}{m_b - m_s}[f_+(q^2)\mathcal{P}.q + f_-(q^2)q^2] , \tag{4}$$

Using above Hamiltonian and definitions of form factors, the decay amplitude for $B \to K_0^*\ell^+\ell^-$ can be written as follows:

$$\mathcal{M}(B \to K_0^*\ell^+\ell^-) = \frac{G_F \alpha V_{tb} V_{ts}^*}{2\sqrt{2}\pi}\left[- A_1 P_\mu \bar{\ell}\gamma^\mu\ell - A_2 P_\mu \bar{\ell}\gamma^\mu\gamma_5\ell - A_3 \bar{\ell}\gamma_5\ell - A_4 \bar{\ell}\ell\right] , \tag{5}$$

where

$$A_1 = C_9 f_+ + \frac{2 m_b C_7 f_T}{m_B + m_{K_0^*}}$$

$$A_2 = C_{10} f_+$$

$$A_3 = 2C_{10} m_\ell f_- + \frac{C_{Q_2}}{m_b - m_s}[(m_B^2 + m_{K_0^*}^2)f_+ + q^2 f_-]$$

$$A_4 = \frac{C_{Q_1}}{m_b - m_s}[(m_B^2 + m_{K_0^*}^2)f_+ + q^2 f_-].$$

Using Eqs. (1)–(5), we get the following expression for the differential decay width:

$$\frac{d\Gamma}{dq^2} = \frac{G_F^2 \alpha^2}{8192 m_B \pi^5}|V_{tb}V_{ts}^*|^2 \, v\sqrt{\lambda(1,r,\hat{s})}\left\{ \frac{4}{3}(|A_1|^2 + |A_2|^2)(-3 + v^2)\left[q^4 \right.\right.$$

$$- 2q^2(m_B^2 + m_{K_0^*}^2) + (m_B^2 - m_{K_0^*}^2)^2\bigg] + 16|A_2|^2 m_\ell^2\left[q^2 - 2(m_B^2 + m_{K_0^*}^2)\right]$$

$$- 4q^2|A_3|^2 + 4|A_4|^2(4m_\ell^2 - q^2) - 6m_\ell(A_2 A_3^* + A_2^* A_3)(m_B^2 - m_{K_0^*}^2)\bigg\} , \tag{6}$$

where $\hat{s} = \frac{q^2}{m_B^2}$, $v = \sqrt{1 - \frac{4m_\ell^2}{q^2}}$, $r = m_{K_0^*}^2/m_B^2$, and $\lambda(1, r, \hat{s}) = 1 + r^2 + \hat{s}^2 - 2\hat{s} - 2(1 + \hat{s})$.

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3   Numerical results

In this section, we present the branching ratio for the both $B \to K_0^*(1430)$ and $B \to K^*$ channel for muon and tau leptons. We investigate the rate difference of electron channel to muon channel. The main input parameters are the form factors for which we use the results of three-point QCD sum rules [21].

The values of the form factors at $q^2 = 0$ are [21]

$$
\begin{aligned}
f_+(0) &= 0.31 \pm 0.08 \ , \\
f_-(0) &= -0.31 \pm 0.07 \ , \\
f_T(0) &= -0.26 \pm 0.07 \ ,
\end{aligned}
\tag{7}
$$

where the errors are due to the variation of Borel parameters.

The best fit for the q^2 dependence of the form factors can be written in the following form:

$$
f_i(\hat{s}) = \frac{f_i(0)}{1 - a_i \hat{s} + b_i \hat{s}^2} \ ,
\tag{8}
$$

where $i = +, -$ or T and $\hat{s} = q^2/m_B^2$. The values of the parameters $f_i(0)$, a_i and b_i are specified in Table 1.

	$f_i(0)$	a_i	b_i
f_+	0.31 ± 0.08	0.81	-0.21
f_-	-0.31 ± 0.07	0.80	-0.36
f_T	-0.26 ± 0.07	0.41	-0.32

Table 1: Form factors for $B \to K_0^*(1430)\ell^+\ell^-$ decay in a three–parameter fit.

The full kinematical interval of the dilepton invariant mass q^2 is $4m_\ell^2 \le q^2 \le (m_B - m_{K_0^*})^2$ for which the long distance effects (the charmonium resonances) can give substantial contribution by the two low lying resonances J/ψ and ψ', in the interval of $8 \ GeV^2 \le q^2 \le 14 \ GeV^2$. In order to minimize the hadronic uncertainties we discard this subinterval by dividing the kinematical region of q^2 for muon:

I $4m_\ell^2 \le q^2 \le (m_{J\psi} - 0.02 \ GeV)^2$,

II $(m_{J\psi} + 0.02 \ GeV)^2 \le q^2 \le (m_{\psi'} - 0.02 \ GeV)^2$,

III $(m_{\psi'} + 0.02 \ GeV)^2 \le q^2 \le (m_B - m_{K_0^*})^2$.

and for tau:

I $4m_\ell^2 \le q^2 \le (m_\psi - 0.02 \ GeV)^2$,

II $(m_\psi + 0.02 \ GeV)^2 \le q^2 \le (m_B - m_{K_0^*})^2$.

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The new Wilson coefficients C_{Q_1} and C_{Q_2} are described in terms of masses of sparticles i.e., chargino-up-type squark and NHBs, $\tan(\beta)$ which is defined as the ratio of the two vacuum values of the 2 neutral Higgses and μ which has the dimension of a mass, corresponding to a mass term mixing the 2 Higgses doublets. Note that μ can be positive or negative. Depending on the magnitude and sign of these parameters, many options in the parameter space can be considered. However, experimental results i.e., the rate of $b \to s\gamma$ and $b \to s\ell^+\ell^-$ constrain us to consider the following options:

- SUSY I: μ takes negative value, C_7 changes its sign and contribution of NHBs are neglected.

- SUSY II: $\tan(\beta)$ takes large values while the mass of superpartners are small i.e., few hundred GeV.

- SUSY III: $\tan(\beta)$ is large and the masses of superpartners are relatively large, i.e., about 450 GeV or more.

The numerical values of Wilson coefficients used in our analysis are referenced from [26, 33, 35]. In fact, according to the experimental results obtained by BELLE collaboration[34]. Refs. [35, 36] indicate that for SUSY II in the case of muon channel C_{Q_1} and C_{Q_2} should not be greater than 0.5. In addition to this, in the absence of real experimental constraints on the FCNC modes in the case of tau channel, we may employ much larger Wilson coefficients (hence, SUSY effects) than we presented in Tables 2, and 3. Because the Yukawa-driven Higgs coupling implies that $C_Q^\tau = m_\tau/m_\mu C_Q^\mu$. The numerical values of Wilson coefficients are collected in Tables 2, and 3.

In Fig. (1) and (2) we present the dependence of the differential branching ratio for the $B \to K_0^*(1430)\ell^+\ell^-$ and $B \to K^*\ell^+\ell^-$ decays, where $\ell = \mu$, τ, on q^2.

Wilson Coefficients	C_7^{eff}	C_9	C_{10}
SM	-0.313	4.334	-4.669
SUSY I	$+0.3756$	4.7674	-3.7354
SUSY II	$+0.3756$	4.7674	-3.7354
SUSY III	-0.3756	4.7674	-3.7354

Table 2: Wilson Coefficients in SM and different SUSY models but without NHBs contributions[26].

Taking into account the q^2 dependence of the form factors given in Eq. (8), performing integration over q^2, and using the total lifetime $\tau_B = 1.53 \times 10^{-12}$ s [37], we get the following results for the branching ratios by considering short distance contribution:

$$\mathcal{B}(B \to K_0^*(1430)\mu^+\mu^-) = \begin{cases} 1.05 \times 10^{-7} & \text{SUSY I}, \\ 2.08 \times 10^{-7} & \text{SUSY II}, \\ 1.10 \times 10^{-7} & \text{SUSY III}, \end{cases}$$

Wilson Coefficients	C_{Q_1}	C_{Q_2}
SM	0	0
SUSY I	0	0
SUSY II	$0.5[35]\ (16.5)[33]$	$-0.5[35]\ (-16.5)[33]$
SUSY III	$1.2\,(4.5)$	$-1.2\,(-4.5)$

Table 3: Wilson coefficients corresponding to NHBs contributions within SUSY I, II and III models [26]. The values in the bracket are for tau channel. Note that the values for SUSY I and III are taken from Ref. [33] and for SUSY II the values taken from [33] and [35].

$$\mathcal{B}(B \to K_0^*(1430)\tau^+\tau^-) = \begin{cases} 9.54 \times 10^{-10} & \text{SUSY I }, \\[2mm] 1.25 \times 10^{-8} & \text{SUSY II }, \\[2mm] 2.69 \times 10^{-9} & \text{SUSY III }. \end{cases}$$

By considering long distance effects in the above–mentioned kinematical regions, we get the following branching ratios for muon:

$$\mathcal{B}(B \to K_0^*(1430)\mu^+\mu^-) = \begin{cases} 1.05 \times 10^{-7} & \text{region I }, \\[2mm] 8.98 \times 10^{-9} & \text{region II }, \quad \text{for SUSY I,} \\[2mm] 1.56 \times 10^{-10} & \text{region III }, \end{cases}$$

$$\mathcal{B}(B \to K_0^*(1430)\mu^+\mu^-) = \begin{cases} 1.73 \times 10^{-7} & \text{region I }, \\[2mm] 3.71 \times 10^{-8} & \text{region II }, \quad \text{for SUSY II,} \\[2mm] 3.25 \times 10^{-9} & \text{region III }, \end{cases}$$

and

$$\mathcal{B}(B \to K_0^*(1430)\mu^+\mu^-) = \begin{cases} 1.08 \times 10^{-7} & \text{region I }, \\[2mm] 1.02 \times 10^{-8} & \text{region II }, \quad \text{for SUSY III.} \\[2mm] 2.83 \times 10^{-10} & \text{region III }, \end{cases}$$

and for tau:

$$\mathcal{B}(B \to K_0^*(1430)\tau^+\tau^-) = \begin{cases} 5.77 \times 10^{-10} & \text{region I }, \\[2mm] 3.43 \times 10^{-10} & \text{region II }, \quad \text{for SUSY I,} \end{cases}$$

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	$B \to K^* \mu^+ \mu^-$	$B \to K_0^* \mu^+ \mu^-$
$SM\ \mathcal{B}(10^{-7})$	$1.21^{+0.35}_{-0.39}$	$1.01^{+0.04}_{-0.04}$
SUSY I $\mathcal{B}(10^{-7})$	2.273	1.05
SUSY II $\mathcal{B}(10^{-7})$	2.270	1.73
SUSY III $\mathcal{B}(10^{-7})$	0.980	1.08
Exp. $\mathcal{B}(10^{-7})$	$1.49^{+0.45}_{-0.40} \pm 0.12[34]$	$-$

Table 4: Experimentally measured values and integrated values of branching ratio at low dileptonic invariant mass region.

	$B \to K^* \mu^+ \mu^-$	$B \to K_0^* \mu^+ \mu^-$	$B \to K^* \tau^+ \tau^-$	$B \to K_0^* \tau^+ \tau^-$
$SM\ \mathcal{B}(10^{-7})$	$0.158^{+0.004}_{-0.0004}$	$0.015^{+0.002}_{-0.002}$	$0.11^{+0.01}_{-0.01}$	$0.023^{+0.015}_{-0.015}$
SUSY I $\mathcal{B}(10^{-7})$	0.181	0.0156	0.083	0.0342
SUSY II $\mathcal{B}(10^{-7})$	0.184	0.0325	0.086	0.0584
SUSY III $\mathcal{B}(10^{-7})$	0.173	0.0283	0.12	0.0115

Table 5: Integrated values of branching ratio at high dileptonic invariant mass region($q^2 \geq 14.5 \text{GeV}^2$).

$$\mathcal{B}(B \to K_0^*(1430)\tau^+\tau^-) = \begin{cases} 4.67 \times 10^{-9} & \text{region I} , \\ \\ 5.84 \times 10^{-9} & \text{region II} , \quad \text{for SUSY II,} \end{cases}$$

and

$$\mathcal{B}(B \to K_0^*(1430)\tau^+\tau^-) = \begin{cases} 1.21 \times 10^{-9} & \text{region I} , \\ \\ 1.15 \times 10^{-9} & \text{region II} , \quad \text{for SUSY III.} \end{cases}$$

at $f_{K_0^*} = 340\ MeV$.

Our results for low and high q^2 regions are shown in the tables 4 and 5.

These results depict that the dominant contribution comes from term proportional to C_7 in region I (low invariant mass region), and this can be attributed to the existence of the factor $1/q^2$. At LHCb 10^{11}–10^{12} pairs are expected to be produced, the expected number of events for the $B \to K_0^*(1430)\mu^+\mu^-$ decay in the low invariant mass region is the order of 10^4–10^5. Since this region is sensitive to the sign of C_7 in the SUSY I model, the study of branching ratio in this region can provide valuable information about the SUSY

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effects. In particular, SUSY I and SUSY II can be distinguished by $B \to K_0^*(1430)$ channel much better than $B \to K^*$ channel(see table 4). When value of the branching ratio for the $B \to K_0^*(1430)\mu^+\mu^-$ decay is considered both with and without long distance effects, valuable results to check structure of the effective Hamiltonian can be achieved. The small value of $\mathcal{B}(B \to K_0^*(1430)\tau^+\tau^-)$ can be attributed to the small phase volume of this decay. Furthermore, SUSY models can enhance the branching ratio up to one order of magnitude with respect to the SM values for both μ and τ cases. The significant discrepancy in the non-resonance regions (low q^2 and high q^2 regions) can be studied for the effects of not only NHBs but also for NP effects.

Fig. 3 illustrates the dependency of R in terms of q^2 for various SUSY scenarios for $q^2 \geq 4m_\ell^2$ region, where R is defined as follows:

$$R(q^2) = \frac{(d\Gamma/dq^2)(B \to K_0^*(1430)\mu^+\mu^-)}{(d\Gamma/dq^2)(B \to K_0^*(1430)e^+e^-)} \tag{9}$$

Finally, the study of rate difference of muon channel to electron channel is complimentary work to the studies of other observables. While SUSY II and SUSY III approximately coincide with each other in the study of branching ratio, referred models can be distinguished by studying the R (see fig. 3). Furthermore, SUSY I lies in the theoretical error bounds of SM when considering both at branching ratio (see fig. 1) and R (see fig. 3).

To sum up, we study the semileptonic rare $B \to K_0^*(1430)\ell^+\ell^-$ and $B \to K^*\ell^+\ell^-$ decays in the supersymmetric theories. The results show that the branching ratio is very sensitive to the SUSY parameters. The branching ratio is enhanced up to one order of magnitude with respect to the corresponding SM values. It is also realized that in the low q^2 region the study of $B \to K_0^*(1430)\ell^+\ell^-$ decay is better than $B \to K^*\ell^+\ell^-$ decay if we try to distinguish SUSY I and SUSY II models. It is also recognized that while studying the rate difference of electron channel to muon channel, R can be complimentary to the studies of branching ratio. The results can be used for indirect search of the SUSY effects in future planned experiments at LHC.

Acknowledgments

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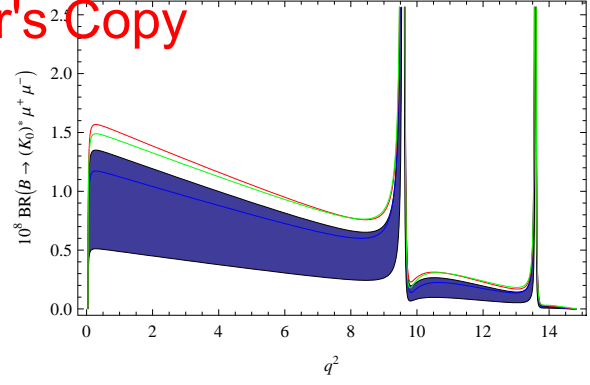[37] C. Amsler et al. [Particle Data Group], Phys. Lett. B 667, 1 (2008).
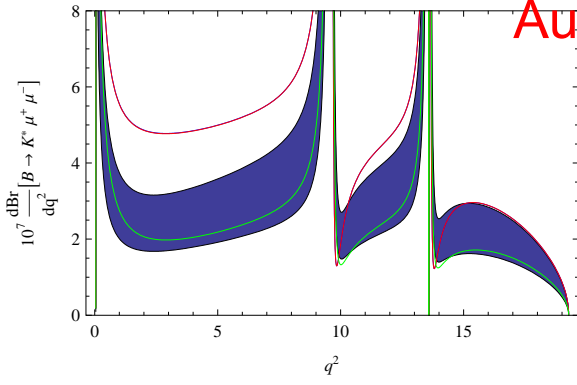
Fig. (1a)

Fig. (1b)

Figure 1: Branching ratio of the $B \to K^* \mu^+ \mu^-$ decay and the $B \to K_0^*(1430)\mu^+\mu^-$ decay. Black, blue, red and green lines correspond to SM, SUSY I, SUSY II, SUSY III models, respectively. Blue bound of the SM is created by the theoretical errors among the formfactors.
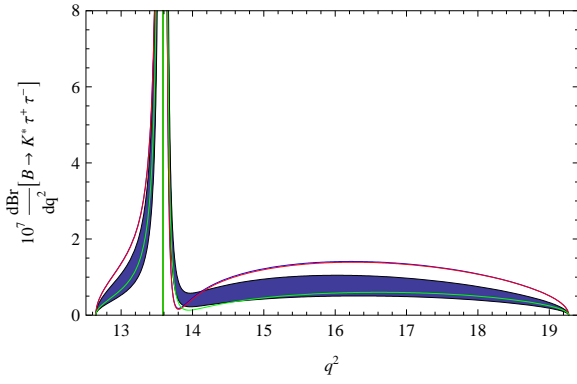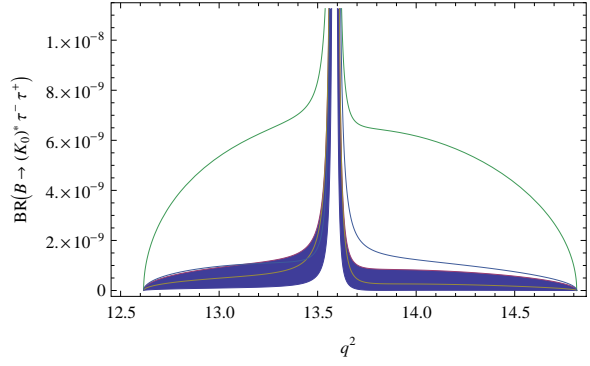

Fig. (1a)

Fig. (1b)

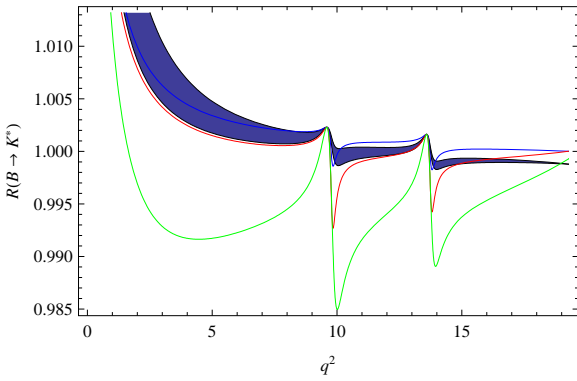Figure 2: The same as Fig. 1 but for tau(τ) channel.

Fig. (3a)
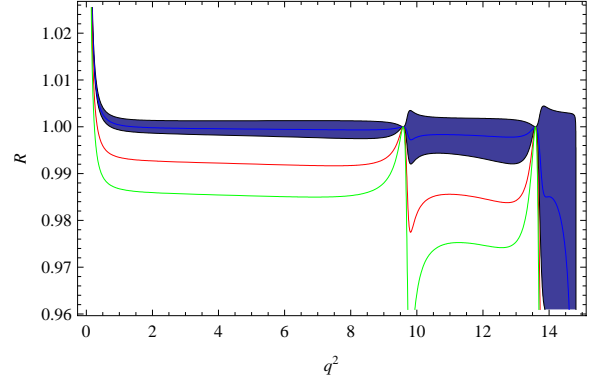
Fig. (3b)

Figure 3: The rate difference of the electron channel to the muon channel for the $B \to K^*$ Fig. (3a) and the $B \to K_0^*(1430)$ Fig. (3b) transitions when $q^2 \geq 4m_\mu^2$ region. Blue bound of the SM is created by the theoretical errors among the formfactors.

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