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Large enhancement of $D^{\pm} \to e^{\pm}\nu$ and $D_s^{\pm} \to e^{\pm}\nu$ in R-parity violating SUSY models

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Abstract

The purely leptonic decays $D^{\pm} \to e^{\pm}\nu$ and $D_s^{\pm} \to e^{\pm}\nu$, for which no experimental limits exist, are highly suppressed in the Standard Model. Mere observation of these decays at the B factories Belle/BaBar or forthcoming CLEO-c would be a clear signal of physics beyond the SM. We show that R-parity violating slepton contributions can give rise to spectacular enhancements of the decay rates, resulting in branching ratios as large as 5×10^{-3}, which strongly motivates a search in these channels.

Keywords: Rare D decay

1. Introduction

The wealth of new data from the B factories Belle and BaBar has caused a great amount of phenomenological interest in B decays in recent years. Already the much anticipated measurement of $\sin 2\phi_1$ [1,2] has been achieved, and many new results in the field of rare B decays (e.g., $b \to s\gamma$ [3] and $b \to d\gamma$ [4]) are eagerly awaited.

Less attention has been devoted to charmed (D) meson decays, although the B factories and forthcoming CLEO-c promise the largest sample of charmed mesons to date. D mesons may be produced at the B factories by two mechanisms: (i) continuum $c\bar{c}$ production and (ii) decay of B mesons. While the majority of B decays involve some charmed particles, it is difficult to extract charm data from these decays due to the high multiplicity of particles in the final states. With the high luminosity of the B factories, however, a lot of $c\bar{c}$ pairs that subsequently hadronize to D mesons are produced directly in the collision of the primary e^+e^- beams. Both Belle and BaBar will each have about 5×10^8 $c\bar{c}$ continuum events in the anticipated data samples of 400 fb^{-1}, thus providing a rich testing ground for charm decays. At CLEO-c, prospects are also very promising with the threshold production of D mesons offering distinct advantages over the $c\bar{c}$ continuum production at the B factories, which compensates for the lower luminosity of CLEO-c [5].

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These experiments will have substantially increased sensitivity to the purely leptonic decays of the charged $D^\pm$ mesons, $D_s^\pm \to l^\pm\nu$ and $D^\pm \to l^\pm\nu$. In the SM, such decays occur via $W^\pm$ annihilation in the s-channel and provide an opportunity to measure the decay constants (f_{D_s}, f_D) for $D_s^\pm$ and $D^\pm$. Of these six leptonic decays, only $D_s^\pm \to \tau^\pm\nu$ and $D_s^\pm \to \mu^\pm\nu$ have been observed, from which f_{D_s} is measured with an error $\sim 14\%$. The $D^\pm$ decays are Cabbibo suppressed compared to $D_s^\pm$, and none have been observed except for 1 event for $D^\pm \to \mu^\pm\nu$. The B factories and CLEO-c will offer improved measurements of $D_s^\pm \to \tau^\pm\nu$ and $D_s^\pm \to \mu^\pm\nu$, which in turn will significantly reduce the error in the current measurements of f_{D_s}. Observation of $D^\pm \to \mu^\pm\nu$ (or the less accessible $D^\pm \to \tau^\pm\nu$) will provide the first serious measurement of f_D.

In this Letter we advocate searching for physics beyond the SM through these decays. Of special interest are $D_s^\pm \to e^\pm\nu$ and $D^\pm \to e^\pm\nu$ for which no experimental limits exist, but could readily be searched for at the above experiments. In the SM these are severely helicity suppressed by m_e^2 and have branching ratios of the order 10^{-7} and 10^{-9}, respectively. Hence such decays have been largely overlooked since (in the context of the SM) they cannot offer a measurement of the decay constant with present or upcoming data samples. However, the smallness of their branching ratios enables these decays to play a new role of probing models beyond the SM. We show that slepton contributions in the Minimal Supersymmetric Standard Model (MSSM) with explicit R-parity violation can enhance these BRs to 5×10^{-3}, a result which strongly motivates a search in these channels. Although the effect of new physics in purely leptonic decays is sometimes tainted by the uncertainty in the decay constant, the tiny SM branching ratios (BRs) for $D_s^\pm \to e^\pm\nu$ and $D^\pm \to e^\pm\nu$ assure that mere observation of these decays at the aforementioned machines would be an unambiguous signal of physics beyond the SM.

Our work is organised as follows. In Section 2 we introduce the $D^\pm$ meson annihilation decays. In Section 3 we show how these decays can be enhanced in R-parity violating SUSY models. Section 4 presents our numerical results and Section 5 contains our conclusions.

2. Annihilation $D^\pm$ meson decays

To date the primary interest in measuring the purely leptonic decays $D^\pm/D_s^\pm \to l^\pm\nu_l$ has been to obtain information on the charged D meson decay constants [6]. In the SM these decays proceed via annihilation to a $W^\pm$ in the s-channel (see Fig. 1). Due to helicity suppression, the rate is proportional to m_l^2, and the phase space suppression is particularly severe for $\tau^\pm\nu$. The partial width is given by:

$$\Gamma\big(D_q^+ \to \ell^+\nu_\ell\big) = \frac{G_F^2 m_{D_q} m_l^2 f_{D_q}^2}{8\pi}|V_{cq}|^2\left(1 - \frac{m_l^2}{m_{D_q}^2}\right)^2, \quad (1)$$

where $q = d$ or s. The SM predictions for the BRs and the current experimental status of the various searches are shown in Table 1.[1] One can see that the decays involving $e^\pm\nu$ have tiny BRs, while those involving $\mu^\pm\nu$ and $\tau^\pm\nu$ have BRs in the range $10^{-2} \to 10^{-4}$. Of the six possible decays, only two have been measured with any sort of accuracy, yielding a world average of $f_{D_s} = 264 \pm 35$ MeV [6]. Additionally there is a very imprecise measurement of $D^\pm \to \mu^\pm\nu$ based on 1 observed event, giving $f_{D_s} = 300^{+180+80}_{-150-40}$ MeV [7]. Of the three decays which have not been searched for $D_s^\pm \to e^\pm\nu$ and $D^\pm \to e^\pm\nu$ have particularly clean signatures. With the expected large samples of $D^\pm$ and $D_s^\pm$ mesons at Belle, BaBar and CLEO-c [5], these experiments should be sensitive to BR $\sim \mathcal{O}(10^{-4})$. CLEO-c aims to accumulate 30 million $D^\pm$ events (6 million fully tagged) and 1.5 million $D_s^\pm$ events (0.3 million fully tagged) by the end of 2004. Belle and BaBar expect 5×10^8 $c\bar{c}$ continuum events by

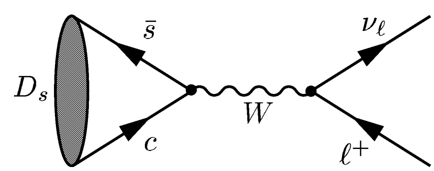

Fig. 1. Leptonic D_s decay in the Standard Model: W exchange.

[1] Our numbers differ substantially—especially in the τ channels—from the ones given, e.g., in the BaBar book. This is because the rate depends very strongly on the mass of the D, for which we are using newer values. We also use a different value for the decay constant of the D_s, see Section 4 for details.

Table 1
SM predictions and current experimental limits

Decay	SM prediction	Experiment
$D_d^+ \to e^+\nu_e$	8.24×10^{-9}	$\times$
$D_d^+ \to \mu^+\nu_\mu$	3.50×10^{-4}	$(8^{+16+5}_{-5\ -2}) \times 10^{-4}$ [7]
$D_d^+ \to \tau^+\nu_\tau$	9.25×10^{-4}	$\times$
$D_s^+ \to e^+\nu_e$	1.23×10^{-7}	$\times$
$D_s^+ \to \mu^+\nu_\mu$	5.22×10^{-3}	$(5.3 \pm 0.9 \pm 1.2) \times 10^{-3}$ [6]
$D_s^+ \to \tau^+\nu_\tau$	5.09×10^{-2}	$(6.05 \pm 1.04 \pm 1.34 \pm 0.22) \times 10^{-2}$ [6]

the end of 2005. Mere observation of these decays would be an patent signal of physics beyond the SM. In the next section we show that SUSY particles in R-parity violating extensions of the MSSM can enhance these decays to experimental observability. Thus in addition to offering measurements of the charged D meson decay constants, the purely leptonic decays of $D^\pm/D_s^\pm$ mesons assume a new role of probing physics beyond the SM. In [5] CLEO-c is considering increasing the selection efficiency of the μ-channel by waiving the μ-tag requirement, stating that no e-contamination is to be expected due to the small SM rate of the respective channel. We strongly encourage also performing an analysis with a muon identification tag, because the e-channel can substantially contribute to the total leptonic annihilation decay rate as will be shown later in this Letter.

The related decays $D^\pm/D_s^\pm \to e^\pm\nu\gamma$, are known to have larger BRs than $D^\pm/D_s^\pm \to e^\pm\nu$ in the SM [8,9]. This is because the presence of a photon in the final state removes the helicity suppression. The analysis of [9] finds $\mathrm{BR}(D^\pm \to e^\pm\nu\gamma) \sim \mathcal{O}(10^{-4} \to 10^{-5})$ and $\mathrm{BR}(D_s^\pm \to e^\pm\nu\gamma) \sim \mathcal{O}(10^{-3} \to 10^{-4})$ The “effective” SM prediction for $\mathrm{BR}(D^\pm/D_s^\pm \to e^\pm\nu)$ should include the contribution from $\mathrm{BR}(D^\pm/D_s^\pm \to e^\pm\nu\gamma)$ with a soft photon (i.e., one which cannot be detected experimentally), whose infra-red singularity cancels with the radiative corrections to $\mathrm{BR}(D^\pm/D_s^\pm \to e^\pm\nu)$:

$$\begin{aligned}\mathrm{BR}^{\mathrm{eff}}\big(D^\pm/D_s^\pm \to e^\pm\nu\big) &= \mathrm{BR}\big(D^\pm/D_s^\pm \to e^\pm\nu\big)\\ &\quad + \mathrm{BR}\big(D^\pm/D_s^\pm \to e^\pm\nu\gamma\big)_{E_\gamma < E_{\mathrm{res}}}. \end{aligned} \tag{2}$$

However, the soft photon contribution is only a small fraction of the total rate for $\mathrm{BR}(D^\pm/D_s^\pm \to e^\pm\nu\gamma)$, and so $\mathrm{BR}^{\mathrm{eff}}(D^\pm/D_s^\pm \to e\nu)$ would still be below the expected experimental sensitivity of $\mathcal{O}(10^{-4})$. Hence we suggest that observation of $\mathrm{BR}(D^\pm/D_s^\pm \to e^\pm\nu) \geqslant 10^{-4}$ could only be attributed to physics beyond the SM.

We note that inclusive measurements of the $\mathrm{BR}(D_s^\pm/D^\pm \to e^\pm + X)$ have been performed, to which any enhanced $D_s^\pm/D^\pm \to e^\pm\nu$ would have contributed. However, the error in the measurements of $D_s^\pm \to e^\pm + X$ [10] and $D^\pm \to e^\pm + X$ [11] still allow for contributions from $D_s^\pm/D^\pm \to e^\pm\nu$ of the order of a percent or more.

3. *R*-parity violating contributions to $D^\pm, D_s^\pm \to \ell^\pm\nu$

The main motivation for R-parity violating SUSY [12,13] is to account for the observed neutrino oscillations without increasing the particle content of the MSSM [14,15]. The superpotential is given by:

$$\begin{aligned} W_R = {} & \frac{1}{2}\lambda_{ijk} L_i L_j E_k^c + \lambda'_{ijk} L_i Q_j D_k^c \\ & + \frac{1}{2}\lambda''_{ijk} U_i^c D_j^c D_k^c. \end{aligned} \tag{3}$$

Bilinear terms $\mu_i L_i H_2$ are also possible, but have negligible impact on the annihilation decays we consider. Since the $\lambda''_{ijk} U_i^c D_j^c D_k^c$ term can mediate proton decay, it is customary to assume that the λ'' couplings vanish due to some discrete symmetry (e.g., baryon parity). The simplest approach to R-parity violating phenomenology is to assume that a single R-parity violating coupling in the *weak basis* (λ'_{ijk}) is dominant with all others negligibly small. It was shown that such an approach leads to several non-zero R-parity violating couplings in the *mass basis* ($\bar{\lambda}'_{imn}$) due to quark

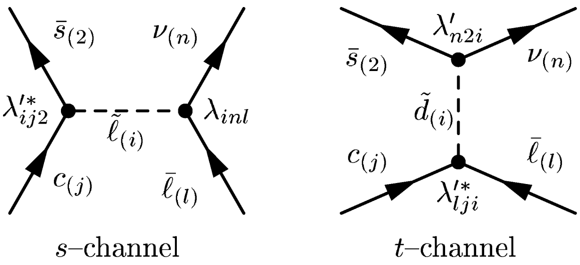

Fig. 2. Leptonic D_s decay in R-parity violating models: sparticle exchange.

mixing [16]:

$$\bar{\lambda}'_{imn} = \lambda'_{ijk} V^{\mathrm{KM}}_{jm} \delta_{kn}. \tag{4}$$

Here we have assumed that all quark mixing lies in the up-type sector, so that the mixing matrix is the usual Kobayashi–Maskawa matrix V^{KM}. This simplification avoids the appearance of the right-handed quark mixing matrix and gives the most conservative limits on the R-parity violating couplings, which would otherwise be constrained more severely from the decay $K^\pm \to \pi^\pm \nu\bar{\nu}$ [16]. A realistic R-parity violating model would have many non-zero couplings *in the weak basis* and so in general would have a very rich phenomenology provided the couplings are not too small.

It has been emphasised before that the purely leptonic decays are very sensitive at tree level to R-parity violating trilinear interactions, and thus these decays constitute excellent probes of the model, e.g., the decays $B^\pm_{u,c} \to l^\pm \nu$ may be enhanced up to current experimental sensitivity [17–20]. The relevant Feynman diagrams for the decays $D^\pm/D^\pm_s \to l^\pm \nu$ are depicted in Fig. 2 and consist of s- and t-channel exchange of sparticles. These additional channels modify the SM rate (1) by

$$m_l \to \left(1 + \mathcal{A}^q_{ln}\right) m_l - \left(R_\ell + \mathcal{B}^q_{ln}\right) M_{D_q}, \tag{5}$$

where $R_\ell = m_\ell M_{D_q} \tan^2\beta / M^2_{H^\pm}$ stems from R-parity conserving SUSY charged Higgs exchange [21] which we will not consider further since it is also proportional to the lepton mass and is relatively unimportant for the lighter leptons on which we focus. The R-parity violating SUSY contributions are given by:

$$\mathcal{A}^q_{ln} = \frac{\sqrt{2}}{4 G_F V_{cq}} \sum_{i,j=1}^{3} \frac{1}{2 m^2_{\tilde{q}_i}} V_{2j} \lambda'_{nqi} \lambda'^{*}_{lji}, \tag{6}$$

$$\mathcal{B}^q_{ln} = \frac{\sqrt{2}}{4 G_F V_{cq}} \sum_{i,j=1}^{3} \frac{2}{m^2_{\tilde{\ell}_i}} V_{2j} \lambda_{inl} \lambda'^{*}_{ijq}, \tag{7}$$

where $q = d, s$ for D^+, D^+_s, respectively. These formulae were derived in [17] for leptonic decays of B mesons. The helicity suppressed contribution from the $\mathcal{A}^q_{ln}$ term can be mediated by just one λ' coupling (if $n = l$ and $q = j$), or by two different couplings (if $n \neq l$ and/or $q \neq j$). The dominant $\mathcal{B}^q_{ln}$ term (which is not helicity suppressed) requires one non-zero λ *and* one non-zero λ'. In the next section we will vary the R-parity violating couplings inside their allowed ranges to determine the obtainable BRs.

The contribution of the t-channel diagrams has been considered in [22] for $D^\pm_s \to \tau^\pm \nu$ and $D^\pm_s \to \mu^\pm \nu$. Here only single coupling limits were considered and weak limits are derived for λ'_{32k} and λ'_{22k}. Analogous t-channel exchange diagrams also occur for the neutral D^0 meson decays $D^0 \to l^+_i l^-_j$ [23,24]. Strong upper limits ($< 10^{-6}$) on $\mathrm{BR}(D^0 \to e^+e^-, e^+\mu^-, \mu^+\mu^-)$ have been obtained from the Tevatron. These decays have no s-channel contributions of the type $\lambda\lambda'$ due to the absence of the coupling $\lambda'_{ijk} \tilde{\nu}_i u_j \bar{u}_k$ in the Lagrangian. We wish to focus on the decays $D^\pm_s, D^\pm \to e^\pm \nu$, in particular, the helicity unsuppressed s-channel contributions mediated by combinations of $\lambda\lambda'$. Although these decays might be problematic at the Tevatron due to the missing energy of ν, they can be readily searched for at the e^+e^- machines Belle, BaBar and CLEO-c.

4. Numerical results

In our analysis we make use of the latest limits on the R-parity violating couplings λ and λ'. Single coupling bounds are listed in [13]. Further input parameters are $m_{D^\pm} = 1.8693$ GeV, $\tau_{D^\pm} = 1.051 \times 10^{-12}$ s, $f_{D^\pm} = 0.2$ GeV for the $D^\pm$ meson and $m_{D^\pm_s} = 1.9685$ GeV, $\tau_{D^\pm_s} = 0.49 \times 10^{-12}$ s, $f_{D^\pm_s} = 0.25$ GeV for the $D^\pm_s$. The parameters for rare τ decays are taken from [26].

Many of the bounds on R-parity violating couplings relevant for our analysis are of the same order of magnitude; the products of these couplings are $\mathcal{O}(10^{-2})$ and can mediate $D^\pm/D^\pm_s \to e^\pm \nu$ with BRs up to $\mathcal{O}(10^{-1})$. However, most combinations of

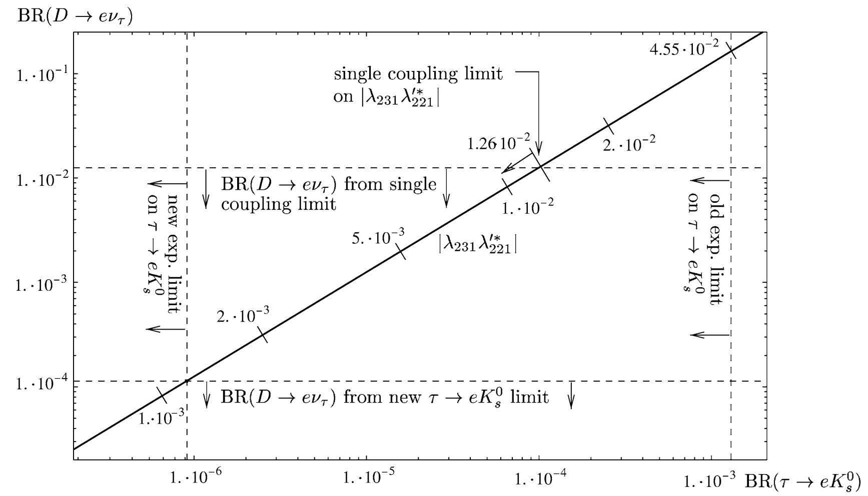

Fig. 3. Dependence of BR($D^\pm \to e^\pm\nu_\tau$) and BR($\tau^\pm \to e^\pm K^0_s$) on the product of $R\!\!\!/_p$ couplings $|\lambda_{231}\lambda'^{*}_{221}|$.

$\lambda\lambda'$ which mediate $D^\pm/D^\pm_s \to e^\pm\nu$ would strongly contribute to the kaon decays, $K^0 \to e^+e^-, e^\pm\mu^\mp, \mu^+\mu^-$, via $\tilde{\nu}$ exchange in the s-channel [25]. The limits on such combinations is $\mathcal{O}(10^{-7})$, which is 10^5 better than the product of the single coupling limits, and at first sight would seem to rule out the possibility of a sizably enhanced $D^\pm/D^\pm_s \to e^\pm\nu$ mediated by $\lambda\lambda'$ combinations.

However, large BRs for $D^\pm/D^\pm_s \to e^\pm\nu$ can occur if the neutrino is ν_τ. This is because the corresponding decay in the kaon sector would involve a τ lepton in the final state, which is kinematically impossible. The only possibility for a lepton flavour violating kaon decay mediated by these combinations of couplings would be $K^0 \to \ell^\pm\tau^{\mp *} \to \ell^\pm\ell'^\mp\nu_\tau\nu_{\ell'}$. Here the additional suppression factors (e.g., off-shell propagators, additional vertices) easily weaken the limits on the relevant $\lambda\lambda'$ couplings to $\mathcal{O}(10^{-2})$ where the single coupling bounds become more restrictive than the bounds from kaon decays. In addition the final state $e^\pm l^\mp\nu_\tau\nu_l$ has not been searched for.

Therefore, the most promising combinations which enhance $D^\pm \to e^\pm\nu_\tau$ and $D^\pm_s \to e^\pm\nu_\tau$ are $\lambda_{231}\lambda'_{221}$ and $\lambda_{231}\lambda'_{222}$, respectively. For these combinations the use of the single coupling bounds is justified.[2] The single coupling bounds $\lambda_{231} = 0.07$ and $\lambda'_{221} = 0.18$ (for sparticle mass 100 GeV) can induce BR($D^\pm \to e^\pm\nu_\tau$) $= 1.251 \times 10^{-2}$. Although as stated above, this combination of couplings is safe from rare kaon decay bounds, the same combination can induce the lepton flavour violating τ decay $\tau^\pm \to e^\pm K^0_s$ [26].

The dependence of BR($D^\pm \to e^\pm\nu_\tau$) and BR($\tau^\pm \to e^\pm K^0_s$) on the product of the $R\!\!\!/_p$ couplings $|\lambda_{231}\lambda'^{*}_{221}|$ is shown in Fig. 3. The x- and y-axes give the respective branching ratios and $|\lambda_{231}\lambda'^{*}_{221}|$ is varied along the diagonal line. The plot is logarithmic along both axes. The experimental bound on BR($\tau^- \to e^- K_0$) prior to summer 2002 [27] (rightmost vertical dashed line) is less restrictive for $|\lambda_{231}\lambda'^{*}_{221}|$, and therefore for BR($D^\pm \to e^\pm\nu_\tau$), than the product of the individual coupling bounds. The BR($D^\pm \to e^\pm\nu_\tau$) attainable with the individual coupling bounds is indicated by the upper horizontal dashed line. However, a much improved experimental bound on BR($\tau^\pm \to e^\pm K^0_s$) has recently been published [28], and this limit is indicated by the left vertical dashed line.[3] This new limit restricts the enhancement of BR($D^\pm \to e^\pm\nu_\tau$) from $R\!\!\!/_p$

[2] Recently some new constraints on these combinations have been derived from considering 2 loop contributions to neutrino masses [15]. These bounds are of the same order of magnitude as the single coupling bounds, and so our results are largely unaffected.

[3] [26] appeared shortly before the new bounds on BR($\tau^\pm \to e^\pm K^0_s$) were released and therefore derives a rather weak bound $|\lambda_{231}\lambda'^{*}_{212}|, |\lambda_{231}\lambda'^{*}_{221}| < 4.7 \times 10^{-2}$, which is less restrictive than the single coupling limit. This limit improves to 1.2×10^{-3}, an order of magnitude better than the single coupling limit, with the new data from [28].

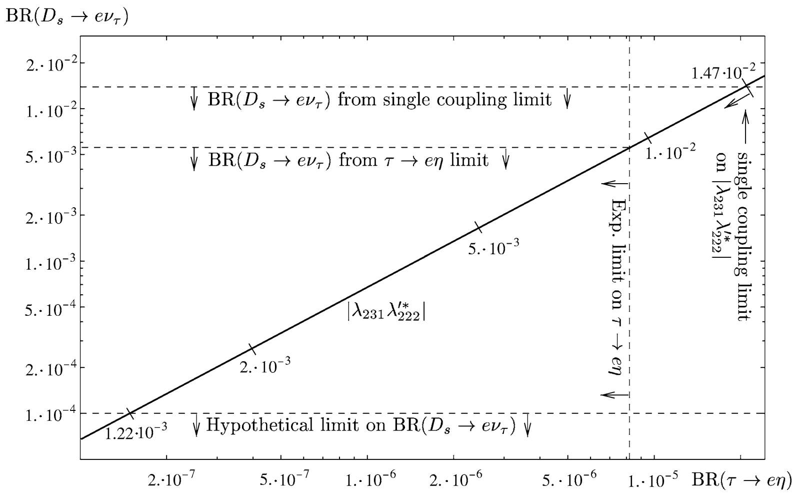

Fig. 4. Dependence of BR($D_s \to e\nu_\tau$) and BR($\tau \to e\eta$) on the product of $\not{R}_p$ couplings $|\lambda_{231}\lambda'^*_{222}|$.

couplings quite substantially; only BRs of $\mathcal{O}(10^{-4})$ remain attainable, while the older bound on lepton flavour violating τ-decays allowed BRs of $\mathcal{O}(1\%)$. CLEO-c expects 30 million $D^\pm$ events (6 million tagged), so even BRs of $\mathcal{O}(10^{-4})$ or smaller could be observed. Alternatively, lack of observation would further improve the limit on $|\lambda_{231}\lambda'^*_{221}|$.

The situation is much more favourable for $D_s^\pm \to e^\pm\nu_\tau$, which is correlated with the less well measured $\tau^\pm \to e^\pm\eta$. The single coupling bounds $\lambda_{231} = 0.07$ and $\lambda'_{222} = 0.21$ give $\text{BR}(D_s^\pm \to e^\pm\nu_\tau) = 1.391 \times 10^{-2}$. The plot analogous to Fig. 3 for the dependence of $\text{BR}(D_s^\pm \to e^\pm\nu_\tau)$ and $\text{BR}(\tau^\pm \to e^\pm\eta)$ on the product of $\not{R}_p$ couplings $|\lambda_{231}\lambda'^*_{222}|$ is shown in Fig. 4. The current experimental bound on $\text{BR}(\tau^\pm \to e^\pm\eta)$ [29] (vertical dashed line) restricts $|\lambda_{231}\lambda'^*_{222}|$ (and therefore $\text{BR}(D_s^\pm \to e^\pm\nu_\tau)$) slightly more than the product of the single coupling limits, indicated in the top right-hand corner of the graph.

The lower horizontal dashed line indicates a hypothetical limit on $\text{BR}(D_s^\pm \to e^\pm\nu_\tau)$ of 10^{-4} which seems realistic in light of an expected number of 1.5 million D_s events (0.3 million fully tagged) after one year of running of CLEO-c. This limit would restrict the product of couplings $|\lambda_{231}\lambda'^*_{222}|$ about a factor of 10 better than present experiments. To compete with this accuracy, the experimental limit on $\text{BR}(\tau^\pm \to e^\pm\eta)$ would have to improve by about two orders of magnitude which does not seem attainable in the current runs of the B factories. We therefore believe that even if searches for $D^\pm/D_s^\pm \to e^\pm\nu_\tau$ do not detect an enhancement in these channels, they would still be useful for setting new limits on products of $\not{R}_p$ couplings.

The poorly measured decay $D^\pm \to \mu^\pm\nu$ may also be enhanced by the combination $\lambda_{232}\lambda'_{221}$. The current error allows for a sizeable enhancement over the SM prediction of the order 3–6, depending on the value of the decay constant. The SM prediction currently lies at the lower end of the experimentally allowed interval. If subsequent measurements should tend towards the upper end of the current interval, non-zero R-parity violating couplings would be a possible explanation for this deviation. SM-conform measurements on the other hand would allow for better limits on $\lambda_{232}\lambda'_{221}$. CLEO-c aims to measure the $\text{BR}(D^\pm \to \mu^\pm\nu)$ to a precision of a few %. For the decays $D^\pm/D_s^\pm \to \tau^\pm\nu$ we do not find sizably enhanced BRs.

The decays $D^\pm \to \ell^\pm\nu$ and $D_s^\pm \to \ell^\pm\nu$ can also be mediated by products of two λ' couplings (right diagram in Fig. 2), but because of the helicity suppression, only the τ-channel can receive a sizeable contribution. Even in these cases, the $\not{R}_p$ contributions can only become as large as the uncertainties of the SM predictions. Therefore, neither a large enhancement, nor improvements of the limits are possible, except for single coupling limits on λ'_{22k} and λ'_{32k} as shown in [22].

5. Conclusions

In the context of the MSSM we have studied the effects of R-parity violating couplings (λ, λ') on the purely leptonic decays $D^\pm/D_s^\pm \to l^\pm\nu$. We showed that slepton mediated contributions proportional to combinations of the type $\lambda\lambda'$ can strongly enhance the previously unmeasured decays $D^\pm/D_s^\pm \to e^\pm\nu$ to the sensitivity of current B factories and forthcoming CLEO-c. Maximum values for $\mathrm{BR}(D_s^\pm \to e^\pm\nu)$ and $\mathrm{BR}(D^\pm \to e^\pm\nu)$ of 5×10^{-3} and 1×10^{-4}, respectively, were found. Mere observation of these decays would be an unequivocal signal of physics beyond the SM. In simple R-parity violating models with a single dominant $\lambda\lambda'$ combination, there would be a correlation with the decays $\tau^\pm \to e^\pm K_S^0$ and $\tau^\pm \to e^\pm\eta$, which would be similarly enhanced to the sensitivity of current and planned experiments. Such correlated signals would provide strong evidence for R-parity violating interactions.

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