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Interplay of LFV at low energies and at colliders: Impact for new physics

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Summary. — We discuss the impact of a type-I SUSY seesaw concerning lepton flavour violation (LFV) at low energies and at colliders. In the framework of a type-I SUSY seesaw, low-energy manifestations of LFV such as radiative and three-body lepton decays are expected to be accompanied by lepton flavour violating high-energy observables, such as large slepton mass splittings and flavour violating neutralino and slepton decays (for example in $\chi_2^0 \to \tilde{\ell}\,\ell \to \ell\,\ell\,\chi_1^0$ decay chains). Based on the strong interplay of high- and low-energy observables, we propose some strategies to derive important information on the underlying mechanism of lepton flavour violation.

PACS `12.60.Jv` – Supersymmetric models.
PACS `14.60.Pq` – Neutrino mass and mixing.
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1. – Motivation

Supersymmetric (SUSY) realisations of the seesaw mechanism offer unique frameworks where in addition to accommodating ν data, many theoretical and experimentally shortcomings of the Standard Model (SM) can be successfully addressed. Such extensions of the SM potentially allow many new phenomena, especially concerning lepton flavour violation (LFV). Within a type-I SUSY seesaw, even if the soft SUSY breaking terms are flavour universal at some high energy unification scale, flavour violation appears at low energies due to the renormalisation group (RG) evolution of the SUSY soft-breaking parameters, which are driven by the potentially large and necessarily non-diagonal neutrino Yukawa couplings [1]. In the framework of the SUSY seesaw, low-energy manifestations of LFV include sizable branching ratios (BR) for radiative decays as $\ell_i \to \ell_j \gamma$, three-body decays, $\ell_i \to 3\ell_j$ and sizable $\mu - e$ conversion rates (CR) in heavy nuclei (for a review, see ref. [2] and references therein).

Flavour violation is also expected to occur at high-energies, as at the LHC, or at a future Linear Collider (LC). At the LHC, slepton mediated neutralino decays offer a golden laboratory to study LFV, and three possible signals are expected: i) flavoured slepton mass splittings—provided that one can effectively reconstruct slepton masses via observables such as the kinematic end-point of the invariant mass distribution of the leptons coming from the above mentioned cascade decay; ii) multiple edges in di-lepton invariant mass distributions $\chi_2^0 \to \chi_1^0\,\ell_i^\pm\,\ell_i^\mp$, arising from the exchange of a different flavour slepton $\tilde{\ell}_j$ (in addition to the left- and right-handed sleptons, $\tilde{\ell}^i_{L,R}$); iii) sizable widths for LFV decay processes like $\chi_2^0 \to \ell_i^\pm\,\ell_j^\mp\,\chi_1^0$. If kinematically accessible, most of these processes can be also studied at Linear Colliders. Moreover, LCs offer further possibilities (in addition to the expected higher precision in SUSY parameter reconstruction): sleptons can be directly produced in e^+e^- collisions, and the possibility of e^-e^- modes might also provide very clean signals of LFV.

As proposed in our analysis of [3], the confrontation of slepton mass splittings (and other collider LFV observables) and of low-energy LFV observables may provide important information about the underlying mechanism of flavour violation in the (s)lepton sector.

2. – LFV in the type I SUSY seesaw

Our analysis is conducted in the framework of the constrained minimal supersymmetric extension of the Standard Model (cMSSM) extended by three right-handed neutrino superfields, so that the leptonic part of the superpotential is given by $\mathcal{W}^{\text{lepton}} = \hat{N}^c\,Y^\nu\,\hat{L}\,\hat{H}_2 + \hat{E}^c\,Y^l\,\hat{L}\,\hat{H}_1 + \frac{1}{2}\,\hat{N}^c\,M_N\,\hat{N}^c$, where the charged lepton Yukawa couplings Y^ℓ and the Majorana mass M_N matrix are assumed to be diagonal in flavour space ($Y^l = \text{diag}(Y^e, Y^\mu, Y^\tau)$, $M_N = \text{diag}(M_{N_i})$, $i = 1, 2, 3$), without loss of generality. New terms are also added to the soft-SUSY breaking Lagragian, and universality of the soft-SUSY breaking parameters is assumed at some high-energy scale, which is chosen to be the gauge coupling unification scale $M_X \sim M_{\text{GUT}} \sim 10^{16}\,\text{GeV}$. In the so-called seesaw limit, one has the usual seesaw equation for the light neutrino masses $m_\nu = -{m_D^\nu}^T M_N^{-1} m_D^\nu$, where $m_D^\nu = Y^\nu\,v_2$, v_i being the vacuum expectation values of the neutral Higgs scalars, $v_{1(2)} = v\,\cos(\sin)\beta$, with $v = 174\,\text{GeV}$. A convenient means of parametrizing the neutrino Yukawa couplings, while at the same time allowing to accommodate the experimental data, is given by the Casas-Ibarra parametrization [4], which reads at the seesaw scale M_N

$$Y^\nu v_2 = m_D^\nu = i\sqrt{M_N^{\text{diag}}}\,R\,\sqrt{m_\nu^{\text{diag}}}\,{U^{\text{MNS}}}^\dagger. \tag{1}$$

In eq. (1), R is a 3×3 complex orthogonal matrix (parametrized by 3 complex angles θ_i), that encodes possible mixings involving the right-handed neutrinos, in addition to those of the low-energy sector (*i.e.* the U^{MNS}). We use the standard parametrization of the U^{MNS}, with the three mixing angles in the intervals favoured by current best-fit analyses [5].

Within the cMSSM, and in the absence of explicit mixing in the slepton sector, the low-energy slepton masses are flavour-diagonal, so that there are no SUSY contributions to flavour violating transitions, such as $\ell_i \to \ell_j\gamma$, $\ell_i \to 3\ell_j$ and $\mu - e$ conversion in nuclei. Moreover, universality of the masses of left- and right-handed sleptons is only broken due to: i) RGE effects proportional to $(Y^\ell)^2_{ij}$; ii) LR mixing effects, also proportional to the lepton masses ($m_i^\ell \tan\beta$). Hence, cMSSM mass differences between the first two families are extremely small implying that, to a large extent, the left- and right-handed selectrons and smuons are nearly degenerate, their mass splittings typically lying at the per mille level.

In the presence of mixings in the lepton sector, Y^ν is clearly non-diagonal in flavour space, and the running from M_X down to the seesaw scale will induce flavour mixing in the otherwise (approximately) flavour conserving SUSY breaking terms. As an example, at low energies the slepton-doublet soft-breaking mass, $m^2_{\tilde L}$ (which at the GUT scale is $m^2_{\tilde L} = \mathrm{diag}(m_0^2)$) now reads

$$(m^2_{\tilde L})_{ij} \approx \left(m_0^2 + 0.5 M^2_{1/2} - m_0^2 |y| (Y^\ell)^2_{ii}\right) + (\Delta m^2_{\tilde L})_{ij}, \qquad (2)$$

$$\text{with} \qquad (\Delta m^2_{\tilde L})_{ij} \approx -\frac{1}{8\,\pi^2}(3m_0^2 + A_0^2)(Y^{\nu\dagger} L Y^\nu)_{ij},$$

where $L_{kl} = \log(M_X/M_{N_k})\delta_{kl}$.

As clear from the above, in the SUSY seesaw, the radiative corrections introduced by the neutrino Yukawa couplings induce both flavour conserving and flavour violating contributions to the slepton soft masses. Having non-diagonal slepton matrices, and hence a misalignement between slepton mass and interaction eigenstates, allows for flavour violating transitions: SUSY contributions to observables such as $\ell_i \to \ell_j \gamma$, $\ell_i \to 3\ell_j$ and $\mu - e$ conversion in nuclei can be large, and well within the sensitivity of current (and future) dedicated experiments. In addition, and since charged and neutral currents involving sleptons and leptons are potentially non-diagonal, flavour violation can be also manifest in sparticle decays. As an example, one can have $\tilde\ell_i \to \chi^0_a \ell_j$, or $\chi^0_a \to \ell_i \tilde\ell_j$ $(i \neq j)$.

In addition to generating LFV effects, the new terms proportional to Y^ν will also break the approximate universality of the first two generations. An augmented mixing between $\tilde e$, $\tilde\mu$ and $\tilde\tau$ translates into larger mass splittings for the mass eigenstates. In particular, as noticed in [6], large mixings involving the third generation can lead to sizable values of the mass splitting between slepton mass eigenstates, while avoiding the stringent BR($\mu \to e\gamma$) constraint. In the latter case (*i.e.* large $Y^\nu_{32,33}$), the mass splittings between left-handed sleptons of the first two generations are given by

$$\frac{\Delta m_{\tilde\ell}}{m_{\tilde\ell}}(\tilde e_L, \tilde\mu_L) = \frac{|m_{\tilde e_L} - m_{\tilde\mu_L}|}{\langle m_{\tilde\ell_{e,\mu}}\rangle} \approx \frac{1}{2}\,\frac{\Delta m_{\tilde\ell}}{m_{\tilde\ell}}(\tilde\mu_L, \tilde\tau_2) \approx \frac{1}{2}\left|\frac{(\Delta m^2_{\tilde L})_{23}}{(m^2_{\tilde L})_{33}}\right|. \qquad (3)$$

Notice that in the framework of the SUSY seesaw, large slepton mass splittings only emerge for the left-handed sleptons ($\tilde\mu_R$ and $\tilde e_R$ remain approximately degenerate).

As mentioned before, LFV can be observable at colliders, and be manifest via different observables. At the LHC, the next-to-lightest neutralino decays into a final state of opposite sign dileptons and missing energy (associated to χ^0_1) offer a unique laboratory to probe FV in the slepton sector.

In the framework of the cMSSM, the decays of a χ^0_2 into a di-lepton final state $\chi^0_2 \to \ell^\pm_i\, \ell^\mp_i\, \chi^0_1$ are flavour conserving, implying that if measurable, the kinematical edges of a di-lepton mass distribution, $m_{\ell\ell} = \frac{1}{m_{\tilde\ell}}\sqrt{(m^2_{\chi^0_2} - m^2_{\tilde\ell})(m^2_{\tilde\ell} - m^2_{\chi^0_1})}$ lead to the reconstruction of intermediate sleptons of the same flavour, $\tilde\ell^i_{L,R}$.

SUSY models violating strict lepton flavour symmetry may leave distinct imprints on the di-lepton mass distribution, depending on whether the soft-breaking slepton terms are non-universal (but flavour conserving) or truly flavour-violating. In the first case, the most significant effect will be a visible displacement of the kinematical edges in each of the di-lepton distributions: for instance, the edge corresponding to $\tilde{e}_L$ in m_{ee} will not appear at the same values as that of $\tilde{\mu}_L$ in $m_{\mu\mu}$, implying that $m_{\tilde{e}_L} \neq m_{\tilde{\mu}_L}$. In the framework of a type-I SUSY seesaw, the slepton mass splittings can be sizable, and well within the expected sensitivity of the LHC [7]. The second case will lead to far richer imprints: in addition to a relative displacement of the $\tilde{\ell}^i_X$ edge in the corresponding $m_{\ell_i \ell_i}$ distributions, the most striking effect is the appearance of new edges: provided there is a large flavour mixing in the mass eigenstates (and that all the decays are kinematically viable), one can have $\chi^0_2 \to \{\tilde{\ell}^i_L\, \ell_i, \tilde{\ell}^i_R\, \ell_i, \tilde{\ell}^j_X\, \ell_i\} \to \chi^0_1\, \ell_i\, \ell_i$ so that in addition to the two $\tilde{\ell}^i_{L,R}$ edges, a new one would appear due to the exchange of $\tilde{\ell}^j_X$.

Depending on the SUSY spectrum and on the beam energy, LFV processes such as those previously described (in association with χ^0_2 decay chains at the LHC) might be also studied at linear colliders. However, it is important to stress that a Linear Collider allows for direct slepton production, so that the kinematical constraints inherent to the above LHC dedicated studies can be softened. In particular, LFV can be studied in the processes $e^+e^- \to \tilde{\ell}_m \tilde{\ell}^*_k \to \ell^-_i \chi^0_1 \ell^+_j \chi^0_1$, in particular looking for $\mu^+\mu^-$ or $\tau^\pm\mu^\mp$ final states (notice that beam polarisation can also play an important rôle). Should the e^-e^- beam option be available, then a LC may provide golden channels to study LFV: the processes $e^-e^- \to \tilde{\ell}_m \tilde{\ell}_k \to \ell^-_i \chi^0_1 \ell^-_j \chi^0_1$ (via t, u-channel exchange of a Majorana neutralino) leads to extremely clean signals, with very little background. As an example $e^-e^- \to \mu^-\mu^- + E_{\text{missing}}$ would be a remarkable signal for FV in the (s)lepton sector.

Having a unique source of flavour violation implies that the high-energy LFV observables, $\Delta m_{\tilde{\ell}}/m_{\tilde{\ell}}(\tilde{\ell}_i, \tilde{\ell}_j)$, are strongly correlated with the low-energy ones (BRs and CR). In the absence of a direct means of testing the SUSY seesaw, the interplay of these sets of observables may allow to either strengthen the seesaw hypothesis, or even disfavour the seesaw (thus suggesting additional or even distinct new sources of flavour violation).

3. – Results

Here we briefly review our proposed strategy to probe a type-I SUSY seesaw based on the interplay of high- and low-energy LFV observables. (We assume that SUSY has been discovered, and a spectrum reconstructed, for instance at the LHC.) The study of LFV in association with the χ^0_2 decay chain requires that several requirements be met: we begin by summarising them, and describing how slepton masses can be reconstructed. We then discuss LFV at high-energies, and how the seesaw hypothesis can be tested.

3˙1. *Slepton mass reconstruction at the LHC.* – The identification of the several high-energy LFV observables at the LHC implies complying with several conditions: first of all, the spectrum must be such that the decay chain $\chi^0_2 \to \tilde{\ell}\ell \to \chi^0_1 \ell\ell$, with intermediate real (on-shell) sleptons, is allowed; secondly, the outgoing leptons should be sufficiently hard, $m_{\chi^0_2} - m_{\tilde{\ell}_L, \tilde{\tau}_2} > 10\,\text{GeV}$; moreover, the χ^0_2 production rates, and the $\text{BR}(\chi^0_2 \to \chi^0_1 \ell\ell)$ must be large enough to ensure that a significant number of events is likely to be observed at the LHC.

The above requirements impose strong constraints on the cMSSM parameters (*i.e.* on m_0, $M_{1/2}$, A_0 and $\tan\beta$). In [3], the cMSSM parameter space was thouroughly

Table I. – *mSUGRA benchmark points selected for the LFV analysis:* m_0*,* $M_{1/2}$ *(in GeV) and* A_0 *(in TeV), and* $\tan\beta$ *(*$\mu > 0$*). HM1 and SU1 are LHC CMS- and ATLAS-proposed benchmark points* [8].

Point	m_0	$M_{1/2}$	A_0	$\tan\beta$
P1	110	528	0	10
P2	110	471	1000	10
P3	137	435	−1000	10
P4	490	1161	0	40
CMS-HM1	180	850	0	10
ATLAS-SU1	70	350	0	10

investigated, leading to the identification of regions where the slepton masses could be successfully reconstructed. This study allowed to identify several benchmark points (to which two LHC ones were added), which were used in the numerical studies. These are summarised in table I (we notice that since the presentation of this work, recent LHC constraints on the cMSSM parameter space [9] have already excluded some of the proposed points—however, the analysis can be generalized to other regions in parameter space in association with a heavier spectrum).

If such events are indeed observable, and successfully reconstructed, one expects a precision of 0.1% in the measurement of the kinematical edges of the di-lepton invariant mass distributions [10,11]. In turn, this will allow to infer the slepton mass differences with a precision of $\sim 10^{-4}$ for a $\tilde{e} - \tilde{\mu}$ relative mass difference [7]; in our analysis we adopted a more conservative view, assuming maximal sensitivities of $\mathcal{O}(0.1\%)$ for $\Delta m_{\tilde{\ell}}/m_{\tilde{\ell}}(\tilde{e},\tilde{\mu})$ and $\mathcal{O}(1\%)$ for $\Delta m_{\tilde{\ell}}/m_{\tilde{\ell}}(\tilde{\mu},\tilde{\tau})$.

3·2. *LFV at the LHC:* χ_2^0 *decays.* – Firstly, let us recall that in the framework of the cMSSM (without a seesaw mechanism), the dilepton invariant mass distribution ($\ell = e, \mu$) for the study points of table I leads to double triangular distributions (except for point P1), with superimposed edges corresponding to the exchange of left- and right-handed selectrons and smuons [3]. The numerical scans of the parameter space further confirm that in the cMSSM both $\Delta m_{\tilde{\ell}}/m_{\tilde{\ell}}(\tilde{e}_L,\tilde{\mu}_L)$ and $\Delta m_{\tilde{\ell}}/m_{\tilde{\ell}}(\tilde{e}_R,\tilde{\mu}_R)$ lie in the range 10^{-7}–10^{-3}.

The impact of the seesaw in the di-muon mass distributions is quite spectacular, particularly in the appearance of a third edge in most of the benchmark points considered. This is manifest in the left panel of fig. 1, where we display the BR($\chi_2^0 \to \mu\,\mu\,\chi_1^0$) as a function of the di-muon invariant mass $m_{\mu\mu}$ for different SUSY seesaw points (see [3]), comparing the distributions with those of the cMSSM. With the exception of the seesaw variation of point P1, all other distributions now exhibit the edge corresponding to the presence of an intermediate $\tilde{\tau}_2$, implying that the decay occurs via $\chi_2^0 \to \tilde{\tau}_2\mu \to \mu\,\mu\,\chi_1^0$. For instance, for point P2′, the BR($\chi_2^0 \to \mu\mu\chi_1^0$) via intermediate $\tilde{\mu}_L$, $\tilde{\mu}_R$ and $\tilde{\tau}_2$ are 2.6%, 1.1% and 1.6%, respectively. Interestingly, the fact that the SUSY seesaw leads to increased mass splittings only for the left-handed sleptons might provide another poten-

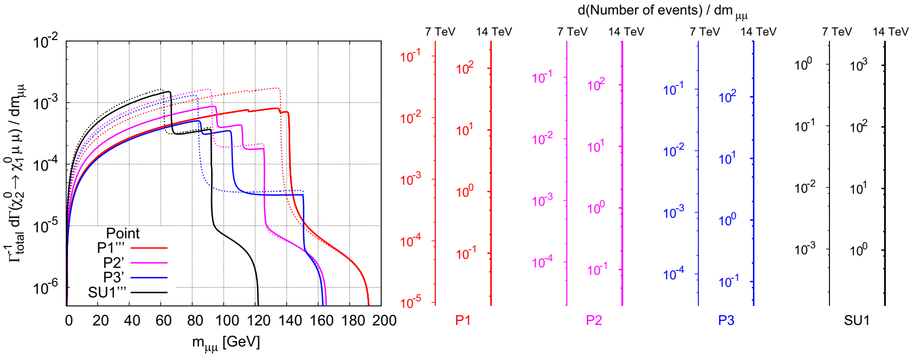

Fig. 1. – (Colour on-line) BR($\chi_2^0 \to \mu\mu\chi_1^0$) as a function of the di-muon invariant mass $m_{\mu\mu}$ (in GeV), with dotted lines coresponding to the corresponding cMSSM case. We consider different realisations of SUSY seesaw points: P1$'''$ (red), P2$'$ (pink), P3$'$ (blue) and SU1$'''$ (black). Secondary y-axes denote the corresponding expected number of events for $\sqrt{s} = 7\,\text{TeV}$ and $14\,\text{TeV}$, respectively with $\mathcal{L} = 1\,\text{fb}^{-1}$ and $\mathcal{L} = 100\,\text{fb}^{-1}$.

tial fingerprint for this mechanism of LFV. Compiling all the data collected throughout our numerical analysis, we have found that the maximal splitting between right-handed smuons and selectrons is $\frac{\Delta m_{\tilde{\ell}}}{m_{\tilde{\ell}}}(\tilde{\mu}_R, \tilde{e}_R)\big|_{\max} \approx 0.09\%$ (while within the SUSY seesaw $\Delta m_{\tilde{\ell}}/m_{\tilde{\ell}}(\tilde{\mu}_L, \tilde{e}_L)$ could easily reach values of a few %). Should the LHC measure mass splittings between right-handed sleptons of the first two families that are significantly above the 0.1% level, this could provide important indication that another mechanism of FV is at work: among the many possibilities, a likely hypothesis would be the non-universality of the slepton soft-breaking terms.

3˙3. *LFV at low and high energies.* – Even in the most minimal implementation of the seesaw, assuming that all flavour mixing in Y^ν is only stemming from the U^{MNS} mixing matrix (*i.e.* taking the conservative limit $R = 1$ in eq. (1)), the left-handed slepton mass splittings are much larger than in the cMSSM, with values as large as $\mathcal{O}(10\%)$. Very large splittings are associated with heavy seesaw scales (in particular, M_{N_3}) and/or large, negative values of A_0. Aside from the perturbativity bounds on Y^ν, the most important constraints on the seesaw parameters arise from the non-observation of LFV processes: since both flavour violating BRs and slepton mass splittings originate from the same unique source (Y^ν), compatibility with current bounds, in particular on BR($\mu \to e\gamma$) and BR($\tau \to \mu\gamma$), may preclude sizable values for the slepton mass splittings(¹). This unique synergy is instrumental in devising strategies to test the SUSY seesaw via the interplay of high- and low-energy observables.

If the LHC measures a given mass splitting, predictions can be made regarding the associated LFV BRs (for an already reconstructed set of mSUGRA parameters). Comparison with current bounds (or possibly an already existing BR measurement) may allow to derive some hints on the underlying source of flavour violation: a measurement of a slepton mass splitting of a few percent, together with a measurement of a low-energy

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(¹) This is in contrast with other scenarios of (effective) flavour violation in the slepton sector where the different off-diagonal elements of the slepton mass matrix can be independently varied [6].

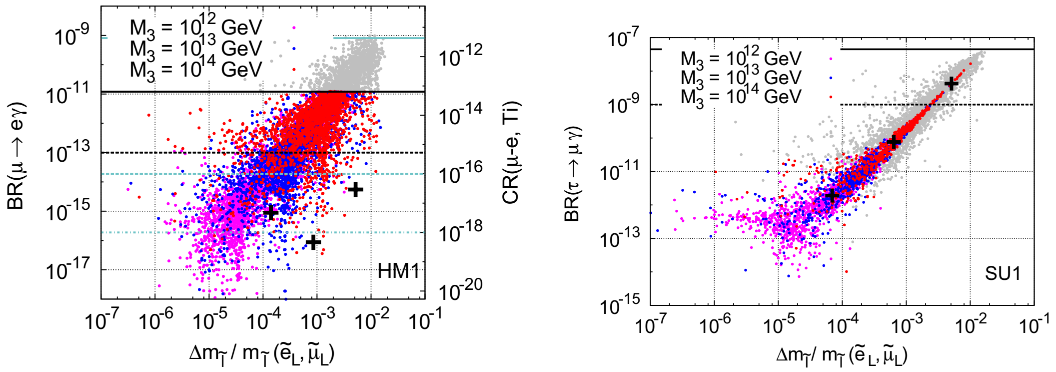

Fig. 2. – (Colour on-line) On the left, BR($\mu \to e\gamma$) as a function of the $\tilde{e}_L - \tilde{\mu}_L$ mass difference, for seesaw variations of point HM1. On the secondary right y-axis, the corresponding predictions of CR($\mu - e$, Ti). On the right, BR($\tau \to \mu\gamma$) as a function of the $\tilde{e}_L - \tilde{\mu}_L$ mass difference, for seesaw variations of point SU1. Horizontal lines denote the corresponding current bounds/future sensitivities. The distinct coloured regions correspond to three different values of $M_{N_3} = \{10^{12}, 10^{13}, 10^{14}\}$ GeV. We take the Chooz angle to be $\theta_{13} = 0.1°$, and the remaining parameters were set as $M_{N_1} = 10^{10}$ GeV, $M_{N_2} = 10^{11}$ GeV, with the complex R matrix angles being randomly varied as $|\theta_i| \in [0, \pi]$, and $\arg(\theta_i) \in [-\pi, \pi]$.

observable (in agreement with what could be expected from the already reconstructed SUSY spectrum) would constitute two signals of LFV that could be simultaneously explained through one common origin—a type-I seesaw mechanism. On the other hand, two conflicting situations may occur: i) a measurement of a mass splitting associated to LFV decays experimentally excluded; ii) observation of LFV low-energy signal, and (for an already reconstructed SUSY spectrum) approximate slepton mass universality. These scenarios would either suggest that non-universal slepton masses or low-energy LFV would be due to a mechanism other than such a simple realisation of a type-I seesaw (barring accidental cancellations or different neutrino mass schemes). For instance, a simple explanation for the first scenario would be that the mechanism for SUSY breaking is slightly non-universal (albeit flavour conserving).

To illustrate this interplay, we conduct a general scan over the seesaw parameter space. In fig. 2 we display different low-energy LFV observables as a function of the $\tilde{e}_L - \tilde{\mu}_L$ mass difference, and choose for this overview of the SUSY seesaw the LHC points HM1 and SU1.

As can be seen from the left panel of fig. 2, if a SUSY type-I seesaw is indeed at work, and θ_{13} has been constrained to be extremely small, a measurement of $\Delta m_{\tilde{\ell}}/m_{\tilde{\ell}}(\tilde{e}_L, \tilde{\mu}_L)$ between 0.1% and 1%, in association with a reconstructed sparticle spectrum similar to HM1, would be accompanied (with a significant probability) by the observation of BR($\mu \to e\gamma$) at MEG [12] (and we notice here that, even for very large values of M_{N_3}, the constraints on the parameter space from BR($\mu \to e\gamma$) would preclude the observation of a $\tau \to \mu\gamma$ transition for an HM1-like spectrum). The most interesting lepton flavour signature of SU1 is related to its potential to induce large BR($\tau \to \mu\gamma$), within the future sensitivity of SuperB [13]: a measurement of $\Delta m_{\tilde{\ell}}/m_{\tilde{\ell}}(\tilde{e}_L, \tilde{\mu}_L) \sim$ 0.1%–1% at the LHC would imply BR($\tau \to \mu\gamma$) $\gtrsim 10^{-9}$, and would hint towards a heavy seesaw scale, $M_{N_3} \gtrsim 10^{13}$ GeV.

Similar analyses can be carried out in the context of a linear collider; further studies(²) relying for instance on direct slepton production are also very promising. As an illustrative example, let us mention that for a reconstructed spectrum ressembling the ATLAS SU1 benchmark point, the chains $e^+e^- \to \mu^+\mu^-\chi_1^0\chi_1^0$ and $e^+e^- \to \tau^\pm\mu^\mp\chi_1^0\chi_1^0$ would lead to $\mathcal{O}(10^4)$ and $\mathcal{O}(1500)$ events, respectively, assuming $\sqrt{s} = 1\,\text{TeV}$, and an integrated luminosity of $1000\,\text{fb}^{-1}$ [15].

4. – Concluding remarks

We have discussed that if a type-I seesaw is indeed the unique source of both neutrino masses and leptonic mixings, and also accounts for low-energy LFV observables within future sensitivity reach, interesting slepton phenomena are expected to be observed at the LHC: in addition to the mass splittings, the most striking effect will be the possible appearance of new edges in di-lepton mass distributions. From the comparison of the predictions for the two sets of observables (high and low energy) with the current experimental bounds and future sensitivities, one can either derive information about the otherwise unreachable seesaw parameters, or disfavour the type-I SUSY seesaw as the unique source of LFV. A complete analysis of the LHC dedicated study can be found in ref. [3], while results regarding the impact for a Linear Collider will appear soon [15].

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(²) While finishing these proceedings a study of lepton flavour violation at linear colliders, based on an effective source of LFV in the framework of the cMSSM, was proposed in [14].