R-Parity Violation and CP-Violating and CP-Conserving Spin Asymmetries in $\ell^+\ell^- \to \tilde{\nu} \to \tau^+\tau^-$: Probing Sneutrino Mixing at $\ell^+\ell^-$ Colliders

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We consider the sneutrino resonance reaction $\ell^+\ell^- \to \tilde{\nu} \to \tau^+\tau^-$ in the minimal supersymmetric standard model (MSSM) without R parity. We introduce CP-violating and CP-conserving τ-spin asymmetries which are generated at *tree level* if there is $\tilde{\nu}$-$\bar{\tilde{\nu}}$ mixing and are forbidden in the standard model. At the CERN e^+e^- collider LEP2, these asymmetries may reach $\sim$75% around resonance for sneutrino mass splitting of $\Delta m \sim \Gamma_{\tilde{\nu}_\mu}$ and $\sim$10% for splitting as low as $\Delta m \sim 0.1\Gamma_{\tilde{\nu}_\mu}$. They may be easily detectable if the beam energy is within $\sim$10 GeV around the $\tilde{\nu}_\mu$ mass and may therefore serve as powerful probes of sneutrino mixing. Future colliders are also discussed. [S0031-9007(98)06177-8]

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The MSSM conserves R parity and predicts that sparticles are produced in pairs, thus requiring colliders with c.m. energy at least twice the sparticle mass. However, if R parity is violated (keeping the proton lifetime within its experimental limit), then one cannot distinguish between the supermultiplets of the lepton-doublet $\hat{L}$ and that of the down-Higgs doublet $\hat{H}_d$. Thus, there is no good reason that prevents the superpotential from having additional Yukawa couplings constructed by $\hat{H}_d \to \hat{L}$ [1].

Here, we are interested only in the pure leptonic R-parity violating ($\not{R}_P$) operator:

$$\mathcal{L}_{\not{L}} = \lambda_{ijk}\hat{L}_i\hat{L}_j\hat{E}^c_k/2\,, \qquad (1)$$

that violates lepton number L, but not baryon number. $\hat{E}^c$ is the charged lepton-singlet superfield, i and j are flavor indices such that $i \neq j$. $\mathcal{L}_{\not{L}}$ drastically changes the phenomenology of the supersymmetric leptonic sector since it gives rise to the possibility of s-channel slepton resonant formation in scattering processes, thus enabling the detection of sleptons with masses up to the collider c.m. energy. This fact was observed about 10 years ago [2] and is recently gaining interest [3]. We focus on the effects of $\mathcal{L}_{\not{L}}$ on the process $\ell^+\ell^- \to \tau^+\tau^-$. The existence of other possible $\not{R}_P$ operators are irrelevant at tree level. In fact, for $e^+e^- \to \tau^+\tau^-$, since $i \neq j$ in (1), only s-channel $\tilde{\nu}_\mu$ exchange contributes with couplings λ_{121} and λ_{323} for $e\tilde{\nu}_\mu e$ and $\tau\tilde{\nu}_\mu\tau$, respectively [4]. We explore two new aspects of $\tilde{\nu}_\mu$ resonance at the CERN e^+e^- collider LEP2: detection of $\tilde{\nu}_\mu$-$\bar{\tilde{\nu}}_\mu$ mixing and CP violation. Both phenomena may exist once $\lambda_{121}, \lambda_{323} \neq 0$.

Sneutrino mixing has been the subject of several recent papers [5,6]. The question of whether the sneutrinos mix or not, is of fundamental importance since it is closely related to the generation of neutrino masses [5,6]. In fact, it was found in [6] that $\Delta m_{\tilde{\nu}_i}/m_{\nu_i} \lesssim$ a few $\times\, 10^3$ is required in order for m_{ν_i} to be within their experimental bounds.

Our interest here is in the detection of sneutrino mixing without assuming any specific model for it to occur. We write: $\tilde{\nu}_\mu = (\tilde{\nu}_+ + i\tilde{\nu}_-)/\sqrt{2}$ and assume that, due to some new physics, there is a mass splitting between the CP-even and CP-odd muon-sneutrino mass eigenstates $\tilde{\nu}_+$ and $\tilde{\nu}_-$, respectively (we assume CP conservation in the mixing), such that $\Delta m/m_\pm \ll 1$, where $\Delta m \equiv m_+ - m_-$ and $m_\pm \equiv m_{\tilde{\nu}_\pm}$. In particular, we take $\Delta m \lesssim \Gamma$ and $\Gamma \equiv \Gamma_- \simeq \Gamma_+ = 10^{-2}m_-$. Indeed, if $m_\pm > m_{\tilde{\chi}^+}, m_{\tilde{\chi}^0}$ ($\tilde{\chi}^+$ and $\tilde{\chi}^0$ are the charginos and neutralinos, respectively), then the two-body channels $\tilde{\nu}_\pm \to \tilde{\chi}^+\ell;\ \tilde{\chi}^0\nu$ are open and the corresponding partial widths are given by $\Gamma(\tilde{\nu}_\pm \to \tilde{\chi}^+\ell); \Gamma(\tilde{\nu}_\pm \to \tilde{\chi}^0\nu) \sim \mathcal{O}[10^{-2}m_\pm \times (1 - m^2_{\tilde{\chi}^+}/m^2_\pm)^2; (1 - m^2_{\tilde{\chi}^0}/m^2_\pm)^2]$ (see Barger *et al.* in [2]). Therefore, for $m_\pm \gtrsim 200$ GeV, $\Gamma = 10^{-2}m_-$ is a viable estimate, since the $\not{R}_P$ two-body modes are an insignificant fraction of Γ.

Apart from the rough theoretical argument for $\Delta m/m_- \ll 1$ [6], there is another reason to consider the limit $\Delta m \lesssim \Gamma$ [7]: in that case the $\tilde{\nu}_+$ and $\tilde{\nu}_-$ resonances will overlap and distinguishing between the two peaks becomes experimentally nontrivial. In such a case, to observe the small $\tilde{\nu}_+$-$\tilde{\nu}_-$ mass splitting one would have to search for flavor oscillations in sneutrino decays in analogy to the B^0-$\bar{B}^0$ system, for example in $e^+e^- \to \tilde{\nu}_+\tilde{\nu}_-$ [6]. However, for $m_\pm \gtrsim 100$ GeV, $\tilde{\nu}$-pair production awaits the next generation of lepton colliders. Here, we show that an alternative to a detection of $\Delta m \neq 0$ for $m_\pm \gtrsim 100$ GeV is to measure appropriate CP-even and CP-odd τ-spin asymmetries in $e^+e^- \to \tau^+\tau^-$ which are proportional to Δm. These asymmetries may reach tens of percents in a wide energy range around the sneutrino resonance even for a small splitting $\Delta m \lesssim \Gamma/4$. Such a small splitting may be detectable already at LEP2 to many standard deviations (SD). Note that spin asymmetries in $\ell^+\ell^- \to f\bar{f}$ can be measured, in practice, only for $f = \tau$ or t. In sneutrino resonant formation they apply only to τ since the $t\tilde{\nu}t$ coupling is forbidden by gauge invariance.

In addition, a possible tree-level CP violation of the order of tens of percents in τ pair production at LEP2, stands out as an interesting issue by itself. Previous studies of CP-violation in $e^+e^- \to \tau^+\tau^-$, for models beyond the SM, involve one-loop exchanges of new particles which generate a CP-violating electric dipole moment for the τ (see [8], and references therein). These CP-odd effects are therefore much smaller than our tree-level effect.

Let us now construct the $\tau^+\tau^-$ double-polarization asymmetries. In the rest frame of τ^- we define the basis vectors: $\vec{e}_z \propto -(\vec{p}_{e^+} + \vec{p}_{e^-})$, $\vec{e}_y \propto \vec{p}_{e^+} \times \vec{p}_{e^-}$ and $\vec{e}_x = \vec{e}_y \times \vec{e}_z$. For the τ^+, $\bar{\vec{e}}_x, \bar{\vec{e}}_y, \bar{\vec{e}}_z$ are related to $\vec{e}_x, \vec{e}_y, \vec{e}_z$ by charge conjugation. We then define the following $\tau^+\tau^-$ double-polarization object with respect to their corresponding rest frames defined above:

$$\Pi_{ij} \equiv \frac{N(\bar{\uparrow}_i \uparrow_j) - N(\bar{\uparrow}_i \downarrow_j) - N(\bar{\downarrow}_i \uparrow_j) + N(\bar{\downarrow}_i \downarrow_j)}{N(\bar{\uparrow}_i \uparrow_j) + N(\bar{\uparrow}_i \downarrow_j) + N(\bar{\downarrow}_i \uparrow_j) + N(\bar{\downarrow}_i \downarrow_j)}, \quad (2)$$

where $i, j = x, y, z$. For example, $N(\bar{\uparrow}_x \uparrow_y)$ stands for the number of events in which τ^+ has spin $+1$ in the direction x in its rest frame and τ^- has spin $+1$ in the direction y in its rest frame. The spin vectors of τ^+ and τ^- are therefore defined in their respective rest frames as $\vec{s}^{\,+} = (\bar{s}_x, \bar{s}_y, \bar{s}_z)$ and $\vec{s}^{\,-} = (s_x, s_y, s_z)$, and Π_{ij} is calculated in the e^+e^- c.m. frame by boosting $\vec{s}^{\,+}$ and $\vec{s}^{\,-}$ from the τ^+ and τ^- rest frames to the e^+e^- c.m. frame.

Then, under the operation of CP and of the naive time reversal T_N [9]: $CP(\Pi_{ij}) = \Pi_{ji}$ for all i, j, $T_N(\Pi_{ij}) = -\Pi_{ij}$ for i or $j = y$ and $i \neq j$ and $T_N(\Pi_{ij}) = \Pi_{ij}$ for $i, j \neq y$ and for $i = j$. We can therefore define:

$$A_{ij} = \frac{1}{2}(\Pi_{ij} - \Pi_{ji}), \quad B_{ij} = \frac{1}{2}(\Pi_{ij} + \Pi_{ji}). \quad (3)$$

Evidently, A_{ij} are CP-odd ($A_{ii} = 0$ by definition) and B_{ij} are CP-even. Also, A_{xy}, A_{zy}, B_{xy}, and B_{zy} are T_N-odd while $A_{xz}, B_{xz}, B_{xx}, B_{yy}$ and B_{zz} are T_N-even.

To calculate A_{ij} and B_{ij} we need the cross-sections for s-channel sneutrino and the SM γ, Z exchanges. The interferences between SM and $\tilde{\nu}_\pm$ as well as between $\tilde{\nu}_+$ and the $\tilde{\nu}_-$ diagrams are $\propto m_e$ and therefore neglected. The cross sections can be subdivided as $\sigma_{SM;\tilde{\nu}_\pm} \equiv \sigma^0_{SM;\tilde{\nu}_\pm}/4 + \sigma^{\vec{s}^{\,-}\vec{s}^{\,+}}_{SM;\tilde{\nu}_\pm}$, where $\sigma^0_{SM;\tilde{\nu}_\pm}$ are the SM, $\tilde{\nu}_\pm$ total cross-sections, respectively, summed over τ^+ and τ^- spins; $\sigma^{\vec{s}^{\,-}\vec{s}^{\,+}}_{SM;\tilde{\nu}_\pm}$ are the spin dependent parts. The total spin dependent cross section for $e^+e^- \to \tau^+\tau^-$ is then $\sigma^T = \sigma_{SM} + \sigma_{\tilde{\nu}_\pm}$. For the SM we find ($m_\tau = 0$ and $\Gamma_Z/m_Z = 0$):

$$\sigma^0_{SM} = \frac{\pi\alpha^2}{3s}[4 + 2\omega(g_L + g_R)^2 + \omega^2(g_L^2 + g_R^2)^2], \quad (4)$$

$$\sigma^{\vec{s}^{\,-}\vec{s}^{\,+}}_{SM} = (\pi\alpha^2/12s)\{s_z\bar{s}_z[4 + 2\omega(g_L + g_R)^2 + \omega^2(g_L^2 + g_R^2)^2] + (s_x\bar{s}_x - s_y\bar{s}_y) \times [2 + \omega(g_L + g_R)^2 + \omega^2 g_L g_R(g_L^2 + g_R^2)] + (s_z + \bar{s}_z)[2\omega(g_R^2 - g_L^2) + \omega^2(g_R^4 - g_L^4)]\}, \quad (5)$$

where $s = (p_{e^+} + p_{e^-})^2$, $\omega \equiv [\sin^2\theta_W \cos^2\theta_W(1 - m_Z^2/s)]^{-1}$, $g_L = \sin^2\theta_W - 1/2$, $g_R = \sin^2\theta_W$.

For the s-channel $\tilde{\nu}_\pm$ exchange, we assume for simplicity that λ_{121} is real (this assumption does not change our results) and define $\lambda_{323} \equiv (a + ib)/\sqrt{2}$. The couplings of the CP-even ($\tilde{\nu}_+$) and the CP-odd ($\tilde{\nu}_-$) sneutrino mass eigenstates are then $e\tilde{\nu}_+ e = i\lambda_{121}/\sqrt{2}$, $e\tilde{\nu}_- e = -\lambda_{121}\gamma_5/\sqrt{2}$, $\tau\tilde{\nu}_+\tau = i(a - ib\gamma_5)/2$, $\tau\tilde{\nu}_-\tau = i(b + ia\gamma_5)/2$, and the sneutrinos cross section is ($m_\tau = 0$):

$$\sigma^0_{\tilde{\nu}_\pm} = (s/64\pi)\lambda_{121}^2|\lambda_{323}|^2 D_+, \quad (6)$$

$$\sigma^{\vec{s}^{\,-}\vec{s}^{\,+}}_{\tilde{\nu}_\pm} = -(s/512\pi)\lambda_{121}^2[s_z\bar{s}_z(a^2 + b^2)D_+ + (s_x\bar{s}_x + s_y\bar{s}_y)(b^2 - a^2)D_- + 2ab(s_y\bar{s}_x - s_x\bar{s}_y)D_-], \quad (7)$$

here $D_\pm \equiv |\pi_+|^2 \pm |\pi_-|^2$, $\pi_\pm = (s - m_\pm^2 + im_\pm\Gamma)^{-1}$.

For only $\tilde{\nu}_\pm$ exchange at tree level, A_{xy}, B_{xx}, B_{yy}, and B_{zz} are nonzero:

$$A_{xy} = \left(\frac{2ab}{a^2 + b^2}\right)\frac{D_-}{D_+}, \quad B_{xx} = B_{yy} = \left(\frac{a^2 - b^2}{a^2 + b^2}\right)\frac{D_-}{D_+}, \quad B_{zz} = -1. \quad (8)$$

For the pure SM case, only the following CP-even asymmetries are nonzero at tree level:

$$B_{xx} = -B_{yy} = \frac{2 + \omega(g_L + g_R)^2 + \omega^2 g_L g_R(g_L^2 + g_R^2)}{4 + 2\omega(g_L + g_R)^2 + \omega^2(g_L^2 + g_R^2)^2}, \quad B_{zz} = 1. \quad (9)$$

As expected, a nonvanishing CP-odd asymmetry results from the interference of the scalar and pseudoscalar couplings of $\tilde{\nu}_\pm$ to $\tau^+\tau^-$ in $e^+e^- \to \tilde{\nu}_\pm \to \tau^+\tau^-$. The possibility of generating a tree-level CP-violating effect when a scalar-fermion-antifermion coupling is of the form $(a + ib\gamma_5)$ was first observed in [10]. There it was suggested that a neutral Higgs of a two Higgs doublet model, may drive large tree-level CP-violating effects. Recently, it was shown [11] that spin correlations can trace similar scalar-pseudoscalar tree-level interference effects in the $H^0 \to t\bar{t}$, $\tau^+\tau^-$ decay modes. However, the tree-level CP-violation in $H^0 \to \tau^+\tau^-$, when applied to $e^+e^- \to H^0 \to \tau^+\tau^-$, is of no interest here since it is $\propto m_e$.

In [11], a nonvanishing tree-level CP-even spin correlation of the form $\vec{s}^{\,+} \cdot \vec{s}^{\,-}$ was suggested for $H^0 \to \tau^+\tau^-$. However, $\vec{s}^{\,+} \cdot \vec{s}^{\,-}$ simply translates to the observable $\sum_{i=x,y,z} B_{ii}$ and it is therefore clear from (9) that in the SM, $\vec{s}^{\,+} \cdot \vec{s}^{\,-} \propto B_{zz} = 1$. Measurement of B_{zz} will be insensitive to the couplings a and b in λ_{323} [see (8)]. We suggest here a new CP-even observable: $B \equiv (B_{xx} + B_{yy})/2$. At tree level, $B = 0$ in the SM and $B = B_{xx} = B_{yy}$ for the sneutrino case. Measurements of $B_{zz} \neq 1$ or $B \neq 0$ will be a strong indication for new physics in $e^+e^- \to \tau^+\tau^-$.

However, unlike B_{zz}, B will provide explicit information on the new $\tau\tilde{\nu}_\mu\tau$ couplings.

From (8) we observe that A_{xy} and $B \propto D_-/D_+$, where the proportionality factors are only functions of the ratio a/b. Without loss of generality, we will assume that a and b are positive and study the asymmetries as a function of the ratio $r \equiv b/(a+b)$. Thus, $0 \leq r \leq 1$, where its lower and upper limits are given by $b = 0$ and $a = 0$, respectively. One can immediately observe that A_{xy} and B complement each other as they probe opposite ranges of r. For A_{xy} the maximal value D_-/D_+ is obtained when $r = 1/2$ ($a = b$) and $B = D_-/D_+$ when $r = 0$ ($b = 0$). Also, at $r = 1$ ($a = 0$), $B = -D_-/D_+$, thus reaching its maximum negative value.

In Fig. 1 we plot the ratio D_-/D_+, i.e., the maximal values of A_{xy} and B, as a function of the lighter $\tilde{\nu}_\mu$ mass m_-. We take $\Delta m = \Gamma$, $\Gamma/2$, $\Gamma/4$, $\Gamma/10$ (recall that $\Gamma = 10^{-2}m_-$) and the c.m. energy at LEP2 as 192 GeV. Evidently, A_{xy} and B can reach $\sim$75% around resonance if $\Delta m = \Gamma$, and $\sim$10% even for the very small splitting $\Delta m = \Gamma/10$. Also, the asymmetries stay large ($\gtrsim$10%) even $\sim$10 GeV away from resonance. Around the narrow region of $E_{\rm CM} \simeq (m_+ + m_-)/2$, $D_-/D_+ \simeq \Delta m/m_-$ and the asymmetries become very small.

The statistical significance with which A_{xy} or B can be detected, is given by $N_{\rm SD} = \sqrt{N}\,|\mathcal{A}|\sqrt{\epsilon}$, where $\mathcal{A} = A_{xy}$ or B, $N = (\sigma^0_{\tilde{\nu}_\pm} + \sigma^0_{SM}) \times L$ is the total number of $e^+e^- \to \tau^+\tau^-$ events and we take $L = 0.5$ fb^{-1} as the total integrated luminosity at LEP2. ϵ is the combined efficiency for the simultaneous measurement of the τ^+ and τ^- spins which, therefore, depend on the efficiency for the spin analysis and on the branching ratios of the τ^+ and τ^- decay channels that are being analyzed. The simplest examples perhaps are the two-body decays $\tau^\pm \to \pi^\pm\nu_\tau$ and $\tau^\pm \to \rho^\pm\nu_\tau$, although three-body decays may also be useful [11,12]. When all combinations of only the above two-body decay channels are taken into account one finds conservatively $\epsilon \sim 0.03$ [11], which we adopt here.

In Fig. 2 we plot $N_{\rm SD}$ for A_{xy} and B at their maximal values, at LEP2, as a function of m_-. We choose the same values for Δm as in Fig. 1. For completeness, the SM contribution to the denominator in (2) is now being included, in which case A_{xy} and $B = B_{xx} = B_{yy}$ in (8) are multiplied by $(1 + \sigma^0_{SM}/\sigma^0_{\tilde{\nu}_\pm})^{-1}$. We calculate $\sigma^0_{\tilde{\nu}_\pm}$ by setting λ_{121} and λ_{323} to their experimentally allowed upper limits [1]: $\lambda_{121} = 0.05 \times (m_-/100\ \text{GeV})$ and $|\lambda_{323}| = 0.06 \times (m_-/100\ \text{GeV})$. It is interesting that both A_{xy} and B may be detectable, under the best circumstances, with a sensitivity reaching well above $\sim$10 SD. For example, for $\Delta m = \Gamma$ these asymmetries induce an effect larger than 3σ at LEP2 around the resonance region, practically over the whole $\sim$10 GeV mass range, $186.5 \lesssim m_- \lesssim 196$ GeV. For $\Delta m = \Gamma/4$ the corresponding 3σ mass range is $189.5 \lesssim m_- \lesssim 194$ GeV and even for $\Delta m = \Gamma/10$ there is a 3σ region over about a 1 GeV interval near the resonance mass.

Figure 3 shows the dependence of $N_{\rm SD}$, for A_{xy} and B, on the ratio r, where, as in Fig. 2, the SM diagrams

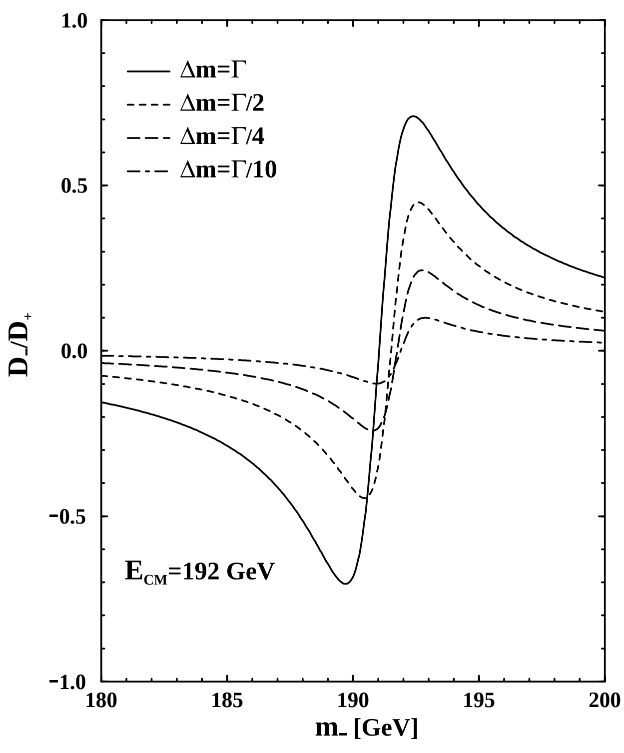

FIG. 1. The maximal value of A_{xy} and B, i.e., D_-/D_+, as a function of the lighter $\tilde{\nu}_\mu$ mass m_-, for four mass-splitting values Δm.

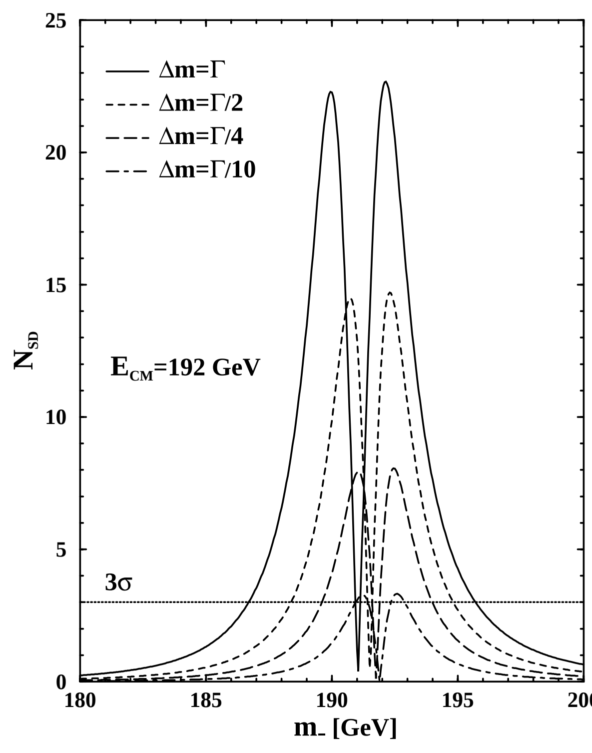

FIG. 2. The statistical significance, $N_{\rm SD}$, attainable at LEP2 for A_{xy} and B at their maximal values, as a function of m_-. See also the caption to Fig. 1.

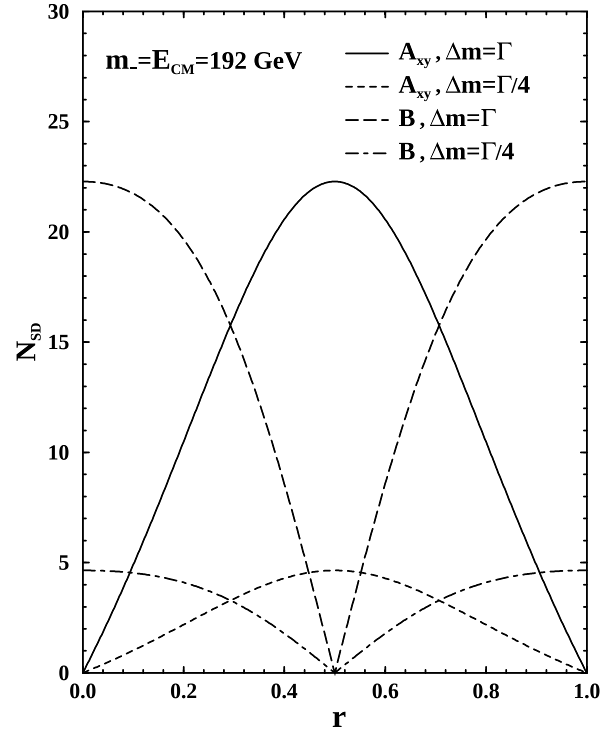

FIG. 3. The attainable N_{SD}, for A_{xy} and B, at LEP2, as a function of $r \equiv b/(a+b)$. The cases $\Delta m = \Gamma$ and $\Delta = \Gamma/4$ are illustrated. See also the caption to Fig. 1.

are included and for illustration we set $m_- = E_{\mathrm{CM}} = 192$ GeV (we note that this value of m_- does not maximize the effects). We see that a measurement of A_{xy} and B at LEP2 can cover a wide range of the parameter r. In particular, for $\Delta m = \Gamma$, LEP2 can have larger than 3σ sensitivity to values of r practically over its entire range, for both A_{xy} and B. For $\Delta m = \Gamma/4$, the following ranges are covered to at least a 3σ significance: for A_{xy}, $0.27 \lesssim r \lesssim 0.73$ and for B, $0 \leq r \lesssim 0.32$ and $0.68 \lesssim r \leq 1$. Thus, even for $\Delta m = \Gamma/4$, the whole range $0 \leq r \leq 1$ can be covered, to at least 3σ, with the simultaneous measurement of A_{xy} and B. We note again that the r ranges being covered to at least 3σ are wider if m_- is slightly away from resonance, i.e., by about 0.5 GeV.

Finally, we have calculated the sensitivity at the NLC with $E_{\mathrm{CM}} = 500$ GeV to A_{xy} and B for a very heavy $\tilde{\nu}_\mu$ $m_- \simeq E_{\mathrm{CM}}$. We found that the NLC will be able to probe these *CP*-odd and *CP*-even asymmetries to at least 3σ (the best effects are again at the $\sim 20\sigma$ level), in a range of $\sim$20 GeV around resonance, even for $\Delta m = 1$ GeV $\simeq \Gamma/5$. Also, with $\Delta m = 1$ GeV, the NLC will have a sensitivity above 3σ to either A_{xy} or B over almost the entire range, $0 \leq r \leq 1$.

To summarize, we introduced *CP*-violating and *CP*-conserving spin asymmetries and applied them to $e^+e^- \to \tau^+\tau^-$. It was shown that two of these asymmetries are unique in their ability to distinguish between the *CP*-odd and *CP*-even muon-sneutrino mass eigenstates in $e^+e^- \to \tilde{\nu}_\pm \to \tau^+\tau^-$. Both asymmetries arise already at the tree level and can be large, of the order of tens of percents. They may therefore be detectable with many SDs already at LEP2 if the muon-sneutrino mass lies within $\sim$10 GeV range around the LEP2 c.m. energy, even if $\Delta m \lesssim \Gamma$. As far as *CP* violation is concerned, it is interesting that large *CP*-nonconserving effects may arise in τ-pair production at LEP2 and may be searched for soon.

We have also found that these asymmetries will yield a significant signal at the NLC with $E_{\mathrm{CM}} = 500$ GeV within a $\sim$20 GeV energy range around resonance. Moreover, the effects reported here may be similarly applied to a future muon collider in the $\tilde{\nu}_e$ resonance channel $\mu^+\mu^- \to \tilde{\nu}_e \to \tau^+\tau^-$. However, while the present limits on the $\tau\tilde{\nu}_e\tau$ and $\tau\tilde{\nu}_\mu\tau$ couplings are comparable, the limit on the coupling $\mu\tilde{\nu}_e\mu$ is more stringent than the one on $e\tilde{\nu}_\mu e$ by about an order of magnitude.

In parting, we remark that measurements of the double τ-spin asymmetries A_{xy} and B in $\tau^+\tau^-$ production at the Tevatron is another interesting possibility [13].

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