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SUPERSYMMETRY PARAMETER ANALYSIS THROUGH THE CHARGINO PRODUCTION IN $e^{-}\gamma$ COLLISIONS

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ABSTRACT

In the present work, we have studied the associated chargino s-neutrino production in electron-gamma interactions, $e^{-}\gamma \rightarrow \tilde{\chi}^{-}_{1,2}, \tilde{\nu}_{L}$, within the framework of the minimal supersymmetric standard model (MSSM). We have examined the effects of polarizations of the outgoing charginos on the cross section and the related asymmetries as functions of three SUSY parametres, namely M_2, μ and $\tan\beta$. We have considered the spin polarizations of the outgoing charginos are taken to be parallel or antiparallel to the direction of the incoming electron seen in the chargino rest frame.

It is observed that the polarization of the outgoing charginos depends strongly on the chargino mass and the momentum. Small mass (up to 170 GeV) and low momentum ($\leq$500 GeV) lead to positively polarized charginos, while large mass and high momentum results in negatively polarized charginos.

KEYWORDS

Minimal supersymmetric standard model, $e^{-}\gamma$ colliders, chargino, polarization, asymmetry.

INTRODUCTION

Supersymmetry (SUSY) is thought to be one of the most popular extensions of the Standard Model (SM). The search for the supersymmetric particles is one of the most important task of present and future colliders. In this work, we focus on the chargino sector which depends on only three SUSY parameters (M_2, μ, $\tan\beta$) of the minimal supersymmetric standard model (MSSM)[Haber et. al,1985]. Detailed analyses of the chargino production at the lepton, photon and hadron colliders are present in the literature , [see for example G.M.Pick et.al.,1995 and S.Y. Choi, 1999, Hasselbach et. al., 1997]; in particular, the attention has been paid to the impact of the beam polarizations on the cross sections the related asymmetries and their roles in the investigations of the SUSY parameter space. On the otherhand the future $e^-\gamma$ colliders might have several advantages for supersymmetric particle search. In the literature very rich physics program of such colliders is analysed (See for example Telnov,2008 and Ginzburg et. al., 1983). We examine here the associated chargino-sneutrino production at γe^- colliders; in particular, the effects of the different chargino polarizations in determining the relevant supersymmetry parameters.

MODEL

In the MSSM the charginos $\tilde{\chi}^{\pm}{}_{1,2}$ are mixtures of spin-1/2 partners of the gauge bosons $W^{\pm}$ (winos) and of the charged Higgs bosons $H^{\pm}$ (higgsinos). After the electroweak gauge symmetry breaking, the chargino mass matrix in the $(\widetilde{W}^-, \widetilde{H}^-)$ basis is

$$\begin{pmatrix} M_2 & \sqrt{2}M_{\mathrm{w}}\cos\beta \\ \sqrt{2}M_{\mathrm{w}}sin\beta & \mu \end{pmatrix}.$$

Here, M_2 is the soft SU(2) breaking gaugino mass term of the winos, μ is the Higgsino mass parameter, and $\tan\beta = v_2/v_1$ is the ratio of the vacuum expectation values of the two neutral Higgs fields. In the charge parity (CP) violating theories $\mu = |\mu|e^{i\phi_\mu}$ with $0 \leq \phi_\mu \leq 2\pi$, while M_2 is generally taken real and positive. One needs two different unitary matrices $U_{\mathrm{L}}, U_{\mathrm{R}}$ to diagonalize the chargino mass matrix, as it is not symmetric[S.Y.Choi, 2000]:

$$U_{\mathrm{L}} = \begin{pmatrix} \cos\phi_{\mathrm{L}} & e^{-i\beta_{\mathrm{L}}}\sin\phi_{\mathrm{L}} \\ -e^{-i\beta_{\mathrm{L}}}\sin\phi_{\mathrm{L}} & \cos\phi_{\mathrm{L}} \end{pmatrix}$$

$$U_{\mathrm{R}} = \begin{pmatrix} e^{i\gamma_1} & 0 \\ 0 & e^{i\gamma_2} \end{pmatrix}\begin{pmatrix} \cos\phi_{\mathrm{R}} & e^{-i\beta_{\mathrm{R}}}\sin\phi_{\mathrm{R}} \\ -e^{-i\beta_{\mathrm{R}}}\sin\phi_{\mathrm{R}} & \cos\phi_{\mathrm{R}} \end{pmatrix}.$$

For CP invariant models ϕ_μ and the other four phases, β_{L}, β_{R}, γ_1, γ_2, are set equal the zero. The chargino mass eigenvalues are obtained after the diagonalization as

$$M^2_{\tilde{\chi}^{\pm}_{1,2}} = \frac{1}{2}[{M_2}^2 + \mu^2 + 2{m_W}^2 \pm 4{m_W}^2\Delta], \qquad (1)$$

where

$$\cos2\phi_{L,R} = -\frac{{M_2}^2 - \mu^2 \pm 2m^2{}_W\cos2\beta}{4m^2{}_W\Delta}$$

$$\sin2\phi_{L,R} = -\frac{\sqrt{{M_2}^2 + \mu^2 \pm ({M_2}^2 - \mu^2)\cos2\beta + 2M_2\mu\sin2\beta}}{2m_W\Delta}$$

$$\Delta = \frac{\sqrt{({M_2}^2 - \mu^2)^2 + 4{m_W}^2({M_2}^2 + \mu^2 + 2M_2\mu\sin2\beta + 4{m_W}^4\cos^2 2\beta)}}{4{m_W}^2}$$

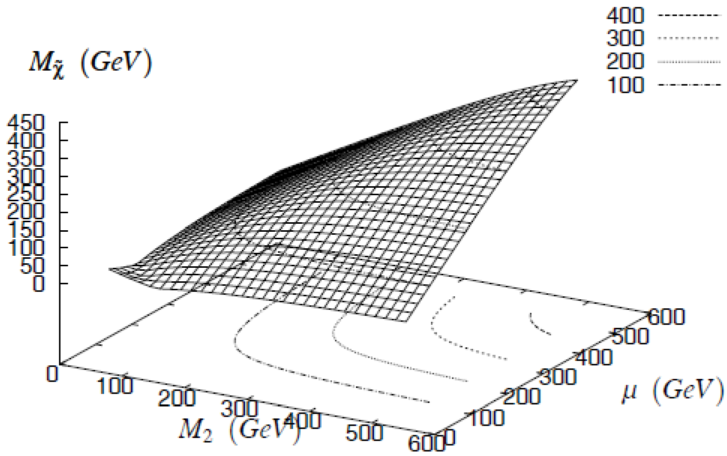

Figure 1: The behaviour of chargino mass $m_{\tilde{\chi}}$ for versus M_2 and μ for different values of tan β. The dotted line curves on the μ-M_2 plane correspond to the $m_{\tilde{\chi}}$ projections for 100, 200, 300 and 400 GeV, respectively.

The mass eigenstates are two Dirac fermions (charginos and their antiparticles) $\tilde{\chi}_{1,2}{}^{\pm}$. $m_{\tilde{\chi}^-}$ depends on M_2, μ and $\tan\beta$. Although they are completely free, there are several phenomenological restrictions to identify the relevant SUSY parameter space. First of all, chargino mass eigenvalues are symmetric in , M_2 and μ. For any value of $\tan\beta$, the mass expression is a multivalued function. Figure 1 shows $m_{\tilde{\chi}^{\pm}_{1,2}}$ as a function of SUSY parametres M_2 and μ for different values of $\tan\beta$ changing from 5 to 100. One immediately observes that not only μ and M_2 can be exchanged, but also $M_{\tilde{\chi}^{\pm}_{1,2}}$ depends only slightly on $\tan\beta$. Recent experimental data is unable to tightly constrain an acceptable SUSY parameter space. For example only if one takes $\mu > 0$, the latest $(g-2)_{\mu}$ experiments for the muon can be interpreted within MSSM. One can see for a detailed discussion on the parameter μ (Feng et. al., 1997).

PRODUCTION OF CHARGINOS AND SNEUTRINOS IN PHOTON-ELECTRON COLLISION

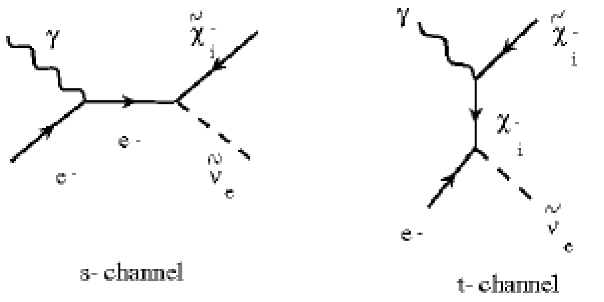

Figure 2: Feynmann graphs for $\mathrm{e}^{-}\gamma \rightarrow \tilde{\chi}_{1,2}^{-}, \tilde{\nu}_{\mathrm{L}}$.

In this work the associated productions of light sneutrinos and charginos in electron photon collisions within the scope of the MSSM is investigated. The related piece of the interaction Lagrangian can be deduced from the following part of Lagrangians of MSSM (Haber and Kane 1985).

$$\mathcal{L}_{e\tilde{\nu}_e\tilde{\chi}} = -\mathrm{g}\sum_{j=1}^{2}(V_{j1}^{\star}\, \tilde{\chi}_j^{c} P_L e\widetilde{\upsilon_e^{\star}} + V_{j1\bar{e}} P_R \tilde{\chi}_j^{c} \tilde{\upsilon}_e)$$

$$\mathcal{L}_{\gamma_{\tilde{\chi}\tilde{\chi}}} = -eA_{\mu}\sum_{j=1}^{2} \bar{\tilde{\chi}}_j\, \gamma \tilde{\chi}_j$$

In these equations $\tilde{\chi}_j (j = 1{,}2)$ and e are the four-component spinors of the chargino and the electron while $\tilde{\nu}_e$ is the field of the electron-sneutrino. $\tilde{\chi}_j^c$ are the charge conjugated spinor fields. Furthermore, $P_{R,L} = (1 \pm \gamma_5)/2$ denote the right- and left-handed projection operators, $g = e/\sin\Theta_W (e > 0)$, and V_{ij} is the 2×2 unitary matrix appearing in the diagonalization of the wino-charged higgsino mass matrix. For details one can see Bartl et. al., (Bartl et. al., 1992)

This process is expected to give higher cross sections with respect to $\mathrm{e}^{-}\mathrm{e}^{+}$ process. In $\mathrm{e}^{-}\gamma$ process one expects for a light sneutrino a clear signature since in this case light chargino decays almost completely leptonically into a single lepton and a neutrino. Experimantally suitable polarized beams may be used to discriminate between the supersymetric process and the standart model background.

The Feynman diagrams for the process $\gamma e^{-} \rightarrow \tilde{\chi}_{1,2}^{-} \tilde{\nu}_{\mathrm{L}}$ include s-channel and t-channel diagrams via electron and charginos respectively are given in Figure 2. The four momentum of the incoming and outgoing particles γ, e, $\tilde{\chi}_{1,2}^{-}$, $\tilde{\nu}_{\mathrm{L}}$ are k, p, p' and k', respectively. The polarized or unpolarized differential cross sections of the process can be calculated in terms of the usual Mandelstam variables

$\hat{s} = (k+p)^2, \hat{t} = (k-k')^2$. The amplitudes corresponding to the s and t channel diagrams are

$$M_s = -\frac{ieg}{\hat{s}}\bar{u}(p')\frac{1}{2}(1-\gamma_5)(k+p)\varepsilon(k)u(p);$$
$$M_t = -\frac{ieg}{(\hat{t}-m_{\tilde{\chi}_i})}\bar{u}(p')\varepsilon(k)[(p-k')+m_{\tilde{\chi}_1}]\frac{1}{2}(1-\gamma_5)u(p), \tag{2}$$

where $e^2 = 4\pi\alpha$, α is the fine structure constant and $g = \frac{e}{\sin\theta_W}$.

The effects of the initial beam polarizations have been investigated in the chargino pair production for e^+e^- collisions thus we concentrate on the arbitrary outgoing chargino polarizations. After squaring the total amplitude, we average over the initial spin polarizations by putting

$$\rho_{\text{photon}} = -\frac{1}{2}g_{\mu\mu} \quad \rho_{electron} = \frac{1}{2}\gamma p, \tag{3}$$

where the value $m_e = 0$ has been used in the calculations.

The charginos are massive and hence, for the totally unpolarized situation the spin summation, leads to the relation

$$\sum_{\tilde{\chi}_i\ spins} u_l(p')\bar{u}_i(p') = (p' + M_{\tilde{\chi}}). \tag{4}$$

The differential and total unpolarized cross sections for the processes can be calculated from the above after convolution with the photon spectrum.

The effects of the incoming particle polarizations have been studied in the literature [S.Y.Choi, ibid]. In those works the general approach have been to employ the helicity formalism for the spin$\frac{1}{2}$ particles. The helicity formalism is quite appropriate when the particles are very light. Our aim in the present work is to investigate effects of the polarizations of the outgoing charginos. Since the chargino is a heavy Dirac particle, it will be interesting to consider the spin polarization chosen along an arbitrary given direction rather than the helicity formalism. Starting from the basic definition of spin polarization, in the chargino rest frame, the chargino spin density function becomes

$$\rho^{\chi} = \frac{1}{2}(1+\gamma_5 s)(p' + m_{\tilde{\chi}}),$$

where, in the center of mass frame, the spin four-vector s^μ is given by the relation

$$S_\chi^\mu = \left(\frac{\vec{p}\prime\cdot\vec{s}\prime}{m_{\tilde{\chi}}}, \vec{s}' + \vec{s}'\cdot\vec{p}'m_{\tilde{\chi}}(E_{\tilde{\chi}} + m_{\tilde{\chi}})\vec{p}'\right).$$

Here, $E_{\tilde{\chi}}$ and $\vec{p}'$ are the energy and momentum of the chargino in the center of mass system and $\vec{s}'$ is the chargino spin vector in its rest frame,

$$(s_{\chi^-}^\mu)_{R\cdot S} = (0, \overrightarrow{s'})$$

so that $s \cdot p' = 0$.

With the initial electron beam orientation known and specified in a certain direction in the experiment, we consider the spin polarizations of the outgoing charginos as parallel and antiparallel to the direction of the incoming electron in the chargino rest frame:

$$\vec{s'} = \lambda \frac{\vec{p}_e{}^{crf}}{|\vec{p}_e{}^{crf}|},\ to1cm\lambda = \pm 1,$$

where the superscript *crf* stands for the chargino rest frame, and the electron's momentum is related to the center of mass variables through the well-known Lorentz transformations

$$\vec{p}_{\mathrm{e}}{}^{crf} = \vec{p}_{\mathrm{e}} + \frac{\gamma-1}{\beta^2}(\vec{\beta}\cdot\vec{p}_{\mathrm{e}})\vec{\beta} - E_{\mathrm{e}}\gamma\vec{\beta}$$

$$\vec{\beta} = \frac{\vec{P}_\chi}{E_\chi},\ \gamma = \frac{1}{\sqrt{1-\beta^2}} \quad \vec{p}_{\mathrm{e}} = \vec{p}.$$

From the rest frame of the chargino, the incoming photon and electron beams are not head-on, and the scalar products of $s^{\mu}_{\tilde{\chi}}$ with k, p, k', and p' can be calculated in any frame. Spin projection operator $P_s = \frac{1}{2}(1+\gamma_5 s)$ measures the polarization of the outgoing charginos. If $\lambda = \pm 1$, the charginos are polarized in the the chosen direction (+) or in the opposite direction (−). For a $\gamma\mathrm{e}^-$ collider one should convolve the above process with the well-known Compton backscattered photon spectrum to obtain the total cross section [Ginzburg,1984]. This convolution has the effect of reducing cross section considerably. We thus can compute the cross section via the integral

$$\sigma_{total} = \int_{(m_{\tilde{\chi}}+m_{\tilde{\nu}})^2/s}^{0.83} f_{\gamma/e}(x)\hat{\sigma}(\hat{s}, M_2, \mu, \tan\beta, m_{\tilde{\nu}})dx,$$

where $\hat{s} = xs$, $s = s_{\mathrm{e}^+\mathrm{e}^-}$, and $x = \frac{E_\gamma}{E_e}$ .The energy spectrum of the high energy real (backscattered) photons, $f_{\gamma/e}(x)$ is given by

$$f_{\gamma/e(x)} = \frac{1}{D(\kappa)}[1 - x + \frac{1}{1-x} - 4r(1-r) - \lambda_e\lambda_0 r\kappa(2r-1)(2-x)]$$

where $\kappa = 4E_e\omega_0/m_e^2$ and $r = x/\kappa(1-x)$. Here λ_0 and λ_e are the laser photon and electron helicities respectively, and $D(\kappa)$ is

$$D(\kappa) = (1 - \frac{4}{\kappa} - \frac{8}{\kappa^2})\ln(1+\kappa) + \frac{1}{2} + \frac{8}{\kappa} - \frac{1}{2(1+\kappa)^2} + \lambda_e\lambda_0[(1+\frac{2}{\kappa}\ln(1+\kappa) - \frac{5}{2} + \frac{1}{1+\kappa} - \frac{1}{2(1+\kappa)^2}]$$

In numeric calculations we assume that $\kappa = 4.8$ which corresponds to the optimum value of $y_{max} = 0.83$. After summarizing these basic ideas behind the analysis one can systematically obtain graphs for the process $\gamma\mathrm{e}^- \to \tilde{\chi}_1{}^-\tilde{\nu}$. This process has been first analysed [J.A.Grifols et al., 1984] in the case of unmixed winos and without any polarization. Due to the nature of the chargino-sneutrino vertex, outgoing particles are expected to be polarized. Considerations of the λ values allows us to study various dependencies between the center of mass energy, masses of the outgoing particles and cross section of the process. From different polarizations one can also calculate asymmetries. In our calculations the expressions for the chargino mixing angles $\phi_{L,R}$, $m_{\tilde{\chi}}$ and Λ can be given solely in terms of the three SUSY parametres M_2, μ and $\tan\beta$. Sneutrino mixing is not considered and the mass of $\tilde{\nu}_L$ is taken as an extra parameter; the upper limits for the chargino and sneutrino masses, arising from direct and indirect searches, as $m_{\tilde{\chi}} \geq 100$ GeV, $m_{\tilde{\nu}} \geq 45$ GeV, have been taken into account (Feng et. al., 1997).

CROSS-SECTION CALCULATIONS FOR CHARGINOS AND NEUTRINOS IN PHOTON-ELECTRON COLLISION

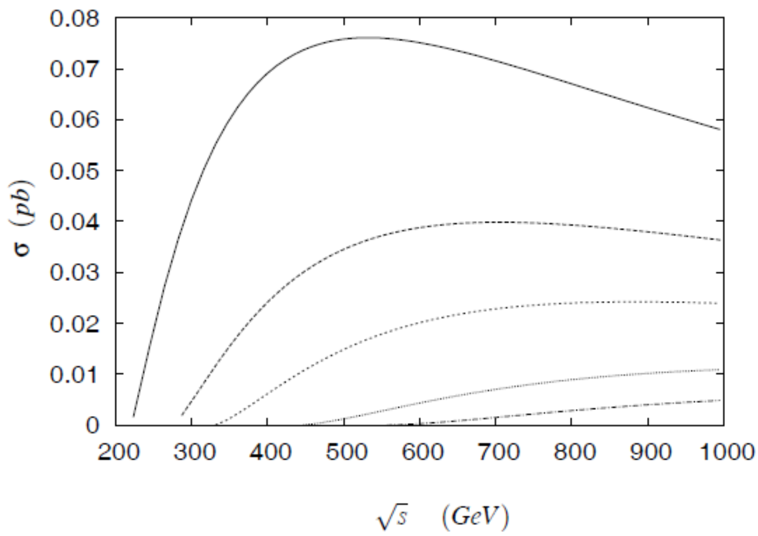

Figure 3: Total cross section σ versus $\sqrt{s}$ for a set of chargino mass values, 100,150,200,300,400 GeV, respectively.

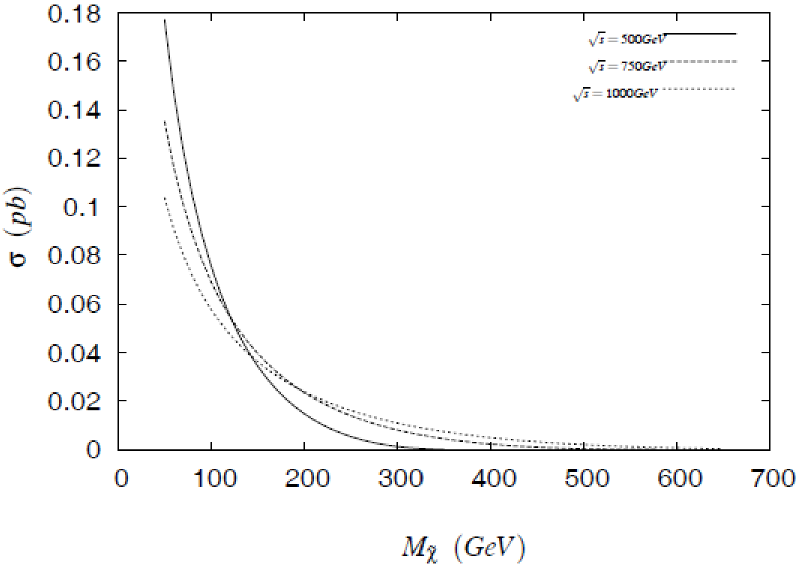

Figure 4: Total cross section versus $m_{\tilde{\chi}}$ for constant center of mass energies 500,750,1000 GeV, respectively.

Figure 3 shows cross-section (σ) versus $\sqrt{s}$ for $\tilde{\chi}^-$ production in electron-photon colliders. In these calculations first polarizations of the outgoing charginos are not taken into consideration and the cross-section with respect to $\sqrt{s}$ is plotted for a set of chargino mass values, $m_{\tilde{\chi}^-}$ = 100, 150, 200, 300, 400 GeV while the sneutrino mass is kept constant at $m_{\tilde{\nu}} = 100$ GeV. As expected, the cross-section decreases as the chargino mass increases. The same calculations can be presented as σ versus $m_{\tilde{\chi}^-}$ for constant center of mass energies. Figure 4 indicates that low chargino mass, ($m_{\tilde{\chi}^-}$: 50--150 GeV) at lower energies result in higher cross-section values; as the energy increases, the total cross-section decreases for the same chargino mass values. The situation reverses at larger mass values ($m_{\tilde{\chi}^-} \geq$ 150--180 GeV). Hence one can distinguish two mass regions which may be indicative of the two different chargino mass values.

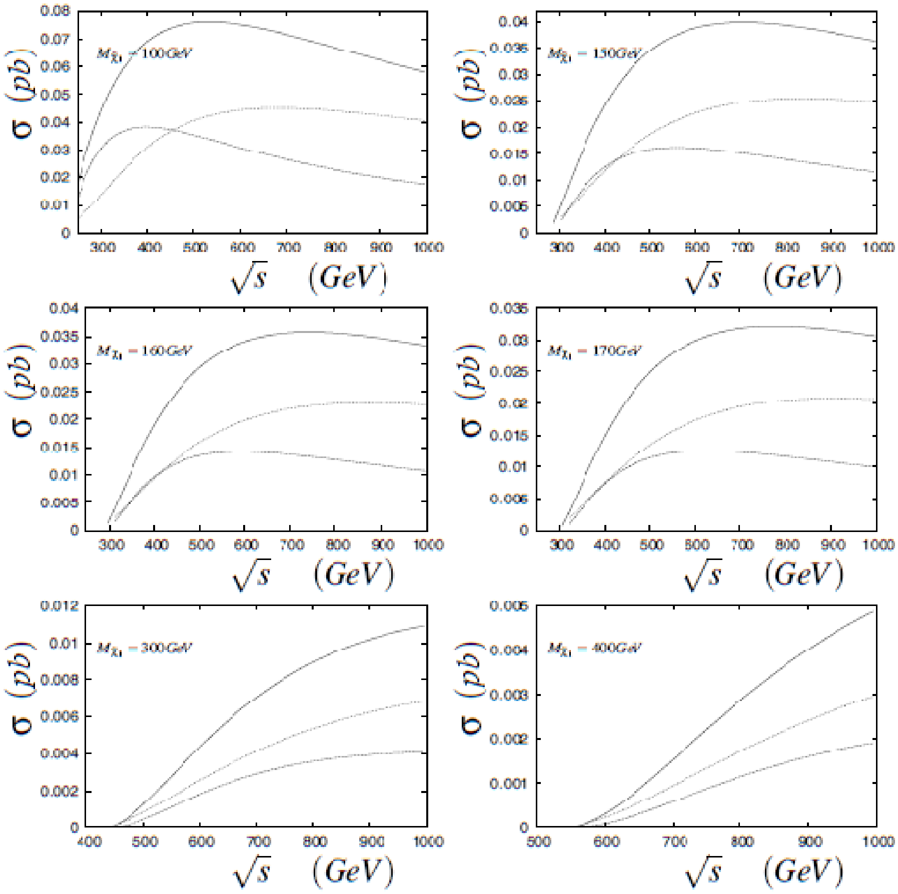

Figure 5: Total cross section versus $\sqrt{s}$ for polarized outgoing charginos, for six different chargino mass values.

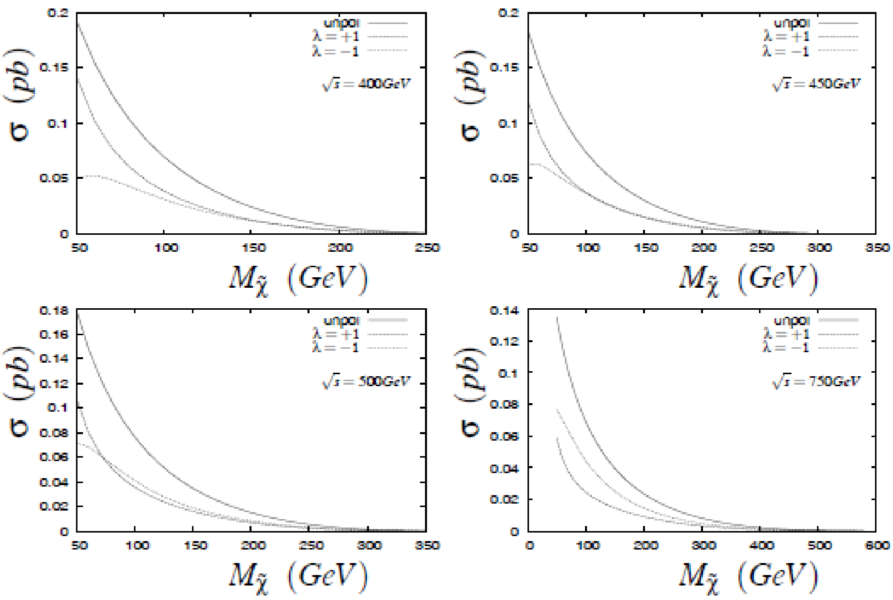

Figure 6: Total cross section versus $\widetilde{m}_{\chi}$ for polarized outgoing charginos at constant center of mass energies.

In the process $e^{-}\gamma \rightarrow \tilde{\chi}_{1,2}^{-}\tilde{\nu}_{L}$, left-handedness of the sneutrino plays a decisive role in the polarization of the outgoing charginos. Hence the polarization calculations of the outgoing charginos are expected to be illuminating for the process. The effects of the polarization calculations on the outgoing charginos can be seen in the Figure 5 and Figure 6. Figure 5 shows the total cross-section of the process as a function of $\sqrt{s}$ for six different chargino mass values. Each figure contains three curves. The solid line indicate the total cross section without any polarization measurement, and the other two curves ,dashed and dotted, are obtained by considering polarization effects and taking $\lambda = \pm 1$. These figures exhibit two different behaviours according to the chargino mass value. For low chargino mass ($m_{\tilde{\chi}^{-}}$: 100 to 160 GeV), in the low energy region (up to $\sqrt{s} = 450$ GeV), the total cross-section values corresponding to $\lambda = +1$ are higher than those cross sections calculated for $\lambda = -1$. For higher energy values the cross-section values calculated for $\lambda = -1$ polarized charginos are higher than the $\lambda = +1$ case. For chargino masses above $m_{\tilde{\chi}^{-}}$: 170 GeV, regardless the energy values, cross-section is dominated by $\lambda = -1$. Similar to the unpolarized case, the same behaviour is observed for cross-section as a function of chargino mass at constant center of mass energy, as is illustrated in Figure 6. At low energies, $\sqrt{s} \lesssim 450$ GeV, up to $m_{\tilde{\chi}^{-}}$:

170 GeV, $\lambda = +1$ polarized charginos are produced with higher cross-section; while $\lambda = -1$ polarization is favoured for center of mass energies above 500 GeV, and all chargino mass values above 170 GeV. Mass and energy dependence of the polarization of the outgoing charginos can be best seen from the asymmetry calculations. One possible definition of forward-backward asymmetry is given by the relation

$$A = \frac{\sigma(s, m_{\tilde{\chi}}, m_{\tilde{\nu}}, \lambda=+1) - \sigma(s, m_{\tilde{\chi}}, m_{\tilde{\nu}}, \lambda=-1)}{\sigma(s, m_{\tilde{\chi}}, m_{\tilde{\nu}}, \lambda=+1) + \sigma(s, m_{\tilde{\chi}}, m_{\tilde{\nu}}, \lambda=-1)} \qquad (6)$$

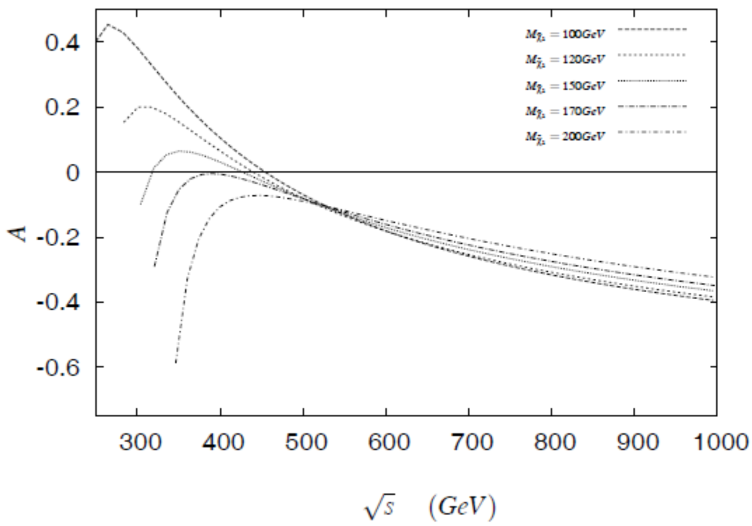

Figure 7: Asymmetry behaviour as defined in equation 7 of the outgoing polarized charginos versus center of mass energies for different chargino mass values between 100--200 GeV.

Figure 7 shows asymmetry behaviour of the outgoing charginos for a wide range of chargino mass values. Low mass chargino production ($m_{\tilde{\chi}^-} < 170$ GeV) exhibits an asymmetry curve which starts from positive values, rapidly attains its peak, then drops to negative values above $\sqrt{s}$: 450 GeV. $m_{\tilde{\chi}^-}$: 170 GeV is a special case, where asymmetry curve remains in the negative half of the figure apart from one point where the curve is tangent to the $A = 0$ line at around $\sqrt{s}$: 450 GeV. For larger mass values, asymmetry remains in the negative region, regardless the center of mass energies of the incoming particles, indicating cross-section values for $\lambda = -1$ are larger than the ones corresponding to $\lambda = +1$.

In order to study the relations between the chargino production in $e^-\gamma$ collision and SUSY parameters one needs to see how chargino mass varies with these parameters. The chargino mass matrix is obtained by diagonalsing mass term in the Yukawa interaction matrix. Hence chargino masses depend on M_2, μ and $\tan\beta$.

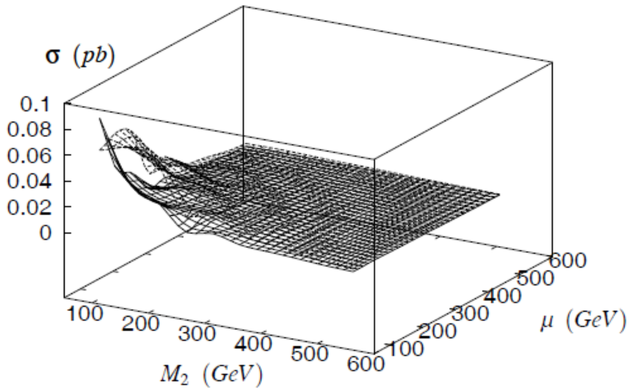

Figure 8: Supersymmetry parameter dependence of the total cross section for two different charginos polarization at center of mass energy $\sqrt{s} = 1$ TeV and $\tan\beta = 5$. The nearly upper surface is for $\lambda = -1$ and lower one $\lambda = 1$.

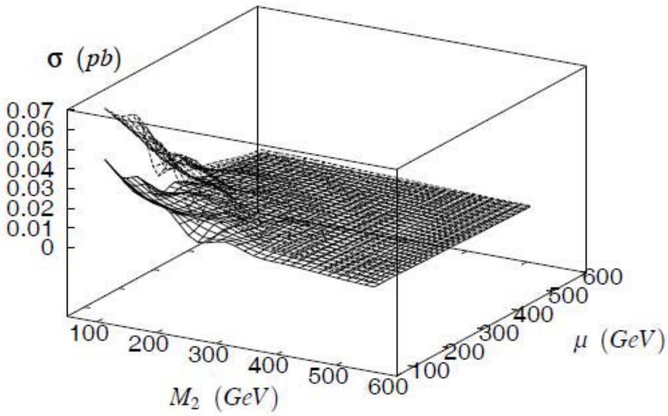

Figure 9: A Figure similar to Figure 7, for $\tan\beta = 50$.

Figures 8 and 9 show the supersymmetry parameter dependence of the cross-section at $m_{\tilde{\nu}} = 100$ GeV. Results are plotted for two different polarisations ($\lambda = +1$ and $\lambda = -1$) at the center of mass energy $\sqrt{s} = 1$ TeV and $\tan\beta = 5$ (Figure 7) and $\tan\beta = 50$ (Figure 8) as functions of M_2 and μ. As expected from the previous discussions, and the SUSY parameter dependence of $m_{\tilde{\chi}^-}$ (Figure 0), for small values of the parameters cross-sections corresponding to $\lambda = +1$ and $\lambda = -1$ show different behaviour while increasing those parameter values lead to the diminishing of these differences. Finally, in order to clarify the role of $\tan\beta$, cross section calculations are plotted for $\lambda = +1$ at two different $\tan\beta$ values, namely $\tan\beta = 5$ and 50.

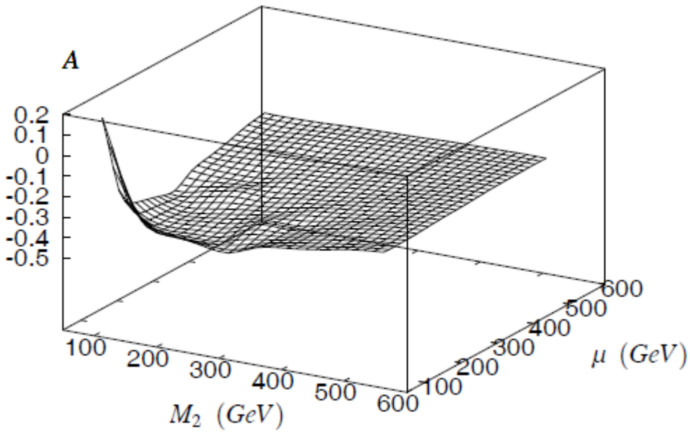

Figure 10: Asymmetry behaviour obtained from Figure 7.

Figure 10, shows asymmetry calculated from Figure 8. In this figure, for small values (M_2, $\mu < 200GeV$) asymmetry exhibits a rapid change in the range from $+0.2$ to -0.5. In the large parameter region the asymmetry curve remains negative and approaches a limiting value.

CONCLUSIONS

The polarization effects in the $e^-\gamma$ process are studied in terms of SUSY parameters. In the literature, chargino production both in e^-e^+ (Choi et. al., ,2000) and $e^-\gamma$ (Grifols et. al., 1984a;Grifols et. al., 1984b; Hasselbach and Fraas, 1966)processes were studied . In those studies polarized and unpolarized incoming particles are taken in consideration. For $e^-\gamma$ process, even using unpolarized incoming particles, outgoing charginos are polarized due to the nature of the vertex. Hence in an experimental set-up measurements done on outgoing chargino polarization may indicate the acceptable domain of the SUSY parameters. Since the initial electron beam orientation is known and specifed, we considered the spin polarizations of the outgoing charginos as parallel and antiparallel to the direction of the incoming electron in the chargino rest frame. This is the main differences of this work with the existing literature (Hasselbach and Fraas, 1966) where polarized beams are considered. In those earlier works usual helicity formalism has been used which is quite reasonable for light fermions,on the other hand in our study chargino spin polarization direction is specified by the incoming beam directions as seen with respect to the chargino rest frame. Since the charginos are very heavy fermions their spins may not be parallel or anti-parallel to the its momenta.

In order to study the relations between the chargino production in $e^-\gamma$ production and SUSY parameters, one first needs to see the SUSY parameter dependence of the chargino mass. The chargino mass matrix is obtained by diagonalsing mass term in the Yukawa interaction matrix; hence chargino masses depend on SUSY parameters, M_2, μ and $\tan\beta$. One observes that, in the mass formula, M_2 and μ are interchangeable; hence more than one parameter set correspond to the same mass value. In addtion, $\tan\beta$ dependence of the chargino mass is very weak. These dependences make chargino processes less sensitive on the MSSM parameter space, especially in $\tan\beta$.

Supersymmetry parameter dependence of the $e^-\gamma$ process cross-section are plotted for two different polarisations at center of mass energy, $\sqrt{s} = 1$ TeV and versus M_2 and μ. As expected from the previous discussions, SUSY parameter dependence of $m_{\tilde{\chi}^-}$ for small values of the SUSY parameters cross-sections corresponding to $\lambda = +1$ and $\lambda = -1$ show different behaviour, while increasing SUSY parameter values lead to the diminishing of these differences. Lastly, a clarification of the role of $\tan\beta$ is shown as a plot of cross section calculations for $\lambda = +1$ at two different $\tan\beta$ values, namely $\tan\beta = 5$ and 50. Our analysis shows that the behaviour of the total cross sections for two different chargino spin polarizations (namely $\lambda = \pm 1$) with respect to the c.m energy have important implications. First for increasing c.m energy one polarization becomes dominant. However the mass of the chargino also has a particular effect namely for values of m_{χ^-} higher than 170 GeV this behaviour is accentuated. For critical chargino masses between $100 - 150$ GeV and for the different spin polarizations the corresponding total cross section change order for low c.m. energies.

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ÖZET : Bu çalışmada, minimal süpersimetrik standart model (MSSM) çerçevesinde elektron-gama çarpıştırıcılarında, $e^{-}\gamma \rightarrow \chi^{-}_{1,2}\tilde{\nu}_L$, chargino ve s-nötrinonun birlikte üretilmelerini inceledik. Etkileşmeler sonucu ortaya çıkan charginoların polarizasyonunun etkileşme tesir kesiti ve SUSYparametrelerinden olan M_2, μ ve *tanh(β)* üzerindeki etkilerini çalıştık. Çıkan charginoların polalizasyonlarını, charginoların durgun oldugu sistemde, gelen elektron demetine paralel ve anti-paralel olarak göz önüne aldık.

Etkilesmelerden çıkan charginoların polarizasyonlarının chargino kütlesine ve momentumuna kuvvetle bağlı olduğu gözlendi. Küçük kütle (170 Gev'ye kadar) ve düşük momentum (500 Gev'ye kadar) değerleri pozitif polarize charginoların üretilmesine neden olurken yüksek kütle ve momentum değerlerinde negatif polarize charginoların üretildiği gözlendi.

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