Sleptons at post-WMAP benchmark points at LHC(CMS)

Yu.M.Andreev [1], S.I.Bityukov [2] and N.V.Krasnikov [3]

Institute for Nuclear Research RAS,
Moscow, 117312, Russia

Abstract

We study a possibility to detect sleptons at post-WMAP benchmark points at LHC(CMS). We find that at $L_{tot} = 30 fb^{-1}$ it would be possible to detect sleptons at points A, B, C, D, G. We also investigate the production and decays of right and left sleptons separately. We find that at $L_{tot} = 30 fb^{-1}$ it would be possible to detect right sleptons with a mass up to 200 GeV and left ones with a mass up to 300 GeV.

[1] e-mail: andreyev@inr.ru
[2] e-mail: bityukov@mx.ihep.su
[3] e-mail: krasniko@ms2.inr.ac.ru

1 Introduction

One of the supergoals of the Large Hadron Collider (LHC) [1] is the discovery of the supersymmetry. In particular, it is very important to investigate the possibility of discovering nonstrongly interacting superparticles (sleptons, higgsino, gaugino). In Refs. [2]-[4] sleptons discovery potential was investigated for direct sleptons production via Drell-Yan mechanism and "generic" LHC detector. In Ref. [4] the production of sleptons from chargino and neutralino decays had been considered. In Ref. [5] the LHC slepton discovery potential was investigated within the minimal supersymmetric model (MSSM) in the minimal supergravity (mSUGRA) scenario ($\tan\beta = 2$ case) for Compact Muon Solenoid (CMS) detector. In Refs. [6] - [7] the (LHC)CMS sleptons discovery potential and the possibility to discover lepton number violation in sleptons decays were investigated for direct production of right and left sleptons within MSSM model.

In this paper we investigate the possibility to discover sleptons at LHC(CMS) for post-WMAP supersymmetric benchmark scenarios [8]. These benchmark points take into account WMAP and other cosmological data, as well as the LEP and $b \to s\gamma$ constraints. We also reanalyze the LHC(CMS) discovery potential for the case of direct production of right and left sleptons in the MSSM model with arbitrary relation between the mass of lightest stable superparticle (LSP) and the slepton mass. One of the important "technical" differences between this paper and the previous studies is that we use PYTHIA program [9] for both simulation of background and signal supersymmetric events whereas in Refs.[5] -[7] the PYTHIA program was used for the simulation of background events and ISAJET program [10] for simulation of supersymmetric events. As in Refs. [5]-[7] we use the CMS fast detector simulation program CMSJET [10]. We find that at total luminosity $L_{tot} = 30 fb^{-1}$ it would be possible to detect sleptons at post-WMAP points B, C, D, G. We also find that at $L_{tot} = 30 fb^{-1}$ it would be possible to detect right sleptons with a mass up to 200 GeV and left ones with a mass up to 300 GeV. The organization of the paper is the following. In Section 2 we review the main features of the mSUGRA model [12] and describe proposed in Ref.[8] post-WMAP benchmark points for supersymmetry. In Section 3 we describe sleptons production mechanisms and sleptons decays relevant for this study. Section 4 is devoted to the discussion of the background and cuts used to suppress the background. In Section 5 we present the results of our numerical calculations. Section 6 contains concluding remarks.

2 Post-WMAP benchmarks

In the MSSM supersymmetry is broken at some high scale M by generic soft terms so in general all soft SUSY breaking terms are arbitrary that complicates the analysis and spoils the predictive power of the theory. In mSUGRA model [12] the universality of different soft parameters at Grand Unified Theory (GUT) scale $M_{GUT} \approx 2 \cdot 10^{16}\ GeV$ is postulated. Namely, all the spin zero particle masses (squarks, sleptons, higgses) are postulated to be equal to the universal value m_0 at GUT scale. All gaugino particle masses are postulated to be equal to the universal value $m_{1/2}$ at GUT scale. Also the coefficients in front of quadratic and cubic SUSY soft breaking terms are postulated to be equal. The renormalization group equations are used to relate GUT and electroweak scales. The equations for the determination of nontrivial minimum of the electroweak potential are used to decrease the number of unknown parameters by two. So mSUGRA model depends on five unknown parameters. At present more or less standard choice of free parameters in mSUGRA model includes $m_0, m_{1/2}, \tan\beta, A$ and $sign(\mu)$ [12]. All sparticle masses depend on these parameters. For instance, the slepton masses of the first two generations are determined by the formulae [12]

$$m^2_{\tilde{l}_R} = m_0^2 + 0.15 m^2_{1/2} - \sin^2\theta_W M_Z^2 \cos 2\beta\,, \tag{1}$$

$$m^2_{\tilde{l}_L} = m_0^2 + 0.52 m^2_{1/2} - 1/2(1 - 2\sin^2\theta_W) M_Z^2 \cos 2\beta\,, \tag{2}$$

$$m^2_{\tilde{\nu}} = m_0^2 + 0.52 m^2_{1/2} + 1/2\cos^2\theta_W M_Z^2 \cos 2\beta\,. \tag{3}$$

Charged left sleptons are the heaviest sleptons whereas the right sleptons are the lightest sleptons. For gaugino masses the following approximate formulae take place:

$$M_{\tilde{\chi}^0_1} \approx 0.45 m_{1/2}\,, \tag{4}$$

$$M_{\tilde{\chi}^0_2} \approx M_{\tilde{\chi}^\pm_1} \approx 2 M_{\tilde{\chi}^0_1}\,, \tag{5}$$

$$M_{\tilde{\chi}^0_2} \approx (0.25 - 0.35) M_{\tilde{g}}\,. \tag{6}$$

In mSUGRA model the $\tilde{\chi}^0_1$ gaugino is the lightest stable superparticle (LSP).

As it has been mentioned before in mSUGRA model sparticle masses depend on five unknown parameters that complicates numerical analysis of the LHC SUSY discovery potential. In Ref.[13] benchmark sets of supersymmetric parameters (13 post-LEP points) within mSUGRA model were suggested for further careful analysis. The suggested points take into account the constraints from LEP, Tevatron, $b \to s\gamma$, $g_\mu - 2$ and cosmology. Recently in Ref.[8] upgraded benchmark sets (post-WMAP benchmarks) were proposed. These post-WMAP benchmarks take into account new WMAP data on dark matter density of the Universe. The mSUGRA model parameters and some sparticle masses for these post-WMAP benchmark points are given in Table 1.

3 Sleptons production and decays

When sleptons are heavy relative to $\tilde{\chi}^\pm_1, \tilde{\chi}^0_1$ sleptons are produced at the LHC only through Drell-Yan mechanism (direct slepton production), via $q\bar{q}$ annihilation with neutral or charged boson exchange in the s-channel, namely, $pp \to \tilde{l}_L\tilde{l}_L, \tilde{l}_R\tilde{l}_R, \tilde{\nu}\tilde{\nu}, \tilde{\nu}\tilde{l}, \tilde{l}_L\tilde{l}_R,$. The left sleptons decay to charginos and neutralinos via the following (kinematically accessible) decays:

$$\tilde{l}^\pm_L \to l^\pm + \tilde{\chi}^0_{1,2}\,, \tag{7}$$

$$\tilde{l}^\pm_L \to \nu_l + \tilde{\chi}^\pm\,, \tag{8}$$

$$\tilde{\nu} \to \nu_l + \tilde{\chi}^0_{1,2}\,, \tag{9}$$

$$\tilde{\nu} \to l^\pm + \tilde{\chi}^\mp_1\,. \tag{10}$$

Point	$m_{1/2}$	m_0	$\tan\beta$	$sgn(\mu)$	A_0	$\tilde{\chi}_1^0$	$\tilde{\chi}_2^0$	$\tilde{e}_L, \tilde{\mu}_L$	$\tilde{e}_R, \tilde{\mu}_R$	$\tilde{\nu}_e, \tilde{\nu}_\mu$	$\tilde{\tau}_1$	$\tilde{\tau}_2$	$\tilde{\nu}_\tau$
A	600	107	5	+	0	242	471	425	251	412	249	425	411
B	250	57	10	+	0	95	180	188	117	167	109	191	167
C	400	80	10	+	0	158	305	290	174	274	167	291	273
D	525	101	10	−	0	212	415	376	224	362	217	376	360
E	300	1532	10	+	0	112	184	1543	1534	1539	1521	1534	1532
F	1000	3440	10	+	0	421	610	3499	3454	3492	3427	3485	3478
G	375	113	20	+	0	148	286	285	185	270	157	290	266
H	935	244	20	+	0	388	750	679	426	665	391	674	657
I	350	181	35	+	0	138	266	304	227	290	150	312	278
J	750	299	35	+	0	309	598	591	410	579	312	579	558
K	1300	1001	39.6	−	0	554	1064	1324	1109	1315	896	1251	1239
L	450	303	45	+	0	181	351	434	348	423	194	420	387
M	1840	1125	45.6	+	0	794	1513	1660	1312	1648	796	1504	1492

Table 1: The mSUGRA parameters and some sparticle masses for proposed post-WMAP benchmarks (all masses in GeV), as calculated in ISASUGRA 7.67 (see Table 2 in Ref.[8]).

For right sleptons only decays to neutralino are possible and they decay mainly to LSP:

$$\tilde{l}_R^\pm \to l^\pm + \tilde{\chi}_1^0 \,, \tag{11}$$

Note that an account of the mixing between left and right charged sleptons slightly complicates the situation and allows decays (7,8) for eigenstates of $\tilde{l}_L$ and $\tilde{l}_R$. If decays to second neutralino or first chargino are kinematically possible, the most interesting decays of $\tilde{\chi}_1^\pm, \tilde{\chi}_2^0$ are the following:

$$\tilde{\chi}_2^0 \to \tilde{\chi}_1^0 + l^+ l^- \,, \tag{12}$$

$$\tilde{\chi}_2^0 \to \tilde{\chi}_1^0 + \nu\bar{\nu} \,, \tag{13}$$

$$\tilde{\chi}_2^0 \to \tilde{\chi}_1^0 + Z^0 \,, \tag{14}$$

$$\tilde{\chi}_1^\pm \to \tilde{\chi}_1^0 + l^\pm + \nu \,, \tag{15}$$

$$\tilde{\chi}_1^\pm \to \tilde{\chi}_1^0 + W^\pm \,, \tag{16}$$

If sleptons are light relative to $\tilde{\chi}_1^\pm, \tilde{\chi}_1^0$ sleptons can be produced besides Drell-Yan mechanism from chargino and neutralino decays ($\tilde{\chi}_1^\pm, \tilde{\chi}_2^0$ indirect production), namely:

$$\tilde{\chi}_2^0 \to \tilde{l}_{L,R}^\pm l^\mp \,, \tag{17}$$

$$\tilde{\chi}_2^0 \to \tilde{\nu}\nu \,, \tag{18}$$

$$\tilde{\chi}_1^\pm \to \tilde{\nu} l^\pm \,, \tag{19}$$

$$\tilde{\chi}_1^\pm \to \tilde{l}^\pm \nu \,. \tag{20}$$

4 Signature and background

The slepton production and decays described in previous section lead to the signature with the simplest event topology: *two leptons* + E_T^{miss} + *no jets*. This signature arises for both direct and indirect slepton pair production. In the case of indirectly produced sleptons not only event topology with two leptons but with single, three and four leptons are possible. Besides indirect slepton production from decays of squarks and gluino through charginos, neutralinos can lead to event topology *two leptons* + E_T^{miss} + $(n \geq 1)$ *jets*.

In this paper we use the event topology *two leptons* + E_T^{miss} + *no jets* to detect sleptons at LHC(CMS). Our simulations are made at the particle level with parametrized detector responses based on a detailed detector simulation. The CMS detector simulation program CMSJET 4.703 [11] is used. It incorporates the full ECAL and HCAL granularity. The energy resolutions for electrons (photons), hadrons and jets are parametrized. Transverse and longitudinal profiles are also included according to parameterizations.

All the SUSY processes except particle spectrum are generated with PYTHIA 6.152 [9]. Sparticle masses for updated post-WMAP benchmark points were taken from Ref.[8]. The Standard Model backgrounds are also generated with PYTHIA 6.152. In our calculations we used the CTEQ 5L parton distribution set. The signature used for the search for sleptons at LHC is: two same-flavour opposite-sign leptons + E_T^{miss} + *no jets* [2] - [7]. Our cuts are the following:

a. for leptons:

- p_T - cut on leptons ($p_T^{lept} \geq p_T^{lept,0}$) and lepton isolation within $\Delta R < 0.3$ cone with ISOL<0.1 (CMSJET default);
- effective mass of two opposite-sign leptons of the same flavour: outside $M_Z \pm \delta M_Z$ band ($\delta M_Z = 10$ GeV);
- $\Delta\Phi(l^+l^-) < \Delta\Phi_{ll}^0$ cut;

b. for E_T^{miss} :

- $E_T^{miss} > E_T^{miss,0}$ cut;
- $\Delta\Phi$ (E_T^{miss}, ll) $> \Delta\Phi^0$ cut for relative azimuthal angle between two same-flavour opposite sign leptons

c. for jets:

- jet veto cut: $N_{jet} = 0$ for some $E_T^{jet} > E_T^{jet,0}$ threshold in pseudorapidity interval $|\eta_{jet}| <$ 4.5.

Such type of cuts is the standard one and it was used in previous Refs.[2] - [7].
In this paper we use the set of 10 cuts, see Table 2.

The main Standard Model (SM) backgrounds are: WW, WZ, $Wt\bar{b}$, $t\bar{t}$, $\tau\bar{\tau}$, $b\bar{b}$. The distributions of the SM background on p_T^{lept} and E_T^{miss} are presented in Figs.1-4. The contribution

	$p_T^{lept,0}$	$E_T^{miss,0}$	$\Delta\Phi_{ll}^0$	$E_T^{jet,0}$	δM_Z	$\Delta\Phi^0$
Cut1	20	50	130	30	10	160
Cut2	20	50	–	30	10	160
Cut3	50	140	140	60	10	150
Cut4	50	100	130	30	10	150
Cut5	100	200	130	60	10	150
Cut6	60	150	130	45	10	150
Cut7	80	120	140	70	10	145
Cut8	75	170	160	100	10	160
Cut9	30	75	130	45	10	150
Cut10	40	90	130	50	10	150

Table 2: The parameters of the used cuts.

of WW background is (40-80)% in the dependence on the cut number. There are also internal SUSY backgrounds which arise through $\tilde{q}\tilde{q}$, $\tilde{g}\tilde{g}$ and $\tilde{q}\tilde{g}$ productions and subsequent cascade decays with jets outside acceptance or below threshold. SUSY backgrounds depend on SUSY masses and as a rule they are small compared to SM backgrounds. Note that when we are interested in new physics discovery (the first stage of any data analysis) we have to compare the calculated number of standard background events N_{bg} with new physics signal events $N_{new\ physics} = N_{slept} + N_{susy,bg}$, so SUSY background events increase the discovery potential of new physics.

SM background cross sections after cuts are given in Table 3.(in fb)

Cut	1	2	3	4	5	6	7	8	9	10
σ_{bg}	288	775	3.6	6.7	0.68	1.9	3.3	3.0	101	24

Table 3: The SM background cross sections after cuts (in fb).

5 Results

For post-WMAP points (A - M) our results are the following. We found that at $L_{tot} = 10 fb^{-1}$ it would be possible to discover sleptons only at point B.[4] For cut 3 we found that $N_S = 45$, $N_B = 38$, $S = 5.9$. For $L_{tot} = 30 fb^{-1}$ it is possible to discover sleptons at points B, C, D, F, see Table 4. [5] .

[4] In our calculations we used the approximate formula for the significance $S = \frac{2N_S}{\sqrt{N_B} + \sqrt{N_S + N_B}}$ that is appropriate characteristic for future experiments, see Refs.[14] and also Ref.[15].

[5] See also Figs.5-6 for an illustration of the dependence of the background and the signal on the cut parameters

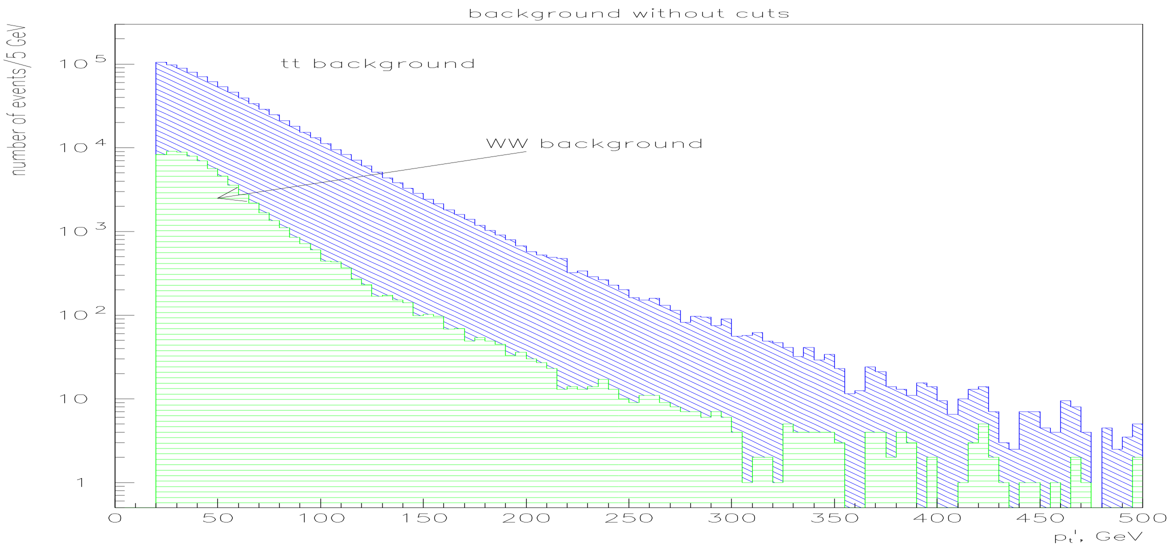

Figure 1: Leptons p_T^{lept} distributions for main SM background (WW, $t\bar{t}$) before any cuts ($L_{tot} = 10\ fb^{-1}$).

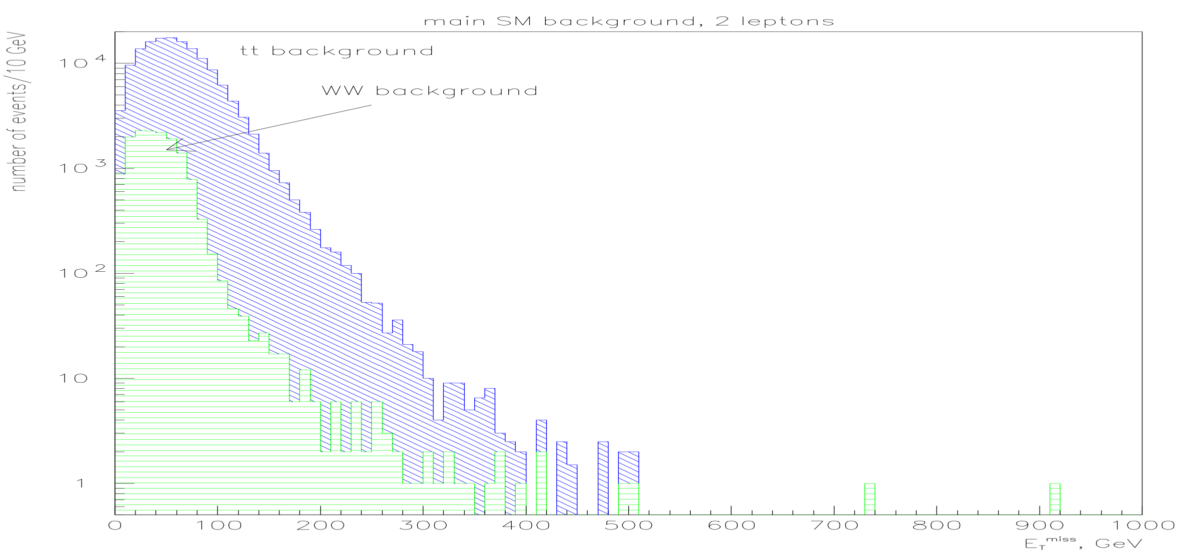

Figure 2: E_T^{miss} distributions for main SM background (WW, $t\bar{t}$) events with two isolated leptons $p_T^{lept} > 20\ GeV$ ($L_{tot} = 10\ fb^{-1}$).

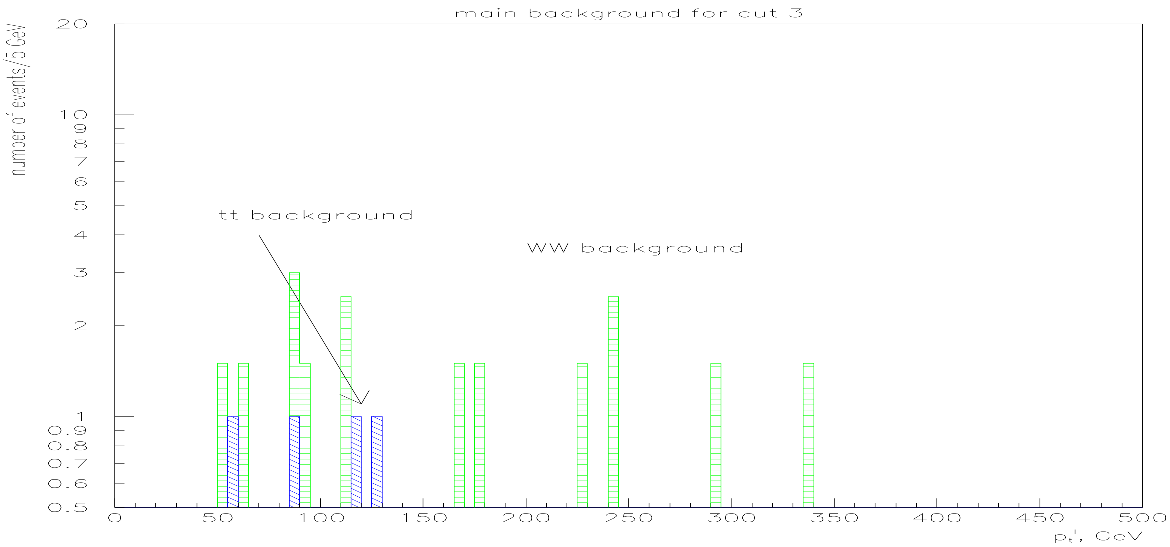

Figure 3: Leptons p_T^{lept} distributions for main SM background (WW, $t\bar{t}$) for cut 3 (L_{tot} = 10 fb^{-1}).

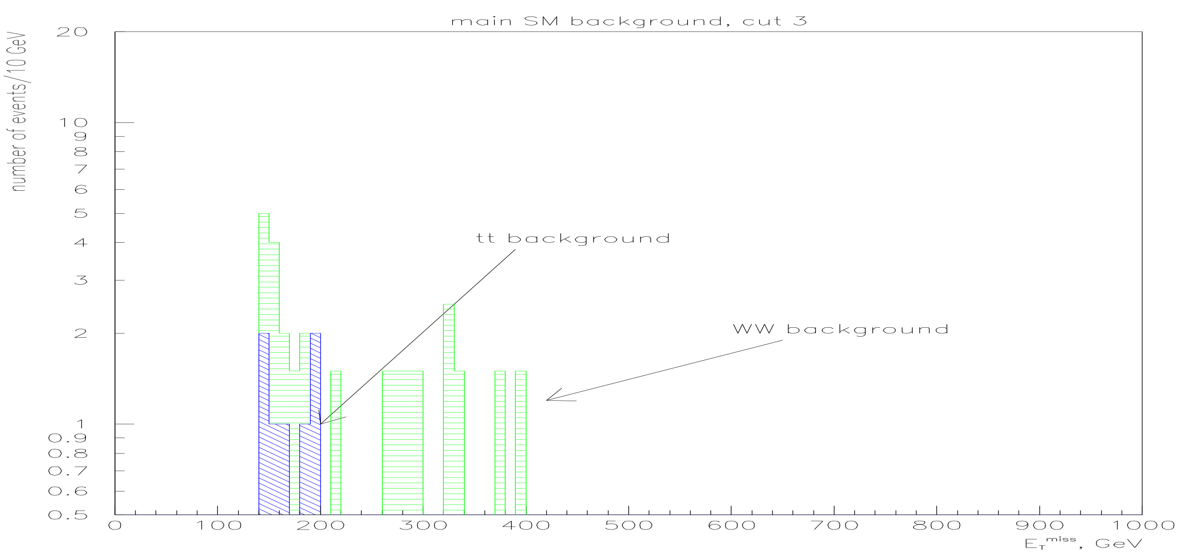

Figure 4: E_T^{miss} distributions for main SM background (WW, $t\bar{t}$) events for cut 3 (L_{tot} = 10 fb^{-1}).

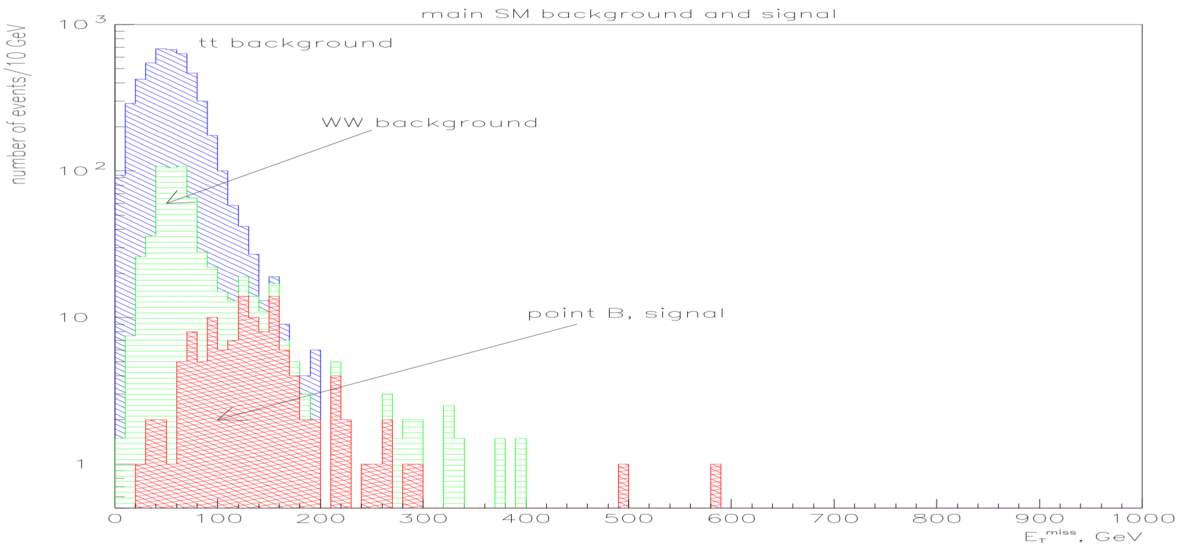

Figure 5: E_T^{miss} distributions for main SM background (WW, $t\bar{t}$) and signal at point B for events with two isolated leptons $p_T^{lept} > 50\ GeV$ for cut 3 before cuts on E_T^{miss} and $\Delta\Phi^0$ ($L_{tot} = 10\ fb^{-1}$).

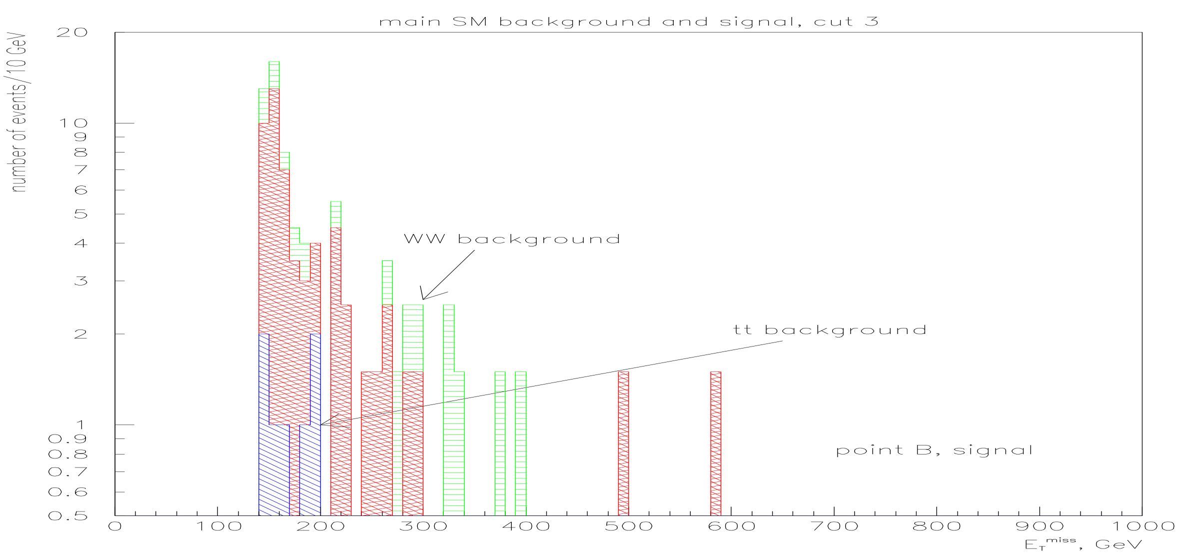

Figure 6: E_T^{miss} distributions for main SM background (WW, $t\bar{t}$) and signal at point B for cut 3 ($L_{tot} = 10\ fb^{-1}$).

Point	Cut	N_S	N_B	S
B	4	180	212	10.5
C	3	84	112	6.8
D	3	61	110	5.2
G	6	49	57	5.5

Table 4: Sleptons discovery points at $L_{tot} = 30\ fb^{-1}$

At $L_{tot} = 100 fb^{-1}$ the sleptons discovery points are A,B,C,D,G,I. [6] We also investigated the slepton discovery potential for post-LEP benchmark points [13] and found that the LHC(CMS) slepton discovery potential for post-LEP points coincides with the slepton discovery potential for post-WMAP points.

In this paper we studied also the production and decays of right and left sleptons separately.[7] In this study we assumed that sleptons decay mainly into LSP and leptons:

$$\tilde{l}^-_R \to l^- + \tilde{\chi}^0_1, \tag{21}$$

$$\tilde{l}^\pm_L \to l^\pm + \tilde{\chi}^0_1. \tag{22}$$

Of course, in real life we expect that the decays of other sparticles will also contribute to the signature $two\ leptons + E_T^{miss} + no\ jets$. But if we are interested in new physics signal discovery additional contribution only increases new physics discovery potential of this signature.

We made simulations for LSP mass m_{LSP} equal to 0.2 $m_{\tilde{l}}$, 0.4 $m_{\tilde{l}}$, 0.6 $m_{\tilde{l}}$ and 0.8 $m_{\tilde{l}}$.[8]. The dependence of the cross section for the production of right and left sleptons for the case of two flavour degenerate right and left charged sleptons is presented in Fig.7. Our results are given in Table 5.

As it follows from our results the sleptons discovery potential depends on the LSP mass. For $m_{LSP} = 0.2\ m_{\tilde{l}}$ it would be possible to detect right sleptons with a mass up to 200 GeV and left ones with a mass up to 300 GeV. For instance, for right slepton with a mass $m_{\tilde{l}_R} = 200\ GeV$ and LSP with a mass $m_{LSP} = 40\ GeV$ we found that $N_S = 70$, $N_B = 108$, $S = 5.9$ (cut 3, $L_{tot} = 30\ fb^{-1}$). For left slepton with a mass $m_{\tilde{l}_R} = 200\ GeV$ and LSP with a mass $m_{LSP} = 40\ GeV$ we found that $N_S = 140$, $N_B = 108$, $S = 10.7$ (cut 3, $L_{tot} = 30\ fb^{-1}$).

[6] We did not take into account pileup effects therefore the results for high luminosity $L_{tot} = 100\ fb^{-1}$ are rather preliminary. We think that the use of "hard" cuts 3 - 8 allows to minimize the influence of pileup effects on the significance.

[7] To be precise we considered the production and decays of the first and second generation sleptons $\tilde{e}_R, \tilde{e}_L, \tilde{\nu}_{e_L}, \tilde{\mu}_R, \tilde{\mu}_L, \tilde{\nu}_{\mu_L}$. An account of the third generation sleptons with the masses equal to the masses of the first and second generation sleptons is not essential since $Br(\tau \to\ leptons) \approx 0.35$.

[8] We assume that $m_{\tilde{e}_R} = m_{\tilde{\mu}_R}$ and $m_{\tilde{e}_L} = m_{\tilde{\mu}_L}$

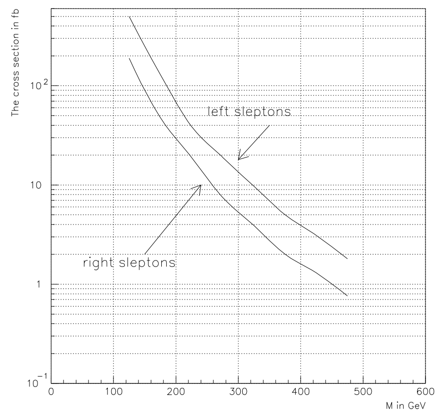

Figure 7: Cross section $\sigma(pp \to \tilde{l}_R \tilde{l}_R)$ for various values of the right slepton masses and cross section $\sigma(pp \to \tilde{l}_L \tilde{l}_L)$ for various values of the left slepton masses at LHC (in fb).

6 Conclusion

In this paper we studied the possibility to detect sleptons at LHC(CMS). For post-WMAP benchmark points we found that it is possible to discover sleptons at point B, points B, C, D, F and points A, B, C, D, G, I for total luminosities $L_{tot} = 10\ fb^{-1}$, $L_{tot} = 30\ fb^{-1}$ and $L_{tot} = 100\ fb^{-1}$ correspondingly. We also investigated the possibility to detect sleptons for the case when they decay dominantly to leptons and LSP. [9] For $L_{tot} = 30\ fb^{-1}$ we found that it is possible to discover right sleptons with masses up to 200 GeV and left sleptons with masses up to 300 GeV.

We are indebted to V.A.Matveev for valuable comments. The work of S.I.B. and N.V.K. has been supported by RFFI grant No 03-02-16933.

References

[1] As a recent review, see for example:
N.V.Krasnikov and V.A.Matveev, Search for new physics at LHC, Preprint INR-1104/2003; hep-ph/0309200.

[2] F. del Aguila and Ll.Ametller, Phys. Rev. Lett. **B261** (1991) 325.

[3] H.Baer, C. h. Chen, F.Paige and X.Tata, Phys. Rev. D **49** (1994) 3283.

[4] H. Baer, C. h. Chen, F. Paige and X. Tata, Phys. Rev. D **53** (1996) 6241; hep-ph/9512383.

[9] For right sleptons they really decay mainly to leptons and LSP while for left sleptons for $m_{\tilde{l}} > m_{\tilde{\chi}_2^0}$ cascade decays can dominate.

[5] D.Denegri, L.Rurua and N.Stepanov, CMS Note TN/96-059, 1996.

[6] N.V.Krasnikov, Jetp. Lett.**65**(1997)148; hep-ph/9611282.

[7] S.I.Bityukov and N.V.Krasnikov, Yad. Fiz. **62** (1999) 1288; hep-ph/9806504.

[8] M.Battaglia *et al.*, hep-ph/0306219.

[9] T.Sjorstrand *et al.*, Comp. Phys. Comm. **135** (2001) 238.

[10] H.Baer, F.E.Paige, S.D.Protopopescu and X.Tata, hep-ph/0001086.

[11] S.Abdullin, A.Khanov and N.Stepanov, CMS Note TN/94-180.

[12] Reviews and original references can be found in:
R.Barbieri, Riv.Nuovo.Cim.**11**(1988)1;
D.V.Nanopoulos, Phys.Rep.**145**(1987)1;
H.P.Nilles, Phys.Rep.**110**(1984)1;
N.V.Krasnikov and V.A.Matveev, Phys.Part.Nucl.**28**(1997)441; hep-ph/9703204.

[13] M.Battaglia *et al.*, hep-ph/0112013.

[14] S.I.Bityukov and N.V.Krasnikov, Mod.Phys.Lett. **A13**(1998)3235;
S.I.Bityukov and N.V.Krasnikov, Nucl.Instrum.Meth.**A452**(2000)518.

[15] V.Bartsch and G.Quast, Expected signal observability at future experiments, CMS-IN-2003/039.

Left sleptons

	0.8	-	-	-	-	-	-	-	-
	0.6	+	-	-	-	-	-	-	-
$L = 10 fb^{-1}$	0.4	+	+	-	-	-	-	-	-
	0.2	+	+	+	-	-	-	-	-
	$m_{LSP}/m_{\tilde{l}_R}$	100	150	200	250	300	350	400	450
	0.8	-	-	-	-	-	-	-	-
	0.6	+	+	+		-	-	-	-
$L = 30 fb^{-1}$	0.4	+	+	+	+	+	-	-	-
	0.2	+	+	+	+	+	-	-	-
	$m_{LSP}/m_{\tilde{l}_R}$	100	150	200	250	300	350	400	450
	0.8	-	-	-	-	-	-	-	-
	0.6	+	+	+	+	+	-	-	-
$L = 100 fb^{-1}$	0.4	+	+	+	+	+	+	-	-
	0.2	+	+	+	+	+	+	+	-
	$m_{LSP}/m_{\tilde{l}_R}$	100	150	200	250	300	350	400	450

Right sleptons

	0.8	-	-	-	-	-	-	-
	0.6	-	-	-	-	-	-	-
$L = 10 fb^{-1}$	0.4	-	-	-	-	-	-	-
	0.2	+	-	-	-	-	-	-
	$m_{LSP}/m_{\tilde{l}_L}$	100	150	200	250	300	350	400
	0.8	-	-	-	-	-	-	-
	0.6	-	-	-	-	-	-	-
$L = 30 fb^{-1}$	0.4	+	-	-	-	-	-	-
	0.2	+	+	+	-	-	-	-
	$m_{LSP}/m_{\tilde{l}_L}$	100	150	200	250	300	350	400
	0.8	-	-	-	-	-	-	-
	0.6	+	-	-	-	-	-	-
$L = 100 fb^{-1}$	0.4	+	+	+	+	-	-	-
	0.2	+	+	+	+	+	-	-
	$m_{LSP}/m_{\tilde{l}_L}$	100	150	200	250	300	350	400

Table 5: The right and left sleptons LHC(CMS) 5 σ discovery potential for different luminosities.