Z'production at LHC in an extended MSSM

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✦ Motivation

✦ Modelling Z' production and decay :
  extending the MSSM with extra U(1)'gauge
  symmetry and Sequential Standard Model

✦ Reference Point: masses and branching ratios

✦ Benchmark Models: branching ratios in SM, MSSM

✦ Z' production cross sections and event rates at LHC

✦ Conclusions

G. Corcella and S.G.,arXiv:1205.5780[hep-ph]

Motivation and state-of-art

✦ **Standard Model extension + U(1)'gauge symmetry:**

new neutral gauge boson Z'

✦ **Experimental searches**: $\mathbf{Z'} \rightarrow \ell^+ \ell^-$ ($\ell = $e, μ)

✦ SM couplings Z'-fermions as Z (**S**equential **S**tandard **M**odel Z')
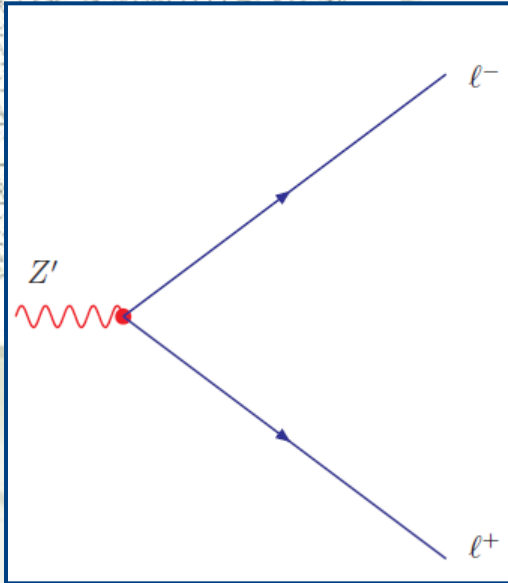
Tevatron: $m_{Z'} > 1023$ GeV (D0), 963 GeV (CDF)

LHC: $m_{Z'ssm} > 2.3$ TeV CMS, 2.2 TeV ATLAS ($\sqrt{s}$=7 TeV, $\mathscr{L} \sim 5$ fb^{-1})

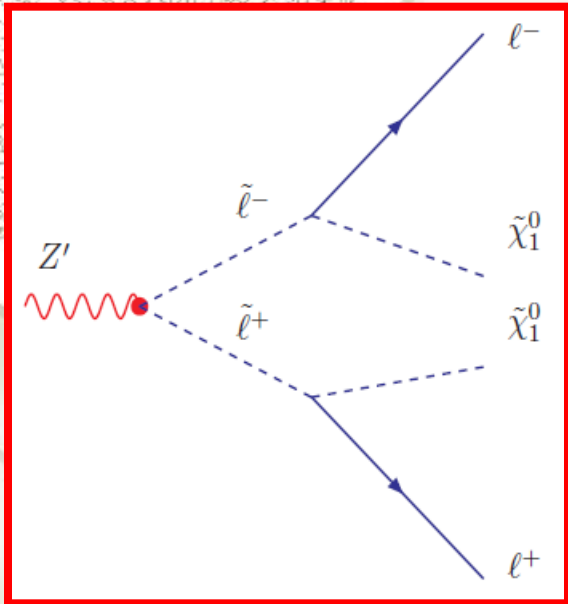✦ String models: $m_{Z'\psi} > 2$ TeV CMS, $m_{Z'U(1)'}$ 1.76 - 1.96 TeV ATLAS

Assumptions:
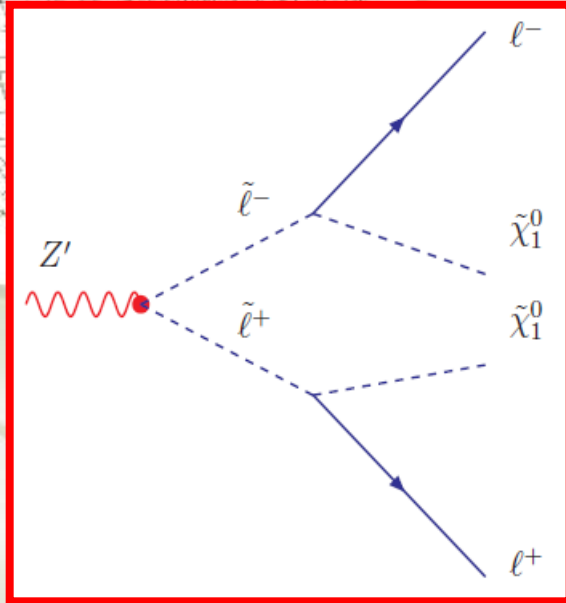✦No physics beyond SM. **Z' decays only into SM particles**
✦Branching ratios depending on masses and couplings
✦String models: one parameter, θ, characterizing U(1)' model

T.Ghergetta, et al.
Phys.Rev. D57(1998) 3178.

Our assumption:

✦ **Z' decays in supersymmetric particles are allowed.**

✦ **Sfermion, Higgs, chargino, neutralino masses and branching ratios are derived taking in account all corrections due to U(1)'[1].**

✦ The new physics contribution will significantly decrease the Br into SM particles ➞ **lower mass exclusion limits**

✦ Sleptons production in Z' decays has an additional constrain $m_{z'}$

✦ Investigate electroweak sector in an unexplored corner of phase space.

**T.Ghergetta, et al.
Phys.Rev. D57(1998) 3178.**

Z' modelling:U(1)' models

Models

✦ All Z' phenomenology can described as:

$$Z'(\theta) = Z'_{\psi} \cos \theta - Z'_{\chi} \sin \theta.$$

✦ The charge of a generic field Φ:

$$Q'(\Phi) = Q_{\psi}(\Phi) \cos \theta - Q_{\chi}(\Phi) \sin \theta$$

Name	θ	value
Z'_{η}	$\mathrm{ArcCos}\left[\sqrt{\frac{5}{8}}\right]$	0.66
Z'_{ψ}	0	0
Z'_{N}	$\mathrm{ArcTan}\left[\sqrt{15}\right] - \frac{\pi}{2}$	-0.25
Z'_{I}	$\mathrm{ArcCos}\left[\sqrt{\frac{5}{8}}\right] - \frac{\pi}{2}$	-0.91
Z'_{S}	$\mathrm{ArcTan}\left[\frac{\sqrt{15}}{9}\right] - \frac{\pi}{2}$	-1.16
Z'_{χ}	$-\frac{\pi}{2}$	-1.57

Decays into SM particles only

✦ Coupling g_1, g_2, g' (U(1)$_y$, SU(2)$_L$, U(1)')

$$g_1 = g_2 \tan \theta_W$$

$$g' = \sqrt{\frac{5}{3}} g_1.$$

Extended MSSM+U(1)' masses

Higgs masses

✦ A third boson is required to break U(1)' and give mass to Z'.

$$\Phi_1 = \begin{pmatrix} \phi_1^0 \\ \phi_1^- \end{pmatrix}, \Phi_2 = \begin{pmatrix} \phi_2^+ \\ \phi_2^0 \end{pmatrix}, \Phi_3 = \phi_3^0. \qquad v = \sqrt{v_1^2 + v_2^2}$$

✦ Vacuum expectation $\langle \phi_i^0 \rangle = v_i/\sqrt{2}$, trilinear scalar potential for neutral Higgs bosons $V_\lambda = \lambda A \phi_1^0 \phi_2^0 \phi_3^0$ and

✦ After symmetry breaking: 6 Higgs ($H^\pm$, A, h, H, **H'**) diagonalising mass matrices: $\mu = \dfrac{\lambda v_3}{\sqrt{2}}$
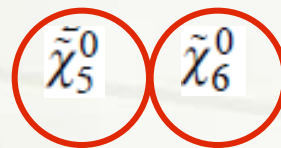
$$m_{H^\pm}^2 = \frac{\lambda A_\lambda v_3}{\sin 2\beta} + \left(1 - 2\frac{\lambda^2}{g_2^2}\right) m_W^2 \qquad m_A^2 = \frac{\lambda A_\lambda v_3}{\sin 2\beta}\left(1 + \frac{v^2}{4v_3^2}\sin^2 2\beta\right),$$

Extended MSSM+U(1)' masses

✦ **Neutralinos masses**

✦ Besides $\tilde{\chi}_1^0$ $\tilde{\chi}_2^0$ $\tilde{\chi}_3^0 \tilde{\chi}_4^0$ **two extra neutralinos** $\tilde{\chi}_5^0$ $\tilde{\chi}_6^0$ associated with extra Z' and H'.

✦ M_1, M_2, M' are the soft masses of $\tilde{B}, \tilde{W}_3$ and $\tilde{B}'$.

$$
\mathcal{M}_{\tilde{\chi}^0} = \begin{pmatrix}
M_1 & 0 & 0 & -\frac{1}{2}g_1 v_1 & \frac{1}{2}g_1 v_2 & 0 \\
0 & M_2 & 0 & \frac{1}{2}g_2 v_1 & \frac{1}{2}g_2 v_2 & 0 \\
0 & 0 & M' & Q_1' g' v_1 & Q_2' g' v_2 & Q_3' g' v_3 \\
-\frac{1}{2}g_1 v_1 & \frac{1}{2}g_2 v_1 & Q_1' g' v_1 & 0 & \frac{1}{\sqrt{2}}\lambda v_3 & \frac{1}{\sqrt{2}}\lambda v_2 \\
\frac{1}{2}g_1 v_2 & -\frac{1}{2}g_2 v_2 & Q_2' g' v_2 & \frac{1}{\sqrt{2}}\lambda v_3 & 0 & \frac{1}{\sqrt{2}}\lambda v_1 \\
0 & 0 & Q_3' g' v_3 & \frac{1}{\sqrt{2}}\lambda v_2 & \frac{1}{\sqrt{2}}\lambda v_1 & 0
\end{pmatrix}
$$

✦ **Charginos**

Being Z' and H' neutral the MSSM chargino sector is **not affected**.

Extended MSSM+U(1)' masses

D-Term

✦ **Sfermion masses**

$$m_a^2 = (m_a^0)^2 + \Delta m_a^2 + \Delta m'_a{}^2$$

$$\Delta \tilde{m}_a'^2 = \frac{g'^2}{2}(Q_1' v_1^2 + Q_2' v_2^2 + Q_3' v_3^2).$$

Soft term

MSSM
hyperfine splitting

U(1)' extension
Higgses to break symmetry

U(1)' charges of
Higgses fields

• Mass eigenstates

$$\mathcal{M}_{\tilde{f}}^2 = \begin{pmatrix} (M_{LL}^{\tilde{f}})^2 & (M_{LR}^{\tilde{f}})^2 \\ (M_{LR}^{\tilde{f}})^2 & (M_{RR}^{\tilde{f}})^2 \end{pmatrix}$$

Assuming a all squarks common mass and all slepton common mass at Z'mass scale.

Extended MSSM+U(1)' masses

✦ **For up down squarks the matrix elements**
$x_w = \sin^2\theta_W,$

$$
\begin{aligned}
(M_{LL}^{\tilde{u}})^2 &= (m_{\tilde{u}_L}^0)^2 + m_u^2 + \left(\frac{1}{2} - \frac{2}{3}x_w\right)m_Z^2 \cos 2\beta + Q'_{\tilde{u}_L}\Delta\tilde{m}'^2_{\tilde{u}_L} \\
(M_{RR}^{\tilde{u}})^2 &= (m_{\tilde{u}_R}^0)^2 + m_u^2 + \left(\frac{1}{2} - \frac{2}{3}x_w\right)m_Z^2 \cos 2\beta + Q'_{\tilde{u}_R}\Delta\tilde{m}'^2_{\tilde{u}_R} \\
(M_{LR}^{\tilde{u}})^2 &= m_u\left(A_u - \mu\cot\beta\right).
\end{aligned}
$$

$m_{Z'}$ and θ dependence in D-term

✦ $m_{\tilde{u}_{L,R}}^0$ mass squark at Z' mass scale A_u is coupling constant Higgs-sfermion

✦ The mass light quarks and slepton is small $(M_{LR}^{\tilde{u}})^2 \sim\sim 0$ $\longrightarrow$ $\mathcal{M}_{\tilde{f}}^2$ diagonal. Weak eigenstates ~ mass eigenstates. Except stop .

$\tilde{f}_1 \sim \tilde{f}_L$ $\tilde{f}_2 \sim \tilde{f}_{R.}$

Extended MSSM+U(1)'

- **Sfermions**: $\tilde{\ell}$ $\tilde{\nu}_\ell$ $(\ell = e, \mu, \tau)$ $\tilde{q}$

- Gauginos: $\tilde{g}$, $\tilde{W}^\pm \tilde{Z}$ $\tilde{\gamma}$, $\tilde{Z}$ '

- **Higgs** h, A, H, H$^\pm$ **H'**

- Charginos $\tilde{\chi}_1^\pm \tilde{\chi}_2^\pm$

- **Neutralinos** $\tilde{\chi}_1^0 \tilde{\chi}_2^0 \tilde{\chi}_3^0 \tilde{\chi}_4^0$ $\tilde{\chi}_5^0$ $\tilde{\chi}_6^0$

- R-parity conserved, LSP $\tilde{\chi}_1^0$

- **D-term** depending on U(1)' sfermion charges and Higgs vacuum expectation values→**sfermion masses.**

- **Some scenario are discarded due large negative D-term**

- **New Z' decays besides the SM ones:**

$$Z' \rightarrow \tilde{q}\tilde{q}^*,\ \tilde{\ell}^+\tilde{\ell}^-,\ \tilde{\nu}\tilde{\nu}^*,\ \tilde{\chi}_i^0\tilde{\chi}_j^0,\ \tilde{\chi}_{1,2}^+\tilde{\chi}^-1,2,\ ZH,\ Zh,\ ZA,\ H^+H^-,\ hA,\ HA,\ WW$$

Representative Point

★ Study Z' decay in a MSSM, U(1)' point:

$$m_{Z'} = 3 \text{ TeV} , \; \theta = \theta_{\text{I}} = \arccos \sqrt{\frac{5}{8} - \frac{\text{Pi}}{2}} ,$$

$$\mu = 200 , \; \tan\beta = 20 , \; A_q = A_\ell = 500 \text{ GeV} ,$$

$$m^0_{\tilde{q}_L} = m^0_{\tilde{q}_R} = m^0_{\tilde{\ell}_T} = m^0_{\tilde{\ell}_R} = m^0_{\tilde{\nu}_L} = m_{\tilde{\nu}_R} = m^0 = 2.5 \text{ TeV}$$
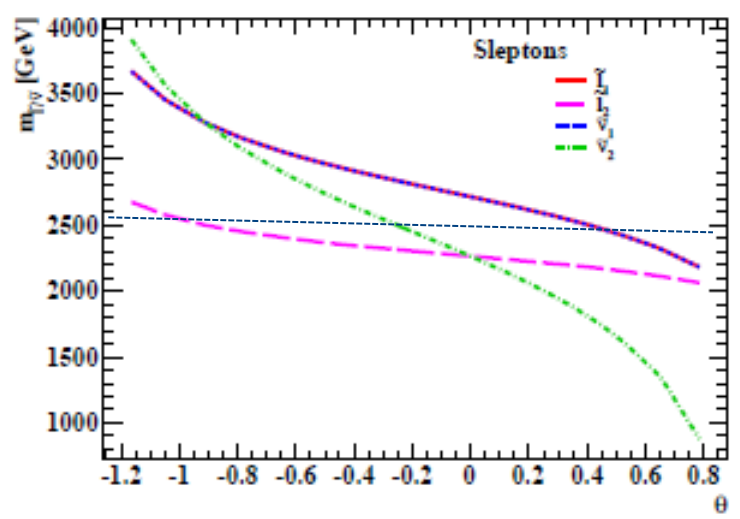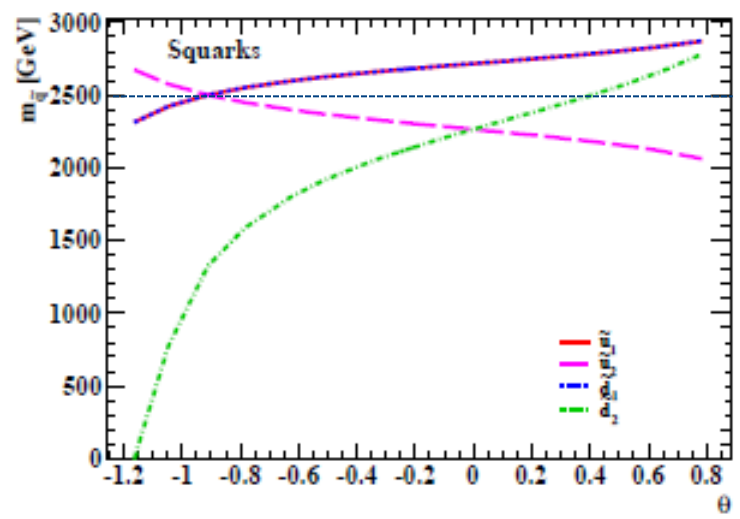
R

gaugino unification

$$\frac{M_1}{M_2} = \frac{5}{3} \tan^2 \theta_W .$$

$$M_1 = 100 \text{ GeV} , \; M_2 = 200 \text{ GeV} , \; M' = 1 \text{ TeV}$$

Model choice
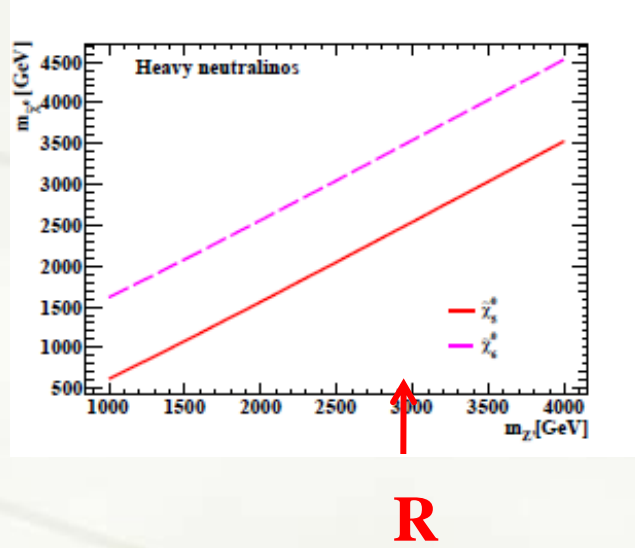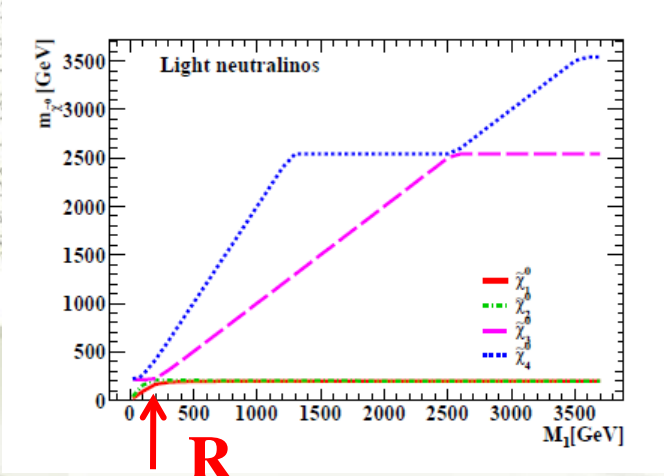

m₀ initial value ← m_0 initial value

D term   negative and large→ unphysical masses

★ $m_{\tilde{u}_1} \approx m_{\tilde{t}_1}$ $m_{\tilde{u}_2} \approx m_{\tilde{t}_2}$ In this parameter space point.

★ θ~-π (Z'$_\chi$) unphysical for m$_{Z'}$ =3TeV → discarded

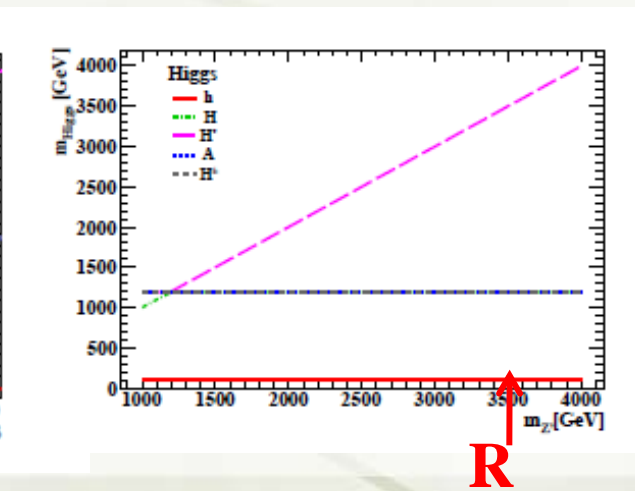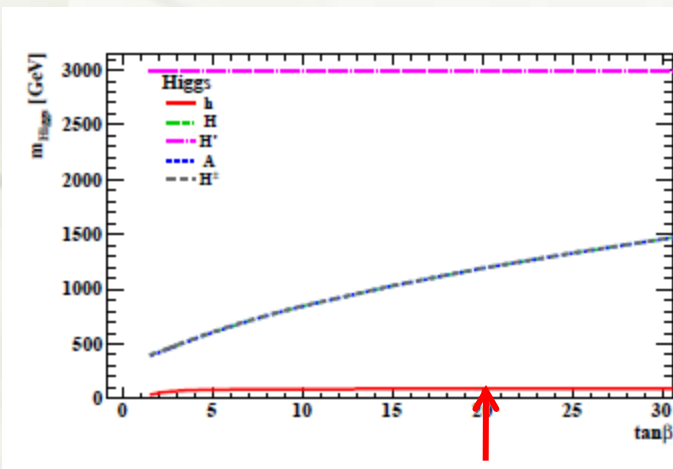# *Masses : neutralinos,Higgs*

✦ **Neutralinos**

✦ **Higgs**

✦ No dependences of light neutralinos From M' ,$M_{Z'}$ and θ

✦ $\tilde{\chi}_5^0$ $\tilde{\chi}_6^0$ **too heavy**
Z' decays not allowed

✦U(1)' Higgs H' mass is
approx Z' mass
✦Z' decays into H' are not allowed

★ **Representative**

$m_{\tilde{u}_1}$	$m_{\tilde{u}_2}$	$m_{\tilde{d}_1}$	$m_{\tilde{d}_2}$
2499.4	2499.7	2500.7	1323.1
$m_{\tilde{\chi}_1^0}$	$m_{\tilde{\chi}_2^0}$	$m_{\tilde{\chi}_3^0}$	$m_{\tilde{\chi}_4^0}$
94.6	156.5	212.2	260.9
m_h	m_A	m_H	$m_{H'}$
90.7	1190.7	1190.7	3000.0

$m_{\tilde{\ell}_1}$	$m_{\tilde{\ell}_2}$	$m_{\tilde{\nu}_1}$	$m_{\tilde{\nu}_2}$
3279.0	2500.4	3278.1	3279.1
$m_{\tilde{\chi}_5^0}$	$m_{\tilde{\chi}_6^0}$	$m_{\tilde{\chi}_1^\pm}$	$m_{\tilde{\chi}_2^\pm}$
2541.4	3541.4	154.8	262.1
$m_{H^\pm}$			
1193.4			

Br SM ~ 77%
Br MSSM ~23%

Final state	BR (%)	Final State	BR (%)
$\sum_i u_i \bar{u}_i$	0.00	$\tilde{\chi}_1^0 \tilde{\chi}_1^0$	0.07
$\sum_i d_i \bar{d}_i$	40.67	$\tilde{\chi}_1^0 \tilde{\chi}_2^0$	0.43
$\sum_i \ell_i^+ \ell_i^-$	13.56	$\tilde{\chi}_1^0 \tilde{\chi}_3^0$	0.71
$\sum_i \nu_i \bar{\nu}_i$	27.11	$\tilde{\chi}_1^0 \tilde{\chi}_4^0$	0.27
$\sum_{i,j} \tilde{u}_i \tilde{u}_j^*$	0.00	$\tilde{\chi}_1^0 \tilde{\chi}_5^0$	1×10^{-6}
$\sum_{i,j} \tilde{d}_i \tilde{d}_j^*$	9.58	$\tilde{\chi}_2^0 \tilde{\chi}_2^0$	0.65
$\sum_{i,j} \tilde{\ell}_i \tilde{\ell}_j^*$	0.00	$\tilde{\chi}_2^0 \tilde{\chi}_3^0$	2.13
$\sum_{i,j} \tilde{\nu}_i \tilde{\nu}_j^*$	0.00	$\tilde{\chi}_2^0 \tilde{\chi}_4^0$	0.80
$W^+ W^-$	1×10^{-5}	$\tilde{\chi}_2^0 \tilde{\chi}_5^0$	3×10^{-6}
$H^+ H^-$	0.50	$\tilde{\chi}_3^0 \tilde{\chi}_3^0$	1.75
hA	3×10^{-3}	$\tilde{\chi}_3^0 \tilde{\chi}_4^0$	1.31
HA	0.51	$\tilde{\chi}_3^0 \tilde{\chi}_5^0$	4×10^{-6}
ZH	3×10^{-3}	$\tilde{\chi}_4^0 \tilde{\chi}_4^0$	0.25
Zh	1×10^{-5}	$\tilde{\chi}_4^0 \tilde{\chi}_5^0$	9×10^{-7}
ZH'	0.00	$\tilde{\chi}_5^0 \tilde{\chi}_5^0$	0.00
$H'A$	0.00	$\sum_i \tilde{\chi}_i^0 \tilde{\chi}_6^0$	0.00
$W^\pm H^\mp$	7×10^{-3}	$\tilde{\chi}_1^\pm \tilde{\chi}_1^\mp$	1.76
		$\tilde{\chi}_1^\pm \tilde{\chi}_2^\mp$	1.95
		$\tilde{\chi}_2^\pm \tilde{\chi}_2^\mp$	0.54
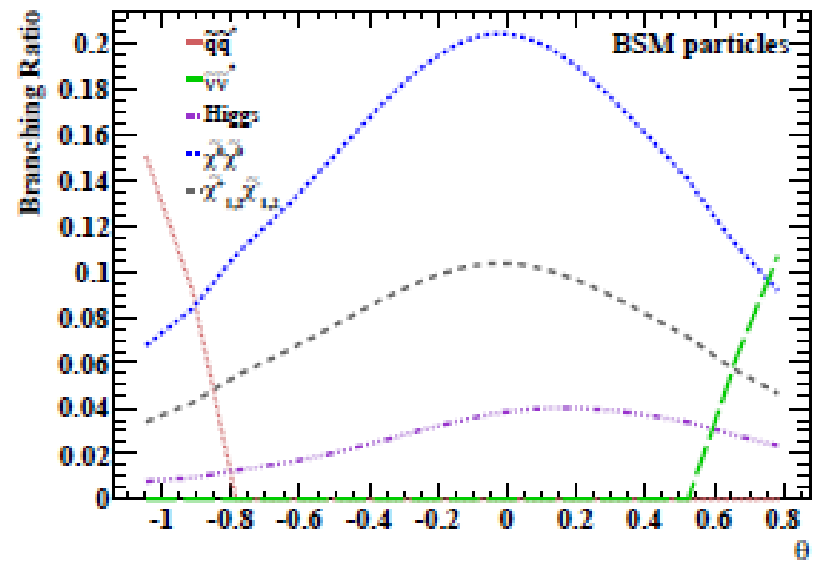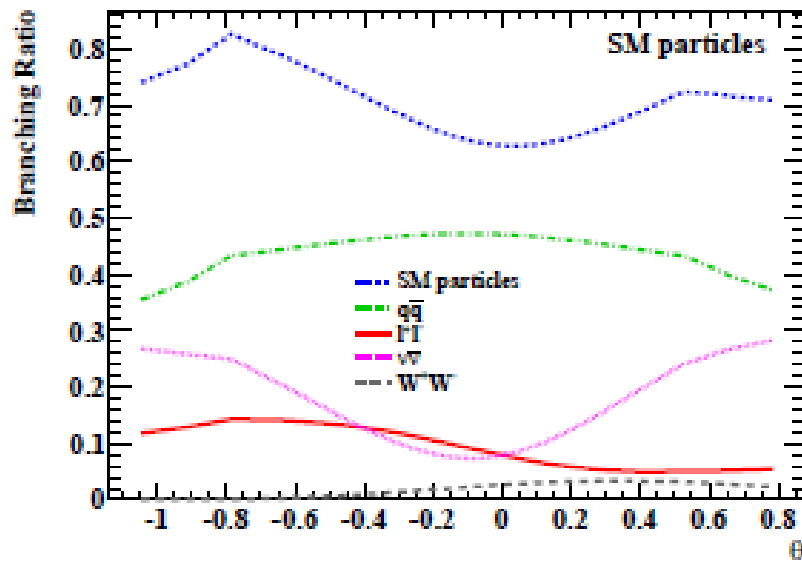
Branching ratios

- ✦ Many decays into supersymmetric particles kinematically **forbidden**(up squarks, **sleptons**,H',heavy neutralinos)
- ✦ Final state **leptons from cascade decays**
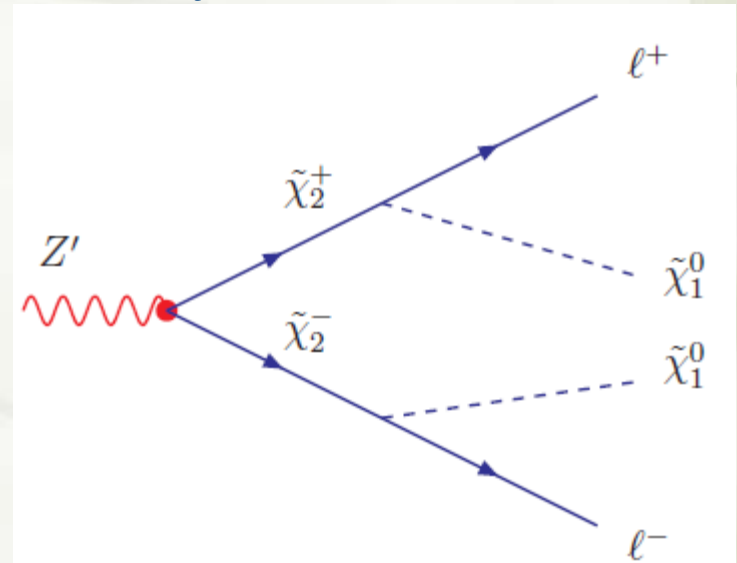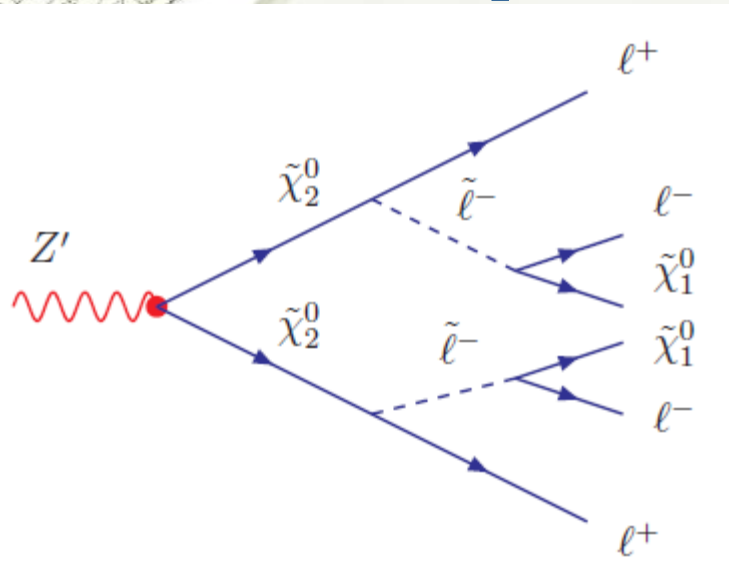
- ✦Study of Z' decays as function of $\tilde{\nu}$, $\tilde{\ell}$ mass, **in different Z' production models, θ**. Assuming $m_{\tilde{q}}^0 = 5 \text{ TeV}$,

Simonetta Gentile, ICHEP2012, Melbourne, Australia.

Z'_η, model, $\theta_\eta = \sqrt{5/8}$

✦ The minimal physical lepton mass

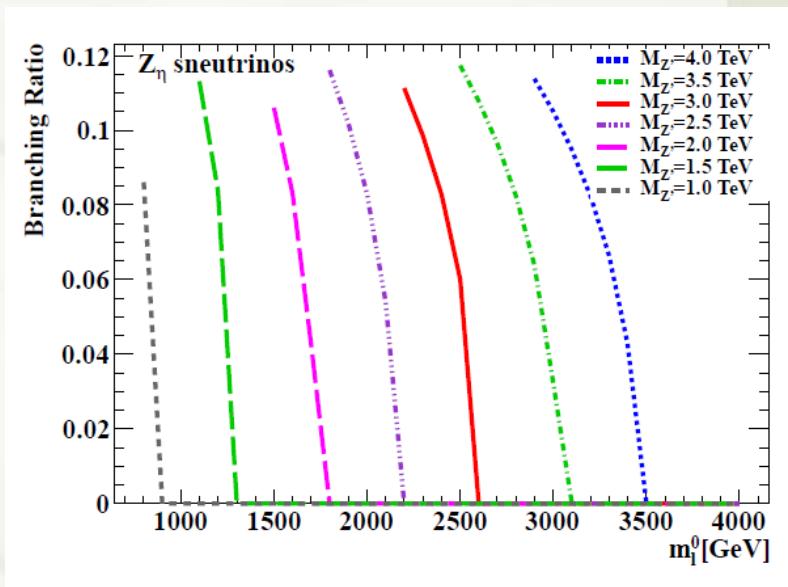$m_{\tilde{\ell}} = 1.6$ GeV.

$m_{\tilde{\ell}}^0 > 2.12$ TeV.

NO

$Z' \rightarrow \tilde{\ell}^+ \tilde{\ell}^-$

$Z' \rightarrow \tilde{\nu}_2 \tilde{\nu}_2^*$

~11% **YES**

$2.13 \text{ TeV} < m_{\tilde{\ell}}^0 < 2.59 \text{ TeV}$

$Z' \rightarrow \tilde{\chi}^0 \tilde{\chi}^0$

~11% **YES**

$\tilde{\chi}^+ \tilde{\chi}^-$

~ 5% **YES**

$m_{Z'}$ [GeV]	$m_{\tilde{\ell}}^0$ [GeV]	$m_{\tilde{\ell}_1}$ [GeV]	$m_{\tilde{\ell}_2}$ [GeV]	$m_{\tilde{\nu}_1}$ [GeV]	$m_{\tilde{\nu}_2}$ [GeV]
3000	2200	1986	1745	1984	586.40

$m_{\tilde{\chi}_1^\pm} = 184$ GeV $m_{\tilde{\chi}_2^\pm} = 330$ GeV
$m_A = m_H = m_{H^\pm} = 1190$ GeV.

All θ

$m_{Z'}$ [GeV]	$m_{\tilde{\chi}_1^0}$ [GeV]	$m_{\tilde{\chi}_2^0}$ [GeV]	$m_{\tilde{\chi}_3^0}$ [GeV]	$m_{\tilde{\chi}_4^0}$ [GeV]	$m_{\tilde{\chi}_5^0}$ [GeV]	$m_{\tilde{\chi}_6^0}$ [GeV]	m_h [GeV]	m_{H_3} [GeV]
3000	136.70	193.20	210.10	330.20	2541.00	3541.00	91.10	3000.00

Z'_η, $model, \theta_\eta = \sqrt{5/8}$

✦ The minimal physical lepton mass

$m_{\tilde\ell} = 1.6$ GeV. $\qquad m_{\tilde\ell}^0 > 2.12$ TeV.

NO

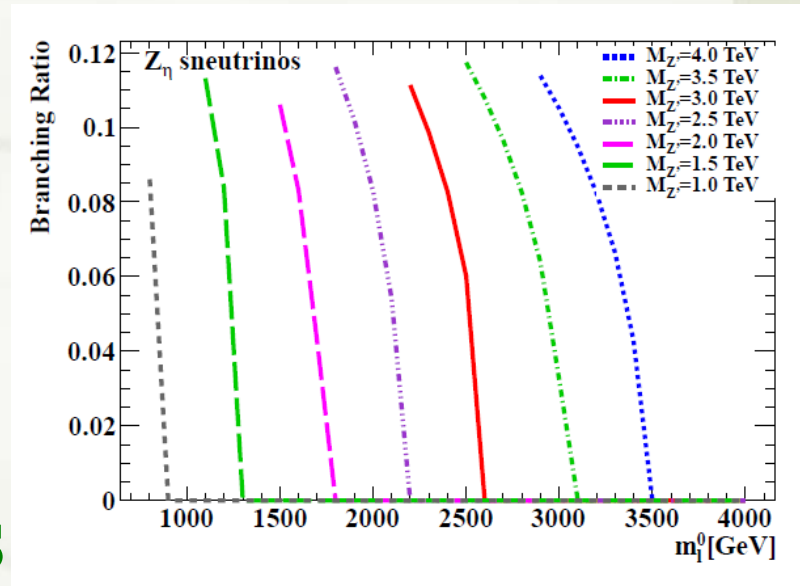✦ $Z' \rightarrow \tilde\ell^+ \tilde\ell^-$

✦ $Z' \rightarrow \tilde\nu_2 \tilde\nu_2^*$ ~11% **YES**

2.13 TeV $< m_{\tilde\ell}^0 < 2.59$ TeV.

✦ $Z' \rightarrow \tilde\chi^0 \tilde\chi^0$ ~11% **YES**

✦ $\tilde\chi^+ \tilde\chi^-$ ~ 5% **YES**

Z_η sneutrinos

Branching Ratio vs m_1^0 [GeV]: $M_{Z'}=4.0$ TeV, $M_{Z'}=3.5$ TeV, $M_{Z'}=3.0$ TeV, $M_{Z'}=2.5$ TeV, $M_{Z'}=2.0$ TeV, $M_{Z'}=1.5$ TeV, $M_{Z'}=1.0$ TeV

$m_{Z'}$ [GeV]	$m_{\tilde\ell}^0$ [GeV]	$m_{\tilde\ell_1}$ [GeV]	$m_{\tilde\ell_2}$ [GeV]	$m_{\tilde\nu_1}$ [GeV]	$m_{\tilde\nu_2}$ [GeV]
3000	2200	1986	1745	1984	586.40

$m_{\tilde\chi_1^\pm}=184$ GeV $m_{\tilde\chi_2^\pm}=330$ GeV

$m_A = m_H = m_{H^\pm} = 1190$ GeV.

All θ

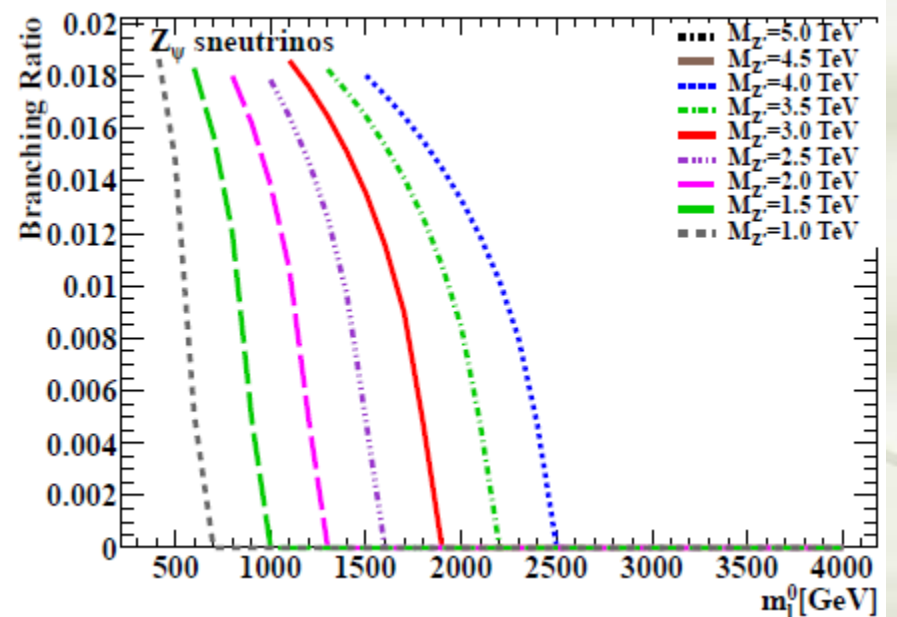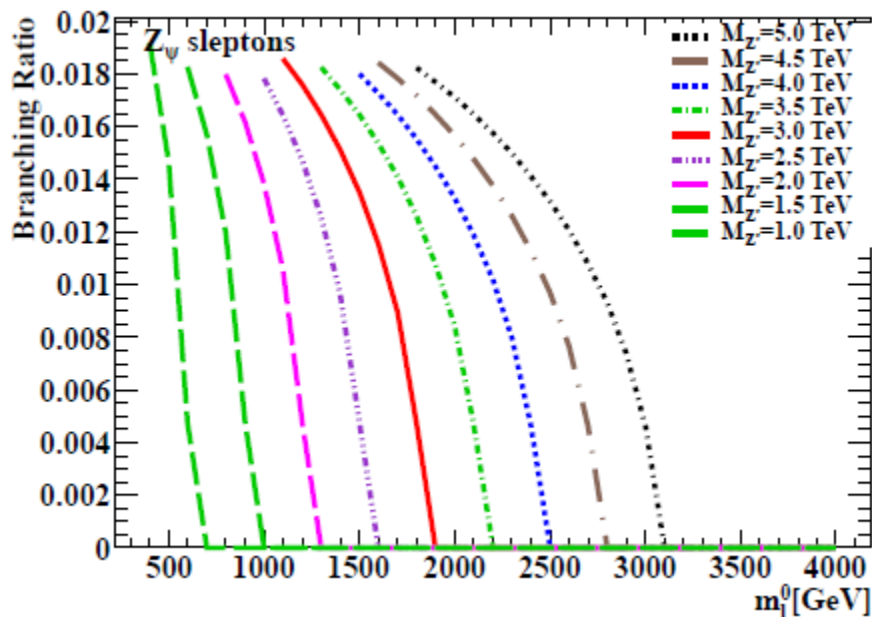| $m_{Z'}$	$m_{\tilde\chi_1^0}$	$m_{\tilde\chi_2^0}$	$m_{\tilde\chi_3^0}$	$m_{\tilde\chi_4^0}$	$m_{\tilde\chi_5^0}$	$m_{\tilde\chi_6^0}$	m_h	m_{H_3}

NOT favourable to reconstruct charged slepton masses

$Z'_{\psi}, \quad model, \theta_{\psi} = 0$

- $Z' \to \tilde{\ell}^+ \tilde{\ell}^-$ ~ 2% **YES**
- $Z' \to \tilde{\nu}_2 \tilde{\nu}_2^*$ ~ 2% **YES**
- $Z' \to \tilde{\chi}^0 \tilde{\chi}^0$ ~20% **YES**
- $Z' \to \tilde{\chi}^+ \tilde{\chi}^-$ ~10% **YES**

$m_{Z'}$ [GeV]	$m_{\tilde{\ell}}^0$ [GeV]	$m_{\tilde{\ell}_1}$ [GeV]	$m_{\tilde{\ell}_2}$ [GeV]	$m_{\tilde{\nu}_1}$ [GeV]	$m_{\tilde{\nu}_2}$ [GeV]
3000	1100	1529	296.20	1526	292.90

Possible to study Z' decay into charged sleptons

Z'_N, model, $\theta_N = \sqrt{15} - \pi/2$

$\star$ $Z' \rightarrow \tilde{\ell}^+ \tilde{\ell}^-$ ~1%   **YES**
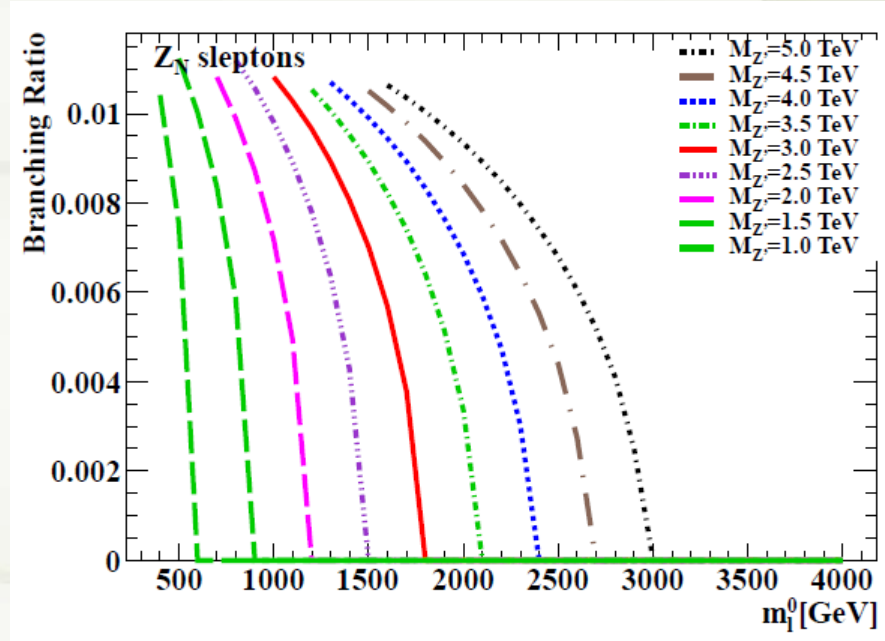
$\star$ $Z' \rightarrow \tilde{\nu}_2 \tilde{\nu}_2^*$ **coupling suppressed**

$\star$ $Z' \rightarrow \tilde{\chi}^0 \tilde{\chi}^0$ ~19%   **YES**

$\star$ $Z' \rightarrow \tilde{\chi}^+ \tilde{\chi}^-$ ~ 10%   **YES**

$m_{Z'}$ [GeV]	$m_{\tilde{\ell}}^0$ [GeV]	$m_{\tilde{\ell}_1}$ [GeV]	$m_{\tilde{\ell}_2}$ [GeV]	$m_{\tilde{\nu}_1}$ [GeV]	$m_{\tilde{\nu}_2}$ [GeV]
3000	1000	1674	319.90	1672	1000

Possible to study Z' decay into charged sleptons

Z'_I, model, $\theta_I = \sqrt{5/8} - \pi/2$

✦ No minimal physical lepton mass

✦ $Z' \to \tilde{\ell}^+ \tilde{\ell}^-$ **suppressed**

✦ $Z' \to \tilde{\nu}_2 \tilde{\nu}_2^*$ **NO**

✦ $Z' \to \tilde{\chi}^0 \tilde{\chi}^0$ ~ 10%

✦ $Z' \to \tilde{\chi}^+ \tilde{\chi}^-$ ~ 5%

$m_{Z'}$ [GeV]	$m_{\tilde{\ell}}^0$ [GeV]	$m_{\tilde{\ell}_1}$ [GeV]	$m_{\tilde{\ell}_2}$ [GeV]	$m_{\tilde{\nu}_1}$ [GeV]	$m_{\tilde{\nu}_2}$ [GeV]
3000	200	2131	204.70	2130	2131
3000	1000	2346	1001	2344	2345

NOT favourable to reconstruct charged slepton masses

Z'_S, model, $\theta_S = \sqrt{15/9} - \pi/2$

✦ No minimal physical lepton mass

✦ $Z' \to \tilde{\ell}^+ \tilde{\ell}^-$ ~ 0.08

✦ $Z' \to \tilde{\nu}_2 \tilde{\nu}_2^*$ **NO**

✦ $Z' \to \tilde{\chi}^0 \tilde{\chi}^0$ ~ 7%

✦ $Z' \to \tilde{\chi}^+ \tilde{\chi}^-$ ~ 4%

| $m_{Z'}$ [GeV]	$m_{\tilde{\ell}}^0$ [GeV]	$m_{\tilde{\ell}_1}$ [GeV]	$m_{\tilde{\ell}_2}$ [GeV]	$m_{\tilde{\nu}_1}$ [GeV]	$m_{\tilde{\nu}_2}$ [GeV]
3000	200	2691	970.50	2690	3007

**NOT favourable to reconstruct charged slepton masses**

Z_{SSM}' *model*

✦ Z' couplings to ferm/sferm as Z SM

✦ Detection SUSY particles depends only on $m_{Z'}$ and SUSY parameters

✦ No D-term, NO parameter θ

✦ **No minimal lepton mass**

✦ $Z' \to \tilde{\ell}^+ \tilde{\ell}^-$ ~ 2%

✦ $Z' \to \tilde{\nu}_2 \tilde{\nu}_2^*$ ~ 3%

✦ $Z' \to \tilde{\chi}^0 \tilde{\chi}^0$ ~ 32%

✦ $Z' \to \tilde{\chi}^+ \tilde{\chi}^-$ ~ 16%

$m_{\tilde{\chi}_1^\pm} = 184.00$ GeV, $m_{\tilde{\chi}_2^\pm} = 330.0$ GeV.

$m_{\tilde{\chi}_1^0} = 129.20$ GeV, $m_{\tilde{\chi}_2^0} = 178.5$ GeV, $m_{\tilde{\chi}_3^0} = 232.30$ GeV, $m_{\tilde{\chi}_4^0} = 333.30$ GeV. $m_{\tilde{\ell}} = 200$ GeV

Cross Sections
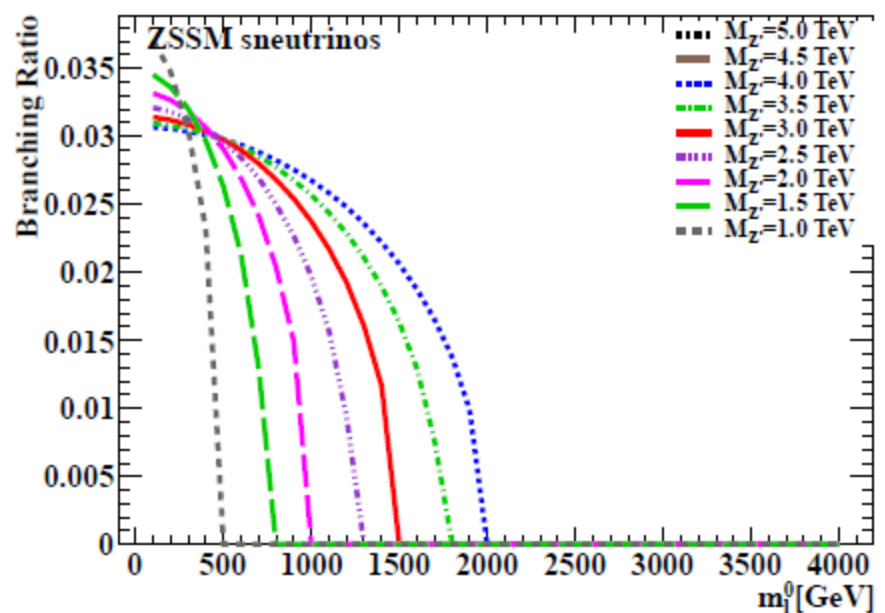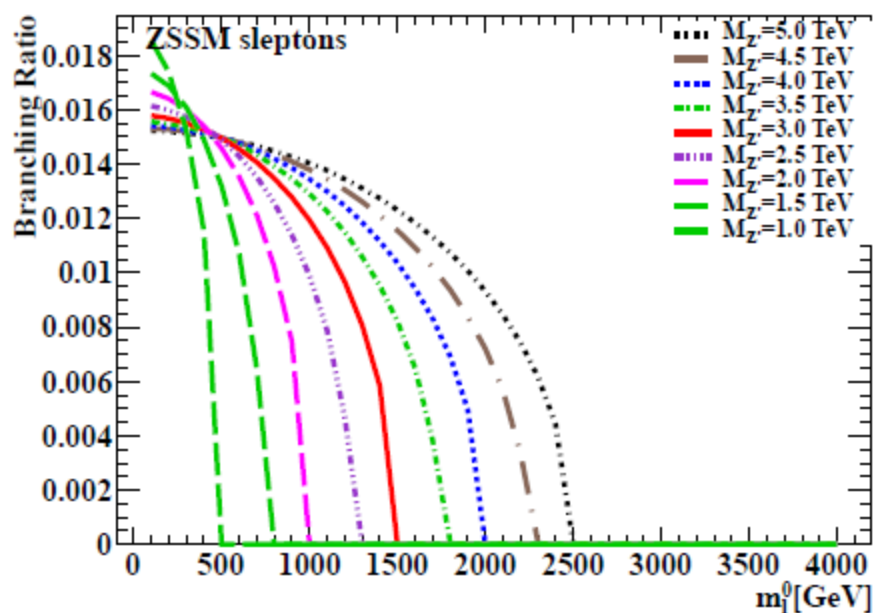
✦ σ Leading-Order, Parton Distribution Function LO CTEQ6L,changing PDF neglegible impact on σ.

✦ Parton-level process analogous Z : $q\bar{q} \rightarrow Z'$

✦ Production **depending** on U(1)' mixing: **θ, Z'mass** not on **SUSY scenario**
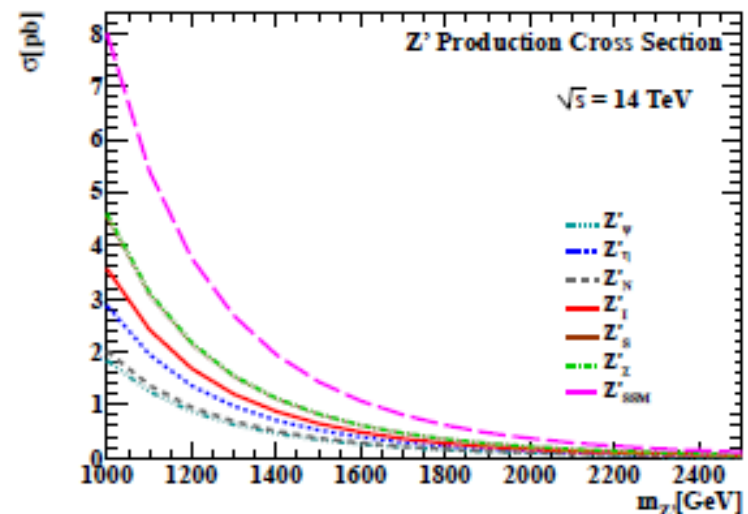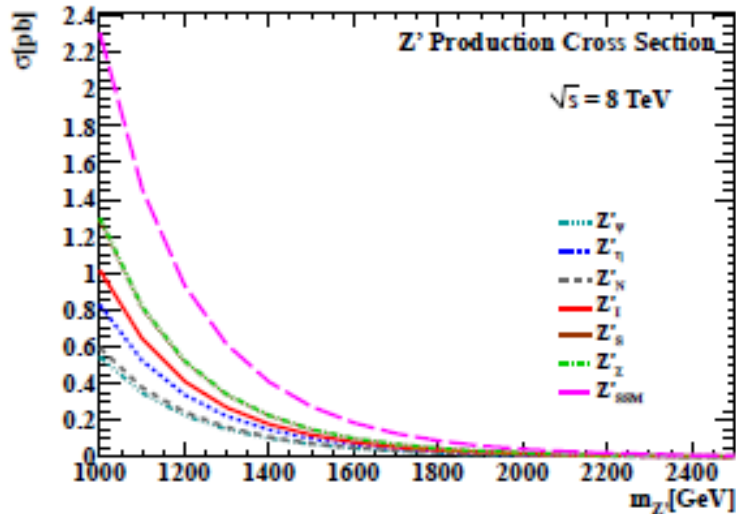
•Z_{SSM} highest
•Z_{ψ} lowest

What do we expect?

√s=14TeV
L_{int}=100 fb^{-1}

√s=8 TeV
L_{int} =20 fb^{-1}
(run 2012)

$M_{Z', TeV}$	Chan	Zη	Zψ	ZN	ZI	ZS	ZSSM
1.5	N_{casc}	13650	10241	9979	8507	8242	775715
1.5	N_{slep}	____	622	414	____	65	24774
2.0	N_{casc}	2344	2784	2705	2230	2146	19570
2.0	N_{slep}	____	162	104	____	16	606
1.5	N_{casc}	523	599	400	317	30	2968
1.5	N_{slep}	____	36	17	____	0	95
2.0	N_{casc}	55	73	70	50	46	462
2.0	N_{slep}	____	4	3	____	0	14

N_{casc}= sneutrinos+neutralinos+charginos, N_{slep}=charged leptons decays

NO acceptance neither reconstruction cuts

Conclusions

✦ **Z' phenomenology in supersymmetry: production and decays** with U(1') gauge symmetry (and SSM) and Supersimmetry(MSSM)

✦ U(1')+ MSSM:1 extra Higgs boson + 2 neutralinos, D-term contribution to sfermion masses(may be large and negative).

✦ Studies of mass spectra, br, σ dependence : θ, μ, tanβ ....

✦ **Br MSSM 10-30% for U(1)' group and up 60% for SSM.**

✦ σ at $\sqrt{s}_{LHC}= 7,\ 8,\ 14$ TeV

✦ Up to ~ 10^5 supersymmetric events with slepton and gauginos in the high luminosity phase of LHC, especcially SSM

✦ Perspectives: implementation of U(1)'/MSSM models in HERWIG: parton shower Z'width effects, hadronization, acceptance and detector simulation is planned.