New results on SUSY combinations from the LEPSUSY Working Group

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on behalf of the LEPSUSY WG

CERN EP seminar, 13/06/2002

Plan:

1. **Introduction**

2. **Updated results**

   2.1 Sfermion searches: sleptons, squarks

   2.2 LSP mass limit

3. **New results**

   3.1 GMSB sleptons

   3.2 Acoplanar and single photon(s)

   3.3 Charginos at low ΔM

   3.4 RPV sleptons and sneutrinos

4. **Conclusions and prospects**

1. Introduction

People: **ALEPH:** B.C. + Gerri Ganis

DELPHI: Stefan Ask + Luc Pape (convenor)

L3: Hannelies Nowak + Sylvie Rosier

OPAL: Paolo Giacomelli + Christoph Rembser

+ F. Cerutti, R. McPherson, S. Braibant, S. Costantini … many others …

thanks !

Task: To combine LEP results of all relevant SUSY searches

- 1. Compatibility candidates vs SM expectation:
  look for excess (SUSY signal) or deficit (bad bg description)
- 2. Upper limit on the production cross section*BR
- 3. Derive constraints in the space of a given model parameters,
  i.e. mass

Data samples per experiment:

year	1997	1998	1999				2000		
sqrt(s) (GeV)	183	189	192	196	200	202	205.2	206.6	208
int. Lumi (pb-1)	55	170	28	80	80	40	75	122	9

Total luminosity (from 183 to 209 GeV) ~ 2.6 fb-1 !

Exchanged files:

- numbers of candidate events
- numbers of bkg substr. + bkg unsubstr.
- efficiencies for the signal + errors

```
As a function of:
  a) the SUSY part. mass
  b) the LSP mass
```

Combination method:

- 9 energy files, 4 experiments …

→ Confidence levels computed using the Likelihood Ratio test-statistic in a “modified” frequentist approach

-1. **Likelihood Ratio estimator** $X(s) = \frac{L(s+b)}{L(b)}$ to compare

background only (b) hypothesis and the signal + background (s+b) hypoth.

L ≡ likelihood of the observation = Poisson probabilities
X>1 for the signal configurations, X<1 for the bg only configurations

$$X_{tot} = \prod_{i=1}^{Nchan} \prod_{j=1}^{n_i} X_{ij}$$

$$\mathrm{Ln}\, X = -s_{tot} + \sum_{j=1}^{Nchan} n_j \,\mathrm{Ln}\left(1 + \frac{s_j}{b_j}\right) = -s_{tot} + \sum_{j=1}^{Nchan} n_j\, \omega_j$$

weighted events

-2. **Computation of the Confidence Level**:

$$CL_{(s)} = \frac{CL_{(s+b)}}{CL_{(b)}} = \frac{P_{(s+b)}(X \le X_{obs})}{P_{(b)}(X \le X_{obs})}$$

If CL(s) < 5% then the signal is excluded at 95% CL

CL(no Excess) = $P_{(b)}$ (X ≥ Xobs) → sensitive to excesses
CL(no Deficit) = $P_{(b)}$ (X ≤ Xobs) → sensitive to deficit

Results + info : + refs. `http://www.cern.ch/LEPSUSY/`

Minimal particle content

- Gauge / Gaugino Sector

Standard Bosons	Supersymmetric Partners
$W^{\pm}$ $H^{\pm}$	Charginos $\chi_1^{\pm}$ $\chi_2^{\pm}$
g Z h H A	Neutralinos χ_1^0 χ_2^0 χ_3^0 χ_4^0
g_i	Gluinos $\tilde{g}_i$

[Two Higgs doublets] [All fermions]

And also …

Graviton G	Gravitino $\tilde{G}$

- Particle / Sparticle Sector

Standard Particles	Supersymmetric Partners
Leptons ℓ	Sleptons $\tilde{\ell}_{R,L}$
Neutrinos ν_ℓ	Sneutrinos $\tilde{\nu}_\ell$
Quarks q	Squarks $\tilde{q}_{R,L}$

[All scalars]

Models and Parameters

1. The Minimal Supersymmetric extension of the Standard Model (MSSM):

- m_A : pseudoscalar Higgs boson mass
- $\tan\beta$: ratio of vacuum expectation values of the two Higgs doublets
- μ : Higgs mixing parameter
- M_1, M_2, M_3 : Gaugino ~~SUSY~~ mass terms (χ^0, $\chi^\pm$, $\tilde{g}$)
- $m_{\tilde{\ell}_R}, m_{\tilde{\ell}_L}, m_{\tilde{\nu}_L}, m_{\tilde{q}_R}, m_{\tilde{q}_L}$: "Sfermion" ~~SUSY~~ mass terms
- A_t, A_b, A_τ, ...: stop/sbottom/stau/… mixing parameters

$\geq$ 100 parameters
Not too predictive

2. The constrained MSSM (C-MSSM):

Constrain the gauginos and sfermions mass parameters with GUT universality relations:

- Unify M_1, M_2, M_3 to a universal gaugino mass $m_{1/2}$ at the GUT scale

$$M_3 : M_2 : M_1 : m_{1/2} = \alpha_3 : \alpha_2 : \alpha_1 : \alpha_{GUT}$$

$$M_1 \approx 0.5 m_{1/2};\ M_2 \approx 0.8 m_{1/2};\ M_3 \approx 3.5 m_{1/2}.$$

χ^0 $\chi^\pm$ $\tilde{g}$ (at the EW scale)

- Unify all sfermion mass parameters to a universal scalar mass m_0

$$m^2_{\tilde{\ell}_R} = m_0^2 + 0.15 m^2_{1/2} + \cdots$$

$$m^2_{\tilde{\ell}_L,\tilde{\nu}} = m_0^2 + 0.5 m^2_{1/2} + \cdots$$

$$m^2_{\tilde{q}_{R,L}} = m_0^2 + 6 m^2_{1/2} + \cdots$$

Scalar and gaugino masses related

3. Minimal SuperGravity (mSUGRA):

- Unify Higgs and scalar sector at the GUT scale

$$\Rightarrow \ \mathrm{m}_{\mathrm{A}} \ \text{ fixed by } \left(m_0, \tan\beta, \ldots\right)$$

- Unify all trilinear couplings at the GUT scale

$$\Rightarrow \text{ all } A_{\mathrm{i}}\text{'s unified to } A_0$$

- Break radiatively the ElectroWeak Symmetry

$$\Rightarrow |\mu| \text{ fixed by } (\mathrm{m}_0, \mathrm{m}_{1/2}, \tan\beta, \ldots)$$

- Only FIVE parameters left

$$m_0, \ m_{1/2}, \ \tan\beta, \ A_0, \ \mathrm{sign}(\mu)$$

Very predictive
Realized in Nature?

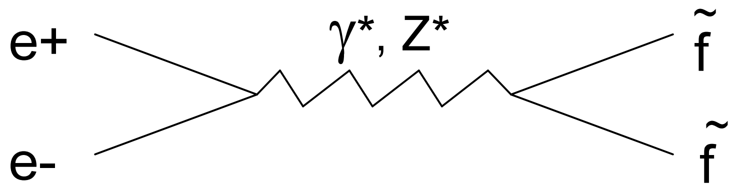
Updated results

2.1 Sfermion searches

2.2 LSP mass limit

2.1 Sfermion searches

- **Production** :



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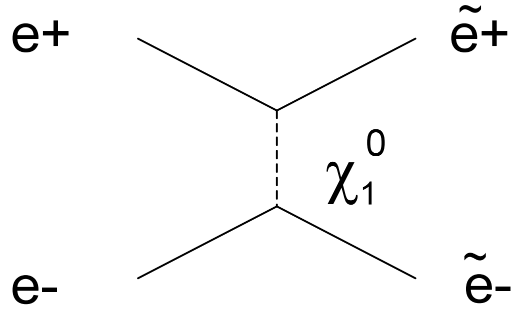
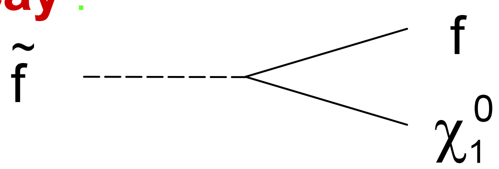


s-channel $\rightarrow$ **σ ($M_{\tilde{f}}$, s)**

t-channel $\rightarrow$ **σ ($M_{\tilde{f}}$, s, μ, tan β)**

- **Decay** :



$\rightarrow$ **events with missing energy**

$\rightarrow$ BR **($M_{\chi_1^0}$, μ, tan β)** ~100% except very low $m_{\chi_i^0}$

- **Decay kine. (visible energy in the detector) depends on:**

$$\Delta M = m_{\tilde{f}} - m_{\chi_1^0}$$

$\rightarrow$ **Analysis for different regions of ΔM**

- **Main backgrounds: WW at high ΔM, and $\gamma\gamma$ at low ΔM**

Slepton Combination

Combination: G. Ganis

A,D,L = final files
O = prel

Candidates and bkg

$ee \to \tilde{e}\tilde{e}$ $\tilde{e} \to e\,\chi_1^0$

$ee \to \tilde{\mu}\tilde{\mu}$ $\tilde{\mu} \to \mu\,\chi_1^0$

$ee \to \tilde{\tau}\tilde{\tau}$ $\tilde{\tau} \to \tau\,\chi_1^0$

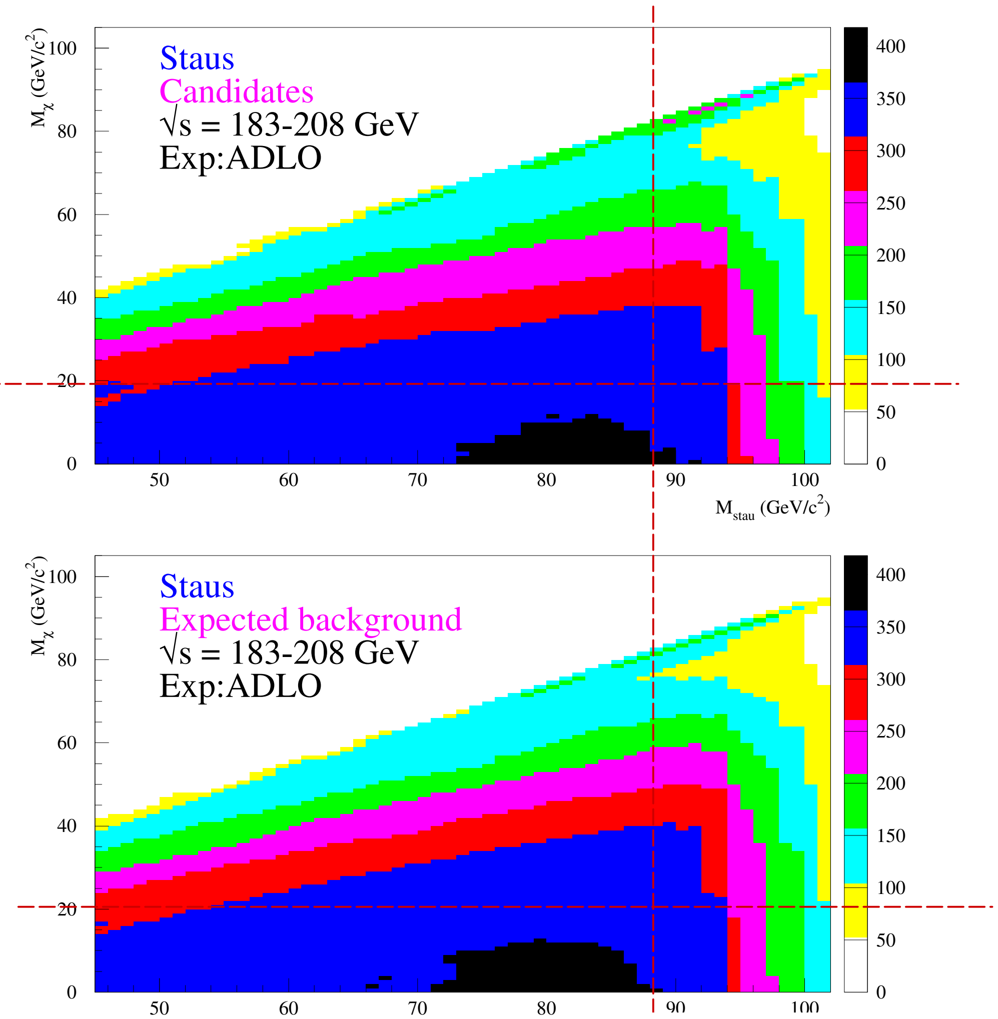
acoplanar leptons

For point (87, 20) :

N(cand) = 343

N(bg) = 349.9

$M(\chi^0)$



$M(\tilde{\tau}_R)$

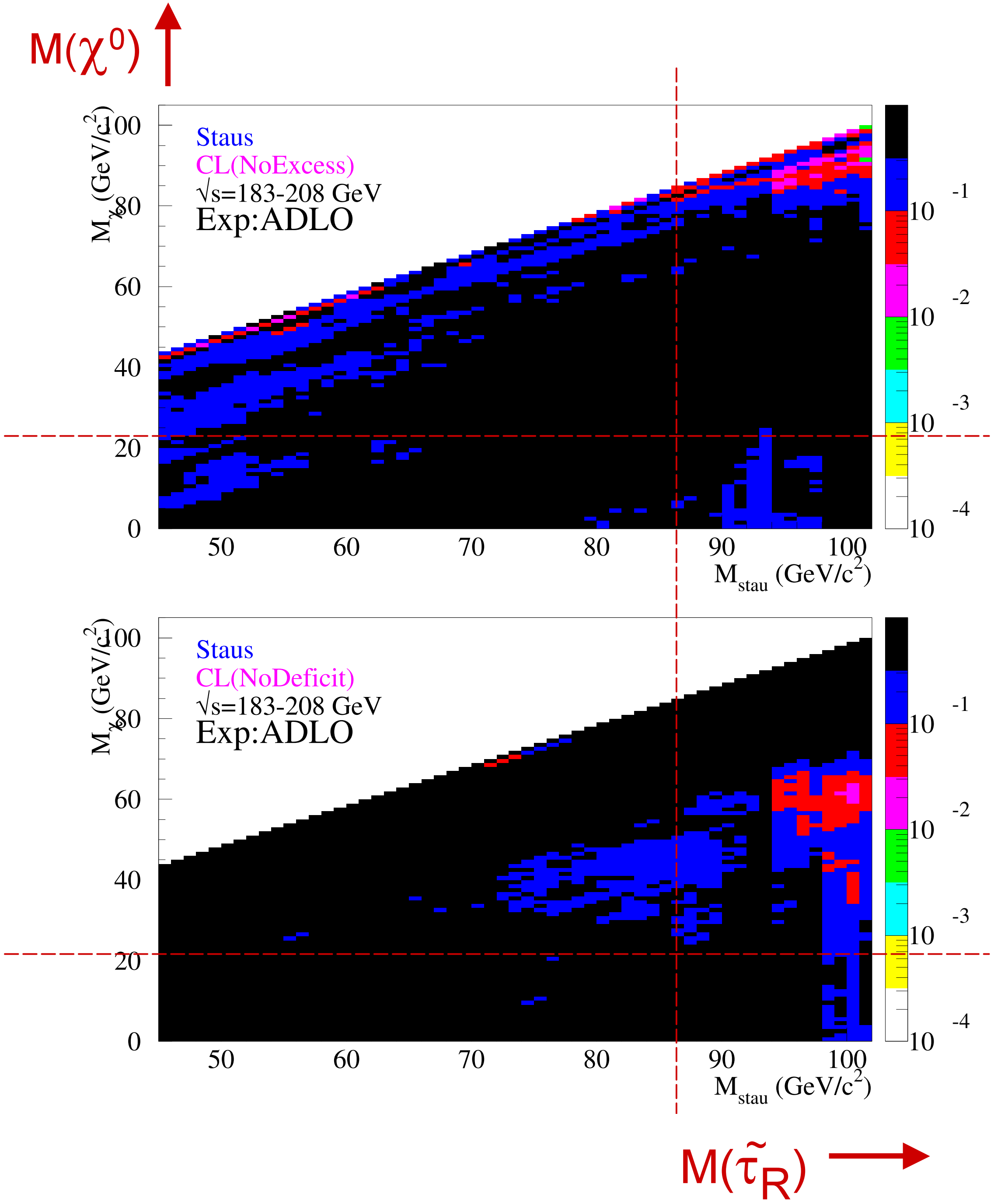
A event populates a whole **region: kine. compatible**

Confidence levels

For point (87, 20) :

CL(No Excess) = 0.604

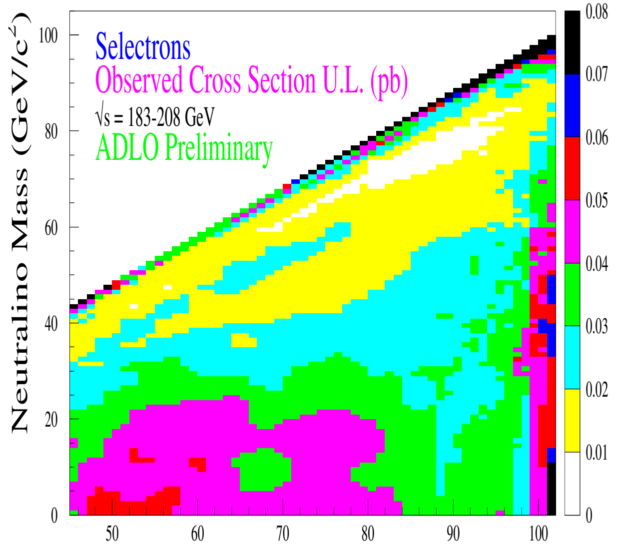
CL(No Deficit) = 0.396



Cross section upper limits

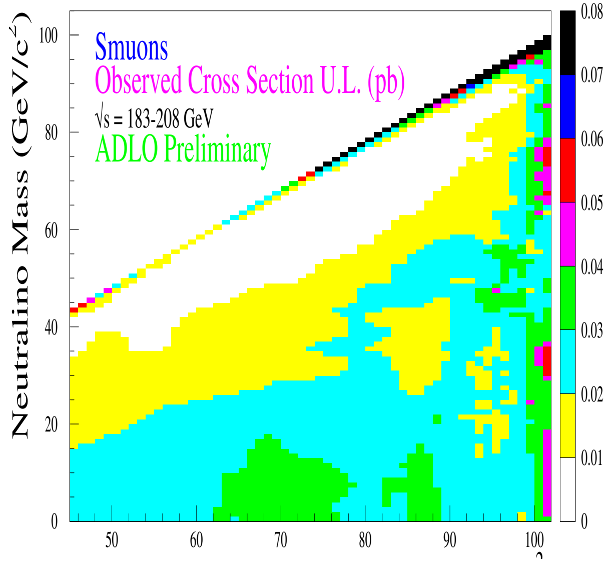
assuming BR ($\tilde{l} \to l\, \chi_1^0$) = 1, minimal model dependent

$\tilde{e}$



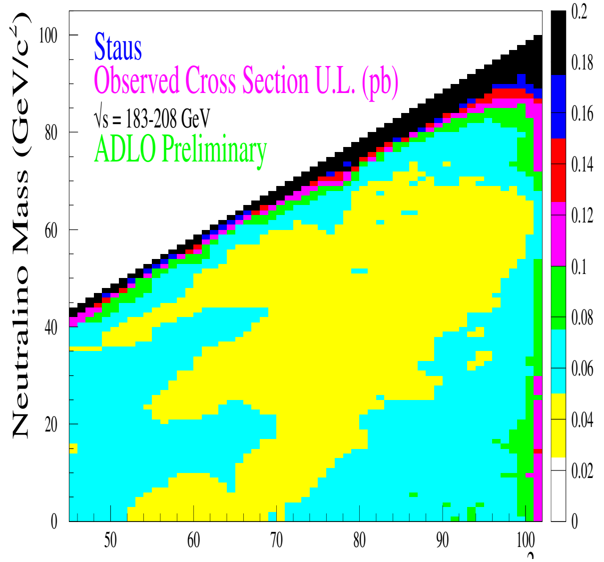
σ <~ 0.03 pb

$\tilde{\mu}$

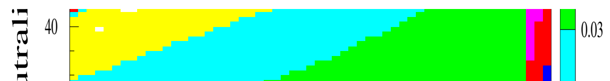


σ <~ 0.03 pb

$\tilde{\tau}$



σ <~ 0.06 pb



Mass limits

CMSSM:

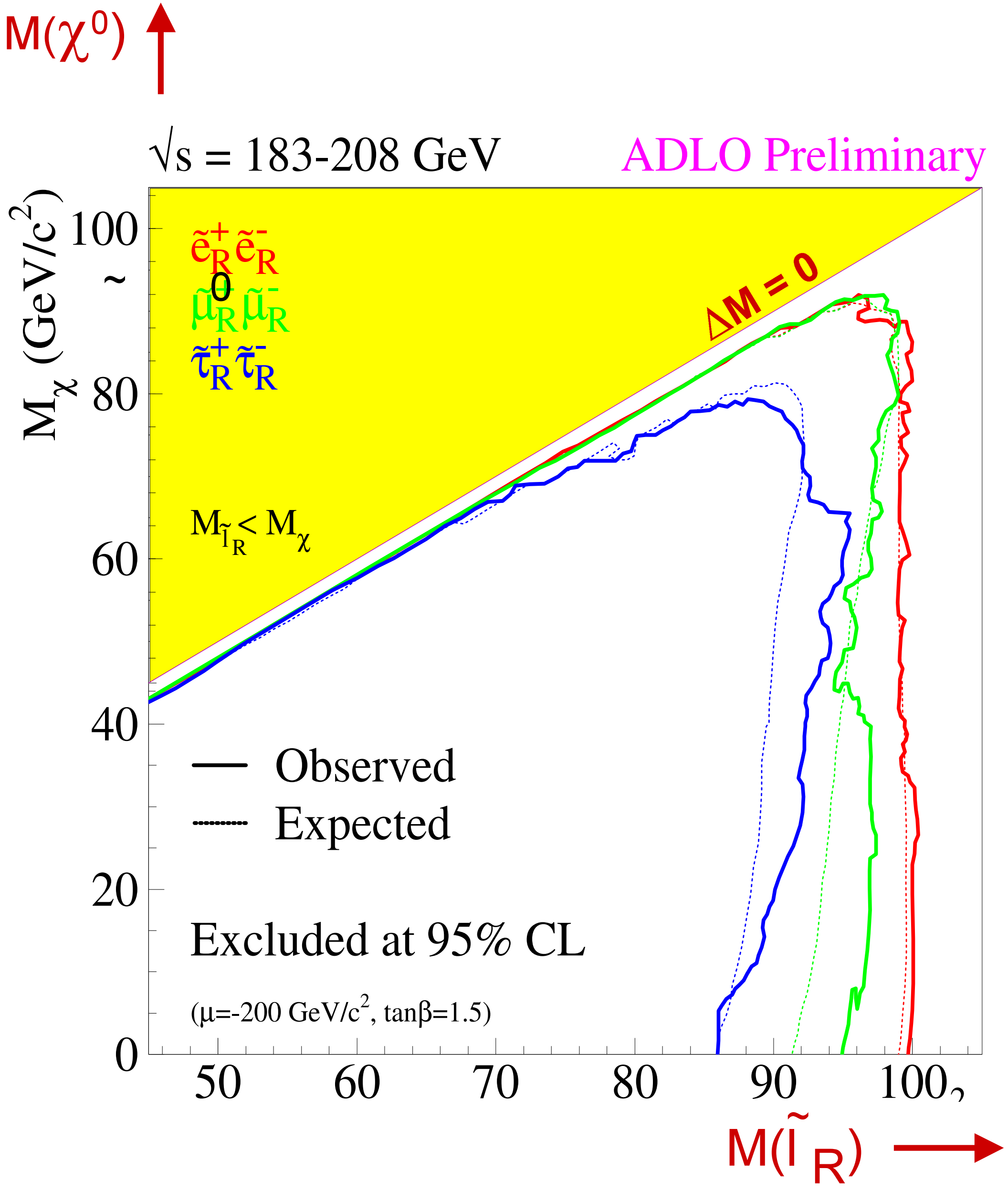
μ = -200 GeV, tanβ = 1.5:

to compute $\sigma(\tilde{e}\tilde{e})$ and BR ($\tilde{l} \to l\chi^0$)

For $M\chi^0 = 0$:

$m_{\tilde{e}R}$	99.6	(99.2)	GeV
$m_{\tilde{\mu}R}$	94.9	(91.4)	GeV
$m_{\tilde{\tau}R}$	85.9	(85.8)	GeV

- limit: → effect of efficiency, σ



$\sigma(\tilde{\mu}\tilde{\mu}) = \sigma(\tilde{\tau}\tilde{\tau})$ and $\sigma(LL) > \sigma(RR)$

Squark Combination

Combination: B. C.

Mixing:

s-channel production: $\rightarrow \sigma (M_{\tilde{q}}, s, + \theta_q)$

$\tilde{t}$ and $\tilde{b}$ may be light due to possible large mixing:

$$\tilde{t}_1 = \tilde{t}_L \cos \theta_q + \tilde{t}_R \sin \theta_q$$

for $\theta_t \sim 56^o$, $\theta_b \sim 63^o$ $\rightarrow$ decoupling from Z $\rightarrow \sigma$ min.

Candidates and bkg

$e\,e \rightarrow \tilde{t}\,\tilde{t}$

A,D,L = final files

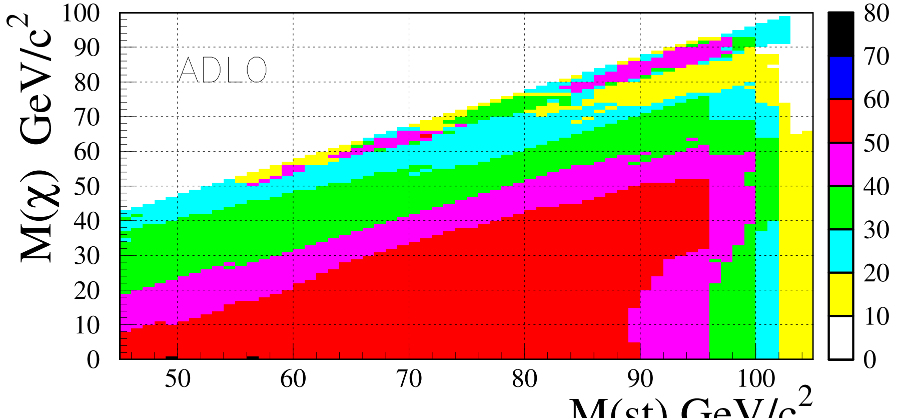
O = prel

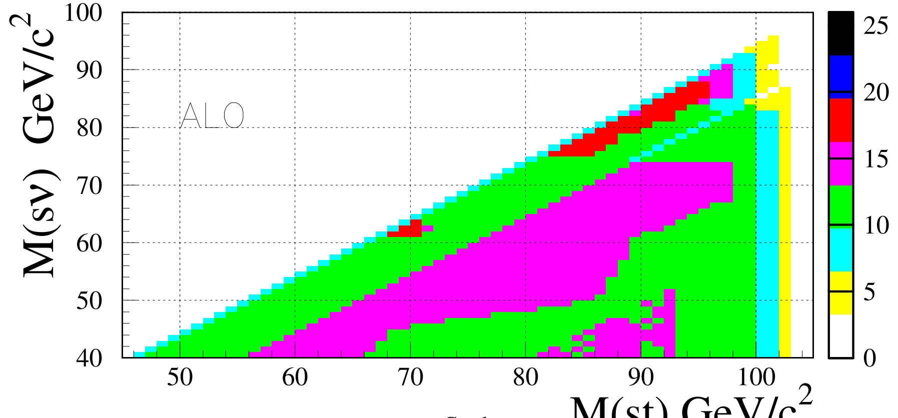
If $m_{\tilde{t}}$ « m_t ,m_{χ^+},$m_{\tilde{l}}$: $\tilde{t} \rightarrow c\,\chi_1^0$

acoplanar jets

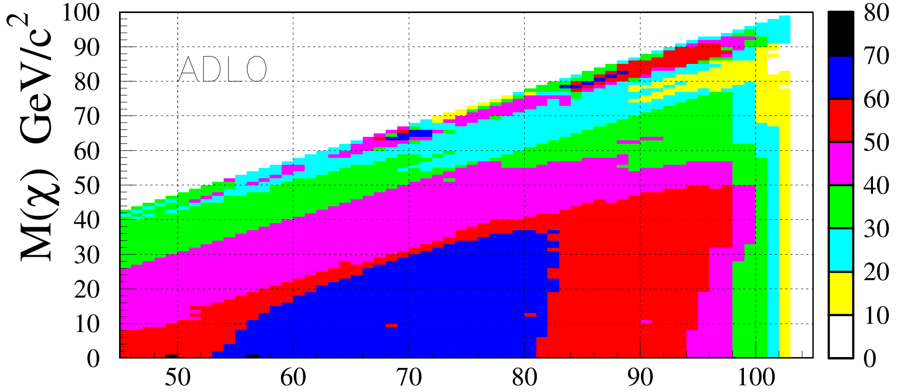
If light $\tilde{\nu}$: $\tilde{t} \rightarrow b\,l\,\tilde{\nu}$

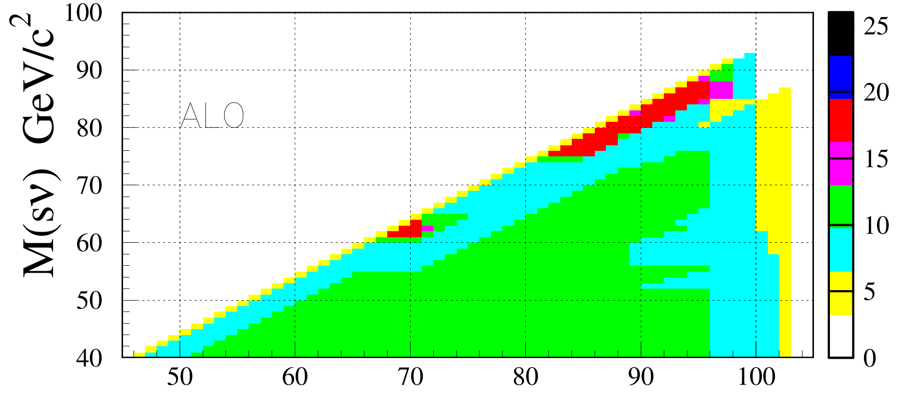
2 b-jets + 2 leptons + Emiss





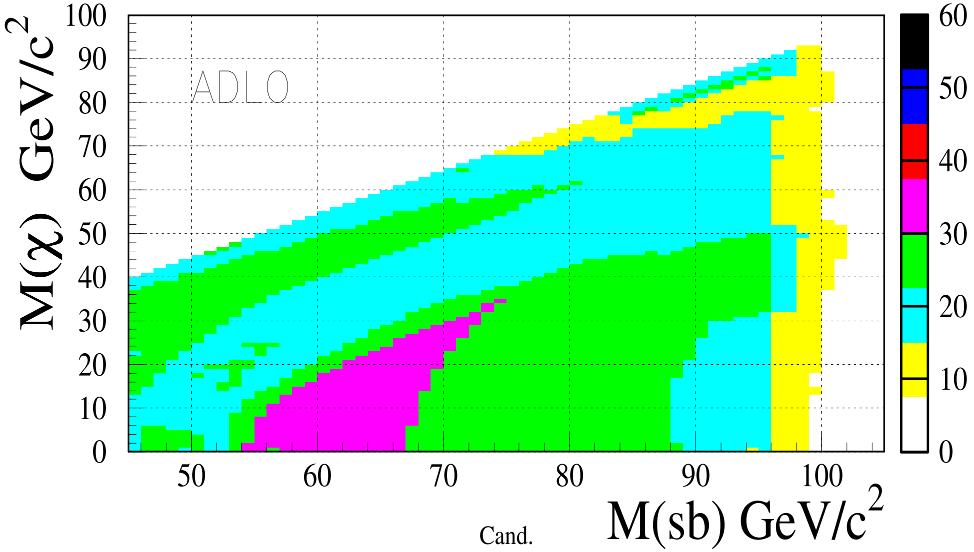
Cand. Cand.

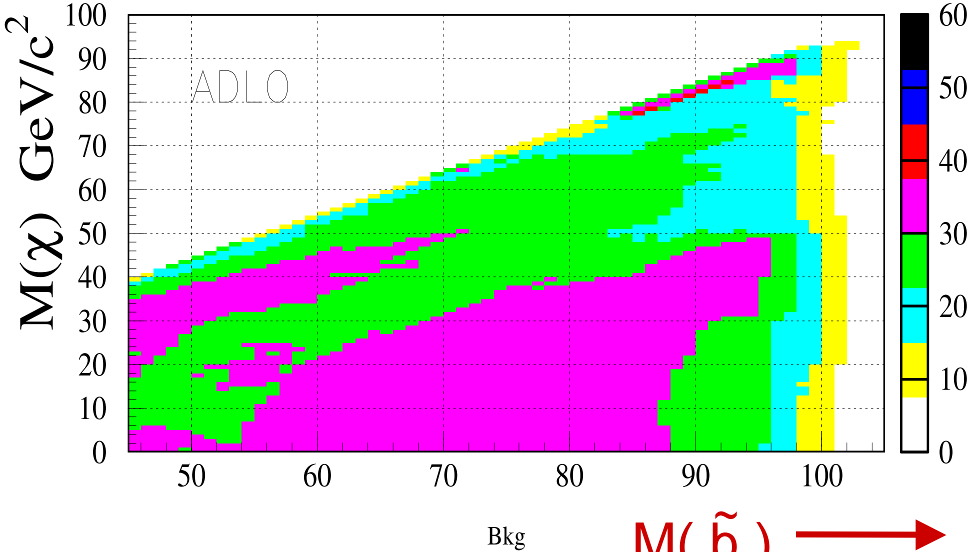




Bkg $M(\tilde{t}) \rightarrow$ Bkg $M(\tilde{t}) \rightarrow$

$M(\chi^0)$ ↑





$M(\tilde{b})$ →

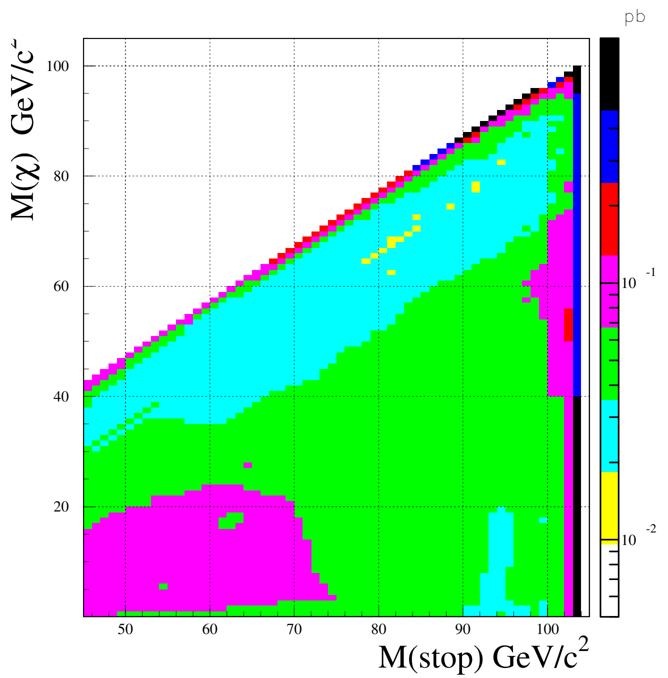
$e\,e \rightarrow \tilde{b}\,\tilde{b}$ $\tilde{b} \rightarrow b\,\chi_1^0$

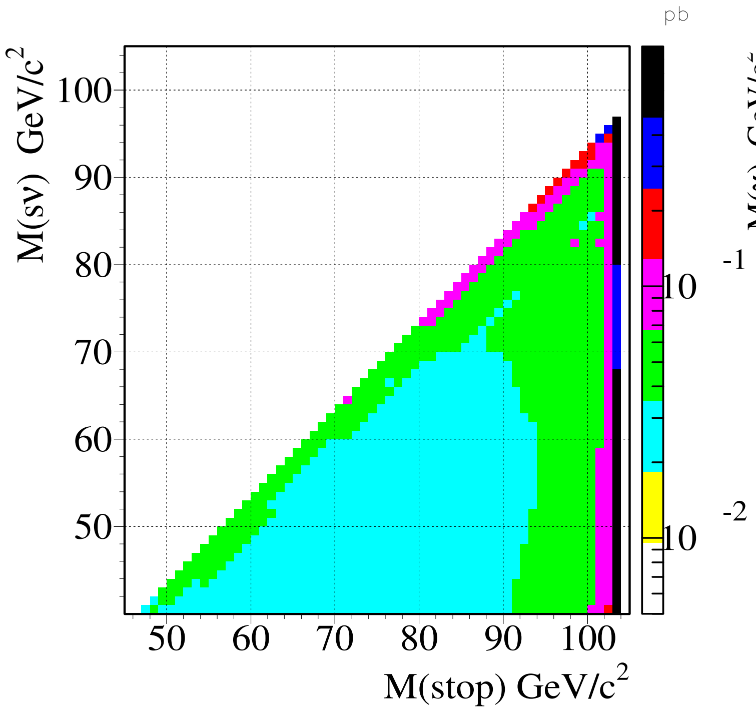
acoplanar b-jets

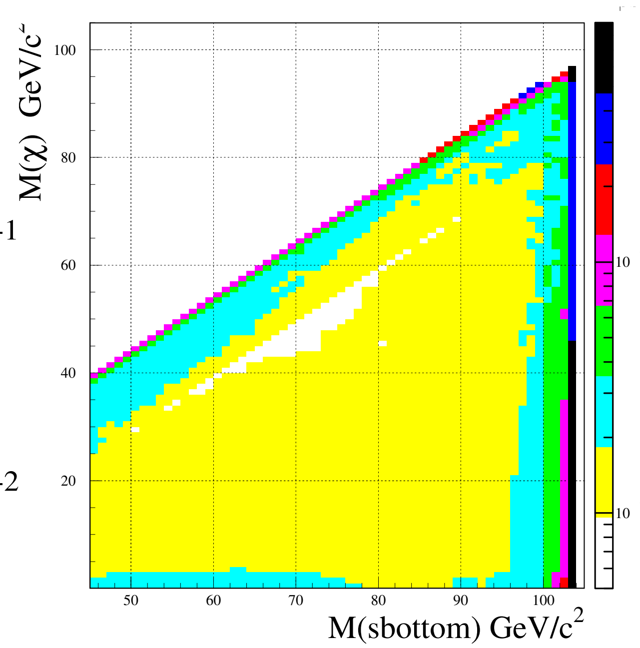
Cross section upper limits

assuming BR = 1, minimal model dependent

$\tilde{t} \to c\,\chi^0_1$	$\tilde{t} \to b\,l\,\tilde{\nu}$	$\tilde{b} \to b\,\chi^0_1$



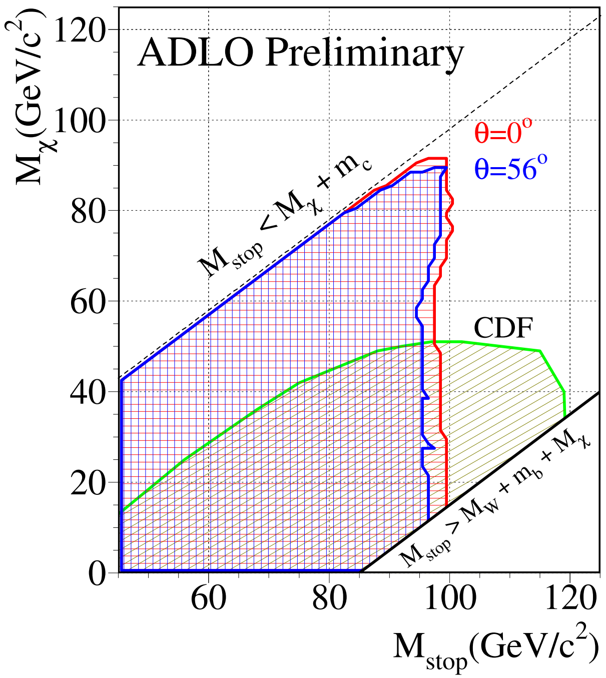


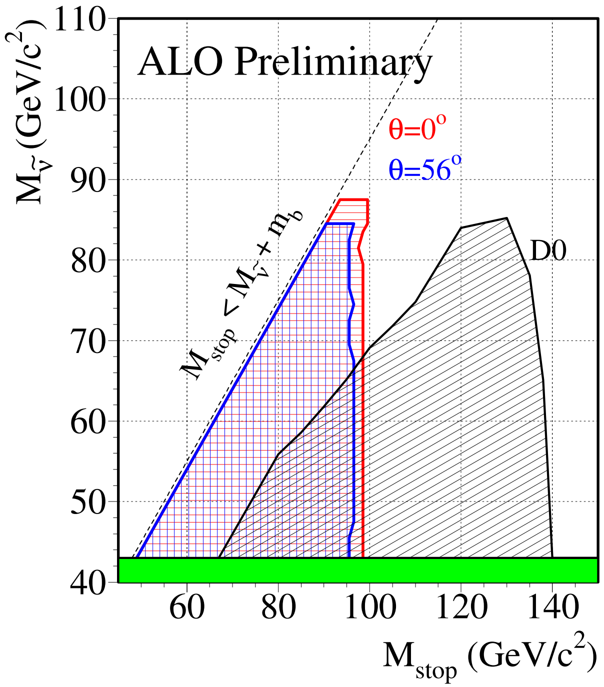


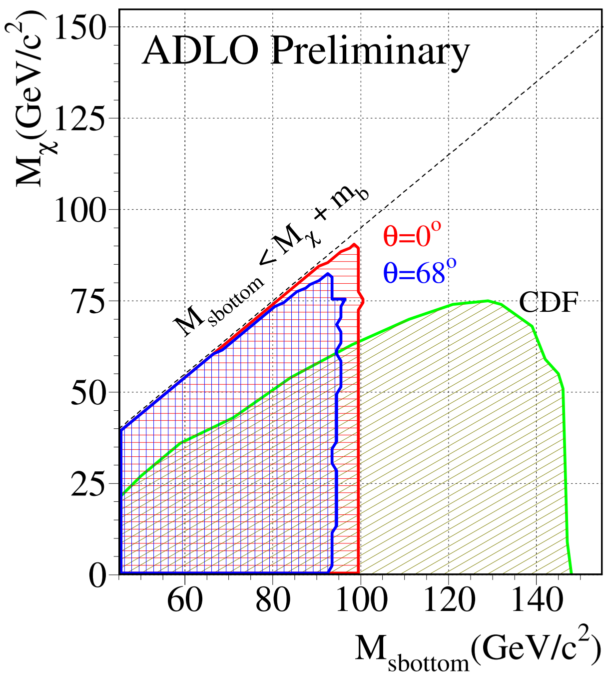
σ <~ 0.04 pb σ <~ 0.04 pb σ <~ 0.03 pb

Mass limits

$\tilde{t} \to c\, \chi_1^0$ | $\tilde{t} \to b\, l\, \tilde{\nu}$ | $\tilde{b} \to b\, \chi_1^0$







$M\chi^0$ = 20 GeV	$\tilde{t} \to c\, \chi_1$	$\tilde{t} \to b\, l\, \tilde{\nu}$	$\tilde{b} \to b\, \chi_1$
θ = 0 ($\tilde{q}_L$)	100	99	99
mixing (σ min.)	98	96	95

Degenerate squarks

$e\,e \rightarrow \tilde{q}\,\tilde{q}$ $\tilde{q} \rightarrow q\,\chi_1^0$

acoplanar jets

- **Signal:** $\tilde{q}_L + \tilde{q}_R$ acccessible

$\rightarrow \sigma(5\text{-}\tilde{q}) = 3^*(\sigma_{\tilde{b}_L} + \sigma_{\tilde{b}_R}) + 2^*(\sigma_{\tilde{t}_L} + \sigma_{\tilde{t}_R})$

$\rightarrow \sigma$ is high

- **to compare to Tevatron:**

$(m_{\tilde{q}}, m_{\chi^0}) \rightarrow (m_{\tilde{q}}, m_{\tilde{g}})$

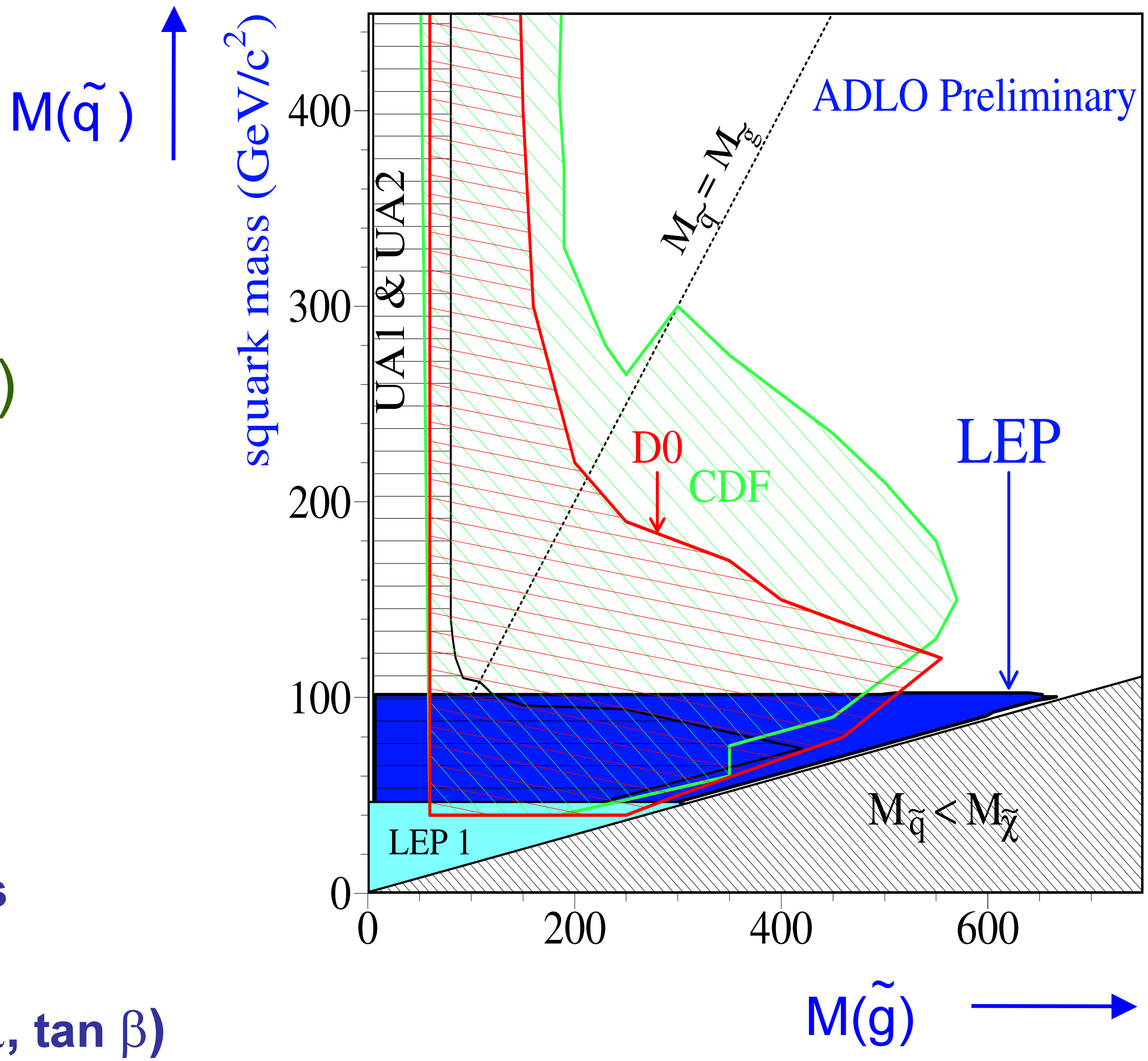
Assume:

GUT relation for gaugino mass

tan β = 4 and μ = -400 GeV

$m_{\tilde{g}}$ **=** $M_3 \sim 6.8\, M_1$, $m_{\chi^0} = f(M_1, \mu, \tan\beta)$

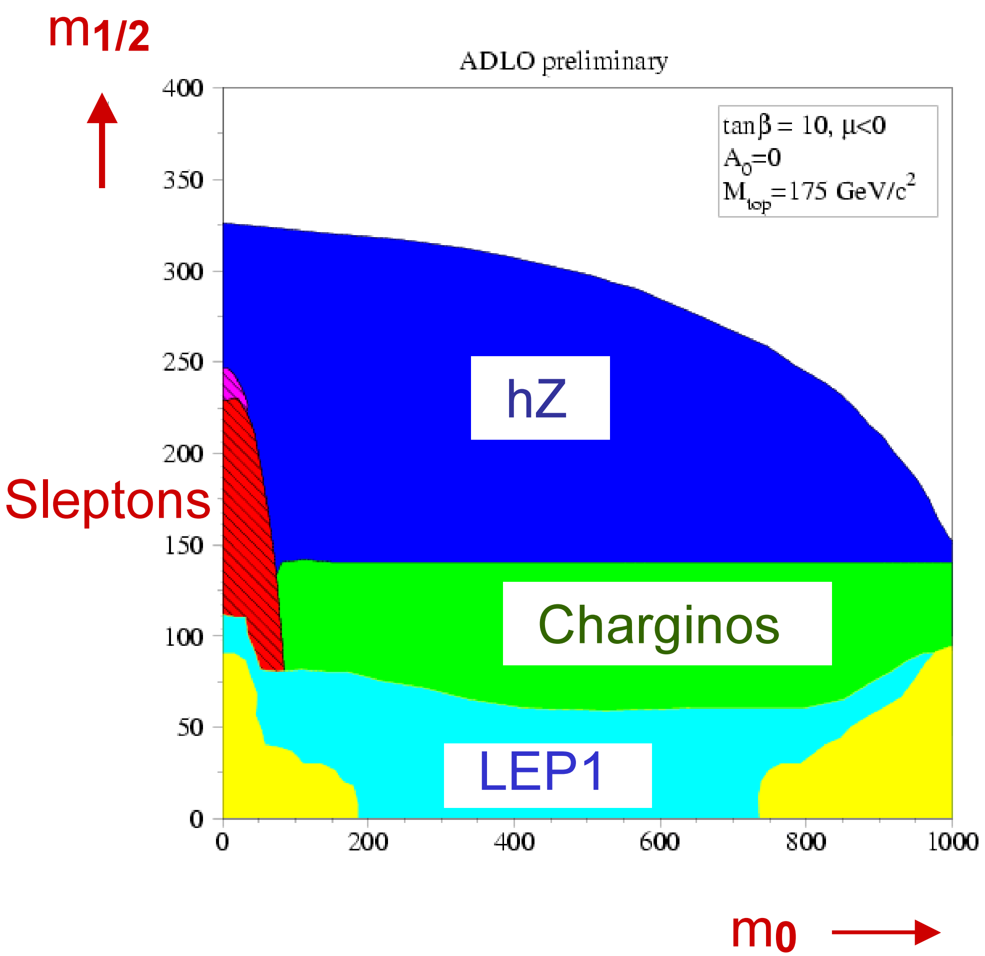
Limits on degenerate $\tilde{q}$: degenerate mass for L- and R- handed $\tilde{u},\tilde{d},\tilde{c},\tilde{s},\tilde{b}$

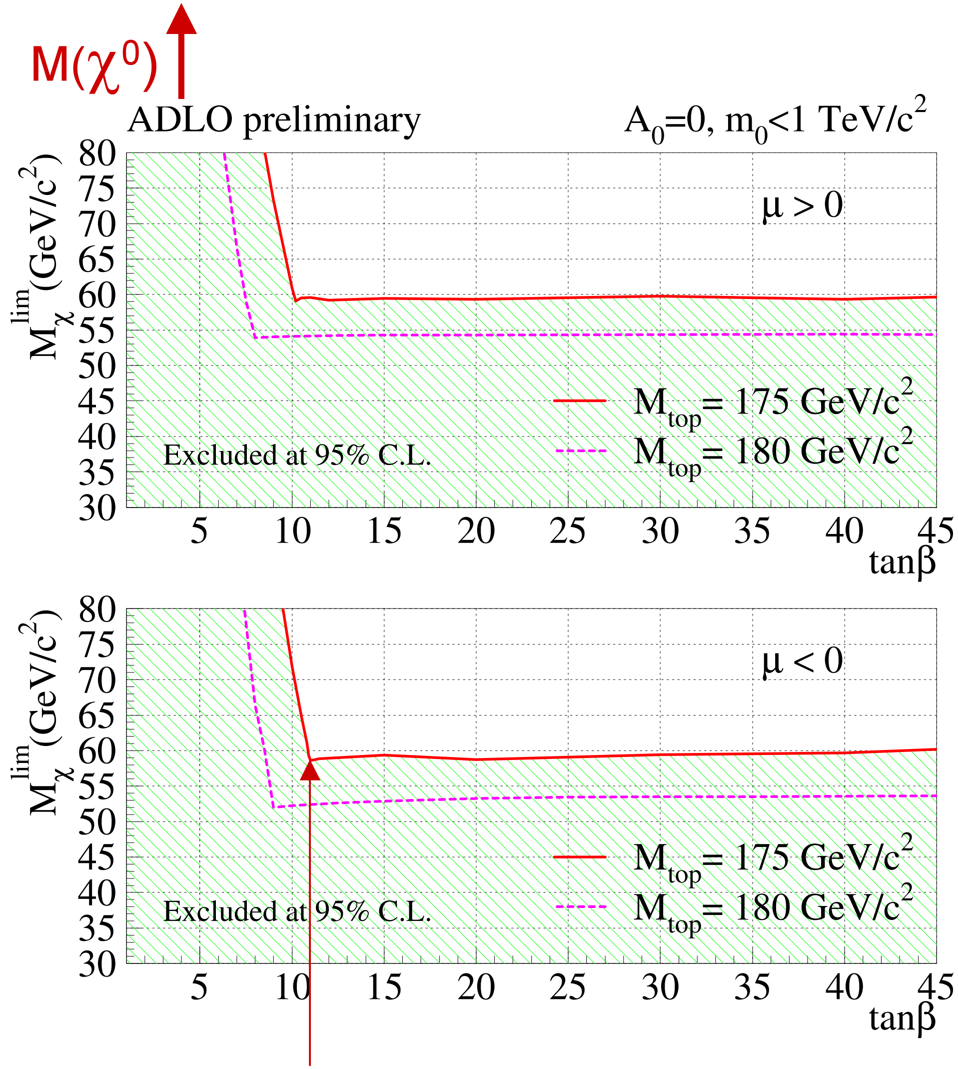


2.1 LSP mass limit

Combination: G. Ganis

Scan on m_0, $m_{1/2}$, $\tan\beta$, sign(μ), $A_0=0$





$m(\chi_1^0) > 59$ GeV $\tan\beta$

3. New results

3.1 Sleptons with lifetime

3.2 Acoplanar and single photon(s)

3.3 Charginos at low ΔM

3.4 RPV sleptons and sneutrinos

3.1 Sleptons with lifetime

Combination: C. Rembser

- Theoretical framework: GMSB

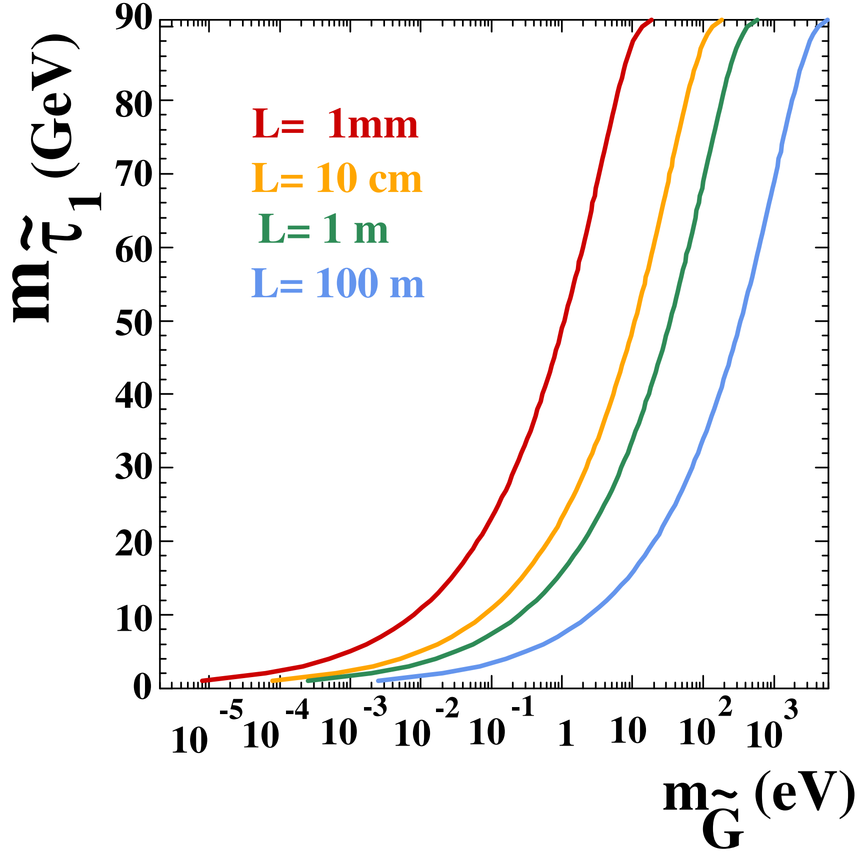
$ee \to \tilde{e}\tilde{e},\ \tilde{\mu}\tilde{\mu},\ \tilde{\tau}\tilde{\tau} \qquad \tilde{l} \to l\,\tilde{G}$

$\tilde{G}$ is the LSP, $m_{\tilde{G}} < O(\mathrm{KeV})$

$\tilde{\tau}$ NLSP scenario or $\tilde{l}$ co-NLSP

$\tilde{l} \to l\,\tilde{G}$, decay length of the NLSP depends on the SUSY breaking scale $\sqrt{F}$ ($\propto m_{\tilde{G}}$) and NLSP mass:

$$c\tau_{NLSP} \propto \left(\frac{100\ \mathrm{GeV}}{m_{NLSP}}\right)^5 \left(\frac{\sqrt{F}}{100\ \mathrm{TeV}}\right)^4 \mathrm{cm}$$



→ $\tilde{l}$ can have arbitrary lifetime

→ need to explore many topologies

→ combine: - zero lifetime: acoplanar leptons
- medium lifetime: large IP
- medium lifetime: kink
- long lifetime: heavy stable sleptons

Data are reported in a grid of slepton mass and slepton lifetime ($-12 < \log(\tau) < -6$).

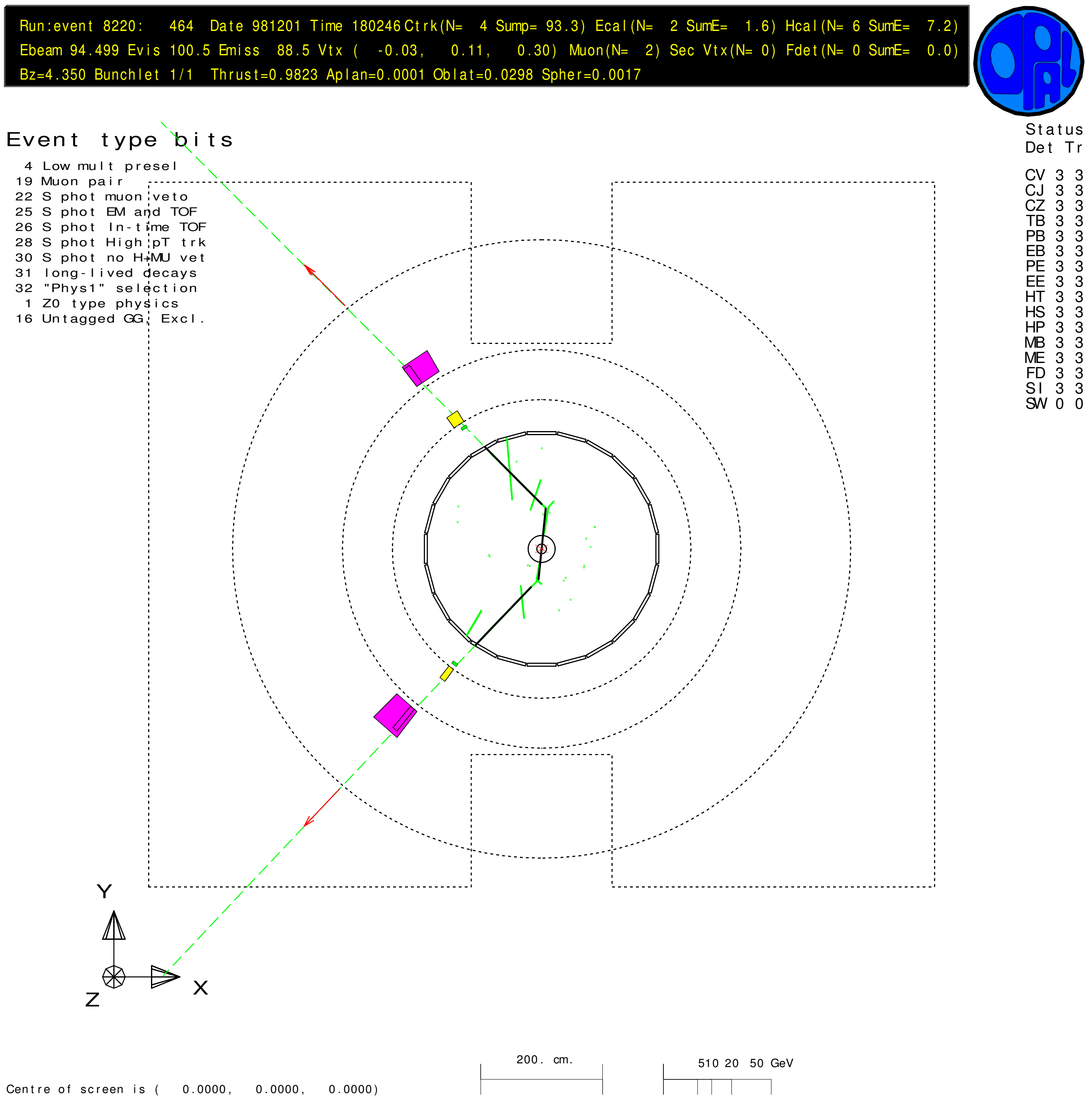
A,D = final files
O,L = prel.

Simulated event:

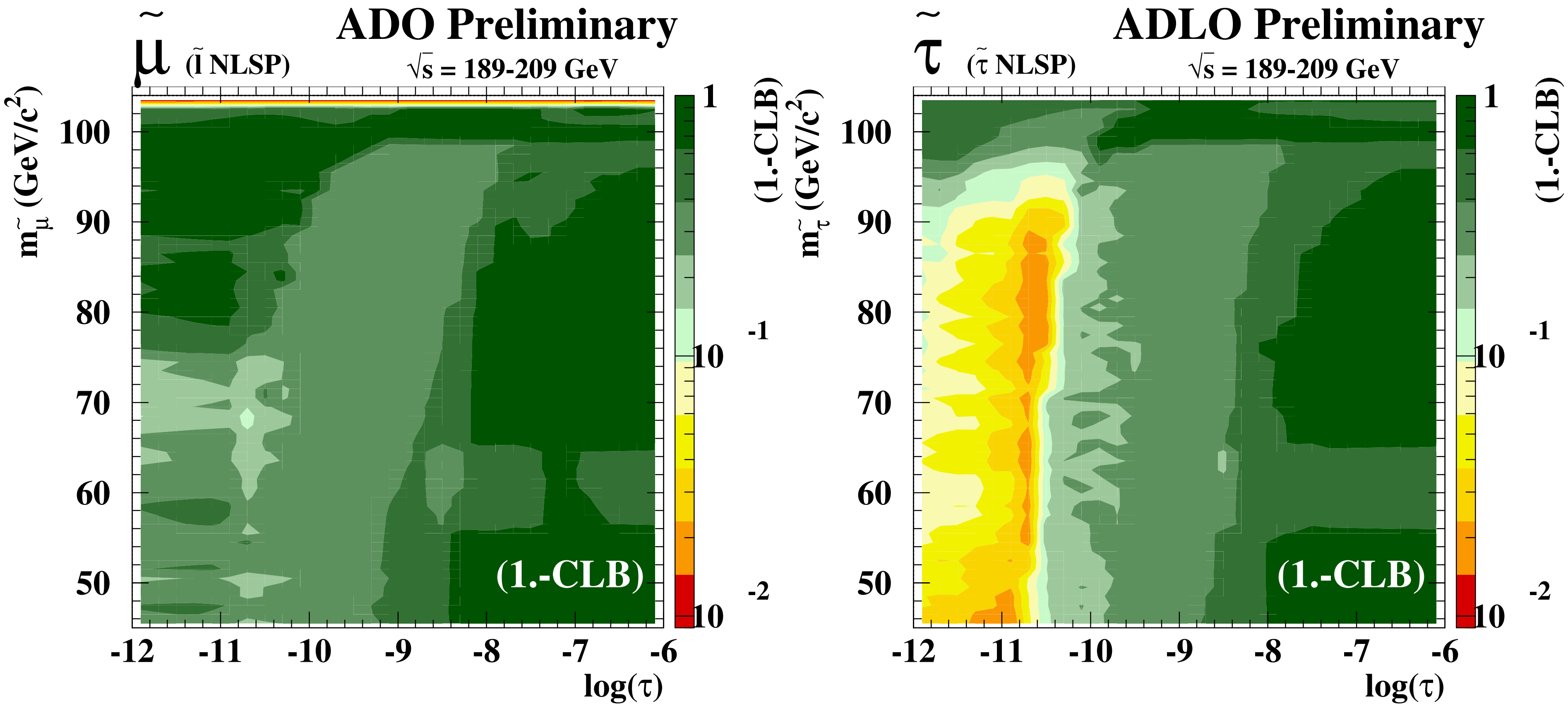
m($\tilde{\mu}$) = 70 GeV

τ ($\tilde{\mu}$) = 5*10-9 s

√s = 189 GeV



Confidence levels



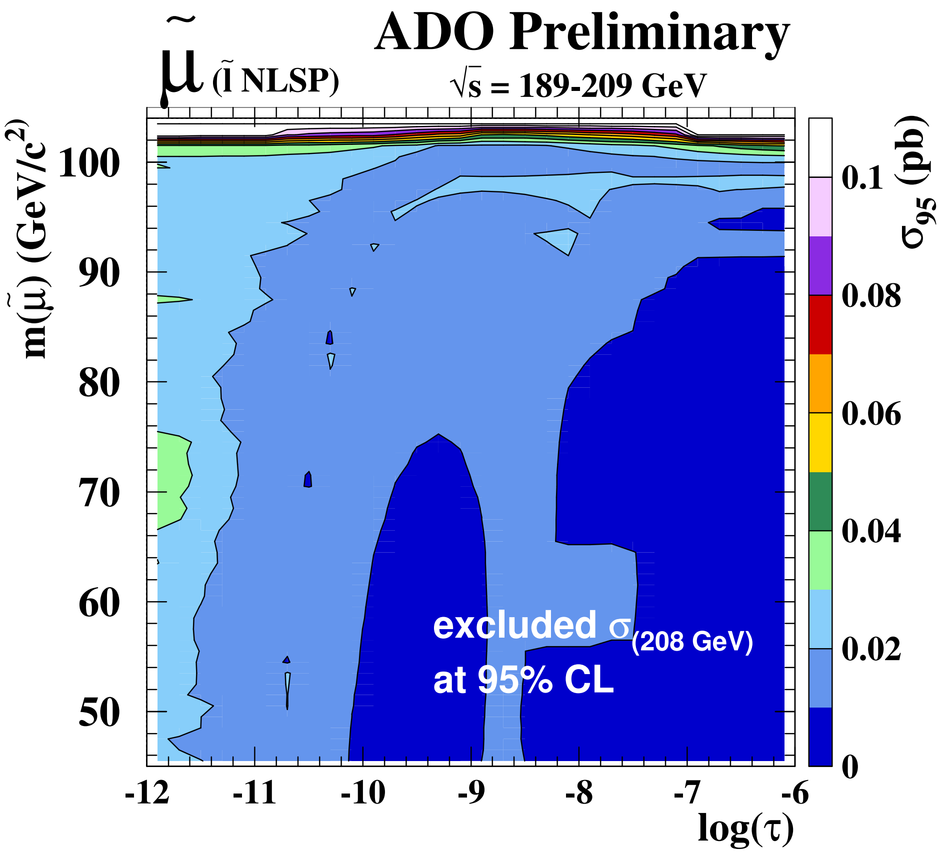
(1 - CL$_b$) ~ CL (No Excess)

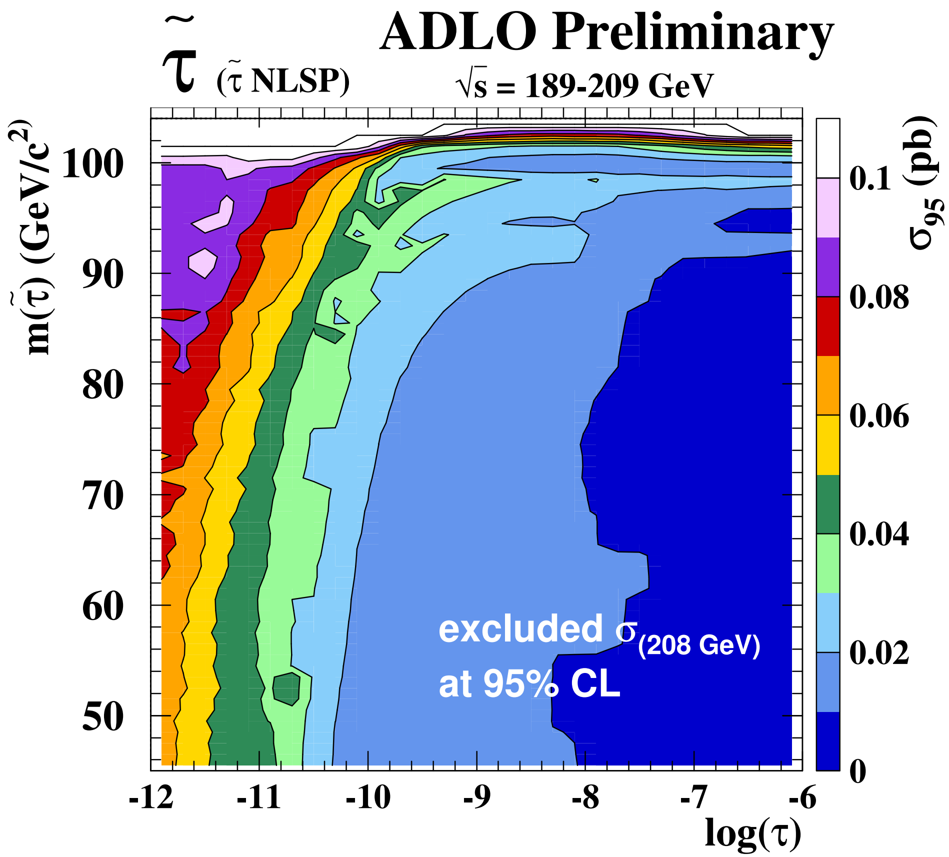
<(1 - CL$_b$)> = 0.5

if (1- CL$_b$) is small → signal

Cross section upper limits

assuming BR ($\tilde{l} \to l \tilde{G}$) = 1, minimal model dependent





σ <~ 0.02 pb

σ <~ 0.05 pb

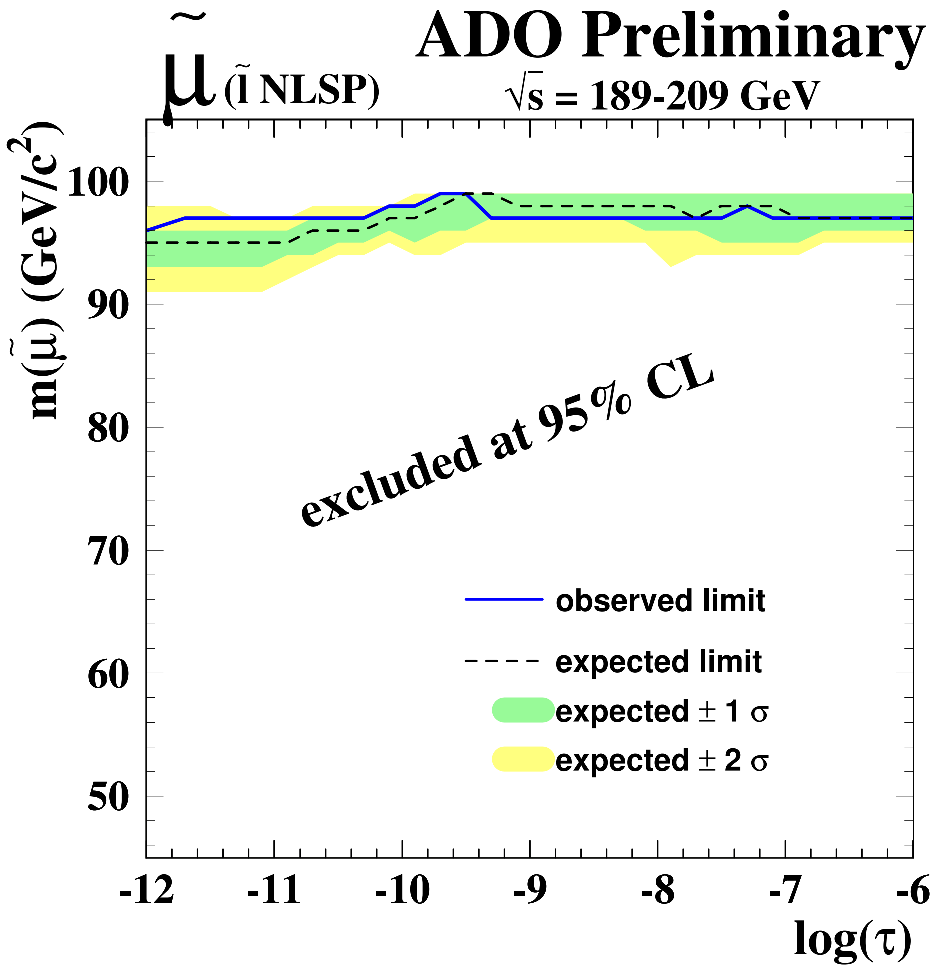
Mass limits

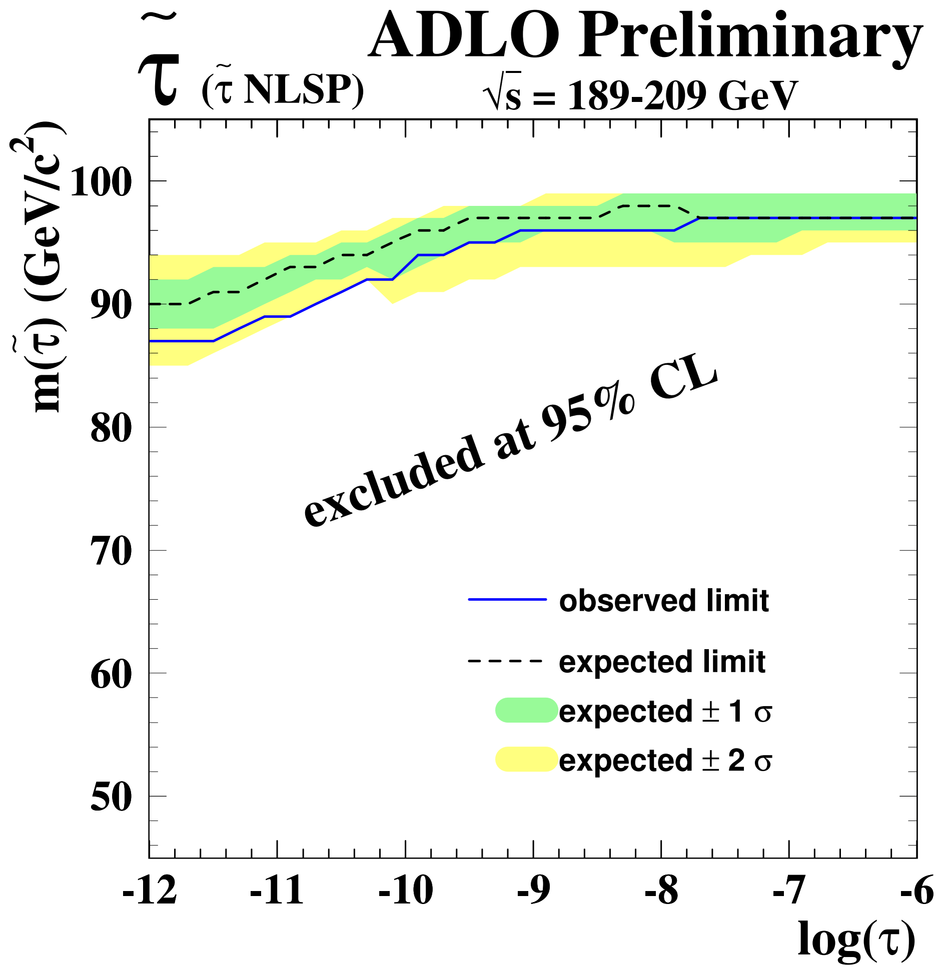
mGMSB: Cross sections and BR:

Calculated performing a scan over

- Λ	SUSY particle mass scale:	5, 6, ...150 TeV
- tan β		2, 2.2, ..., 50
- M	messenger mass scale :	1.01*Λ, 250 TeV, 10E6 TeV
- N	number of messengers:	1, 2, 3, 4, 5
- sign(μ)		+1,-1

$\rightarrow$ searching for a minimum cross sections and BR at each slepton mass.





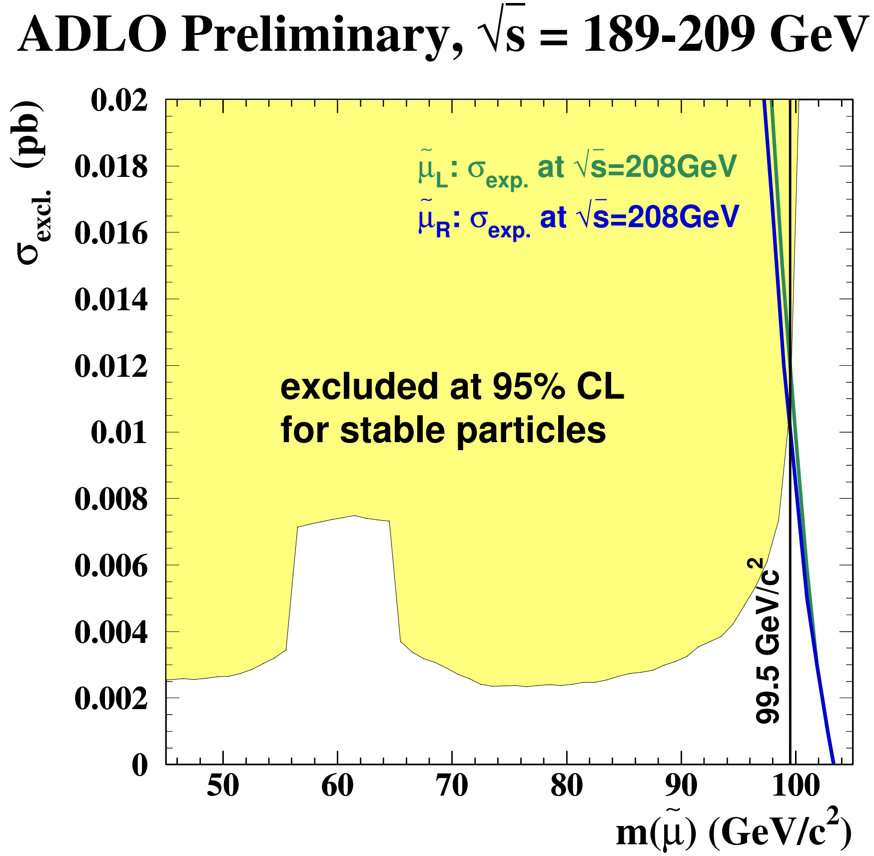
limit (all lifetimes)
$m(\tilde{\mu}) > 95.2$ GeV

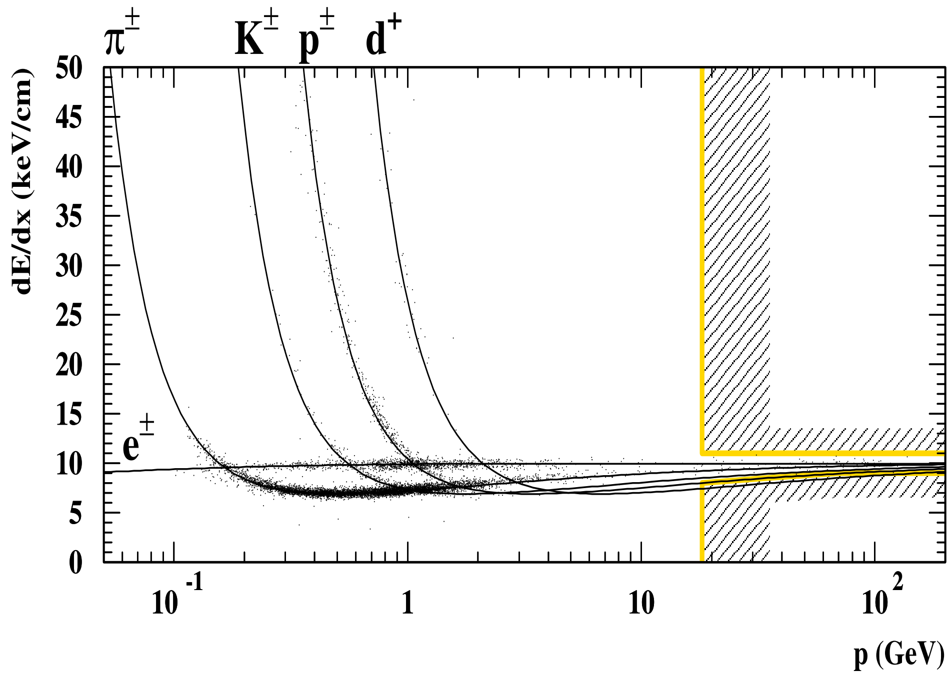
limit (all lifetimes)
$m(\tilde{\tau}) > 86.9$ GeV

Compared to single-exp: expected Limit → + 5 GeV

Heavy stable sleptons

Selection based on dEdx
Very striking analysis
Best excluded cross section!





m(slepton) > 99.5 GeV

- at 183 GeV: m > 87 GeV
- + ~4 GeV compared to single-exp

20 30 40 50 60 70 80 90 100 200
p (GeV)

3.2 Acoplanar and single photon(s)

Combination: S. Ask

- Many SUSY processes lead to single γ or acoplanar γ signatures, i.e. :

- Single photon: γ + Emiss	**- Acoplanar photons:** $\gamma\gamma$ + Emiss
$ee \to \chi_2\chi_1 \to \chi_1\gamma\ \chi_1$ (MSSM) $ee \to \tilde{G}\chi_1 \to \tilde{G}\ \tilde{G}\gamma$	$ee \to \chi_2\chi_2 \to \chi_1\gamma\ \chi_1\gamma$ (MSSM) $ee \to \chi_1\chi_1 \to \tilde{G}\gamma\ \tilde{G}\gamma$ (GMSB) χ_1 NLSP

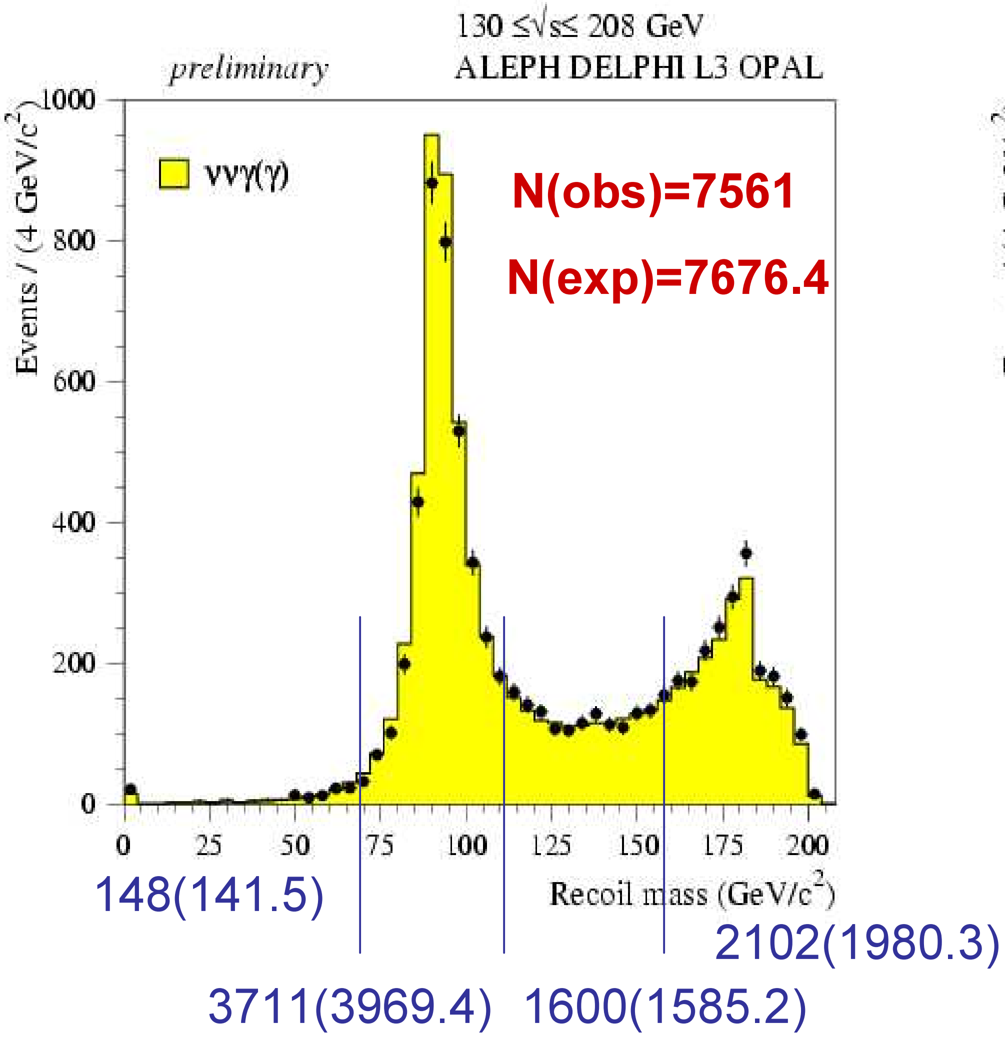
- Main SM background largely dominated by $ee \to \nu\nu\gamma(+\gamma)$

  Generators used for bg: KORALZ - NUNUGPV - KK

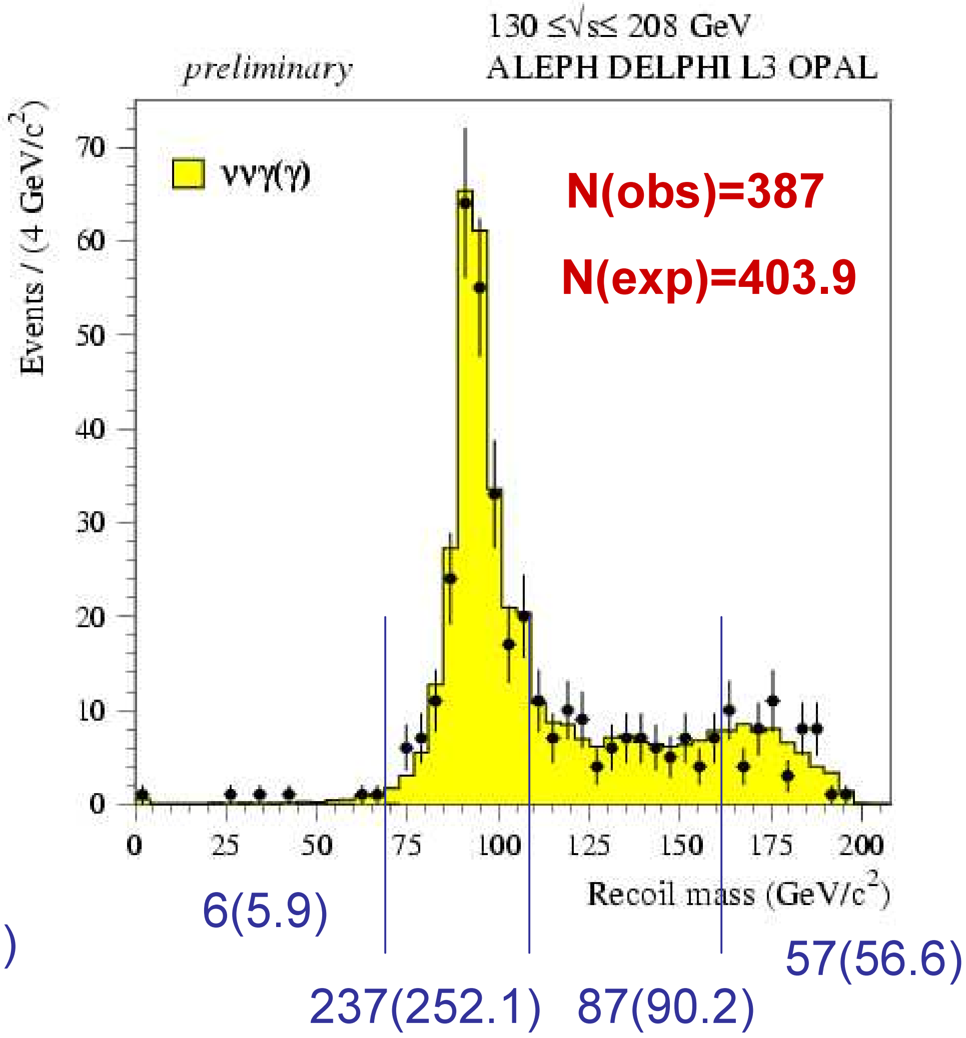
A,D = final files, O = prel
high energy L missing

Recoil mass distributions
at the preselection level:

Single photon



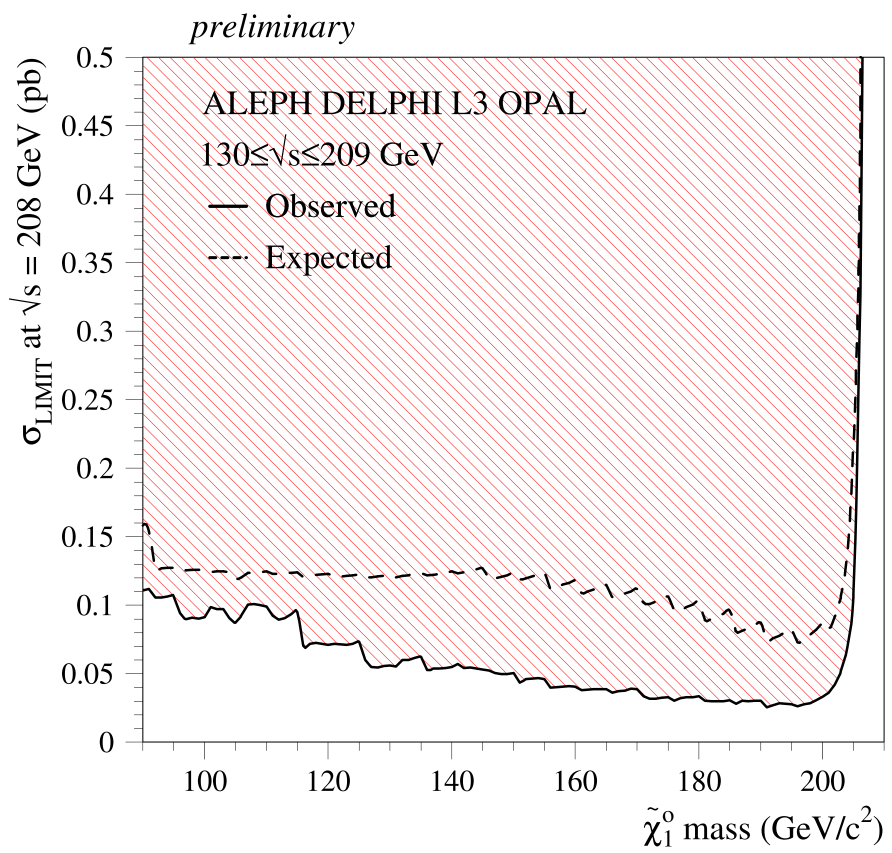
Acoplanar photons

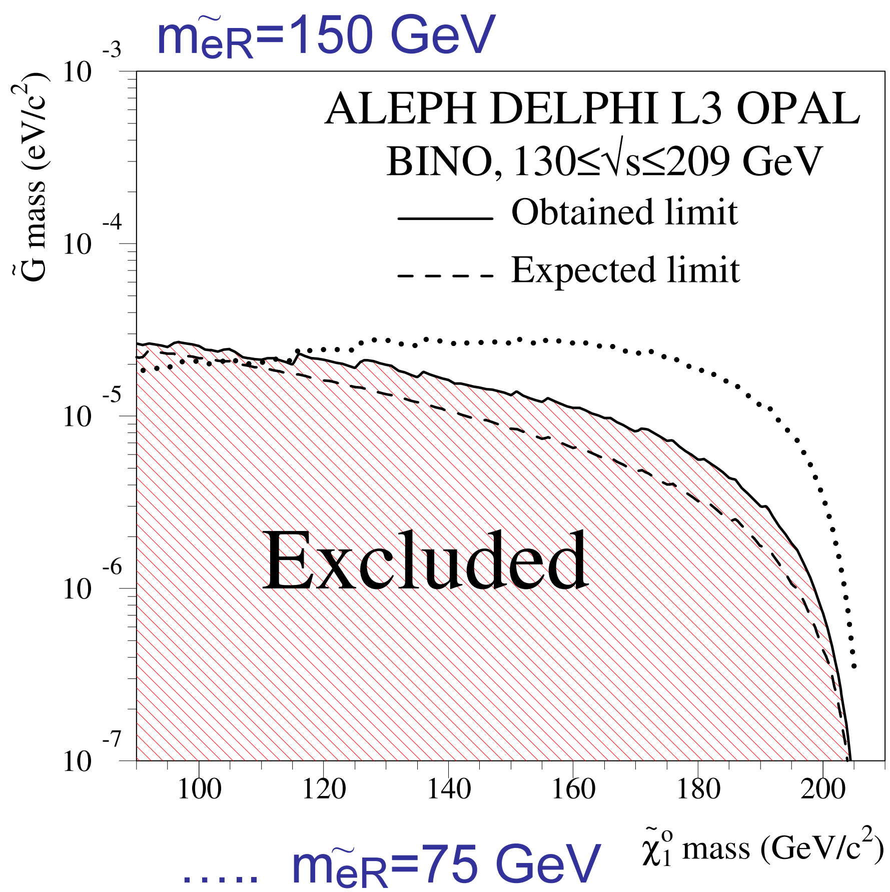


Single photon, Gravitino - LSP: → 1 energetic photon

Ultralight gravitino : **ee → $\tilde{G}\chi_1$ → $\tilde{G}\,\tilde{G}\gamma$**

Signal cross section: $\chi_1 \sim \tilde{B}$

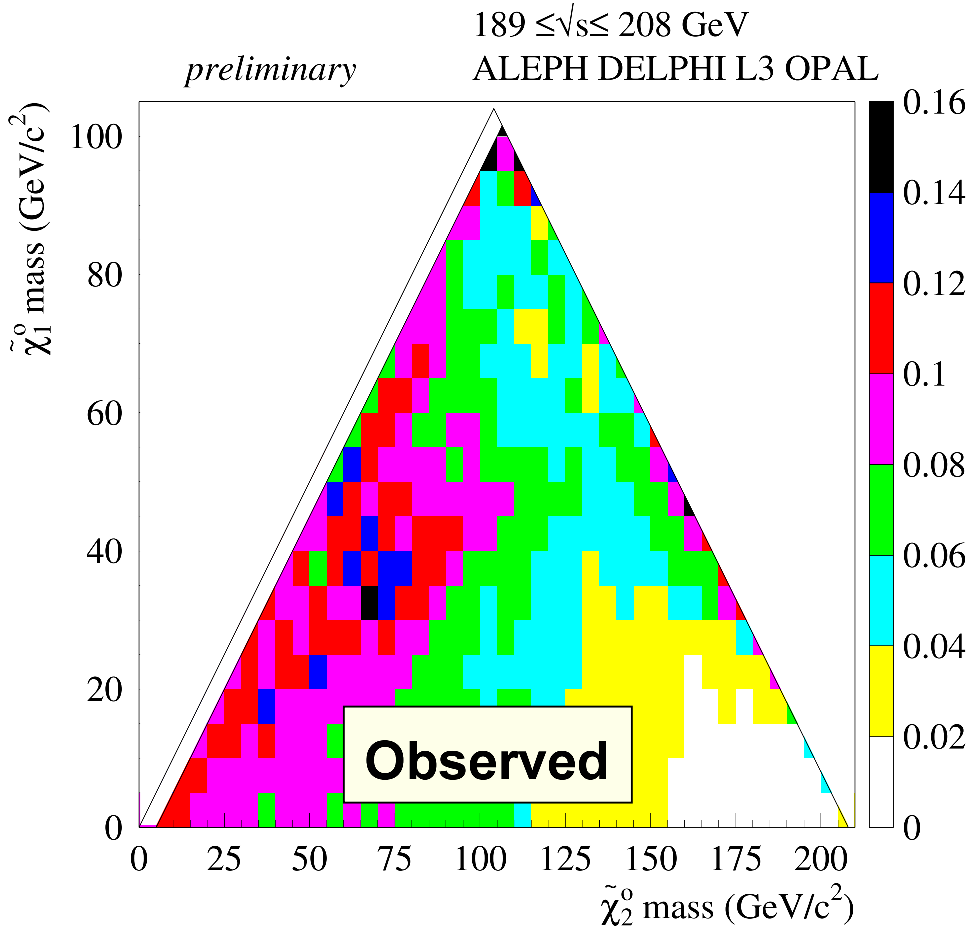


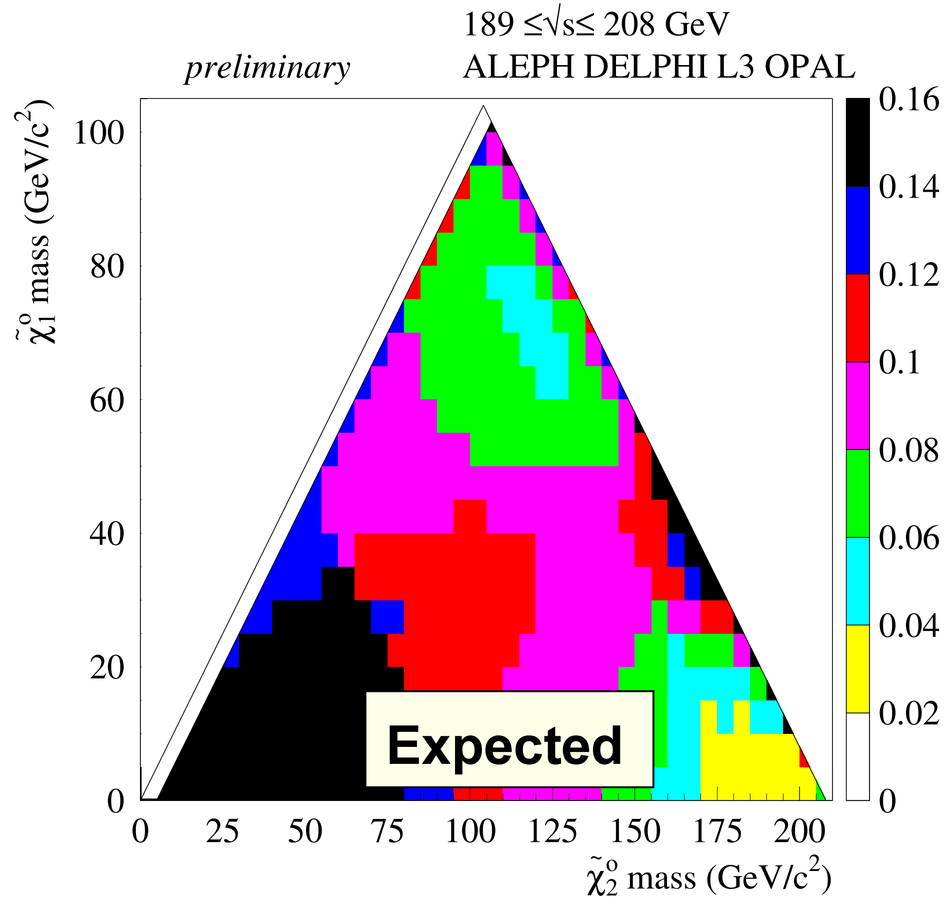


Single photon, Neutralino - LSP: → may have a soft photon

MSSM: **ee** $\to \chi_2\chi_1 \to \chi_1\gamma\ \chi_1$

Upper limit on the production cross section (BR=1):





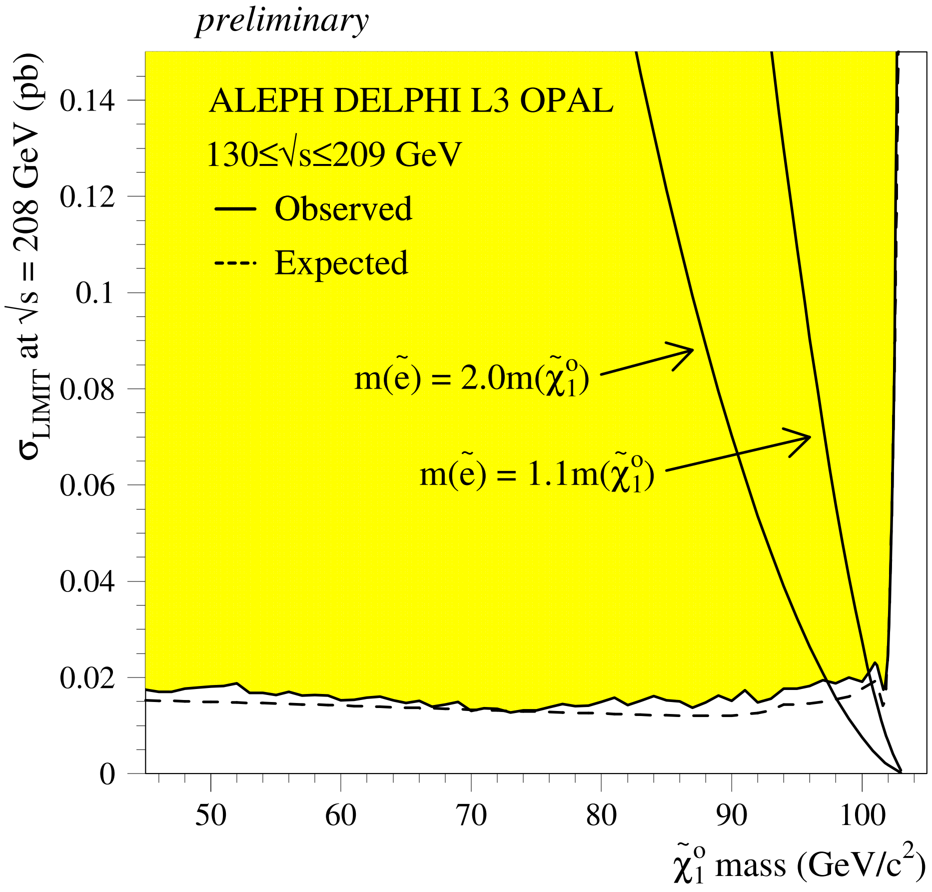
σ <~ 0.1 pb

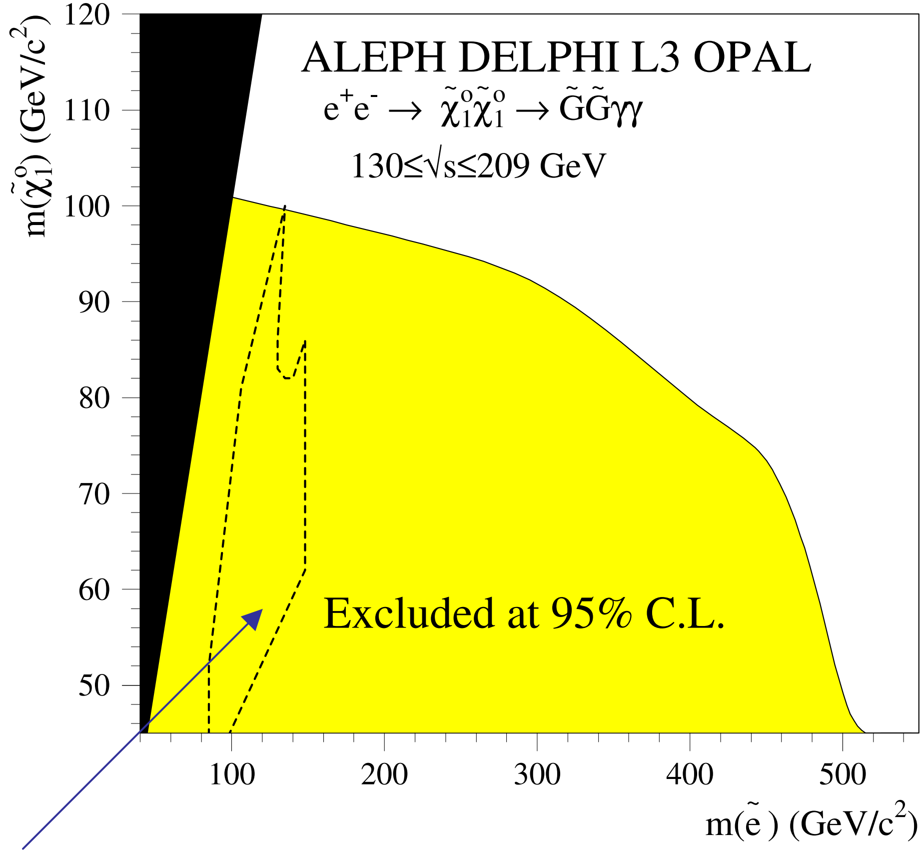
σ <~ 0.1 pb

- 2. Acoplanar photon(s), Gravitino - LSP: $\rightarrow$ energetic photons

Ultralight gravitino: **ee** $\rightarrow \chi_1 \chi_1 \rightarrow \tilde{G} \gamma \tilde{G} \gamma$

Signal cross section: $\chi_1 \sim \tilde{B}$





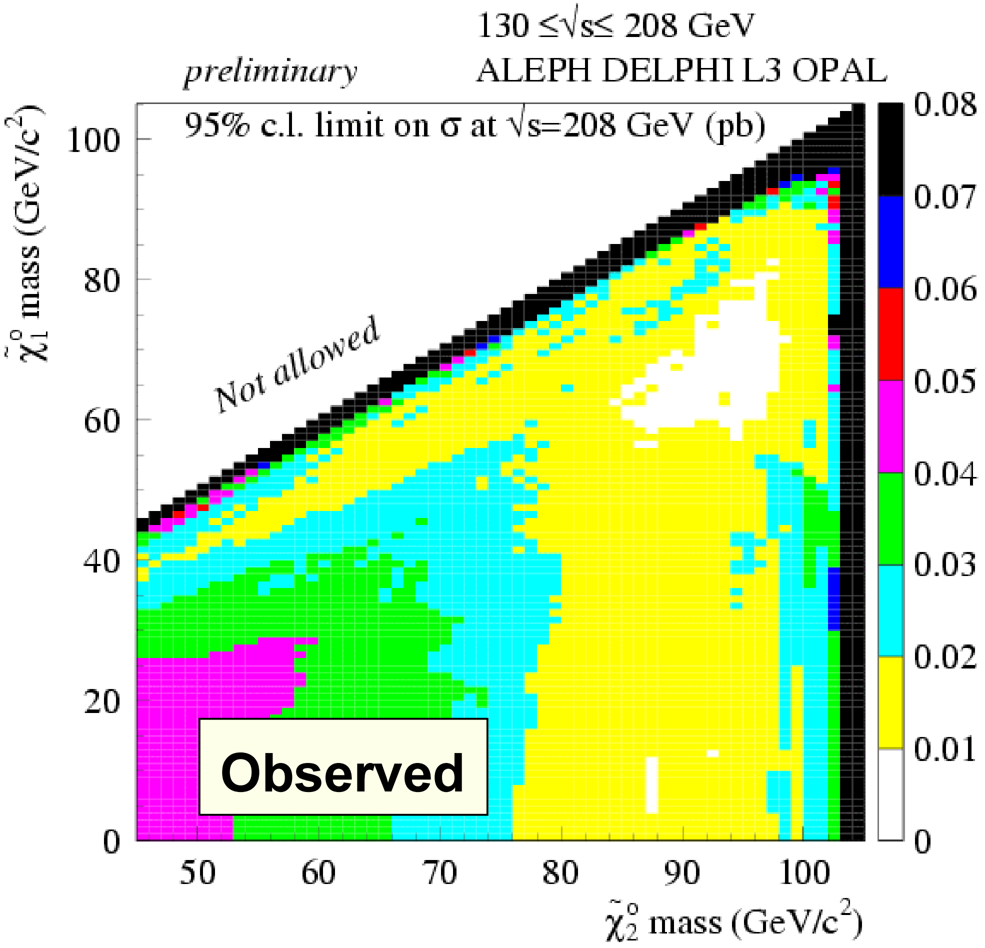
$\tilde{e}$ interpretation of the CDF ee $\gamma\,\gamma$ Emiss event

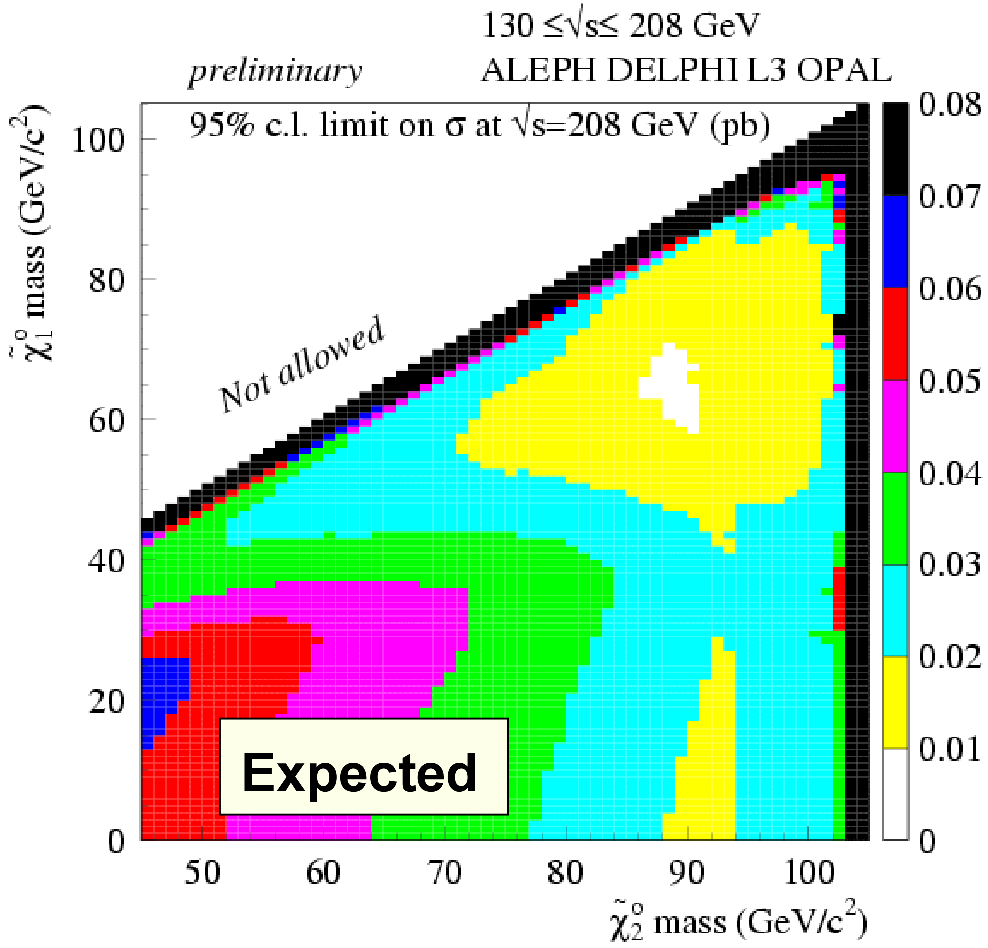
qq $\rightarrow \tilde{e}\tilde{e} \rightarrow$ ee $\chi_1\chi_1 \rightarrow$ ee $\tilde{G}\gamma\ \tilde{G}\gamma$

Acoplanar photon(s), Neutralino - LSP: → may have soft photons

MSSM: ee → $\chi_2\chi_2 \rightarrow \chi_1\gamma\ \chi_1\gamma$

Upper limit on the production cross section (BR=1):





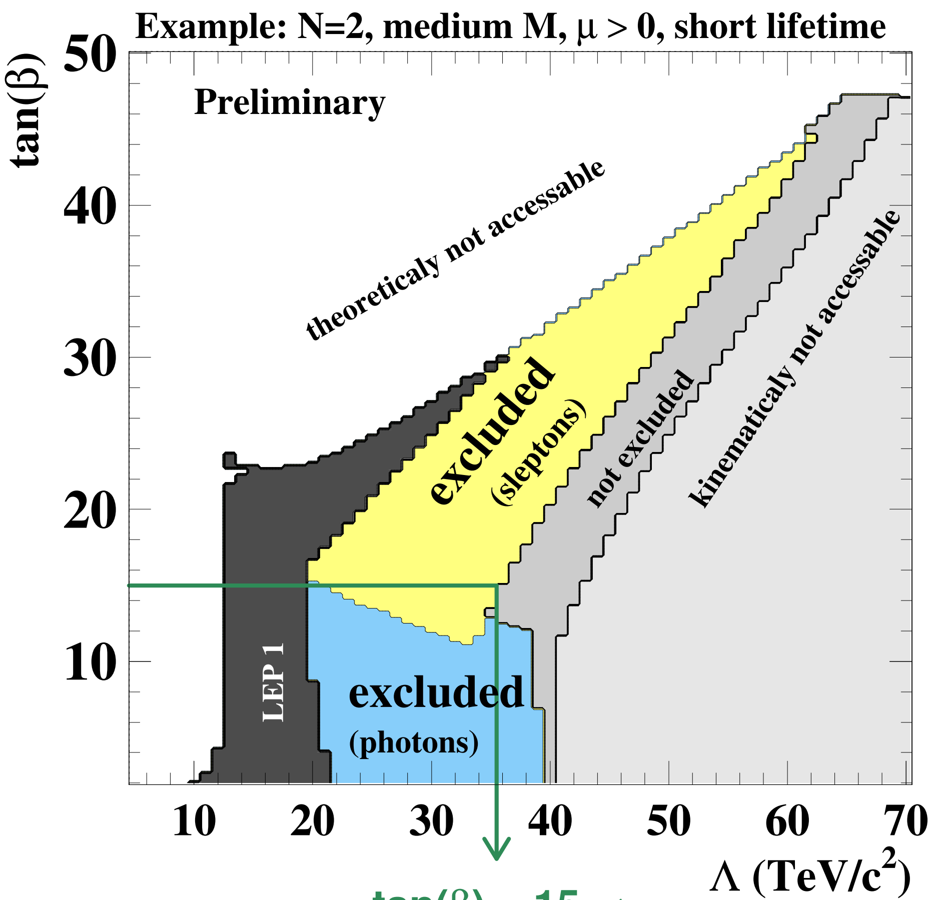
σ <~ 0.03 pb

σ <~ 0.03 pb

GMSB: Comparison with Tevatron

Scan in GMSB parameter space following

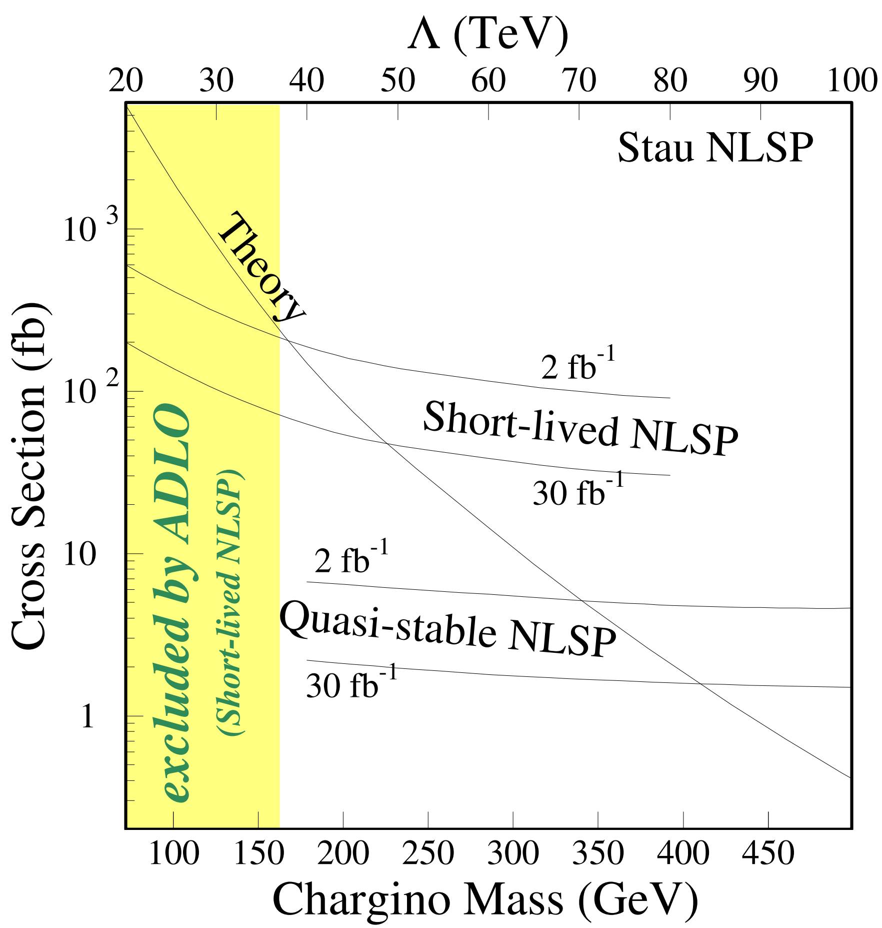
Dimopoulos, Thomas, Wells, Nucl. Phys. B488 (1997) 39



tan(β) = 15 ⇒

$\Lambda > 35.5$ TeV/c^2

$$N = 2,\ \frac{M}{\Lambda} = 3,\ tan\beta = 15,\ \mu > 0$$



5 σ Potential discovery

A,D,L = final files

O = prel, ΔM > 170 MeV

3.3 Charginos at low ΔM

Combination: S. Rosier

An absolute mass lower limit on charginos $\rightarrow$ need dedicated analysis in the low $\Delta M = (m_{\chi+} - m_{\chi0})$ region ($\Delta M < 5$ GeV/c^2)

Exchange of: main SM bg

ΔM

- **Prompt decay** into lept., lept.+jets, or jets (chargino decay via W*) — 4f, 2f

~ 3 GeV

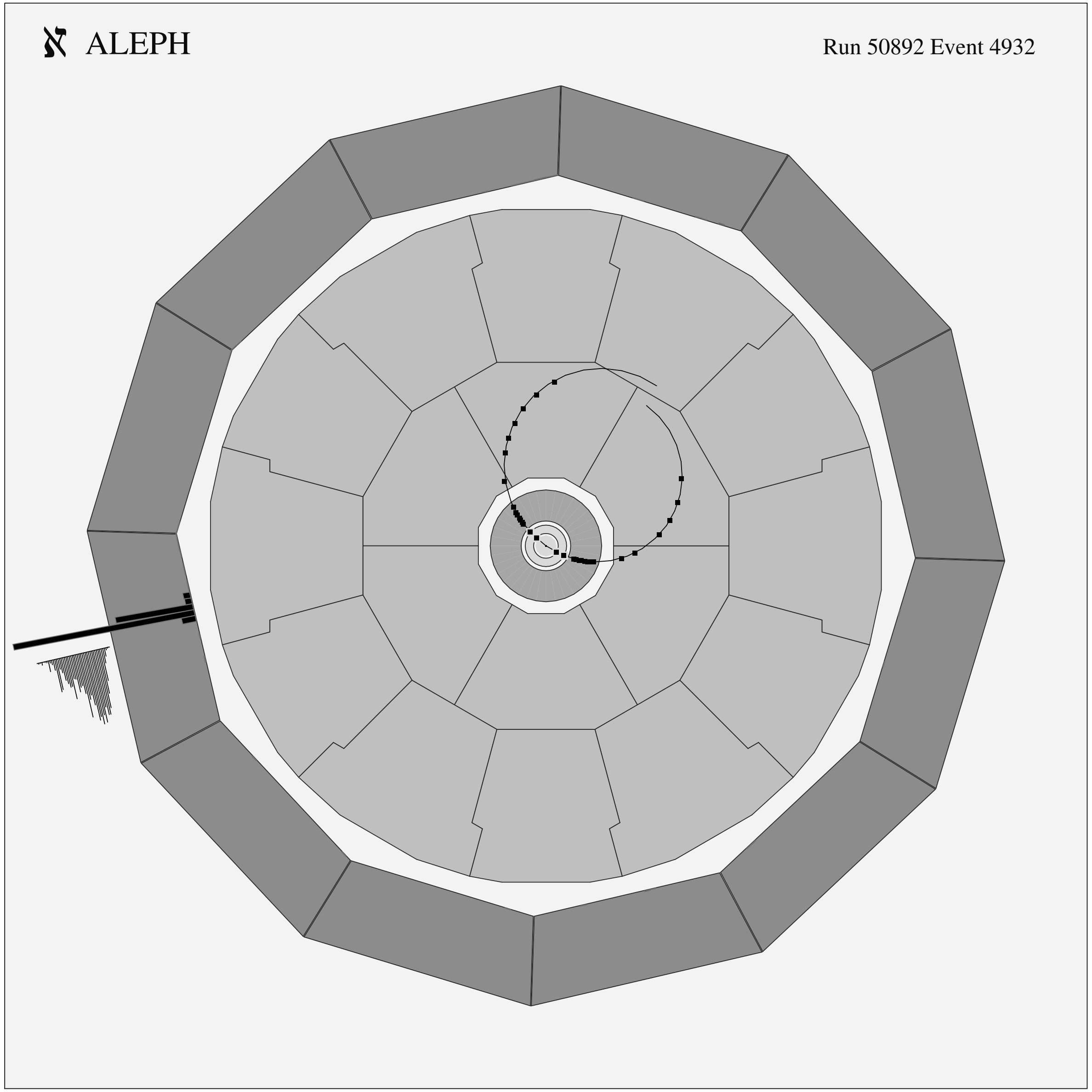
- **Soft events with ISR photon** — $\gamma\gamma$ (+γ)

~ m_π

- **Heavy stable charged particles** long-lived and strongly ionizing particles — –

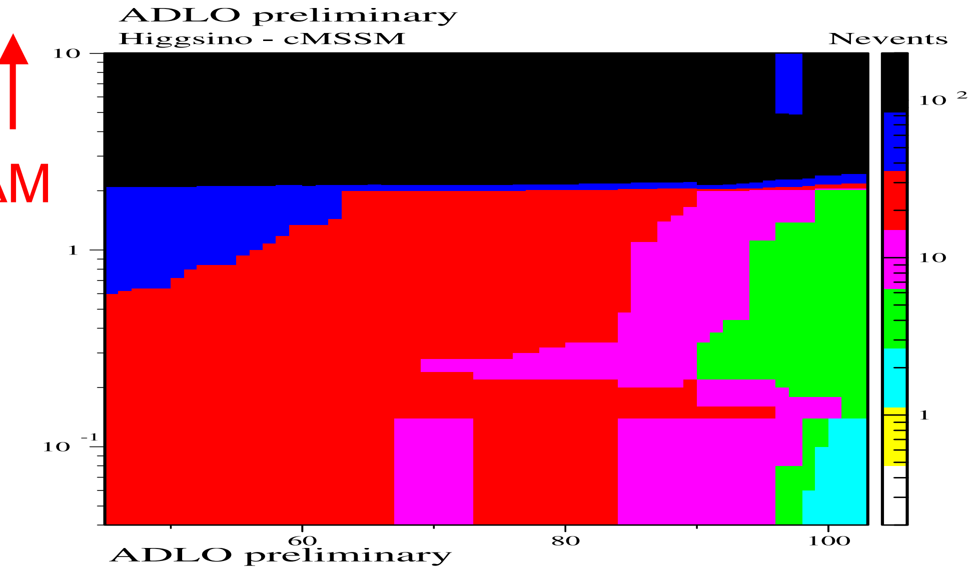
A candidate event at 195.4 GeV, Contribues to range $m_{\chi+} < 84$ GeV/c^2

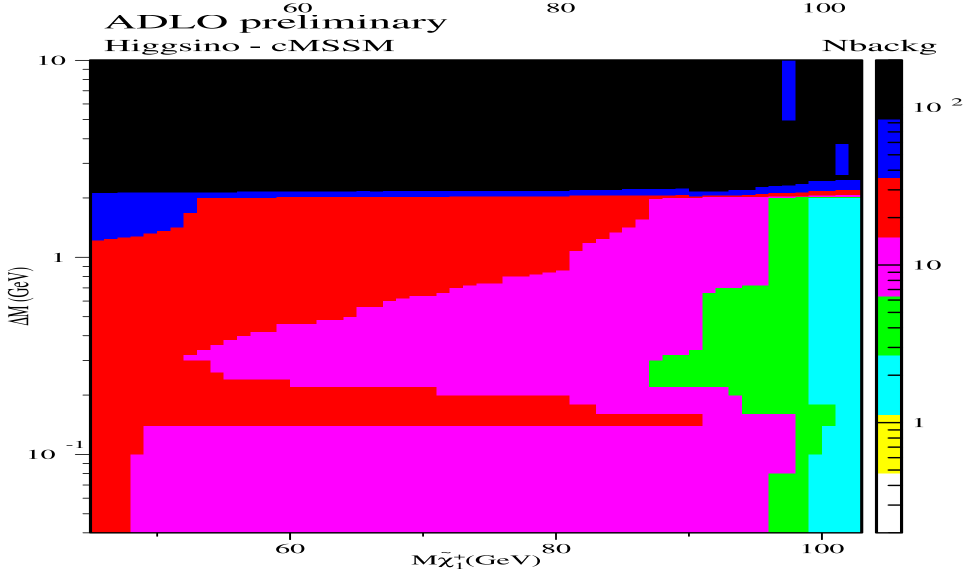
$E_\gamma = 21$ GeV

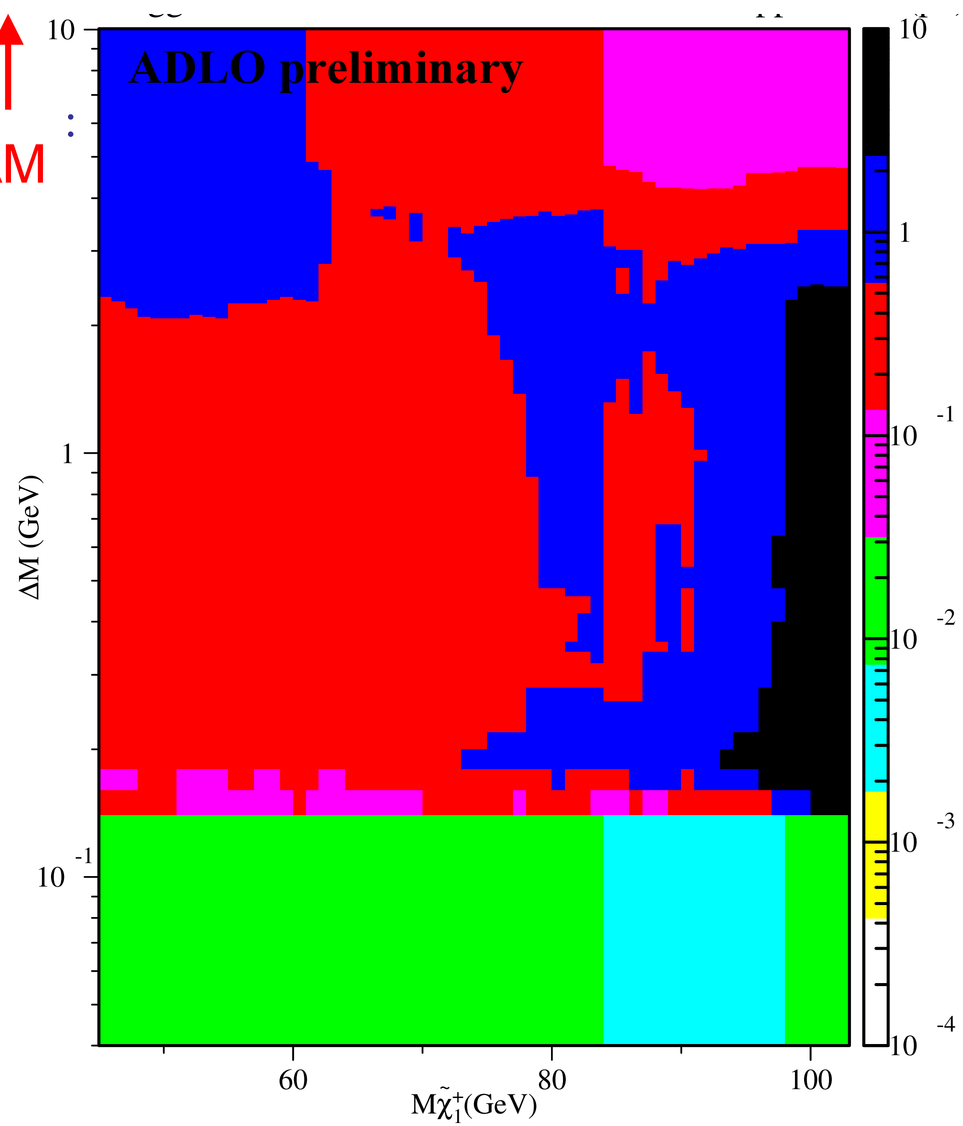


Candidates and bg:

Upper limit on the production cross section:







ΔM ↑ M(χ^+) →

σ <~ 0.6 pb

Low ΔM can occur in MSSM in:

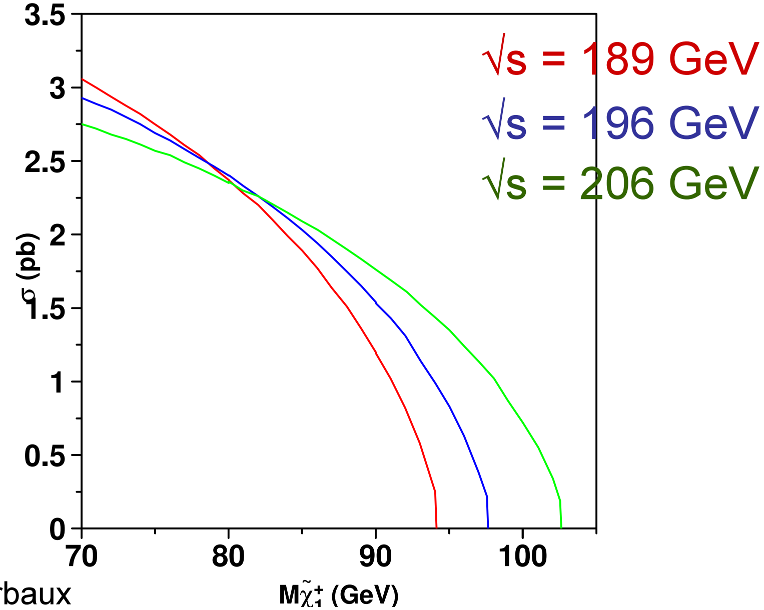
- Higgsino-like region : $|\mu| \ll M_2$ - in the CMSSM

  Scan on: M_2 (M_2 >1 TeV), sign(μ)= ±1, tanβ=1,10 (M_1/ $M_2 \cong 0.55$)

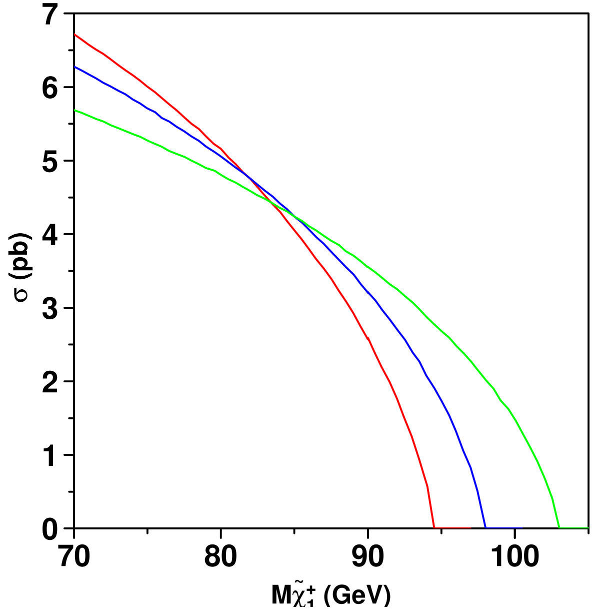
- Gaugino-like region : $|\mu| \gg M_2$ - suppose large m_0

  Scan on: M_1/ M_2 = 2→10, μ= ±600, tanβ=1→40

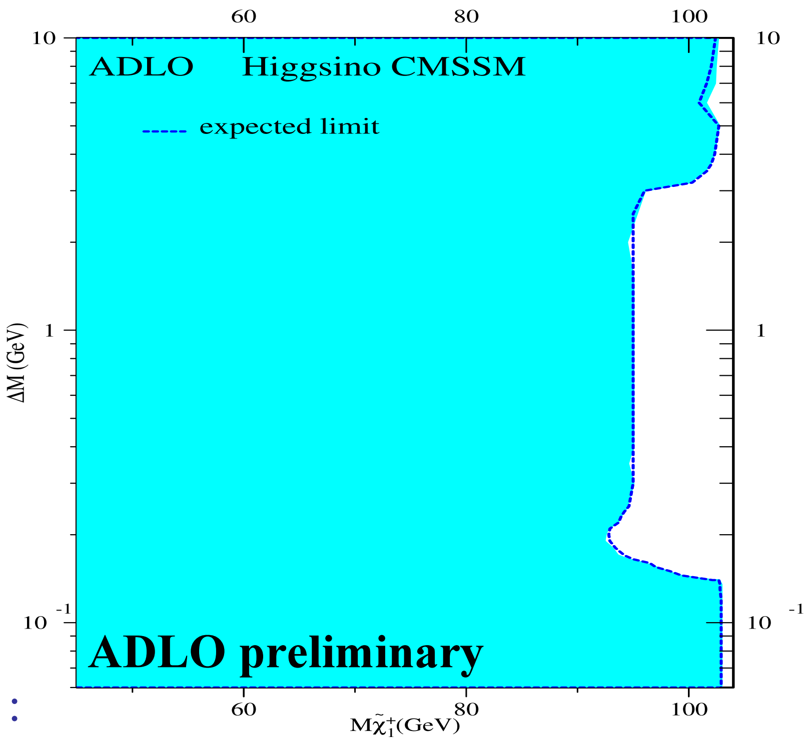
σ for higgsino-like χ^+



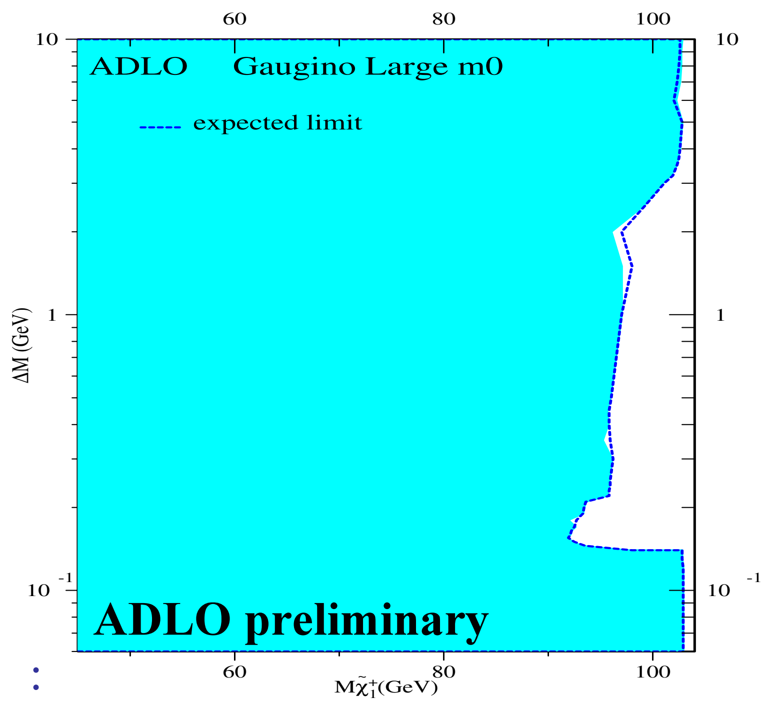
σ for gaugino-like χ^+



Higgsino - CMSSM



Gaugino - large m_0



$m_{\chi+} > 92.4$ (92.9) GeV
(ΔM = 190 MeV, λ = 11.2 cm)

$m_{\chi+} > 91.9$ (91.9) GeV
(ΔM = 150 MeV, λ = 11.0 cm)

+ ~4 GeV compared to single-exp

3.4 RPV sleptons and sneutrinos

Combination: H. Nowak

SUSY/Gauge invariance do not require RPC

Baryonic Number

Spin

$$R_P = (-1)^{3B+L+2S}$$

Leptonic number

+1 for Standard Particles

-1 for Supersymmetric Partners

Explicit RPV breaking trilinear superpotential terms:

$$\lambda_{ijk}\, L_L^i L_L^j \overline{E}_R^k + \lambda'_{ijk}\, L_L^i Q_L^j \overline{D}_R^k + \lambda''_{ijk}\, \overline{U}_R^i \overline{D}_R^j \overline{D}_R^k$$

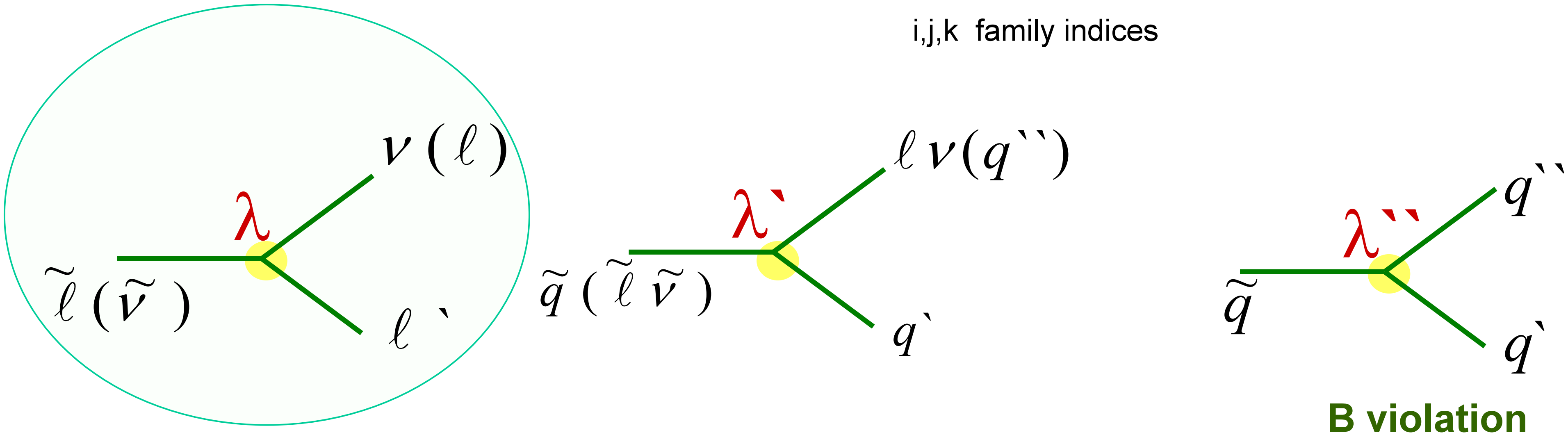
$\lambda, \lambda', \lambda''$: Yukawa couplings

L_L, Q_L left-handed lepton and quark doublets

E_R right-handed lepton singlets

U_R, D_R right-handed Up and Down quark singlets

i,j,k family indices



L violation

B violation

9 couplings (i≠j)

27 couplings

9 couplings (j≠k)

R_P Conserved	R_P Violated
• SUSY particles are pair-produced • The LSP is stable (→ neutral,colourless → good dark-matter candidate) • All SUSY particles decay into the LSP	• The LSP decay into standard particles (no candidate for dark matter) • And so do all other SUSY particles
Experimental	**Signature**
• The LSP (neutral, colourless) interacts only weakly with matter: it is invisible. → MISSING ENERGY	• SUSY particles decay into quarks, leptons, neutrinos. → Multi-jet, multi-leptons final state, missing energy or not

New topologies !

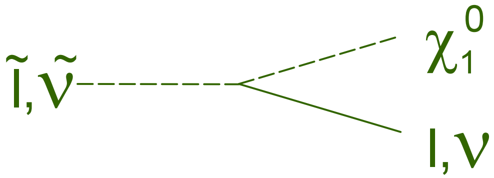
Assumptions

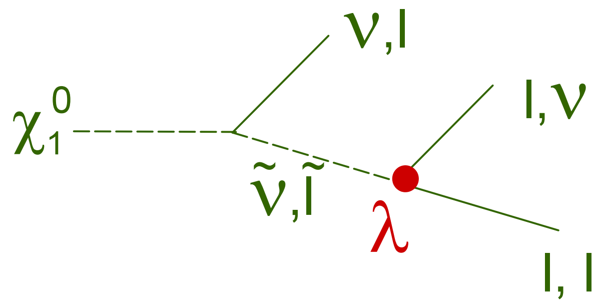
1. **LLE coupling - Indirect decays**

   Charged and neutral scalar sleptons ($\tilde{e}$, $\tilde{\mu}$, $\tilde{\tau}$, $\tilde{\nu}_e$,$\tilde{\nu}_\mu$)

   Pair produced sleptons

$e\,e \rightarrow \tilde{l}\,\tilde{l}$





- 2. **ΔM > 3 GeV**

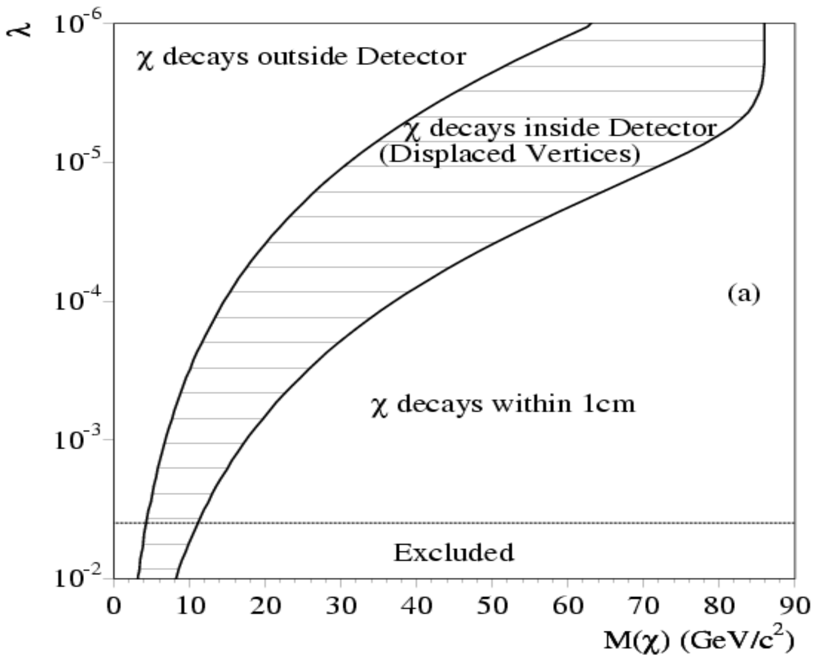
   Stau decays into tau LSP and

   at very small ΔM, direct decay dominates

- 3. **Prompt decay of he LSP** :

   m_{χ^0} > 10 GeV

   Decay within 1 cm



λ_{121} , λ_{122} , λ_{123} , λ_{131} , λ_{132} , λ_{133} , λ_{231} , λ_{232} , λ_{233}

- 4. **Only one Yukawa coupling λ_{ijk} is non-zero at the time**.

The efficiencies derived from MC produced with $\lambda_{133} \neq 0$
(final states with at least 4 taus + Emiss)
$\rightarrow$ yielding to the worse signal efficiency
$\rightarrow$ results are valid for the other λ_{ijk} couplings.

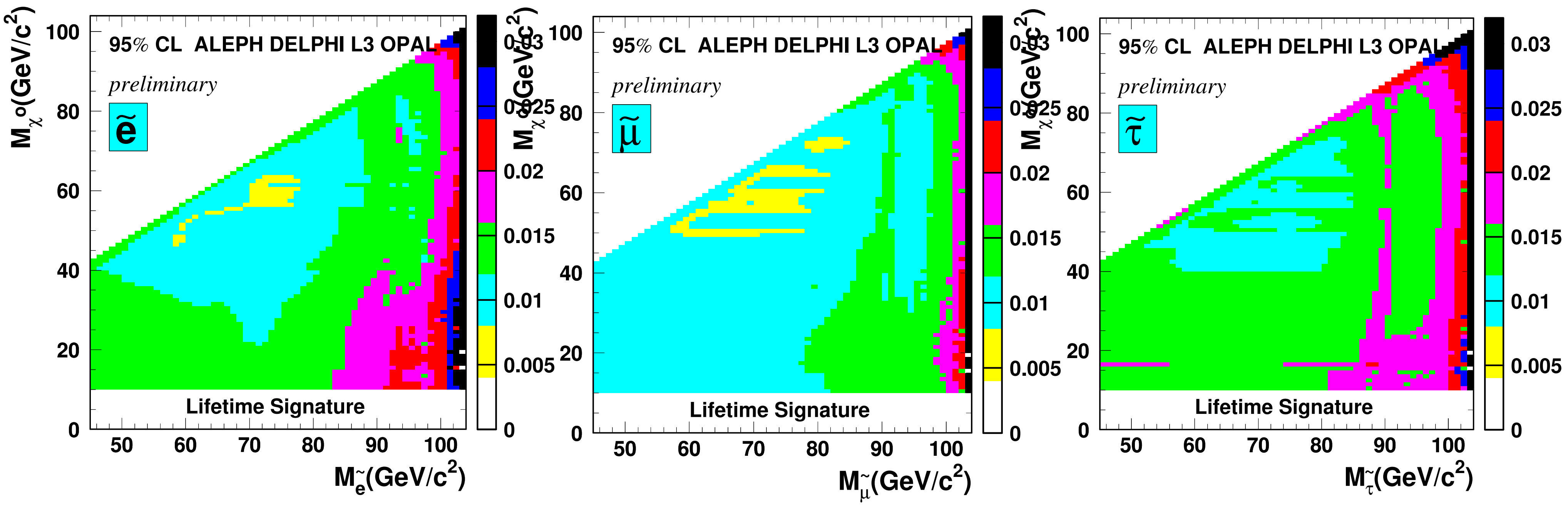
Analysis: for the charged sleptons:

λ_{133}: for example: ee $\rightarrow \tilde{l}\tilde{l} \rightarrow$ $l\chi_1$ $l\chi_1 \rightarrow$ l $\upsilon\tau\tau$ l $\upsilon\tau\tau$

$\rightarrow$ final state with 6 leptons and Emiss

Cross section upper limits

assuming BR ($\tilde{l} \rightarrow l\, \chi_1^0$) = 1, minimal model dependent



σ <~ 0.02 pb   σ <~ 0.02 pb   σ <~ 0.02 pb

Mass limits

Δ**M > 3 GeV**:

$m_{\tilde{e}R}$	96.6	(92.9)	GeV
$m_{\tilde{\mu}R}$	96.8	(94.8)	GeV
$m_{\tilde{\tau}R}$	95.9	(92.0)	GeV

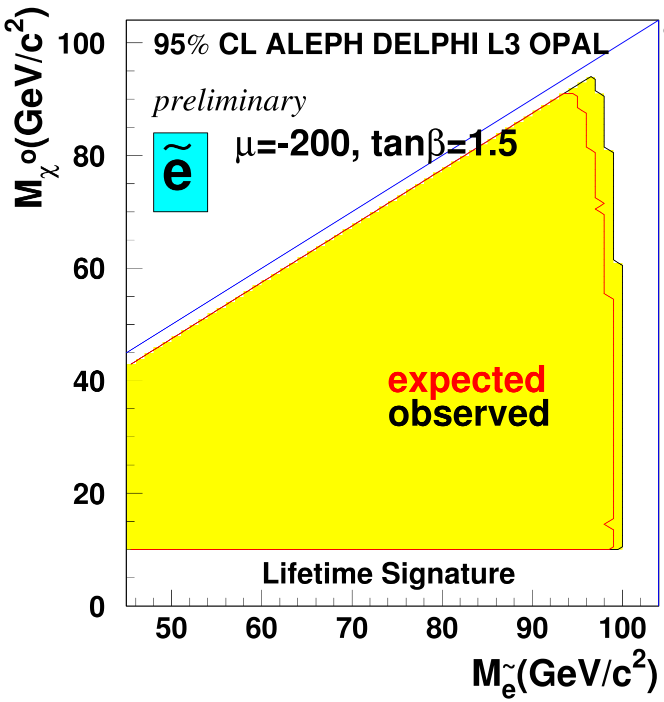
CMSSM: scan m_0 and M_2

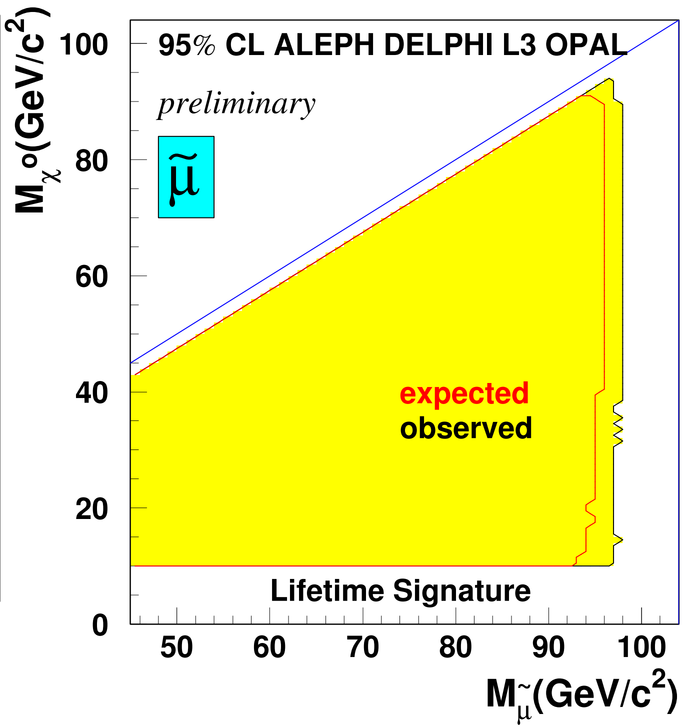
μ **= -200 GeV, tan**β **= 1.5:**

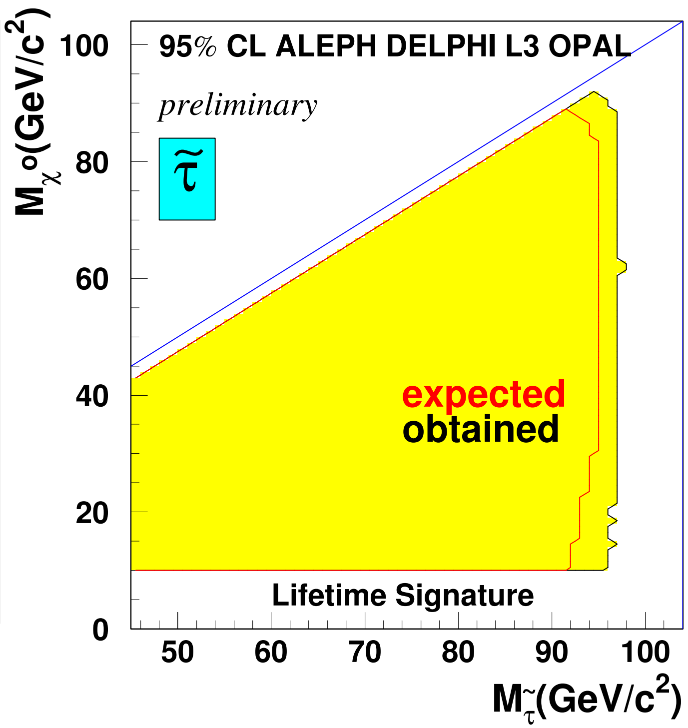
to compute $\sigma(\tilde{e}\tilde{e})$ **and BR** $(\tilde{l} \rightarrow l\chi^0)$

$\sigma(\tilde{\mu}\tilde{\mu})$ **=** $\sigma(\tilde{\tau}\tilde{\tau})$ **and** σ**(LL) >** σ**(RR)**

Comparable to the RPC cases







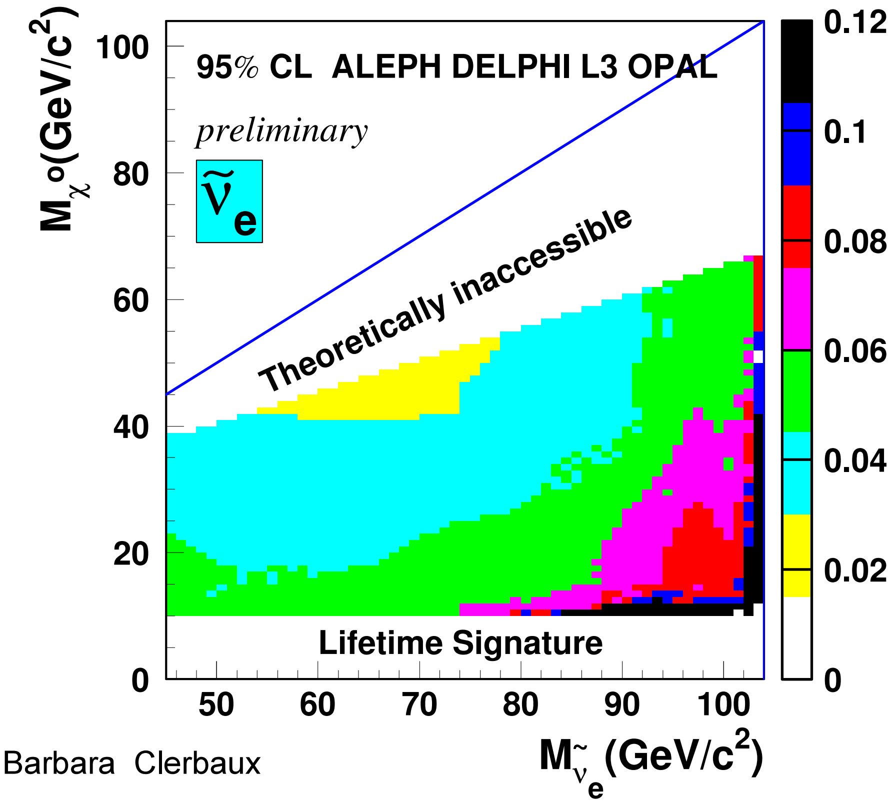
Analysis for the sneutrinos:

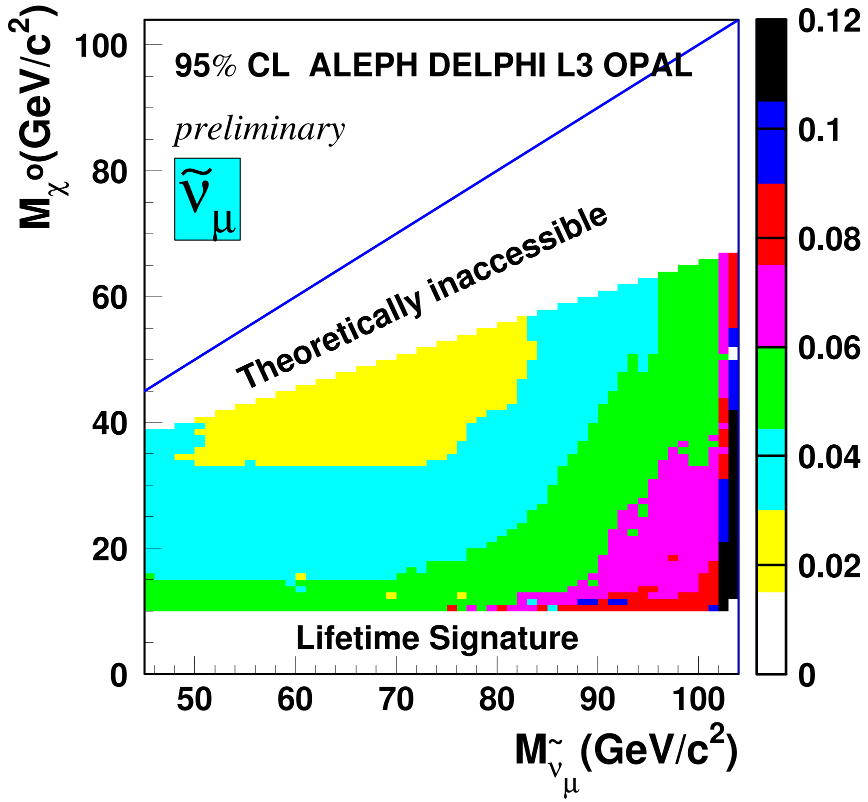
λ_{133}: for example: ee $\rightarrow \tilde{\upsilon}\tilde{\upsilon} \rightarrow \upsilon\chi_1\ \upsilon\chi_1 \rightarrow \upsilon\ \upsilon\tau\tau\ \ \upsilon\ \upsilon\tau\tau$

$\rightarrow$ final state with up to 4 taus and Emiss

Cross section upper limits

assuming BR ($\tilde{\upsilon}\rightarrow\upsilon\chi_1^0$) = 1, minimal model dependent





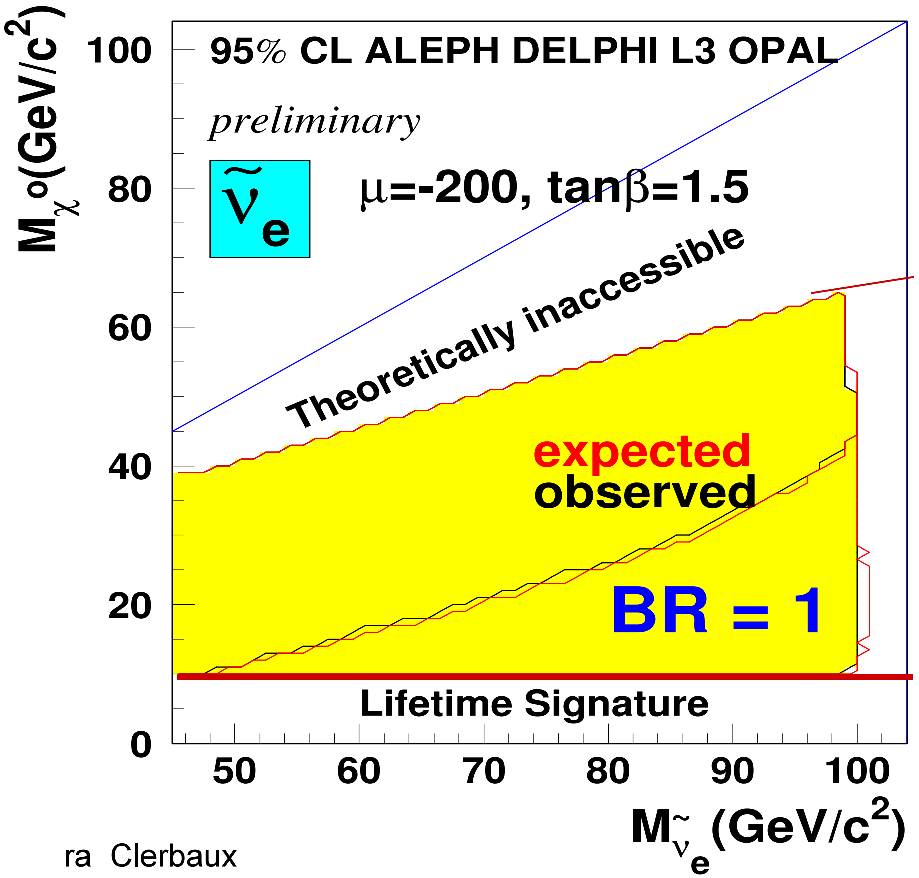
Mass limits

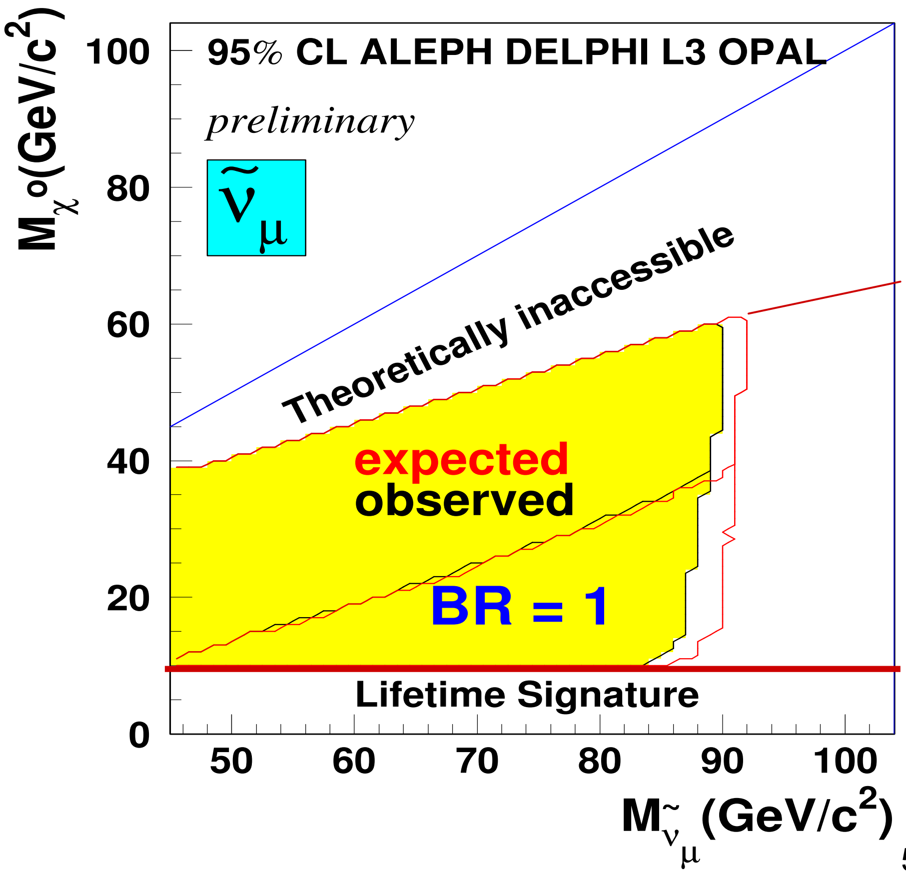
CMSSM: scan m_0 and M_2

μ **= -200 GeV, tanβ = 1.5:**

to compute $\sigma(\tilde{e}\tilde{e})$ and BR ($\tilde{l} \rightarrow l\chi^0$)

$m_{\tilde{\nu}_e}$	98.9	(99.1)	GeV
$m_{\tilde{\nu}_\mu}$	84.5	(86.0)	GeV





4. Conclusions and prospects

→ Updated LEP combined results on MSSM

→ New LEP combined results on charginos at low ΔM!

→ New LEP combined results on GMSB and RPV!

→ **Final** LEP combinations will come soon

REMIND: all the results and info in:
http://www.cern.ch/LEPSUSY/

What we also would like to do:

- mSUGRA scan: A_0 scan
- Charginos at low ΔM: low-m_0 region
- RPV: LEE (λ) direct, UDD (λ'')

→ LEPSUSY paper in preparation