

SUSY at ILC-LPNHE

Mikael Berggren, LPNHE

LPNHE Conseil Scientific, May 2006

Outline

1 ILC - SUSY

Sfermions to probe mSUGRA

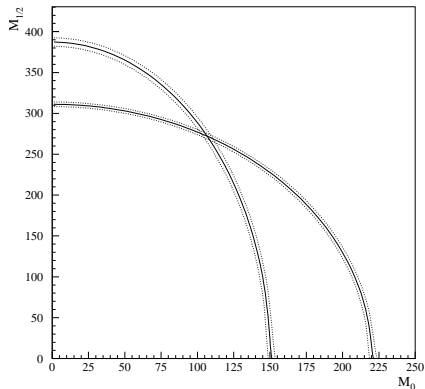
Sfermions as a probe into all mSUGRA parameters: (MB, Proceeding of the Lund ILC workshop, Sept 1999). Eg.:

- $M_{\tilde{\mu}_L}$ and $M_{\tilde{\mu}_R}$ gives M_0 and $M_{1/2}$
- $M_{\tilde{\mu}_L}$ and $M_{\tilde{\mu}_R}$ and $M_{\tilde{\tau}_1}$ gives θ_τ ; ie. $\mu - A \tan \beta$
- π spectrum in $\tilde{\tau}$ decays gives $\tilde{\tau}$ polarisation, \rightarrow other func. of μ and $\tan \beta$.
- EW breaking condition gives $|\mu|$.

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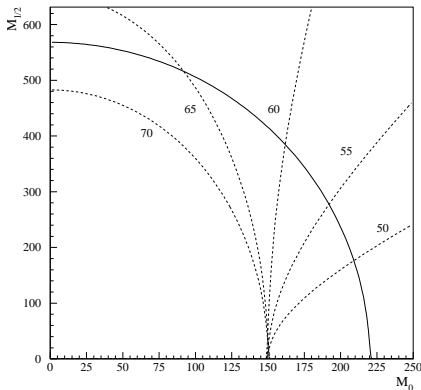
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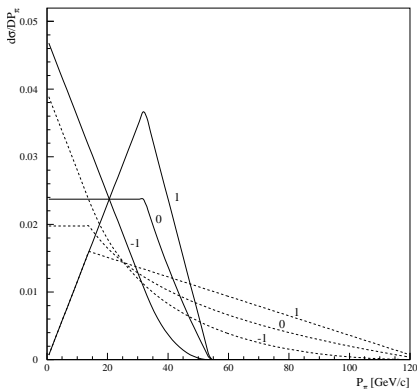
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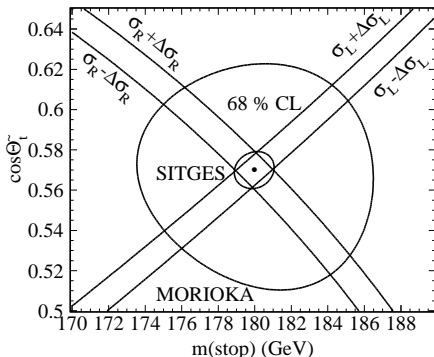
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\tilde{t} production

Study of \tilde{t} production (MB, H Nowak (DESY-Zeuten) A. Sopczak, R. Keranen (Karlsruhe). EPJdirect C7 (2000) and hep-ph/9911345)

- Study $e^+e^- \rightarrow \tilde{t}\tilde{t}^*$, with $\tilde{t} \rightarrow \chi^0 c$ or $\tilde{t} \rightarrow \chi^\pm b$
- Polarised electron beams
- IDA to select signal.
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- $M_{\tilde{t}}$ to 0.5-1 GeV/c², $\cos\theta$ to 0.0004 - 0.0009.

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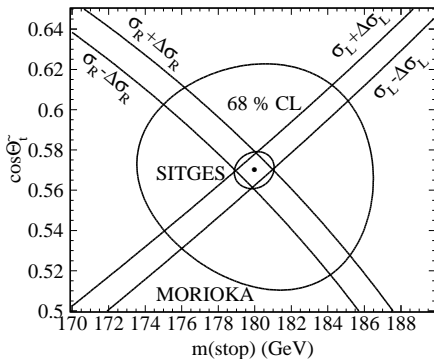
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- Study $e^+ e^- \rightarrow b\bar{b} \rightarrow b\bar{b}A$
- $b\bar{b}A$ Yukawa-coupling is proportional to $\tan \beta$
- Small signal, big background $t\bar{t}$.
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- Error 7% for $\tan \beta=50$. 5σ signal for $\tan \beta > 35$.

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Cascade decays

Full reconstruction of sparticles in cascade decays, yielding precision measurements.

(MB, proceedings of LCWS '04, Paric - hep-ph/0508247)

- Kinematic fit allows to fully reconstruct sparticles in cascade decays.
- Typically, one finds $\sigma(M)$ one to two orders of magnitude better than traditional methods
- Works for $\tilde{\tau}$, for multiple cascades, and to extract $M_{\tilde{\chi}}$
- ILC(SUSY)=LEP(SM)

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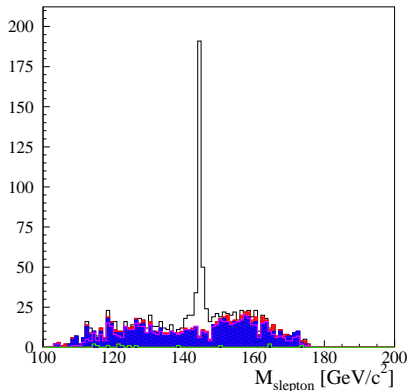
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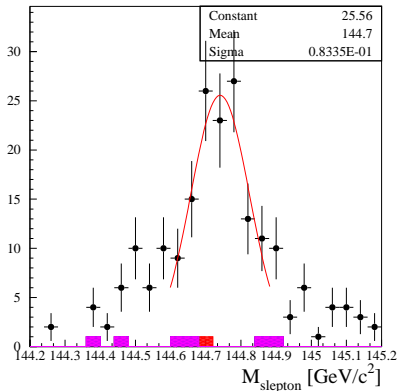


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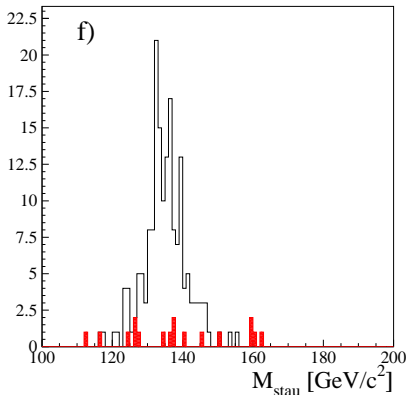
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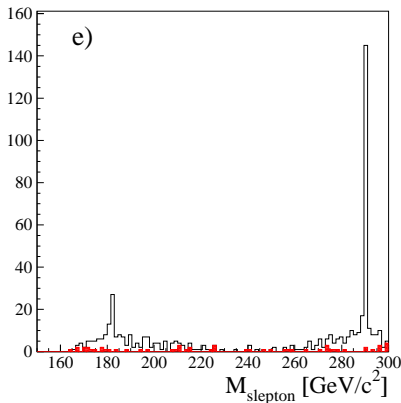
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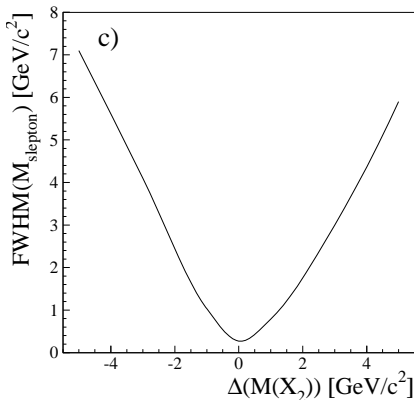
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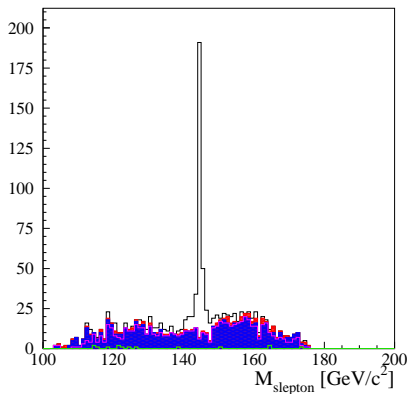


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Dark matter

The $\tilde{\chi}^0$ is a good CDM candidate, but there shouldn't be too much of them \rightarrow need a mechanism to annihilate.

Regions of interest

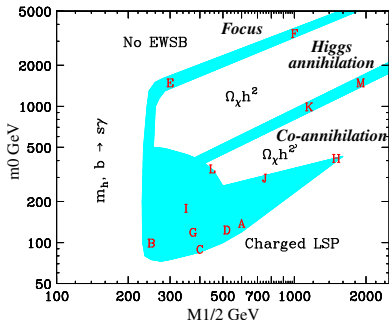
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 $\tilde{\chi}^0 \tilde{\tau} \rightarrow \tau \gamma$, $\Delta(M)$ small.
- Higgs annihilation region:
 $M_{\tilde{\chi}^0} = M_A/2$, resonant s-channel annihilation.
- Focus region: $\tilde{\chi}^0$ is Higgsino, so $\tilde{\chi}^0 \tilde{\chi}^0 \rightarrow WW$ or ZZ in t-channel possible.

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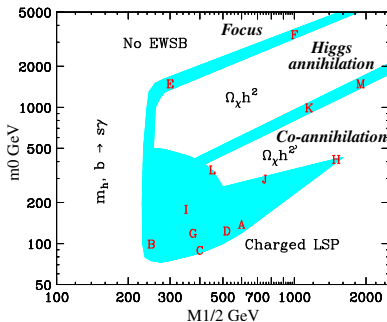


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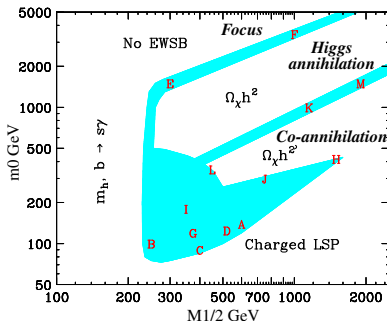


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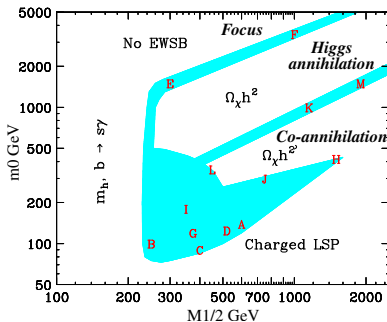


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Study of the Co-annihilation region (MB, P. Bambade, F Richard, Z. Zhang (LAL), hep-ph/0406010)

- Aim: measure $M_{\tilde{\tau}}$ at threshold
- Problem: $\gamma\gamma$
- Massive simulation ($O(100)$ Mevents done here), and design of cuts
- Optimisation of working point.
- Error on $M_{\tilde{\tau}}$ few 100 MeV/c², \rightarrow DM to a few % \approx PLANK .

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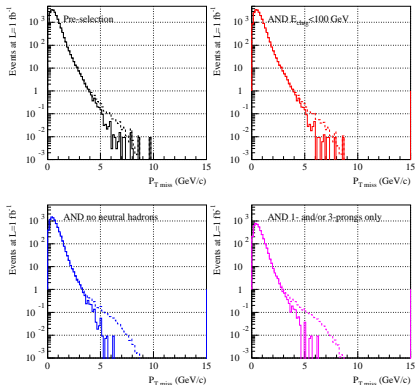
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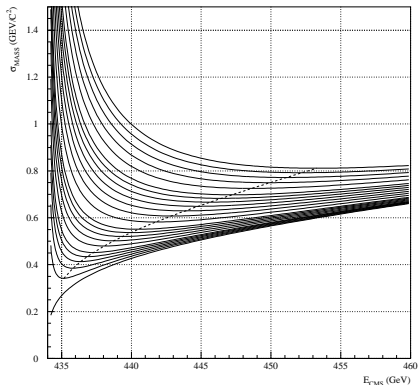
Generator cut set 2, different data cuts



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