Distinguishing the NMSSM and the MSSM using Fittino

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- NMSSM / MSSM parameters
- A problem observable point
- Fittino attempts at distinguishing MSSM/NMSSM at the "problem point"
- Future work

MSSM/NMSSM feautures

MSSM

- R-parity -> proton stability

NMSSM

- Additional singlet/singlino Superfield $\hat{S}$
- Mu term replaced by trilinear fields

$$\mu \hat{H}_1 \hat{H}_2 \rightarrow \lambda \hat{H}_1 \hat{H}_2 \hat{S} + \frac{\kappa}{3} \hat{S}^3$$

$$\mu eff = \lambda \langle \hat{S} \rangle$$

- 2 extra Higgs, scalar: H^1 H^2 H^3

  pseudoscalar: A^1 A^2

  charged $H^{\pm}$
- 1 extra neutralino χ^0_1 ,χ^0_2 ,χ^0_3 ,χ^0_4 ,χ^0_5

To make the task fair:

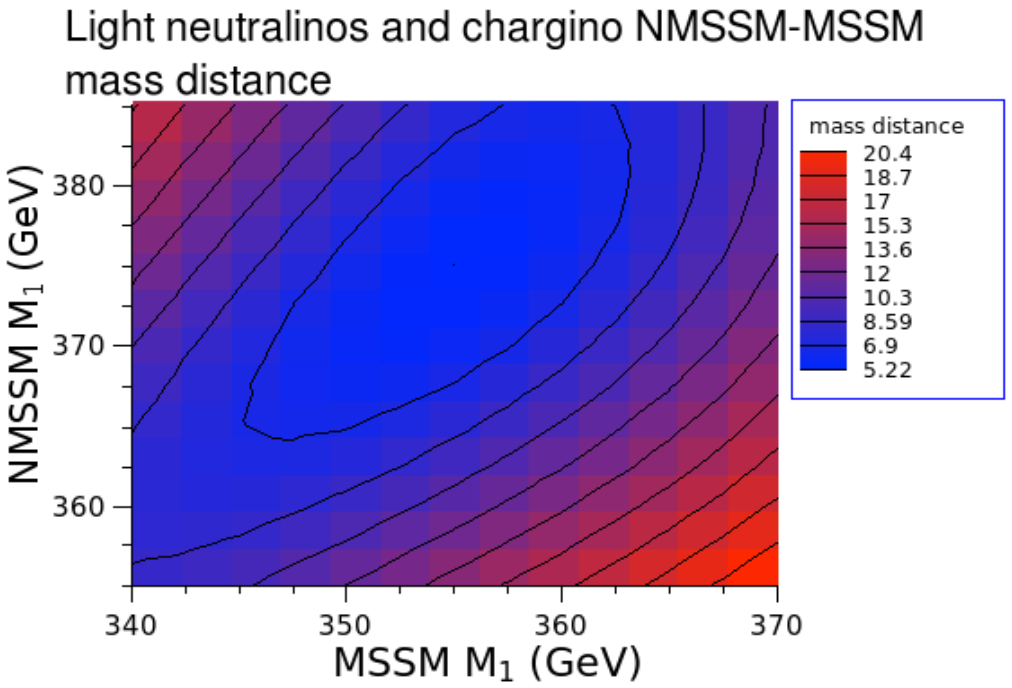
Assume that none of the NMSSM-specific particles are seen

A "difficult" NMSSM/MSSM point

Moortgat-Pick, Hesselbach, Franke & Fraas hep-ph/0502036 (ILC study)

	MSSM	NMSSM
M1	375 GeV	360 GeV
M2	152 GeV	147 GeV
Tan β	8	10
μ	360 GeV	-
μeff	-	457.5 GeV
κ	-	0.2
$m(\tilde{\chi}^0_1)$	138 GeV	138 GeV
$m(\tilde{\chi}^0_2)$	344 GeV	337 GeV
$m(\tilde{\chi}^\pm_1)$	139 GeV	139 GeV
$m(\tilde{e}_L)$	240 GeV	240 GeV
$m(\tilde{e}_R)$	220 GeV	220 GeV
$m(\tilde{\nu}_e)$	226 GeV	226 GeV

$$D_{NM} = \sqrt{\sum \left(m^{NMSSM}_{\chi^0_1} - m^{MSSM}_{\chi^0_1}\right)^2 + \left(m^{NMSSM}_{\chi^\pm_1} - m^{MSSM}_{\chi^\pm_1}\right)^2}$$



At the ILC cannot distinguish NMSSM/MSSM (at this Par point)

For s=400,500 GeV x-sects

Need s=650 GeV x-sects

Fittino NMSSM/MSSM fit

Schema:

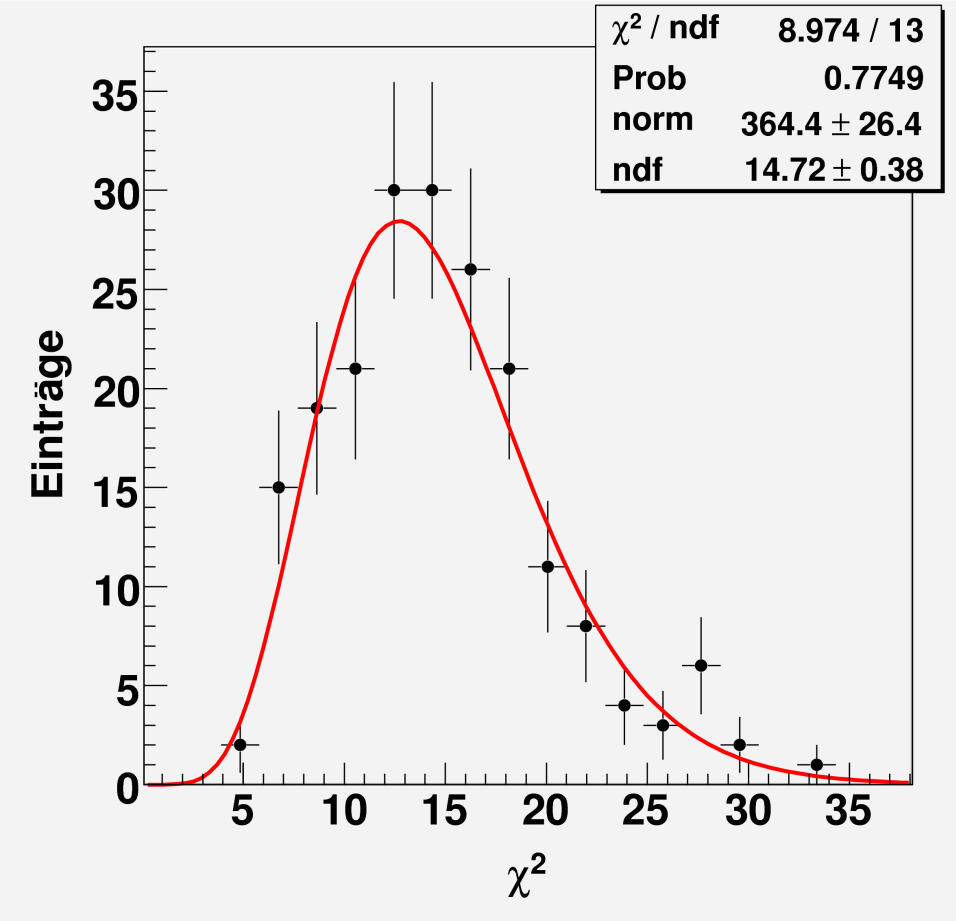
- Choose the "difficult" hep-ph/050236 NMSSM/MSSM point
- For model-specific parameters, μ (MSSM) and λ, κ, μeff (NMSSM) – **fix λ, κ and fit μ and μeff.**

So both NMSSM and MSSM fit to 22 parameters

- Fit the $\tilde{\chi}^0_1$, $\tilde{\chi}^0_2$, $\tilde{\chi}^\pm_1$, $\tilde{e}_L$, $\tilde{e}_R$, $\tilde{\nu}_L$ masses. Fix other masses
- Other observables $\sigma(e^+e^- \to \chi^{0,\pm}_{\text{light}})$
- NMSSM is the "true" model

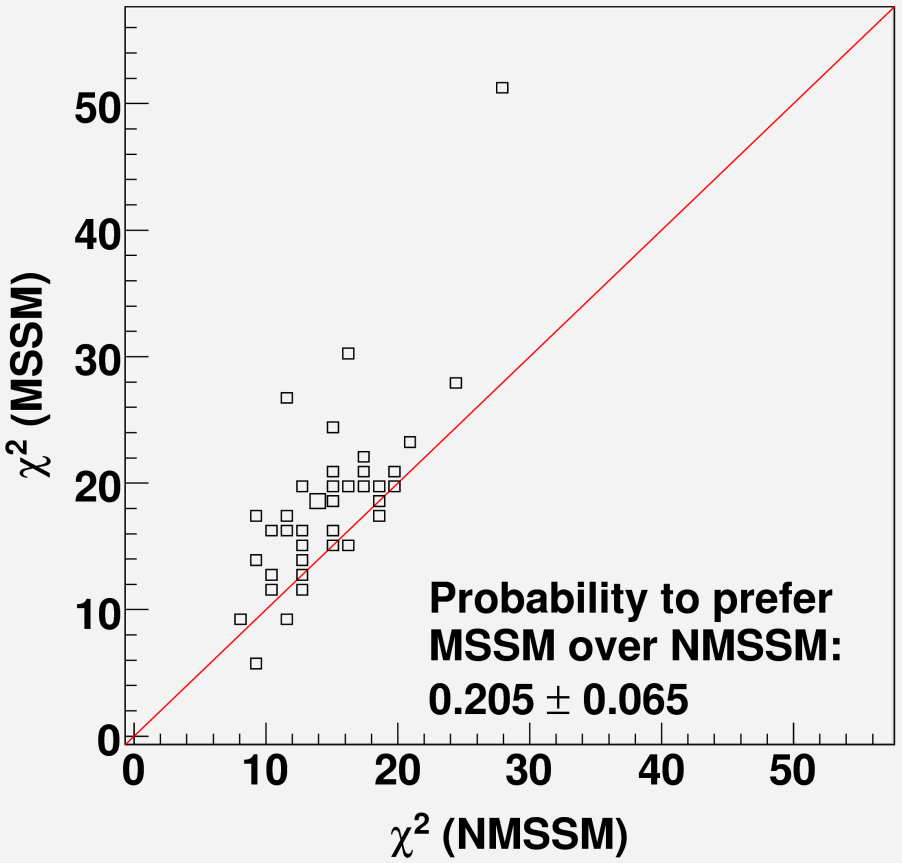
NMSSM ↔ NMSSM

Params - Obs = 15



NMSSM/MSSM χ^2 correlation

$s^{0.5}$ = 400,500 GeV
Polarised & Unpolarised Beams
50 Toyfits



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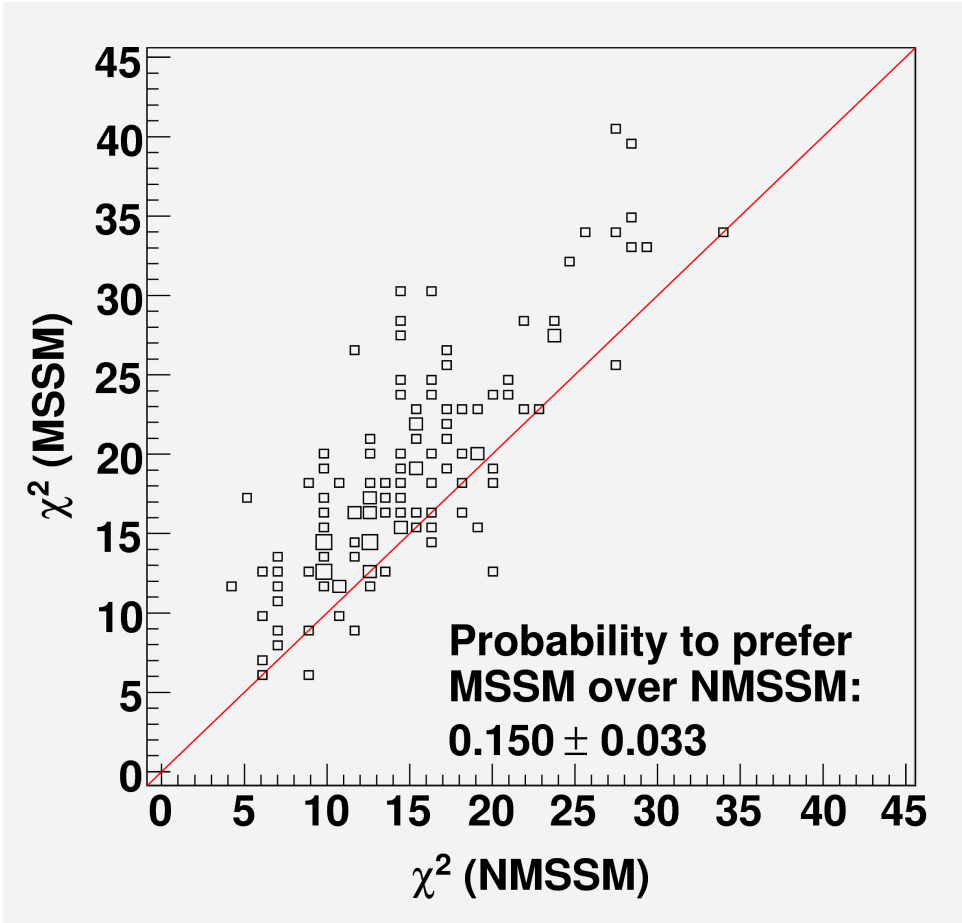
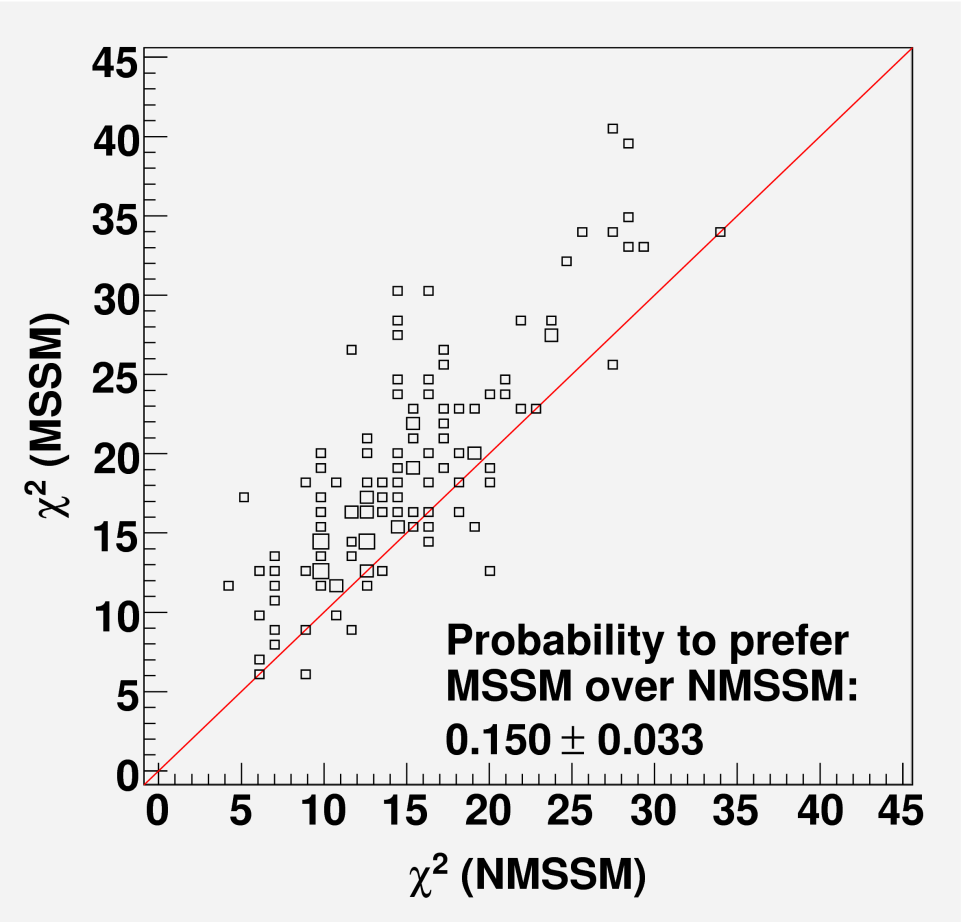


NMSSM/MSSM χ^2 correlation

$s^{0.5}$ = 400,500 GeV
Polarised&Unpolarised Beams
250 Toyfits

$s^{0.5}$ = 400,500,650 GeV
Polarised&Unpolarised Beams
250 Toyfits



MSSM(Param) <-> NMSSM(Obs)

# Job	chisq	TanBeta	M1
11	4027.256477	24.8969	509.551
14	4025.688755	23.1517	510.37
01	4043.016866	23.1182	510.046
27	3695.092157	25.6162	514.124
43	3923.791504	25.5593	375.707

Questions/Ongoing work

(1) More statistics – for χ^2 correlation what is the threshold for distinguishing models? 95%?

(2) include other observables at $s^{0.5}$=400,500 GeV

(3) Study Other NMSSM/MSSM "difficult points" ?

(4) Other suggestions?