

# BSM @ IPPP

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# Who are we?

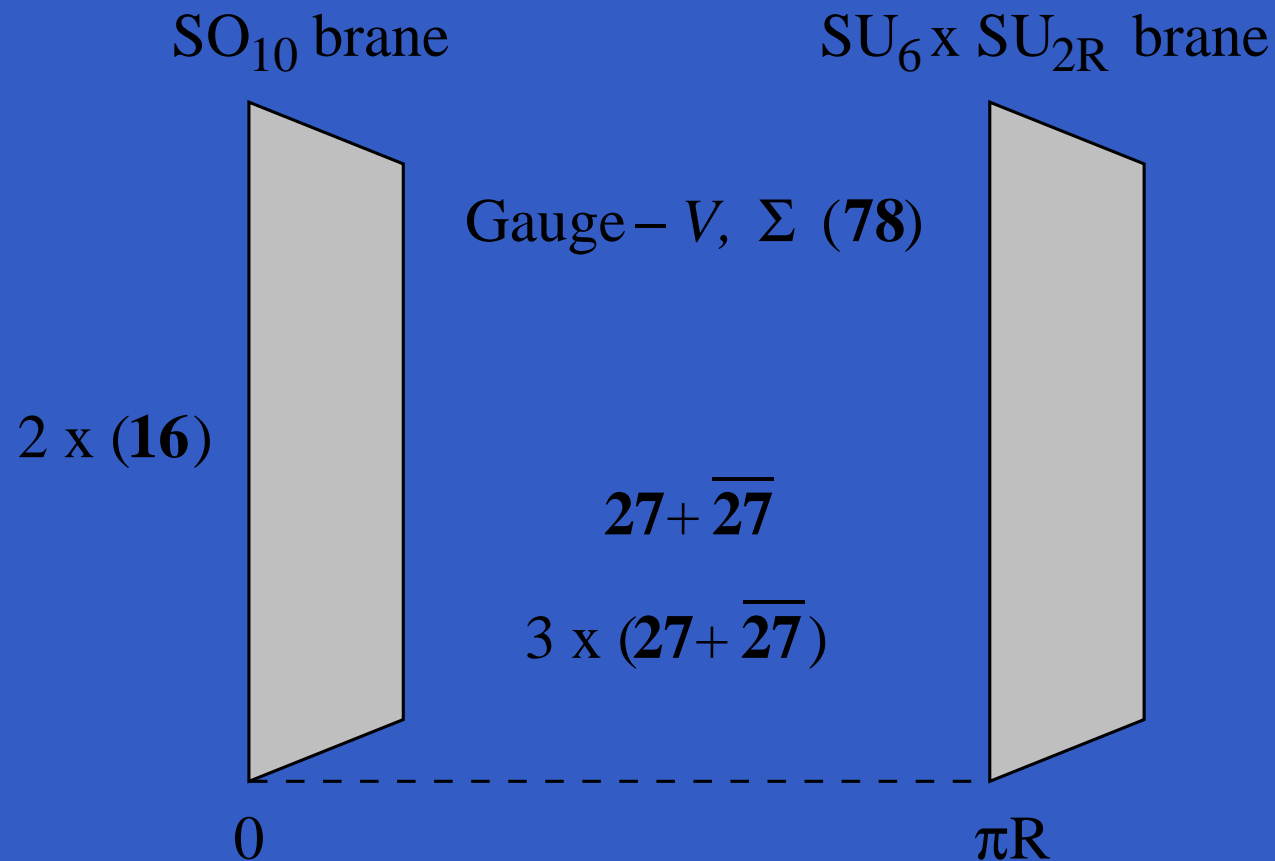


# Who are we?



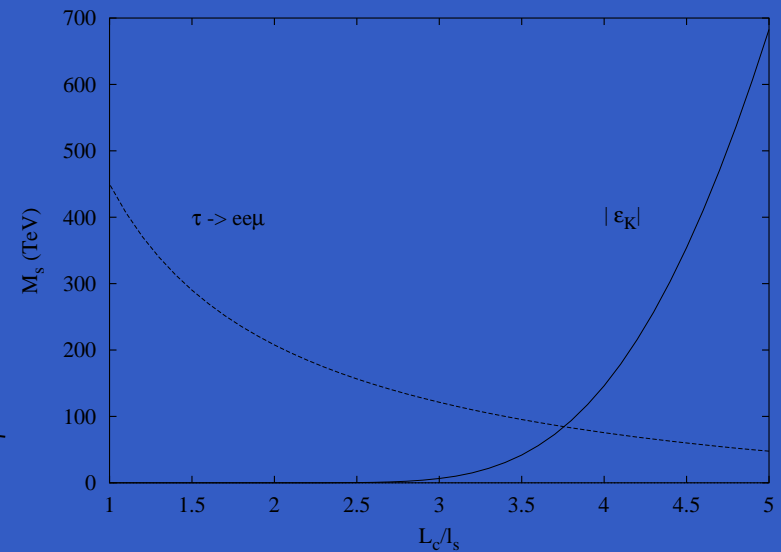
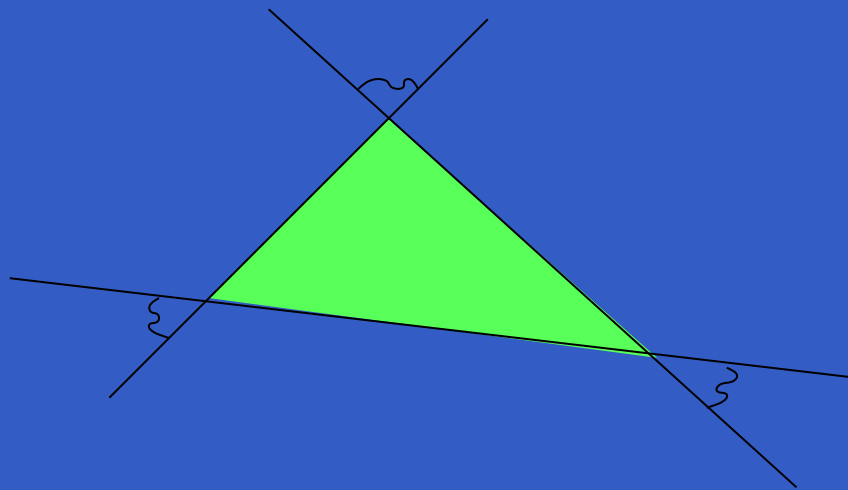
# String phenomenology

- Heterotic string (Forste): geometry of rank reduction



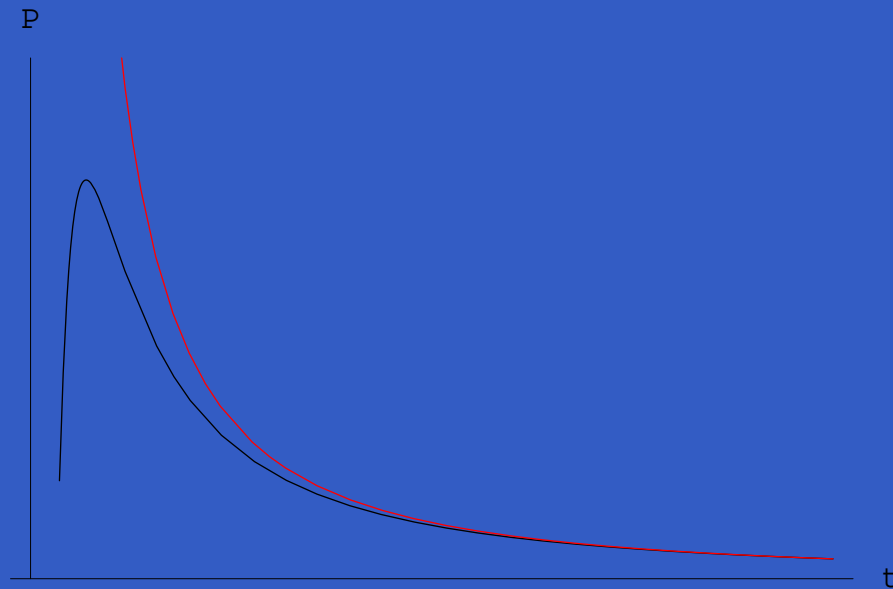
# String phenomenology

- Perturbation theory on intersecting D-branes (Abel, Goodsell + Owen, Schofield): Yukawas, FCNC's ( $M_{str} > 10^2 TeV$ )



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# String phenomenology

- Type IIA strings with fluxes (Zavala): possibility of obtaining de Sitter vacua within this theory?
- Type IIB strings with fluxes (Abel, Goodsell): couplings with non-trivial backgrounds

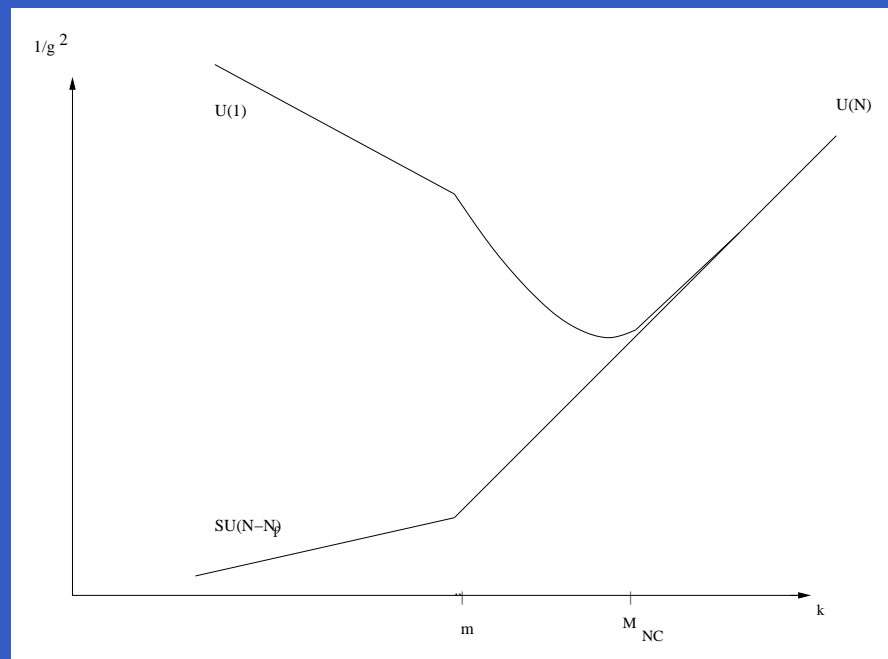
# String phenomenology

- The String Vacuum Project (Grellscheid - EU network): a searchable tool for string phenomenology. Can we falsify string theory?
- Production of black holes at colliders (Richardson, Kanti)



# String phenomenology

- Phenomenology of non-commutative field theories  
 $[x^\mu, x^\nu] = i\theta^{\mu\nu}$ : (Chu, Khoze, Levell, Travaglini, Abel)

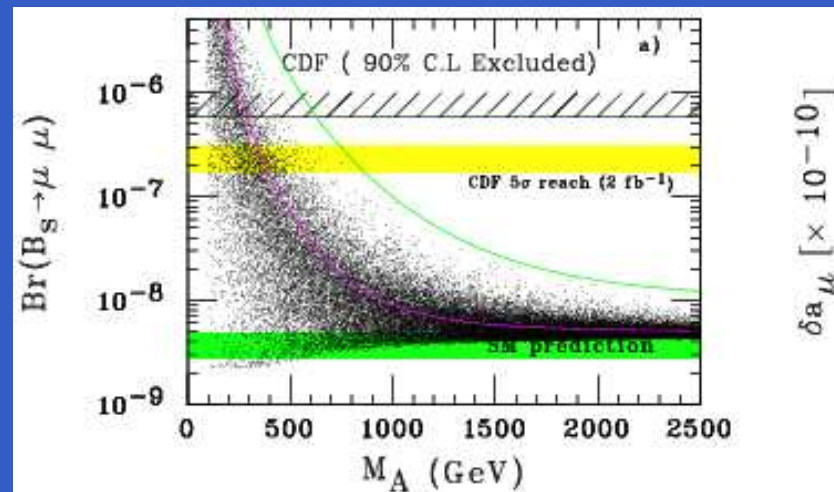


# SUSY phenomenology

- Scalar sector of general R-parity violating MSSM (Dedes, Rimmer, Schmidt-Sommerfeld): proof of no CP violation in neutral potential. Definition of convenient basis for calculations (hep-ph/0506209)
- Higgs mediated lepton flavour violating effects (Dedes): Discovery Potential of Super B factory. Study of LFV  $\tau \rightarrow 3l$  and  $B \rightarrow \tau\mu$ .

# SUSY phenomenology

- What happens if  $\text{BR}(B_s \rightarrow \mu^+ \mu^-) \sim 10^{-7}$  at the Tevatron? Constrains heaviest Higgs mass  $< 800 \text{ GeV}$ .



# SUSY phenomenology

- LHC/ILC Study Group (Weiglein): worldwide study group, spring 2002 - hep-ph/0410364

## Physics Interplay of the LHC and the ILC

The LHC / LC Study Group

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[G. Weiglein et al. '04]

Exploratory study

122 authors from  
75 institutions,  
472 pages

To appear in  
*Physics Reports*

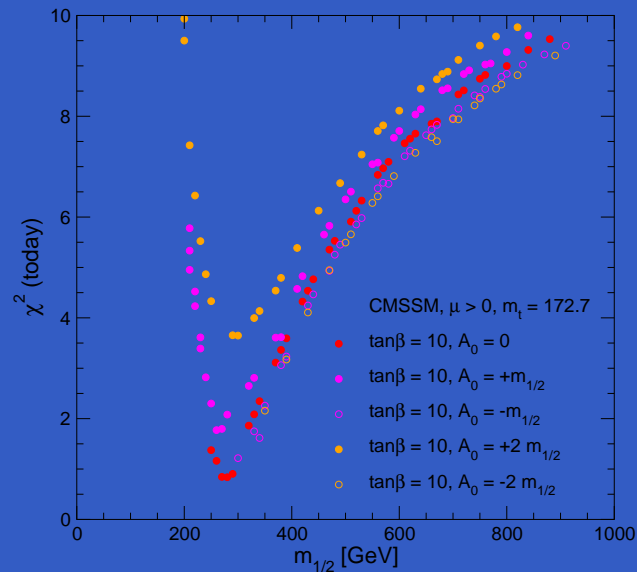
- [www.ippp.dur.ac.uk/~georg/lhcilc](http://www.ippp.dur.ac.uk/~georg/lhcilc)

# SUSY phenomenology

- CMSSM w/ precision observables and WMAP: e.g.  $M_W$ ,  $\sin^2 \theta_{eff}$ ,  $(g - 2)_\mu$ ,  $\text{BR}(b \rightarrow s\gamma)$  (Weiglein)

[J. Ellis, S. Heinemeyer, K. Olive, G. Weiglein '04]

CMSSM with dark matter constraints,  $\tan \beta = 10$ :



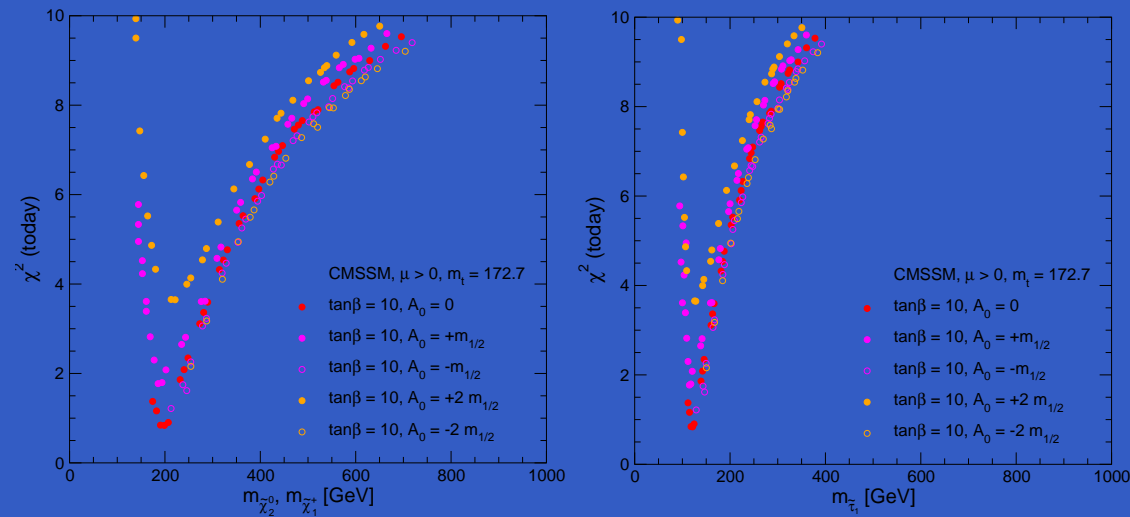
⇒ very good description  
of the data

preference for relatively  
small mass values

# SUSY phenomenology

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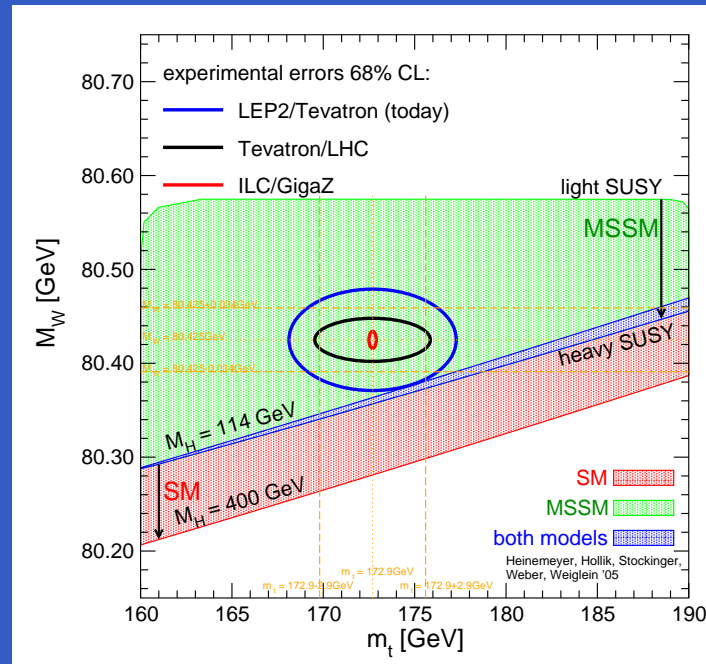
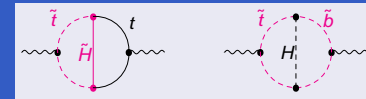


⇒ Good prospects for the LHC and ILC

# SUSY phenomenology

- Most precise evaluation of EW precision variables in MSSM (Stockinger, Weiglein): need to understand RG procedures.

Experiment prefers MSSM. e.g.  $M_W \rightarrow$



# SUSY phenomenology

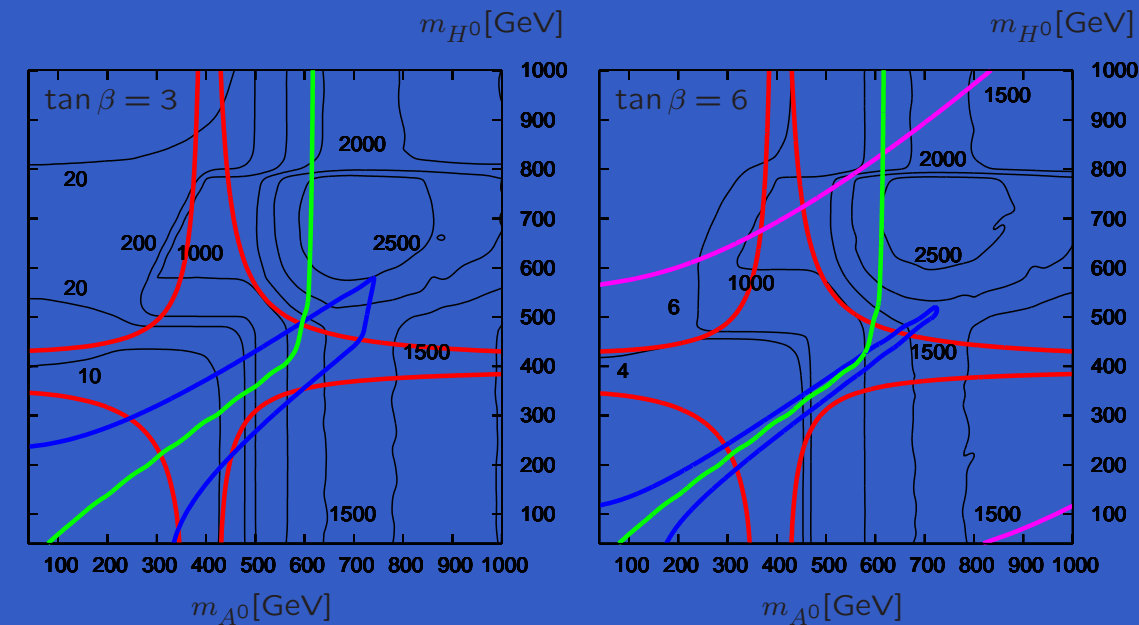
- Impact of SUSY loop corrections on Tevatron and LHC Higgs searches (Weiglein): drastic effects on Tevatron limits.
- EDMs (abel): Correlations between  $d_e$ ,  $d_{Hg}$ ,  $d_n$ .  
Non-observation of  $d_e$  at  $10^{-30} e\text{cm}$  implies  $M_{SUSY} > 100\text{TeV}$ .



# SUSY phenomenology

- Two Higgs Doublet Model MSSM (Brein): Study  $H^\pm W^\pm$  production at LHC to unravel Higgs sector.

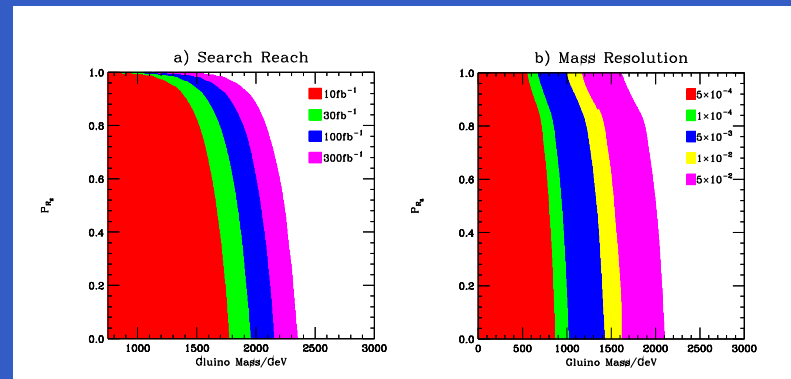
inclusive hadronic cross section  $\sigma(W^\pm H^\mp)$  for  $M^2 = m_{A^0}^2/2$



constraints: magn. moment  $a_\mu$  +  $\rho$ -parameter +  $\mu$  +  $\tan \beta$  + pert. unitarity + vac. stability

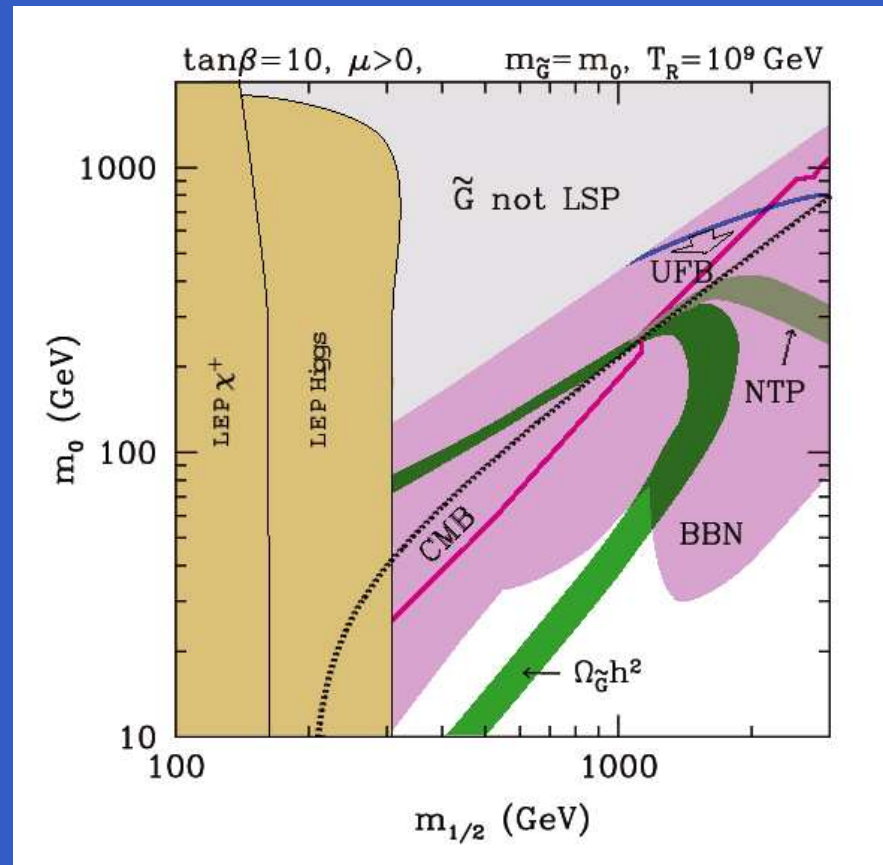
# SUSY phenomenology

- Monte-Carlo event generators (Richardson, Gigg, Grellscheid): HERWIG++
- Split SUSY (Richardson): observation and classification of R-hadrons at LHC and ILC



# Dark Matter, $\nu$ 's and baryogenesis

- Gravitino DM (Cerdeno)

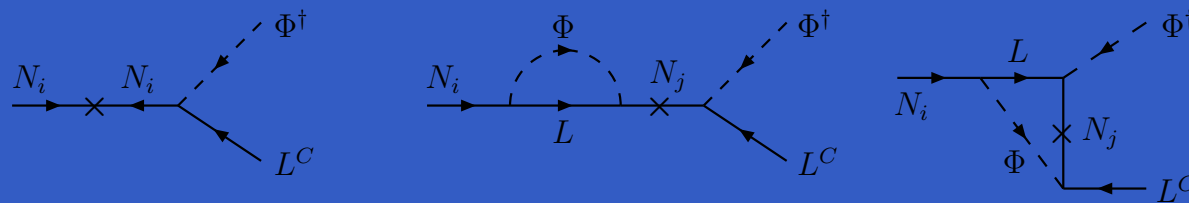


# Dark Matter, $\nu$ 's and baryogenesis

- Neutrino masses in  $R$ -parity violating MSSM (Dedes, Rimmer): Complete one-loop calculation of masses and mixings
- Natural Dirac and pseudo-Dirac neutrinos in SUGRA and Affleck-Dine leptogenesis (Abel, Dedes, Page)
- Supermassive gravitinos and thermal leptogenesis (Pascoli)

# Dark Matter, $\nu$ 's and baryogenesis

- Electroweak scale resonant leptogenesis  
(Underwood): how to accommodate  $T_R < 10^9 GeV$ ?



# Our collaborators

Allanach, Allahverdi, Asakawa, Baek, Bowcock, Branco, Burgess, Carena, Choi, Chu, Cvetcic, de Austi, Degrassi, Dixon, Dreiner, Ellis, Gray, Hannestad, Harris, Heinemeyer, Hewett, Hollik, Huffman, Hugonie, Jaeckel, Jedamzik, Jokinen, Kanemura, Kanti, Khalil, Kilian, Kim, Lebedev, Marquard, Masip, Mazumdar, Mrenna, Munoz, Nilles, Olive, Parker, Petcov, Pilaftsis, Plehn, Quevedo, Raidal, Ringwald, Rosiek, Roszkowski, Santiago, Schwetz, Svrcek, Tamvakis, Tasinato, Teixeira, Travaglini, Vaudrevange, Wagner, Webber, Wingerter

# Conference highlights (2003-)

- 3 × Annual theory meetings
- 5 × LHC/LC study meetings
- 2 × Exotic signals at Hadron Colliders
- UK HEP forum - pinning down the neutrino
- World according to WMAP
- String Phenomenology 2003 (founded at IPPP in 2002)
- BSM meeting, Sussex, Sept 2003

# Conference highlights (2003-)

- Neutrinoless double beta decay, April 2004
- UK HEP forum: from Tevatron to LHC, April 2004
- post-Strings 2004
- ECFA-DESY LC Workshop, Sept 2004
- New trends in PP and Cosmology, Sept 2004



# Conference highlights (2003-)

- C++ MC developers' forum, Jan 2005
- HEP Young researchers' meeting, Jan 2005
- UK HEP forum: Dark Matter, Cosmology and Particle Physics, May 2005
- Theory and experiment in Quantum Gravity
- Pre-SUSY 2005, June/July 2005
- SUSY 2005, July 2005
- UK Cosmology meeting, Sept 2005
- $\nu$ -mass meeting, Dec 2005