

Phase space analysis of models of supersymmetry

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2. Model description
3. Likelihood function
4. Markov Chains
5. Constraints
6. Phase Spaces
7. Implications
8. Conclusion

- Attempt to explore the phase space of various models of SUSY
 - Predict spectrum (SoftSUSY)
 - Observables (Feyn-Higgs, micrOmegas, SUSY-POPE)
- Determine preferred regions
 - Constrain models against list of observables
 - Calculate χ^2 from global likelihood function

VCMSSM (very CMSSM)

- Much like CMSSM
- Imposes GUT scale condition
 $\rightarrow B_0 = A_0 + m_0$
- Removes a degree of freedom
- 3 free parameters

MSUGRA

- VCMSSM + constraint on gravitino
 $\rightarrow m_0 = m_{3/2}$
- Need non-gravitino LSP (for Cosmology to be preserved)

Constraints from one sided exclusion limits
 $BR(B_s \rightarrow \mu\mu), M_h$

Experimentally measured value

Model-predicted value

$$\chi^2 = \sum_i^N \frac{(C_i - P_i)^2}{\sigma(C_i)^2 + \sigma(P_i)^2} + \chi^2(\text{one-sided})$$

$$+ \chi^2(\text{SUSY-searches}) + \sum_i^M \frac{(f_{SM_i}^{obs} - f_{SM_i}^{fit})^2}{\sigma(f_{SM_i})^2}$$

Limits on direct searches for SUSY (LEP)

Standard model parameters
 $\Delta\alpha_{had}, m_t, M_Z$

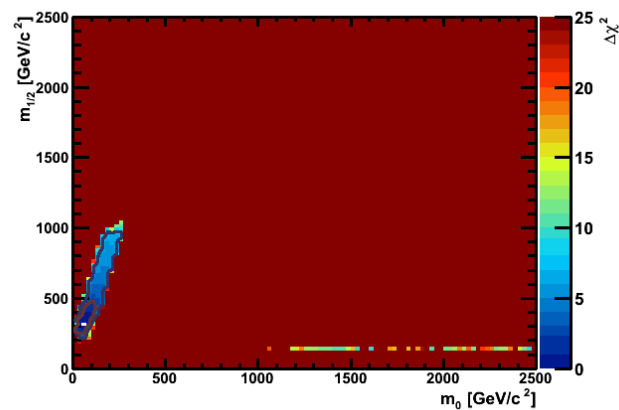
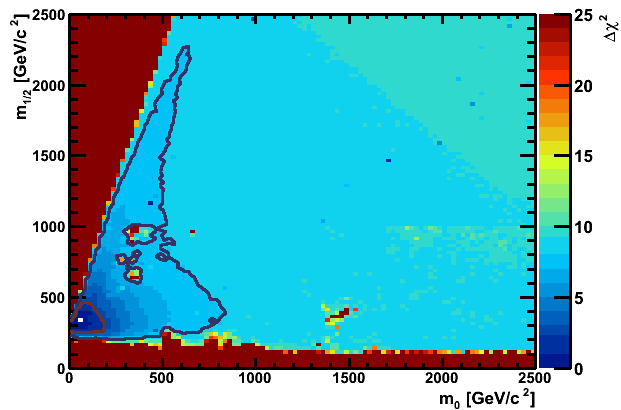
- Standard MCMC approach
 - Vary all input parameters simultaneously
 - Individually minimise χ^2 w.r.t. each parameter
- “Embarassingly parallel” method
 - Run multiple chains to sample space
 - Avoid bias by implementing random starting parameters

- General (30 constr.)
 - $\text{BR}(b \rightarrow s\gamma)$
 - $(g-2)_\mu$
 - Γ_Z
 - Dark Matter
 - micrOmegas calculates Ω_{CDM} for a given spectrum
 - Sampling carried out with constraint off
- Constraints can be turned on and off with no resampling required.

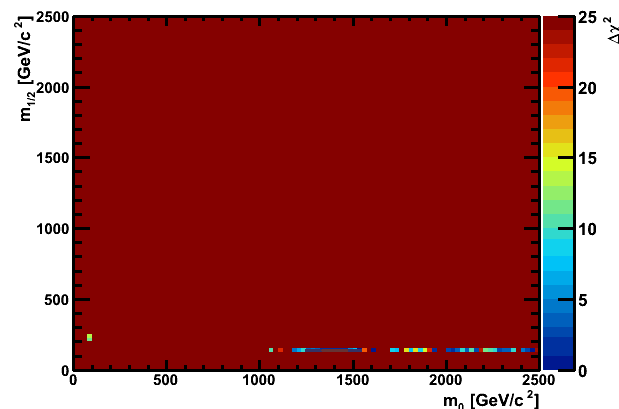
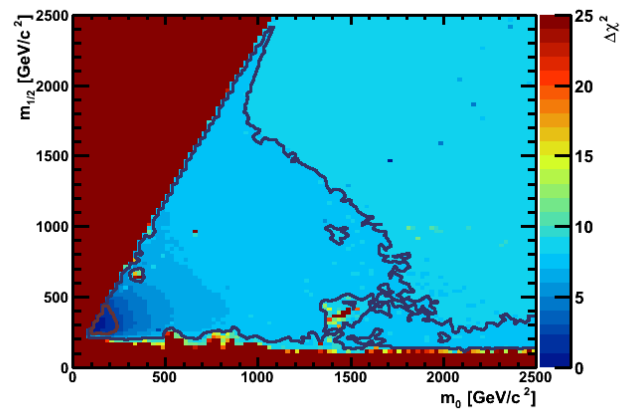
No CDM constraint

CDM constraint

VCMSSM



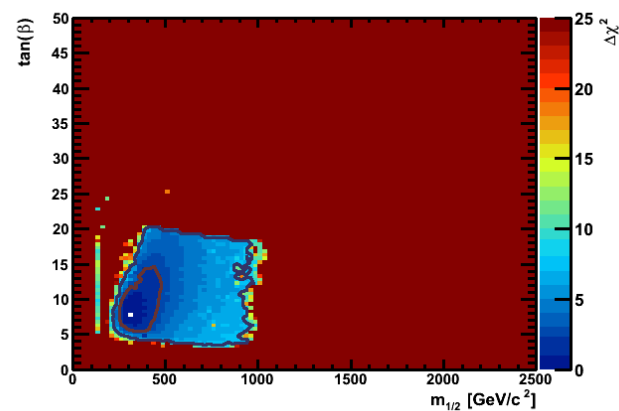
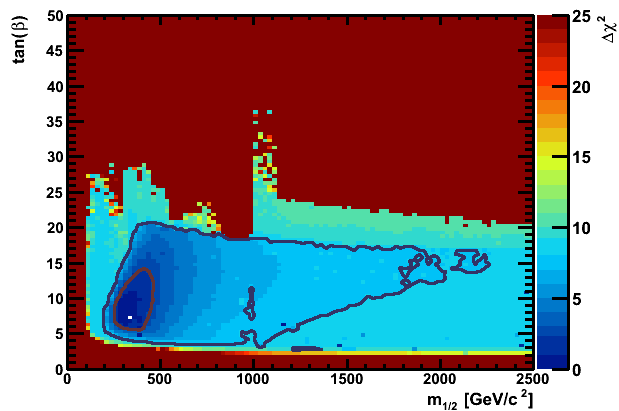
mSUGRA



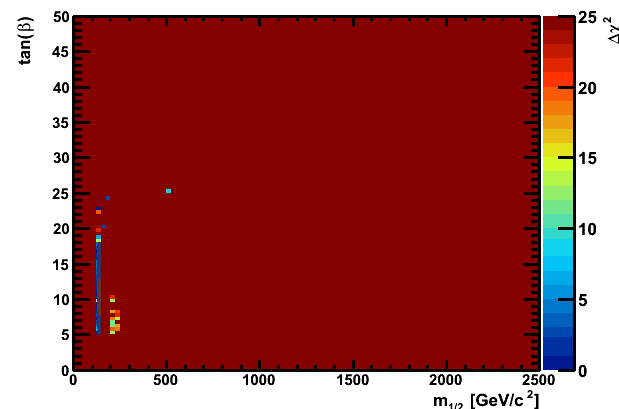
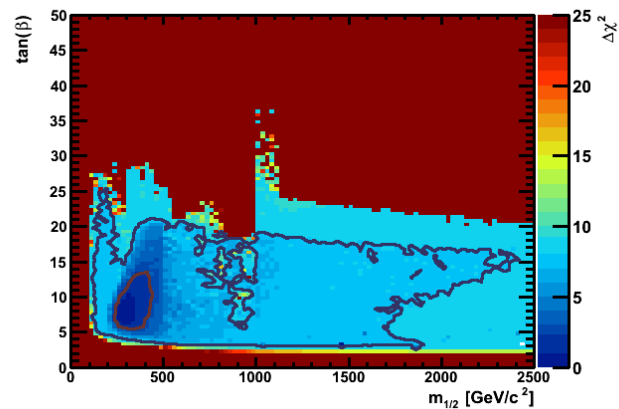
No CDM constraint

CDM constraint

VCMSSM



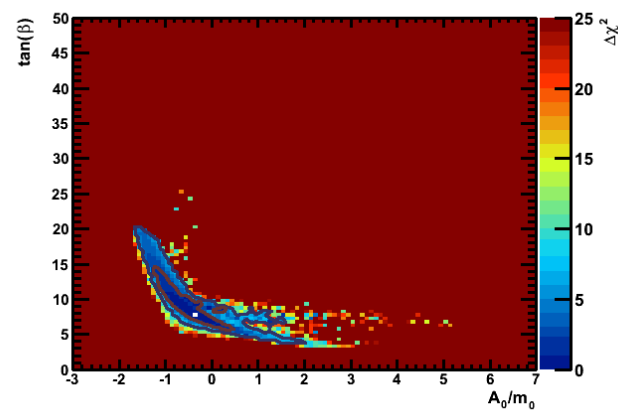
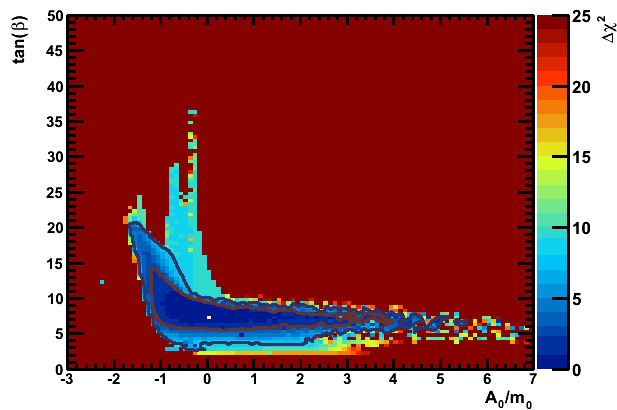
mSUGRA



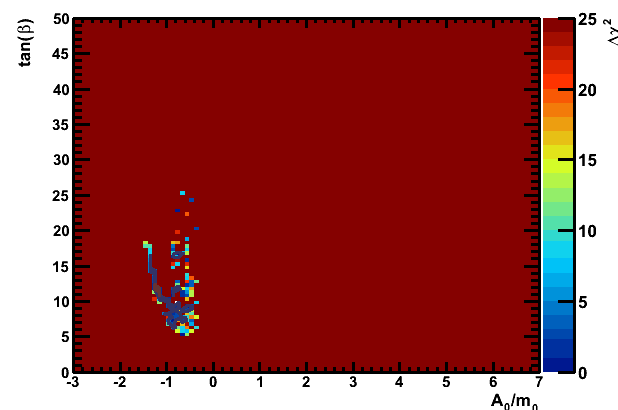
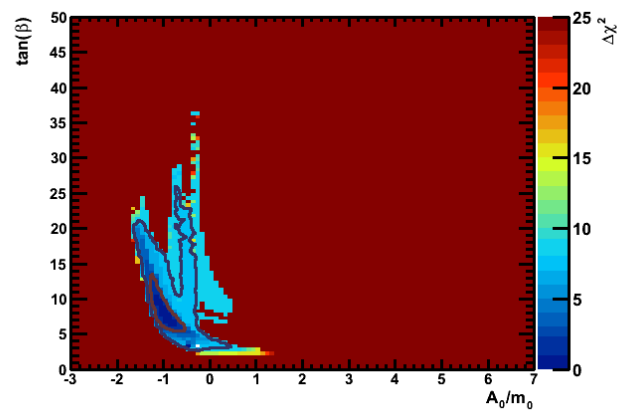
No CDM constraint

CDM constraint

VCMSSM



mSUGRA



	VCSSM	MSUGRA
No CDM	21.5 (55,345,0,7.5)	23.0 (120,300,-100,7.5)
With CDM	22.0 (60,310,-20,8)	32.0 (2450,130,-1400,10)

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

Comments

All of these points lie near one of the benchmark points (respectively LM1/LM6, LM2, LM1, LM10)

As can be seen from the phase space, mSUGRA suffers hugely from applying the CDM constraint

- The best fit regions for all situations show best fit regions in regions favouring early discovery
- If SUSY is of CMSSM/SUGRA flavour and has consistent electroweak behaviour would expect an “early” signal