Parameter determination (or property determination) in “m oderately” constrained models at the LHC.

Christopher Lester

Note to people who only see this talk on the web:
You only get to see the “results”. The actual discussion of Sampling Theory and Bayesian Inference and why it is an important way of approaching the subject of the talk is only on the blackboard below, and the chalk probably won't stick to the file on the web!

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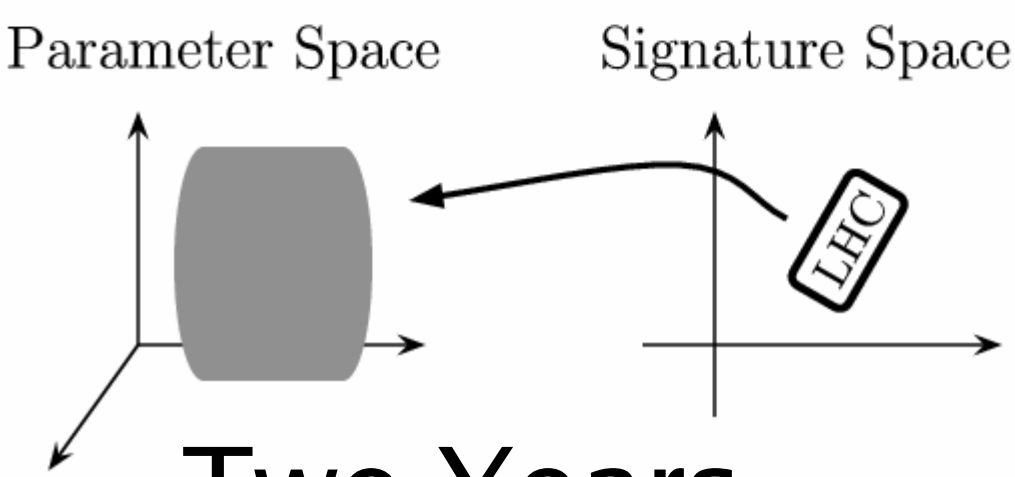
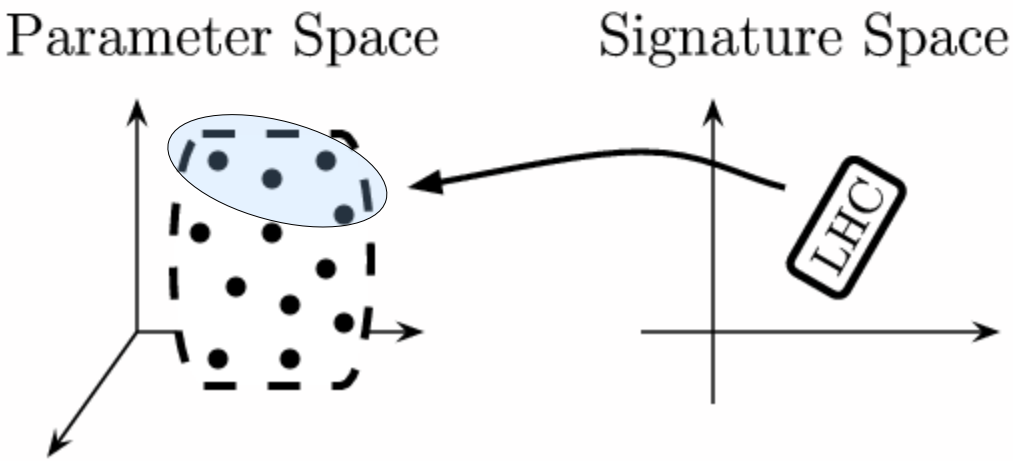
Work in association with members of the “Cambridge SUSY Working Group”.
http://www.hep.phy.cam.ac.uk/atlas/susy/susywg.html



Two Years

Six Years



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hep-ph/0507283

What is WMAP trying to tell us?

Omega_DM h^2 = 0.1126 +0.0081 −0.0091
delta((g-2)_mu)/2 = 19.0 +- 8.4 * 10^-10
BR(b->s gamma) = 3.52 +- 0.42 * 10^-4
mb(mb)^MSBAR = 4.2 +- 0.2 GeV
mtop = 172.7 +- 2.9 GeV

Sparticle mass bounds from exiting searches:

chi1>37 GeV, chgino>67.7 GeV,
slepton>88 GeV etc ...

Look at model of 7 free parameters:
(CMSSM + important SM quantities)

m0, A0, m1/2, tanB, mTop, mBottom, alpha_Strong(mZ)

Grid scan granularity 1% needs 10^14 points to cover space.

Metropolis manages with fewer than 10^7 points.

7-D

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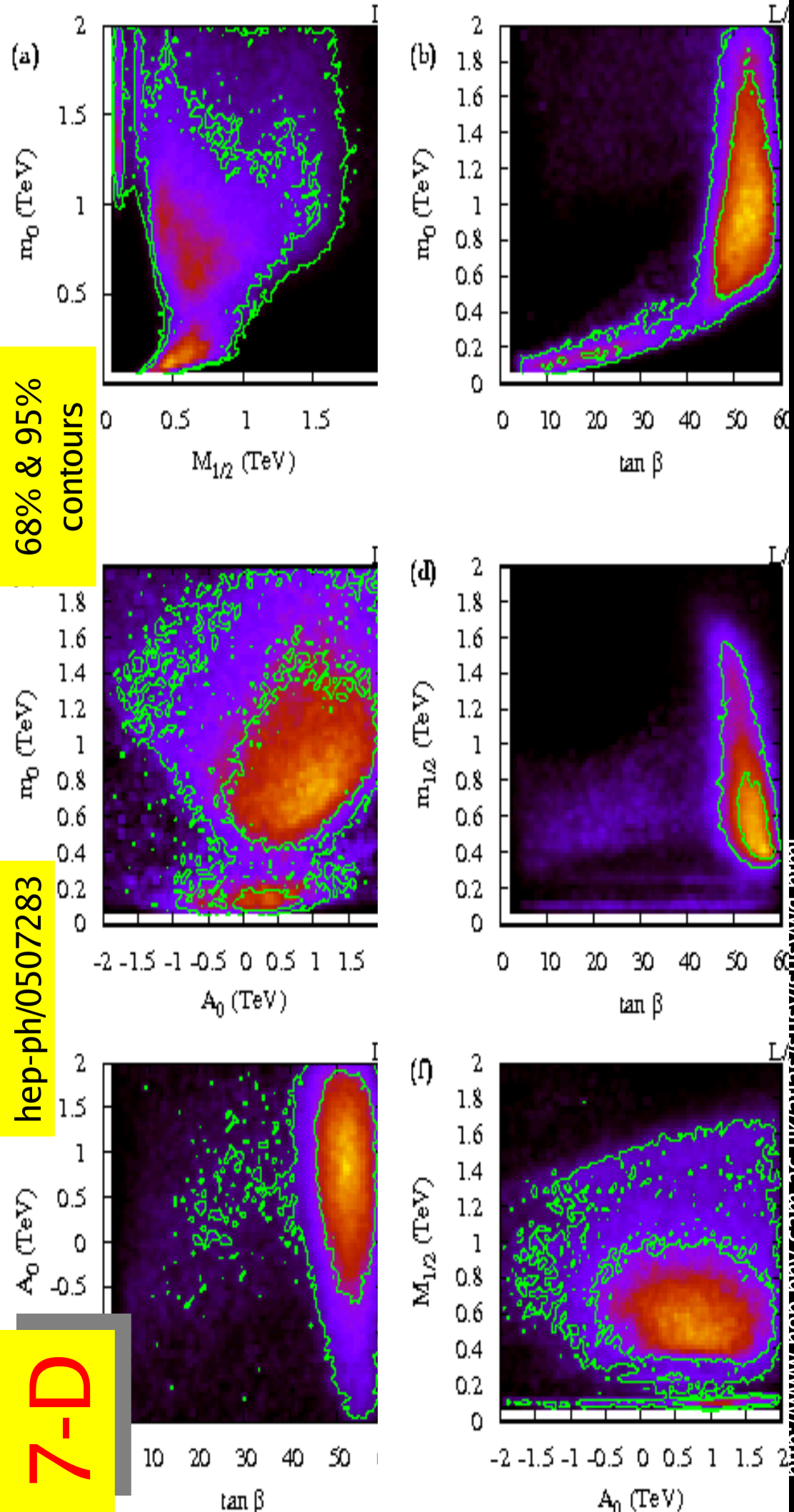

68% & 95% contours

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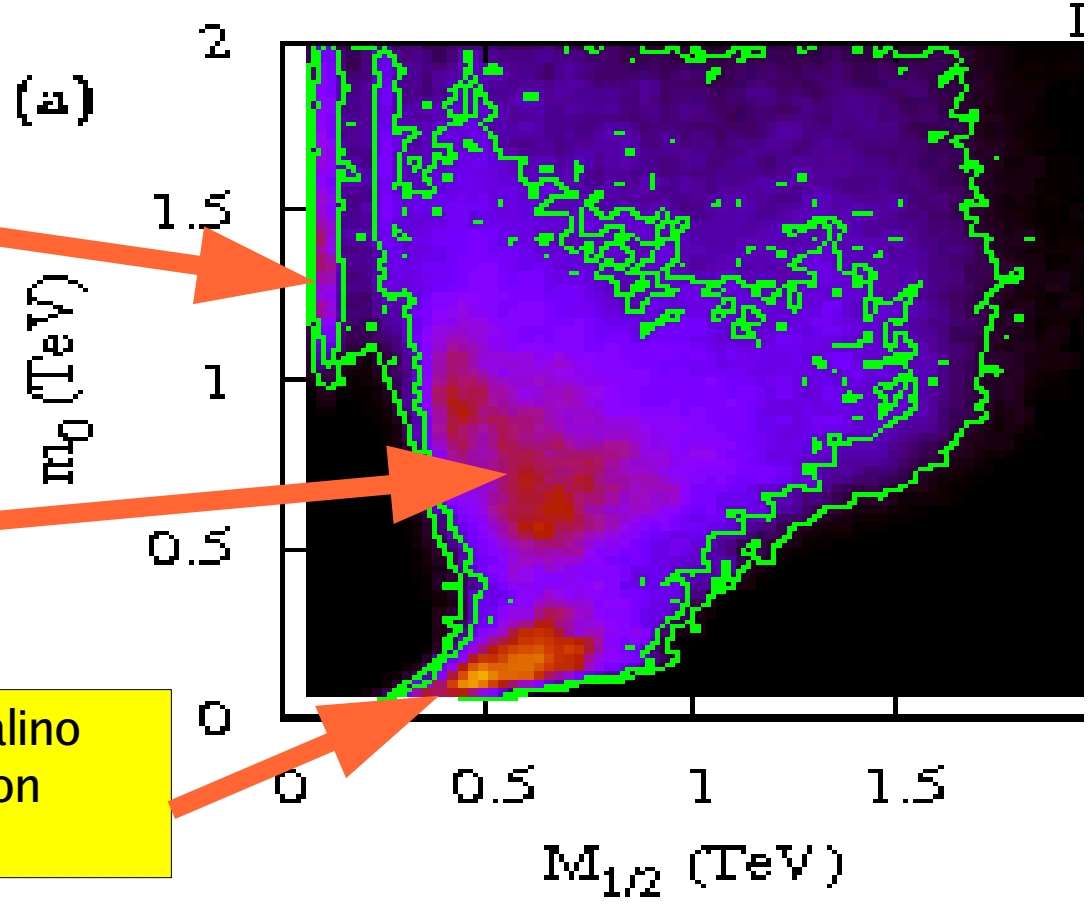
Degenerate regions are found!



h0 pole region

Pseudoscalar higgs A0 s-channel annihilation region

Slepton-neutralino co-annihilation region

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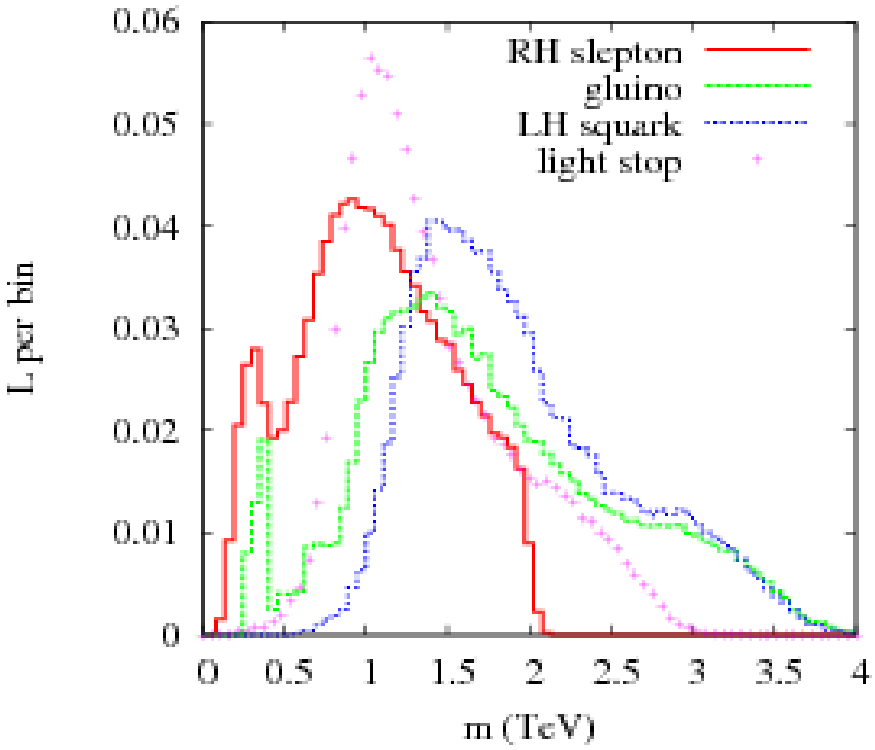
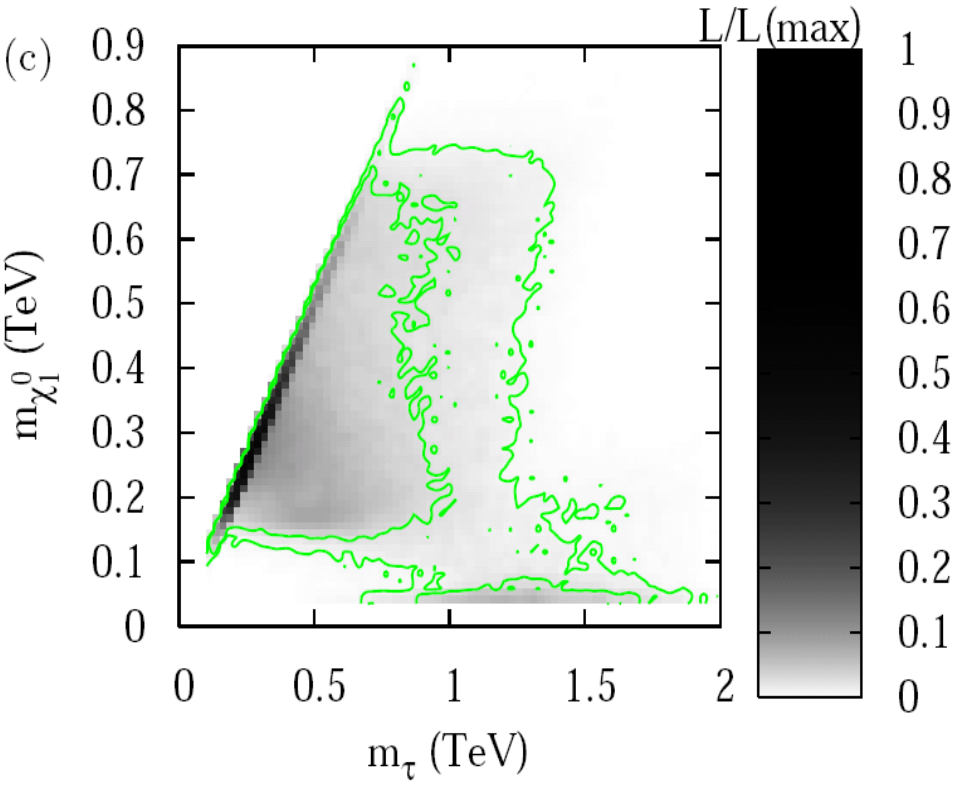
Look at just the sparticle masses:





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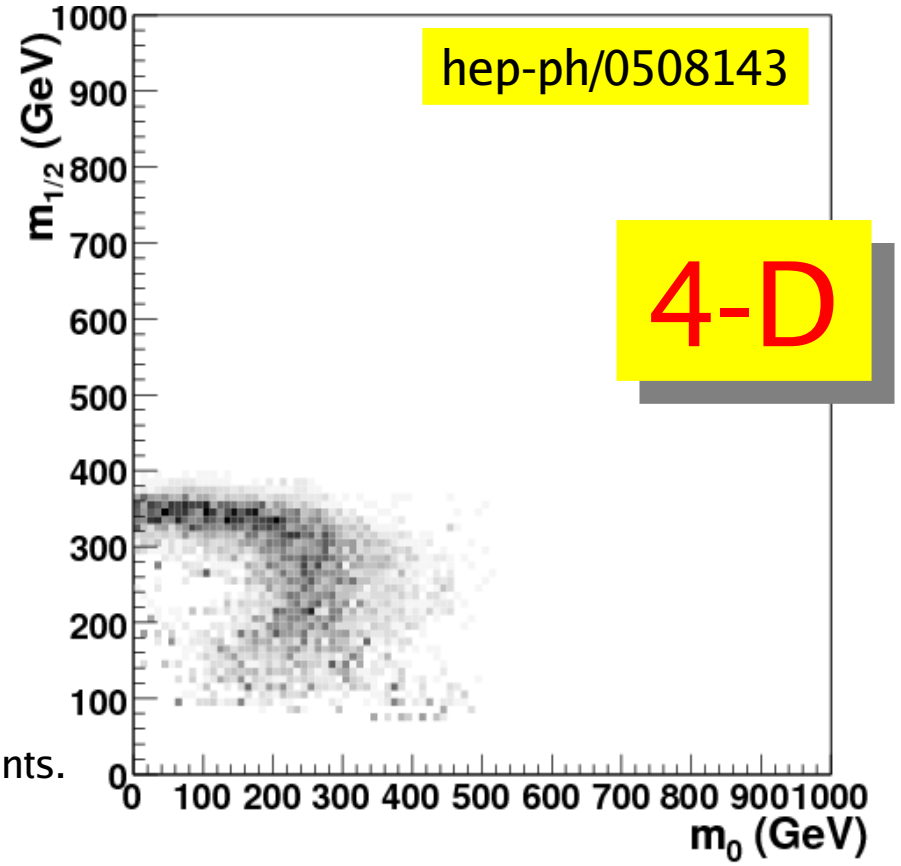
What might a count of events with missing transverse momentun > 500 GeV tell us in CMSSM (mSUGRA) ?

(Experimental "data" happens to be a WMAP favoured point for this scan)



Only 15,000 points needed by Metropolis Algorithm.

4-D grid scan with 1% granularity would take 100,000,000 points.

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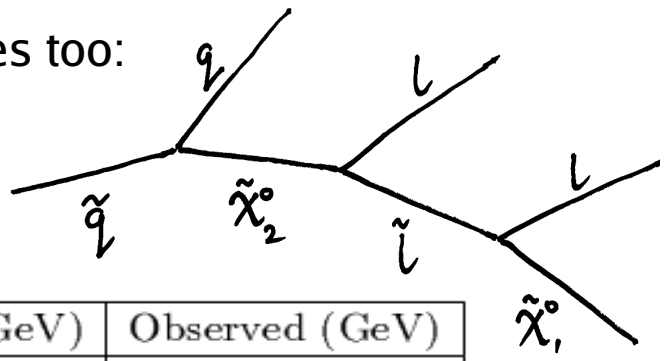
Claim to measure some edges too:



Edge	Predicted (GeV)	Observed (GeV)
ll edge	57.64	57.5±2.5
llq edge	600.1	600±10
llq threshold	134.0	150±30
lq max edge	592.1	590±10
lq min edge	181.7	180±10

Must be really careful with the interpretation or you delude yourself very easily! Many sparticles could generate the edges you see ...

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Name	Hieracrchy
H_1	$m_{\tilde{q}} > m_{\tilde{\chi}^0_2} > m_{\tilde{e}_L} > m_{\tilde{\chi}^0_1}$
H_2	$m_{\tilde{q}} > m_{\tilde{\chi}^0_3} > m_{\tilde{e}_L} > m_{\tilde{\chi}^0_1}$
H_3	$m_{\tilde{q}} > m_{\tilde{\chi}^0_3} > m_{\tilde{e}_L} > m_{\tilde{\chi}^0_2}$
H_4	$m_{\tilde{q}} > m_{\tilde{\chi}^0_4} > m_{\tilde{e}_L} > m_{\tilde{\chi}^0_1}$
H_5	$m_{\tilde{q}} > m_{\tilde{\chi}^0_4} > m_{\tilde{e}_L} > m_{\tilde{\chi}^0_2}$
H_6	$m_{\tilde{q}} > m_{\tilde{\chi}^0_4} > m_{\tilde{e}_L} > m_{\tilde{\chi}^0_3}$
H_7	$m_{\tilde{q}} > m_{\tilde{\chi}^0_2} > m_{\tilde{e}_R} > m_{\tilde{\chi}^0_1}$
H_8	$m_{\tilde{q}} > m_{\tilde{\chi}^0_3} > m_{\tilde{e}_R} > m_{\tilde{\chi}^0_1}$
H_9	$m_{\tilde{q}} > m_{\tilde{\chi}^0_3} > m_{\tilde{e}_R} > m_{\tilde{\chi}^0_2}$
H_{10}	$m_{\tilde{q}} > m_{\tilde{\chi}^0_4} > m_{\tilde{e}_R} > m_{\tilde{\chi}^0_1}$
H_{11}	$m_{\tilde{q}} > m_{\tilde{\chi}^0_4} > m_{\tilde{e}_R} > m_{\tilde{\chi}^0_2}$
H_{12}	$m_{\tilde{q}} > m_{\tilde{\chi}^0_4} > m_{\tilde{e}_R} > m_{\tilde{\chi}^0_3}$

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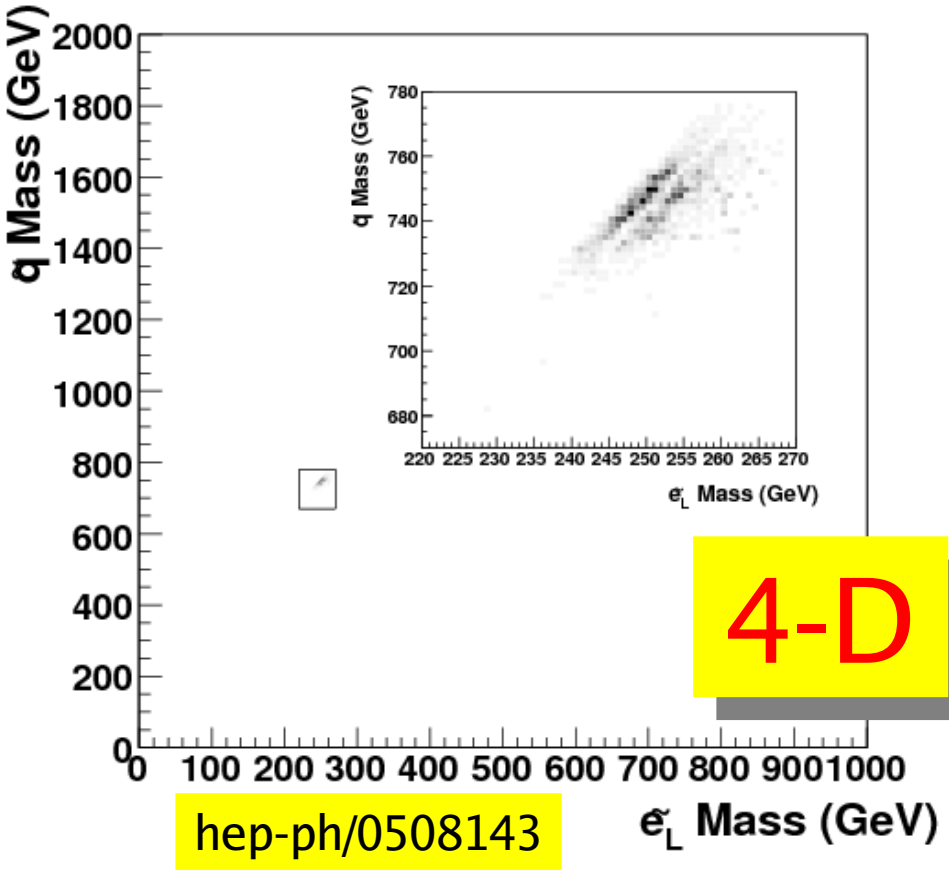
Look! Some degeneracy!

Why?

Right or left sleptons can look like each other to a simple analysis.

Perhaps other observables (lepton counts) would separate them ...



4-D

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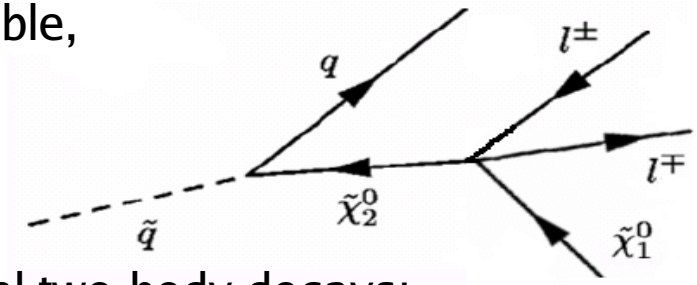
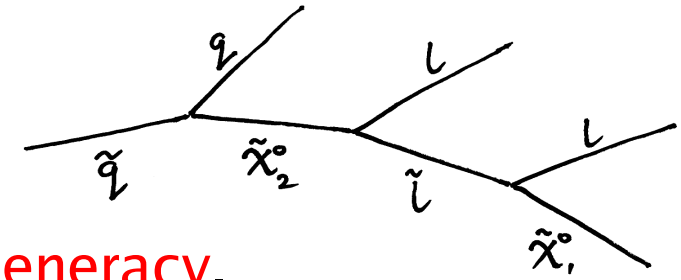
But must continue to make things more general.

Break higgs doublet universality.
Gain two new parameters, mu and mA.
(or equivalently mHu, mHd at GUT scale)

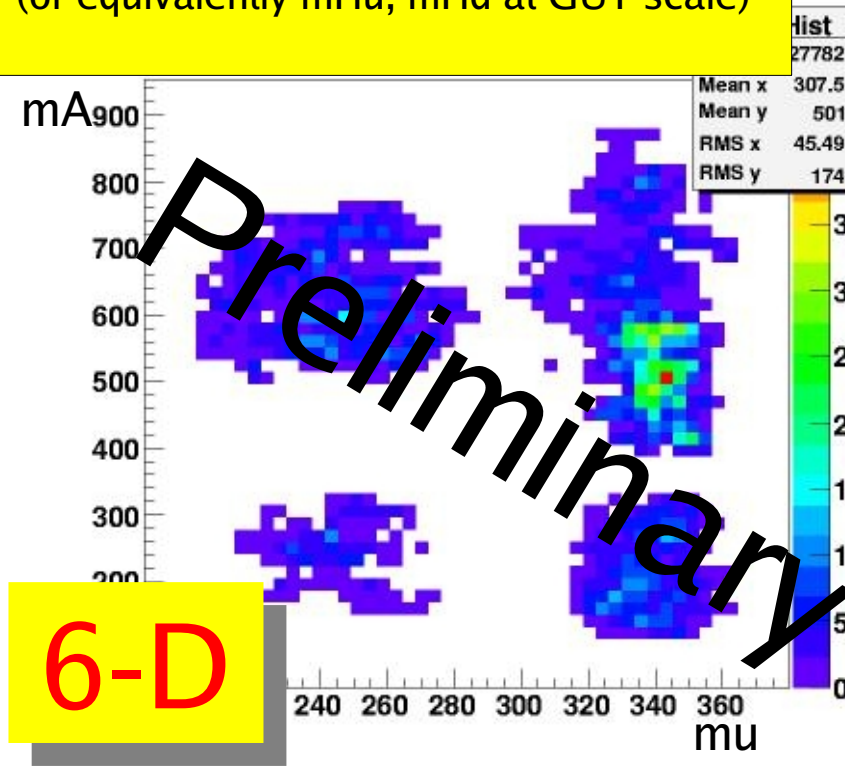
Allow edges to also be interpreted as three-body decays, where sensible,



as well as the original two-body decays:



see four-fold degeneracy.



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Aim of our game: (not new! ... around since Kepler!)

(1) Start with models with few parameters.

(2) Understand them.
Look for degeneracies.
Resolve degeneracies if possible (new expt methods).

(3) Enlarge the models.

(4) Go to step (2)!

Many groups have been doing this in LHC context for some time.

Hopefully more will join in.

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