Users’ Feedback

by

Ben Allanach (University of Cambridge)

Talk outline

- Ambiguities in definitions
- ATLAS jets plus $\not{E}_T$
- CMS efficiencies

CMS α_T Search

CMS: jets and missing energy `arXiv:1101.1628`

$\mathcal{L} = 35$ pb^{-1}. $H_T = \sum_{i=1}^{N_{jet}} |\mathbf{p}_T^{j_i}| > 350$ GeV.

(1) $$\Delta H_T \equiv \sum_{j_i \in A} |\mathbf{p}_T^{j_i}| - \sum_{j_i \in B} |\mathbf{p}_T^{j_i}|.$$

One then calculates

(2) $$\alpha_T = \frac{H_T - \Delta H_T}{2\sqrt{H_T^2 - \not{H}_T^2}} > 0.55$$

where $\not{H}_T = \sqrt{(\sum_{i=1}^{N_{jet}} p_x^{j_i})^2 + (\sum_{i=1}^{N_{jet}} p_y^{j_i})^2}$.

Ambiguities

- 21 α_T definitions were consistent with the 35 pb^{-1} paper - all numerically different. This was fixed for 1 fb^{-1}.
- Ben Gripaios reported problems re-interpreting a di-quark search. No Lagrangian was written in the conf note: which model was being constrained? Probably the one implemented in `PYTHIA`, but then this should be stated. In the papers (arXiv:1009.5069, 1102.2020), Lagrangians were given (but not the flavour structure).
- $\not{E}_T$ should be defined. Is it defined by sum over calorimeter cells, over jets plus leptons, or what?
- Also, M_{T_2} as a search variable.

Science & Technology Facilities Council

Supersymmetry Cambridge Working group

ATLAS 0-lepton, jets and $\not{p}_T$ search

ATLAS use cuts on different variables to search for SUSY:

- jet p_Ts
- $m_{eff} = \sum p_T^{(j)} + |\not{p}_T|$
- ${m_T^{(i)}}^2(\mathbf{p}_T{}^{(i)}, \not{\mathbf{q}}_T{}^{(i)}) \equiv 2\left|\mathbf{p}_T{}^{(i)}\right|\left|\not{\mathbf{q}}_T{}^{(i)}\right| - 2\mathbf{p}_T{}^{(i)} \cdot \not{\mathbf{q}}_T{}^{(i)}$ where $\not{\mathbf{q}}_T{}^{(i)}$ is the transverse momentum of particle (i). For each event, it is a lower bound on $m(NLSP)$.

$$M_{T2}(\mathbf{p}_T{}^{(1)}, \mathbf{p}_T{}^{(2)}, \not{\mathbf{p}}_T) \equiv \min_{\sum \not{\mathbf{q}}_T = \not{\mathbf{p}}_T} \left\{ \max\left(m_T^{(1)}, m_T^{(2)} \right) \right\}$$

ATLAS 1 fb^{-1} 0-lepton Search Results

	≥ 2 jets	≥ 3 jets	≥ 4 jets	≥ 4 jets'	High mass
$p_T(j_1)$	> 130 GeV	> 130 GeV	> 130 GeV	> 130 GeV	> 130 GeV
$p_T(j_2)$	> 40 GeV	> 40 GeV	> 40 GeV	> 40 GeV	> 80 GeV
$p_T(j_3)$	–	> 40 GeV	> 40 GeV	> 40 GeV	> 80 GeV
$p_T(j_4)$	–	–	> 40 GeV	> 40 GeV	> 80 GeV
$\lvert p_T^{miss} \rvert$	> 130 GeV	> 130 GeV	> 130 GeV	> 130 GeV	> 130 GeV
$\Delta\phi$	> 0.4	> 0.4	> 0.4	> 0.4	> 0.4
p_T^{miss}/m_{eff}	> 0.3	> 0.25	> 0.25	> 0.25	> 0.2
m_{eff}	> 1000 GeV	> 1000 GeV	> 500 GeV	> 1000 GeV	> 1100 GeV
Observed	58	59	1118	40	18
Background	$62.4 \pm 4.4 \pm 9.3$	$54.9 \pm 3.9 \pm 7.1$	$1015 \pm 41 \pm 144$	$33.9 \pm 2.9 \pm 6.2$	$13.1 \pm 1.9 \pm 2.5$
$\sigma \times A \times \epsilon$/fb	22	25	429	27	17

At any point in parameter space, one chooses the set of cuts with the greatest expected sensitivity[a].

[a] ATLAS, `arxiv:1109.6572`

Science & Technology Facilities Council

Supersymmetry Cambridge Working group

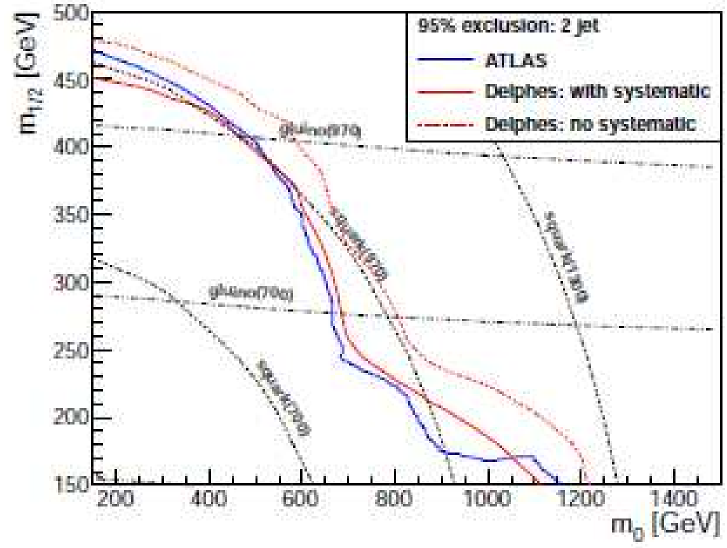
Intepretation

The results give a lower limit of 1020 GeV for $m_{\tilde{g}} = m_{\tilde{q}}$ in the CMSSM. We wish to *reinterpret* the search in mAMSB, to find the exclusion there (and study if mAMSB evades the search).

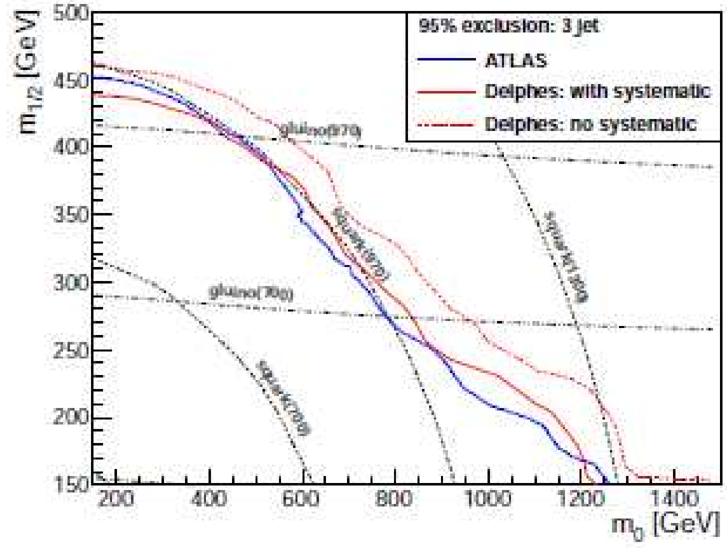
We simulate *signal* only, with `HERWIG++-2.5.1`, and use ATLAS' upper limits on $\sigma \times A \times \epsilon$. However *we have to fit the signal systematics*.

This becomes more involved when you want to do a fit and reconstruct the likelihood. To validate then, you need also details on the statistics.

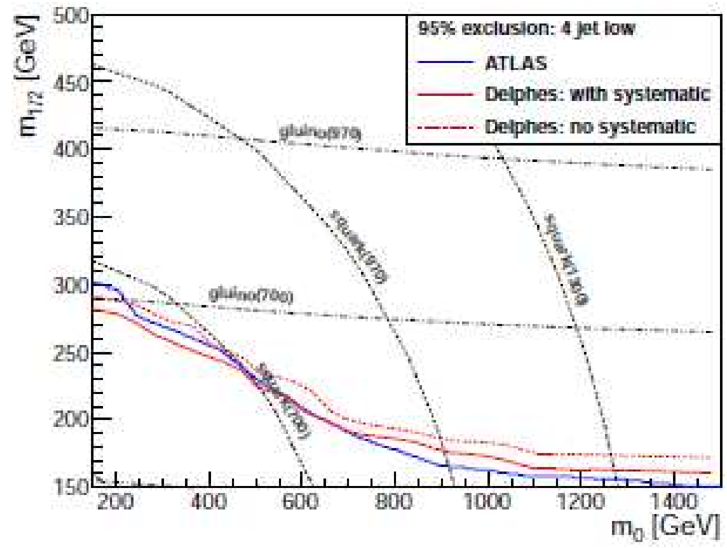
ATLAS Validation



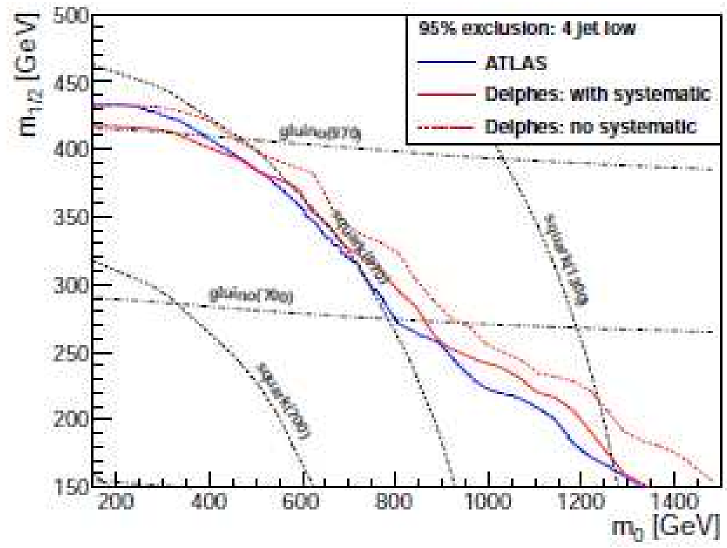
(a) 2 jets



(b) 3 jets



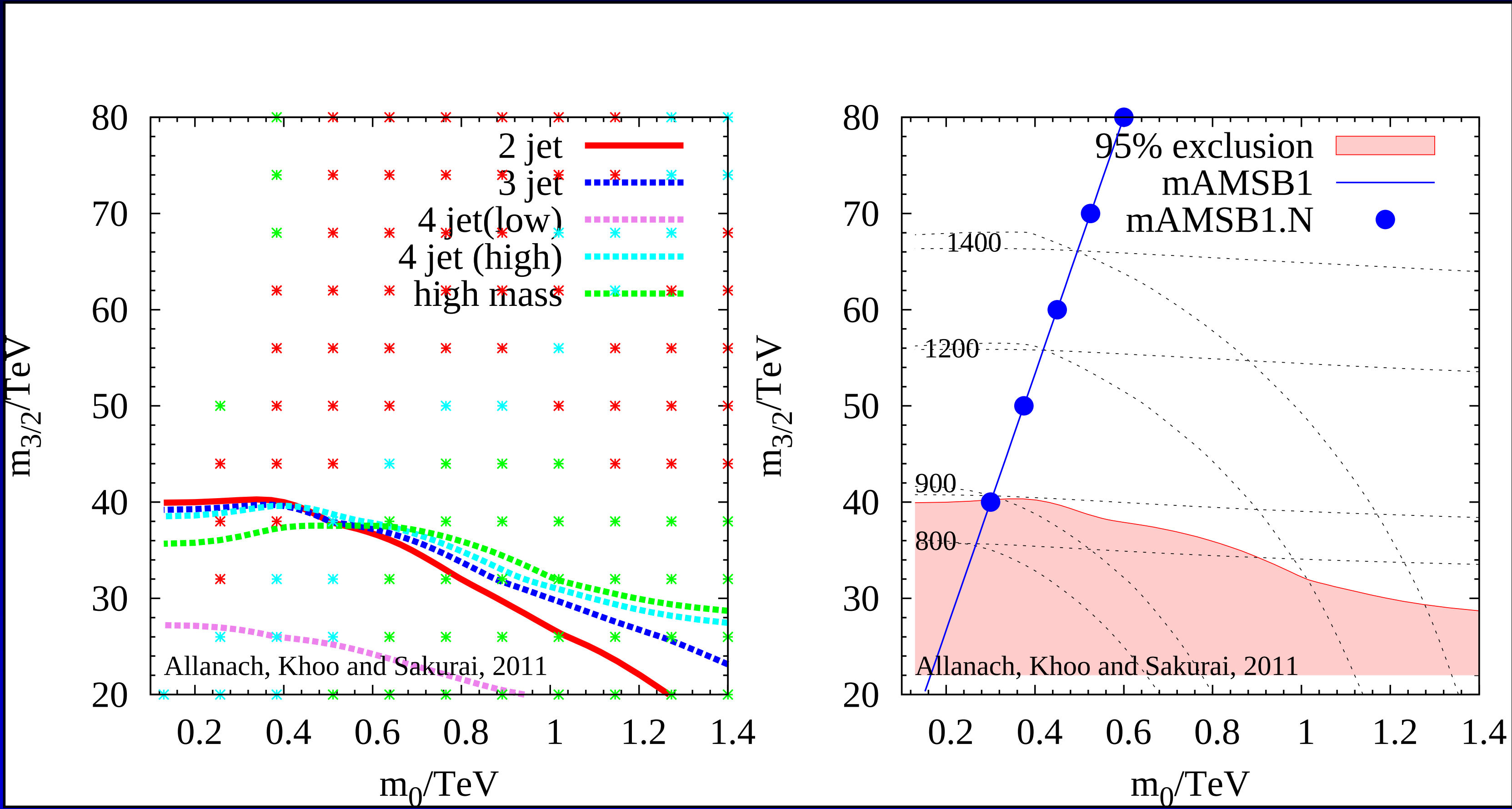
(c) 4 jets



(d) 4 jets'

mAMSB Exclusion

Interpret ATLAS exclusion in a different model: mAMSB.



CMS di-lepton $\not{E}_T$

Search for new physics with same-sign isolated dilepton events with jets and missing energy

The CMS Collaboration

Abstract

The results of a search for new physics in events with two same-sign isolated leptons (electrons, muons, or hadronically decaying tau-leptons), hadronic jets, and missing transverse energy in the final state are presented. These results are based on analysis of a data sample with a corresponding integrated luminosity of 0.98 fb^{-1} produced in pp collisions at a center-of-mass energy of 7 TeV collected by the CMS experiment at the LHC. The observed numbers of events agree with the standard model predictions, and no evidence for new physics is found. These observations are used to set upper limits on the number of events from new physics contributions and to constrain supersymmetric models.

CMS di-lepton $\not{E}_T$ efficiencies

The efficiency dependence can be parameterized as a function of p_T as $\epsilon_\infty\{\text{erf}[(p_T - C)/\sigma]\} + \epsilon_C\{1 - \text{erf}[(p_T - C)/\sigma]\}$, where ϵ_∞ gives the value of efficiency plateau at high momenta, C is equal to 5 (10) for muons (electrons), ϵ_C gives the value of the efficiency at $p_T = C$, and σ describes how fast the transition region is. The parameterization is summarized in Table 5 for electrons and muons. Tau selection efficiency fits a slightly different shape $\epsilon_\infty\{1 - \exp[-\alpha(p_T - C)]\}$, where the parameters ϵ_∞, α, and C are equal to 0.34, 0.052, and 15, respectively.

Table 5: Parameterization of the electron and muon selection efficiencies using the function described in text.

Parameter	Electrons	Muons
C, (GeV)	10	5
ϵ_∞	0.68	0.74
ϵ_C	0.19	0.24
σ, (GeV)	19	15

Table 6: Summary of parameters of the function $0.5\epsilon_\infty\{\text{erf}[(x - x_{1/2})/\sigma] + 1\}$ used to characterize the H_T and E_T^{miss} selection efficiency.

Parameter	H_T		E_T^{miss}		
	> 200 GeV	> 400 GeV	> 50 GeV	> 100 GeV	> 120 GeV
ϵ_∞	0.998	0.987	0.998	0.997	0.999
$x_{1/2}$, (GeV)	193	379	46	100	121
σ, (GeV)	87	113	33	37	40

Science & Technology Facilities Council

Supersymmetry Cambridge Working group

Summary

- Actually, the experiments currently do much to allow interpretation of their results, and should be congratulated on this.
- There are occasions when standards slip. Often (eg ambiguities) these are rectified somewhat later. Mistakes will sometimes happen, but of course we must all strive for perfection.
- An exact solution of some problems (signal systematics in a different model) are an insurmountable problem, but there is plenty of scope for easing the flow of scientific information.