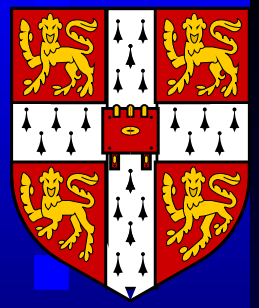


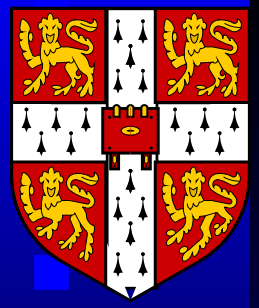
Users' Feedback

by

Ben Allanach (University of Cambridge)

Talk outline

- ATLAS jets plus $\not{E}_T$: `DELPHES`
- A_{FB}: `MadGraph`
- Feedback
- A couple of recommendations



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 $m(NLSP)$.

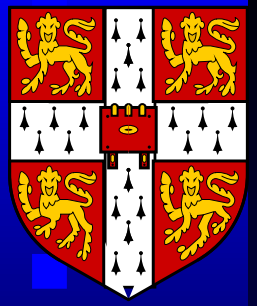
$$M_{T2}(\mathbf{p}_T{}^{(1)}, \mathbf{p}_T{}^{(2)}, \not{\mathbf{p}}_T) \equiv \min_{\sum \not{\mathbf{q}}_T = \not{\mathbf{p}}_T} \left\{ \max\left(m_T^{(1)}, m_T^{(2)} \right) \right\}$$

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



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.

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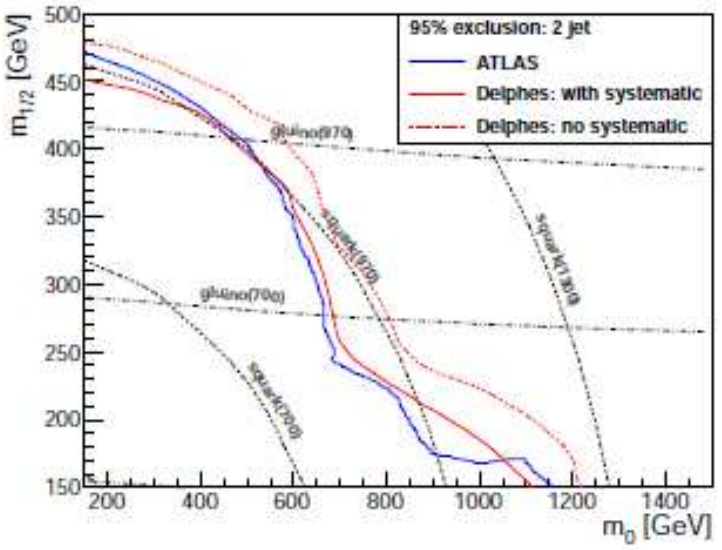
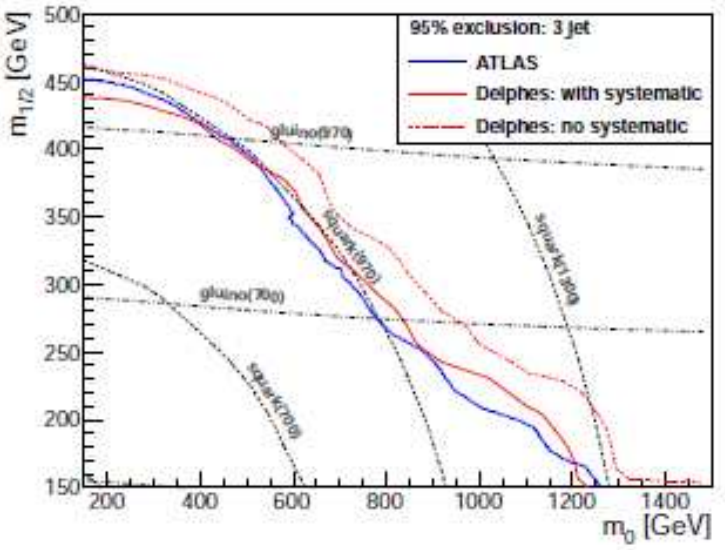
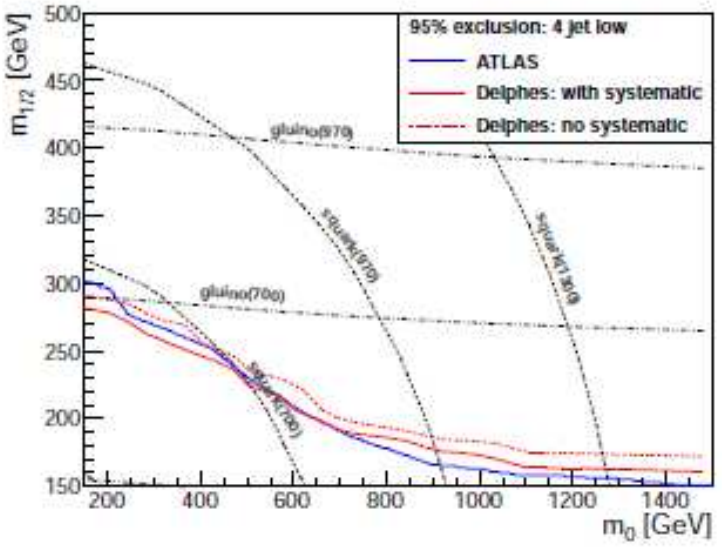
ATLAS Validation



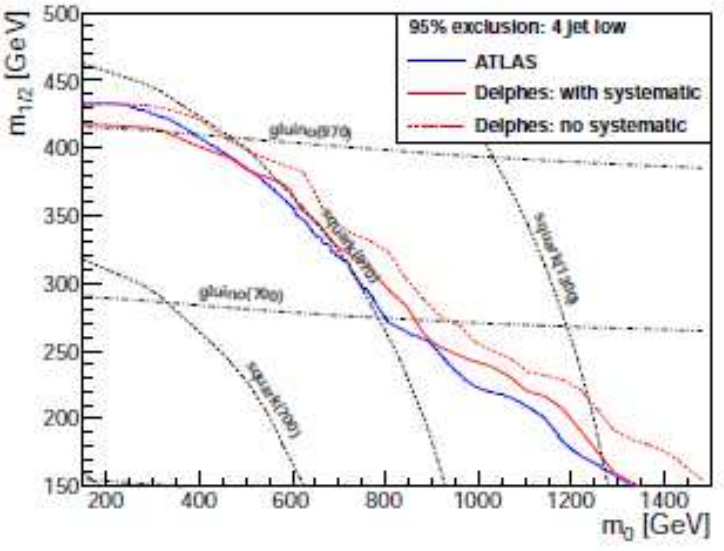
(a) 2 jets



(b) 3 jets



(c) 4 jets



(d) 4 jets'

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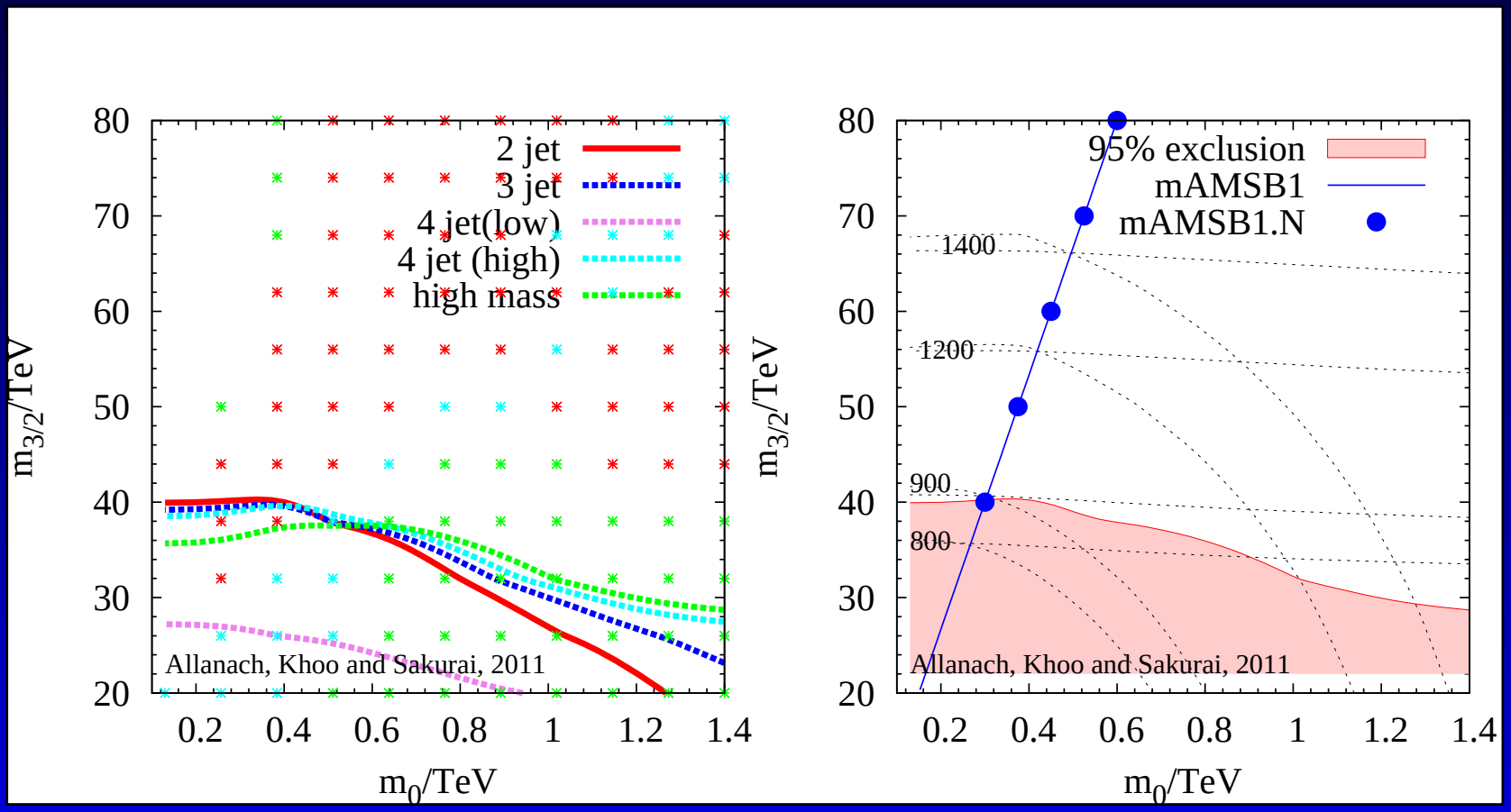
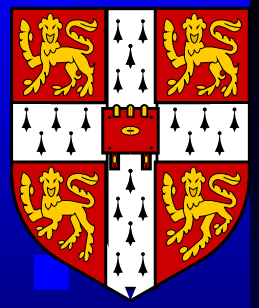
mAMSB Exclusion

Interpret ATLAS exclusion in a different model: mAMSB.





Feedback For Fast Simulators

- It was tricky in `DELPHES1.9` to get it to compile, this took a while and involved me using the `noFROG` version. This is much better in `v2.0`.
- Providing a list of hepmc files was a bit annoying and the error message was non-obvious.

On the whole, my experience with `DELPHES` was extremely good - it did a pretty good job of simulating the full detector sim for our simple cases, and putting in a simple mass independent fudge factor to simulate the effect of systematic errors allowed us to model the experiments' acceptances well.

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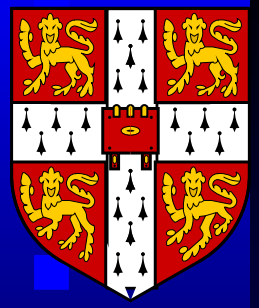


Recommendations For Fast Simulators

There is a problem using `DELPHES` in that it uses the `HepMC` format. These files are extremely big: in a 10x10 grid with 10000 signal events saved, one can have Terabytes of HepMC data.

- It would be useful to somehow rig up the piping of single events through your `FastSim`, preferably through standard input/output. This would allow faster debugging, and better use of statistics (sometimes one needs to simulate more/less events depending on the cuts acceptance).
- Is there any way to have a sort of `HepMClight` in order to reduce the size of saved HepMC files?

A_{FB}

$$A_{FB} = \frac{N(c>0) - N(c<0)}{N(c>0) + N(c<0)}.$$ 3σ too high

$$W = \frac{\lambda''_{313}}{2} t_R d_R b_R$$

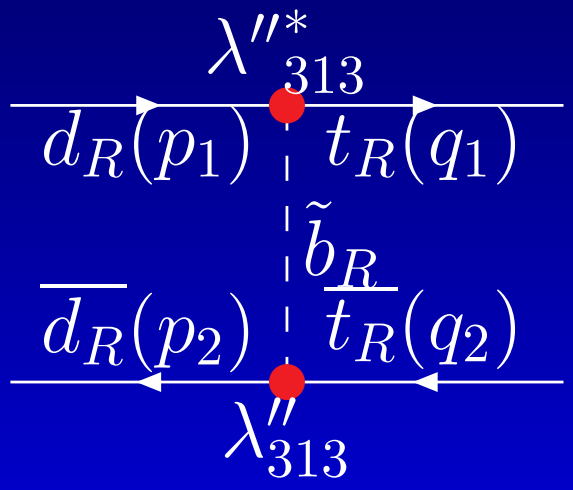
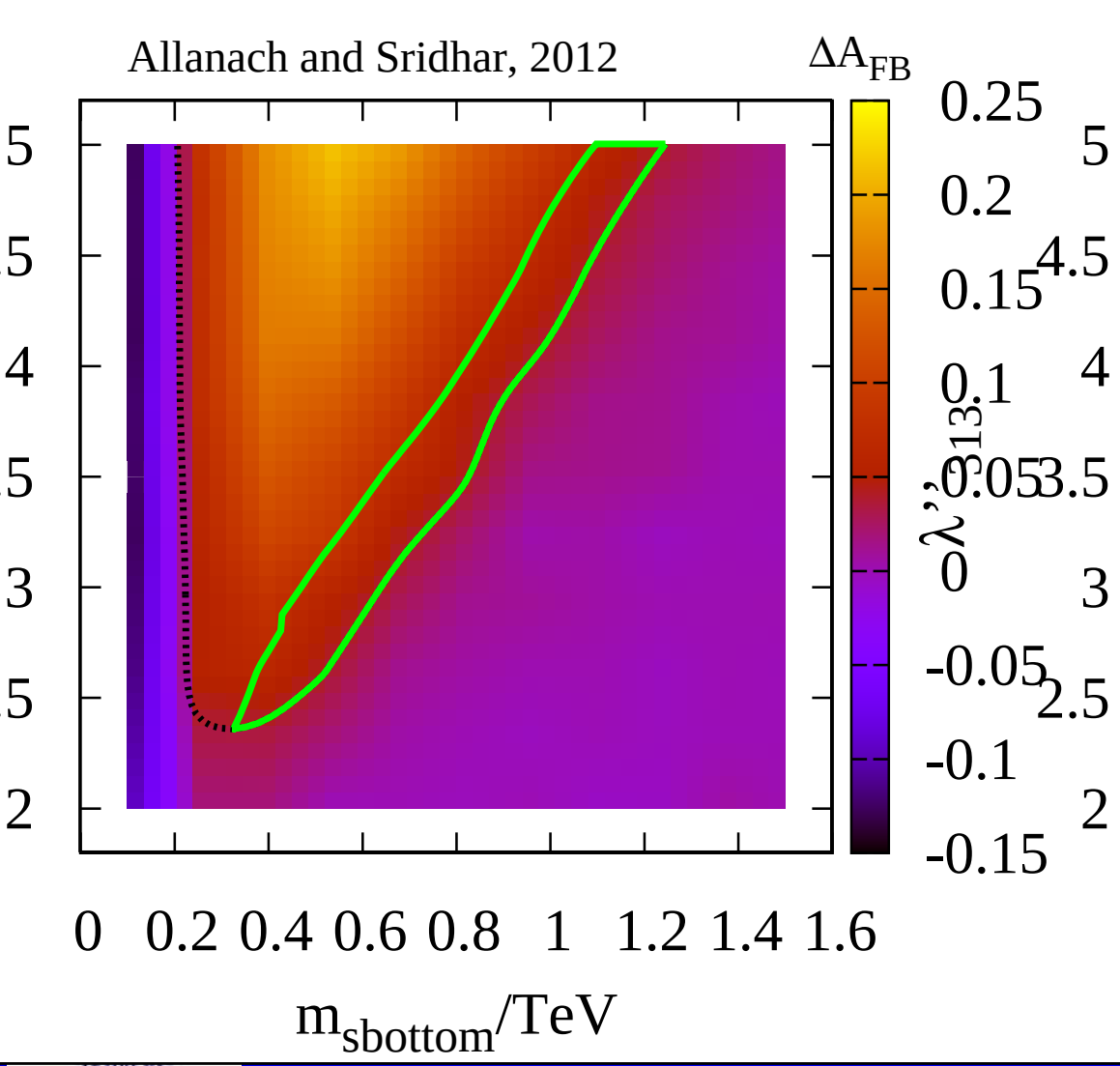
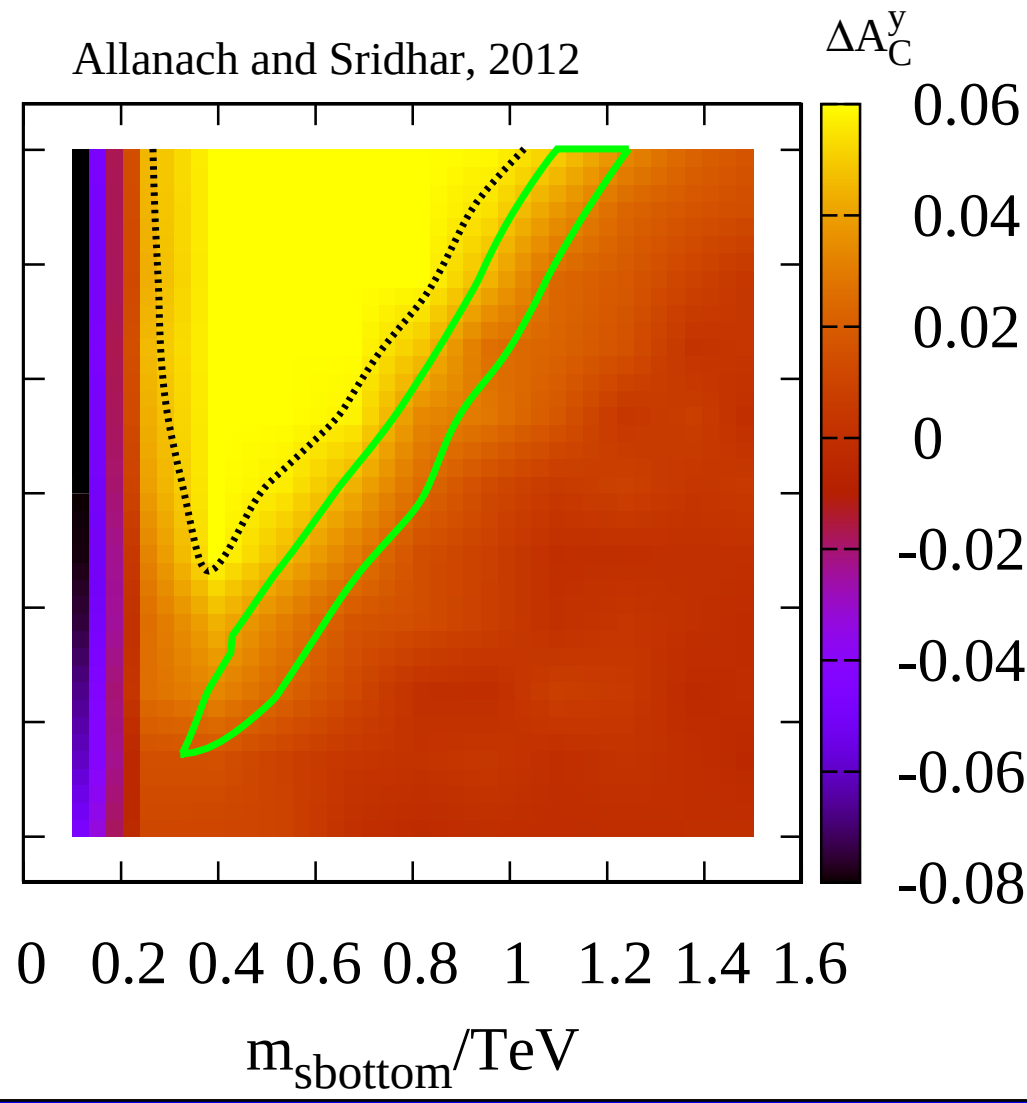


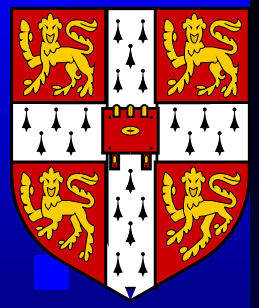
Figure 1: SUSY contribution to A_{FB}[a]

[a] BCA, Sridhar arXiv:1205.5170

Calculate observables with MadGraph arXiv:1205.5170







MadGraph1.4.5

Easy to compile, download and run. Just used simple scripting commands (`gawk, sed`) to analyse the event files.

Used the `UFO` file provided to define R-parity violation. Even though many couplings are set to zero, `MadGraph` still prints out their diagrams. Does it use them to calculate?

Again, `MADGRAPH` likes to work on a batch of events, and generating a stream of events as it works would be handy. The Les Houches event format is very light touch, and works well for very simple applications (eg $t\bar{t}$ production).

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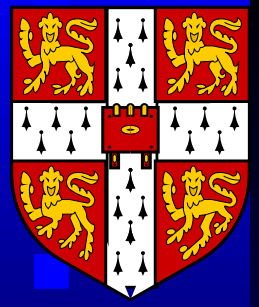

Summary

- `MadGraph` easy to use.
- `DELPHES` doing a good job for simple searches, but I haven't tried the other fast sims.
- `HepMC` format rather heavy on memory.
- Bug reporting and the user interface could be tweaked I think.
- A stream of single events for all event generators would be handy.

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