Rivet and BSM pheno studies

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Rivet and BSM studies

Rivet is a generator-agnostic validation system for MC event generators, i.e. a tool to produce physics plots from an MC generator code which can produce HepMC events.

Reference data provided by HepData export.

Primary use is for validating and tuning event generators, both for MC theorists and collider experiments, and e.g. **mcplots.cern.ch**.

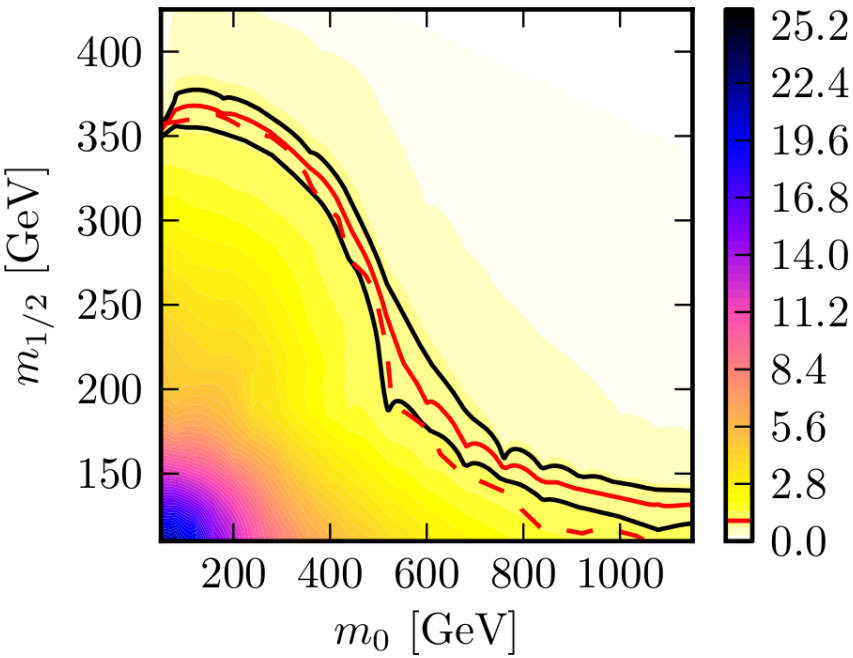
Portability between generators means that the analysis only has to be written once.

Also useful as an input to MC tuning, model development, BSM studies, ...

Caveat: *analyses must either be unfolded for detector effects or have simple corrections (e.g. unbiased lossiness of track reconstruction) which can be applied by Rivet.*

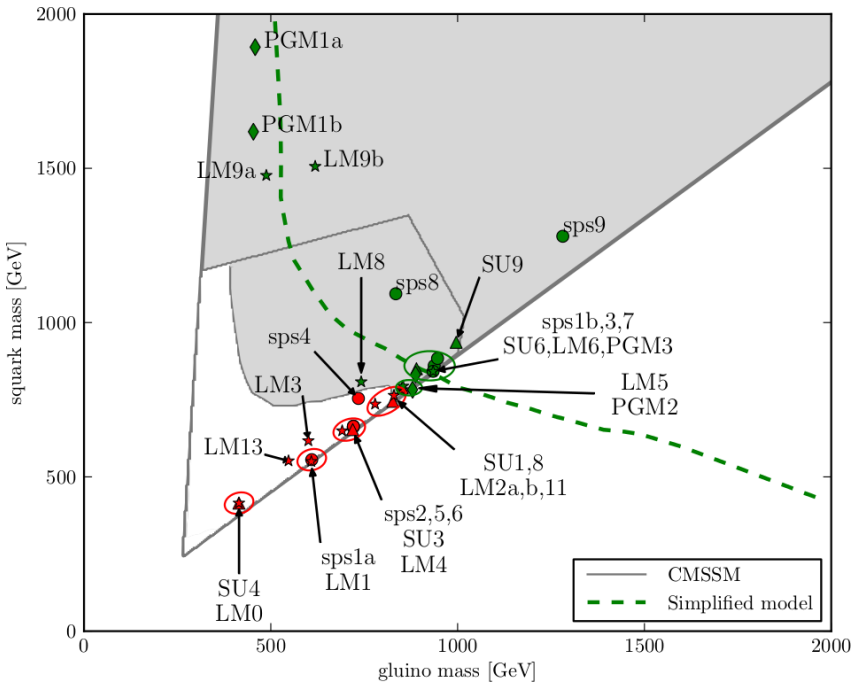
A Rivet-based BSM study

- SUSY pheno studies w.r.t. ATLAS data made using Rivet by Durham IPPP group:
- **JHEP 1106 (2011) 095 (arXiv:1104.0585 [hep-ph]):** constraining general gauge mediated SUSY models, plus validity checks on SPS, ATLAS and CMS standard SUSY scenario points.
- **arXiv:1111.3365 [hep-ph]:** Extension of the above to include comparisons with the SUSY model constraints from the LEP Higgs bound.
- Rivet implementation of (uncorrected) ATLAS 0-lepton SUSY analysis used for parameter space scans using Herwig++ and Prospino:



A Rivet-based BSM study (2)

- Slightly conservative approach needed to use uncorrected results and a simplified statistical treatment w.r.t. ATLAS: results still significant: lack of unfolding is not a deal-breaker for pheno.
- Unfolded analysis results would be nicer, of course. . . but typically a lot more work for the experiment. Certainly can't expect unfolded BSM search results for first announcements.
- Rivet analysis validated against ATLAS' provided number of MC events passing cuts at each point in the ATLAS SUSY grid scan ⇒ *very* useful extra information for an experiment to provide. (Or, alternatively, provide the analysis...)



A non-Rivet-based BSM study

So that was a BSM study made using Rivet and relying on detector correction being a small effect. What's the alternative?

Similar study performed in **Comput.Phys.Commun. 183 (2012) 960-970, arXiv:1106.4613 [hep-ph]**: same ATLAS 0-lepton SUSY analysis, using a fast simulation chain with HERWIG and AcerMC.

$\Rightarrow$ continuous parameterisation in 4-param CMSSM using machine learning. Currently being updated with Herwig++, Prospino, and Delphes...

AcerMC/Delphes provide fast detector simulation. Previously noted that reco track distributions in Delphes are highly dubious – but calo distribution *shapes* have worked ok. Normalisations have required explicit correction factors w.r.t. ATLAS full-sim: again, published MC numbers important.

Note: AcerMC is ATLAS-specific, out of date, and unmaintained. Delphes is also apparently unmaintained and unsupported, and requires hacking to run. Lots of disk space and CPU needed: Delphes cannot be run in the generator event loop: whole runs need to be written out. INCONVENIENT!

Summary (personal opinion)

- Rivet is a general analysis tool for HepMC events, with connection to HepData
- Main use is MC validation/tuning/development, but BSM studies possible. . . and have been done already! Valid pheno with new exclusions can be done without detector-unfolded data
- However, unfolded data would be nicer. Realistic prospect for search publications? *Several LHC unfolding tools on the "market": RooUnfold, Imagiro, HBOM, . . . and lots of input events from expt SUSY grid scans.*
- Durham Rivet-based SUSY studies benefited from expt release of MC performance benchmarks: please continue this (or provide the analysis!)
- LHC BSM pheno also possible with fast sim. Adds CPU time and disk requirements, inconvenience, as much validation and rescaling as Rivet. . . and unmaintained code. Still, it's possible.