Workshop on

(Re)interpreting the results of new physics searches at the LHC

The LHC collaborations are pursuing searches for new physics in a vast variety of channels. The full understanding of the implications of these searches requires the interpretation of the experimental results in the context of all kinds of theoretical models. This is a very active field, with several public tools being developed.

The goal of this workshop is to
- review the status of efforts and tools for the BSM (re)interpretation of LHC data, and to
- set the stage for a continued interaction between theorists and the experiments.

A possible outcome of the meeting is the creation of a working group, whose plan and organization can be outlined during the available discussion time.

General discussion session
17 June 2016

This workshop

- Where do we stand? What is the status of efforts and (public!) tools for the BSM reinterpretation of the LHC data?

- What information is / should / needs to be provided for an efficient and reliable usage of the experimental results? How can this be done in a systematic way?

- In what way can the experimental collaborations benefit from providing more information to theorists? What questions do experimentalists want theorists to address?

- (How) can we set the stage for a continued interaction between theorists and the experiments on this topic?

- Can we achieve a more open information exchange?

> guiding principle:
> mutual interest

Points to discuss

- How to use the experimental results; systematic approach to providing the crucial information to maximise use(fulness)

- Efforts towards making analysis implementations sharable between tools

- Publishing likelihoods — follow up on LHCb

- What return would the experiments like to get from us so they can see a benefit [for themselves] in giving more information

- Structure of future activities of this workshop/forum

  - small teams and miniworkshops to address specific questions (list of topics?)

  - recurrent larger meetings like the one we just had (date?)

- Would it be useful to produce some sort of written document? At what timescale?

systematic approach to providing all the crucial information to maximise use(fulness) of the experimental results

Analysis documentation

- Object definitions, event selections and their efficiencies

- RIVET routines are a great and robust way of providing this

- a LHADA would make this framework-independent #

  # need proof of principle example

Results documentation

- Observed signal, exp. background, correlations across bins, …

- Likelihoods (LHCb sets precedence)

- Extensive use of HEPData recommended *

- CheckMATE, MadAnalysis5, etc. take you from simulated events to a limit; this is infrastructure is not available in Rivet (but see Contur).

* want proper citations of datasets like for papers; provide download statistics for uploaders?

systematic approach to providing all the crucial information to maximise use(fulness) of the experimental results

Analysis documentation

- Object definitions, event selections and their efficiencies

- RIVET routines are a great and robust way of providing this

- a LHADA would make this framework-independent [#]

  [#] need proof of principle example

Results documentation

- Observed signal, exp. background, correlations across bins, …

- Likelihoods (LHCb sets precedence)

- Extensive use of HEPData recommended [*]

- CheckMATE, MadAnalysis5, etc. take you from simulated events to a limit; this is infrastructure is not available in Rivet (but see Contur).

Combination of results from different sectors is important for the global picture: not only direct BSM constraints but also SM, Higgs, flavour measurements → CONTUR, GAMBIT, …

[*] want proper citations of datasets like for papers; provide download statistics for uploaders?
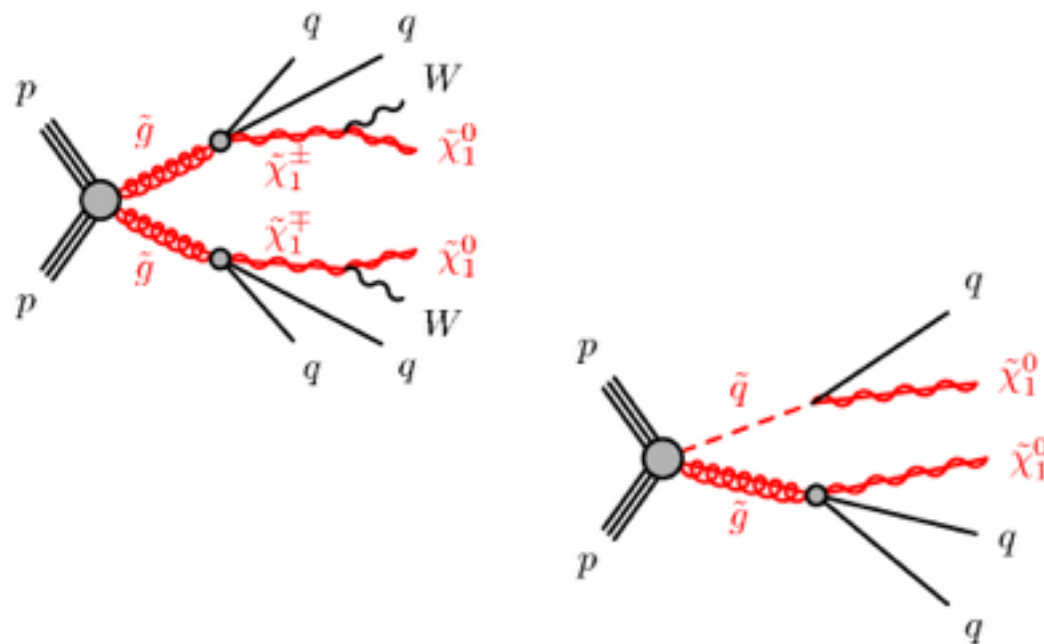
simplified model interpretations

Long decay chains aren't simplified models

- Only useful for constraining real models if many mass planes would be given

- Probability to have two identical branches rather low: "SMS" limit too optimistic
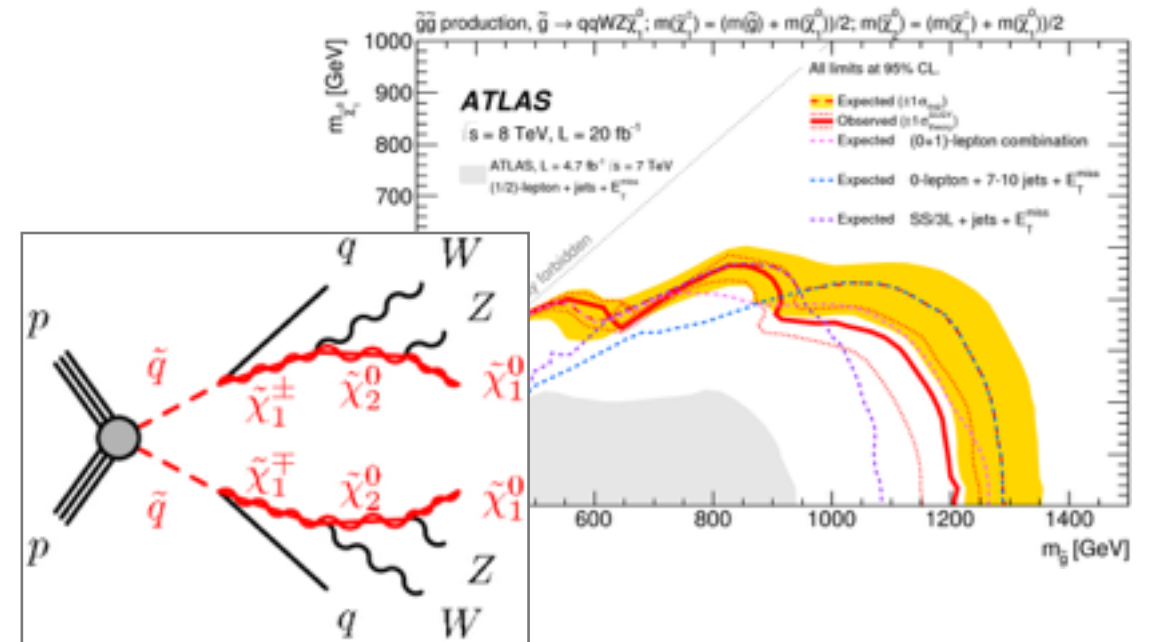
arXiv:1507.05525

Much more useful to provide more results on real SMS (at most 2 steps)

- please provide efficiency maps (for all signal regions or aggregated regions)

- at least 3 mass planes for SMS with 2 steps (need to interpolate)

- consider mixed branches

- different masses, e.g. in gluino-squark prod.

see Suchita's presentation for more

What return can we give the experiments?

- Feedback on impact of searches on full models (with or w/o combining experiments)

- Holes in analyses or in coverage of parameter space

- Suggestions for optimising sensitivity to scenarios not yet covered

- Identify sensitivity to new models not yet considered

- Identify sensitivity in unexpected final states (e.g. SM, cf. J. Butterworth talk)

- Show impact of combining SM / Higgs / BSM measurements

- …. [Are the examples of our short contributions interesting for the experimental collaborations ?] ….

- In the case of a discovery help determine the underlying model (NB `SUSY' signatures can also arise from a variety of other models; but vize-versa SUSY can also look 'exotic')

Continued TH-EXP interaction: what & how?

- Small th-exp teams to solve concrete problems / demonstrate feasibility

  - use of likelihoods

  - showcase for recasting MVA/BDT selection

  - demonstration what can be gained from non-trivial information
    (e.g. shape analysis, combining bins, …)

  - include HSCP analyses in recast tools

  - …

- Digitizing plots and making codes public is good practice also for theorists

  - "home-grown" efficiency maps etc. can also be submitted to HEPData

  - modular building of more complete infrastructure for (re)interpretation

  - open access → increased visibility and usage

- Create a forum with recurrent meetings — 2/year plus small vidyo mtgs?

- Envisage a write-up, e.g. like DM forum report ?

mailing list: info-LHC-interpretation@cern.ch

You may say I'm a dreamer
But I'm not the only U(1)
I hope some day with more data
New physics will have won! *)

*) from the 2013 Les Houches BSM song