Working Group II:“MET Signatures”

Discussion points…

…future direction

CERN
Implications of LHC Workshop

Some issues raised

- **Format of expt. results / tools for interpretation**
  - σxA ?
  - SMS limits ?
  - Likelihoods (workspaces) ?
  - Additional CL contours ?
- **Comment from one experimental colleague:**
  - "Experiments have provided many data types, little feedback from theory so far"
- **Comment from on theoretical colleague:**
  - "We keep requesting, but the experiments are not responding"
- **Reality:**
  - there is no common, experiment-wide rule for expressing results
  - very heterogeneous: depends on analysis, analysers, approval
- **Suggest common WG2/3 sub-group to study this topic**
  - form concrete proposals

Some issues raised

- **The challenge:**
  - **N: number of events**
    - what we actually measure! what to do with it?
  - **σ: cross section**
    - what we want! how to estimate A? ($\sigma \times A = N \times L$)
  - **model parameters (m_0, $m_{1/2}$)**
    - What we typically provide! well defined, easy to compare with history
    - toy model, defined at GUT, not possible to map onto all models
    - equivalent, though, to σxA (just invert RGEs)
- **Fundamental problem:**
  - Acceptance, A, is model and analysis dependent
  - arbitrary new physics model is not well defined
- **For exclusion limits,**
  - one could quote the acceptance for the SM (well defined)
  - must then evolve SM acceptance to NP acceptance
    - object efficiency driven (are these useful to provide?)
    - simulation driven (clearly useful, but how valid?)

Some issues raised

- **Fast Detector Simulation**
  - Can in principle make one's own (tune it to published results)
    - not as difficult as one might think
  - Key: stay within the toy sim's region of validity!
  - Corollary: do not use outside region of validity!
    - rare phase-space regions are difficult to model correctly
    - rare phase-space regions also tend to be the most interesting for most models!
- **Why prefer an experiment blessed Det Sim?**
  - "I want to make sure my results are realistic" (Good!)
  - "I want a reference for the tools I use" (Irrelevant!)
  - "I want my results to be credible" (Bad!)
    - precisely what the experimentalist fears: someone will use "ATLAS/CMS" blessed tools to study an invalid region of the tool and say: "it must be OK because I used ATLAS/CMS blessed tools!"
- **If 20% is good enough, then Delphes, should be OK…**
  - if more precision is needed, then it is becoming an "analysis"
  - nevertheless, the interest in a "blessed" fast toy det sim is clear!

Some issues raised

- Prioritized list of analyses not covered
  - Not models! Analyses!
    - different signatures
    - different regions of phase-space
  - Interplay of difficult SUSY signatures vs searches for exotic signatures: MET vs non-MET searches
    - what is the coverage of all searches on difficult to find SUSY searches?
  - Put into categories (e.g. Low MET, soft jets….how low, how soft?)
    - what is the model coverage in each category
- Missing any critical analysis methods
  - counting n-WIMPS, etc
- Missing any critical analysis objects?
  - kinematic variables (a la MT2, alpha_T, etc)
  - boosted objects (jet substructure, etc)
- What are the efficiency/systematic limits of
  - MET, jets, b-jets, taus, leptons, photons, charged pions, etc…

Some issues raised

- Challenges to getting to difficult regions
  - trigger
  - SM backgrounds
  - experimental apparatus
  - ignorance of existence
- Aids to getting to difficult regions
  - ISR! need common prescription for both ATLAS and CMS
- How does the physics potential evolve with machine conditions (luminosity)? High pT vs subtle signatures
  - online (trigger),
  - offline (PU reconstruction),
  - analysis (NP sensitivity)

Some issues raised

- Model independent searches
  - Look-elsewhere-effect: Challenging, but understood
  - Systematics: Challenging, and sometimes not understood
- Simple fact:
  - Believing an observation without a prediction is extremely hard!
  - Believing an observation with a prediction is much easier!
  - Concrete predictions are model dependent; the more specific the easier the analysis
    - this is why experimentalists like the CMSSM
    - and why we don't like the MSSM, string theory, etc
    - this might also be why we have not yet observed anything!
- LHC data analysis is all about compromises:
  - large MET vs large pT vs n-leptons/photons, etc (fact of reality)
    - strongly dependent on experimental apparatus, LHC running conditions, etc
  - inclusive vs exclusive (less model sensitive vs more model sensitive)
    - inclusive: one can easily miss a subtle signature
    - exclusive: one can easily miss a gross signature
- Model indendent searches very useful!
  - ...but not a silver bullet!

Future Directions/Goals

- Future:
  - what do the 7 TeV results imply for 14 TeV?
    - where should we invest our resources?
  - what do the 7 TeV results imply for a CLIC?
    - motivate specific R&D activity based on physics
- Formulate a plan to identify and anticipate which analysis are not currently covered and are of high priority
  - Such analyses should inform about physics at 7 TeV physics & where to look at 14 TeV
  - Such analyses should also provide possible insight for CLIC
  - light stops is one extremely good, well motivated example
- Next steps: possible WG sub-groups
  - Data Formats Group
  - Missed Analysis Categories Group
  - Interpretation Group
  - others?