Goals of the Workshop

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for the organizers:

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The LHC Era is Now

- LHC is exploring new territory as we speak.
- "Characterization of New Physics at the LHC"
  - joint ATLAS/CMS/LPCC workshop in June @ CERN

    http://indico.cern.ch/conferenceDisplay.py?confId=94910

    ATLAS and CMS eager to include more theoretical possibilities in the planning of LHC searches, including variety of simple models

    $\Rightarrow$ invitation for suggestions from theorists

  - 2nd workshop planned Nov 5-6, 2010, @ CERN

The LHC Era is Now

Goal of the workshop is to create a response before the Nov 5-6 Meeting:

Propose a “good” set of “models” to aid the search and characterization of LHC data

Terminology

Signature

Description of the final state in a hard-scattering event
e.g. “3 or more jets + MET”

- Every new-physics search is based on 1 or more signatures

Topology (or Reaction)

Particle production and decay modes in a given event
e.g. squark pair production, with each squark decaying to a quark + stable neutralino

- Often, associate a characteristic (but not fixed) rate (e.g. QCD production of squarks)

Terminology

Simplified Model

A short list of new particles with a minimal Lagrangian specifying the interactions mediating their production and decay

- often limits of a more complete new physics scenario, with particles irrelevant for a specific search removed

e.g. A Lagrangian with:

a "squark" (color triplet scalar with usual QCD interactions)

a"neutralino" (neutral stable fermion)

a squark-neutralino-quark vertex

Note: a simplified model may give rise to multiple topologies. A given topology can fall under more than one signature and multiple topologies can populate the same signature.

Understanding the mapping both ways is an important part of classifying signatures and models.

The LHC Era is Now...

ATLAS & CMS already have searches defined around categories of signatures

→ we should keep this in mind

ATLAS & CMS 10-100 pb^{-1} searches underway!

→ physics recommendations should also come soon

→ should keep scope of this workshop targeted

Focus on searches (characterizing discoveries) to ensure that new physics is not missed

→ baseline set of models and topologies is appropriate

→ useful to makes specific suggestions for how to present results

→ keep in mind mappings between models, topologies and signatures

Baseline Models

Models on which searches are based have impact:

- Guiding where experiments look for new physics (and when they look in given phase space)
- Delineate the boundaries of explored territory, and what new physics ***is*** allowed
- First interpretation if a signal is seen

Why organize searches around simplified models?

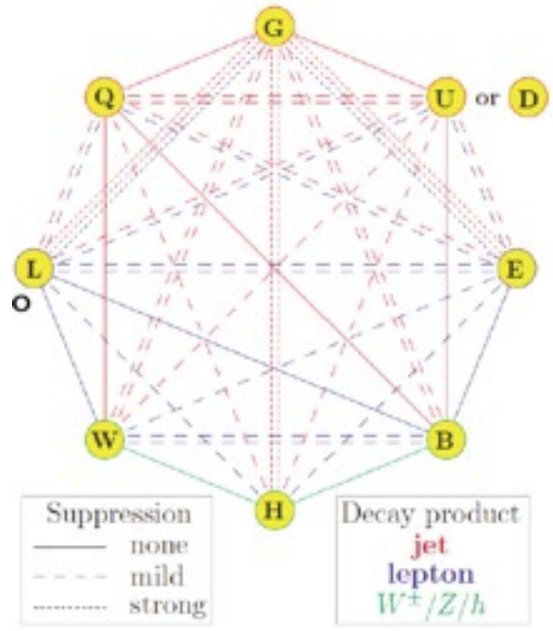
- Applicability to other models/other reactions is more transparent.
- Closer to the ideal of getting back kinematic description of new physics

Exhaustiveness vs. Practicality

Exhaustively exploring the space of possibilities in general terms is useful! → develop awareness of what we might be missing…

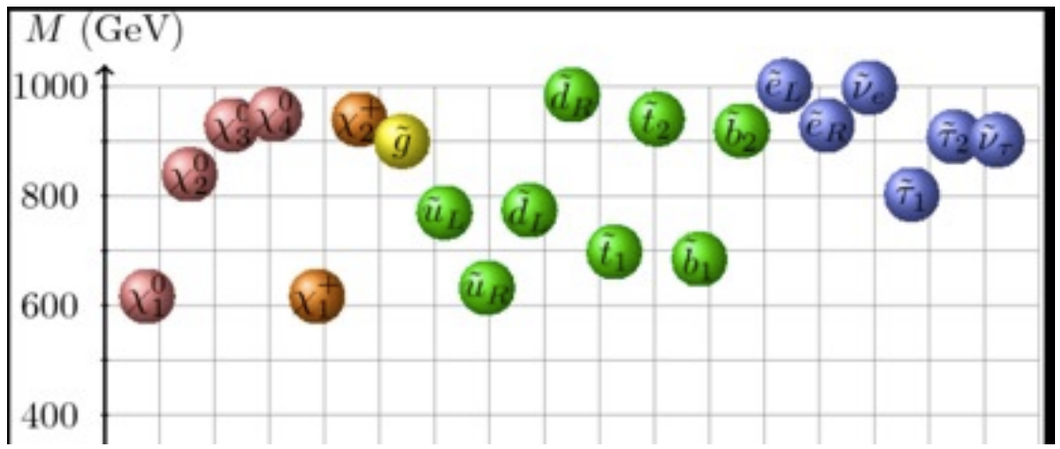
Myeonghun Park

	$n_v = 0$		$n_v = 1$		$n_v = 2$	
n_ℓ	$n_j = 1$	$n_j = 2$	$n_j = 1$	$n_j = 2$	$n_j = 1$	$n_j = 2$
0	79296	26880	12768	3360	1344	672
1	30240	10080	1824	480	192	96
2	19770	6030	1500	180	0	0
3	4656	1296	312	72	6	6
4	1656	396	66	6	0	0



Jamie Gainer

Analysis	50% error 1 fb^{-1}	50% error 10 fb^{-1}	20% error 1 fb^{-1}	20% error 10 fb^{-1}
4j0l	88.331	88.578	98.912	99.014
2j0l	87.616	87.774	98.75	98.802
1l4j	41.731	44.885	56.849	63.045
1l3j	64.058	70.907	69.725	81.111
1l2j	62.942	68.419	70.646	80.641
OSDL	6.0958	6.6796	15.262	18.659
SSDL	14.774	25.518	18.501	32.887
3lj	13.549	17.361	19.293	28.97
3lm	2.7406	2.9135	4.8844	5.8284
tau	83.51	86.505	96.928	98.695
b	73.983	76.939	91.672	94.867



→ theory input is critical

Exhaustiveness vs. **Practicality**

We know that there are too many possibilities to search through or use every possible BSM reaction or model

It may be necessary to stand back and collapse options with common signatures into representative cases

→ theory input important

If the signatures are sufficiently striking (e.g. many leptons), dedicated models may not be needed and inclusive searches good enough

→ theory input important

Working Group Goals

1) Prepare a baseline set of simplified models that populate signatures. Group together similar models.

2) Further develop some collection of "particularly interesting" simplified models. Many (subjective) factors go into these preferences:

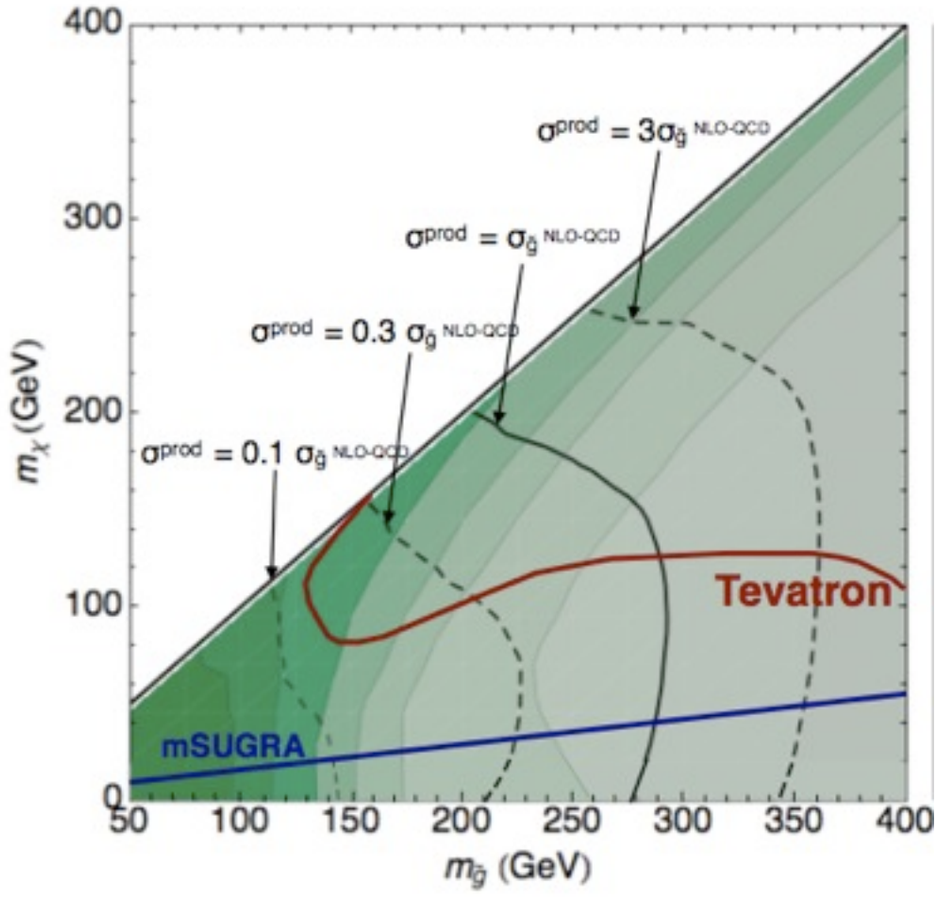
   - theoretical motivation
   - parameter choices (when necessary)
   - breadth of coverage
   - sensitivity in early running
   - simple enough that null results are easy to interpret
   - …

3) Begin creating write-ups of these simplified models, which will be assembled for experiments' use.

Simplified Model Write-Ups

Each write-up/section focused on one simplified model:

- Theoretical motivation
- Definition
- Monte Carlo implementation
- Existing Limits, and Parameter Space for Presentation of Future Limits
- Not MC studies
- Not specific cuts
- At most of sketch of expected sensitivity



[Few examples: http://lhcnewphysics.org/web/Topology_Sets.html]

This workshop is driven by the participants

Up Now:

Discussion on how to proceed
with **working groups** and a **document**

This afternoon:
discussion & division into the working groups