Disentangling SUSY Models with Experiment

Robert Kehoe

TeV4LHC Workshop

February 4, 2005

Southern Methodist University
Department of Physics

- Use of Observables
- Single Object Measurem
- Backgrounds
- Final Comments

The Charge

- many SUSY variants
- two questions
  - how produce a general search which is optimally sensitive ac
    many models?
  - how use experimental measurements to distinguish model
    operating in nature?

- consider Binetruy, et al., hep-ph/0312248
  - take all measurements in conjunction (collider, cosmol., EWSB
    to nail down model
  - concentrate on observables which are directly obtained in
    detectors
    - model independent

Observables

hep-ph/0312248

- twelve models
  - pick parameter points which are thought to be representative of wid range within each model
  - observe rates and kinematic distributions
    - interpretation of results: model dependent
- inclusive signatures
  - Etmiss, > 100 GeV
  - prompt gamma, get N_1 or G, isolated w/Pt > 20 GeV
  - isolated pi+/-, get $N_1^{\pm}$, pt > 2 GeV
  - trilepton
  - same-sign dilepton
  - opposite sign dilepton
  - tau rich
  - b rich
  - long-lived (N)LSP

Inclusive Sample

hep-ph/0312248

- assume 10 fb-1
- select events with
  - Etmiss > 100 GeV
  - Ptj2 > 100 GeV

	SM	mSUGR
• count # of events with these cuts	100k	60k
• + 1 lepton	13k	17k
• opposite sign dilepton	7k	6k
• same sign dilepton	20	1300
• trilepton	60	740
• #s significantly model-dependent		

exam

- consider also kinematic distributions, eg. Ht or St ('meff')
- may do likelihood or other fit across experimental measurements ascertain SUSY parameters

Jets and Etmiss

- jet energy scale
  - wide range of energies correct to get calibrated Etmiss
  - systematic uncertainty influences #BG pass cut
  - in situ methods:
    - □+jet (D0)
    - single particle (CDF)
- jet energy and Etmiss resolution
  - primary issue is non-Gaussian tail
  - need to be monitoring for data quality
    - much experience at Tevatron for this
    - crucial element for these kinds of searches
- need to ascertain extent to which BGs susceptible to miscalibratio and resolution tails

Leptons and b-Quarks

- electrons
  - require highly effective rejection against pi0 jets
  - eg. multiparameter likelihood discriminant (D0)
    - requires understanding of correlation of input parameters
- muons
  - impact of poorly measured tracks on momentum measurement
    - translates into Etmiss also
- tau's and b's
  - need to provide optimal vertex reconstruction
- methods to estimate fake lepton and mis-tagged jets well-establish at Tevatron

Multijet and W/Z Backgrounds

- multijet backgrounds
  - all characteristics (Etmiss, leptons, vertices) must be faked
  - what is pass rate for Etmiss selection, and how dependent on resolution and tails?
  - how well understand lepton instrumental backgrounds?
    - eg. 3 jet + Etmiss => 2 jet + 'e' + Etmiss
- W and Z
  - need to understand Etmiss faking in Z events
  - ascertain how well can model high Pt jets
    - MC generator comparison to Tevatron data with maximu luminosity

Top Backgrounds

- can contribute at almost all levels
  - particularly issue for opposite-sign dilepton
- a good understanding of all single object systematics will b important, perhaps most importantly
  - lepton efficiencies
  - b-tagging efficiencies
  - jet kinematic distributions at high Pt
- Tevatron provides only way to cross check event generator for kinematic distributions

More General Issues

- what can do with less luminosity, eg. 1 fb-1?
  - appears that #events for various scenarios still enough that senstivity different parameters is present
  - simulation study is needed for this
  - demands stable, effective reconstruction; optimal not needed
- examine validity of signatures across parameter space within mod
- what is best way to benefit from exclusive measurements
  - specific final states may allow measurements which can narrow the f
- overall optimization of search strategy in face of realistic detector simulation necessary
  - eg. grid search vs. multiparameter discriminants like NN to get optim inclusive and other selection

thank you to Gordon Kane, Frank Paige