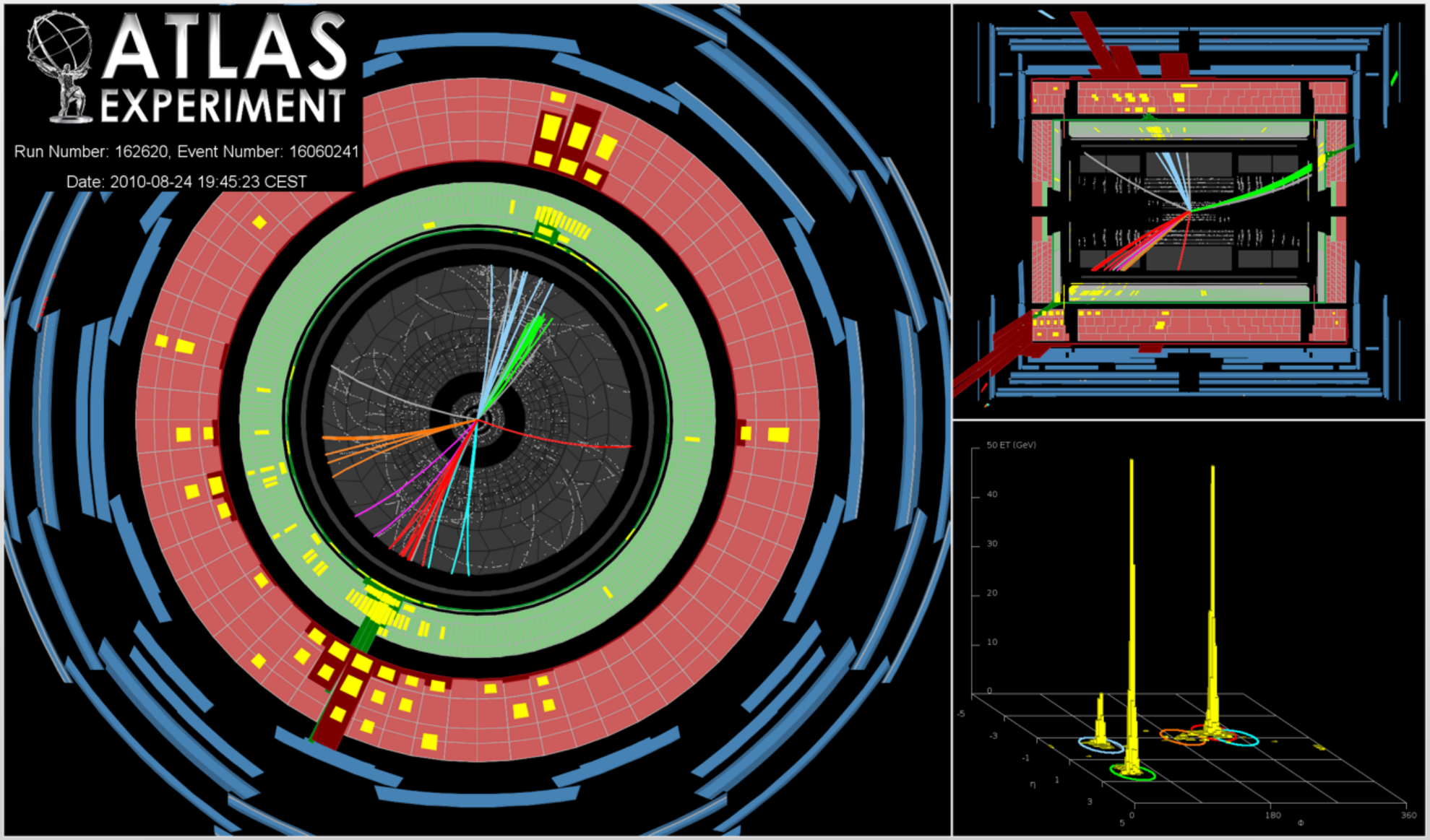
# LHC Limits, Anomalies, Discoveries

**J.-F. Arguin, R.M. Barnett (LBNL) November 19-20, 2010**



# Introduction

- **LHC: a new era of particle physics**
  - Largest center-of-mass increase in ~40 years
  - First detailed survey of TeV scale (where we have reasons to expect new physics)
- **Can revolutionize PDG and RPP! → need to be prepared**
- **What should we prepare for?**
  - Limits
  - First signals
  - Discoveries
- **Disclaimers:**
  - Form of new physics is unknown → some amount of speculation in this talk
  - **Reminder:** PDG doesn't decide when something has been discovered, the HEP community does
    - **Close relationship with community will be crucial (e.g. experiments working groups)**

# Limits

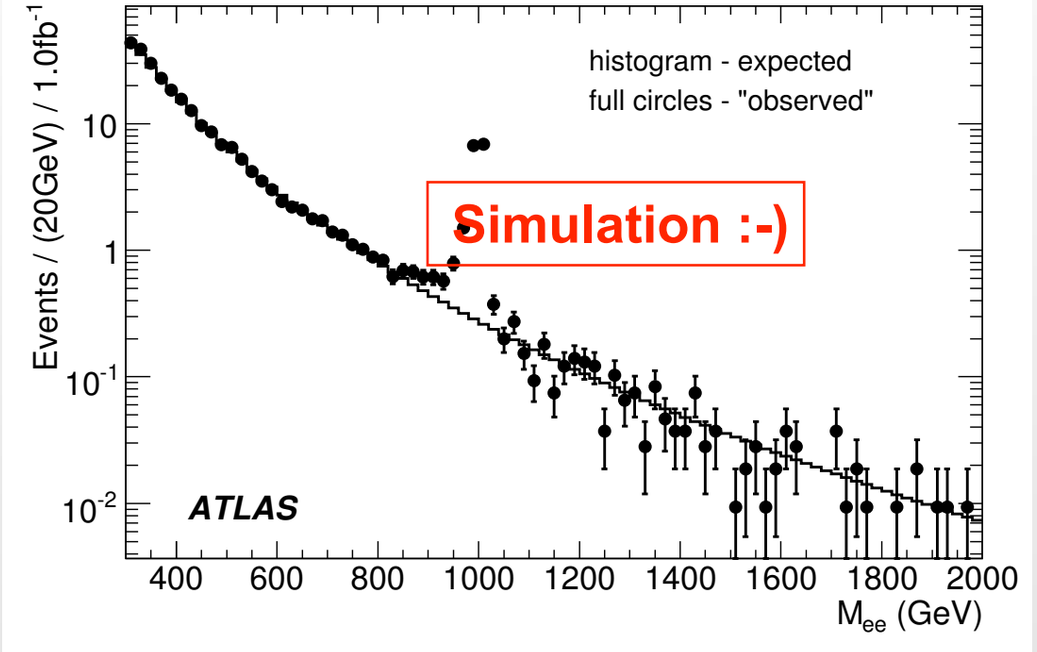
- In principle, there could be no change in the work qualitatively, just quantitatively!
  - Number of searches expected to increase in the coming few years
  - Need to make sure we stay up-to date with developments in new theoretical models
- However, this could be an opportunity to make our handling of new physics searches as useful as possible (in particular to theorists)
  - Suggestion we received: keep a database of papers containing limits based on **signatures** (e.g. multijets+missing energy, dilepton resonance, etc)

# First Signals

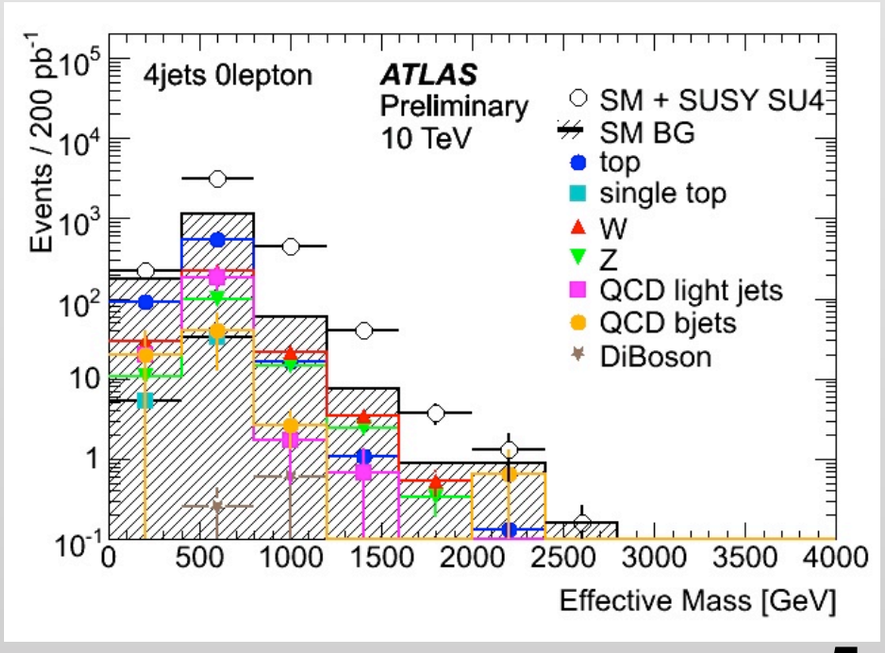
- Hopefully, an excess over SM background will eventually show up!!
- Is it Higgs or something else? (e.g. diphoton resonance)
  → hopefully can be resolved "quickly"
  - E.g. consistency in mass and branching ratio in >1 channels (maybe Tevatron+LHC), consistency with EWK precision fits
- Otherwise, it will take sometime before we can identify the nature of the signal with confidence
- **Proposal:** will have new review(s) that discuss LHC first signals (and maybe their possible theoretical interpretations)

# Example Scenarios

- **Scenario 1: Large dilepton invariant mass peak around 1 TeV (>> 5 σ)**
- **What should we call it?** Is it a sneutrino (S=0), a Z' (S=1) or a KK graviton excitation (S=2)?




- **Scenario 2: Large excess of leptons, missing $E_T$ and jets**
- "Beyond the SM look-alikes": SUSY, universal extra-dimensions, little Higgs, etc
- Rich phenomenology and set of signatures: could take <u>many</u> years to figure out the correct model
  - In some cases: maybe new lepton colliders



# Discovery: Scenario 2

- **What should PDG do?**
  - Possibility 1: keep discussion in LHC anomaly review until the matter is resolved
    - **Scenario 1**: find other signatures, like other SUSY-like particles, which leads to a consensus within the community
    - **Scenario 2**: could take several editions!
  - Possibility 2: include the encoding in the listing generally favored by the community until we have more information
    - For example Z' for **scenario 1** and SUSY for **scenario 2**
  - Possibility 3: include encoding in all relevant listings and remove when models are excluded
    - Ex.: heavy gauge bosons + SUSY + extra-dimensions for **scenario 1**
  - Possibility 4: create listings with neutral names of newly found particles until the matter is resolved

# Conclusions

- **LHC:** a new era for particle physics AND PDG!
- **What to prepare for:**
  - Many limits
  - **Hopefully discoveries!**
    - LHC anomalies review(s) that will contain initial signals and possible theoretical interpretations
    - Handling of listings will depend on community consensus
- **Intercommunication with HEP community will be crucial!**
  - Need to collaborate early on with experiment working groups, like newly formed LHC Higgs Combination Group (e.g. fit using PDG rules like using only published data)