Snowmass21 pMSSM scan: workflow overview and open items

Jennet Dickinson, Jim Hirschauer

EF08 pMSSM Scan Meeting

November 11, 2020

Goal for today

- Agree on the outline of our pMSSM scan workflow and start to assign tasks to interested groups
- This talk
  - Summarizes the steps in our workflow
    - Inspired by last week's talks and discussion
  - Points out important open items
  - Makes a few concrete proposals as a starting point
    - Of course these are still up for discussion
- Later talks: introductions to some of the technical tools that fit in to this workflow

Sampling pMSSM parameter space

- Scan the 19D pMSSM parameter space
  - **Proposal**: use a Markov Chain Monte Carlo
- The scan must span a *REALLY LARGE* range of pMSSM parameter space
  - **Option 1**: a single "grand scan" covering the OR of the accessible ranges of all future collider scenarios
    - 🙂 Elegant, easily interpreted in a Bayesian framework, easy to compare the reach of different experiments
    - 😕 The parameter space may be too large to perform oversampling with a meaningful resolution
  - **Option 2**: multiple scans targeting the accessible range of a smaller group of future collider scenarios
    - 🙂 Can more easily get reasonable statistics in regions of interest
    - 😕 Not straightforward to compare experiments across different scans

Sampling pMSSM parameter space (2)

- What is the best way to incorporate existing experimental results into the scan?
  - **Option 1**: directly into the likelihood
    - 😕 Potential for bias if experimental results change…
  - **Option 2**: by over-sampling in regions of interest
    - 😕 Scan could spend lots of time covering less interesting areas…
- In the end, some measurements will be included via Option 1, others via Option 2
  - Which ones in which way? We will need to discuss

Signal generation and simulation

- Signal simulation with Delphes for all pMSSM points for all future colliders of interest
  - We can use Snowmass MC TF tools
- Additional steps could reduce the number of points to simulate. We should consider:
  - Rejecting points with small cross sections / low yield at fixed luminosity
  - Rejecting points based on a truth-based likelihood (with smearing), as ATLAS does

Event counts

- Obtain background yields (B) from Snowmass groups dedicated to specific future experiments
  - For missing searches, generate B ourselves using centrally produced SM MC samples
- Generate signal yields (S) from signal simulation
  - In complex cases, e.g. missing tracks analysis, ask other Snowmass groups for help
- Generation of S and B can be done with e.g. RECAST or MadAnalysis5
- Hypothesis testing using simplified likelihood based on S, B, δS, and δ B

Today's meeting

- We will get details of the technical implementation of some of the steps in this workflow: