Search for the Supersymmetric Stop: Top Reconstruction Techniques in 0-Lepton Direct Stop Searches

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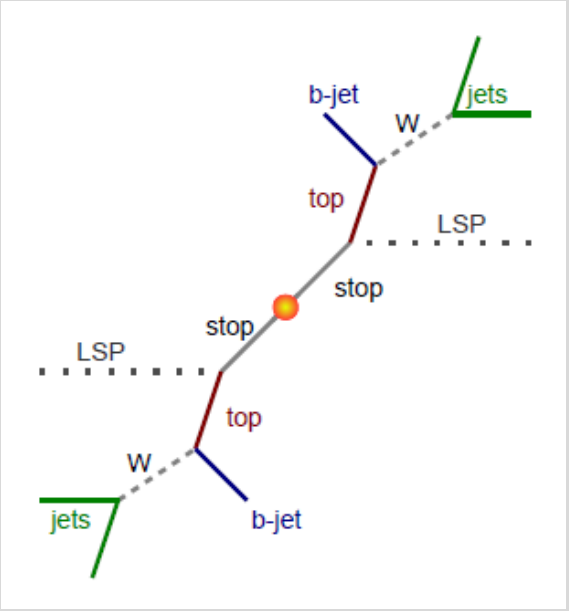
0-Lepton Direct top Squark Searches

- Proton collisions produce a stop anti-stop pair:

$$pp \rightarrow \tilde{t}\bar{\tilde{t}} + X$$

- Stop decays within the detector to a top quark and an undetected particle (model dependent e.g. neutralino):

$$\tilde{t} \rightarrow t + \tilde{\chi}^0_1$$



- Each top quark decays hadronically to 3 jets (6 total):

$$t \rightarrow b + W, W \rightarrow \text{jets}$$

- Largest Background: $t\bar{t} \rightarrow bjj + b\tau\nu$

Top Reconstruction

Objective:

- Determine a more efficient way to reconstruct two top quarks, given an event with 6+ jets. Where "efficient" refers to recovering top quarks that decay from top squarks more often than those from non-stop processes (for example ttbar).

Current Algorithm:

- "dR method" where the 3 jets closest together are clustered to top 1, then the process is repeated to find top 2.

How Results Will Be Used:

- The most efficient algorithm will be implemented into the 0-lepton direct stop search. Events with reconstructed top quarks will be checked for large amounts of missing E_T. If found, it may be an indication that a top squark pair decayed in the event.

The Big Picture

- **Why stop?**
  1. Often one of the lightest SUSY particles, meaning it is one of the most likely to be found at the LHC.
  2. Helps with the stability of the Higgs.

- **Why SUSY?**
  1. Provides answers to the “fine-tuning” problem of the SM.
  2. May help us understand Dark Matter.
  3. Is a component in nearly all String Theory Models. No SUSY, no String Theory.

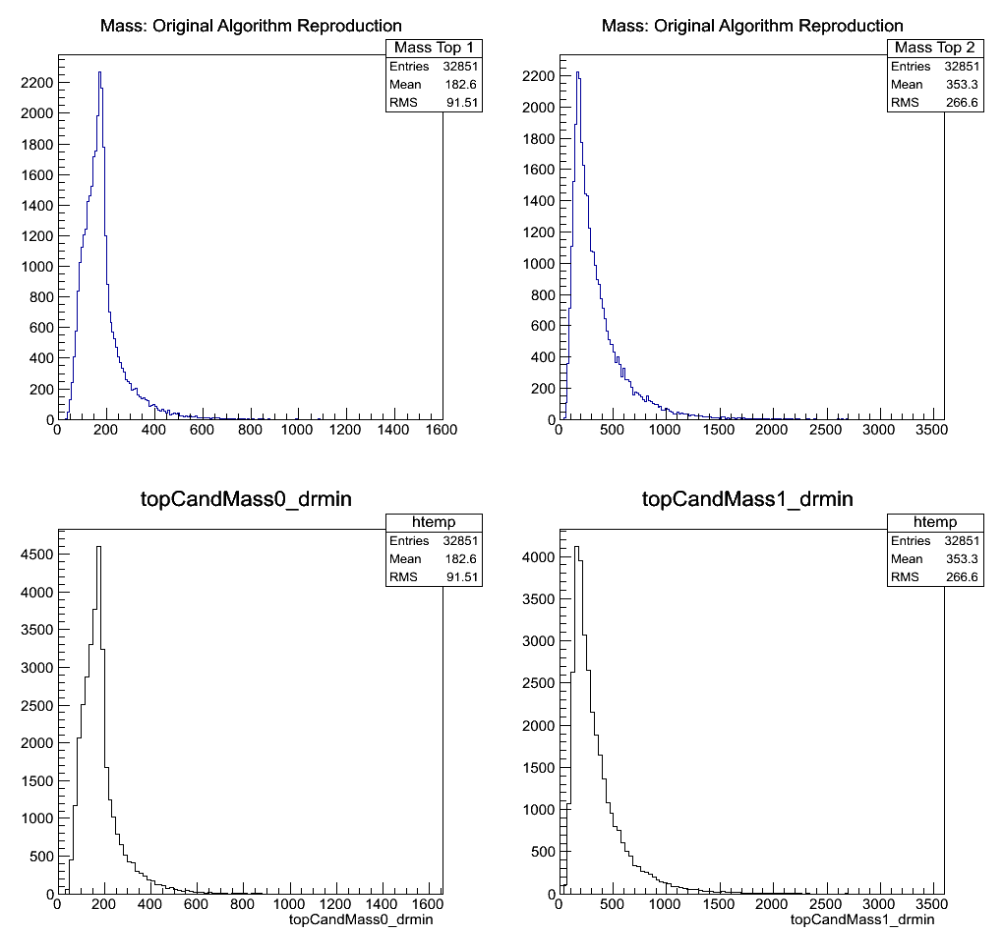
Results To-Date and Potential Concerns

Current Results

- Reproduced the original search algorithm, and developed it into easier to use classes.

Concerns

- No real issues.
- An almost endless list of possible solutions.



Outside the Office

Atrium, Building 40, CERN

The Matterhorn: Swiss Alps Zermatt, Switzerland

Crêt de la Neige: Jura Mountains, France

Thanks

- I would like to thank my advisors Dr. George Redlinger and Dr. Nathan Triplett for all of their help and time in my first few weeks of research.
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Questions?

Monte Carlo

- Signal Events -HERWIG++ with MRST2007LO* parton-distribution functions
- Ttbar -ALPGEN using CTEQ6L1 PDF interfaced with HERWIG for particle production.
  -JIMMY used for underlying event model.
- Ttbar+V -MadGraph interfaced with PYTHIA.
- Single top events -MC@NLO and ACERMC
  -associated W and Z productions made using ALPGEN.