The quest for supersymmetry in final states of 7-11 hadronic jets, 0 leptons, and $E_T^{\text{miss}}$ with the ATLAS detector

Supersymmetry (SUSY) is an extension to the Standard Model where the lightest supersymmetric particle (LSP) makes for an ideal dark matter candidate [2].

Search for strongly-produced gluinos, which undergo a cascade decay giving states with many hadronic jets [3] and an LSP which is not strongly boosted, producing moderate missing transverse momentum, $E_T^{\text{miss}}$ [4].

1. Searching for Supersymmetry

Signal regions (SRs) are constructed from 7, 8, 9, 10, and 11 inclusive jets (leptons vetoed). Two channels:

- **Jet mass channel**: Jets are reclustered into larger fat-jets [5], uses the total fat-jet mass per event ($M_J$).
- **Heavy-flavour channel**: 0, 1, and 2 inclusive $b$-jets are required.

**Common Selection**
- Lepton veto
- Many central jets (|p_T| > 20 GeV)

**Key variables**: $E_T^{\text{miss}}$, $H_T = \sum p_T^\text{jets}$, $M_J = \sum_j M_j$

Two analysis streams
- Flavour-select $b$-jets
- MJSig: makes use of jet reclustering

2. Backgrounds

Major backgrounds:
- Multi-jet background: QCD multi-jets and fully-hadronic top production.
- Leptonic backgrounds.

Large multi-jet background at moderate $E_T^{\text{miss}}$ significance.

For each $N_j$ SR of jet multiplicity $N_j$, an $N_j-1$ CR is calculated for the $W+\text{jets}$ and hadronic top backgrounds.

3. The Template Method

The signal yields in each SR using 2015 + 2016 LHC data.

Smoking gun for this new physics search: large SR excesses at moderate $E_T^{\text{miss}}$ significance coming from SUSY particle production.

No statistically significant excesses are observed, so set exclusion limits on current SUSY models.

4. Results with 2015 + 2016 Data

95% confidence level (CL) exclusion limits are set on different strongly-produced SUSY models: three $R$-parity conserving (2 shown above), and a fourth model which is an $R$-parity violating (RPV) [6].

RPV: no LSP, stop undergoes a direct decay into heavy-favour quarks. The multi-jets analysis is sensitive to such a model because its SRs contain some real $E_T^{\text{miss}}$.

5. Exclusion with 2015 + 2016 Data

95% confidence level (CL) exclusion limits are set on different strongly-produced SUSY models:

- A third $R$-parity conserving model (2 shown above), and a fourth model which is an $R$-parity violating (RPV) [6].

Exclusion limit of gluino mass extended up to 1.8 TeV.

References


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