A search for new phenomena in monojet final states with large missing transverse momentum was performed on 10.5 fb$^{-1}$ of $\sqrt{s} = 8$ TeV data collected in 2012 with the ATLAS detector at the LHC. Good agreement is observed between the number of events in data and the Standard Model predictions. The results are translated into limits on pair production of weakly interacting dark matter candidates, as well as on the production of light gravitinos, leading to the best lower bound to date on the gravitino mass. Limits on models with extra spatial dimensions are also presented.

**Summary**

A search for new physics in events with a monojet signature and large missing transverse energy was performed on 10.5 fb$^{-1}$ of $\sqrt{s} = 8$ TeV proton-proton collision data recorded with the ATLAS experiment at the LHC during 2012. No evidence for new phenomena is observed, the data agrees well with the Standard Model predictions. This is translated into model-independent upper limits on the visible cross section as well as in the context of various scenarios of physics beyond the Standard Model. Limits on the suppression scale M$\text{s}$ as a function of the WIMP mass for the pair production of dark matter candidates are presented.

**Analysis Setup**

- **Physics Objects Definition:**
  - Jets: reconstructed with anti-$k_t$ algorithm (R = 0.4)
  - Missing transverse momentum (E$_{\text{T}}^{\text{miss}}$): reconstructed from energy deposits in the calorimeter up to $|\eta| = 4.5$
  - Electrons: selection criteria based on shower shape and track selection, $p_T > 30$ GeV, $|\eta| < 2.5$
  - Muons: selection based on match of inner tracker and muon system tracks, $p_T > 7$ GeV, $|\eta| < 2.5$
- **Event Selection:**
  - Events with trigger $E_{\text{T}}^{\text{miss}} > 80$ GeV
  - Quality cuts to reject non-collision backgrounds: reject events containing jets with anomalous charge or electromagnetic fraction or timing
  - Leading jet $p_T > 120$ GeV, |$\eta$| < 2
  - E$_{\text{T}}^{\text{miss}} > 120$ GeV, |$\eta$| (jet) < 0.5 (suppress dijet events)
  - 2 jets with $p_T > 30$ GeV and |$\eta$| < 4.5, no leptons

**Systematic Uncertainties**

- **Electroweak (EW) Background Estimation:**
  - Jet Energy Scale/Resolution (JES/JER): 2% - 4% on transfer factor (TF)
  - Lepton identification efficiencies: 1% - 3% on TF
  - Remaining non-EW backgrounds: 20% - 50% uncertainty in signal regions
  - Parton shower and hadronisation modeling: 3%

**Results**

The data are compared with the background estimation in 4 different signal regions (SRs), categorized by leading jet $p_T$ and missing transverse momentum:

- **SR1:** $p_T (\text{jet})$, E$_{\text{T}}^{\text{miss}} > 120$ GeV,
- **SR2:** $p_T (\text{jet})$, E$_{\text{T}}^{\text{miss}} > 350$ GeV,
- **SR3:** $p_T (\text{jet})$, E$_{\text{T}}^{\text{miss}} > 220$ GeV,
- **SR4:** $p_T (\text{jet})$, E$_{\text{T}}^{\text{miss}} > 500$ GeV

Event yields are compared with the Standard Model prediction in each signal region:

- The measured number of events agrees well with the background prediction within the errors from statistical and systematic uncertainties for all signal regions
- The largest fraction of events comes from Zv$\nu$ (50 - 70%), the Wv backgrounds add up to 30 - 40%, of which Wv$\nu$ has the largest contribution (16 - 25%)

**Background Estimation**

- Multijet Background: Different fits used in data-driven estimation: $< 100$% on background
- Other Backgrounds: 20% on top and diboson backgrounds

**Limits on Large Extra Dimensions**

The limits in the visible cross section are interpreted in terms of the ADD model of large extra dimensions:

- Large difference between the electroweak scale and the Planck scale might be explained:
- Gravitino in gauge-mediated SUSY:
- A gravitino being the lightest supersymmetric particle (LSP) in gauge-mediated SUSY scenarios can lead to monojet signatures:
- Associated production of gravitinos with squarks/gluinos, giving rise to monojet final states, becomes important for light gravitinos
- Cross section is inversely proportional to the gravitino mass, limits give lower bounds on it
- Previous bounds from colliders are at 1.3 TeV, assuming high squark/gluino masses ($> 2$ TeV)
- The present limit, considering associated production with squark/gluinos, covers also lower squark/gluino masses

**Gravitino Production**

A gravitino being the lightest supersymmetric particle (LSP) in gauge-mediated SUSY scenarios can lead to monojet signatures:

- Associated production of gravitinos with squarks/gluinos, giving rise to monojet final states, becomes important for light gravitinos
- Cross section is inversely proportional to the gravitino mass, limits give lower bounds on it
- Previous bounds from colliders are at 1.3 TeV, assuming high squark/gluino masses ($> 2$ TeV)
- The present limit, considering associated production with squark/gluinos, covers also lower squark/gluino masses

**References**

- The results are documented in: ATLAS-CONF-2012-147 and arXiv:1210.4491
- WIMP interpretation and the effective field theory approach are discussed in: arXiv:1310.3782
- For the ADD model, N. Arkani-Hamed et al., arXiv:hep-ph/0003135

**Johanna Gramling (University of Geneva), for the ATLAS Collaboration**