Search for Supersymmetry in events with a Z boson, jets and large E_{T}^{miss} with ATLAS

Motivation
Strong production in models with supersymmetry breaking via General Gauge Mediation (GGM):
- Gravitino LSP, higgsino-like Neutralino NLSP
- Z bosons from the decay χ_{1}\rightarrow Z+\tilde{G}
- Branching ratio for this decay high (~60-100%) in parameter space under study

Dominant Uncertainties
- Flavour-symmetric background:
  - Limited number of e\mu events (24% with respect to total background expectation)
  - Systematic error due to subtraction of flavour non-symmetric backgrounds and errors on k and α factors (4%)
- Fake lepton background: uncertainties on efficiencies (14%)
- WZ: combined MC generator and parton shower uncertainty (7%)
- Signal cross-sections calculated at NLO+NLL, uncertainties include variations of PDF’s and scales (3-20%)

Analysis Strategy
- Select only clean events (no problems with detector, reconstruction, etc.)
- Event recorded by di-lepton OR single lepton trigger
- Preselect events with a opposite-sign ee or μμ pair (81 GeV<\m_{T}<101 GeV)
- Search region SR-Z:
  - At least 2 jets, E_{T}^{miss}>225 GeV, \Delta p_{T}^{\text{jet1,2}} > 600 GeV
  - Variance and control regions (VR/CR) inside and outside Z mass window to cross-check background estimate

Flavour-symmetric Backgrounds
- Dominant background
- Dileptonic t\bar{t}, WW, W+H and Z→tt branching fractions fulfill relation e\mu:e\mu\approx 1:1.2
  - can be estimated from e\mu:
    \begin{align*}
    N_{\text{e\mu}} &= \frac{1}{\epsilon_{\mu}} N_{\text{e\mu}}^{\text{fake}} \\
    N_{\text{e\mu}}^{\text{fake}} &= \frac{1}{\epsilon_{\mu}} N_{\text{e\mu}}^{\text{real}}
    \end{align*}
  - different e\mu reconstruction efficiencies, α: different efficiencies for e\mu and μμ triggers
- Cross-check: extrapolation of t\bar{t} MC from CRT to SR-Z

Z\gamma*+jets Background
- Mismeasurement of jets can lead to background with fake E_{T}^{miss}
- Use data-driven jet smearing method
- Cross-check: JZB method and MC
  - Negligible due to Δφ(jets,E_{T}^{miss}) cut

Other Backgrounds
- WZ/ZZ and rare Top (t+Z and t+V): from MC simulations
- Fake leptons estimated with data-driven matrix method
  \[ n_{\text{fake}} = \frac{N_{\text{fake}}^{\text{MC}} - (1/\epsilon_{\mu\mu} - 1) N_{\text{MC}}^{\text{data}}}{\epsilon_{\mu\mu}} \]
  (for 2 leptons analogously)
  - ε_{\gamma}: efficiencies for real/fake leptons
  - N: number of leptons that fail/pass tight identification and isolation requirements
  - Triboson, Higgs, Z+γ negligible

Expected Events
- ee channel:
  - Observed events: 16 ± 13
  - Expected background: 4.2 ± 1.6
  - P-value of background-only hypothesis (expressed in Gaussian standard deviations):
    - ee channel: 3.0 σ
    - μμ channel: 1.7 σ
    - Combination (sum of channels): 3.0 σ

Interpretation of the Results
- Place limits on the parameters of two GGM signal models: observed limits weaker than expected due to excess in data
  - tan β = 1.5
    - BR(χ_{1}\rightarrow Z+\tilde{G}) ≈ 100%
  - tan β = 30
    - BR(χ_{1}\rightarrow Z+\tilde{G}) ≈ 60%

Cross-Checks of the Analysis
No significant deviations in any CR or VR, excess visible only in SR.