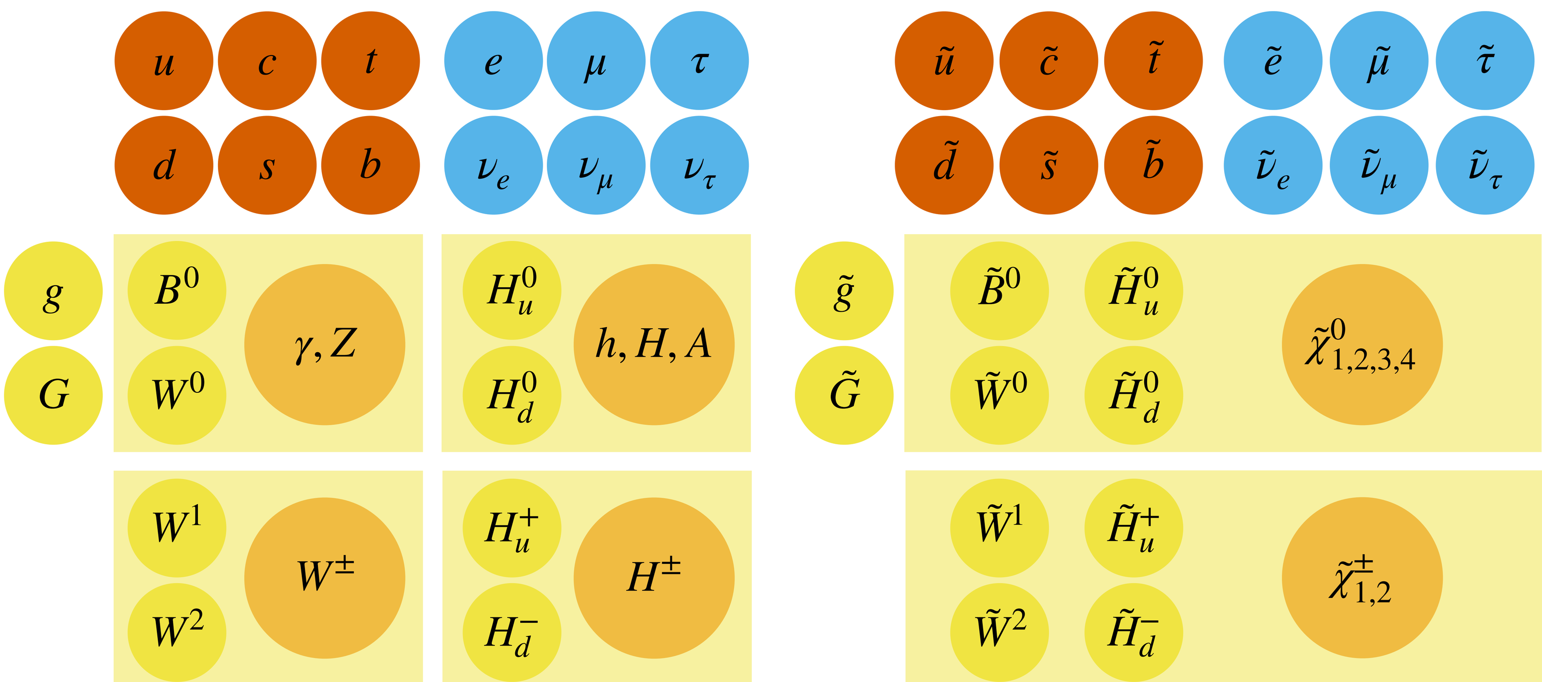
Search for higgsinos with compressed spectra exploiting a low-momentum track with large transverse impact parameter

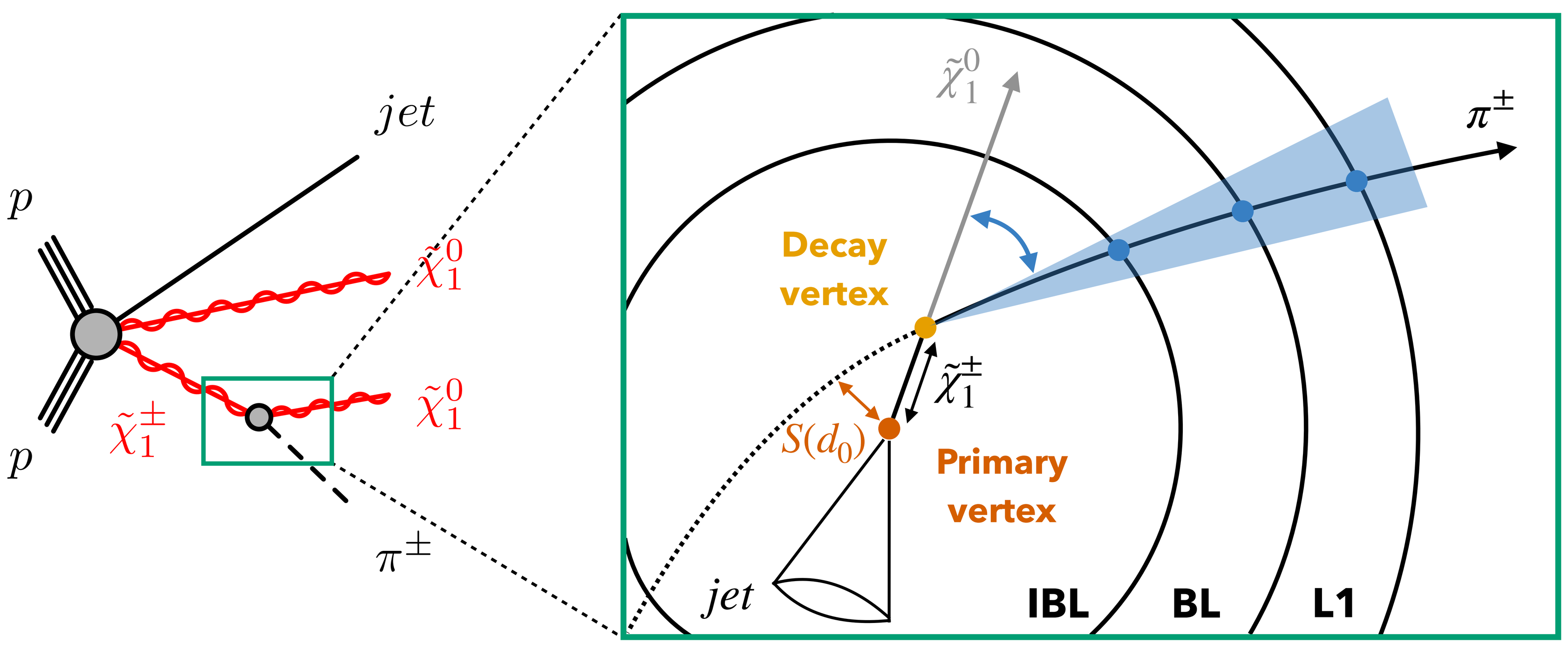
Alessandro Sala on behalf of the **ATLAS Collaboration** - **ICHEP 2024**, Prague

1 Extending the SM with SUSY

- SUSY is one of the most compelling Standard Model (SM) extensions
- Introduces a new set of particles which can provide explanations to many still open problems
  - Higgs boson mass hierarchy
  - Nature of the Dark Matter content of the Universe
  - $(g-2)_\mu$ anomaly between theory and experiments



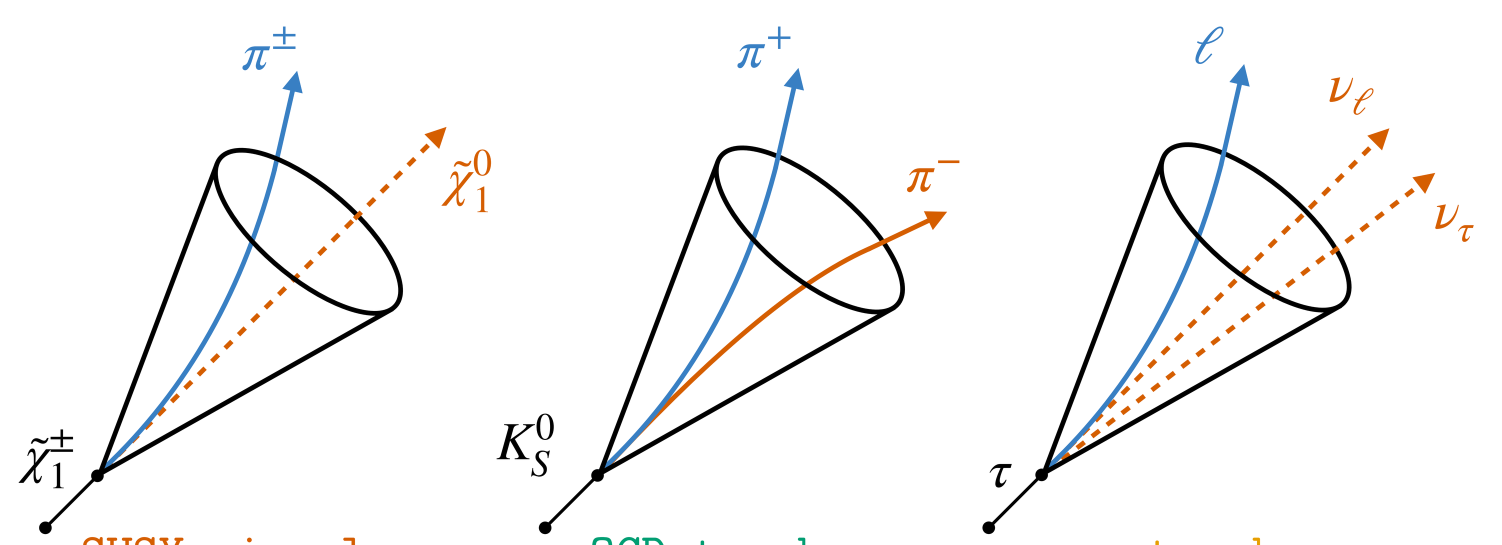
2 Compressed higgsinos @ LHC



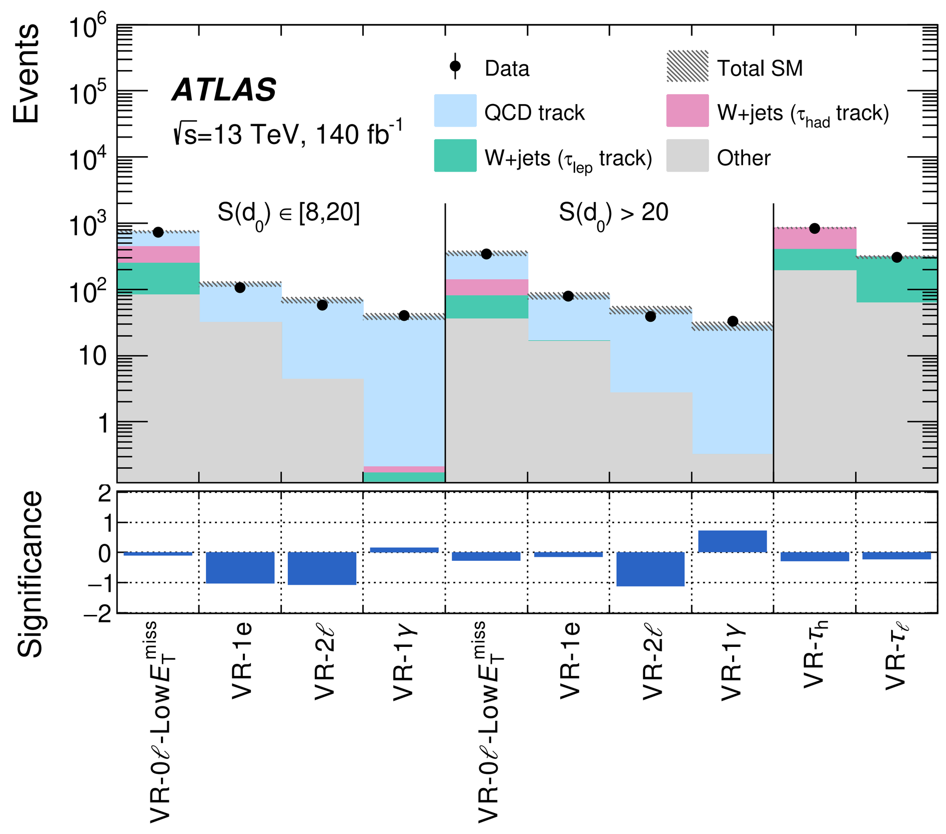
- Since $\Delta m(\tilde{\chi}_1^\pm, \tilde{\chi}_1^0) \sim \mathcal{O}(1\text{ GeV})$ between the higgsinos, a $\tilde{\chi}_1^\pm$ can travel a few millimetres from pp vertex before decaying to a soft pion. Final state:
  - Large missing transverse momentum E_T^{miss} due to $\tilde{\chi}_1^0$ boosted by the recoiling jet
  - Isolated $\pi^\pm$ track with finite displacement $d_0 \sim$ mm from pp vertex $\Longrightarrow$ selection on significance $S(d_0)$

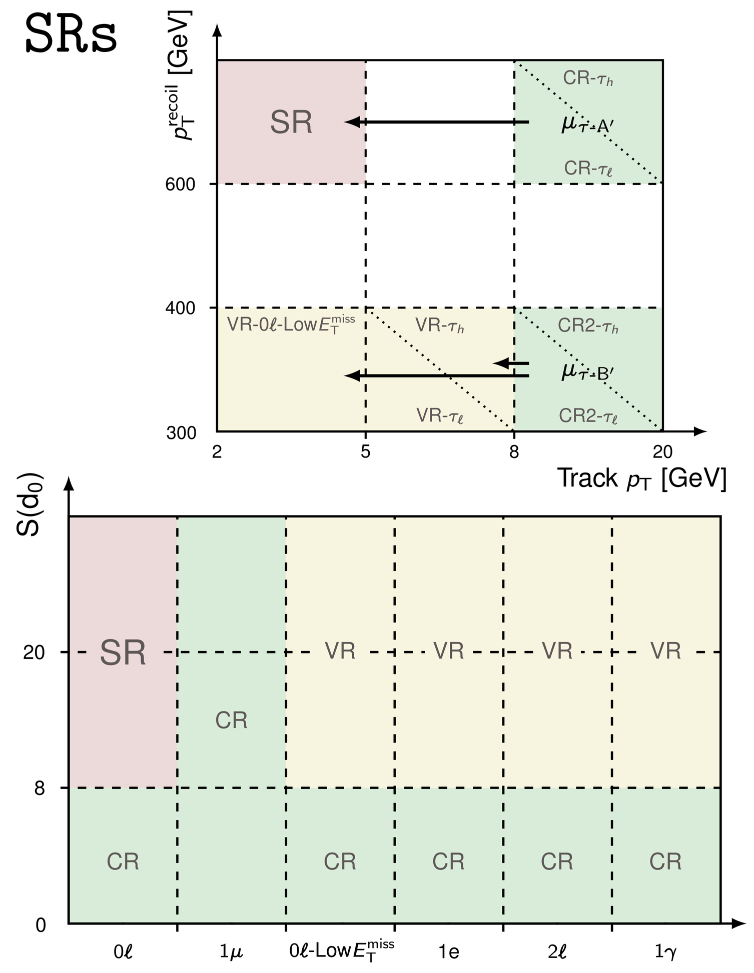
3 The analysis at a glance

- Signal Regions (SRs) enriched in SUSY signals
  - $E_T^{miss} > 600$ GeV, $S(d_0) > 8$ and $2 < p_T^{track}/\text{GeV} < 5$
- Control regions (CRs) to constrain SM backgrounds
  - "QCD tracks": hadron decay/pileup tracks in $V+$jets events $\Longrightarrow$ estimation via data-driven ABCD method
  - "τ tracks": pion/lepton track in $W(\to\tau\nu)$ events, tagged as signal-like $\Longrightarrow$ estimation via Monte Carlo simulation normalisation to data

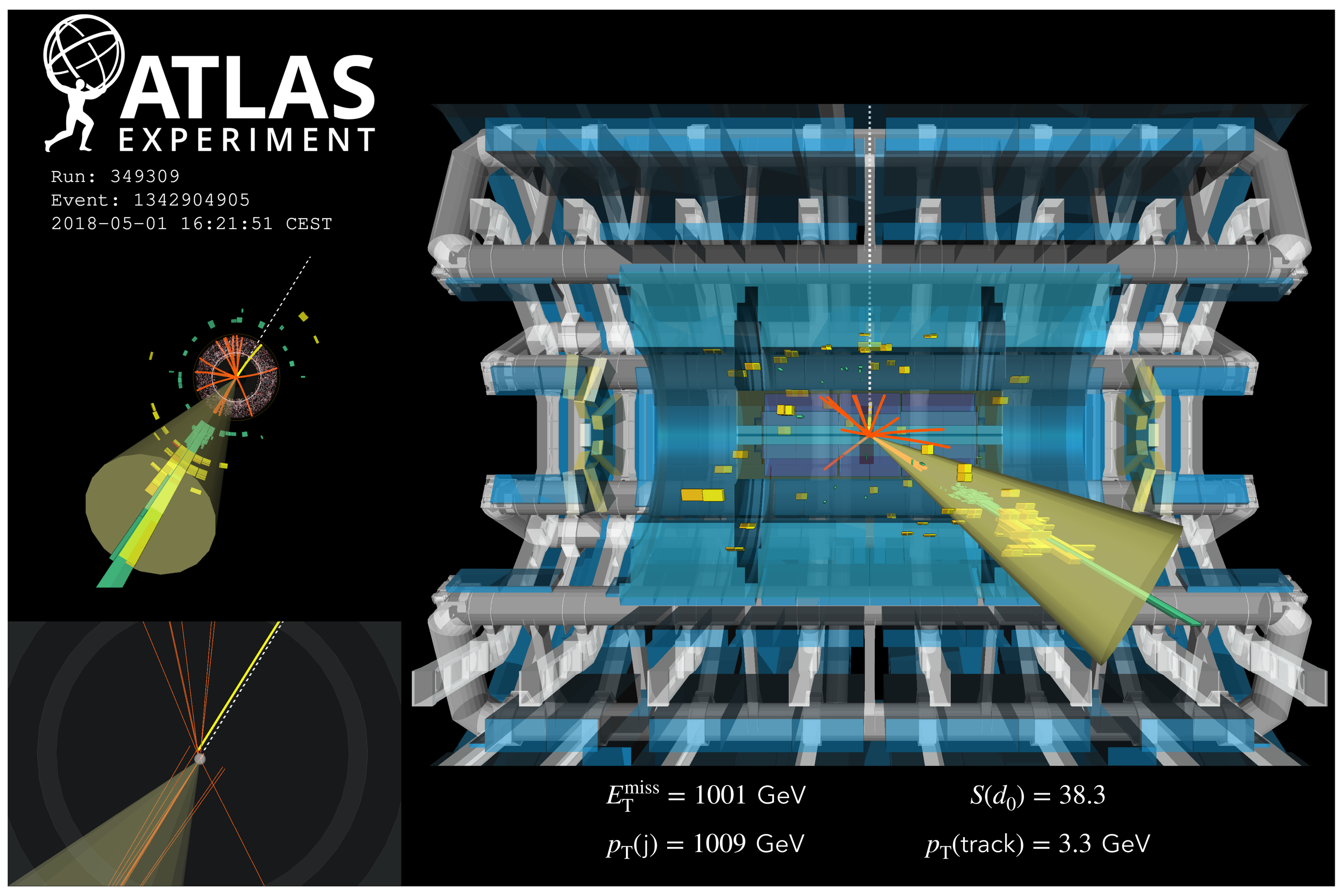


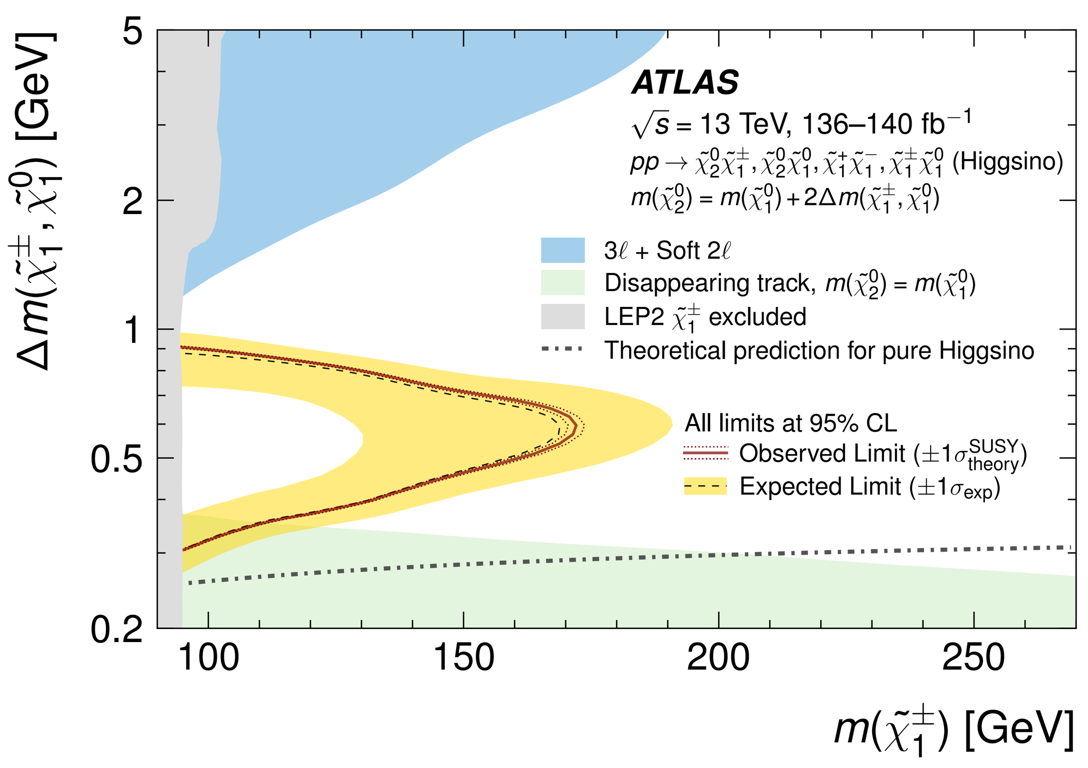
- Validation Regions (VRs) with similar bkg. composition as the SRs or with different lepton, photon content used to validate bkg. estimation strategy before unblinding SRs

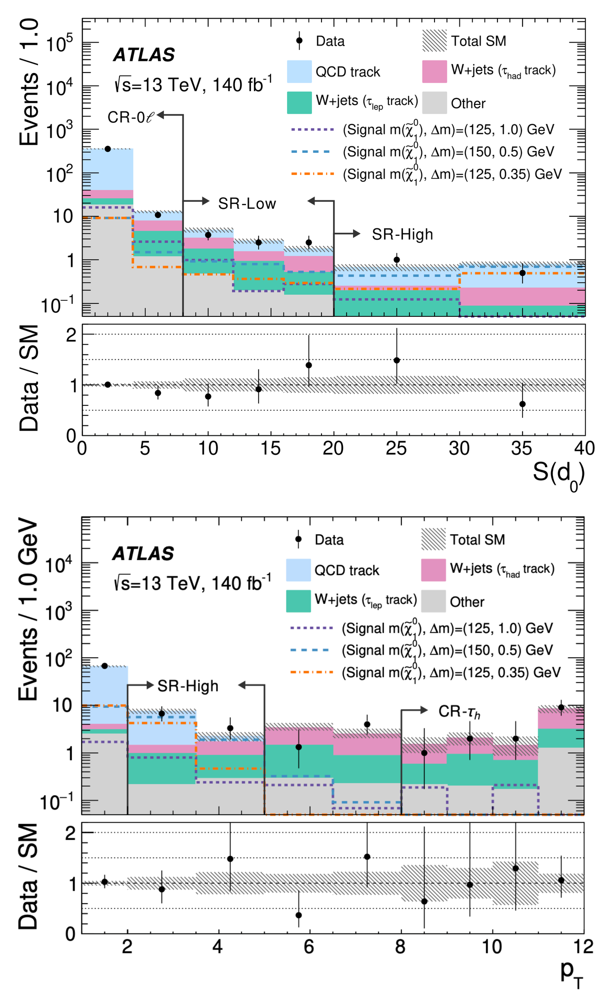




4 Time to unblind!







- Excellent agreement in SRs between observed data and SM predictions

5 Conclusions

- Brand new analysis targeting compressed higgsinos using soft displaced tracks
- No significant excess over SM predictions
- Exclusion limits covering for the first time since LEP the region with $\Delta m(\tilde{\chi}_1^\pm, \tilde{\chi}_1^0) \sim \mathcal{O}(1\text{ GeV})$!

SCAN ME

alessandro.sala@cern.ch