Contribution ID: **119** Type: **not specified**

LHC constraints on monojet signatures from electroweakino DM and coloured-superpartner decays

Wednesday 29 June 2022 16:00 (20 minutes)

We revisit LHC searches for heavy invisible particles by exploiting QCD initial-state radiation. In the first part, we recast a monojet and a dijet signal region in a general multijet plus missing transverse momentum analyses by ATLAS. We find non-trivial mass limit can already be obtained for the Wino and Higgsino LSP scenarios with the present data of 139 fb^{-1} thoroughly from hadronic channels; $m_{\widetilde{W}} > 160$ GeV for Wino and $m_{\widetilde{h}} > 100$ GeV for Higgsino, depending on the chargino-neutralino mass splitting. We also study simplified dark matter scenarios with scalar and axial-vector mediators and derive limits on the coupling vs mediator mass planes.

In the second part , we study the application of the mono-jet channel at the LHC as a mean of searching for squarks and gluinos. We consider two separate scenarios. In the first scenario the lighter of the squark and gluino is almost mass degenerated with the lightest neutralino, which is assumed to be the lightest supersymmetric particle and stable due to the R-parity. The associated squark-gluino production, $pp \to \tilde{q}\tilde{g}$ then leads to a distinctive mono-jet signature, where the high p_T jet is produced from the decay of the heavier coloured particle into the lighter one ($\tilde{q} \to q + \tilde{g}$ for $m_{\tilde{q}} > m_{\tilde{g}}$ and $\tilde{g} \to q + \tilde{q}$ for $m_{\tilde{g}} > m_{\tilde{q}}$), and the lighter coloured particle is registered as the missing transverse energy due to the mass degeneracy with the neutralino. We recast an existing mono-jet analysis for this scenario and find non-trivial exclusion limits on the squark-gluino mass plane with heavy neutralinos. In the second scenario we assume large mass hierarchy between the squarks and the lightest electroweakino ($\tilde{\chi}$). The associated squark-wino production, $pp \to \tilde{q}\tilde{\chi}$ then leads to a mono-jet signature, where the high p_T jet is originated from the squark decay, $\tilde{q} \to q + \tilde{\chi}$. Comparing projected sensitivity of the mono-jet analysis to the associated squark-wino production and that of the standard multi-jet analysis to the squark pair production, we find that the former may be superior or at least competitive to the latter at the high-luminosity LHC if the lightest electroweakino is Wino-like.

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Session Classification: SUSY: Phenomenology and Experiment