Searches for Dark Matter and Dark Energy produced in association with a jet using the ATLAS detector

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Interpretations

WIMPs\([4]\)

The monojet search is sensitive to various WIMP candidates. Pair-production involving an axial-vector, vector or a pseudoscalar mediator in the s-channel, & a coloured scalar mediator are considered.

Large Extra Spatial Dimensions (LED)\([4]\)

LED can explain the difference between the EW scale \(O(100)\) GeV and the Planck scale \(O(10^{19})\) GeV. The ADD model of LED leads to a reduced Planck Scale \(M_D\), predicted to be on the TeV scale, accessible at the LHC. It also results in massive graviton modes escaping into the LED resulting in \(E_T^{miss}\) leading to a monojet signature.

SUSY\([4]\)

Pair production of stop and sbottom squarks has been considered. Exclusion limits are enhanced for the compressed scenario where the stop and neutralino masses are almost degenerate.

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Scalar Dark Energy (DE)\([1]\)

A horndeski model postulating a DE scalar field that couples to both SM matter fields and gravitational fields in such a way as to cause a small cosmological constant has been considered. The DE field results in an invisible scalar particle that's coupling is enhanced at high momentum transfers which are involved in the monojet signature.

Event Selection

- \(E_T^{miss} > 250\) GeV
- Leading jet \(p_T > 250\) GeV
- Jet quality restrictions (pileup and non collision background rejection)
- \(n_{jets} \leq 4\) with \(p_T > 30\) GeV & \(|\eta| < 2.8\)
- \(|\Delta\phi(jet, p_T^{miss})| > 0.4\) for any jet
- Electrons with \(p_T > 20\) GeV vetoed
- Muons with \(p_T > 10\) GeV vetoed
- Signal Regions (SR) defined based on \(E_T^{miss}\)

Results

Backgrounds measured with various Control Regions (CR) & modelled within the SR. Monte Carlo is normalized with data in the CR, by a global fit including systematics. A 2.4% background uncertainty on total events in the SR is reached.

Systematic improvements also enhance discovery potential, especially theoretical systematics.

References - The ATLAS Collaboration.

[1] "Search for scalar dark energy in \(t\bar{t}\) events with the ATLAS detector" ATL-PHYS-PUB-2018-08
[3] "Extrapolation of \(E_T^{miss}+\text{jet}\) search results to an integrated luminosity of 300 and 3000 fb\(^{-1}\)" ATL-PHYS-PUB-2018-043

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