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Beyond Standard Model searches in monojet events with the ATLAS experiment at LHC

F. Cirotto on behalf of the ATLAS Collaboration

Università degli studi di Napoli Federico II and INFN, Sezione di Napoli - Napoli, Italy

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Summary. — A search for new phenomena in final state events with missing transverse energy and jets is reported. For the monojet signature data collected by ATLAS experiment at LHC in 2015 corresponding to an integrated luminosity of $3.2\,\mathrm{fb}^{-1}$ at $\sqrt{s} = 13\,\mathrm{TeV}$ has been used. Events with heavy flavour jets and missing transverse energy extend the sensitivity of inclusive monojet searches in non universal couplings between SM and DM particles. Preliminary data/MC comparison on the mono-b analysis with $0.68\,\mathrm{pb}^{-1}$ at $\sqrt{s} = 13\,\mathrm{TeV}$ are shown.

1. – Theoretical models

Events with energetic jets and large missing transverse momentum in the final state may be used in searches for physics beyond the Standard Model (SM). This signature is sensitive to several theoretical models: Dark Matter (DM), Supersimmetry (SUSY) and Large Extra Dimensions (LED).

DM detection is one of the most challenging goal at the Large Hadron Collider (LHC). DM candidates (weakly interacting massive particle, WIMPs) are searched in events with high missing transverse energy E_T^{miss} and SM particles. In Run 2 analyses, simplified models [1] are the paradigma adopted. They are based on 4 parameters: mediator and DM masses and SM-DM couplings. As mediators are expected to have Yukawa-like couplings to SM quarks, the final state with heavy quarks (b or t) and E_T^{miss} has a great relevance.

Supersimmetry has been introduced to solve the hierarchy problem and predicts a new supersymmetric partner (sparticle) for each SM particle. In some SUSY scenarios supersymmetric partners of the third-generation SM quarks are the lightest coloured sparticles. As a consequence, the sbottom ($\tilde{b}_1$) and the stop ($\tilde{t}_1$) could decay via SM particles and lightest supersymmetric particle (LSP), which is assumed to be the lightest neutralino, $\tilde{\chi}_1^0$. The search for $\tilde{b}_1 \to b\tilde{\chi}_1^0$ and $\tilde{t}_1 \to t\tilde{\chi}_1^0$ final states has the typical signature of events with energetic jets and large missing transverse momentum.

TABLE I. – *Observed 95% CL upper limits on the visible cross section for the seven inclusive region.*

Inclusive SR	$\langle\sigma\rangle_{obs}^{95}$[fb^{-1}]
IM1	553
IM2	308
IM3	196
IM4	153
IM5	61
IM6	23
IM7	19

The large difference between the electroweak unification scale $\mathcal{O}(10^2)$ GeV and the Planck scale $M_{Pl} \sim \mathcal{O}(10^{19})$ GeV can be explained by introducing n extra spatial dimensions of size R. These extra spatial dimensions are compactified, resulting in a Kaluza-Klein tower of massive graviton modes. Events with graviton modes (which escape detection) and energetic jet can be produced in high-energy colliders, thus leading to a monojet signature.

2. – Results

For the monojet analysis inclusive and exclusive signal regions (SR) have been considered with increasing E_T^{miss} threshold from 250 to 700 GeV. The study of main backgrounds W+jets, $Z(\rightarrow \nu\bar{\nu})$+jets, $Z/\gamma^*(\rightarrow \tau^+\tau^-)$+jets and $Z/\gamma^*(\rightarrow \mu^+\mu^-)$ has been performed in dedicated control regions (containing 1e, 1 μ or 2 μ plus the SR selection). The remaining backgrounds from $Z/\gamma^*(\rightarrow e^+e^-)$, $t\bar{t}$, single top, diboson and multijets have been estimated using MC samples and data driven methods. A simultaneous likelihood fit to the control regions has been applied and transfer factors have been extracted to constrain background estimates in the signal regions. No deviations from SM predictions have been observed. Model-independent 95% confidence level (CL) upper limits on the cross section for the 7 inclusive signal regions can be found in table I. A model-dependent interpretation has been also applied to results. Details can be found in [2].

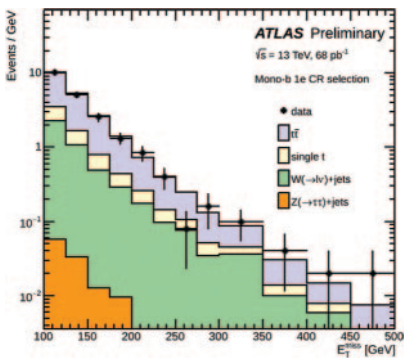

Fig. 1. – Data/MC comparison in the control region with 1 electron for the mono-b analysis for the E_T^{miss} distribution.

In the mono-b analysis signal and control region definition is ongoing. Signal regions have been defined according to b-jets multiplicity. A first data/MC comparison [3] in the control regions with 1 lepton showed a good agreement. The missing transverse energy distribution for a control region with 1 electron is shown in fig. 1.

REFERENCES

[1] Abercrombie D. *et al.*, arXiv:1507.00966 [hep-ex].
[2] ATLAS Collaboration, arXiv:1604.07773 [hep-ex].
[3] ATLAS Collaboration, EXOT-2015-007.