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Search for Dark Matter in association with bottom quarks at LHC Run-2 with the ATLAS experiment

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Summary. — The latest results in the search for Dark Matter associated production with bottom quarks using the 2015 and 2016 LHC pp collisions data at centre-of-mass energy $\sqrt{s} = 13\,\text{TeV}$ recorded by the ATLAS detector and corresponding to a luminosity of $13.3\,\text{fb}^{-1}$ will be presented.

1. – Theoretical models

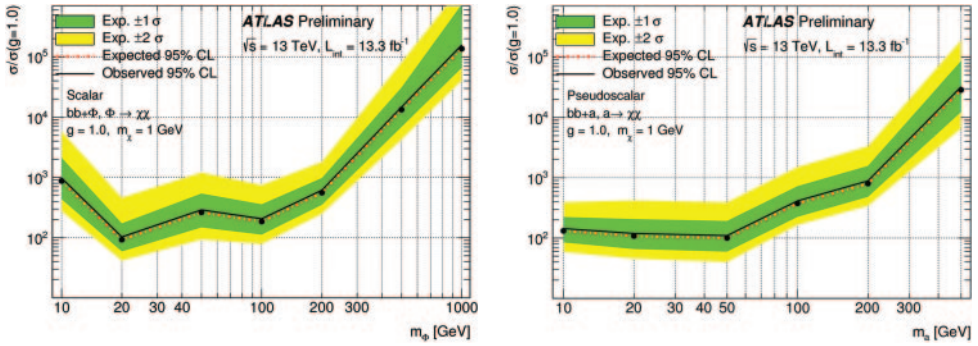
Events with bottom quarks and missing transverse momentum $E_{\text{T}}^{\text{miss}}$ in the final states may be used for Dark Matter (DM) searches. DM existence in the Universe is highly motivated by different astrophysical evidence, providing weakly interacting massive particle (WIMP) as possible candidates.

In Run 2 analyses at LHC, simplified models [1] are the paradigm adopted. They are based on 4 parameters: mediator and DM masses (M_{med} and m_χ) and couplings between mediator and SM and DM particles (g_v and g_χ). Since spin-0 scalar and pseudoscalar mediators are expected to have Yukawa-like couplings to SM quarks, the final state with heavy quarks (bottom or top) and $E_{\text{T}}^{\text{miss}}$ has a great relevance. In particular, signatures involving bottom quarks can test theoretical scenarios where new particles couple differently with down generation quarks.

2. – Results

A zero lepton dedicated signal region (SR) has been developed with an event topology characterised by low jet multiplicity (2 or 3 jets) with exactly 2 b-jets and missing energy originated from mediator decay into DM particles. Angular cuts have been applied in order to enhance signal yields over the expected SM background. Details can be found in [2].

The estimation of major backgrounds has been performed by adopting a data-driven method with the definition of Control Regions (CR) designed in order to select a region



(a) Scalar mediator (b) Pseudoscalar mediator

Fig. 1. – Signal strength limits obtained as a function of scalar (a) and pseudoscalar (b) mediators for $m_\chi = 1\,\text{GeV}$ and $g_v = g_\chi = 1$. The dashed red line indicates the expected limits, the solid black line the observed ones [2].

with a high purity of a specific background. Three CRs have been used: for the estimation of irreducible Z+jets background, for $t\bar{t}$ backgrounds and for W+jets and single top backgrounds. The CR definitions followed selection criteria similar to those applied in SR and further requirements on lepton candidates. In the CR designed for Z+jets estimation the momenta of the 2 leptons required in the selection are added vectorially to the missing energy computation to mimic the expected missing energy momentum of $Z \to \nu\nu$ events. Other minor backgrounds, dibosons and $t\bar{t} + W/Z$, have been estimated from Monte Carlo (MC) simulation. The multi-jet background is estimated from data.

The normalization factors extrapolated from a simultaneous fit in all CRs have been used to rescale MC predictions in the SR. The background estimate is validated by comparing normalized predictions in dedicated validation regions (VR), designed to be mutually orthogonal and kinematically similar to SR, with a negligible signal contamination.

As no evidence of significant excess has been found, 95% confidence level (CL) upper limits on the signal strength, defined as the scaling factor that should be applied to the theoretical cross-section to exclude the considered model, have been derived. In fig. 1 limits are shown as a function of M_{med}, for a DM mass of 1 GeV and equal couplings $g_v = g_\chi = 1$ for scalar (a) and pseudoscalar (b) mediators for an integrated luminosity of $13.3\,\text{fb}^{-1}$ at $\sqrt{s} = 13\,\text{TeV}$.

The analysis is currently under re-optimization in order to exploit the total integrated luminosity collected during Run 2 data taking, corresponding to $36.1\,\text{fb}^{-1}$.

REFERENCES

[1] Abercrombie D. *et al.*, arXiv:1507.00966 [hep-ex].
[2] ATLAS Collaboration, ATLAS-CONF-2016-086.