Search for new phenomena in mono-X final states using pp collision data collected in Run-2 by the ATLAS experiment at the LHC

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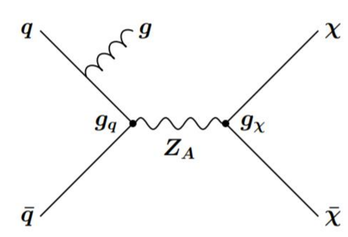
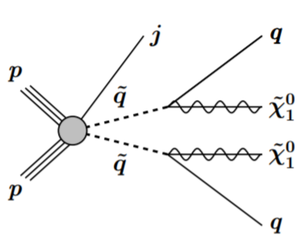
- Cosmological observations point to the existence of a form of matter known as Dark Matter (DM) that accounts for about 27% of the total mass-energy of the Universe.
- If DM interacts with the Standard Model (SM) it may be produced in proton-proton collisions at the LHC and identified via initial state radiation (ISR) of the incoming partons or from SM particles produced in association to the DM. The latest results from the ATLAS experiment from monojet and monophoton searches are presented in this poster.

MonoX signatures

WIMP production with ISR gluon

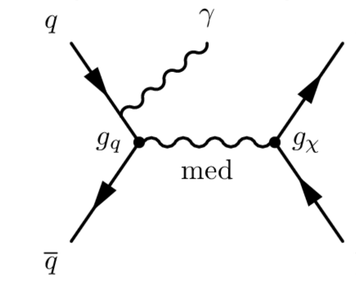


squarks production

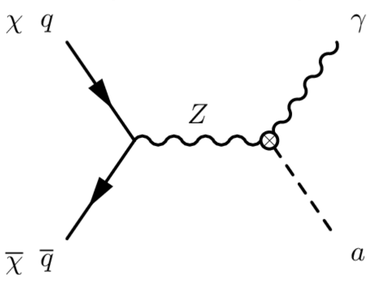


- The monojet and monophoton signatures have been extensively studied at the LHC in the context of searches for DM.
- Results have been interpreted in models with DM candidates such as large extra spatial dimensions (LED), supersymmetry (SUSY), weakly interactive massive particles (WIMPs) and axion-like particles (ALPs). Models inspired in dark energy (DE) that lead to the production of new scalar particles in the final state have also been considered together with reinterpretations of the results in terms of invisible Higgs boson decays.

WIMP production with ISR photon

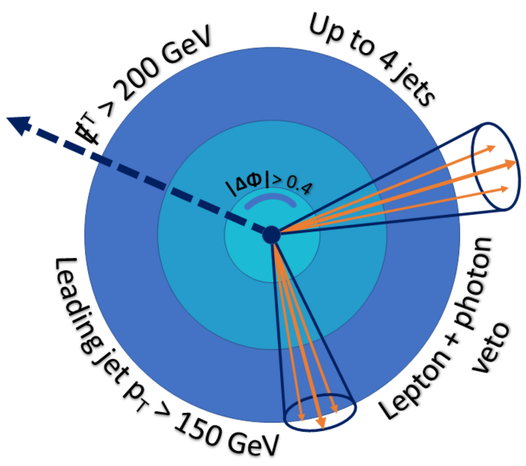


ALPs production with a photon

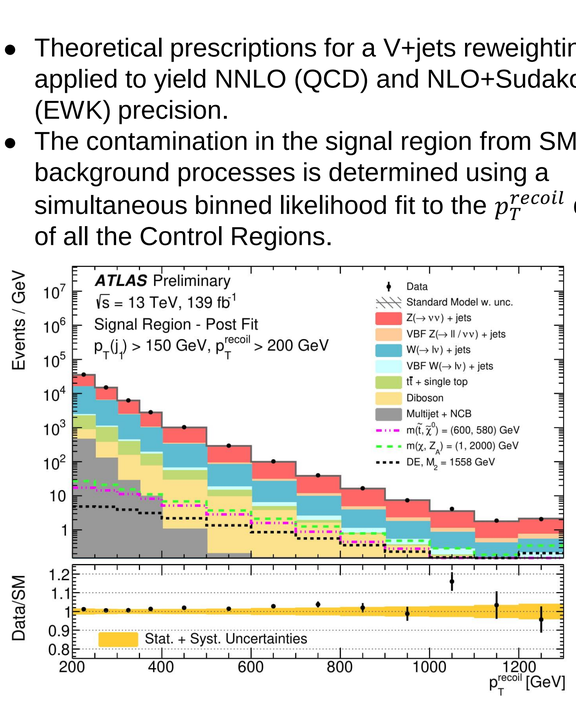


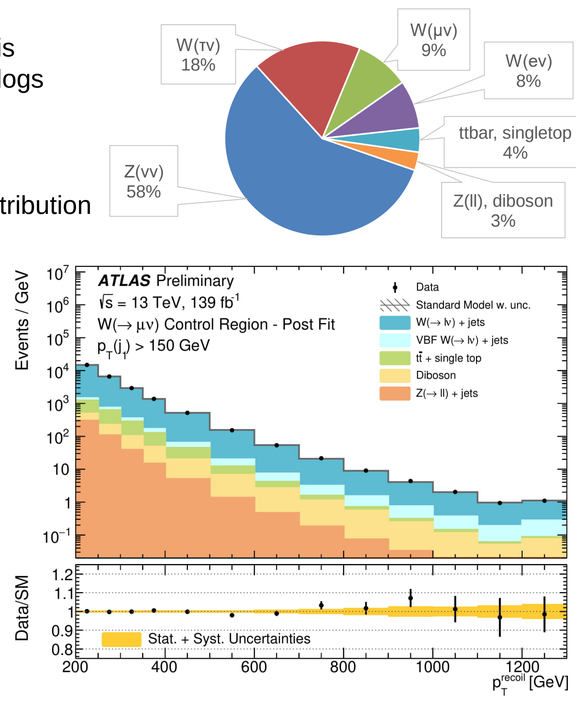
MonoJet

- Search for DM in events with an energetic jet and large missing transverse momentum.
- Events triggered using E_T^{miss}.



- Theoretical prescriptions for a V+jets reweighting is applied to yield NNLO (QCD) and NLO+Sudakov logs (EWK) precision.
- The contamination in the signal region from SM background processes is determined using a simultaneous binned likelihood fit to the p_T^{recoil} distribution of all the Control Regions.

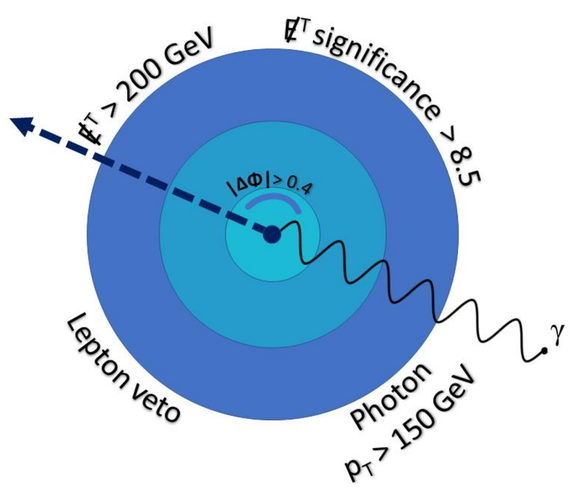




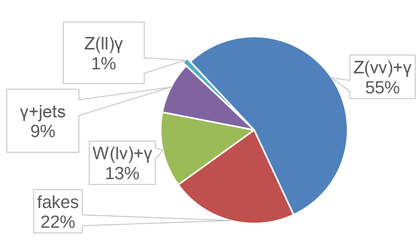
Background composition in the signal region

MonoPhoton

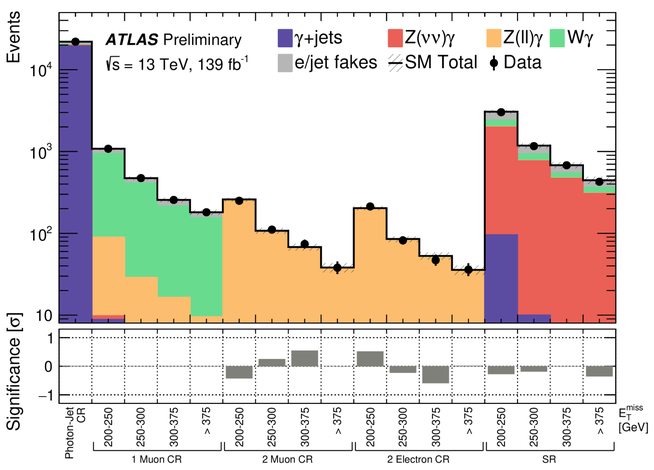
- Search for DM matter in events with an energetic photon and missing transverse momentum.
- Photon triggers are used to trigger the events.

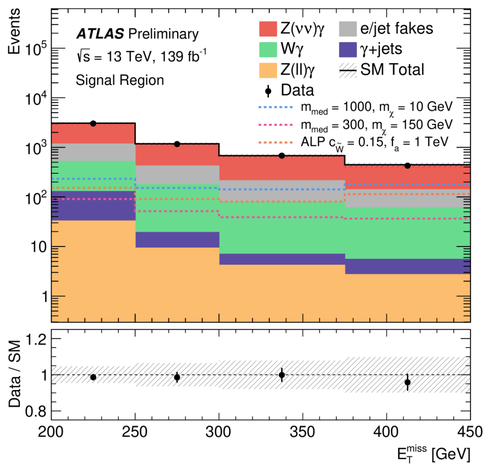


Background composition in the signal region



- The background expectation is obtained using Monte Carlo simulations constrained by observed event counts in dedicated Control Regions.
- The backgrounds arising from jets or electrons being misidentified as photons in W/Z+jets processes are estimated through data-driven methods.

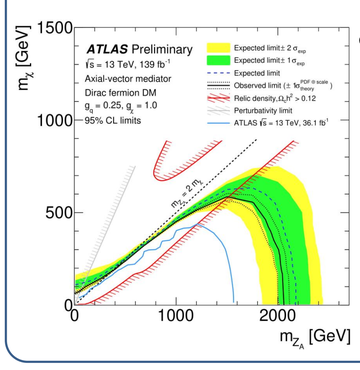


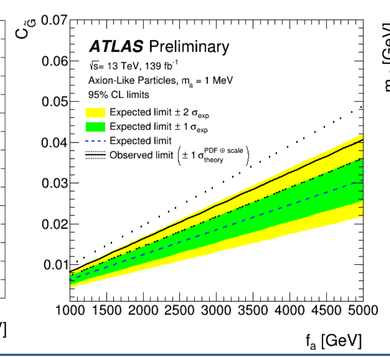


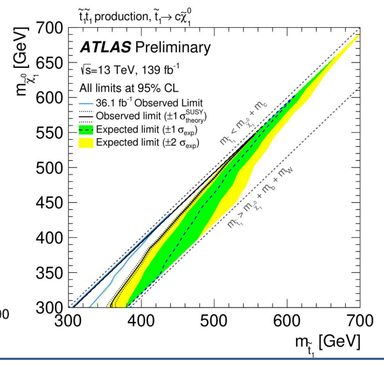
Exclusion limits

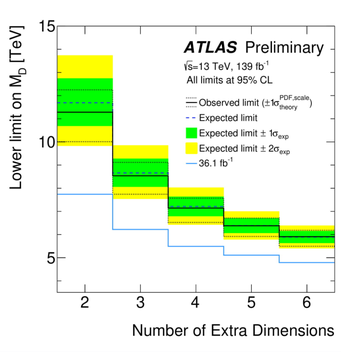
- No significant deviations to the Standard Model predictions are observed and the results are interpreted as exclusion limits on various models.
- For the simplified WIMP model both analyses limit the parameter space on the mass of the DM particle (m_χ) and the mediator (denoted m_{Z_A} in monojet and m_{med} in monophoton). Mediator masses up to 2.0 TeV (1.3 TeV) are excluded for m_χ=1 GeV in monojet (monophoton).
- An ALPs model is also considered for the first time in both analyses. The limits are set on the scale of the effective field theory (f_a) and the coupling of the ALP to gluons ($C_{\tilde{G}}$) for the case of monojet. In the monophoton case, a constraint on the coupling of the ALP to two photons is introduced which reduces the number of free parameters and allows the limit to be set on the coupling of the ALP with the weak isospin fields ($C_{\widetilde{W}}$).
- Monojet also considers models of squark-pair production. Here the result of stop-pair production with $\tilde{t}_1 \to c + \tilde{\chi}_1^0$ is shown. The limits are set as a function of the squark mass (i.e $m_{\tilde{t}_1}$) for different neutralino masses ($m_{\tilde{\chi}_1^0}$).
- The Arkani-Hamed, Dimopoulos and Dvali (ADD) model of LED is also considered in monojet providing limits on the fundamental scale of theory (M_D) as a function of the number of extra dimensions (n). Values of M_D below 12.0 TeV at n = 2 and below 5.9 TeV at n = 6 are excluded at 95% CL.
- An effective field theory implementation of theories introducing a new DE scalar field (ϕ) is also studied in monojet and limtis are placed in the plane of the visible cross section as a function of the suppression scale of the theory (M_2). Values for M_2 below 1530 GeV are excluded.
- Finally, the monojet results are also interpreted as upper limits on the branching ratio for an invisibly decaying Higgs boson. The observed agreement between data and SM prediction excludes Higgs invisible branching ratios above 0.65 at 95% CL with an expected limit of 0.57.

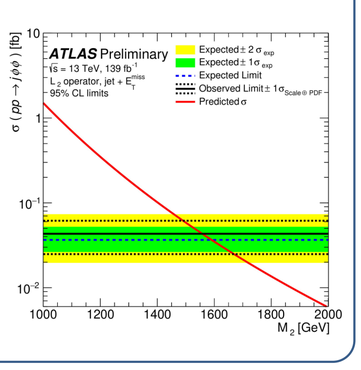
Monojet



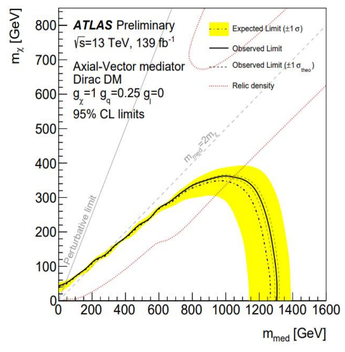


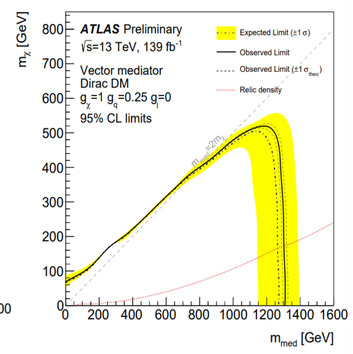


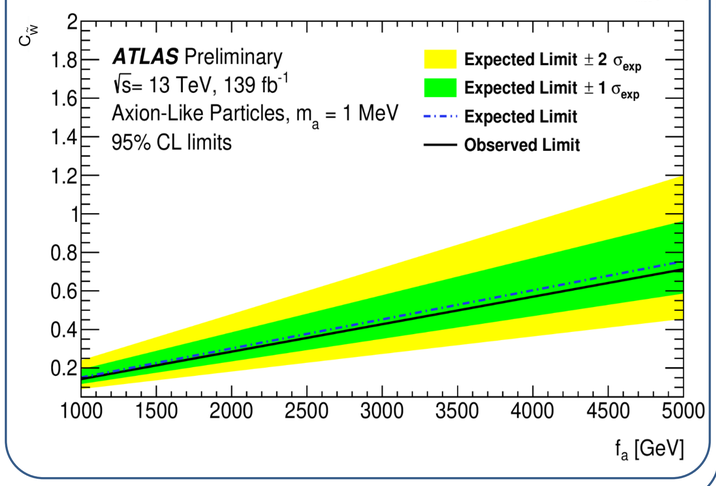




Monophoton







ICHEP – 2020

[1] Search for new phenomena in events with jets and missing transverse momentum in p p collisions at √s = 13 TeV with the ATLAS detector, ATLAS Collaboration, ATL-COM-PHYS-2019-1200

[2] Search for dark matter in association with an energetic photon in pp collisions at √s=13 TeV with the ATLAS detector, ATLAS Collaboration, ATLAS-CONF-2020-02

ATLAS EXPERIMENT