

New results for mono-jet searches with full Run 2 data

source: [ATLAS-CONF-2020-048](#)

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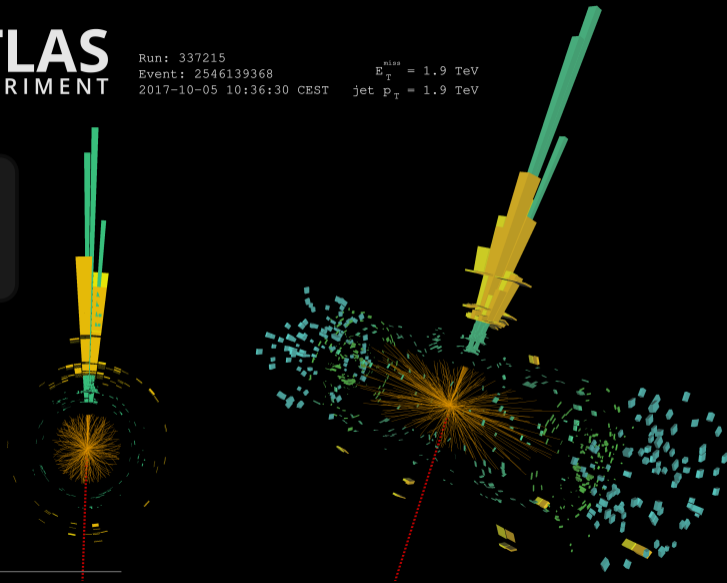
4th Red LHC Workshop

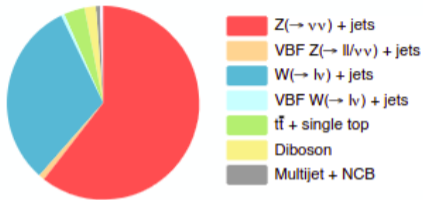
5th November 2020



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- ✓ Jet $p_T > 150 \text{ GeV}$
- ✓ $E_T^{\text{miss}} > 200 \text{ GeV}$
- ✗ Lepton veto





Analysis strategy

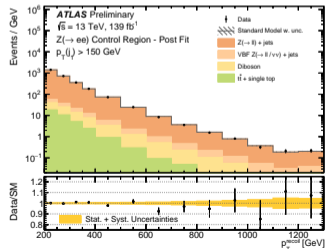
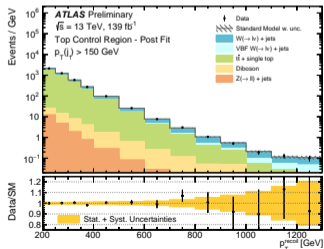
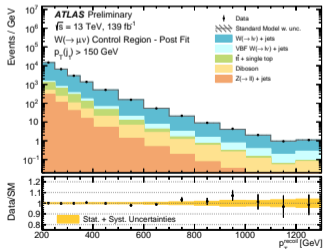
- Simultaneous binned likelihood fit on p_T^{recoil} distribution in **5 Control Regions (CRs)**

$$W \rightarrow \mu\nu, W \rightarrow e\nu, Z \rightarrow \mu\mu, Z \rightarrow ee$$

⇒ **1 norm. factor for V+jets**

$$W \rightarrow l\nu (+b\text{-jet})$$

⇒ **2 norm. factors for single- t and $t\bar{t}$**



PRELIMINARY results presented in [ATLAS-CONF-2020-048](#)

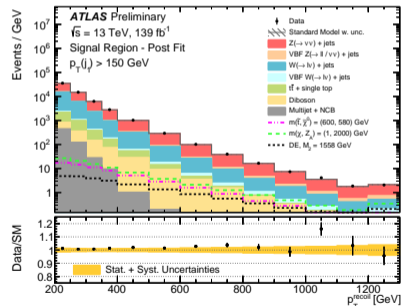
- + $\sqrt{s} = 13$ TeV pp data with a total integrated luminosity of 139 fb^{-1} (period 2015–2018)
 - ▶ 36.1 fb^{-1} results (period 2015–2016) can be found in [JHEP 01 \(2018\) 126](#)
- + V+jets predictions at NNLO in QCD and NLO in EW
- + Tau and photon veto included + lower thresholds on E_T^{miss} and leading jet p_T

Background estimations

- Good agreement data/MC within uncertainties (χ^2 p-values: 0.49 in $Z \rightarrow ee$ CR, 0.99 in top CR)
- Slight excess ($\sim 1.5\sigma$) at $600 < p_T^{\text{recoil}} \leq 800$ GeV

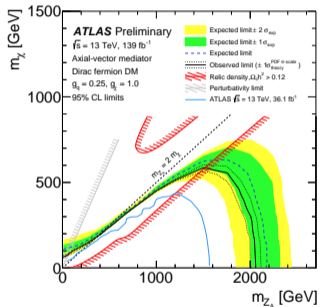
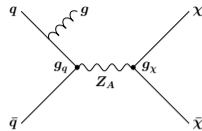
Total background uncertainties

- 1.5% (200 GeV), 1.2% (400 GeV), 4.1% (1.2 TeV)
- Stat. uncs. negligible at low p_T^{recoil} and $< 7\%$ at the tail



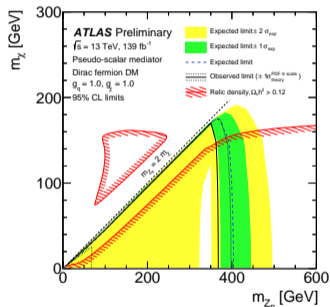
Interpretations – DM

- ▶ Pair of WIMPs + ISR jet produced \rightarrow mono-jet signature
- ▶ Simplified DM models considered, 95% CL exclusion limits set as function of the assumed mediator and Dark Matter (DM) masses



DMA: $S = 1$ mediator Z_A + AV coupling

$m_{Z_A} < 2.1 \text{ TeV}$ excluded for $m_\chi = 1 \text{ GeV}$,
 improving previous results (blue line)



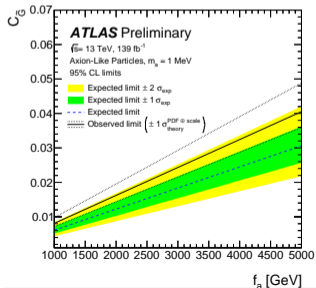
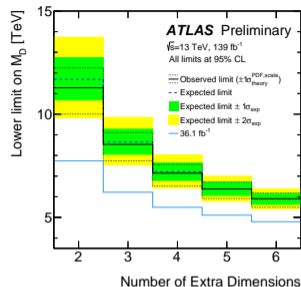
DMP: $S = 0$ mediator Z_P + PS coupling

$m_{Z_P} < 367 \text{ GeV}$ excluded for light m_χ ,
 new interpretation in ATLAS

Interpretations – Large Extra Dimensions & ALPs

- ▶ **ADD** model: n large extra dimensions, KK graviton escaping through $\rightarrow E_T^{\text{miss}}$ signature. 95% CL Exclusion limits are set on the fundamental scale of the $4 + n$ -dim theory, M_D

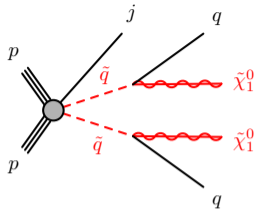
The resulting limit improves previous results (blue line) from 7.7 TeV up to ~ 12 TeV in the $n = 2$ case



- ▶ **Axion-Like Particles (ALPs)** produced in association with a gluon. 95%CL limits set in the $c_{\tilde{G}}-f_a$ plane for an ALP mass of 1 MeV

For an effective scale $f_a = 1 \text{ TeV}$, couplings $c_{\tilde{G}} > 0.008$ are excluded

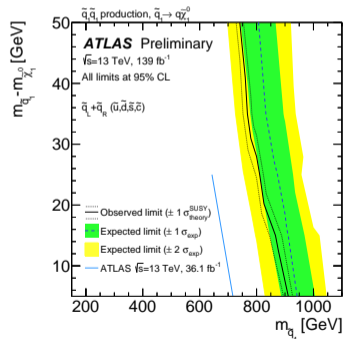
Interpretations – SUSY



- ▶ Supersymmetric quarks (\tilde{q}) \rightarrow SM quarks + $\tilde{\chi}_1^0$ ($\Rightarrow E_T^{\text{miss}}$)
- ▶ Compressed scenarios ($\Delta m = m_{\tilde{q}} - m_{\tilde{\chi}_1^0}$ small) give high sensitivity in the mono-jet signature

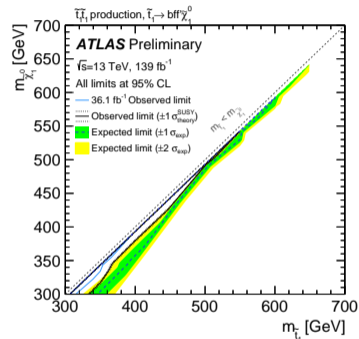
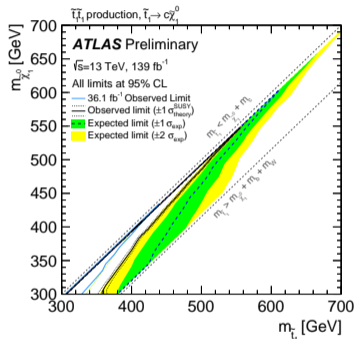
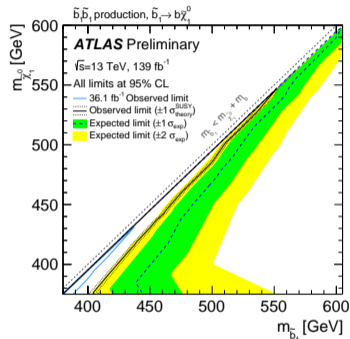
- ▶ The results are translated into 95% CL exclusion limits on $m_{\tilde{q}}$.
- ▶ In the **Squark–Squark** scenario, only light quarks ($q = u, d, c, s$) are considered

Preliminary results allow to exclude $m_{\tilde{q}} \lesssim 900$ GeV for $\Delta m = 5$ GeV, improving the previous published results (blue line)



Interpretations – SUSY

- Third generation quarks ($q = t, b$) are treated separately. 3 different scenarios are considered: **Sbottom** direct decay (left), **Stop** direct decay (middle) and **Stop 4-body** decay (right)

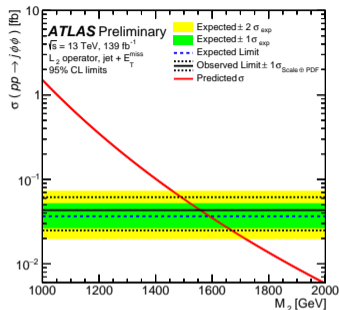


In all cases, the reported limits on $m_{\tilde{q}}$ are stronger than in the previous publication (blue line), excluding $m_{\tilde{q}} \lesssim 550$ GeV in the most compressed region ($\Delta m \rightarrow 5$ GeV close to the diagonal)

Interpretations – Dark Energy & invisible–decaying Higgs

- ▶ **Dark Energy (DE) model:** scalar field φ (effective mass M_2 , universal coupling g^*). Stable particle produced together with a gluon \rightarrow mono–jet like signature

95% CL limits on the σ – M_2 plane: $M_2 < 1558$ GeV excluded, improving previous results (1.2 TeV)



- ▶ The decay of the **Higgs boson into DM particles** leads to a signature of E_T^{miss} in the final state. The signal yields are dominated by gluon–fusion processes (about 54%)

95% CL observed (expected) exclusion limit on the invisible branching ratio of the Higgs boson of 0.63 (0.57)

Summary

- ▶ Full Run II preliminary results presented in the ICHEP Conference on August 14th 2020
 - ▶ Link [here](#) to the CONF note
 - ▶ High level of precision (1.5%–4.1% total uncertainty) achieved in the background estimation
 - ▶ Improved bounds on the parameters of a wide set of models for new physics are set wrt. 36.1 fb^{-1} results
- ▶ Work in progress being finalised for publication

The logo for the ATLAS Experiment, featuring a stylized globe in the background and the text "ATLAS" in large, bold, blue letters above "EXPERIMENT" in smaller, blue letters.

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