

Dark Matter searches with the ATLAS Detector

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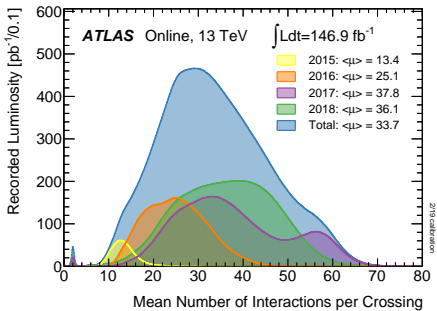
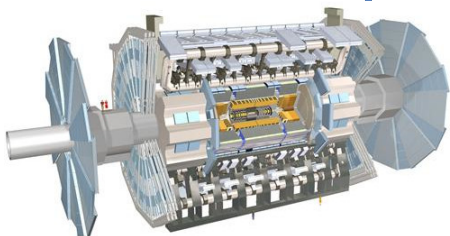


Introduction

The ATLAS detector

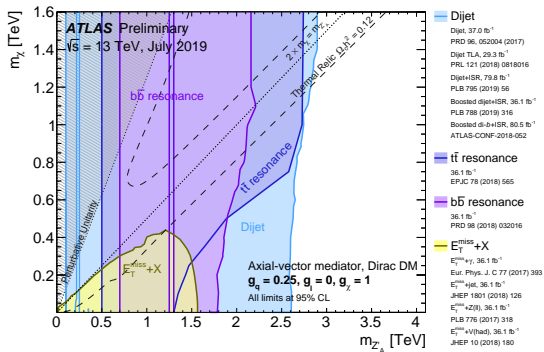
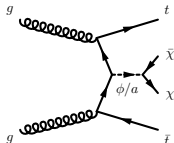
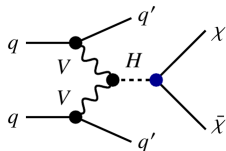


- Multi-purpose experiment:
 - Inner tracking system
 - Calorimetry system: electromagnetic & hadronic
 - Muon system
- LHC Run 2:
 - Data taken from 2015 until 2018
 - Proton-proton collisions at $\sqrt{s} = 13$ TeV
 - Recorded integrated luminosity: 147 fb^{-1}
 - Integrated luminosity used in analysis: 139 fb^{-1}





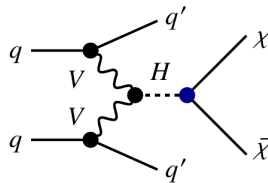
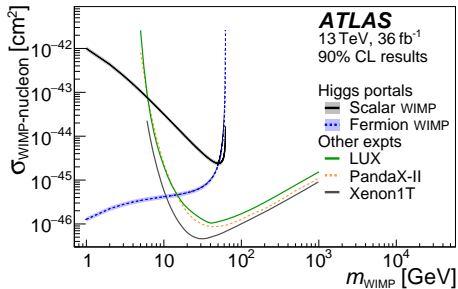
- Diverse dark matter (DM) search programme within the ATLAS experiment
- Will concentrate on a few recent results:
 - invisible Higgs boson decays: ATLAS-CONF-2020-008
 - (pseudo-) scalar mediator decaying to DM: ATLAS-CONF-2020-003



Higgs portal in VBF production

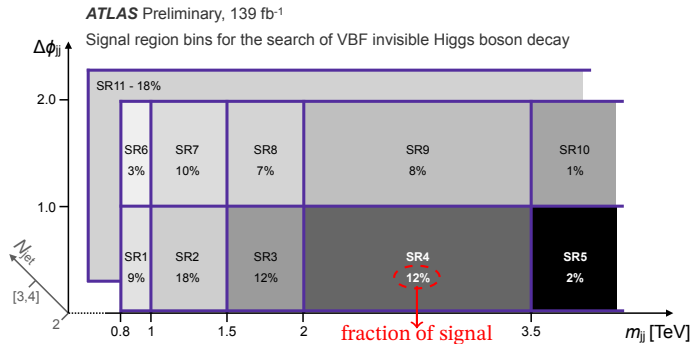


- Invisible Higgs decay in production via vector boson fusion (VBF) in the Standard Model (SM): $\mathcal{B}_{\text{inv}}^{\text{SM}} = 0.12\%$
- Best ATLAS limit from combination: $\mathcal{B}_{\text{inv}} < 0.26$
- DM scenarios allow $\mathcal{B}_{\text{inv}} \sim \mathcal{O}(10\%)$
- Higgs-portal models: DM candidate singlet under SM gauge symmetries and couples to Higgs
- Predict observed relic DM density via s-channel annihilation process





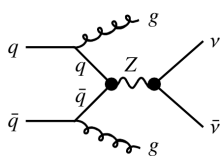
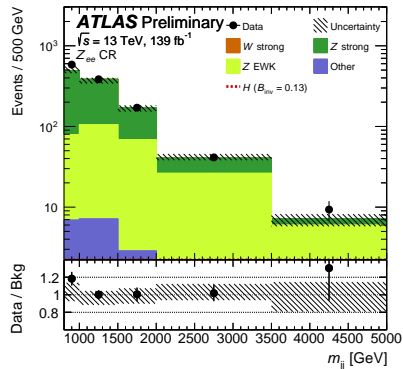
- $E_T^{\text{miss}} > 200 \text{ GeV}$
- Leading p_T anti- $k_T^{0.4}$ -jets in different hemispheres with large separation in η
- Leading p_T anti- $k_T^{0.4}$ -jets not back-to-back
- Improved over previous analysis:
 - lepton veto
 - kinematic requirements (looser)
 - pile-up discrimination
 - signal region binning



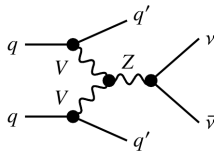
→ obtain result by simultaneous maximum likelihood fit of background components to data



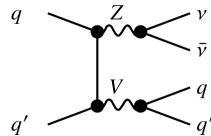
- Major background: V +jets (95 %)
→ prediction from MC simulation normalised in one/two-lepton control regions
- Minor backgrounds:
 - diboson & $t\bar{t}$ production
→ prediction from MC simulation
 - multijet processes
→ data driven estimate



strong

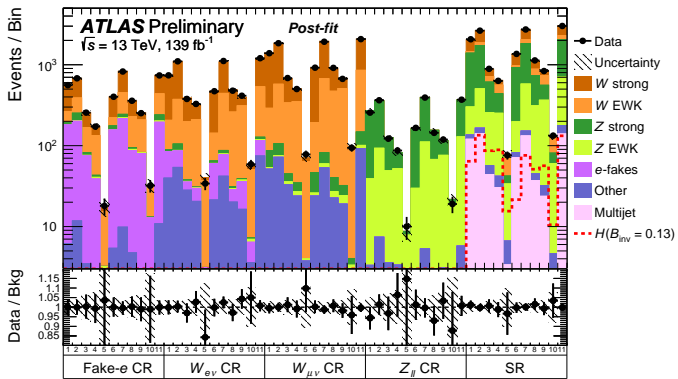


electroweak



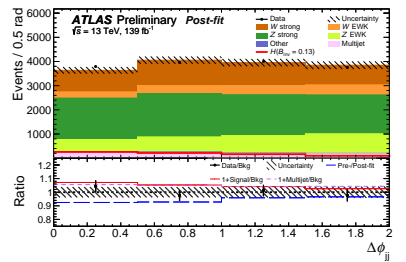
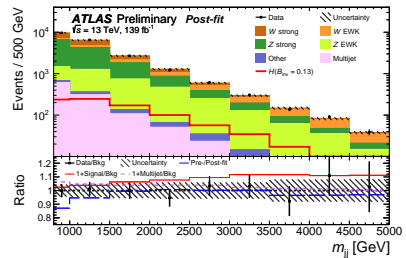
Results

ATLAS-CONF-2020-008



Limits on \mathcal{B}_{inv}

Observed	Expected	$+1\sigma$	-1σ	$+2\sigma$	-2σ
0.132	0.132	0.183	0.095	0.248	0.071

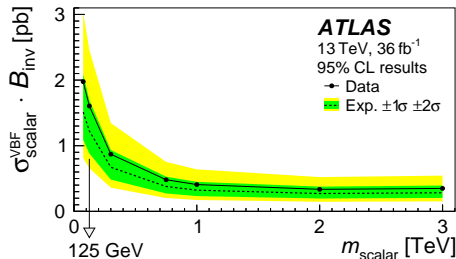
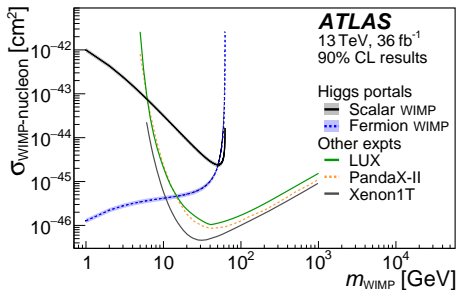


Results

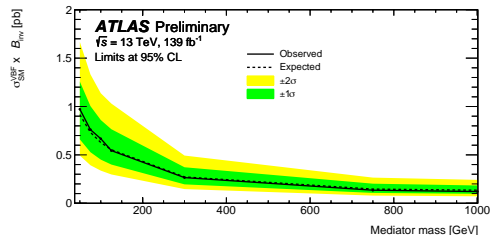
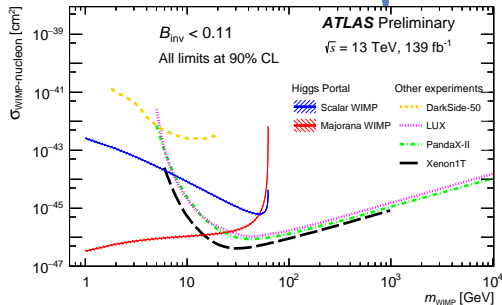
ATLAS-CONF-2020-008



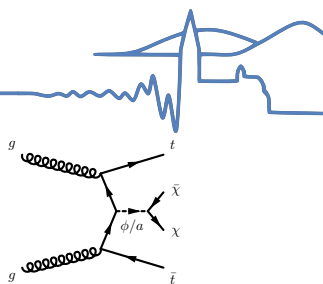
old results



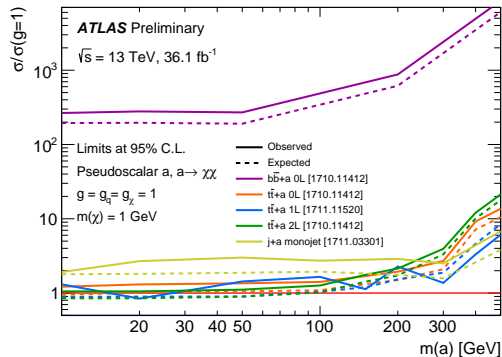
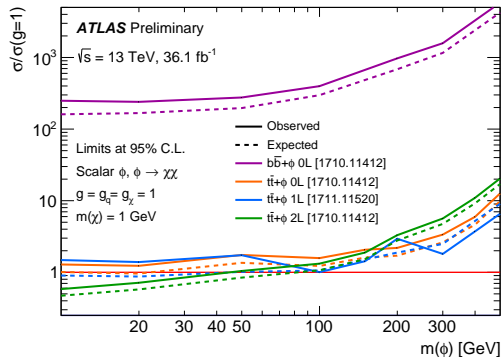
new results



Search for (pseudo-)scalar mediator to DM



- Simple extension of the SM: additional (pseudo-)scalar decaying into pair of DM particles





Signal:

- Exactly one lepton in the event
- $E_T^{\text{miss}} > 230 \text{ GeV}$
- At least four anti- $k_T^{0.4}$ -jets with at least two of them being b -tagged jets

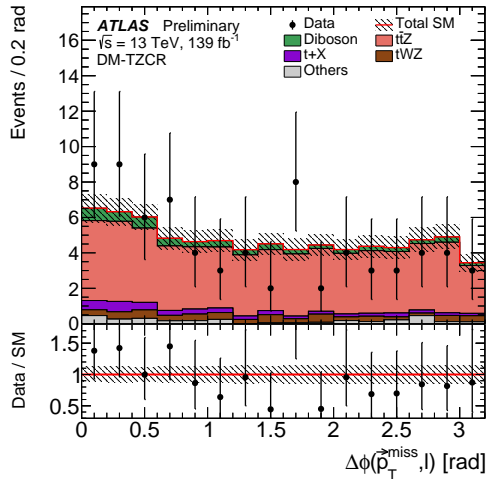
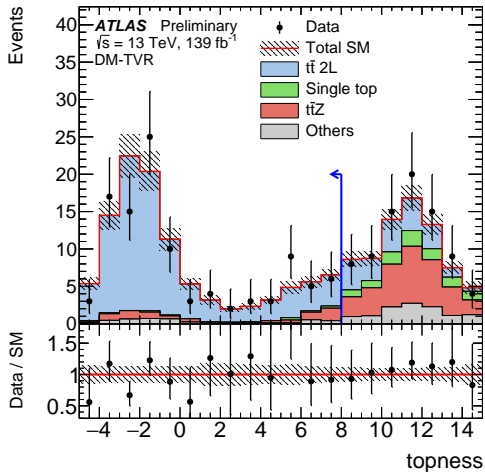
Backgrounds:

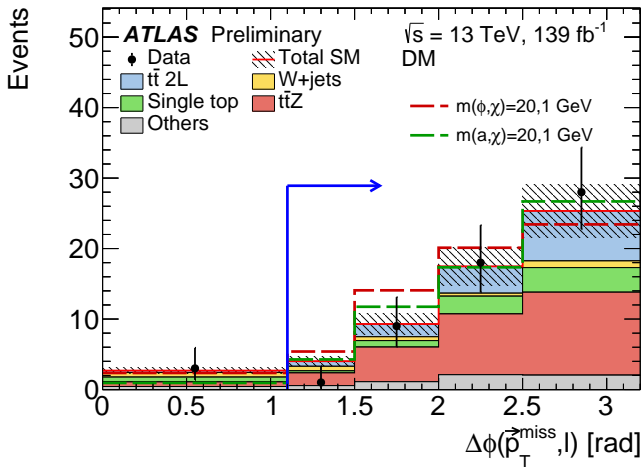
- Major backgrounds estimated from MC simulation and normalised in control regions:
 - $t\bar{t}2\ell$: 2nd lepton lost, 1ℓ control region
 - $t\bar{t}Z(\rightarrow \nu\nu)$: $t\bar{t}Z(\rightarrow \ell\ell)$ control region
- Minor backgrounds estimated from MC simulation only:
single top, W +jets & multiboson production

→ obtain result with multi-bin profile-likelihood fit

Background estimate

ATLAS-CONF-2020-003

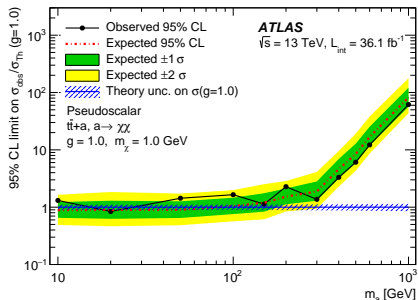
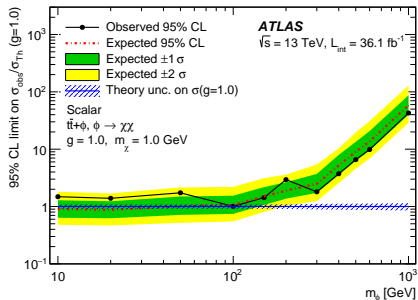




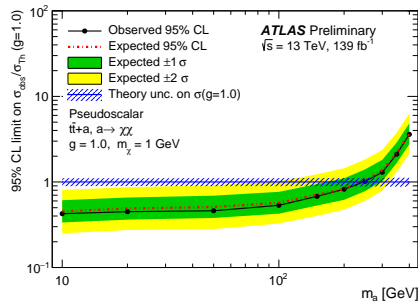
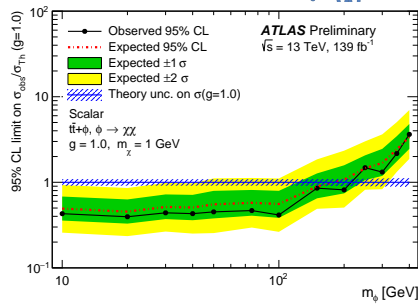
→ spot on agreement with SM expectation



old results



new results





- Search of DM production major part of ATLAS search programme
- Two recent results were presented:
 - invisible Higgs boson decays: ATLAS-CONF-2020-008
→ most stringent result on \mathcal{B}_{inv} to date
 - (pseudo-) scalar mediator decaying to DM: ATLAS-CONF-2020-003
- No evidence for DM particle production found
- Significantly improved limits have been established