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MOSCOW STATE UNIVERSITY

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Searches for new phenomena with the ATLAS detector

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ATLAS EXPERIMENT

Introduction

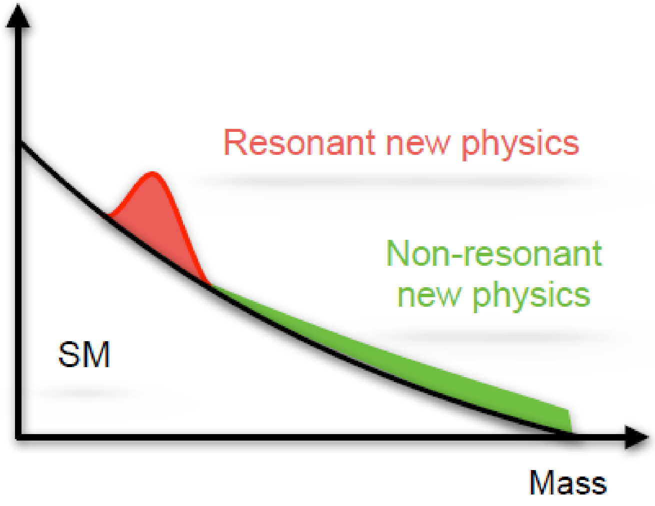
- Despite its success, the Standard Model (SM) is not considered as a complete theory since several aspects are not included within its prediction:

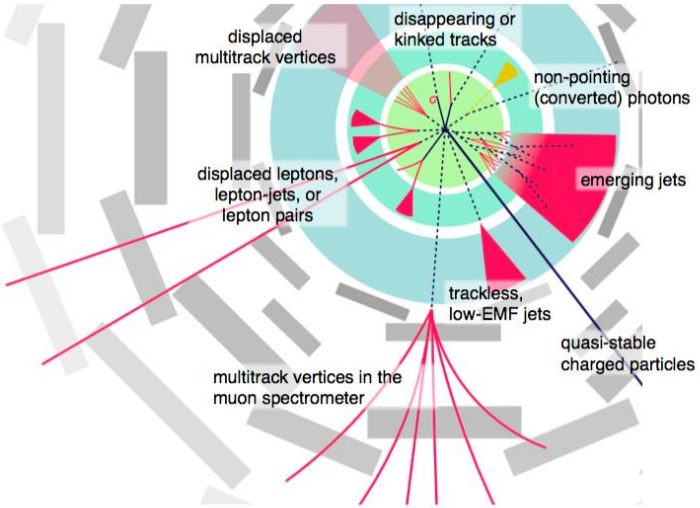
  - ☐ Hierarchy problem
  - ☐ Existence of dark matter and dark energy
  - ☐ Gravitational force
  - ☐ Neutrino Masses and oscillation
  - ☐ …etc

- For those and other reasons, experimental searches for new phenomena predicted by more advanced theories can help establish new theoretical frameworks to cover the SM weaknesses.

  - ☐ SUSY
  - ☐ Extra Higgs doublets
  - ☐ TopColour
  - ☐ Randall-Sundrum Models
  - ☐ ..etc

Introduction

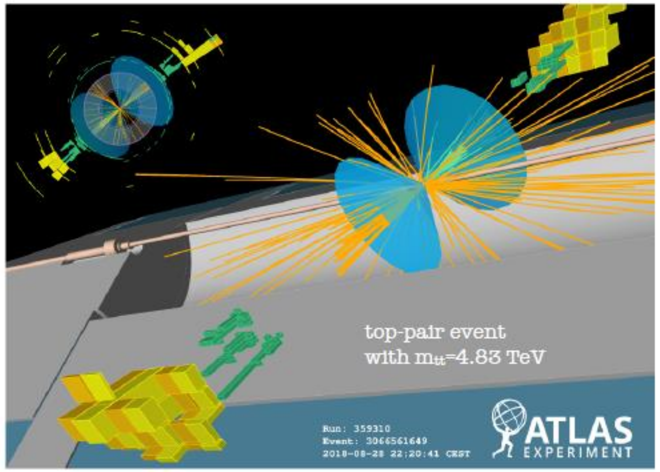


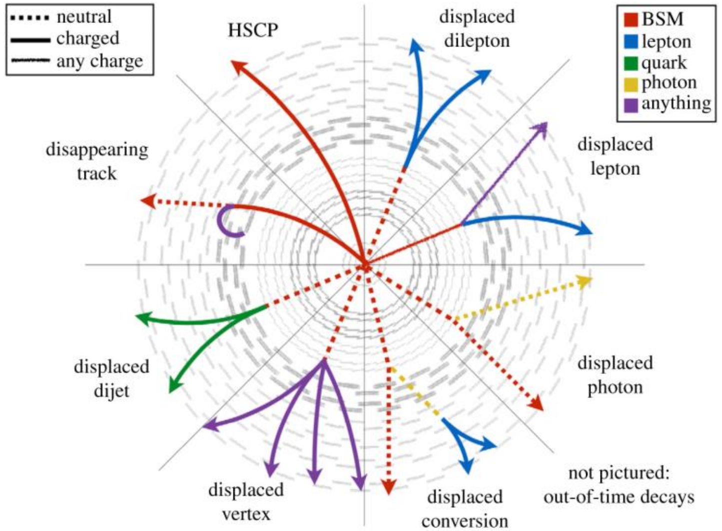


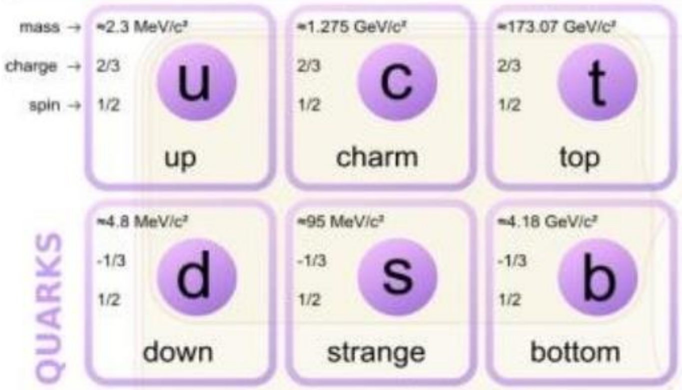
- Several Beyond Standard Model (BSM) analyses are taking place in the ATLAS experiment to address the many questions left unanswered by SM.
- From a myriad of BSM scenarios, new phenomena could manifest themselves via Resonant or non-Resonant effects in different ranges of energy.
- This talk covers new results from the ATLAS experiment, targeting BSM (non-)resonances and exotic decays into long-lived particles in channels:
  - Hadronic (allhad)
  - Single Lepton (1L)
  - Dilepton (2L)
  - Diboson (VV)

Searchers for Resonances and exotic decays in Hadronic decay channel

- Covered in heavy gauge bosons, heavy pseudo(scalar) Higgs boson, excited quark, Kaluza-Klein excitations (gluon and Graviton excitations), Top-assisted-technicolour Z', Top-down theories (LLPs)..etc
- Wide resonance mass ranges go from about 400 GeV up to 10 TeV.
- Highlighting several techniques and improvements:
  - ☐ New trigger technique for low mass acceptance.
  - ☐ Improved b-tagging algorithm for jets with high pT.
  - ☐ Dedicated techniques to identify the top-jets, in particular, boosted Tops.
  - ☐ Algorithms to reconstruct tracks and vertices of particles with macroscopic lifetime.

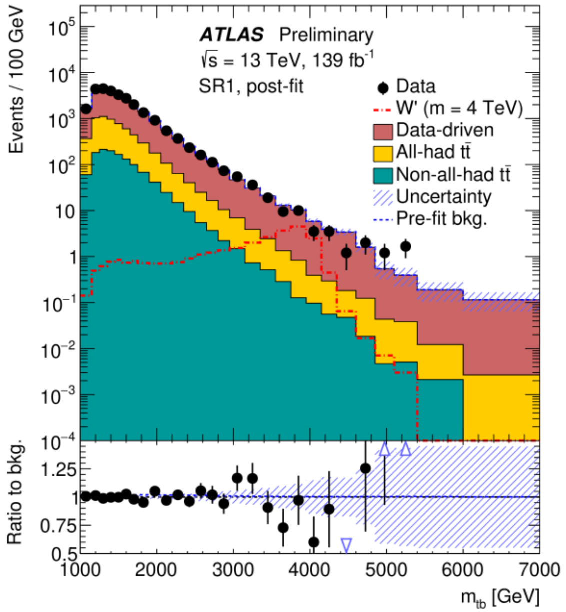


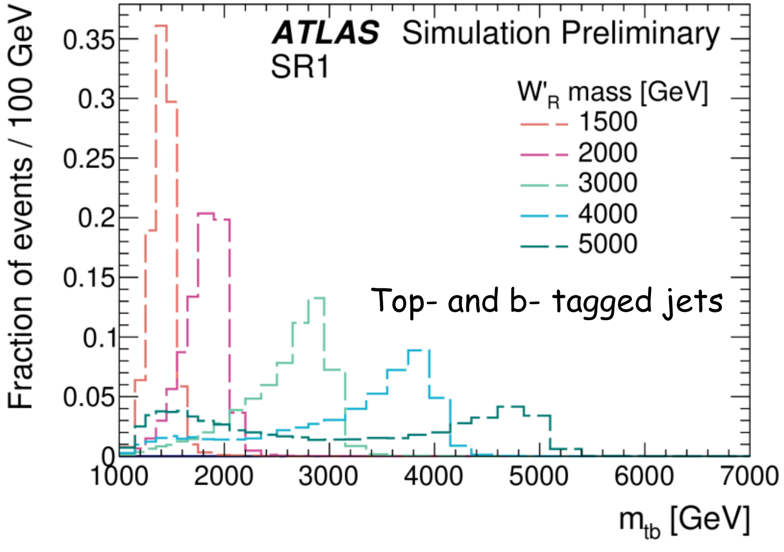


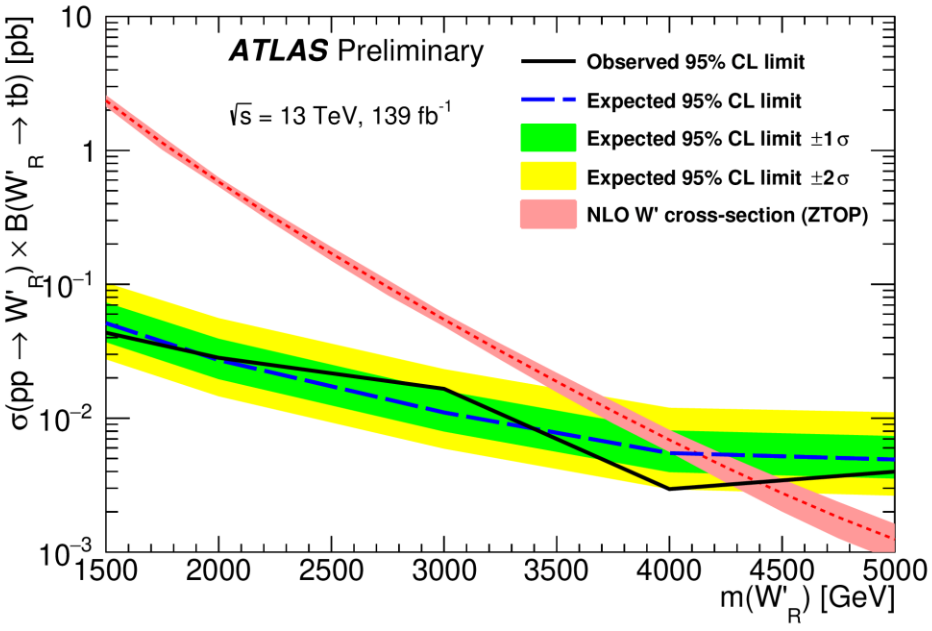


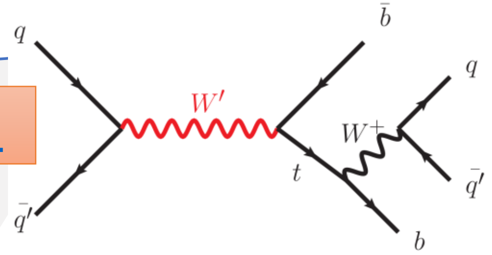
Vector Boson Resonances decaying in top- and b-quark

- Large-R jets are identified as containing a top-quark decaying Hadronically (known as top-tagged jets) using DNN.
- Small-R jets are reconstructed using the anti-k_t algorithm and identified as b-jets using the DLr1 algorithm.
- Improved multi-jets BK estimation based on data-driven method.
- Two signal regions “SR” are defined according to the top- and b-tagging status.
- Limits set on the right-handed W’ boson “predicted by Chiral W’-boson model” with mass in the range 1.5-5TeV.









Full Run 2 Dataset

ATLAS-CONF-2021-043

Resonances in 1L and 2L decay channels

- They are the cleanest decay channels in particular the dilepton one.
- A probe for Z′ in Sequential Standard Model SSM, E6-motivated Grand Unification mode, Top-assisted-technicolour, and excitations in Randall-Sundrum Model..etc/
- Other variables sensitive to the presence of new physics might be used.

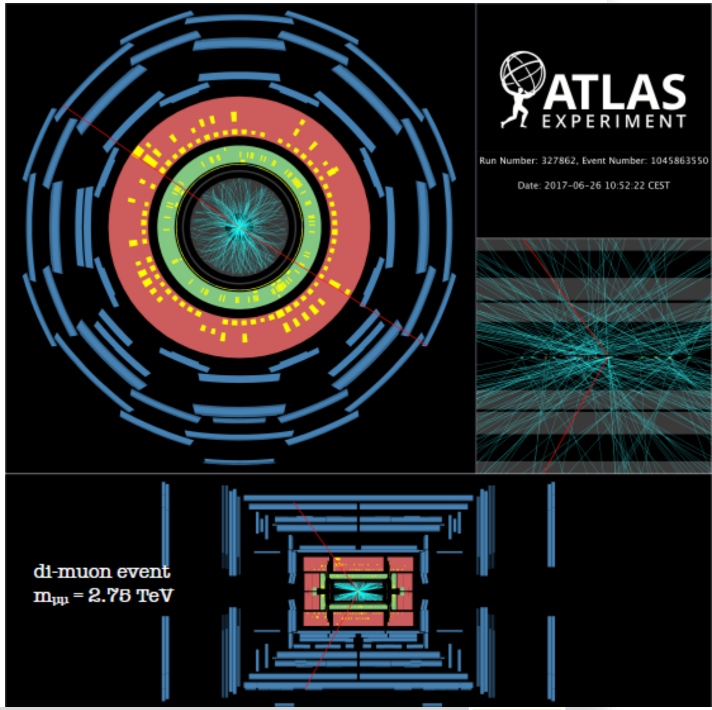
Highlighting several techniques and improvements:

☐ Using the generated MC samples or data-driven methods to estimate the BK in Signal regions (SR).

☐ Reweighting techniques are used to get better Data/MC agreements.

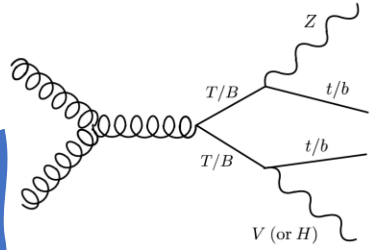
☐ New tools to keep leptons with high pT and close to jets.

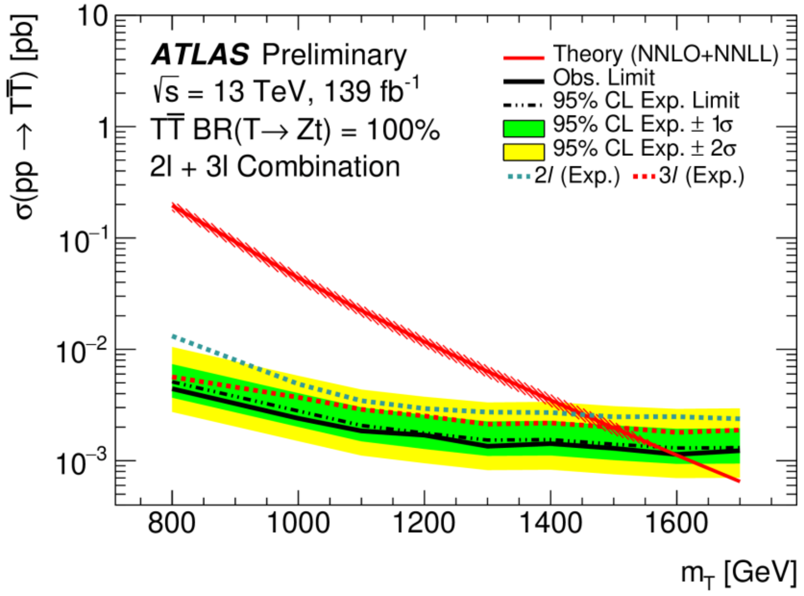
☐ Advanced techniques can be used to reconstruct the top-antitop quark Mass.

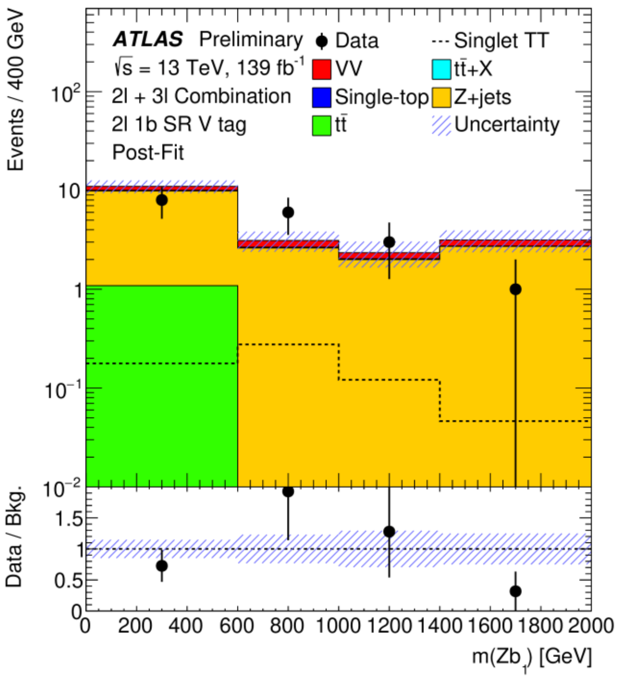


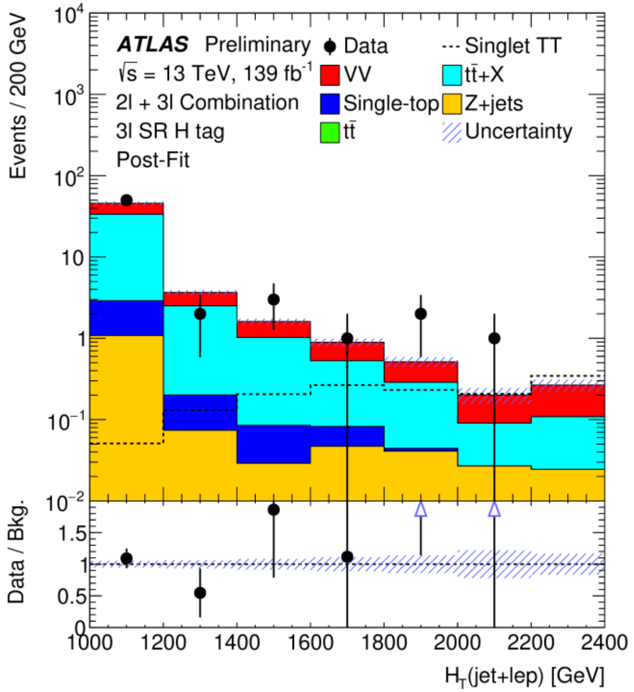
Vector-like quarks production in 2L/3L decay channel

- Many BSM addresses the existence of VLQs that couple preferentially to third-gen quark as well as to the SM W/Z and Higgs boson.
- VLQ of the top (T) and bottom (B) quarks can exist with charges 2/3e and -1/3e respectively (they can have exotic charges).
- Deep neural network (DNN) is used to classify the jets originated from either Z/W or Higgs boson or top quark.
- In 3L channel, the scalar sum of jets and leptons pT (HT) used as discriminating variable while in 2L channel the m(Zb) is used.
- Limits in singlet (doublet) model are set at $m_T >$ 1.27 (1.46) TeV and $m_B >$ 1.20 (1.32) TeV.









Full Run 2 Dataset

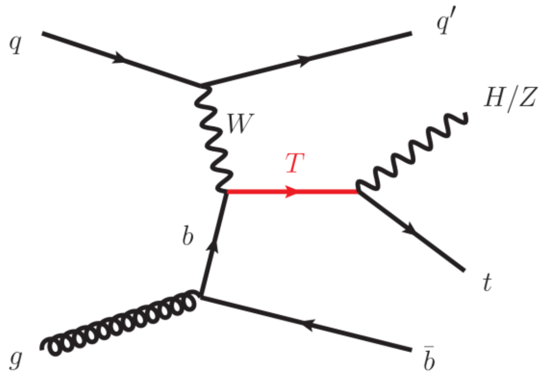
ATLAS-CONF-2021-024

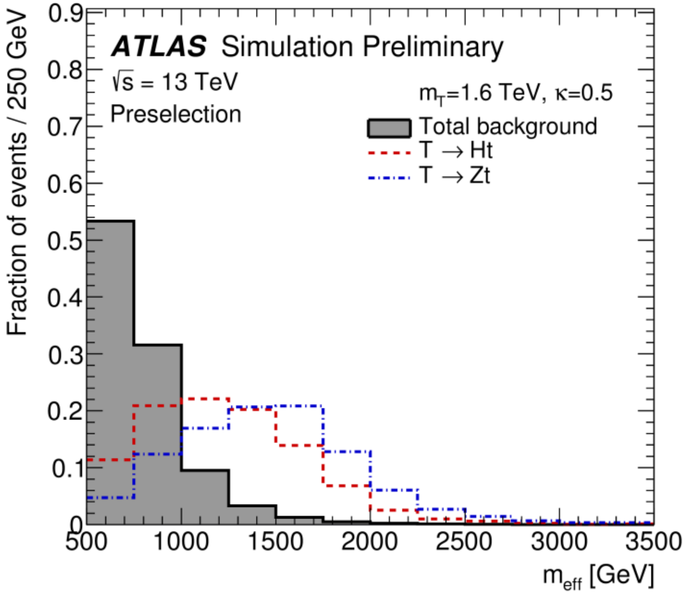
Single Vector-like quark production in 1L decay channel

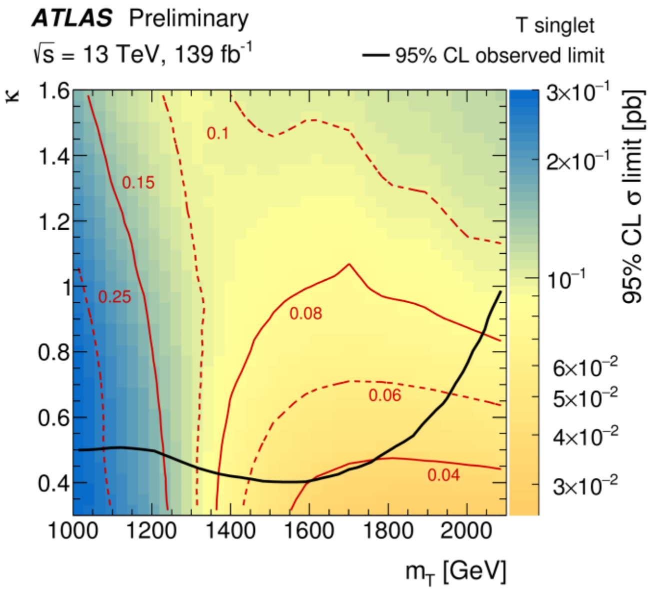
- This search designed to target the production of T-> t (lep)Z/H (had).
- Results are interpreted in several benchmark scenarios to set limits on the mass and universal coupling strength (κ).
- re-clustered Large-jet (RC) are used for tagging the hadronic decay of top-quark, W/Z boson and Higgs boson.
- Events are divided based on the number of jets and b-tagged jets "LJ and HJ".
- Meff (scalar sum of lepton and jets pT + MET) is used as a discriminating variable.
- All k values above the black line are excluded at each mass point.

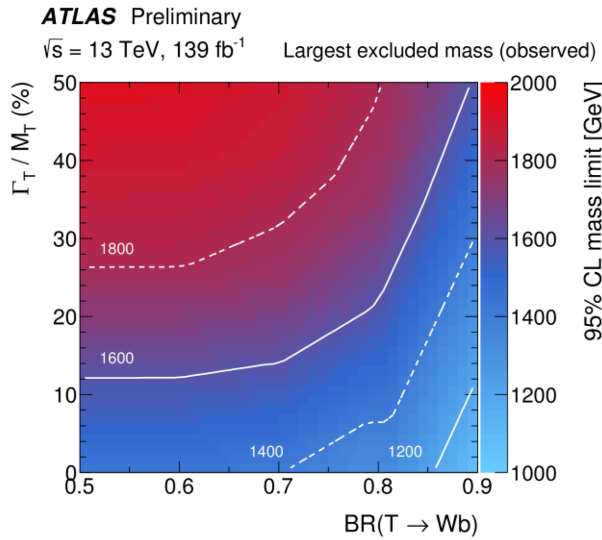
Full Run 2 Dataset

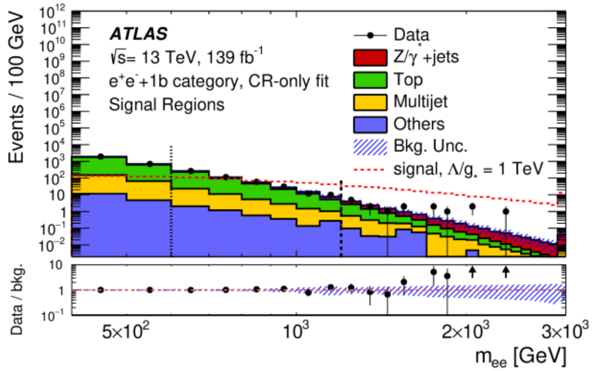
[ATLAS-CONF-2021-040]

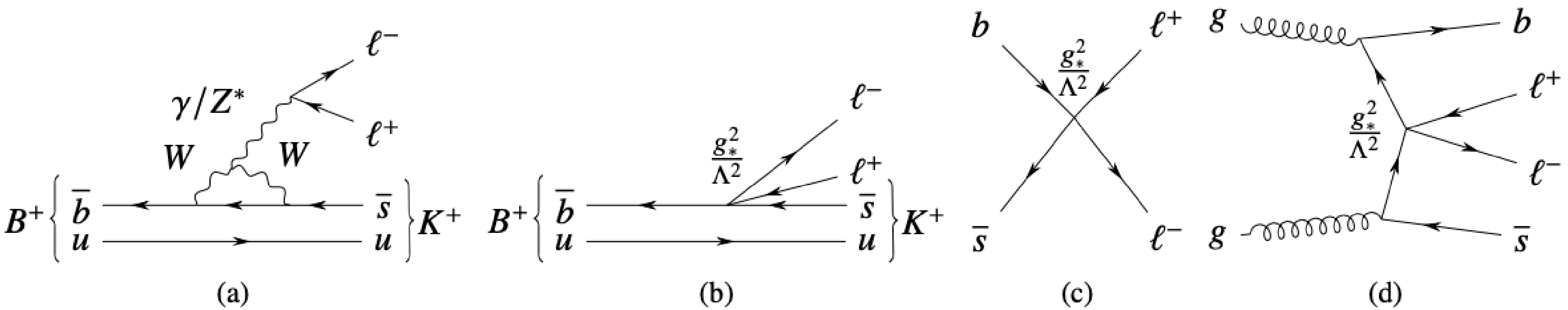








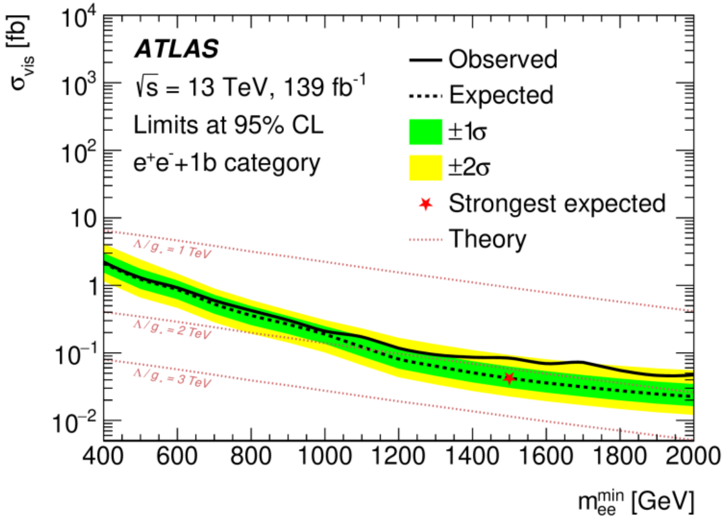


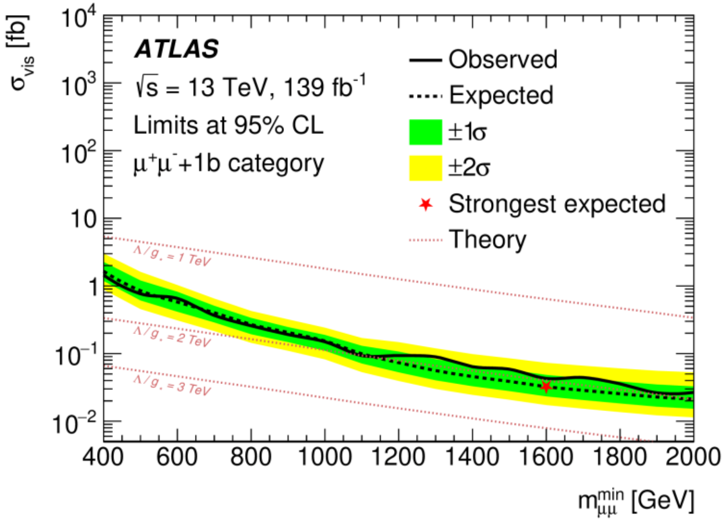


(a) (b) (c) (d)

non-resonant Dilepton

- Several recent measurements give hints of possible lepton flavour (LFU) violation in e.g. rare decay of B-meson into K-meson and a pair of muons or electrons.
- Interpreted with four-fermion (two quarks “b-quark and S-quark” and two leptons: bs2L) ‘Contact’ interactions (CI) models.
- A fit-based extrapolation procedure is used to estimate the tails of the Top mll distribution.
- Contract interactions with (energy scale Λ and coupling g_*) Λ/g_* lower than 2 (2.4) TeV are excluded for electrons (muons) in regions with 0b- and 1b-tagged jets.



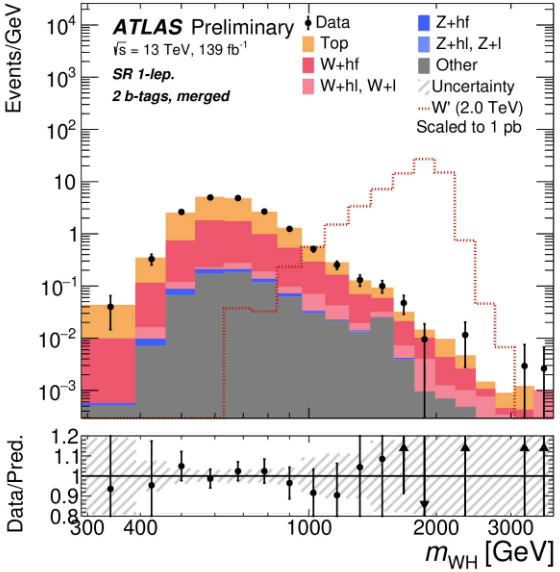


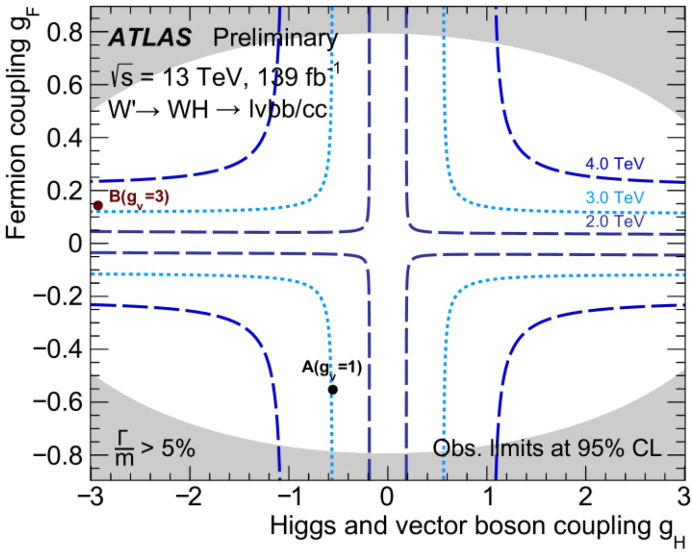
Full Run 2 Dataset

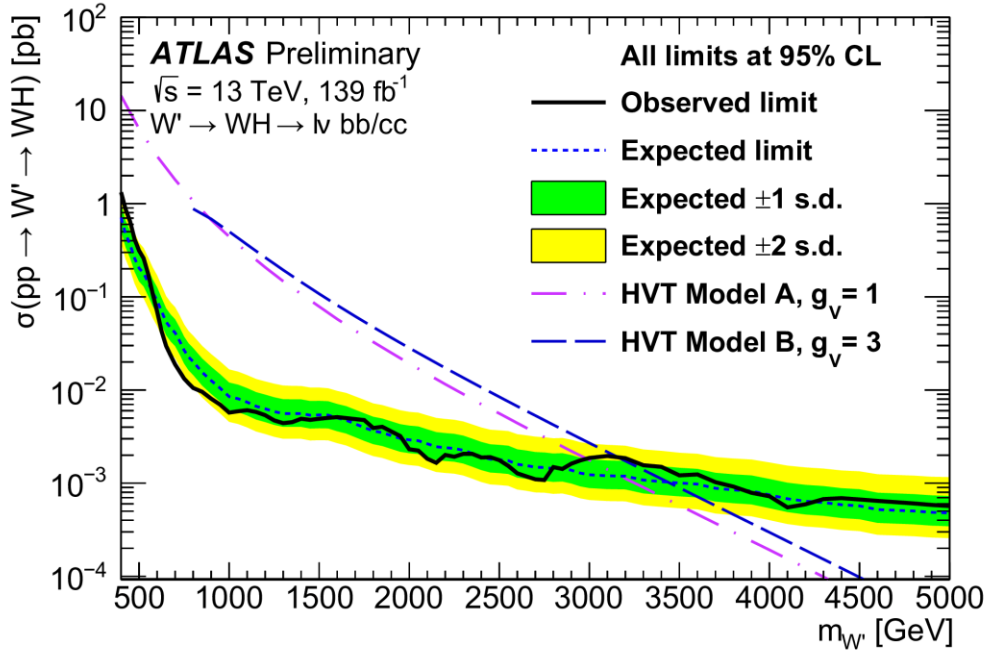
arXiv:2105.13847v1

Heavy diboson resonances in semileptonic channel

- Searches for heavy resonances, W′ and Z,′ in the mass range 300 GeV to 5 TeV via gg fusion (ggF), Drell-Yan (DY) or vector boson fusion (VBF).
- $H \rightarrow b\bar{b}$ reconstructed as 2 small-R jets or a single large-R jet depending on pT(V).
- Variable radius (VR) track jets are used to identify the b-jets from boosted Higgs boson decay.
- Two signal regions are defined based on the number of b-tagged jets (1b or 2b).
- Limits on the W′->Wh production are set as well as the exclusion contours in {gH,gf} HVT space.
- Limits on the production of Z′->Zh is set in the 0L/2L decay channel excluding masses below 2.9 (3.2)TeV for Model A (B) with gv=1 (3).







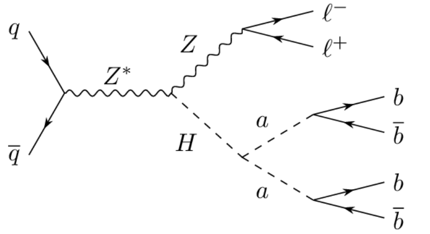
Full Run 2 Dataset

ATLAS-CONF-2020-043 (Z′)

ATLAS-CONF-2021-026 (W′)

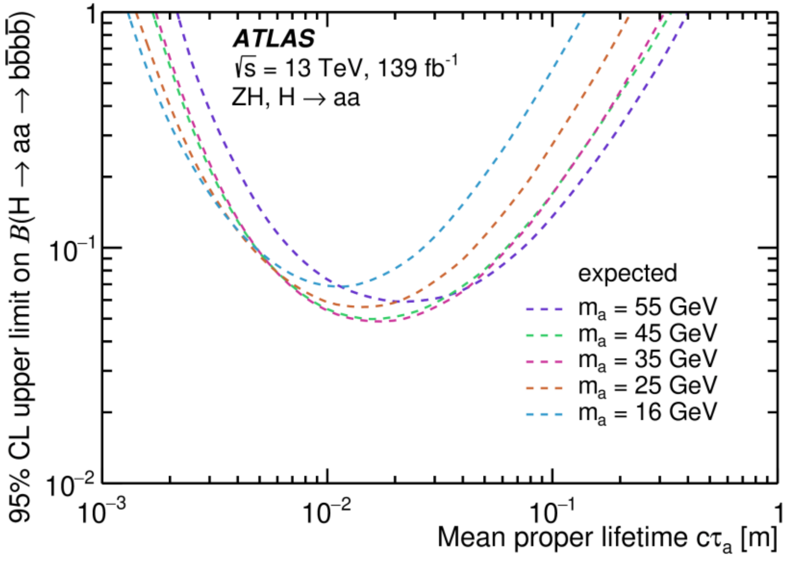
Full Run 2 Dataset

arXiv:2107.06092v1



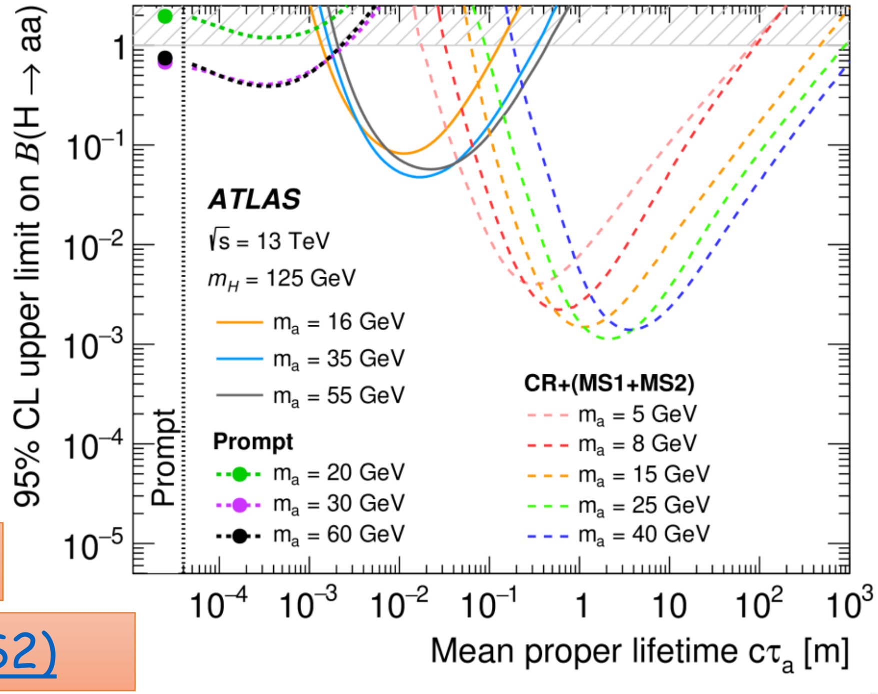
Exotic decay of Higgs boson “allHad”

- Predicted by Top-down (bottom-up) theories e.g. theories based on Neutral Naturalness concept, Folded SUSY ..etc.
- Higgs boson decays into pair of electrically neutral pseudoscalar “a” boson and “a” boson subsequently decaying into $b\bar{b}$.
- Data-driven technique is used to estimate the contributions from BK.
- Displaced vertices DV are reconstructed from a combined collection of standard and LRT tracks.
- The number of observed events in SR = 0.
- Branching ratios above 10% are excluded.

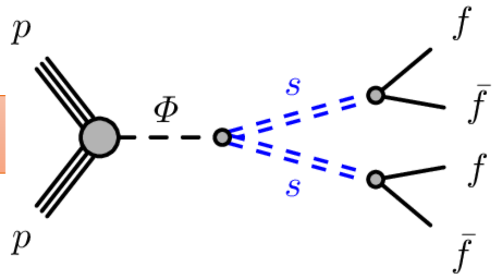


Prompt

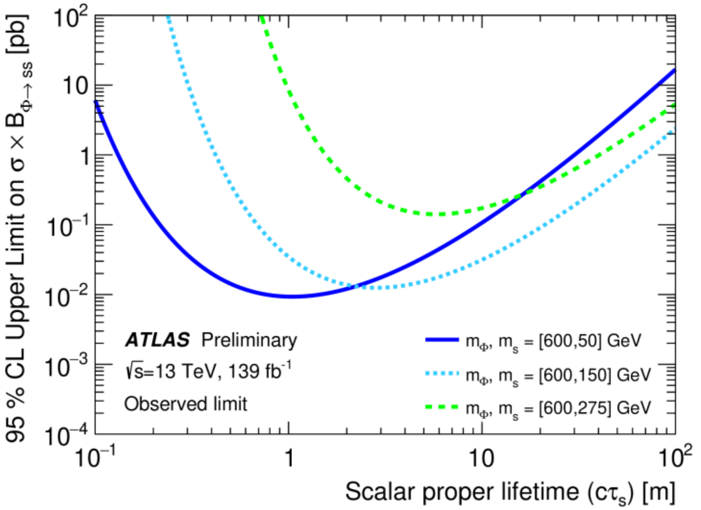
CR+(MS1+MS2)



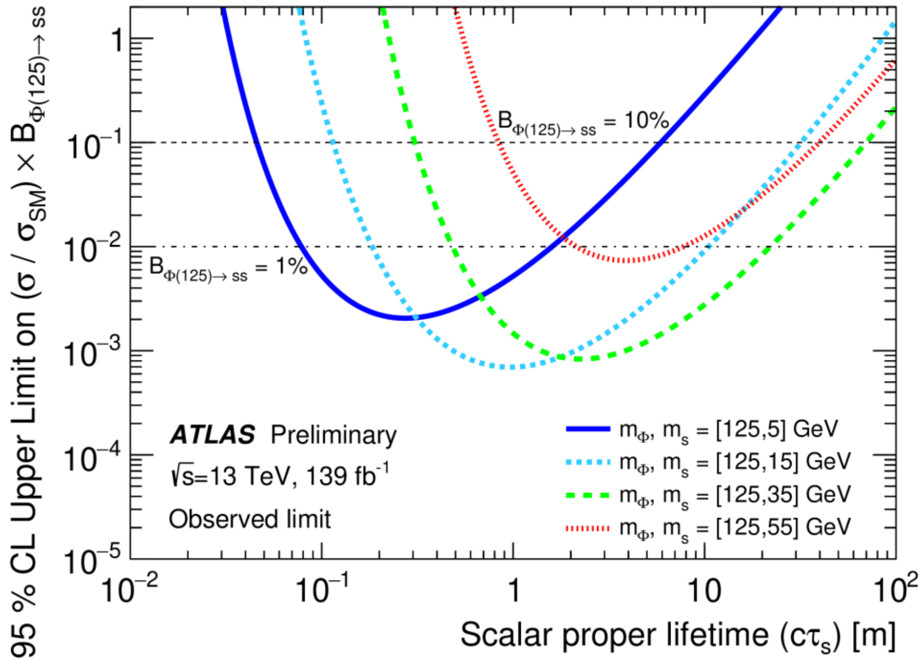
Full Run 2 Dataset **ATLAS-CONF-2021-032**



Long-lived particles decaying into hadronic jets in the ATLAS Muon System



- Sensitive to a large variety of models. However, in this analysis, the results were interpreted in terms of scalar portal model, where an SM-like Higgs, Φ , decaying into two Long-lived scalars, s.
- "**S**" decaying mainly to the heaviest fermion pair e.g. $b\bar{b}$, $c\bar{c}$ and $\tau\bar{\tau}$.
- Improved BK estimation in MS and more advanced modelling and algorithm used for trigger and vertex reconstruction.
- Branching ratios above 10% are excluded for Φ with mass =125GeV.



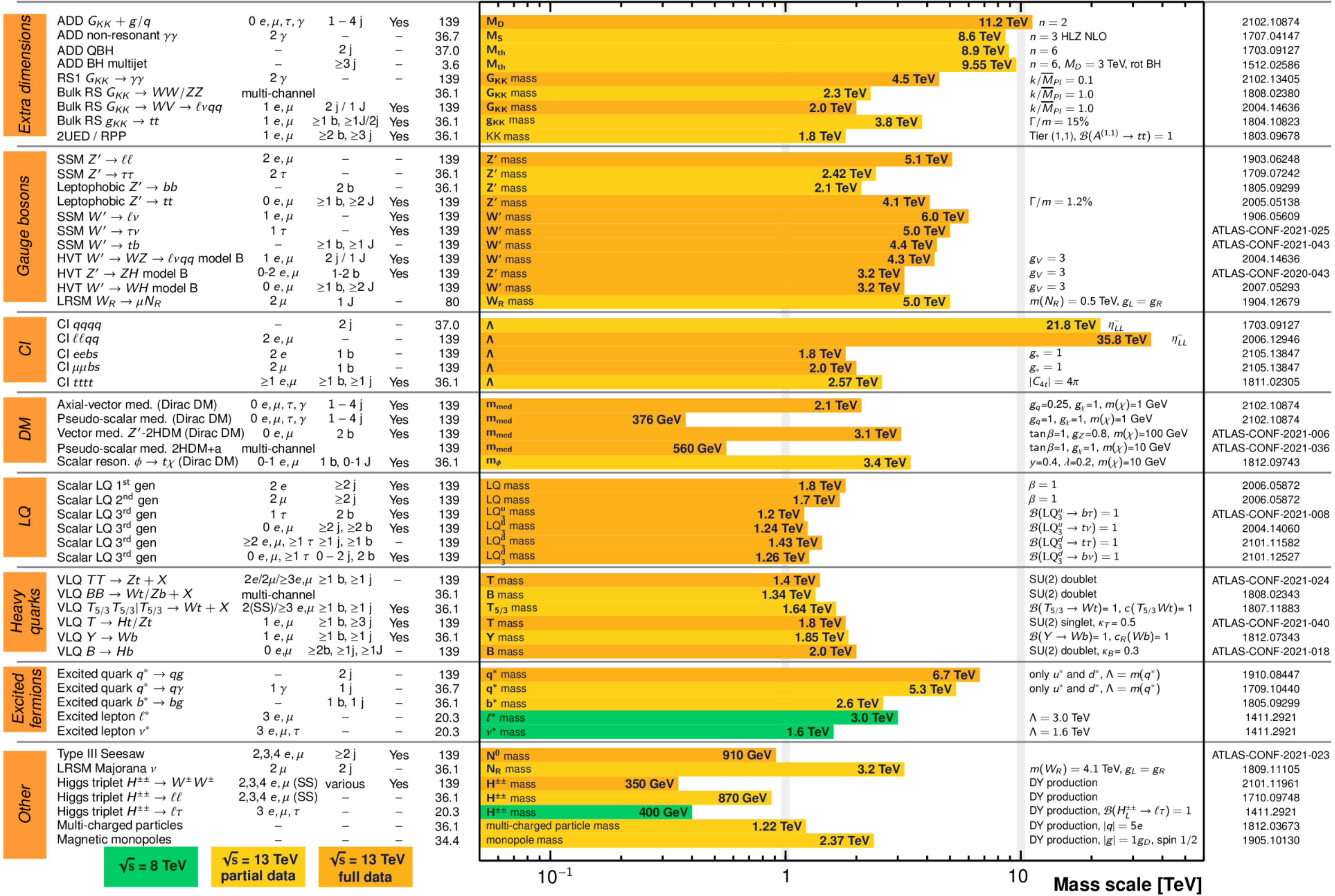
ATLAS Heavy Particle Searches* - 95% CL Upper Exclusion Limits

Status: July 2021

ATLAS Preliminary

$\int \mathcal{L}\, dt = (3.6 - 139)\ \mathrm{fb}^{-1}$

$\sqrt{s} = 8, 13$ TeV



	Model	ℓ, γ	Jets†	E_T^{miss}	$\int\mathcal{L}\,dt[\mathrm{fb}^{-1}]$	Limit		Reference
Extra dimensions	ADD $G_{KK} + g/q$	0 e, μ, τ, γ	1 – 4 j	Yes	139	🟧 M_D 11.2 TeV	$n = 2$	2102.10874
	ADD non-resonant $\gamma\gamma$	2 γ	–	–	36.7	🟨 M_S 8.6 TeV	$n = 3$ HLZ NLO	1707.04147
	ADD QBH	–	2 j	–	37.0	🟨 M_{th} 8.9 TeV	$n = 6$	1703.09127
	ADD BH multijet	–	≥3 j	–	3.6	🟨 M_{th} 9.55 TeV	$n = 6$, $M_D = 3$ TeV, rot BH	1512.02586
	RS1 $G_{KK} \to \gamma\gamma$	2 γ	–	–	139	🟧 G_{KK} mass 4.5 TeV	$k/\overline{M}_{Pl} = 0.1$	2102.13405
	Bulk RS $G_{KK} \to WW/ZZ$	multi-channel			36.1	🟨 G_{KK} mass 2.3 TeV	$k/\overline{M}_{Pl} = 1.0$	1808.02380
	Bulk RS $G_{KK} \to WV \to \ell\nu qq$	1 e, μ	2 j / 1 J	Yes	139	🟧 G_{KK} mass 2.0 TeV	$k/\overline{M}_{Pl} = 1.0$	2004.14636
	Bulk RS $g_{KK} \to tt$	1 e, μ	≥1 b, ≥1J/2j	Yes	36.1	🟨 g_{KK} mass 3.8 TeV	$\Gamma/m = 15\%$	1804.10823
	2UED / RPP	1 e, μ	≥2 b, ≥3 j	Yes	36.1	🟨 KK mass 1.8 TeV	Tier (1,1), $\mathcal{B}(A^{(1,1)} \to tt) = 1$	1803.09678
Gauge bosons	SSM $Z' \to \ell\ell$	2 e, μ	–	–	139	🟧 Z' mass 5.1 TeV		1903.06248
	SSM $Z' \to \tau\tau$	2 τ	–	–	36.1	🟨 Z' mass 2.42 TeV		1709.07242
	Leptophobic $Z' \to bb$	–	2 b	–	36.1	🟨 Z' mass 2.1 TeV		1805.09299
	Leptophobic $Z' \to tt$	0 e, μ	≥1 b, ≥2 J	Yes	139	🟧 Z' mass 4.1 TeV	$\Gamma/m = 1.2\%$	2005.05138
	SSM $W' \to \ell\nu$	1 e, μ	–	Yes	139	🟧 W' mass 6.0 TeV		1906.05609
	SSM $W' \to \tau\nu$	1 τ	–	Yes	139	🟧 W' mass 5.0 TeV		ATLAS-CONF-2021-025
	SSM $W' \to tb$	–	≥1 b, ≥1 J	–	139	🟧 W' mass 4.4 TeV		ATLAS-CONF-2021-043
	HVT $W' \to WZ \to \ell\nu qq$ model B	1 e, μ	2 j / 1 J	Yes	139	🟧 W' mass 4.3 TeV	$g_V = 3$	2004.14636
	HVT $Z' \to ZH$ model B	0-2 e, μ	1-2 b	Yes	139	🟧 Z' mass 3.2 TeV	$g_V = 3$	ATLAS-CONF-2020-043
	HVT $W' \to WH$ model B	0 e, μ	≥1 b, ≥2 J		139	🟧 W' mass 3.2 TeV	$g_V = 3$	2007.05293
	LRSM $W_R \to \mu N_R$	2 μ	1 J	–	80	🟨 W_R mass 5.0 TeV	$m(N_R) = 0.5$ TeV, $g_L = g_R$	1904.12679
CI	CI $qqqq$	–	2 j	–	37.0	🟨 Λ 21.8 TeV	η_{LL}^{-}	1703.09127
	CI $\ell\ell qq$	2 e, μ	–	–	139	🟧 Λ 35.8 TeV	η_{LL}^{-}	2006.12946
	CI $eebs$	2 e	1 b	–	139	🟧 Λ 1.8 TeV	$g_* = 1$	2105.13847
	CI $\mu\mu bs$	2 μ	1 b	–	139	🟧 Λ 2.0 TeV	$g_* = 1$	2105.13847
	CI $tttt$	≥1 e,μ	≥1 b, ≥1 j	Yes	36.1	🟨 Λ 2.57 TeV	$\lvert C_{4t}\rvert = 4\pi$	1811.02305
DM	Axial-vector med. (Dirac DM)	0 e, μ, τ, γ	1 – 4 j	Yes	139	🟧 m_{med} 2.1 TeV	g_q=0.25, g_χ=1, $m(\chi)$=1 GeV	2102.10874
	Pseudo-scalar med. (Dirac DM)	0 e, μ, τ, γ	1 – 4 j	Yes	139	🟧 m_{med} 376 GeV	g_q=1, g_χ=1, $m(\chi)$=1 GeV	2102.10874
	Vector med. Z'-2HDM (Dirac DM)	0 e, μ	2 b	Yes	139	🟧 m_{med} 3.1 TeV	tanβ=1, g_Z=0.8, $m(\chi)$=100 GeV	ATLAS-CONF-2021-006
	Pseudo-scalar med. 2HDM+a	multi-channel			139	🟧 m_{med} 560 GeV	tanβ=1, g_χ=1, $m(\chi)$=10 GeV	ATLAS-CONF-2021-036
	Scalar reson. $\phi \to t\chi$ (Dirac DM)	0-1 e, μ	1 b, 0-1 J	Yes	36.1	🟨 m_ϕ 3.4 TeV	y=0.4, λ=0.2, $m(\chi)$=10 GeV	1812.09743
LQ	Scalar LQ 1st gen	2 e	≥2 j	Yes	139	🟧 LQ mass 1.8 TeV	$\beta = 1$	2006.05872
	Scalar LQ 2nd gen	2 μ	≥2 j	Yes	139	🟧 LQ mass 1.7 TeV	$\beta = 1$	2006.05872
	Scalar LQ 3rd gen	1 τ	2 b	Yes	139	🟧 LQ_3^u mass 1.2 TeV	$\mathcal{B}(LQ_3^u \to b\tau) = 1$	ATLAS-CONF-2021-008
	Scalar LQ 3rd gen	0 e, μ	≥2 j, ≥2 b	Yes	139	🟧 LQ_3^u mass 1.24 TeV	$\mathcal{B}(LQ_3^u \to t\nu) = 1$	2004.14060
	Scalar LQ 3rd gen	≥2 e, μ, ≥1 τ	≥1 j, ≥1 b	–	139	🟧 LQ_3^d mass 1.43 TeV	$\mathcal{B}(LQ_3^d \to t\tau) = 1$	2101.11582
	Scalar LQ 3rd gen	0 e, μ, ≥1 τ	0 – 2 j, 2 b	Yes	139	🟧 LQ_3^d mass 1.26 TeV	$\mathcal{B}(LQ_3^d \to b\nu) = 1$	2101.12527
Heavy quarks	VLQ $TT \to Zt + X$	2e/2μ/≥3e,μ	≥1 b, ≥1 j	–	139	🟧 T mass 1.4 TeV	SU(2) doublet	ATLAS-CONF-2021-024
	VLQ $BB \to Wt/Zb + X$	multi-channel			36.1	🟨 B mass 1.34 TeV	SU(2) doublet	1808.02343
	VLQ $T_{5/3}T_{5/3}\lvert T_{5/3} \to Wt + X$	2(SS)/≥3 e,μ	≥1 b, ≥1 j	Yes	36.1	🟨 $T_{5/3}$ mass 1.64 TeV	$\mathcal{B}(T_{5/3} \to Wt)$= 1, $c(T_{5/3}Wt)$= 1	1807.11883
	VLQ $T \to Ht/Zt$	1 e, μ	≥1 b, ≥3 j	Yes	139	🟧 T mass 1.8 TeV	SU(2) singlet, κ_T= 0.5	ATLAS-CONF-2021-040
	VLQ $Y \to Wb$	1 e, μ	≥1 b, ≥1 j	Yes	36.1	🟨 Y mass 1.85 TeV	$\mathcal{B}(Y \to Wb)$= 1, $c_R(Wb)$= 1	1812.07343
	VLQ $B \to Hb$	0 e,μ	≥2b, ≥1j, ≥1J	–	139	🟧 B mass 2.0 TeV	SU(2) doublet, κ_B= 0.3	ATLAS-CONF-2021-018
Excited fermions	Excited quark $q^* \to qg$	–	2 j	–	139	🟧 q^* mass 6.7 TeV	only u^* and d^*, $\Lambda = m(q^*)$	1910.08447
	Excited quark $q^* \to q\gamma$	1 γ	1 j	–	36.7	🟨 q^* mass 5.3 TeV	only u^* and d^*, $\Lambda = m(q^*)$	1709.10440
	Excited quark $b^* \to bg$	–	1 b, 1 j	–	36.1	🟨 b^* mass 2.6 TeV		1805.09299
	Excited lepton ℓ^*	3 e, μ	–	–	20.3	🟩 ℓ^* mass 3.0 TeV	$\Lambda = 3.0$ TeV	1411.2921
	Excited lepton ν^*	3 e, μ, τ	–	–	20.3	🟩 ν^* mass 1.6 TeV	$\Lambda = 1.6$ TeV	1411.2921
Other	Type III Seesaw	2,3,4 e, μ	≥2 j	Yes	139	🟧 N^0 mass 910 GeV		ATLAS-CONF-2021-023
	LRSM Majorana ν	2 μ	2 j	–	36.1	🟨 N_R mass 3.2 TeV	$m(W_R) = 4.1$ TeV, $g_L = g_R$	1809.11105
	Higgs triplet $H^{\pm\pm} \to W^\pm W^\pm$	2,3,4 e, μ (SS)	various	Yes	139	🟧 $H^{\pm\pm}$ mass 350 GeV	DY production	2101.11961
	Higgs triplet $H^{\pm\pm} \to \ell\ell$	2,3,4 e, μ (SS)	–	–	36.1	🟨 $H^{\pm\pm}$ mass 870 GeV	DY production	1710.09748
	Higgs triplet $H^{\pm\pm} \to \ell\tau$	3 e, μ, τ	–	–	20.3	🟩 $H^{\pm\pm}$ mass 400 GeV	DY production, $\mathcal{B}(H_L^{\pm\pm} \to \ell\tau) = 1$	1411.2921
	Multi-charged particles	–	–	–	36.1	🟨 multi-charged particle mass 1.22 TeV	DY production, $\lvert q\rvert = 5e$	1812.03673
	Magnetic monopoles	–	–	–	34.4	🟨 monopole mass 2.37 TeV	DY production, $\lvert g\rvert = 1g_D$, spin 1/2	1905.10130

*Only a selection of the available mass limits on new states or phenomena is shown.

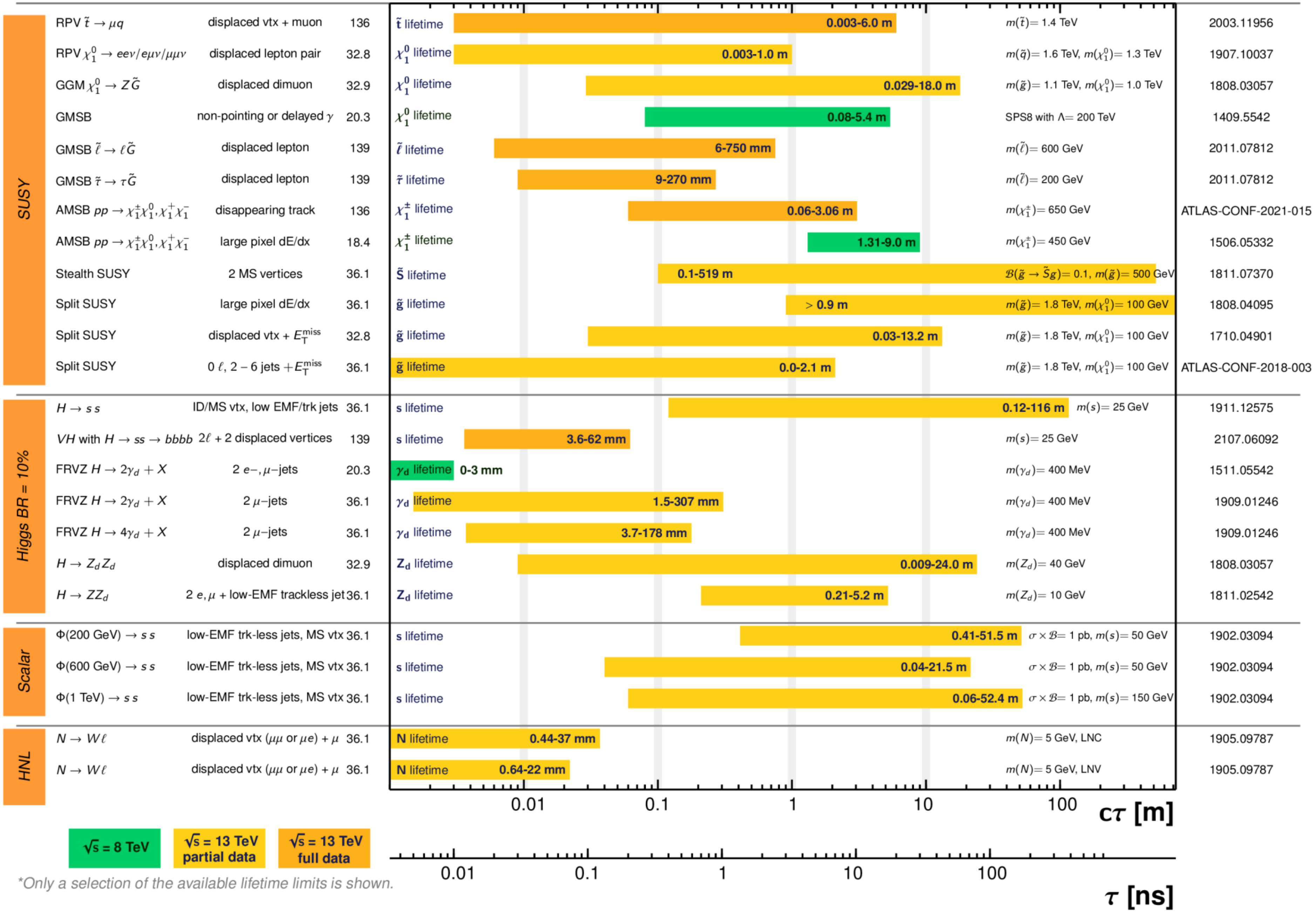
†Small-radius (large-radius) jets are denoted by the letter j (J).

ATLAS Long-lived Particle Searches* - 95% CL Exclusion

Status: July 2021

ATLAS Preliminary

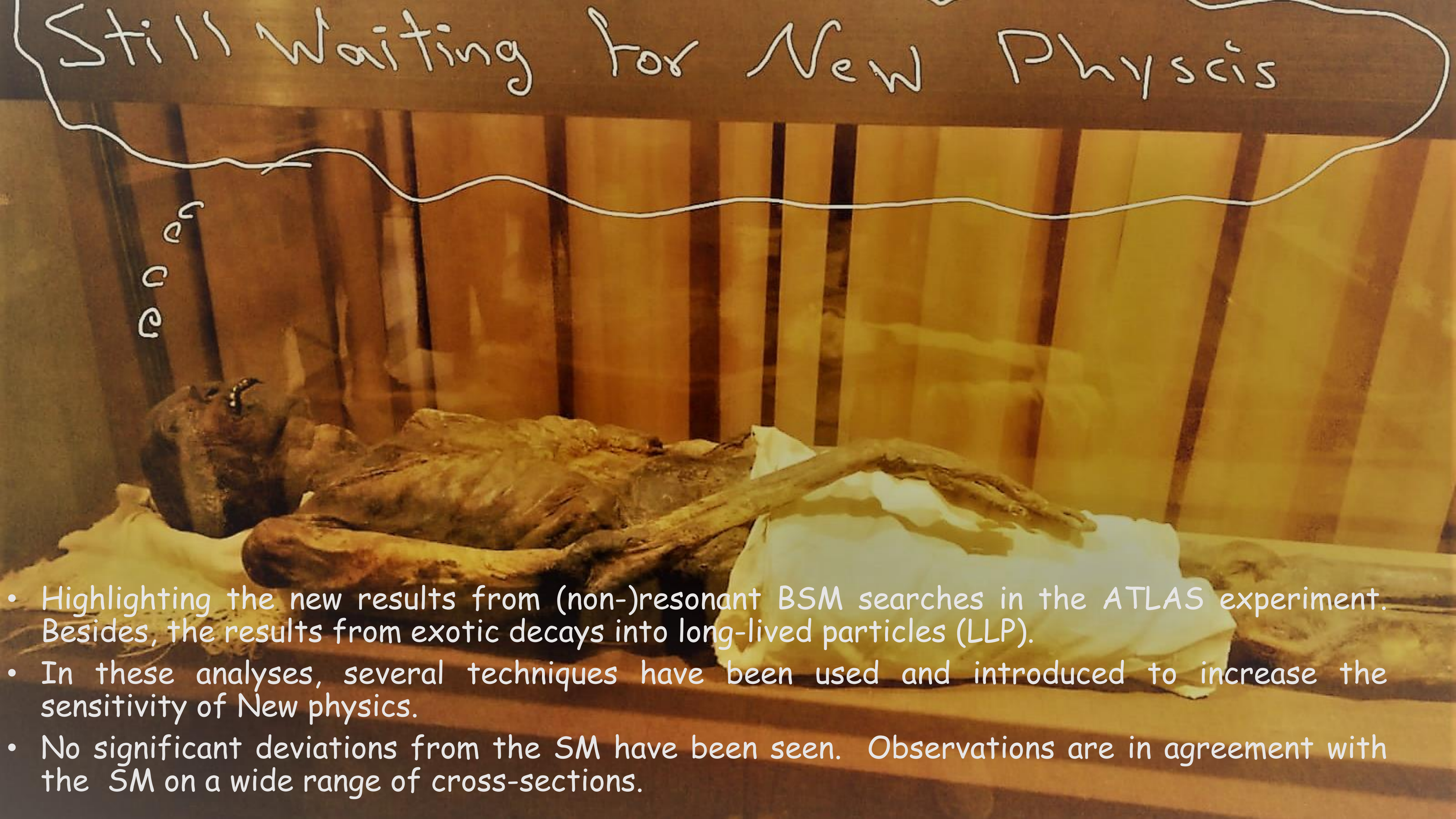
$\int \mathcal{L}\, dt = (18.4 - 139)\ \mathrm{fb}^{-1}$ $\sqrt{s} = 8, 13$ TeV



	Model	Signature	$\int \mathcal{L}\, dt$ [fb^{-1}]	Lifetime limit			Reference
SUSY	RPV $\tilde{t} \to \mu q$	displaced vtx + muon	136	$\tilde{t}$ lifetime	🟧 0.003-6.0 m	$m(\tilde{t})$= 1.4 TeV	2003.11956
	RPV $\chi_1^0 \to ee\nu/e\mu\nu/\mu\mu\nu$	displaced lepton pair	32.8	χ_1^0 lifetime	🟨 0.003-1.0 m	$m(\tilde{q})$= 1.6 TeV, $m(\chi_1^0)$= 1.3 TeV	1907.10037
	GGM $\chi_1^0 \to Z\tilde{G}$	displaced dimuon	32.9	χ_1^0 lifetime	🟨 0.029-18.0 m	$m(\tilde{g})$= 1.1 TeV, $m(\chi_1^0)$= 1.0 TeV	1808.03057
	GMSB	non-pointing or delayed γ	20.3	χ_1^0 lifetime	🟩 0.08-5.4 m	SPS8 with Λ= 200 TeV	1409.5542
	GMSB $\tilde{\ell} \to \ell\tilde{G}$	displaced lepton	139	$\tilde{\ell}$ lifetime	🟧 6-750 mm	$m(\tilde{\ell})$= 600 GeV	2011.07812
	GMSB $\tilde{\tau} \to \tau\tilde{G}$	displaced lepton	139	$\tilde{\tau}$ lifetime	🟧 9-270 mm	$m(\tilde{\ell})$= 200 GeV	2011.07812
	AMSB $pp \to \chi_1^{\pm}\chi_1^0, \chi_1^+\chi_1^-$	disappearing track	136	$\chi_1^{\pm}$ lifetime	🟧 0.06-3.06 m	$m(\chi_1^{\pm})$= 650 GeV	ATLAS-CONF-2021-015
	AMSB $pp \to \chi_1^{\pm}\chi_1^0, \chi_1^+\chi_1^-$	large pixel dE/dx	18.4	$\chi_1^{\pm}$ lifetime	🟩 1.31-9.0 m	$m(\chi_1^{\pm})$= 450 GeV	1506.05332
	Stealth SUSY	2 MS vertices	36.1	$\tilde{S}$ lifetime	🟨 0.1-519 m	$\mathcal{B}(\tilde{g} \to \tilde{S}g)$= 0.1, $m(\tilde{g})$= 500 GeV	1811.07370
	Split SUSY	large pixel dE/dx	36.1	$\tilde{g}$ lifetime	🟨 > 0.9 m	$m(\tilde{g})$= 1.8 TeV, $m(\chi_1^0)$= 100 GeV	1808.04095
	Split SUSY	displaced vtx + E_T^{miss}	32.8	$\tilde{g}$ lifetime	🟨 0.03-13.2 m	$m(\tilde{g})$= 1.8 TeV, $m(\chi_1^0)$= 100 GeV	1710.04901
	Split SUSY	$0\ \ell$, $2-6$ jets $+E_T^{\mathrm{miss}}$	36.1	$\tilde{g}$ lifetime	🟨 0.0-2.1 m	$m(\tilde{g})$= 1.8 TeV, $m(\chi_1^0)$= 100 GeV	ATLAS-CONF-2018-003
Higgs BR = 10%	$H \to s\,s$	ID/MS vtx, low EMF/trk jets	36.1	s lifetime	🟨 0.12-116 m	$m(s)$= 25 GeV	1911.12575
	VH with $H \to ss \to bbbb$	2ℓ + 2 displaced vertices	139	s lifetime	🟧 3.6-62 mm	$m(s)$= 25 GeV	2107.06092
	FRVZ $H \to 2\gamma_d + X$	2 $e-,\mu-$jets	20.3	γ_d lifetime	🟩 0-3 mm	$m(\gamma_d)$= 400 MeV	1511.05542
	FRVZ $H \to 2\gamma_d + X$	2 $\mu-$jets	36.1	γ_d lifetime	🟨 1.5-307 mm	$m(\gamma_d)$= 400 MeV	1909.01246
	FRVZ $H \to 4\gamma_d + X$	2 $\mu-$jets	36.1	γ_d lifetime	🟨 3.7-178 mm	$m(\gamma_d)$= 400 MeV	1909.01246
	$H \to Z_d Z_d$	displaced dimuon	32.9	Z_d lifetime	🟨 0.009-24.0 m	$m(Z_d)$= 40 GeV	1808.03057
	$H \to ZZ_d$	2 e, μ + low-EMF trackless jet	36.1	Z_d lifetime	🟨 0.21-5.2 m	$m(Z_d)$= 10 GeV	1811.02542
Scalar	Φ(200 GeV) $\to s\,s$	low-EMF trk-less jets, MS vtx	36.1	s lifetime	🟨 0.41-51.5 m	$\sigma \times \mathcal{B}$= 1 pb, $m(s)$= 50 GeV	1902.03094
	Φ(600 GeV) $\to s\,s$	low-EMF trk-less jets, MS vtx	36.1	s lifetime	🟨 0.04-21.5 m	$\sigma \times \mathcal{B}$= 1 pb, $m(s)$= 50 GeV	1902.03094
	Φ(1 TeV) $\to s\,s$	low-EMF trk-less jets, MS vtx	36.1	s lifetime	🟨 0.06-52.4 m	$\sigma \times \mathcal{B}$= 1 pb, $m(s)$= 150 GeV	1902.03094
HNL	$N \to W\ell$	displaced vtx ($\mu\mu$ or μe) + μ	36.1	N lifetime	🟨 0.44-37 mm	$m(N)$= 5 GeV, LNC	1905.09787
	$N \to W\ell$	displaced vtx ($\mu\mu$ or μe) + μ	36.1	N lifetime	🟨 0.64-22 mm	$m(N)$= 5 GeV, LNV	1905.09787

🟩 $\sqrt{s}$ = 8 TeV 🟨 $\sqrt{s}$ = 13 TeV partial data 🟧 $\sqrt{s}$ = 13 TeV full data

*Only a selection of the available lifetime limits is shown.



Still Waiting for New Physcis

- Highlighting the new results from (non-)resonant BSM searches in the ATLAS experiment. Besides, the results from exotic decays into long-lived particles (LLP).
- In these analyses, several techniques have been used and introduced to increase the sensitivity of New physics.
- No significant deviations from the SM have been seen. Observations are in agreement with the SM on a wide range of cross-sections.

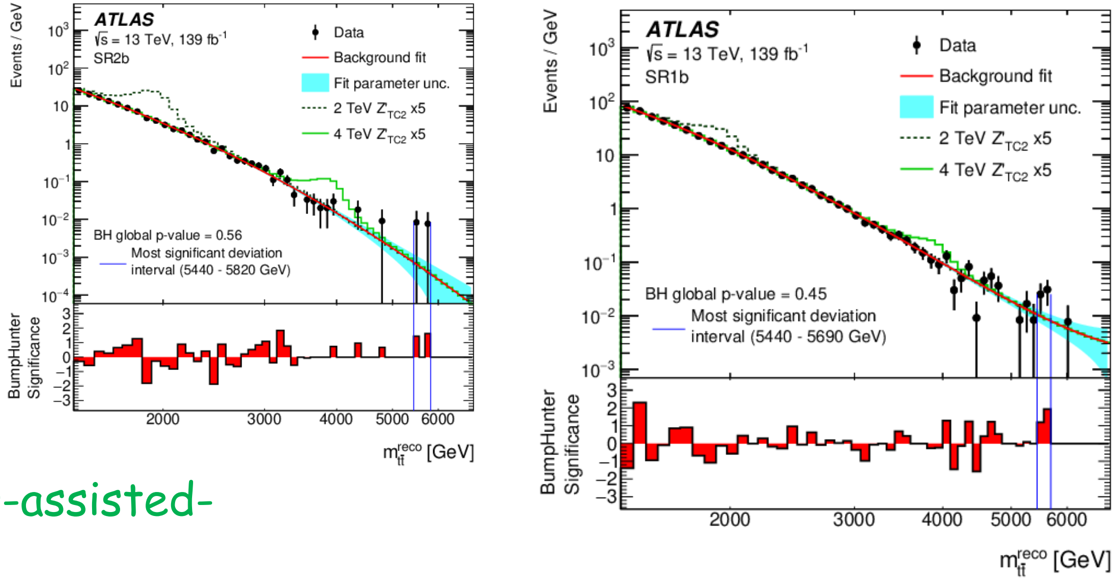
Backup

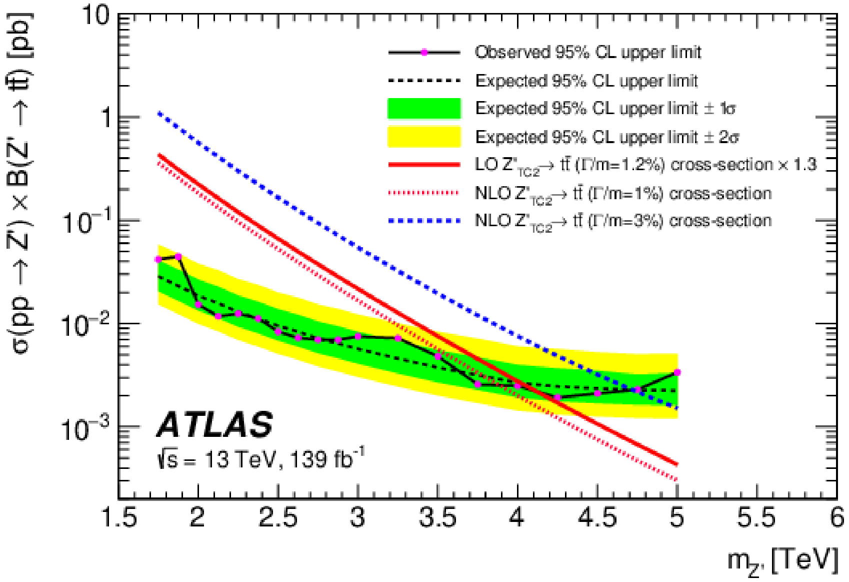
Full Run 2 Dataset

JHEP 10 (2020) 61

$t\bar{t}$ quark resonances in allhad decay channel

- A Spin-1, $Z`_{TC2}$, particle predicted from the Topcolour-assisted-technicolour IV model is considered:
  - ❑ For top-antitop invariant mass greater than 1.4TeV.
  - ❑ Couples only to the first- and third-generation quarks.
- In this analysis, the IV model parameters are chosen to maximize branching fraction for $Z`_{TC2} \rightarrow t\bar{t}$ decay.
- Fully-hadronic top decays are captured in a large-radius jet.
- Two signal regions are defined based on the number of b-tagged jets: SR1b and SR2b.
- BK from multijets and top-quark pair production are obtained from fit to data.
- $Z`_{TC2}$ for masses $<$ 3.9 (4.7) TeV are excluded for $\Gamma/m = 1\% \ (3\%)$.



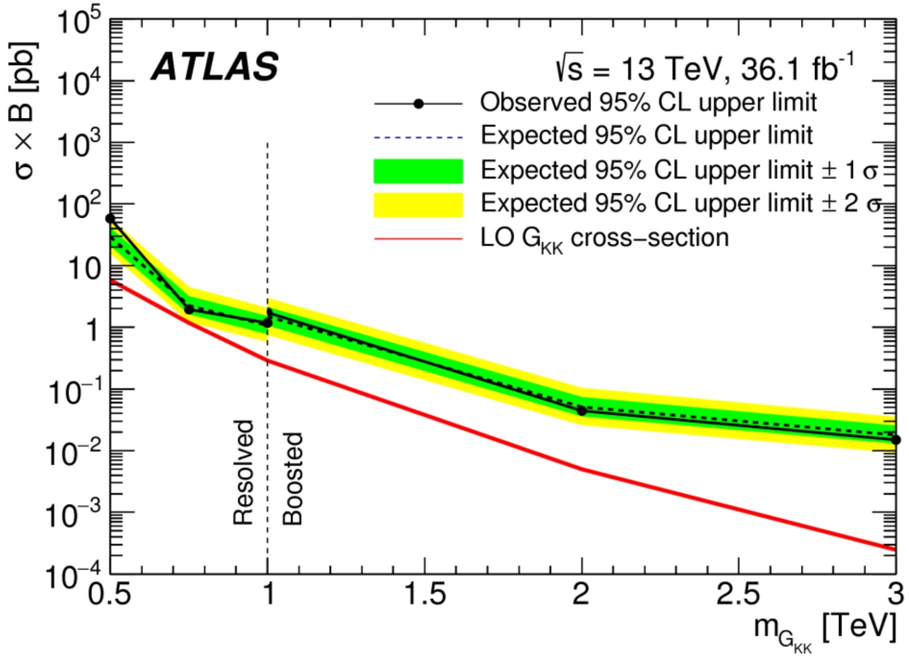


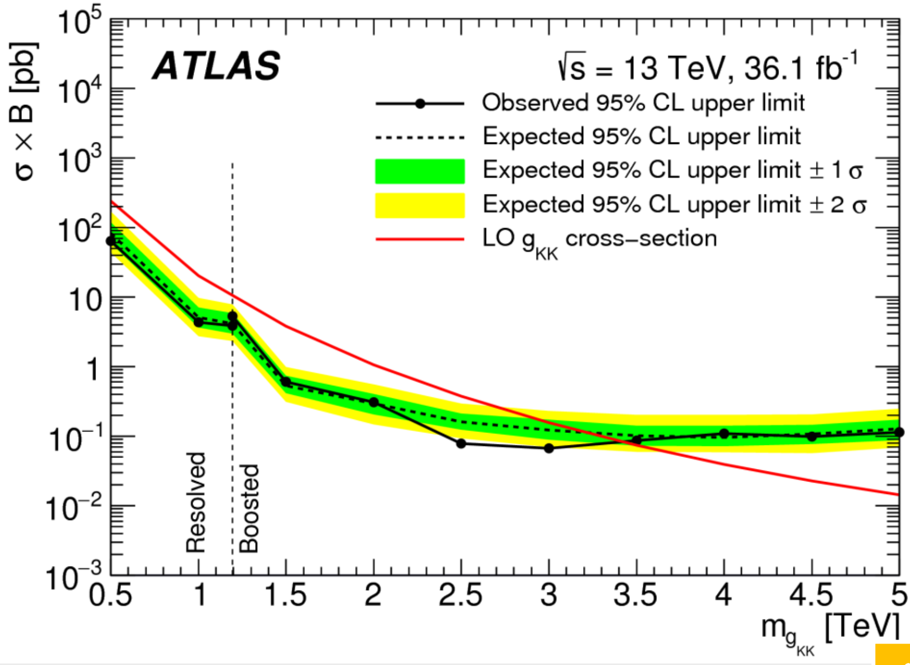
36.1 fb-1 Dataset

[arXiv:1902.10077v2](https://arxiv.org/abs/1902.10077v2)

$t\bar{t}$ quark resonances in allhad decay channel

- Spin-1 and Spin-2, gKK and Gkk respectively, excitations predicted in Randall-Sundrum (RS) model
  - ❑ For top-antitop invariant mass 0.5-3TeV and 0.5-5TeV for Gkk and gKK respectively.
- Fully-hadronic top decays are captured in a large-radius jet.
- Two signal regions are defined based on the number of b-tagged jets: SR1b and SR2b.
- BK from multijets and top-quark pair production are obtained from fit to data.
- gKK for masses $<$ 3.4TeV are excluded for $\Gamma/m = 30\%$.



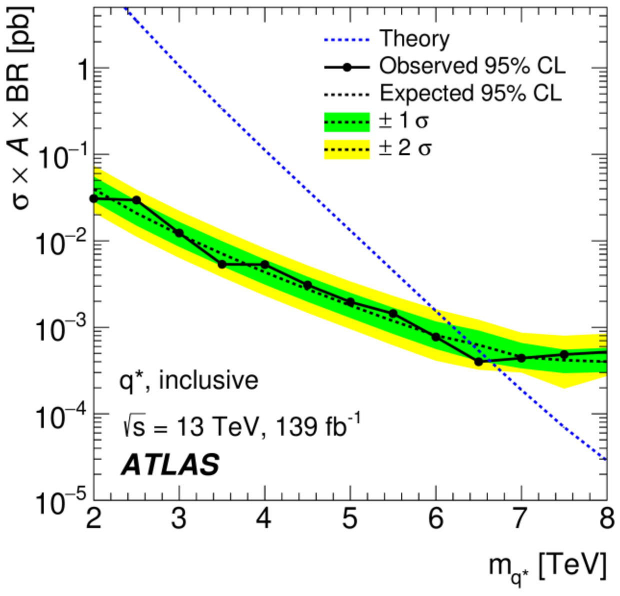


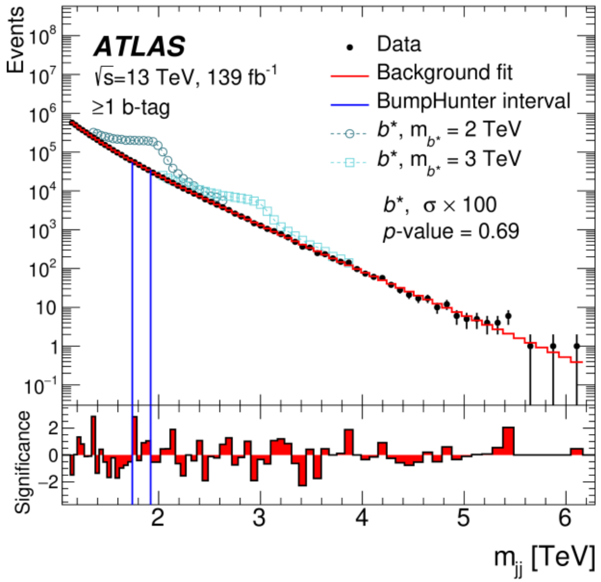
Resonances in dijet mass distributions

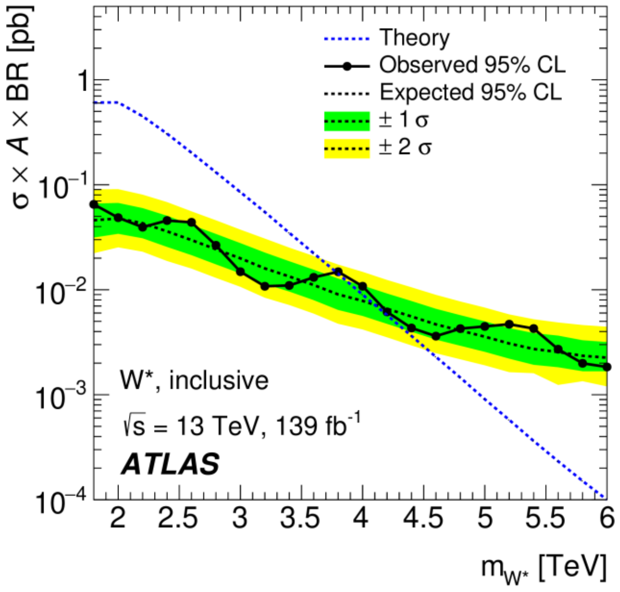
- Signal dijets close in |Δy| while large for BKs.
- Mjj scanned in regions with at least one b-tagged jet or with exactly two b-jets.
- Limits set on several benchmarks with mjj in range 1.1-8TeV: e.g. excited quarks, chiral excitation of the W, Heavy Z` and W` gauge bosons.
- For reinterpretation: limits on generic Gaussian-shaped of various widths as a function of the mass.

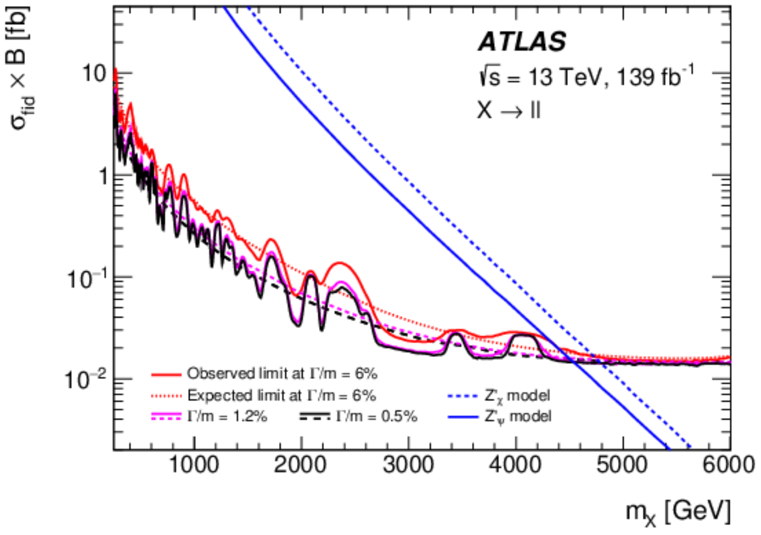
Full Run 2 Dataset

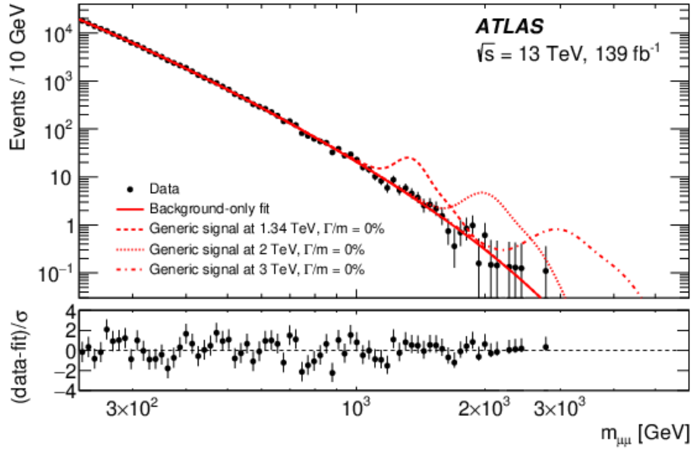
JHEP 03 (2020) 145

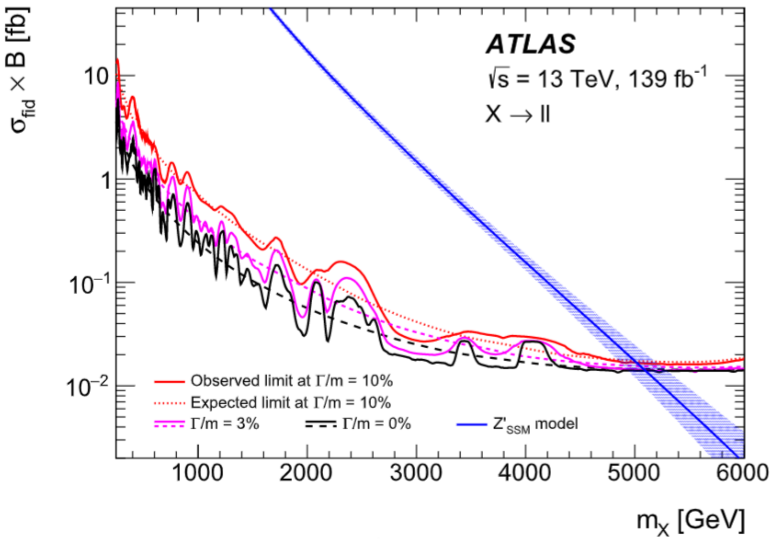












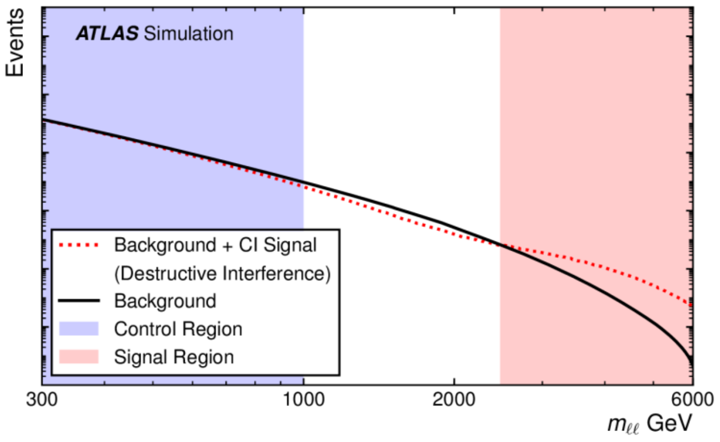
Dilepton resonances

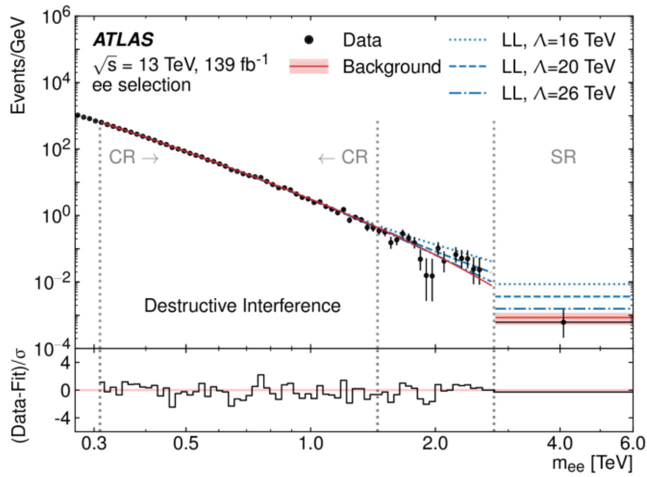
- Dielectron and dimuon resonances in the mass range of 250 GeV to 6TeV.
- Generic signal shapes are constructed from non-relativistic Breit–Wigner functions of various widths convolved with the detector resolution.
- Exclusions on several benchmarks: e.g. Z` boson in SSM, HVT and E6 GUT Model.

Full Run 2 Dataset

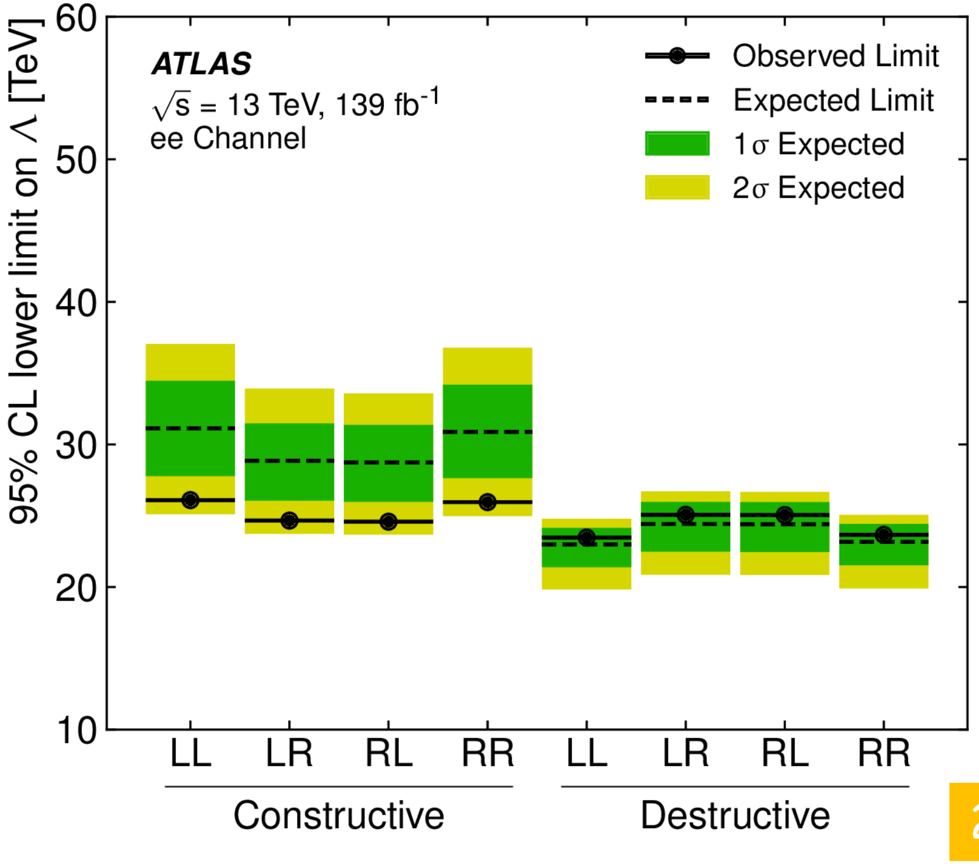
Phys. Lett. B 796 (2019)

non-resonant Dilepton





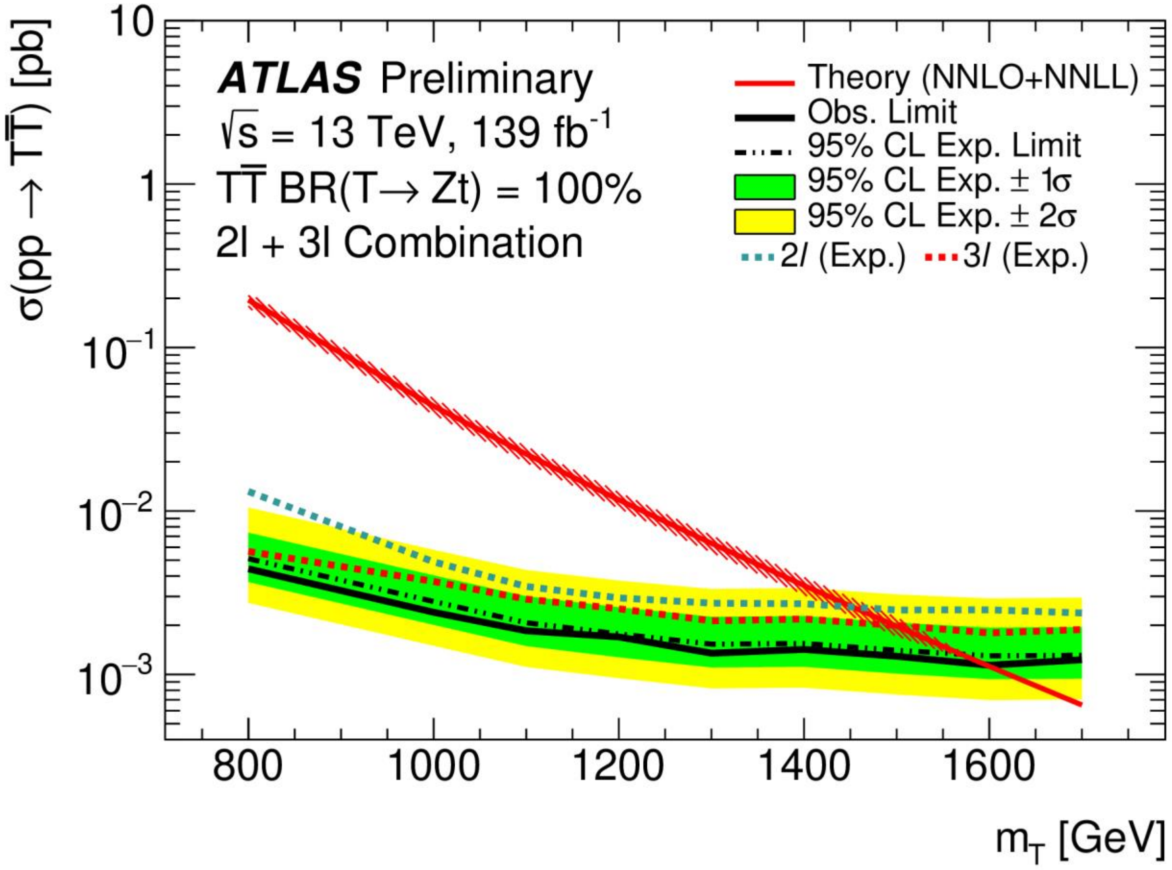
- Search for enhanced rate of dilepton (ee and $\mu\mu$) event with masses above 2TeV.
- Interpreted with four-fermion (two quarks and two leptons: 2q2L) 'Contact' interactions (CI) models.
- Data-driven method used to estimate the BKs in the low mass region then extrapolate to higher mass single-bin signal regions (SR).
- Lower limits on the CI scale for different chiral structure and interference sign. The strongest Lower limits is on the LL constructive model.

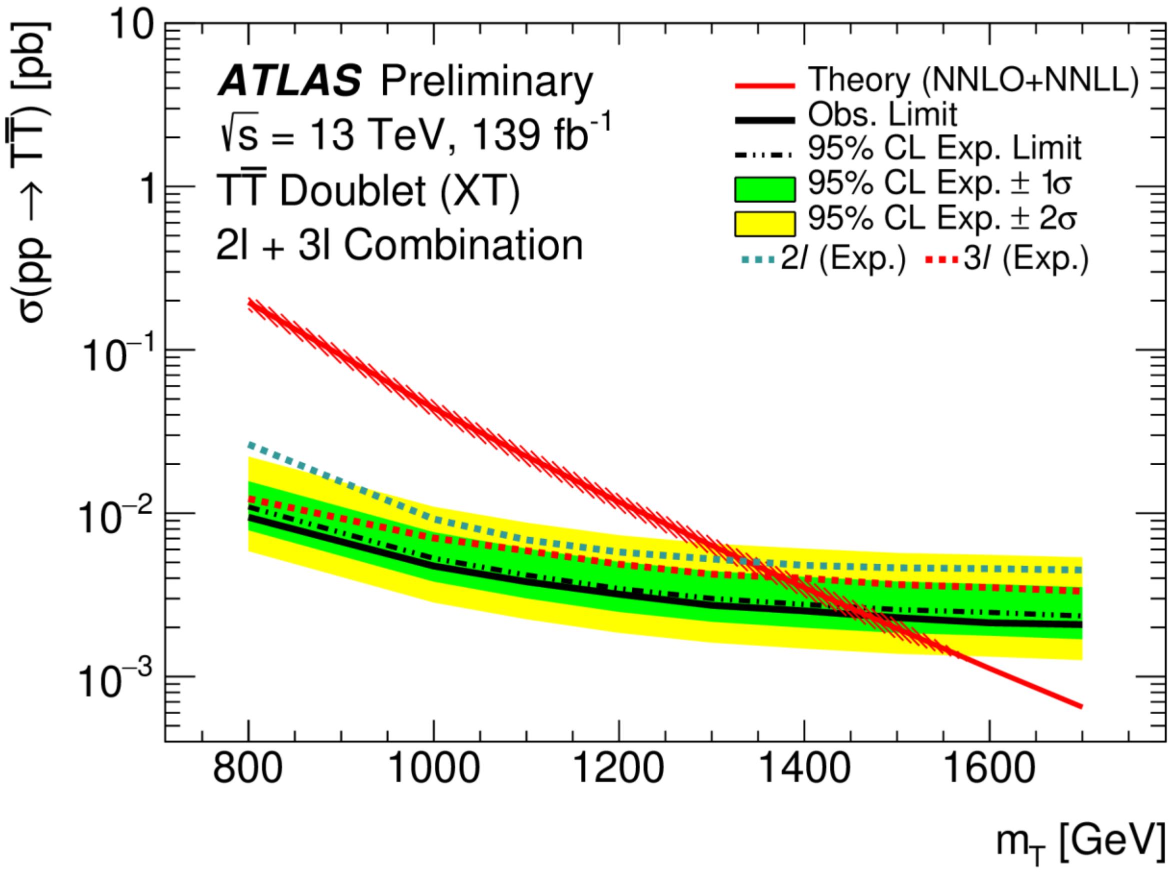


Full Run 2 Dataset

JHEP 11 (2020) 005

Vector-like quarks production in 2L/3L decay channel





Full Run 2 Dataset

ATLAS-CONF-2021-024