ATLAS searches for BSM physics using taus

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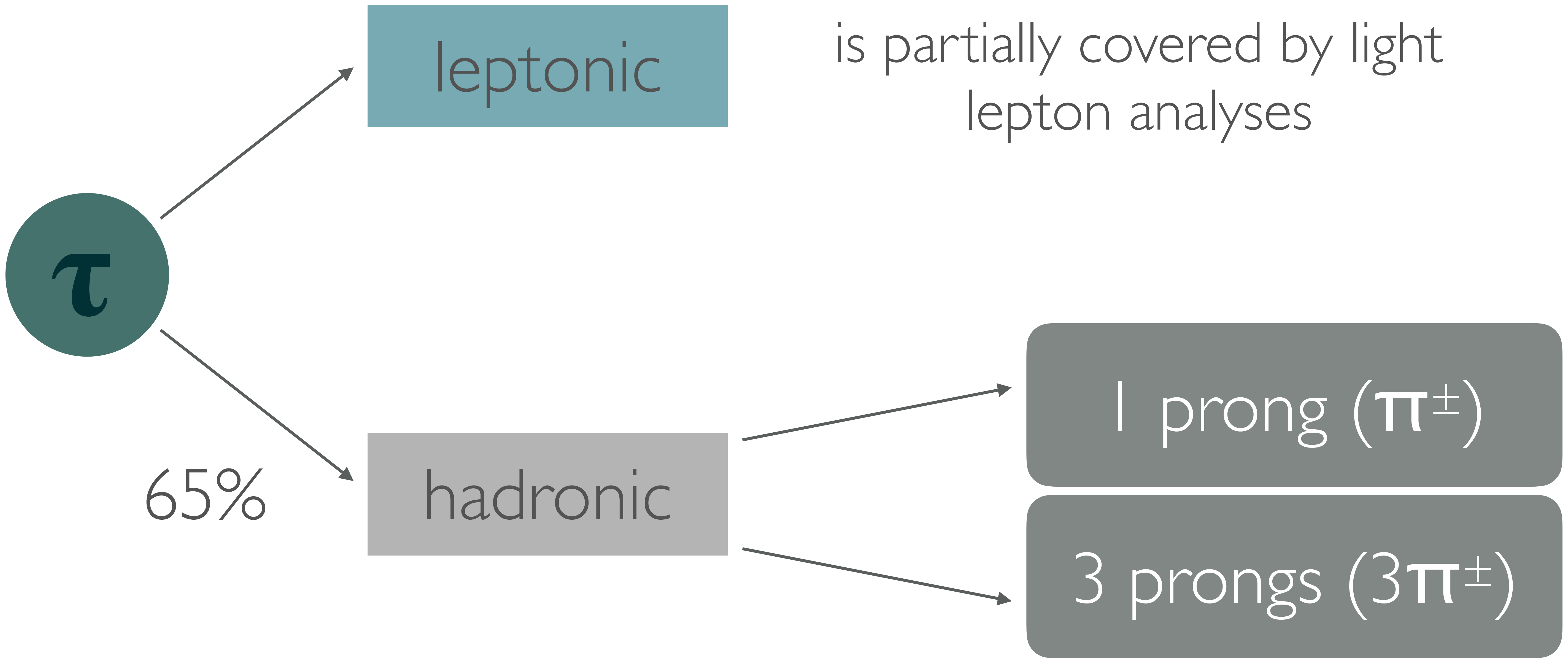
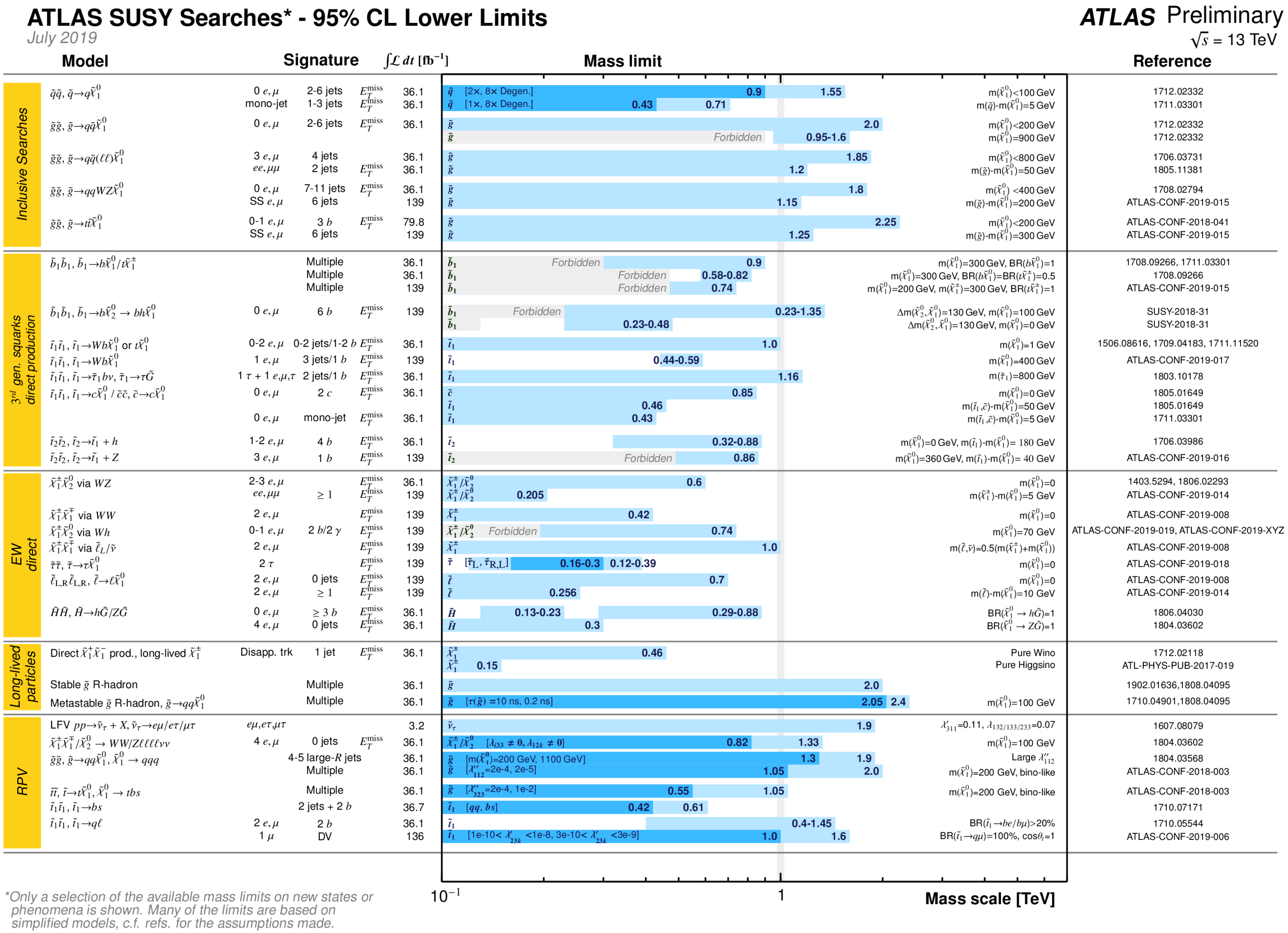
Pushing the Boundaries - Standard Model and Beyond at the LHC
18th - 20th September, Durham

Why taus?

experimentally challenging,
only leptons that decay in ATLAS

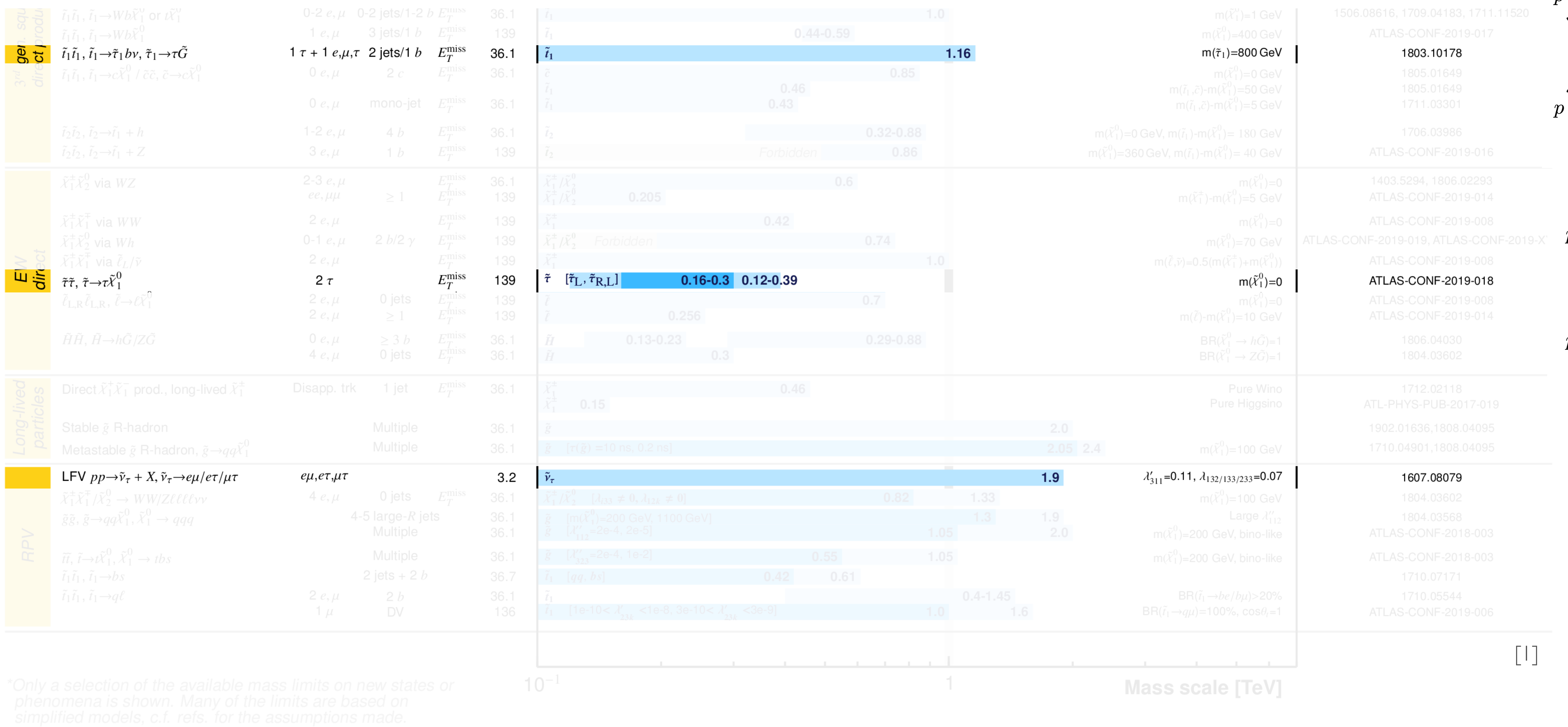
only considered in a few ATLAS analyses

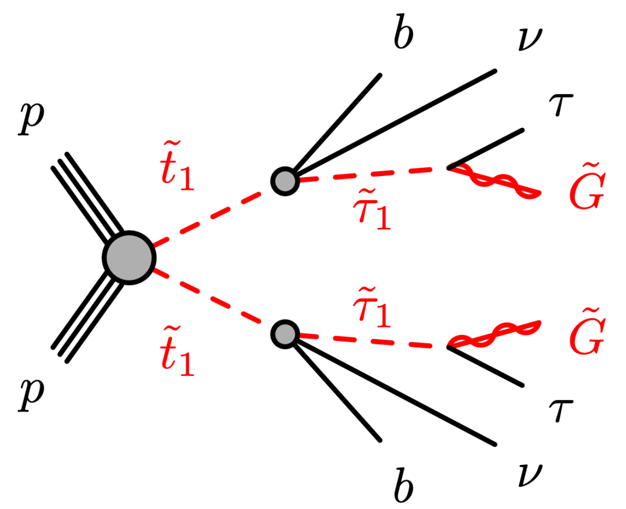


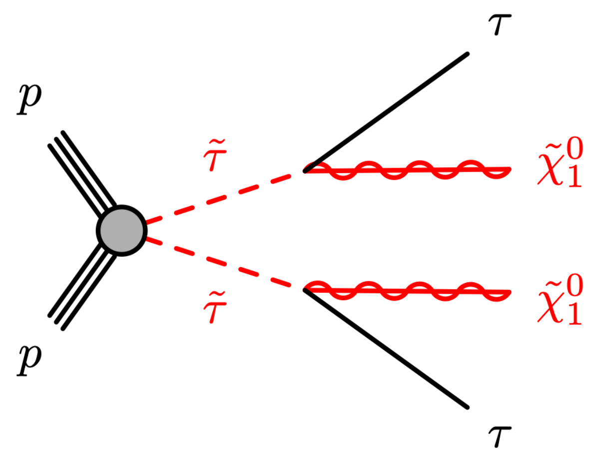


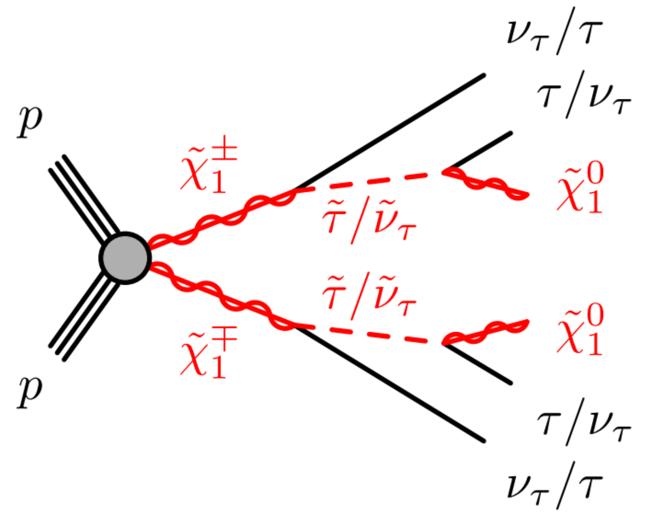
ATLAS SUSY Searches* - 95% CL Lower Limits
July 2019
ATLAS Preliminary
$\sqrt{s}$ = 13 TeV
Model
Signature
$\int\mathcal{L}\,dt$ [fb^{-1}]
Mass limit
Reference
Inclusive Searches
$\tilde{q}\tilde{q}$, $\tilde{q}\to q\tilde{\chi}^0_1$ | 0 e,μ | 2-6 jets | E_T^{miss} | 36.1 | $\tilde{q}$ [2×, 8× Degen.] 0.9 1.55 | m($\tilde{\chi}^0_1$)<100 GeV | 1712.02332
mono-jet | 1-3 jets | E_T^{miss} | 36.1 | $\tilde{q}$ [1×, 8× Degen.] 0.43 0.71 | m($\tilde{q}$)-m($\tilde{\chi}^0_1$)=5 GeV | 1711.03301
$\tilde{g}\tilde{g}$, $\tilde{g}\to q\bar{q}\tilde{\chi}^0_1$ | 0 e,μ | 2-6 jets | E_T^{miss} | 36.1 | $\tilde{g}$ 2.0 | m($\tilde{\chi}^0_1$)<200 GeV | 1712.02332
$\tilde{g}$ Forbidden 0.95-1.6 | m($\tilde{\chi}^0_1$)=900 GeV | 1712.02332
$\tilde{g}\tilde{g}$, $\tilde{g}\to q\bar{q}(\ell\ell)\tilde{\chi}^0_1$ | 3 e,μ | 4 jets | 36.1 | $\tilde{g}$ 1.85 | m($\tilde{\chi}^0_1$)<800 GeV | 1706.03731
$ee,\mu\mu$ | 2 jets | E_T^{miss} | 36.1 | $\tilde{g}$ 1.2 | m($\tilde{g}$)-m($\tilde{\chi}^0_1$)=50 GeV | 1805.11381
$\tilde{g}\tilde{g}$, $\tilde{g}\to qqWZ\tilde{\chi}^0_1$ | 0 e,μ | 7-11 jets | E_T^{miss} | 36.1 | $\tilde{g}$ 1.8 | m($\tilde{\chi}^0_1$) <400 GeV | 1708.02794
SS e,μ | 6 jets | 139 | $\tilde{g}$ 1.15 | m($\tilde{g}$)-m($\tilde{\chi}^0_1$)=200 GeV | ATLAS-CONF-2019-015
$\tilde{g}\tilde{g}$, $\tilde{g}\to t\bar{t}\tilde{\chi}^0_1$ | 0-1 e,μ | 3 b | E_T^{miss} | 79.8 | $\tilde{g}$ 2.25 | m($\tilde{\chi}^0_1$)<200 GeV | ATLAS-CONF-2018-041
SS e,μ | 6 jets | 139 | $\tilde{g}$ 1.25 | m($\tilde{g}$)-m($\tilde{\chi}^0_1$)=300 GeV | ATLAS-CONF-2019-015
3rd gen. squarks direct production
$\tilde{b}_1\tilde{b}_1$, $\tilde{b}_1\to b\tilde{\chi}^0_1/t\tilde{\chi}^\pm_1$ | Multiple | 36.1 | $\tilde{b}_1$ Forbidden 0.9 | m($\tilde{\chi}^0_1$)=300 GeV, BR($b\tilde{\chi}^0_1$)=1 | 1708.09266, 1711.03301
Multiple | 36.1 | $\tilde{b}_1$ Forbidden 0.58-0.82 | m($\tilde{\chi}^0_1$)=300 GeV, BR($b\tilde{\chi}^0_1$)=BR($t\tilde{\chi}^\pm_1$)=0.5 | 1708.09266
Multiple | 139 | $\tilde{b}_1$ Forbidden 0.74 | m($\tilde{\chi}^0_1$)=200 GeV, m($\tilde{\chi}^\pm_1$)=300 GeV, BR($t\tilde{\chi}^\pm_1$)=1 | ATLAS-CONF-2019-015
$\tilde{b}_1\tilde{b}_1$, $\tilde{b}_1\to b\tilde{\chi}^0_2\to bh\tilde{\chi}^0_1$ | 0 e,μ | 6 b | E_T^{miss} | 139 | $\tilde{b}_1$ Forbidden 0.23-1.35 | $\Delta m(\tilde{\chi}^0_2,\tilde{\chi}^0_1)$=130 GeV, m($\tilde{\chi}^0_1$)=100 GeV | SUSY-2018-31
$\tilde{b}_1$ 0.23-0.48 | $\Delta m(\tilde{\chi}^0_2,\tilde{\chi}^0_1)$=130 GeV, m($\tilde{\chi}^0_1$)=0 GeV | SUSY-2018-31
$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to Wb\tilde{\chi}^0_1$ or $t\tilde{\chi}^0_1$ | 0-2 e,μ | 0-2 jets/1-2 b | E_T^{miss} | 36.1 | $\tilde{t}_1$ 1.0 | m($\tilde{\chi}^0_1$)=1 GeV | 1506.08616, 1709.04183, 1711.11520
$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to Wb\tilde{\chi}^0_1$ | 1 e,μ | 3 jets/1 b | E_T^{miss} | 139 | $\tilde{t}_1$ 0.44-0.59 | m($\tilde{\chi}^0_1$)=400 GeV | ATLAS-CONF-2019-017
$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to\tilde{\tau}_1 b\nu$, $\tilde{\tau}_1\to\tau\tilde{G}$ | 1 τ + 1 e,μ,τ | 2 jets/1 b | E_T^{miss} | 36.1 | $\tilde{t}_1$ 1.16 | m($\tilde{\tau}_1$)=800 GeV | 1803.10178
$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to c\tilde{\chi}^0_1$ / $\tilde{c}\tilde{c}$, $\tilde{c}\to c\tilde{\chi}^0_1$ | 0 e,μ | 2 c | E_T^{miss} | 36.1 | $\tilde{c}$ 0.85 | m($\tilde{\chi}^0_1$)=0 GeV | 1805.01649
$\tilde{t}_1$ 0.46 | m($\tilde{t}_1$,$\tilde{c}$)-m($\tilde{\chi}^0_1$)=50 GeV | 1805.01649
0 e,μ | mono-jet | E_T^{miss} | 36.1 | $\tilde{t}_1$ 0.43 | m($\tilde{t}_1$,$\tilde{c}$)-m($\tilde{\chi}^0_1$)=5 GeV | 1711.03301
$\tilde{t}_2\tilde{t}_2$, $\tilde{t}_2\to\tilde{t}_1+h$ | 1-2 e,μ | 4 b | E_T^{miss} | 36.1 | $\tilde{t}_2$ 0.32-0.88 | m($\tilde{\chi}^0_1$)=0 GeV, m($\tilde{t}_1$)-m($\tilde{\chi}^0_1$)= 180 GeV | 1706.03986
$\tilde{t}_2\tilde{t}_2$, $\tilde{t}_2\to\tilde{t}_1+Z$ | 3 e,μ | 1 b | E_T^{miss} | 139 | $\tilde{t}_2$ Forbidden 0.86 | m($\tilde{\chi}^0_1$)=360 GeV, m($\tilde{t}_1$)-m($\tilde{\chi}^0_1$)= 40 GeV | ATLAS-CONF-2019-016
EW direct
$\tilde{\chi}^\pm_1\tilde{\chi}^0_2$ via WZ | 2-3 e,μ | E_T^{miss} | 36.1 | $\tilde{\chi}^\pm_1/\tilde{\chi}^0_2$ 0.6 | m($\tilde{\chi}^0_1$)=0 | 1403.5294, 1806.02293
$ee,\mu\mu$ | $\geq$ 1 | E_T^{miss} | 139 | $\tilde{\chi}^\pm_1/\tilde{\chi}^0_2$ 0.205 | m($\tilde{\chi}^\pm_1$)-m($\tilde{\chi}^0_1$)=5 GeV | ATLAS-CONF-2019-014
$\tilde{\chi}^\pm_1\tilde{\chi}^\mp_1$ via WW | 2 e,μ | E_T^{miss} | 139 | $\tilde{\chi}^\pm_1$ 0.42 | m($\tilde{\chi}^0_1$)=0 | ATLAS-CONF-2019-008
$\tilde{\chi}^\pm_1\tilde{\chi}^0_2$ via Wh | 0-1 e,μ | 2 b/2 γ | E_T^{miss} | 139 | $\tilde{\chi}^\pm_1/\tilde{\chi}^0_2$ Forbidden 0.74 | m($\tilde{\chi}^0_1$)=70 GeV | ATLAS-CONF-2019-019, ATLAS-CONF-2019-XYZ
$\tilde{\chi}^\pm_1\tilde{\chi}^\mp_1$ via $\tilde{\ell}_L/\tilde{\nu}$ | 2 e,μ | E_T^{miss} | 139 | $\tilde{\chi}^\pm_1$ 1.0 | m($\tilde{\ell}$,$\tilde{\nu}$)=0.5(m($\tilde{\chi}^\pm_1$)+m($\tilde{\chi}^0_1$)) | ATLAS-CONF-2019-008
$\tilde{\tau}\tilde{\tau}$, $\tilde{\tau}\to\tau\tilde{\chi}^0_1$ | 2 τ | E_T^{miss} | 139 | $\tilde{\tau}$ [$\tilde{\tau}_L$, $\tilde{\tau}_{R,L}$] 0.16-0.3 0.12-0.39 | m($\tilde{\chi}^0_1$)=0 | ATLAS-CONF-2019-018
$\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}$, $\tilde{\ell}\to\ell\tilde{\chi}^0_1$ | 2 e,μ | 0 jets | E_T^{miss} | 139 | $\tilde{\ell}$ 0.7 | m($\tilde{\chi}^0_1$)=0 | ATLAS-CONF-2019-008
2 e,μ | $\geq$ 1 | E_T^{miss} | 139 | $\tilde{\ell}$ 0.256 | m($\tilde{\ell}$)-m($\tilde{\chi}^0_1$)=10 GeV | ATLAS-CONF-2019-014
$\tilde{H}\tilde{H}$, $\tilde{H}\to h\tilde{G}/Z\tilde{G}$ | 0 e,μ | $\geq$ 3 b | E_T^{miss} | 36.1 | $\tilde{H}$ 0.13-0.23 0.29-0.88 | BR($\tilde{\chi}^0_1\to h\tilde{G}$)=1 | 1806.04030
4 e,μ | 0 jets | E_T^{miss} | 36.1 | $\tilde{H}$ 0.3 | BR($\tilde{\chi}^0_1\to Z\tilde{G}$)=1 | 1804.03602
Long-lived particles
Direct $\tilde{\chi}^+_1\tilde{\chi}^-_1$ prod., long-lived $\tilde{\chi}^\pm_1$ | Disapp. trk | 1 jet | E_T^{miss} | 36.1 | $\tilde{\chi}^\pm_1$ 0.46 | Pure Wino | 1712.02118
$\tilde{\chi}^\pm_1$ 0.15 | Pure Higgsino | ATL-PHYS-PUB-2017-019
Stable $\tilde{g}$ R-hadron | Multiple | 36.1 | $\tilde{g}$ 2.0 | 1902.01636,1808.04095
Metastable $\tilde{g}$ R-hadron, $\tilde{g}\to qq\tilde{\chi}^0_1$ | Multiple | 36.1 | $\tilde{g}$ [$\tau(\tilde{g})$ =10 ns, 0.2 ns] 2.05 2.4 | m($\tilde{\chi}^0_1$)=100 GeV | 1710.04901,1808.04095
RPV
LFV $pp\to\tilde{\nu}_\tau+X$, $\tilde{\nu}_\tau\to e\mu/e\tau/\mu\tau$ | $e\mu,e\tau,\mu\tau$ | 3.2 | $\tilde{\nu}_\tau$ 1.9 | λ'_{311}=0.11, $\lambda_{132/133/233}$=0.07 | 1607.08079
$\tilde{\chi}^\pm_1\tilde{\chi}^\mp_1/\tilde{\chi}^0_2\to WW/Z\ell\ell\ell\ell\nu\nu$ | 4 e,μ | 0 jets | E_T^{miss} | 36.1 | $\tilde{\chi}^\pm_1/\tilde{\chi}^0_2$ [$\lambda_{i33}\neq 0$, $\lambda_{12k}\neq 0$] 0.82 1.33 | m($\tilde{\chi}^0_1$)=100 GeV | 1804.03602
$\tilde{g}\tilde{g}$, $\tilde{g}\to qq\tilde{\chi}^0_1$, $\tilde{\chi}^0_1\to qqq$ | 4-5 large-R jets | 36.1 | $\tilde{g}$ [m($\tilde{\chi}^0_1$)=200 GeV, 1100 GeV] 1.3 1.9 | Large λ''_{112} | 1804.03568
Multiple | 36.1 | $\tilde{g}$ [λ''_{112}=2e-4, 2e-5] 1.05 2.0 | m($\tilde{\chi}^0_1$)=200 GeV, bino-like | ATLAS-CONF-2018-003
$t\bar{t}$, $\tilde{t}\to t\tilde{\chi}^0_1$, $\tilde{\chi}^0_1\to tbs$ | Multiple | 36.1 | $\tilde{g}$ [λ''_{323}=2e-4, 1e-2] 0.55 1.05 | m($\tilde{\chi}^0_1$)=200 GeV, bino-like | ATLAS-CONF-2018-003
$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to bs$ | 2 jets + 2 b | 36.7 | $\tilde{t}_1$ [qq, bs] 0.42 0.61 | 1710.07171
$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to q\ell$ | 2 e,μ | 2 b | 36.1 | $\tilde{t}_1$ 0.4-1.45 | BR($\tilde{t}_1\to be/b\mu$)>20% | 1710.05544
1 μ | DV | 136 | $\tilde{t}_1$ [1e-10< λ'_{23k} <1e-8, 3e-10< λ'_{23k} <3e-9] 1.0 1.6 | BR($\tilde{t}_1\to q\mu$)=100%, cosθ_t=1 | ATLAS-CONF-2019-006
10^{-1}
1
Mass scale [TeV]
*Only a selection of the available mass limits on new states or phenomena is shown. Many of the limits are based on simplified models, c.f. refs. for the assumptions made.

SUSY searches including taus in the final state









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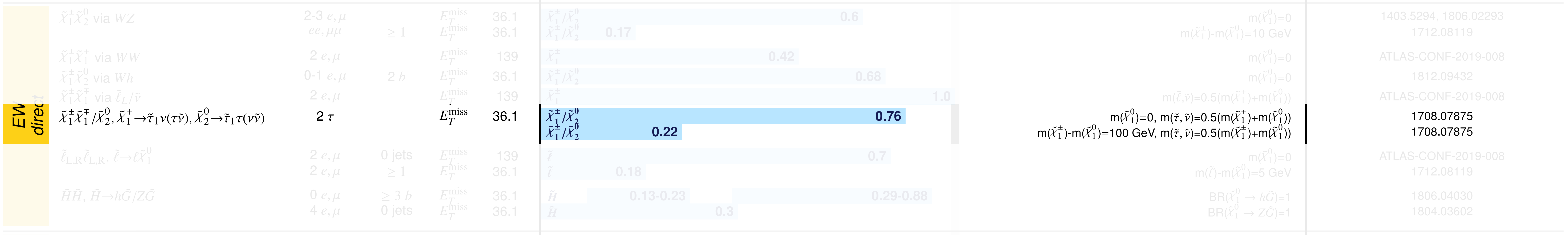
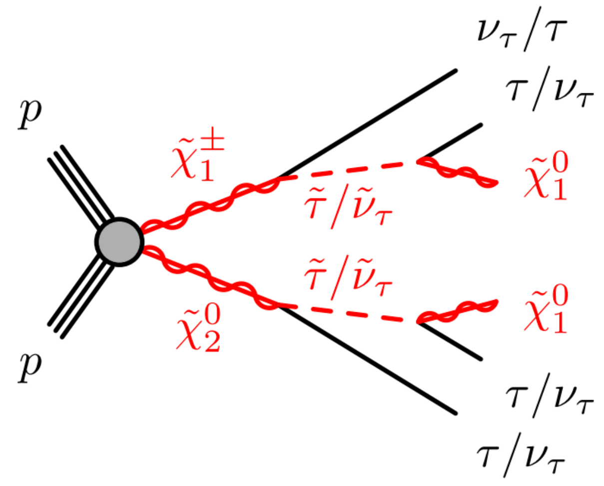
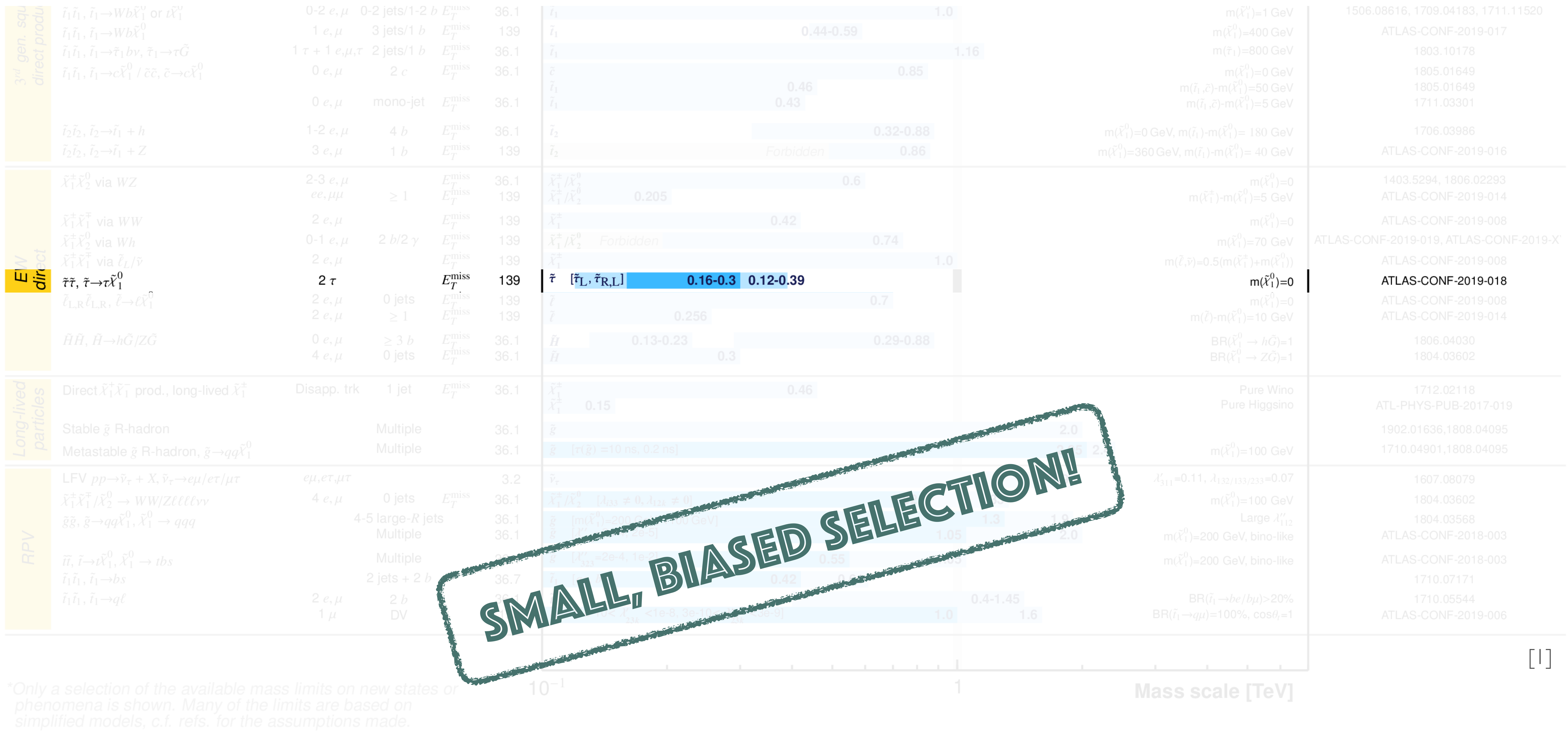
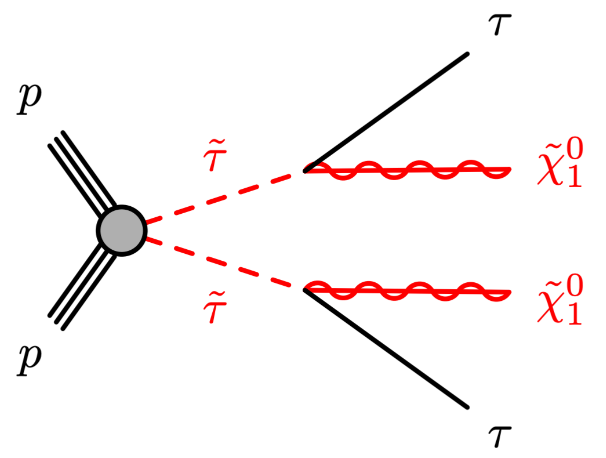




[2]

SUSY searches including taus in the final state





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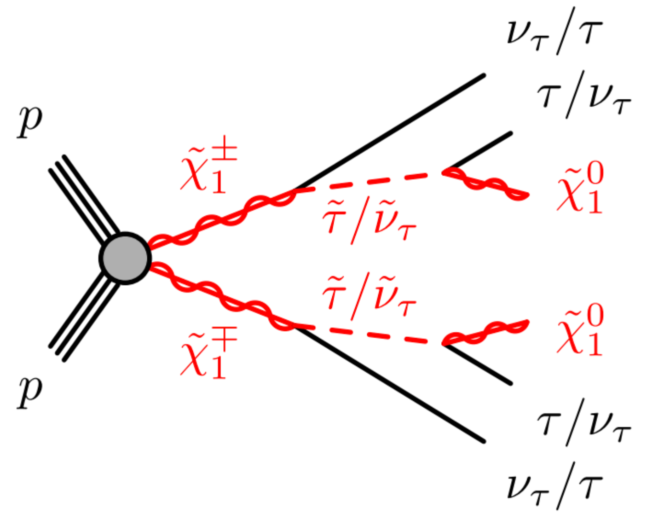
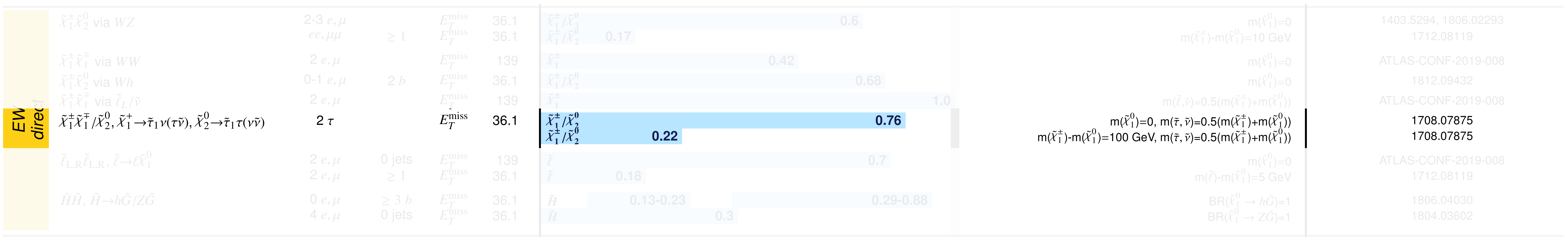
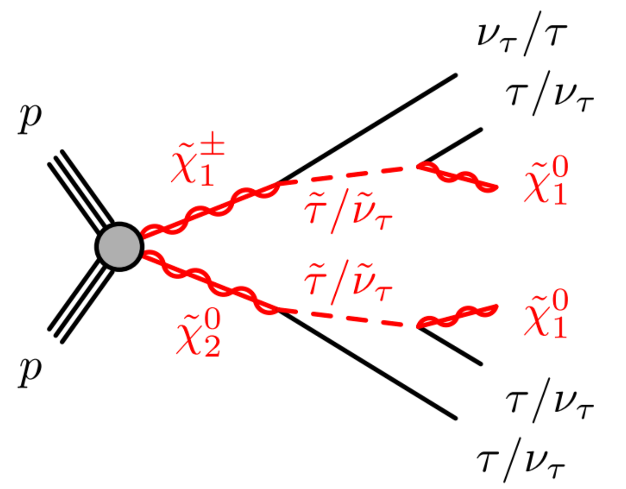


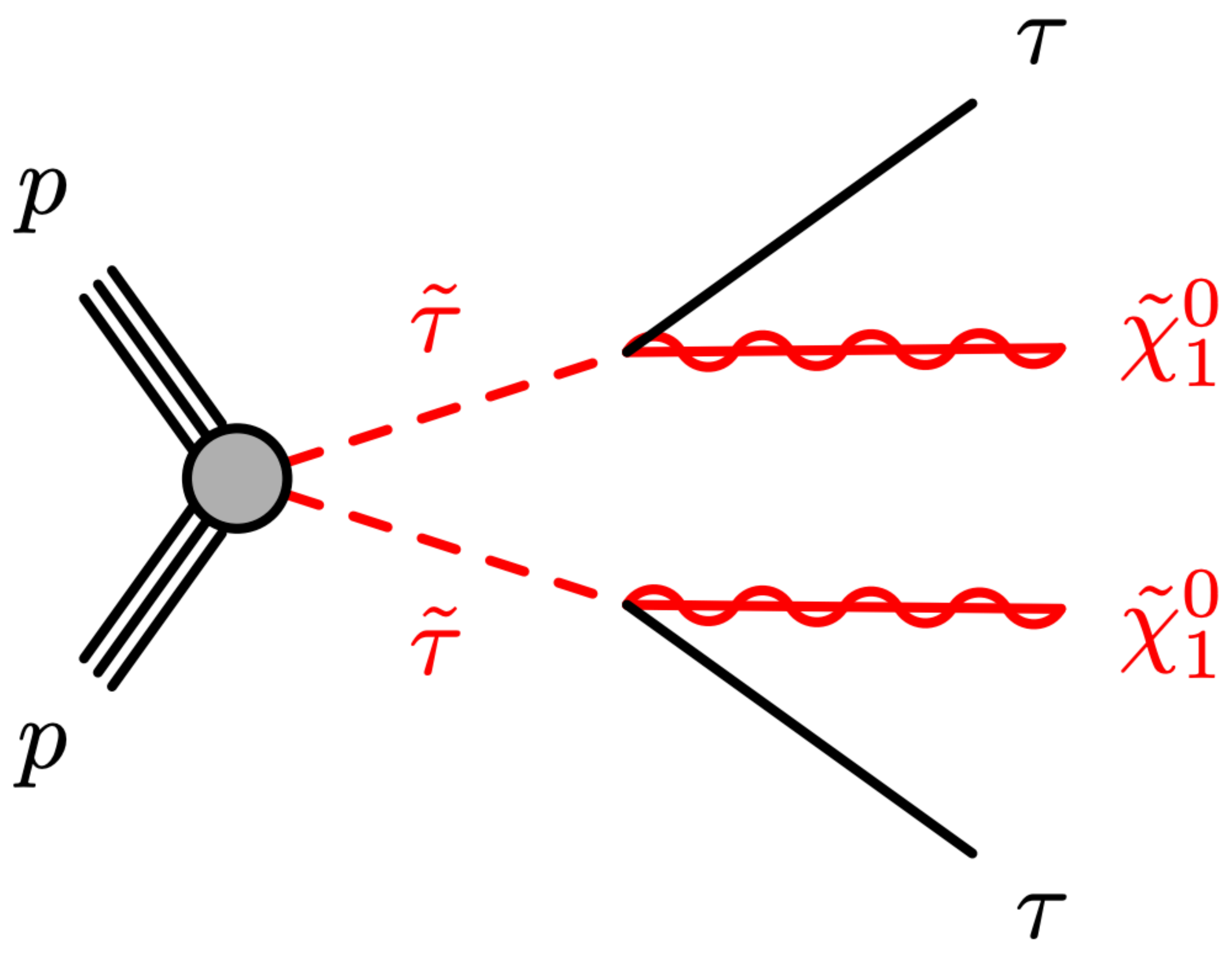




[2]

Direct stau production

ATLAS-CONF-2019-018



Final state with
two hadronic taus
and
missing transverse energy

SR-lowMass	SR-highMass
2 tight τs (OS)	2 medium τs (OS) , $\geq$ 1 tight τ
asymmetric di-tau trigger	di-tau+$E_{\mathrm{T}}^{\mathrm{miss}}$ trigger
$75 < E_{\mathrm{T}}^{\mathrm{miss}} < 150$ GeV	$E_{\mathrm{T}}^{\mathrm{miss}} > 150$ GeV
tau p_{T} and $E_{\mathrm{T}}^{\mathrm{miss}}$ cuts described in Section 5	
light lepton veto and 3rd medium τ veto	
b-jet veto	
Z/H veto ($m(\tau_1, \tau_2) > 120$ GeV)	
$\Delta R(\tau_1, \tau_2) < 3.2$	
$\lvert\Delta\phi(\tau_1, \tau_2)\rvert > 0.8$	
$m_{\mathrm{T2}} > 70$ GeV	

$$m_{\mathrm{T2}} = \min_{\mathbf{q}_{\mathrm{T}}} \left[\max \left(m_{\mathrm{T},\tau_1}(\mathbf{p}_{\mathrm{T},\tau_1}, \mathbf{q}_{\mathrm{T}}), m_{\mathrm{T},\tau_2}(\mathbf{p}_{\mathrm{T},\tau_2}, \mathbf{p}_{\mathrm{T}}^{\mathrm{miss}} - \mathbf{q}_{\mathrm{T}}) \right) \right]$$

Direct stau - SM backgrounds

real tau lepton backgrounds

MC simulation, validated in validation regions

top | Z+jets | diboson

one fake tau

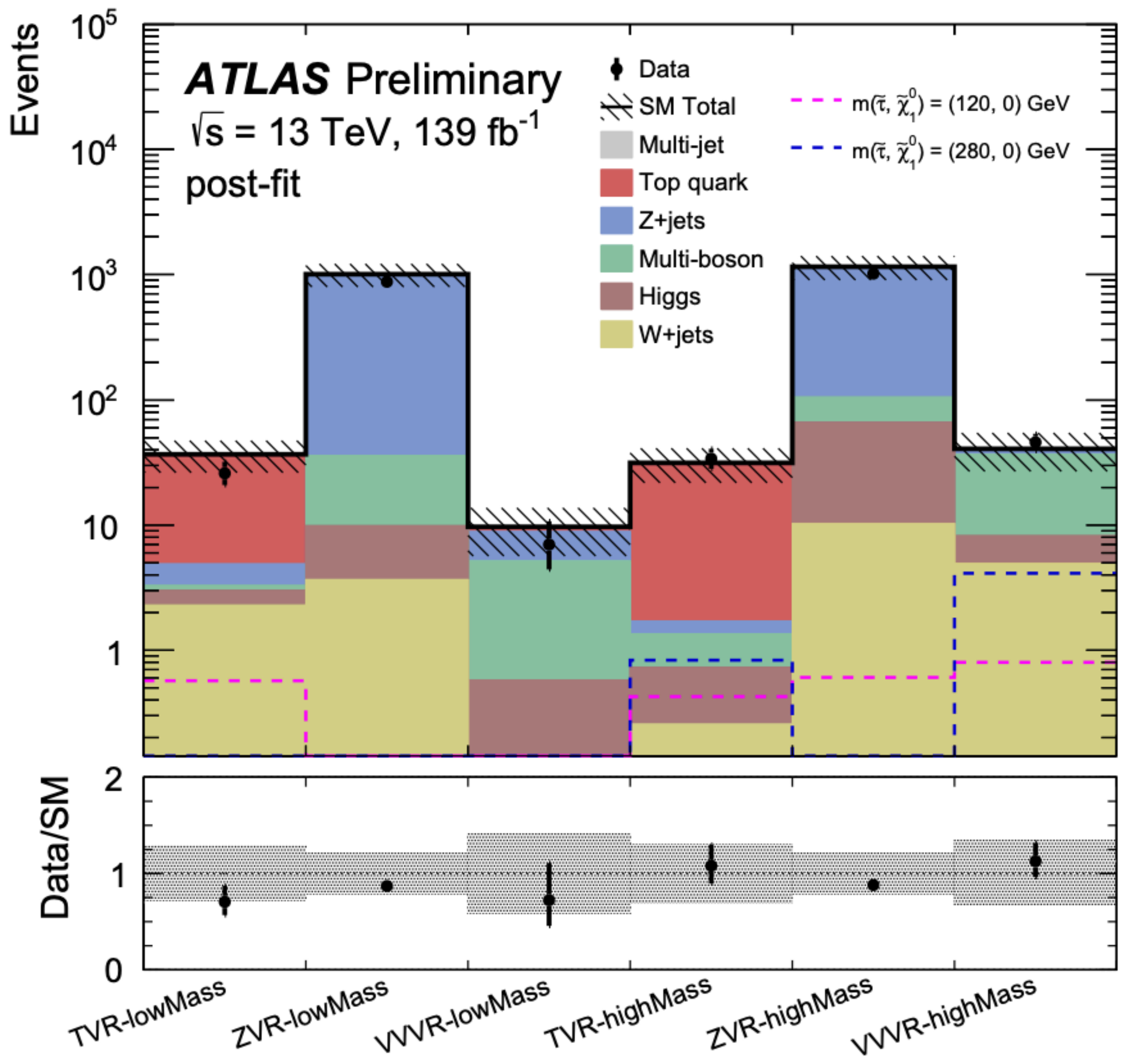
control region to normalize, validation region

W+jets

two fake taus

estimated in ABCD method

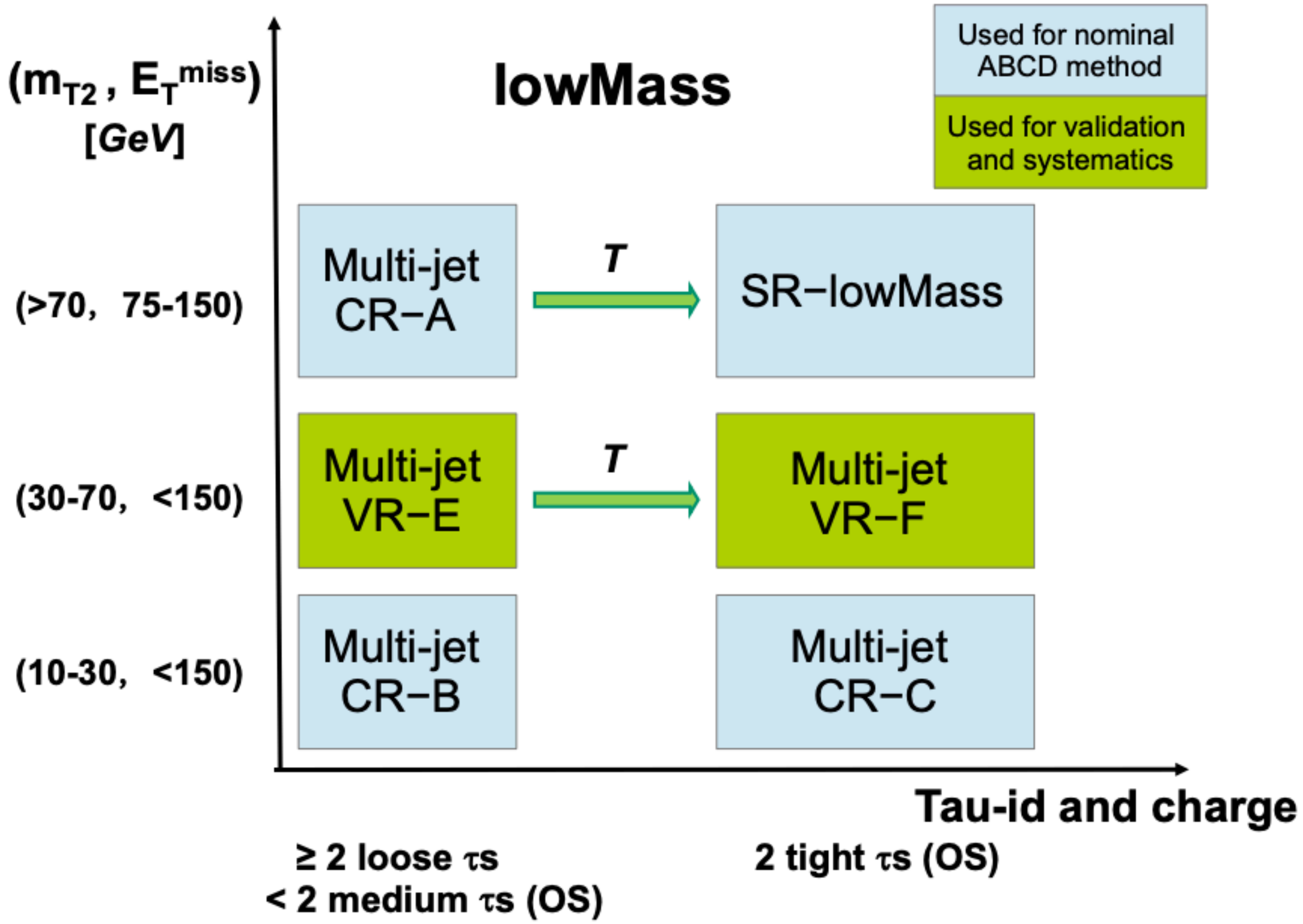
multi-jet

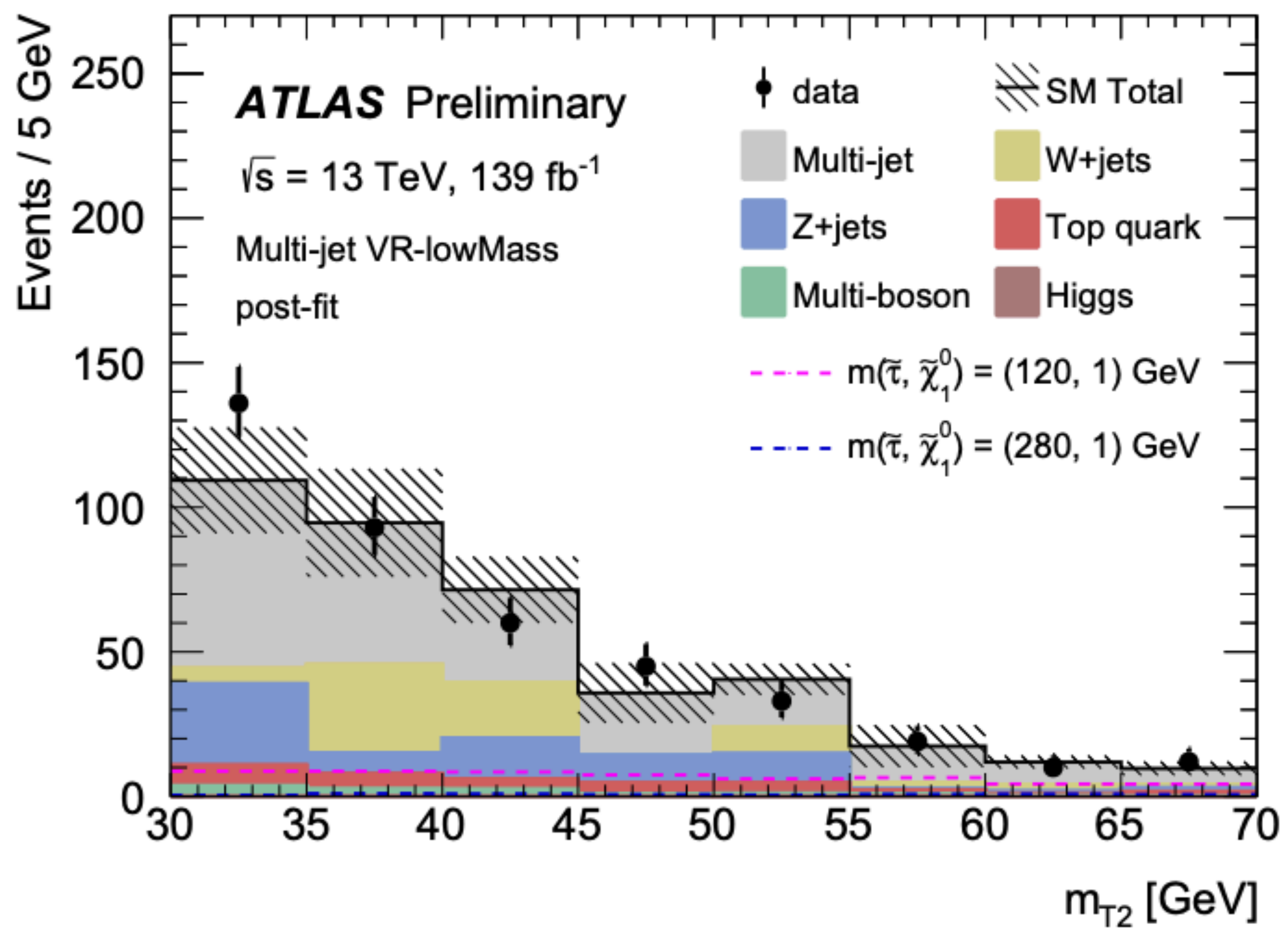


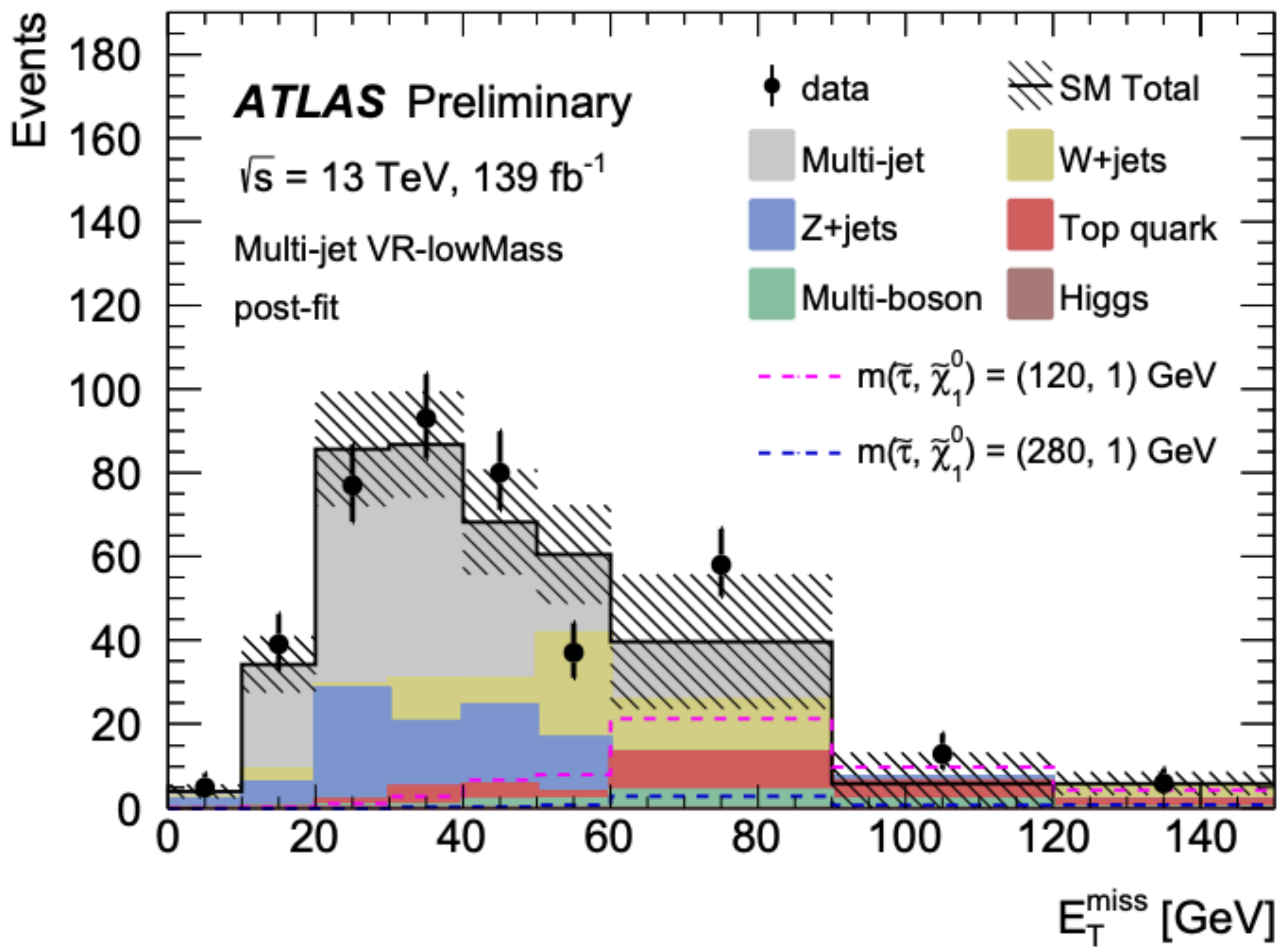
Multijet background estimation

ATLAS-CONF-2019-018

ABCD method

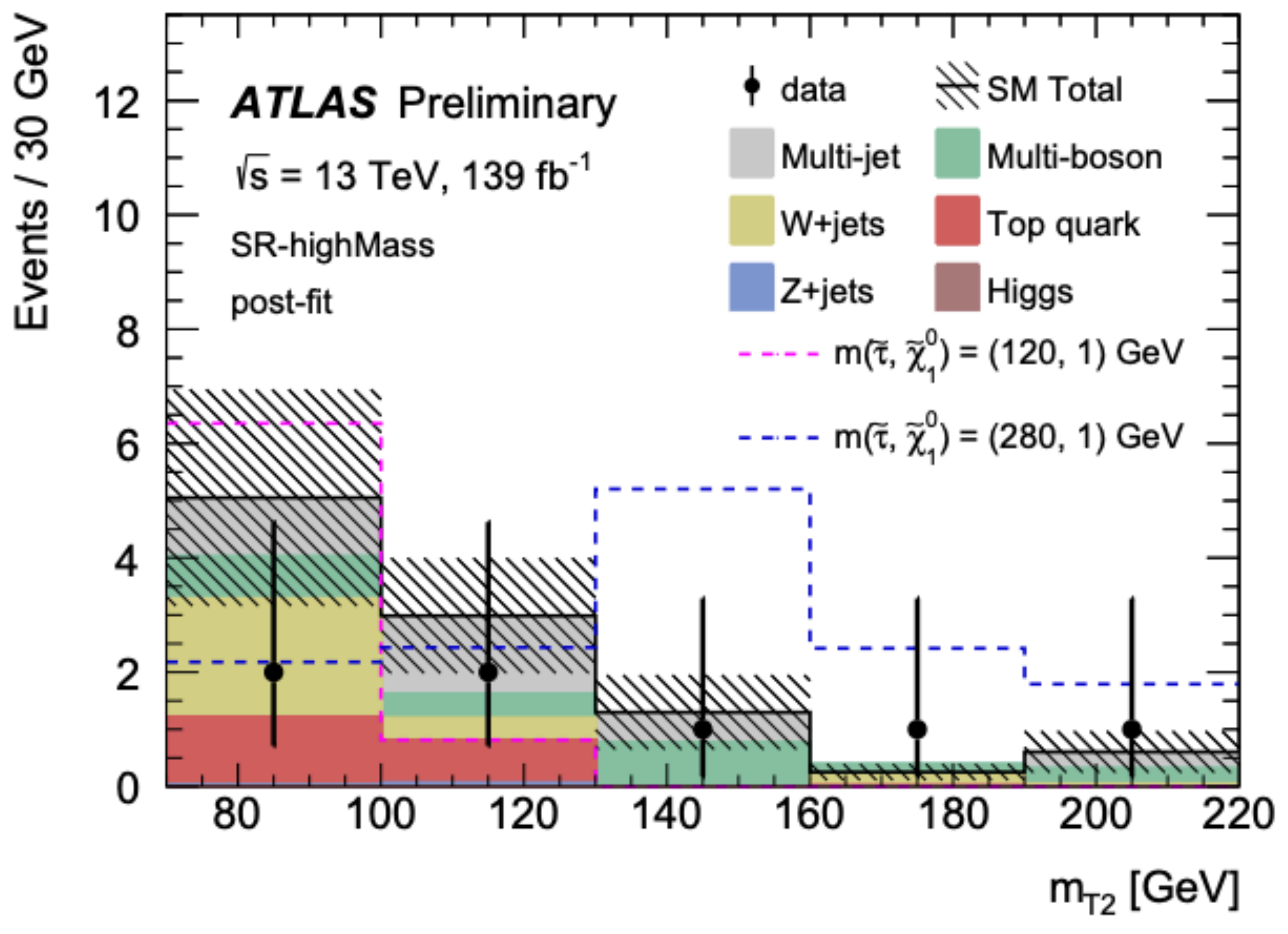


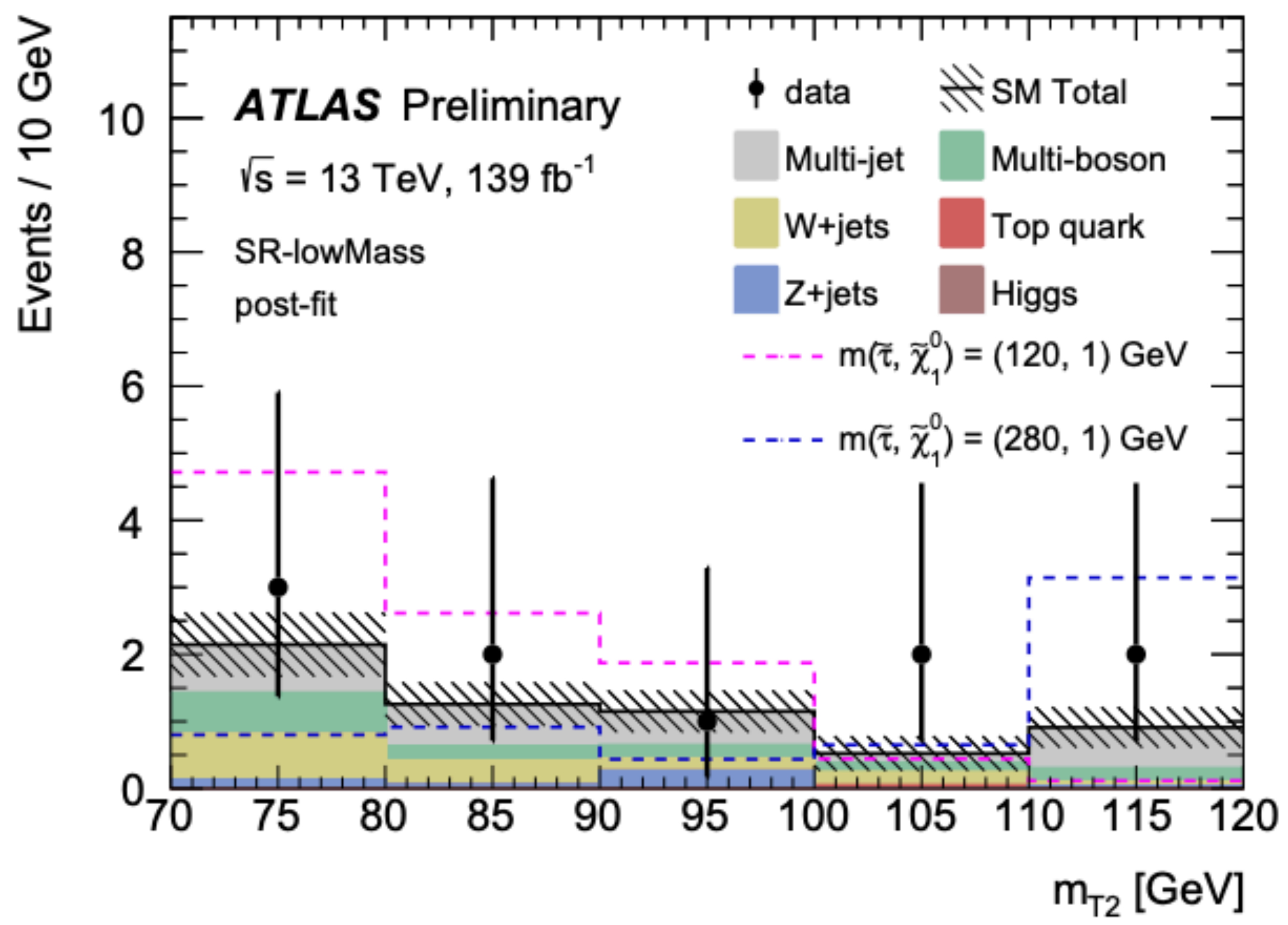


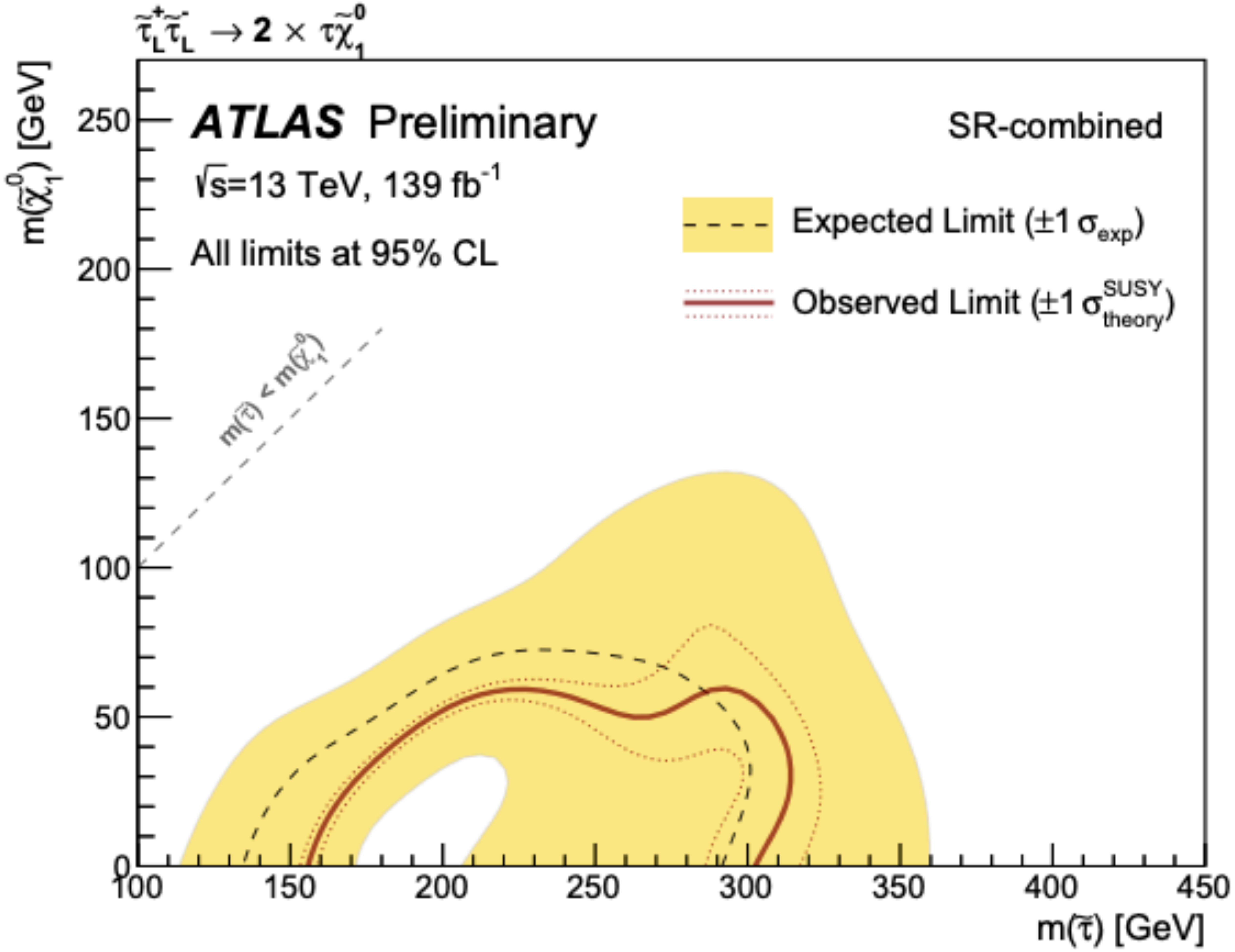


Direct stau - Interpretation

ATLAS-CONF-2019-018

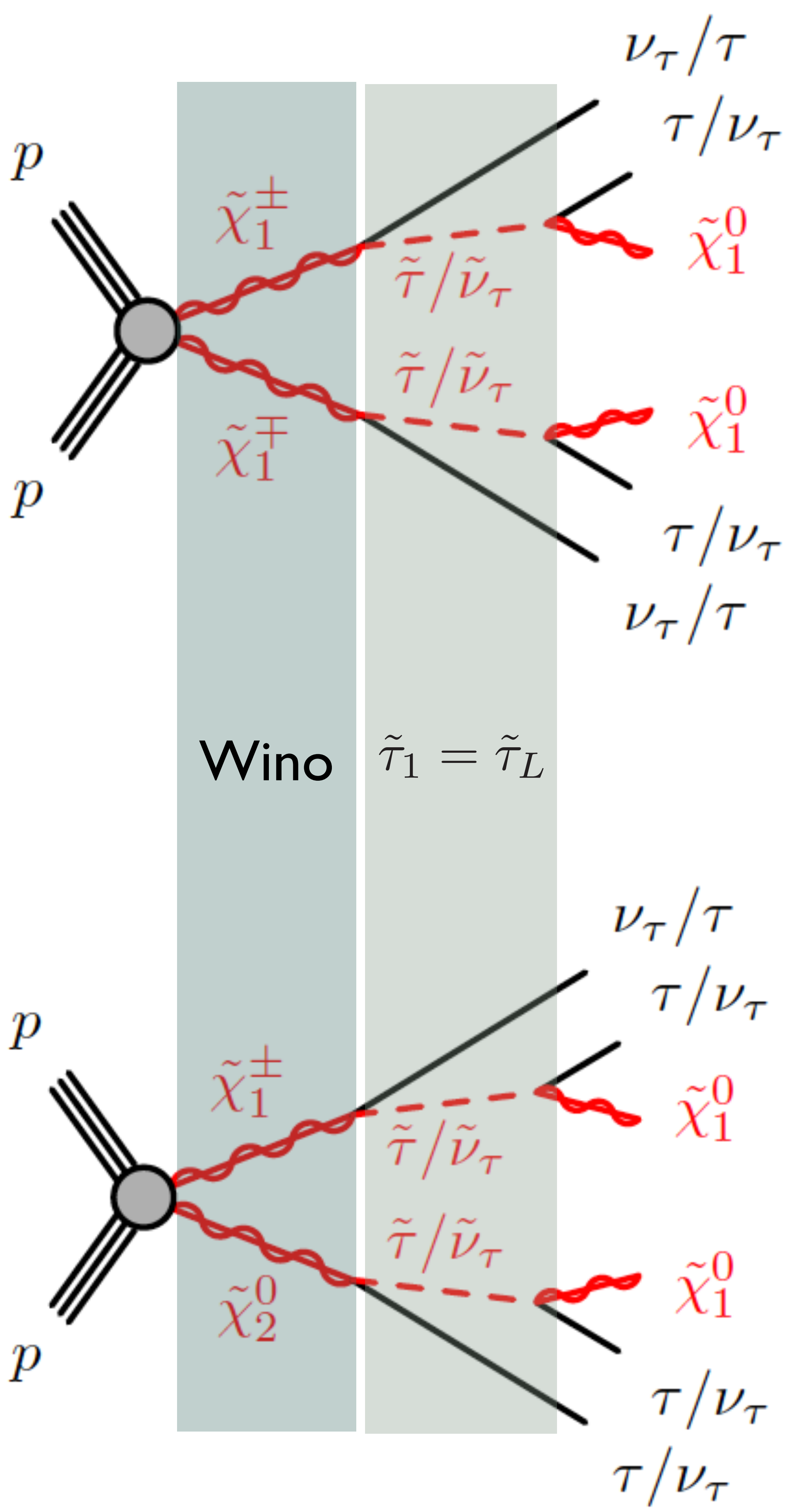






first limit on left/right handed stau non-degenerate

C1N2/C1C1 via staus to taus



$$m_{\tilde{\chi}_2^0} = m_{\tilde{\chi}_1^\pm}$$
$$m_{\tilde{\tau}_L} = m_{\tilde{\chi}_1^0} + x(m_{\tilde{\chi}_1^\pm} - m_{\tilde{\chi}_1^0})$$

SR-lowMass	SR-highMass	
At least one opposite-sign tau pair		
b-jet veto		
Z-veto		
At least two medium tau candidates	At least one medium and one tight tau candidates	
—	$m(\tau_1, \tau_2) > 110$ GeV	
$m_{\mathrm{T2}} > 70$ GeV	$m_{\mathrm{T2}} > 90$ GeV	
Di-tau+$E_{\mathrm{T}}^{\mathrm{miss}}$ trigger	di-tau+$E_{\mathrm{T}}^{\mathrm{miss}}$ trigger	Asymmetric di-tau trigger
$E_{\mathrm{T}}^{\mathrm{miss}} > 150$ GeV	$E_{\mathrm{T}}^{\mathrm{miss}} > 150$ GeV	$E_{\mathrm{T}}^{\mathrm{miss}} > 110$ GeV
$p_{\mathrm{T},\tau_1} > 50$ GeV	$p_{\mathrm{T},\tau_1} > 80$ GeV	$p_{\mathrm{T},\tau_1} > 95$ GeV
$p_{\mathrm{T},\tau_2} > 40$ GeV	$p_{\mathrm{T},\tau_2} > 40$ GeV	$p_{\mathrm{T},\tau_2} > 65$ GeV

real tau lepton backgrounds
MC simulation, validated in validation regions

top | Z+jets | diboson

one fake tau
control region
validation region

W+jets

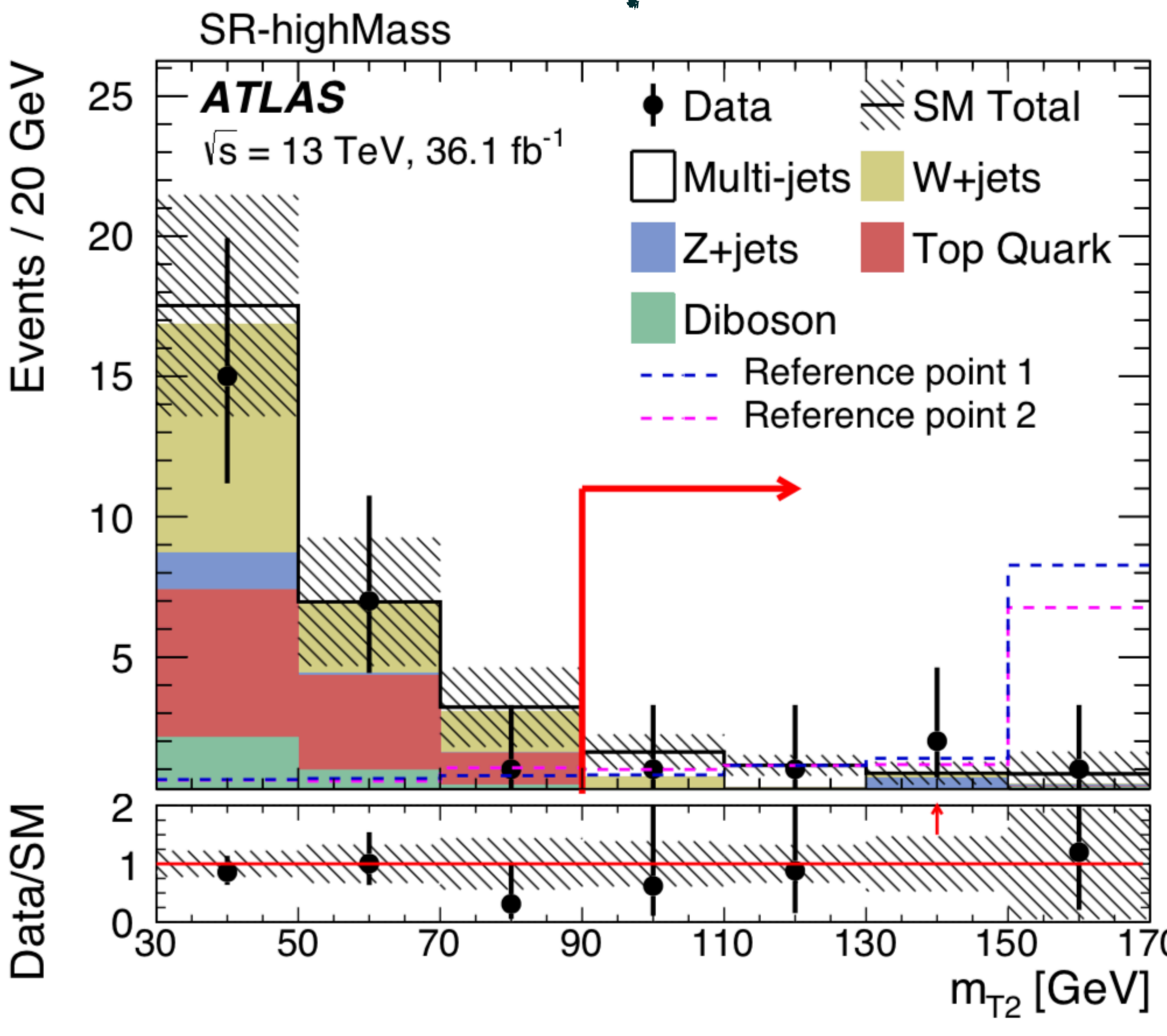
two fake taus
estimated in ABCD method

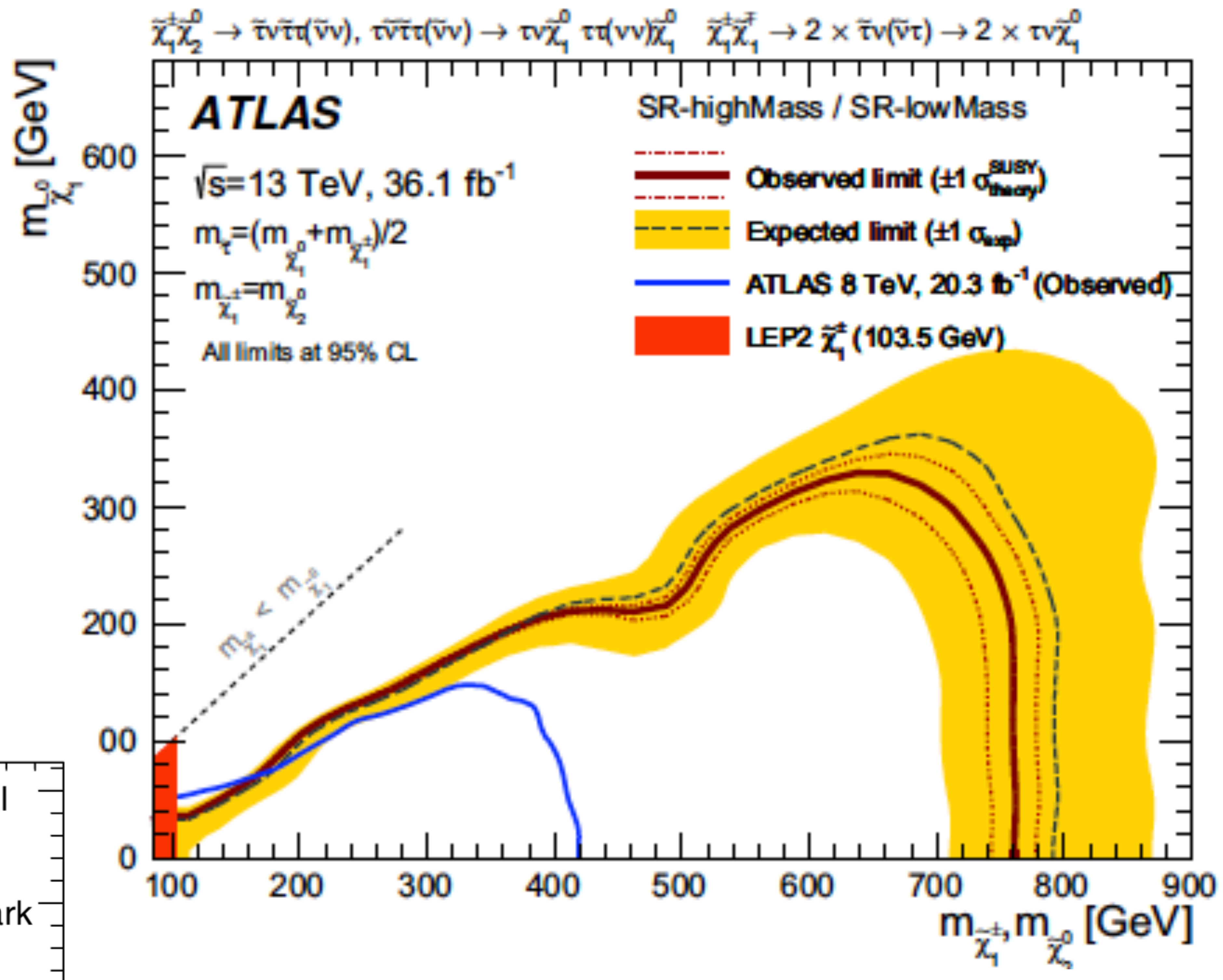
multi-jet

Interpretation

1708.07875

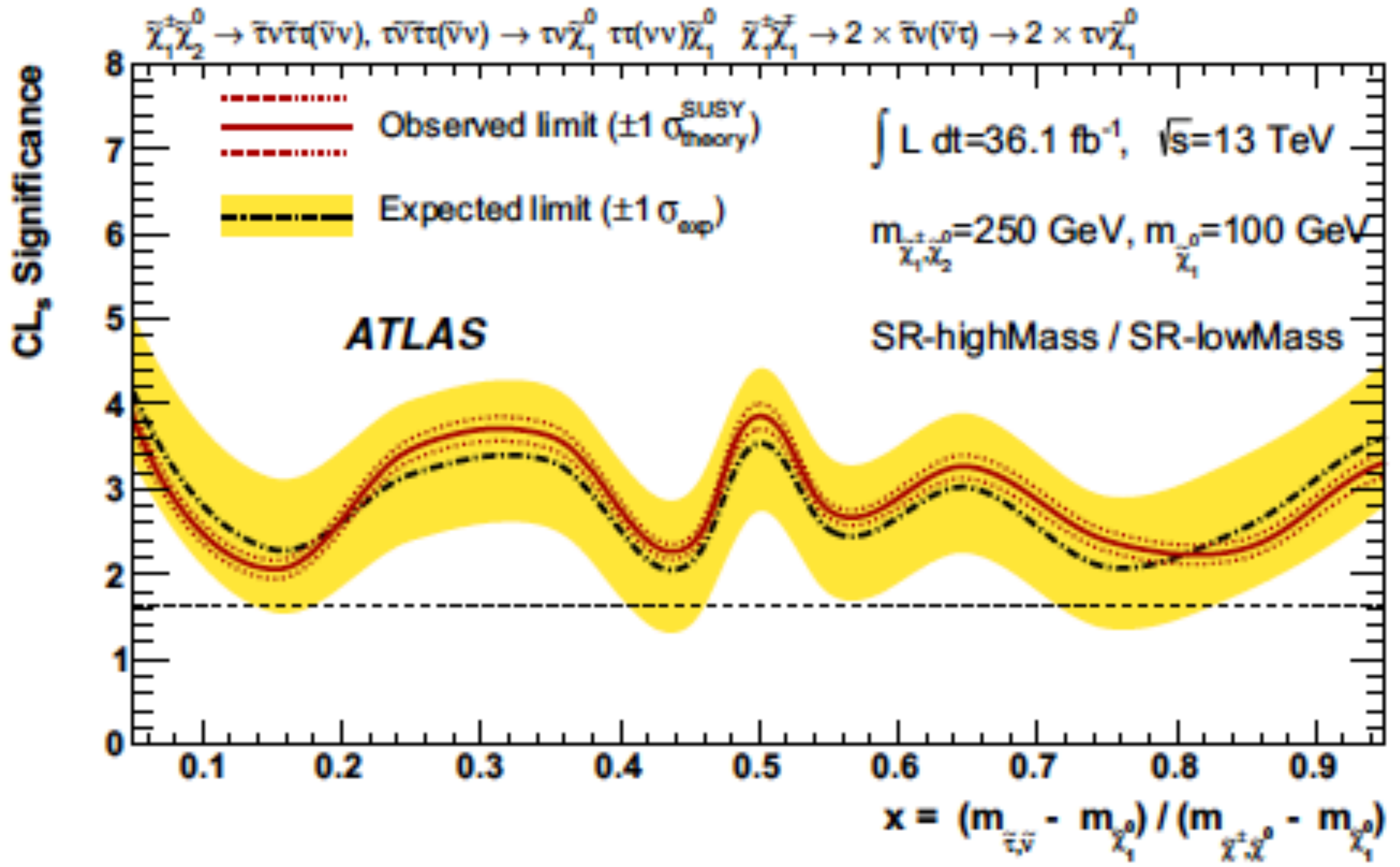
no significant excess





scan over

x



ATLAS Exotics Searches* - 95% CL Upper Exclusion Limits

Status: May 2019

ATLAS Preliminary

$\int \mathcal{L}\, dt = (3.2 - 139)\ \mathrm{fb}^{-1}$ $\sqrt{s} = 8, 13$ 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	1 – 4 j	Yes	36.1	M_D	7.7 TeV $n = 2$	1711.03301
	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 high $\sum p_T$	≥ 1 e, μ	≥ 2 j	–	3.2	M_{th}	8.2 TeV $n = 6$, $M_D = 3$ TeV, rot BH	1606.02265
	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	–	–	36.7	G_{KK} mass	4.1 TeV $k/\overline{M}_{Pl} = 0.1$	1707.04147
	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 $G_{KK} \to WW \to qqqq$	0 e, μ	2 J	–	139	G_{KK} mass	1.6 TeV $k/\overline{M}_{Pl} = 1.0$	ATLAS-CONF-2019-003
	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 $Z' \to tt$	1 e, μ	≥ 1 b, ≥ 1J/2j	Yes	36.1	Z' mass	3.0 TeV $\Gamma/m = 1\%$	1804.10823
	SSM $W' \to \ell\nu$	1 e, μ	–	Yes	139	W' mass	6.0 TeV	CERN-EP-2019-100
	SSM $W' \to \tau\nu$	1 τ	–	Yes	36.1	W' mass	3.7 TeV	1801.06992
	HVT $V' \to WZ \to qqqq$ model B	0 e, μ	2 J	–	139	V' mass	3.6 TeV $g_V = 3$	ATLAS-CONF-2019-003
	HVT $V' \to WH/ZH$ model B	multi-channel			36.1	V' mass	2.93 TeV $g_V = 3$	1712.06518
	LRSM $W_R \to tb$	multi-channel			36.1	W_R mass	3.25 TeV	1807.10473
	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	–	–	36.1	Λ	40.0 TeV η_{LL}^-	1707.02424
	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 mediator (Dirac DM)	0 e, μ	1 – 4 j	Yes	36.1	m_{med}	1.55 TeV g_q=0.25, g_χ=1.0, $m(\chi) = 1$ GeV	1711.03301
	Colored scalar mediator (Dirac DM)	0 e, μ	1 – 4 j	Yes	36.1	m_{med}	1.67 TeV g=1.0, $m(\chi) = 1$ GeV	1711.03301
	$VV\chi\chi$ EFT (Dirac DM)	0 e, μ	1 J, ≤ 1 j	Yes	3.2	M_*	700 GeV $m(\chi) < 150$ GeV	1608.02372
	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 $y = 0.4$, $\lambda = 0.2$, $m(\chi) = 10$ GeV	1812.09743
LQ	Scalar LQ 1st gen	1,2 e	≥ 2 j	Yes	36.1	LQ mass	1.4 TeV $\beta = 1$	1902.00377
	Scalar LQ 2nd gen	1,2 μ	≥ 2 j	Yes	36.1	LQ mass	1.56 TeV $\beta = 1$	1902.00377
	Scalar LQ 3rd gen	2 τ	2 b	–	36.1	LQ_3^u mass	1.03 TeV $\mathcal{B}(LQ_3^u \to b\tau) = 1$	1902.08103
	Scalar LQ 3rd gen	0-1 e, μ	2 b	Yes	36.1	LQ_3^d mass	970 GeV $\mathcal{B}(LQ_3^d \to t\tau) = 0$	1902.08103
Heavy quarks	VLQ $TT \to Ht/Zt/Wb + X$	multi-channel			36.1	T mass	1.37 TeV SU(2) doublet	1808.02343
	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 $Y \to Wb + X$	1 e, μ	≥ 1 b, ≥ 1j	Yes	36.1	Y mass	1.85 TeV $\mathcal{B}(Y \to Wb)$= 1, $c_R(Wb)$= 1	1812.07343
	VLQ $B \to Hb + X$	0 e,μ, 2 γ	≥ 1 b, ≥ 1j	Yes	79.8	B mass	1.21 TeV κ_B= 0.5	ATLAS-CONF-2018-024
	VLQ $QQ \to WqWq$	1 e, μ	≥ 4 j	Yes	20.3	Q mass	690 GeV	1509.04261
Excited fermions	Excited quark $q^* \to qg$	–	2 j	–	139	q^* mass	6.7 TeV only u^* and d^*, $\Lambda = m(q^*)$	ATLAS-CONF-2019-007
	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	1 e, μ	≥ 2 j	Yes	79.8	N^0 mass	560 GeV	ATLAS-CONF-2018-020
	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 $H^{\pm\pm} \to \ell\ell$	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

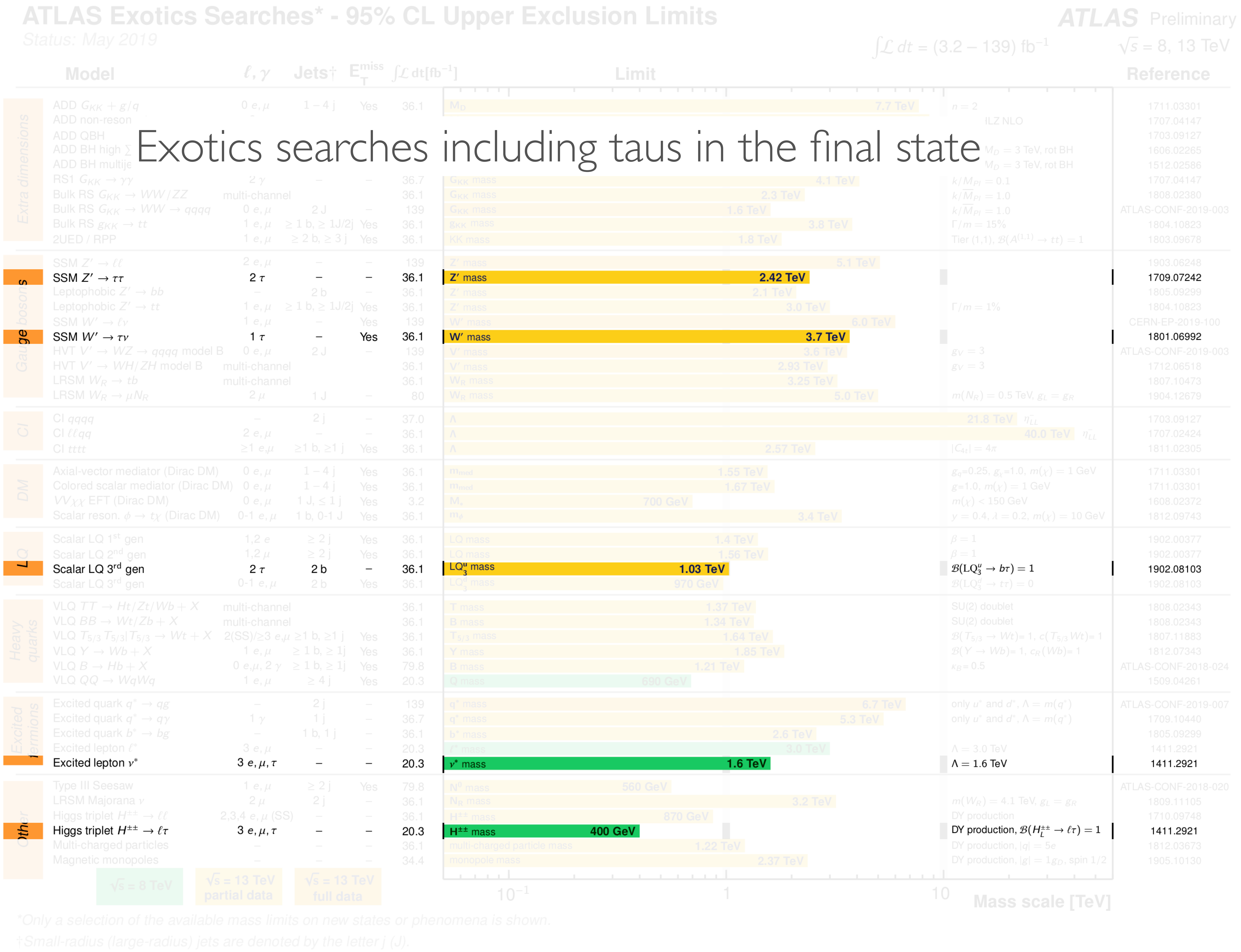
$\sqrt{s}$ = 8 TeV · $\sqrt{s}$ = 13 TeV partial data · $\sqrt{s}$ = 13 TeV full data

Mass scale [TeV]: 10^{-1}, 1, 10

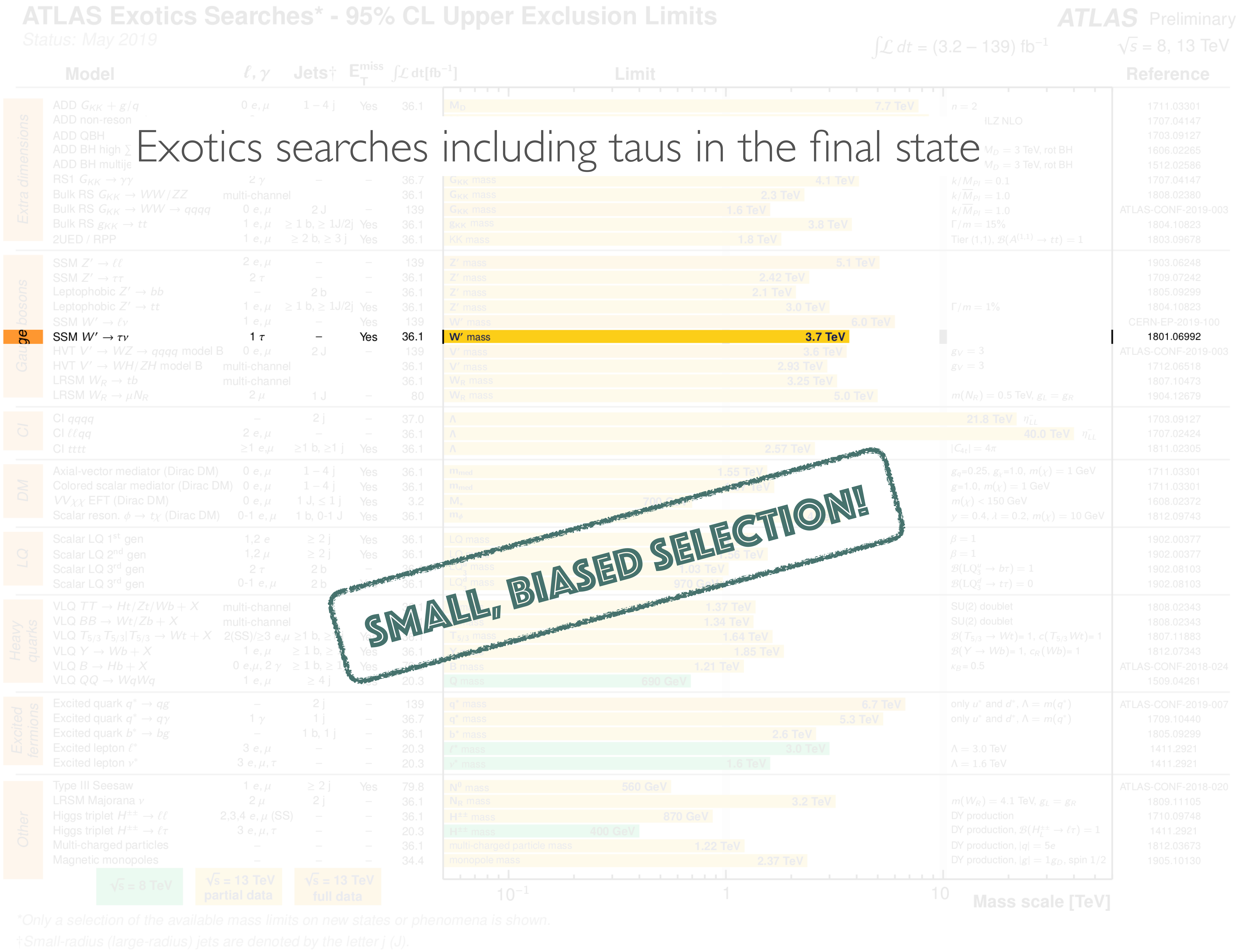
*Only a selection of the available mass limits on new states or phenomena is shown.

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

Exotics searches including taus in the final state



Exotics searches including taus in the final state



Exotic searches with taus - W'

1801.06992

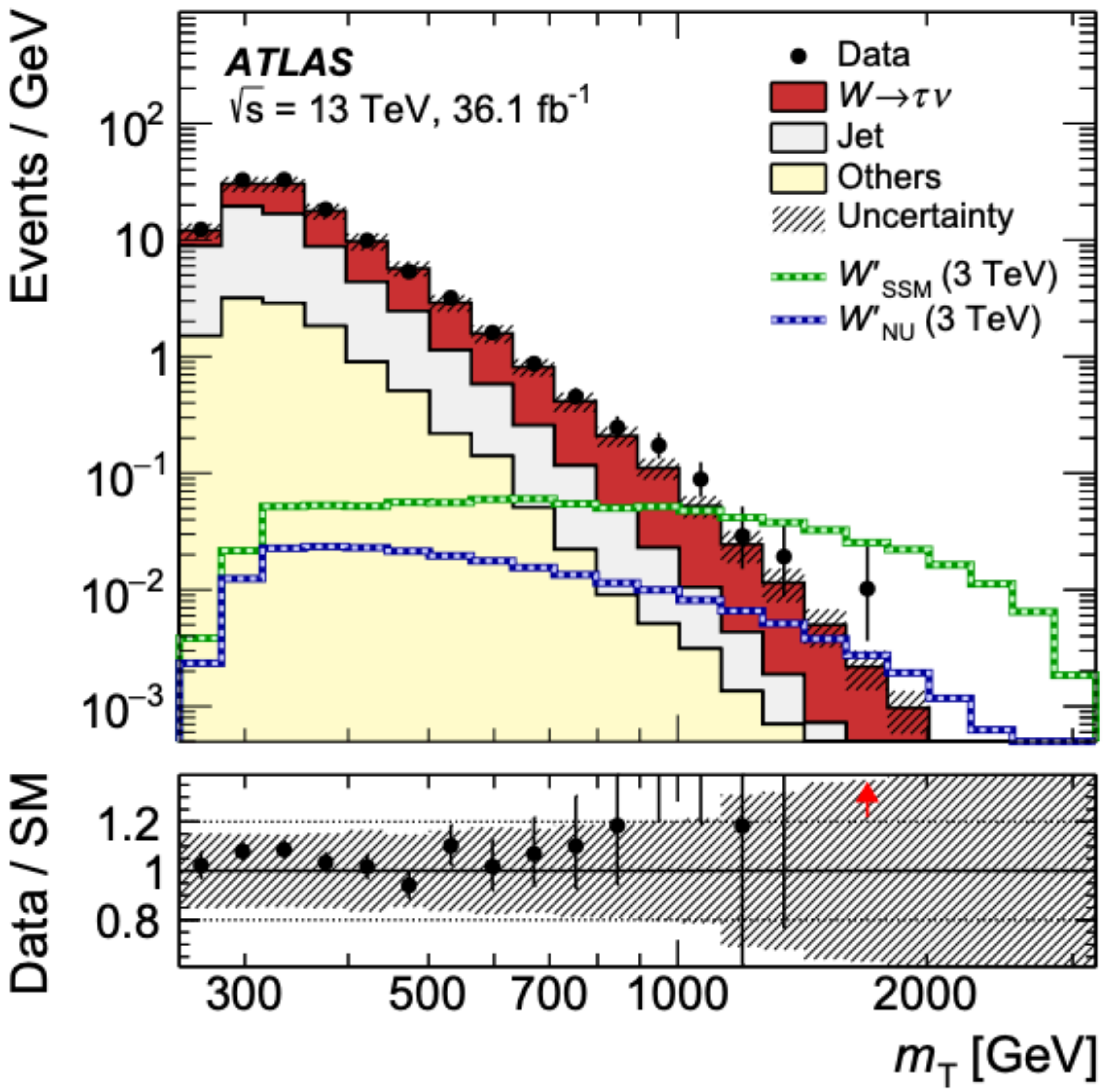
final state with **one** hadronically decaying tau, missing transverse energy

$$m_T^2 \equiv 2p_T^\tau E_T^{\text{miss}}(1 - \cos\Delta\phi)$$

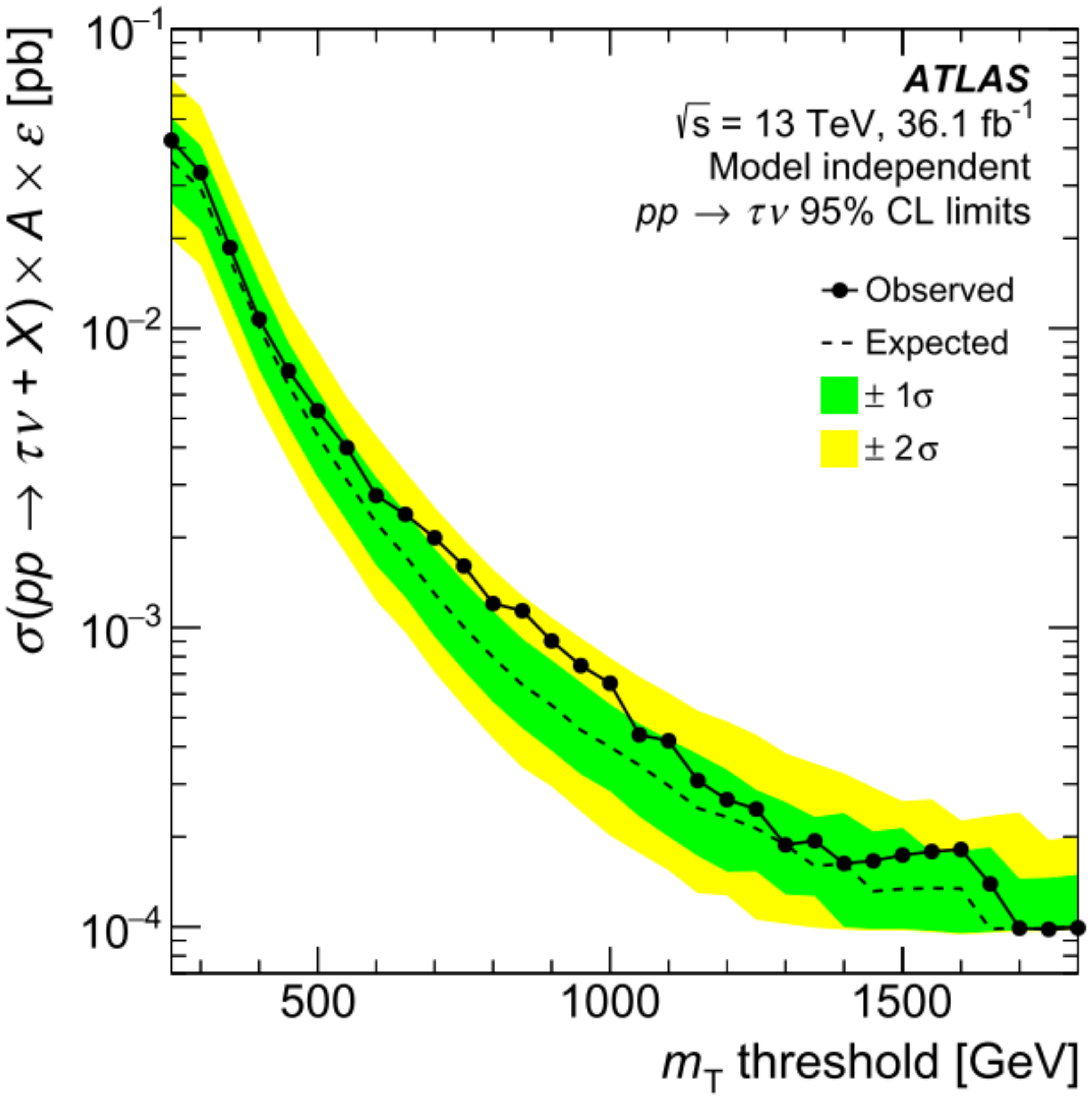
$W \rightarrow \tau\nu$, estimated from MC

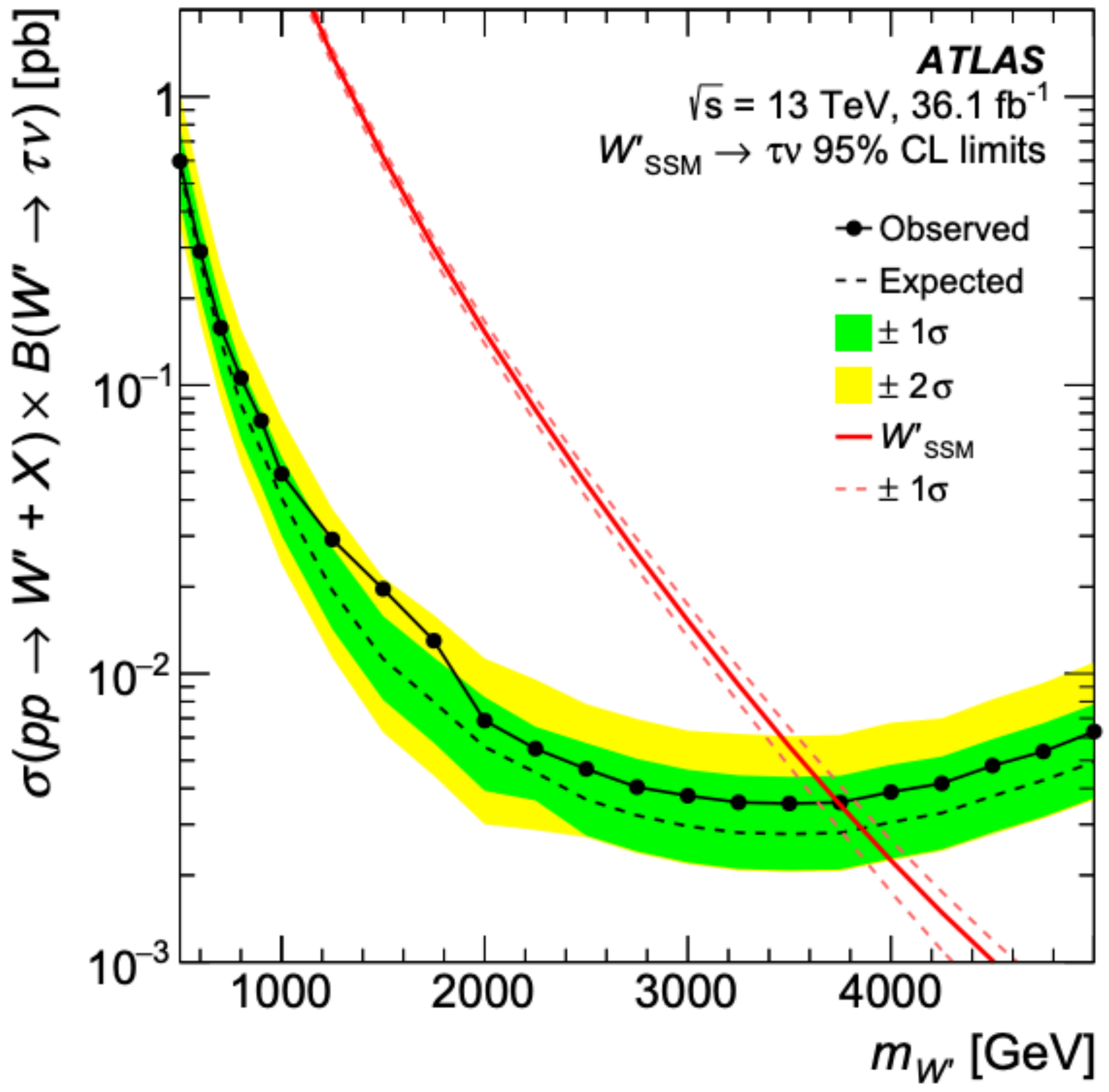
Jet background (taus faked from q/g jet)
data driven estimation

'Others' (diboson, top, .)



Exotic searches with taus - W'





model independent upper limit → model dependent limit

Conclusions

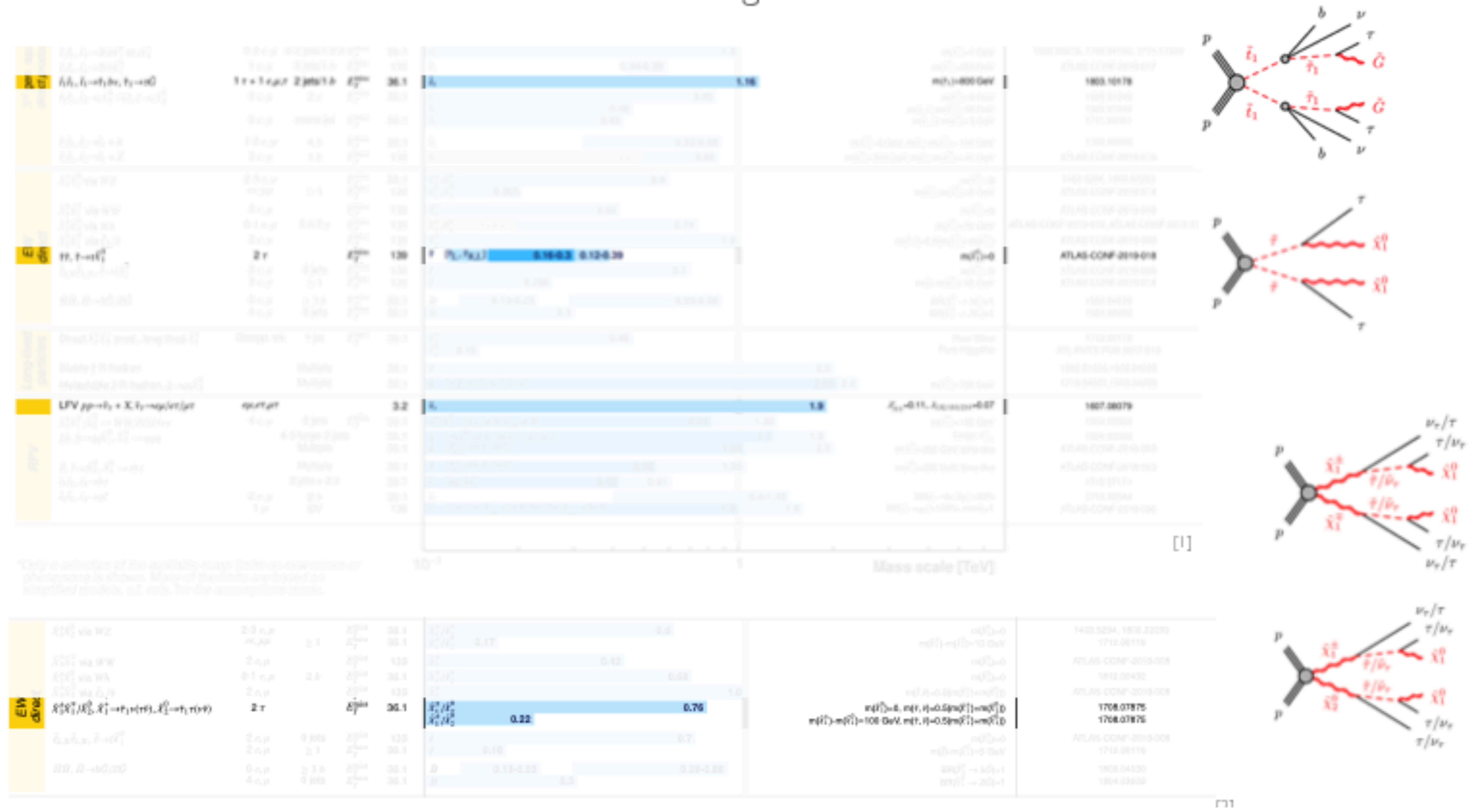
taus present challenging final states in ATLAS

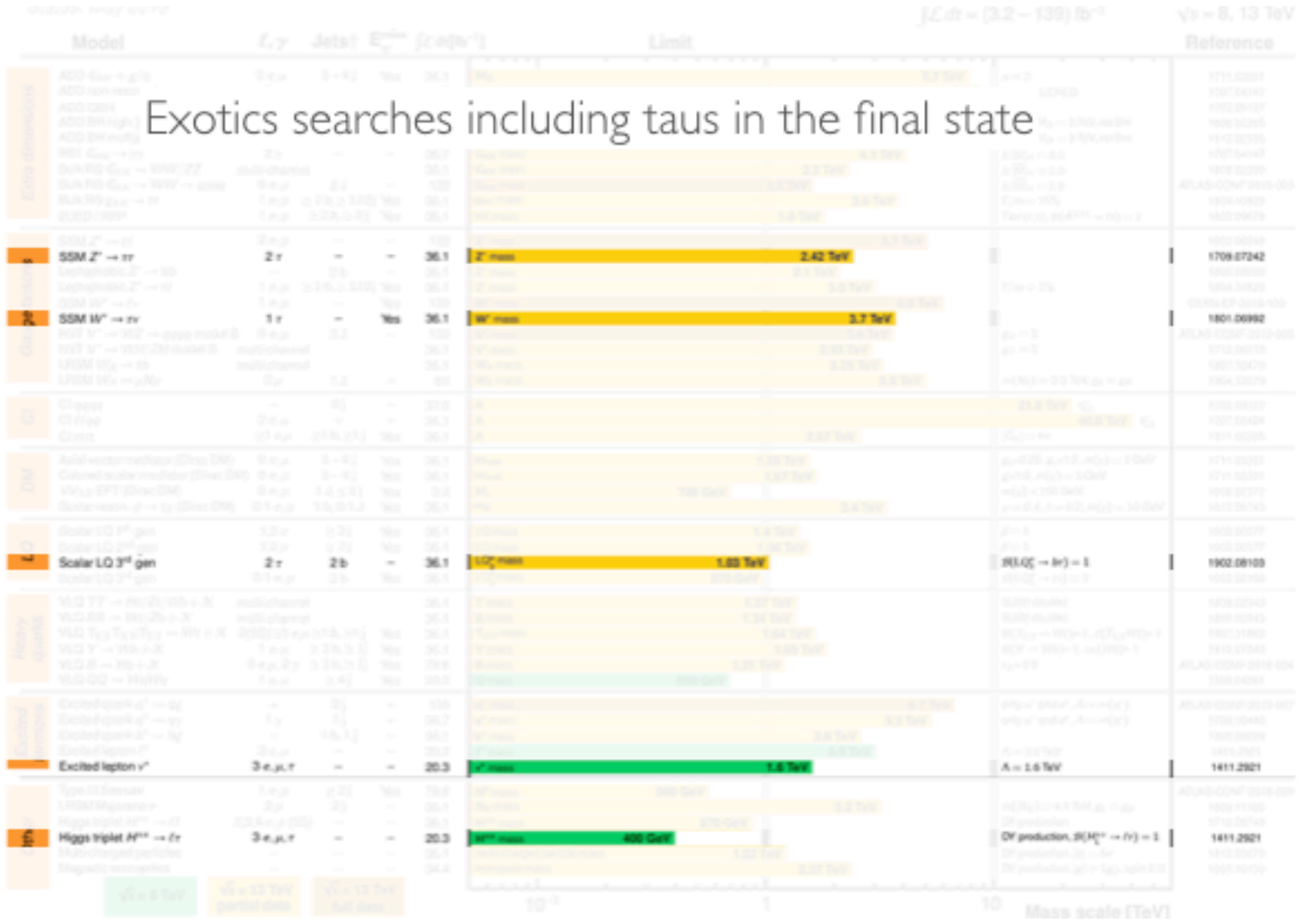
ongoing SUSY searches for stau productions leading to taus in final state

several efforts in exotics including tauonic final states

still room for many more analyses

SUSY searches including taus in the final state





Exotics searches including taus in the final state

References

[1] Mass reach of the ATLAS searches for Supersymmetry. https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PUBNOTES/ATL-PHYS-PUB-2019-022/fig_23.png

[2] Mass reach of the ATLAS searches for Supersymmetry. , March 2019 https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CombinedSummaryPlots/SUSY/ATLAS_SUSY_Summary/ATLAS_SUSY_Summary_201903.pdf

[3]Reach of ATLAS searches for new phenomena other than Supersymmetry https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CombinedSummaryPlots/EXOTICS/ATLAS_Exotics_Summary/ATLAS_Exotics_Summary.png