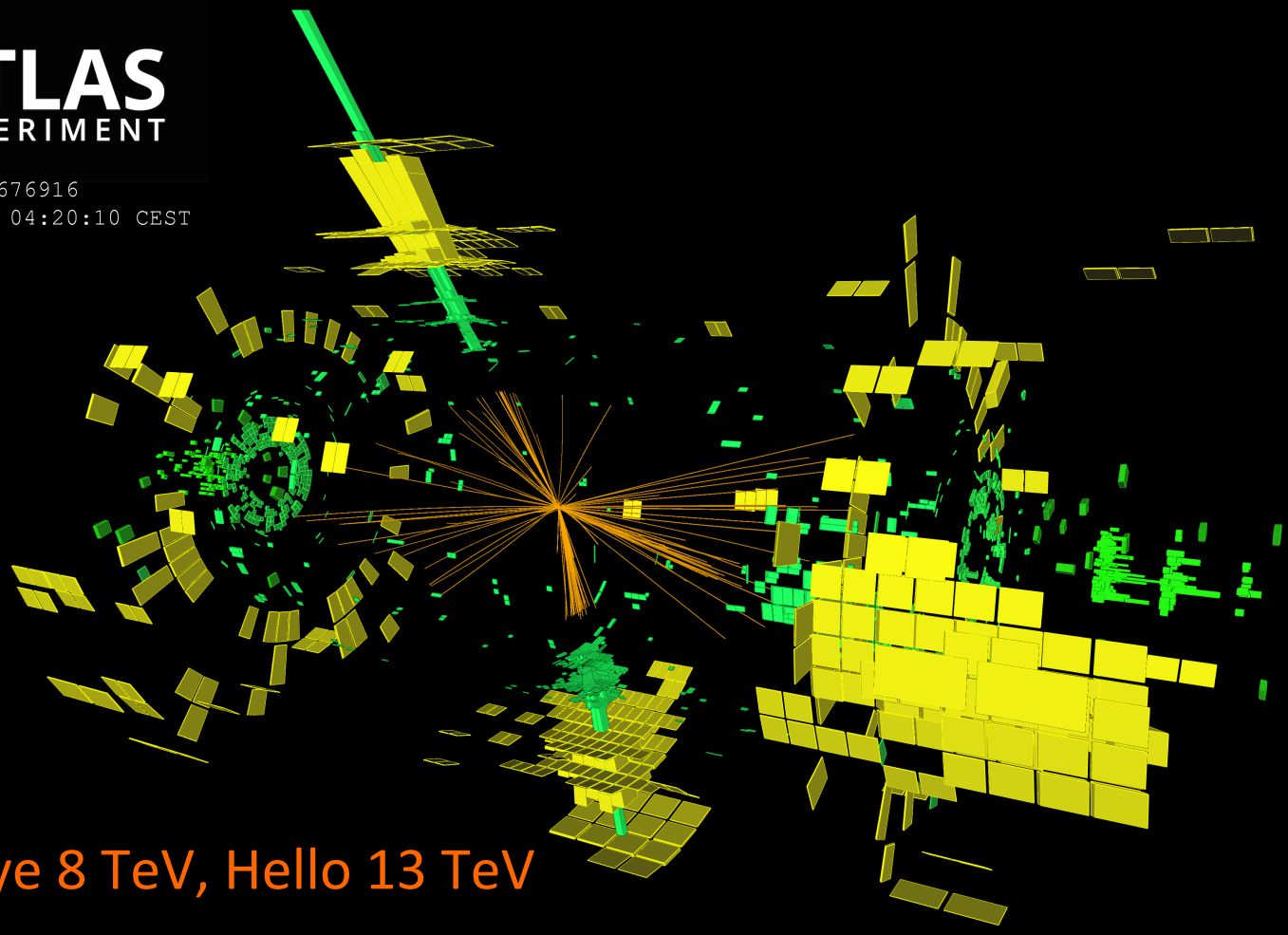
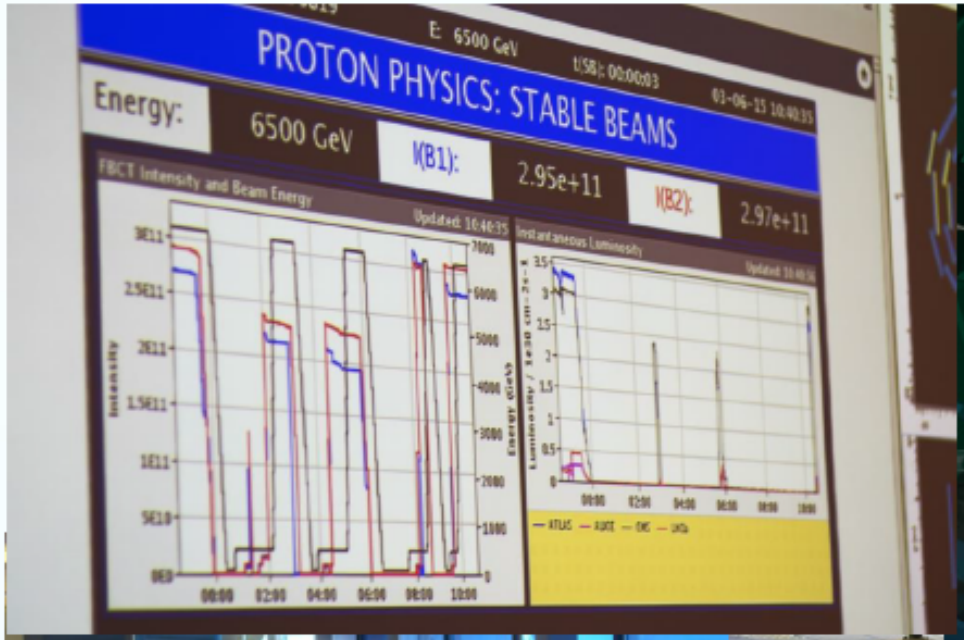
Searches for New Particles with the ATLAS Experiment

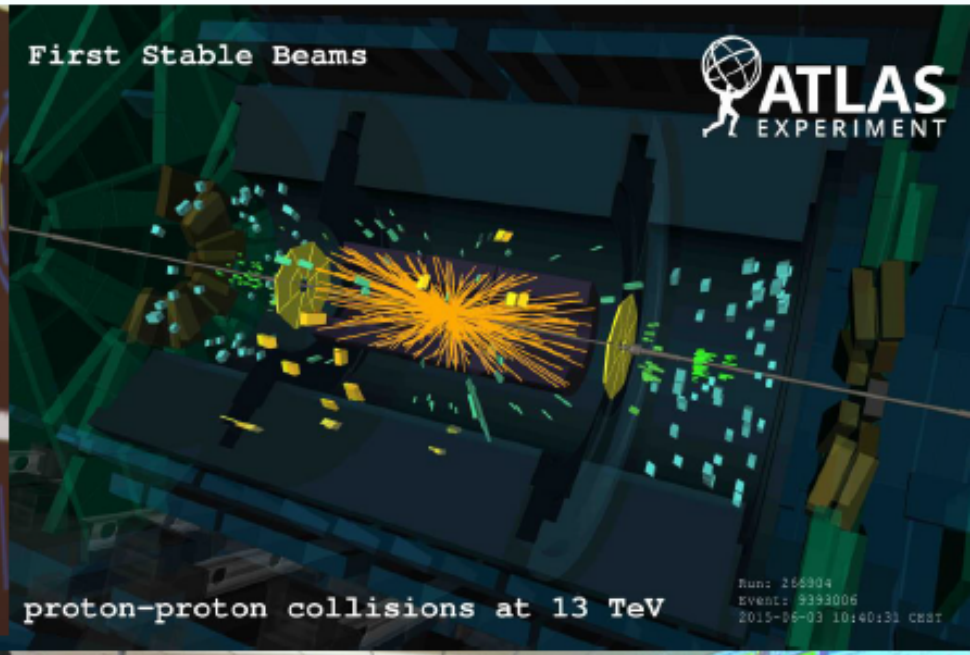


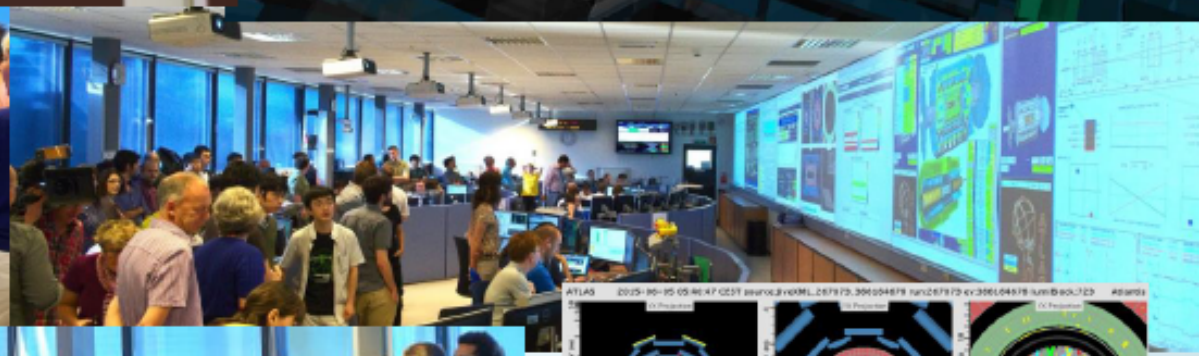
Goodbye 8 TeV, Hello 13 TeV

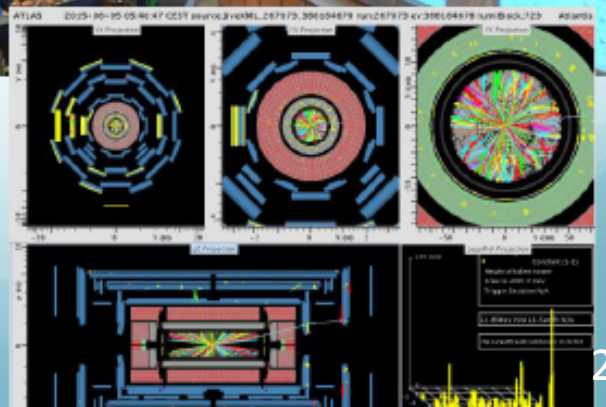
Paul de Jong, Nikhef
On behalf of the ATLAS Collaboration
Kavli-IPMU-Durham-KIAS Workshop Tokyo

June 3, 2015: first stable beams at 13 TeV

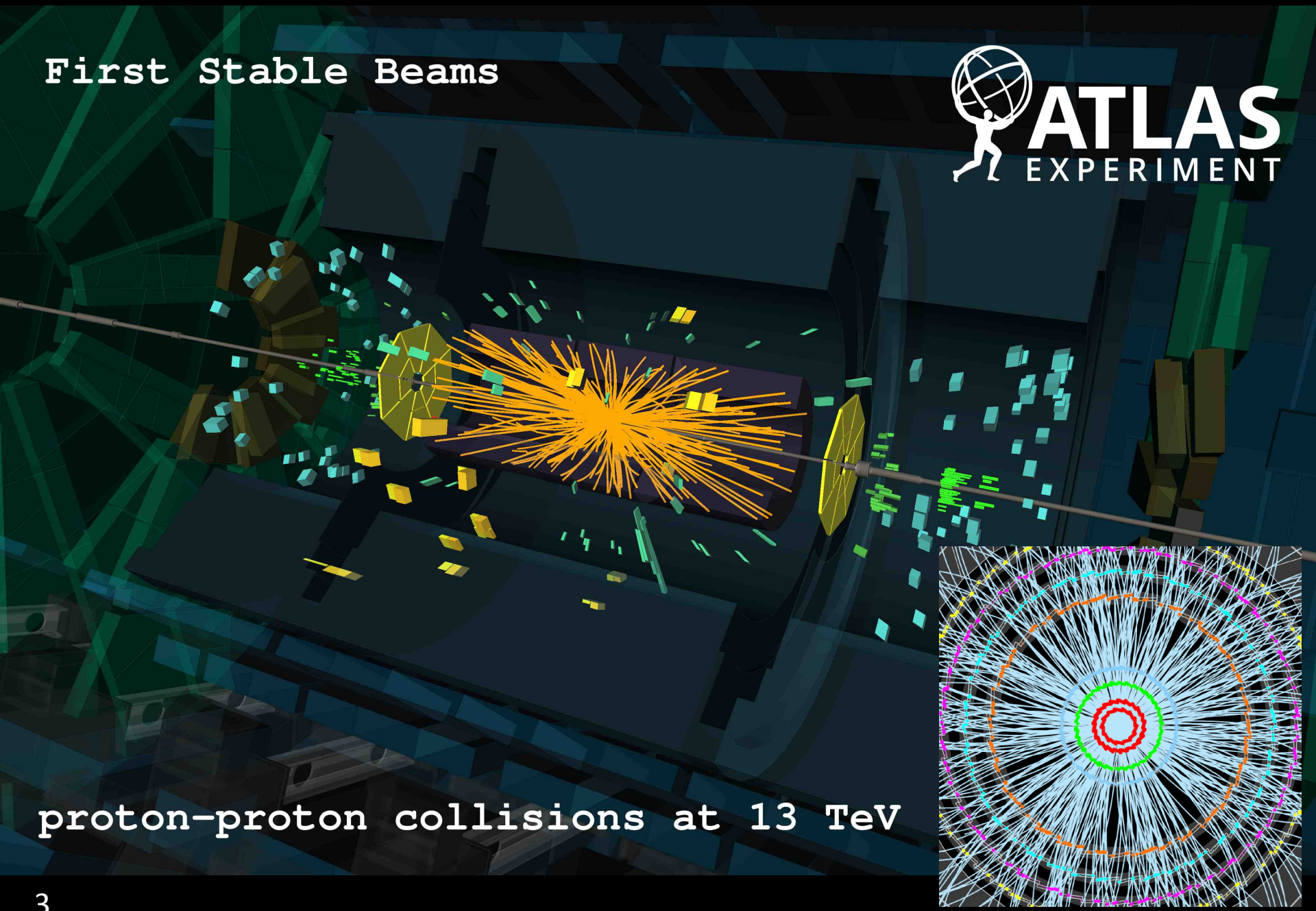








First Stable Beams



proton–proton collisions at 13 TeV

Outline of the talk

ATLAS detector activities in long shutdown

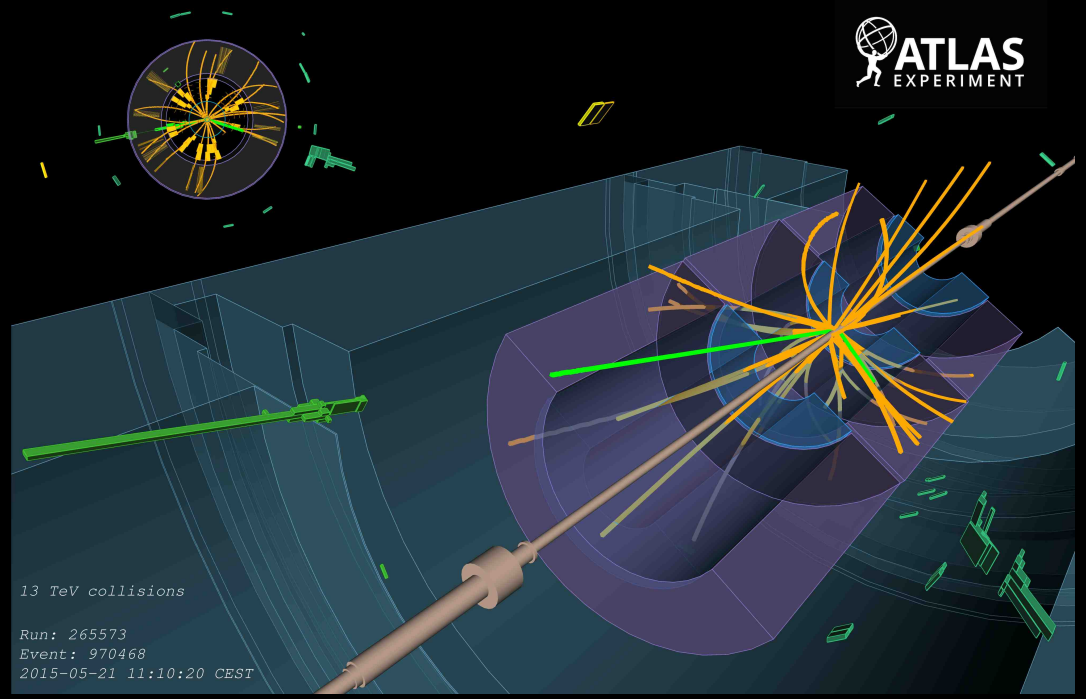
Wrapping up 8 TeV physics analyses

LHC and ATLAS performance 2015

Early 13 TeV measurements

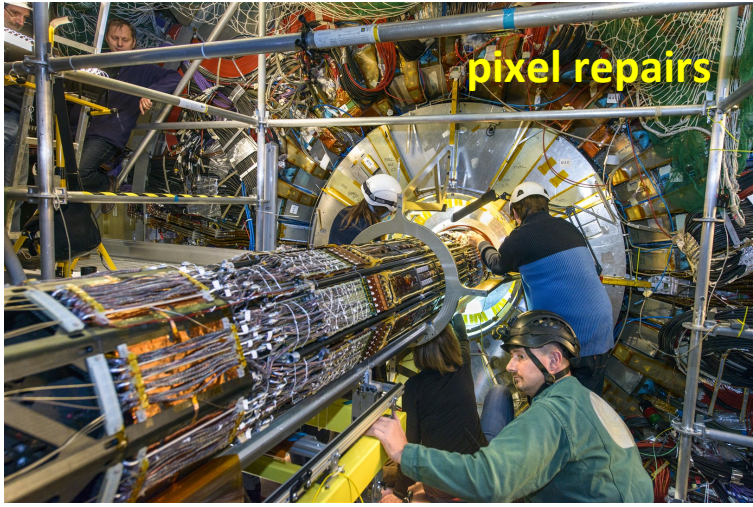
First 13 TeV searches

Outlook



2013-2015: Detector consolidations and repair

beam pipe, pixels, calorimeter, muon chambers
new luminosity detector
new minimum bias scintillators

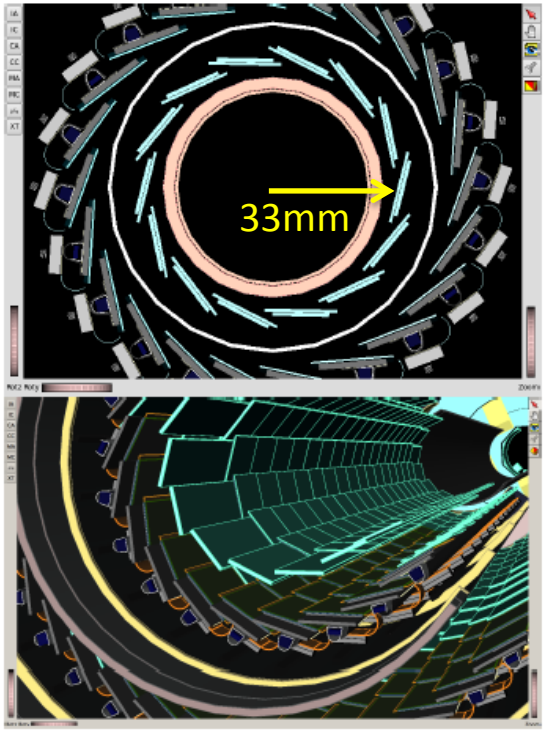


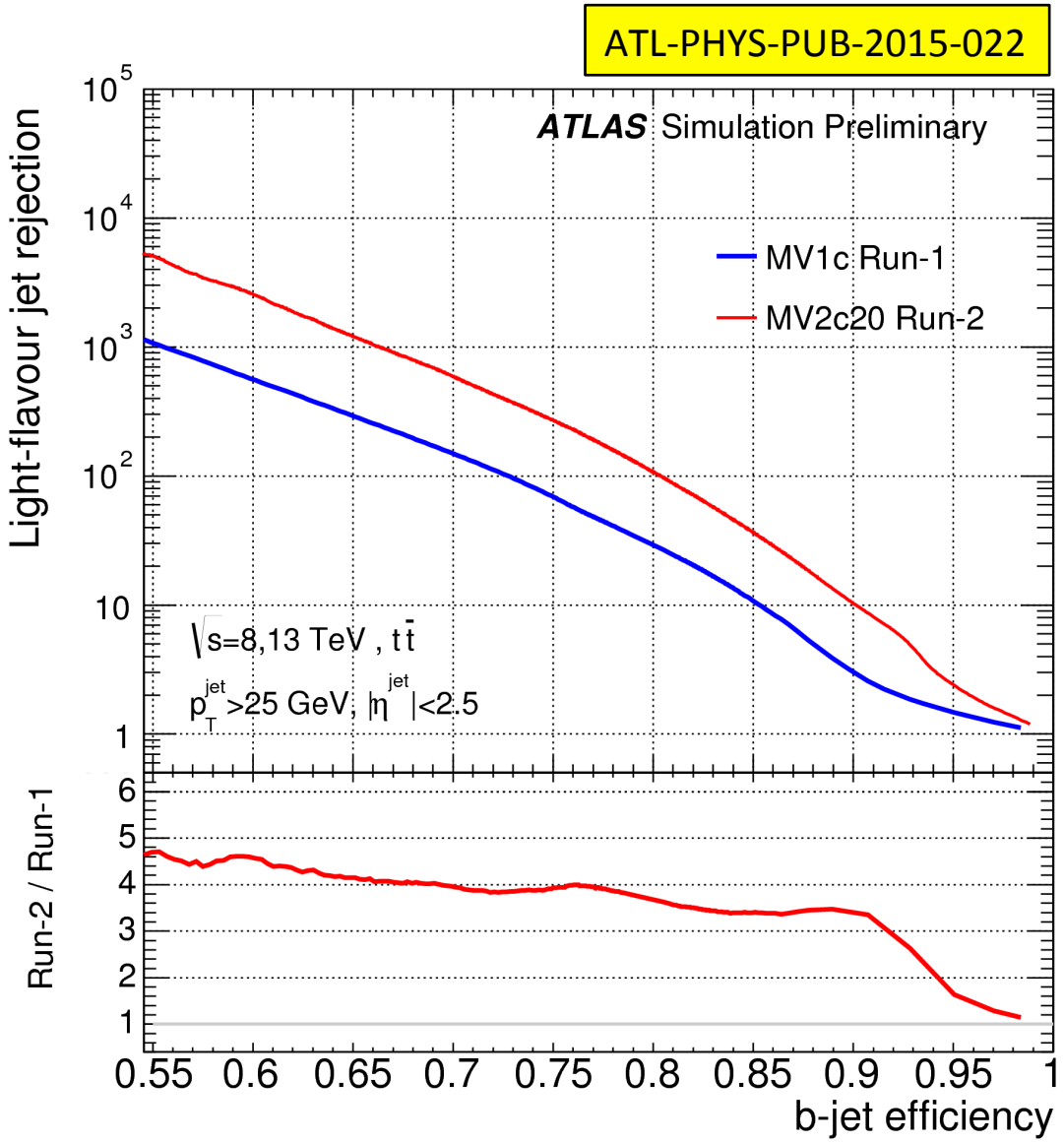
ATLAS Run-2 Detector Status (from Apr. 2015)

Subdetector	Number of Channels	Approximate Operational Fraction
Pixels	92 M	99.0%
SCT Silicon Strips	6.3 M	98.9%
TRT Transition Radiation Tracker	350 k	97.3%
LAr EM Calorimeter	170 k	100%
Tile calorimeter	4900	99.2%
Hadronic endcap LAr calorimeter	5600	99.6%
Forward LAr calorimeter	3500	99.8%
LVL1 Calo trigger	7160	100%
LVL1 Muon RPC trigger	370 k	98.7%
LVL1 Muon TGC trigger	320 k	100%
MDT Muon Drift Tubes	357 k	99.8%
CSC Cathode Strip Chambers	31 k	98.4%
RPC Barrel Muon Chambers	370 k	97.1%
TGC Endcap Muon Chambers	320 k	99.8%

95.0% in 2012

New inner layer of pixel detector: IBL





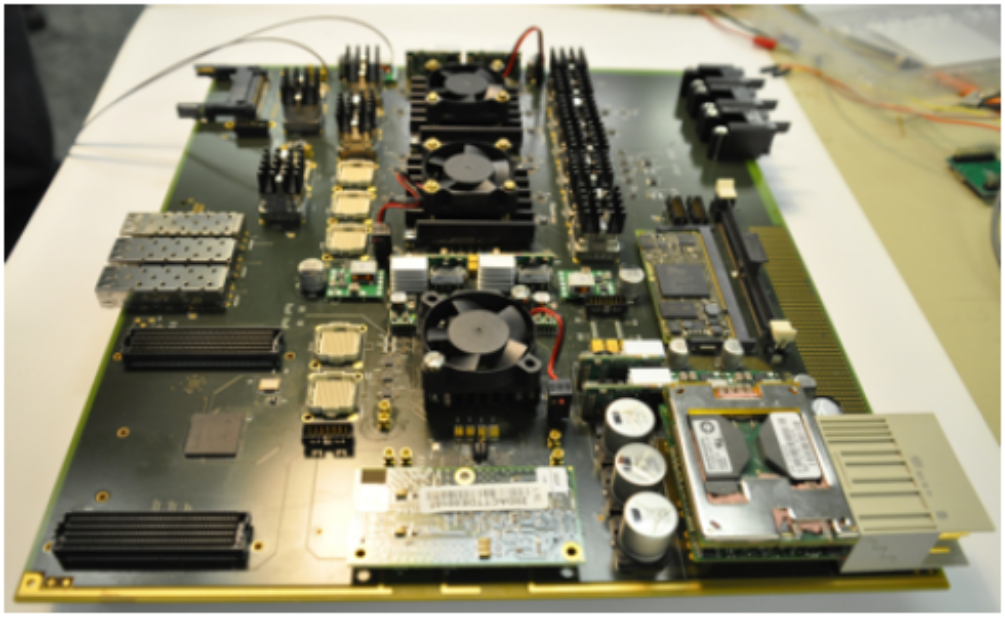
Trigger and Software

Reorganization of high-level-trigger
New central trigger processor
New topological level-1 trigger

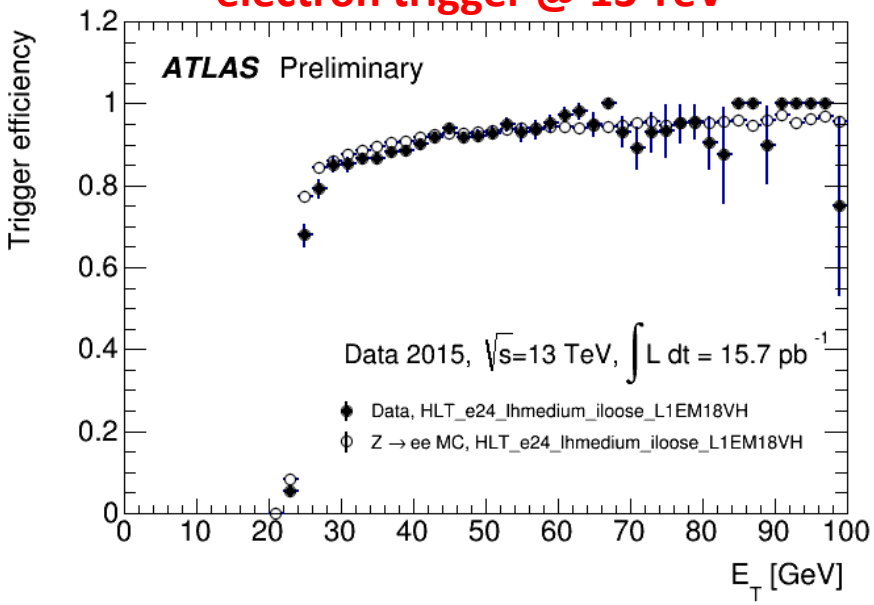
Ready for 100 kHz level-1 accept
1 kHz event rate to disk

Software upgrades for analysis

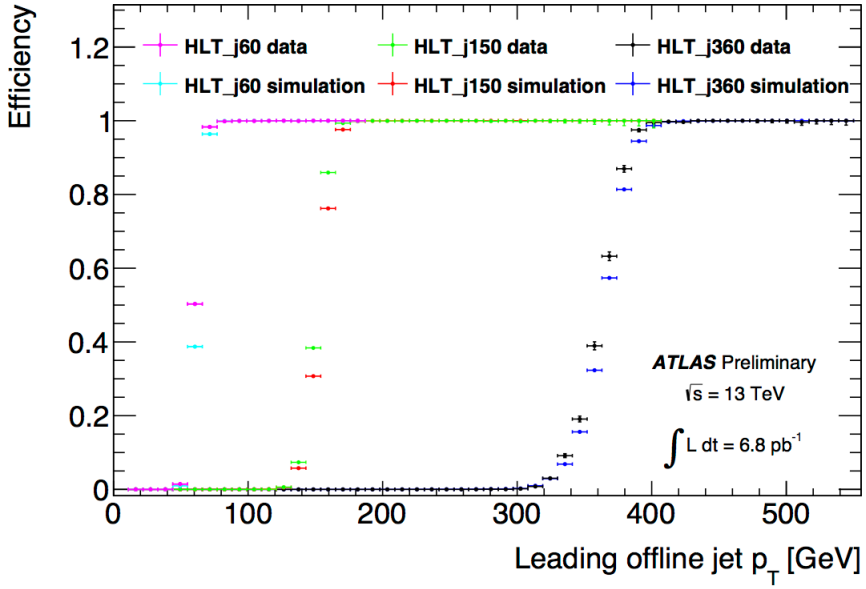
L1TOPO board



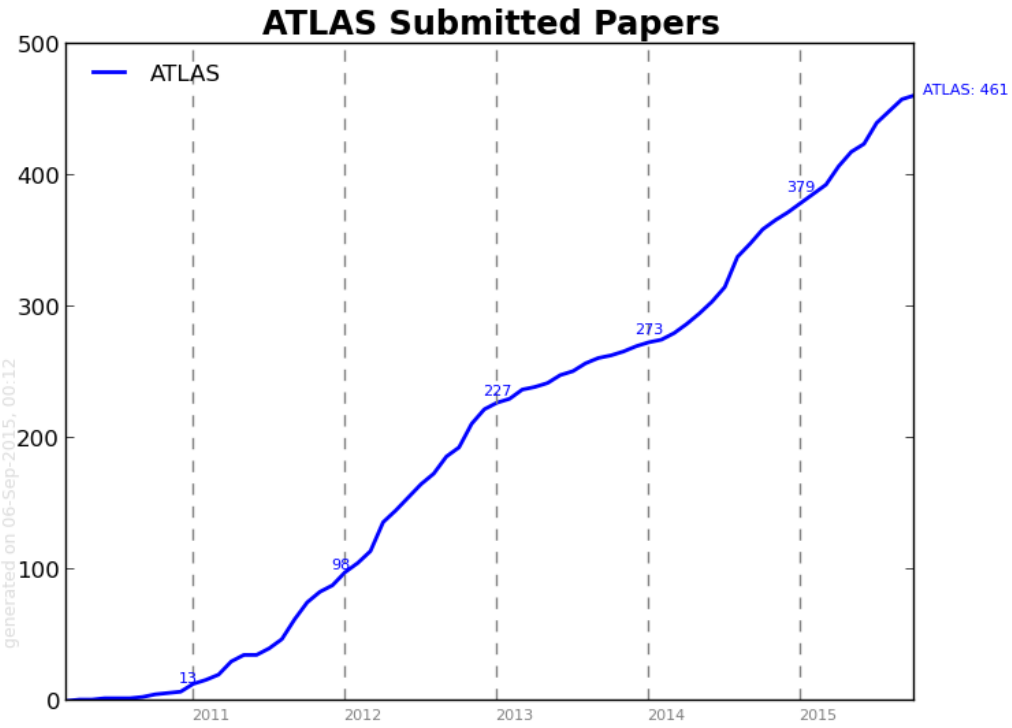
electron trigger @ 13 TeV

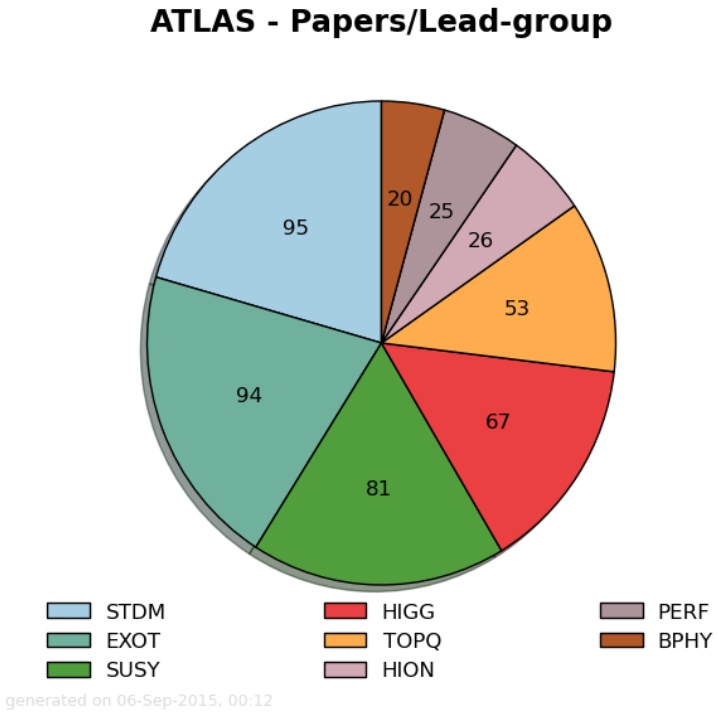


jet trigger @ 13 TeV



and wrapping up on the 8 TeV results



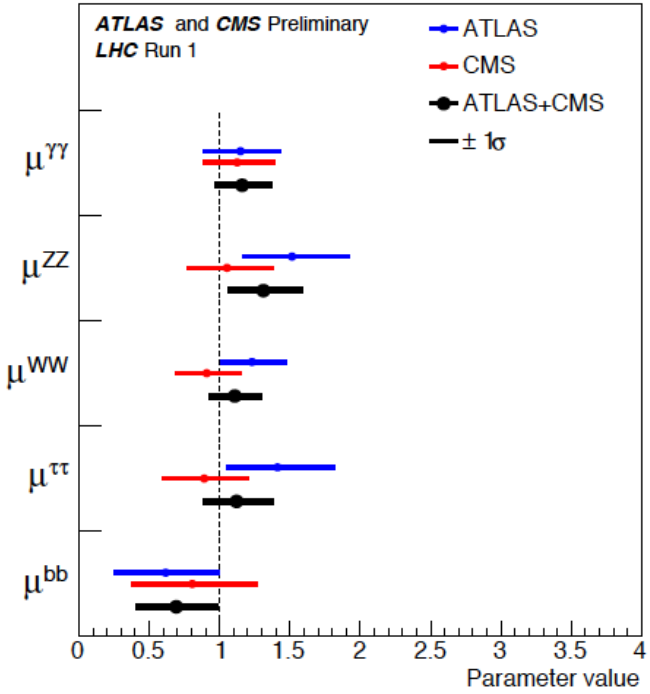


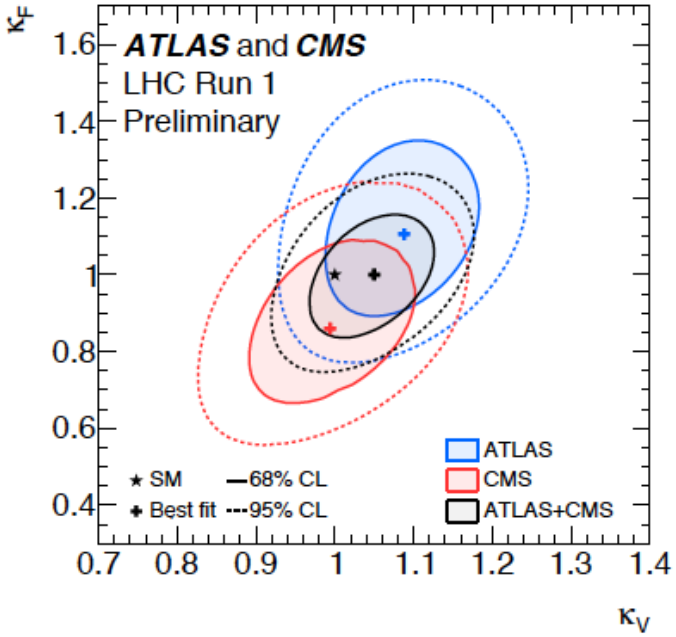
> 80 papers on Run-1 data published in 2015 so far.

Legacy papers on Higgs boson properties, EW and QCD measurements
Many results on top quark properties
Summary papers on Run-1 supersymmetry searches
Broad coverage of many new physics searches
and much more…

Higgs results in the last 5 months

- ATLAS + CMS couplings combination
- BSM constraints from H couplings
- High mass H→WW, H→ZZ
- VBF H(→invisible)
- LFV H→μτ
- Decay rates and couplings
- Associated (W/Z)H, H→WW
- ttH (multilepton final states)
- Higgs spin and parity
- mono-Higgs (H→γγ)
- differential cross section H→γγ + H→ZZ
- Associated (W/Z)H, H→invisible
- ATLAS + CMS Higgs mass combination





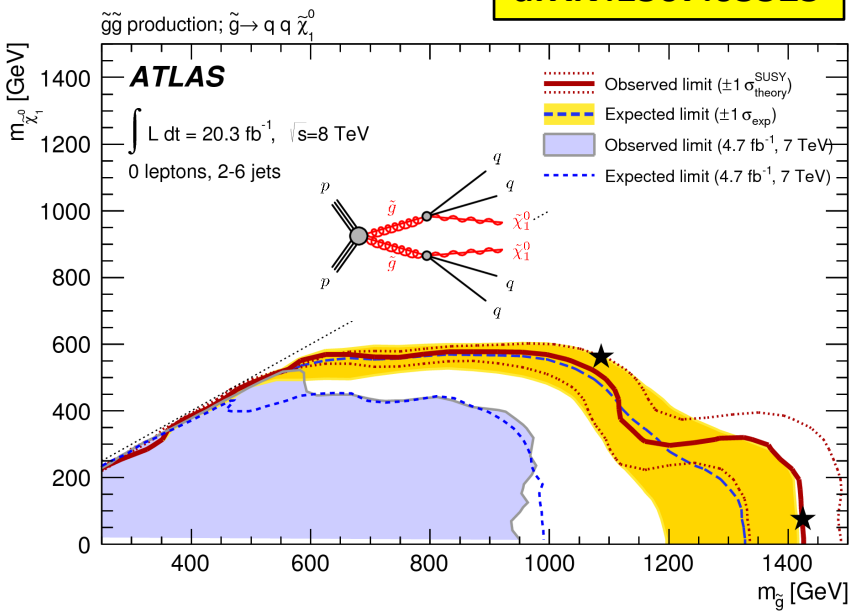
Summary publications on Run-1 supersymmetry searches by ATLAS

Simplified model interpretations: factorize model in 1 or a few production/decay modes
Vary all relevant parameters, optimize sensitivity for different kinematics
Assumes decoupling of all other masses

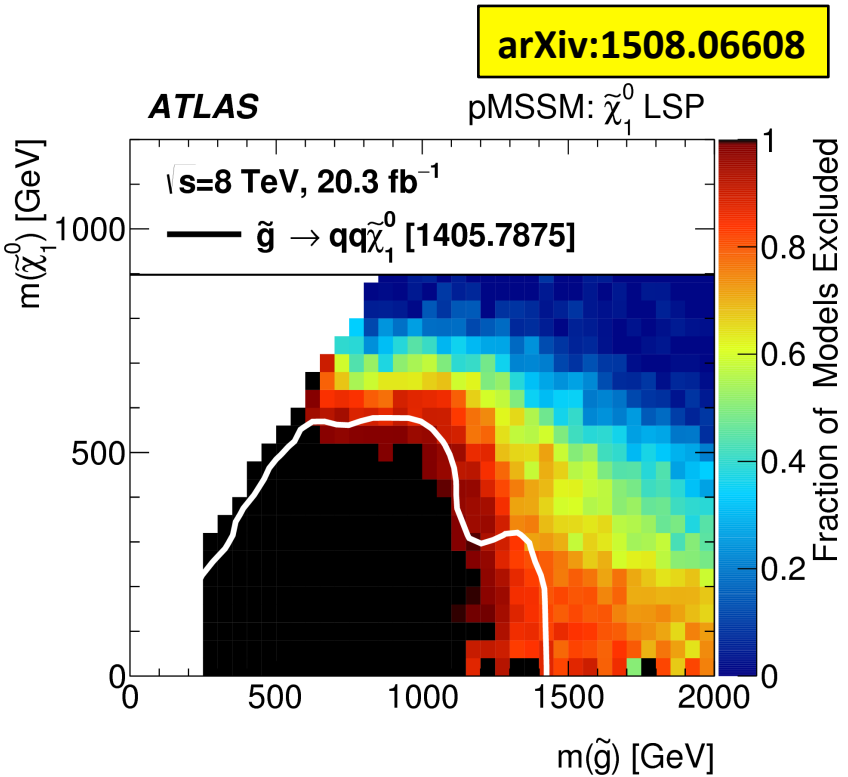
Alternative: **scan phenomenological MSSM** (19 parameters)
Generate 5x10^8 model points, apply experimental constraints (e.g. dark matter)
Simulate ATLAS response of 310000 model points, apply 22 ATLAS SUSY searches
Mixes different production/decay modes

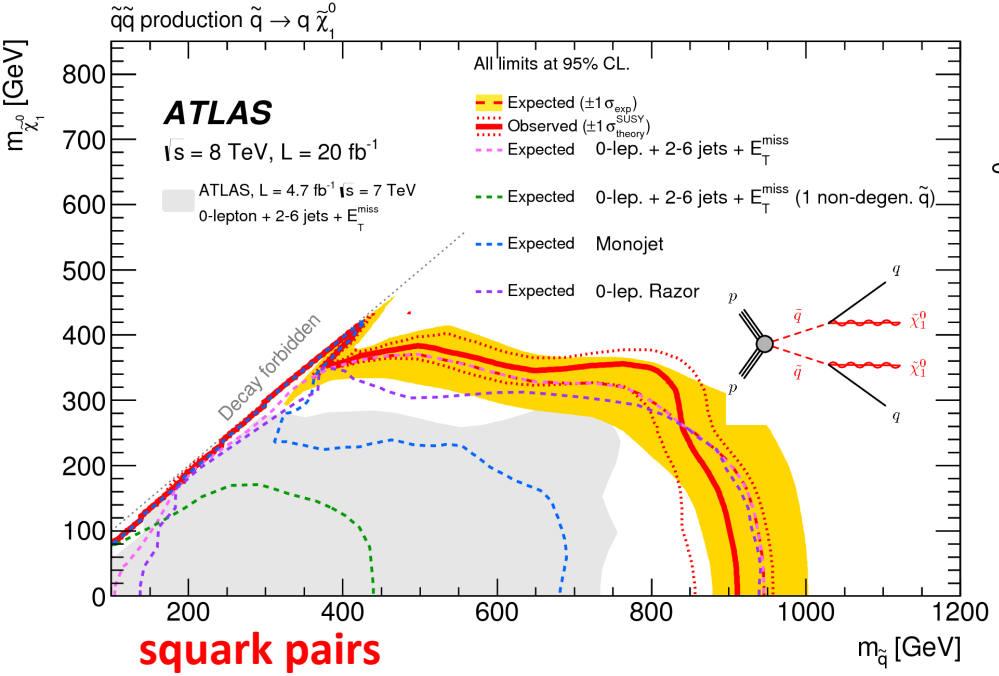
gluino pairs

arXiv:1507.05525

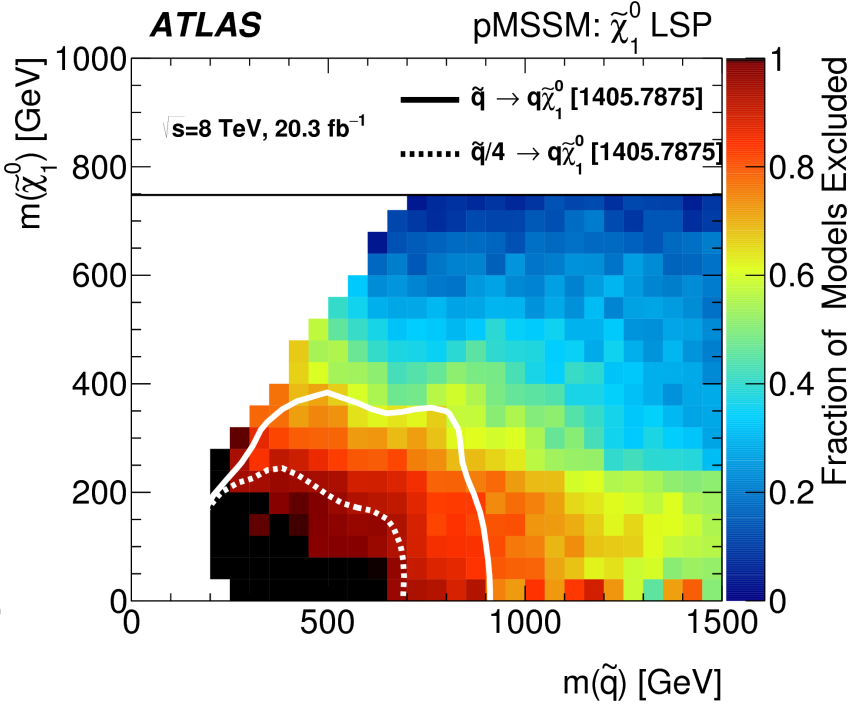


arXiv:1508.06608



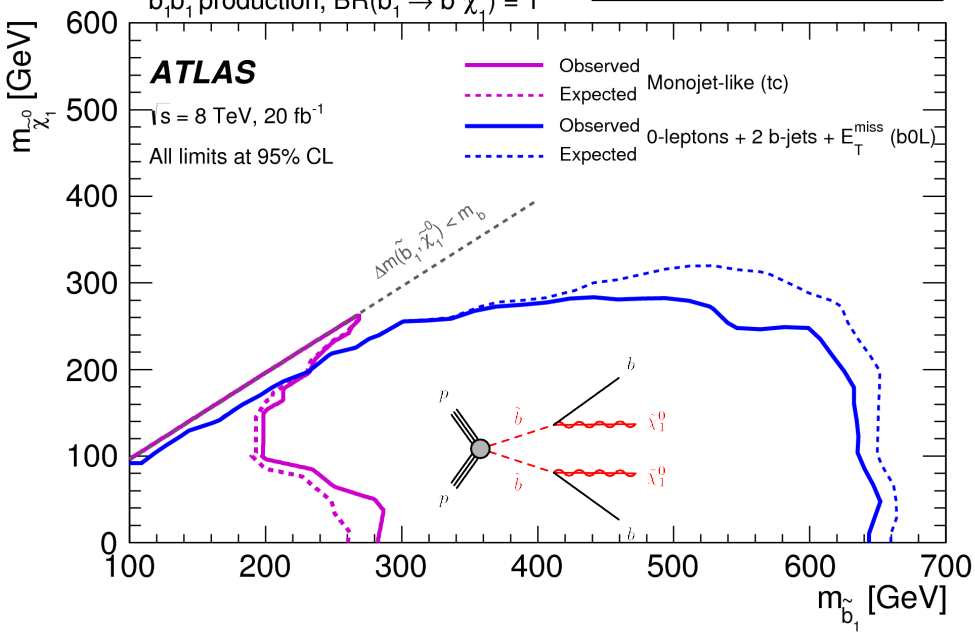


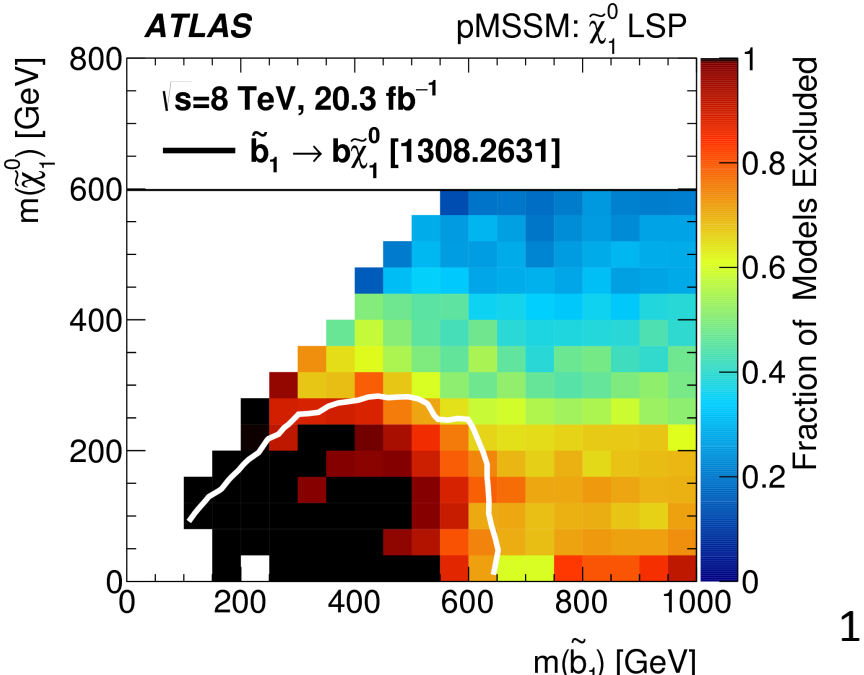
squark pairs



sbottom pairs

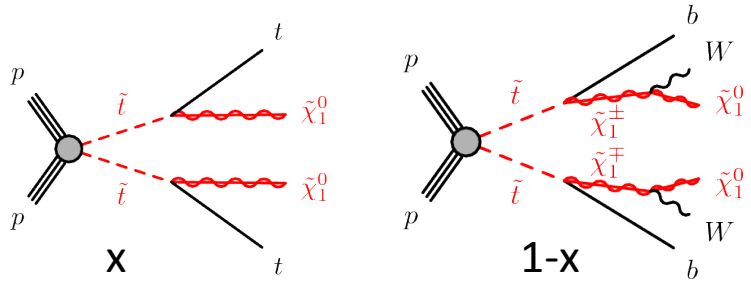
arXiv:1506.08616

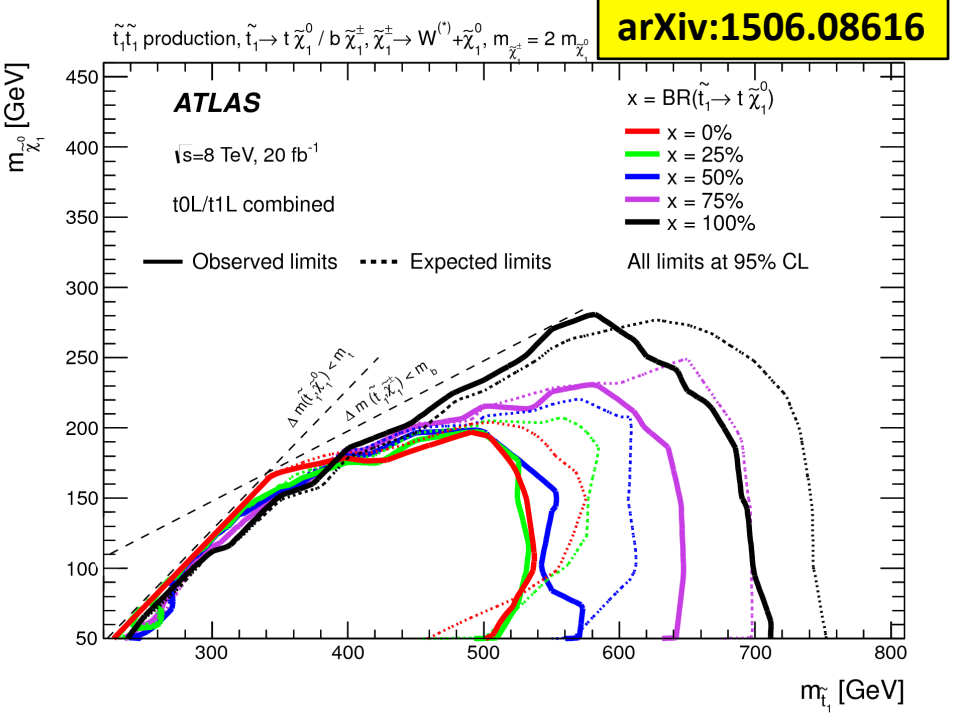


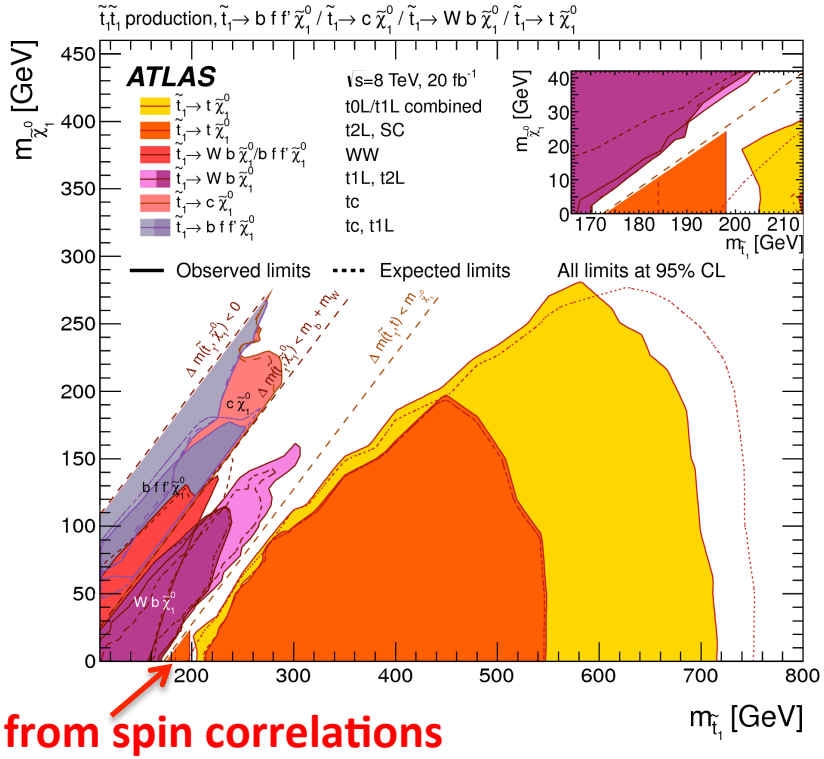


top squark pair production

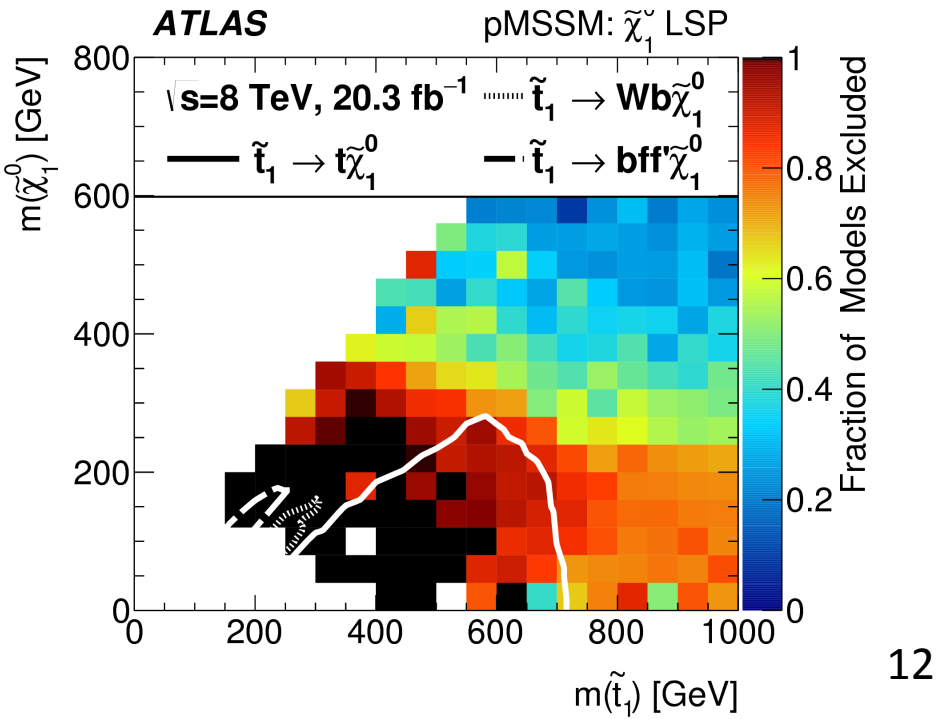
vary the decay modes







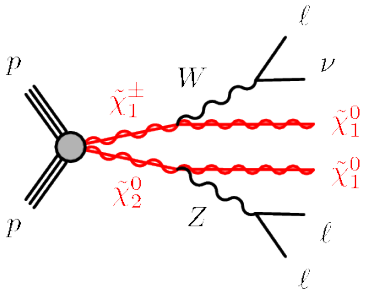
from spin correlations

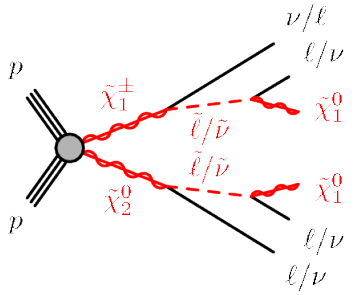


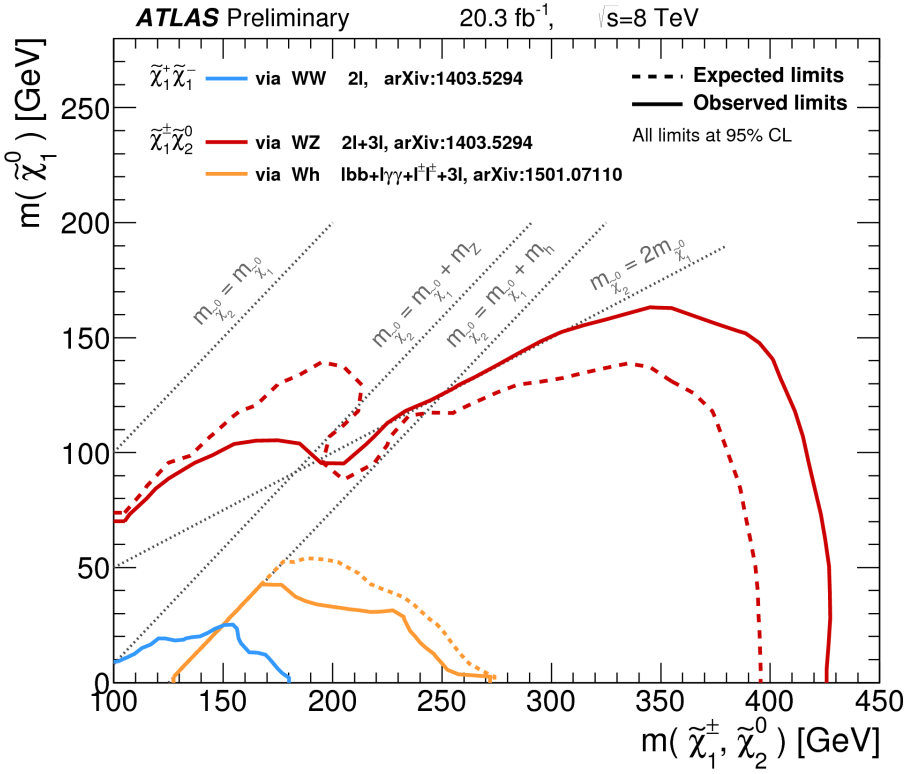
SUSY summary on electroweak gaugino production

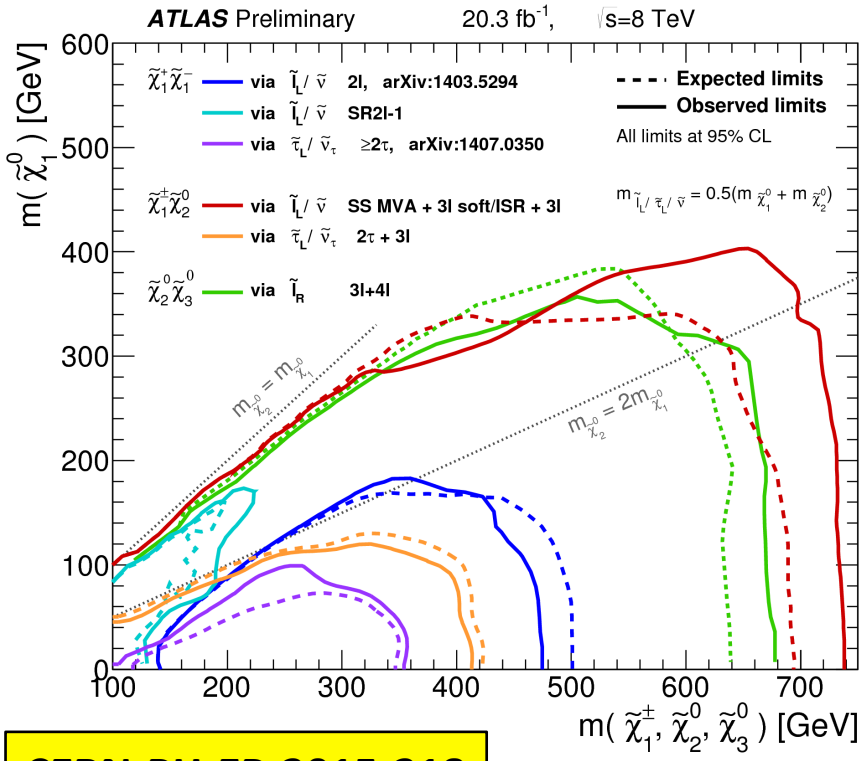
Simplified models, assuming bino LSP, wino $\chi^{\pm}$ and χ^{0}_{2} with equal masses

multilepton searches
same-charge leptons
VBF





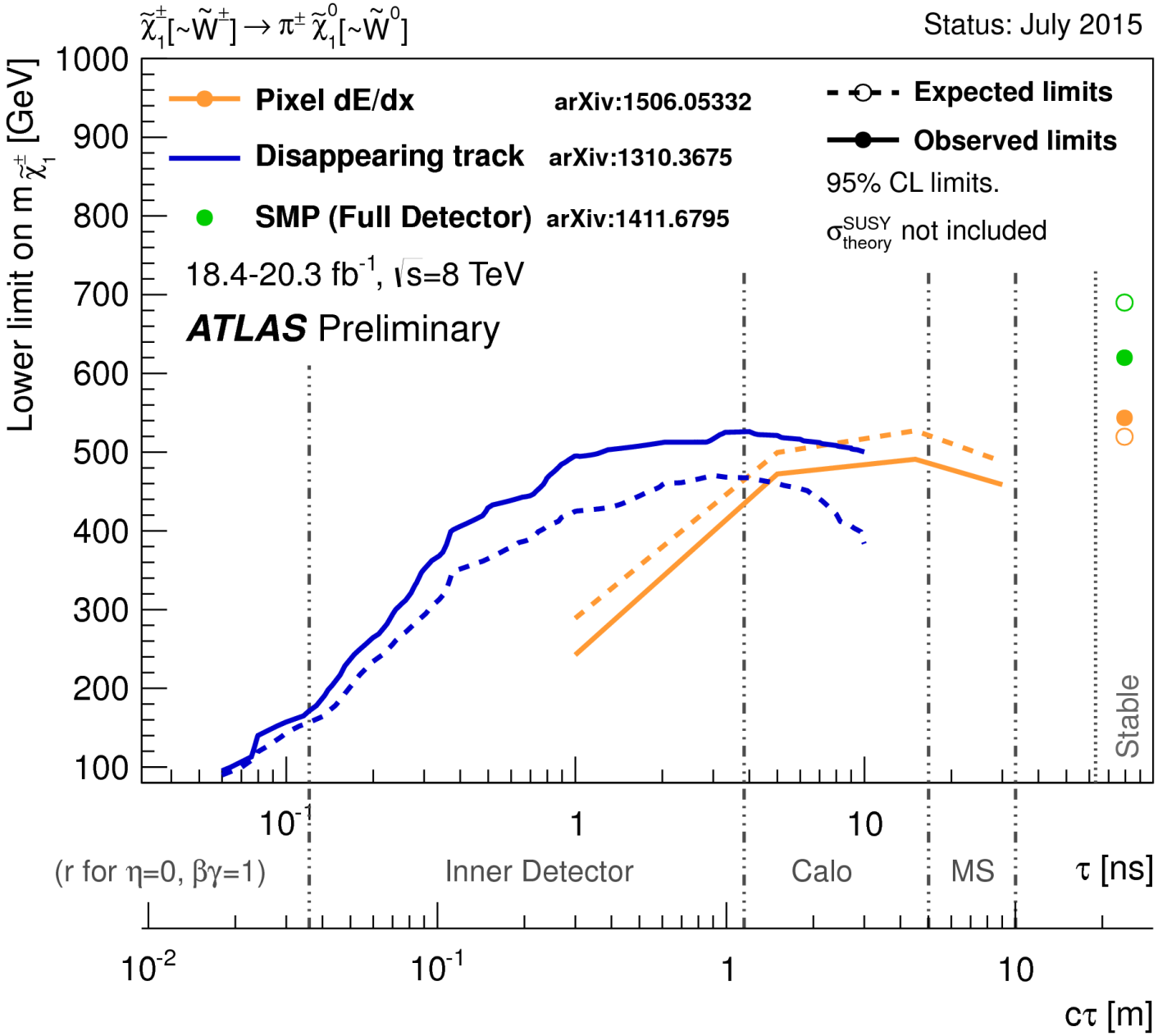




CERN-PH-EP-2015-218

Long-lived charginos

PRD 88, 112006; JHEP 01, 068; arXiv:1506.05332



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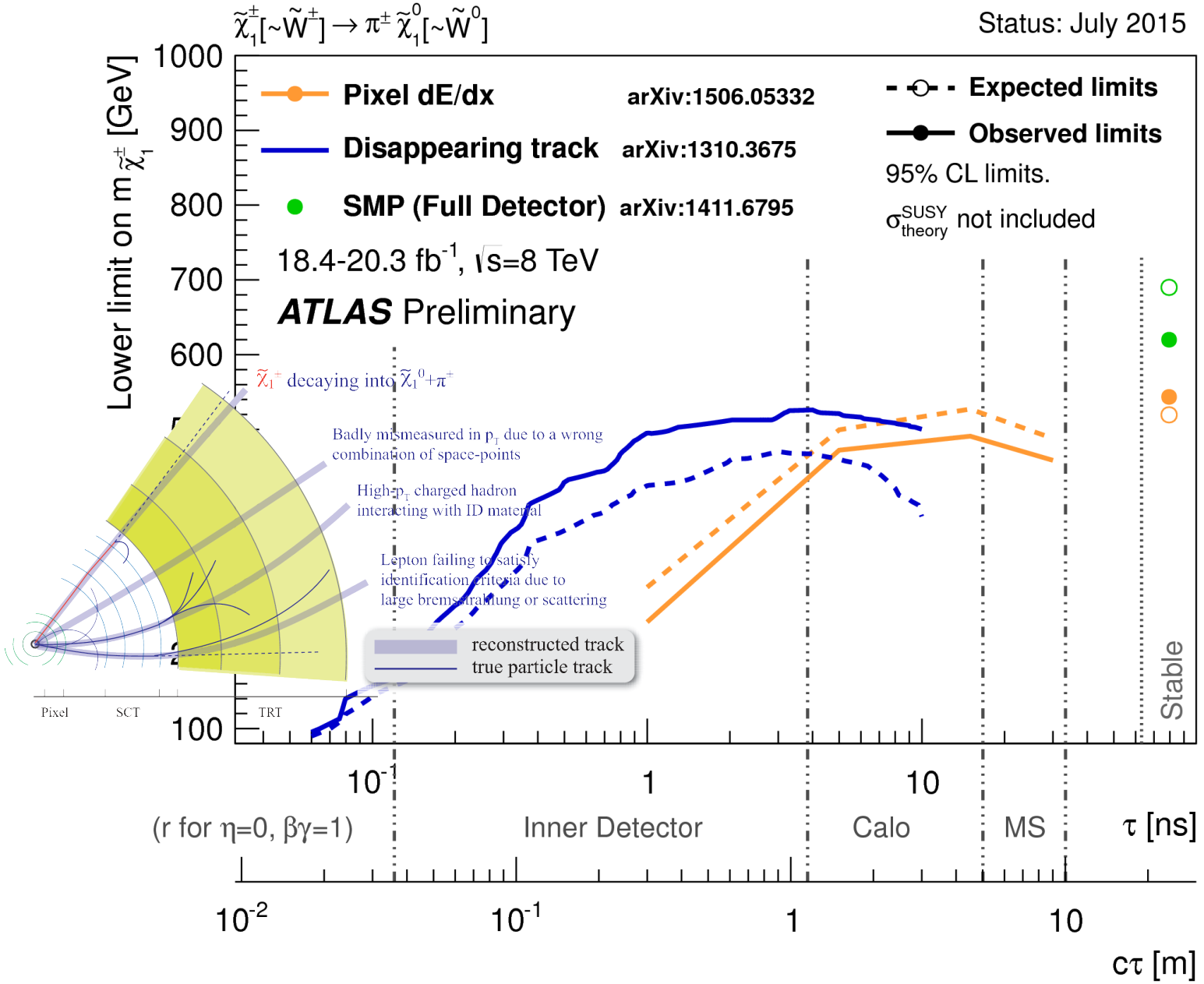
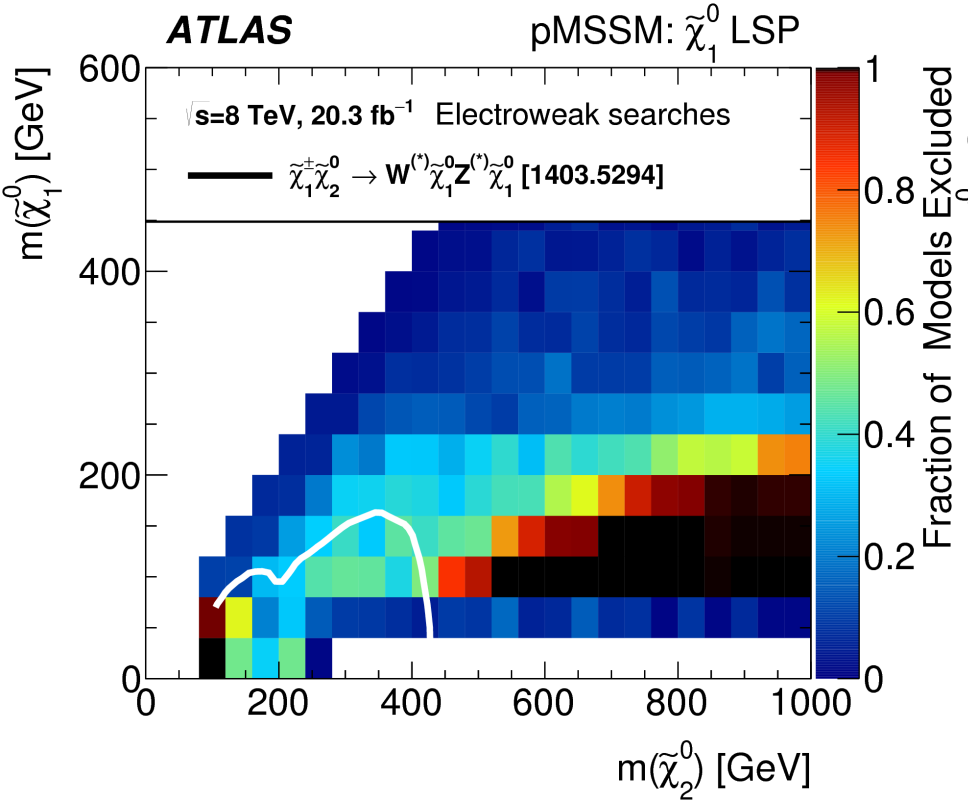
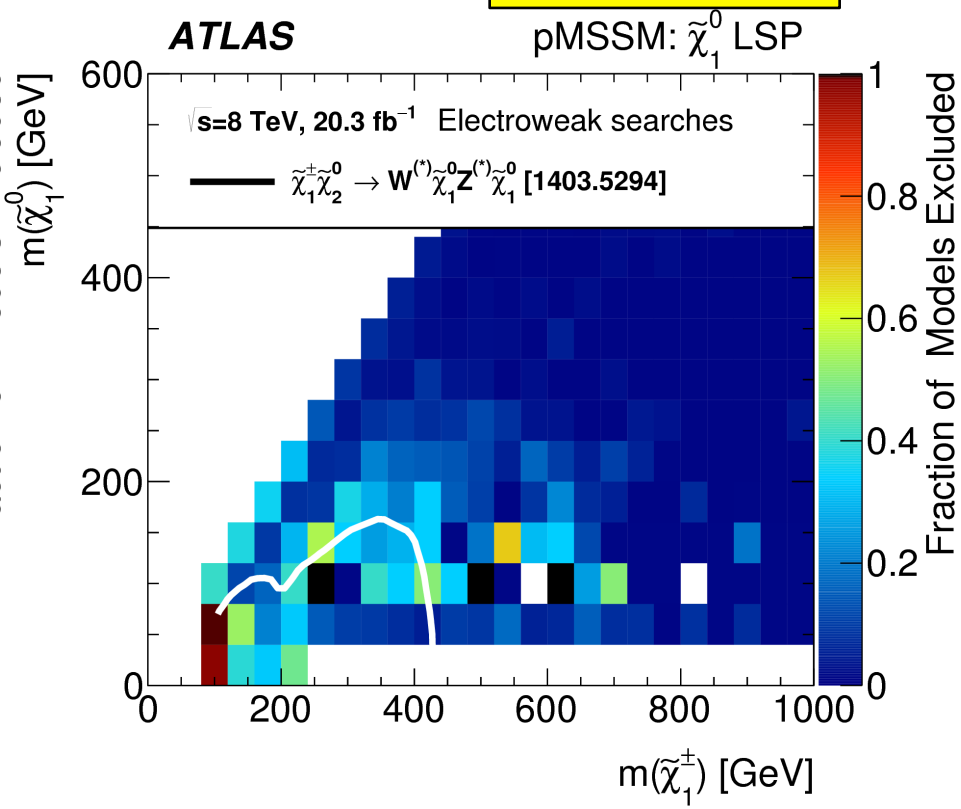


Electroweak gaugino scan in pMSSM:

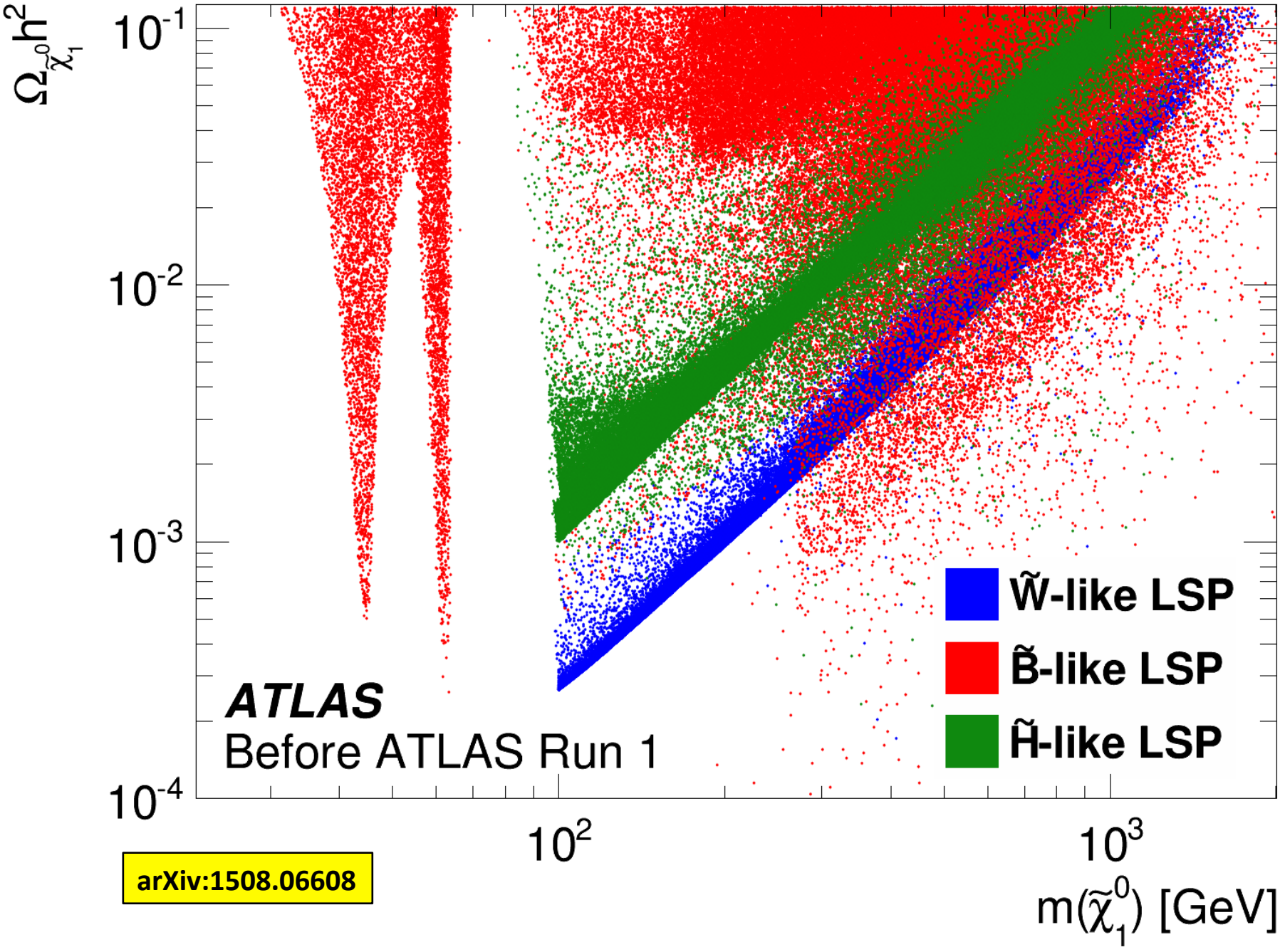
arXiv:1508.06608

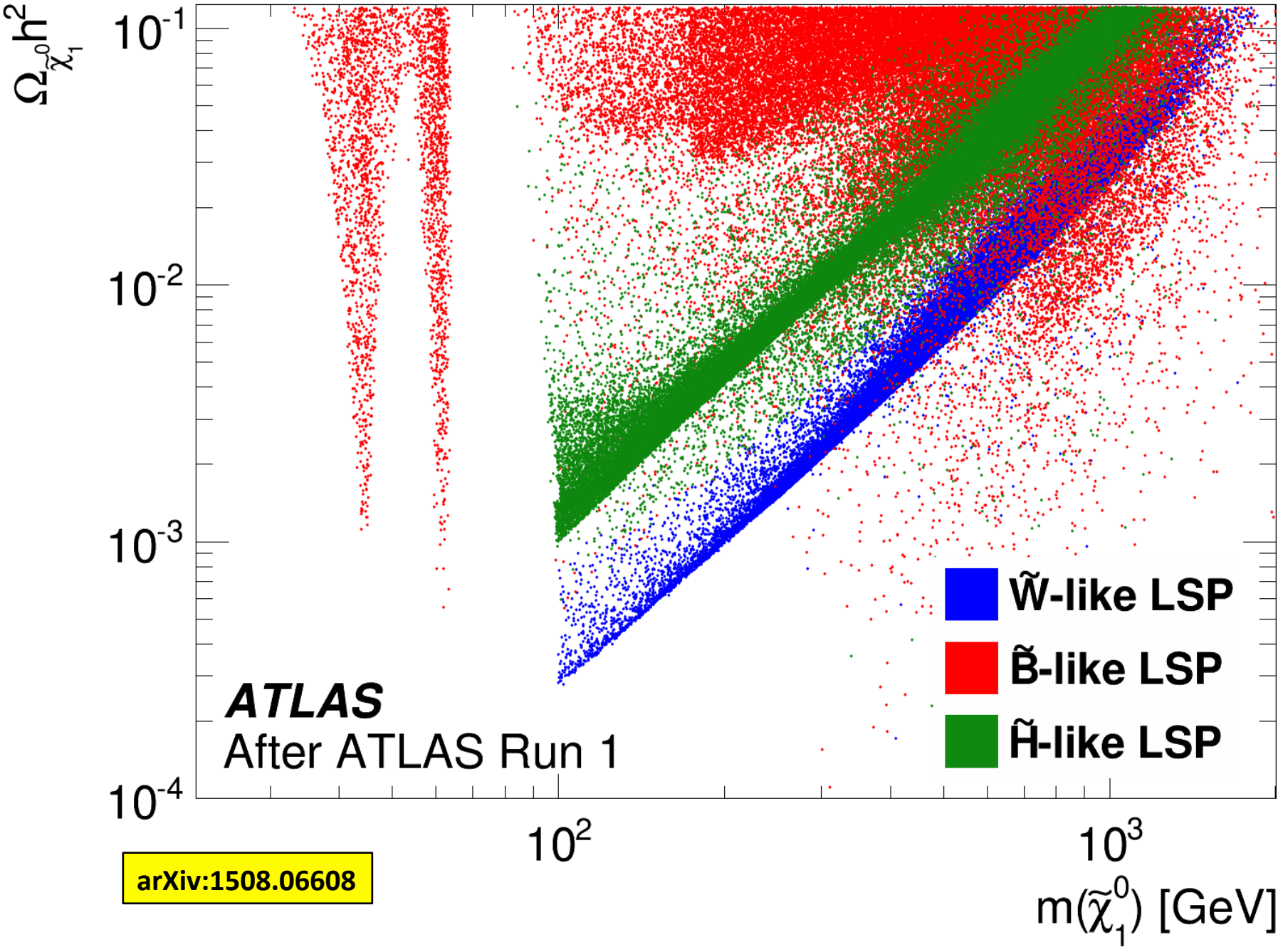




Allowed gaugino mass spectrum and mixings strongly affected by external constraints, in particular relic density of dark matter

Simplified models used seem to capture this rather poorly


$\Omega_{\tilde{\chi}_1^0}h^2$
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^2
10^3
$m(\tilde{\chi}_1^0)$ [GeV]
$\tilde{W}$-like LSP
$\tilde{B}$-like LSP
$\tilde{H}$-like LSP
ATLAS
Before ATLAS Run 1
arXiv:1508.06608


$\Omega_{\tilde{\chi}_1^0}h^2$
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^2
10^3
$m(\tilde{\chi}_1^0)$ [GeV]
$\tilde{W}$-like LSP
$\tilde{B}$-like LSP
$\tilde{H}$-like LSP
ATLAS
After ATLAS Run 1
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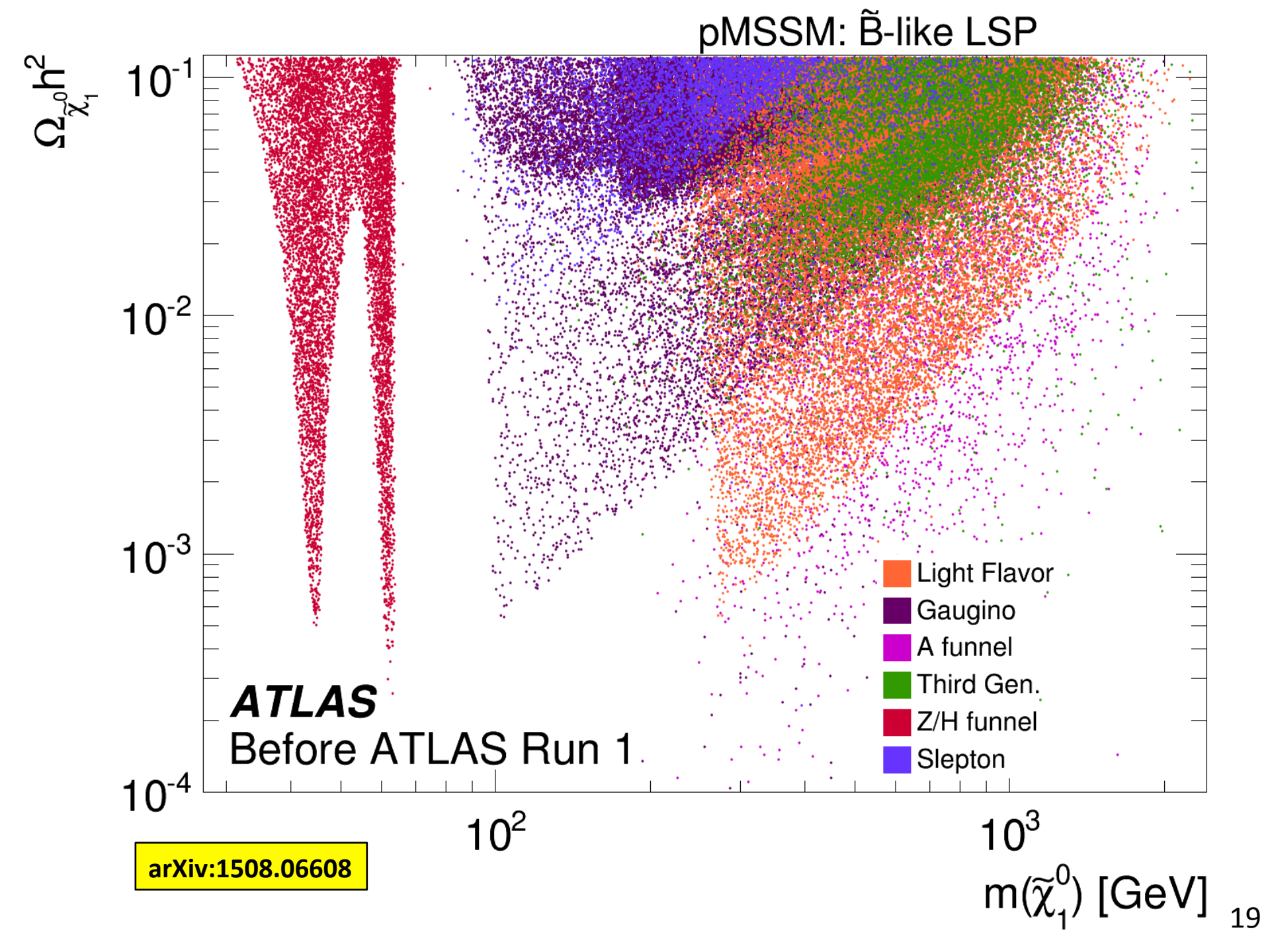
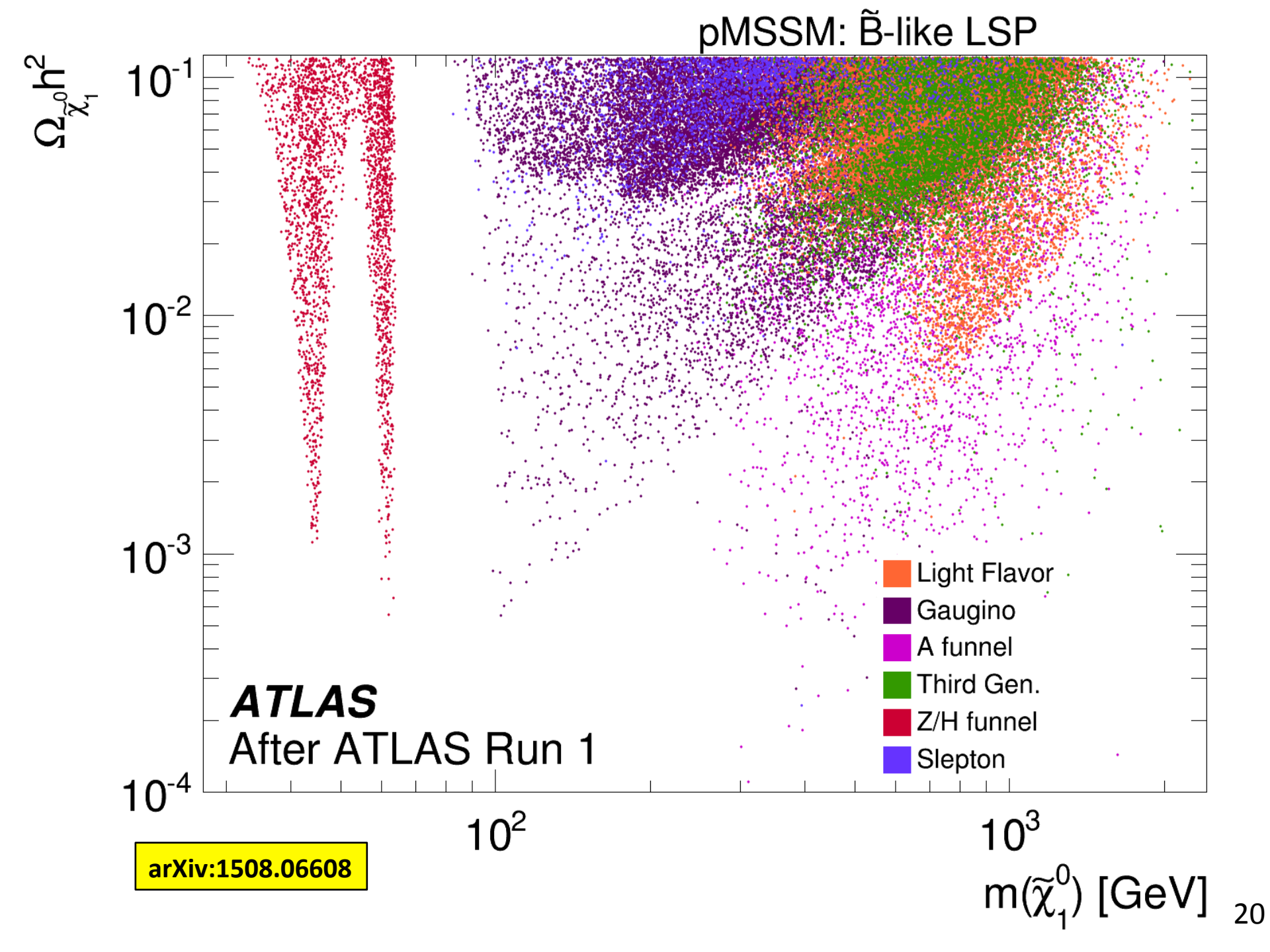
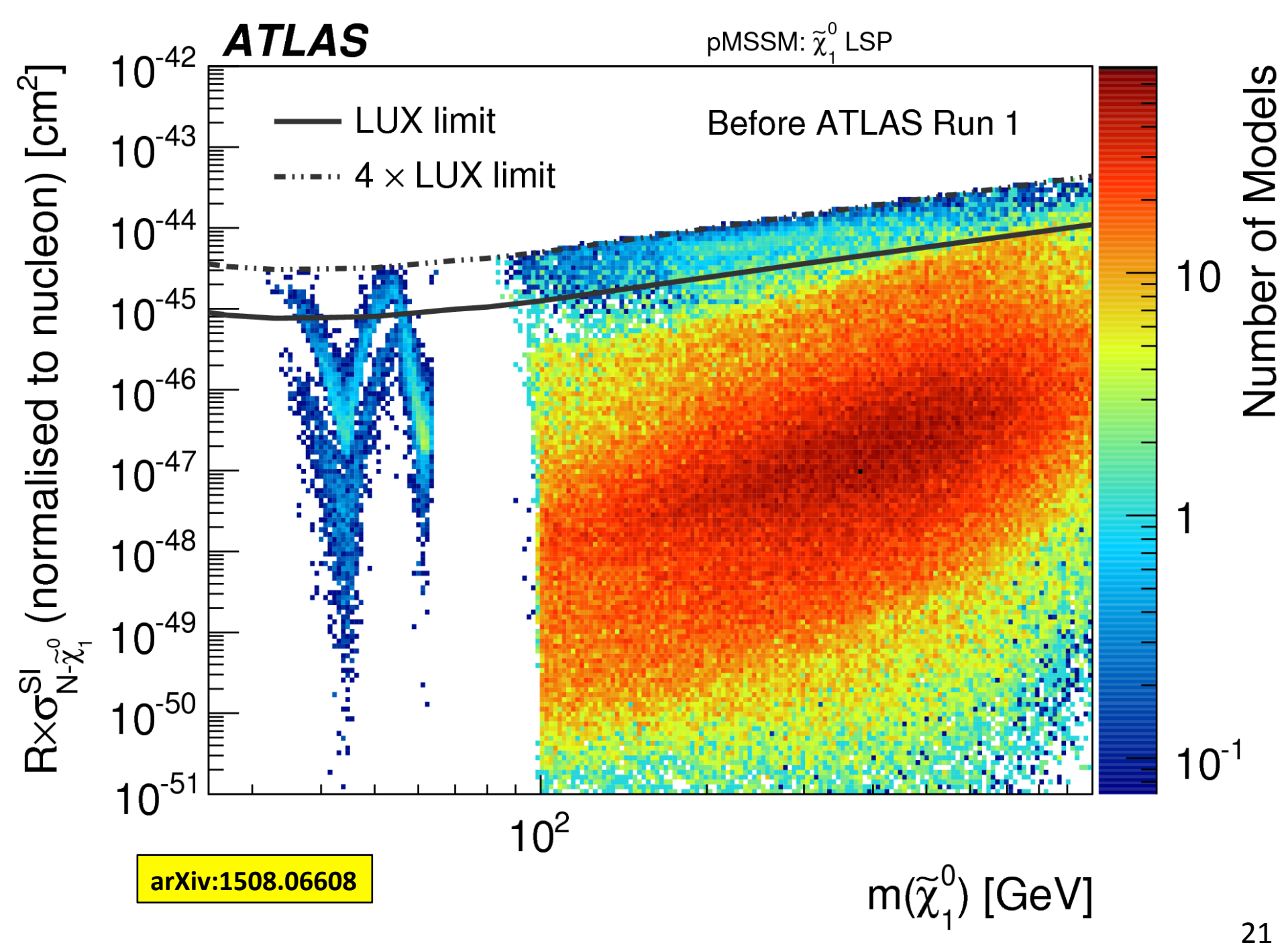
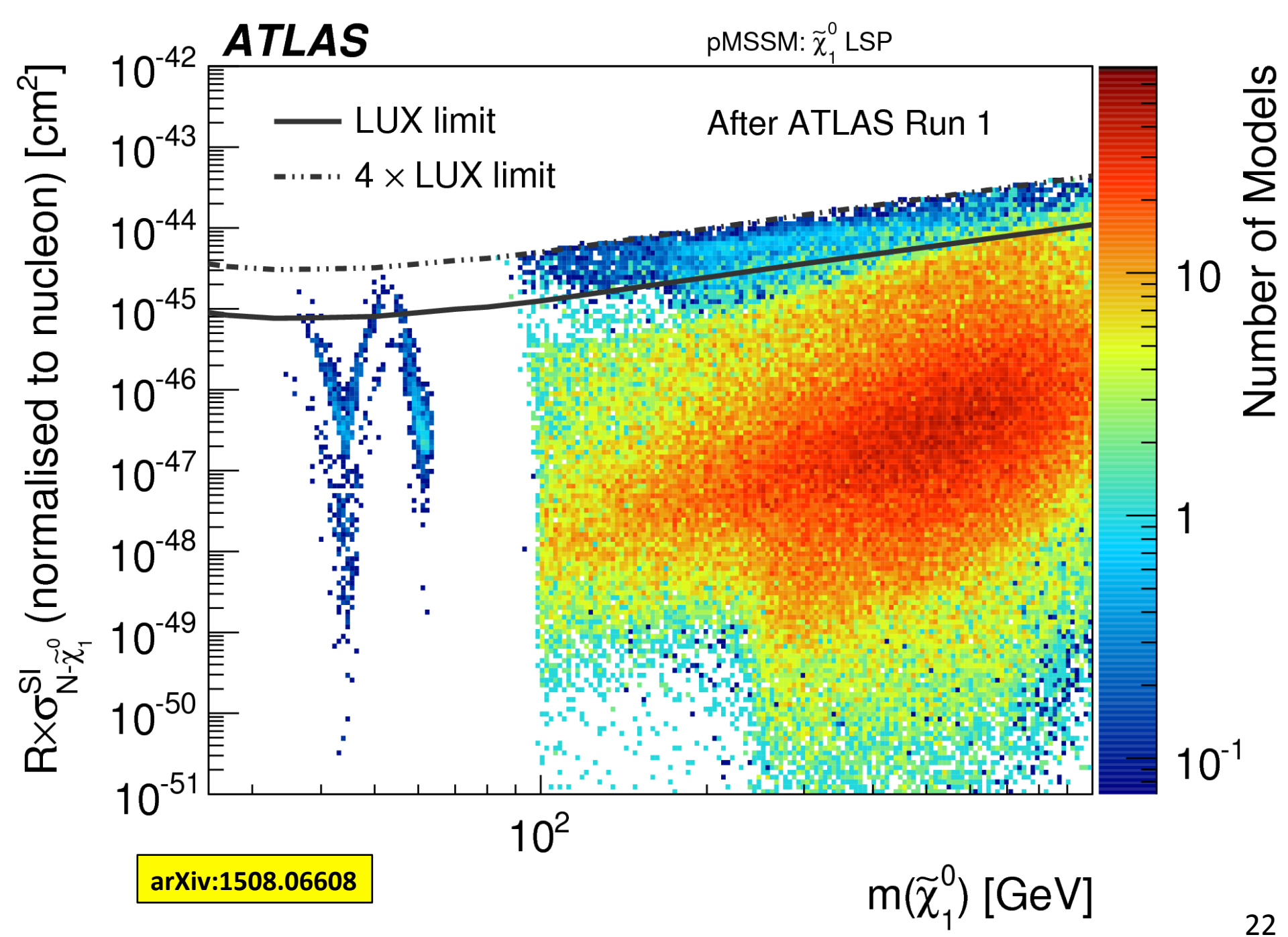
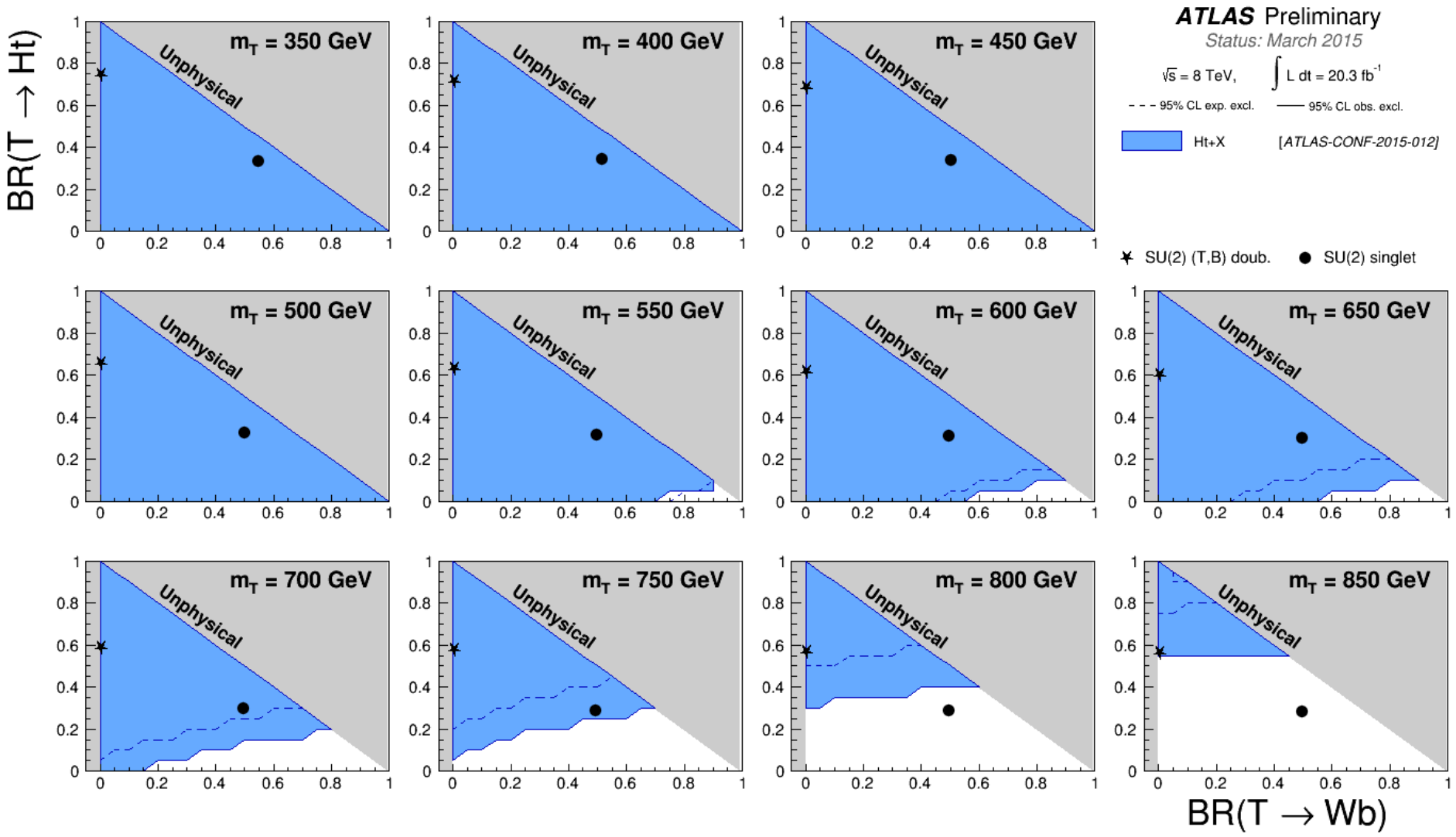

pMSSM: B̃-like LSP
$\Omega_{\tilde{\chi}_1^0}h^2$
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^2
10^3
$m(\tilde{\chi}_1^0)$ [GeV]
Light Flavor
Gaugino
A funnel
Third Gen.
Z/H funnel
Slepton
ATLAS
Before ATLAS Run 1
arXiv:1508.06608


pMSSM: B̃-like LSP
$\Omega_{\tilde{\chi}_1^0} h^2$
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^2
10^3
$m(\tilde{\chi}_1^0)$ [GeV]
Light Flavor
Gaugino
A funnel
Third Gen.
Z/H funnel
Slepton
ATLAS
After ATLAS Run 1
arXiv:1508.06608

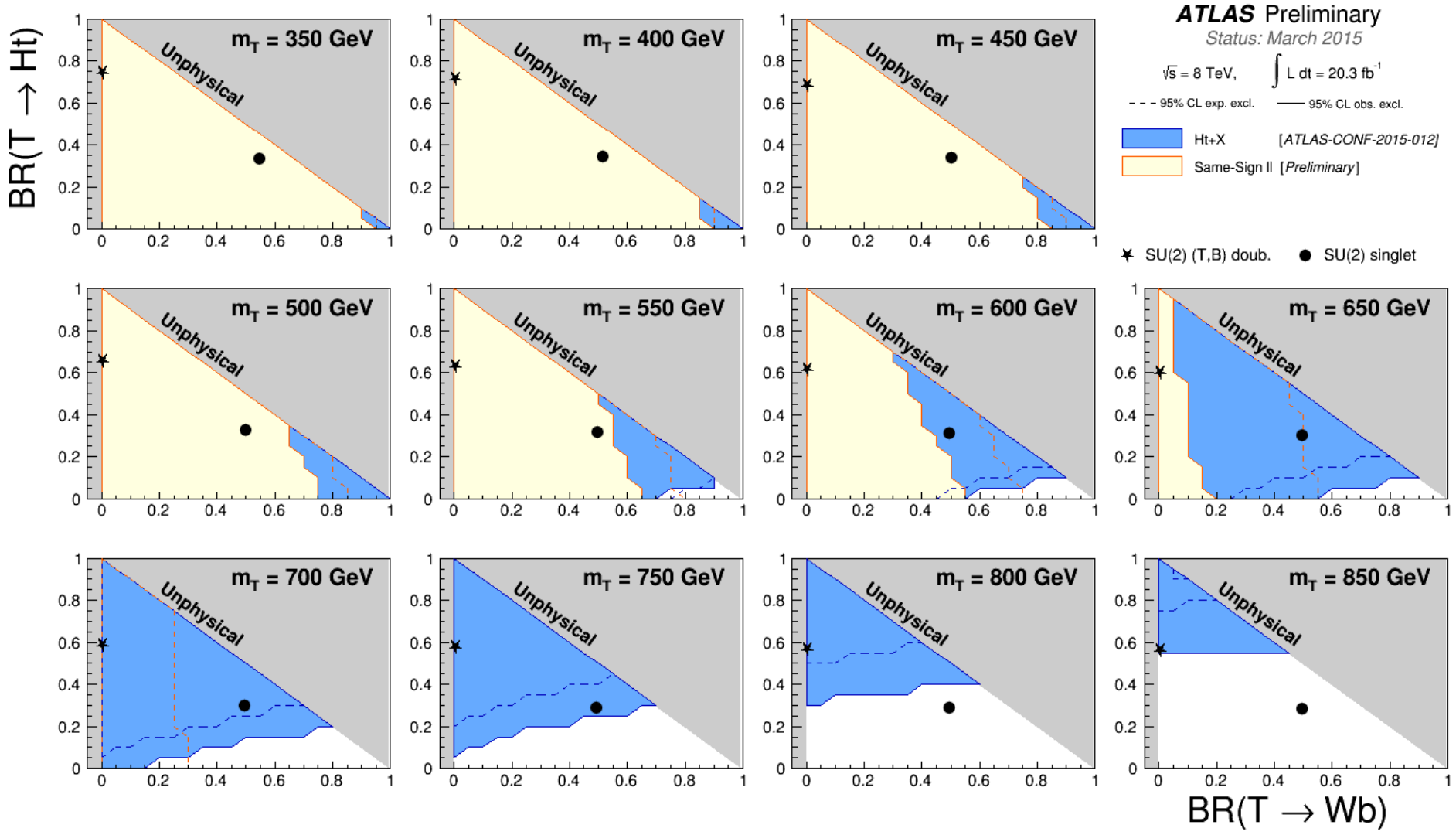

ATLAS
pMSSM: $\tilde{\chi}_1^0$ LSP
LUX limit
4 × LUX limit
Before ATLAS Run 1
$R\times\sigma^{SI}_{N\text{-}\tilde{\chi}_1^0}$ (normalised to nucleon) [cm^2]
10^{-42}
10^{-43}
10^{-44}
10^{-45}
10^{-46}
10^{-47}
10^{-48}
10^{-49}
10^{-50}
10^{-51}
10^2
$m(\tilde{\chi}_1^0)$ [GeV]
Number of Models
10
1
10^{-1}
arXiv:1508.06608


ATLAS
pMSSM: $\tilde{\chi}_1^0$ LSP
LUX limit
4 × LUX limit
After ATLAS Run 1
$R\times\sigma^{SI}_{N\text{-}\tilde{\chi}_1^0}$ (normalised to nucleon) [cm^2]
10^{-42}
10^{-43}
10^{-44}
10^{-45}
10^{-46}
10^{-47}
10^{-48}
10^{-49}
10^{-50}
10^{-51}
10^2
$m(\tilde{\chi}_1^0)$ [GeV]
Number of Models
10
1
10^{-1}
arXiv:1508.06608

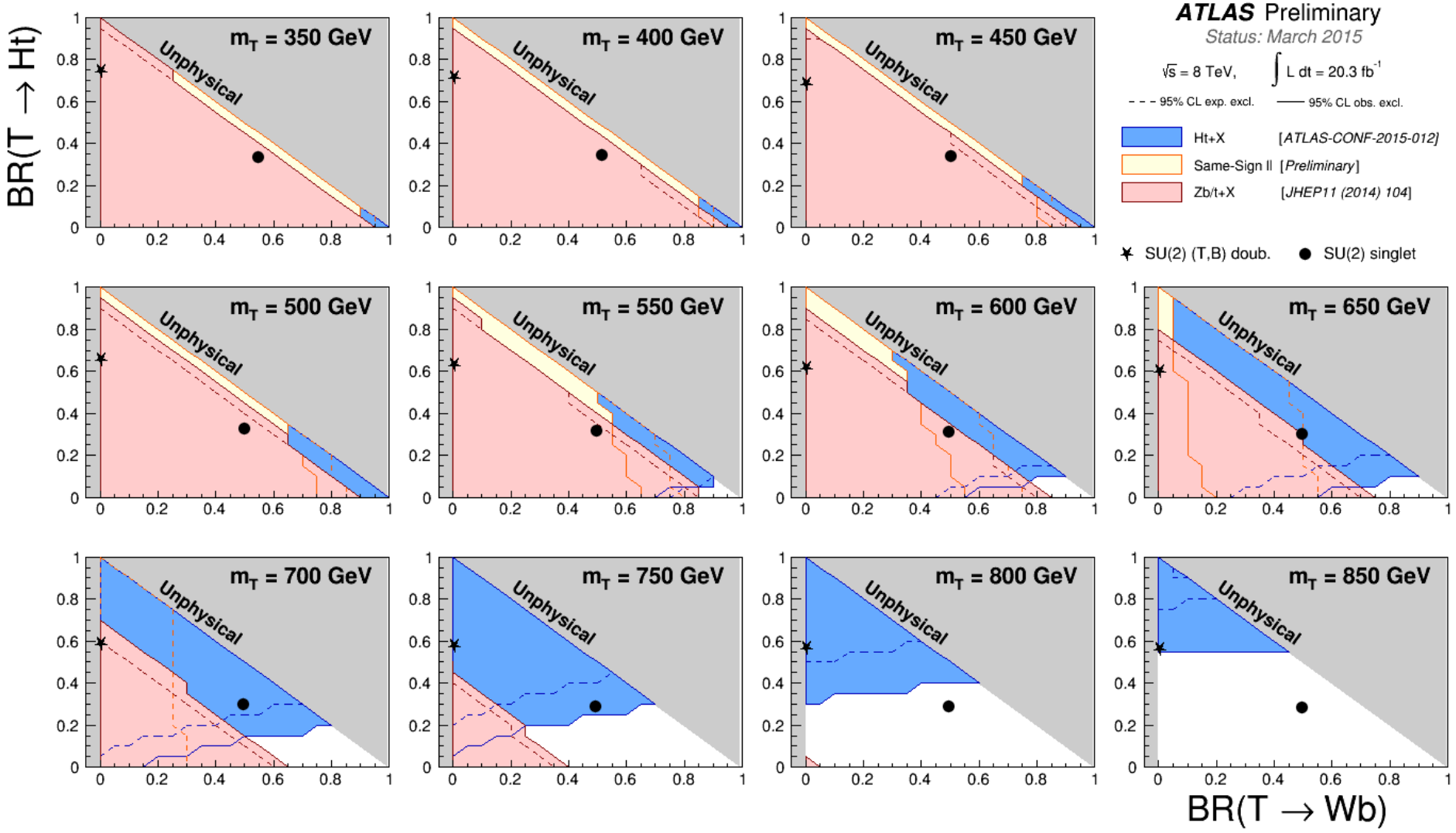
New generation of quarks: a vector-like heavy top quark



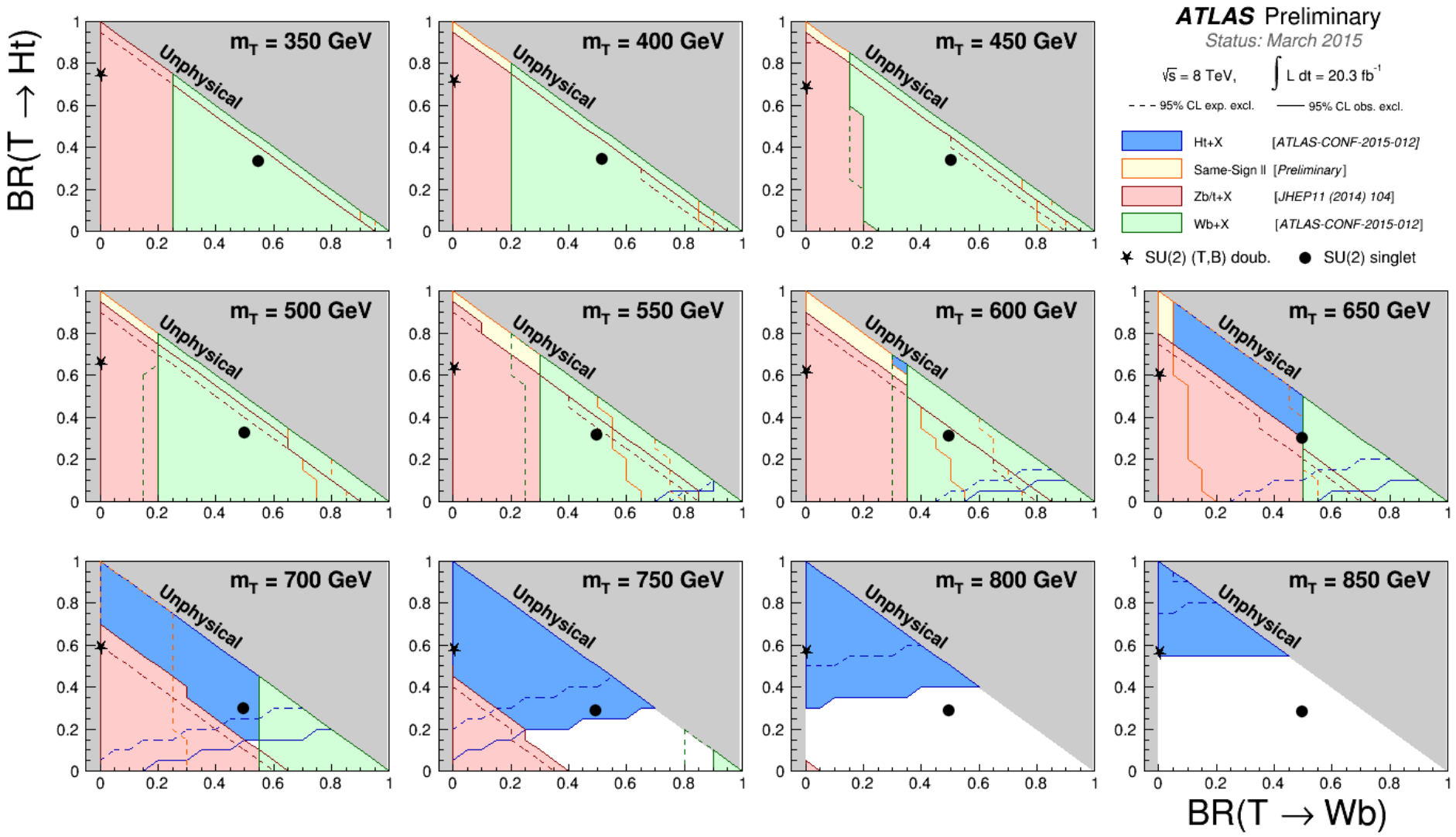
New generation of quarks: a vector-like heavy top quark



New generation of quarks: a vector-like heavy top quark



New generation of quarks: a vector-like heavy top quark

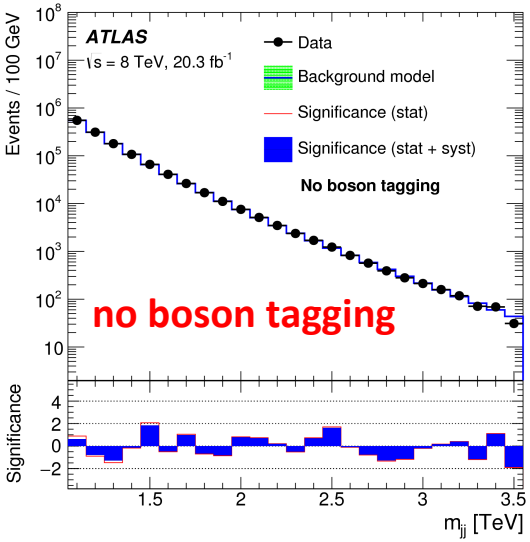


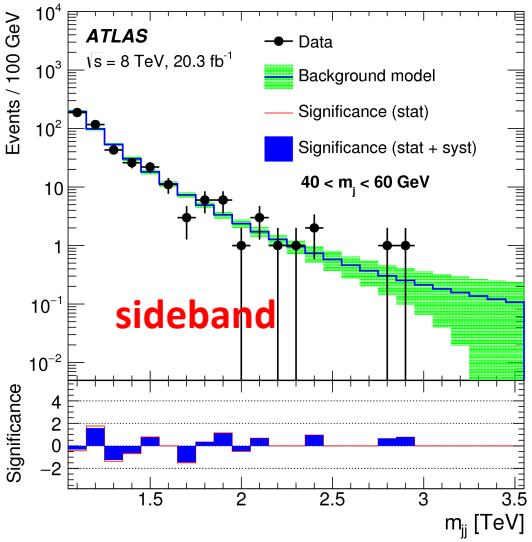
Diboson resonances

W'/G* → V V → j j j j (V = W,Z)

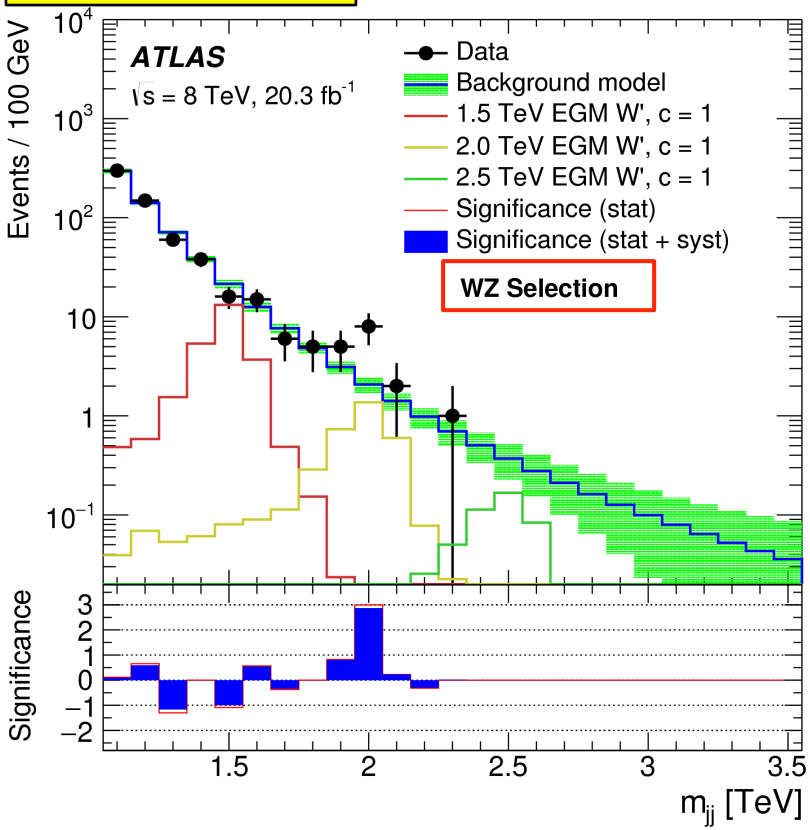
high mass W'/G* : V boosted

jets merged in "fat jets", which can be "boson-tagged"

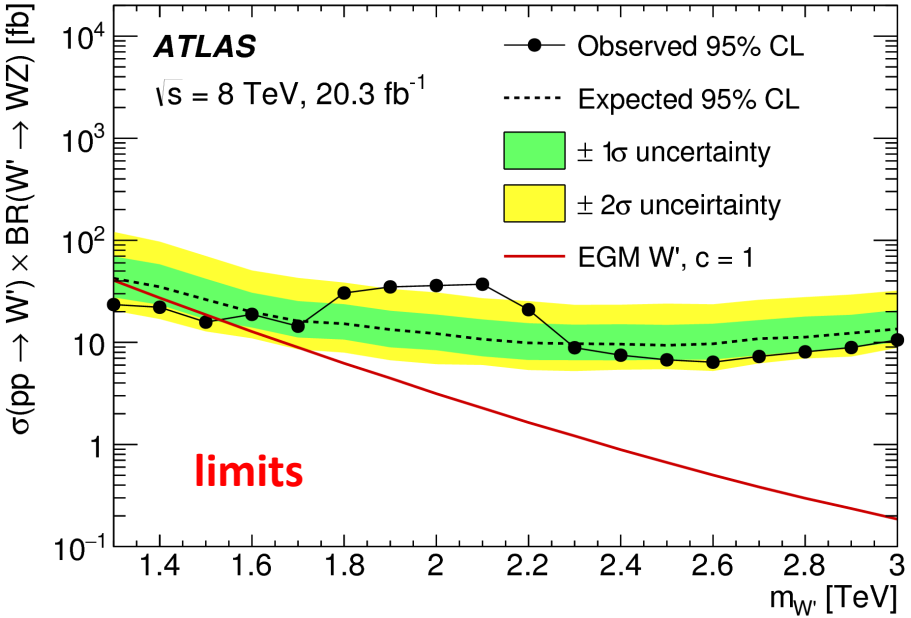




arXiv:1506.00962



3.4 σ local significance, 2.5 σ global significance

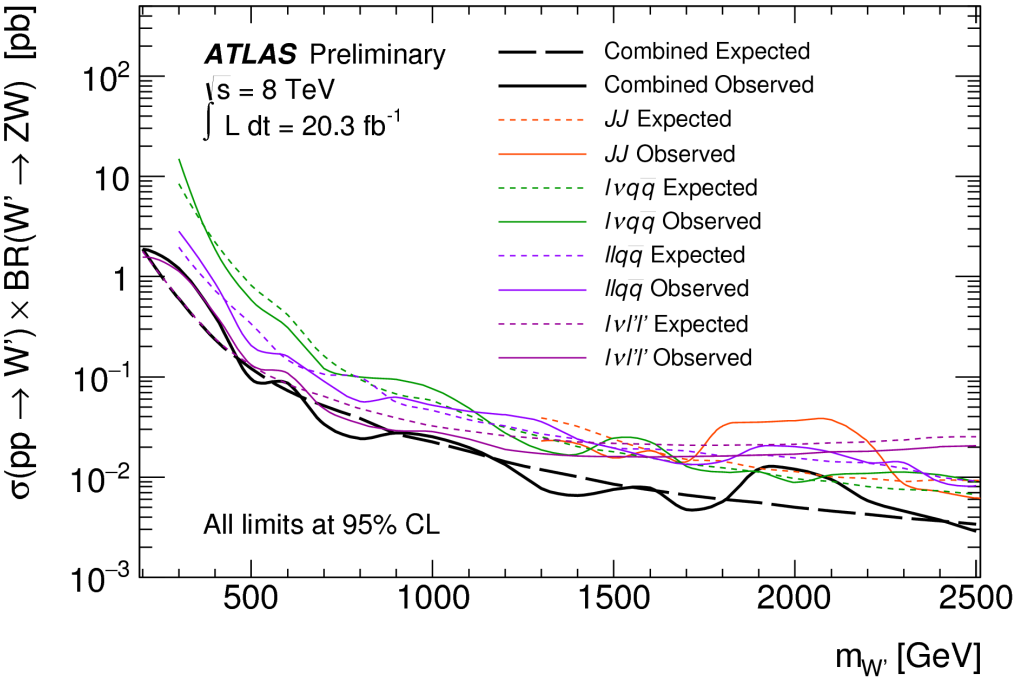


New: combination with leptonic and lepton+jets channels

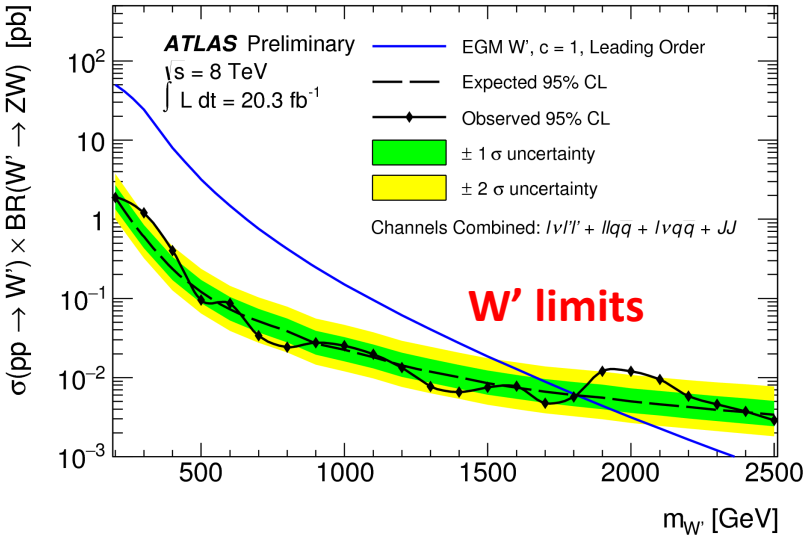
Channel	Signal Region	W' mass range [TeV]	G^* mass range [TeV]
$\ell\nu\ell'\ell'$	low-mass	0.2-1.9	–
	high-mass	0.2-2.5	–
$\ell\ell q\bar{q}$	low- resolved	0.3-0.9	0.2-0.9
	high- resolved	0.6-2.5	0.6-0.9
	merged	0.9-2.5	0.9-2.5
$\ell\nu q\bar{q}$	low- resolved	0.3-0.8	0.2-0.7
	high- resolved	0.6-1.1	0.6-0.9
	merged	0.8-2.5	0.8-2.5
JJ	WZ selection	1.3-3.0	–
	$WW+ZZ$ selection	–	1.3-3.0

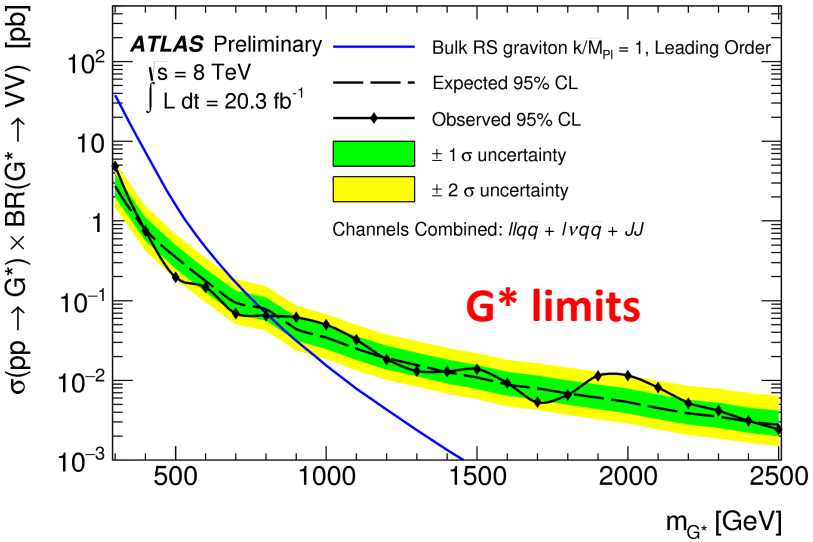
EGM W' excluded below 1.8 TeV (observed equals expected limit)

2 TeV local significance 3.4 → 2.5 σ



ATLAS-CONF-2015-045





ATLAS Exotics Searches* - 95% CL Exclusion

Status: July 2015

ATLAS Preliminary

$\int \mathcal{L}\, dt$ = (4.7 - 20.3) fb^{-1} $\sqrt{s}$ = 7, 8 TeV

	Model	ℓ, γ	Jets	E_T^{miss}	$\int \mathcal{L}\, dt$[fb^{-1}]	Limit	Reference
Extra dimensions	ADD $G_{KK} + g/q$	–	≥ 1 j	Yes	20.3	M_D 5.25 TeV, $n = 2$	1502.01518
	ADD non-resonant $\ell\ell$	2e,μ	–	–	20.3	M_S 4.7 TeV, $n = 3$ HLZ	1407.2410
	ADD QBH $\rightarrow \ell q$	1 e,μ	1 j	–	20.3	M_{th} 5.2 TeV, $n = 6$	1311.2006
	ADD QBH	–	2 j	–	20.3	M_{th} 5.82 TeV, $n = 6$	1407.1376
	ADD BH high N_{trk}	2 μ (SS)	–	–	20.3	M_{th} 4.7 TeV, $n = 6$, $M_D = 3$ TeV, non-rot BH	1308.4075
	ADD BH high $\sum p_T$	≥ 1 e,μ	≥ 2 j	–	20.3	M_{th} 5.8 TeV, $n = 6$, $M_D = 3$ TeV, non-rot BH	1405.4254
	ADD BH high multijet	–	≥ 2 j	–	20.3	M_{th} 5.8 TeV, $n = 6$, $M_D = 3$ TeV, non-rot BH	1503.08988
	RS1 $G_{KK} \rightarrow \ell\ell$	2 e,μ	–	–	20.3	G_{KK} mass 2.68 TeV, $k/\overline{M}_{Pl} = 0.1$	1405.4123
	RS1 $G_{KK} \rightarrow \gamma\gamma$	2 γ	–	–	20.3	G_{KK} mass 2.66 TeV, $k/\overline{M}_{Pl} = 0.1$	1504.05511
	Bulk RS $G_{KK} \rightarrow ZZ \rightarrow qq\ell\ell$	2 e,μ	2 j / 1 J	–	20.3	G_{KK} mass 740 GeV, $k/\overline{M}_{Pl} = 1.0$	1409.6190
	Bulk RS $G_{KK} \rightarrow WW \rightarrow qq\ell\nu$	1 e,μ	2 j / 1 J	Yes	20.3	W' mass 760 GeV, $k/\overline{M}_{Pl} = 1.0$	1503.04677
	Bulk RS $G_{KK} \rightarrow HH \rightarrow b\bar{b}b\bar{b}$	–	4 b	–	19.5	G_{KK} mass 500-720 GeV, $k/\overline{M}_{Pl} = 1.0$	1506.00285
	Bulk RS $g_{KK} \rightarrow t\bar{t}$	1 e,μ	≥ 1 b, ≥ 1J/2j	Yes	20.3	g_{KK} mass 2.2 TeV, BR = 0.925	1505.07018
	2UED / RPP	2 e,μ (SS)	≥ 1 b, ≥ 1 j	Yes	20.3	KK mass 960 GeV	1504.04605
Gauge bosons	SSM $Z' \rightarrow \ell\ell$	2 e,μ	–	–	20.3	Z' mass 2.9 TeV	1405.4123
	SSM $Z' \rightarrow \tau\tau$	2 τ	–	–	19.5	Z' mass 2.02 TeV	1502.07177
	SSM $W' \rightarrow \ell\nu$	1 e,μ	–	Yes	20.3	W' mass 3.24 TeV	1407.7494
	EGM $W' \rightarrow WZ \rightarrow \ell\nu\ell'\ell'$	3 e,μ	–	Yes	20.3	W' mass 1.52 TeV	1406.4456
	EGM $W' \rightarrow WZ \rightarrow qq\ell\ell$	2 e,μ	2 j / 1 J	–	20.3	W' mass 1.59 TeV	1409.6190
	EGM $W' \rightarrow WZ \rightarrow qqqq$	–	2 J	–	20.3	W' mass 1.3-1.5 TeV	1506.00962
	HVT $W' \rightarrow WH \rightarrow \ell\nu bb$	1 e,μ	2 b	Yes	20.3	W' mass 1.47 TeV, $g_V = 1$	1503.08089
	LRSM $W'_R \rightarrow t\bar{b}$	1 e,μ	2 b, 0-1 j	Yes	20.3	W' mass 1.92 TeV	1410.4103
	LRSM $W'_R \rightarrow t\bar{b}$	0 e,μ	≥ 1 b, 1 J	–	20.3	W' mass 1.76 TeV	1408.0886
CI	CI $qqqq$	–	2 j	–	17.3	Λ 12.0 TeV, $\eta_{LL} = -1$	1504.00357
	CI $qq\ell\ell$	2 e,μ	–	–	20.3	Λ 21.6 TeV, $\eta_{LL} = -1$	1407.2410
	CI $uutt$	2 e,μ (SS)	≥ 1 b, ≥ 1 j	Yes	20.3	Λ 4.3 TeV, $\lvert C_{LL}\rvert = 1$	1504.04605
DM	EFT D5 operator (Dirac)	0 e,μ	≥ 1 j	Yes	20.3	M_* 974 GeV, at 90% CL for $m(\chi) < 100$ GeV	1502.01518
	EFT D9 operator (Dirac)	0 e,μ	1 J, ≤ 1 j	Yes	20.3	M_* 2.4 TeV, at 90% CL for $m(\chi) < 100$ GeV	1309.4017
LQ	Scalar LQ 1st gen	2 e	≥ 2 j	–	20.3	LQ mass 1.05 TeV, $\beta = 1$	Preliminary
	Scalar LQ 2nd gen	2 μ	≥ 2 j	–	20.3	LQ mass 1.0 TeV, $\beta = 1$	Preliminary
	Scalar LQ 3rd gen	1 e,μ	≥1 b, ≥3 j	Yes	20.3	LQ mass 640 GeV, $\beta = 0$	Preliminary
Heavy quarks	VLQ $TT \rightarrow Ht + X$	1 e,μ	≥ 2 b, ≥ 3 j	Yes	20.3	T mass 855 GeV, T in (T,B) doublet	1505.04306
	VLQ $YY \rightarrow Wb + X$	1 e,μ	≥ 1 b, ≥ 3 j	Yes	20.3	Y mass 770 GeV, Y in (B,Y) doublet	1505.04306
	VLQ $BB \rightarrow Hb + X$	1 e,μ	≥ 2 b, ≥ 3 j	Yes	20.3	B mass 735 GeV, isospin singlet	1505.04306
	VLQ $BB \rightarrow Zb + X$	2/≥3 e,μ	≥2/≥1 b	–	20.3	B mass 755 GeV, B in (B,Y) doublet	1409.5500
	$T_{5/3} \rightarrow Wt$	1 e,μ	≥ 1 b, ≥ 5 j	Yes	20.3	$T_{5/3}$ mass 840 GeV	1503.05425
Excited fermions	Excited quark $q^* \rightarrow q\gamma$	1 γ	1 j	–	20.3	q^* mass 3.5 TeV, only u^* and d^*, $\Lambda = m(q^*)$	1309.3230
	Excited quark $q^* \rightarrow qg$	–	2 j	–	20.3	q^* mass 4.09 TeV, only u^* and d^*, $\Lambda = m(q^*)$	1407.1376
	Excited quark $b^* \rightarrow Wt$	1 or 2 e,μ	1 b, 2 j or 1 j	Yes	4.7	b^* mass 870 GeV, left-handed coupling	1301.1583
	Excited lepton $\ell^* \rightarrow \ell\gamma$	2 e,μ, 1 γ	–	–	13.0	ℓ^* mass 2.2 TeV, $\Lambda = 2.2$ TeV	1308.1364
	Excited lepton $\nu^* \rightarrow \ell W, \nu Z$	3 e,μ,τ	–	–	20.3	ν^* mass 1.6 TeV, $\Lambda = 1.6$ TeV	1411.2921
Other	LSTC $a_T \rightarrow W\gamma$	1 e,μ, 1 γ	–	Yes	20.3	a_T mass 960 GeV	1407.8150
	LRSM Majorana ν	2 e,μ	2 j	–	20.3	N^0 mass 2.0 TeV, $m(W_R) = 2.4$ TeV, no mixing	1506.06020
	Higgs triplet $H^{\pm\pm} \rightarrow \ell\ell$	2 e,μ (SS)	–	–	20.3	$H^{\pm\pm}$ mass 551 GeV, DY production, BR($H_L^{\pm\pm} \rightarrow \ell\ell$)=1	1412.0237
	Higgs triplet $H^{\pm\pm} \rightarrow \ell\tau$	3 e,μ,τ	–	–	20.3	$H^{\pm\pm}$ mass 400 GeV, DY production, BR($H_L^{\pm\pm} \rightarrow \ell\tau$)=1	1411.2921
	Monotop (non-res prod)	1 e,μ	1 b	Yes	20.3	spin-1 invisible particle mass 657 GeV, $a_{non-res} = 0.2$	1410.5404
	Multi-charged particles	–	–	–	20.3	multi-charged particle mass 785 GeV, DY production, $\lvert q\rvert = 5e$	1504.04188
	Magnetic monopoles	–	–	–	7.0	monopole mass 1.34 TeV, DY production, $\lvert g\rvert = 1g_D$, spin 1/2	Preliminary

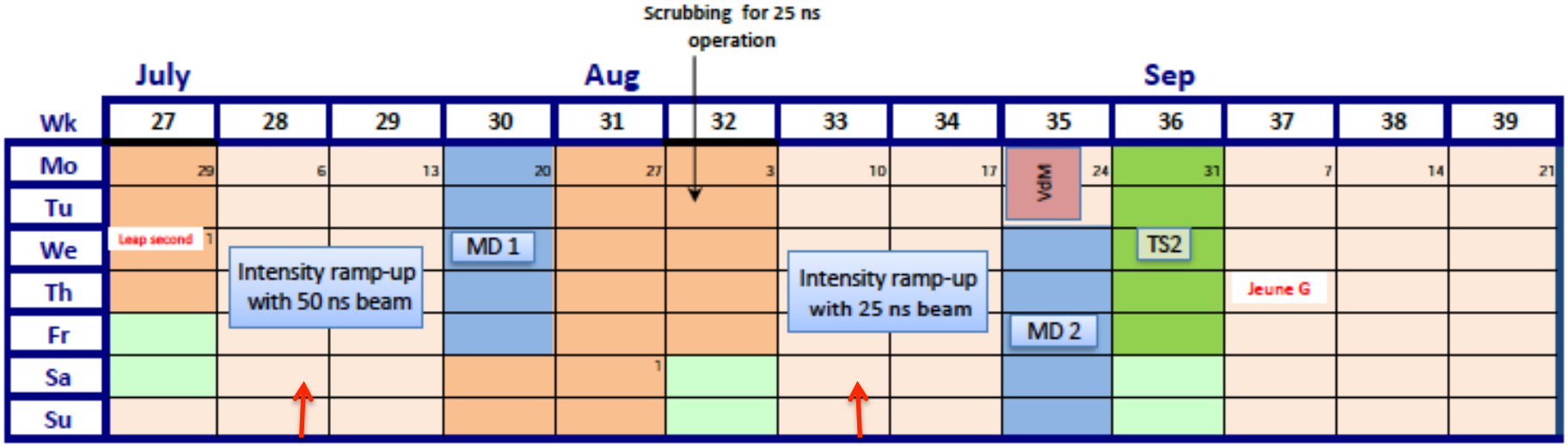
$\sqrt{s}$ = 7 TeV $\sqrt{s}$ = 8 TeV

10^{-1} 1 10 **Mass scale [TeV]**

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

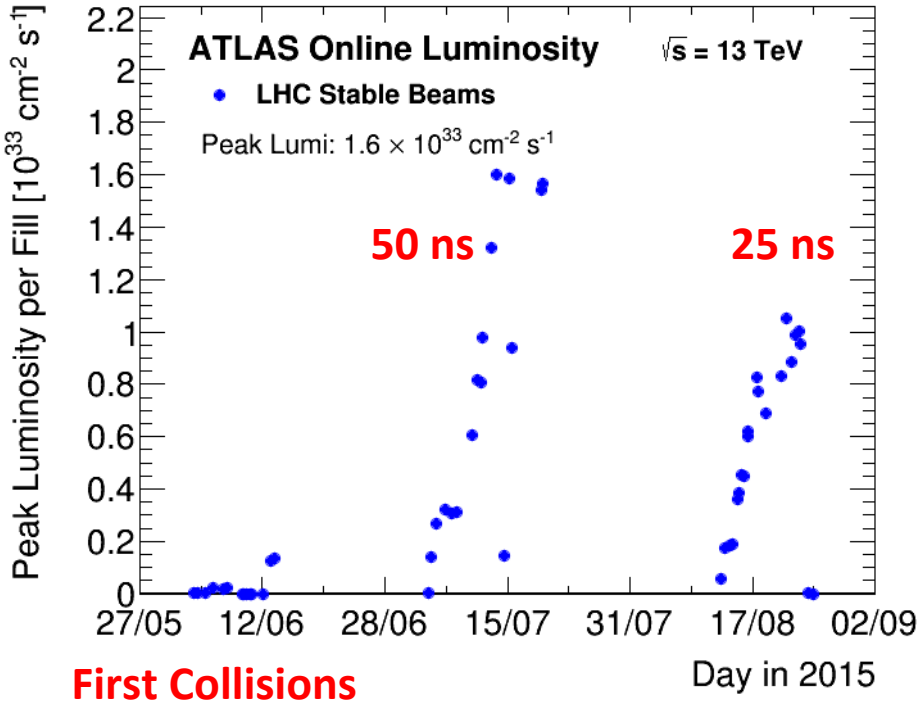
The LHC in 2015

First Collisions

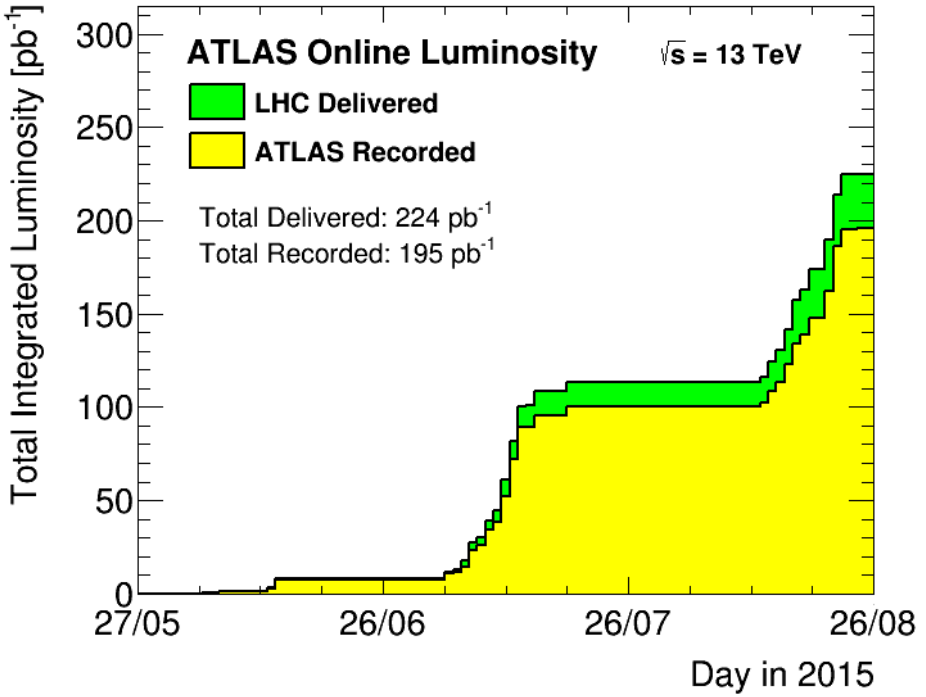


50 ns bunch spacing

25 ns bunch spacing



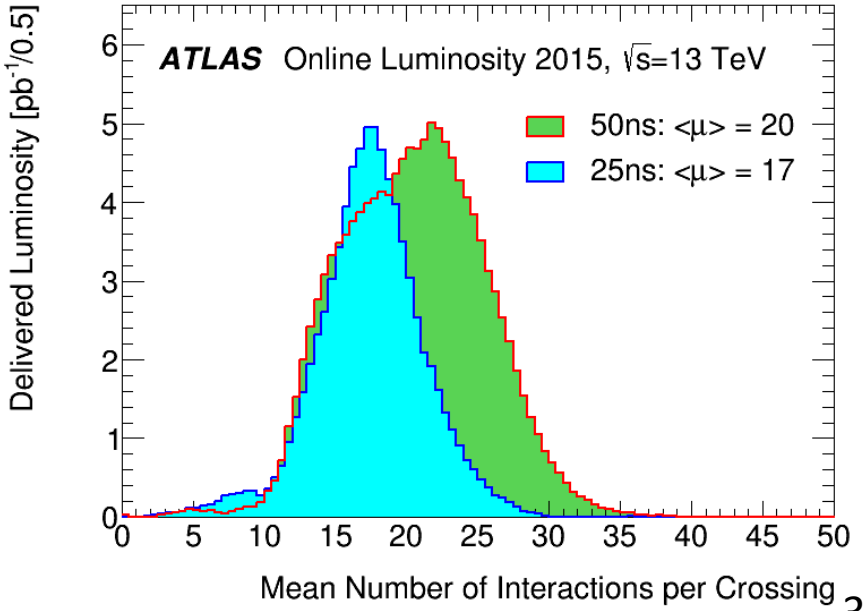
First Collisions



Luminosity uncertainty ±9%
from preliminary calibration

Better calibration scans performed
end of August, not yet processed

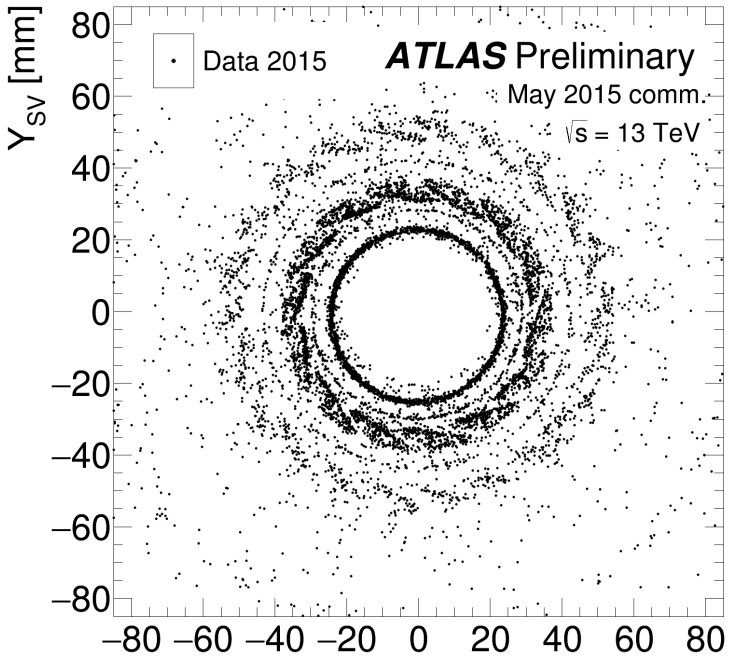
Maximum 476+476 bunches



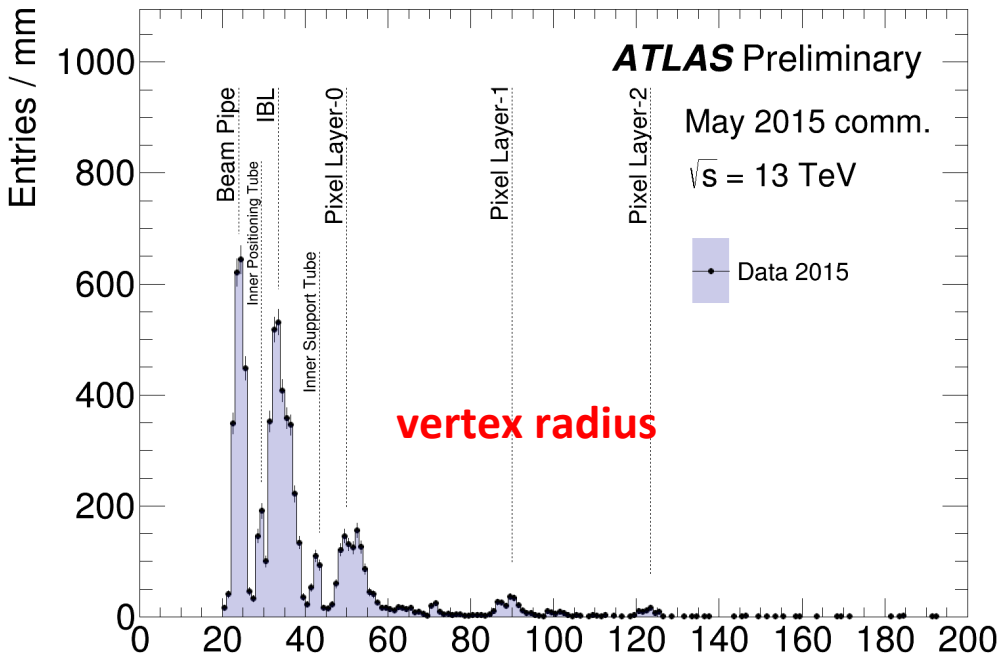
ATLAS pp run: June-August 2015

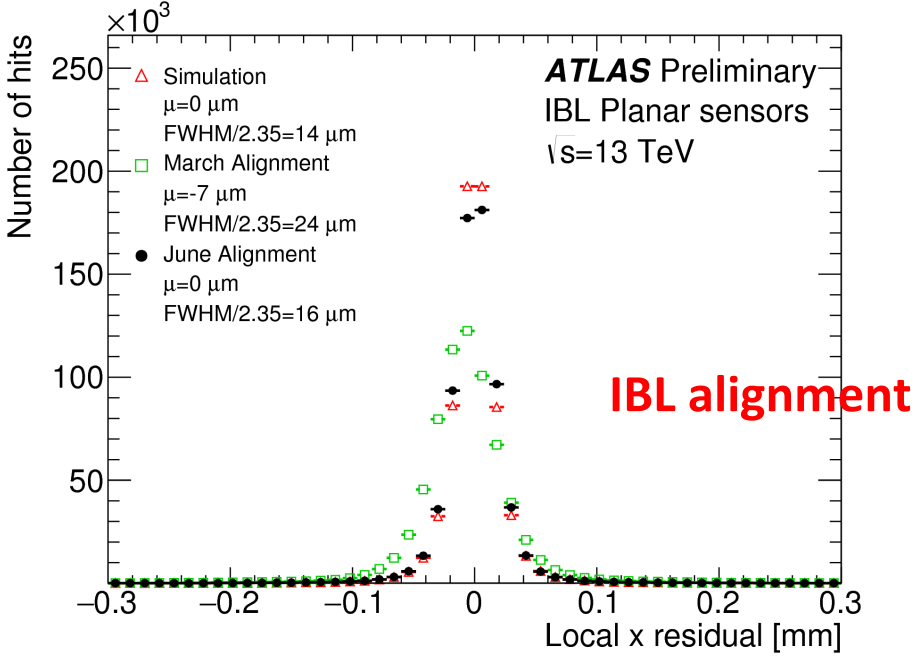
Inner Tracker			Calorimeters		Muon Spectrometer				Magnets	
Pixel	SCT	TRT	LAr	Tile	MDT	RPC	CSC	TGC	Solenoid	Toroid
98.5	99.7	100	99.1	100	100	99.3	100	100	100	99.6

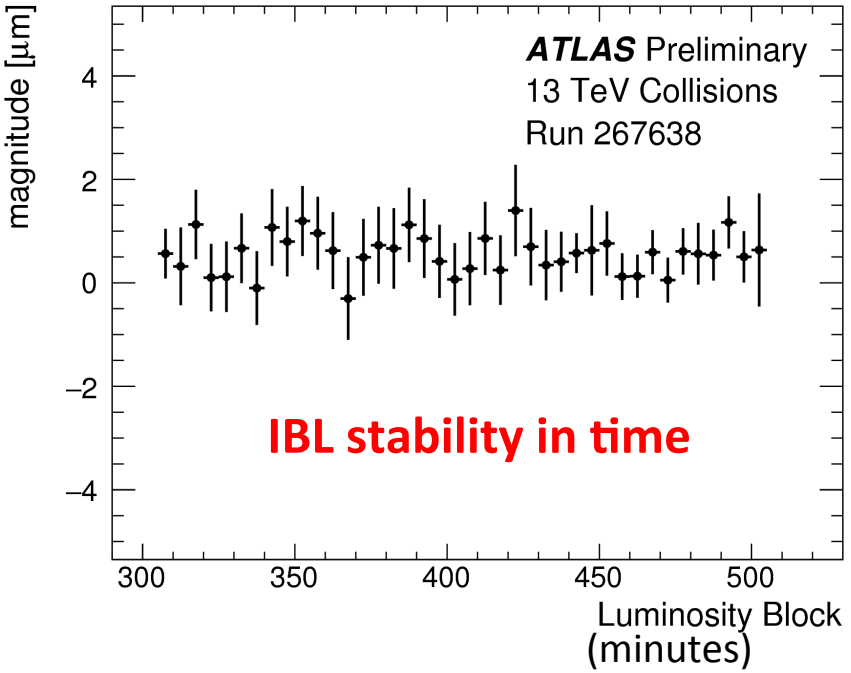
Luminosity weighted relative detector uptime (in percent) and good quality data delivery during the stable beams in pp collisions at 13 TeV between June-August 2015, corresponding to 173 pb^{-1} recorded luminosity.

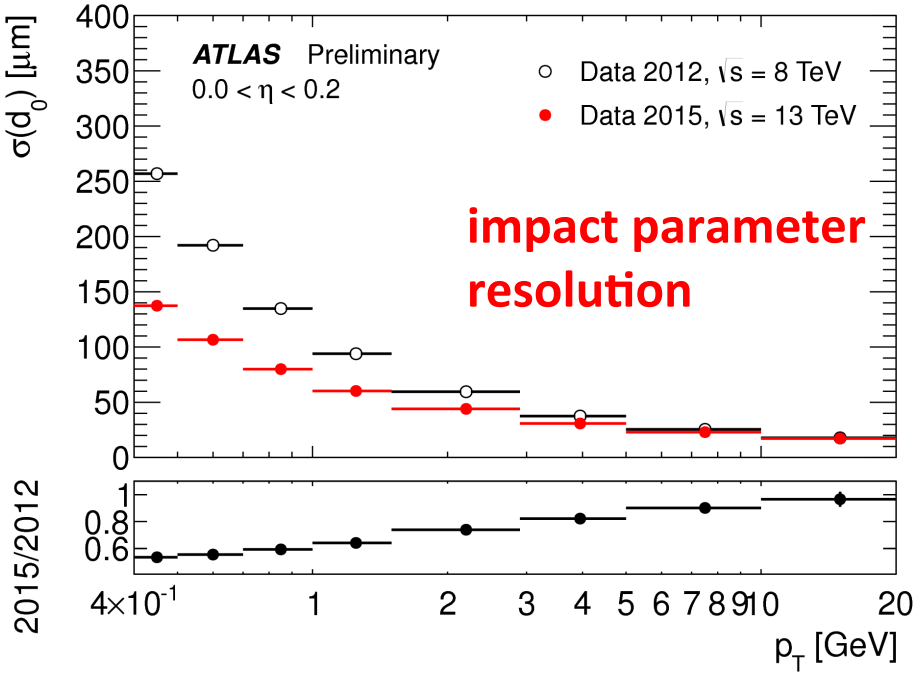


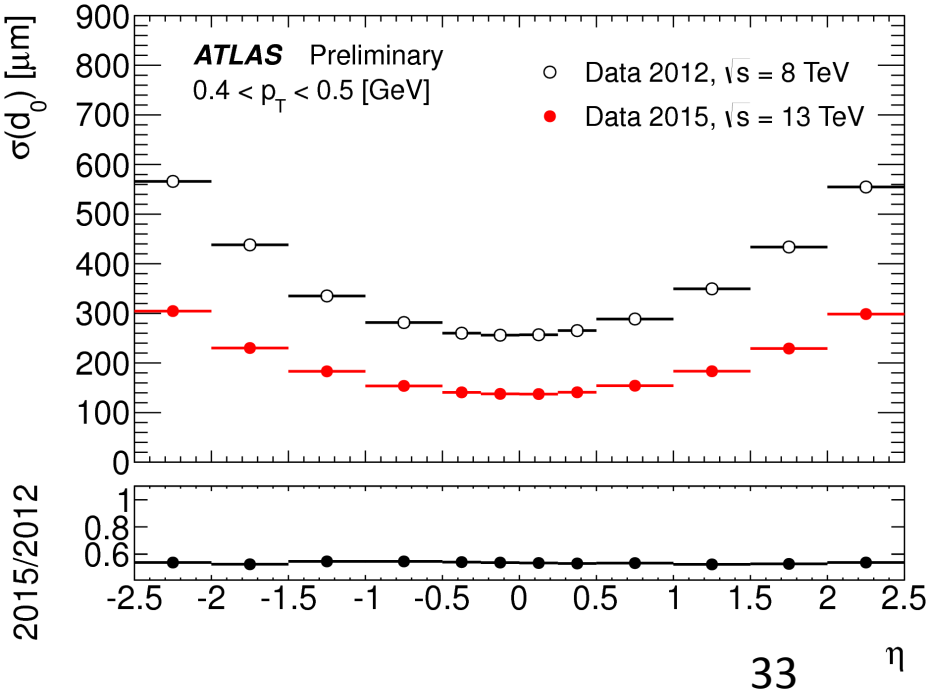
hadronic interaction vertices




ATLAS Preliminary
IBL Planar sensors
√s=13 TeV
Simulation
μ=0 μm
FWHM/2.35=14 μm
March Alignment
μ=-7 μm
FWHM/2.35=24 μm
June Alignment
μ=0 μm
FWHM/2.35=16 μm
Number of hits
Local x residual [mm]
IBL alignment

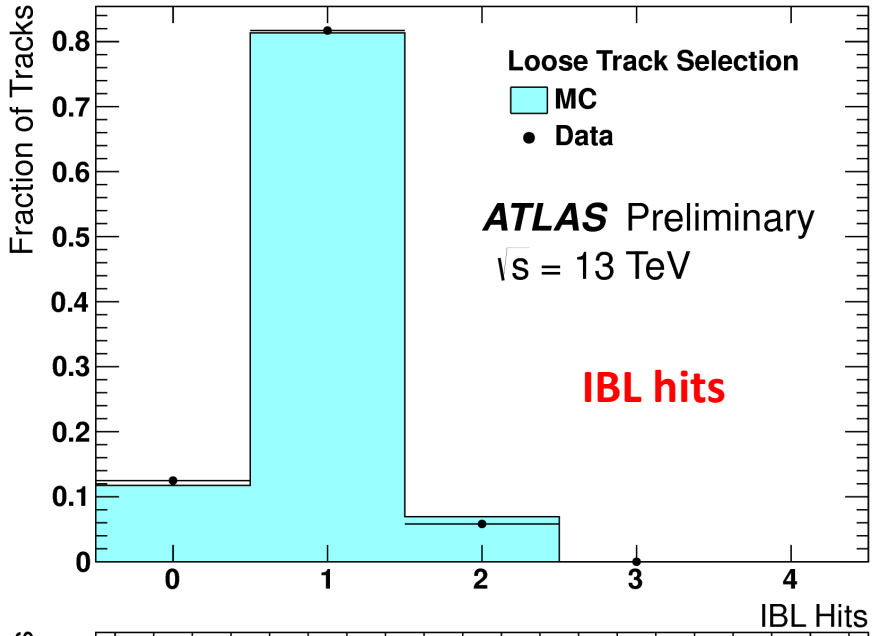

ATLAS Preliminary
13 TeV Collisions
Run 267638
magnitude [μm]
Luminosity Block
(minutes)
IBL stability in time

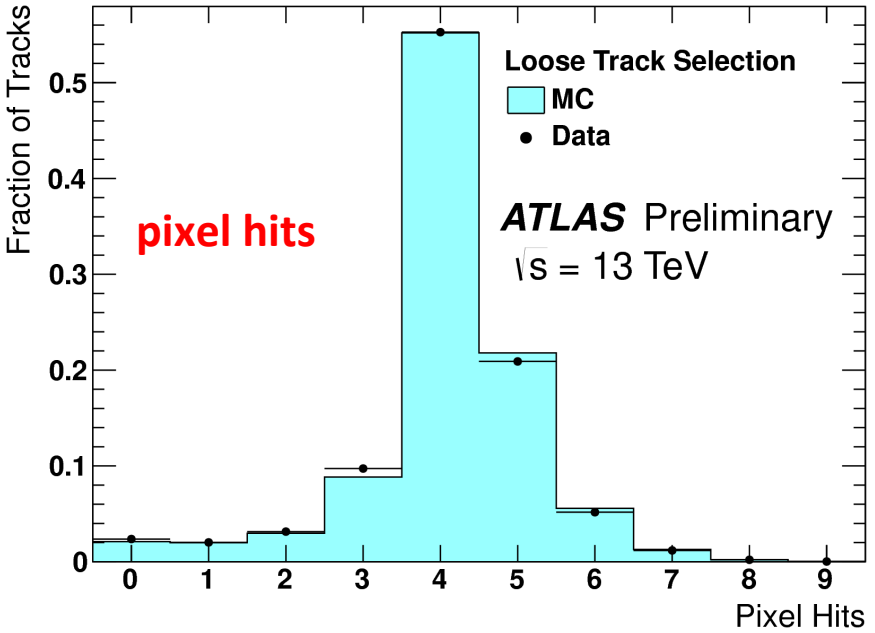

ATLAS Preliminary
0.0 < η < 0.2
Data 2012, √s = 8 TeV
Data 2015, √s = 13 TeV
σ(d0) [μm]
impact parameter resolution
2015/2012
pT [GeV]

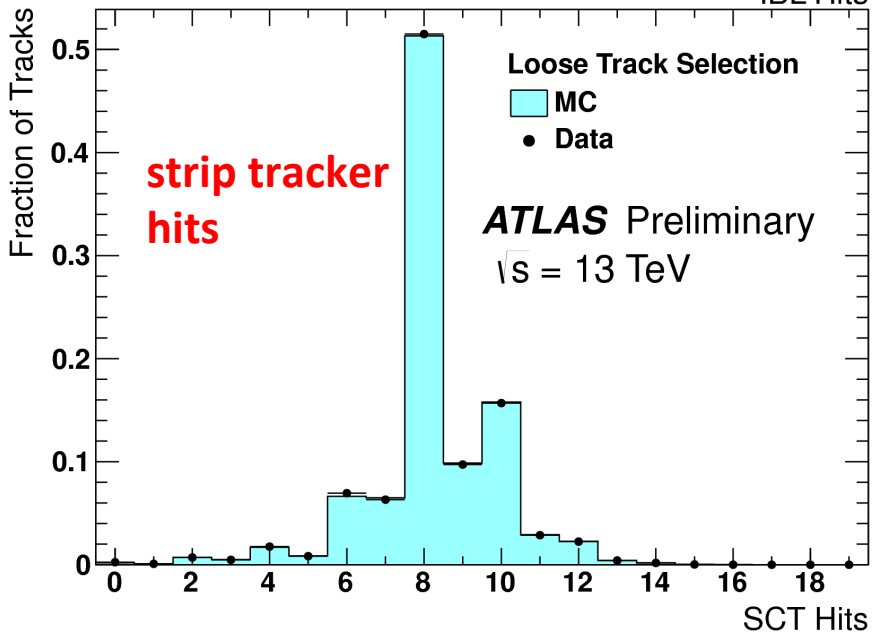

ATLAS Preliminary
0.4 < pT < 0.5 [GeV]
Data 2012, √s = 8 TeV
Data 2015, √s = 13 TeV
σ(d0) [μm]
2015/2012
η

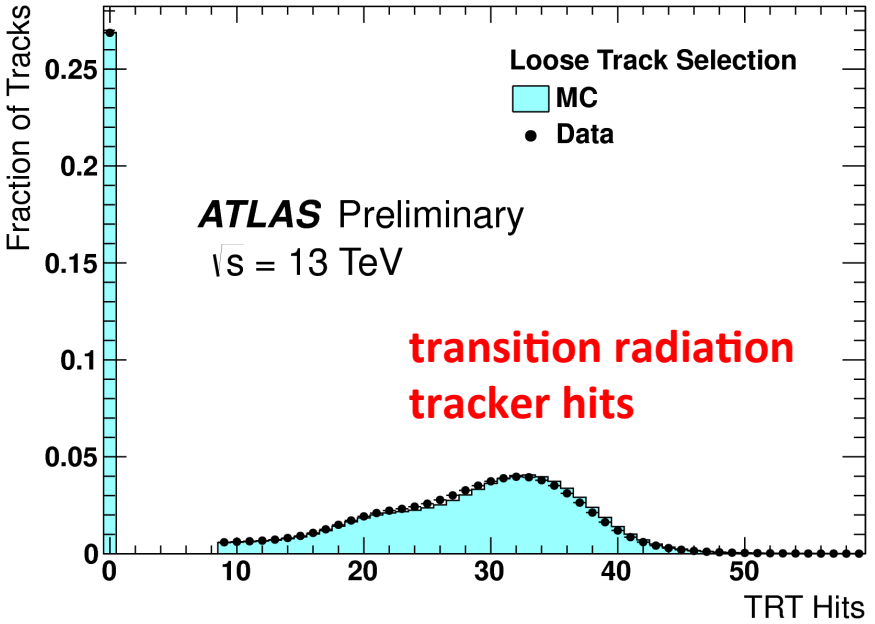
Inner Detector

ATL-PHYS-PUB-2015-018

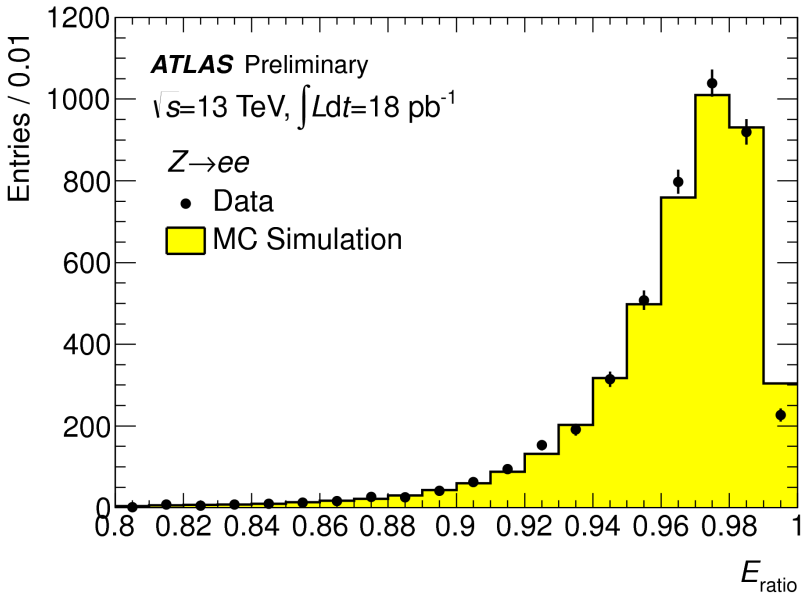


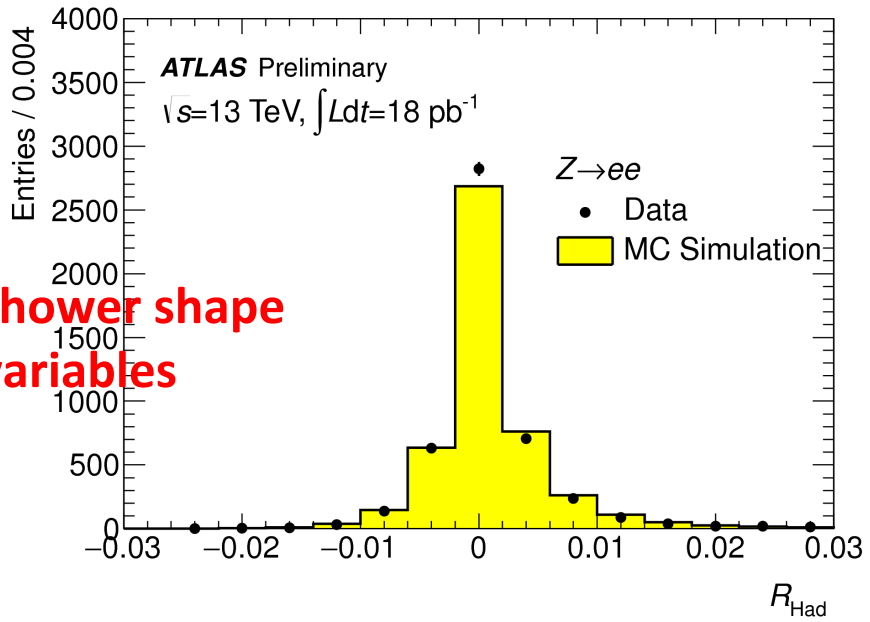




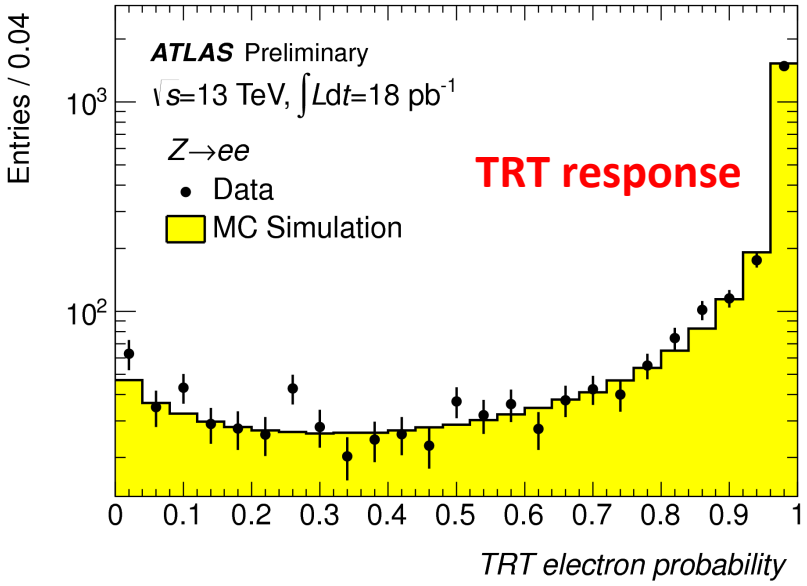


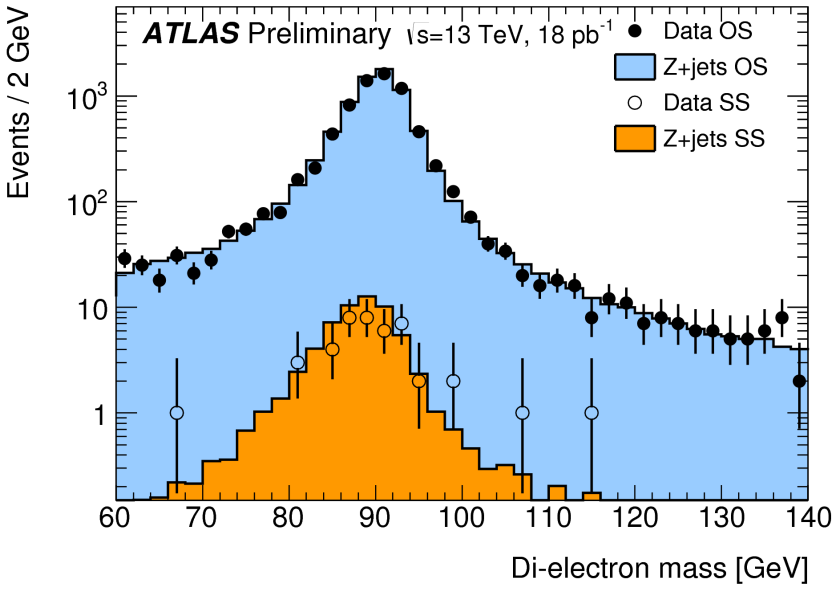
Electron reconstruction and identification

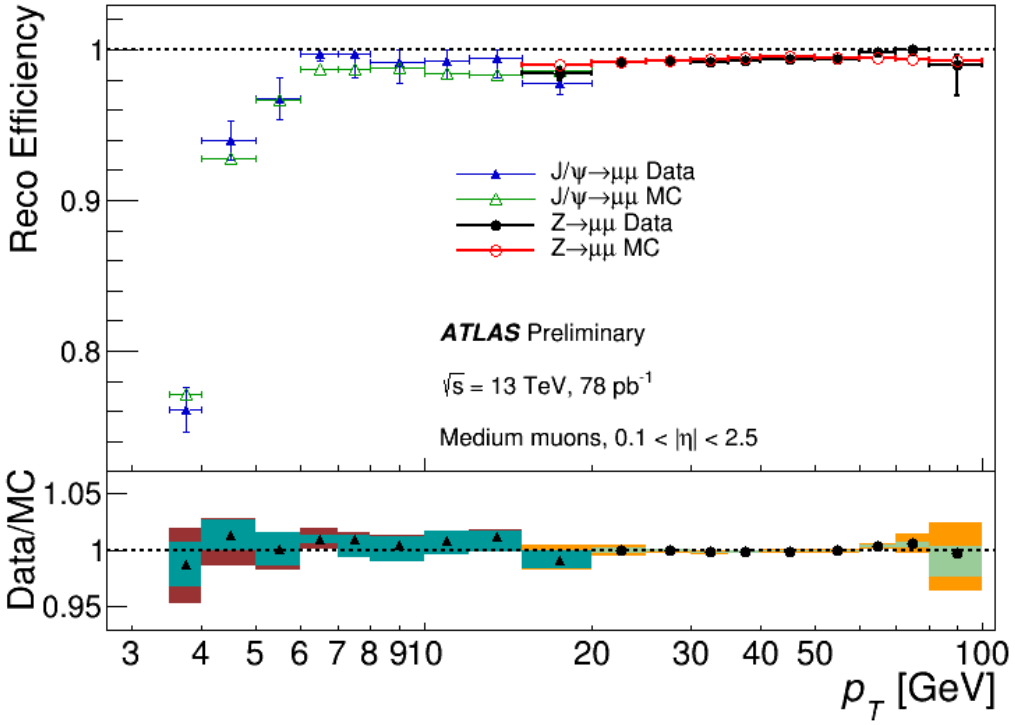




shower shape variables







Muon reconstruction

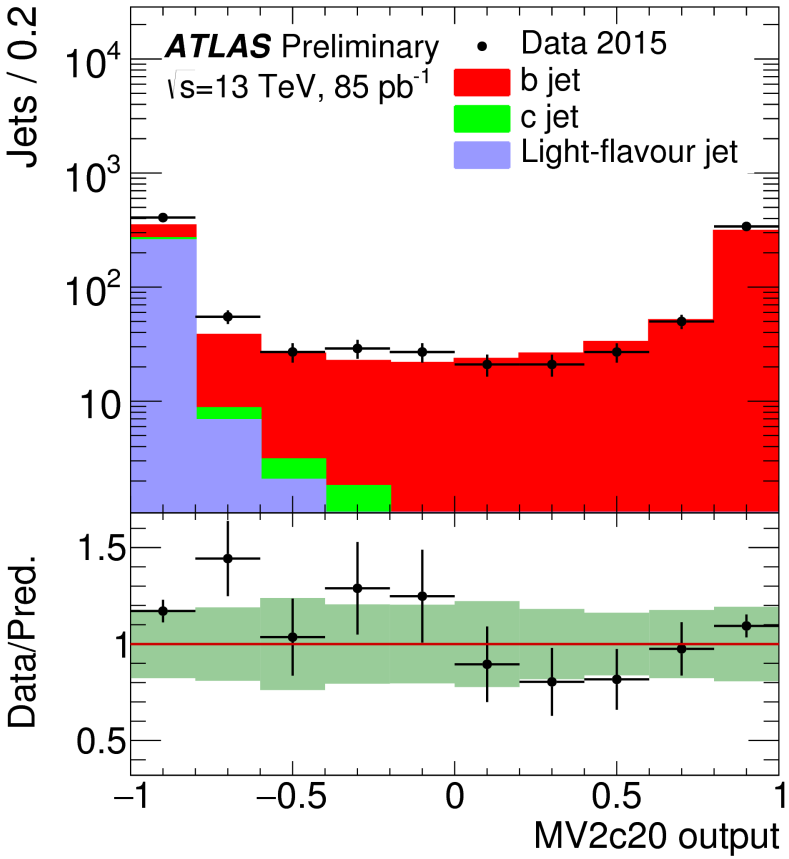
performance on data, J/ψ → μμ, Z → μμ

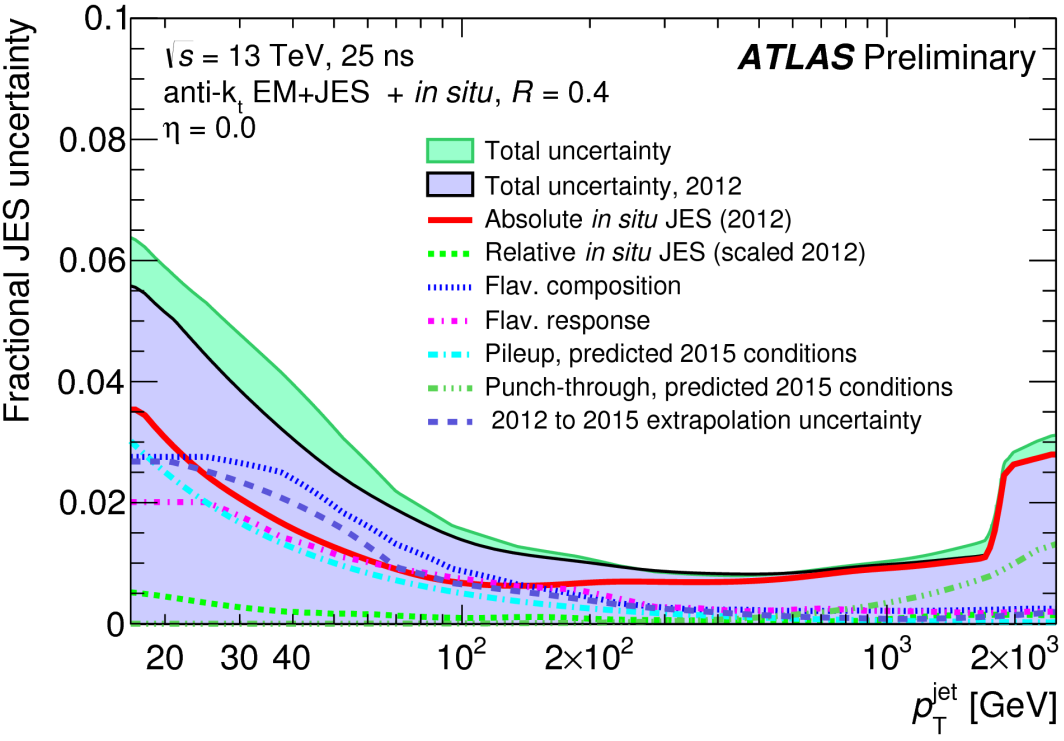
ATL-PHYS-PUB-2015-037

ATL-PHYS-PUB-2015-039

performance on data
from top quark pairs

b-tagging



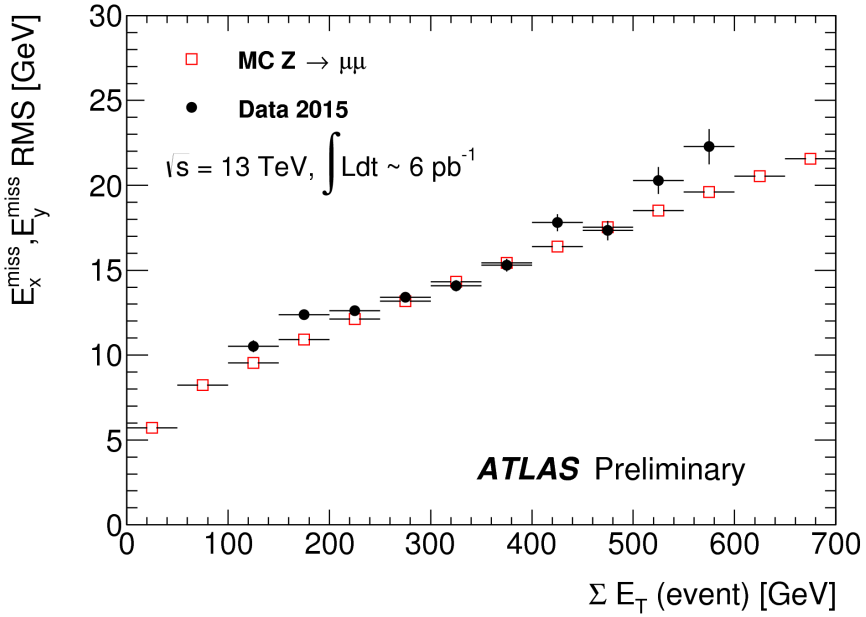


jet energy uncertainty

ATL-PHYS-PUB-2015-015

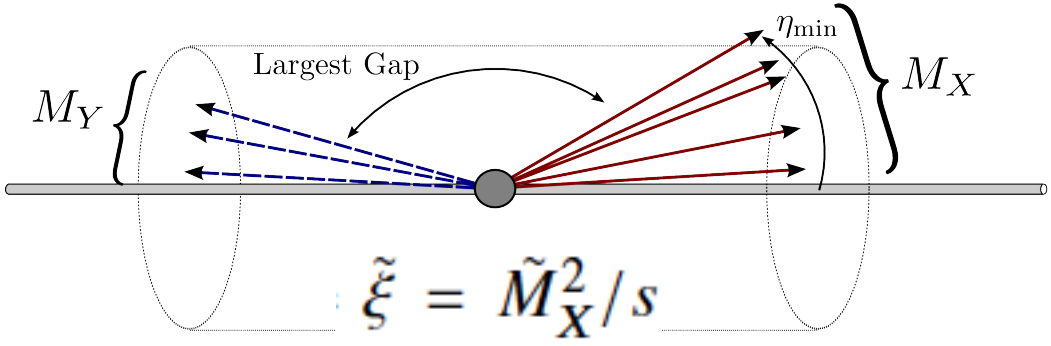
ATL-PHYS-PUB-2015-027

E_T^{miss} resolution



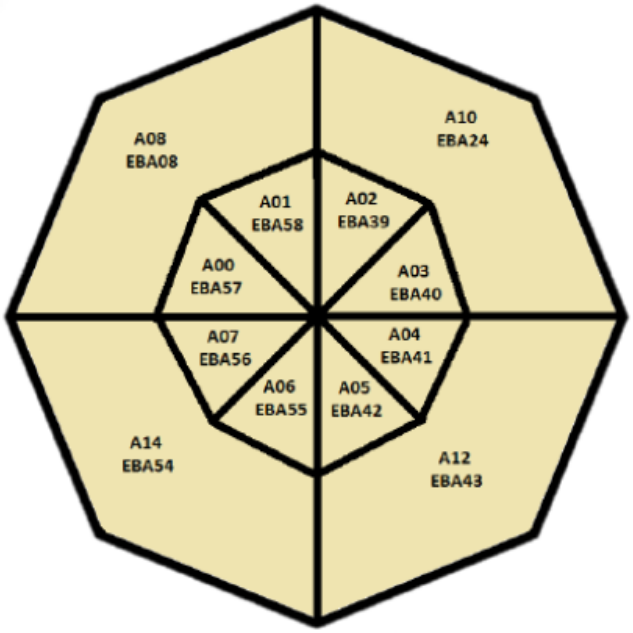
Measurement of the total inelastic cross section

63 μb^{-1} of early, low pile-up data

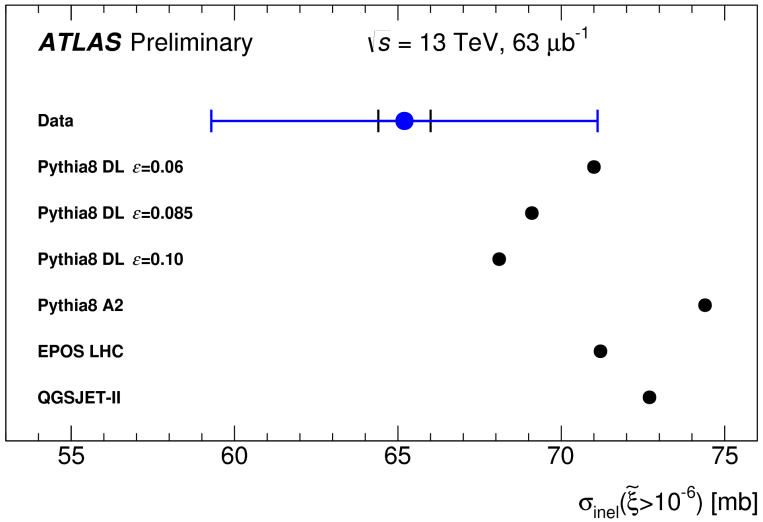


$$\sigma_{\text{inel}}(\tilde{\xi} > 10^{-6}) = \frac{N - N_{\text{BG}}}{\epsilon_{\text{trig}} \times L} \times \frac{1 - f_{\tilde{\xi}<10^{-6}}}{\epsilon_{\text{sel}}},$$

minimum bias trigger scintillators

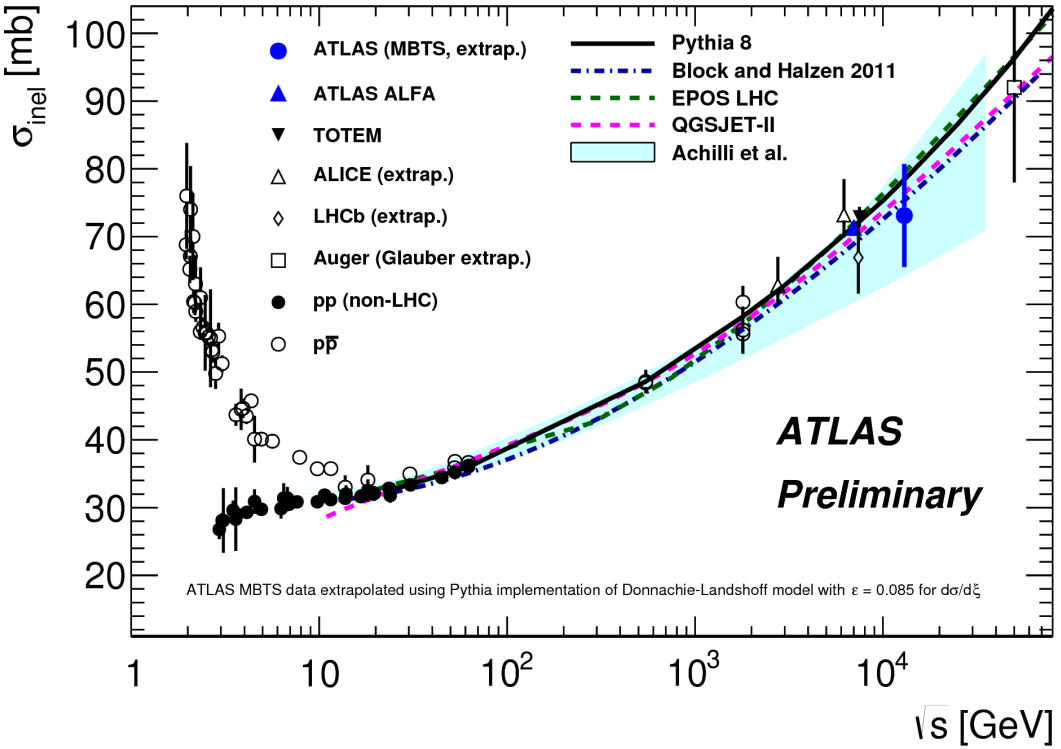


- 2cm thick discs at z=±3.6 m
- Efficiency high and uniform within ±1%
- Pseudorapidity range: 2.07<|η|<3.86
  - defines acceptance of fiducial measurement (M_X>13 GeV, ξ>10^{-6})



Measurement in fiducial region

Systematics dominated by luminosity



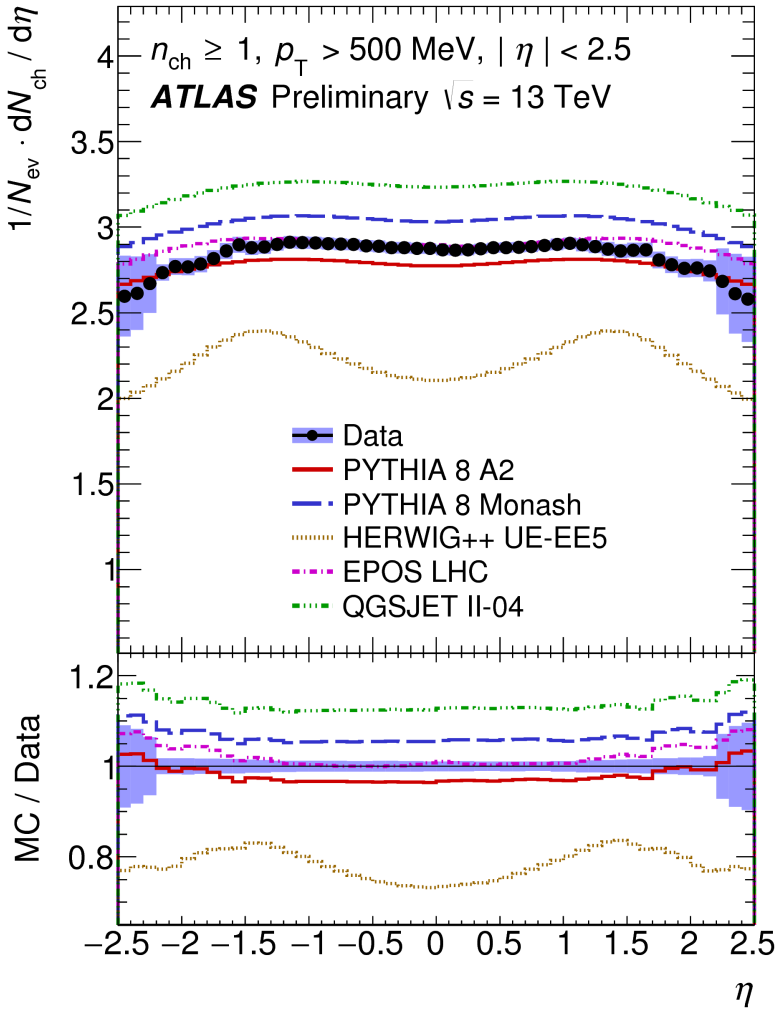
Extrapolation to full cross section

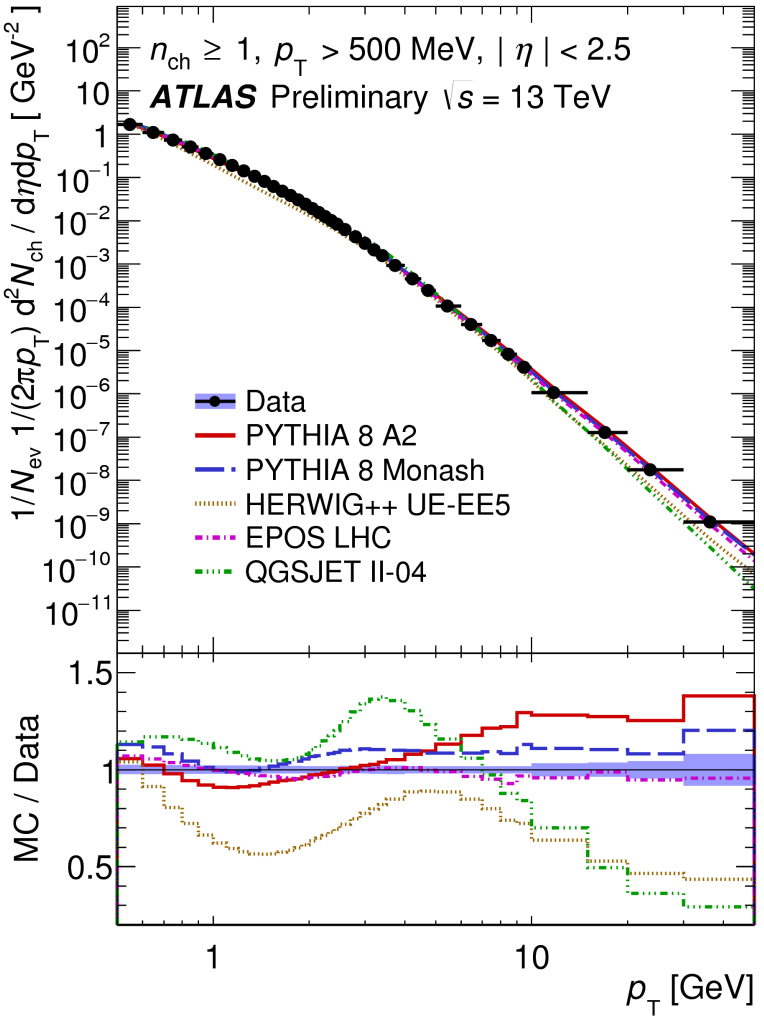
Source	Value
This measurement	73.1 ± 0.9 (exp.) ± 6.6 (lum.) ± 3.8 (extr.) mb
Pythia8	78.4 mb
Kopeliovich et al. [33]	79.8 mb
Menon et al. [34]	81.4 ± 2.0 mb
Khoze et al. [35]	81.6 mb
Gotsman [36]	81.0 mb
Fagundes [37]	77.2 mb

ATLAS-CONF-2015-028

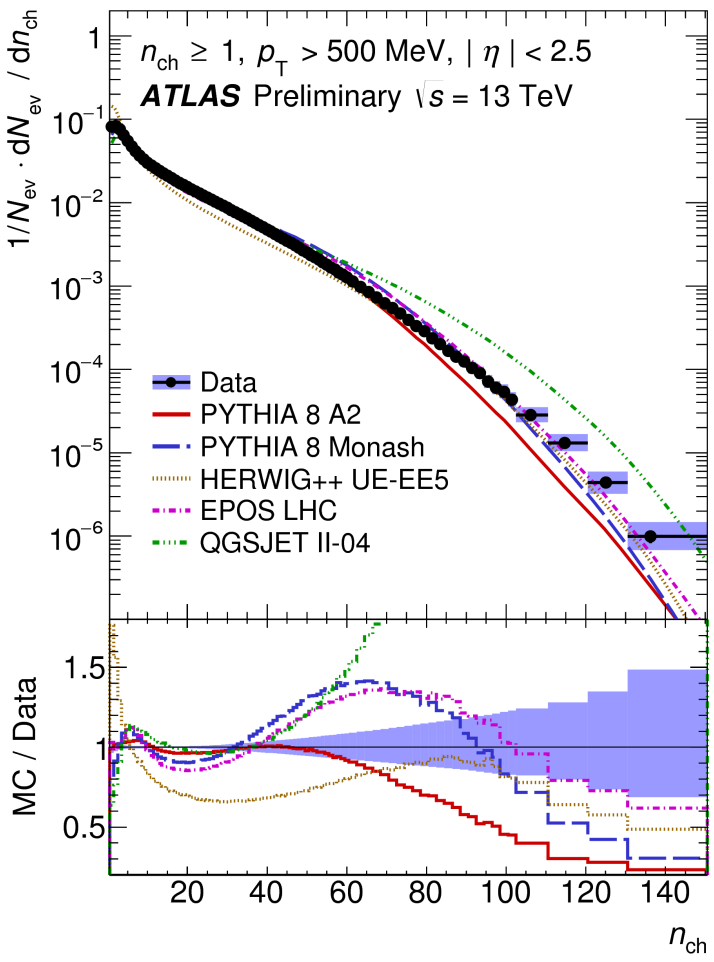
Charged particle multiplicity at 13 TeV

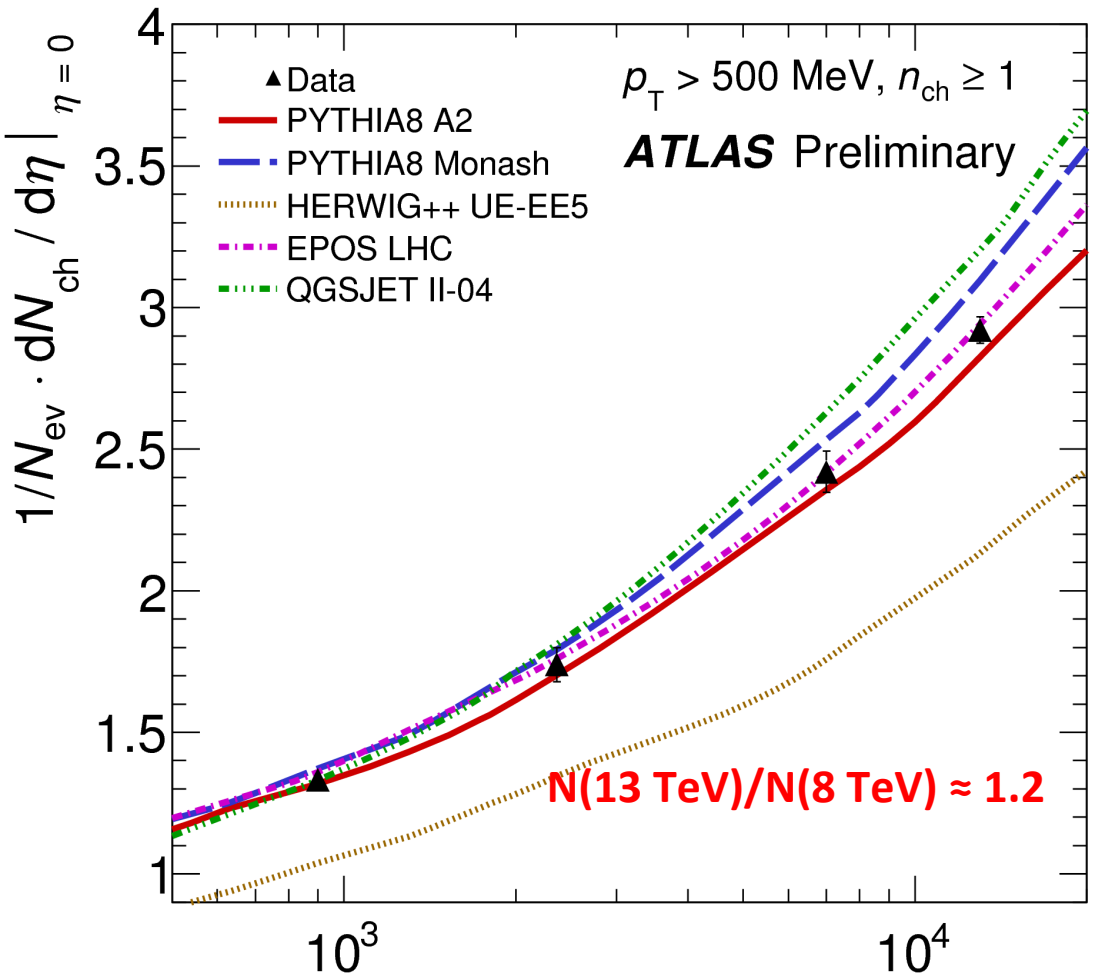
170 μb^{-1} of early low pile-up data, triggered by MBTS counters (ε>99%)
≥1 track with p_T > 500 MeV and |η| < 2.5, vertex ≥ 2 tracks





Charged particle multiplicity distribution, and evolution with √s





Systematic uncertainties: track&vertex efficiency, material, trigger, unfolding, corrections

Underlying event studies with tracks

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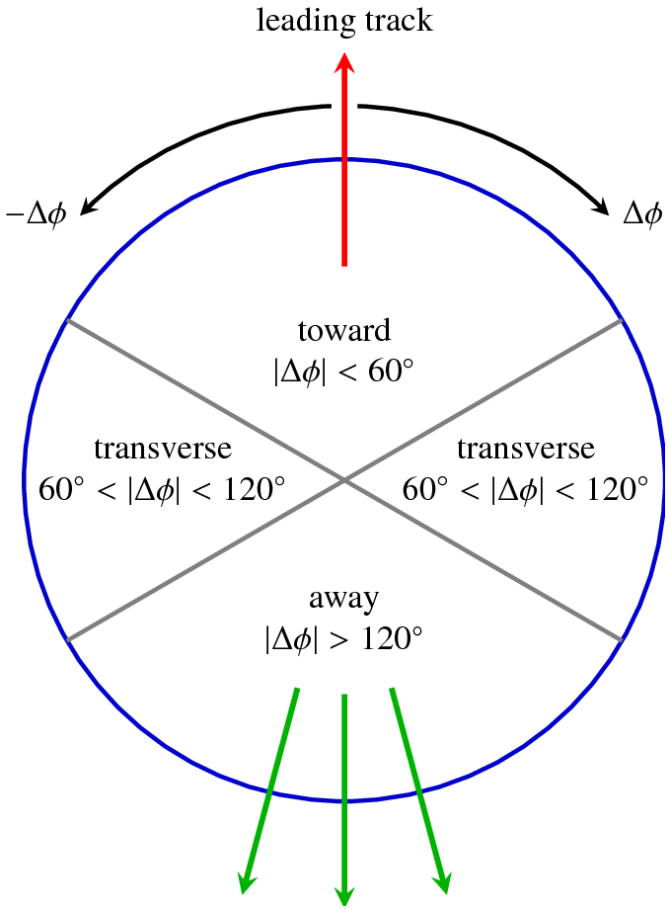
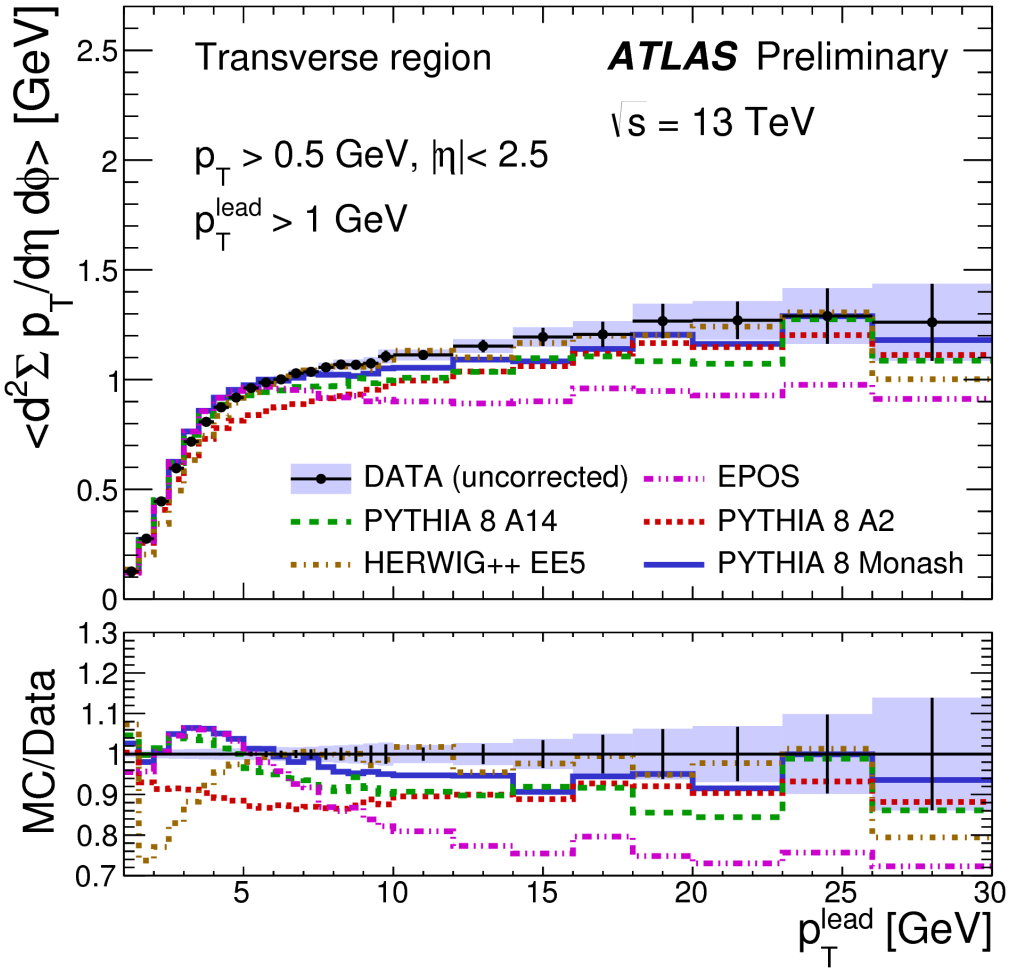
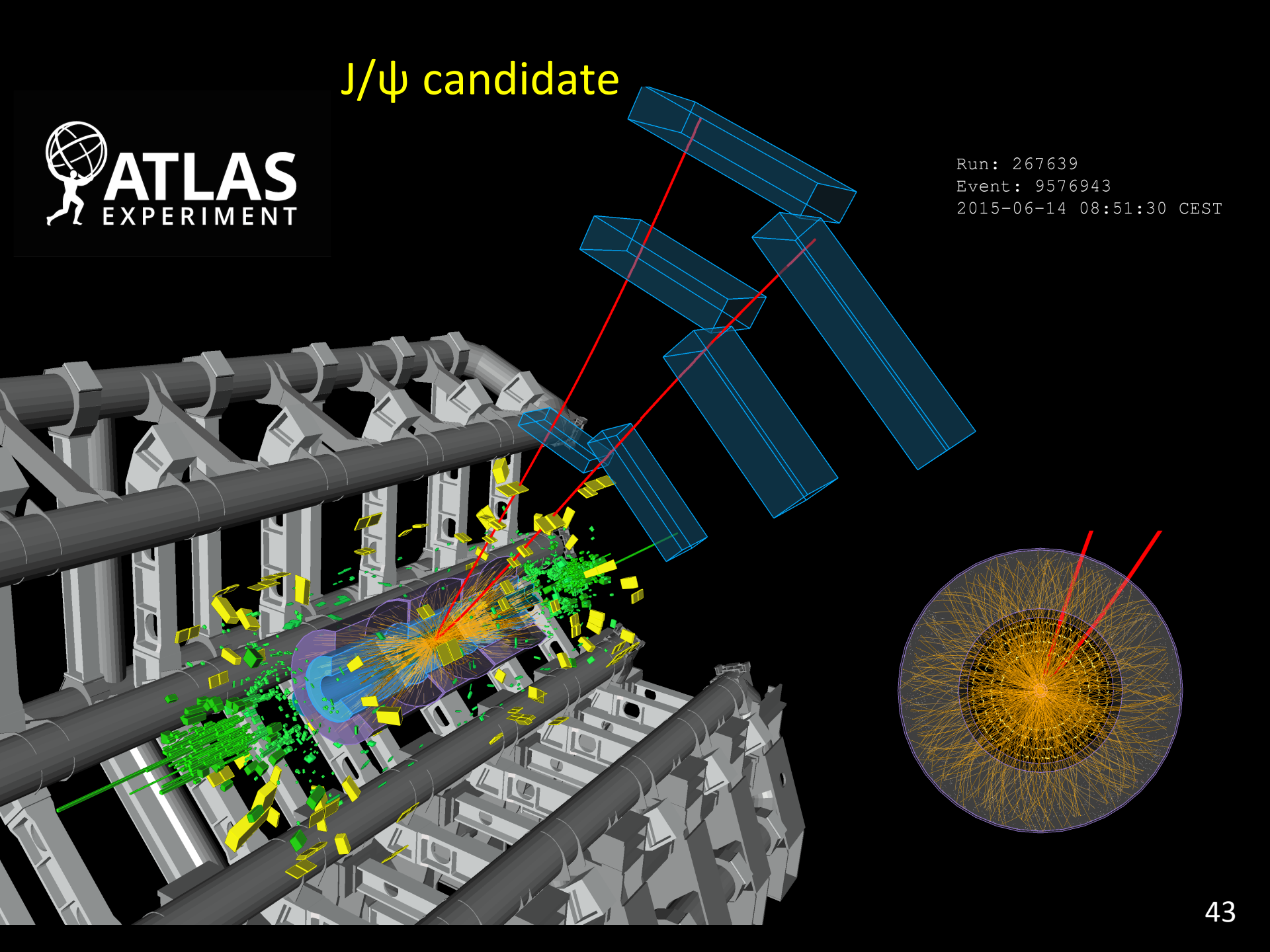


scalar sum of track p_T per unit η-ϕ



Valuable input for further generator tuning

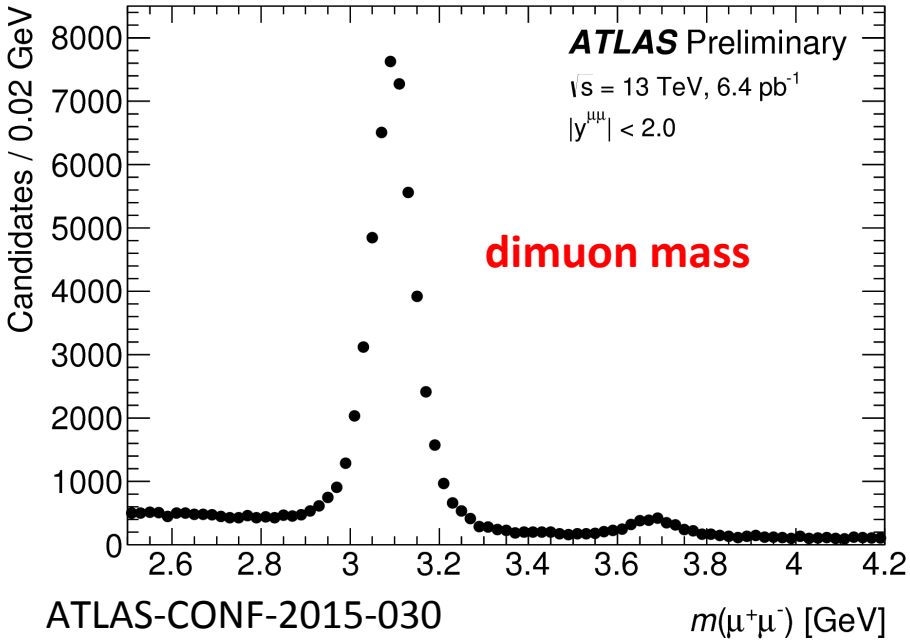
J/ψ candidate

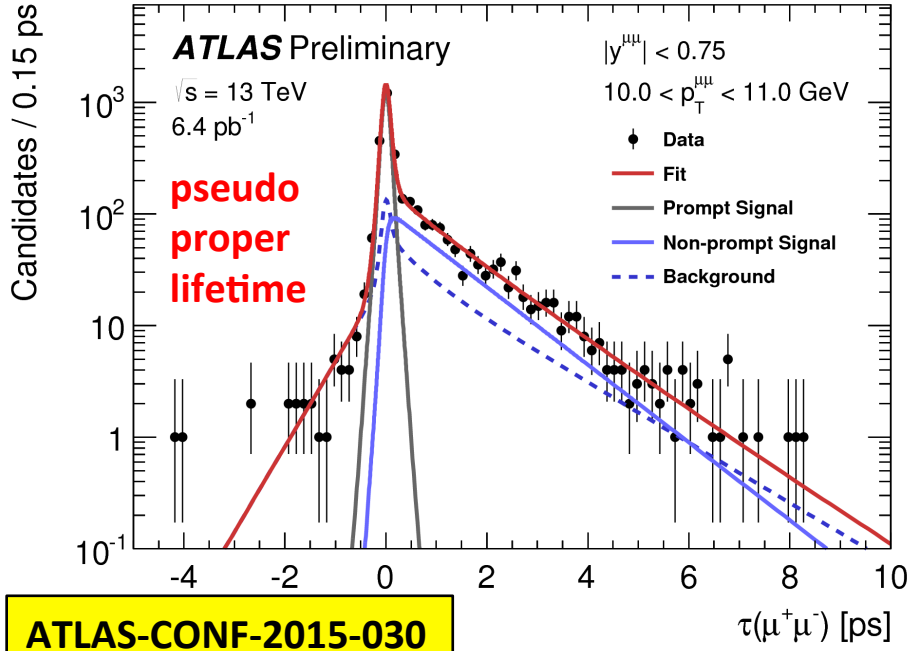


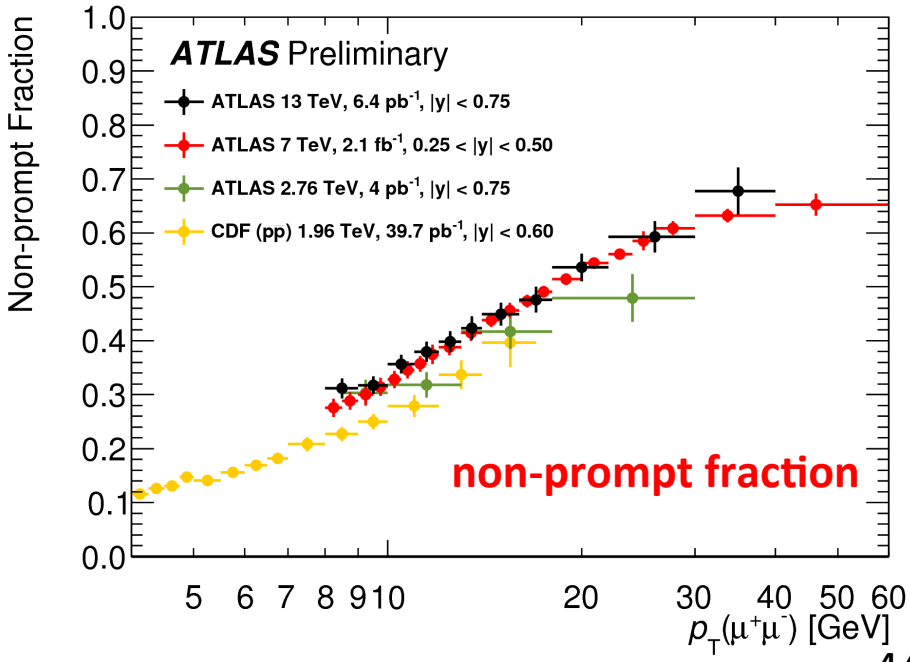
Measurement of non-prompt fraction of J/ψ (i.e. from b-decay)

6.4 pb^{-1} of data
Triggered by single μ p_T > 14 GeV
or di-μ p_T > 4 GeV

Opposite sign dimuons
Pseudo proper lifetime $\tau = L_{xy}\,(m_{\mu\mu}/p_T)$

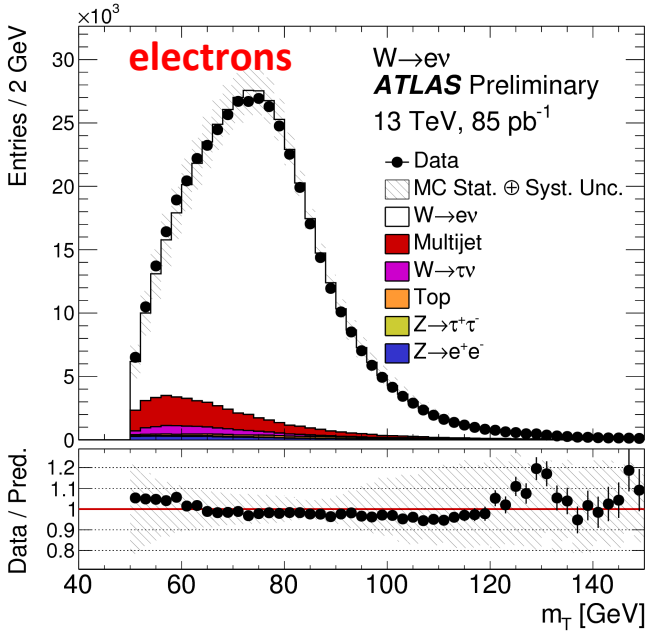


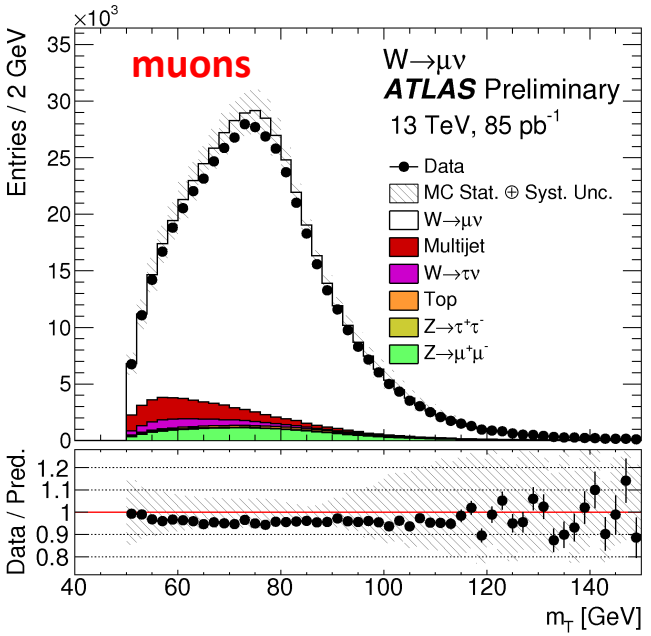




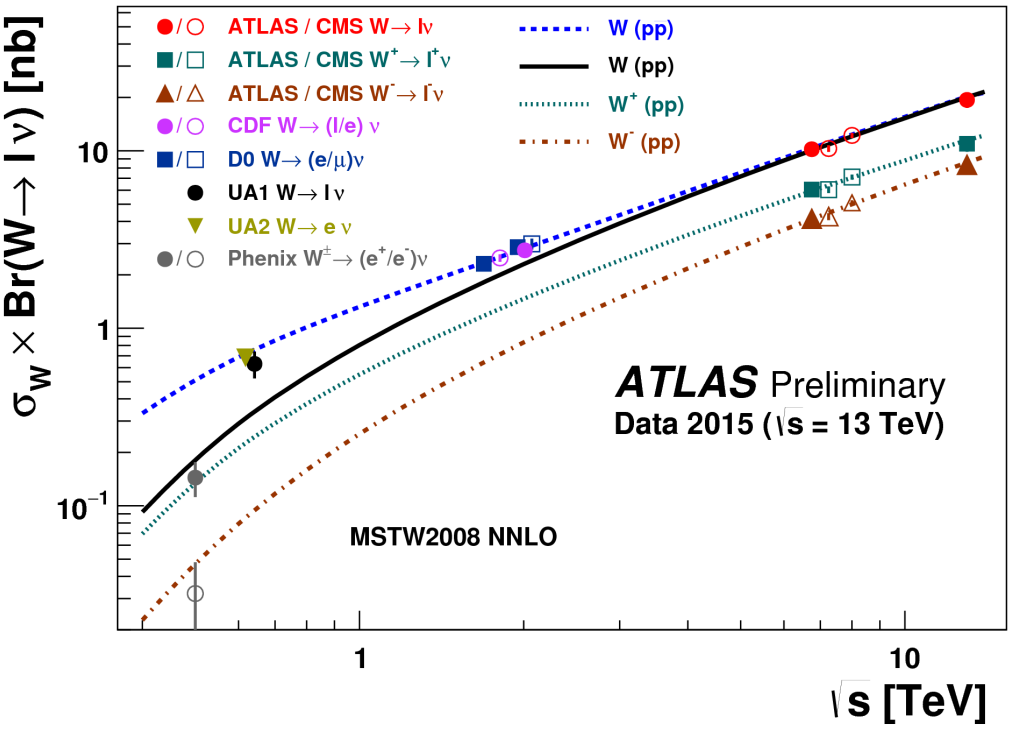
W production

85 pb^{-1}
$p_T^{l,\nu} > 25$ GeV
$|\eta_l| < 2.5$
$m_T > 50$ GeV

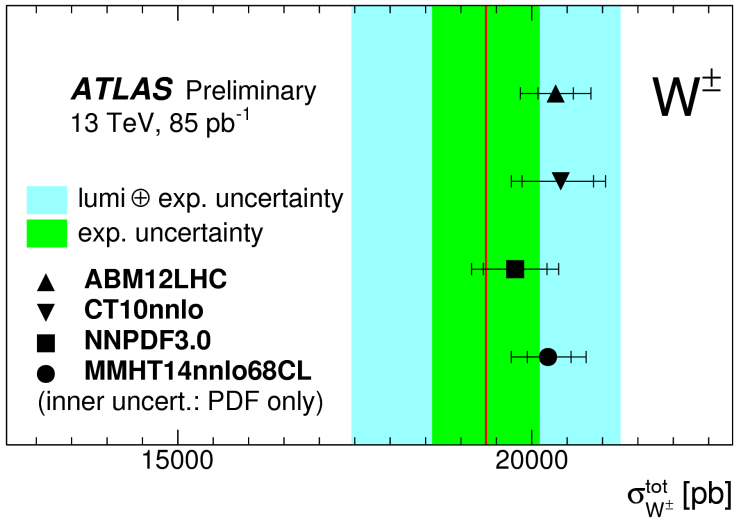




ATLAS-CONF-2015-039

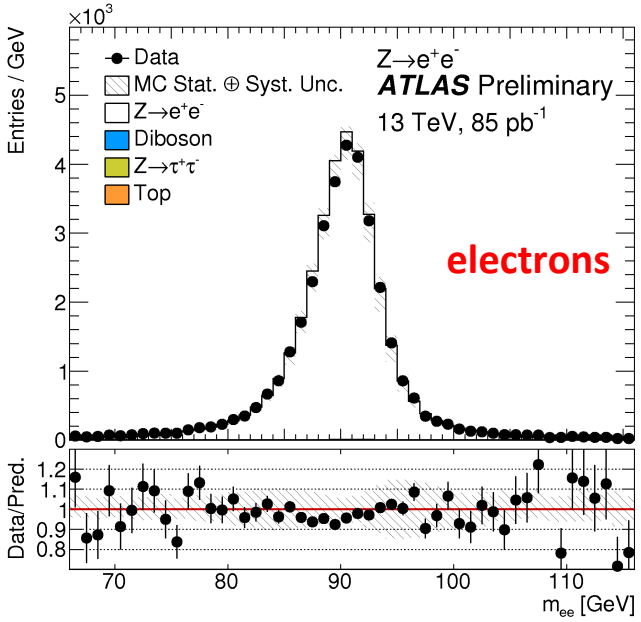


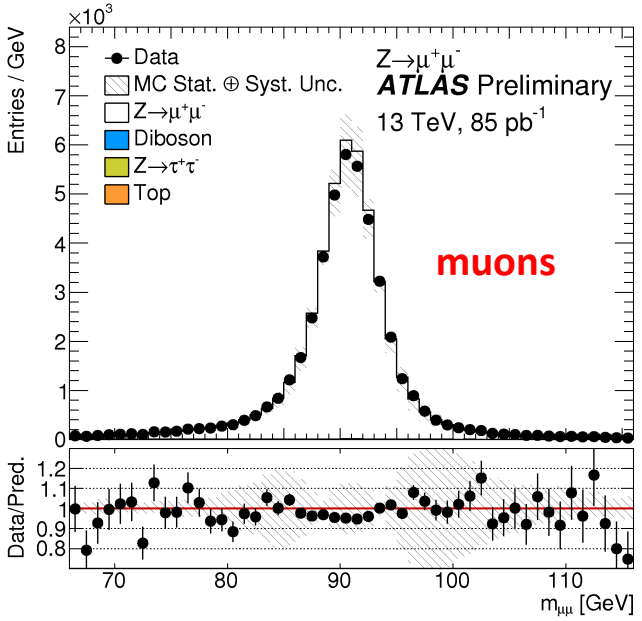
total cross section



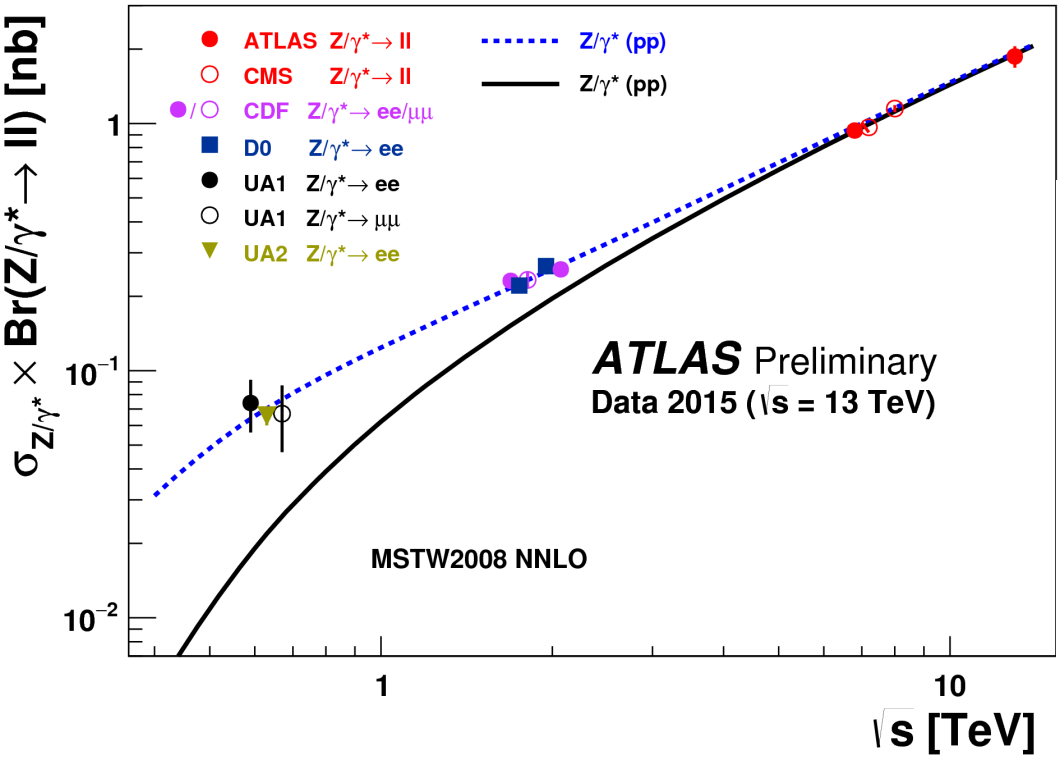
Z production

85 pb^{-1}
$p_T^l > 25$ GeV
$|\eta_l| < 2.5$
$66 < m_{ll} < 116$ GeV

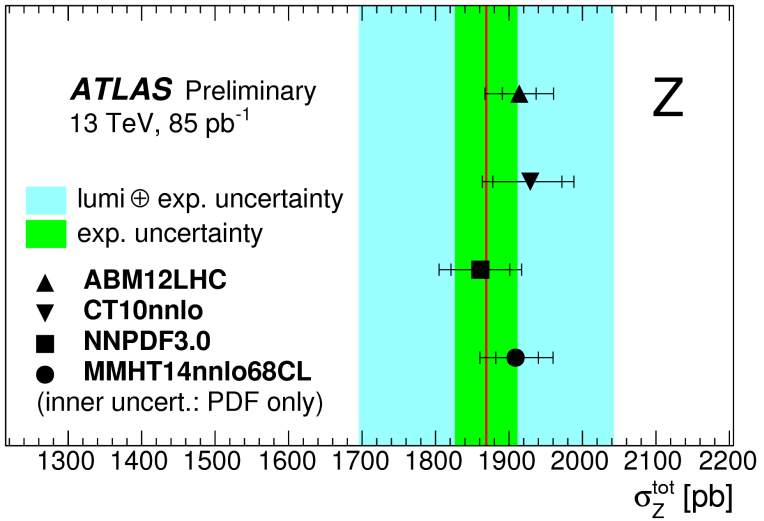




ATLAS-CONF-2015-039



total cross section

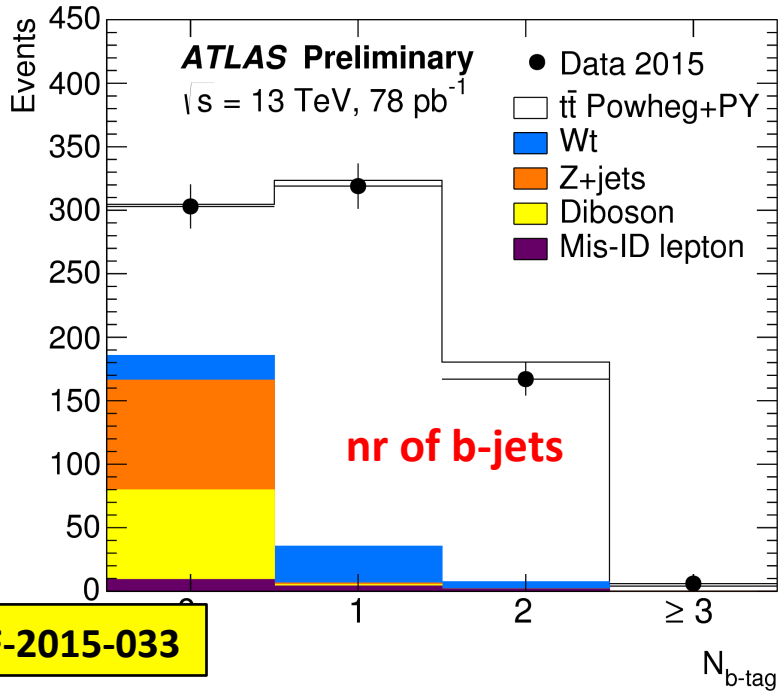


Top-quark pair production at 13 TeV

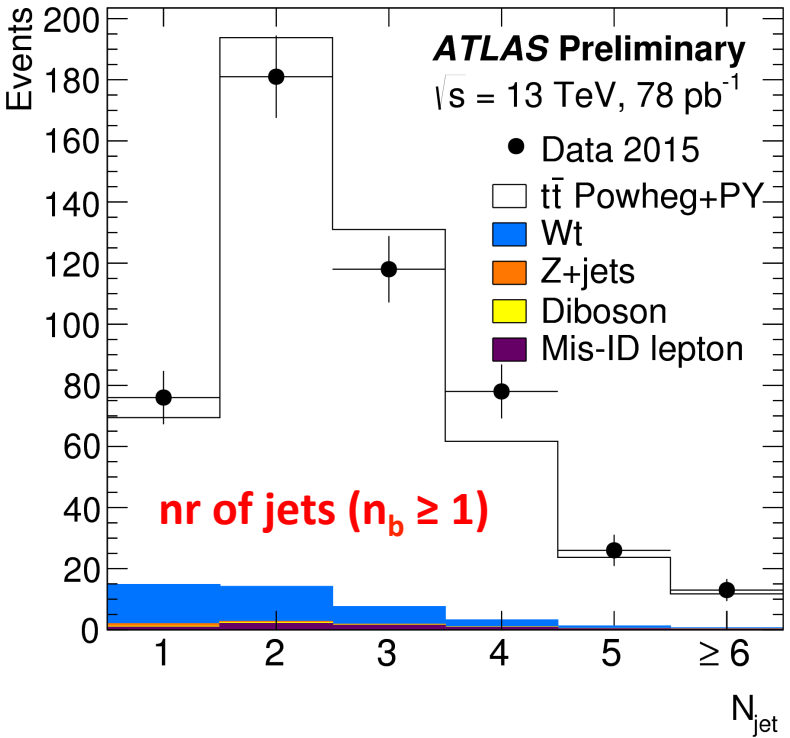
$$t\bar{t} \rightarrow W^+bW^-\bar{b} \rightarrow e^+\mu^-\nu\bar{\nu}b\bar{b}$$

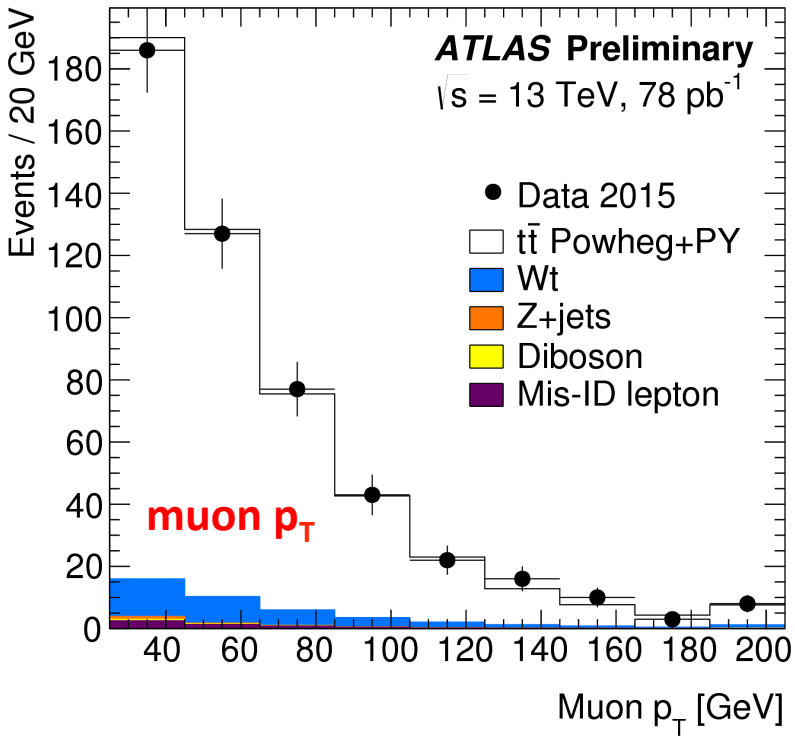
e and μ, p_T > 25 GeV, ≥ 1 b-tagged jet, 78 pb^{-1}

Event counts	N_1	N_2
Data	319	167
Wt single top	29.0 ± 3.8	5.6 ± 2.0
Dibosons	1.1 ± 0.2	0.0 ± 0.0
$Z(\rightarrow \tau\tau \rightarrow e\mu)$+jets	1.3 ± 0.7	0.1 ± 0.1
Misidentified leptons	6.0 ± 3.9	2.8 ± 2.9
Total background	37.3 ± 5.5	8.5 ± 3.5



ATLAS-CONF-2015-033



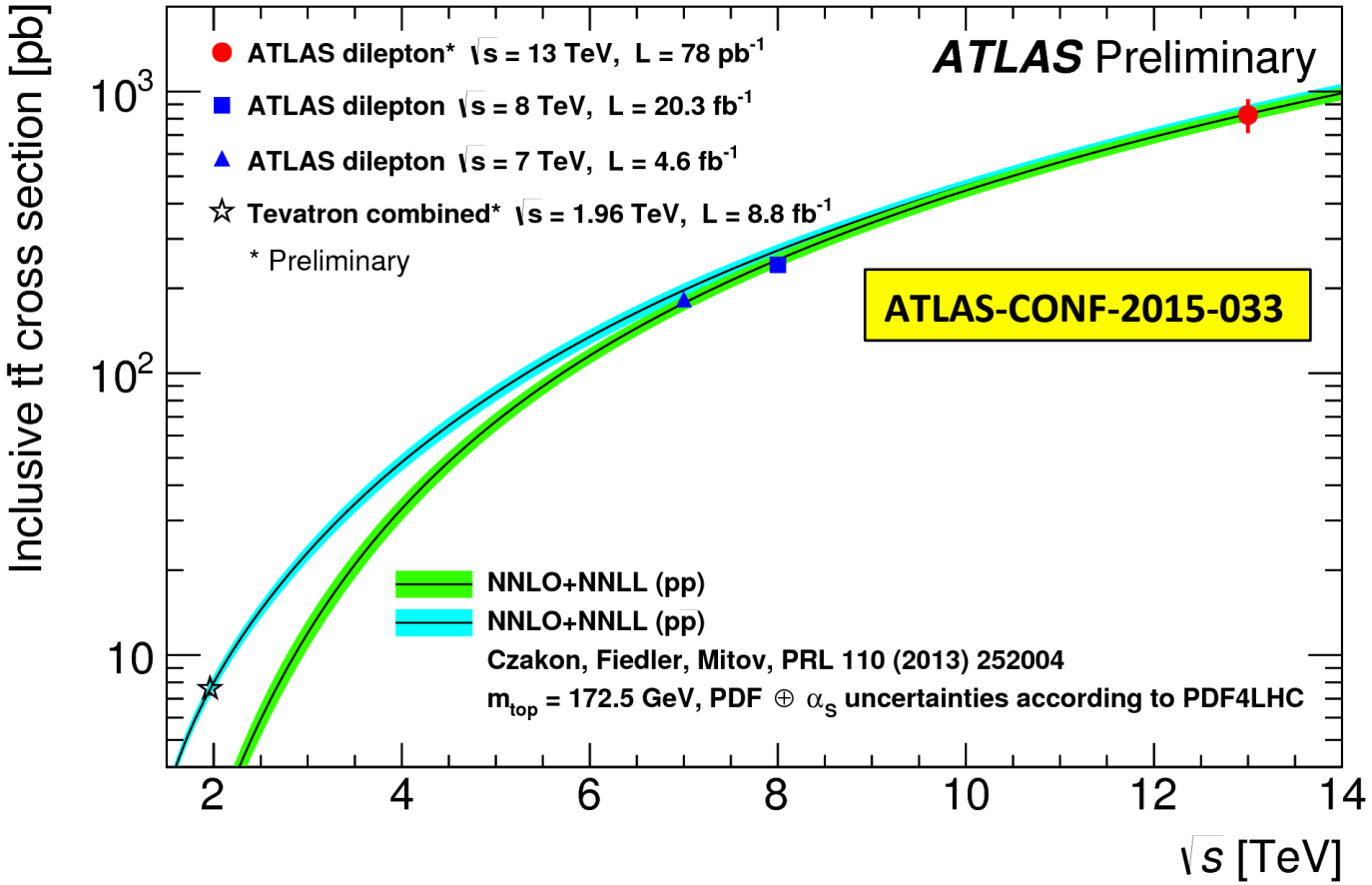


1 b-tagged jet: $N_1 = L\sigma_{t\bar{t}}\,\epsilon_{e\mu} 2\epsilon_b(1 - C_b\epsilon_b) + N_1^{\mathrm{bkg}}$

2 b-tagged jets: $N_2 = L\sigma_{t\bar{t}}\,\epsilon_{e\mu} C_b\epsilon_b^{\,2} + N_2^{\mathrm{bkg}}$

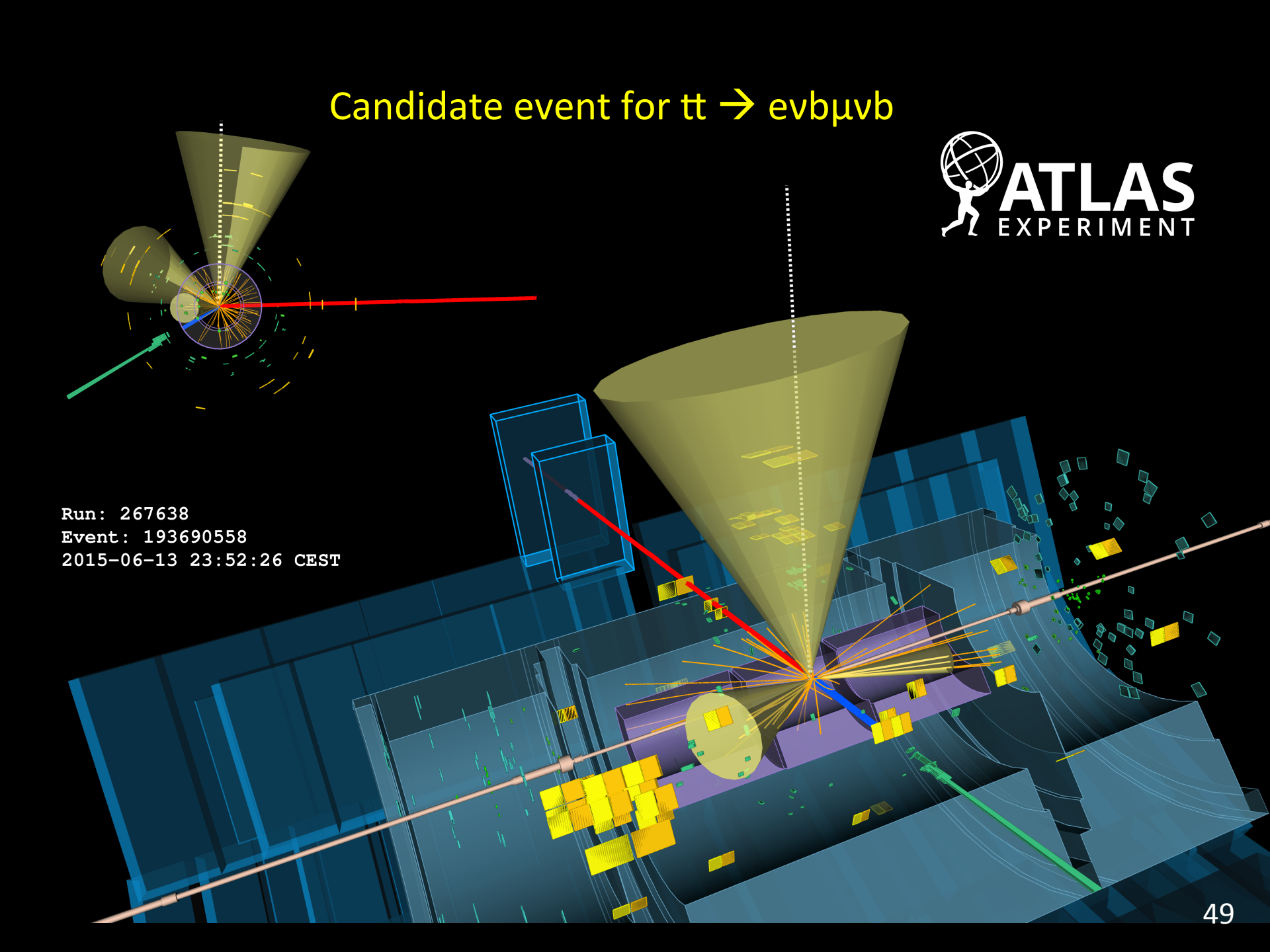
$\epsilon_b = 0.527 \pm 0.026 \pm 0.006$ (in simulation: 0.543)

$\sigma_{t\bar{t}} = 825 \pm 49\ (\mathrm{stat}) \pm 60\ (\mathrm{syst}) \pm 83\ (\mathrm{lumi})\ \mathrm{pb}$



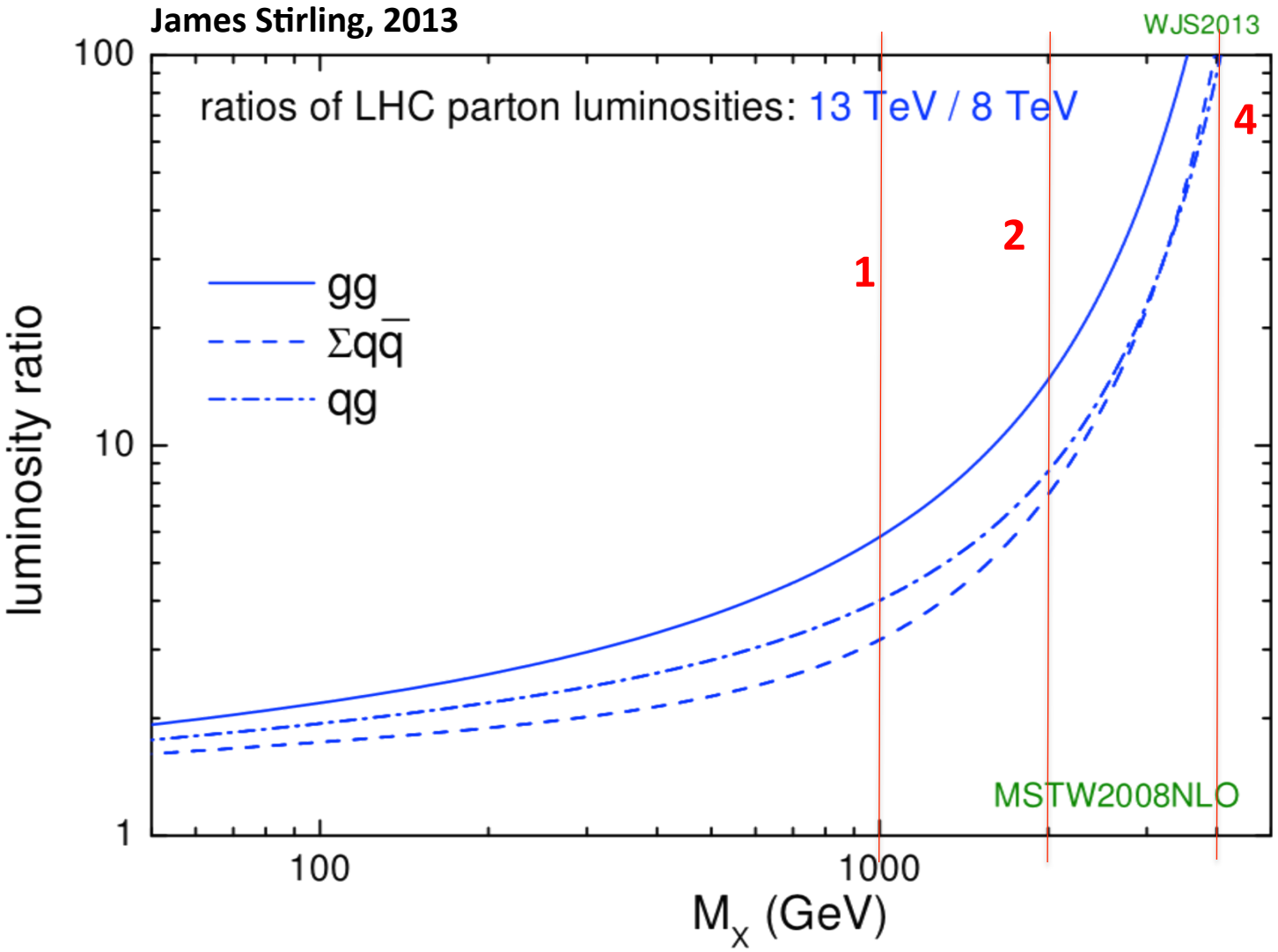
Systematics:
luminosity
signal modelling
pdfs
lepton identification

Candidate event for tt → evbμvb

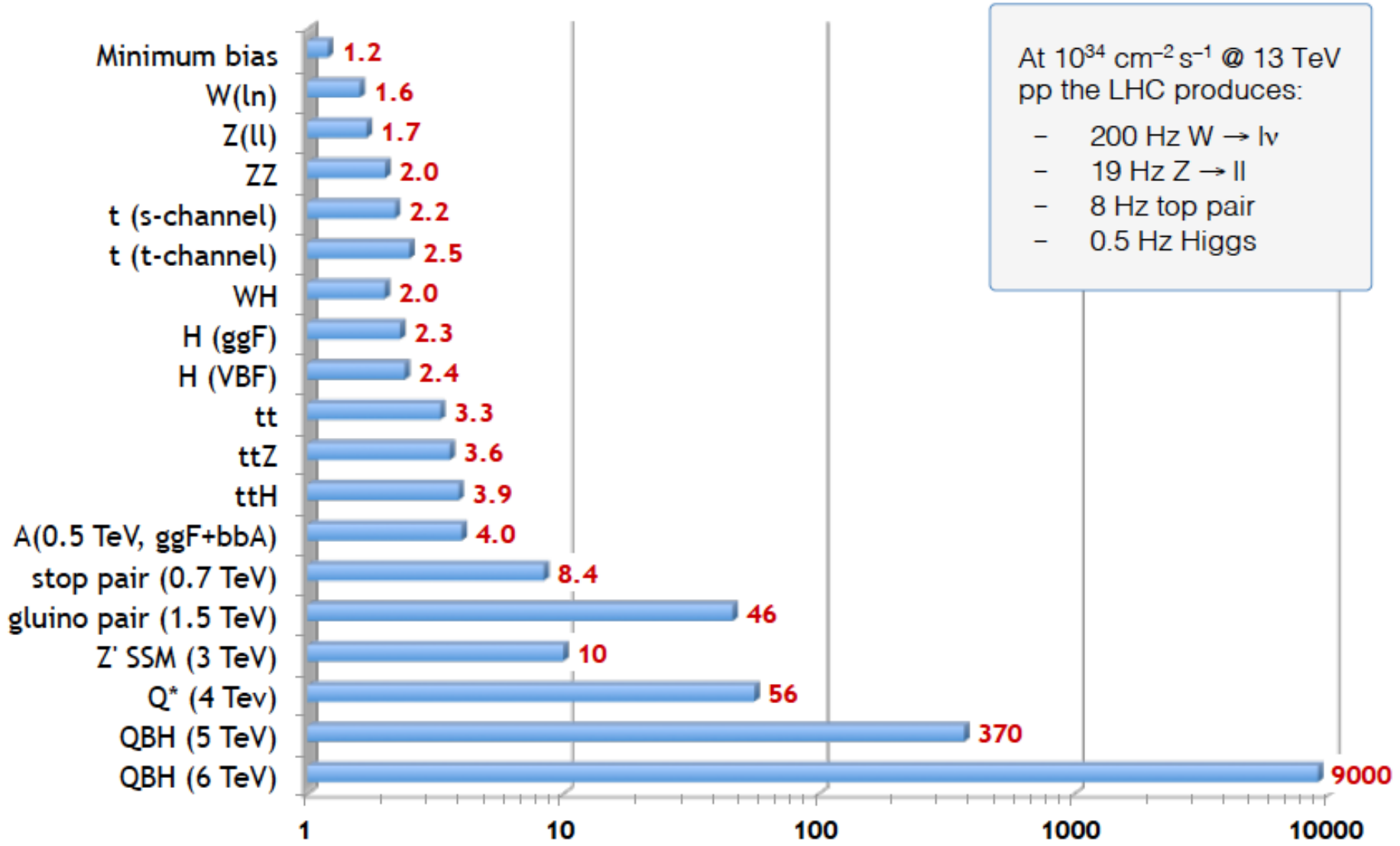


New particle searches at 13 TeV

13/8 TeV parton luminosity ratio determines sensitivity



13 TeV / 8 TeV inclusive pp cross-section ratio



Andreas Hoecker, 2014

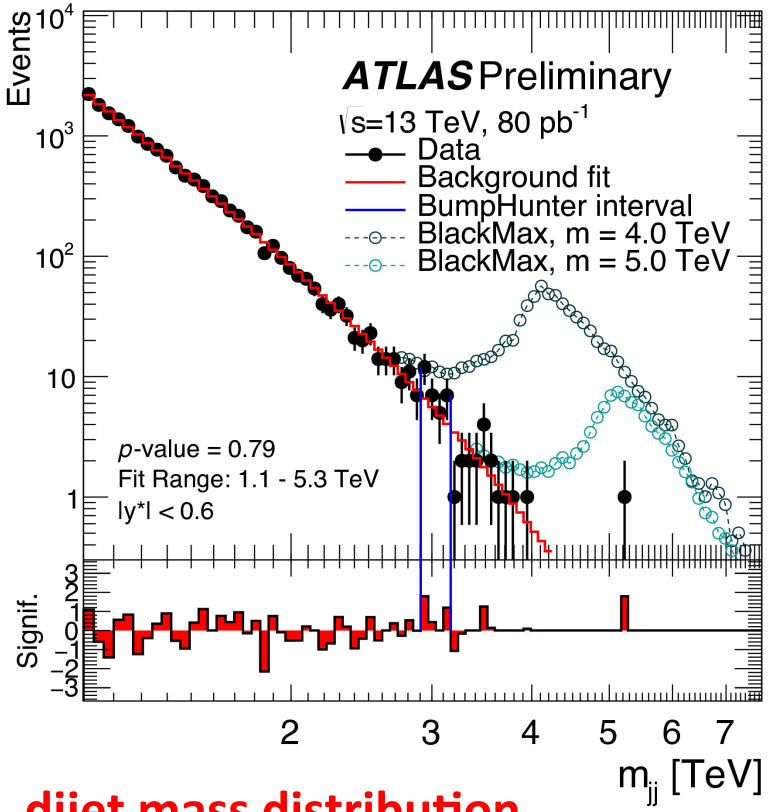
ATLAS-CONF-2015-042

New phenomena in dijet events at 13 TeV

80 pb^{-1}

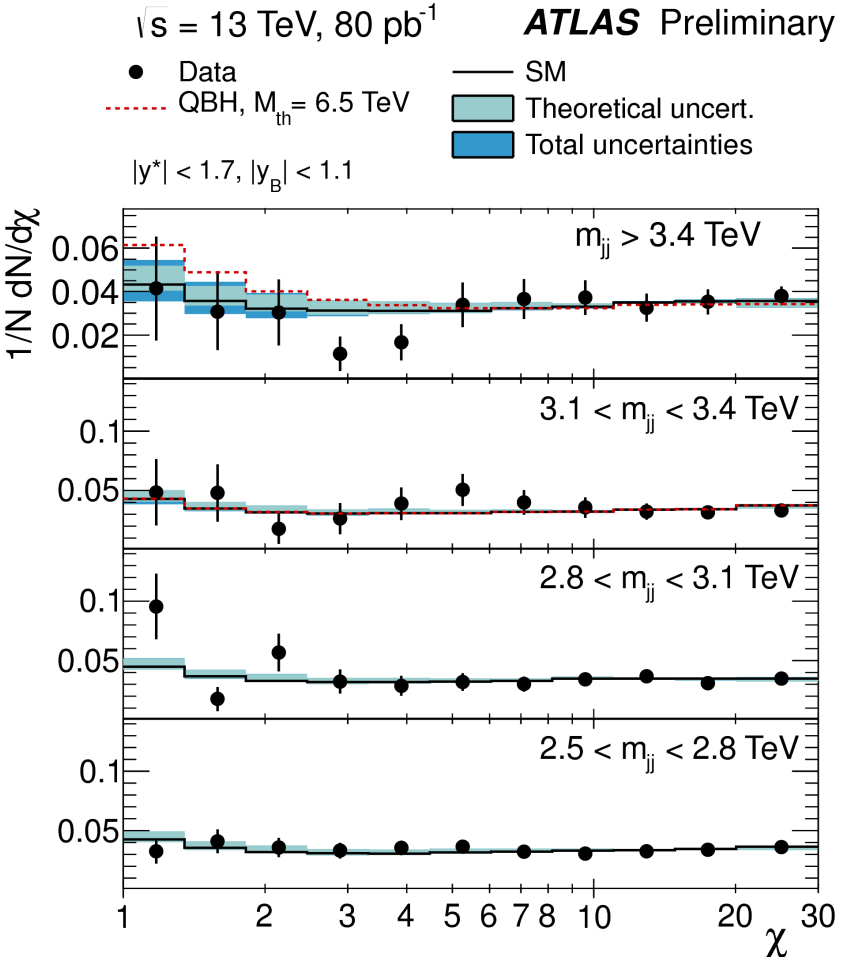
jets: anti-k_t , R = 0.4

≥ 2 jets, p_T > 410, 50 GeV



dijet mass distribution

$|y^*| < 0.6$

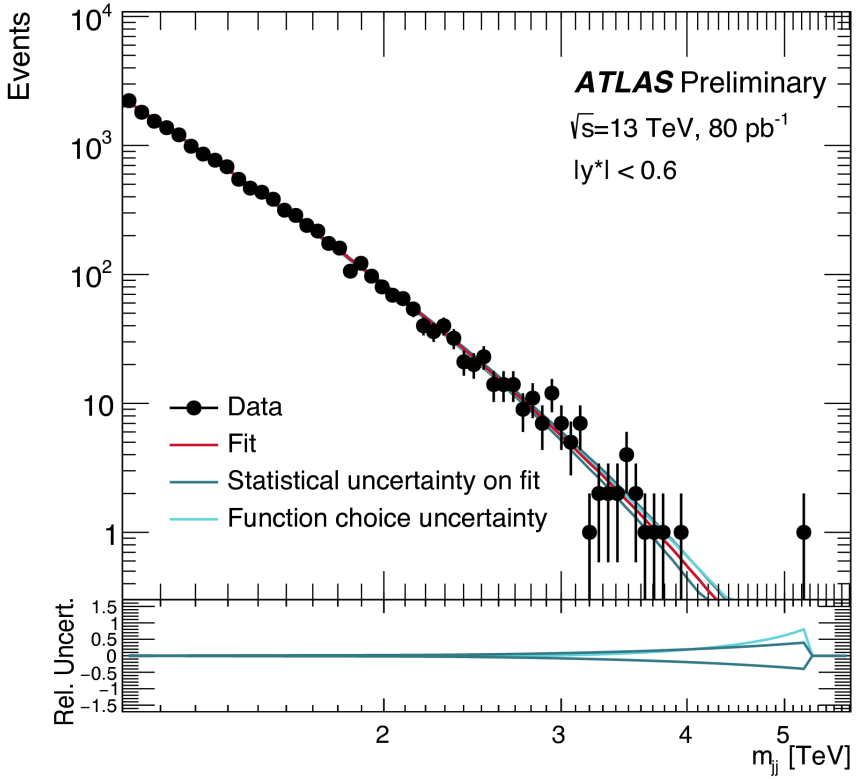


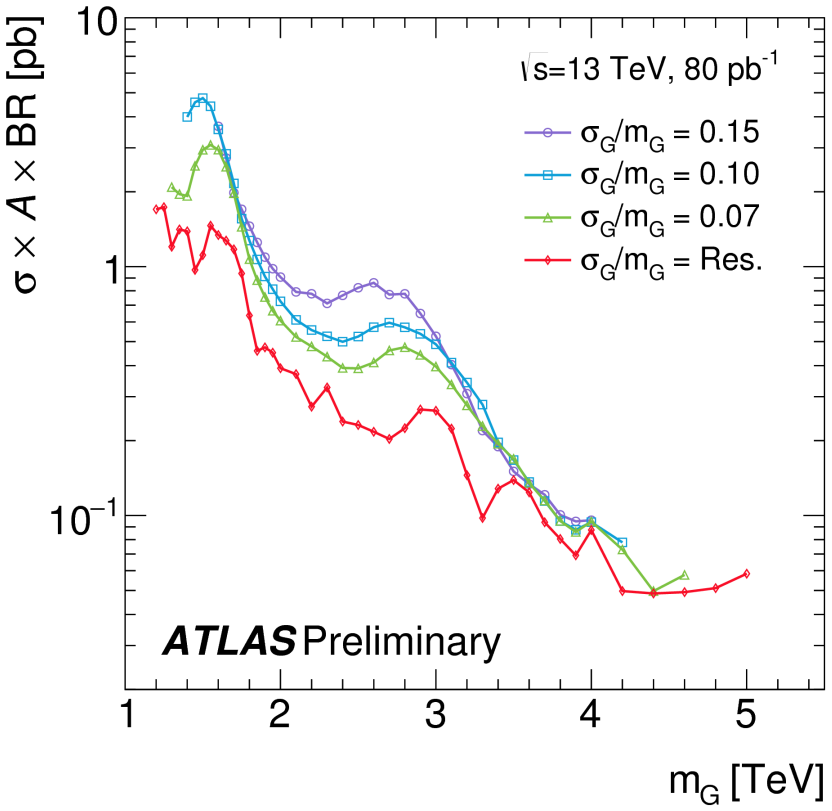
$$\chi = e^{2|y^*|} \sim \frac{1+\cos\theta^*}{1-\cos\theta^*} \qquad y^* = \tfrac{1}{2}(y_1 - y_2)$$

ATLAS-CONF-2015-042

Data-driven background estimation by fitting mass spectrum

Bump-hunter algorithm looks for devations, most significant one has p = 0.79





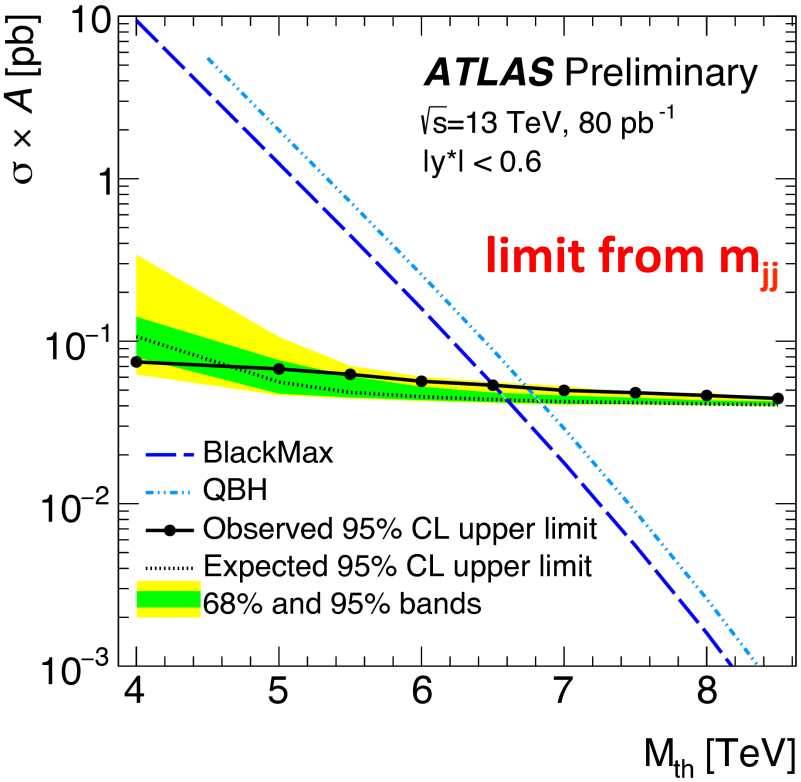
Limits are set on σ x A x Br for various signal width hypotheses

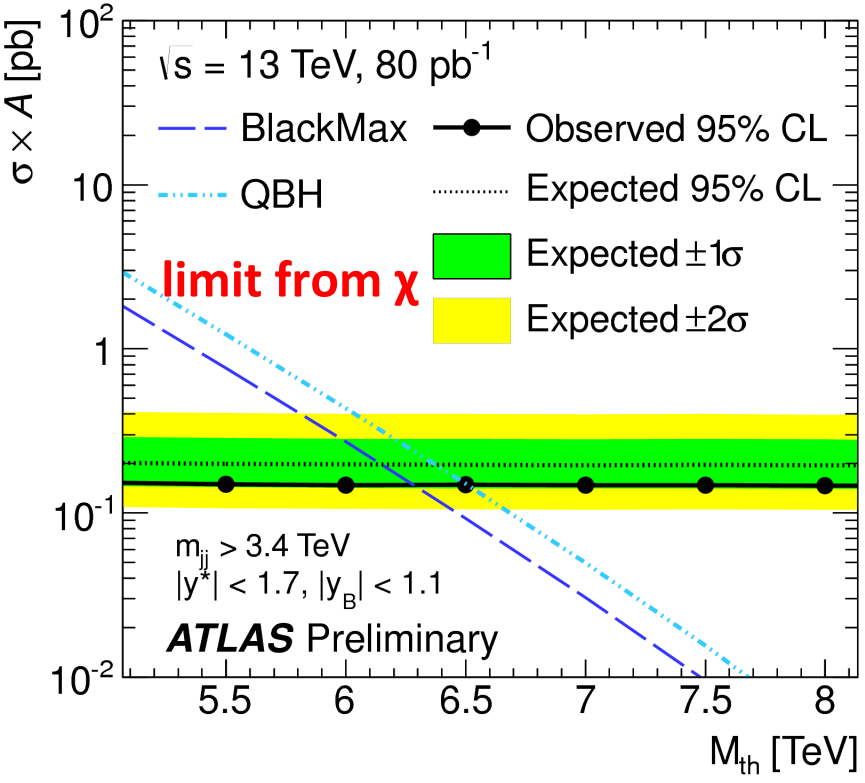
ATLAS-CONF-2015-042

Interpretation in a model of extra dimensions and Quantum Black Holes

Assume n=6, $M_D = M_{th}$

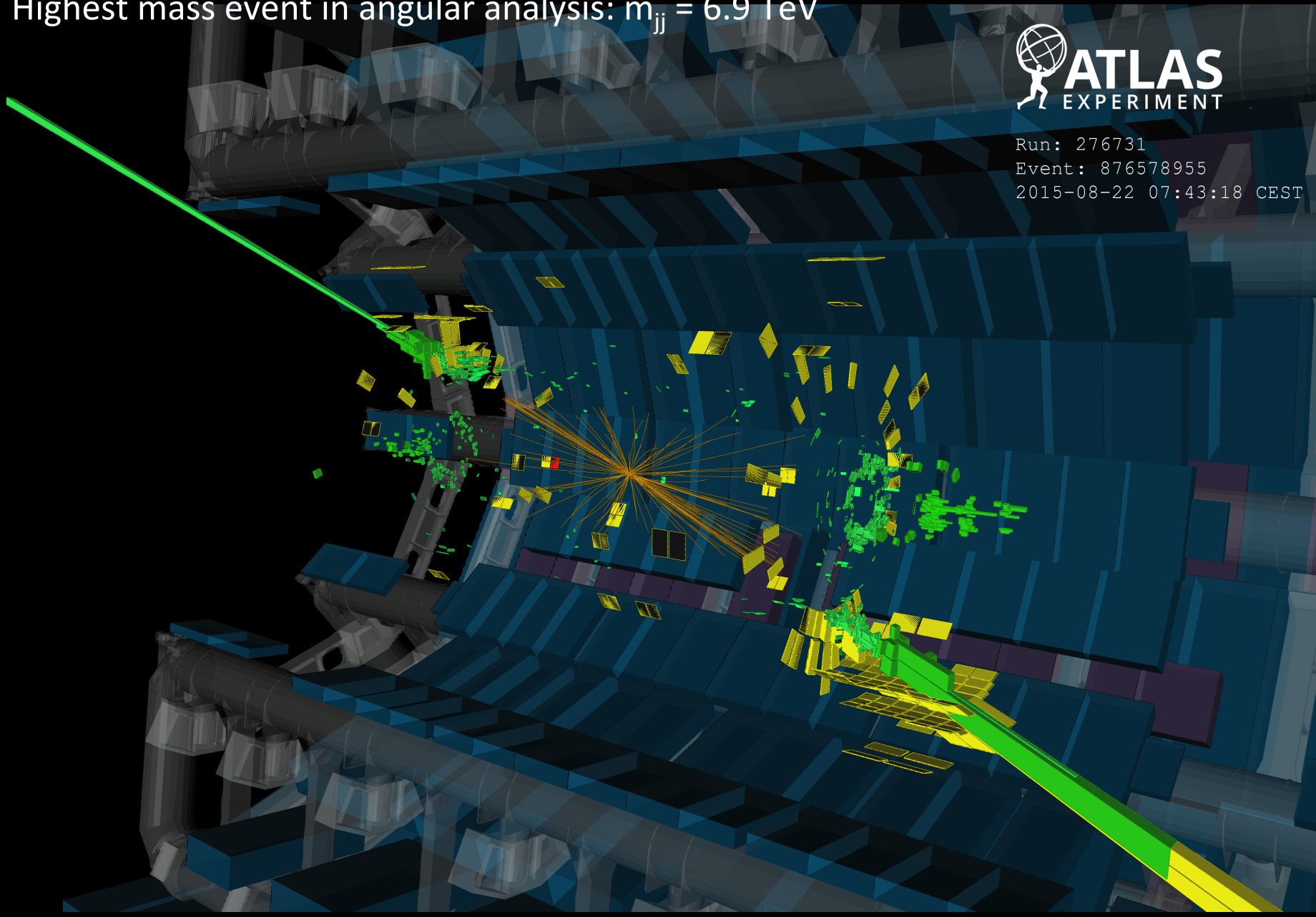
M_D: fundamental scale of gravity in n dimensions
M_{th}: threshold scale for black hole production





Excludes M_{th} < 6.8 TeV (QBH generator) or 6.5 TeV (BlackMax generator)

Highest mass event in angular analysis: m_{jj} = 6.9 TeV



ATLAS-CONF-2015-043

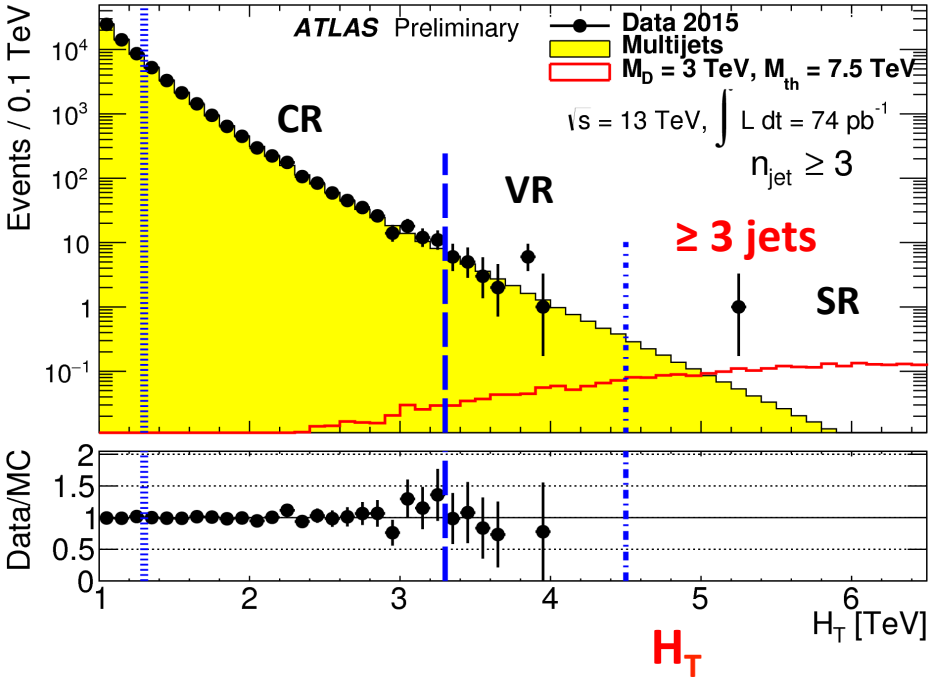
Search for strong gravity in multijet final states

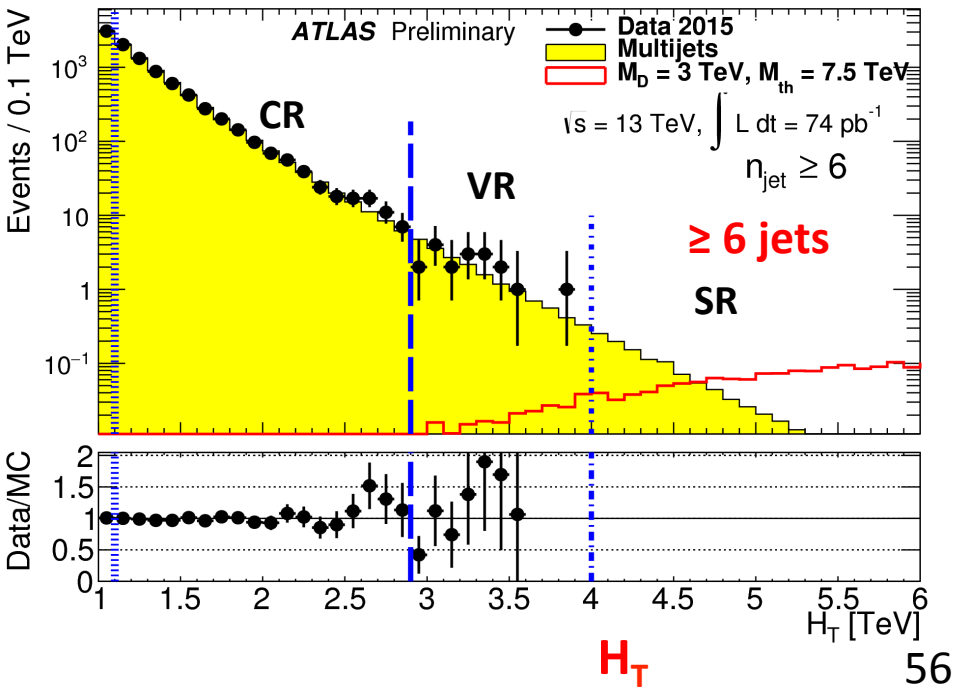
High-p_T - High-jet multiplicity final states, selected with H_T = Σ jet p_T > 1 TeV
Individual jets: anti-k_t , R = 0.4, p_T > 50 GeV, $|\eta| < 2.8$

Control region: 1 < H_T < V TeV
Validation region: V < H_T < S TeV
Signal region: H_T > S TeV

2-step procedure, 6 pb^{-1} , 74 pb^{-1}

Signal model: rotating black hole, n=6, $M_{th} > M_D$ Charybdis generator



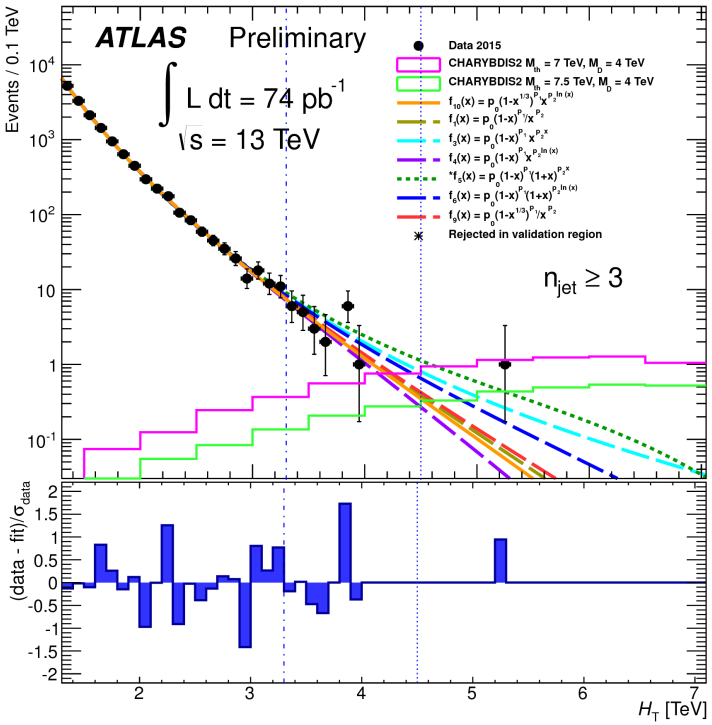


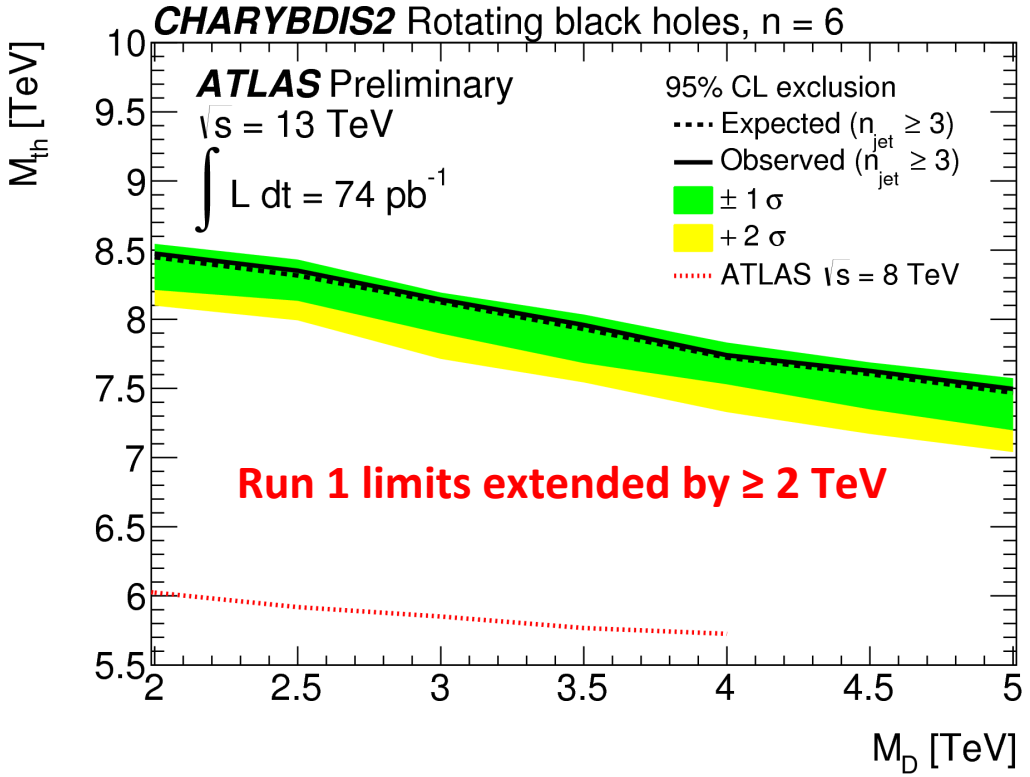
ATLAS-CONF-2015-043

Background estimated from data: fit in control region, extrapolated to VR and SR

$n_{\text{jet}} \geq$	VR (obs)	VR (exp)	SR (obs)	SR (exp)
3	23	27.1 ± 3.7 (PE) ± 9.6 (DD)	1	1.42 ± 0.41 (PE) ± 4.3 (DD)
4	27	25.4 ± 3.2 (PE) ± 15.5 (DD)	0	1.62 ± 0.46 (PE) ± 9.2 (DD)
5	21	18.8 ± 2.9 (PE) ± 9.9 (DD)	0	1.32 ± 0.48 (PE) ± 5.0 (DD)
6	18	20.7 ± 3.3 (PE) ± 10.4 (DD)	0	1.19 ± 0.48 (PE) ± 13.3 (DD)
7	29	22.2 ± 3.7 (PE) ± 7.0 (DD)	0	0.81 ± 0.36 (PE) ± 0.60 (DD)

many bg functions evaluated



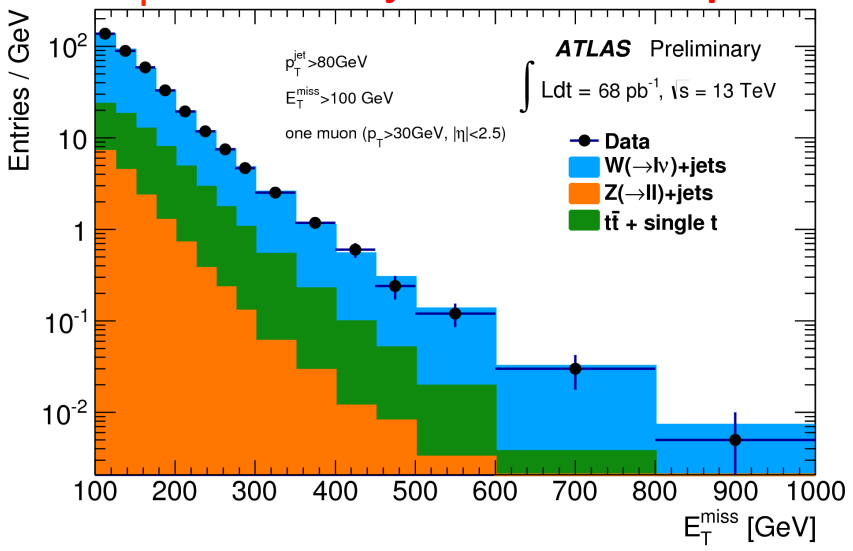


Further searches need more luminosity

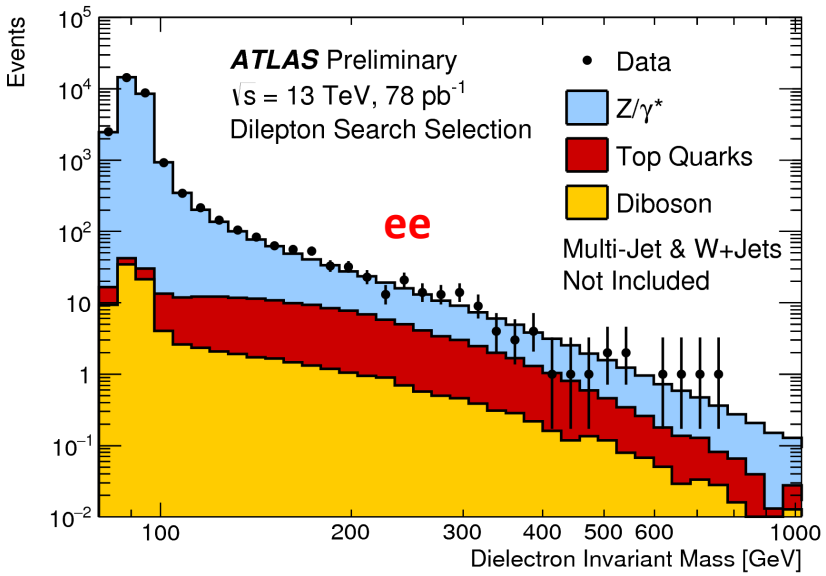
0.2 fb^{-1} is very exciting
but not enough for most searches

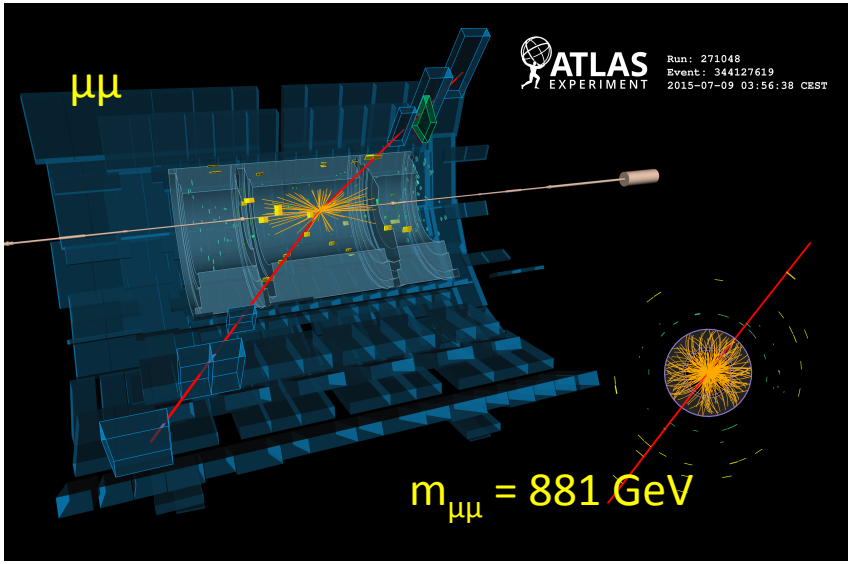
use the data to check our understanding
in control regions

E_T^{miss} in monojet search: W →μν CR



dilepton resonance search



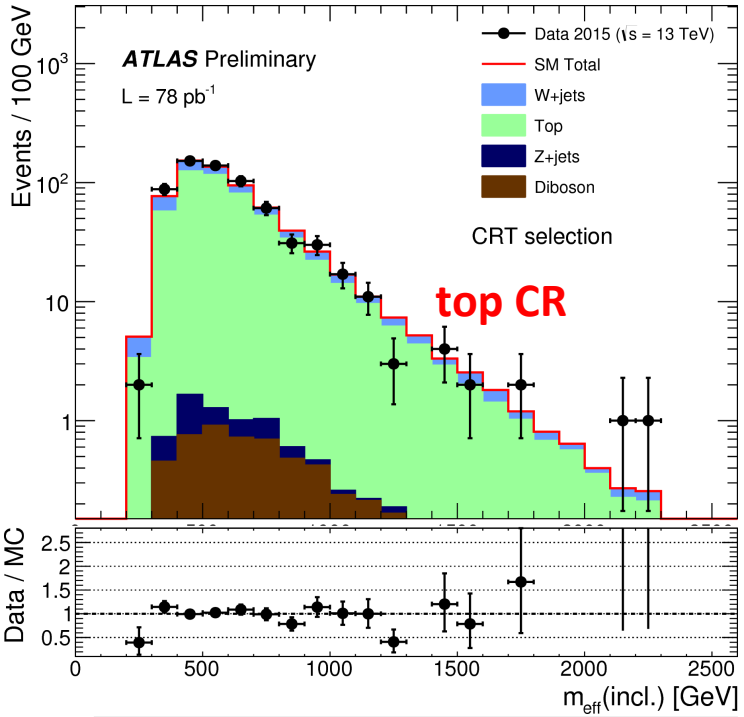


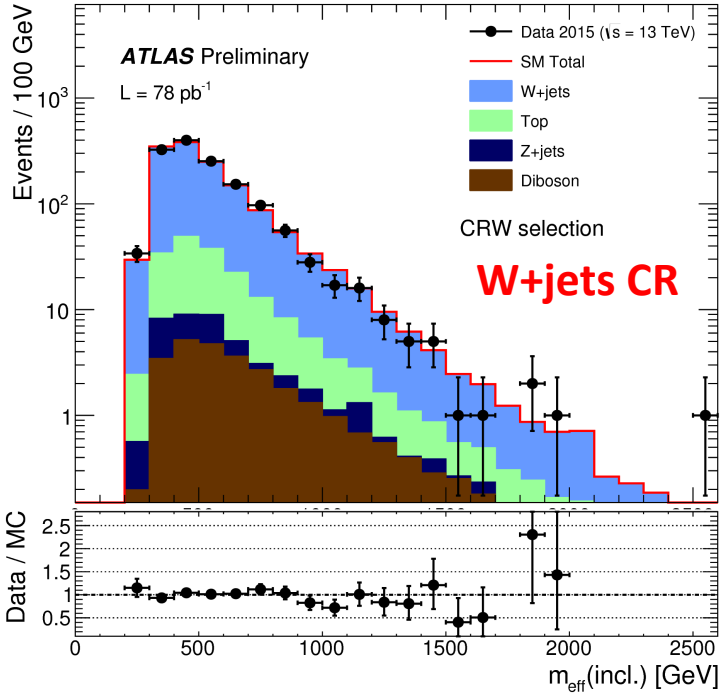
Control regions for supersymmetry searches

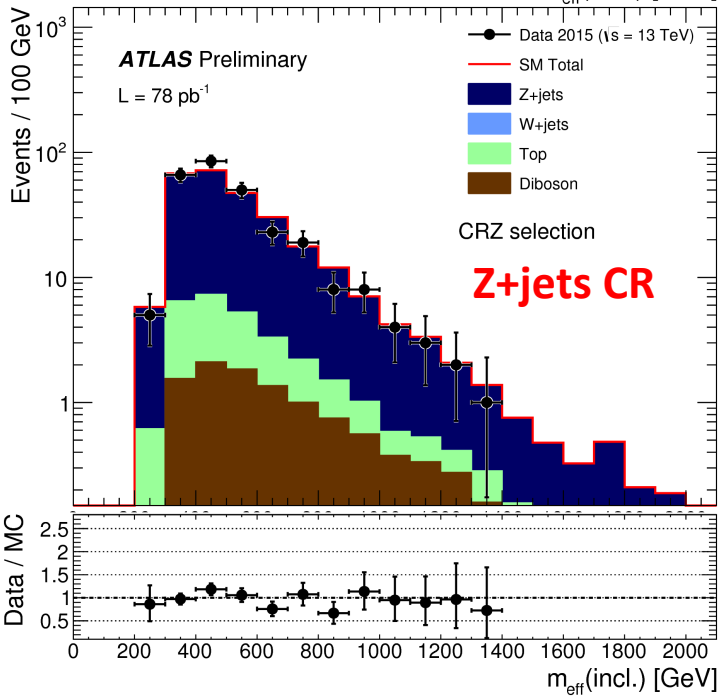
2-6 jets + missing transverse momentum

control region for top-pairs
W+jets
Z+jets

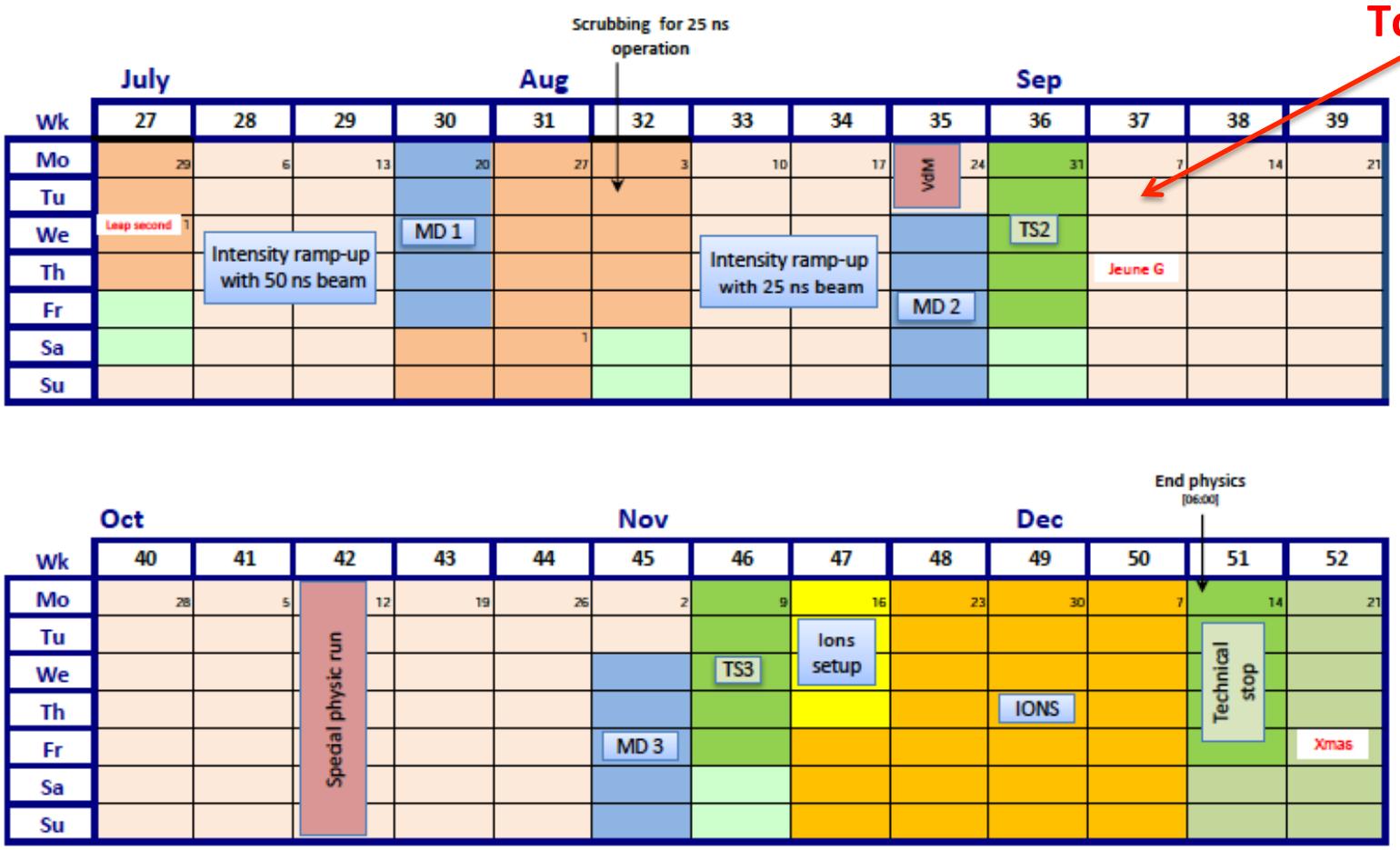
shown: effective mass distribution, 78 pb^{-1}







Outlook for the rest of 2015 and beyond



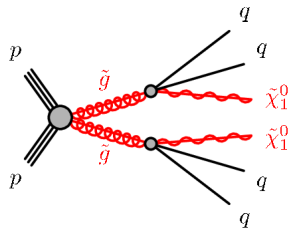
	Nc	Beta *	ppb	EmitN	Lumi [cm^{-2}s^{-1}]	Days (approx)	Int lumi	Pileup
50 ns	476	80	1.1e11	1.8	1.6e33	14	0.1 fb^{-1}	27
2015.1	1200	80	1.2e11	3.5	3.6e33	50	~2.3 fb^{-1}	21
2015.2	1200	60	1.2e11	2.3	5.6e33	47	~3.4 fb^{-1}	33

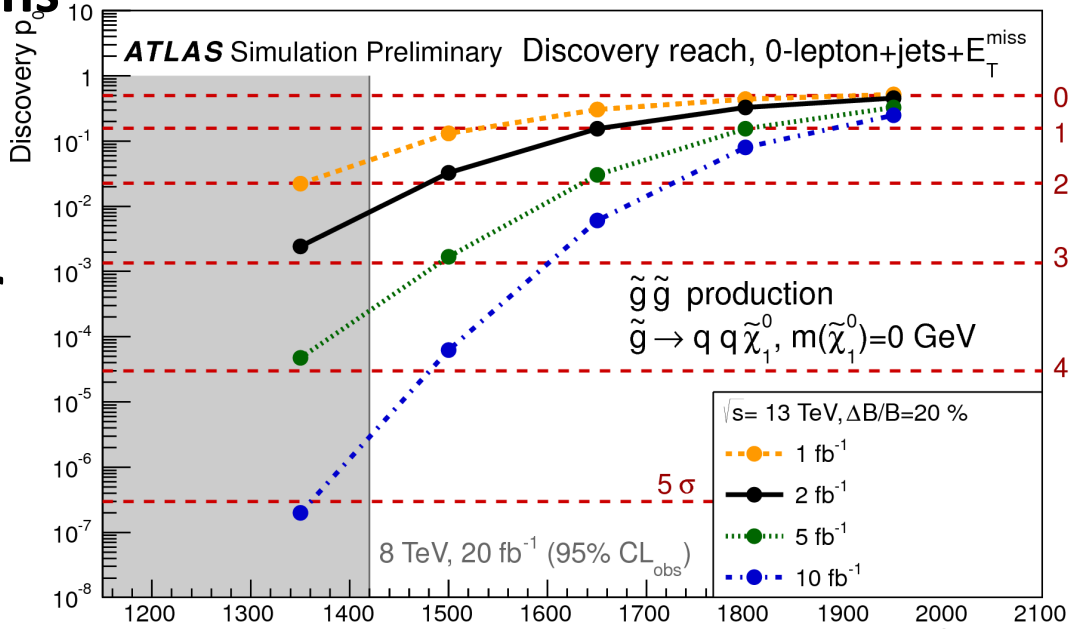
	Peak lumi E34 cm^{-2}s^{-1}	Days proton physics	Approx. int lumi [fb^{-1}]
2015	~0.5	65	3
2016	1.2	160	30
2017	1.5	160	36
2018	1.5	160	36

Expectations

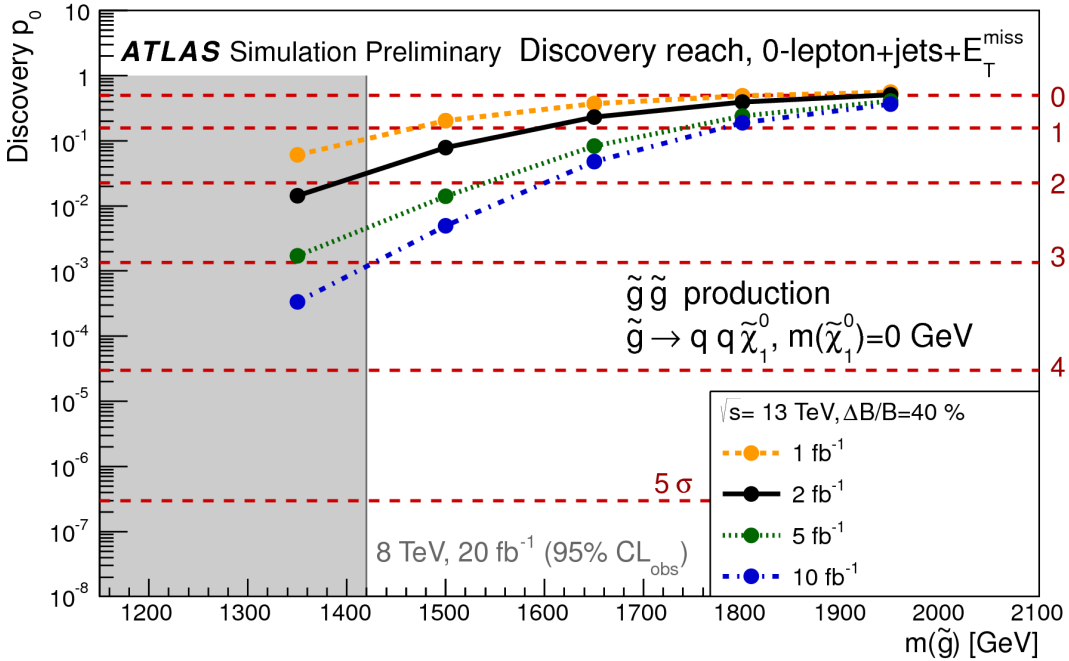
ATL-PHYS-PUB-2015-005

gluino pair search





20% systematic uncertainty

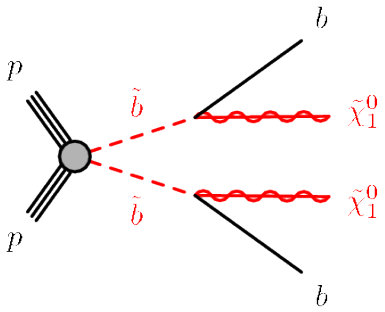


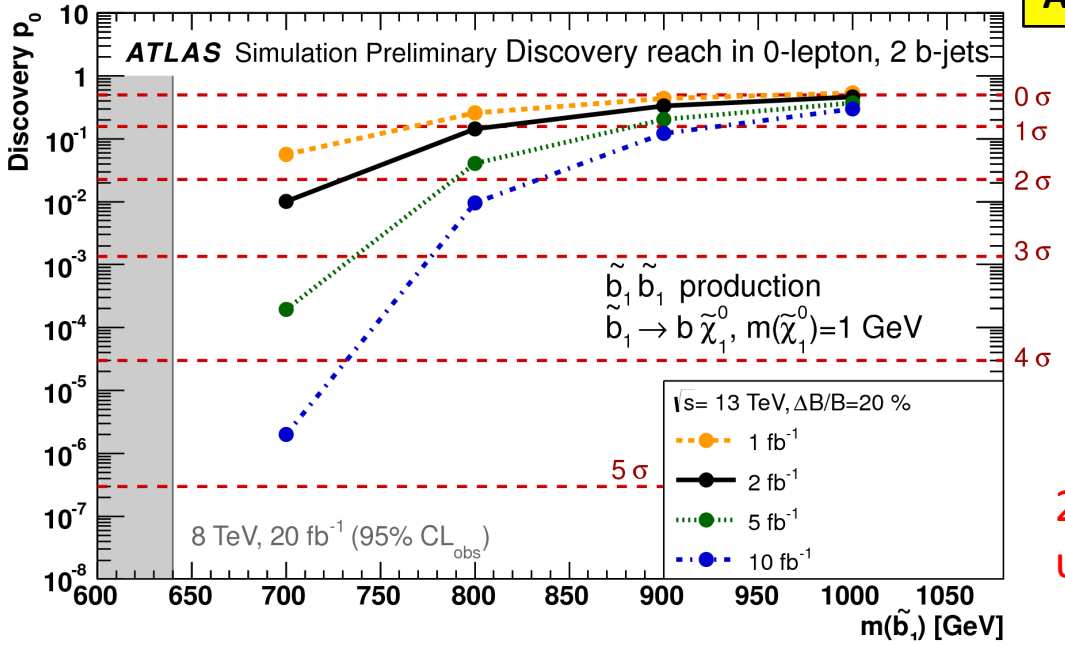
40% systematic uncertainty

Expectations

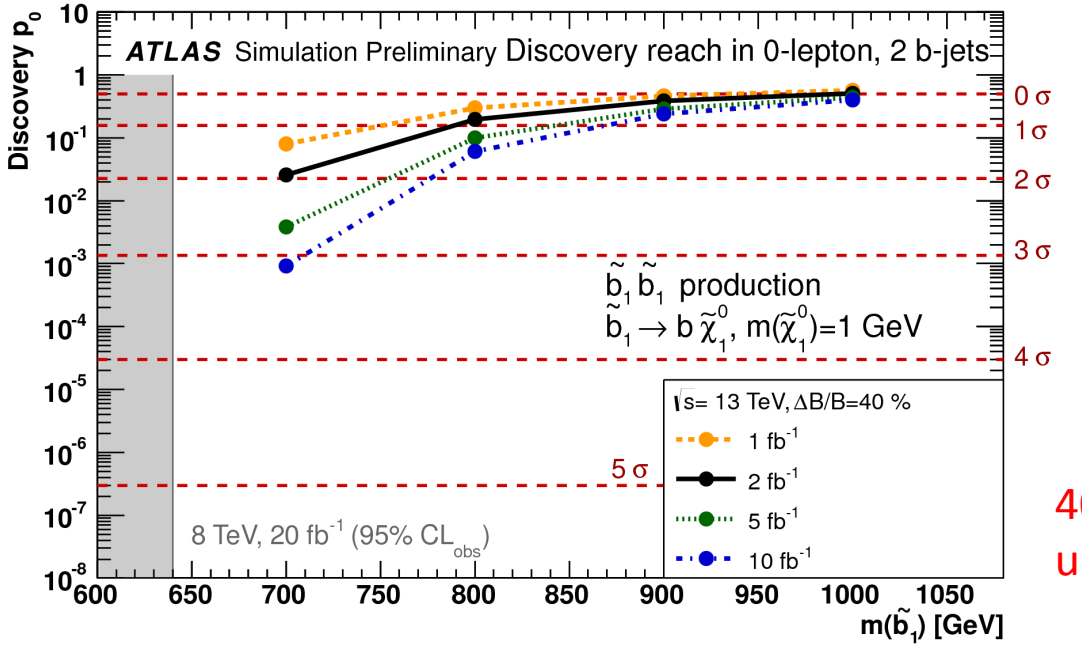
ATL-PHYS-PUB-2015-005

sbottom pair search

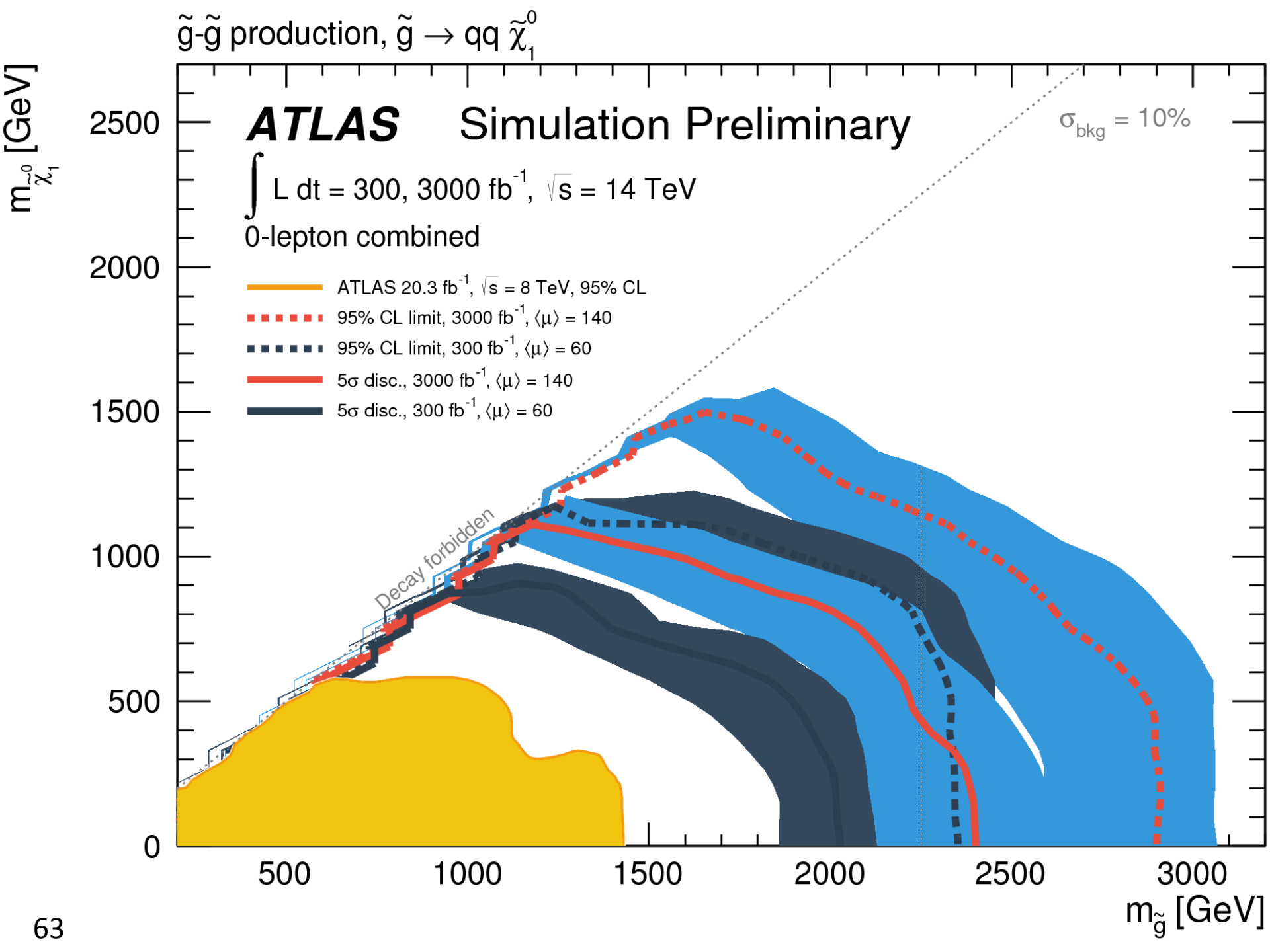


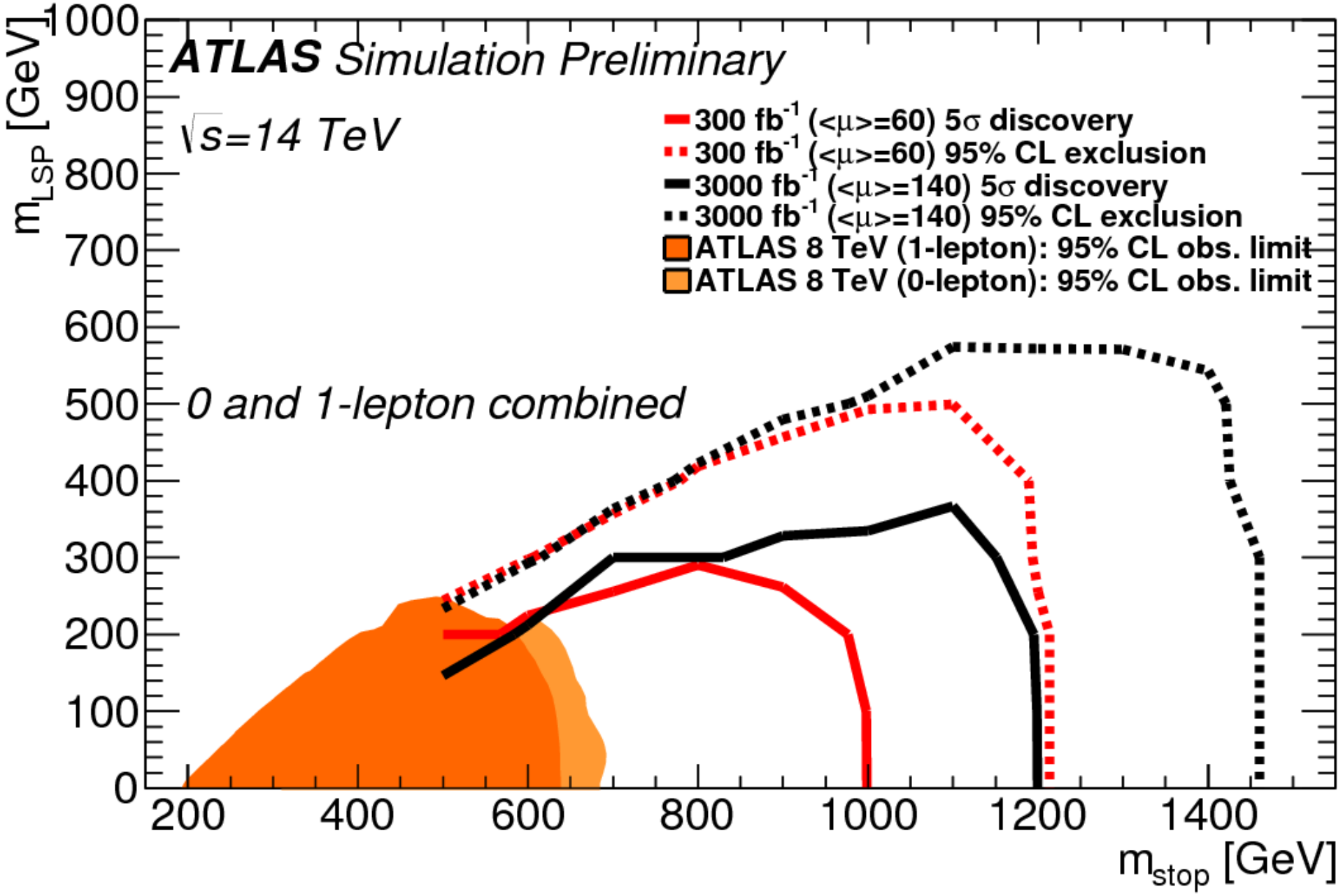


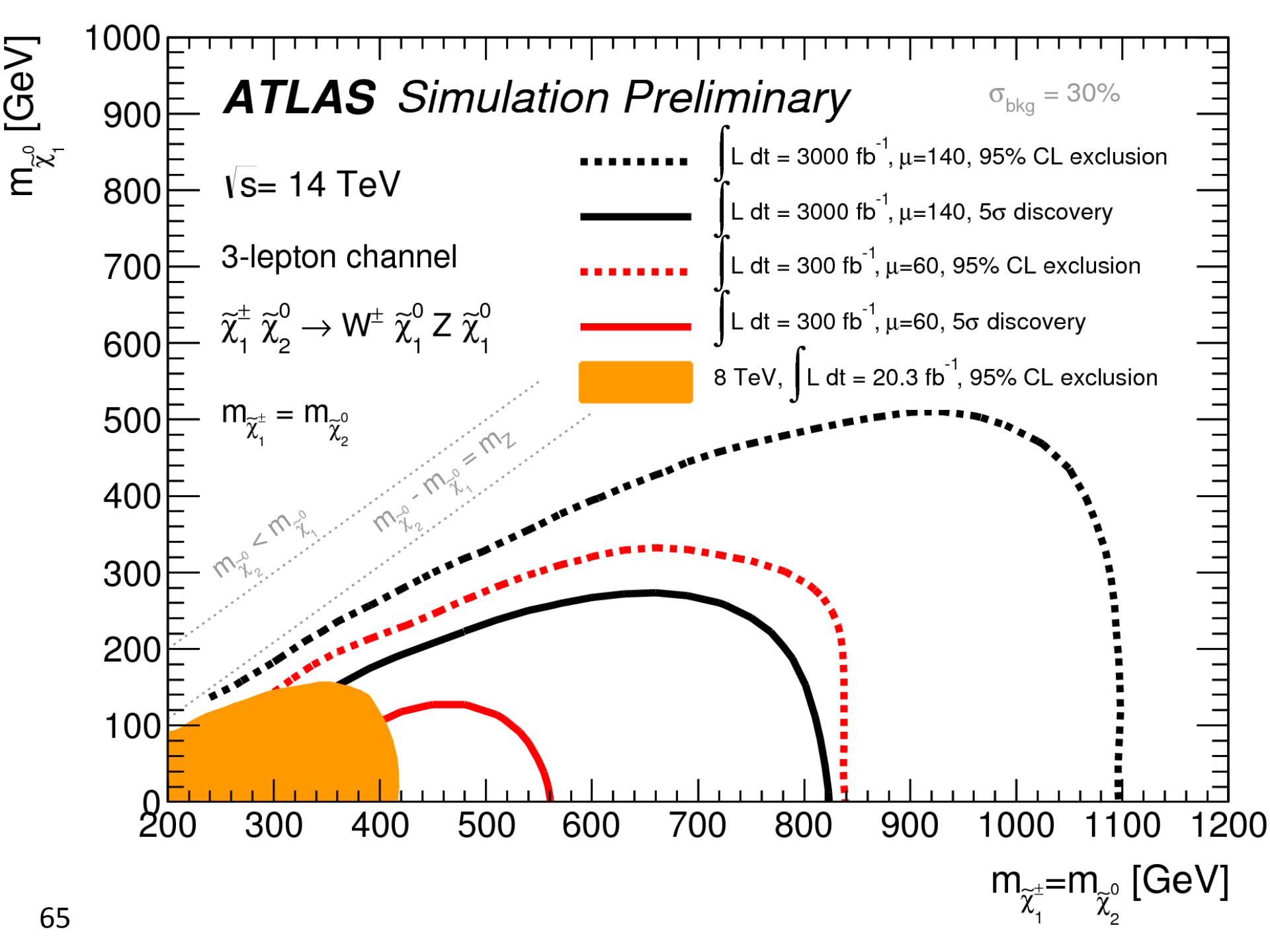
20% systematic uncertainty



40% systematic uncertainty


$\tilde{g}$-$\tilde{g}$ production, $\tilde{g} \rightarrow qq\,\tilde{\chi}_1^0$
ATLAS Simulation Preliminary
$\int$ L dt = 300, 3000 fb^{-1}, $\sqrt{s}$ = 14 TeV
0-lepton combined
σ_{bkg} = 10%
ATLAS 20.3 fb^{-1}, $\sqrt{s}$ = 8 TeV, 95% CL
95% CL limit, 3000 fb^{-1}, ⟨μ⟩ = 140
95% CL limit, 300 fb^{-1}, ⟨μ⟩ = 60
5σ disc., 3000 fb^{-1}, ⟨μ⟩ = 140
5σ disc., 300 fb^{-1}, ⟨μ⟩ = 60
Decay forbidden
$m_{\tilde{\chi}_1^0}$ [GeV]
$m_{\tilde{g}}$ [GeV]
0
500
1000
1500
2000
2500
3000


ATLAS Simulation Preliminary
√s=14 TeV
0 and 1-lepton combined
300 fb-1 (<μ>=60) 5σ discovery
300 fb-1 (<μ>=60) 95% CL exclusion
3000 fb-1 (<μ>=140) 5σ discovery
3000 fb-1 (<μ>=140) 95% CL exclusion
ATLAS 8 TeV (1-lepton): 95% CL obs. limit
ATLAS 8 TeV (0-lepton): 95% CL obs. limit
m_LSP [GeV]
m_stop [GeV]
0
100
200
300
400
500
600
700
800
900
1000
200
400
600
800
1000
1200
1400


ATLAS Simulation Preliminary
σbkg = 30%
√s= 14 TeV
3-lepton channel
χ̃1± χ̃20 → W± χ̃10 Z χ̃10
mχ̃1± = mχ̃20
∫ L dt = 3000 fb-1, μ=140, 95% CL exclusion
∫ L dt = 3000 fb-1, μ=140, 5σ discovery
∫ L dt = 300 fb-1, μ=60, 95% CL exclusion
∫ L dt = 300 fb-1, μ=60, 5σ discovery
8 TeV, ∫ L dt = 20.3 fb-1, 95% CL exclusion
mχ̃20 < mχ̃10
mχ̃20 - mχ̃10 = mZ
mχ̃10 [GeV]
mχ̃1±=mχ̃20 [GeV]
0
100
200
300
400
500
600
700
800
900
1000
200
300
400
500
600
700
800
900
1000
1100
1200

Conclusions

The ATLAS detector is ready for Run 2

Pipelines of remaining Run 1 papers are draining (searches, Higgs)

The LHC @ 13 TeV Is still on a learning curve.
2015 will be a commissioning year for 25 ns operation.
But no show-stoppers for 100 fb^{-1} by end of 2018

ATLAS has made first measurements and searches at 13 TeV.
For very optimistic scenarios, Run 1 limits have been extended.
Further searches will need more luminosity.