Recent results from the ATLAS Experiment

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Outline

A brief look at ATLAS

Recent Run I results

- Data taking
- Selected recent results
  - From SM to Exotics (SM, Top, Higgs, SUSY, Exotics)

Run II

- Upgrades and Performance
- First results with 13 TeV data
  - From SM to preparation for Exotic searches

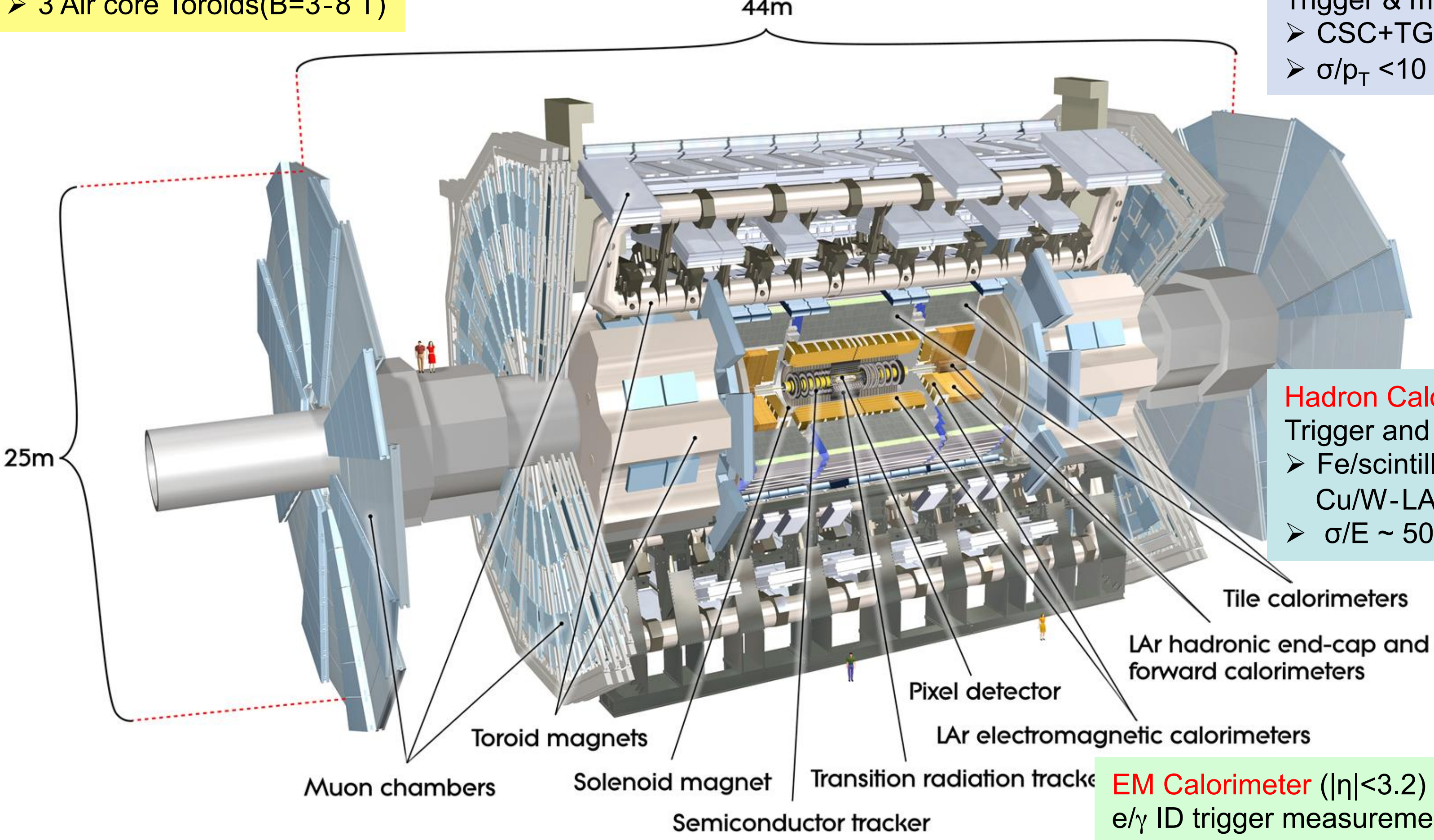
The ATLAS detector at LHC

- ATLAS is a multi-purpose detector at CERN’s LHC
- 38 countries, ~ 178 institutions, ~ 3000 physicists

The ATLAS Detector in Run I

Magnets 4 Superconducting
- Central Solenoid (B= 2T)
- 3 Air core Toroids(B=3-8 T)

Muon spectrometer ($|\eta| < 2.7$)
Trigger & meas. of muon
- CSC+TGC+RPC+MDT
- σ/p_T <10 % up to 1 TeV



Hadron Calorimeter ($|\eta|<5$)
Trigger and meas. of jet/Emiss
- Fe/scintillator (central), Cu/W-LAr (fwd)
- $\sigma/E \sim 50\%/\sqrt{E}(\mathrm{GeV}) \oplus 3\%$

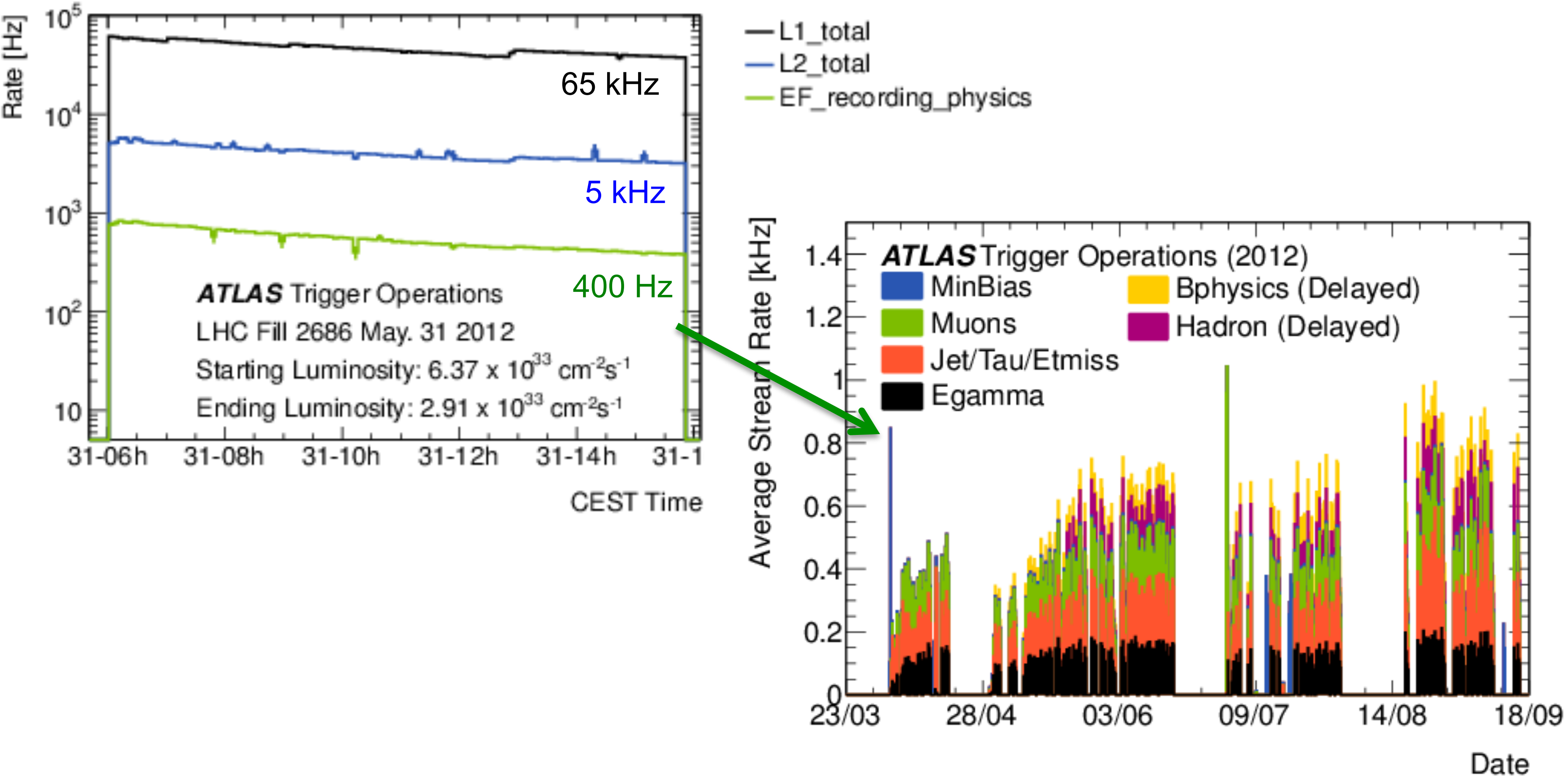
EM Calorimeter ($|\eta|<3.2$)
e/γ ID trigger measurement
- Pb-LAr accordion
- $\sigma/E \sim 10\%/\sqrt{E}(\mathrm{GeV}) \oplus 1\%$

Inner detector ($|\eta|< 2.5$, B=2T)
Tracking, vertexing, dE/dx, e/π ID
- Si pixels, Si strips, Trans. Rad. det.
- $\sigma/p_T \sim 3.8 \times 10^{-4} p_T(\mathrm{GeV}) \oplus 0.015$

ATLAS Trigger systems in Run I

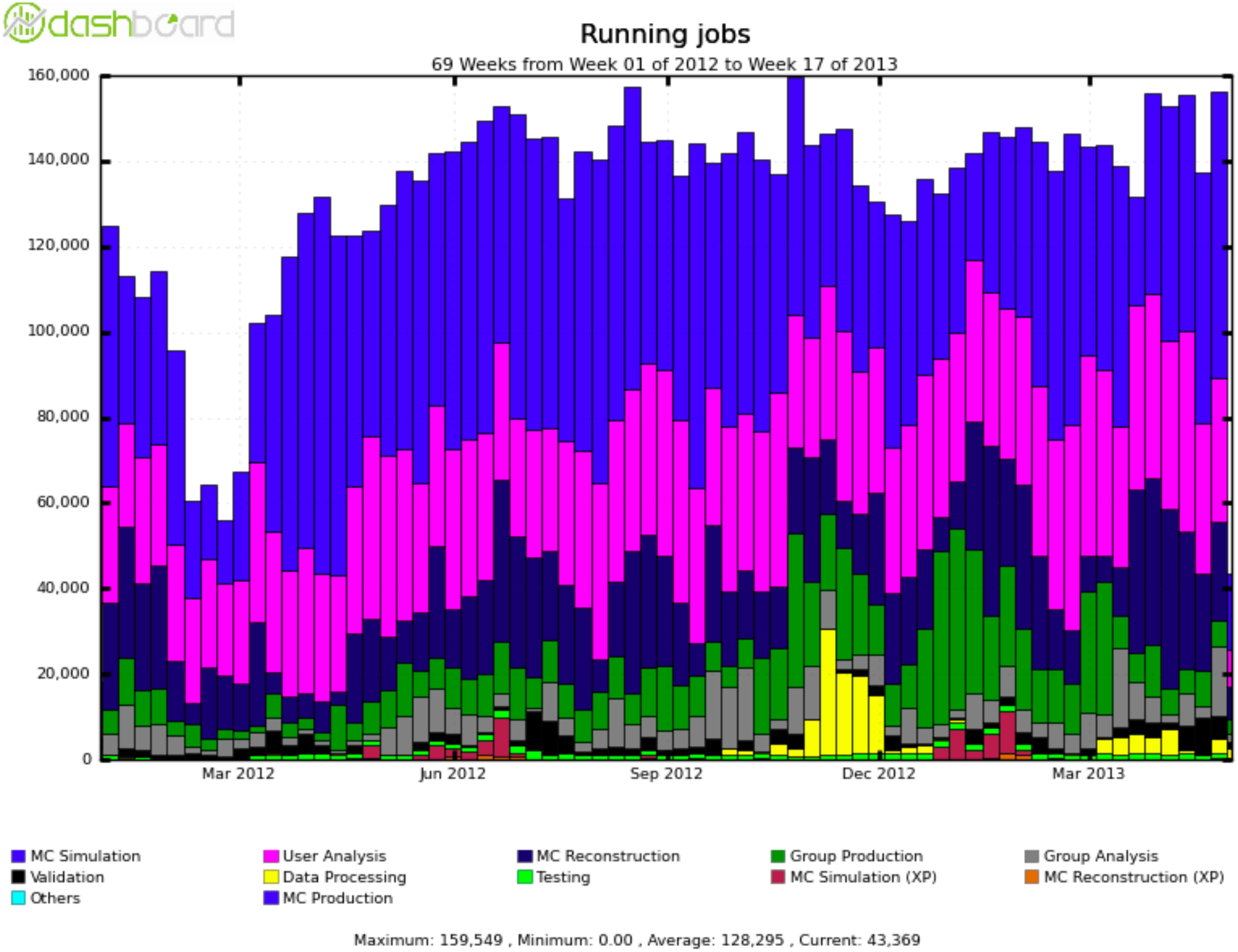
Multi-level trigger system selects interesting events from O(20 MHz)

Stored events for physics analysis ~ 400 Hz



ATLAS Distributed Computing System

- Manages world-wide data processing, MC production, user analysis jobs
- O(150k) computing cores



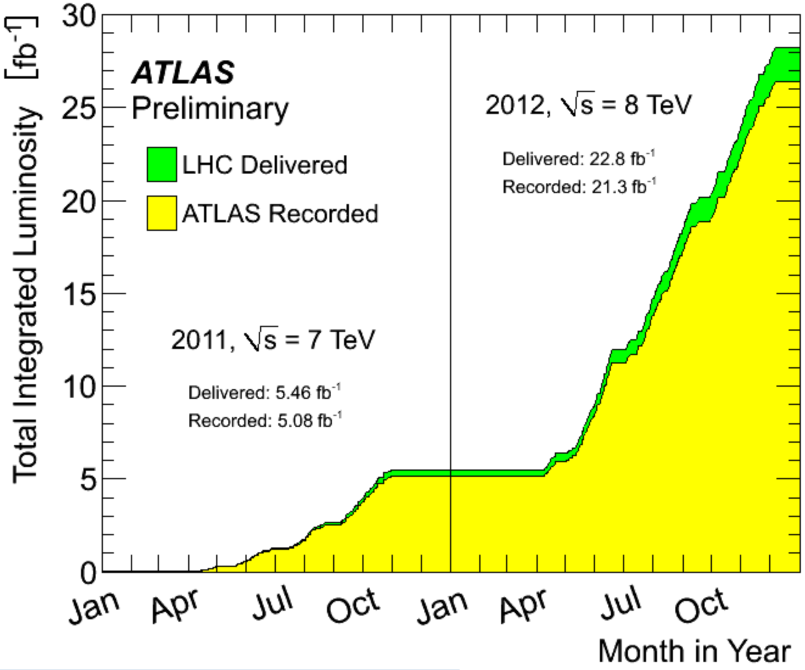
ATLAS Run I data (2009 – early 2013)

2009: ~ 20 μb^{-1} at $\sqrt{s}$ = 900 GeV

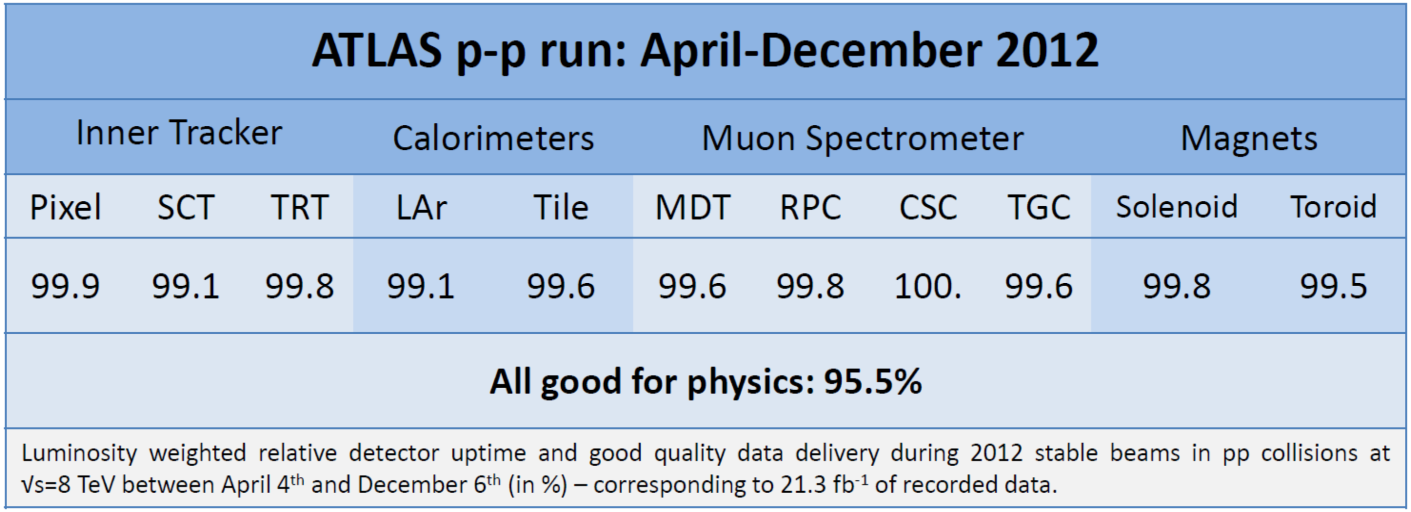
2010: ~ 45 pb^{-1} at $\sqrt{s}$ = 7 TeV

2011 + 2012 ~ 25 fb^{-1} at $\sqrt{s}$ = 7,8 TeV

- 7.6 billion pp events, 7.4 PB data volume



Excellent performance of LHC, detector and data taking:



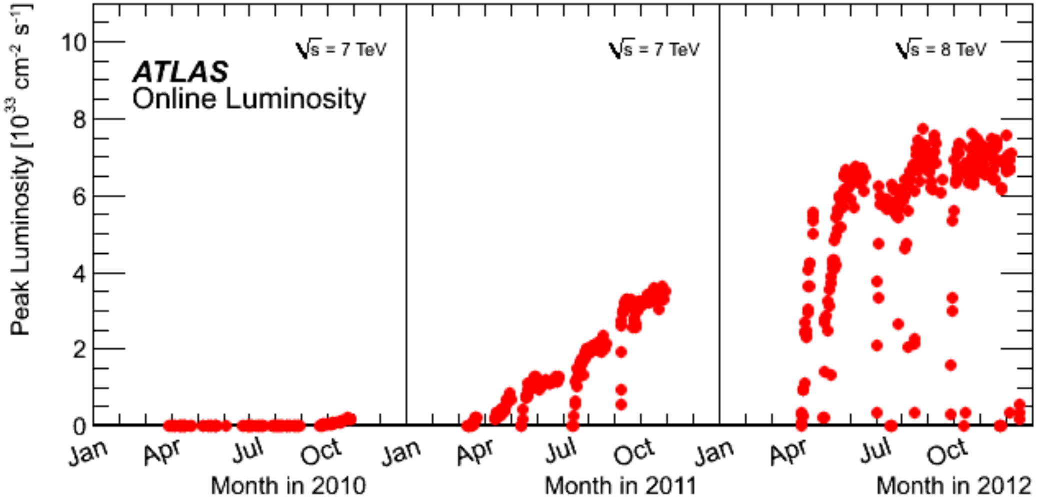
ATLAS p-p run: April-December 2012

Inner Tracker			Calorimeters		Muon Spectrometer				Magnets	
Pixel	SCT	TRT	LAr	Tile	MDT	RPC	CSC	TGC	Solenoid	Toroid
99.9	99.1	99.8	99.1	99.6	99.6	99.8	100.	99.6	99.8	99.5

All good for physics: 95.5%

Luminosity weighted relative detector uptime and good quality data delivery during 2012 stable beams in pp collisions at $\sqrt{s}$=8 TeV between April 4th and December 6th (in %) – corresponding to 21.3 fb^{-1} of recorded data.

Pileup

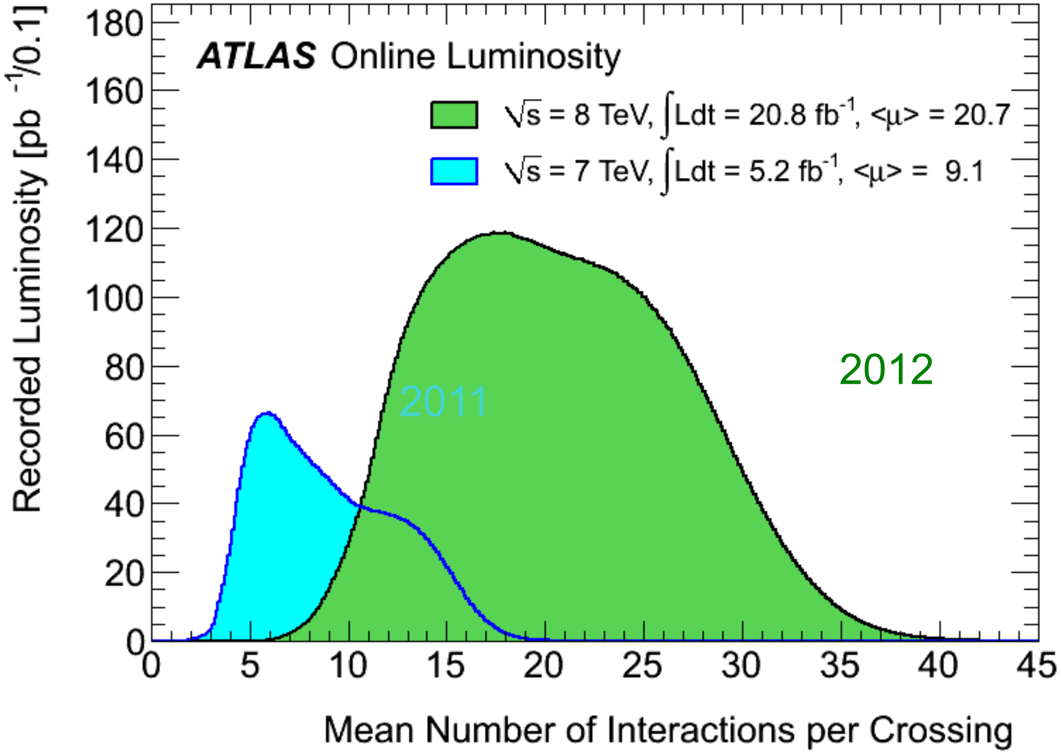


Higher luminosity brings a higher ***pile-up.***

i.e. ***number of interactions per bunch crossing***

Average pile-up:

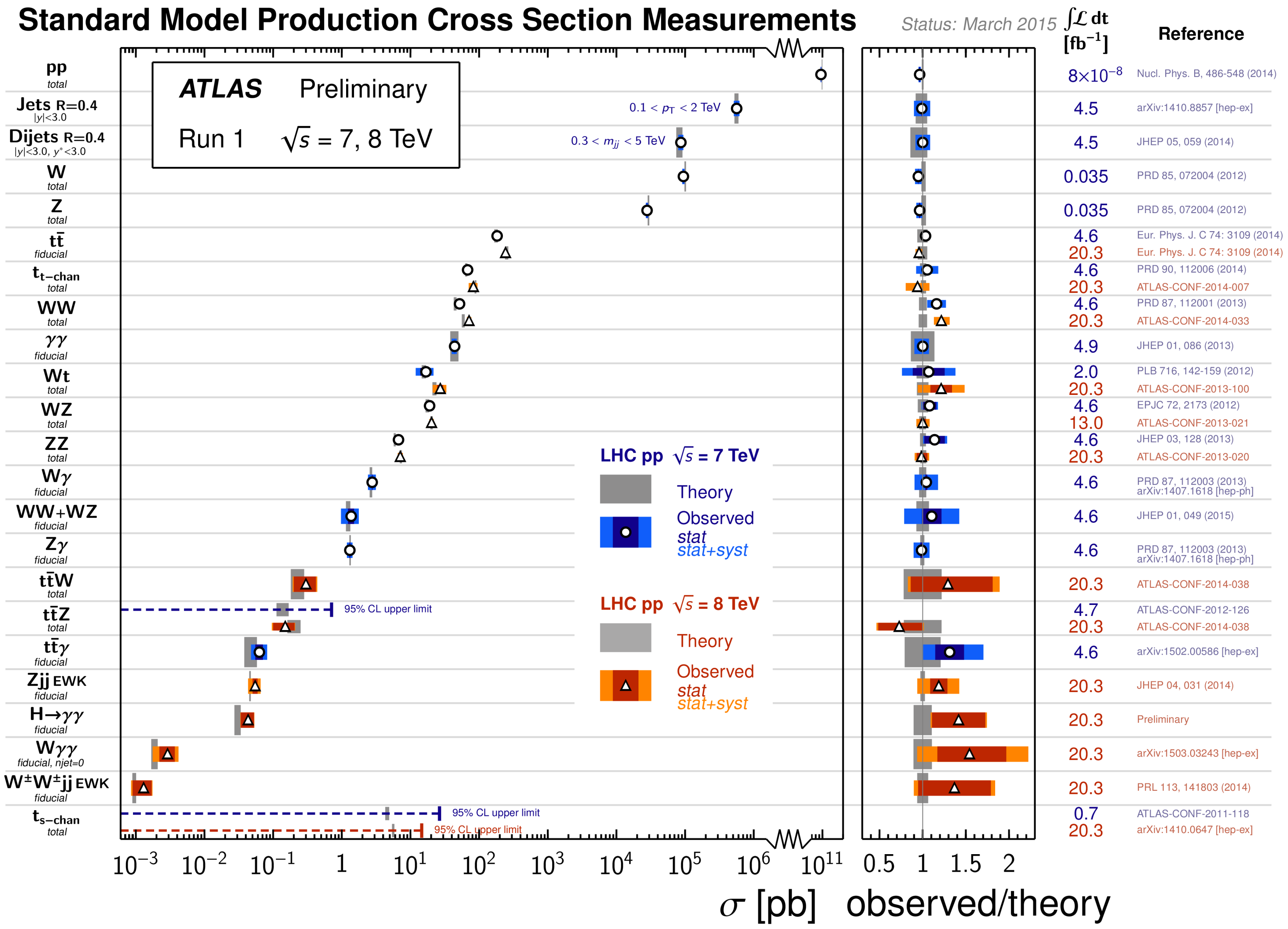
<μ> : 9 in 2011
21 in 2012



STANDARD MODEL

SM production cross sections

- Tests of the SM at higher energy, probing new physics
- Backgrounds for searches and precision measurements (W/Z+jets, ttbar, di-bosons)



Only with 35 pb^{-1} data

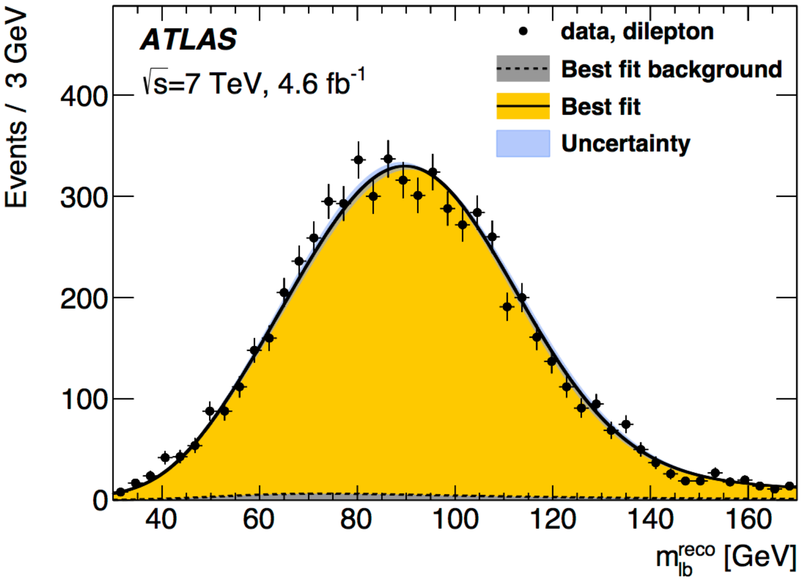
Theory values at NLO or higher

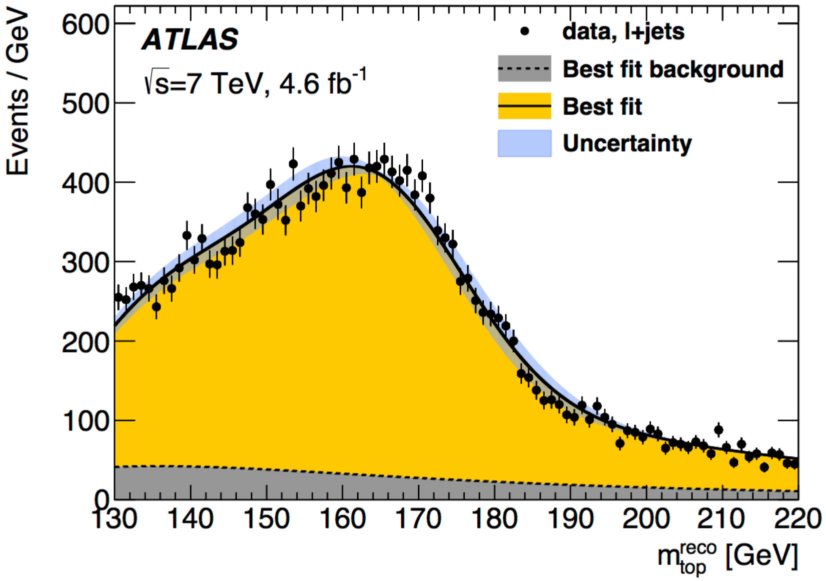
TOP QUARK STUDIES

Top quark mass

EPJC (2015) 75:330

- Precise measurements is a critical input to EW fits
- Measured in ttbar → lepton +jets (fully reconstructed) or di-lepton, 7 TeV (~5 fb^{-1})
  - Single lepton: **3D fit** (m_{top}^{reco}, m_W^{reco} (hadronically decaying W) and R_{bq}^{reco}))
    - R_{bq}^{reco} : ratio of transverse momentum of *b*-tagged jet to average transverse momentum of the two jets of the hadronic *W* boson decay
    - 3D reduces systematic uncertainty wrt previous method (2D)
  - Di-lepton : **1D fit** (m_{lb}^{reco})



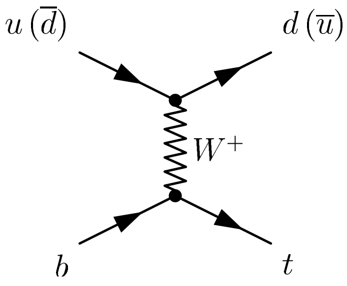


$$m_{top}^{comb} = 172.99 \pm 0.48(stat) \pm 0.78(syst)\ \text{GeV} \ = \ 172.99 \pm 0.91\ \text{GeV}$$

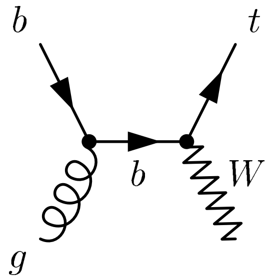
World avg:
173.34 ± 0.76

Single top production

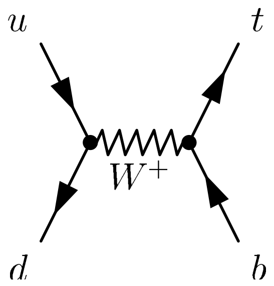
t-channel

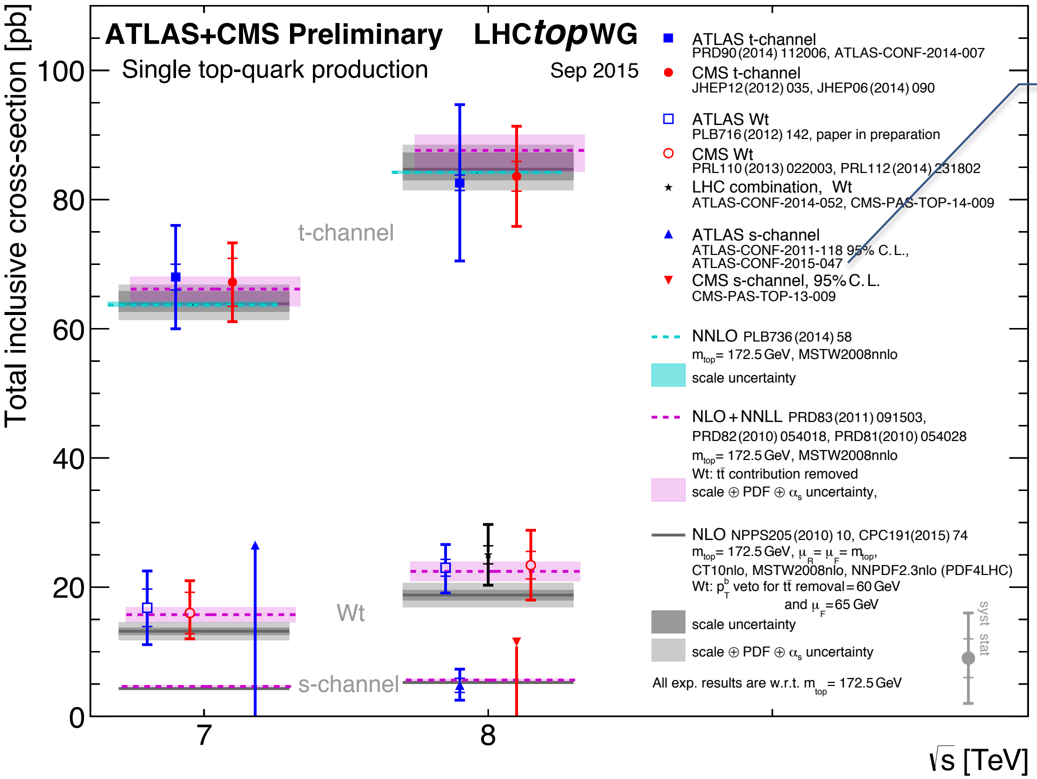


Wt-channel



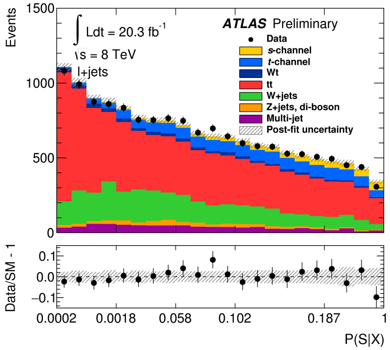
s-channel





The most recent update on s-channel by ATLAS (ATLAS-CONF-2015-047)

Signal significance observed(expected) : 3.2σ (3.9σ)

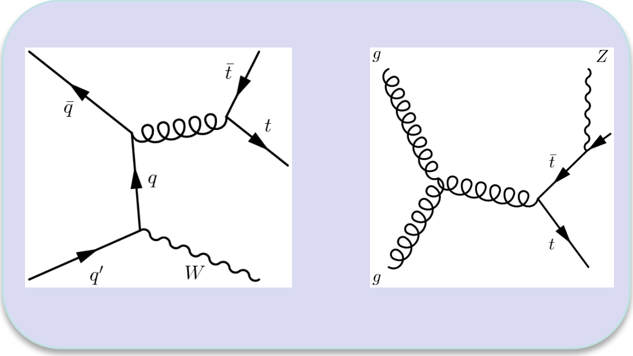


$$\sigma_s = 4.8 \pm 1.1(stat)^{+2.2}_{-2.0}(syst)\ \mathrm{pb}$$

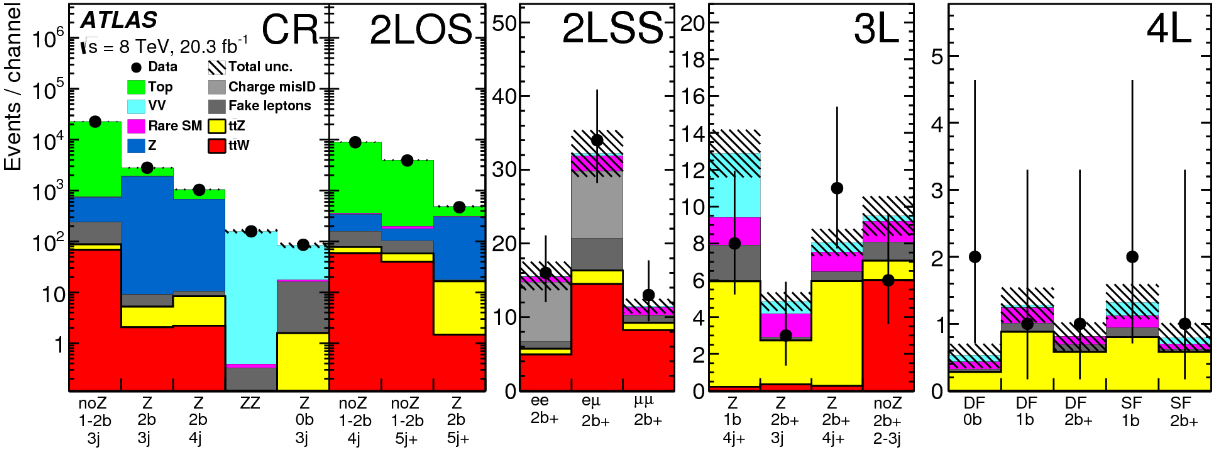
- **t-channel** : 1 isolated leptons (e / μ), one b-tagged jet, 1 forward jet, missing E_T
- **Wt channel** : 2 isolated leptons (e / μ), one b-tagged jet, missing E_T
- **s-channel** : 1 isolated lepton (e / μ), two b-tagged jets, missing E_T

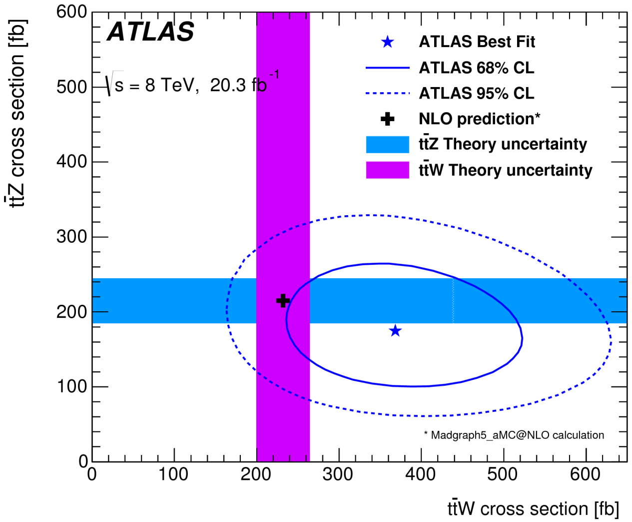
Top production with W or Z (ttV)

arXiv:1509.05276



Fit results on 15 signal and 5 control regions





Channel	$t\bar{t}W$ significance Expected	$t\bar{t}W$ significance Observed	$t\bar{t}Z$ significance Expected	$t\bar{t}Z$ significance Observed
2ℓOS	0.4	0.1	1.4	1.1
2ℓSS	2.8	5.0	-	-
3ℓ	1.4	1.0	3.7	3.3
4ℓ	-	-	2.0	2.4
Combined	3.2	5.0	4.5	4.2

$$\sigma_{t\bar{t}W} = 369^{+86}_{-79}(stat) \pm 44(syst)\ \text{fb}$$

$$\sigma_{t\bar{t}Z} = 176^{+52}_{-48}(stat) \pm 24(syst)\ \text{fb}$$

Simultaneous fit to all four channels to extract the cross sections

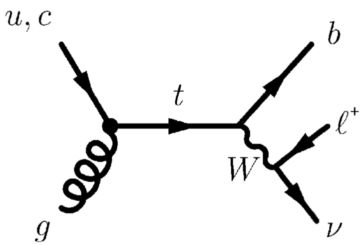
Searching for new physics with the top

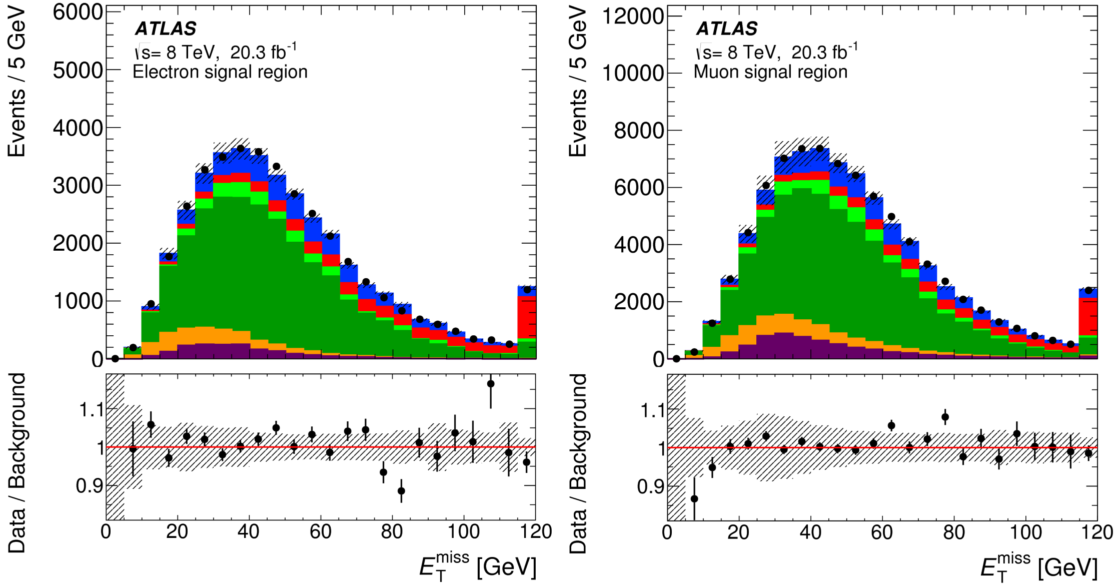
arXiv:1509.00294

FCNC forbidden at tree level, suppressed at higher orders

Enhanced rate in BSM models (B ~ 10^{-5}- 10^{-3})

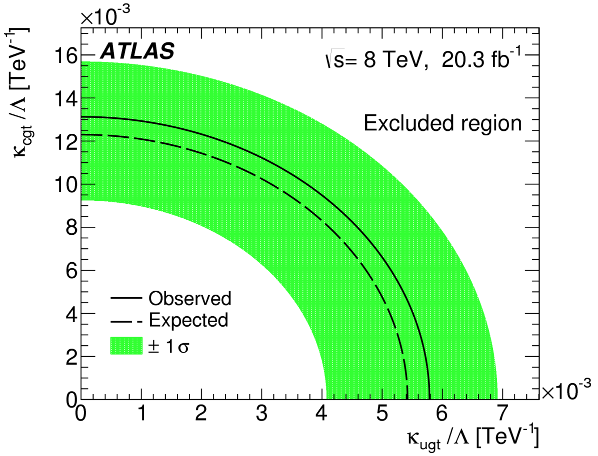
qg→t→bW (W in leptonic decay)





No signal seen, upper limit is set at 95% CL:

$$\sigma_{qg\to t} \times B\left(t \to bW\right) < 2.9\ \ (3.4)\ \text{pb}\ \ \text{expected(observed)}$$



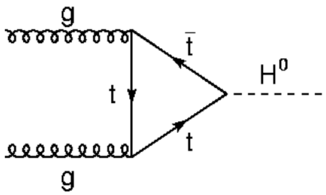
Upper limits on the coupling constants divided by the scale of new physics:

$$\left\{\begin{array}{l} \kappa_{u(c)gt}/\Lambda < 5.8\ (13)\ \times 10^{-3}\ \text{TeV}^{-1} \\ B\left(t \to u(c)g\right) < \ 4\ (17)\ \times\ 10^{-5} \end{array}\right.$$

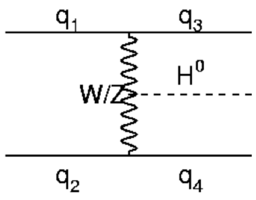
HIGGS BOSON STUDIES

SM Higgs boson at the LHC

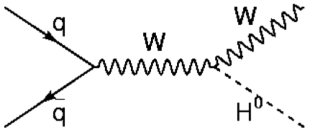
Gluon fusion process (87%)



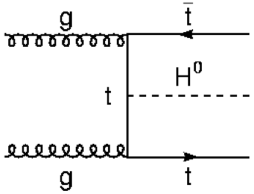
Vector Boson fusion (7%)



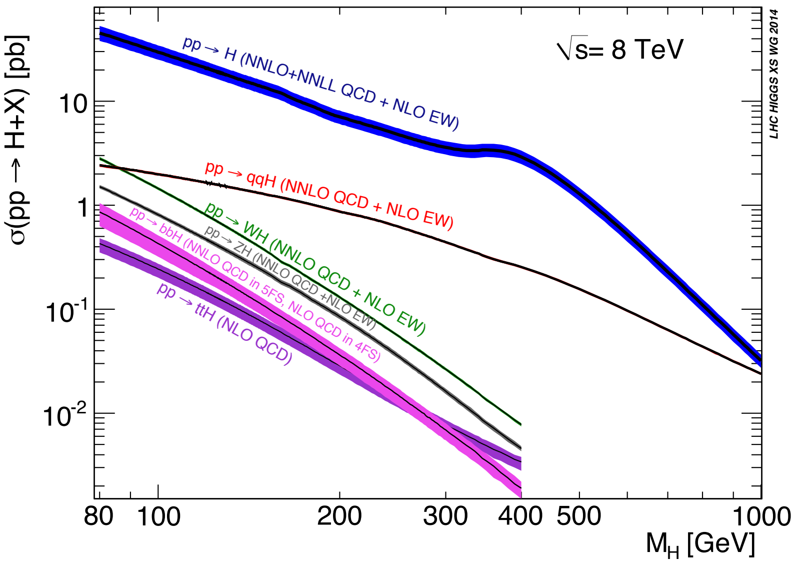
Associated production with W/Z (5%)

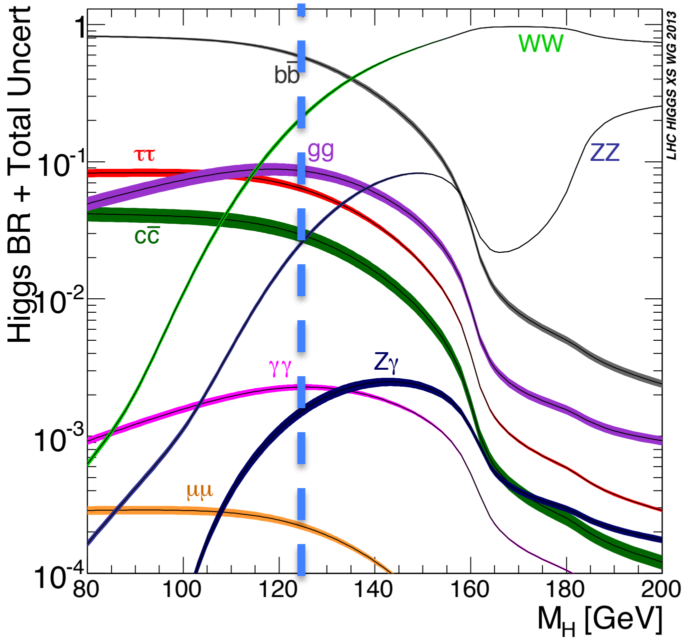


Associated production with top (1%)



LHC Higgs Cross Section Working Group





Cross section [pb] at m_H = 125.5 GeV ($\sqrt{s}$=8 TeV)

ggF	VBF	WH	ZH	ttH
19.1	1.6	0.7	0.4	0.1

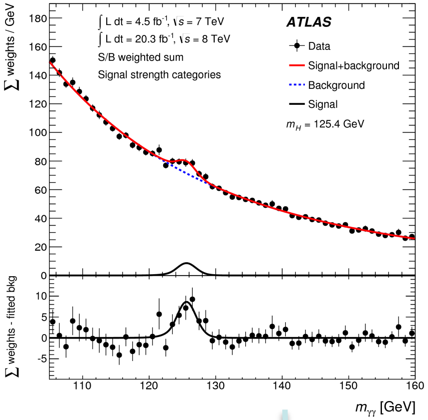
BR [%] at m_H = 125.5 GeV

WW	ZZ	γγ	Zγ
22	2.8	0.23	0.16

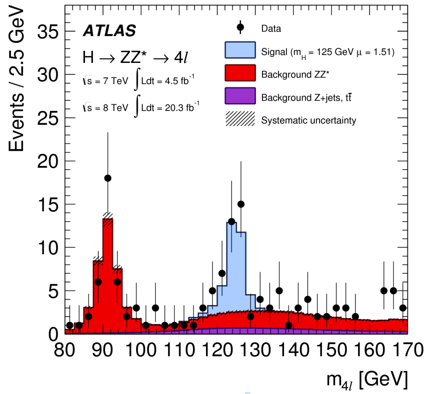
bbH cross section at 7 TeV and 8TeV is 1.1% of ggF

Higgs measurements and searches in ATLAS

H➝γγ : good resolution

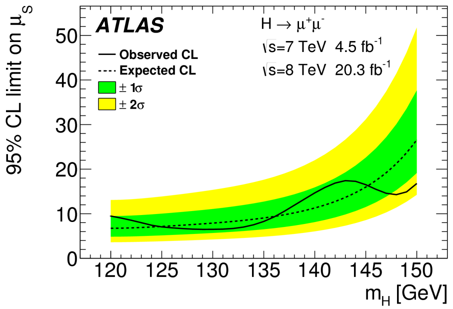


H➝ZZ* ➝ 4l: Golden channel

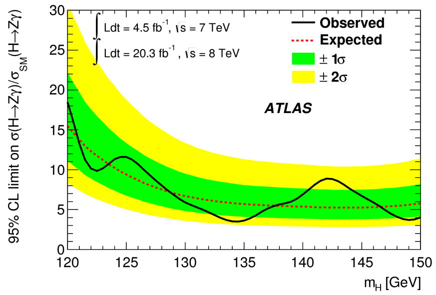


$$m_H = 125.36 \pm 0.37(stat) \pm 0.18(syst)\ \text{GeV}$$

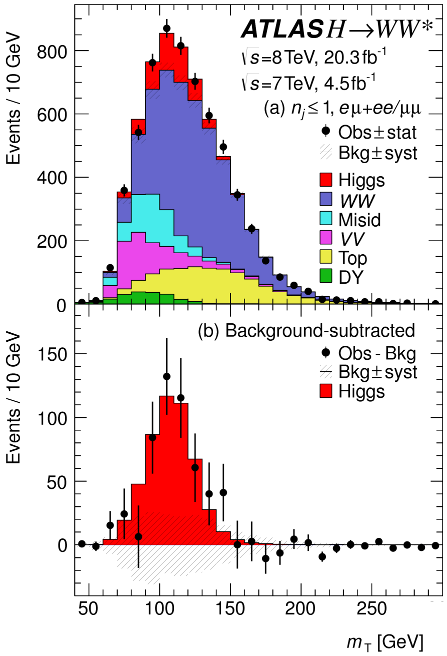
H➝ μ⁺μ⁻ : Clean signal
B(H➝ μ⁺μ⁻) < 21.9 10⁻⁵
(m_H=125 GeV)



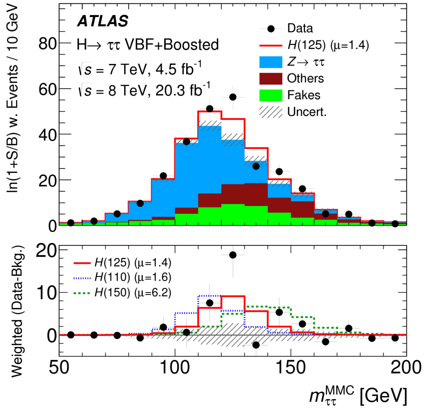
H➝ Zγ : Clean signal
B(H➝ Zγ) < 1.6 10⁻³
(m_H=125 GeV)



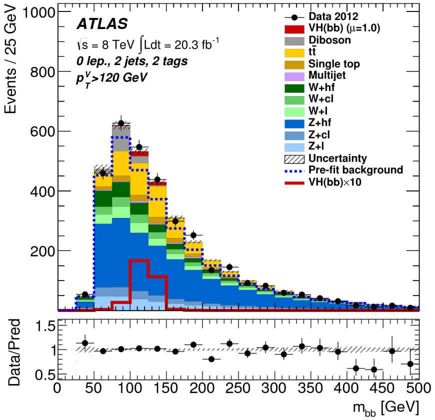
H➝WW* ➝ 4l: Good statistics,
low resolution;
Observed (expected) significance :
6.1 (5.8) σ



H➝ τ⁺τ⁻ : Best fermionic channel
Observed(expected) significance:
4.5 (3.4) σ



H➝bb : not possible ggF
(though VH)
Observed(expected)
significance: 1.4 (2.6) σ

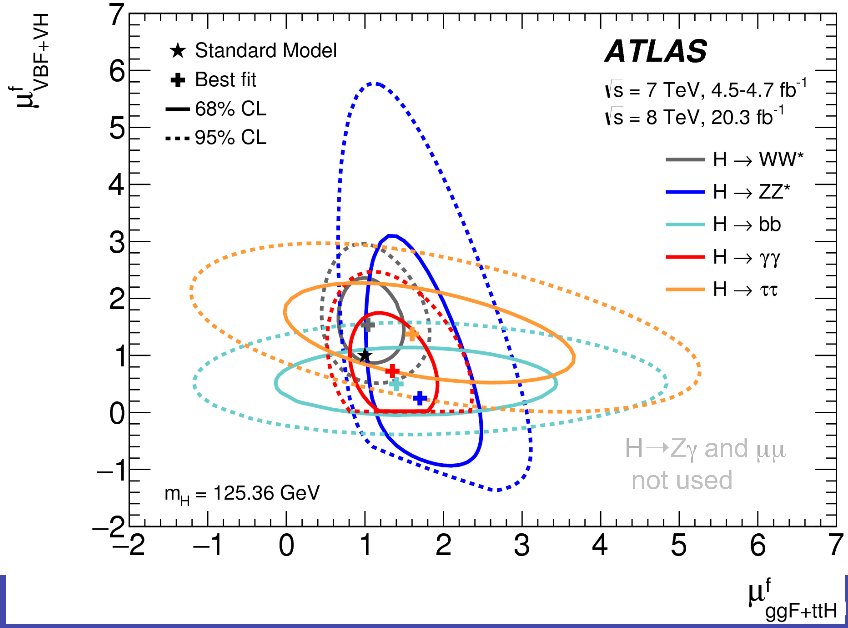


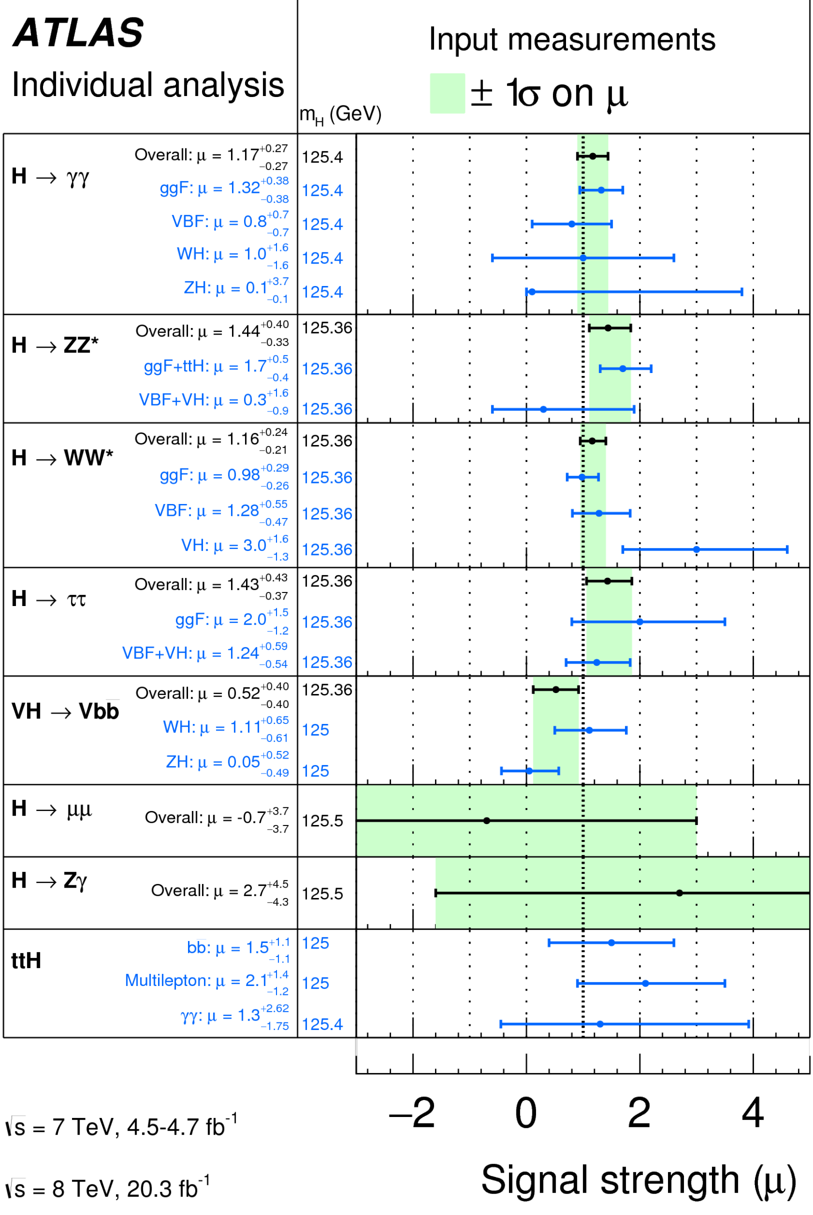
Signal strength

arXiv:1507.04548

- Full Run I data combination: di-boson decays H→ZZ*→4l, WW*, γγ rare decays H→Zγ, bb, ττ and μμ and VH(bb), ttH
  - Signal strength, μ: ratio of a given Higgs boson production cross section (σ) to its SM value (σ_{SM}), $\mu = \sigma/\sigma_{SM}$
- Categorization of the production processes:
  - Couplings to fermions : ggF + ttH ($\mu_{ggF+ttH}$)
  - Couplings to vector bosons : VBF + VH (μ_{VBF+VH})

$$\frac{\mu_{VBF+VH}/\mu_{ggF+ttH}}{\left[\mu_{VBF+VH}/\mu_{ggF+ttH}\right]_{SM}} = 0.96^{+0.33}_{-0.26}(stat)^{+0.20}_{-0.13}(syst)^{+0.18}_{-0.10}(th)$$



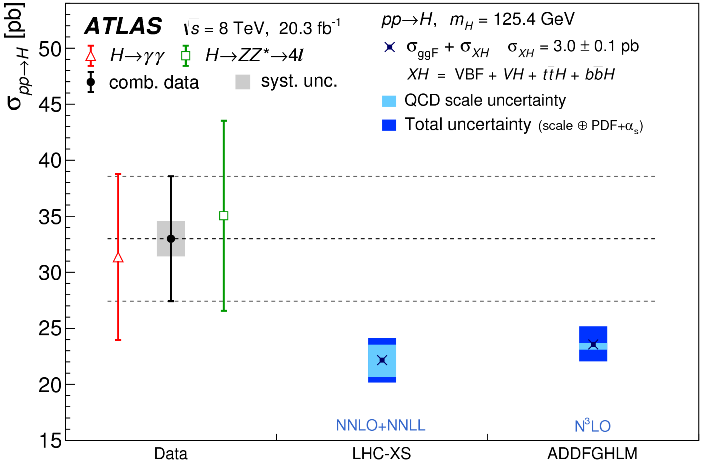


$$\mu = 1.18 \pm 0.10(\mathrm{stat}) \pm 0.07(\mathrm{syst})^{+0.08}_{-0.07}(\mathrm{th})$$

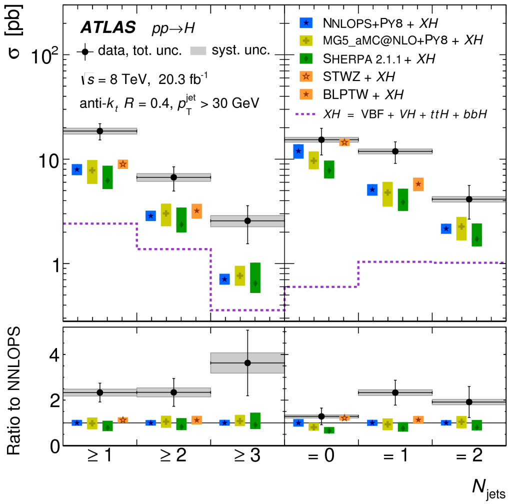
Fiducial and differential cross sections

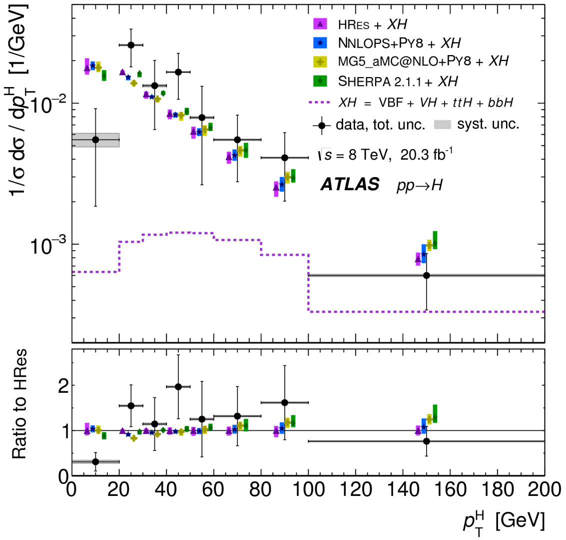
Model independent measurement of cross section from 8 TeV data using H→ZZ* and H→γγ

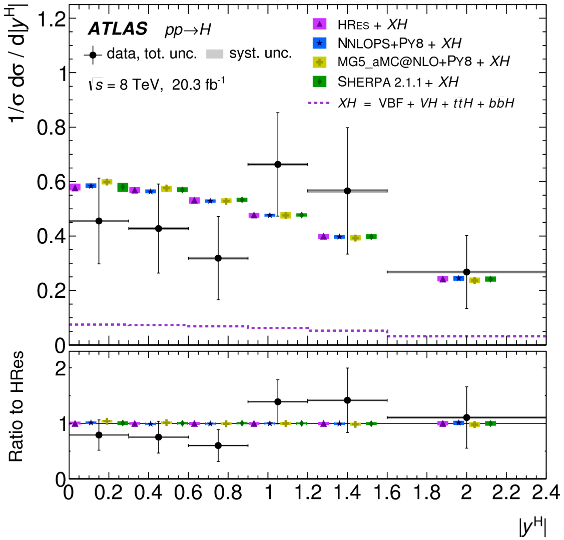
- Observed xs higher than theory
- For all inclusive and exclusive jet multiplicities, data is higher
  - Least agreement is on ≥1 or =1 bins (p-value 0.1% and 3.6%)
- Need more data to confirm
  - Results are statistically dominated

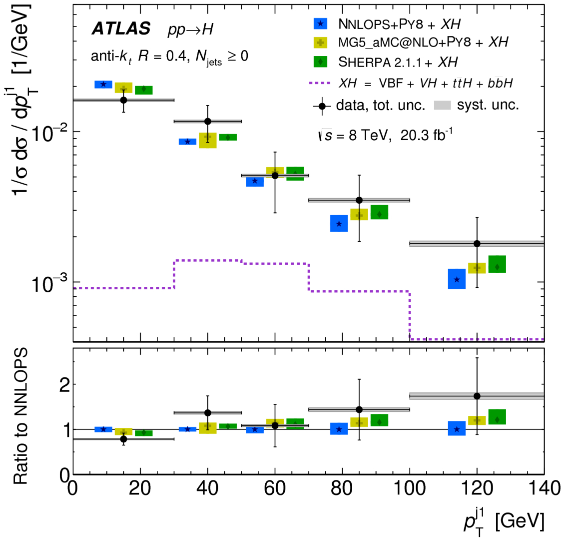


PRL 115 (2015) 091801









Higgs boson couplings

arXiv:1507.04548

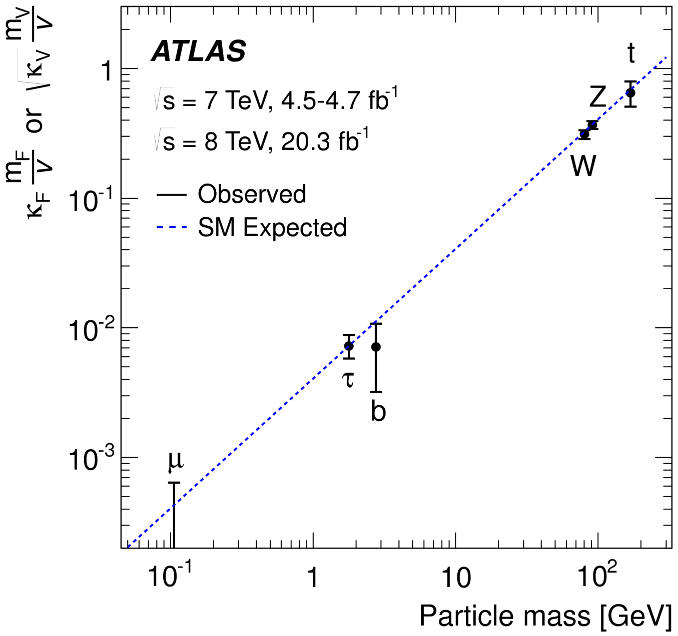
$$\kappa_i \equiv g_i / g_i^{SM}, \quad \lambda_{ij} \equiv \kappa_i / \kappa_j, \quad \kappa_{ij} \equiv \kappa_i \cdot \kappa_j / \kappa_H$$

Assuming only SM contribution to the total width and no invisible or undetected H boson decays (simplest case)

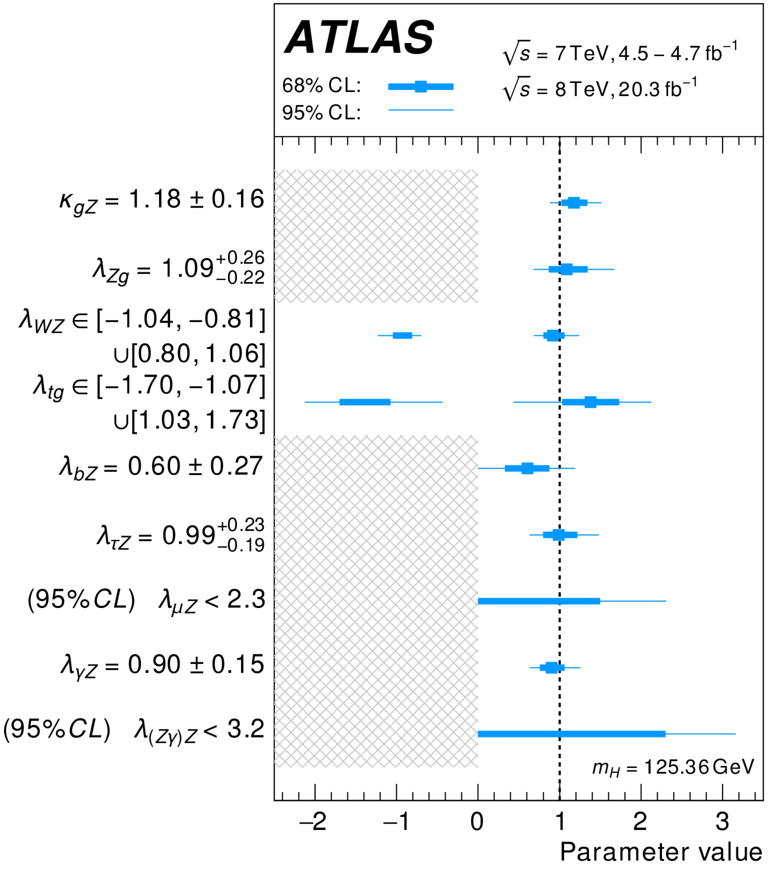
- Global fit to all data & decay channels
- Measured fermion & vector coupling-strength scale factors in agreement with SM

$$\kappa_V = 1.09 \pm 0.07$$

$$\kappa_F = 1.11 \pm 0.16$$



Most generic case: Allowing new particles in loops, no assumption on total width



Spin and Parity

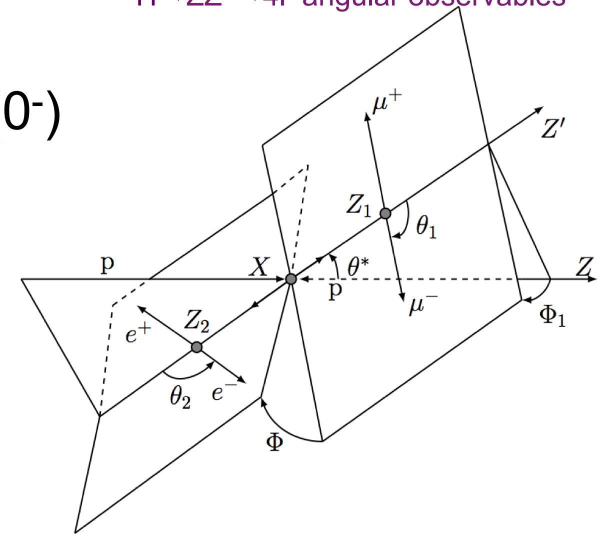
arXiv:1506.05669

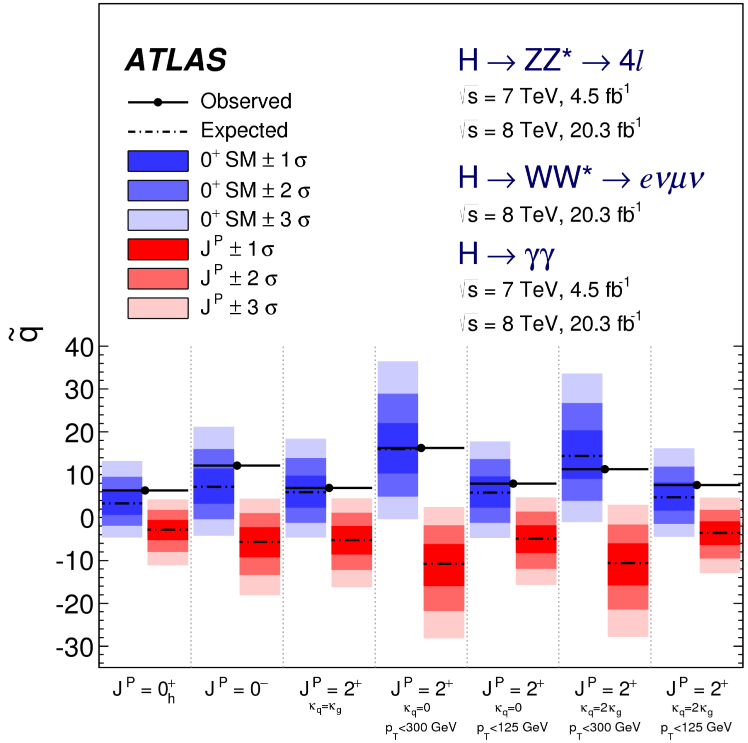
Using H→ZZ*→4l, H→WW*→eνμν, H→γγ

- Spin-0: CP-even BSM (0^+_h), CP-odd pseudo-scalar (0^-)
- Spin-2: Universal couplings and κ_q/κ_g = 0 and 2

Exclusion determined from q: likehood ratio to distinguish between two spin hypotheses

H→ZZ*→4l angular observables





J^P	Model	Choice of tensor couplings			
		$\kappa_{\rm SM}$	κ_{HVV}	κ_{AVV}	α
0^+	Standard Model Higgs boson	1	0	0	0
0^+_h	BSM spin-0 CP-even	0	1	0	0
0^-	BSM spin-0 CP-odd	0	0	1	$\pi/2$

Values of spin-2 quark and gluon couplings		$p_{\rm T}^X$ selections (GeV)	
$\kappa_q = \kappa_g$	Universal couplings	–	–
$\kappa_q = 0$	Low light-quark fraction	< 300	< 125
$\kappa_q = 2\kappa_g$	Low gluon fraction	< 300	< 125

SM is favored; alternative models excluded > 99.9%CL_S

Spin and Parity

Combined fit to H→ZZ* and H→WW* final states

- Constraint the Spin-0 coupling ratios

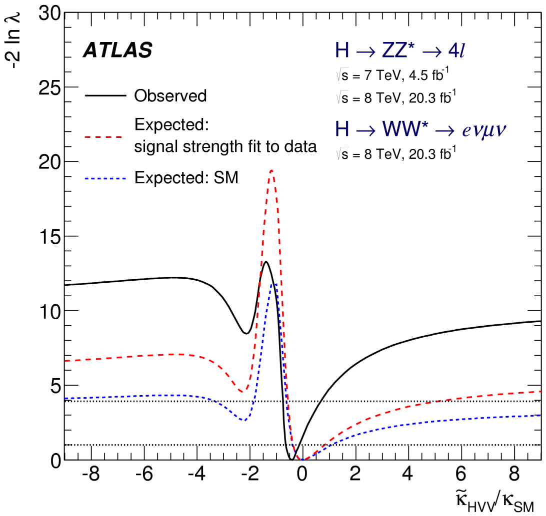
$$\left(\tilde{\kappa}_{AVV}/\kappa_{SM}\right)\cdot\tan\alpha \text{ and } \tilde{\kappa}_{HVV}/\kappa_{SM}$$

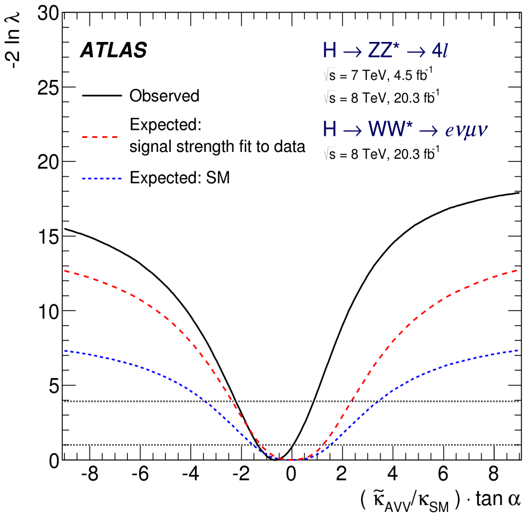
$$\tilde{\kappa}_{A(H)VV} = \frac{1}{4}\frac{\mathrm{v}}{\Lambda}\kappa_{A(H)VV}$$

L for spin-0 particle interaction with W or Z boson

$$\begin{aligned}\mathcal{L}_0^V = \quad & \Big\{\cos(\alpha)\kappa_{\rm SM}\left[\tfrac{1}{2}g_{HZZ}Z_\mu Z^\mu + g_{HWW}W_\mu^+W^{-\mu}\right] \\ & -\tfrac{1}{4}\tfrac{1}{\Lambda}\left[\cos(\alpha)\kappa_{HZZ}Z_{\mu\nu}Z^{\mu\nu} + \sin(\alpha)\kappa_{AZZ}Z_{\mu\nu}\tilde{Z}^{\mu\nu}\right] \\ & -\tfrac{1}{2}\tfrac{1}{\Lambda}\left[\cos(\alpha)\kappa_{HWW}W^+_{\mu\nu}W^{-\mu\nu} + \sin(\alpha)\kappa_{AWW}W^+_{\mu\nu}\tilde{W}^{-\mu\nu}\right]\Big\}X_0\end{aligned}$$

Spin-even BSM contribution





Spin-odd BSM contribution

Coupling ratio	Best-fit value	95% CL Exclusion Regions	
Combined	Observed	Expected	Observed
$\tilde{\kappa}_{HVV}/\kappa_{\rm SM}$	-0.48	$(-\infty, -0.55] \bigcup [4.80, \infty)$	$(-\infty, -0.73] \bigcup [0.63, \infty)$
$(\tilde{\kappa}_{AVV}/\kappa_{\rm SM}) \cdot \tan\alpha$	-0.68	$(-\infty, -2.33] \bigcup [2.30, \infty)$	$(-\infty, -2.18] \bigcup [0.83, \infty)$

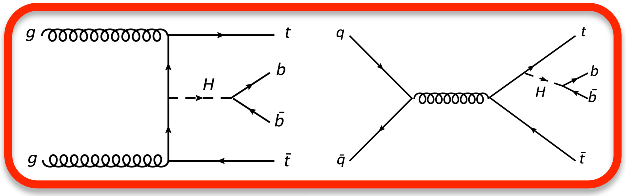
BSM to SM tensor couplings are compatible with the SM expectation

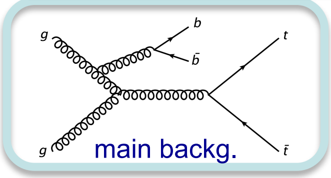
Rare processes

Higgs boson production in association with a top-quark pair

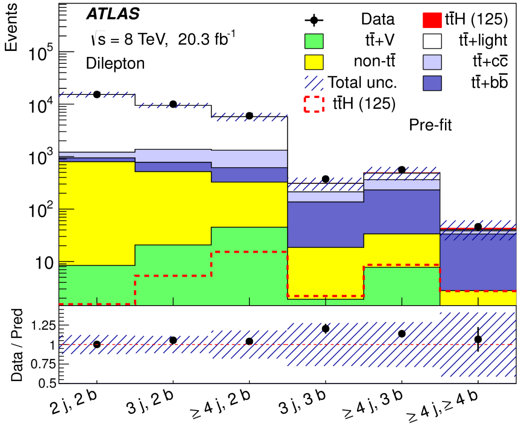
- Direct measurement of top quark-Higgs coupling
- ttH (H → bb / multilepton H(→ZZ, WW, ττ))

ttH (H→ bb)

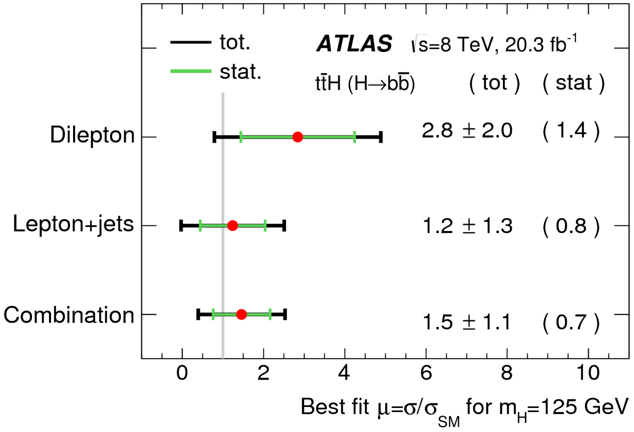




main backg.

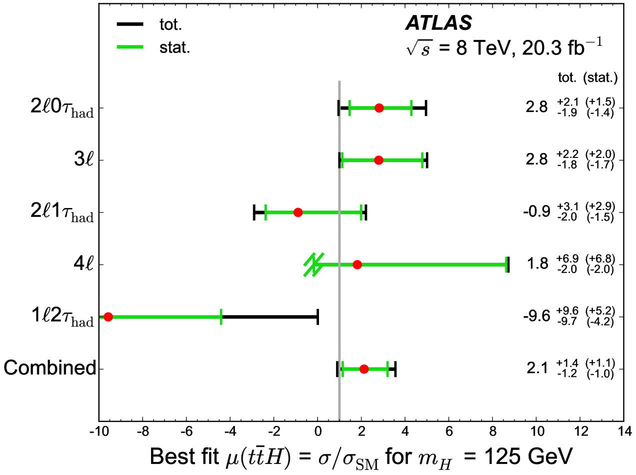


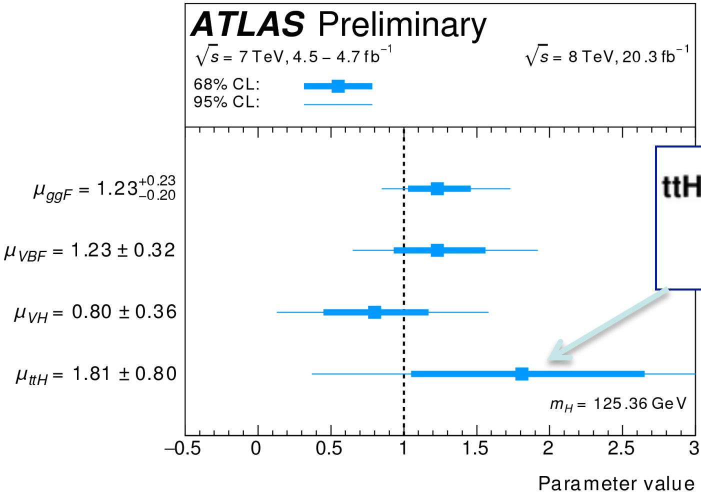
EPJC (2015) 75:349



ttH (H→ multilepton)

(PLB 749 (2015) 519)





ttH

bb: $\mu = 1.5^{+1.1}_{-1.1}$

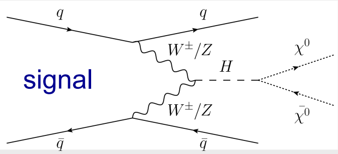
Multilepton: $\mu = 2.1^{+1.4}_{-1.2}$

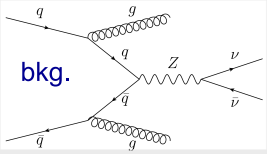
γγ: $\mu = 1.3^{+2.6}_{-1.8}$

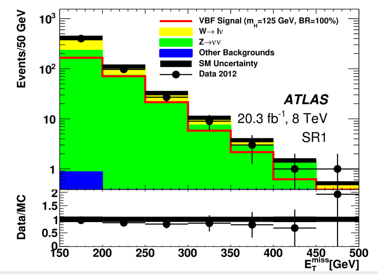
No significant excess over the background is observed in both searches

Searching for new physics with the Higgs boson

Invisible Higgs decay (VBF) arXiv:1508.07869



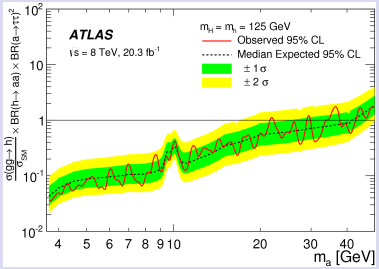


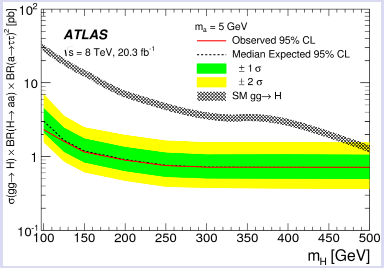


No excess over expected background
At 95% CL.
B(H→invisible) < 28 % (31%) obs (exp)

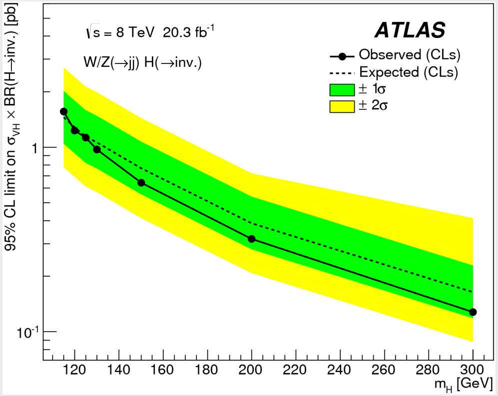
H→aa→μμττ (PRD 92 2015 052002)

NMSSM : H decays to lightest pseudoscalar higgs





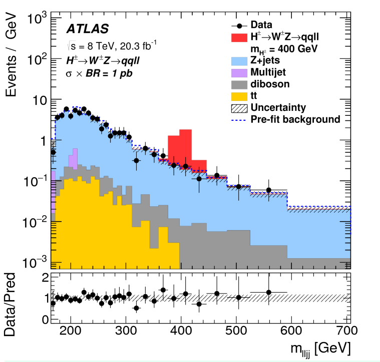
VH(W/Z→hadronic, H→invisible)

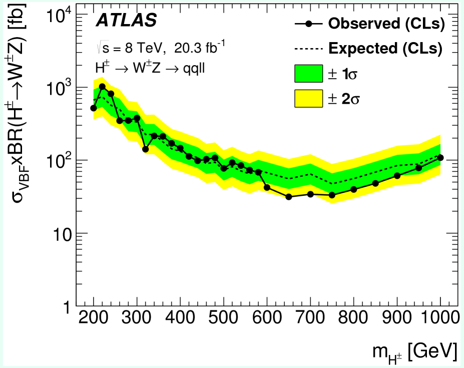


EPJC (2015) 75:337
m_H=125 GeV
B(H→invisible) < 78% (86%) obs (exp)

H±→W±Z→qqll (PRL 114 231801 (2015))

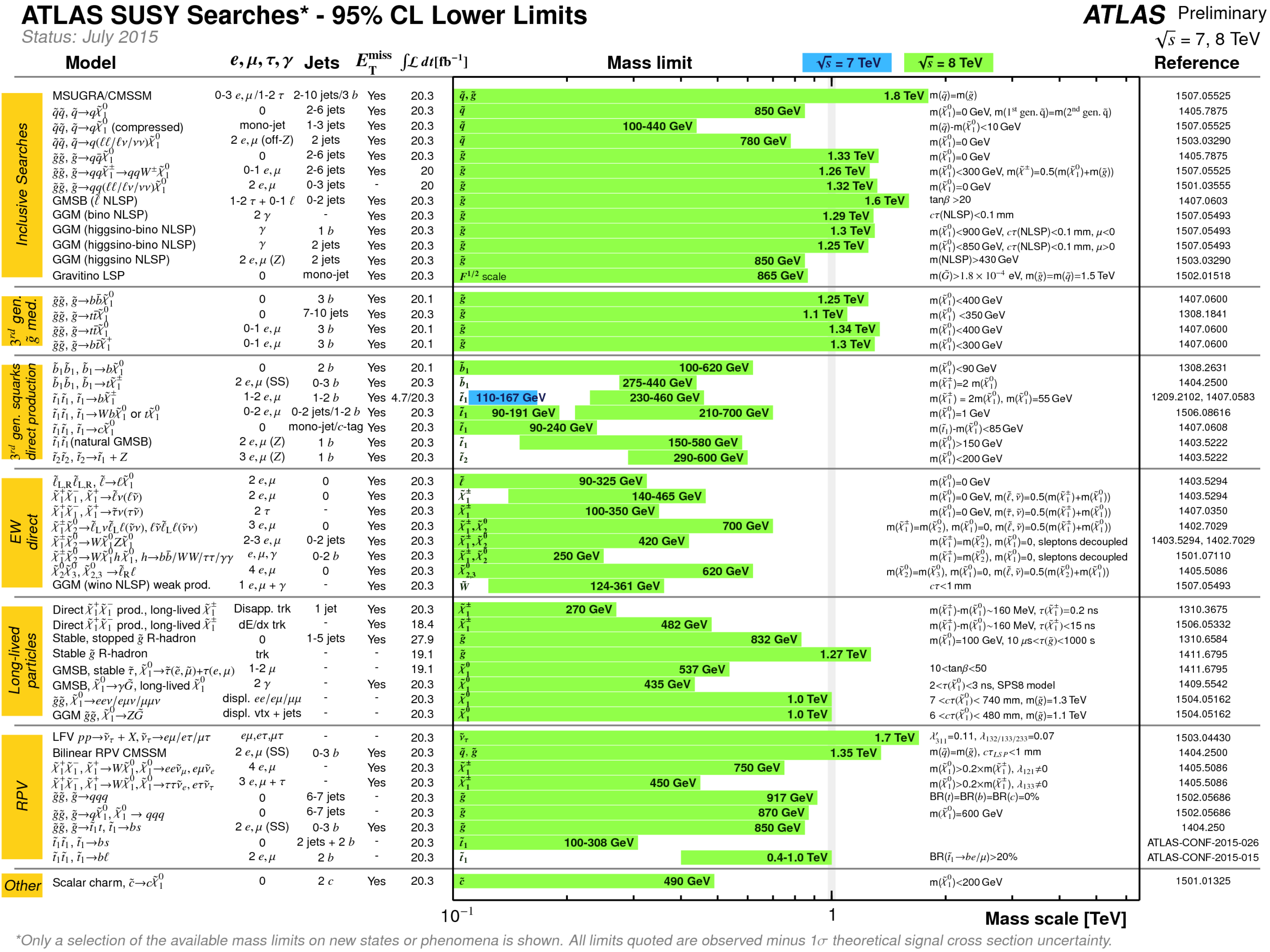
Charged Higgs boson appears in many SM extension models : 2HDM, Higgs Triplet model





SUSY

Mass limits



ATLAS SUSY Searches* - 95% CL Lower Limits

Status: July 2015

ATLAS Preliminary

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

	Model	e, μ, τ, γ	Jets	E_T^{miss}	$\int \mathcal{L}\, dt[fb^{-1}]$	Mass limit		Reference
Inclusive Searches	MSUGRA/CMSSM	0-3 e,μ/1-2 τ	2-10 jets/3 b	Yes	20.3	$\tilde{q},\tilde{g}$ 1.8 TeV	m($\tilde{q}$)=m($\tilde{g}$)	1507.05525
	$\tilde{q}\tilde{q}$, $\tilde{q}\to q\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{q}$ 850 GeV	m($\tilde{\chi}_1^0$)=0 GeV, m(1st gen. $\tilde{q}$)=m(2nd gen. $\tilde{q}$)	1405.7875
	$\tilde{q}\tilde{q}$, $\tilde{q}\to q\tilde{\chi}_1^0$ (compressed)	mono-jet	1-3 jets	Yes	20.3	$\tilde{q}$ 100-440 GeV	m($\tilde{q}$)-m($\tilde{\chi}_1^0$)<10 GeV	1507.05525
	$\tilde{q}\tilde{q}$, $\tilde{q}\to q(\ell\ell/\ell\nu/\nu\nu)\tilde{\chi}_1^0$	2 e,μ (off-Z)	2 jets	Yes	20.3	$\tilde{q}$ 780 GeV	m($\tilde{\chi}_1^0$)=0 GeV	1503.03290
	$\tilde{g}\tilde{g}$, $\tilde{g}\to q\bar{q}\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{g}$ 1.33 TeV	m($\tilde{\chi}_1^0$)=0 GeV	1405.7875
	$\tilde{g}\tilde{g}$, $\tilde{g}\to qq\tilde{\chi}_1^{\pm}\to qqW^{\pm}\tilde{\chi}_1^0$	0-1 e,μ	2-6 jets	Yes	20	$\tilde{g}$ 1.26 TeV	m($\tilde{\chi}_1^0$)<300 GeV, m($\tilde{\chi}^{\pm}$)=0.5(m($\tilde{\chi}_1^0$)+m($\tilde{g}$))	1507.05525
	$\tilde{g}\tilde{g}$, $\tilde{g}\to qq(\ell\ell/\ell\nu/\nu\nu)\tilde{\chi}_1^0$	2 e,μ	0-3 jets	-	20	$\tilde{g}$ 1.32 TeV	m($\tilde{\chi}_1^0$)=0 GeV	1501.03555
	GMSB ($\tilde{\ell}$ NLSP)	1-2 τ + 0-1 ℓ	0-2 jets	Yes	20.3	$\tilde{g}$ 1.6 TeV	tanβ >20	1407.0603
	GGM (bino NLSP)	2 γ	-	Yes	20.3	$\tilde{g}$ 1.29 TeV	$c\tau$(NLSP)<0.1 mm	1507.05493
	GGM (higgsino-bino NLSP)	γ	1 b	Yes	20.3	$\tilde{g}$ 1.3 TeV	m($\tilde{\chi}_1^0$)<900 GeV, $c\tau$(NLSP)<0.1 mm, μ<0	1507.05493
	GGM (higgsino-bino NLSP)	γ	2 jets	Yes	20.3	$\tilde{g}$ 1.25 TeV	m($\tilde{\chi}_1^0$)<850 GeV, $c\tau$(NLSP)<0.1 mm, μ>0	1507.05493
	GGM (higgsino NLSP)	2 e,μ (Z)	2 jets	Yes	20.3	$\tilde{g}$ 850 GeV	m(NLSP)>430 GeV	1503.03290
	Gravitino LSP	0	mono-jet	Yes	20.3	$F^{1/2}$ scale 865 GeV	m($\tilde{G}$)>1.8×10^{-4} eV, m($\tilde{g}$)=m($\tilde{q}$)=1.5 TeV	1502.01518
3^{rd} gen. $\tilde{g}$ med.	$\tilde{g}\tilde{g}$, $\tilde{g}\to b\bar{b}\tilde{\chi}_1^0$	0	3 b	Yes	20.1	$\tilde{g}$ 1.25 TeV	m($\tilde{\chi}_1^0$)<400 GeV	1407.0600
	$\tilde{g}\tilde{g}$, $\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$	0	7-10 jets	Yes	20.3	$\tilde{g}$ 1.1 TeV	m($\tilde{\chi}_1^0$) <350 GeV	1308.1841
	$\tilde{g}\tilde{g}$, $\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$	0-1 e,μ	3 b	Yes	20.1	$\tilde{g}$ 1.34 TeV	m($\tilde{\chi}_1^0$)<400 GeV	1407.0600
	$\tilde{g}\tilde{g}$, $\tilde{g}\to b\bar{t}\tilde{\chi}_1^+$	0-1 e,μ	3 b	Yes	20.1	$\tilde{g}$ 1.3 TeV	m($\tilde{\chi}_1^0$)<300 GeV	1407.0600
3^{rd} gen. squarks direct production	$\tilde{b}_1\tilde{b}_1$, $\tilde{b}_1\to b\tilde{\chi}_1^0$	0	2 b	Yes	20.1	$\tilde{b}_1$ 100-620 GeV	m($\tilde{\chi}_1^0$)<90 GeV	1308.2631
	$\tilde{b}_1\tilde{b}_1$, $\tilde{b}_1\to t\tilde{\chi}_1^{\pm}$	2 e,μ (SS)	0-3 b	Yes	20.3	$\tilde{b}_1$ 275-440 GeV	m($\tilde{\chi}_1^{\pm}$)=2 m($\tilde{\chi}_1^0$)	1404.2500
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to b\tilde{\chi}_1^{\pm}$	1-2 e,μ	1-2 b	Yes	4.7/20.3	$\tilde{t}_1$ 110-167 GeV 230-460 GeV	m($\tilde{\chi}_1^{\pm}$) = 2m($\tilde{\chi}_1^0$), m($\tilde{\chi}_1^0$)=55 GeV	1209.2102, 1407.0583
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to Wb\tilde{\chi}_1^0$ or $t\tilde{\chi}_1^0$	0-2 e,μ	0-2 jets/1-2 b	Yes	20.3	$\tilde{t}_1$ 90-191 GeV 210-700 GeV	m($\tilde{\chi}_1^0$)=1 GeV	1506.08616
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to c\tilde{\chi}_1^0$	0	mono-jet/c-tag	Yes	20.3	$\tilde{t}_1$ 90-240 GeV	m($\tilde{t}_1$)-m($\tilde{\chi}_1^0$)<85 GeV	1407.0608
	$\tilde{t}_1\tilde{t}_1$(natural GMSB)	2 e,μ (Z)	1 b	Yes	20.3	$\tilde{t}_1$ 150-580 GeV	m($\tilde{\chi}_1^0$)>150 GeV	1403.5222
	$\tilde{t}_2\tilde{t}_2$, $\tilde{t}_2\to\tilde{t}_1+Z$	3 e,μ (Z)	1 b	Yes	20.3	$\tilde{t}_2$ 290-600 GeV	m($\tilde{\chi}_1^0$)<200 GeV	1403.5222
EW direct	$\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}$, $\tilde{\ell}\to\ell\tilde{\chi}_1^0$	2 e,μ	0	Yes	20.3	$\tilde{\ell}$ 90-325 GeV	m($\tilde{\chi}_1^0$)=0 GeV	1403.5294
	$\tilde{\chi}_1^+\tilde{\chi}_1^-$, $\tilde{\chi}_1^+\to\tilde{\ell}\nu(\ell\tilde{\nu})$	2 e,μ	0	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 140-465 GeV	m($\tilde{\chi}_1^0$)=0 GeV, m($\tilde{\ell},\tilde{\nu}$)=0.5(m($\tilde{\chi}_1^{\pm}$)+m($\tilde{\chi}_1^0$))	1403.5294
	$\tilde{\chi}_1^+\tilde{\chi}_1^-$, $\tilde{\chi}_1^+\to\tilde{\tau}\nu(\tau\tilde{\nu})$	2 τ	-	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 100-350 GeV	m($\tilde{\chi}_1^0$)=0 GeV, m($\tilde{\tau},\tilde{\nu}$)=0.5(m($\tilde{\chi}_1^{\pm}$)+m($\tilde{\chi}_1^0$))	1407.0350
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0\to\tilde{\ell}_L\nu\tilde{\ell}_L\ell(\tilde{\nu}\nu), \ell\tilde{\nu}\tilde{\ell}_L\ell(\tilde{\nu}\nu)$	3 e,μ	0	Yes	20.3	$\tilde{\chi}_1^{\pm},\tilde{\chi}_2^0$ 700 GeV	m($\tilde{\chi}_1^{\pm}$)=m($\tilde{\chi}_2^0$), m($\tilde{\chi}_1^0$)=0, m($\tilde{\ell},\tilde{\nu}$)=0.5(m($\tilde{\chi}_1^{\pm}$)+m($\tilde{\chi}_1^0$))	1402.7029
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0\to W\tilde{\chi}_1^0 Z\tilde{\chi}_1^0$	2-3 e,μ	0-2 jets	Yes	20.3	$\tilde{\chi}_1^{\pm},\tilde{\chi}_2^0$ 420 GeV	m($\tilde{\chi}_1^{\pm}$)=m($\tilde{\chi}_2^0$), m($\tilde{\chi}_1^0$)=0, sleptons decoupled	1403.5294, 1402.7029
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0\to W\tilde{\chi}_1^0 h\tilde{\chi}_1^0$, $h\to b\bar{b}/WW/\tau\tau/\gamma\gamma$	e,μ,γ	0-2 b	Yes	20.3	$\tilde{\chi}_1^{\pm},\tilde{\chi}_2^0$ 250 GeV	m($\tilde{\chi}_1^{\pm}$)=m($\tilde{\chi}_2^0$), m($\tilde{\chi}_1^0$)=0, sleptons decoupled	1501.07110
	$\tilde{\chi}_2^0\tilde{\chi}_3^0$, $\tilde{\chi}_{2,3}^0\to\tilde{\ell}_R\ell$	4 e,μ	0	Yes	20.3	$\tilde{\chi}_{2,3}^0$ 620 GeV	m($\tilde{\chi}_2^0$)=m($\tilde{\chi}_3^0$), m($\tilde{\chi}_1^0$)=0, m($\tilde{\ell},\tilde{\nu}$)=0.5(m($\tilde{\chi}_2^0$)+m($\tilde{\chi}_1^0$))	1405.5086
	GGM (wino NLSP) weak prod.	1 $e,\mu+\gamma$	-	Yes	20.3	$\tilde{W}$ 124-361 GeV	$c\tau$<1 mm	1507.05493
Long-lived particles	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^{\pm}$	Disapp. trk	1 jet	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 270 GeV	m($\tilde{\chi}_1^{\pm}$)-m($\tilde{\chi}_1^0$)~160 MeV, τ($\tilde{\chi}_1^{\pm}$)=0.2 ns	1310.3675
	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^{\pm}$	dE/dx trk	-	Yes	18.4	$\tilde{\chi}_1^{\pm}$ 482 GeV	m($\tilde{\chi}_1^{\pm}$)-m($\tilde{\chi}_1^0$)~160 MeV, τ($\tilde{\chi}_1^{\pm}$)<15 ns	1506.05332
	Stable, stopped $\tilde{g}$ R-hadron	0	1-5 jets	Yes	27.9	$\tilde{g}$ 832 GeV	m($\tilde{\chi}_1^0$)=100 GeV, 10 μs<τ($\tilde{g}$)<1000 s	1310.6584
	Stable $\tilde{g}$ R-hadron	trk	-	-	19.1	$\tilde{g}$ 1.27 TeV		1411.6795
	GMSB, stable $\tilde{\tau}$, $\tilde{\chi}_1^0\to\tilde{\tau}(\tilde{e},\tilde{\mu})+\tau(e,\mu)$	1-2 μ	-	-	19.1	$\tilde{\chi}_1^0$ 537 GeV	10<tanβ<50	1411.6795
	GMSB, $\tilde{\chi}_1^0\to\gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$	2 γ	-	Yes	20.3	$\tilde{\chi}_1^0$ 435 GeV	2<τ($\tilde{\chi}_1^0$)<3 ns, SPS8 model	1409.5542
	$\tilde{g}\tilde{g}$, $\tilde{\chi}_1^0\to ee\nu/e\mu\nu/\mu\mu\nu$	displ. $ee/e\mu/\mu\mu$	-	-	20.3	$\tilde{\chi}_1^0$ 1.0 TeV	7 <$c\tau$($\tilde{\chi}_1^0$)< 740 mm, m($\tilde{g}$)=1.3 TeV	1504.05162
	GGM $\tilde{g}\tilde{g}$, $\tilde{\chi}_1^0\to Z\tilde{G}$	displ. vtx + jets	-	-	20.3	$\tilde{\chi}_1^0$ 1.0 TeV	6 <$c\tau$($\tilde{\chi}_1^0$)< 480 mm, m($\tilde{g}$)=1.1 TeV	1504.05162
RPV	LFV $pp\to\tilde{\nu}_\tau+X, \tilde{\nu}_\tau\to e\mu/e\tau/\mu\tau$	$e\mu$,$e\tau$,$\mu\tau$	-	-	20.3	$\tilde{\nu}_\tau$ 1.7 TeV	λ'_{311}=0.11, $\lambda_{132/133/233}$=0.07	1503.04430
	Bilinear RPV CMSSM	2 e,μ (SS)	0-3 b	Yes	20.3	$\tilde{q},\tilde{g}$ 1.35 TeV	m($\tilde{q}$)=m($\tilde{g}$), $c\tau_{LSP}$<1 mm	1404.2500
	$\tilde{\chi}_1^+\tilde{\chi}_1^-$, $\tilde{\chi}_1^+\to W\tilde{\chi}_1^0$, $\tilde{\chi}_1^0\to ee\tilde{\nu}_\mu, e\mu\tilde{\nu}_e$	4 e,μ	-	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 750 GeV	m($\tilde{\chi}_1^0$)>0.2×m($\tilde{\chi}_1^{\pm}$), $\lambda_{121}\neq0$	1405.5086
	$\tilde{\chi}_1^+\tilde{\chi}_1^-$, $\tilde{\chi}_1^+\to W\tilde{\chi}_1^0$, $\tilde{\chi}_1^0\to\tau\tau\tilde{\nu}_e, e\tau\tilde{\nu}_\tau$	3 $e,\mu+\tau$	-	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 450 GeV	m($\tilde{\chi}_1^0$)>0.2×m($\tilde{\chi}_1^{\pm}$), $\lambda_{133}\neq0$	1405.5086
	$\tilde{g}\tilde{g}$, $\tilde{g}\to qqq$	0	6-7 jets	-	20.3	$\tilde{g}$ 917 GeV	BR(t)=BR(b)=BR(c)=0%	1502.05686
	$\tilde{g}\tilde{g}$, $\tilde{g}\to q\tilde{\chi}_1^0$, $\tilde{\chi}_1^0\to qqq$	0	6-7 jets	-	20.3	$\tilde{g}$ 870 GeV	m($\tilde{\chi}_1^0$)=600 GeV	1502.05686
	$\tilde{g}\tilde{g}$, $\tilde{g}\to\tilde{t}_1 t$, $\tilde{t}_1\to bs$	2 e,μ (SS)	0-3 b	Yes	20.3	$\tilde{g}$ 850 GeV		1404.250
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to bs$	0	2 jets + 2 b	-	20.3	$\tilde{t}_1$ 100-308 GeV		ATLAS-CONF-2015-026
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to b\ell$	2 e,μ	2 b	-	20.3	$\tilde{t}_1$ 0.4-1.0 TeV	BR($\tilde{t}_1\to be/\mu$)>20%	ATLAS-CONF-2015-015
Other	Scalar charm, $\tilde{c}\to c\tilde{\chi}_1^0$	0	2 c	Yes	20.3	$\tilde{c}$ 490 GeV	m($\tilde{\chi}_1^0$)<200 GeV	1501.01325

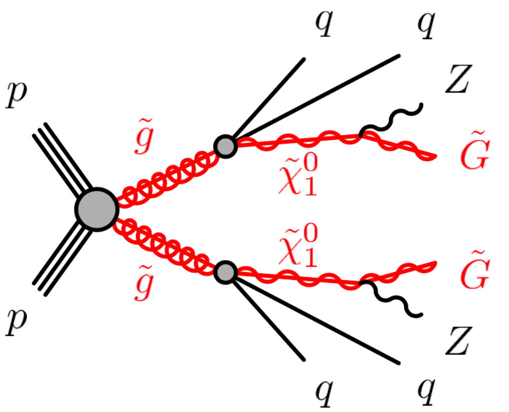
*Only a selection of the available mass limits on new states or phenomena is shown. All limits quoted are observed minus 1σ theoretical signal cross section uncertainty.

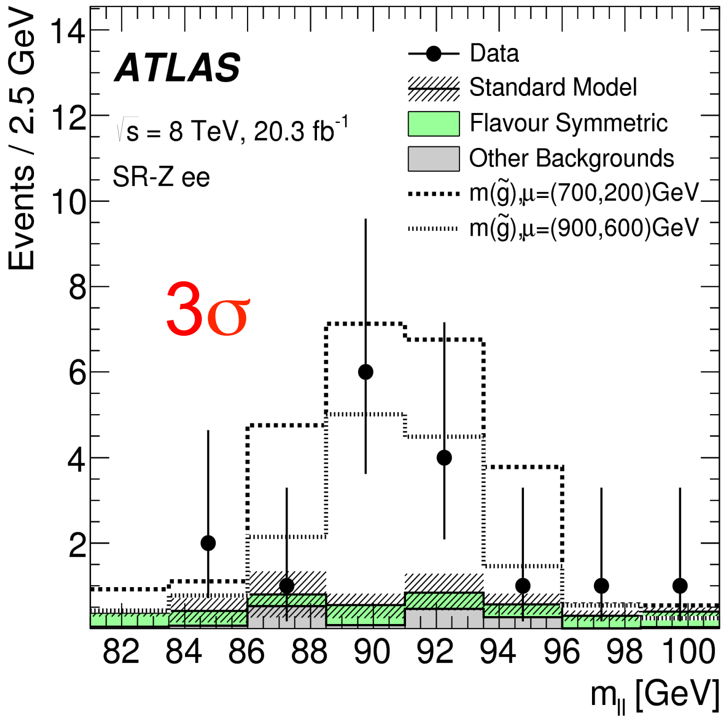
No significant evidence of a SUSY signal at Run 1

2-lepton + jets + MET

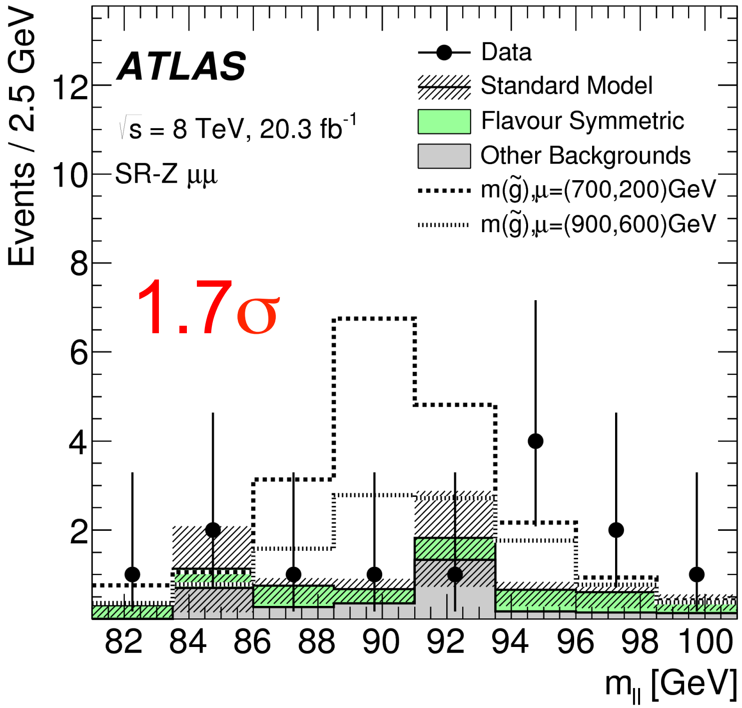
arXiv:1503.03290

- Two same-flavor opposite-charge leptons, jets and MET
- Dilepton mass compatible with Z
- Compatible with SUSY decays with Z bosons in the final state





3σ



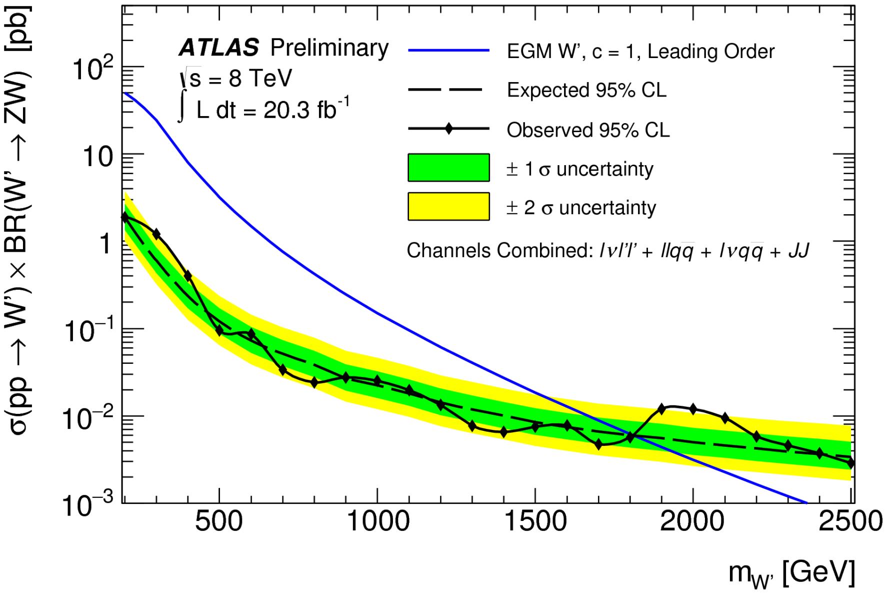
1.7σ

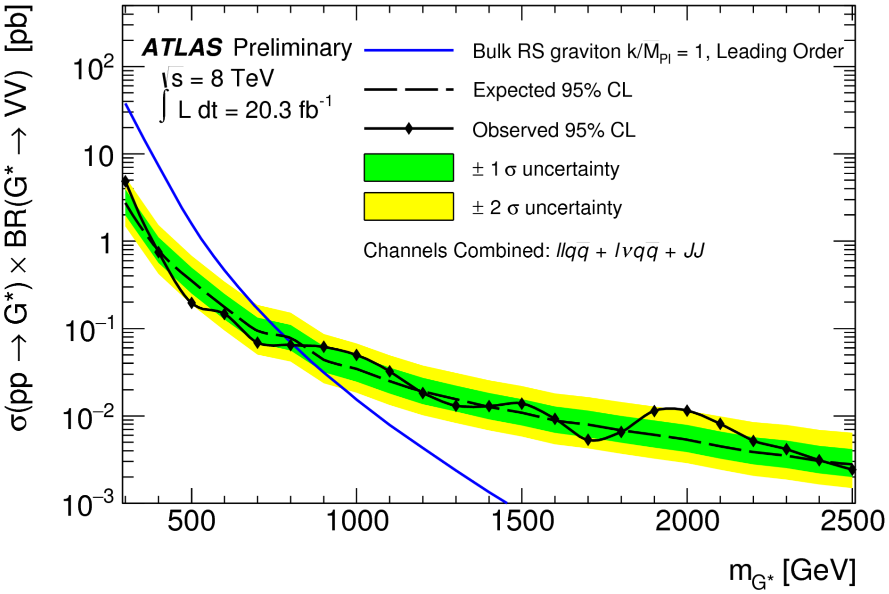
EXOTICS

Heavy boson searches (decays to WW, WZ, ZZ)

ATLAS-CONF-2015-045

- All leptonic, semileptonic and hadronic final states considered
- No excess observed and limit set for the models:
  - Extended Gauge Model with a heavy W'
  - Randall-Sundrum model with a heavy spin-2 graviton





EGM model exclusion limit:
Largest deviation ~2 TeV with p_0 value of 3.4σ (2.5σ) obs (exp) in JJ

@ 95% CL., $m_{W'}$ < 1.81 TeV

RS model exclusion limit:
@ 95% CL., m_{G*} < 810 (790) GeV obs (exp)

Best sensitivity from lνqq

Scalar leptoquarks search

arXiv:1508.04735

- Leptoquarks (LQ):
  - Color-triplet bosons with fractional electric charge and non-zero values of both baryon and lepton number
  - Expected to decay directly to lepton–quark pairs
- First and second generation LQs (LQ1 and LQ2) are searched in 2e+2jets and 2μ+2jets,
- Third generation (LQ3) in $b\nu_\tau b\nu_\tau$, $t\nu_\tau t\nu_\tau$
  - Similar to SUSY searches

Excluded range at 95% CL.

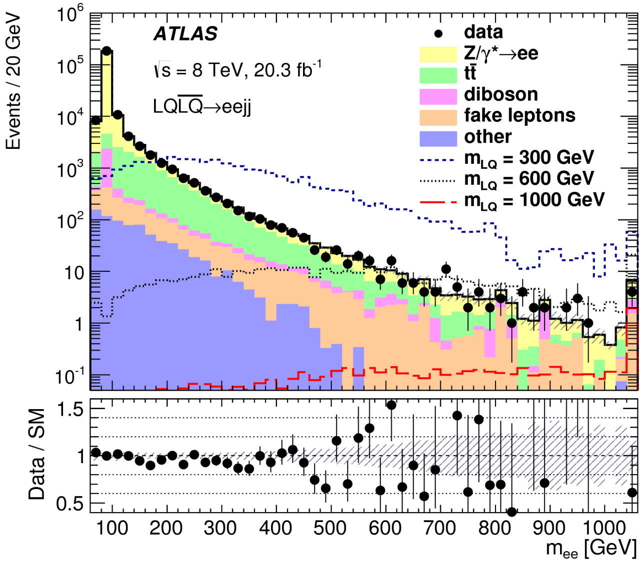
$m_{LQ1} < 1050$ GeV

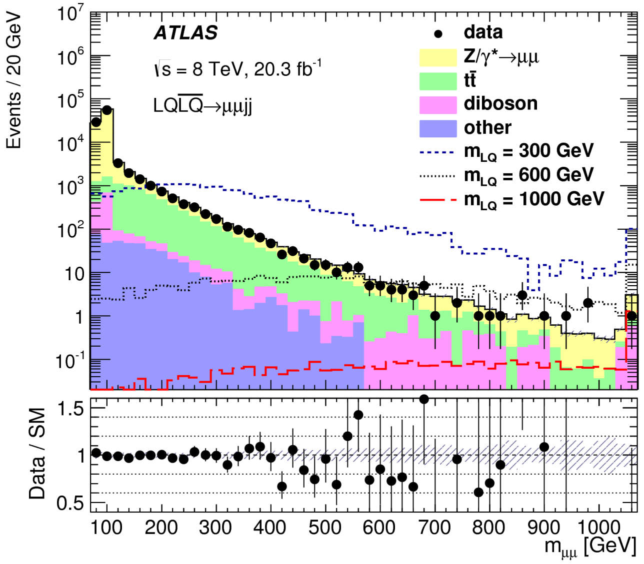
$m_{LQ2} < 1000$ GeV

b-channel $m_{LQ3} < 640$ (625) GeV expected (observed)

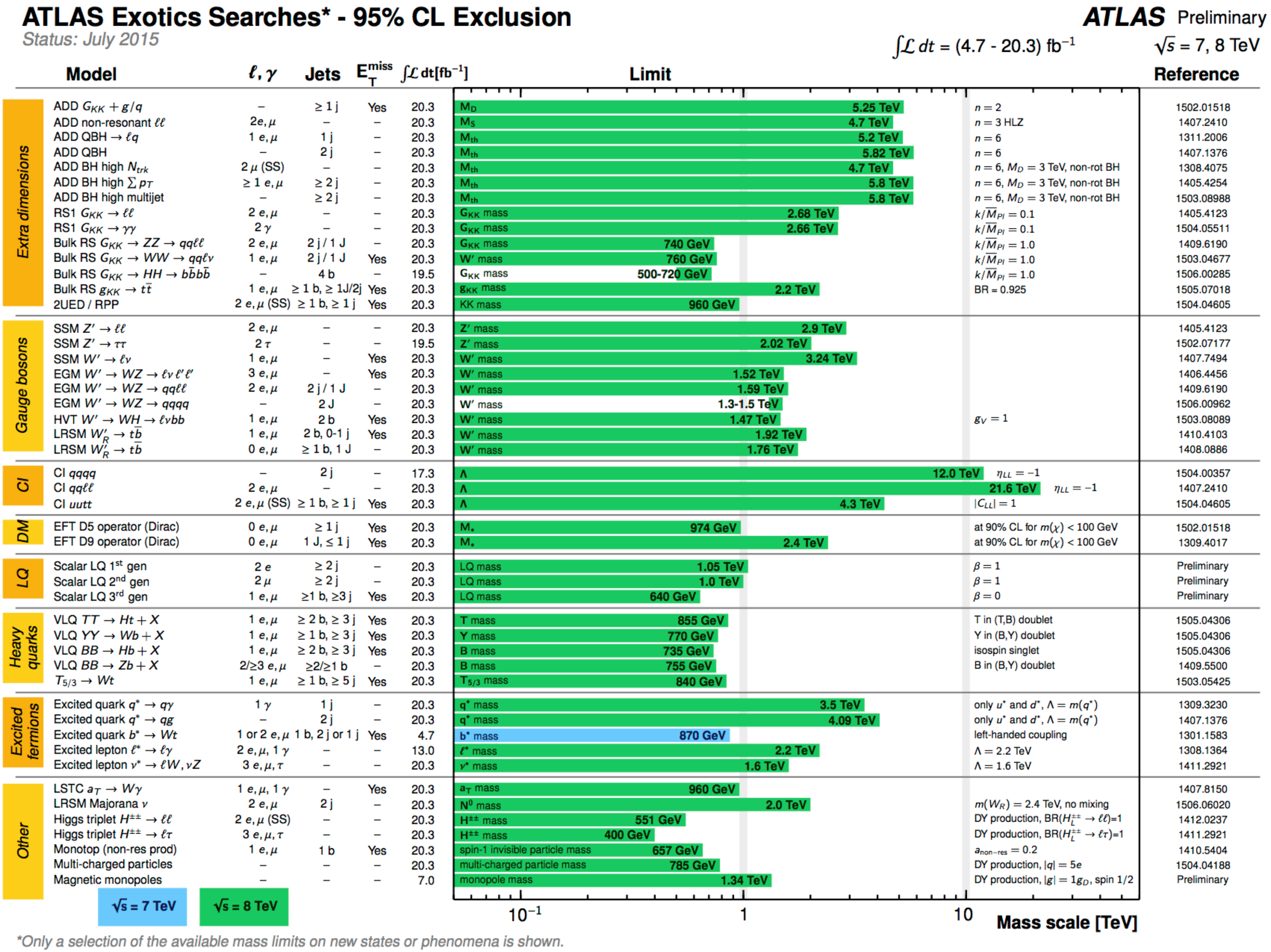
t-channel

200 (210) $< m_{LQ3} <$ 685 (640) GeV expected (observed)





Exotics summary



ATLAS Exotics Searches* - 95% CL Exclusion

Status: July 2015

ATLAS Preliminary

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

	Model	ℓ, γ	Jets	E_T^{miss}	$\int\mathcal{L}\,dt[\text{fb}^{-1}]$	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 $\ell\ell$	$2e, \mu$	–	–	20.3	M_S	4.7 TeV	$n = 3$ HLZ	1407.2410
	ADD QBH $\to \ell q$	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 $G_{KK} \to \ell\ell$	2 e, μ	–	–	20.3	G_{KK} mass	2.68 TeV	$k/\overline{M}_{Pl} = 0.1$	1405.4123
	RS1 $G_{KK} \to \gamma\gamma$	2 γ	–	–	20.3	G_{KK} mass	2.66 TeV	$k/\overline{M}_{Pl} = 0.1$	1504.05511
	Bulk RS $G_{KK} \to ZZ \to qq\ell\ell$	2 e, μ	2 j / 1 J	–	20.3	G_{KK} mass	740 GeV	$k/\overline{M}_{Pl} = 1.0$	1409.6190
	Bulk RS $G_{KK} \to WW \to qq\ell\nu$	1 e, μ	2 j / 1 J	Yes	20.3	W′ mass	760 GeV	$k/\overline{M}_{Pl} = 1.0$	1503.04677
	Bulk RS $G_{KK} \to HH \to b\bar{b}b\bar{b}$	–	4 b	–	19.5	G_{KK} mass	500-720 GeV	$k/\overline{M}_{Pl} = 1.0$	1506.00285
	Bulk RS $g_{KK} \to t\bar{t}$	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 $Z' \to \ell\ell$	2 e, μ	–	–	20.3	Z′ mass	2.9 TeV		1405.4123
	SSM $Z' \to \tau\tau$	2 τ	–	–	19.5	Z′ mass	2.02 TeV		1502.07177
	SSM $W' \to \ell\nu$	1 e, μ	–	Yes	20.3	W′ mass	3.24 TeV		1407.7494
	EGM $W' \to WZ \to \ell\nu\,\ell'\ell'$	3 e, μ	–	Yes	20.3	W′ mass	1.52 TeV		1406.4456
	EGM $W' \to WZ \to qq\ell\ell$	2 e, μ	2 j / 1 J	–	20.3	W′ mass	1.59 TeV		1409.6190
	EGM $W' \to WZ \to qqqq$	–	2 J	–	20.3	W′ mass	1.3-1.5 TeV		1506.00962
	HVT $W' \to WH \to \ell\nu bb$	1 e, μ	2 b	Yes	20.3	W′ mass	1.47 TeV	$g_V = 1$	1503.08089
	LRSM $W'_R \to t\bar{b}$	1 e, μ	2 b, 0-1 j	Yes	20.3	W′ mass	1.92 TeV		1410.4103
	LRSM $W'_R \to t\bar{b}$	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	$\geq$1 b, $\geq$3 j	Yes	20.3	LQ mass	640 GeV	$\beta = 0$	Preliminary
Heavy quarks	VLQ $TT \to Ht + X$	1 e, μ	≥ 2 b, ≥ 3 j	Yes	20.3	T mass	855 GeV	T in (T,B) doublet	1505.04306
	VLQ $YY \to Wb + X$	1 e, μ	≥ 1 b, ≥ 3 j	Yes	20.3	Y mass	770 GeV	Y in (B,Y) doublet	1505.04306
	VLQ $BB \to Hb + X$	1 e, μ	≥ 2 b, ≥ 3 j	Yes	20.3	B mass	735 GeV	isospin singlet	1505.04306
	VLQ $BB \to Zb + X$	2/$\geq$3 e, μ	$\geq$2/$\geq$1 b	–	20.3	B mass	755 GeV	B in (B,Y) doublet	1409.5500
	$T_{5/3} \to Wt$	1 e, μ	≥ 1 b, ≥ 5 j	Yes	20.3	$T_{5/3}$ mass	840 GeV		1503.05425
Excited fermions	Excited quark $q^* \to q\gamma$	1 γ	1 j	–	20.3	q* mass	3.5 TeV	only u^* and d^*, $\Lambda = m(q^*)$	1309.3230
	Excited quark $q^* \to qg$	–	2 j	–	20.3	q* mass	4.09 TeV	only u^* and d^*, $\Lambda = m(q^*)$	1407.1376
	Excited quark $b^* \to Wt$	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 $\ell^* \to \ell\gamma$	2 e, μ, 1 γ	–	–	13.0	ℓ^* mass	2.2 TeV	$\Lambda = 2.2$ TeV	1308.1364
	Excited lepton $\nu^* \to \ell W, \nu Z$	3 e, μ, τ	–	–	20.3	ν^* mass	1.6 TeV	$\Lambda = 1.6$ TeV	1411.2921
Other	LSTC $a_T \to W\gamma$	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 $H^{\pm\pm} \to \ell\ell$	2 e, μ (SS)	–	–	20.3	$H^{\pm\pm}$ mass	551 GeV	DY production, BR($H_L^{\pm\pm} \to \ell\ell$)=1	1412.0237
	Higgs triplet $H^{\pm\pm} \to \ell\tau$	3 e, μ, τ	–	–	20.3	$H^{\pm\pm}$ mass	400 GeV	DY production, BR($H_L^{\pm\pm} \to \ell\tau$)=1	1411.2921
	Monotop (non-res prod)	1 e, μ	1 b	Yes	20.3	spin-1 invisible particle mass	657 GeV	$a_{\text{non-res}} = 0.2$	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, $\lvert g \rvert = 1 g_D$, spin 1/2	Preliminary

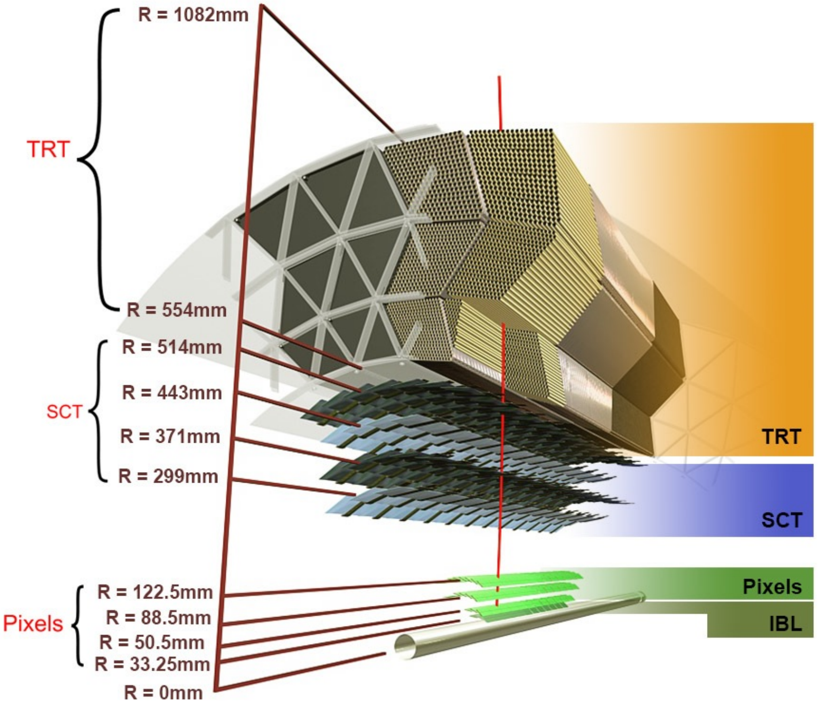
🟦 $\sqrt{s} = 7$ TeV 🟩 $\sqrt{s} = 8$ TeV

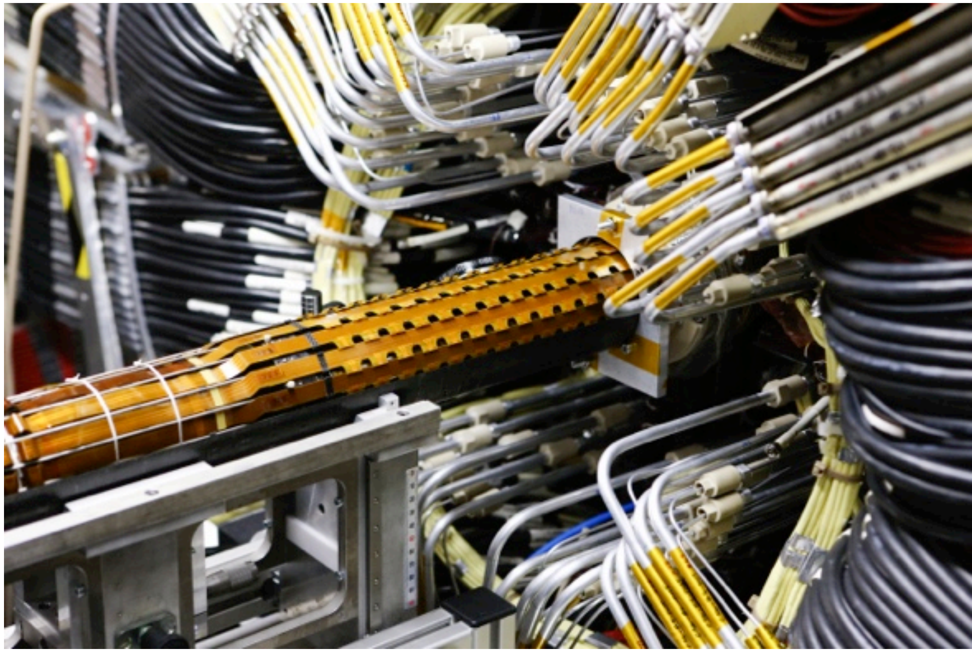
*Only a selection of the available mass limits on new states or phenomena is shown.

ATLAS UPGRADES FOR RUN II

Insertable B-Layer

- One major addition: the Insertable B-Layer (IBL)
  - New innermost tracking detector, 3.3 cm from the beam
  - Required a new smaller beampipe to fit
  - Significantly improves tracking performance

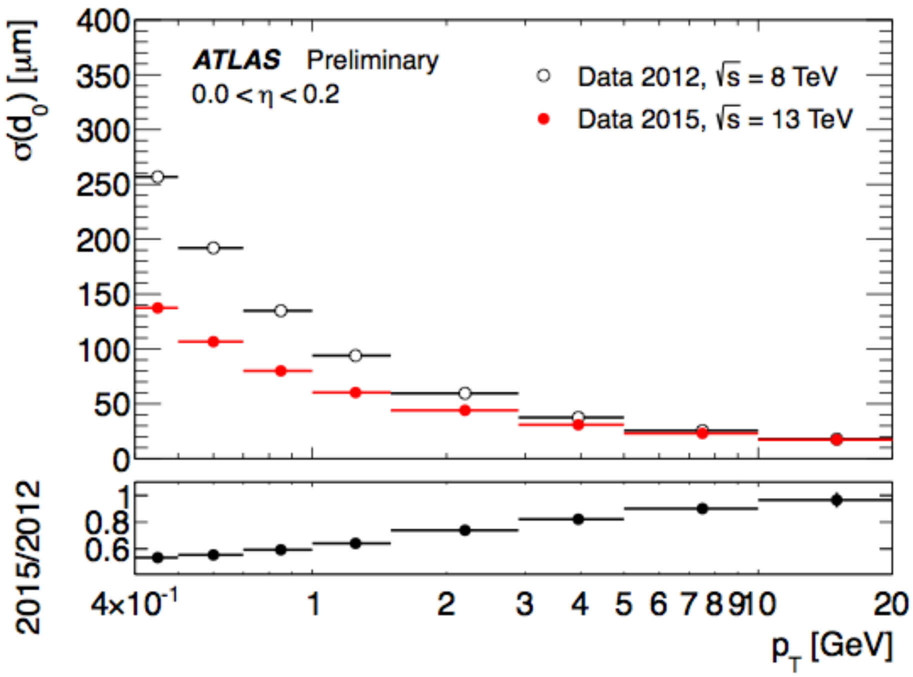


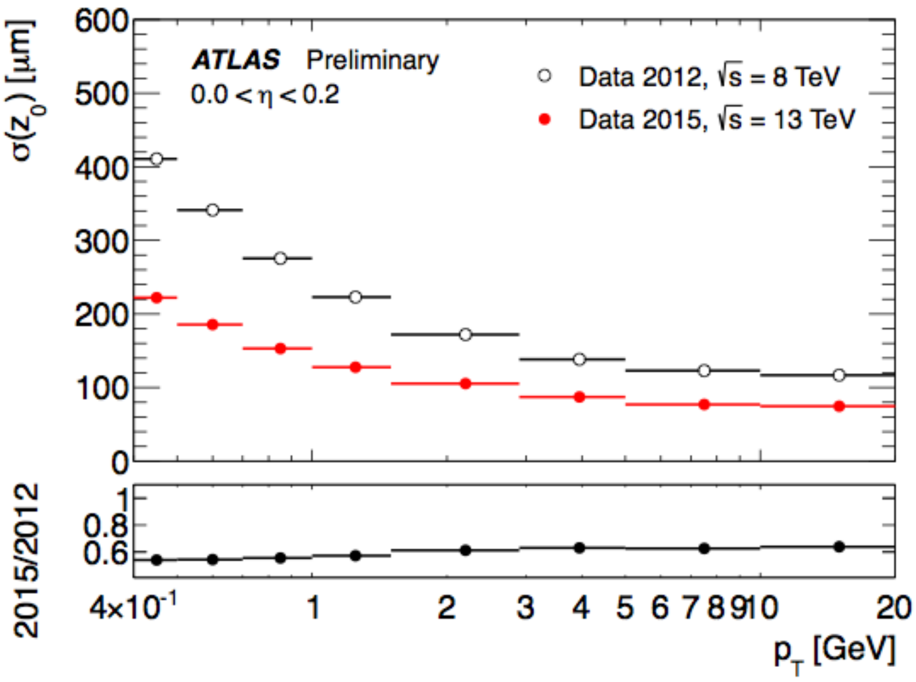


IBL Commissioning

IDTR-2015-007

- Already fully operational
- Improved impact parameter resolution
- Expect ~4x improvement in light-flavor rejection





Other upgrades

Infrastructure

- New beampipe
- Improvements to magnet and cryo system

Detector consolidation

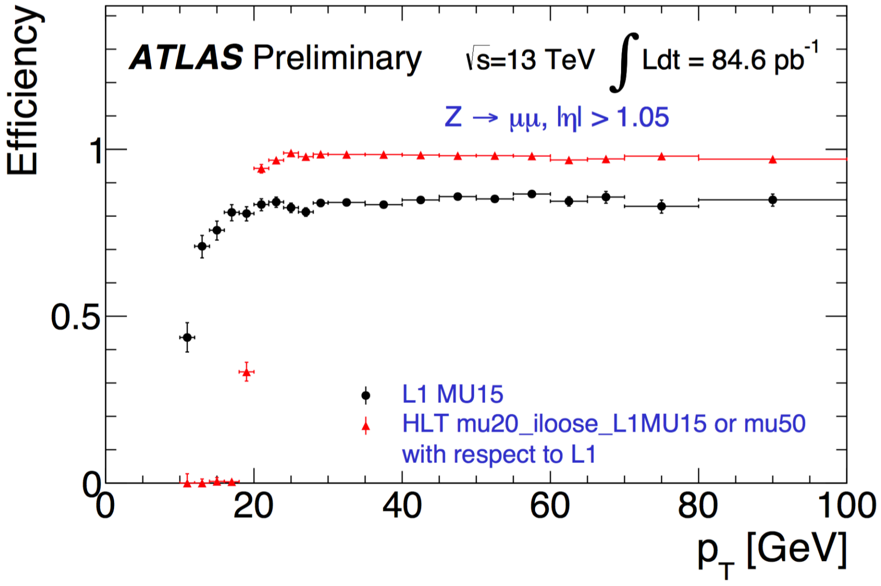
- Muon chamber completion and repairs
- Improved readout for 100 kHz L1 rate
- Repair of various systems, new pixel services, new lumi detectors, new MBTS

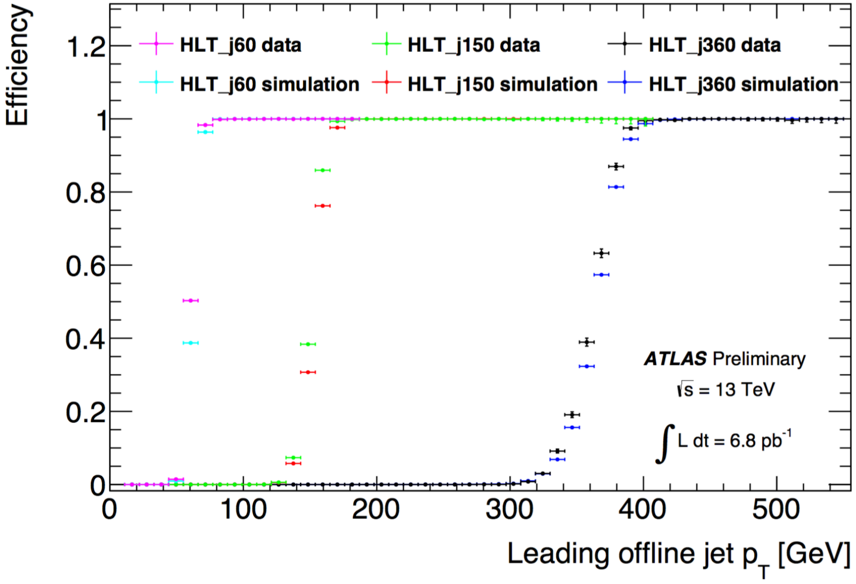
Software and reconstruction

- New analysis model, event data model, production workflow
- Improved tracking code, grid software, monitoring.

Trigger upgrades and commissioning

- LHC beams collide currently in ATLAS every 25 ns (40 MHz)
- Data can be written out only up to ~ 3 GB/s (~ 1k events/s)
- Trigger system and architecture updated to cope with data rate
- Trigger turn-on curves well understood

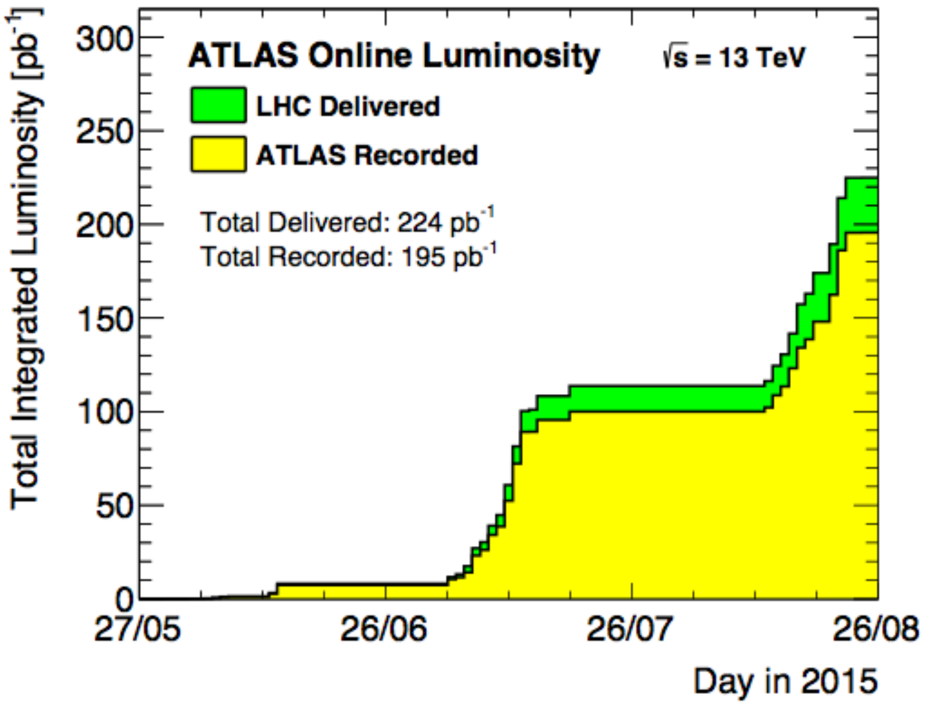


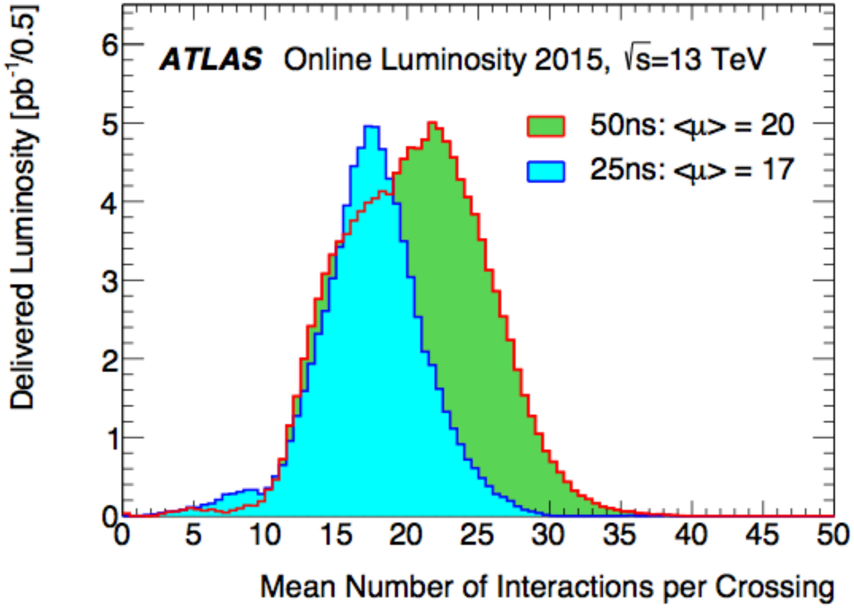


- New topological L1 trigger, new central trigger processor, Tile-muon coincidence, restructured high-level trigger, Fast TracK trigger (FTK), Improved L1 Calo.

INITIAL RUN II RESULTS

Dataset used for summer 2015

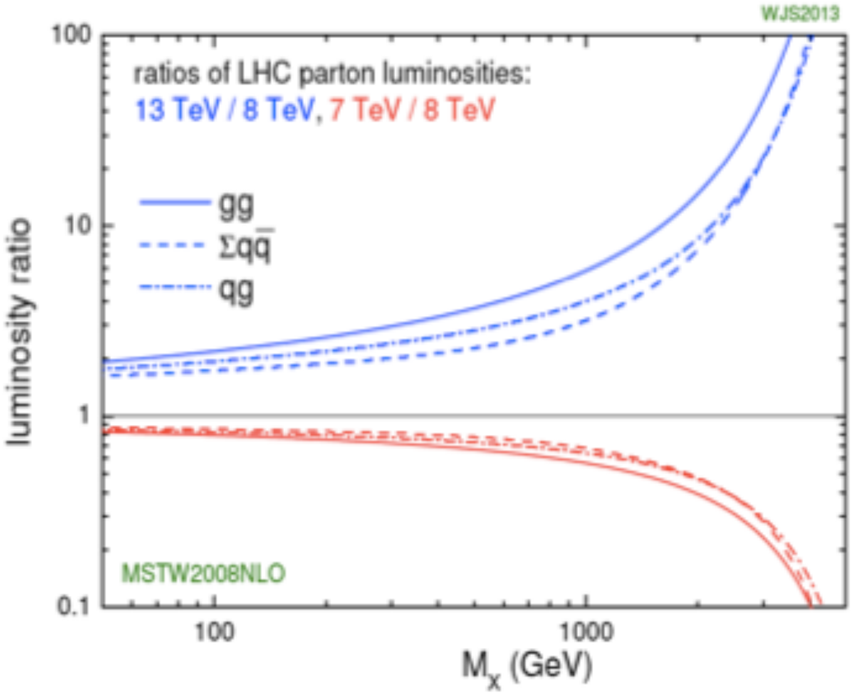


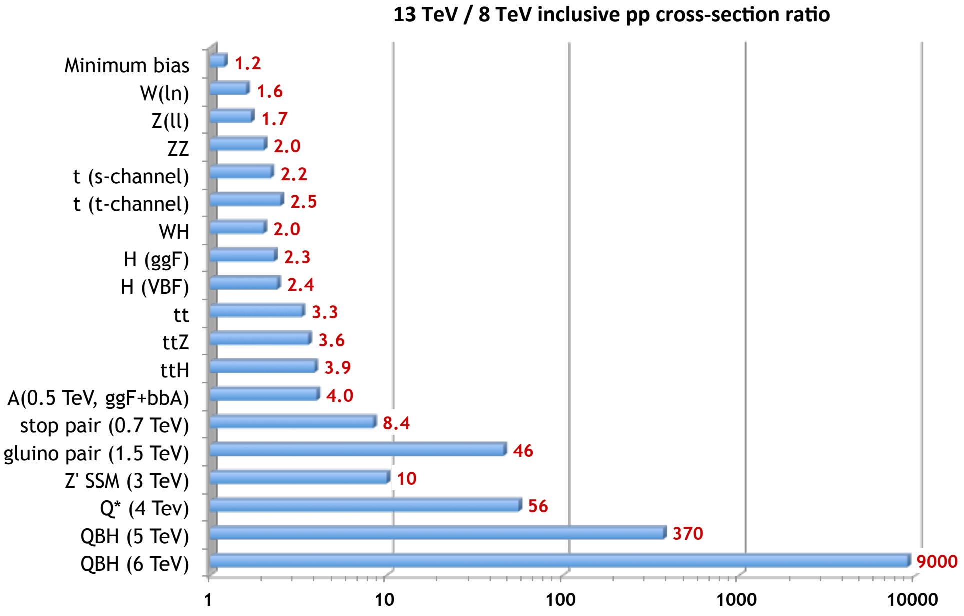


- 195 pb^{-1} recorded (inlcuding 25ns + 50ns bunch spacing)
- Average Pileup around 20 interactions/crossing
  - Special low pileup sample also collected ($\mu < 0.05$, 15 nb^{-1})
- Early mini-scan (± 6σ) in June to determine Luminosity scale
  - Current preliminary uncertainty $\delta L/L$: ±9%

“Only” 200 pb^{-1}?

- Re-commission detector and establish performance
- Measure high cross-section SM processes
- Search for high-mass final states exploiting parton luminosities at $\sqrt{s}$ = 13 TeV





Run 1 limits surpassed after few fb^{-1} of luminosity collected at Run 2.

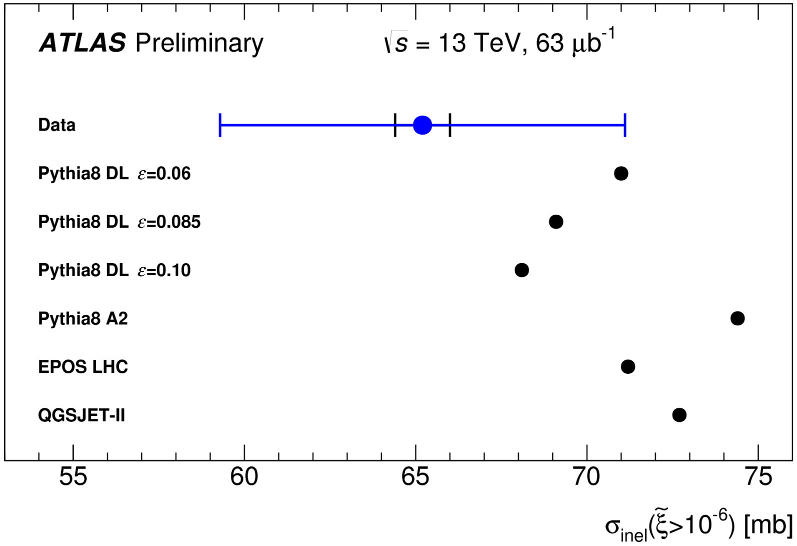
Inelastic pp Cross-Section

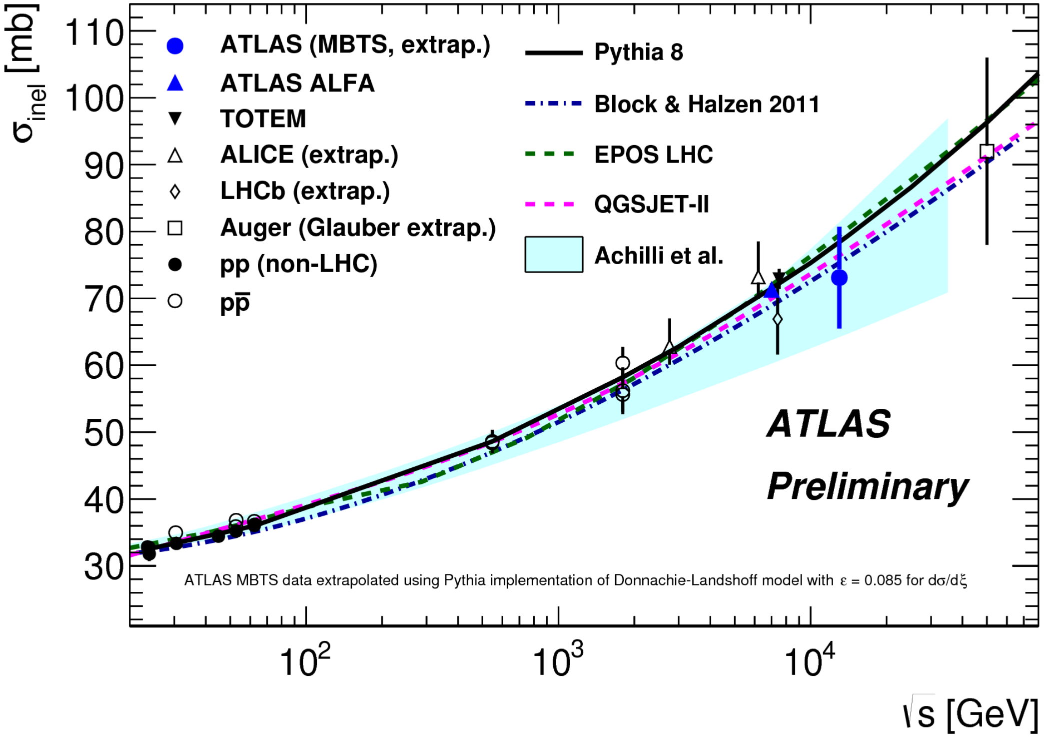
ATLAS-CONF-2015-038

- Using low-pileup data set ($\mu < 0.05$)
- Analysis w/ new MBTS scintillators ($2.1 < |\eta| < 3.9$)
- Result dominated by luminosity uncertainty

Fiducial cross-section:
65.2 ± 0.8 (exp) ± 5.9 (lum) mb

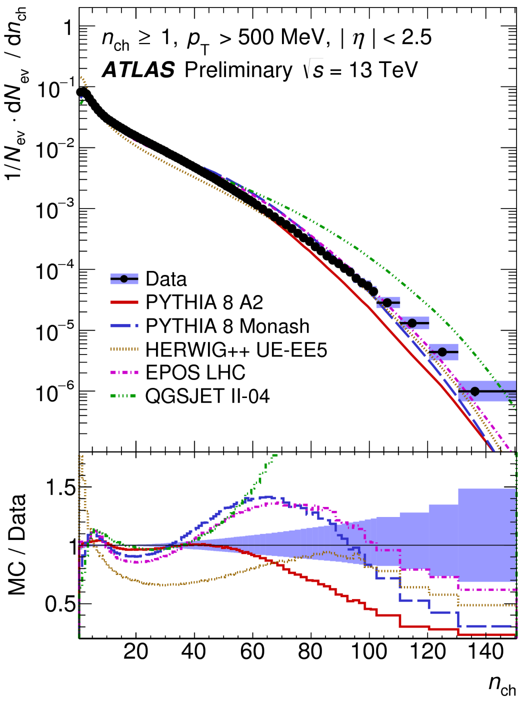
4.2M events selected in 63 μb^{-1}
Estimated 1% background

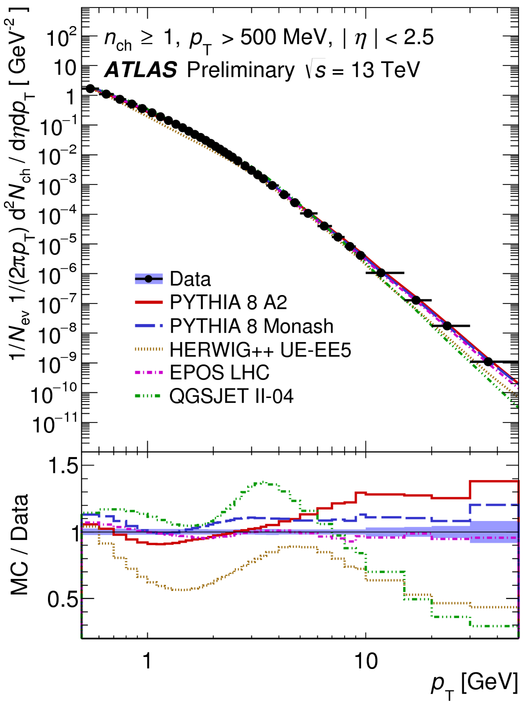




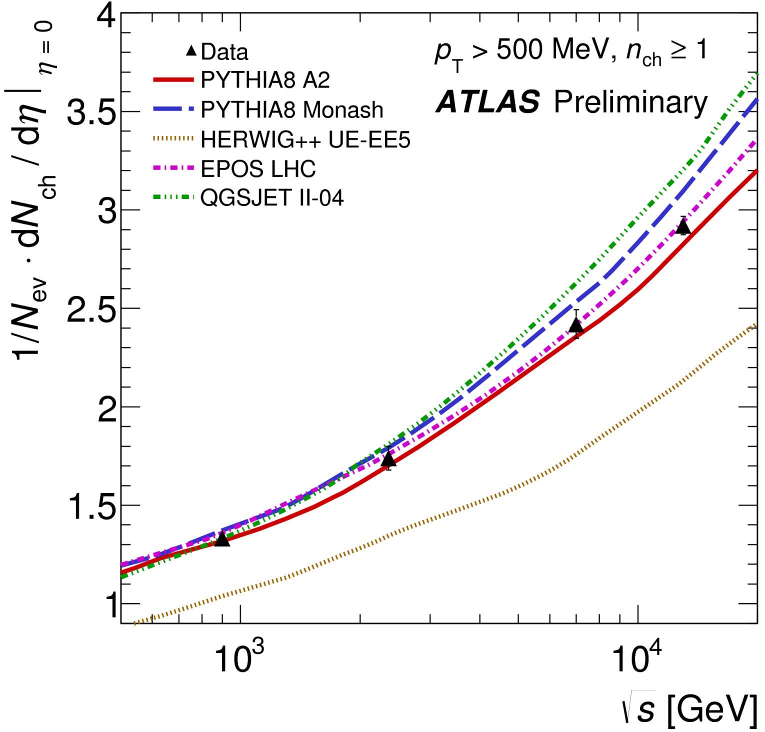
Inelastic pp event properties

- Triggered by MBTS (ε > 99%) in low-pileup data
- Unfolded distributions
- Uncertainties from tracking efficiency, unfolding
- Adequate modeling from Pythia and EPOS
- Validates pileup modeling for early analysis





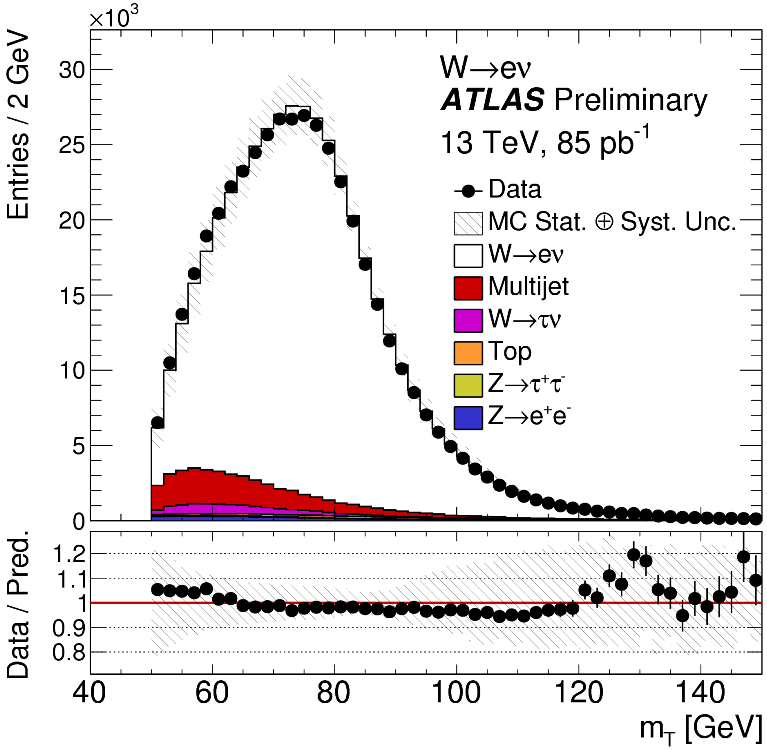
N(13TeV)/N(8TeV) ~ 1.2

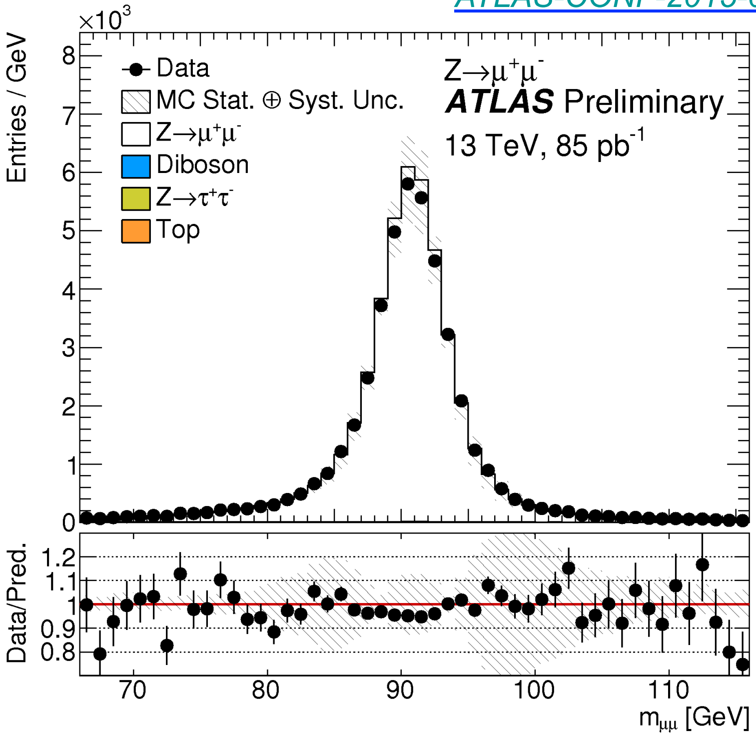


Also underlying event studies: *ATL-PHYS-PUB-2015-019*

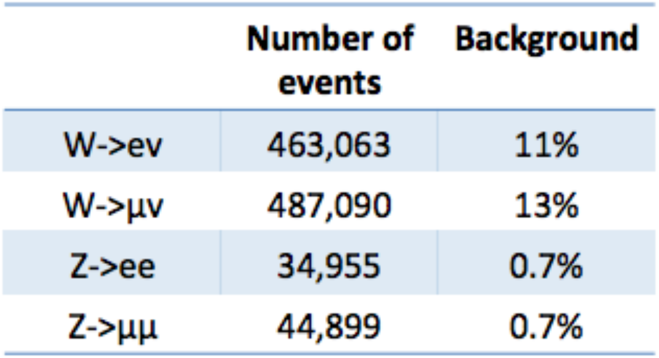
W/Z Cross-Section

ATLAS-CONF-2015-039





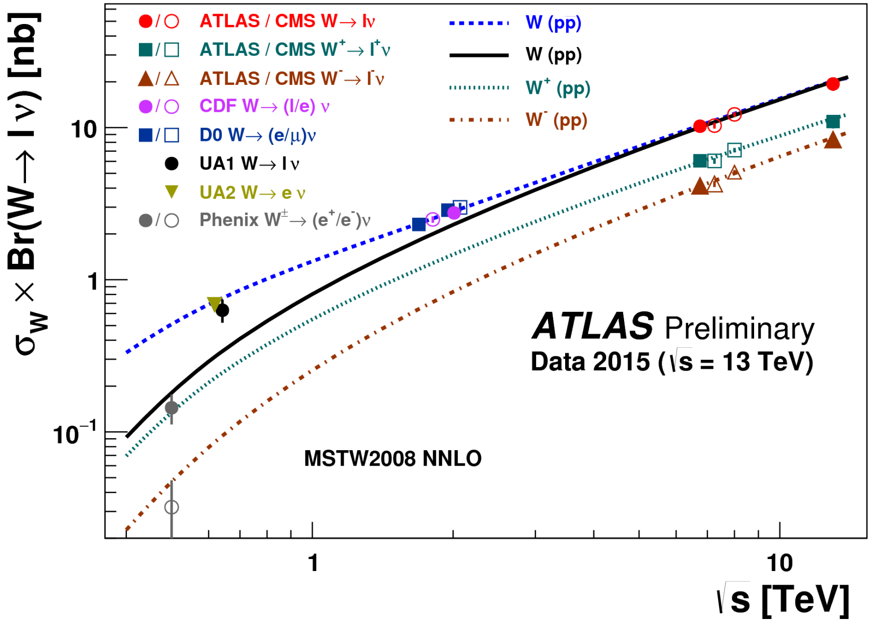
- Isolated e or μ
  - $p_T > 25$ GeV
- W bosons
  - $E_T^{miss} > 25$ GeV, $m_T > 50$ GeV
- Z bosons
  - Opp. charge, $66 < m(ll) < 116$ GeV

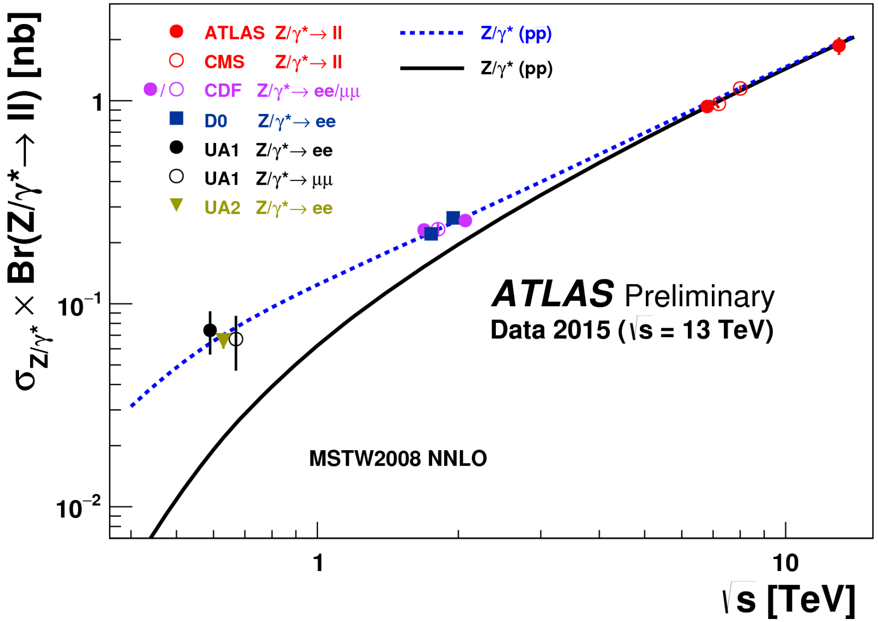


	Number of events	Background
W->eν	463,063	11%
W->μν	487,090	13%
Z->ee	34,955	0.7%
Z->μμ	44,899	0.7%

W/Z Cross-Section

ATLAS-CONF-2015-039



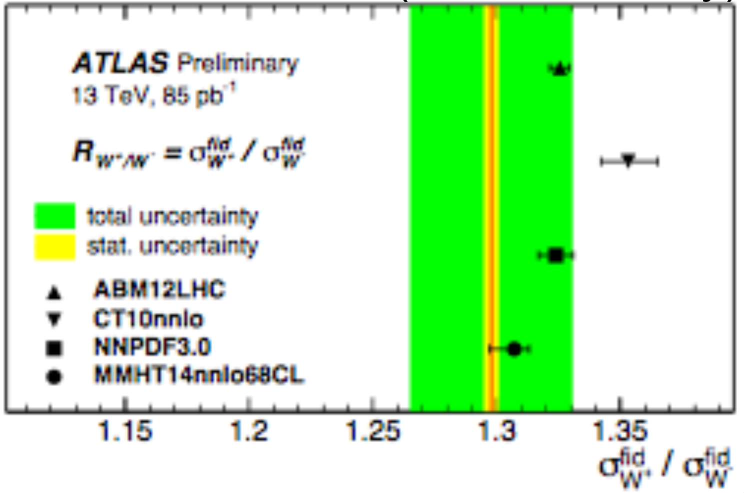


Fiducial cross-sections

Channel	value ± stat ± syst ± lumi [pb]
W^-	$3344 \pm 6 \pm 113 \pm 301$
W^+	$4340 \pm 7 \pm 138 \pm 391$
$W^\pm$	$7684 \pm 9 \pm 232 \pm 692$
Z	$746 \pm 3 \pm 13 \pm 67$

Currently dominated by lumi uncertainty

W+/W- Fiducial Ratio (2.5% accuracy)

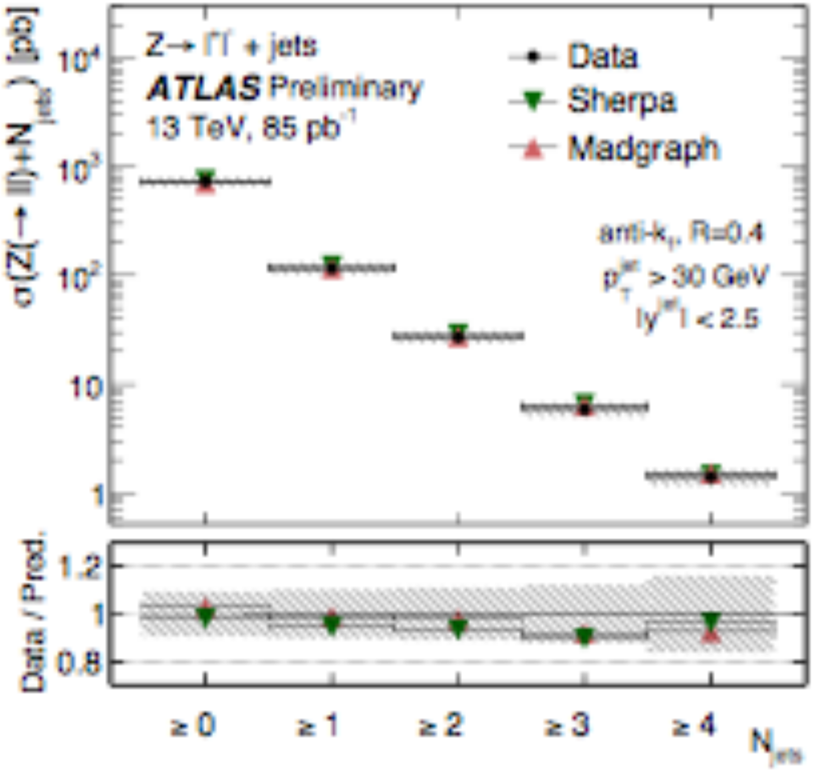


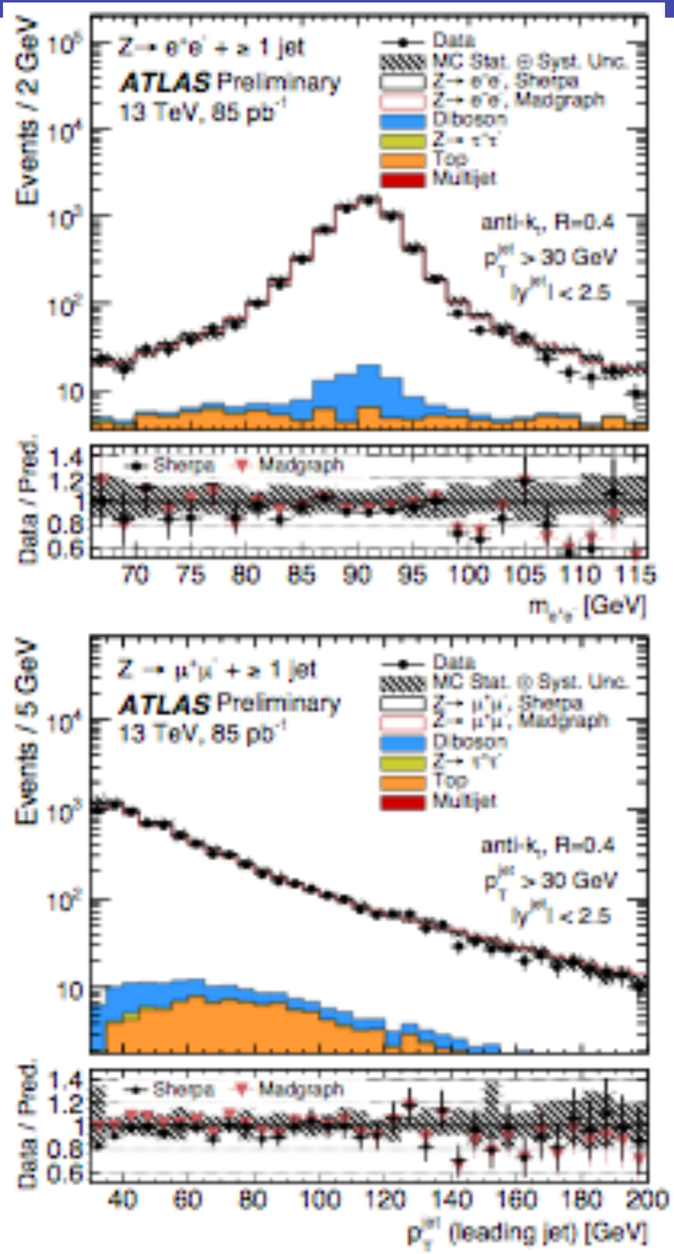
Was 1.54 at 8 TeV, reduced valence quark asymmetry at 13 TeV

Z+jets

ATLAS-CONF-2015-041

- Inclusive Z event selection
- Particle-level fiducial cross-sections
  - Jet $p_T > 30$ GeV, $|y| < 2.5$
- Backgrounds from top, diboson
- Syst. dominated by Lumi, Jets

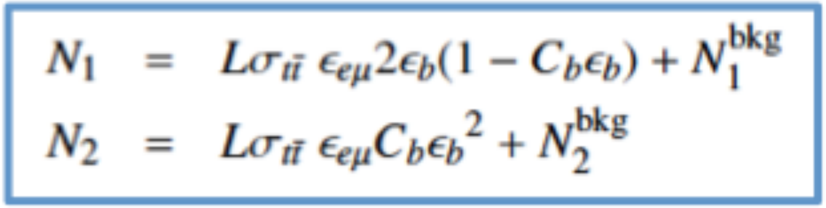




Top Cross-Section

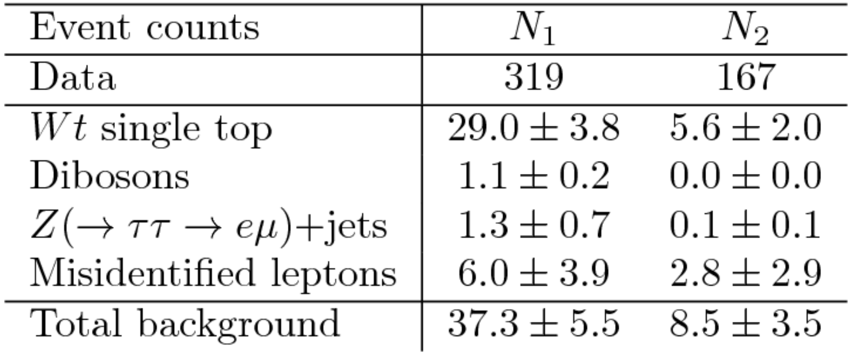
ATLAS-CONF-2015-033

- Dilepton selection
  - Isolated e & μ, $p_T > 25$ GeV
  - One or 2 b-jets
- Extract b-tag yield and cross-section simultaneously
- Syst. dominated by Luminosity

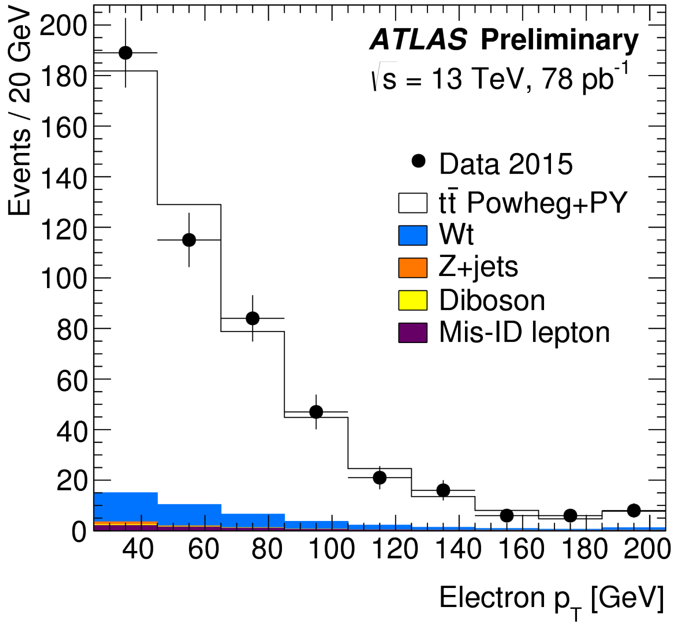


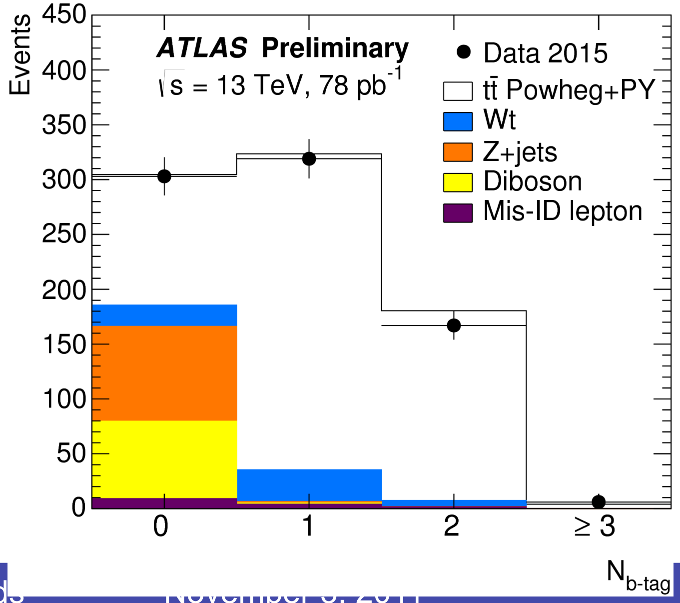
$$N_1 = L\sigma_{t\bar{t}}\,\epsilon_{e\mu}2\epsilon_b(1 - C_b\epsilon_b) + N_1^{\text{bkg}}$$
$$N_2 = L\sigma_{t\bar{t}}\,\epsilon_{e\mu}C_b\epsilon_b{}^2 + N_2^{\text{bkg}}$$

ϵ_b = 52.7 ± 2.6 (stat) ± 0.6 (syst) %
MC expectation: 54.3 %



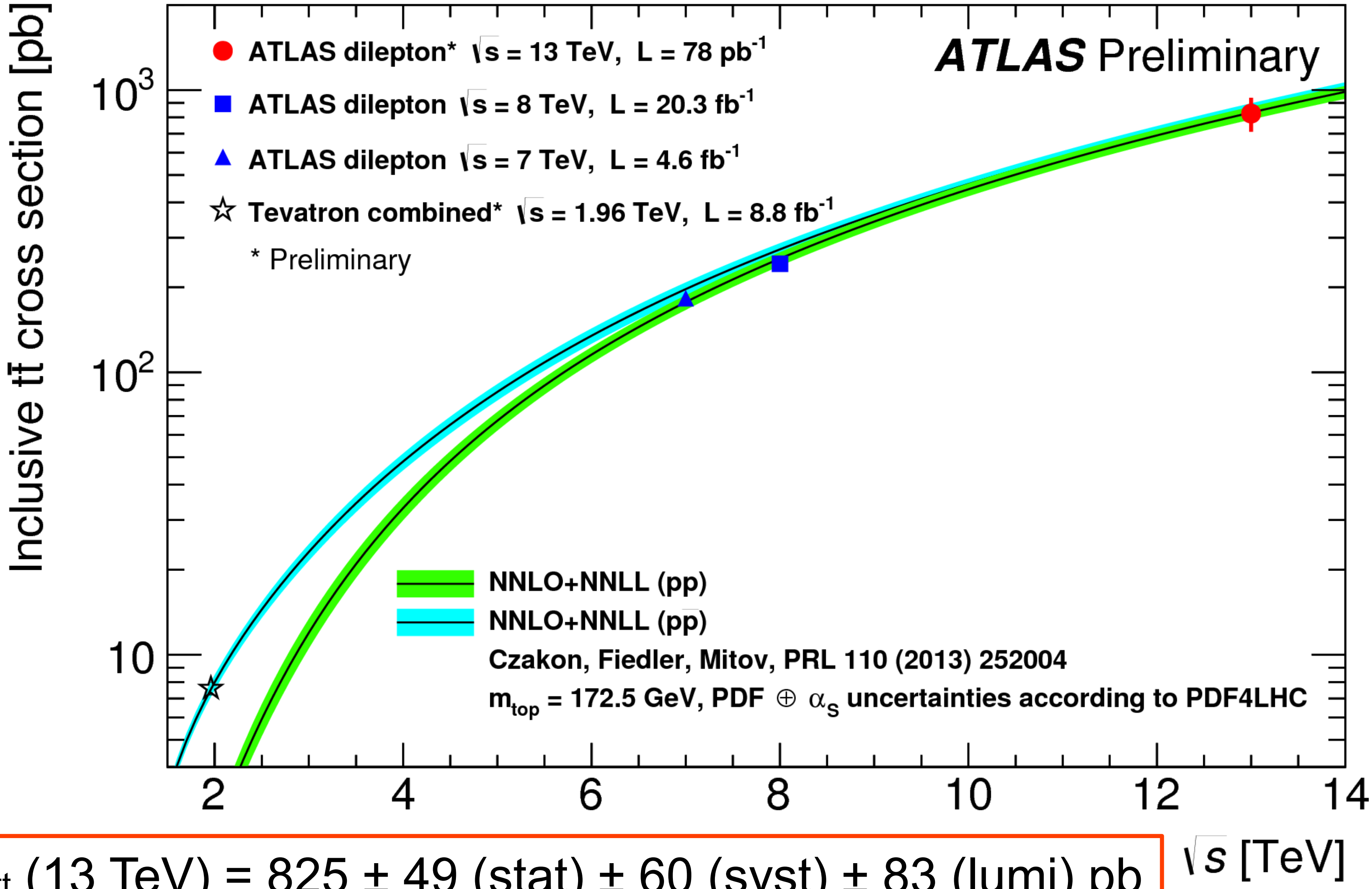
Event counts	N_1	N_2
Data	319	167
Wt single top	29.0 ± 3.8	5.6 ± 2.0
Dibosons	1.1 ± 0.2	0.0 ± 0.0
$Z(\rightarrow \tau\tau \rightarrow e\mu)$+jets	1.3 ± 0.7	0.1 ± 0.1
Misidentified leptons	6.0 ± 3.9	2.8 ± 2.9
Total background	37.3 ± 5.5	8.5 ± 3.5





Top Cross-Section

ATLAS-CONF-2015-033



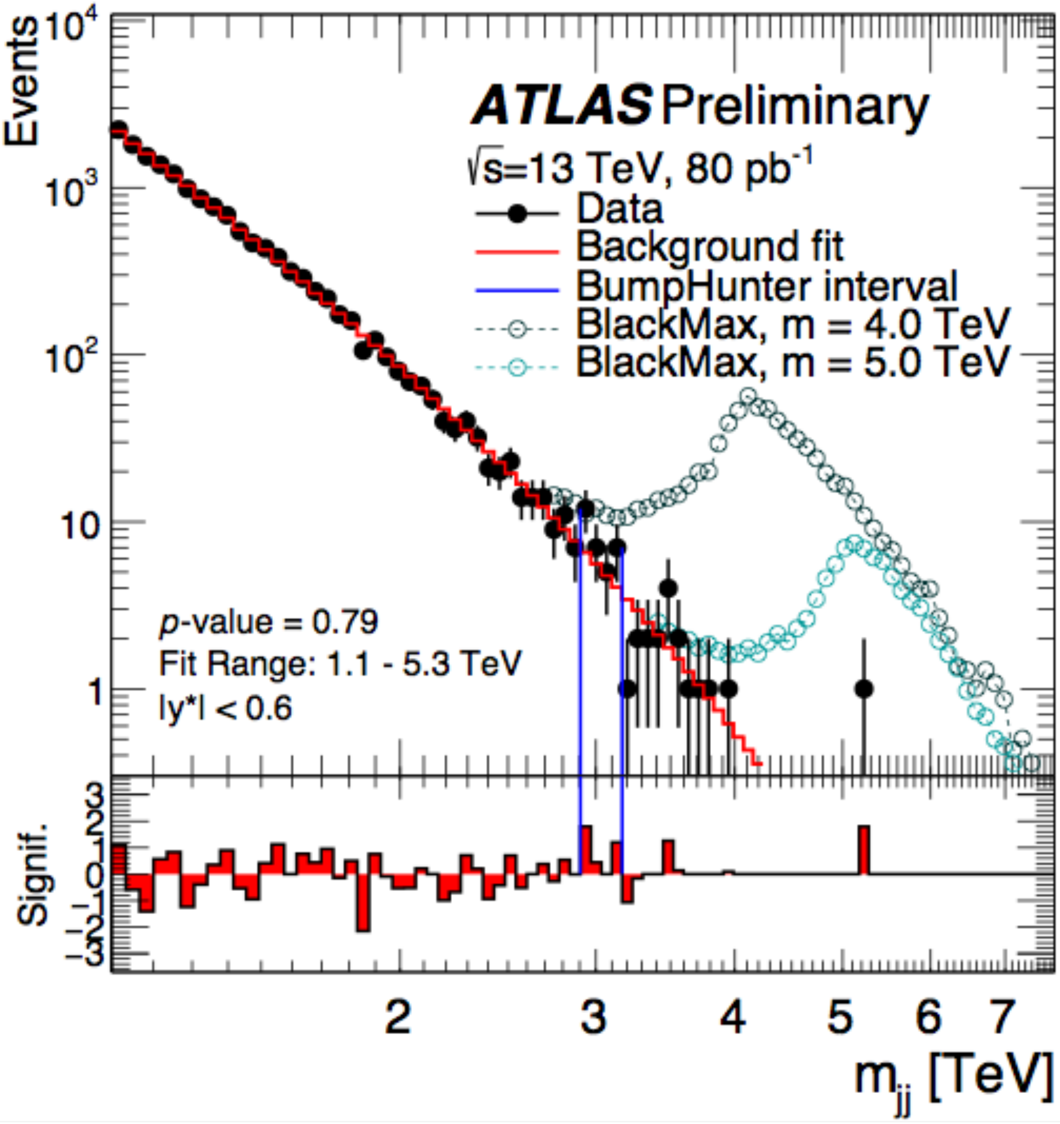
σ_{tt} (13 TeV) = 825 ± 49 (stat) ± 60 (syst) ± 83 (lumi) pb

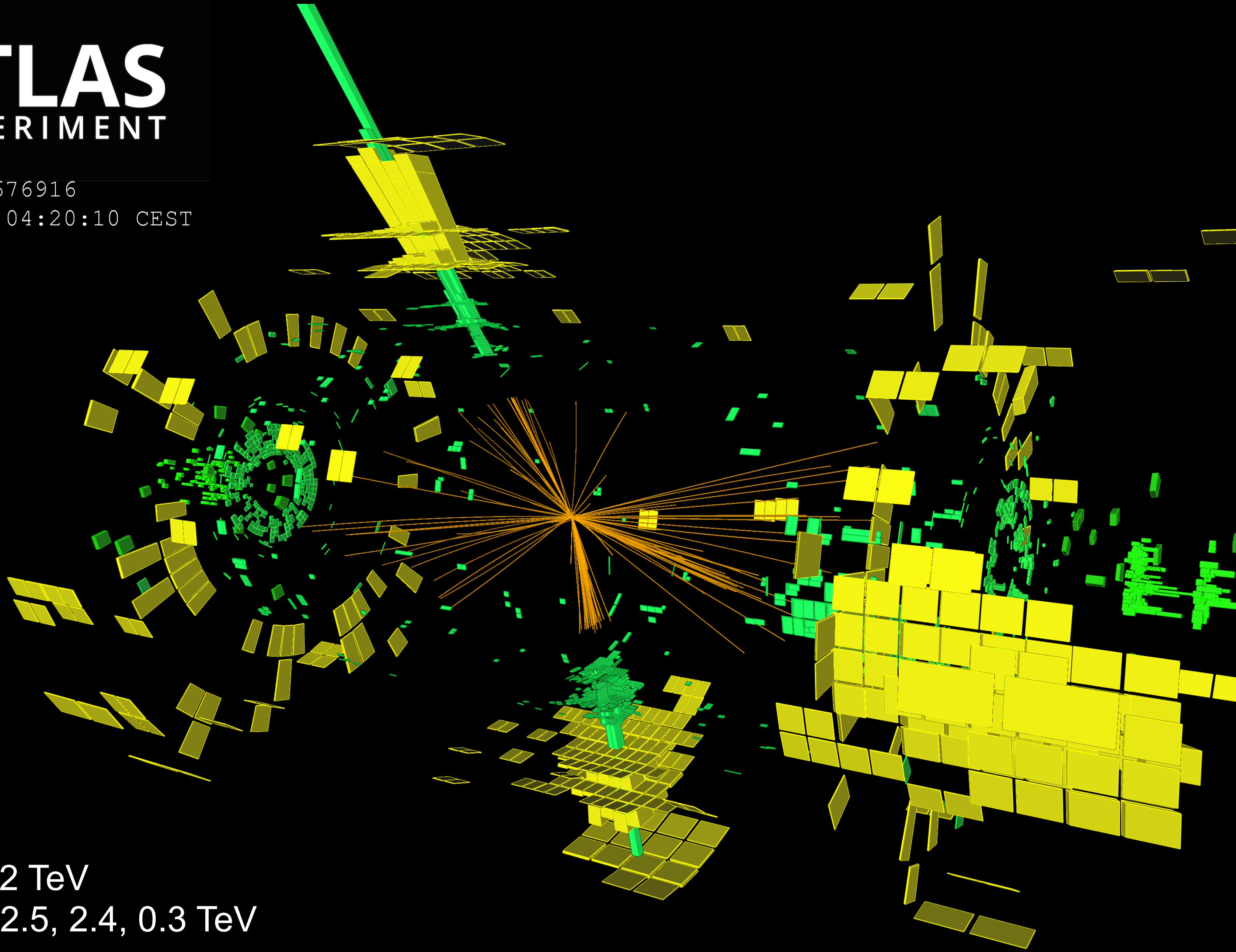
Resonant Di-jet Search

ATLAS-CONF-2015-042

- Resonance search
- Jet trigger, dijet selection
  - $|y_1-y_2| < 1.2$, reduces QCD dijets
  - $m_{jj} > 1.2$ TeV
- Data-driven background fits
  - $f(z) = p_1 (1-z)^{p2} z^{p3 + p4 \log(z)}$
  - $z = m_{jj} / \sqrt{s}$
- 'Bumphunter' to find most significant local excess
- Uncertainty dominated by jet energy scale

No significant excess found

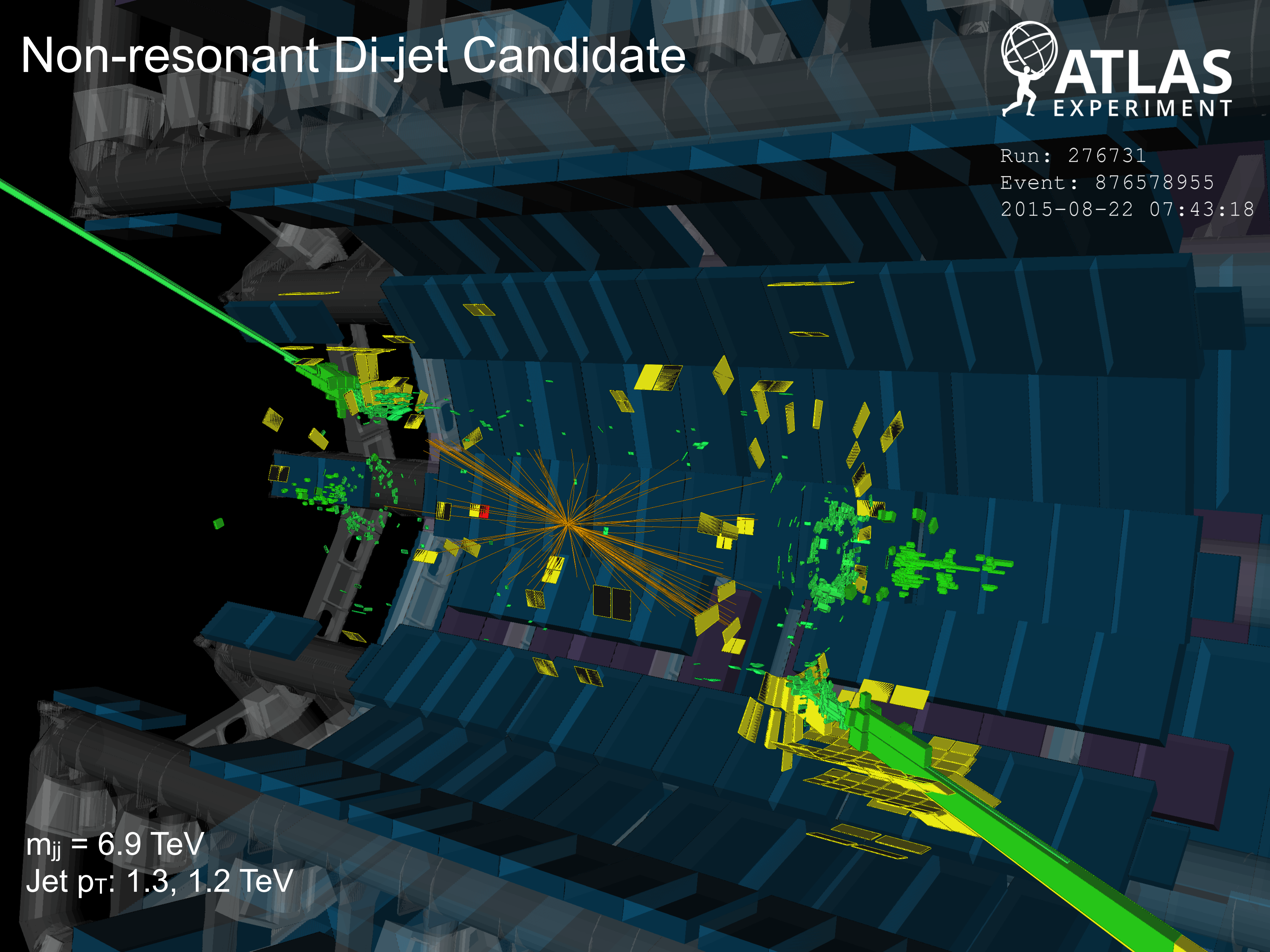




Event: 531676916
2015-08-22 04:20:10 CEST

m_{jj} = 5.2 TeV
Jet p_T: 2.5, 2.4, 0.3 TeV

Non-resonant Di-jet Candidate

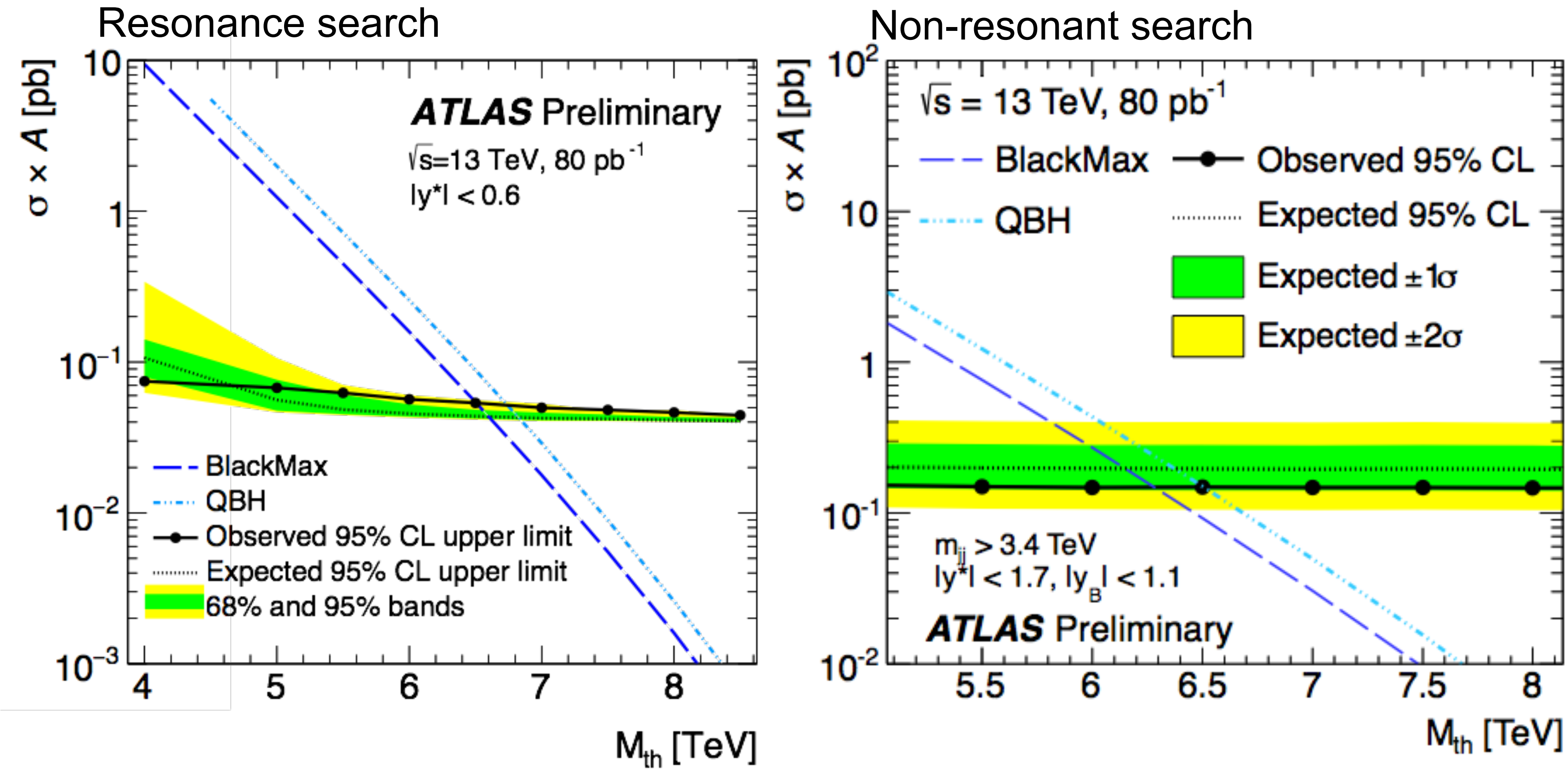


Run: 276731
Event: 876578955
2015-08-22 07:43:18

m_{jj} = 6.9 TeV
Jet p_T: 1.3, 1.2 TeV

Di-jet Search Results

ATLAS-CONF-2015-042



Sensitive to strong gravity models

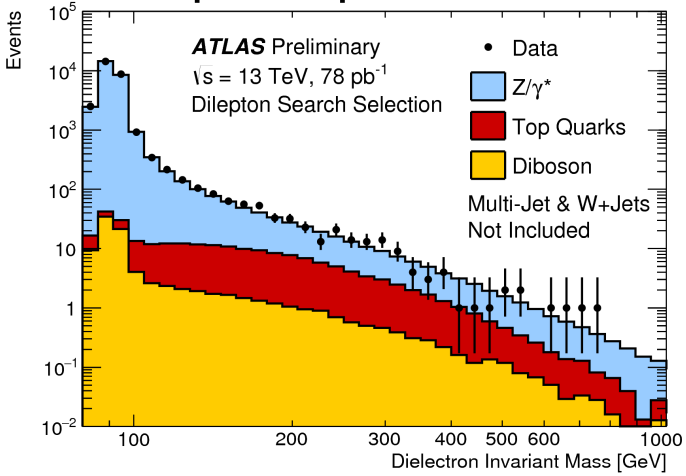
Compare to quantum BH production at threshold (ADD scenario, n = 6, $M_D = M_{th}$)

Threshold mass limit (QBH): m_{Th} > 6.8 TeV @ 95% CL

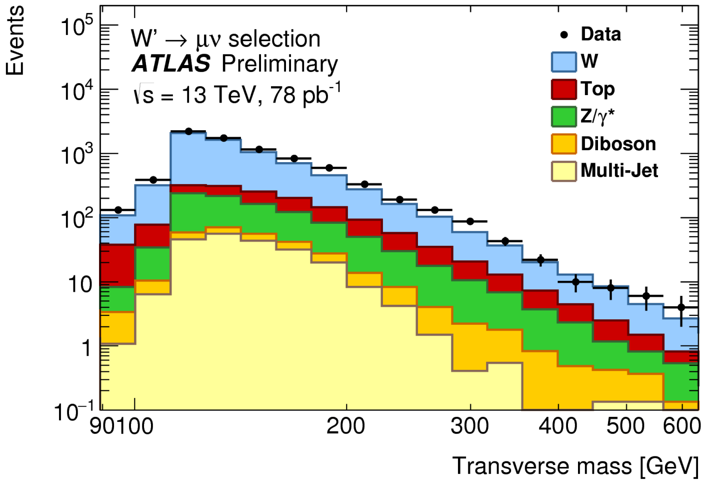
Run1 limit: m_{Th} > 5.7 TeV

Preparations for Higher Luminosity

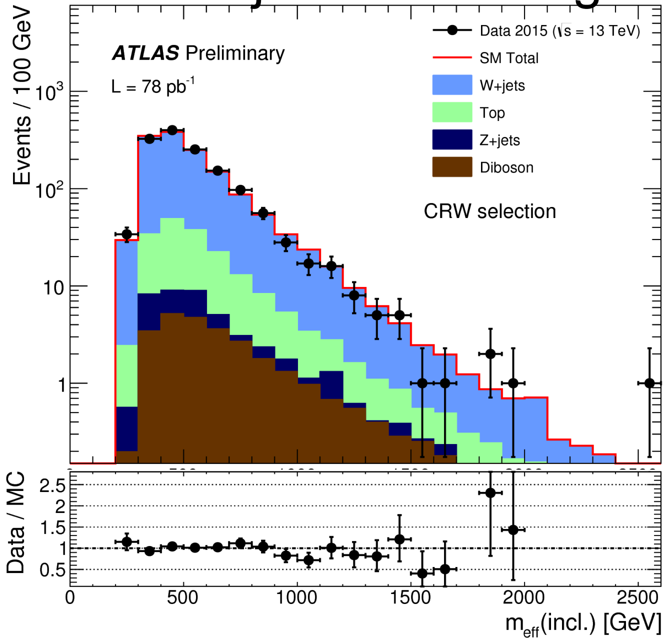
di-lepton spectrum



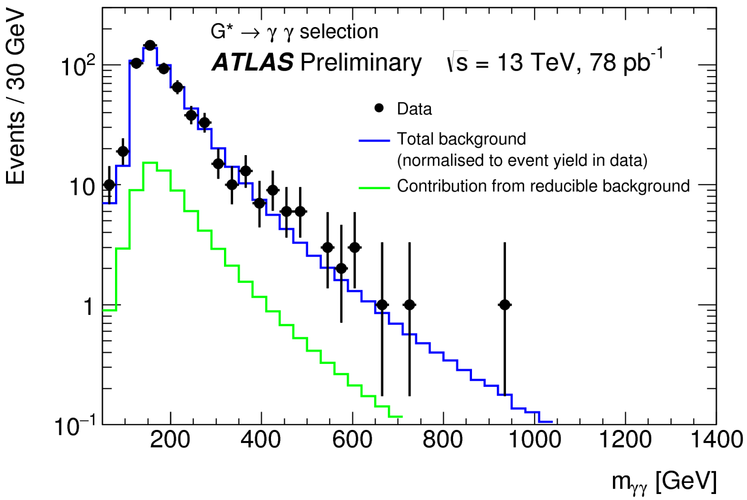
lepton+MET mass (W')



SUSY l+jets control region

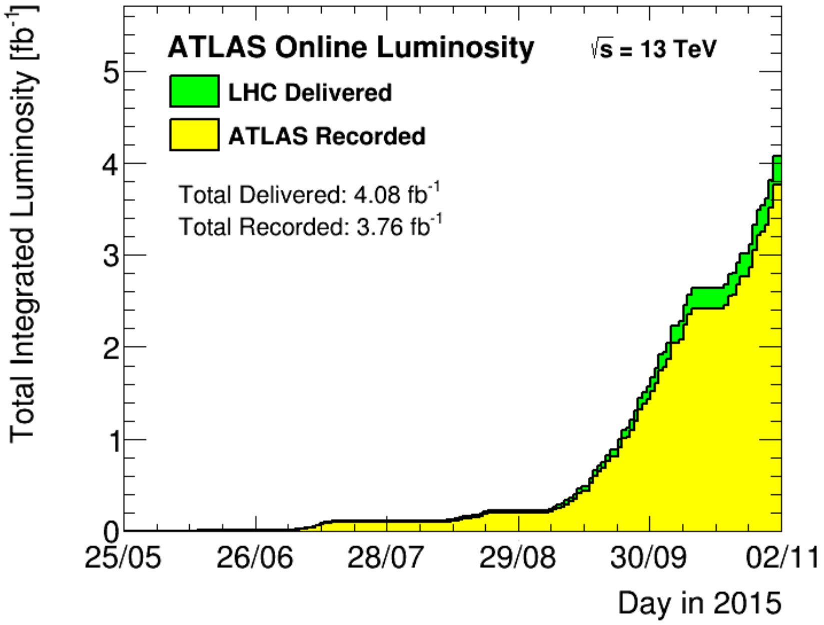


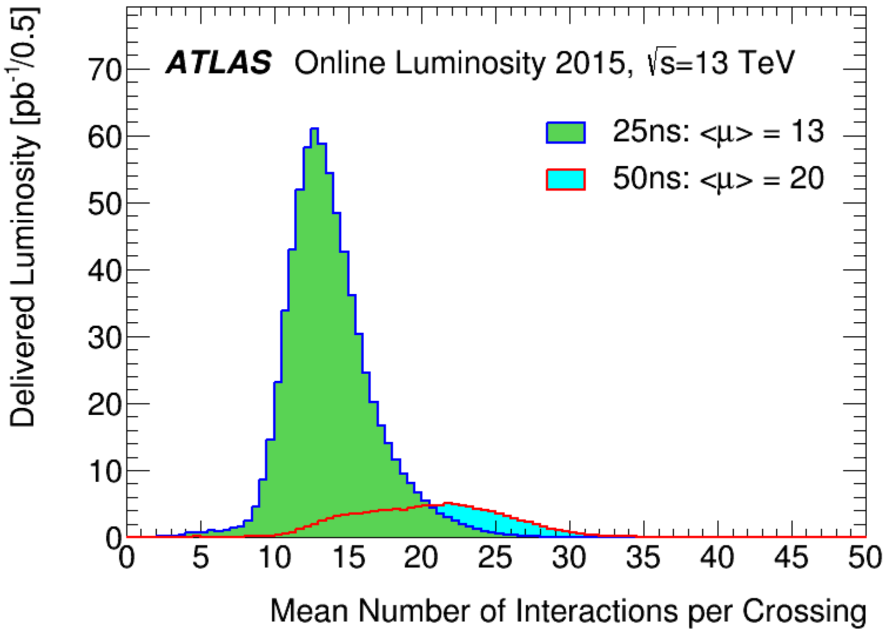
di-photon spectrum



https://twiki.cern.ch/twiki/bin/view/AtlasPublic/Summer2015-13TeV

2015 data, so far





(up to September 22, 2015)

- 3.62 fb^{-1} recorded 2015 (mainly 25ns bunch spacing)
- Full sample processed and available for analysis
- Many analyses under way
- Expected for Run II (until 2018) : ~ 100 fb-1

Outlook

- **Rich set of recent results from Run I**
  - SM and Higgs boson properties measured
  - Extensive NP searches
  - No new physics observed yet

- **ATLAS is working well at 13TeV**
  - Upgraded components have been commissioned
  - Performance already close to (or exceeding) Run1

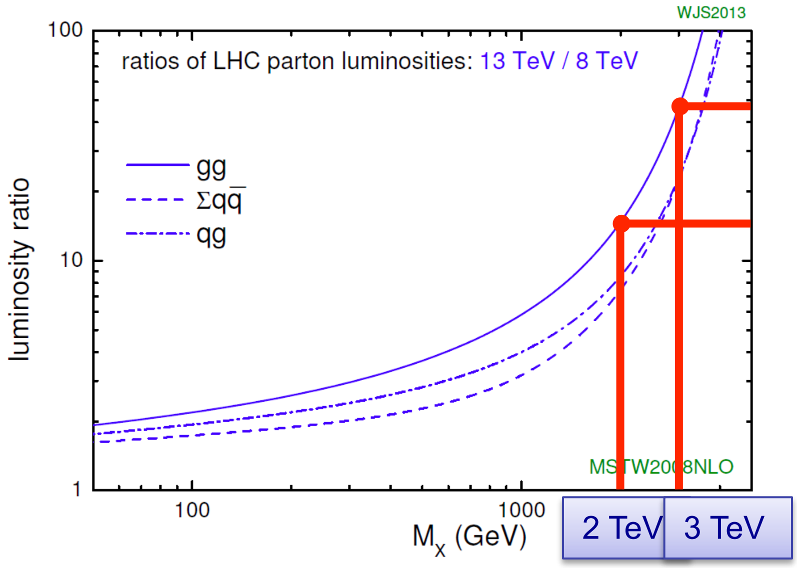
- **Initial measurements and searches with early data**
  - SM processes from inclusive pp to ttbar cross-section
  - Many measurements limited by luminosity uncertainty
  - First competitive searches at 13TeV
  - Nothing found yet, but a lot of data in the pipeline already

BACKUP SLIDES

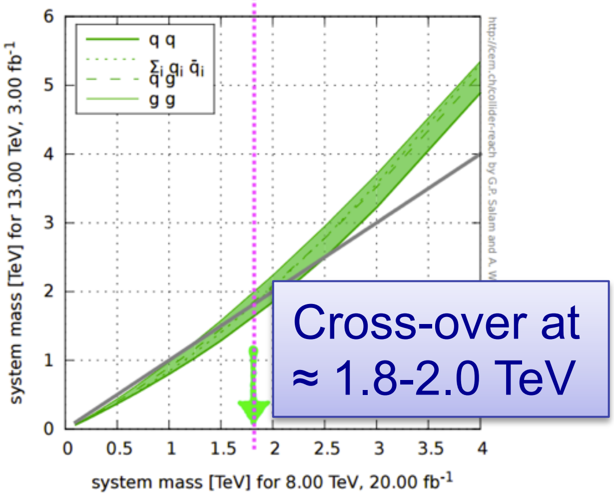
Run II has started; Run II is on

- We'll soon be crossing the "few fb^{-1} at 13 TeV" mark

	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



3 fb^{-1} @13 TeV

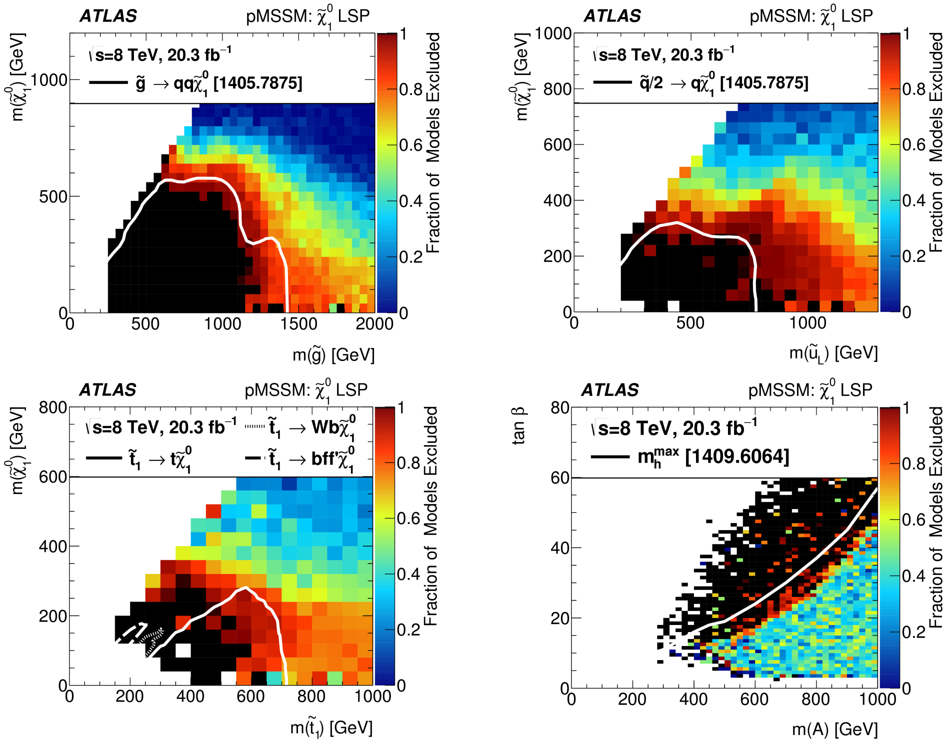


Cross-over at ≈ 1.8-2.0 TeV

Constraints to the pMSSM

arXiv:1508.06608

- MSSM has over 100 parameters to describe sparticles and masses
- Phenomenological MSSM, (pMSSM) ~ 19 parameters under the assumptions that:
  - R-parity conserved- LSP is stable, the neutralino and sparticles are produced in pairs
  - Minimal flavor violation with no new source of CP violation
  - Degenerate 1st and 2nd generation squarks and sleptons
- Re-interpret 22 ATLAS Run 1 results in pMSSM



Generate 19 pMSSM parameters within the ranges:

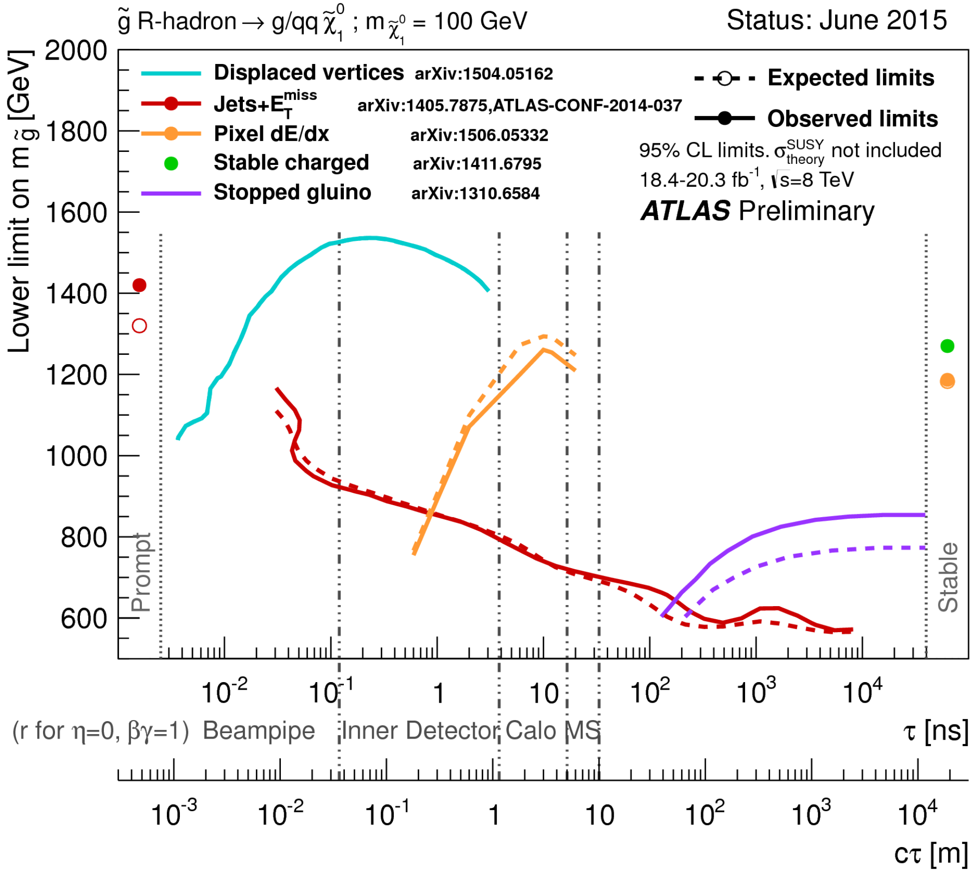
Parameter	Min value	Max value	Note
$m_{\tilde{L}_1}(=m_{\tilde{L}_2})$	90 GeV	4 TeV	Left-handed slepton (first two gens.) mass
$m_{\tilde{e}_1}(=m_{\tilde{e}_2})$	90 GeV	4 TeV	Right-handed slepton (first two gens.) mass
$m_{\tilde{L}_3}$	90 GeV	4 TeV	Left-handed stau doublet mass
$m_{\tilde{e}_3}$	90 GeV	4 TeV	Right-handed stau mass
$m_{\tilde{Q}_1}(=m_{\tilde{Q}_2})$	200 GeV	4 TeV	Left-handed squark (first two gens.) mass
$m_{\tilde{u}_1}(=m_{\tilde{u}_2})$	200 GeV	4 TeV	Right-handed up-type squark (first two gens.) mass
$m_{\tilde{d}_1}(=m_{\tilde{d}_2})$	200 GeV	4 TeV	Right-handed down-type squark (first two gens.) mass
$m_{\tilde{Q}_3}$	100 GeV	4 TeV	Left-handed squark (third gen.) mass
$m_{\tilde{u}_3}$	100 GeV	4 TeV	Right-handed top squark mass
$m_{\tilde{d}_3}$	100 GeV	4 TeV	Right-handed bottom squark mass
$\lvert M_1\rvert$	0 GeV	4 TeV	Bino mass parameter
$\lvert M_2\rvert$	70 GeV	4 TeV	Wino mass parameter
$\lvert\mu\rvert$	80 GeV	4 TeV	Bilinear Higgs mass parameter
M_3	200 GeV	4 TeV	Gluino mass parameter
$\lvert A_t\rvert$	0 GeV	8 TeV	Trilinear top coupling
$\lvert A_b\rvert$	0 GeV	4 TeV	Trilinear bottom coupling
$\lvert A_\tau\rvert$	0 GeV	4 TeV	Trilinear τ lepton coupling
M_A	100 GeV	4 TeV	Pseudoscalar Higgs boson mass
$\tan\beta$	1	60	Ratio of the Higgs vacuum expectation values

Constraints: considerations of precision EW and flavour results, dark matter relic density, and other ollider measurements

Parameter	Minimum value	Maximum value
$\Delta\rho$	-0.0005	0.0017
$\Delta(g-2)_\mu$	-17.7×10^{-10}	43.8×10^{-10}
$\mathrm{BR}(b\to s\gamma)$	2.69×10^{-4}	3.87×10^{-4}
$\mathrm{BR}(B_s\to\mu^+\mu^-)$	1.6×10^{-9}	4.2×10^{-9}
$\mathrm{BR}(B^+\to\tau^+\nu_\tau)$	66×10^{-6}	161×10^{-6}
$\Omega_{\tilde{\chi}_1^0}h^2$	—	0.1208
$\Gamma_{\mathrm{invisible(SUSY)}}(Z)$	—	2 MeV
Masses of charged sparticles	100 GeV	—
$m(\tilde{\chi}_1^\pm)$	103 GeV	—
$m(\tilde{u}_{1,2},\,\tilde{d}_{1,2},\,\tilde{c}_{1,2},\,\tilde{s}_{1,2})$	200 GeV	—
$m(h)$	124 GeV	128 GeV

Long-lived SUSY particles

- Constraints on the gluino R-hadron are set
  - R-hadrons formed from long-lived coloured sparticle (squark or gluino) and SM quarks and gluons



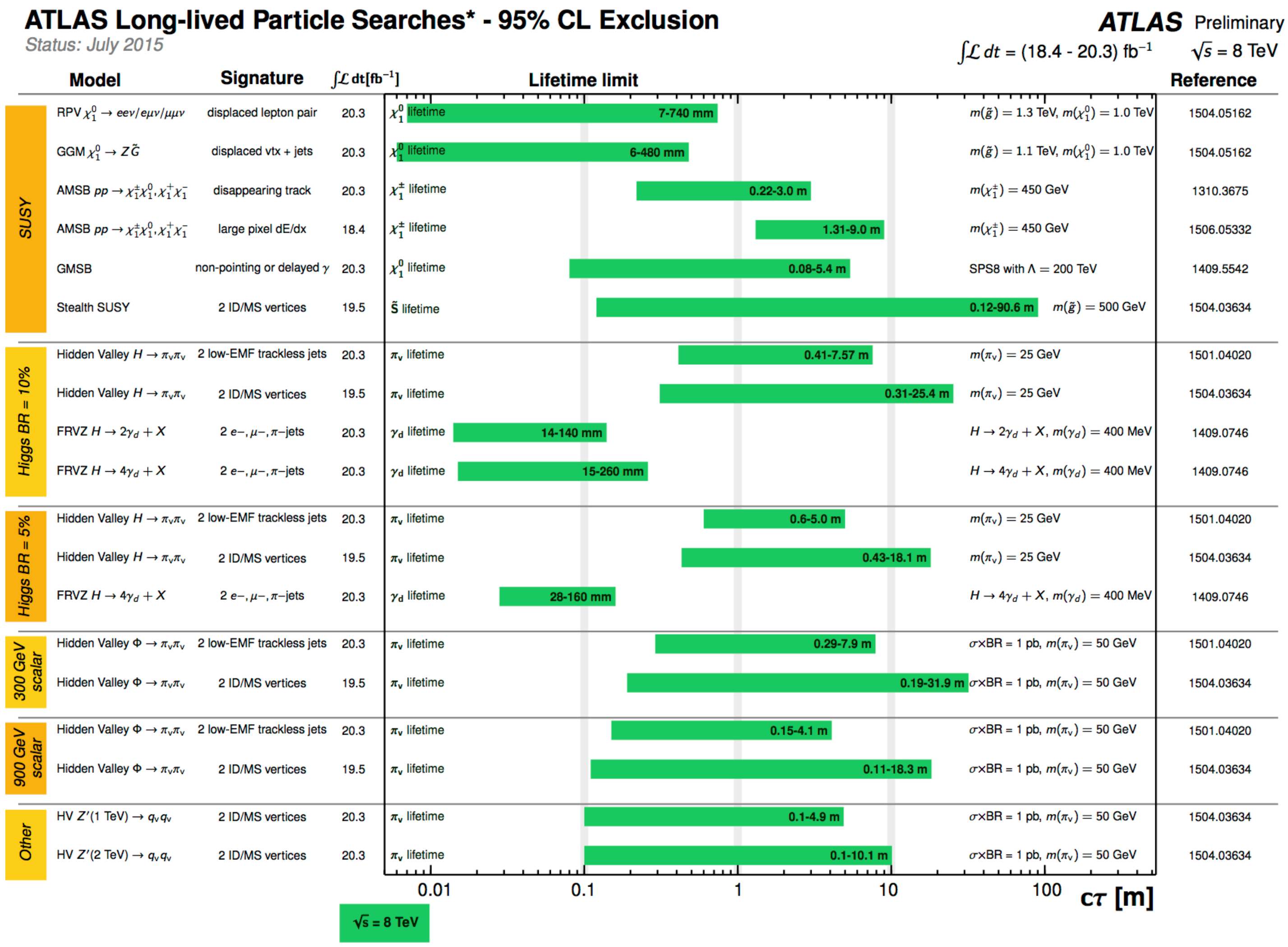
Complementary sensitivity from different searches relying on:

- ➢ reconstructed displaced vertex
- ➢ high ionization in tracker
- ➢ timing measurement in muon and calorimeters

From dE/dx study:

Gluino R-hadron with 10ns lifetime and masses up to 1185 GeV are excluded.

Long-lived particle summary



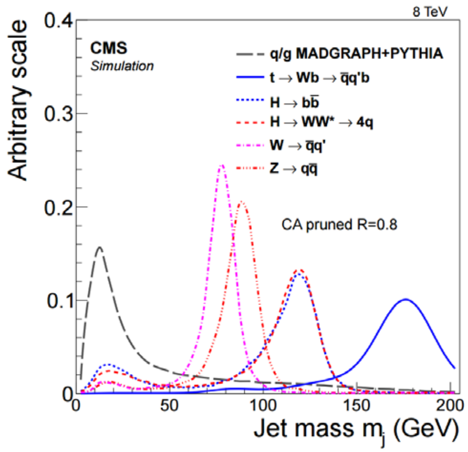
*Only a selection of the available lifetime limits on new states is shown.

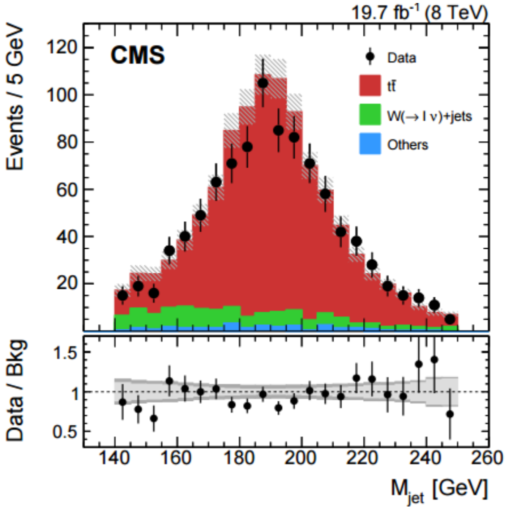
SUSY and Exotic searches

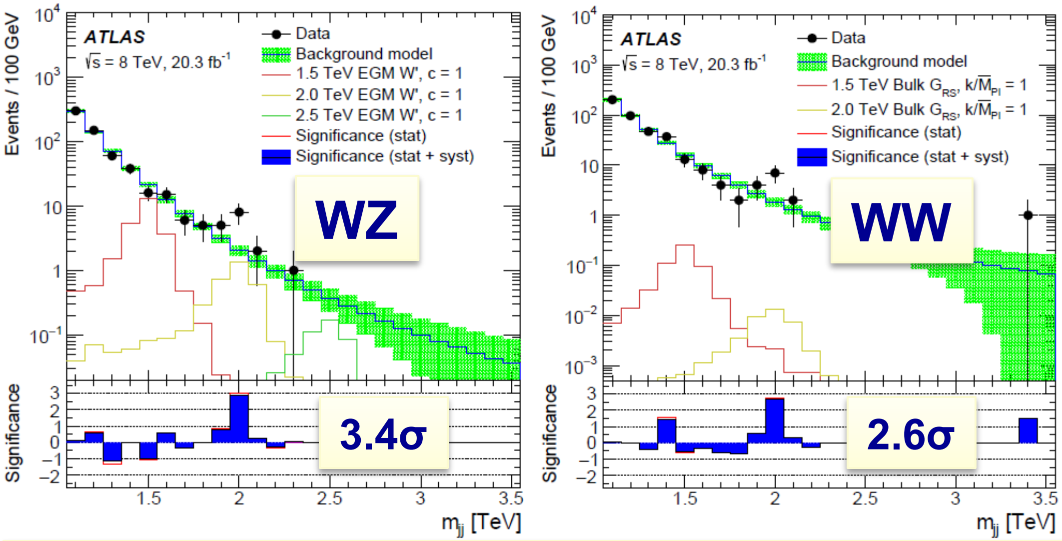
Various scenarios are considered, but no signal yet

Resonances decaying to VV, with V→jets?

- **Major new tool: jet substructure**







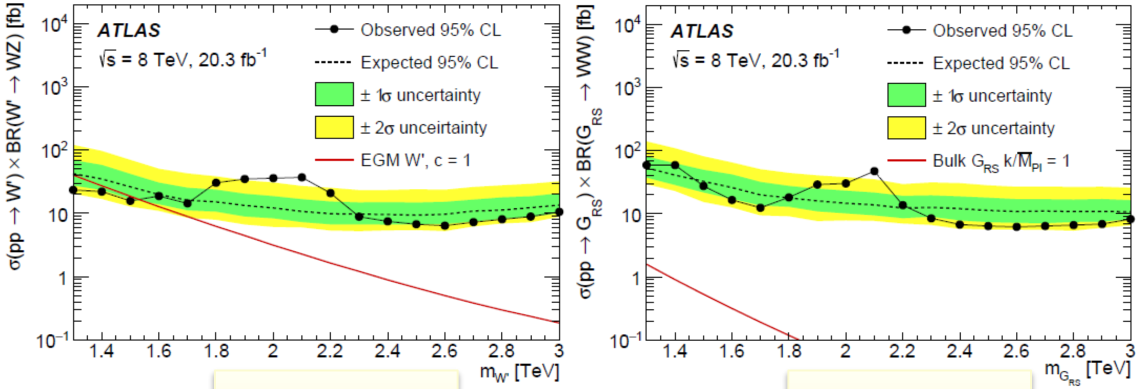
WZ

WW

3.4σ

2.6σ

To the innocent slide reader: large overlap in events…

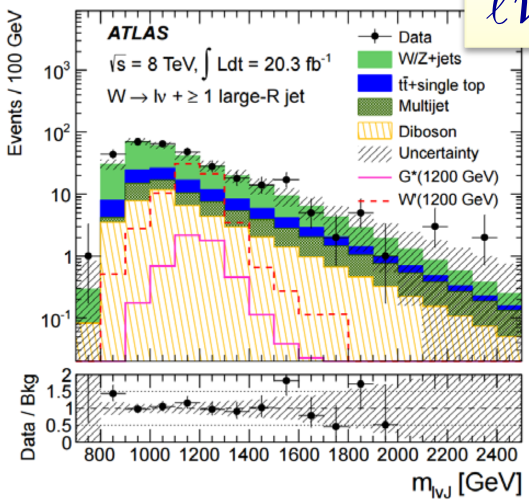


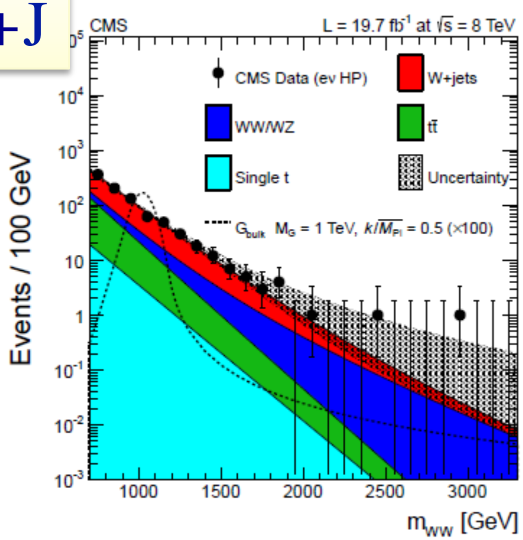
$W' \rightarrow WZ$

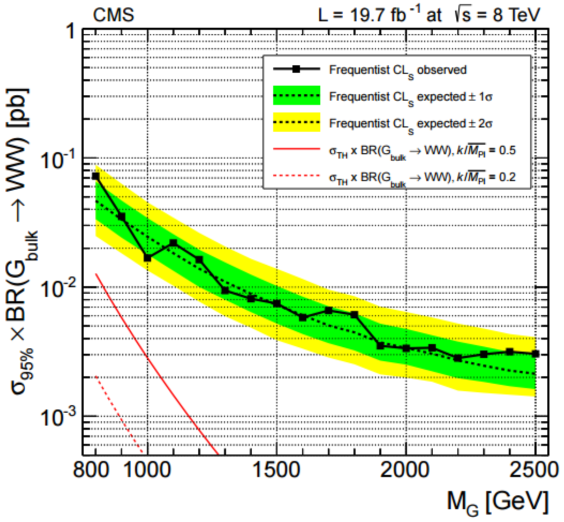
$G_B \rightarrow WW$

Turning fast to leptonic modes…

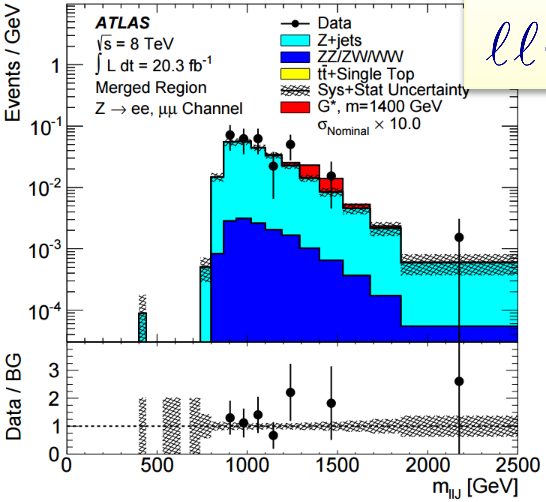
$\ell\nu$+J

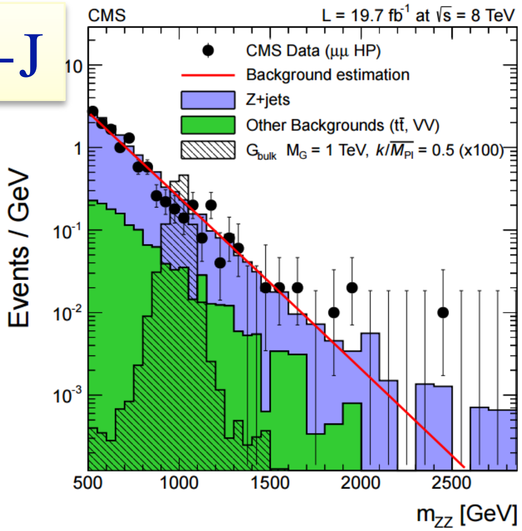


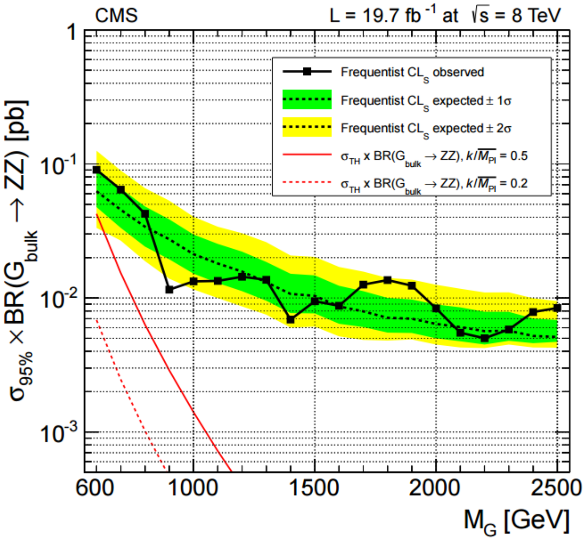




$\ell\ell$+J





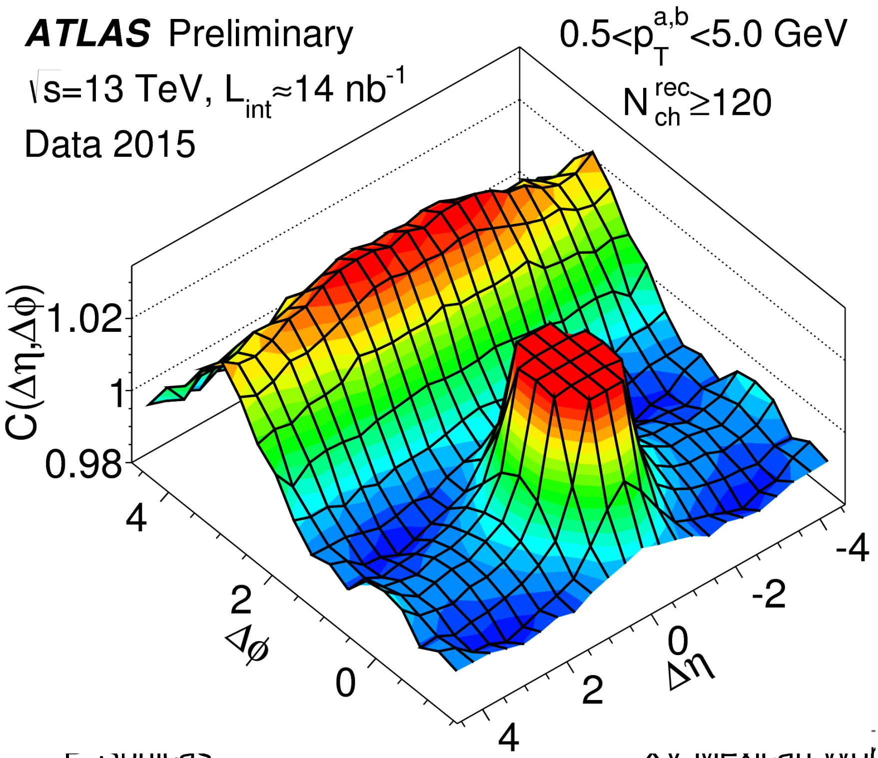


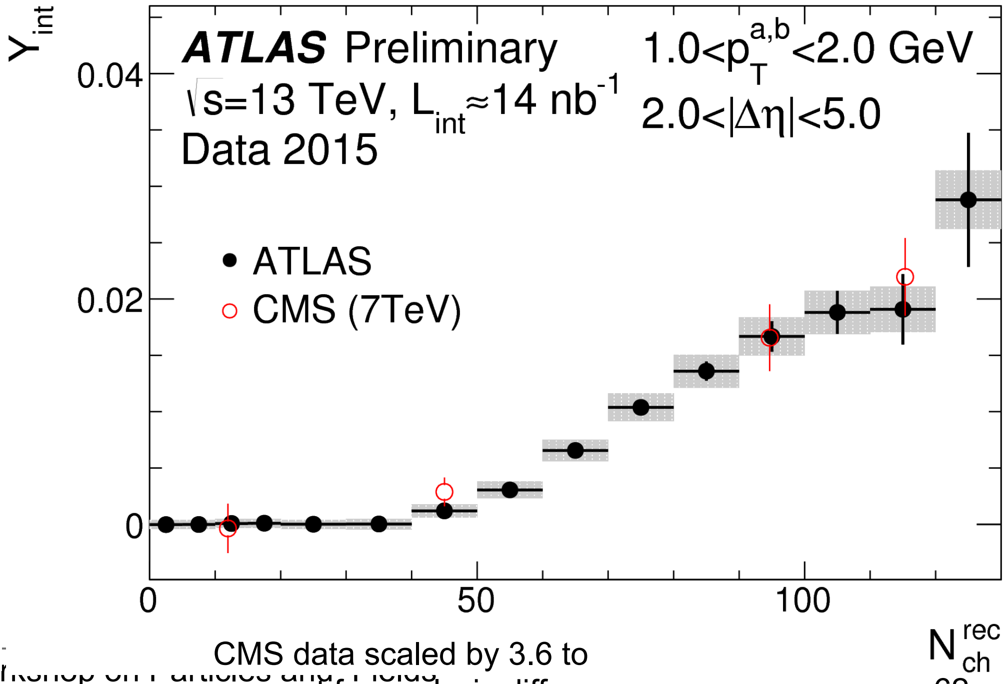
Long-range Correlations

ATLAS-CONF-2015-027

- High-multiplicity events show long-range correlations at $\Delta\Phi \sim 0$ (near-side ridge)
- Dedicated MBTS + high multiplicity trigger in low-pileup data
- Tracks with $p_T > 0.4$ GeV $|\eta| < 2.5$
- Strength consistent with 7 TeV CMS data

$$Y(\Delta\phi) = \left(\frac{\int B(\Delta\phi)\mathrm{d}\Delta\phi}{N^{a}\int \mathrm{d}\Delta\phi}\right)C(\Delta\phi),$$





CMS data scaled by 3.6 to account for analysis differences

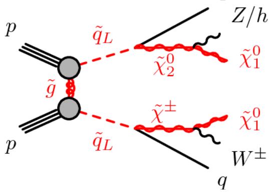
Inclusive 1st and 2nd squark and gluino

arXiv:1507.05525

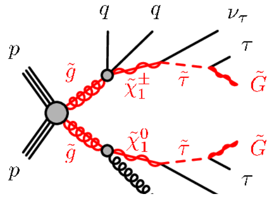
- **Inclusive searches of squarks and qluinos with final states:**
  - **High p_T jets + MET + with or without leptons or b-jets**
- **Exclusion limits are set on various SUSY models**
  - **Simplified models (R-parity+LSP stable), mSUGRA/ CMSSM, bRPV, mGMSB, nGM, NUHMG, mUED**

squark and gluino pair production in the simplified models

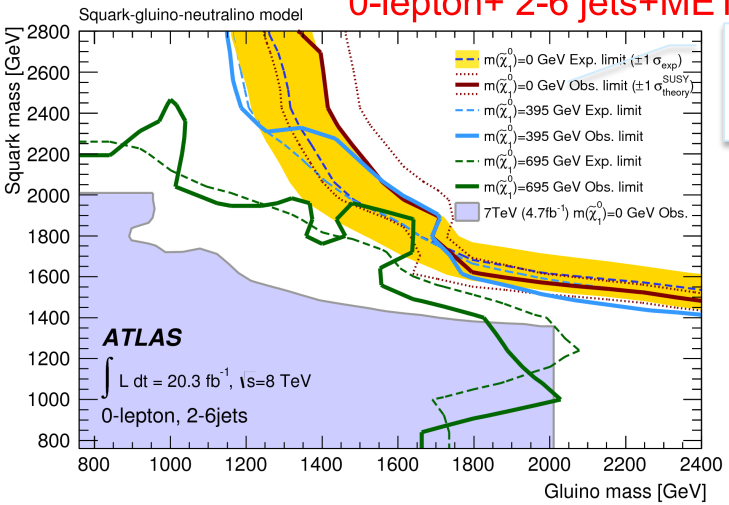
left-handed squark in the pMSSM



gluino-pair production in nGM

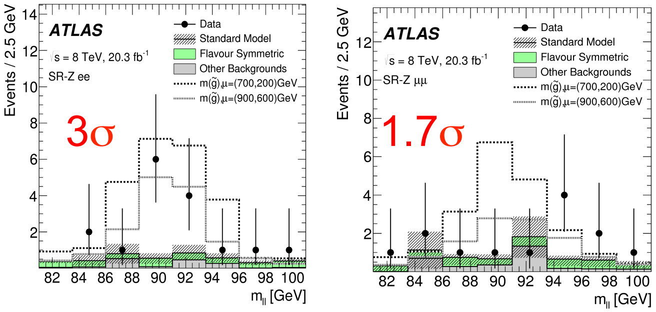


0-lepton+ 2-6 jets+MET

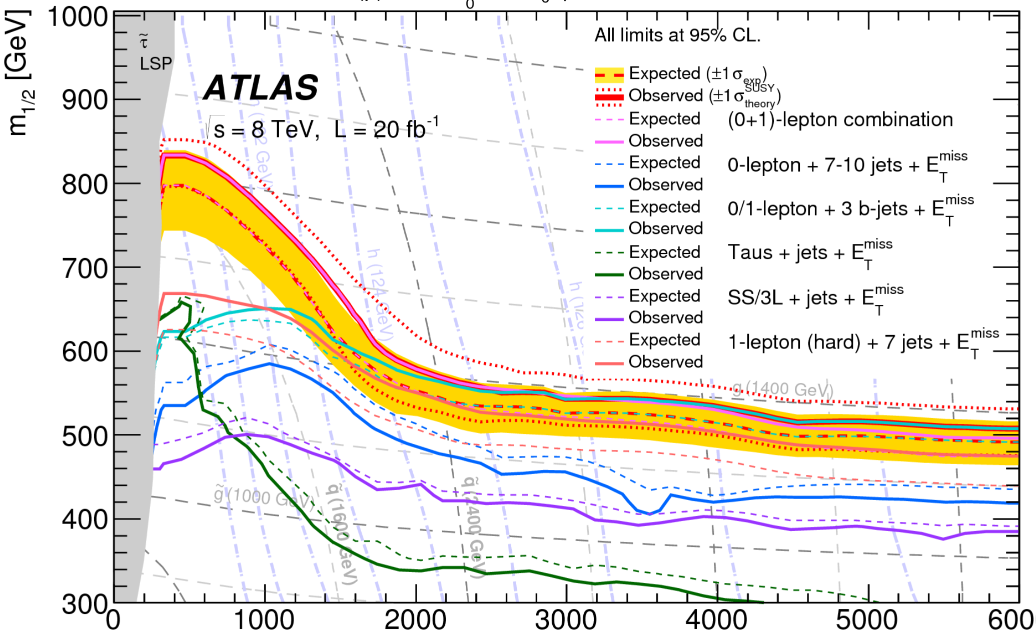


For massless neutralino, lower limit for squark and gluino is at 1650 GeV.

2-lepton+jets+MET arXiv:1503.03290



MSUGRA/CMSSM: tan(β) = 30, A_0 = -2m_0, μ > 0

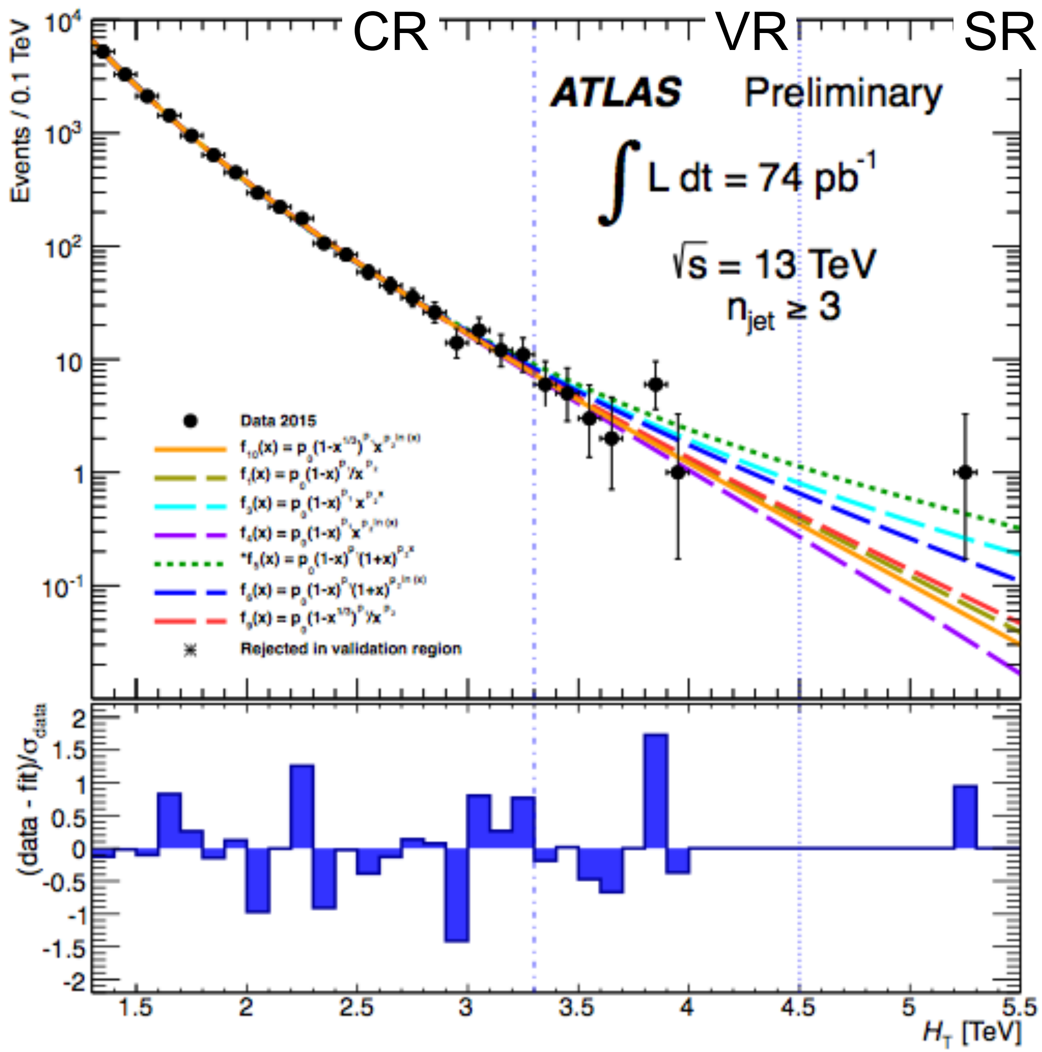


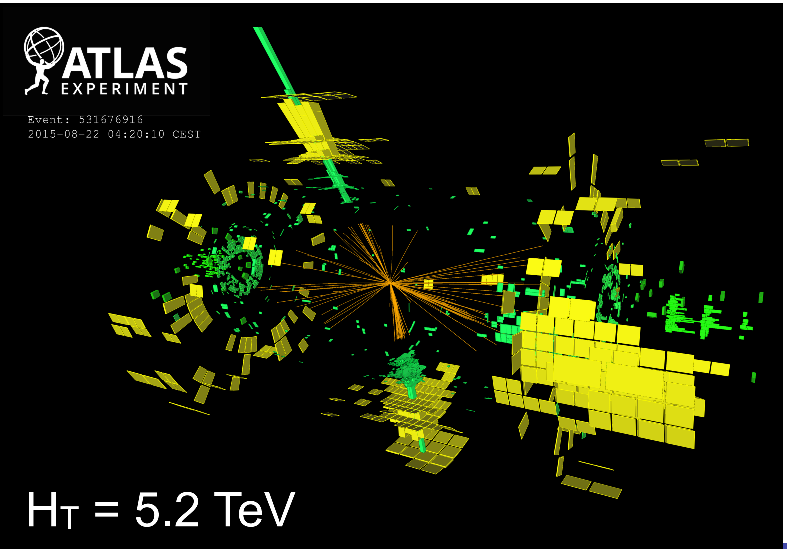
@ 95% CL. gluino mass < 1280 GeV excluded

Multi-jet Search

ATLAS-CONF-2015-043

- Non-resonant search
- H_T trigger (0.85 TeV)
- $N_{jet} \geq 3$, $p_T > 50$ GeV
- Look for excess in $H_T = \sum p_T$ (jets)
- Data-driven background fits in control region (CR)
- Check in validation (VR)
- Compared to events in signal region (SR)



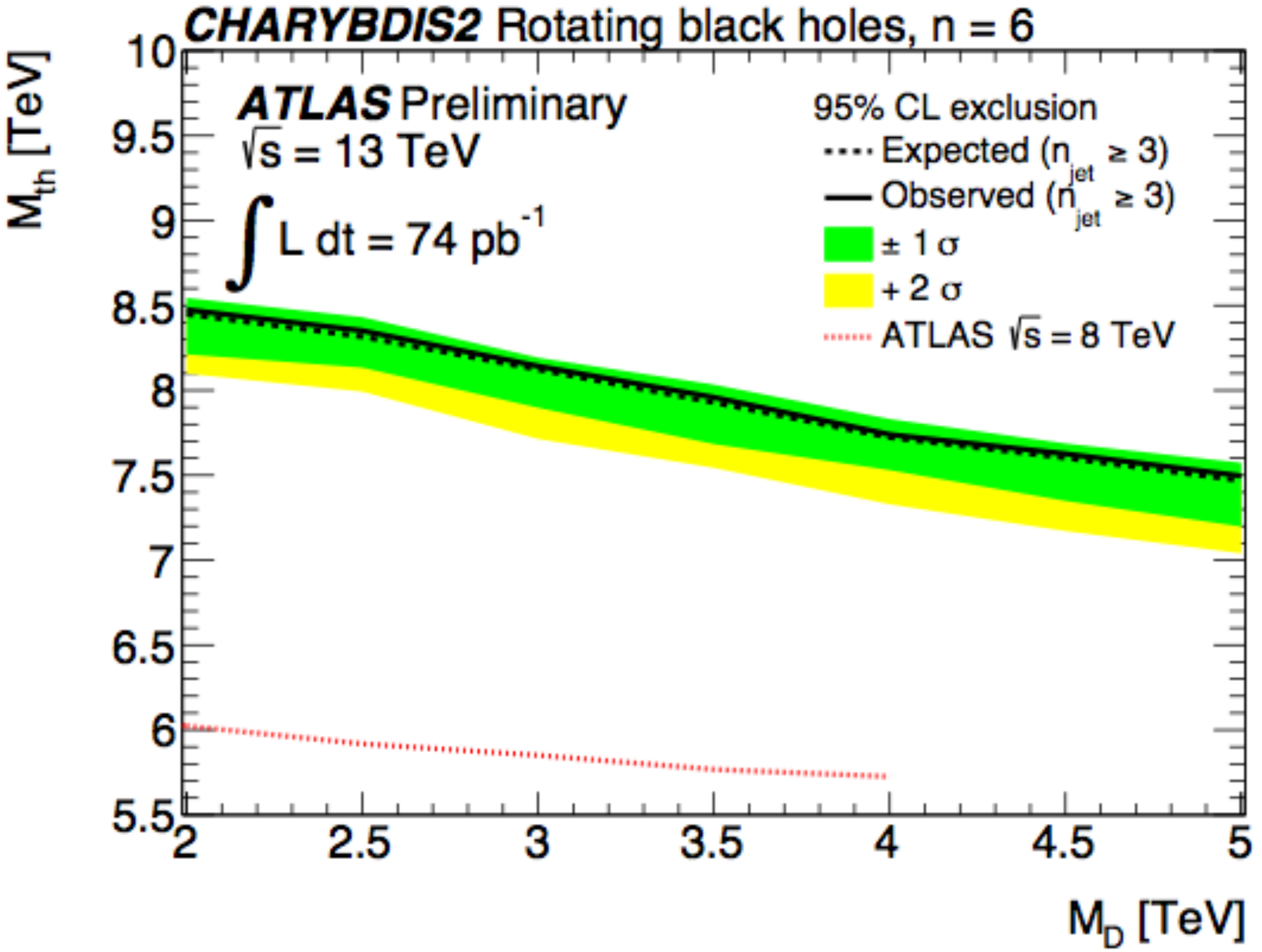


H_T = 5.2 TeV

No significant excess found

Multi-jet search results

ATLAS-CONF-2015-043



Sensitive to many strong-gravity models

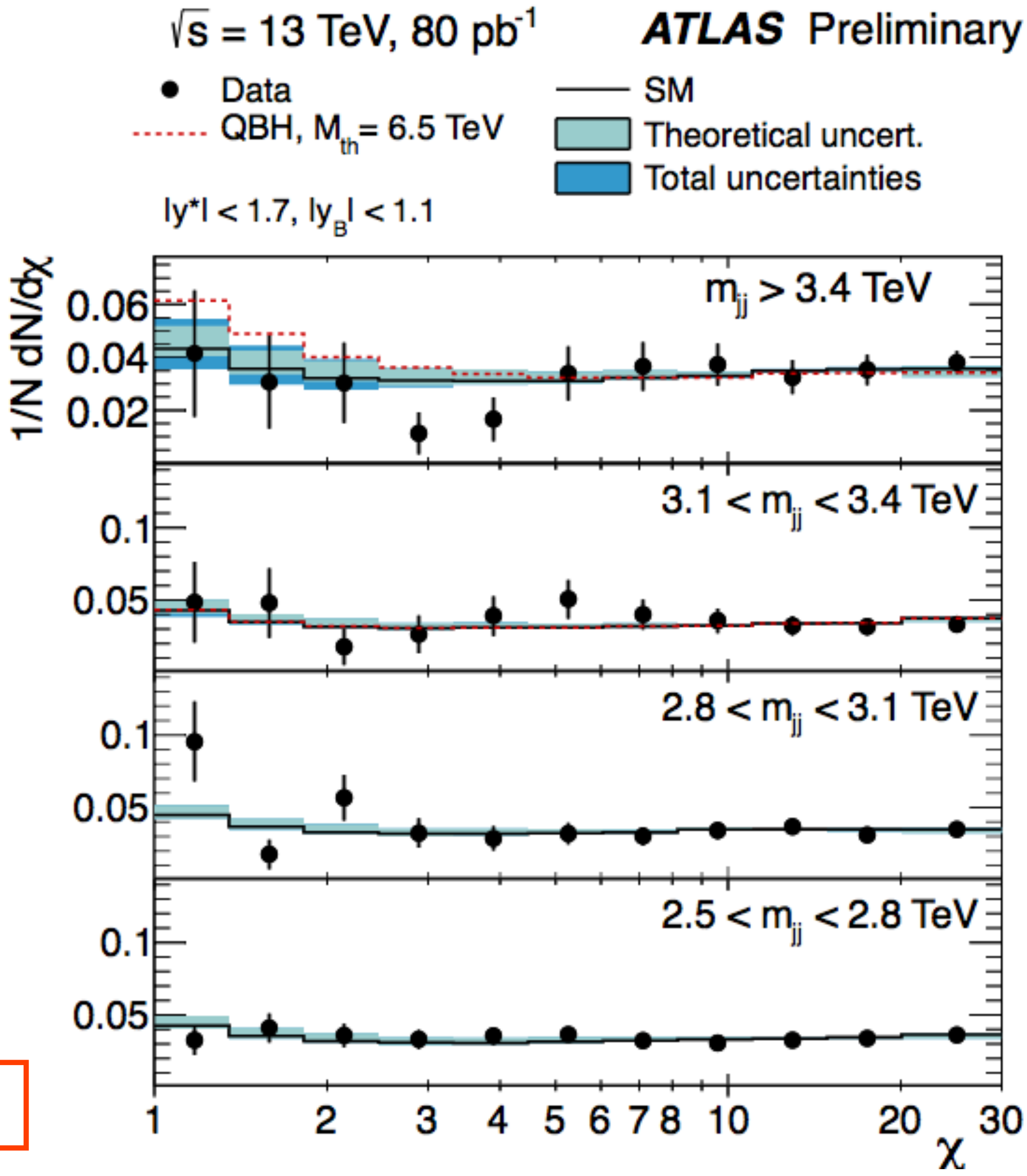
Limits set for thermal black hole model (Charybdis2)

Improvement over Run1 limit

Non-resonant Di-jet Search

ATLAS-CONF-2015-042

- Look for anomalies in shapes and rates at high mass
- $\chi = \exp|y_1 - y_2|$
  - ~independent of m_{12} for t-channel LO QCD
  - $|y_1 - y_2| < 3.4$ ($\chi < 30$)
    $|y_B| = |y_1 + y_2|/2 < 1.1$
    $m_{jj} > 2.5$ TeV
- Prediction from NLOJET++ including EW effects
- Systematics dominated by QCD prediction and jet energy scale



No significant deviation found