Exotics Overview

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Searches for "Exotics"

Attempts to make progress on long-standing questions:

- Is the SM Higgs mechanism correct?
- Why the Planck/weak scale hierarchy?
- Why are there so many seemingly arbitrary parameters?
- Why three generations of fermions?
- Are there three generations of neutrinos?
- What gives mass to the fermions?
- …etc…
- Is there anything unexpected at higher energies?
- Why such a large baryon asymmetry?
- How do we understand gravity as small lengths?
- What is dark matter?
- What is dark energy?

Suspect the SM is only a low-energy approximation of a theory that would answer many of these.

But without solid, new clues, progress has been very hard.

Types of Beyond-the-Standard-Model theories

We don't know what we're looking for...

look for extensions that combine familiar ingredients

leptons, jets, MET, photons…

in familiar ways

two-body resonances, X+MET…

=> Search systematically by final state 'signature': jet+X, lepton+X, top+X, dibosons/multileptons (DBL)

Typically choose final state, look at a falling tail in mass, p_T, MET, ...

Sensitive to compositeness / excited fermions / additional generations

Copies of SM gauge bosons: W', Z', H', axigluons, … (GUT breaking, KK towers in ED)

WIMP DM, etc. etc.

Or BSM physics could involve new kinds of objects, or those that we may not immediately recognize as new:

quirks, R-hadrons, lepton-jets, long-lived particles, anomalous tracks (HI, displaced, unexpected charge), ...

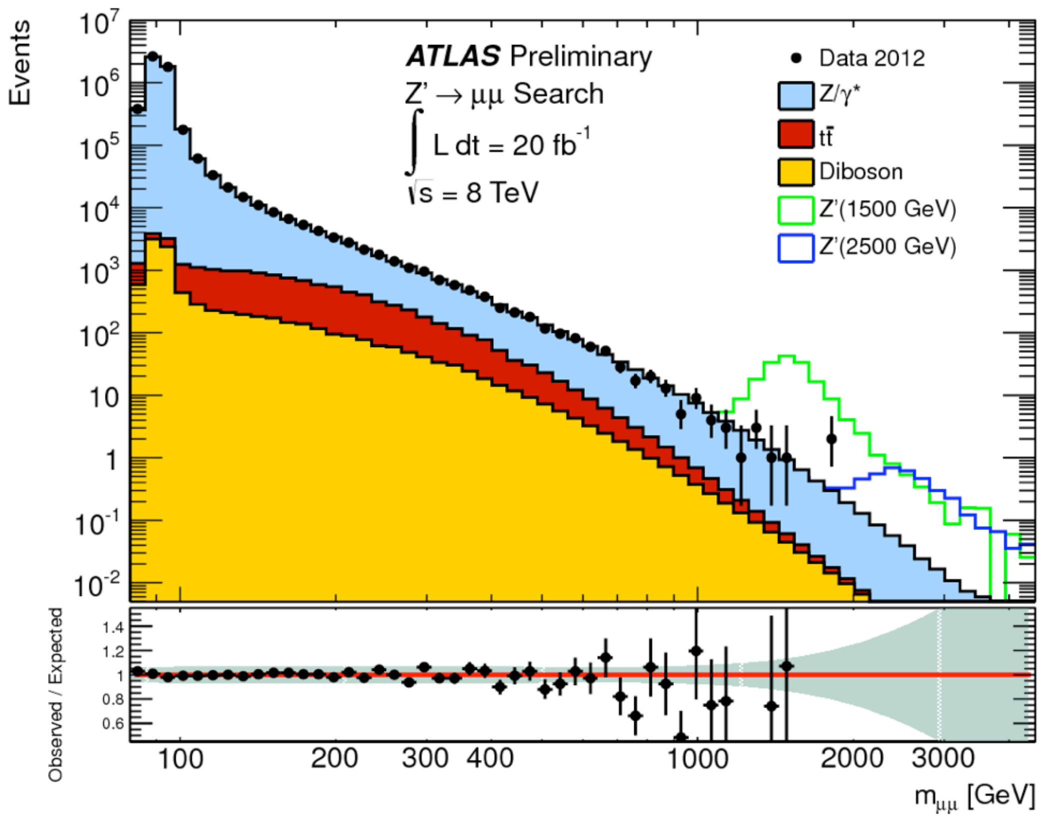
=> hard to consider systematically; searches tend to follow specific models/experimental hints to guide our imagination

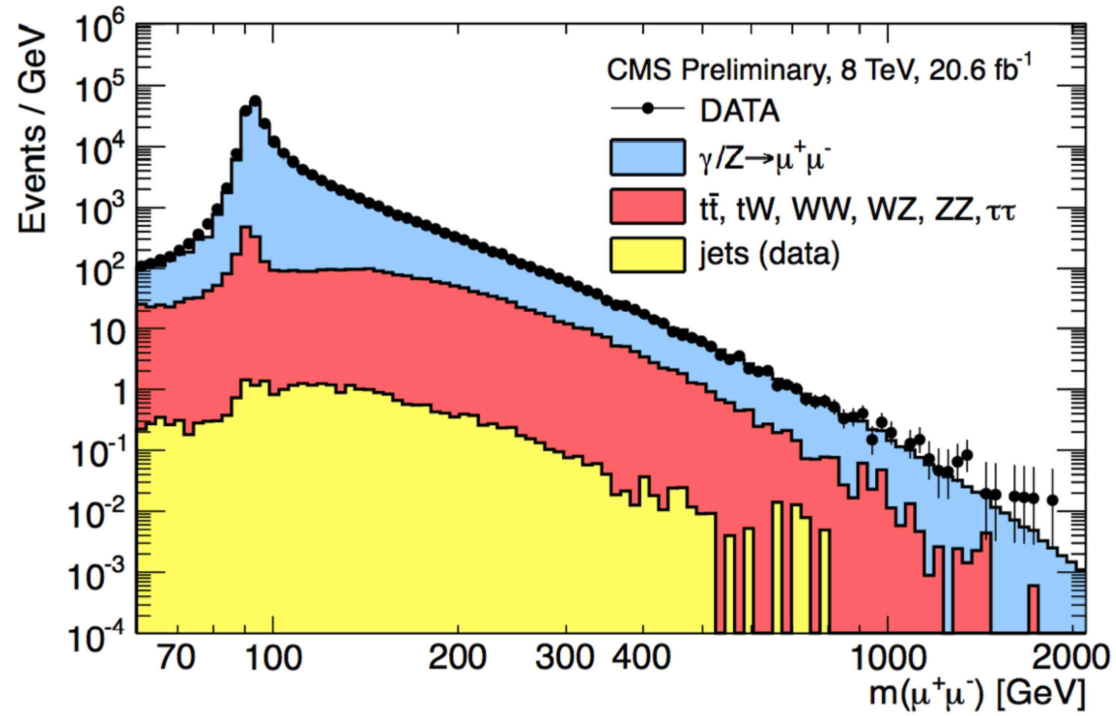
Dilepton mass resonances

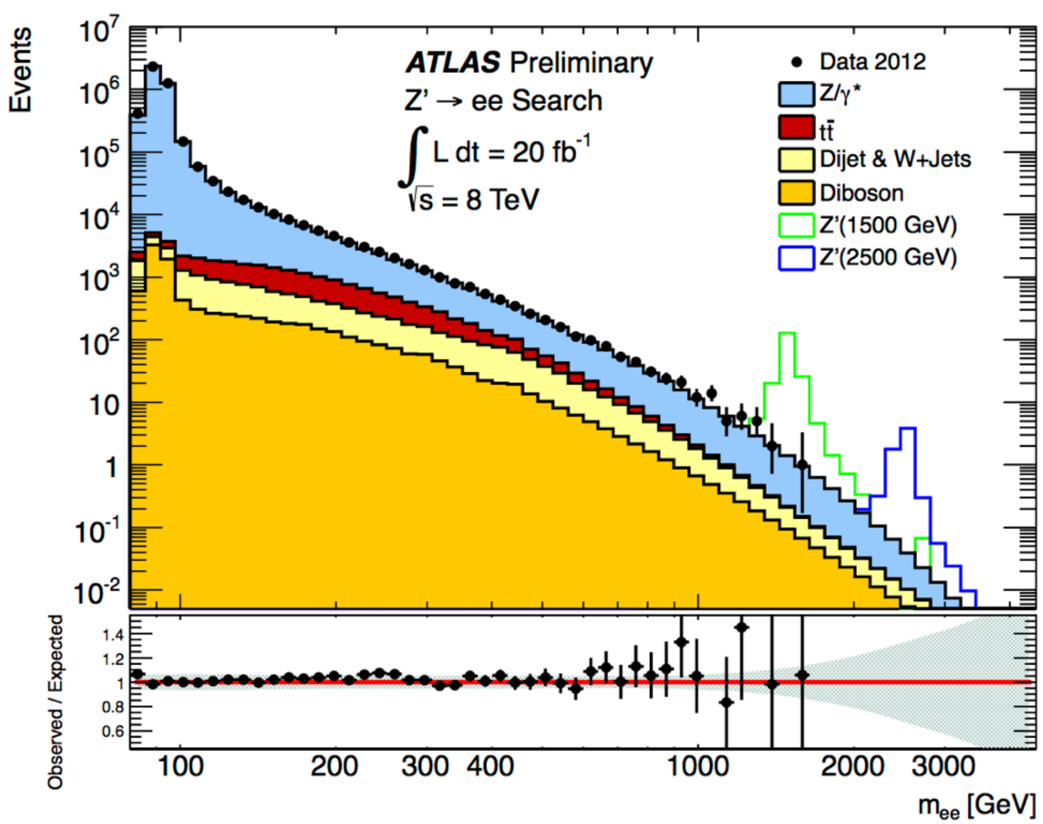
ATLAS-CONF-2013-017

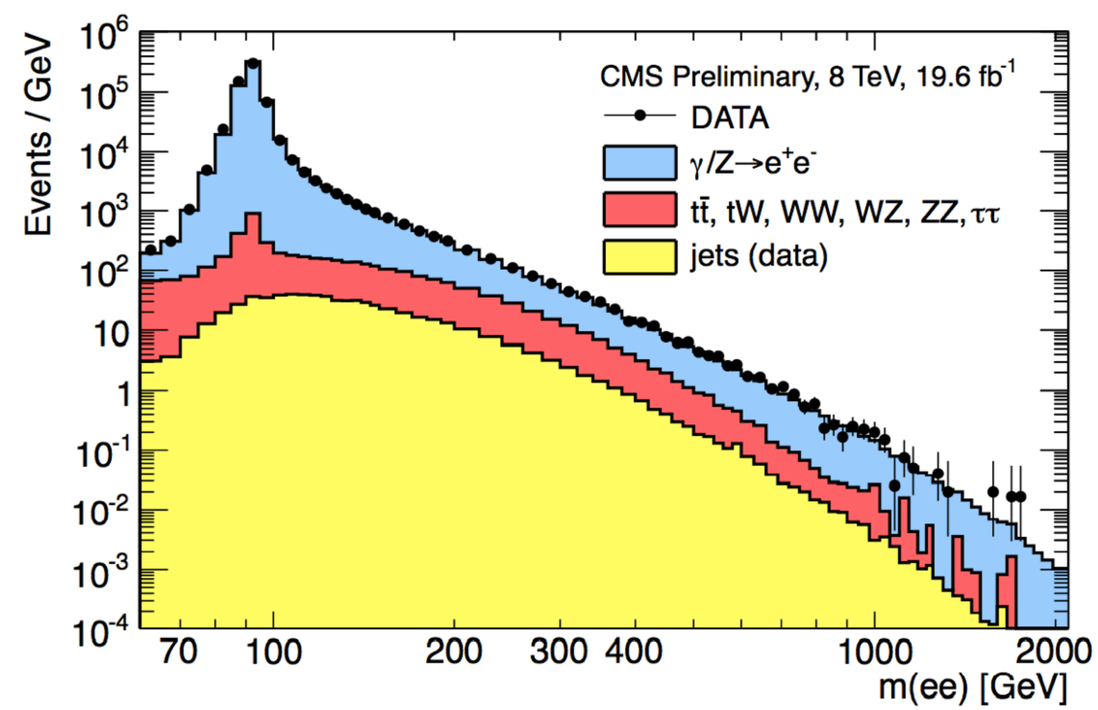
CMS PAS EXO12061

Consummate "signature-based" search: well understood final states, clean SM prediction, many BSM models: Z's, KK virtual gravitons (RS), strings, technicolor, little higgs, …









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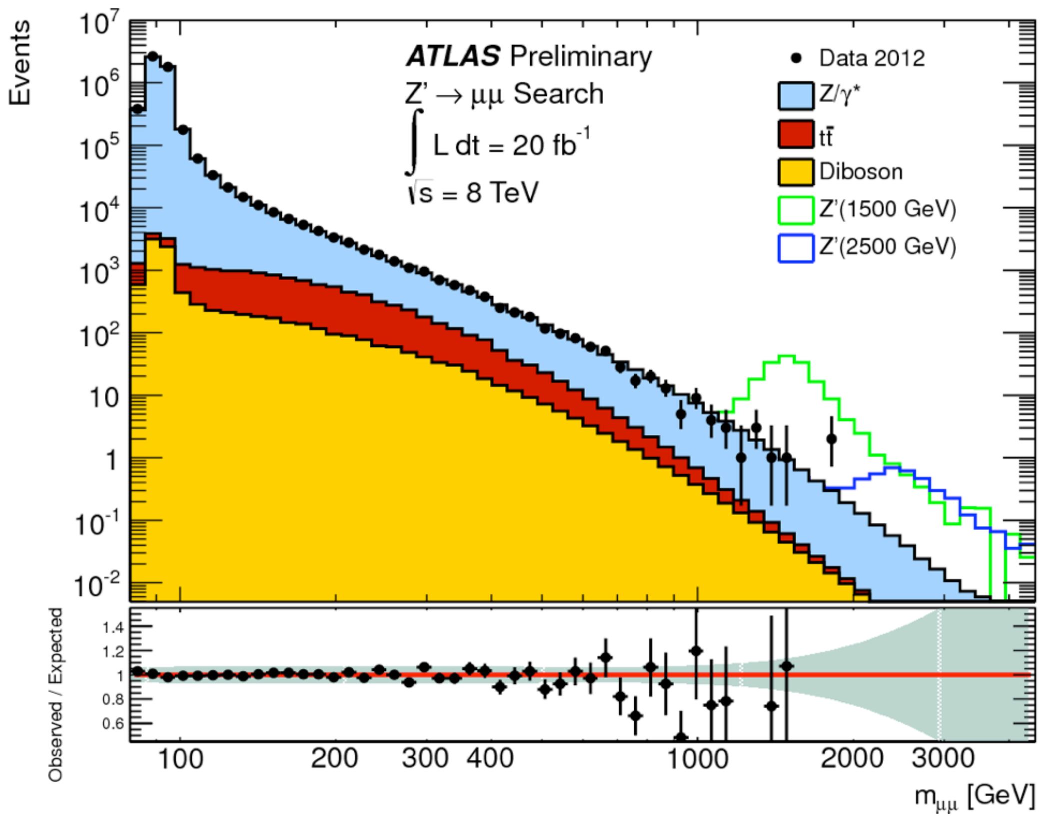
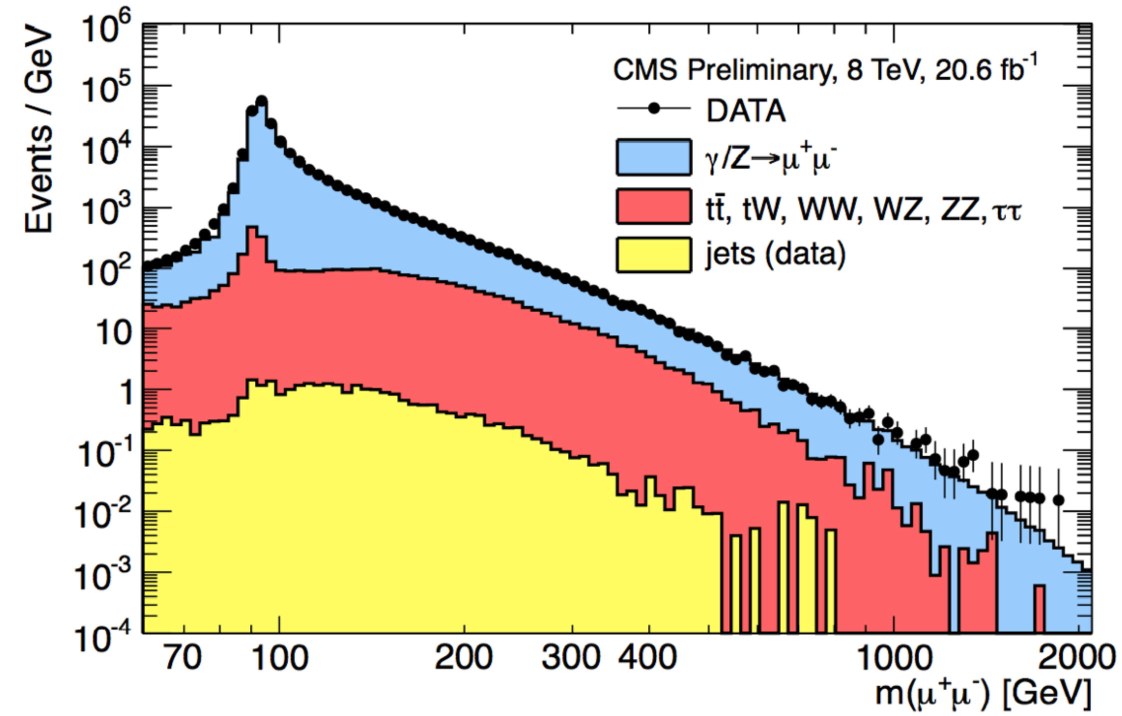
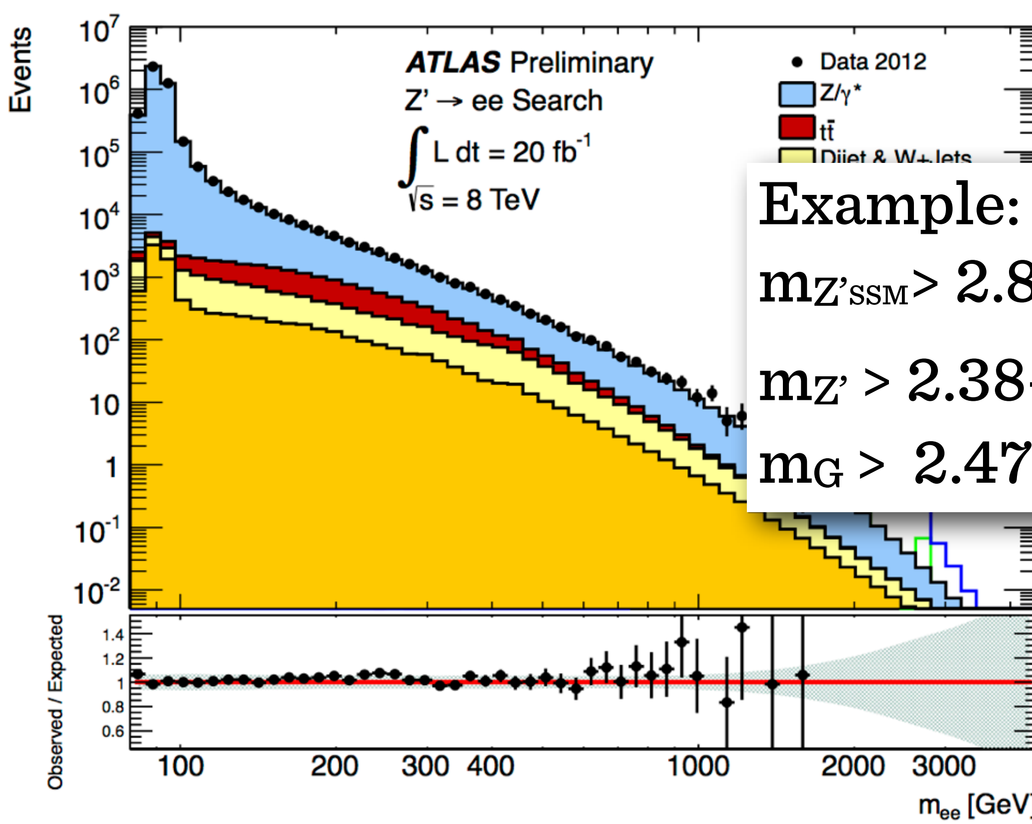
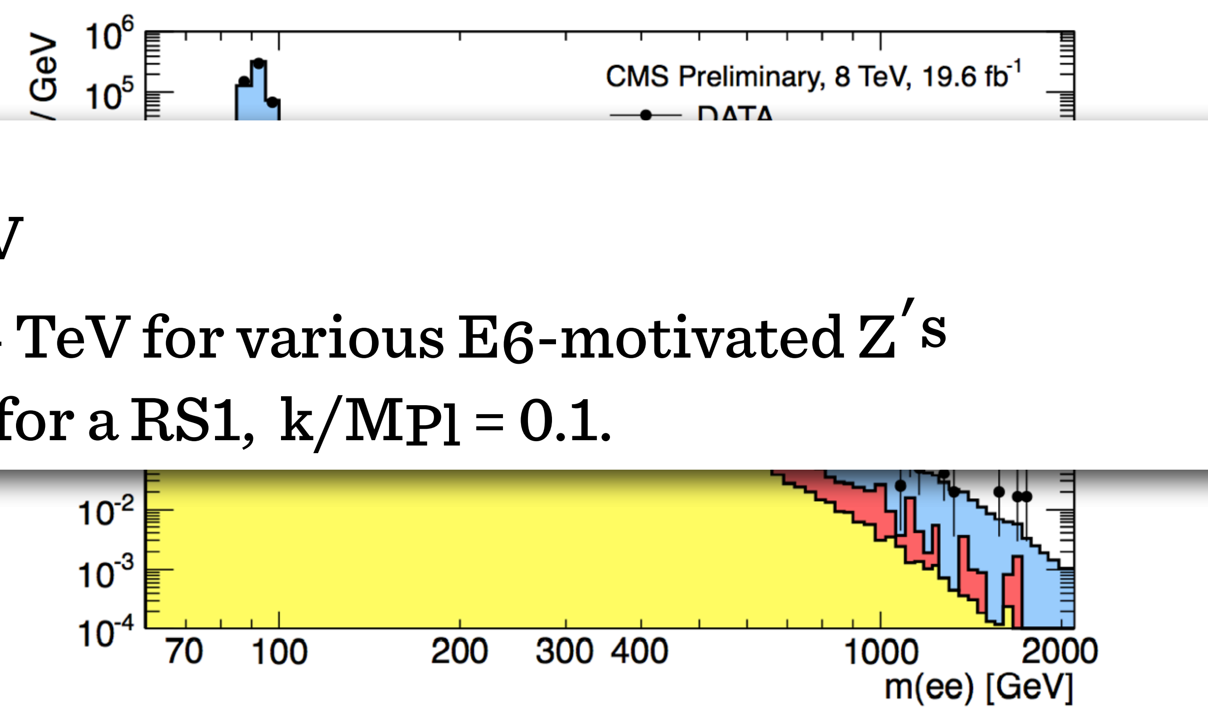








Example:

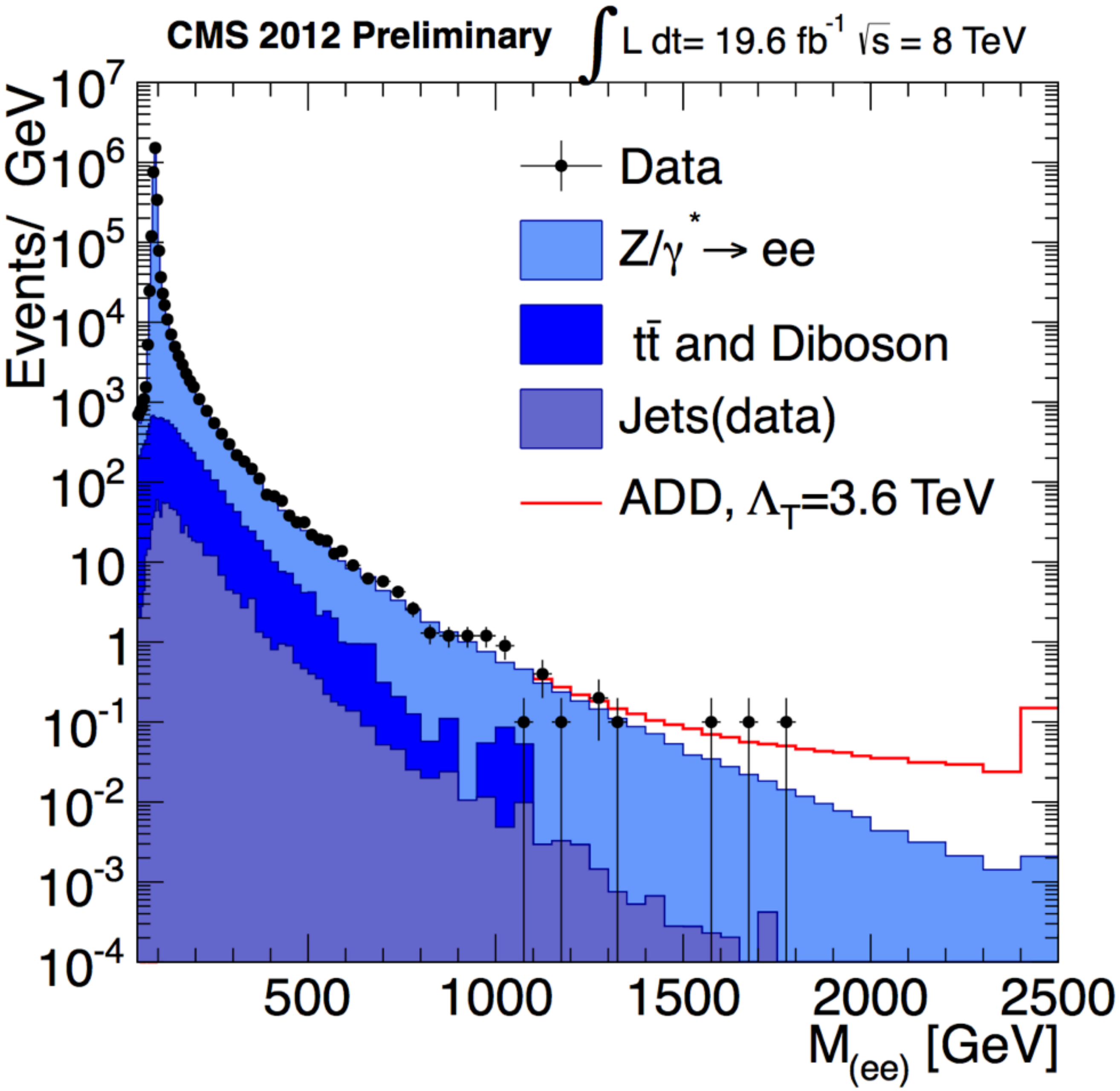
$m_{Z'_{SSM}} > 2.86$ TeV

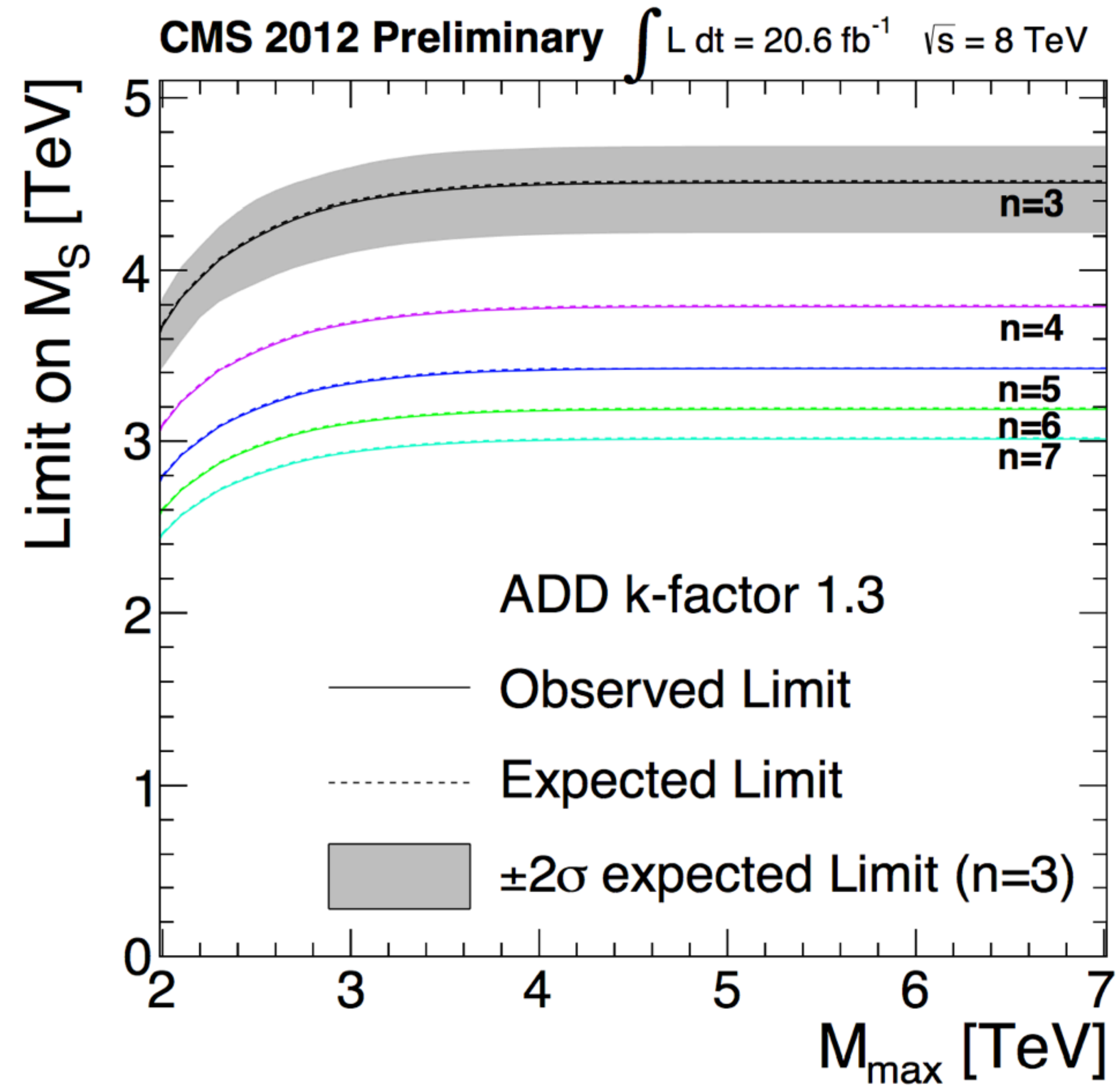
$m_{Z'} > 2.38–2.54$ TeV for various E6-motivated Z′s

$m_G > 2.47$ TeV for a RS1, $k/M_{Pl} = 0.1$.

Non-resonant dilepton mass search

CMS PAS EXO-12-027



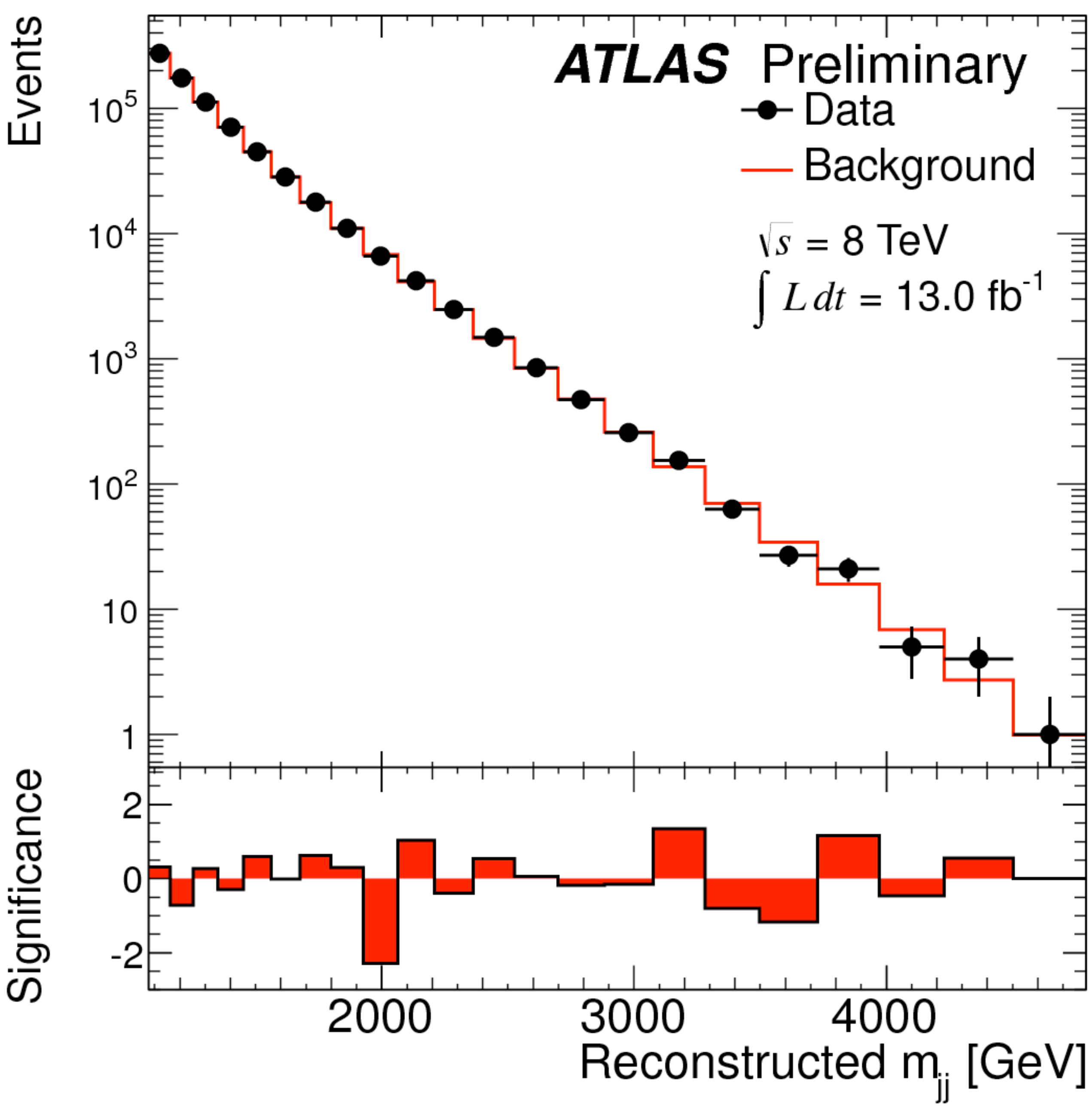


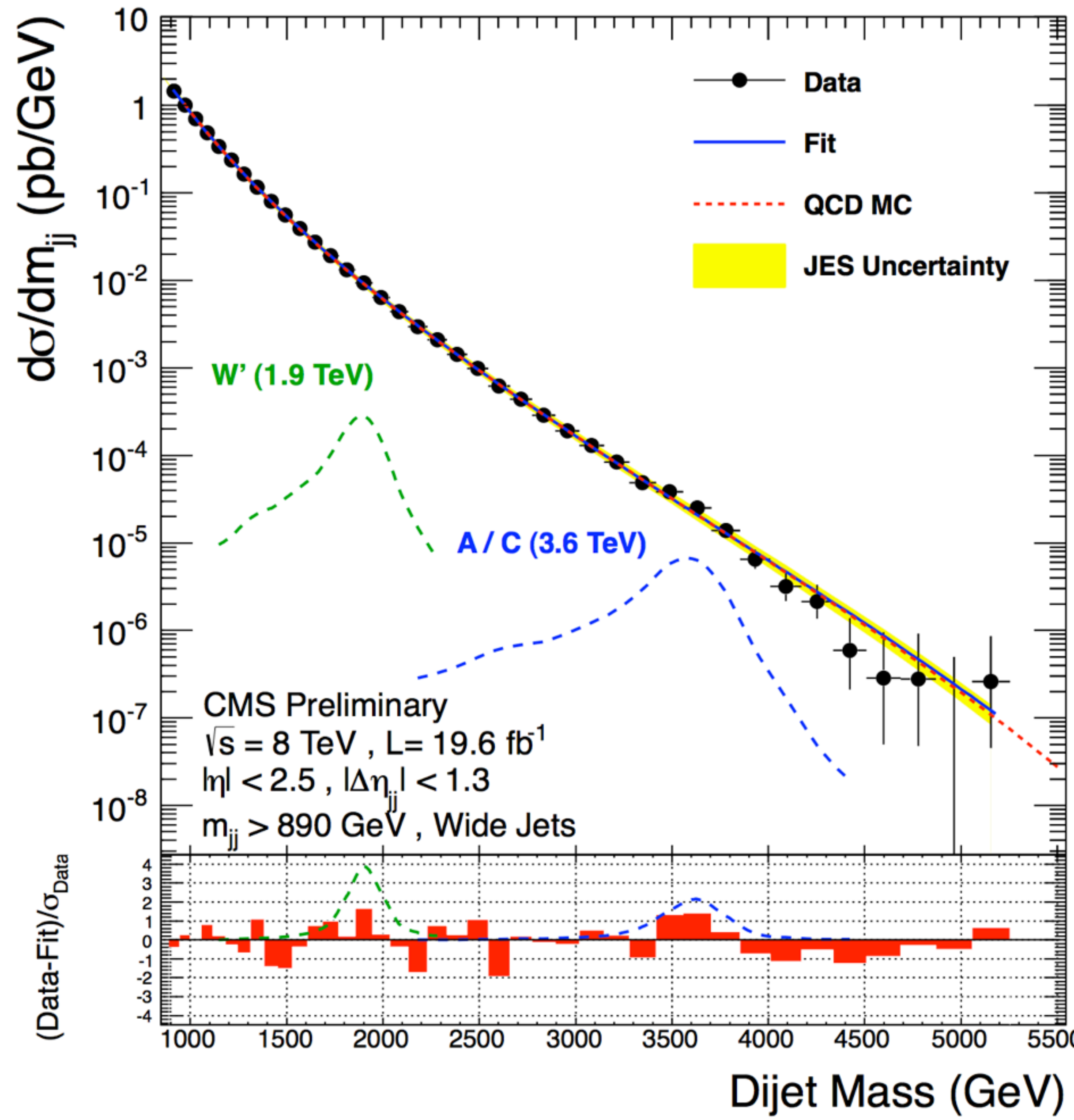
ATLAS-CONF-2012-148
CMS PAS EXO-12-059

Dijet mass resonances

Two-body decays to jets are a signature of many many models: Z'/W', excited quarks (qg), diquarks, chiral color, axigluons, black holes, KK gravitons, ...

$$f(x) = p_1(1-x)^{p_2} x^{p_3 + p_4 \ln x}$$





Dijet mass resonances

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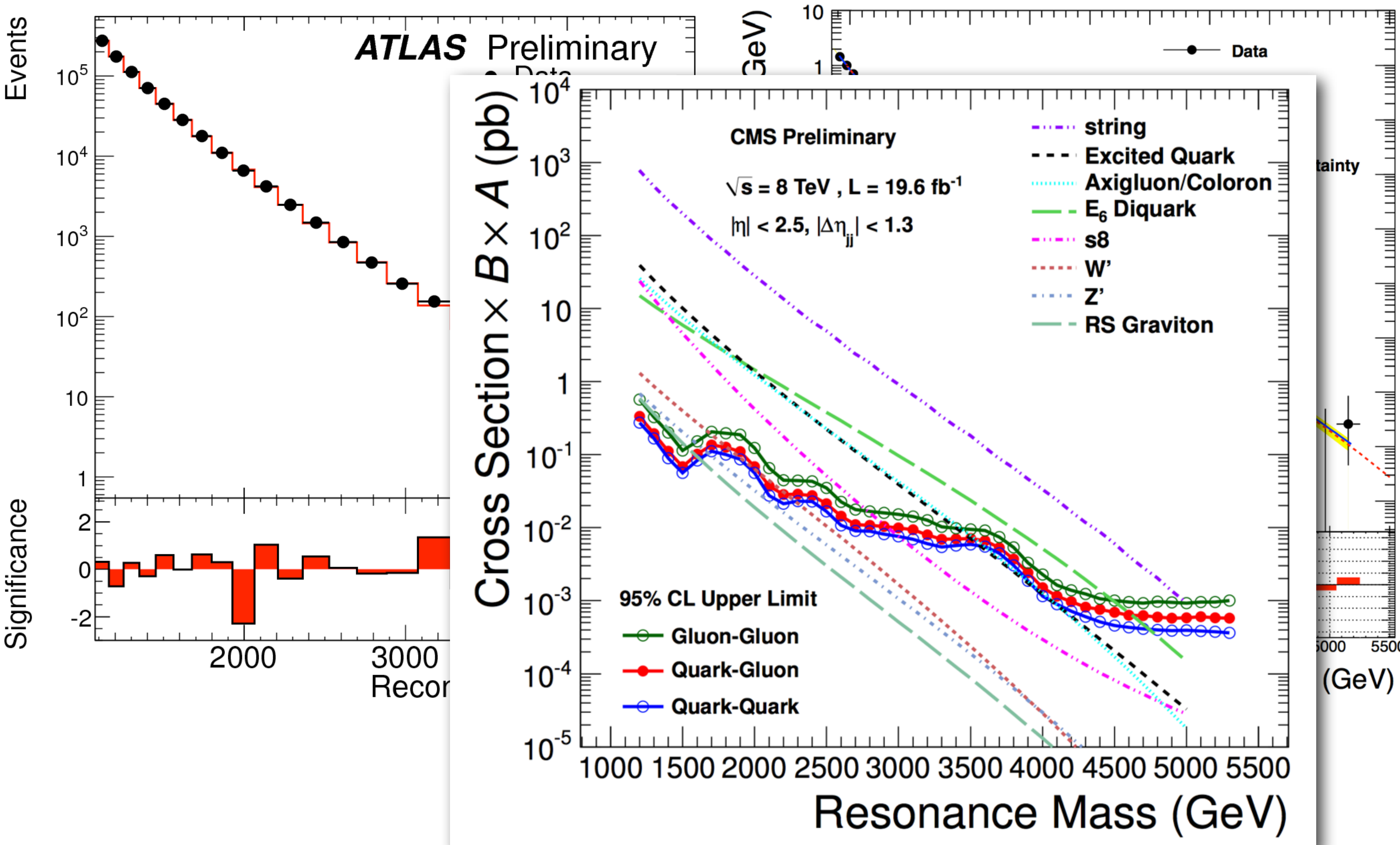
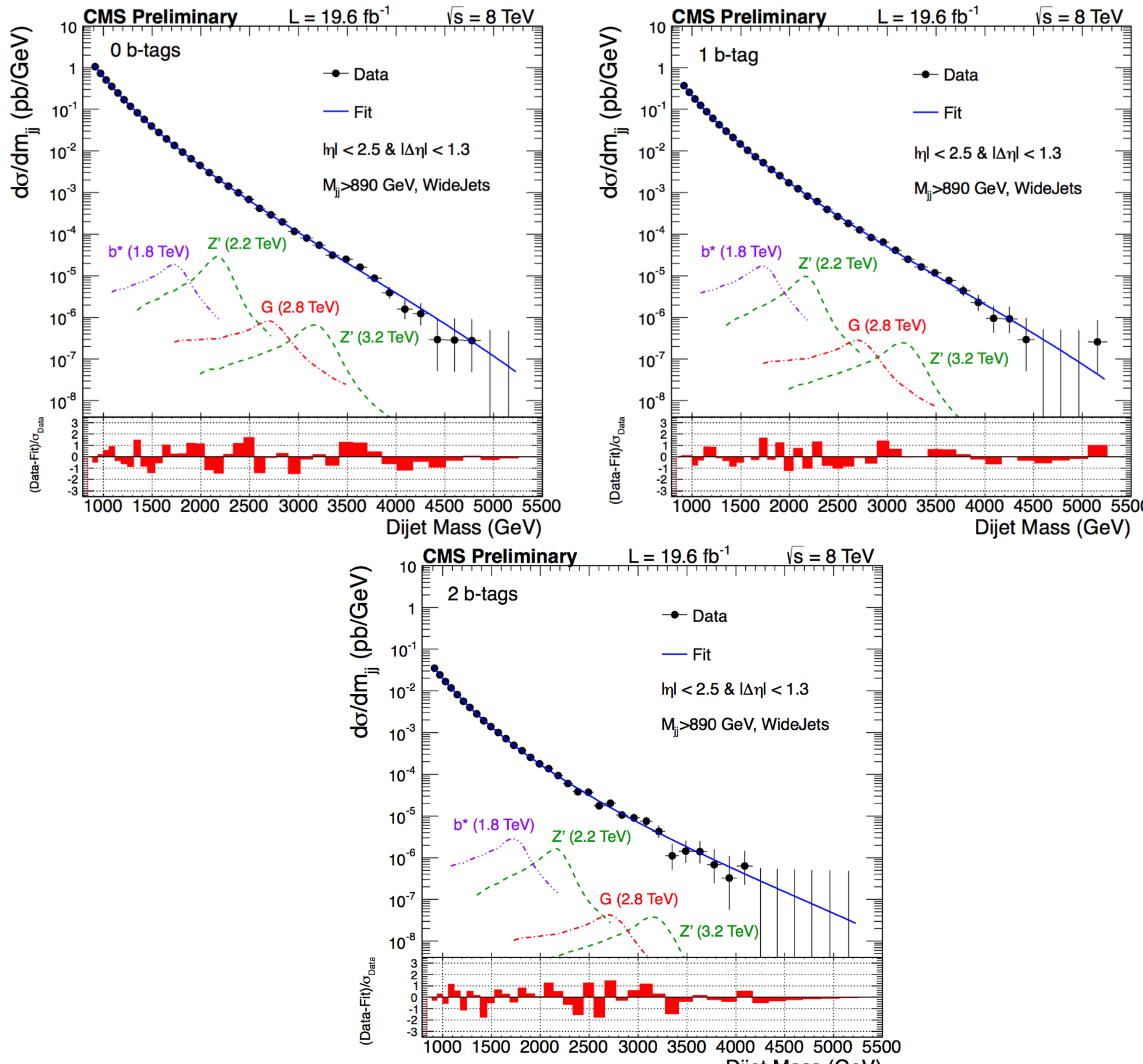
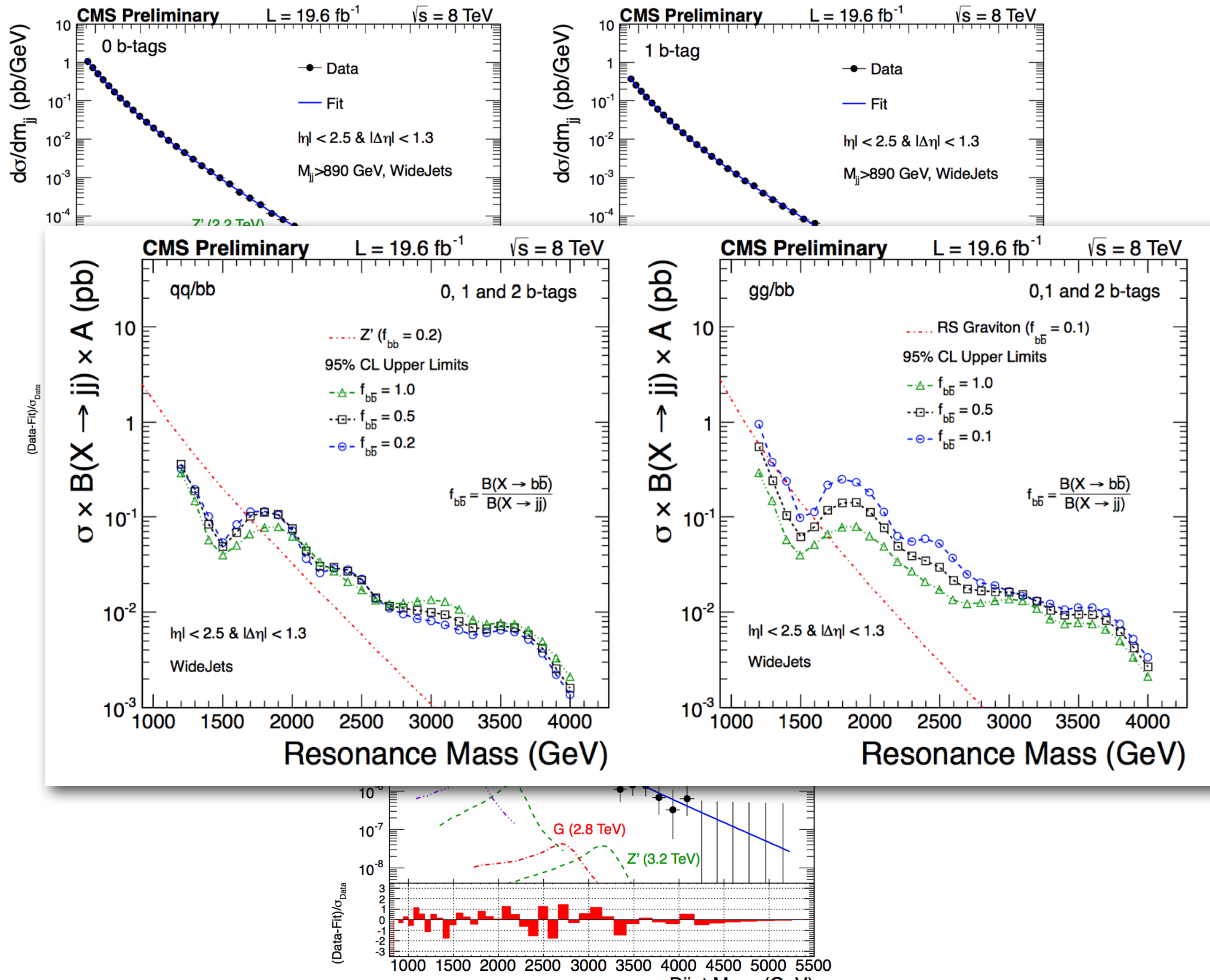


Dijet mass resonances with b tags



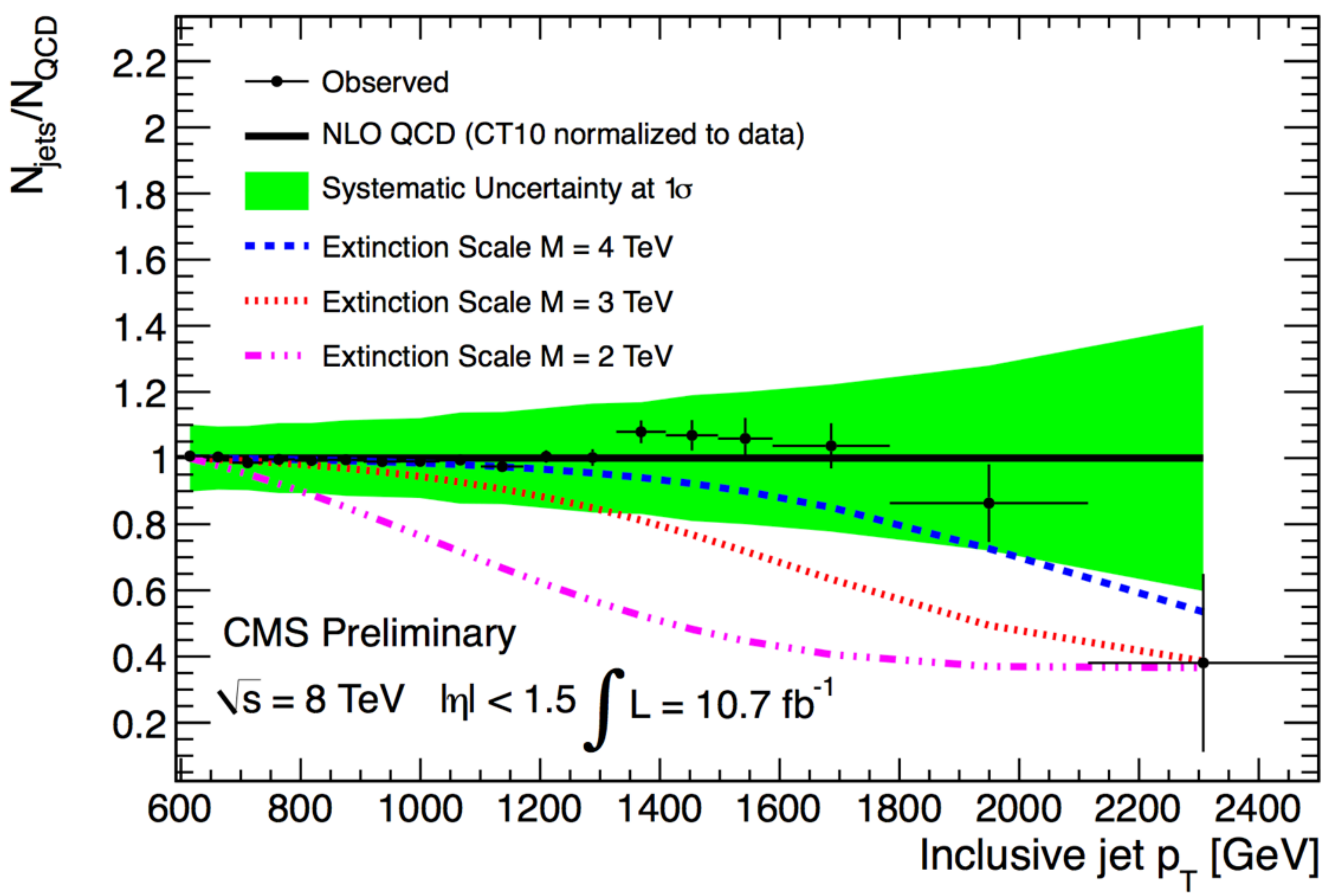
Dijet mass resonances with b tags

CMS PAS EXO-12-023

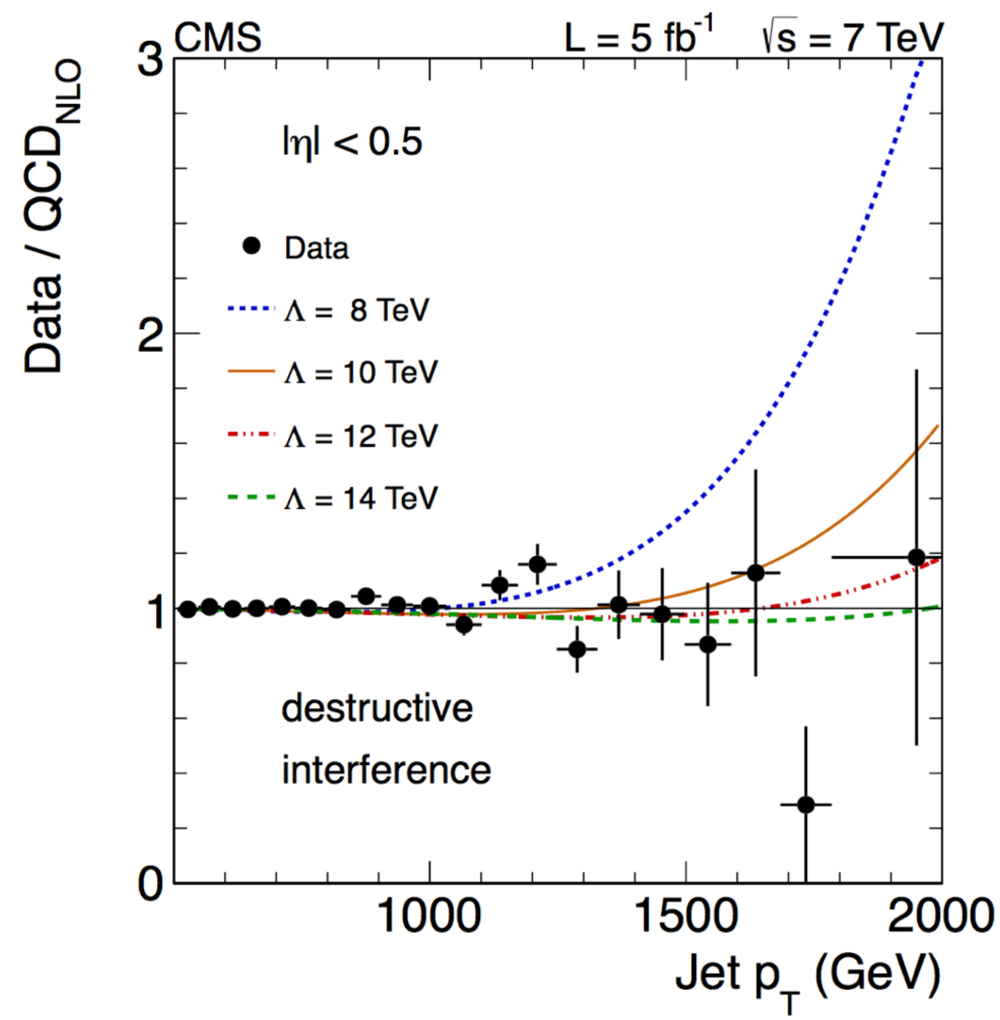


Searches using the inclusive jet pT spectrum

CMS PAS EXO-12-051
arXiv:1301.5023



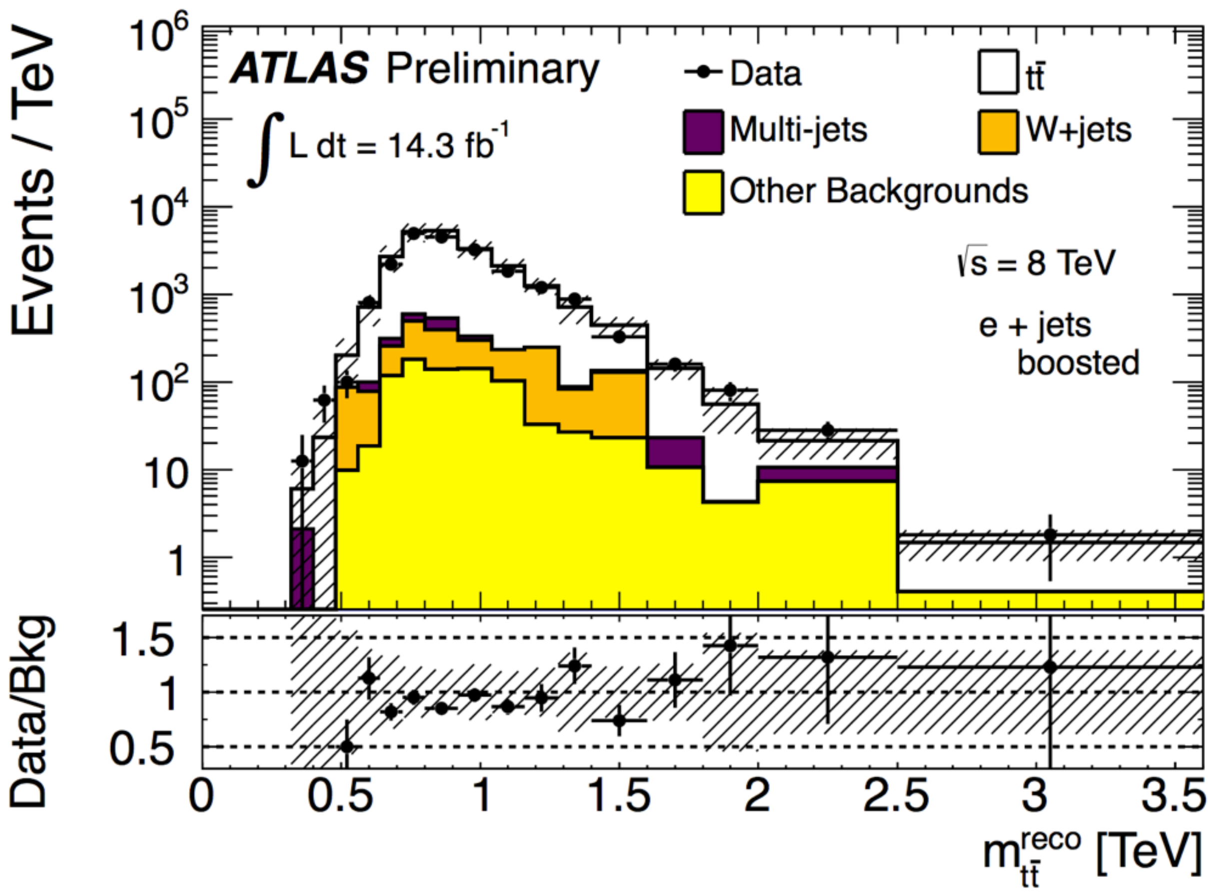
Exclude M<3.3 TeV @ 95% CL

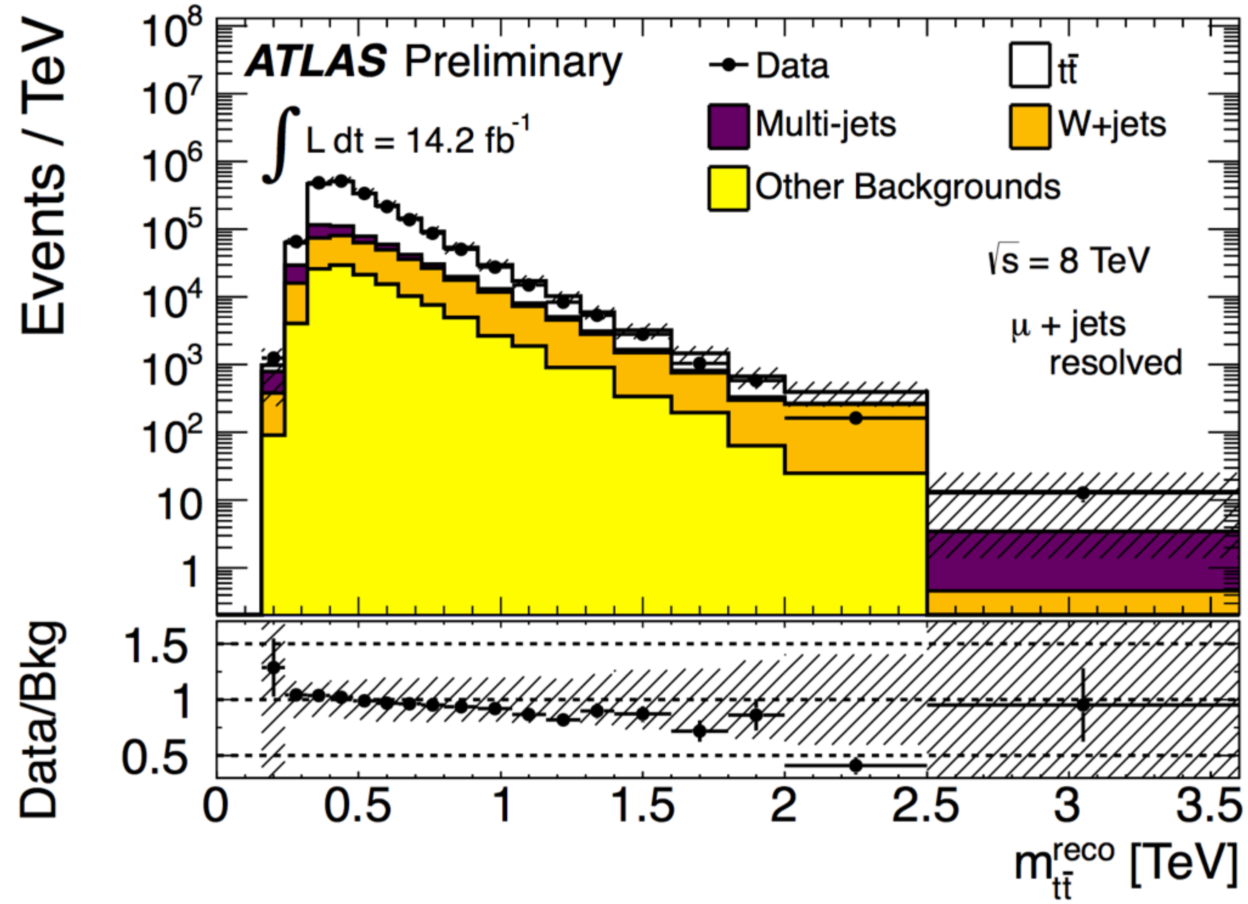


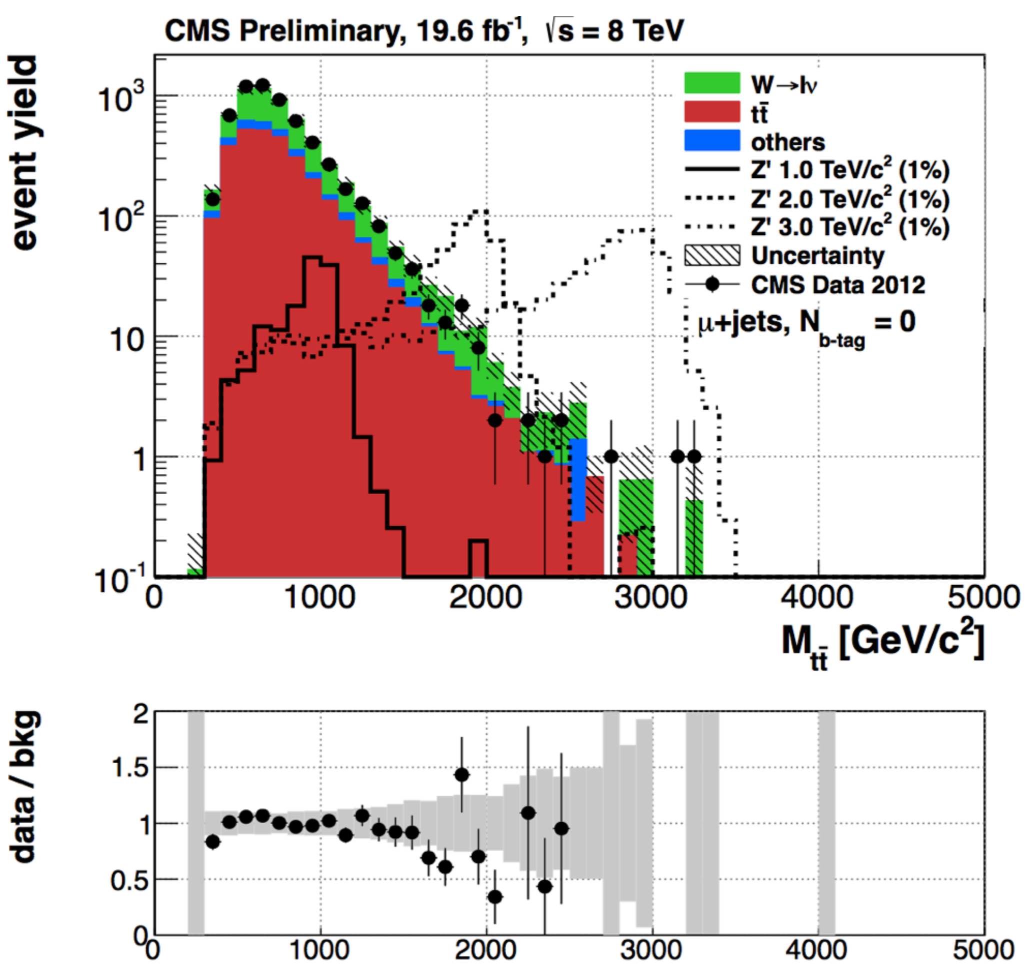
Exclude Λ< 9.9 TeV /14.3 TeV @ 95% CL (destructive/constructive)

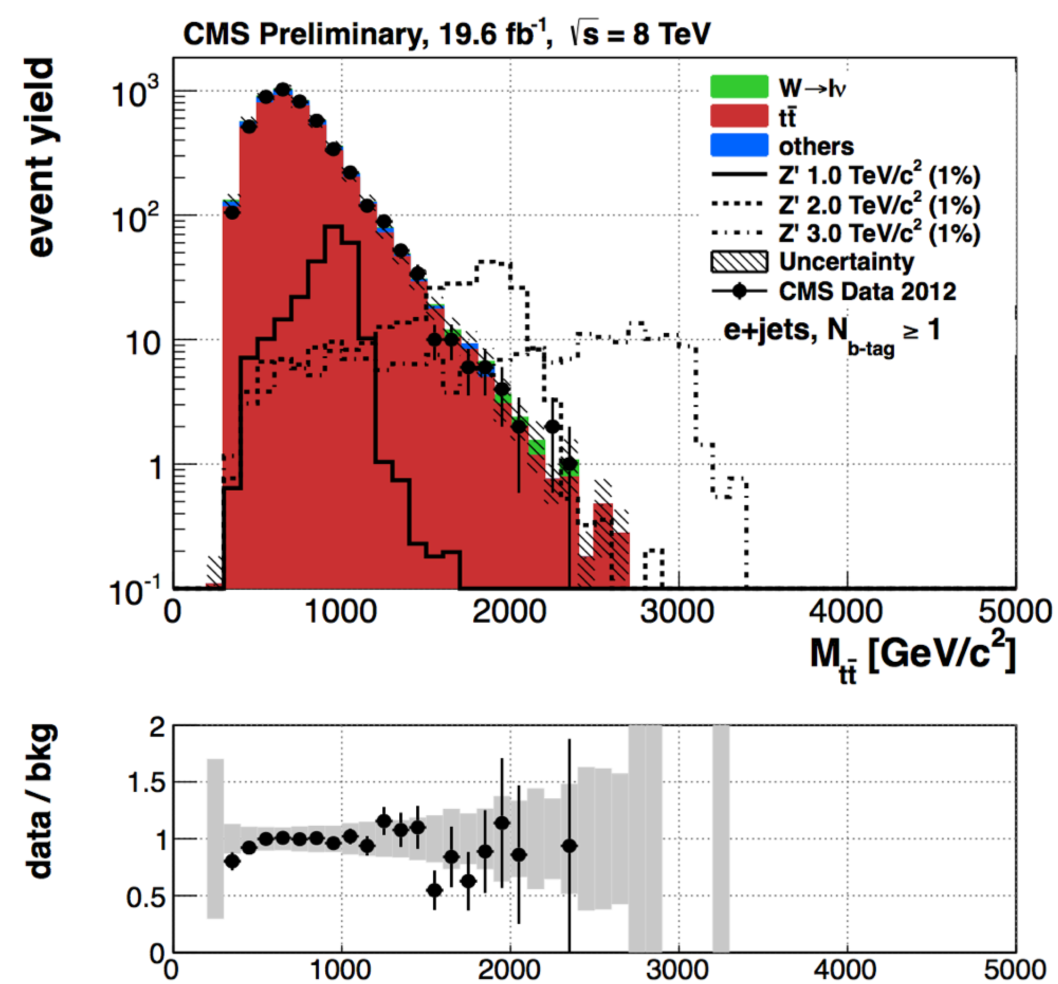
ATLAS-COM-CONF-2013-052
CMS PAS B2G-12-006

Top pair resonances



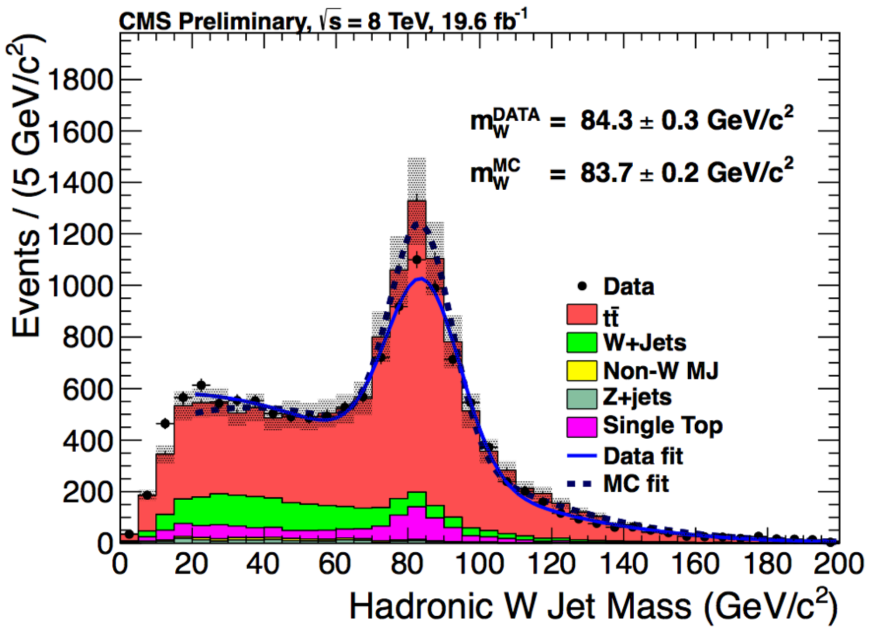


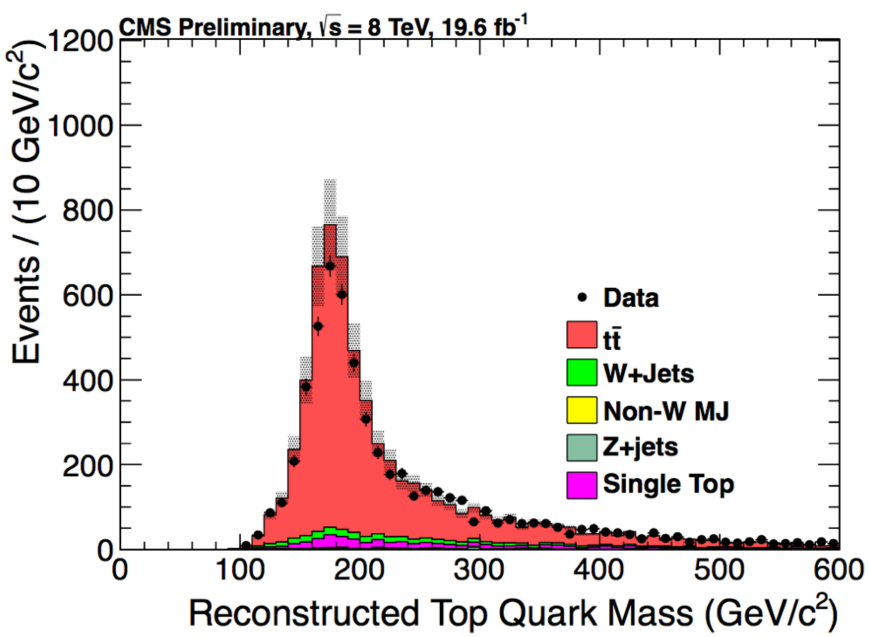


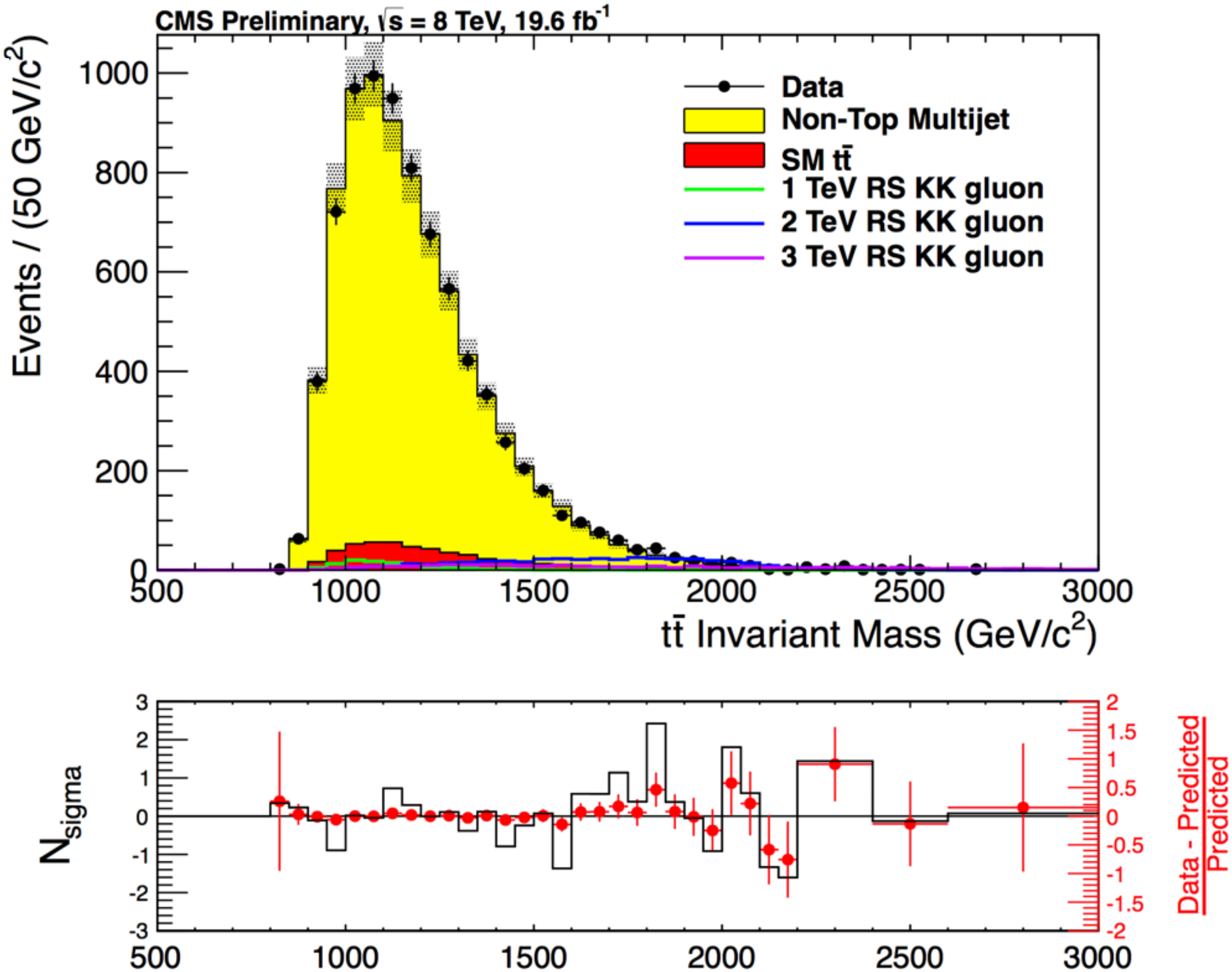


Top pair resonances

CMS PAS B2G-12-005





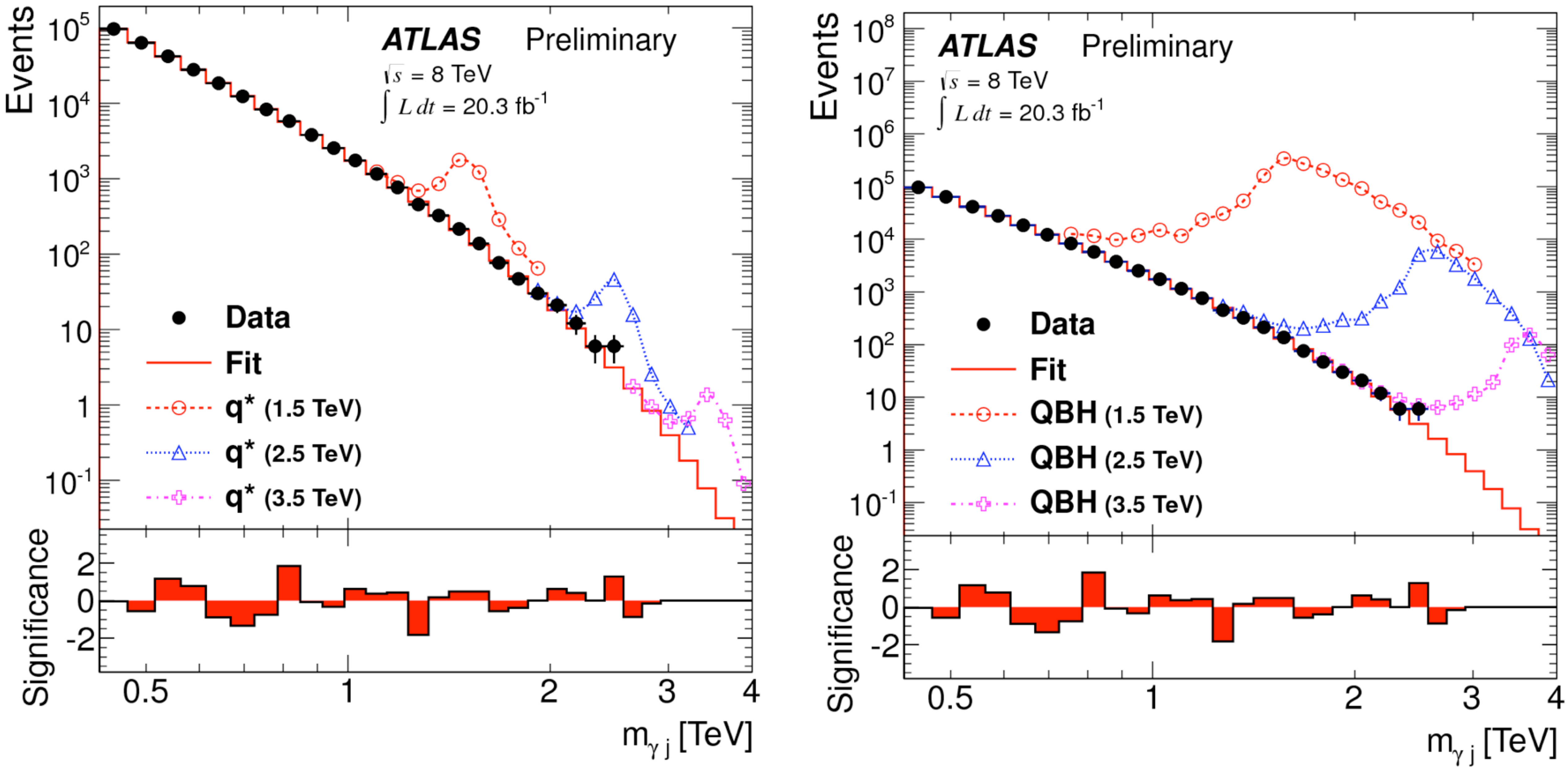


Excludes

- *Wide (10%) topcolor Z' from 1 to 2.35 TeV*
- *Narrow (1%) Z' from 1 to 1.7 TeV*
- *KK (RS) gluon from 1 to 1.8 TeV*

Search for photon-jet mass resonance

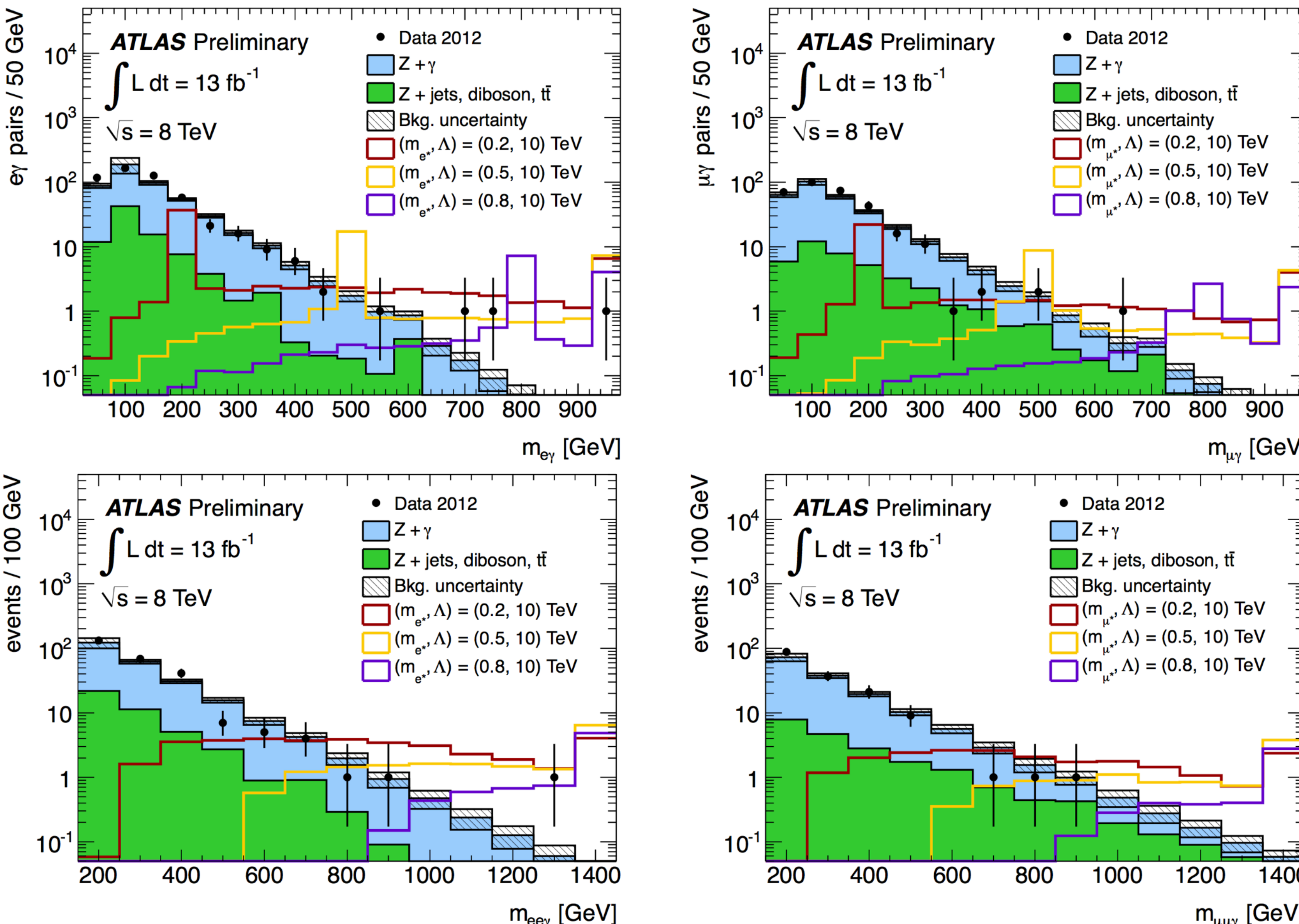
ATLAS-CONF-2013-059



Exclude m_{q^*} < 3.5 TeV, m_{QBH} < 4.6 TeV @ 95% CL

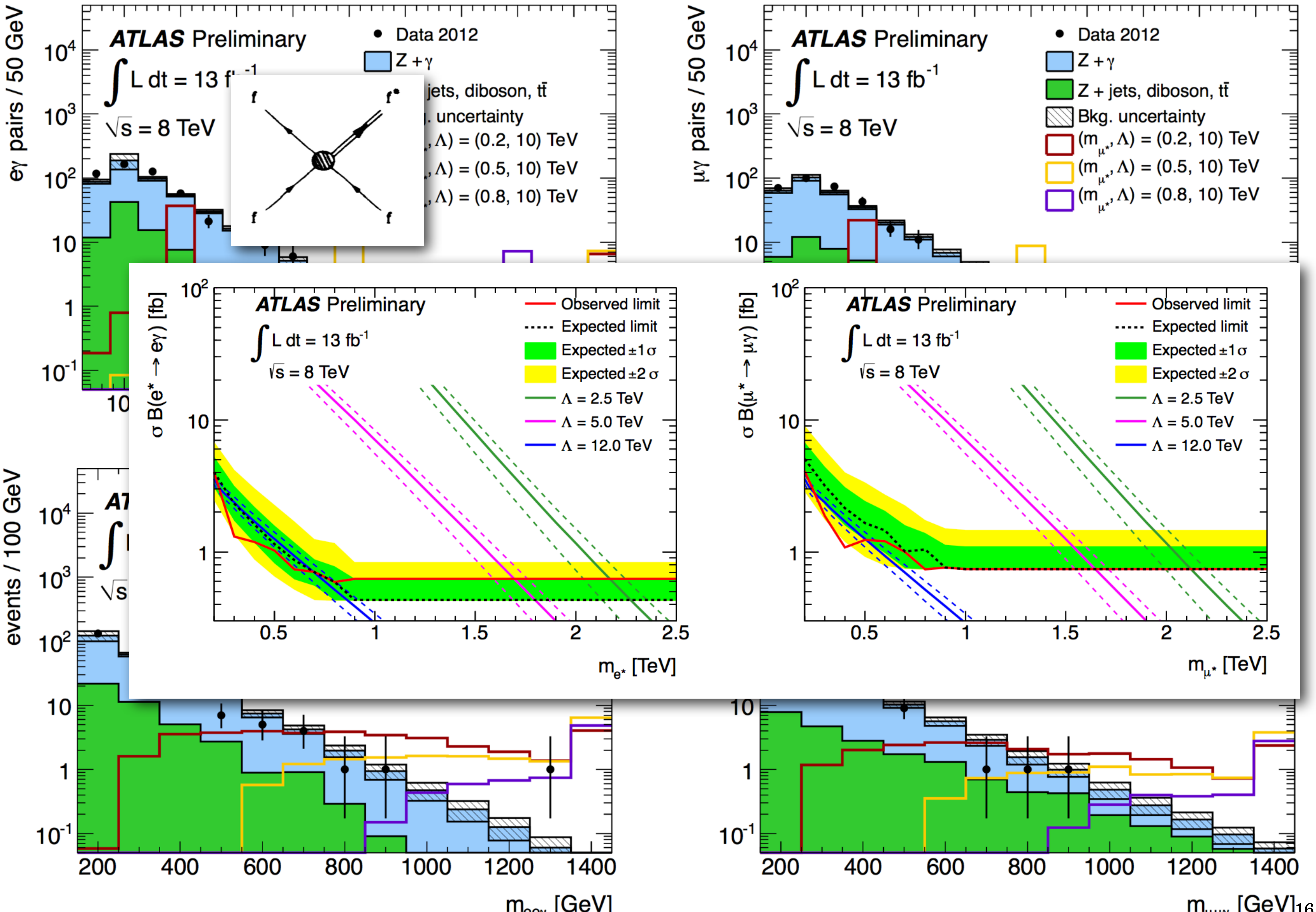
Search for photon-lepton & photon+2 lepton mass resonances

ATLAS-CONF-2012-146



Search for photon-lepton & photon+2 lepton mass resonances

ATLAS-CONF-2012-146

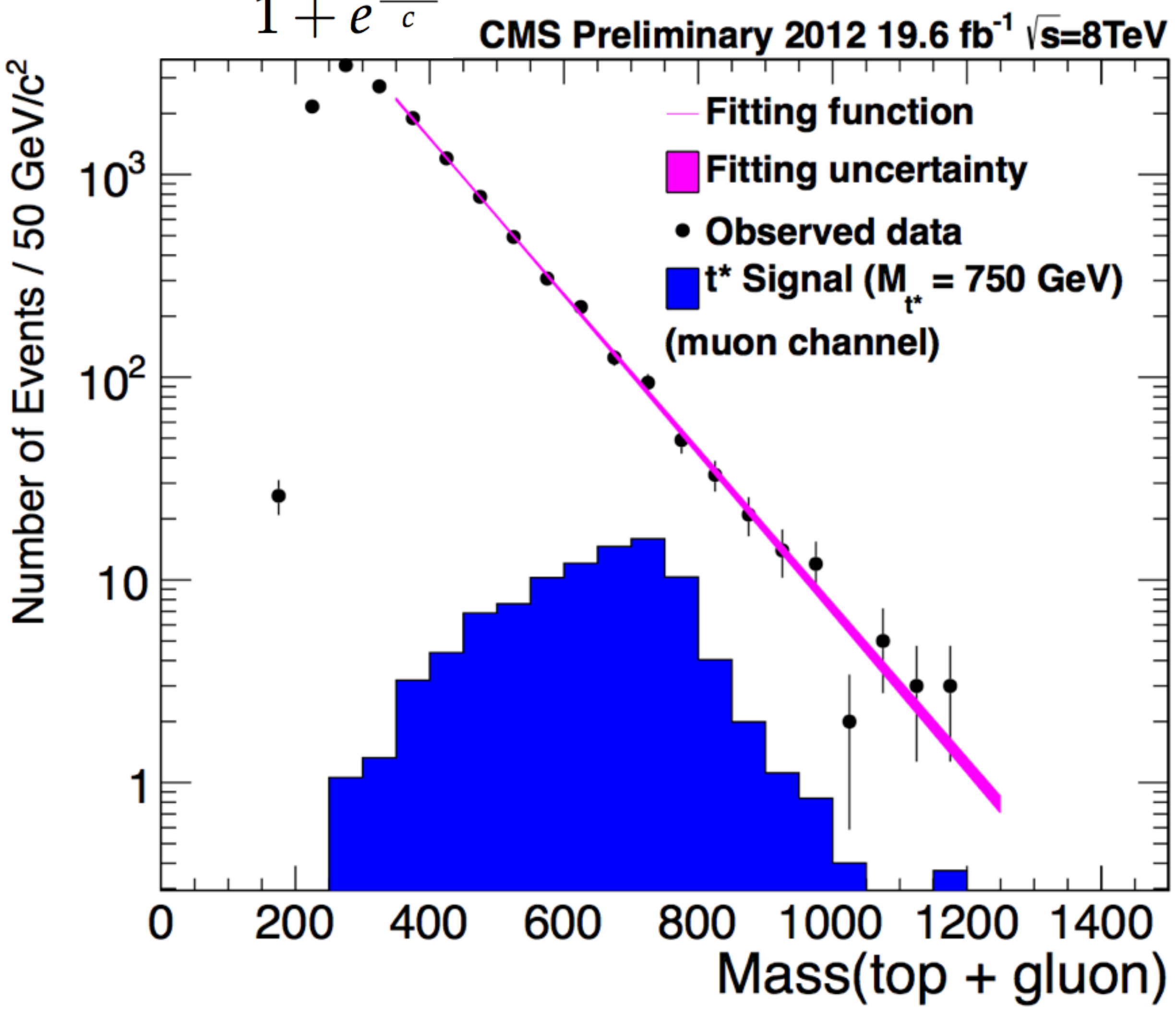


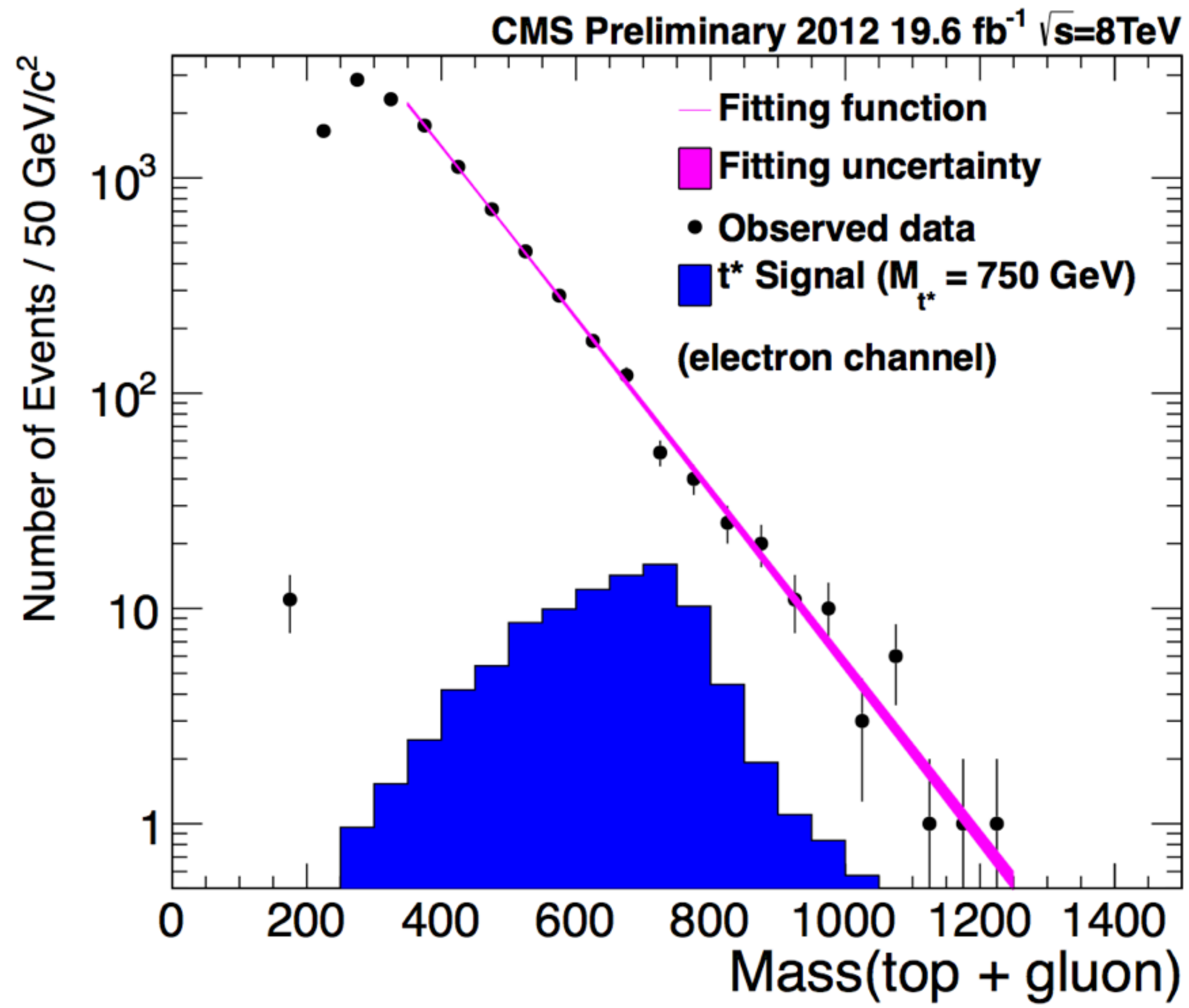
Search for top-gluon mass resonance

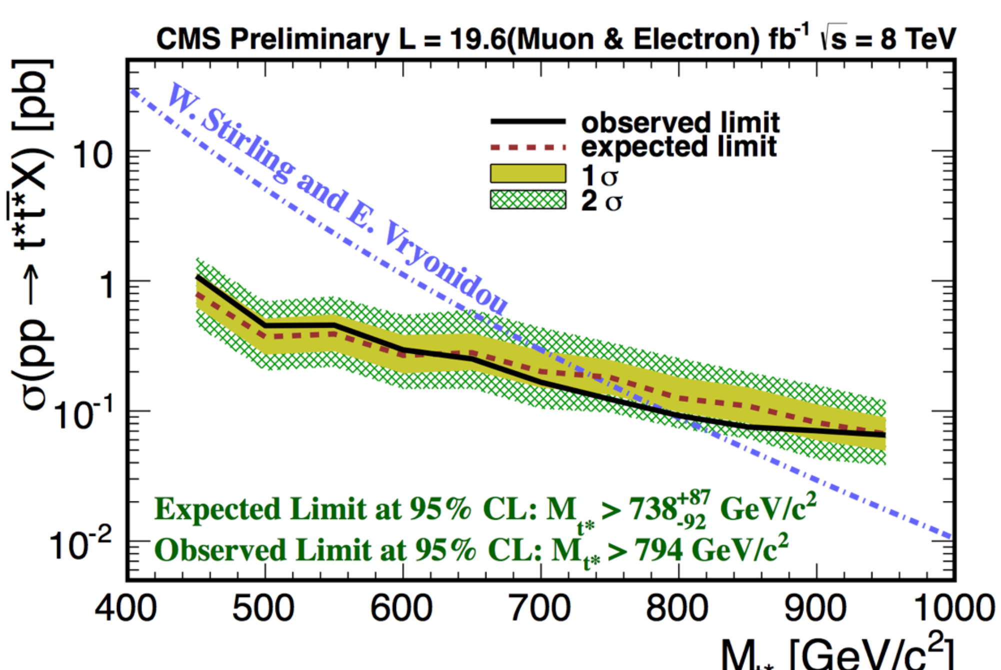
$t^{*}\overline{t^{*}} \rightarrow (\ell\nu bg)(q\bar{q}bg)$

CMS PAS B2G-12-014

$$f(x) = \frac{a}{1 + e^{\frac{x-b}{c}}}$$

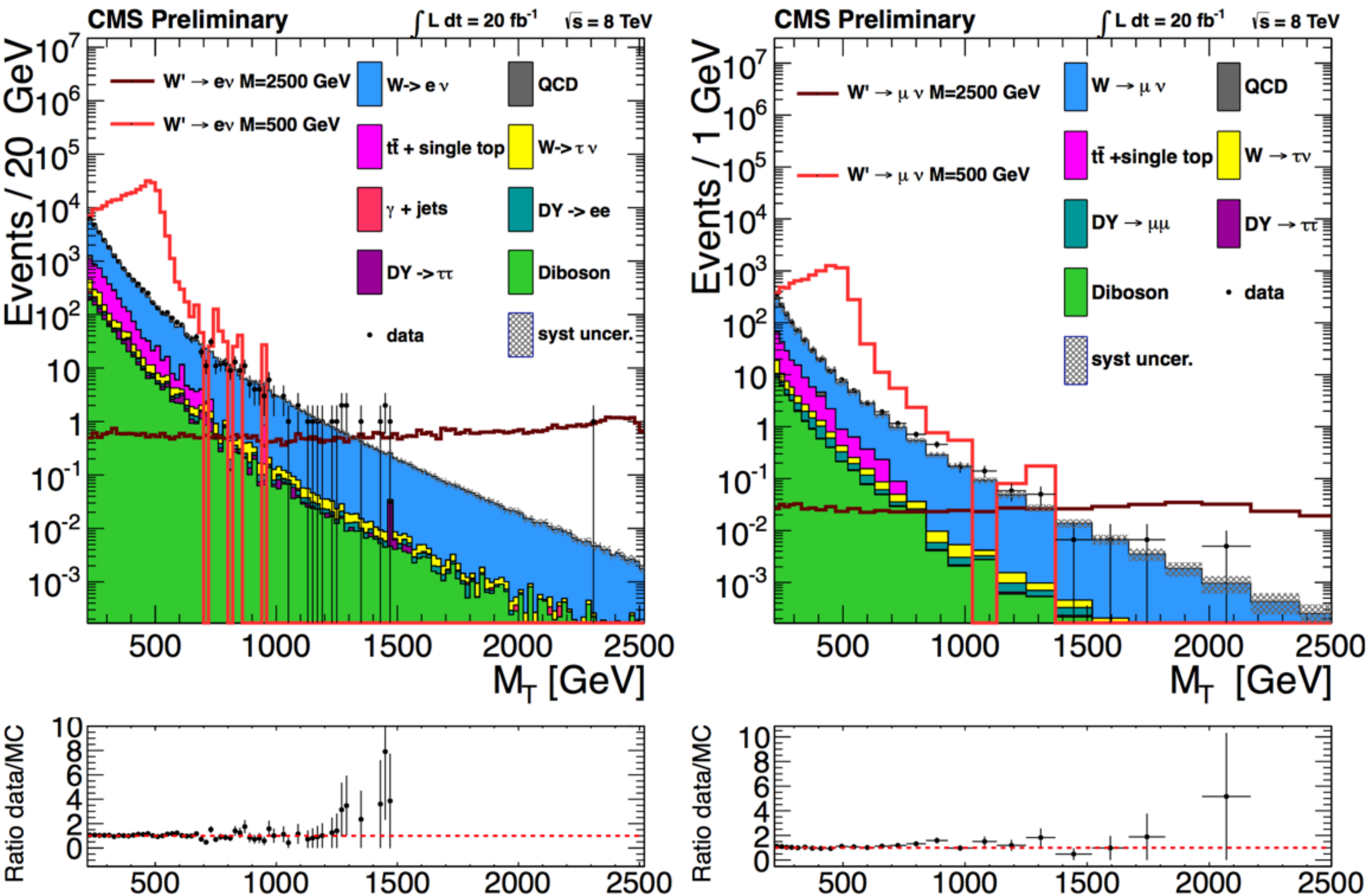






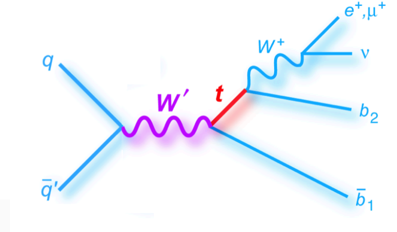
W' -> lν

CMS PAS EXO-12-060



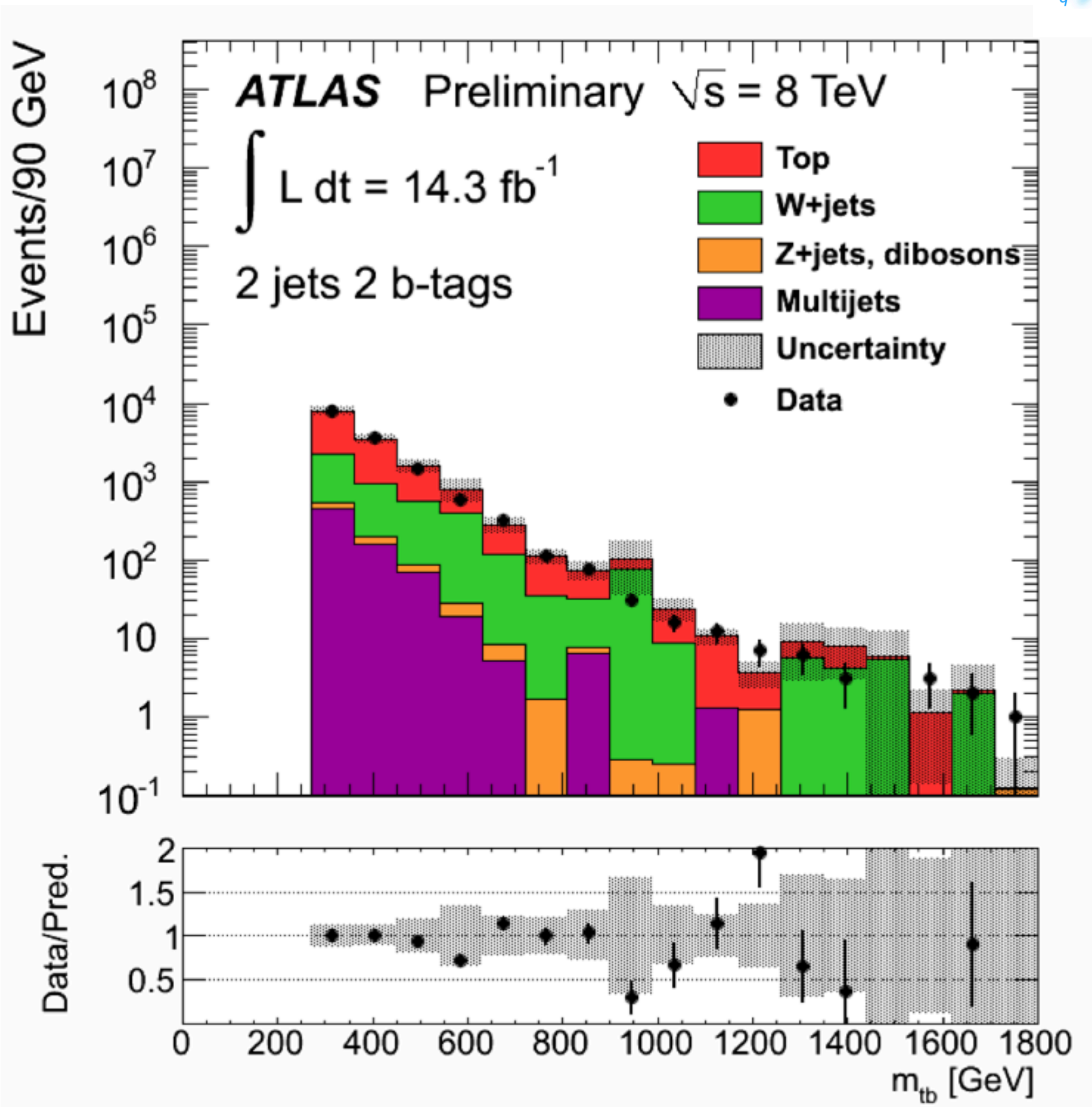
W' -> t b

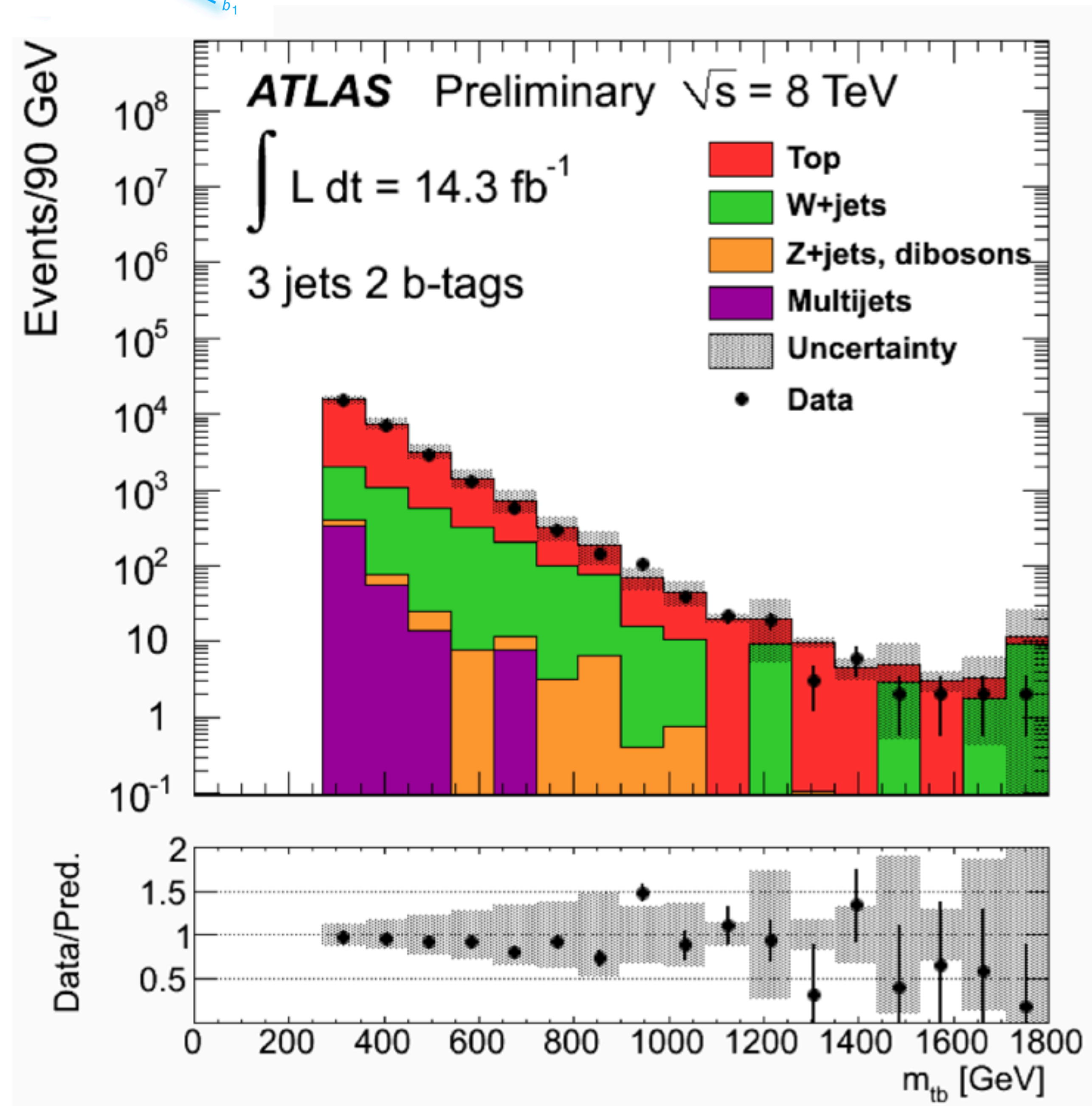
$$\mathcal{L} = \frac{V'_{ij}}{2\sqrt{2}} \bar{f}_i \gamma_\mu \left(g'_{R_{i,j}}(1+\gamma^5) + g'_{L_{i,j}}(1-\gamma^5) \right) W'^{\mu} f_j$$



ATLAS-CONF-2013-050

CMS PAS B2G-12-010





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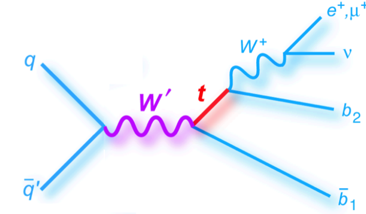
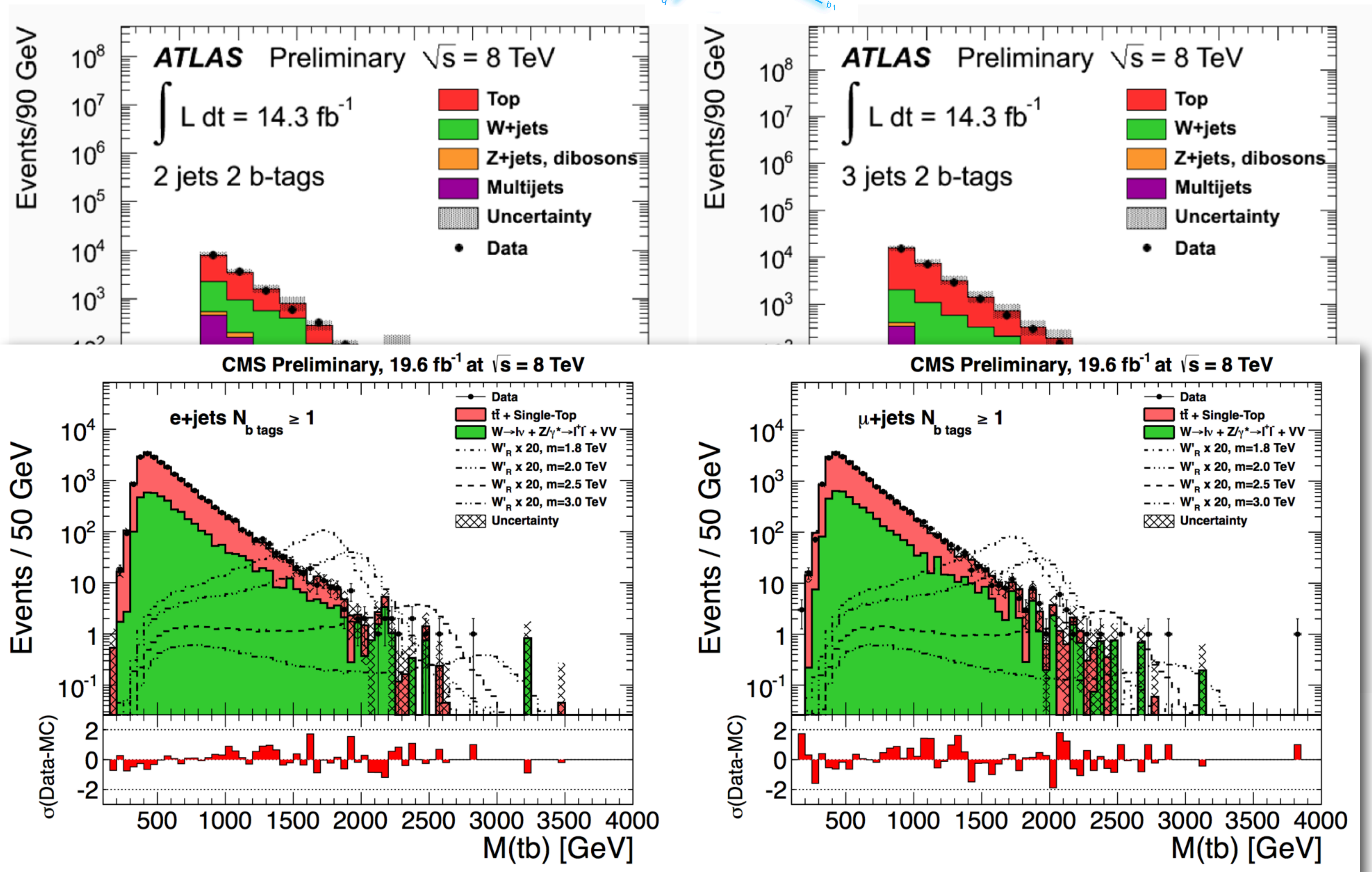


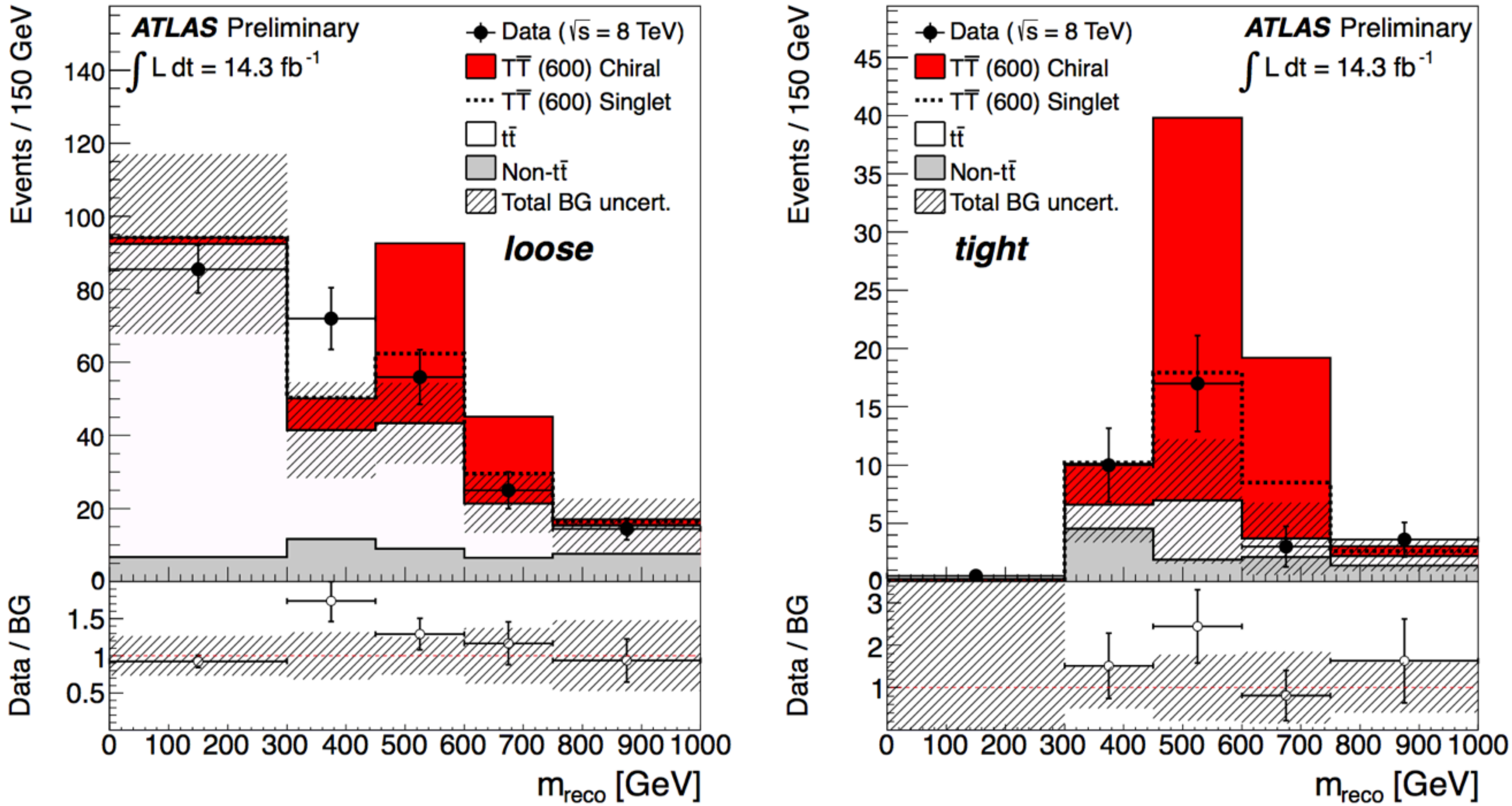
ATLAS-CONF-2013-050
CMS PAS B2G-12-010

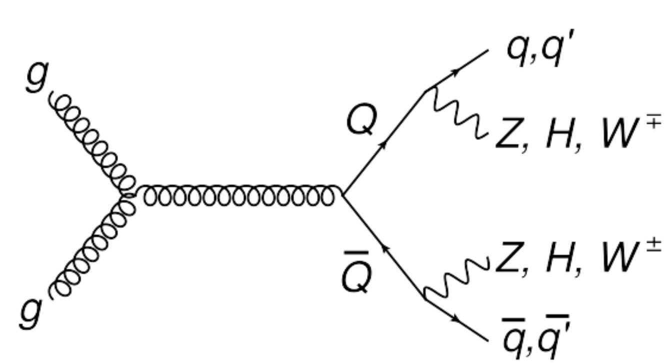


Additional top-like or bottom-like heavy quarks

ATLAS-CONF-2013-060

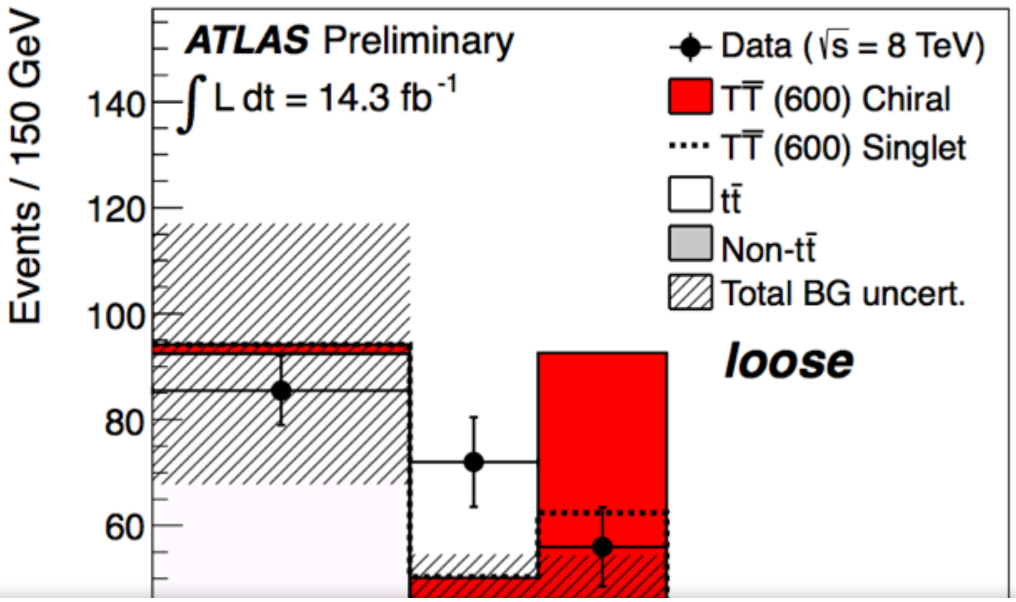
T->Wb

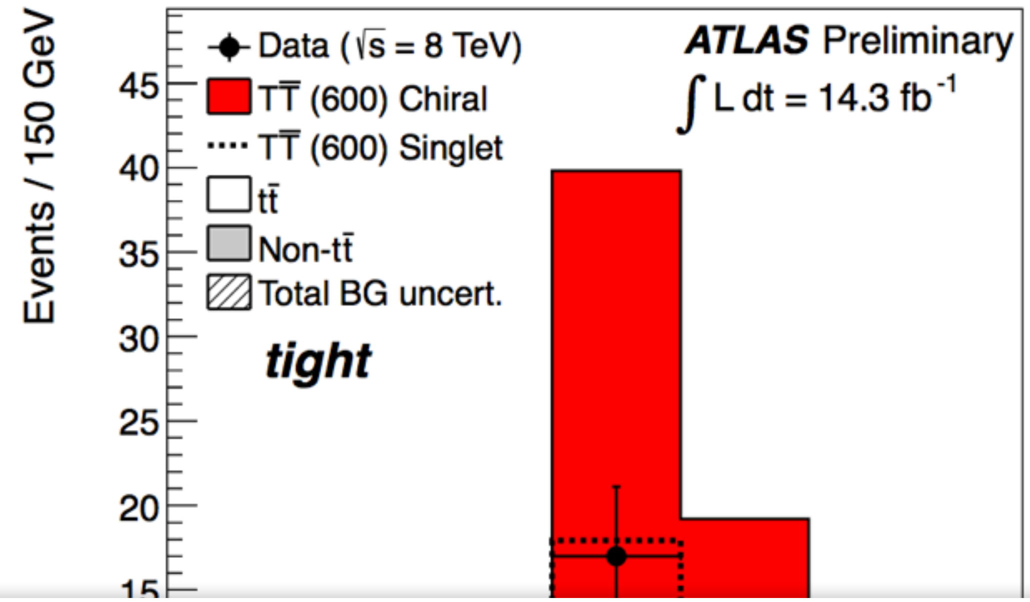


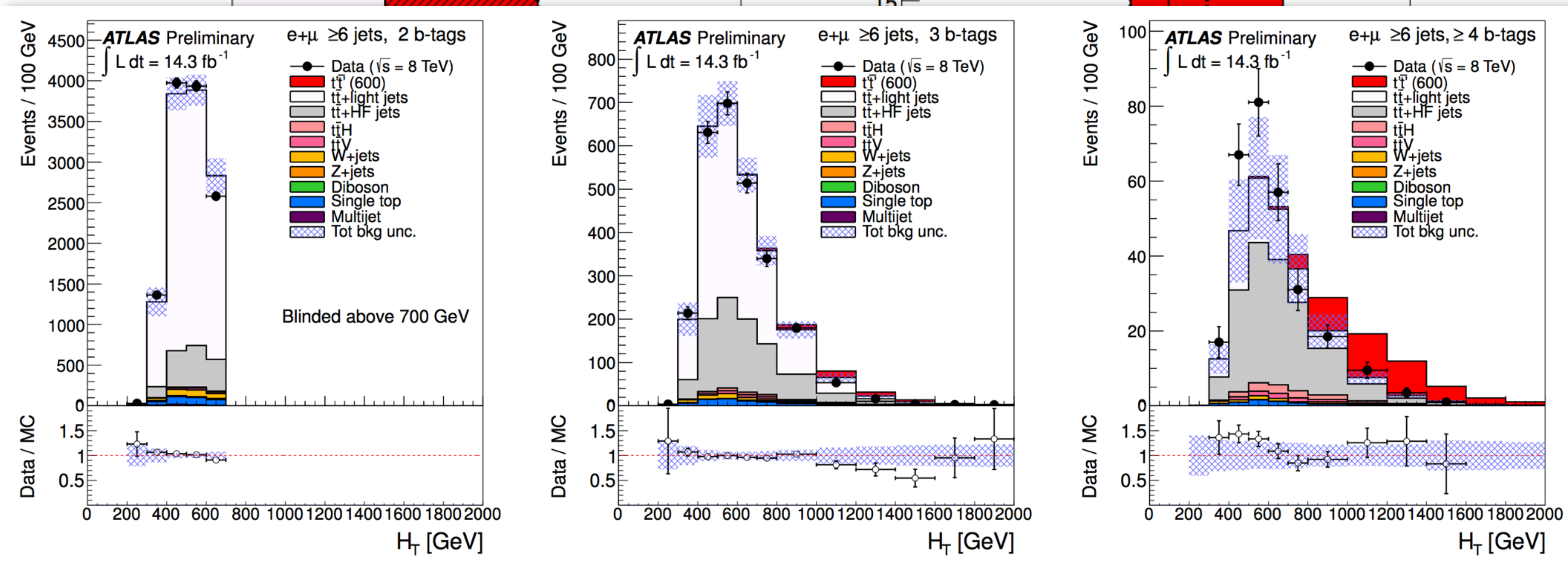


Additional top-like or bottom-like heavy quarks

ATLAS-CONF-2013-060
ATLAS-CONF-2013-018



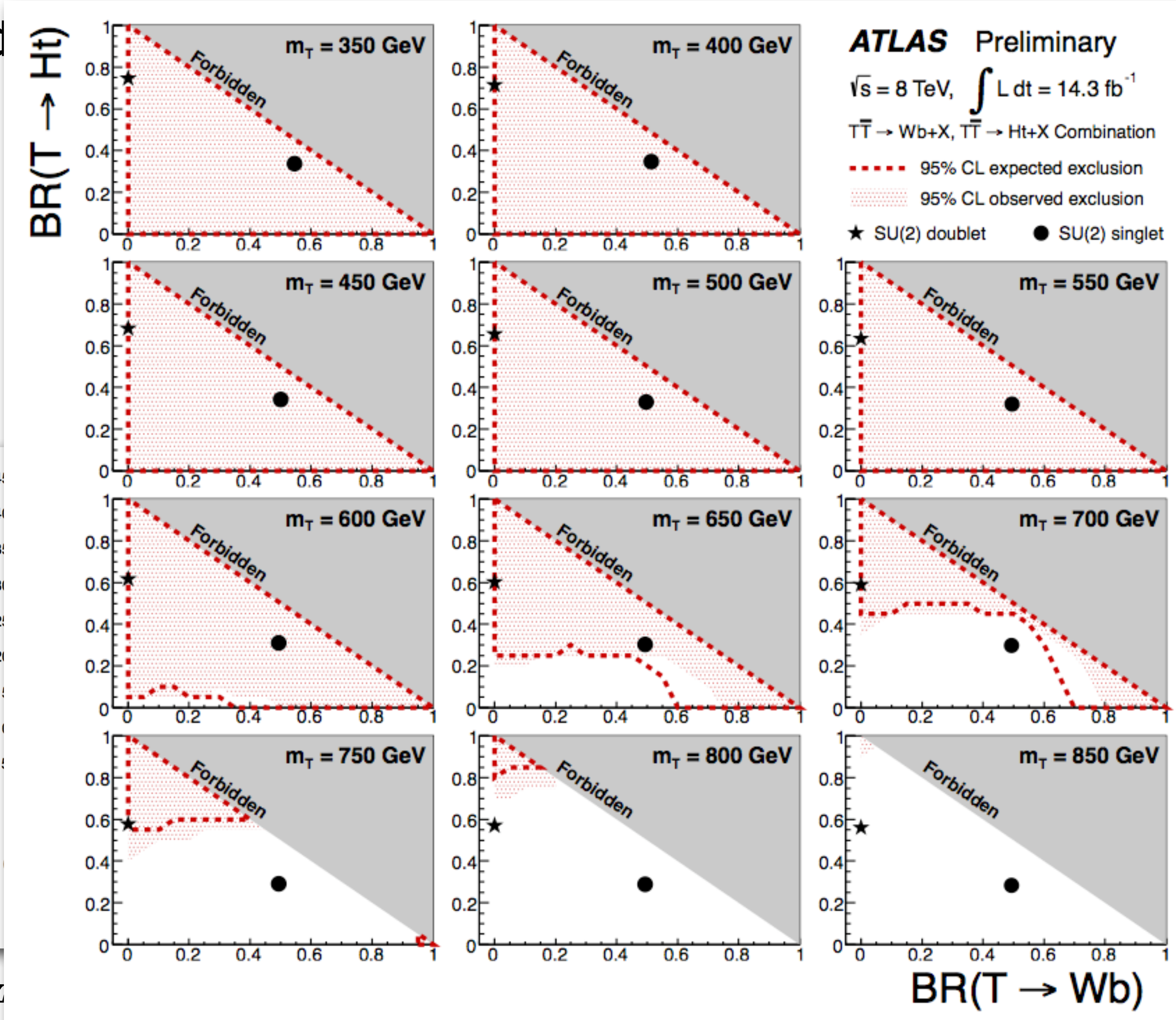


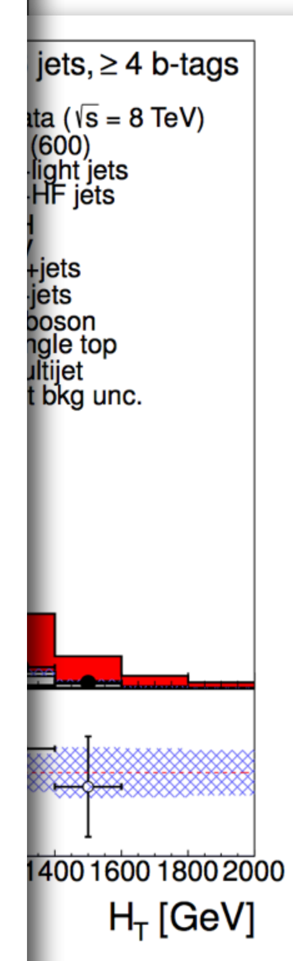


TT -> tHtH, tZtH, bWtH

Ad

-2013-060
-2013-018

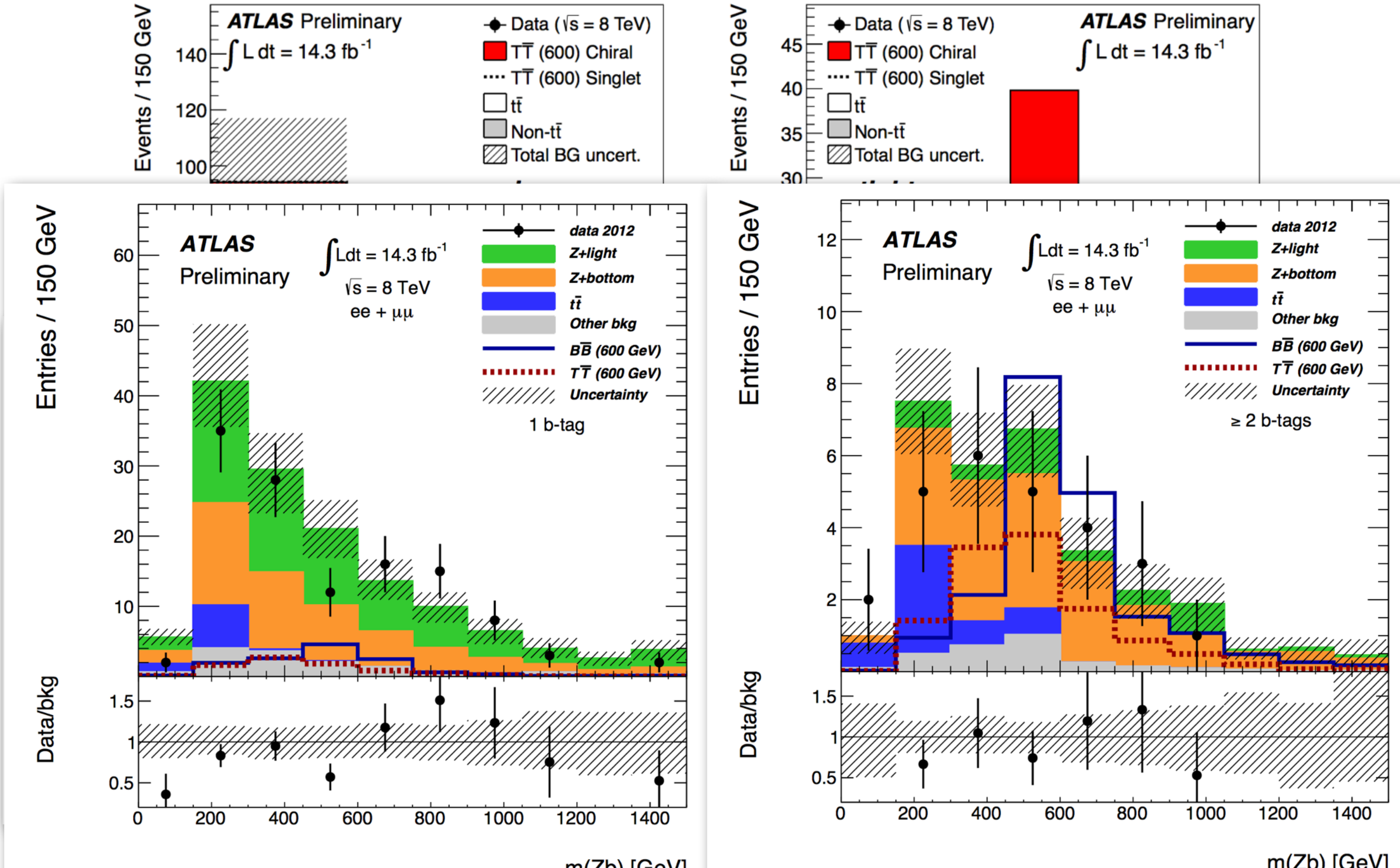




TT

Additional top-like or bottom-like heavy quarks

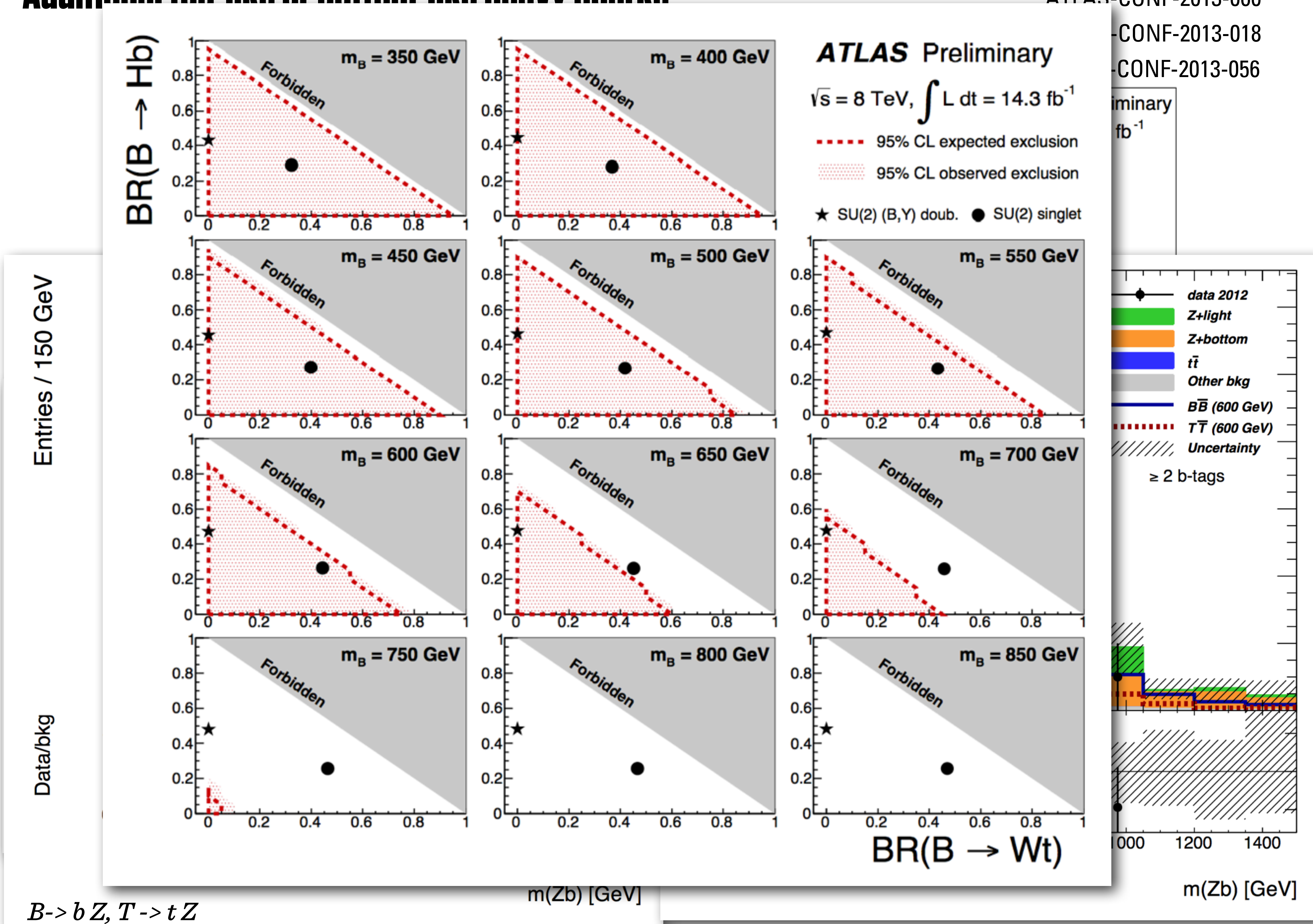
ATLAS-CONF-2013-060
ATLAS-CONF-2013-018
ATLAS-CONF-2013-056



B-> b Z, T -> t Z

Additional top-like or bottom-like heavy quarks

ATLAS-CONF-2013-060
-CONF-2013-018
-CONF-2013-056

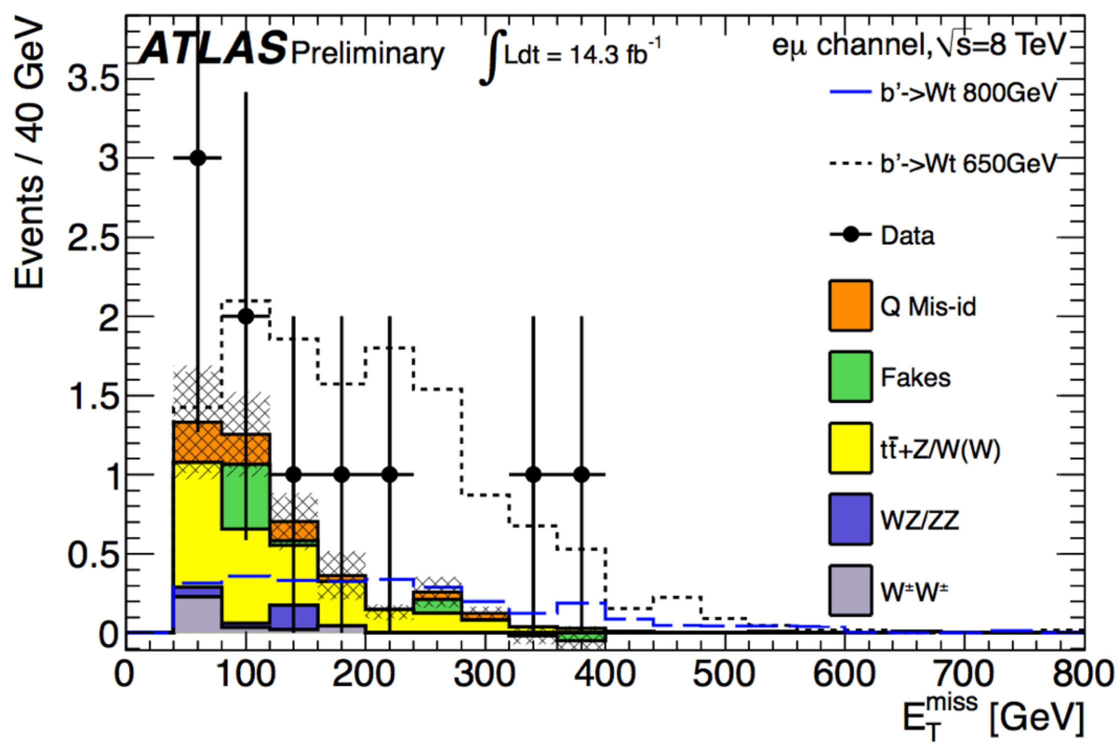


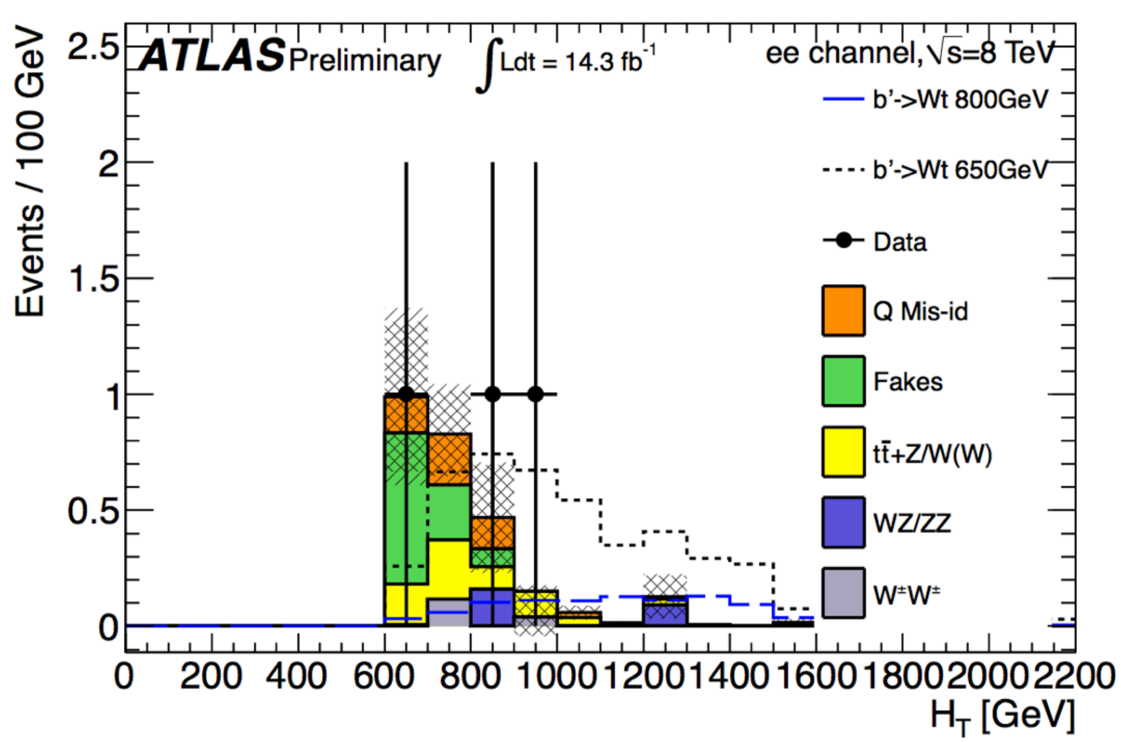
B-> b Z, T -> t Z

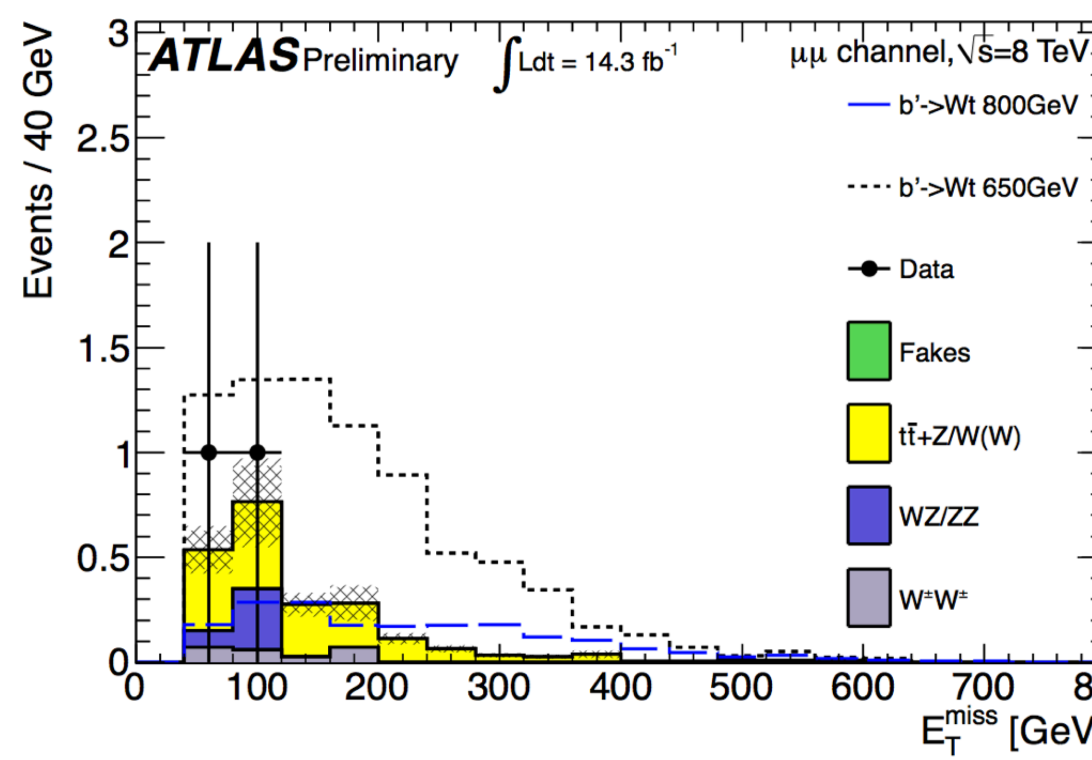
Same-charge leptons + X

Vector-like quarks, chiral b’, four top quarks (e.g. gluino pairs decaying to stops), sgluons, same-sign tops, KK photon pairs…

ATLAS-CONF-2013-051



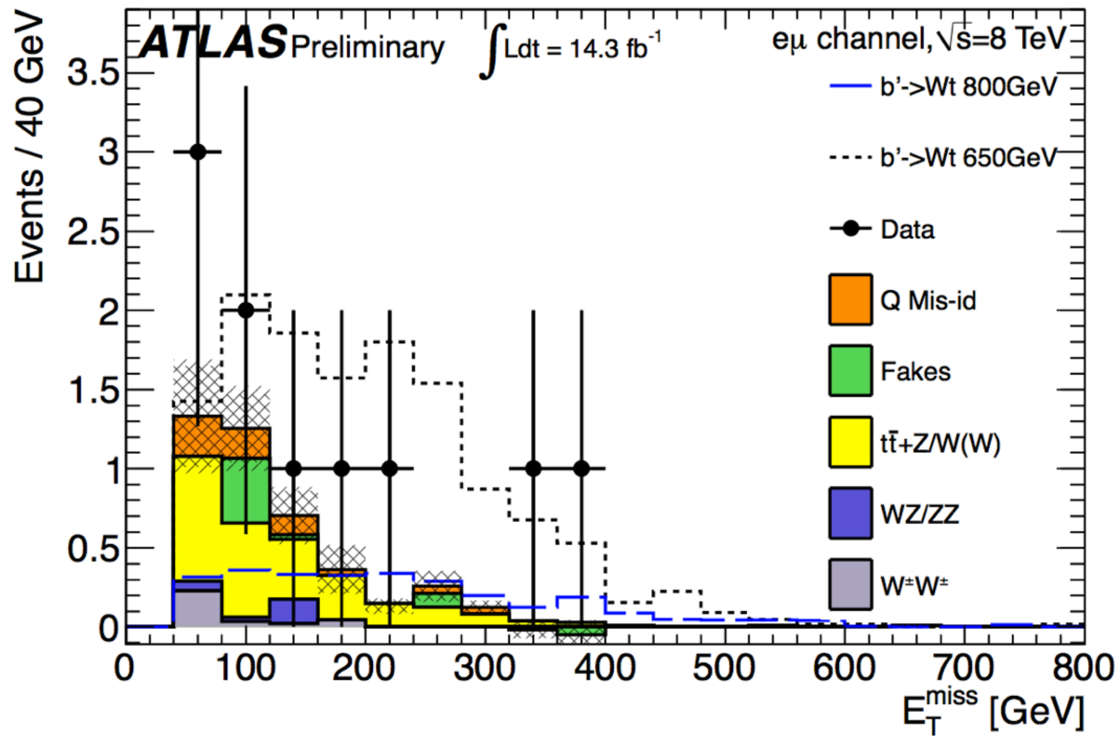




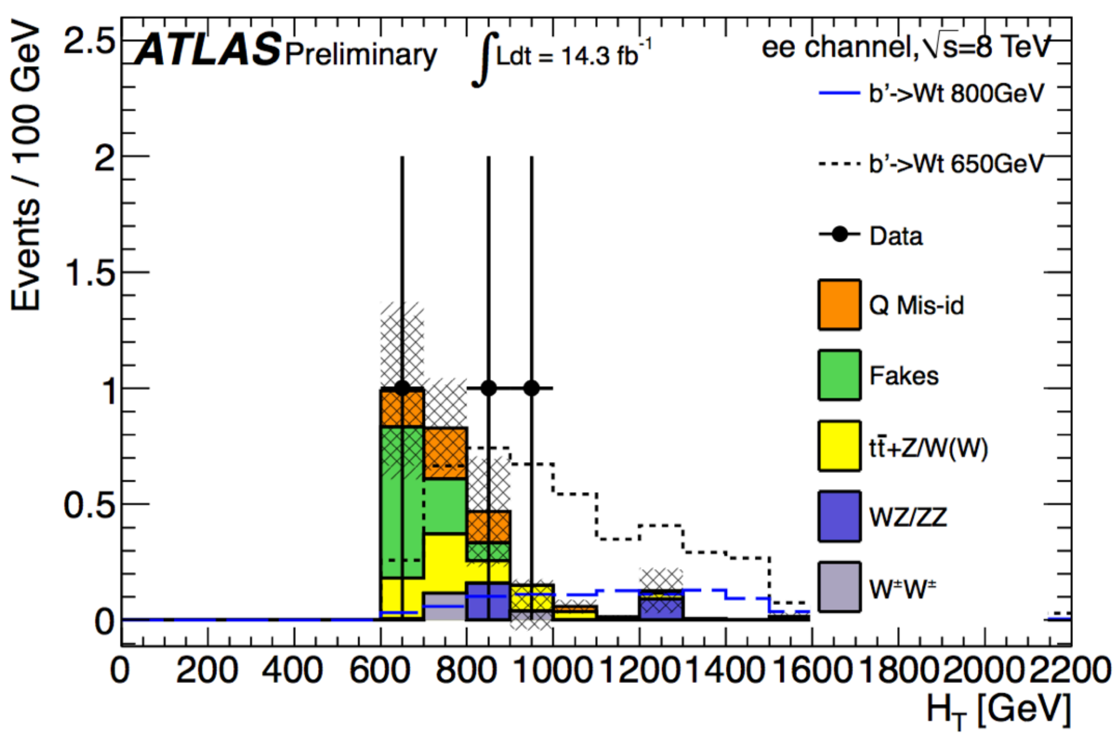
Same-charge leptons + X

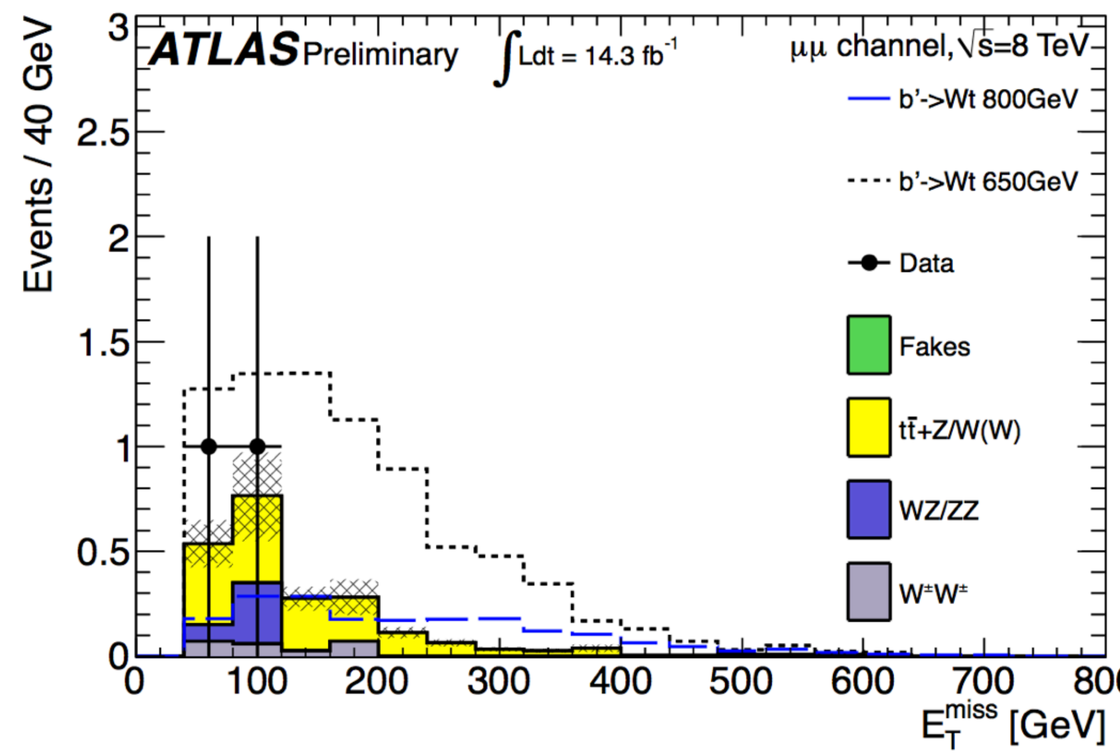
Vector-like quarks, chiral b', four top quarks (e.g. gluino pairs decaying to stops), sgluons, same-sign tops, KK photon pairs...

ATLAS-CONF-2013-051



Excludes:
$m_{b'} < 0.72$ TeV (100% BR to Wt)
$m_B < 0.59$ TeV (singlet model)
$m_T < 0.54$ TeV (singlet model)
ss top production rate > 0.21 pb
SM 4t production > 85 pb
$m_{sgluon} < 0.8$ TeV
$m_{KKphoton} < 0.9$ TeV (2UED)

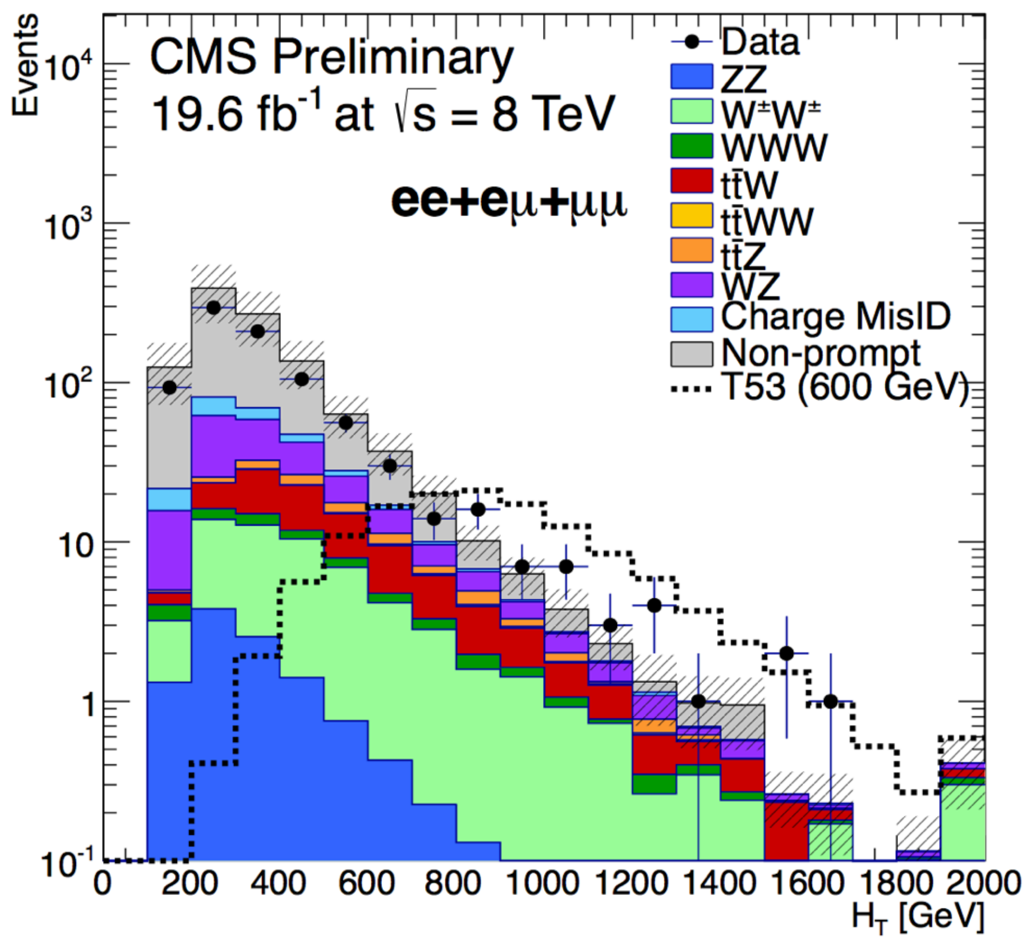


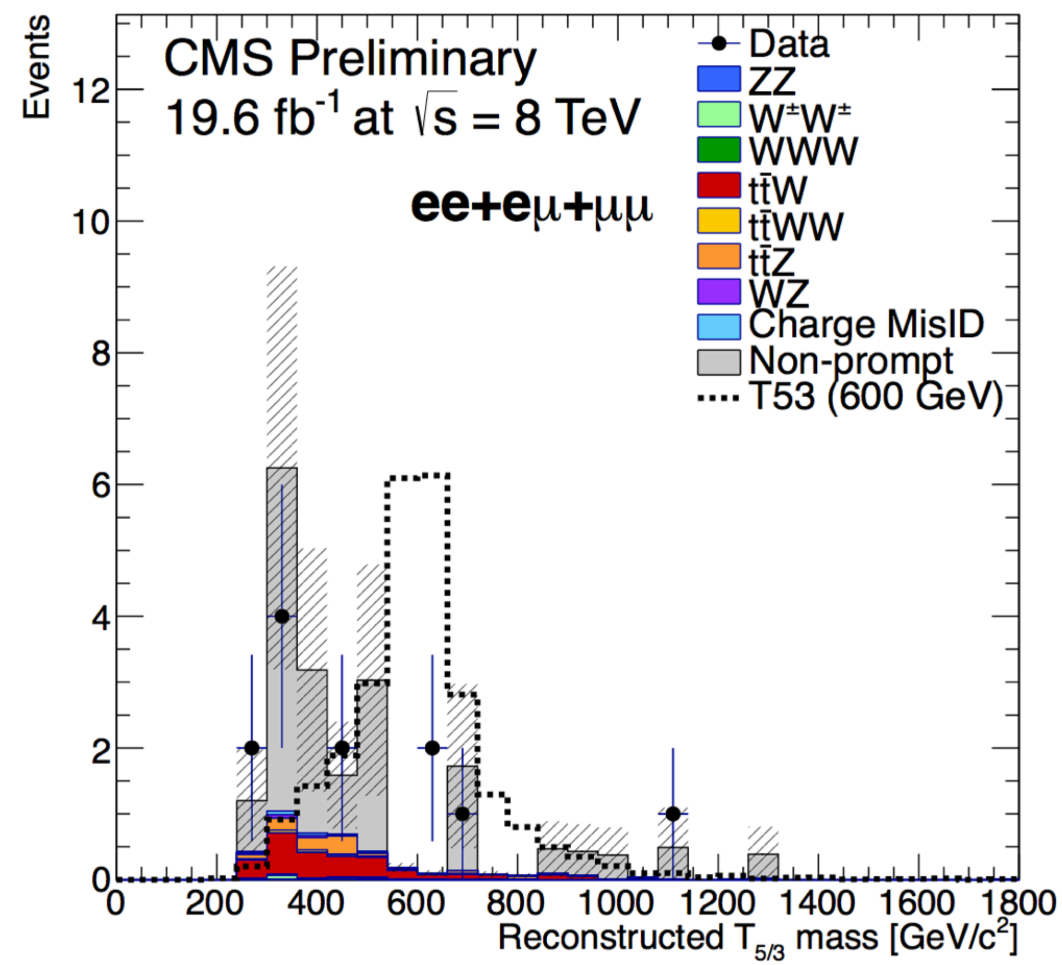


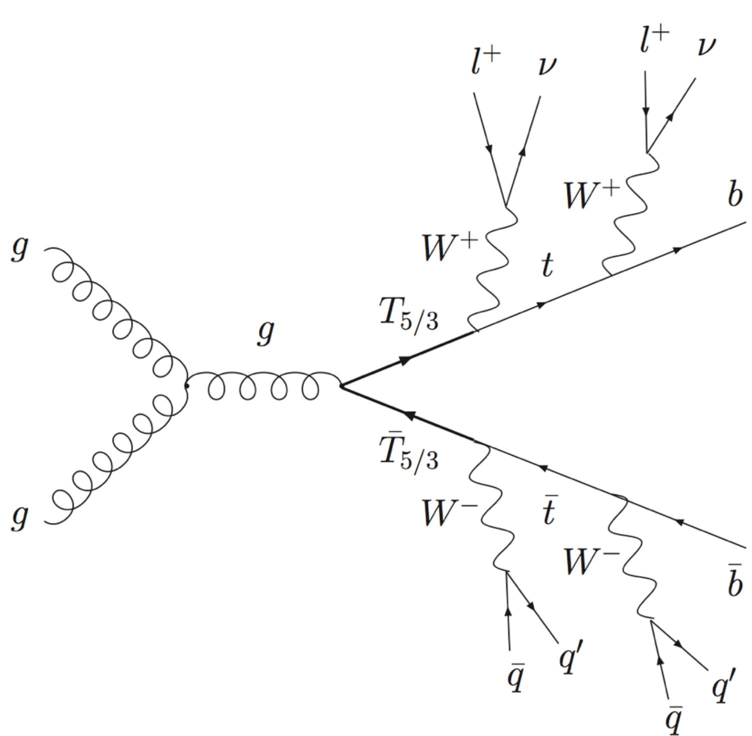
Same-charge leptons + X

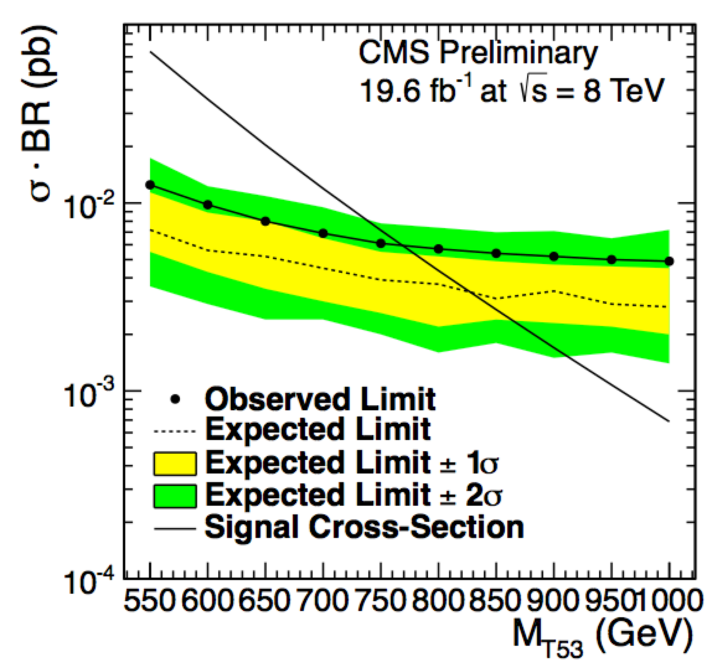
Vector-like quarks, chiral b', four top quarks (e.g. gluino pairs decaying to stops), sgluons, same-sign tops, KK photon pairs… fractionally charged top patrtners

CMS PAS B2G-12-012





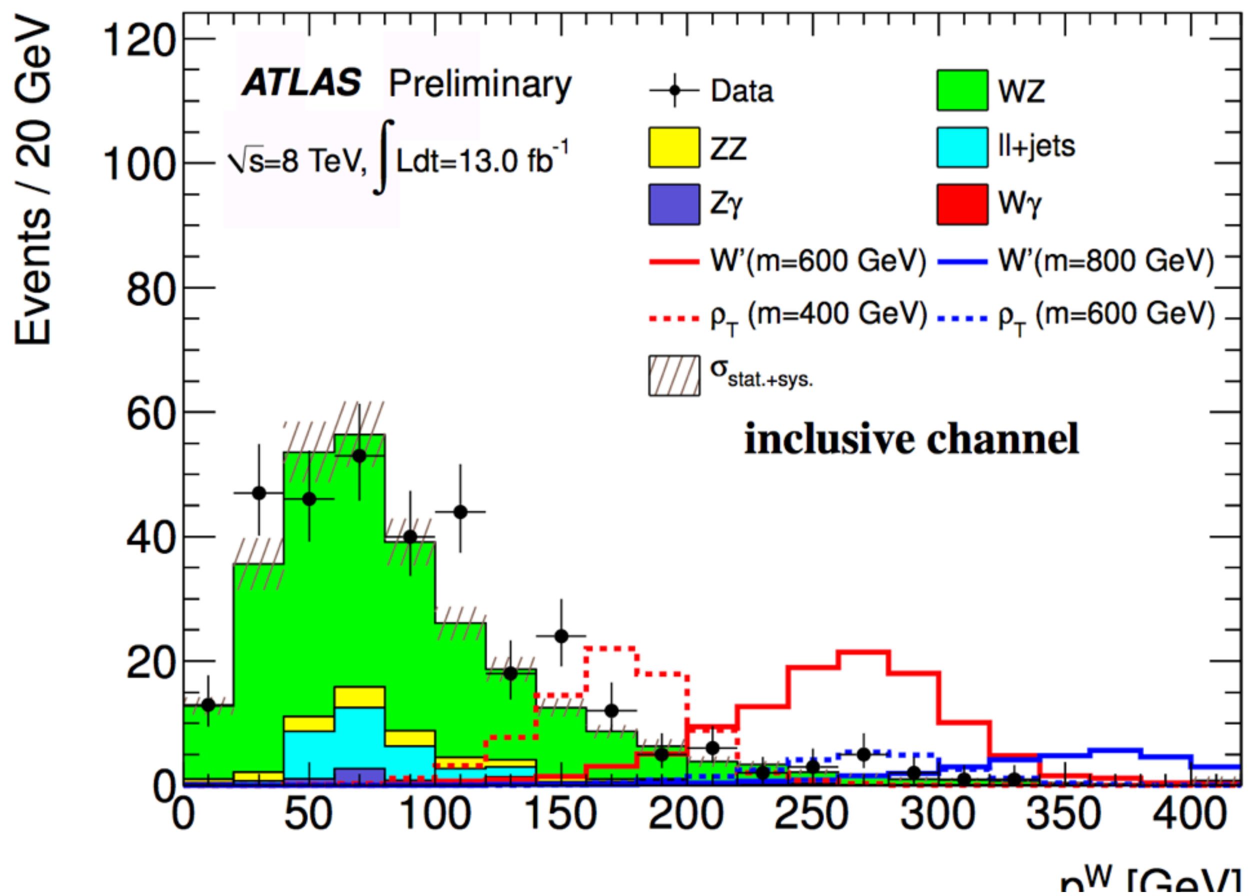


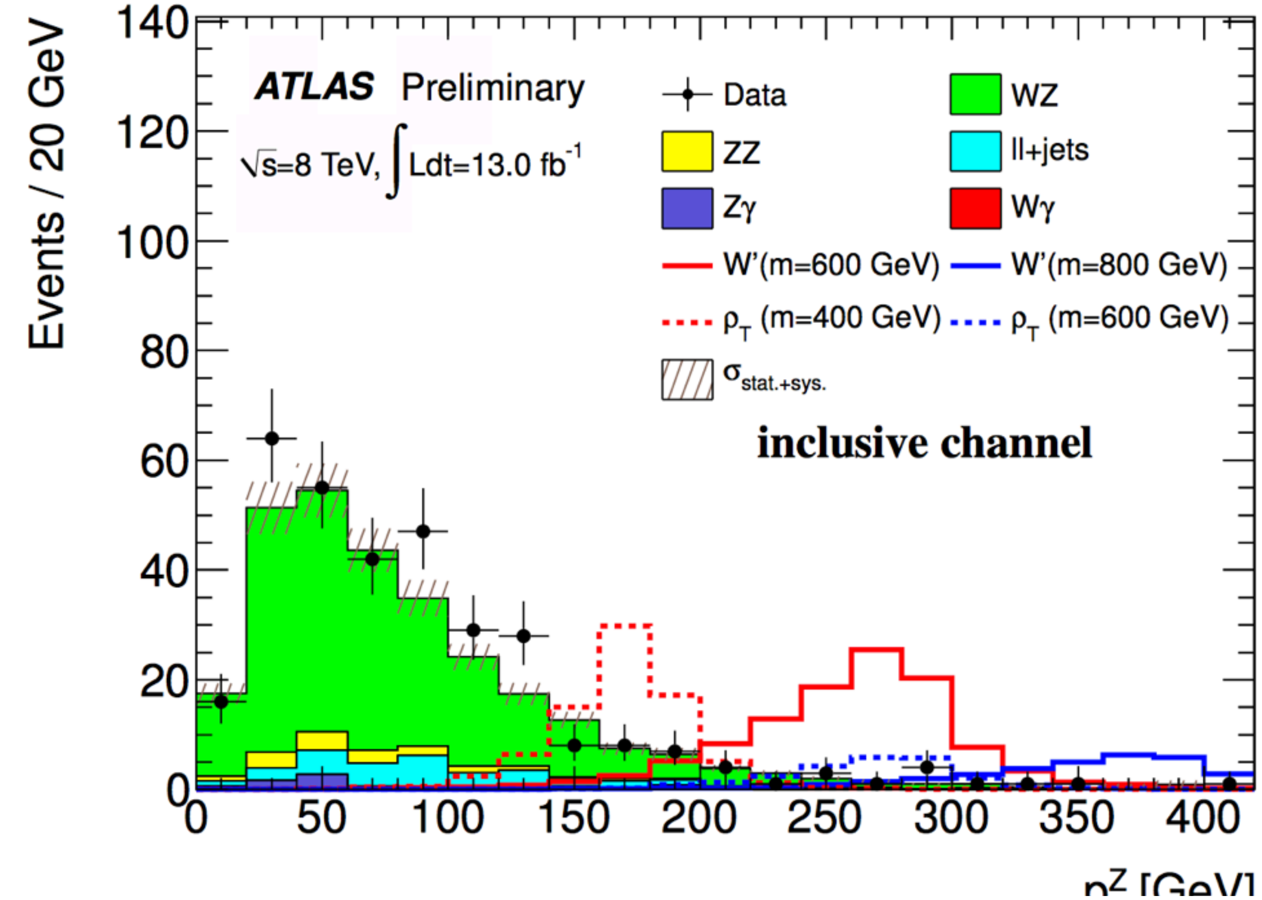


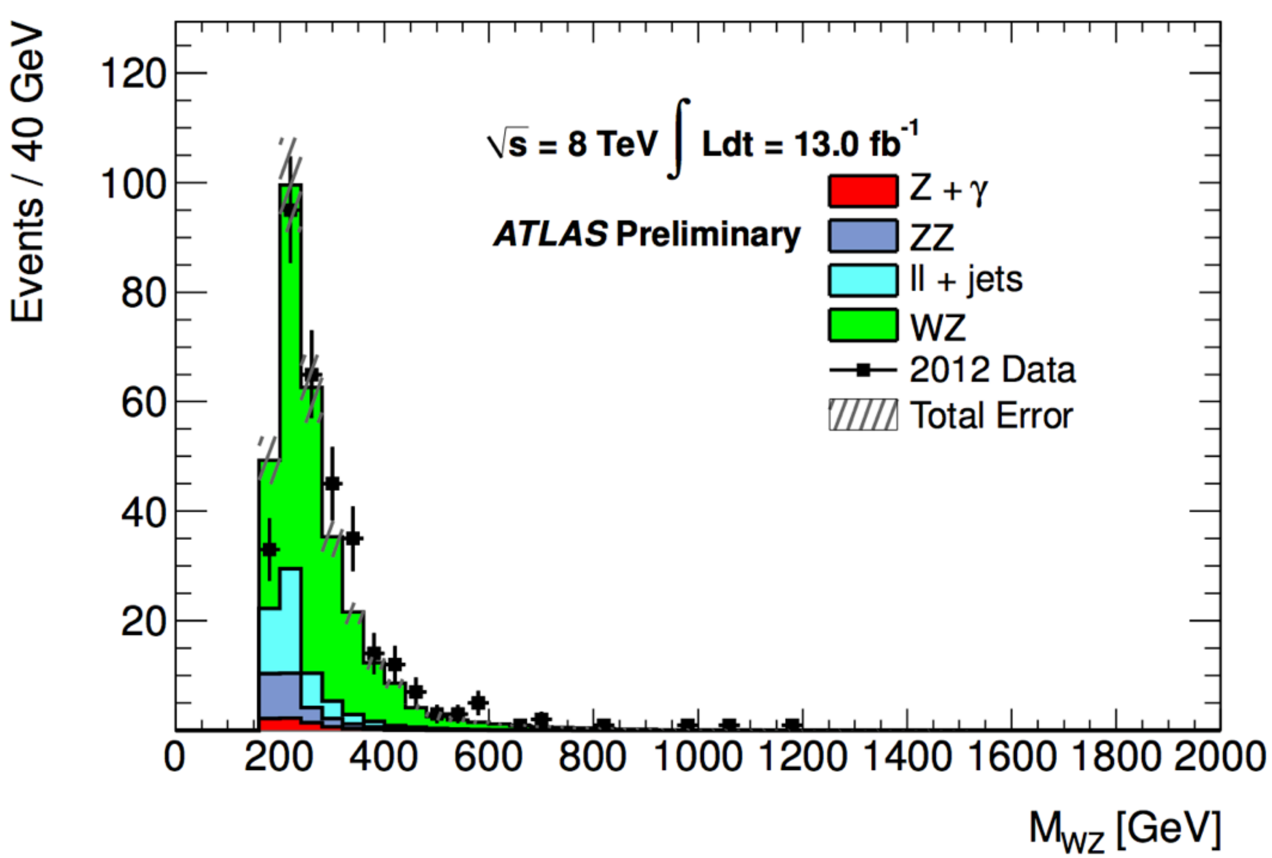
Diboson resonances

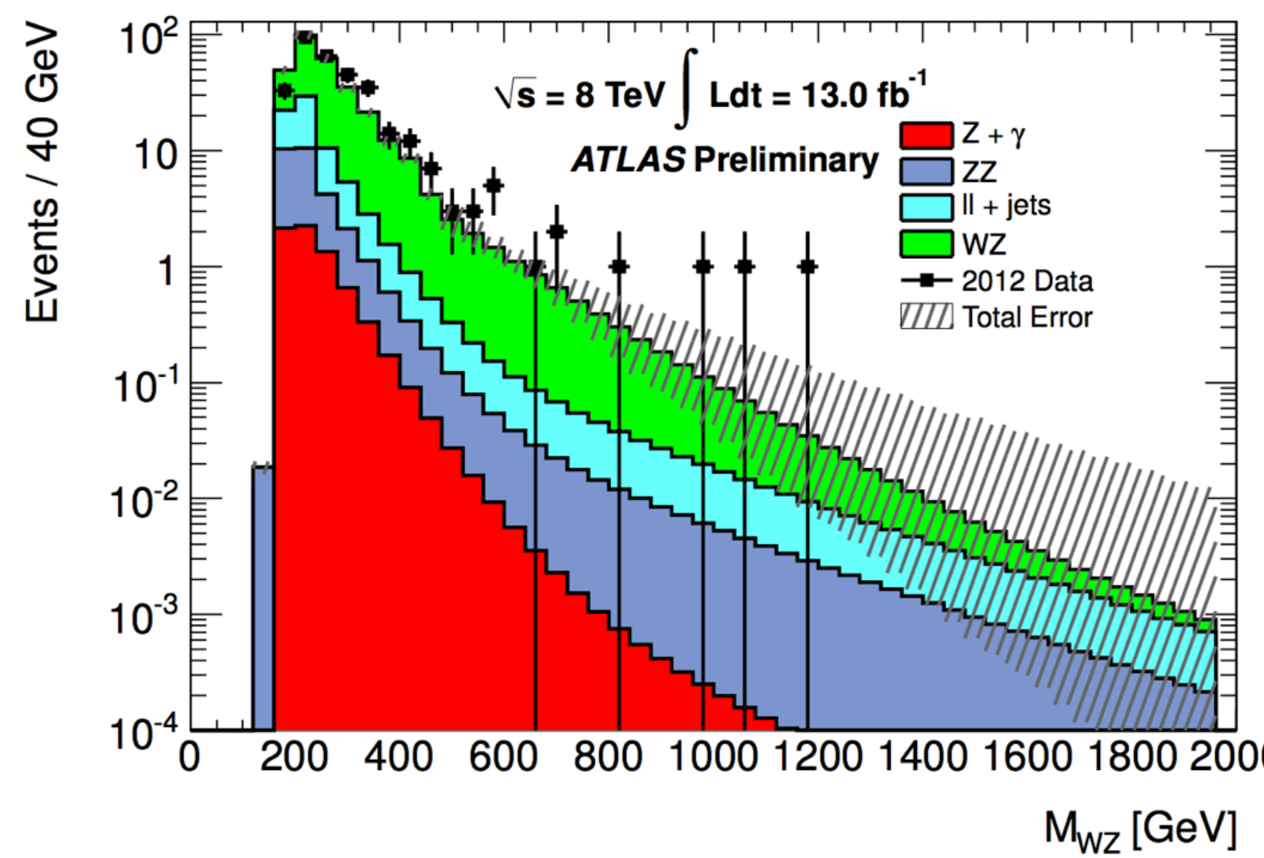
WZ -> lνll

ATLAS-CONF-2013-015





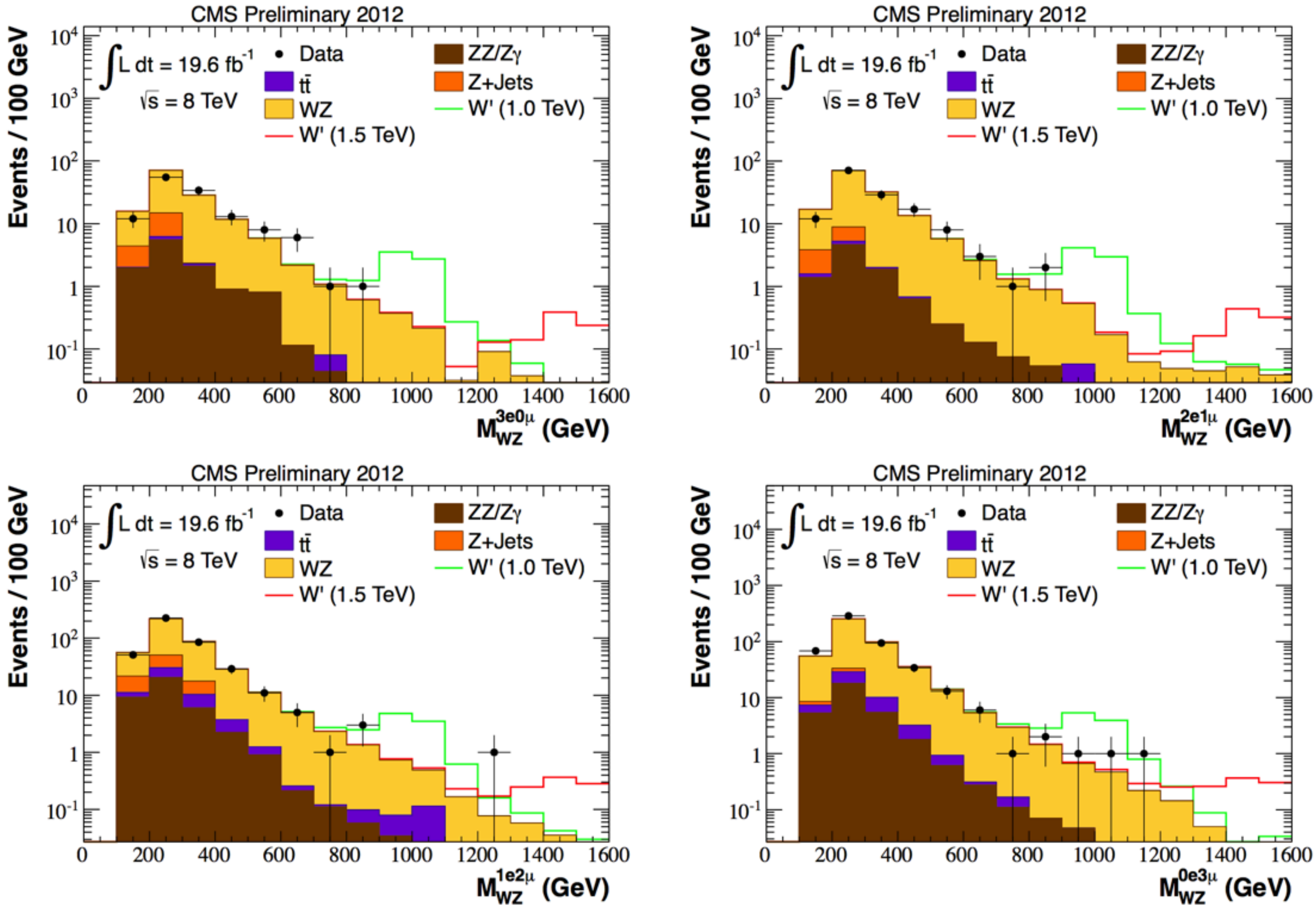




Diboson resonances

WZ -> lνll

CMS PAS EXO-12-025



Diboson resonances

WW/WZ -> lvjj

PRD 87, 112006 (2013)

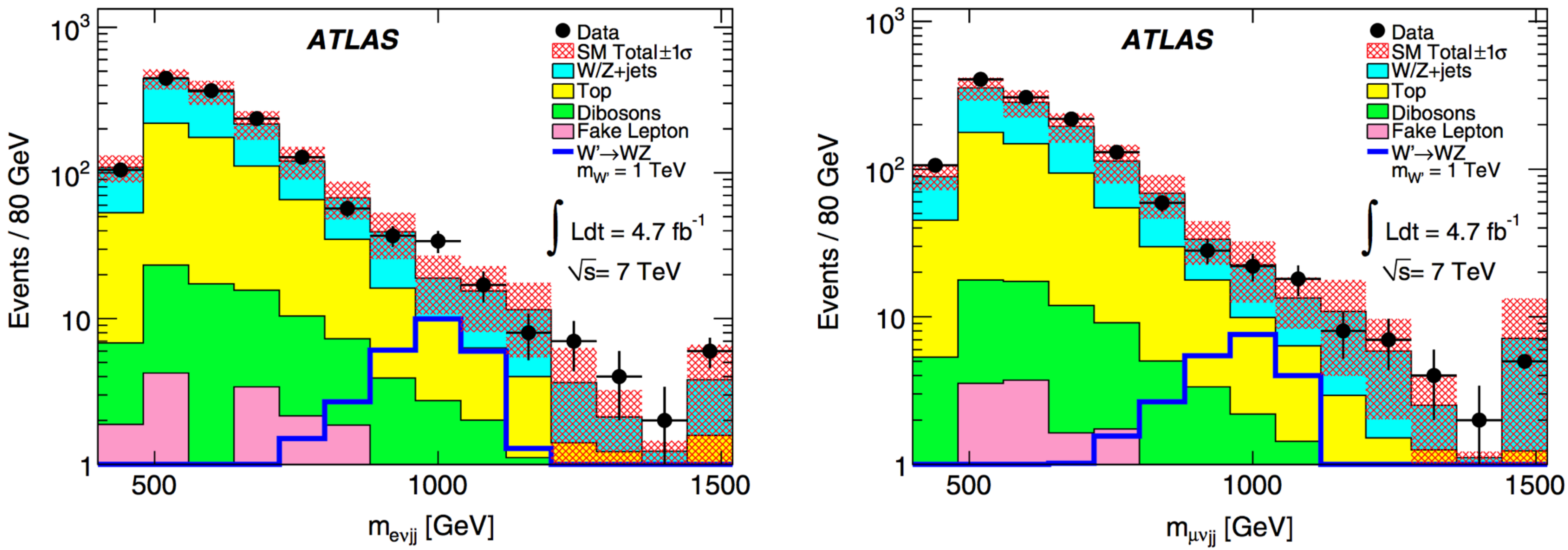


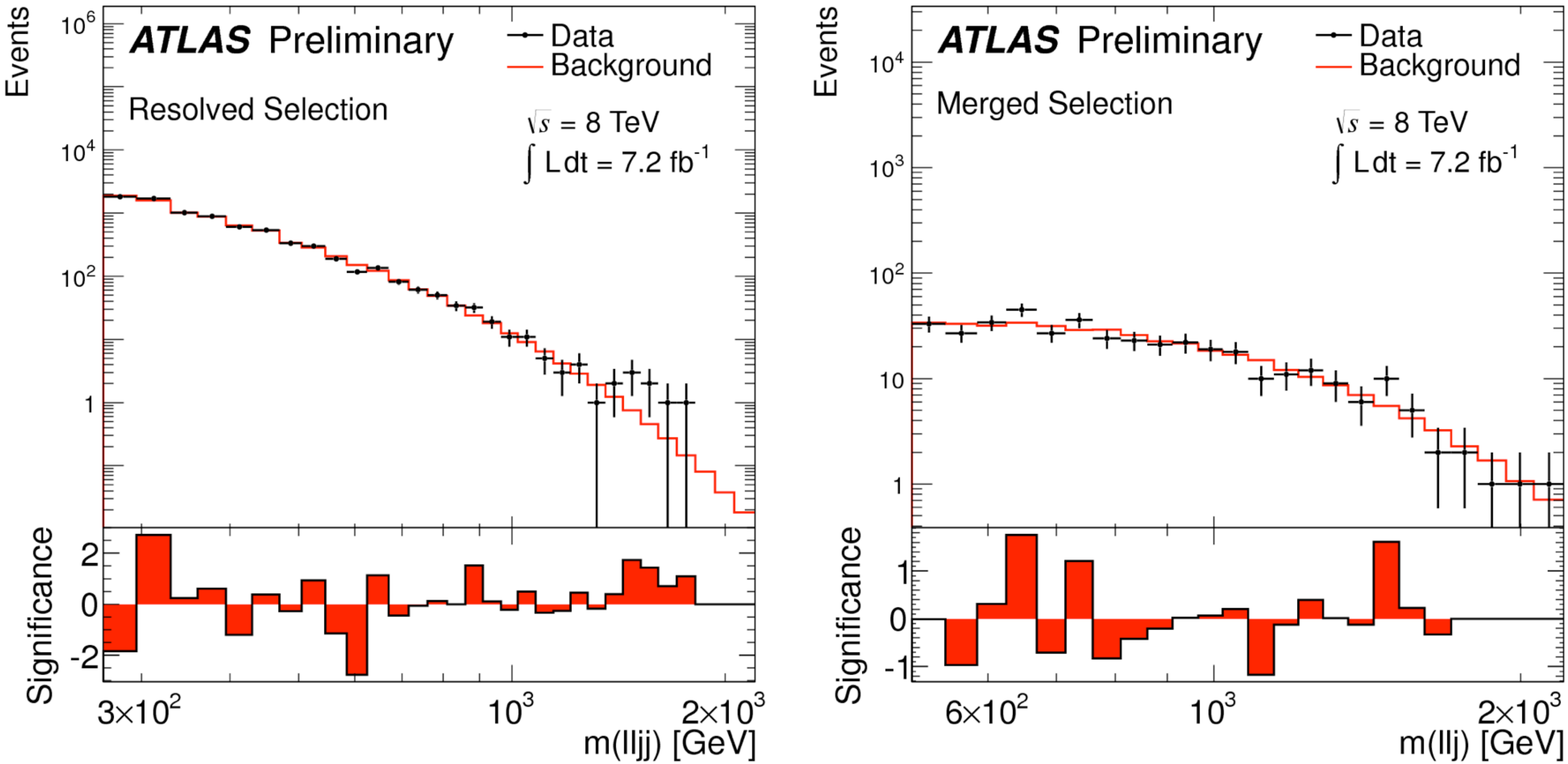
TABLE IV. Expected and observed 95% C.L. lower mass limits (GeV) for the RS1 G^*, bulk RS G^*, and the EGM W' boson using $e\nu jj$ events, $\mu\nu jj$ events and the combined channels.

Process	$e\nu jj$	$\mu\nu jj$	$\ell\nu jj$
Expected Limits [GeV]			
RS1 G^*	930	900	**950**
Bulk RS G^*	740	710	**750**
EGM W'	950	930	**970**
Observed limits [GeV]			
RSI G^*	910	920	**940**
Bulk RS G^*	760	650	**710**
EGM W'	930	930	**950**

Diboson resonances

ZZ->lljj / llJ

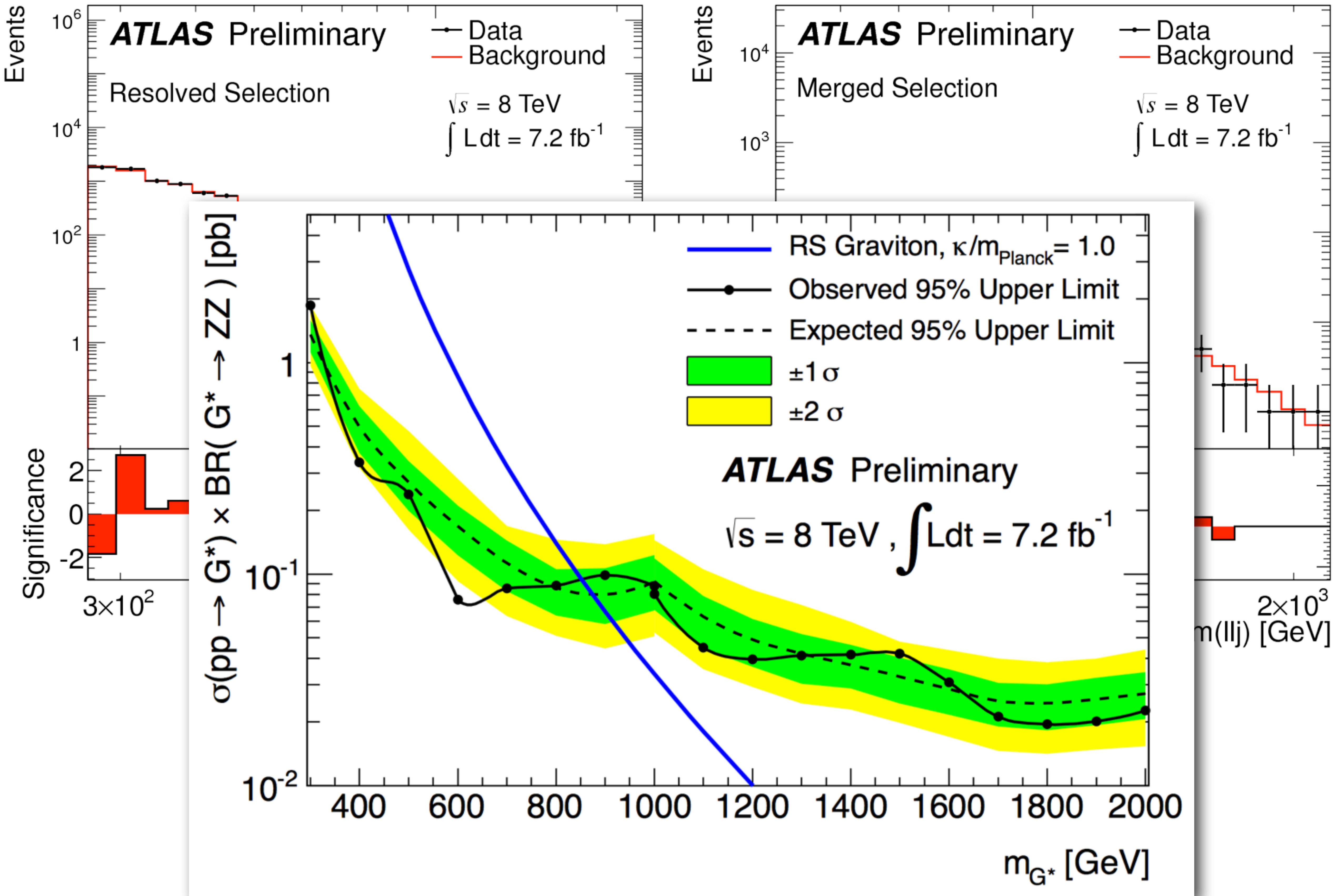
ATLAS-CONF-2012-150



Diboson resonances

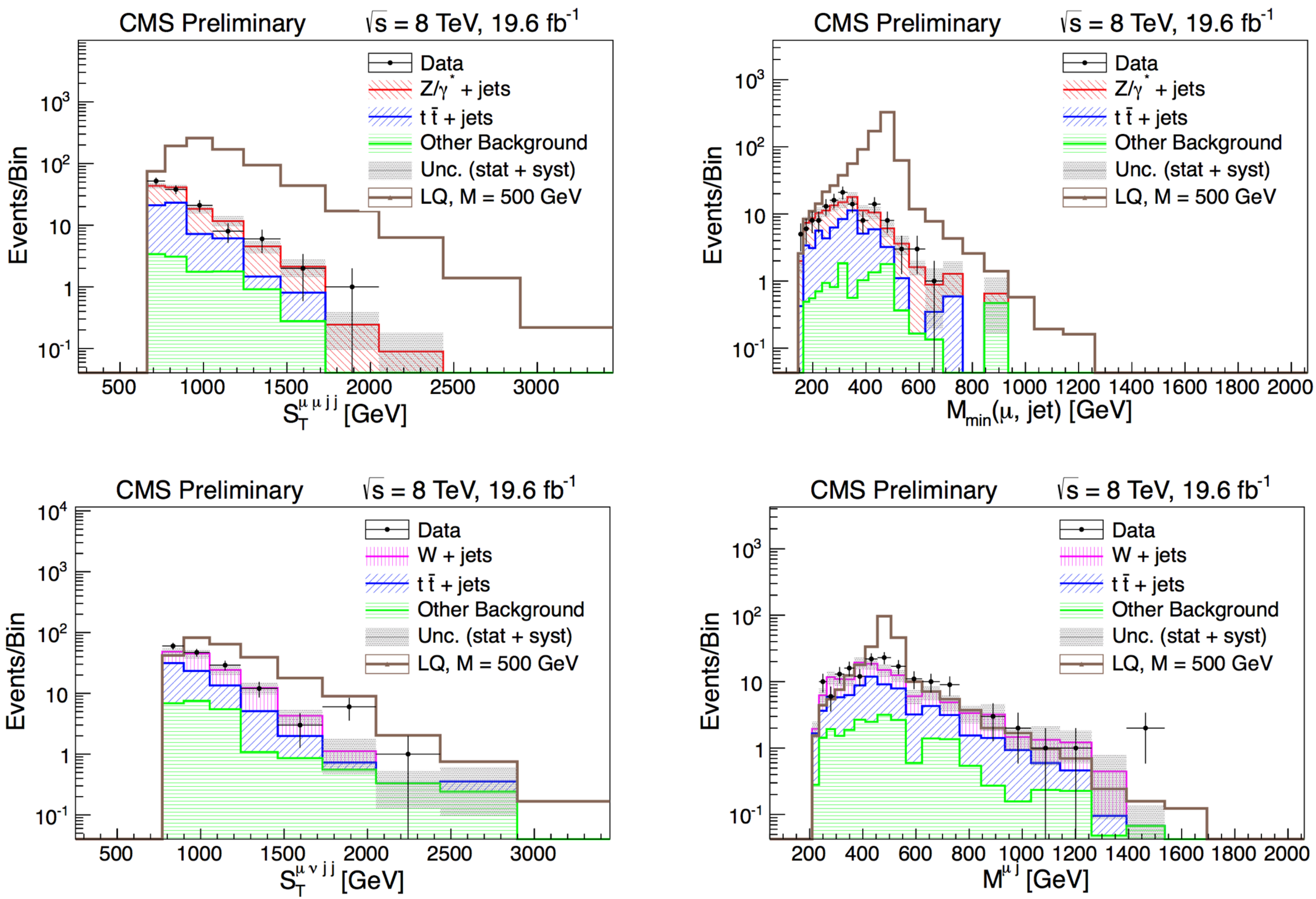
ZZ->lljj / llJ

ATLAS-CONF-2012-150



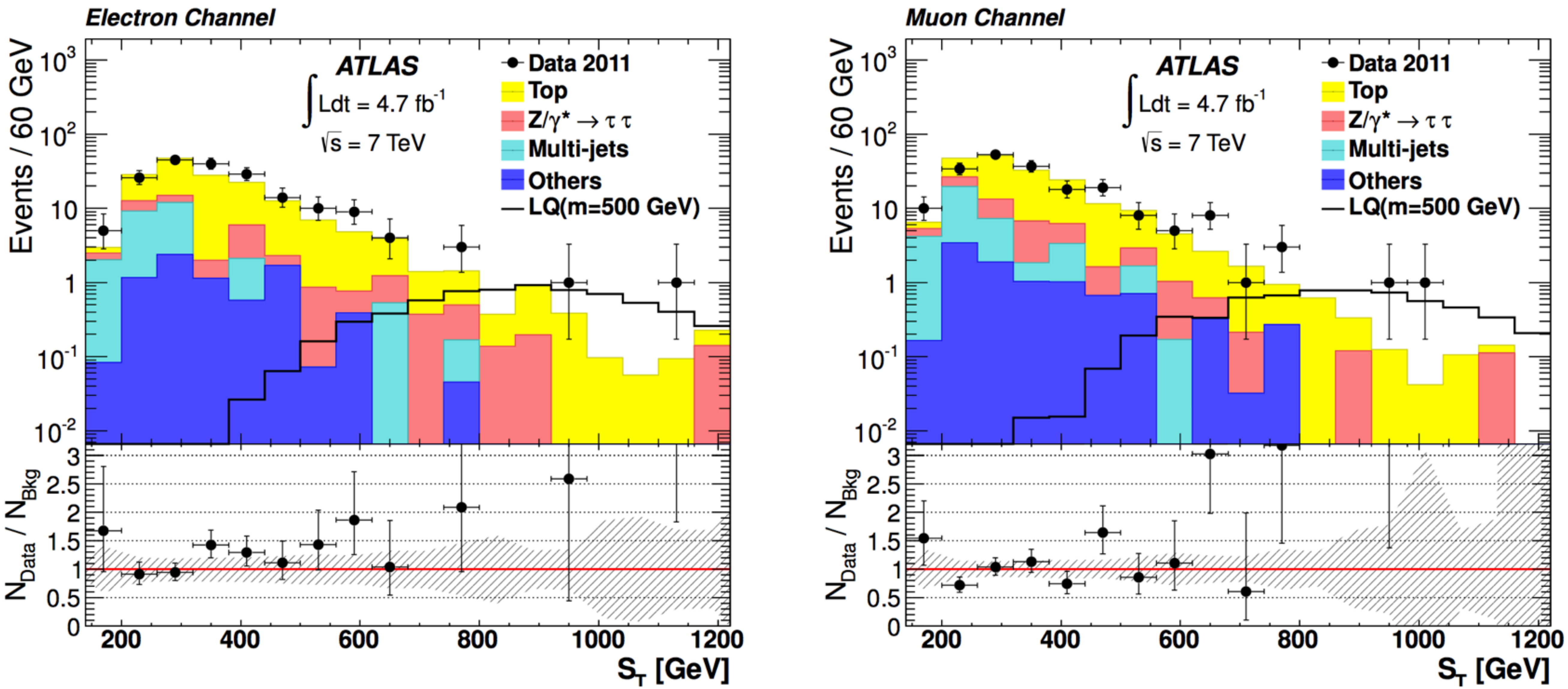
Search for second-generation leptoquarks

CMS PAS EXO-12-042



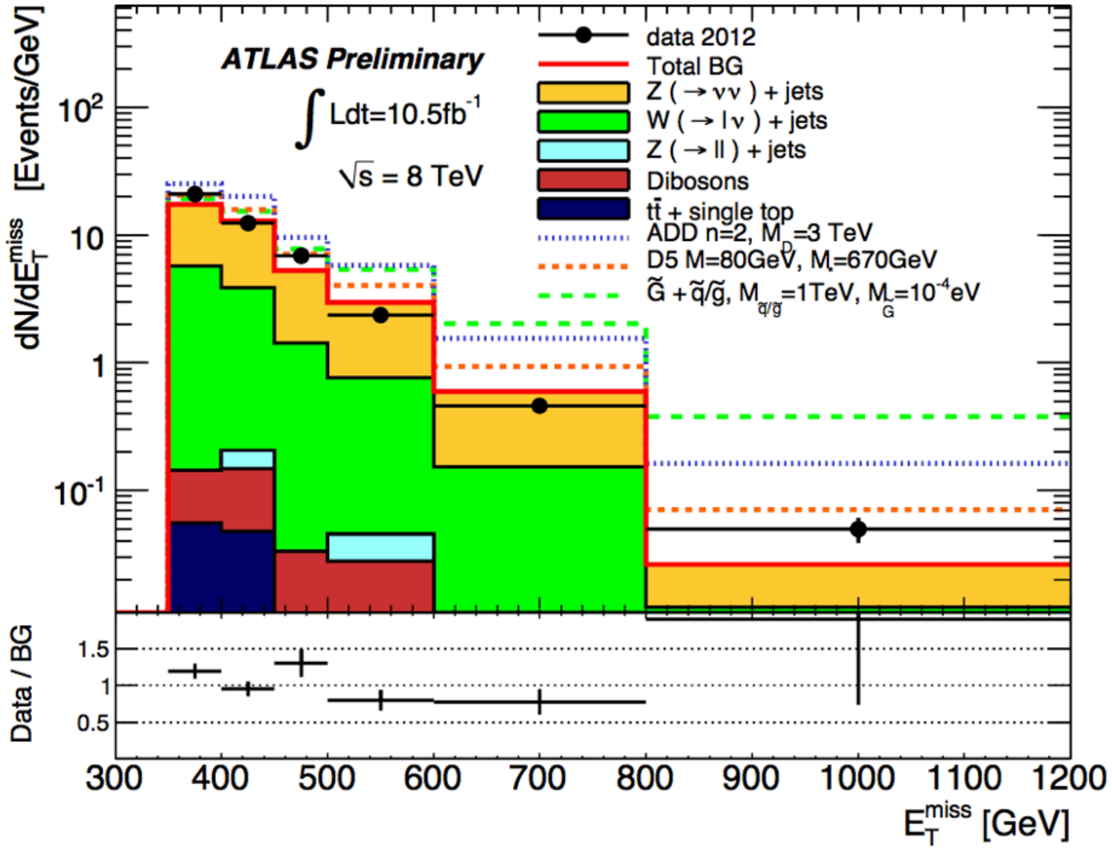
Third generation scalar leptoquarks

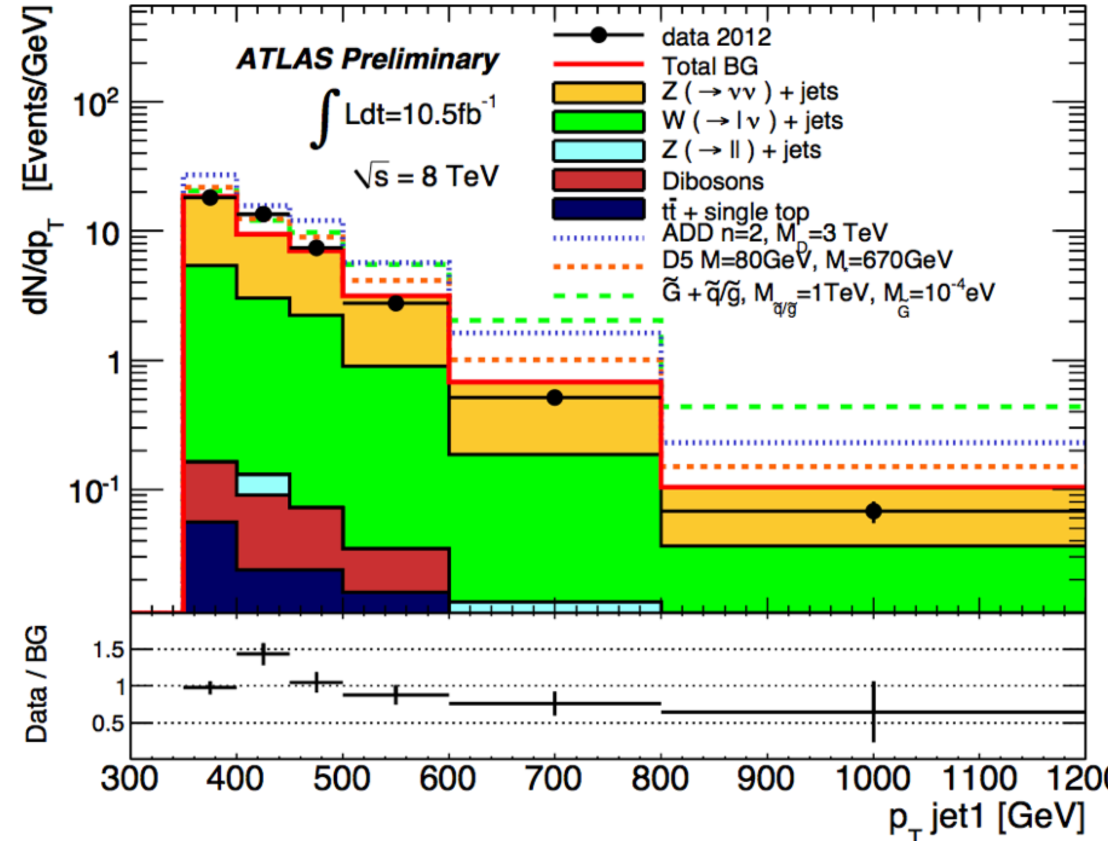
JHEP06(2013)033



Mono-jet

ATLAS-CONF-2012-147

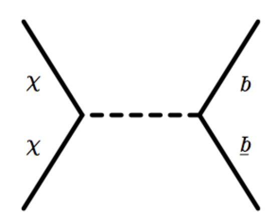




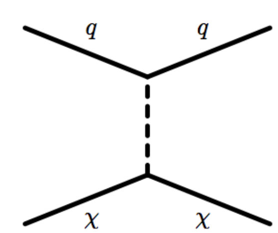
P. Fox

TABLE I. Operators coupling WIMPs to SM particles. The operator names beginning with D, C, R apply to WIMPS that are Dirac fermions, complex scalars or real scalars, respectively.

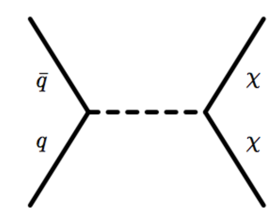
Name	Operator	Coefficient
D1	$\bar\chi\chi\bar q q$	m_q/M_*^3
D2	$\bar\chi\gamma^5\chi\bar q q$	im_q/M_*^3
D3	$\bar\chi\chi\bar q\gamma^5 q$	im_q/M_*^3
D4	$\bar\chi\gamma^5\chi\bar q\gamma^5 q$	m_q/M_*^3
D5	$\bar\chi\gamma^\mu\chi\bar q\gamma_\mu q$	$1/M_*^2$
D6	$\bar\chi\gamma^\mu\gamma^5\chi\bar q\gamma_\mu q$	$1/M_*^2$
D7	$\bar\chi\gamma^\mu\chi\bar q\gamma_\mu\gamma^5 q$	$1/M_*^2$
D8	$\bar\chi\gamma^\mu\gamma^5\chi\bar q\gamma_\mu\gamma^5 q$	$1/M_*^2$
D9	$\bar\chi\sigma^{\mu\nu}\chi\bar q\sigma_{\mu\nu}q$	$1/M_*^2$
D10	$\bar\chi\sigma_{\mu\nu}\gamma^5\chi\bar q\sigma_{\alpha\beta}q$	i/M_*^2
D11	$\bar\chi\chi G_{\mu\nu}G^{\mu\nu}$	$\alpha_s/4M_*^3$
D12	$\bar\chi\gamma^5\chi G_{\mu\nu}G^{\mu\nu}$	$i\alpha_s/4M_*^3$
D13	$\bar\chi\chi G_{\mu\nu}\tilde G^{\mu\nu}$	$i\alpha_s/4M_*^3$
D14	$\bar\chi\gamma^5\chi G_{\mu\nu}\tilde G^{\mu\nu}$	$\alpha_s/4M_*^3$
C1	$\chi^\dagger\chi\bar q q$	m_q/M_*^2
C2	$\chi^\dagger\chi\bar q\gamma^5 q$	im_q/M_*^2
C3	$\chi^\dagger\partial_\mu\chi\bar q\gamma^\mu q$	$1/M_*^2$
C4	$\chi^\dagger\partial_\mu\chi\bar q\gamma^\mu\gamma^5 q$	$1/M_*^2$
C5	$\chi^\dagger\chi G_{\mu\nu}G^{\mu\nu}$	$\alpha_s/4M_*^2$
C6	$\chi^\dagger\chi G_{\mu\nu}\tilde G^{\mu\nu}$	$i\alpha_s/4M_*^2$
R1	$\chi^2\bar q q$	$m_q/2M_*^2$
R2	$\chi^2\bar q\gamma^5 q$	$im_q/2M_*^2$
R3	$\chi^2 G_{\mu\nu}G^{\mu\nu}$	$\alpha_s/8M_*^2$
R4	$\chi^2 G_{\mu\nu}\tilde G^{\mu\nu}$	$i\alpha_s/8M_*^2$



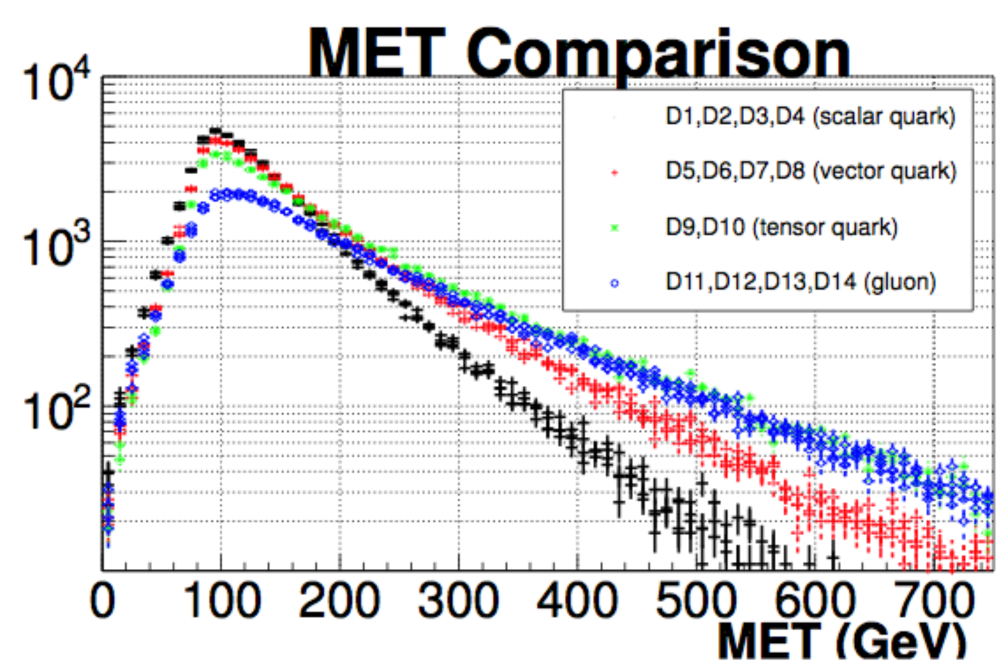
Indirect detection



Direct detection

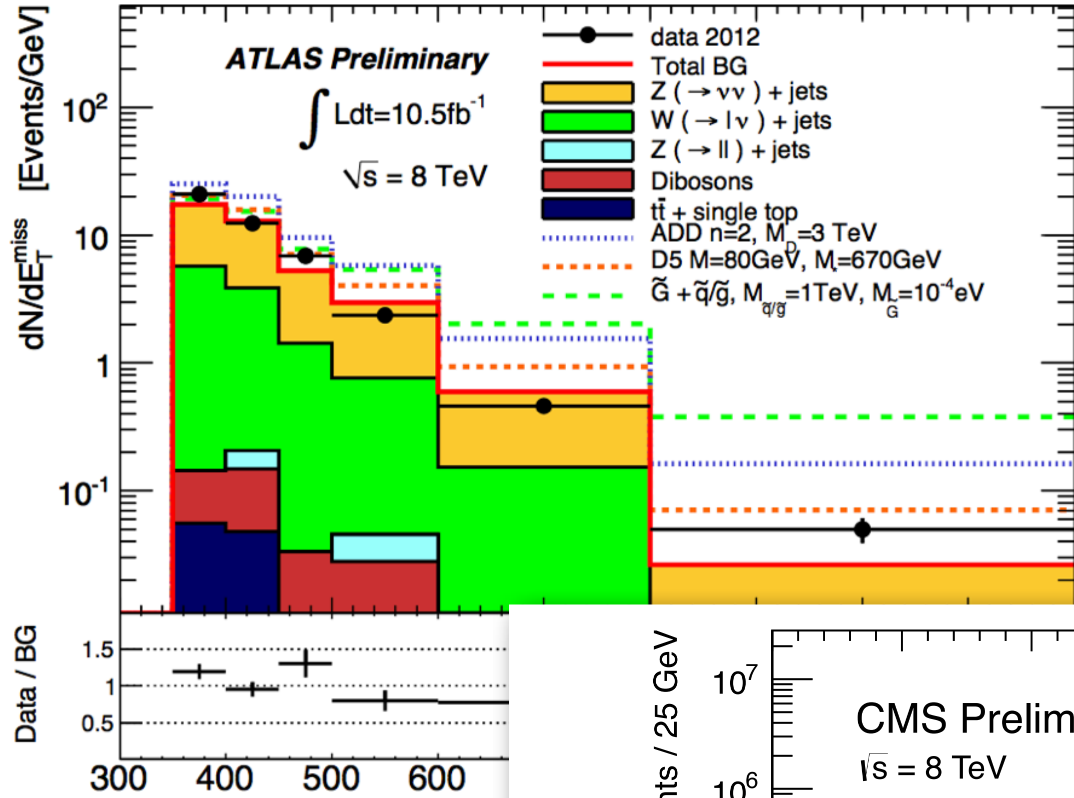


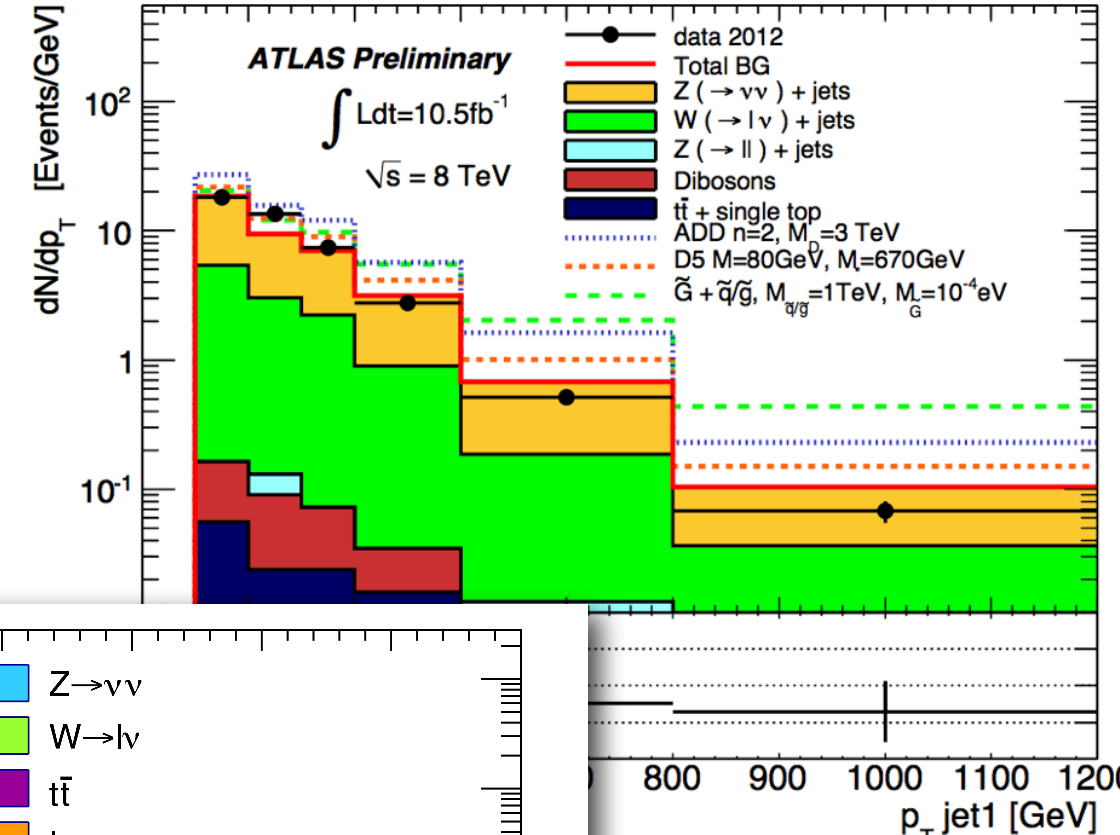
Collider searches



Mono-jet

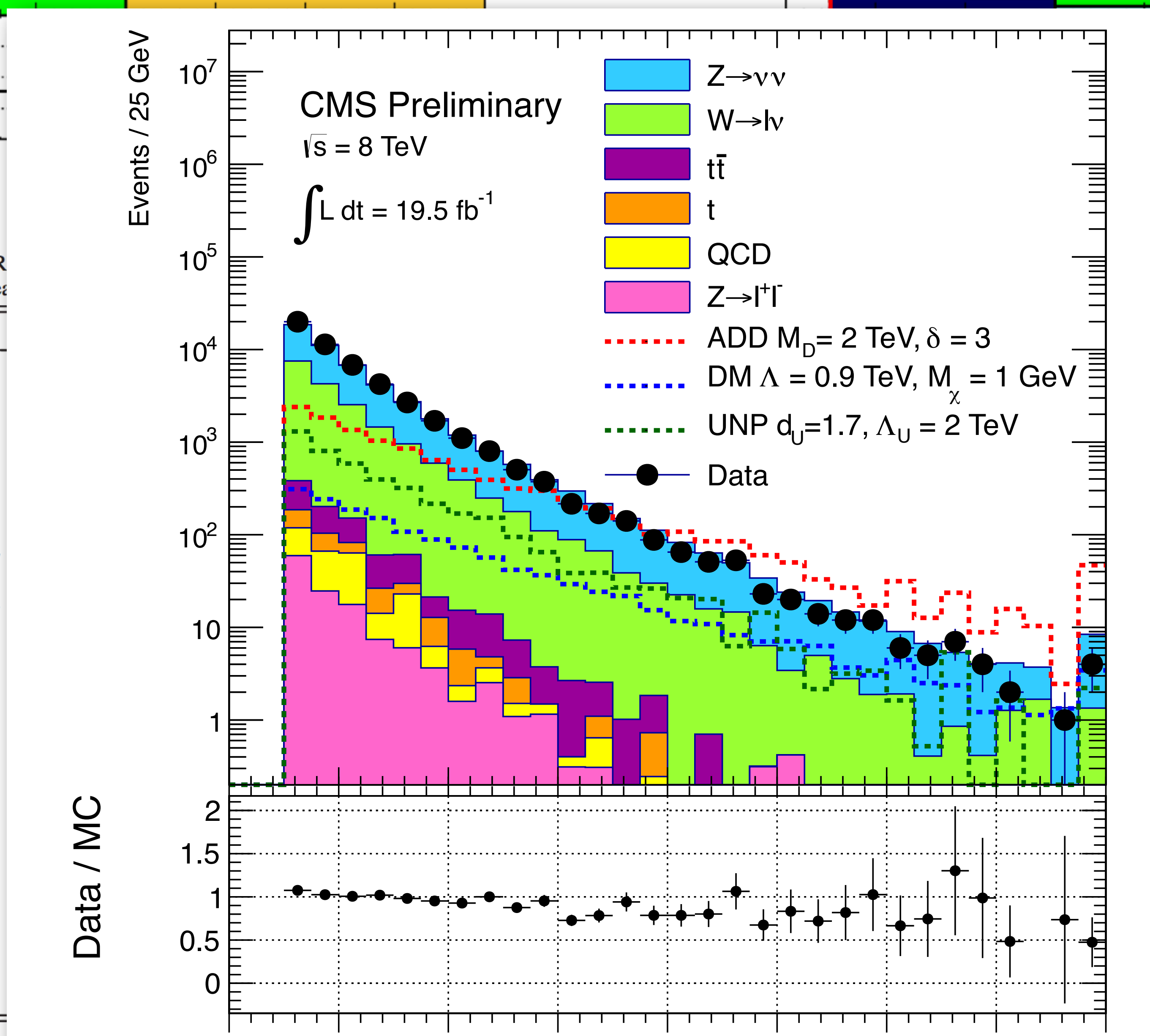
ATLAS-CONF-2012-147
CMS-PAS-EXO-12-048

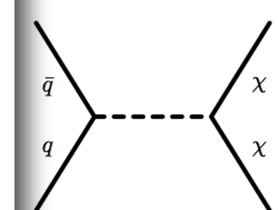




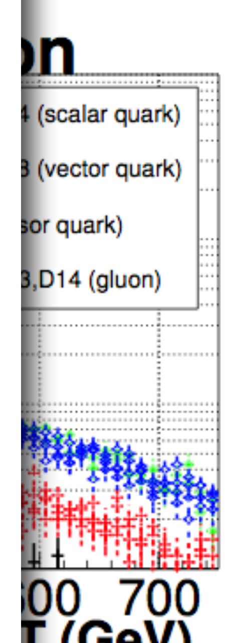
operator names beginning with D, C, R
Dirac fermions, complex scalars or rea

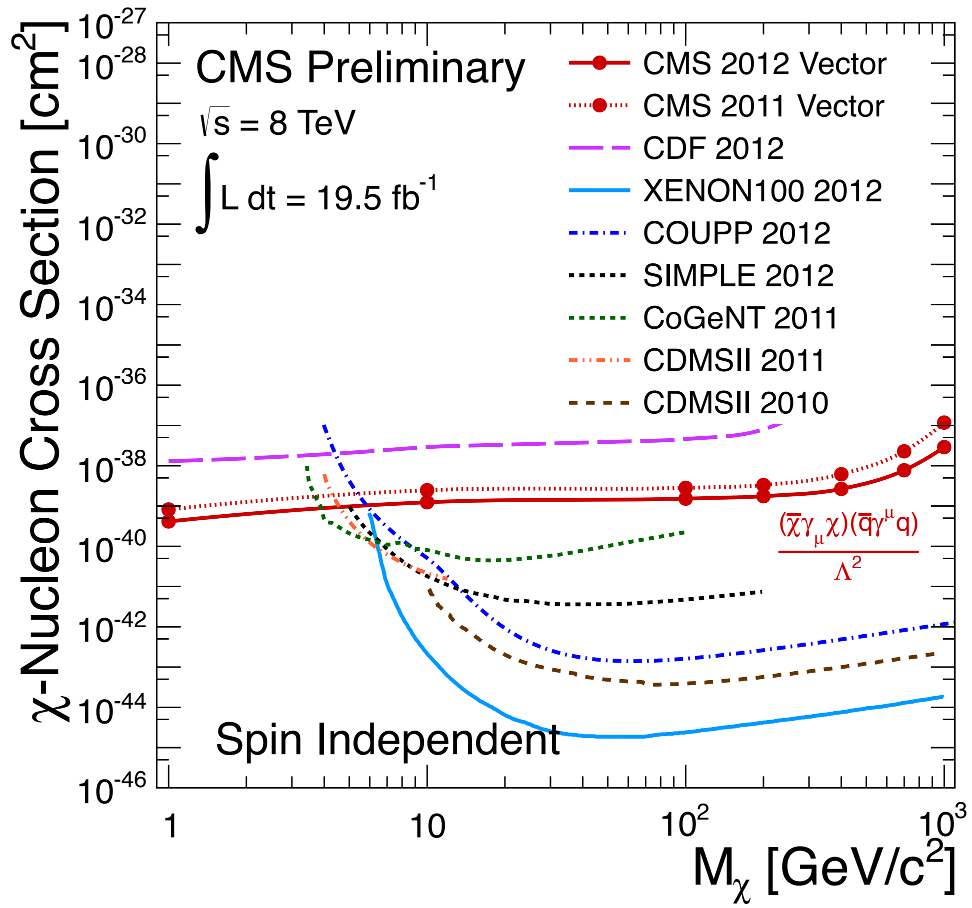
Name	Operator
D1	$\bar\chi\chi\bar q q$
D2	$\bar\chi\gamma^5\chi\bar q q$
D3	$\bar\chi\chi\bar q\gamma^5 q$
D4	$\bar\chi\gamma^5\chi\bar q\gamma^5 q$
D5	$\bar\chi\gamma^\mu\chi\bar q\gamma_\mu q$
D6	$\bar\chi\gamma^\mu\gamma^5\chi\bar q\gamma_\mu q$
D7	$\bar\chi\gamma^\mu\chi\bar q\gamma_\mu\gamma^5 q$
D8	$\bar\chi\gamma^\mu\gamma^5\chi\bar q\gamma_\mu\gamma^5 q$
D9	$\bar\chi\sigma^{\mu\nu}\chi\bar q\sigma_{\mu\nu}q$
D10	$\bar\chi\sigma_{\mu\nu}\gamma^5\chi\bar q\sigma_{\alpha\beta}q$
D11	$\bar\chi\chi G_{\mu\nu}G^{\mu\nu}$
D12	$\bar\chi\gamma^5\chi G_{\mu\nu}G^{\mu\nu}$
D13	$\bar\chi\chi G_{\mu\nu}\tilde G^{\mu\nu}$
D14	$\bar\chi\gamma^5\chi G_{\mu\nu}\tilde G^{\mu\nu}$
C1	$\chi^\dagger\chi\bar q q$
C2	$\chi^\dagger\chi\bar q\gamma^5 q$
C3	$\chi^\dagger\partial_\mu\chi\bar q\gamma^\mu q$
C4	$\chi^\dagger\partial_\mu\chi\bar q\gamma^\mu\gamma^5 q$
C5	$\chi^\dagger\chi G_{\mu\nu}G^{\mu\nu}$
C6	$\chi^\dagger\chi G_{\mu\nu}\tilde G^{\mu\nu}$
R1	$\chi^2\bar q q$
R2	$\chi^2\bar q\gamma^5 q$
R3	$\chi^2 G_{\mu\nu}G^{\mu\nu}$
R4	$\chi^2 G_{\mu\nu}\tilde G^{\mu\nu}$

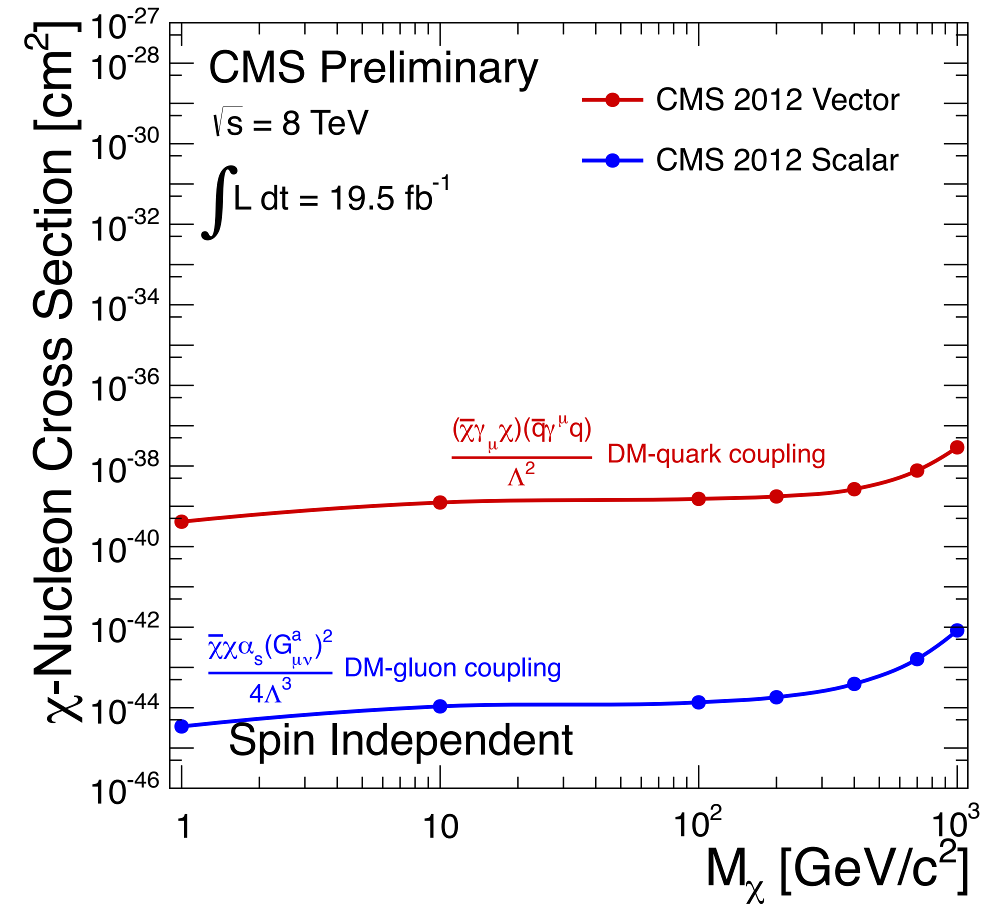




ollider searches




CMS Preliminary
√s = 8 TeV
∫L dt = 19.5 fb-1
CMS 2012 Vector
CMS 2011 Vector
CDF 2012
XENON100 2012
COUPP 2012
SIMPLE 2012
CoGeNT 2011
CDMSII 2011
CDMSII 2010
(χ̄γμχ)(q̄γμq) / Λ2
Spin Independent
χ-Nucleon Cross Section [cm2]
Mχ [GeV/c2]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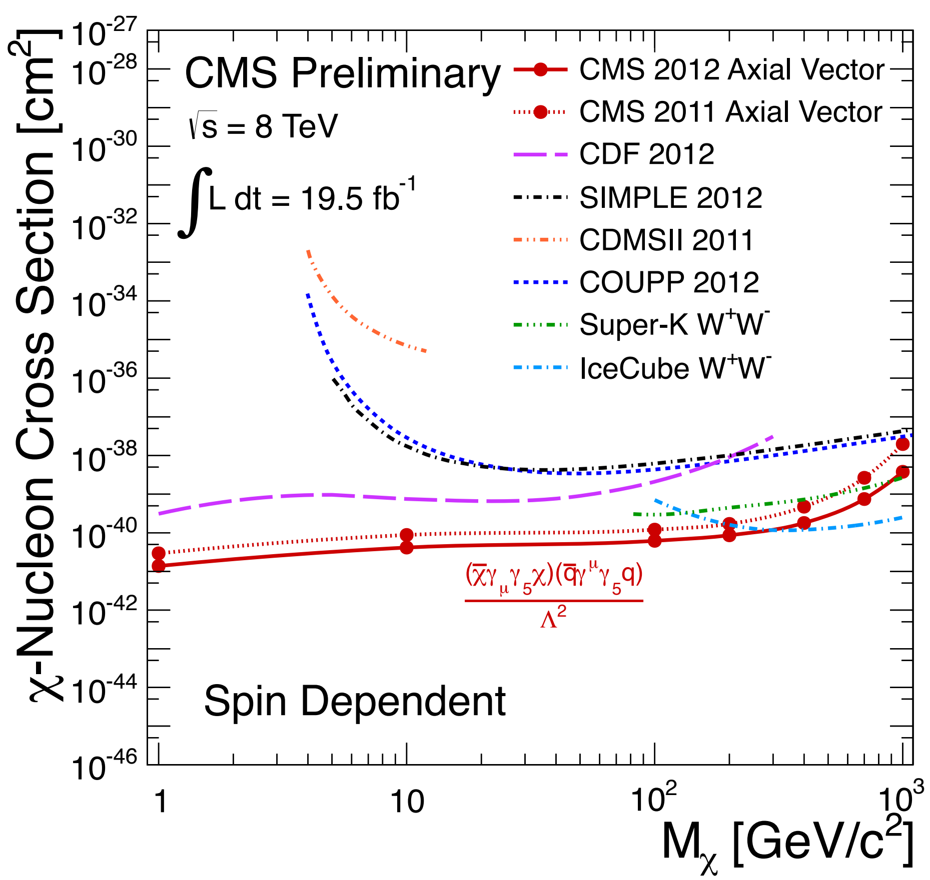
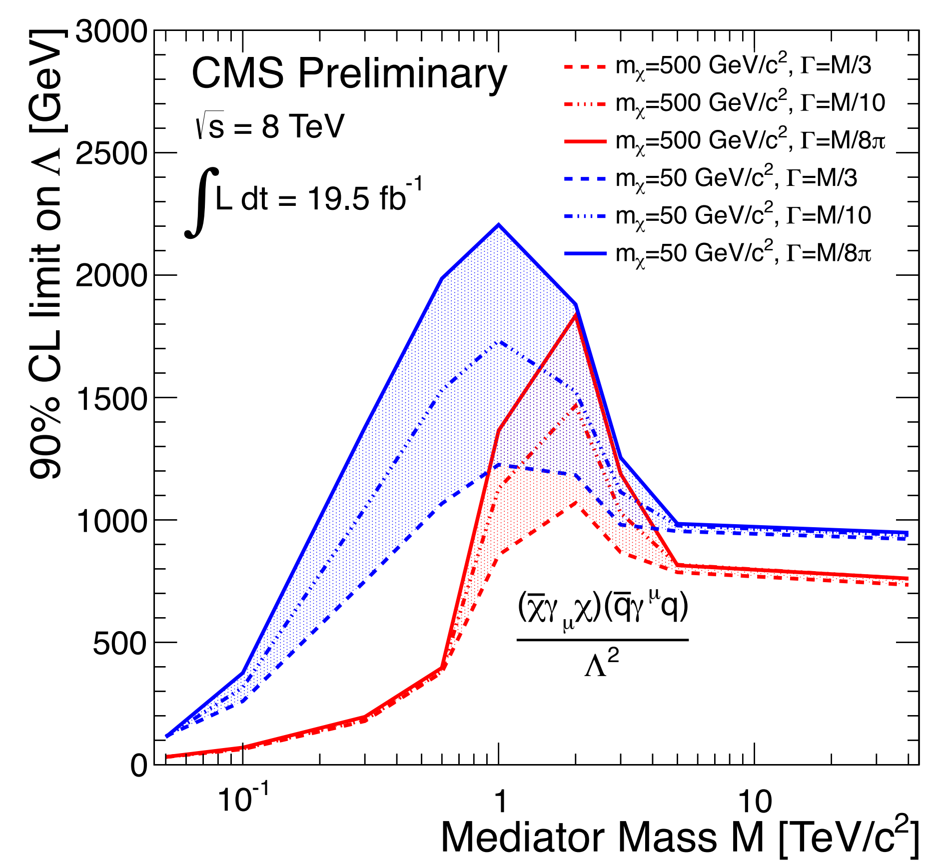
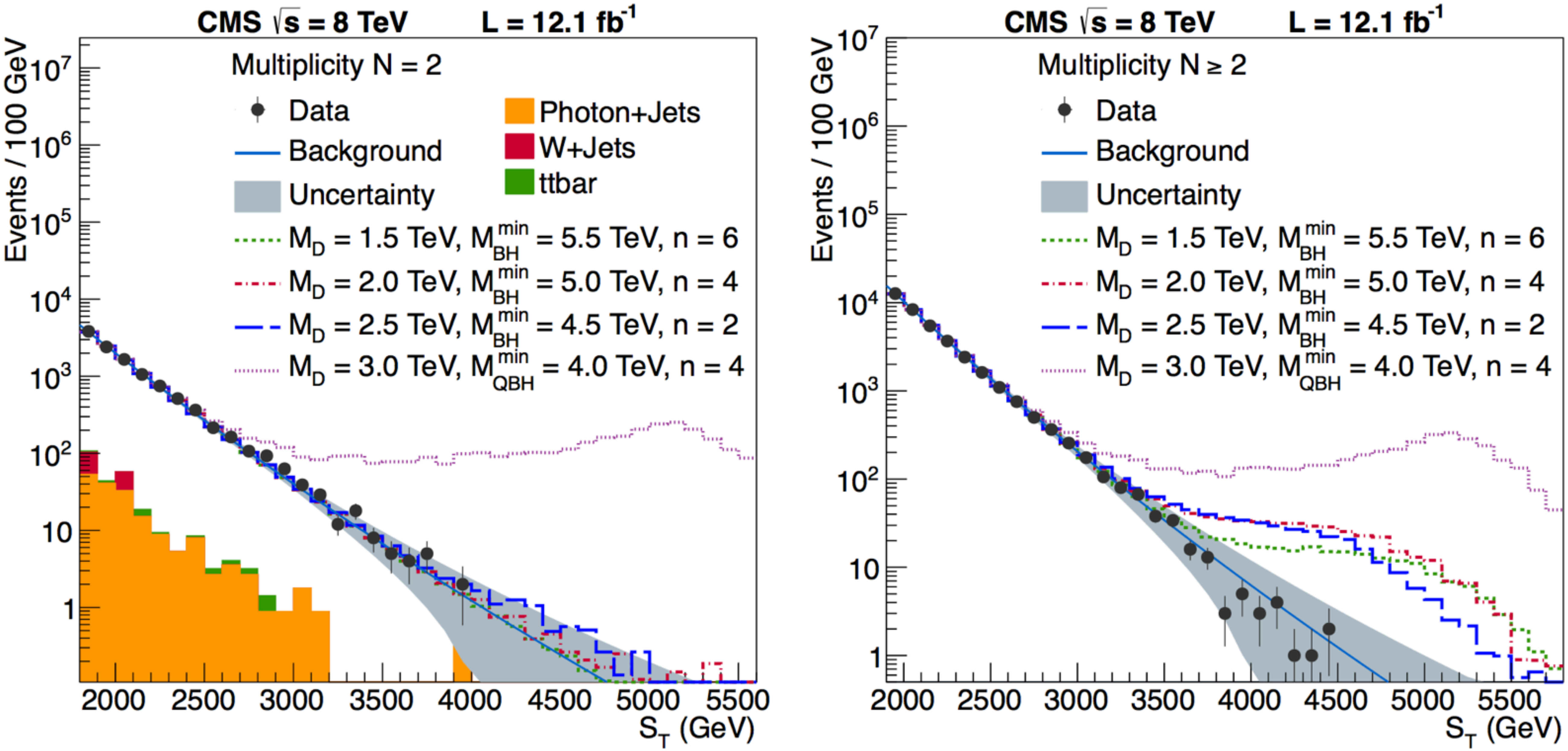
∫L dt = 19.5 fb-1
CMS 2012 Vector
CMS 2012 Scalar
(χ̄γμχ)(q̄γμq) / Λ2 DM-quark coupling
χ̄χαs(Gaμν)2 / 4Λ3 DM-gluon coupling
Spin Independent
χ-Nucleon Cross Section [cm2]
Mχ [GeV/c2]


CMS Preliminary
√s = 8 TeV
∫L dt = 19.5 fb-1
CMS 2012 Axial Vector
CMS 2011 Axial Vector
CDF 2012
SIMPLE 2012
CDMSII 2011
COUPP 2012
Super-K W+W-
IceCube W+W-
(χ̄γμγ5χ)(q̄γμγ5q) / Λ2
Spin Dependent
χ-Nucleon Cross Section [cm2]
Mχ [GeV/c2]


CMS Preliminary
√s = 8 TeV
∫L dt = 19.5 fb-1
mχ=500 GeV/c2, Γ=M/3
mχ=500 GeV/c2, Γ=M/10
mχ=500 GeV/c2, Γ=M/8π
mχ=50 GeV/c2, Γ=M/3
mχ=50 GeV/c2, Γ=M/10
mχ=50 GeV/c2, Γ=M/8π
(χ̄γμχ)(q̄γμq) / Λ2
90% CL limit on Λ [GeV]
Mediator Mass M [TeV/c2]

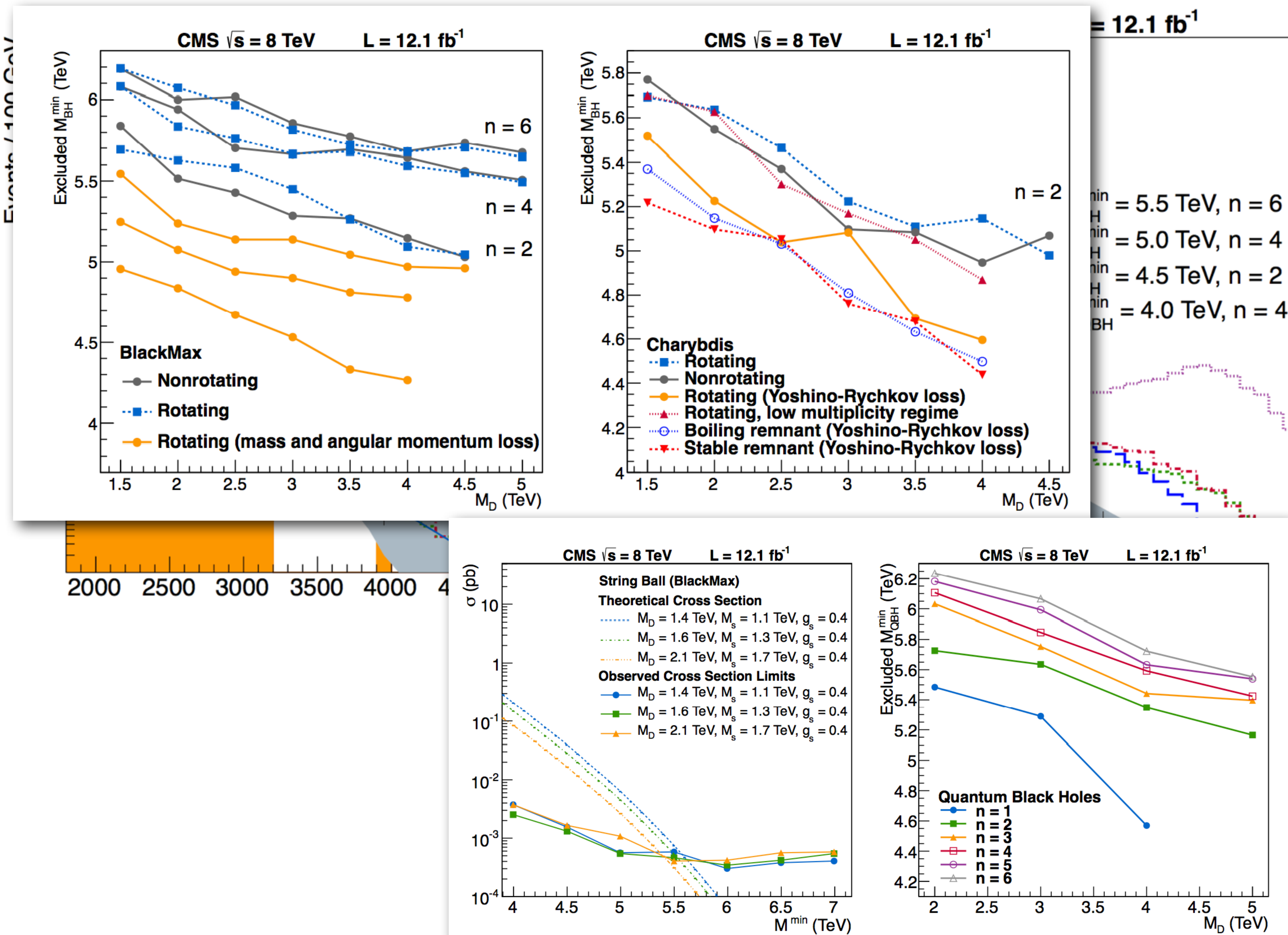
Multi-particle signatures of TeV-scale gravity

arXiv:1303.5338



Multi-particle signatures of TeV-scale gravity

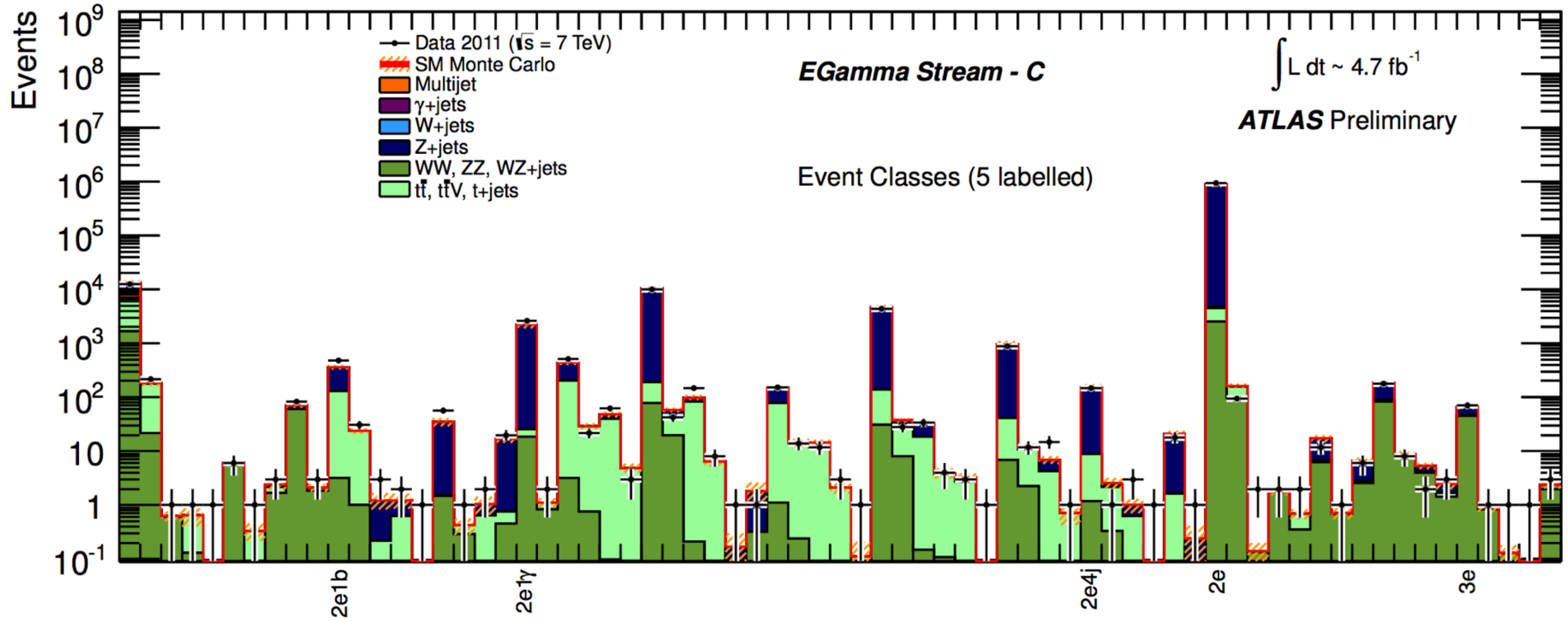
arXiv:1303.5338

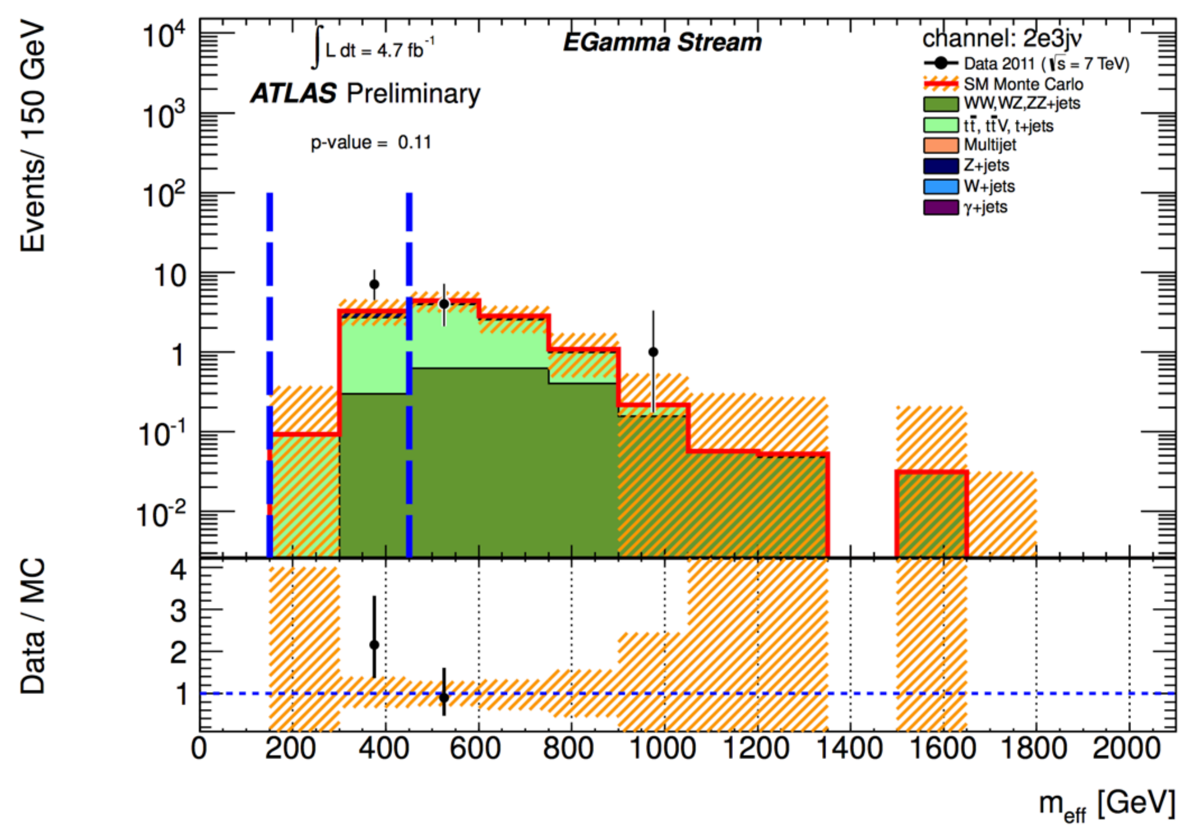


“General” Search for Familiar New Physics

ATLAS-CONF-2012-107

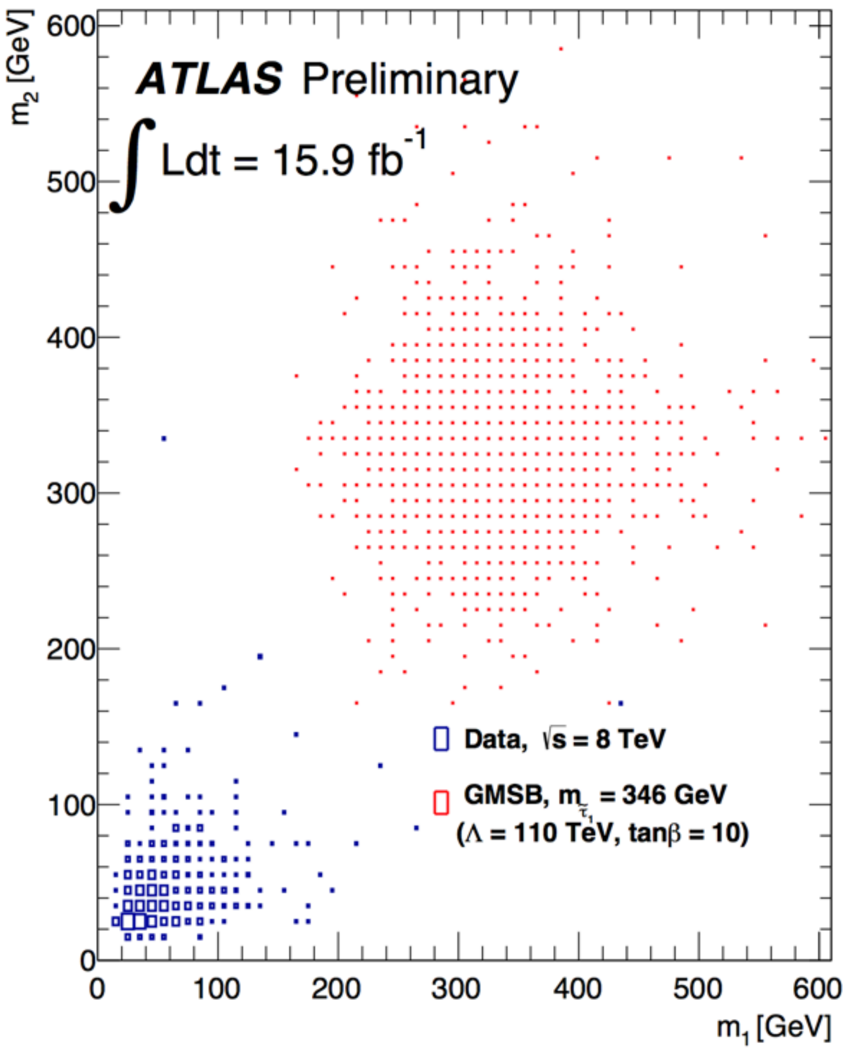
object	jet	b-jet	electron	muon	photon	E_T^{miss}
label	j	b	e	μ	γ	ν
lower p_T cut	50 GeV	50 GeV	25 GeV	20 GeV	40 GeV	130 GeV

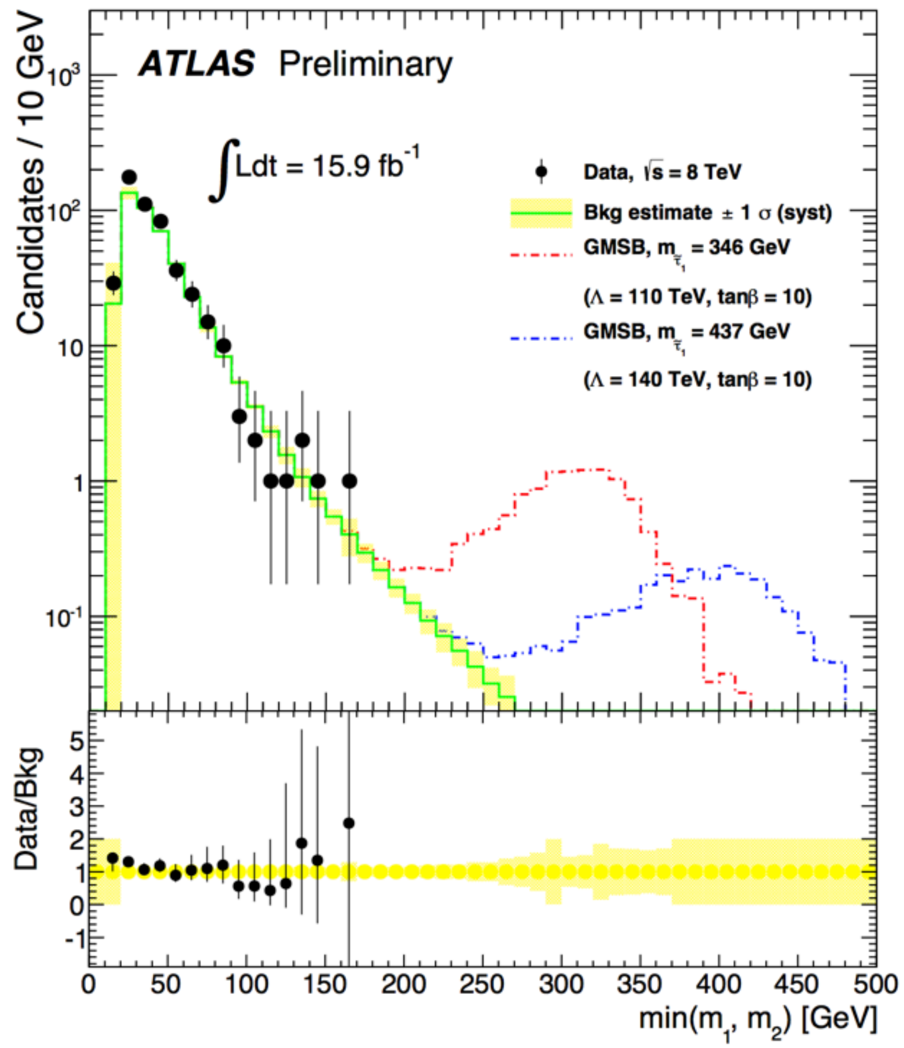


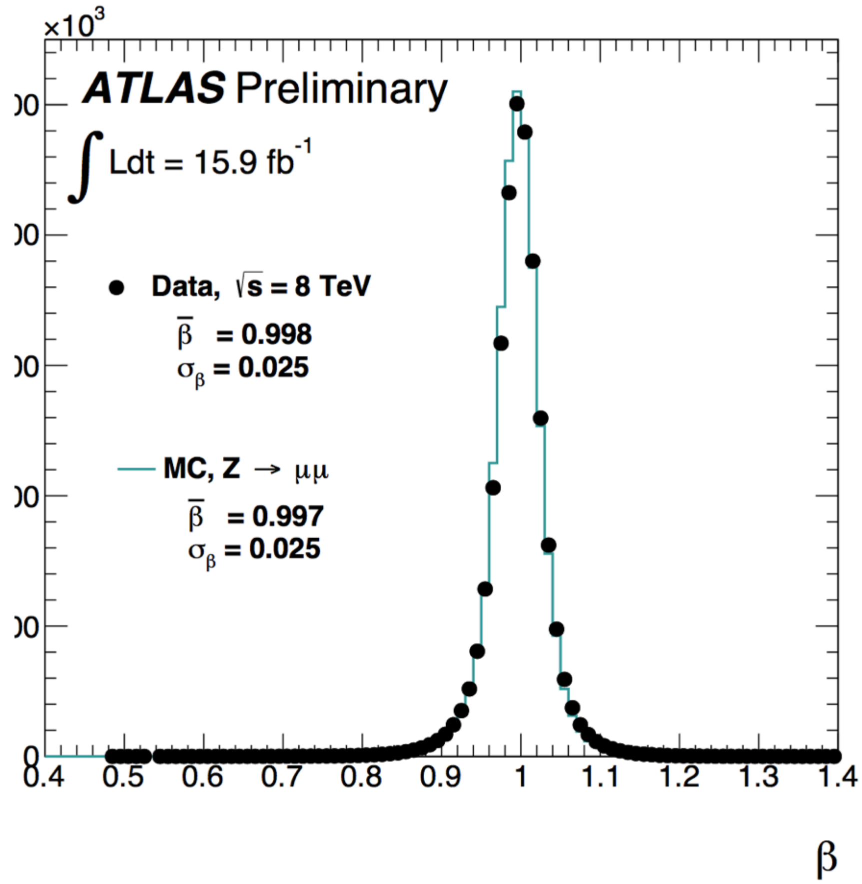


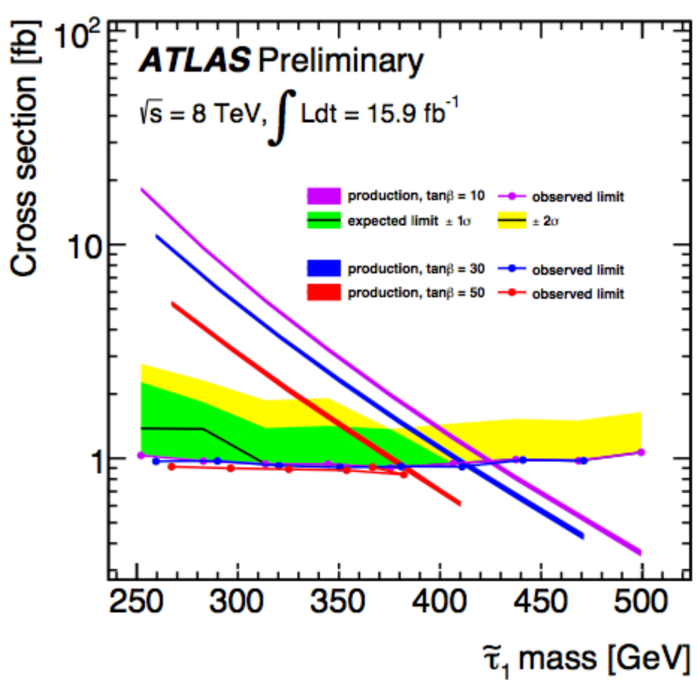
Search for Long-Lived Sleptons

ATLAS-CONF-2013-058







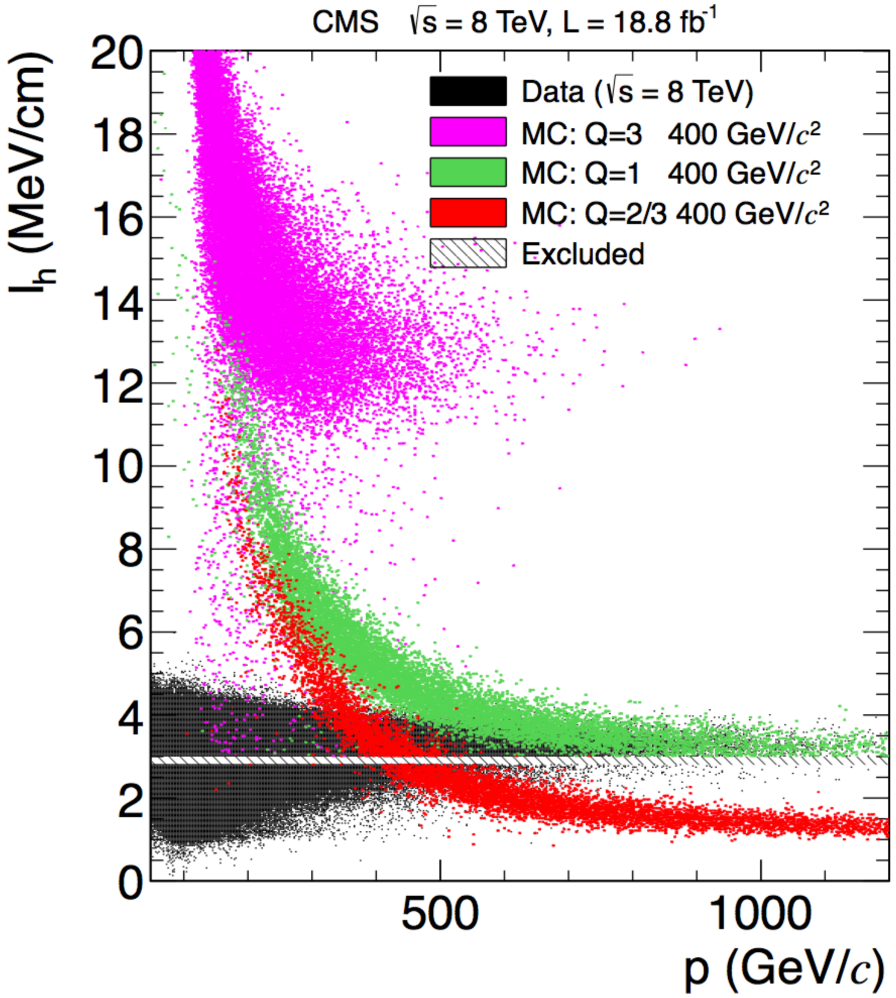


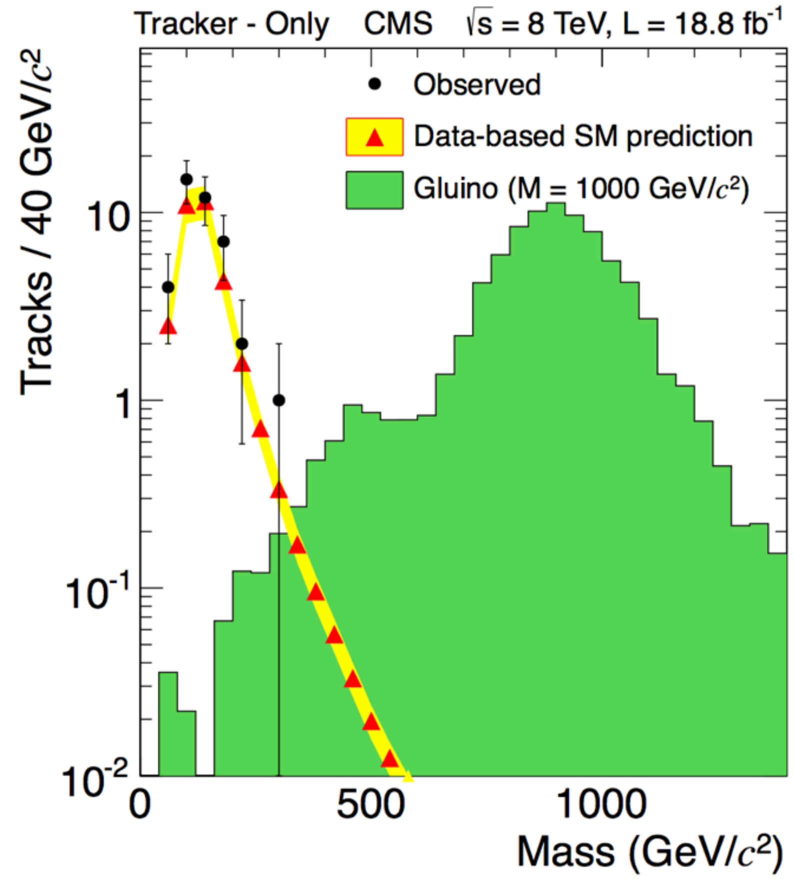
Exclude

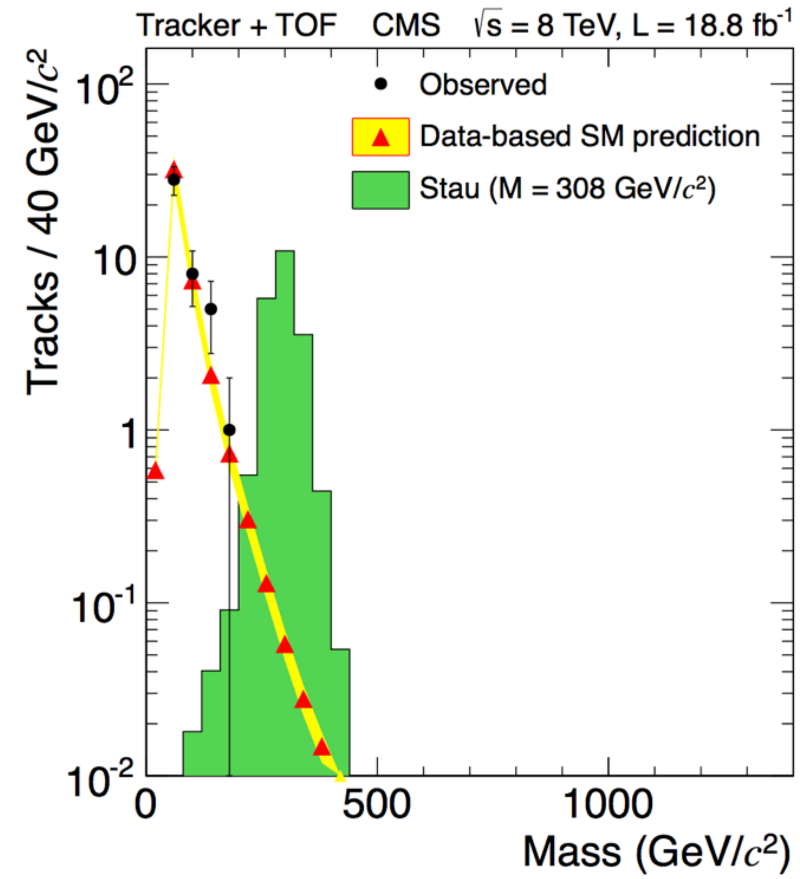
- *long-lived staus in GMSB for $m_{\tilde{\tau}_1}$ < 425–385 for tan β = 5–50*
- *directly-produced sleptons below 395–365 GeV (mass-splitting-dependent)*
- *neutralinos decaying to $\tilde{\tau}$s below 475 GeV*

Search for Heavy Stable Charged Particles

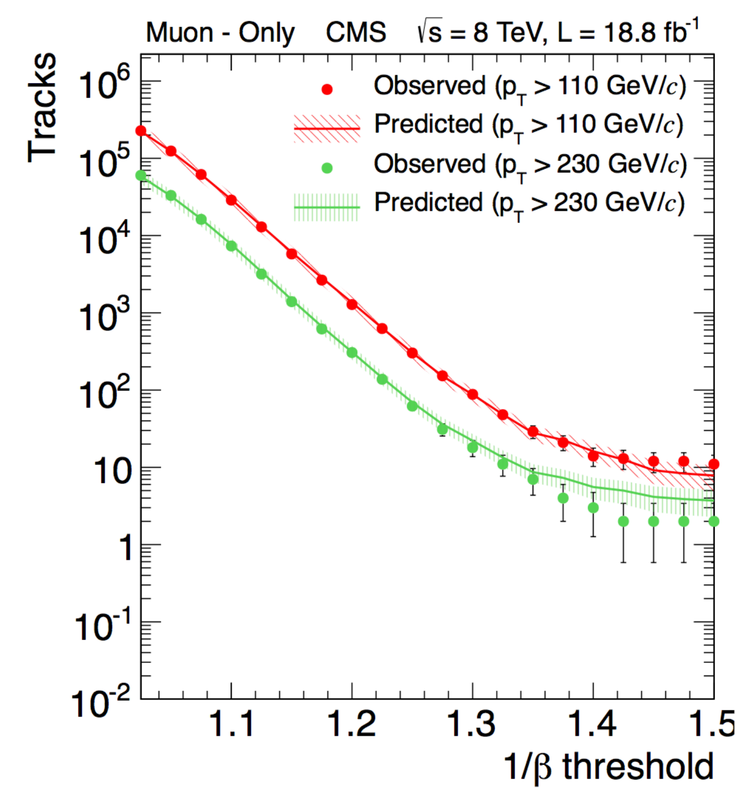
arXiv:1305.0491





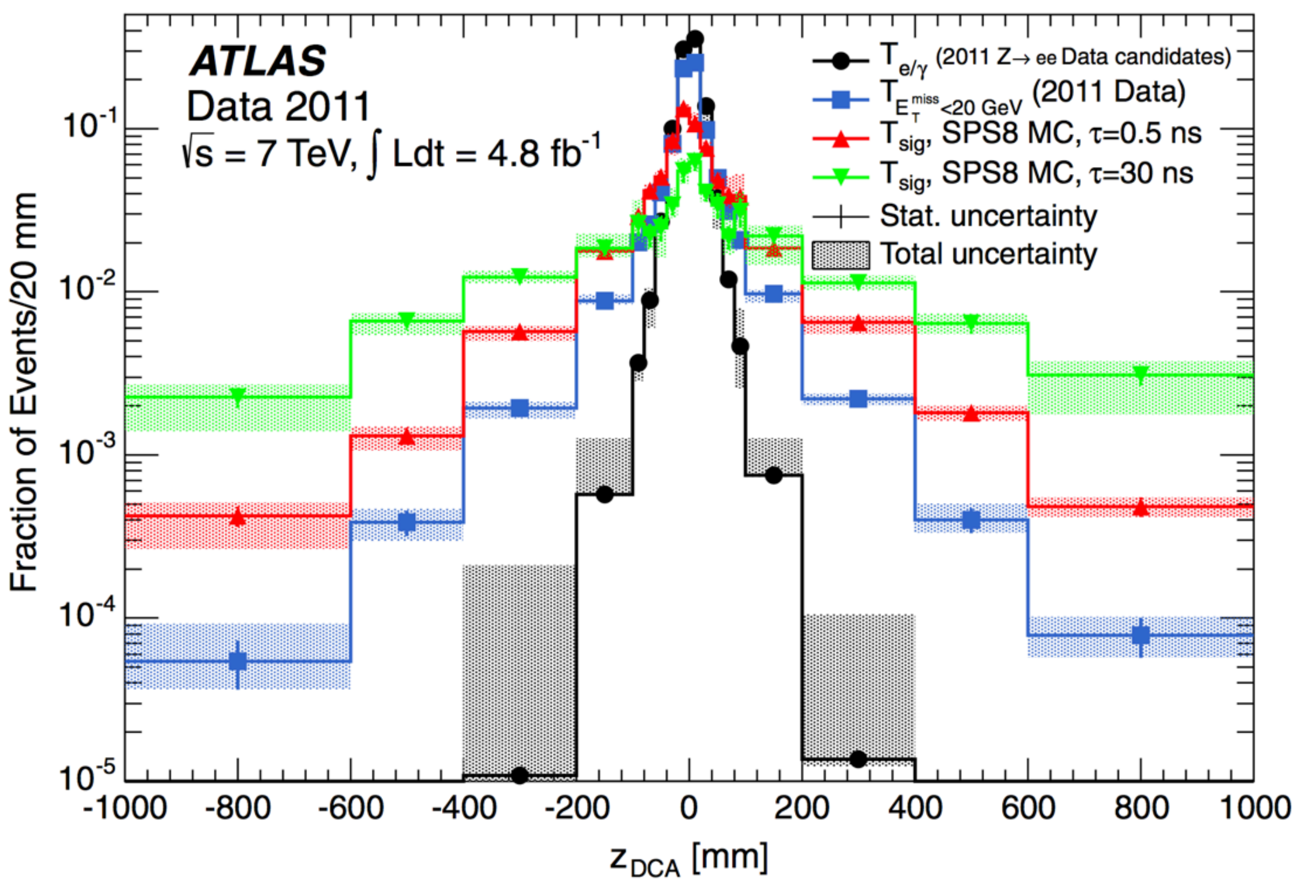


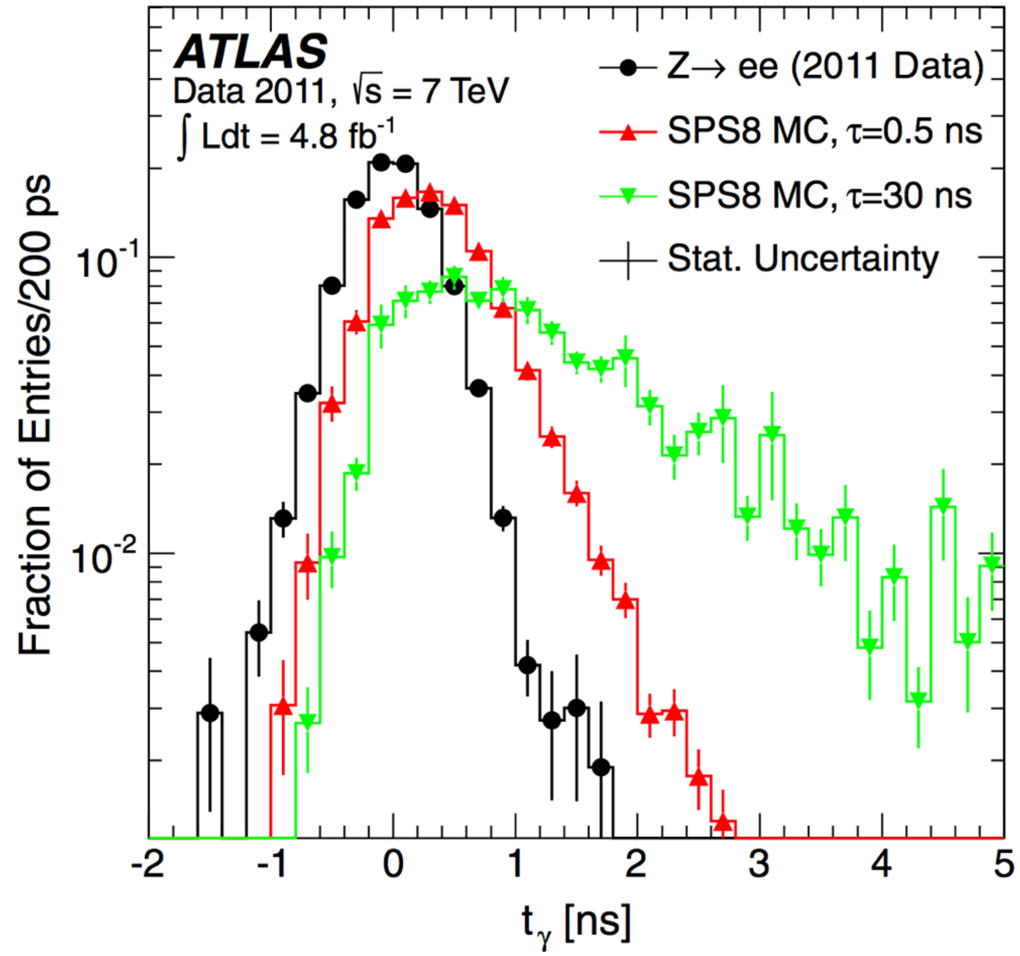
	Selection criteria				Number of events			
					$\sqrt{s} = 7$ TeV		$\sqrt{s} = 8$ TeV	
	p_T (GeV/c)	$I_{as}^{(\prime)}$	$1/\beta$	Mass (GeV/c^2)	Pred.	Obs.	Pred.	Obs.
Tracker-only	>70	>0.4	–	>0	7.1 ± 1.5	8	33 ± 7	41
				>100	6.0 ± 1.3	7	26 ± 5	29
				>200	0.65 ± 0.14	0	3.1 ± 0.6	3
				>300	0.11 ± 0.02	0	0.55 ± 0.11	1
				>400	0.030 ± 0.006	0	0.15 ± 0.03	0
Tracker+TOF	>70	>0.125	>1.225	>0	8.5 ± 1.7	7	44 ± 9	42
				>100	1.0 ± 0.2	3	5.6 ± 1.1	7
				>200	0.11 ± 0.02	1	0.56 ± 0.11	0
				>300	0.020 ± 0.004	0	0.090 ± 0.02	0
Muon-only	>230	–	>1.40	–	–	–	6 ± 3	3
$\lvert Q \rvert > 1e$	–	>0.500	>1.200	–	0.15 ± 0.04	0	0.52 ± 0.11	1
$\lvert Q \rvert < 1e$	>125	>0.275	–	–	0.12 ± 0.07	0	1.0 ± 0.2	0

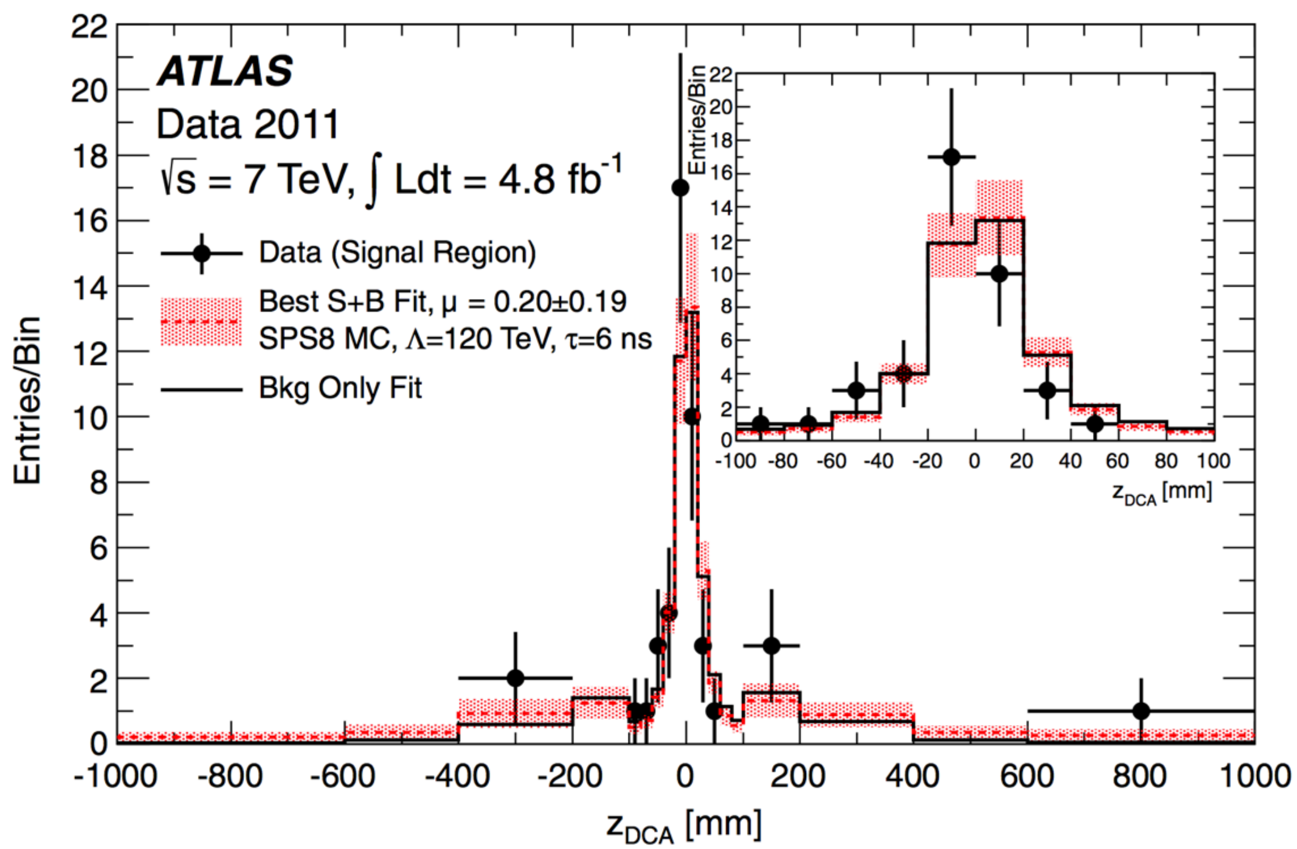


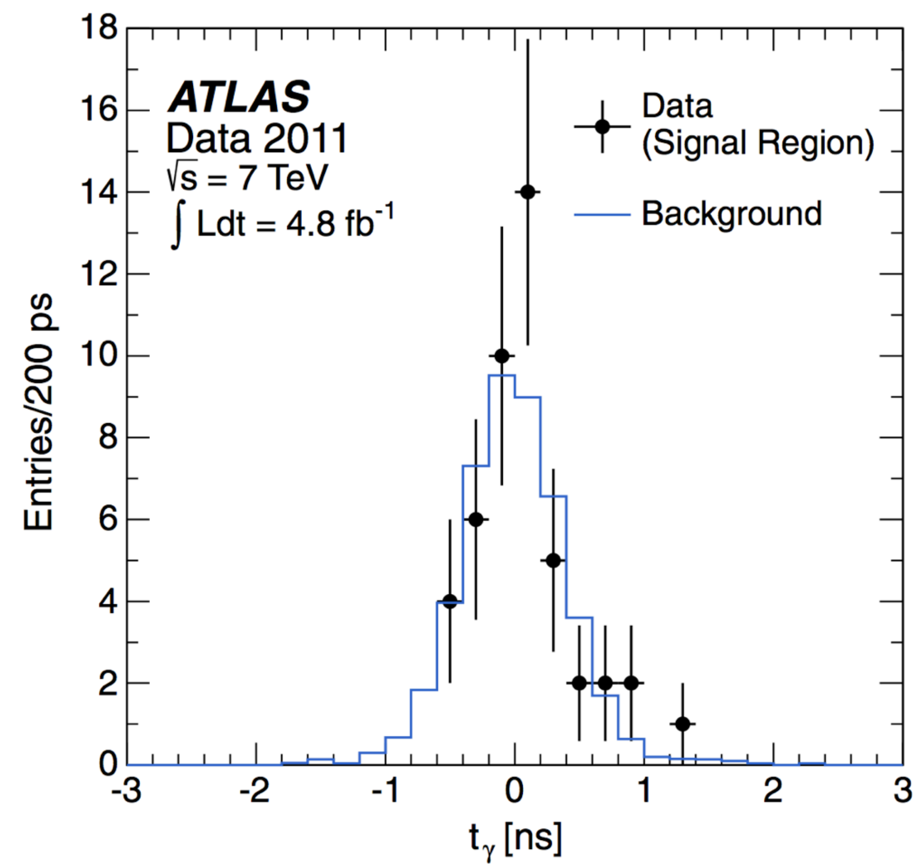
Non-pointing photons in diphoton+MET events

PRD 88, 012001 (2013)





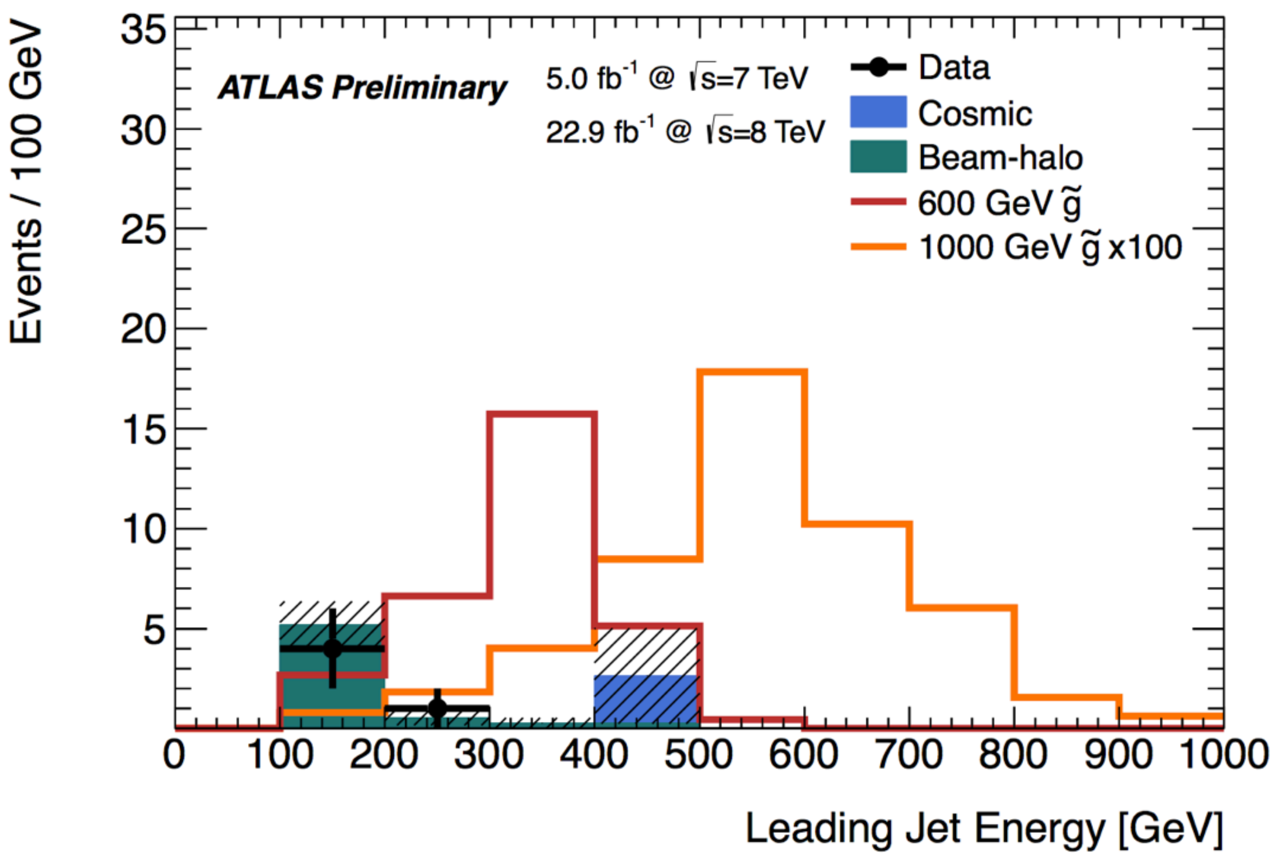


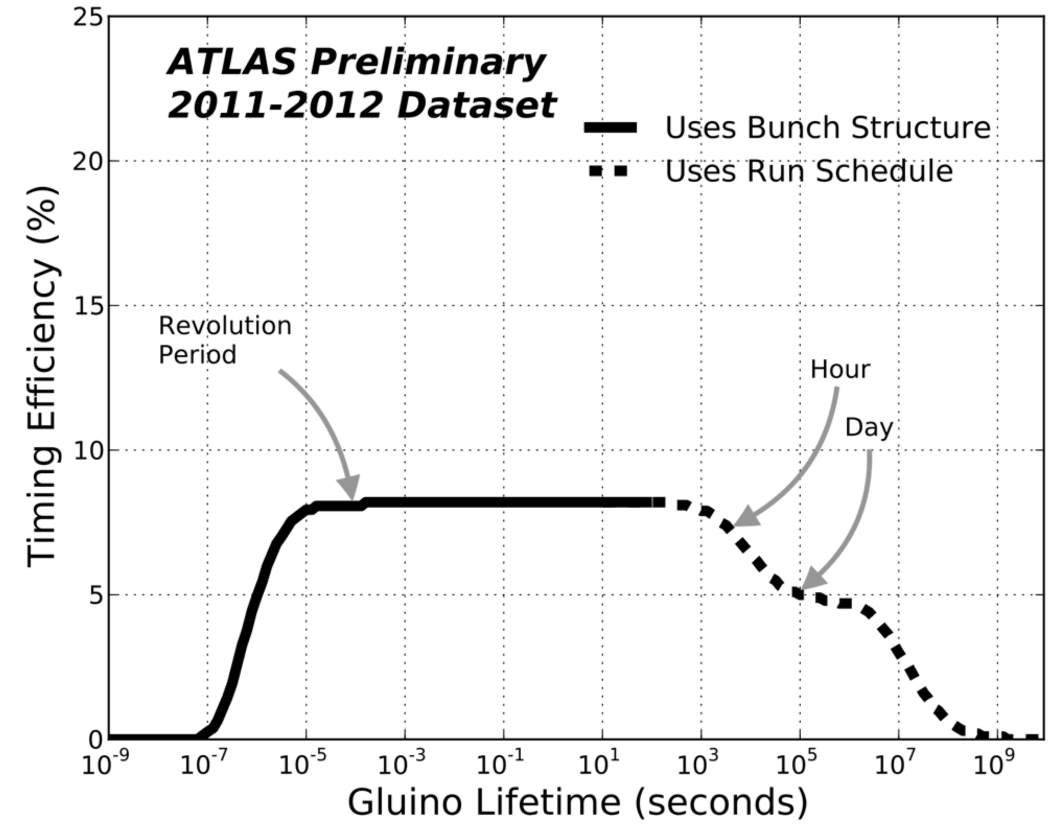


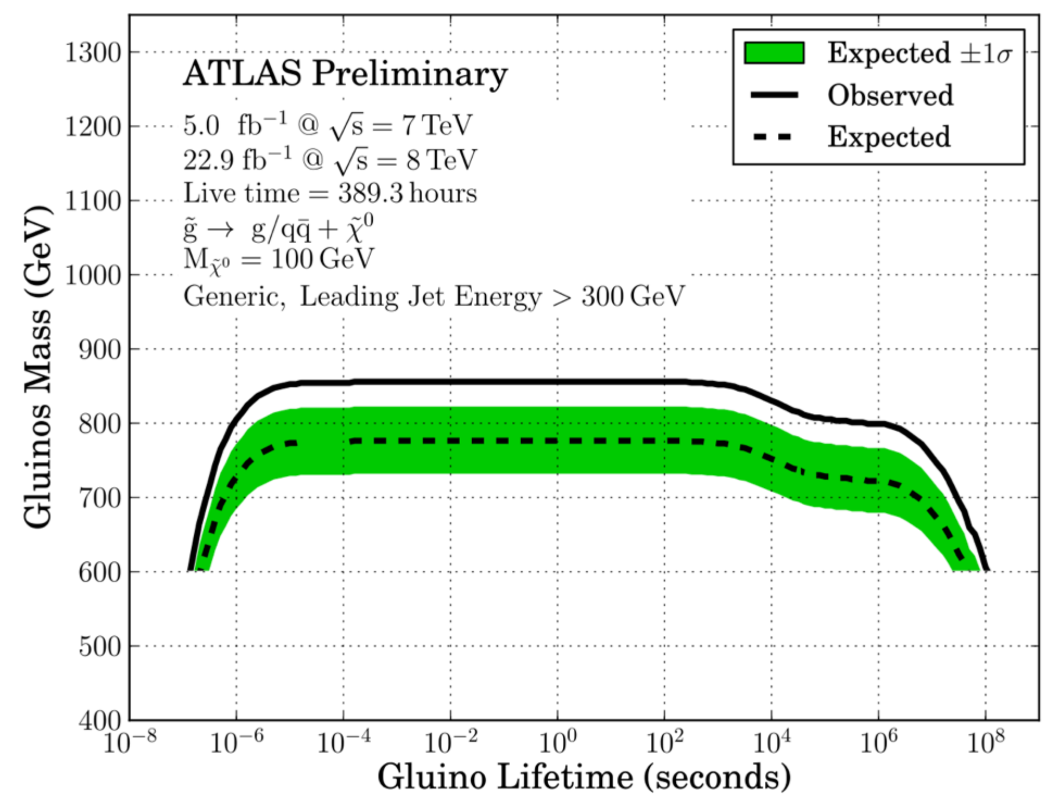
Search for Long-Lived Stopped Gluino R-hadrons

ATLAS-CONF-2013-057

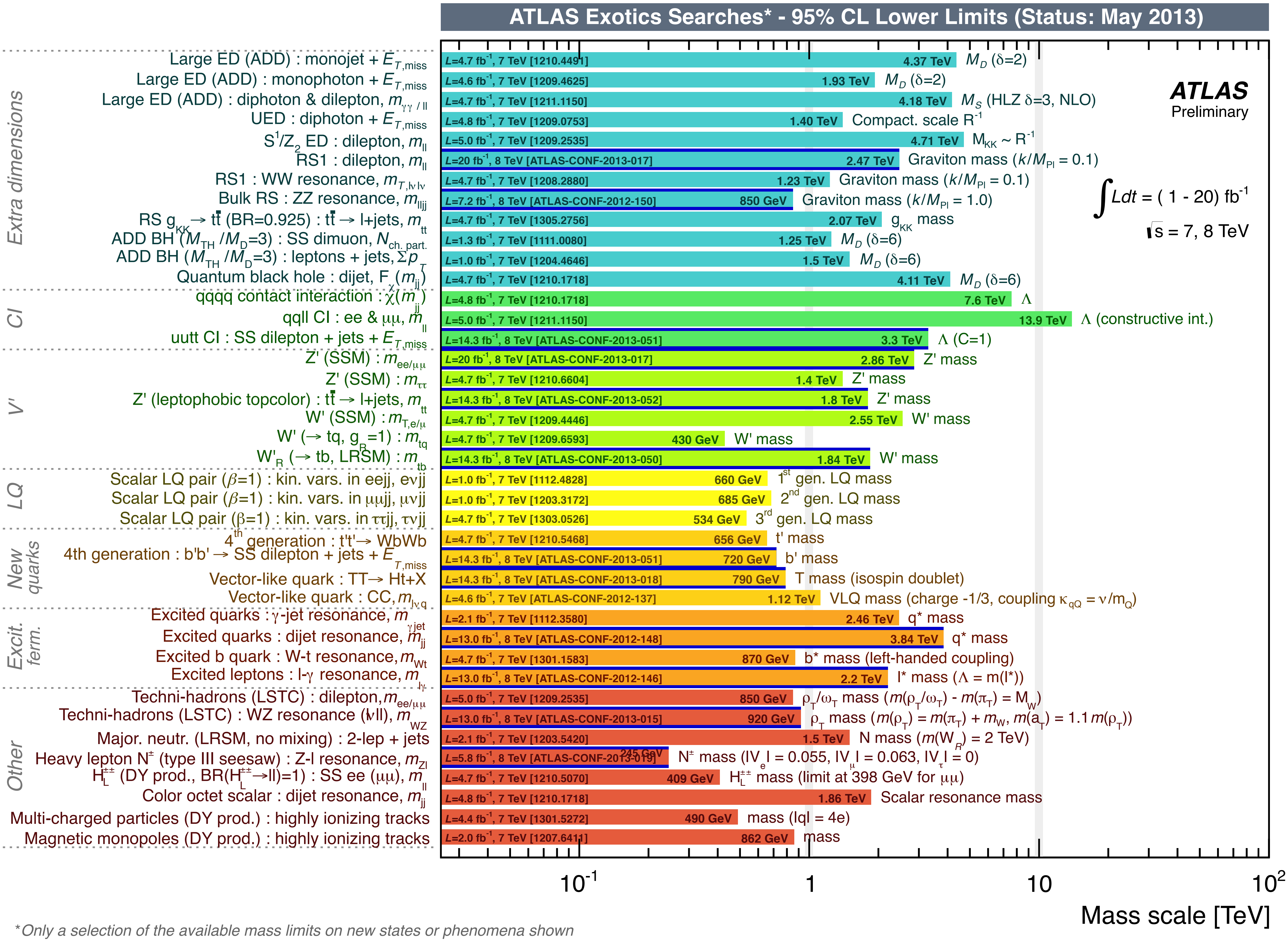
Data period	Delivered luminosity (fb^{-1})@CM energy (TeV)	Recorded empty live time (hours)
Cosmic	0.3 @ 7	125.8
Search	5.0 @ 7 + 22.9 @ 8	389.3
Total	5.3 @ 7 + 22.9 @ 8	515.1



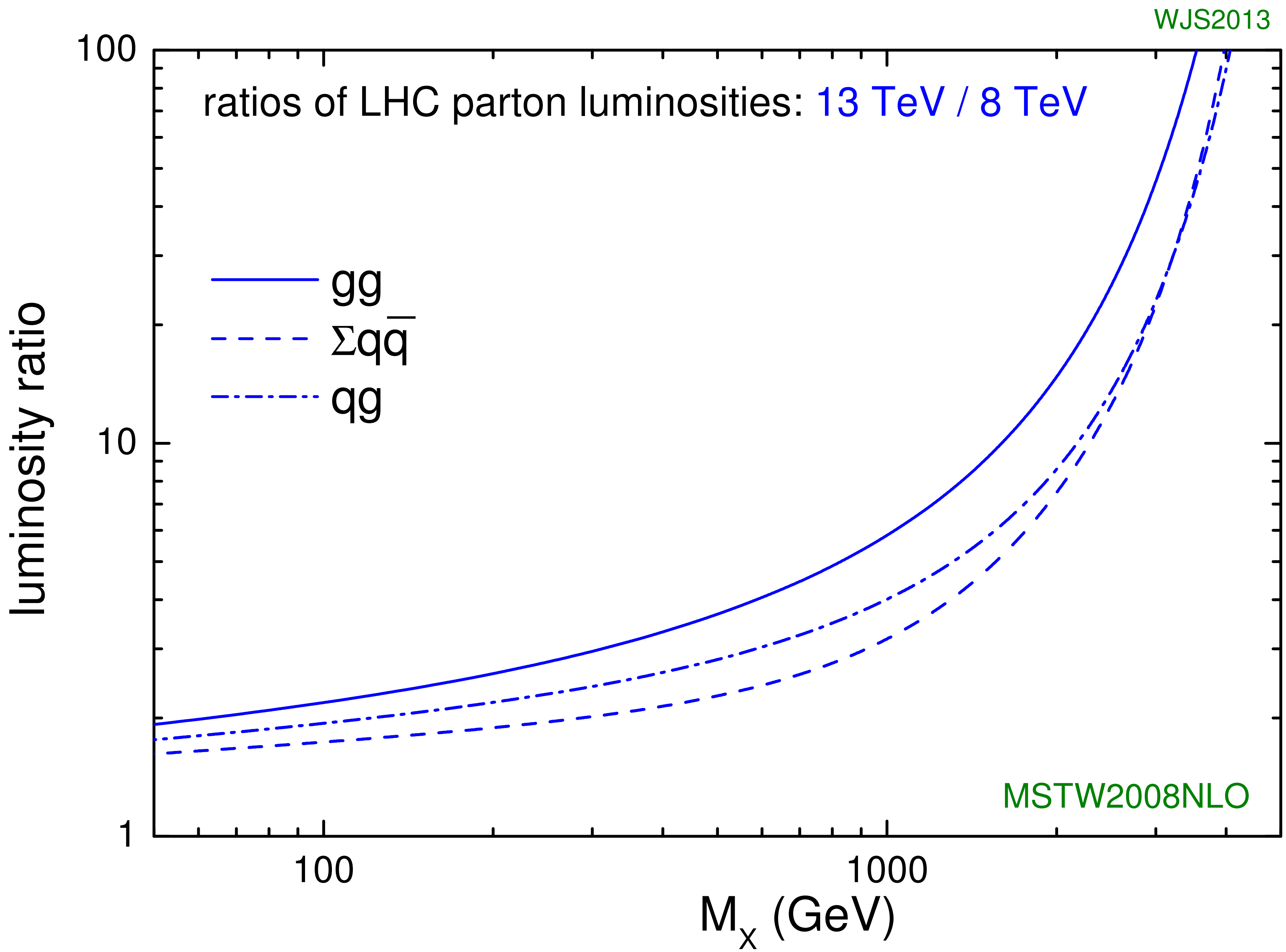




Leading jet energy (GeV)	*R*-hadron model	Gluino decay	Neutralino mass (GeV)	Limits on $m_{\tilde{g}}$ (GeV) Expected	Observed
100	Generic	$g/q\bar{q}+\tilde{\chi}^0$	$M_{\tilde{g}}$ − 100	549	572
100	Generic	$t\bar{t}+\tilde{\chi}^0$	$M_{\tilde{g}}$ − 380	711	723
300	Generic	$t\bar{t}+\tilde{\chi}^0$	100	722	809
300	Generic	$g/q\bar{q}+\tilde{\chi}^0$	100	763	857
300	Intermediate	$g/q\bar{q}+\tilde{\chi}^0$	100	635	722
300	Regge	$g/q\bar{q}+\tilde{\chi}^0$	100	687	788

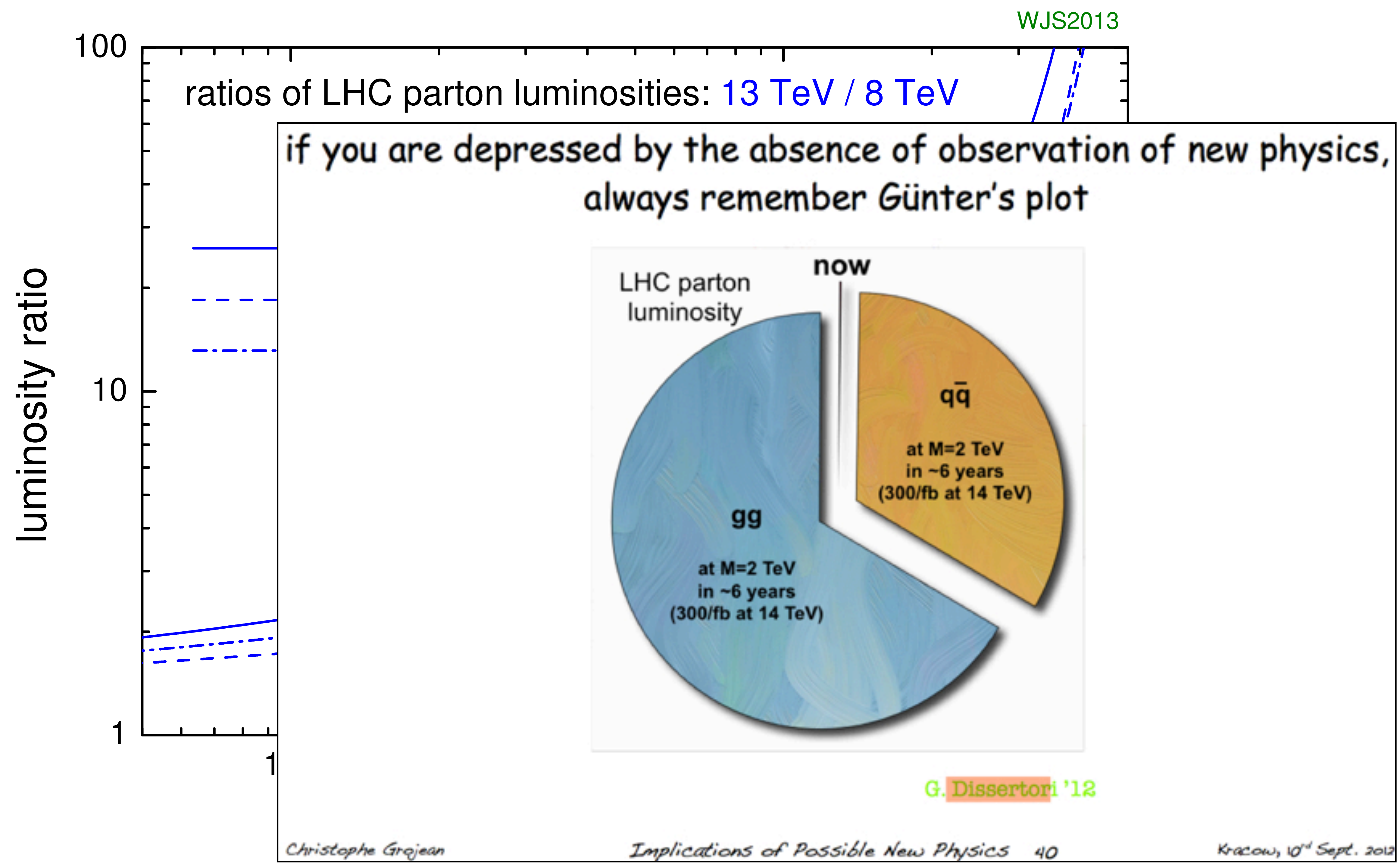

ATLAS Exotics Searches* - 95% CL Lower Limits (Status: May 2013)
ATLAS
Preliminary
∫Ldt = (1 - 20) fb^-1
√s = 7, 8 TeV
Extra dimensions
Large ED (ADD) : monojet + E_T,miss | L=4.7 fb^-1, 7 TeV [1210.4491] | 4.37 TeV | M_D (δ=2)
Large ED (ADD) : monophoton + E_T,miss | L=4.6 fb^-1, 7 TeV [1209.4625] | 1.93 TeV | M_D (δ=2)
Large ED (ADD) : diphoton & dilepton, m_γγ / ll | L=4.7 fb^-1, 7 TeV [1211.1150] | 4.18 TeV | M_S (HLZ δ=3, NLO)
UED : diphoton + E_T,miss | L=4.8 fb^-1, 7 TeV [1209.0753] | 1.40 TeV | Compact. scale R^-1
S^1/Z_2 ED : dilepton, m_ll | L=5.0 fb^-1, 7 TeV [1209.2535] | 4.71 TeV | M_KK ~ R^-1
RS1 : dilepton, m_ll | L=20 fb^-1, 8 TeV [ATLAS-CONF-2013-017] | 2.47 TeV | Graviton mass (k/M_Pl = 0.1)
RS1 : WW resonance, m_T,lνlν | L=4.7 fb^-1, 7 TeV [1208.2880] | 1.23 TeV | Graviton mass (k/M_Pl = 0.1)
Bulk RS : ZZ resonance, m_lljj | L=7.2 fb^-1, 8 TeV [ATLAS-CONF-2012-150] | 850 GeV | Graviton mass (k/M_Pl = 1.0)
RS g_KK → tt̄ (BR=0.925) : tt̄ → l+jets, m_tt | L=4.7 fb^-1, 7 TeV [1305.2756] | 2.07 TeV | g_KK mass
ADD BH (M_TH /M_D=3) : SS dimuon, N_ch. part. | L=1.3 fb^-1, 7 TeV [1111.0080] | 1.25 TeV | M_D (δ=6)
ADD BH (M_TH /M_D=3) : leptons + jets, Σp_T | L=1.0 fb^-1, 7 TeV [1204.4646] | 1.5 TeV | M_D (δ=6)
Quantum black hole : dijet, F_χ(m_jj) | L=4.7 fb^-1, 7 TeV [1210.1718] | 4.11 TeV | M_D (δ=6)
CI
qqqq contact interaction : χ(m_jj) | L=4.8 fb^-1, 7 TeV [1210.1718] | 7.6 TeV | Λ
qqll CI : ee & μμ, m_ll | L=5.0 fb^-1, 7 TeV [1211.1150] | 13.9 TeV | Λ (constructive int.)
uutt CI : SS dilepton + jets + E_T,miss | L=14.3 fb^-1, 8 TeV [ATLAS-CONF-2013-051] | 3.3 TeV | Λ (C=1)
V'
Z' (SSM) : m_ee/μμ | L=20 fb^-1, 8 TeV [ATLAS-CONF-2013-017] | 2.86 TeV | Z' mass
Z' (SSM) : m_ττ | L=4.7 fb^-1, 7 TeV [1210.6604] | 1.4 TeV | Z' mass
Z' (leptophobic topcolor) : tt̄ → l+jets, m_tt | L=14.3 fb^-1, 8 TeV [ATLAS-CONF-2013-052] | 1.8 TeV | Z' mass
W' (SSM) : m_T,e/μ | L=4.7 fb^-1, 7 TeV [1209.4446] | 2.55 TeV | W' mass
W' (→ tq, g_R=1) : m_tq | L=4.7 fb^-1, 7 TeV [1209.6593] | 430 GeV | W' mass
W'_R (→ tb, LRSM) : m_tb | L=14.3 fb^-1, 8 TeV [ATLAS-CONF-2013-050] | 1.84 TeV | W' mass
LQ
Scalar LQ pair (β=1) : kin. vars. in eejj, eνjj | L=1.0 fb^-1, 7 TeV [1112.4828] | 660 GeV | 1st gen. LQ mass
Scalar LQ pair (β=1) : kin. vars. in μμjj, μνjj | L=1.0 fb^-1, 7 TeV [1203.3172] | 685 GeV | 2nd gen. LQ mass
Scalar LQ pair (β=1) : kin. vars. in ττjj, τνjj | L=4.7 fb^-1, 7 TeV [1303.0526] | 534 GeV | 3rd gen. LQ mass
New quarks
4th generation : t't'→ WbWb | L=4.7 fb^-1, 7 TeV [1210.5468] | 656 GeV | t' mass
4th generation : b'b' → SS dilepton + jets + E_T,miss | L=14.3 fb^-1, 8 TeV [ATLAS-CONF-2013-051] | 720 GeV | b' mass
Vector-like quark : TT→ Ht+X | L=14.3 fb^-1, 8 TeV [ATLAS-CONF-2013-018] | 790 GeV | T mass (isospin doublet)
Vector-like quark : CC, m_lνq | L=4.6 fb^-1, 7 TeV [ATLAS-CONF-2012-137] | 1.12 TeV | VLQ mass (charge -1/3, coupling κ_qQ = ν/m_Q)
Excit. ferm.
Excited quarks : γ-jet resonance, m_γjet | L=2.1 fb^-1, 7 TeV [1112.3580] | 2.46 TeV | q* mass
Excited quarks : dijet resonance, m_jj | L=13.0 fb^-1, 8 TeV [ATLAS-CONF-2012-148] | 3.84 TeV | q* mass
Excited b quark : W-t resonance, m_Wt | L=4.7 fb^-1, 7 TeV [1301.1583] | 870 GeV | b* mass (left-handed coupling)
Excited leptons : l-γ resonance, m_lγ | L=13.0 fb^-1, 8 TeV [ATLAS-CONF-2012-146] | 2.2 TeV | l* mass (Λ = m(l*))
Other
Techni-hadrons (LSTC) : dilepton, m_ee/μμ | L=5.0 fb^-1, 7 TeV [1209.2535] | 850 GeV | ρ_T/ω_T mass (m(ρ_T/ω_T) - m(π_T) = M_W)
Techni-hadrons (LSTC) : WZ resonance (lνll), m_WZ | L=13.0 fb^-1, 8 TeV [ATLAS-CONF-2013-015] | 920 GeV | ρ_T mass (m(ρ_T) = m(π_T) + m_W, m(a_T) = 1.1 m(ρ_T))
Major. neutr. (LRSM, no mixing) : 2-lep + jets | L=2.1 fb^-1, 7 TeV [1203.5420] | 1.5 TeV | N mass (m(W_R) = 2 TeV)
Heavy lepton N^± (type III seesaw) : Z-l resonance, m_Zl | L=5.8 fb^-1, 8 TeV [ATLAS-CONF-2013-019] | 245 GeV | N^± mass (|V_e| = 0.055, |V_μ| = 0.063, |V_τ| = 0)
H_L^±± (DY prod., BR(H_L^±±→ll)=1) : SS ee (μμ), m_ll | L=4.7 fb^-1, 7 TeV [1210.5070] | 409 GeV | H_L^±± mass (limit at 398 GeV for μμ)
Color octet scalar : dijet resonance, m_jj | L=4.8 fb^-1, 7 TeV [1210.1718] | 1.86 TeV | Scalar resonance mass
Multi-charged particles (DY prod.) : highly ionizing tracks | L=4.4 fb^-1, 7 TeV [1301.5272] | 490 GeV | mass (|q| = 4e)
Magnetic monopoles (DY prod.) : highly ionizing tracks | L=2.0 fb^-1, 7 TeV [1207.6411] | 862 GeV | mass
10^-1
1
10
10^2
Mass scale [TeV]
*Only a selection of the available mass limits on new states or phenomena shown

Effective Luminosity Increases in 2015



http://www.hep.phy.cam.ac.uk/~wjs/plots/plots.html

Effective Luminosity Increases in 2015



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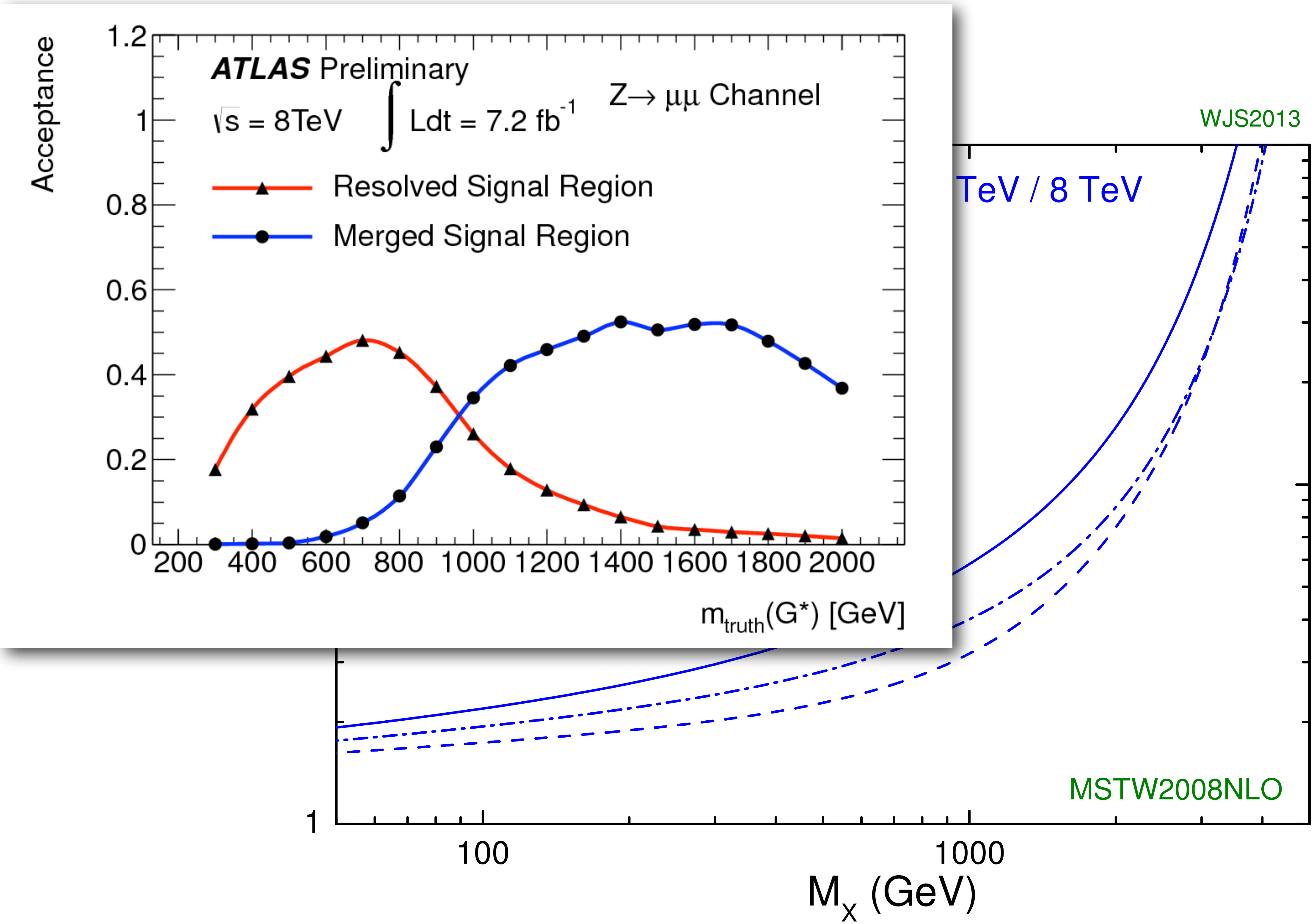


http://www.hep.phy.cam.ac.uk/~wjs/plots/plots.html

Outlook

Exotics searches have been very busy with the Run I datasets

- Small teams (in some cases single people) have covered a lot of interesting ground
- But there remains much left undone
  - see JetPlusXAnalysisIdeas for some examples well-motivated analyses just in the Jet+X group

Exotics are a crucial and promising part of the Run II physics program

- It will take a long time to significantly improve measurements of Higgs coupling ratios
- High mass searches in 13/14 TeV collisions will quickly surpass much of what I've just shown

Many opportunities for new postdocs/students to do interesting work

- Strong ties to combined performance groups due to special needs (e.g.high pT objects)
- Friendly culture
- Wide lattitude for topics, scope, team size, pace, level of experience, etc.
- US ATLAS represented in leadership: both conveners (Stephane Willocq & Tobias Golling, starting October) convener roles for 4/5 Exotics subgroups

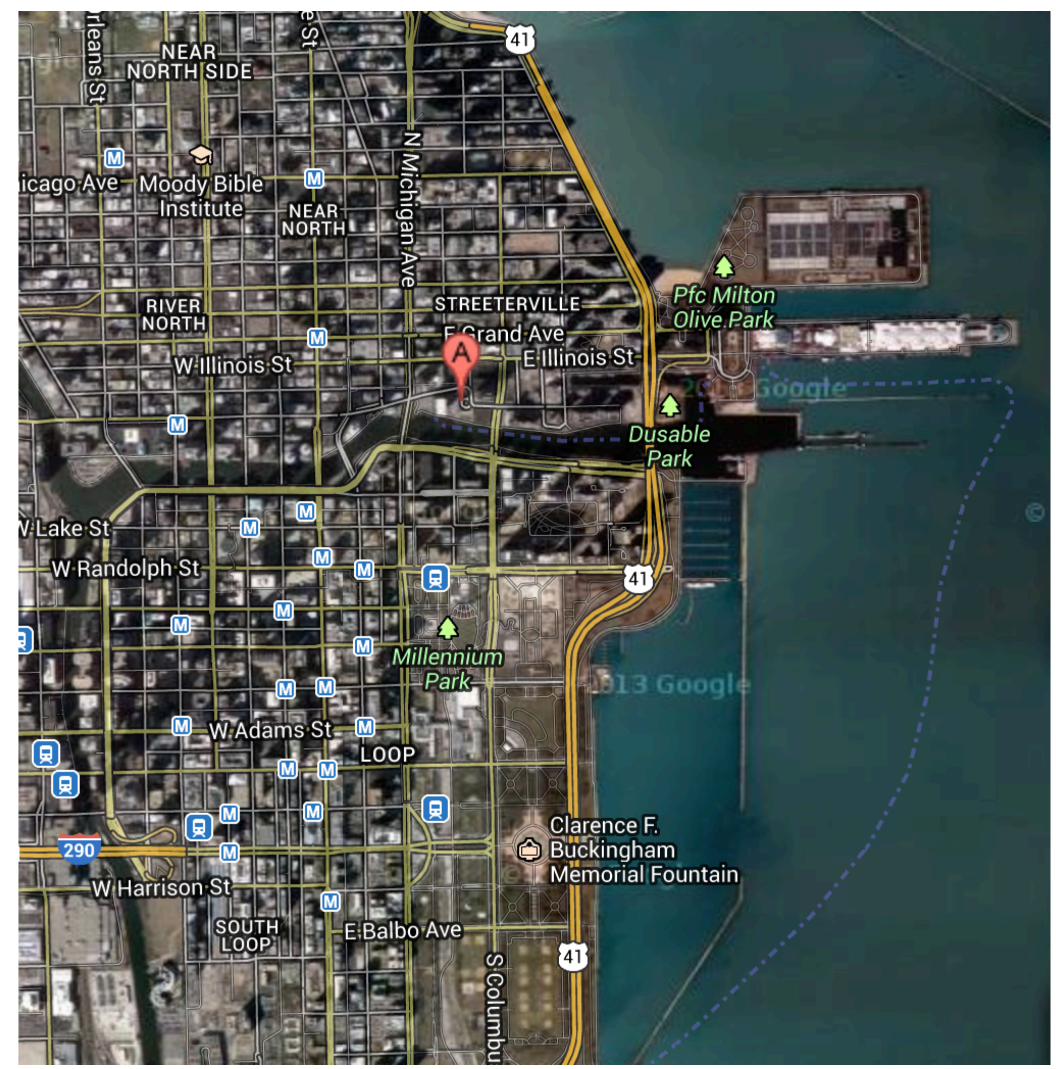
Additional Slides

2013 Hadronic Calibration Workshop

The ninth annual ATLAS Hadronic Calibration Workshop will be held in Chicago, Illinois, USA, from September 23–26, 2013.

Workshop Homepage: http://hcw2013.uchicago.edu/

“The format of the workshop follows the tradition of the previous workshops with emphasis on discussions. Based on the material submitted, session conveners will guide the discussions. The focus of this year's workshop is to review the calibration and analysis strategies for Run 1, and to prepare and organize for the reconstruction and calibration of jets and missing ET for Run 2, and Run 3.”



Dark Matter at the LHC Workshop

- http://kicp-workshops.uchicago.edu/DM-LHC2013

“The workshop will include both theorists and experimentalists actively working on LHC signals of dark matter. The focus will be on model independent approaches. Some topics we plan to cover are monojet, monophoton, and related searches, and improvements in theoretical predictions and experimental techniques. The goal of the meeting is to discuss avenues for taking full advantage of the next LHC run for dark matter studies. This includes exploring new signals of DM models that may be challenging for direct detection or indirect detection experiments, as well as more sophisticated calculations and analyses to improve existing searches.”

Topics:

Monojet searches for dark matter

Mono-photon, mono-Z, mono-b, and other signatures

Effective field theory constraints

Theoretical improvements in calculations