ATLAS Highlights and Outlook

US LHC Users Association

Argonne National Laboratory
November 13, 2014

Chip Brock, for the ATLAS Collaboration
Michigan State University

ATLAS @work

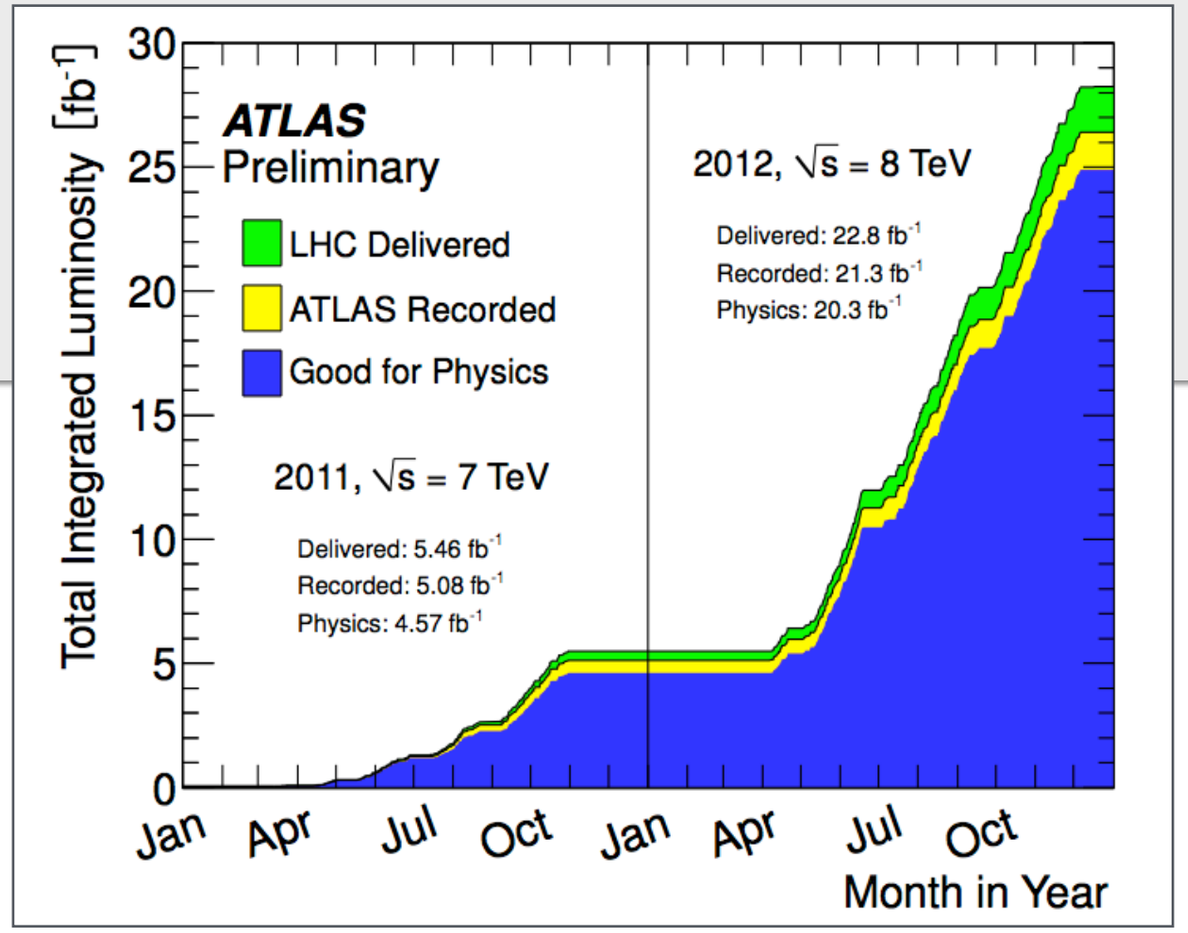
efficient and productive

~90% usable data efficiency

2010: $\sqrt{s}$ = 7 TeV, 0.05/fb

2011: $\sqrt{s}$ = 7 TeV, 4.6/fb

2012: $\sqrt{s}$ = 8 TeV, 20.3/fb



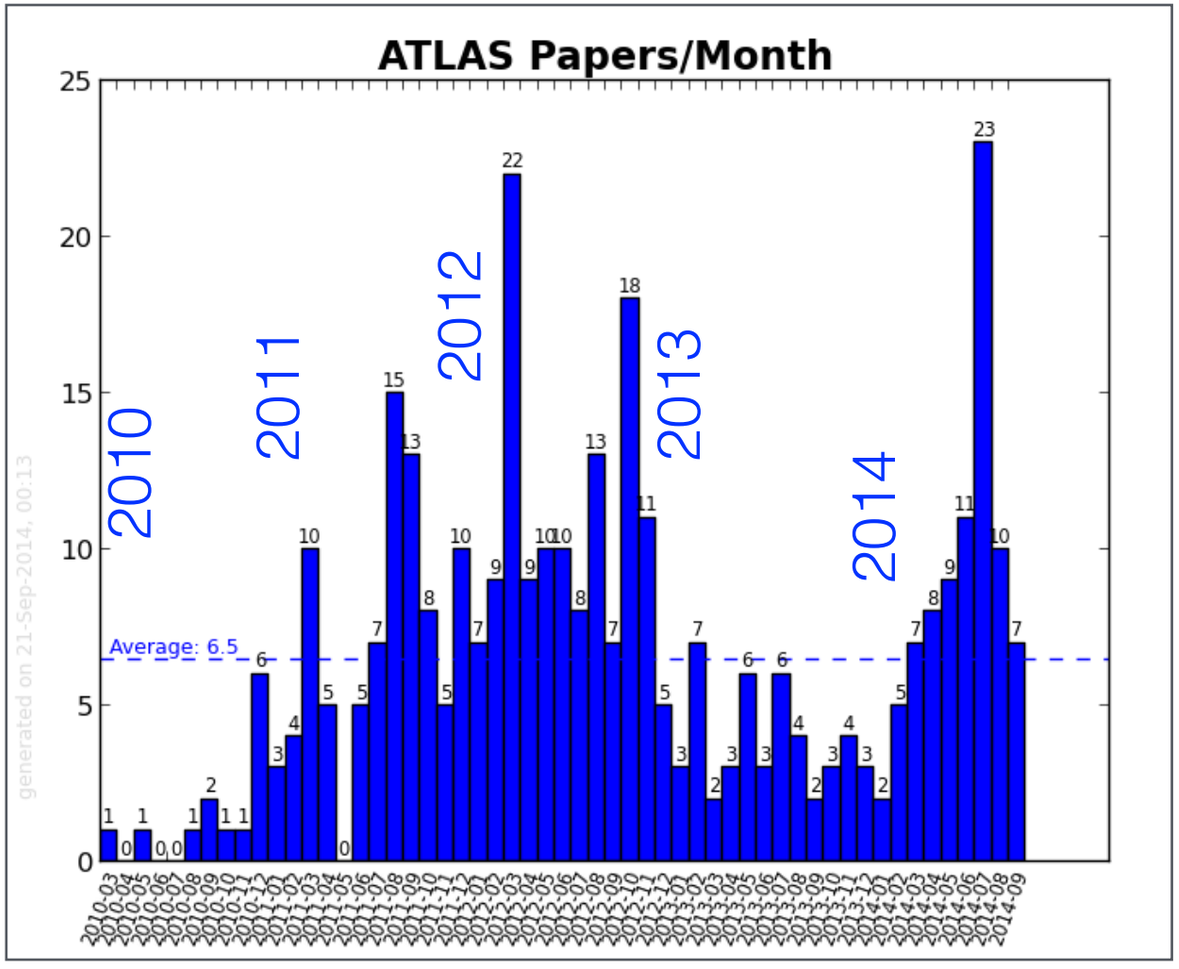
Run I results: a 2014 publication stream

350 publications, ~150 performance

~100 to come

600 CONF notes

660 conference talks



Snowmass Energy Frontier

Research Program:

1. **Measure properties of the Higgs boson.**

   Including: mass, CP properties, and especially couplings

2. **Measure properties of the: t, W, and Z**

   Because they talk “loudly” to the Higgs

3. **Search for TeV-scale particles**

   A scale inspired by naturalness

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I'll add:

4. **Wrestle the Standard Model to the ground.**

5. **Search for kinematical anomalies wrt SM (see #4)**

1%

buckle in

- The LHC running is just beginning

(Anadi Canepa, today)

you are here

“phase 0 upgrades”

“phase 1 upgrades”

2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Run I 8 TeV 0.75 10^{34} $cm^{-2}s^{-1}$				Run II 13-14 TeV 1.5 10^{34} $cm^{-2}s^{-1}$					Run III 14 TeV 1.7-2.2 10^{34} $cm^{-2}s^{-1}$				

~x2

~x2

20 fb^{-1}

100 fb^{-1}

300 fb^{-1}

stay buckled in

"phase 2 upgrades"

2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038

Run III
14 TeV
1.7-2.2 10^{34} $cm^{-2}s^{-1}$

Run IV
14 TeV
1.7-2.2 10^{34} $cm^{-2}s^{-1}$

Run IV
14 TeV
1.7-2.2 10^{34} $cm^{-2}s^{-1}$

3000 fb^{-1}

Is excitement about Run 2...

sort of ...underwhelming?

Rule of thumb: a x10 increase in $\mathscr{L}$ is like x2 in E_{cm}

and visa versa

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Rule of thumb: a x10 increase in $\mathscr{L}$ is like x2 in E_{cm}

and visa versa

Run 2 nearly gives us both leading to:

Unprecedented precision

W ’s, tops, Higgs!, flavor, inclusive σ ’s,

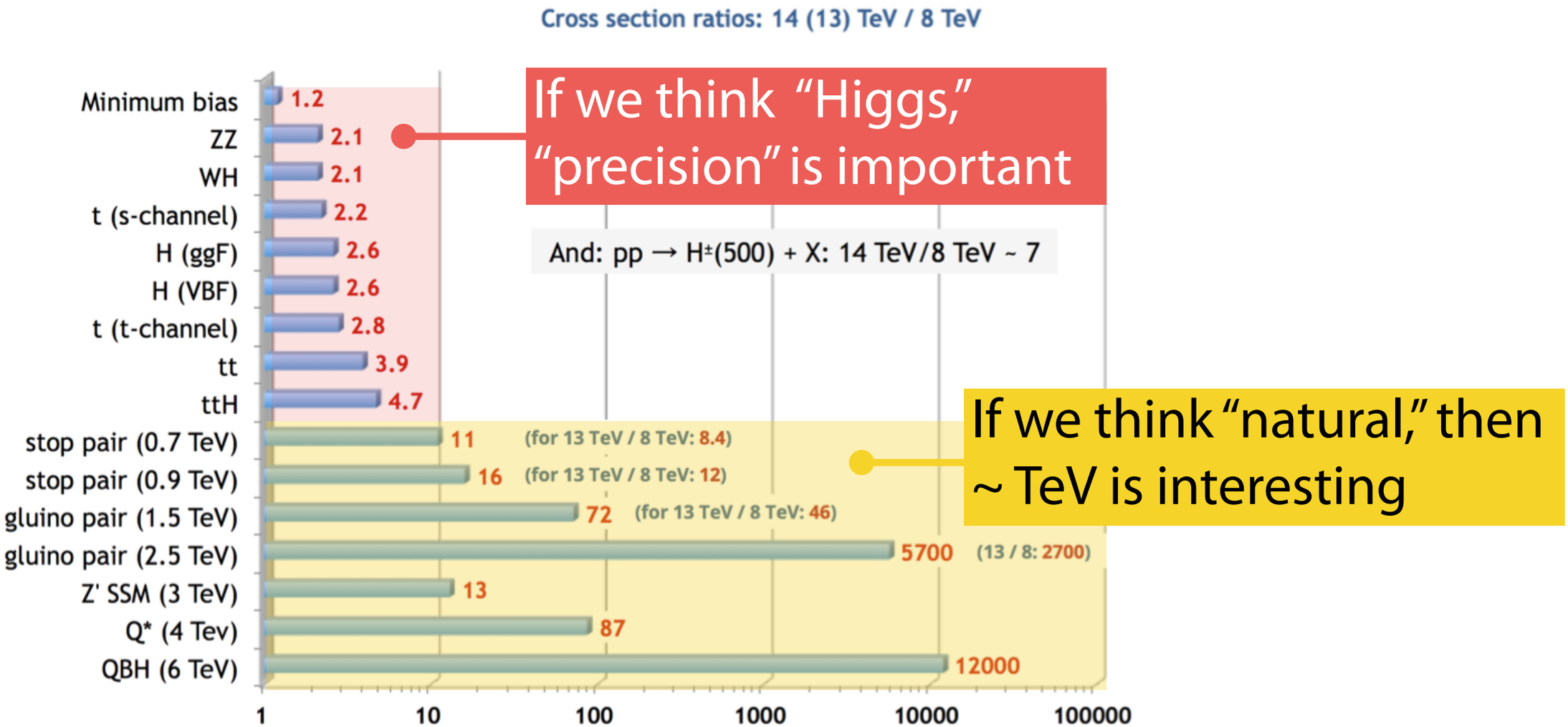
Significant discovery reach

surpass the 1 TeV SUSY scale, Z'/W', BSM Higgs

x2

Higher energy:

larger cross sections, more partons



Run 1 is essentially a wrap

Higgs Boson Physics

Notable results

from Run 1 we anticipated:

Discovery, first looks

from Run 1 we achieved:

Discovery, indeed. and more:

mass, couplings, important final states, differential distributions

in Run 2, we expect:

Cross sections 13/14 TeV, ttH, high mass BSM searches, combination precision couplings, differential distributions

~x10 more statistics

Higgs Boson mass

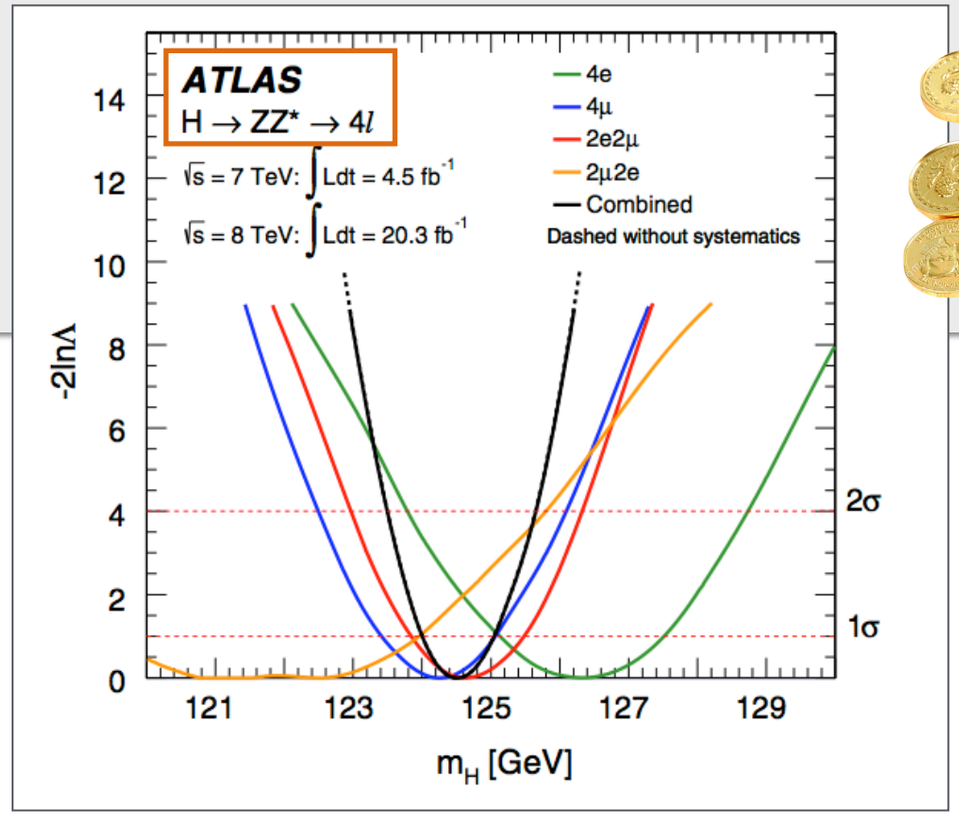
Agony and Ecstasy

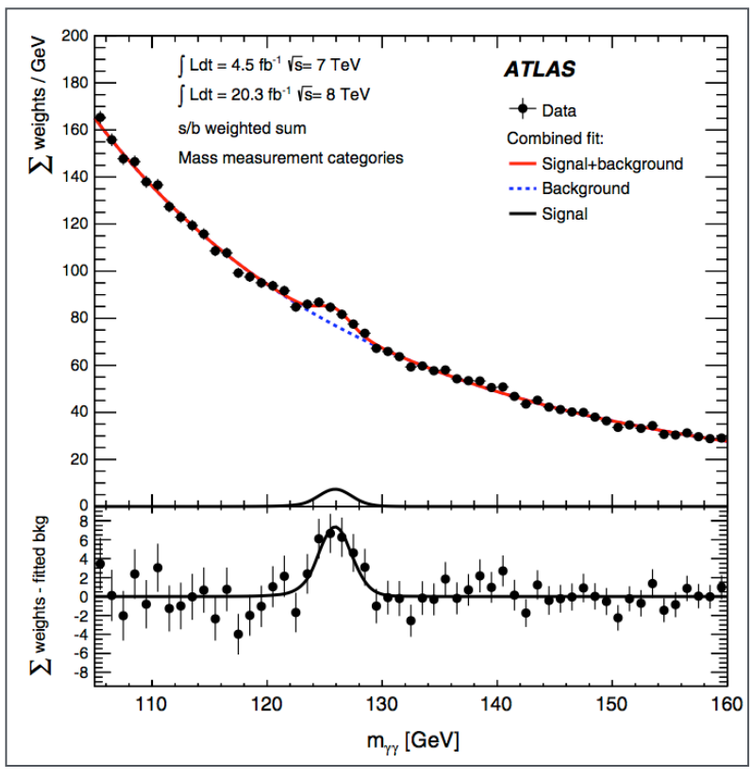
Agony:

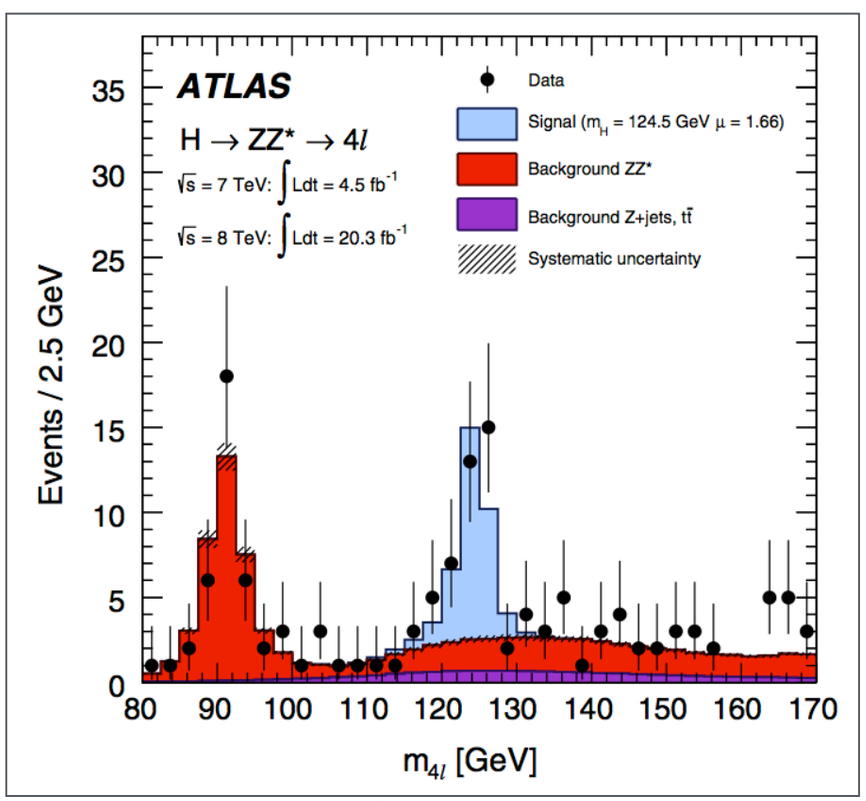
m_H only ~ 125 GeV

Ecstasy:

m_H precisely = 125.36 ± 0.37 ± 0.18 GeV $\gamma\gamma$ and Z^*Z







(Laser Kaplan, Today)

~ 40 signal/channel

Run II: expect 400-500

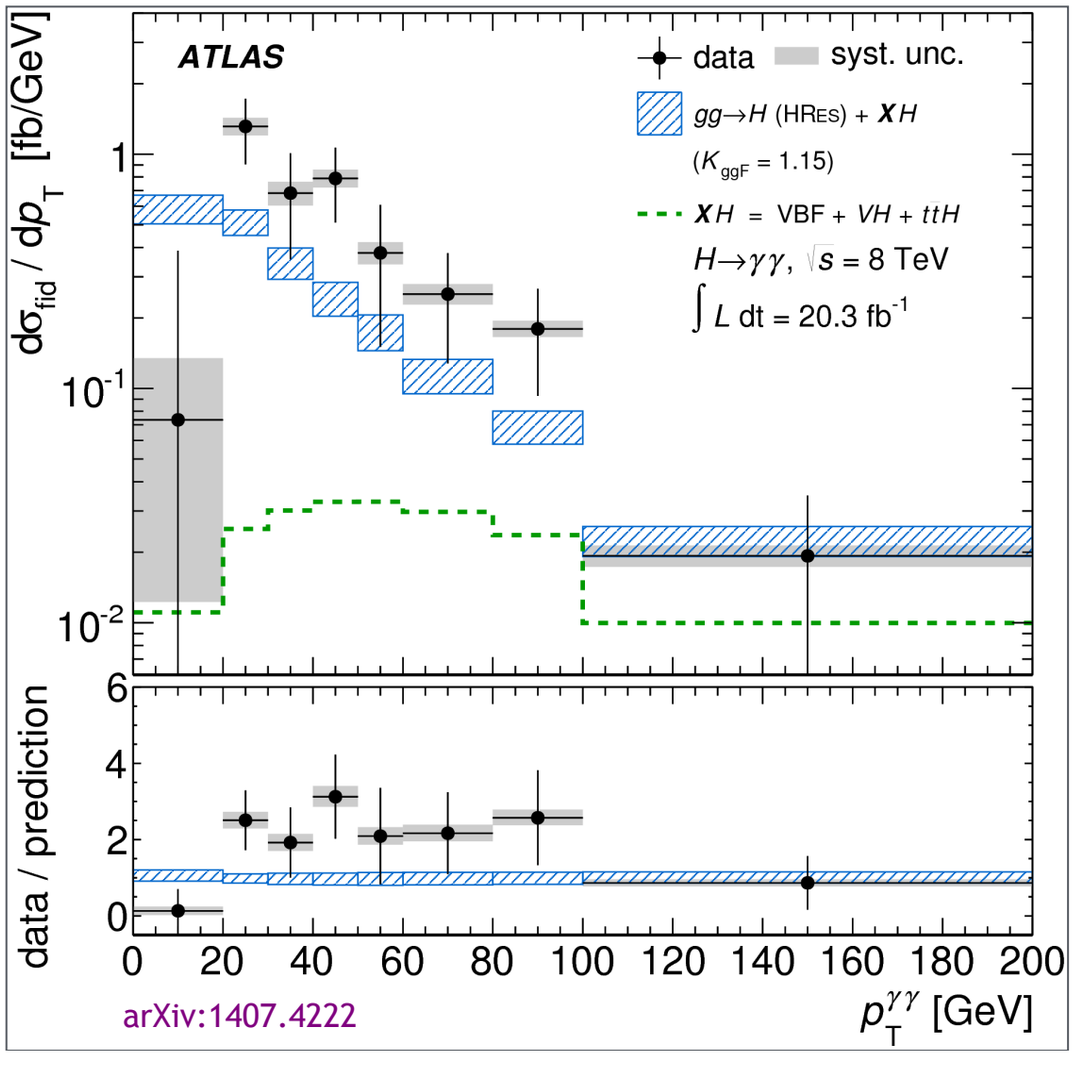
PHYSICAL REVIEW D 90, 052004 (2014)

Higgs in slices

differential distributions

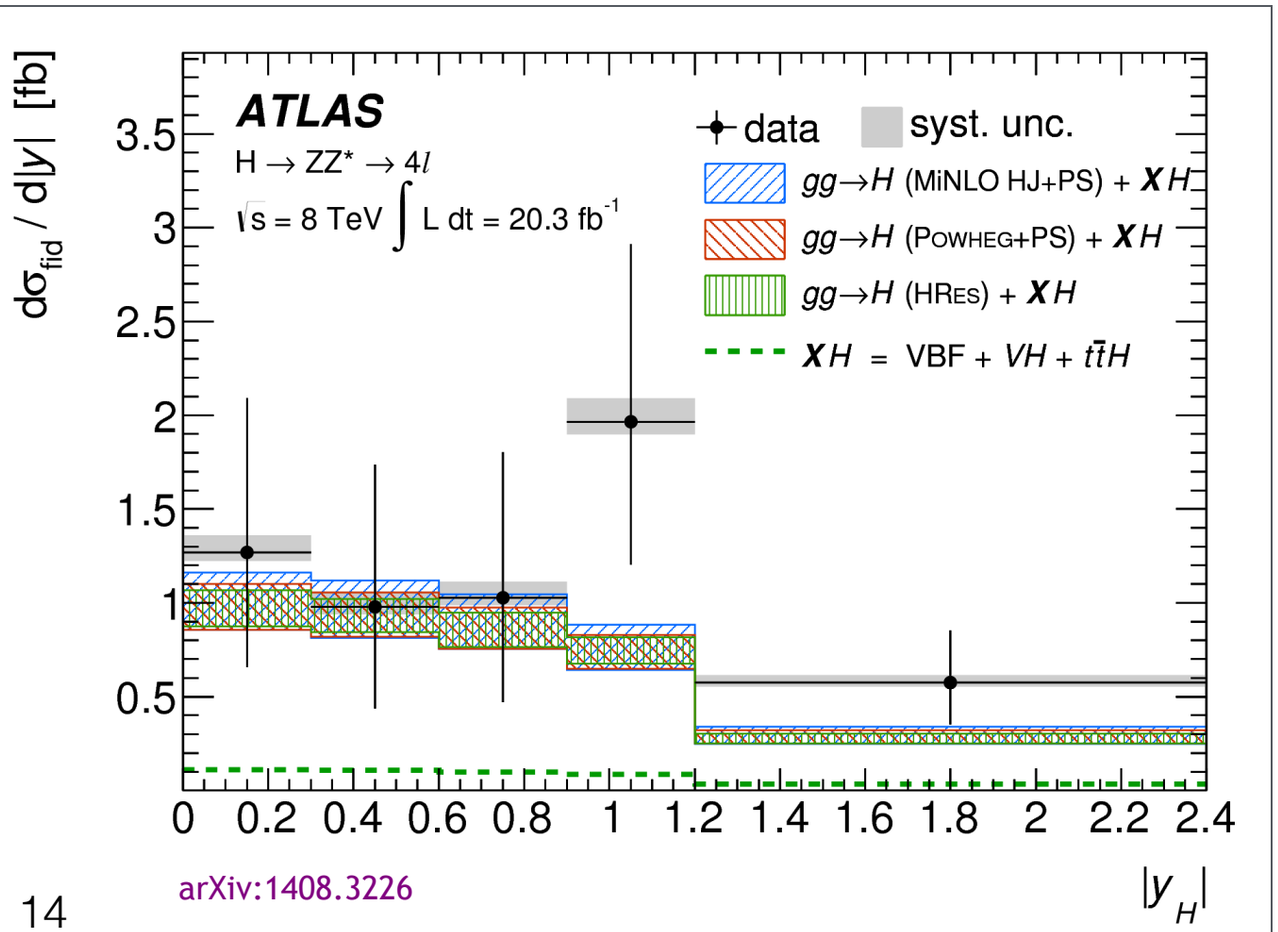
the details unfolded to the particle level

$H \to \gamma\gamma$ $gg \to H$ HRES



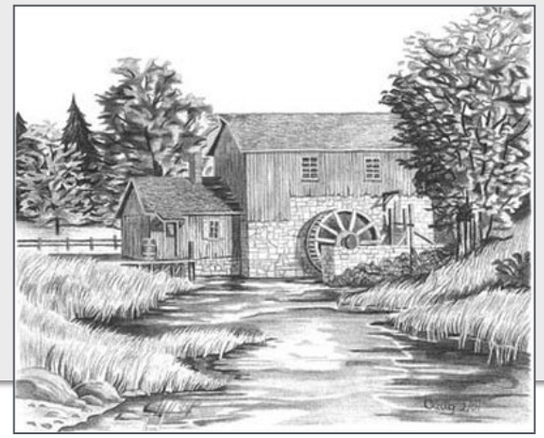
$H \to ZZ^* \to 4\ell$

$gg \to H$ MiNLO, POWHEG, HRES2



Higgs couplings, 1

signal strengths, small, vibrant industry

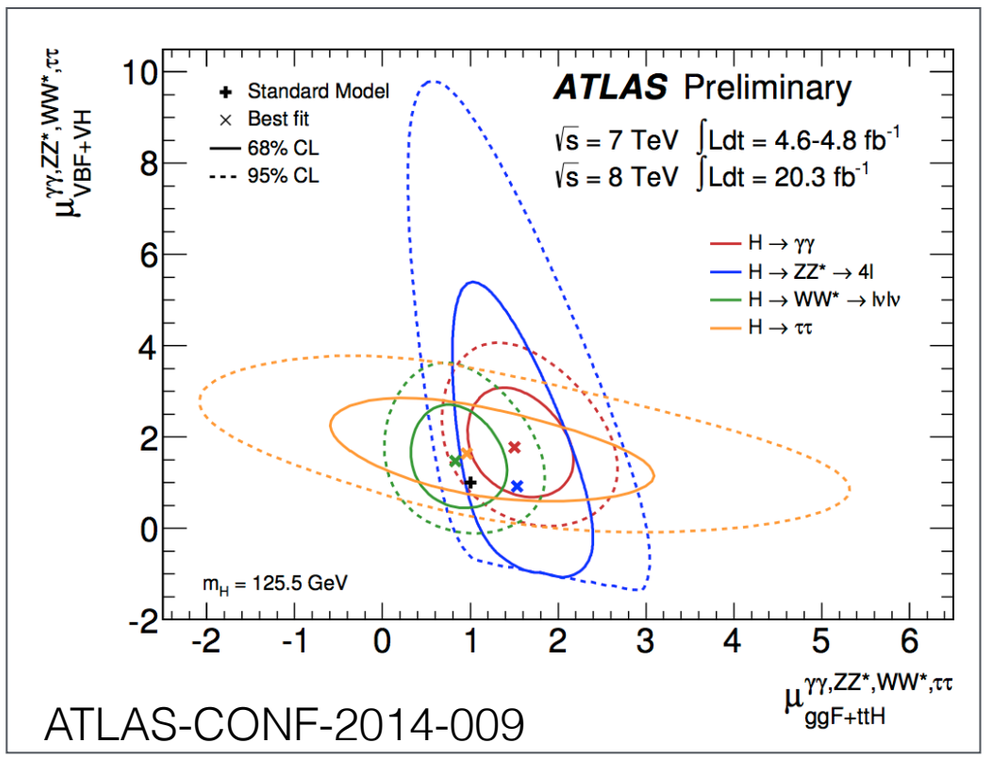


succession of assumptions

least constrained, signal strength:

other fits with constraints

$$\mu_{VBF+VH} = \mu_{VBF} = \mu_{VH} \quad \mu_{ggf+t\bar{t}H} = \mu_{ggf} = \mu_{t\bar{t}}$$



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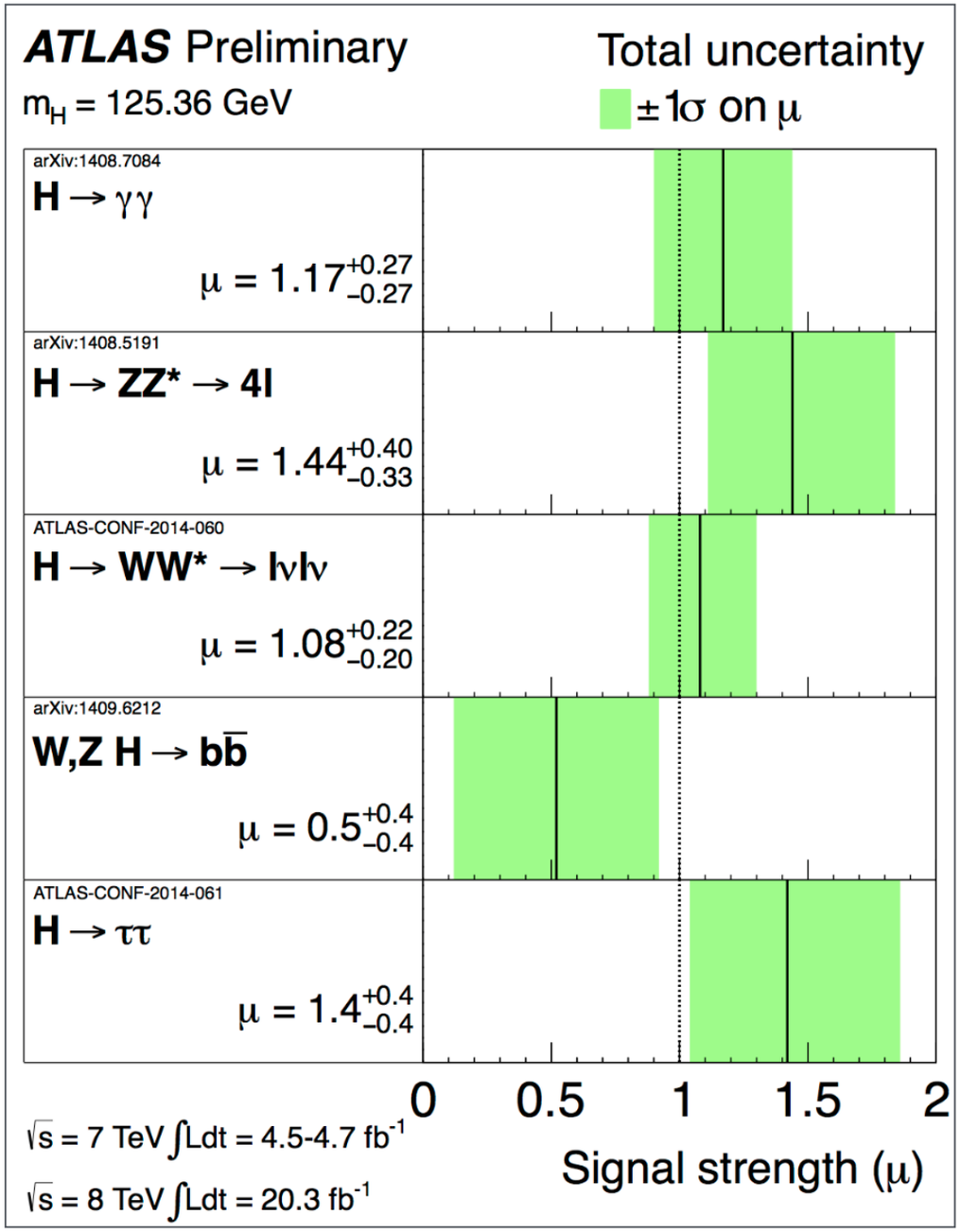
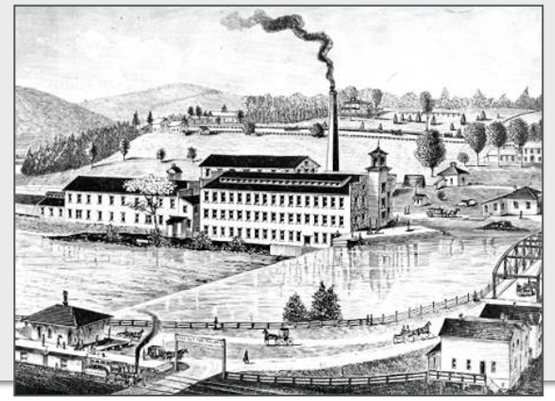
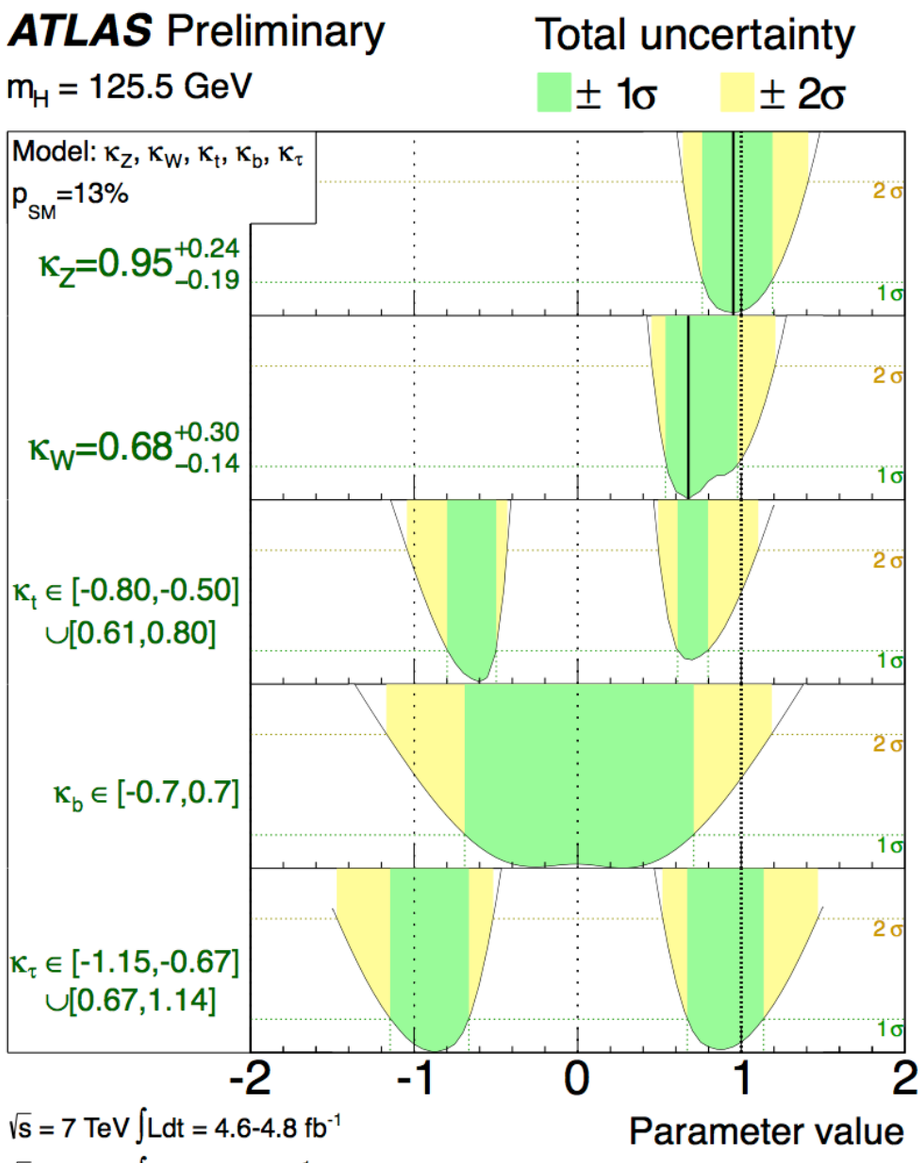


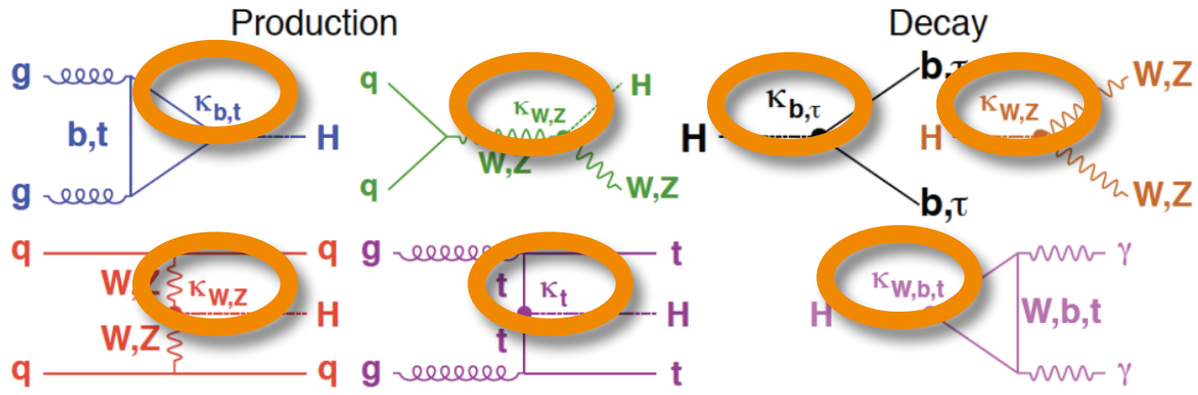
Higgs couplings, 2

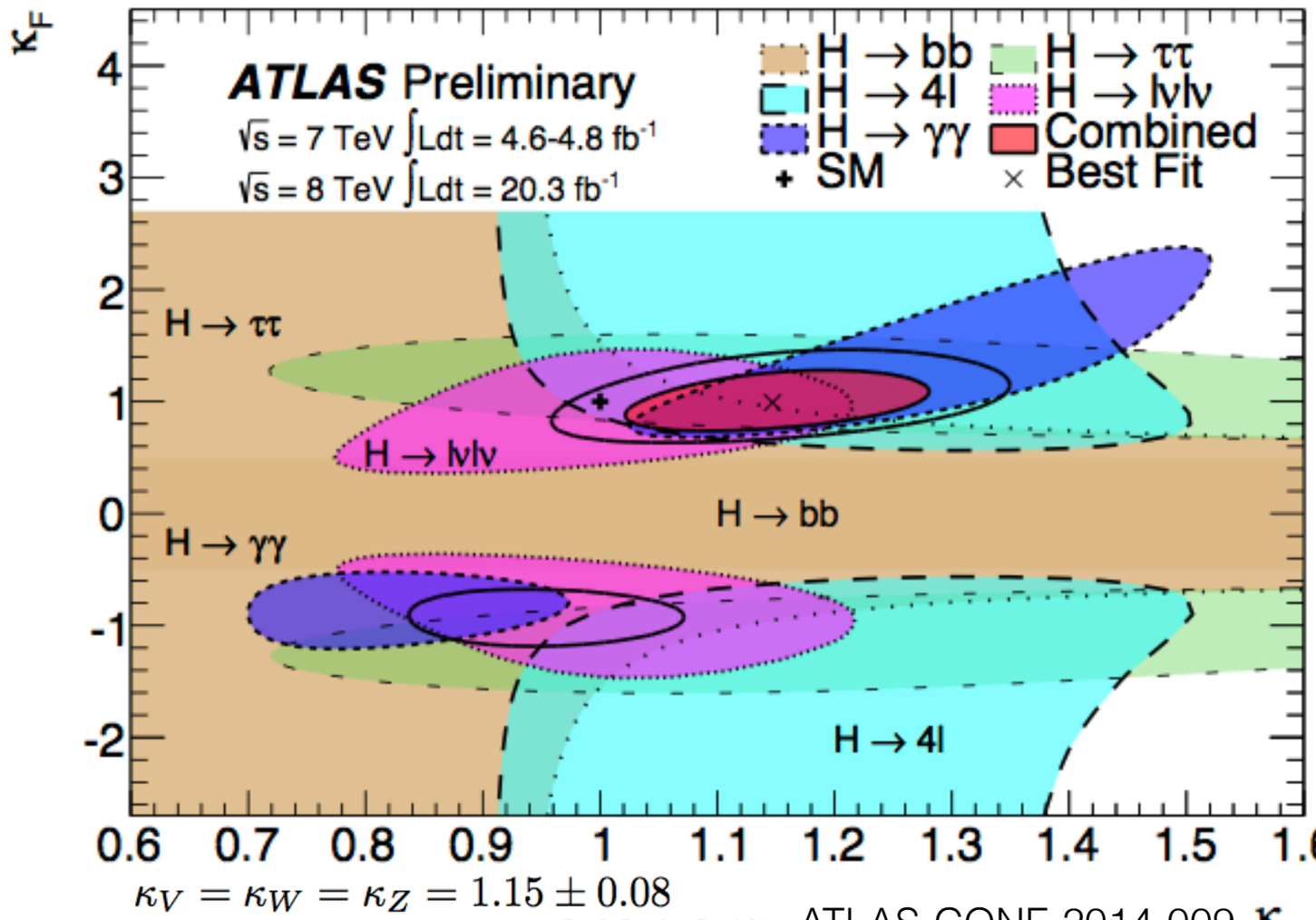
global fitting, big, growing industry



global fitting



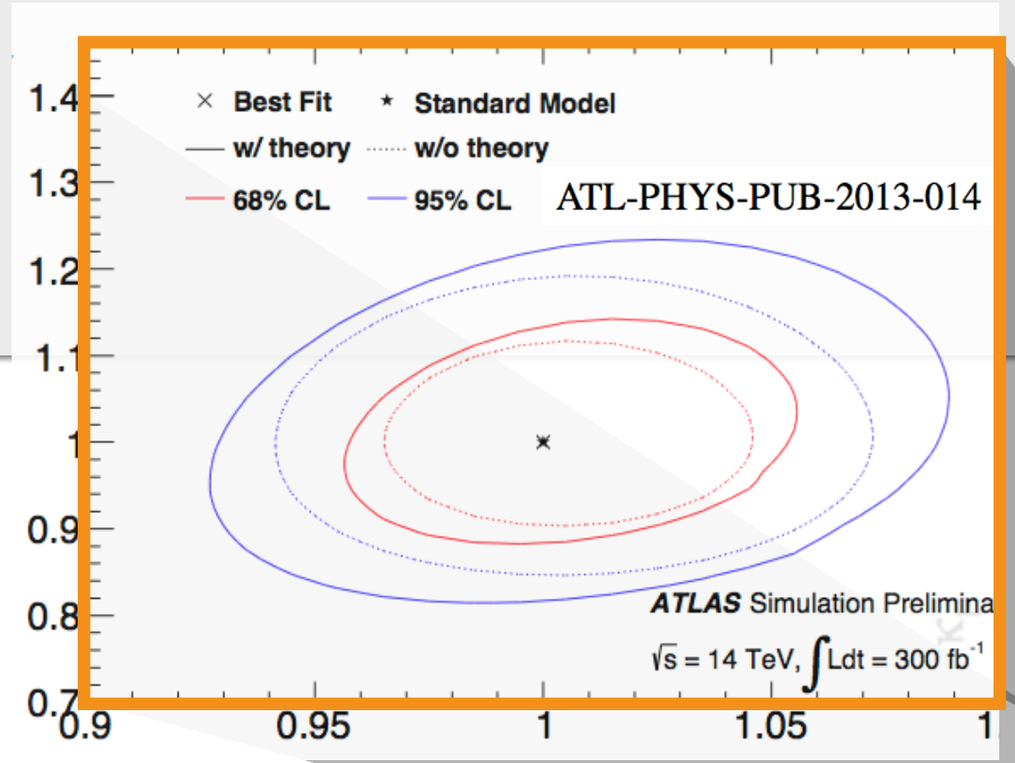


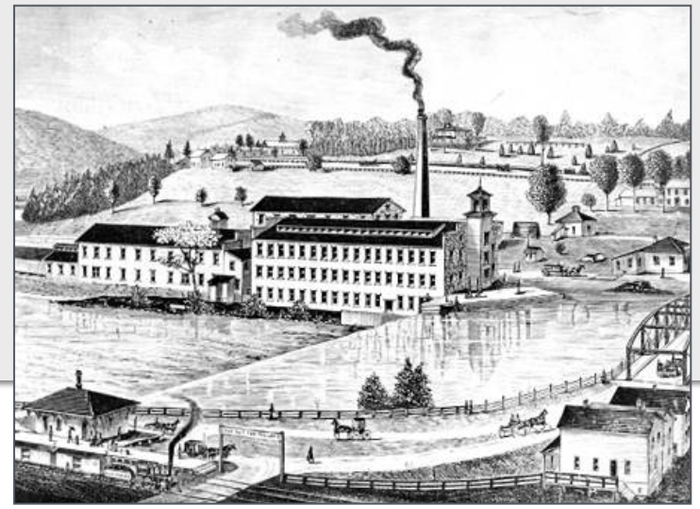


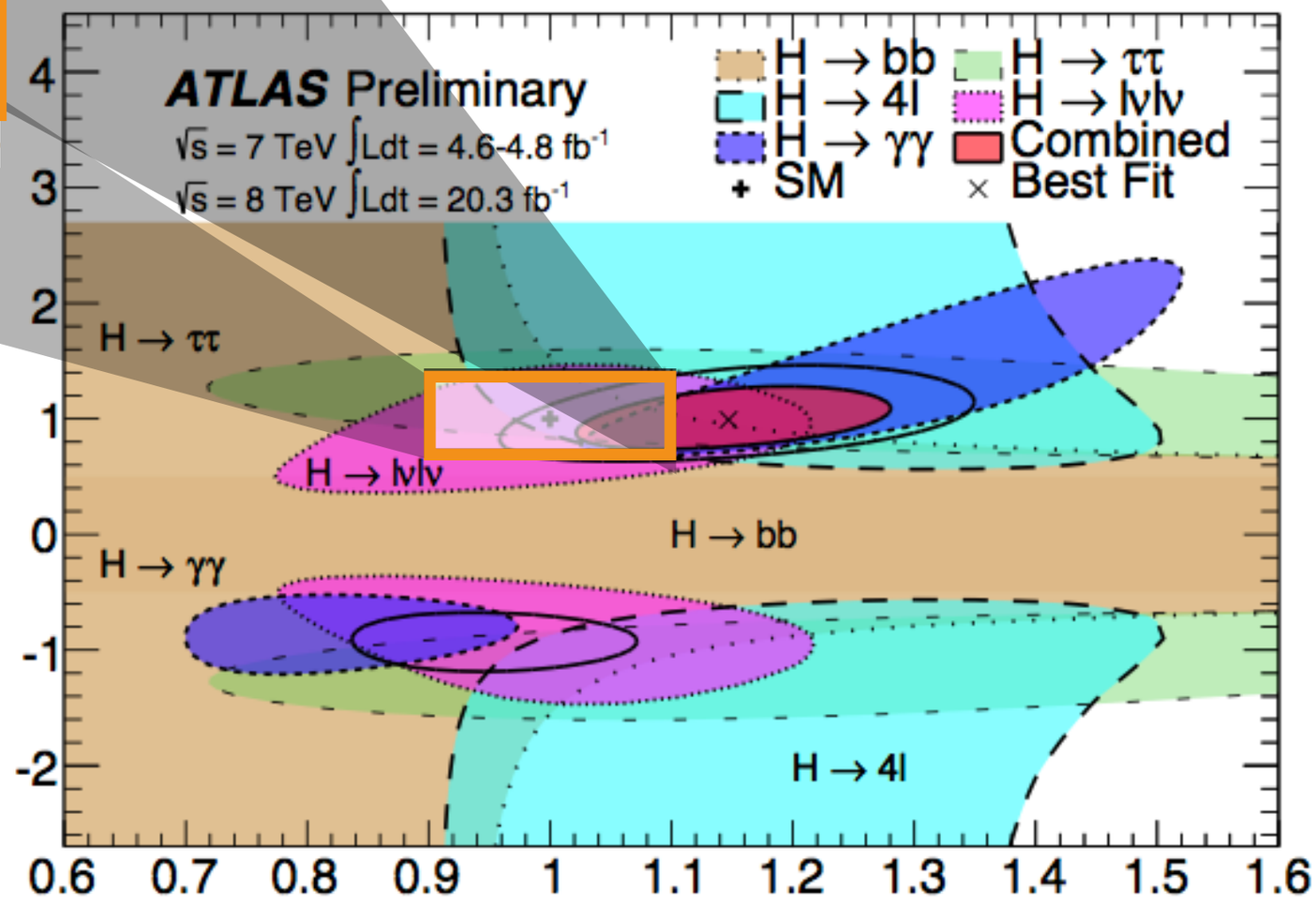
$\kappa_V = \kappa_W = \kappa_Z = 1.15 \pm 0.08$

$\kappa_F = \kappa_t = \kappa_b = \kappa_\tau = \kappa_g = 0.99 \pm 0.17$

ATLAS-CONF-2014-009







$$\kappa_V = \kappa_W = \kappa_Z = 1.15 \pm 0.08$$
$$\kappa_F = \kappa_t = \kappa_b = \kappa_\tau = \kappa_g = 0.99 \pm 0.17$$

The precision Higgs Boson era has begun.

ATLAS-CONF-2014-009

But Wait... THERE'S MORE!

SM higgs final state configurations:

WW, τ τ, bb **(Puja Saha, Friday)**

fiducial and differential cross sections ZZ

tTH —> 2 gamma, constrain top Yukawa

on-off peak total width measurement

125 GeV Higgs Boson characteristics

differential distributions, CP, spin

BSM Higgs searches

Charged Higgs, LFV final states, Heavy Higgs, NMSSM, Invisible decays, Exotic Higgs, scalar diphoton

Standard Model Physics

Notable results

from Run 1 we anticipated:

"Rediscovery"...Precision total & inclusive cross sections, VV studies, differential cross sections. Did we expect MW?

from Run 1 we achieved:

Rediscovery, indeed.

in Run 2, we expect:

Re-rediscovery...Precision couplings, differential distributions, much pileup study.

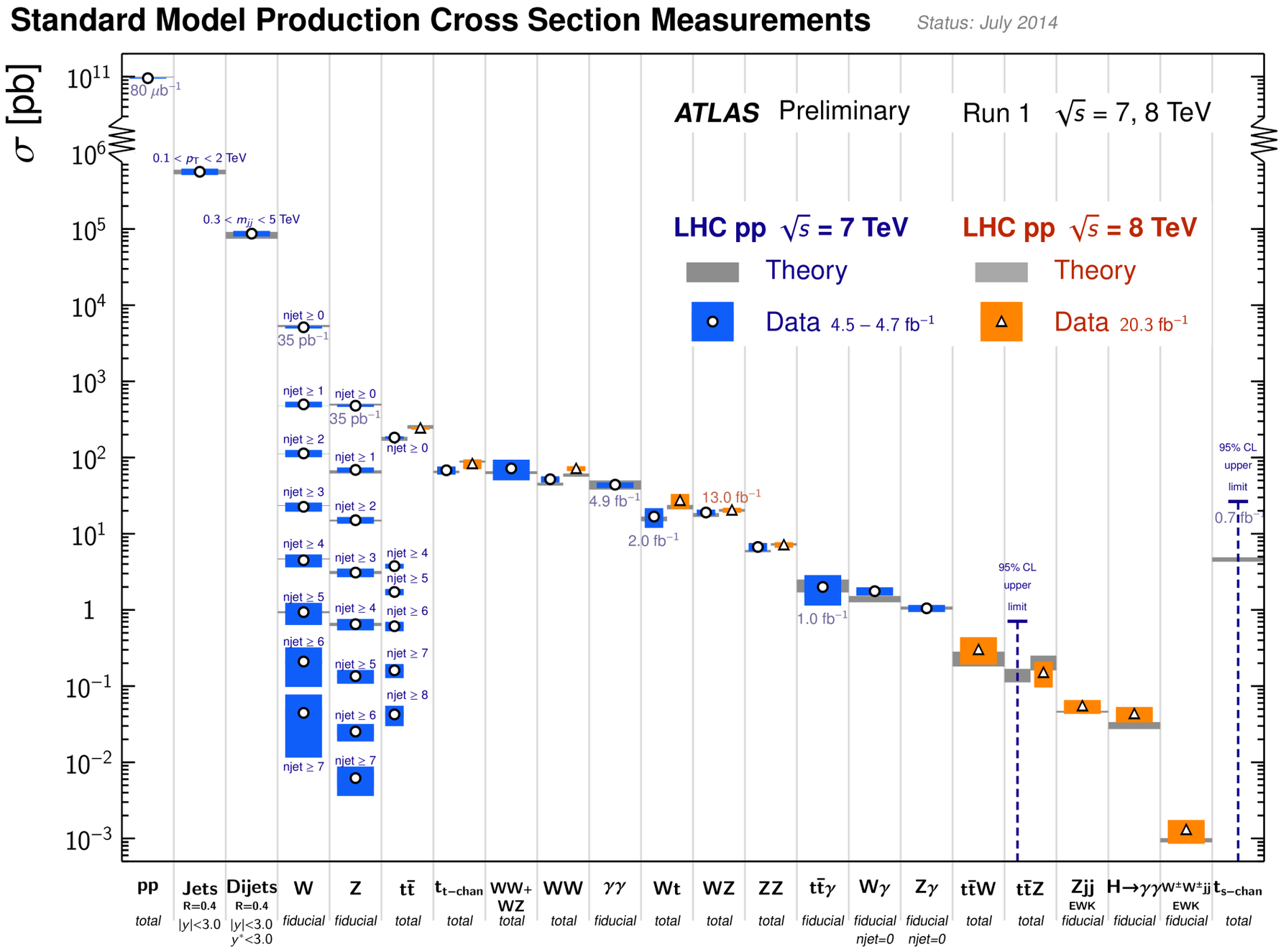
First M_W?

Attention to WW

5x - 10x more statistics

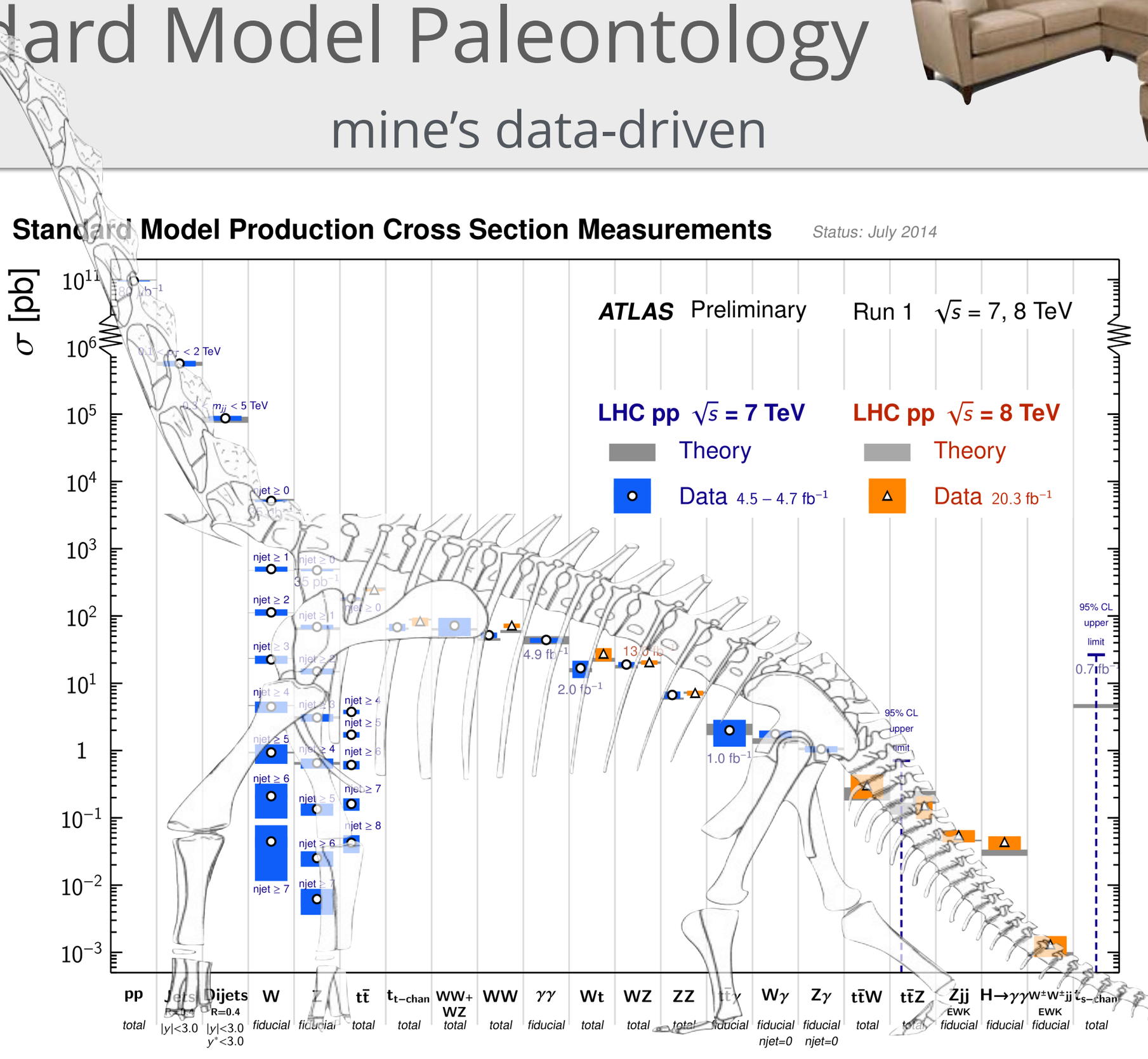
Standard Model Paleontology

pick your favorite dinosaur



Standard Model Paleontology

mine's data-driven



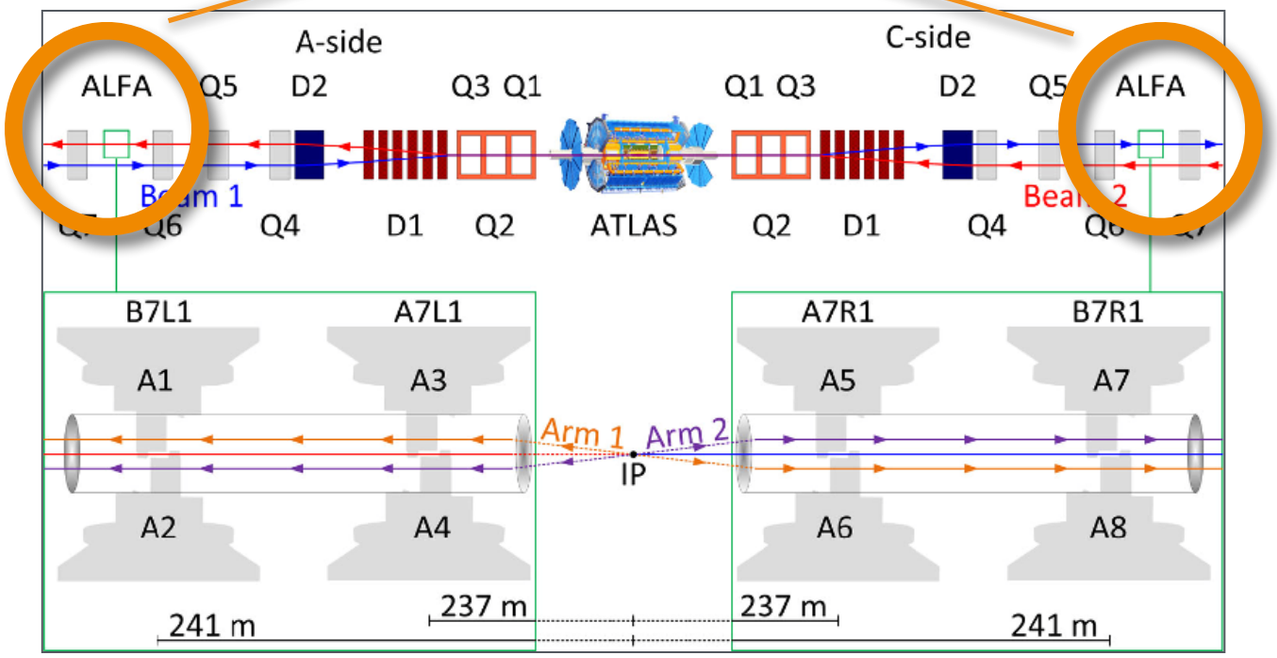
The basics

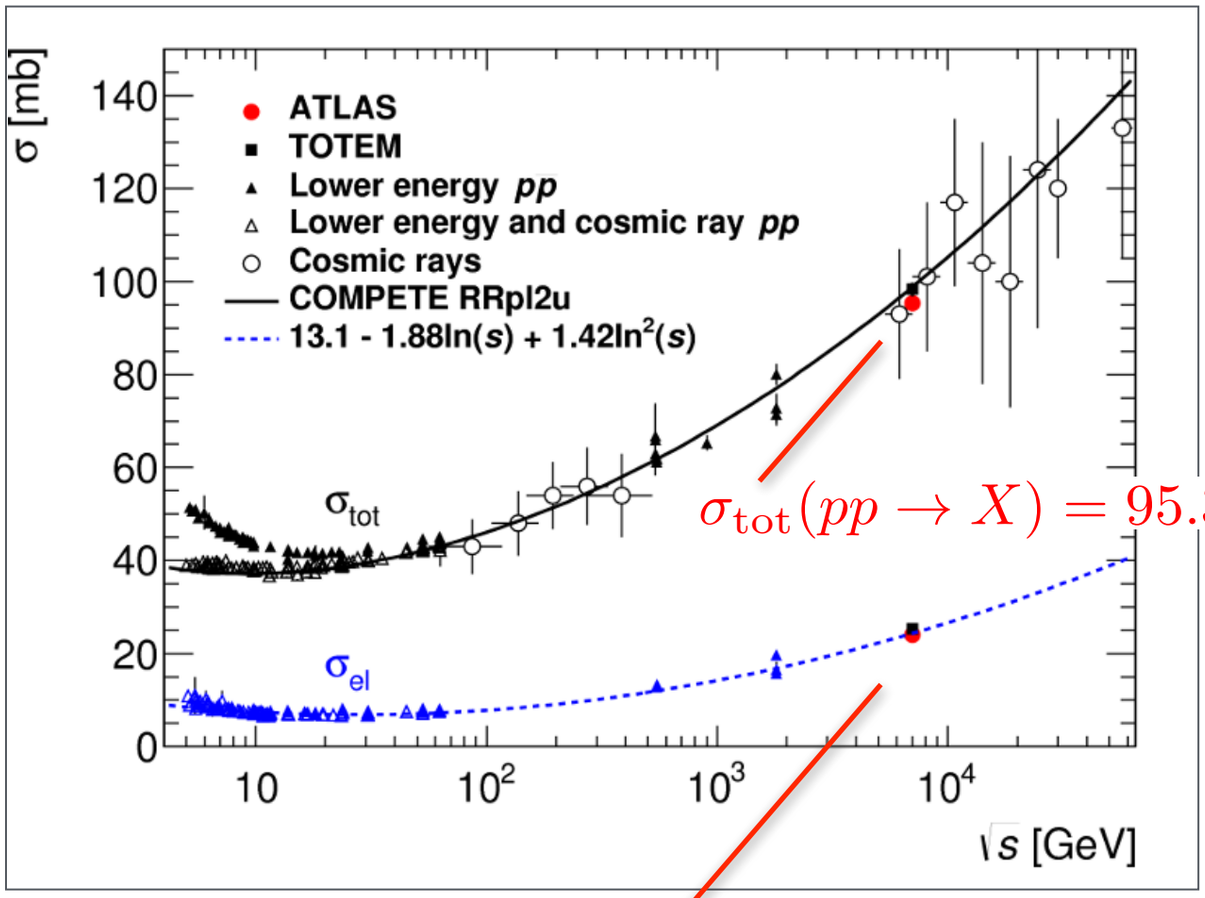
Elastic and total pp cross section

ALFA detectors at +238 m & –241 m

special run of 80/ μb

$|\eta| > 8.5$

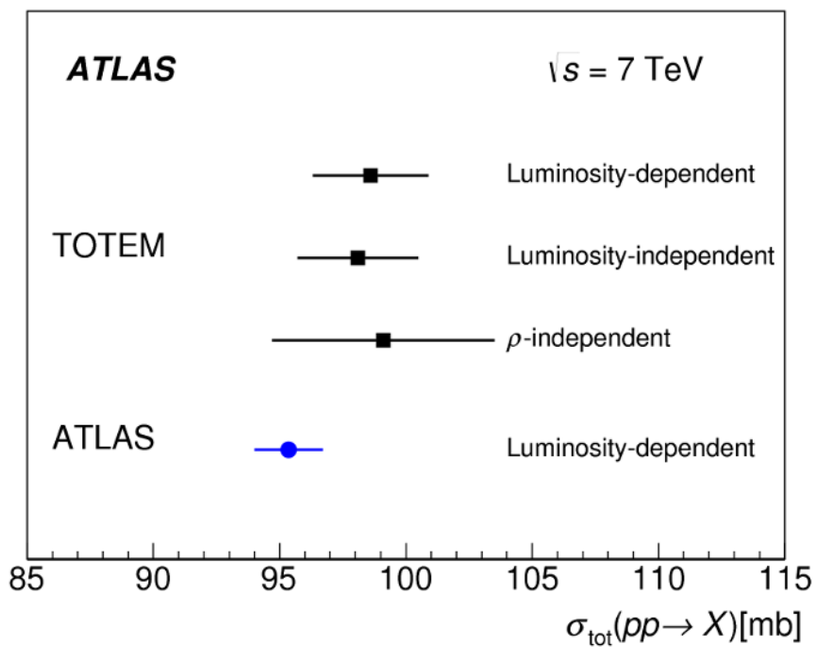




arXiv:1408.5778

$\sigma_{\rm tot}(pp \to X) = 95.35 \pm 0.38({\rm stat}) \pm 1.25({\rm exp}) \pm 0.37({\rm extr}){\rm mb}$

$\sigma_{\rm el}(pp \to X) = 24.00 \pm 0.19({\rm stat}) \pm 0.57({\rm exp}){\rm mb}$



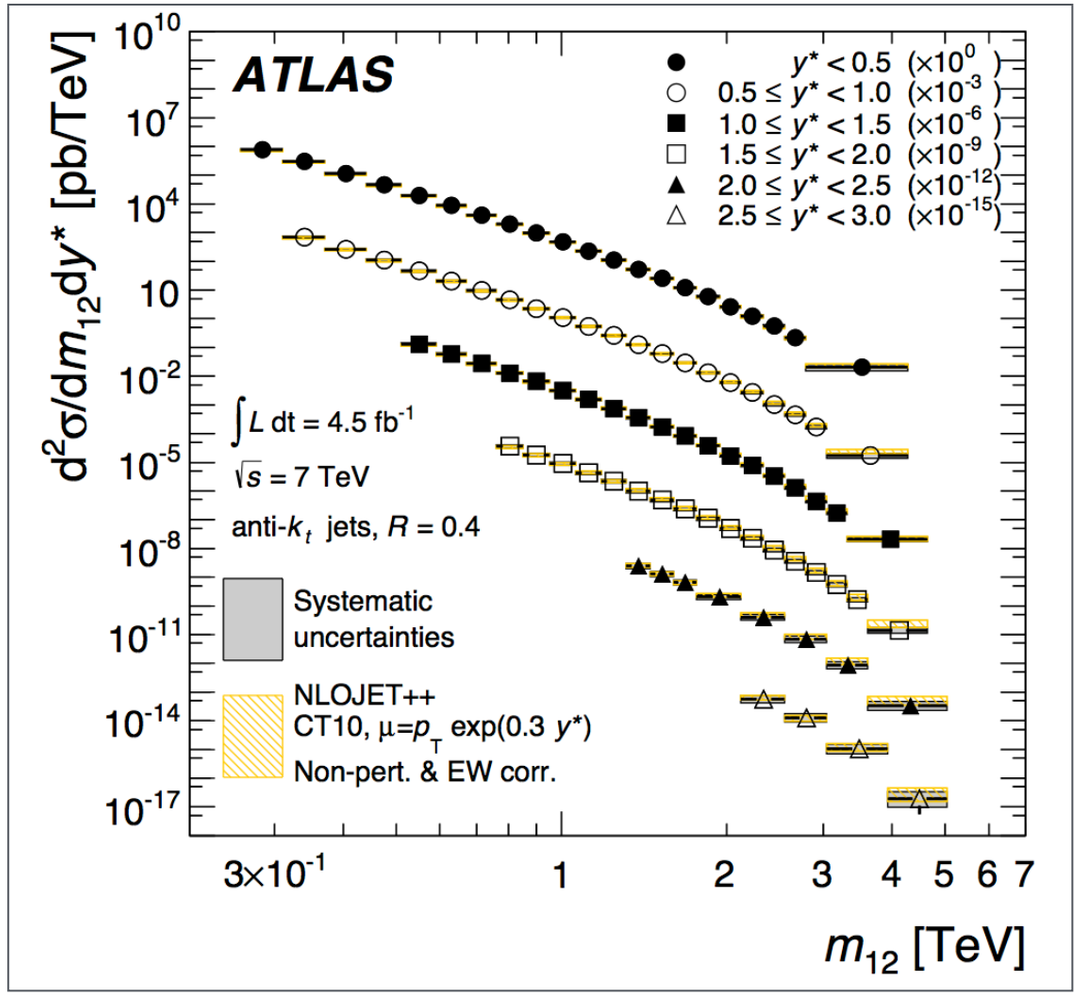
QCD jet physics

di- jet observables

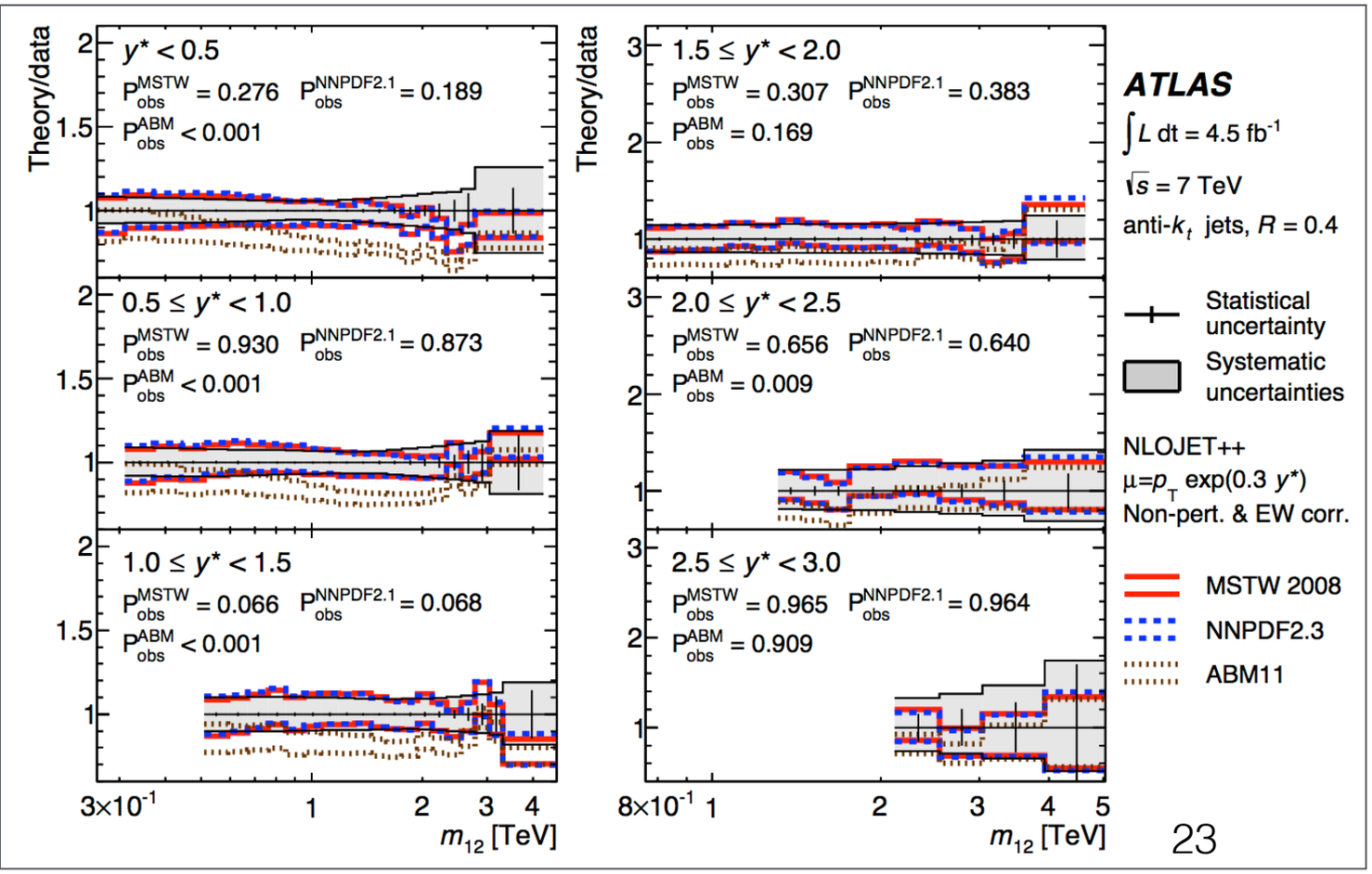
7 TeV running, double differential

Bins of m_{12} and rapidity

composite scale limit Λ < 6.9 - 7.7 TeV



arXiv:1312.3524



Agreement found:

NLOJet++ predictions using CT10, NNPDF2.1, and MSTW 2008

Disagreement found:

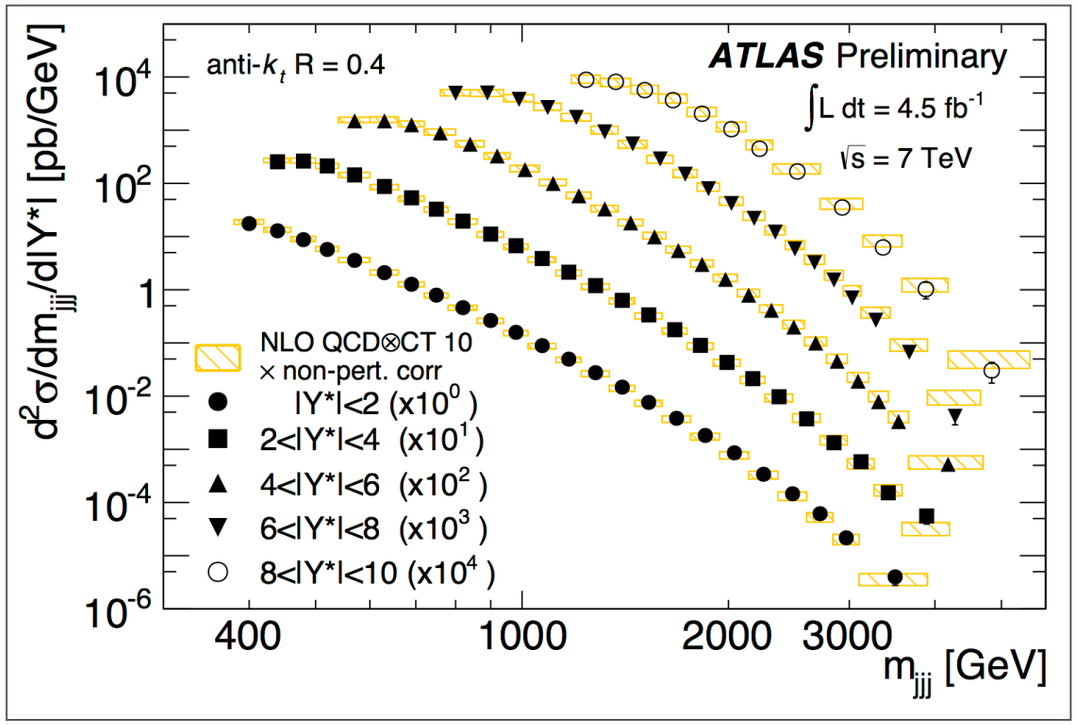
NLOJet++ predictions using ABM11 & HERAPDF1.5

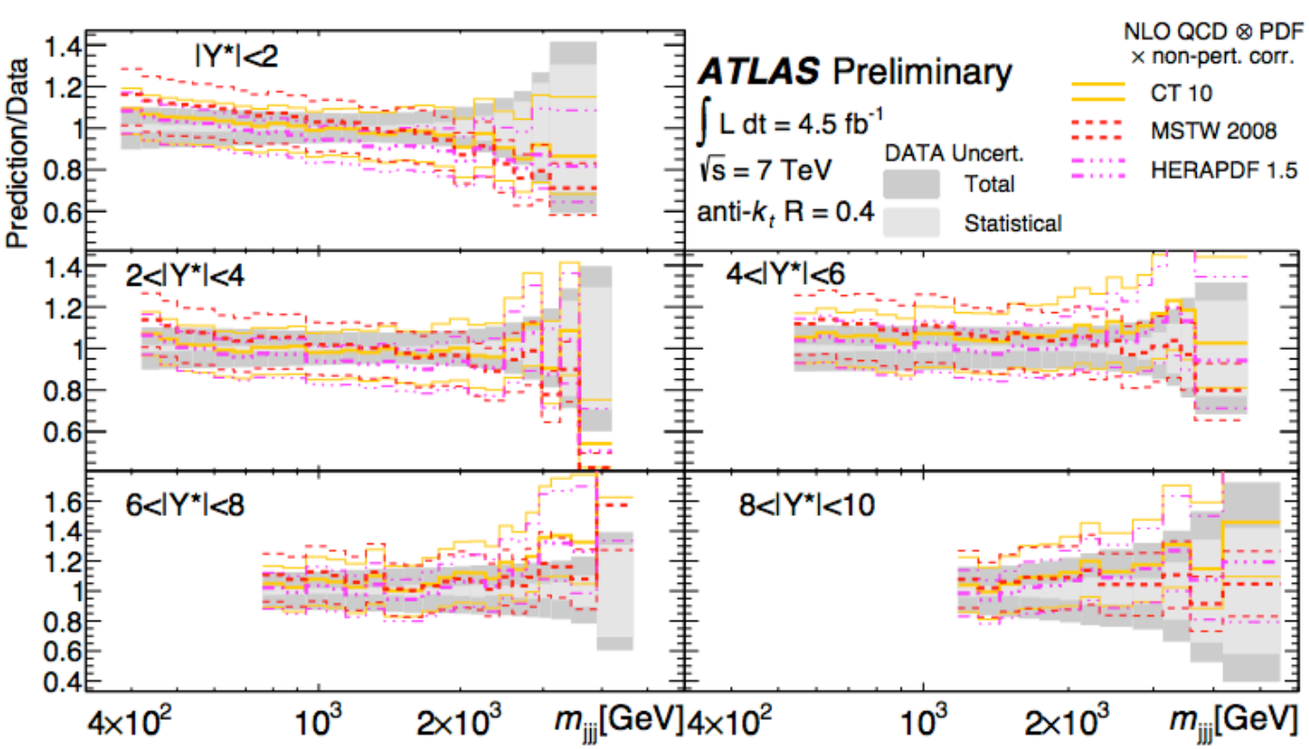
QCD jet physics

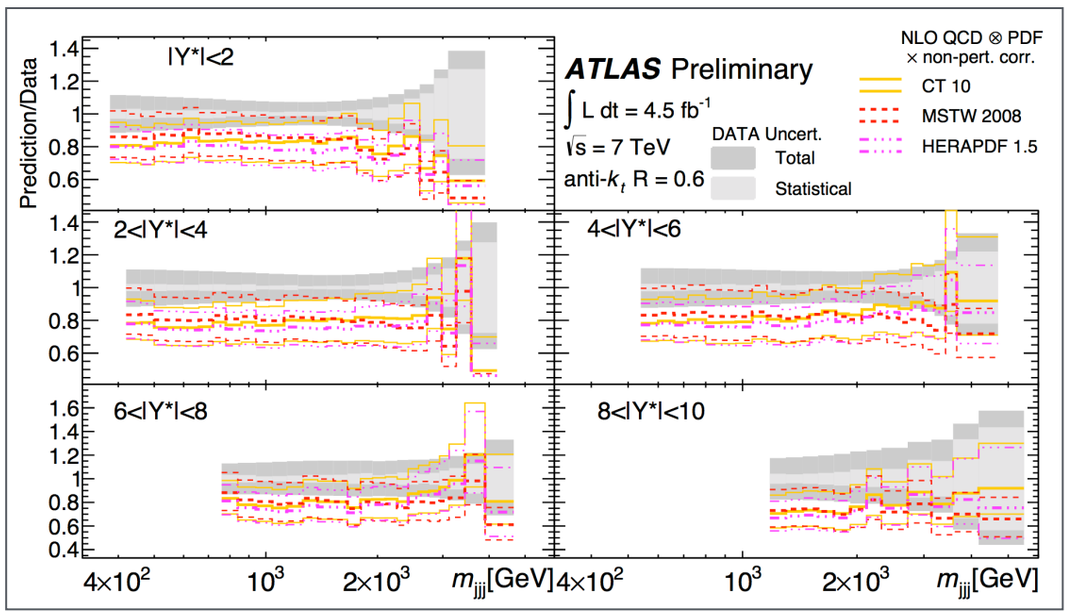
3 jet cross sections

7 TeV running, double differential, m_{jjj}

good agreement with most NLO pdf for R =0.4, less for R = 0.6







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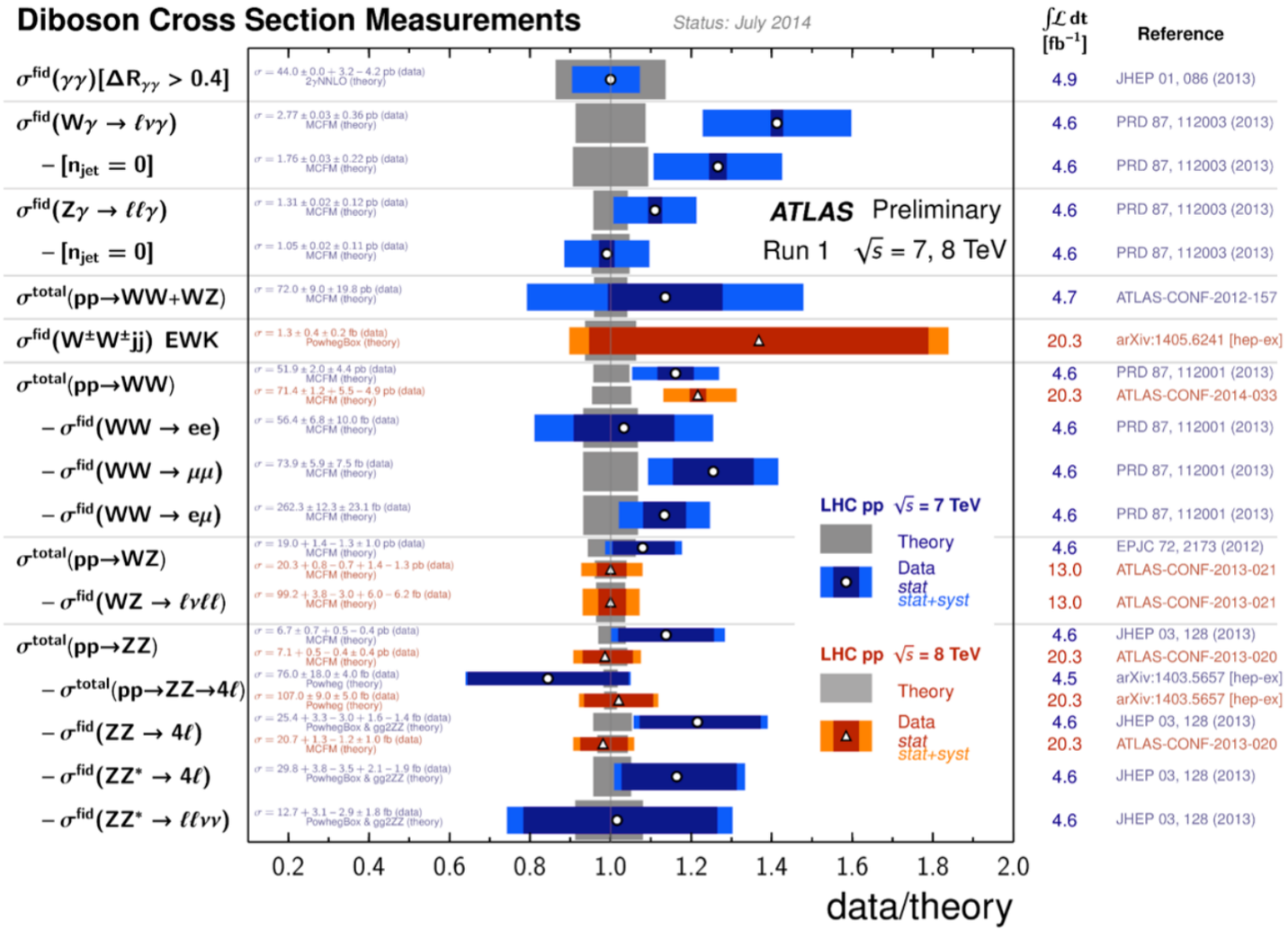
Electroweak physics

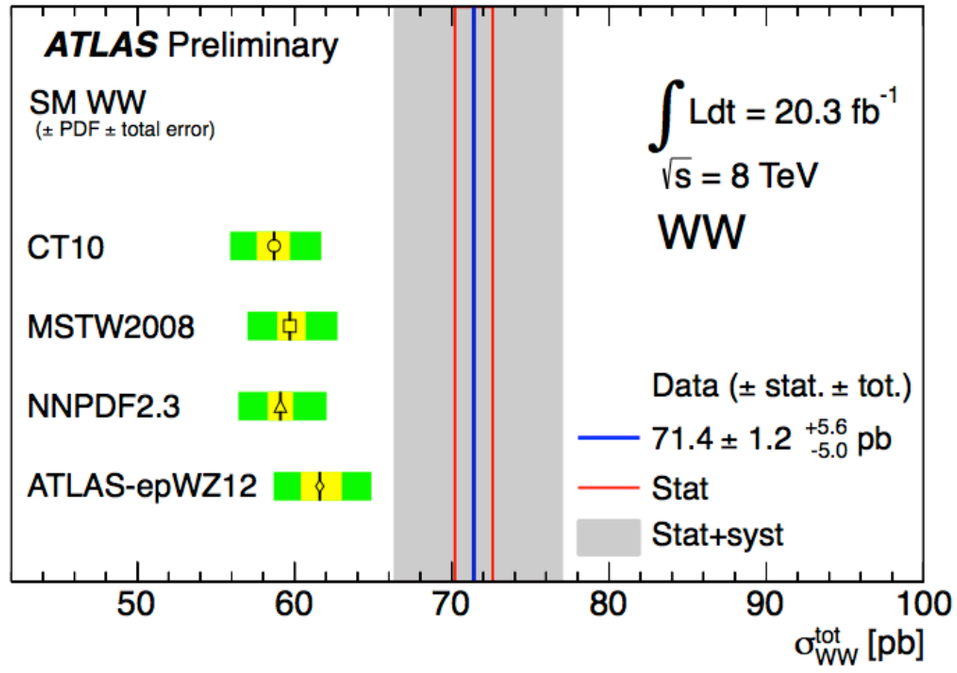
W^+W^- continues to be interesting

yesterday's background is today's confusion?



ATLAS-CONF-2014-033

Comparison with theory is difficult



tt and t backgrounds mandate a jet-veto requirement of $p_{\mathrm{T}} > 25$ GeV

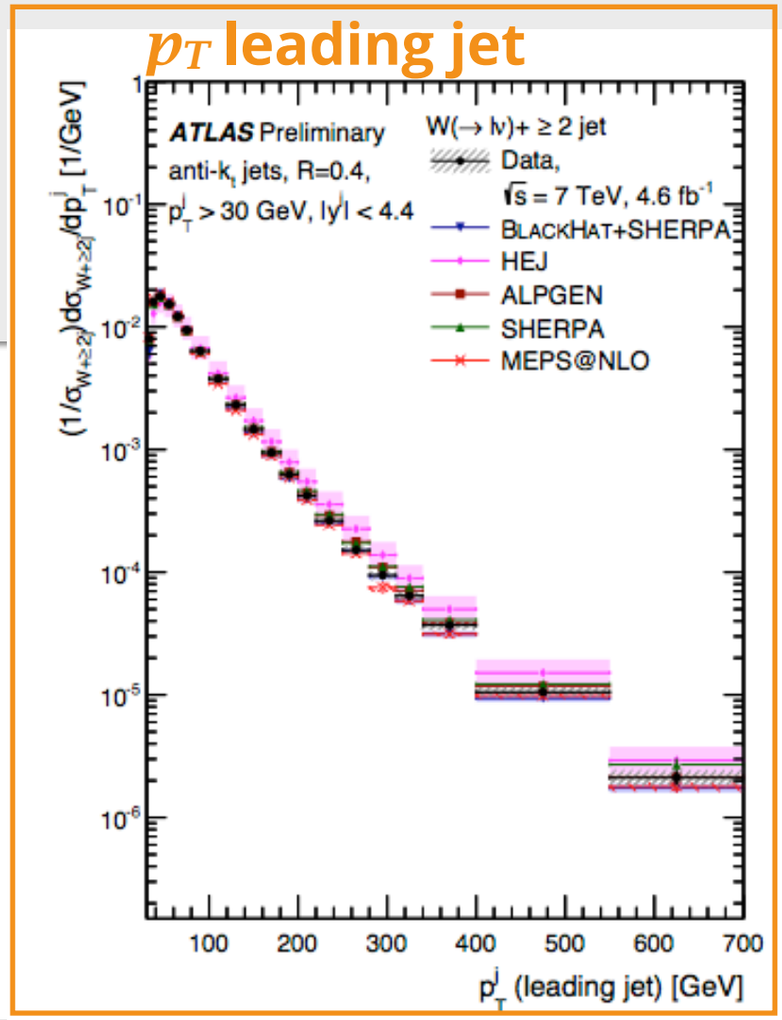
expect x10 or so more statistics

W+jets

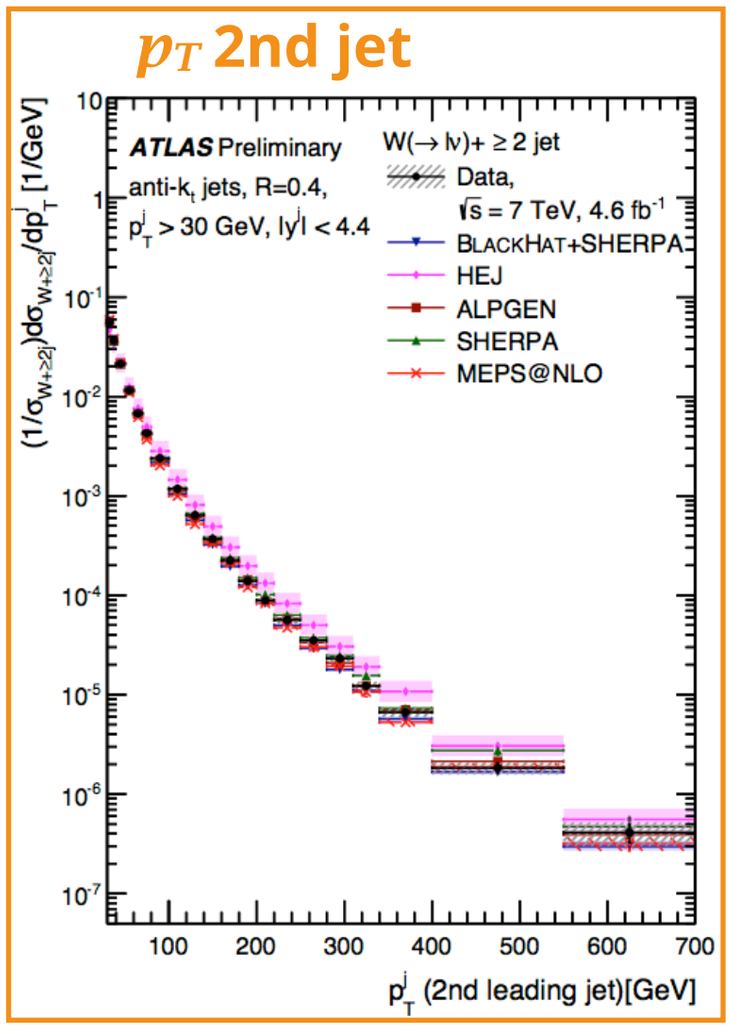
up to 8!

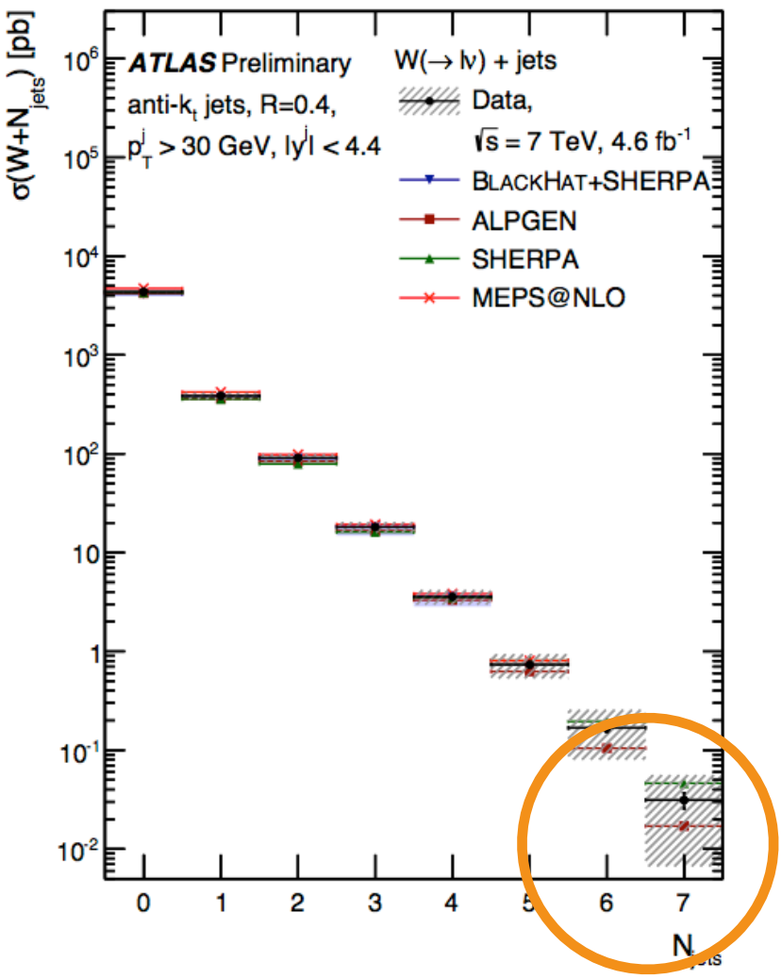
7 TeV running, leptonic decay modes

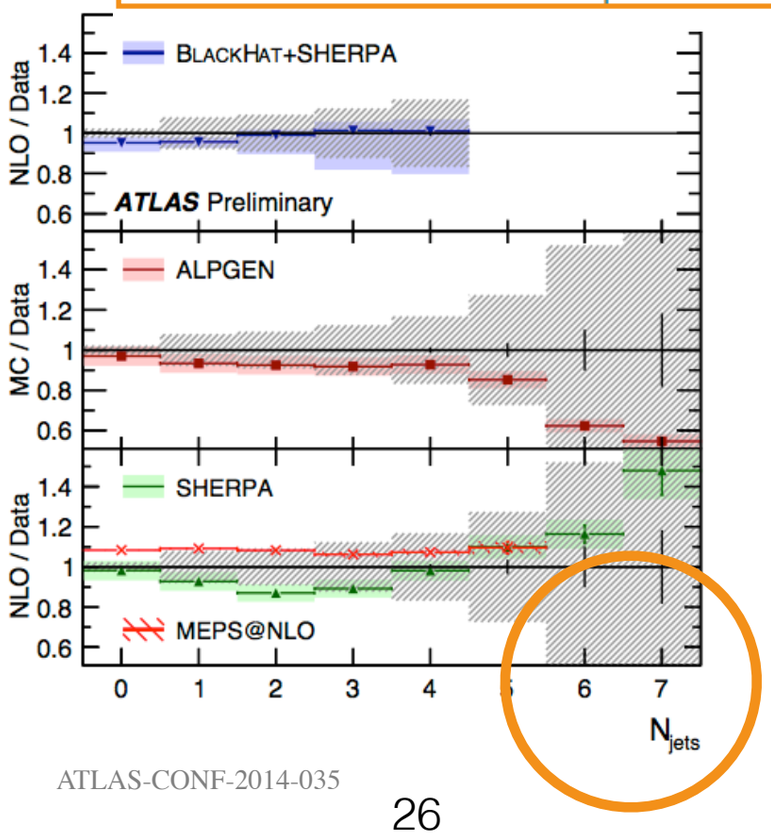
BLACKHAT+SHERPA, HEJ, ALPGEN, SHERPA AND MEPS@NLO



e.g. ≥ 2 j







ATLAS-CONF-2014-035

generally, good agreement but no prediction fits all distributions

But Wait... THERE'S MORE!

Z/W production

heavy flavor: $W + c$ (arXiv:1402.6263) and $Z \to b\bar{b}$ (arXiv:1404.7042)

underlying event

$p_T(Z)$

$W\gamma$, $Z\gamma$, ZZ, W^+W^-, $W^\pm Z$, fully leptonic and semileptonic

jet structure

inclusive jet m_{jj}, boosted W/Zs, jet gap studies

Multi-bosons

aQGCs, TCG for Z/γ - WW

QGC for $WWWW$

evidence for electroweak WW fusion **(Jessica Metcalfe, Friday)**, Zjj production

evidence for WW —> WWjj scattering

Top quark Physics

Notable results

from Run 1 we anticipated:

precision cross sections, precision mass of 1-3.5 GeV, rediscovery of single top, single top Wt channel

from Run 1, we achieved:

precise cross sections, mass, distributions ttbar and single top

in Run 2, we expect:

20x more statistics!

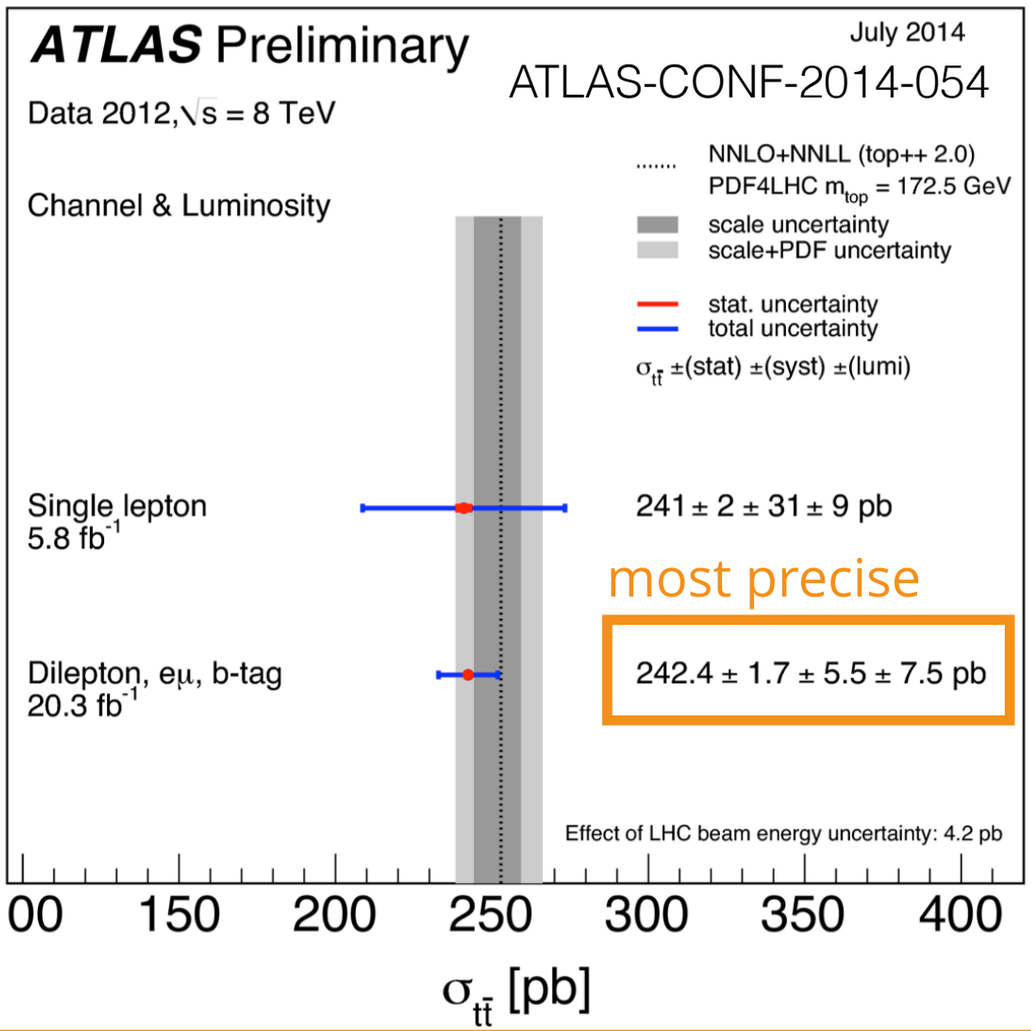
Top quark cross section

win-win

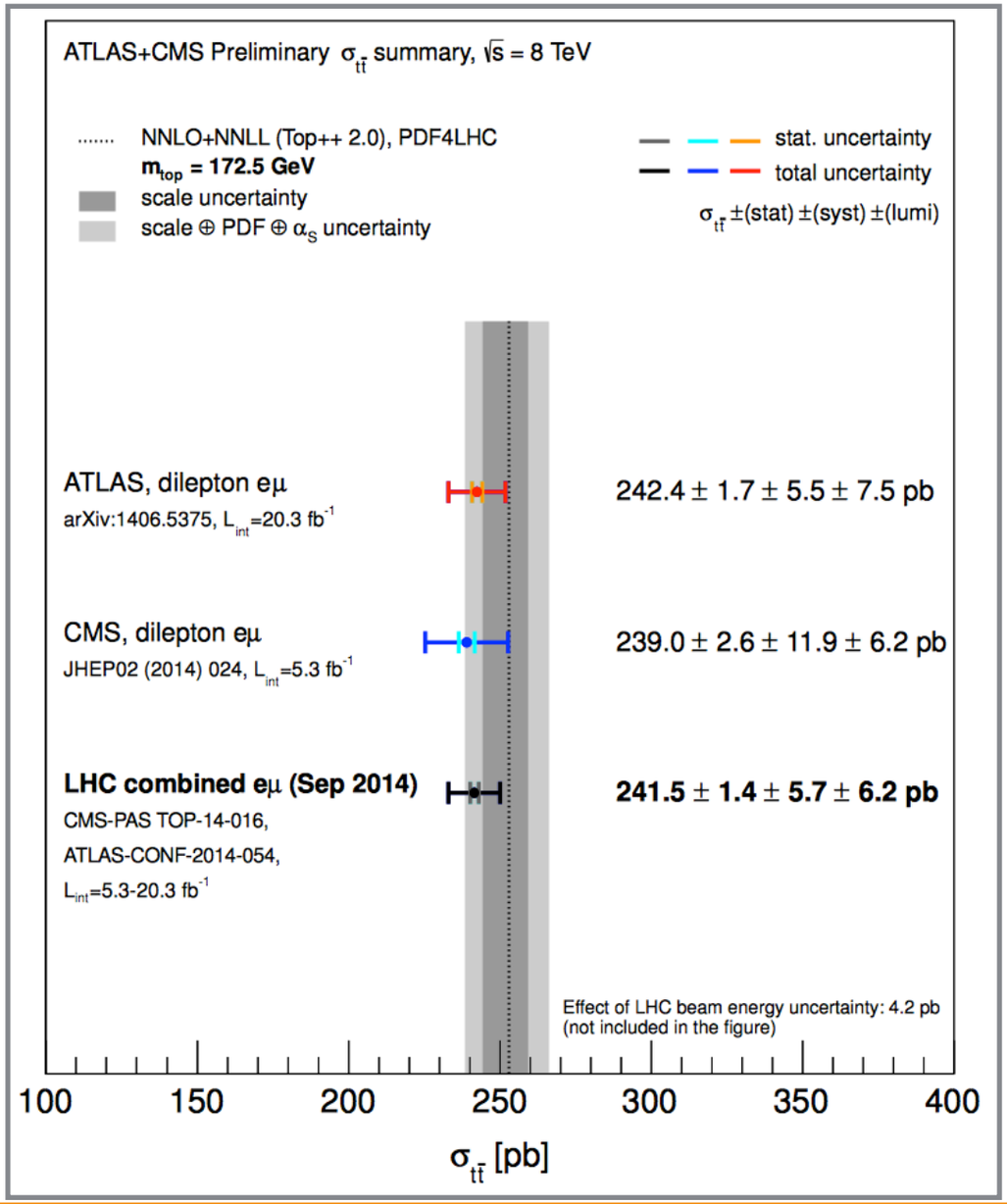
Most precise determinations from single and di-lepton channels

NNLO+NNLL agreement

largest sys: ttbar modeling & pdfs



Combined ATLAS+CMS $e\,\mu$



Single top, Wt

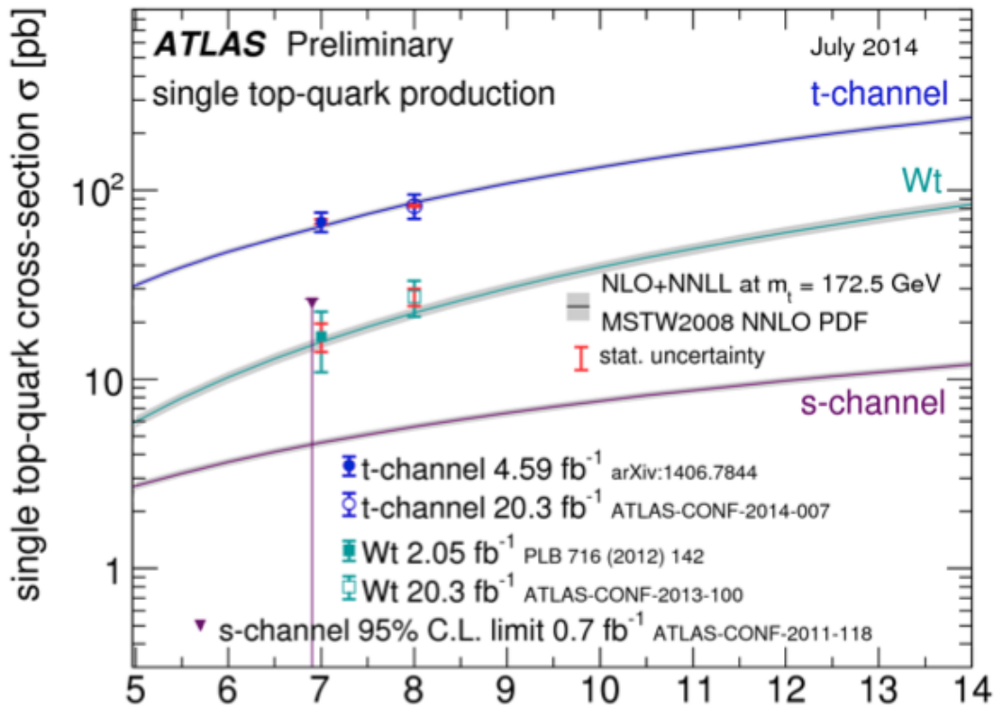
win-win

ATLAS evidence at 4.2σ

then ATLAS + CMS

agreement with NLO+NNLL

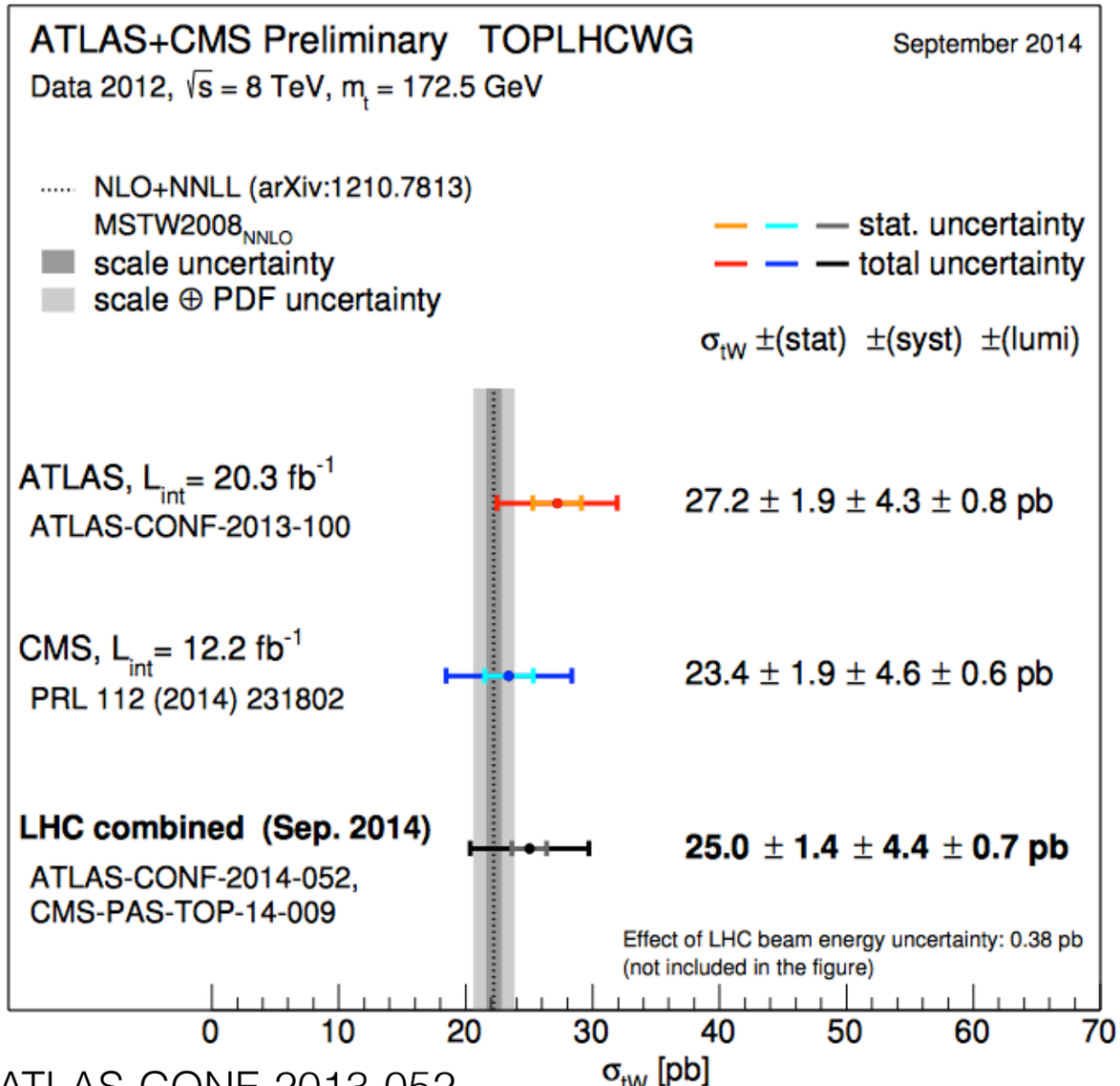
All 3 single top channels:



ATLAS-CONF-2013-100

ATLAS-CONF-2011-118 ATLAS-CONF-2014-007

Combined ATLAS+CMS Wt



ATLAS-CONF-2013-052

Top quark mass

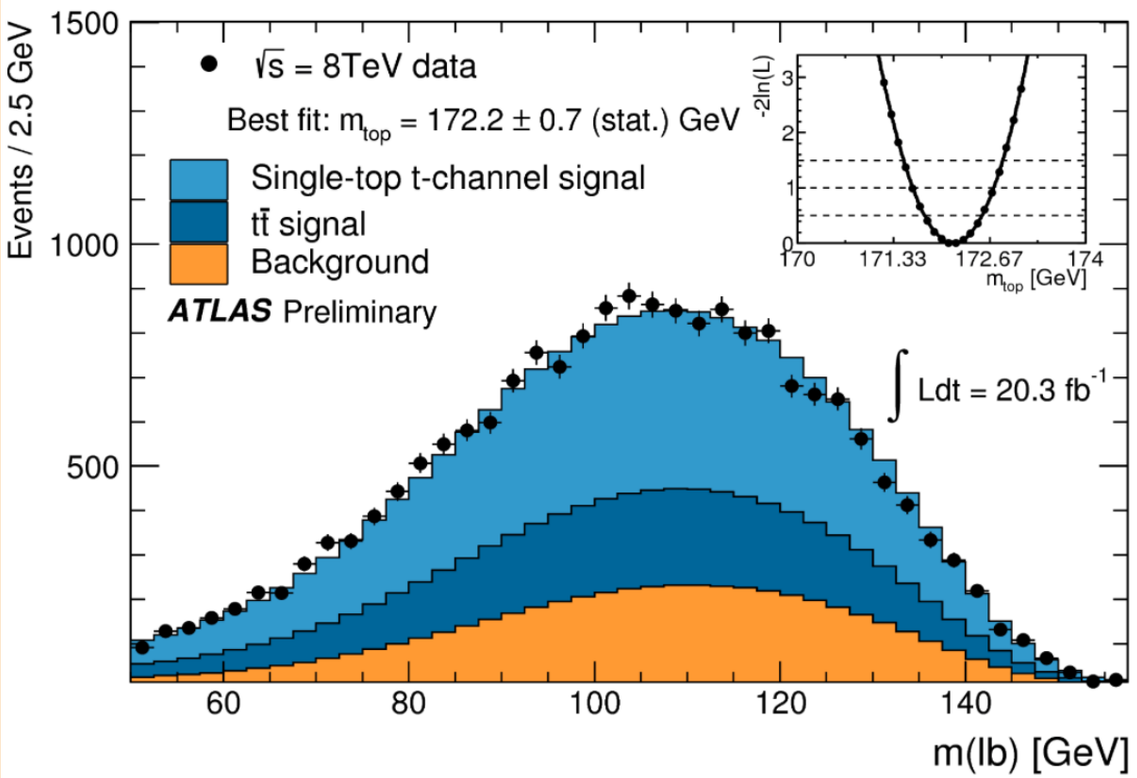
win-win-win

2008 estimates for 1/fb: ±1–3.5 GeV in three channels

Run 1 results? Better than predicted.

the world: < 0.5% uncertainties

Single top “enhanced”



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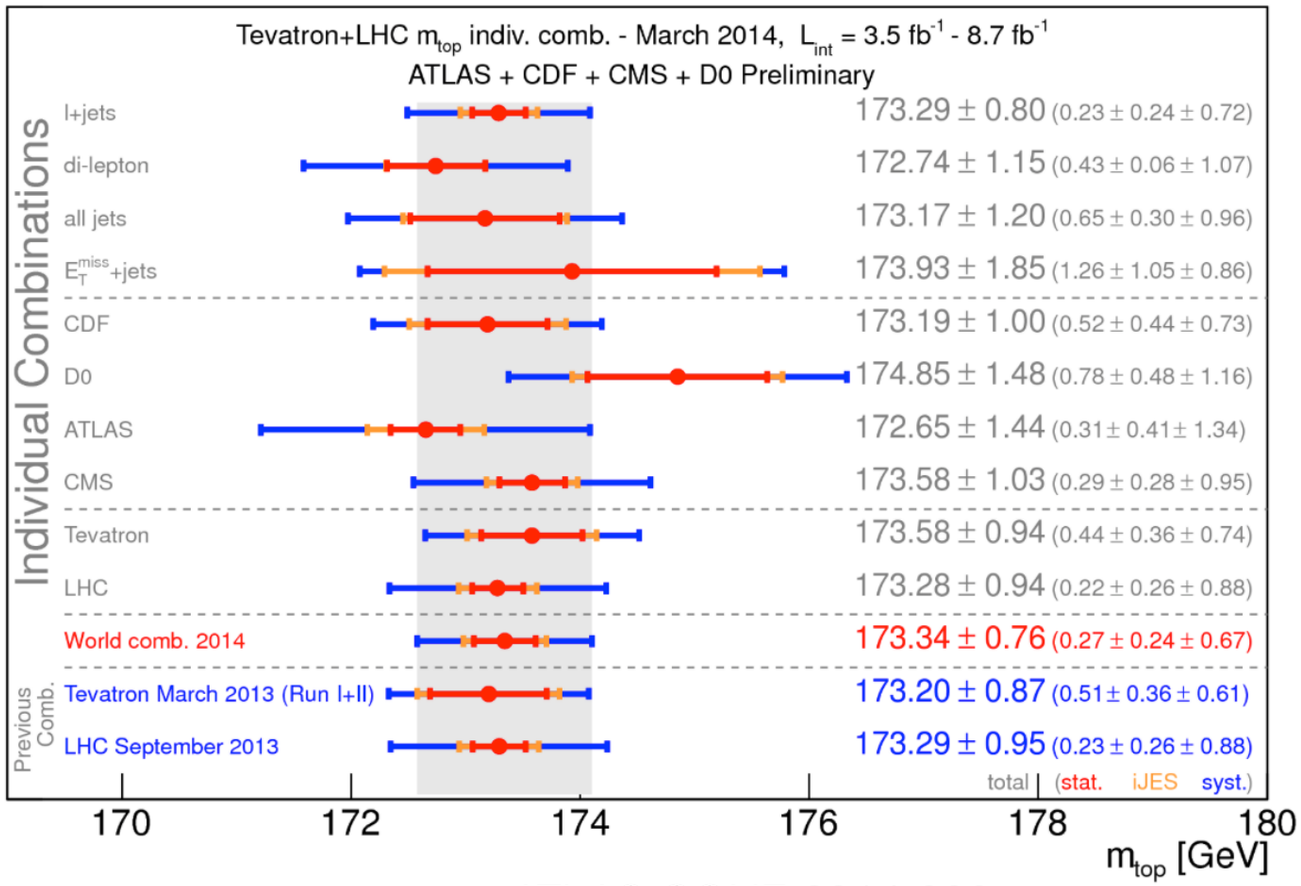
Combined ATLAS+CMS + CDF + D0



ATLAS-CONF-2014-008

But Wait... THERE'S MORE!

top cross sections

all hadronic final states, tau final states, ttbar/Z/WW

differential distributions: parton level, boosted ttbar, associated production with jets and heavy flavor, W/Z, high pt boosted

single top

CP violation

top mass

pole mass from cross section tail, t -T mass difference

top properties

charge, W polarization, FCNC searches, charge asymmetry, t polarization

Exotic Physics

Notable results

from Run 1 we anticipated:

supersymmetry discovery? no Higgs? Higgs? BSM Higgses (SP?), extension of Tevatron IVB' searches by x2 or more,

from Run 1 we achieved:

supersymmetry limits! one Higgs, BSM Higgs searches, IVB' searches

in Run 2, we expect:

early concentration on gluino searches, di- ℓ & di-jet bump searches

BSM Higgs hints

additional IVB' searches

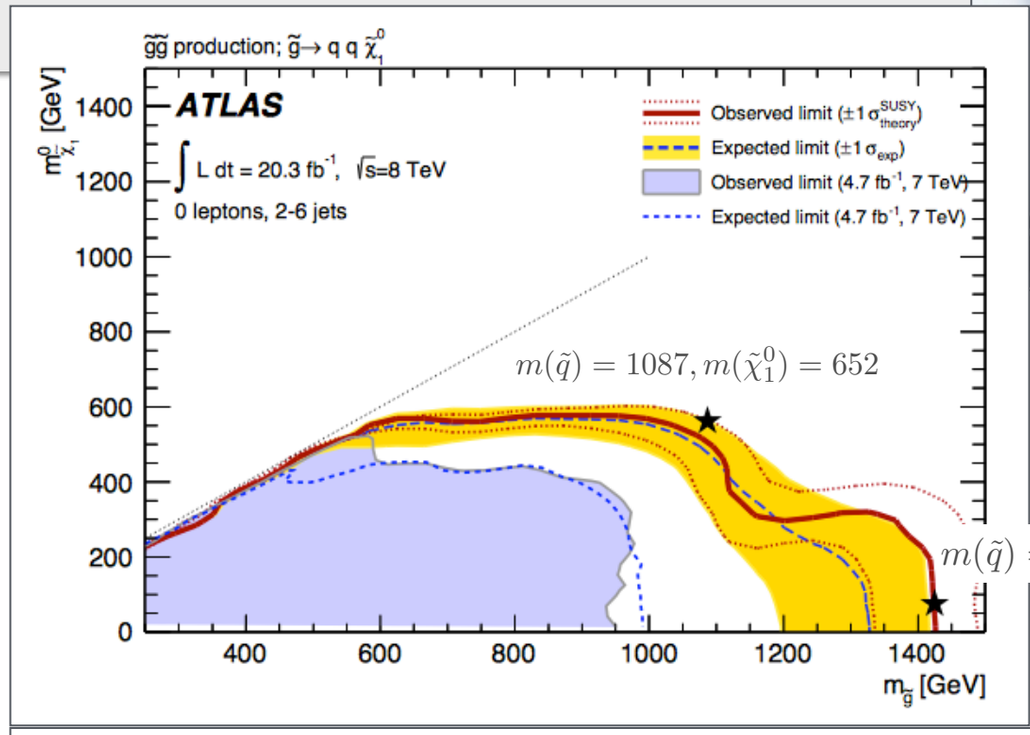
50x - 1000x more statistics!

Supersymmetric Physics

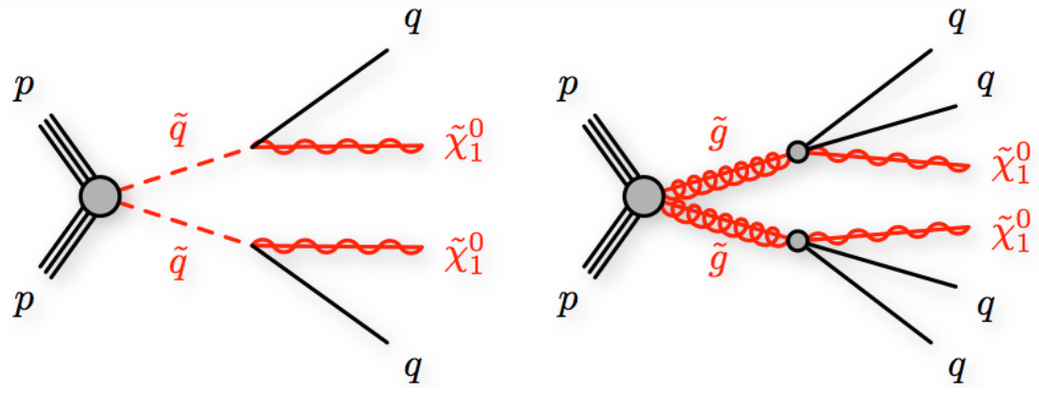
squarks and gluinos

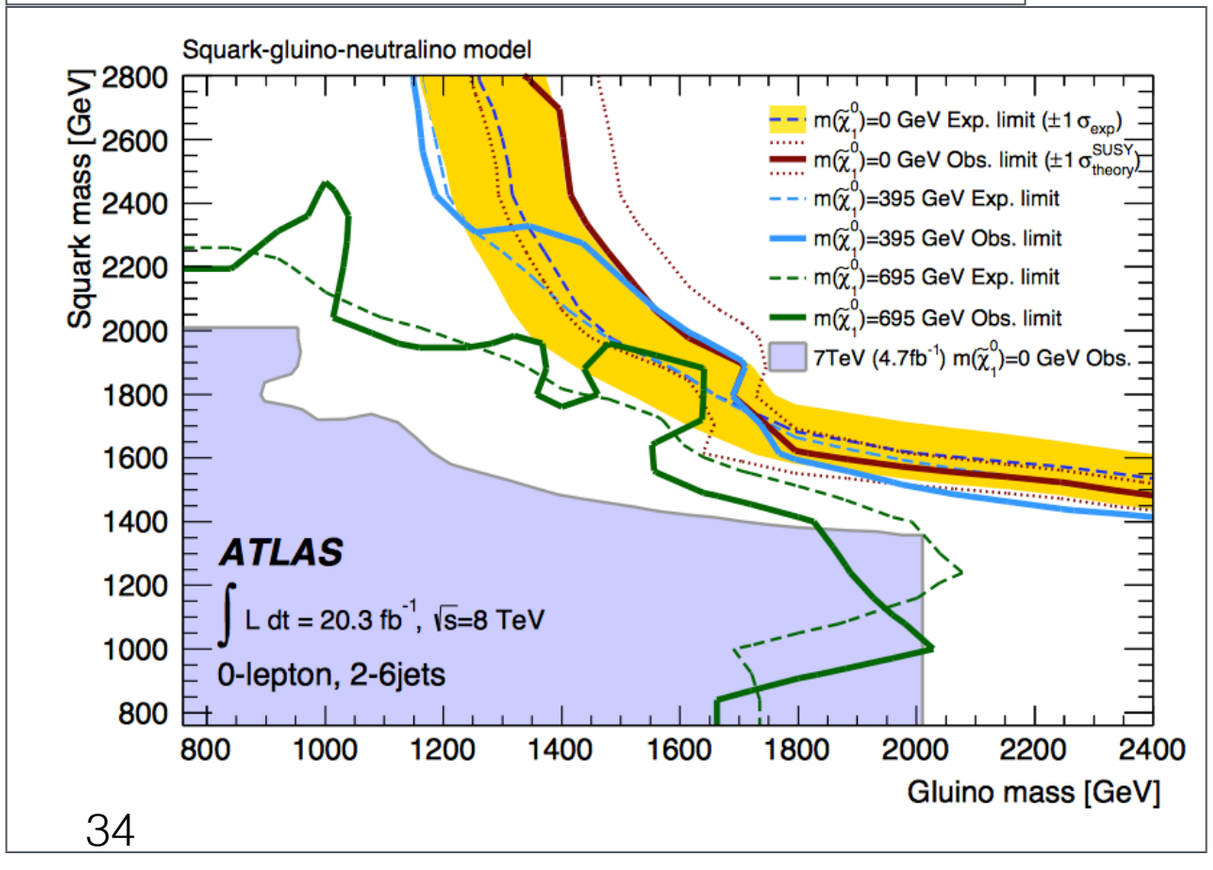
eg inclusive searches:

- 0 leptons + 2-6 jets + MET
- simplified models MSSM scenario
- strong production of gluinos + 1st- and 2nd-generation squarks
- direct decays to quarks and lightest neutralinos.



arXiv:1405.7875





stop

“Natural” scenarios?

Tev-ish new particle solution?

$$M_H^2 = M_{\text{tree}}^2 + \left(\begin{array}{c}H\\ \bigcirc\\ H\quad H\end{array}\right) + \left(\begin{array}{c}t\\ \bigcirc\\ H\quad \bar{t}\quad H\end{array}\right) + \left(\begin{array}{c}W,Z\\ \bigcirc\\ H\quad H\end{array}\right) + \left(\text{BSM}\right)$$

stop

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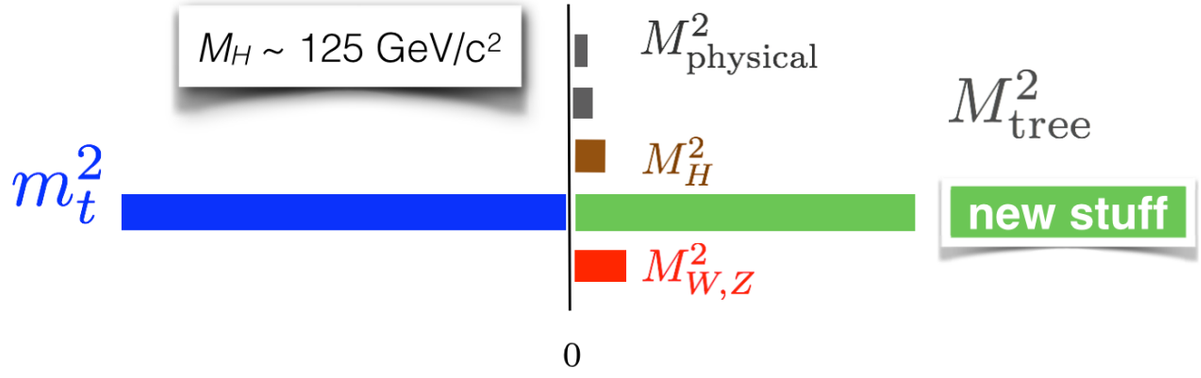
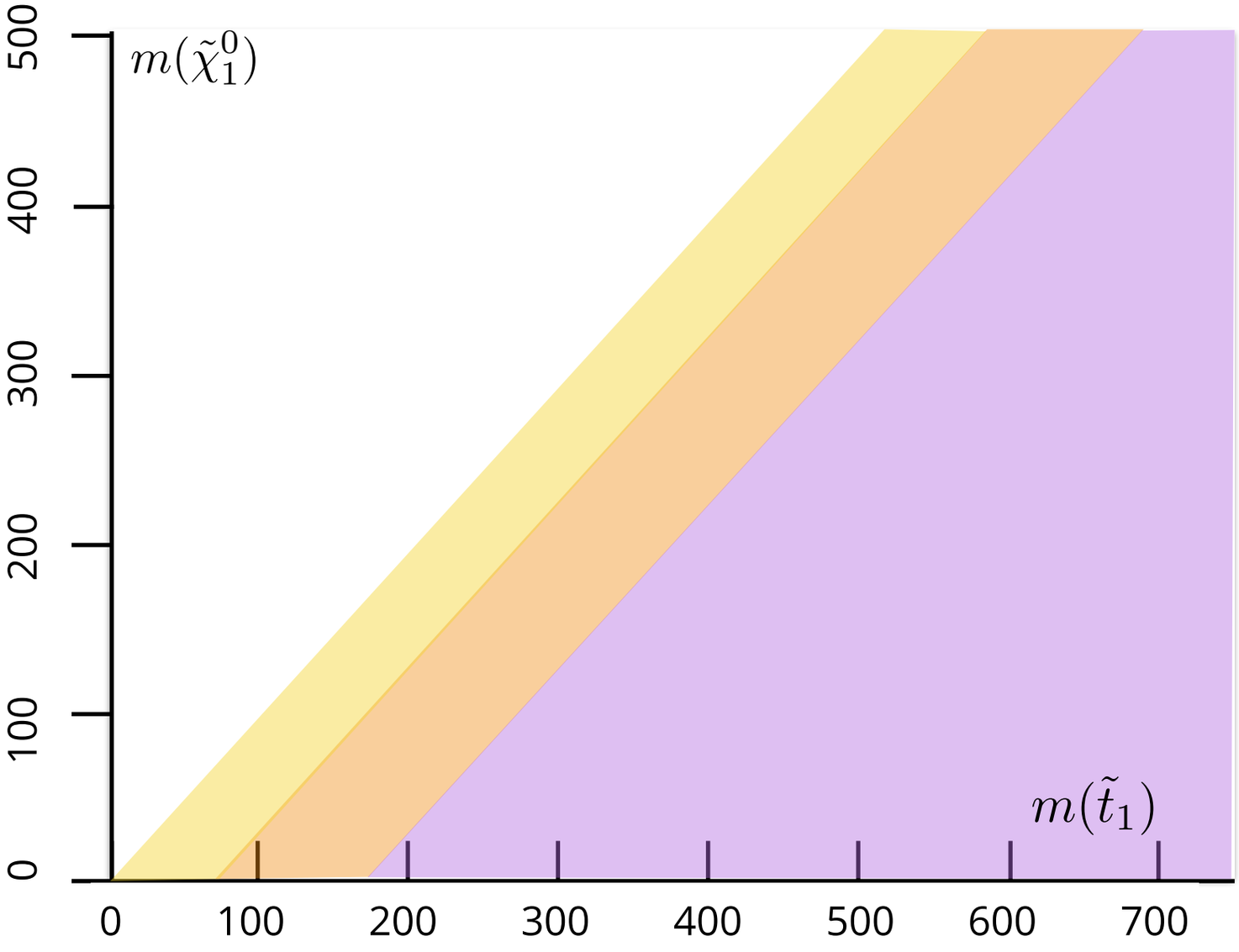


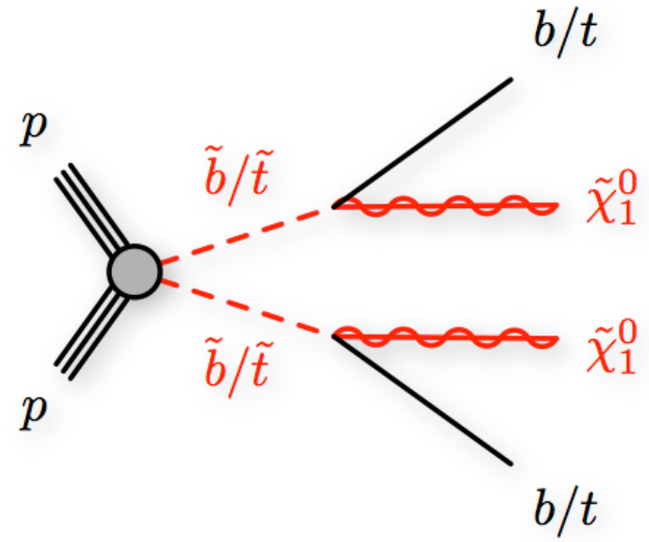
stop

naturally motivated

e.g. direct stop/sbottom production

look like conventional tT





Signature-based analyses:

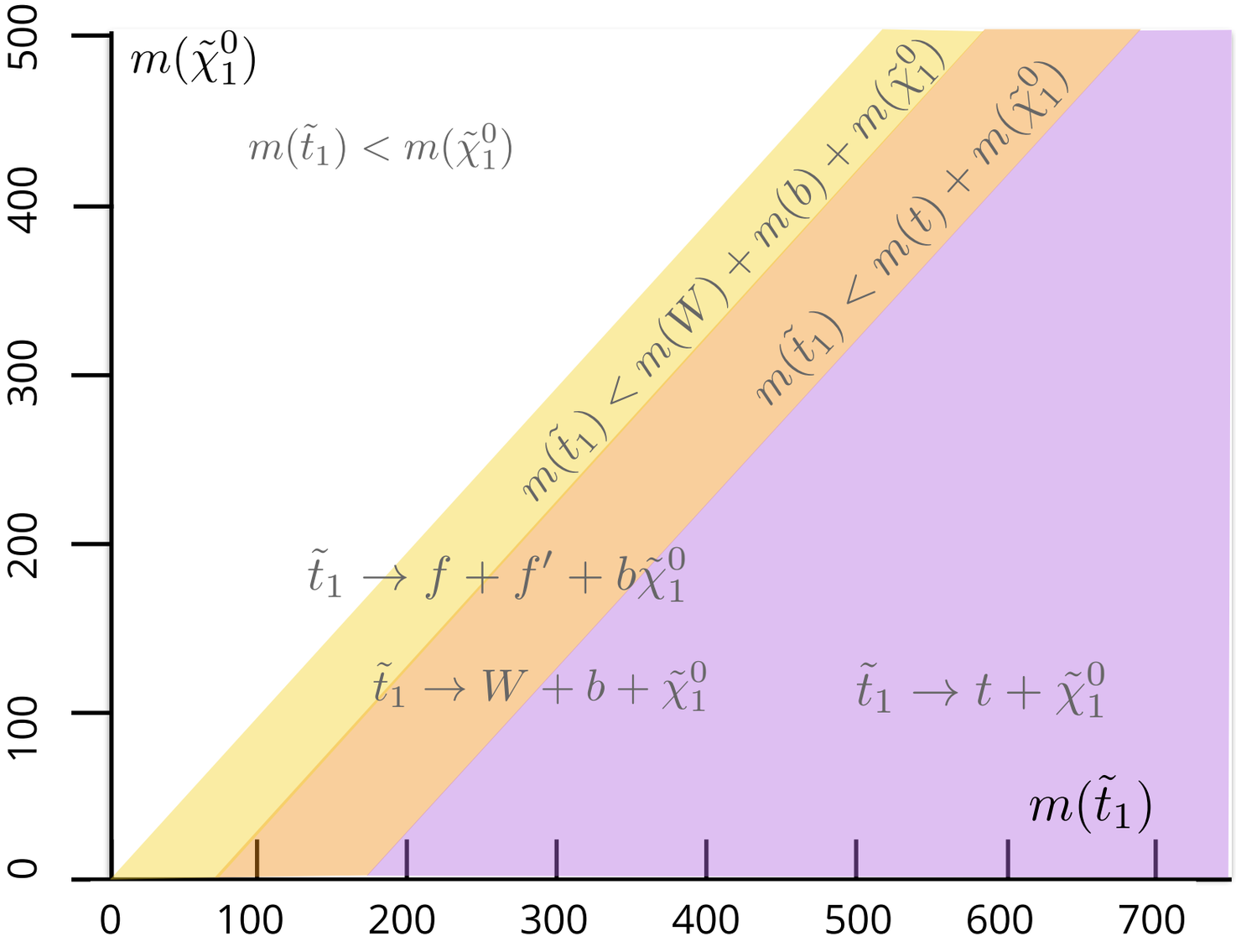
- 0L + 2 bjets + MET
- 0L + 6 (2b) jets + MET
- 1L + 4 (1b) jets + MET
- 2L + jets + MET

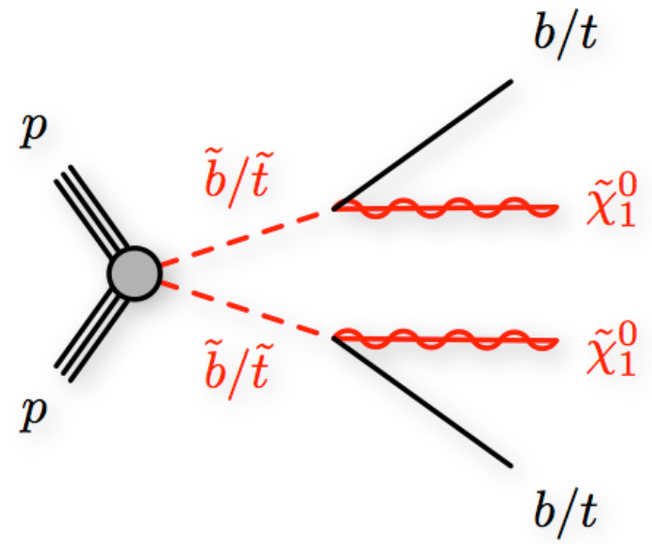
stop

naturally motivated

e.g. direct stop/sbottom production

look like conventional tT





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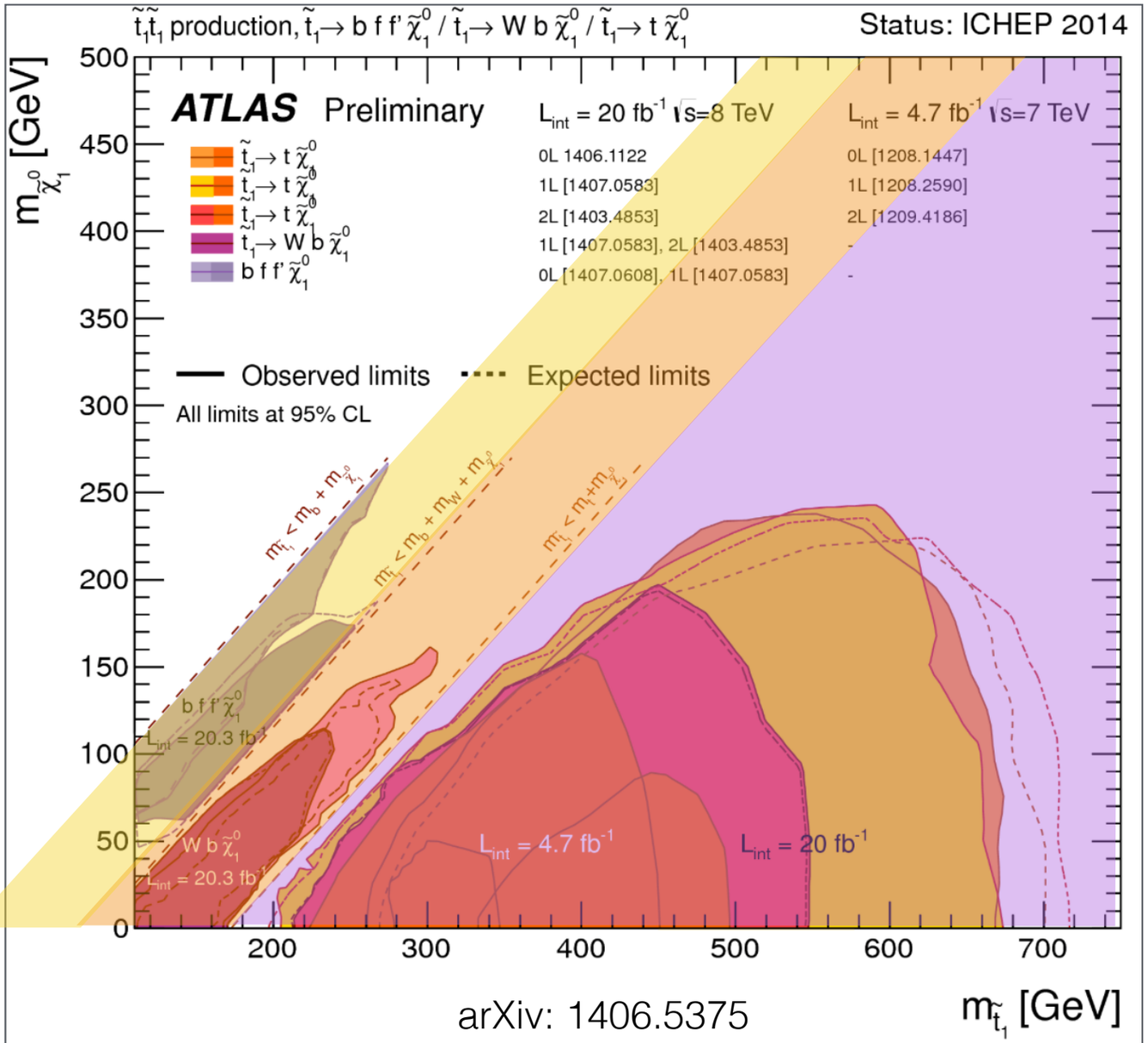
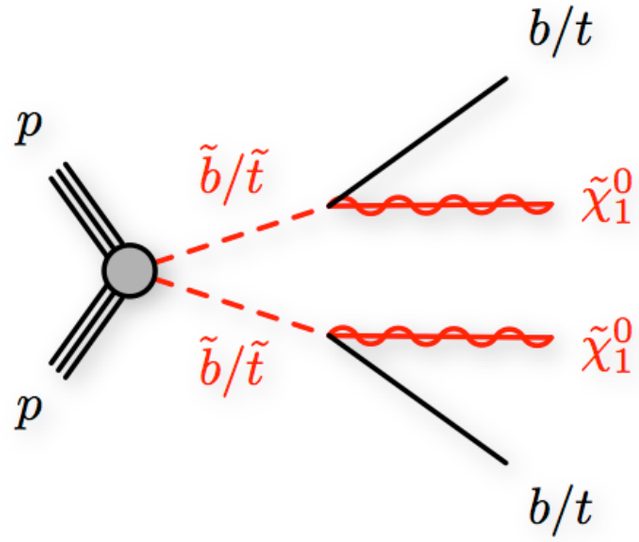


arXiv: 1406.5375



Signature-based analyses:

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arxiv:1208.1447 (0 lepton 7 TeV)
arxiv:1208.2590 (1 lepton 7 TeV)
arxiv:1209.4186 (2 leptons 7 TeV)
arxiv:1407.0583 (1 lepton 8 TeV, 20/fb)
arxiv:1406.1122 (0 lepton + 5/6 jets 8 TeV, 20/fb)
arxiv:1403.4853 (2 lepton + jets+ MET 8 TeV, 20/fb)
[7] arxiv:1407.0608 (0 lepton + jets (c-jets) + MET 8 TeV, 20/fb)

stop

naturally motivated

e.g. direct stop/sbottom production

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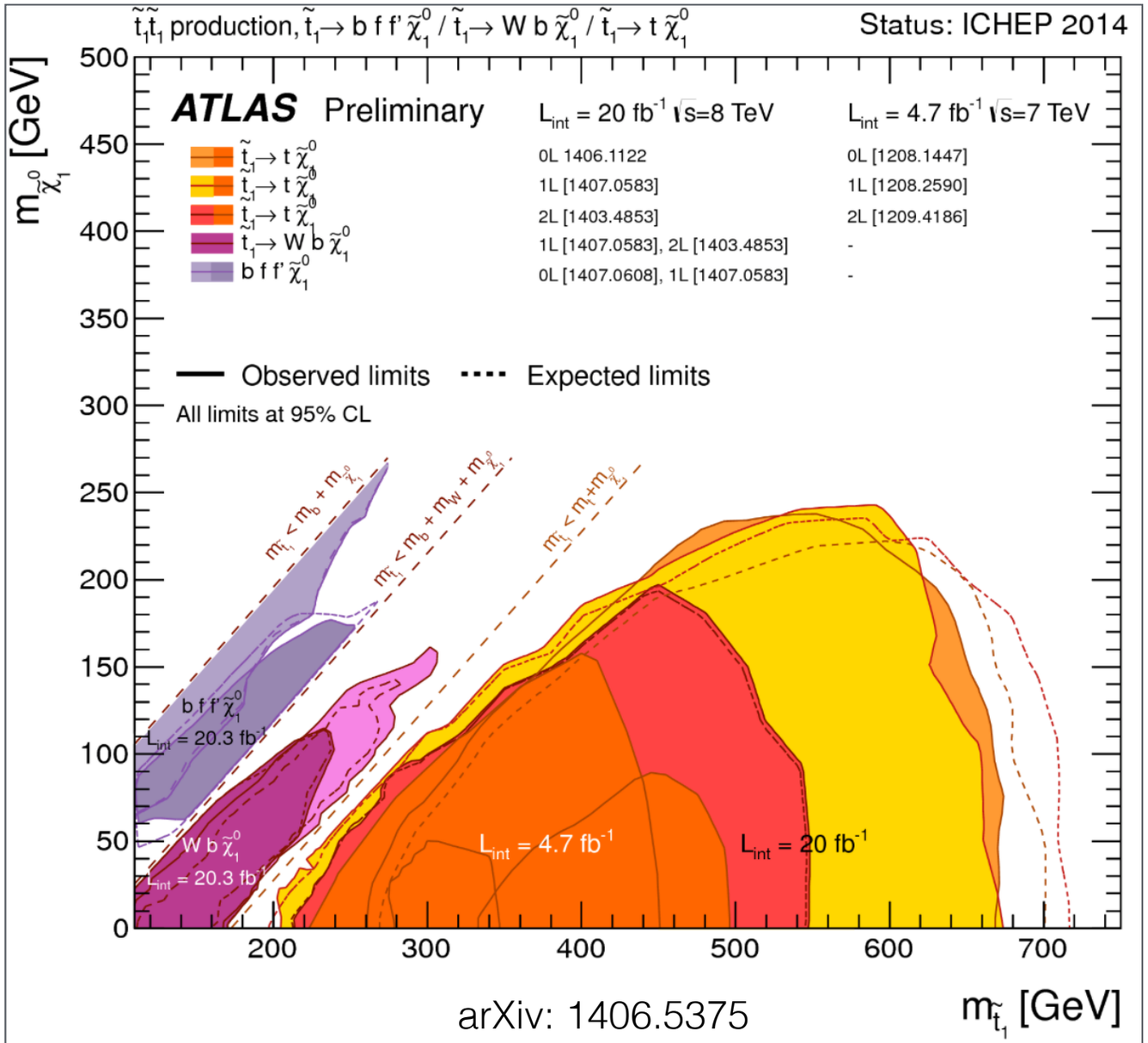

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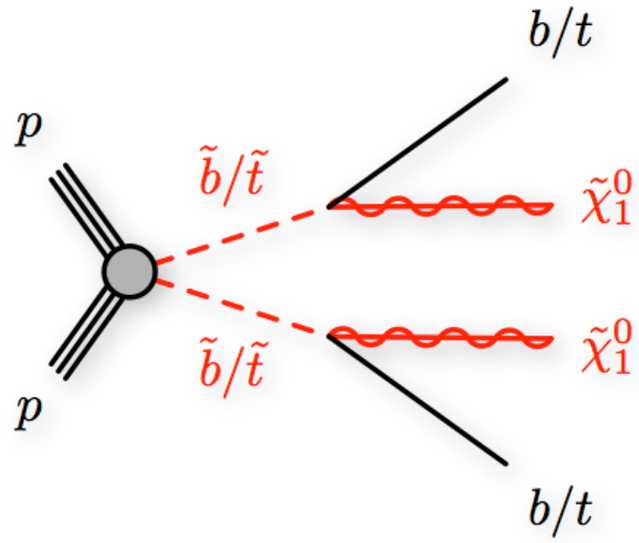

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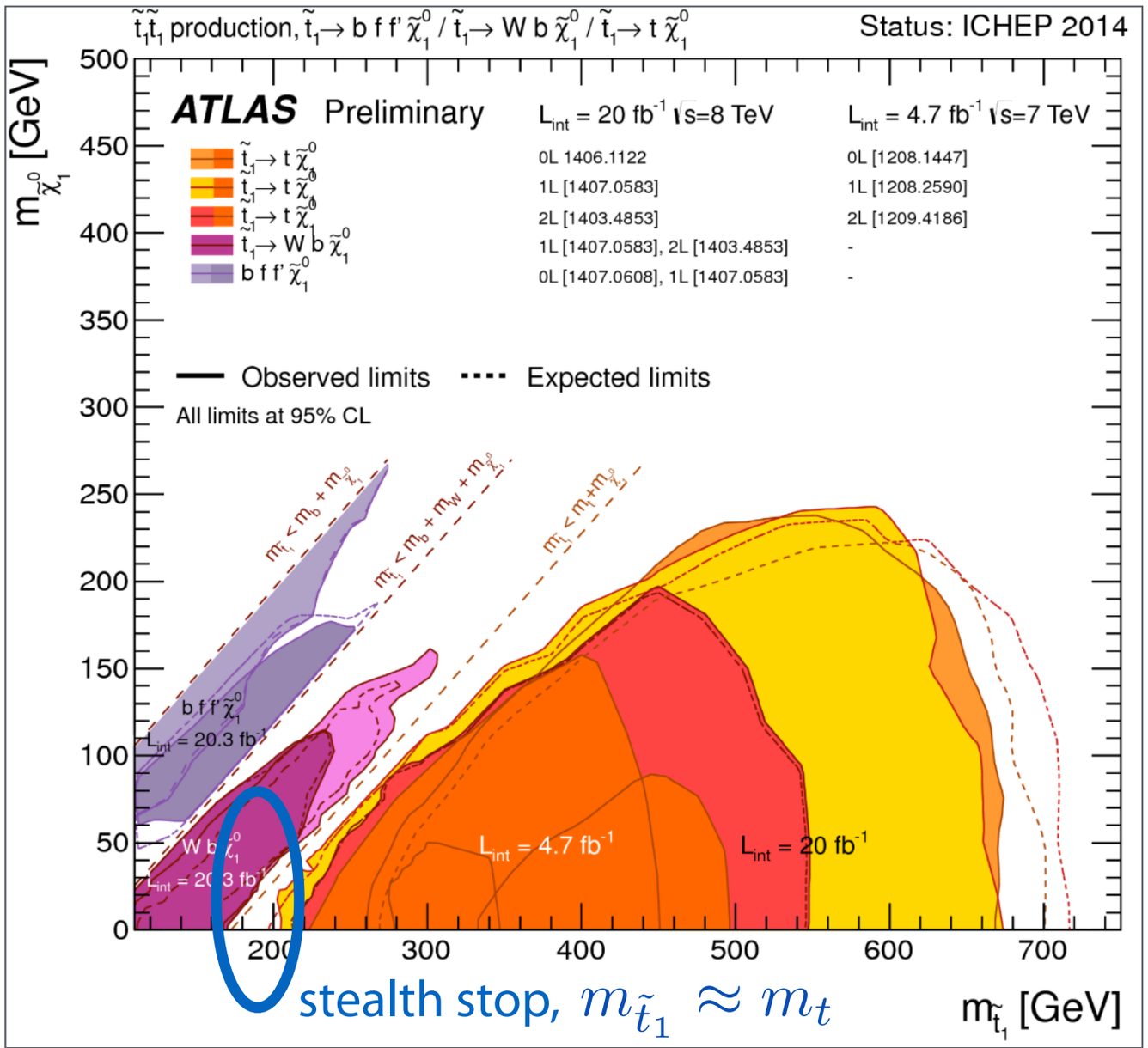
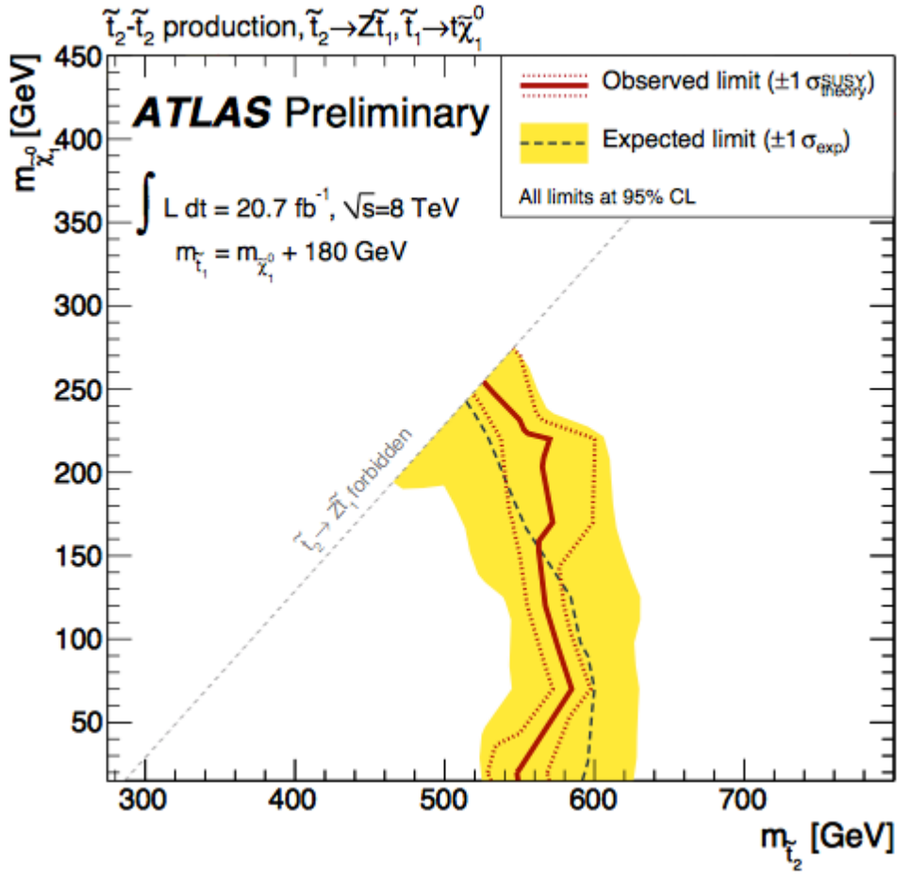
stealthy stop

kinematical no-man's land

stop hides among top?



second generation



ATLAS-CONF-2013-025

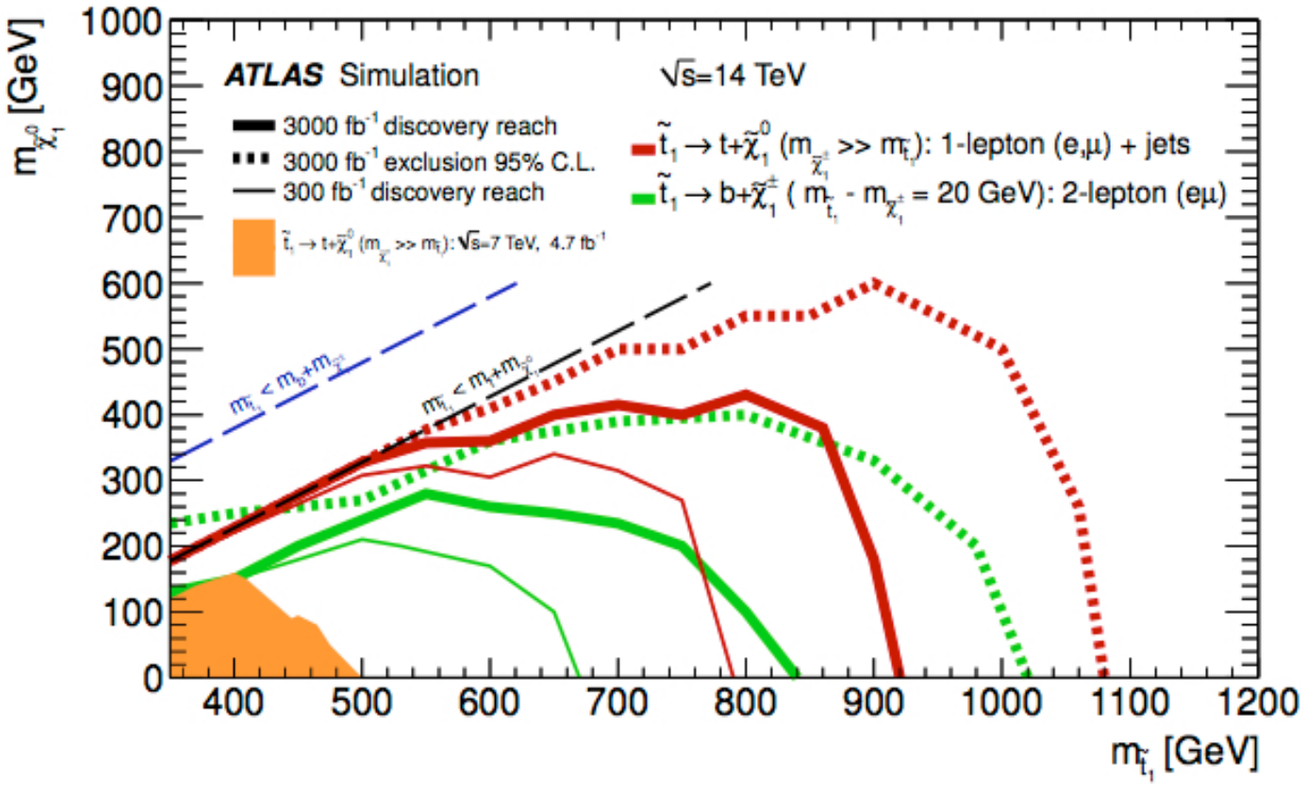
$$\tilde{t}_2 \to Z + \tilde{t}_1 \to Z + t + \tilde{\chi}_1^0$$

$$m_{\tilde{t}_1} = m_{\tilde{\chi}_1^0} + 180\ \text{GeV}$$

Run 2

Center of mass energy directly extends searches

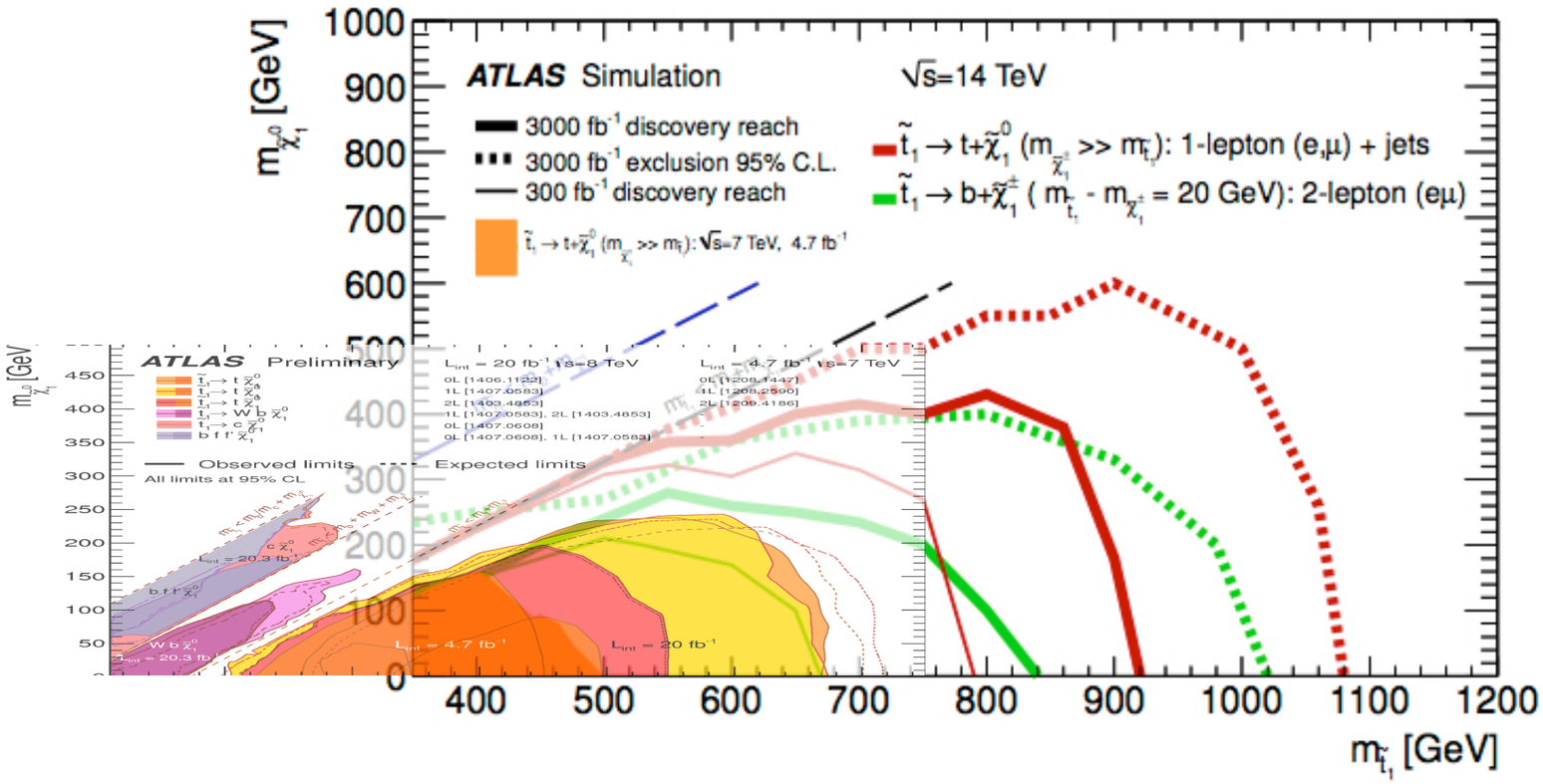
that rule of thumb...



ATL-PHYS-PUB-2012-001

Run 2

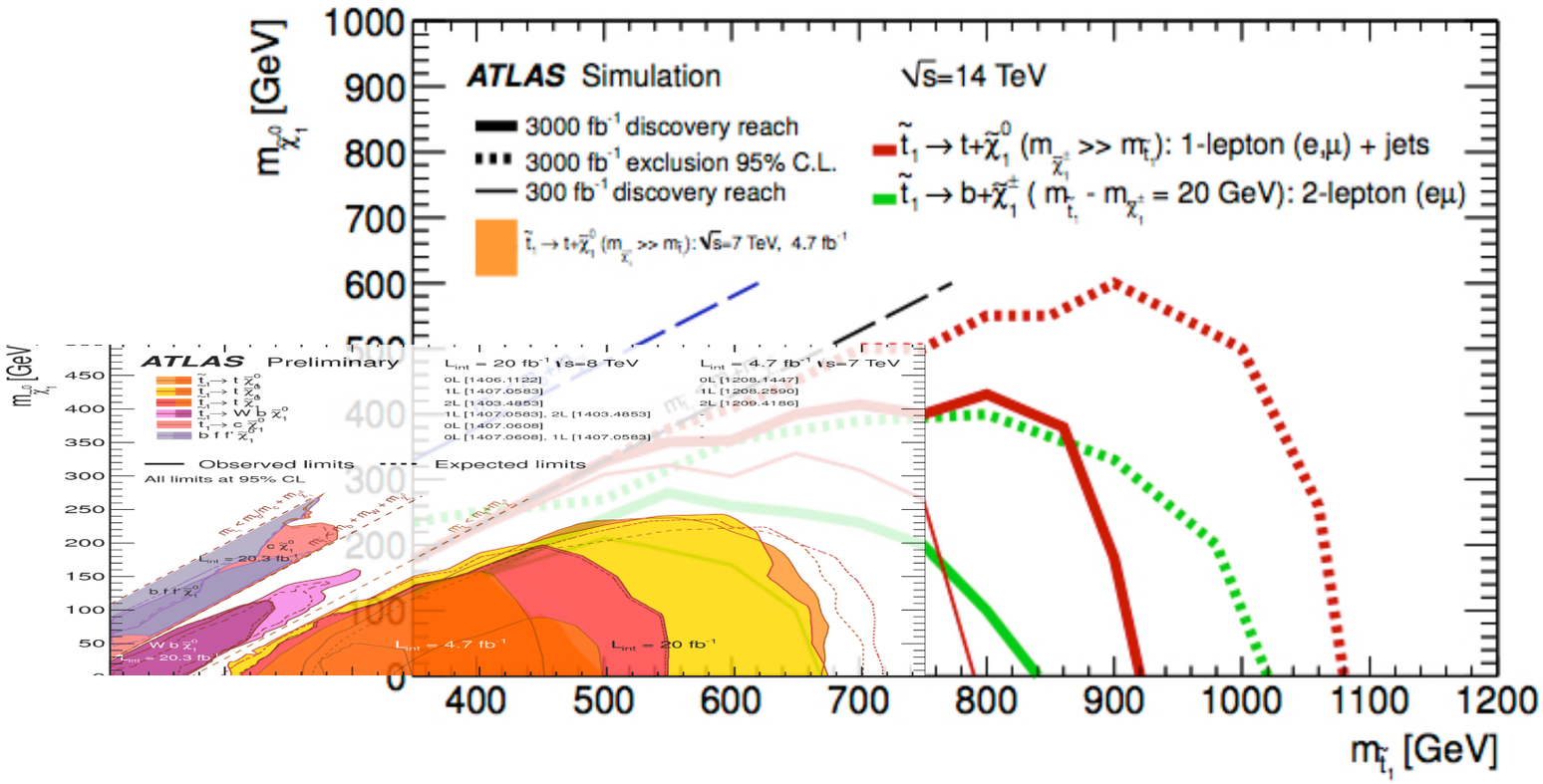
Center of mass energy directly extends searches



ATL-PHYS-PUB-2012-001

Run 2

Center of mass energy directly extends searches



ATL-PHYS-PUB-2012-001

Z prime

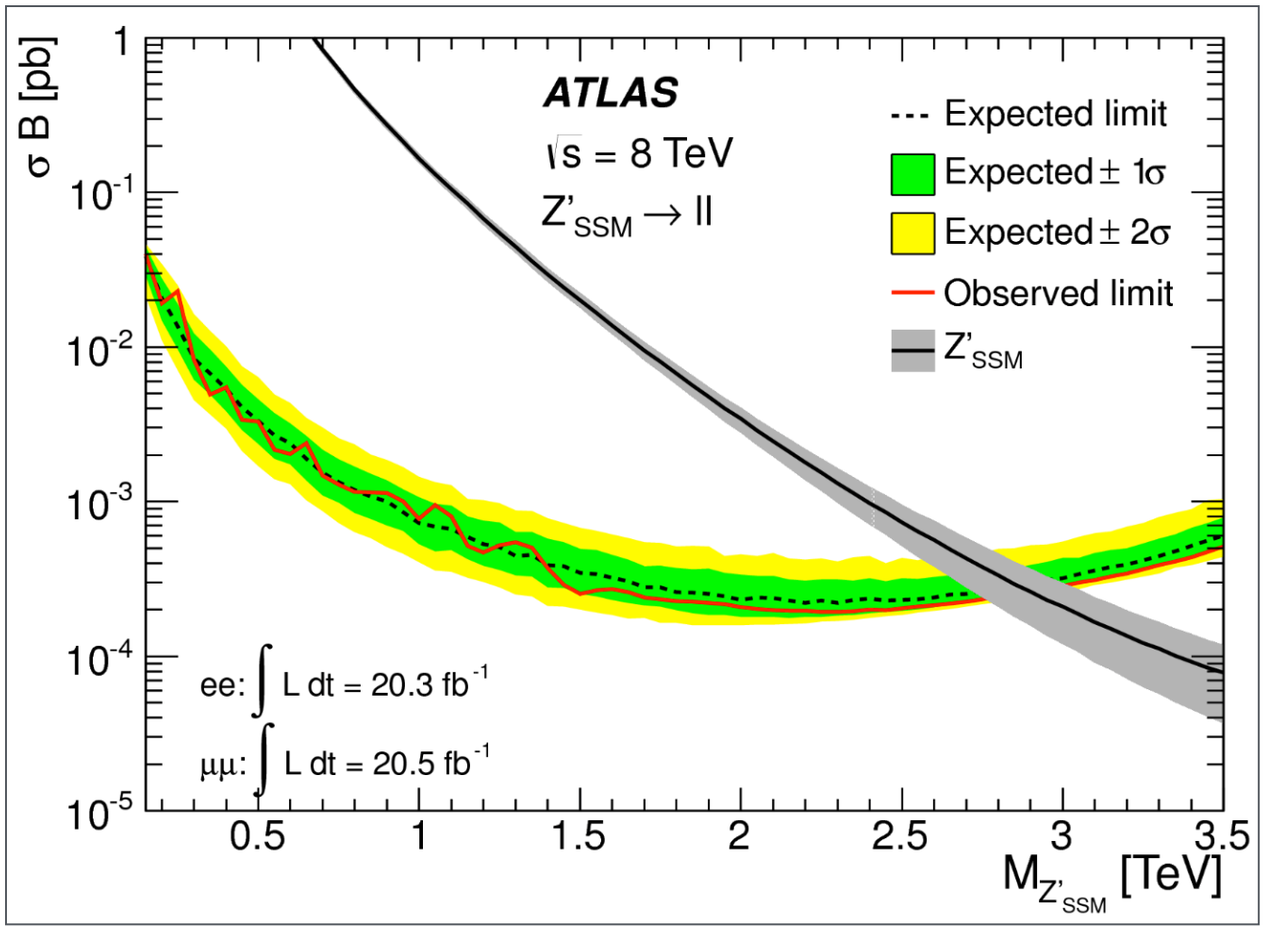
electrons and muons

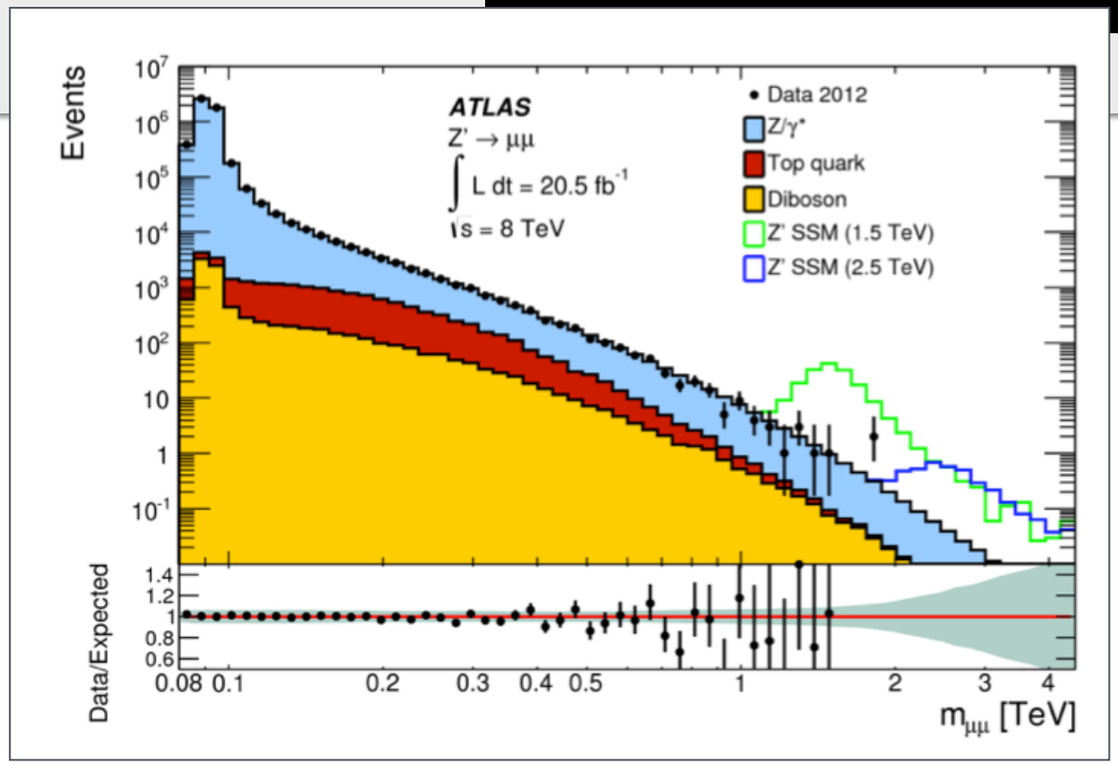
EM: E_T > 40, 30 GeV, |η|<1.37, 1.52< |η| <2.47

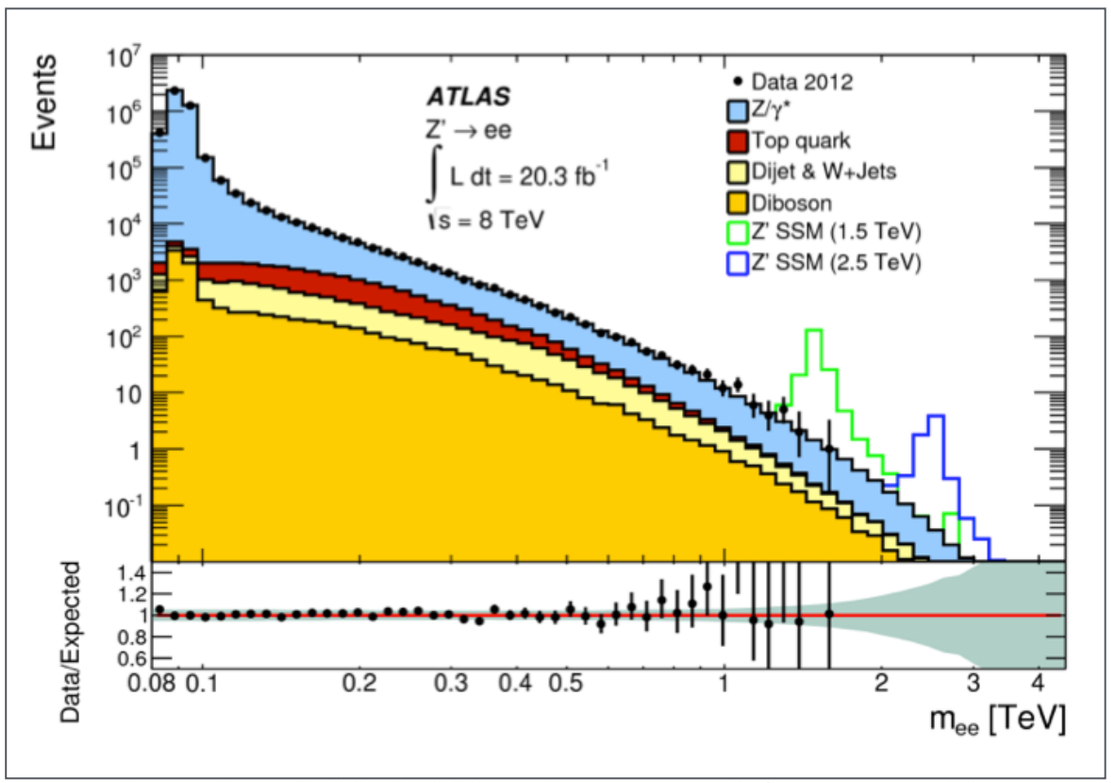
A•ε_{ID} ~ 71%

muons: p_T > 25, 25 GeV, |η|<1, 1.3< |η| <2

A•ε_{recon} ~ 46%







Phys. Rev. D 90, 052005 – Published 19 September 2014
G. Aad et al. (ATLAS Collaboration)

W prime

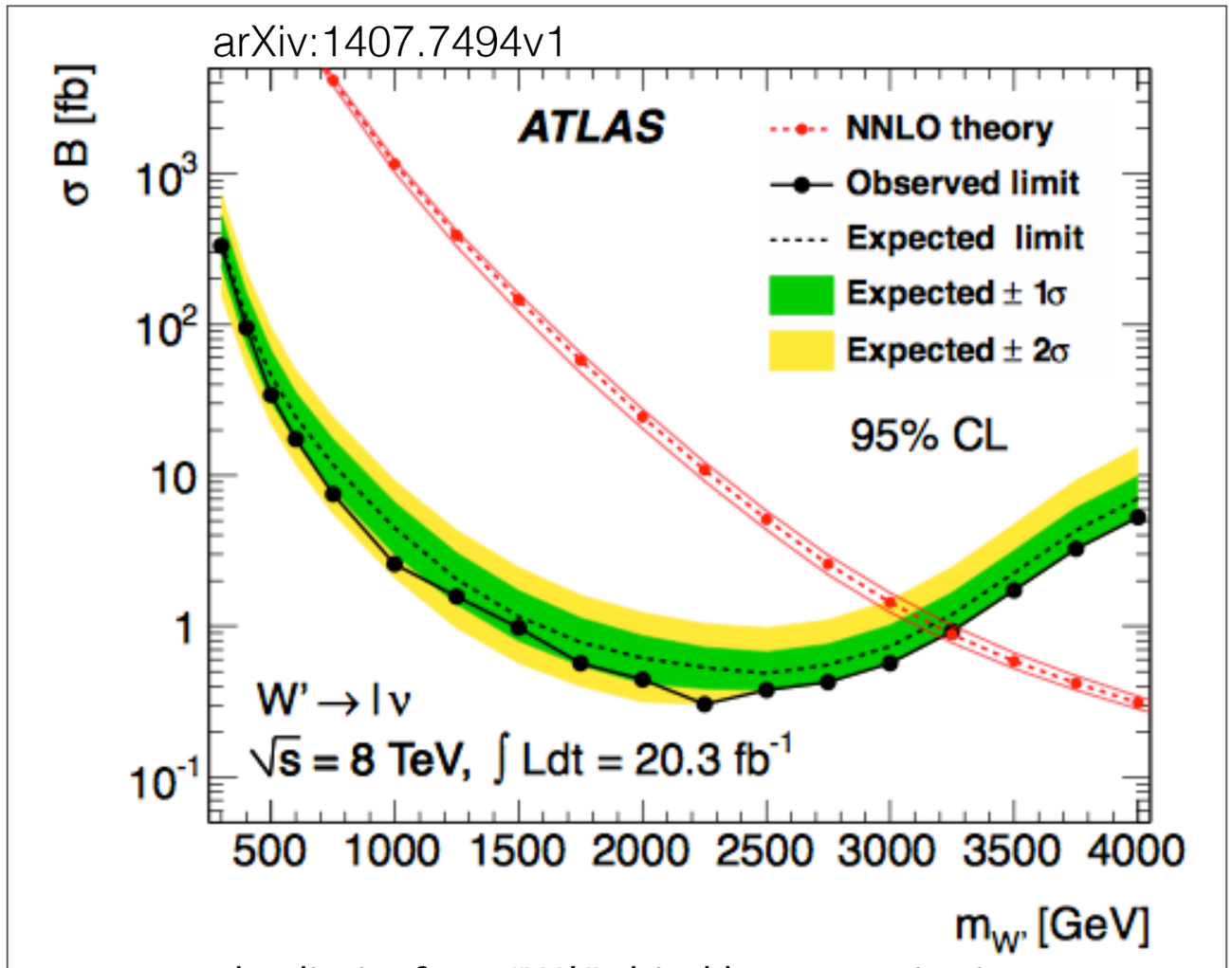
electrons and muons

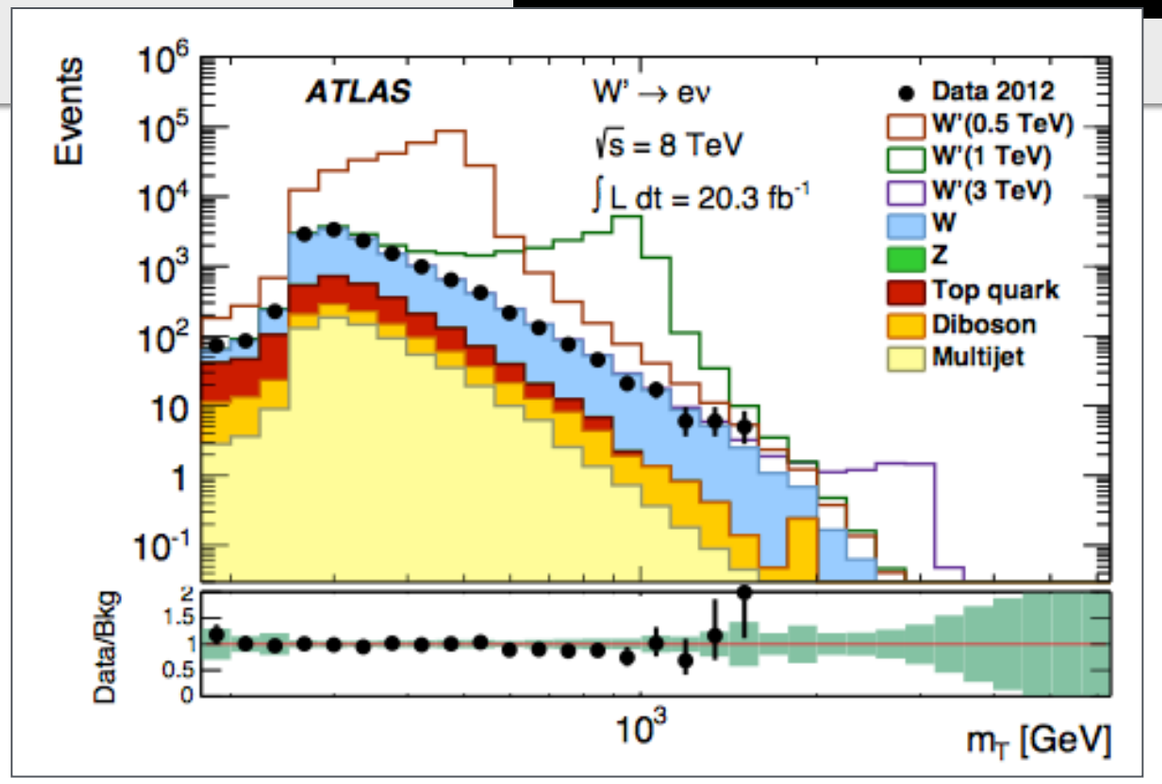
EM: E_T > 125 GeV, |η|<1.37, 1.52< |η| <2.47

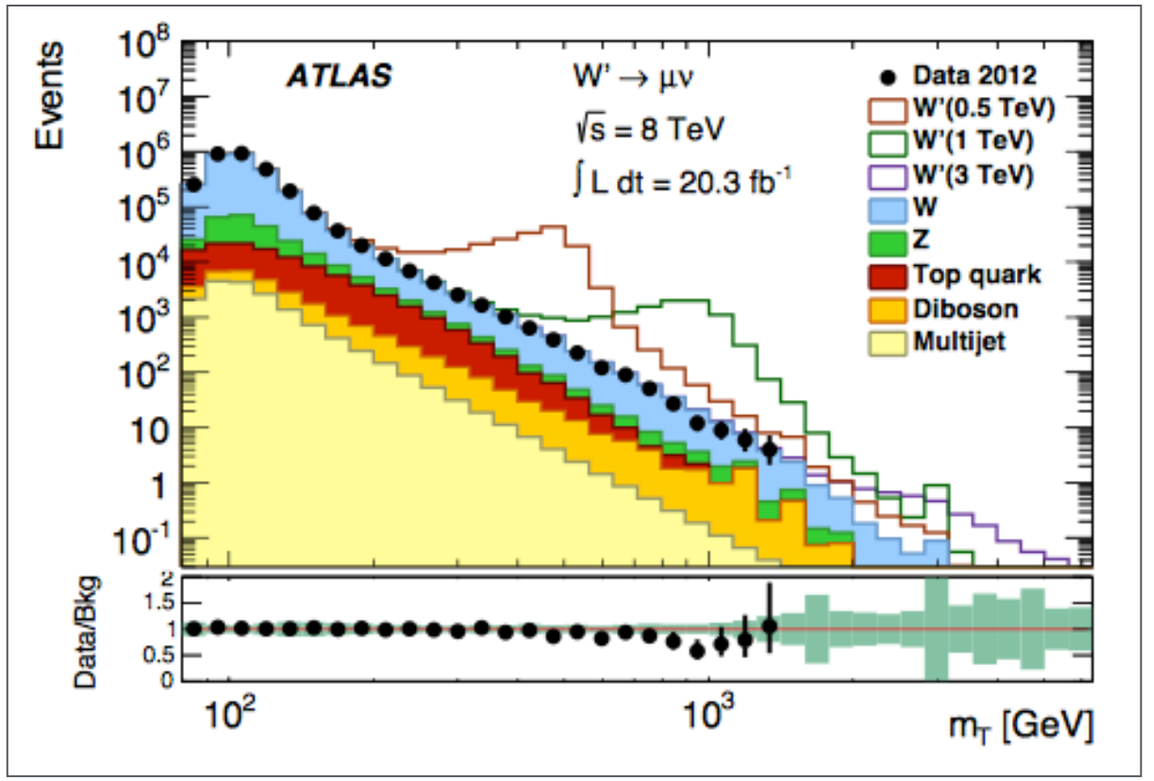
ε_{ID} ~ 90%

muons: p_T > 45 GeV, |η|<1, 1.3< |η| <2

ε_{recon} ~ 80%



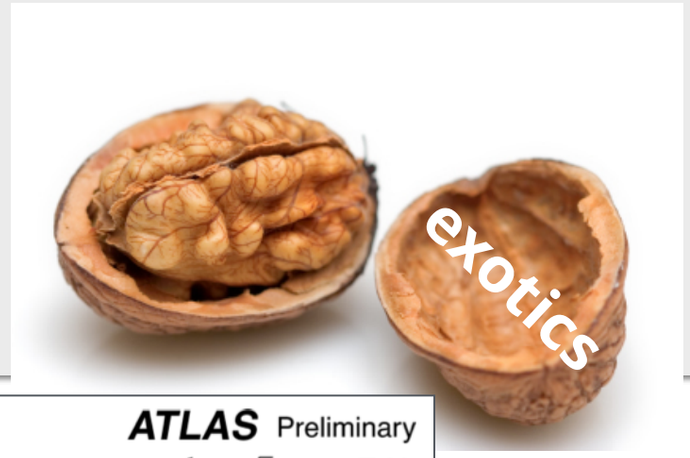




also limits for a “W*” chiral boson excitation

Exotics in a nutshell

a big nutshell



ATLAS Exotics Searches* - 95% CL Exclusion — *Status: ICHEP 2014*

1 TeV scale

ATLAS Preliminary — $\int \mathcal{L}\,dt$ = (1.0 - 20.3) fb^{-1} — $\sqrt{s}$ = 7, 8 TeV

	Model	ℓ, γ	Jets	E_T^{miss}	$\int \mathcal{L}\,dt$[fb^{-1}]	Mass limit		Reference
Extra dimensions	ADD $G_{KK} + g/q$	–	1-2 j	Yes	4.7	M_D	4.37 TeV	1210.4491
	ADD non-resonant $\ell\ell$	2 e, μ	–	–	20.3	M_S	5.2 TeV	ATLAS-CONF-2014-030
	ADD QBH $\rightarrow \ell q$	1 e, μ	1 j	–	20.3	M_{th}	5.2 TeV	1311.2006
	ADD QBH	–	2 j	–	20.3	M_{th}	5.82 TeV	to be submitted to PRD
	ADD BH high N_{trk}	2 μ (SS)	–	–	20.3	M_{th}	5.7 TeV	1308.4075
	ADD BH high $\sum p_T$	$\geq$ 1 e, μ	$\geq$ 2 j	–	20.3	M_{th}	6.2 TeV	1405.4254
	RS1 $G_{KK} \rightarrow \ell\ell$	2 e, μ	–	–	20.3	G_{KK} mass	2.68 TeV	1405.4123
	RS1 $G_{KK} \rightarrow WW \rightarrow \ell\nu\ell\nu$	2 e, μ	–	Yes	4.7	G_{KK} mass	1.23	1208.2880
	Bulk RS $G_{KK} \rightarrow ZZ \rightarrow \ell\ell qq$	2 e, μ	2 j / 1 J	–	20.3	G_{KK} mass	730 GeV	ATLAS-CONF-2014-039
	Bulk RS $G_{KK} \rightarrow HH \rightarrow b\bar{b}b\bar{b}$	–	4 b	–	19.5	G_{KK} mass	590-710 GeV	ATLAS-CONF-2014-005
	Bulk RS $g_{KK} \rightarrow t\bar{t}$	1 e, μ	$\geq$ 1 b, $\geq$ 1J/2j	Yes	14.3	g_{KK} mass	2.0 TeV	ATLAS-CONF-2013-052
	S^1/Z_2 ED	2 e, μ	–	–	5.0	$M_{KK} \approx R^{-1}$	4.71 TeV	1209.2535
	UED	2 γ	–	Yes	4.8	Compact. scale R^{-1}	1. TeV	ATLAS-CONF-2012-072
Gauge bosons	SSM $Z' \rightarrow \ell\ell$	2 e, μ	–	–	20.3	Z' mass	2.9 TeV	1405.4123
	SSM $Z' \rightarrow \tau\tau$	2 τ	–	–	19.5	Z' mass	1.9 TeV	ATLAS-CONF-2013-066
	SSM $W' \rightarrow \ell\nu$	1 e, μ	–	Yes	20.3	W' mass	3.28 TeV	ATLAS-CONF-2014-017
	EGM $W' \rightarrow WZ \rightarrow \ell\nu\,\ell'\ell'$	3 e, μ	–	Yes	20.3	W' mass	2 TeV	1406.4456
	EGM $W' \rightarrow WZ \rightarrow qq\ell\ell$	2 e, μ	2 j / 1 J	–	20.3	W' mass	59 TeV	ATLAS-CONF-2014-039
	LRSM $W'_R \rightarrow t\bar{b}$	1 e, μ	2 b, 0-1 j	Yes	14.3	W' mass	1.84 TeV	ATLAS-CONF-2013-050
	LRSM $W'_R \rightarrow t\bar{b}$	0 e, μ	$\geq$ 1 b, 1 J	–	20.3	W' mass	1.77 TeV	to be submitted to EPJC
CI	CI $qqqq$	–	2 j	–	4.8	Λ	7.6 TeV	1210.1718
	CI $qq\ell\ell$	2 e, μ	–	–	20.3	Λ	21.6 TeV	ATLAS-CONF-2014-030
	CI $uutt$	2 e, μ (SS)	$\geq$ 1 b, $\geq$ 1 j	Yes	14.3	Λ	3.3 TeV	ATLAS-CONF-2013-051
DM	EFT D5 operator (Dirac)	0 e, μ	1-2 j	Yes	10.5	M_*	731 GeV	ATLAS-CONF-2012-147
	EFT D9 operator (Dirac)	0 e, μ	1 J, $\leq$ 1 j	Yes	20.3	M_*	2.4 TeV	1309.4017
LQ	Scalar LQ 1st gen	2 e	$\geq$ 2 j	–	1.0	LQ mass	660 GeV	1112.4828
	Scalar LQ 2nd gen	2 μ	$\geq$ 2 j	–	1.0	LQ mass	685 GeV	1203.3172
	Scalar LQ 3rd gen	1 e, μ, 1 τ	1 b, 1 j	–	4.7	LQ mass	534 GeV	1303.0526
Heavy quarks	Vector-like quark $TT \rightarrow Ht + X$	1 e, μ	$\geq$ 2 b, $\geq$ 4 j	Yes	14.3	T mass	790 GeV	ATLAS-CONF-2013-018
	Vector-like quark $TT \rightarrow Wb + X$	1 e, μ	$\geq$ 1 b, $\geq$ 3 j	Yes	14.3	T mass	670 GeV	ATLAS-CONF-2013-060
	Vector-like quark $TT \rightarrow Zt + X$	2/$\geq$3 e, μ	$\geq$2/$\geq$1 b	–	20.3	T mass	735 GeV	ATLAS-CONF-2014-036
	Vector-like quark $BB \rightarrow Zb + X$	2/$\geq$3 e, μ	$\geq$2/$\geq$1 b	–	20.3	B mass	755 GeV	ATLAS-CONF-2014-036
	Vector-like quark $BB \rightarrow Wt + X$	2 e, μ (SS)	$\geq$ 1 b, $\geq$ 1 j	Yes	14.3	B mass	720 GeV	ATLAS-CONF-2013-051
Excited fermions	Excited quark $q^* \rightarrow q\gamma$	1 γ	1 j	–	20.3	q^* mass	3.5 TeV	1309.3230
	Excited quark $q^* \rightarrow qg$	–	2 j	–	20.3	q^* mass	4.09 TeV	to be submitted to PRD
	Excited quark $b^* \rightarrow Wt$	1 or 2 e, μ	1 b, 2 j or 1 j	Yes	4.7	b^* mass	870 GeV	1301.1583
	Excited lepton $\ell^* \rightarrow \ell\gamma$	2 e, μ, 1 γ	–	–	13.0	ℓ^* mass	2.2 TeV	1308.1364
Other	LSTC $a_T \rightarrow W\gamma$	1 e, μ, 1 γ	–	Yes	20.3	a_T mass	960 GeV	to be submitted to PLB
	LRSM Majorana ν	2 e, μ	2 j	–	2.1	N^0 mass	5 TeV	1203.5420
	Type III Seesaw	2 e, μ	–	–	5.8	$N^\pm$ mass	245 GeV	ATLAS-CONF-2013-019
	Higgs triplet $H^{\pm\pm} \rightarrow \ell\ell$	2 e, μ (SS)	–	–	4.7	$H^{\pm\pm}$ mass	409 GeV	1210.5070
	Multi-charged particles	–	–	–	4.4	multi-charged particle mass	490 GeV	1301.5272
	Magnetic monopoles	–	–	–	2.0	monopole mass	862 GeV	1207.6411

$n = 2$			
$n = 3$ HLZ			
$n = 6$			
$n = 6$			
$n = 6$, $M_D = 1.5$ TeV, non-rot BH			
$n = 6$, $M_D = 1.5$ TeV, non-rot BH			
$k/\overline{M}_{Pl} = 0.1$			
$k/\overline{M}_{Pl} = 0.1$			
$k/\overline{M}_{Pl} = 1.0$			
$k/\overline{M}_{Pl} = 1.0$			
BR = 0.925			
$\eta = +1$			
$\eta_{LL} = -1$			
$\lvert C \rvert = 1$			
at 90% CL for $m(\chi) < 80$ GeV			
at 90% CL for $m(\chi) < 100$ GeV			
$\beta = 1$			
$\beta = 1$			
$\beta = 1$			
T in (T,B) doublet			
isospin singlet			
T in (T,B) doublet			
B in (B,Y) doublet			
B in (T,B) doublet			
only u^* and d^*, $\Lambda = m(q^*)$			
only u^* and d^*, $\Lambda = m(q^*)$			
left-handed coupling			
$\Lambda = 2.2$ TeV			
$m(W_R) = 2$ TeV, no mixing			
$\lvert V_e \rvert$=0.055, $\lvert V_\mu \rvert$=0.063, $\lvert V_\tau \rvert$=0			
DY production, BR($H^{\pm\pm} \rightarrow \ell\ell$)=1			
DY production, $\lvert q \rvert = 4e$			
DY production, $\lvert g \rvert = 1g_D$			

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

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

SUSY in a nutshell

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: ICHEP 2014

1 TeV scale

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	2-6 jets	Yes	20.3	$\tilde{q}, \tilde{g}$ 1.7 TeV	$m(\tilde{q})=m(\tilde{g})$	1405.7875
	MSUGRA/CMSSM	1 e,μ	3-6 jets	Yes	20.3	$\tilde{g}$ 1.2 eV	any $m(\tilde{q})$	ATLAS-CONF-2013-062
	MSUGRA/CMSSM	0	7-10 jets	Yes	20.3	$\tilde{g}$ 1.1 T	any $m(\tilde{q})$	1308.1841
	$\tilde{q}\tilde{q}, \tilde{q}\to q\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{q}$ 850 GeV	$m(\tilde{\chi}_1^0)$=0 GeV, $m(1^{st}$ gen. $\tilde{q})=m(2^{nd}$ gen. $\tilde{q})$	1405.7875
	$\tilde{g}\tilde{g}, \tilde{g}\to q\bar{q}\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{g}$ 1 3 TeV	$m(\tilde{\chi}_1^0)$=0 GeV	1405.7875
	$\tilde{g}\tilde{g}, \tilde{g}\to qq\tilde{\chi}_1^\pm\to qqW^\pm\tilde{\chi}_1^0$	1 e,μ	3-6 jets	Yes	20.3	$\tilde{g}$ 1.18 eV	$m(\tilde{\chi}_1^0)$<200 GeV, $m(\tilde{\chi}^\pm)=0.5(m(\tilde{\chi}_1^0)+m(\tilde{g}))$	ATLAS-CONF-2013-062
	$\tilde{g}\tilde{g}, \tilde{g}\to qq(\ell\ell/\ell\nu/\nu\nu)\tilde{\chi}_1^0$	2 e,μ	0-3 jets	-	20.3	$\tilde{g}$ 1.12 T	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-089
	GMSB ($\tilde{\ell}$ NLSP)	2 e,μ	2-4 jets	Yes	4.7	$\tilde{g}$ 1.2 TeV	tanβ<15	1208.4688
	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	$\tilde{g}$ 1.2 TeV	$m(\tilde{\chi}_1^0)$>50 GeV	ATLAS-CONF-2014-001
	GGM (wino NLSP)	1 e,μ + γ	-	Yes	4.8	$\tilde{g}$ 619 GeV	$m(\tilde{\chi}_1^0)$>50 GeV	ATLAS-CONF-2012-144
	GGM (higgsino-bino NLSP)	γ	1 b	Yes	4.8	$\tilde{g}$ 900 GeV	$m(\tilde{\chi}_1^0)$>220 GeV	1211.1167
	GGM (higgsino NLSP)	2 e,μ (Z)	0-3 jets	Yes	5.8	$\tilde{g}$ 690 GeV	m(NLSP)>200 GeV	ATLAS-CONF-2012-152
	Gravitino LSP	0	mono-jet	Yes	10.5	$F^{1/2}$ scale 645 GeV	$m(\tilde{G})>10^{-4}$ eV	ATLAS-CONF-2012-147
3rd gen. $\tilde{g}$ med.	$\tilde{g}\to b\bar{b}\tilde{\chi}_1^0$	0	3 b	Yes	20.1	$\tilde{g}$ 1.2 TeV	$m(\tilde{\chi}_1^0)$<400 GeV	1407.0600
	$\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$	0	7-10 jets	Yes	20.3	$\tilde{g}$ 1.1 T	$m(\tilde{\chi}_1^0)$ <350 GeV	1308.1841
	$\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$	0-1 e,μ	3 b	Yes	20.1	$\tilde{g}$ 1 4 TeV	$m(\tilde{\chi}_1^0)$<400 GeV	1407.0600
	$\tilde{g}\to b\bar{t}\tilde{\chi}_1^+$	0-1 e,μ	3 b	Yes	20.1	$\tilde{g}$ 1 TeV	$m(\tilde{\chi}_1^0)$<300 GeV	1407.0600
3rd 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
	$\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\to b\tilde{\chi}_1^\pm$	1-2 e,μ	1-2 b	Yes	4.7	$\tilde{t}_1$ 110-167 GeV	$m(\tilde{\chi}_1^0)$=55 GeV	1208.4305, 1209.2102
	$\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\to Wb\tilde{\chi}_1^0$	2 e,μ	0-2 jets	Yes	20.3	$\tilde{t}_1$ 130-210 GeV	$m(\tilde{\chi}_1^0)$ =$m(\tilde{t}_1)$-$m(W)$-50 GeV, $m(\tilde{t}_1)$<<$m(\tilde{\chi}_1^\pm)$	1403.4853
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\to t\tilde{\chi}_1^0$	2 e,μ	2 jets	Yes	20.3	$\tilde{t}_1$ 215-530 GeV	$m(\tilde{\chi}_1^0)$=1 GeV	1403.4853
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\to b\tilde{\chi}_1^\pm$	0	2 b	Yes	20.1	$\tilde{t}_1$ 150-580 GeV	$m(\tilde{\chi}_1^0)$<200 GeV, $m(\tilde{\chi}_1^\pm)$-$m(\tilde{\chi}_1^0)$=5 GeV	1308.2631
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\to t\tilde{\chi}_1^0$	1 e,μ	1 b	Yes	20	$\tilde{t}_1$ 210-640 GeV	$m(\tilde{\chi}_1^0)$=0 GeV	1407.0583
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\to t\tilde{\chi}_1^0$	0	2 b	Yes	20.1	$\tilde{t}_1$ 260-640 GeV	$m(\tilde{\chi}_1^0)$=0 GeV	1406.1122
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to c\tilde{\chi}_1^0$	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	$\tilde{\ell}_{LR}\tilde{\ell}_{LR}, \tilde{\ell}\to\ell\tilde{\chi}_1^0$	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
	$\tilde{\chi}_1^\pm\tilde{\chi}_2\to\tilde{\ell}_L\nu\tilde{\ell}_L\ell(\tilde{\nu}\nu), \ell\tilde{\nu}\tilde{\ell}_L\ell(\tilde{\nu}\nu)$	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	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
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to W\tilde{\chi}_1^0 h\tilde{\chi}_1^0$	1 e,μ	2 b	Yes	20.3	$\tilde{\chi}_1^\pm,\tilde{\chi}_2^0$ 285 GeV	$m(\tilde{\chi}_1^\pm)=m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)$=0, sleptons decoupled	ATLAS-CONF-2013-093
	$\tilde{\chi}_2^0\tilde{\chi}_3^0, \tilde{\chi}_{2,3}^0\to\tilde{\ell}_R\ell$	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
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, $\tau(\tilde{\chi}_1^\pm)$=0.2 ns	ATLAS-CONF-2013-069
	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<$\tau(\tilde{g})$<1000 s	1310.6584
	GMSB, stable $\tilde{\tau}$, $\tilde{\chi}_1^0\to\tilde{\tau}(\tilde{e},\tilde{\mu})+\tau(e,\mu)$	1-2 μ	-	-	15.9	$\tilde{\chi}_1^0$ 475 GeV	10<tanβ<50	ATLAS-CONF-2013-058
	GMSB, $\tilde{\chi}_1^0\to\gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$	2 γ	-	Yes	4.7	$\tilde{\chi}_1^0$ 230 GeV	0.4<$\tau(\tilde{\chi}_1^0)$<2 ns	1304.6310
	$\tilde{q}\tilde{q}, \tilde{\chi}_1^0\to qq\mu$ (RPV)	1 μ, displ. vtx	-	-	20.3	$\tilde{q}$ 1.0 TeV	1.5 <$c\tau$<156 mm, BR(μ)=1, $m(\tilde{\chi}_1^0)$=108 GeV	ATLAS-CONF-2013-092
RPV	LFV $pp\to\tilde{\nu}_\tau + X, \tilde{\nu}_\tau\to e+\mu$	2 e,μ	-	-	4.6	$\tilde{\nu}_\tau$ 1.61 TeV	λ'_{311}=0.10, λ_{132}=0.05	1212.1272
	LFV $pp\to\tilde{\nu}_\tau + X, \tilde{\nu}_\tau\to e(\mu)+\tau$	1 $e,\mu+\tau$	-	-	4.6	$\tilde{\nu}_\tau$ 1.1 T	λ'_{311}=0.10, $\lambda_{1(2)33}$=0.05	1212.1272
	Bilinear RPV CMSSM	2 e,μ (SS)	0-3 b	Yes	20.3	$\tilde{q}, \tilde{g}$ 1 5 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×$m(\tilde{\chi}_1^\pm)$, $\lambda_{121}\neq 0$	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×$m(\tilde{\chi}_1^\pm)$, $\lambda_{133}\neq 0$	1405.5086
	$\tilde{g}\to qqq$	0	6-7 jets	-	20.3	$\tilde{g}$ 916 GeV	BR(t)=BR(b)=BR(c)=0%	ATLAS-CONF-2013-091
	$\tilde{g}\to\tilde{t}_1 t, \tilde{t}_1\to bs$	2 e,μ (SS)	0-3 b	Yes	20.3	$\tilde{g}$ 850 GeV		1404.250
Other	Scalar gluon pair, sgluon$\to q\bar{q}$	0	4 jets	-	4.6	sgluon 100-287 GeV	incl. limit from 1110.2693	1210.4826
	Scalar gluon pair, sgluon$\to t\bar{t}$	2 e,μ (SS)	2 b	Yes	14.3	sgluon 350-800 GeV		ATLAS-CONF-2013-051
	WIMP interaction (D5, Dirac χ)	0	mono-jet	Yes	10.5	M* scale 704 GeV	$m(\chi)$<80 GeV, limit of<687 GeV for D8	ATLAS-CONF-2012-147

$\sqrt{s}$ = 7 TeV full data | $\sqrt{s}$ = 8 TeV partial data | $\sqrt{s}$ = 8 TeV full data

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

*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.

But Wait... THERE'S MORE!

SUSY

stop searches **(Max Wanotayaroj, Friday)**

spin correlations

Electroweak-ino production, many channels and assumptions

GSMB models, delayed and non-pointing photons

out of time events and disappearing tracks

R-parity violating final states

Additional searches

W’ searches to hadronic final states **(Ho Ling Li, Friday)**

dijet, ZZ, ZW, W\gamma, Z\gamma resonances

Vector like quarks **(Brad Schoenrock, Friday)**

Dark Matter inspired: Mono jets, tT, b, t

LFV and long-lived neutral particles **(Andrew Hard, Friday)**

prompt and non-prompt lepton jets **(Hari Namasivayam, today)**

Flavor Physics

Notable results

from Run 1 we anticipated:

measure: $bb \to J/\psi$, $pp \to J/\psi$, and $B^+ \to J/\psi + K^+$ cross section ratios

begin to contribute to world averages on B-hadron properties; start to set limits on rare decays

from Run 1 we achieved:

many production studies, χ, ψ studies, new physics searches, new b states

in Run 2, we expect:

increased statistics, improved performance/triggers, robust against $\mathscr{L}$

First excited B^*_c

open beauty discovery, cb

S. Godfrey PHYSICAL REVIEW D **70** 054017

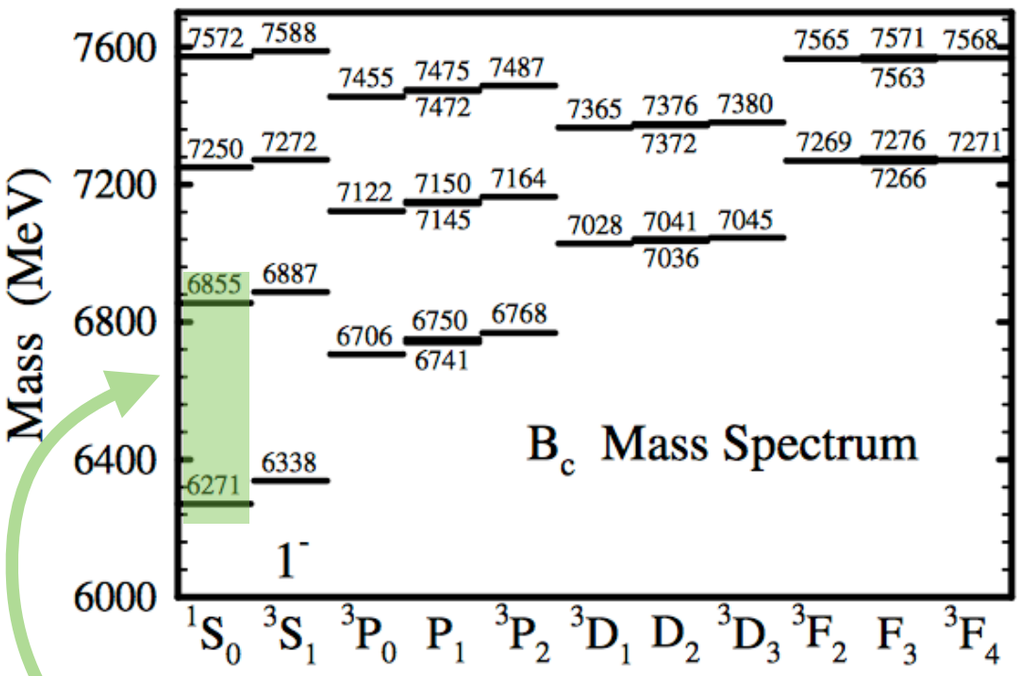
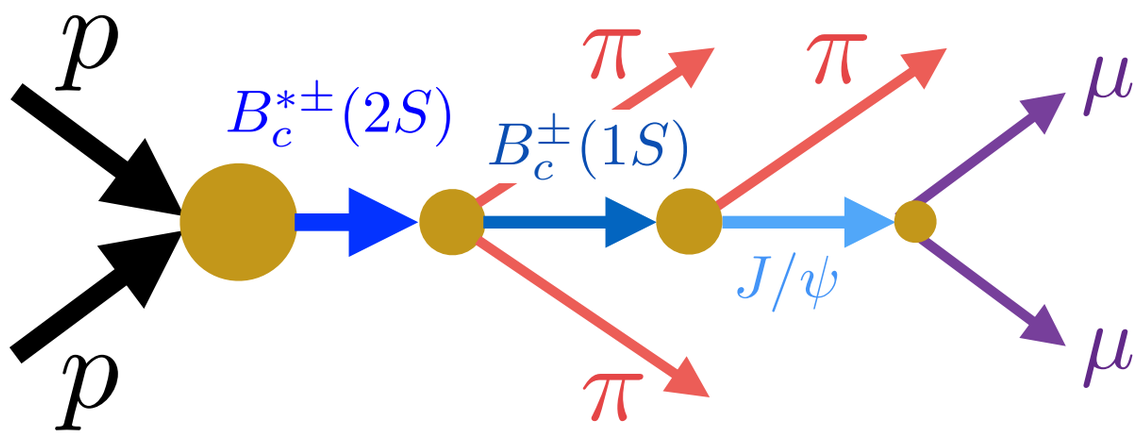


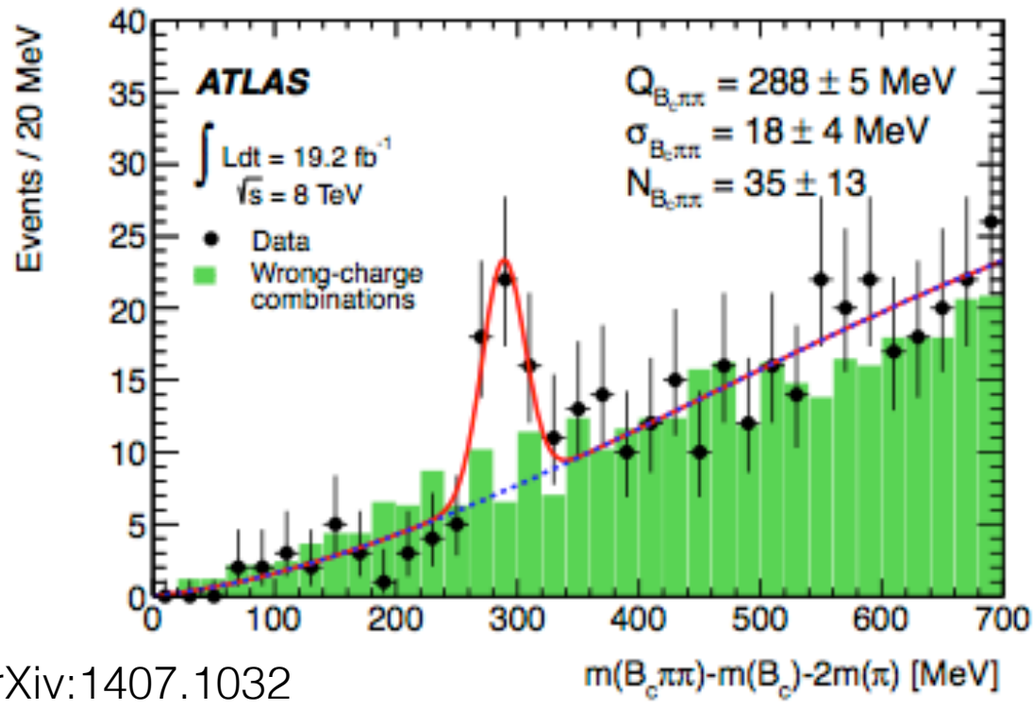
FIG. 1. The B_c mass spectrum.



$2^1S_0 \to 1^1S_0 + 2\pi$ E1 - E1 transition

Q values consistent with the production and decay of a new state, B*$_C$ with a mass of 6842 ± 4 ± 5 MeV

Significance is 5.2 σ with “look-back”



arXiv:1407.1032

Production and Decays, incl

$\psi(2s)$ in many distributions, prompt and non-prompt

W+ incl double parton scattering contribution

χ_c production, prompt?

$\Upsilon(1s,2s,3s)$ production

open charm/beauty, in jets, inclusive

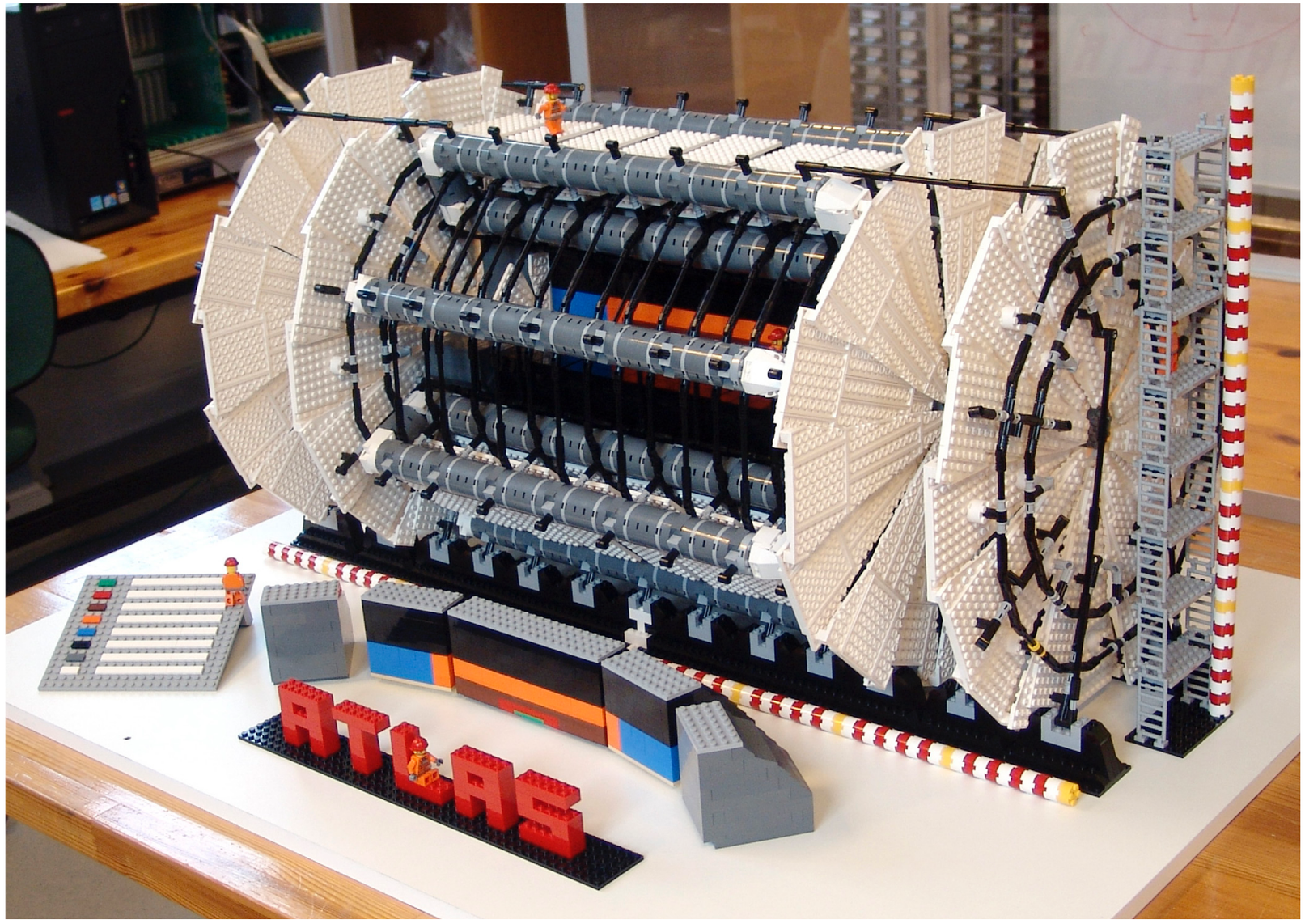
Spectroscopy, incl

$\chi_b(3P)$ discovery, Λ_b mass, lifetime, PV in $\Lambda_b \to J/\psi\ \Lambda^0$, Rare Decays

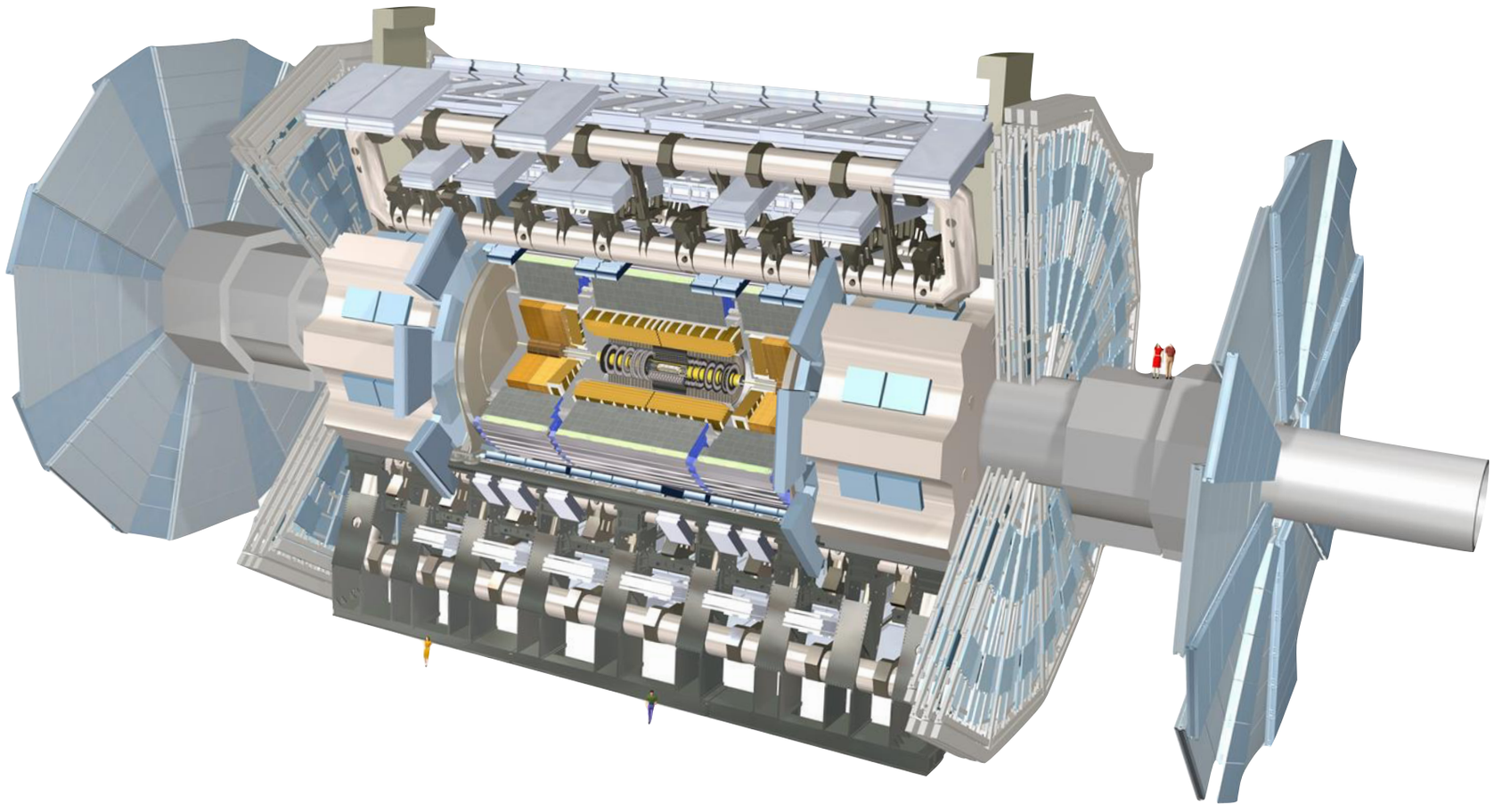
Searches, incl

FCNC search for $B_{d/s} \to \mu^+\ \mu^-$

Long Shutdown 1 Projects



http://www.atlas.ch/atlas-lego.html



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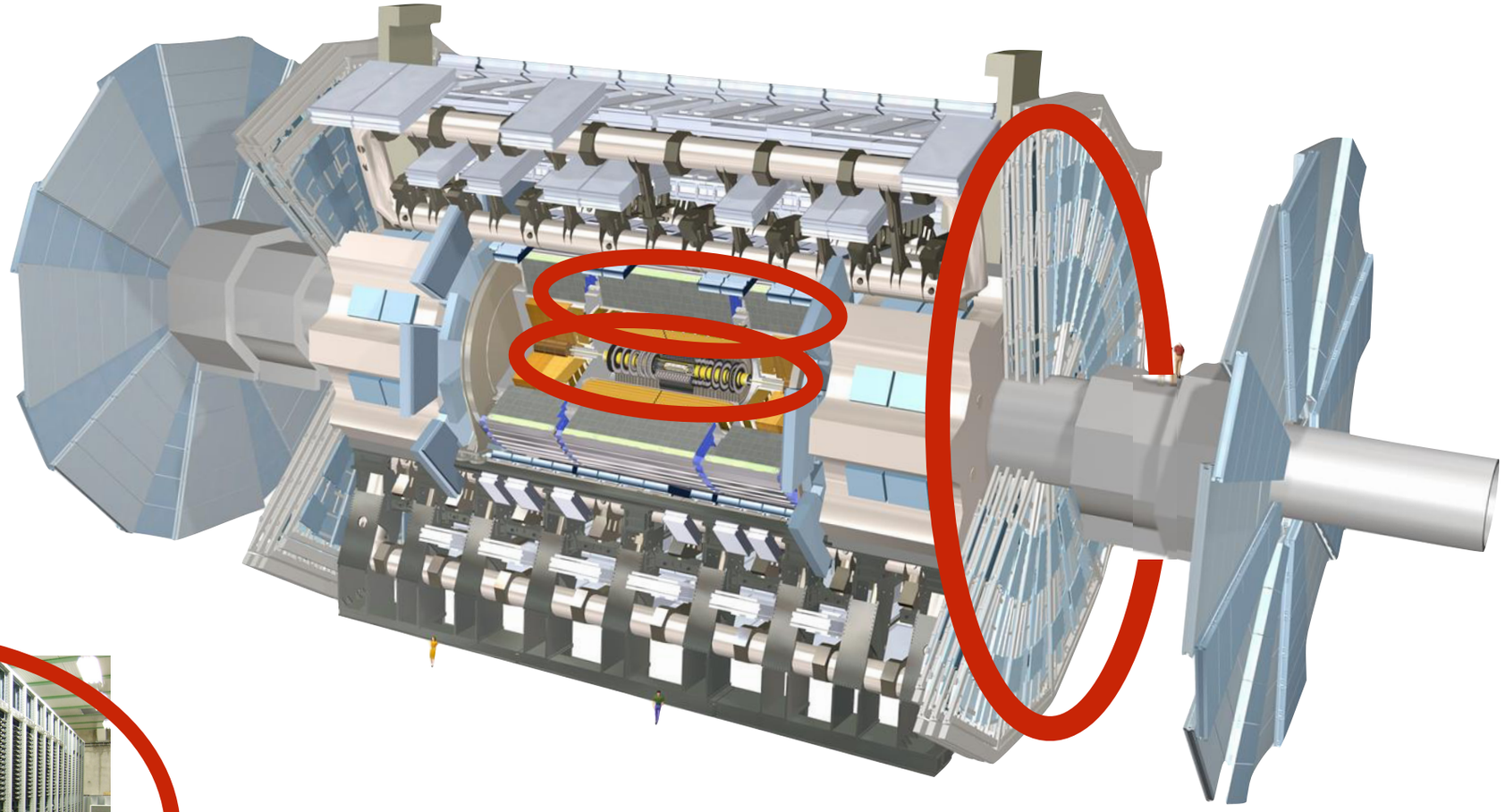
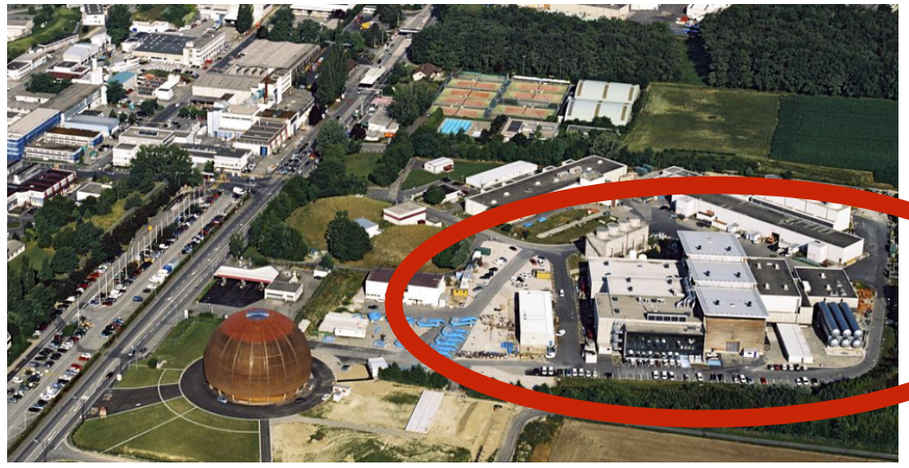
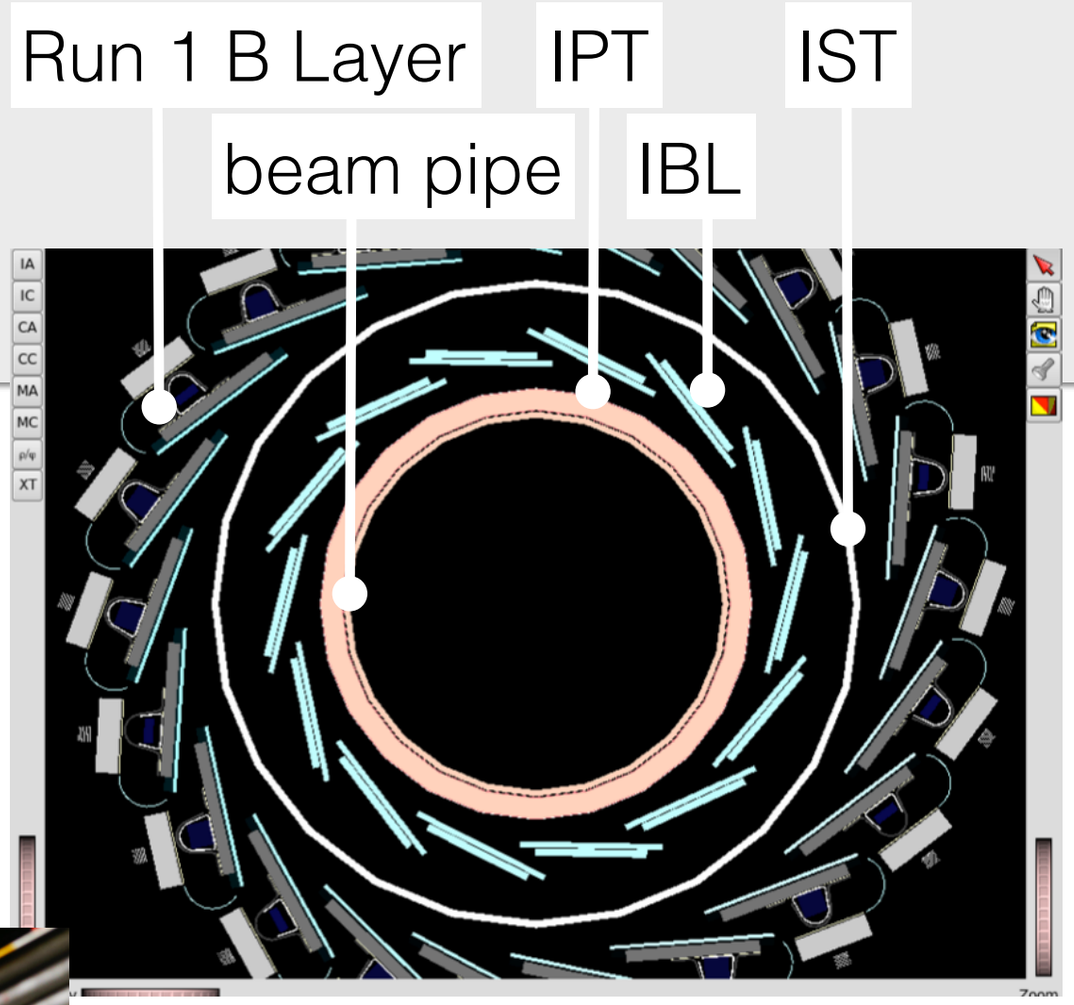




Tracking system

Insertable B Layer, aka IBL

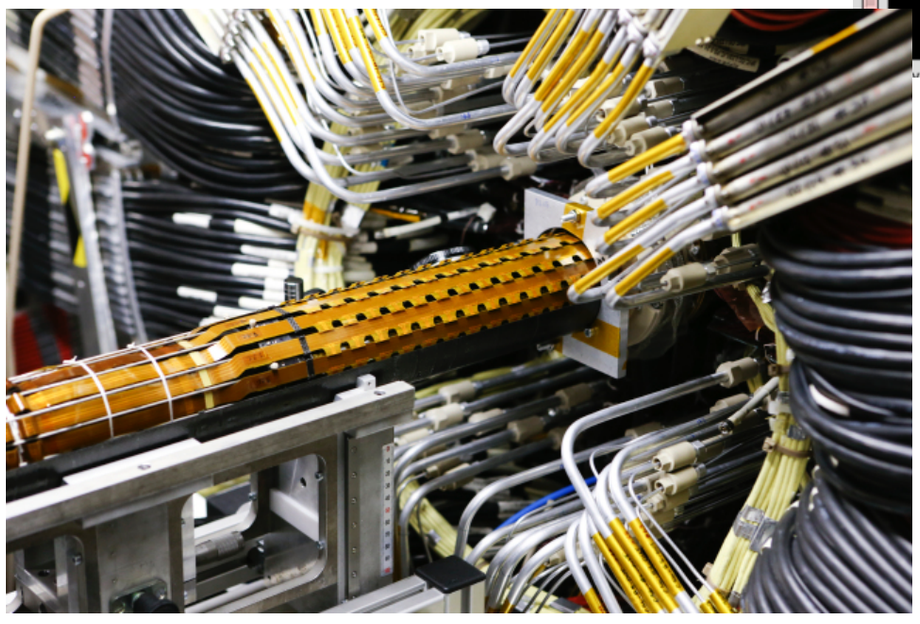


5.1 to 3.3 cm to IP

pixels reduced: 50 x 250 μm

new sensors and readout chip

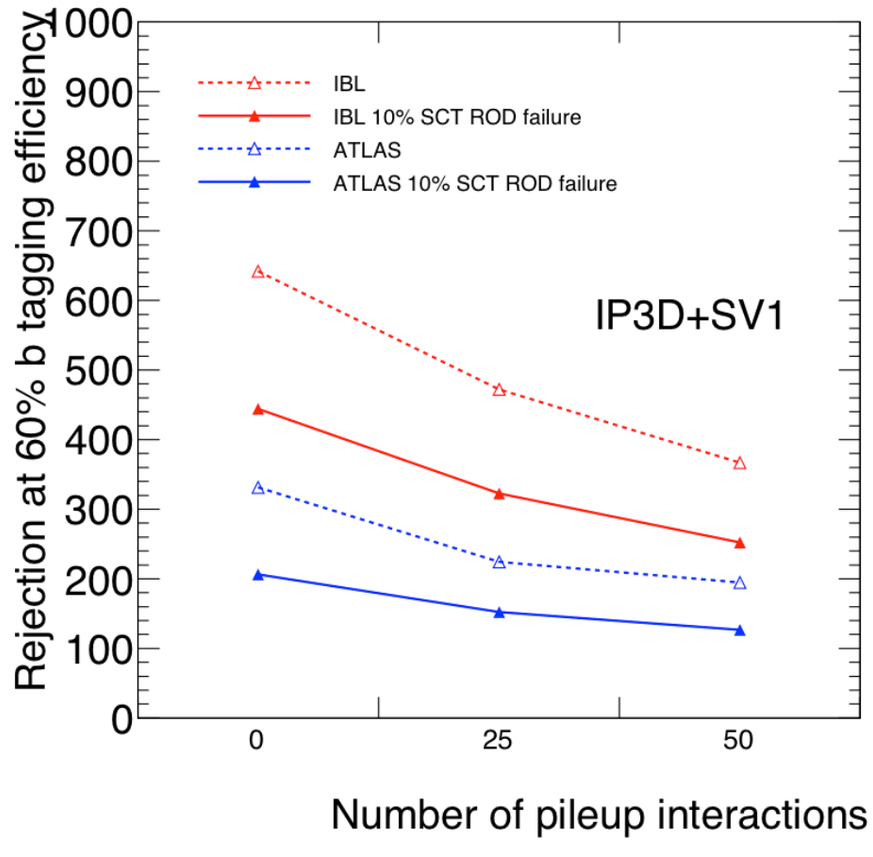
May 7:



Gains:

- impact param
- light jet reject
- redundancy

Status: live >99.9%



Tracking and Calorimeter Systems

many projects

SCT and TRT readouts enhanced, operational

new ROD in SCT

90 → 128 S links and compression leading to 100 kHz @ μ = 87

data compression, different gating in TRT leading to 104 kHz with 2% occupancy

Pixel Detector brought to surface, reinstalled

Layer 0: 6.3% → 1.4%; Layer 2: 7% → 1.9%; now 98% functional of 1744

new diamond/Si beam monitors installed

prepared for IBL

LAr and Tilecal

LVPS replaced (LAr) fixed (Tilecal): readouts tested to more than 100 kHz

Phase 1 “demonstrator” installed

Min-bias trigger scintillators

Muon system

staged from Run 1

New ROD for CSC system

limited ATLAS L1 trigger rate to 70 kHz...now 100 kHz

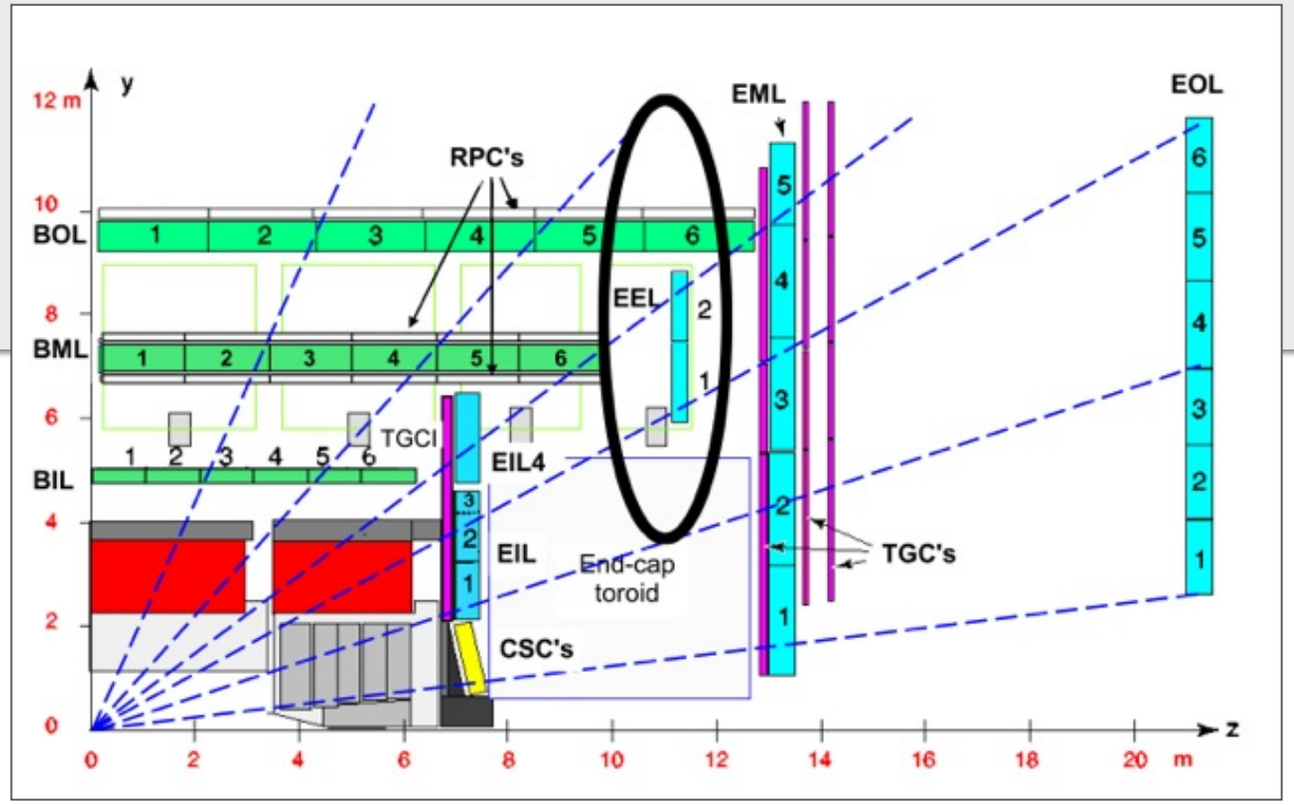
New EE endcap chambers

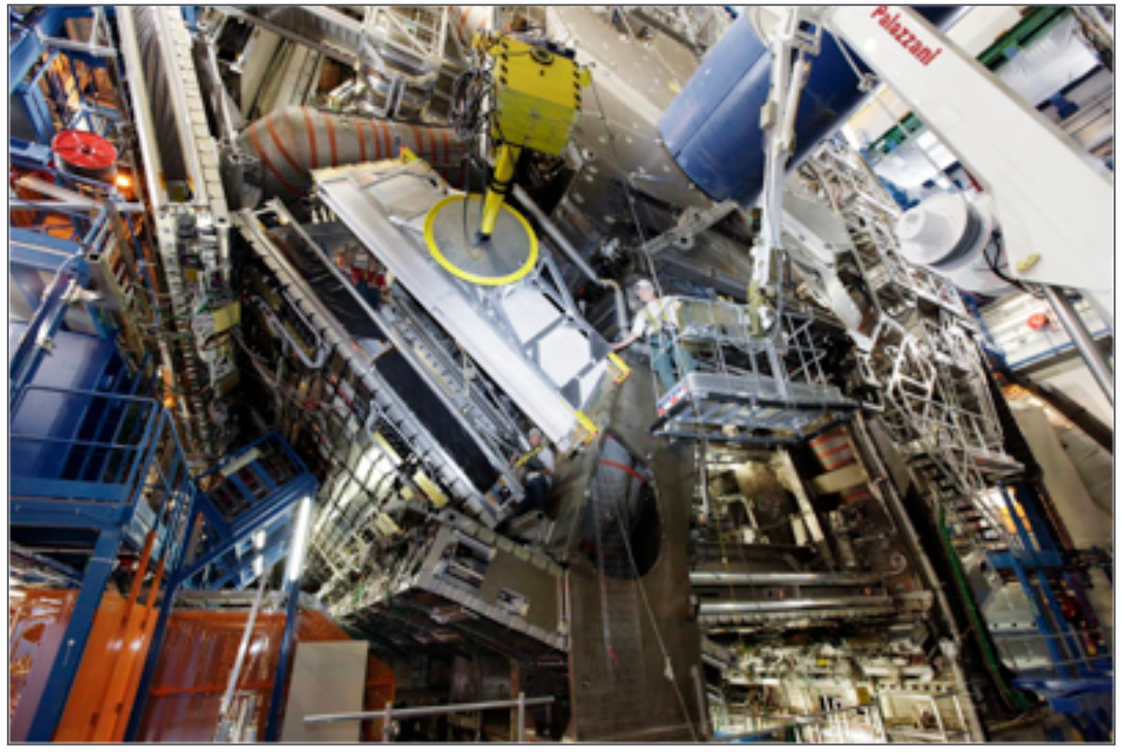
Repairs

Broken CSC chambers, repaired, reinstalled

RPC leak repairs

TGC chamber replacement requires detector to be closed





Trigger system

considerable enhancements

E_{CM} from 8 to 13 TeV (x2.5) +

$\mathscr{L}_{peak}$ 0.8 to 1.6 x 10^{34}/cm^2/s

5x trigger rates from Run 1

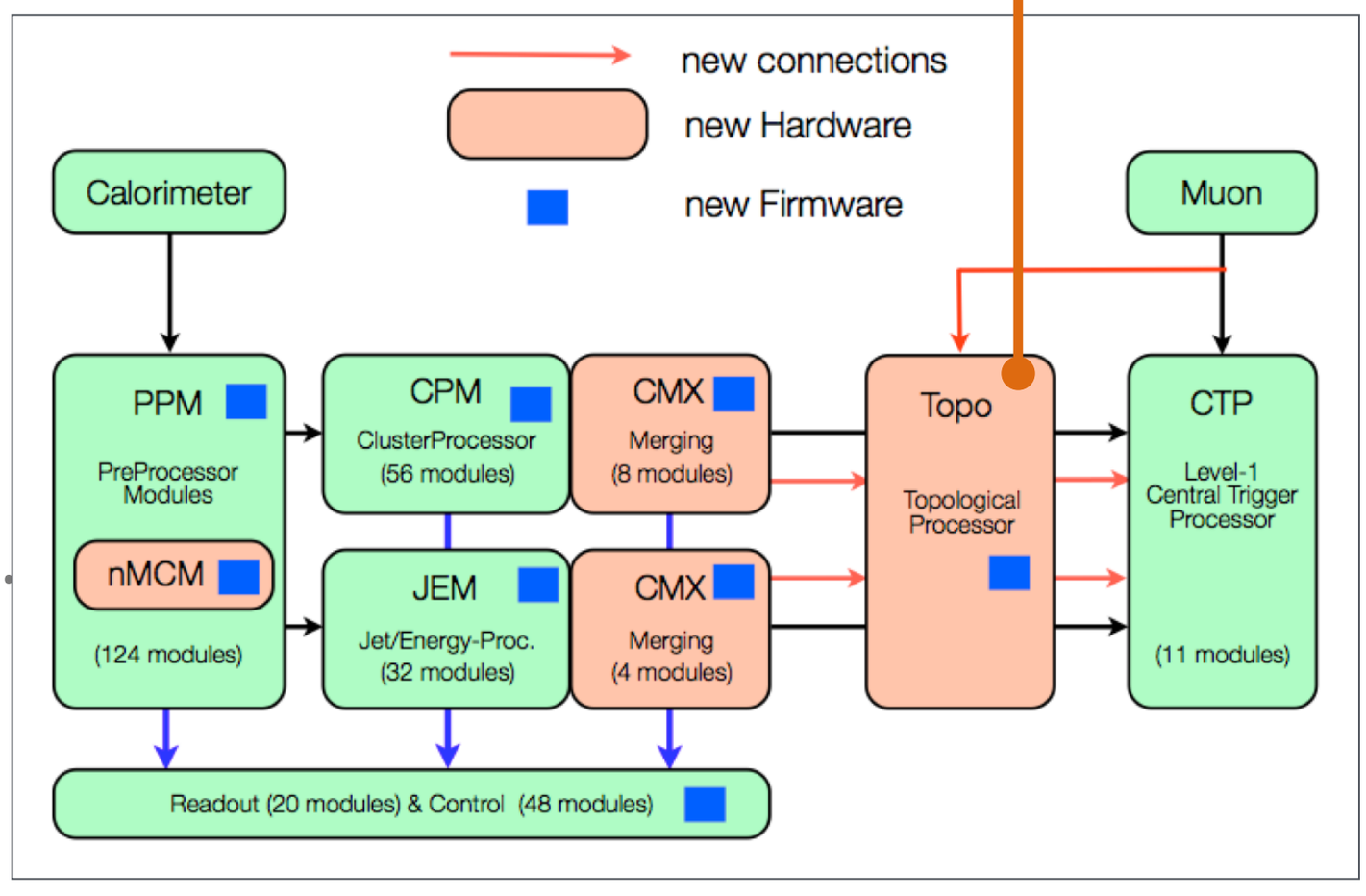
Upgrades to:

L1 rate, 70 kHz →100 kHz operation, factor 4/3 increase. **hardware**

HLT rate, 400 Hz → ~1 kHz operation, factor of ~2 increase. **algorithms**

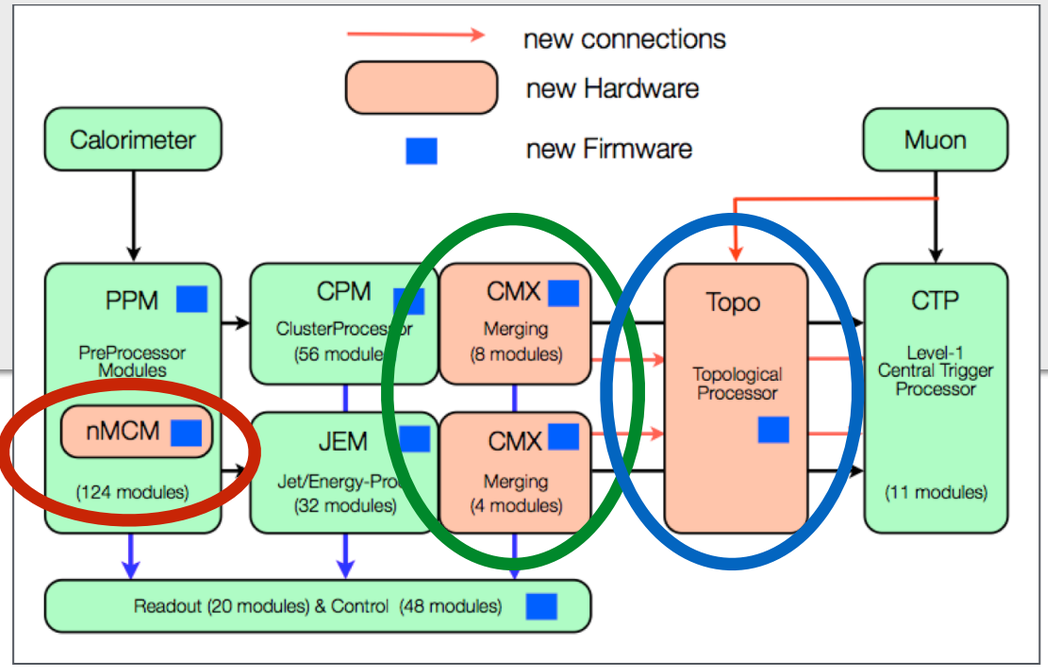
"L1Topo": topological object correlations at L1

jet + Etmiss + angle sep & improved Etmiss



Trigger system

hardware



New preprocessors (nMCM)

80 MHz digitization, lower noise

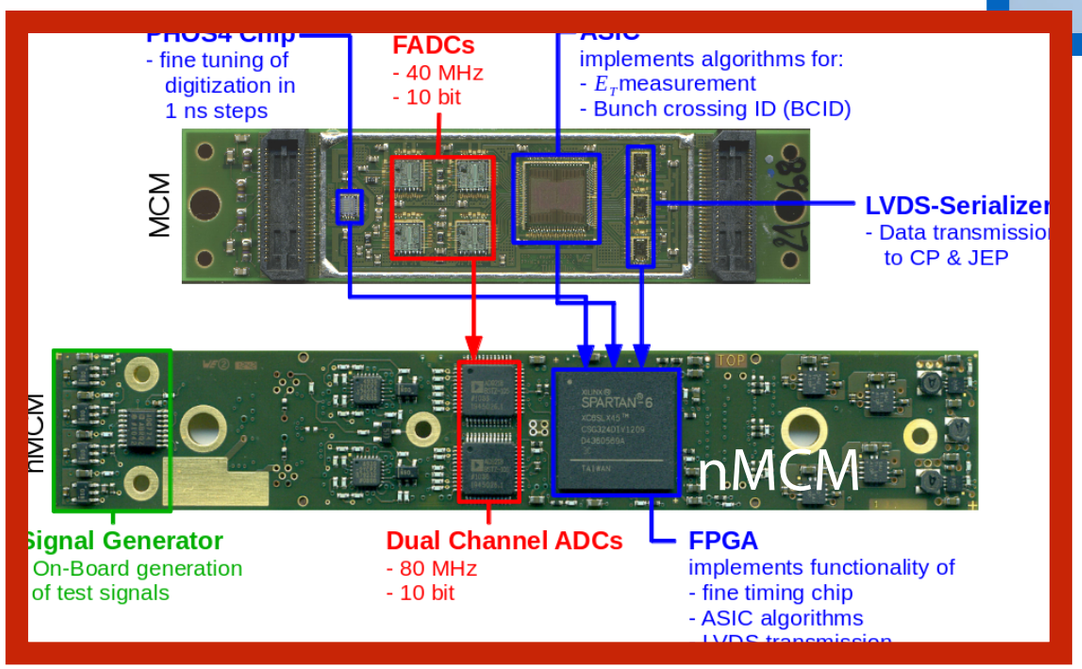
New merger modules (CMX)

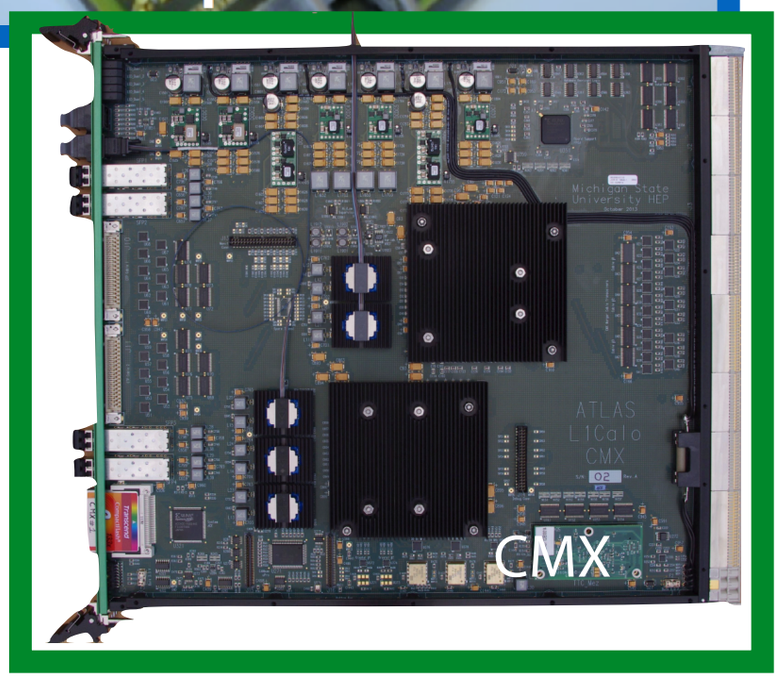
x4 speed enhancement over CMM

L1 Topo processor

trigger on object relations at L1 e.g. $\Delta\phi(E^{miss}{}_T, j)$

Commissioning underway in-situ

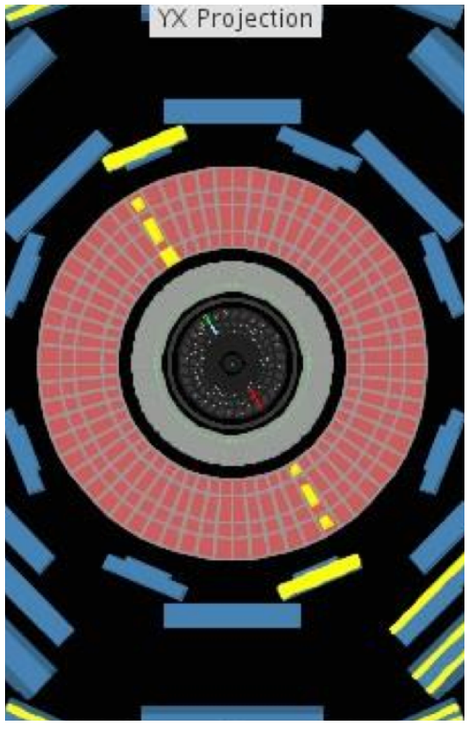




Commissioning

multiple “Milestone weeks”

24/5! M’s cosmic rays HLT & reco’d Tier 0



	M3	M4	M5	M6	M7
	May19-May 23	Jul 7-Jul 11	Sep 8-Sep 12	Oct 13-Oct 17	Nov 24-Dec 08
PIX		X^1, X^2	X^2		
IBL		X^1	X^2		
SCT		X	X^2		
TRT					
LAR		X			
TIL		X			
MBTS		X			
L1Calo		X^2	X^3	X^4	
CSC			X^2	X^2	
MDT					
RPC	X^1				
TGC				X^2	
BCM					
ALFA			X		
LUCID				X	
Lumi			X		

Commissioning

multiple “Milestone weeks”

24/5! M’s cosmic rays HLT & reco’d Tier 0

nCSC and IBL in for the first time

	M3	M4	M5	M6	M7
	May19-May 23	Jul 7-Jul 11	Sep 8-Sep 12	Oct 13-Oct 17	Nov 24-Dec 08
PIX		X^1, X^2	X^2		
IBL		X^1	X^2		
SCT		X	X^2		
TRT					
LAR		X			
TIL		X			
MBTS		X			
L1Calo		X^2		X^4	
CSC			X^2	X^2	
MDT					
RPC	X^1				
TGC				X^2	
BCM					
ALFA			X		
LUCID				X	
Lumi			X		

ATLAS reading out since “M5”

Computing & Software & Analysis

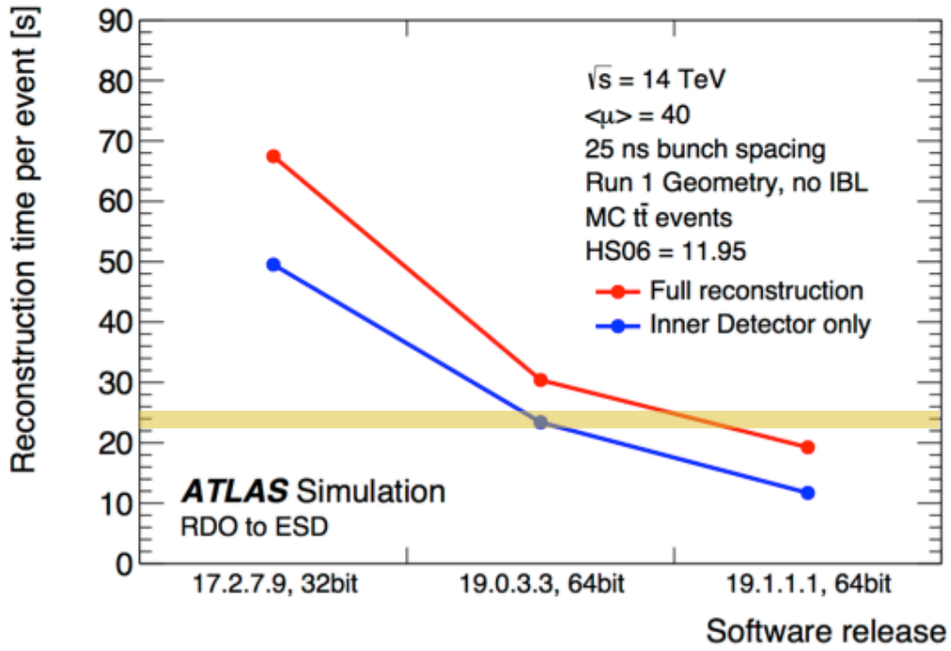
speed/efficiency and pileup

Many algorithmic, mathematical, fitting changes

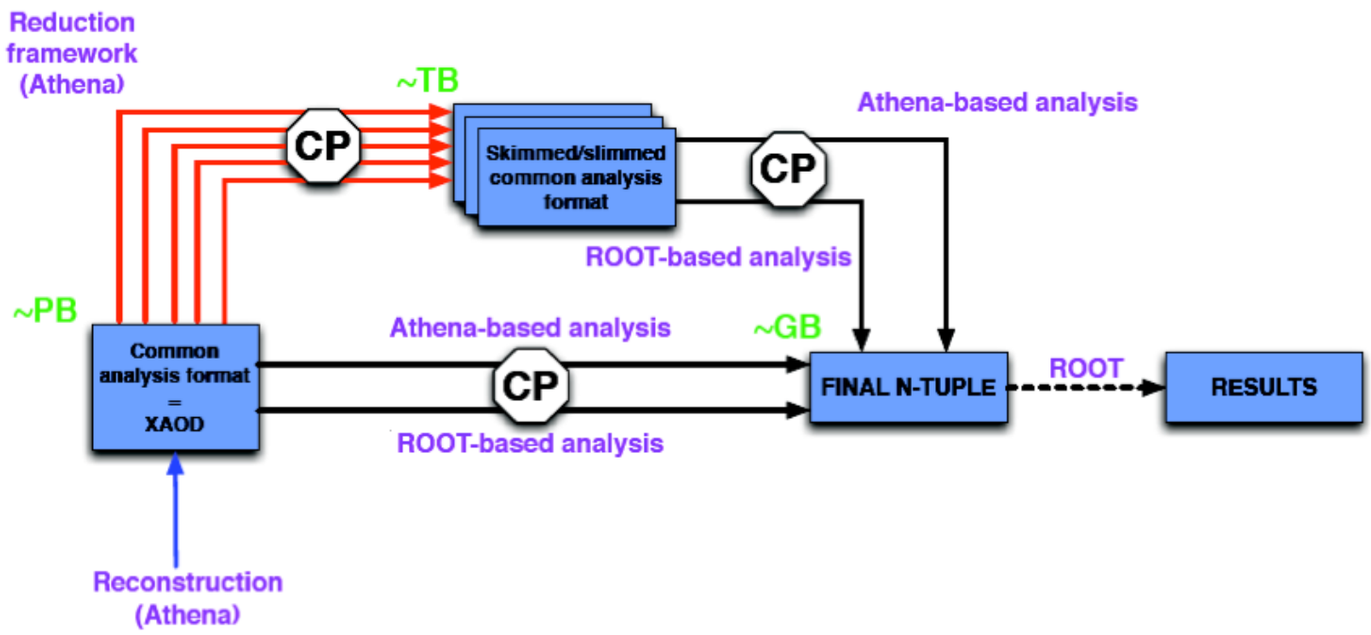
- factor >3 gains
- pileup robustness

Completely redesigned analysis model

- "xAOD" Athena reconstruction is ROOT-readable, tuning.
- disk usage tight…working on xAOD sizes
- memory usage gymnastics
- CP tools mostly migrated



budget @0.4 LHC eff



Conclusions

Run 2

is a big deal

we've seen CM energy increases:

tevatron 2 TeV to LHC 8 TeV

now we can anticipate:

14 TeV

Run 2

is a big deal

we've seen CM energy increases:

tevatron 2 TeV to LHC 8 TeV

now we can anticipate:

14 TeV

we've seen instantaneous $\mathscr{L}$ increases:

tevatron peak of 4 x 10^{32} /cm^2/s to LHC peak of 7 x 10^{33} /cm^2/s

now we can anticipate:

1.5 x 10^{34} /cm^2/s

Run 2

is a big deal

we've seen CM energy increases:

tevatron 2 TeV to LHC 8 TeV

now we can anticipate:

14 TeV

Orders of magnitude!

we've seen instantaneous $\mathscr{L}$ increases:

tevatron peak of 4×10^{32} /cm^2/s to LHC peak of 7×10^{33} /cm^2/s

now we can anticipate:

1.5×10^{34} /cm^2/s

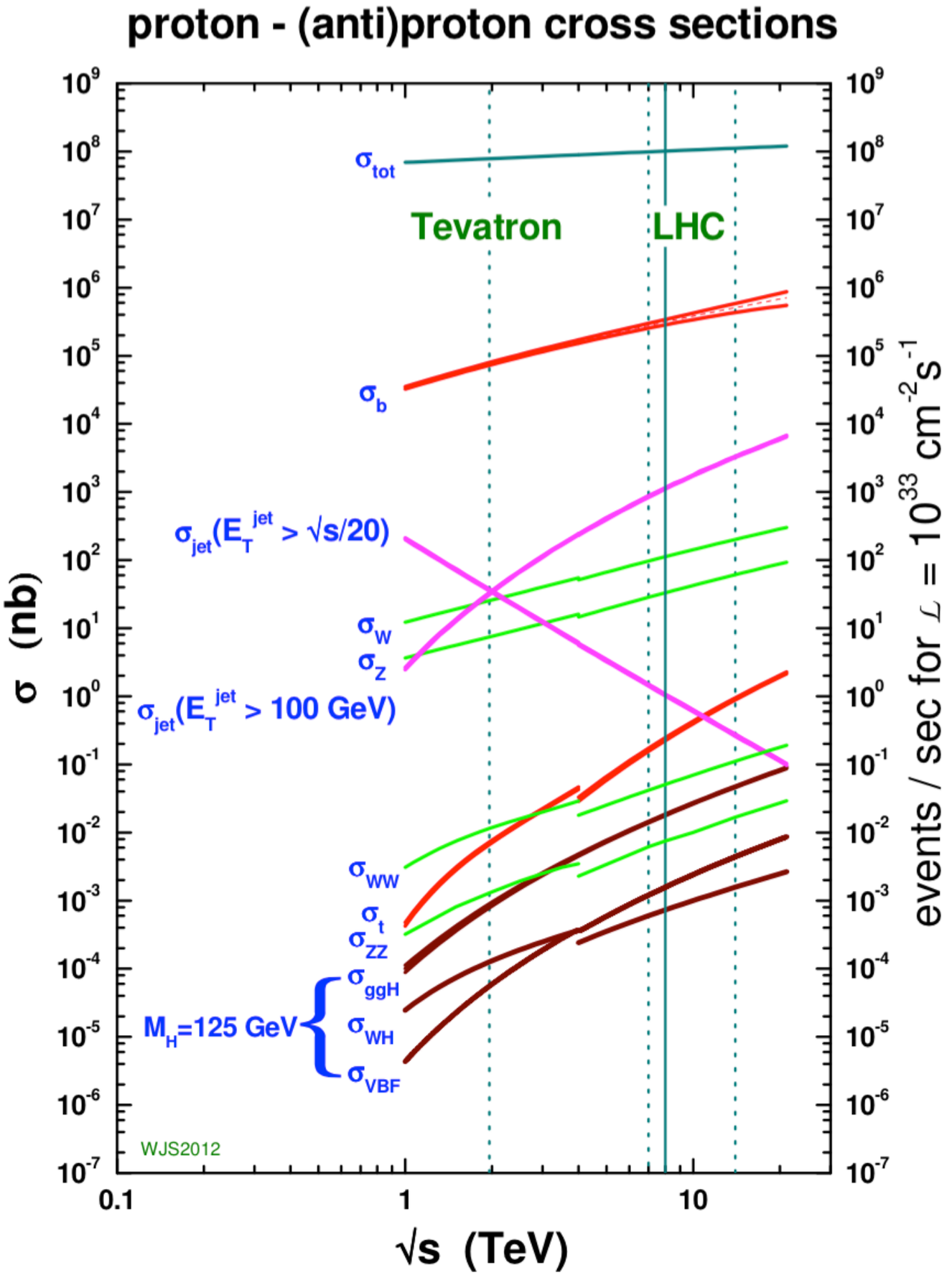
Run 2

is a generational event

Run 1 to Run 2

bigger science increment than

Run 2 to Run 3



http://www.hep.ph.ic.ac.uk/~wstirlin/plots/plots.html

Run 2

is a generational event

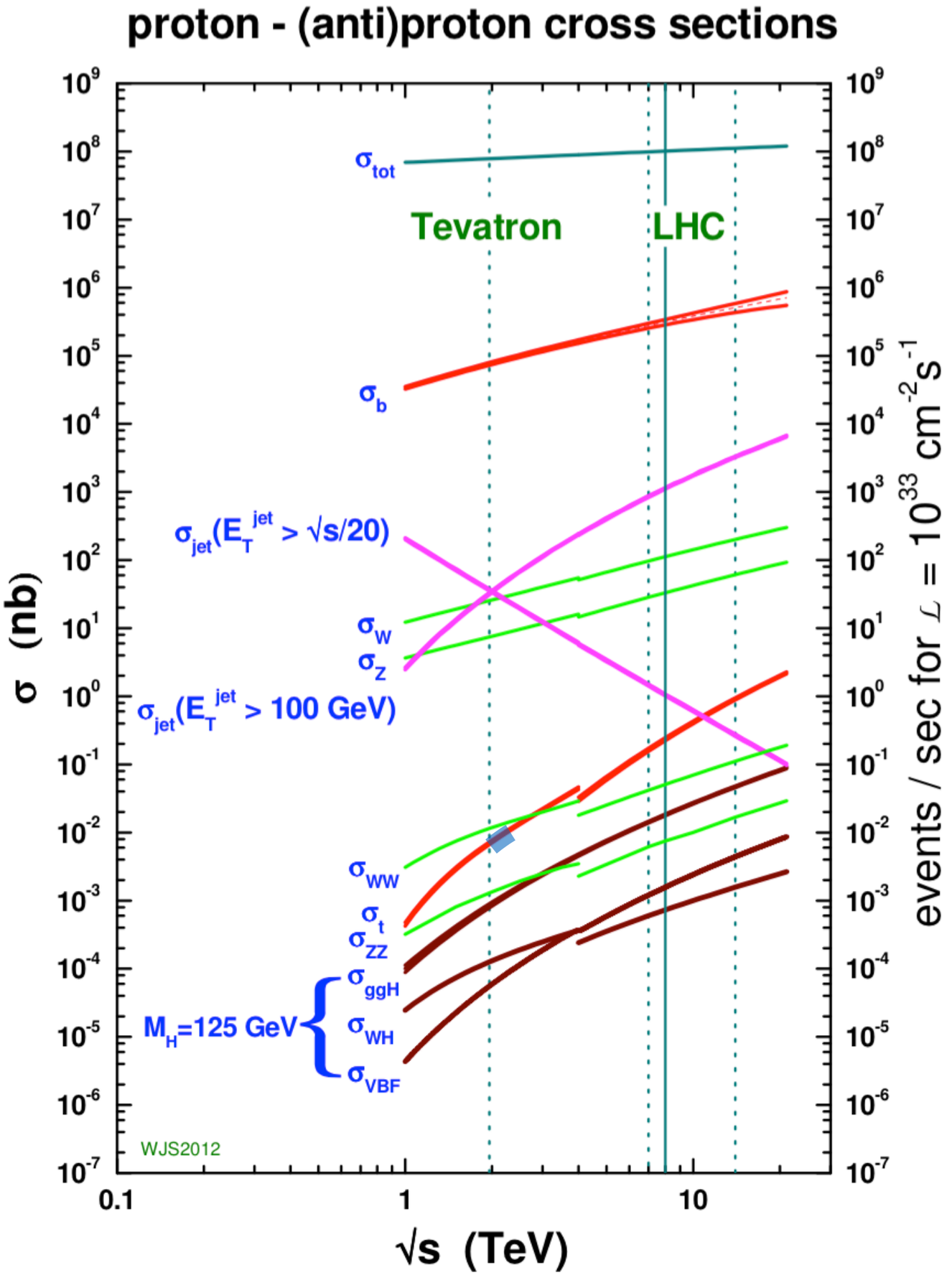
Run 1 to Run 2

bigger science increment than

Run 2 to Run 3

from:

< 1 tT event/s @ tevatron



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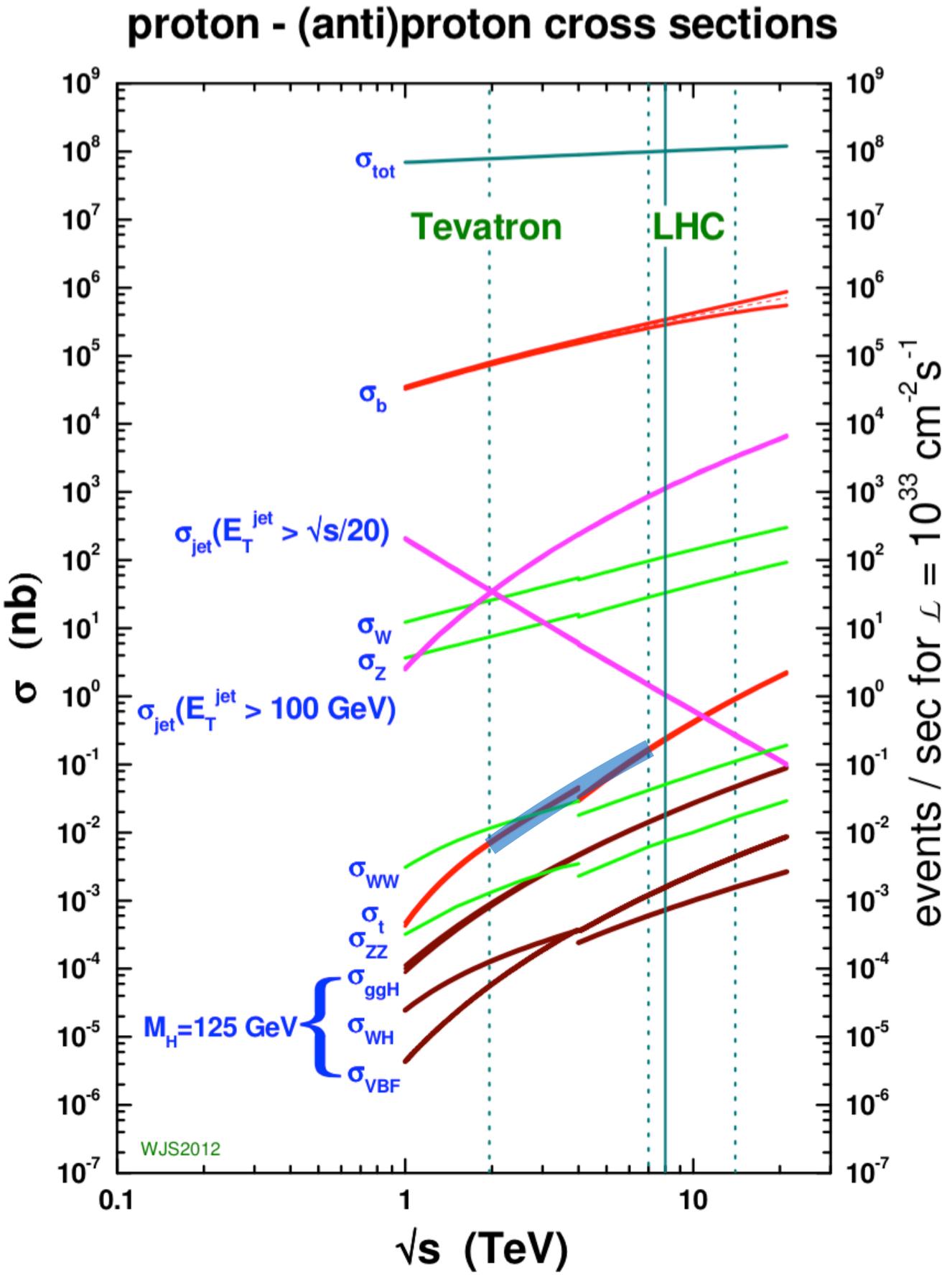
from:

< 1 tT event/s @ tevatron

to:

2 tT events/s in Run 1



http://www.hep.ph.ic.ac.uk/~wstirlin/plots/plots.html

Run 2

is a generational event

Run 1 to Run 2

bigger science increment than

Run 2 to Run 3

from:

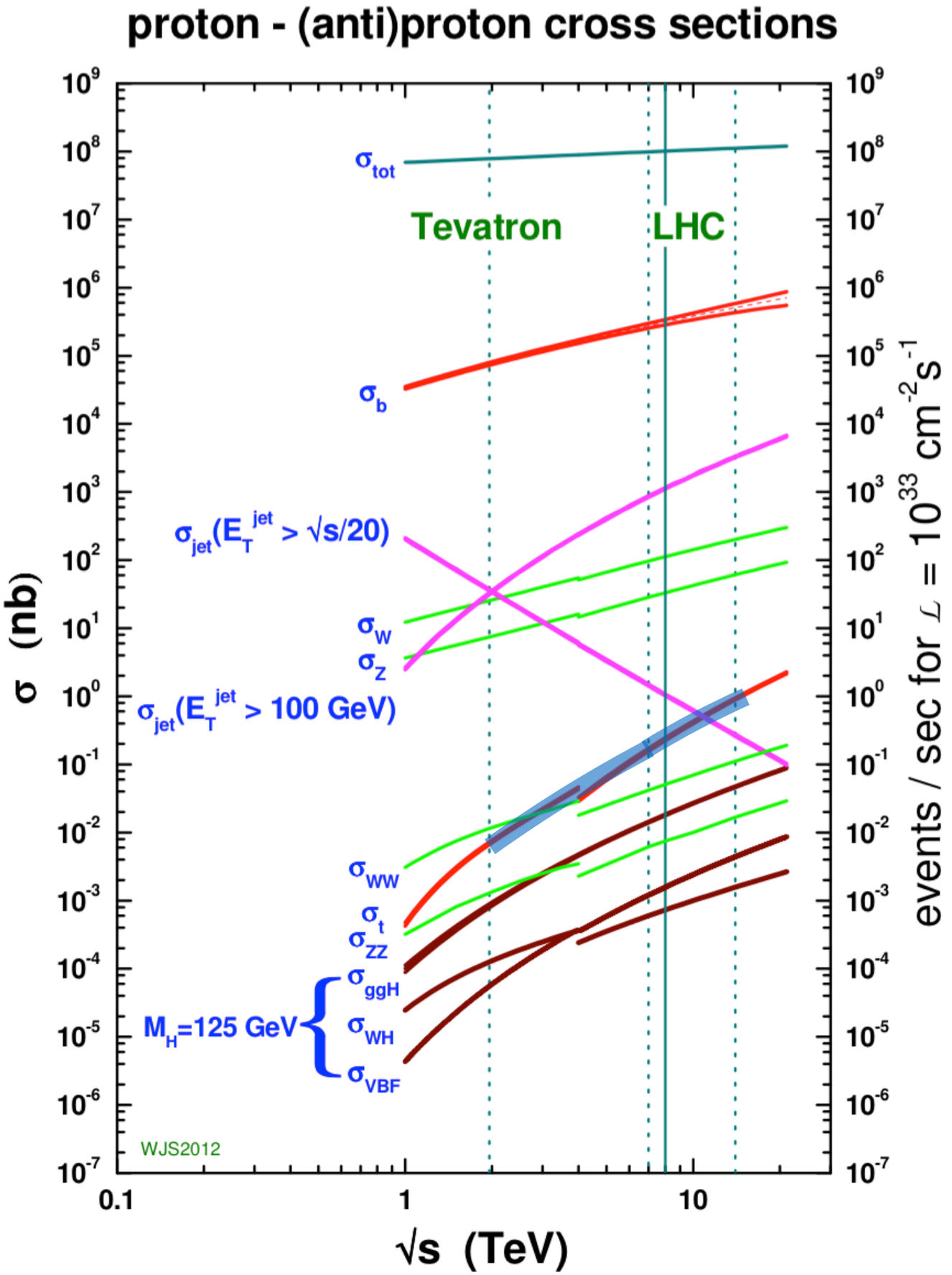
< 1 tT event/s @ tevatron

to:

2 tT events/s in Run 1

to:

13 tT events/s in Run 2



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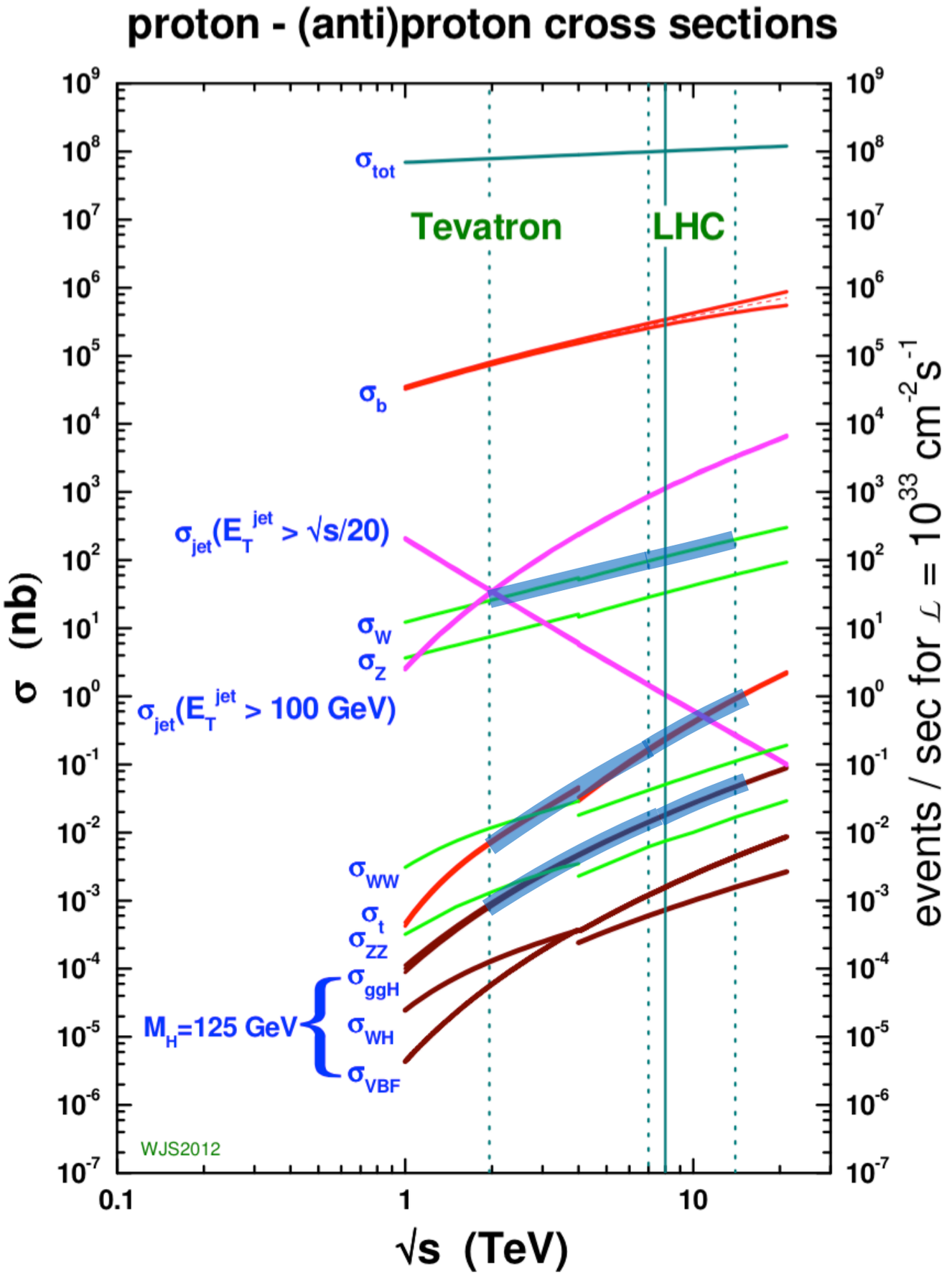

http://www.hep.ph.ic.ac.uk/~wstirlin/plots/plots.html

Run 2

requires all hands on deck

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Higher luminosities and the increase in E_{CM}

tracking improvements

trigger upgrades

computing and analysis strategies

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Robustness against pileup = Discovery tools!

techniques! Clever calorimetric algorithms, tracking tools

ideas of jets as collective objects - boosting

ideas in tagging

nicely summarized by David Miller

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Nimble!

nicely summarized by David Miller