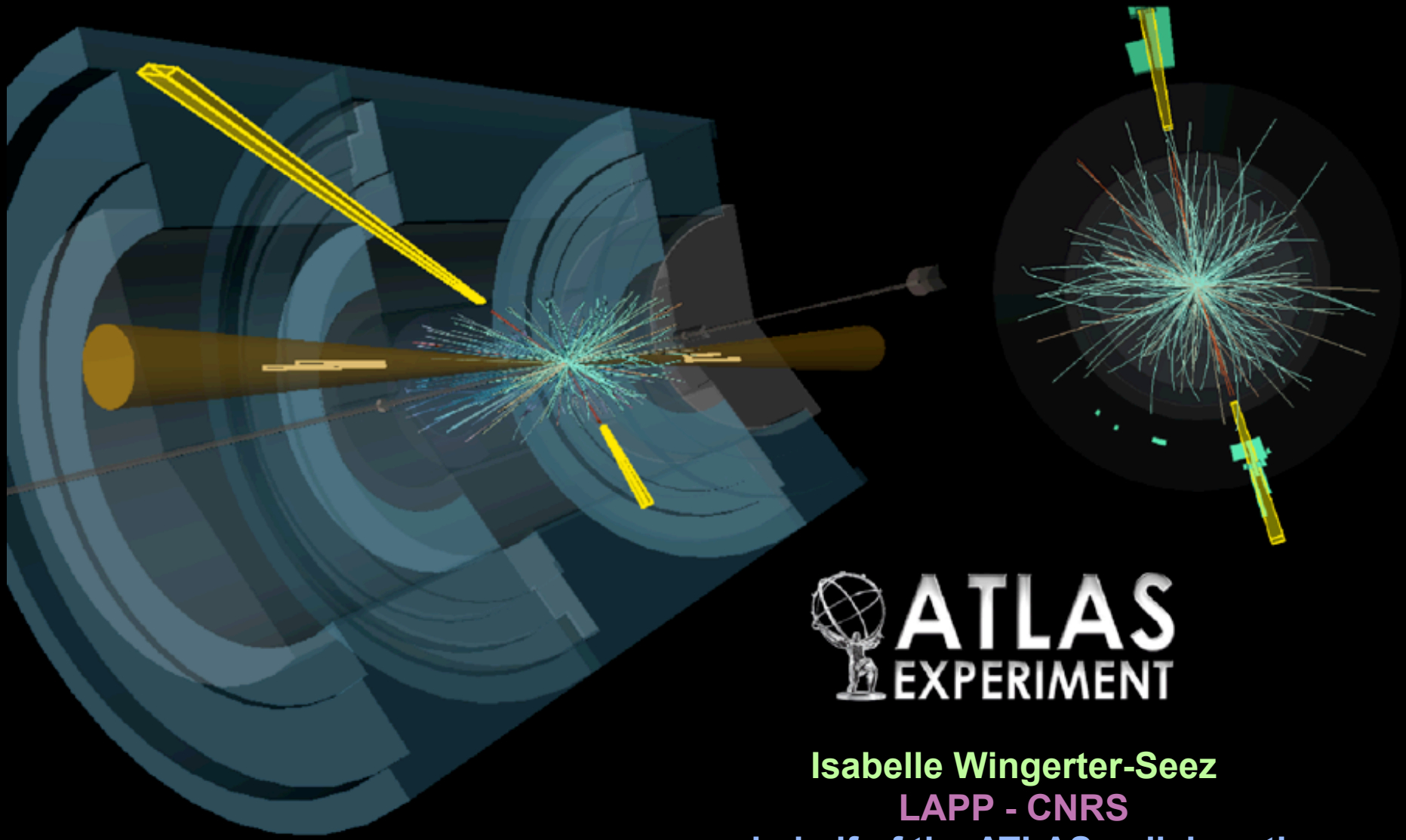
ATLAS HIGHLIGHTS



Isabelle Wingerter-Seez
LAPP - CNRS
on behalf of the ATLAS collaboration

Current status & prospects for LHC Run II

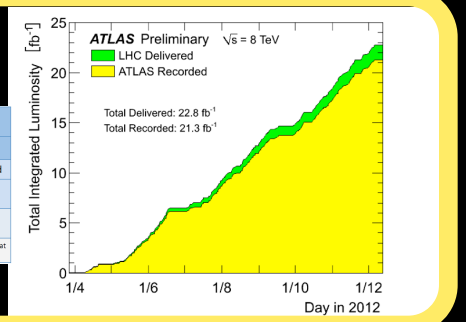
Detector & Operation

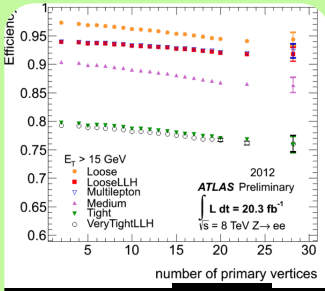
ATLAS p-p run: April-December 2012

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

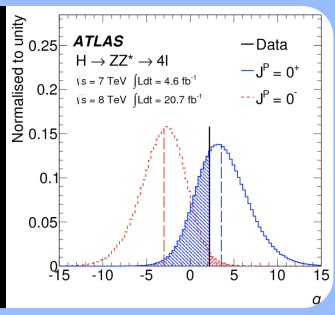
All good for physics: 95.5%

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



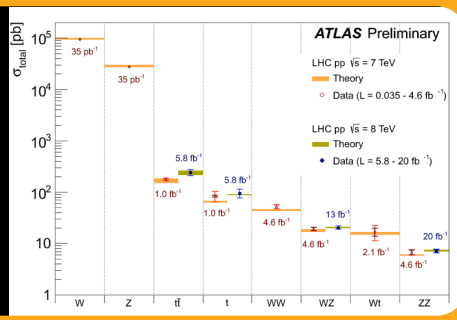


HIGGS

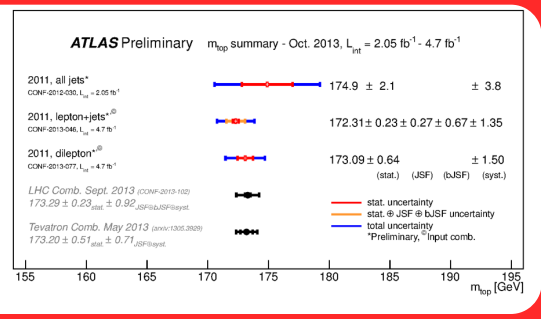


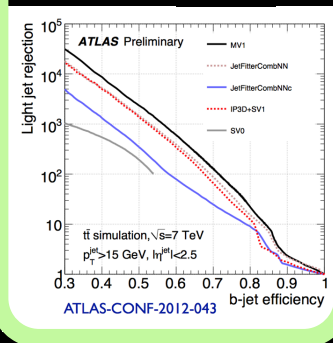
COMBINED PERFORMANC

Standard Model EW & QCD

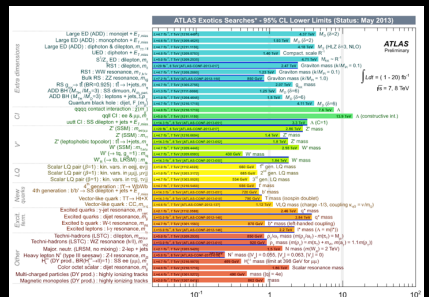


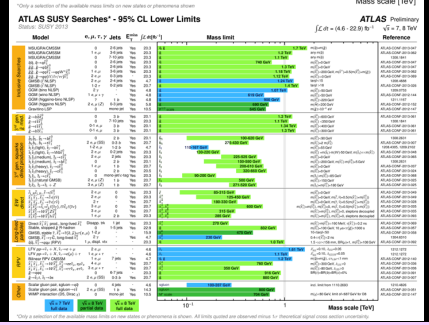
Top Quark



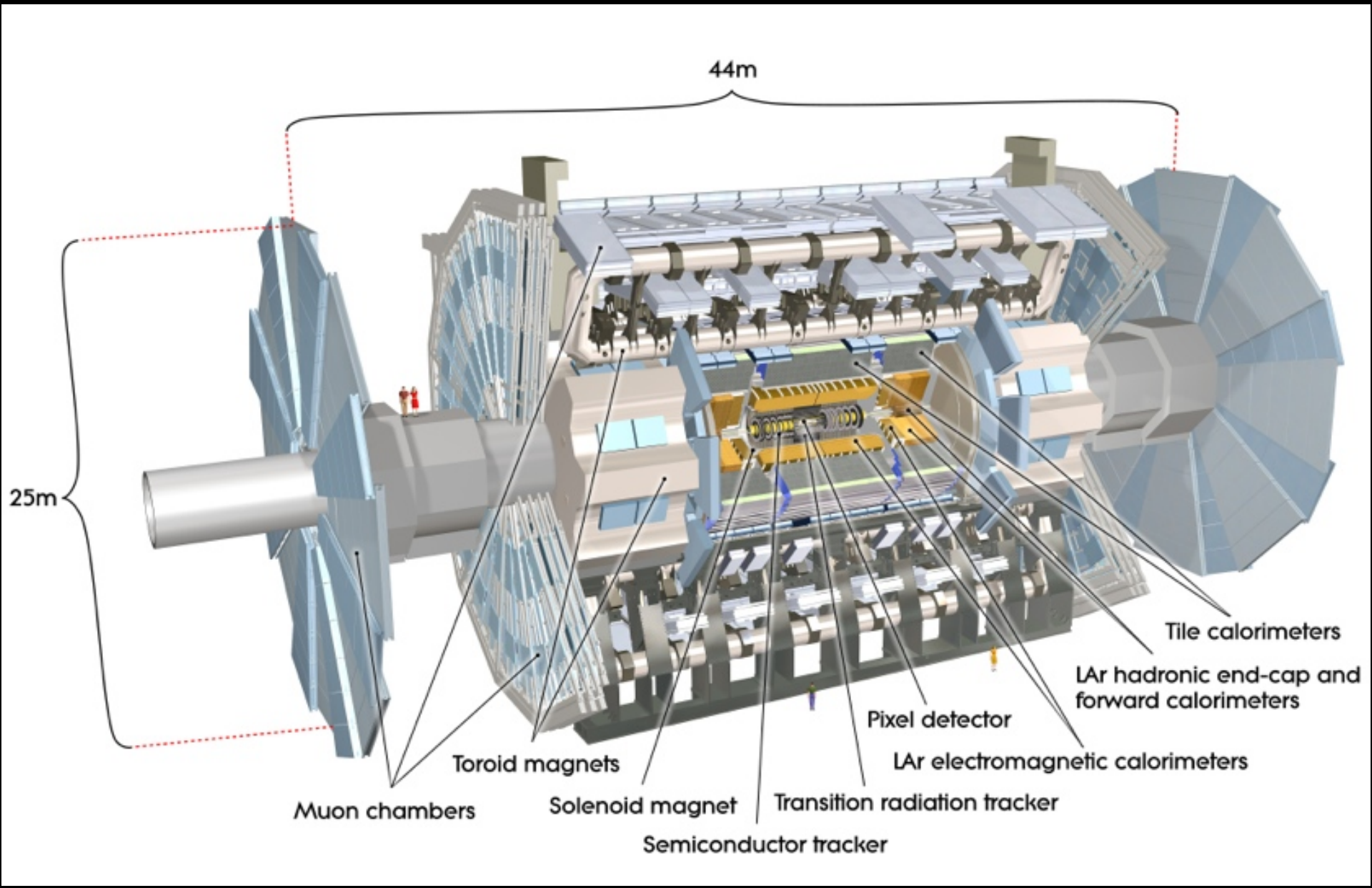


Beyond the Standard Model ?



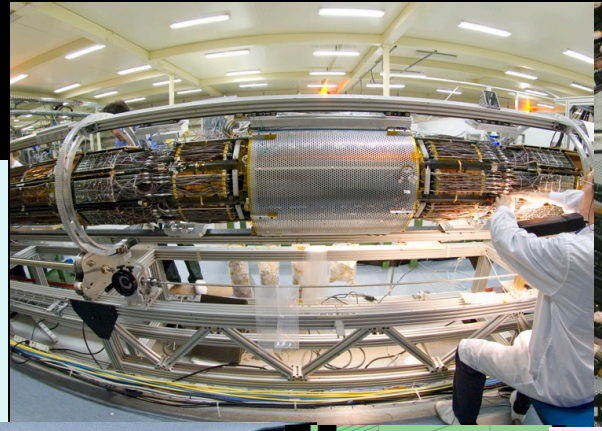


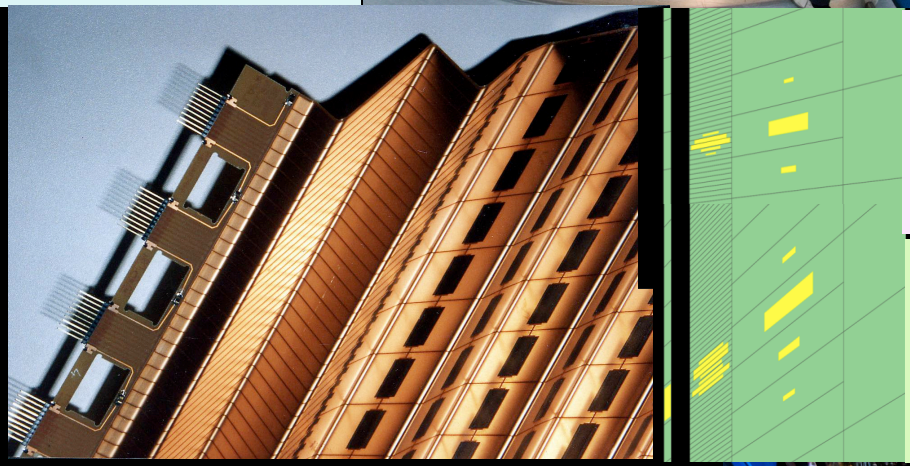
ATLAS detector



ATLAS detector

Tracker $|\eta|<2.5$
B=2T
Si: pixels+strips,
Transition Radiation straws
Precise tracking, vertexing, e/hadron sep.
$\sigma/p_T \sim 0.05\% \; p_T \oplus 1\%$



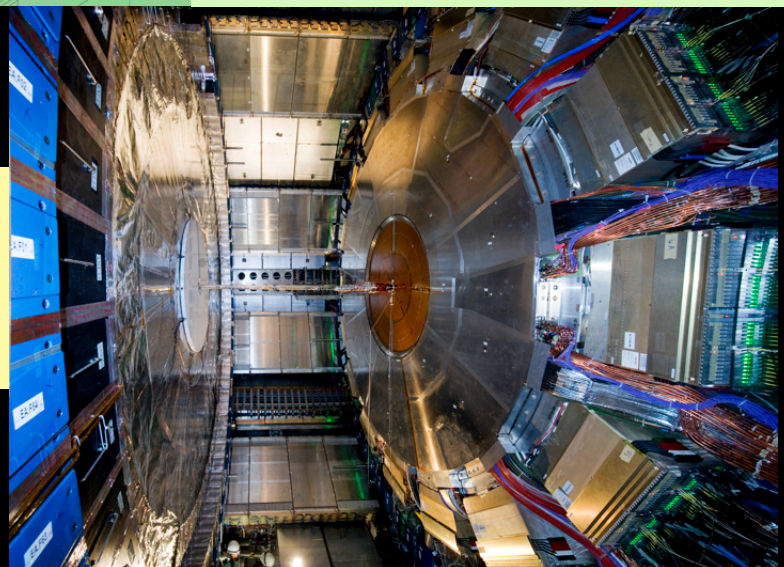


Electromagnetic Calorimeter $|\eta|<3.2$
Pb/LAr with accordion geometry
L1 trigger, electrons/photons, jets & E_T^{miss}
Energy, position, angle
$\sigma/E \sim 10\%/\sqrt{E} \oplus 0.7\%$

Hadronic Calorimeter $|\eta|<4.9$
Fe/Tiles scintillator $|\eta|<1.7$
Cu or W/LAr $1.5<|\eta|<4.9$
L1 trigger, complete jet & E_T^{miss}
$\sigma/E \sim 50\%/\sqrt{E} \oplus 3\%$

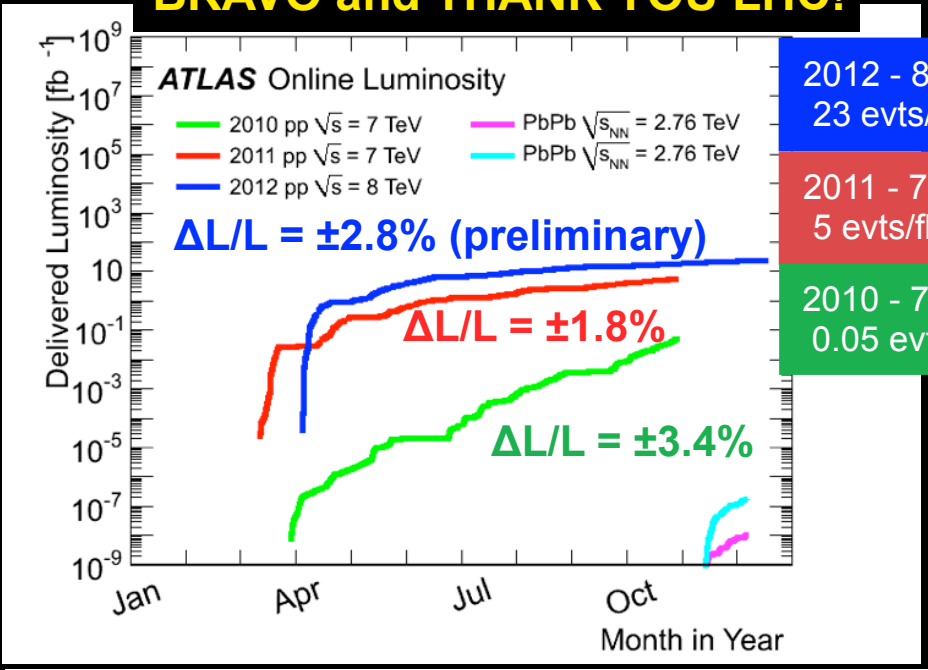
Muon Spectrometer $|\eta|<2.7$
Air core toroid & gas chambers
L1 trigger - momentum & position

$\sigma/p_T < 10\%$ for $p_T^{\mu}<1$ TeV



ATLAS Luminosity & Data Taking

BRAVO and THANK YOU LHC!

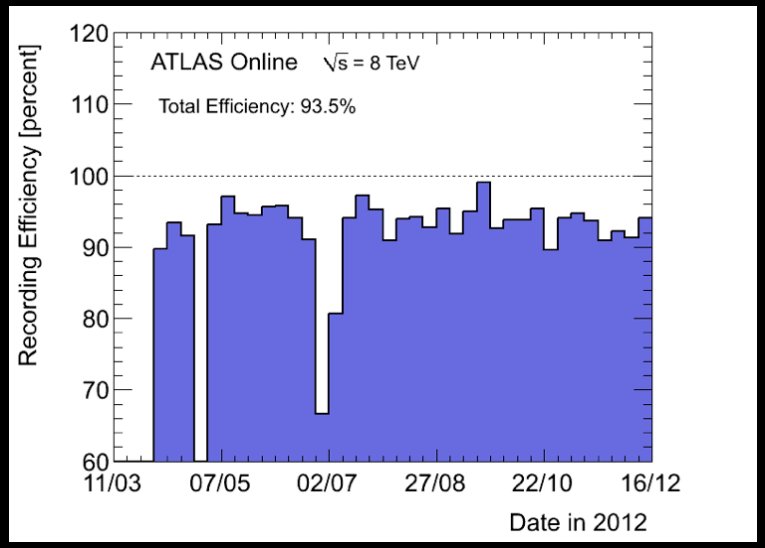


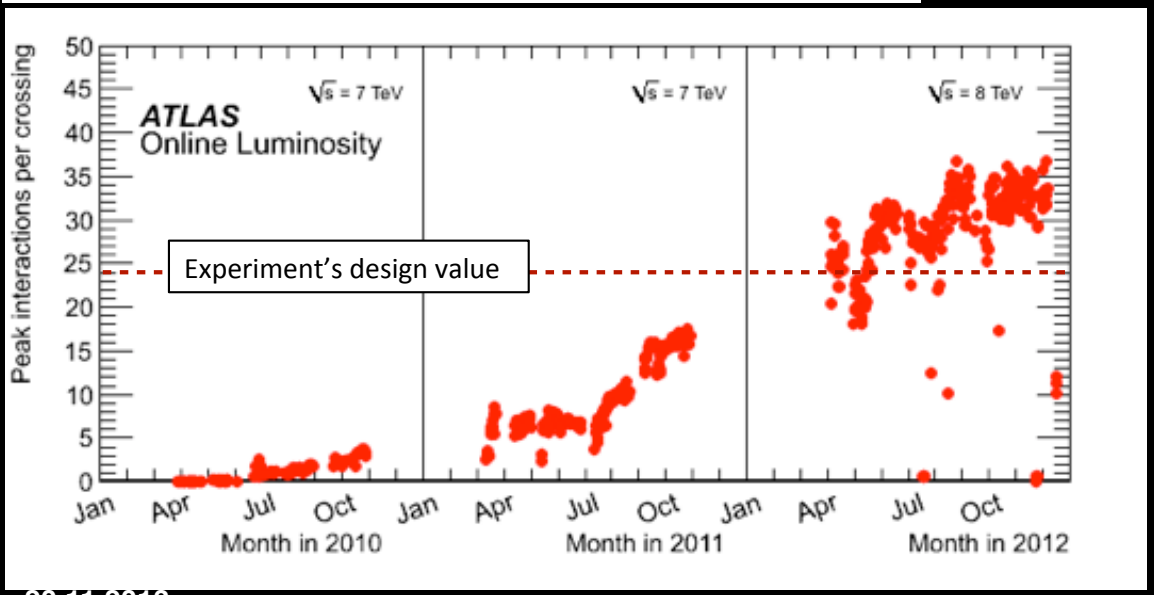
2012 - 8TeV
23 evts/fb

2011 - 7TeV
5 evts/fb

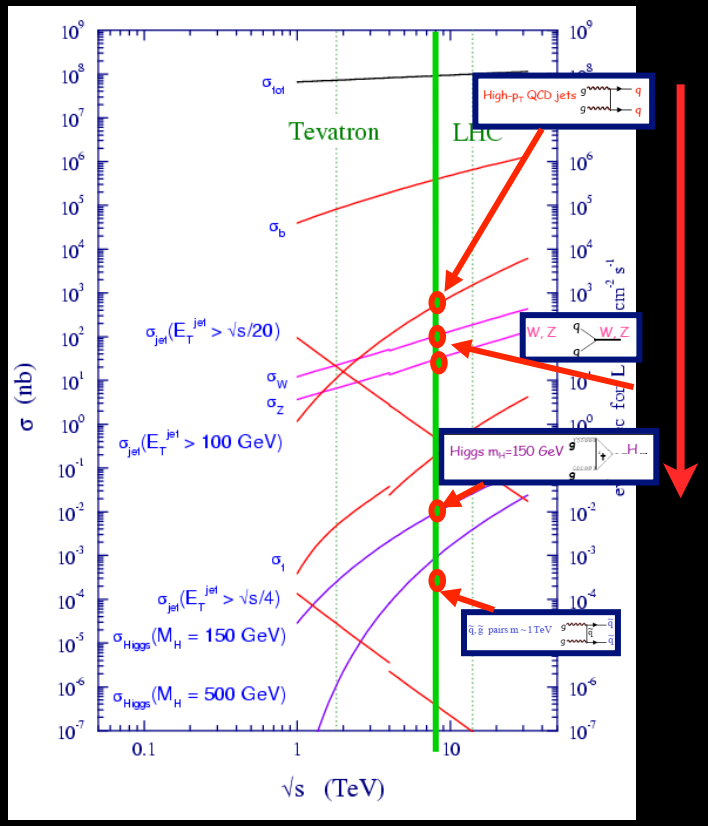
2010 - 7TeV
0.05 evts/fb

93.5%



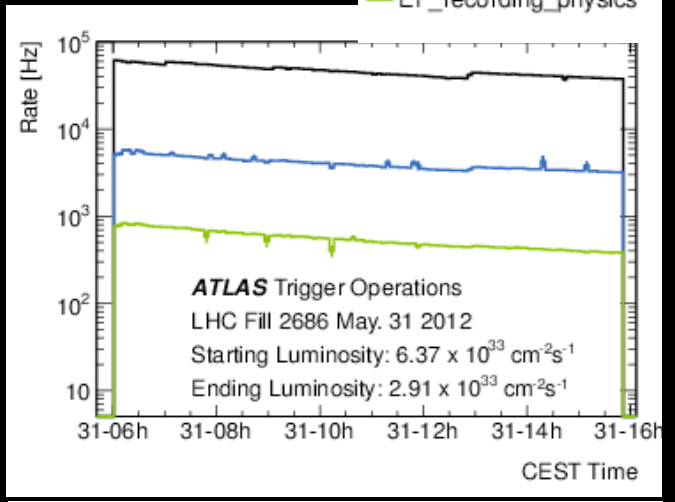


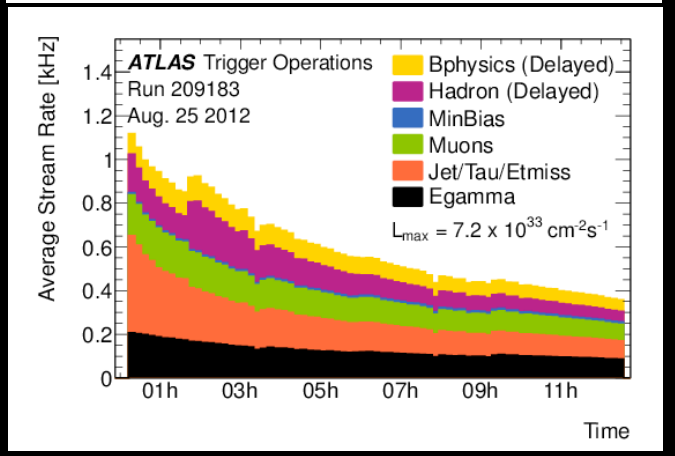
Detector operation: trigger & data quality



10^{10}

Maximise trigger efficiency and acceptance.





High Data Quality
Constant attention to detector operation and performance

ATLAS p-p run: April-December 2012

Inner Tracker			Calorimeters		Muon Spectrometer				Magnets	
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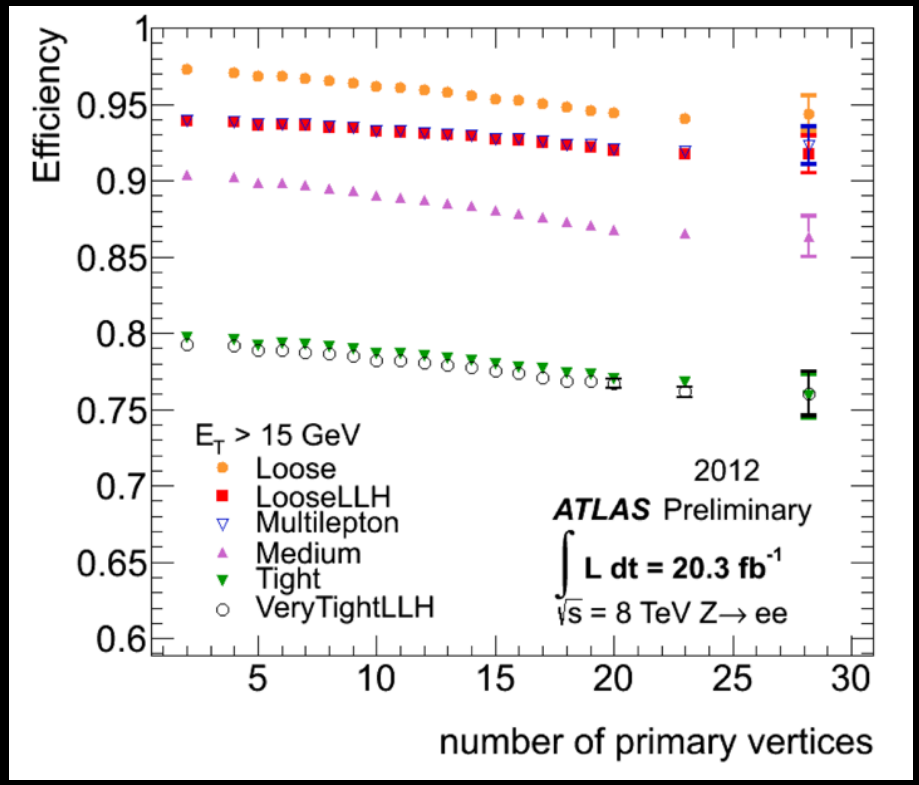
All good for physics: 95.5%

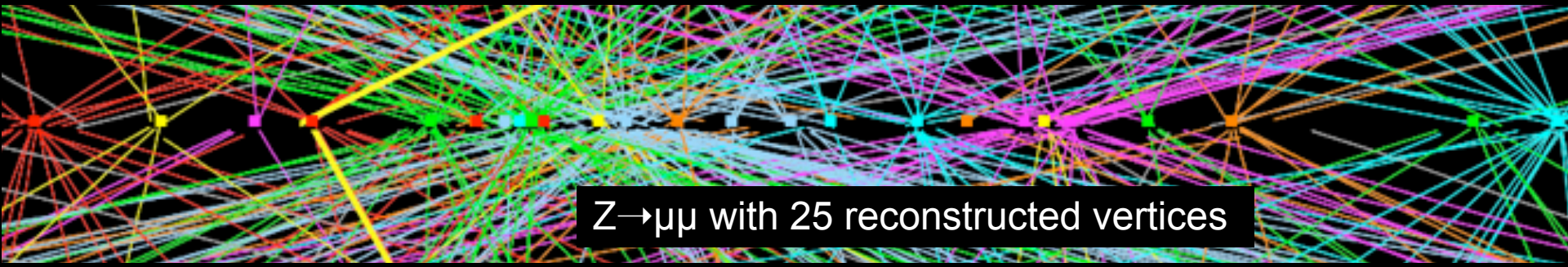
Luminosity weighted relative detector uptime and good quality data delivery during 2012 stable beams in pp collisions at √s=8 TeV between April 4th and December 6th (in %) – corresponding to 21.3 fb^{-1} of recorded data.

Combined performance: Electron Reconstruction

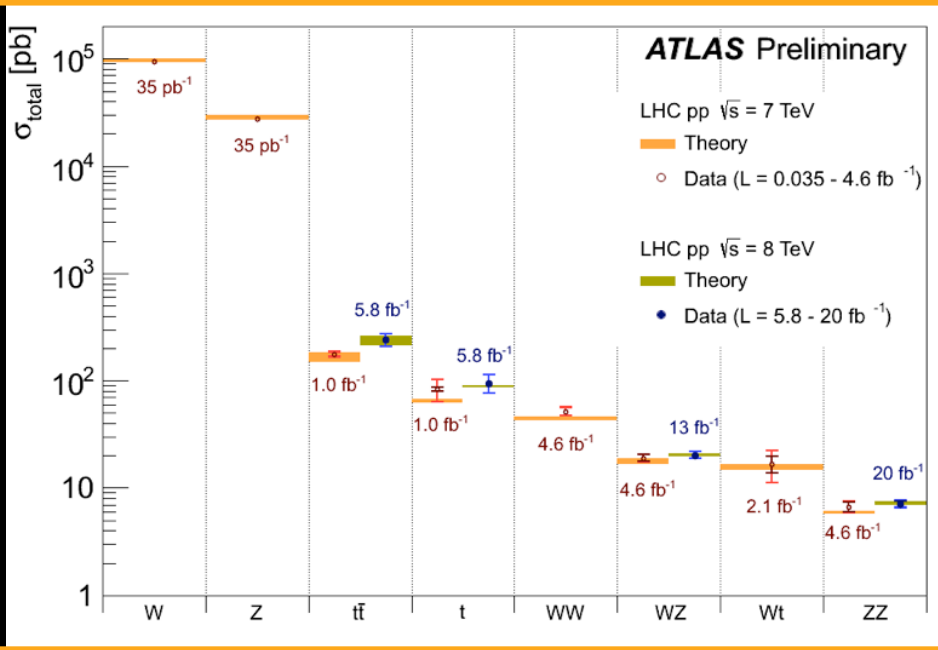
Electron identification efficiency for E_T>15GeV vs
vs number of primary vertices

Selection cuts have been adapted to cope with the highest activity in the event.





Standard Model EW & QCD



B Physics	C. Bini	Properties and spectroscopy of b-hadrons with the ATLAS detector
	J. Gunther	Study of rare and suppressed processes in B meson decays with ATLAS
	T. Okuyama	Mixing and CP violation in the Bs system with ATLAS
Top	J. Donini	Single top quark production cross section at LHC in ATLAS
	T. Heck	Searches for vector-like quarks and ttbar resonances with the ATLAS detector
	R. Peters	Top quark properties in ATLAS
	O. Rosenthal	Top quark pair production cross section at LHC in ATLAS
SM QCD	J. Hejbal	Measurements of vector bosons and vector bosons plus jet production….
	V. Pleskot	Recent QCD results from ATLAS
	D. Tsybichev	Measurement of multi-boson production with the ATLAS detector

Jets and pQCD

EPJC (2013) 73 2509, EPJC (2011) 71 1512, PRD 86 (2012) 014022

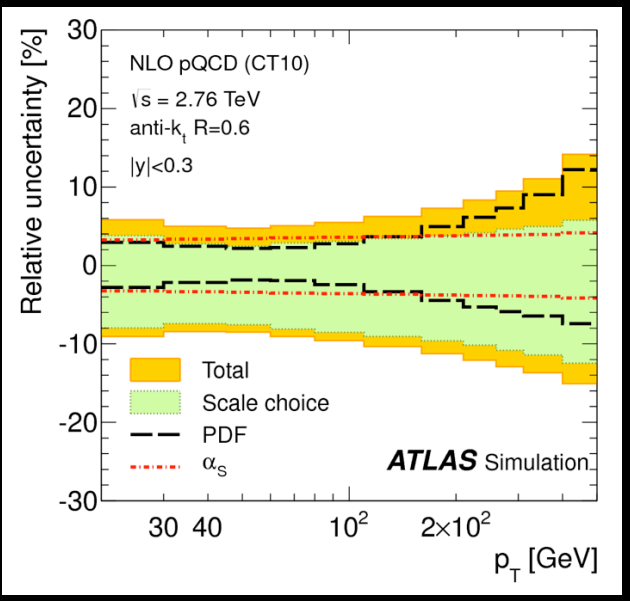
ATLAS has recently published the inclusive jet cross section at √s=2.76 TeV

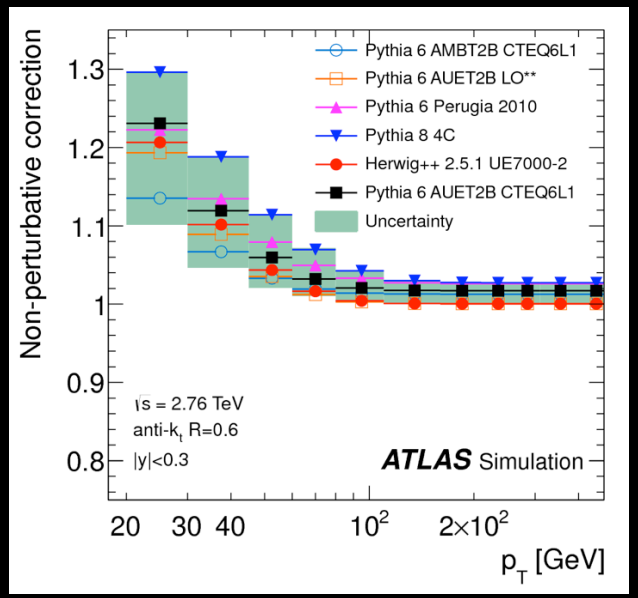
- Bridge with previous results
- Ratio 2.76 to 7 TeV with reduced systematics
- Comparison to pQCD calculations
- Gluons & light quark pdf

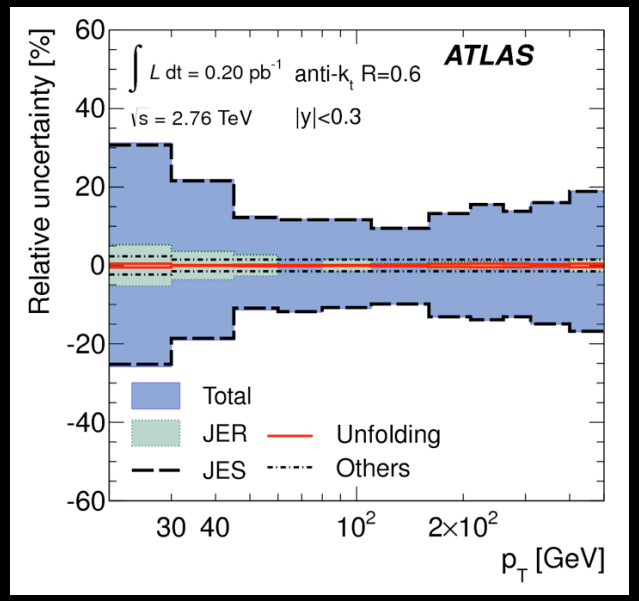
Jets reconstruction:
anti-k_t algorithm ΔR=0.4 or 0.6
Noise suppression

Ingredients to the measurements

Theory relative uncertainty Non perturbative corrections Experimental uncertainties

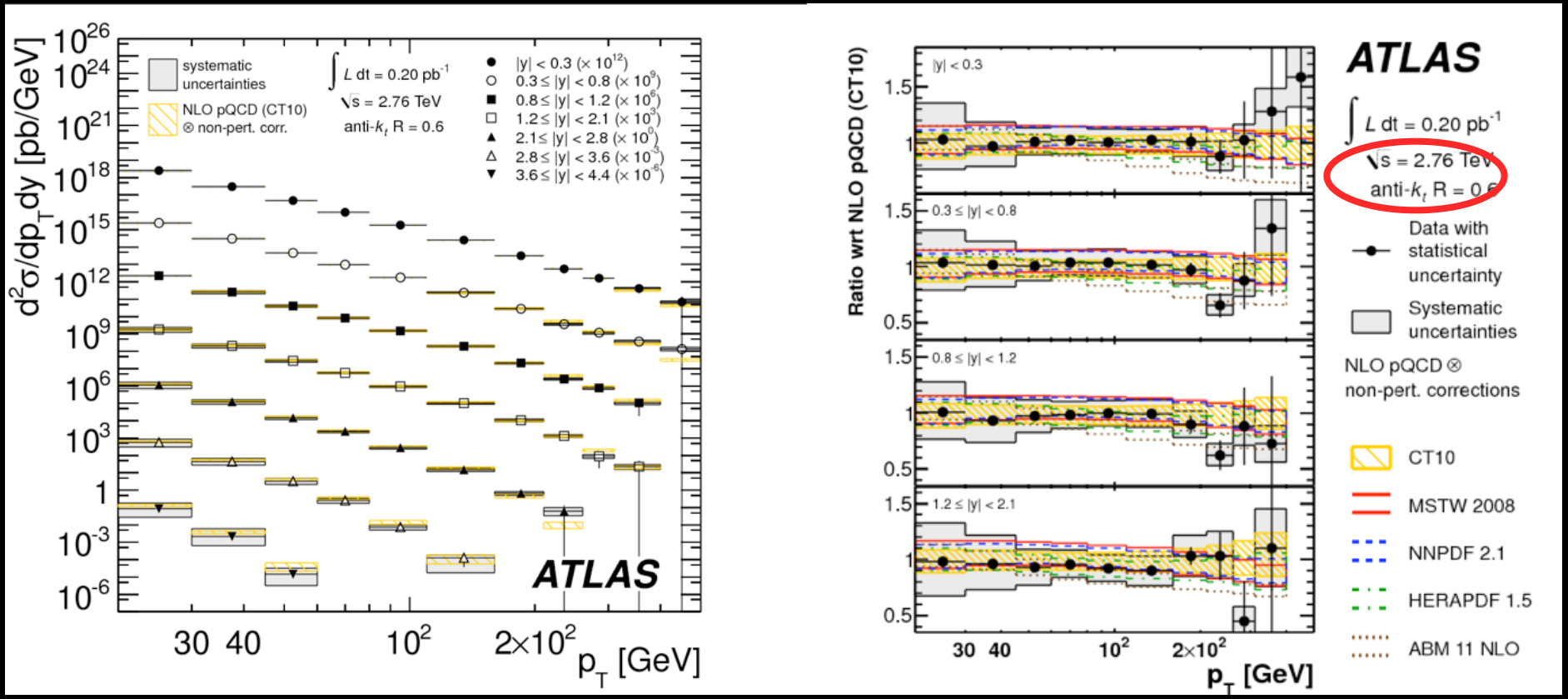






Jets and pQCD

EPJC (2013) 73 2509, EPJC (2011) 71 1512, PRD 86 (2012) 014022



NLO pQCD with non-pert. corrections gives a good description of data (ΔR=0.6).

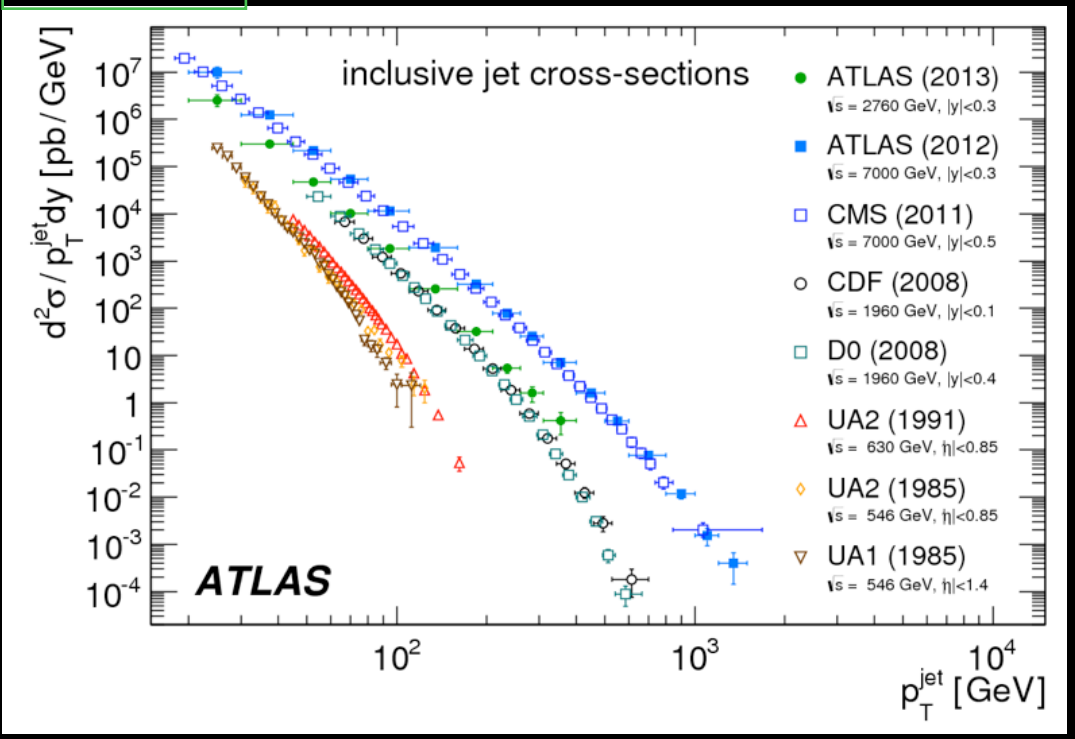
Jets and pQCD

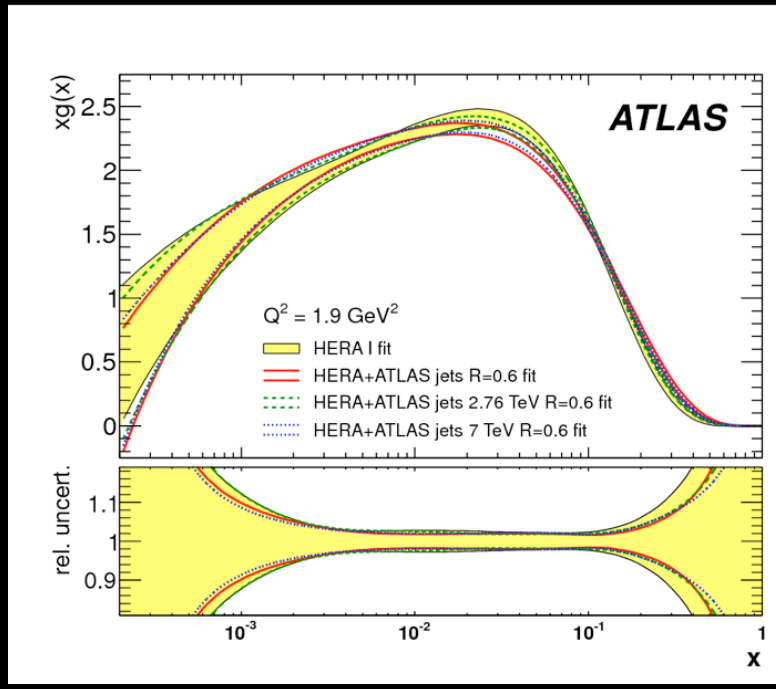
EPJC (2013) 73 2509

EPJC (2011) 71 1512

PRD 86 (2012) 014022

Summary





Combined NLO pQCD analysis with
√s=2.76 & 7 TeV ATLAS jets and
HERA 1 data
DGLAP formalism
→ Constrain gluon and quark parton density function in proton

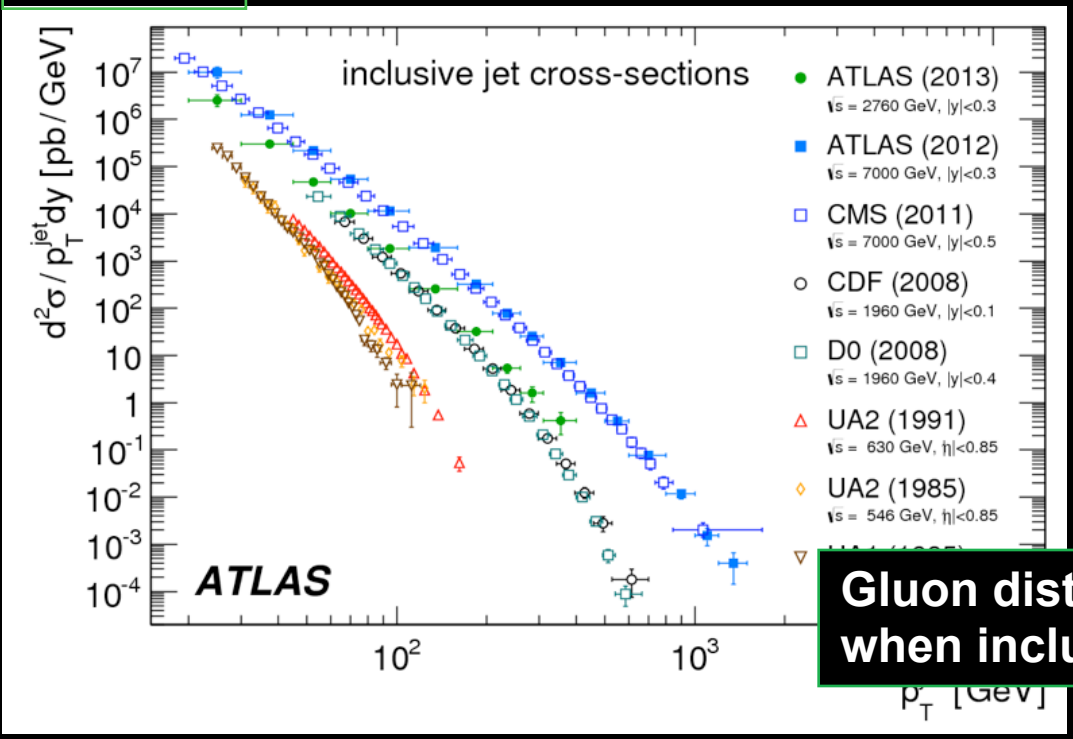
Jets and pQCD

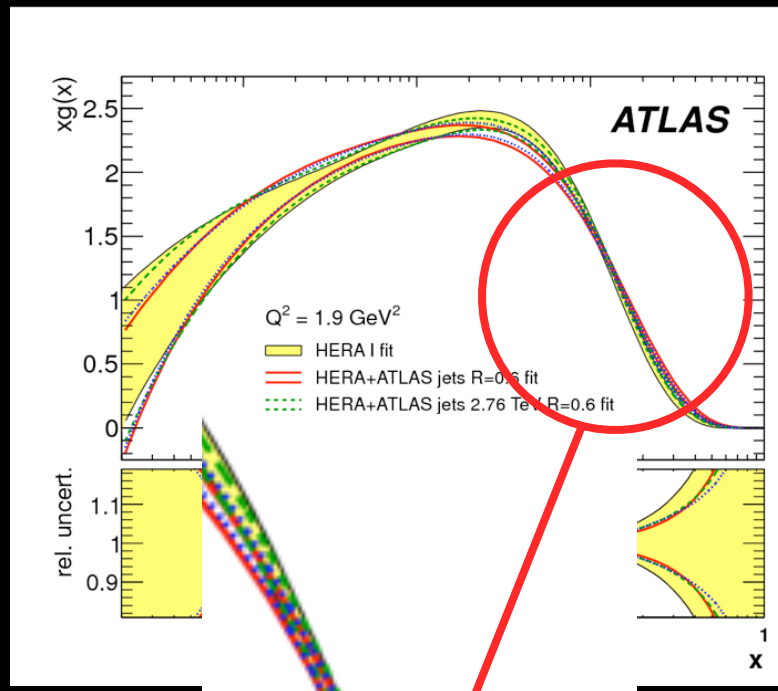
EPJC (2013) 73 2509

EPJC (2011) 71 1512

PRD 86 (2012) 014022

Summary





Gluon distribution harder when including ATLAS data

Combined NLO pQCD analysis with
√s=2.76 & 7 TeV ATLAS jets and
HERA 1 data
DGLAP formalism
→ Constrain gluon and quark parton

$W^{\pm}$ production in ass. with charm quark

ATLAS-CONF-2013-045

Phys.Rev.Lett. 109 (2012) 012001

The production of pp→WcX is directly sensitive to the s-quark distribution in the proton for $Q^2 \sim m_W^2$

Select events

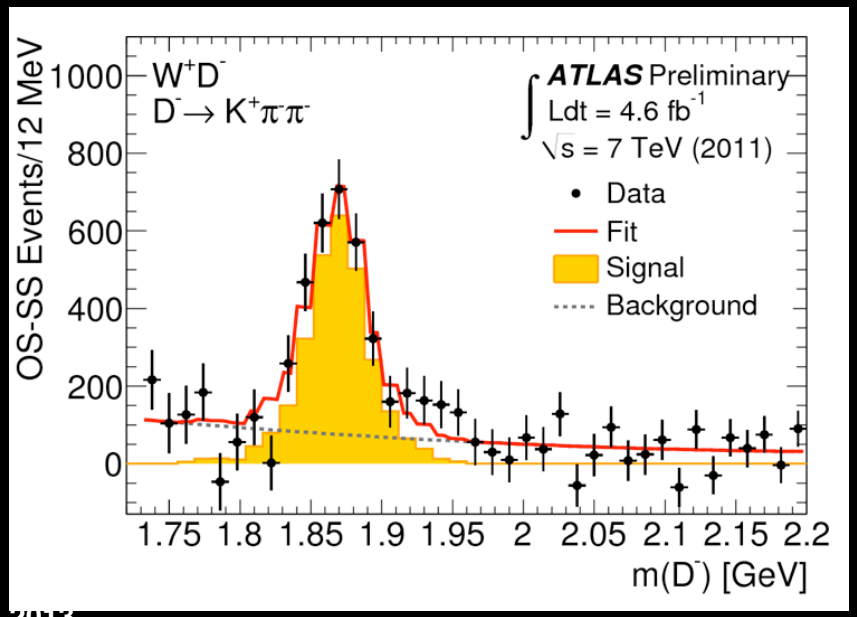
with a $W^{\pm}$ decaying to leptons (e,μ)

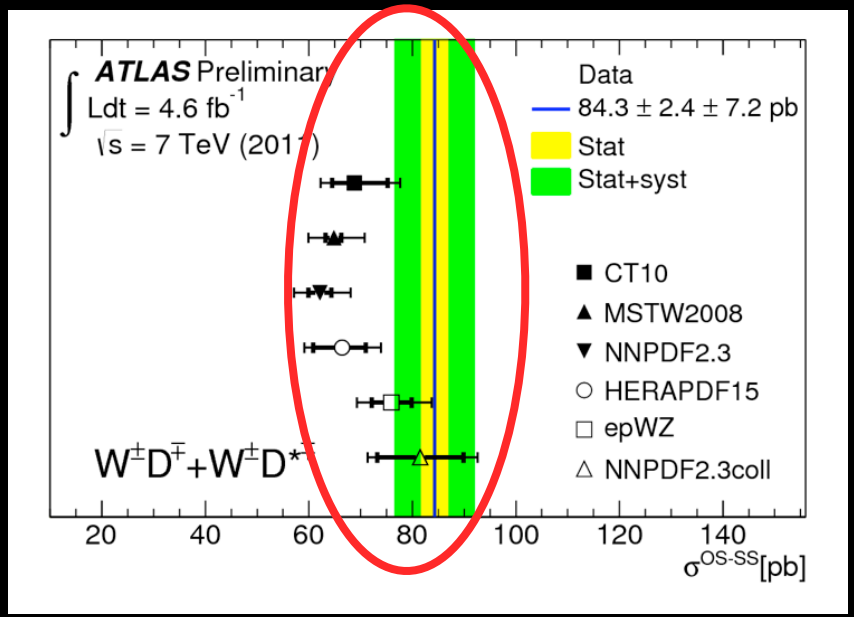
Reconstruct charm hadrons $D^+ \rightarrow K^-\pi^+\pi^+$ $D^{*+} \rightarrow D^0\pi^+$ $D^0 \rightarrow K^-\pi^+$ $D^0 \rightarrow K^-\pi^+\pi^0$ $D^0 \rightarrow K^-\pi^+\pi^-\pi^+$

Correlation btw W & c-meson charge (OS)

Single charm contribution obtained by subtracting contribution from SS events

Systemactic error ~7-8%, dominated by tracking efficieng=cy





Inclusive di-photon cross-section at √s=7 TeV

JHEP01(2013)086

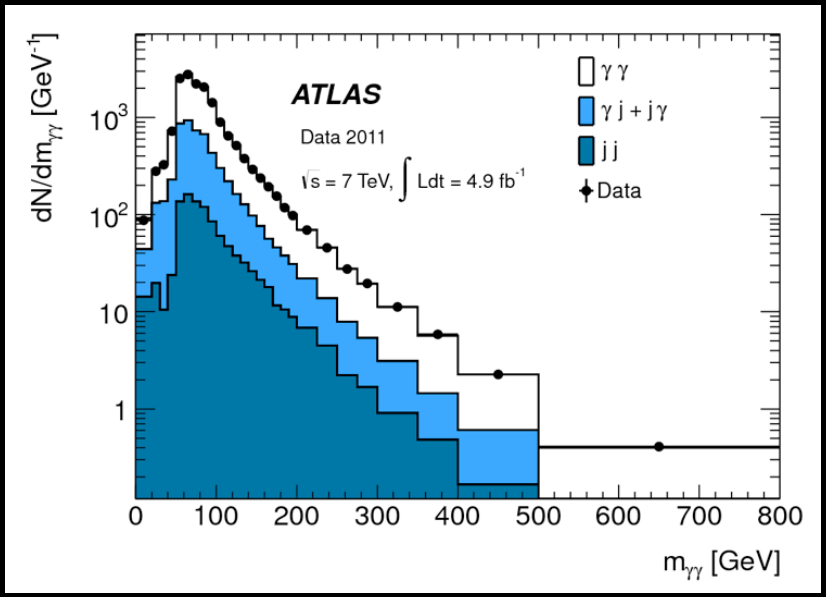
Isolated photon pair candidate E_T^1>25 GeV & E_T^2>22 GeV

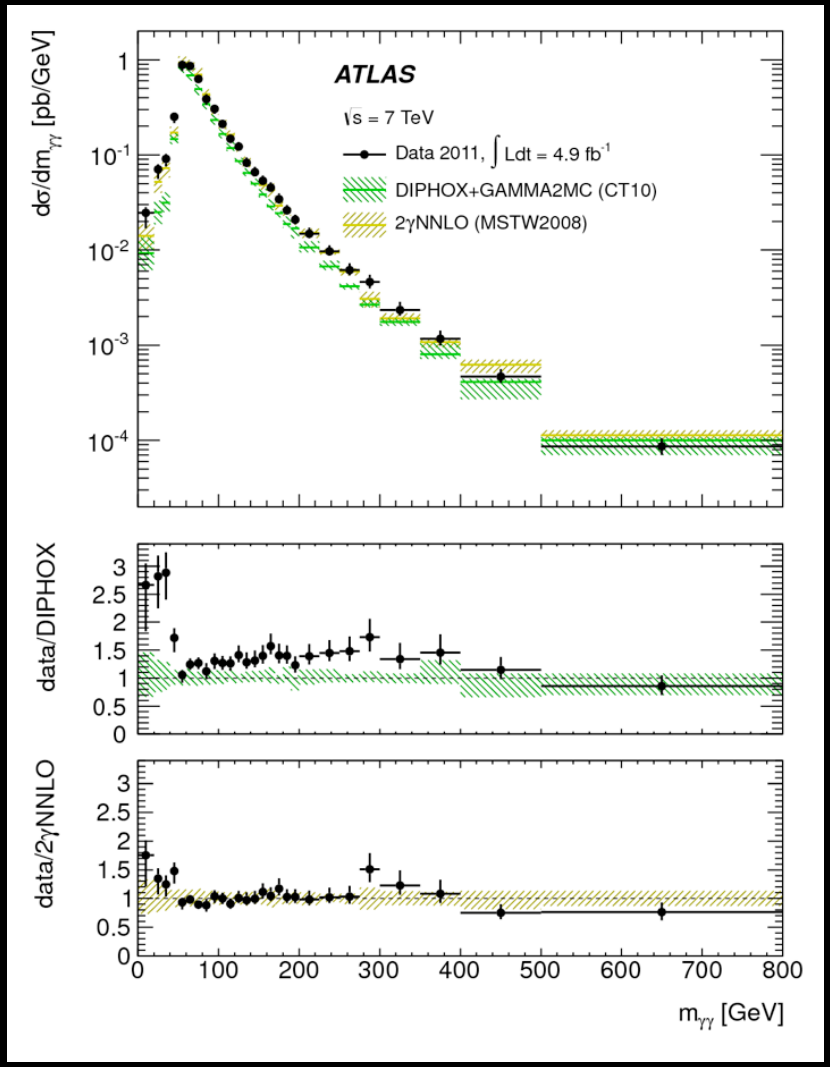
$\sigma_{tot}=44^{+3.2}_{-4.2}$ pb at √s=7 TeV

Differential cross-sections to probe QCD

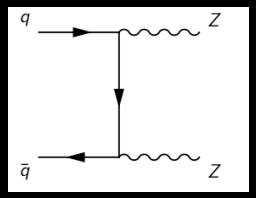
Exploiting isolation one can separate the three components: γγ, γ-jet and jet-jet

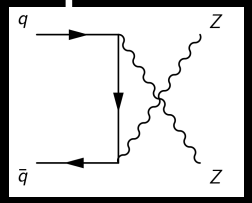
$m_{\gamma\gamma}$ spectrum being understood gives credit to H→γγ discovery.

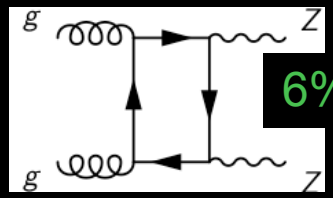


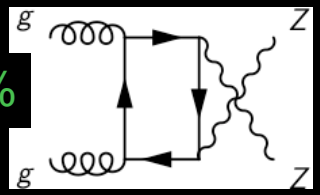


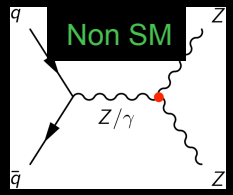
Diboson production at √s=7 TeV: $ZZ^{(*)} \rightarrow l^+l^-l^+l^-$ $ZZ \rightarrow l^+l^-\nu\nu$











JHEP03(2013)128

Fundamental test of SM: gauge boson couplings

Probe for new physics

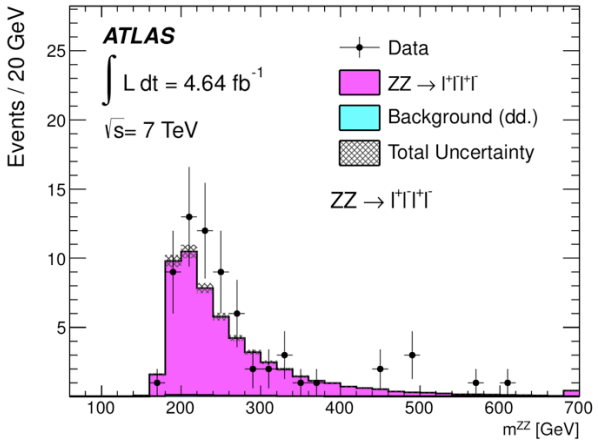
- Anomalous Triple Gauge Coupling ?
- Search for resonances

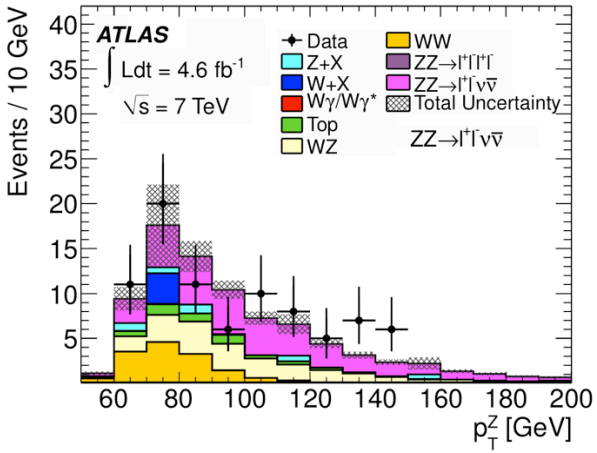
Background to Higgs boson

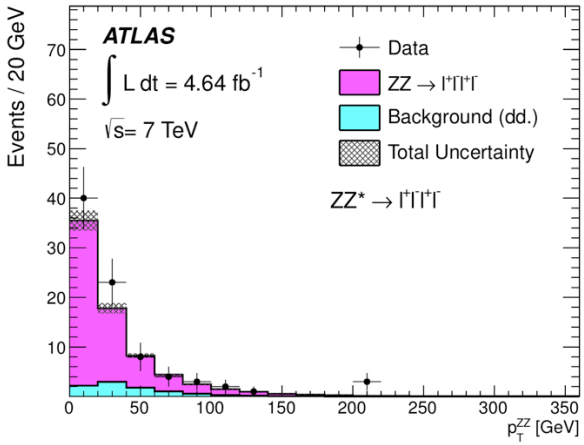
Select events with

4e, 4μ, 2e2μ

2e or 2μ + E_T^{miss}







Diboson production at √s=7 TeV: $ZZ^{(*)} \to l^+l^-l^+l^-$ $ZZ \to l^+l^-\nu\nu$

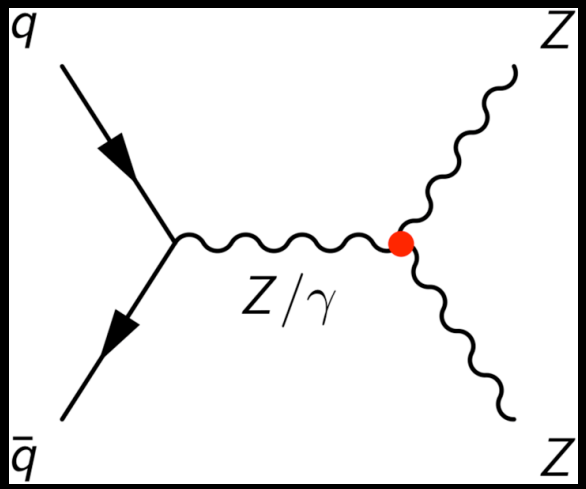
JHEP03(2013)128

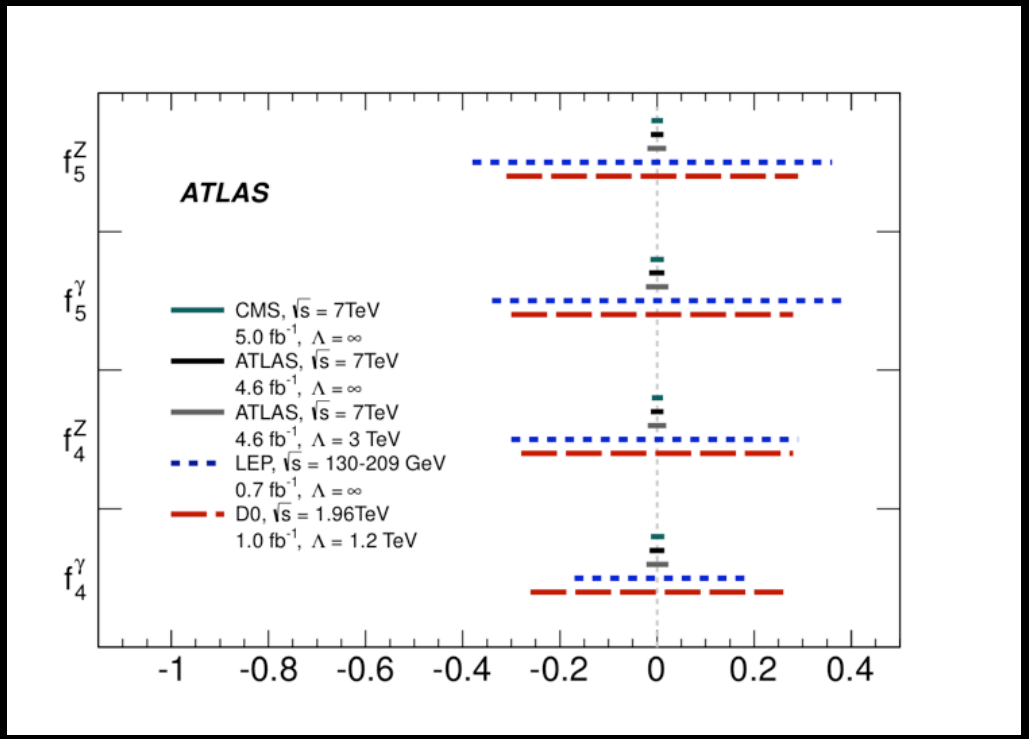
Total cross section

$$\sigma_{ZZ}^{\text{tot}} = 6.7 \pm 0.7\ (\text{stat.})\ ^{+0.4}_{-0.3}\ (\text{syst.}) \pm 0.3\ (\text{lumi.})\ \text{pb}$$

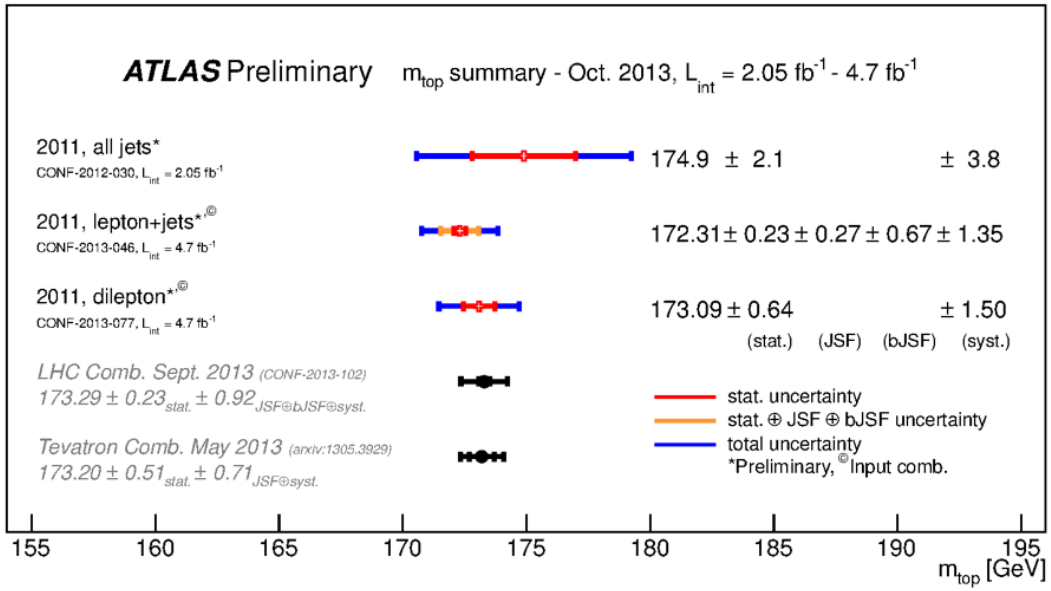
Theory (QCD-NLO) $5.89^{+0.22}_{-0.18}$ pb

Anomalous triple gauge coupling





Top Quark


ATLAS Preliminary
m_top summary - Oct. 2013, L_int = 2.05 fb^-1 - 4.7 fb^-1
2011, all jets*
CONF-2012-030, L_int = 2.05 fb^-1
174.9 ± 2.1 ± 3.8
2011, lepton+jets*,©
CONF-2013-046, L_int = 4.7 fb^-1
172.31 ± 0.23 ± 0.27 ± 0.67 ± 1.35
2011, dilepton*,©
CONF-2013-077, L_int = 4.7 fb^-1
173.09 ± 0.64 ± 1.50
(stat.) (JSF) (bJSF) (syst.)
LHC Comb. Sept. 2013 (CONF-2013-102)
173.29 ± 0.23_stat. ± 0.92_JSF⊕bJSF⊕syst.
Tevatron Comb. May 2013 (arxiv:1305.3929)
173.20 ± 0.51_stat. ± 0.71_JSF⊕syst.
stat. uncertainty
stat. ⊕ JSF ⊕ bJSF uncertainty
total uncertainty
*Preliminary, © Input comb.
155
160
165
170
175
180
185
190
195
m_top [GeV]

Top mass: from dileptons - √s=7TeV - 4.7 fb^{-1}

ATLAS-CONF-2013-077

Very clean signature

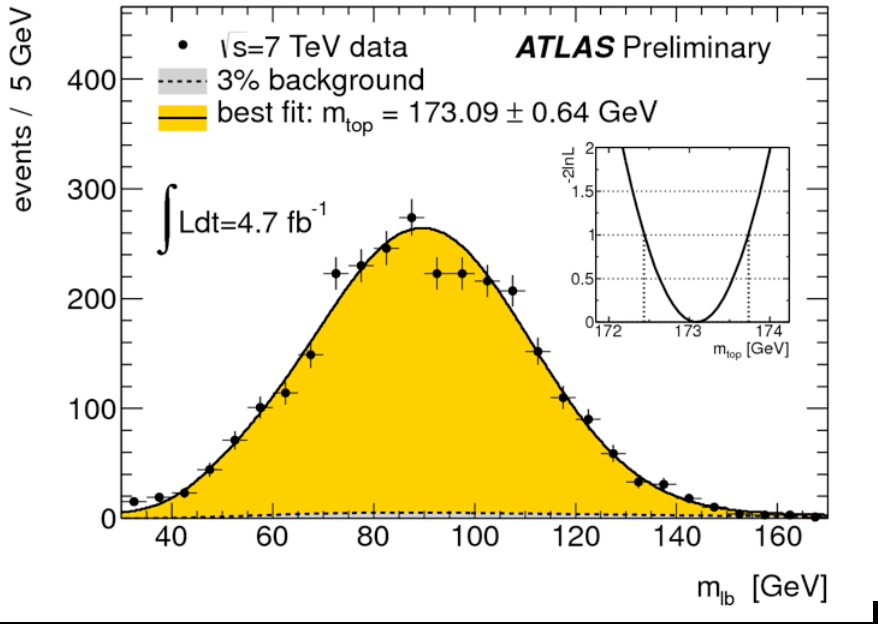
- 2 opp. sign leptons, $N_{jets} \geq 2$, 2 $N_{btag}=2$

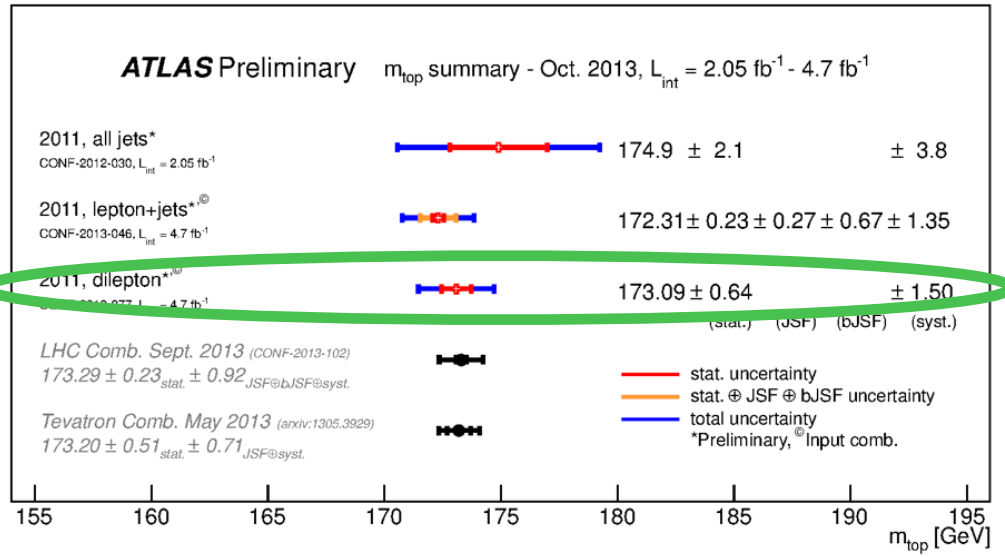
Background (fake leptons, single top, diboson) < 3%

Template fit based on $m_{b\text{-lepton}}$

- Correct b assignment in 76.6±0.3%

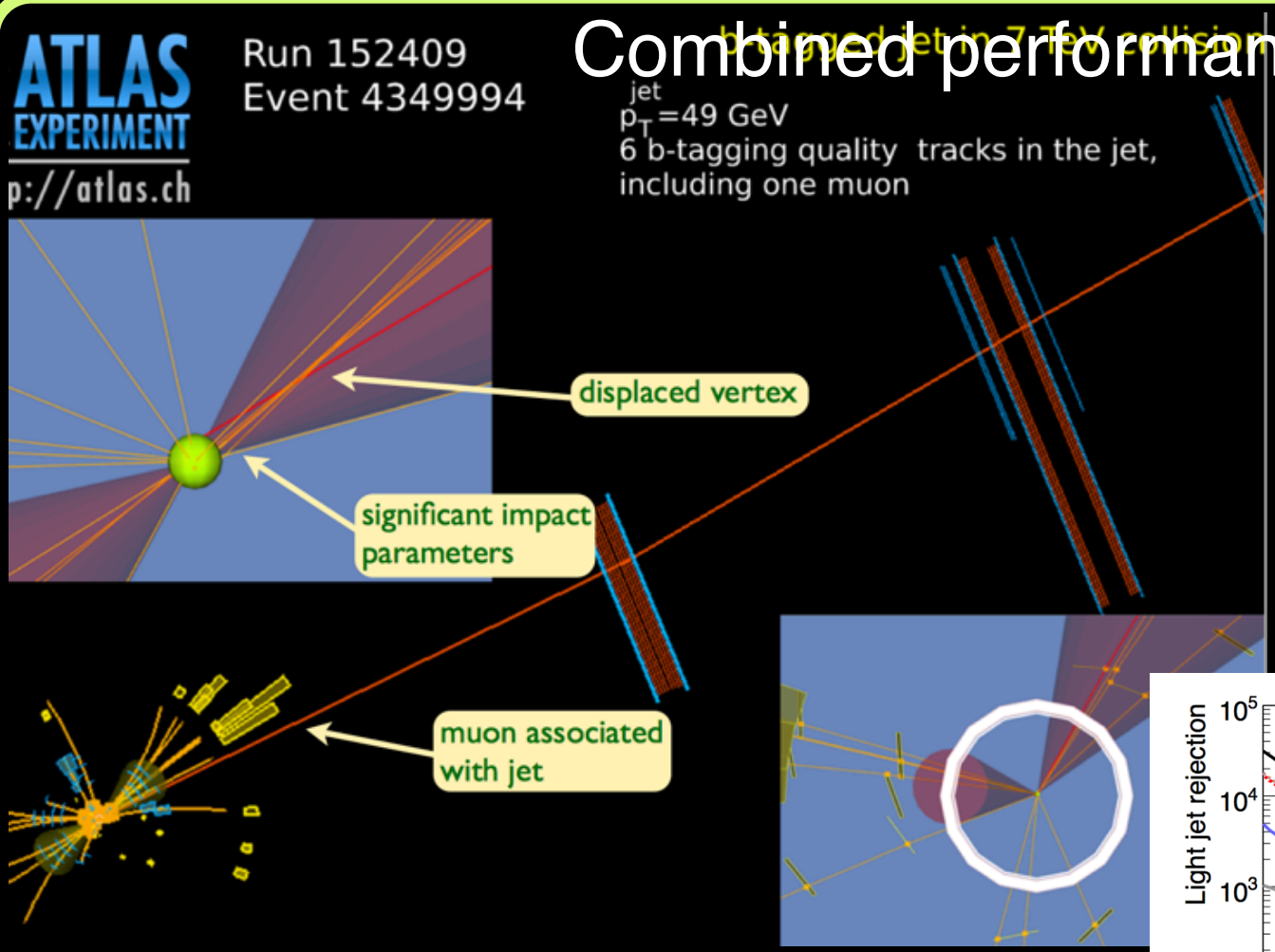
Dominant systematic errors: JES, bJES



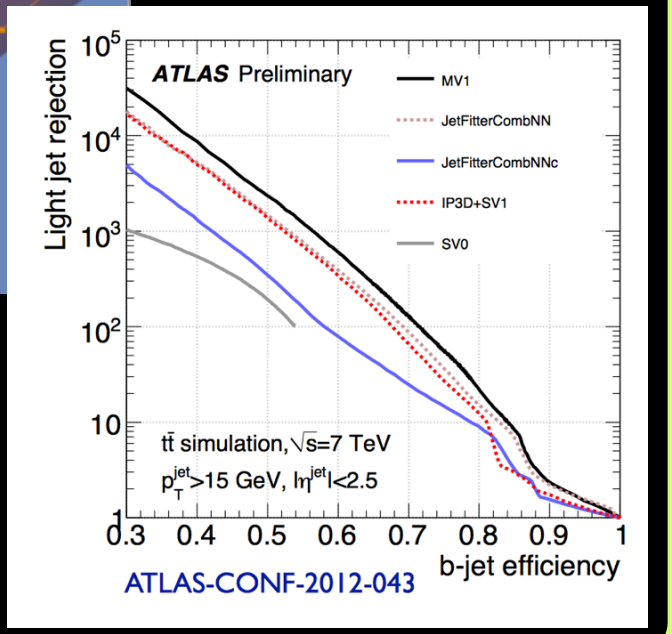


$$m_{\text{top}} = 173.09 \pm 0.64\,(\text{stat}) \pm 1.50\,(\text{syst})\ \text{GeV}$$

Combined performance: b-tagging



ATLAS-CONF-2012-043



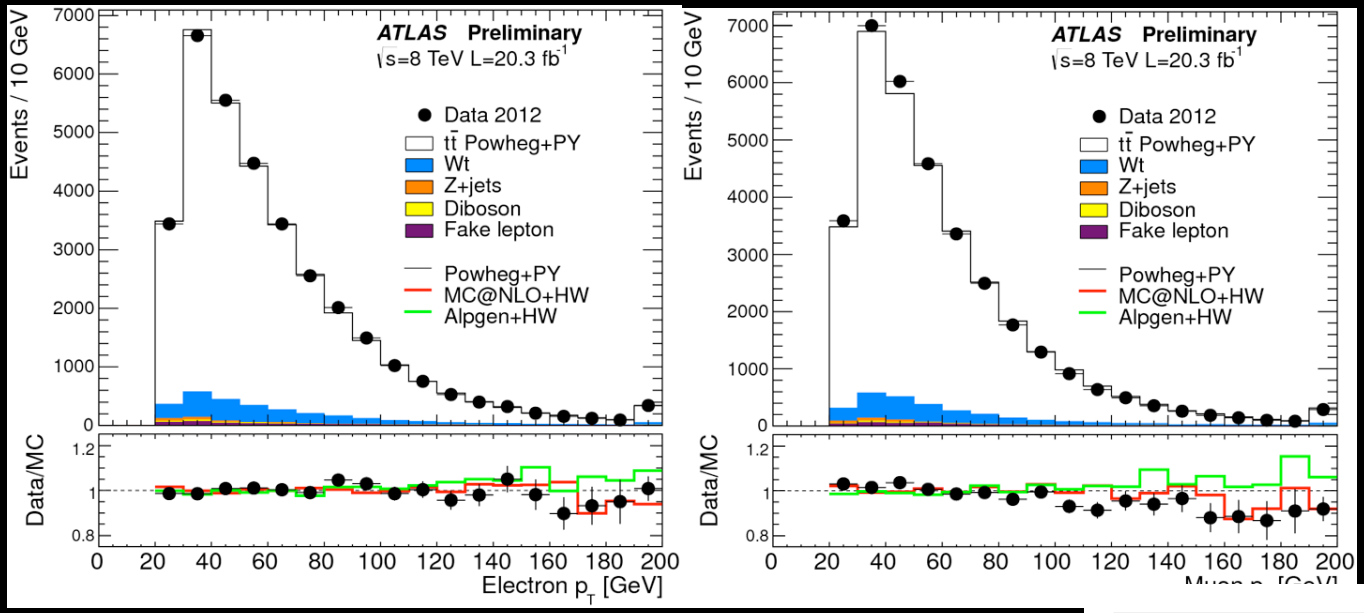
b-tag is under constant development, e.g. exploiting the rich b sample from top events.

b-tag is also evolving toward c-tagging

t-tbar cross-section measurement at √s=8TeV: e-μ

ATLAS-CONF-2013-097

eμ+btag: pure sample of ttbar events → precise xs measurement



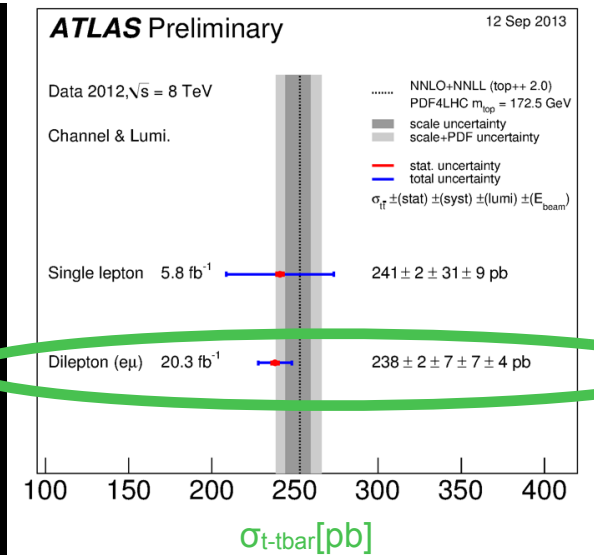
This measurement √s=8TeV

4.8% precision

$$\sigma_{t\bar{t}} = 237.7 \pm 1.7\,(\text{stat}) \pm 7.4\,(\text{syst}) \pm 7.4\,(\text{lumi}) \pm 4.0\,(\text{beam energy})\ \text{pb}$$

NNLO+NNLL calculation

$$252.9^{+13.3}_{-14.5}\ \text{pb at}\ m_{\text{top}} = 172.5\ \text{GeV}$$



t-tbar differential cross sections

ATLAS-CONF-2013-099

Only one isolated lepton ($e^{\pm}$,$\mu^{\pm}$)

p_T^l>25 GeV

N_{jets}≥4 - p_T^{jet}>25 GeV, at least one b-tag

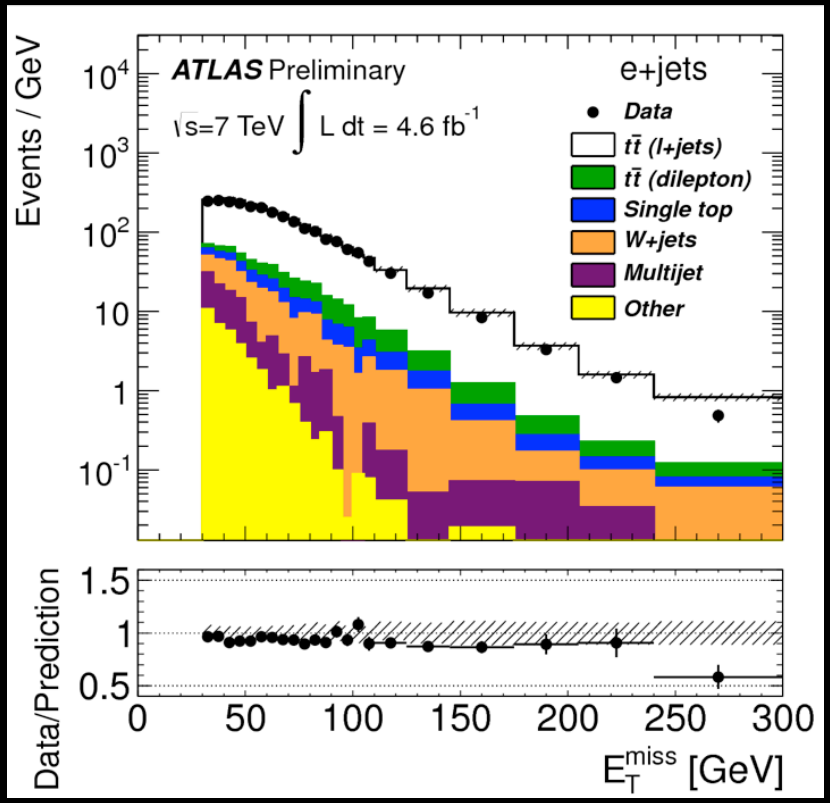
E_T^{miss}>30 GeV - m_T^W>35 GeV

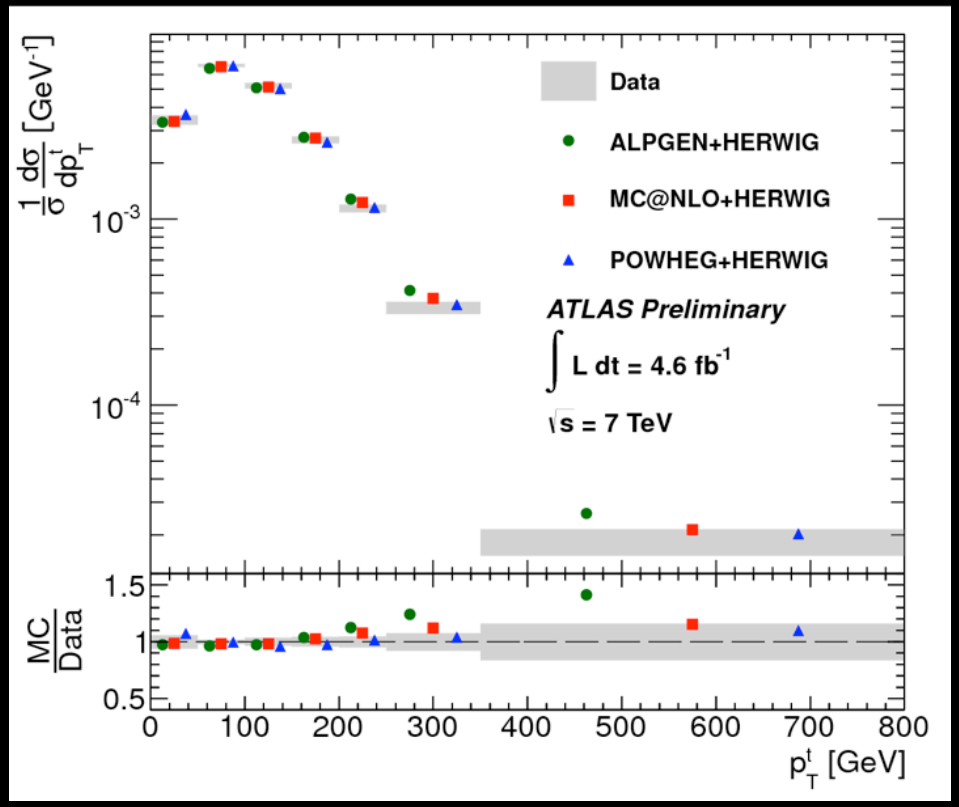
Four variables p_T^t, m_{tt}, p_T^{tt}, y_{tt}

Compare data vs

- MC
- NLO, NLO+NNLL QCD predictions
- QCD predictions & PDFs

Result here: p_T^t





Most MC harder than data

Wt cross-section at √s=8 TeV-20fb^{-1} ATLAS-CONF-2013-100

eμ only +E_T^{miss} + [1-jet 1-tagged or
2 jets ≥1-tagged]

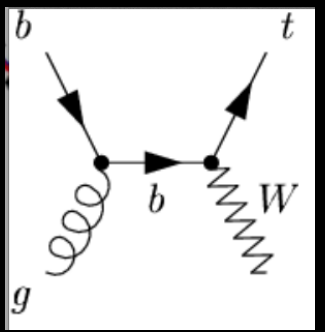
Multivariate approach for cross section measurement

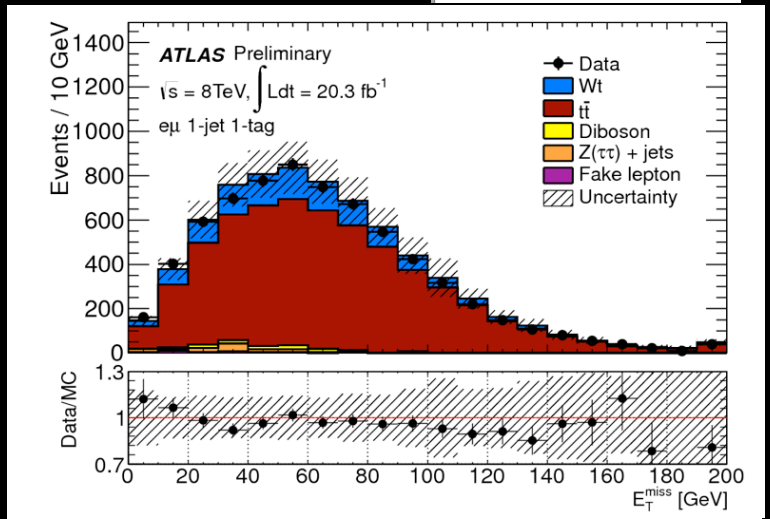
One BDT discriminant per jet bin

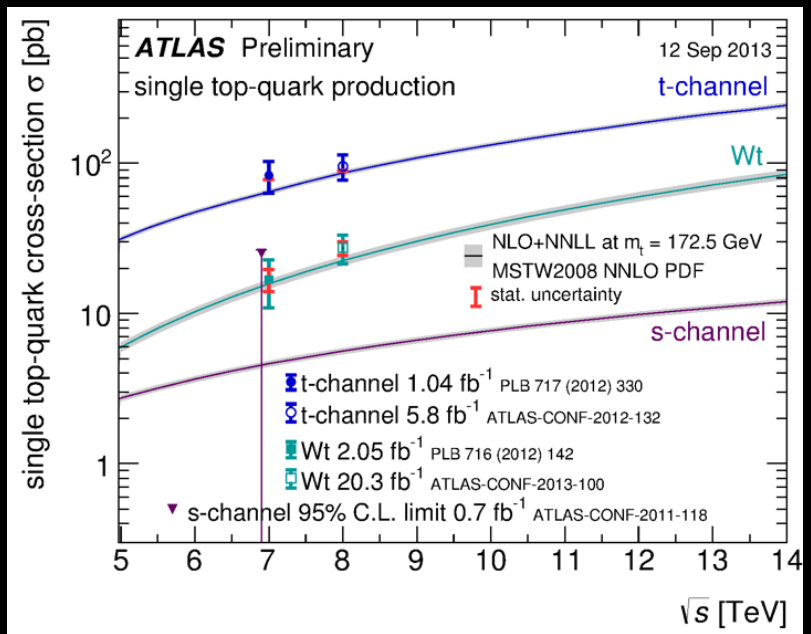
Most powerful variables: Σp_T^{jet}, p_T^{lepton}, E_T^{miss}

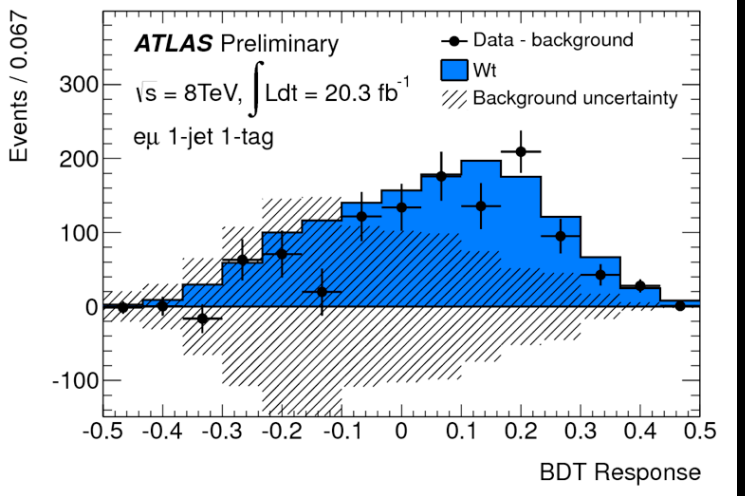
Dominated by systematic uncertainties (20 vs 7%)
Theory: ISR/FSR, Wt and tt generators & PS
Experiment: E_T^{miss}, b-tag & JES

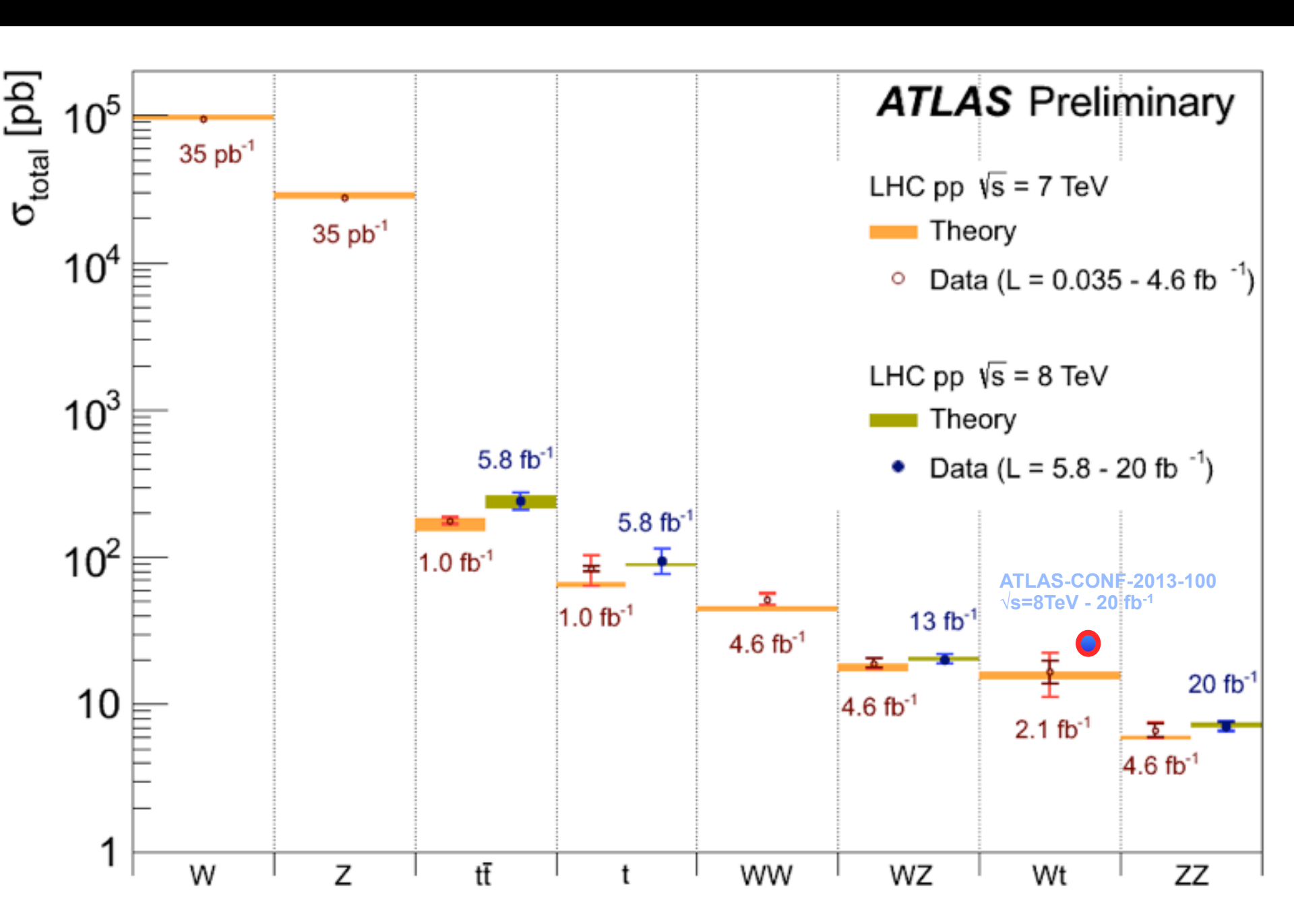
27.2±2.8(stat)±5.4(syst) pb (m_{top}=172.5 GeV)










ATLAS Preliminary
LHC pp √s = 7 TeV
Theory
Data (L = 0.035 - 4.6 fb -1)
LHC pp √s = 8 TeV
Theory
Data (L = 5.8 - 20 fb -1)
σtotal [pb]
10^5
10^4
10^3
10^2
10
1
35 pb-1
35 pb-1
1.0 fb-1
5.8 fb-1
1.0 fb-1
5.8 fb-1
4.6 fb-1
4.6 fb-1
13 fb-1
2.1 fb-1
20 fb-1
4.6 fb-1
ATLAS-CONF-2013-100
√s=8TeV - 20 fb-1
W
Z
tt̄
t
WW
WZ
Wt
ZZ

Standard Model Measurements

Measuring *SM* processes is the foundation for any new physics search.

- Electroweak production cross sections from ~100 nb down to ~10 pb ($H \rightarrow \gamma\gamma$ cross section ~0.05 pb)

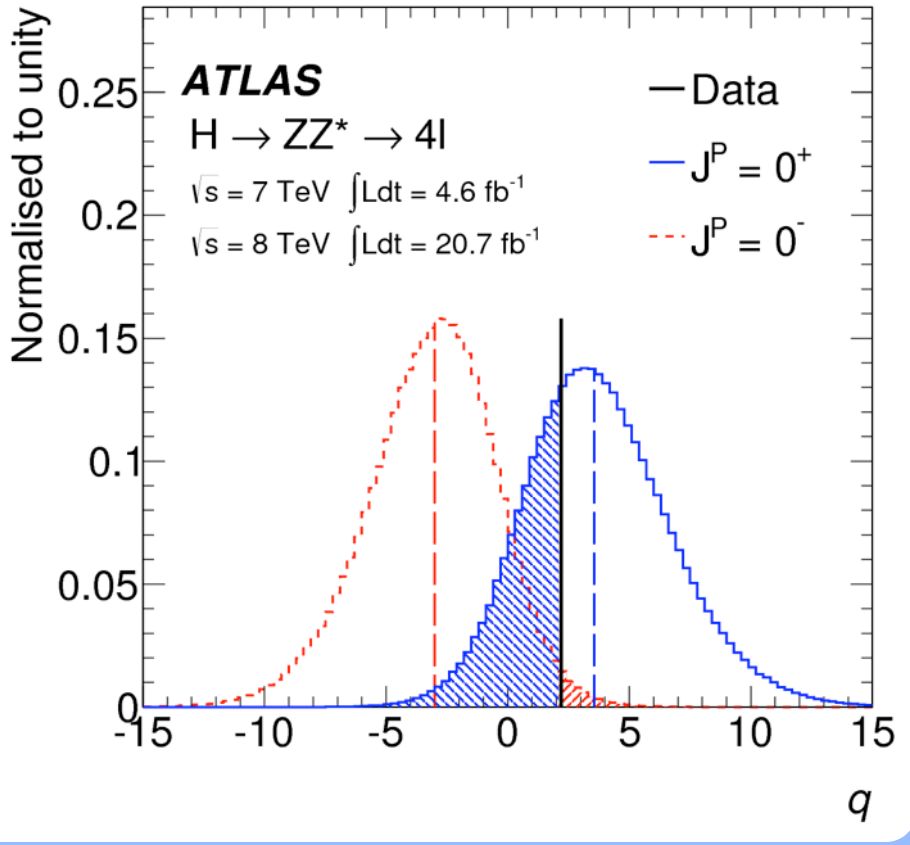
- Jet production up to E_T^{jet} ~1.5 TeV and compared data to the latest QCD calculations

- Top mass, total and differential cross-sections, single top processes

Next steps

- Improve precision and reach on γ, jet, VB p_T, VB + light and heavy quark jets
- Measure observables sensitive to VBF and VBS
- Multi boson production with increased measurement precision
- Measure the W mass with a few MeV precision
- Improve the top mass measurement down to < 1 GeV

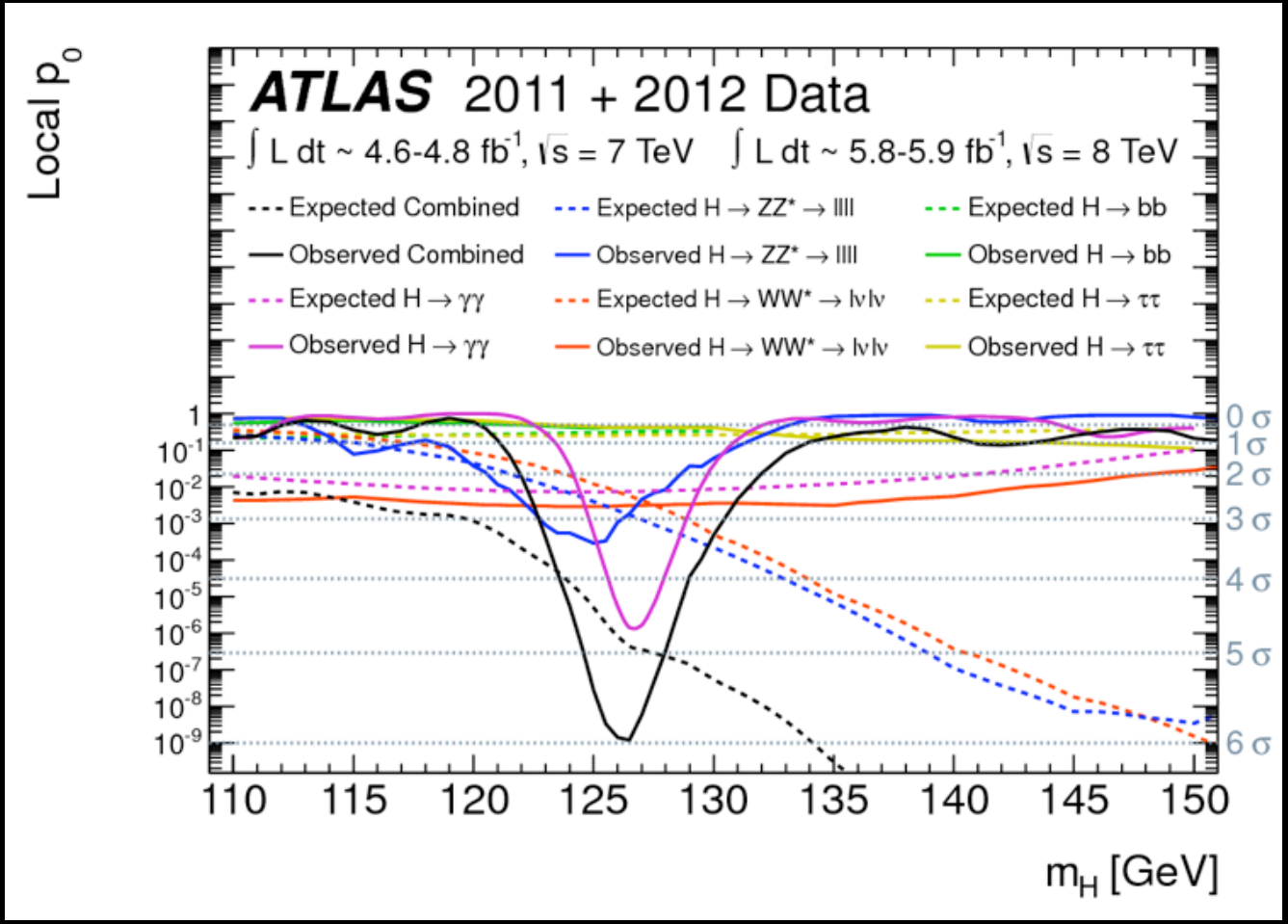
HIGGS



Higgs	E. Monnier	**Summary of LHC Higgs results (ATLAS & CMS)**
	A. Baroncelli	**Searches for Rare decays of the Higgs boson with the ATLAS detector**
	F. U. Bernlochner	**Combined Measurements of the Mass and Coupling Properties of the Higgs boson ...**
	R. Di Nardo	**Individual and Combined Measurements of the Spin and Parity Properties of the Higgs**
	K. Hanagaki	**Search for the Higgs boson in fermionic channels using the ATLAS detector**
	A. Kotwal	**Beyond-?the-?Standard Model Higgs Physics using the ATLAS Experiment**
	A. Palma	**Measurement of Properties of the Higgs boson in bosonic decay channels …..**

Higgs boson discovered in 2012

Phys. Lett. B 716 (2012) 1-29

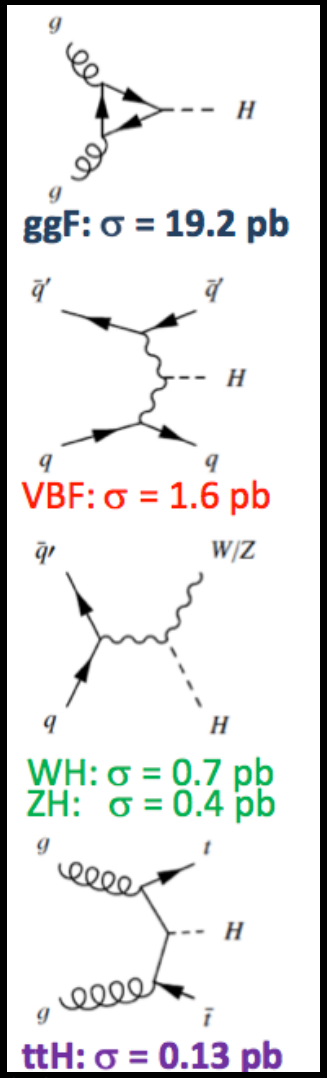


The 2013 Nobel prize for physics was awarded to François Englert and Peter Higgs: Congratulations!

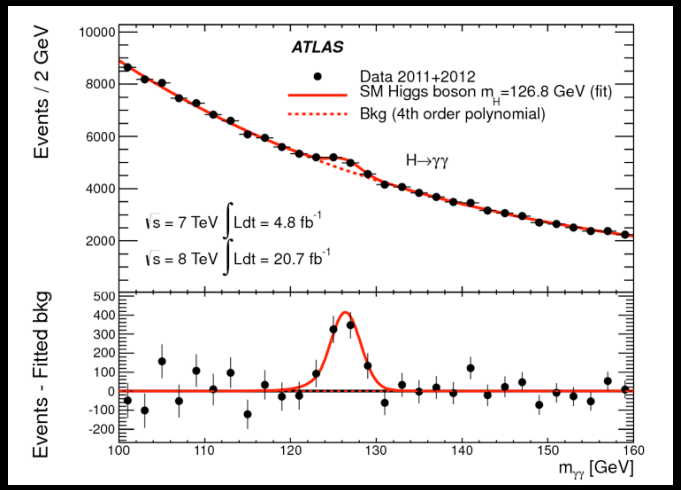
Higgs Boson: a reminder

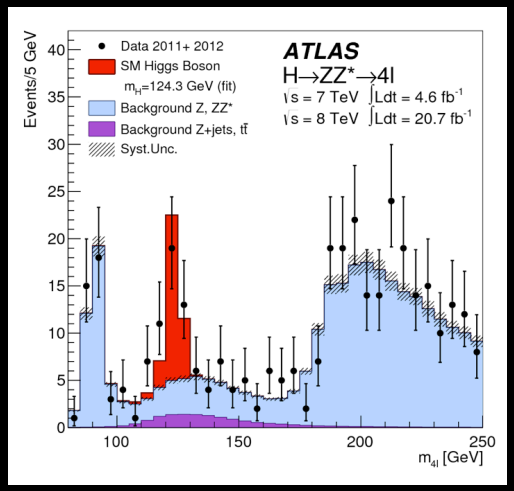
LHC Higgs Xsec WG: https://twiki.cern.ch/twiki/bin/view/LHCPhysics/CrossSections

For m_H=125 GeV

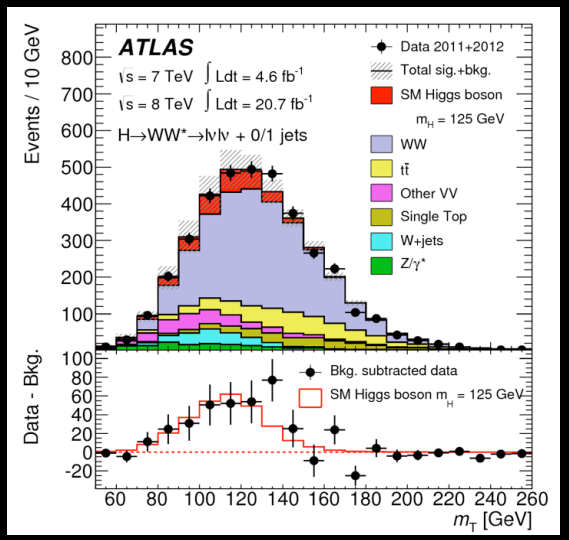


Br(H→WW) : 22% Br(H→bb) : 57%
Br(H→ZZ) : 2.8% Br(H→ττ) : 6.2%
Br(H→γγ) : 0.23%





arXiv:1307.1427



$pp \rightarrow W/Z + H \rightarrow bb$ ATLAS-CONF-2013-079

Categories in $N_{leptons}$, jets, jets tagged as b, p_T^V

0-lepton+2 b-tag jets+E_T^{miss}>120GeV

1-lepton+2 b-tag jets+E_T^{miss}>25GeV+m_T^W<120 GeV

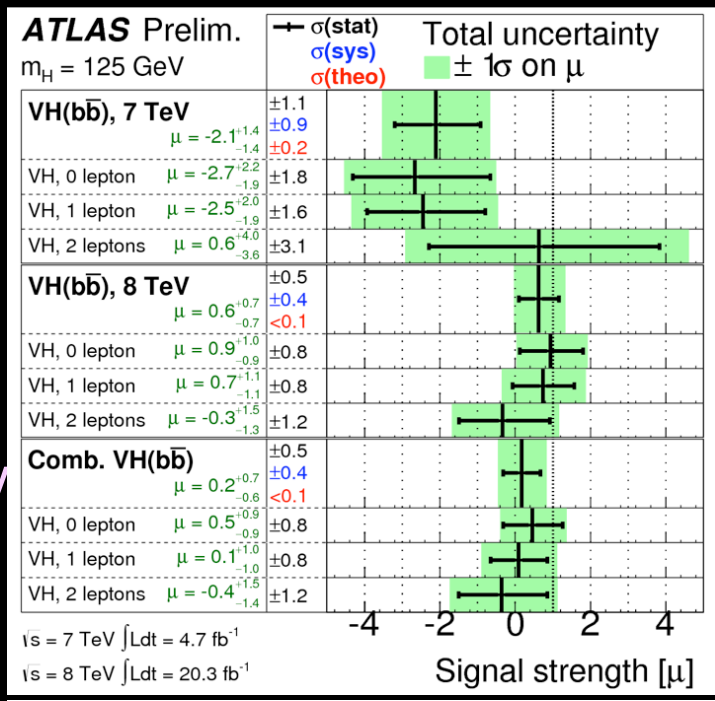
2-leptons+2b-tag jets+E_T^{miss}<60GeV+83<m_{ll}<99 GeV

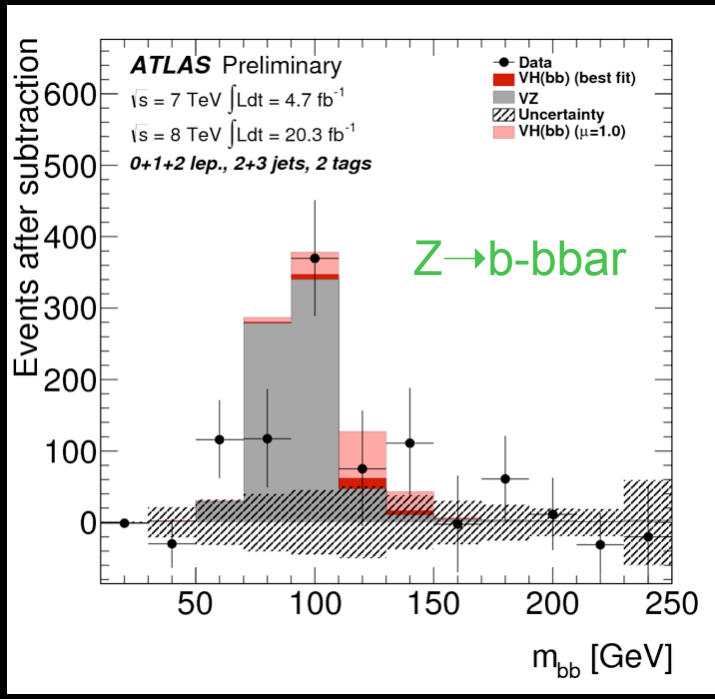
$\mu_{Hbb}=0.2\pm0.5(stat)\pm0.4(syst)$

Analysis procedure validated by measuring diboson production $pp \rightarrow W/Z + Z \rightarrow$ b-bar

$\mu_{diboson}=0.9\pm0.2$

$\mu=N_{measured}/N_{SM}$ is the signal strength



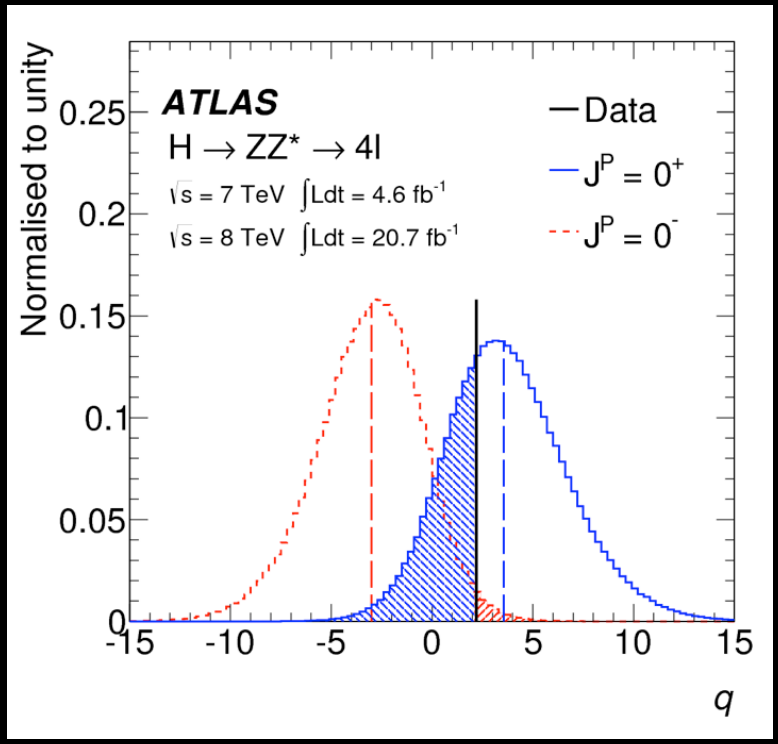


Boson → Higgs boson

Spin arXiv:1307.1432

$H \to \gamma\gamma$ $H \to ZZ^* \to 4\ell$ $H \to WW^* \to \ell\nu\ell\nu$

Data favour $J^P=0^+$
$J^P=0^-$ rejected at 97.8%CL with 4l alone
$J^P=1^\pm$ rejected at 99.7% CL with 4l & WW
$J^P=2^+$ rejected at 99.9% with these three channels
(limit uses minimal graviton-inspired model 2^+_m)



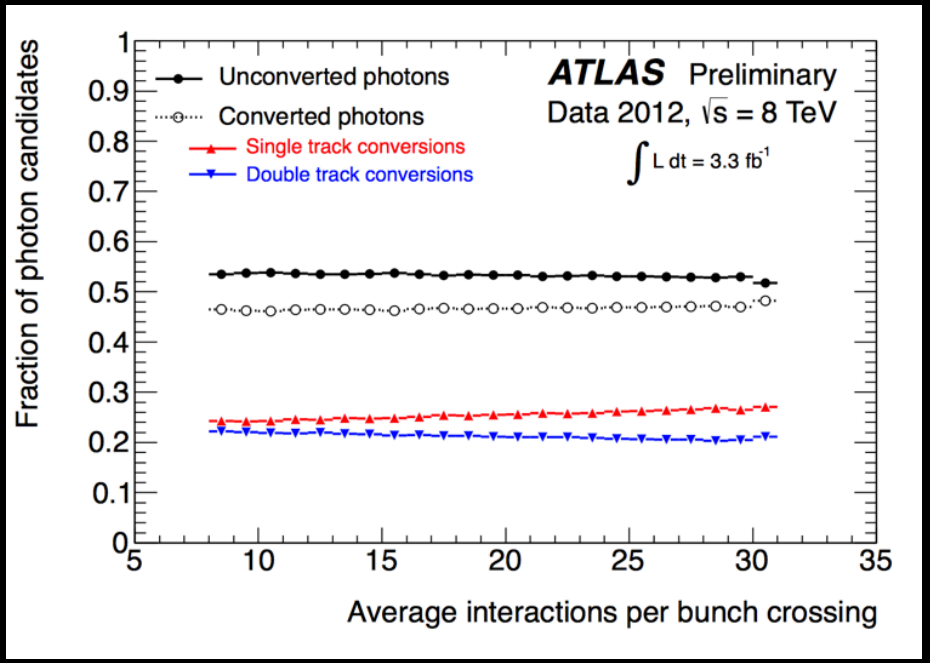
Combined performance: Photon Conversion

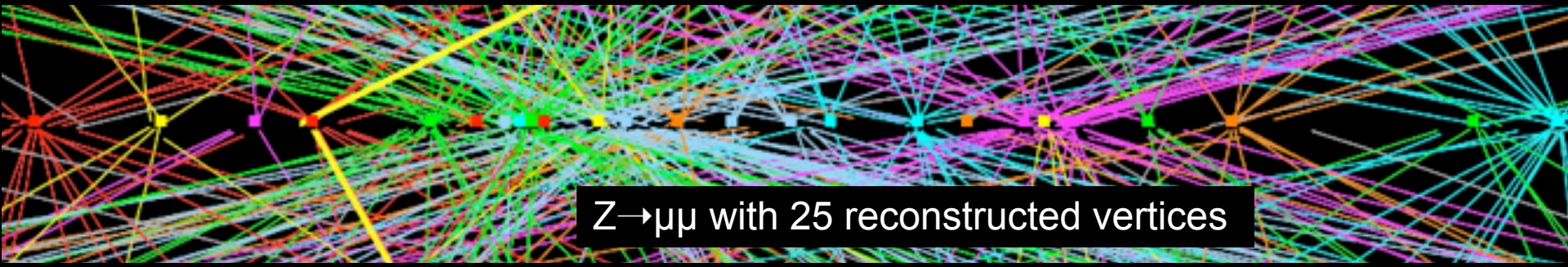
Fraction of photon candidates

E_T>30GeV
EM calorimeter & tracking acceptances

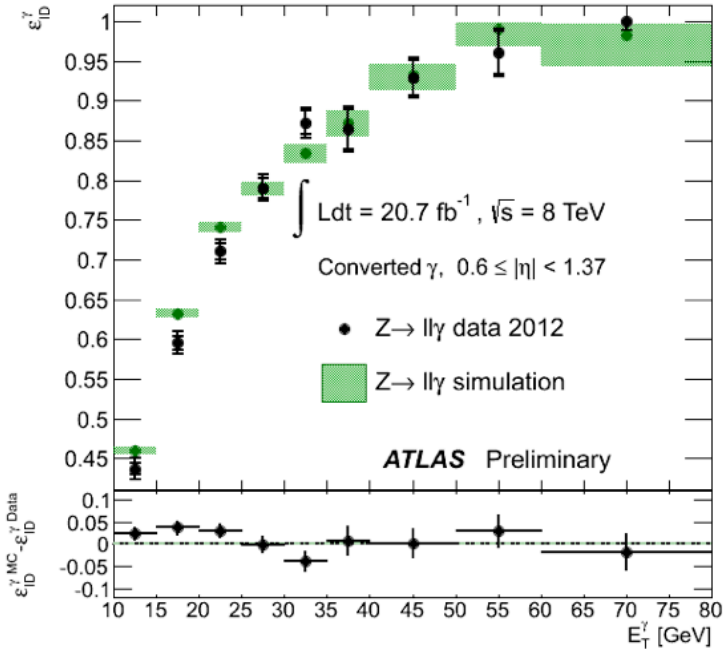
Unconverted vs Converted photons fractions: stable vs the number of interactions per bunch-crossing.

Photon detection efficiency constant





Combined performance: Photon efficiency



Improved measurement of photon identification efficiency

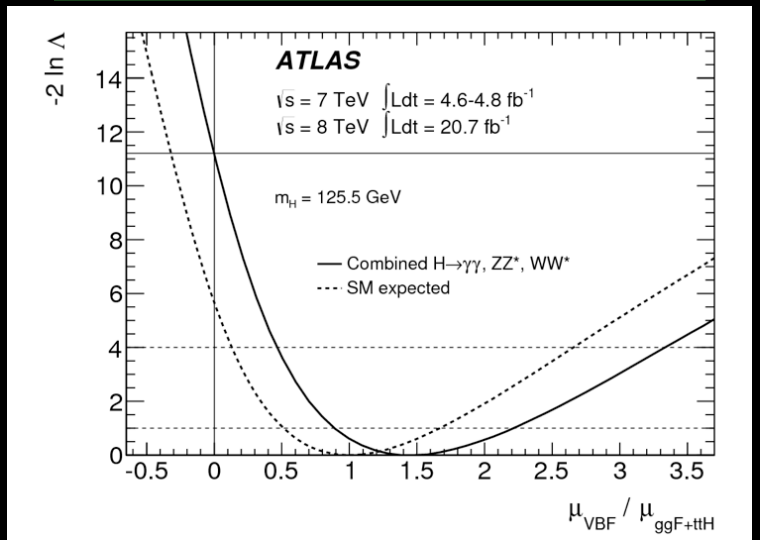
Reduced uncertainty on event yield from γ efficiency

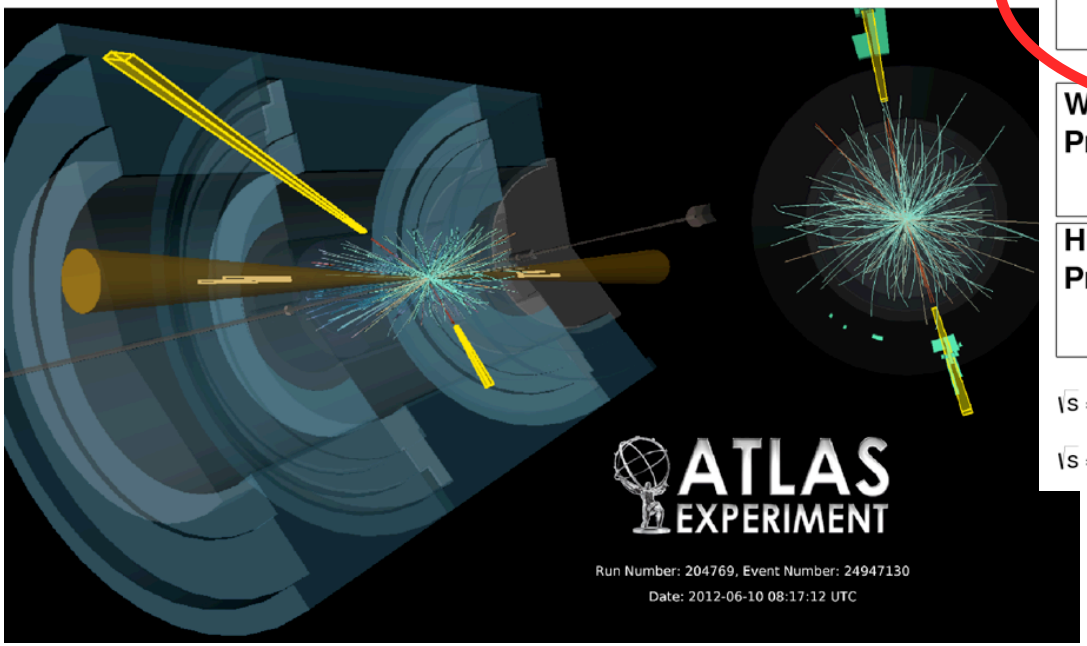
→ from **5.3%**(ATLAS-CONF-2012-168)
to **2.4%**(ATLAS-CONF-2013-012)

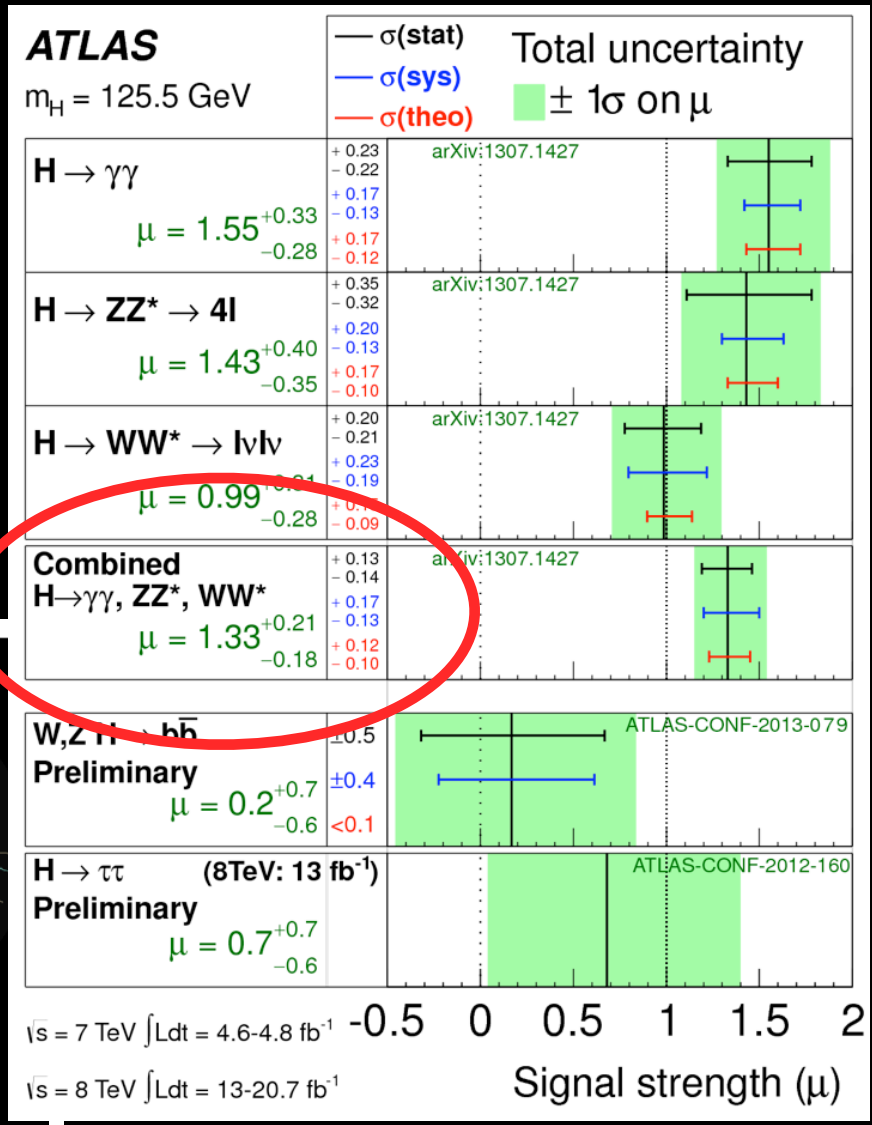
Reduced uncertainty on the measurement of μ

Higgs boson couplings & signal strength arXiv:1307.1427

Evidence for VBF production

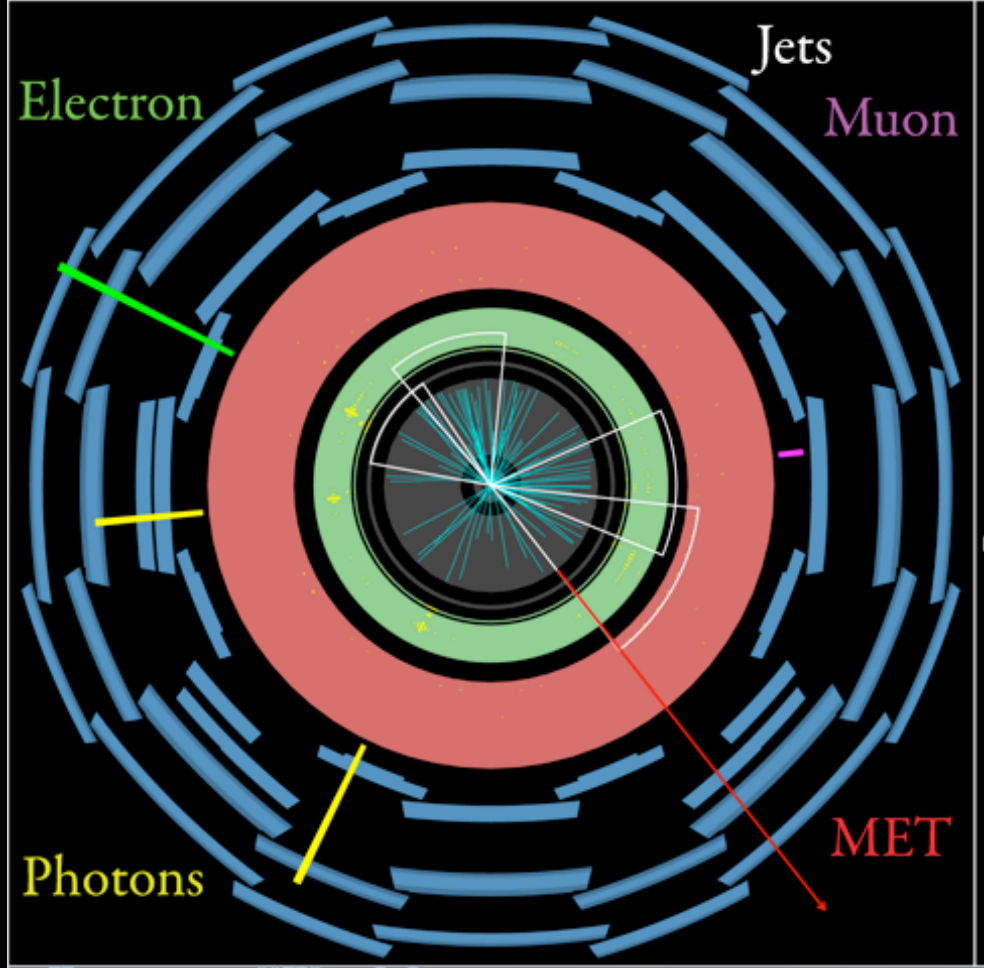


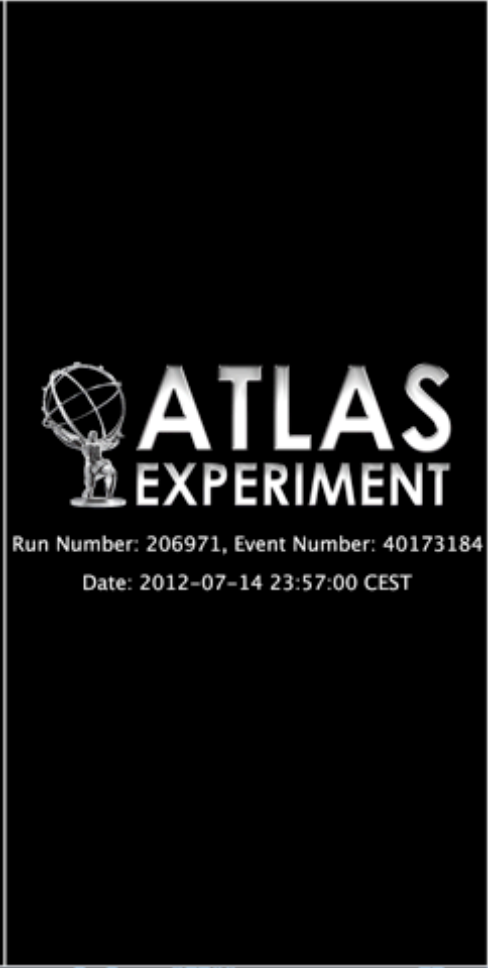


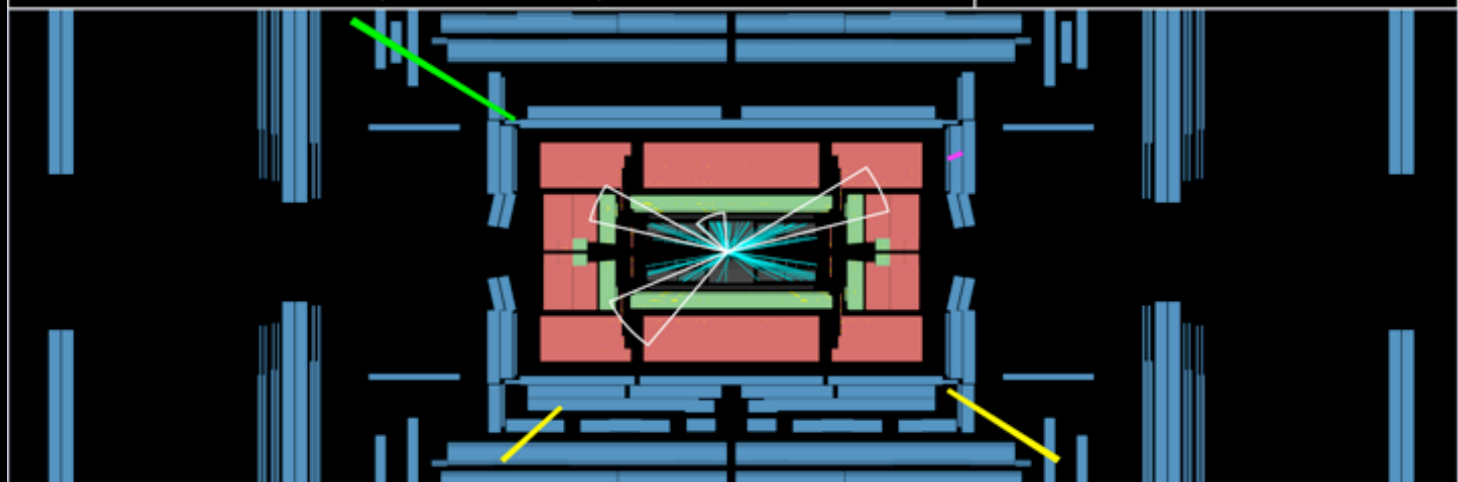


Search for ttH with H→γγ

One candidate
mγγ=126.6 GeV
S/B~0.45 in 120-130 GeV



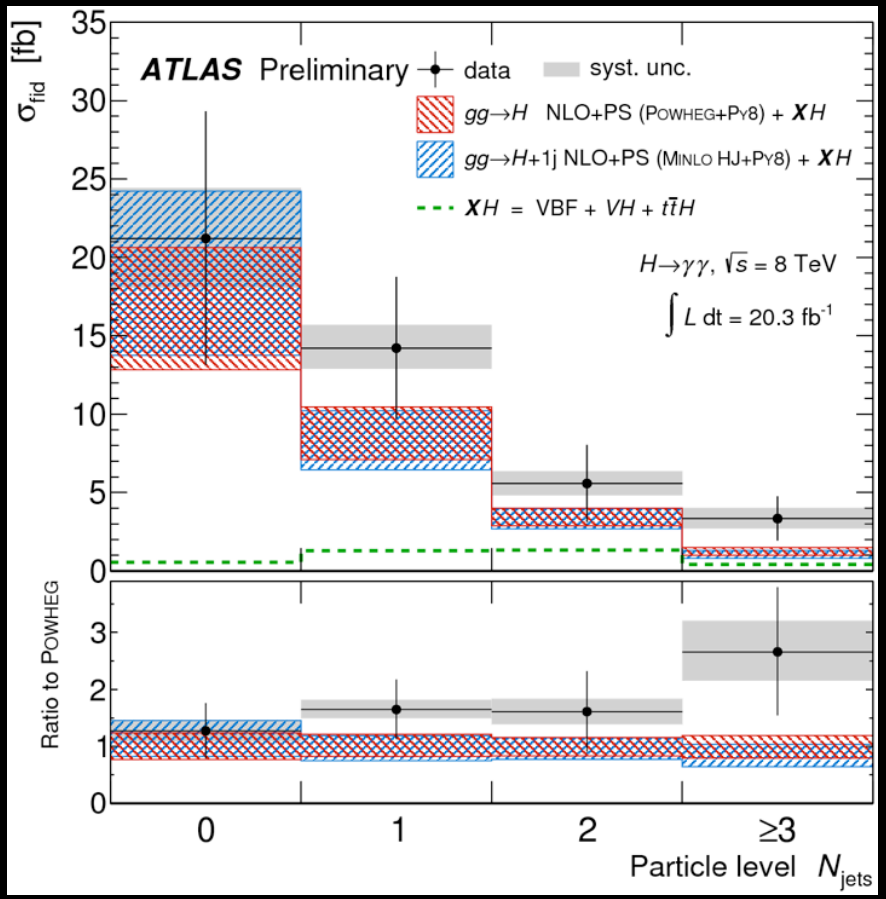


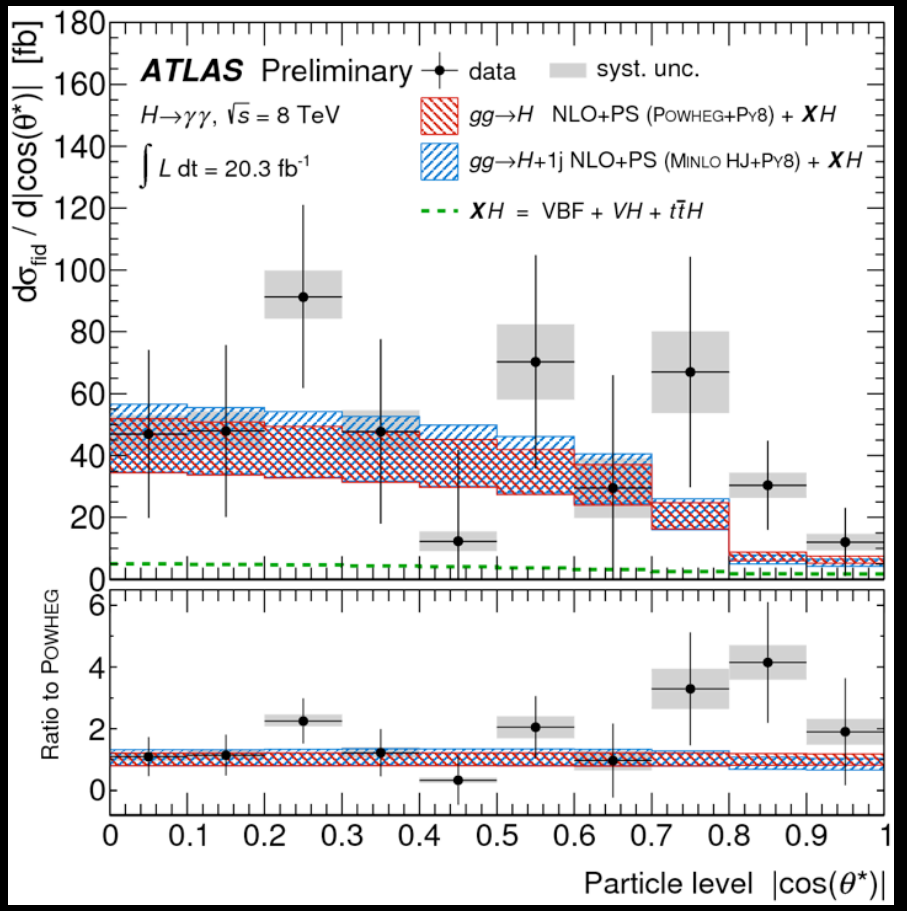


Recent Higgs boson measurements in ATLAS

H→ γγ differential cross sections fully corrected to fiducial acceptance

ATLAS-CONF-2013-072





Preparing for Run II

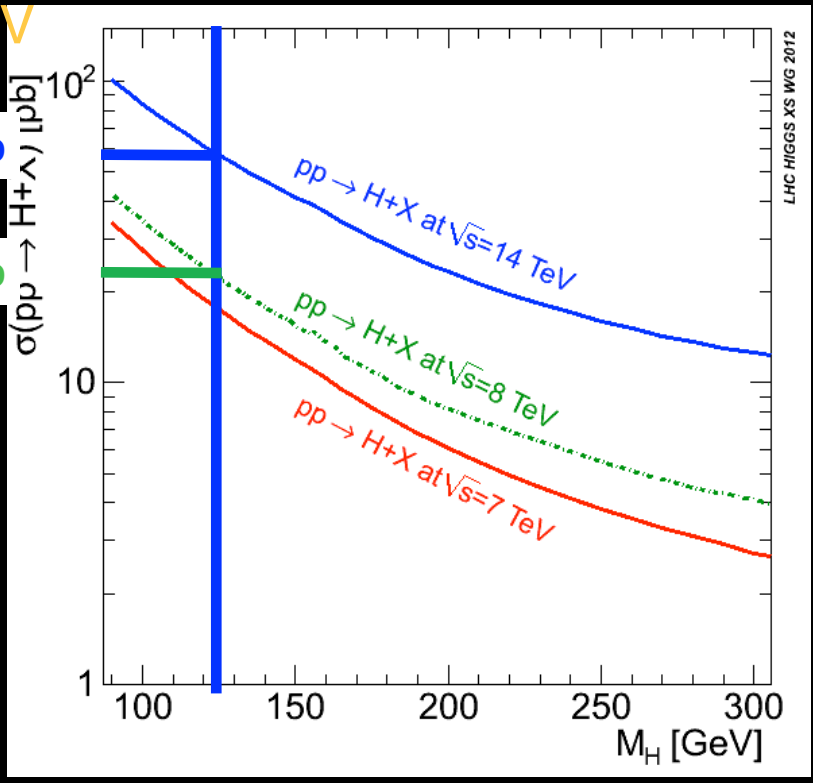
The Higgs boson at the end of Run II (100 evts/fb)

H production cross-section √s=8 TeV & 14 TeV

xs [pb]	8 TeV	14 TeV	Ratio
gluon-gluon	20	50	2.5
ttH	0.13	0.6	~4
HW+HZ	1.1	2.4	~2
VBF	1.6	4.2	2.5

50 pb

20 pb



Four times more integrated luminosity

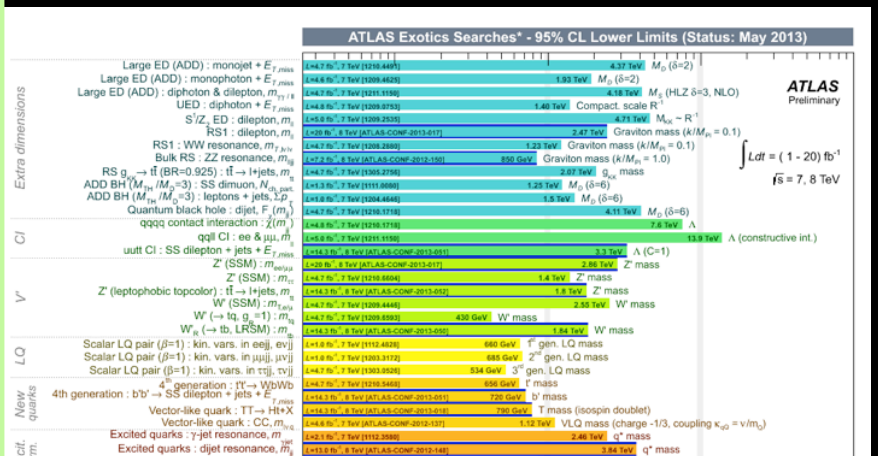
→ ~4000 γγ, ~100 ZZ, ~10 ttbar-H events

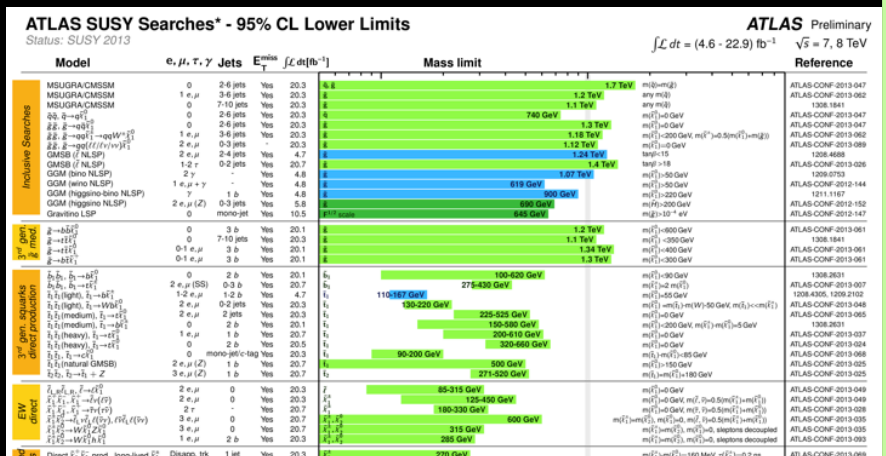
Up to twice more pile-up

Precision on m_H: ~ 300 MeV (today ~800 MeV)

Coupling measurements

Beyond the SM ?



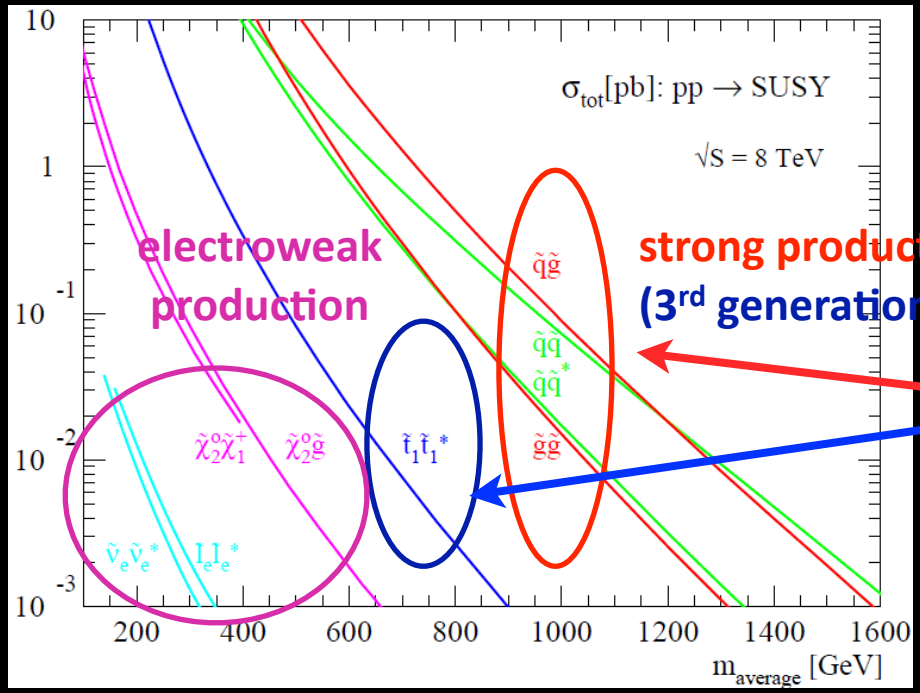


SUSY	J.A. Benitez Garcia	Searches for supersymmetry in resonance production, R-parity violating signatures and events with long-lived particles with the ATLAS detector
	D. Guest	Searches for direct pair production of third generation squarks with the ATLAS ….
	L. Morvaj	Inclusive searches for squarks and gluinos with the ATLAS detector
	A. Tudorache	Searches for gluino-mediated production of third generation squarks…..
	S. Williams	Searches for electroweak production of supersymmetric neutralinos, charginos and sleptons…..
Exotics	O.C. Endner	Searches for heavy resonances with the ATLAS detector
	S.P. McKee	Searches for dark matter and extra dimensions with the ATLAS detector
	T. Varol	Searches for new phenomea in events with multiple leptons with the ATLAS
	T. Heck	Searches for vector-like quarks and ttbar resonances with the ATLAS detector

Searches for SUSY

24 results with 20fb^{-1}

Gluino and 1st/2nd generation squarks	6 CONF - 1 paper
3rd generation (top & bottom) squarks	6 CONF - 1 paper
Electroweak SUSY (charginos, neutralinos, sleptons)	5 CONF
R-parity Violating scenarios & long-lived particles	5 CONF - 2 papers



Searches in scenarios motivated by naturalness

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: SUSY 2013

ATLAS Preliminary

$\int \mathcal{L}\, dt$ = (4.6 - 22.9) fb^{-1} $\sqrt{s}$ = 7, 8 TeV

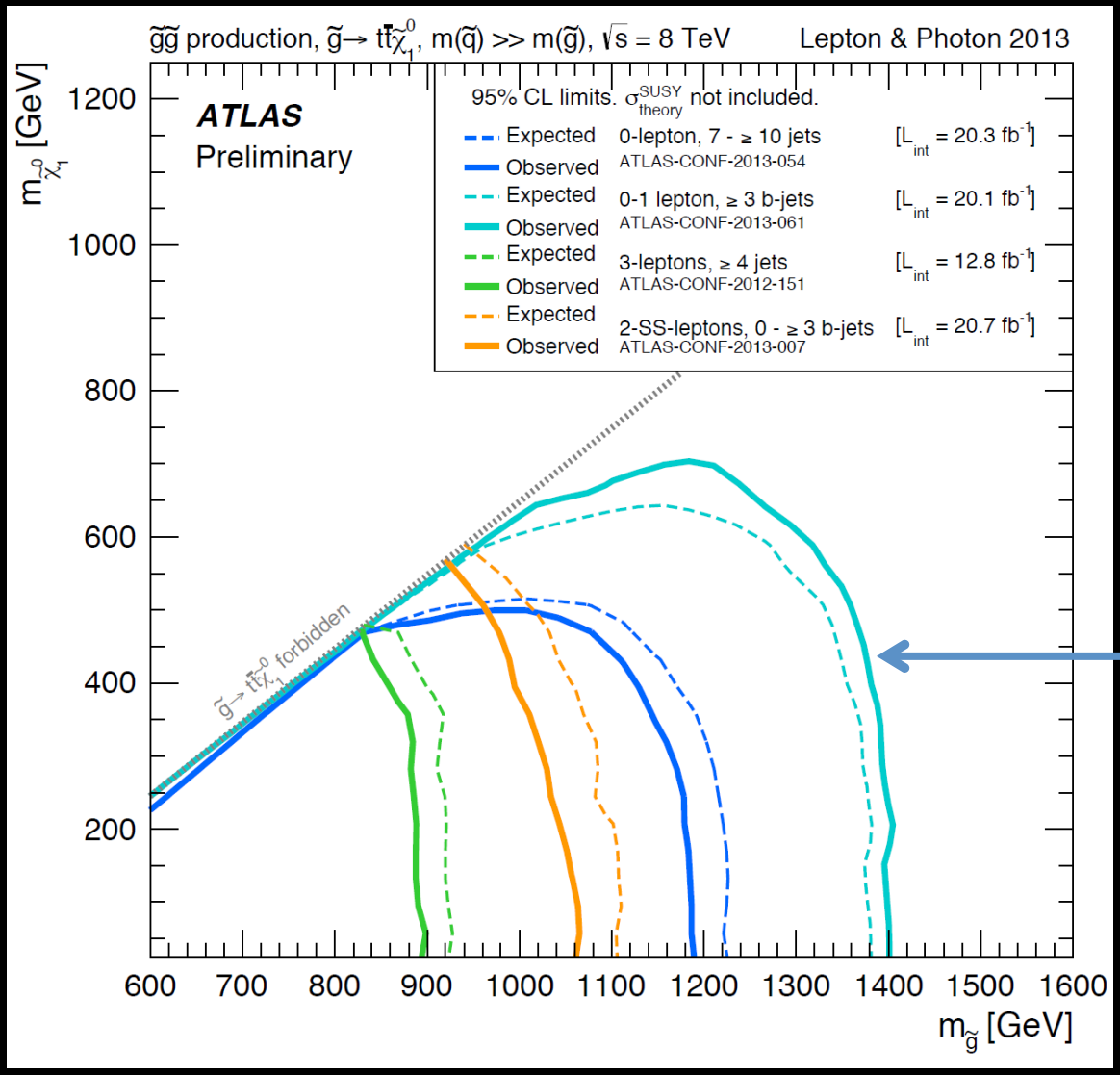
	Model	e, μ, τ, γ	Jets	E_T^{miss}	$\int \mathcal{L}\, dt$[fb^{-1}]	Mass limit	Reference
Inclusive Searches	MSUGRA/CMSSM	0	2-6 jets	Yes	20.3	q, g 1.7 TeV	ATLAS-CONF-2013-047
	MSUGRA/CMSSM	1 e, μ	3-6 jets	Yes	20.3	$\tilde{g}$ 1.2 eV	ATLAS-CONF-2013-062
	MSUGRA/CMSSM	0	7-10 jets	Yes	20.3	$\tilde{g}$ 1.1 T	1308.1841
	$\tilde{q}\tilde{q}, \tilde{q}\to q\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{q}$ 740 GeV	ATLAS-CONF-2013-047
	$\tilde{g}\tilde{g}, \tilde{g}\to q\bar{q}\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{g}$ 1 TeV	ATLAS-CONF-2013-047
	$\tilde{g}\tilde{g}, \tilde{g}\to qq\tilde{\chi}_1^\pm\to qqW^*\tilde{\chi}_1^0$	1 e, μ	3-6 jets	Yes	20.3	$\tilde{g}$ 1.18 eV	ATLAS-CONF-2013-062
	$\tilde{g}\tilde{g}, \tilde{g}\to qq(\ell\ell/\ell\nu_\ell/\nu\nu)\tilde{\chi}_1^0$	2 e, μ	0-3 jets	-	20.3	$\tilde{g}$ 1.12 T	ATLAS-CONF-2013-089
	GMSB ($\tilde{l}$ NLSP)	2 e, μ	2-4 jets	Yes	4.7	$\tilde{g}$ 1.2 TeV	1208.4688
	GMSB ($\tilde{\tau}$ NLSP)	1-2 τ	0-2 jets	Yes	20.7	$\tilde{g}$ .4 TeV	ATLAS-CONF-2013-026
	GGM (bino NLSP)	2 γ	-	Yes	4.8	$\tilde{g}$ 1.07 Te	1209.0753
	GGM (wino NLSP)	1 e, μ + γ	-	Yes	4.8	$\tilde{g}$ 619 GeV	ATLAS-CONF-2012-144
	GGM (higgsino-bino NLSP)	γ	1 b	Yes	4.8	$\tilde{g}$ 900 GeV	1211.1167
	GGM (higgsino NLSP)	2 e, μ (Z)	0-3 jets	Yes	5.8	$\tilde{g}$ 690 GeV	ATLAS-CONF-2012-152
	Gravitino LSP	0	mono-jet	Yes	10.5	$F^{1/2}$ scale 645 GeV	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 eV	ATLAS-CONF-2013-061
	$\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$	0	7-10 jets	Yes	20.3	$\tilde{g}$ 1.1 Te	1308.1841
	$\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$	0-1 e, μ	3 b	Yes	20.1	$\tilde{g}$ 1. TeV	ATLAS-CONF-2013-061
	$\tilde{g}\to b\bar{t}\tilde{\chi}_1^+$	0-1 e, μ	3 b	Yes	20.1	$\tilde{g}$ 1 TeV	ATLAS-CONF-2013-061
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	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	20.7	$\tilde{b}_1$ 275-430 GeV	ATLAS-CONF-2013-007
	$\tilde{t}_1\tilde{t}_1$(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	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	$\tilde{t}_1$ 130-220 GeV	ATLAS-CONF-2013-048
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\to t\tilde{\chi}_1^0$	2 e, μ	2 jets	Yes	20.3	$\tilde{t}_1$ 225-525 GeV	ATLAS-CONF-2013-065
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\to b\tilde{\chi}_1^\pm$	0	2 b	Yes	20.1	$\tilde{t}_1$ 150-580 GeV	1308.2631
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\to t\tilde{\chi}_1^0$	1 e, μ	1 b	Yes	20.7	$\tilde{t}_1$ 200-610 GeV	ATLAS-CONF-2013-037
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\to t\tilde{\chi}_1^0$	0	2 b	Yes	20.5	$\tilde{t}_1$ 320-660 GeV	ATLAS-CONF-2013-024
	$\tilde{t}_1\tilde{t}_1$, $\tilde{t}_1\to c\tilde{\chi}_1^0$	0	mono-jet/c-tag	Yes	20.3	$\tilde{t}_1$ 90-200 GeV	ATLAS-CONF-2013-068
	$\tilde{t}_1\tilde{t}_1$(natural GMSB)	2 e, μ (Z)	1 b	Yes	20.7	$\tilde{t}_1$ 500 GeV	ATLAS-CONF-2013-025
	$\tilde{t}_2\tilde{t}_2, \tilde{t}_2\to\tilde{t}_1+Z$	3 e, μ (Z)	1 b	Yes	20.7	$\tilde{t}_2$ 271-520 GeV	ATLAS-CONF-2013-025
EW direct	$\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}, \tilde{\ell}\to\ell\tilde{\chi}_1^0$	2 e, μ	0	Yes	20.3	$\tilde{l}$ 85-315 GeV	ATLAS-CONF-2013-049
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to\tilde{l}\nu(l\tilde{\nu})$	2 e, μ	0	Yes	20.3	$\tilde{\chi}_1^\pm$ 125-450 GeV	ATLAS-CONF-2013-049
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to\tilde{\tau}\nu(\tau\tilde{\nu})$	2 τ	-	Yes	20.7	$\tilde{\chi}_1^\pm$ 180-330 GeV	ATLAS-CONF-2013-028
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to\tilde{l}_L\nu\tilde{l}_L l(\tilde{\nu}\tilde{\nu}), l\tilde{\nu}\tilde{l}_L l(\tilde{\nu}\tilde{\nu})$	3 e, μ	0	Yes	20.7	$\tilde{\chi}_1^\pm,\tilde{\chi}_2^0$ 600 GeV	ATLAS-CONF-2013-035
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to W\tilde{\chi}_1^0 Z\tilde{\chi}_1^0$	3 e, μ	0	Yes	20.7	$\tilde{\chi}_1^\pm,\tilde{\chi}_2^0$ 315 GeV	ATLAS-CONF-2013-035
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to W\tilde{\chi}_1^0 h\tilde{\chi}_1^0$	1 e, μ	2 b	Yes	20.3	$\tilde{\chi}_1^\pm,\tilde{\chi}_2^0$ 285 GeV	ATLAS-CONF-2013-093
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	ATLAS-CONF-2013-069
	Stable, stopped $\tilde{g}$ R-hadron	0	1-5 jets	Yes	22.9	$\tilde{g}$ 832 GeV	ATLAS-CONF-2013-057
	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	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	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	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	1212.1272
	LFV $pp\to\tilde{\nu}_\tau+X, \tilde{\nu}_\tau\to e(\mu)+\tau$	1 e, μ + τ	-	-	4.6	$\tilde{\nu}_\tau$ 1.1 Te	1212.1272
	Bilinear RPV CMSSM	1 e, μ	7 jets	Yes	4.7	$q, \tilde{g}$ 1.2 eV	ATLAS-CONF-2012-140
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to W\tilde{\chi}_1^0, \tilde{\chi}_1^0\to ee\tilde{\nu}_\mu, e\mu\tilde{\nu}_e$	4 e, μ	-	Yes	20.7	$\tilde{\chi}_1^\pm$ 760 GeV	ATLAS-CONF-2013-036
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to W\tilde{\chi}_1^0, \tilde{\chi}_1^0\to\tau\tau\tilde{\nu}_e, e\tau\tilde{\nu}_\tau$	3 e, μ + τ	-	Yes	20.7	$\tilde{\chi}_1^\pm$ 350 GeV	ATLAS-CONF-2013-036
	$\tilde{g}\to qqq$	0	6-7 jets	-	20.3	$\tilde{g}$ 916 GeV	ATLAS-CONF-2013-091
	$\tilde{g}\to\tilde{t}_1 t, \tilde{t}_1\to bs$	2 e, μ (SS)	0-3 b	Yes	20.7	$\tilde{g}$ 880 GeV	ATLAS-CONF-2013-007
Other	Scalar gluon pair, sgluon→$q\bar{q}$	0	4 jets	-	4.6	sgluon 100-287 GeV	1210.4826
	Scalar gluon pair, sgluon→$t\bar{t}$	2 e, μ (SS)	1 b	Yes	14.3	sgluon 800 GeV	ATLAS-CONF-2013-051
	WIMP interaction (D5, Dirac χ)	0	mono-jet	Yes	10.5	M* scale 704 GeV	ATLAS-CONF-2012-147

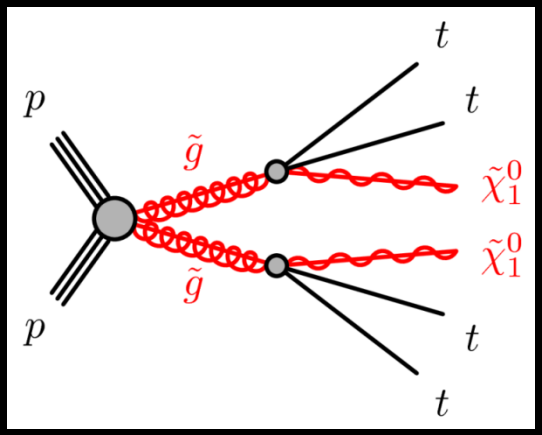
$\sqrt{s}$ = 7 TeV full data | $\sqrt{s}$ = 8 TeV partial data | $\sqrt{s}$ = 8 TeV full data

10^{-1} 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.

Gluino-mediated stop→top χ^0_1





ATLAS-CONF-2013-061

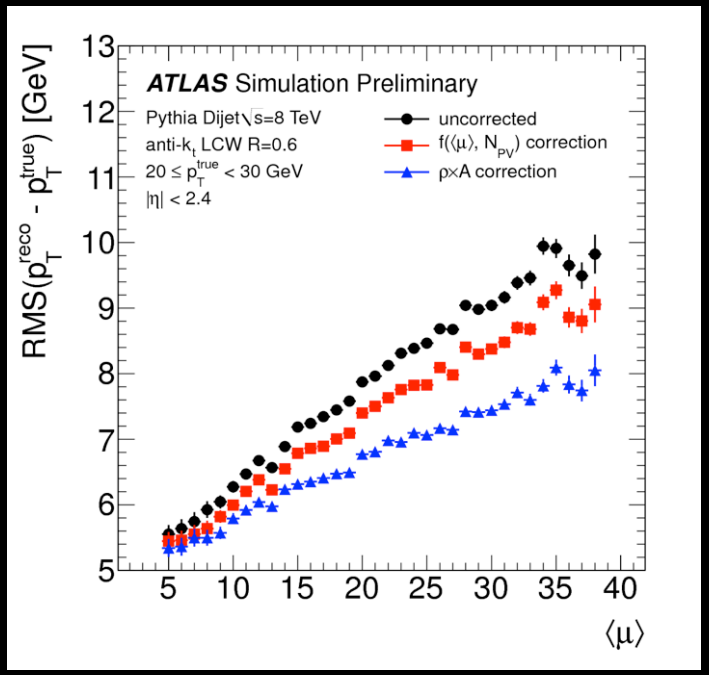
Further increased sensitivity from **channel:** 3b + 1L + E_T^{miss}

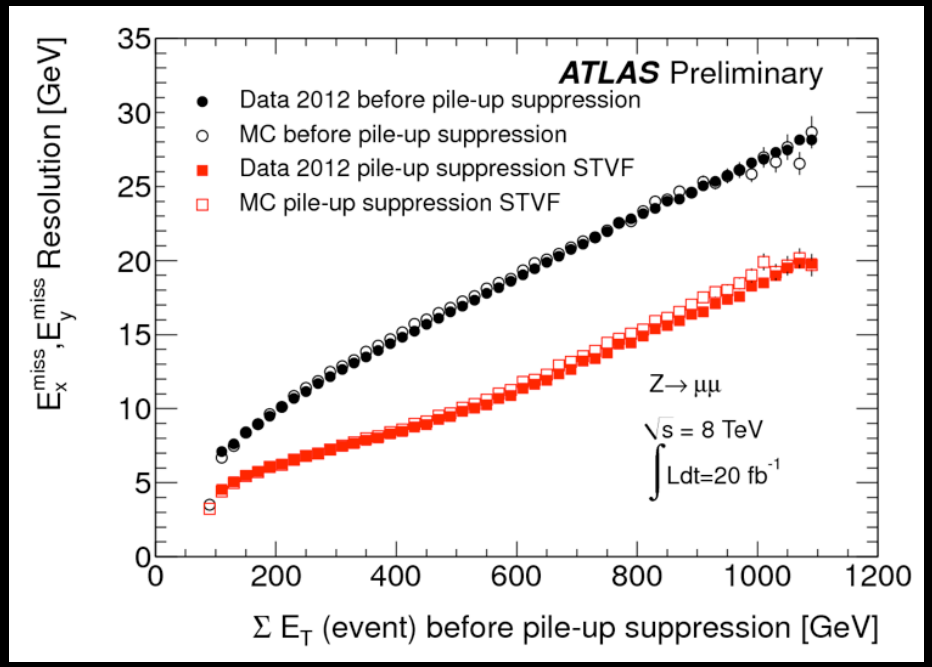
Excluding

m_{gluino} < ~1.4 TeV for

$m_{\chi^0_1}$ < ~400 GeV

Combined performance: Jets Energy & E_T^{miss}





Pile-up treatment

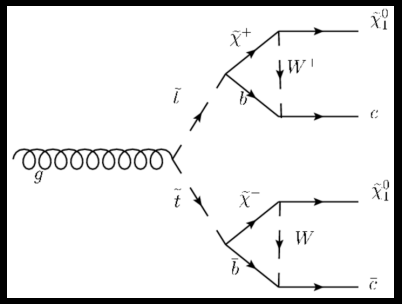
Measuring ambiant energy in the events

jet energy and E_T^{miss} resolutions improved

ATLAS-CONF-2013-012

ATLAS-CONF-2013-082

Direct stop searches

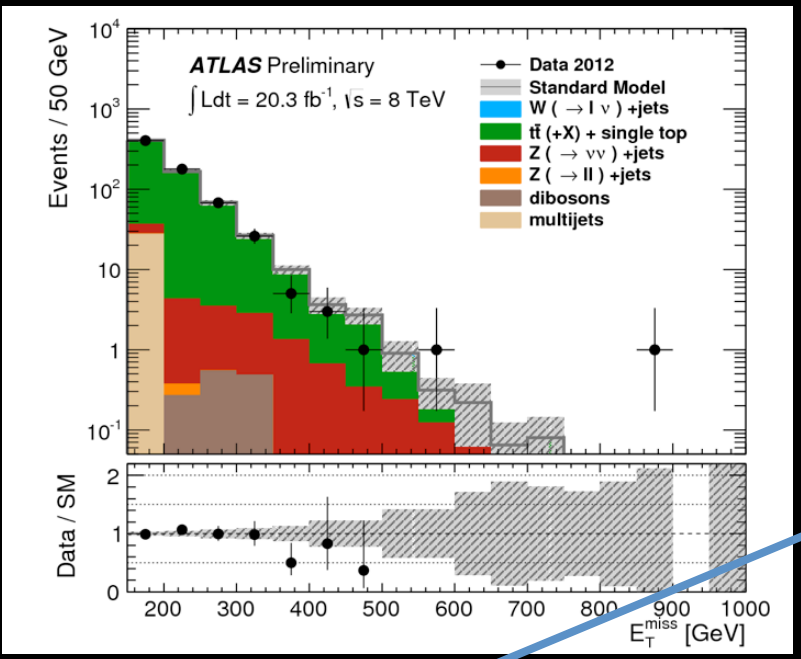


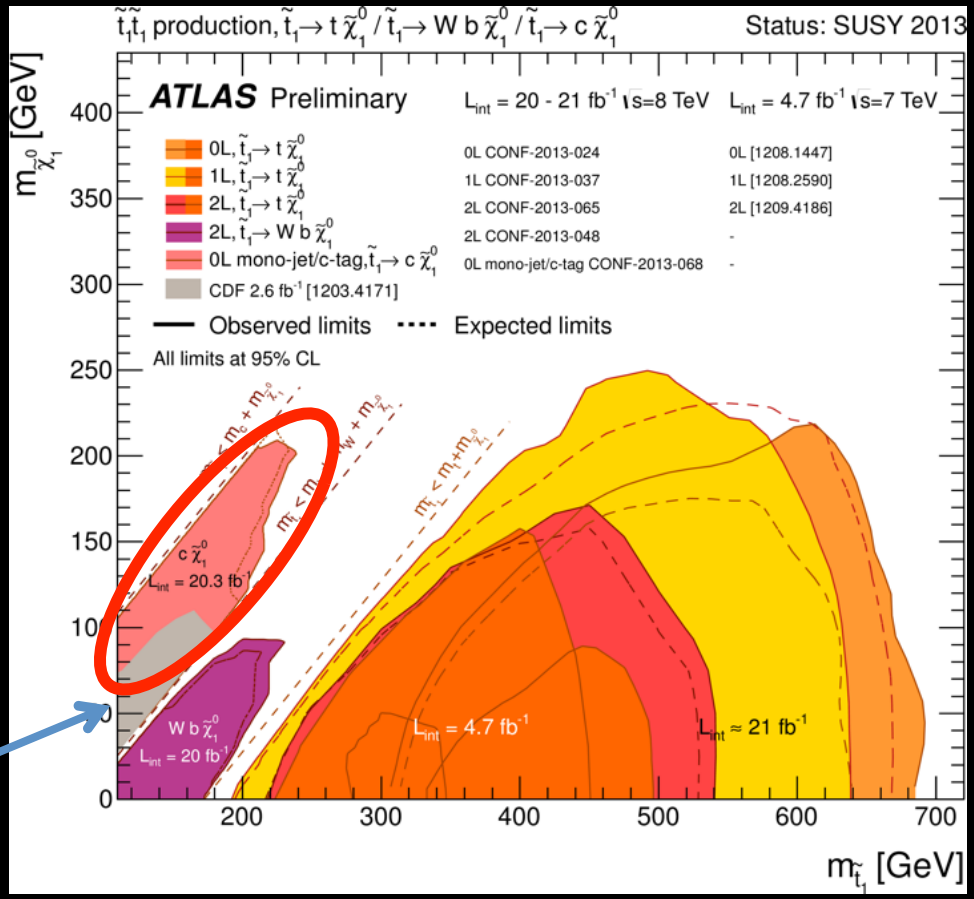
Excludes in several scenarios
m_{stop} < ~600 GeV for
$m_{\chi^0_1}$ < ~250 GeV

Region at low Δm:
charm tagging brings improved sensitivity

E_T^{miss} > 410 GeV
$N_{jets} \geq 1$ p_T^{jet} > 270 GeV - lepton veto
$N_{jets} \geq 3$ p_T^{jet} > 30 GeV
b-veto for 2nd & 3rd jet
c-tag for 4th jet

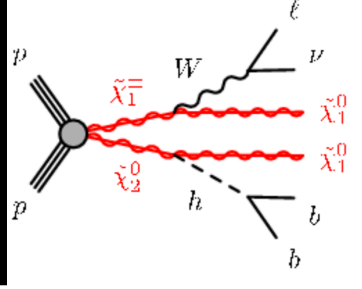
ATLAS-CONF-2013-068

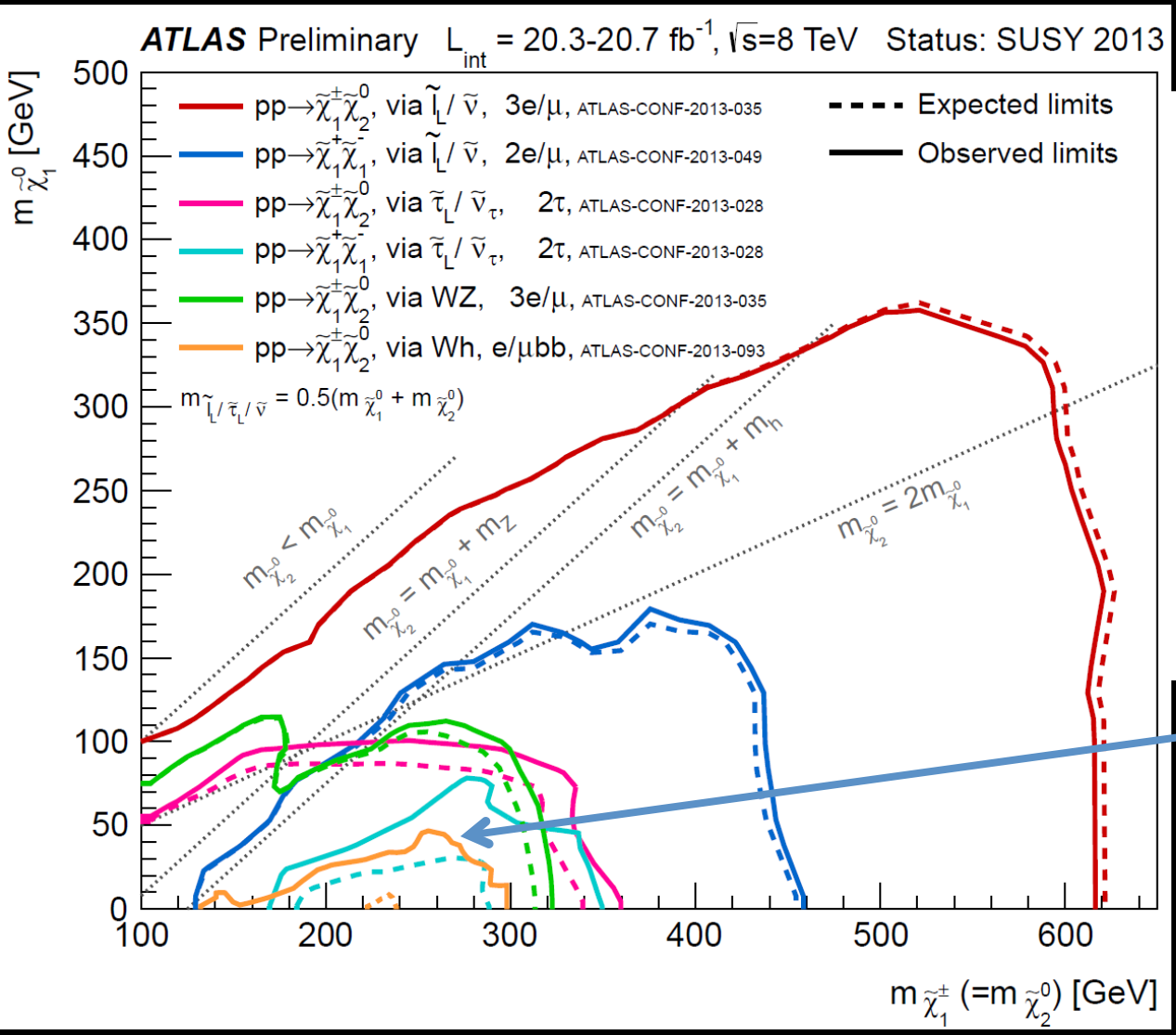


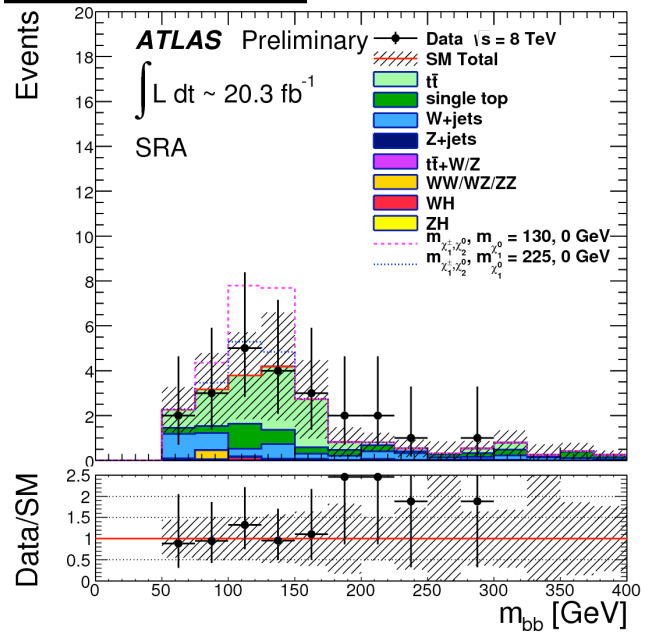


new channel: charm-tagging & mono-jet sensitive to $\tilde{t} \rightarrow c\,\tilde{\chi}_1^0$

Chargino & neutralino searches







new channel: h(bb) + 1L + E_T^{miss}

sensitive to $\chi^{\pm}_1\chi^0_2 \rightarrow W^{\pm} h \chi^0_1\chi^0_1$

ATLAS-CONF-2013-093

SM Higgs in decay chain: first time at LHC

Sensitivity to chargino & neutralino decay to sleptons, W, Z and Higgs bosons

Search for exotics phenomena (not SUSY)

https://twiki.cern.ch/twiki/bin/view/AtlasPublic/ExoticsPublicResults

Five papers with √s=8 TeV data (2012)

Title	Journal	Papers and Plots	Int. luminosity	Date
Search for quantum black-hole production in high-invariant-mass lepton+jet final states using proton-proton collisions at √s = 8 TeV and the ATLAS detector	Submitted to PRL	Plots and more Info; arXiv:1311.2006	20.3/fb	Novembe 2013
Search for dark matter in events with a hadronically decaying W or Z boson and missing transverse momentum in pp collisions at √s =8 TeV with the ATLAS detector	Submitted to PRL	Plots and more Info; arXiv:1309.4017	20.3/fb	Septemb 2013
Search for new phenomena in photon+jet events collected in proton--proton collisions at √s = 8 TeV with the ATLAS detector	Submitted to PLB	Plots and more Info; arXiv:1309.3230	20.3/fb	Septemb 2013
Search for microscopic black holes in a like-sign dimuon final state using large track multiplicity with the ATLAS detector	Published in PRD	Plots and more Info; arXiv:1308.4075; PRD 88, 072001 (2013)	20.3/fb	August 2
Search for excited electrons and muons in √s = 8 TeV proton-proton collisions with the ATLAS detector	Published in NJP	Plots and more Info; arXiv:1308.1364; NJP 15 (2013) 093011	13/fb	August 2

20 CONFerence notes with ∫L.dt≃20 evts/fb at √s=8 TeV data (2012)

Title	Conference Note and Plots	Int. luminosity	Date
Search for a dijet resonance produced in association with a leptonically decaying W or Z boson with the ATLAS detector at sqrt(s) = 8 TeV	ATLAS-CONF-2013-074	20.3/fb	July 2013
Search for dark matter pair production in events with a hadronically decaying W or Z boson and missing transverse momentum in pp collision data at sqrt(s) = 8 TeV with the ATLAS detector	ATLAS-CONF-2013-073	20.3/fb	July 2013
Search for New Phenomena in Events with Three Charged Leptons at a Center-of-Mass Energy of 8 TeV with the ATLAS detector	ATLAS-CONF-2013-070	20.3/fb	July 2013
A search for high-mass ditau resonances decaying in the fully hadronic final state in pp collisions at √s=8 TeV with the ATLAS detector	ATLAS-CONF-2013-066	19.5/fb	July 2013
Search for pair production of heavy top-like quarks decaying to a high-pT W boson and a b quark in the lepton plus jets final state in pp collisions at sqrt(s) = 8 TeV with the ATLAS detector	ATLAS-CONF-2013-060	14.3/fb	June 2013
Search for New Phenomena in Photon+Jet Events Collected in proton-proton collisions at sqrt(s)=8 TeV with the ATLAS Detector	ATLAS-CONF-2013-059	20.3/fb	June 2013
Search for pair production of new heavy quarks that decay to a Z boson and a third generation quark in pp collisions at sqrt(s)=8 TeV with the ATLAS detector	ATLAS-CONF-2013-056	14.3/fb	June 2013
A search for tt resonances in lepton plus jets events with ATLAS using 14/fb of proton-proton collisions at sqrt(s) = 8 TeV	ATLAS-CONF-2013-052	14.3/fb	May 2013
Search for anomalous production of events with same-sign dileptons and b jets in 14.3/fb of pp collisions at sqrt(s) = 8 TeV with the ATLAS detector	ATLAS-CONF-2013-051	14.3/fb	May 2013
Search for W → tb in proton-proton collisions at a centre-of-mass energy of sqrt(s) = 8 TeV with the ATLAS detector	ATLAS-CONF-2013-050	14.3/fb	May 2013
Search for Type III Seesaw Model Heavy Fermions in Events with Four Charged Leptons using 5.8/fb of sqrt(s) = 8 TeV Data with the ATLAS Detector	ATLAS-CONF-2013-019	5.8/fb	March 2013
Search for heavy top-like quarks decaying to a Higgs boson and a top quark in the lepton plus jets final state in pp collisions at sqrt(s) = 8 TeV with the ATLAS detector	ATLAS-CONF-2013-018	14.3/fb	March 2013
Search for high-mass dilepton resonances in 20/fb of pp collisions at sqrt(s) = 8 TeV with the ATLAS experiment	ATLAS-CONF-2013-017	20/fb	March 2013
Search for resonant WZ -> lnu ll production using sqrt(s) = 8 TeV pp collisions with ATLAS	ATLAS-CONF-2013-015	13/fb	March 2013
Search for resonant ZZ production in the ZZ -> llqq channel with the ATLAS detector using 7.2/fb of sqrt(s) = 8 TeV pp collision data	ATLAS-CONF-2012-150	7.2/fb	November 2012
Search for New Phenomena in the Dijet Mass Distribution updated using 13/fb of pp Collisions at sqrt(s) = 8 TeV collected by the ATLAS Detector	ATLAS-CONF-2012-148	13/fb	November 2012
Search for New Phenomena in Monojet plus Missing Transverse Momentum Final States using 10/fb of pp Collisions at sqrt(s) = 8 TeV with the ATLAS detector at the LHC	ATLAS-CONF-2012-147	10.5/fb	November 2012
Search for excited electrons and muons with 13/fb of proton-proton collisions at sqrt(s) = 8 TeV with the ATLAS detector	ATLAS-CONF-2012-146	13/fb	November 2012
Search for high-mass dilepton resonances in 6.1/fb of pp collisions at sqrt(s) = 8 TeV	ATLAS-CONF-2012-129	6.1/fb	September 2012
Search for New Phenomena in the Dijet Mass Distribution using 5.8/fb of pp collisions at sqrt(s) = 8 TeV collected by the ATLAS Detector	ATLAS-CONF-2012-088	5.8/fb	July 2012

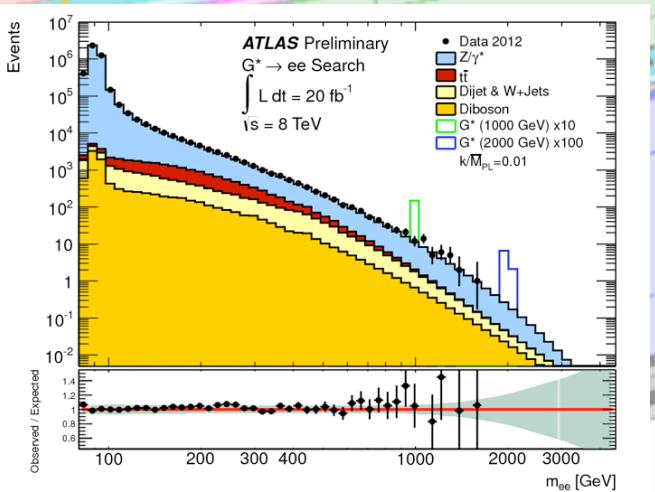
Very beautiful events detected, no signal Beyond the Standard Model

Text

ATLAS EXPERIMENT

Run Number: 206962
Event Number: 38652990
Date: 2012-07-14, 08:31:06 CET

m_{ee}=1.541 TeV



Search for new phenomena in multi-lepton events

ATLAS-CONF-2013-070

Multi-leptons: rare at hadron colliders

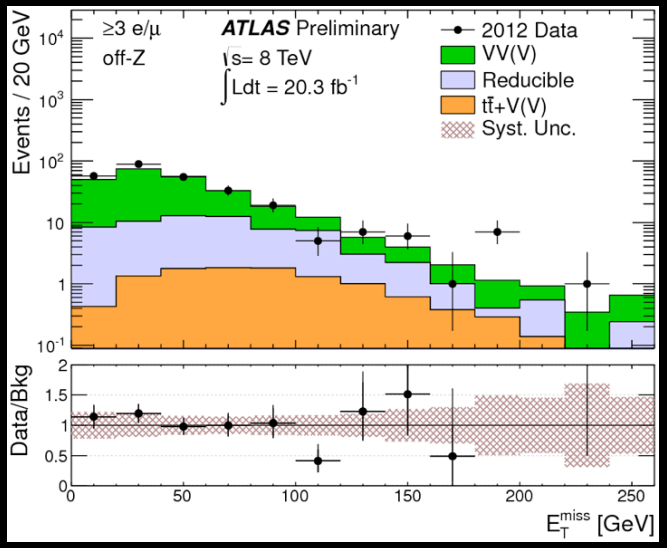
At least 3 leptons: (ee,μμ,eμ,μe) x (e,μ,τ)

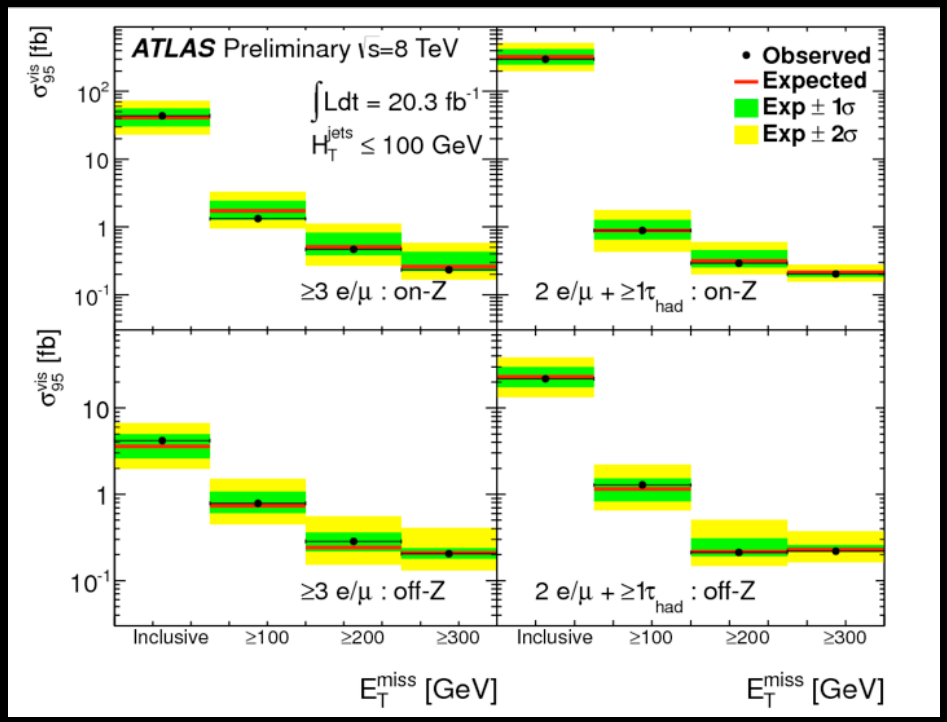
SM background ZZ,WZ, DY

No excess →

cross-section limits on 94 signal regions

Wide range of models tested





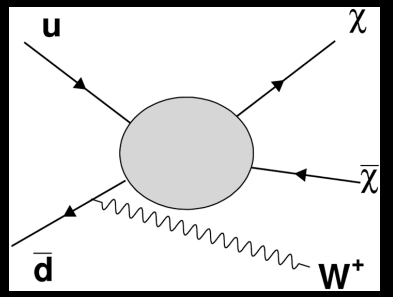
Dark Matter search

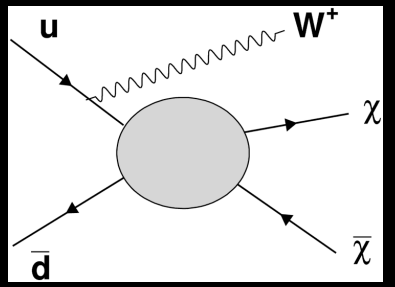
Search for Weak Interacting Massive Particle: pp→$\chi\chi$+X

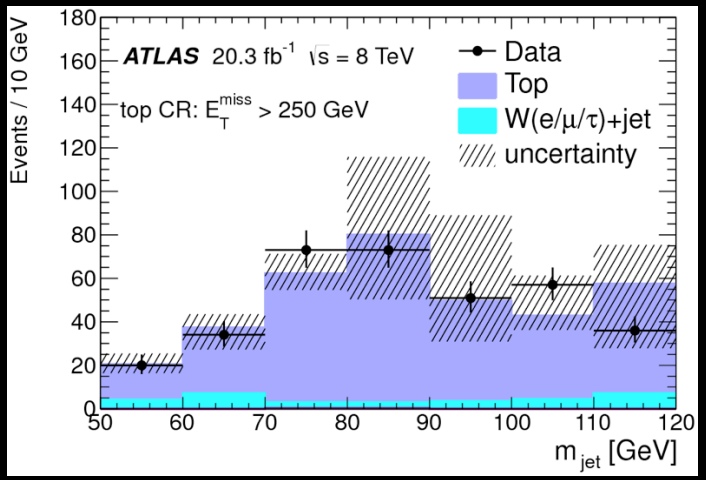
- Need to trigger on the events
- X being a jet, γ, W or Z produced in Initital State Radiation

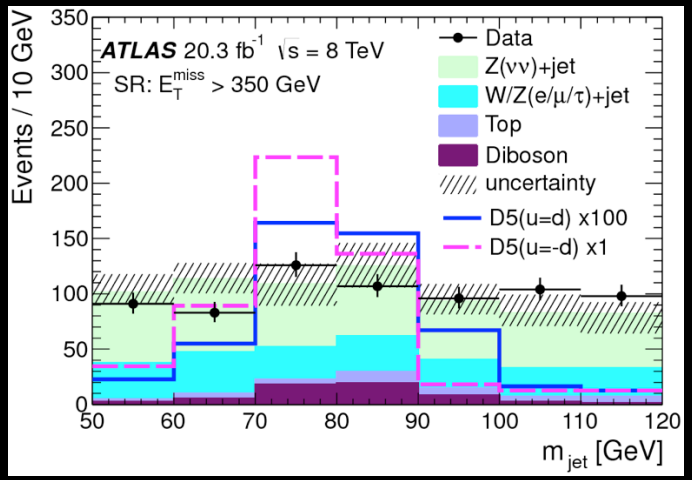
Recently ATLAS has presented a search for WIMPS where a W or Z decays to jets with 20.3 evts/fb at √s=8 TeV

- Larger rate than when W/Z → leptons
- Search for events with a large jet and E_T^{miss}
- Jet substructure techniques used to select hadronically decaying W/Z
- Dominant source of background is events with Z→νν







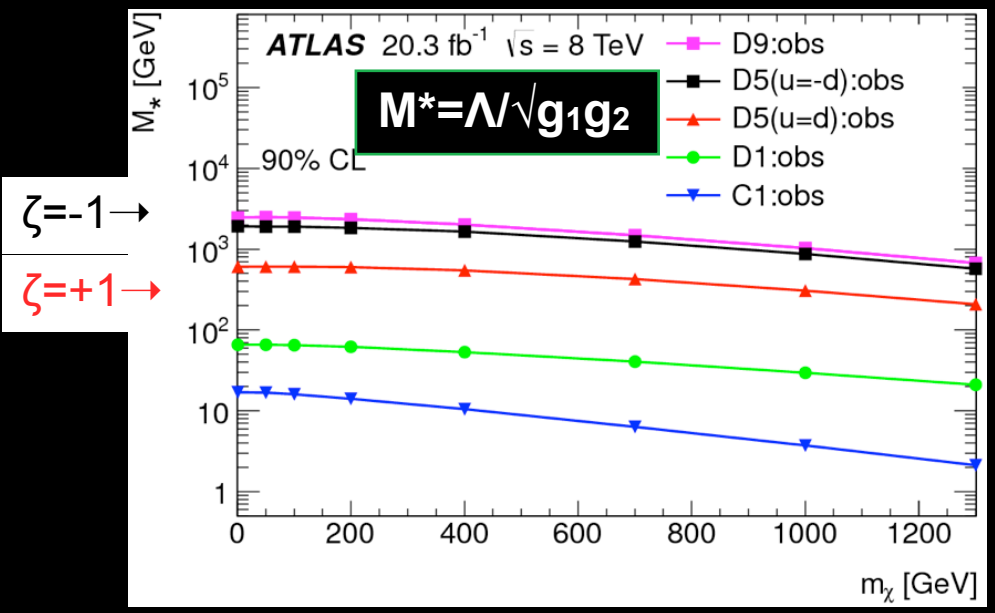


arXiv:1309.4017

Submitted to PRL

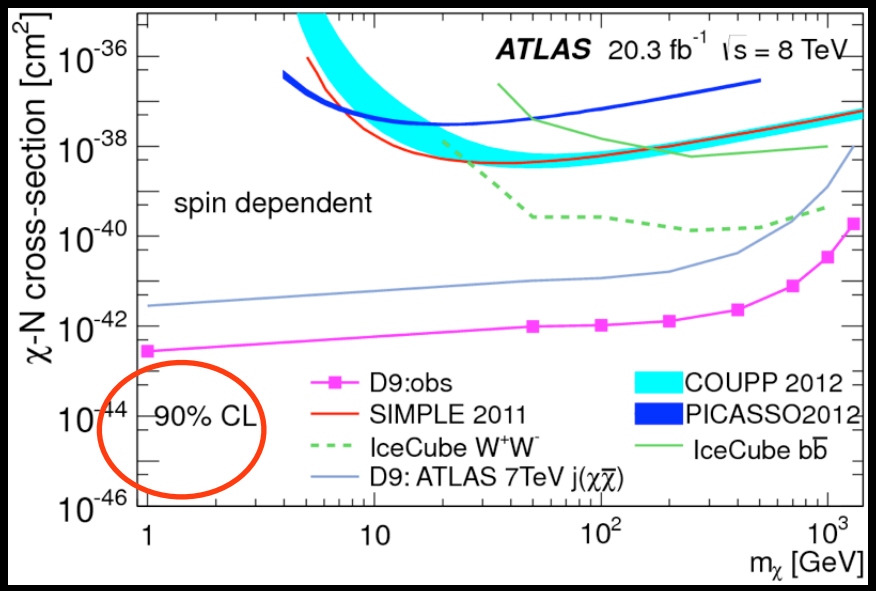
Dark Matter search: mono-W

ATLAS-CONF-2013-073



ζ=-1→

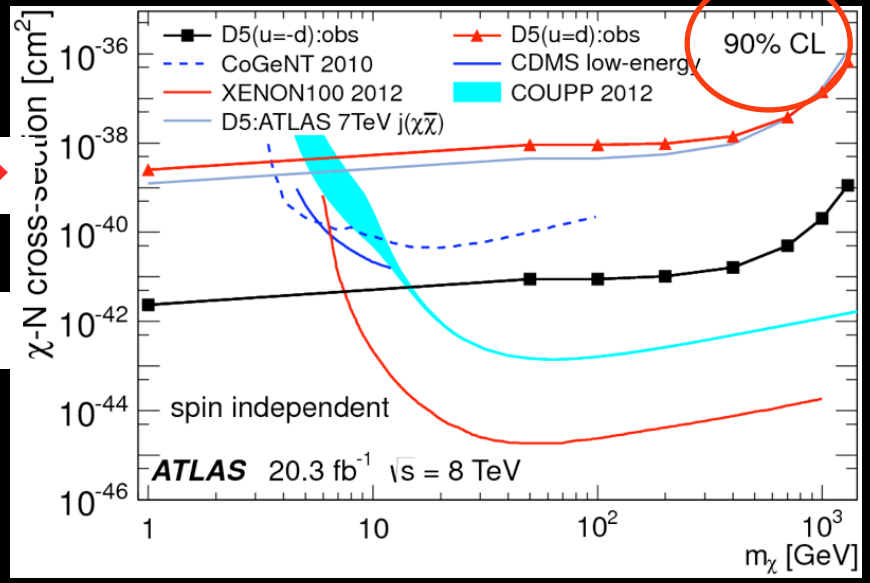
ζ=+1→

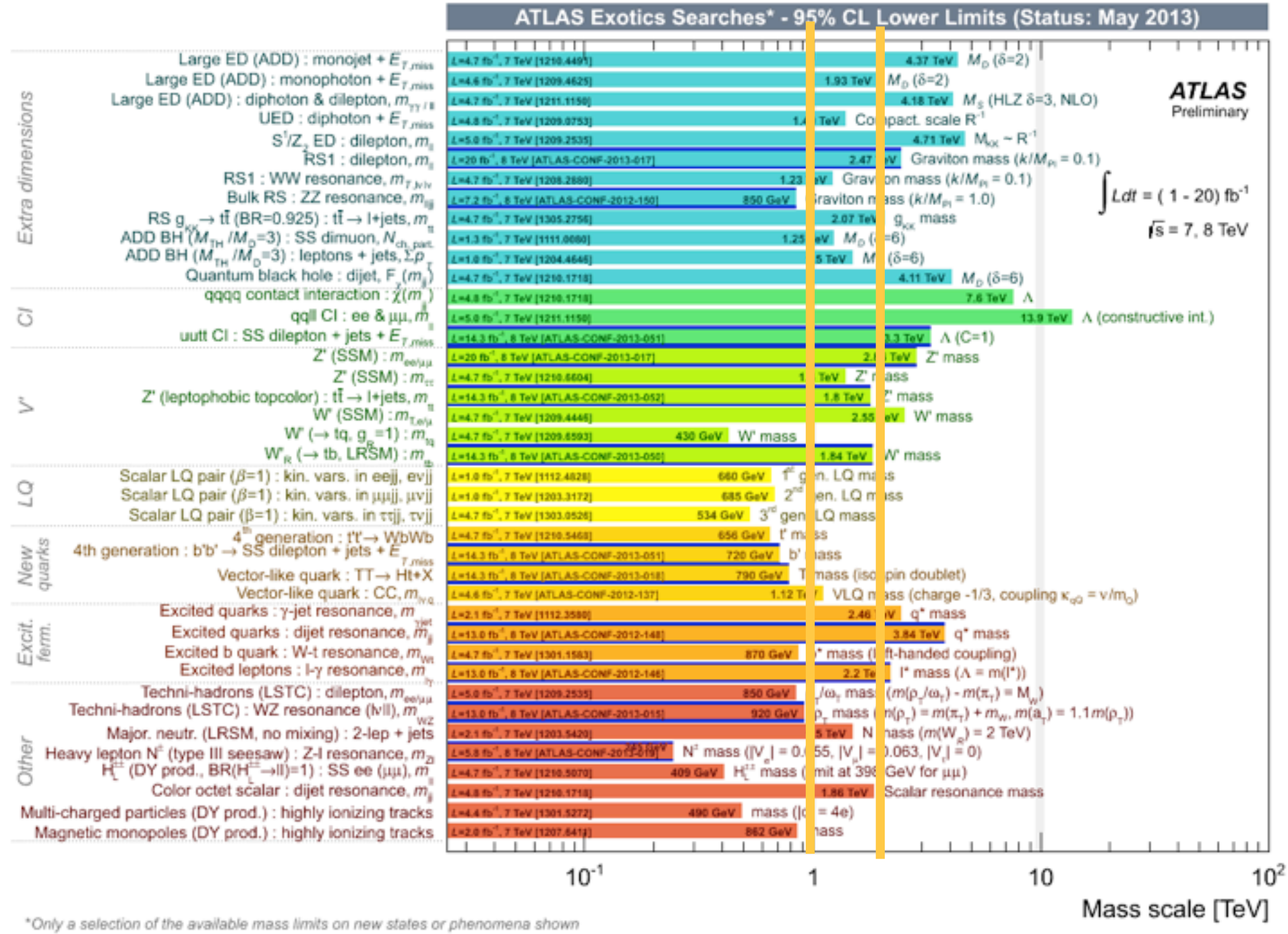


Name	Operator	Coefficient
D1	$\bar{\chi}\chi\bar{q}q$	m_q/M_*^3
D5	$\bar{\chi}\gamma^\mu\chi\bar{q}\gamma_\mu q$	$1/M_*^2$
D9	$\bar{\chi}\sigma^{\mu\nu}\chi\bar{q}\sigma_{\mu\nu}q$	$1/M_*^2$
C1	$\chi^\dagger\chi\bar{q}q$	m_q/M_*^2

ζ=+1→

ζ=-1→



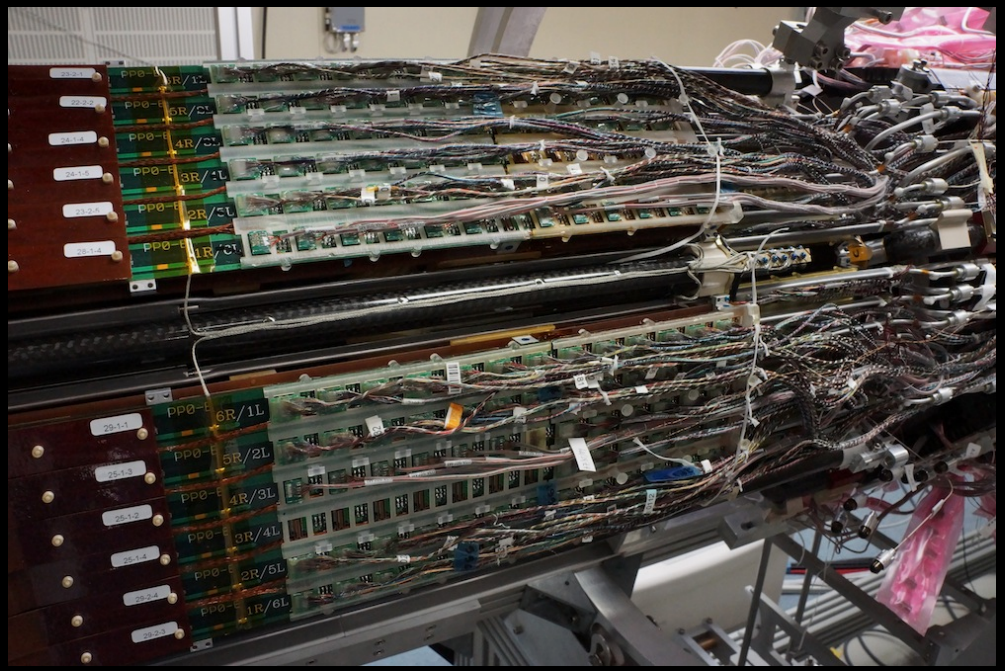


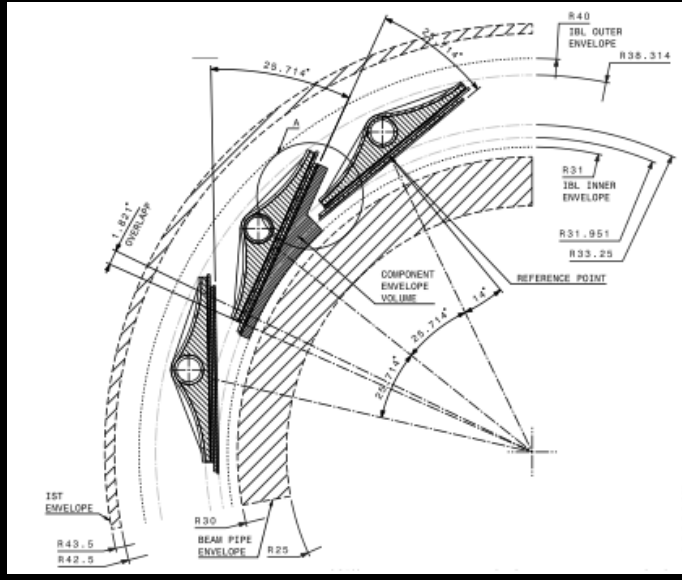
*Only a selection of the available mass limits on new states or phenomena shown

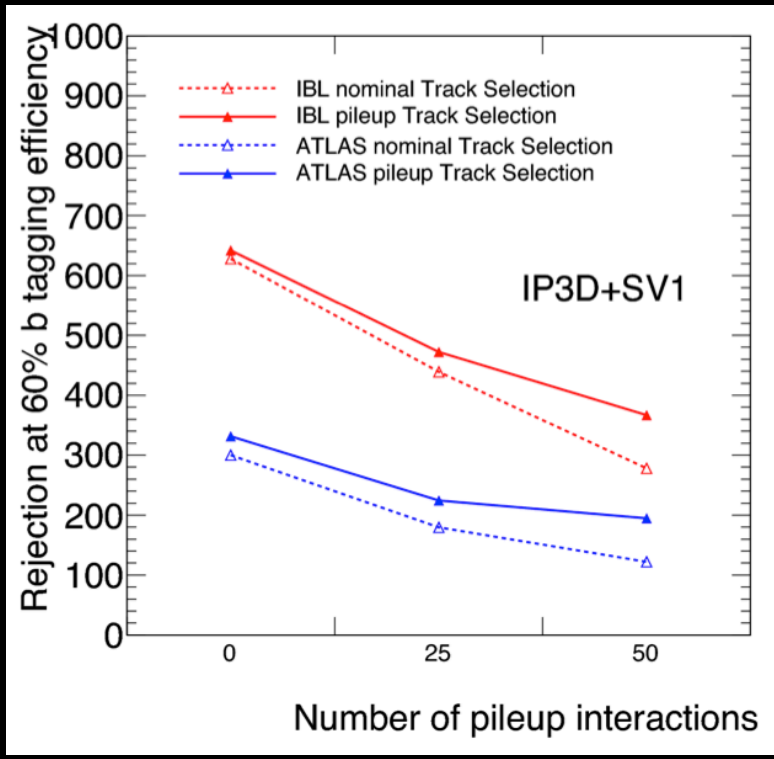
ATLAS is preparing Run II

Fourth layer for pixel detector:
improve light quark rejection to b-quark

Consolidation of ATLAS detector



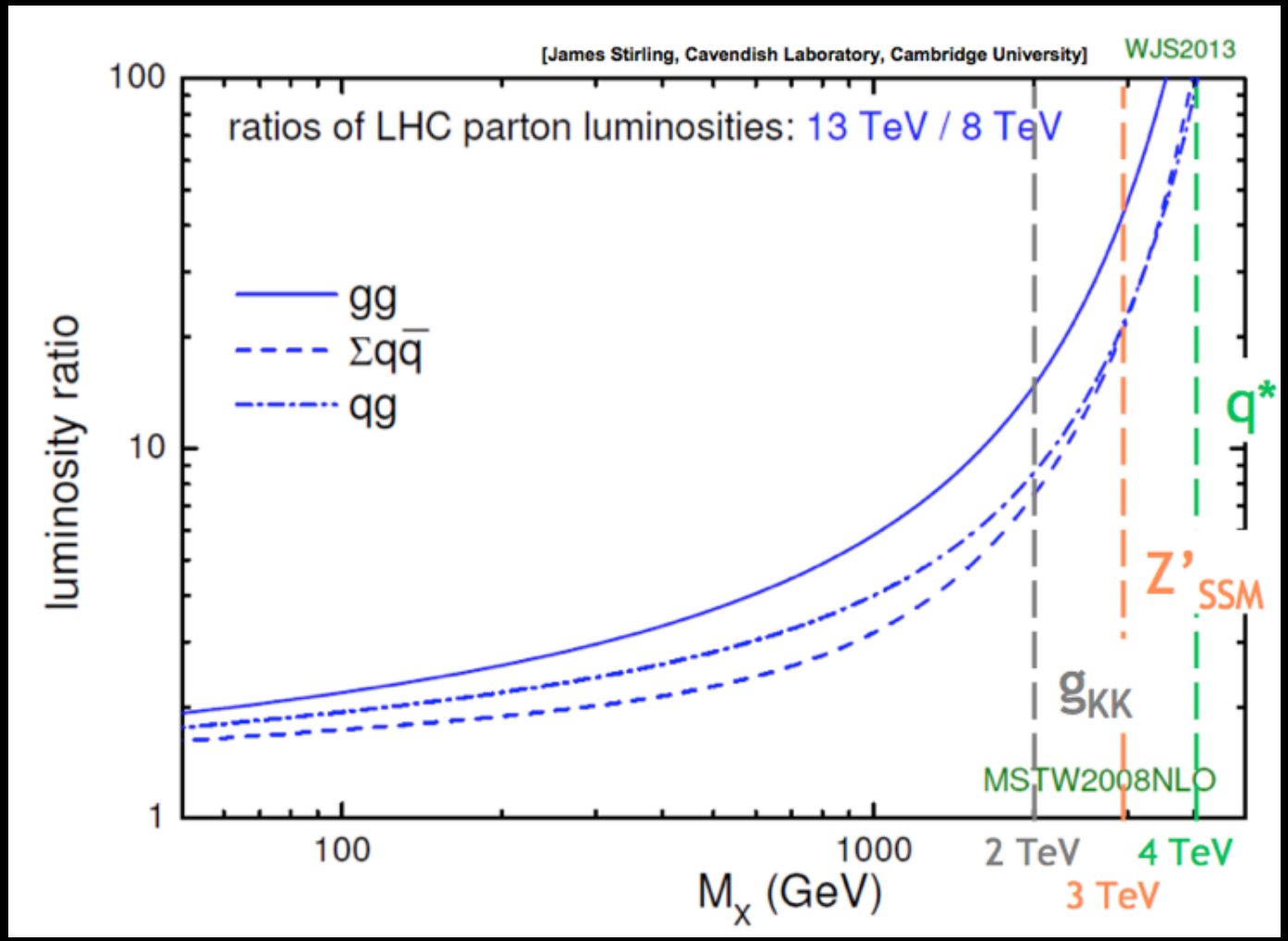




Preparing for beam energy increase from
$\sqrt{s}$=8 to $\sqrt{s}$ > 13 TeV

BSM at LHC Run II

Add the reference



Conclusions & outlook

The Large Hadron Collider of CERN has operated beautifully during these three fantastic years 2010-2012, producing $\int L.dt \sim 30$ evts/fb of proton-proton collisions at $\sqrt{s}$=7 & 8 TeV.

The ATLAS collaboration has collected $\int L.dt \sim 25$ evts/fb of pp data and published ~270 physics results.

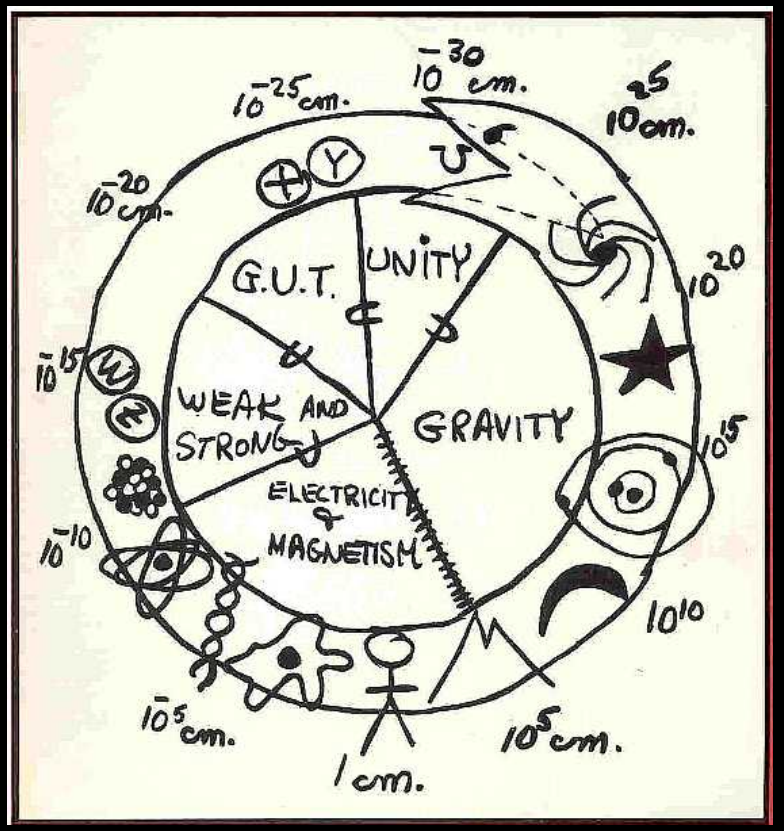
ATLAS (with CMS) has discovered a Higgs boson with $m_H \sim 125$ GeV and measured some of its parameters.

YET, NO PROCESS BEYOND the SM has been observed.

LHC will resume operation beginning of 2015 with $\sqrt{s}$>13 TeV.

ATLAS is ready to detect and discover any new phenomena.

Sheldon Lee Glashow

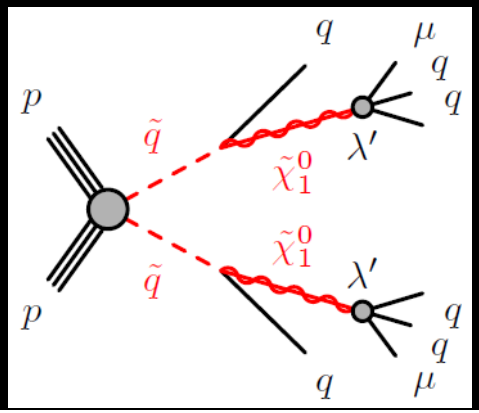


The serpent representing the interconnection between **particle physics** and **cosmology**

BACKUP

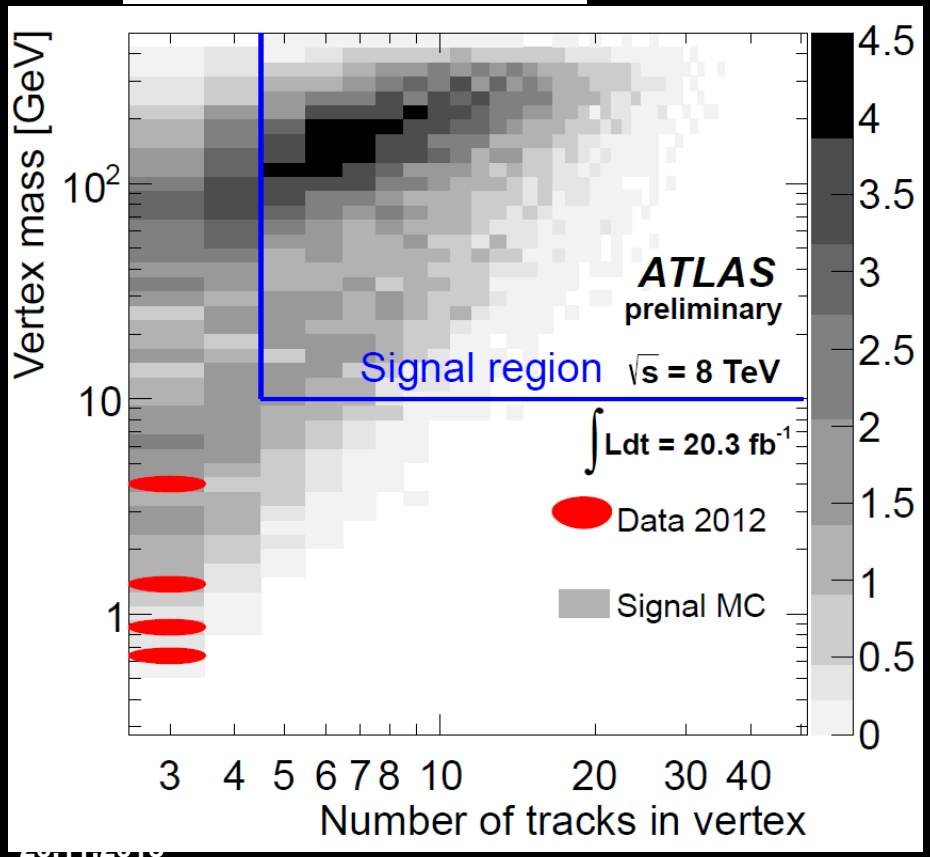
Most recent search for long lived particles

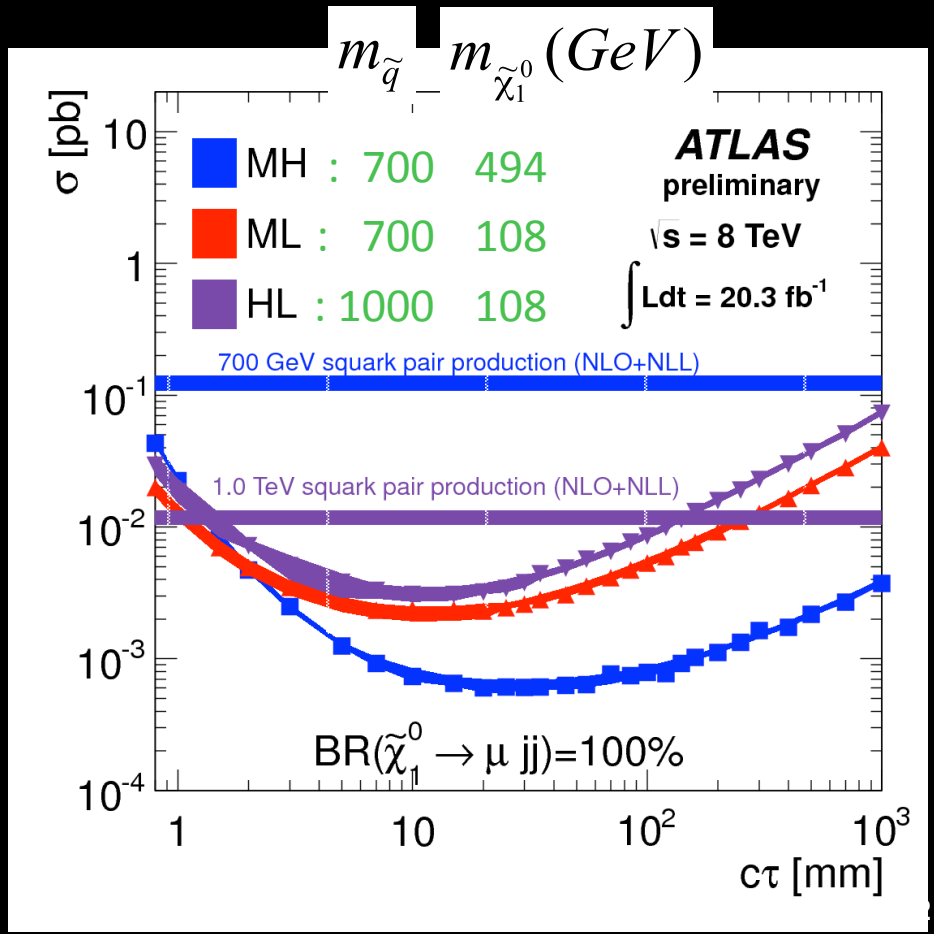
ATLAS-CONF-2013-092



signature: muon + displaced vertex

expected background: 0.02 ± 0.02 event
observed in data: 0 event





M. Cacciari, G.P. Salam & G. Soyez
MI.JHEP04(2008)063

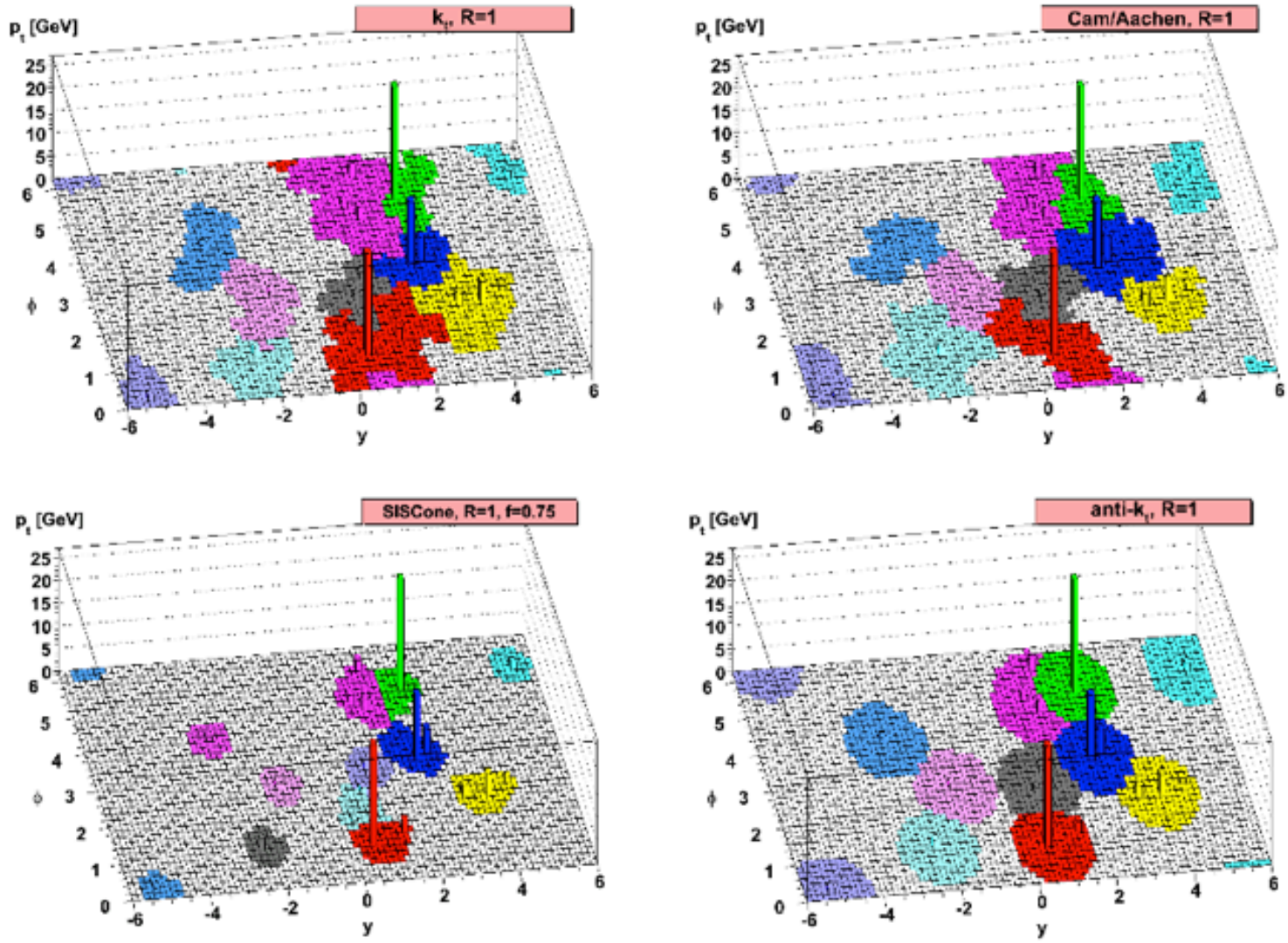
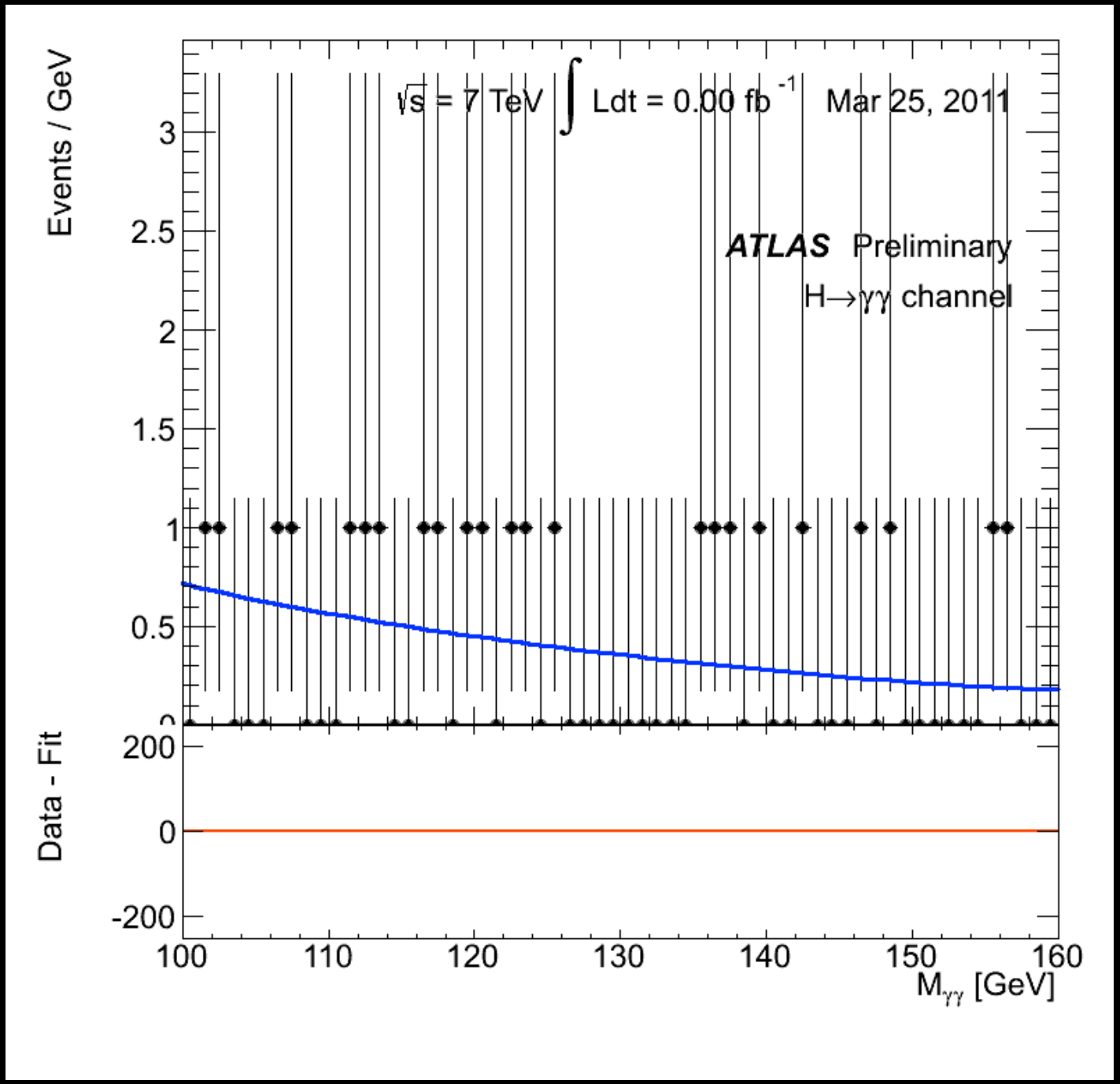


Figure 1: A sample parton-level event (generated with Herwig [8]), together with many random soft "ghosts", clustered with four different jets algorithms, illustrating the "active" catchment areas of the resulting hard jets. For k_t and Cam/Aachen the detailed shapes are in part determined by the specific set of ghosts used, and change when the ghosts are modified.


√s = 7 TeV ∫ Ldt = 0.00 fb -1 Mar 25, 2011
ATLAS Preliminary
H→γγ channel
Events / GeV
3
2.5
2
1.5
1
0.5
Data - Fit
200
0
-200
100
110
120
130
140
150
160
Mγγ [GeV]

Anti-k_T algorithm

M. Cacciari, G.P. Salam & G. Soyez
MI.JHEP04(2008)063

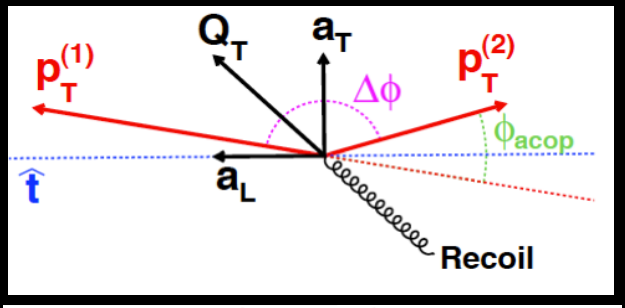
$$d_{ij} = \min(k_{ti}^{2p}, k_{tj}^{2p}) \frac{\Delta_{ij}^2}{R^2}\,, \tag{1.1a}$$

$$d_{iB} = k_{ti}^{2p}\,, \tag{1.1b}$$

where $\Delta_{ij}^2 = (y_i - y_j)^2 + (\phi_i - \phi_j)^2$ and k_{ti}, y_i and ϕ_i are respectively the transverse momentum, rapidity and azimuth of particle i. In addition to the usual radius parameter R, we have added a parameter p to govern the relative power of the energy versus geometrical (Δ_{ij}) scales.

Differential cross section vs ϕ_η^*

Phys. Lett. B 720 (2013) 32-51



Pioneered by the D0 collaboration at Tevatron
Phys. Rev. 106 (2011) 122001 arXiv:1010.0262

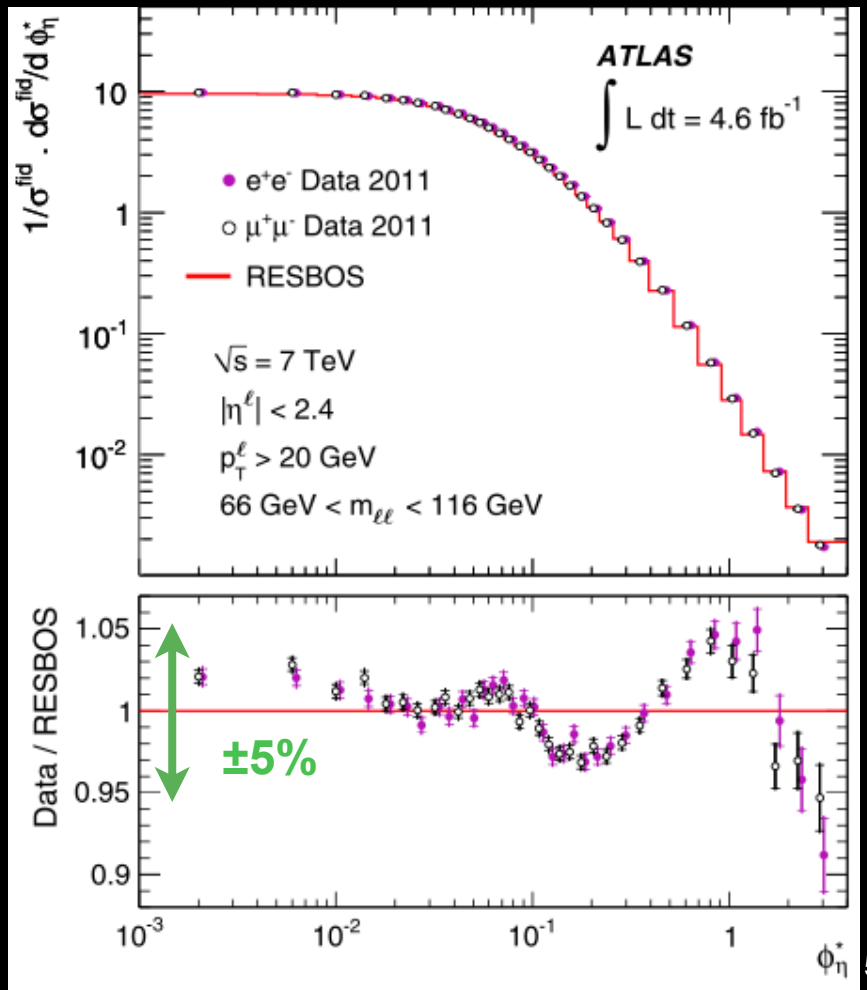
$$\Phi_\eta^* = \tan\left(\frac{\Phi_{acop}}{2}\right) * \sin(\Theta_\eta^*)$$

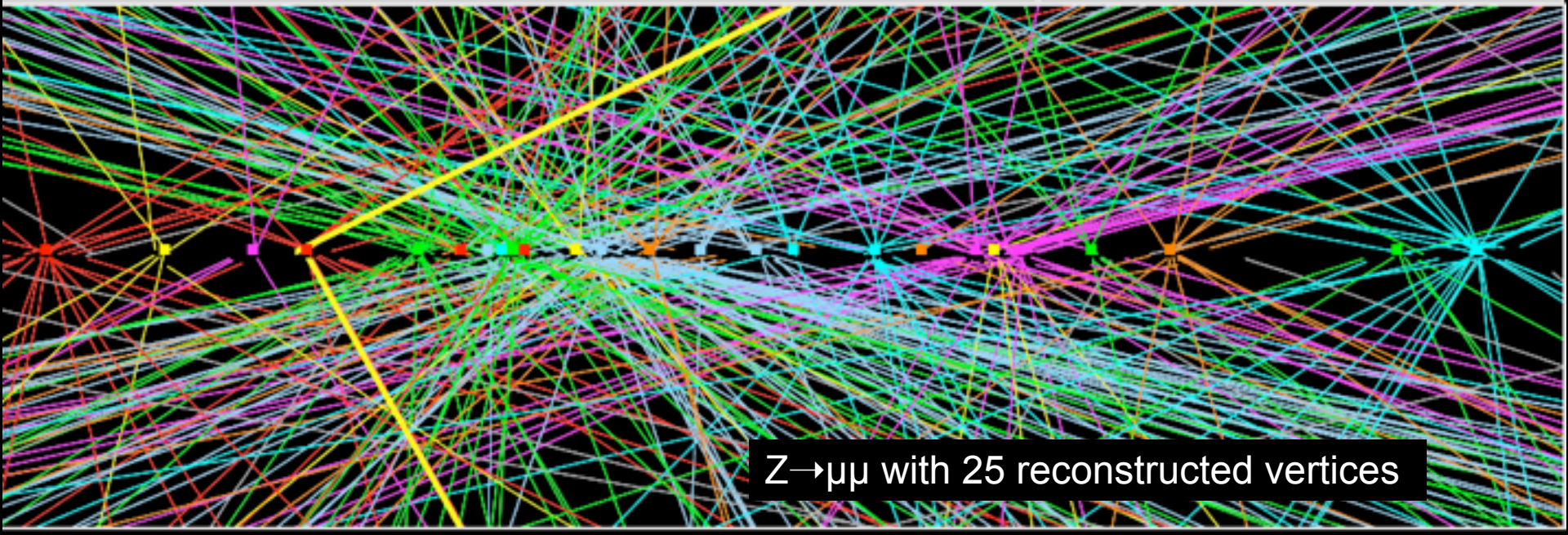
Use ϕ_η^* to probe modelling of p_T of Z boson in MC

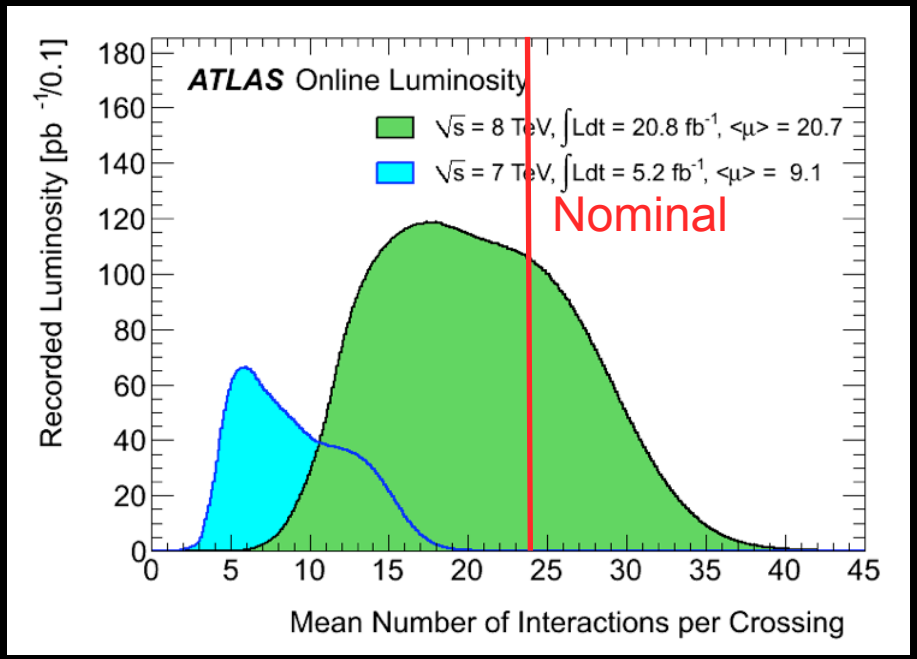
- precise measurement of M_W
- Higgs boson studies

High precision measurement

- Systematic errors 01.-0.3%
- Statistical error 0.3%







The treatment of events with <μ>=20.7 (μ between 10 and 35) superimposed interactions has been at the centre of most ATLAS analysis.

The robustness of performance against this *pile-up* has driven the development of resilient identification & rejection definitions.

ATLAS detector status

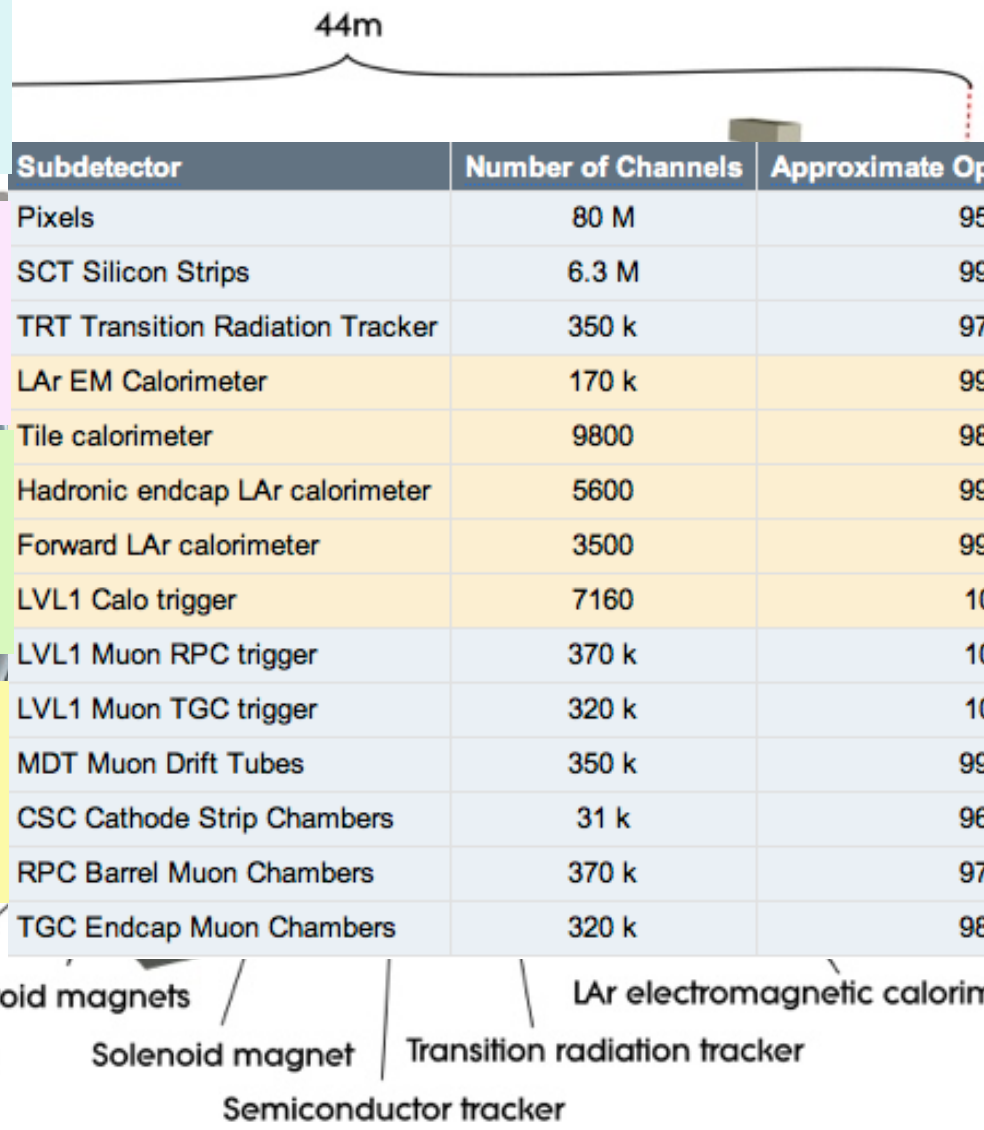
Tracker $|\eta|<2.5$
B=2T
Si: pixels+strips,
Transition Radiation straws
Precise tracking, vertexing, e/hadron sep.
$\sigma/p_T \sim 0.05\%\ p_T \oplus 1\%$

Electromagnetic Calorimeter $|\eta|<3.2$
Pb/LAr with accordion geometry
L1 trigger, electrons/photons, jets & E_T^{miss}
Energy, position, angle
$\sigma/E \sim 10\%/\sqrt{E} \oplus 0.7\%$

Hadronic Calorimeter $|\eta|<4.9$
Fe/Tiles scintillator $|\eta|<1.7$
Cu or W/LAr $1.5<|\eta|<4.9$
L1 trigger, complete jet & E_T^{miss}
$\sigma/E \sim 50\%/\sqrt{E} \oplus 3\%$

Muon Spectrometer $|\eta|<2.7$
Air core toroid & gas chambers
L1 trigger - momentum & position

$\sigma/p_T < 10\%$ for $p_T^{\mu}<1$ TeV



Subdetector	Number of Channels	Approximate Operational Fraction
Pixels	80 M	95.0%
SCT Silicon Strips	6.3 M	99.3%
TRT Transition Radiation Tracker	350 k	97.5%
LAr EM Calorimeter	170 k	99.9%
Tile calorimeter	9800	98.3%
Hadronic endcap LAr calorimeter	5600	99.6%
Forward LAr calorimeter	3500	99.8%
LVL1 Calo trigger	7160	100%
LVL1 Muon RPC trigger	370 k	100%
LVL1 Muon TGC trigger	320 k	100%
MDT Muon Drift Tubes	350 k	99.7%
CSC Cathode Strip Chambers	31 k	96.0%
RPC Barrel Muon Chambers	370 k	97.1%
TGC Endcap Muon Chambers	320 k	98.2%