Recent results from ATLAS

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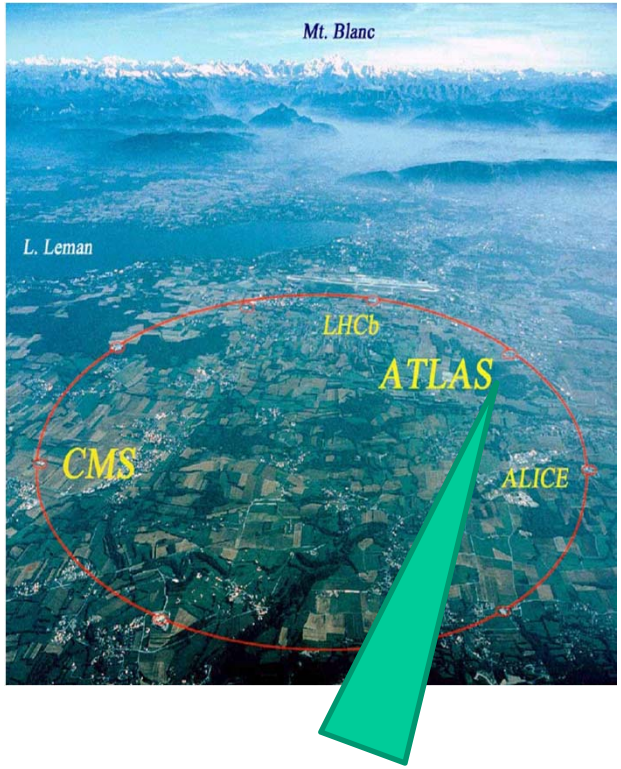
(KEK/IPNS)

KEK Physics Seminar
17 June 2011



LHC

- Proton-proton collider with c.m.s energy → 14 TeV
  -- c.m.s. energy of elementary parton-parton collision

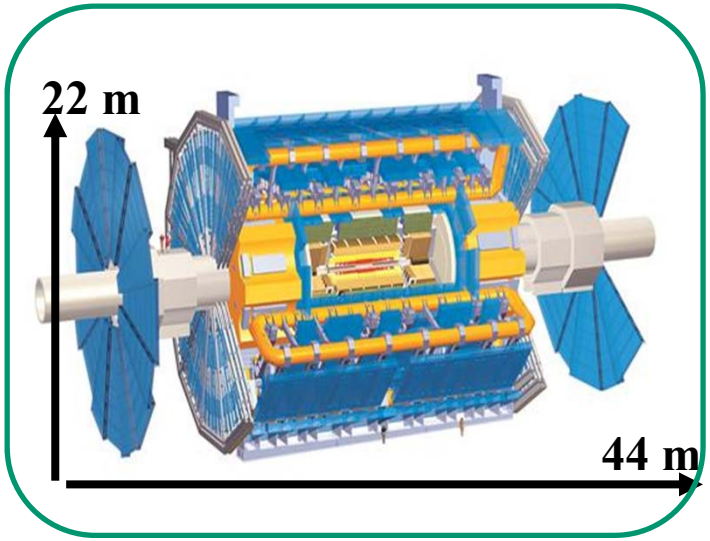
$$\sqrt{s}_{eff}\,(q-q) \approx \mathrm{O}(1)\ \mathrm{TeV}$$

→ The real explorer for "TeV scale" physics

-- Origin of EW symmetry breaking; SM Higgs

-- New physics (necessary to stabilize EW scale);
SUSY, Extra Dimension, etc…

* which can bring good dark matter candidates

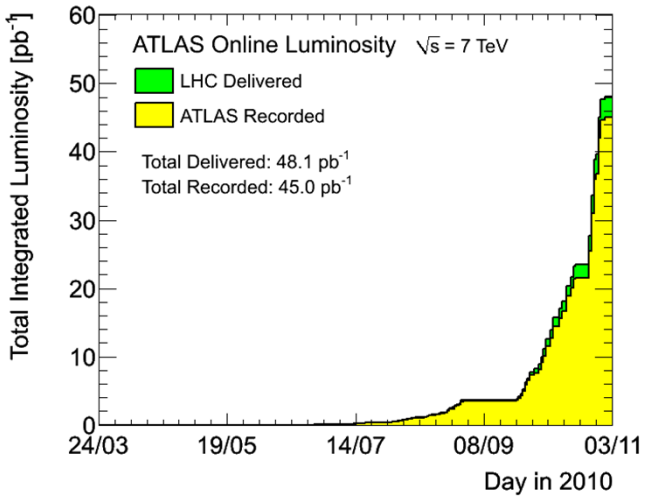


ATLAS

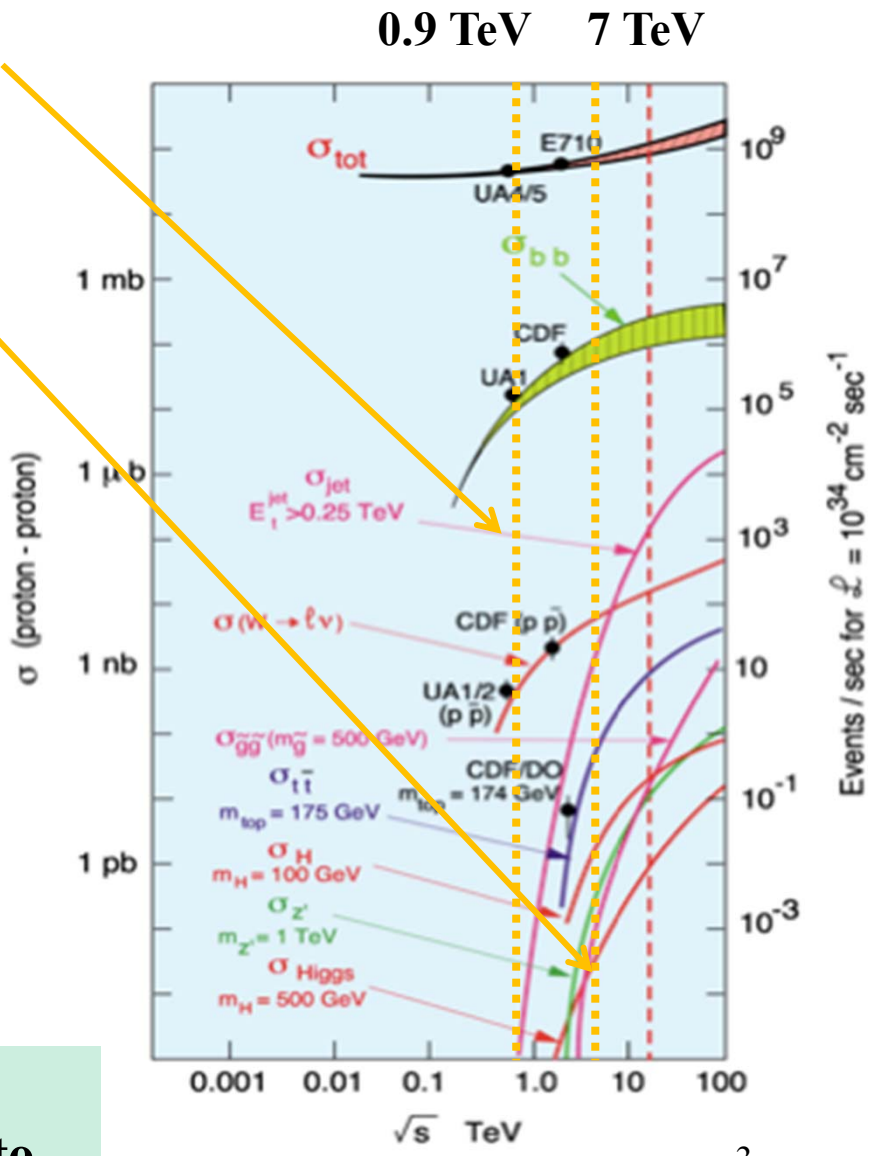
- General purpose detector, covering ~4π solid angle
  -- Detection capability to Higgs with mass covered seamlessly up to ~1 TeV
- Inner detector: combination of silicon strip / pixel detector and straw tube tracker (2 T by solenoid).
- Calorimeter: LAr for EM and had (endcap) , scintillator tiles for had (barrel)
- Muon spectrometer : stand-alone measurement by using Toroid magnet

LHC and ATLAS Operations in 2009, 2010

- Year 2009: $\sqrt{s}$=0.9, 2.36 TeV : ~12 μb^{-1}
- **Year 2010: $\sqrt{s}$=7 TeV**
  ~45 pb^{-1} collected by ATLAS



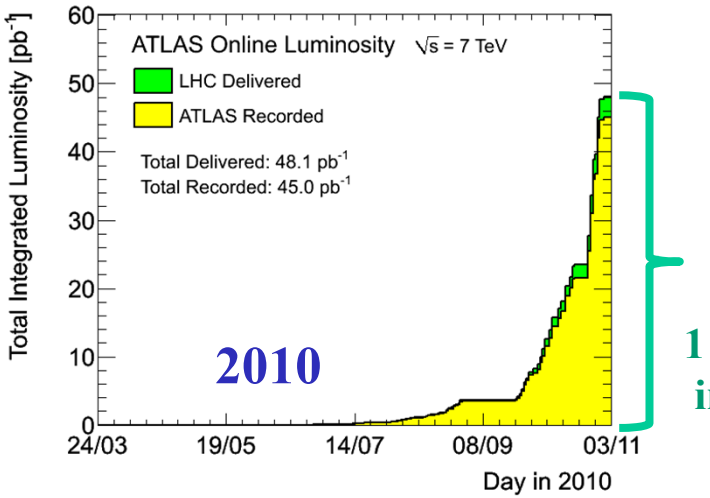
- ~92 % data-taking efficiency
- ~97-100% detector elements were in operation



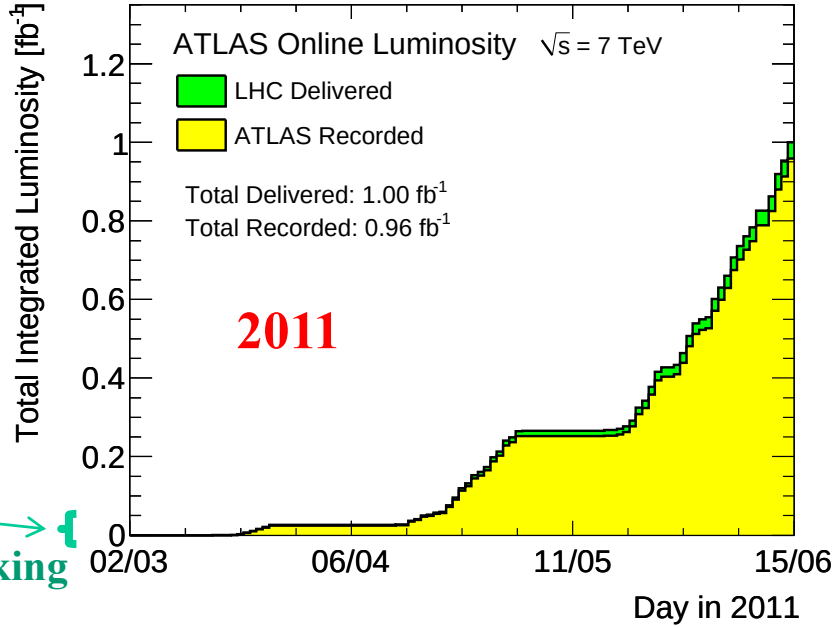
► **Today's talk:**
-- Full data set (~40 pb^{-1}) allows ATLAS to produce a large variety of physics results

LHC and ATLAS Operations in 2011

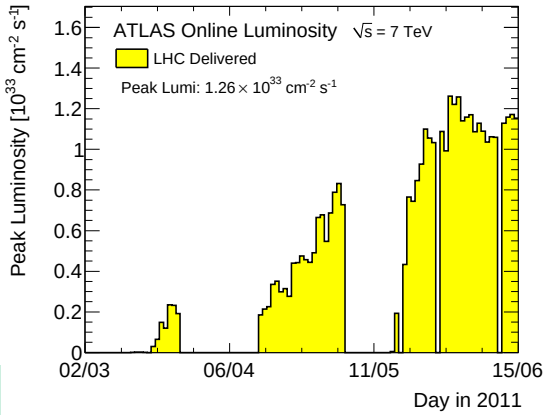
- Delivered luminosity: **1.0 fb^{-1}**
  ATLAS ready recorded: **0.95 fb^{-1}**
  Data taking efficiency > 95%



1 day data-taking in 2011



- Max inst. luminosity: 1.26×10^{33} cm^{-2} s^{-1}

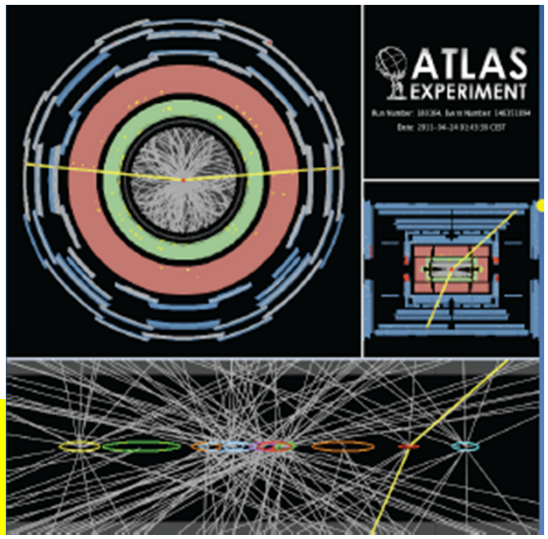


Now LHC is not only highest-energy, but also highest-luminosity hadron collider! (At 10^{33} cm^{-2}s^{-1}, 1 SM Higgs with 150 GeV mass is produced every 83 seconds)

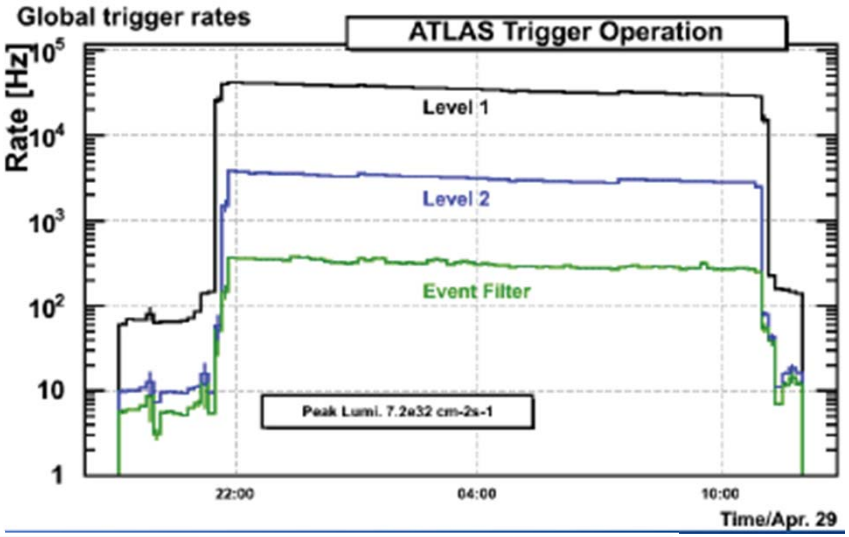
► **Today's talk also includes:**
-- Some hot results using up to ~200 pb^{-1} (New at PLHC2011, 6-11/June)

Challenging days for Trigger

- Event trigger rate has to be reduced from 40 MHz down to ~200 Hz → 1/500000 rejection necessary
- Under high pile-up (average 6 interactions (max 8-12) per crossing in 2011) environment
- Pipelined, dead-time free, 3-levels trigger
  - -- Typical deadtime 2-3% in 2011 runs
  - -- Dynamic changes to trigger settings during a run w/o stop/start
  - -- Stopless removal/recovery of detector r/o elements
- Need to cover the wide and rich physics potentials comprehensively
  - -- Various kinds of trigger logic ("chain") e.g. inclusive, exclusive, combination…
  - -- Typically, few hundred trigger logics are deployed at any time.



11 vertices with 1 Z→μμ



Trigger	L1 Item	L1 Rate (Hz)	EF Rate (Hz)
e20_medium	EM14	8500	50
2e12_medium	2EM7	5700	1
g40_tight	EM30	700	16
mu18	MU10	5300	40
2mu10	2MU10	100	1
xe60	XE40	300	4
J180	J75	200	6
tau29medium_xe35	TAU11_XE20	3800	6
tau16_e15	TAU6_EM10	7500	6
j75_xe45	J50_XE20	500	10

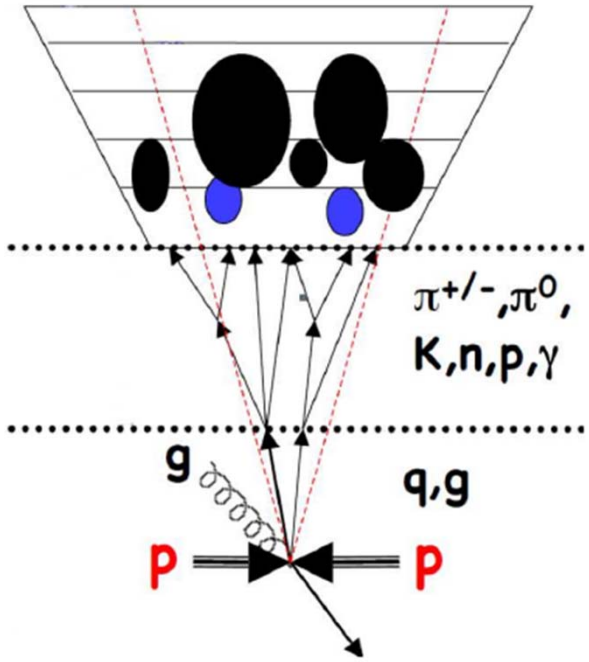
The trigger system has been successfully operating in a wide range of conditions: 10^{27} to over 10^{33} $cm^{-2}s^{-1}$ (6 orders!)

Standard Model Physics

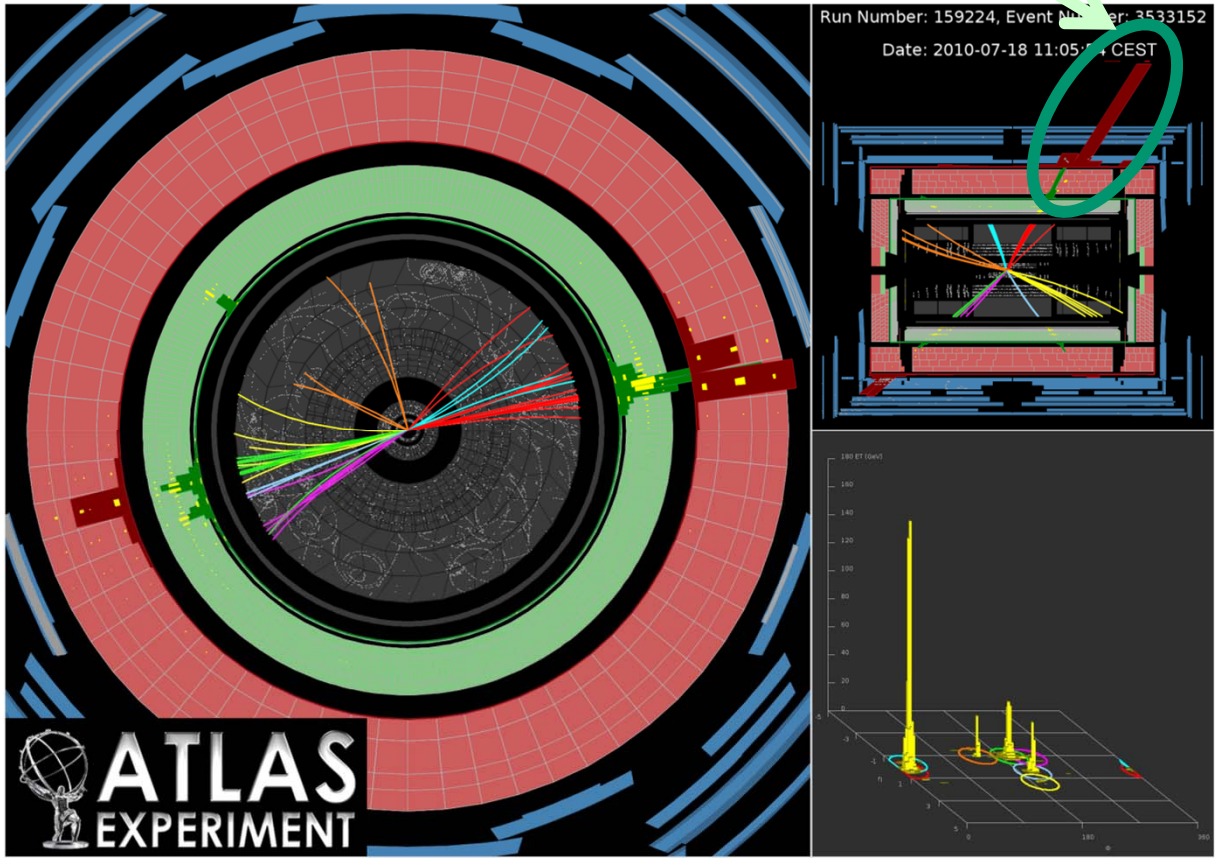
- Hard QCD
- Electro-weak
- Top

Jets @ LHC

- QCD validation at unexplored kinematic phase space
  -- We are seeing $p_T \geq 1$ TeV and di-jets with $M_{jj} \geq 3$ TeV !



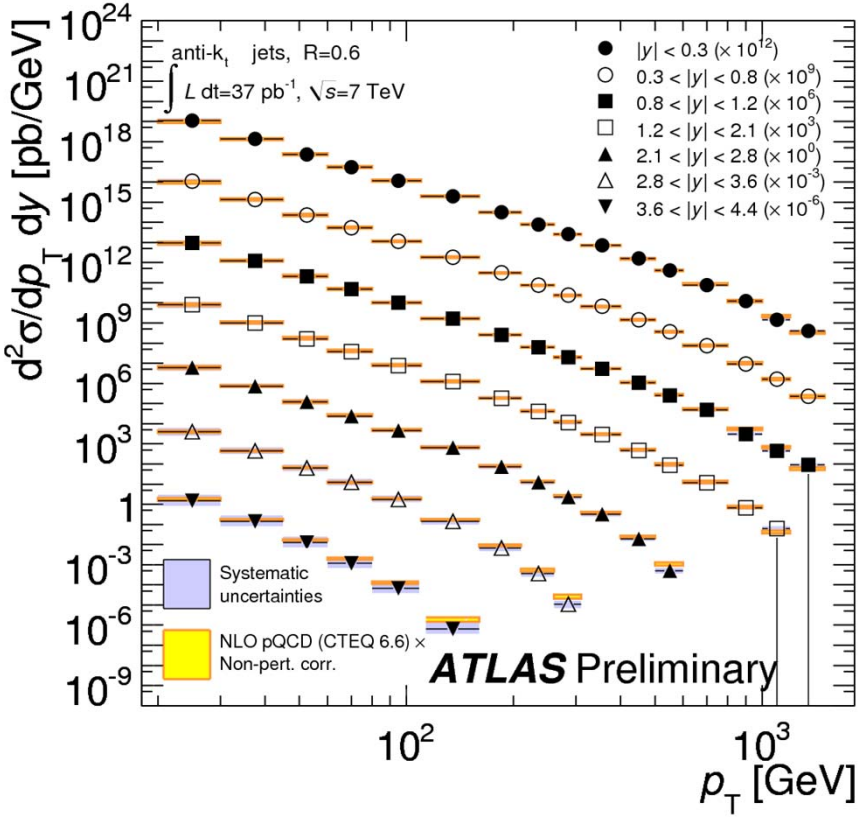
Jet with $p_T \geq 1$ TeV

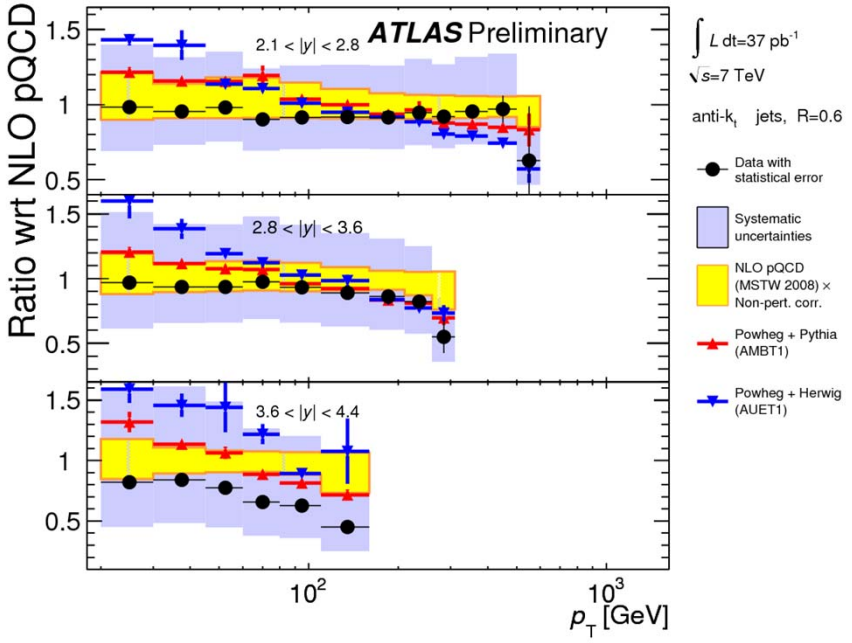


ATLAS-CONF-2011-047

Inclusive jet cross sections

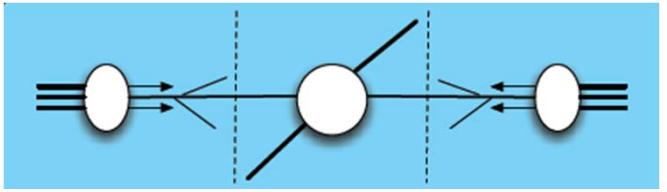
- Anti-k_T, R=0.6 (Measurement with R=0.4 was also made) :
  - -- p_T(jet)>20 GeV to 1.5 TeV
  - -- $|y_{jet}|$ up to 4.4





- Data are consistent with NLO pQCD prediction with non-pert. corr
- Some differences observed at high p_T and large |y|

EW bosons @ LHC



- SM "candles" provide:
  - -- QCD validation, with sensitivity to quark's parton density functions (PDFs)
  - -- Important in-situ calibration method

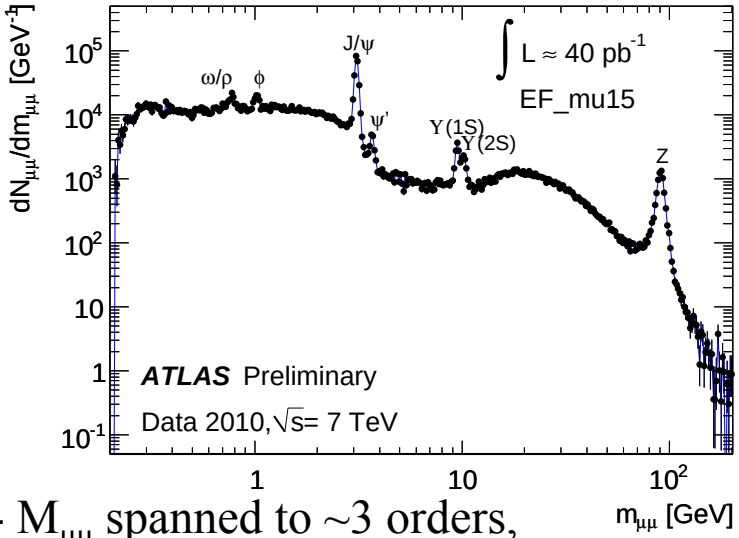
$$\sigma = \sum_{pdf} \int dx_i dx_j [\, f_i(x_i)\, f_j(x_j) \times \Delta\sigma(q_i q_j \to X; x_i, x_j)]$$

$$u\bar{d} \to W^+$$

$$d\bar{u} \to W^-$$

- Z: Event selection
  - -- p_T (lepton) > 20 GeV
  - -- Oppositely charged pair

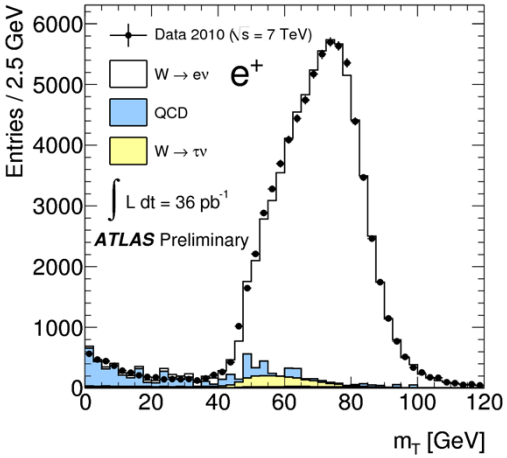
► Di-muon invariant mass



-- $M_{\mu\mu}$ spanned to ~3 orders, several familiar resonances

- W: Event selection
  - -- Isolated p_T (lepton) > 20 GeV
  - -- E_T^{miss} > 25 GeV
  - -- m_T > 40 GeV

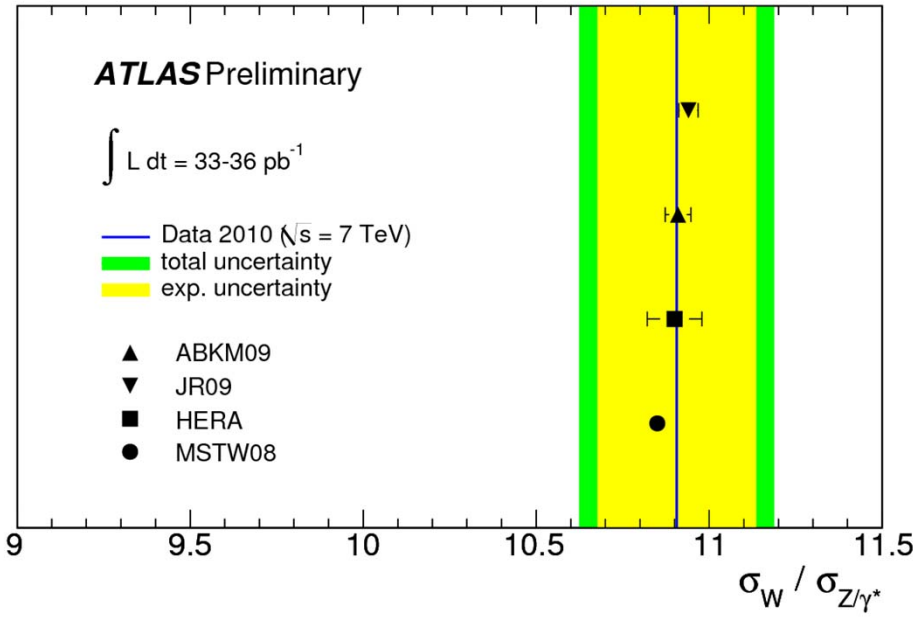
$$m_T = \sqrt{2\, p_T^{\,l}\, p_T^{\,\nu} (1 - \cos(\phi^l - \phi^\nu))}$$



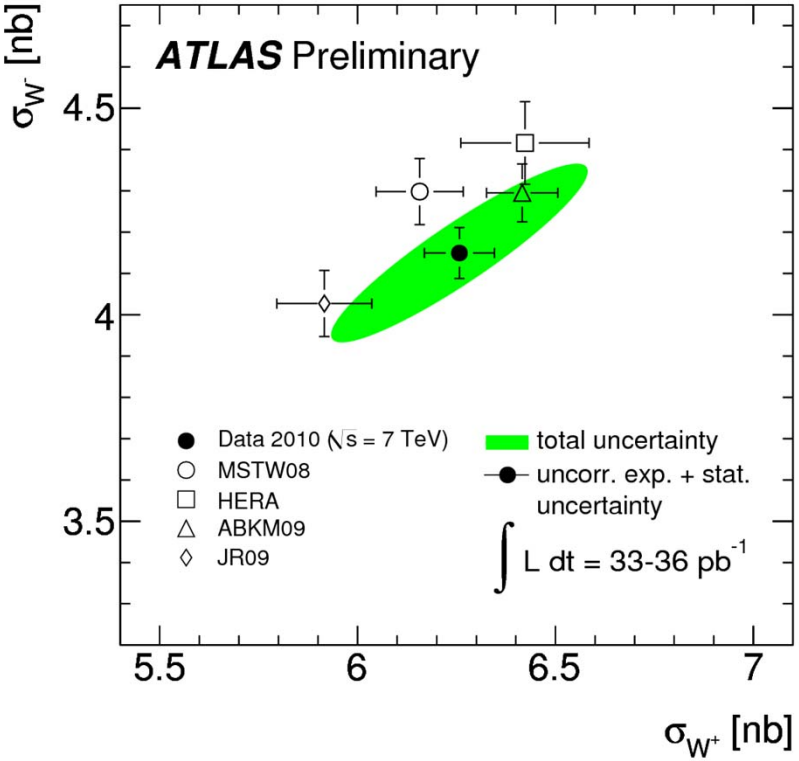
ATLAS-CONF-2011-041

W/Z-production cross section

► Ratio of W to Z cross sections: $\sigma(W)/\sigma(Z/\gamma^*)$



► $\sigma(W)$



- In the cross section ratio, both exp/theory uncertainties partially cancel
  - -- Exp: luminosity, theory: PDF

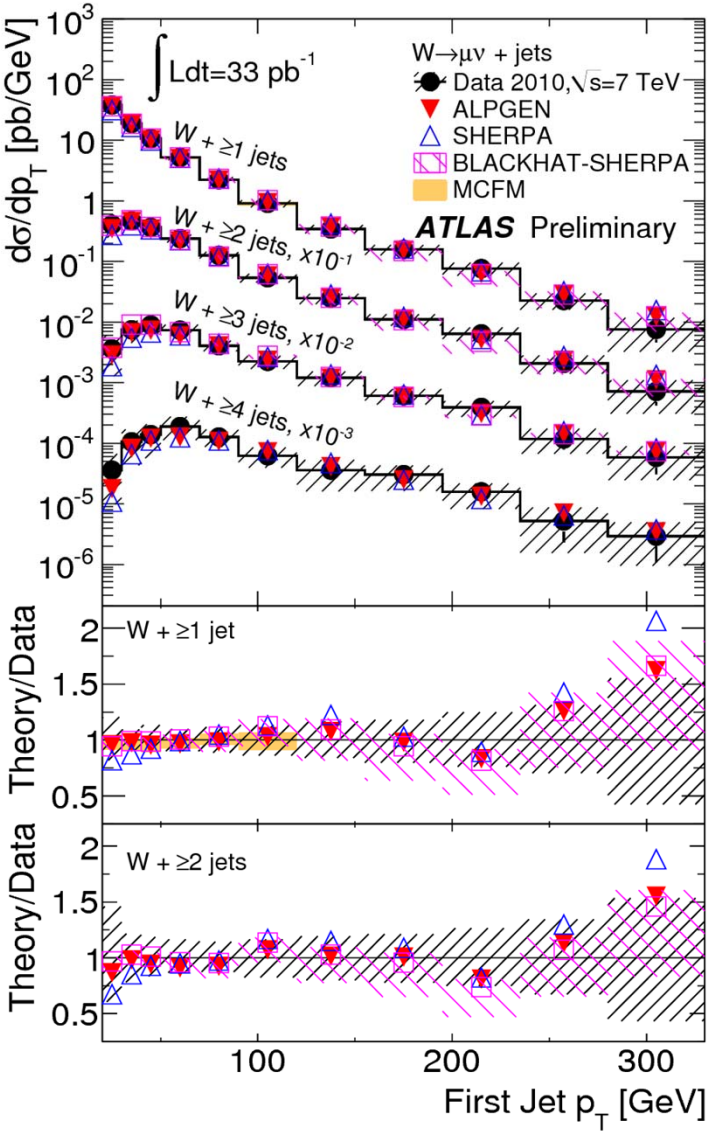
- Started to constraint PDFs!

- Measured cross sections are in agreement with theoretical predictions based on NNLO QCD

ATLAS-CONF-2011-060

EW bosons + Jets

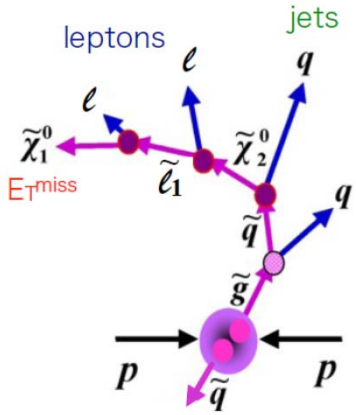
► W+nJets cross section



● A powerful test of QCD

● Often becomes irreducible/main backgrounds for top, Higgs, SUSY, new physics searches, etc.

→ Mandatory to understand with real data



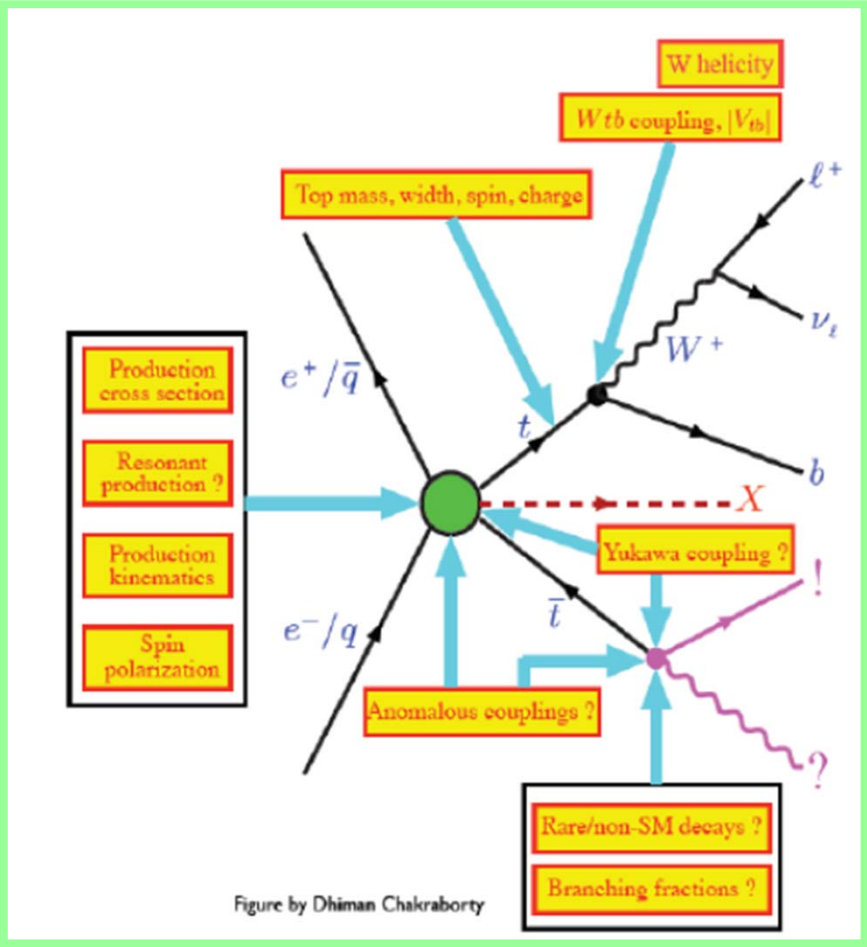
➔ Measured cross sections are in agreement both with Multi-parton ME + PS MC models (ALPGEN, SHERPA) and also NLO calculations (MCFM, BLACKHAT-SHEPA)

► Z+nJets cross section

→ See ATLAS-CONF-2011-042

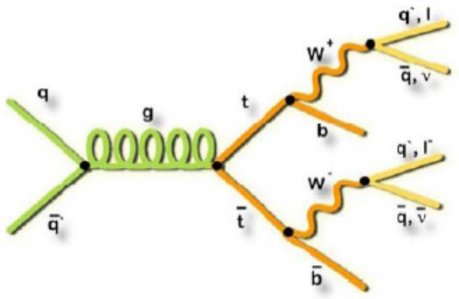
Top

- Rich physics programs



C.Helsens, FPCP 2011

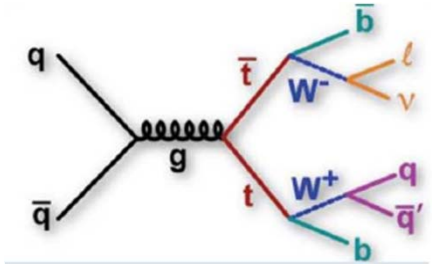
- Experimentally:
  Measurement of top quarks requires understanding of full detector performance
  -- Lepton identification
  -- E_T^{miss}
  -- multi-jets
  -- b-tagging
  and also, understanding of QCD backgrounds (W/Z+nJets etc.))

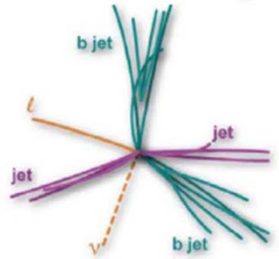


ATLAS-CONF-2011-023
ATLAS-CONF-2011-035

σ(ttbar) [1-lepton mode]

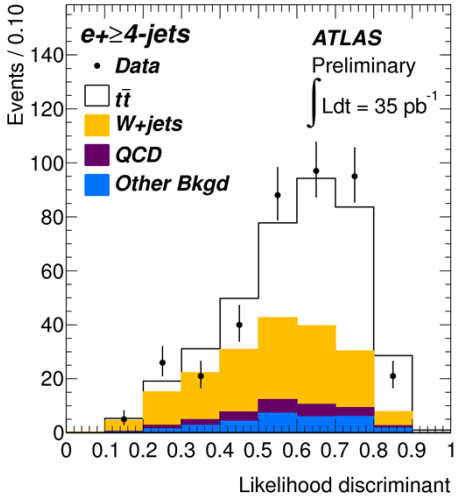
- Br=33% : "Golden" channel
- Event Selection
  - -- $p_T^{\,l} > 20$ GeV, $|\eta^l|<2.5$
  - -- $E_T^{miss} > 20$ (35) GeV (for e)
  - -- $m_T(W) > 60\text{-}E_T^{miss}$ (25) GeV (for e)
  - -- ≥ 1 jets of $p_T^{jet} > 25$ GeV, $|\eta^{jet}| < 2.5$

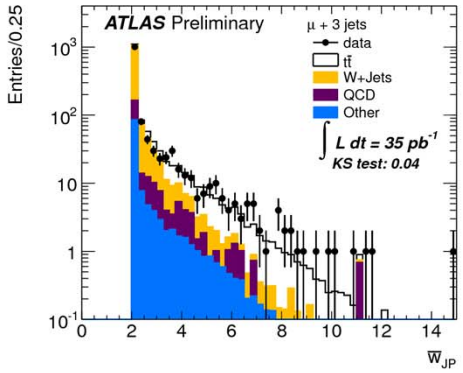


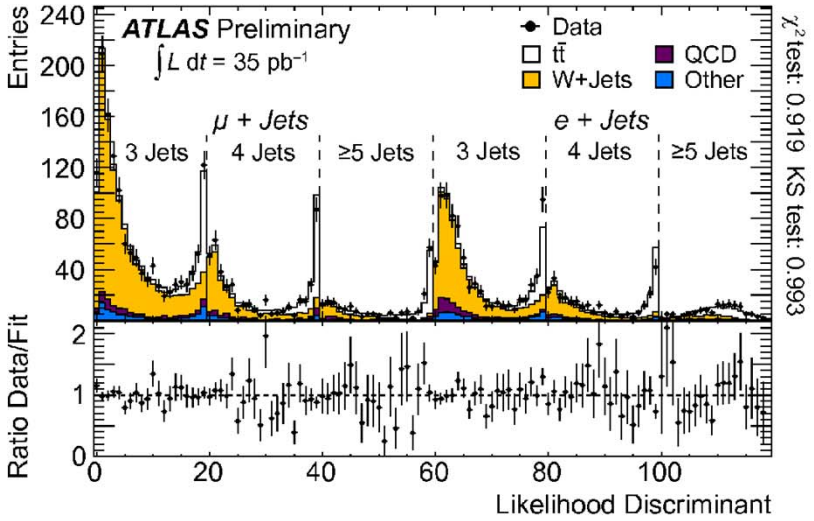


► W/o b-tagging
  -- Multivariable discriminant
    * $|\eta_l|$, $|Q_l|$, aplanarity

► W/ b-tagging
  -- Impact parameter based and secondary vertex based
  -- Multivariate discriminant
    * W_{JP}, $|\eta_l|$, aplanarity, $H_{T,3p}$







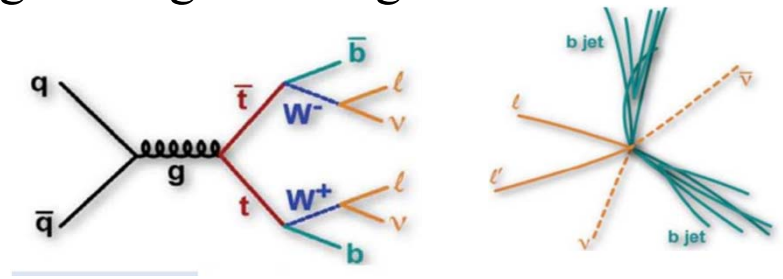
$$\sigma = 171 \pm 17(stat)^{+20}_{-17}(syst) \pm 6(lumi)\,pb$$

$$\sigma = 186 \pm 10(stat)^{+21}_{-20}(syst) \pm 6(lumi)\,pb$$

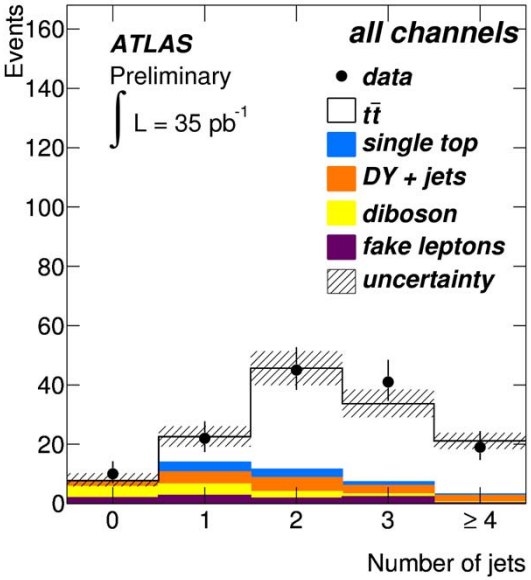
ATLAS-CONF-2011-034

σ(ttbar) [2-lepton mode]

- Br=6% : "High purity" channel → "Counting" taking advantage of high purity
- Event Selection
  - -- 2 opposite sign leptons with $p_T^{\,l} > 20$ GeV, $|\eta^l|<2.5$
  - -- $E_T^{miss} > 40$ GeV
  - -- ≥ 2 jets of $p_T^{jet} > 20$ GeV, $|\eta^{jet}| < 2.5$
  - -- $H_T=\Sigma p_T^{\,l} + \Sigma p_T^{jet} > 130$ GeV
  - -- $|M_{ll} - M_Z| > 10$ GeV

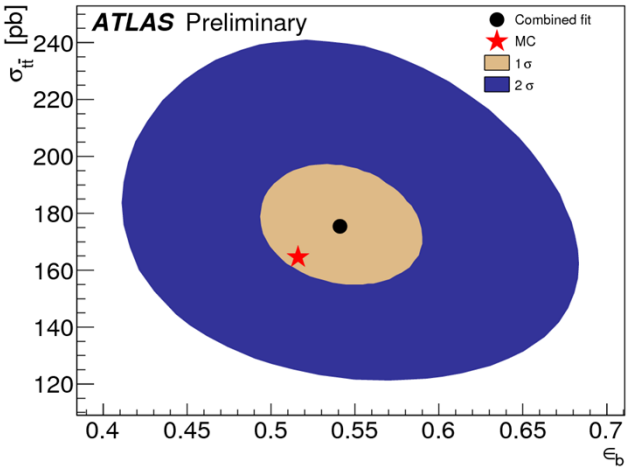


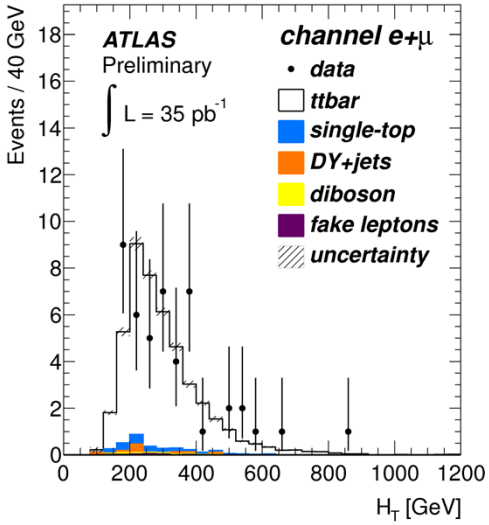
► W/o b-tagging



► W/ b-tagging

-- σ(tt) and ε(btag) extracted simultaneously



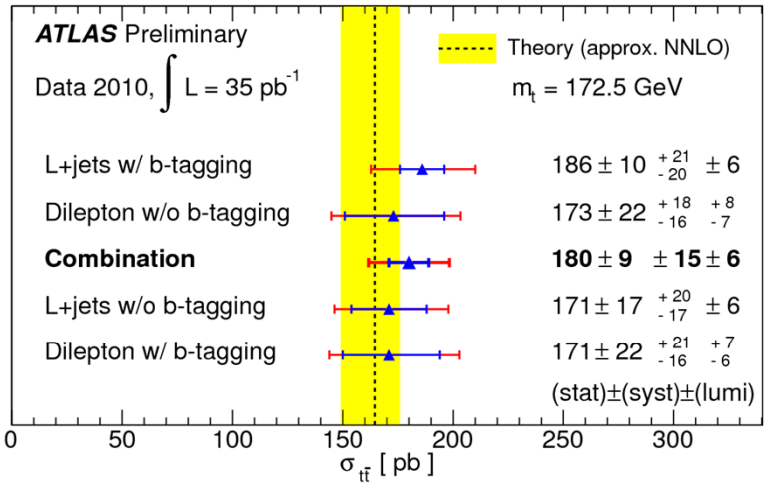


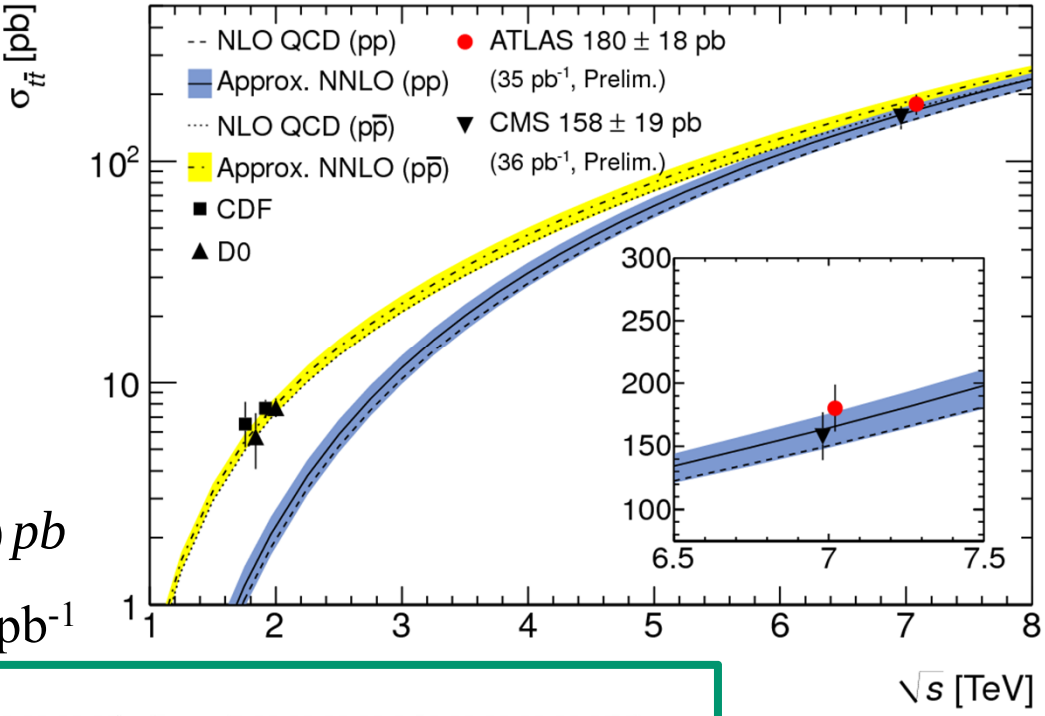
$$\sigma = 173 \pm 22(stat)^{+18}_{-16}(syst)^{+8}_{-7}(lumi)\,pb$$

$$\sigma = 176 \pm 22(stat) \pm 22(syst) \pm 6(lumi)\,pb$$

ATLAS-CONF-2011-040

Summary of σ(ttbar)

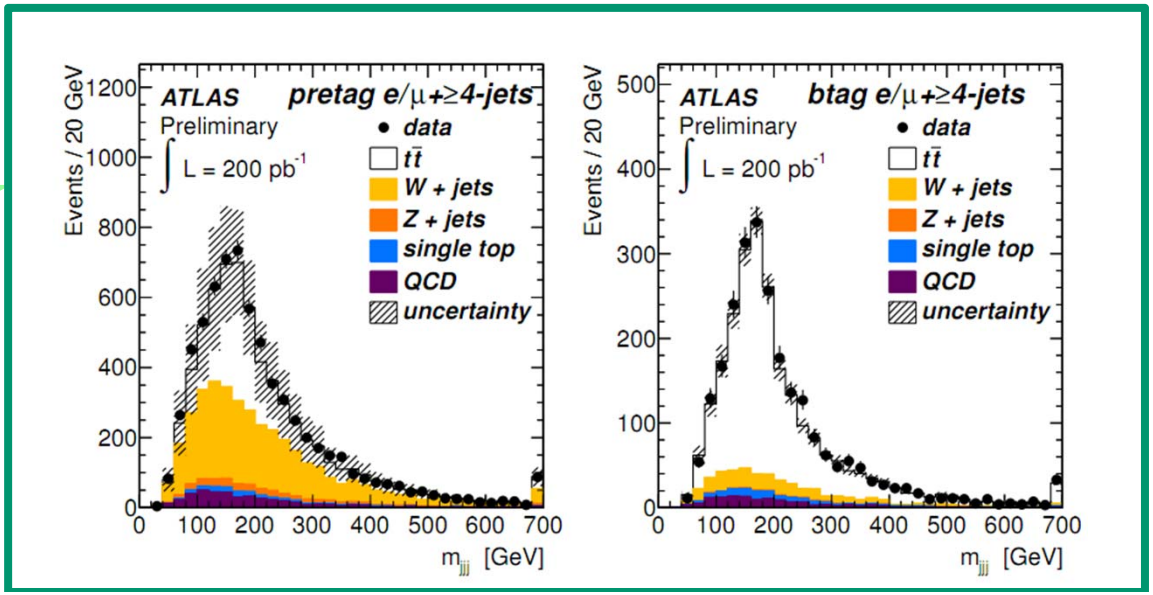




$$\sigma = 180 \pm 9(stat) \pm 15(syst) \pm 6(lumi)\, pb$$

- 10% precision already with L=~35 pb^{-1}

2011 data (200 pb^{-1}) New @ LHCC 14/6



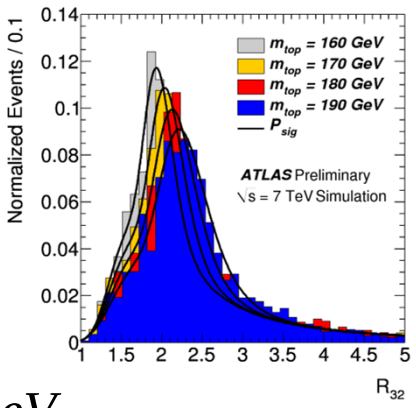
ATLAS-CONF-2011-033
ATLAS-CONF-2011-054

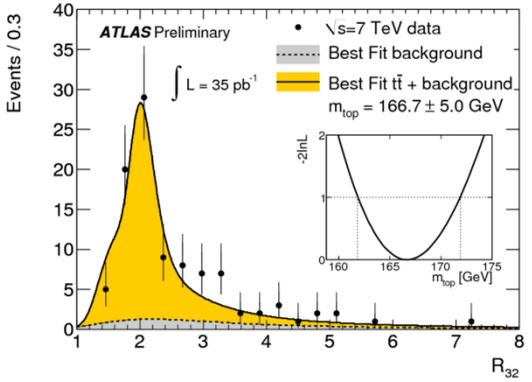
Top mass

▶ Main result: template fit to R_{32}

$$R_{32} = \frac{m_{top}^{reco}}{m_{w}^{reco}} = \frac{m_{jjb}}{m_{jj}}$$

- m_{top}: three jets with highest vector sum p_T
- m_w: non b-tagged jets/smaller dR in top rest frame ($60<m_W<100$ GeV)

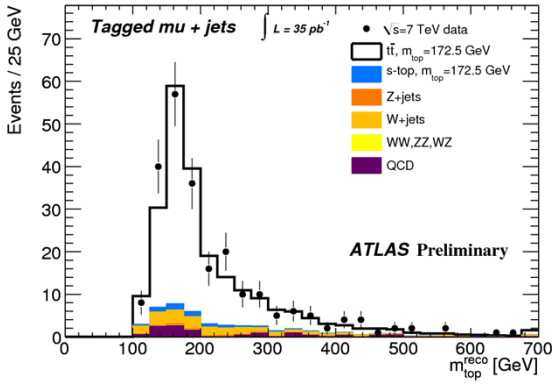




$$m_{top} = 169.3 \pm 4.0(stat) \pm 4.9(syst) GeV$$

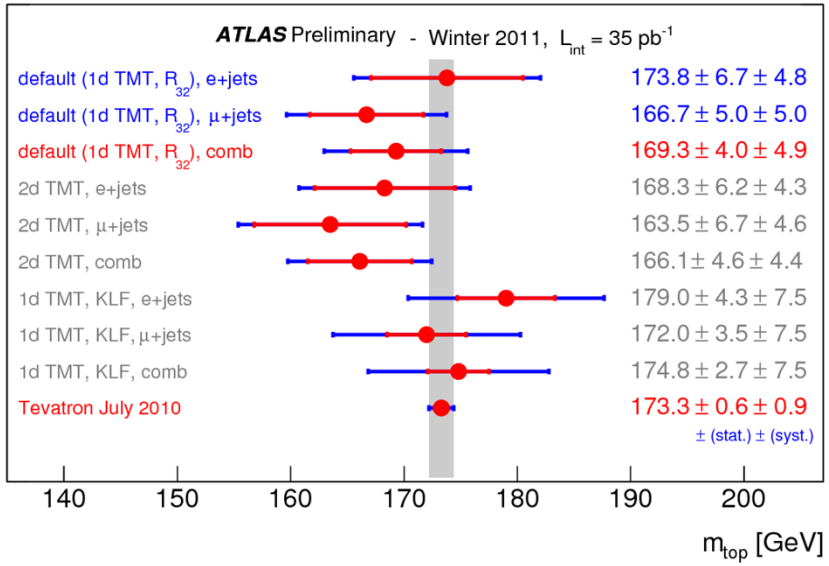
-- Dominant syst: ISR/FSR, JES

▶ Template fit to m_{top} (by kine. fit)



-- Dominant syst: JES (larger),

→ Simultaneous fit to JES and m_{top}



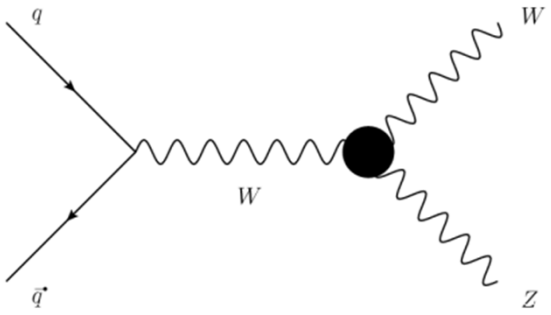
$$m_{top} = 174.8 \pm 2.7(stat) \pm 7.5(syst) GeV$$

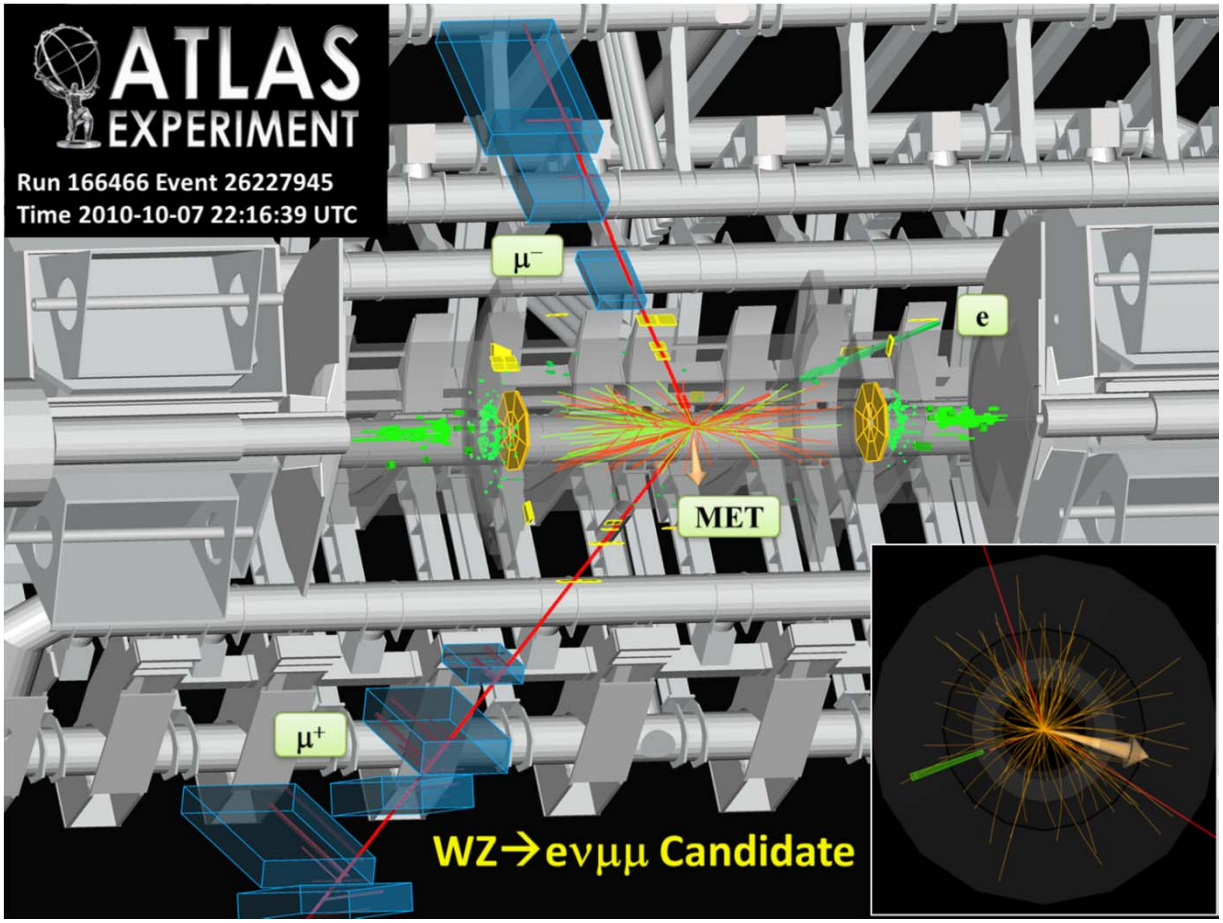
$$m_{top} = 166.1 \pm 4.6(stat) \pm 4.4(syst) GeV$$

● 3.7 % precision already with L=~35 pb^{-1} (expects δm_{top} ~ 1GeV with 1fb^{-1})

Di-boson

- Sensitivity to Triple Gauge Boson Coupling (TGC)
- Irreducible backgrounds to Higgs, Susy searches, e.g. H→WW, ZZ





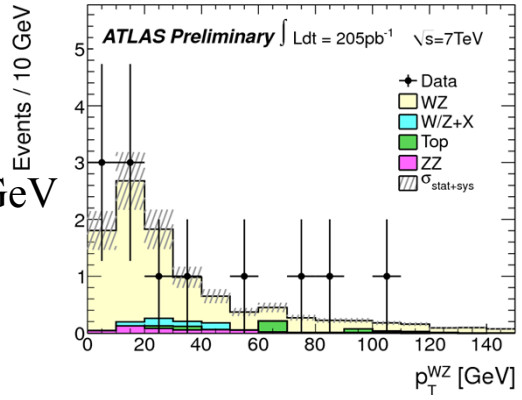
2011 data (205 pb^{-1})

Di-boson production [WZ, WW]

ATLAS-CONF-2011-084
arXiv:1104.5225

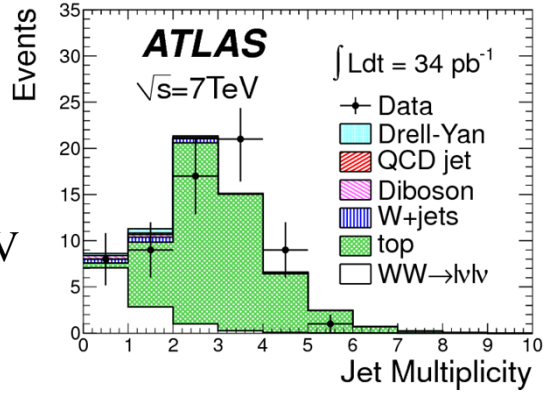
▶ σ(WZ)

-- 2 opposite sign leptons with $p_T^{\,l} > 20$ GeV
-- $|M_{ll} - M_Z| < 10$ GeV
-- $E^{miss}_T > 40$ GeV
-- 3rd lepton $p_T^{\,l} > 20$ GeV



▶ σ(WW)

-- 2 opposite sign leptons with $p_T^{\,l} > 20$ GeV
-- 0 jet of $p_T^{jet} > 20$ GeV
-- $|M_{ll} - M_Z| > 10$ GeV
-- $E^{miss}_{T,\,rel} > 40$ GeV



$$E_{\mathrm{T,rel}}^{\mathrm{miss}} = \begin{cases} E_{\mathrm{T}}^{\mathrm{miss}} \times \sin(\Delta\phi) & \text{if } \Delta\phi < \pi/2 \\ E_{\mathrm{T}}^{\mathrm{miss}} & \text{if } \Delta\phi \geq \pi/2, \end{cases}$$

Final State	$eee + E_T^{miss}$	$ee\mu + E_T^{miss}$	$e\mu\mu + E_T^{miss}$	$\mu\mu\mu + E_T^{miss}$	combined
Observed	2	2	2	6	12
Signal	1.32±0.09	1.76±0.10	2.48±0.11	3.52±0.13	9.08±0.22±1.26
Bkg					
ZZ	0.028±0.003	0.12±0.01	0.08±0.01	0.18±0.01	0.40±0.01±0.05
W/Z+jets	0.09±0.02	0.17±0.04	0.24±0.07	0.52±0.08	1.02±0.12±0.50
Top	–	0±0.03	–	0.35±0.18	0.35±0.18±0.05
$W/Z+\gamma$	0.14±0.14	0 (< 0.05)	0.07±0.07	0 (< 0.05)	0.21±0.15±0.07
Bkg(tot)	0.25±0.14	0.29±0.05	0.39±0.10	1.05±0.19	1.98±0.27±0.67
S/B	5.3	6.2	6.3	3.3	4.6

Final State	$e^+e^-E_{T,rel}^{miss}$	$\mu^+\mu^-E_{T,rel}^{miss}$	$e^\pm\mu^\mp E_{T,rel}^{miss}$	Combined
Observed Events	1	2	5	8
Expected W^+W^-	$0.79 \pm 0.02 \pm 0.09$	$1.61 \pm 0.04 \pm 0.14$	$4.45 \pm 0.06 \pm 0.44$	$6.85 \pm 0.07 \pm 0.66$
Backgrounds				
Drell-Yan	$0.00 \pm 0.10 \pm 0.07$	$0.01 \pm 0.10 \pm 0.07$	$0.22 \pm 0.06 \pm 0.15$	$0.23 \pm 0.15 \pm 0.17$
WZ, ZZ, $W\gamma$	$0.05 \pm 0.01 \pm 0.01$	$0.10 \pm 0.01 \pm 0.01$	$0.23 \pm 0.05 \pm 0.02$	$0.38 \pm 0.04 \pm 0.04$
W+jets	$0.08 \pm 0.05 \pm 0.03$	$0.00 \pm 0.29 \pm 0.10$	$0.46 \pm 0.12 \pm 0.17$	$0.54 \pm 0.32 \pm 0.21$
Top	$0.04 \pm 0.02 \pm 0.02$	$0.14 \pm 0.06 \pm 0.07$	$0.35 \pm 0.10 \pm 0.19$	$0.53 \pm 0.12 \pm 0.28$
Total Background	$0.17 \pm 0.11 \pm 0.08$	$0.25 \pm 0.31 \pm 0.15$	$1.26 \pm 0.17 \pm 0.31$	$1.68 \pm 0.37 \pm 0.42$

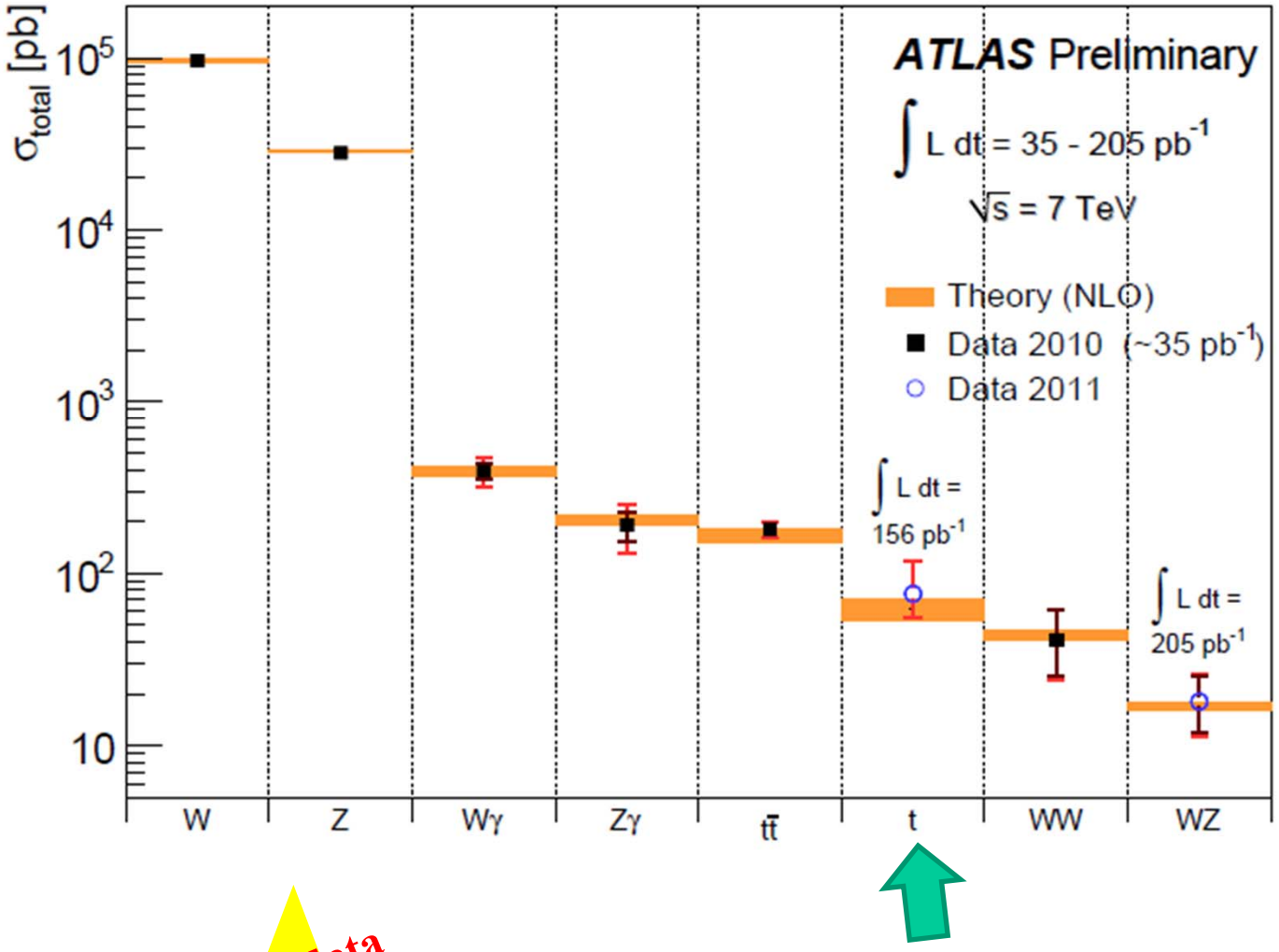
$$\sigma = 18^{+7}_{-6}(stat) \pm 3(syst) \pm 1(lumi)\,pb$$

$$\sigma = 41^{+20}_{-16}(stat) \pm 5(syst) \pm 1(lumi)\,pb$$

- Started to observe di-bosons

(For Zγ、Wγ: see arXiv:1106.1592)

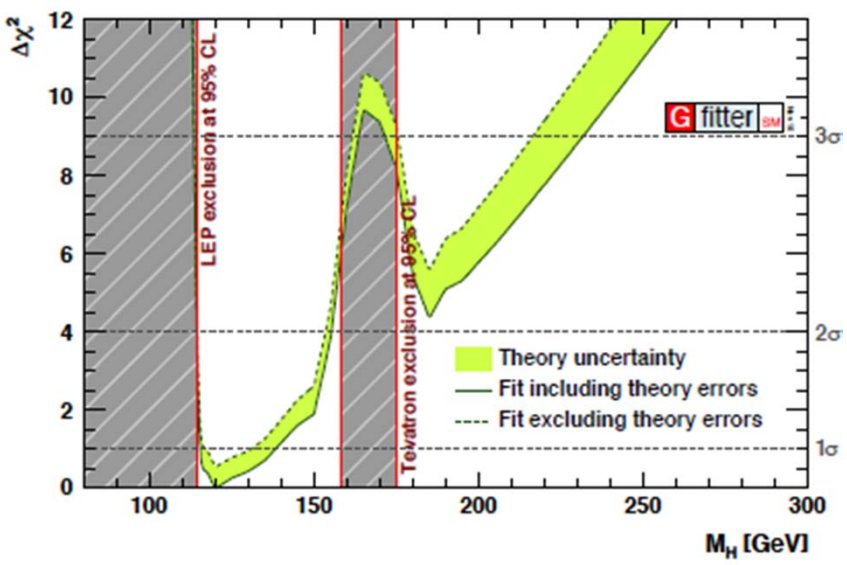
Summary of EW, top cross sections

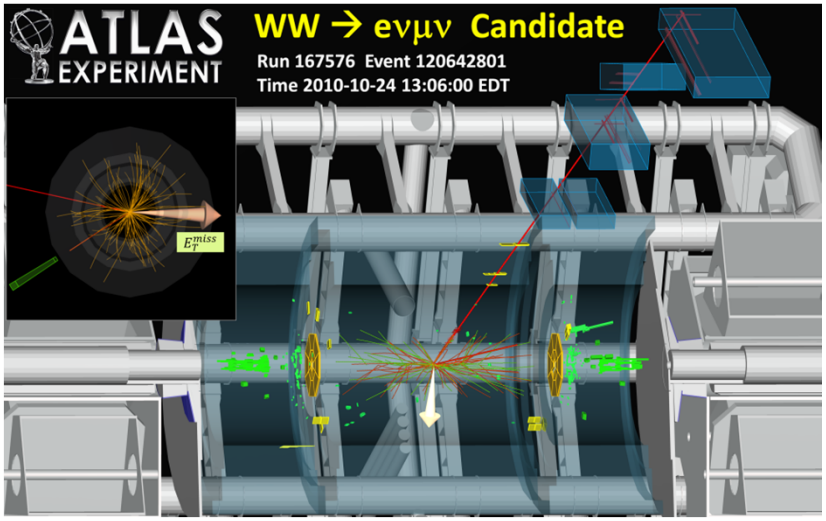


2011 data (156 pb^{-1})

- Observation of t-channel single top production (ATLAS-CONF-2011-088)

Higgs searches: the last missing in SM



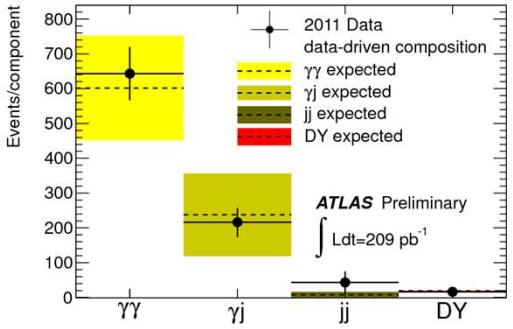


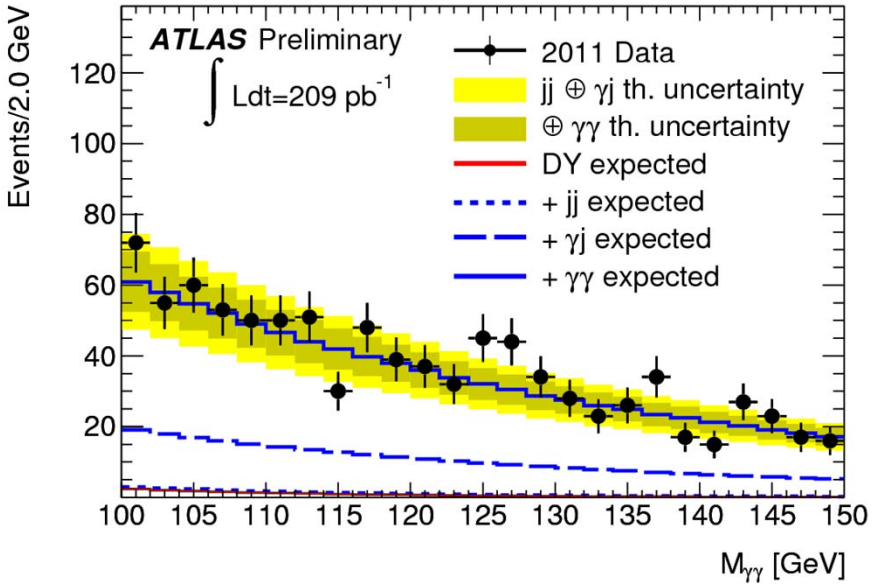
ATLAS-CONF-2011-085

2011 data (209 pb^{-1})

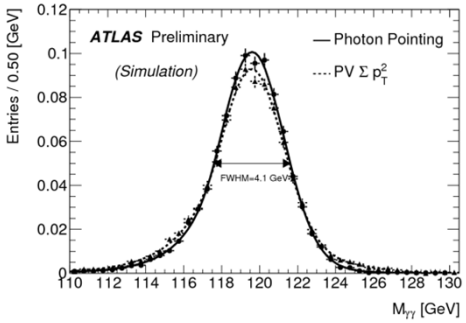
H→γγ

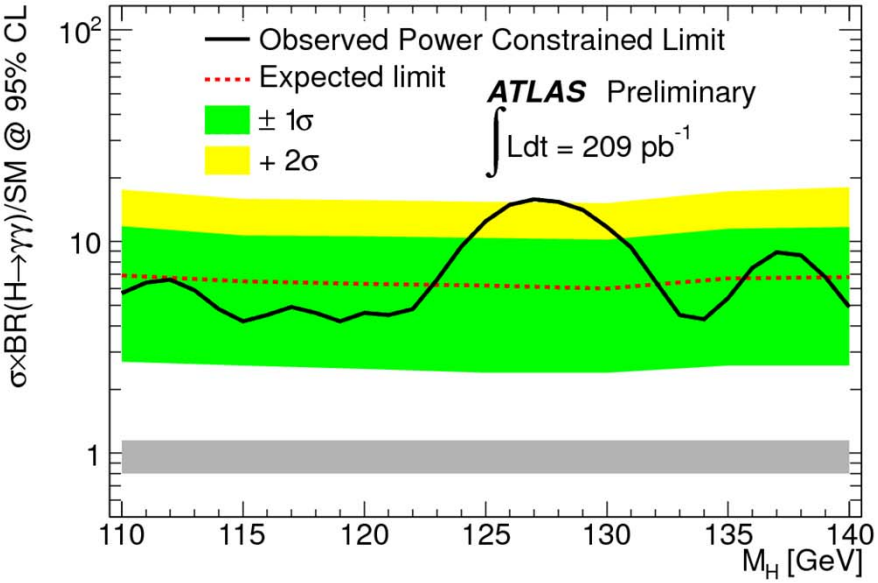
- Despite low BR, significant due to excellent γ resolution
- Event Selection: 2 isolated γ with $p_T^{\gamma} > 40$ (25) GeV
- Backgrounds
  - -- Loosened γ-id. to normalize bkgd from jets
  - -- "double-sideband"





► New vertex reconstruction by using photon direction at LAr
-- Cope with 2011 high pileup condition



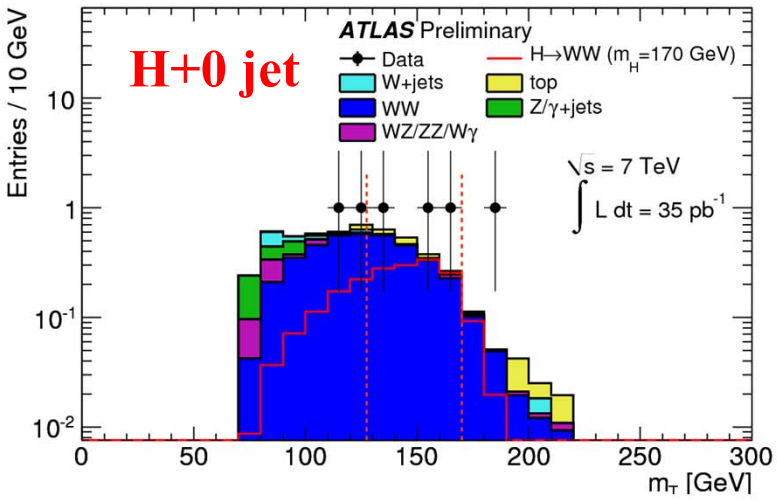


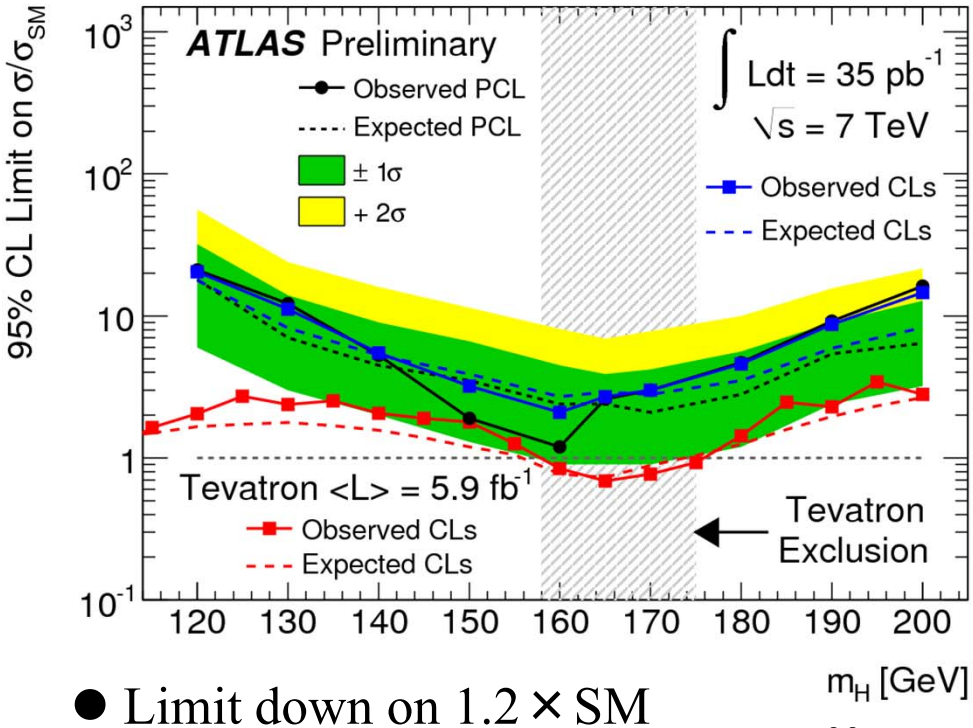
- Limit down on 4.2 × SM
- World best limit for H→γγ

ATLAS-CONF-2011-005

H→WW [→lνlν]

- Unlike most other channels, full mass reconstruction not possible
- Event Selection: exploit differences in angular distributions (due to spin correl.) + dedicated selection for H+0,1,2 jets
  - -- 2 opposite charge leptons with $p_T^{\,l} > 20$ (15) GeV
  - -- $E^{miss}_T > 40$ GeV, $|M_{ll} - M_Z| > 10$ GeV
  - -- $\Delta\varphi(ll) < 1.3$ (1.8) for $m_H < 170$ (> 170) GeV
- Backgrounds: estimated from control sample
  - -- W+jets: loosing lepton id
  - -- ttbar: altered jet cuts, b-tag
  - -- Di-boson: altered M_{ll} and $\Delta\varphi(ll)$



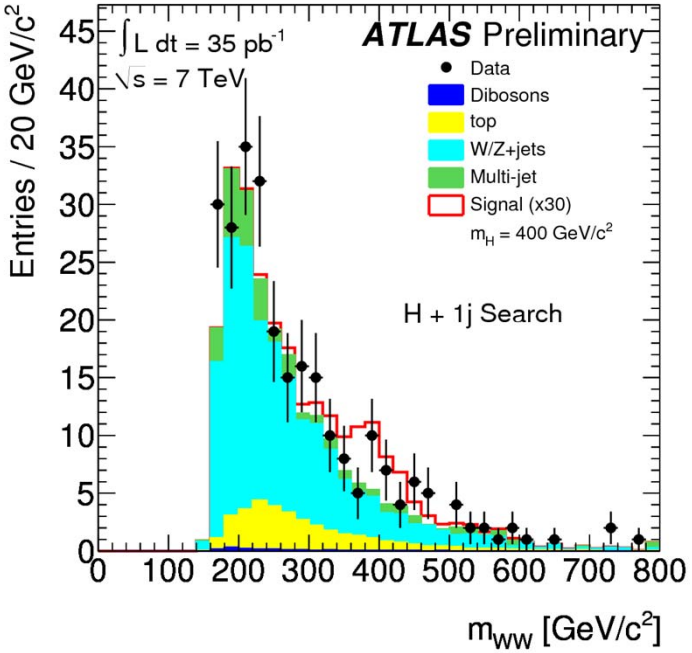


- Limit down on 1.2 × SM
- Approaching Tevatron excluded region

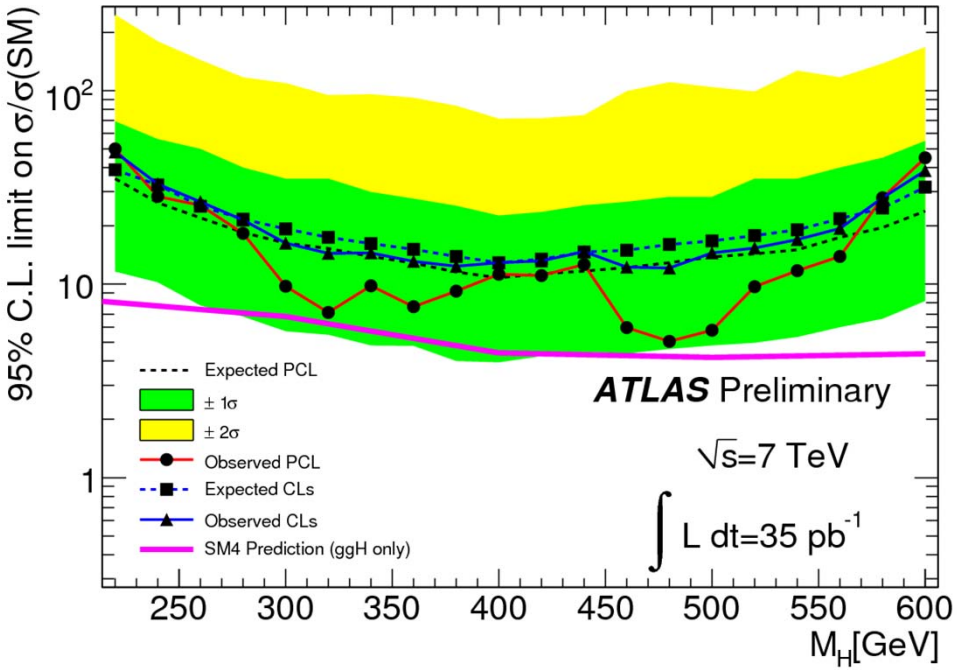
ATLAS-CONF-2011-052

H→WW [→lνqq]

- One of the best channels for intermediate and high masses
- Possible to estimate P_Z^{ν} and M_{WW} by solving $M_W=M_{l\nu}$
- Event Selection:
  - -- 1 leptons with $p_T^{\,l} > 30$ GeV, veto 2nd with $p_T^{\,l} > 20$ GeV
  - -- $E^{miss}_T > 40$ GeV
  - -- 2 or 3 jets with $p_T^{jet} > 30$ GeV, $|\eta^{jet}| < 4.5$
  - -- Veto bjet (against ttbar)



- Background normalization from fit
  - -- Cross-checked using an anti-isolated lepton sample



- Excluded 11.2 × SM for m_H=400 GeV

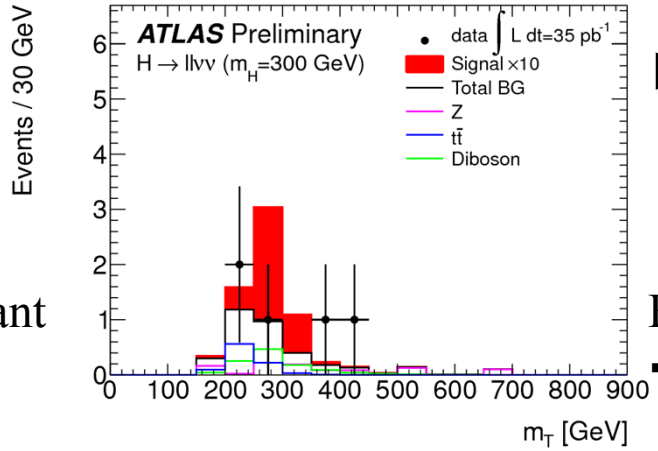
ATLAS-CONF-2011-026

H→ZZ [→llqq, llνν]

► llνν

-- E^{miss}_T > 66 GeV
-- Veto bjet
-- 76<Mll<106 GeV

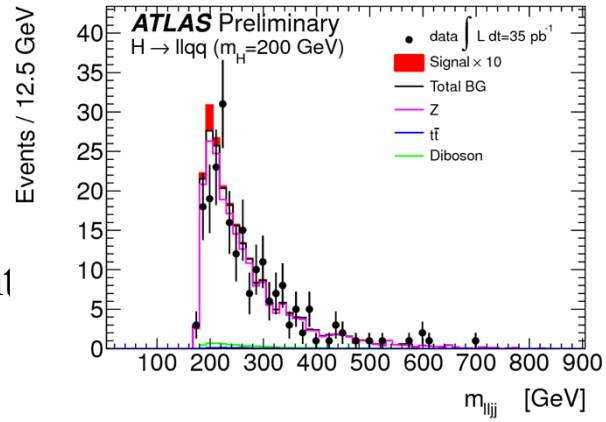
Final discriminant
➔ m_T

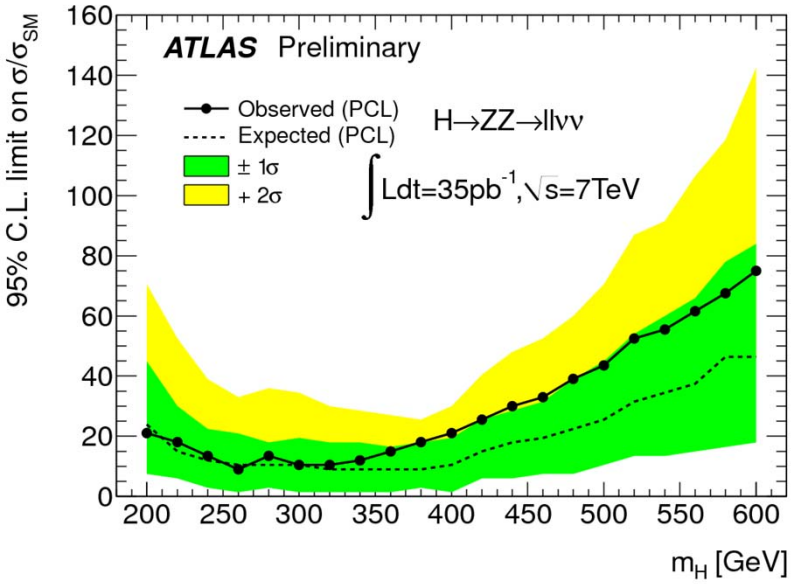


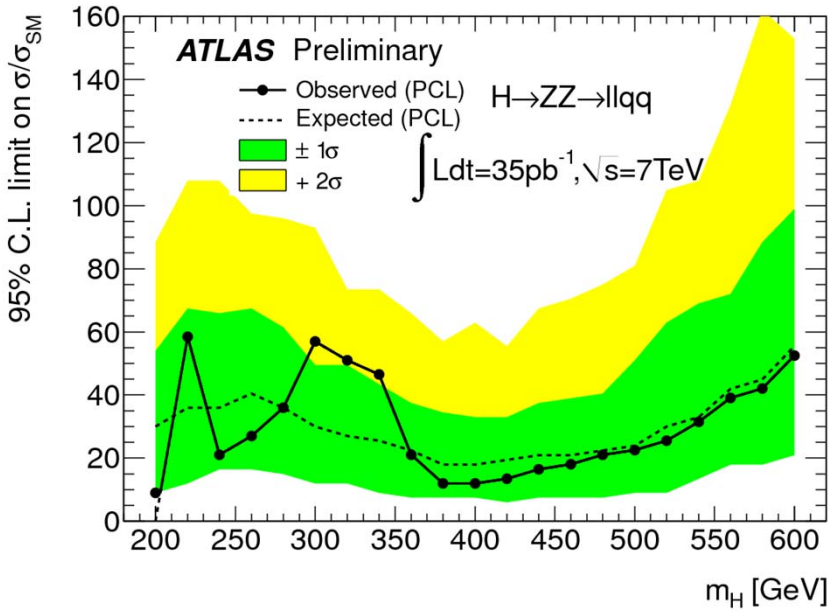
► llqq

-- E^{miss}_T < 50 GeV
-- 70<|Mjj|<105 GeV
-- 76< Mll< 106 GeV

Final discriminant
➔ m_{lljj}





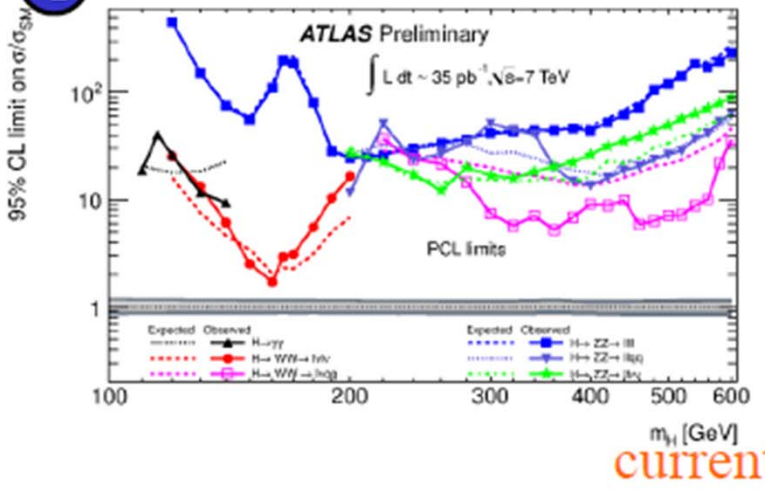


- Most sensitive channel in 200-400 GeV
- Excluded 10.5 × SM for m_H=300 GeV

- Good sensitivity in 200-600 GeV

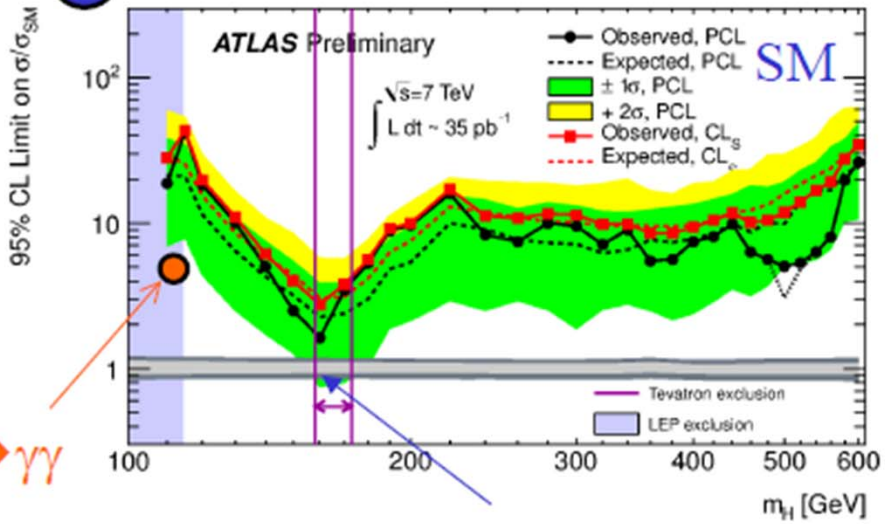
Exclusion limits

1 individual channels



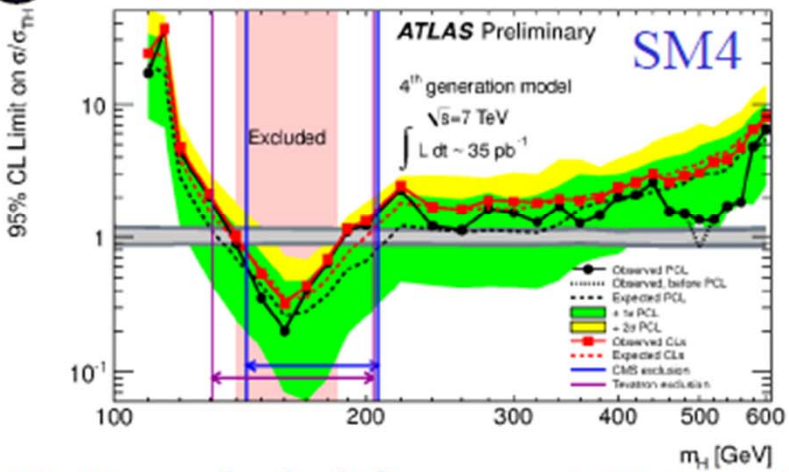
current H→γγ

2 combination



Atlas approaching SM (x1.6 SM)
Tevatron excl. limit

3



SM4 excluded for m_H : 140-185 GeV

arXiv:1106.2748

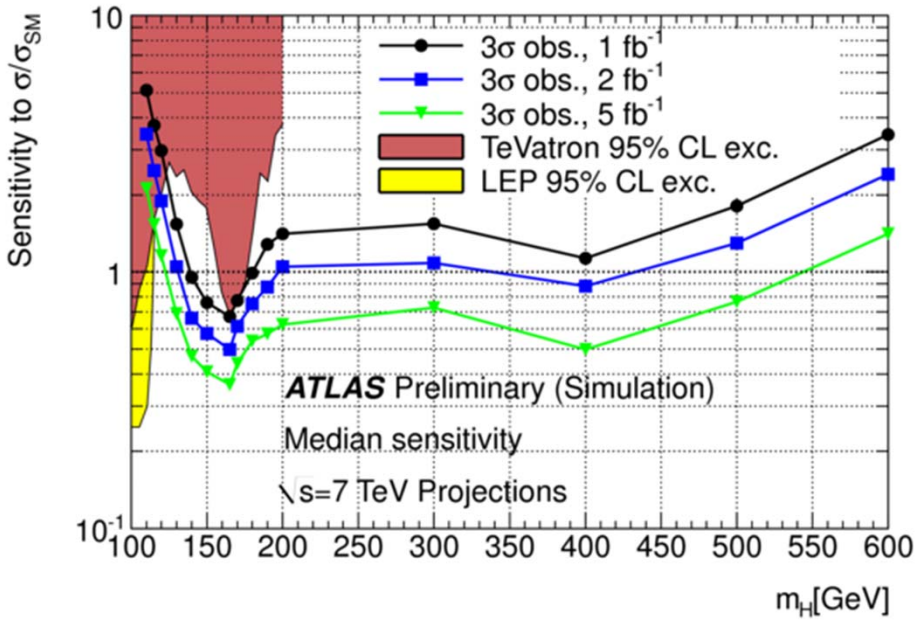
ATL-PHYS-PUB-2010-015

Higgs prospects with ~1 fb^{-1}

► SM Higgs

-- Conservative analysis scenario (cut based, robust systematic error estimates)

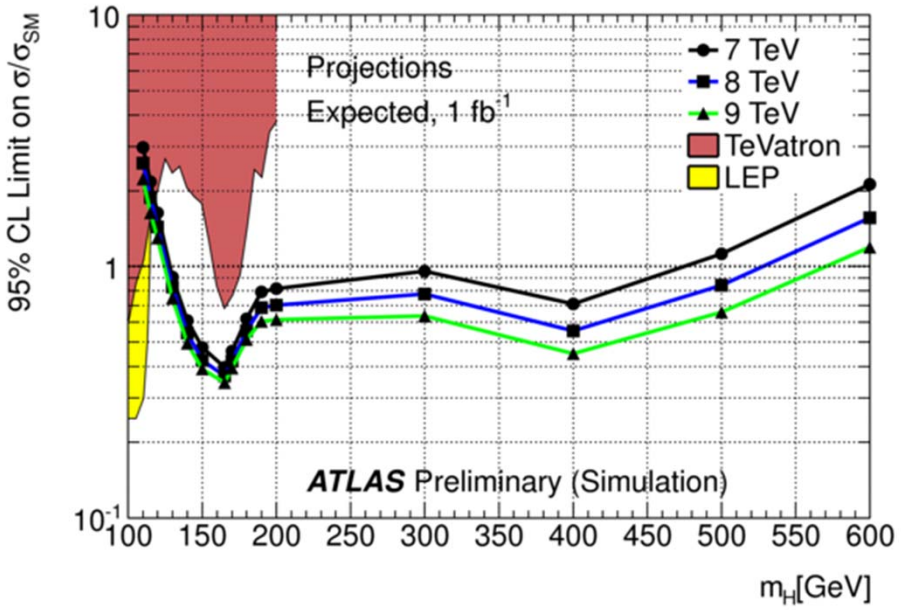
● Observation sensitivity (median)



→ 3σ observation: 139 < m_h < 180 GeV

(~50% chance to 3σ : 200 < m_h < 430 GeV)

● 95% CL exclusion



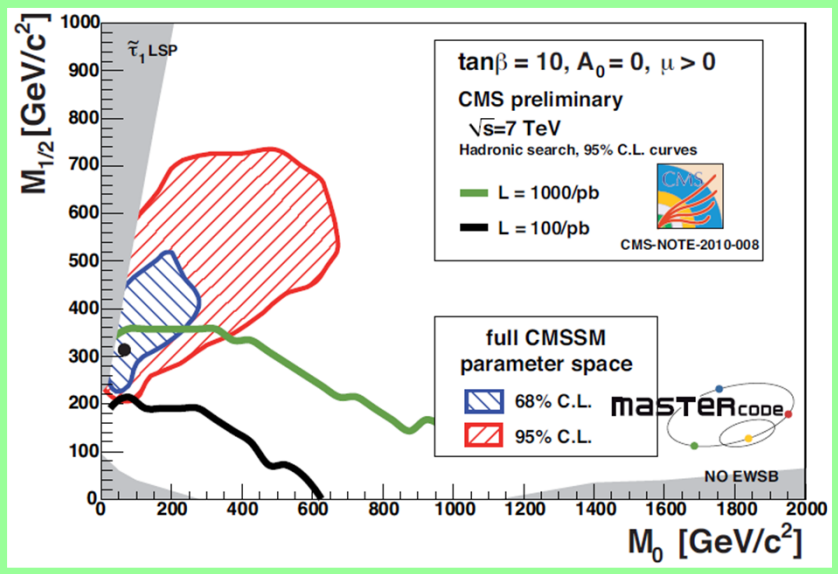
→ Exclusion: 129 < m_h < 460 GeV

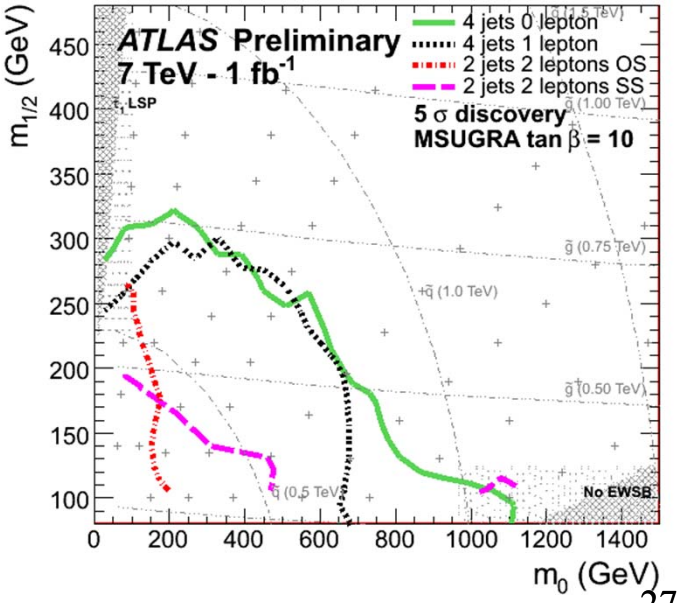
(~1 fb^{-1} @ 7 TeV)

● Reminder: 1 fb^{-1} = already we have in our hand.

→ Now, no surprise if we see surprise in our data

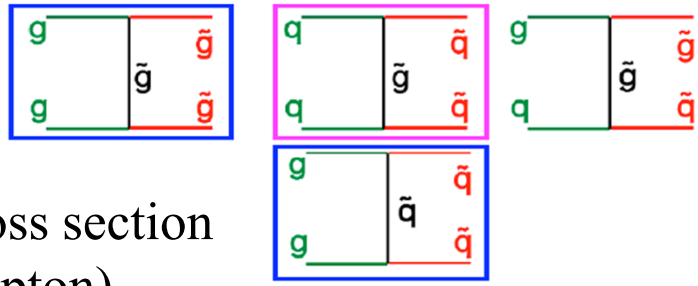
SUSY searches





S. Heinemeyer, Feb/2011
"Prediction for LHC" (fit on EW, B rare, g-2)

SUSY searches @ LHC



- SUSY @ LHC
  - -- Gluino/squark pair can be produced 'strongly' via t-channel exchange → large production cross section
  - -- Cascade decays to lighter ones → multi-jet, (lepton)
  - -- LSP (if Rp conserved) → E_T^{miss}
  - → Event topology: Multi-jets + E_T^{miss} + (X) X=e, μ, τ,γ, b…

- Model-independent inclusive search based on event topology
  - -- (0, 1…) lepton + (1, ≥2, ≥3, ≥4…) jets + E_T^{miss} + (b-jet)…

Channel	Signature	Main backgrounds
0 leptons + jets + $E_{T,miss}$	≥ 2–4 jets, large $E_{T,miss}$, $m_{eff}^{(*)}$	W / Z + jets, top, QCD
1 lepton + jets + $E_{T,miss}$	≥ 3 jets, large $E_{T,miss}$, m_{eff}, m_T	top, W / Z + jets
2 leptons (SS / OS) + jets + $E_{T,miss}$ (also "flavour subtraction" OS analysis)	large $E_{T,miss}$	SS: Fakes, diboson; OS: top, Z + jets, also cosmics ($\mu\mu$)
≥ 3 leptons + jets + $E_{T,miss}$	≥ 2 jets, $E_{T,miss}$, $m_{l+l-} \neq m_Z$	top, Z + jets
(**) 0(1) lepton + b-jets + $E_{T,miss}$	≥ 3(2) jets, $E_{T,miss}$, m_{eff}, (m_T)	top, W / Z + jets
2 photons + $E_{T,miss}$	$E_{T,miss}$	QCD, top, $W(\gamma)$ + jets
+ more targeted analyses for SUSY scenarios with features not covered by above inclusive searches		

Incomplete list

(*) $m_{eff} = E_{T,miss} + \Sigma p_{T,jets}$

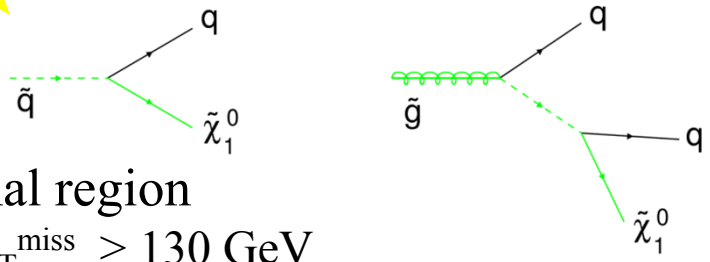
(**) Large mixing scenario can give light sbottom, stop with: $\tilde{g} \to \tilde{b}_1 b$, $\tilde{g} \to \tilde{t}_1 t$

A. Hoecker Planck 2011

ATLAS-CONF-2011-086

2011 data (165 pb^{-1})

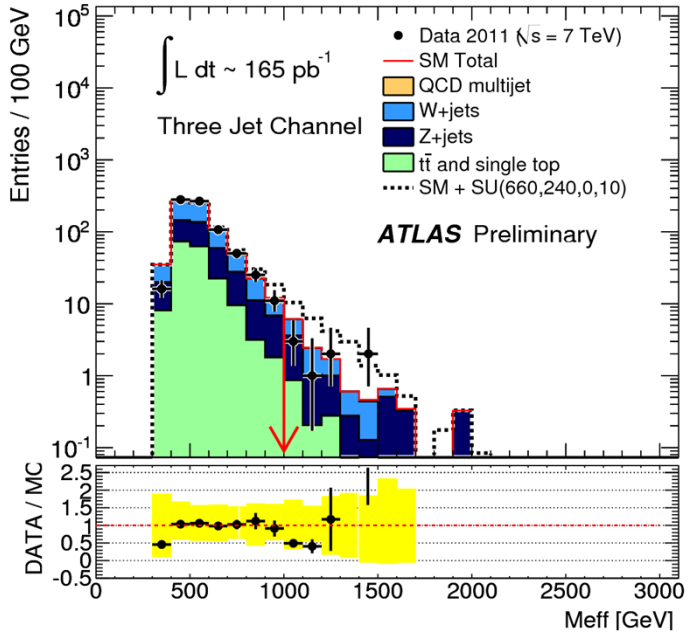
Jets + mE$_T$ [0-lepton]

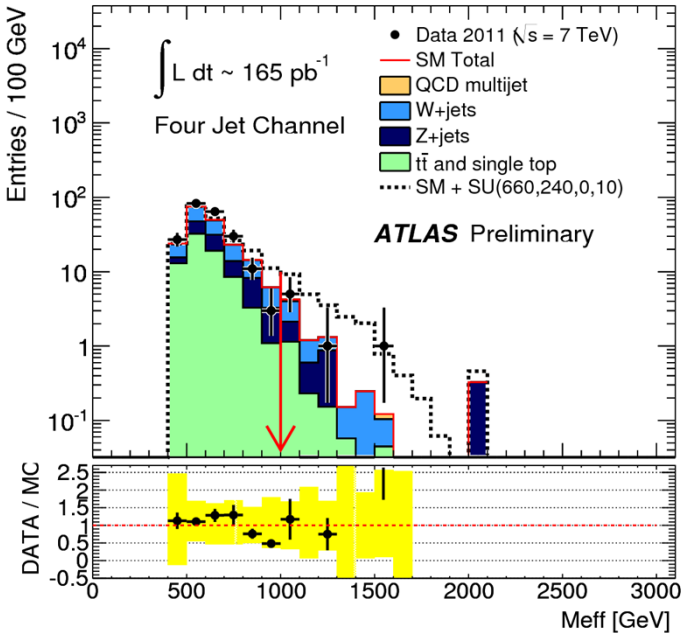


- Signal region
  - -- E_T^{miss} > 130 GeV
  - -- $\Delta\varphi$(jet, E_T^{miss}) > 0.4
  - -- E_T^{miss} / M_{eff} > 0.3 (0.25 for nJet >= 3)
  - -- p_T^{jet} > 130 (40) GeV (for sub-leading)

  Final discriminant cut:
  - -- M_{eff} > 1000 GeV

- Background estimation
  - -- Z+jets (irreducible, Z→νν)
  - -- W+jets
  - -- Top ($t\bar{t} \rightarrow b\bar{b}\tau\nu qq$)
    - → Control regions + Transfer factors (TFs) from MC
  - -- QCD multi-Jets (E_T^{miss} by miss reconstruction)
    - → Control region ($\Delta\varphi$ inverted) TFs data-driven



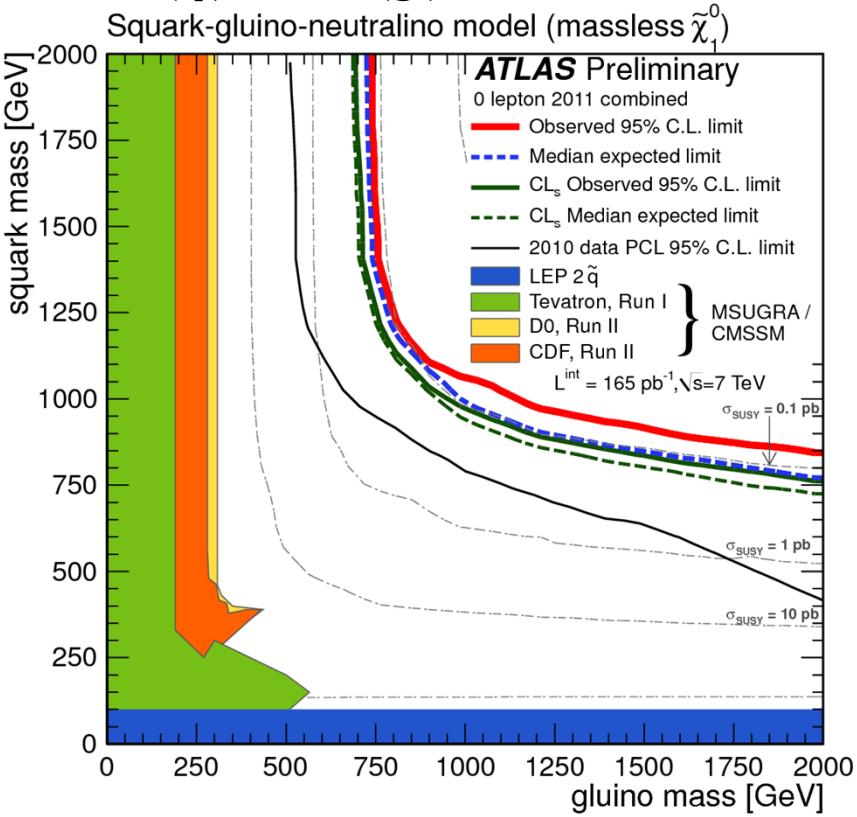


2011 data
(165 pb^{-1})

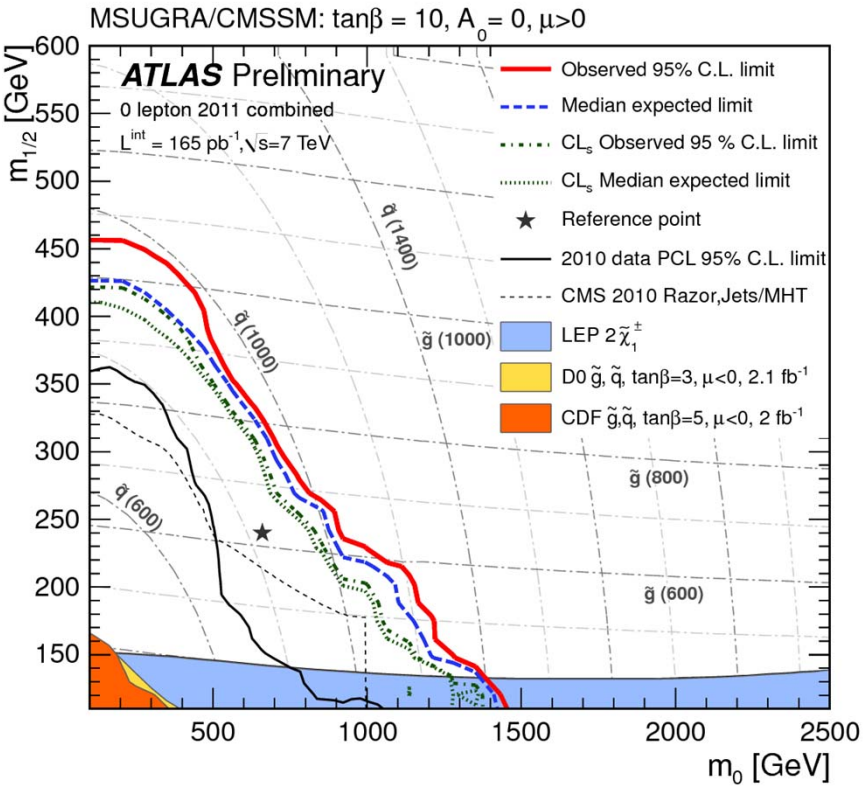
ATLAS-CONF-2011-086

Jets + mE$_T$ [0-lepton]

▶ $m(\tilde{q})$ vs $m(\tilde{g})$



▶ $m_{1/2}$ vs m_0



- In MSUGRA/CMSSM,
  $m(\tilde{g}) = m(\tilde{q}) < 950$ GeV and $m_{1/2} < 455$ GeV are excluded.
- Cutting into a new territory of SUSY parameter spaces

2011 data (165 pb^{-1}) New @ LHCC 14/6

ATLAS-CONF-2011-090

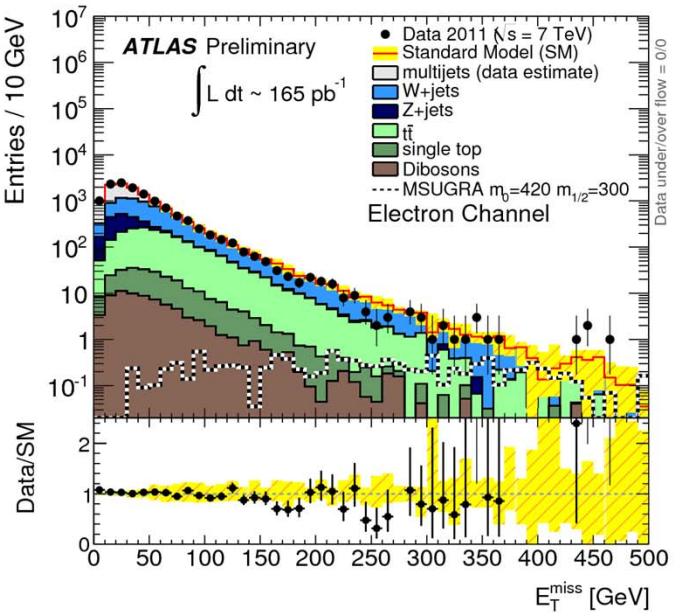
Jets + mE$_T$ [1-lepton]

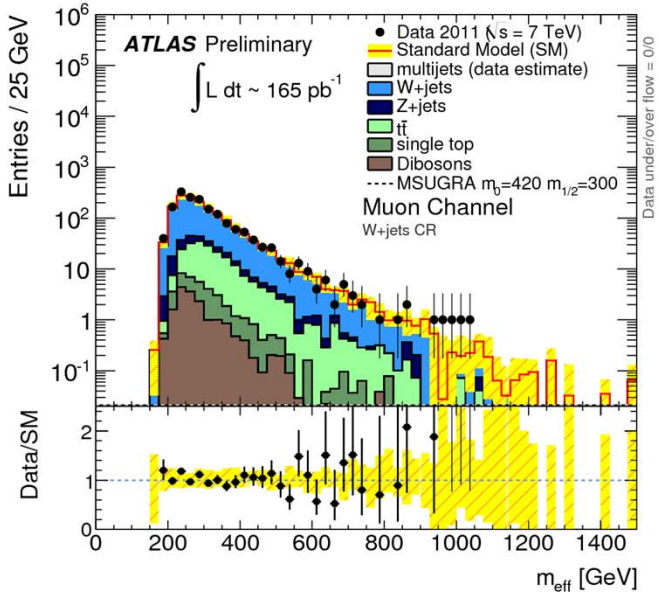
$$\tilde{q}_L \to q\tilde{\chi}^{\pm} \to q l^{\pm} \nu \tilde{\chi}_1^0$$
$$\tilde{g} \to q\bar{q}'\tilde{\chi}^{\pm} \to q\bar{q}' l^{\pm} \nu \tilde{\chi}_1^0$$

- Signal region
  - -- $p_T > 25$ (20) GeV for e (μ)
  - -- $E_T^{miss} > 125$ GeV
  - -- $m_T > 100$ GeV
  - -- $E_T^{miss} / M_{eff} > 0.25$

  Final discriminant cut
  - -- $M_{eff} > 500$ GeV

- Background estimation
  - --W+jets
  - -- Top
    - → Control regions + Transfer factors (TFs) from MC
  - -- QCD multi-Jets (E_T^{miss} by miss reconstruction)
    - → Control region TFs data-driven

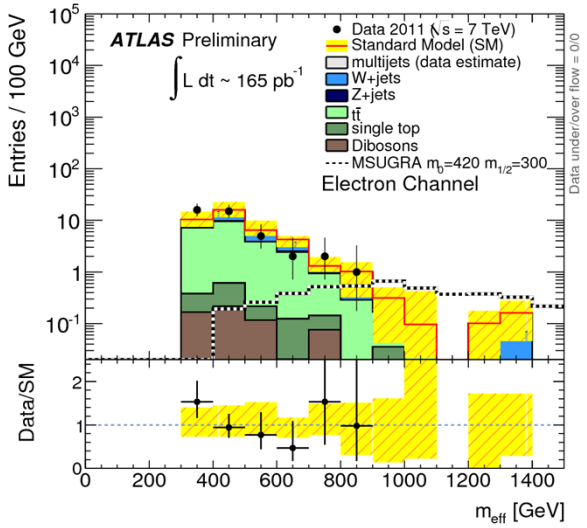


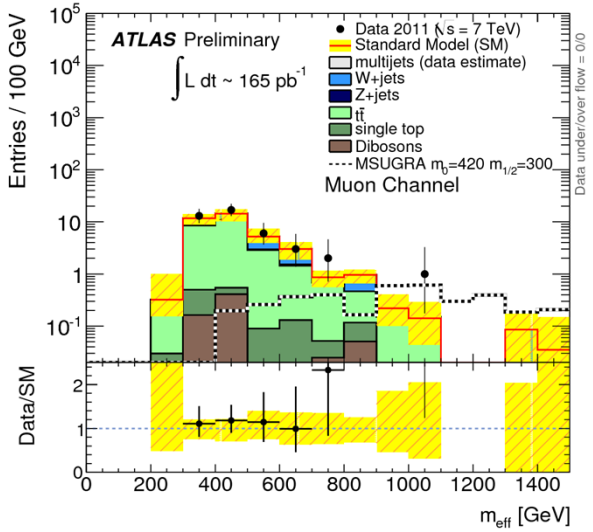


2011 data (165 pb^{-1}) New @ LHCC 14/6

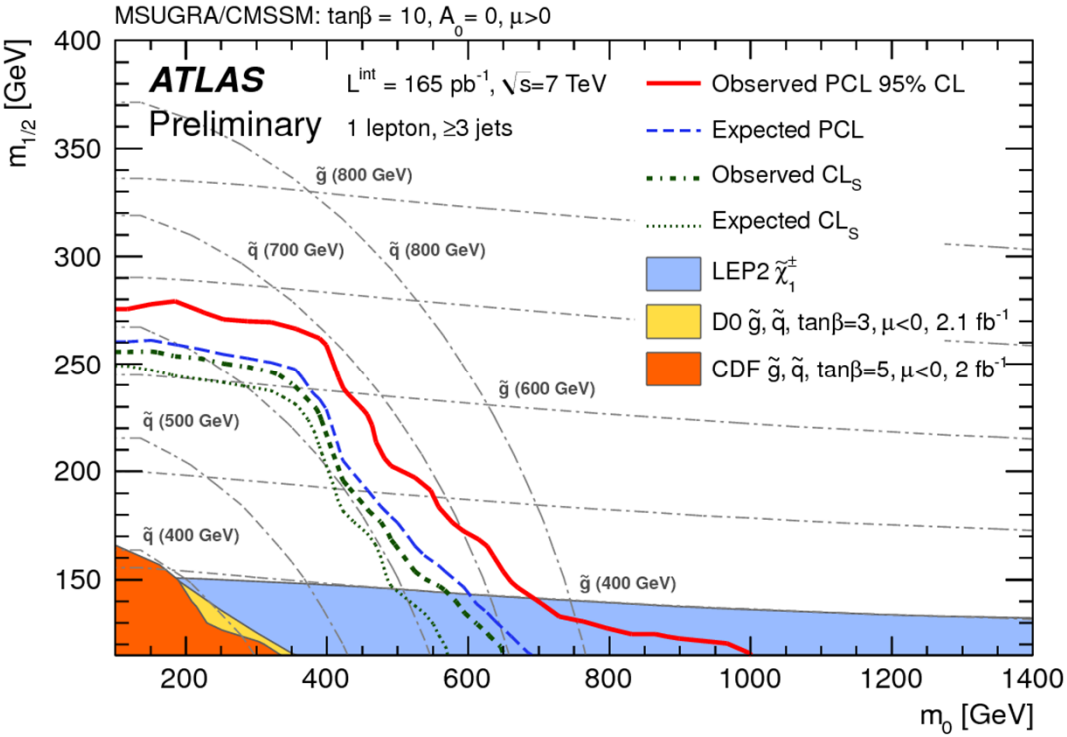
ATLAS-CONF-2011-086

Jets + mE$_T$ [1-lepton]





▶ $m_{1/2}$ vs m_0



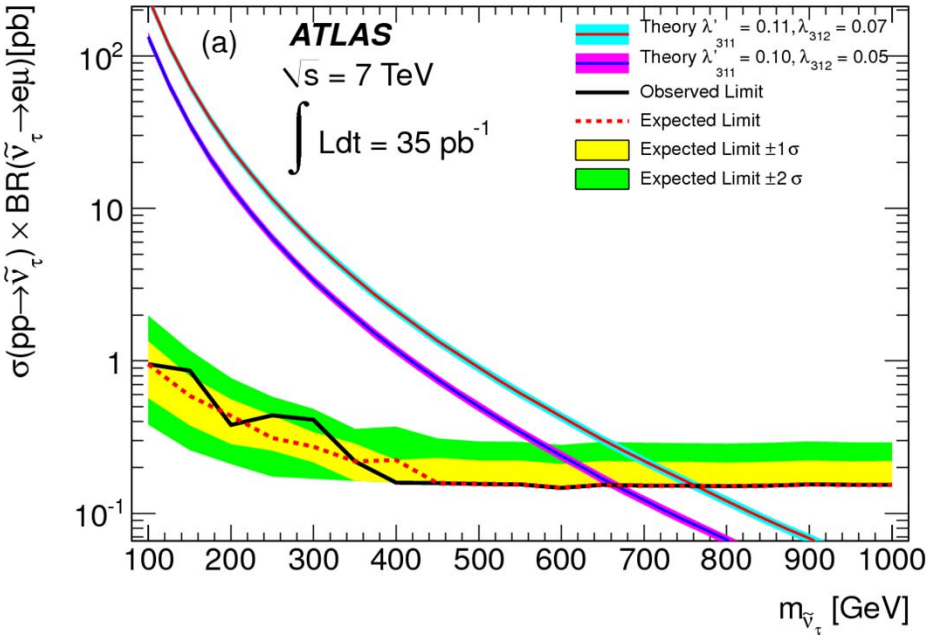
arXiv:1103.5559

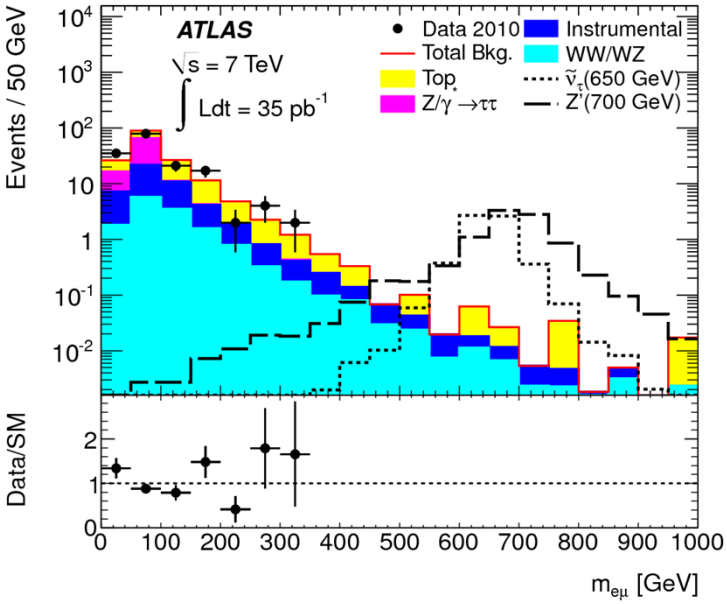
e + μ

- Benchmark: R-parity violating SUSY

$$d\bar{d} \xrightarrow[\lambda'_{311}]{} \tilde{\nu}_\tau \xrightarrow[\lambda_{321}]{} e^{\pm}\mu^{\mp}$$

- Very clean signals: isolated, $p_T^{\,l} > 20$ GeV





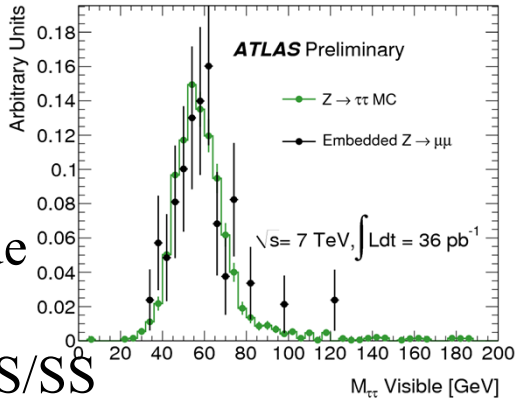
- $m(\tilde{\nu}_\tau) < 750 GeV$ for (λ'_{311}=0.11, λ'_{312}=0.07) excluded

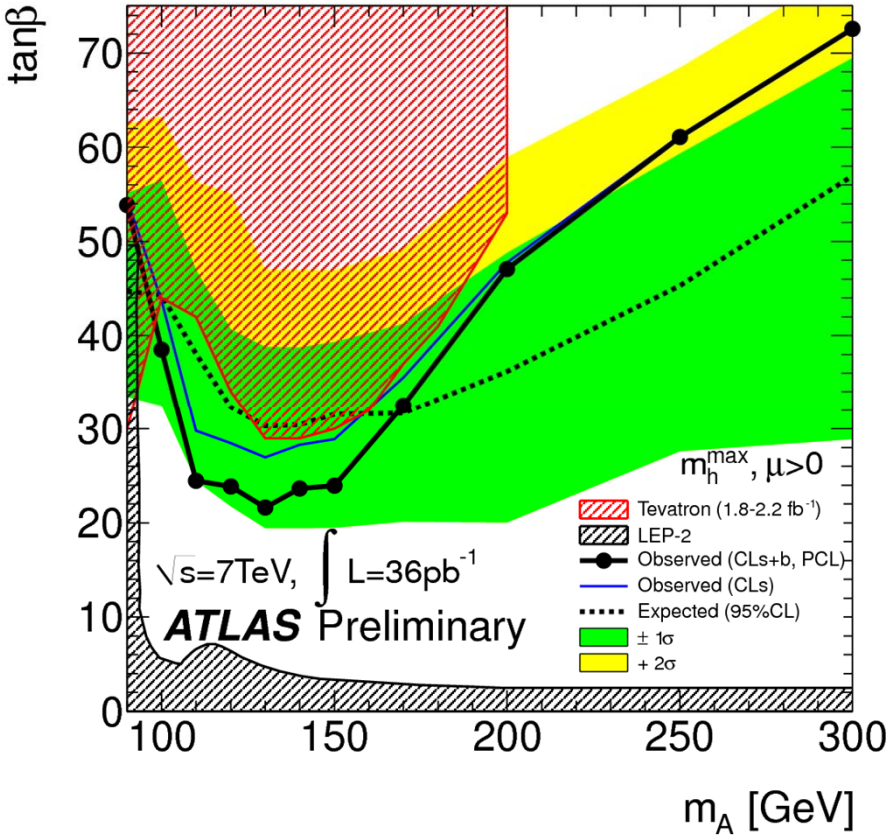
ATLAS-CONF-2011-024

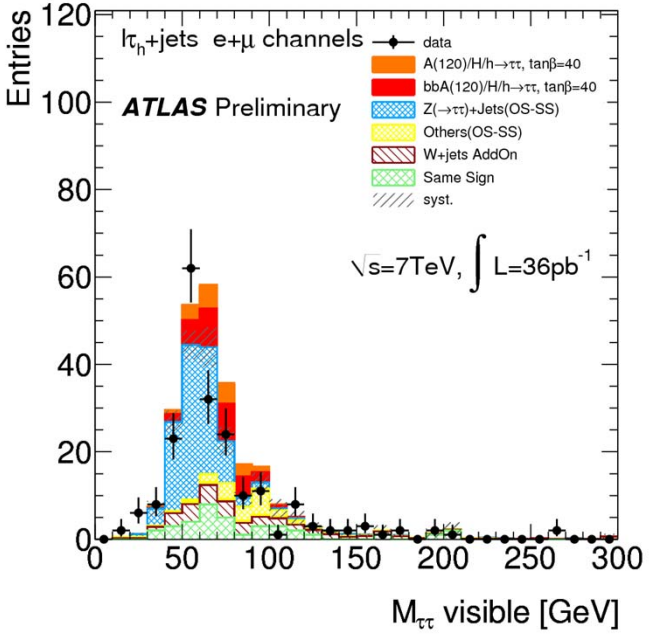
MSSM A/H/h→ττ

- $e/\mu + \tau_{had}$
- Event Selection
  - -- 1 isolated e/μ with $p_T^{\,l} > 20$ GeV
  - -- 1 had τ、charge opposite to e/μ
  - -- $E_T^{miss} > 20$ GeV
  - -- $m_T < 30$ GeV

- Background estimation
  - -- $Z(\rightarrow\tau\tau)$+jets : embedding technique
  - -- W+jets: control sample + OS/SS







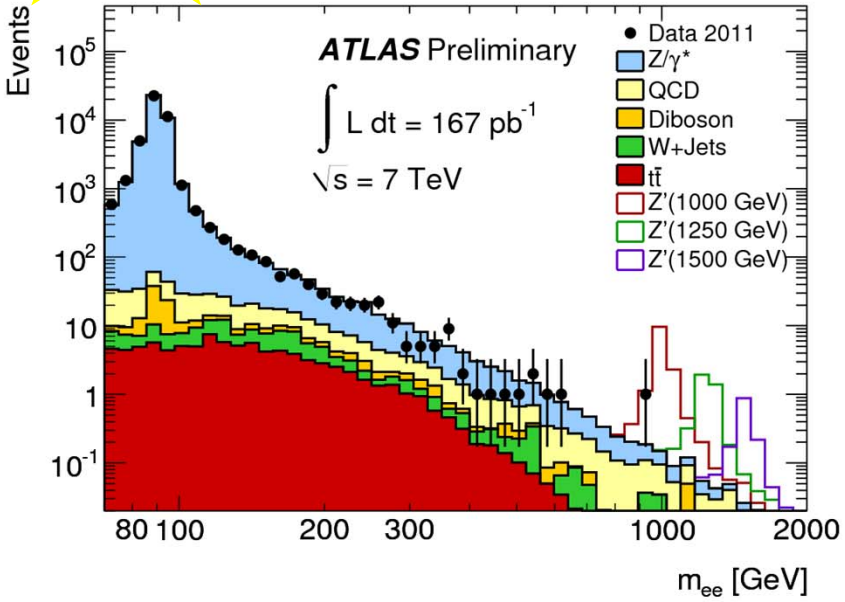
- Excluded:
  m_A=110-150 GeV (tanβ=23)

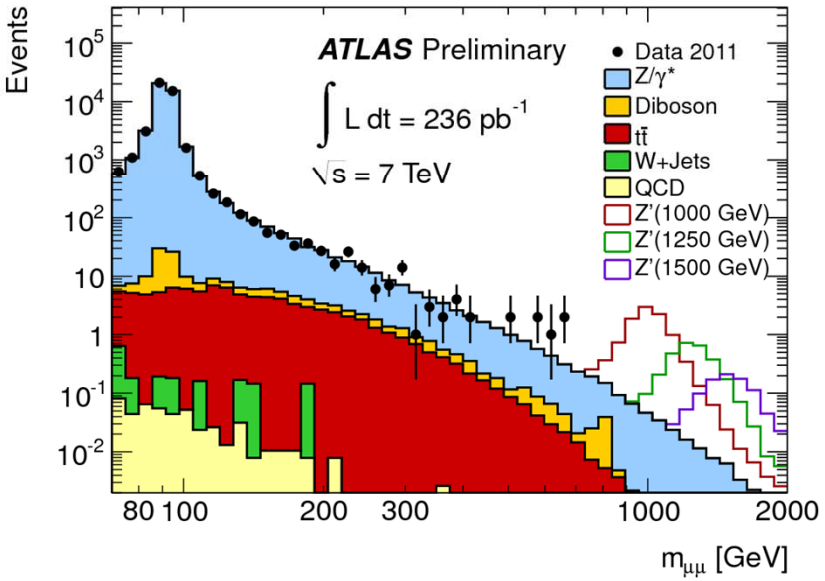
Other BSM searches

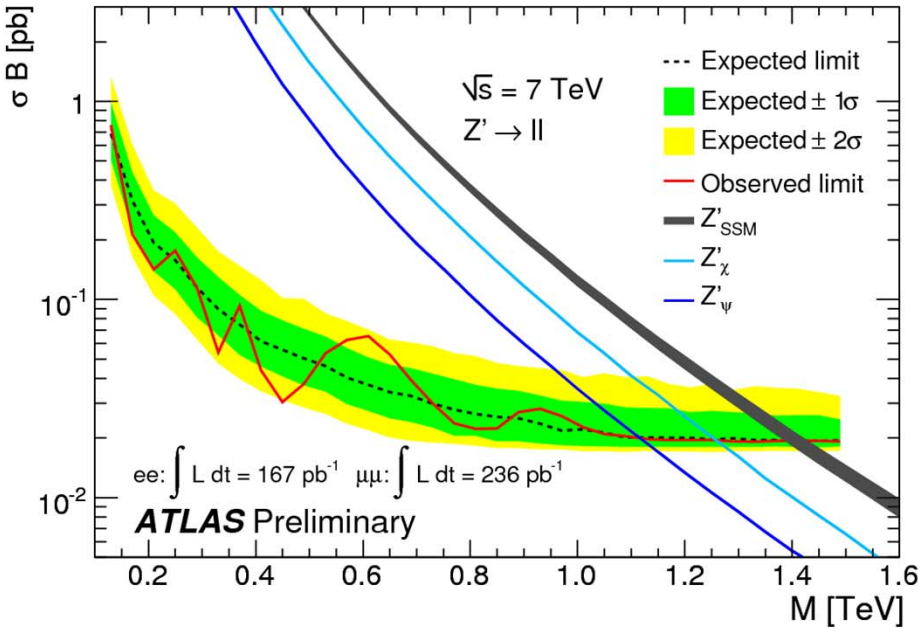
ATLAS-CONF-2011-083

2011 data (236 pb^{-1})

Resonance search in M(lep-lep)







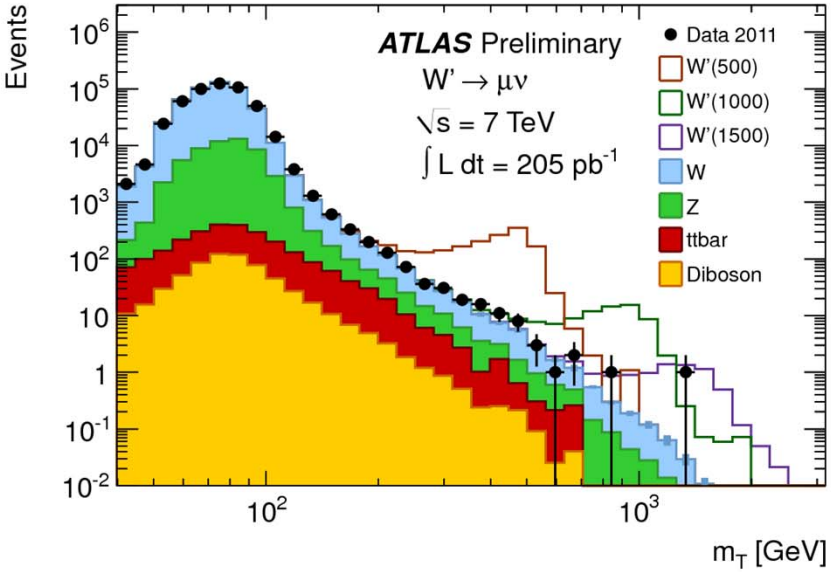
- Benchmark: Z'
  - Sequential Standard Model (SSM)
    -- Z': same coupling to fermion as Z

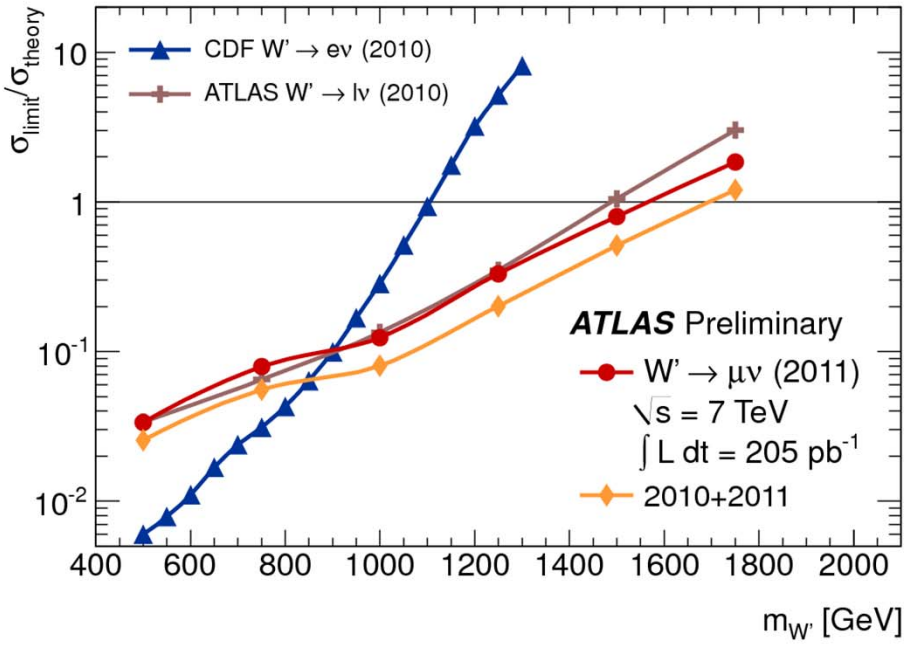
➔ M(Z') < 1.408 TeV excluded.

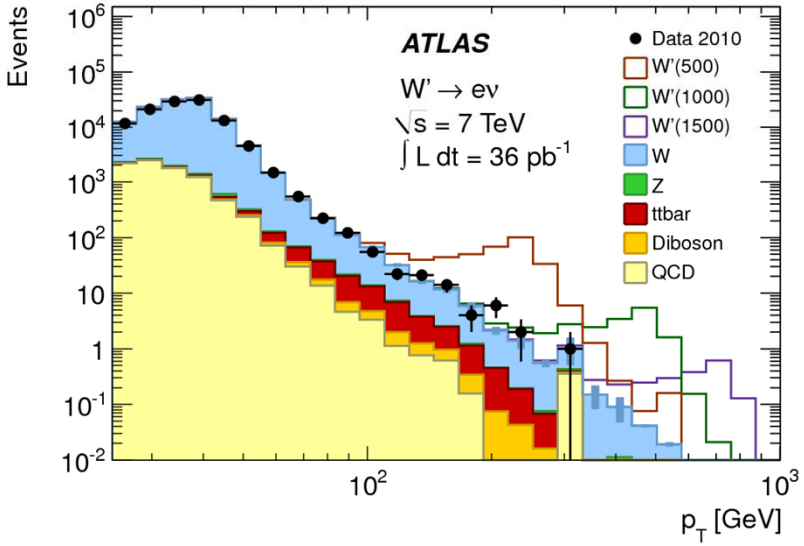
ATLAS-CONF-2011-082

2011 data ($205\ pb^{-1}$)

Resonance search in M(lep-mE$_T$)







- Benchmark: W'
  - Sequential Standard Model (SSM)
    -- W': same coupling to fermion as W

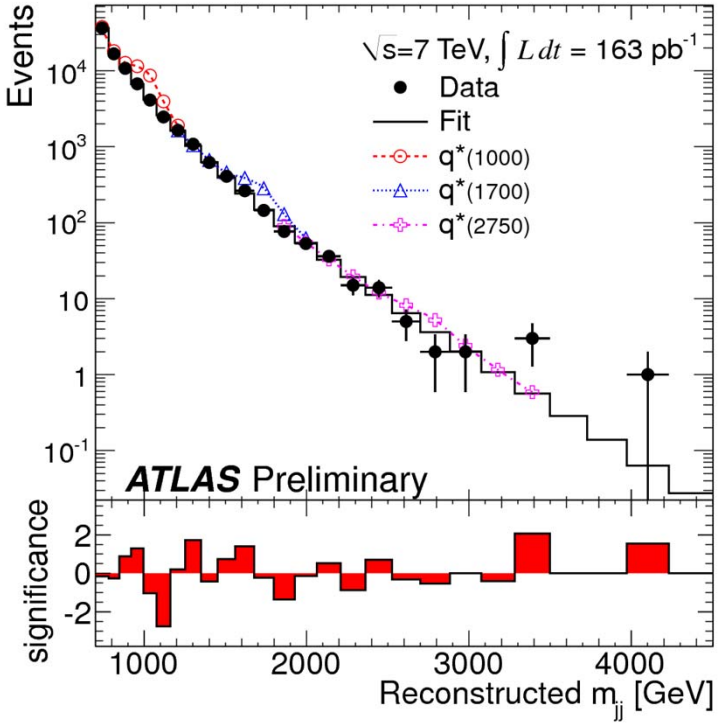
➔ M(W') < 1.70 TeV excluded.

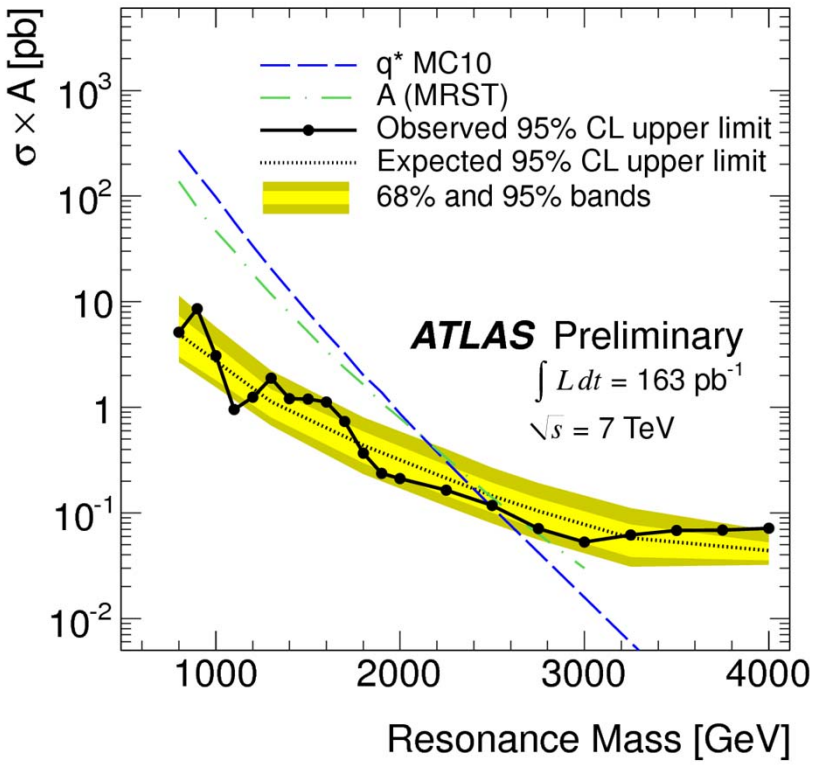
ATLAS-CONF-2011-081

2011 data (163 pb^{-1})

Resonance search in M(jet-jet)

▶ Benchmark: Excited Quark





- Fit with smooth function $\frac{dN}{dx} = p_1(1-x)^{p2}\, x^{p3+p4\ln x}$ + BumpHunter
- Excluded q* mass range : $0.80 < m_{q^*} < 2.49$ TeV

SUMMARY OF MASS LIMITS

Several table entries: to be updated if approved

channel	particle	Limits [TeV]
jet+MET+X	mSUGRA g, q	0.950* if m(g)=m(q)
bjets+MET	gluino	0.590* if m(b)<m(g)
Long lived particles	gluino	0.562-0.584*
	stop	0.309*
	sbottom	0.294*
	slepton	0.110-0.136
di-jets	Excited quarks	2.49*
	axigluons	2.67*
di-leptons	SSM Z'	1.407
	E6 Z'	1.116-1.259
Lep+MET	SSM W'	1.70

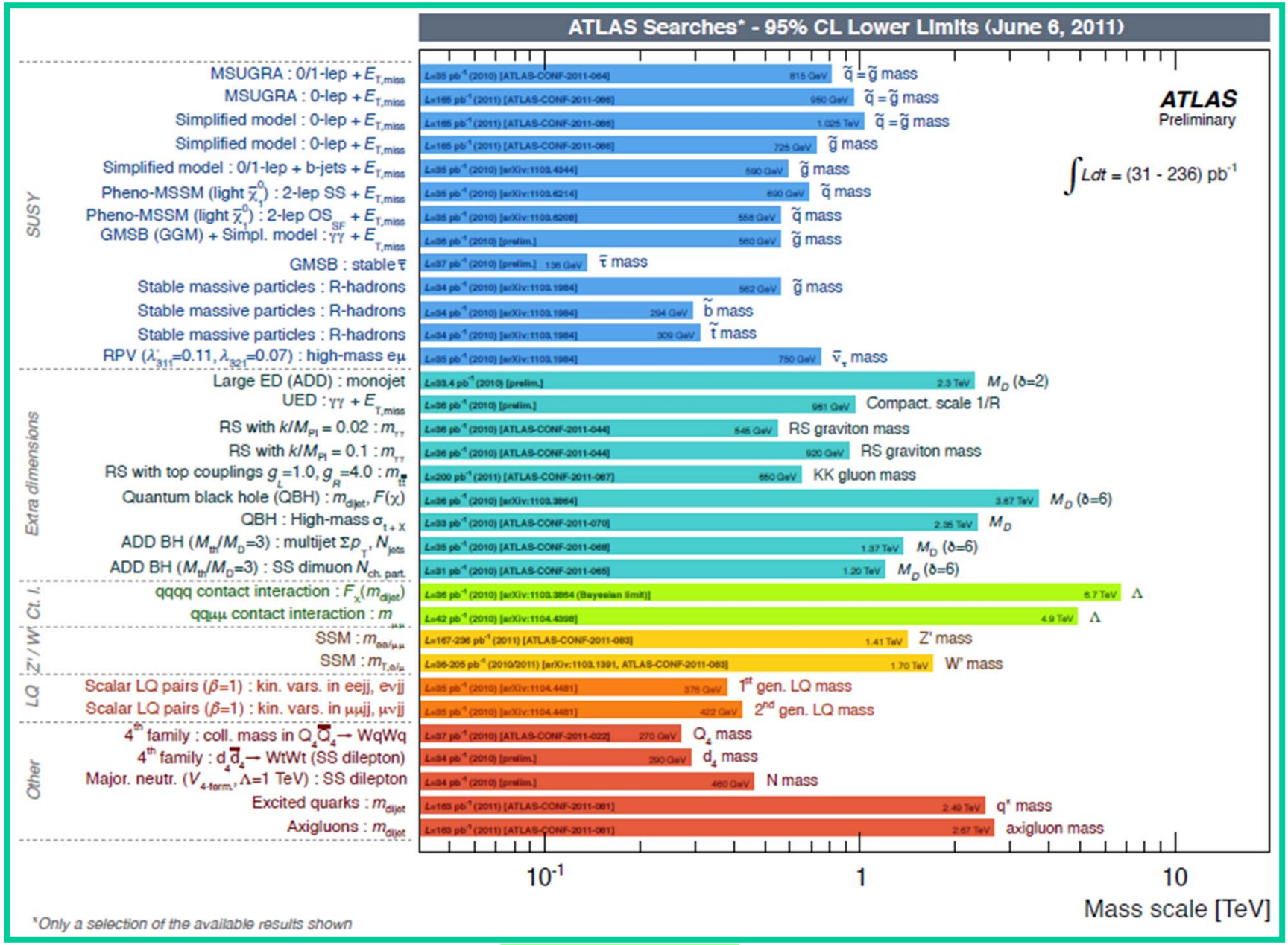
channel	Model/particles	Limits [TeV]
Lep+jets +MET	1st gen. LQ(β=1)	0.376
	2nd gen. LQ(β=1)	0.422*
γγ+MET	UED(1/R)	0.961
	Gluino (GGM)	0.560
γγ	RS graviton	0.920 (k/M_{Pl}=0.1)
lqνlqν	4th gen. u	0.270

* World's best limit

2010 data already allowed us to set better limits than Tevatron/LEP searches In most channels

50-100 times more data expected by the end of 2011!

24


ATLAS Searches* - 95% CL Lower Limits (June 6, 2011)
ATLAS
Preliminary
∫Ldt = (31 - 236) pb-1
SUSY
MSUGRA : 0/1-lep + E T,miss
MSUGRA : 0-lep + E T,miss
Simplified model : 0-lep + E T,miss
Simplified model : 0-lep + E T,miss
Simplified model : 0/1-lep + b-jets + E T,miss
Pheno-MSSM (light χ̃1 0) : 2-lep SS + E T,miss
Pheno-MSSM (light χ̃1 0) : 2-lep OS SF + E T,miss
GMSB (GGM) + Simpl. model : γγ + E T,miss
GMSB : stable τ̃
Stable massive particles : R-hadrons
Stable massive particles : R-hadrons
Stable massive particles : R-hadrons
RPV (λ'311=0.11, λ321=0.07) : high-mass eμ
Extra dimensions
Large ED (ADD) : monojet
UED : γγ + E T,miss
RS with k/MPl = 0.02 : mγγ
RS with k/MPl = 0.1 : mγγ
RS with top couplings gL=1.0, gR=4.0 : mtt
Quantum black hole (QBH) : mdijet, F(χ)
QBH : High-mass σ1 + X
ADD BH (Mth/MD=3) : multijet Σp T, N jets
ADD BH (Mth/MD=3) : SS dimuon N ch. part.
Ct. I.
qqqq contact interaction : Fχ(mdijet)
qqμμ contact interaction : mΛ
Z' / W'
SSM : mee/μμ
SSM : mτ,e/μ
LQ
Scalar LQ pairs (β=1) : kin. vars. in eejj, evjj
Scalar LQ pairs (β=1) : kin. vars. in μμjj, μνjj
Other
4th family : coll. mass in Q4Q̄4 → WqWq
4th family : d4d̄4 → WtWt (SS dilepton)
Major. neutr. (V 4-ferm, Λ=1 TeV) : SS dilepton
Excited quarks : mdijet
Axigluons : mdijet
q̃ = g̃ mass
q̃ = g̃ mass
q̃ = g̃ mass
g̃ mass
g̃ mass
q̃ mass
g̃ mass
τ̃ mass
g̃ mass
b̃ mass
t̃ mass
ν̃τ mass
MD (δ=2)
Compact. scale 1/R
RS graviton mass
RS graviton mass
KK gluon mass
MD (δ=6)
MD
MD (δ=6)
MD (δ=6)
Λ
Λ
Z' mass
W' mass
1st gen. LQ mass
2nd gen. LQ mass
Q4 mass
d4 mass
N mass
q* mass
axigluon mass
10-1
1
10
Mass scale [TeV]
*Only a selection of the available results shown

Summary and future plan

- LHC is the explorer of the highest energy frontier, no substitute to it. Given the highest energy, search regions for new physics are being significantly extended

- Running plan:
  - -- 2011-12: Physics run @ 7 TeV
    - * Max inst. Luminosity may increase up to 5×10^{33} $cm^{-2}s^{-1}$
    - * May add a few fb^{-1} more alredy in 2011
  - -- 2014 mid: Physics run @ 14 TeV

- KEK physics seminar on 26/July (c.f. "EPS-HEP 2011" 21-27/July)
  ATLAS results report by Soshi Tsuno (KEK)
  - -- Most probably, many updates with several 100 pb^{-1} or even O(1 fb^{-1})
  - → Stay tuned!