Overview of ATLAS results

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On behalf of the ATLAS Collaboration
INFN and University of Roma Tor Vergata

LHC Days in Split 2012
1-6 October 2012
Split, Croatia

ATLAS experiment: 176 Institutions and 38 Countries, ~2900 physicists

20 years of history from conception to start of operation.
Main milestones:

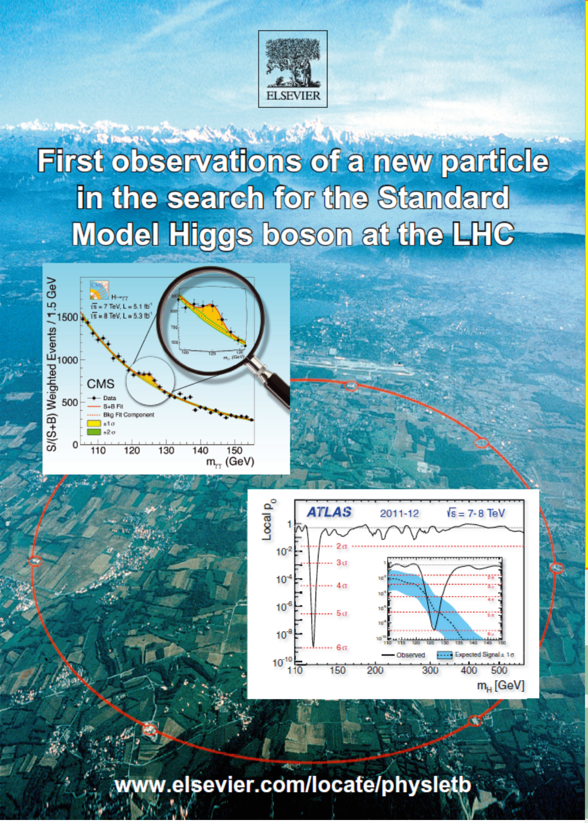
1989: R&D starts

July 4th (CERN and Melbourne)

Italy
Japan

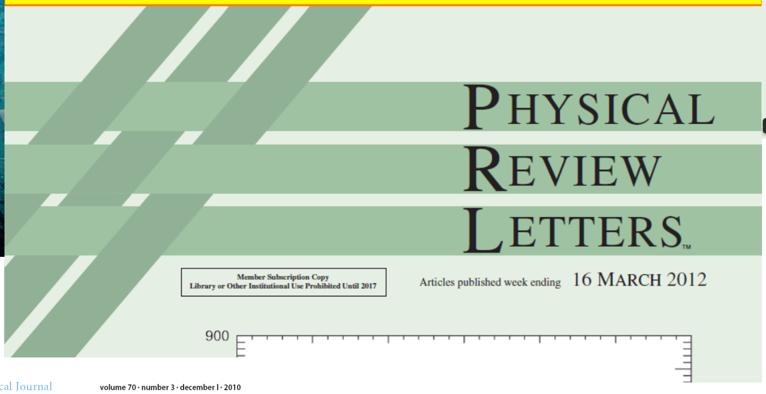
CERN
JINR

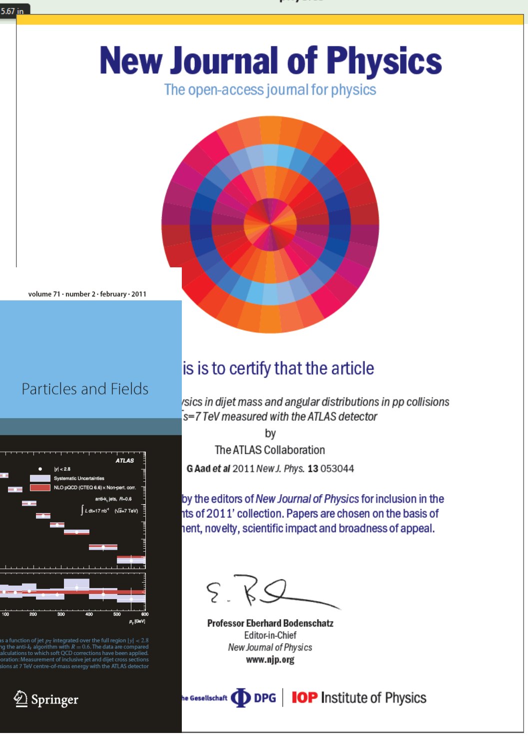
July 2010

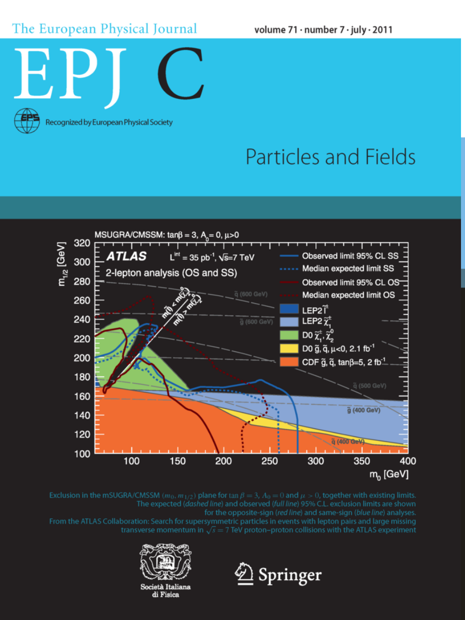


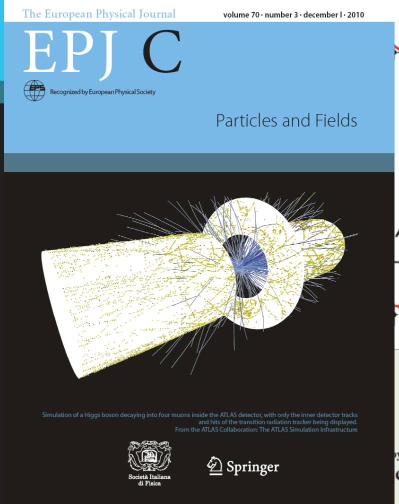
ATLAS submitted/published 192 papers, 401 CONF notes

All ATLAS results available at https://twiki.cern.ch/twiki/bin/view/AtlasPublic









Outline of the talk

- Detector status and operation
  - Highlights on detector performance
- A few selected physics results
  - Precision tests of Standard Model
  - Higgs measurements
  - Supersymmetry searches
  - Exotics searches
- Many more results in the next ATLAS talks
  - I will list the speakers in the presentation

ATLAS Talks at this Conference

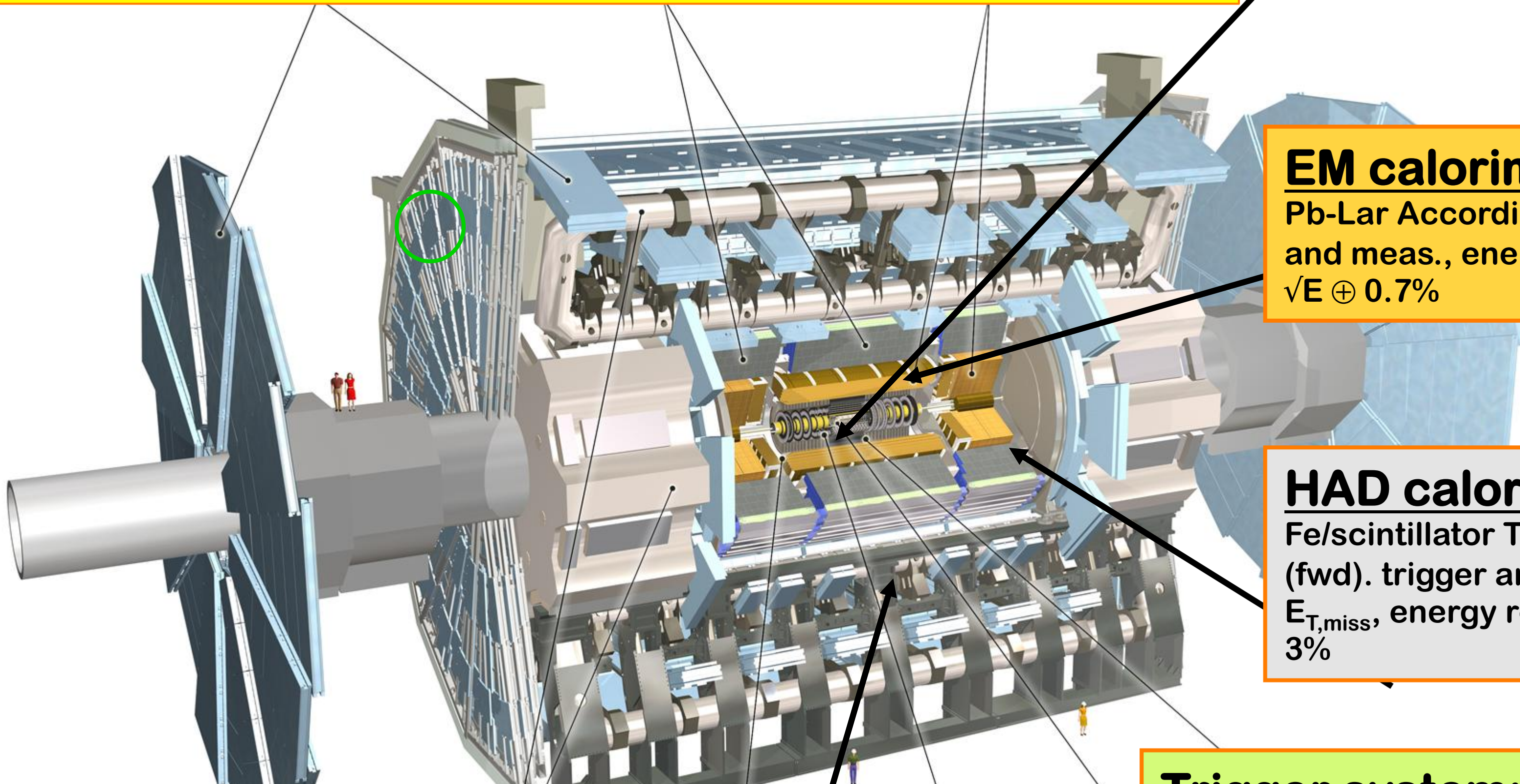
Subject	Speakers
B Physics in ATLAS	Maren UGLAND
QCD ATLAS	James John LACEY
Top Physics in ATLAS	Jaroslava SCHOVANCOVA
W and Z physics in ATLAS	Mauro IODICE
Di-boson cross sections and limits on anomalous couplings	Andreas George PETRIDIS
Higgs ATLAS in ZZ/WW/2gamma	Efstathios PAGANIS
Higgs ATLAS in 2tau/2b + BSM	Yann COADOU
Higgs ATLAS SM combination + properties	Sven KREISS
Search for pair production of supersymmetric particles in R-parity conserving scenarios	Gabriella GAUDIO
Search for supersymmetry in events with resonances or long-lived particles	Lucian Stefan ANCU
Boosted physics at ATLAS	Dominique PALLIN
Overview of Exotica Physics in ATLAS	Mark Stephen COOKE
Upgrade and future of ATLAS	Sergey BURDIN

The ATLAS Detector

L ~ 46 m, ∅ ~ 22 m, 7000 tons
~10^8 electronic channels

- Gigantic general purpose detector with well balanced performance on resolutions and high hermetic acceptance
- Emphasis on lepton measurements with excellent magnets

Inner Tracker ($|\eta|<2.5$, B=2T):
Si Pixels, Si strips, Trans. Rad. Det.
Precise tracking and vertexing, e/π separation, momentum resolution: $\sigma/p_T \sim 0.04\%\ p_T\,(\text{GeV}) \oplus 1.5\%$



EM calorimeter($|\eta|<5$):
Pb-Lar Accordion, e/γ trigger, id. and meas., energy res.: $\sigma/E \sim 10\%/\sqrt{E} \oplus 0.7\%$

HAD calorimetry ($|\eta|<5$):
Fe/scintillator Tiles (cen), Cu/W-LAr (fwd). trigger and meas. of jets and $E_{T,miss}$, energy res.: $\sigma/E \sim 50\%/\sqrt{E} \oplus 3\%$

Muon Spectrometer ($|\eta|<2.7$): air-core toroids with gas-based muon chambers.
trigger and meas. with momentum resolution < 10% up to $E_\mu \sim 1$ TeV

Trigger system: 3-levels reducing the rate from 40 MHz to ~200 Hz

ATLAS operation status

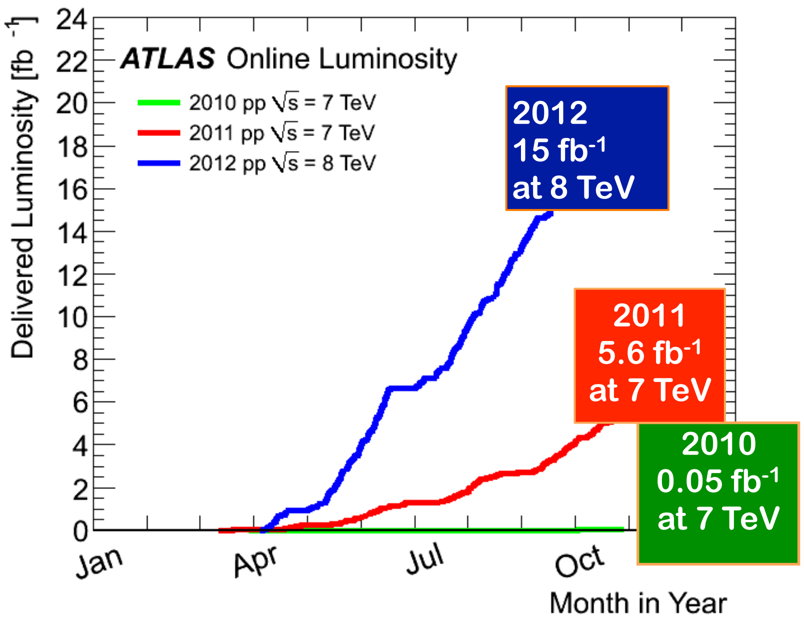
Fraction of operational channels near 100% for most of the subdetector systems !

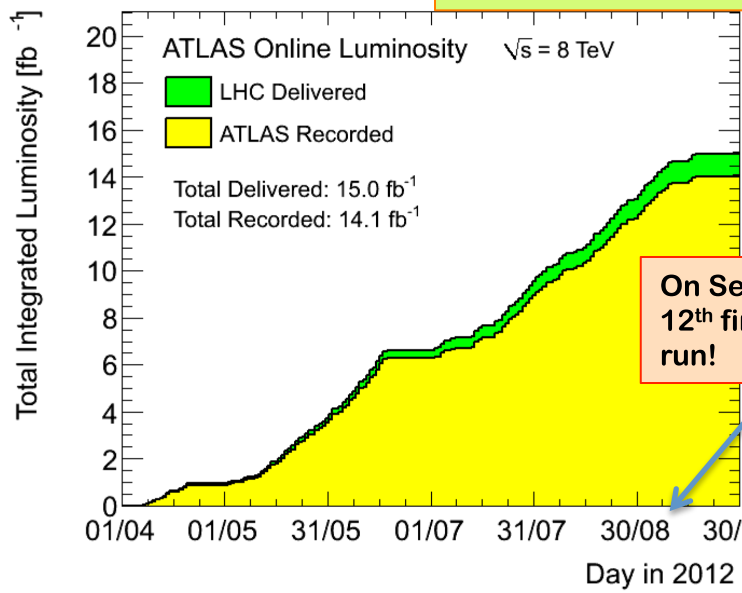
Subdetector	Number of Channels	Approximate Operational Fraction
Pixels	80 M	95.9%
SCT Silicon Strips	6.3 M	99.3%
TRT Transition Radiation Tracker	350 k	97.5%
LAr EM Calorimeter	170 k	99.9%
Tile calorimeter	9800	99.5%
Hadronic endcap LAr calorimeter	5600	99.6%
Forward LAr calorimeter	3500	99.8%
LVL1 Calo trigger	7160	100%
LVL1 Muon RPC trigger	370 k	99.5%
LVL1 Muon TGC trigger	320 k	100%
MDT Muon Drift Tubes	350 k	99.7%
CSC Cathode Strip Chambers	31 k	97.7%
RPC Barrel Muon Chambers	370 k	97.1%
TGC Endcap Muon Chambers	320 k	99.7%

Data Taking and data quality

Outstanding performance of LHC!

Peak Luminosity: 7.73 x 10^{33} cm^{-2} s^{-1}





On September 12th first p-Pb run!

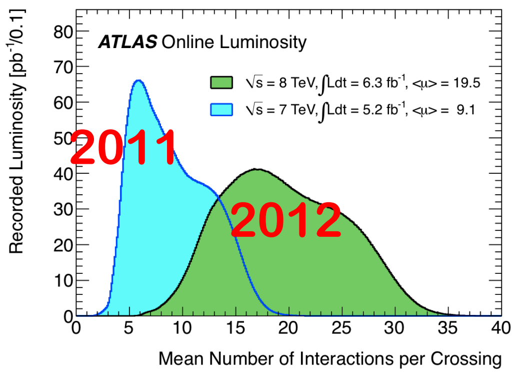
- **Data-taking efficiency = (recorded lumi)/(delivered lumi): ~ 93.7%**
- **Fraction of data after data quality cuts used for analysis: ~ 94%**
- **Fraction of delivery luminosity used for physics: ~ 90%**

→ excellent performance of data taking and data quality

Inner tracking Detectors			Calorimeters				Muon Detectors				Magnets	
Pixel	SCT	TRT	LAr EM	LAr HAD	LAr FWD	Tile	MDT	RPC	CSC	TGC	Solenoid	Toroid
99.8	99.6	99.2	97.5	99.2	99.5	99.2	99.4	98.8	99.4	99.1	99.8	99.3

A challenge in 2012 : mastering pile up events

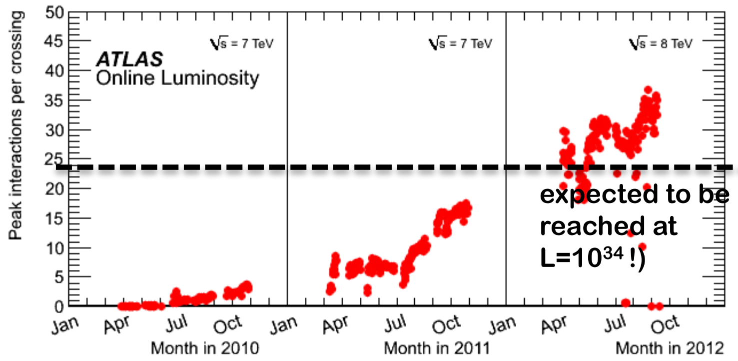
Numbers of interactions per bunch crossing



$\mu = L \times \sigma_{inel} / (n_{bunch} \times f_r)$

Huge efforts invested over the last months to minimise the impact of pile-up on physics

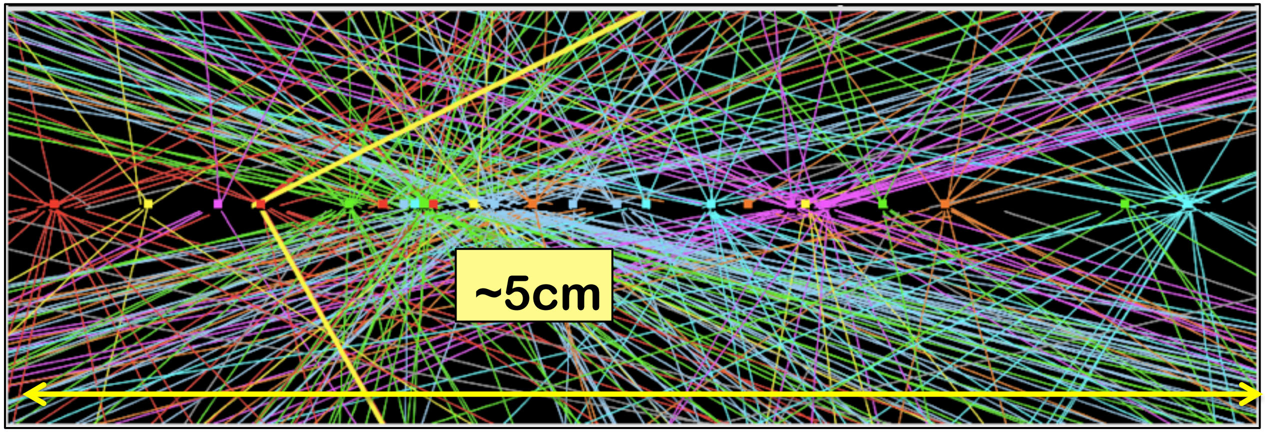
peak # collisions vs time



Strategy:

- Developed pile-up robust fast triggers
- Optimized reconstruction and identification of physics objects
- Precise modeling of in-time and out-of-time pile-up in simulation
- Flexible computing model to handle x2 trigger rate and x2 event size

Z→μμ event from 2012 data with 25 reconstructed vertices



Trigger in 2012

Menu optimised for 7×10^{33} $cm^{-2}s^{-1}$ at 8 TeV:

- **improvement of object selection, e.g. isolation, to keep single lepton threshold low (in-spite of 2 x lumi and 2 x pile-up with respect to 2011)**
- **Pile-up robust algorithms close to offline selections**

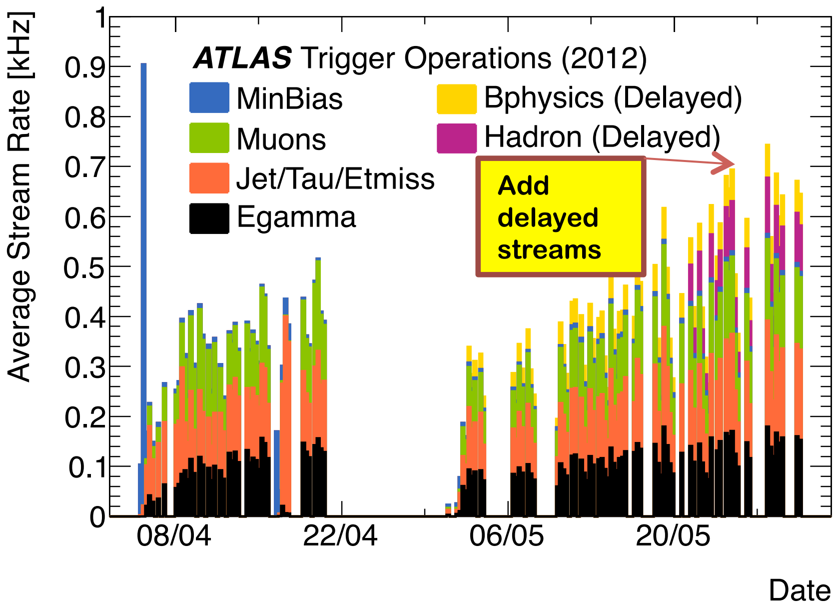
Operations in 2012 show trigger is coping very well (in terms of rates, efficiencies, robustness, ..) with harsh conditions while meeting physics requirements

Trigger rates:

- **Level 1 rates ~ 65 kHz**
- **Level 2 rates ~ 5 kHz**
- **Event Filter (EF) rates ~ 400 Hz**

Main triggers at 7×10^{33} $cm^{-2}s^{-1}$

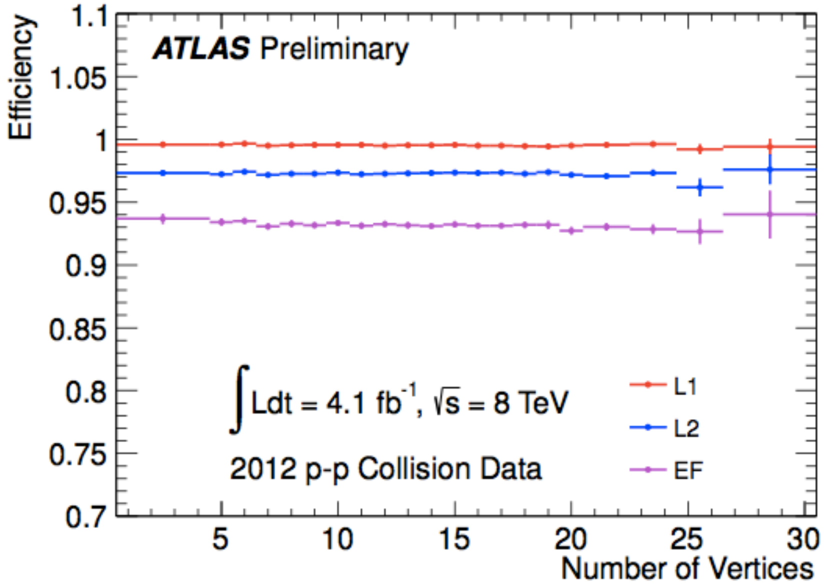
Offline (GeV)	L1 thr (GeV)	L1 rate (kHz)	EF thr (GeV)	EF rate (Hz) @5 10^{33}
e > 25	18	17	24	70
μ > 25	15	8	24	45
dilepton	10-15	15	8-18	21
2γ 25-40	10-16	12	20-35	17
2τ 30-45	11-15	12	20-29	12
Jet > 360	75	2	2	5
MET 120	40	2	80	17



(*) Additionl b-physics and hadronic triggers to 'delayed' streams for later processing

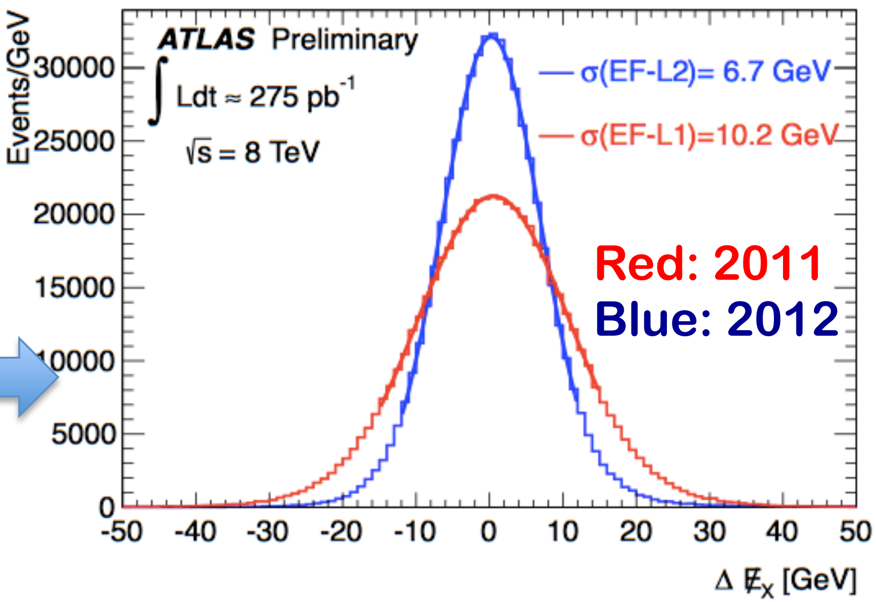
Trigger performance in 2012

Efficiency of Inclusive single electron trigger as a function of pile-up



High efficiency for electrons with $E_T > 25$ GeV and $|\eta|<2.47$ using isolation – independent of pile-up

E_T^{miss} Trigger resolution



E_T^{miss} threshold lower than 2011. Better trigger resolution in 2012 thanks to:

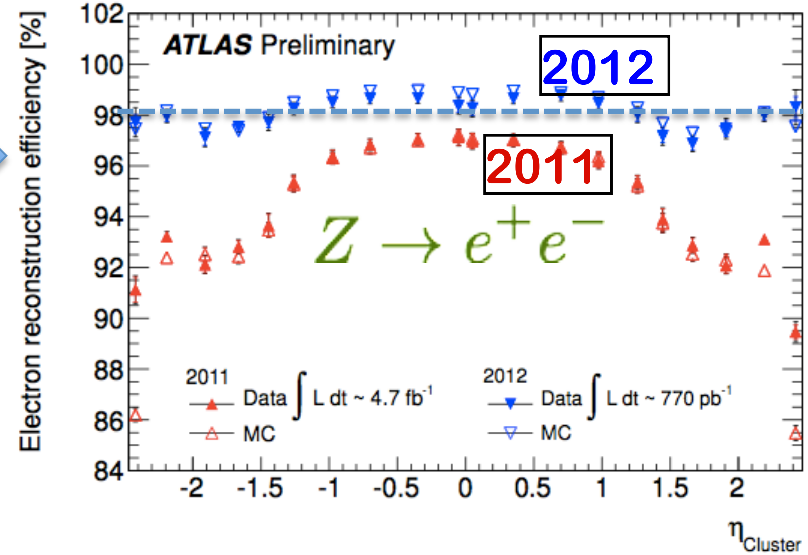
- Noise cuts at L1 to suppress pile-up
- Fast Front End Board sums at Level 2
- Better algorithm at Event Filter

Electron Performance

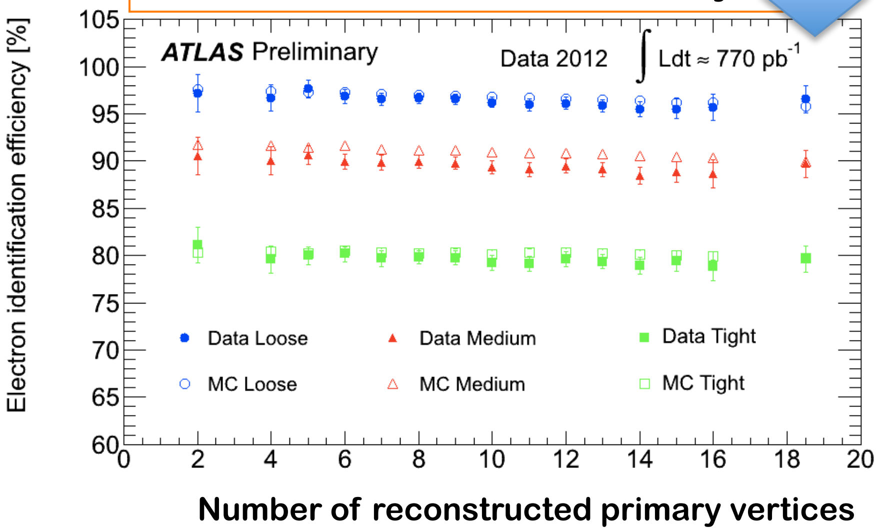
- **Electron reconstruction improved**
  - More performing track cluster matching
  - Track pattern recognition takes in account of bremsstrahlung losses
  - Achieved ~ 98% reconstruction efficiency, ~ flat vs η and E_T

- **Retuning of cuts (shower shape)**
  - Identification efficiency →achieved ~ 95%, ~ flat vs pile-up
  - excellent energy scale stability in time and as a function of pileup to better than 0.1%

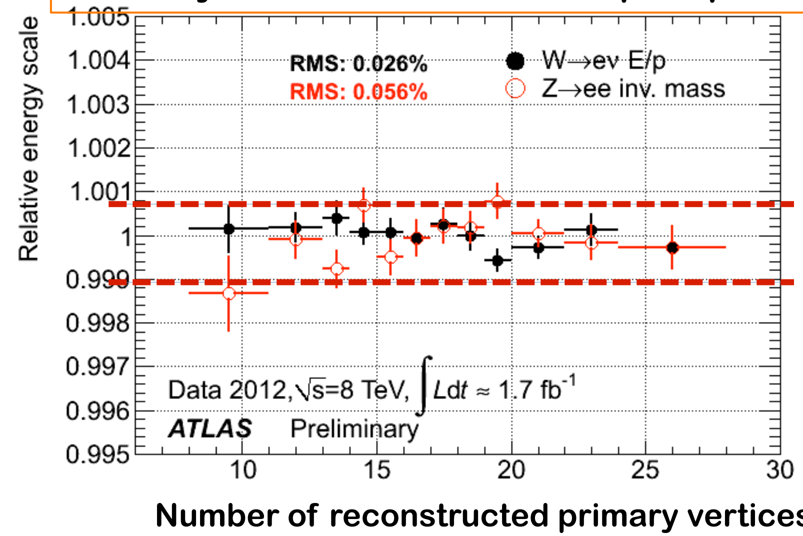
Results are from Z→ ee data and MC tag-and-probe



Electron identification efficiency



Stability of EM calorimeter vs pileup

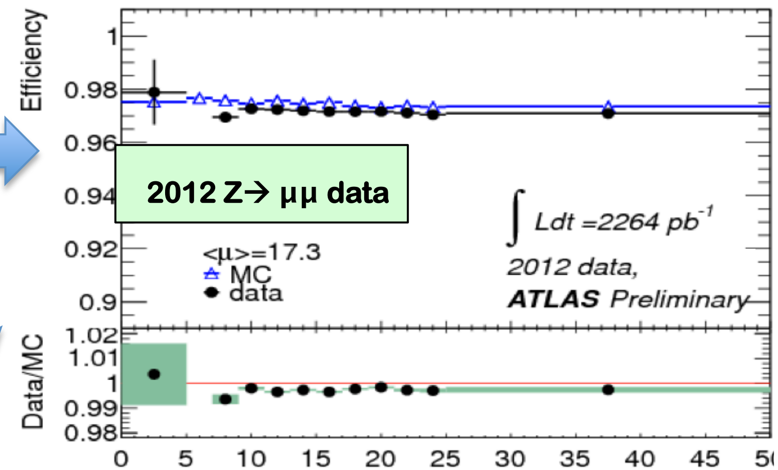


Muon Performance

ATL-COM-PHYS-2012-716

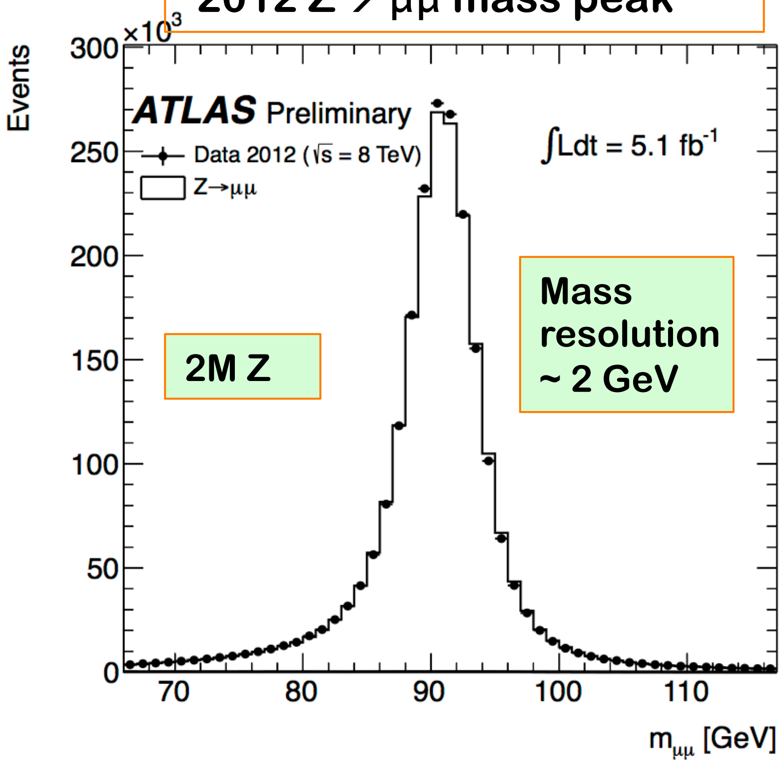
- Reconstruction efficiency ~ 97%,
  - ~ flat down to p_T ~ 6 GeV and over $|\eta|$~2.7
  - not affected by pile-up
- Mass resolution, reconstruction and isolation efficiency well described by Monte Carlo

Reconstruction efficiency vs Nvtx



Number of reconstructed primary vertices μ

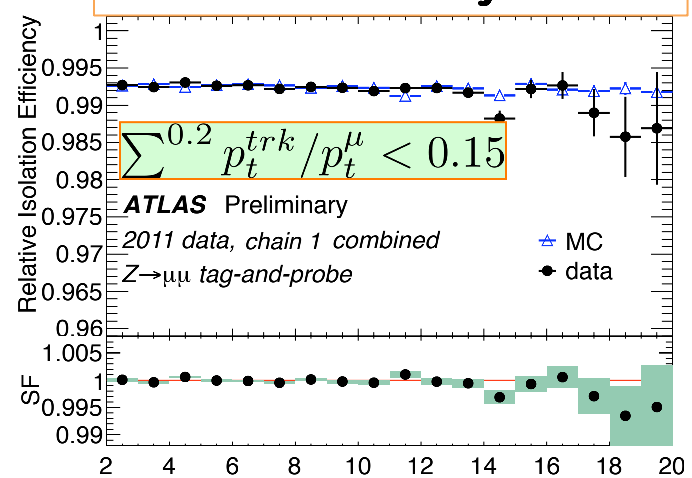
2012 Z→ μμ mass peak



2M Z

Mass resolution ~ 2 GeV

isolation efficiency vs Nvtx



$\sum^{0.2} p_t^{trk}/p_t^{\mu} < 0.15$

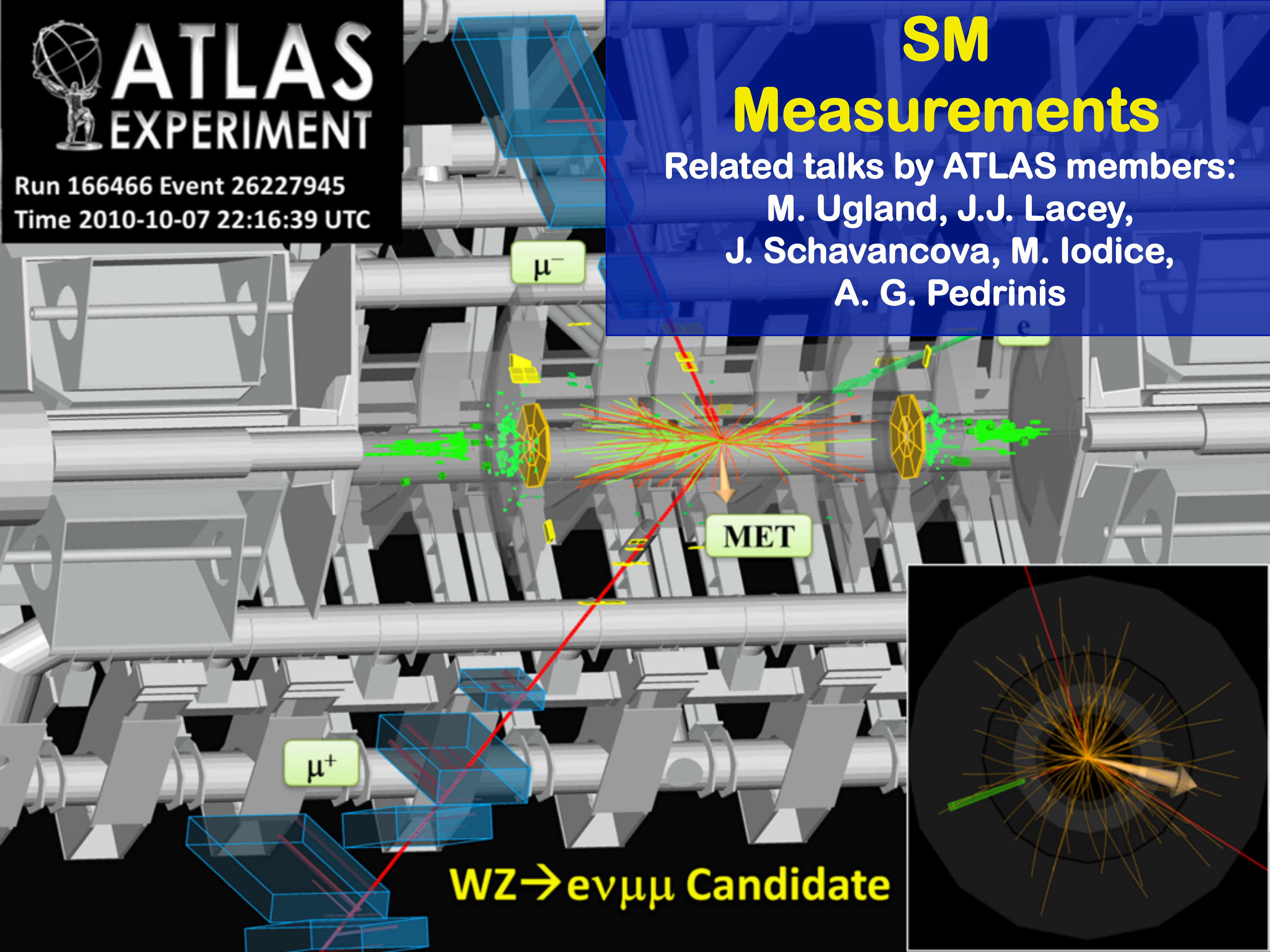
Number of reconstructed primary vertices μ

A few highlights of physics results

(at 7 and 8 TeV)

SM Measurements

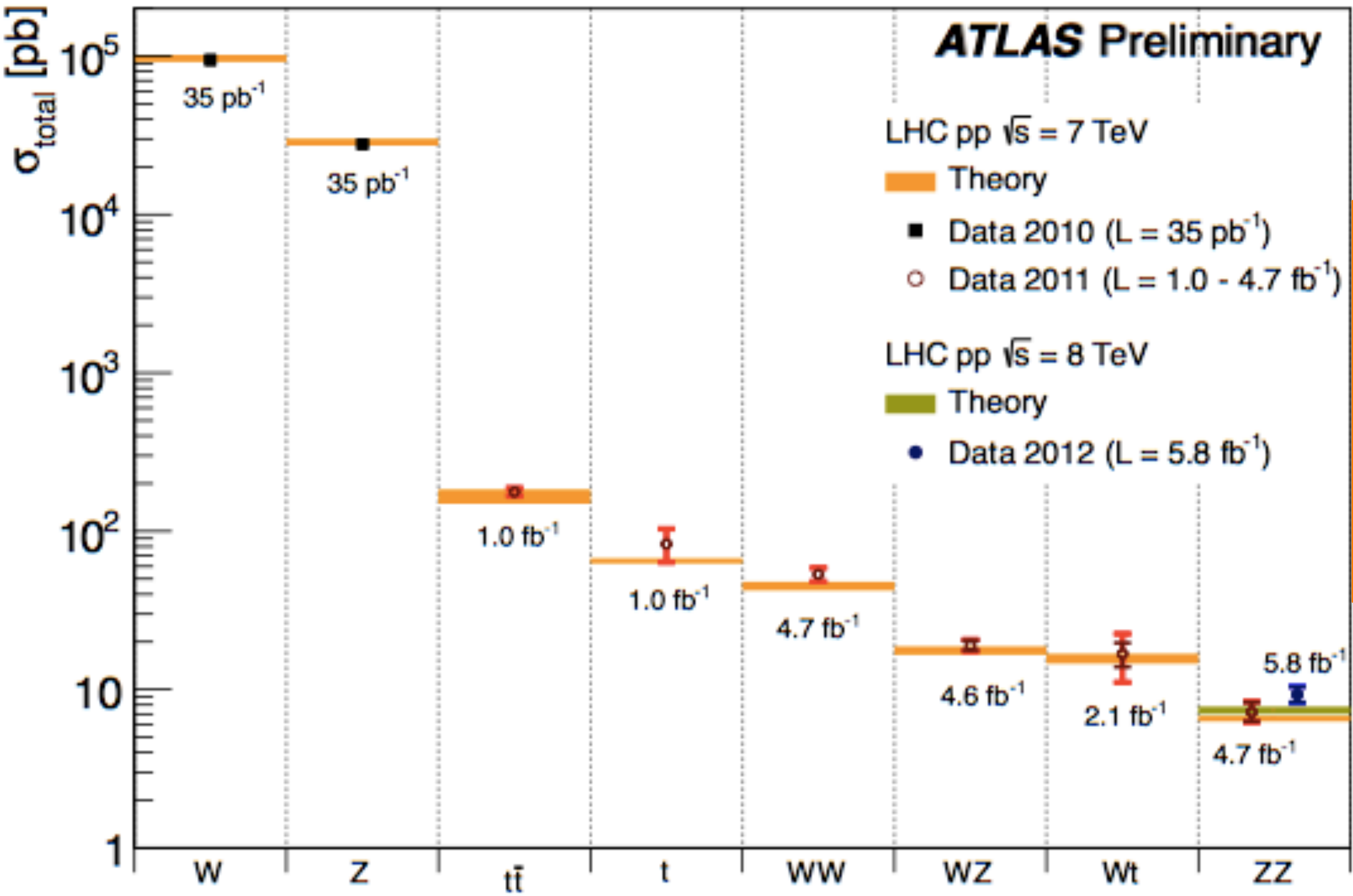
Related talks by ATLAS members:
M. Ugland, J.J. Lacey,
J. Schavancova, M. Iodice,
A. G. Pedrinis



Standard Model Measurements

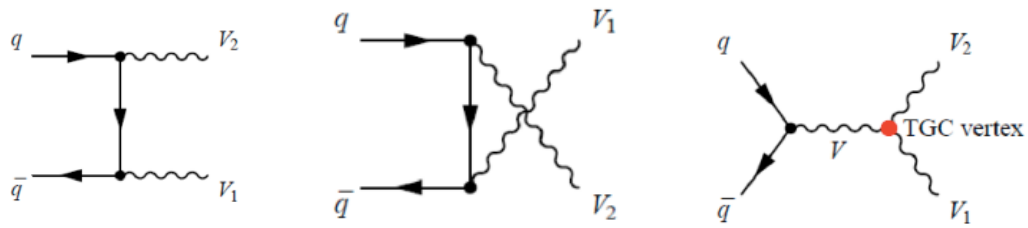
Cross-section measurements from inclusive W, Z to ZZ production. Foundation of SM.
- **tests of the SM & probing new physics**
- **backgrounds for searches and precision measurements**

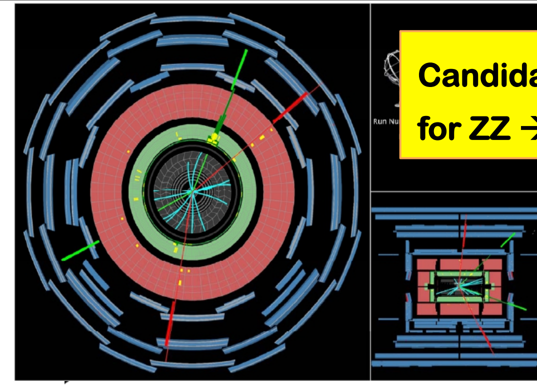
https://twiki.cern.ch/twiki/bin/view/AtlasPublic



- **Plenty of interesting results**
  →presented in detail in next ATLAS talks
- **Only a few will be presented in the next slides**
  - **Di-bosons**
  - **Single top**

Di-Boson Productions (WW, WZ, ZZ, Wγ, Zγ)





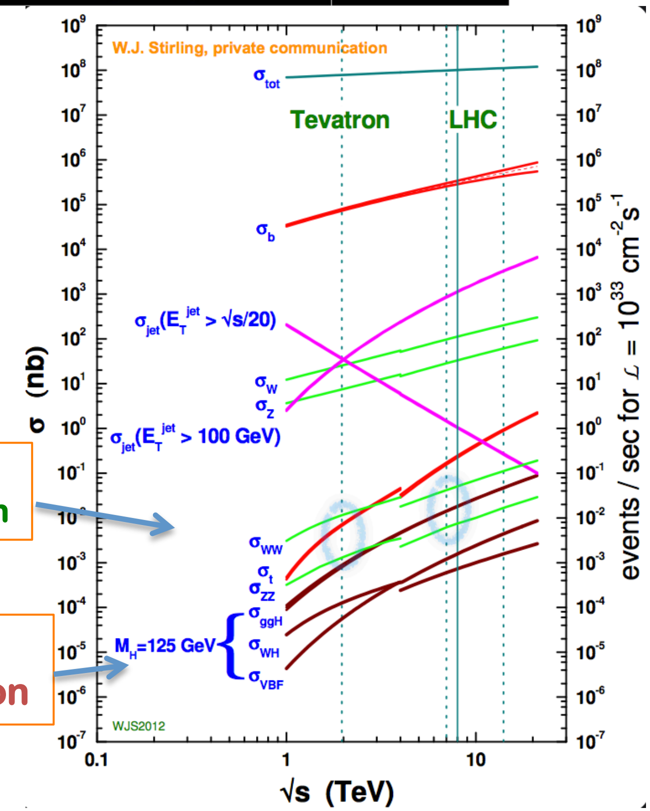
Candidate event for ZZ → ee μμ

Importance of di-boson measurements

- Sensitive to Triple Gauge Couplings (TGC): fundamental test of SM
  - WWγ and WWZ allowed;
  - ZZγ, Zγγ and ZZZ forbidden at tree level
- Search for physics beyond SM
  → anomalous coupling measurements and resonances
- Irreducible Background to Higgs processes and SUSY and Exotica searches

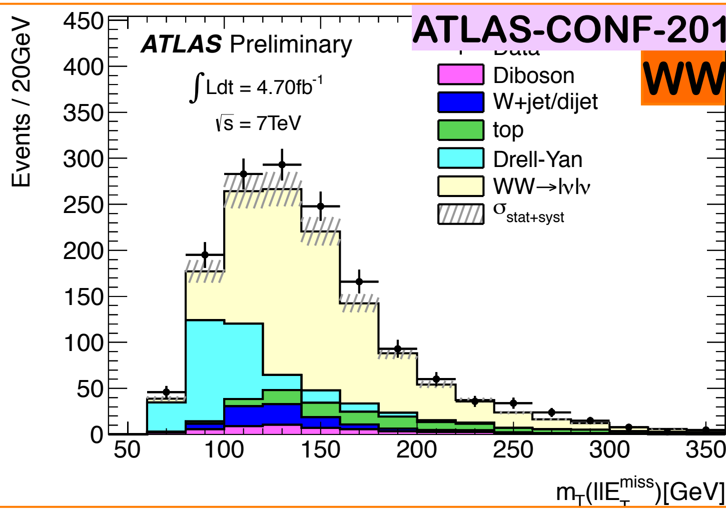
Diboson production

Higgs production

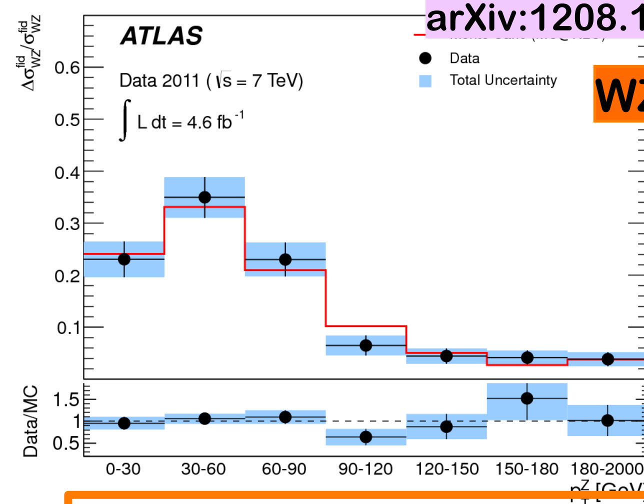


Di-boson (WW, WZ, ZZ) cross-sections

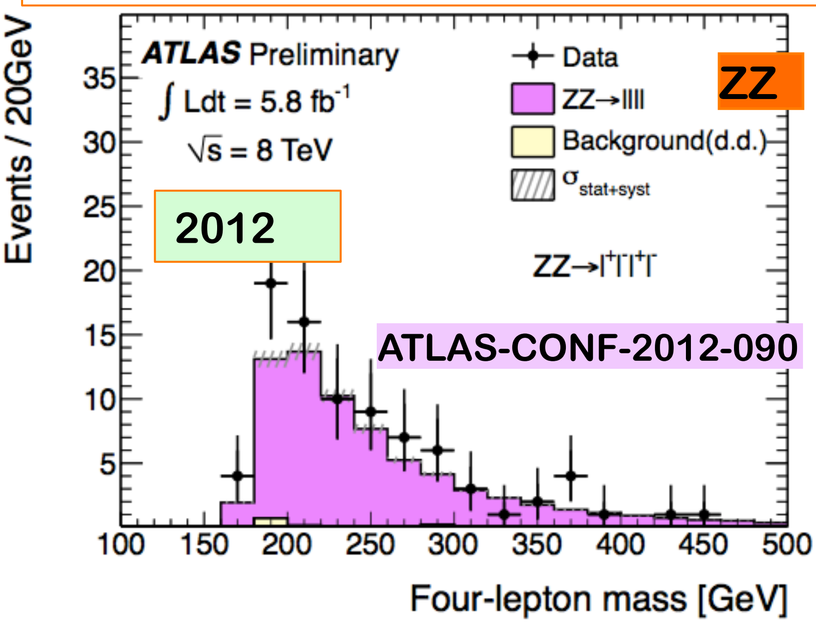
Measure cross section in WW→2l2ν channel



Measure cross section in WZ->3l1ν channel



Measure cross-section in channels: ZZ→4l and ZZ→2l2ν



Dedicated talk: A. G. Pedrinis

Process	σ_{meas} (pb)	σ_{NLO} (pb)	$\sqrt{s}$
WW	$53.4 \pm 2.1 \pm 4.5 \pm 2.1$	45.1 ± 2.8	
WZ	$19.0^{+1.4}_{-1.3} \pm 0.9 \pm 0.4$	$17.6^{+1.1}_{-1.0}$	7 TeV
ZZ	$7.2^{+1.1}_{-0.9}\,^{+0.4}_{-0.3} \pm 0.3$	$6.5^{+0.3}_{-0.2}$	
ZZ	$9.3^{+1.1}_{-1.1}\,^{+0.4}_{-0.3} \pm 0.3$	7.4 ± 0.4	8 TeV

- **Good agreement with SM prediction**
  - **Di-boson cross-sections are calculate up to NLO with uncertainty of about 5%**

Limits on Charged Triple Gauge Coupling

- Set limits to the anomalous couplings assuming an effective Lagrangian with EW gauge and CP invariance

$$\frac{\mathcal{L}_{WWV}}{g_{WWV}} = i\left[g_1^V(W^\dagger_{\mu\nu}W^\mu V^\nu - W_{\mu\nu}W^{\dagger\mu}V^\nu) + \kappa^V W^\dagger_\mu W_\nu V^{\mu\nu} + \frac{\lambda^V}{m_W^2}W^\dagger_{\rho\mu}W^\mu_\nu V^{\nu\rho}\right]$$

  – CP invariance + EM gauge invariance→ 5 independent couplings: g_1^Z, k_γ, k_Z, λ_γ, λ_Z In SM : $g_1^Z= 1$, $k_\gamma= k_Z= 1$, $\lambda_\gamma = \lambda_Z =0$

arXiv:1208.1390v2

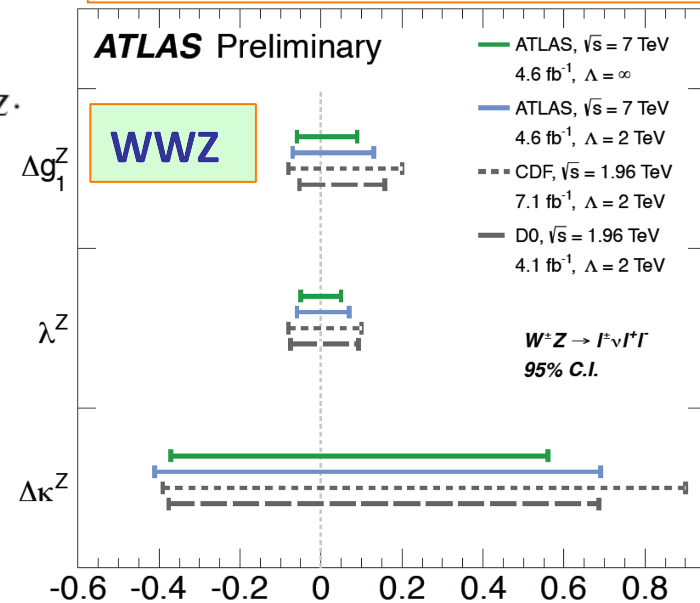
- TGC are studied as deviation wrt SM
  → 5 'Anomalous Coupling':

$$\Delta g_1^Z \equiv g_1^Z - 1,\quad \Delta\kappa_\gamma \equiv \kappa_\gamma - 1,\quad \Delta\kappa_Z \equiv \kappa_Z - 1,\quad \lambda_\gamma,\quad \text{and}\quad \lambda_Z.$$

  - in SM : $\Delta g_1^Z=0$, $\Delta k_\gamma= \Delta k_Z= 0$, $\lambda_\gamma = \lambda_Z =0$

- MC@NLO is used to generate WZ events with non-SM TGC
  - Amplitude grow with energy and eventually violate tree level unitarity--> introduce a cutoff scale
- Anomalies appear as enhanced rates and modify event kinematics
- To extract AC :
  → fit p_T^Z differential distribution

Anomalous TGC limits at 95% confidence level



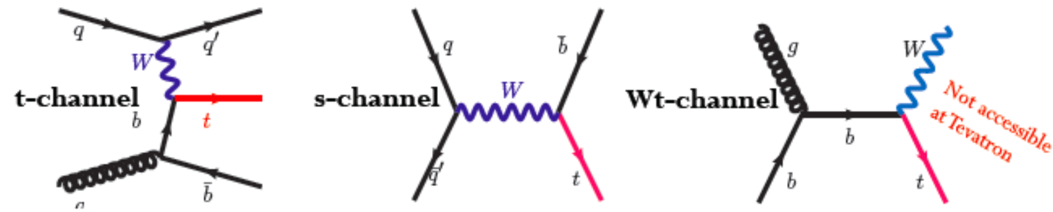
- Consistent with SM
- LHC limits are surpassing Tevatron

Single top t-channel at 7 and 8 TeV

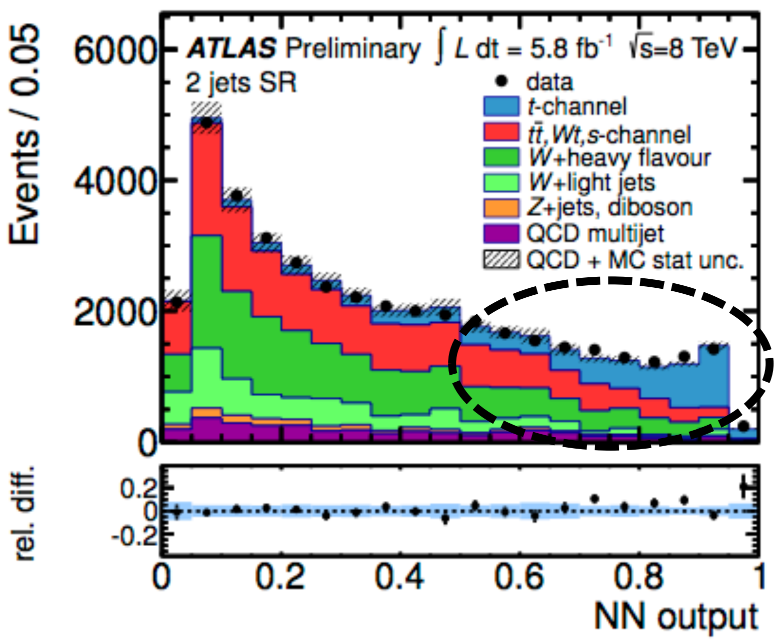
- Background to Higgs and other searches
- Difficult to extract signal from ttbar and W+jets backgrounds

  → requires "advanced" analysis techniques (NN)

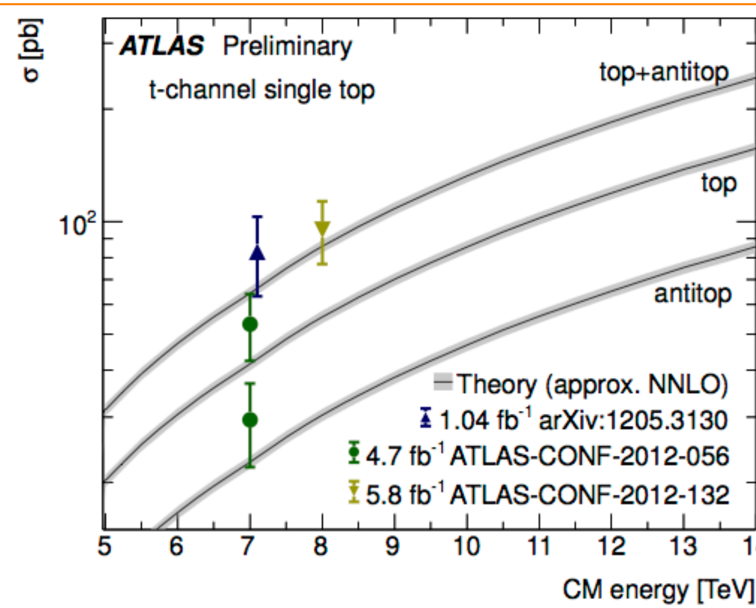
ATLAS-CONF-2012-132



	t-channel	s-channel	Wt-channel
Theory 7TeV	64.6±2.4pb	4.6±0.2pb	15.7±1.1pb
ATLAS 7TeV	83±20pb	<26.5pb	17±6pb @3.3σ



Single top t-channel x-sections at 7 and 8 TeV



At 8 TeV $\sigma_t(t) = 95.1 \pm 2.4\,(\text{stat.}) \pm 18.0\,(\text{syst.})\ \text{pb}$

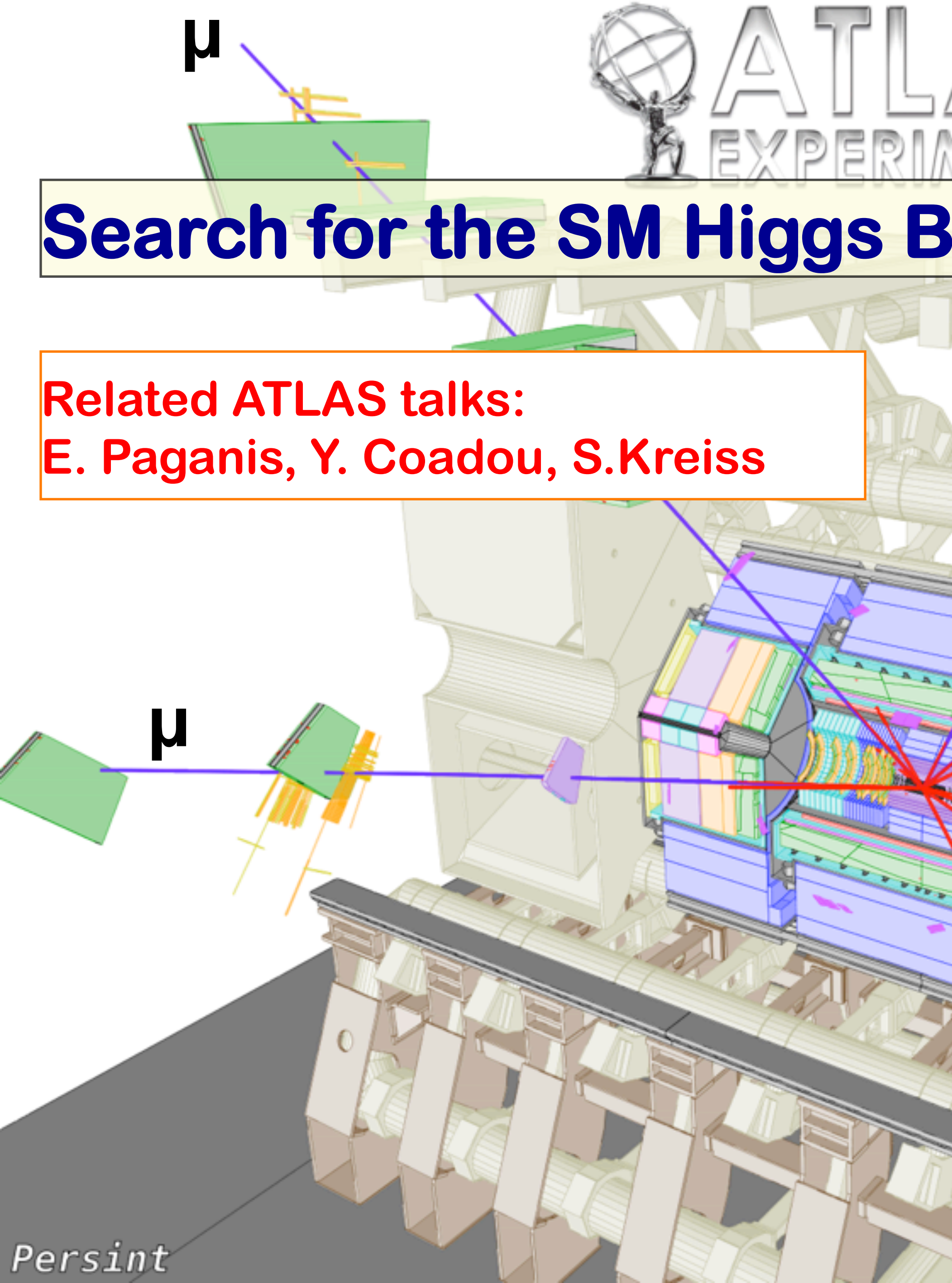
$|V_{tb}| = 1.04^{+0.10}_{-0.11}$

Theory (8 TeV) σ_t **(t)= 87.8±3.4pb**

$|V_{tb}| < 1$ → $|V_{tb}| > 0.80$ at 95% CL

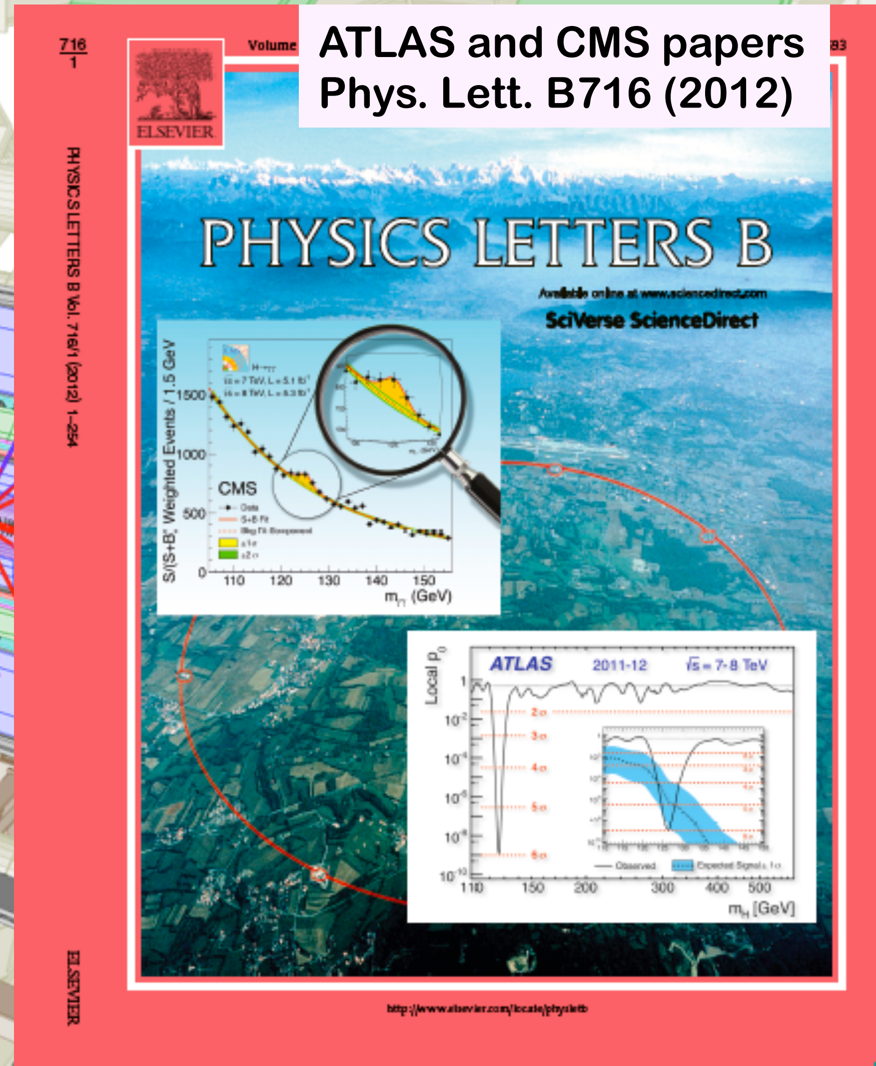
Dedicated talk: J. Schavancova

Search for the SM Higgs Boson



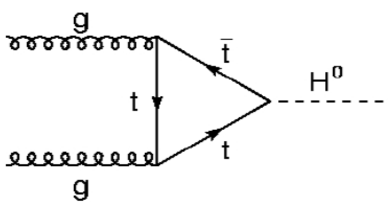
Related ATLAS talks:
E. Paganis, Y. Coadou, S.Kreiss

ATLAS and CMS papers
Phys. Lett. B716 (2012)

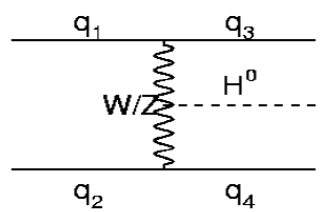


Higgs production and decay rates at √s =8 TeV

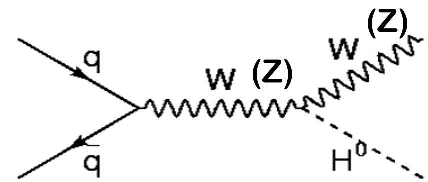
Gluon Fusion
pp→H

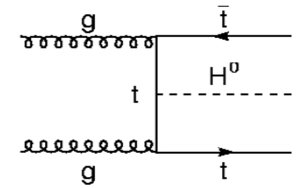


Vector Boson Fusion:
pp→qqH

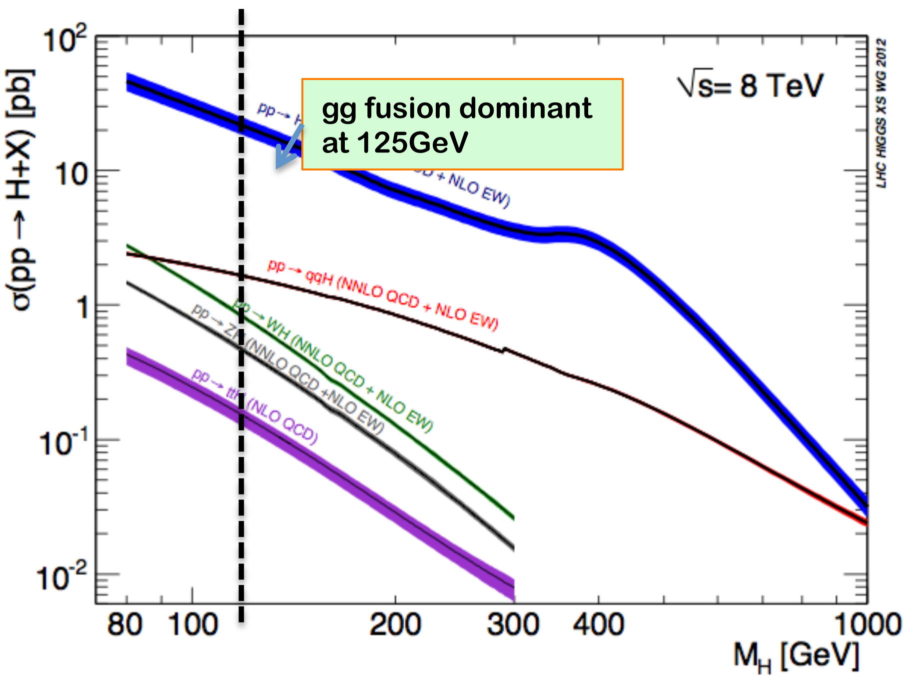


Associated Production:
pp→ WH, ZH, ttH

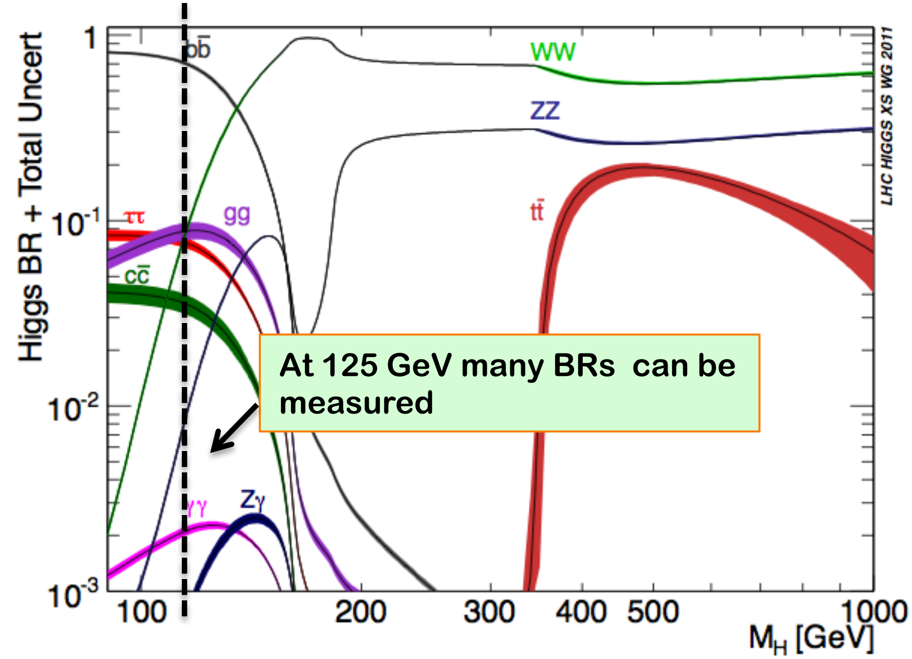




Higgs production cross-section vs MH



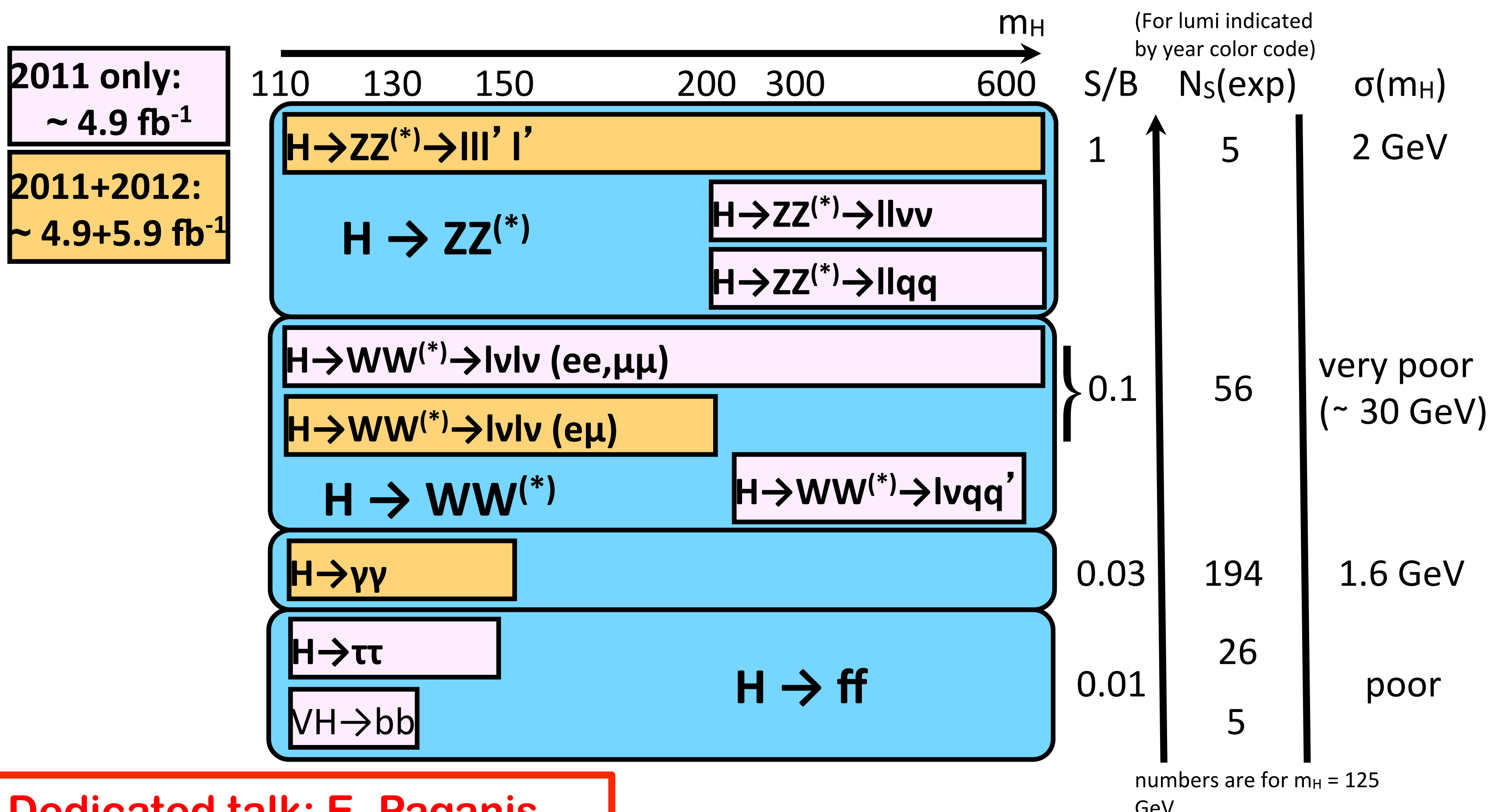
Higgs decay channels: BRs depend on Higgs mass



√s=7 → 8 TeV: Higgs cross-section increases by ~ 1.3 for m_H ~ 125 GeV

Standard Model Higgs Search Channels

- **Channels and luminosity currently used in 2011 and 2012 ATLAS Higgs Combination**
- **In 2012 analyses re-optimised for high pileup and to enhance sensitivity to low m_H (i.e. improvement in the electr. reconstrution and identification)**
- **All selections and analysis techniques fixed before looking at 2012 data : blinded analysis**



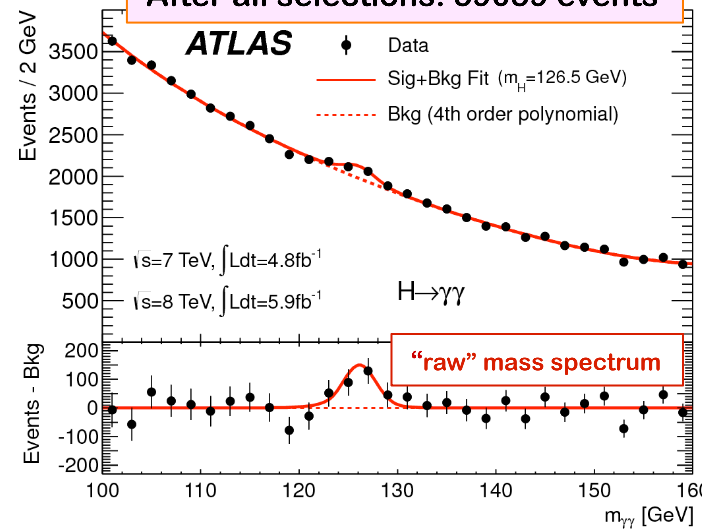
Dedicated talk: E. Paganis

H→ $\gamma\gamma$ channel search

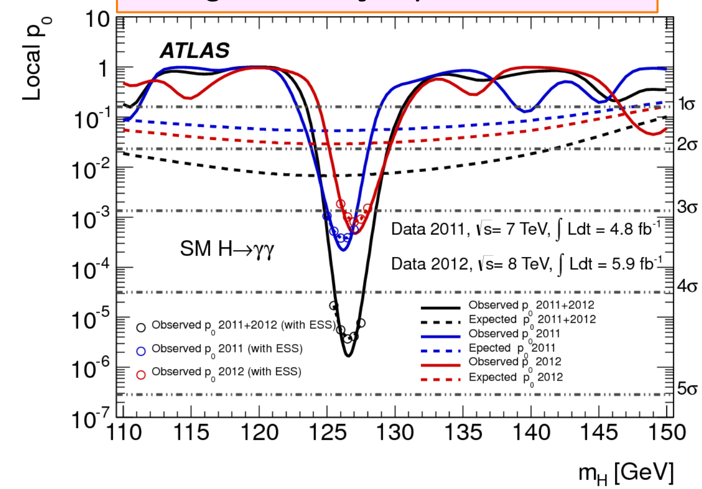
Production and decay through loops: sensitive to t/W Higgs couplings and to new physics

- Select 2 isolated photon events (E_T> 40, 30 GeV)
- Look for narrow peak in the $m_{\gamma\gamma}$ distribution
  - Very large irreducible (continuum di-photons) and reducible (γ-jet, jet-jet) backgrounds
  - Background extrapolated from sidebands using data
  - Signal is extracted by fitting $m_{\gamma\gamma}$ in 10 categories with different S/B ratio and $m_{\gamma\gamma}$ resolution
    - new category (in 2011+2012) with 2 forward jets (sensitive to VBF)
  - Signal only visible if excellent mass resolution (1.6 GeV) → reconstruct angles and energies of photons
    - energy resolution below 1%
    - photon direction resolution below 5 mrad (i.e. vertex res. < 1.5 cm)

After all selections: 59059 events



p-value: consistency of data with background-only expectation



Most significant deviation from background-only hypothesis at m_H=126.5 GeV

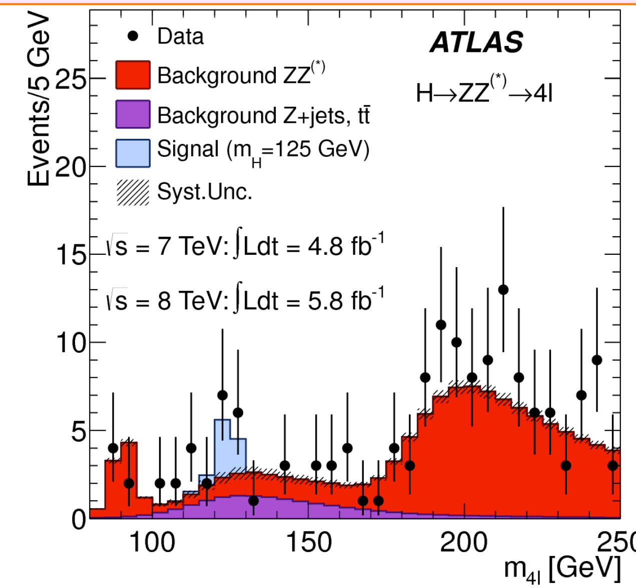
- **Local significance of 4.5 σ (expected 2.5 σ)**

$H \rightarrow ZZ^{(*)} \rightarrow 4l$ (l=e,μ) search

The golden channel – very few events but S/B ~1!

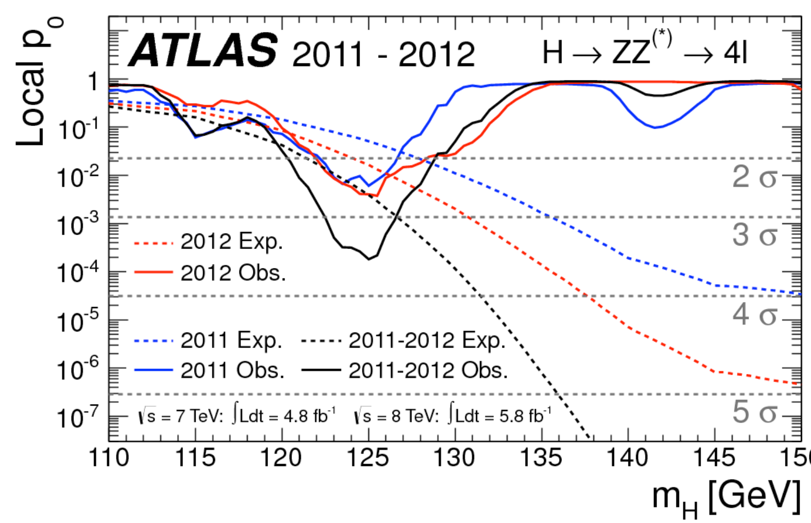
- Select four isolated leptons
- Main backgrounds:
  - Irreducible bkg: continuum ZZ*
  - Reducible bkg (low mass): Z+bbar,Z+ light jets, ttbar with two leptons from b-jets or q-jets
- Key-points:
  - Very high lepton reco/ID efficiency needed: down to low p_T and largest possible coverage
  - Excellent mass resolution
    - improved by using Z-constraint on leading lepton pair

Reconstructed 4l mass spectrum after all selections



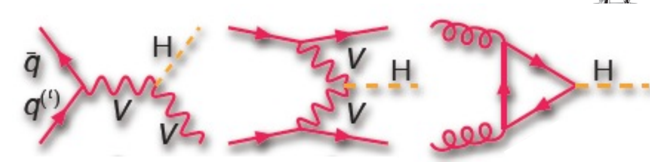
Most significant deviation from background-only hypothesis at m_H=125 GeV.

- Local p_0-value corresponding to 3.6 σ (2.7 σ expected)
- Both, 2011 and 2012 data contribute to excess in the same mass range.



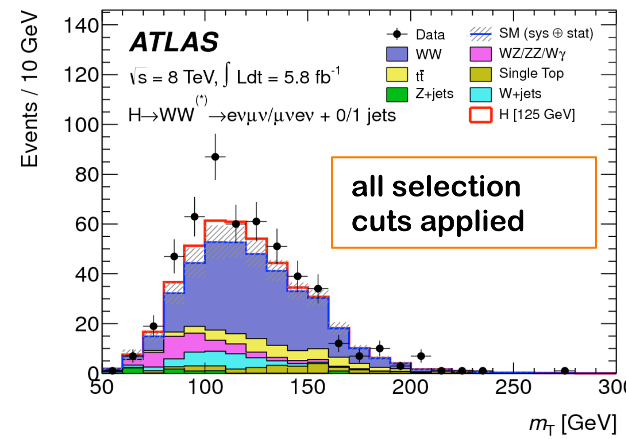
H→WW$^{(*)}$→l ν l' ν search

Large cross-section but 2ν in final state → mass peak cannot be reconstructed → "counting channel"



- **Higher pile-up in 2012:** higher Drell-Yan background for same flavour final state
  → 2012 result only for different flavour final state (H→ eνμν)
- **Different signal productions lead to different kinematic signatures and jet multiplicities**
- **Backgrounds different for each jet multiplicity:**
  - H+0 jet: WW, Z/W+jets
  - H+1 jet: WW, top (ttbar, Wt, single top)
  - H+≥2 jets: ttbar, single top

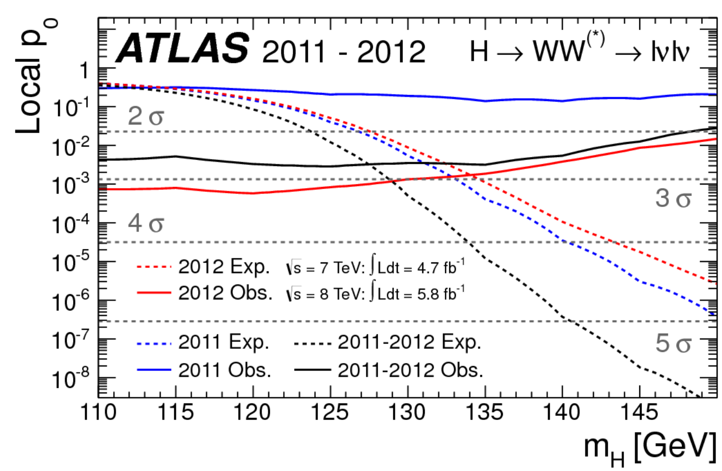
  → analysis carried out in different jet multiplicity bins
- **Main handles to fight backgrounds:**
  - WW: spin correlations and topological cuts,
  - top bkg: b-tagging veto



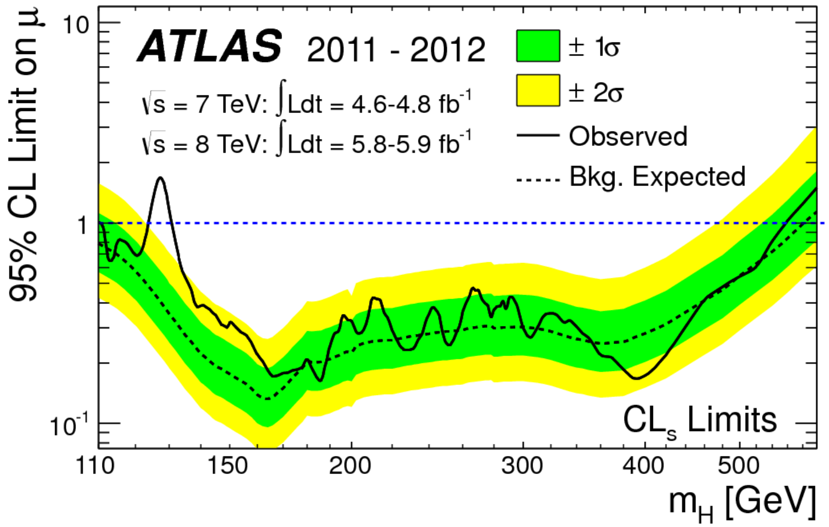
Transverse mass is the discriminant used :

$$m_{\mathrm{T}} = \sqrt{(E_{\mathrm{T}}^{\ell\ell} + E_{\mathrm{T}}^{\mathrm{miss}})^2 - |\mathbf{p}_{\mathrm{T}}^{\ell\ell} + \mathbf{E}_{\mathrm{T}}^{\mathrm{miss}}|^2}$$

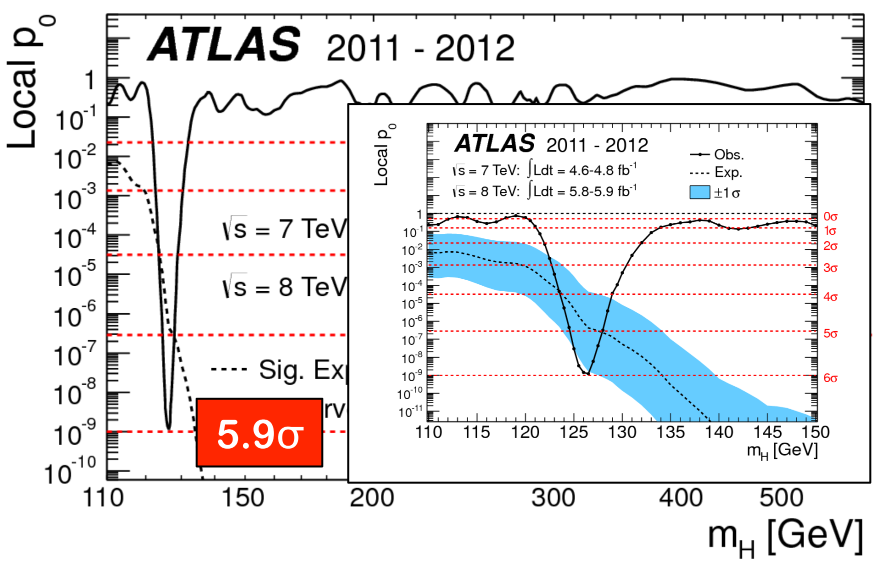
Final results obtained from binned likelihood fits to m_T distribution:
- Broad excess observed (due to poor mass resolution)
- Significant deviation from background-only hypothesis:
  - e.g. at m_H=125 GeV observed 2.8 σ
- (2.3 σ expected)



Higgs Searches Combination (2011+2012)



Excluded masses at 95% CL :
- **Observed : 112-122 GeV and 131-559 GeV**
- **Expected : 110 GeV to 582 GeV**



Maximum excess observed at m_H=126.5 GeV

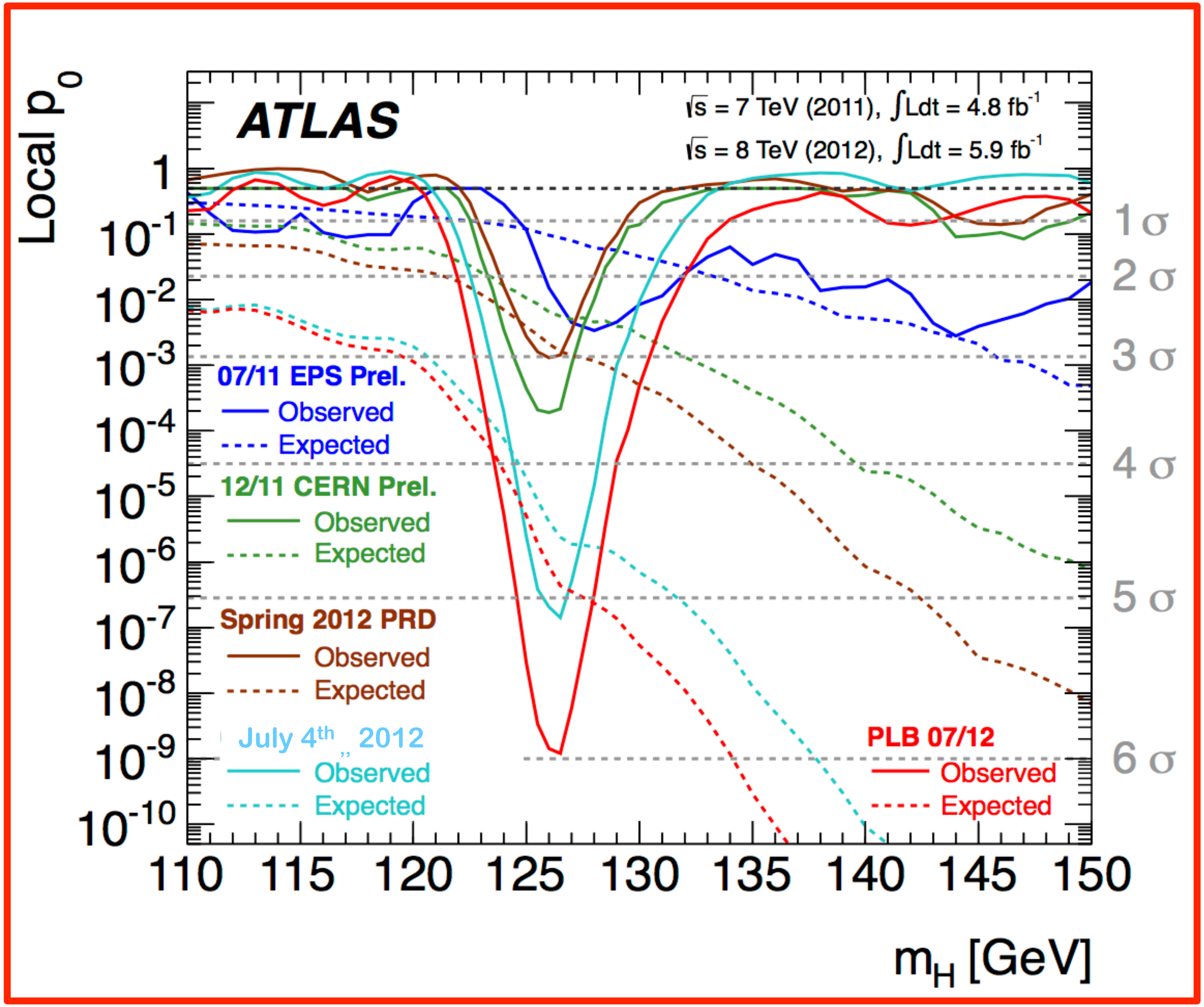
- **Local significance 5.9 σ**
- **Expected: 4.9 σ**

(Global significance: ~ 5.2 σ)

- **Probability of background fluctuation to the observation: 1.7 x 10^{-9}**

Dedicated talk : Sven Kreiss

Evolution of the excess with time



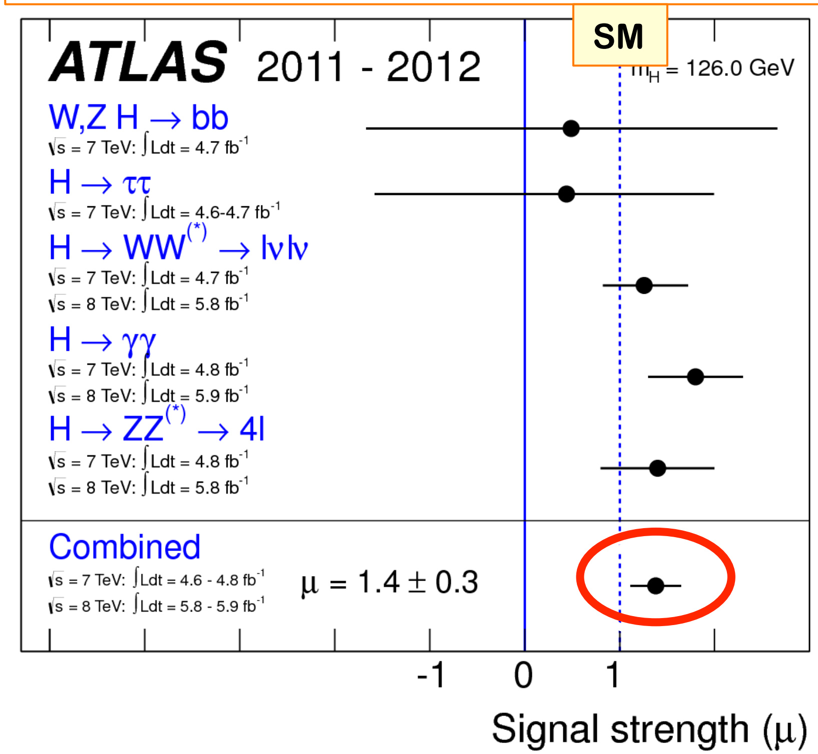
Significance increase from 4th July to the PLB from including H→ WW* search for 2012 data (from 5.2 to 5.9 σ)

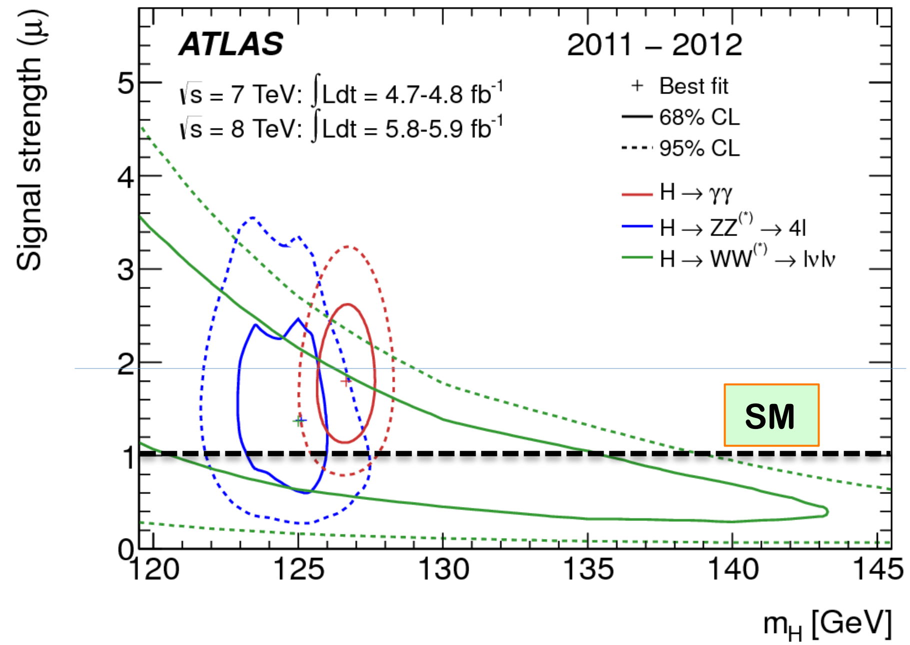
Mass and Signal strength of the new particle

2-dim likelihood fit to mass and signal strength (for H->ZZ(*)->4l and H->$\gamma\gamma$)

Estimated mass:
m_H = 126 ± 0.4 (stat) ± 0.4 (syst) GeV

μ = signal strength normalized to the SM Higgs expectation at m_H = 126 GeV





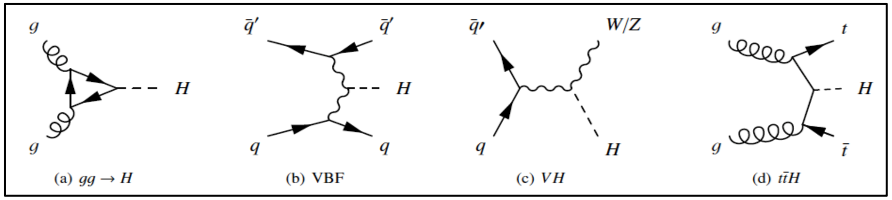
Best-fit value at 126 GeV:

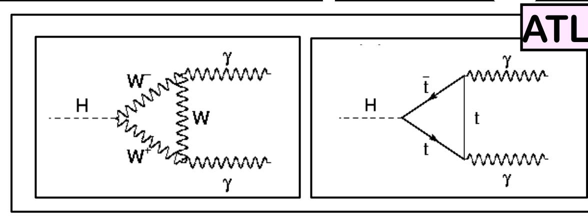
$\mu = 1.4 \pm 0.3$

→ **good agreement with the expectation for a SM Higgs within the present statistical uncertainty**

First measurements of couplings

ATLAS-CONF-2012-127



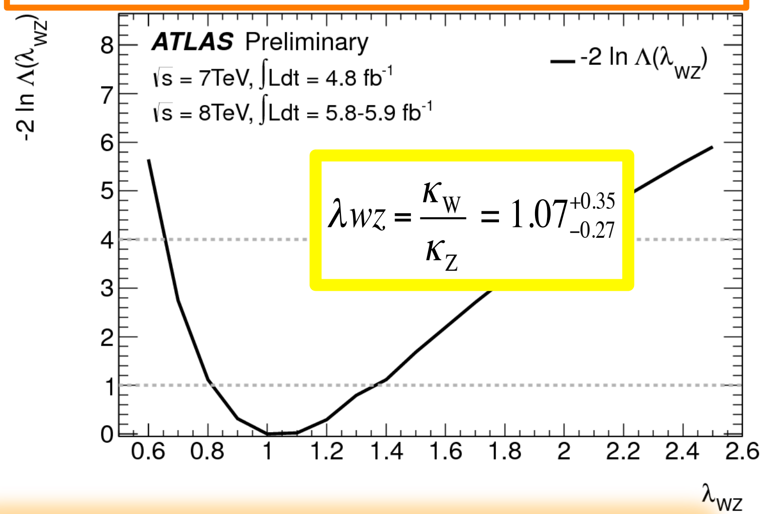


$$\kappa_i^2 = \frac{\Gamma_i^{data}}{\Gamma_i^{SM}}$$

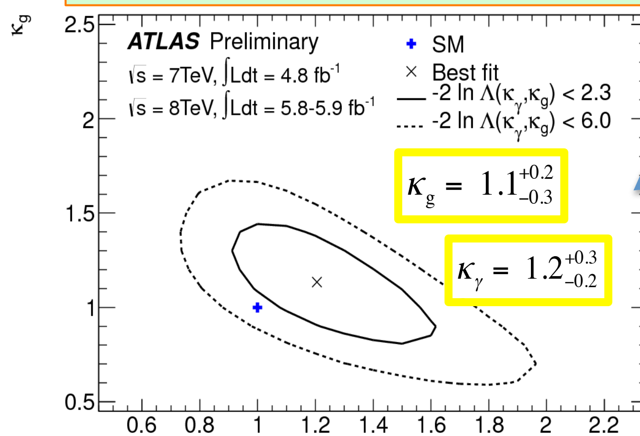
Several benchmarks to probe different aspects/deviation from SM boson couplings, a few examples:

Probing the custodial symmetry from the ratio of HWW to HZZ coupling

λ_{WZ} should be 1 to be consistent with EW precision data (ρ=1 measured at LEP)



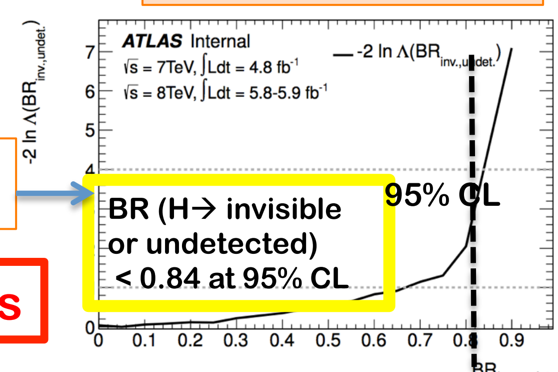
Probing potential non-SM contributions: new particles in the gg → H and H→ γγ loops ?



Assuming only SM contribution to Higgs width

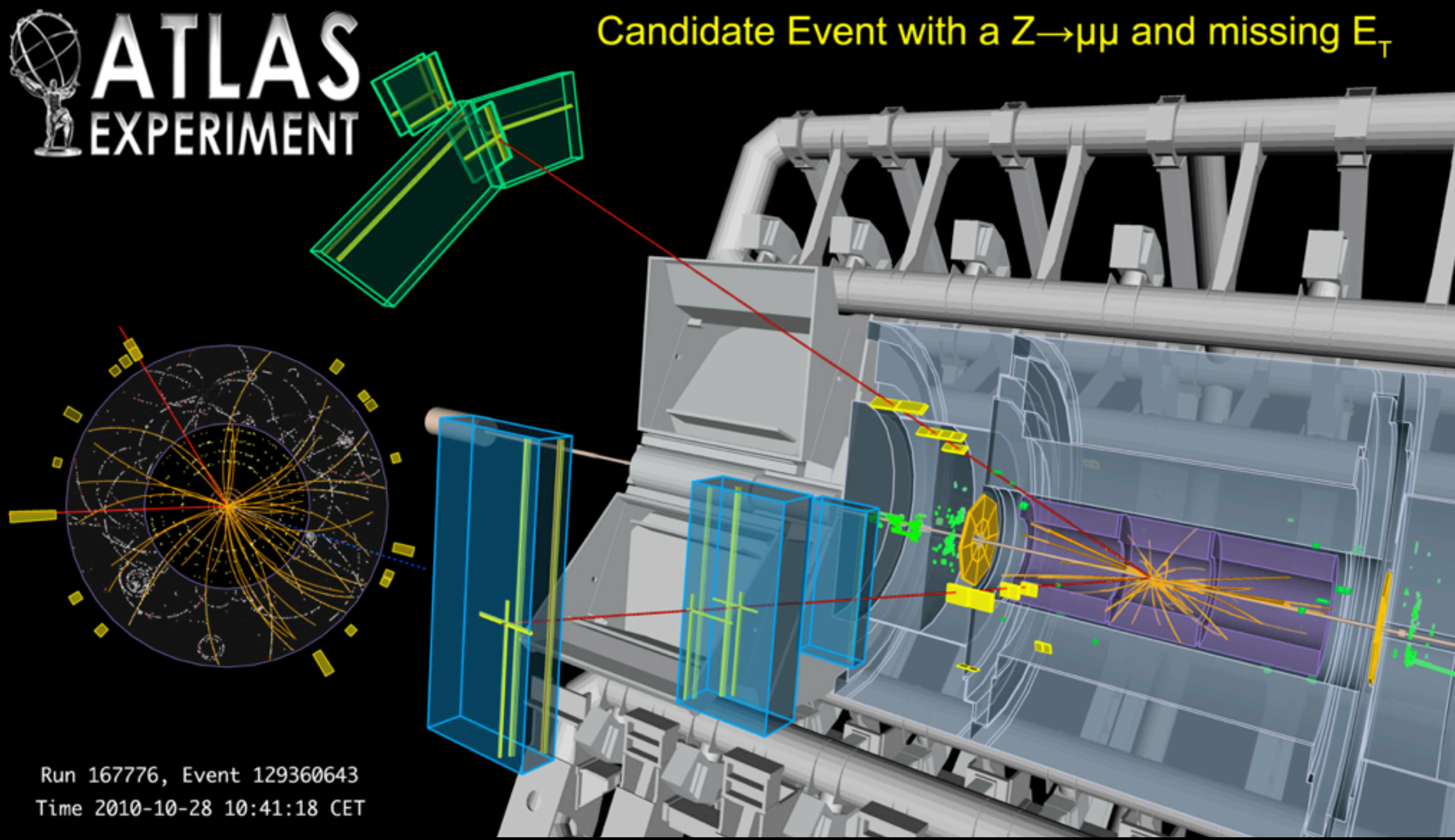
New final states ?

No assumption on the total H width



No significant deviation from the prediction for a SM Higgs

Dedicated talk : S. Kreiss



Supersymmetry

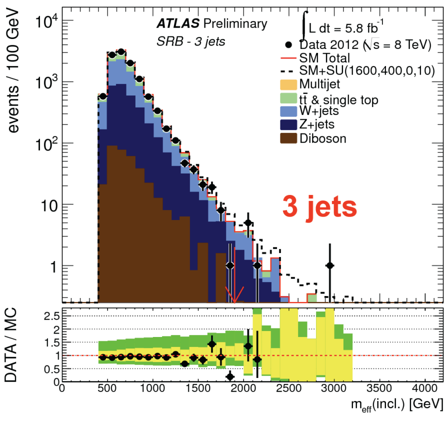
Related ATLAS talks :
G. Gaudio, Y. Coadou, L.S.Ancu

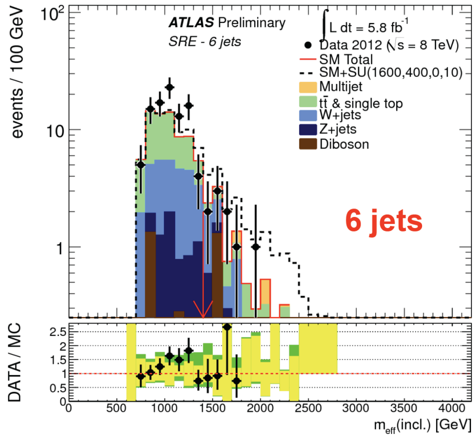
SUSY inclusive searches with 2012 Data

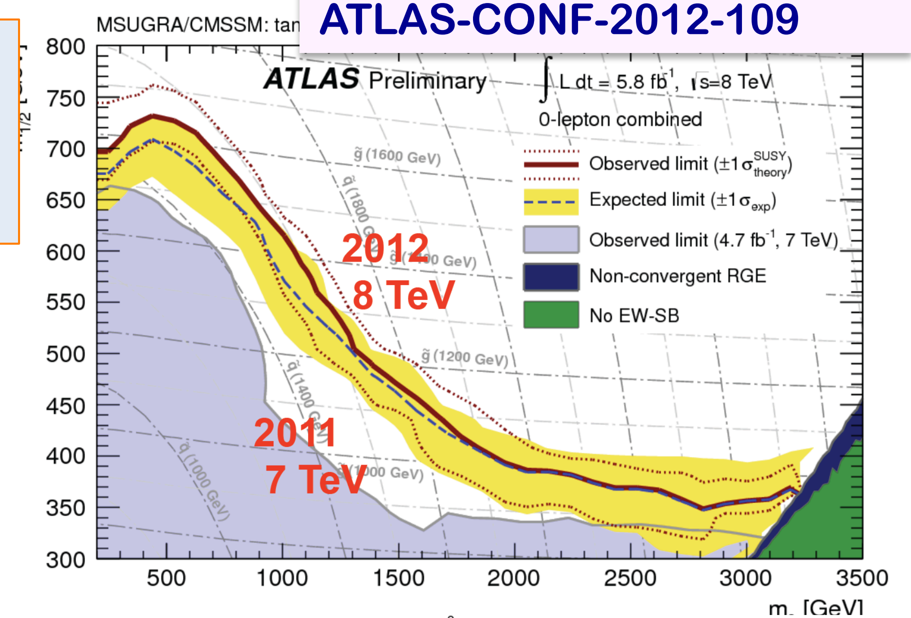
ATLAS-CONF-2012-109

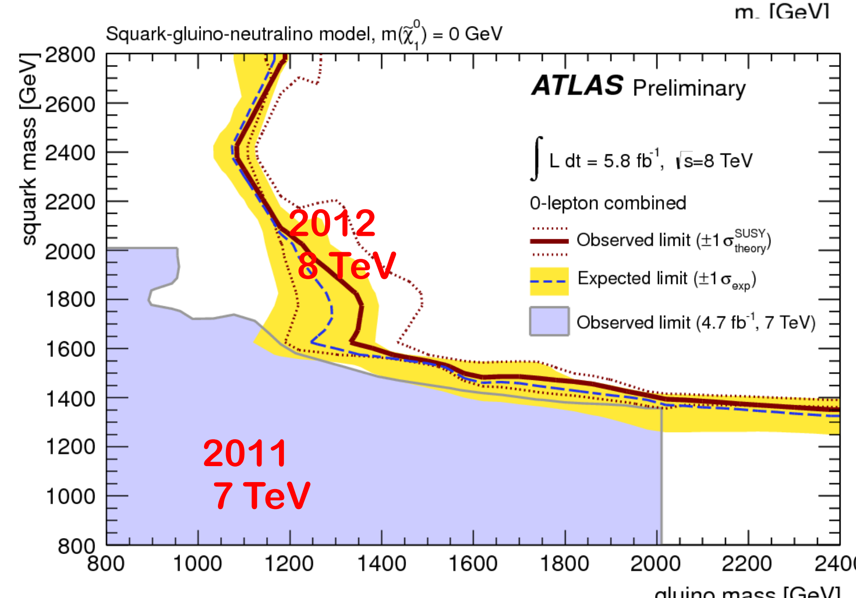
Inclusive search for events with 2-6 jets and E_t^{miss} (0 leptons). M_{eff} definition

$M_{eff} = \Sigma\, p_T^{jets} + E_t^{miss}\ (+\, p_T^{lepton})$









no excess above SM background observed

MSUGRA/CMSSM interpretation

- $\tan\beta = 10$, $A_0 = 0$, $\mu > 0$: $m_{1/2} < 350$ GeV excluded
- For equal squark and gluino masses: $m(\tilde{q})$, $m(\tilde{g}) < 1500$ GeV excluded

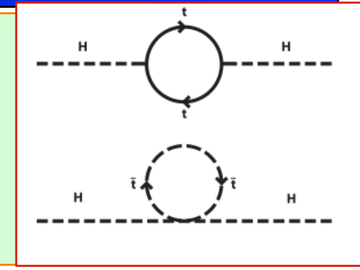
Simplified squark-gluino model :

- $m(\tilde{g}) < 1100$ GeV

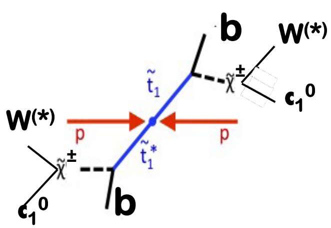
Dedicated talk: G. Gaudio

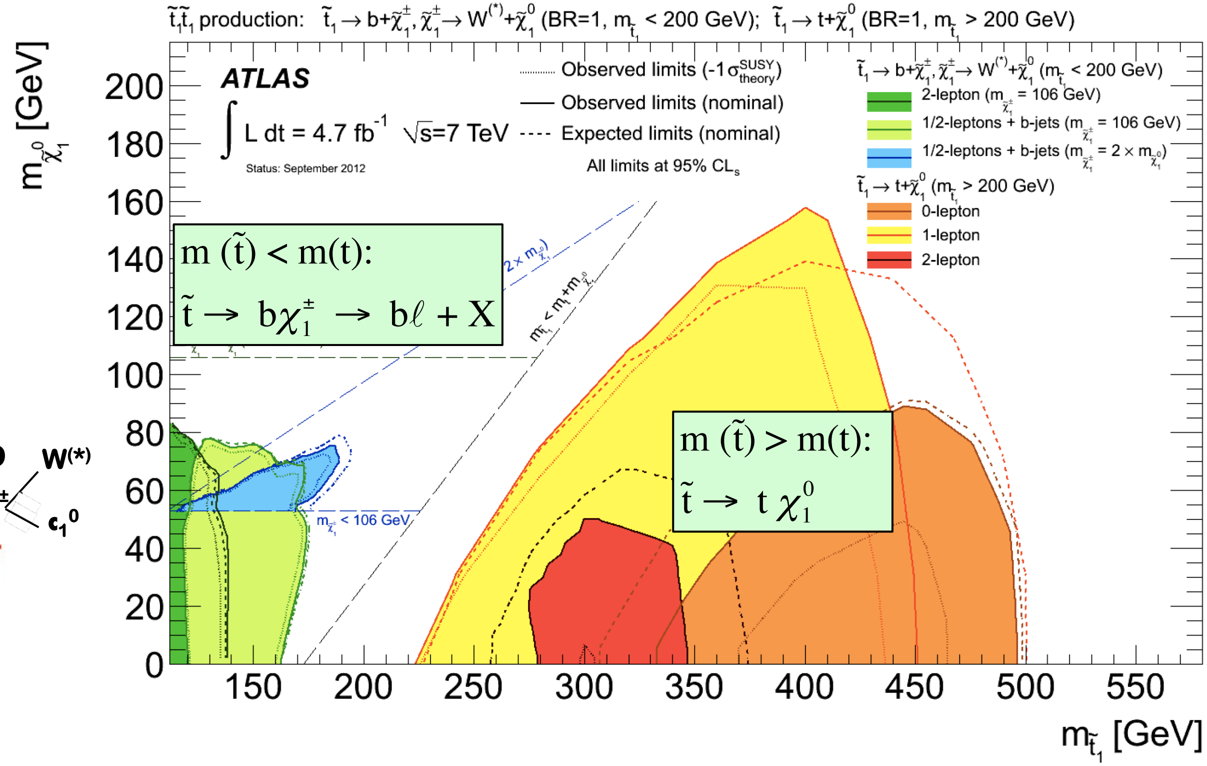
SUSY – Direct Stop pair searches

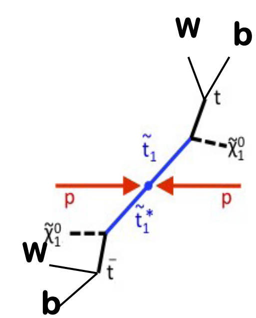
- Limits for **inclusive searches** are much more stringent on the first two generations squarks
- **Stop must be light (below TeV scale)** to cancel large top corrections to Higgs mass (fine-tuning) → **natural SUSY**



arXiv: 1208.1447, 1208.2590; ATLAS-CONF-2012-059, 070, 071







Many different scalar top searches with 7 TeV data covering masses up to 500 GeV

- For $m_{stop} \approx m_{top}$ need more powerful discriminating variables
- By end 2012 (~ 30 fb^{-1}): expect to cover stop masses up to ~ 700-800 GeV

SUSY Summary

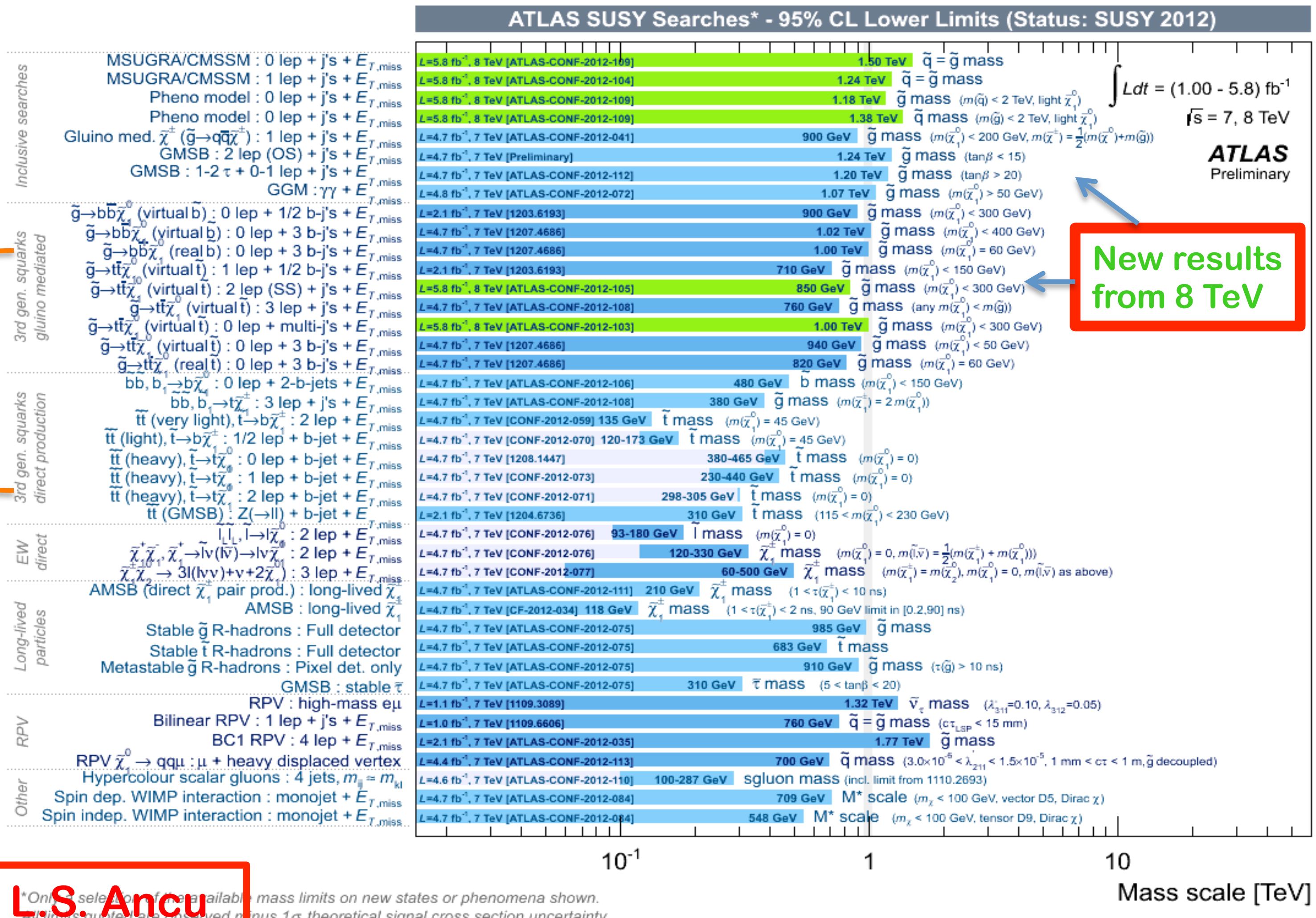
ATLAS seriously attack to Weak scale SUSY between 100 GeV and 1 TeV

Inclusive searches

Natural SUSY

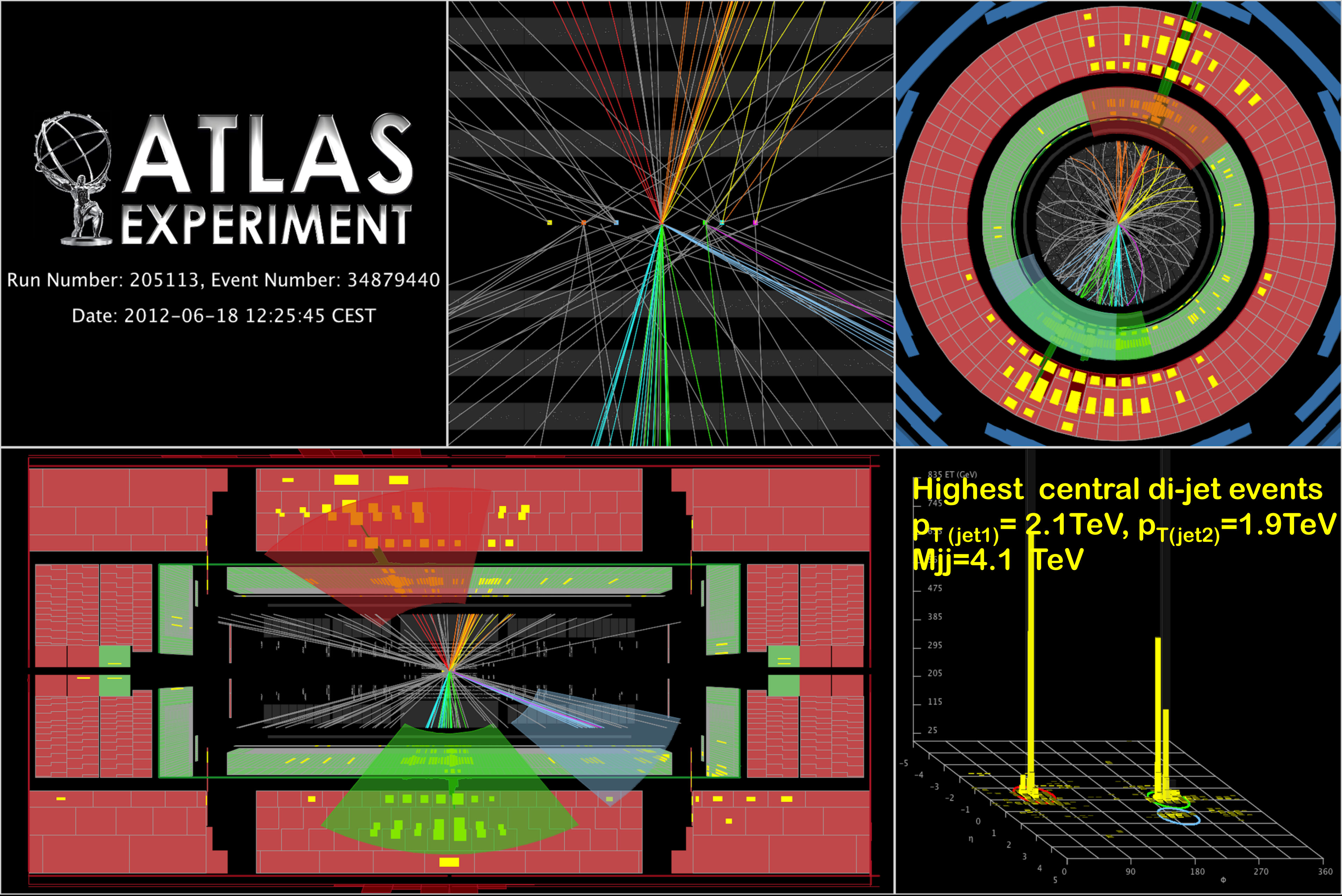
Long-Lived Particle

RPV



New results from 8 TeV

Dedicated talk : L.S. Ancu



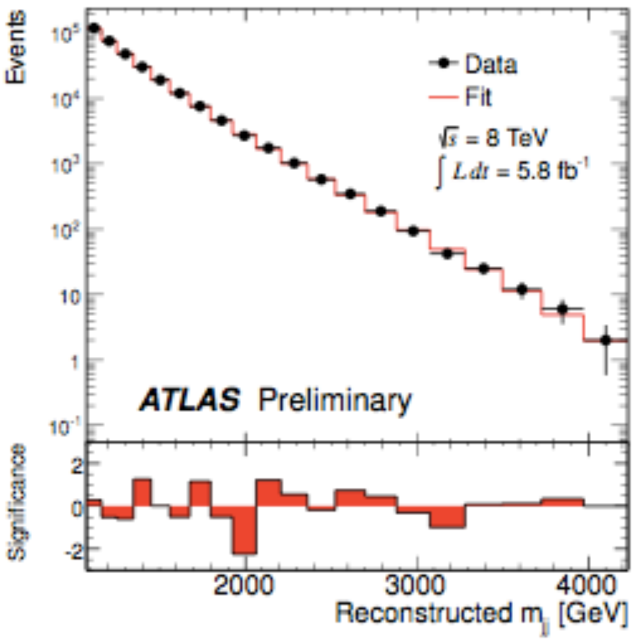
Exotics

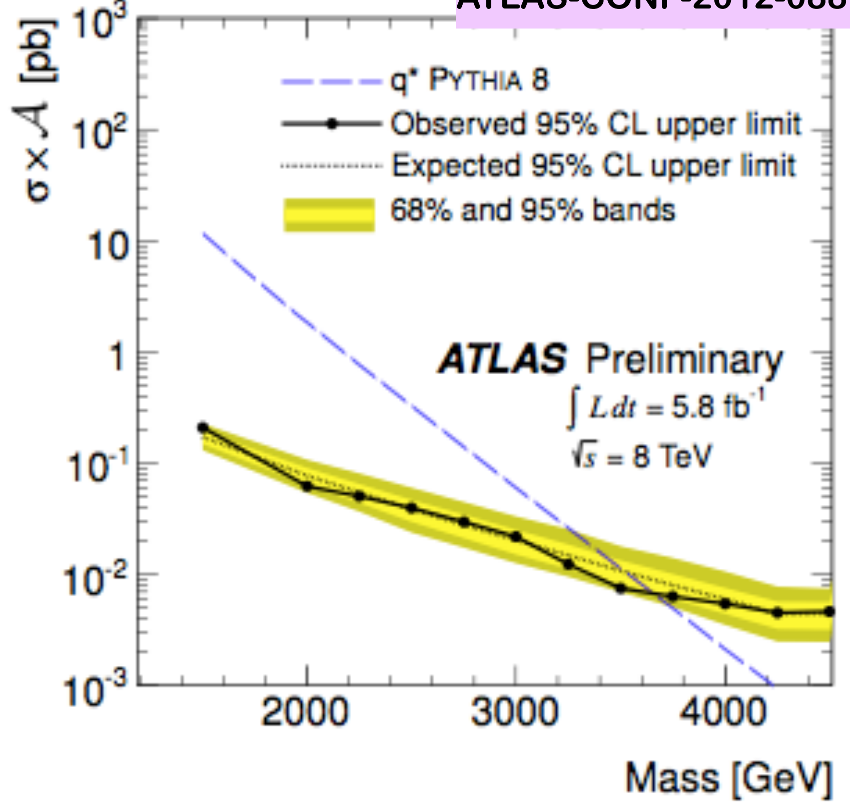
Related ATLAS talks :
D. Pallin, M.S Cooke

Di-Jet Mass Distribution at 8 TeV

- **Excited quarks are a common prediction of composite models.**

ATLAS-CONF-2012-088



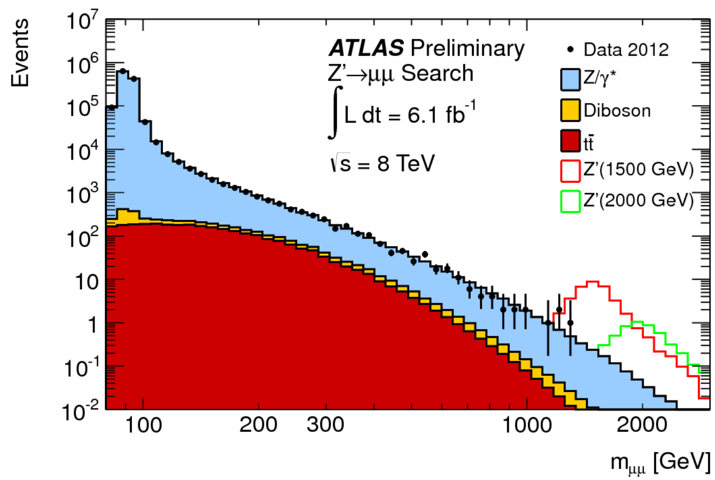


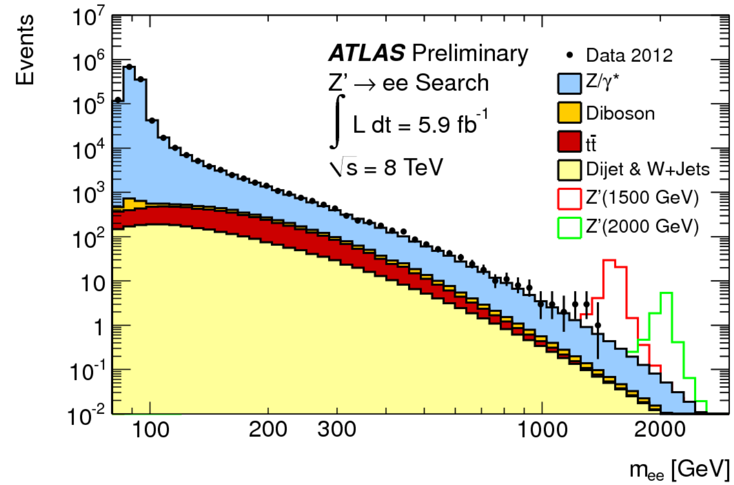
- **Look for localised excesses in the dijet mass (*mjj*) distribution**
  - ***mj j* > 1000 GeV and $|y_{1,2}| < 2.8$**
- **Used the BumpHunter algorithm to look for resonances**

No excess of events found
Excited quarks (q*) excluded
up to a mass > 3.66 TeV (95% C.L.)

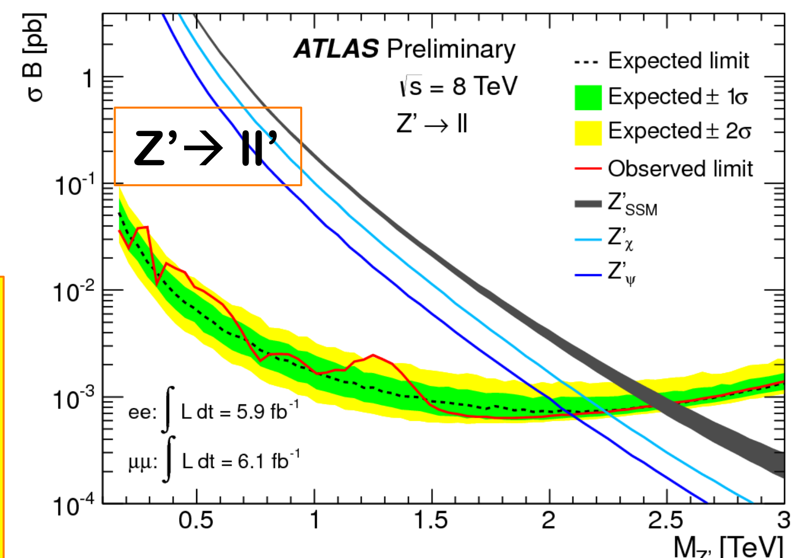
High mass Di-leptons at 8 TeV

ATLAS-CONF-2012-129





- Search for narrow di-lepton resonances
  Selection:
  - Two Isolated, High P_T Electrons or Muons
- Main backgrounds:
  - Drell-Yan, W, Top, QCD fakes (data-driven)



No excess over SM

Limits on σ B for Z'->ll (e+μ channels combined):

- **Z' $_{SSM}$ > 2.49 TeV at 95% C.L.**
- **E6 → SU(5)+2U(1) Z' > 2.09- 2.24 TeV at 95%C**

Exotics

No hints for New Physics so far …

Extra dimensions

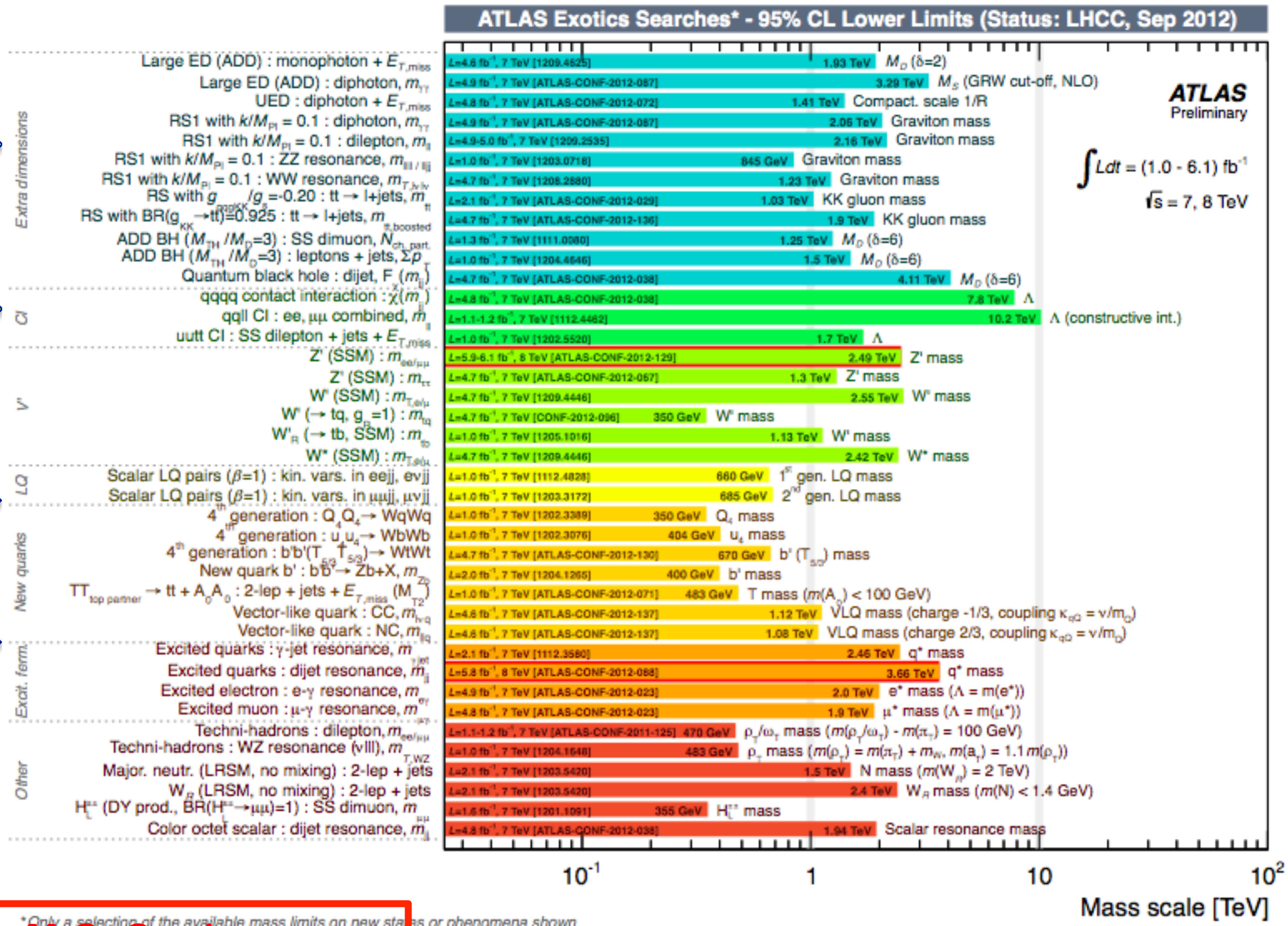
Contact interactions

W'/Z'

leptoquarks

New/ excited fermions

Others



Dedicated talk :M.S. Cooke

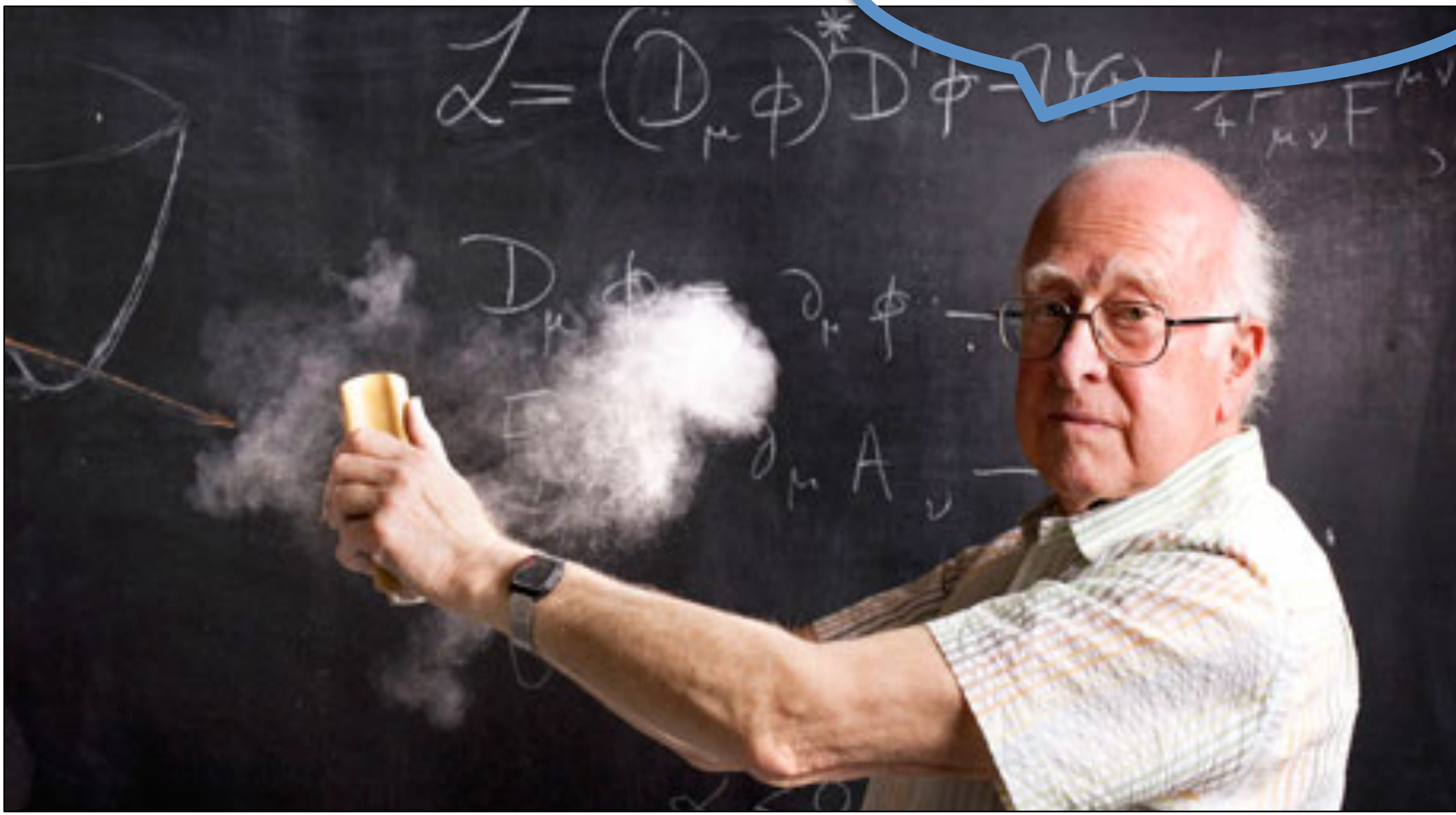
Conclusions

- **Superb performance of the LHC accelerator**
- **Very fruitful times for the ATLAS collaboration:**
  - ✓ **Very good performance of the detector**
  - ✓ **Highly efficient data taking/computing/ physics analysis**
- **Impressive quantity of new physics results being published.**
  - ✓ **All results : https://twiki.cern.ch/twiki/bin/view/AtlasPublic**
  - ✓ **The most exciting one:**
  - – **Observation of a new boson at 126 GeV – properties consistent with the SM Higgs within the current uncertainties**
    - – **excess seen in the $\gamma\gamma$, ZZ and WW channels (5.9 σ local significance)**
- **(Near) future work:**
  - – **Continue to measure the properties of the new boson**
  - – **Use all integrated luminosity collected by 2012 (~30fb^{-1}) to continue to search for new effects and constrain BSM models**
  - – **Prepare for Phase 0 upgrade at 14 TeV and Phase 1 upgrade for high luminosity ($L>10^{34}cm^{-2}s^{-1}$)**

Dedicated talk: S. Burdin)

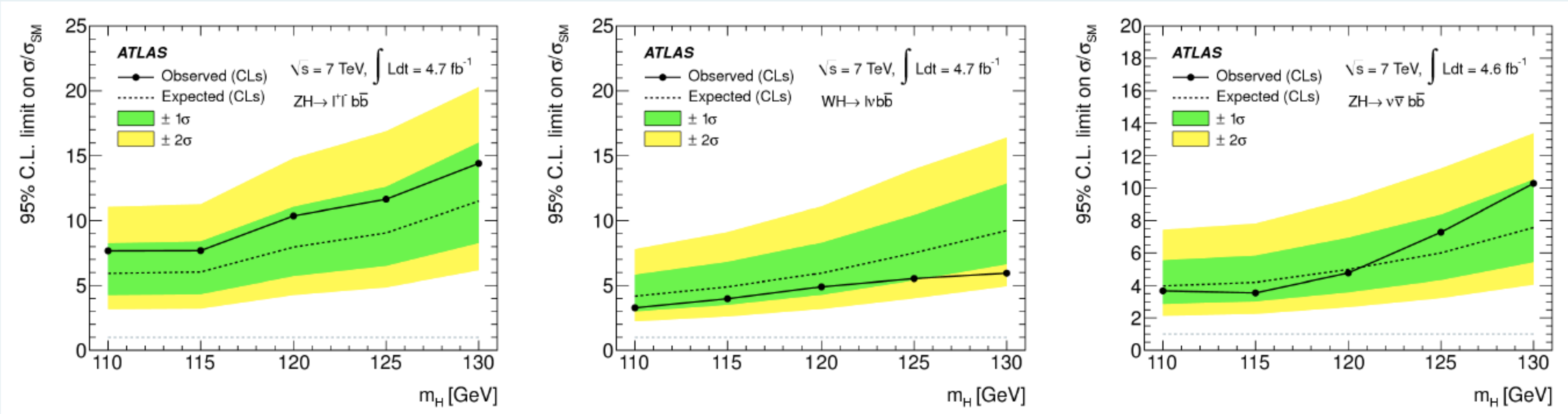
Thanks!

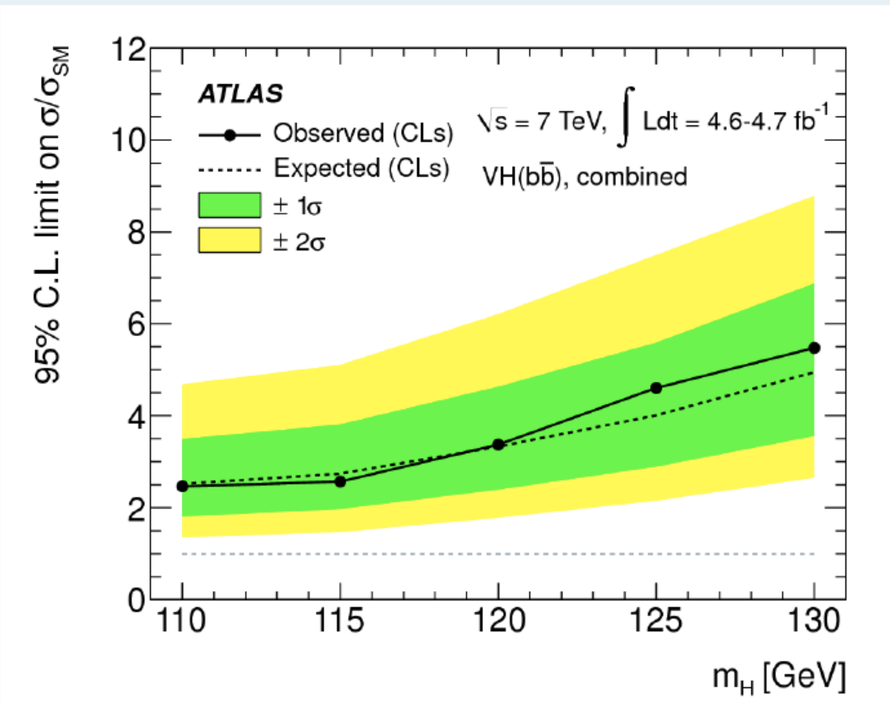
Is the SM boson found or not?



Back-up

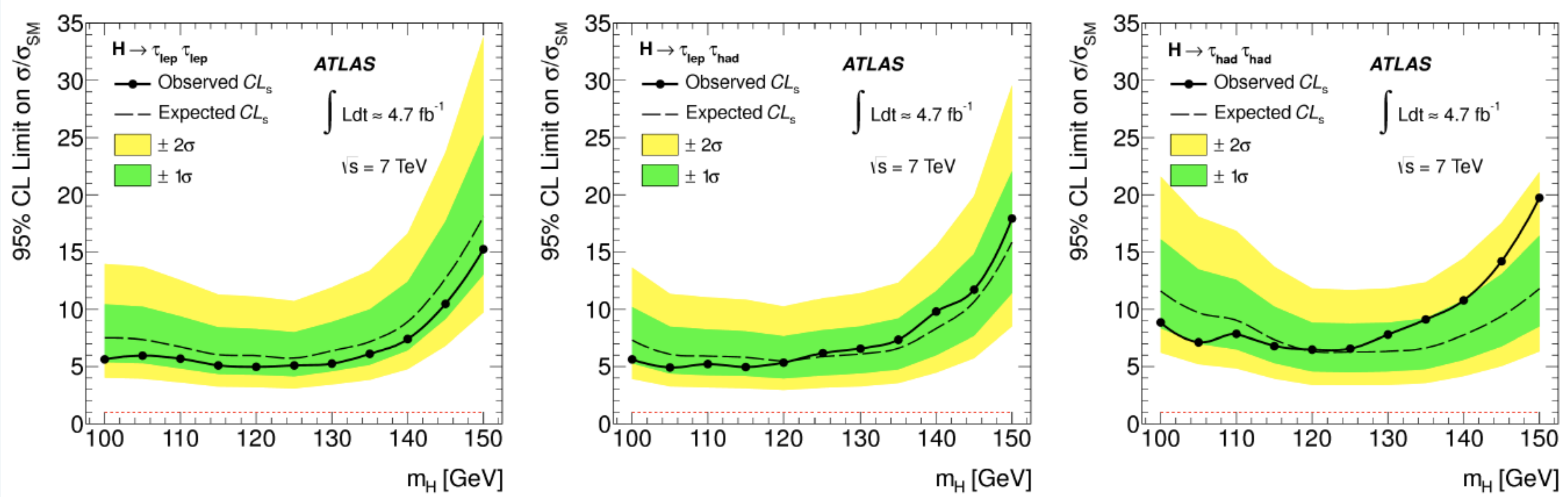
Limits in VH (bbar)

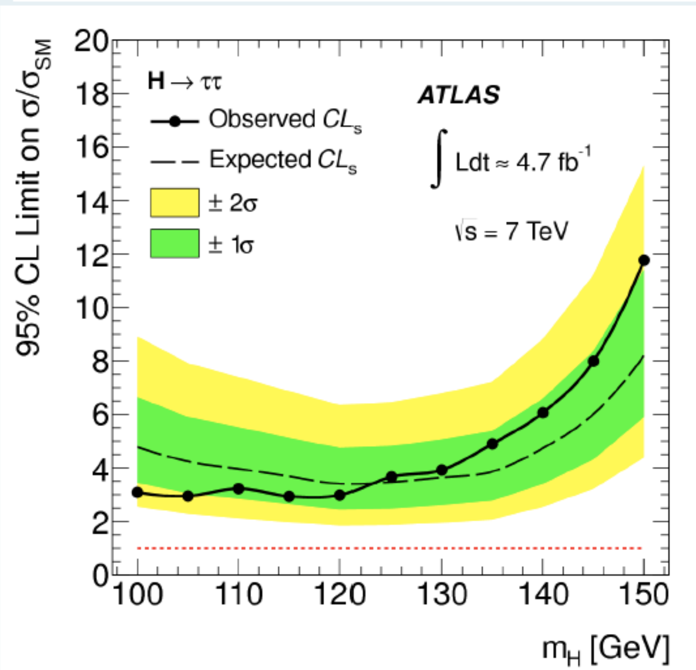




- 95% CL upper limits using CLs
- Observed (expected) per channel sensitivity ($\times\sigma_{\rm SM}$):
  - $ZH \to \ell\ell b\bar{b}$: 8(6)–14(12)
  - $WH \to \ell\nu b\bar{b}$: 3(4)–6(9)
  - $ZH \to \nu\bar{\nu} b\bar{b}$: 4(4)–10(8)
- Combined: 2.5–5.5 times SM expectation, 4.6 at $m_H = 125$ GeV
- Coming: 2012 data, improved $m_{b\bar{b}}$ resolution, MVA

Limits on H-> tautau





- 95% CL upper limits using CLs
- Most sensitive: $\tau_{had}\tau_{had}$, H+2jet VBF in $\tau_{lep}\tau_{had}$ and $\tau_{lep}\tau_{lep}$
- Combined observed (expected) limit: 2.9(3.4)–11.7(8.2) times SM expectation, 3.7 at $m_H = 125\,\text{GeV}$
- Coming: 2012 data analysis