Search for the Higgs boson in the WW decay channel with ATLAS using 4.7 fb^{-1} of data from 2011

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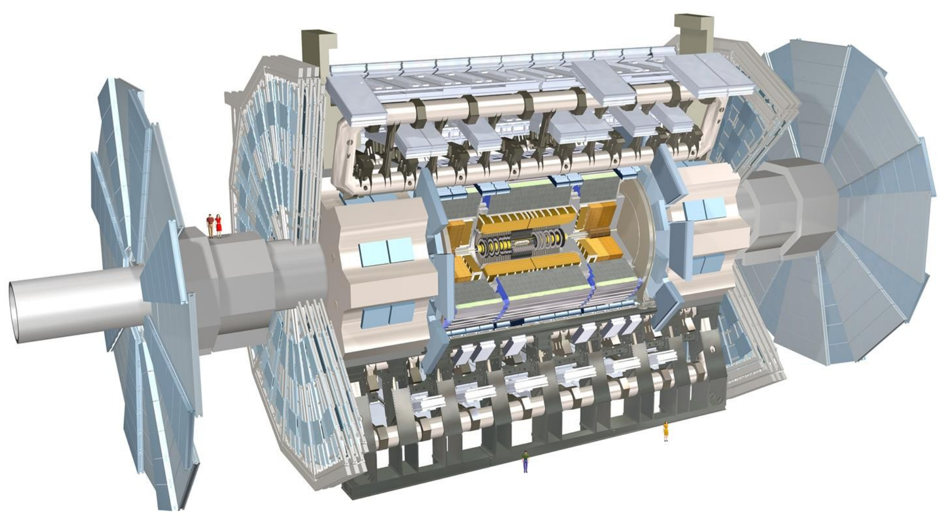
For the ATLAS Collaboration

Rencontres de Moriond 2012

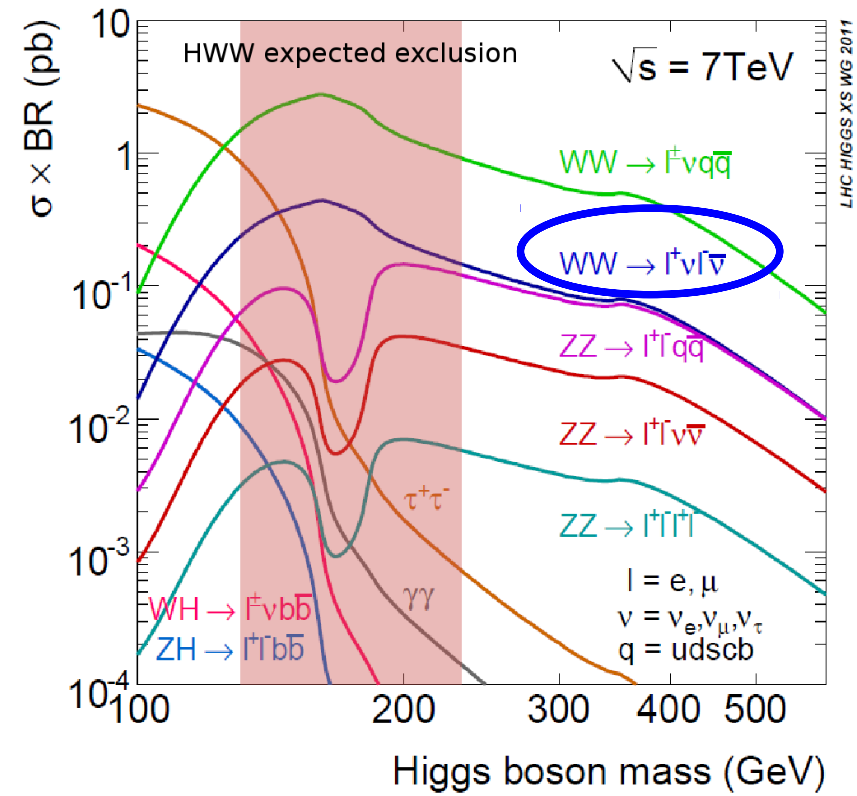


http://arxiv.org/abs/1112.2577

Why we search in $H \rightarrow WW \rightarrow l^+ \nu l^- \nu$

•Large branching fraction for wide range of masses – Large window of sensitivity

•Expected sensitivity extends to low m_H (127 GeV with 4.7fb^{-1}). Competitive with $H \rightarrow \gamma\gamma$



Why is $H \rightarrow WW \rightarrow l^+ \nu l^- \nu$ difficult?

Two neutrinos in final state → no mass reconstruction. Signal is a broad excess of events

Must have confidence in background model to identify an emerging signal

How to select $H \to WW \to l^+ \nu l^- \nu$

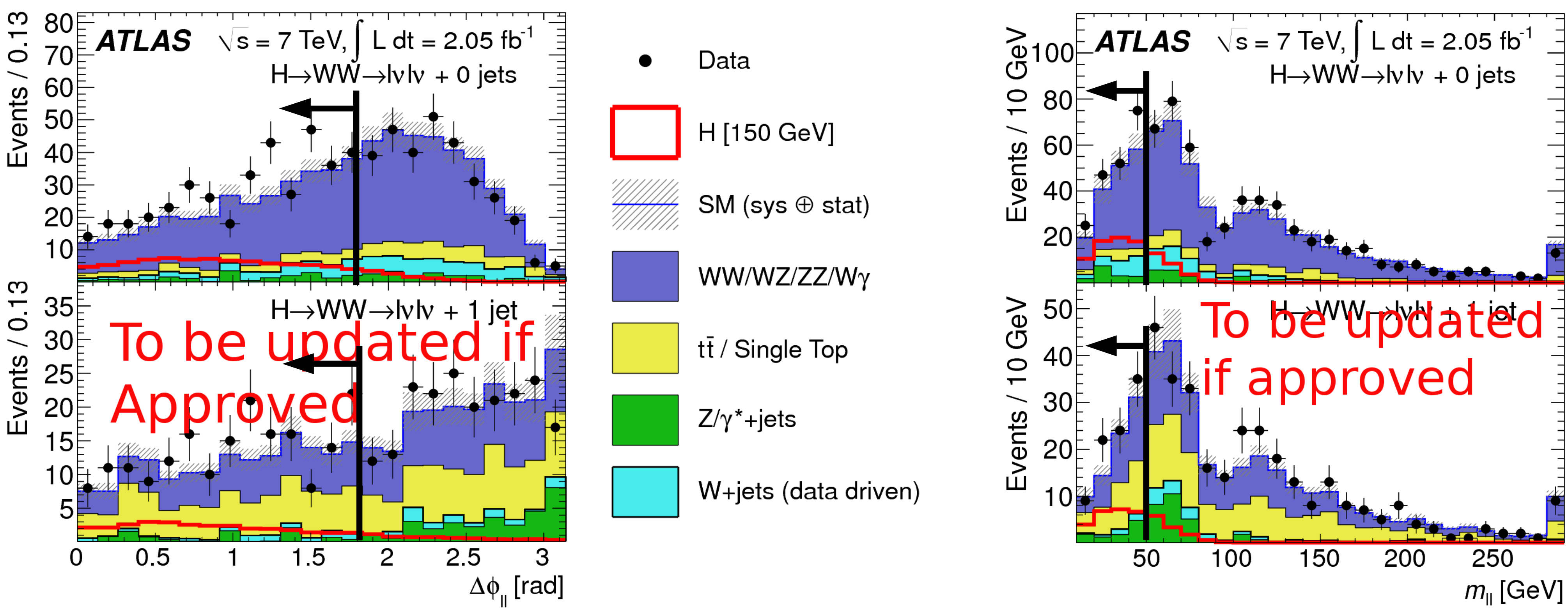
- Opposite-sign lepton pairs – ee μμ eμ
- Large missing transverse momentum from neutrinos
- Use 0 and 1 jet final states + 2 jet VBF (tag forward jets)

WW Spin correlation :

Require small $\Delta\varphi(l^+, l^-)$

Low m_H :

Require low $m(l^+, l^-)$



Backgrounds to $H \to WW \to l^+ \nu l^- \nu$

Use data-driven estimates for main backgrounds

W + jets	Z/γ^* + jets
Reject with isolation, PID	Reject with met cut
10 % of Background	5% of Background
Extrapolate from inverted lepton PID control region	Normalize MC using Z control region

Top	WW
Reject with jet cuts	Reject with $\Delta\varphi(l,l)$, $m(l,l)$ cut
5% of Background	65 % of Background
Jet veto efficiency derived in b-tag control region	Normalize MC using high $m(l^+,l^-)$ control region

Remaining backgrounds from Di-Bosons are estimated using simulation

Final distributions

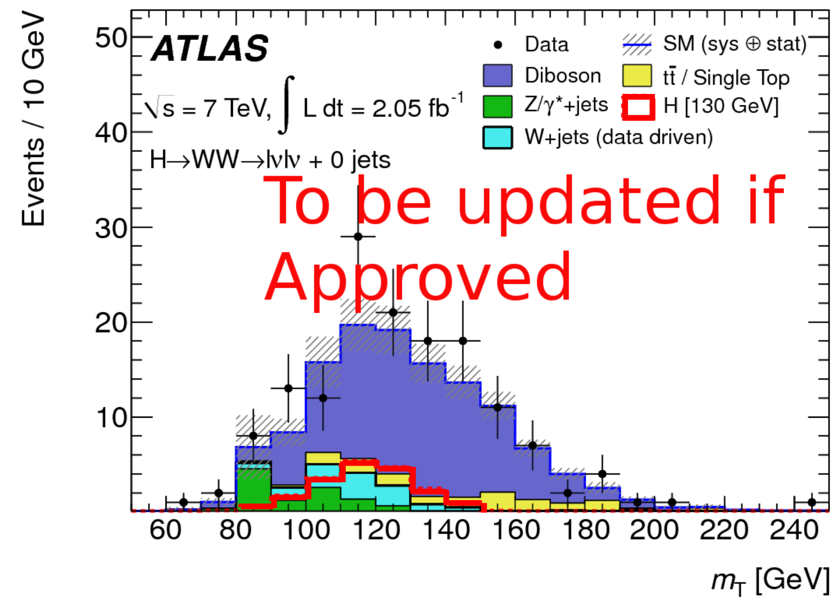
After all analysis cuts

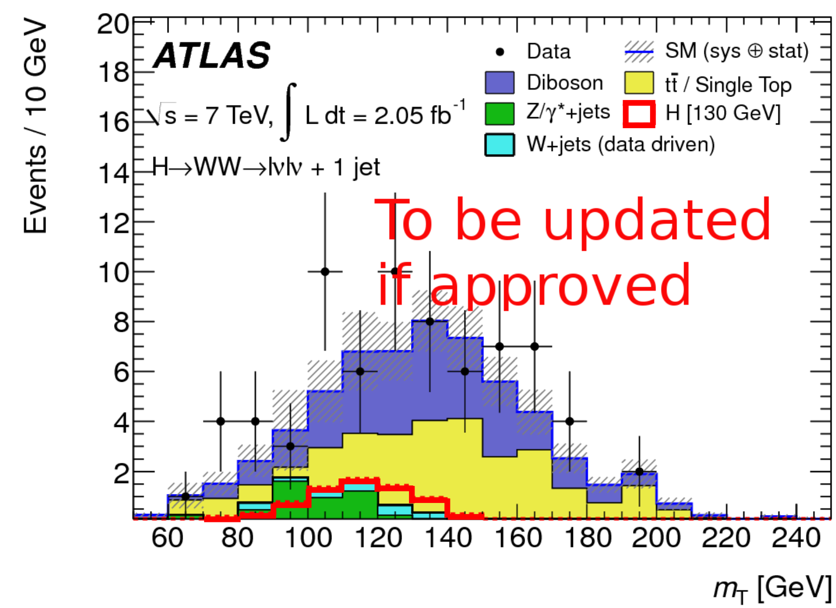
Transverse Mass (m_T) is a proxy for Higgs mass for WW channel

130 GeV Higgs signal shown

No significant excess observed

Fit m_T shape to extract limits



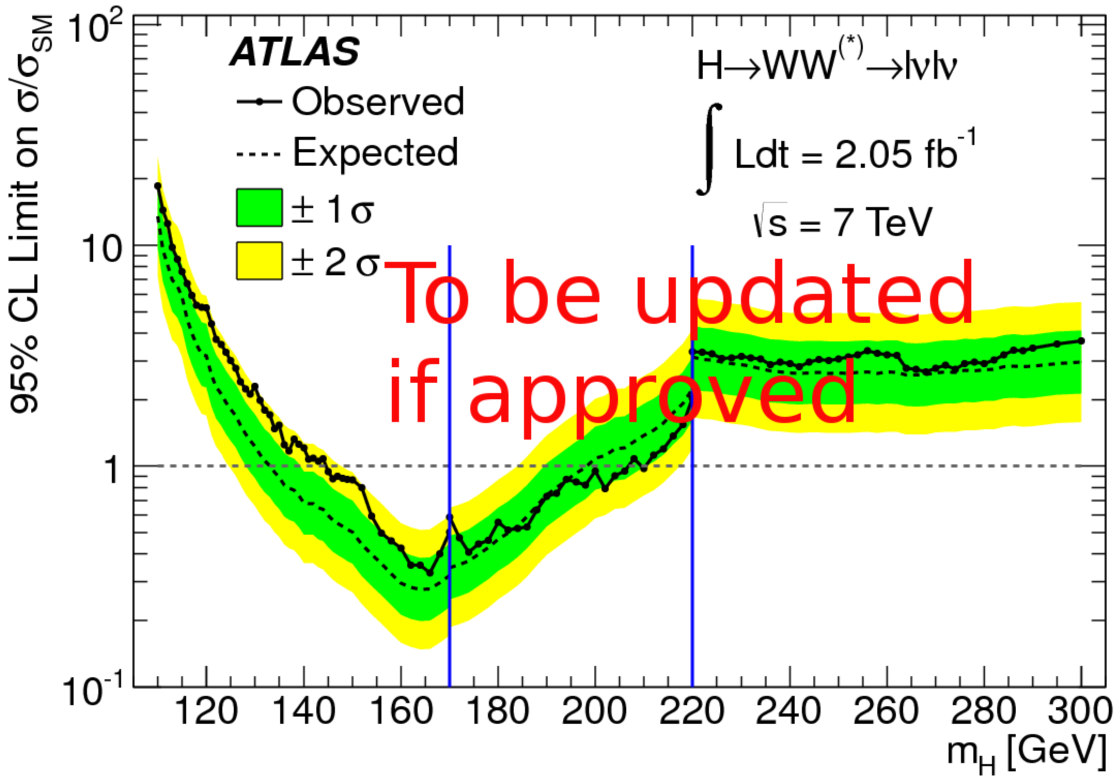


Limit results

Likelihood for each M_H in 9 channels (ee, mm, em) x (0 jet, 1 jet, 2 jet)

Expected 95% C.L. Exclusion : 134 GeV < m_H < 200 GeV

Observed 95% C.L. Exclusion : 145 GeV < m_H < 206 GeV



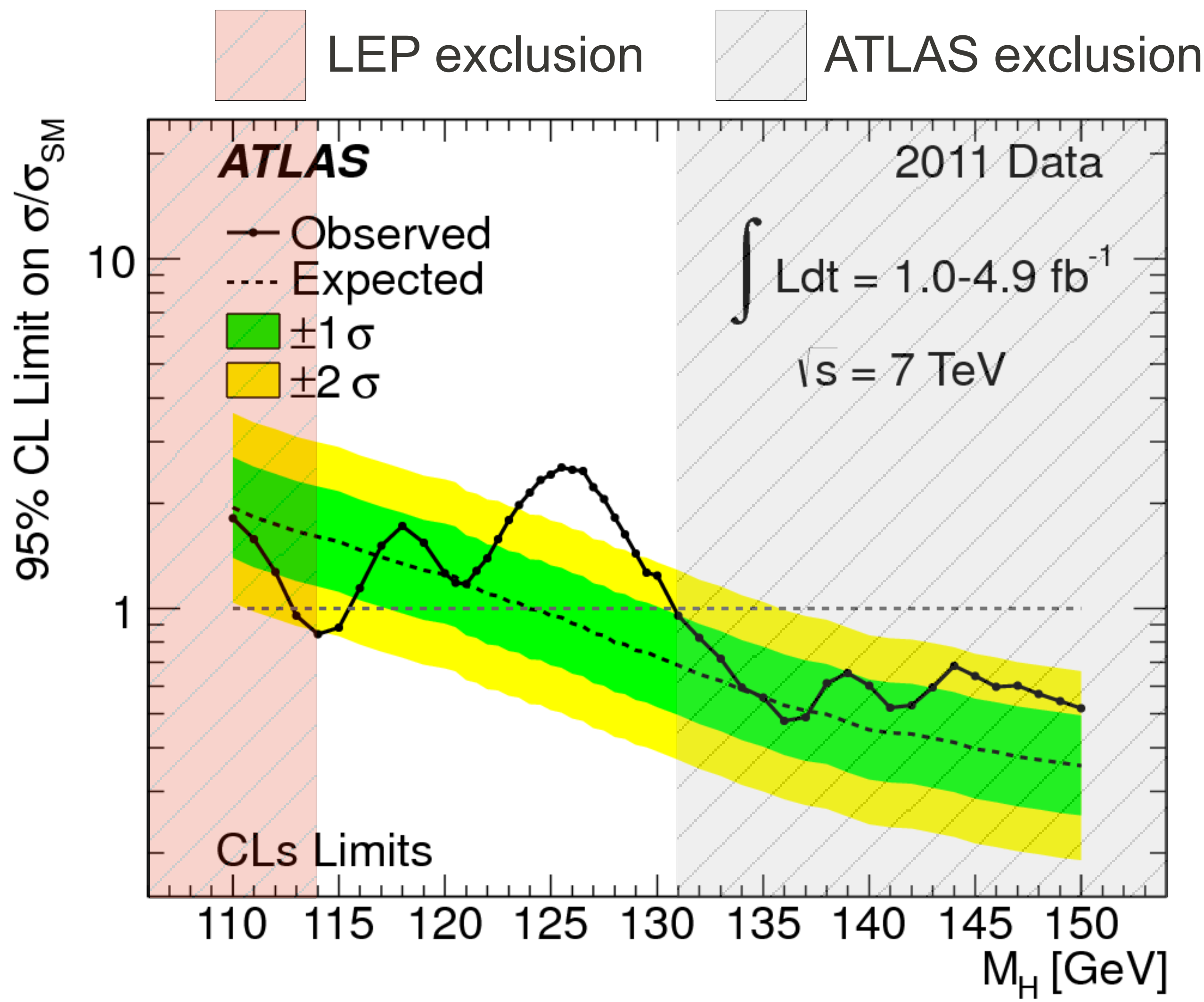
What's next for the Higgs search?

$H \to WW \to l^+ \nu l^- \nu$ is one of the most sensitive Higgs search channels

Combine WW and 5 other channels (right)

We will "close the gap" with the 2012 data

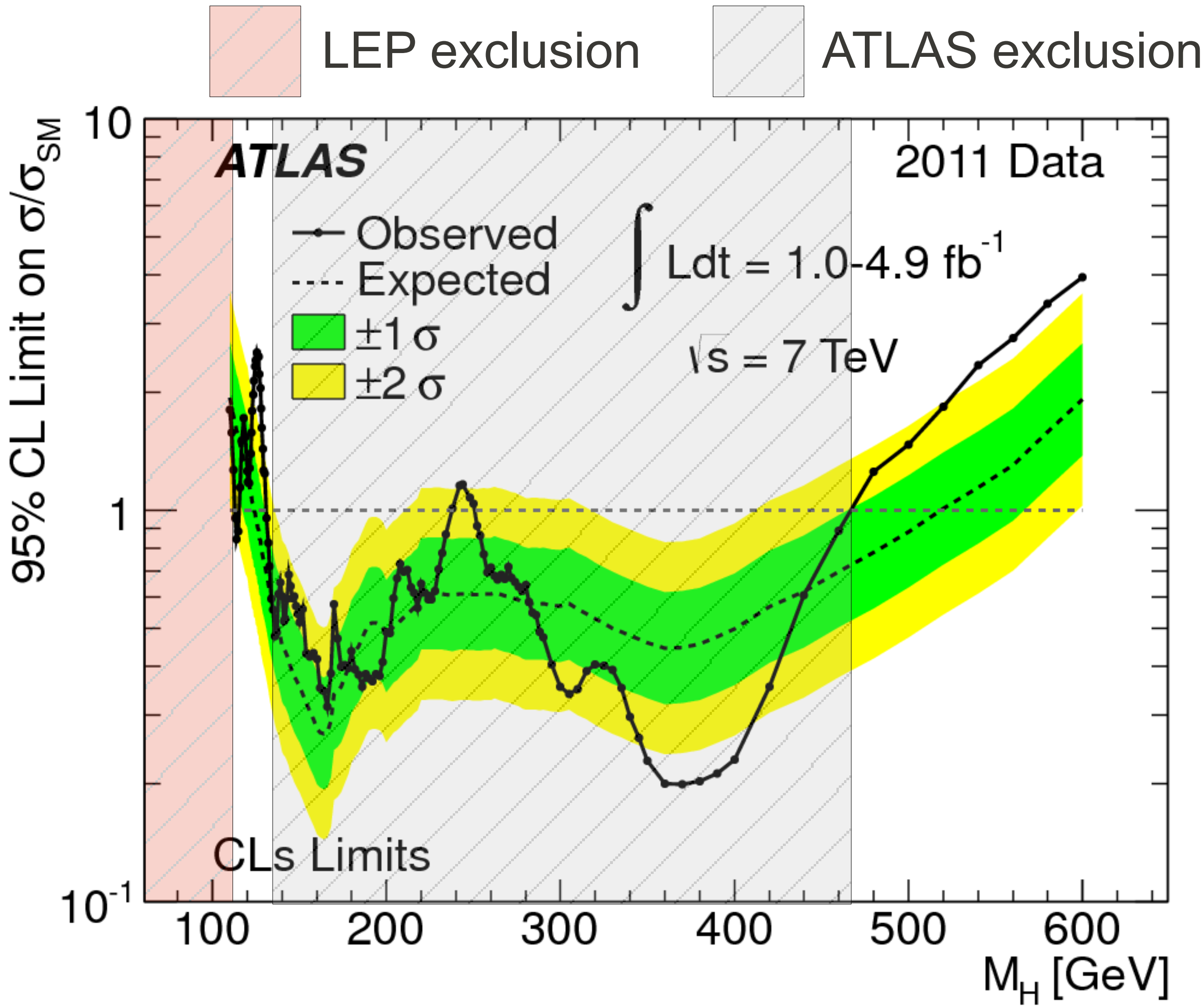
Expect discovery or exclusion this year!



Backup

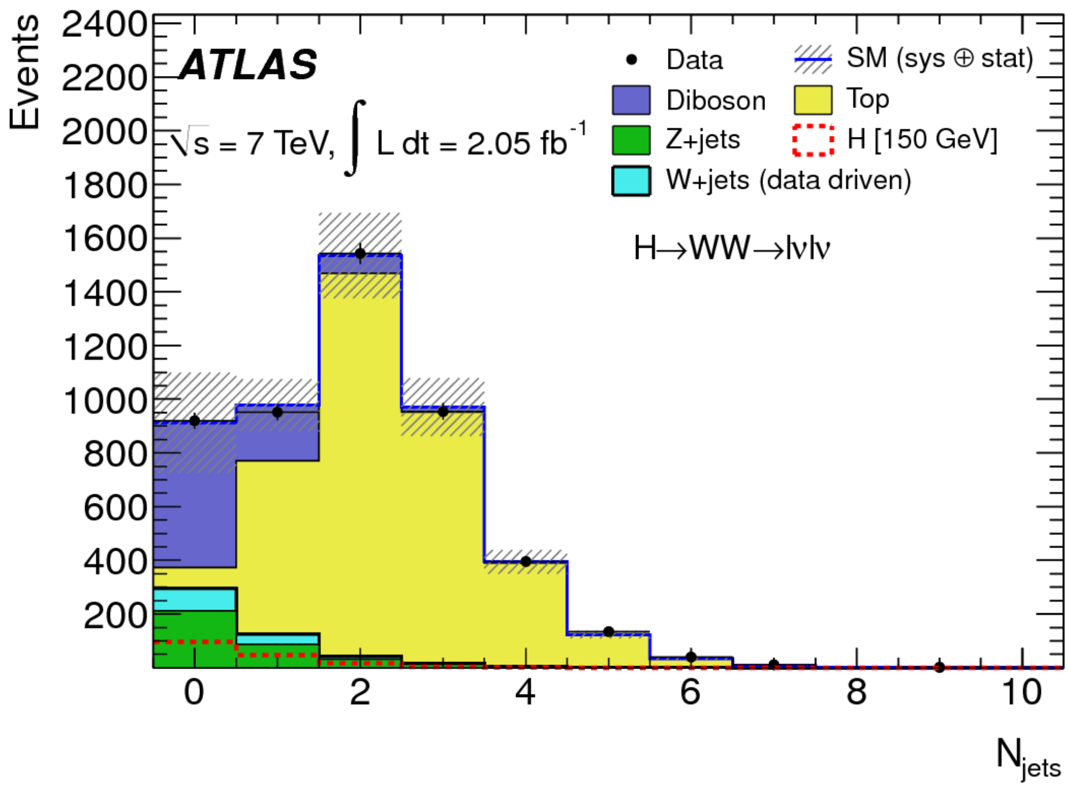
All backup plots will be updated if the analysis is approved

Full combined limit plot



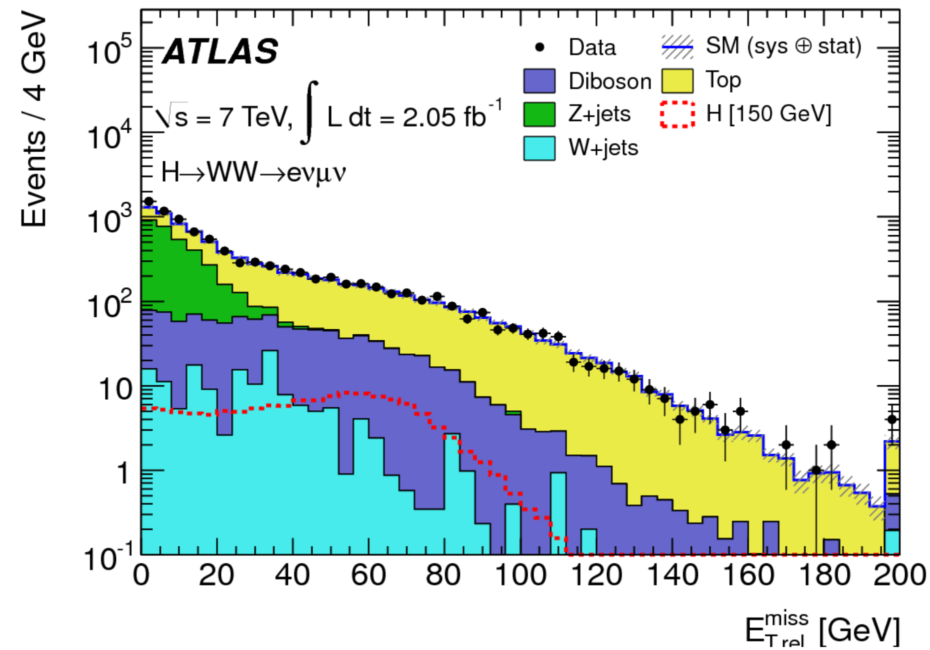
Jet multiplicity

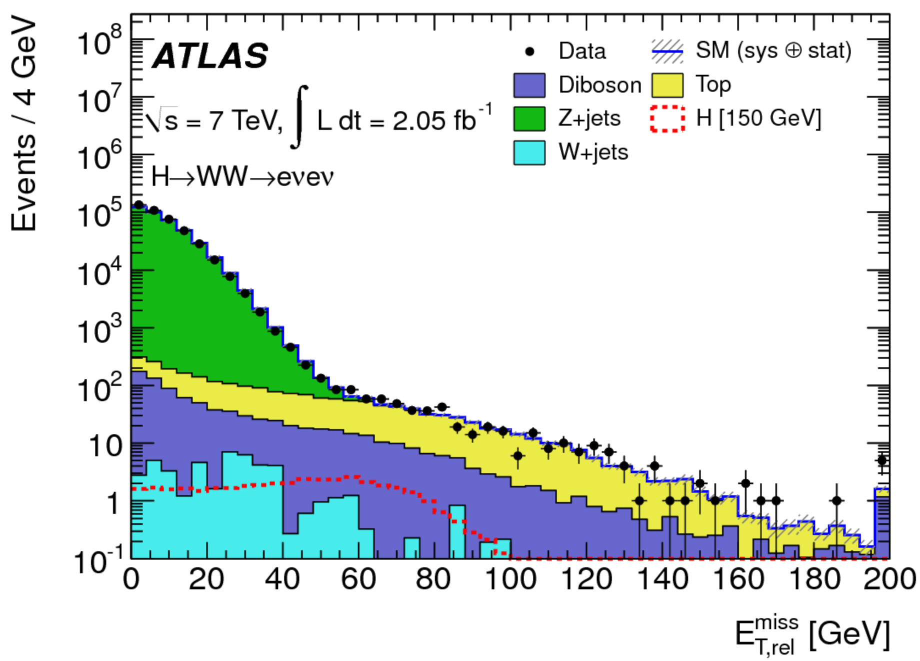
- VBF analysis in 2 jet bin to remove top background
- Plots of VBF were not shown because only one data event passes the full selection
- While the VBF channel cannot exclude the Higgs alone, it does contribute to the combined limit

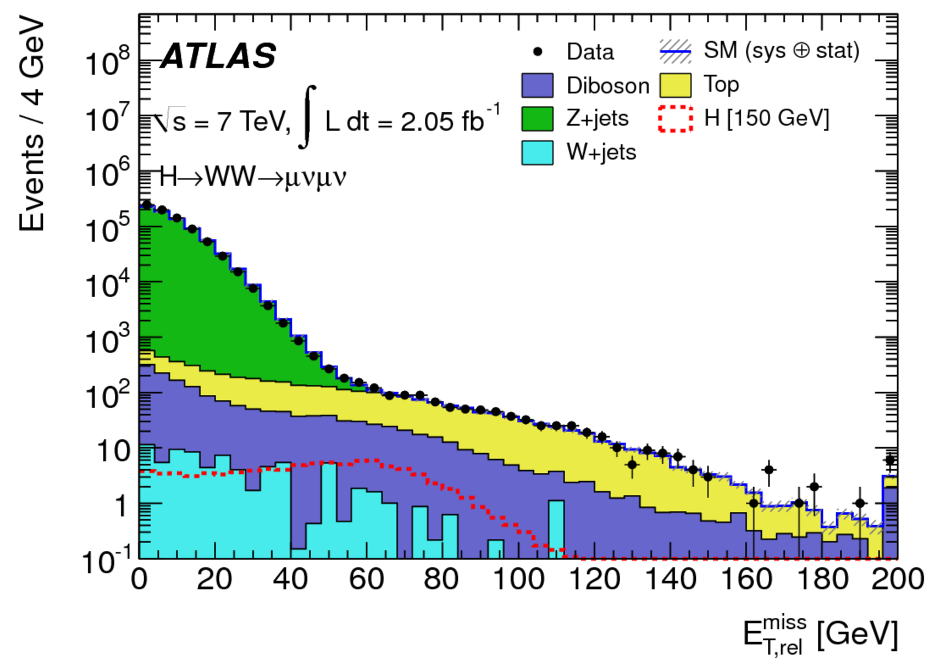


Missing Energy Distributions

Missing Energy distributions for the eμ (top right), ee (bottom left), μμ (bottom right) channels. The cut removes a majority of Z+jets events

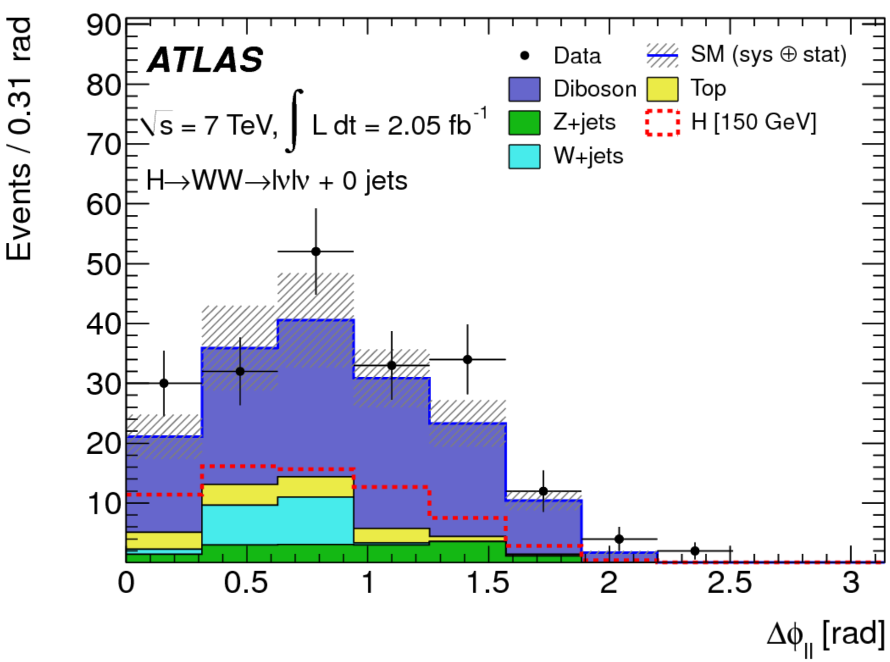


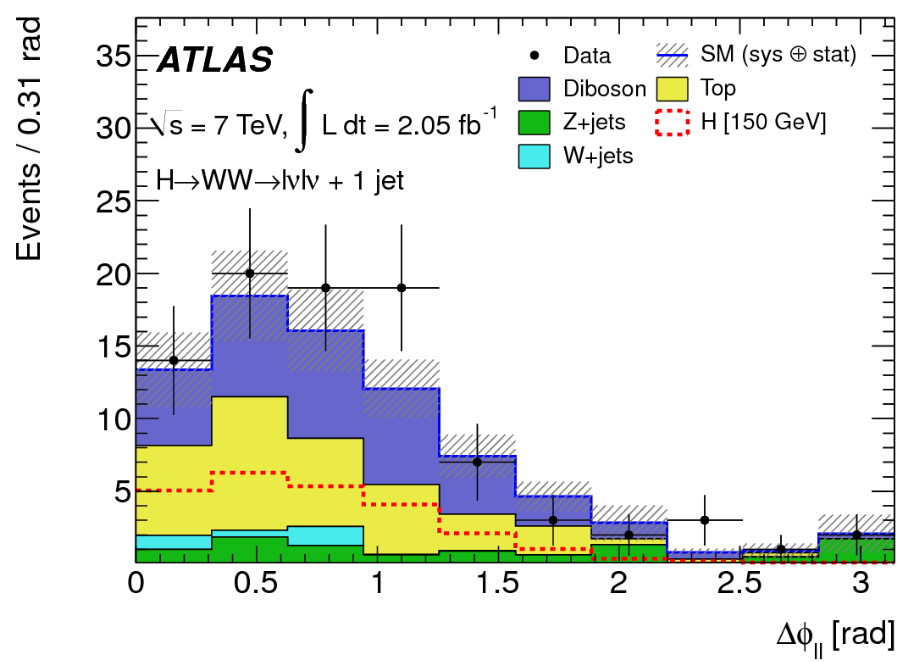




Delta Phi distribution after $M(l^+,l^-)$ cut

Although both a Delta Phi and an $M(l^+,l^-)$ cut are applied, they are correlated. These are the Delta Phi distributions after the $M(l^+,l^-)$ cut for the 0 jet (left) and 1 jet (right) analyses





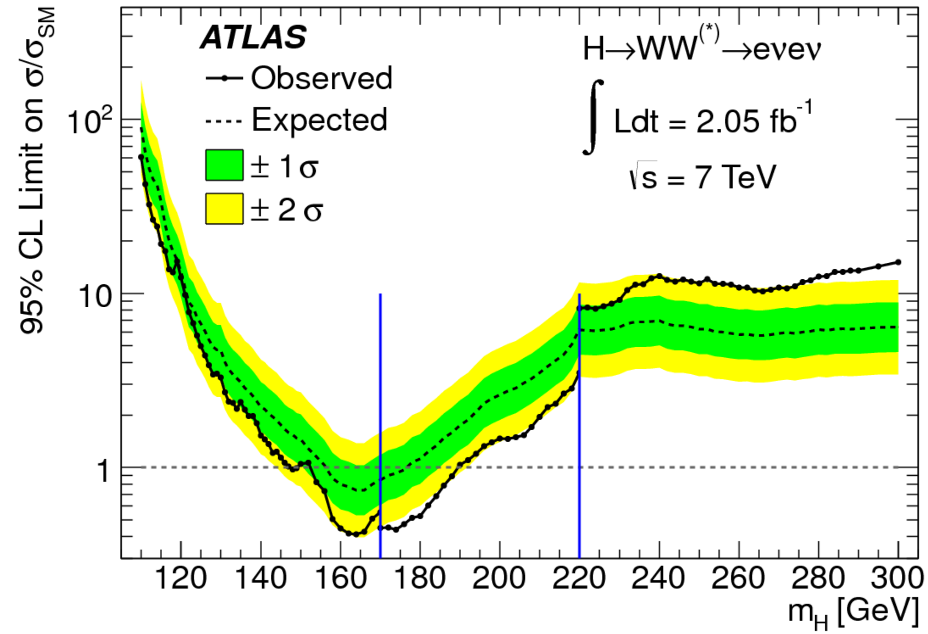
Other Backgrounds

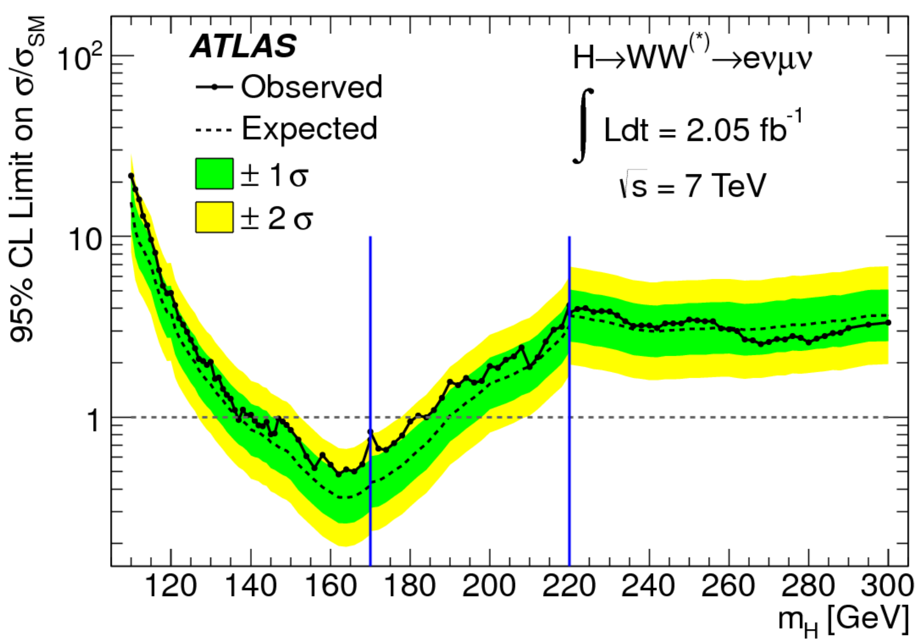
WZ + ZZ – Small backgrounds. Estimate from Simulation

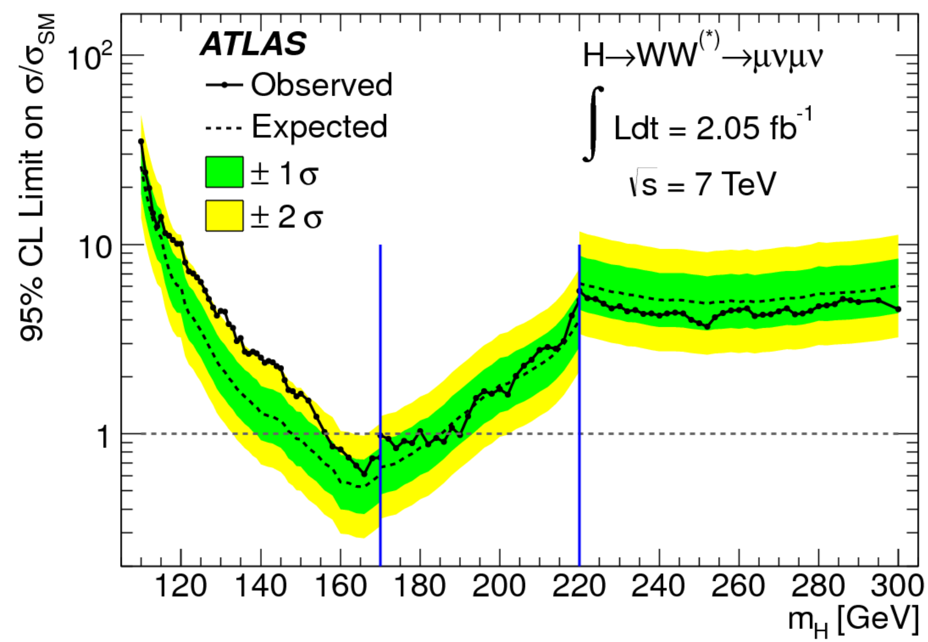
Single Top – Included in the Top background. Differences in b-jet kinematics shown to be negligible

Wγ* - Important at low mass. Background estimate currently from Monte Carlo. Data driven methods are being developed.

Limits per channel







Limits per jet bin