



Search for the Higgs boson in the $H \rightarrow WW \rightarrow l\nu l\nu$ channel in ATLAS

Aaron Armbruster

On behalf of ATLAS Higgs

University of Michigan

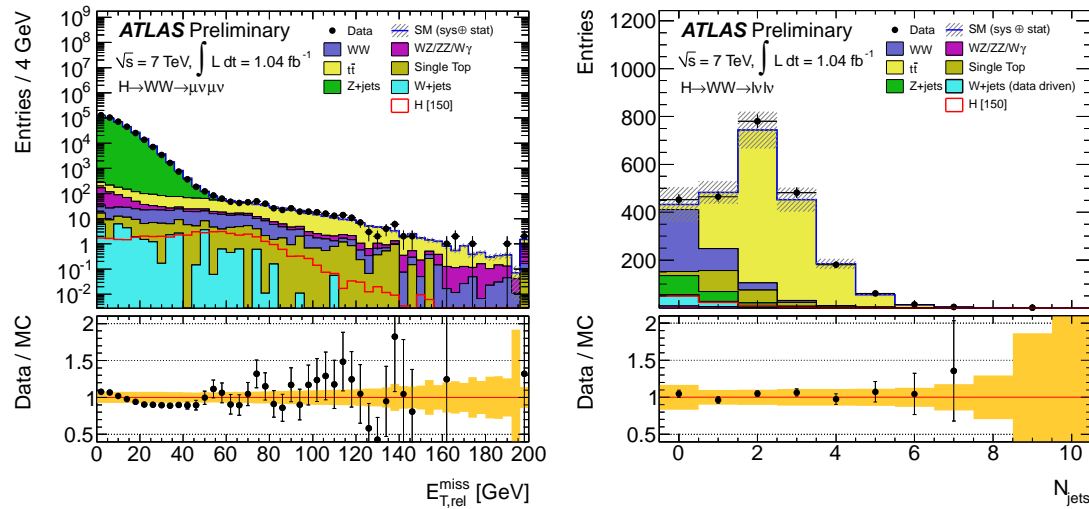
July 28, 2011



Status

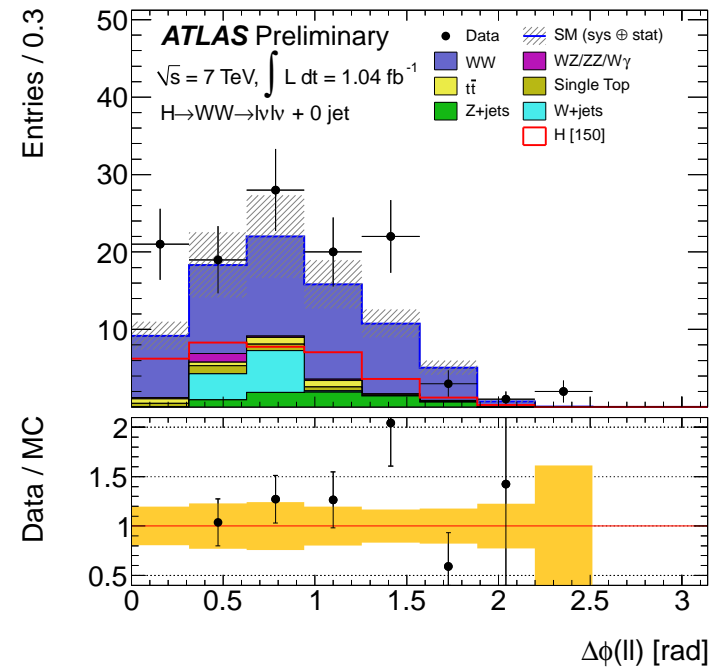
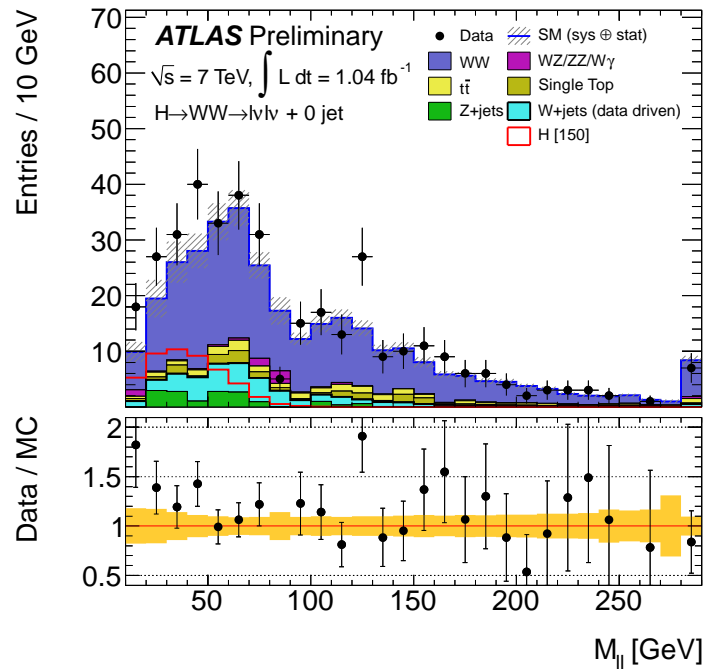
- Analysis uses 1.04 fb^{-1} of 7 TeV LHC data
- Search range between 110 and 240 GeV
- Most sensitive in the range 160-170 GeV
 - Large $H \rightarrow WW$ branching ratio
 - Good S/B due to clean dilepton signature

Event Selections



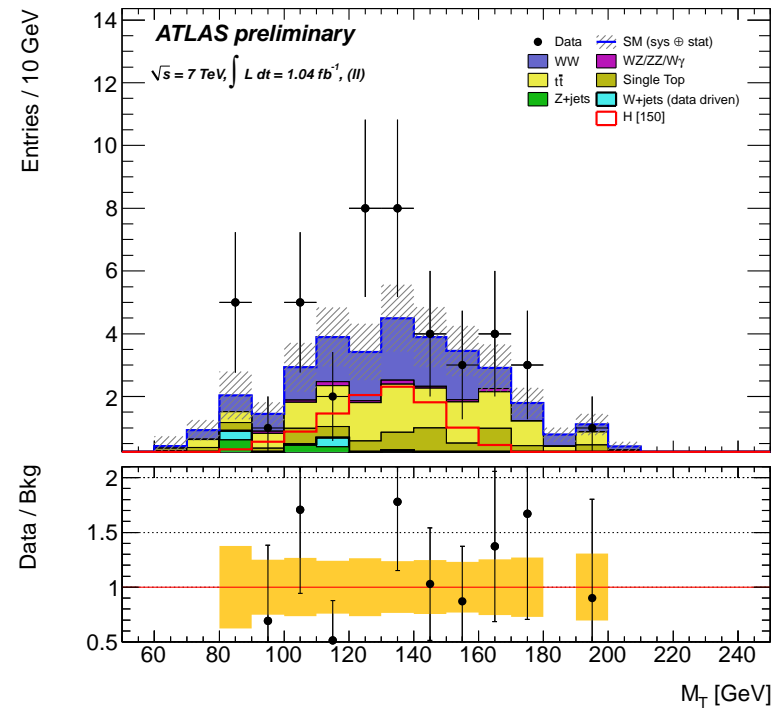
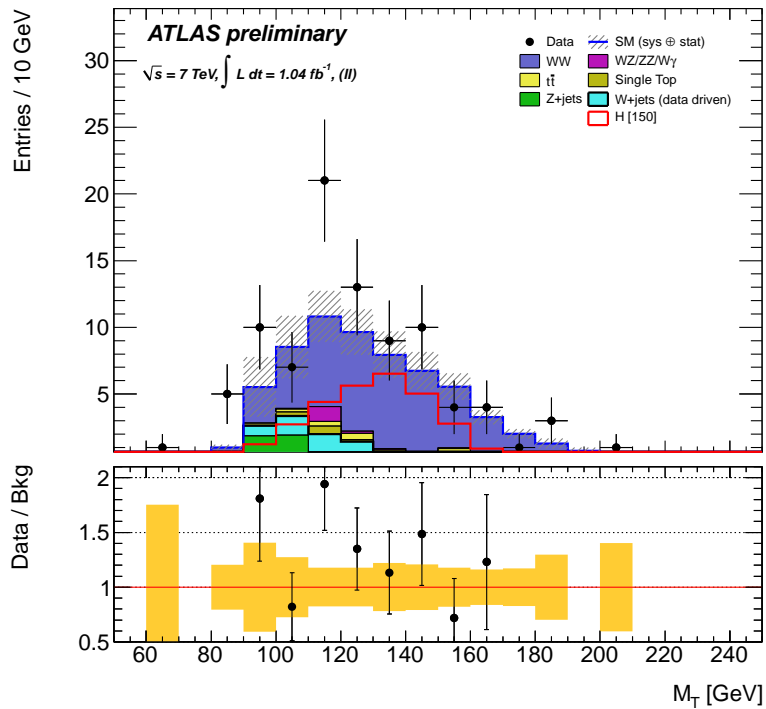
- Search for high E_T opposite sign dilepton events
 - $E_T^{rel} > 40$ (25) GeV for $ee, \mu\mu$ ($e\mu$)
- Analysis is split by jet multiplicity
 - Jets required to have $p_T > 25$ GeV, $|\eta| < 4.5$ (anti- k_T R=0.4)
 - Dilepton p_T cut in zero-jet to suppress Drell-Yan
 - B-veto in one-jet analysis to reject $t\bar{t}$ + single top

Event Selections



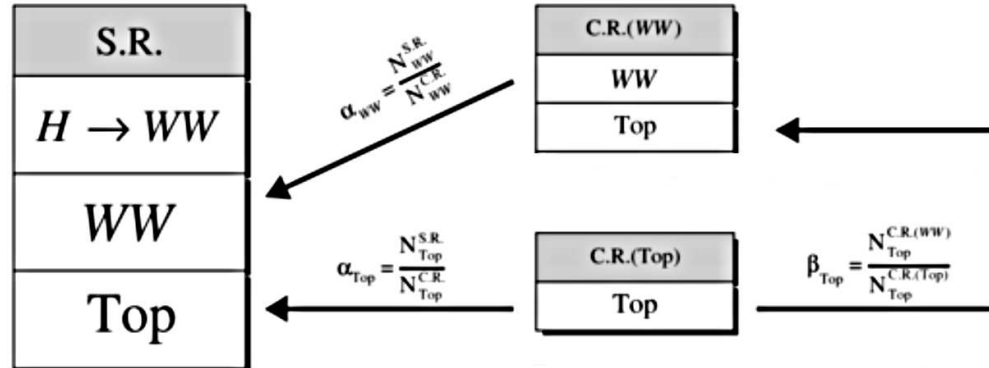
- Two selection criteria optimized for **low mass** and **high mass**, with a cutoff at 170 GeV
 - $M_{\ell\ell} < 50$ or 65 GeV for low and high mass
 - $\Delta\phi(\ell_1, \ell_2) < 1.3$ or 1.8 for low and high mass

Mass Distributions



- Transverse Mass distribution for zero-jet (left) and one-jet (right) after all selections
 - Sliding mass cut as final selection: $0.75 \times M_H < M_T < M_H$

Model



$$L(\mu, \vec{\theta}) = \prod_{\ell=ee, e\mu, \mu\mu} \left[\prod_{j=0,1} \left[P^{SR}(N_{\ell j} | \mu s_{\ell j} + \alpha_{\ell j}^{WW} N_{e\mu, j}^{WW} + \delta_j^1 \alpha_{\ell}^{top} N_{\ell, 1j}^{top} + \sum_k b_{\ell j k}) \right. \right. \\ \left. \left. P^{CR_{WW}}(N_{\ell j} | \mu s_{\ell j} + \gamma_{\ell j}^{WW} N_{e\mu, j}^{WW} + \delta_j^1 \beta_{\ell, 1j}^{top} N_{e\mu}^{top} + \sum_k b_{\ell j k}) \right] \right. \\ \left. P^{CR_{top}}(N_{\ell j} | \mu s_{\ell j} + \delta_j^1 \gamma_{\ell, 1j}^{top} N_{e\mu}^{top} + \sum_k b_{\ell j k}) \times \prod_i G(\theta_i) \right]$$

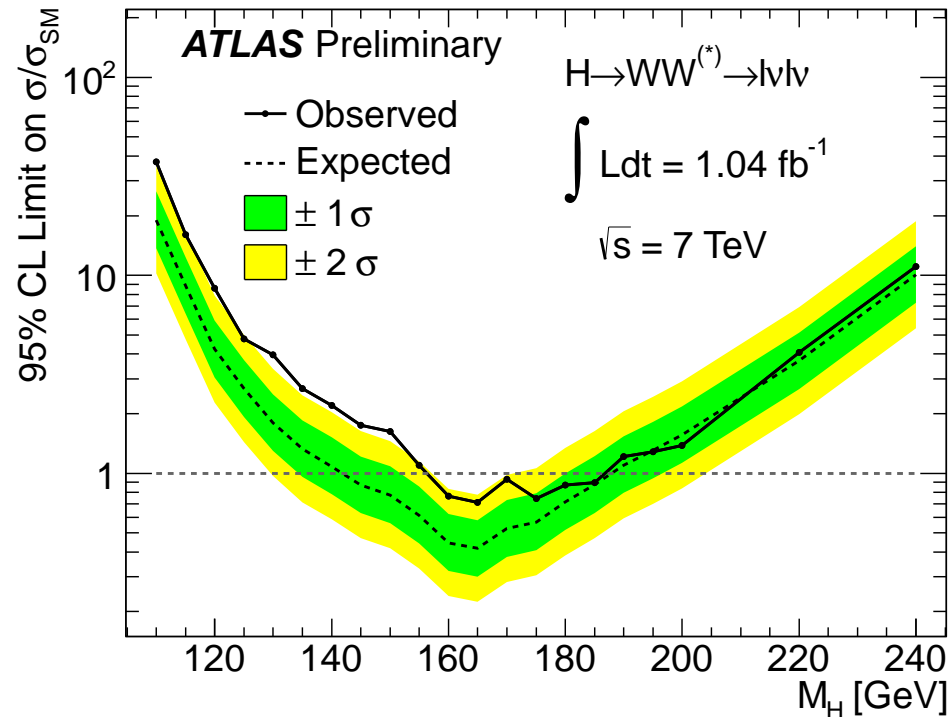
- α terms describe background extrapolation into signal region
- β terms describe extrapolation between control regions

Event Rates

m_H (GeV)	Lepton Flavors	Nominal		$\mu = 0$	$\mu = 1$		Observed
		Signal	Total Bkg.	Total Bkg.	Signal	Total Bkg.	
150 H+0j	ee	3.1	4.7	5.7	3.1	4.4	7
	$e\mu$	10.6	17.2	20.8	10.4	15.7	21
	$\mu\mu$	6.8	10.9	13.4	6.7	10.1	21
150 H+1j	ee	0.94	2.2	2.3	1.05	1.98	4
	$e\mu$	4.0	9.0	8.8	4.4	7.0	8
	$\mu\mu$	2.3	4.0	4.2	2.5	3.0	9
180 H+0j	ee	4.2	6.3	6.8	4.0	4.5	3
	$e\mu$	11.8	19.1	20.9	11.3	12.7	25
	$\mu\mu$	7.8	13.5	14.7	7.4	9.6	16
180 H+1j	ee	1.60	4.9	4.9	1.44	4.4	5
	$e\mu$	5.5	14.6	12.3	4.9	10.1	8
	$\mu\mu$	3.4	6.5	6.4	3.1	4.5	12

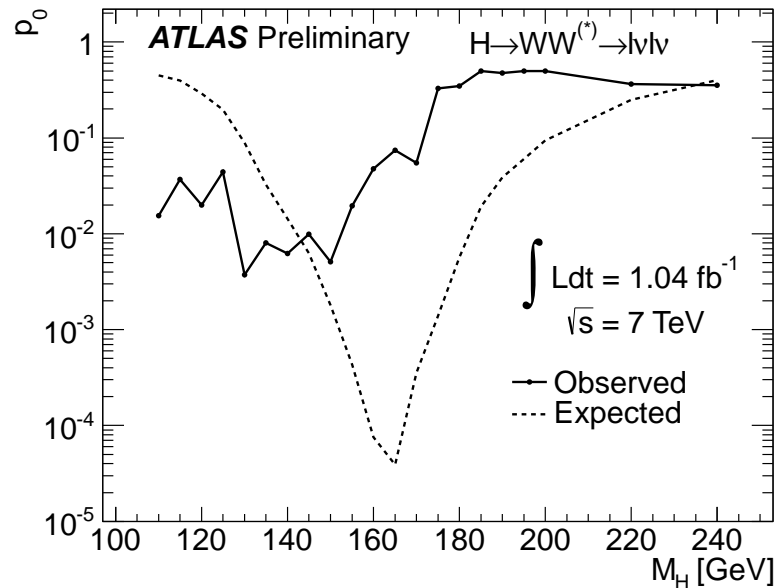
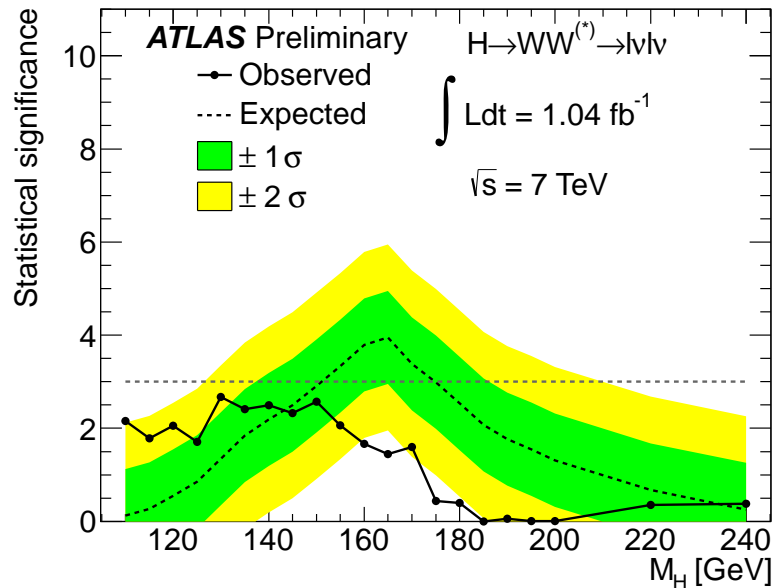
- Expected and best fit signal, background rates
 - Nominal expectation before fit
 - Post-fit assuming $\mu = 0$
 - Post-fit assuming $\mu = 1$

Standard Model Limit



- Observed 95% CL exclusion with CLs: 158-186 GeV
- Expected exclusion: 142-186 GeV

p-values, significance



- $>2\sigma$ excess between 126-158 GeV. The largest is 2.7σ at 130 GeV
- Right plot shows background-only p-value



Summary

- $H \rightarrow WW \rightarrow l\nu l\nu$ analysis done with 1.04 fb^{-1}
- 95% CL exclusion region between 158-186 GeV
- Slight excess above background observed in low mass region

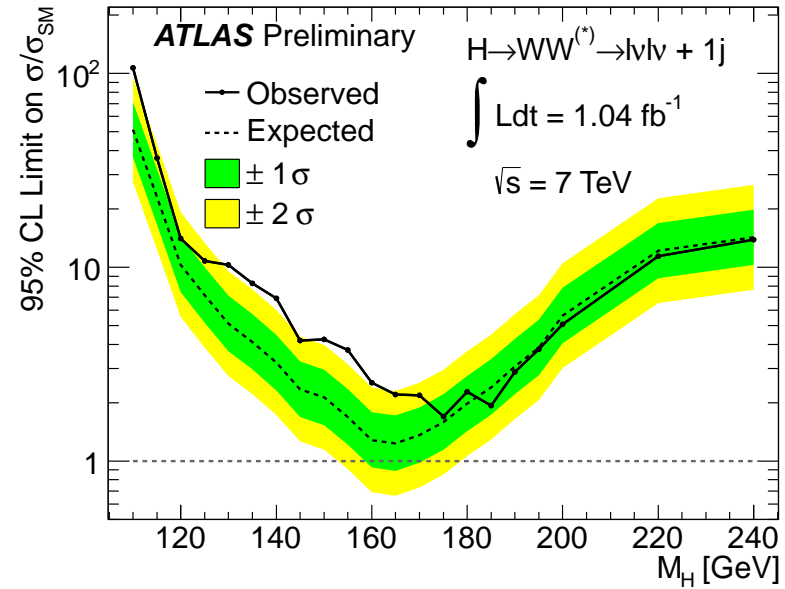
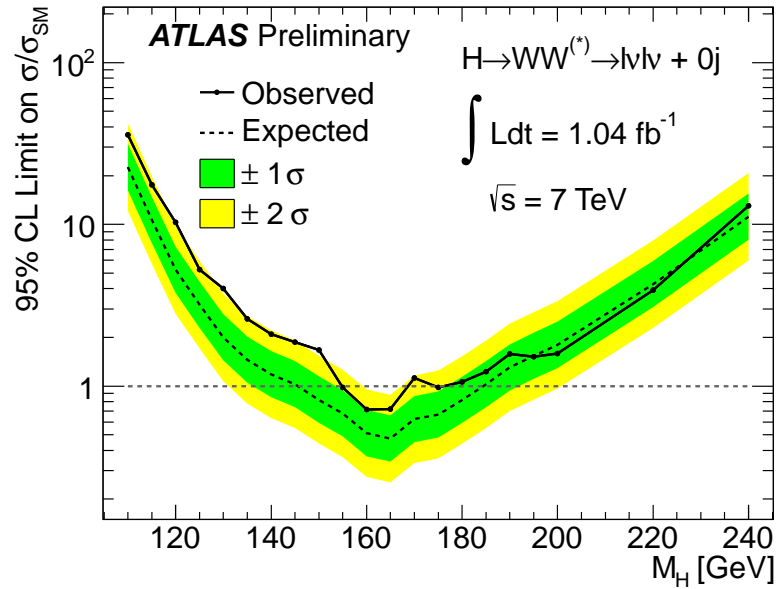


Backup

Background Estimation

- Data-driven estimates for Drell-Yan, W+jets, and top in 0-jet
 - Drell-Yan is scaled by a E_T mis-modelling factor derived from events in Z window
 - W+jets estimated by deriving fake factor from a control region with loosened lepton ID
 - Top in 0-jet applies a jet veto survival probability scale factor derived from a b-tagged control region

Limit by jet bin



Significance by jet bin

