Higgs search studies in H→WW channel
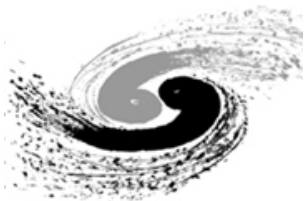
Xifeng RUAN

Co-supervised by

Shan JIN (IHEP) & Zhiqing ZHANG (LAL)
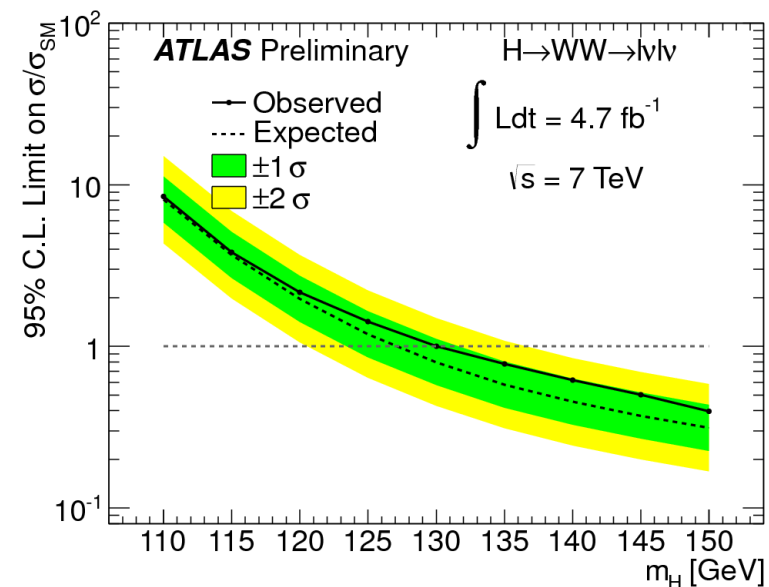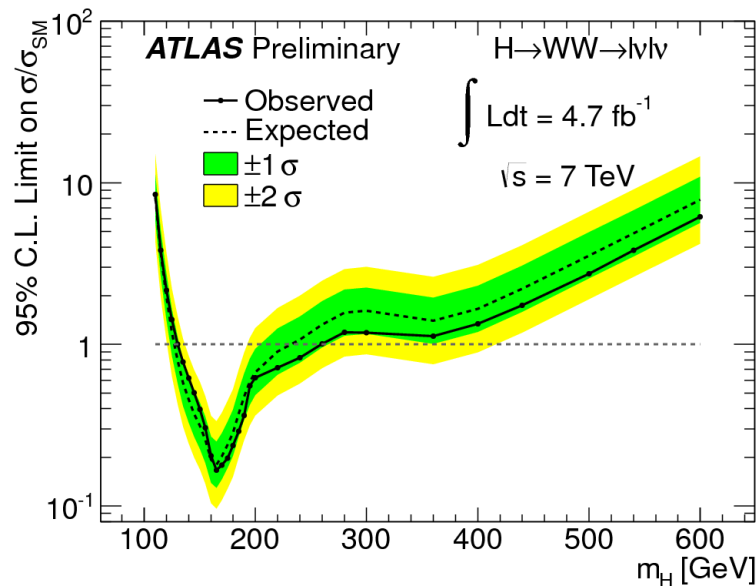
Outline of the Talk

Results of 2011 data

Main contributions

Future plan

Results of 2011 Data

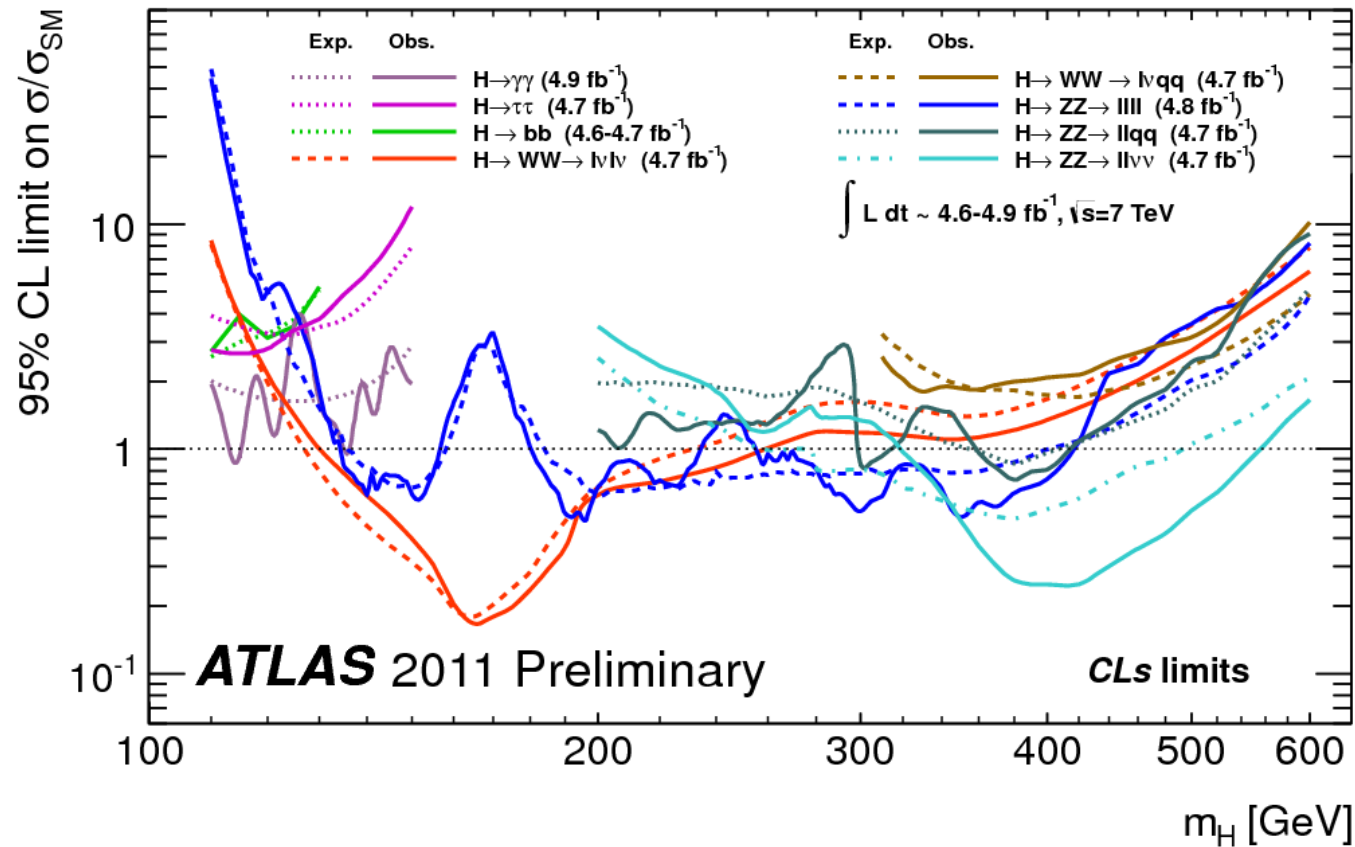- Both LHC & ATLAS performed excellently in 2011 → integrated lumi: 5 fb⁻¹

- H→WW→ lνlν (l=e, μ) analysis performed using full 2011 data in 0, 1 and 2 jets and ee, μμ and eμ channels

- Exclusion limits (cut based) reported to Moriond 2012

- No significant excess observed

- Observed limits: 130-260 GeV @ 95% CL

- Expected limits: 127-234 GeV @ 95% CL

WW Channel vs. Other Channels

For the ATLAS combination, WW channel is the dominant channel for essentially the full mass range 110-600GeV

Main Contributions

1) Data-driven method and estimate for top background in the dominant H + 0jet channel

2) One of the initiators of multivariate analyses in HWW searches

3) Original method pour correcting mismodeling data/MC in the missing transverse energy distribution of Drell-Yan sample using W+jets events

4) Our calculation of Higgs production cross section and decay branching fractions in a 4th generation scenario used in setting Higgs mass exclusion limits

5) Drift time measurement in the ATLAS liquid argon barrel electromagnetic calorimeter with dedicated collision data

Top Data-Driven Method and Estimate

Motivation:

- Top (ttbar and single top) is one of the dominant background processes
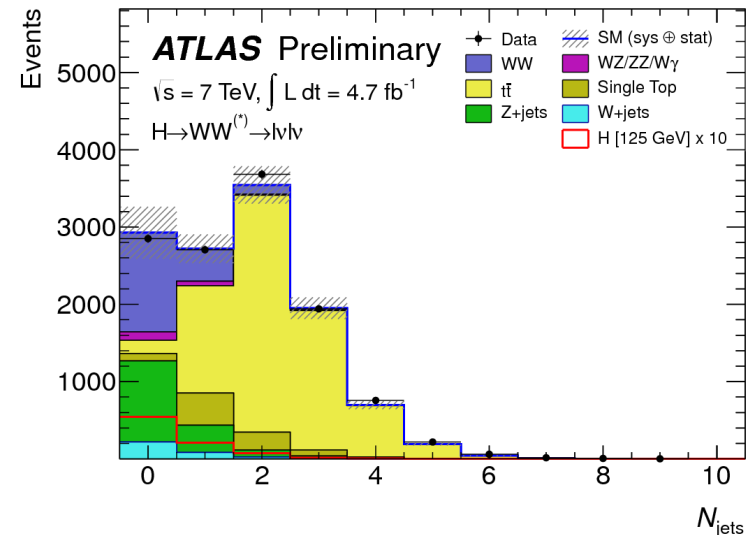- Data-driven top background estimate is extremely important

Method:

B. Mellado, X. Ruan and Z. Zhang, Phys. Rev. D84, 096005 (2011), arXiv:1101.1383 [hep-ph]

$$N_{\text{top}}^{\text{exp}}(\ell\ell + E_T^{\text{miss}}, 0j) \simeq N_{\text{top}}^{\text{exp}}(\ell\ell + E_T^{\text{miss}}) \times P_2^{\text{MC}} \times \left(\frac{P_1^{\text{Btag,exp}}}{P_1^{\text{Btag,MC}}}\right)^2$$
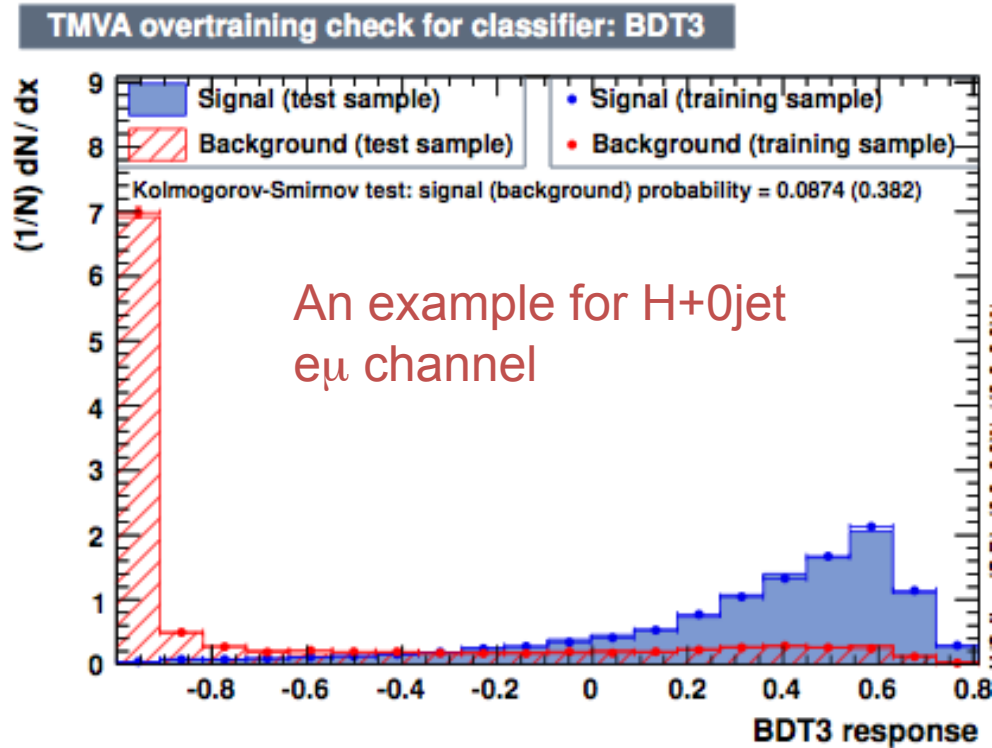
Applications:

- H→WW search:
  published paper (2.1fb-1)
  draft paper (4.7fb-1)

- SM WW cross section measurements:
  published paper (1fb-1)
  conference note (4.7fb-1)

- SUSY searches:
  on-going analyses
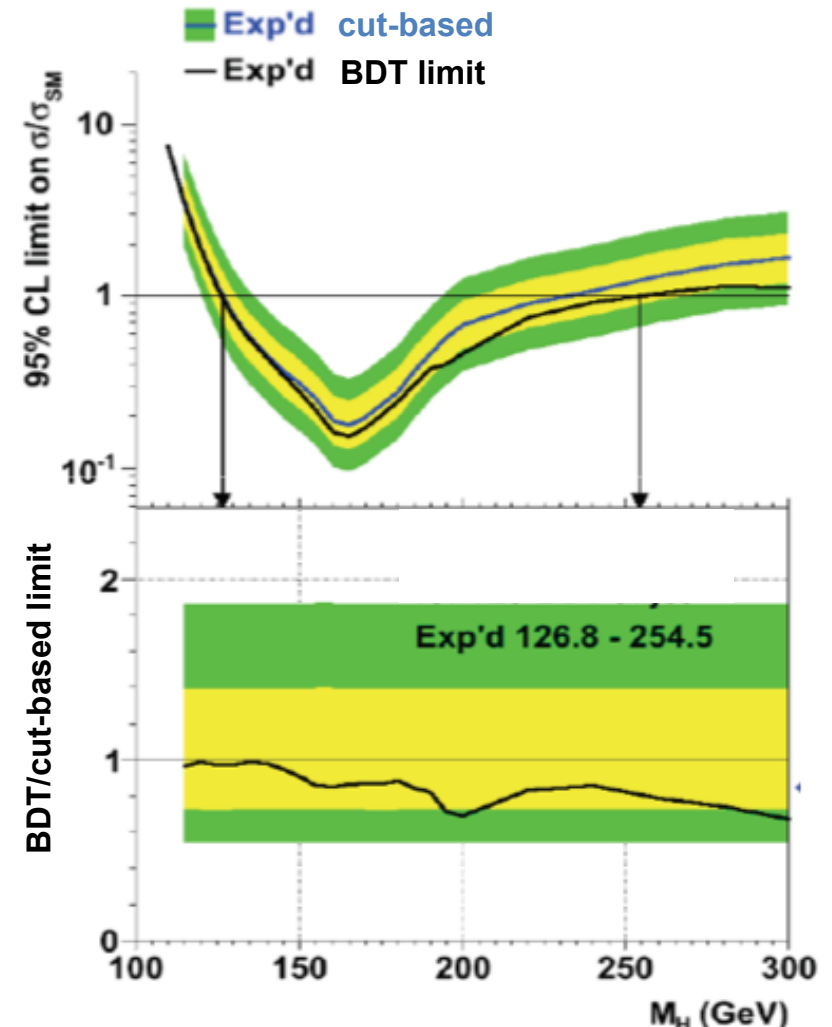
Multivariate Analyses

Use only 4 kinematic variables (m_{ll}, P_T^{ll}, $\Delta\phi_{ll}$, M_T) same as the cut-based analysis, the expected sensitivity substantially improved in particular at large Higgs mass

An example for H+0jet
eμ channel

- Clear separation between signal (blue) and background (red)
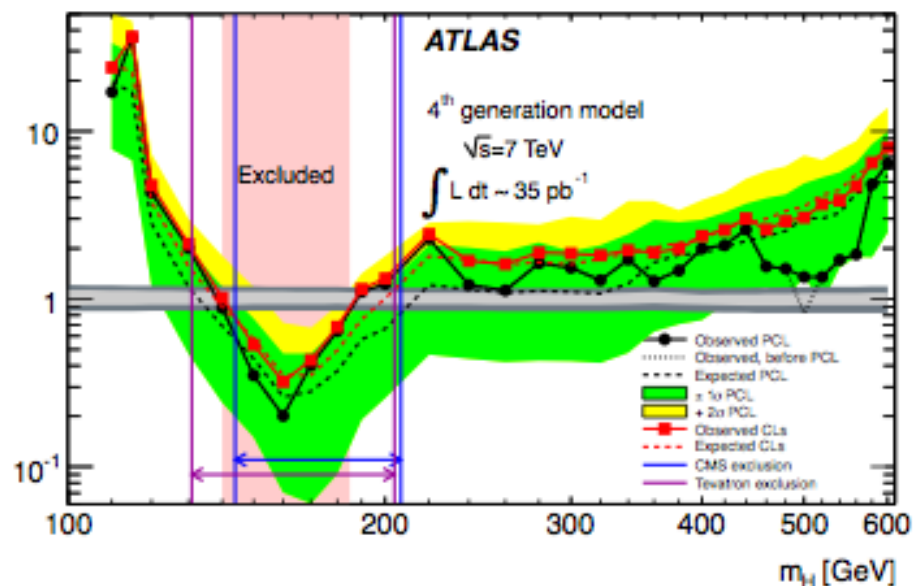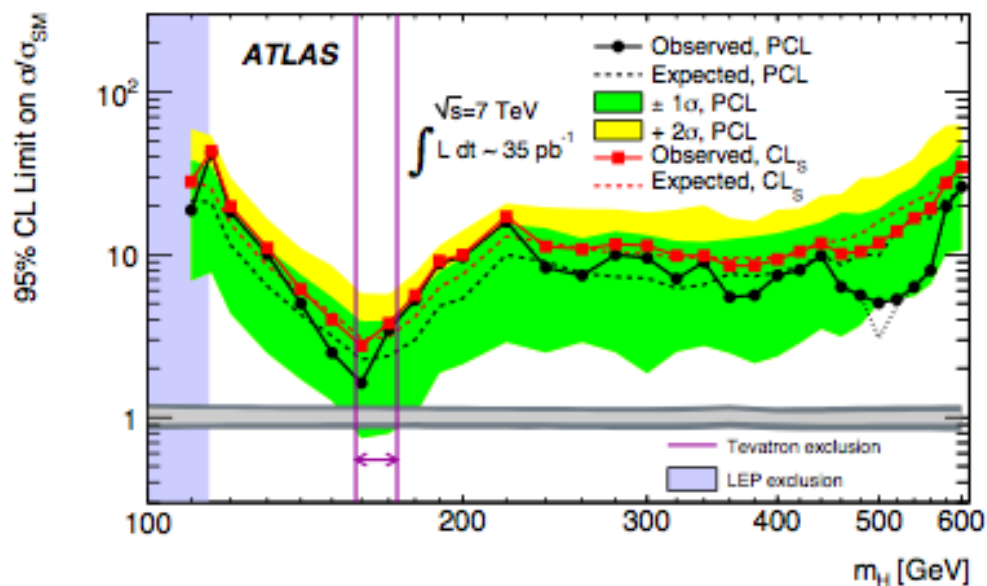- No indication of over training

Higgs Production,Decays in a 4th Model

X. Ruan and Z. Zhang, Impact on the Higgs production cross section and decay branching fractions of heavy quarks and leptons in a 4th generation model, arXiv: 1105.1634 [hep-ph]

Cited and used in the 1st ATLAS combination paper (Eur. Phys. J. C71 (2011) 1728, arXiv:1106.2748 [hep-ex]) based on 35pb^{-1} 2010 data:

No exclusion for SM Higgs

Exclusion (140-185 GeV) for Higgs in 4th generation with moderate data sample
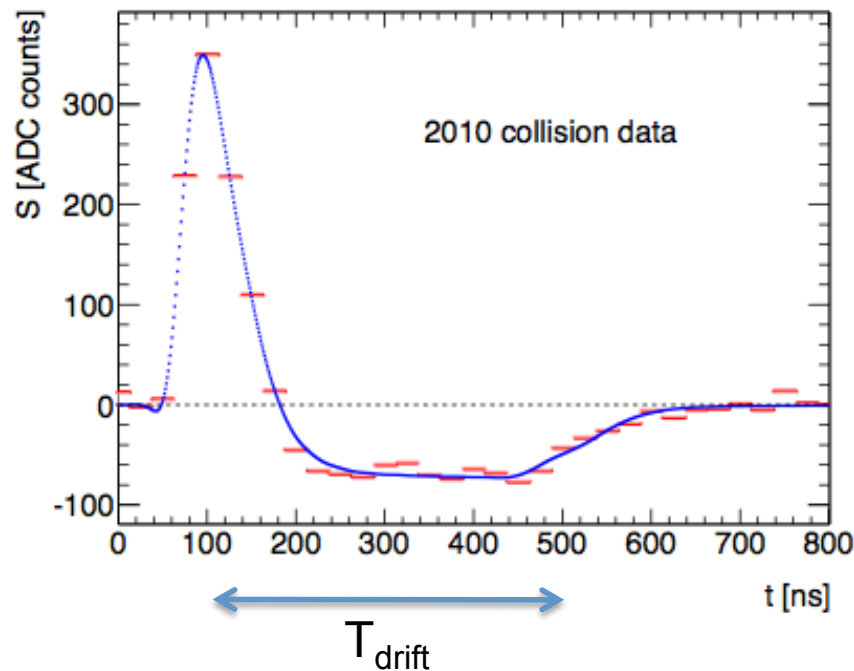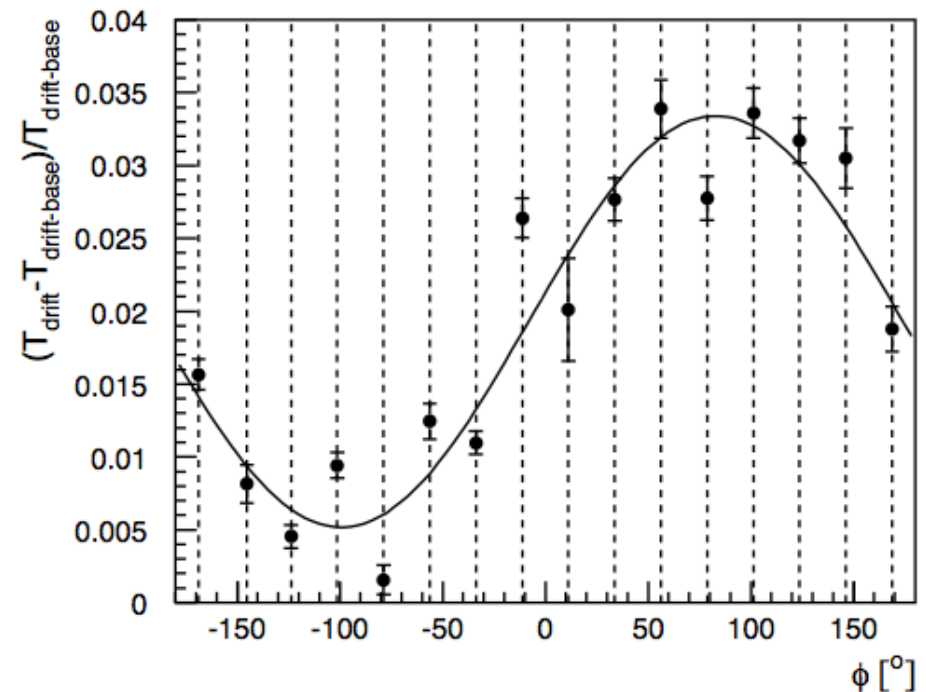
Drift Time Measurement

X. Ruan, D. Fournier, S. Jin, Z. Zhang, Drift time measurement of the ATLAS liquid argon barrel electromagnetic calorimeter using collision events, ATL–COM-LARG-2011-039.

Dedicated collision data taken in 2010, 2011 with full pulse shape in 32 samples (nominal collision data-taking has only partial pulse shape in 5 samples)

One typical pulse in 32 samples vs. fitted pulse shape

Observed sagging effect (~3% variation in drift time in transition regions between phi sectors)

Future Plan

For 2012, the LAL-IHEP ATLAS Higgs program extended to include Nanjing university

→A joint PhD program for Yichen LI cosupervised by

                        Zhiqing ZHANG (LAL)

                        Shenjian CHEN (Nanjing University)

Main focus of the thesis is to maximize the search sensitivity at low Higgs mass below 130GeV in H→WW* channel

- with lower Pt threshold applied to subleading lepton (from 15GeV to 10GeV)
- using multivariate analysis technique