Interview for Chung-Yao Chao Fellowship

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27 March, 2018

Resume

- Current position
  - Postdoctoral researcher at TDLI, SJTU, 2018–
- Education
  - PhD at ICEPP, University of Tokyo, 2014–2018
  - Master at ICEPP, University of Tokyo, 2012–2014
  - Bachelor at Tokyo Metropolitan University, 2008–2012

- Publication
  - "Evidence for the H→bb decay with the ATLAS detector", ATLAS Collaboration, 2017, arXiv:1708.03299,
  - "Search for heavy resonances decaying to a W or Z boson and a Higgs boson in final states with leptons and b-jets in 36.1 fb^{-1} of pp collision data at $\sqrt{s}$ = 13 TeV with the ATLAS detector", ATLAS Collaboration, 2017, arXiv:1712.06518

Resume

- Talks
  - "Searches for new phenomena in leptonic final states using the ATLAS detector", International Workshop on Baryon and Lepton Number Violation, 2017, Case Western Reserve University
  - "Kinematic Fit for VHbb", ATLAS Hbb Workshop, 2017, Stony Brook University
  - "Search for the VHbb in pp collisions at 13 TeV using the ATLAS detector", ICHEP 2016 ATLAS Approval, CERN
  - "Lepton Triggers for VHbb", ATLAS Hbb Workshop, 2016, University College London
  - "Phase-1 Endcap Muon Trigger New Sector Logic Board", ATLAS TDAQ Week, 2014, Niels Bohr Institute
- Posters
  - "World LHC Computing Grid", Society of Scientific Systems, 2012 , Kobe

Previous work and achievements

- ATLAS
  - Muon Trigger
    - Upgrade studies
    - Preparation for Run2
  - VHbb analysis
    - b-jet energy correction
    - Evidence for H→bb

- ZH→llbb (2-lepton) channel

- Introduction
  - The Higgs boson was discovered by ATLAS and CMS experiment
  - However, the most dominant (58%) decay of the Higgs boson, H→bb was not observed in Run1
  - The rate is important to test the SM and also sensitive to new physics
  - Therefore, the measurement is followed with great attention in Run2
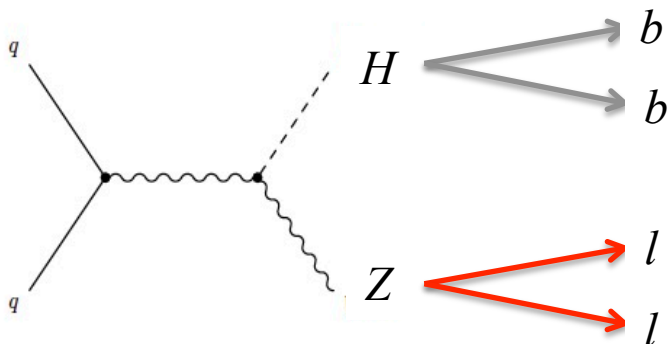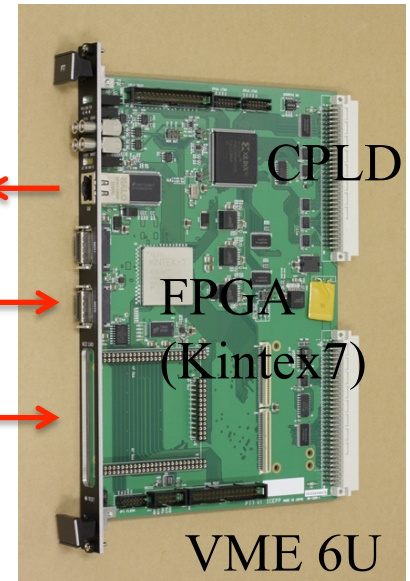
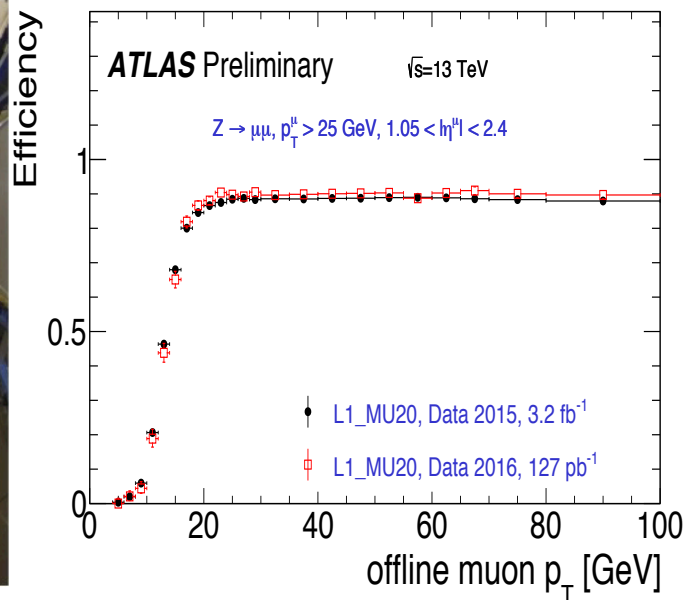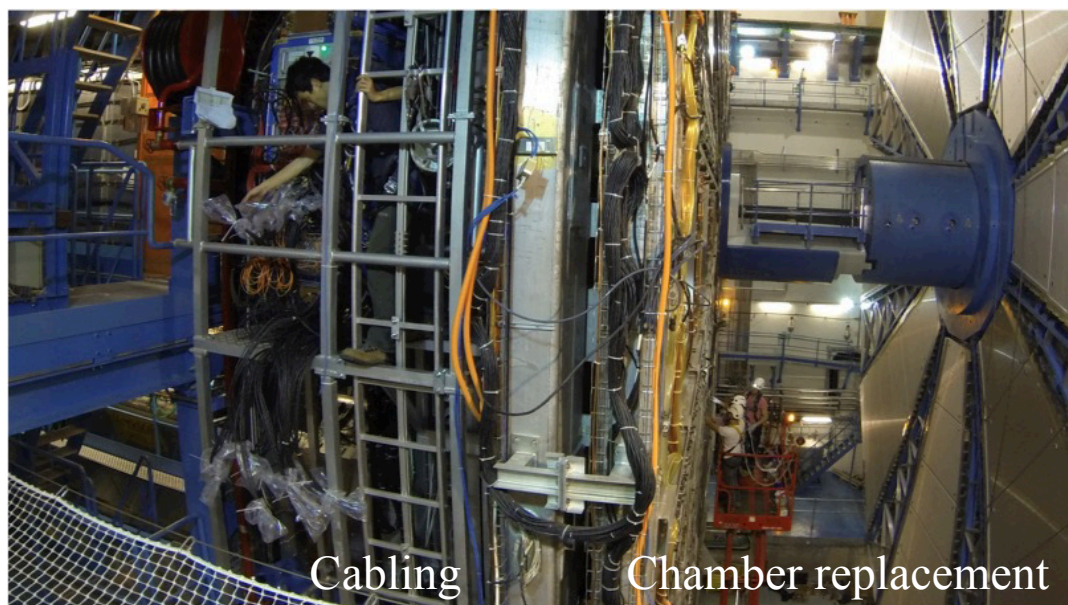# Muon trigger upgrade studies
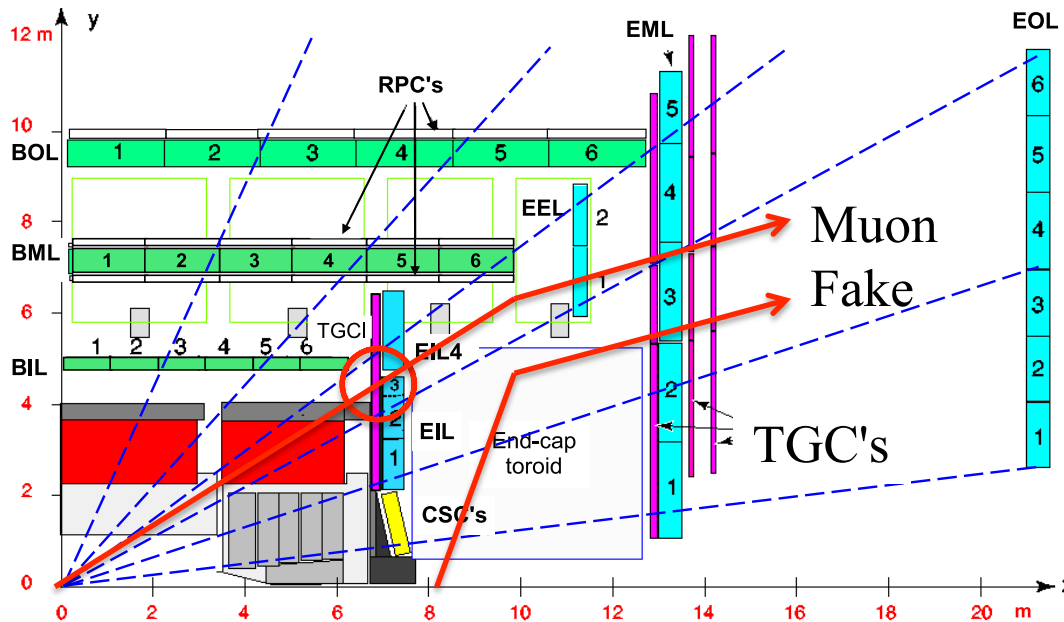
New trigger board prototype

- Thin Gap Chamber (TGC) is used to select events with high p_T muons
  - Most of events at the LHC are multi-jet background (10^{11} pb)
  - Trigger rate must be < 20 kHz while the bunch crossing rate is 40 MHz
- In order to reduce fake triggers (proton, low p_T muon), a coincidence logic for the inner station was enabled from Run2 (left)
- New trigger board prototype was developed for Run3 (right)

Muon trigger preparation for Run2

Cabling Chamber replacement

ATLAS Preliminary $\sqrt{s}$=13 TeV

$Z \to \mu\mu$, $p_T^\mu > 25$ GeV, $1.05 < |\eta^\mu| < 2.4$

- L1_MU20, Data 2015, 3.2 fb^{-1}
- L1_MU20, Data 2016, 127 pb^{-1}

Efficiency

offline muon p_T [GeV]

- In 2012 at Weizmann institute, we made new chambers to replace broken ones and recover efficiency
- In 2014 at CERN, we replaced the broken chambers (left), and achieved about 90% efficiency (right)
  - https://twiki.cern.ch/twiki/bin/view/AtlasPublic/L1MuonTriggerPublicResults
  - https://twiki.cern.ch/twiki/bin/view/AtlasPublic/MuonTriggerPublicResults

b-jet energy correction

- Muon-in-jet: Add semileptonic decay muon back to the jet after subtracting energy loss in the calorimeter (13%)

- PtReco: Apply p_T dependent correction factor for semileptonic decay neutrino and out-of-cone effect (18%)
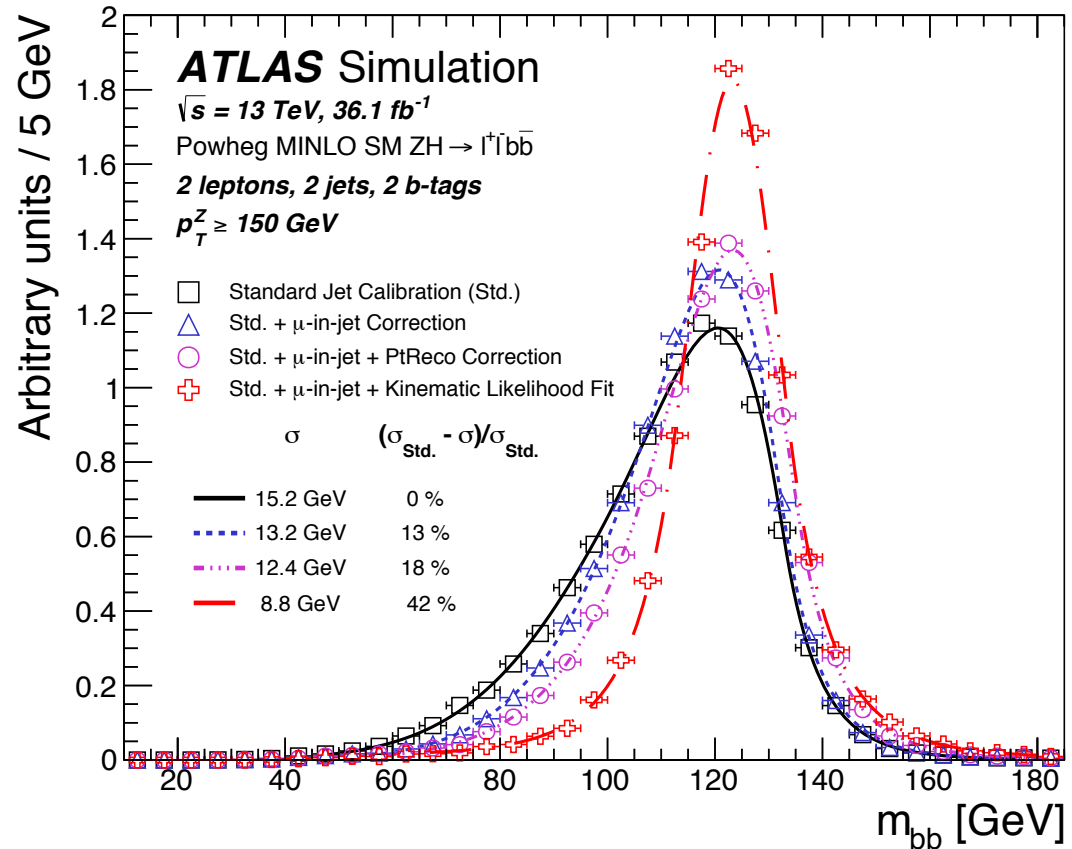
- **Kinematic Fit**: Constrain llbb system to be balanced in the transverse plane, and improve b-jet energy correction (42%)

- Achieved about 40% gain in the Higgs mass resolution
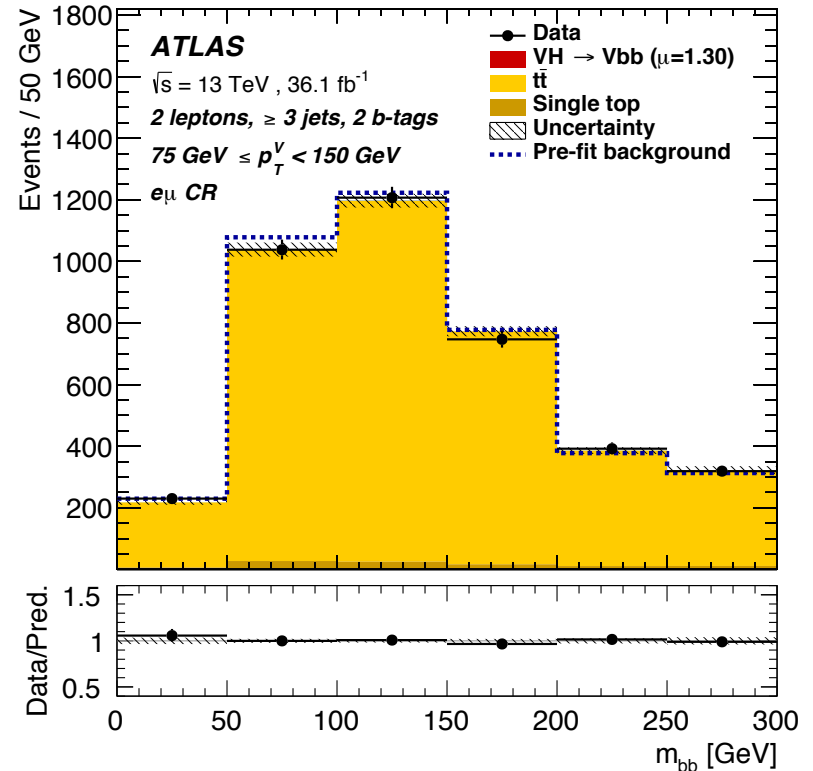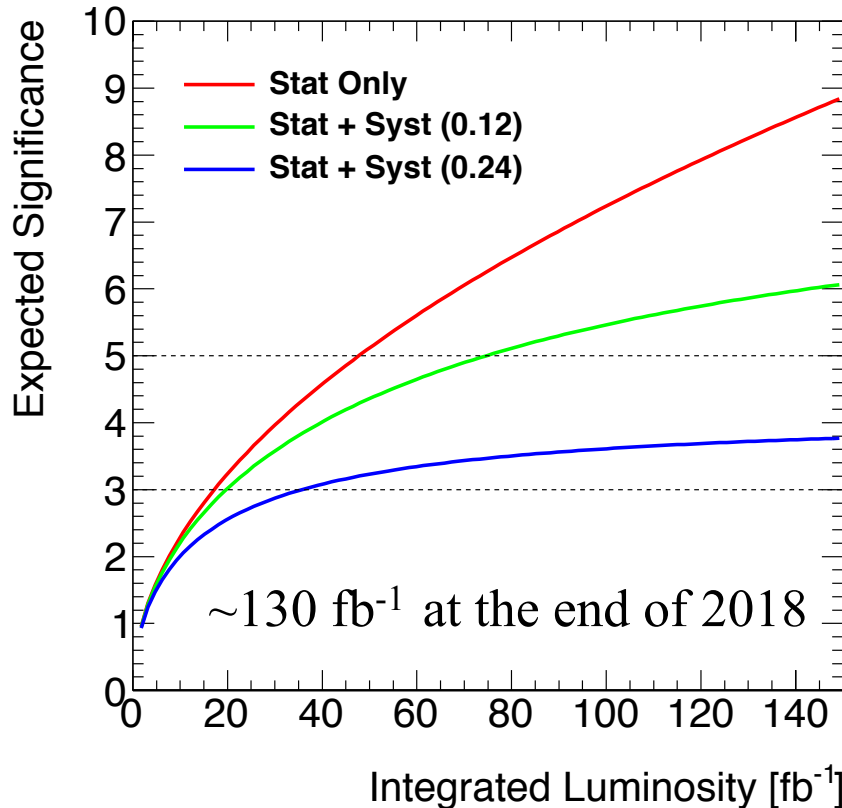
Evidence for the H → bb

arXiv:1708.03299
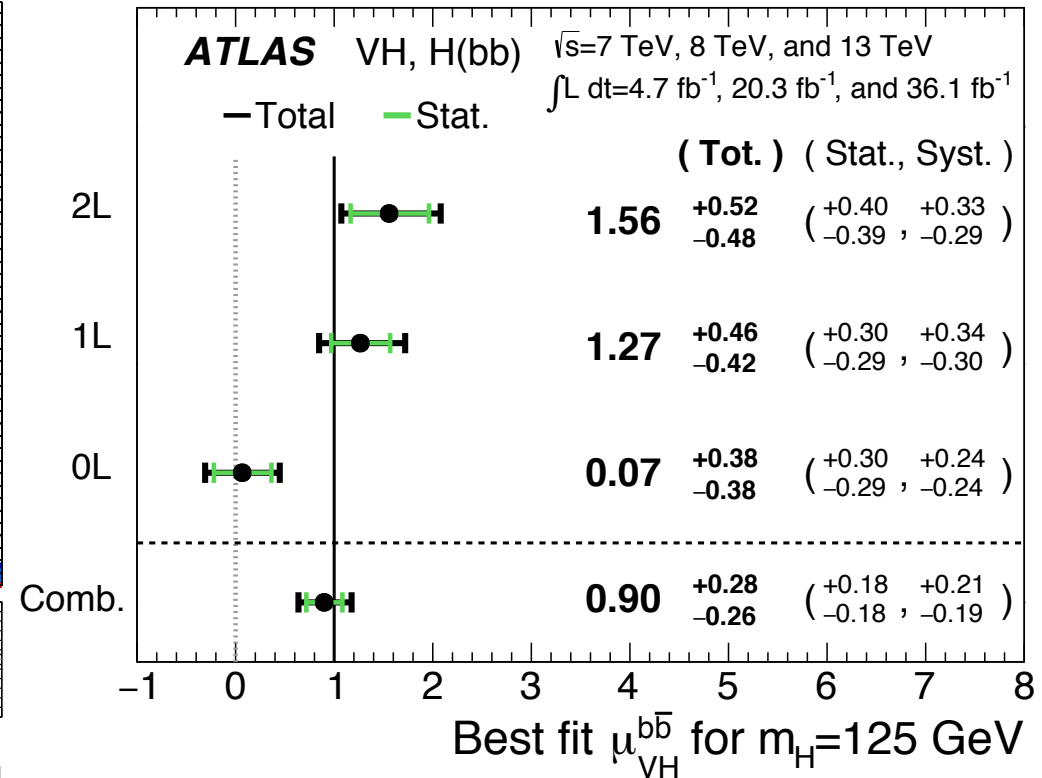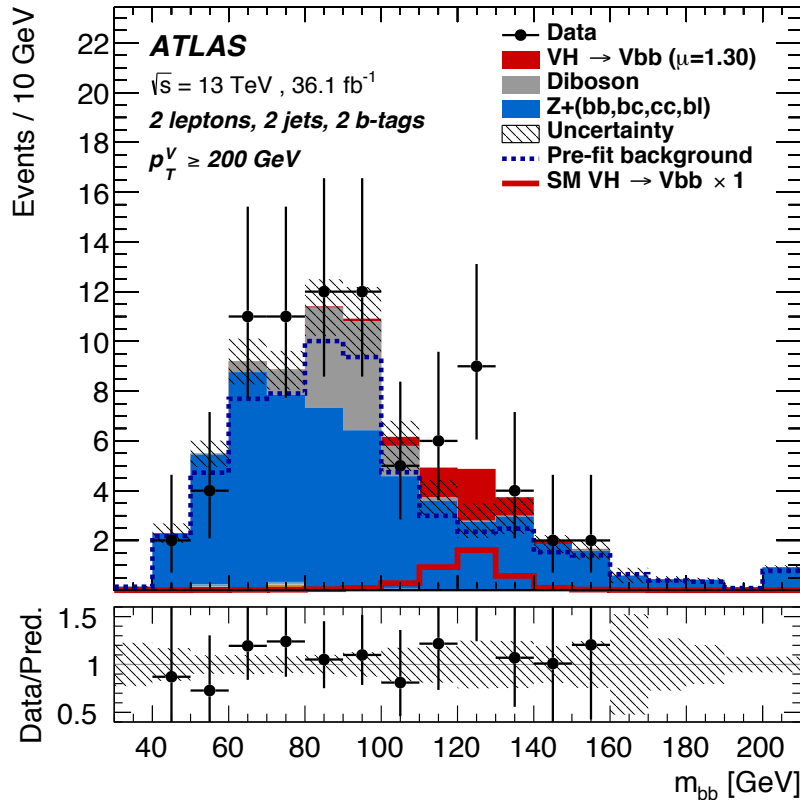
- 2-lepton Run2 cut-based analysis results (left)
- 0, 1, 2-lepron, Run1, Run2 multivariate analysis combined results (right)
  - Observed (expected) significance: 3.6 (4.0) standard deviations
  - $\mu = 0.90\ ^{+0.18}_{-0.18}$ (stat.) $^{+0.21}_{-0.19}$ (syst.)

Working Plan

- Reduce uncertainties to reach 5 standard deviations (left)
  - Muon trigger and software studies
  - ttbar data driven estimation using data in a control region (right)
  - Kinematic Fit to use soft track information

Summary

- Previous work and achievements
  - Muon trigger: 90% efficiency
  - b-jet energy correction: 40% gain in the Higgs mass resolution
  - Evidence for the H→bb
    - Observed (expected) significance: 3.6 (4.0) standard deviations
    - $\mu = 0.90 \; ^{+0.18}_{-0.18} \; \text{(stat.)} \; ^{+0.21}_{-0.19} \; \text{(syst.)}$

- Working Plan
  - Reduce uncertainties to reach 5 standard deviations
    - Muon trigger and software studies
    - ttbar data driven estimation using data in a control region
    - Kinematic Fit to use soft track information

Thank you!