H->bb Weekly Meeting

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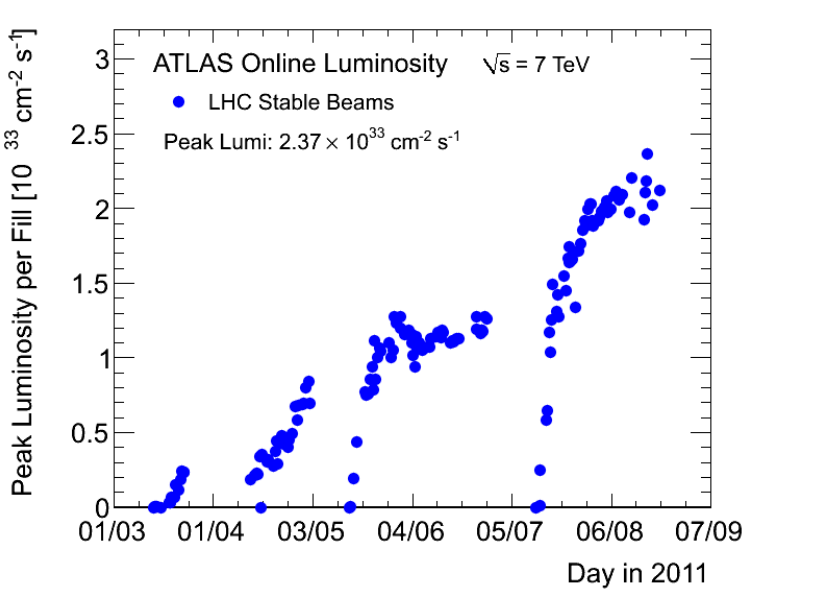
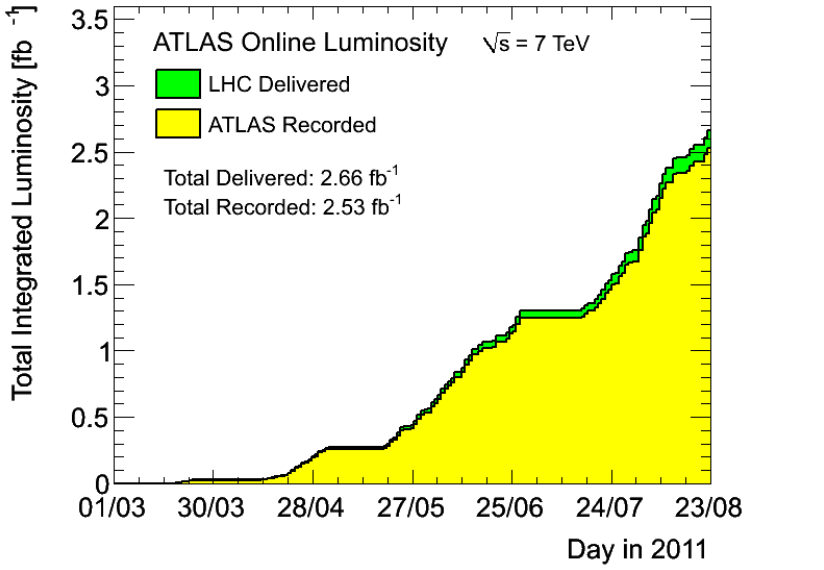
HSG5 H->bb weekly meeting, 23 August 2011

News! News! News!

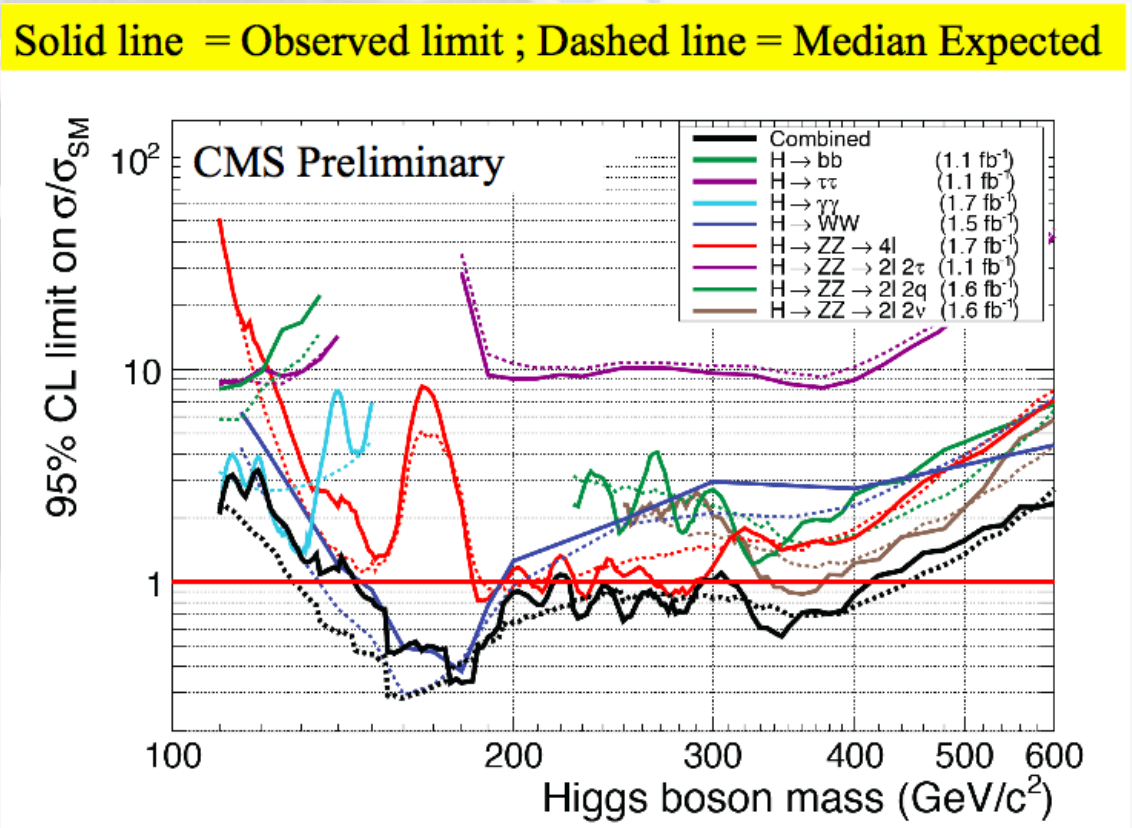
- Peak stable lumi $2.37 \times 10^{33} cm^{-2} s^{-1}$
- $2.5 fb^{-1}$ with stable beams collected so far
- Peak pileup around 12 – 13
- 1380 bunches in the machine – maximum for 50ns





CMS H->bb results

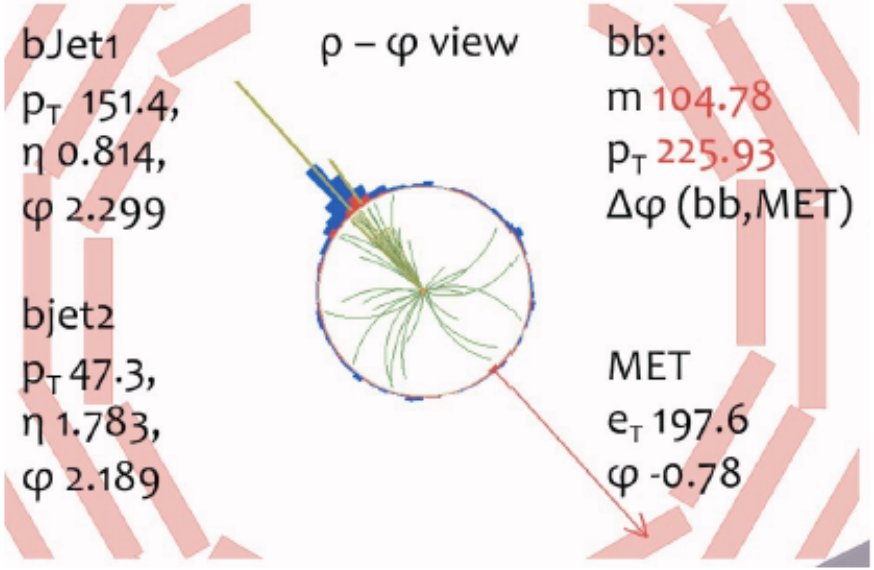
- CMS new results for Lepton-Photon available yesterday
- Include H->bb exclusion limits: 6xSM @ m_H=115GeV up to ≈15xSM @ 135GeV (expected)
- Could not find public note on it (checked again this morning)
- Differences to our current results:
  - Include ZH->vvbb
  - Multivariate analyses
  - B-tagging optimized for high-p_T
  - (possibly) double b-tagging inside jets
  - Cut on vector boson p_T (but no substructure analysis)

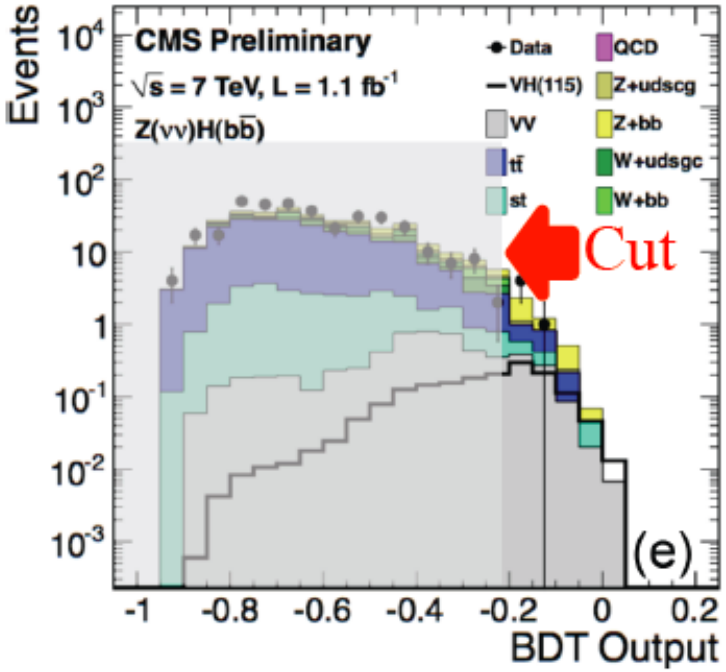


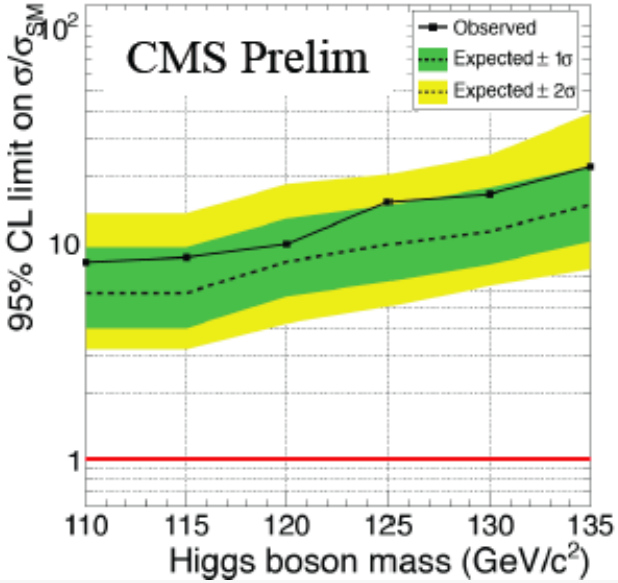
NEW: CMS H->bb at Lepton Photon

Low Mass Higgs Search : H→ b $\bar{b}$

- gg→ H→ bb and VBF are dominant production modes but overwhelmed by enormous QCD di-jet background
- Best option: qq→ VH; H → bb
  - Major backgrounds are V+jets, VV, ttbar
- Use
  - VH topology : $\Delta\Phi(V,H) > 3$
  - $P_T(V)$> 100-160 GeV (boosted W/Z)
  - Tight b-tagging & MET quality
  - Backgrounds estimated from control data







Vivek Sharma – LP2011

Monte Carlo samples

- To be able to produce new results quickly must try to plan for rel.16 analysis with data up to rel.17 switchover
- MC10b samples needed for this:
  - Signal: complement existing mass points for inclusive analysis, add boosted mass points and ZH->vvbb
  - Background: Z+jets, W+jets
- Need to converge on generators and final sample composition
  - EVO meeting to arrive at a complete list – propose tomorrow morning

Data skims for H->bb – DPD train

- We need to have data skims to avoid pain of running over too much data – both for inclusive and boosted analyses (ZH inclusive already using HSG2 skims)

- Plan to join the DPD train:
  - The code to produce DAODs or D3PDs should be in AtlasPhysics cache and fully tested
  - The production needs to be done with a single Reco_trf.py instruction (fully tested standalone)
  - Write the data to Higgs group space
  - DPD production done in Tier1 from AODs
  - Skims should be small enough for this to make sense

- Latest news: D3PD for boosted analysis being tested at Edinburgh and UCL
  - Requested new package goes to production release
  - Intended name is NTUP_HSG5BOOST
  - More details on this next week

H->bb trigger studies for upgrade LoI

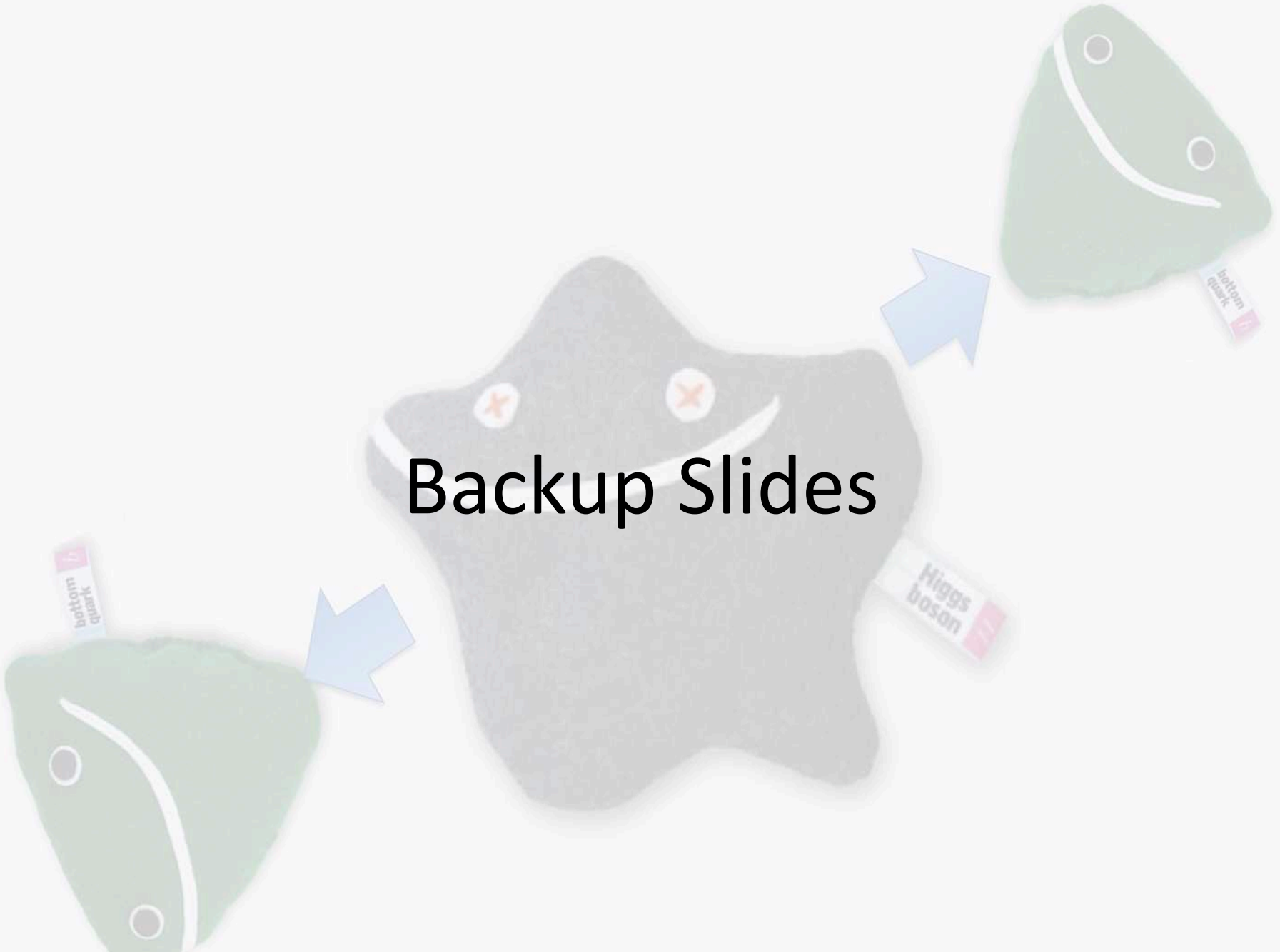
- Upgrade Letter of Intent being prepared for October
- WH->lvbb is one of the Higgs benchmarks
  - Concentrate on SM for now and study Higgs properties with 300fb^{-1} if light Higgs is found
  - Meeting last Tuesday concentrated on this: https://indico.cern.ch/conferenceDisplay.py?confId=151142
  - MC samples exist: https://twiki.cern.ch/twiki/bin/viewauth/Atlas/UpgradeSimulation2011LoI
- Need one or two volunteers to do WH trigger studies for phase 1 upgrade with help from Stefania and me
  - Main requirement is availability during next 2 months
  - Will give OTP and may contribute to student qualification
- If interested please contact me and Stefania (xella@nbi.dk) and cc Eilam and Bill

Upcoming workshops

- Physics Analysis Tools workshop:
  - From 26 to 30 September at CERN
  - https://indico.cern.ch/conferenceDisplay.py?ovw=True&confId=149202

- Fast simulation workshop
  - Fast simulation will be more and more needed with increased statistics
  - Already successfully used for SUSY results for EPS
  - Workshop dedicated to fast simulations and the new integrated simulation framework on 7th September 2011:
    - https://indico.cern.ch/conferenceDisplay.py?confId=150893

Backup Slides



Trigger! Be worried! Be very worried!

- **Higher-threshold triggers** in use since period **K**
  - $3x10^{33}$ prescale set used since 4th August, run 186873
  - Several combined MET chains and and L1_MU10 unprescaled in last part of each fill
- Single-electron triggers will use isolation
  - Problem for fake electron background estimation
  - Nice page from Will Bell (top group) with list of planned studies: https://twiki.cern.ch/twiki/bin/view/AtlasProtected/FakeLeptonTriggers
- A new sample T was just produced for trigger studies
  - Using AtlasTrigMC 16.6.7.7.1 cache; AMI tag: r2597
  - Sample names start with "valid": valid1.*.recon.AOD.e598_s933_s946_r2597_tid…
  - Useful for looking at recent changes for the 3e33 menu (e.g. e22_medium, e22_medium1, etc)
  - Similar sample may be produced with 17.0.X.Y if there's enough popular demand
  - See: https://twiki.cern.ch/twiki/bin/viewauth/Atlas/TriggerSampleT

Disabled or prescaled from run 186873:
2b10_medium_4L1J10
2b10_medium_L1_2J10J50
2b10_medium_3L1J20
2e12_medium
2mu4_DiMu
3b15_loose_4L1J15
3j75_a4tc_EFFS
L1FJ75_NoAlg
e15_medium_e12_medium
e20_loose
e20_loose1
e20_looseTrk
e20_medium
e20_medium1
e20_medium2
e20_medium_SiTrk
e20_medium_TRT
e7_tight_e14_etcut_Jpsi
g40_loose_EFxe40_noMu
ht350_a4tc_EFFS_L2je255
j100_a4tc_EFFS_ht350
j75_2j30_a4tc_EFSF_ht350
j75_j30_a4tc_EFFS_anymct150
j75_j30_a4tc_EFFS_anymct175
mu15i_medium
tau100_medium
tau125_medium
tau16_loose tau16_loose_e15_medium
tau16_loose_mu15
tau16_medium_mu10 tau29_loose

Post-mortem of WH/ZH results

- M_{bb} resolution is extremely poor
  - Should try to get a peak, but this needs work on jet (and b-jet) energy scale
  - Try to think about this together with jet/ E_T^{miss} people
  - Could we improve other things in jet reco to improve m_{bb}?
  - In ZH->llbb could try to use ll vs bb p_T balance to do in-situ calibration?
- B-tagging systematic uncertainty dominates by far
  - 16% vs 7-9% for JES and ≈1-2% others
  - Should be possible to improve this, since the error is dominated by the statistics used in b-tagging studies
  - Would improve limits by up to 25-30%
  - Think about this with b-tagging people
- Limits: must get help from roostats experts to understand the difference between expected and observed
- WH cuts on exactly 2 jets
  - A lot of signal is lost there – can it be improved?
- WH backgrounds:
  - Top and W+jets background estimate using simultaneous template fit to m_{bb} sidebands (<80GeV and 140-250GeV)
  - Probably should try to also constrain jet energy scale from this fit
  - JES changes m_{bb} distribution and could affect normalization of backgrounds
  - In light of H->WW results, should move upper sideband to e.g. 160-250GeV – at m_H=150GeV, σ*BR already 1/10 of value at 115GeV, but H->WW and H->bb resolution is very broad
  - Can top background be reduced further?
- ZH background from Z+bb seems irreducible – can it be improved?

WH/ZH analysis plans

- We can still try to improve cut based analysis:
  - Get a m_{bb} peak, improve b-tagging systematics, constrain JES in WH, etc…
  - Reduce top background in WH:
    - Try using looser leptons or extending lepton id to forward region to veto tt->lvlvbb
    - Loosen jet η cut (at $|\eta|<2.5$ now) and maybe p_T cut to veto tt->lvjjbb/jjjjjbb
  - But… must keep pileup and JVF in mind

- Reduce Z+bb background in ZH? Would probably need a clever new variable like $\cos^{*}\theta$

- Then clearly we should include multivariate methods
  - Used intensively by Tevatron
  - e.g. use NN to target top background – may allow to relax 2-jet cut in WH
  - NN may also help in rejecting Z+bb background in ZH?
  - See if MV method can improve existing b-tagging

- Add more channels!
  - Can something be done with ZH->vvbb? Very good channel in Tevatron, but complex and mature analysis
    - Academia Sinica group plans to work on this But trigger is the crucial part
  - Boosted VH is clearly the next thing to push! WH->lvbb and ZH->llbb, but also ZH->vvbb
    - UCL and Edinburgh working on this – should be enough manpower now, but need to get results soon
  - ttH has been slowly building up in Glasgow – will push for this to happen together with Chris

Boosted VH Data Format

- Had a phone meeting two weeks ago to discuss a common D3PD format for boosted VH analyses
- Will use “official” Jet/ETmiss D3PD maker code by Bertrand Capleau to produce SM W/Z D3PDs including jet substructure variables
  - https://twiki.cern.ch/twiki/bin/view/AtlasProtected/GroomedJetsD3PD
  - Filtered Cambridge-Aachen jets and their constituent jets etc
  - Need to run b-tagging on sub-jets
  - Edinburgh (Robert H.) working on this with help from UCL
- Then the idea is to make data skims to ease running on new data