Update on BSM Higgs searches

Xiaohu SUN, IHEP, Beijing, 17-03-2014

2HDM heavy Higgs [central prod]

- ggH (D3PD) **10/16** samples: already informed analyzers
  - mc12_8TeV.189076.MadGraphPythia8_AU2CTEQ6L1_ggH260_hh125_bbaa.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
  - mc12_8TeV.189077.MadGraphPythia8_AU2CTEQ6L1_ggH300_hh125_bbaa.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
  - mc12_8TeV.189080.MadGraphPythia8_AU2CTEQ6L1_ggH400_hh125_bbaa.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
  - mc12_8TeV.189082.MadGraphPythia8_AU2CTEQ6L1_ggH800_hh125_bbaa.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
  - mc12_8TeV.189079.MadGraphPythia8_AU2CTEQ6L1_ggH350_hh125_bbaa.merge.NTUP_PHOTON.e2619_s1773_s1776_r4485_r4540_p1344
  - mc12_8TeV.189085.MadGraphPythia8_AU2CTEQ6L1_ggH300_hh125_bbbb.merge.NTUP_COMMON.e2619_s1773_s1776_r4485_r4540_p1575
  - mc12_8TeV.189086.MadGraphPythia8_AU2CTEQ6L1_ggH340_hh125_bbbb.merge.NTUP_COMMON.e2619_s1773_s1776_r4485_r4540_p1575
  - mc12_8TeV.189087.MadGraphPythia8_AU2CTEQ6L1_ggH350_hh125_bbbb.merge.NTUP_COMMON.e2619_s1773_s1776_r4485_r4540_p1575
  - mc12_8TeV.189088.MadGraphPythia8_AU2CTEQ6L1_ggH400_hh125_bbbb.merge.NTUP_COMMON.e2619_s1773_s1776_r4485_r4540_p1575
  - mc12_8TeV.189090.MadGraphPythia8_AU2CTEQ6L1_ggH800_hh125_bbbb.merge.NTUP_COMMON.e2619_s1773_s1776_r4485_r4540_p1575

2HDM heavy Higgs [central prod]

- ggH (AOD) **5/16** samples: will be ready maybe this weekend
  - mc12_8TeV.189078.MadGraphPythia8_AU2CTEQ6L1_ggH340_hh125_bbaa.merge.AOD.e2619_s1773_s1776_r4485_r4540
  - mc12_8TeV.189081.MadGraphPythia8_AU2CTEQ6L1_ggH500_hh125_bbaa.merge.AOD.e2619_s1773_s1776_r4485_r4540
  - mc12_8TeV.189083.MadGraphPythia8_AU2CTEQ6L1_ggH1000_hh125_bbaa.merge.AOD.e2619_s1773_s1776_r4485_r4540
  - mc12_8TeV.189089.MadGraphPythia8_AU2CTEQ6L1_ggH500_hh125_bbbb.merge.AOD.e2619_s1773_s1776_r4485_r4540
  - mc12_8TeV.189091.MadGraphPythia8_AU2CTEQ6L1_ggH1000_hh125_bbbb.merge.AOD.e2619_s1773_s1776_r4485_r4540
- ggH (before AOD) 1/16 sample: will be ready maybe next week
  - mc12_8TeV.189084.MadGraphPythia8_AU2CTEQ6L1_ggH260_hh125_bbbb.merge.AOD.e2619_s1773_s1776_r4485_r4540

2HDM heavy Higgs [central prod]

- VBF H (AOD) 2/4 samples: ->D3PD maybe this weekend
  - mc12_8TeV.189507.PowhegPythia8_AU2CT10_VBFH1000_hh_bbyy.merge.AOD.e2730_s1773_s1776_r4485_r4540
  - mc12_8TeV.189504.PowhegPythia8_AU2CT10_VBFH500_hh_bbbb.merge.AOD.e2730_s1773_s1776_r4485_r4540
- VBF H (before AOD) 2/4 samples: ->D3PD maybe next week
  - mc12_8TeV.189506.PowhegPythia8_AU2CT10_VBFH500_hh_bbyy.merge.AOD.e2730_s1773_s1776_r4485_r4540
  - mc12_8TeV.189505.PowhegPythia8_AU2CT10_VBFH1000_hh_bbbb.merge.AOD.e2730_s1773_s1776_r4485_r4540

2HDM heavy Higgs [private prod]

- As introduced by Yu, our production was finished last weekend, well, there was a mistake in the stage of digitization due to a wrong configuration on pileups (many communications with Wolfgang Ehrenfeld and Claire Gwenlan, although both of them are against any private prod...)
- Restarted the production last weekend, but intterupted by SUSY urgent tasks, so our production was killed and all the finished jobs are messed up, now we restarted again the production from the stage of digitization
- Hopefully we can finish one of the samples by tomorrow and try to catch up the meeting
- But I am not sure these samples will be used in the end, since the central production is extraordinarily fast for VBF, as I introduced in the last page (central VBF samples were submitted Mars le 5, and will be finished the next week hopefully)

2HDM heavy Higgs comb

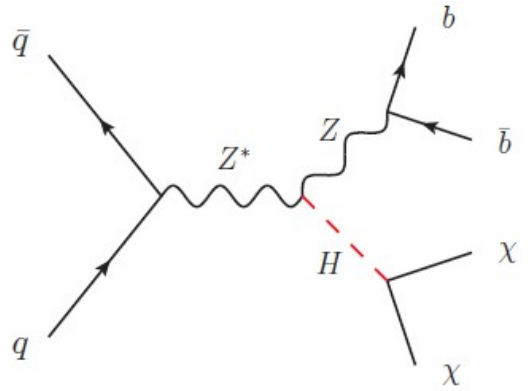
- Analysis bbyy is being unblinded last friday, I hope they can provide a workspace this week
- Analysis bbbb finished Moriond conf note, they will give an update on tomorrow's meeting
  - Hopefully, they will start to use 2HDM Higgs signal this week and do the optimization on the invariant mass cut
- Training Yu with the workspace and the combination machinary
  - Now he can work very well with simplified workspaces and combine them to check the improvements

VH → bb + invisible

- Started in Mars, working with Jike on a new analysis
  - V(bb)H(inv.) → bb+MET (V=W/Z)
- This is not an easy channel, but not yet covered by any other people, existing analysis and overlaps:
  - Z(ll)H(inv.): no overlap
  - Fat-jet based W/Z H(inv.): should be small, single fat-jet
  - VBF H(inv.): no overlap, very high Mjj cut
  - Mono-jet(s): large overlap 
- Go to publication and then a combination
  - One of VH and Mono-jet(s) will win out to the comb
- From the other side of the big ring, CMS has a similar study
  - CMS-PAS-HIG-13-028 Z(bb)H(inv.) with a BDT

Strategy

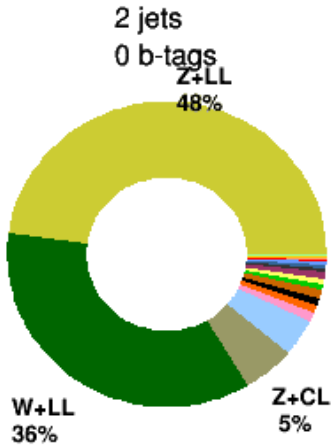
- Define categories:
  - 2/>=3-jet bins
  - 0/1/2-tagged bins
  - 0/1/2-lepton bins
  - MET bins [120,160], [160,200], [200,300], [>300]

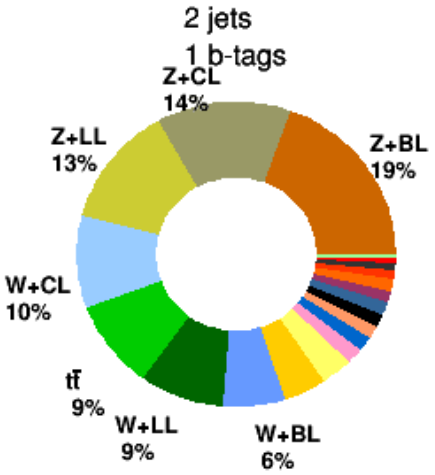


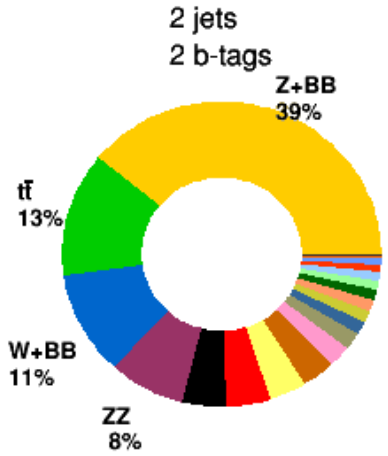
- Non-zero lepton bins are CRs for
  - W(ev)jj W(muv)jj Z(ll)jj ttbar(emu)
- Fit to the template of pTV (so MET for the VH signal regions, pT(W)/pT(Z) for the lepton control regions)
- All the events are MET triggered

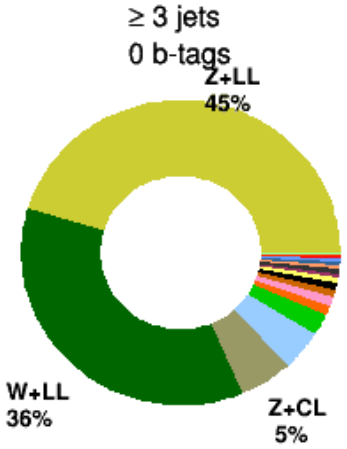
Signal and background normalizations are extracted from the a global fit

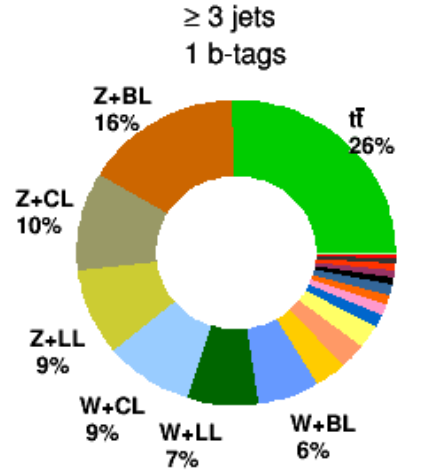
Bkg components

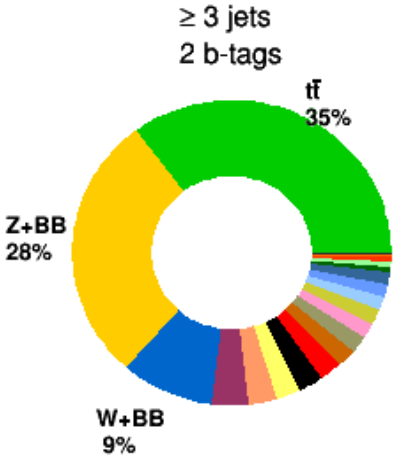


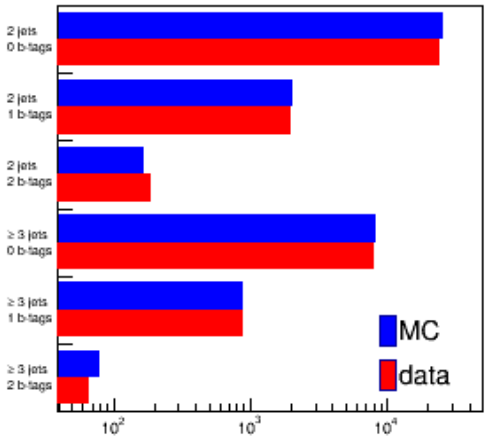






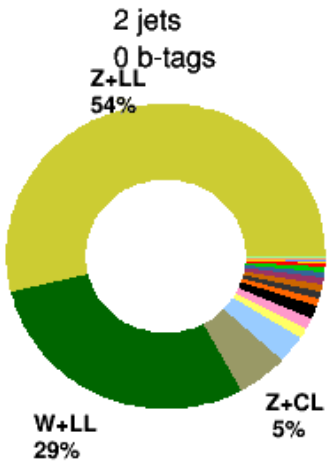


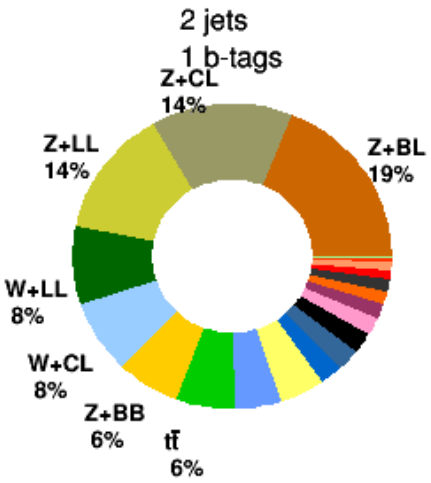


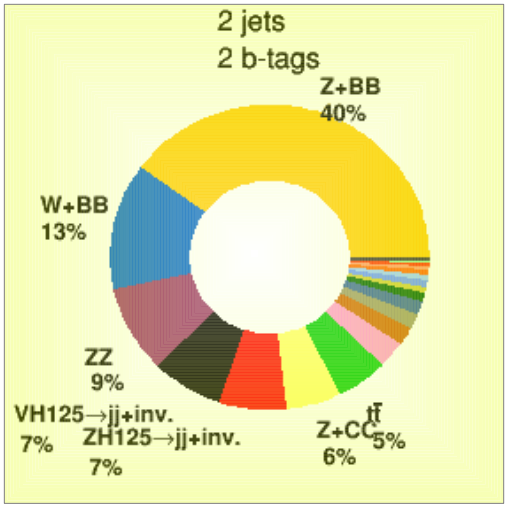


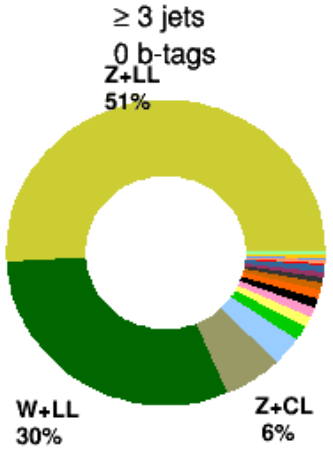
Signal region, MET1 [160,200]

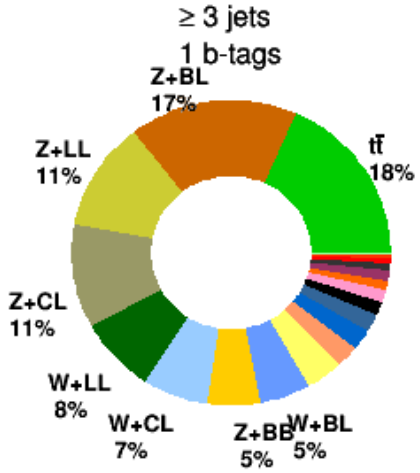
Bkg components

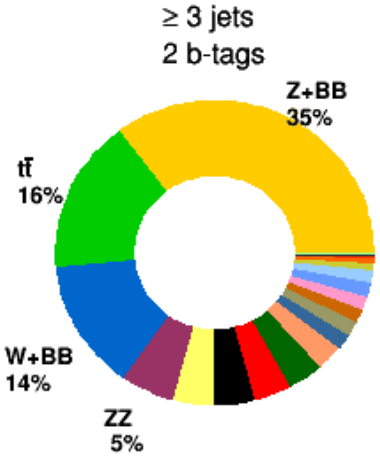


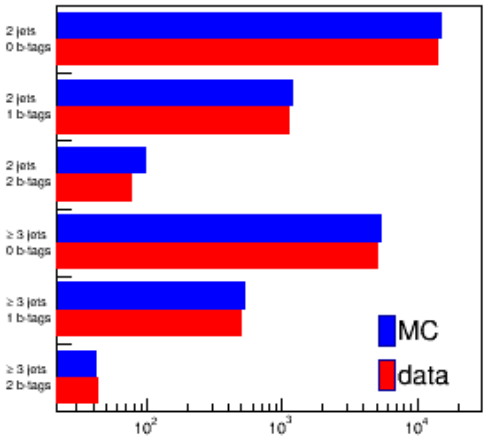






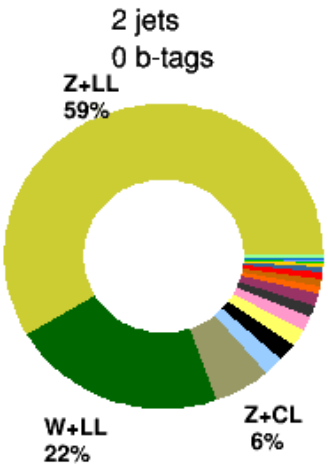


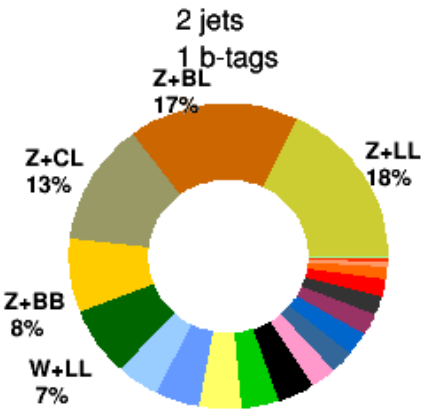


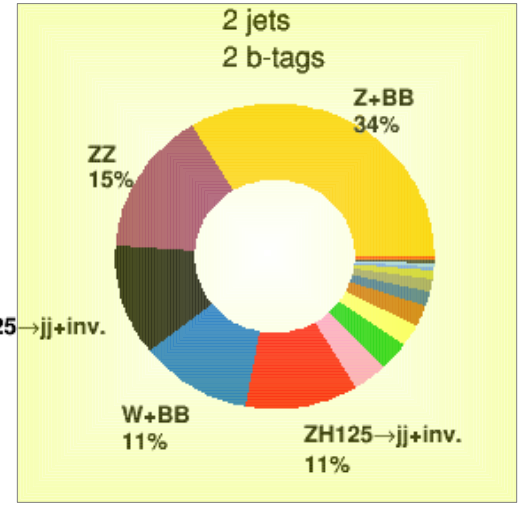


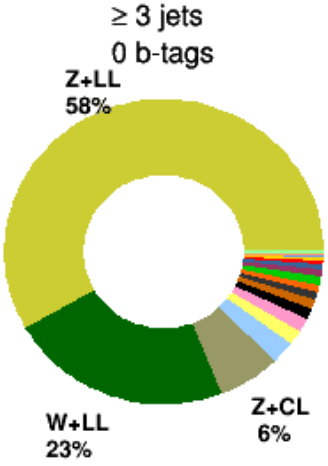
Signal region, MET2 [200,300]

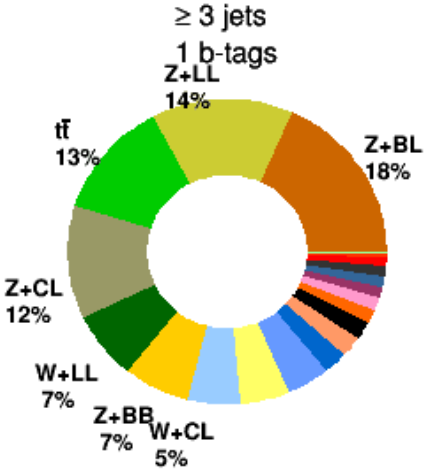
Bkg components

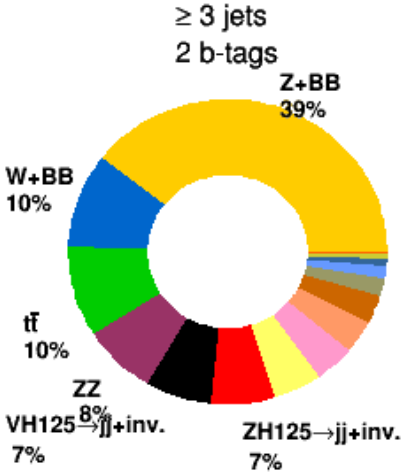


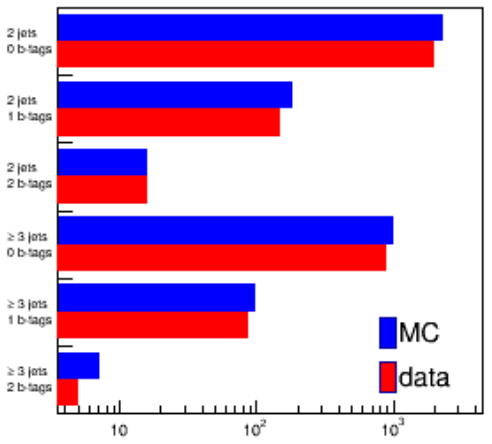






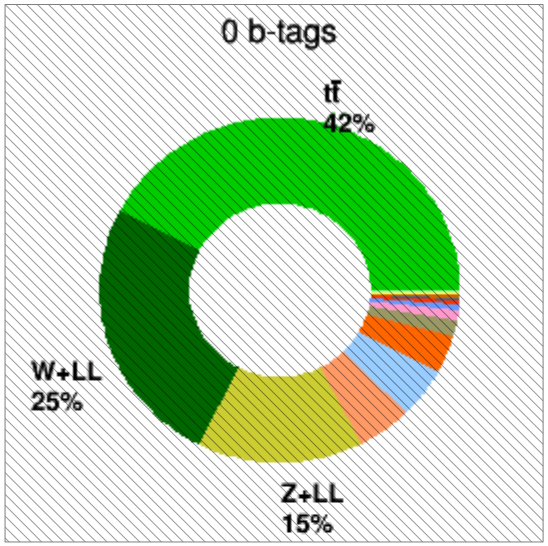


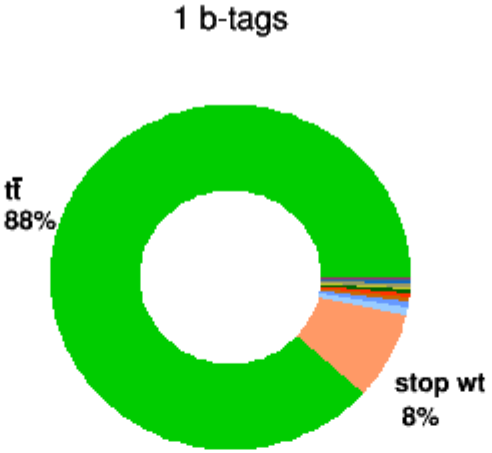


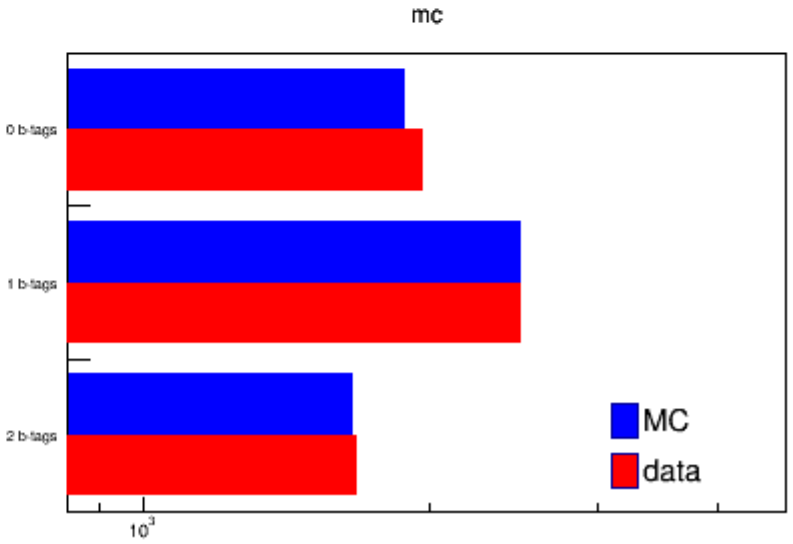


Signal region, MET3 [>300]

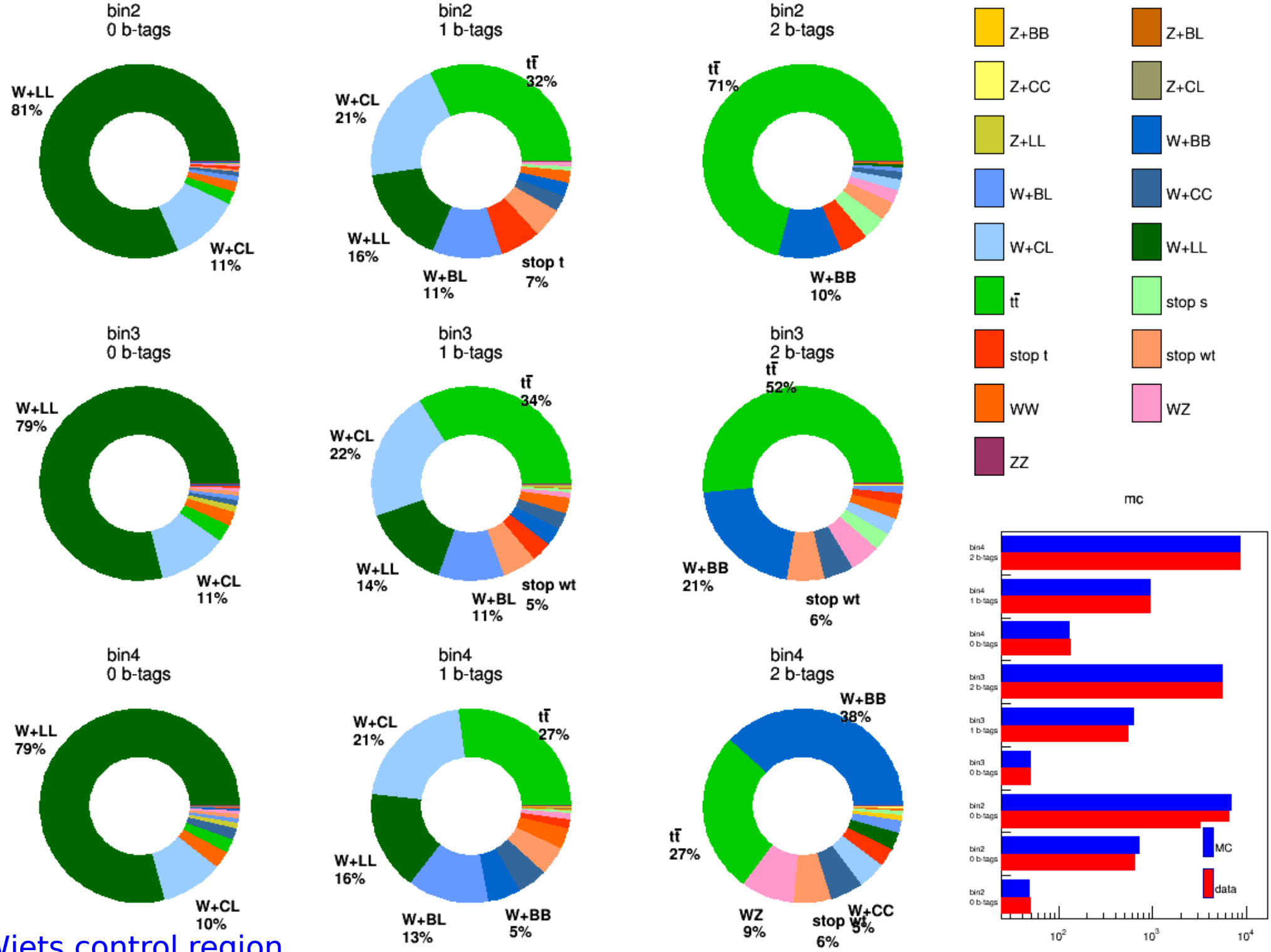
Bkg components



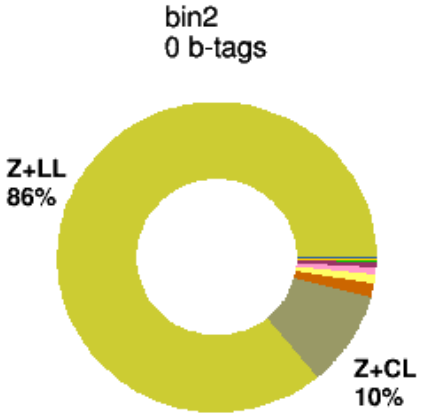


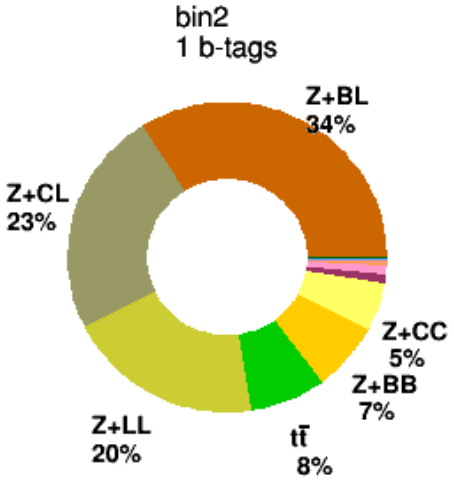


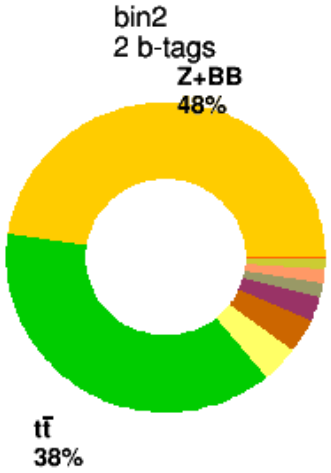
ttbar control region (emu)

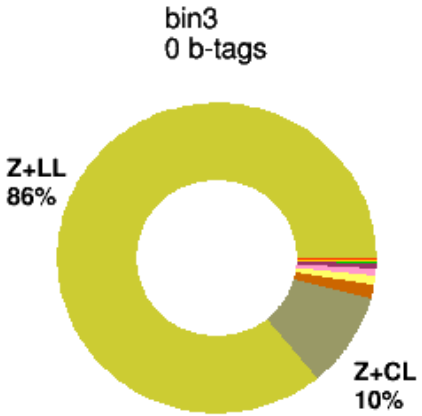


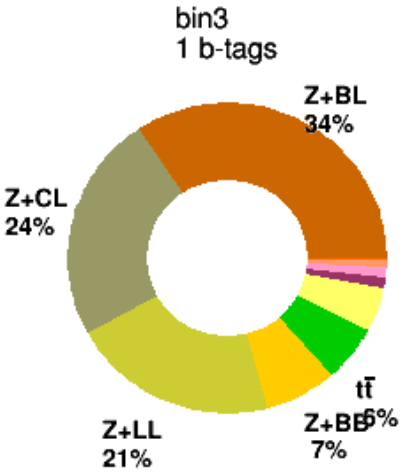
Wjets control region

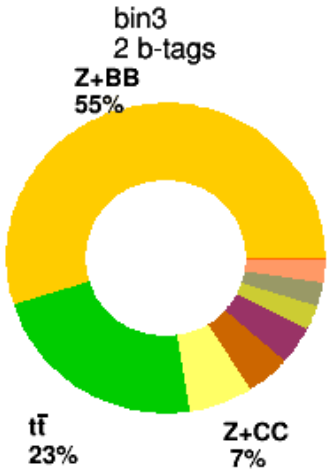


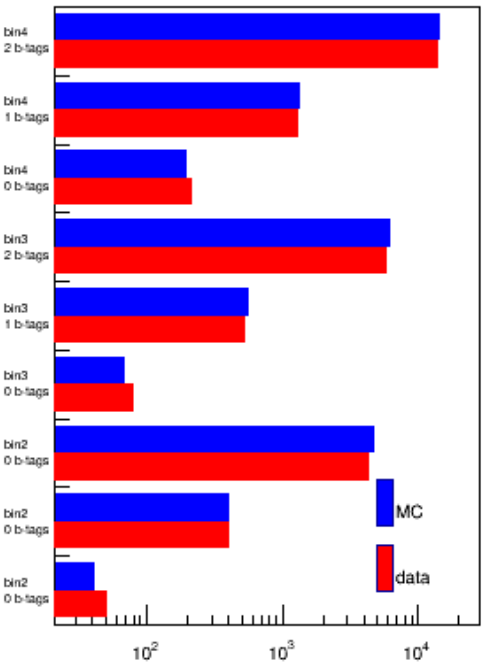


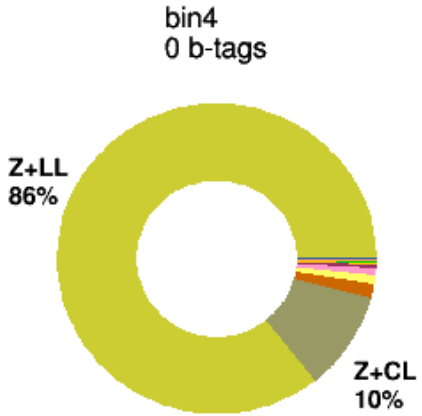


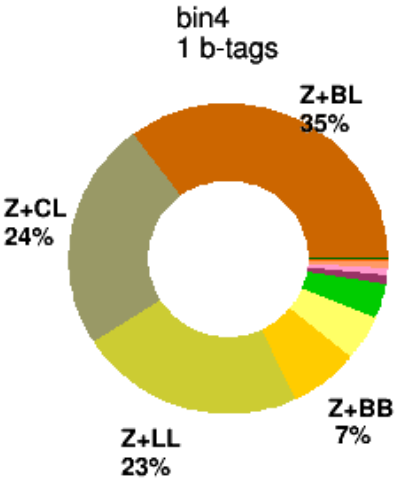


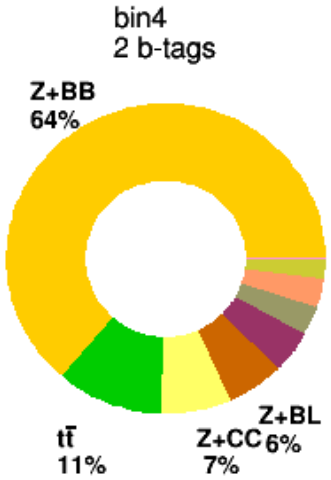








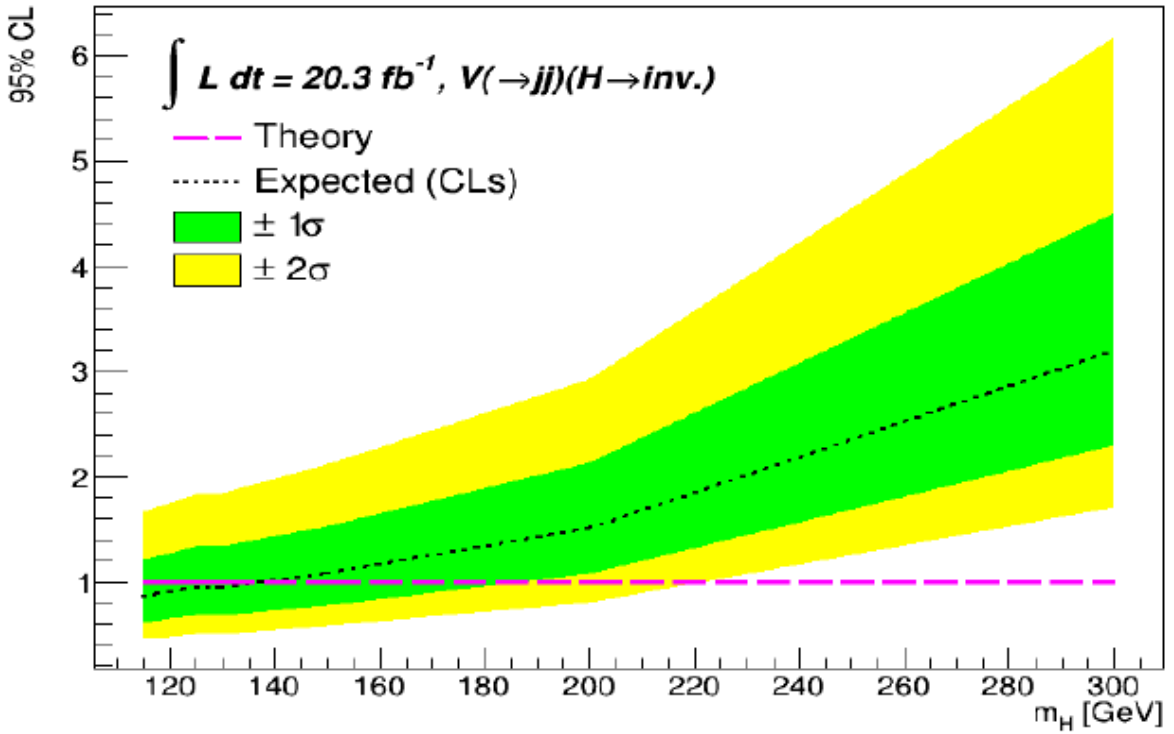




Zjets control region

Global fit

- For now, we include all the bins, althought I think it is too much
  - Some of bins can be removed, since they only increase the complication of the workspace



Expected upper limit = 0.95 @ 125GeV

Upper limits:
Z(ll)H(inv.): 0.4~0.5; FatJet+H(inv.): 2.2; VBF H(inv.) 0.4;
CMS Z(bb)H(inv.): 1.9

Other things

- Please send me some slides showing your recent works
  - ACCM will need them
  - The weekly meeting chaired by Boss Jin will also need them
- I am taking trainee shifts for ADCos shift
  - It is the only shift we can find for now
  - It requires >= 10 trainee shifts before one becomes a real shifter – quite time consuming!
  - I have done 3 trainee shifts, still a lot awaiting