Searches for

BSM neutral Higgs

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Overview

- Combination A (lltautau:hadhad,lephad,leplep; xxbb: llbb,vvbb):
  - workspaces are available and being tested, especially from xxbb side, it takes more than 12 hours for individual channel ll,vv bb to finish upper limit setting with asymptotics (toy-throwing is impossible)
  - lltautau is unblinded, will include their updated workspaces
- Combination H (bbyy; bbbb)
  - only for non-resonant: bbbb doesn't provide ws for the time-being
- WWyy analysis is ongoing:
  - analysis chain is complete
  - main uncertainties on myy and BDT cuts are estimated with data driven
  - systematic uncertainties from detector are to be done
    - thanks to Yanping and Cong, the SM Higgs samples with variations are processed and got preliminary uncertainties

Overview

- HiggsBSM2HDMPlotting tool is widely used in HSGs
  - https://twiki.cern.ch/twiki/bin/view/AtlasProtected/HiggsBSM2HDMPlotting
  - receiving lots of feedbacks and demands
  - updating the code and extending the functions
    - [done] realizing mask creation to indicate areas where exclusions are invalid
    - [doing] making exclusion on new planes tanb/cos(b-a) vs mH/mA, not trivial, since for each exclusion plots, all upper limits from scanned masses are passed, need to rescale the contour, under developping
- 2HDM theoretical cross section calculation, “grid file”
  - finalizing, but met problem of dumping sushi files into ntuples
  - [invetigating] tmp solution, remove additional charged higgs case
  - [additional work] is coming on systematic estimations on the cross sections

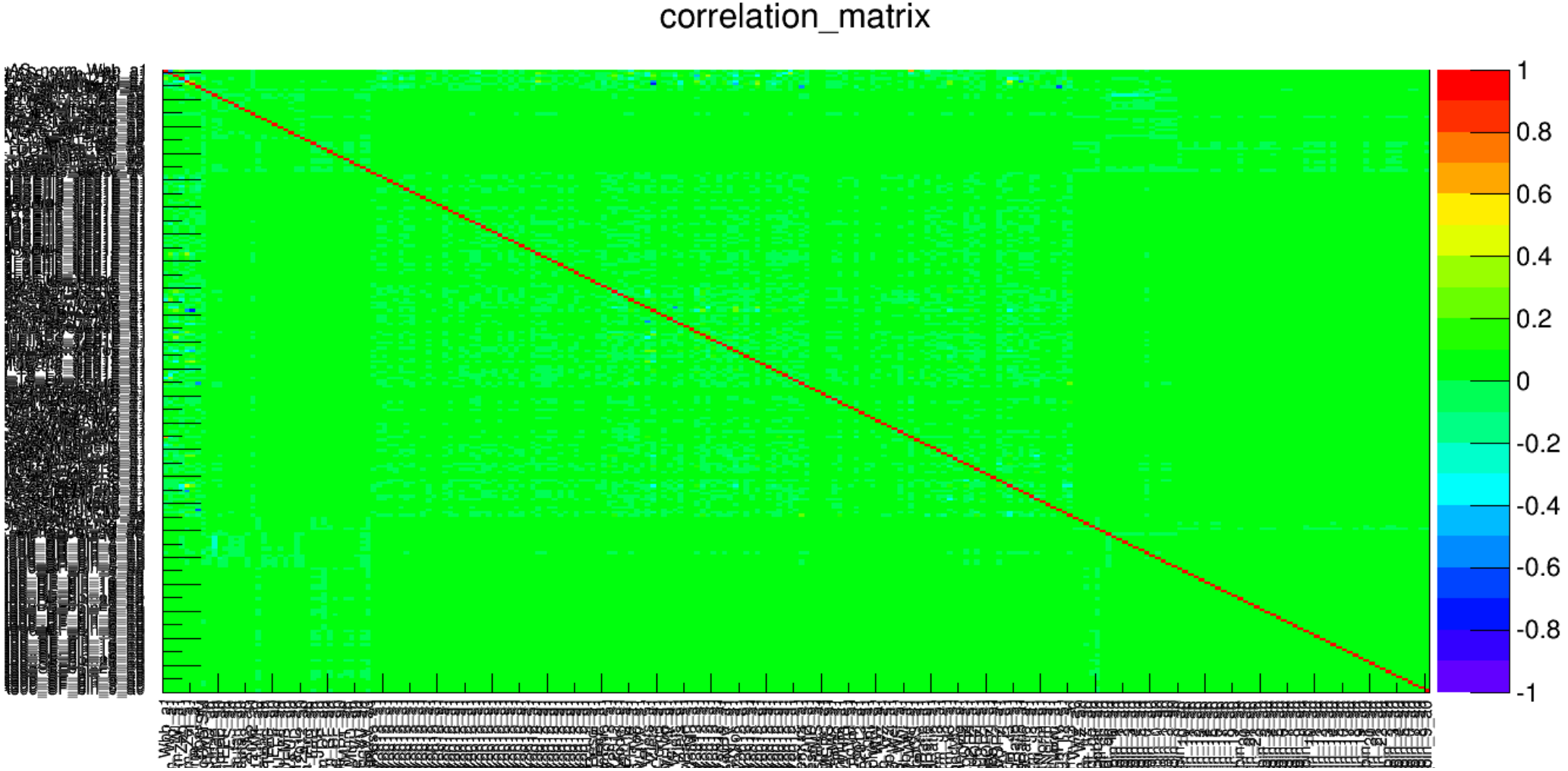
AZh - Nuisance parameters

- No correlation is between lltautau and xxbb for the time-being

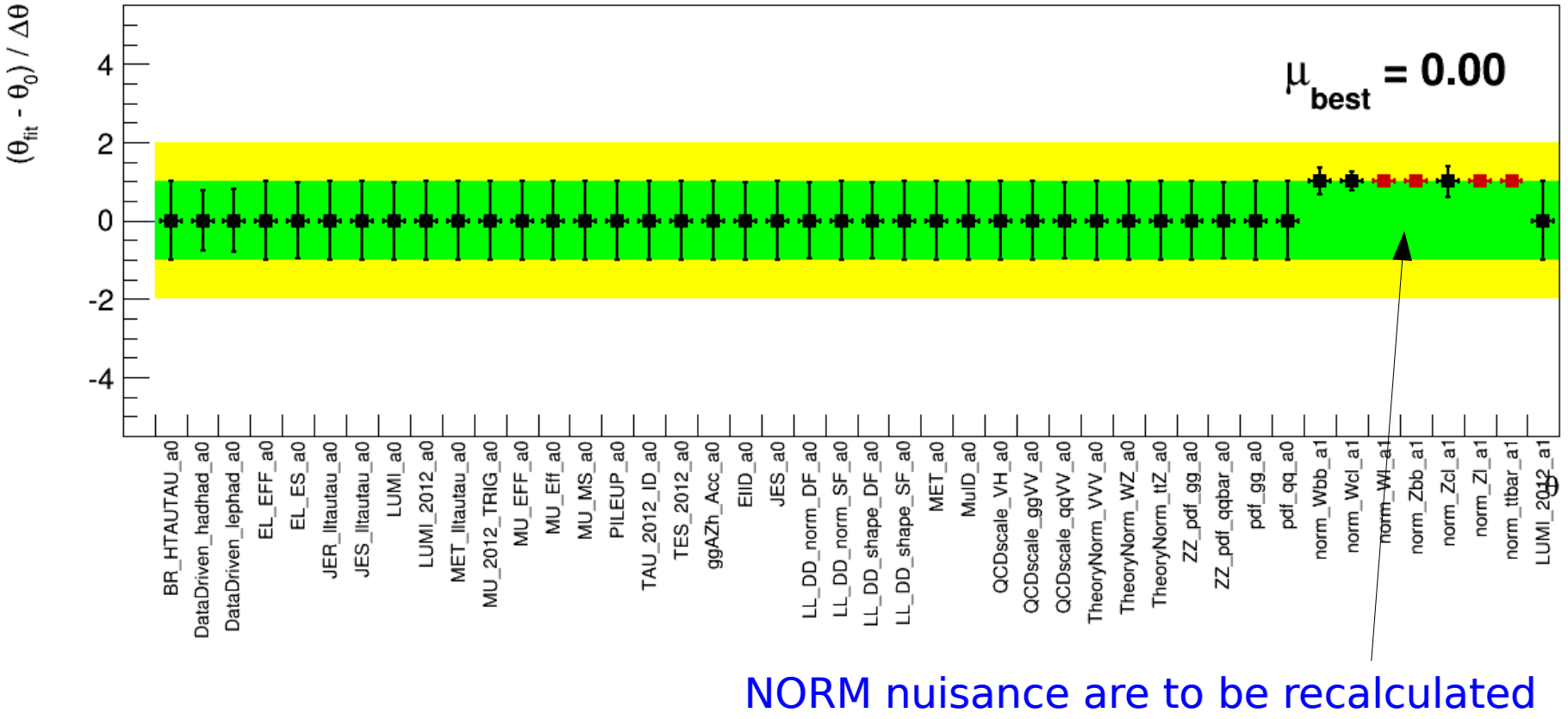
	lltautau	xxbb
# nui parameters syst+stats	36+58	136+0
correlation	(only hadhad and lephad) alpha_ATLAS_BR_HTAUTAU, alpha_ATLAS_EL_EFF, alpha_ATLAS_EL_ES, alpha_ATLAS_JER_lltautau, alpha_ATLAS_JES_lltautau, alpha_ATLAS_MET_lltautau, alpha_ATLAS_MU_2012_TRIG, alpha_ATLAS_MU_EFF(TO BE), alpha_ATLAS_MU_MS, alpha_ATLAS_PILEUP, alpha_ATLAS_TAU_2012_ID, alpha_ATLAS_TES_2012, alpha_QCDscale_VH, alpha_QCDscale_ggVV, alpha_QCDscale_qqVV, alpha_pdf_qq	(between llbb and vvbb) 40 SysBtag* 25 SysJet* SysJVF 3 SysMET ATLAS_norm_Zbb, ATLAS_norm_Zcl, ATLAS_norm_Zl, ATLAS_norm_ttbar, etc.

Correlation matrix

- mA=300GeV

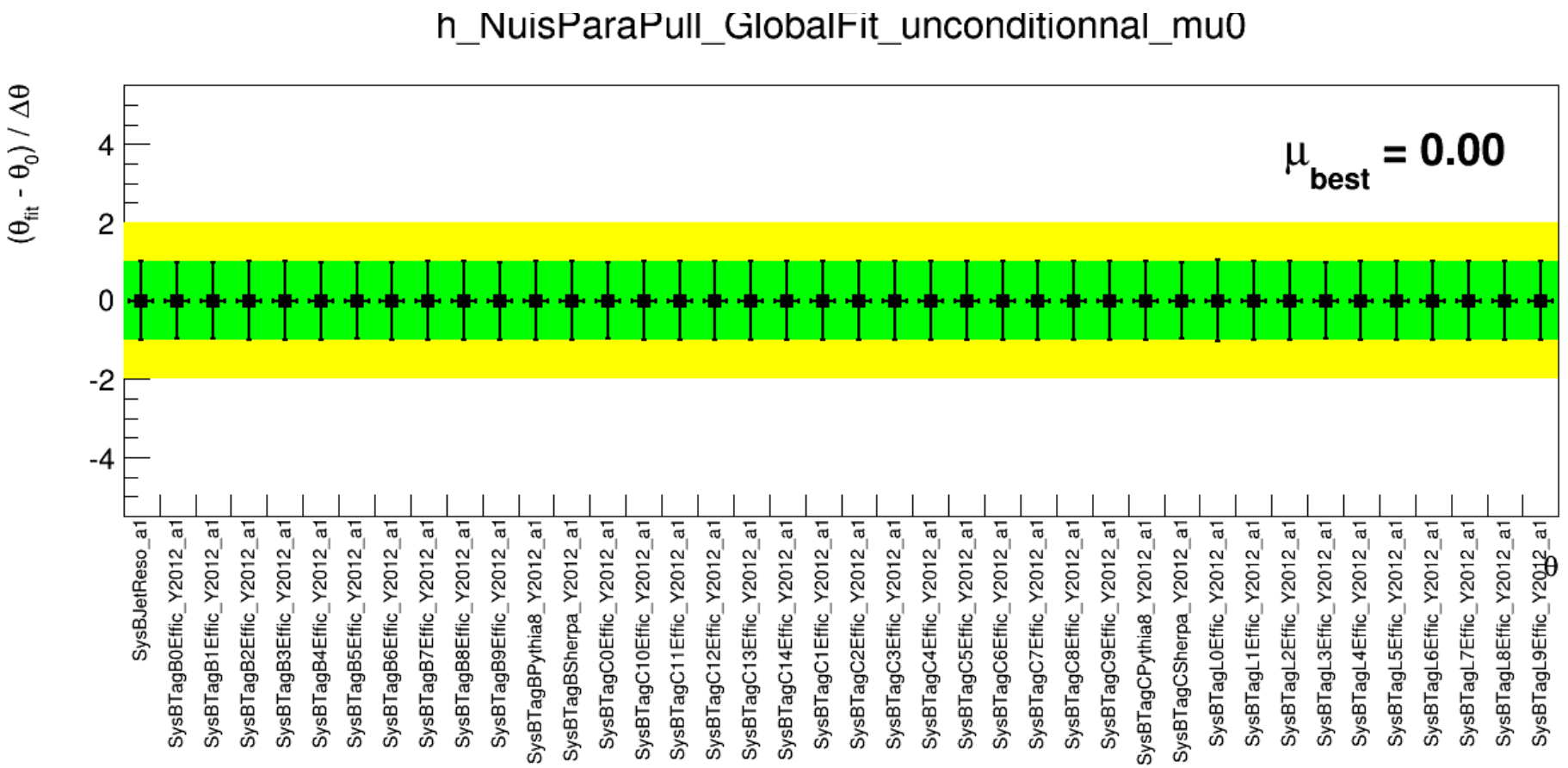


Pull checks

- 

NORM nuisance are to be recalculated

Pull checks

- 
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$(\theta_{fit} - \theta_0) / \Delta\theta$
μ_{best} = 0.00
4
2
0
-2
-4
SysBJetReso_a1
SysBTagB0Effic_Y2012_a1
SysBTagB1Effic_Y2012_a1
SysBTagB2Effic_Y2012_a1
SysBTagB3Effic_Y2012_a1
SysBTagB4Effic_Y2012_a1
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SysBTagB6Effic_Y2012_a1
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SysBTagB9Effic_Y2012_a1
SysBTagBPythia8_Y2012_a1
SysBTagBSherpa_Y2012_a1
SysBTagC0Effic_Y2012_a1
SysBTagC10Effic_Y2012_a1
SysBTagC11Effic_Y2012_a1
SysBTagC12Effic_Y2012_a1
SysBTagC13Effic_Y2012_a1
SysBTagC14Effic_Y2012_a1
SysBTagC1Effic_Y2012_a1
SysBTagC2Effic_Y2012_a1
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SysBTagC8Effic_Y2012_a1
SysBTagC9Effic_Y2012_a1
SysBTagCPythia8_Y2012_a1
SysBTagCSherpa_Y2012_a1
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SysBTagL2Effic_Y2012_a1
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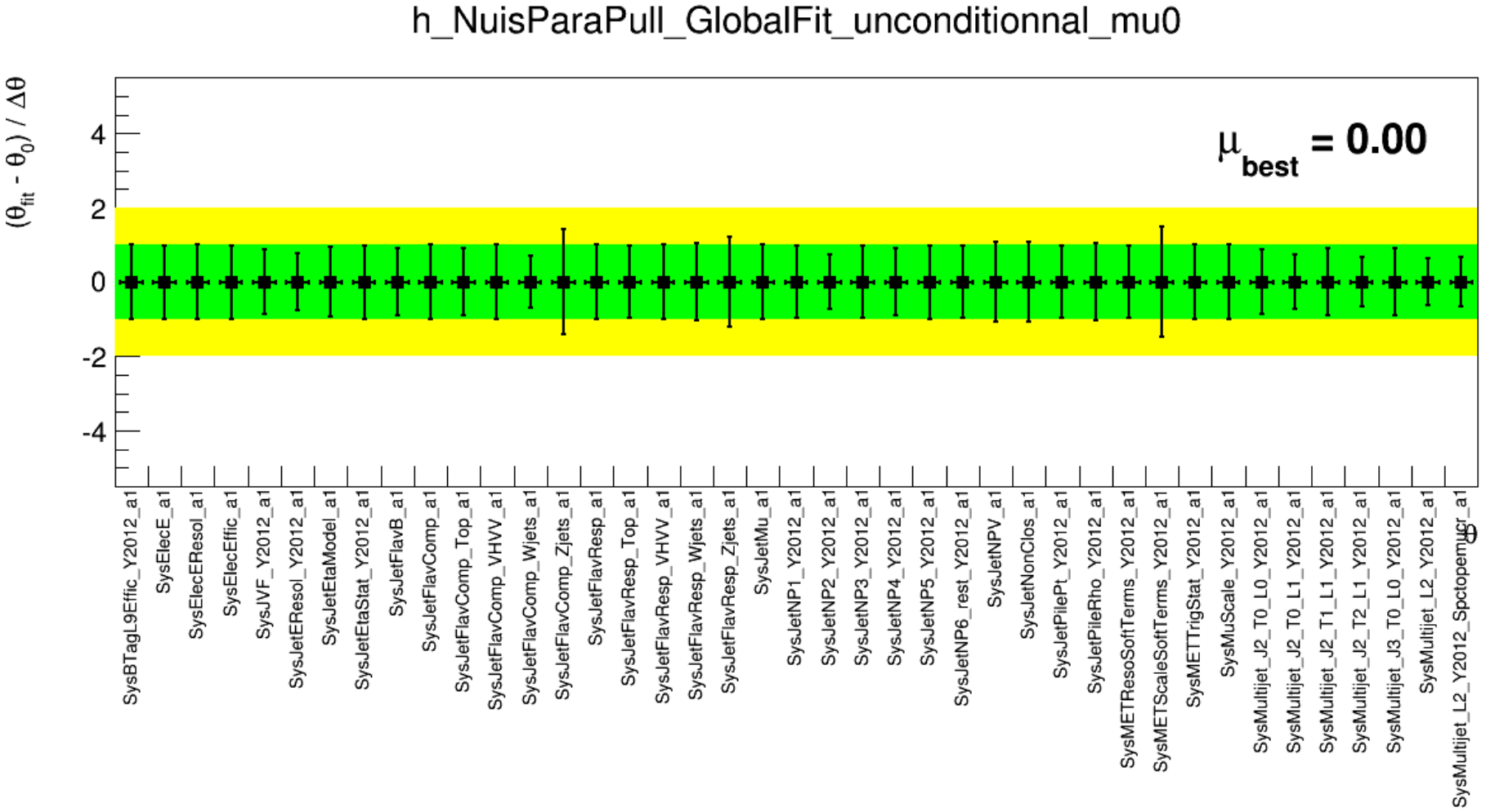
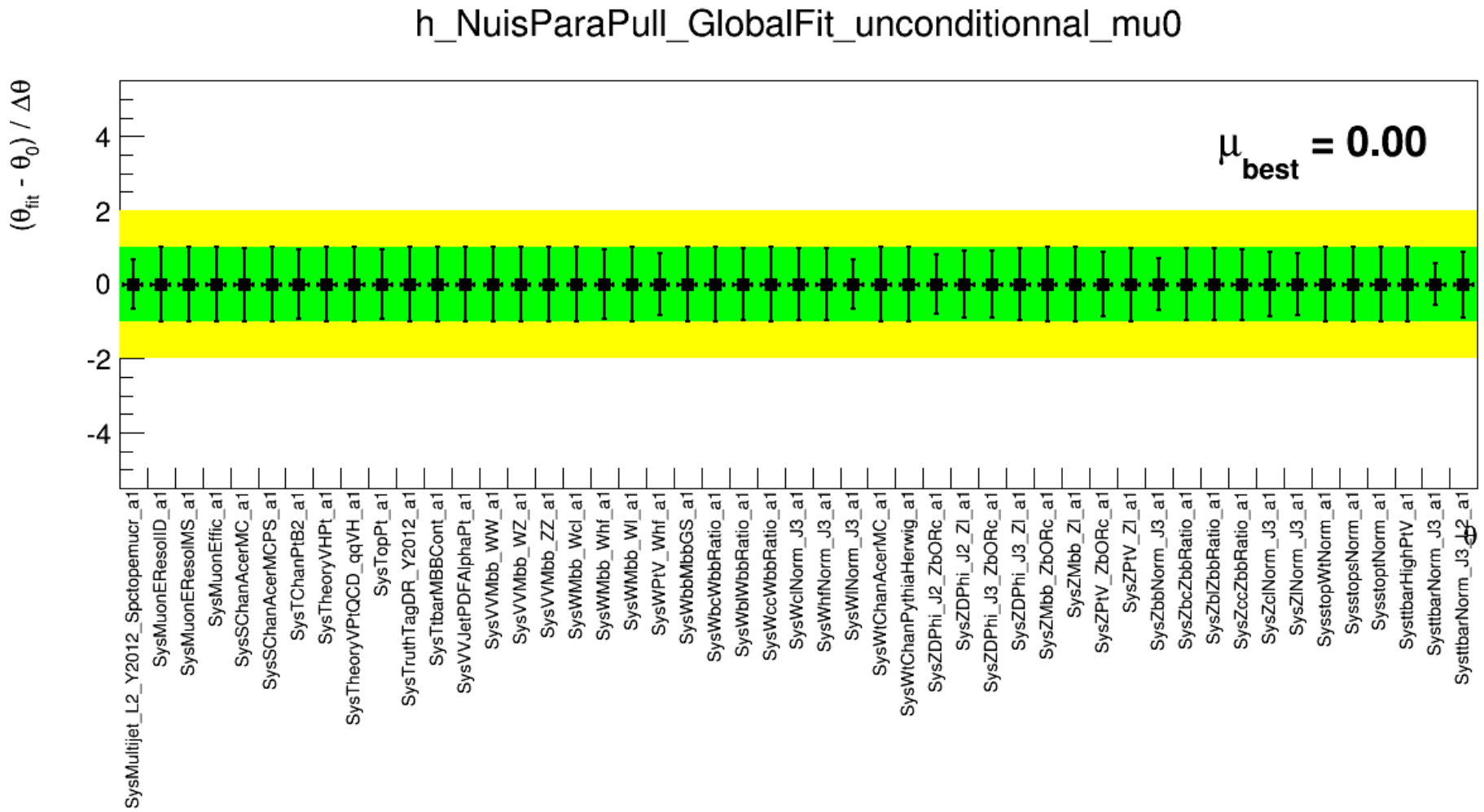
SysBTagL7Effic_Y2012_a1
SysBTagL8Effic_Y2012_a1
SysBTagL9Effic_Y2012_a1
θ

Pull checks

- a bit wider pulls on SysJetFlavorComp_Zjets, SysJetFlavorResp Zjets and SysMETScaleSoftTerms Y2012



Pull checks

- 
h_NuisParaPull_GlobalFit_unconditionnal_mu0
$(\theta_{fit} - \theta_0) / \Delta\theta$
μ_{best} = 0.00
4
2
0
-2
-4
SysMultijet_L2_Y2012_Spctopemucr_a1
SysMuonEResolID_a1
SysMuonEResolMS_a1
SysMuonEffic_a1
SysSChanAcerMC_a1
SysSChanAcerMCPS_a1
SysTChanPtB2_a1
SysTheoryVHPt_a1
SysTheoryVPtQCD_qqVH_a1
SysTopPt_a1
SysTruthTagDR_Y2012_a1
SysTtbarMBBCont_a1
SysVVJetPDFAlphaPt_a1
SysVVMbb_WW_a1
SysVVMbb_WZ_a1
SysVVMbb_ZZ_a1
SysWMbb_Wcl_a1
SysWMbb_Whf_a1
SysWMbb_Wl_a1
SysWPtV_Whf_a1
SysWbbMbbGS_a1
SysWbcWbbRatio_a1
SysWblWbbRatio_a1
SysWccWbbRatio_a1
SysWclNorm_J3_a1
SysWhfNorm_J3_a1
SysWlNorm_J3_a1
SysWtChanAcerMC_a1
SysWtChanPythiaHerwig_a1
SysZDPhi_J2_ZbORc_a1
SysZDPhi_J2_Zl_a1
SysZDPhi_J3_ZbORc_a1
SysZDPhi_J3_Zl_a1
SysZMbb_ZbORc_a1
SysZMbb_Zl_a1
SysZPtV_ZbORc_a1
SysZPtV_Zl_a1
SysZbbNorm_J3_a1
SysZbcZbbRatio_a1
SysZblZbbRatio_a1
SysZccZbbRatio_a1
SysZclNorm_J3_a1
SysZlNorm_J3_a1
SysstopWtNorm_a1
SysstopsNorm_a1
SysstoptNorm_a1
SysttbarHighPtV_a1
SysttbarNorm_J3_a1
SysttbarNorm_J3_L2_a1
θ

AZh combination

- Trying different scripts for upper limit setting (only asymptotics):
  - Standard script from StatForum (Kyle): >2days, endless
  - Aaron script: 1~2 days
  - Modified Aaron script from HSG5: comb/xxbb/vvbb >3 days not finished yet, llbb is done < 1 days

mA 300GeV

+++ Aaron script +++

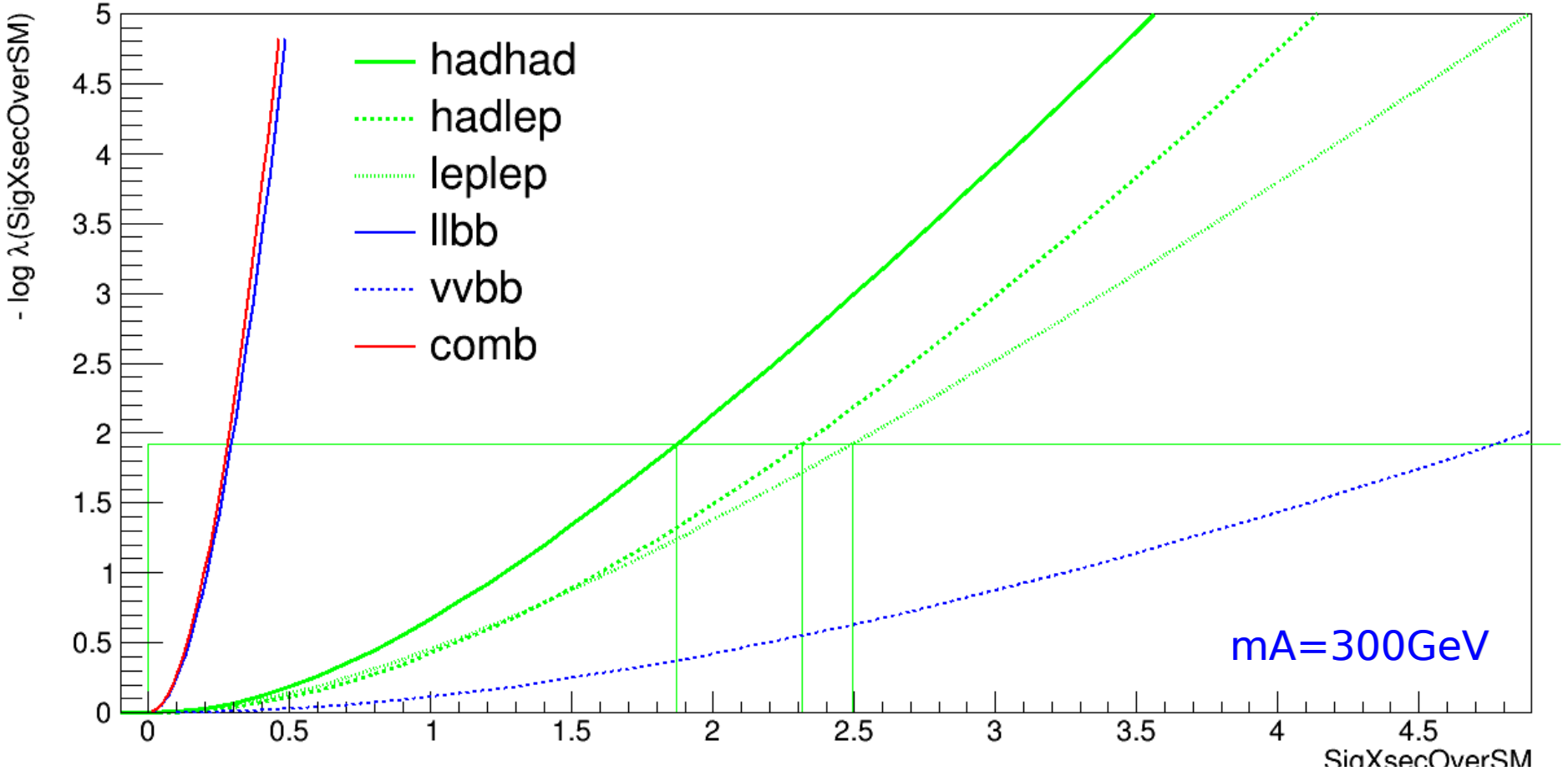
	Observed	Median	+2sig	+1sig	-1sig	-2sig
combined	0.2798	0.2798	0.5432	0.3946	0.2016	0.1502
xxbb	0.2918	0.2918	0.5704	0.4122	0.2103	0.1566
llbb	0.2945	0.2945	0.5778	0.4171	0.2122	0.1580
vvbb	4.7677	4.7677	10.7129	7.0971	3.4354	2.5589
hadhad	1.8711	1.8711	4.0766	2.7397	1.3482	1.0043
lephad	2.3156	2.3156	4.7806	3.3400	1.6685	1.2429
leplep	2.4921	2.4921	5.5921	3.7159	1.7957	1.3376

+++ Aaron script modified in HSG5 +++

llbb	0.294514	0.294514	0.563147	0.39158	0.212214	0.158073

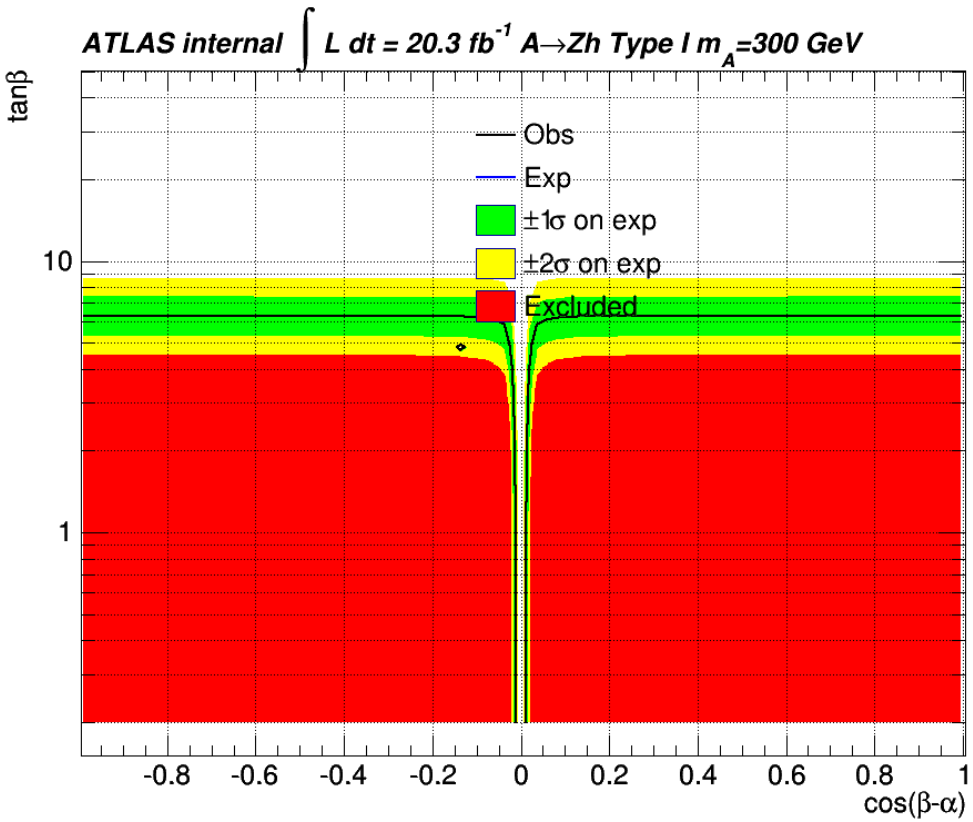
AZh – PLR curves (asimov mu=0)

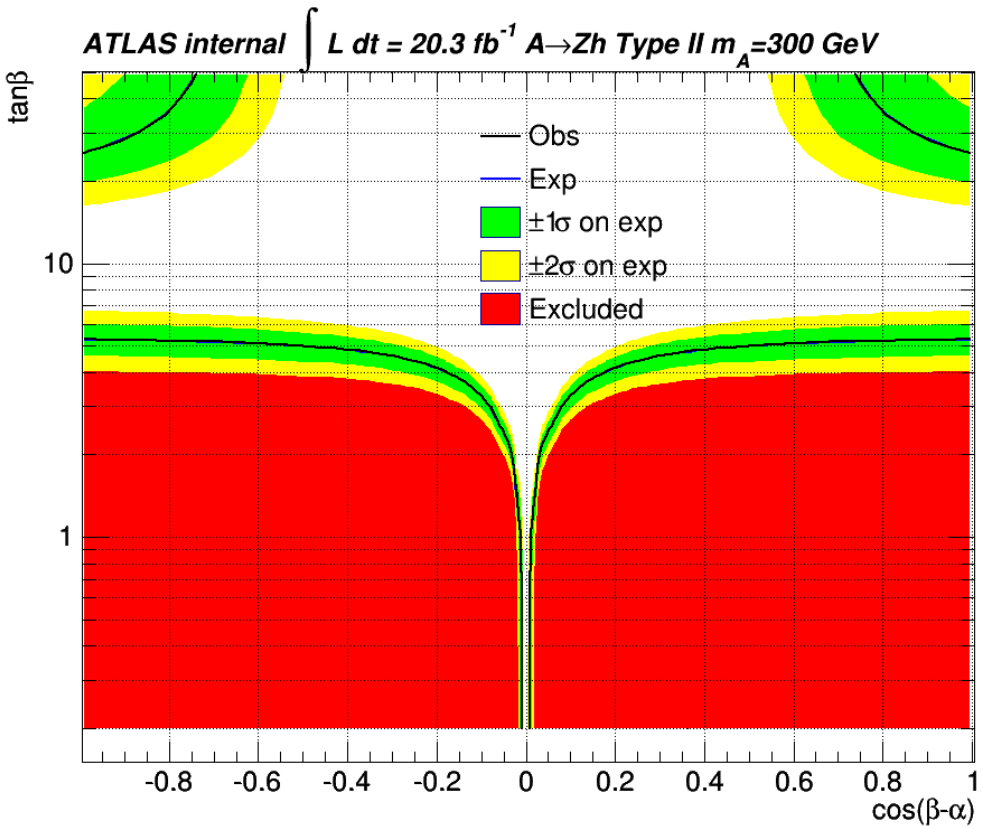
- PLR curves are calculated for each sub-channel and the combined to have a basic idea of sensitivities and cross check with asymptotic upper limit setting
- PLR is calculated with asimovData in which signal strength is set to 0, so one-sided curves are shown as below (min_mu=0)



2HDM interpretation

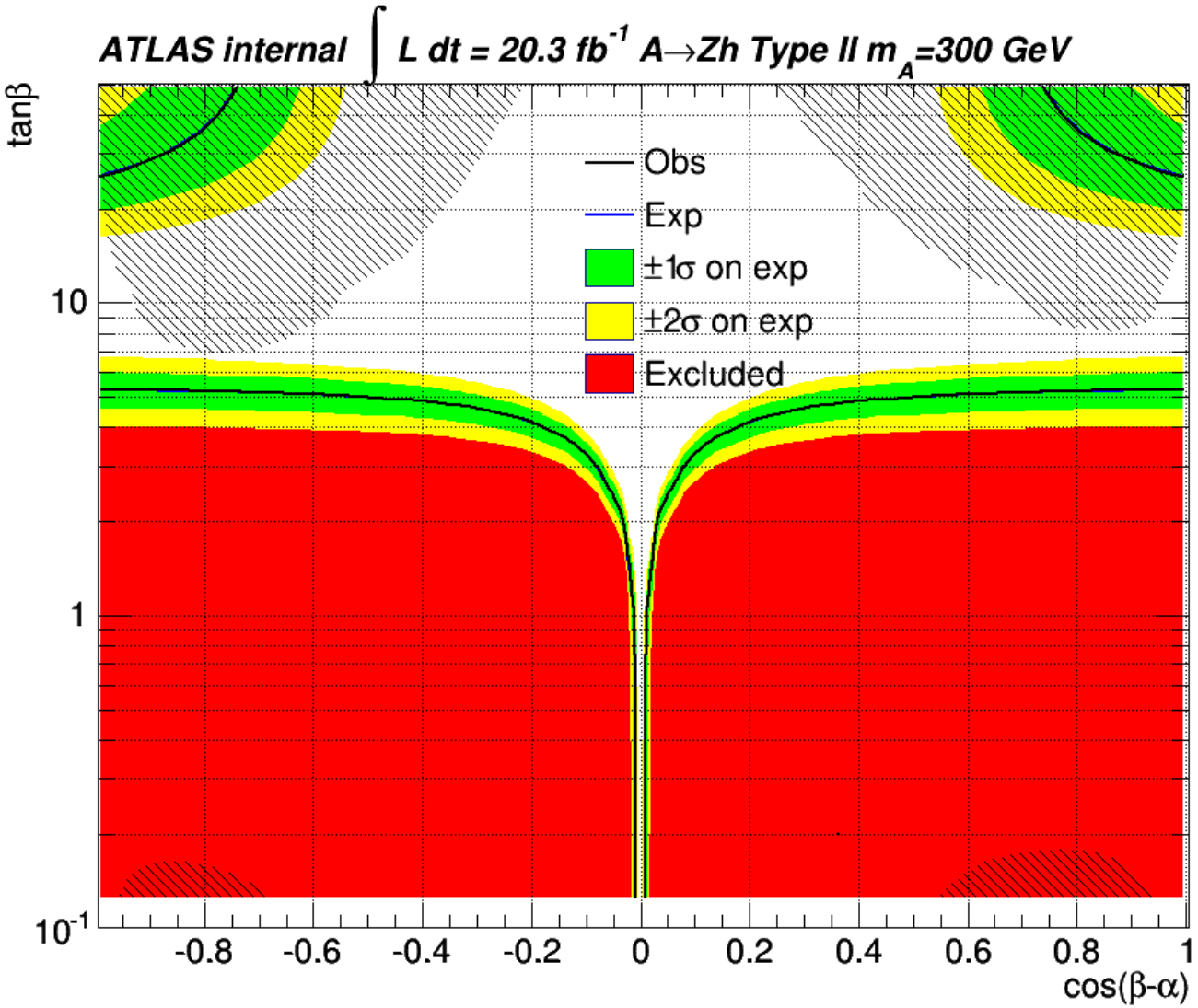
- With tool to plot 2HDM exclusion in phase space
- https://twiki.cern.ch/twiki/bin/view/AtlasProtected/HiggsBSM2HDMPlotting
- Using A -> Zh limits from all channel combined





2HDM interpretation

- with shadowed area showing width/mass > 20%



WWyy - SM Higgs uncert

- Applying all cuts, and look at variation
- for example, ggH uncertainties decrease as a function of mass of heavy Higgs

260 300 350 400 500
56% -> 31% -> 30% -> 13% -> 17%

- ggH VBF ttH WH ZH are estimated with their corresponding uncertainties
- On the right, it is 260GeV, ggH uncertainties on JET
  - pileup, JVF etc contributes a lot

Uncertainty source	Relative variations
Pileuprand	-0.136204
JES_Nuisance_16_down	-0.094278
JES_FlavResp_down	-0.160425
JES_PileupTopo_down	-0.195590
JES_Nuisance_11_down	-0.027108
JES_Nuisance_8_up	-0.107691
JES_Nuisance_9_down	0.061521
JES_Nuisance_1_up	-0.063918
JES_BJES_down	-0.025596
JES_Nuisance_2_up	0.061521
JES_BJES_up	0.000000
JES_Nuisance_4_up	-0.321957
JES_NPV_up	-0.050688
JES_Nuisance_16_up	0.036377
JES_FlavComp_down	-0.333704
JES_Nuisance_1_down	0.087117
JES_Nuisance_5_down	0.272420
JES_Nuisance_11_up	-0.053135
JES_Nuisance_13_up	0.030776
JES_Nuisance_7_up	-0.094278
JES_Nuisance_10_up	0.020378
JES_Nuisance_8_down	-0.042029
JES_Nuisance_2_down	-0.025144
JES_Nuisance_13_down	-0.144963
JES_PileupTopo_up	-0.160939
JES_Nuisance_6_down	0.087117
JES_Nuisance_15_down	0.000000
JES_MU_down	0.008838
JES_Nuisance_3_down	-0.116168
JES_Nuisance_10_down	-0.094278
JES_Nuisance_15_up	0.000000
JES_FlavResp_up	-0.249568
JES_Nuisance_14_down	0.130712
JES_MU_up	0.039178
JES_Nuisance_14_up	0.053483
JES_Nuisance_3_up	0.024711
JES_Nuisance_9_up	-0.027539
JER_Nom	-0.252856
JES_Nuisance_6_up	0.066740
JES_Nuisance_4_down	-0.060599
JES_Nuisance_7_down	-0.005219
JES_PileupPt_up	0.023478
JES_NPV_down	-0.035408
JVF_up	-0.260336
JES_Nuisance_5_up	0.066740
JES_PileupPt_down	0.092767
JES_Nuisance_12_down	0.155800
JVF_down	0.449327
JES_Nuisance_12_up	0.181396
JES_FlavComp_up	0.122264
Overall	0.559045

260GeV

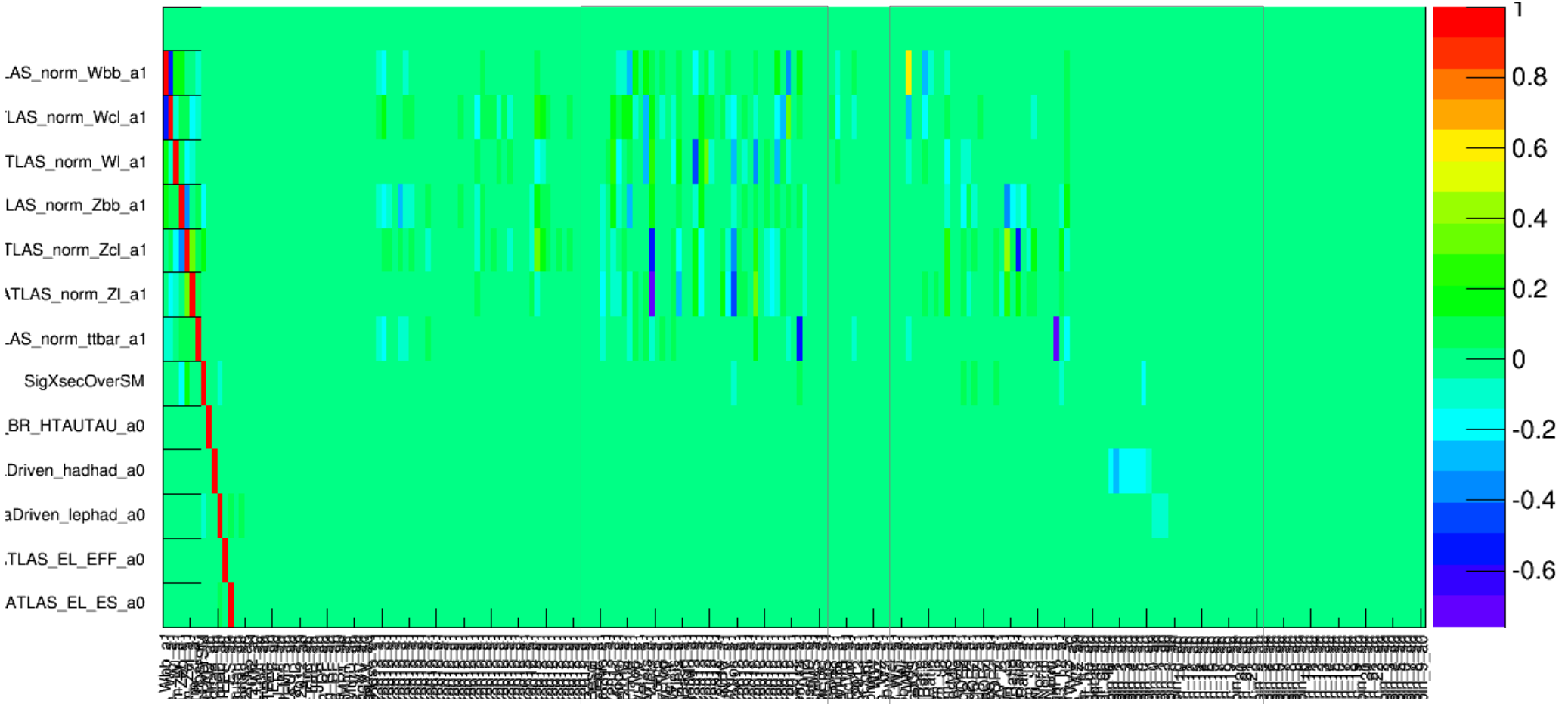
Backup

Bref list

- LHC BSM Xsection contribution:
  - https://twiki.cern.ch/twiki/bin/view/LHCPhysics/LHCHXSWG
    - created in January 2010, restructured 2012
  - producing BSM ggH ggA cross section and branching ratio calculations within 2HDM framework
  - running on ihep slc6 cluster
  - close to the end of the calculation for 7/8TeV
- HSG6 2HDMPlottingTool development
  - mature compilable code for creating 2HDM exclusion plots
  - WW,ZZ,lltautau,llvvbb people are using
  - receiving feedbacks and being extending function to support exclusions on more planes tanb vs mA/mH (not easy to realize).
- Class III shift on ATLAS SW testing:
  - relatively quite these days, since no new release is demanded recently, only some urgent requests from phys-vali group, finished

Correlation matrix – zoom in

- high correlations are mainly related to **ATLAS_norm_XXX**

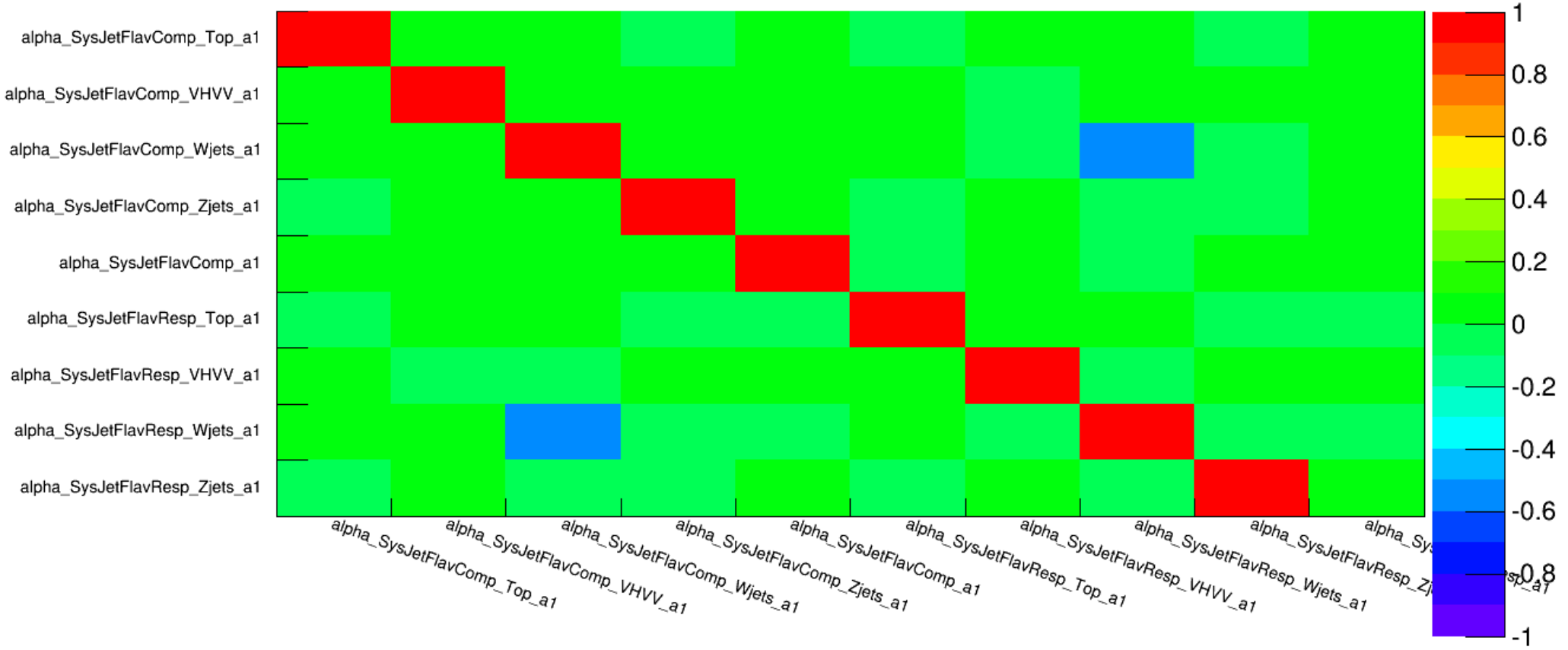


SysJet

SysZbbNorm_J3
SysZblZbbRatio
SysttbarHighPtV

Correlation matrix – zoom in

- SysJetFlavComp_Wjets correlated with SysJetFlavResp_Wjets



All nuisance parameters

lltautau (syst)
alpha_ATLAS_BR_HTAUTAU_a0,
alpha_ATLAS_DataDriven_hadhad_a0,
alpha_ATLAS_DataDriven_lephad_a0,
alpha_ATLAS_EL_EFF_a0,
alpha_ATLAS_EL_ES_a0,
alpha_ATLAS_JER_lltautau_a0,
alpha_ATLAS_JES_lltautau_a0,
alpha_ATLAS_LUMI_a0,
alpha_ATLAS_LUMI_2012_a0,
alpha_ATLAS_MET_lltautau_a0,
alpha_ATLAS_MU_2012_TRIG_a0,
alpha_ATLAS_MU_EFF_a0,
alpha_ATLAS_MU_Eff_a0,
alpha_ATLAS_MU_MS_a0,
alpha_ATLAS_PILEUP_a0,
alpha_ATLAS_TAU_2012_ID_a0,
alpha_ATLAS_TES_2012_a0,
alpha_ATLAS_ggAZh_Acc_a0,
alpha_ElID_a0,
alpha_JES_a0,
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alpha_MuID_a0,
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alpha_QCDscale_ggVV_a0,
alpha_QCDscale_qqVV_a0,
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alpha_TheoryNorm_WZ_a0,
alpha_TheoryNorm_ttZ_a0,
alpha_ZZ_pdf_gg_a0,
alpha_ZZ_pdf_qqbar_a0,
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alpha_pdf_qq_a0,

All nuisance

xxbb (syst)
ATLAS_norm_Wbb_a1,
ATLAS_norm_Wcl_a1,
ATLAS_norm_Wl_a1,
ATLAS_norm_Zbb_a1,
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alpha_SysBJetReso_a1,
alpha_SysBTagB0Effic_Y2012_a1,
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alpha_SysBTagB9Effic_Y2012_a1,
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All nuisance parameters

xxbb (syst)
alpha_SysElecE_a1,
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alpha_SysJetFlavComp_a1,
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alpha_SysJetFlavComp_Zjets_a1,
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All nuisance parameters

xxbb (syst)
alpha_SysMuonEResolID_a1,
alpha_SysMuonEResolMS_a1,
alpha_SysMuonEffic_a1,
alpha_SysSChanAcerMC_a1,
alpha_SysSChanAcerMCPS_a1,
alpha_SysTChanPtB2_a1,
alpha_SysTheoryVHPt_a1,
alpha_SysTheoryVPtQCD_qqVH_a1,
alpha_SysTopPt_a1,
alpha_SysTruthTagDR_Y2012_a1,
alpha_SysTtbarMBBCont_a1,
alpha_SysVVJetPDFAlphaPt_a1,
alpha_SysVVMbb_WW_a1,
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alpha_SysWMbb_Wl_a1,
alpha_SysWPtV_Whf_a1,
alpha_SysWbbMbbGS_a1,
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alpha_SysWblWbbRatio_a1,
alpha_SysWccWbbRatio_a1,
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alpha_SysWhfNorm_J3_a1,
alpha_SysWlNorm_J3_a1,
alpha_SysWtChanAcerMC_a1,
alpha_SysWtChanPythiaHerwig_a1,

All nuisance parameters

xxbb (syst)
alpha_SysZDPhi_J2_ZbORc_a1,
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alpha_SysZlNorm_J3_a1,

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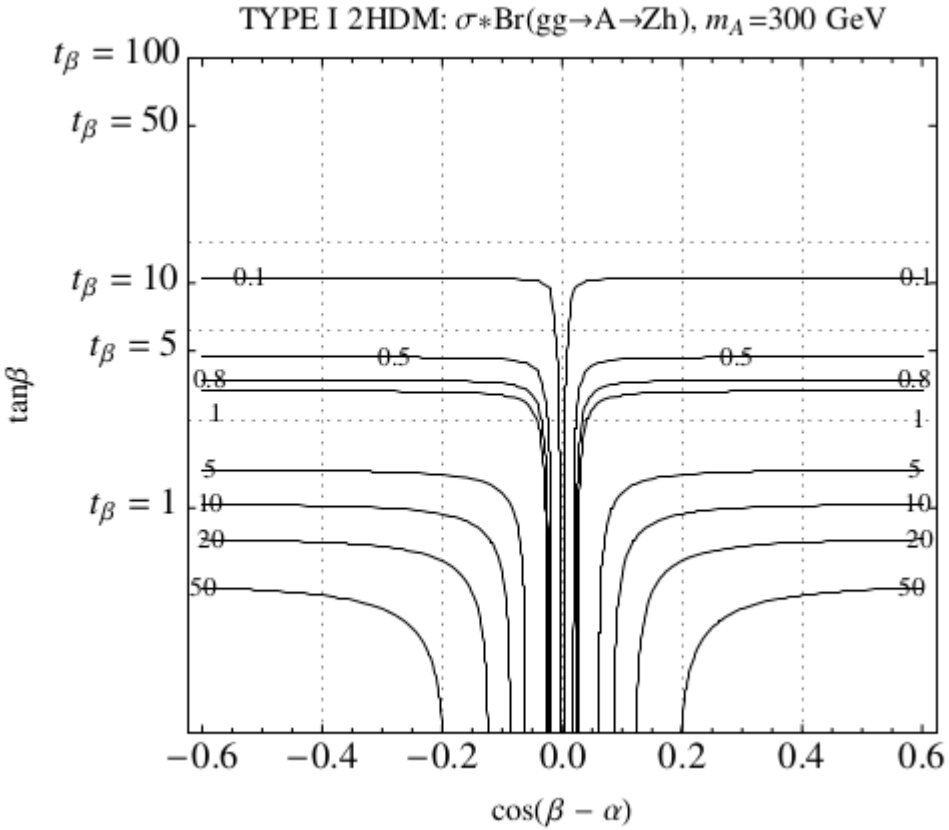
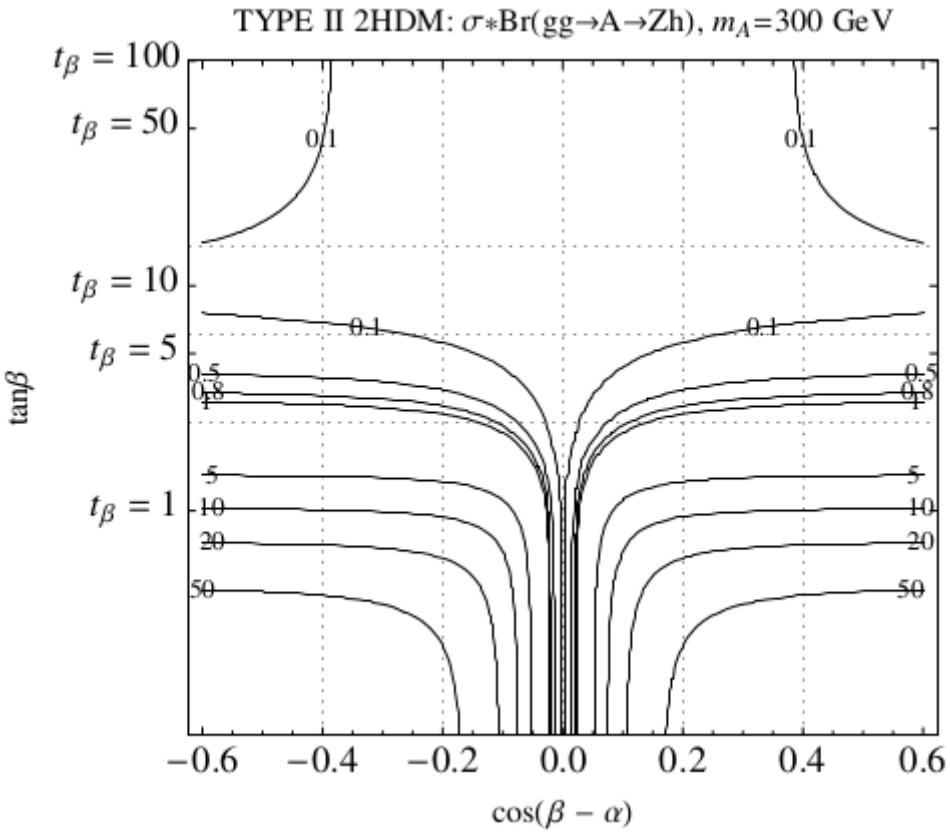
alpha_SysstopsNorm_a1,
alpha_SysstoptNorm_a1,
alpha_SysttbarHighPtV_a1,
alpha_SysttbarNorm_J3_a1,
alpha_SysttbarNorm_J3_L2_a1

2HDM xsec contour





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