Weekly report

Xiaohu Sun
20-01-2015
IHEP

AZh combination

- Asked for the second circulation
- electronic sign-off: all EB members
- many many thanks to all EB members and analyzers

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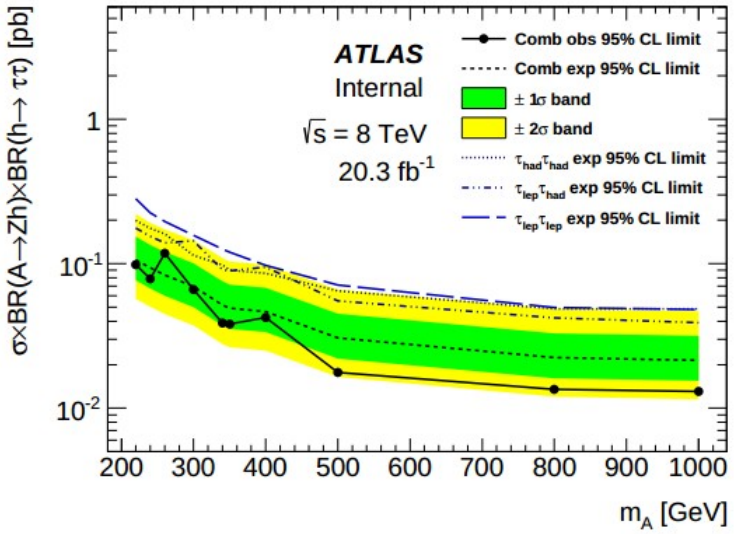
P. Kluit (*)
D. Varouchas
L. Chevalier
G. Facini

(*): EdBoard Chair

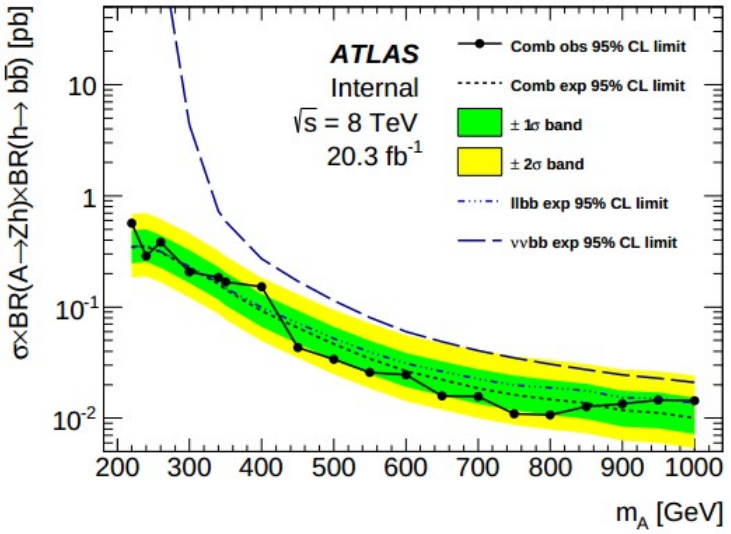
AZh - introduction

- Search for a **CP-odd Higgs boson** decaying to **Zh**

model independent



(a) $A \to Zh, h \to \tau\tau$



(b) $A \to Zh, h \to b\bar{b}$

- To properly interpret our AZh results in 2HDM, one has to consider the following issues

model dependent

  - BR(h->tautau) and BR(h->bb), rescale in the same way in type I and II, but differently in type III and IV
  - Natural width, since we assume resonance width is narrow
  - bbA production, especially at high tanb in type II and IV
- Type III and IV are newly added
- A->tautau interpretation in 2HDM is overlaid
- New transparent styles

2nd circul

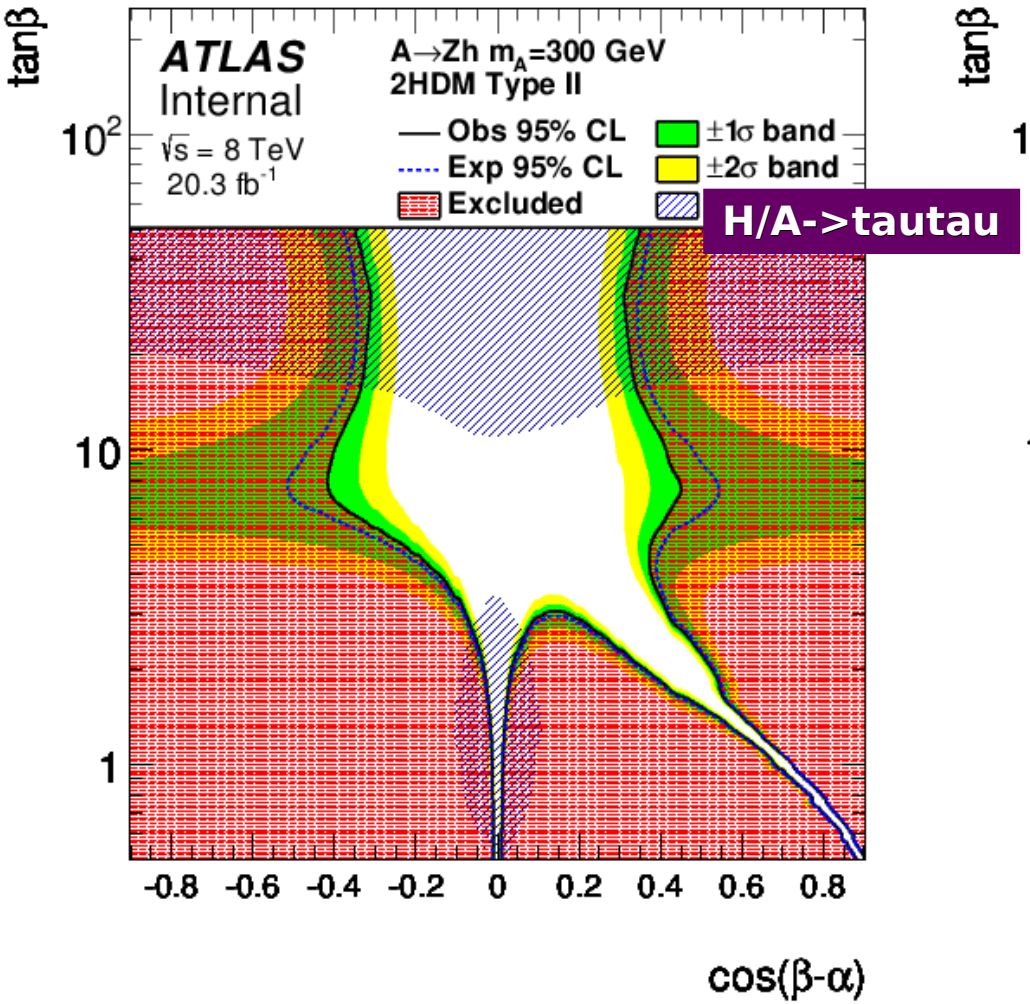
2nd circul

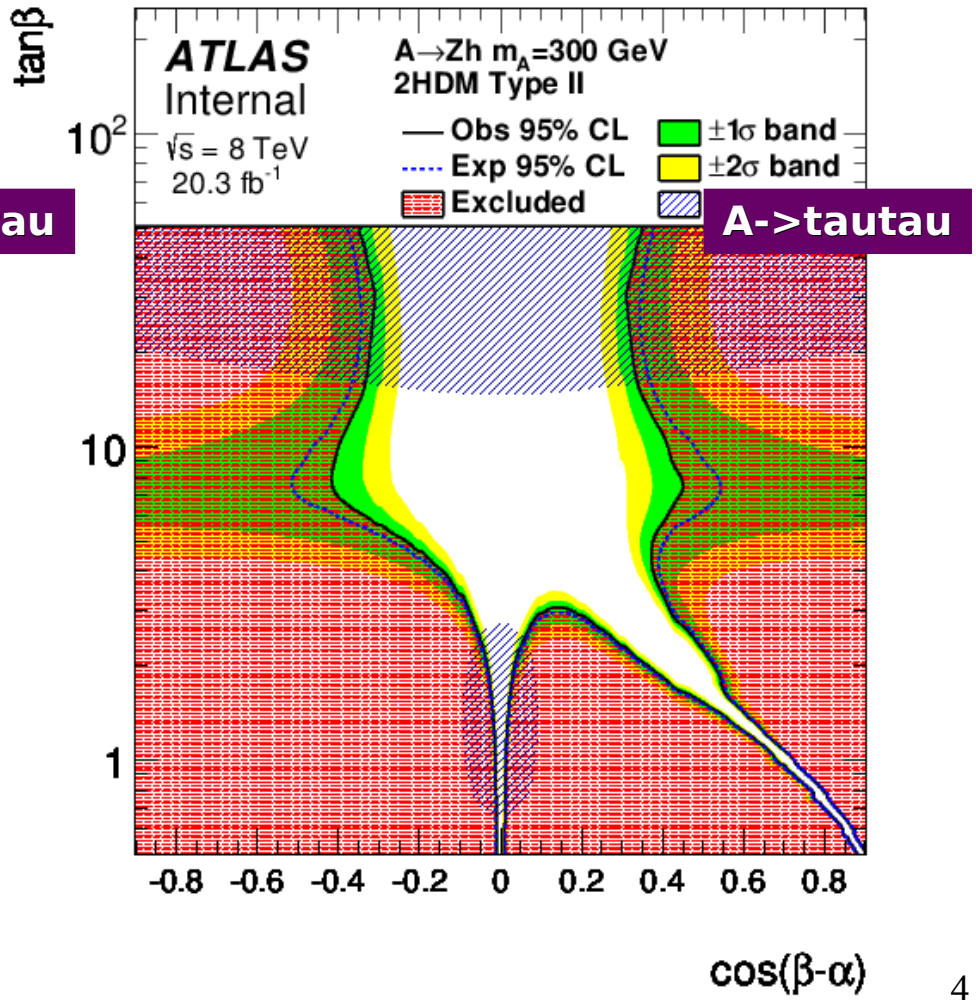
2nd circul

2nd circul

H/A -> tau tau effects

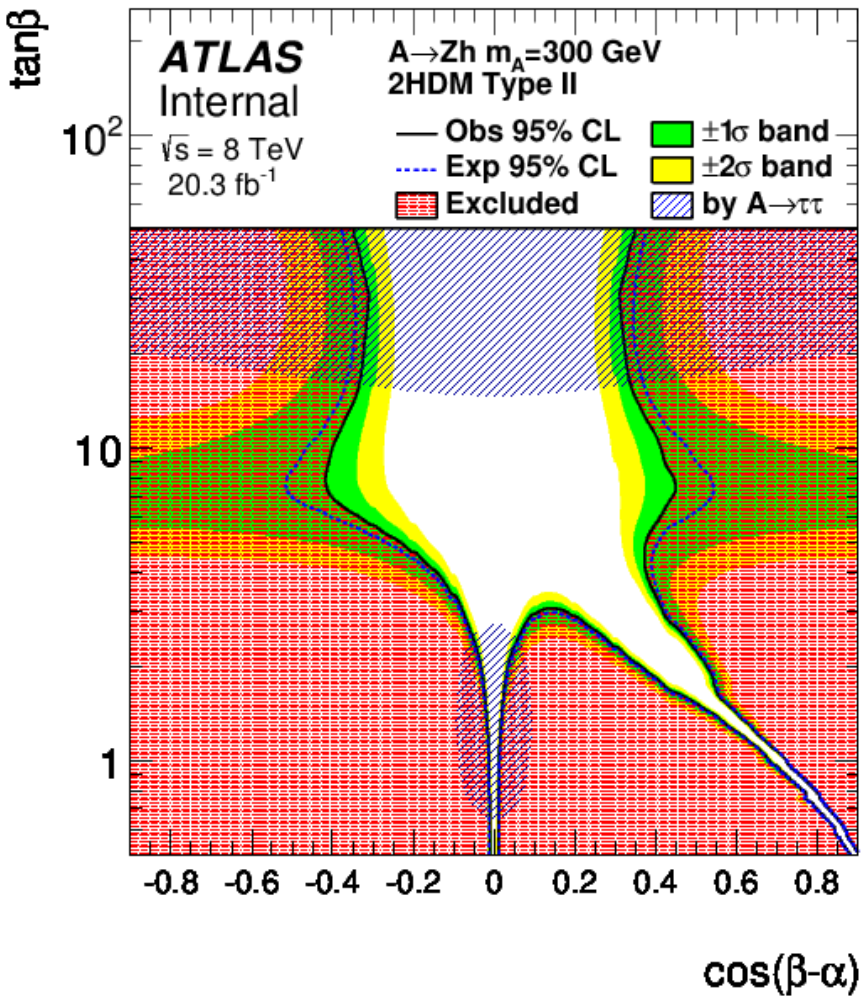
- Proposed by Marumi, the overlaid A->tautau exclusions are asked to be compared with H/A->tautau exclusions
-

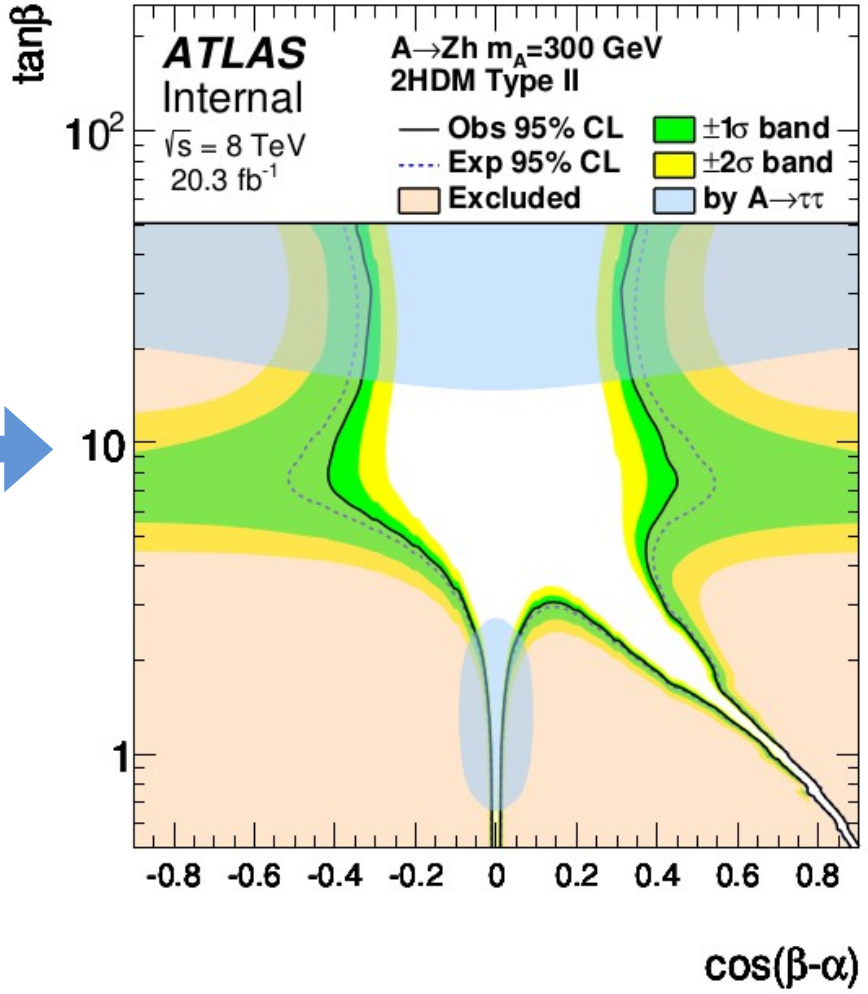




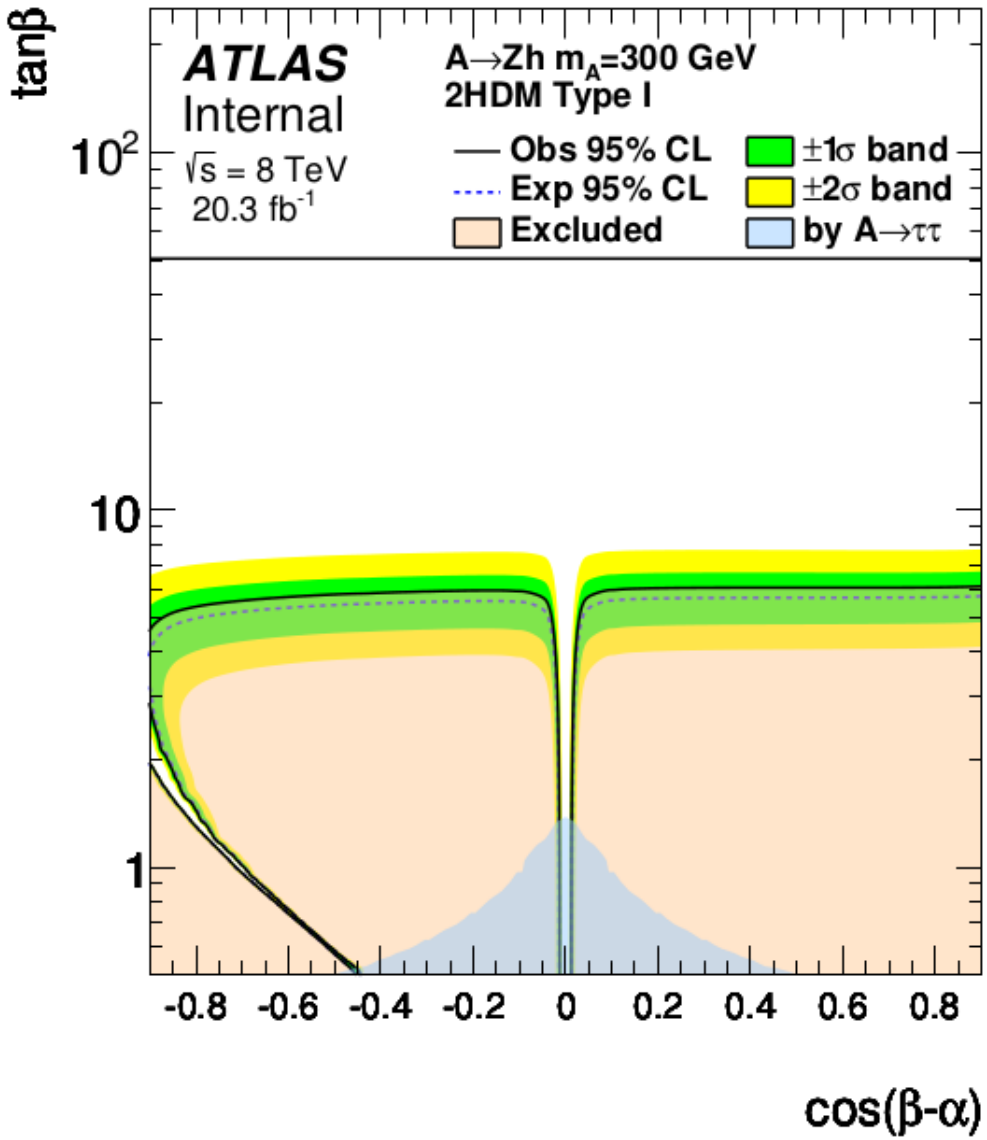
New transparent style

- Proposed by Marumi, we are changing all the hatched styles into transparent styles and use pdf instead of eps





2HDM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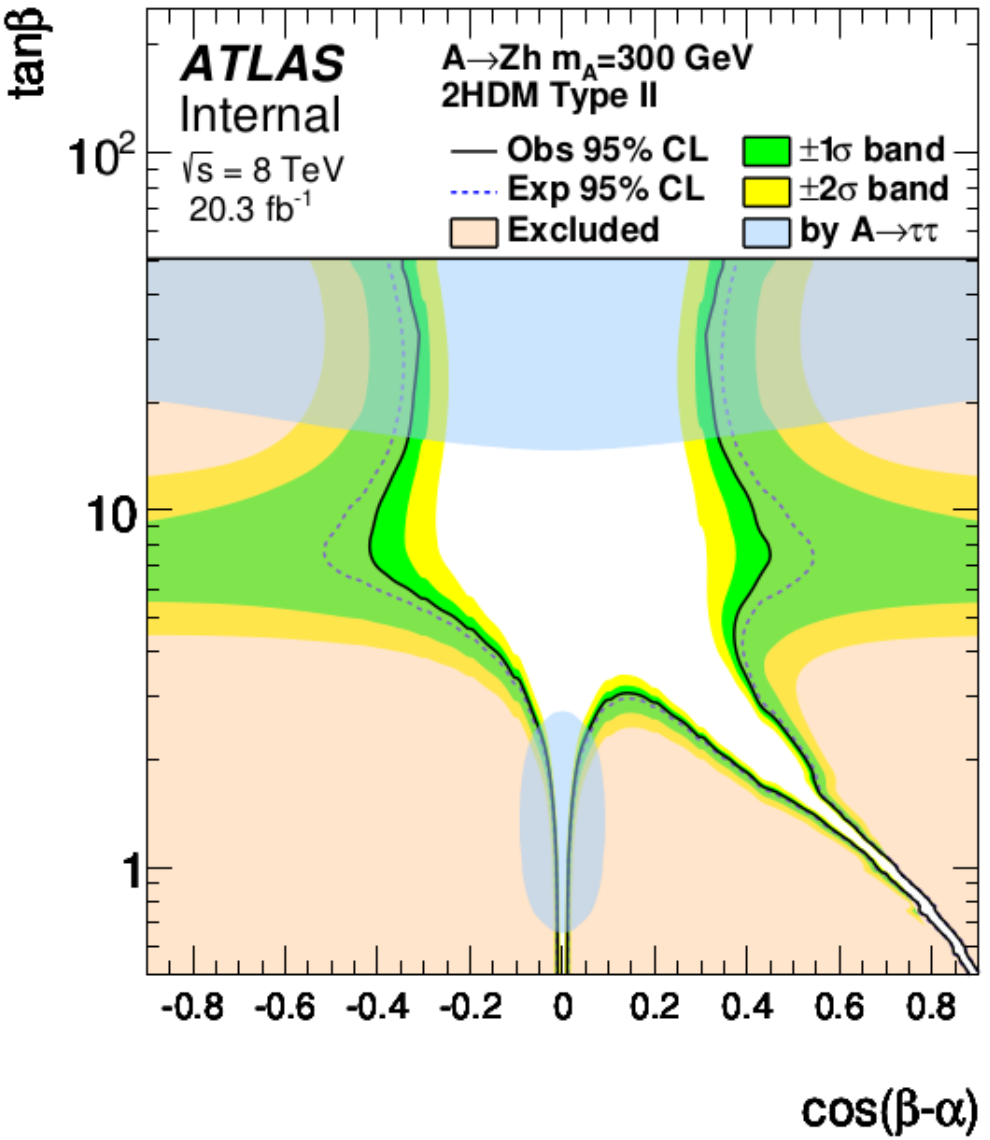
√s = 8 TeV
20.3 fb-1
A→Zh mA=300 GeV
2HDM Type I
Obs 95% CL
Exp 95% CL
Excluded
±1σ band
±2σ band
by A→ττ
tanβ
10²
10
1
-0.8 -0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8
cos(β-α)


ATLAS
Internal
√s = 8 TeV
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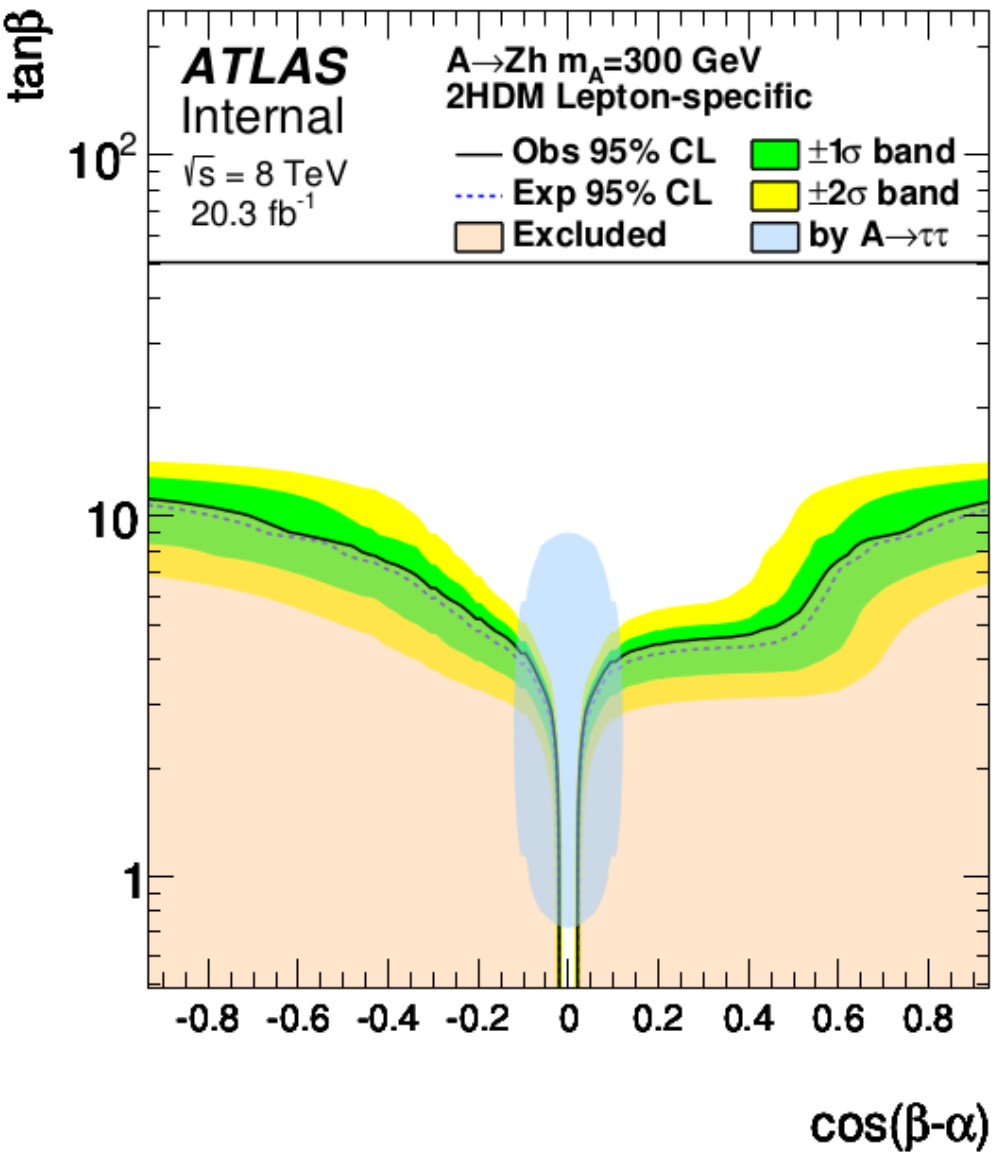
A→Zh mA=300 GeV
2HDM Type II
Obs 95% CL
Exp 95% CL
Excluded
±1σ band
±2σ band
by A→ττ
tanβ
10²
10
1
-0.8 -0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8
cos(β-α)

2HDM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Internal
√s = 8 TeV
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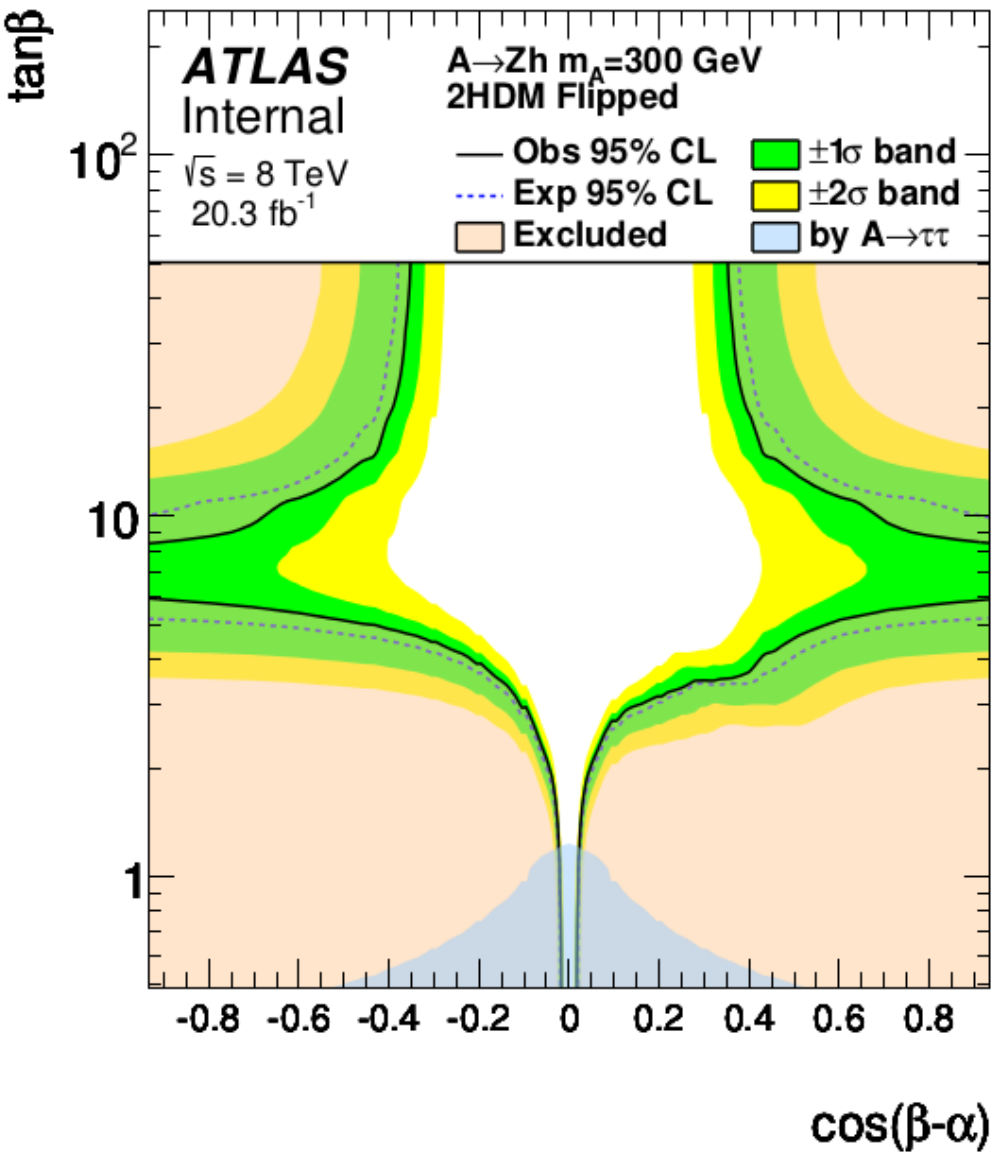
A→Zh mA=300 GeV
2HDM Lepton-specific
Obs 95% CL
Exp 95% CL
Excluded
±1σ band
±2σ band
by A→ττ
tanβ
10²
10
1
-0.8 -0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8
cos(β-α)


ATLAS
Internal
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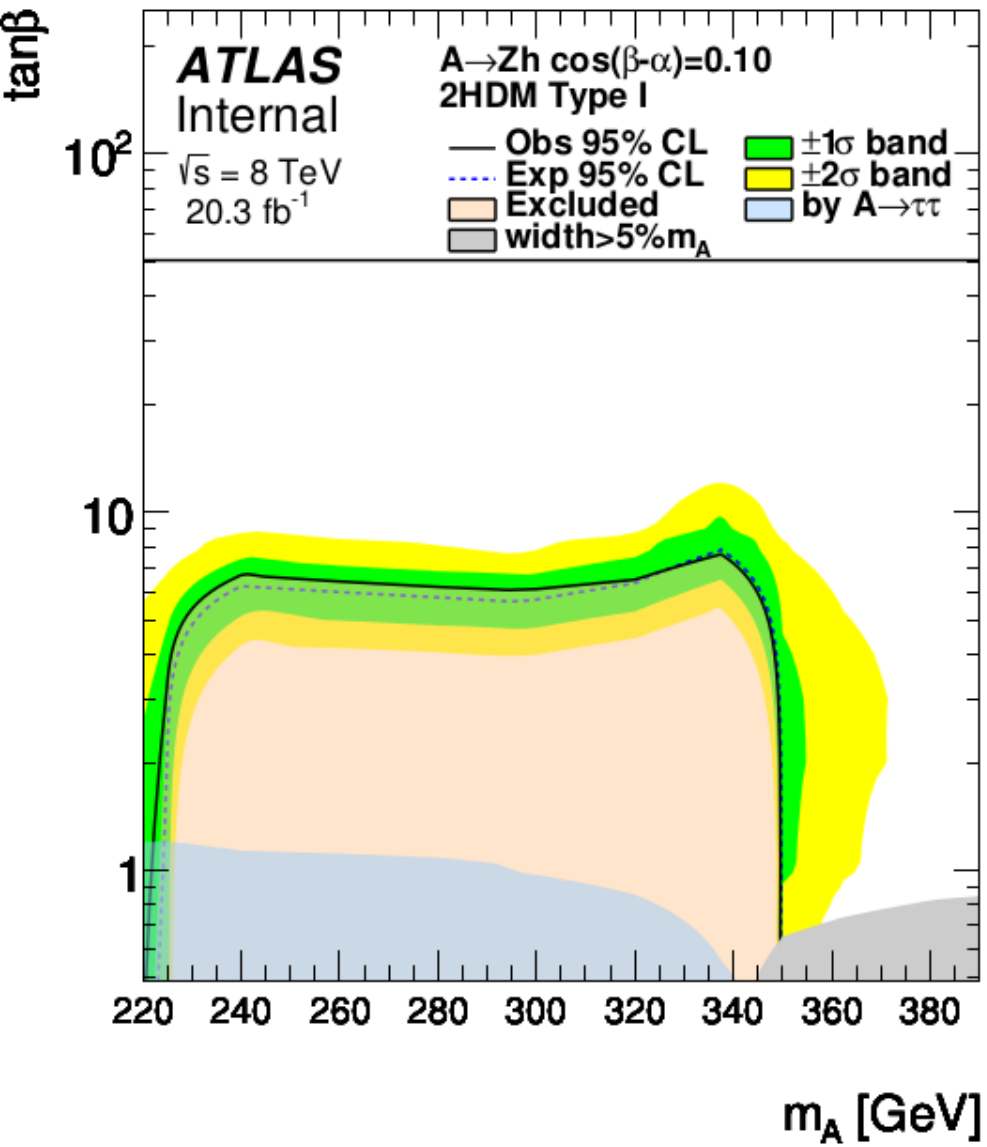
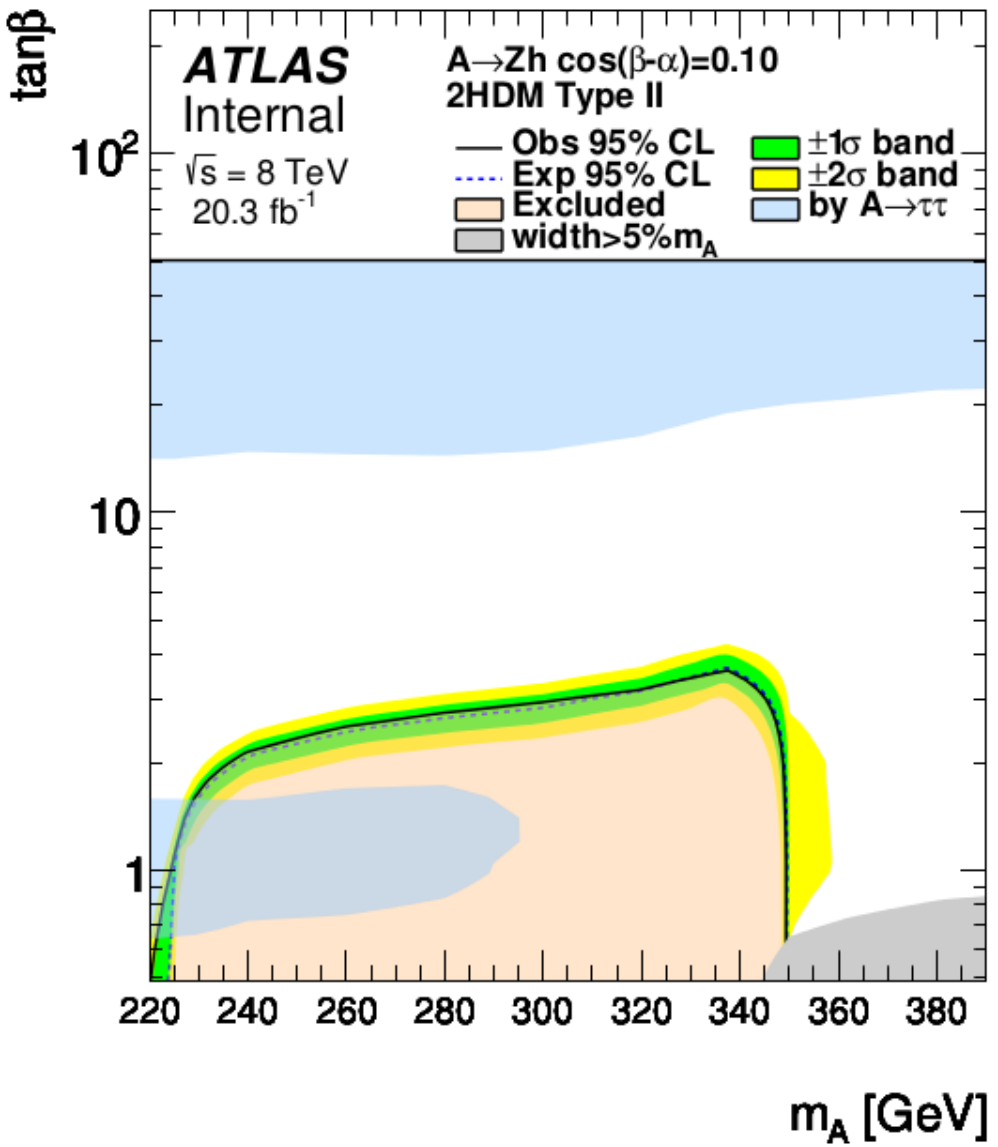
20.3 fb-1
A→Zh mA=300 GeV
2HDM Flipped
Obs 95% CL
Exp 95% CL
Excluded
±1σ band
±2σ band
by A→ττ
tanβ
10²
10
1
-0.8 -0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8
cos(β-α)

2HDM


ATLAS
Internal
√s = 8 TeV
20.3 fb-1
A→Zh cos(β-α)=0.10
2HDM Type I
Obs 95% CL
Exp 95% CL
Excluded
width>5%mA
±1σ band
±2σ band
by A→ττ
tanβ
10²
10
1
220 240 260 280 300 320 340 360 380
mA [GeV]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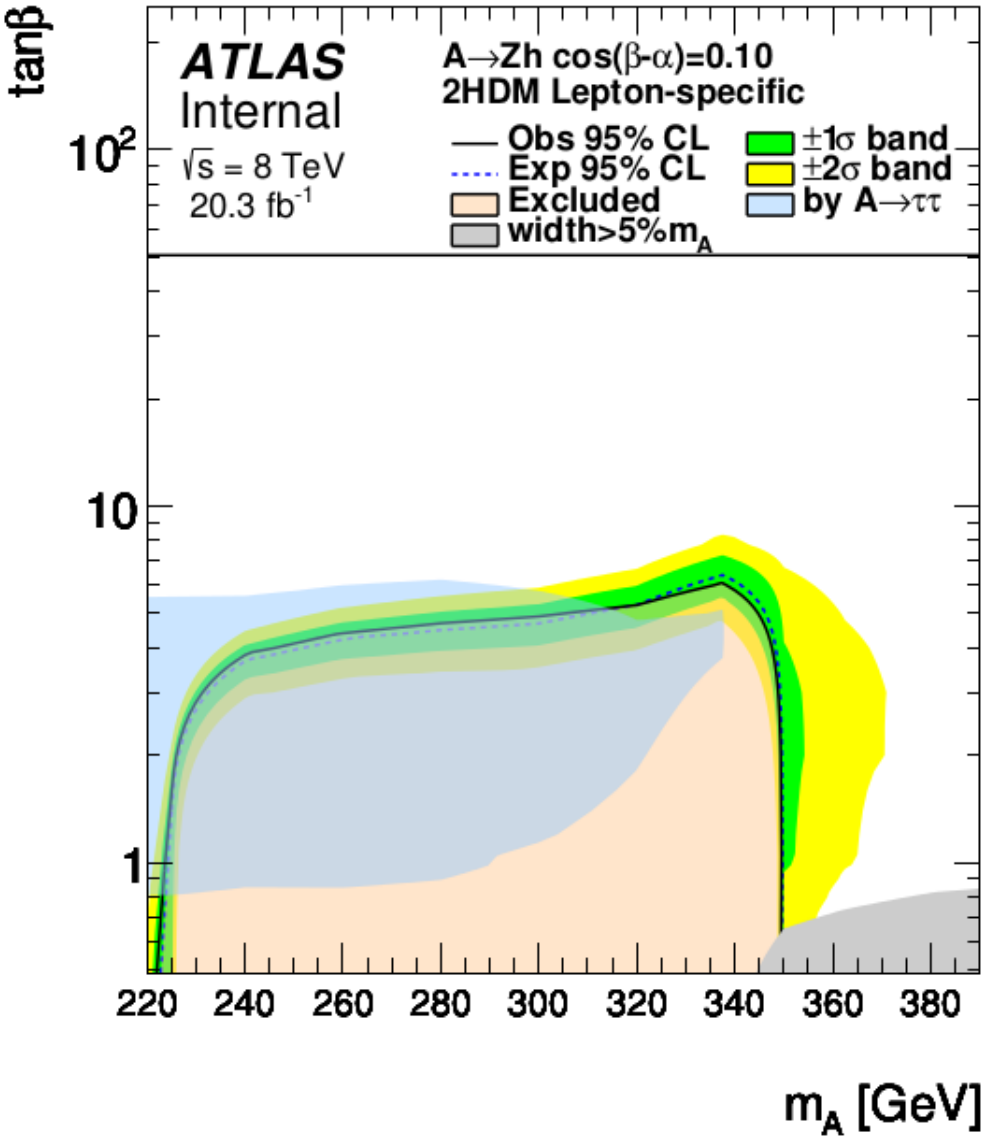
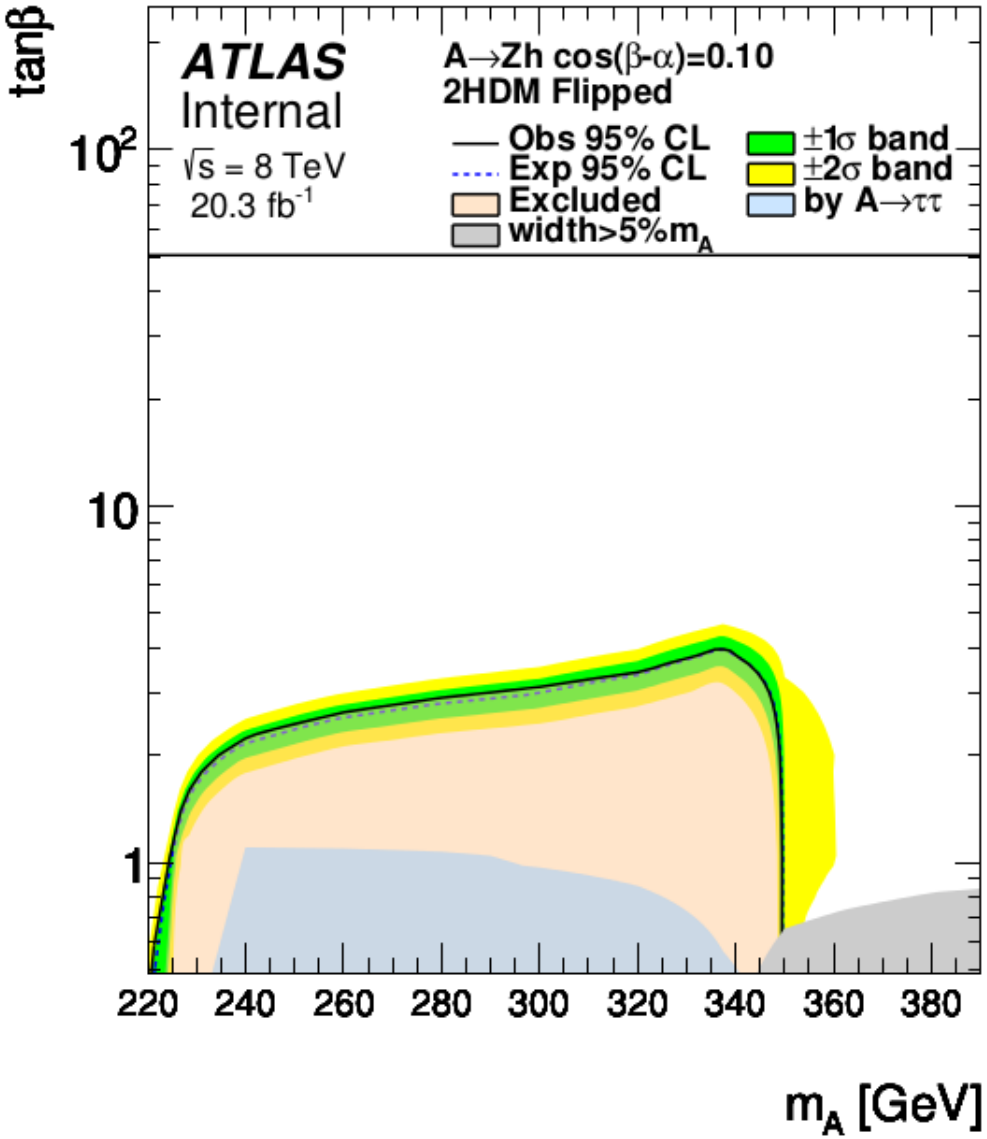
2HDM Type II
Obs 95% CL
Exp 95% CL
Excluded
width>5%mA
±1σ band
±2σ band
by A→ττ
tanβ
10²
10
1
220 240 260 280 300 320 340 360 380
mA [GeV]

2HDM


ATLAS
Internal
√s = 8 TeV
20.3 fb-1
A→Zh cos(β-α)=0.10
2HDM Lepton-specific
Obs 95% CL
Exp 95% CL
Excluded
width>5%mA
±1σ band
±2σ band
by A→ττ
tanβ
10²
10
1
220 240 260 280 300 320 340 360 380
mA [GeV]


ATLAS
Internal
√s = 8 TeV
20.3 fb-1
A→Zh cos(β-α)=0.10
2HDM Flipped
Obs 95% CL
Exp 95% CL
Excluded
width>5%mA
±1σ band
±2σ band
by A→ττ
tanβ
10²
10
1
220 240 260 280 300 320 340 360 380
mA [GeV]

AZh - summary

- 2HDM interpretation plots are made for 300 and 500 GeV, on the planes of tanb vs cos(b-a) and tanb vs mass, covering type I, II, III (lepton-specific) and IV (flipped), all with final cosmetics ready in paper draft
- Branching ratio, width and bbA production effects are properly taken into account in the interpretation
- Only need to check bbA acceptance with the MC samples when they are ready
-
- Quite recent:
- All plots 8 (main body) + 17 (auxiliary) are updated
- Asking for 2nd circulation Monday morning (CERN time)

hh combination - updates

bbbb, bbyy
bbtautau, wwyy

- Updated bbbb workspaces with all mu set to 0, thanks to David
- Extending res combination 500, 800, 1000 GeV, including bbtautau, wwyy and bbbb
- Many thanks to Liron and Junichi:
  - bbH samples request: JOs ready, validated, approved

    https://its.cern.ch/jira/browse/ATLMCPROD-920
  - VBF samples request: LHE & JOs ready, validated, approved

    https://its.cern.ch/jira/browse/ATLMCPROD-957
  - WWyy background samples, in preparation of LHE files

    https://its.cern.ch/jira/browse/ATLMCPROD-974

hh combination - ws status

- A reminder of the workspace updates in last week:
  - bbbb: update with mu=0 in asimov
  - bbyy: no update
  - bbtautau: no update
  - wwyy: no update
- Thank all analyzers for providing the workspaces and welcome to any updates in them

Pull check - nonres

bbbb+bbyy+bbtautau+wwyy

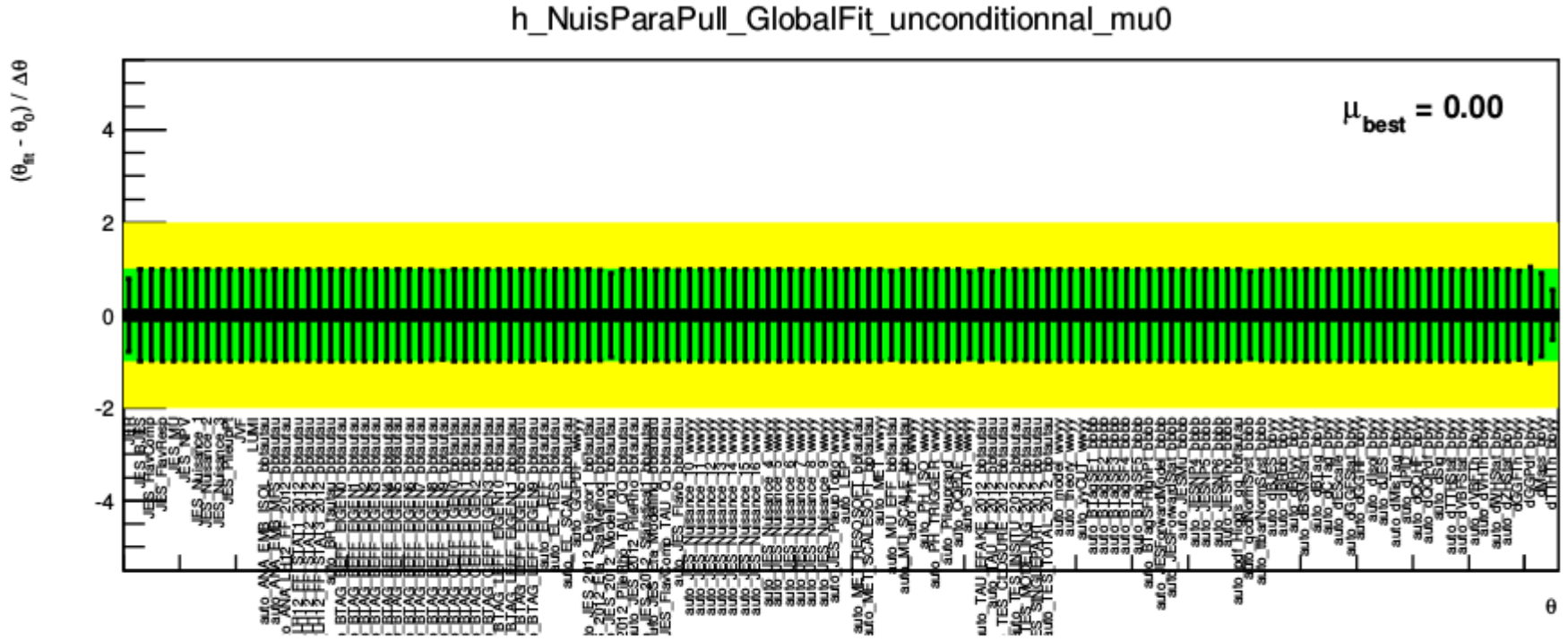
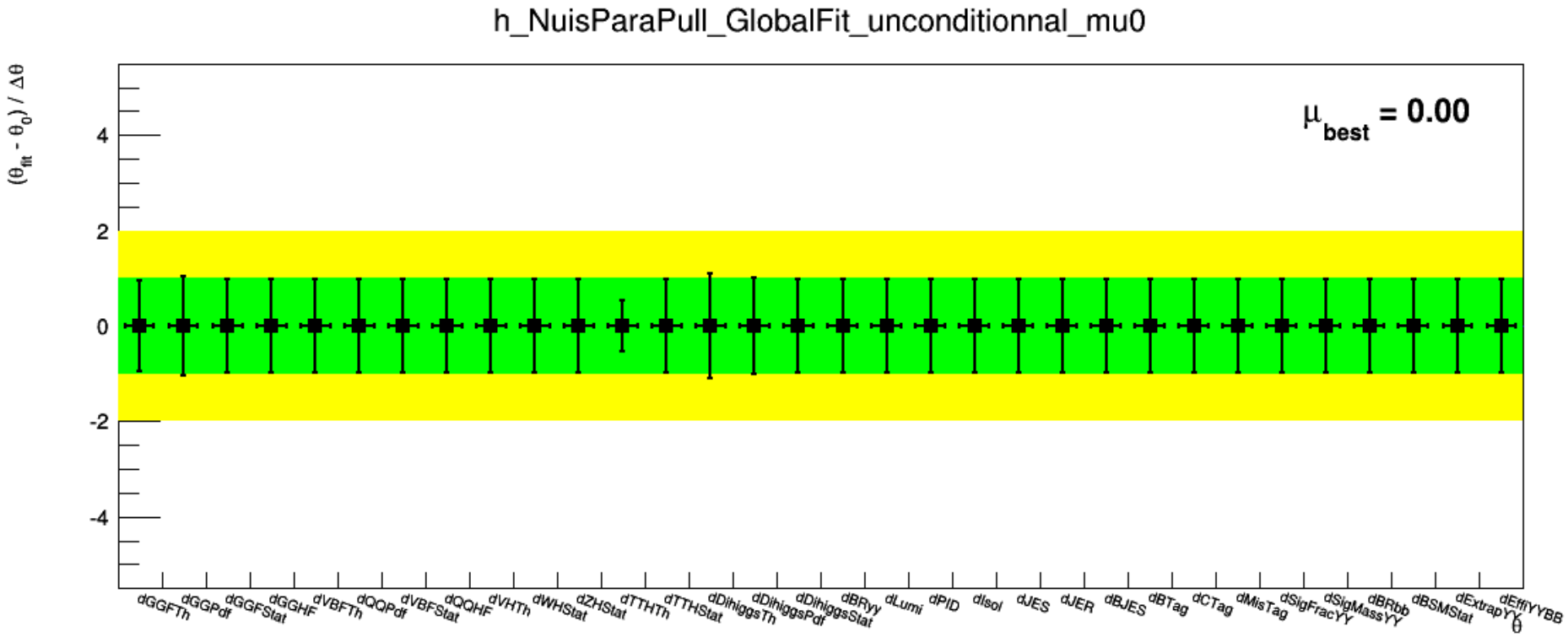


Figure 16: Nuisance parameter pull checks for non-resonance

Pull check - bbyy

bbbb+bbyy+bbtautau+wwyy

look at bbyy-only workspace, tth theo nuisance parameter is constrained



	Cross Section [pb]	Scale up [%]	Scale down [%]
ggh @ 125GeV	19.27	+7.2	-7.8
tth @ 125 GeV	0.1293	+3.8	-9.3

Cross check with Jamie and Jahred, they also see smaller-than-one error from toys

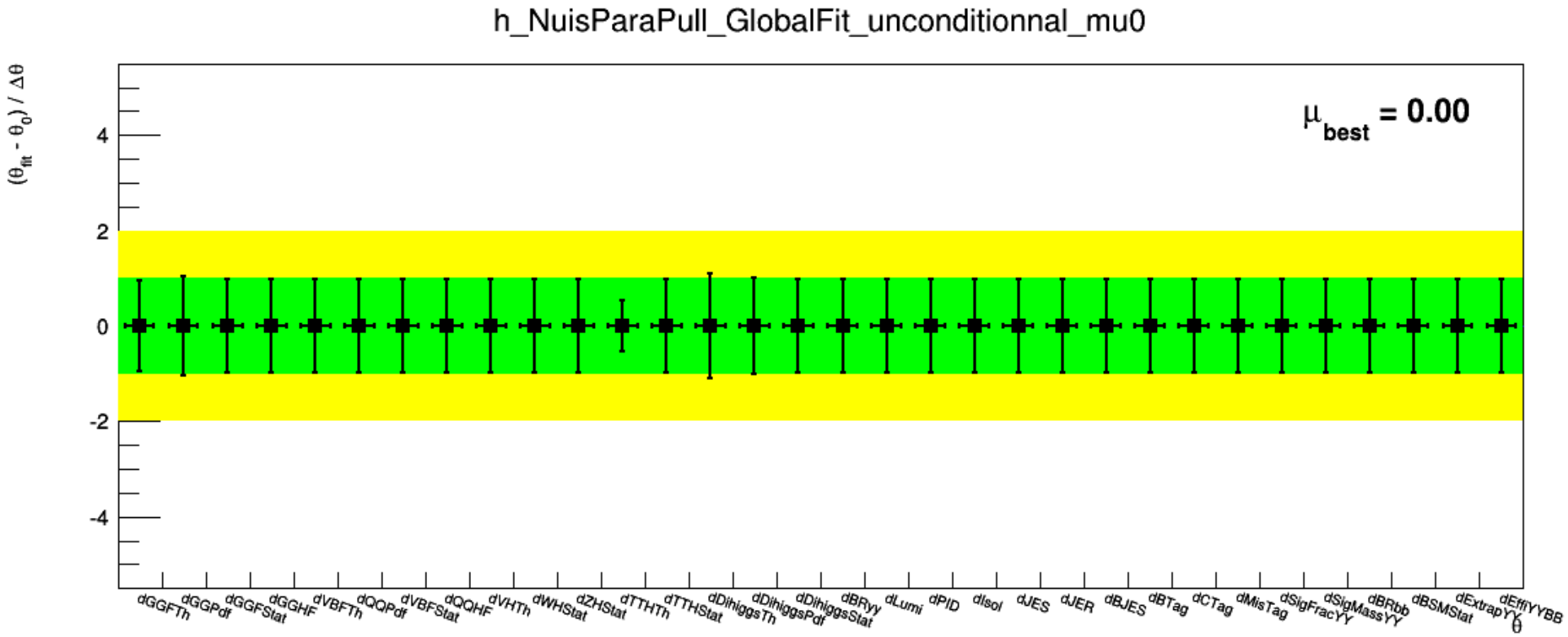
tth is the largest background in bbyy analysis and tth theo uncertainty is the asymmetrically the largest one

it is possible to see the uncertainty is constrained

Pull check - bbyy

bbbb+bbyy+bbtautau+wwyy

look at bbyy-only workspace, tth theo nuisance parameter is constrained



	Cross Section [pb]	Scale up [%]	Scale down [%]
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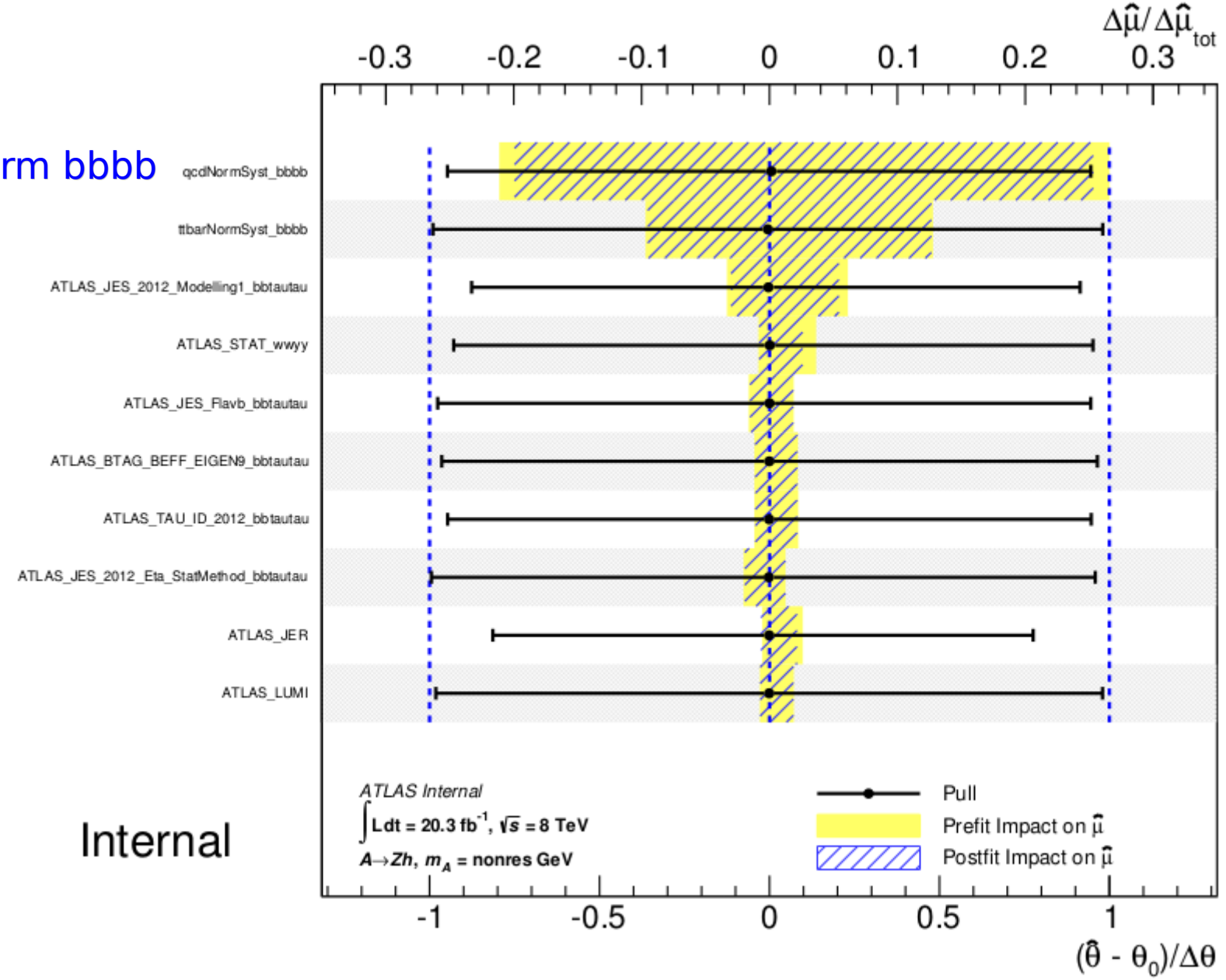
Nuis ranking - nonres

QCD norm bbbb



Internal

Upper limits – nonres

- Expected upper limits [pb] are extracted
- Asymmptotics is implemented

	OBS	EXP	+2sig	+1sig	-1sig	-2sig
bbbb	- *new*	0.594466	1.22212	0.853699	0.428346	0.319065
bbyy	- *new*	1.00546	2.39049	1.52719	0.724492	0.539658
wwyy	- *no change*	6.56869	15.034	9.85594	4.7331	3.52558
bbtautau	- *no change*	1.54221	3.41345	2.2871	1.11125	0.827747
combined	- *new*	0.440961	0.892447	0.631184	0.317737	0.236675

changes are slight due to the updates in bbbb workspace

Pull check – 260 GeV

bbyy+bbtautau+wwyy

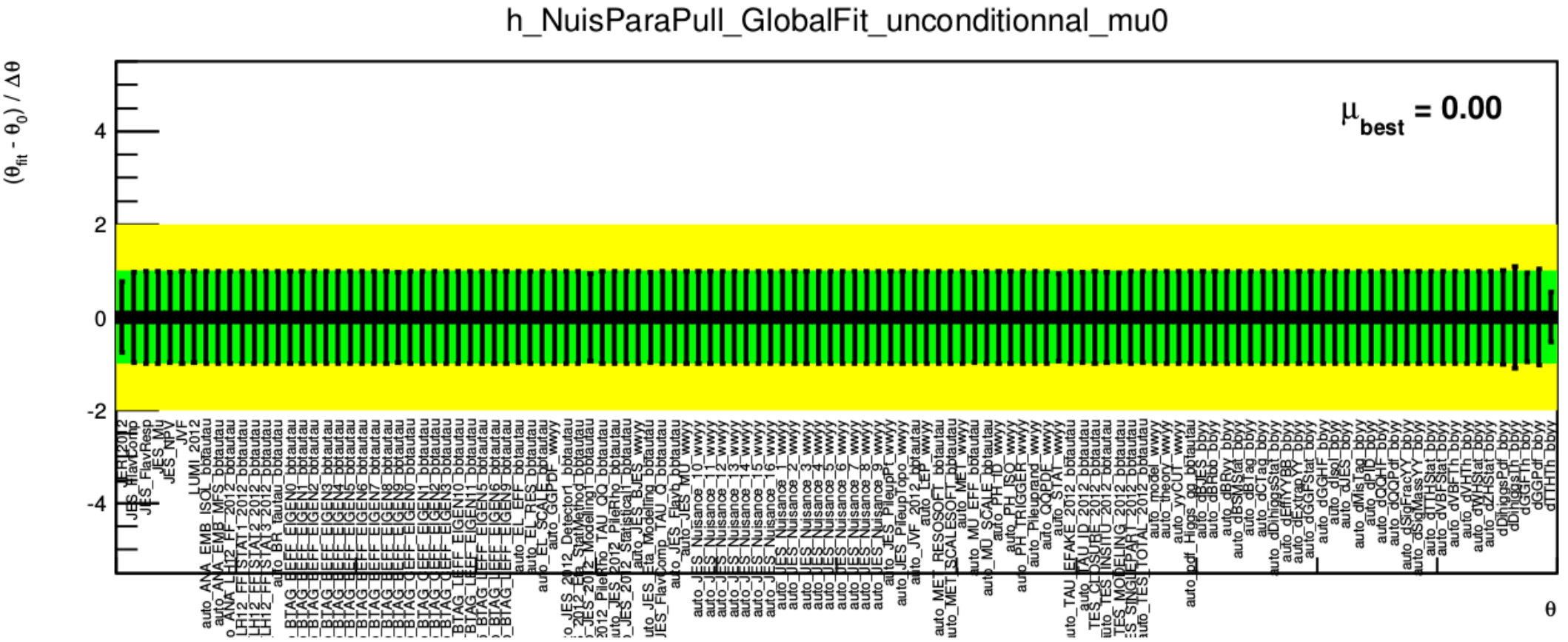


Figure 9: Nuisance parameter pull checks for $m_H = 260$ GeV

Pull check – 300 GeV

bbyy+bbtautau+wwyy

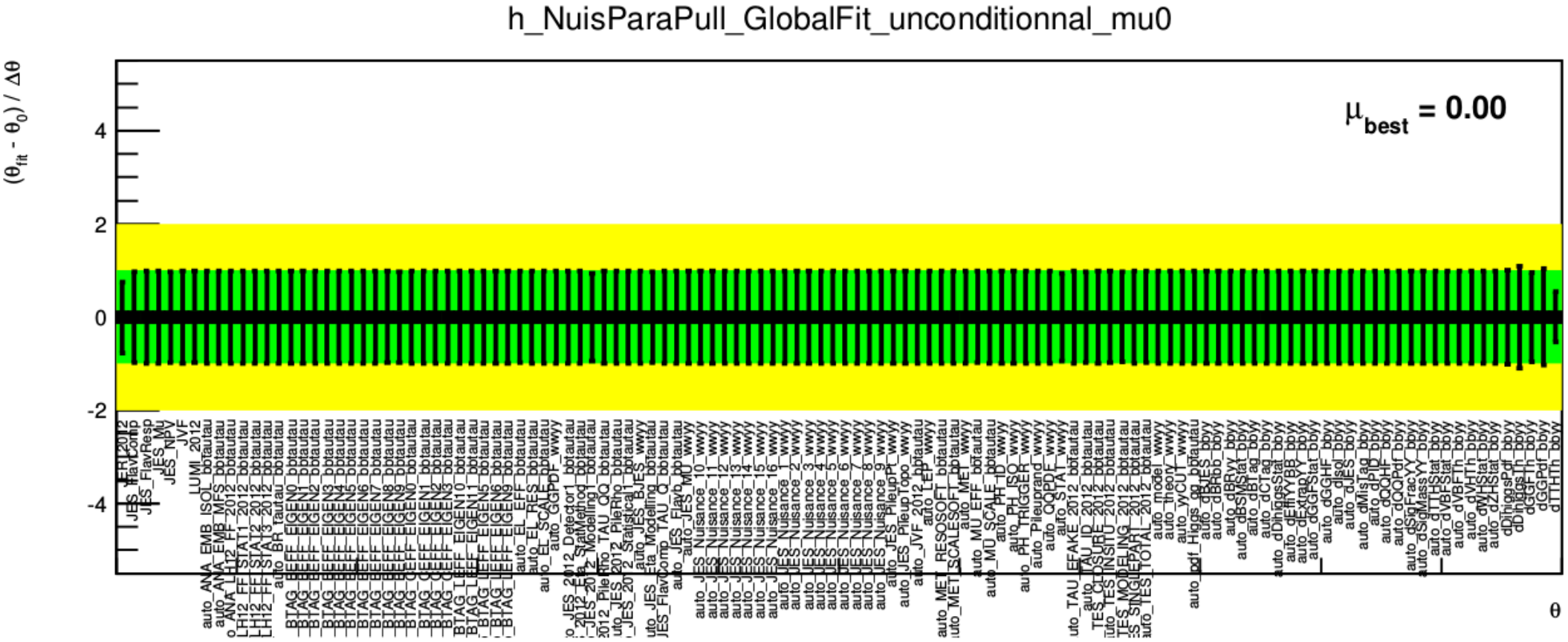


Figure 10: Nuisance parameter pull checks for $m_H = 300$ GeV

Pull check – 350 GeV

bbyy+bbtautau+wwyy

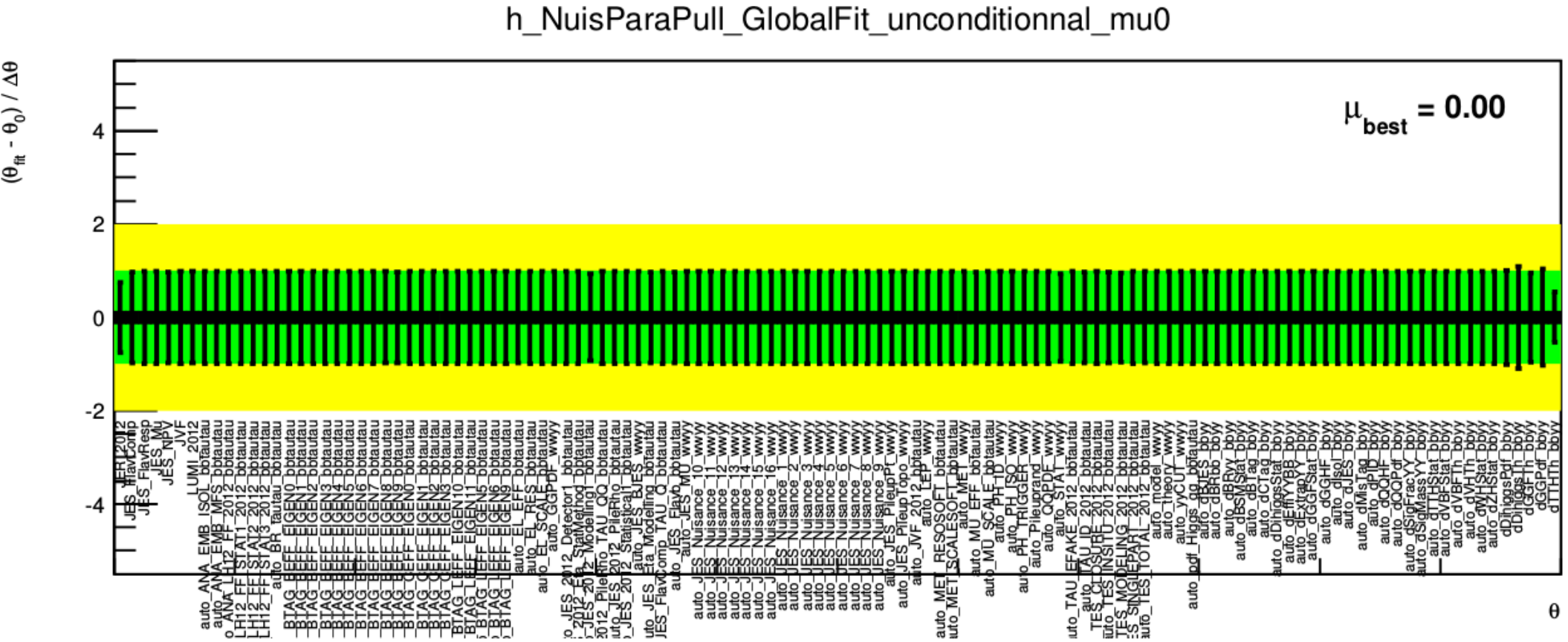


Figure 11: Nuisance parameter pull checks for $m_H = 350$ GeV

Pull check – 400 GeV

bbyy+bbtautau+wwyy

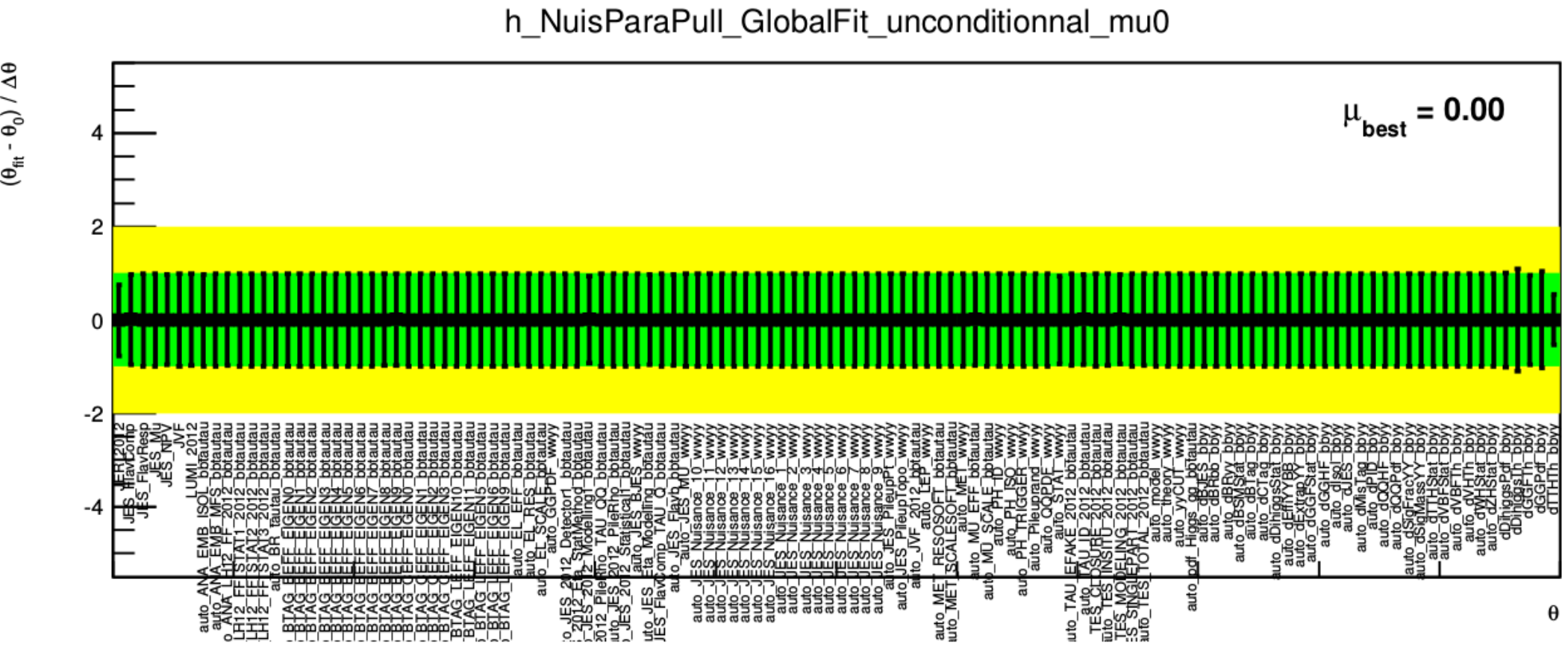


Figure 12: Nuisance parameter pull checks for $m_H = 400$ GeV

Pull check – 500 GeV

bbbb+bbyy+bbtautau+wwyy

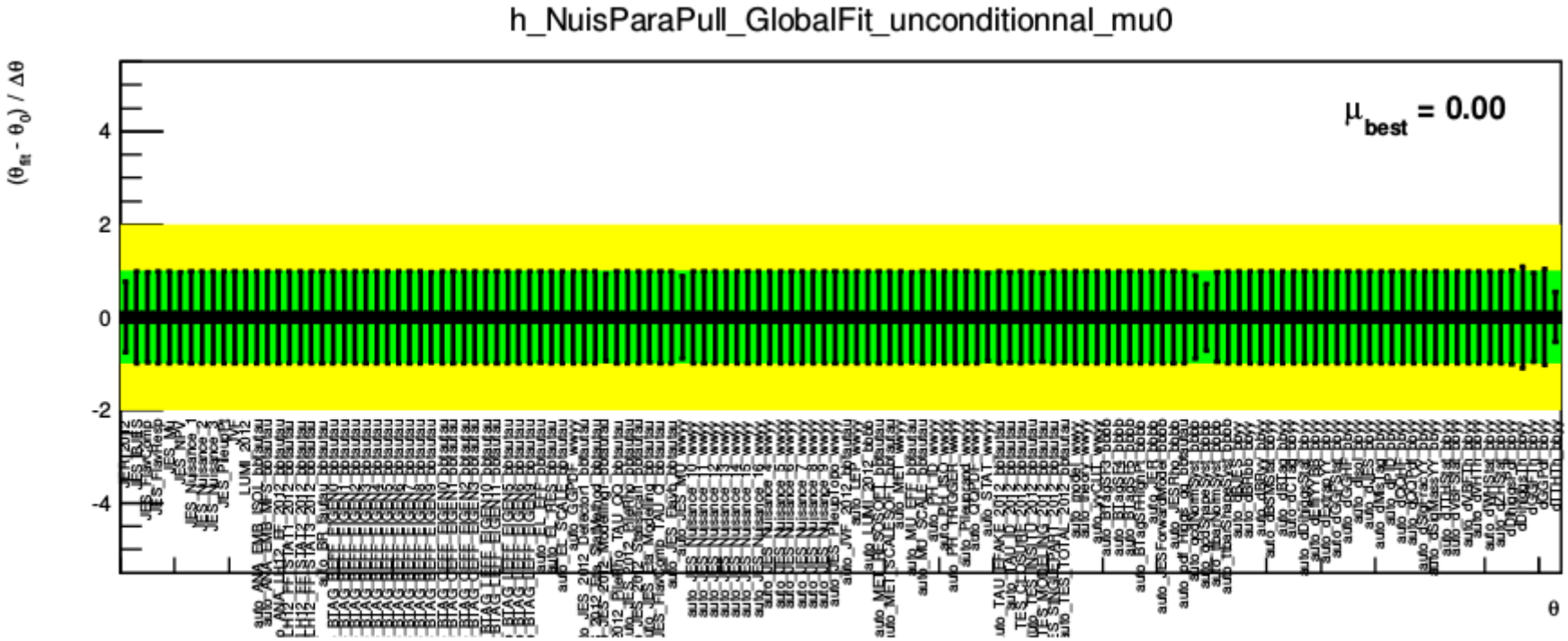


Figure 13: Nuisance parameter pull checks for $m_H = 500$ GeV

Pull check – 800 GeV

bbbb+bbtautau+wwyy

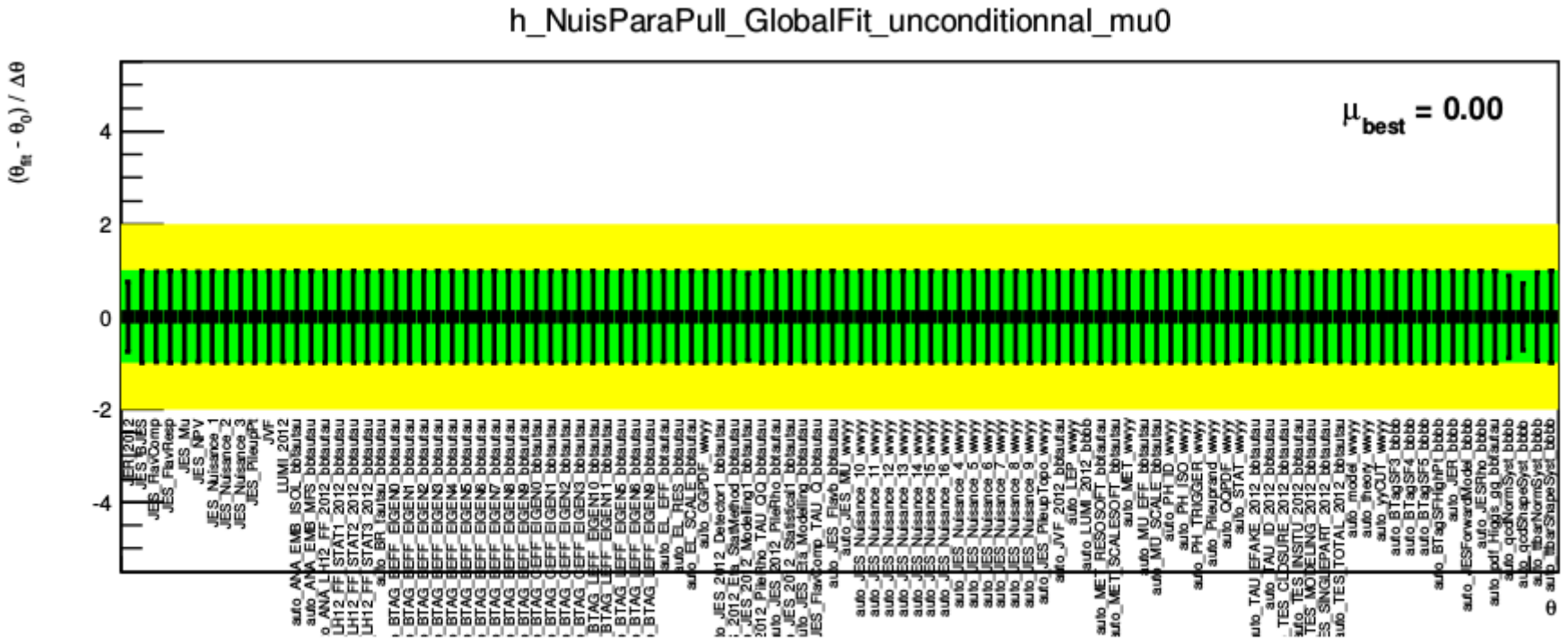


Figure 14: Nuisance parameter pull checks for $m_H = 800$ GeV

Pull check – 1000 GeV

bbbb+bbtautau+wwyy

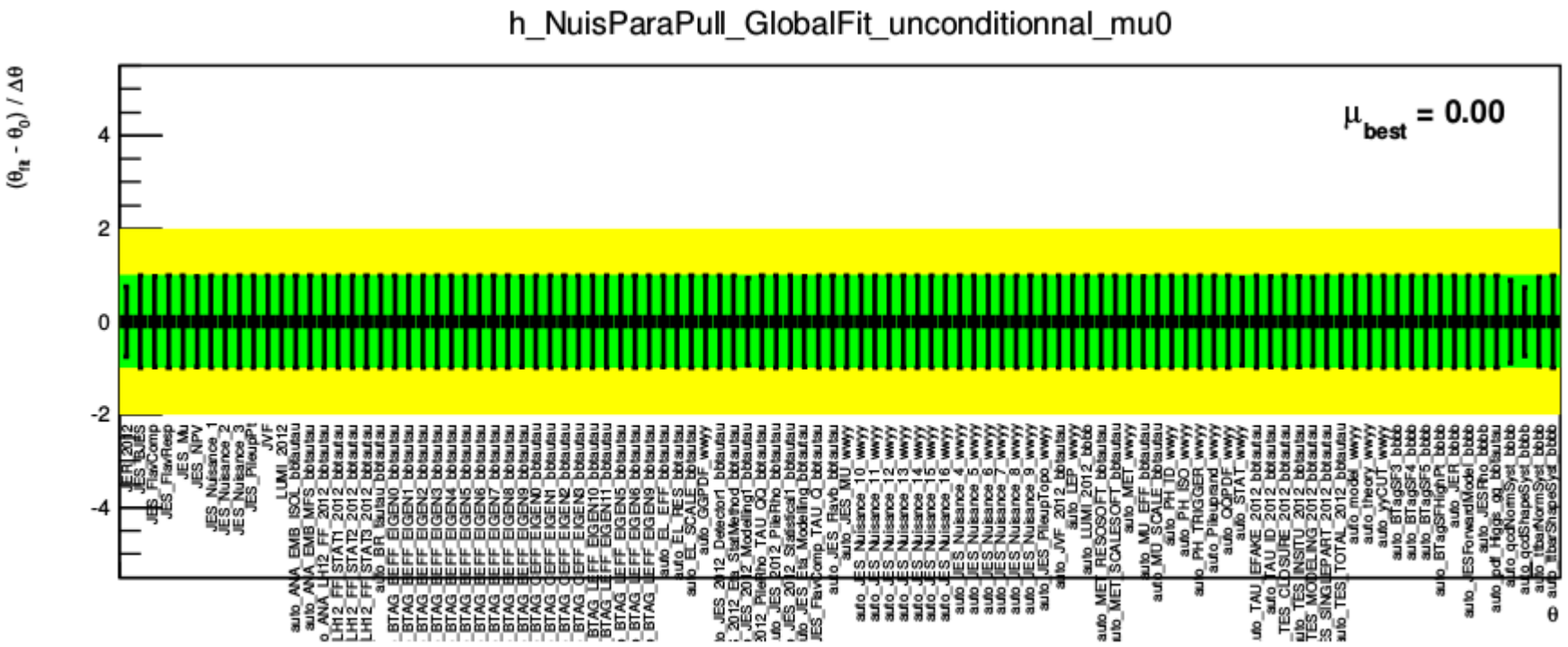


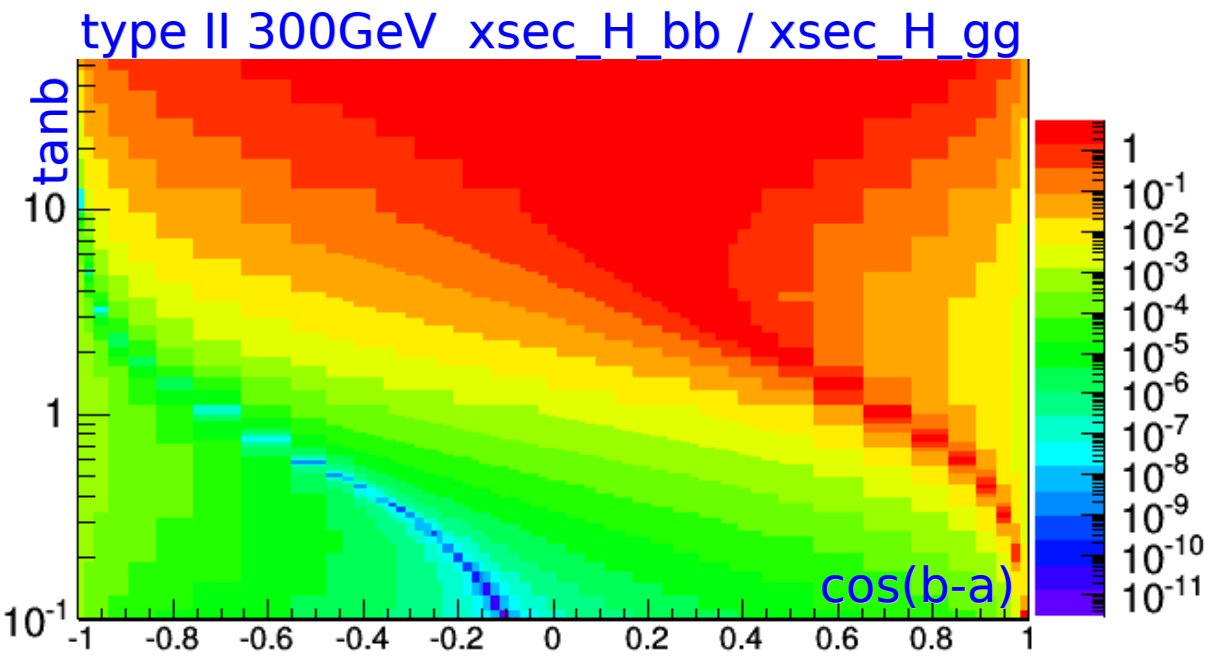
Figure 15: Nuisance parameter pull checks for $m_H = 1000$ GeV

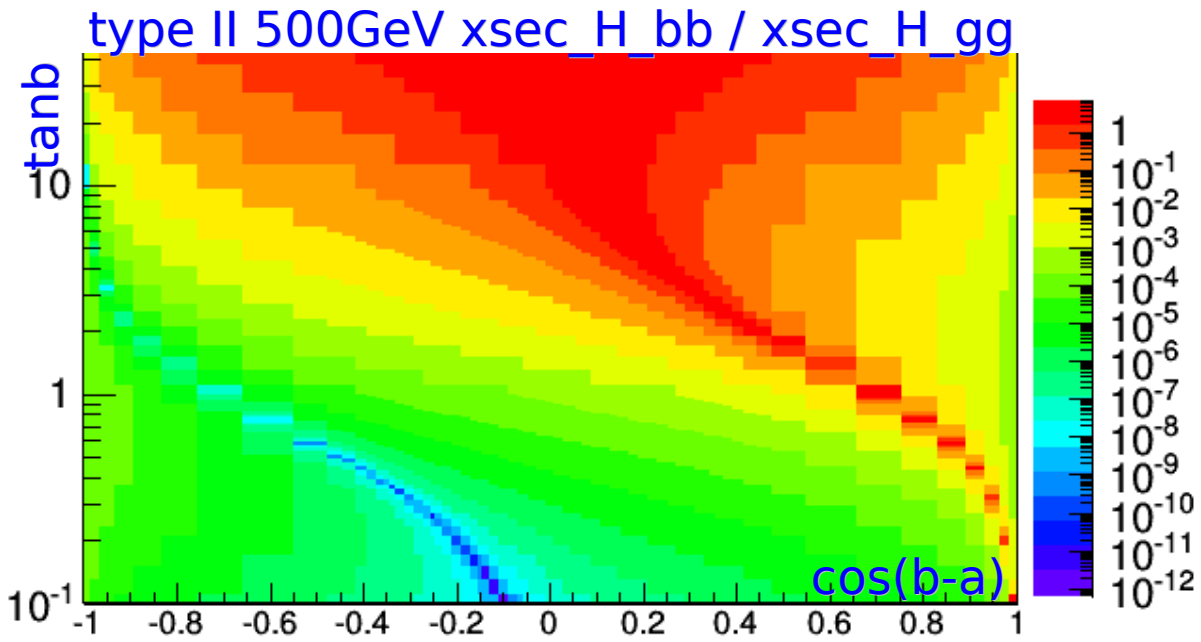
hh combination - summary

- nonres search has all nuisance parameters behaves being understood
- the current nonres expected upper limit is ~0.44 with the main contribution from bbbb
- res searches has all nuisance parameter behaves being understood

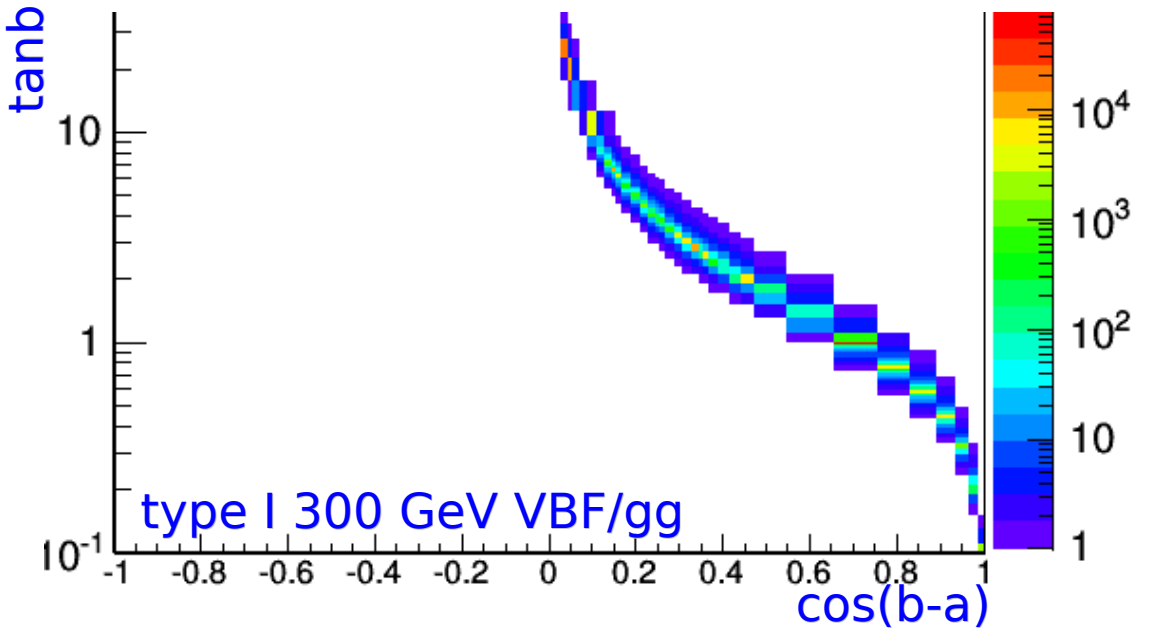
backup

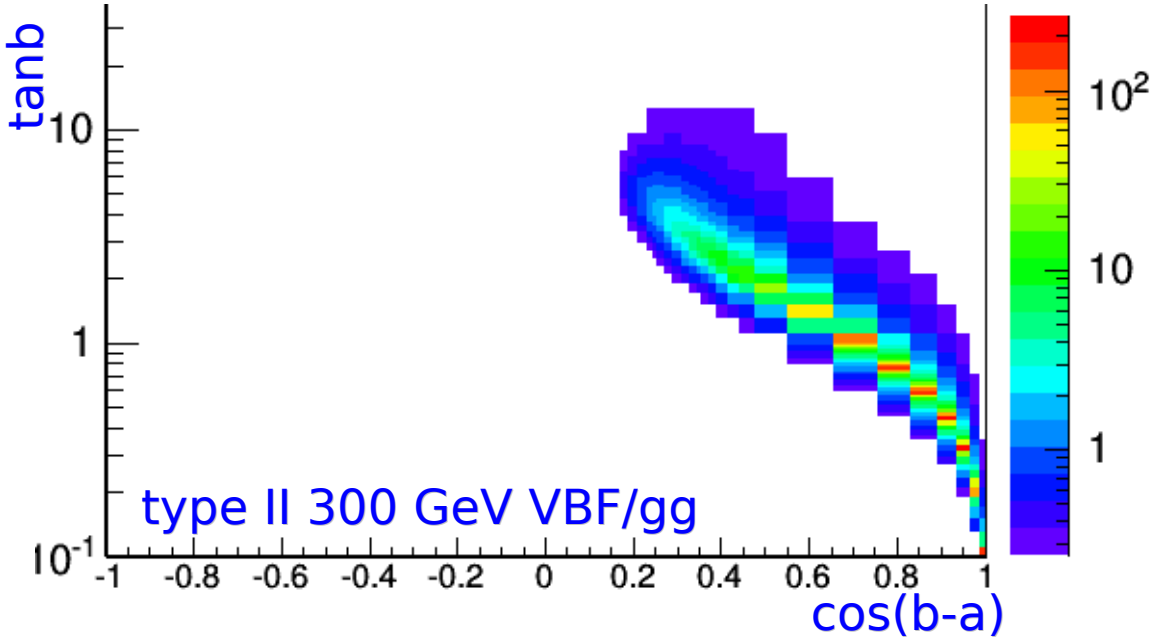
bbH production



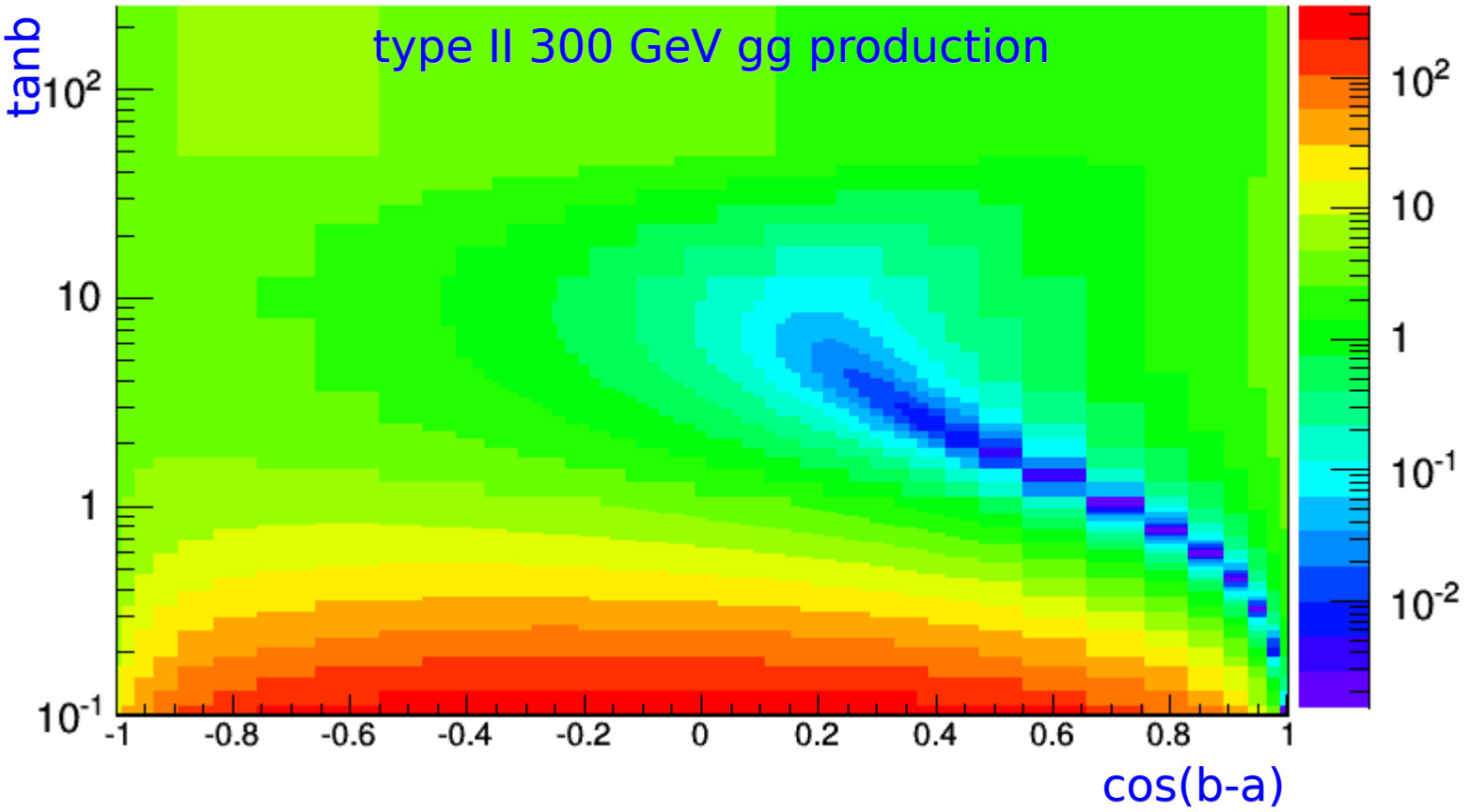


VBF production





gg production



Non-resonance

- Overview of nuisance parameters

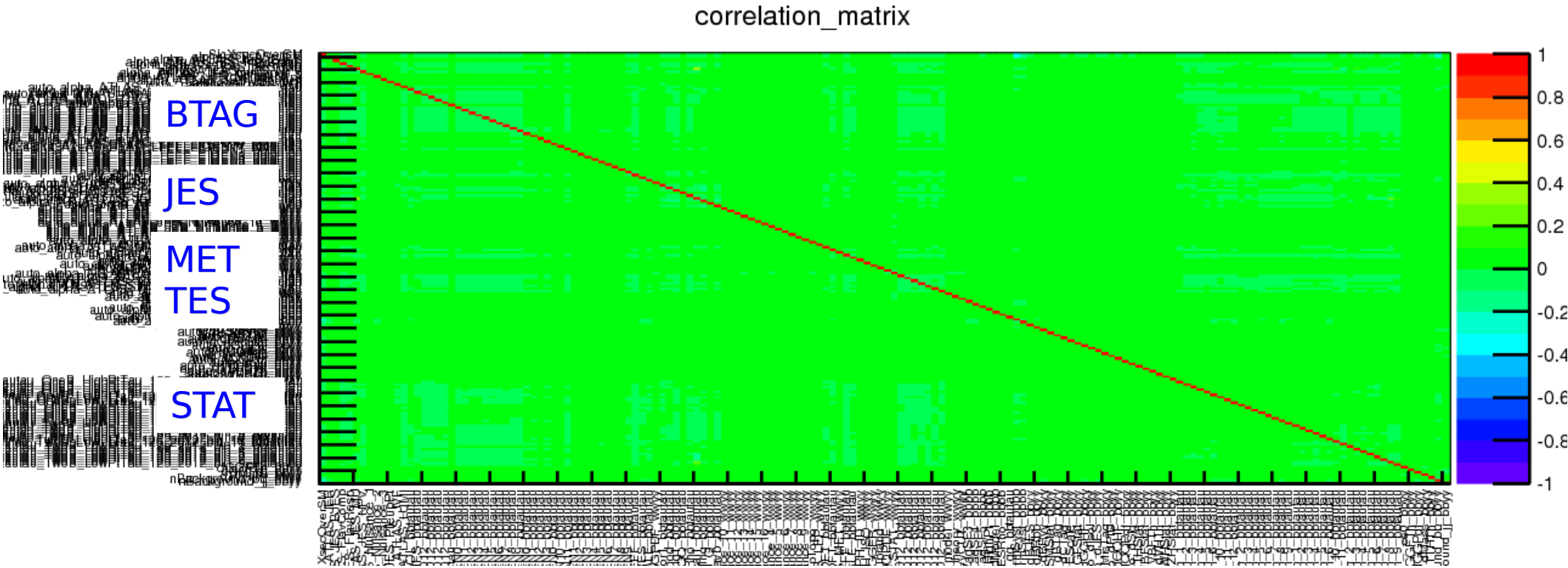
	channel	syst nui	stat nui	total nui
updates	**WWyy**	37	1	38
NEW	**bbtautau**	63	33	96
	bbyy	25	6	31
	bbbb	18	0	18
updates	**combined**	125	40	165

* correlations:

all channels: lumi
wwyy, bbyy/bb: JER (bbtautau no JER?)
wwyy, bbtt/bb: JES_FlavComp, JES_FlavResp, JES_NPV
wwyy, bbtt: JES_Mu, JVF
wwyy, bbbb: JES_BJES, JES_Nuisance_1/2/3, JES_PileupPt

Correlation check - nonres

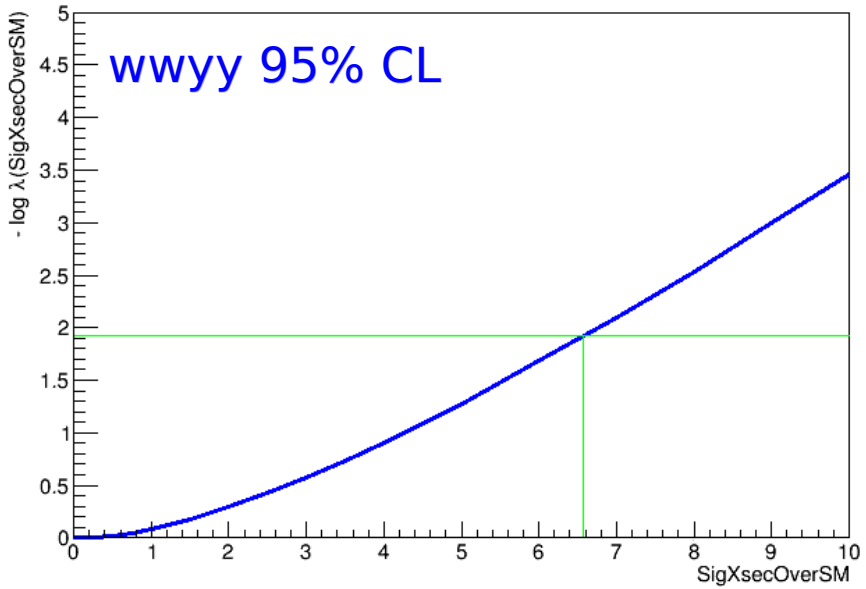
- check correlations in between each nuisance parameter

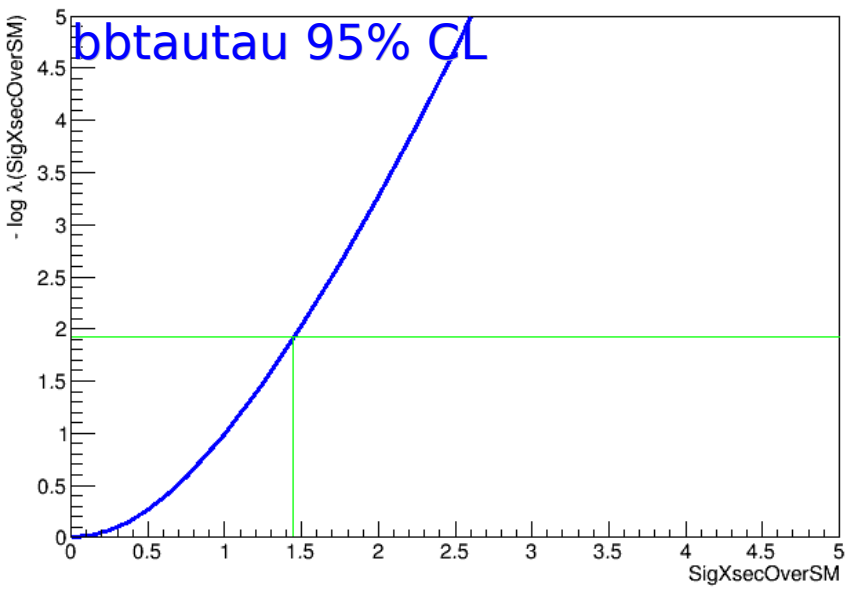


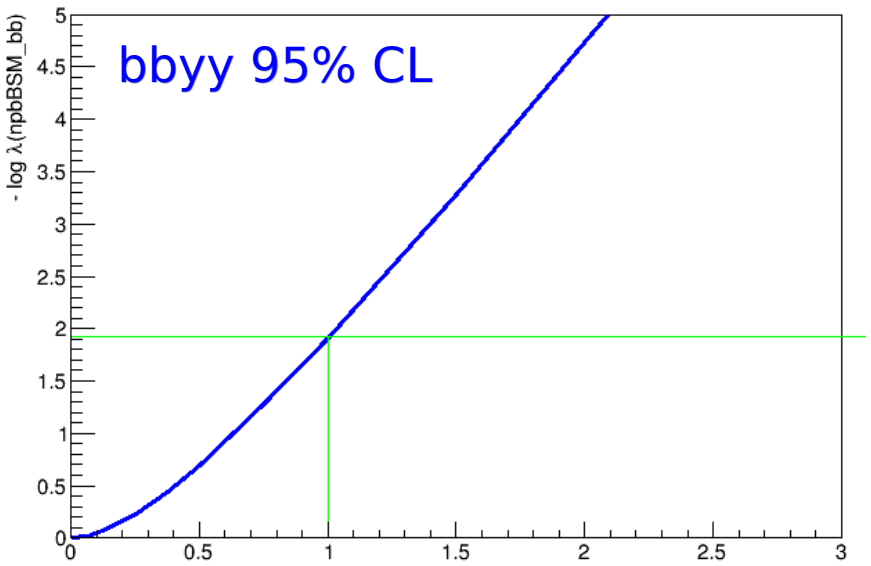
slight higher correlations come
mainly from tautau individual nuisance parameters

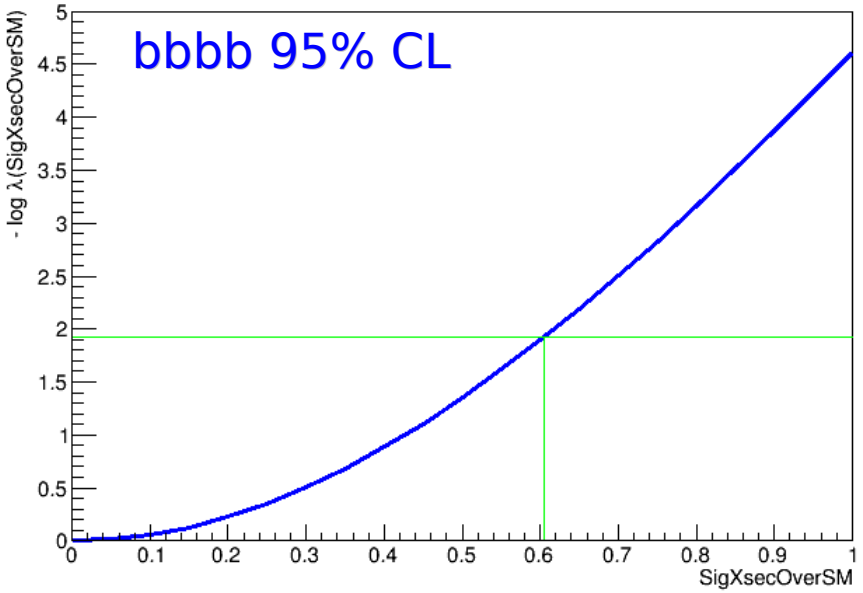
PLR curve check – nonres

- Check the profile likelihood ratio curve for individual channels



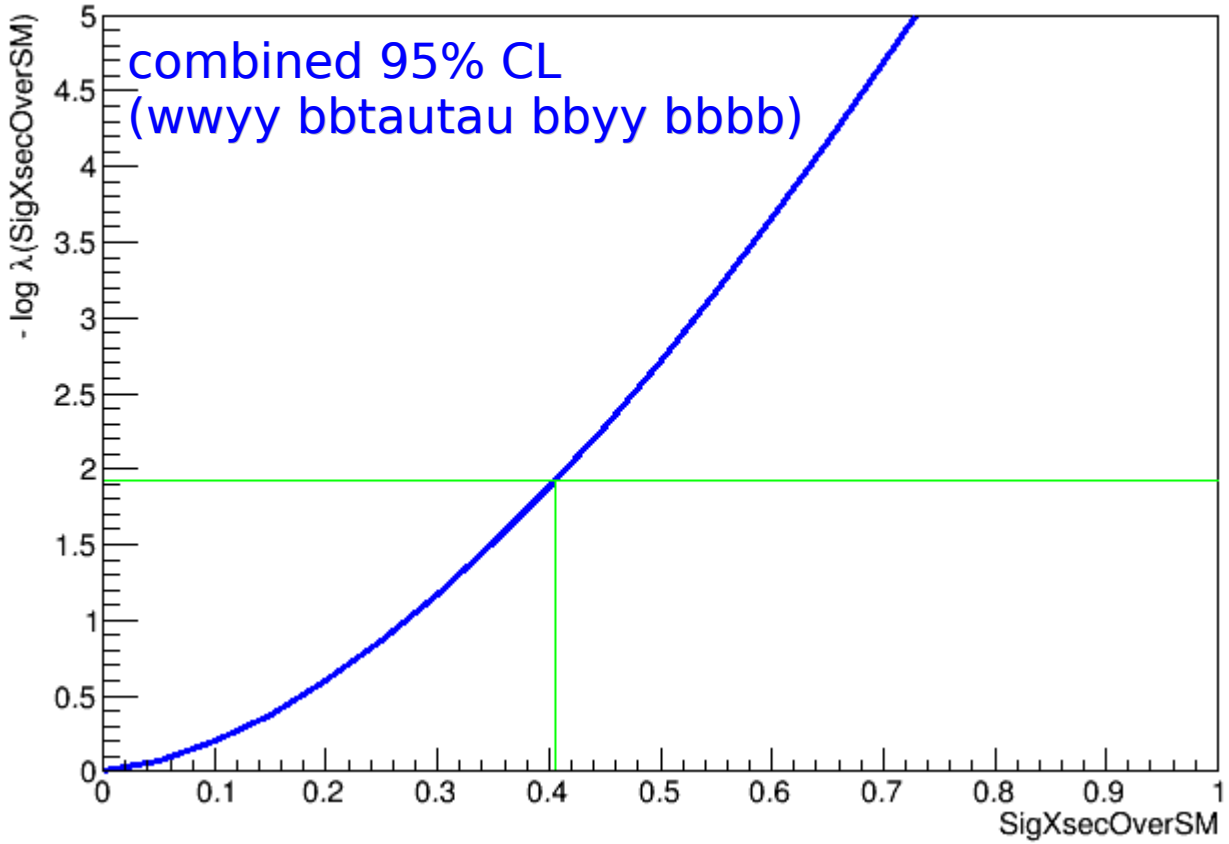






PLR curve check – nonres

- Check the profile likelihood ratio curve for combined



Upper limits – nonres

- Expected upper limits [pb] are extracted

	OBS	EXP	+2sig	+1sig	-1sig	-2sig
bbbb	-	0.594477	1.22232	0.853741	0.428353	0.319071
bbyy	-	1.07251	2.52278	1.62458	0.772804	0.575645
wwyy	-	6.56869	15.034	9.85594	4.7331	3.52558
bbtautau	-	1.50199	3.16927	2.1858	1.08226	0.806155
combined	-	0.454955	0.915959	0.649968	0.32782	0.244186

combined limit exp ~ 0.45 pb on xsec(hh)

Resonance

- Overview on nuisance parameters

channel	syst nui	stat nui	total nui
WWyy	37	1	38
bbtautau	64	26	90
bbyy	26	7	33
bbbb	-	-	-
comb	120	34	154

updates

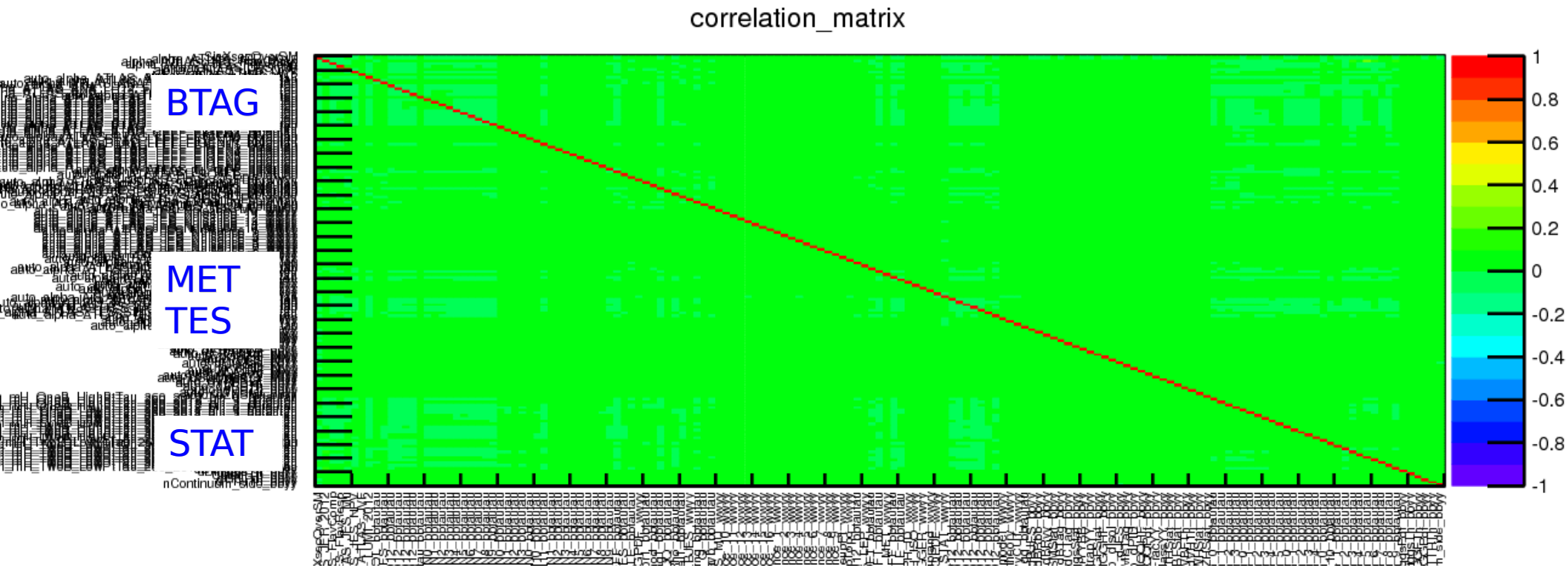
updates

* correlations:

all channels: lumi, JER
wwyy and bbbb: JES_FlavComp, JES_FlavResp, JES_Mu, JES_NPV, JVF

Correlation check - mH260

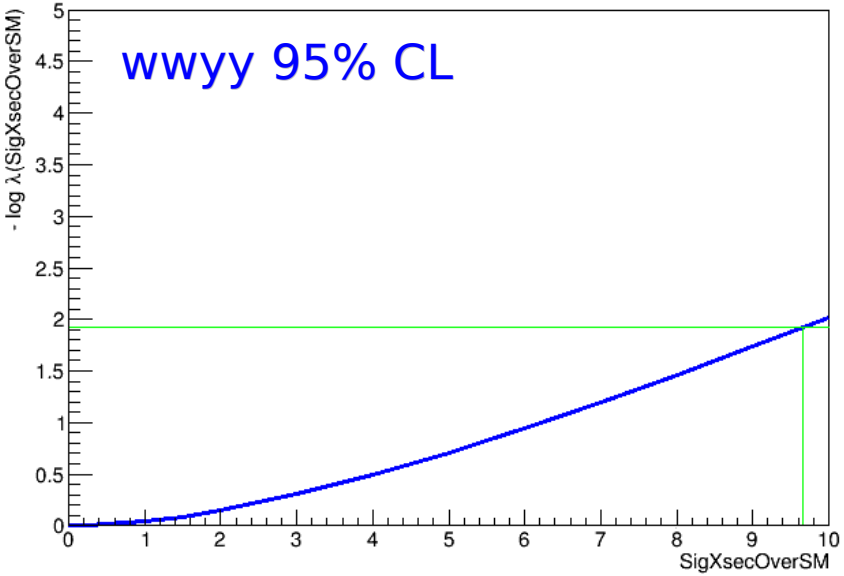
- check correlations in between each nuisance parameter

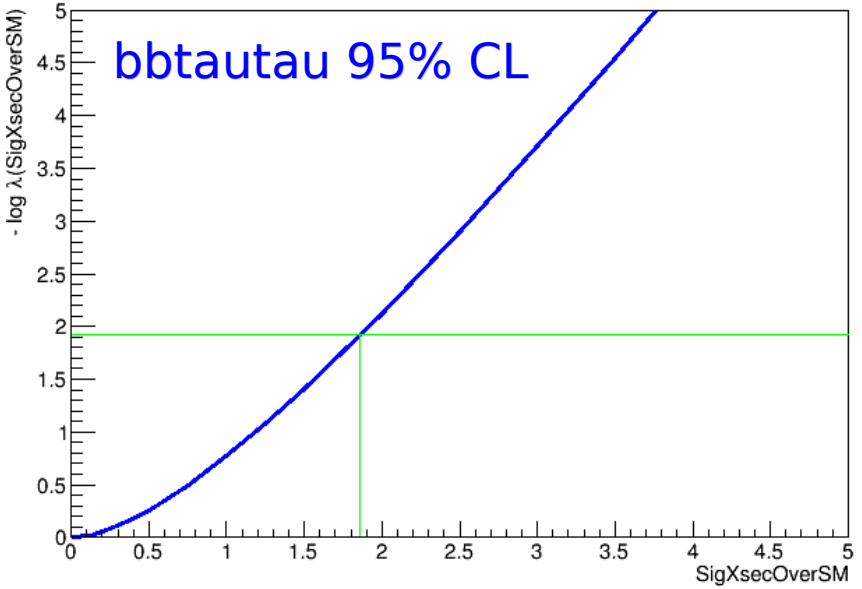


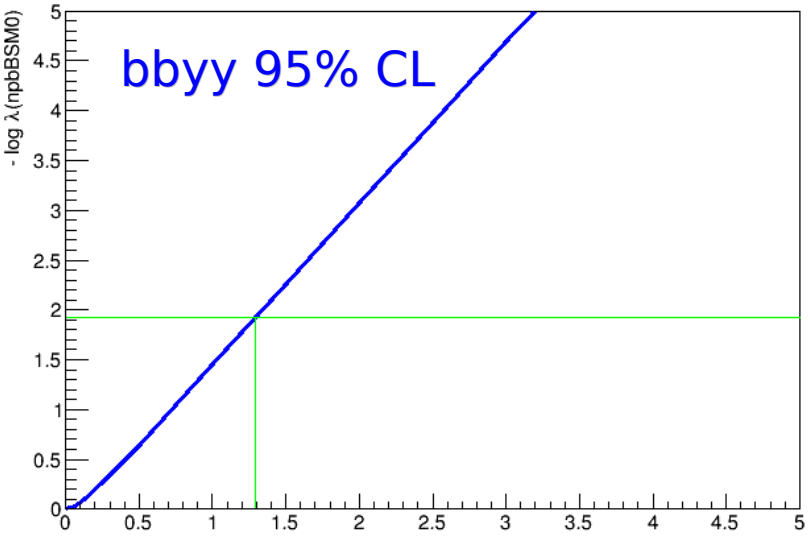
slight higher correlations come
mainly from tautau individual nuisance parameters

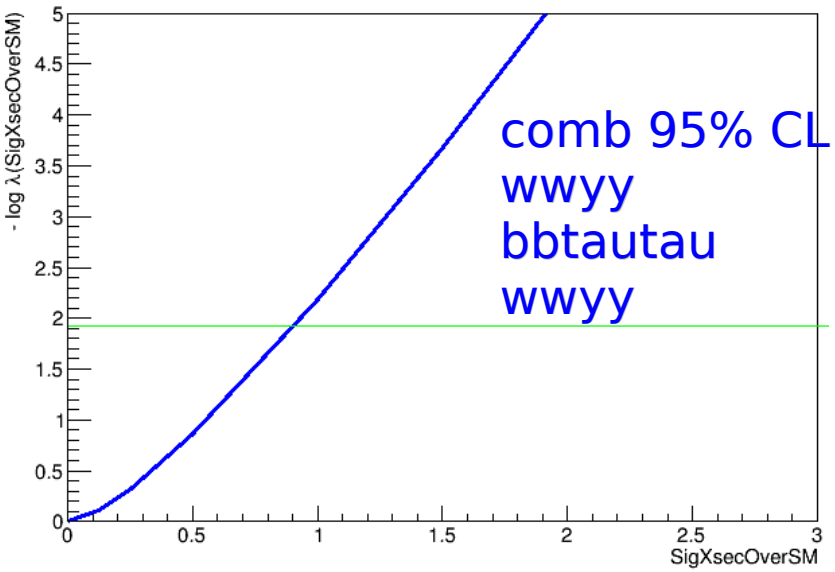
PLR curve check – mH260

- Check the profile likelihood ratio curve for individual channels

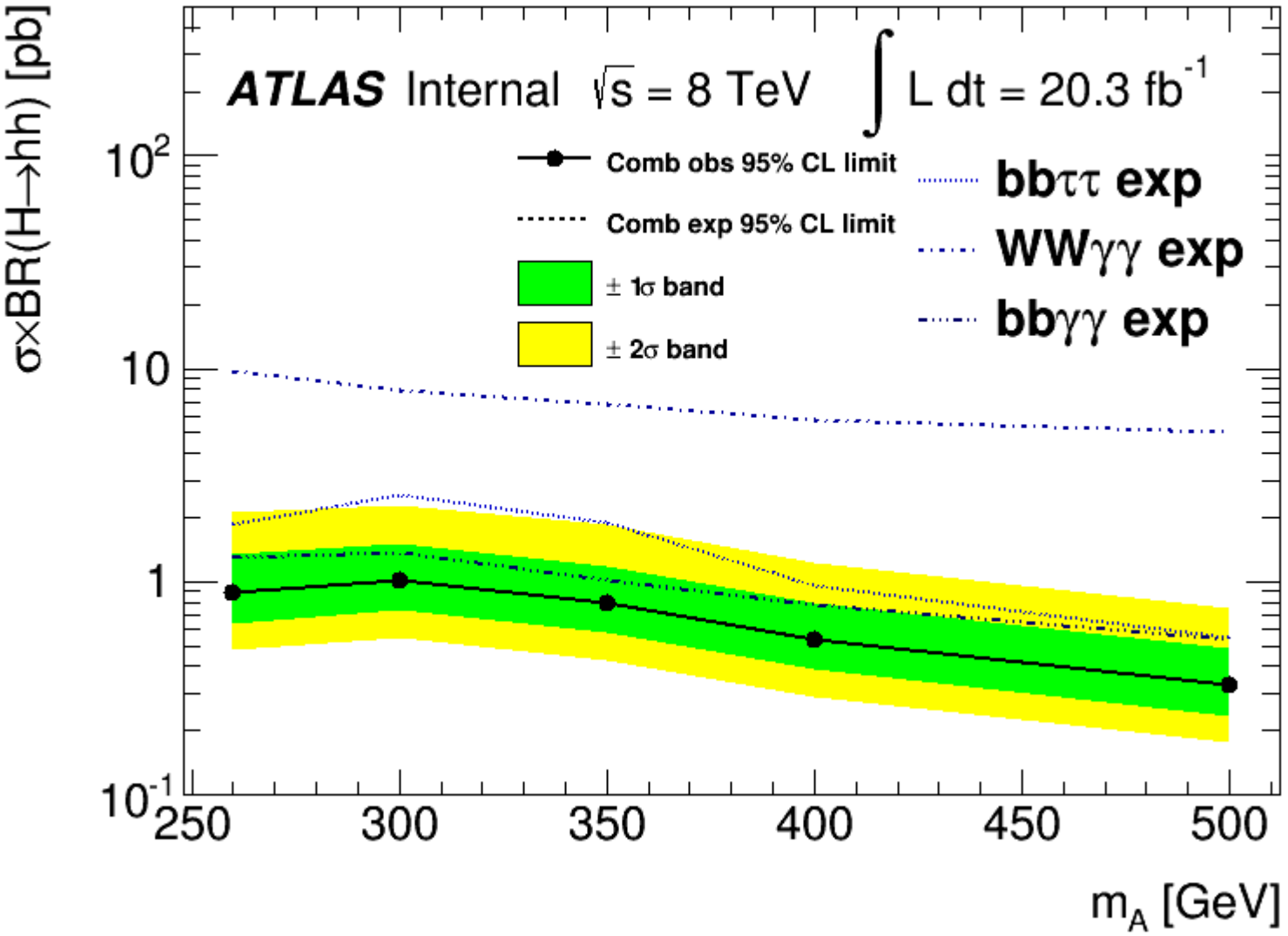








Expected upper limits – res



Interpretations

- Some thoughts in advance to the stage of interpretation
- 2HDM and others ...
- the branching ratios: light Higgs h->yy/WW/bb/tautau
- the width effects:
- b-associated production: preparing JO for all channels
- overlay with AZh or A->tt or others from H->WW/ZZ etc.

$y_{\mathrm{2HDM}}/y_{\mathrm{SM}}$	2HDM 1	2HDM 2	2HDM 3	2HDM 4
HVV	$c_{\beta-\alpha}$	$c_{\beta-\alpha}$	$c_{\beta-\alpha}$	$c_{\beta-\alpha}$
HQu	$c_{\beta-\alpha} - s_{\beta-\alpha}/t_\beta$	$c_{\beta-\alpha} - s_{\beta-\alpha}/t_\beta$	$c_{\beta-\alpha} - s_{\beta-\alpha}/t_\beta$	$c_{\beta-\alpha} - s_{\beta-\alpha}/t_\beta$
HQd	$c_{\beta-\alpha} - s_{\beta-\alpha}/t_\beta$	$c_{\beta-\alpha} + t_\beta s_{\beta-\alpha}$	$c_{\beta-\alpha} - s_{\beta-\alpha}/t_\beta$	$c_{\beta-\alpha} + t_\beta s_{\beta-\alpha}$
HLe	$c_{\beta-\alpha} - s_{\beta-\alpha}/t_\beta$	$c_{\beta-\alpha} + t_\beta s_{\beta-\alpha}$	$c_{\beta-\alpha} + t_\beta s_{\beta-\alpha}$	$c_{\beta-\alpha} - s_{\beta-\alpha}/t_\beta$