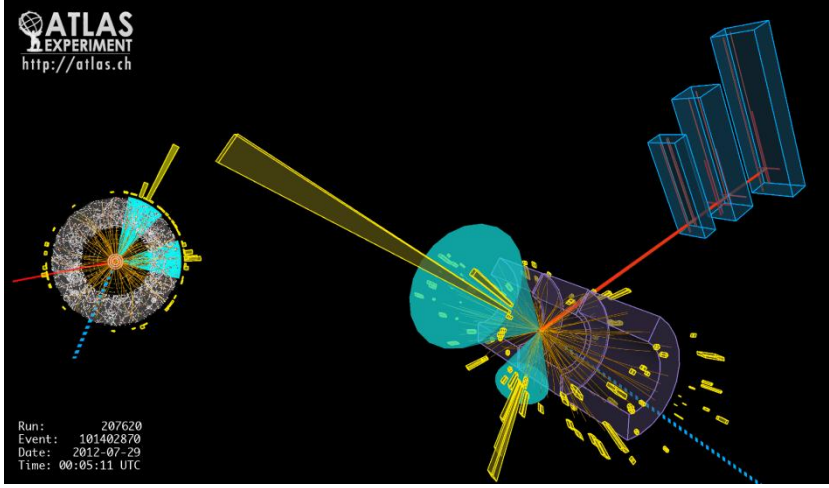


Search for $b\bar{b}$ decay of Higgs associated with a vector boson at ATLAS

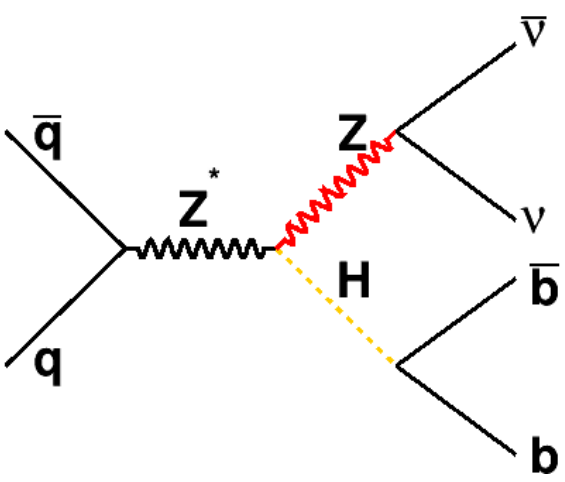
Lei Zhang

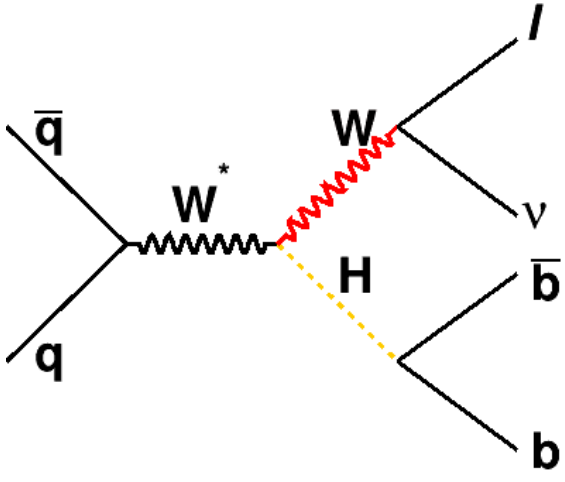
on behalf of ATLAS collaboration

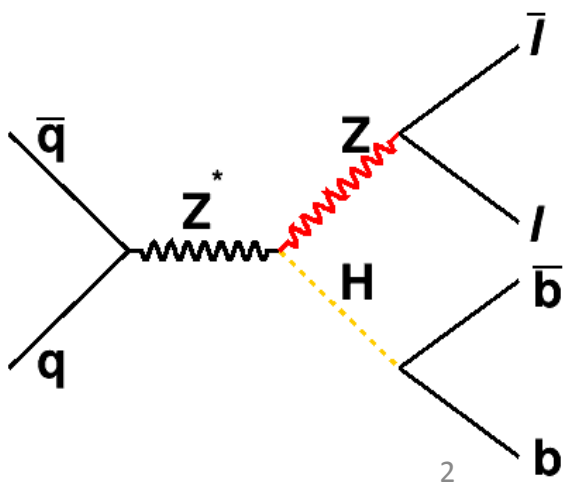
International Symposium on Higgs Physics,
IHEP, Beijing, 12-16, Aug. 2013

Introduction

- Higgs→$b\bar{b}$ is important for directly testing the Higgs mechanism in the quark sector.
- Due to the large multi-jet background at LHC, the inclusive search of H->$b\bar{b}$ is almost impossible.
- The Higgs associated production with W/Z boson is one of the most promising channels for H->$b\bar{b}$ search.
- Three distinct channels, i.e. 0 lepton, 1 lepton and 2 lepton, have been explored mainly aiming to Z->vv, W->lv and Z->ll.







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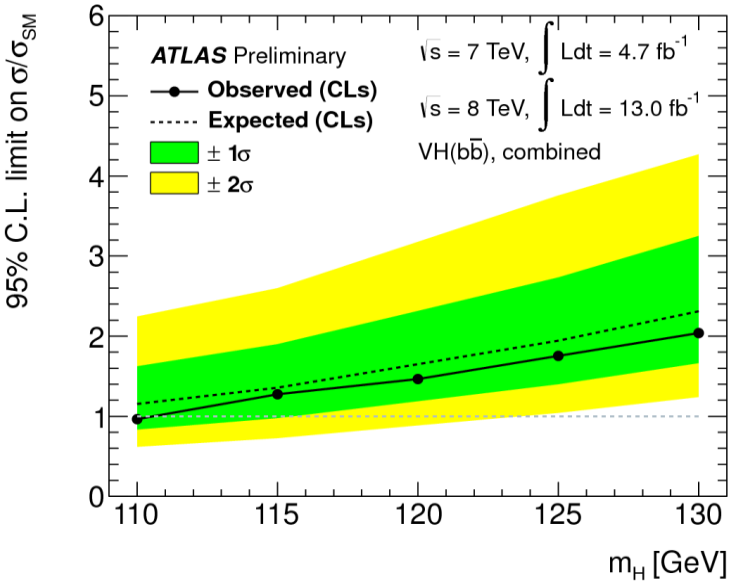

HCP2012: (ATLAS-CONF-2012-161)

Using combined 7TeV and partial 8TeV datasets, the observed (expected) limit is 1.8 (1.9) times the Standard Model prediction.

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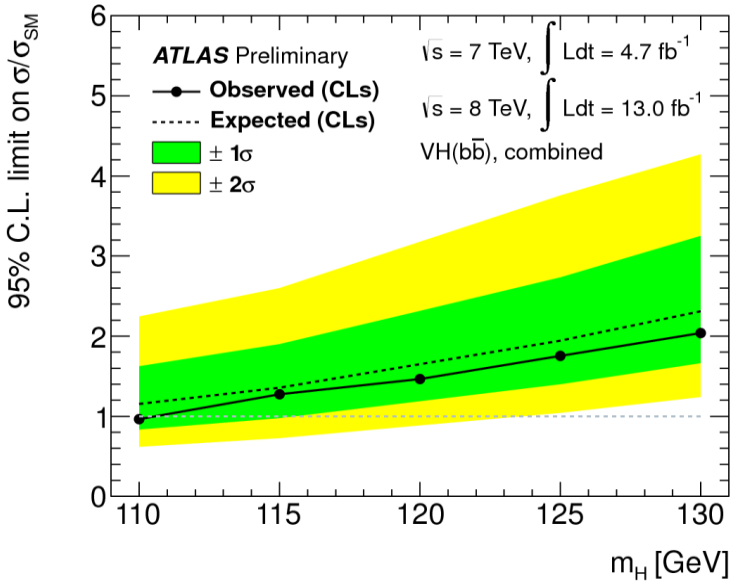

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Using combined 7TeV and partial 8TeV datasets, the observed (expected) limit is 1.8 (1.9) times the Standard Model prediction.

In this talk, the latest ATLAS full run-I data result (ATLAS-CONF-2013-079) will be presented.

Event Selection

- Common selections :
  - At least two jets with P_T^1>45GeV, P_T^2 (or P_T^3)>20GeV and $|\eta|$<2.5
  - ΔR(jet, jet) cut has been optimized as a function of P_T^V

0 lepton:
- E_t^{miss} trigger
- Veto leptons
- E_t^{miss} (P_T^Z)>120 GeV

QCD rejection cuts:
- $\Delta\phi(E_T^{miss}, jets) > 1.5$
- $\Delta\phi E_T^{miss}, P_T^{miss}) < \pi/2$
- $\Delta\phi E_T^{miss}, bb) > 2.8$

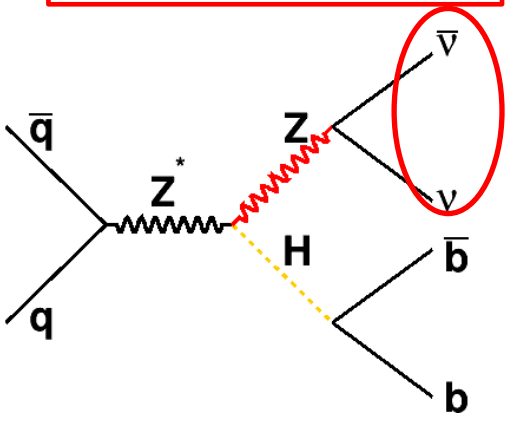
1 lepton:
- 1-Lepton trigger+E_T^{miss} **trigger**
- Exactly 1 lepton
- M_T^W<120GeV and E_T^{miss}>25GeV

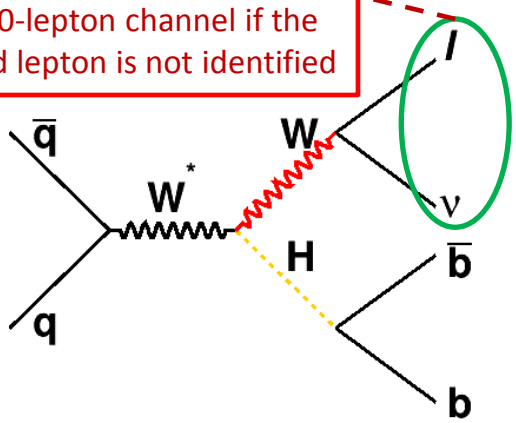
QCD rejection cuts:
- P_T^W<160, M_T^W>40GeV
- P_T^W>200, E_T^{miss}>50GeV

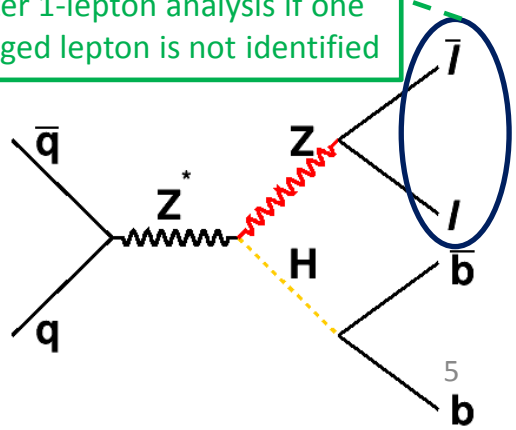
2 lepton:
- 1 and 2 -lepton trigger
- Exactly 2 leptons
- 81GeV < M_{ll} < 99GeV
- E_T^{miss}<60GeV
- QCD negligible

Enter 0-lepton channel if the charged lepton is not identified

Enter 1-lepton analysis if one charged lepton is not identified





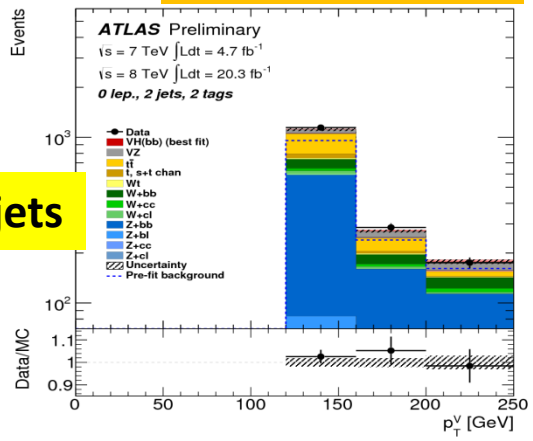


Background composition:

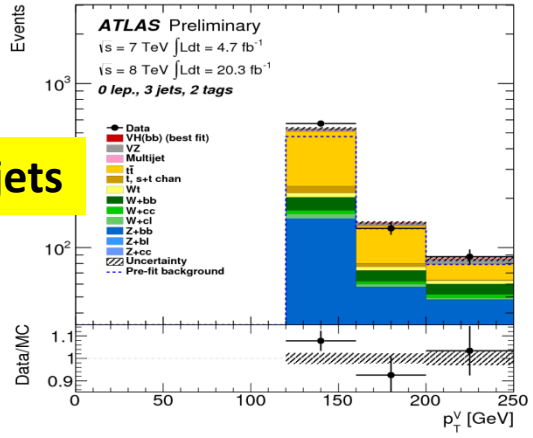
post fit signal region (SR)

2-tag region plots

2 jets



3 jets



0-lepton: (mixture)

Z+jets, **top** and **W+jets.**

Orange: $t\bar{t}$

Dark Orange: Wt channel

Yellow: s and t channel

Grean: W+jets

Blue: Z+jets

The heavier coler, the heavier flavor jets.

Pink : Multi-jet

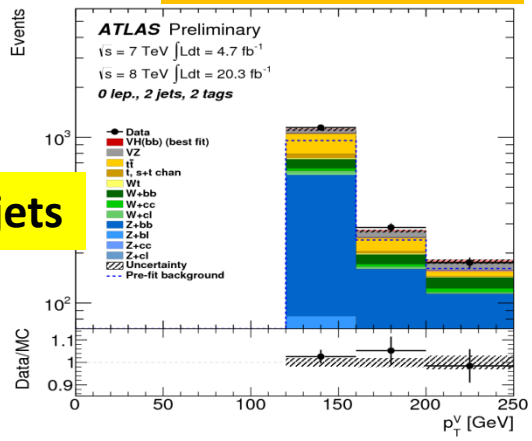
Control region(CR) following the same color convention.

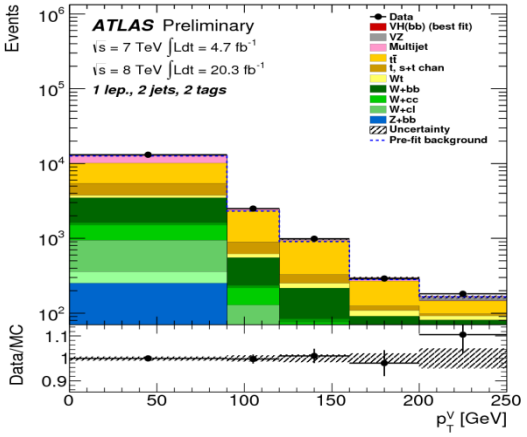
Background composition:

post fit signal region (SR)

2-tag region plots

2 jets





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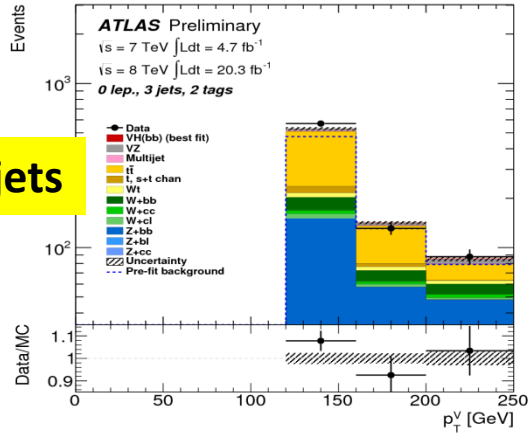
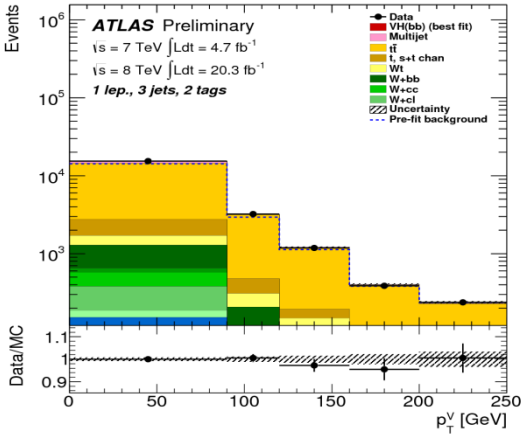




0-lepton: (mixture)

Z+jets, **top** and **W+jets.**

1-lepton:

top and **W+jets.**

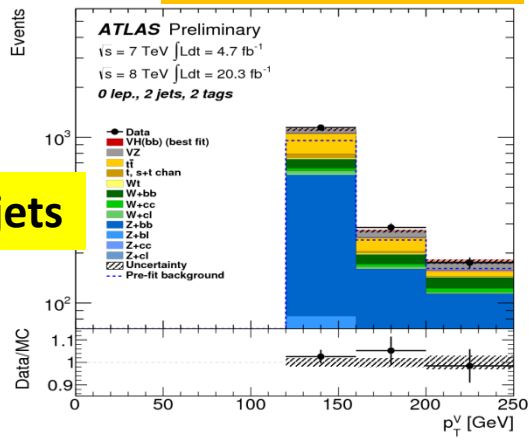
Some **MJ** at low P_T^W bin.

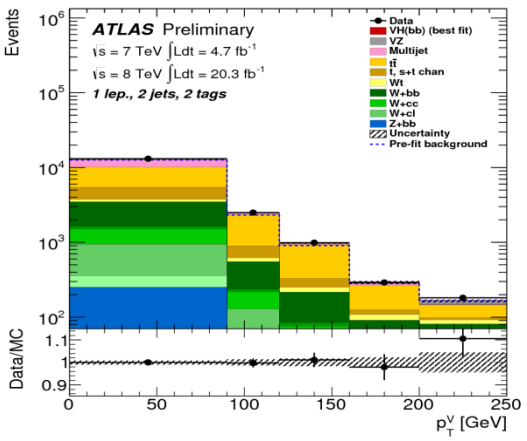
Background composition:

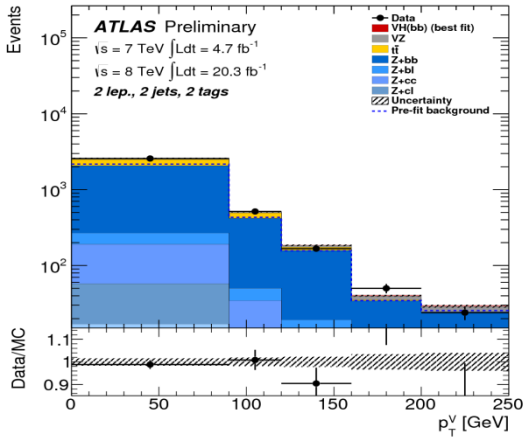
post fit signal region (SR)

2-tag region plots

2 jets







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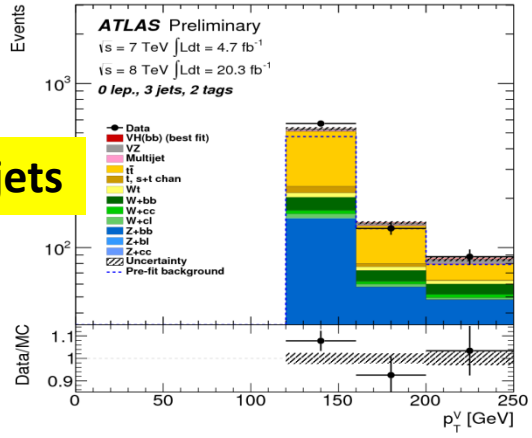
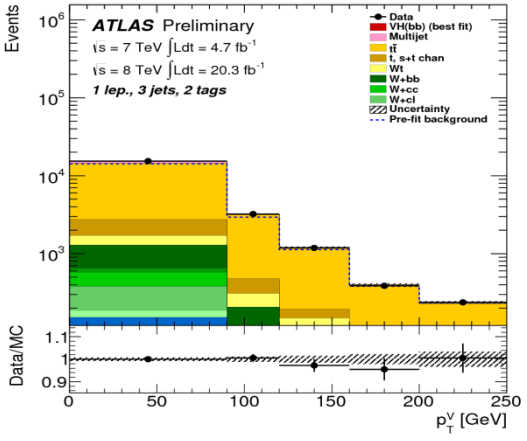
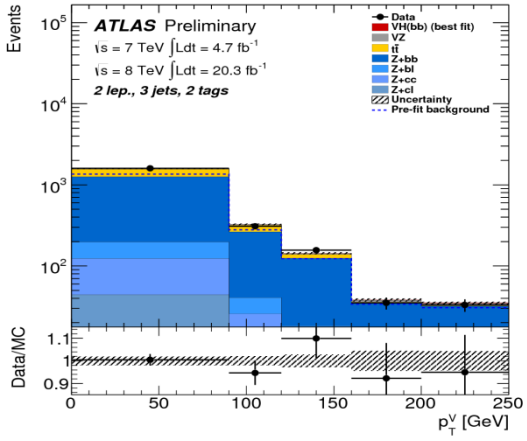






0-lepton: (mixture)

Z+jets, **top** and **W+jets.**

1-lepton:

top and **W+jets.**

Some **MJ** at low P_T^W bin.

2-lepton:

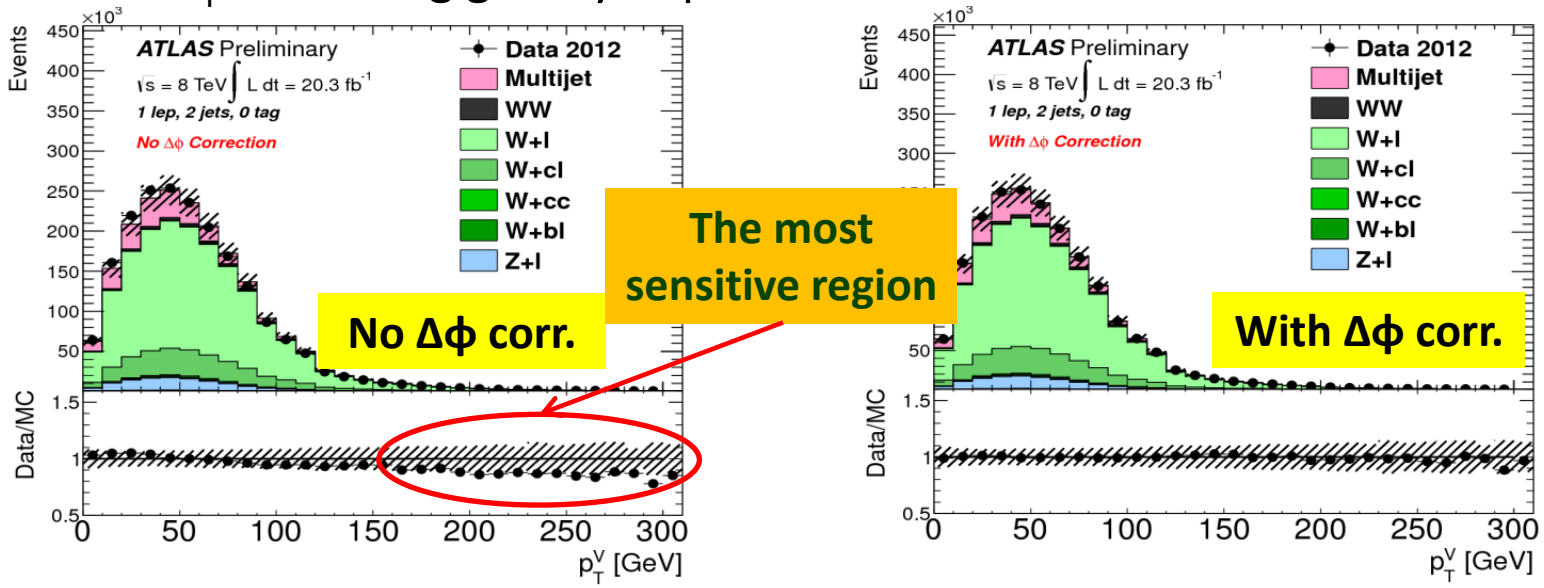
Z+jets

some **top** at low P_T^Z regions

Background modeling (I)

Important corrections:

- $t\bar{t}$ sample (POWHEG+PYTHIA):
  - Top p_T correction applied at the level of generated top quarks.
- V+jets sample (LO SHERPA):
  - Δϕ(jet, jet) correction applied due to NLO effect (arXiv: 1207.5030v1) .
  - The P_T^V modeling greatly improved after correction.



Background modeling (II)

Multijet: (Data driven method)

- **Source:** 0 lepton(mis-measured jets); 1 / 2 lepton (the jets faking leptons)
- **The amount: 0 lepton (1%); 1 lepton (15% - <1%); 2-lepton (negligible).**

Non-multijet backgrounds: (M_{bb} shape from MC)

- Fixed to MC: Diboson, single-top, V+light-jets
- **Float in fit: V+cl, V+bl, V+bb/cc, and $t\bar{t}$**

Inputs to Global fit

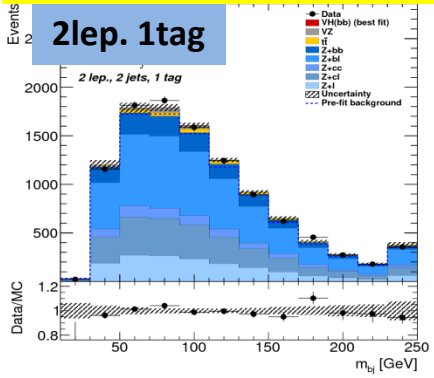
		2jets, 1-tags	3jets, 1-tags	2jets, 2-tags	3jets, 2-tags	Top eμ
3 P_T^V bins	0-lepton	CR	CR	SR	SR	-
5 P_T^V bins	1-lepton	CR	CR	SR	SR	-
5 P_T^V bins	2-lepton	CR	CR	SR	SR	CR

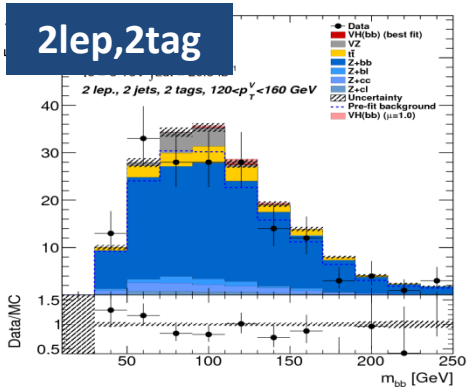
Control Region(CR) : Normalization **Signal Region (SR) : Shape**

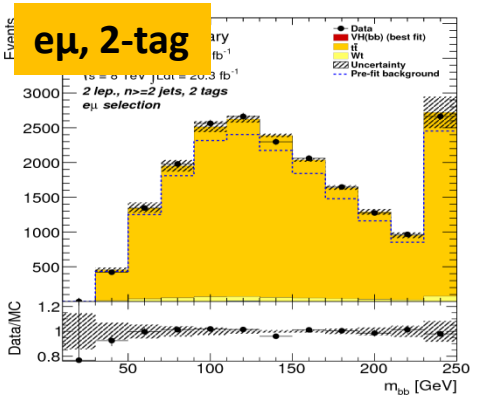
Global fit Model: the idea

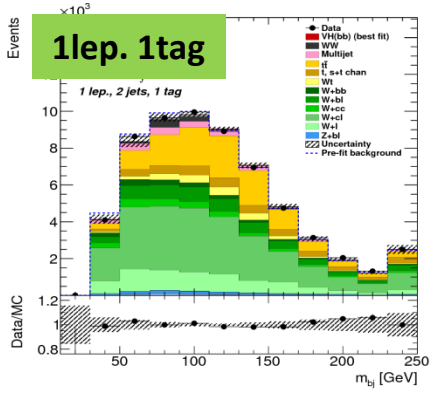
- **Adjust the normalization by simultaneous fit**
  - **Normalization floated: V+cl, V+bl/bb/cc(HF) and $t\bar{t}$**
  - **Background scale factors have been correlated among regions.**

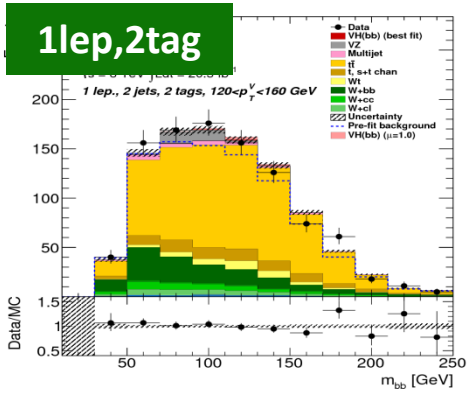
Illustrative plots

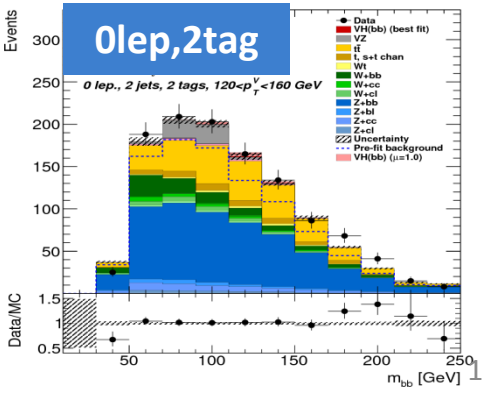












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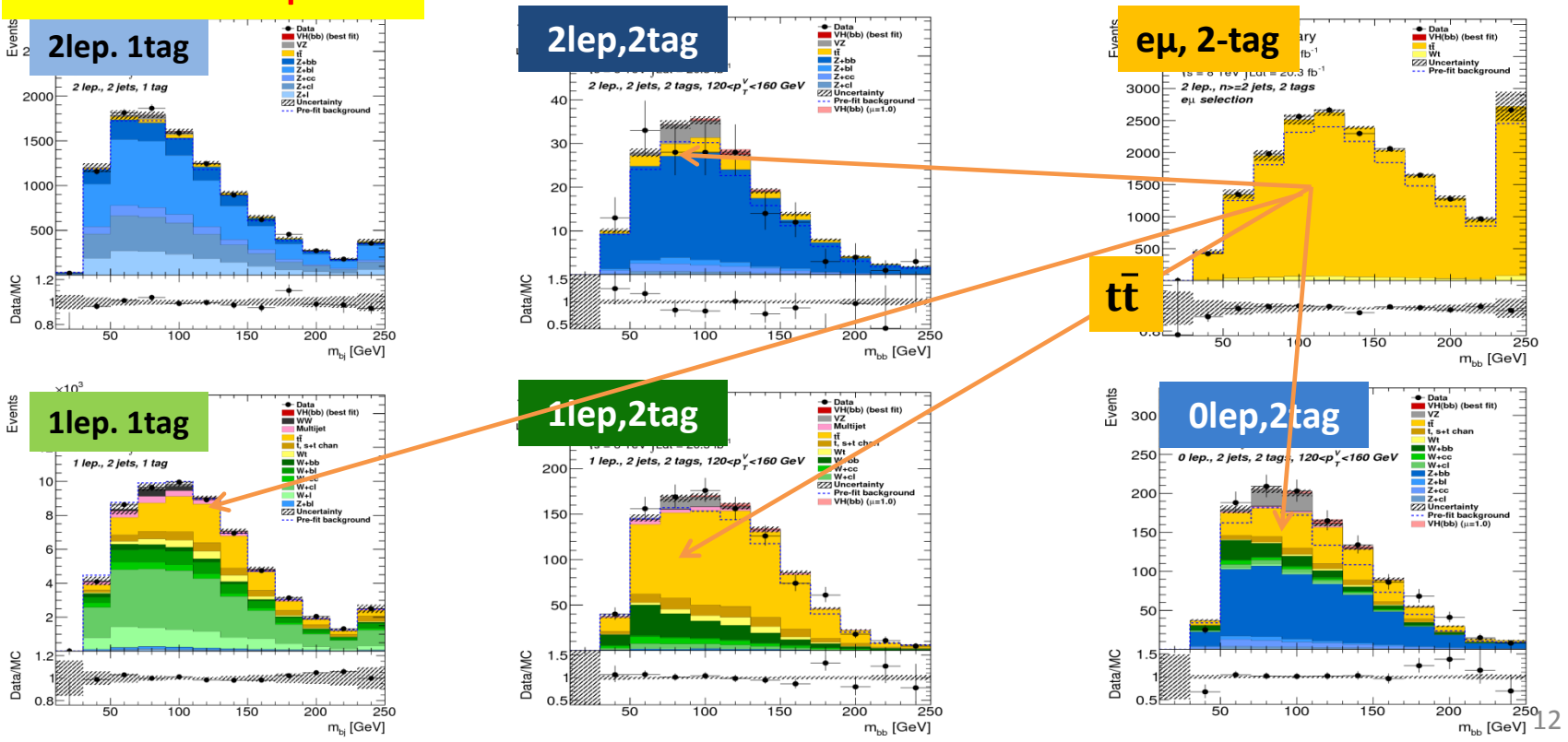

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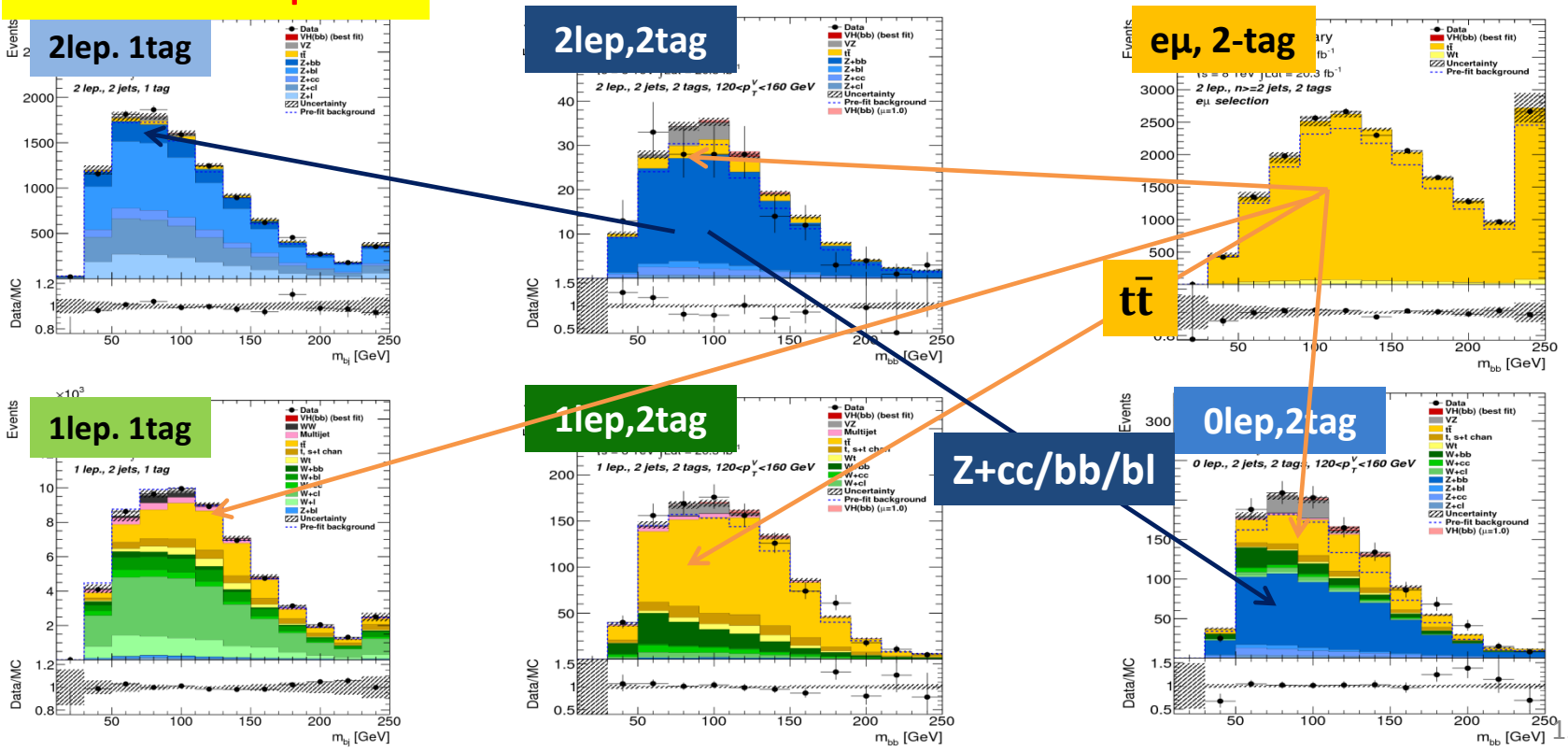

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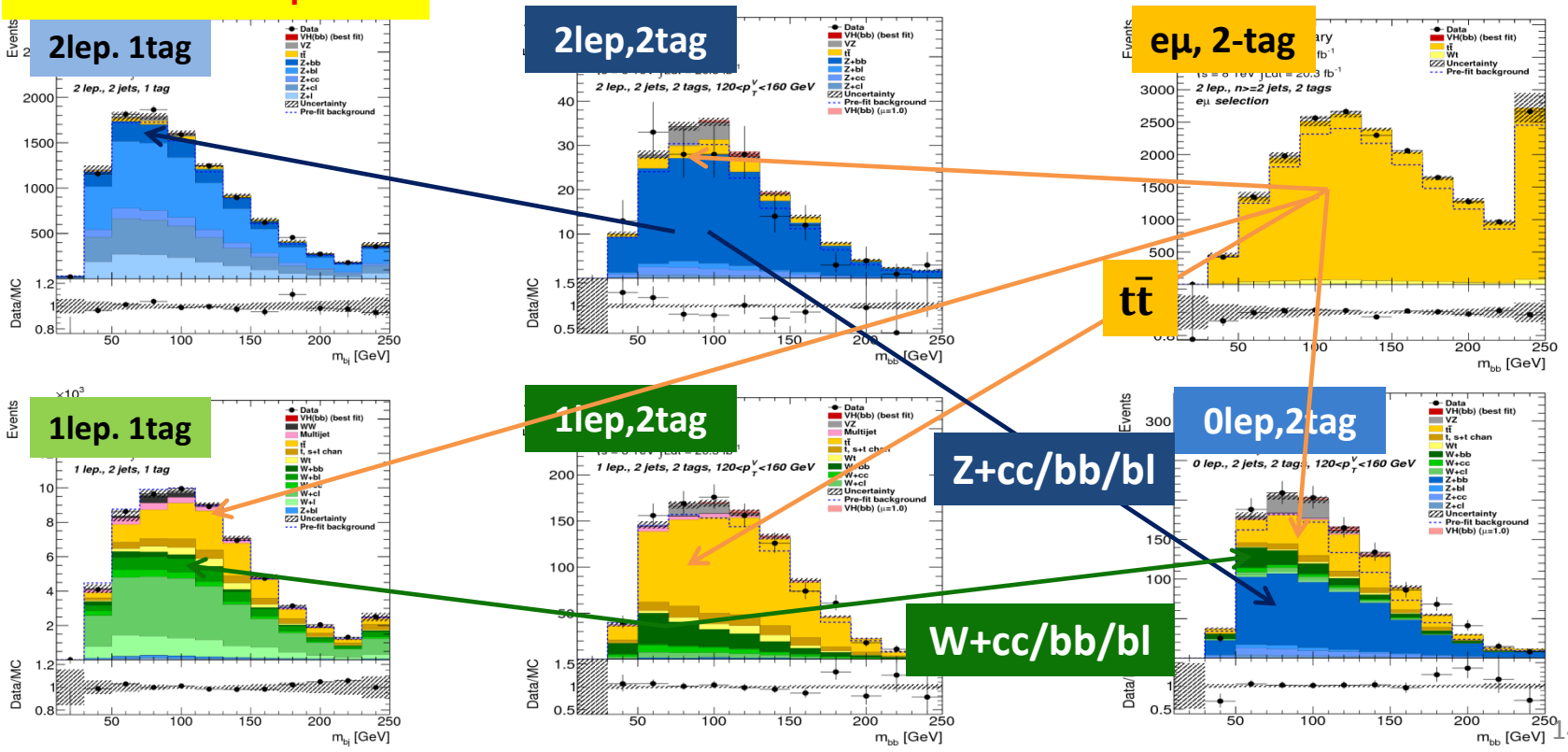

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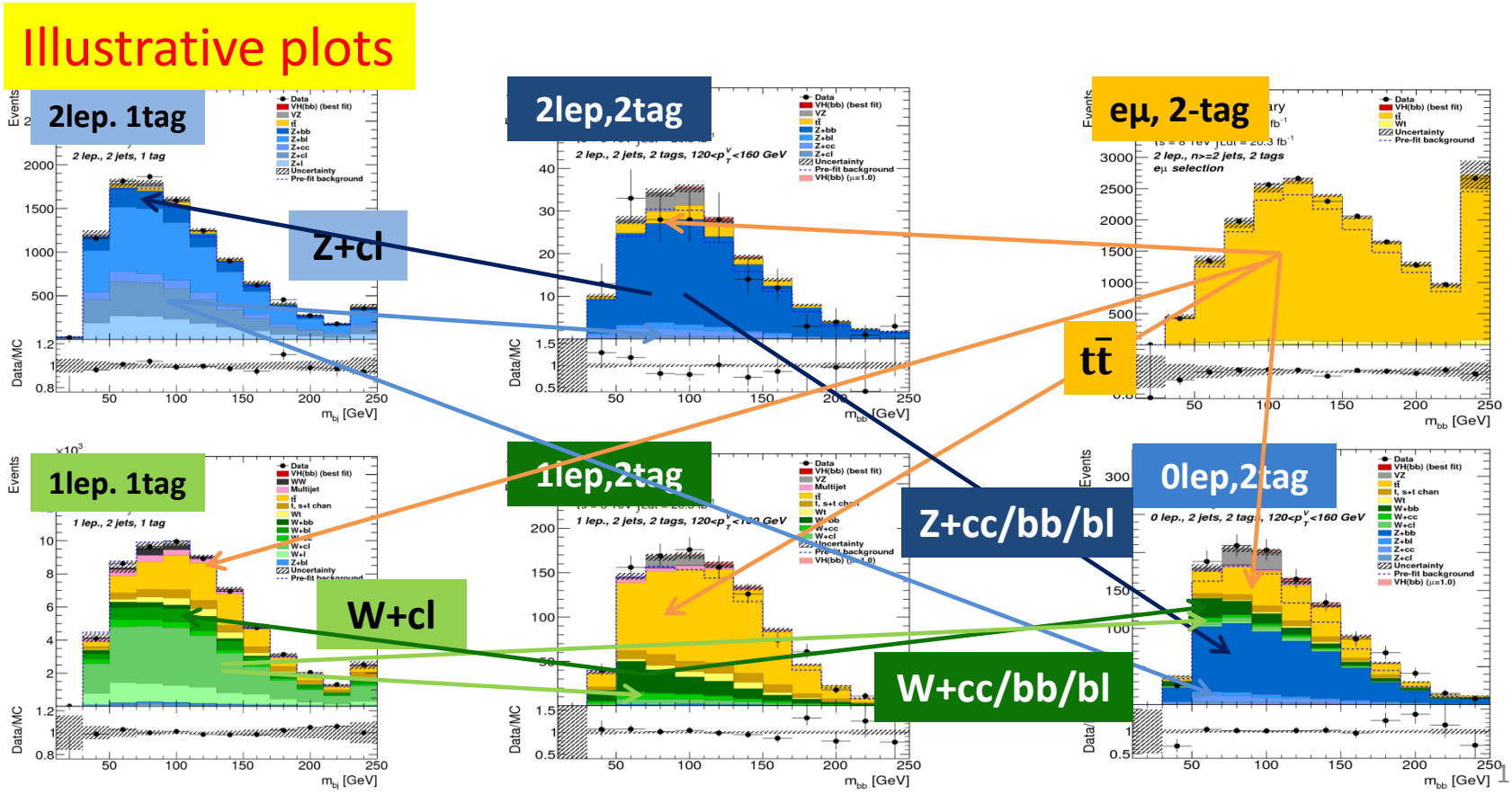

Global fit Model:
Constrain Systematic Uncertainties

- Experimental:
  - JER/JES
  - B-tagging
  - Lepton ID
  - E_T^{miss}

- Modeling:
  - M_{bb} shape
  - P_T^V and Top pt
  - Jet multiplicity

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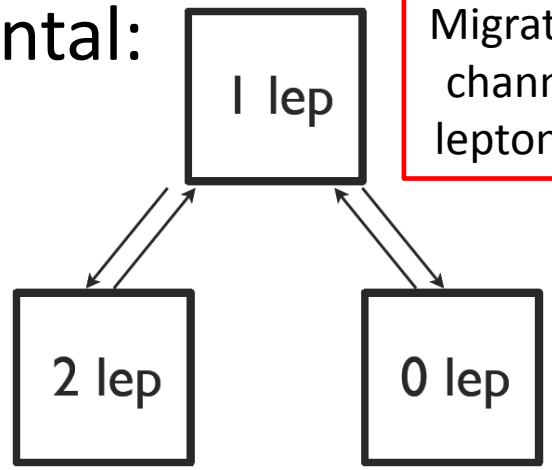
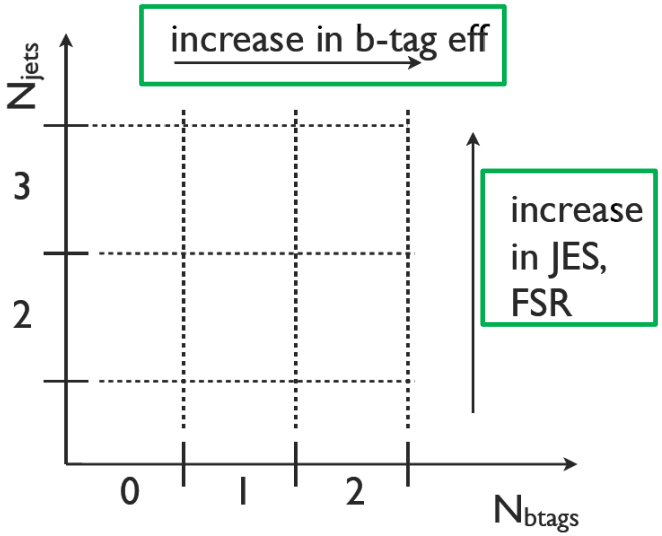


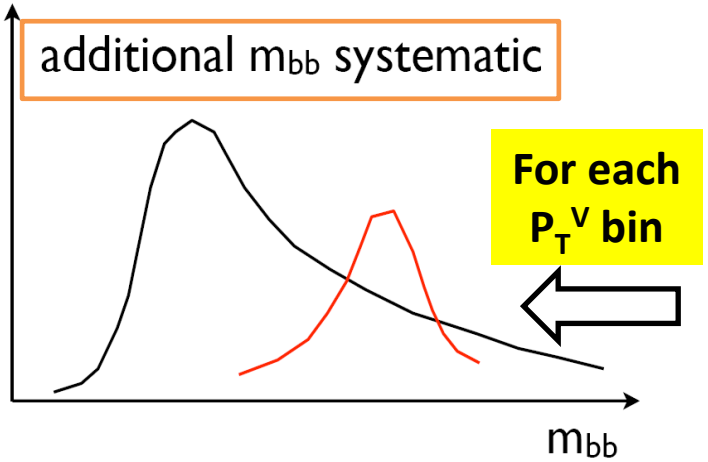
Migration between channels through lepton sysetmatics

For each channel

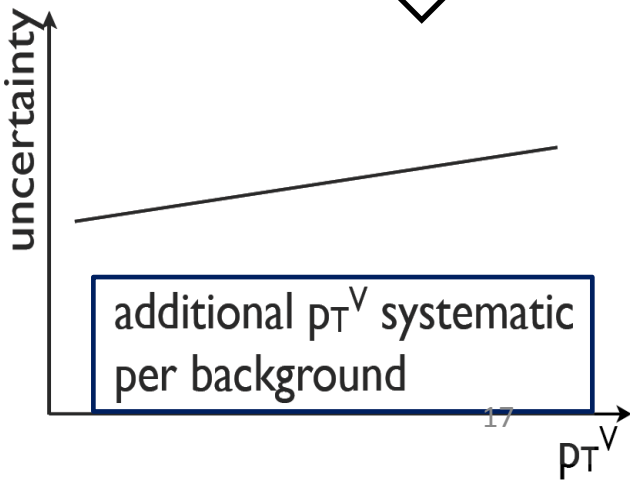


For each bin

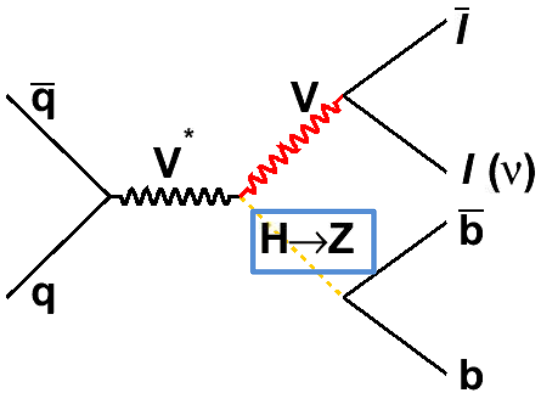
- Modeling:
  - M_{bb} shape
  - P_T^V and Top pt
  - Jet multiplicity



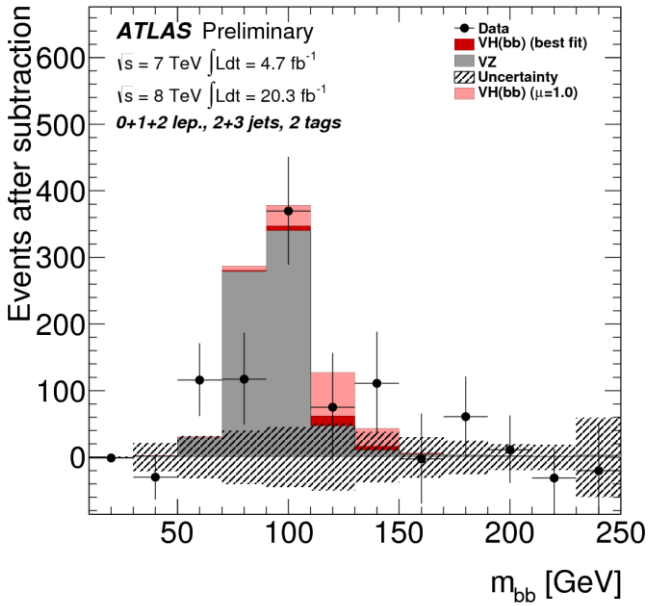
For each P_T^V bin

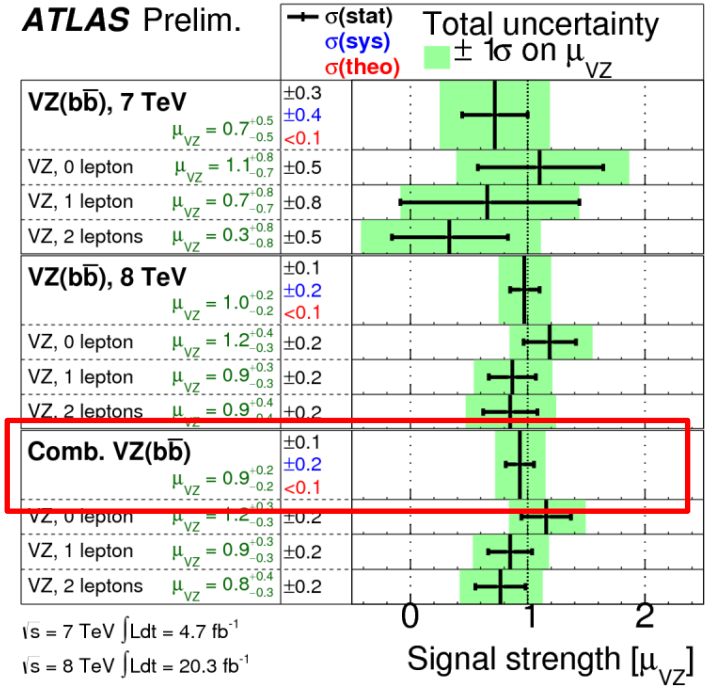


Fitted results: Diboson



- VZ(bb): a similar signature with 5 times larger cross section than VH(bb)
- Diboson fit: a validation of the Higgs analysis.
- The obs. (exp.) significance of VZ is **4.8 (5.1) σ.**
- $\mu_{VZ} = \sigma_{meas}(VZ) / \sigma_{SM}(VZ) = 0.9 \pm 0.2$.





Fitted results:

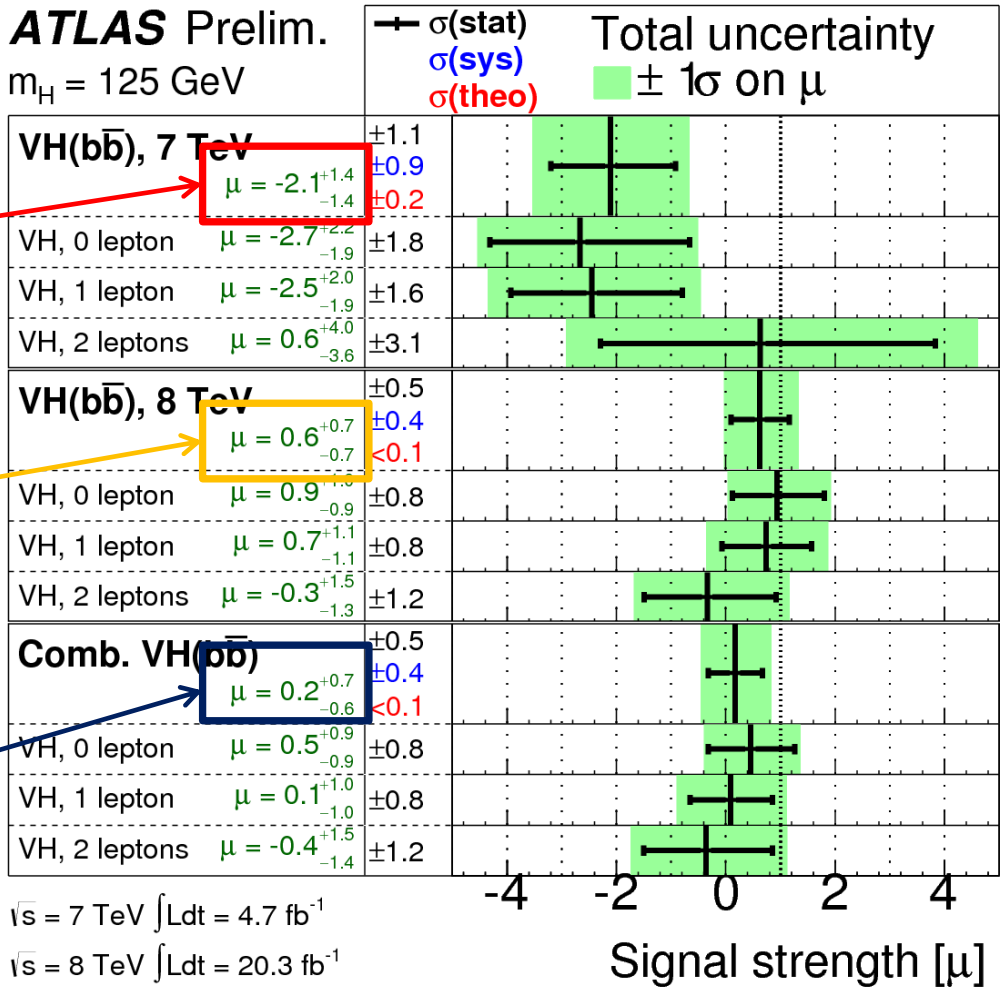
μ_{Higgs} for each year and channel

For m_H = 125 GeV :

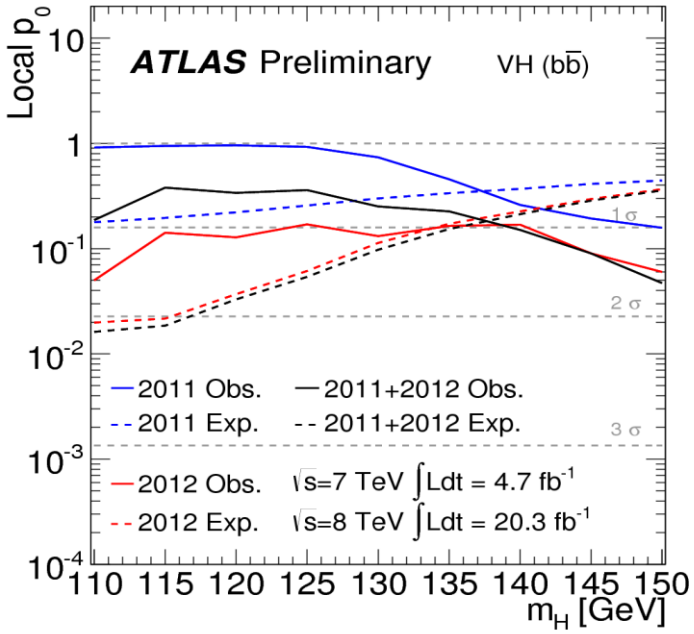
- 7TeV:
  - 2 sigma deficit w.r.t. SM expectation.
- 8TeV:
  - Consistent with both S+B and B only hypothesis in 1σ.
- Combined fit result:

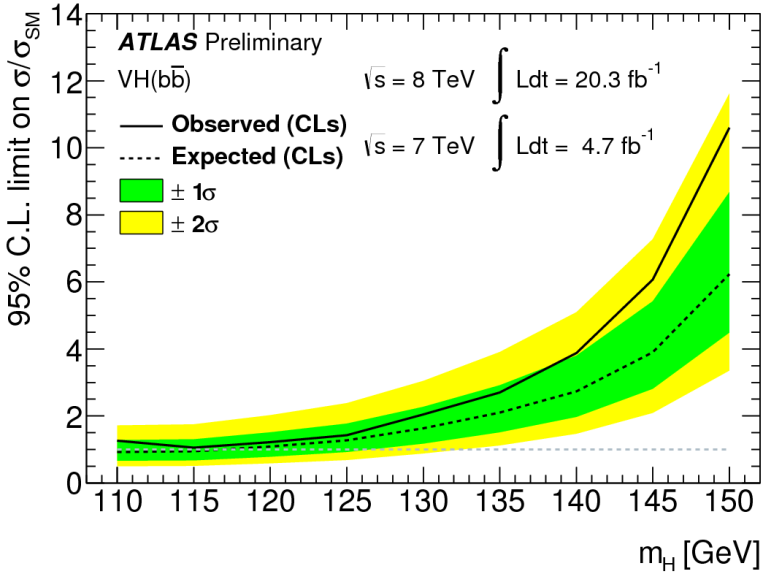
$$\frac{\sigma_{VH\to b\bar{b}}}{\sigma_{\rm SM}} = 0.2^{+0.7}_{-0.6}$$

Results still dominated by statistical uncertainties.



Fitted results: Upper limit





- 1 sigma excess in 8TeV data at m_H=125GeV, as well as higher masses.
- Deficit in 7TeV data which makes the combined results a small excess at m_H=125 GeV.
- At m_H=125GeV, The observed (expected) upper limit at 95 C.L. is 1.4(1.3) times SM prediction.

Summary

- A search for H->$b\bar{b}$ has been performed via the Higgs associated production with a vector boson by using full ATLAS run-I data.
- Diboson(VZ) result is consistent with the SM expectation, with 4.8σ significance.
- For m_H=125 GeV, VH→$b\bar{b}$ cross section combined fit results is:

$$\frac{\sigma_{VH\to b\bar{b}}}{\sigma_{\mathrm{SM}}} = 0.2^{+0.7}_{-0.6}$$

- The observed (expected) 95% C.L. limit for m_H=125 GeV is 1.4 (1.3) times the SM expectation. Respect to the previous analysis, a 35% improvement in significance on top of luminosity due to the optimization and reduced systematics.

With run-I data, we are close to the critical region, and it will be very exciting to look the first bunch of data at 2015.

Thank you

backup

Trigger and Evt. selection

Zero lepton: E_T^{miss} trigger

One lepton: 1-Lepton trigger + **E_T^{miss} trigger (for muon channel)**

Two lepton:
1-Lepton trigger
+ 2-lepton trigger

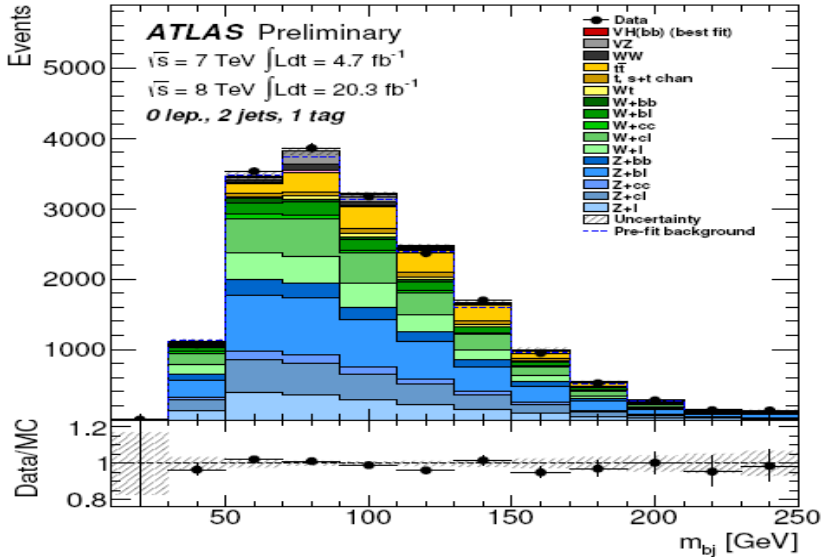
Object	0-lepton	1-lepton	2-lepton
Leptons	0 loose leptons	1 tight lepton + 0 loose leptons	1 medium lepton + 1 loose lepton
Jets	2 b-tags $p_{\mathrm{T}}^{\mathrm{jet}_1} > 45$ GeV $p_{\mathrm{T}}^{\mathrm{jet}_2} > 20$ GeV + ≤ 1 extra jets		
Missing E_T	$E_{\mathrm{T}}^{\mathrm{miss}} > 120$ GeV $p_{\mathrm{T}}^{\mathrm{miss}} > 30$ GeV $\Delta\phi(\boldsymbol{E}_{\mathrm{T}}^{\mathrm{miss}}, \boldsymbol{p}_{\mathrm{T}}^{\mathrm{miss}}) < \pi/2$ $\min[\Delta\phi(\boldsymbol{E}_{\mathrm{T}}^{\mathrm{miss}}, \mathrm{jet})] > 1.5$ $\Delta\phi(\boldsymbol{E}_{\mathrm{T}}^{\mathrm{miss}}, b\bar{b}) > 2.8$	$E_{\mathrm{T}}^{\mathrm{miss}} > 25$ Gev	$E_{\mathrm{T}}^{\mathrm{miss}} < 60$ GeV
Vector Boson	-	$m_{\mathrm{T}}^{W} < 120$ GeV	$83 < m_{\ell\ell} < 99$ GeV

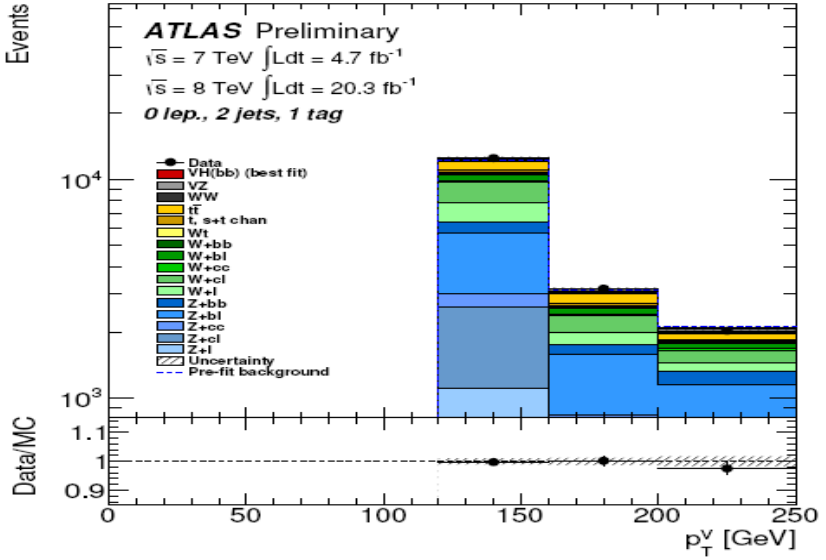
	p_{T}^{V} [GeV]	0-90	90-120	120-160	160-200	>200
All Channels	$\Delta R(b, \bar{b})$	0.7-3.4	0.7-3.0	0.7-2.3	0.7-1.8	<1.4
1-lepton	$E_{\mathrm{T}}^{\mathrm{miss}}$ [GeV]	>25				>50
	m_{T}^{W} [GeV]	40-120			<120	

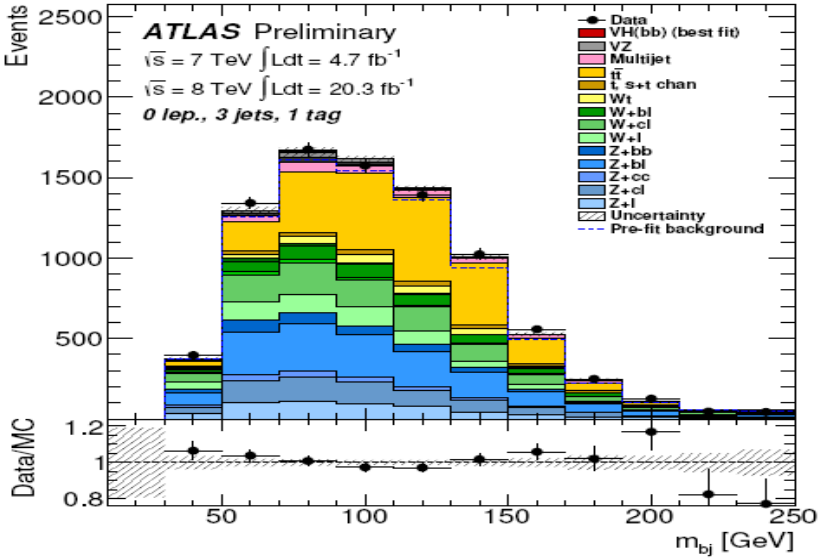
Xsec*Br and acceptance

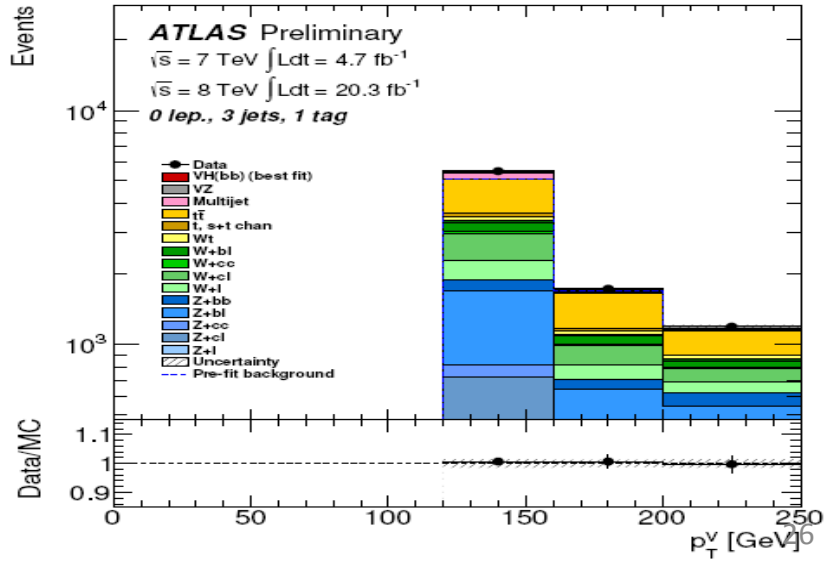
m_H = 125 GeV at 7 TeV				
$(W/Z)(H \to b\bar{b})$	Cross-section × BR [fb]	Acceptance [%]		
		0-lepton	1-lepton	2-lepton
$Z \to \ell\ell$	12.3	0.0	0.7	8.2
$W \to \ell\nu$	107.1	0.2	3.5	-
$Z \to \nu\nu$	36.4	2.2	-	-
m_H = 125 GeV at 8 TeV				
$(W/Z)(H \to b\bar{b})$	Cross-section × BR [fb]	Acceptance [%]		
		0-lepton	1-lepton	2-lepton
$Z \to \ell\ell$	15.3	0.0	0.9	8.4
$W \to \ell\nu$	130.2	0.2	3.3	-
$Z \to \nu\nu$	45.5	2.5	-	-

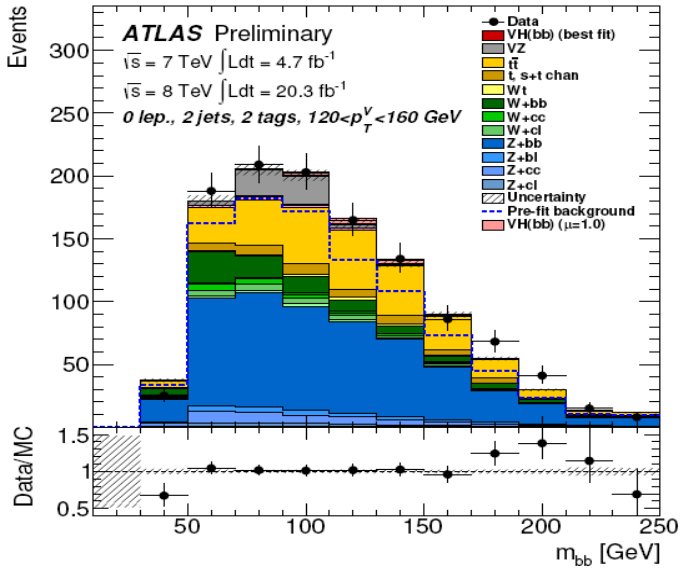
0-lepton: data-MC plots

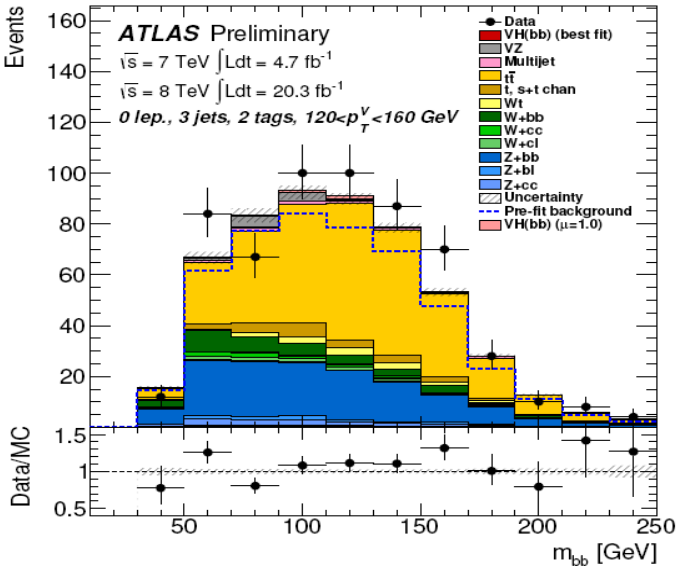


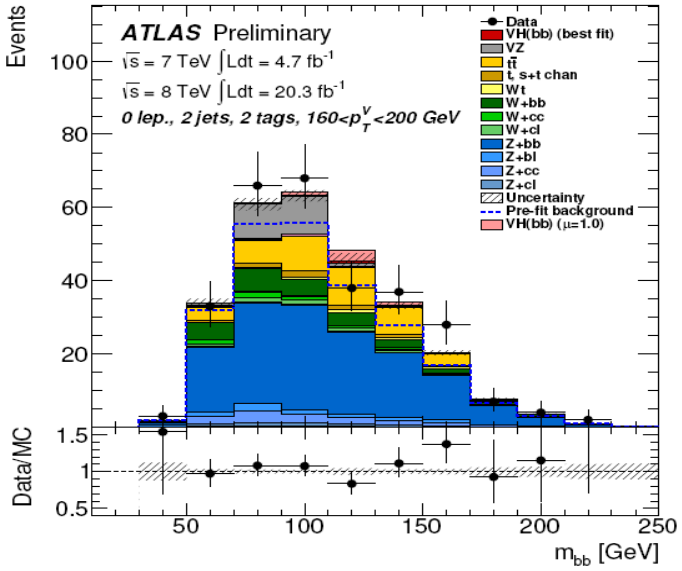


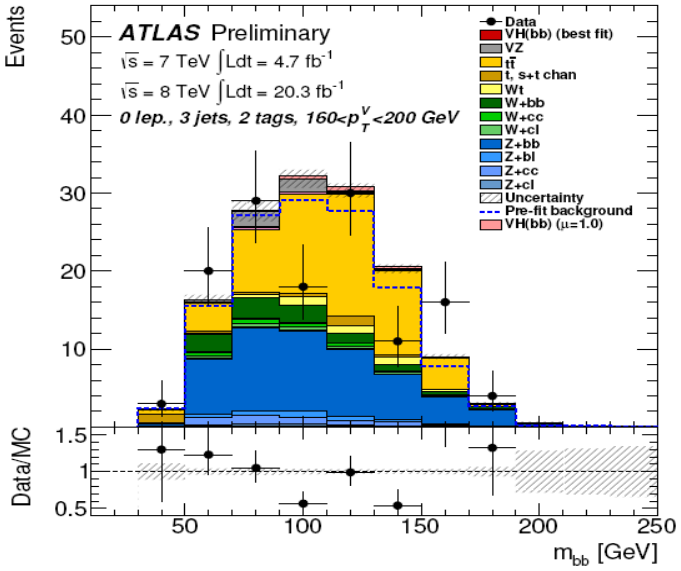


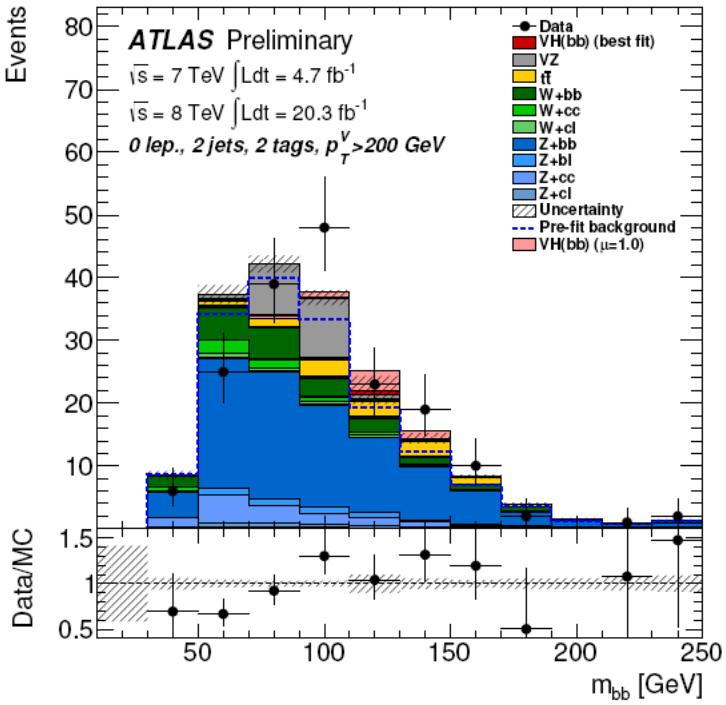


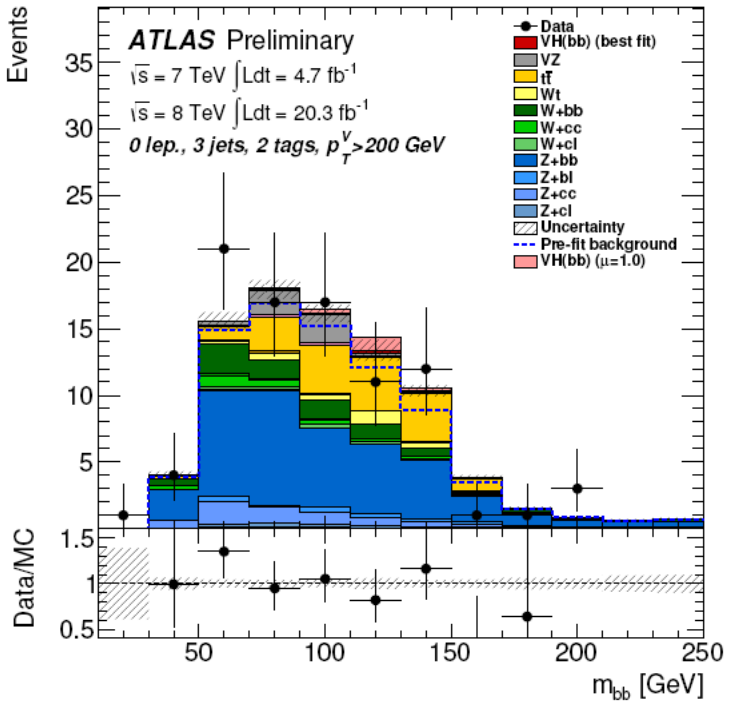

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
0 lep., 2 jets, 2 tags, 120<p_T^V<160 GeV
Data
VH(bb) (best fit)
VZ
tt̄
t, s+t chan
Wt
W+bb
W+cc
W+cl
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
m_bb [GeV]


ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
0 lep., 3 jets, 2 tags, 120<p_T^V<160 GeV
Data
VH(bb) (best fit)
VZ
Multijet
tt̄
t, s+t chan
Wt
W+bb
W+cc
W+cl
Z+bb
Z+bl
Z+cc
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
m_bb [GeV]

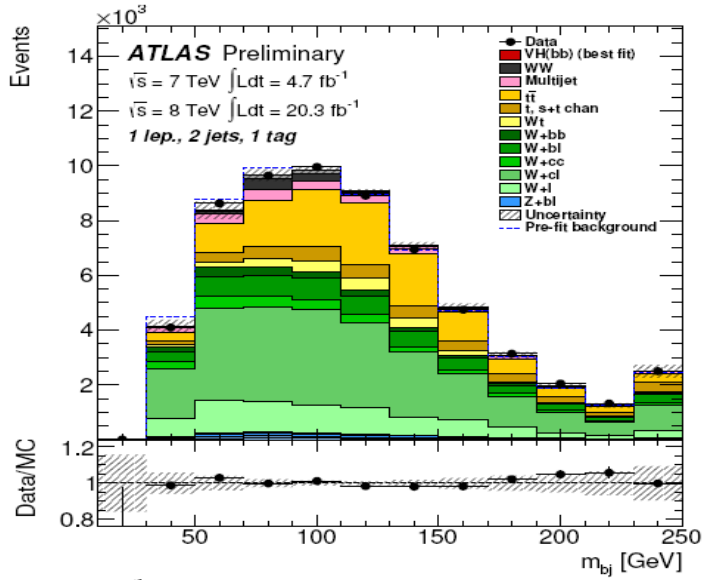

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
0 lep., 2 jets, 2 tags, 160<p_T^V<200 GeV
Data
VH(bb) (best fit)
VZ
tt̄
t, s+t chan
Wt
W+bb
W+cc
W+cl
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
m_bb [GeV]

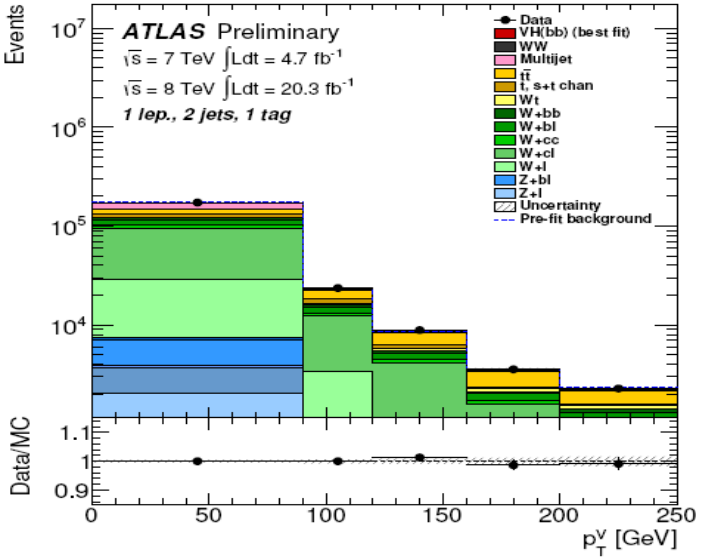

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
0 lep., 3 jets, 2 tags, 160<p_T^V<200 GeV
Data
VH(bb) (best fit)
VZ
tt̄
t, s+t chan
Wt
W+bb
W+cc
W+cl
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
m_bb [GeV]

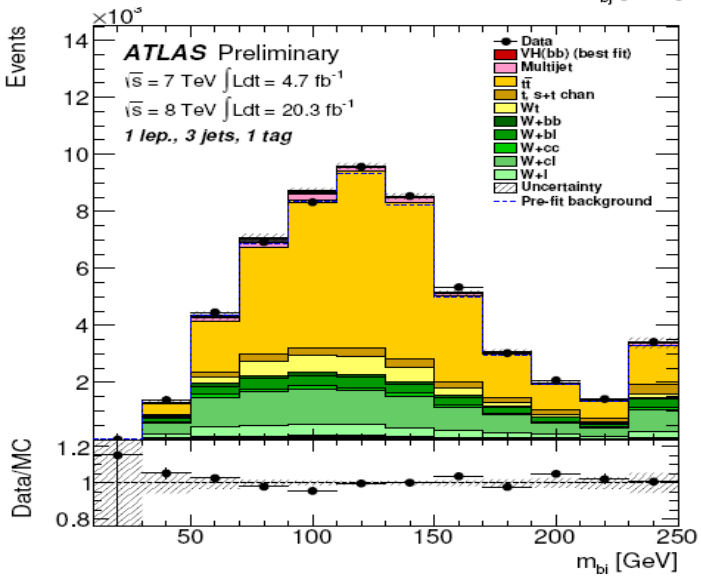

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
0 lep., 2 jets, 2 tags, pTV>200 GeV
Data
VH(bb) (best fit)
VZ
tt̄
W+bb
W+cc
W+cl
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

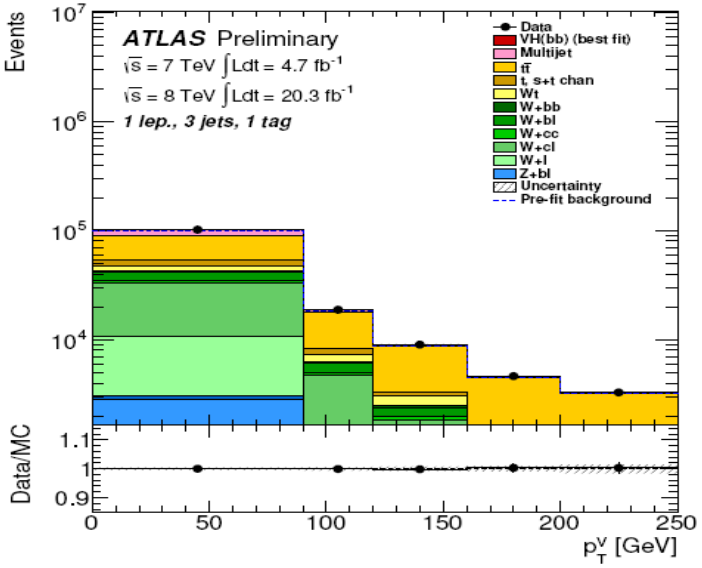

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
0 lep., 3 jets, 2 tags, pTV>200 GeV
Data
VH(bb) (best fit)
VZ
tt̄
Wt
W+bb
W+cc
W+cl
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

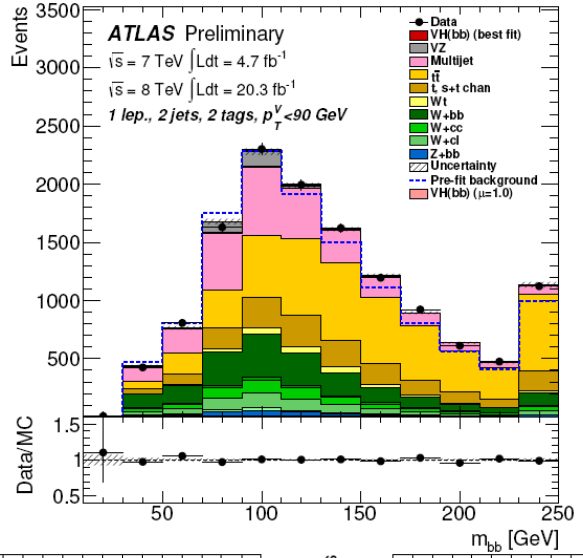
1-lepton: data-MC plots

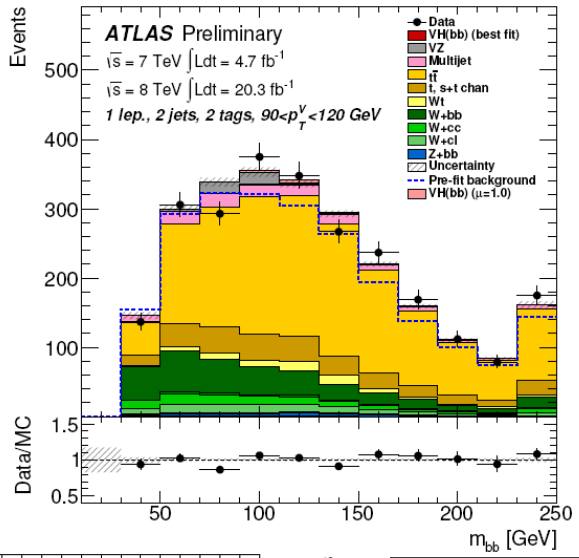


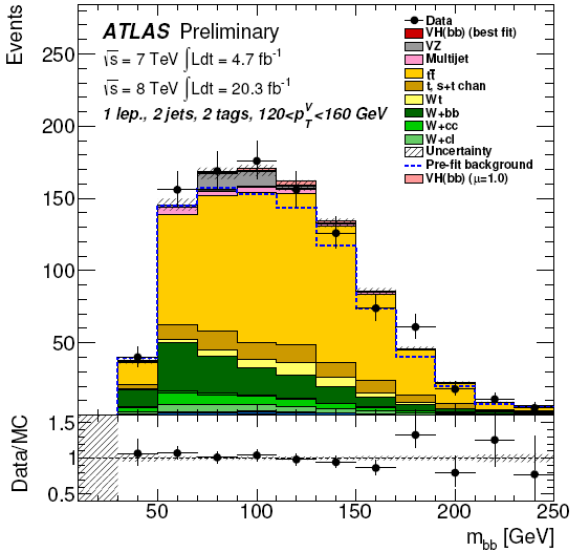


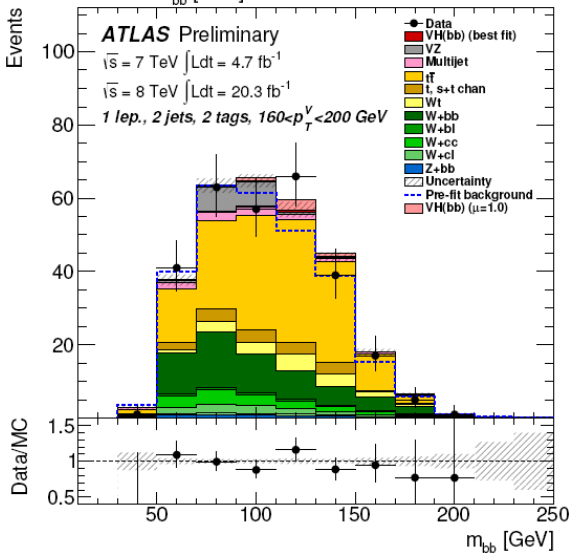


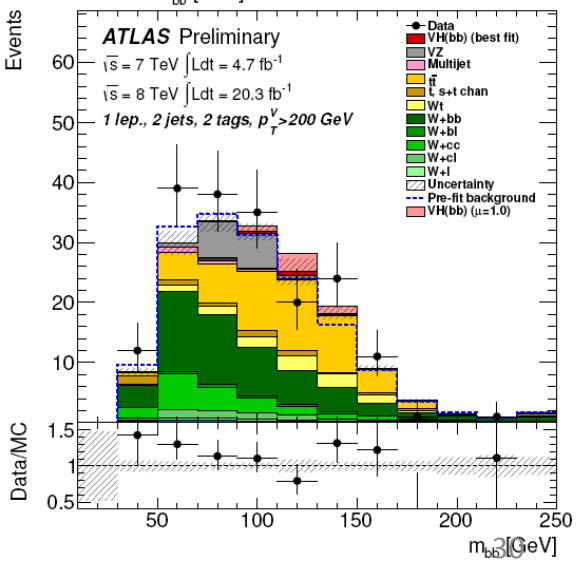


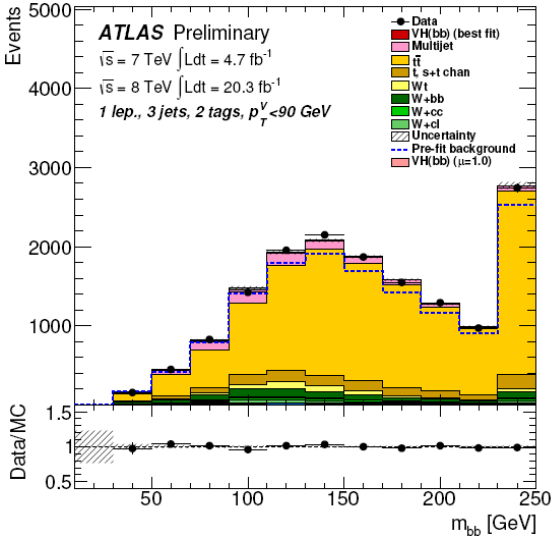

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
1 lep., 2 jets, 2 tags, pTV<90 GeV
Data
VH(bb) (best fit)
VZ
Multijet
tt̄
t, s+t chan
Wt
W+bb
W+cc
W+cl
Z+bb
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

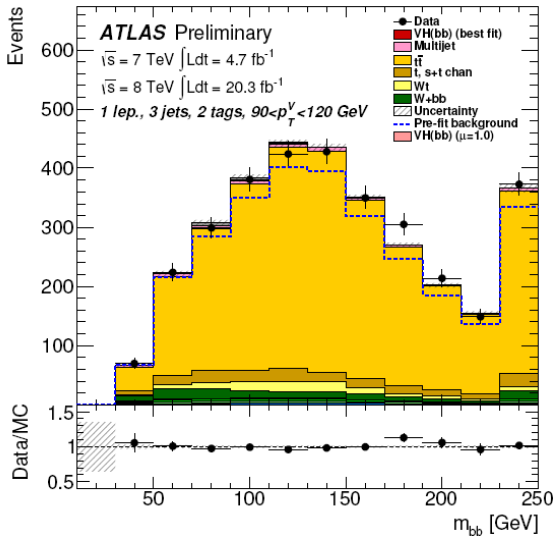

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
1 lep., 2 jets, 2 tags, 90<pTV<120 GeV
Data
VH(bb) (best fit)
VZ
Multijet
tt̄
t, s+t chan
Wt
W+bb
W+cc
W+cl
Z+bb
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

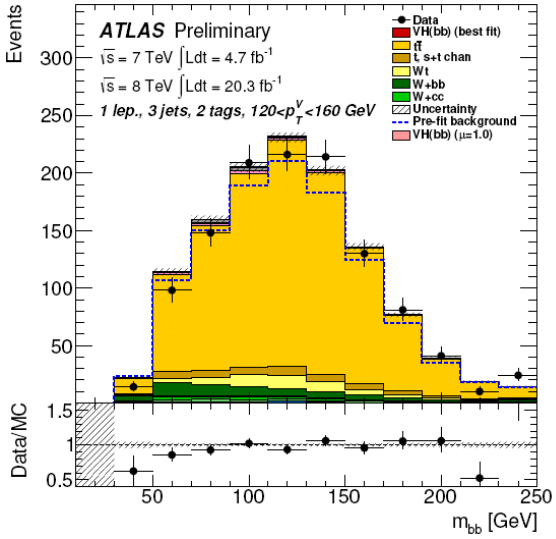

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
1 lep., 2 jets, 2 tags, 120<pTV<160 GeV
Data
VH(bb) (best fit)
VZ
Multijet
tt̄
t, s+t chan
Wt
W+bb
W+cc
W+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

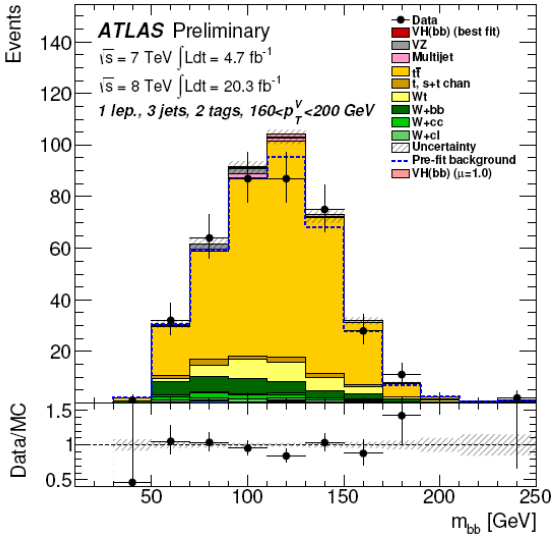

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
1 lep., 2 jets, 2 tags, 160<pTV<200 GeV
Data
VH(bb) (best fit)
VZ
Multijet
tt̄
t, s+t chan
Wt
W+bb
W+bl
W+cc
W+cl
Z+bb
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

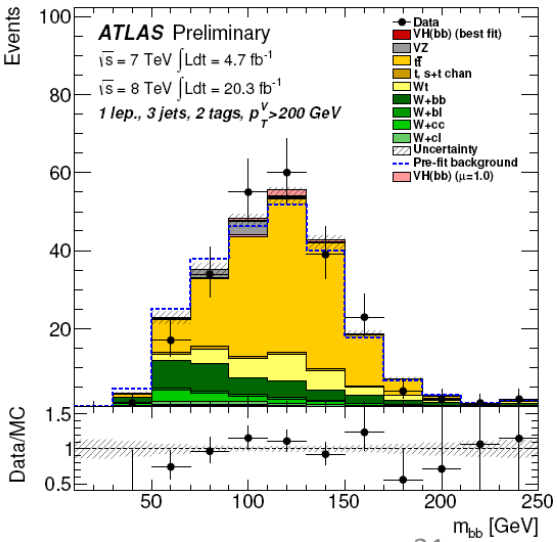

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
1 lep., 2 jets, 2 tags, pTV>200 GeV
Data
VH(bb) (best fit)
VZ
Multijet
tt̄
t, s+t chan
Wt
W+bb
W+bl
W+cc
W+cl
W+l
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]


ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
1 lep., 3 jets, 2 tags, pTV<90 GeV
Data
VH(bb) (best fit)
Multijet
tt̄
t, s+t chan
Wt
W+bb
W+cc
W+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

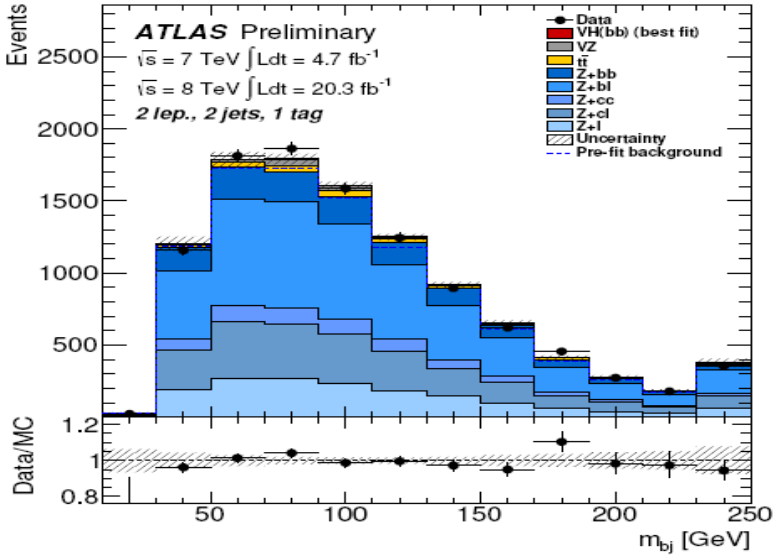

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
1 lep., 3 jets, 2 tags, 90<pTV<120 GeV
Data
VH(bb) (best fit)
Multijet
tt̄
t, s+t chan
Wt
W+bb
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

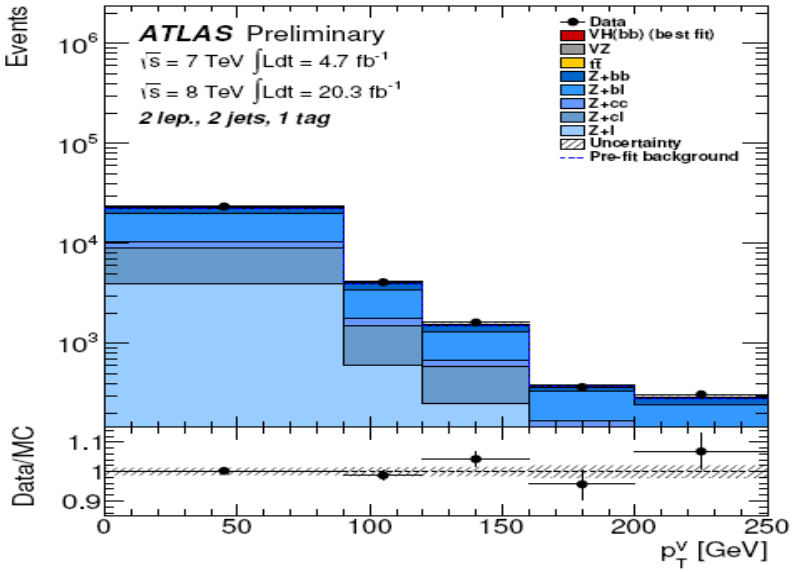

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
1 lep., 3 jets, 2 tags, 120<pTV<160 GeV
Data
VH(bb) (best fit)
tt̄
t, s+t chan
Wt
W+bb
W+cc
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

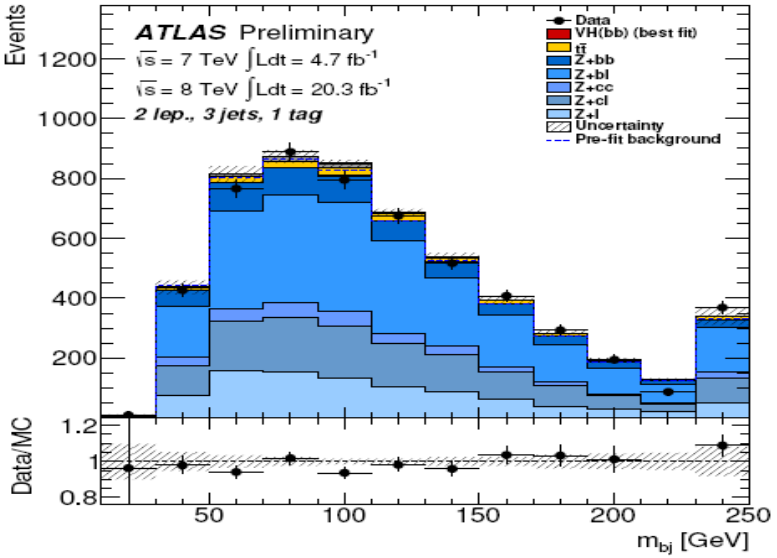

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
1 lep., 3 jets, 2 tags, 160<pTV<200 GeV
Data
VH(bb) (best fit)
VZ
Multijet
tt̄
t, s+t chan
Wt
W+bb
W+cc
W+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

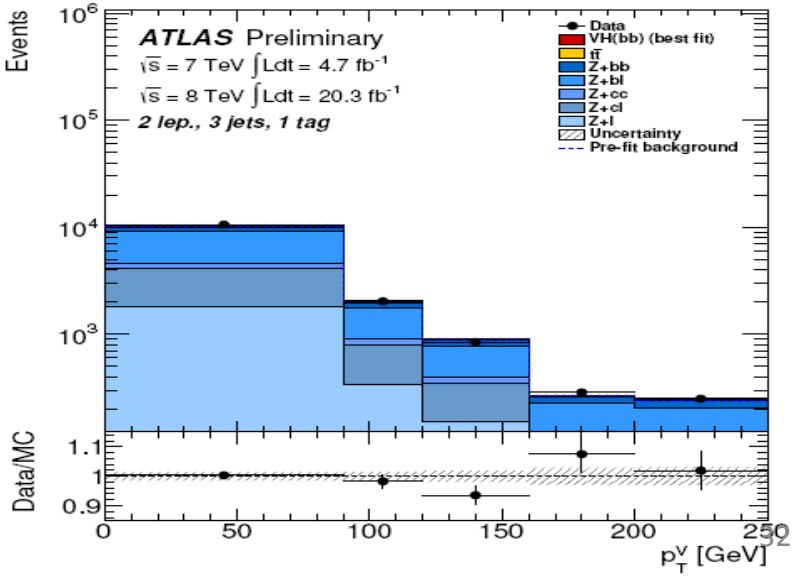

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
1 lep., 3 jets, 2 tags, pTV>200 GeV
Data
VH(bb) (best fit)
VZ
tt̄
t, s+t chan
Wt
W+bb
W+bl
W+cc
W+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

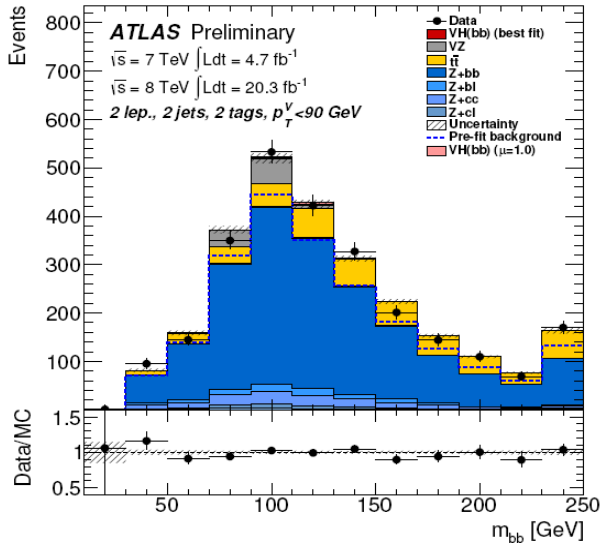
2-lepton: data-MC plots

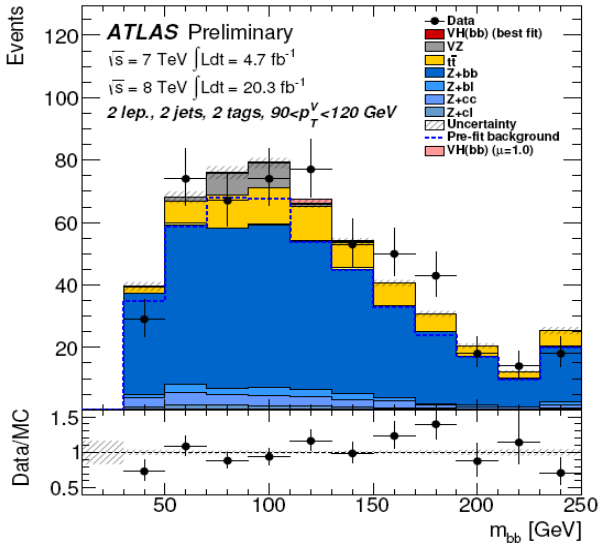


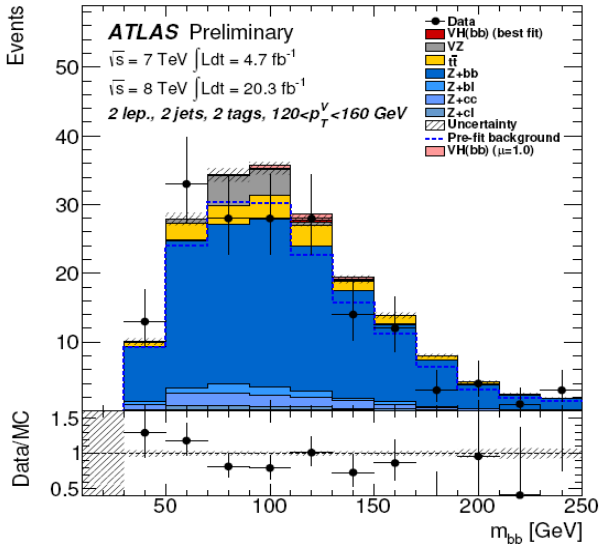


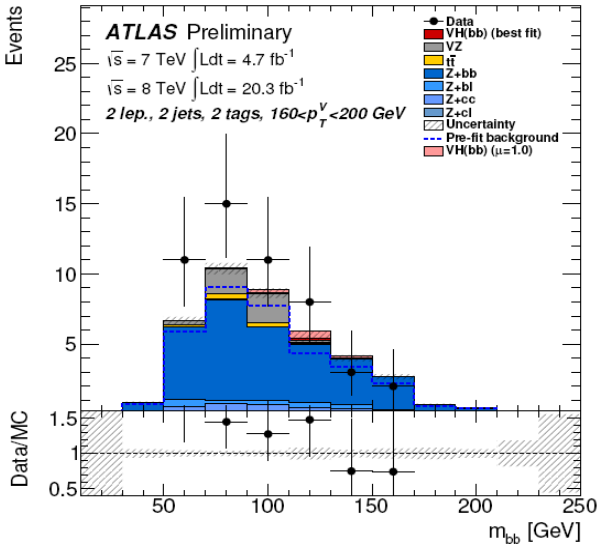


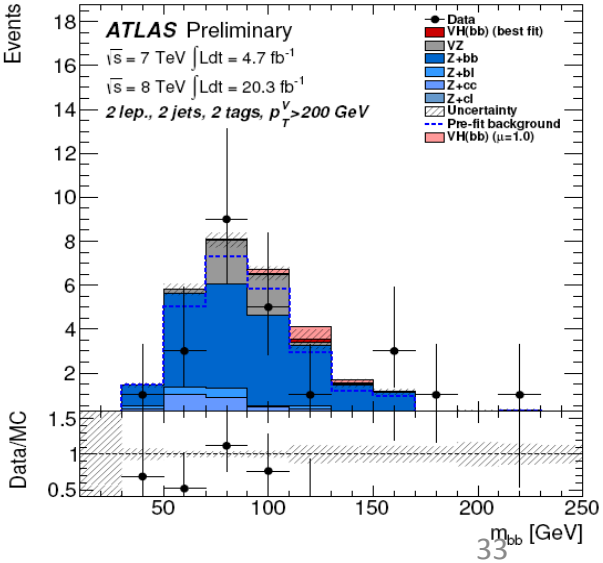


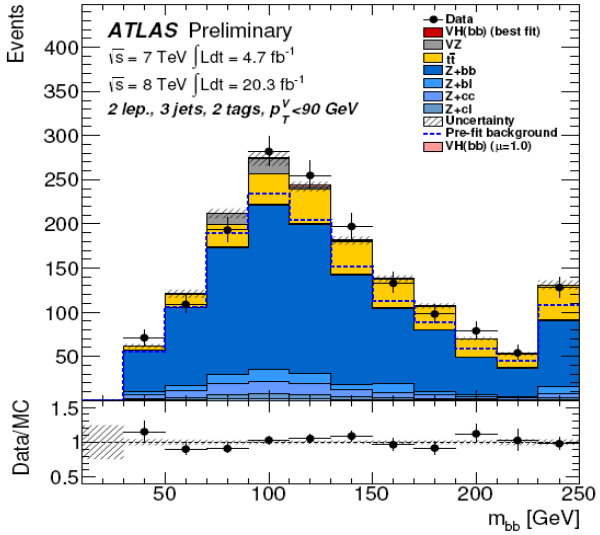

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., 2 jets, 2 tags, pTV<90 GeV
Data
VH(bb) (best fit)
VZ
tt̄
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

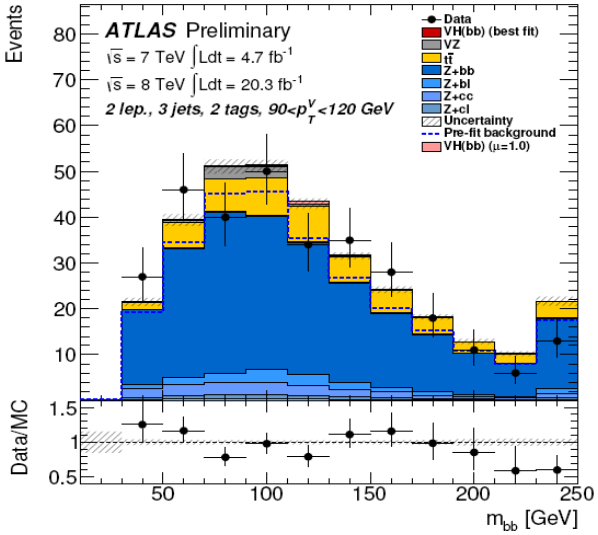

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., 2 jets, 2 tags, 90<pTV<120 GeV
Data
VH(bb) (best fit)
VZ
tt̄
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

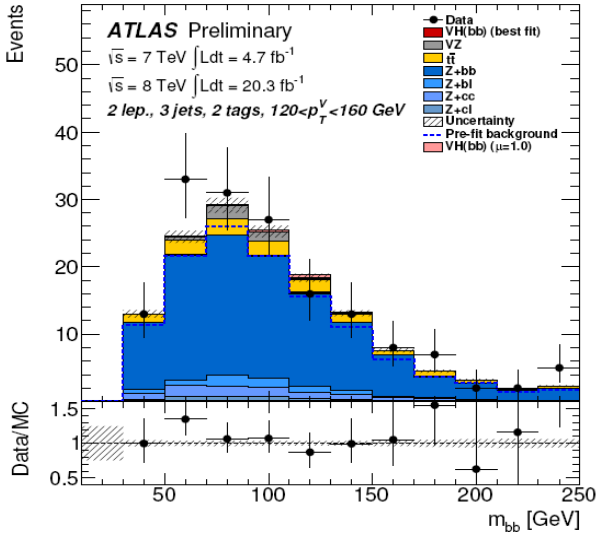

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., 2 jets, 2 tags, 120<pTV<160 GeV
Data
VH(bb) (best fit)
VZ
tt̄
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

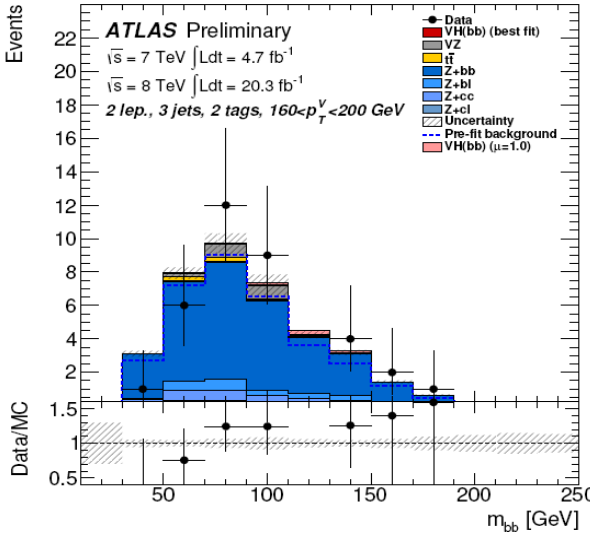

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., 2 jets, 2 tags, 160<pTV<200 GeV
Data
VH(bb) (best fit)
VZ
tt̄
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

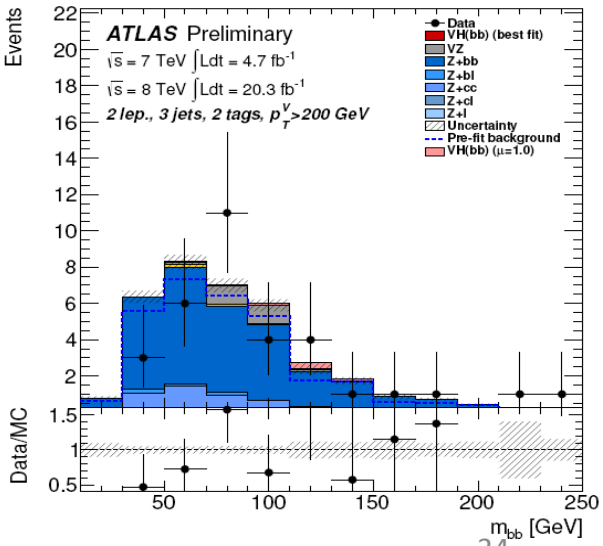

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., 2 jets, 2 tags, pTV>200 GeV
Data
VH(bb) (best fit)
VZ
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

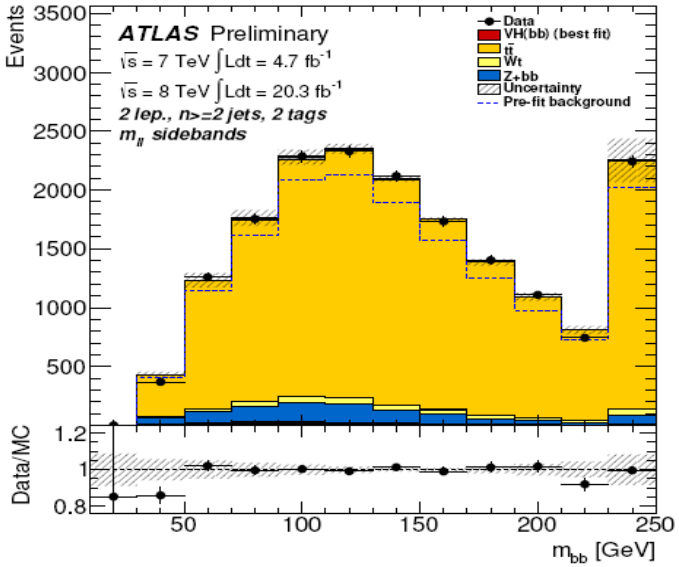

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., 3 jets, 2 tags, pTV<90 GeV
Data
VH(bb) (best fit)
VZ
tt̄
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

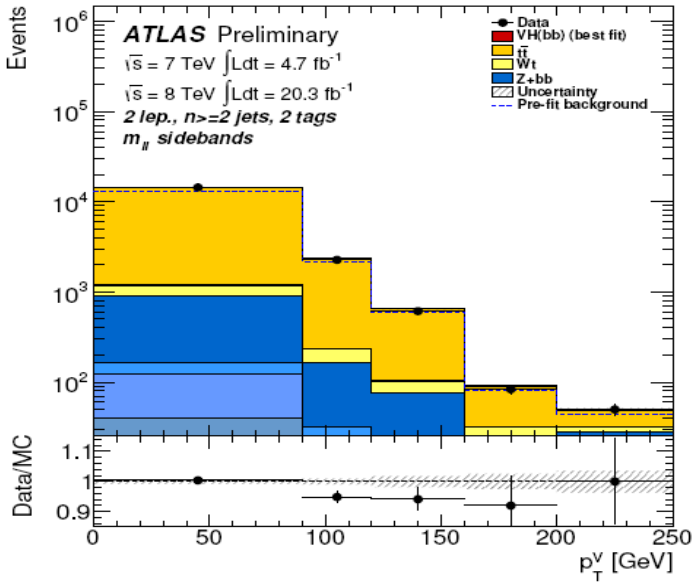

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., 3 jets, 2 tags, 90<pTV<120 GeV
Data
VH(bb) (best fit)
VZ
tt̄
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

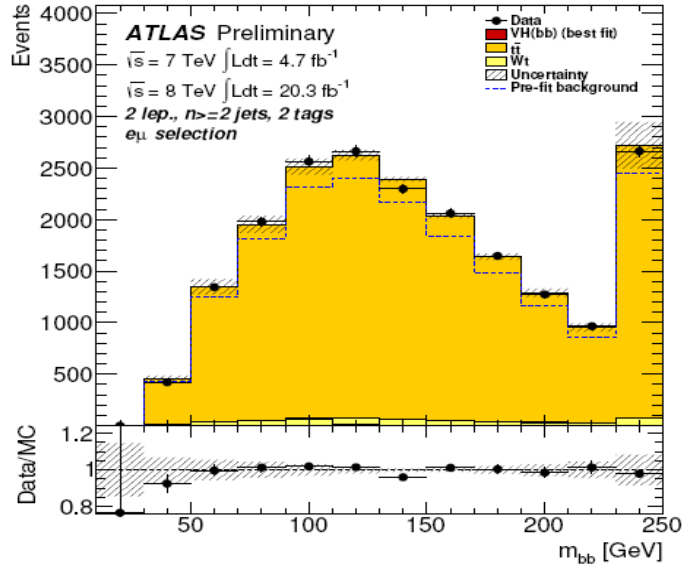

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., 3 jets, 2 tags, 120<pTV<160 GeV
Data
VH(bb) (best fit)
VZ
tt̄
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]

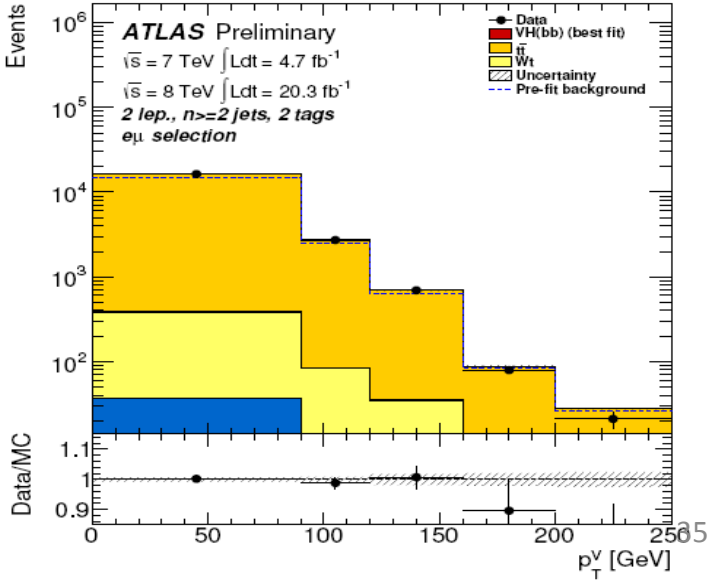

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., 3 jets, 2 tags, 160<pTV<200 GeV
Data
VH(bb) (best fit)
VZ
tt̄
Z+bb
Z+bl
Z+cc
Z+cl
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]


ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., 3 jets, 2 tags, pTV>200 GeV
Data
VH(bb) (best fit)
VZ
Z+bb
Z+bl
Z+cc
Z+cl
Z+l
Uncertainty
Pre-fit background
VH(bb) (μ=1.0)
Events
Data/MC
mbb [GeV]


ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., n>=2 jets, 2 tags
mll sidebands
Data
VH(bb) (best fit)
tt̄
Wt
Z+bb
Uncertainty
Pre-fit background
Events
Data/MC
mbb [GeV]

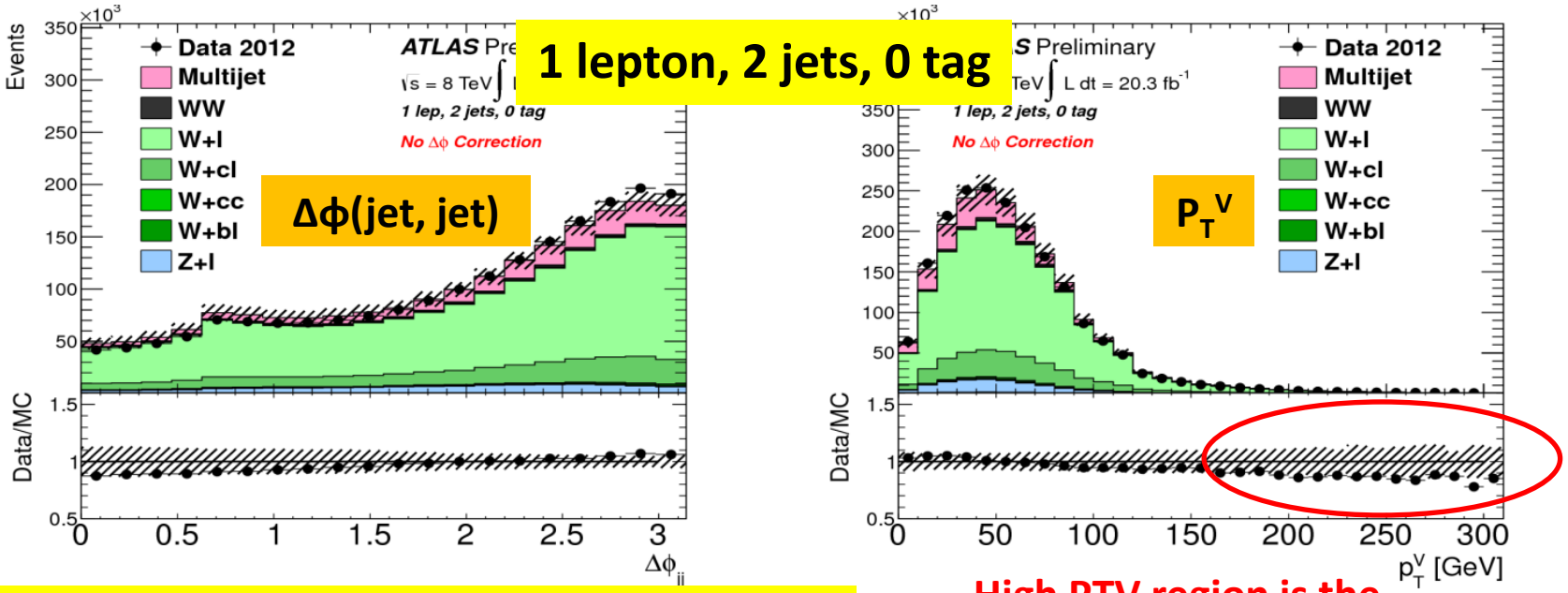

ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., n>=2 jets, 2 tags
mll sidebands
Data
VH(bb) (best fit)
tt̄
Wt
Z+bb
Uncertainty
Pre-fit background
Events
Data/MC
pTV [GeV]


ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., n>=2 jets, 2 tags
eμ selection
Data
VH(bb) (best fit)
tt̄
Wt
Uncertainty
Pre-fit background
Events
Data/MC
mbb [GeV]


ATLAS Preliminary
√s = 7 TeV ∫Ldt = 4.7 fb-1
√s = 8 TeV ∫Ldt = 20.3 fb-1
2 lep., n>=2 jets, 2 tags
eμ selection
Data
VH(bb) (best fit)
tt̄
Wt
Uncertainty
Pre-fit background
Events
Data/MC
pTV [GeV]

Background modeling (II):
V+jets before Δϕ(jet, jet) correction

- V+jets: modeled by Leading order(LO) generator.
- Mismodeling found in Δϕ(jet, jet) and P_T^V distribution.
- Interprated as Next Leading Order(NLO) effect--[arxiv: 1207.5030v1]

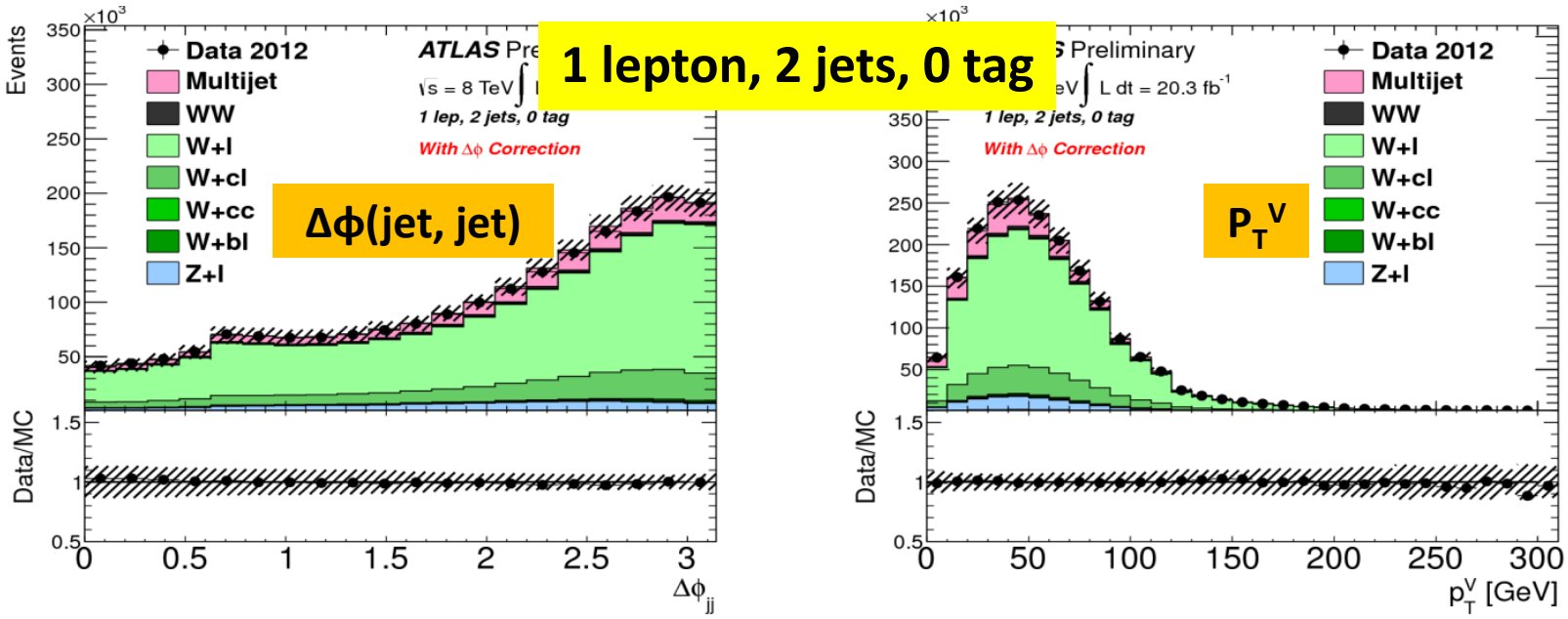


Δϕ(jet, jet) correction has been applied

High PTV region is the most sensitive region.

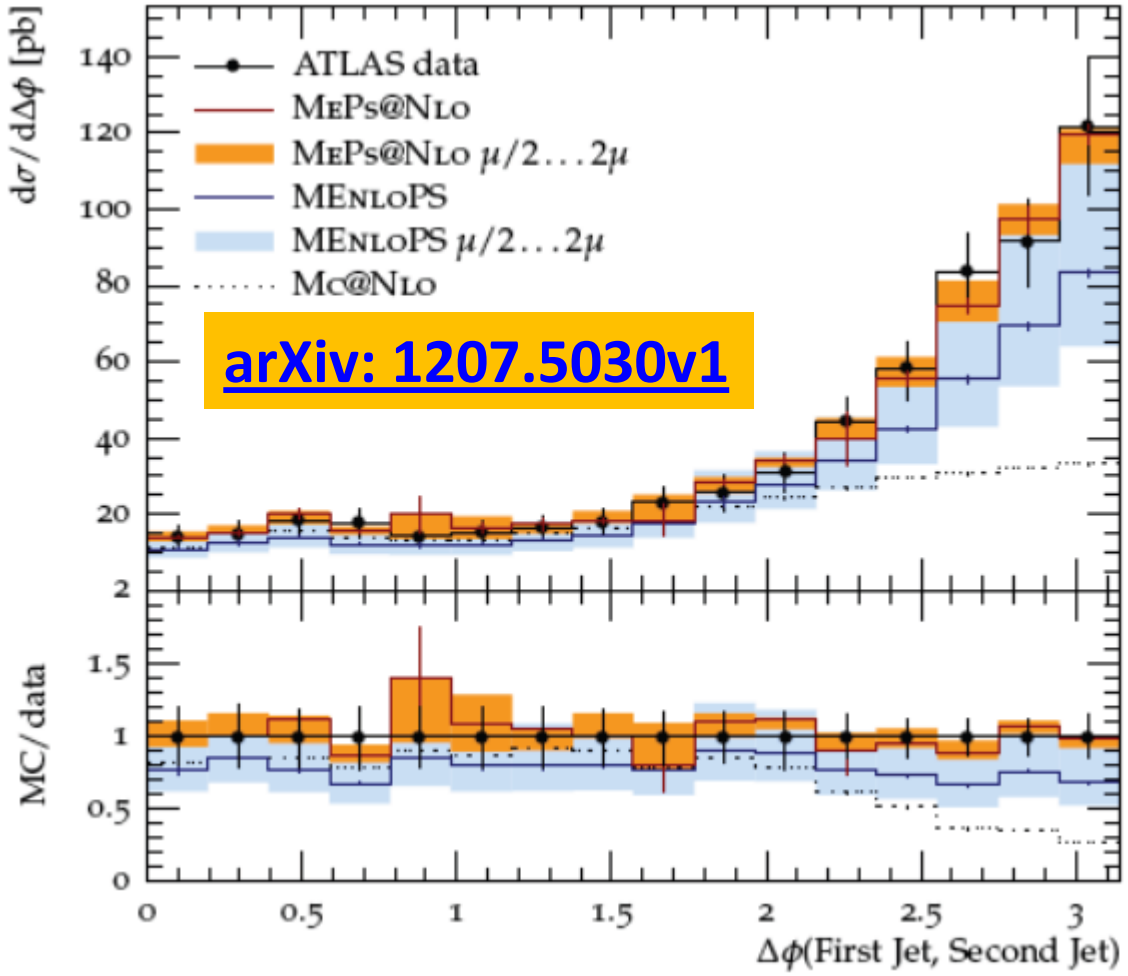
Background modeling (II):
V+jets after Δϕ(jet, jet) correction

- After Δϕ(jet, jet) correction:
  - The modeling of the P_T^W distribution greatly improved.
  - This correction has been applied in all channels and all regions.
- Z+jets : similar correction applied



- The similar reweighting has been performed in Z+jets processes.

Δϕ(jet, jet) mismodeling:
NLO effect



Modeling Sys. summary

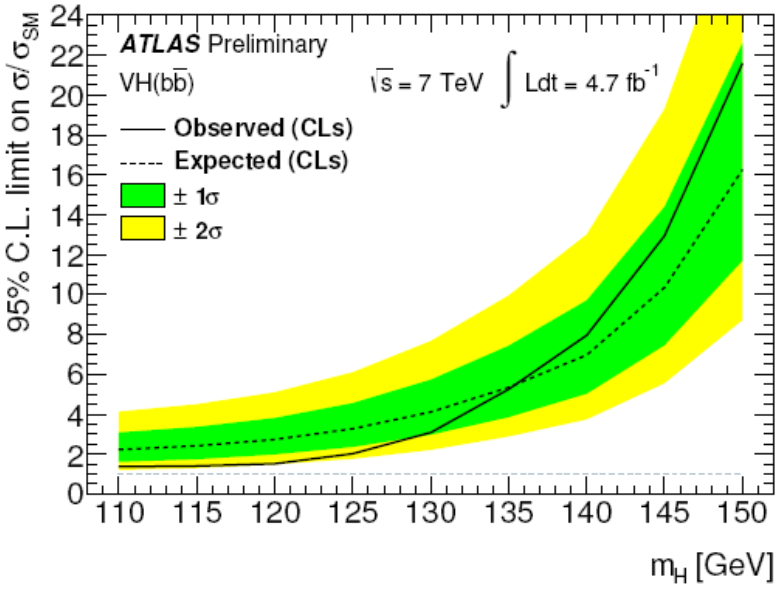
	m_{bb}	$\Delta\varphi$	p_T^V	3-to-2-jet ratio	Normalization
tt	-Herwig++/Pyt -ISR/FSR -Alpgen/MC@NLO/Powheg	-	-50% of corr. applied	-Herwig++/Pyt -ISR/FSR -Alpgen/MC@NLO/Powheg	-Freely floating
W+jets	-Sherpa/Powheg/ MC@NLO	-50% of corr. applied	-Residual data systematic	MC	-Wcl/Wbb freely floating -Relative ratios to others: 30% (NLO/ Sherpa)
Z+jets	-Extrapolation from sidebands	-50% of corr. applied	-	MC MC	-Zcl/Zbb freely floating -Relative ratios to others: 30% (NLO/ Sherpa)
single top	-Herwig++/Pyt -ISR/FSR -Alpgen/MC@NLO/Powheg	-	-Herwig++/Pyt -ISR/FSR -Alpgen/MC@NLO/ Powheg	MC	-Approx. NNLO uncertainties
Diboson	-Pythia/Herwig	-	-LO/MCFM		-NLO calculation uncertainties

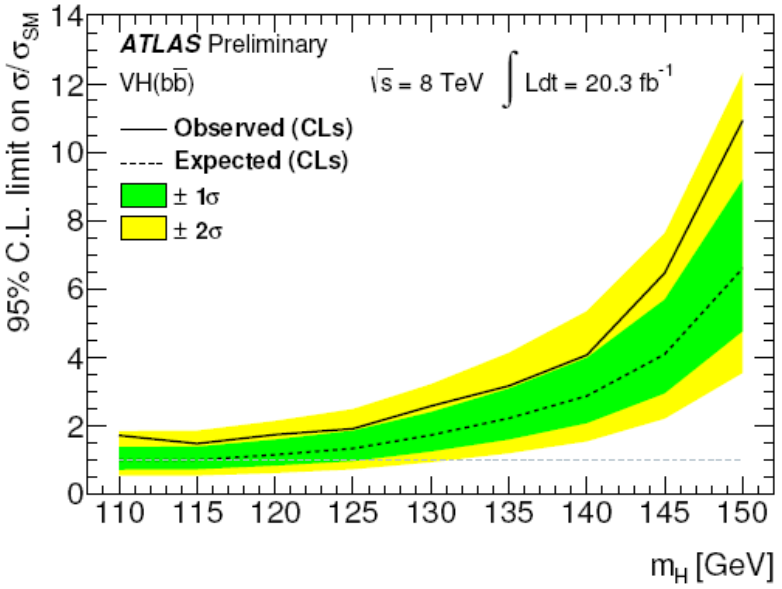
- Trigger: neglable except the 0-lepton (120-160GeV) which is about 5%.
- JES: from 4% to 1% depending on the jet p_T.
- B-tag: 2-3% over most of the jet p_T range. Due to the sample dependence, a 2% and 5% extra uncertainties have been applied for b and c jet, respectively.
- Lumi : 2.8% for 2012, 1.8% for 2011.

Fitted BKG scale factor

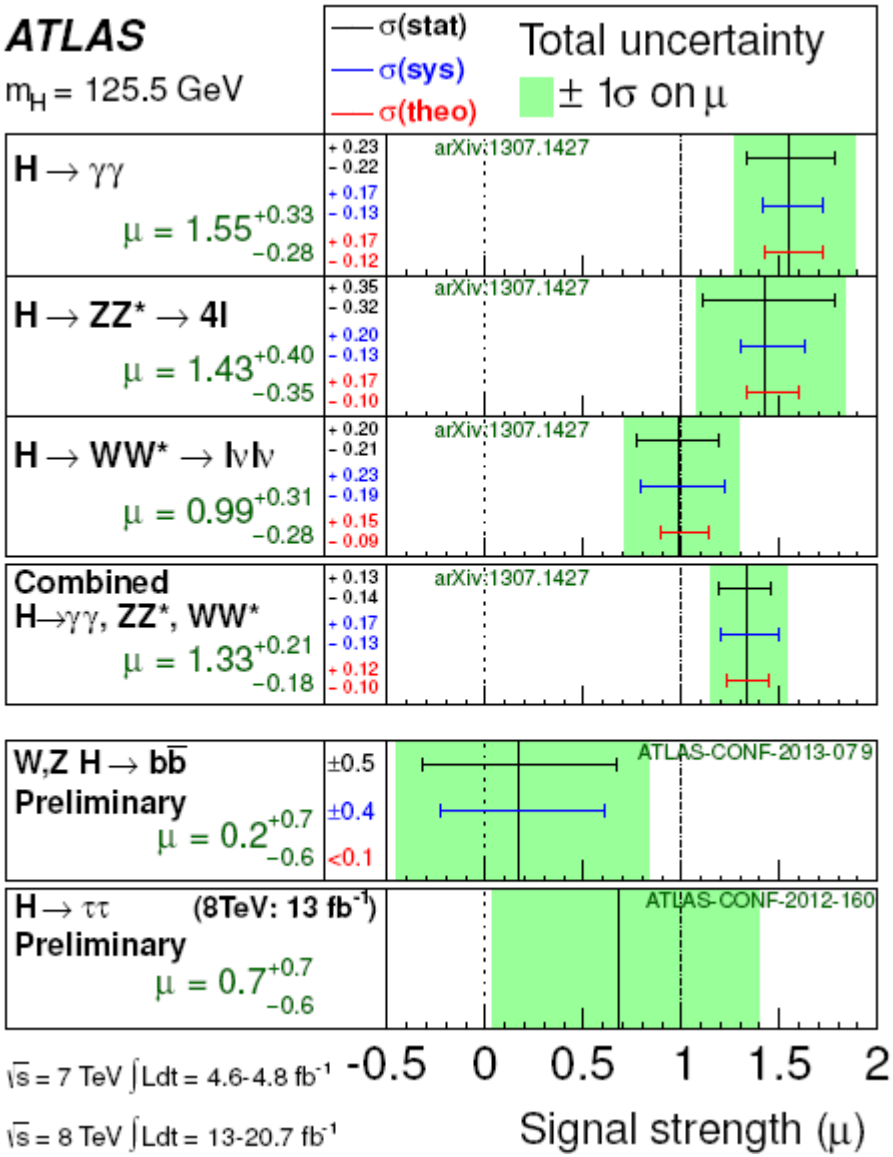
Process	Scale factor
$t\bar{t}$	1.13 ± 0.05
Wb	0.89 ± 0.15
Wcl	1.05 ± 0.14
Zb	1.30 ± 0.07
Zcl	0.89 ± 0.48

Separated limit: 7/8 TeV





ATLAS Higgs mu summary



Mbb resolution: Bukin fit