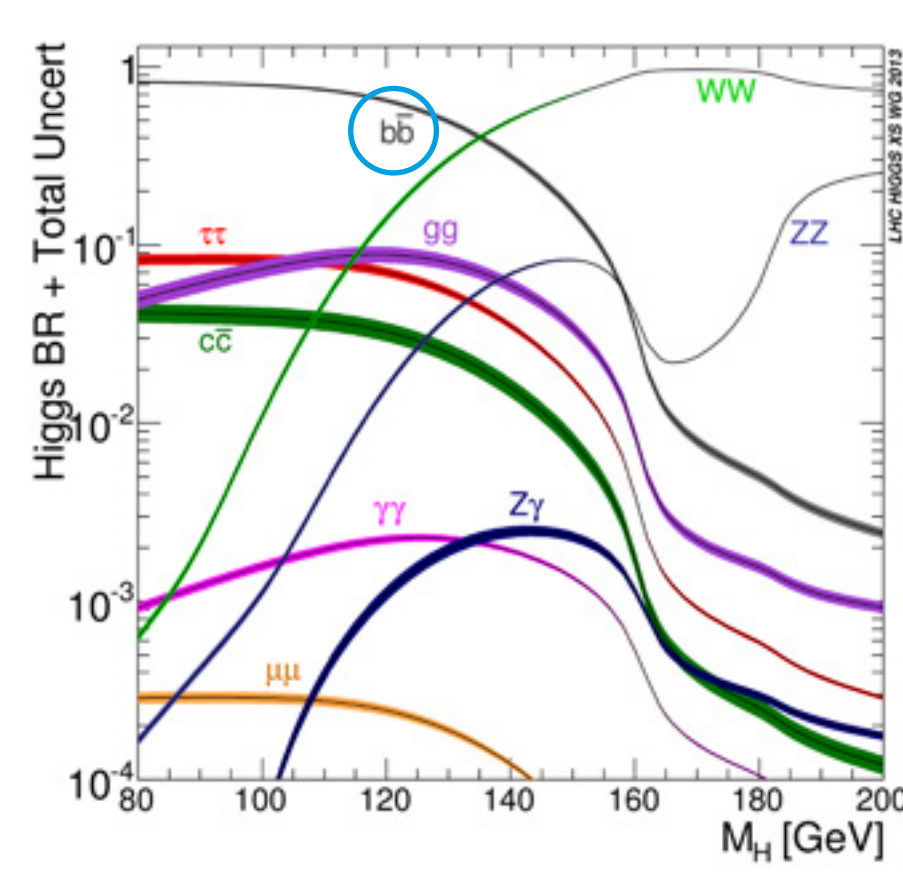
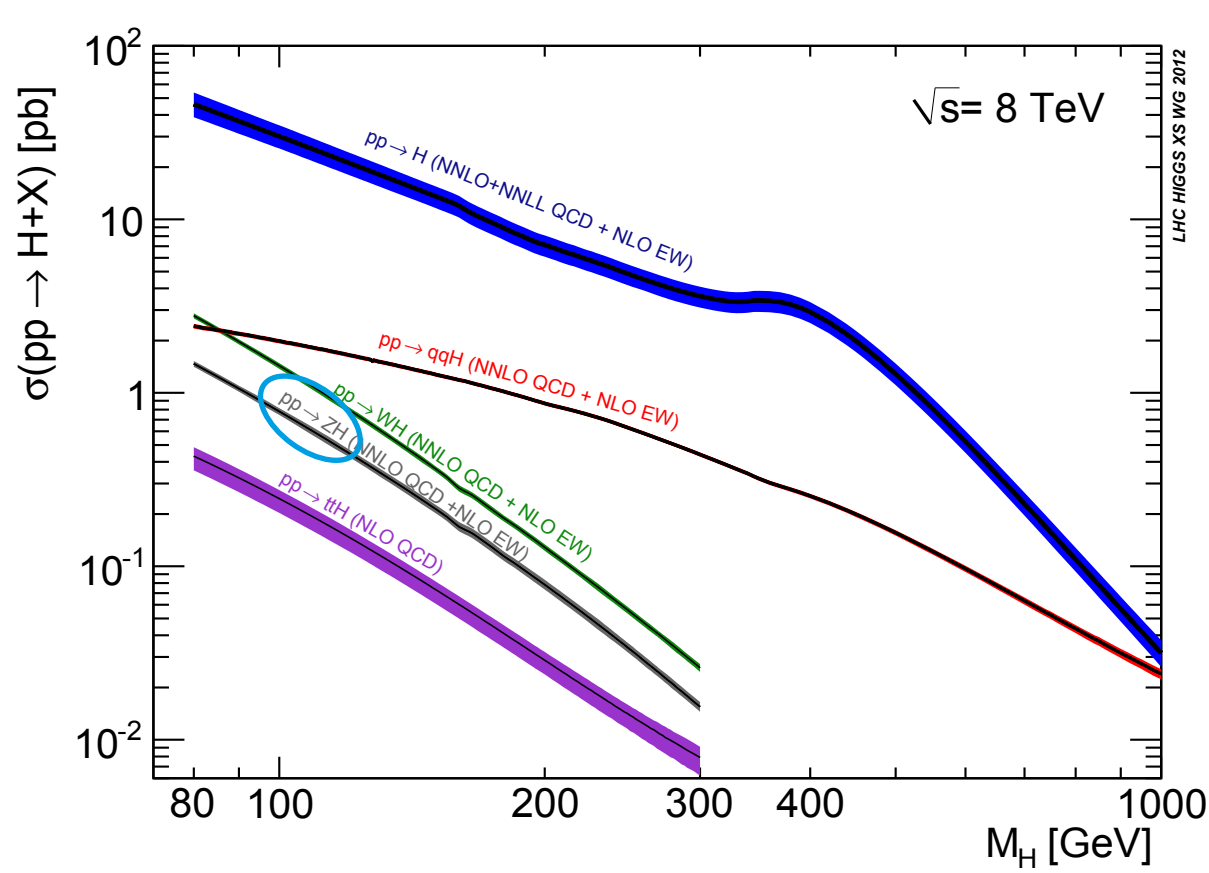




Since its discovery a large effort has been made to improve the sensitivity of analyses and make precision measurements of the properties of the Higgs Boson. At a mass of 125 GeV Higgs to bb is the dominant decay mode, however large QCD backgrounds mean that the gluon-gluon fusion production mode is not directly accessible at the LHC. Instead an analysis of Higgs to bb is considered where the Higgs is produced in association with a Vector Boson (W/Z). An ATLAS analysis of the full 7 + 8 TeV run 1 data is presented.

MOTIVATION

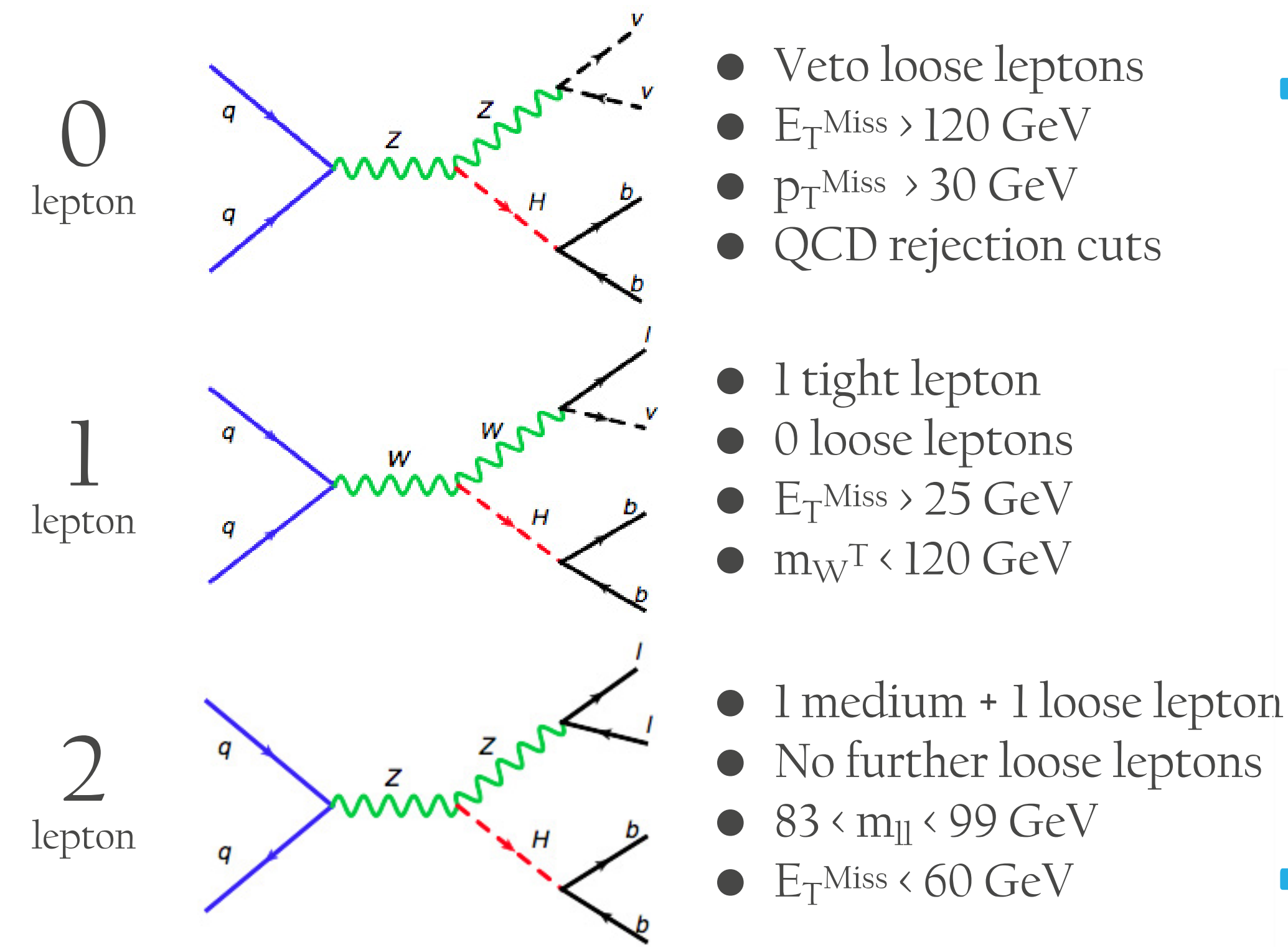
At 125 GeV the Higgs preferentially decays to a b-quark pair. Observing the Higgs coupling to fermions is important to confirm the SM Higgs hypothesis. Higgs to bb can supply direct constrain on coupling to quarks, specifically the b-quark.



Unfortunately high multi-jet background makes direct analysis impossible. Associated production mechanisms are utilised in order to reduce these backgrounds.

SEARCH STRATEGY

Three channels, 0-, 1- and 2- lepton are simultaneously explored and combined to maximise the sensitivity of the search.



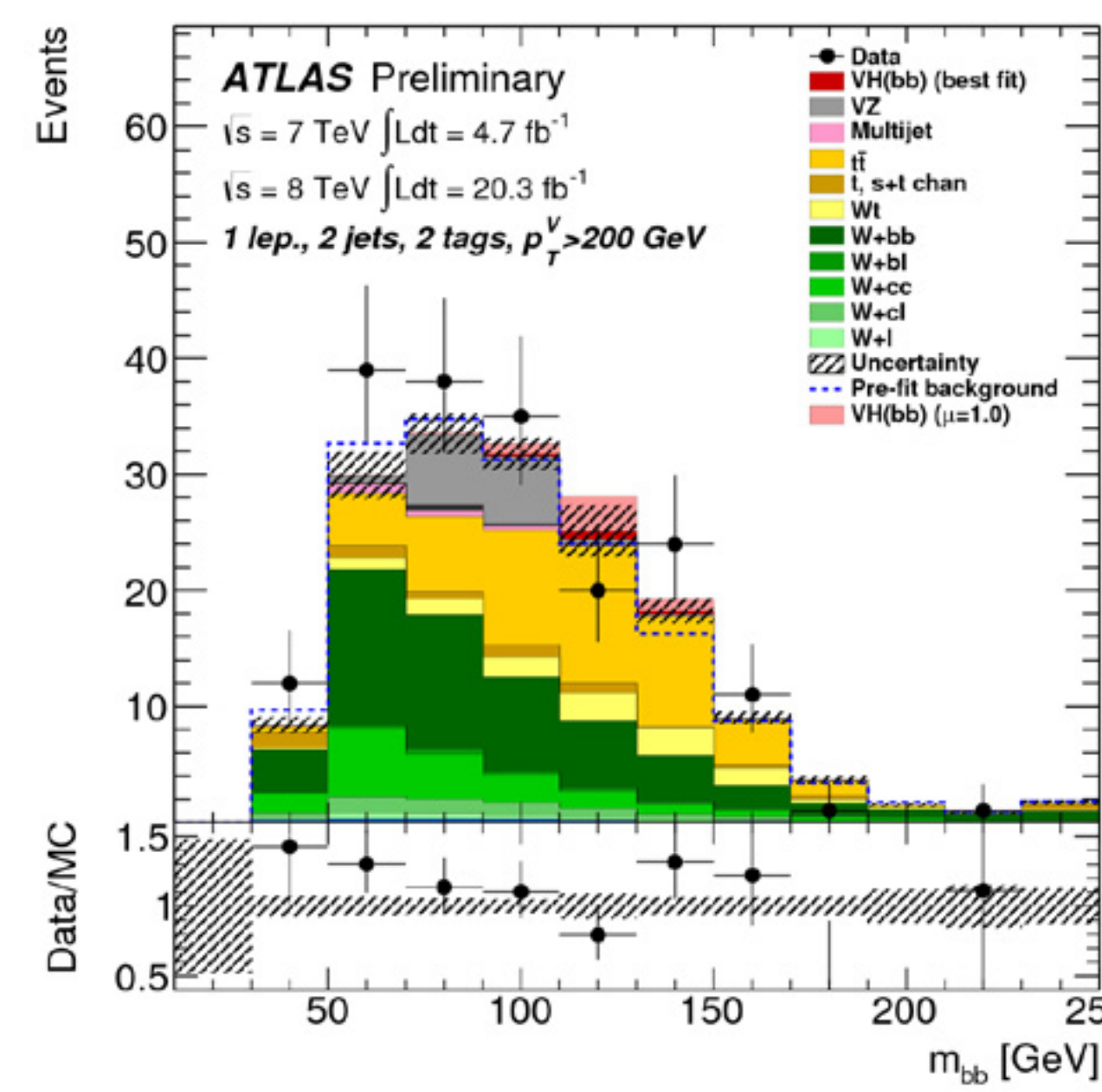
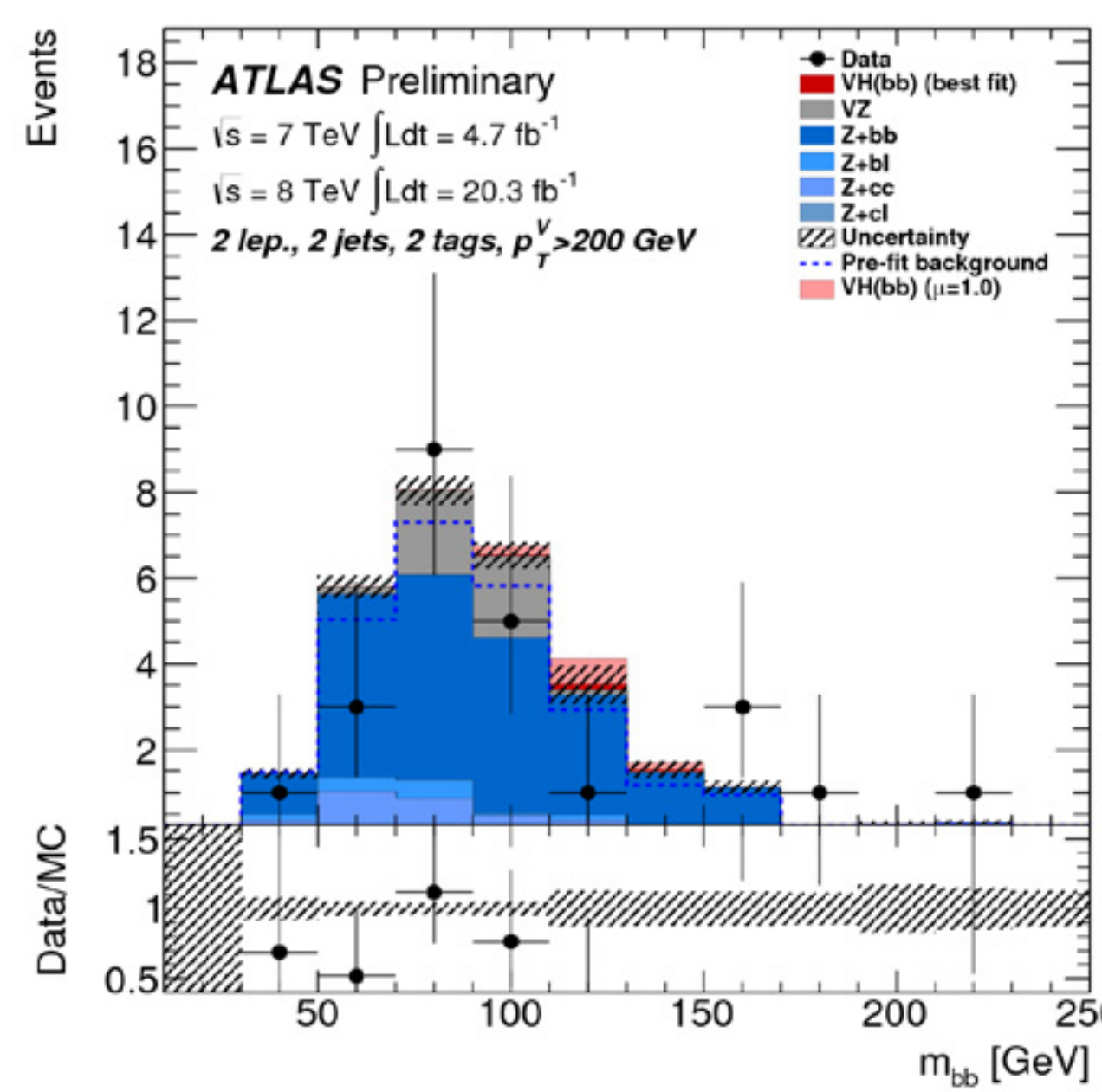
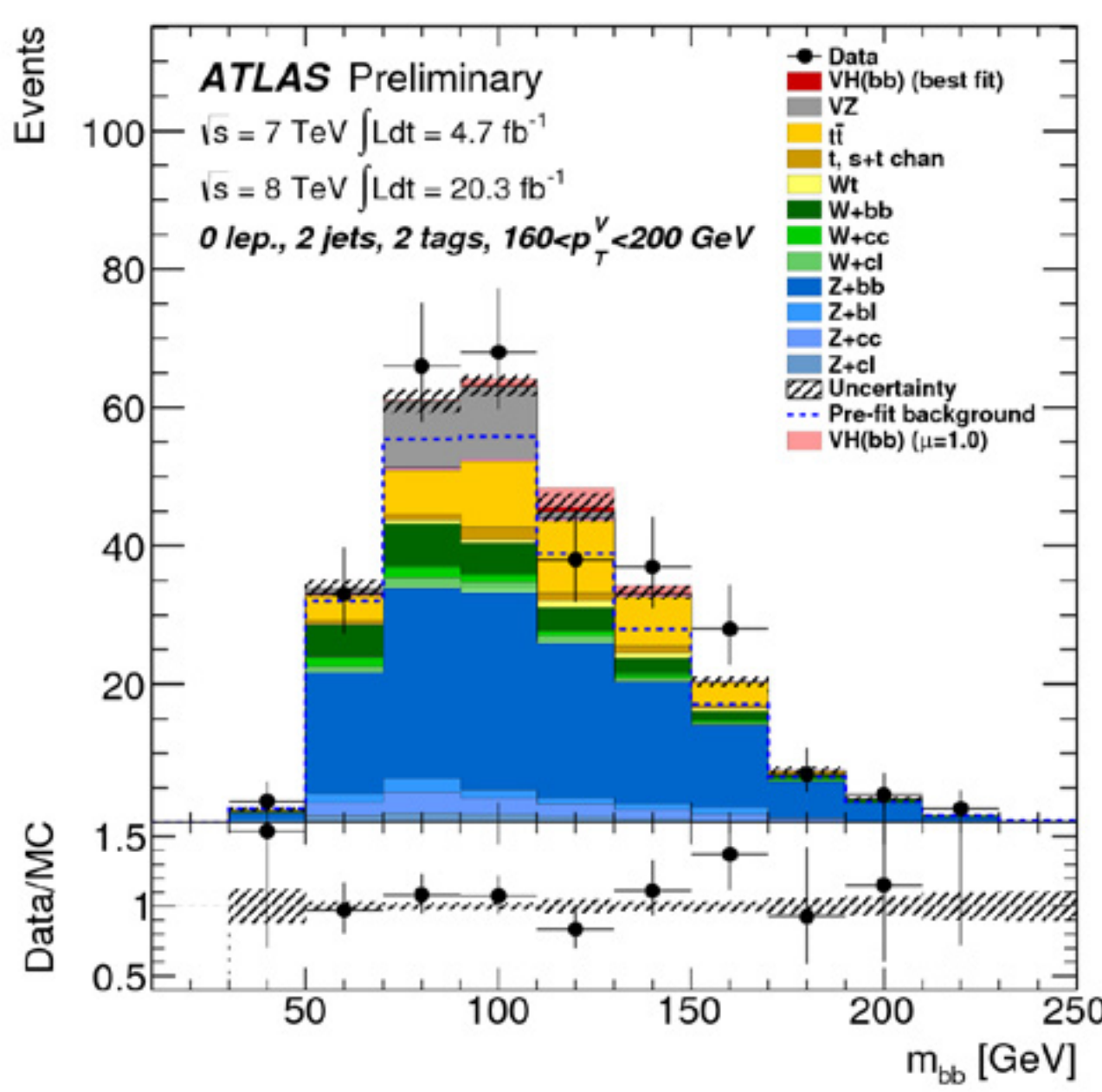
All events must contain 2 or 3 jets, of which exactly 2 are b-tagged, with lead b-jet $p_T > 45$ GeV.

Events are categorised based on n_{jet} and $p_{T, V}$ in order to exploit different S/B and increase overall sensitivity

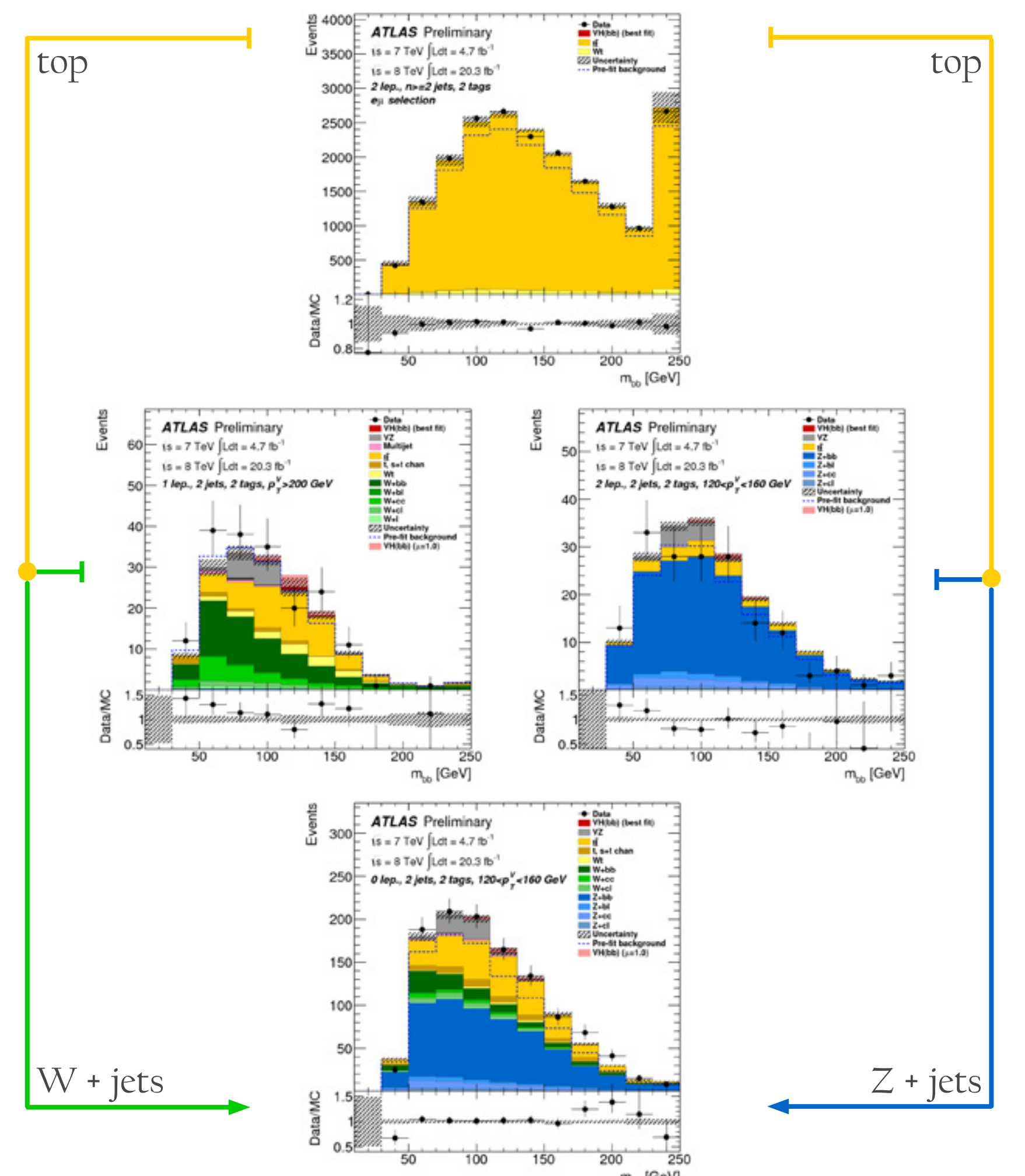
Category dependant ΔR_{bb} selection cuts help to improve modelling and increase sensitivity of the search

GLOBAL FIT

Perform analysis simultaneously in 0-, 1- and 2- lepton channels using a global binned likelihood fit to 26 2 b-tag signal regions and 31 control regions where m_{bb} is used as the discriminant variable. The table below shows regions used in the fit and the backgrounds they help constrain, examples of some post fit plots are also shown for 0-, 1- and 2- lepton in the $p_{T, V} > 200$ GeV bin.



Even in the VH channel S/B is still large and consists of a diverse selection of background processes over a large phase space. Interplay between the different control regions regions guide the fit and constrain the different backgrounds.



Normalisation of tt , W_b , W_{cl} , Z_b , and Z_{cl} backgrounds are allowed to float freely in the fit

QCD backgrounds are derived through data driven methods, other backgrounds are constrained by theoretical uncertainties

Common nuisance parameters across the regions, additional systematics placed on extrapolations of the backgrounds between regions

	2 Jet, 1 b-Tag	3 Jet, 1 b-Tag	2 Jet, 2 b-Tag	3 Jet, 2 b-Tag	Top e- μ CR
0-lepton	W+jets/Z+jets	W+jets/Z+jets/Top	Z+b/Top	Z+b/Top	-
1-lepton	W+c	W+c, Top	W+b, Top	Top	-
2-lepton	Z+c	Z+c	Z+b	Z+b	Top

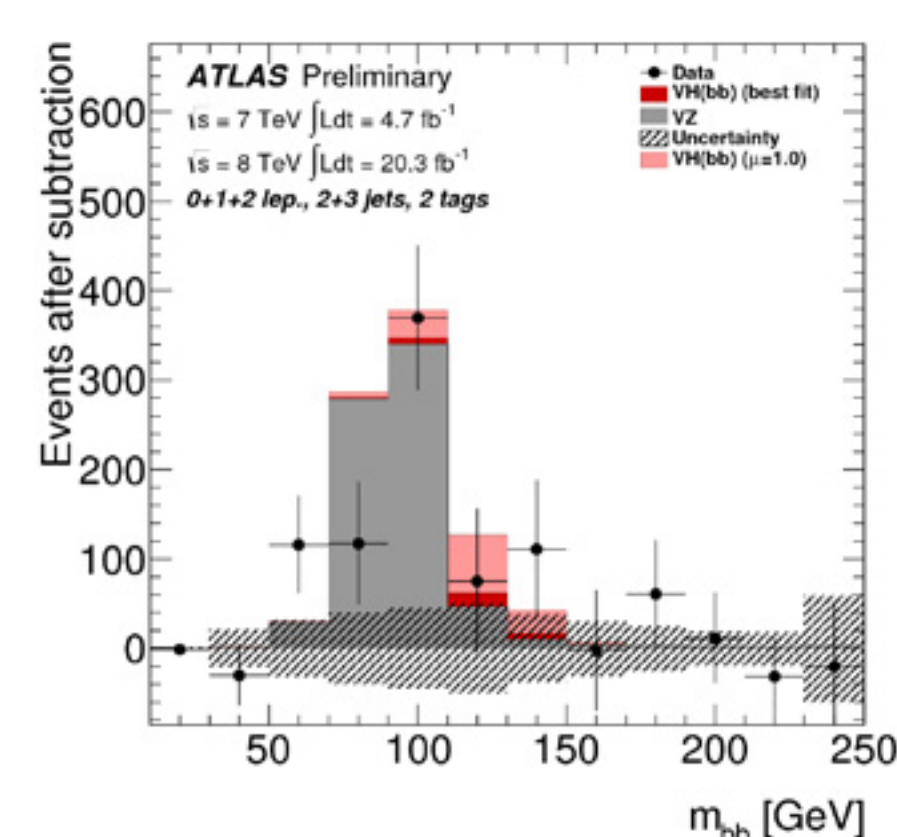
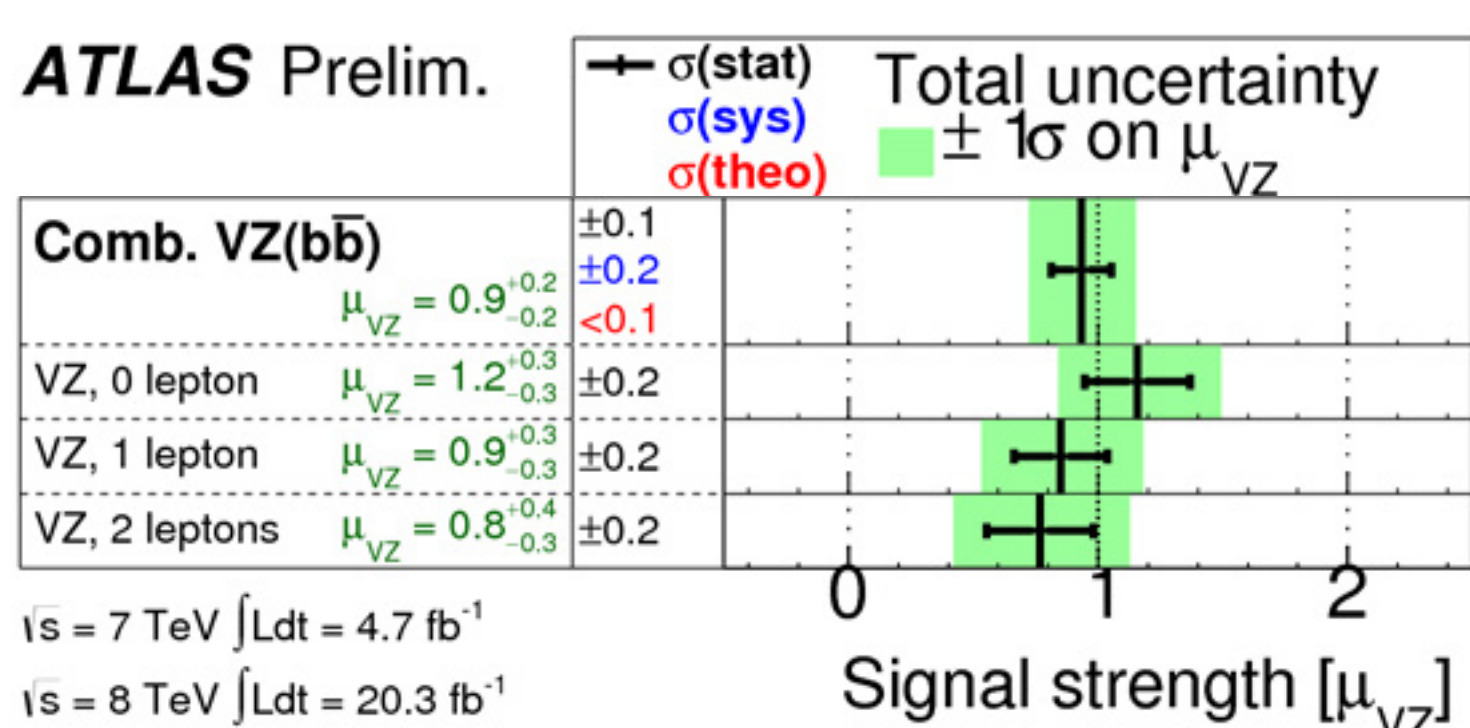
VALIDATION

By using a similar SM process, $VZ(bb)$ it is possible to validate the fit. $VZ(bb)$ is a known SM signal with a cross-section five times that of $VH(bb)$.

$VZ(bb)$ is observed at 4.8 sigma, a best fit signal strength is measured

$$\mu = 0.9 \pm 0.2$$

Consistent with SM expectation



RESULTS

Results show no significant excess observed. For a $m_H = 125$ GeV Higgs Boson the observed (expected) upper-limit on the cross-section times the branching ratio was found to be 1.4 (1.3) times the standard model prediction

A best fit signal strength is measured

$$\mu = 0.2 \pm 0.7 - 0.6$$

Measurement compatible with SM both with and without SM Higgs

