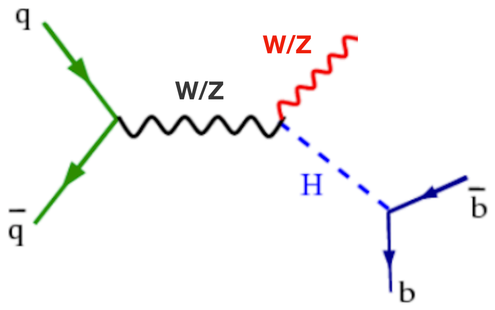
LHCP 2020 Poster Session

Measurement of the Standard Model Higgs boson produced in association with a vector boson and decaying to a pair of *b*-quarks in *pp* collisions at 13 TeV using full Run-2 data with the ATLAS detector

CONF note: ATLAS-CONF-2020-006

Introduction

- ***H→bb* decay mode with the highest branching ratio**
  - Allows the coupling to *d*-type quarks to be measured
  - Constrains the Higgs boson decay width

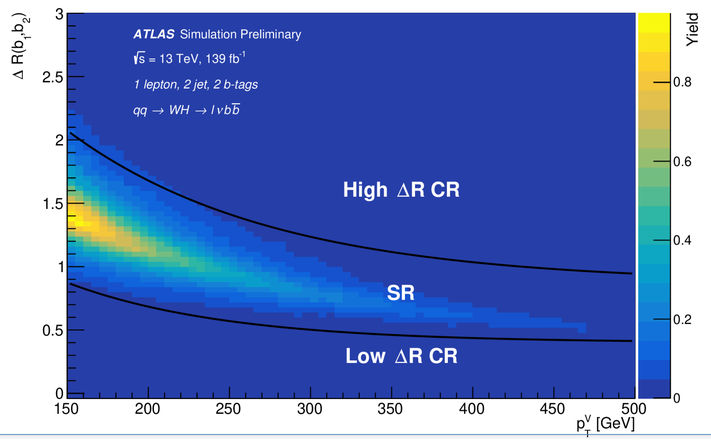


- ***VH* (*V* = *W* or *Z*) production with leptonic *V* decays**
  - Efficient trigger and multi-jet suppression
  - Improved sensitivity at high *V* transverse momentum (p_T^V)
  - The most sensitive channel to measure *H→bb*

- Three sub-channels depending on charged lepton multiplicity
  - Z→νν , W→lν and Z→ll decays targeted (l=e or μ)
- In the final state: at least 2 jets and exactly 2 *b*-tagged jets
  - 70% *b*-jet efficiency, rejection rate of ~8 for *c*-jets and ~300 for light jets

Event Categorisation

- Events are categorised dependent on:
  - Number of jets: 2-jet or 3-jet (≥3-jet in 2-lepton)
  - p_T^V: 75 GeV < p_T^V< 150 GeV (2-lepton only), 150 GeV < p_T^V< 250 GeV and p_T^V > 250 GeV
  - New ΔR$_{bb}$ between the two Higgs candidate jets: defines signal regions (SRs) and low/high ΔR$_{bb}$ control regions (CRs)
    - Continuous ΔR$_{bb}$ selection as a function of p_T^V
    - CRs provide better control of dominant backgrounds

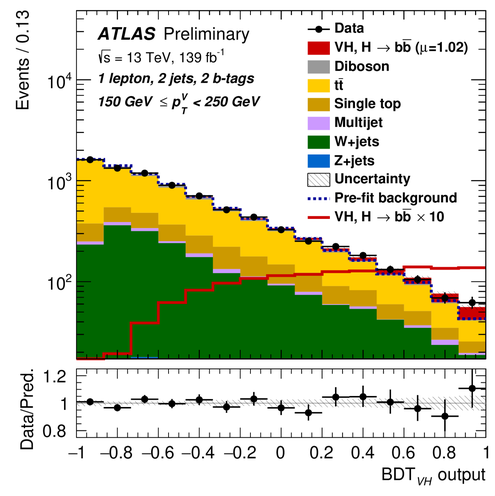


Background Modelling

- Use state-of-the-art Monte-Carlo generators to model dominant backgrounds:
  - Single top and top-pair production
  - Vector boson production in association with jets
  - Diboson production
- Data-driven method used for estimation of:
  - Multi-jet background in 1-lepton using template fit
  - New Top background in 2-lepton using eμ CR data
- Normalisation and shape uncertainties assigned to the background predictions
  - New Multi-dimensional reweighting used to extract shape uncertainties on top-pair and W+jets backgrounds

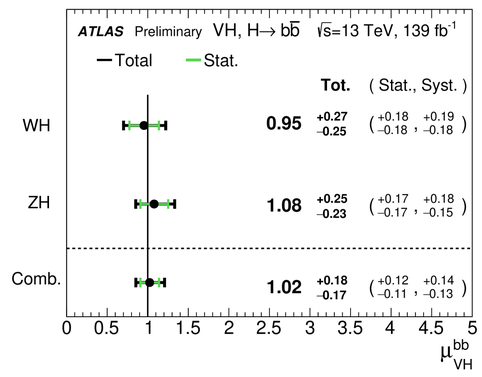
Multivariate Analysis

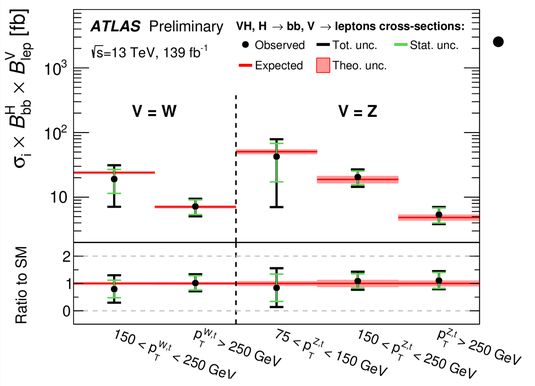
- Boosted Decision Tree (BDT) increases sensitivity in the SR
  - Discriminant constructed from variables that distinguish between *VH* signal and backgrounds
  - Trained individually in each category and channel



Results

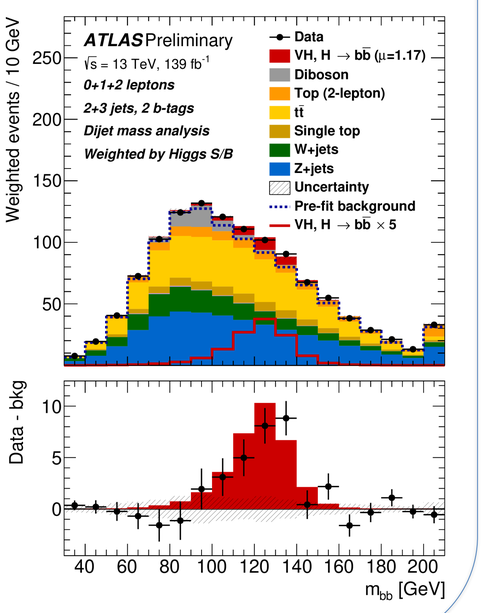
- Simultaneous binned likelihood fit in the 3-lepton channels uses yields in the CRs and BDT distributions in SRs





- The *VH*, *H→bb* signal strength defined as the ratio of the observed signal yield to the expected yield: μ_{VH}^{bb} = 1.02 ± 0.18
- Observation of *VH* with 6.7σ
- Observation of *ZH* with 5.3σ and strong evidence of *WH* with 4.0σ
- Simplified template cross-section measurement in 5 p_T^V bins
  - Good agreement with the SM

- Validated with diboson (*VZ*, *Z→bb*) analysis: μ_{VZ}^{bb} = 0.93 ± 0.15
- Cross-checked using di-jet mass (m_{bb}) instead of the BDT discriminant in the SR:
  - μ_{VH}^{bb} = 1.17 ± 0.24
  - Observation of *VH* with 5.5σ



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