Search for pair-produced vector-like quarks decaying to a Z boson with the ATLAS experiment

Tiago Vale, on behalf of the ATLAS Collaboration

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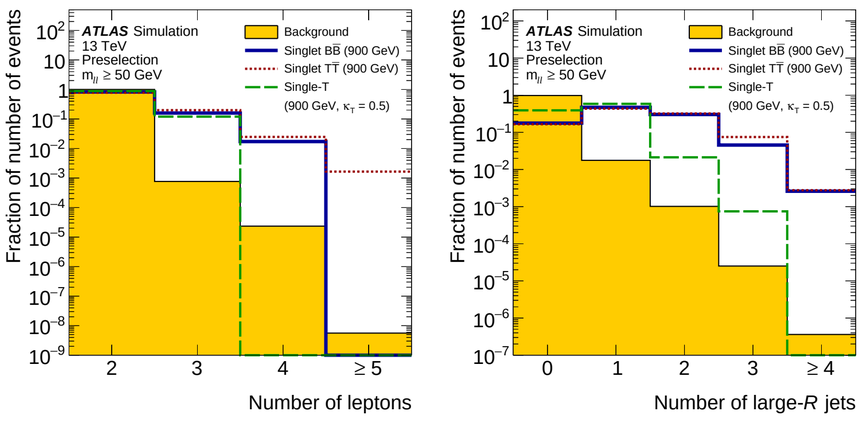
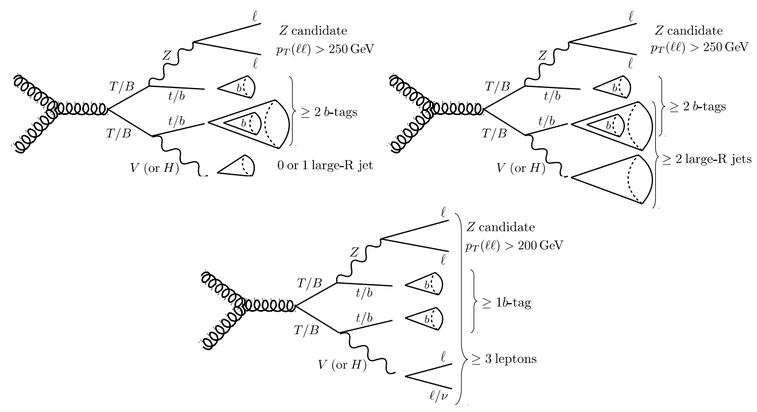
Vector-like quarks are predicted by many beyond the Standard Model theories [1]. They have the same left- and right-handed SU(2) quantum numbers and can have Flavor-Changing Neutral Currents at tree level. They can be isospin singlets, doublets or triplets. This analysis [2] uses the 2015 and 2016 dataset collected by the ATLAS detector, corresponding to 36.1 fb^{-1}, targeting pair-production of VLQ with at least one decay to Zt/b. Channels design, signal regions and results interpretation are shown.

Analysis strategy

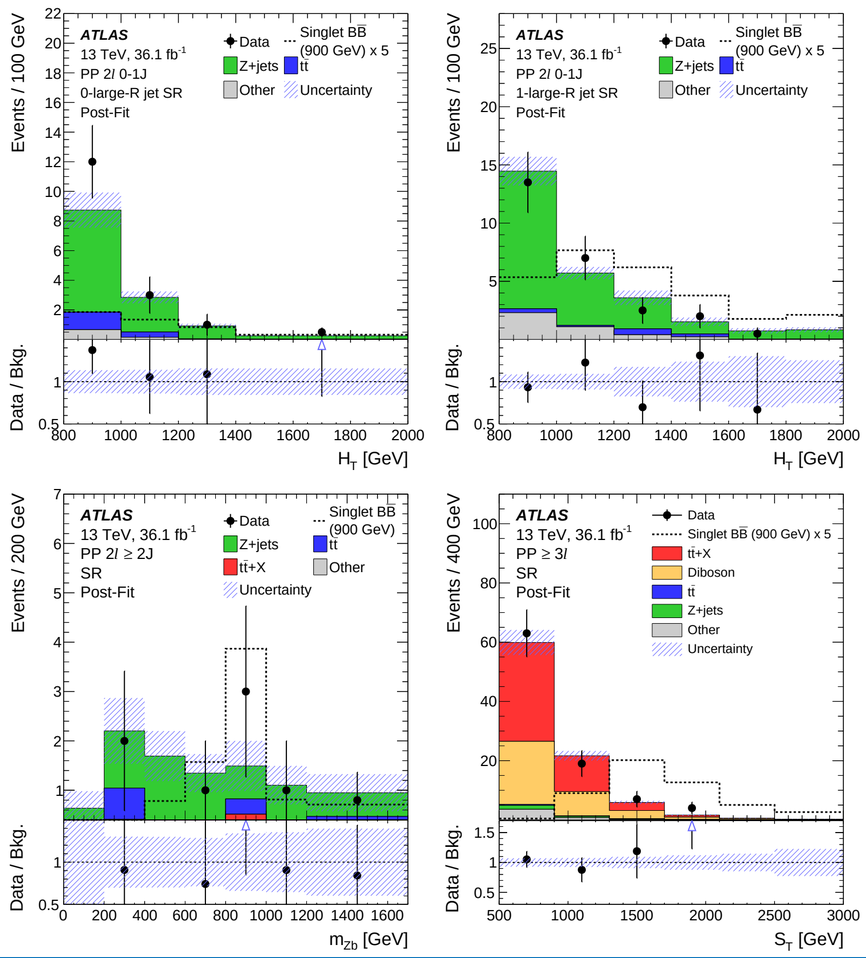


- 2ℓ and 3ℓ channels $\rightarrow$ High **statistics** and high **signal purity**.
- **Resolved** 2ℓ with 0-1 large-R jet, **boosted** 2ℓ channel with ≥ 2.



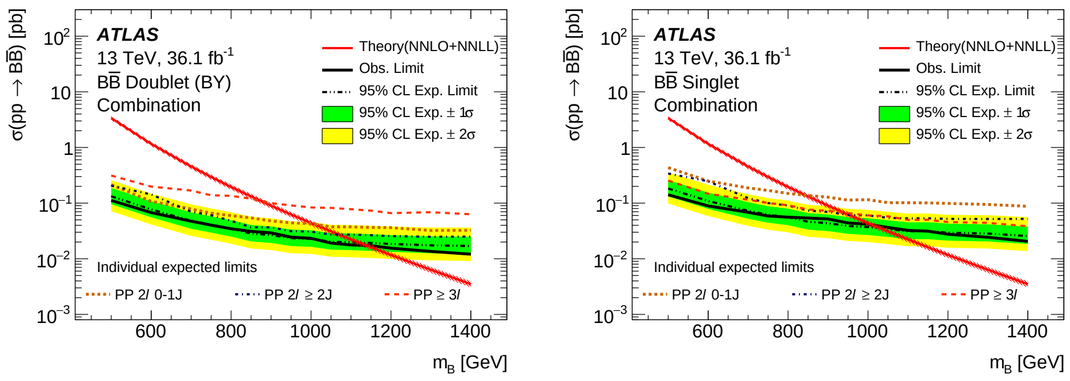
Signal Regions

Top: PP 2ℓ 0-1J, **Bottom left**: PP $2\ell \geq 2$J, **Bottom right**: PP $\geq 3\ell$
H_T: Σp_T(jets), **S_T**: Σp_T(jets+leptons)

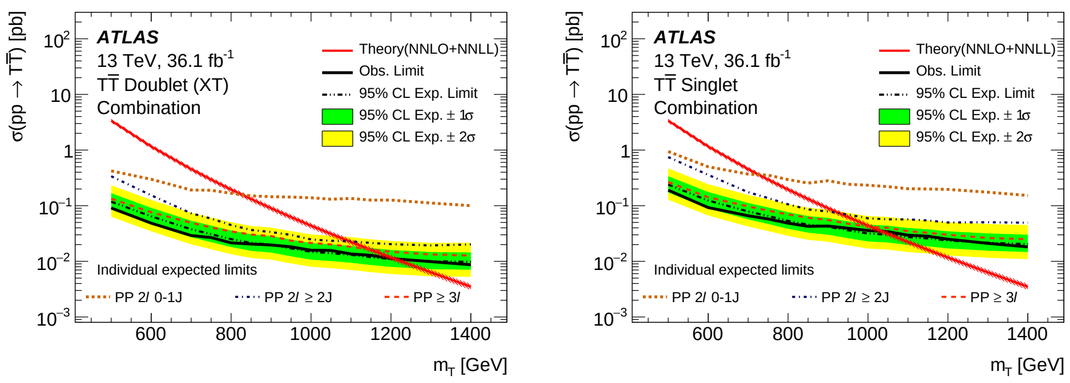


Lower mass limits

Lower mass limits with 95% Confidence Level (C.L.) were derived using the CL_S method in a profile likelihood fit, for the singlet and doublet hypotheses. It combines all channels' signal and control regions.



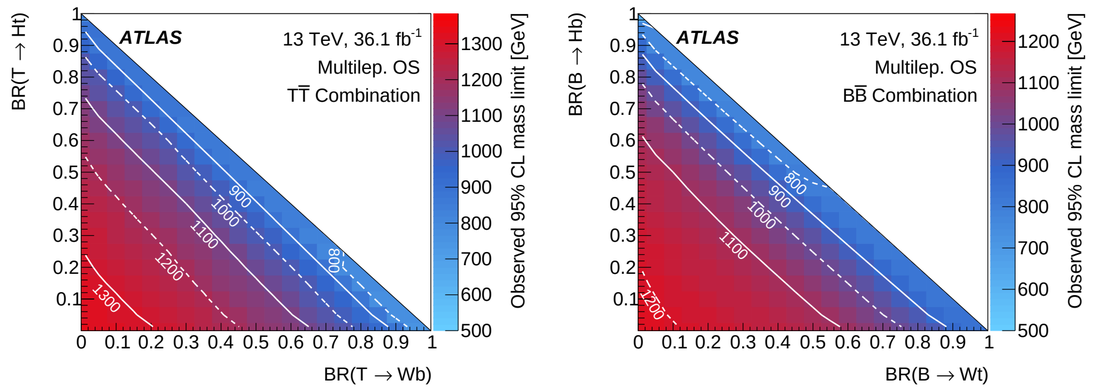
The vector-like B, in the singlet and doublet hypotheses has observed lower mass limits of **1010** and **1140** GeV, respectively.



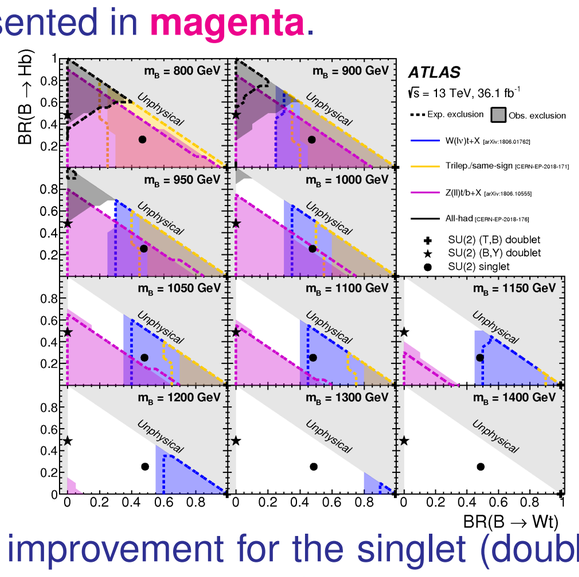
The vector-like T, in the singlet and doublet hypotheses has observed lower mass limits of **1030** and **1210** GeV, respectively.

Branching Ratio scan

Observed 95% C.L. lower limits on the mass of vector-like quarks for **all BR combinations**, adding up to unity.



Observed 95% CL **exclusion** for different VLQ masses in the combination of all pair-production analyses [3]. The search from this poster is represented in **magenta**.



270 (160) GeV improvement for the singlet (doublet) vector-like T and **200 (10)** GeV for the vector-like B, w.r.t. this analysis. Major contribution to the Z corner of the BR plane.

References:

1. **J. A. Aguilar-Saavedra**, *Identifying top partners at LHC*, JHEP 11 (2009) 030
2. **ATLAS Collaboration**, *Search for pair- and single-production of vector-like quarks in final states with at least one Z boson decaying into a pair of electrons or muons in pp collision data collected with the ATLAS detector at $\sqrt{s}$=13 TeV*, https://arxiv.org/abs/1806.10555
3. **ATLAS Collaboration**, *Combination of the searches for pair-produced vector-like partners of the third-generation quarks at $\sqrt{s} = 13$ TeV with the ATLAS detector*, https://arxiv.org/abs/1808.02343

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