

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



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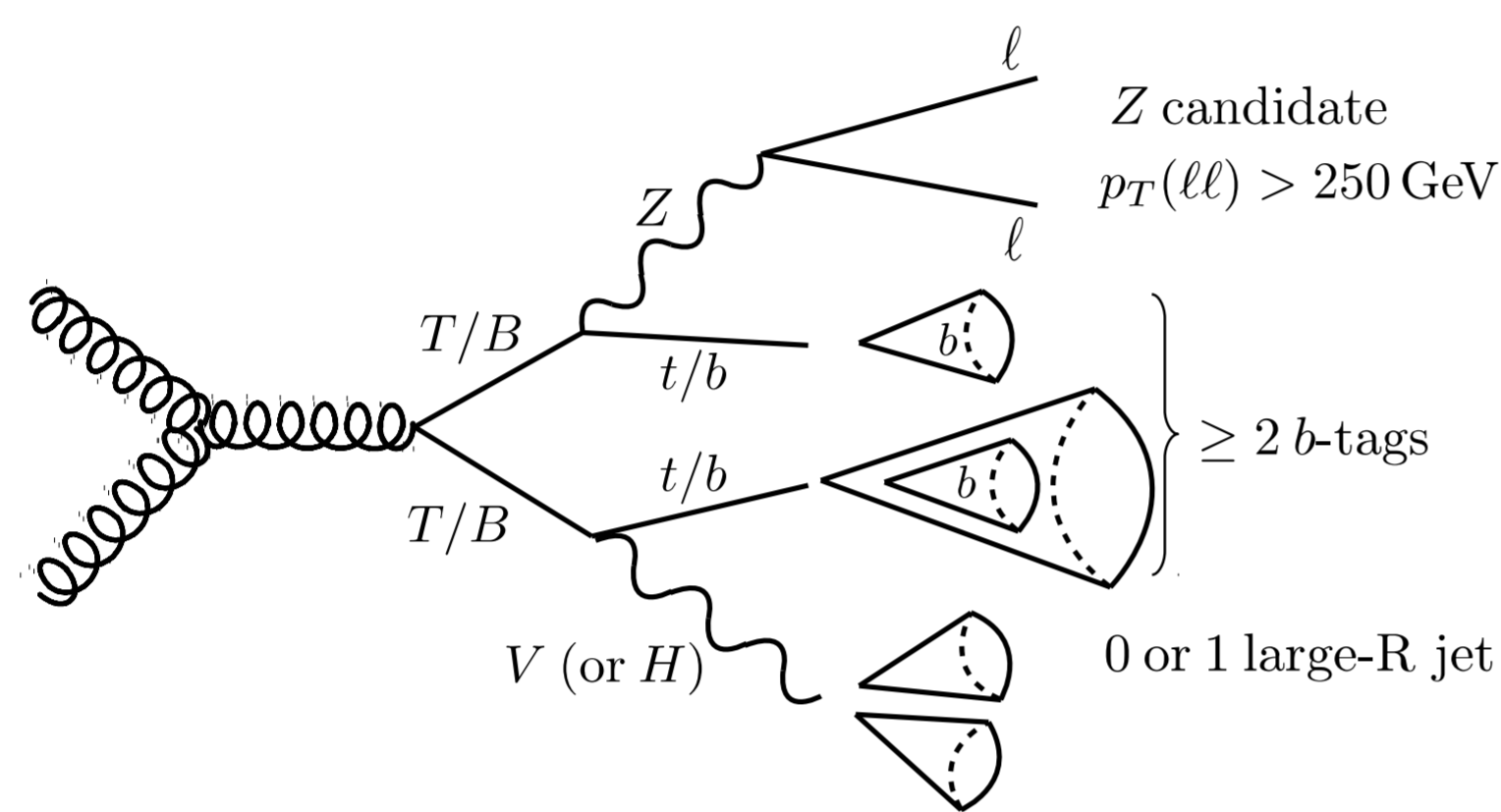


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Vector-like quarks are a prediction of many beyond the Standard Model theories [1]. They have the same left- and right-handed SU(2) quantum numbers and can have FCNC at tree level. They can be isospin singlets, doublets or triplets. This analysis uses the full run-2 dataset collected by the ATLAS detector, targeting pair production of VLQ (with SM electric charge) decaying to a Z boson, in a semi-boosted, dileptonic final state. This is a key channel in the evolution of the Run 1 analysis published by ATLAS [2]. Control and signal regions design, results interpretation and treatment of the systematic uncertainties are discussed.

Analysis strategy

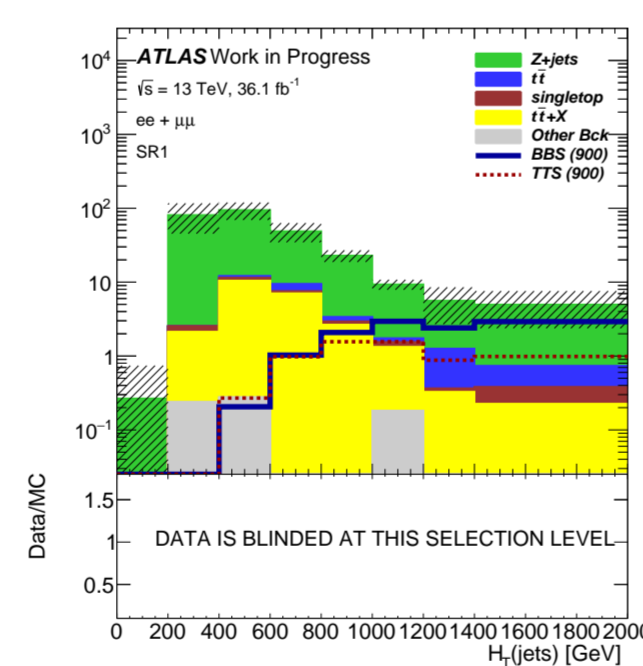
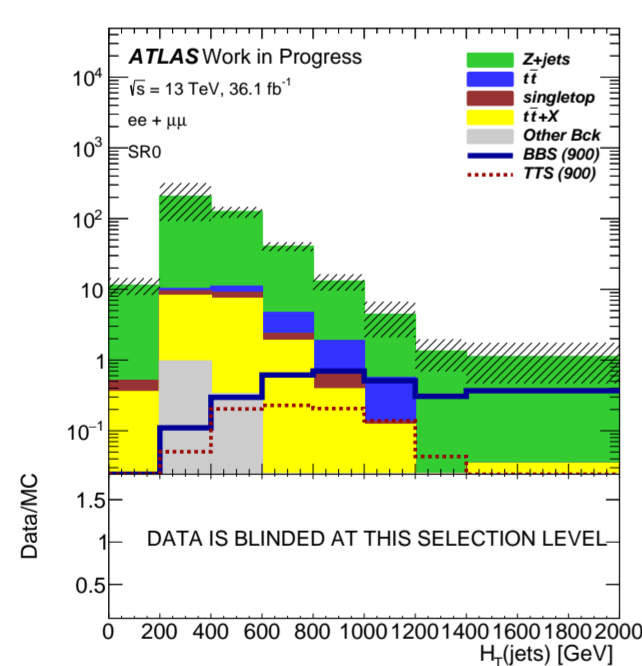
Semi-boosted channel to be combined with a boosted dilepton channel and a trilepton channel. Search for events with low large-R jet multiplicity, at least 2 b -tagged jets and high energy Z candidate.



There will be two signal regions, split by multiplicity of large-R jets, to take advantage of the signal to background composition differences, in order to improve the fit. Two control regions are defined, targeting the two main backgrounds: Z + jets and $t\bar{t}$. The scalar sum of jets p_T will be used as the discriminant variable.

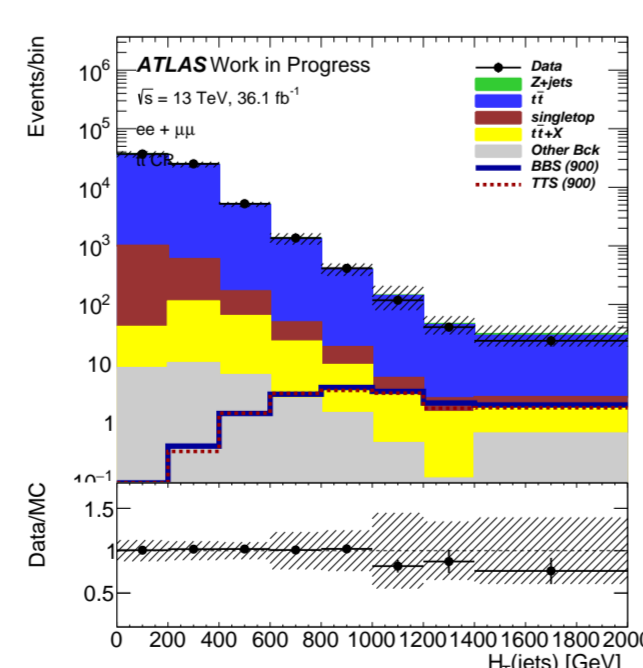
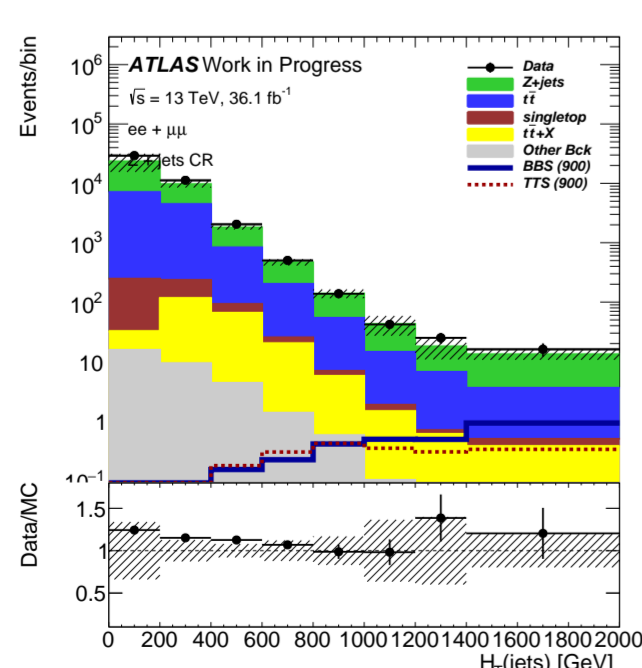
Signal Regions

- Pre-Selection: ≥ 2 b -tagged jets, ≤ 1 large-R jet, 1 OS-SF lepton pair with mass > 50 GeV
- Signal Regions: 0 or 1 large-R jet, $|m_{\ell\ell} - m_Z| < 10$ GeV, $p_T(\ell\ell) < 250$ GeV



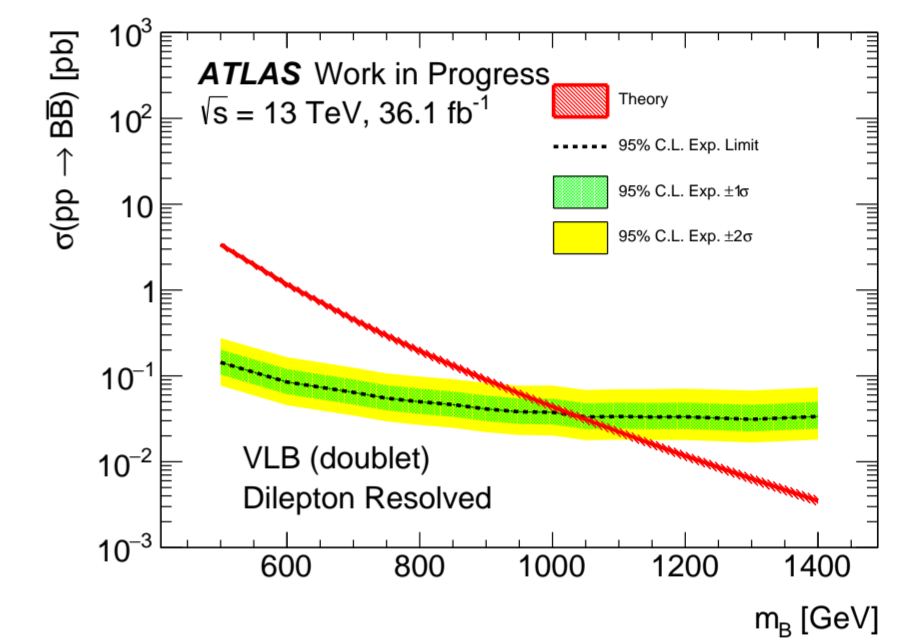
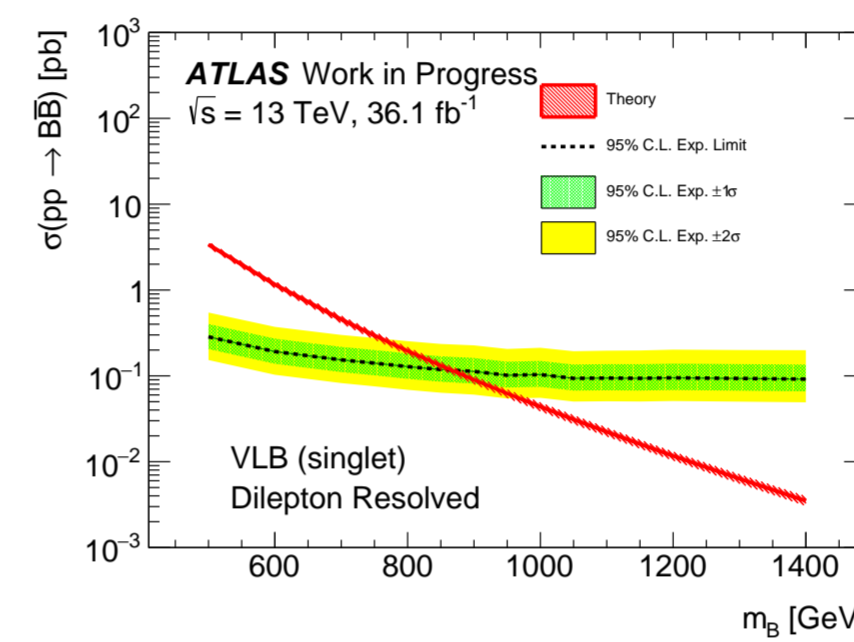
Control Regions

- Z + jets CR (left): $|m_{\ell\ell} - m_Z| < 10$ GeV, $p_T(\ell\ell) < 250$ GeV
- $t\bar{t}$ CR (right): $|m_{\ell\ell} - m_Z| > 10$ GeV, $p_T(\ell\ell) < 600$ GeV

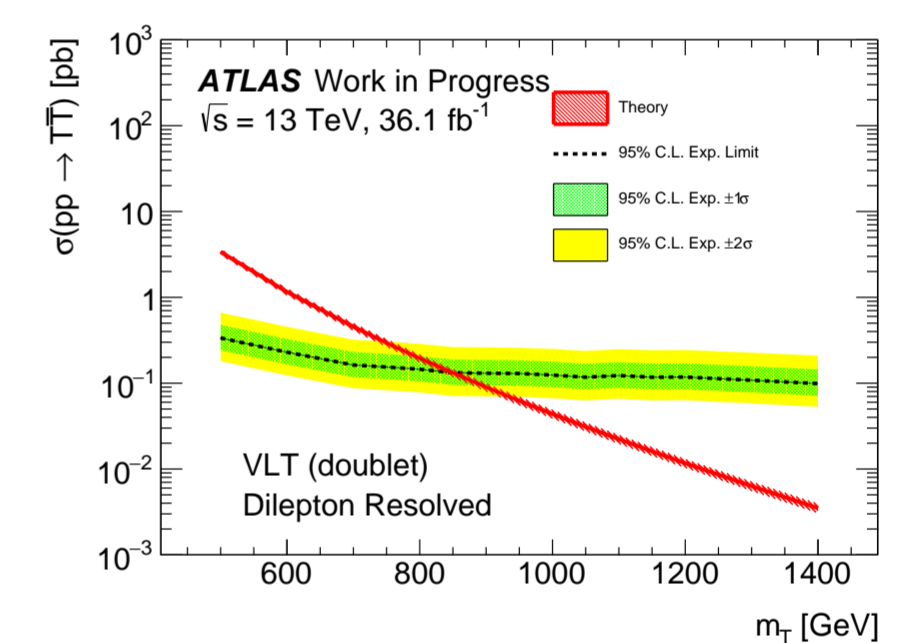
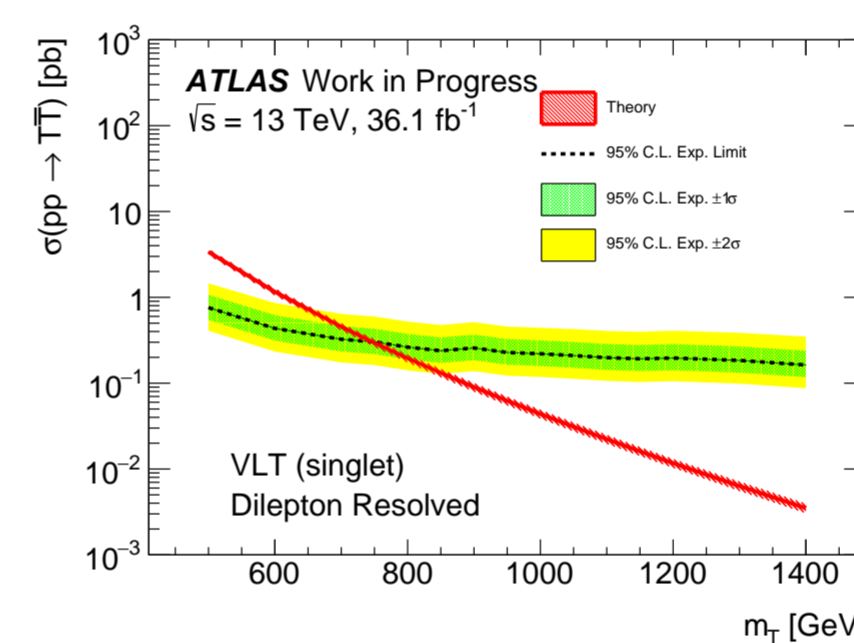


Expected mass limits

Expected upper limits (stat only) with 95% Confidence Level (C.L.) were derived using the CL_S method, for the singlet and doublet hypotheses.



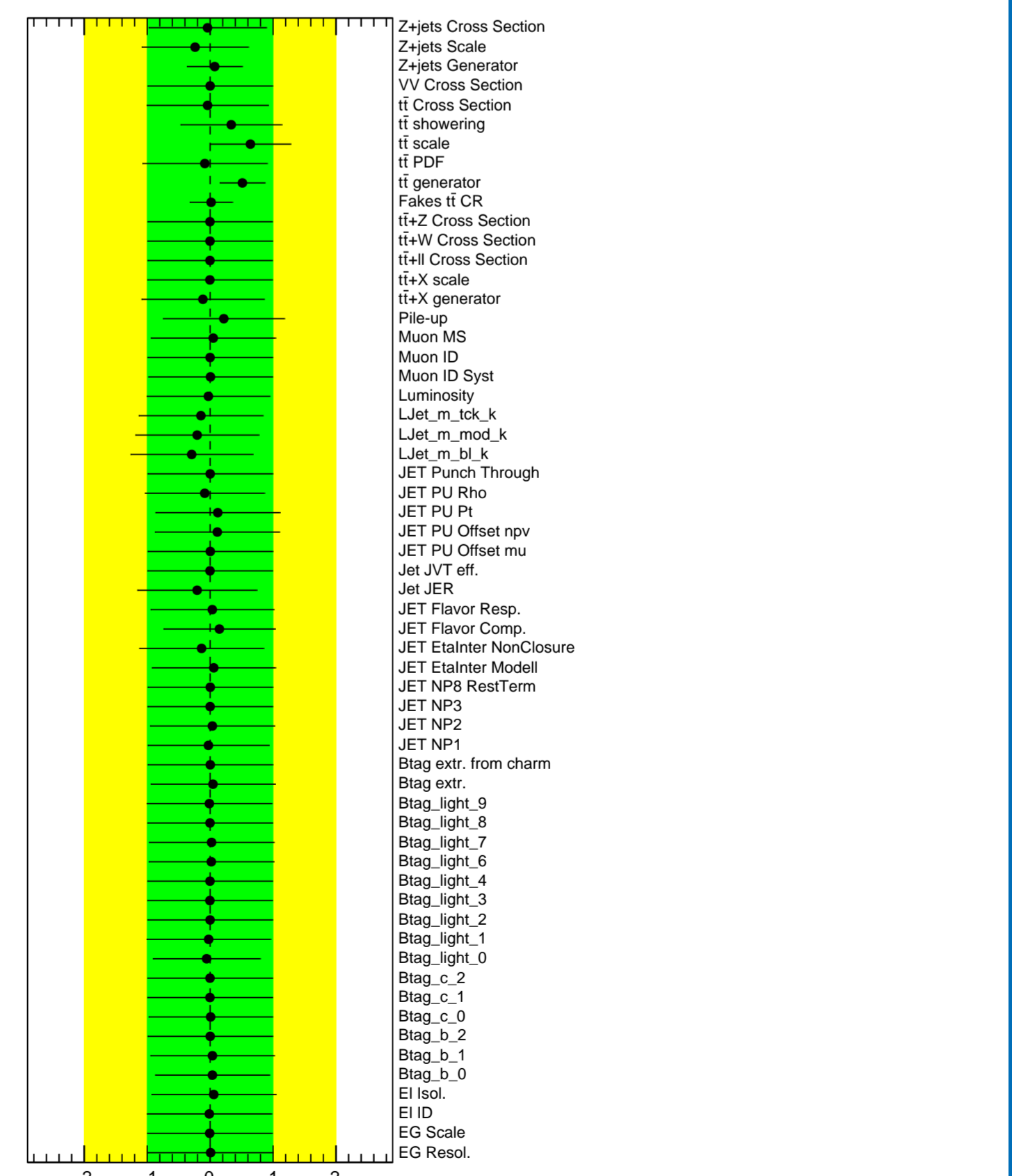
The vector-like B , in the singlet and doublet hypotheses has expected lower mass limits of 864 and 1034 GeV, respectively.



The vector-like T , in the singlet and doublet hypotheses has expected lower mass limits of 746 and 850 GeV, respectively.

Fitting strategy

Background only fit, with data in the signal and control regions. Experimental and theoretical uncertainties are fitted as nuisance parameters.



References:

1. J. A. Aguilar-Saavedra, *Identifying top partners at LHC*, Journal of High Energy Physics, Volume 2009, JHEP11(2009)
2. ATLAS Collaboration, *Search for pair and single production of new heavy quarks that decay to a Z boson and a third-generation quark in pp collisions at sqrt(s) = 8 TeV with the ATLAS detector*, JHEP 11 (2014) 104