



BETHEL
UNIVERSITY

VLQ Pair search, Deep jet ID

PROPOSED HL-LHC PROJECTION

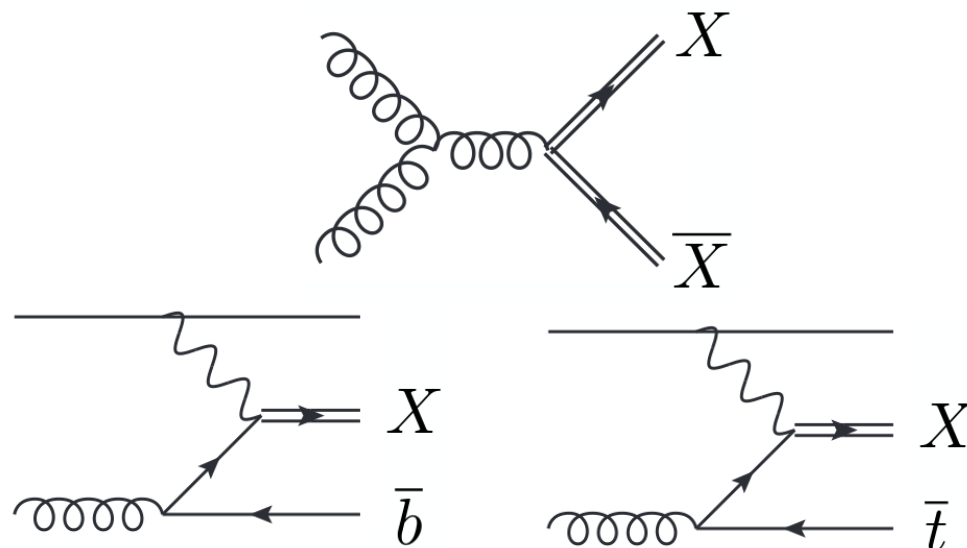
J. HOGAN

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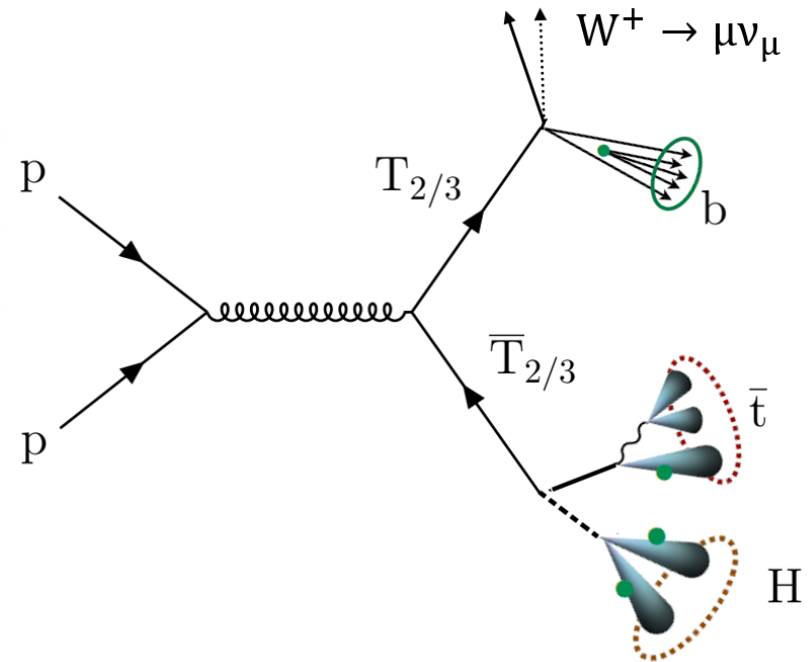
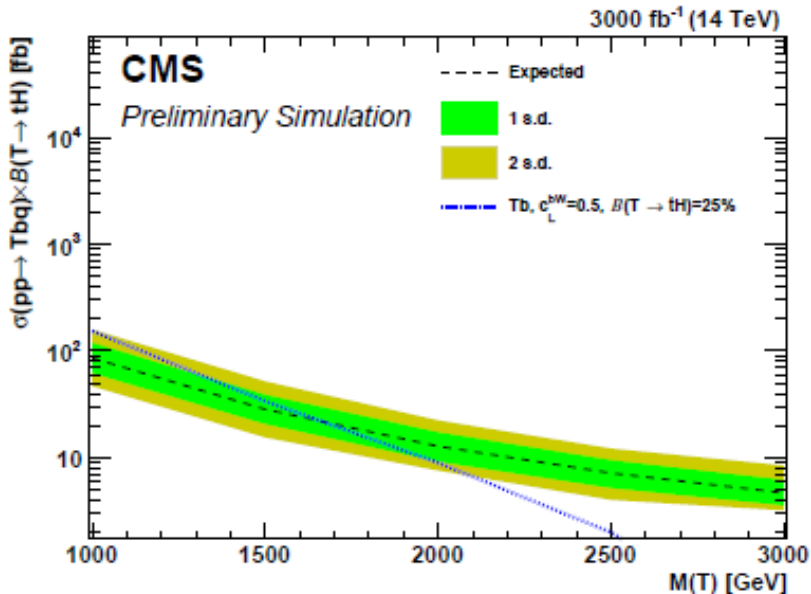
- ▶ Many SM extensions feature **new fermions**
- ▶ Non-chiral **vector-like quarks** in models such as Little/Composite Higgs
- ▶ Could help stabilize Higgs mass – no Yukawa coupling required for mass term
- ▶ **Strong** production of pairs, **electroweak** single production
- ▶ Various multiplets possible with corresponding T or B decay modes (preferential mixing with 3rd generation SM)

Weak multiplets (isospin_{hypercharge})

Singlets	Doublets	Triplets
$1_{2/3} = T$	$2_{1/6} = \begin{pmatrix} T \\ B \end{pmatrix}$	$3_{2/3} = \begin{pmatrix} X \\ T \\ B \end{pmatrix}$
$1_{-1/3} = B$	$2_{7/6} = \begin{pmatrix} X \\ T \end{pmatrix}$	$3_{-1/3} = \begin{pmatrix} T \\ B \\ Y \end{pmatrix}$
	$2_{-5/6} = \begin{pmatrix} B \\ Y \end{pmatrix}$	



- ▶ Robust search program in ATLAS and CMS in many final states – sensitivity pushing past 1.4 TeV in some production/decay modes
- ▶ **Unique signature** with many high-momentum, massive SM particles
- ▶ [Previous CMS projection](#) of $T \rightarrow tH$ search was performed using traditional boosted object identification
- ▶ Many Run 2 searches now utilize jet identification techniques based on **deep neural networks**



- ▶ CMS search for **T quark pairs** in a single lepton final state
- ▶ Large-radius jets identified using the [DeepAK8 algorithm](#)
- ▶ Investigate DeepAK8 performance in 200 PU simulation
- ▶ Validate application/parameterization in Delphes framework
- ▶ HL-LHC sensitivity projection with various uncertainty scenarios
- ▶ Participate in upcoming CMS LoI

