

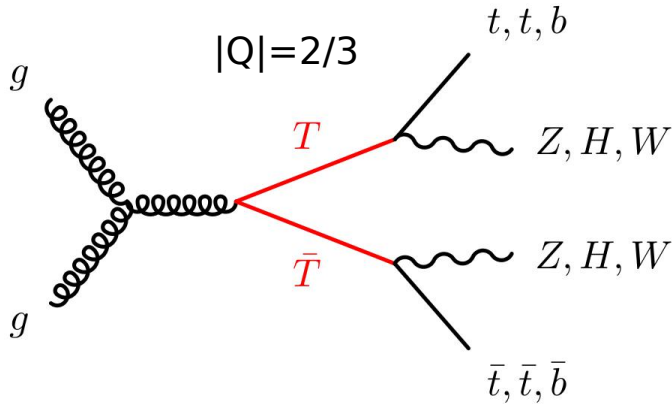
A recast of VLQ

Dipan Sengupta, Gang Li, Ui Min, Fangzhou Xu

ATLAS-EXOT-2016-15 (arXiv: 1705.10751)

VLQ pair production

13 TeV, 36.1 fb⁻¹



$T \rightarrow Zt, Wb, Ht$

Br(Zt)=0.8
Br(Wb)=0.1
Br(Ht)=0.1

BRs depend on the model

Singlet	Doublet	$T \rightarrow Zt$	$T \rightarrow Wb$	$T \rightarrow Ht$	Benchmark

$p p \rightarrow T T^{\sim}$
 $m_T = 1 \text{ TeV}$

This analysis focuses on the channel $T T^{\sim} \rightarrow Zt + X$, where the Z boson decays into a neutrino pair and exactly one charged lepton is produced in either the top quark decay or from the other leg of the VLT pair de-

ATLAS:

LO: Protos 2.2

NNLL: Top++ 2.0, 0.044 \pm 0.005 pb

Our group:

LO: FeynRules + MadGraph5_aMC@NLO v2.4.3
0.03253 \pm 0.00019 pb

```
import model VLQ_UFO
generate p p > tp tp~, (tp > t z, z > vl vl~), tp~ > t~ z
+ PYTHIA 6 + Delphes 3.4.1
```

validation: OK

Rec. and Cuts

Cut
Event cleaning → no
≥ 1 baseline lepton
≥ 1 signal lepton
= 1 signal lepton
= 1 baseline lepton
$E_T^{\text{miss}} > 200$ GeV
≥ 4 jets
Trigger
$ \Delta\phi(j_i, E_T^{\text{miss}}) > 0.4, i = 1, 2$
$m_T^W > 120$ GeV
≥ 1 b-jet
$am_{T2} > 175$ GeV
$m_{T2}^\tau > 80$ GeV
$E_T^{\text{miss}} > 350$ GeV
$m_T^W > 170$ GeV
$H_{T,\text{sig}}^{\text{miss}} > 12$
small- R jet p_T
1st large- R jet
2nd large- R jet

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```
for(int ie=SignalElectrons.size()-1;ie>=0;ie--)  
{  
  const RecLeptonFormat * myElectron = &(event.rec()->electrons()[ie]);  
  double myept=myElectron->pt();  
  double chargepte=PHYSICS->Isol->eflow->sumIsolation(myElectron,event.rec(),0.2,0.,IsolationEFlow::TRACK_COMPONENT);  
  double neutralpte=PHYSICS->Isol->eflow->sumIsolation(myElectron,event.rec(),0.2,0.,IsolationEFlow::NEUTRAL_COMPONENT);  
  double photonpte=PHYSICS->Isol->eflow->sumIsolation(myElectron,event.rec(),0.2,0.,IsolationEFlow::PHOTON_COMPONENT);  
  double ttpte=chargepte + neutralpte + photonpte;  
  if(ttpte > 0.06*myept)  
    SignalElectrons.erase(SignalElectrons.begin()+ie);  
}
```

Rec. and Cuts

Cut
Event cleaning
≥ 1 baseline lepton
≥ 1 signal lepton
$= 1$ signal lepton
$= 1$ baseline lepton
$E_T^{\text{miss}} > 200 \text{ GeV} \longrightarrow \text{easy}$
≥ 4 jets
Trigger
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Rec. and Cuts

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= 1 baseline lepton

$E_T^{\text{miss}} > 200$ GeV

≥ 4 jets \longrightarrow

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$|\Delta\phi(j_i, E_T^{\text{miss}})| > 0.4, i = 1, 2$

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small- R jet p_T \longrightarrow

1st large- R jet

2nd large- R jet

```
for(unsigned int ij=0; ij<event.rec()->jets().size(); ij++)
{
    const RecJetFormat * CurrentJet = &(event.rec()->jets()[ij]);
    if ( CurrentJet->pt() > 20.0 && abs(CurrentJet->eta())<4.4)
        BaselineJets.push_back(CurrentJet);
}
```

```
// Overlap removal (atlas_1605_03814 recast)
```

```
SignalElectrons = Removal(SignalElectrons, SignalJets, 0.2);
SignalMuons = Removal(SignalMuons, SignalJets, 0.4); // jet.ntracks()
SignalJets = Removal(SignalJets, SignalElectrons, 0.4);
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SignalElectrons = Removal(SignalElectrons, SignalTaus, 0.1);
```

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small- R jet p_T
1st large- R jet \longrightarrow
2nd large- R jet \longrightarrow

fat jet:

Large-radius jets are constructed from signal jets using the anti- k_r algorithm with $R = 1.0$. Constituent small-radius jets with p_T less than 5% of the large-radius jet p_T are removed, mainly in order to reduce the impact of soft radiation.



```
for(unsigned int ij=0; ij<event.rec()->fatjets().size(); ij++)  
{  
    const RecJetFormat * CurrentFatJet = &(event.rec()->fatjets()[ij]);  
    SignalFatJets.push_back(CurrentFatJet);  
}
```



jet cluster not yet

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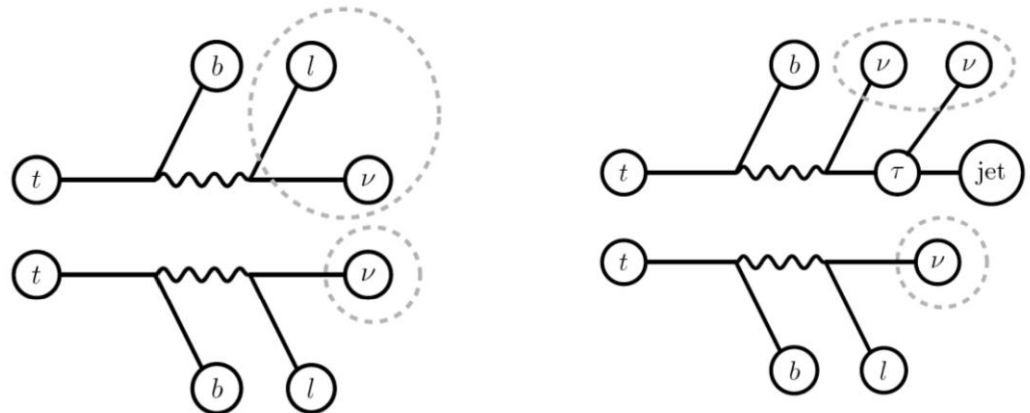
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$$m_{T2}^2 = \left(\sqrt{p_{Ti}^2 + m_{pi}^2} + \sqrt{q_{Ti}^2 + m_{qi}^2} \right)^2 - (\vec{p}_{Ti} + \vec{q}_{Ti})^2$$

↓ ↓
visible invisible

$$m_{T2} \equiv \min_{\vec{q}_{Ta} + \vec{q}_{Tb} = \vec{p}_T^{\text{miss}}} \{ \max(m_{Ta}, m_{Tb}) \}$$



CMS-B2G-14-004



```
double mt2w = PHYSICS->Transverse->MT2W(SignalJets,SignalLeptons[0],event.rec()->MET());
```

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$$H_{T,\text{sig}}^{\text{miss}} \equiv (H_T^{\text{miss}} - 100 \text{ GeV}) / \sigma_{H_T^{\text{miss}}}$$

vectorial sum of visible p_T

resolution of H_T^{miss}



How?

Exclusion limits

- not yet...