

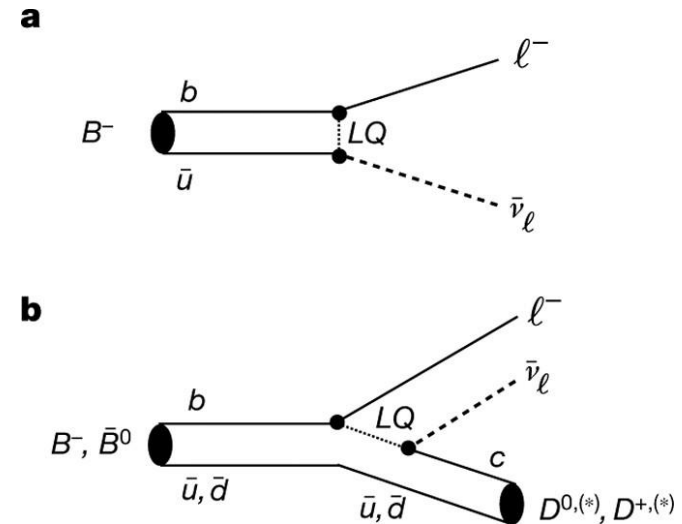
Analysis Sensitivity Test for Novel Asymmetric Leptoquark Pair Production Mechanism

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Introduction

- LQ's are hypothesized BSM particles that have both baryon and lepton number, so they can couple to both quarks and leptons
- Can help to explain strange behaviors with B-meson decays, as well as explain neutrino masses
- The search for LQ's have revived in recent years due to higher energy events at the LHC
- Lots of studies are being done to constrain the parameter space



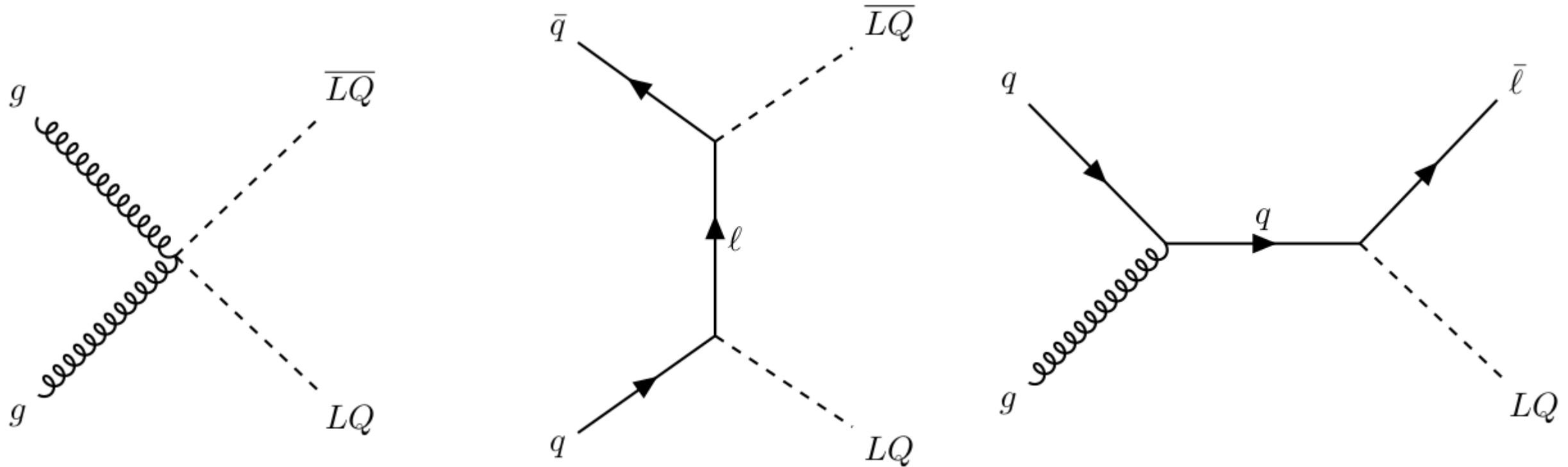
Scalar Leptoquarks

- There are both scalar and vector leptoquarks proposed, but we focus on the scalar leptoquarks

$SU(3)_c \times SU(2)_L \times U(1)_Y$	Symbol	Lepton/Quark Chirality	F
$(\bar{\mathbf{3}}, \mathbf{3}, 1/3)$	S_3	LL	-2
$(\mathbf{3}, \mathbf{2}, 7/6)$	R_2	RL, LR	0
$(\mathbf{3}, \mathbf{2}, 1/6)$	\tilde{R}_2	RL	0
$(\bar{\mathbf{3}}, \mathbf{1}, 4/3)$	\tilde{S}_1	RR	-2
$(\bar{\mathbf{3}}, \mathbf{1}, 1/3)$	S_1	LL, RR	-2

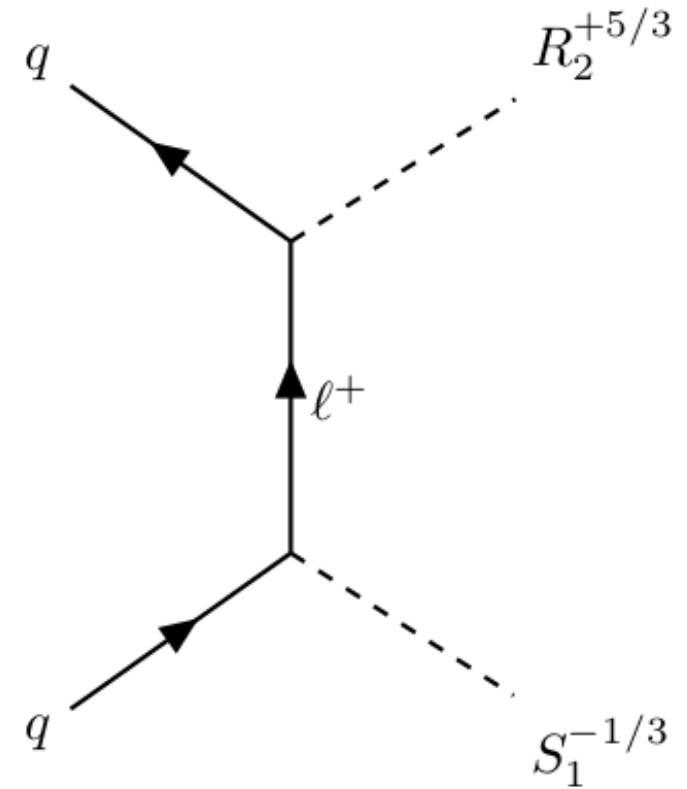


Current/Conventional Production



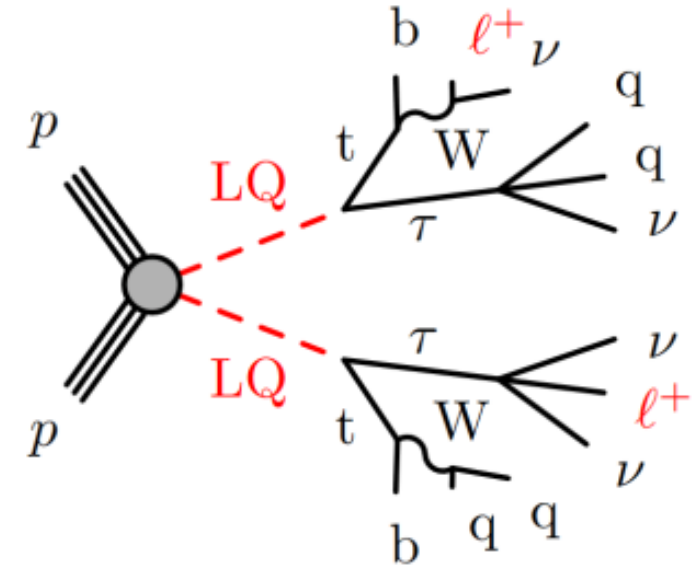
Novel Asymmetric Production Method

- Recently, a novel method has been proposed for pair producing LQ's that are not charge conjugates of each other and have a different fermion number
- Added benefit of a quark-quark initial state, which is desirable at the LHC
- Requires the LQ's to couple to a lepton of the same flavor and chirality; we can turn on the relevant Yukawa couplings and this asymmetric production automatically happens



Analysis Channel

- Our group focuses on the $2\ell SS + 1\tau$ channel/signature: two same sign leptons plus a hadronically decaying tau
- Existing analyses in this channel have proved fruitful, such as that for Higgs production or previous LQ production
- We look to apply this existing analysis to this novel production method to test sensitivity



Challenges

- **The analysis uses machine learning to try and separate signal from background based on a variety of different features**
- **My background/signal uses release 22 ntuples; *very* different from the previous release 21 ntuples!**
- **I am missing 2/3 of the background ntuples; specifically, I am missing the campaigns mc20a and mc20e**
- **Code I was provided is relatively poorly organized; makes doing the substitutions for the different features/ntuples very challenging**



Next Steps

- Work with others to try and get the features/ntuples sorted out as fast as possible, so I can train the model and generate some predictions
- Run some statistical analysis with TRExFitter
- Start working on the report

