Optimizing Background Simulations for Charged-Lepton Flavor Violation in the Leptoquark Framework at the Electron-Ion Collider

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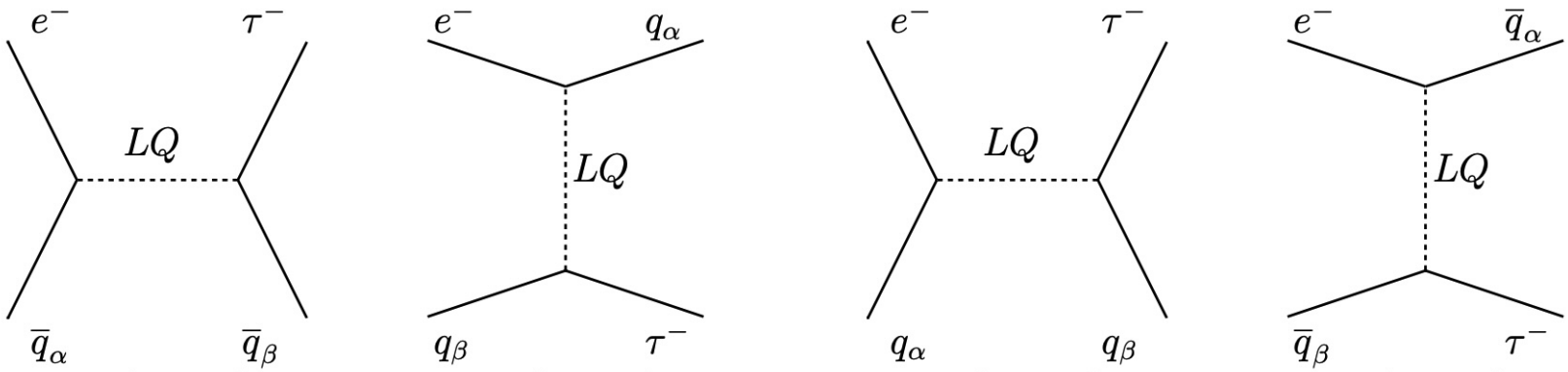
Charged-Lepton Flavor Violation (CLFV)

- ν oscillations $\rightarrow$ LFV $\rightarrow$ CLFV
- Br$(\mu \rightarrow e\gamma) < 10^{-54}$
- GUT, SUSY predict enhanced rates for CLFV(1,3) $\rightarrow$ motivating the search for e $\leftrightarrow \tau$ transitions
- EIC searches for BSM measurements

Leptoquarks

- Leptoquarks mediate CLFV (1,3) processes



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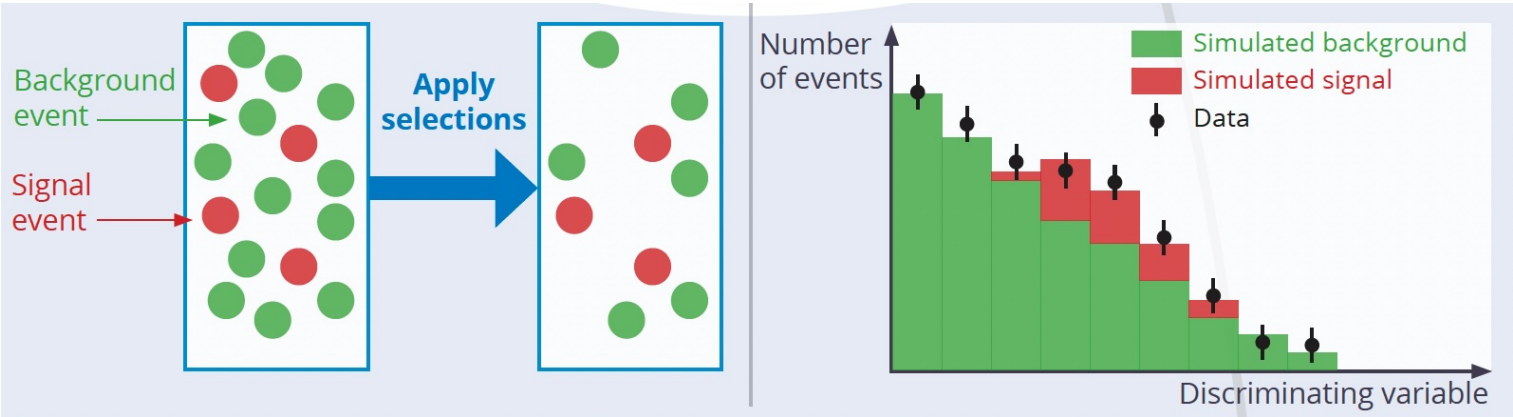
- We carry out the simulation analysis for determining sensitivity to the CLFV(1,3) process $e + p \rightarrow \tau + X$ in the leptoquark framework at the EIC

Background and Signal Simulations

- In this study the hadronic tau decay will be focused on: $\tau^- \rightarrow \pi^+\pi^-\pi^-\nu_\tau$
- Background processes: NC DIS, CC DIS, and Photoproduction
- Event generators:
  1. `LQGENEP` (L. Bellagamba, 2001)
  2. `DJANGOH(4.6.21)` (H. Spiesberger 2023)
  3. `Pythia(6.428)` (Torbjörn Sjöstrand, Stephen Mrenna, Peter Skands, 2006)

Separating signal and background using Multivariate Analysis (MVA)

- The goal of this work is to study for $e^- \to \tau^-$ conversion at the EIC based on **ePIC** detector simulations focusing on the highest collision energy 18×275 GeV.
- Background events coming from NC, CC and Photoproduction events need to be differentiated from LQ events.



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- Boosted Decision Trees (BDT)