

# Optimization of the selection criteria for NC, CC and Photoproduction at the EIC

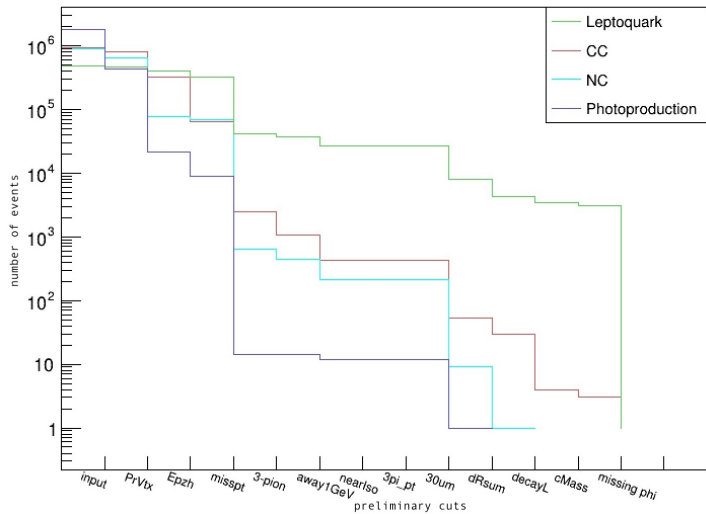
Bardh Quni

ePIC inclusive PWG meeting

March 18, 2024



# MC statistics of leptoquark, NC, CC, and Photoproduction



## Selection criteria/Preliminary cuts

The selection criteria to identify  $e \rightarrow \tau$  events includes:

- **PrVtx**: there must be a primary vertex reconstructed;
- **Epzh**:  $\sum_h (E - p_z) > 18$  GeV, where  $E$  and  $p_z$  are the energy and the  $z$ -component of the 3-momentum of the final state particles, and the summation is over all detected hadrons;
- **missing  $p_T$** :  $1 < p_T^{miss} < 9$  GeV, where the lower limit is to suppress events with small missing  $p_T$ , and the upper limit is to suppress NC and CC events with large missing  $p_T$  ;
- **3-pion** : 3 charged pions in a  $\Delta R < 1.0$  cone, where  $R$  is cone radius in  $(\phi - \eta)$  space,  $\Delta R \equiv \sqrt{\Delta\phi^2 + \Delta\eta^2}$ ;

## Selection criteria/Preliminary cuts

- **away1GeV**:  $p_T$  sum of all tracks on the away-side of the  $3\pi$  candidate,  $\sum_{\Delta\phi(-p_{3\pi}) < 1.0} p_T$  is  $> 1\text{GeV}$ ;
- **nearIso**:  $p_T$  sum in a cone around the  $3\pi$  candidate,  $\sum_{\Delta R(p_{3\pi}) < 1.0} p_T$  is  $< 3.0\text{ GeV}$ ;
- **3pi\_pt**:  $p_T$  sum of the 3 charged-pion,  $p_T(3\pi)$ , is  $> 3.0\text{ GeV}$ ;
- **30 $\mu\text{m}$** : candidate decay length reconstructed from 3 charged pions is  $> 30\mu\text{m}$  ;

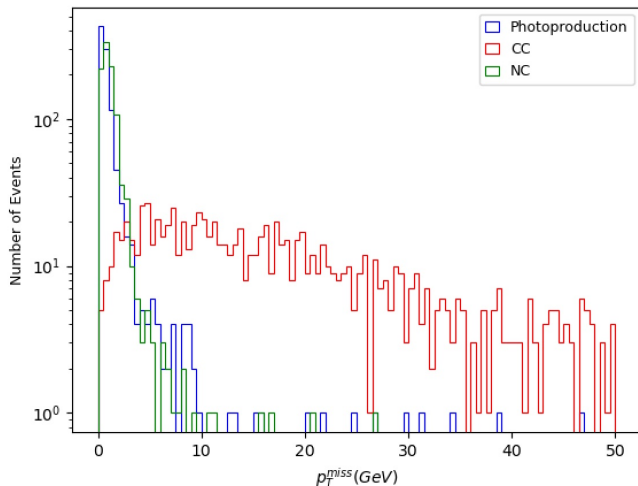
## Selection criteria/Preliminary cuts

- **dRsum**: sum of the "distances" in  $(\phi - \eta)$  space of the 3 charged pions decay vectors  $\Delta R = \Delta R_{1,2} + \Delta R_{1,3} + \Delta R_{2,3}$  is  $< 0.4$ . Decay vector points from the primary vertex to secondary vertex;
- **decayL**: average of the reconstructed decay length from  $3\pi$  candidate,  $dl = (dl_{1,2} + dl_{1,3} + dl_{2,3})/3$ , is  $> 0.5$  mm;
- **cMass**:  $\sqrt{M_{3\pi}^2 + p_{3\pi}^2 \sin^2\theta} < 1.8$  GeV,  $M_{3\pi}$  is mass reconstructed from  $3\pi$ , while  $\theta$  is the angle between the reconstructed decay direction and the  $3\pi$  momentum direction;
- **missing phi**: missing  $p_T$  which is azimuthally on the near side of the  $3\pi$  candidate, that is,  $\Delta\phi$  between  $p_{3\pi}$  and  $p_T^{miss}$  is  $< 1.0$ .

## MC simulations for the background events

- DJANGO 4.6.21 version was employed to simulate 10M background events for both **NC DIS** and **CC DIS**;
- Pythia 6.428 used to simulate 10M **Photoproduction** background events.

# MC simulations for the background events



missing  $p_T$  in the configurations of epic\_craterlake detector for NC, CC, and Photoproduction events in  $28 \times 275$  GeV.

## Next steps

- With the reconstructed particles from simulated files, we can compute variables or observables parameters such as the **missing  $p_T$ , 3-pion, 3pi\_pt, away1GeV, nearIso** ;
- **dRsum, decayL, cMass** requires secondary vertex (vertex group), unless some truth smearing techniques can be applied to simulate the reconstruction of secondary vertex;
- The goal is to maximize the discriminating power of our selection criteria. This means we want to optimize selection criteria in such a way that effectively to distinguish between SM events processes and those from LQ processes.