Proposal: Improve trigger efficiency with Graph Neural Network (GNN)

PHYS 570
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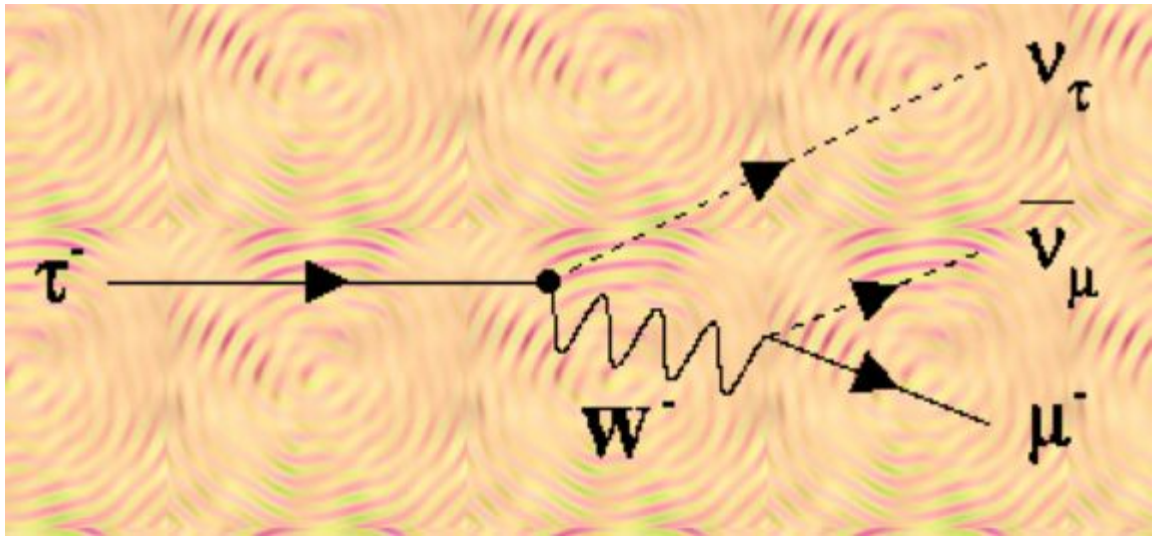
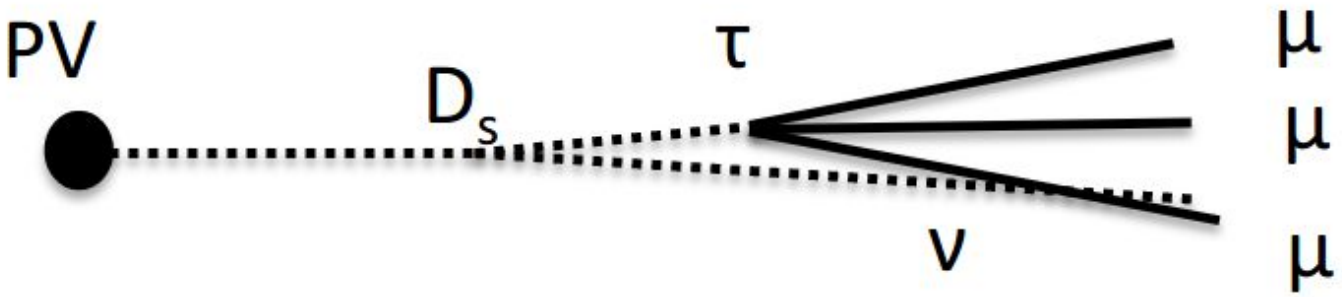
Background


LEPTONS
0.511 MeV/c²
-1
1/2
e
electron
105.7 MeV/c²
-1
1/2
μ
muon
1.777 GeV/c²
-1
1/2
τ
tau
<2.2 eV/c²
0
1/2
νe
electron neutrino
<0.17 MeV/c²
0
1/2
νμ
muon neutrino
<15.5 MeV/c²
0
1/2
ντ
tau neutrino


τ⁻
W⁻
ν_τ
ν̄_μ
μ⁻

Background

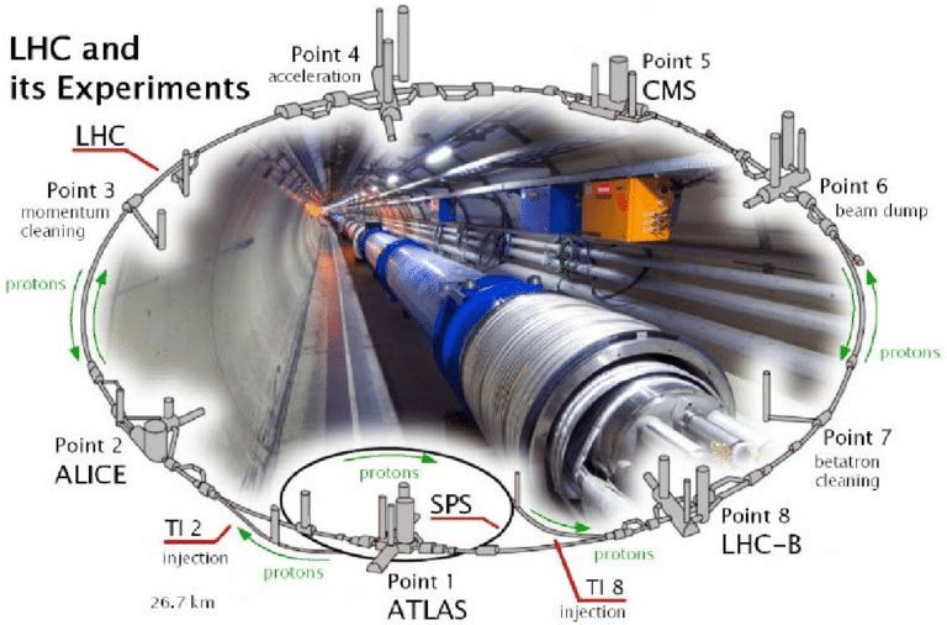
τ -> 3 u Decay



HL-LHC (L=3000 fb-1) τ production ~ 5.6 x 10^{14} events

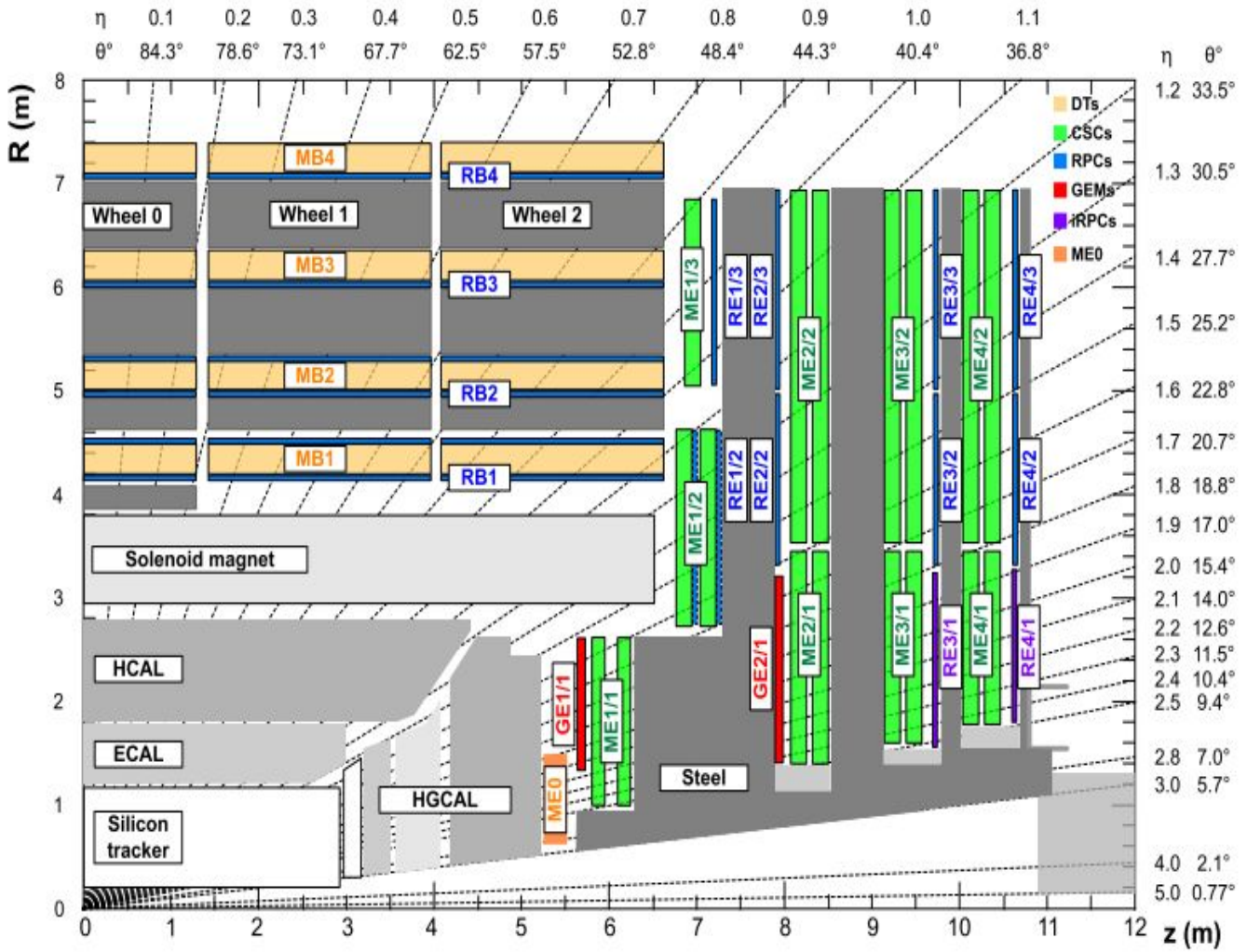
Mostly from the production of D mesons

(~72% from Ds ⟶ τ + ν decays)



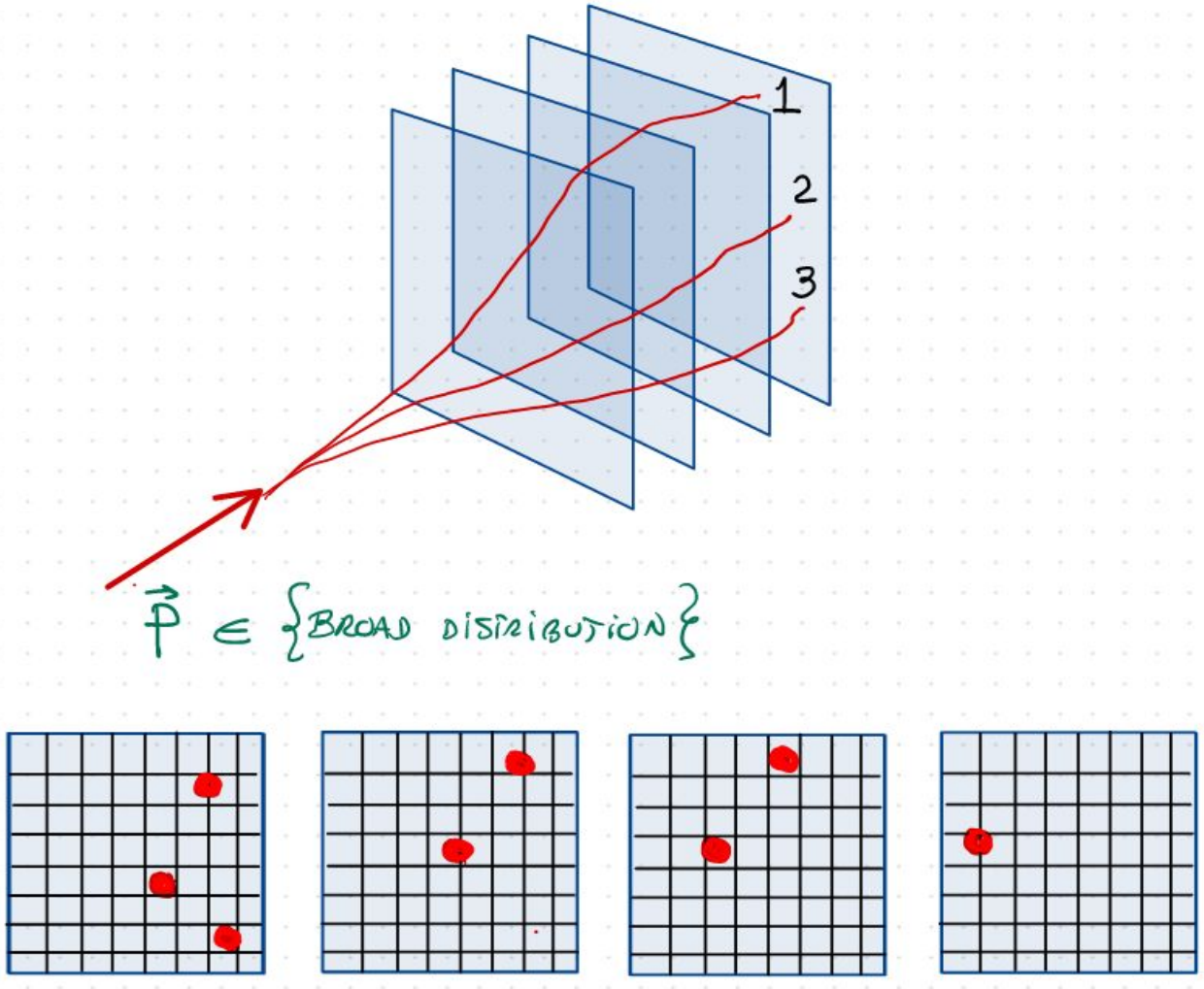
Efficiency of L1 trigger is less than 25%.

Improve this with ML.

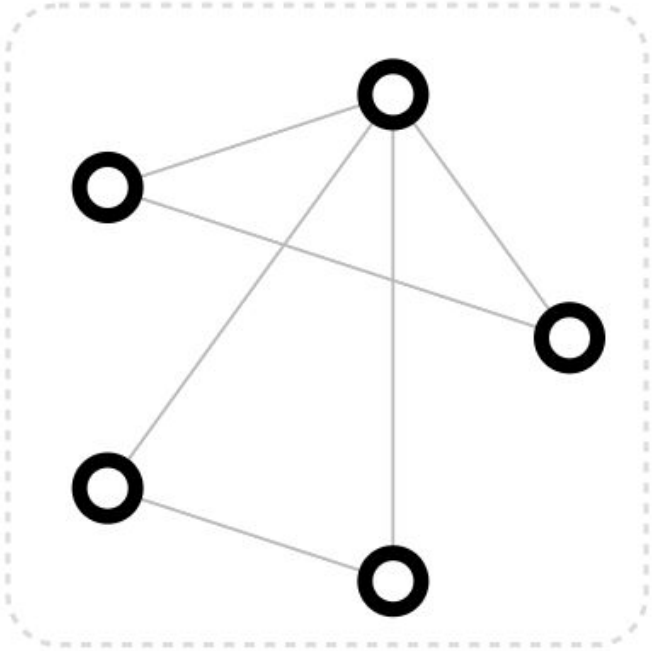


Learning aim: Tigger

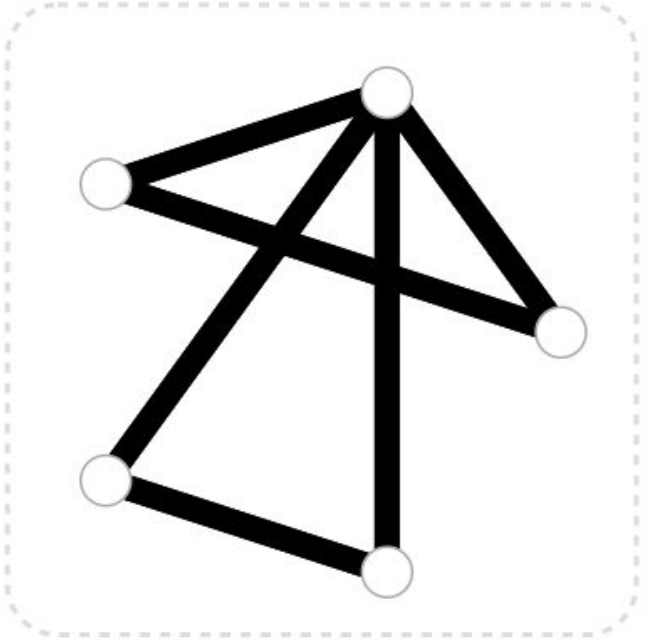
Design a trigger using only muon hits left in the muon stations



Graph



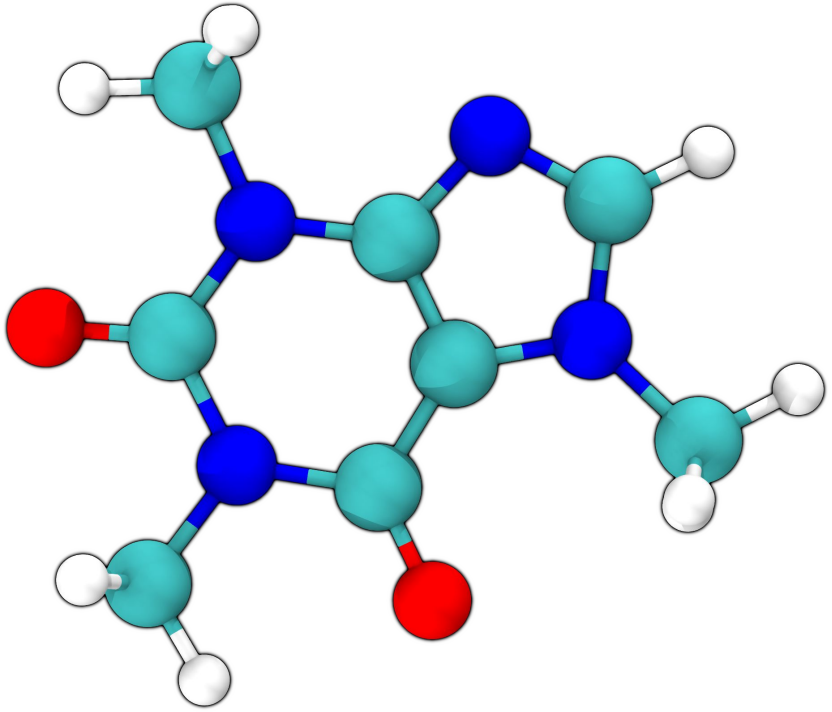
Node



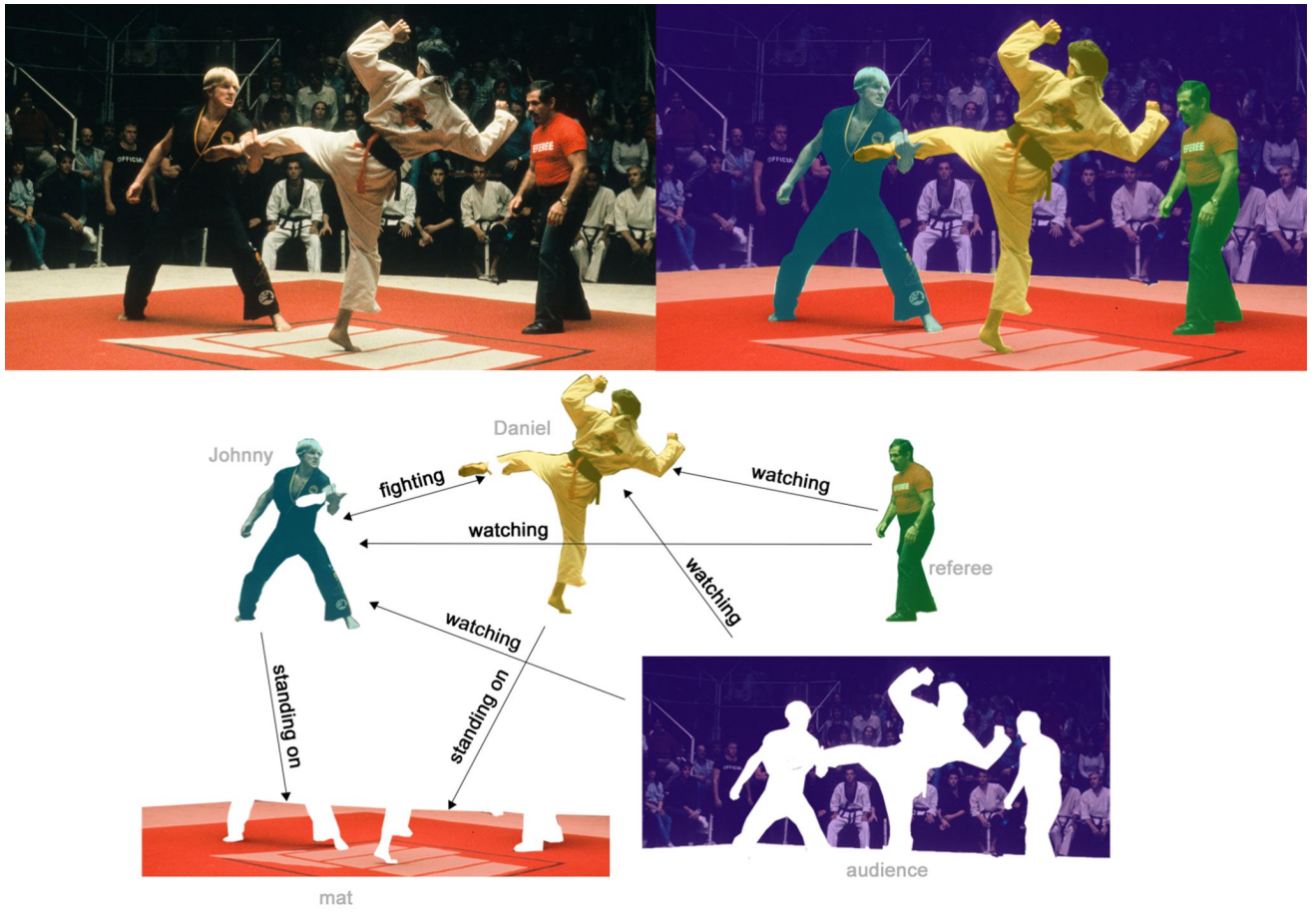
Edge

https://distill.pub/2021/gnn-intro/

Molecules



Social network



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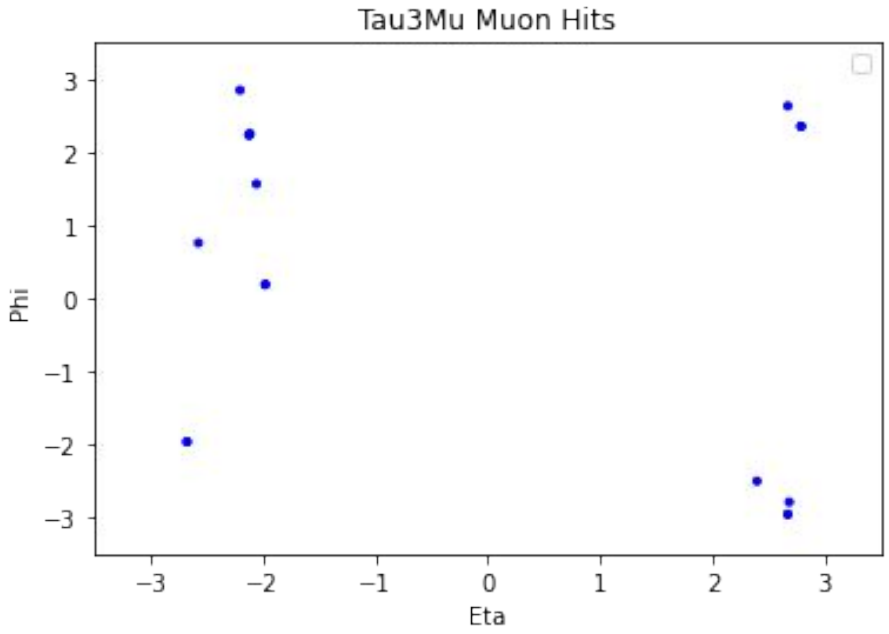
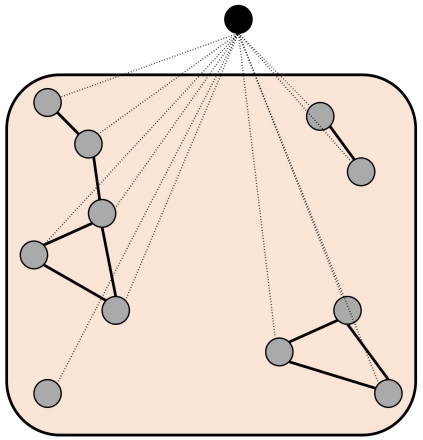
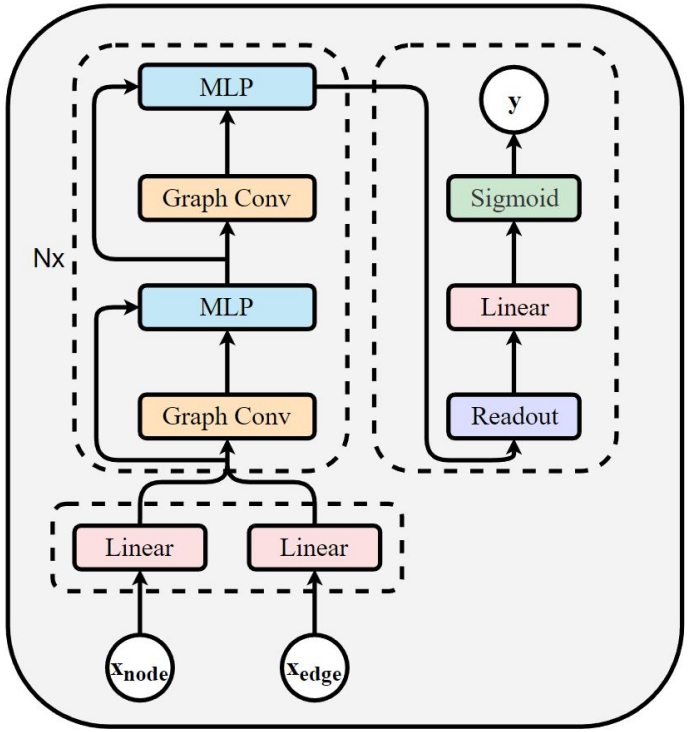
Model: Graph Neural Networks

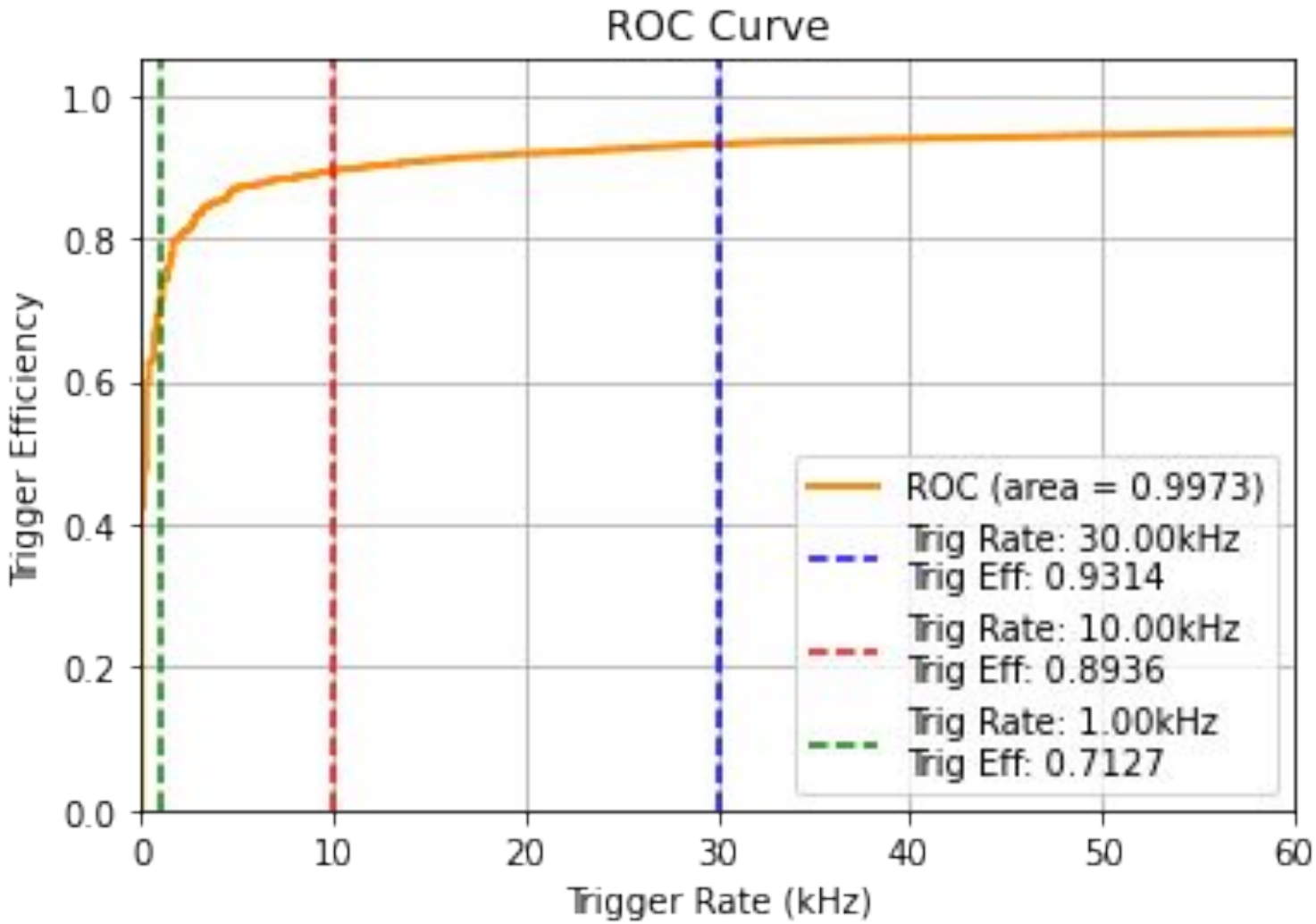




$$\Delta R = \sqrt{(\Delta\eta)^2 + (\Delta\phi)^2}$$



The performance on current dataset



Plan

- **Learn GNN model**
- **Train the Model on new CMS simulation data**
- **Study GNN model performance for new dataset**