Machine Learning to Reduce PDF Uncertainties

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PDF uncertainty now dominates many theory calculations including $t\bar{t}$ production cross-sections (Figure 1)

Furthermore, other colliders that will further constrain the PDFs are far in the future (i.e. EIC)

Global PDF fits utilize η or p_T of the top or other final-state variables, which do not provide the full information available for a given process

Our idea: utilize machine learning tools to find a variable(s) that offers the most information to constrain the PDFs

Our focus is on the gluon PDF at high X (Figure 2)

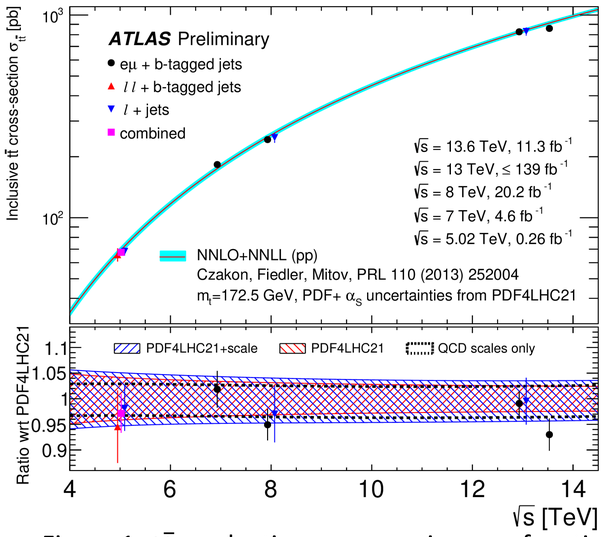


Figure 1: $t\bar{t}$ production cross section as a function of COM energy. *ATLAS (2023)*

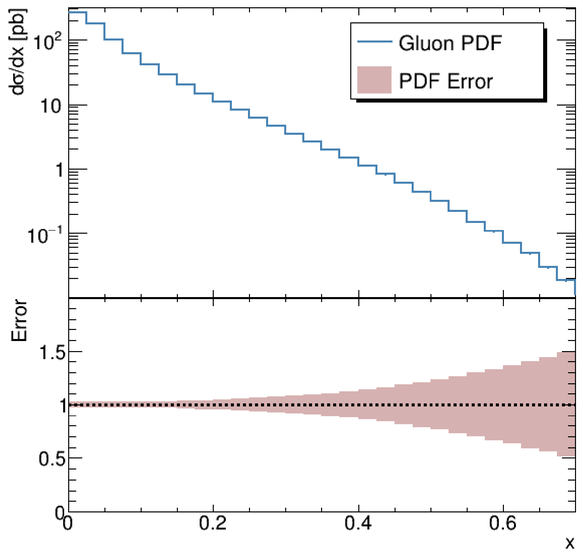
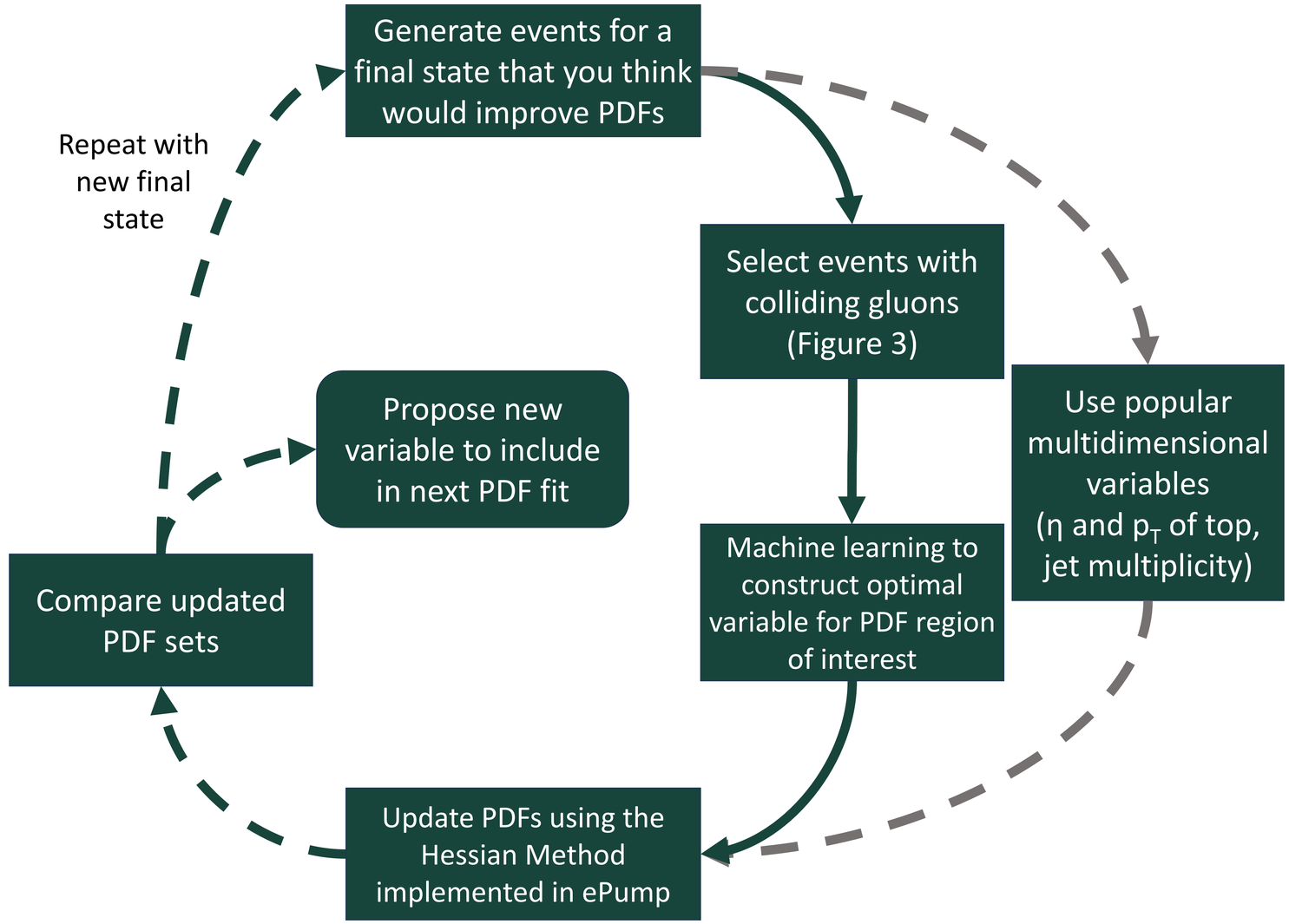


Figure 2: Differential cross section of $t\bar{t}j$ at NLO and COM energy of 14 TeV as a function of the initial gluon parton momentum fraction (CT18NLO)



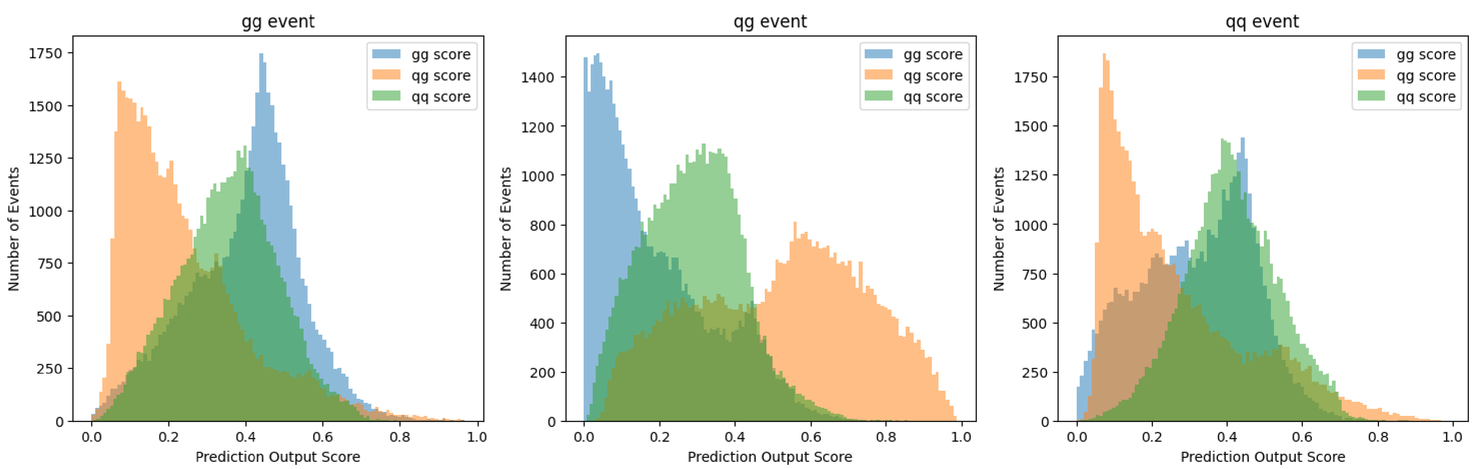


Figure 3: DNN output score from the multiclass classifier for the 3 different initial parton configurations.