**Top Quark Initial State Classification**

**Aim:** Classifying quark-antiquark initial state top-quark anti-top-quark events from gluon-gluon fusion initial states

**Helpful review sources:**

[A Living Review of Machine Learning for Particle Physics | HEPML-LivingReview](https://iml-wg.github.io/HEPML-LivingReview/)

**Attempt 1: XGBoost**

XGBClassifier(base\_score=0.5, booster='gbtree', colsample\_bylevel=1,

colsample\_bynode=1, colsample\_bytree=1, enable\_categorical=False,

gamma=0, gpu\_id=-1, importance\_type=None,

interaction\_constraints='', learning\_rate=0.001, max\_delta\_step=0,

max\_depth=7, min\_child\_weight=1, missing=nan,

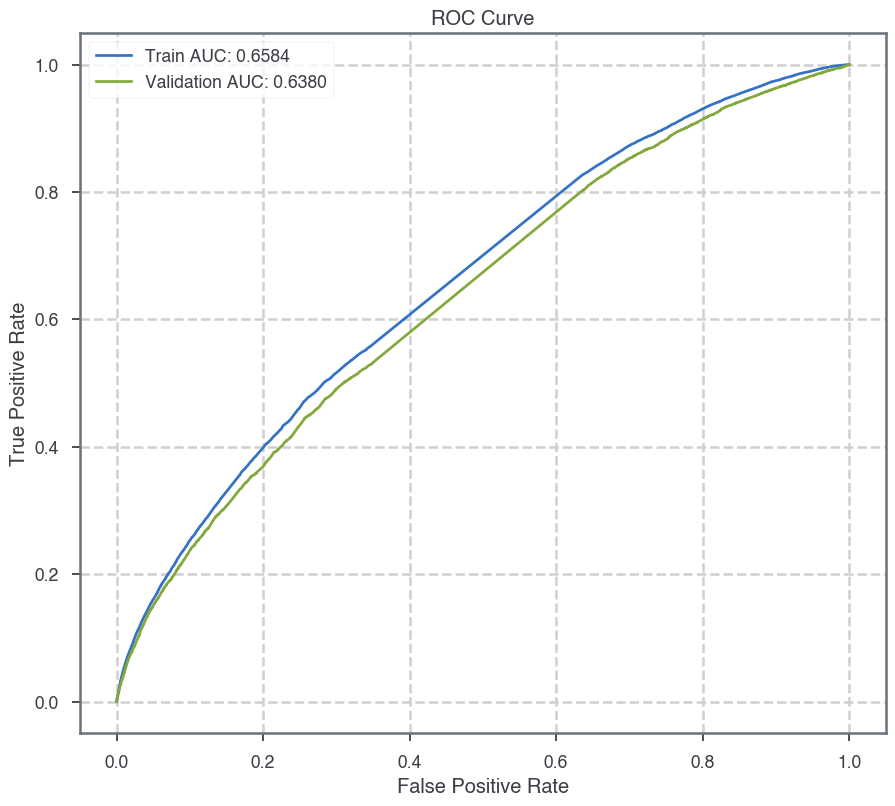
monotone\_constraints='()', n\_estimators=300, n\_jobs=8,

num\_parallel\_tree=1, predictor='auto', random\_state=0,

reg\_alpha=5, reg\_lambda=1, scale\_pos\_weight=1, subsample=1,

tree\_method='exact', validate\_parameters=1, verbosity=None)

**Results:**

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**Attempt 2 (Higher-dimensional input): XGBoost**

XGBClassifier(base\_score=0.5, booster='gbtree', colsample\_bylevel=1,

colsample\_bynode=1, colsample\_bytree=1, enable\_categorical=False,

gamma=0, gpu\_id=-1, importance\_type=None,

interaction\_constraints='', learning\_rate=0.01, max\_delta\_step=0,

max\_depth=5, min\_child\_weight=1, missing=nan,

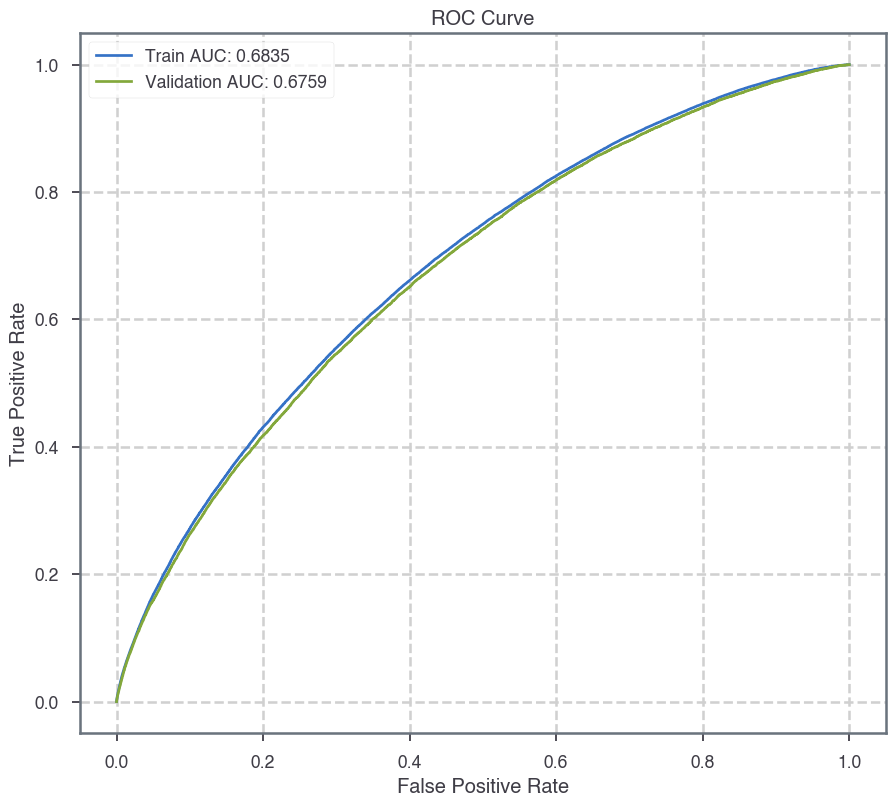
monotone\_constraints='()', n\_estimators=300, n\_jobs=8,

num\_parallel\_tree=1, predictor='auto', random\_state=0,

reg\_alpha=10, reg\_lambda=1, scale\_pos\_weight=1, subsample=1,

tree\_method='exact', validate\_parameters=1, verbosity=None)

**Results:**

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**Attempt 3 (Higher-dimensional input): DNN with L1 norm regularization**