Optimization of STAR sTGC track finding using boosted decision trees

Youqi Song (Yale University) on behalf of the STAR collaboration

The Forward Tracking System (FTS) is part of the STAR forward detector upgrade that will start data taking for the first time in November 2021. The FTS covers $2.5 < \eta < 4.0$ in pseudorapidity and consists of silicon microstrip sensors and small-Strip Thin Gap Chambers (sTGC). Charged particles that originate from collisions are detected via hits in the tracking detectors. These hits are fed into an algorithm, which ends up reconstructing charged tracks. We utilize a boosted decision tree (BDT) algorithm via AdaBoost as implemented in a Scikit-learn python package to improve the sTGC tracking efficiency and purity as compared to standard cut-based approaches. We generate PYTHIA8 pp Drell-Yan events at $\sqrt{s}$ = 510 GeV and construct hit pair and triplet observables from the hit locations created in the GEANT simulations of charged particles within our detector acceptance. A sequence of BDTs is then trained to evaluate tracks as real or fake, based on their hit pair and triplet observables. The trained model is then tested on PYTHIA8 Drell-Yan and soft QCD events. For both cases, the track finding performance is improved if the appropriate BDT setup is used.

In this talk, I will present the BDT method that we use for STAR sTGC track finding for PYTHIA events and compare its performance with the cut-based method.