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Time determination of hard scatter vertices using the ATLAS experiment's High Granularity Timing Detector - a machine learning approach

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Starting in 2027, the HL-LHC will begin operation and deliver unprecedented luminosities allowing higher-precision measurements and searches for new physics processes. One central problem that arises in the ATLAS detector when reconstructing event information is to separate the interesting hard scatter (HS) vertex from uninteresting pileup (PU) vertices in a spatially compact environment. This problem becomes even harder to solve at higher luminosities. Our project relies on leveraging the time dimension by using information measured by the upcoming High-Granularity Timing Detector (HGTD). Using Monte Carlo simulated event data for HL-LHC that incorporates the HGTD, we propose to tackle this problem using a two-step machine learning model approach. First, we use an aggressive model to group tracks with the goal of having as many HS tracks in one group as possible. Secondly, we use a model that cleans up and rejects the PU tracks that do not belong in the group with the most HS tracks. Finally, we can use this group of predicted HS tracks to determine a time of the HS vertex. This approximated time can then be used to separate background processes from the signal process.

Abstract Track

Flash talk, LHC

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