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Dealing with High Background Rates in Simulations of the STAR Heavy Flavor Tracker

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The STAR Heavy Flavor Tracker (HFT) has enabled a rich physics program, providing important insights into heavy quark behavior in heavy ion collisions. Acquiring data during the 2014 through 2016 runs at the Relativistic Heavy Ion Collider (RHIC), the HFT consisted of four layers of precision silicon sensors. Used in concert with the Time Projection Chamber (TPC), the HFT enables the reconstruction and topological identification of tracks arising from charmed hadron decays. The ultimate understanding of the detector efficiency and resolution demands large quantities of high quality simulations, accounting for the precise alignment of sensors, and the detailed response of the detectors and electronics to the incident tracks. The background environment presented additional challenges, as simulating the significant rates from pileup events accumulated during the long integration times of the tracking detectors could have quickly exceeded the available computational resources, and the relative contributions from different sources was unknown. STAR has long addressed these issues by embedding simulations into background events directly sampled during data taking at the experiment. This technique has the advantage of providing a completely realistic picture of the dynamic background environment while introducing minimal additional computational overhead compared to simulation of the primary collision alone, thus scaling to any luminosity. We will discuss how STAR has applied this technique to the simulation of the HFT, and will show how the careful consideration of misalignment of precision detectors and calibration uncertainties results in the detailed reproduction of basic observables, such as track projection to the primary vertex. We will further summarize the experience and lessons learned in applying these techniques to heavy-flavor simulations and discuss recent results.

Consider for promotion

No

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