

Primary Vertex finding in the RHIC high precision measurement era - enhancement and experience in STAR

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Since 2014, the STAR experiment has been exploiting data collected by the Heavy Flavor Tracker (HFT), a group of high precision silicon-based detectors installed to enhance track reconstruction and pointing resolution of the existing Time Projection Chamber (TPC). The significant improvement in the primary vertex resolution resulting from this upgrade prompted us to revisit the variety of vertex reconstruction algorithms currently employed by the experiment. In this contributions we share the experience gained in our search for a unified vertex finder (VF) for STAR and improvements made to the algorithms along the way.

The Relativistic Heavy Ion Collider (RHIC) is capable of providing collisions of particle beams made from a wide range of possible nuclei, from protons up to uranium. Historically, STAR utilized different VFs for heavy ion and proton-proton programs to cope with the distinctive nature of these two types of particle interactions. We investigate the possibility of having a universally acceptable vertex reconstruction algorithm that could equally satisfy all ongoing physics analyses. To achieve this goal we establish a common strategy, reshape generic interfaces over the years, and develop tools to evaluate the performance of diversified implementations in an unbiased way. In particular, we introduce independent measurements of the beamline position into the primary vertex fitting routine common to all VFs. This additional constraint on the vertex position is aimed to strengthen the identification of secondary vertices from short-lived particles decaying near the beamline. Finally, we discuss the vertex ranking schemes used in STAR to mitigate the effect of pile-up events contaminating the identification of triggered event vertices at high instantaneous luminosities. The pile-up hits are inevitable due to the inherently slow readout of the TPC and MAPS-based HFT detectors, therefore the systematic approach established for the VF comparison will be of a great help in the future exploration of various ranking schemes.

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