Performance of the FVTX high-multiplicity trigger system for the RHIC-PHENIX experiment Run15

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Protons and neutrons, which are components of familiar substances, are composed of quarks and gluons that bind quarks together. Immediately following the big bang, under extremely high-density and high-temperature conditions, quarks and gluons are considered to escape from the boundary of nucleons. This liquid-like state is called quark-gluon plasma (QGP).

Relativistic Heavy Ion Collider(RHIC) is the first accelerator aimed at investigating QGP. In particle angular correlations of generated particles in a Au+Au colliding system that was performed at RHIC until 2005, elliptic azimuthal anisotropy considered to be due to QGP was observed. Conventionally, QGP was considered to be observed only in nucleus+nucleus collisions because the energy density is not high enough in small colliding systems. However, several experiment groups at the LHC have recently reported that similar azimuthal anisotropy was observed in small colliding systems, such as p+p[1]. At RHIC, similar results have been observed in d+Au and 3He+Au collisions, but detailed investigation of p+p collisions has not been done so far.

The PHENIX experiment group introduced a new high-multiplicity trigger system using the Forward Silicon Vertex Detector (FVTX) for observation of the elliptic azimuthal anisotropy in the p+p colliding system in RHIC. The trigger signal is generated based on the number of tracks detected in the FVTX detector. The FVTX trigger was operated using the AND/OR operations of south and north trigger signals in Run15 p+p collision. The trigger was commissioned at the beginning of Run15 and started recording physics data by March 2015. Figure 1 shows the integrated triggered events in the p+p collision plotted as a function of the run number. The trigger accumulated 500M events in p+p collisions.

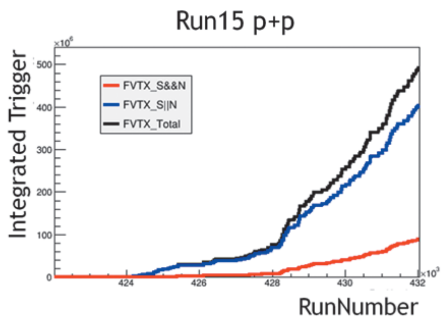

Fig. 1. FVTX trigger statistics. Red : South AND North. Blue : South OR North. Black : Sum of AND and OR.

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Figure 2 shows the distribution of the number of tracks detected in the FVTX with a normalized scale on a vertical axis. Compared to the minimum bias trigger, the FVTX trigger shows a higher average number of tracks. Especially in the high-multiplicity region, the FVTX trigger have more statistics by a factor of 100.

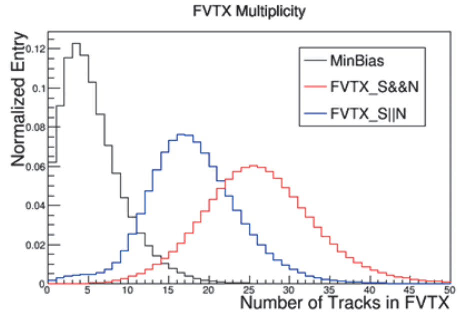

Fig. 2. Distribution of number of FVTX tracks for each trigger.

The stability of the trigger is evaluated in Figure 3 by correlating the average number of tracks in FVTX as a function of the run number. The trigger was operated in different multiplicity trigger thresholds, which caused variations in the average in earlier runs in the plots. There are significantly lower average runs, which appeared discretely. They cannot be explained by the change of the above mentioned trigger condition and the reason of this behavior is under investigation.

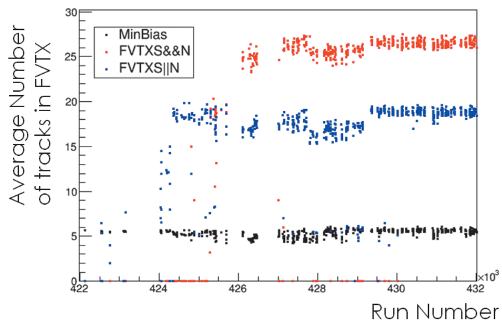

Fig. 3. Average number of tracks as a function of run number.

The FVTX triggered samples will be used for two-particle correlation analysis, one of the methods used to study the anisotropy of the generated matter from collision. The analysis of multiplicity dependence in Run15 p+p collision is underway.

Reference

1) V. Khachatryan et al.: CMS Collaboration, JHEP 1009 091 (2010)