Performance improvement of PHENIX MUID

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PHENIX Muon Identifier, MUID, is one of the PHENIX detectors. It has north and south arms, and each arm consists of 5 layers of alternating energy absorbers and low-resolution ionization chambers. The chamber is composed of many bunches of larocci tubes.[1)]

During the RHIC-Run 13, the efficiency of the MUID dropped to less than down under 60% under conditions of high beam luminosity, as shown in Fig. 1. The high voltage supply system is implemented with 400 M Ω current-limiting resistors, and thus, the voltage is sagged at the tube as a function the drawing current, which results in the efficiency drop. The latest performance of MUID indicated a possible degradation of the efficiency from what was observed at the early stage of MUID operation a decade ago.

In order to update the performance, we executed the high voltage(HV) scan in July 2014. The resulting efficiency curve as a function of HV values demonstrated that the current operation voltage (4400V) is almost the edge of the plateau curve and an additional current draw immediately leads to a substantial efficiency drop, as shown in Fig. 2. Overall, more than 50% of the HV chains showed degraded efficiency performance as compared to that observed in 2004. All these phenomena signify that the plateau of the MUID became narrower than observed initially. Thus, it is obvious that an improvement of the MUID performance is required before starting the RHIC-Run 16. We aim to measure Drell-Yan using a high luminosity beam at a collision energy of 500GeV. The MUID efficiency is a topic of much concern because detection efficiency affects on square for this measurement.

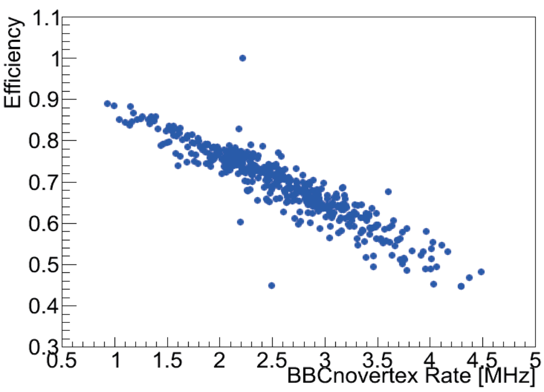

Fig. 1. Efficiency drop with an increase in BBC novertex rate. BBC is the beam luminosity monitoring device.

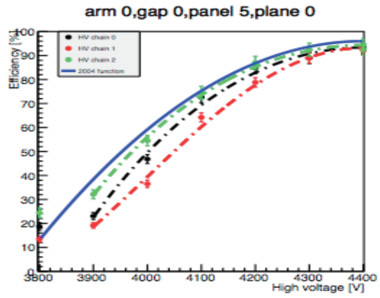

Fig. 2. Efficiency versus high voltage for south arm gap 0, panel 5, plane 0. New data (green, black, red points) indicate a steeper drop than the efficiency turn on curve (blue solid line) observed in 2004.

One of the ways to improve the aforesaid situation is to reconsider the operating HV condition, i.e., if a higher voltage can be set away from the edge of the plateau. To define the current plateau region, we explored the higher voltage region and evaluated hit rates vs HV values, as shown in Fig. 3.

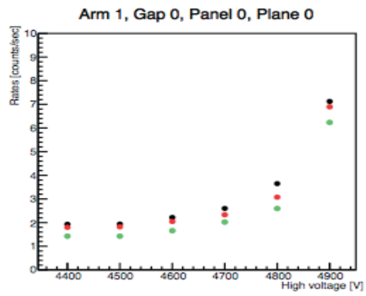

Fig. 3. Hits per sec graph range of 4400V to 4900V at north arm gap 0, panel 0, plane 0.

Fig. 3. shows the result of the scan up to 4900V. It is obvious that the operation voltage should not be pushed over 4600V, because a plateau region is created from 4400V to 4600V.

The observed plateau runs up to 4550 - 4600V depending on the HV chain. The results obtained thus far indicate that the MUID can be operated at a higher voltage of +100V to +200V with a relatively small increase in the noise hit rates. HV optimization is currently in progress.

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References

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