RHICf-STAR common operation in $\sqrt{s} = 510$ GeV proton-proton collisions

M. Ueno[*1,*2] for the RHICf collaboration

The RHIC forward (RHICf) experiment[1,2] and the STAR experiment[4] had a joint operation in June 2017.[3] During the RHICf operation, RHICf took about 1.1×10^8 events in total, and 80% of the events were common with STAR. At the RHICf-STAR joint data taking, we recorded the data of the STAR detector, Zero Degree Calorimeter (ZDC),[5] Beam Beam Counter (BBC),[6] and Vertex Position Detector (VPD)[7] together. These common data are useful for the improvement of physics performance. In this report, the improvement of energy resolution for neutrons is discussed.

The RHICf detector has two independent calorimeter towers, which are composed of tungsten plates, 16 layers of GSO scintillators, and 4 X-Y hodoscopes of GSO bar bundles.[1] The thickness of the RHICf detector is 44 radiation length and 1.6 interaction length. The STAR-ZDC detectors were installed on both sides of the STAR IP. The detector was installed 18 m away from the STAR interaction point in front of the west-side STAR ZDC, as shown in Fig. 1. The particle identification between photons and neutrons is performed by using the difference in detector response. The hadronic showers induced by neutrons develop in deeper layers than the electromagnetic showers induced by photons. Because the RHICf detector thickness is not enough to contain hadronic showers, these shower particles leak out from the detector and hit the STAR-ZDC. An MC simulation study by Geant4 shows that the energy resolution for neutrons is expected to be improved from 40% to 20% by combining the RHICf data and ZDC data.

The correlation between the RHICf detected energy and the STAR-ZDC detected energy was confirmed by the data. Figure 2 shows the correlation between the RHICf raw energy and the STAR-ZDC ADC sum when the beam center was set at the RHICf small calorimeter tower (TS tower). The upper figures show the results of the west-side STAR ZDC and the lower figures show the results of the east-side STAR ZDC. Figure 2 shows that there is a correlation between the west side STAR-ZDC and RHICf raw data. On the other hand, there is no correlation between the east side STAR-ZDC and RHICf raw data. These results indicate that the event matching between the RHICf and STAR data worked correctly. Analysis of common operation data is on going.

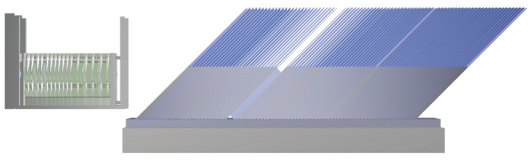

Fig. 1. Schematic location view of the RHICf detector (left) and the STAR-ZDC (right).

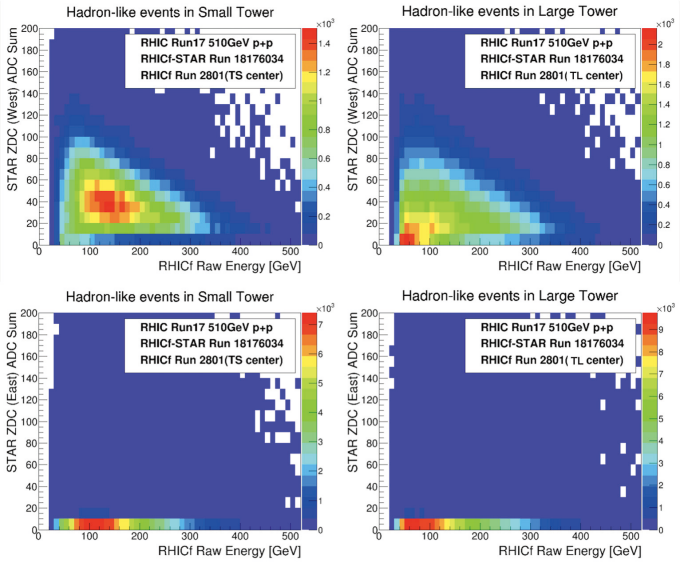

Fig. 2. Correlation between RHICf detected energy and the STAR-ZDC detected energy. The horizontal axis shows the RHICf raw energy and the vertical axis shows STAR-ZDC ADC sum. The RHICf detector, which consists of two calorimeter towers, was installed at the west side of the STAR interaction point. Only the west side STAR-ZDC ADC sum shows correlation with RHICf raw energy.

*1 RIKEN Nishina Center
*2 Institute for Space-Earth Environmental Research, Nagoya University

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