Commissioning status of sPHENIX experiment at RHIC

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The sPHENIX[1] is a new state-of-art jet detector at RHIC. The construction of the detector complex was completed by the end of April 2023 as shown in Fig. 1. The concept of sPHENIX follows the typical geometry of collider detectors, with a tracking system consisting of a pixel detector (MVTX) based on monolithic active pixel sensor technology, a silicon strip intermediate tracker (INTT) and a time projection chamber (TPC). The calorimeter stack includes a tungsten/scintillating fiber electromagnetic calorimeter (EMCAL) and a steel/scintillator tile hadronic calorimeter (HCAL), divided into inner and outer parts. The inner HCAL sits inside a 1.5 T superconducting solenoid.

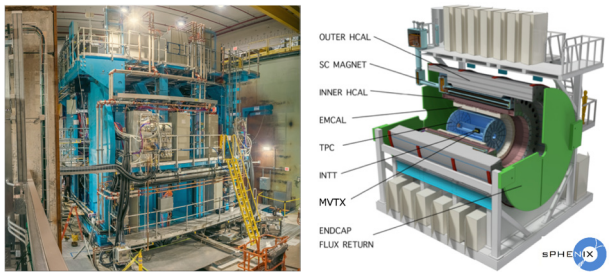

Fig. 1. Newly built sPHENIX detector along the RHIC beam line at 1008 site after the decomissioned PHENIX detector.

The very first beam commissioning took place following the completion of the construction using Au + Au collision at $\sqrt{s_{NN}} = 200$ GeV (Run23). The calorimeters achieved quite high live regions as shown in Fig. 2. The figure shows the event display of the EMCAL, inner and outer HCALs observed in a high multiplicity event in Au + Au collision. Shown in Fig. 3 is the reconstructed invariant mass of di-photon pairs observed by the EMCAL. Although there is still a room for improvement in energy calibration, the π^0 peak is visible around 100th ADC channel which implies the EMCAL is functioning properly.

The commissioning of tracking detectors was also pursued in parallel. The INTT detector was successfully commissioned and appeared 99% channels active amongst 373k total channels. Details are discussed in elsewhere.[2] Unfortunately, due to the helium leak accident of the RHIC cryogenic system on August 1st, the Run23 was discontinued leaving two months of remaining program unfilled. This unexpected end of the experiment made the MVTX and the TPC detectors remain their commissioning incomplete. It will be resumed in the coming Run24 with

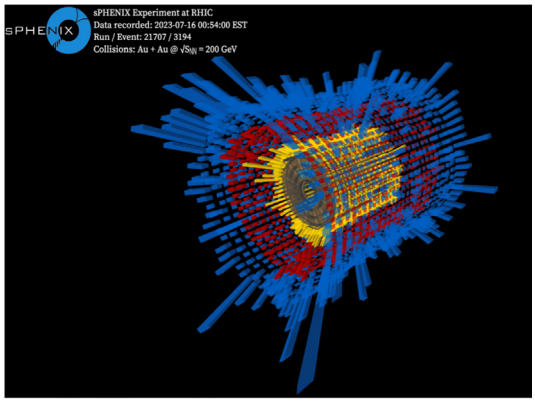

Fig. 2. Event display of the EMCAL (yellow), the Inner (red), and the Outer (blue) HCAL observed in $\sqrt{s} = 200$ GeV Au + Au collision. The length of the bar is proportional to the energy deposit measured by each calorimeter tower.

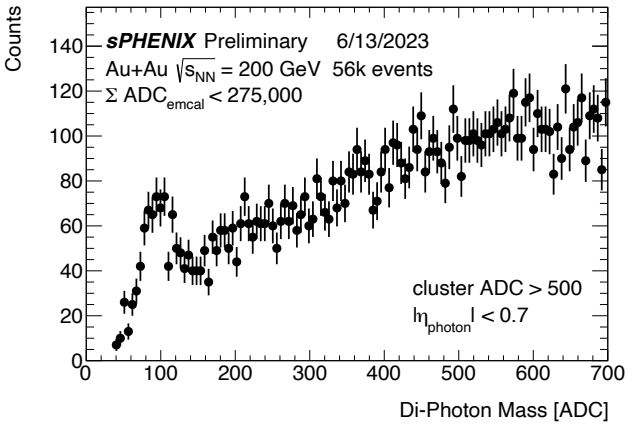

Fig. 3. Reconstructed invariant mass distribution from observed di-photon pairs in the EMCAL. The peak around 100th channel in ADC unit corresponds to π^0.

$\sqrt{s} = 200$ GeV transversely polarized proton + proton and $\sqrt{s_{NN}} = 200$ GeV Au + Au (as the compensation of Run23) collisions. On the other hand, we accumulated reasonably high quality data even under the commissioning period. Some working groups for several physics topics have been launched aiming for physics publications from Run23 data. The charged particle distribution as a function of rapidity ($dN/d\eta$) is one of them using INTT tracklets.

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References

1) Technical Design Report of sPHENIX (2019), https://indico.bnl.gov/event/7081/.
2) Nikkei Science, June (2023).
3) G. Nukazuka *et al.*, in this report.

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