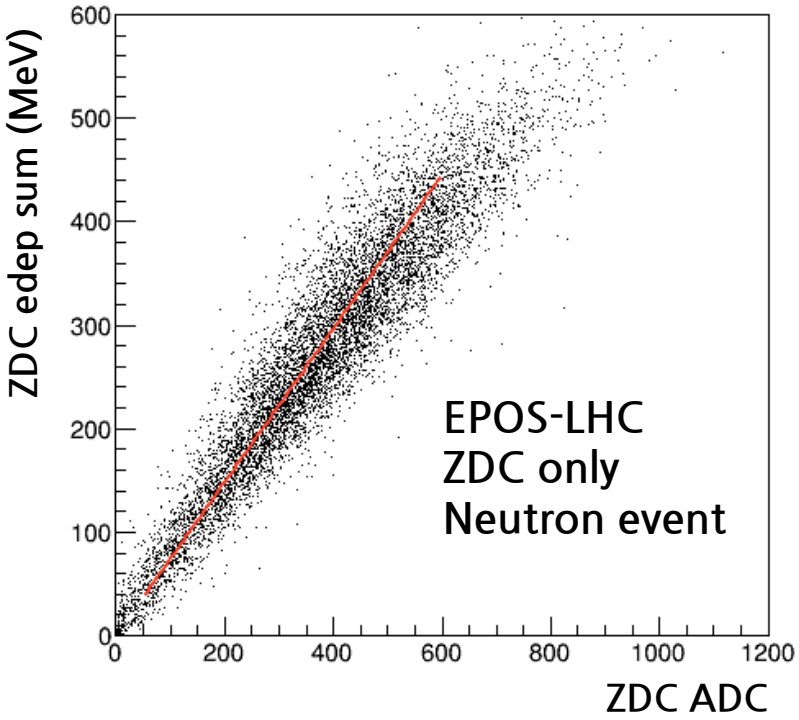
Expected ZDC performance in the RHICf-II experiment

8 Apr 2022

Minho Kim

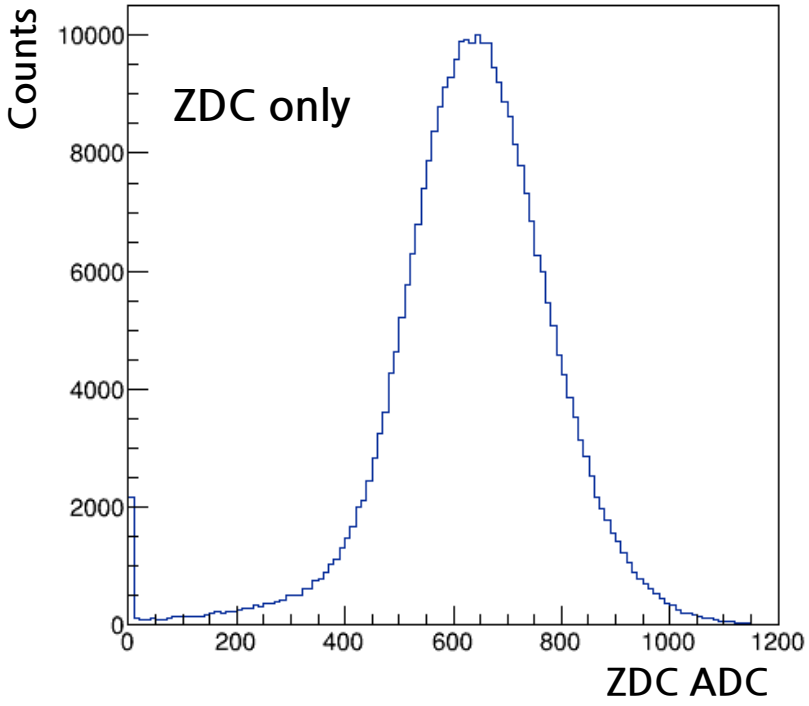
ZDC ADC (temporarily defined)

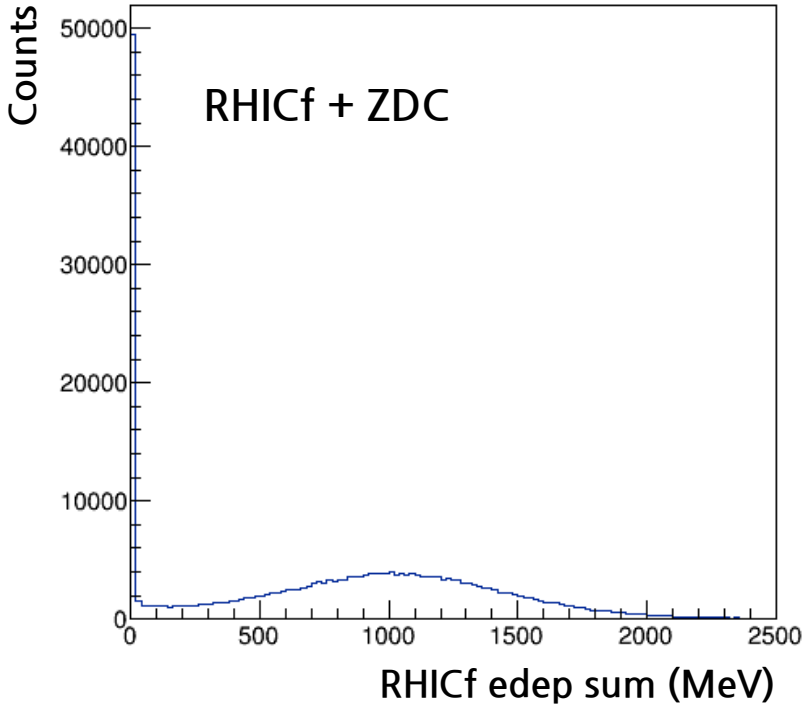


- It was found that the ZDC energy deposit had been not filled in the previously produced MC data.
- In this study, ZDC ADC corresponds to the summed number of Cherenkov photons generated in three ZDC modules.
- Energy deposit sum of the ZDC was estimated as 0.7 * ADC (MeV).

Interaction lengths of detectors

Condition: 100 GeV neutron hit the center of the detector.

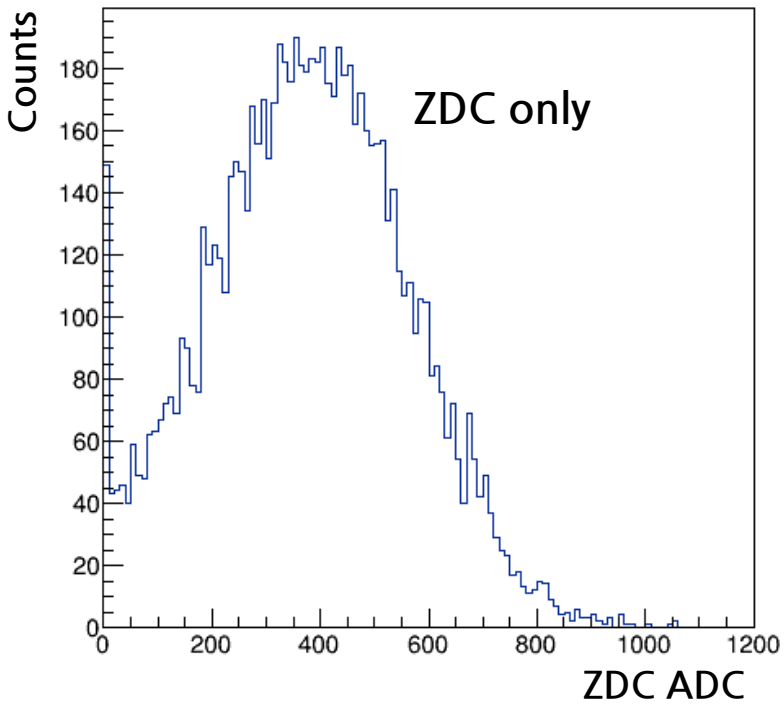


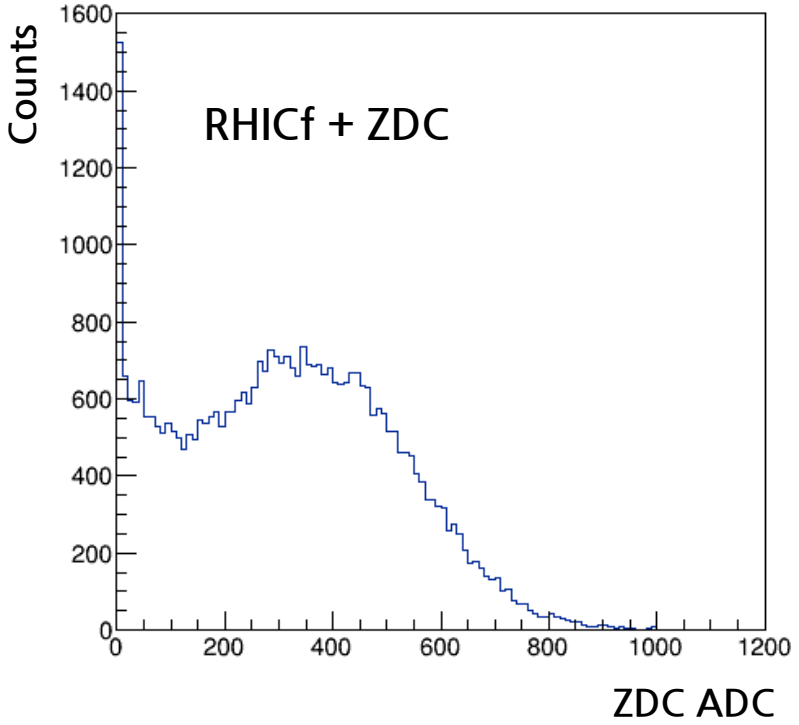


- Ratio of 0 ADC is 0.0060. This is comparable with $e^{-5.1} = 0.0067$.
- Ratio of 0 edep sum is 0.196. This is comparable with $e^{-1.6} = 0.201$.

ADC distribution of ZDC

Condition: Neutron is heading to the ZDC at EPOS-LHC.

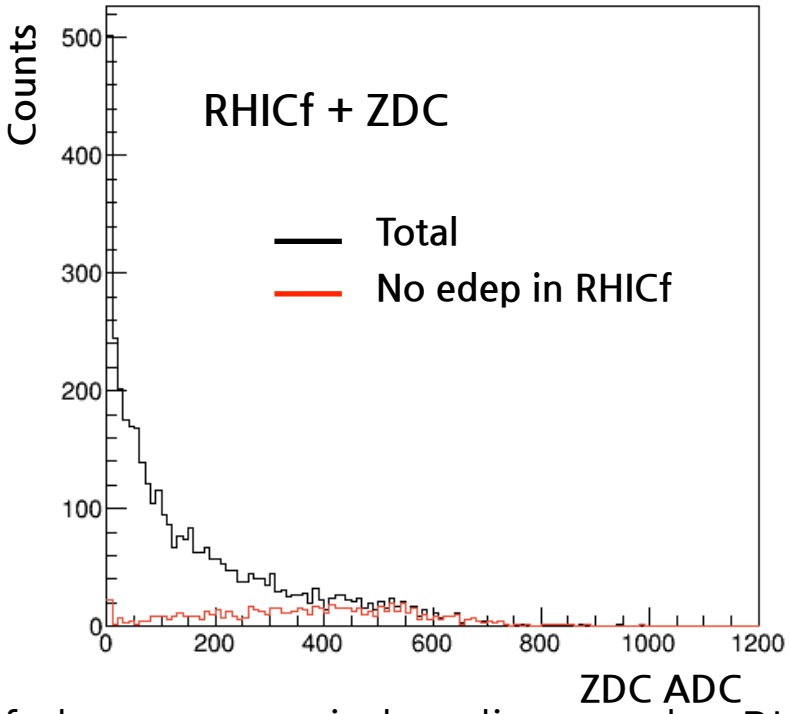




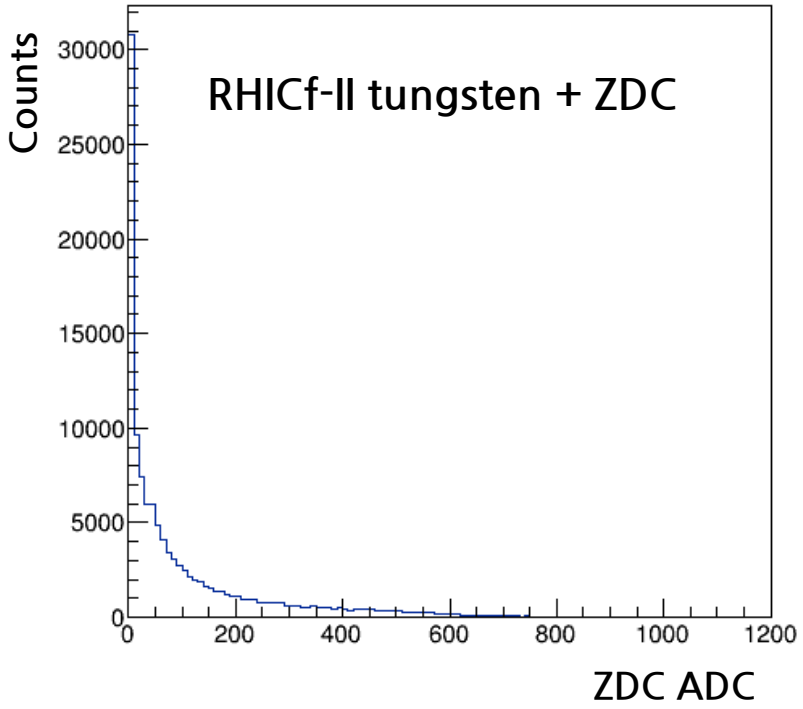
- Second peak is clearly seen, it corresponds to the case the hadronic shower is mainly developed in the ZDC.
- However, the second peak in the RHICf + ZDC setup is because the RHICf detector doesn't cover the ZDC completely.

ADC distribution of ZDC

Condition: Neutron is heading to the RHICf at EPOS-LHC.



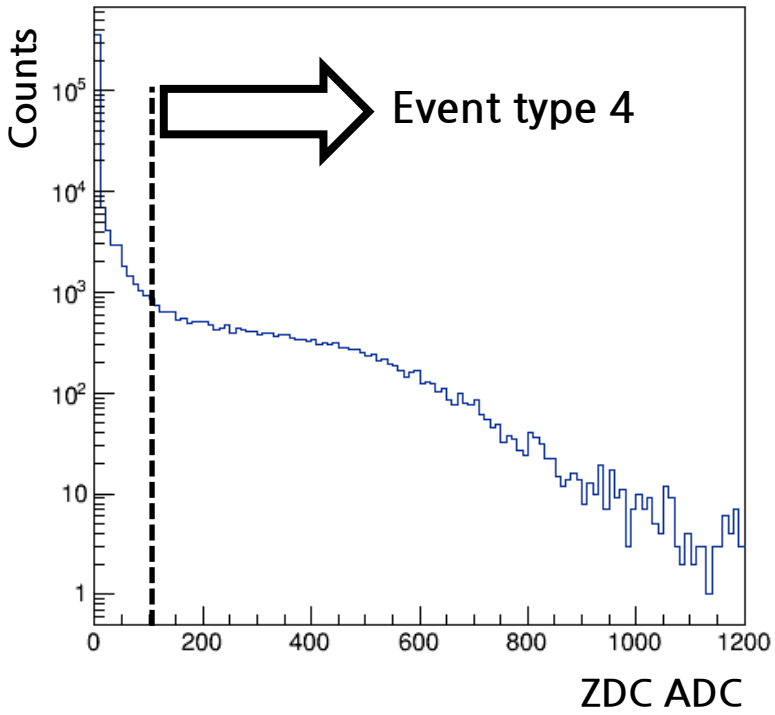
Neutron is heading to the ZDC at EPOS-LHC.

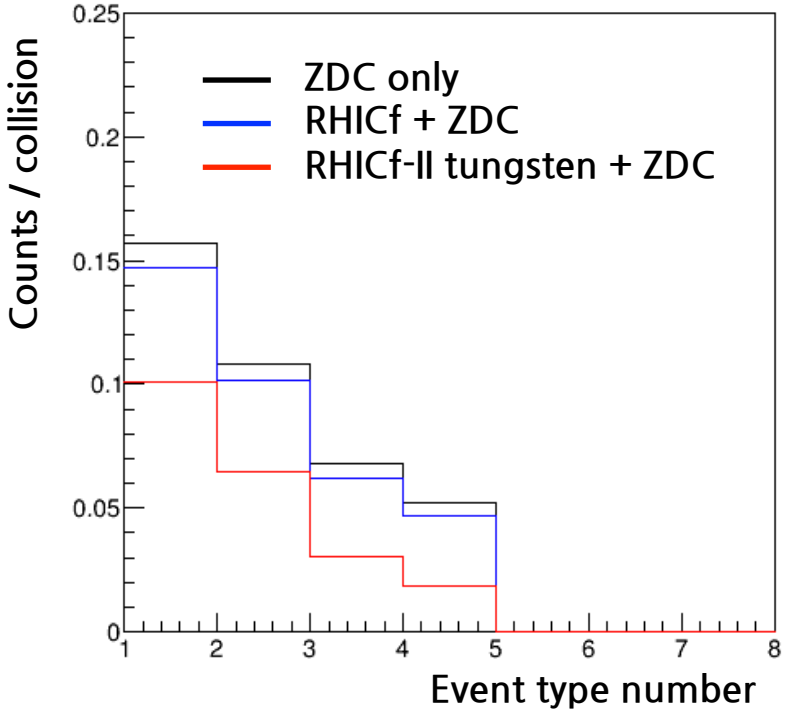


- If the neutron is heading to the RHICf, the second peak disappears but actually, there is.
- Ratio of red / black is ~0.2. This is comparable with $e^{-1.6} = 0.201$.
- If the RHICf-II tungsten is located in front of the ZDC, there will be no second peak as well (right figure).

Number of hits in ZDC

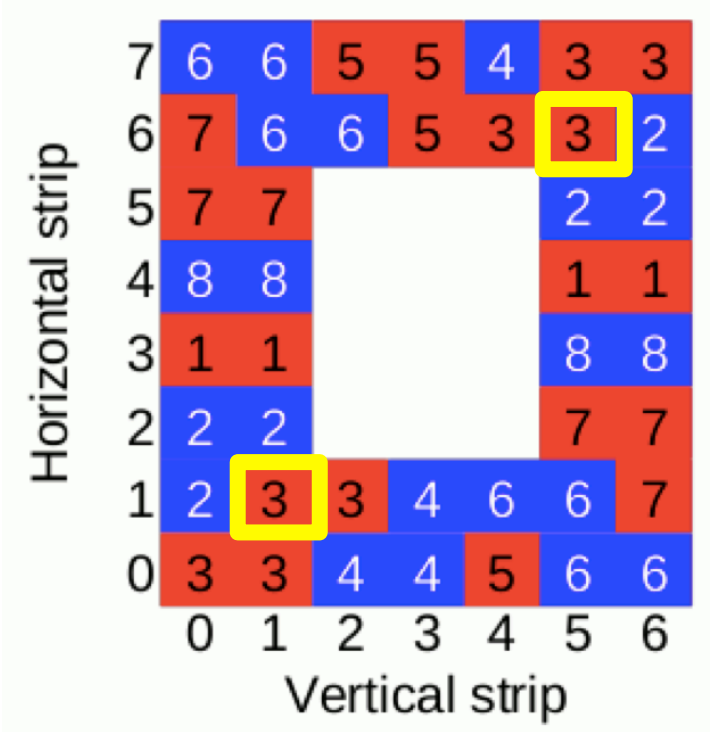
Condition: All events at EPOS-LHC





- Hits are counted if the ZDC ADC is larger than a threshold, 0, 10, 50, and 100 (x-axis in left figure) which are 0, 7, 35, and 70 MeV, respectively.
- It seems that the RHICf-II coverage makes the ZDC rate suppressed.
- If there is a ratio observed for 200 GeV run between the BBC and ZDC rates, we can approach it by lowering the ZDC hit threshold.

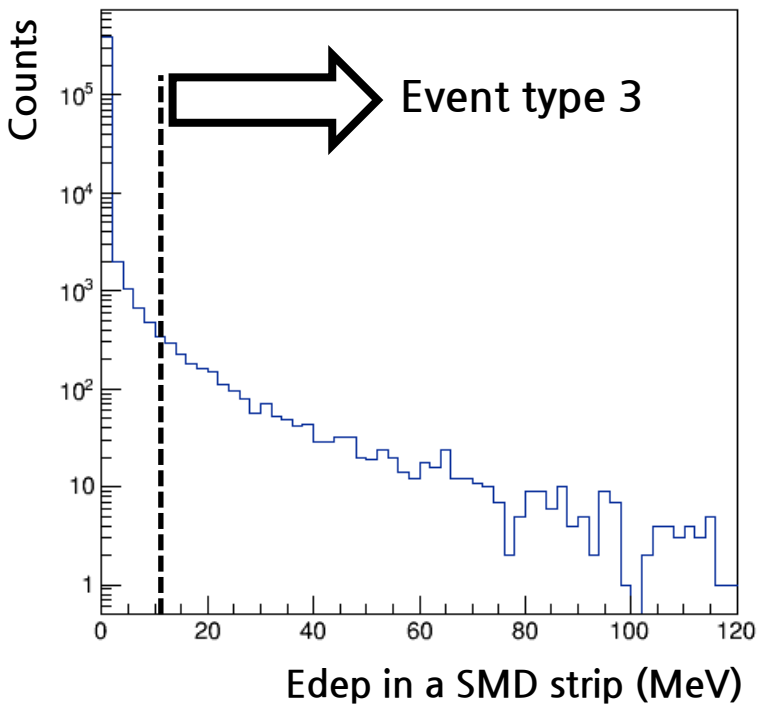
Number of hits in SMD

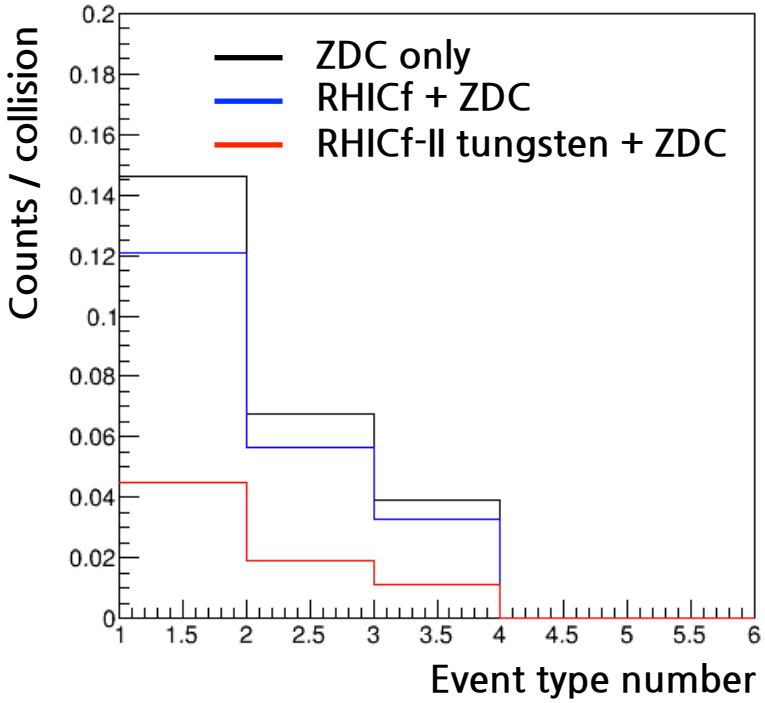


- Regarding each square-shaped region, hits are counted if the edeps of corresponding horizontal and vertical strips are larger than a threshold.
- Any horizontal or vertical strips were counted if the edep is larger than a thresholdlast time (corrected).
- In this study, if two particles hit the inside region of each yellow box, four hits were counted.

Number of hits in SMD

Condition: All events at EPOS-LHC

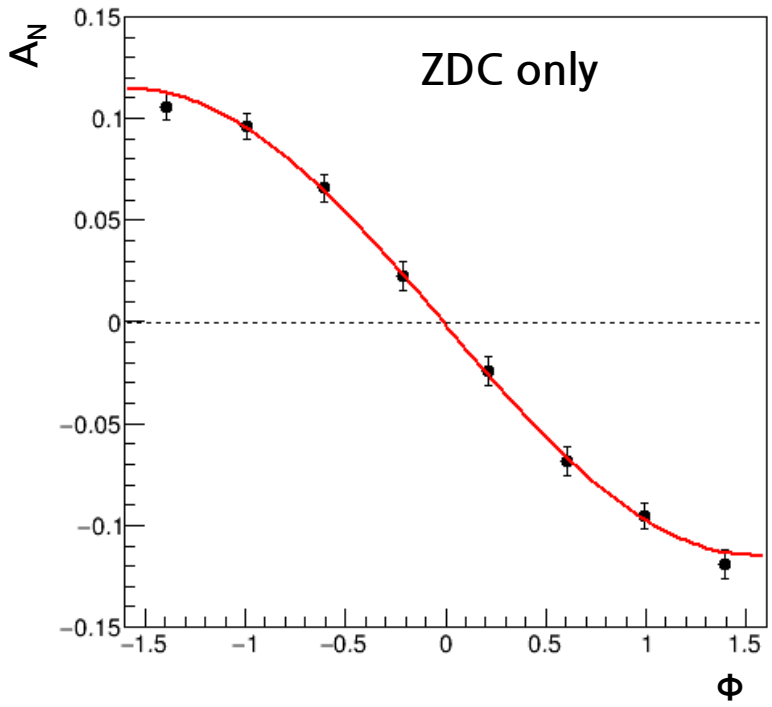


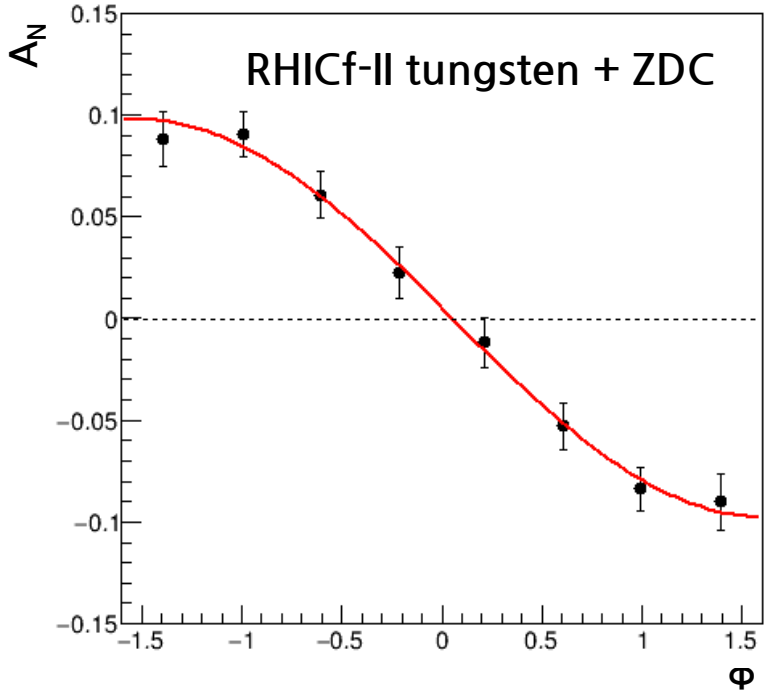


- The threshold was set as 5, 10, and 15 MeV.
- RHICf-II tungsten shows relatively suppressed statistics with a factor of 25~30% which will make ~2 times larger error bar in the polarization measurement.

Φ modulation of the ZDC

Condition: SMD hit with 5 MeV threshold at EPOS-LHC (2 x 10^6 collisions)

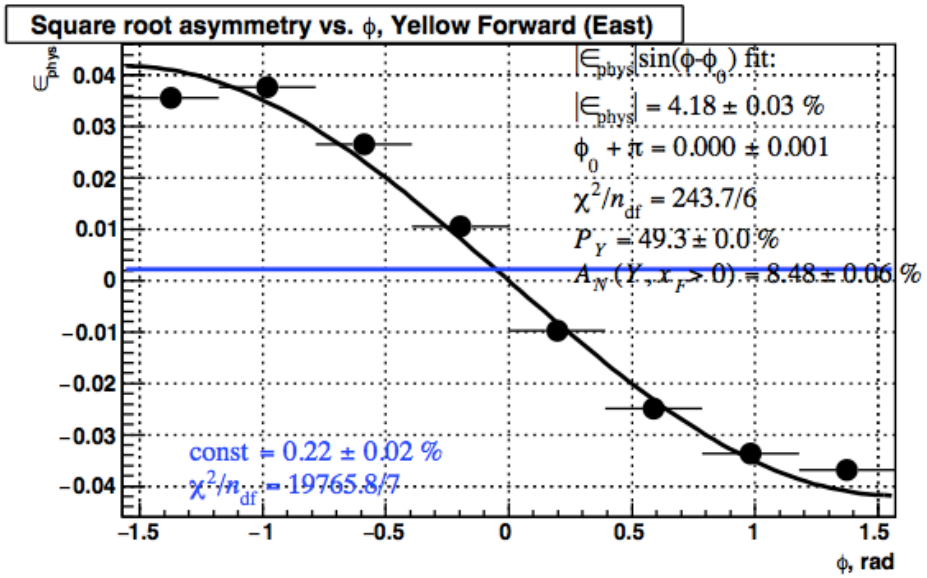


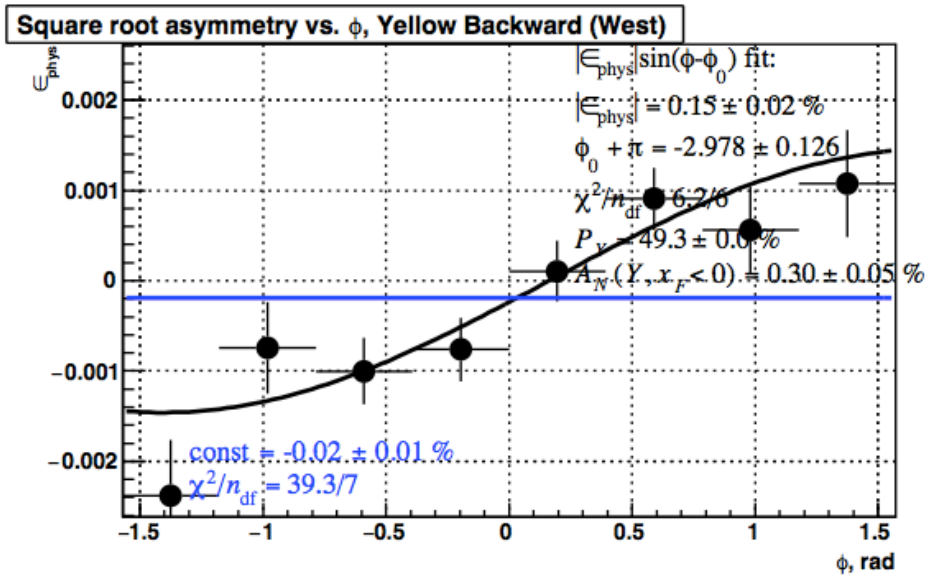


- Artificial spin patterns were assigned only to the neutron events for a p_T-proportional A_N.
- Due to the RHICf-II tungsten, the A_N is diluted and will have about two times larger error bars.

Φ modulation of the ZDC

STAR Run 18140921 (2017)





- If we see the Φ modulation of a run in 2017, two times larger error bar will not be problematic.
- However, lower ZDC threshold will make more diluted A_N.
- Comparison will be done with the actual threshold value used in STAR.