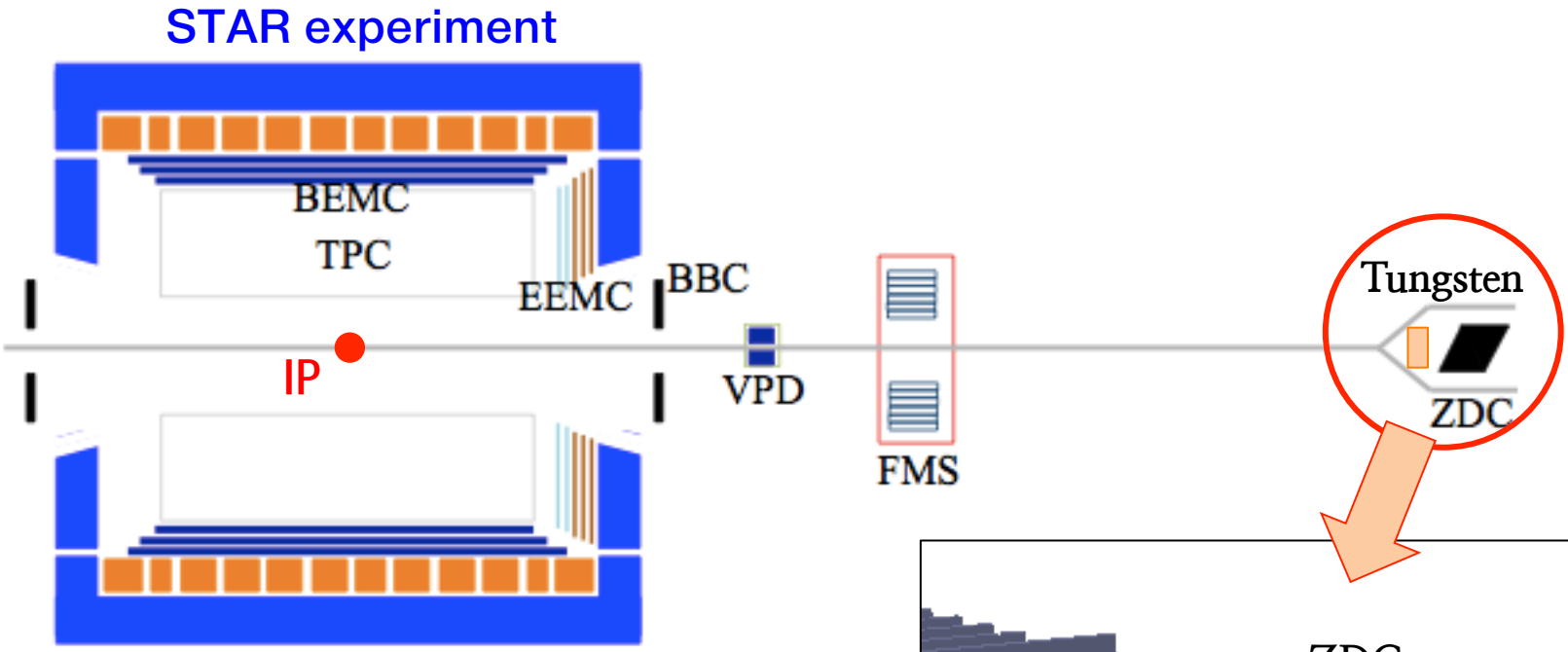
1. Expected ZDC performance as a polarimeter in the RHICf-II experiment

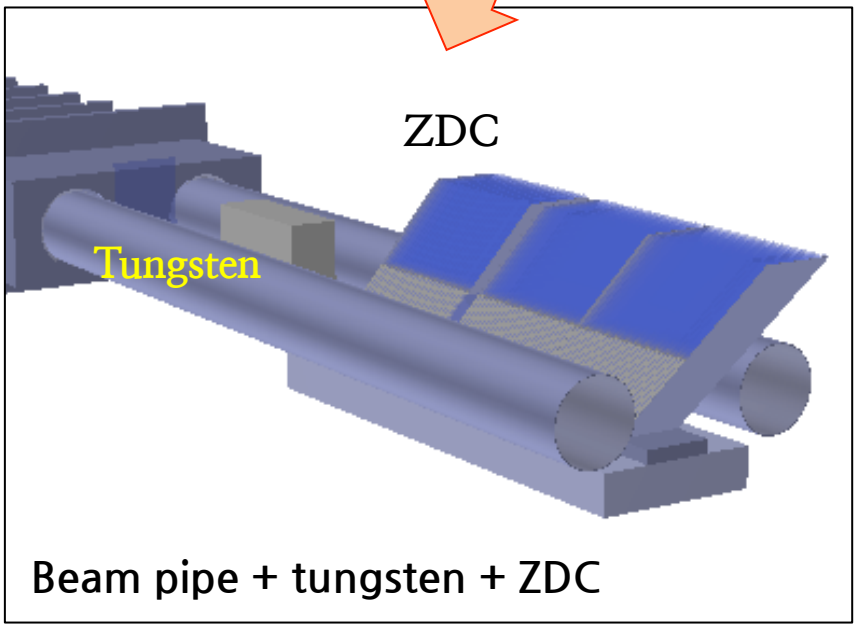
25 Mar 2022

Minho Kim

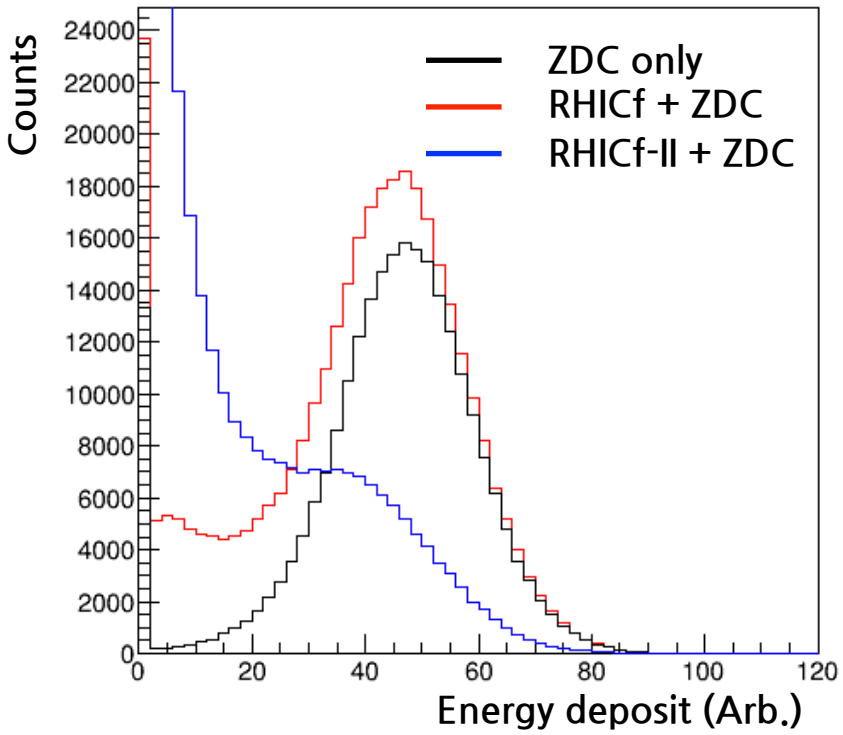
Simulation setup

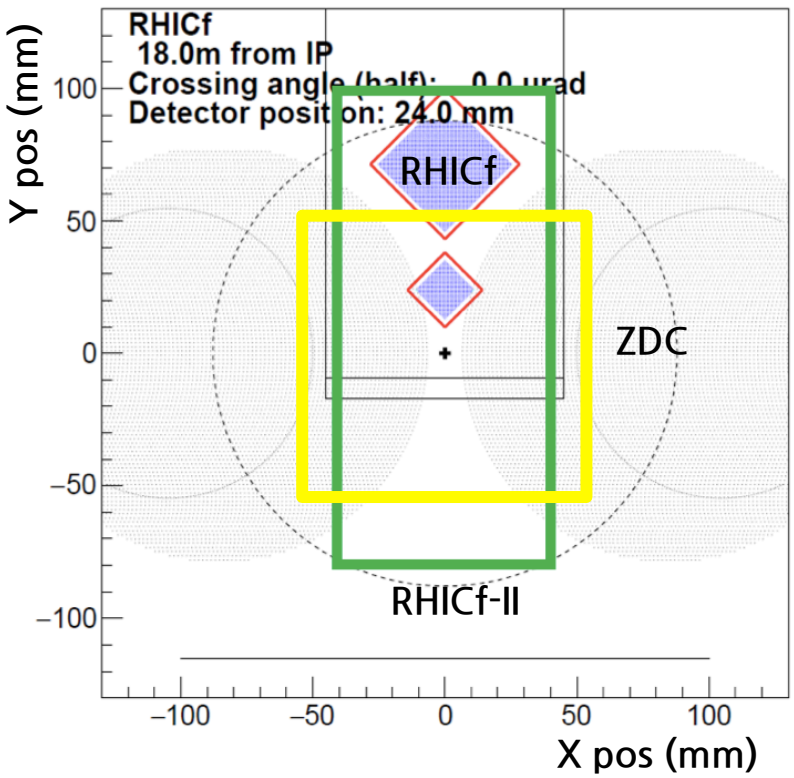


- A tungsten of 2.3 λ_{int} was located in front of the ZDC.
- 80 GeV neutron was generated from the IP.
- Artificial spin patterns were assigned to each event to reproduce the A_N = -0.1 with the Φ modulation.



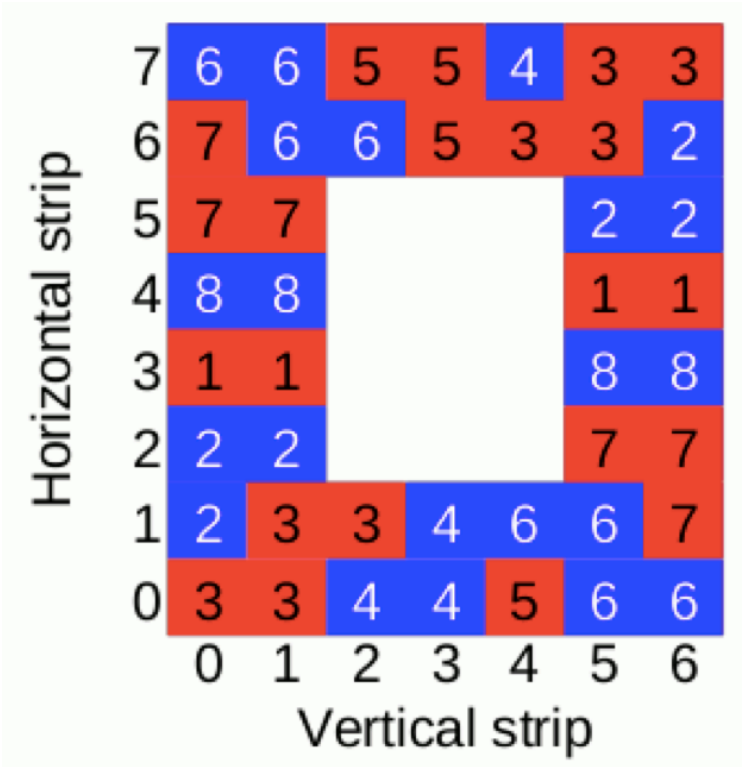
Energy deposit in the ZDC

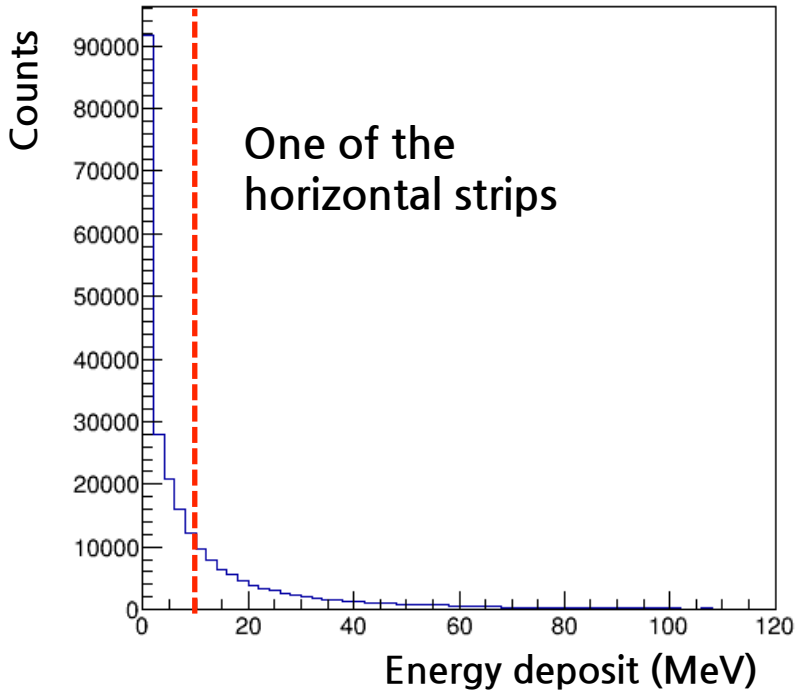




- Some neutrons don't face the ZDC.
- RHICf detector doesn't cover all of the ZDC effective area.
- RHICf-II detector covers almost all of the ZDC effective area.

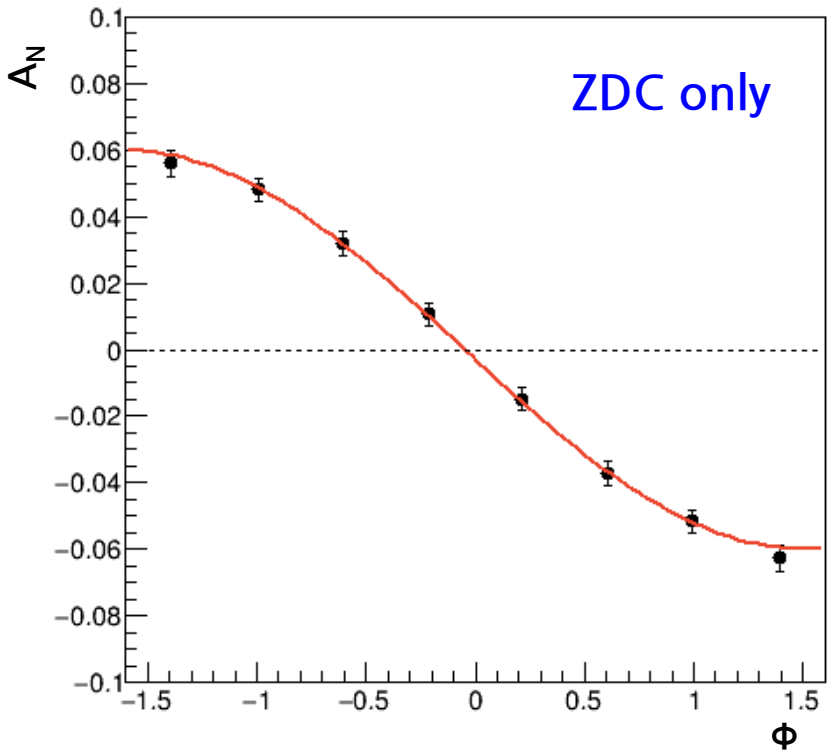
Energy deposit in the SMD

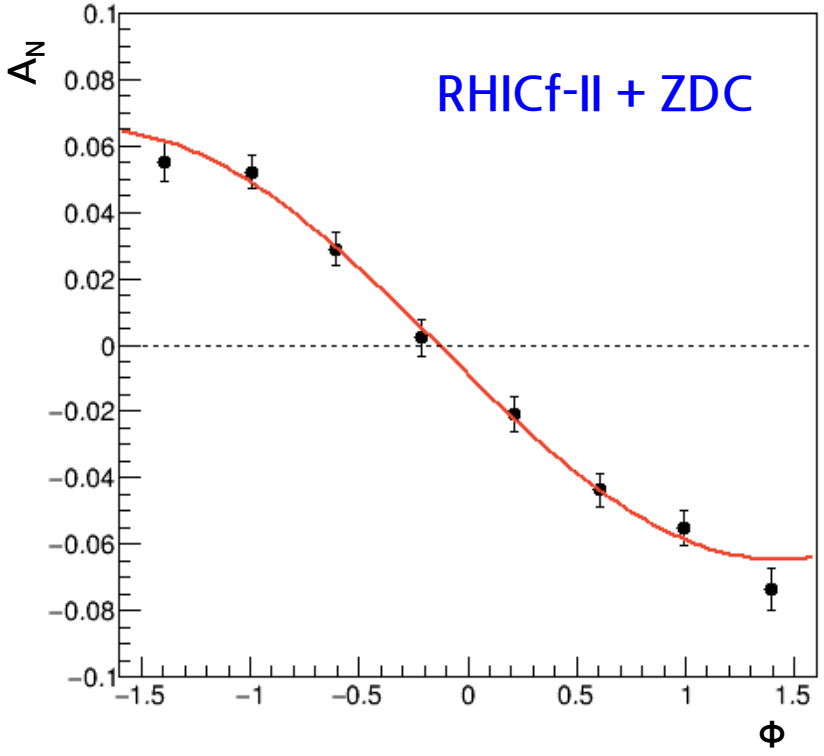




- SMD is composed of horizontal and vertical strips for the position measurement.
- A square-shaped area is fired when there is a signal larger than 10 MeV in the corresponding horizontal and vertical strips.

Azimuthal angular modulation



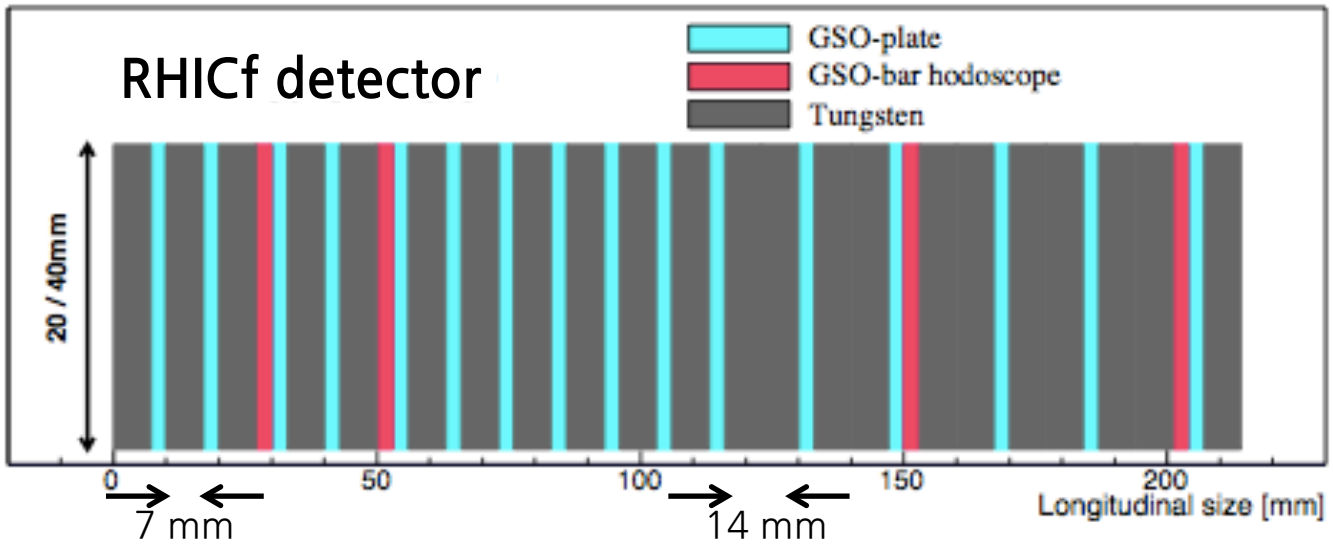


- Though the RHICf-II detector is located in front of the ZDC, it is expected that the ZDC would be working well as a polarimeter.
- Since some interaction is generated by the RHICf-II detector, the statistics will be lower.

2. Status of the RHICf-II detector configuration study

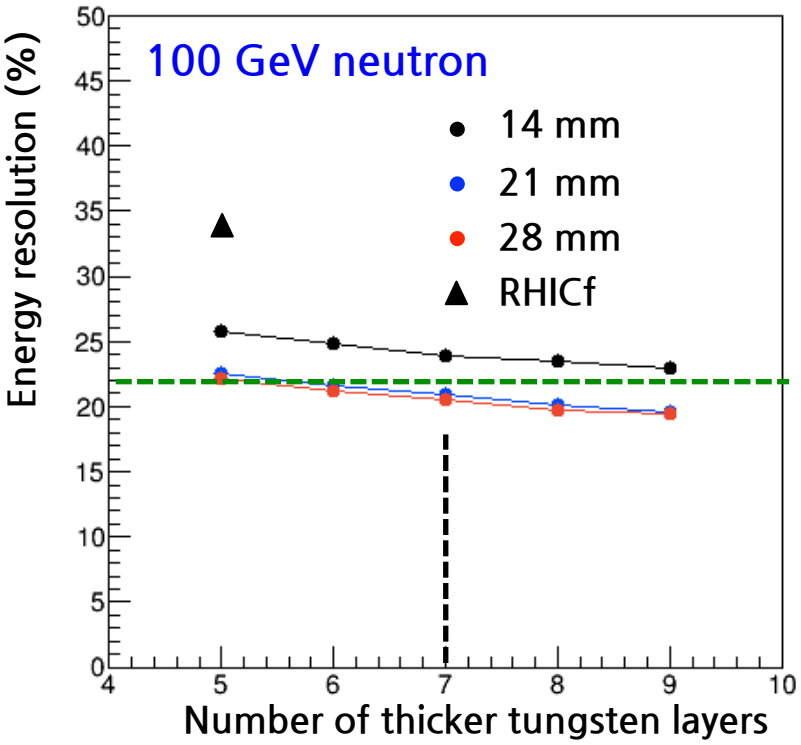
RHICf detector to RHICf-II detector

44 X_0, 1.6 λ_{int}



- Since the photon performance of the RHICf detector is enough, we will use the forward geometry of the RHICf detector as it is (11 layers).
- Since the interaction length of the RHICf detector is insufficient for the neutron measurement, we will increase the backward tungsten thickness (7 layers).
- We need to optimize the locations of the HG layers (2 layers).

Thicker tungsten thickness



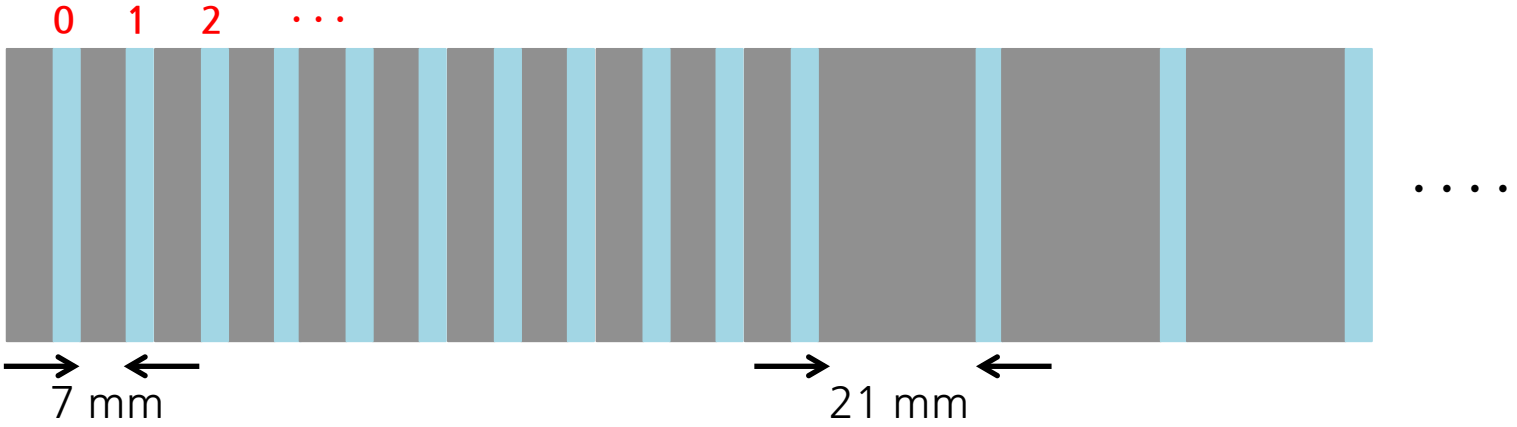
- Since the FoCal-E uses 3.5 mm tungsten, RHICf-II would be better to use multiple of 3.5 or 7.0 for the tungsten thickness.
- The energy resolution is not be dramatically improved from the 21 mm thickness.

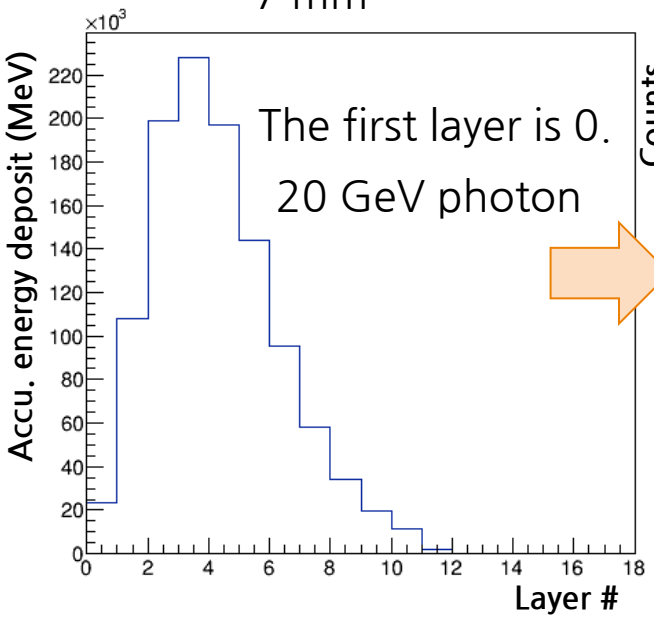
EM shower development

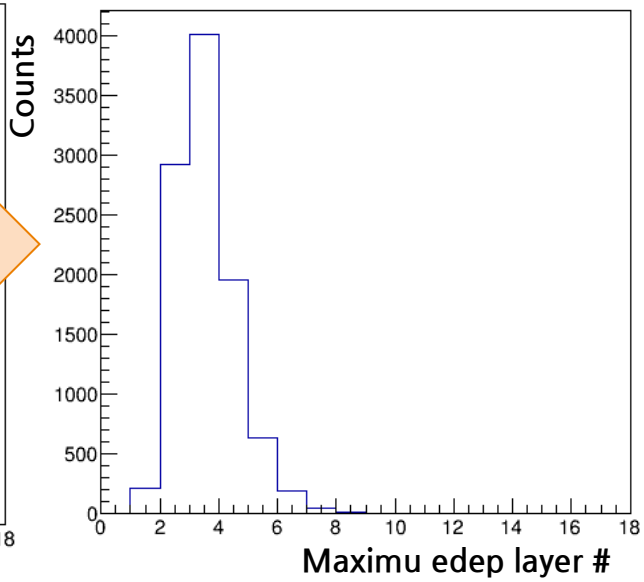
: Tungsten

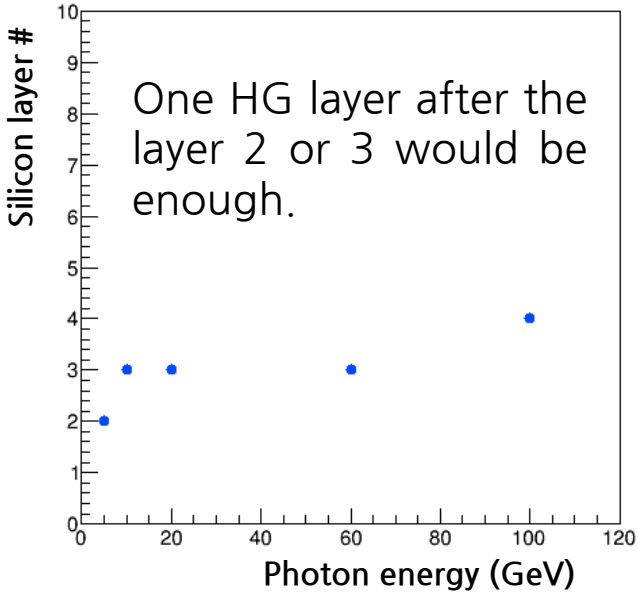
: Glue + silicon + glue + readout

11 thinner + 7 thicker layers

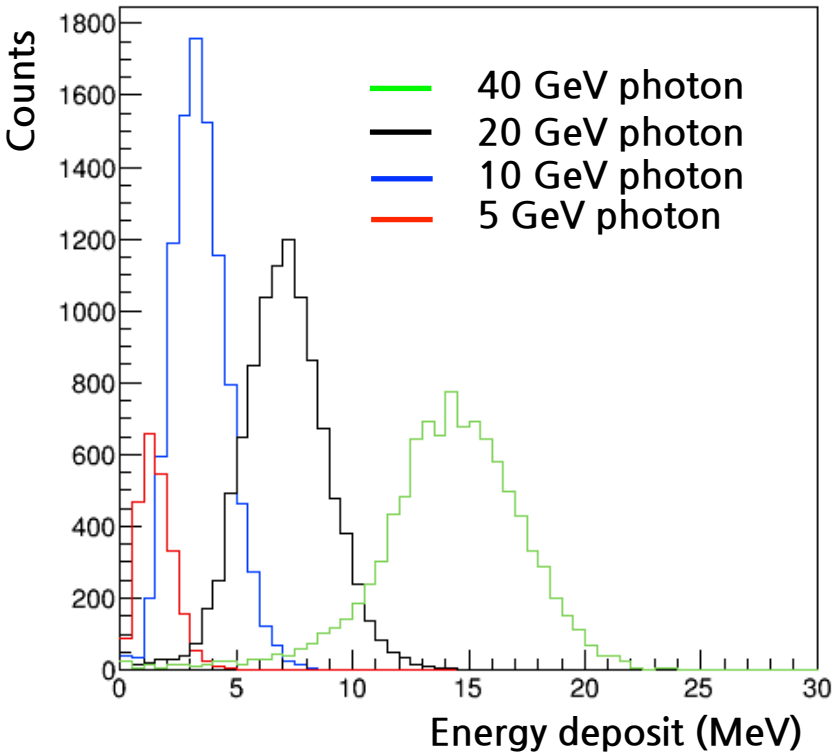


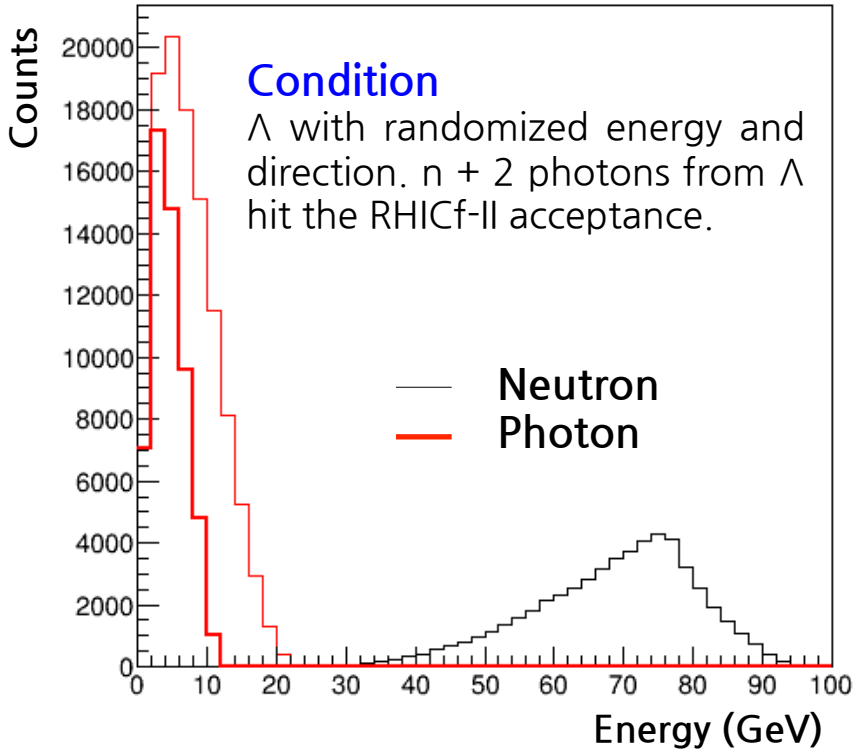






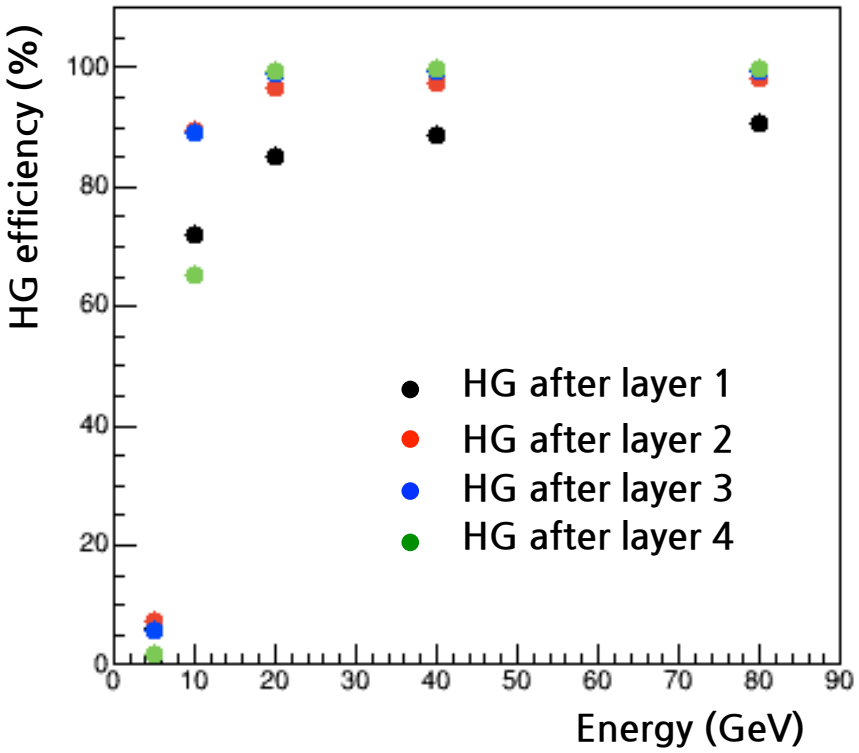
Energy deposit in the HG layer

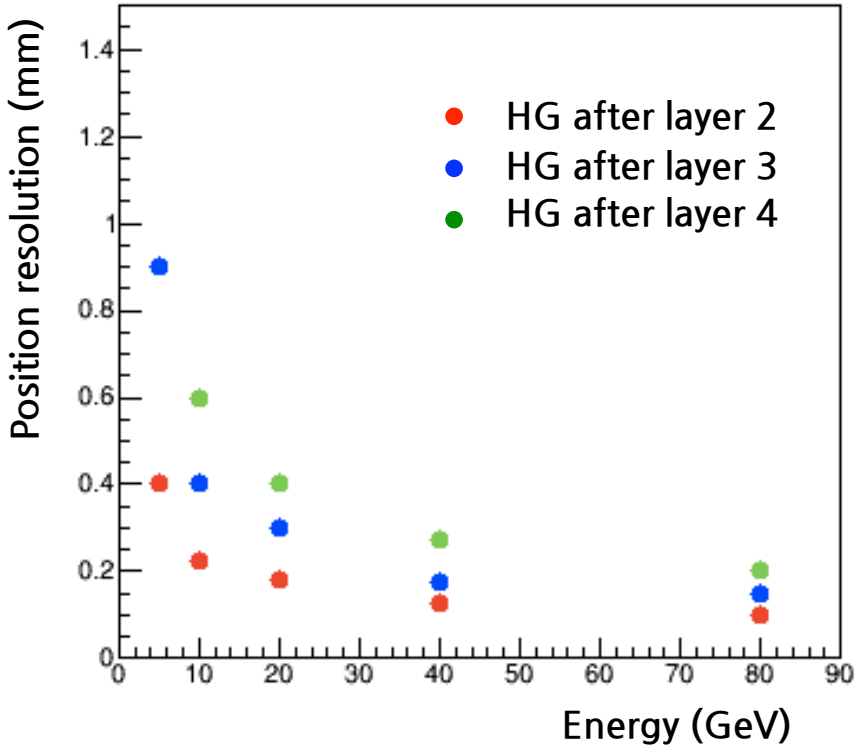




- Since the minimum photon energy of Λ is usually smaller than 10 GeV, the position reconstruction was proceeded if the energy deposit is larger than 2 MeV.
- To shorten the simulation time, 1 mm x 1 mm pixels were used.
- HG layer is located with a tungsten of 3 mm thickness.

Detector performance for photon





- Regarding the HG efficiency, there is no noticeable difference between when the HG is located after layer 2 and 3.
- Position resolution is better due to the size of the EM shower when the HG is located after layer 2.
- HG layer after layer 2 is the best for the photon measurement.