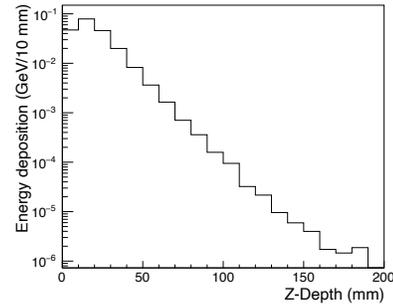


Summary of eRD27: Developing a high resolution ZDC for EIC

Period Reported: from 10/1/2020 to 3/5/2021

Leader: Yugi Goto, **Contact:** Michael Murray

We implemented the ZDC within G4E. As requested by the program committee we focused low energy photon reconstruction. Reconstructing 400 MeV photons seems beyond the capabilities Cherenkov Fiber/Tungsten ZDCs so we focussed on crystals. The plot shows energy deposition versus depth for 400 MeV photons in PbWO₄. It is clear that a 10cm section should be sufficient to tag these



photons. Next we will implement detailed optical tracking in the crystals based on FOCAL experience. PbWO₄ is not particularly radiation hard so it is important to understand dose as a function of beam energy and neutron transverse momentum. The picture to the right shows the dose map for a 100 GeV neutrons, near shower max. For neutrons with $p_T=100$ MeV/c the maximum dose is $1.5 \cdot 10^{-10}$ Gy/event. The next step is to use realistic generators such as BeAGLE. For the remainder of this cycle we will finish out standalone studies of the ZDC energy resolution for our current configuration. However we will delay studies of neutron position resolution in order to focus on developments with the EIC beam pipe.

Recently Alex Jentsch has alerted us to a concern about the beam pipe in the forward region. Because of shallow angles with respect to the neutron cone some neutrons may see as much as 10 cm of beam pipe. This is an important issue to address and perhaps iterate with the machine group. We hope to get step files for the current beam pipe in the next two weeks and will then incorporate them in to G4E. Accurate simulations of the beam pipe will be essential before we can approach the beam group about possible modifications in either geometry or materials. For photon reconstruction the use of a pre-shower within B0 could be provide complimentary information to the ZDC. We plan to make a preliminary investigation of this in the next months. In order to produce a TDR we estimate that we would need 1.5 -2.0 FTE postdocs for the period fall 2021 to fall 2023. During this period at least 2 test beam campaigns would be required. Support for two students would be very helpful.

KU recently obtained ~\$73K from DOE-HEP for development of fast timing for forward calorimeters. KU is also collaborating with UIUC on building identical ZDCs for ATLAS & CMS. The paper “*Performance of the CMS Zero Degree Calorimeters in pPb collisions at the LHC*”, O. Surányi, et al. 2102.06640 [hep-ex], was accepted by JINST.

