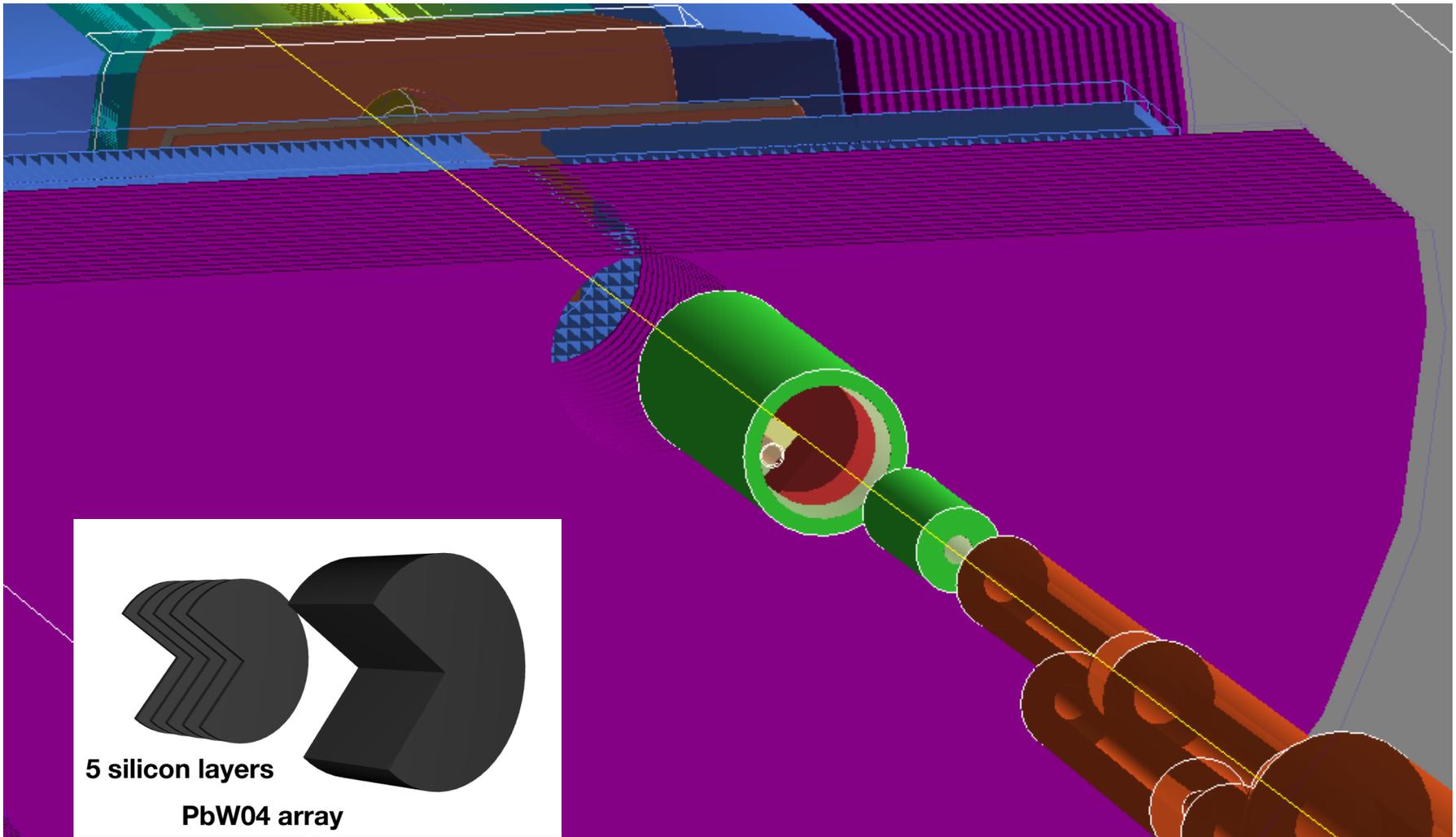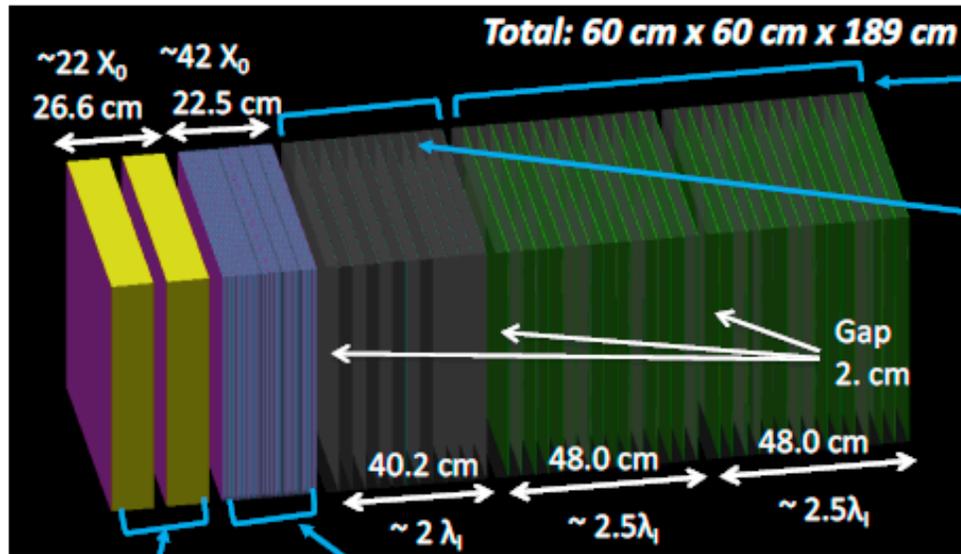# Far Forward/Backward Detectors

- Currently we have a first implementation of ZDC and B0.

- ZDC based on PbW04 and W/Si W/scintillator (Quan Wang, Shima Shimizu)

  - Currently EM section too deep but this is easy to modify

  - Also plan to add 1 timing layer

  - Working on photon/neutrons reconstruction.

- For B0 we want to detect soft photons, PbW04 (Quan Wang)

- For Roman Pots plan on copying TOTEM CMS-PPS

- Off momentum detectors based on silicon planes

- Just starting with low Q^2 tagger (Dhevan Gangadaren)

- For first set of simulations we will just start with grant planes

Michael Murray 10 June 2021

Looking for soft photons in B0 using lead tungstenate array

5 silicon layers

PbW04 array

First ZDC design

~22 X_0 ~42 X_0
26.6 cm   22.5 cm

Total: 60 cm x 60 cm x 189 cm

Gap 2. cm

40.2 cm   48.0 cm   48.0 cm
~ 2 λ_I ~ 2.5λ_I ~ 2.5λ_I

30 layers (15 layers x 2)

Pb 3cm Thickness
Scintilator
10 cm x 10 cm x 2 mm
Gap 0.0013 mm

12 layers

Pb 3cm Thickness
PET (Glue) 0.11 mm
Silicon
1 cm x 1 cm x 320 µm
PET (Glue, FPC) 0.41 mm
Gap 1. mm

2 layers

Silicon
3 mm x 3mm x 300 µm
PET (Glue, FPC) 0.39 mm
Gap 1.2mm
Crystal (PbWO4)
3cm x 3cm x 10 cm
Gap 3 cm

Si: 3 layers,
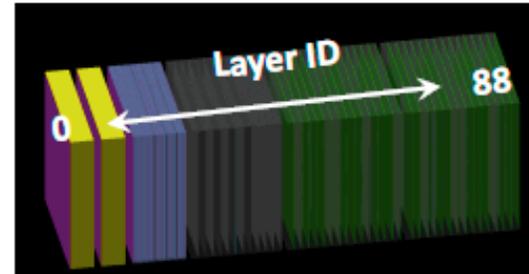**Si:** 40 layers,
W: 42 layers

= **Si** + 2 x

20 layers

Tungsten 3.5 mm Thickness
PET (Glue) 0.11 mm
Silicon   1 cm x 1 cm x 320 µm
PET (Glue, FPC) 0.41 mm, Gap 1.mm

+

1 layer

Tungsten 3.5 mm Thickness
PET (Glue) 0.11 mm
Silicon 3 mm x 3mm x 300 µm
PET (Glue, FPC) 0.39 mm, Gap 1.2mm

3

Energy deposition per layer

- Using particle gun of photon and neutron.
  - 1, 20, 100 GeV

- Layer 1, 3:   Crystal 3cm x 3cm   10cm thick
- Layer 0, 2, 4, 25, 46: Silicon 3mm x 3mm   300μm thick
- Layer 5-24, 25-45:   Silicon 1cm x 1cm (w/ Tungsten)   320μm thick
- Layer 47-58:   Silicon 1cm x 1cm (w/ Pb)   320μm thick
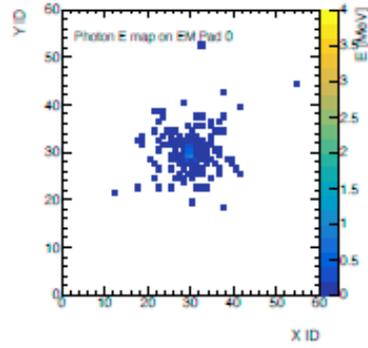- Layer 59-88:   Scintillator 10cm x 10cm (w/ Pb)   2mm thick
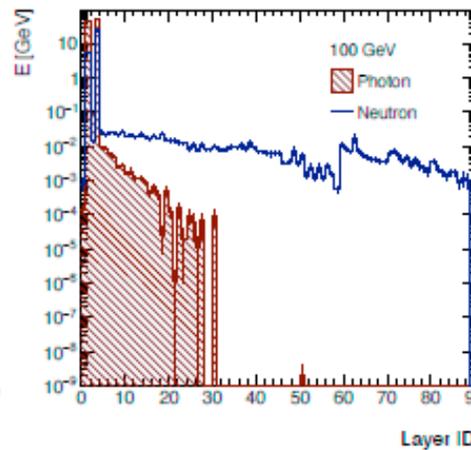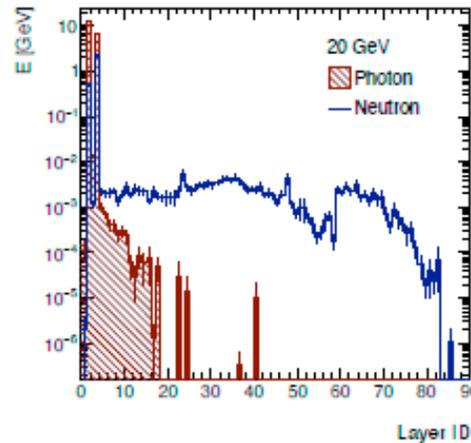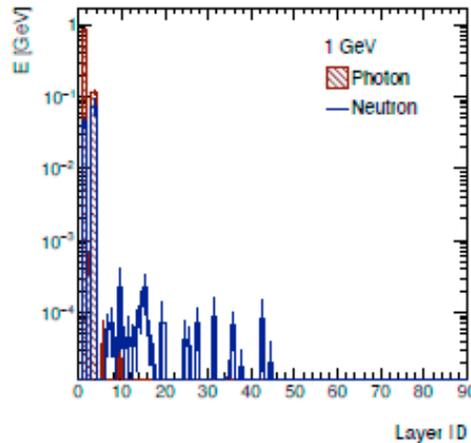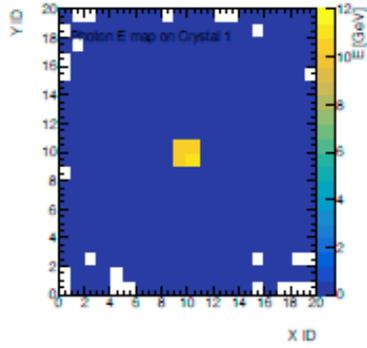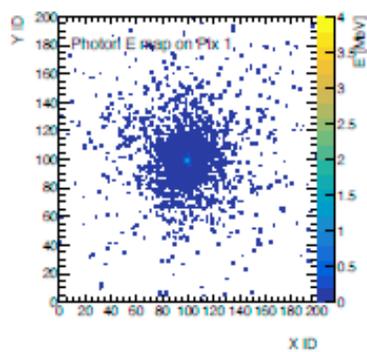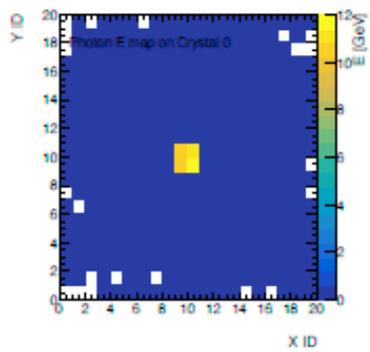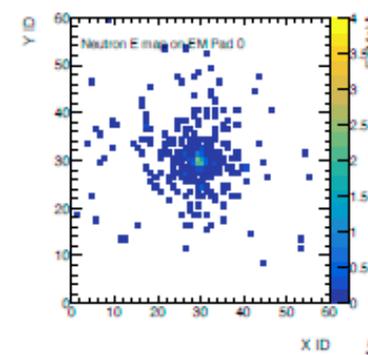
Energy map w/ 100 GeV photon or neutron

Layer 1
(Crystal 0)

Layer 2
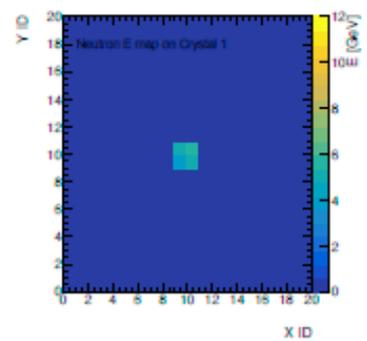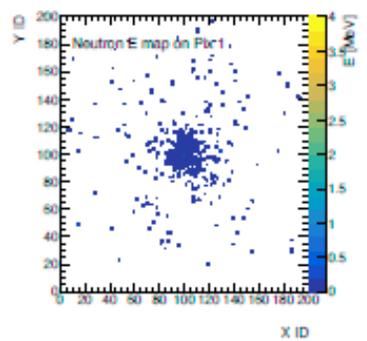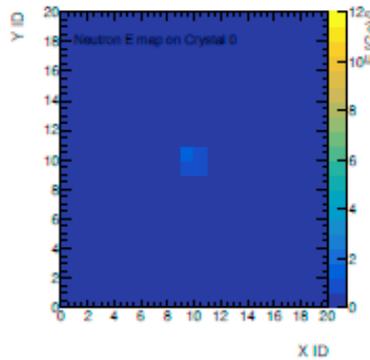(3mm x 3mm Silicon)

Layer 3
(Crystal 1)

Layer 5
(1cm x 1cm Silicon)

Photon

Neutron

Submission to eic/fun4all_eicdetectors github

- Codes are placed under:
  eic/fun4all_eicdetectors/simulation/g4simulation/**g4zdc**

- Will be **EICG4ZDC** library.

  - In Fun4All_XX.C macro:
    ```
    #include <eicg4zdc/EICG4ZDCSubsystem.h>
    #include <eicg4zdc/EICG4ZDCHitTree.h>

    EICG4ZDCSubsystem *mydet = new EICG4ZDCSubsystem("EICG4ZDC");
    mydet->SetActive();
    g4Reco->registerSubsystem(mydet);

    EICG4ZDCHitTree *zdctree = new EICG4ZDCHitTree("Hits");
    zdctree->AddNode("EICG4ZDC_0", 0);
    se->registerSubsystem(zdctree);
    ```
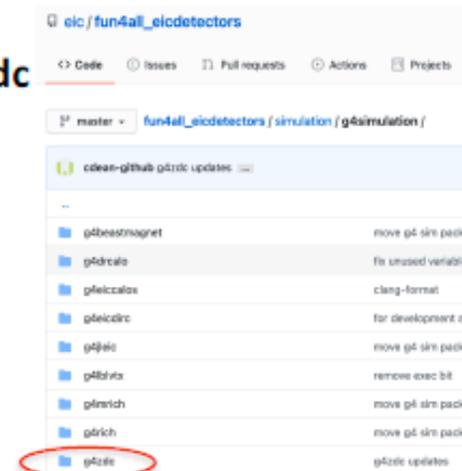
  - Placement of ZDC can be modified in the macro
    ```
    //for test
    mydet->set_double_param("place_z",375.);
    mydet->set_double_param("place_x",0.);
    mydet->set_double_param("rot_y",0.);
    ```

- Next: modification of G4_hFarFwdBeamLine_EIC.C

  - It takes care of forward configuration (incl. magnet, pipe, RP, B0, OM) for
    both IP6 and IP8.

Summary

- Will use particle gun in ZDC to develop neutron/photon reconstruction
  - These studies will guide choice of granularity and technology choice
- Will also use particle gun to evaluate photon reconstruction using silicon and crystals
- Other detectors to be developed later.