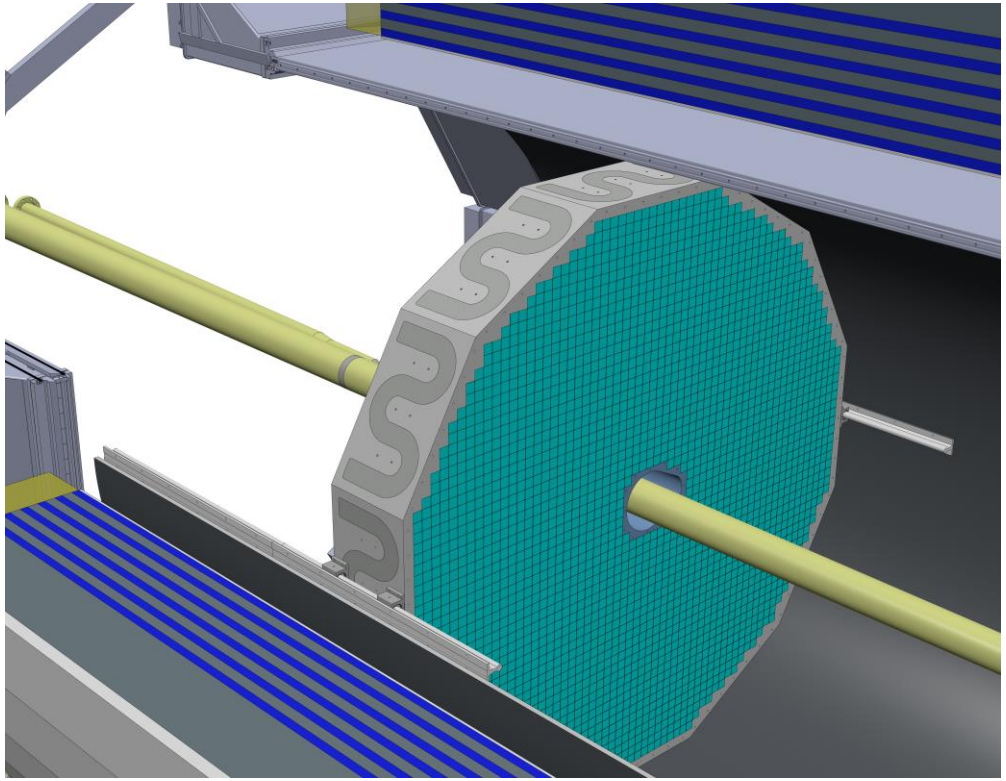


Backward ECal

ePIC calo meeting

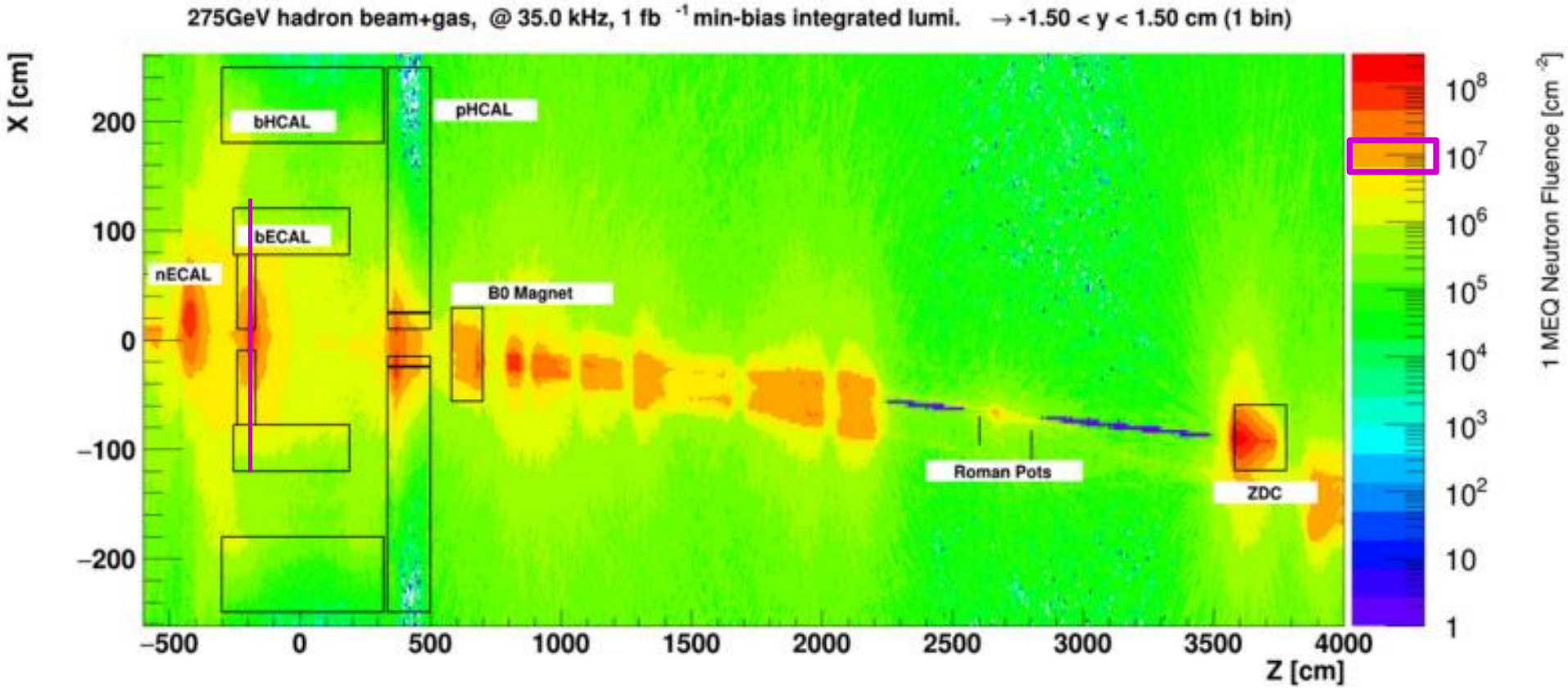
June 25, 2025

Questions asked

1. Expected neutron fluxes for an integrated luminosity of 100 fb^{-1}
2. Expected dark current levels
3. Light yield (LY) per GeV in pixels
4. Readout threshold in pixels
5. Noise contribution to energy resolution
6. Rates of hits above threshold caused by SiPM noise
7. Planned measurements and/or additional measurements you believe are necessary
8. Potential impact on readout electronics
9. Any other relevant information or concerns

Tentative answers

1. Expected neutron fluxes for an integrated luminosity of 100 fb^{-1}

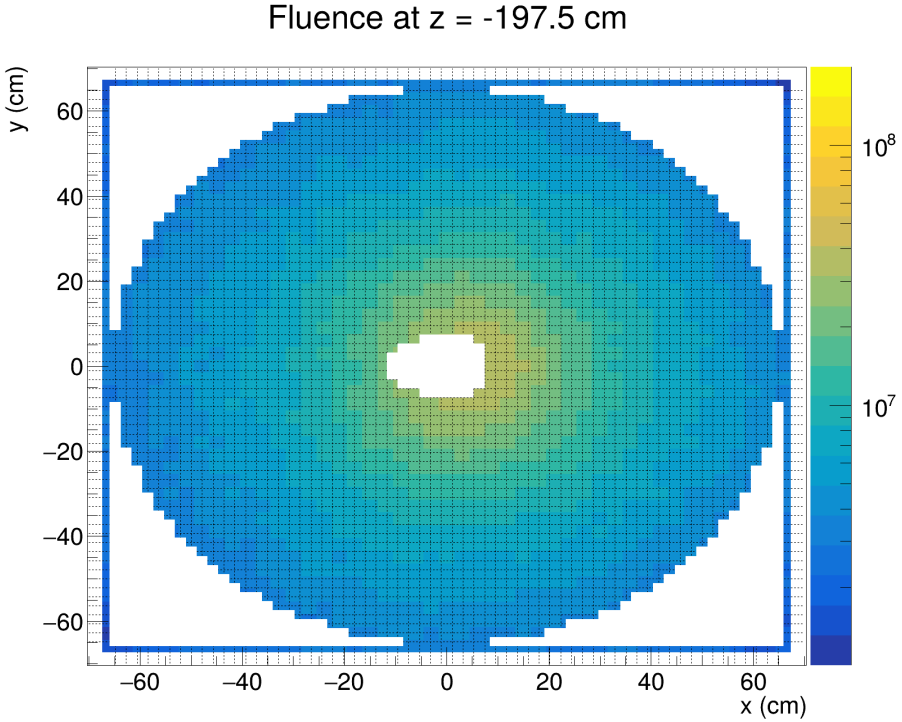


~10^9 cm^{-2}

Better estimate in next slide

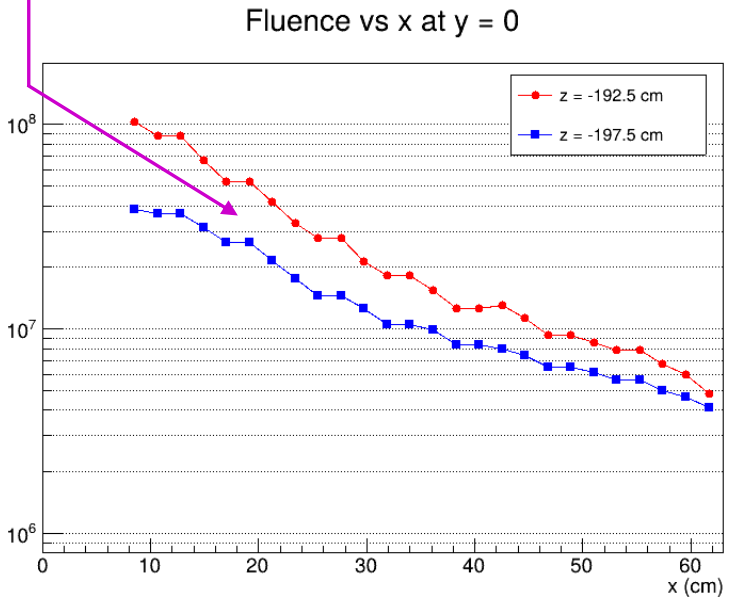
Tentative answers

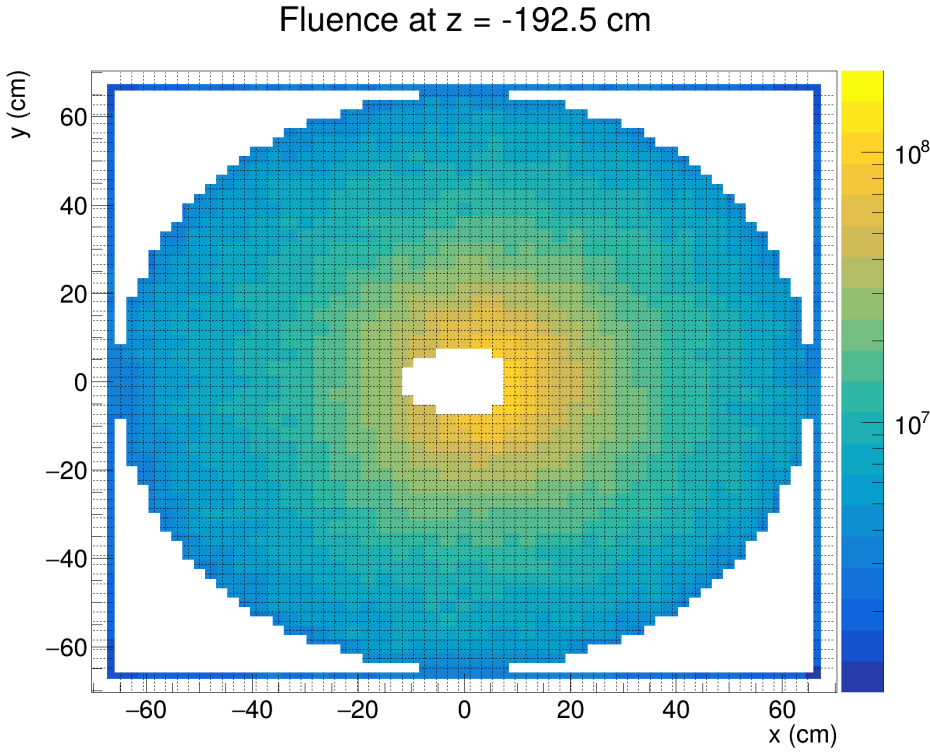
1. Expected neutron fluxes for an integrated luminosity of 100 fb^{-1}



EEEMCal SiPM at z=-194.0 cm

Plots show expected dose per crystal at 1 fb^{-1}





At 100 fb^{-1}(and z=-194 cm):

~$5 \cdot 10^9$-$5 \cdot 10^8$ depending on the crystal

Source: 3D_map_full_detector_and_IR__1_MEQ_NEUTRON__canyonLake_SiPMOnTile_pipes_vacuum__hadronBeamGas_crossing_angle_2752_29_2024.root
(Fig. 3 at https://wiki.bnl.gov/EPIC/index.php?title=Radiation_Doses#Full_ePIC_Detector_Region_and_IR_2 (Accessed July 29, 2025).

Tentative answers

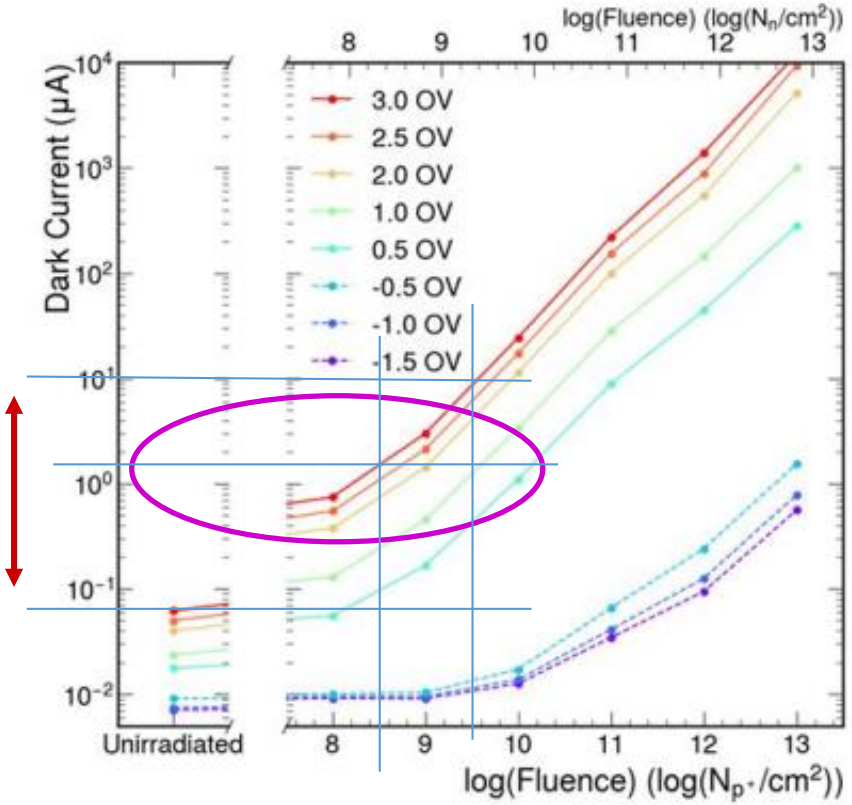
2. Expected dark current levels

For S14160-3015PS:

1.7 ± 0.4 Mcps (measurement before irradiation, at Vop (Vbr+4V)

~ ×25-150 after 5e8-5e9 (equivalent to 100 fb^{-1})

×25-150 at 3.0 OV
(1.5-10/6.5e-2)



UC Davis results

Tentative answers

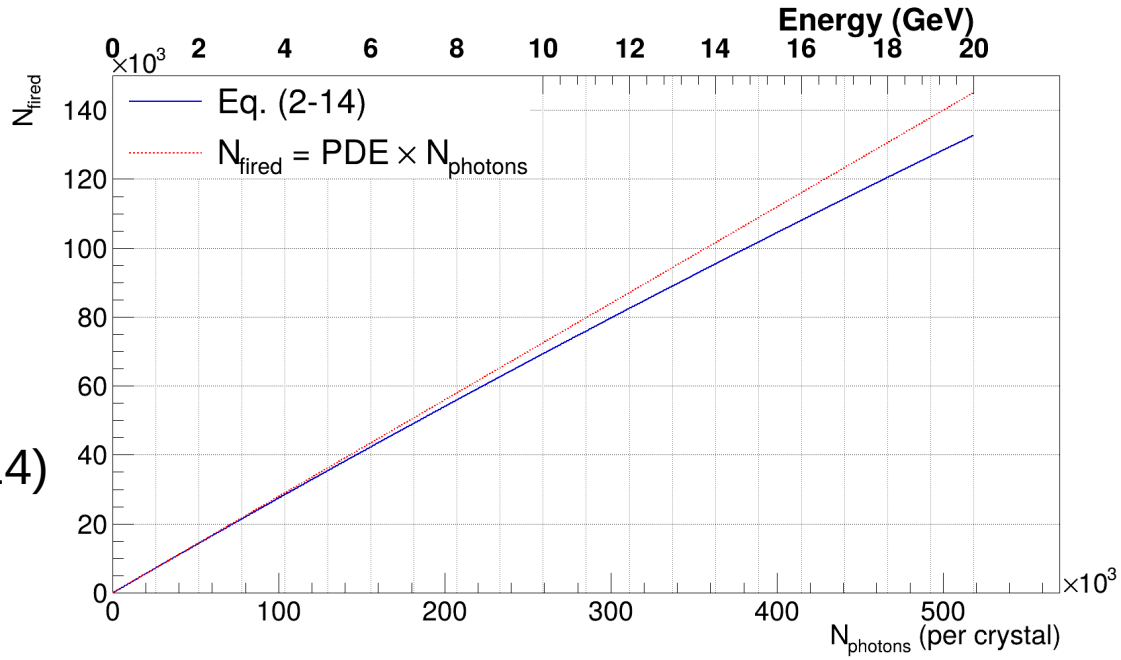
3. Light yield (LY) per GeV in pixels

18000 p.e. / GeV (PWO) x 16*9/400 (light collection) x 1/0.25 (QE PMT) x 0.28 (PED)

7258 pixels / GeV

$$N_{fired} = \frac{N_{pixel} \times PW}{T_d} \left(1 - e^{-\frac{N_{photon} \times PDE \times T_d}{N_{pixel} \times PW}}\right) \quad (2\text{-}14)$$

Fired Pixels vs Incident Photons



- N_{pixel}=39984*16=639744
- PW= 100 ns (PWO)
- Nphoton=18000 p.e. / GeV (PWO) x 16*9/400 (light collection) x 1/0.25 (QE PMT)
- Td=80 ns (Hamamatsu datasheet)
- PDE=0.28 (Hamamatsu datasheet)

7225 pixels / GeV

Tentative answers

4. Readout threshold in pixels

   5-10 MeV: 36-72 pixels

5. Noise contribution to energy resolution

- 1.7 Mcps x 100 ns = 0.17 → Noise: sqrt (0.17) = 0.41 (before irradiation)
- $0.41\times\sqrt{25} - 0.41\times\sqrt{150}$ after irradiation: 2–5 pixels (0.28-0.69 MeV) per SiPM **(x4 for 16 SiPM: 1.1 – 2.8 MeV)**

Tentative answers

6. Rates of hits above threshold caused by SiPM noise

TBD by simulation

7. Planned measurements and/or additional measurements you believe are necessary

Investigation on noise observed during last DESY beam test (~13 MeV/crystal) – work ongoing

8. Potential impact on readout electronics

9. Any other relevant information or concerns

Backup