NPS background simulations
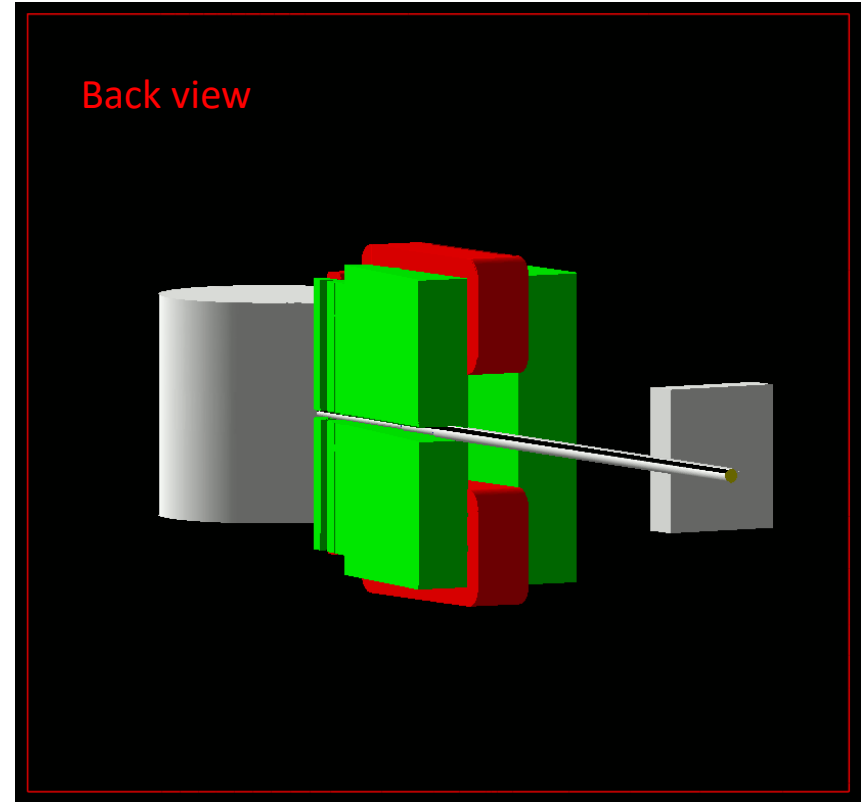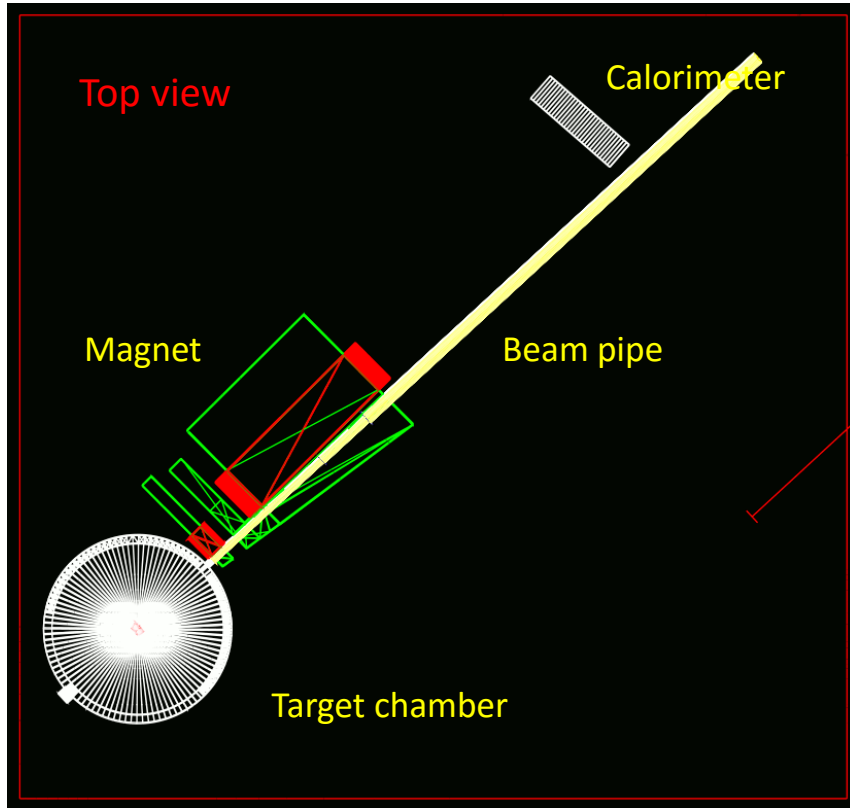## (Geant4 code)

V. Tadevosyan

Parameters of simulation

Set up:

- 4.4 cm LH2 target, thin Al cell (~0.1 mm wall, entrance and exit window thicknesses)
- 50 cm in diameter scattering chamber of Al, 10 cm wall thickness, 0.02 mm window thickness
- Beam pipe of Al, 3 segments, 1° critical angle, 4 cm minimal diameter, 1 mm wall thickness
- Scatt. Chamber exit window, of 0.16 mm thick Ti
- Magnet, with small angle slot, 0.6 Tm horizontal field (field map from Bogdan)
- Calorimeter, 2x2x18 cm^3 lead tungstate crystals in 31x36 matrix
- 10^{-6} Tor vacuum in scattering chamber and beam pipe
- NPS at 6.3 °!

Simulation:
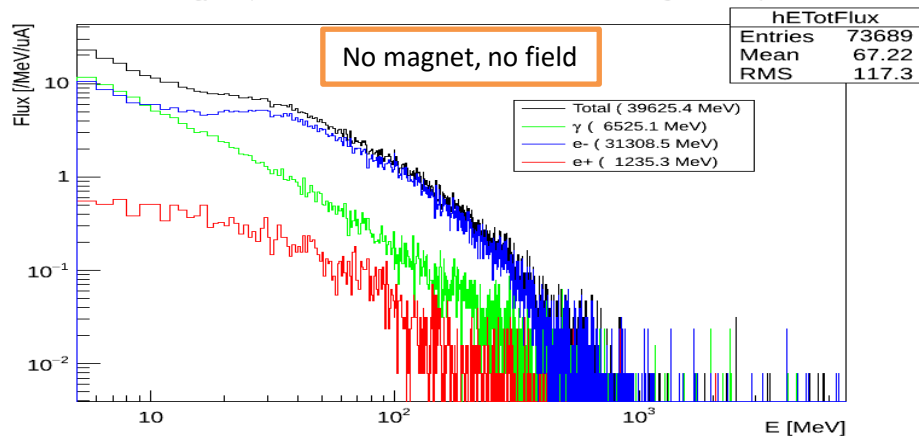
- Geant4.10.01.p3, FTFP_BERT physics list
- 6.6 GeV electron beam
- ~300,000,000 events
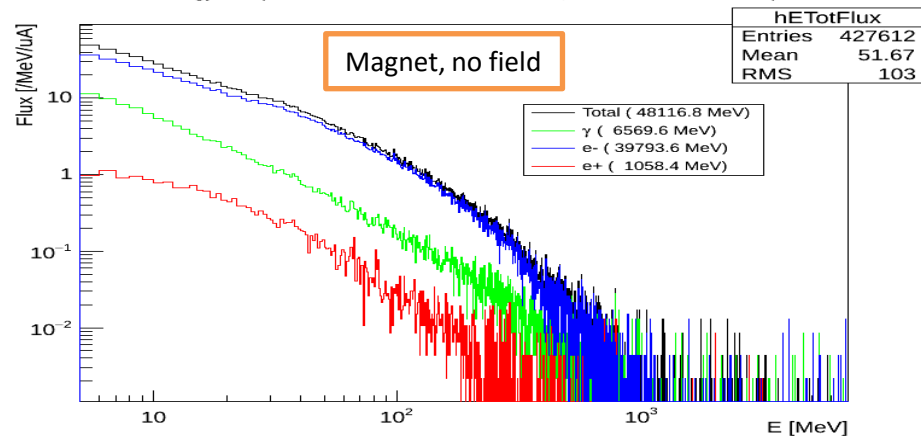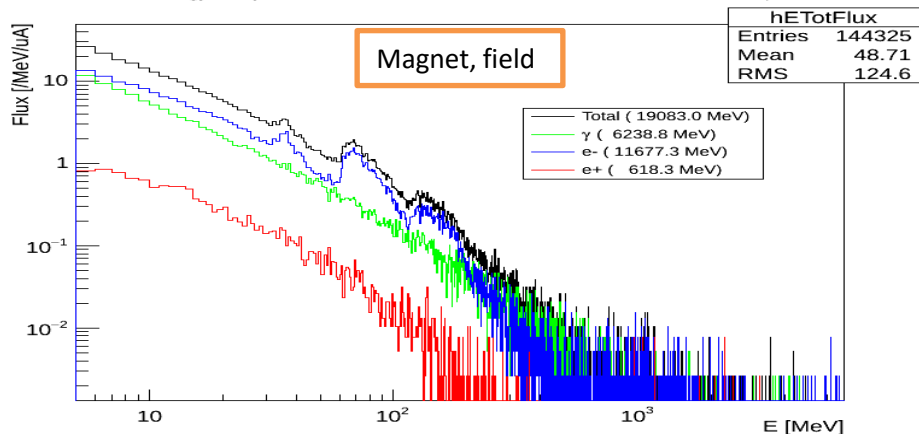- 100 ns signal integration time

NPS setup at 6.3 deg

Energy fluxes

Energy flux (10 cm LH2, I = 1 uA, T = 100 ns, Eb = 6.6 GeV, no magnet, no field)

No magnet, no field

hETotFlux	
Entries	73689
Mean	67.22
RMS	117.3

Total (39625.4 MeV)
γ (6525.1 MeV)
e- (31308.5 MeV)
e+ (1235.3 MeV)

Energy flux (10 cm LH2, I = 1 uA, T = 100 ns, Eb = 6.6 GeV, no field)

Magnet, no field

hETotFlux	
Entries	427612
Mean	51.67
RMS	103

Total (48116.8 MeV)
γ (6569.6 MeV)
e- (39793.6 MeV)
e+ (1058.4 MeV)

Energy flux (10 cm LH2, I = 1 uA, T = 100 ns, Eb = 6.6 GeV, 0.6Tm field)

Magnet, field

hETotFlux	
Entries	144325
Mean	48.71
RMS	124.6

Total (19083.0 MeV)
γ (6238.8 MeV)
e- (11677.3 MeV)
e+ (618.3 MeV)

Increase of flux by ~20 with magnet positioned.
Flux reduction by ~2 times with magnet and field.

Per block energy fluxes [MeV]

Total energy flux [MeV] (10cm LH2, I=1uA, T=100ns, Eb = 6.6 GeV, no magnet, no field)

Total energy flux (10cm LH2, I=1uA, T=100ns, Eb = 6.6 GeV, magnet, no field)

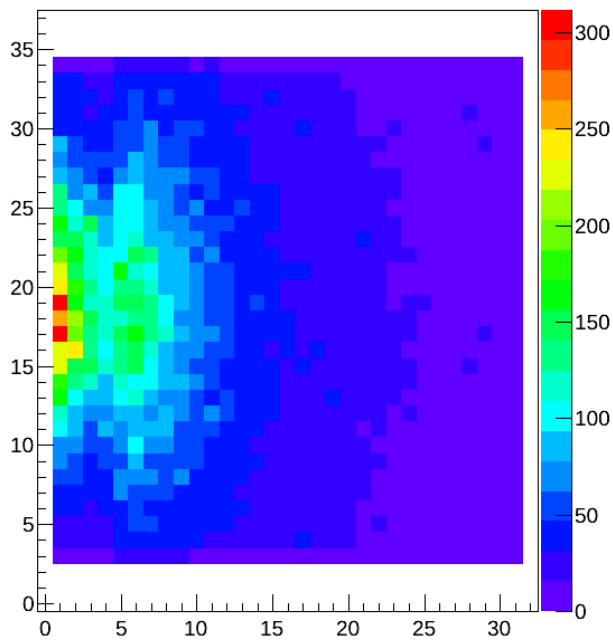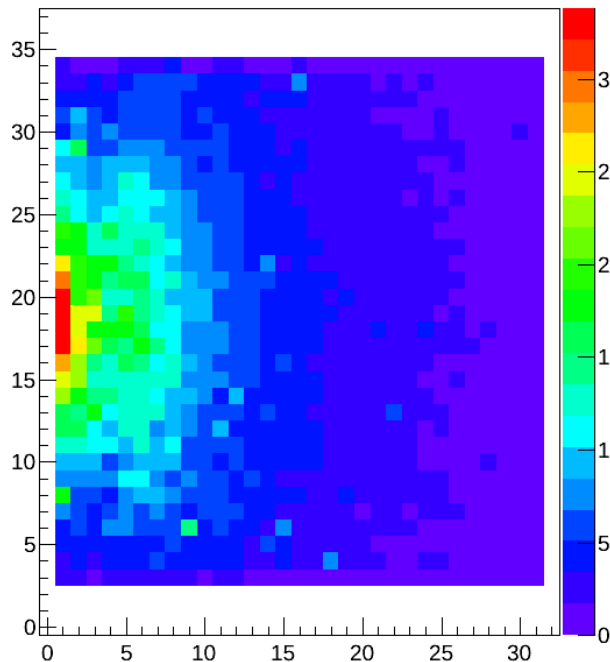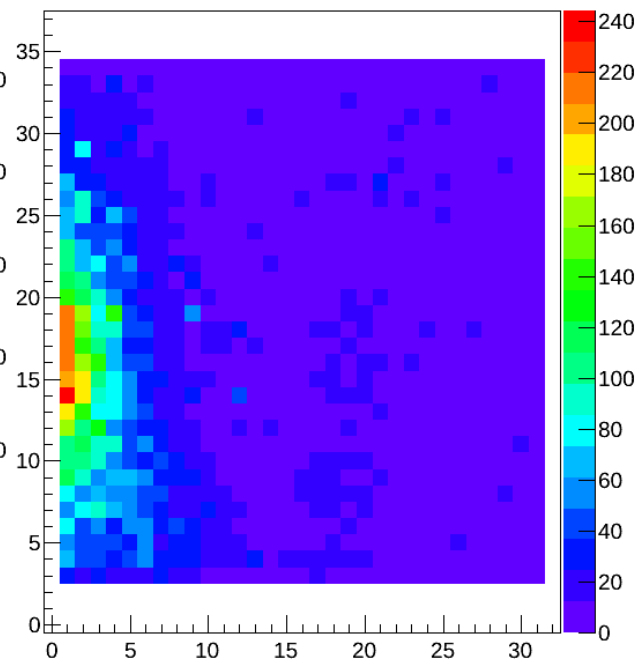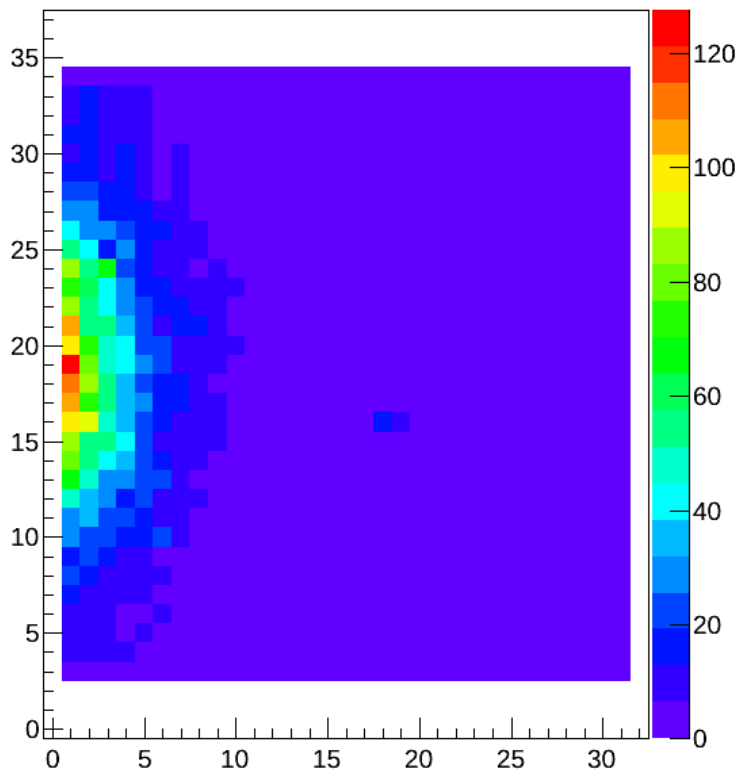Total energy flux (10cm LH2, I=1uA, T=100ns, Eb = 6.6 GeV, magnet, 0.6Tm field)
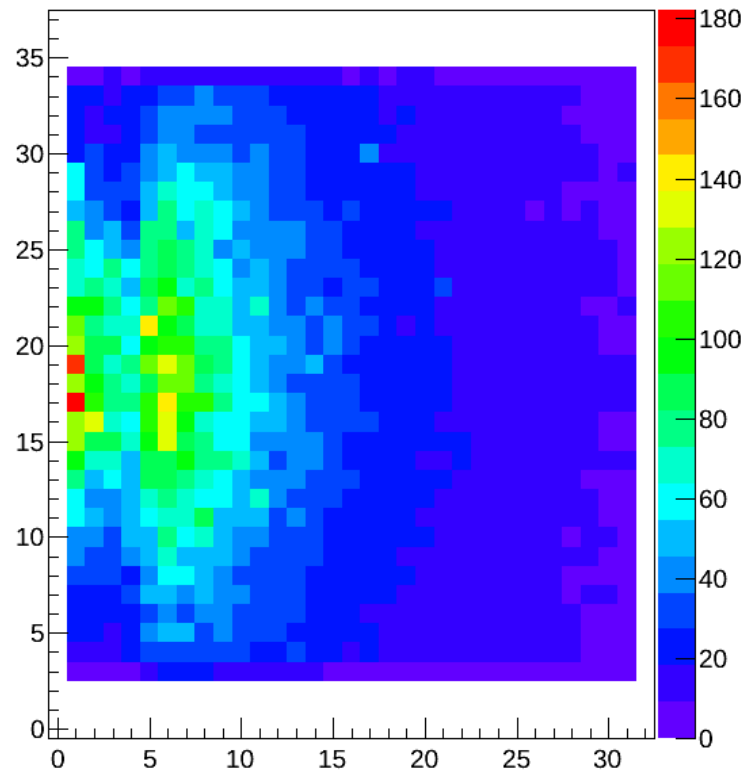
No magnet, no field

Magnet, no field

Magnet, field

Per block energy fluxes (no magnet, no field) [MeV]

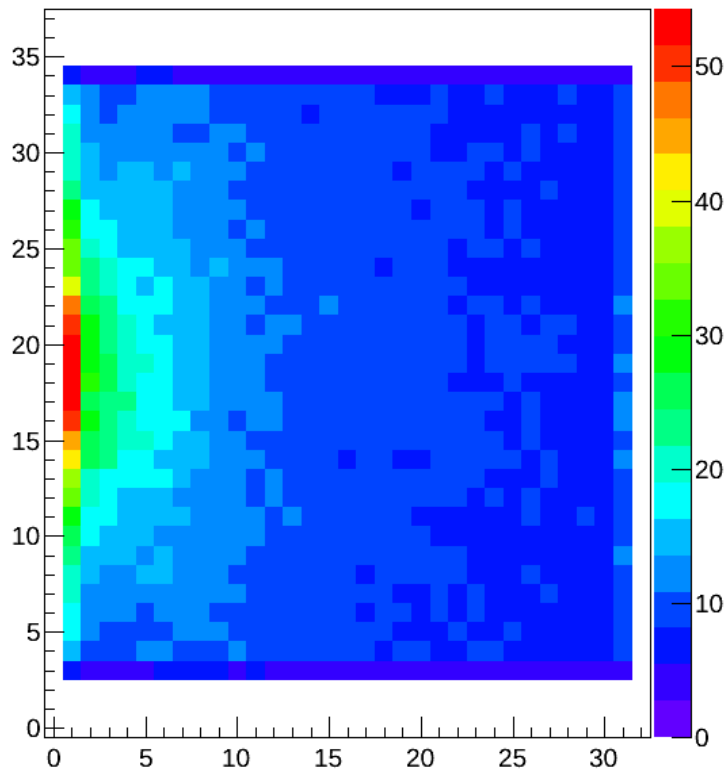Gamma energy flux [MeV] (10cm LH2, I=1uA, T=100ns, Eb = 6.6 GeV, no magnet, no field)

Electron energy flux [MeV] (10cm LH2, I=1uA, T=100ns, Eb = 6.6 GeV, no magnet, no field)
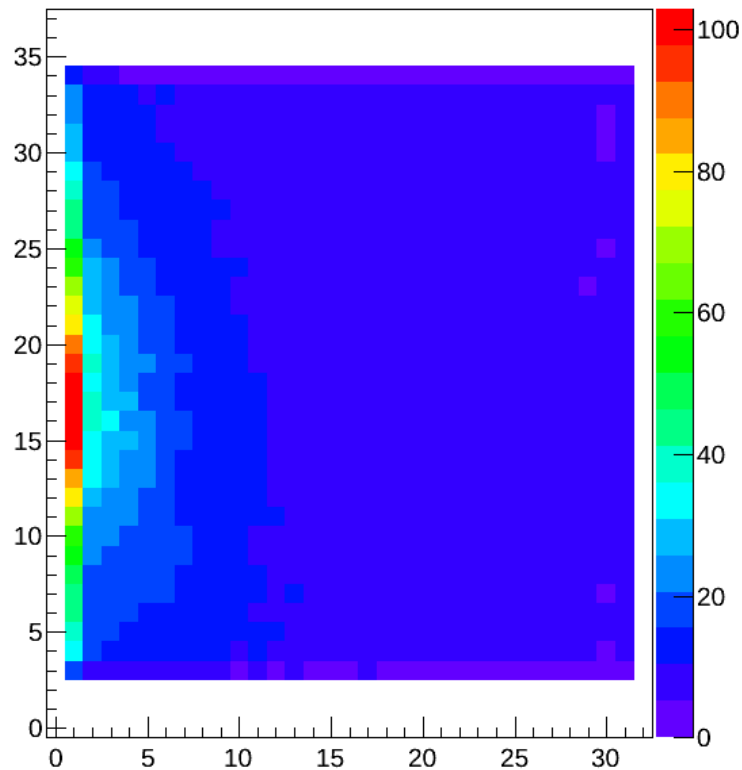

Photons

Electrons

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Hit rates [MHz/uA], E_{kin}>5MeV

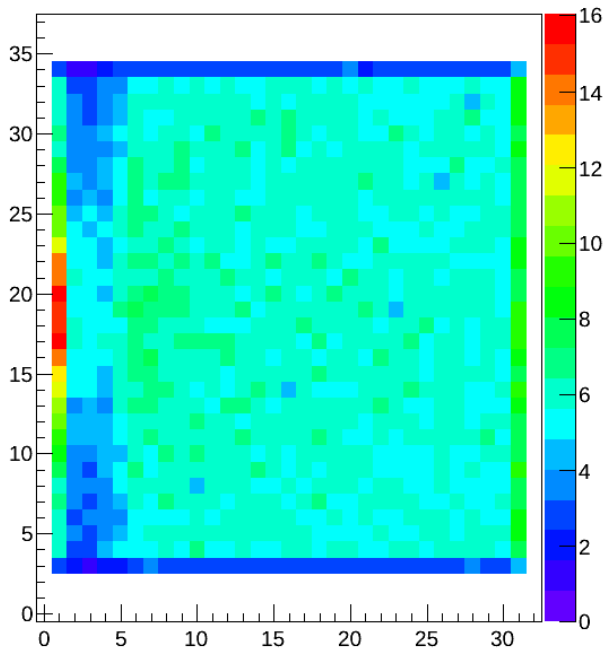Total hit rate [MHz/uA] (10cm LH2, E > 0 MeV, Eb = 6.6 GeV, no magnet, no field)

Total hit rate [MHz/uA] (10cm LH2, E > 0 MeV, Eb = 6.6 GeV, magnet, 0.6Tm field)
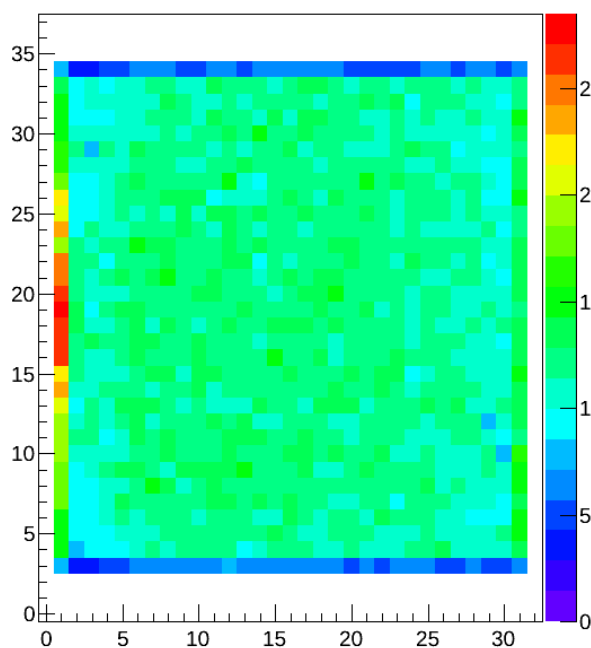
No magnet, no field

Magnet, 0.6 Tm field

Electron hit rates [MHz/uA]

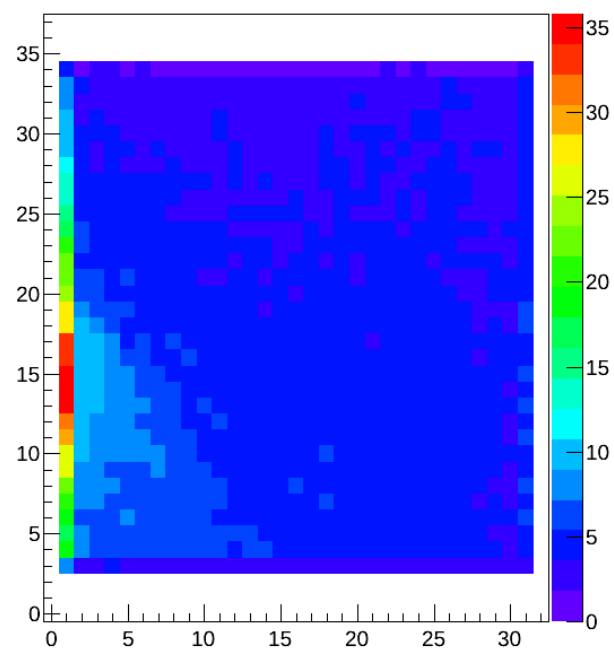Electron hit rate [MHz/uA] (10cm LH2, E > 0 MeV, Eb = 6.6 GeV, no magnet, no field)

Electron hit rate [MHz/uA] (10cm LH2, E > 0 MeV, Eb = 6.6 GeV, magnet, no field)

Electron hit rate [MHz/uA] (10cm LH2, E > 0 MeV, Eb = 6.6 GeV, magnet, 0.6Tm field)

No magnet, no field

Magnet, no field

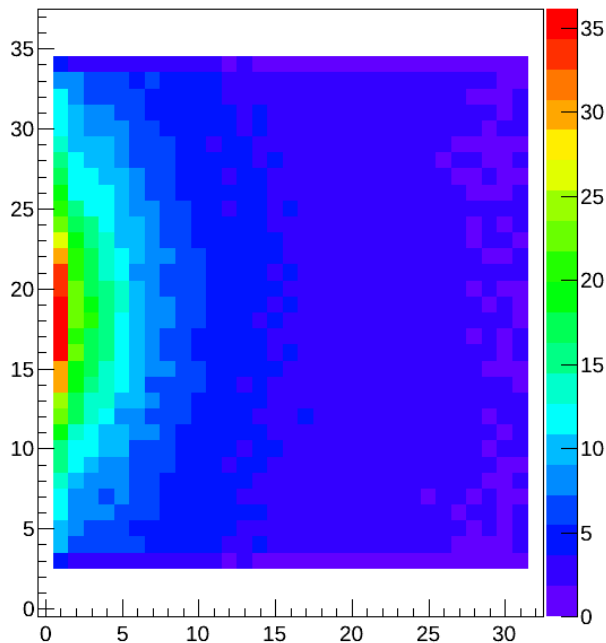Magnet, 0.6Tm field

8

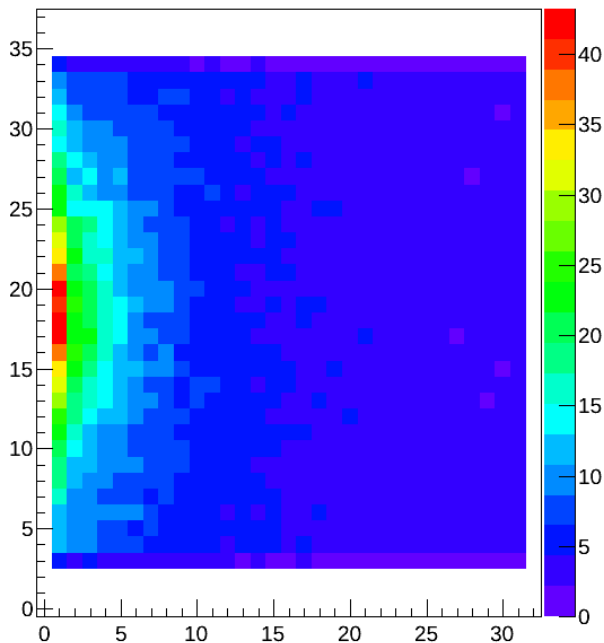# Photon hit rates [MHz/uA]

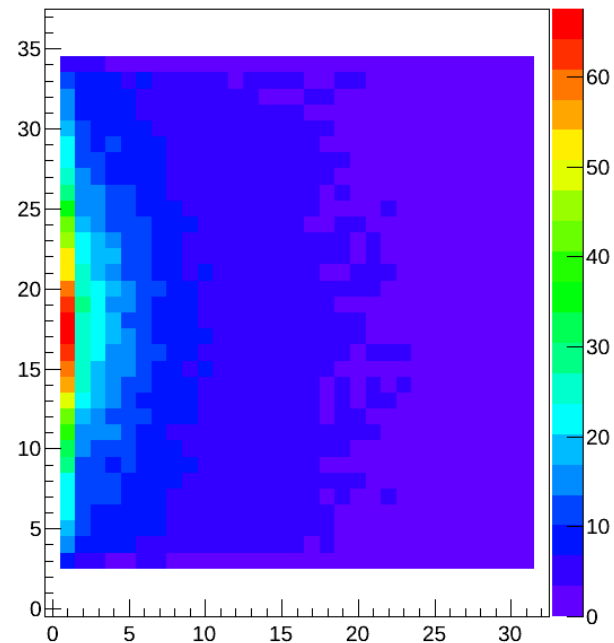Gamma hit rate [MHz/uA] (10cm LH2, E > 0 MeV, Eb = 6.6 GeV, no magnet, no field)   Gamma hit rate [MHz/uA] (10cm LH2, E > 0 MeV, Eb = 6.6 GeV, magnet, no field)   Gamma hit rate [MHz/uA] (10cm LH2, E > 0 MeV, Eb = 6.6 GeV, magnet, 0.6Tm field)
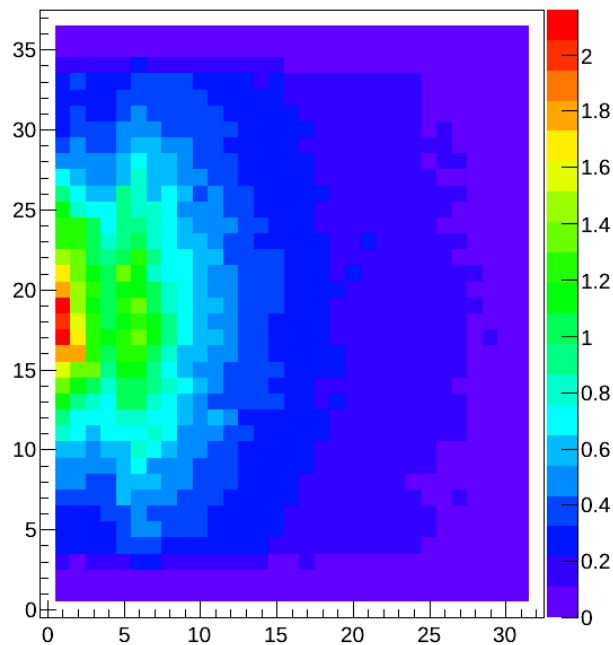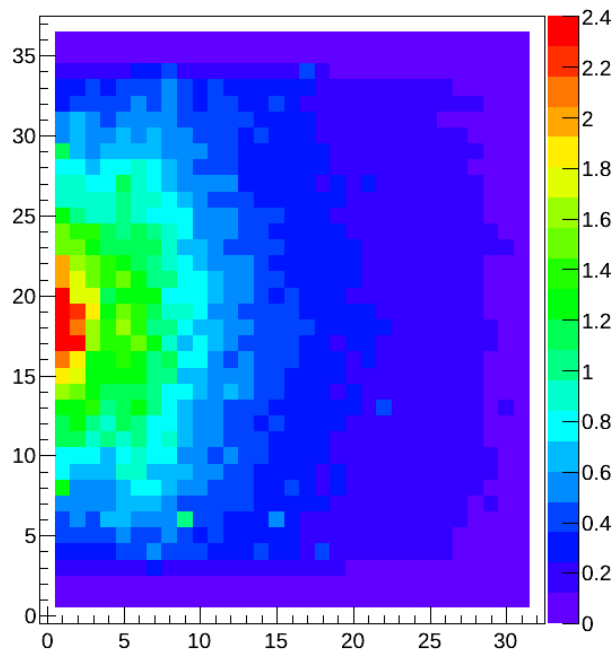

No magnet, no field   Magnet, no field   Magnet, 0.6Tm field

Dose rates [Gy/uA/h]

Doses(Gy/(uA*h)), Eb = 6.6 GeV, no magnet, no field
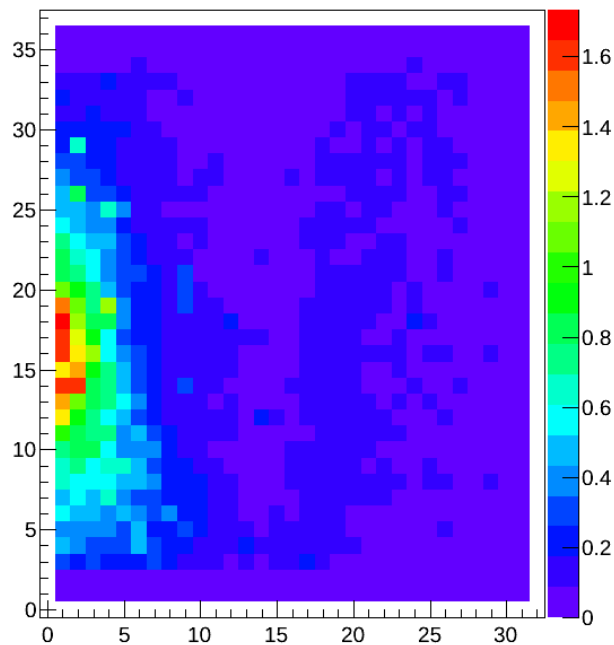
Doses(Gy/(uA*h)), Eb = 6.6 GeV, 0 field

Doses(Gy/(uA*h)), Eb = 6.6 GeV, 0.6Tm field

No magnet, no field

Magnet, no field

Magnet, 0.6Tm field

In summary:

➢ Background reduction by ~2 times in the energy fluxes and dose rates ;
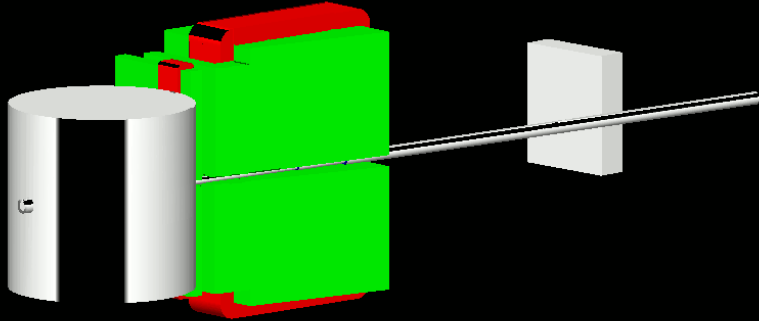➢ No background reduction in the hit rates.

Outlook:

▪ Run "no magnet, 0.6 Tm field";
▪ Change target length to 10 cm;
▪ Change beam energy to 11 GeV;
▪ Try different physics list?

Backup slides

NPS setup at 6.3 deg

From right

From left