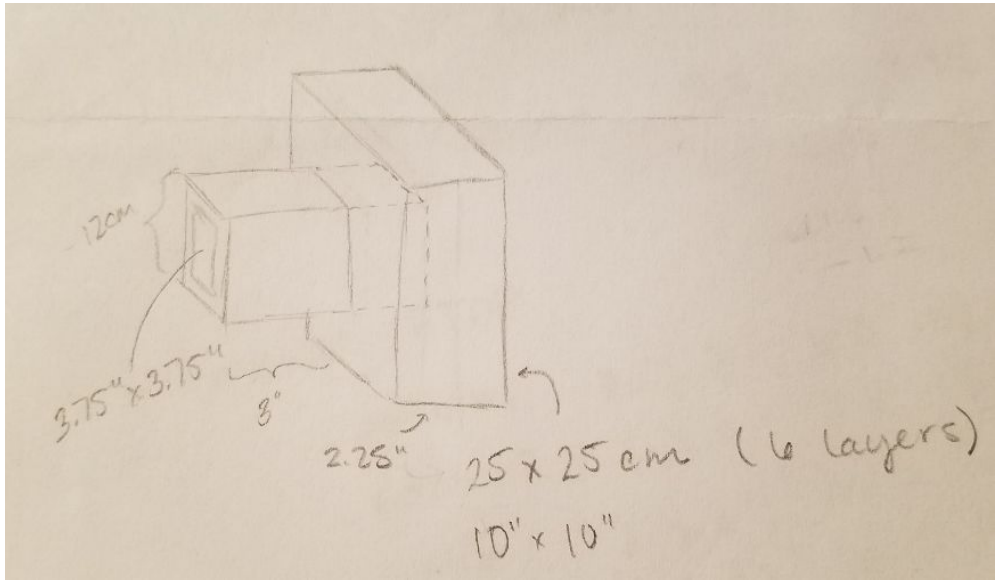
TOF Lucite Shielding Simulation

Richard Jones
University of Connecticut

physical description

from Ashley, presentation Dec. 5, 2018
to the TOF working group meeting:



- 6 layers, 3/8” lucite
- 25x25 cm^2 outer dimension
- inner cutout 12 x 12 cm^2
- supported by square tube (polyethylene)
- extends through TOF planes
- clearance hole 3.75” square

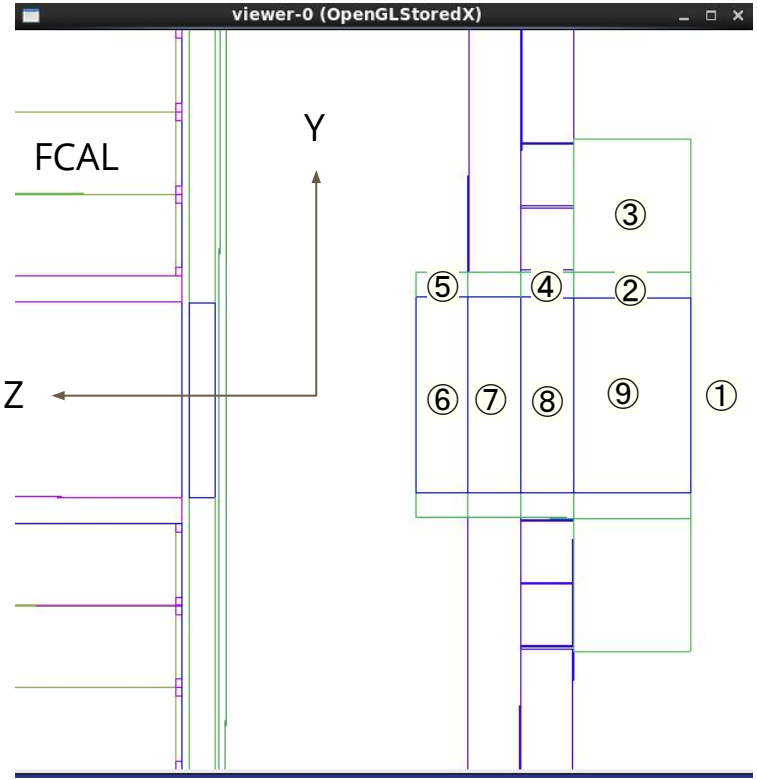
geometry description (hdds)

- 4 new volumes in ForwardTOF_HDDS.xml
  a. lucite shield plates
     - “shield_front” (SHLH) - “Plexiglas” box
  b. poly support tube
     - “shield_front_insert” (SINS) - “Polyethylene” box
     - “shield_feedthru” (SHFT) - “Polyethylene” box
     - “shield_back” (SHLB) - “Polyethylene” box
- air-filled boxes inside the “shield_xxx” volumes make them effectively into 4-sided polygons
- added to master branch of hdds github repo
- added to ccdb geometry for runs 30000 and greater

verification

- alignment verification
  - visualization tools in simulation
- for geometry verification (checks proper embedding, overlaps)
  - active picking in visualization
  - automatic overlap checking
  - verbose tracking printout
- functional verification
  - observation of interactions
- For all of these I used hdgeant4.
- Equivalent tools also exist in hdgeant, could equally well have been used.

alignment verification



Window activated for picking (left-mouse), exit (middle).

① /World:0/HALL::1:1 layer 0 material: **Air**, magnetic field (Tesla): 6.24684e-08,9.10436e-05,0.0125597

② /Parallel World 1:0/HALL:1/SHLH:1/SINS:1 layer 1 material: **Polyethylene**, magnetic field (Tesla): 0,0,1e-99

③ /Parallel World 1:0/HALL:1/SHLH:1 layer 1 material: **Plexiglas**, magnetic field (Tesla): 0,0,1e-99

④ /Parallel World 1:0/HALL:1/FTOF:2/SHFT:1 layer 1 material: **Polyethylene**, magnetic field (Tesla): 0,0,1e-99

⑤ /Parallel World 1:0/HALL:1/SHLB:1 layer 1 material: **Polyethylene**, magnetic field (Tesla): 0,0,1e-99

⑥ /Parallel World 1:0/HALL:1/SHLB:1/SINB:1 layer 1 material: **Air**, magnetic field (Tesla): 0,0,1e-99

⑦ /Parallel World 1:0/HALL:1/FTOF:1/SHFT:1/SINC:1 layer 1 material: **Air**, magnetic field (Tesla): 0,0,1e-99

⑧ /Parallel World 1:0/HALL:1/FTOF:2/SHFT:1/SINC:1 layer 1 material: **Air**, magnetic field (Tesla): 0,0,1e-99

⑨ /Parallel World 1:0/HALL:1/SHLH:1/SINS:1/SINA:1 layer 1 material: **Air**, magnetic field (Tesla): 0,0,1e-99

geometry verification: /tracking/verbose 2

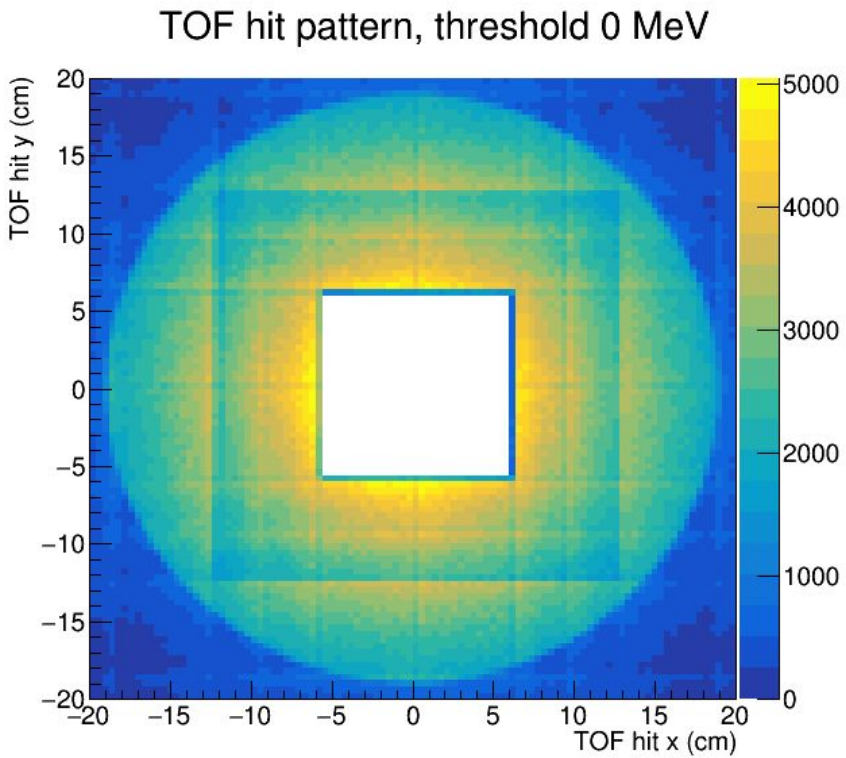

```
**********************************************************************************************************
G4WT0 > * G4Track Information:   Particle = gamma,   Track ID = 1,   Parent ID = 0
**********************************************************************************************************
```

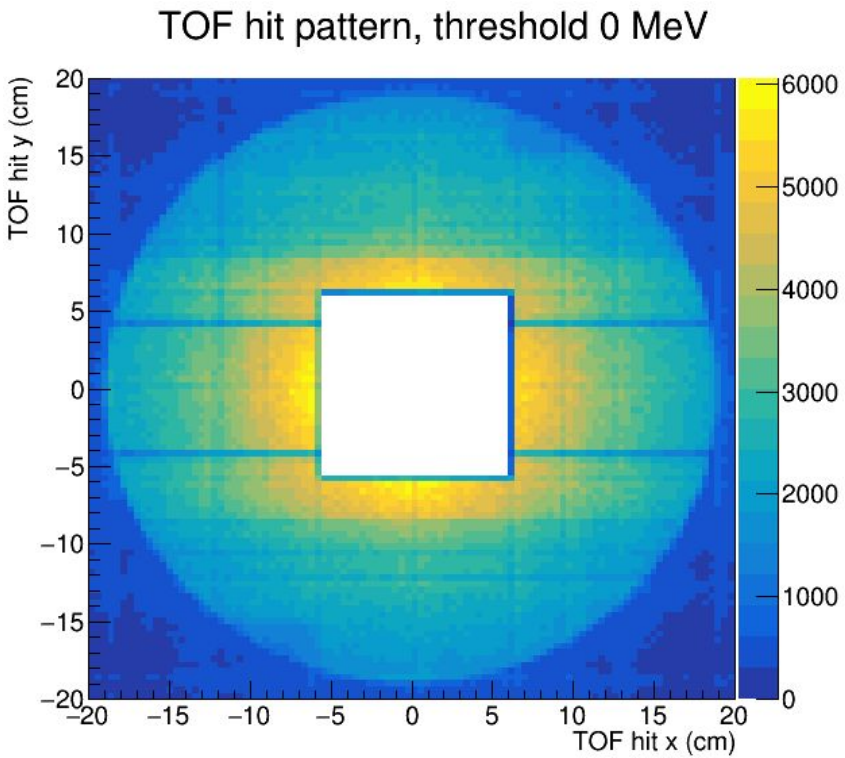
	Step#	X	Y	Z	KineE	dEStep	StepLeng	TrackLeng	Volume	Process
G4WT0 >	0	0 fm	0 fm	65 cm	355.24 keV	0 eV	0 fm	0 fm	LIH2:1	initStep
G4WT0 >	1	-2.1213 mm	-2.5477 mm	79.856 cm	355.24 keV	0 eV	14.859 cm	14.859 cm	TGTV:1	Parallel World 1
G4WT0 >	2	-2.1228 mm	-2.5495 mm	79.866 cm	355.24 keV	0 eV	104.31 um	14.87 cm	TARG:1	Parallel World 1
G4WT0 >	3	-2.8015 mm	-3.3646 mm	84.619 cm	355.24 keV	0 eV	4.7542 cm	19.624 cm	DWIT:1	Parallel World 1
G4WT0 >	4	-2.8033 mm	-3.3668 mm	84.632 cm	355.24 keV	0 eV	127.03 um	19.637 cm	TARG:1	Parallel World 1
G4WT0 >	5	-2.8034 mm	-3.3668 mm	84.632 cm	355.24 keV	0 eV	500.12 nm	19.637 cm	LASS::1:1	Parallel World 1
G4WT0 >	6	-5.6404 cm	-6.7741 cm	4.6 m	355.24 keV	0 eV	3.7546 m	3.951 m	HALL::1:1	CoupledTrans
G4WT0 >	7	-7.6407 cm	-9.1764 cm	6.0008 m	355.24 keV	0 eV	1.4011 m	5.3521 m	SHLH:1	Parallel World 1
G4WT0 >	8	-7.7223 cm	-9.2744 cm	6.0579 m	355.24 keV	0 eV	5.7166 cm	5.4093 m	HALL::1:1	Parallel World 1
G4WT0 >	9	-7.7224 cm	-9.2745 cm	6.058 m	355.24 keV	0 eV	75.021 um	5.4094 m	yd12:0	Parallel World 1
G4WT0 >	10	-7.7225 cm	-9.2746 cm	6.0581 m	355.24 keV	0 eV	50.014 um	5.4094 m	FTOX:1	Parallel World 1
G4WT0 >	11	-7.757 cm	-9.316 cm	6.0822 m	316.79 keV	38.4 keV	2.4171 cm	5.4336 m	FTOX:1	compt
G4WT0 >	12	-7.7508 cm	-9.2351 cm	6.0835 m	316.79 keV	0 eV	1.4774 mm	5.4351 m	yd12:0	Parallel World 1
G4WT0 >	13	-7.7505 cm	-9.2318 cm	6.0835 m	316.79 keV	0 eV	59.804 um	5.4351 m	HALL::1:1	Parallel World 1
G4WT0 >	14	-7.749 cm	- 9.2122 cm	6.0838 m	316.79 keV	0 eV	358.83 um	5.4355 m	yd12:1	Parallel World 1
G4WT0 >	15	-7.7488 cm	-9.2089 cm	6.0839 m	316.79 keV	0 eV	59.804 um	5.4355 m	FTOX:1	Parallel World 1
G4WT0 >	16	-7.6221 cm	-7.5449 cm	6.1093 m	316.79 keV	0 eV	3.0381 cm	5.4659 m	yd12:1	Parallel World 1
G4WT0 >	17	-7.6218 cm	-7.5416 cm	6.1093 m	316.79 keV	0 eV	59.804 um	5.466 m	HALL::1:1	Parallel World 1

functional verification, part 1

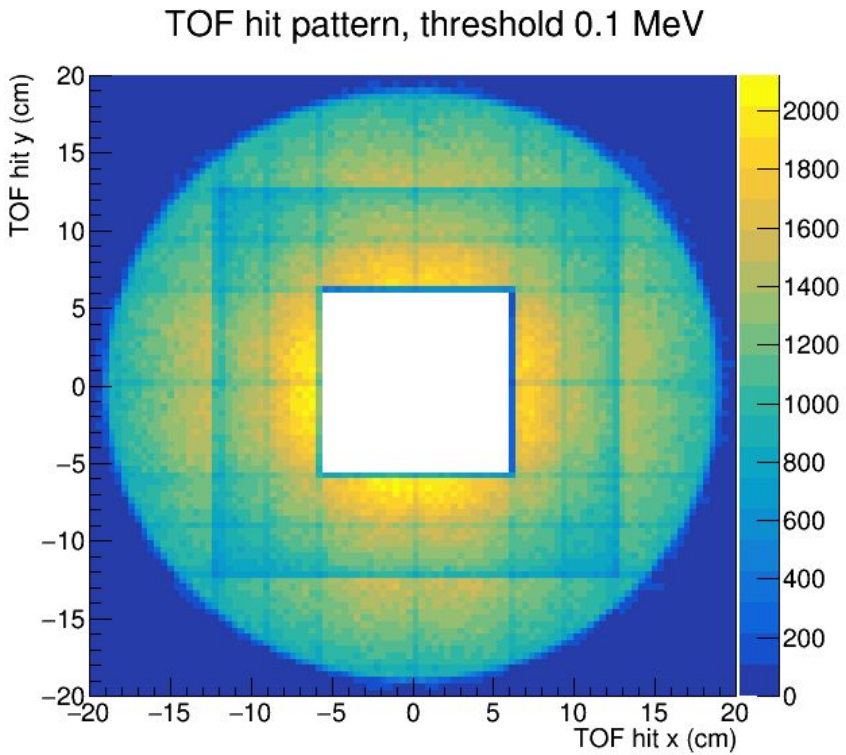
- gamma generator, E_γ~Unif(0,2)MeV, θ~Unif(0,5°), φ~Unif(0,360°)
- start inside the liquid hydrogen target, filled
- 10^7 photons, mainly Compton, photoelectric effect interactions
- count hits above pulse height threshold (varied) in the tof bars
- compare runs with and without the tof shield present
- hits in each bar are counted just once, not twice in case of 2-ended r.o.
- some hits shadowing / boosting is present due to multi-pulse overlap
  - double-pulse resolution: 25 ns
  - max hits per bar: 25 / event

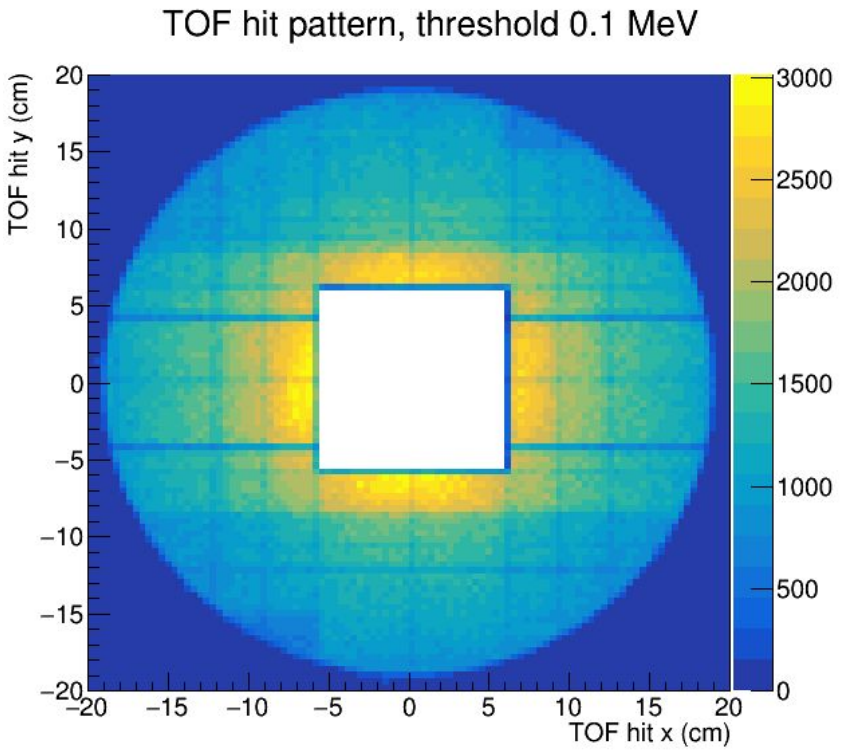
functional verification, part 1



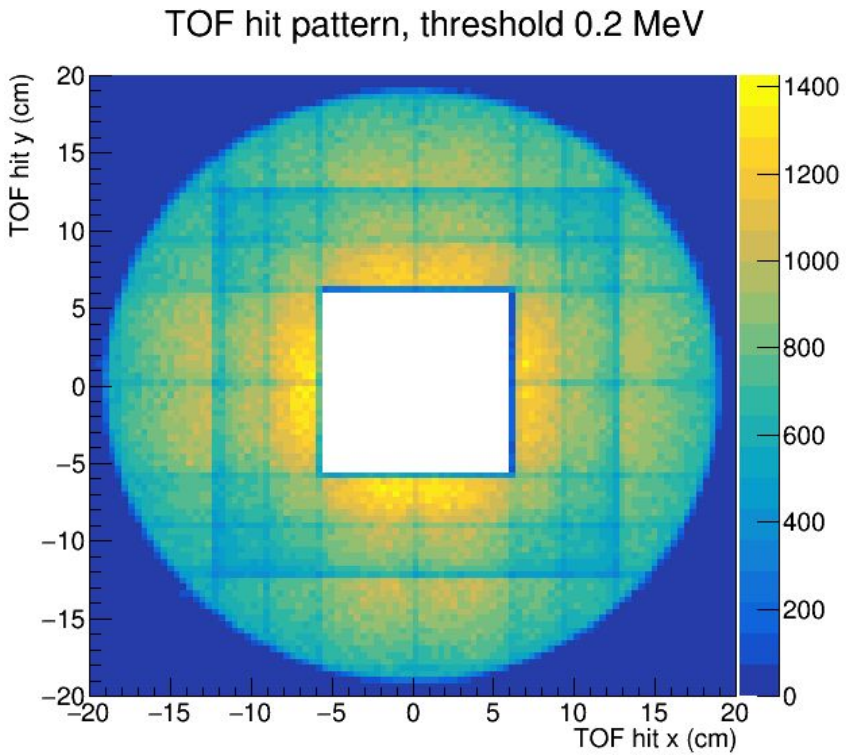


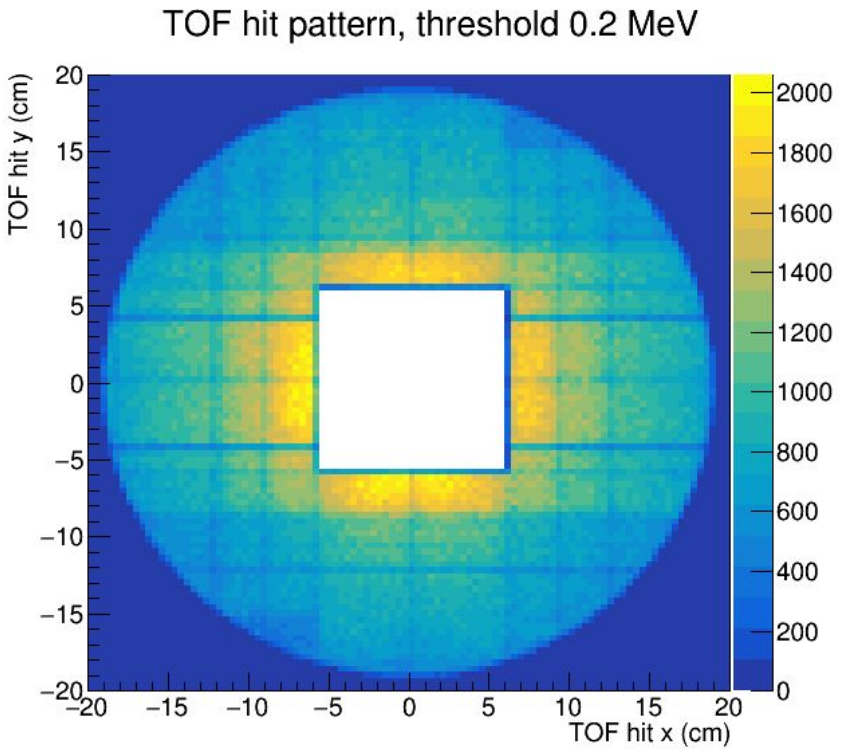
functional verification, part 1



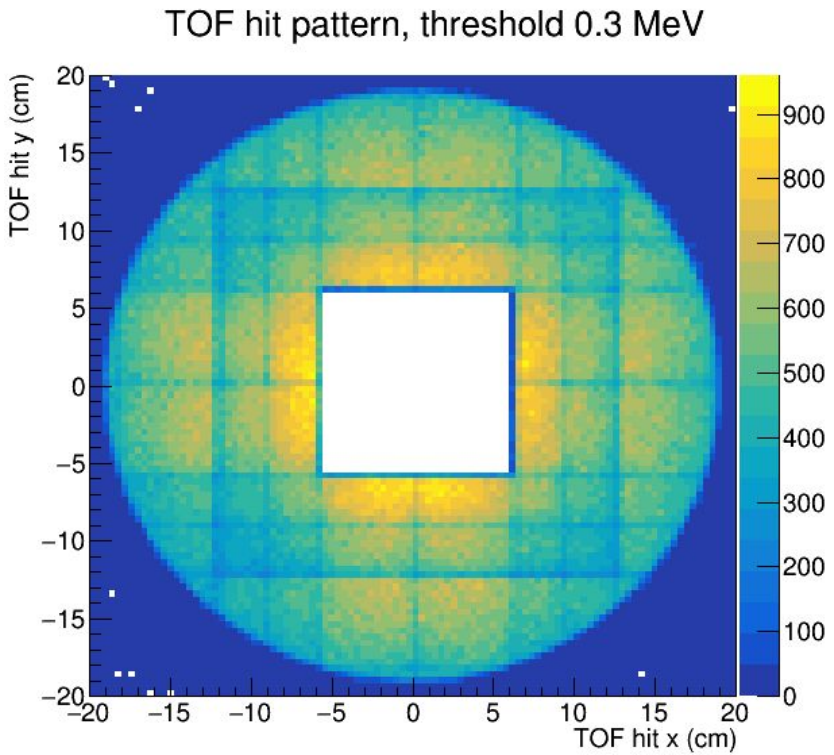


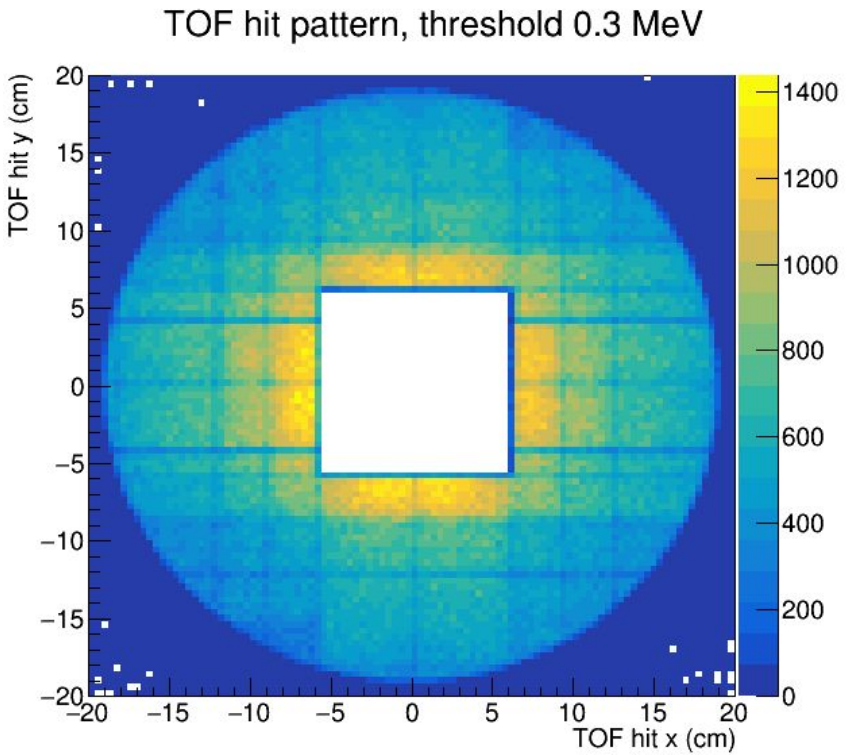
functional verification, part 1



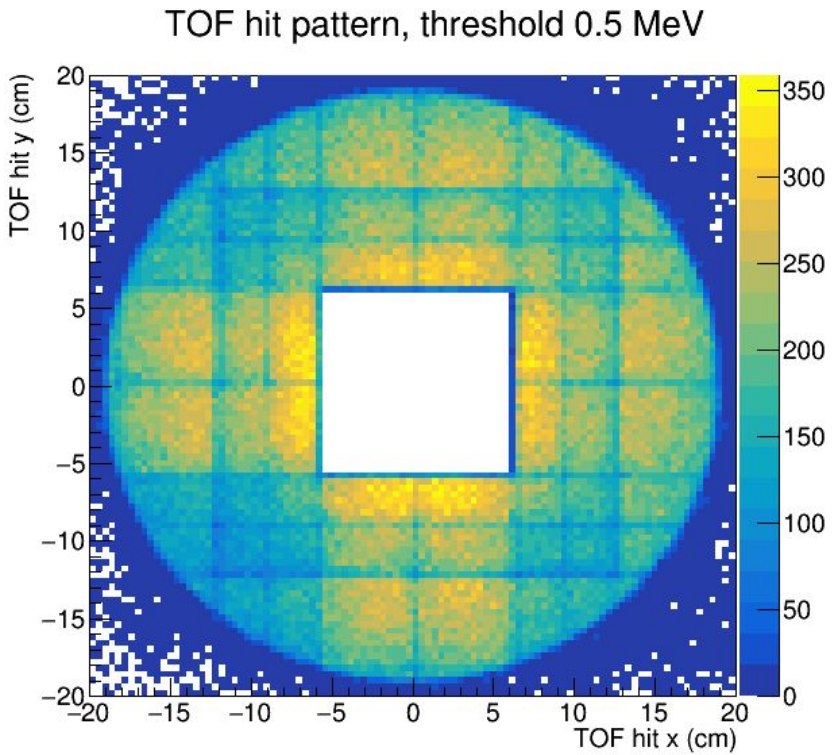


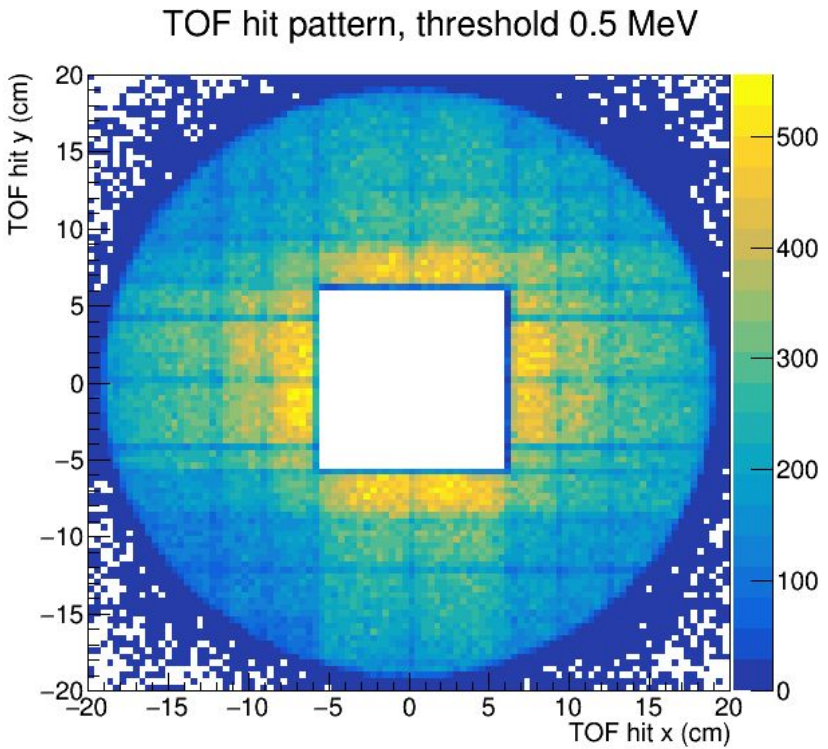
functional verification, part 1





functional verification, part 1

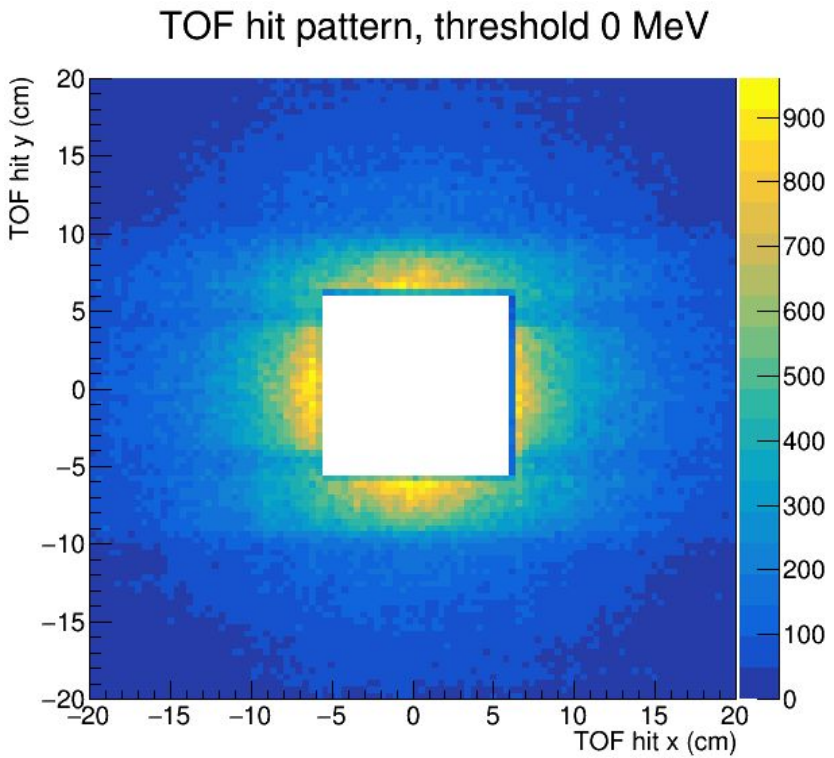


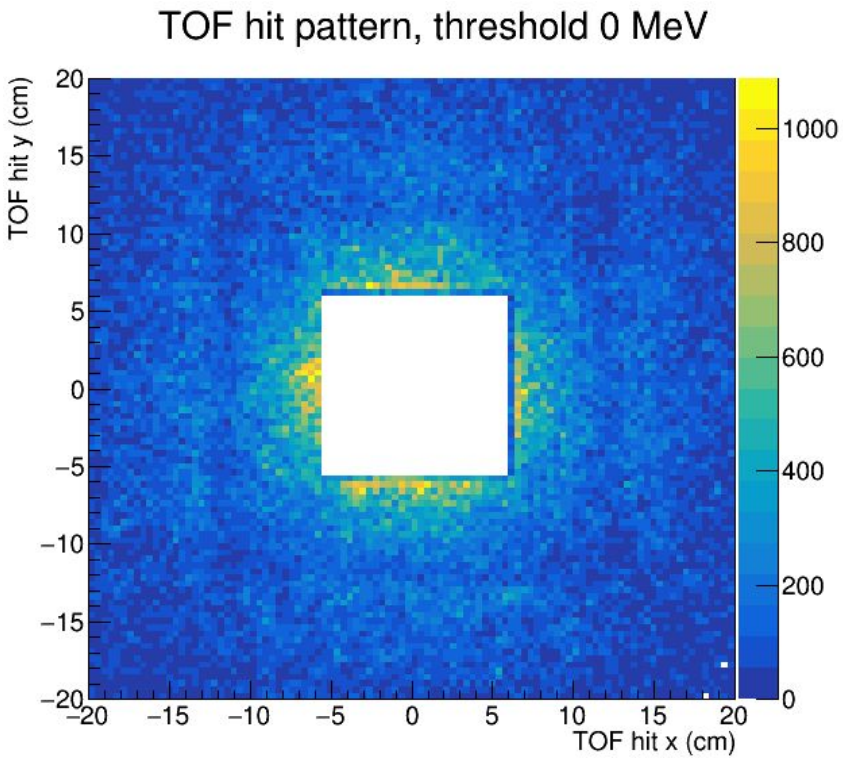


functional verification, part 2

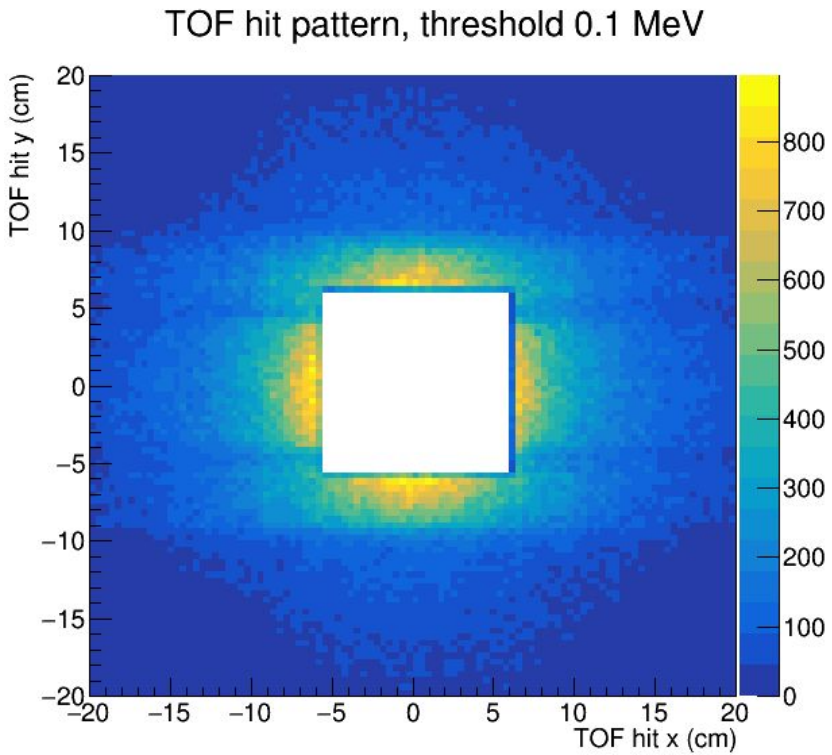
- coherent bremsstrahlung beam generator, E_{min}=1.2MeV, E_{max}= 12 GeV
- passes through liquid hydrogen target, filled
- 10^8 beam photons, mainly electromagnetic interactions
- count hits above pulse height threshold (varied) in the tof bars
- compare runs with and without the tof shield present
- hits in each bar are counted just once, not twice in case of 2-ended r.o.
- some hits shadowing is present
  - double-pulse resolution: 25 ns
  - max hits per bar: 25 / event

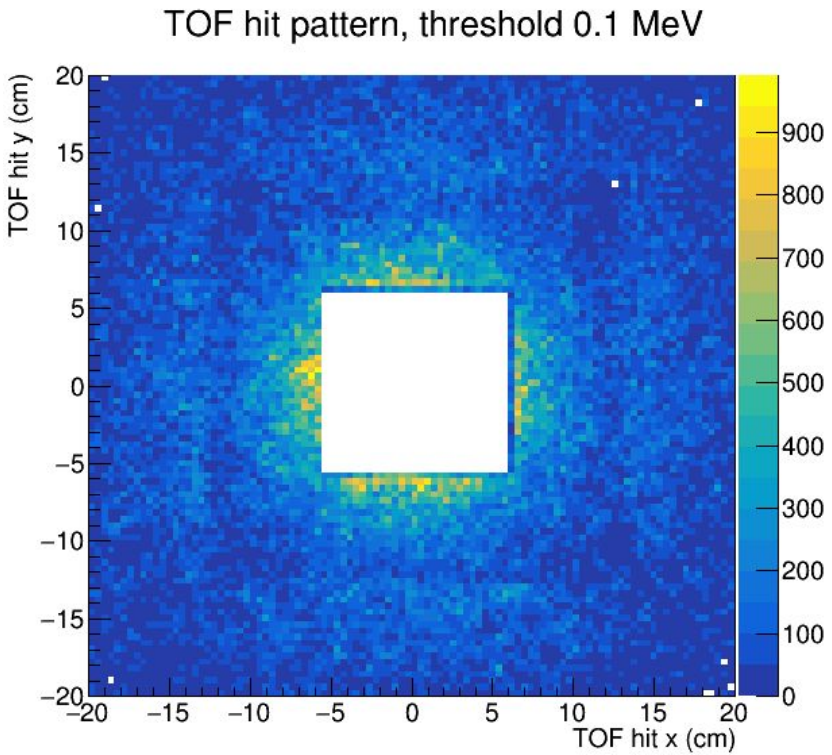
functional verification, part 2



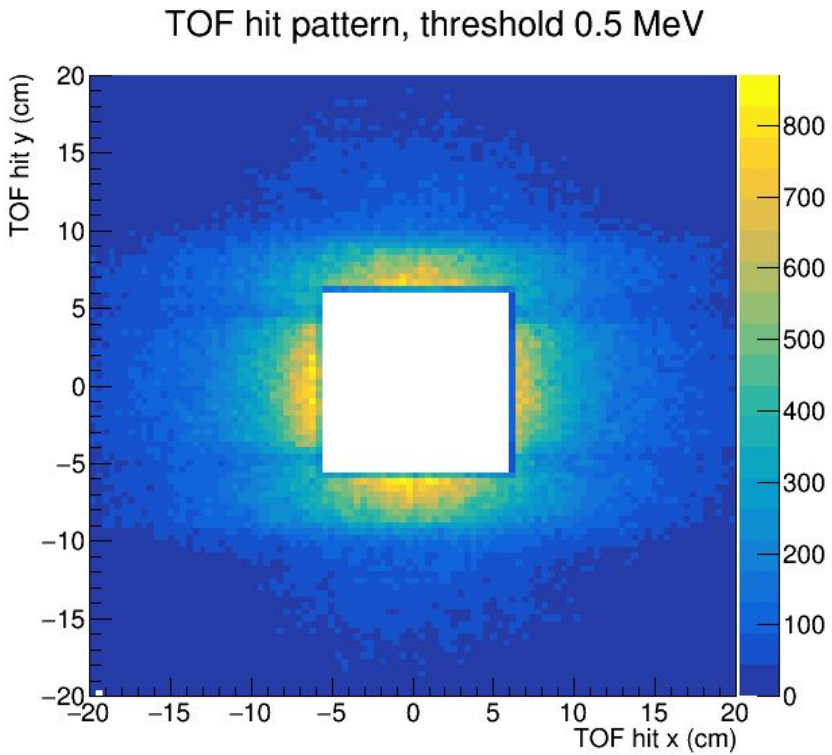


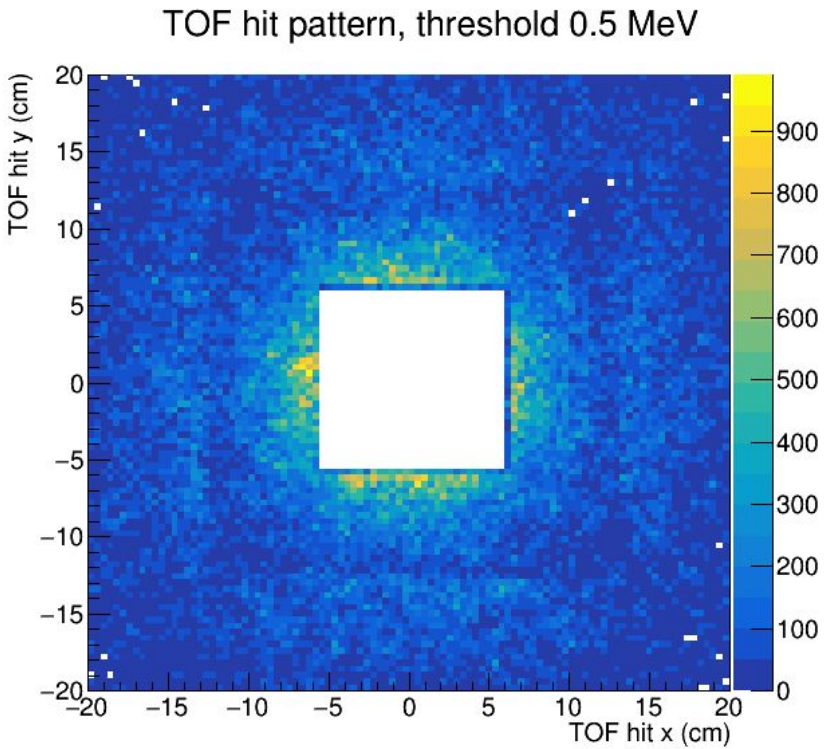
functional verification, part 2



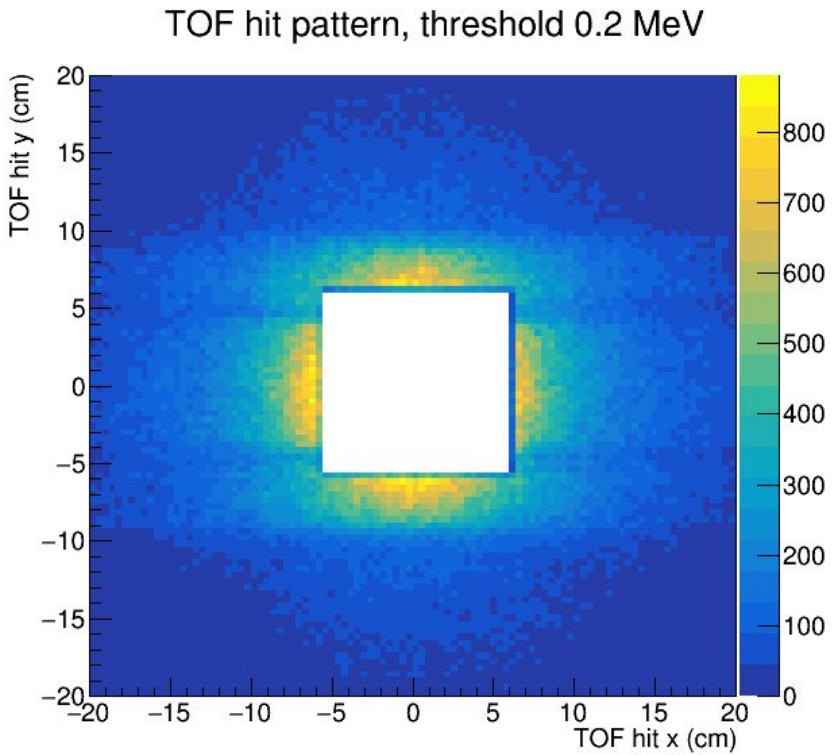


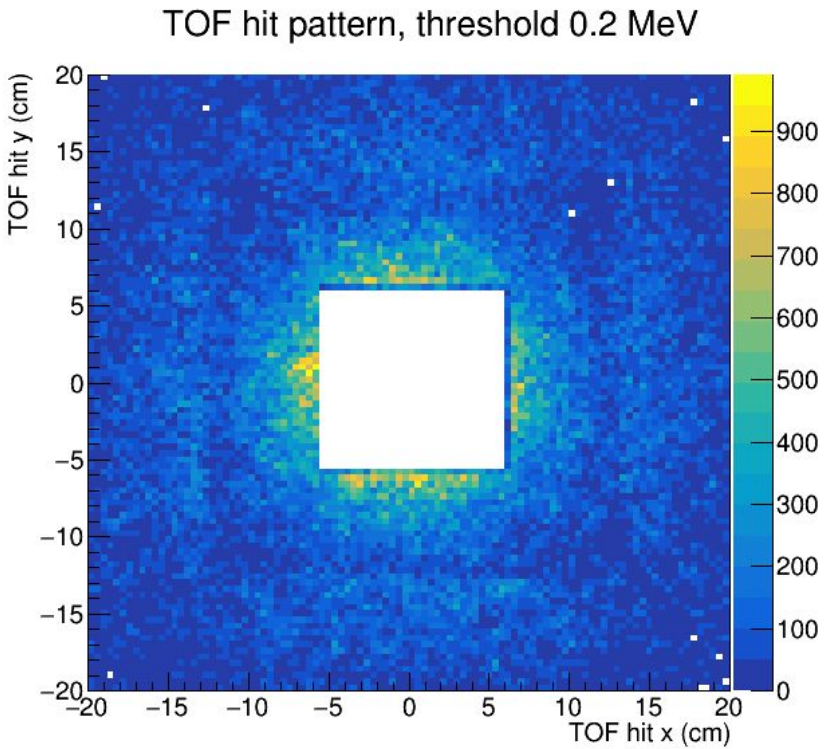
functional verification, part 2



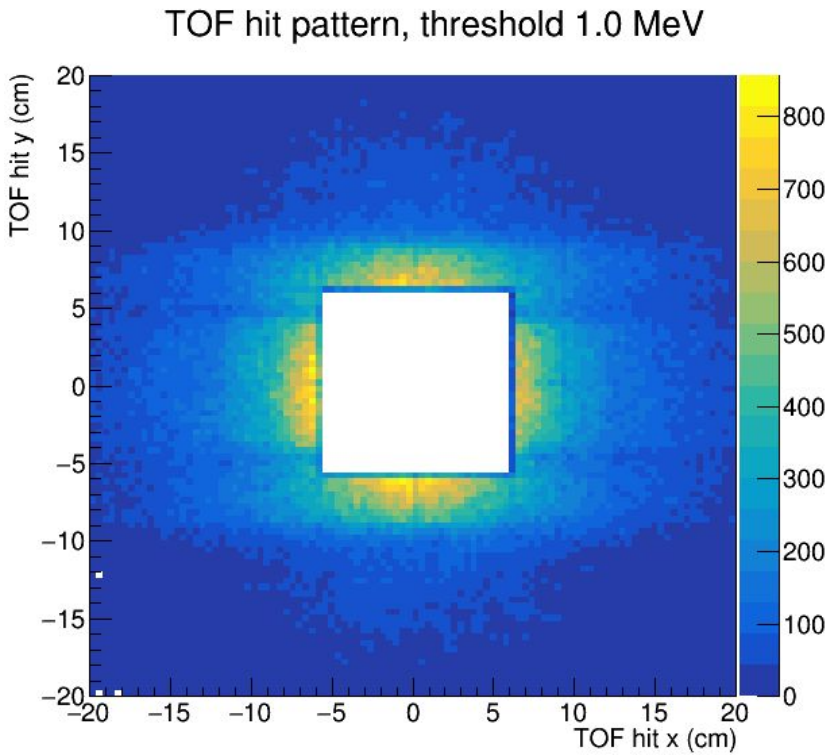


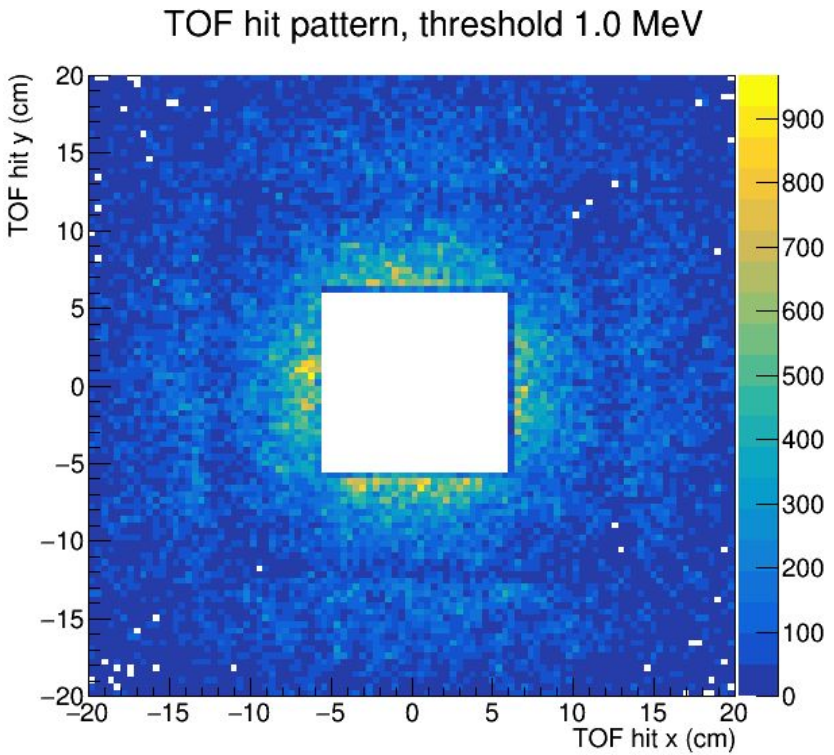
functional verification, part 2





functional verification, part 2





functional verification, part 2