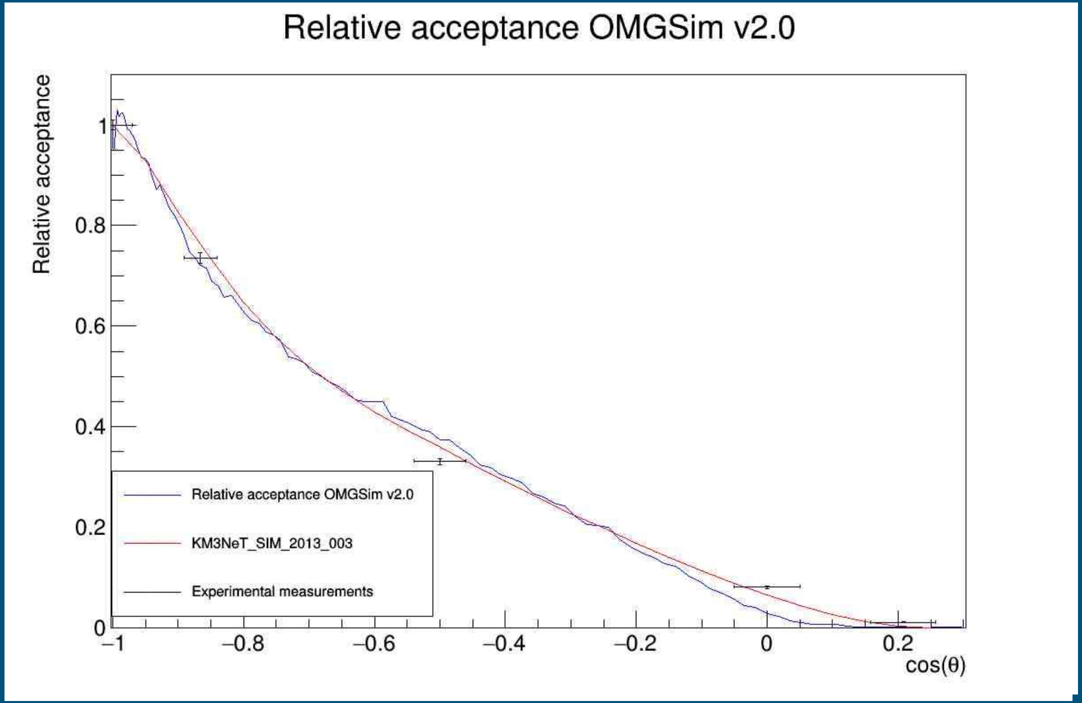
Angular Acceptance

Angular acceptance seems to check out with the simulations

Experimental measurements see a relatively high acceptance for cos(θ) >= 0

But how about the time and ToT distributions for different positions on the PMT?

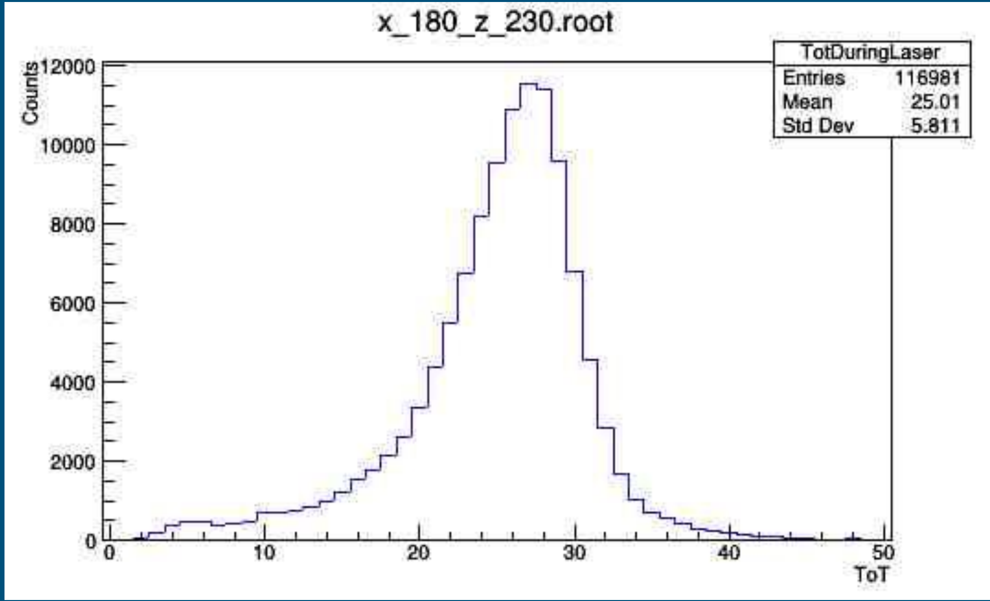


Gridscan - ToT (θ = 180)

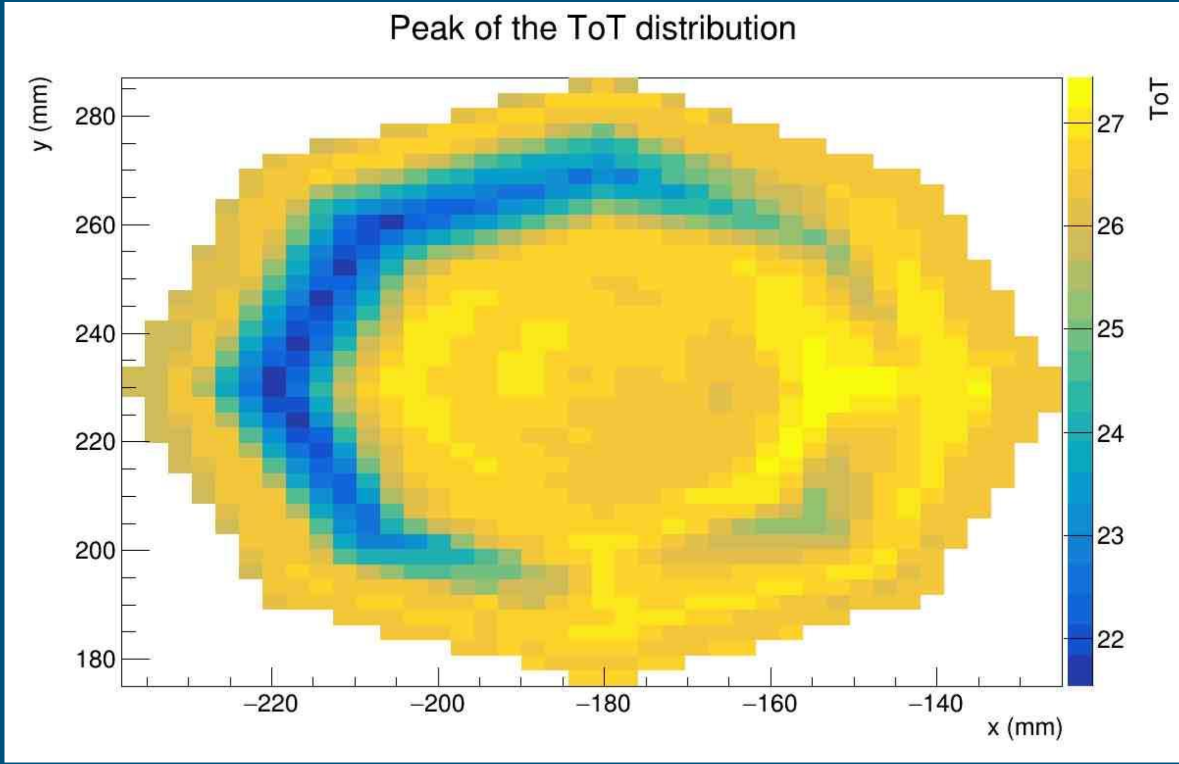
Normal ToT distribution:

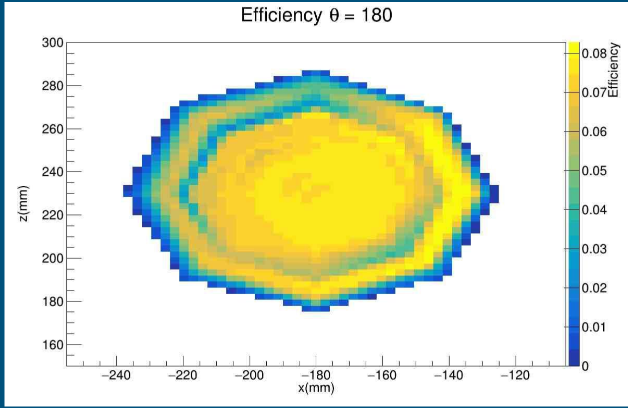
- Peaks around 26.4 ns
- Small peak around 5 ns

How does the peak position vary for different positions on the PMT?

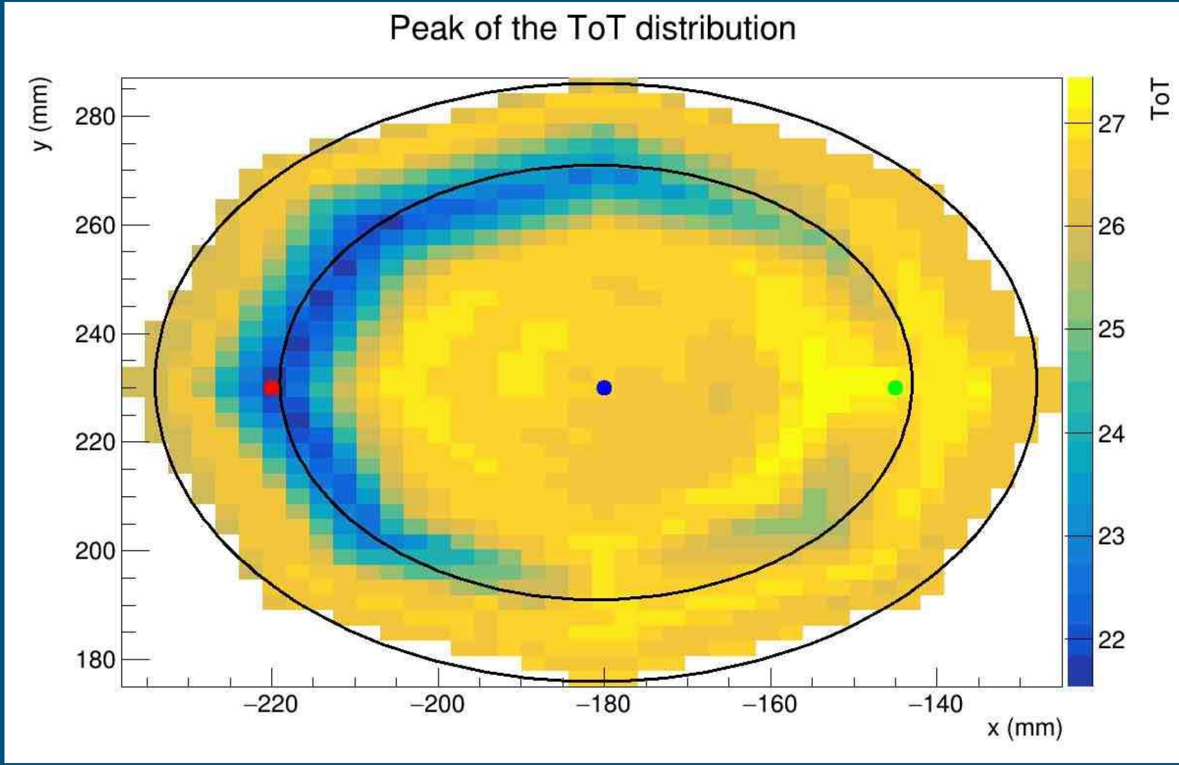


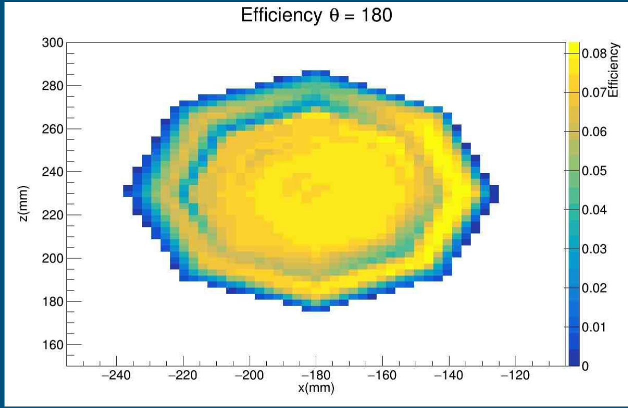
Gridscan - Peak of ToT (θ = 180)



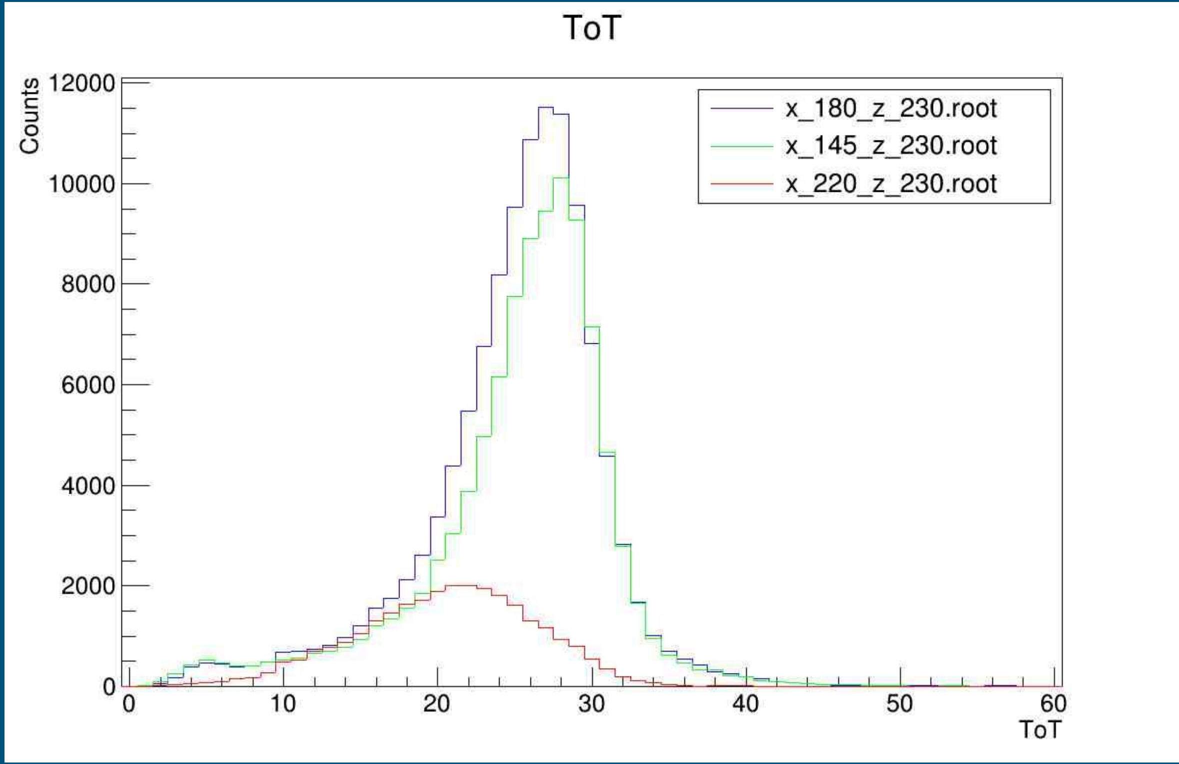


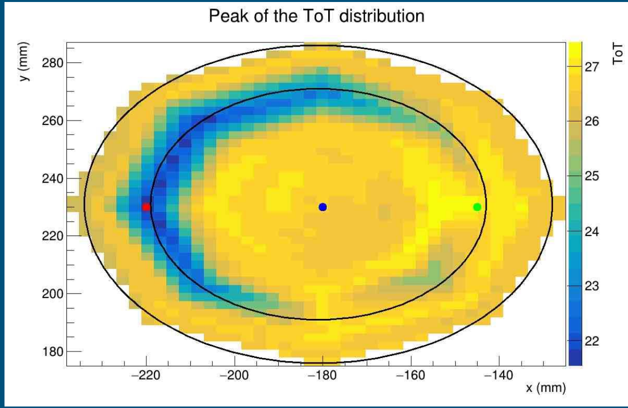
Gridscan - Peak of ToT (θ = 180)





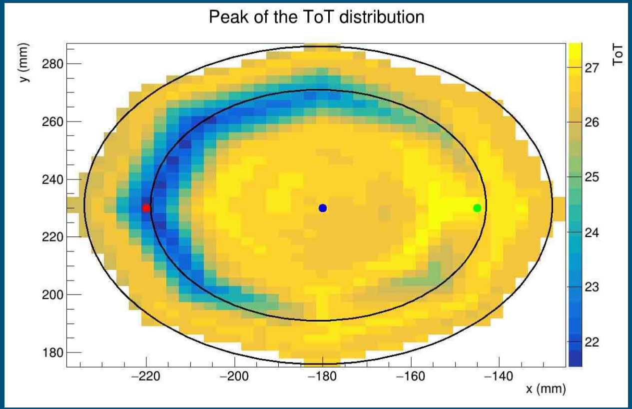
Gridscan - Peak of ToT (θ = 180)

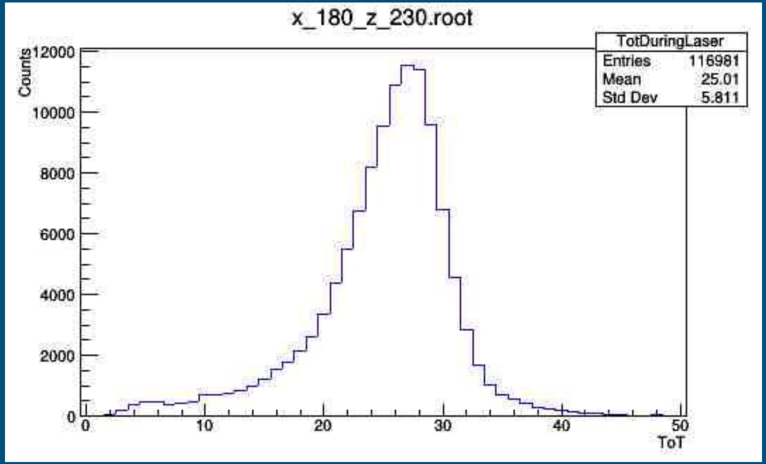




Gridscan - Peak of ToT (θ = 180)

- Peak of the ToT distribution varies for positions on the PMT
- When you average over all positions you should get the expected distribution



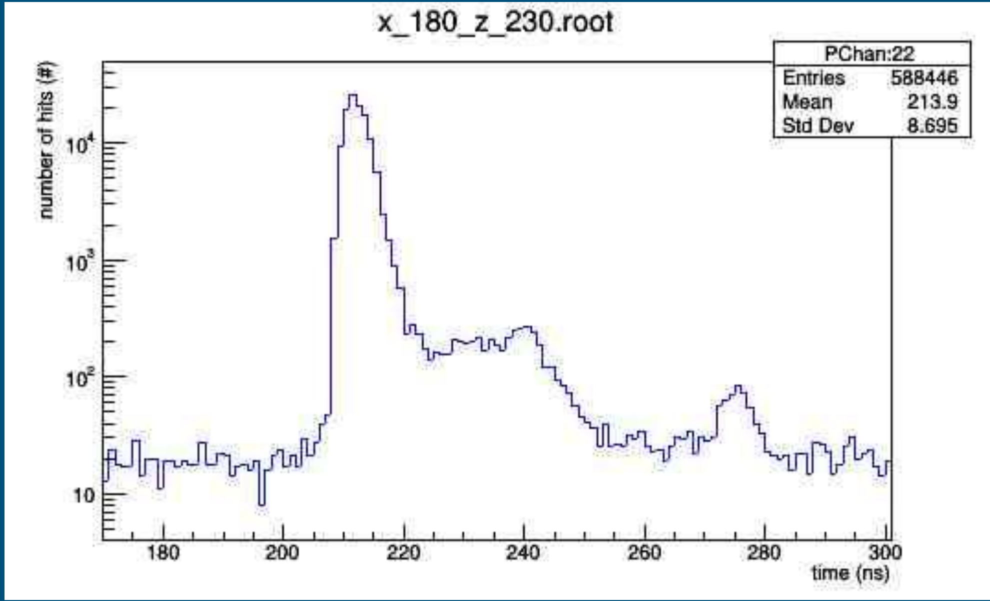


Gridscan - Transit time (θ = 180)

Normal transit time distribution:

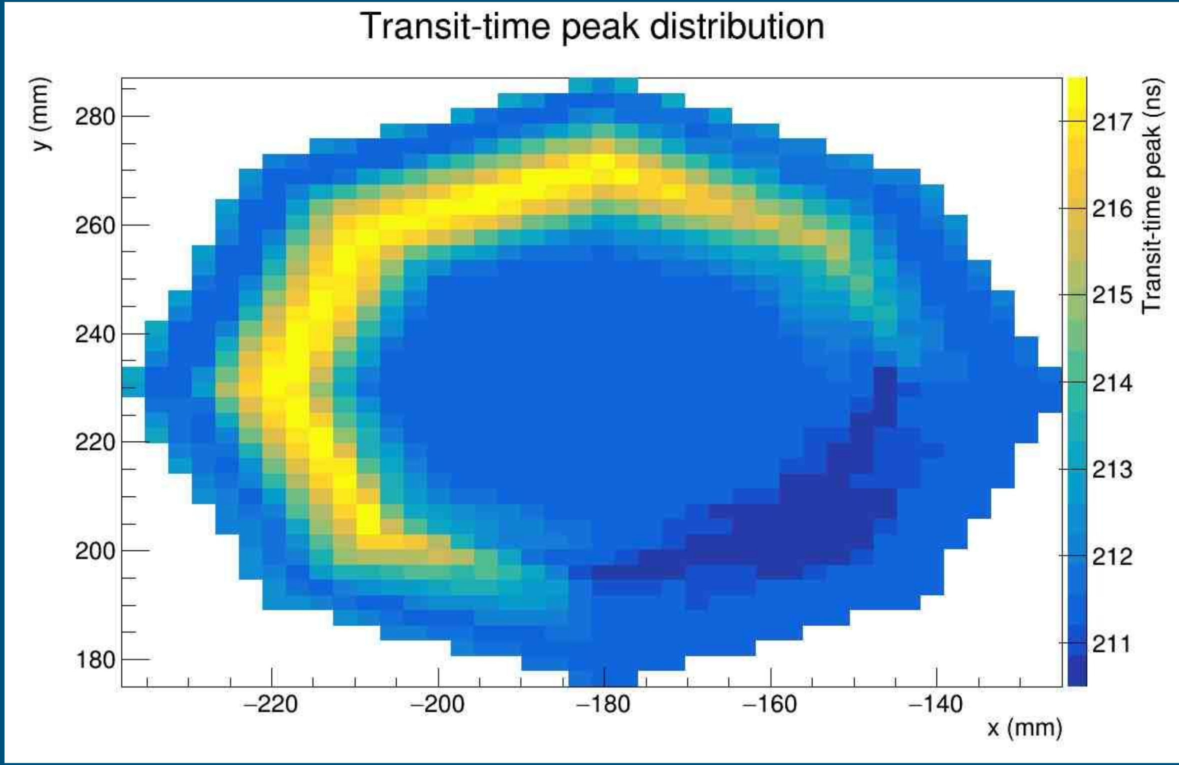
- Peaks when most hits are counted

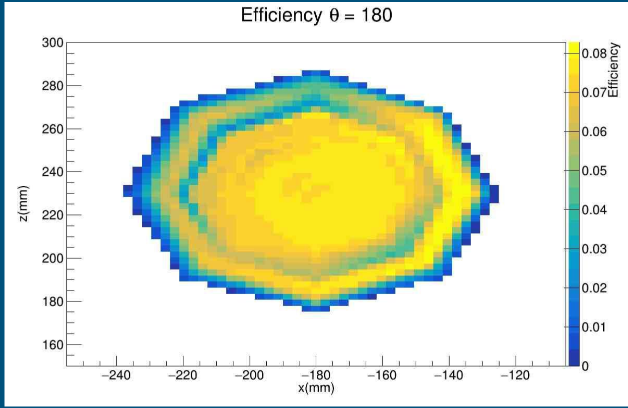
We expect varying peak positions for different measurements due to different optical paths



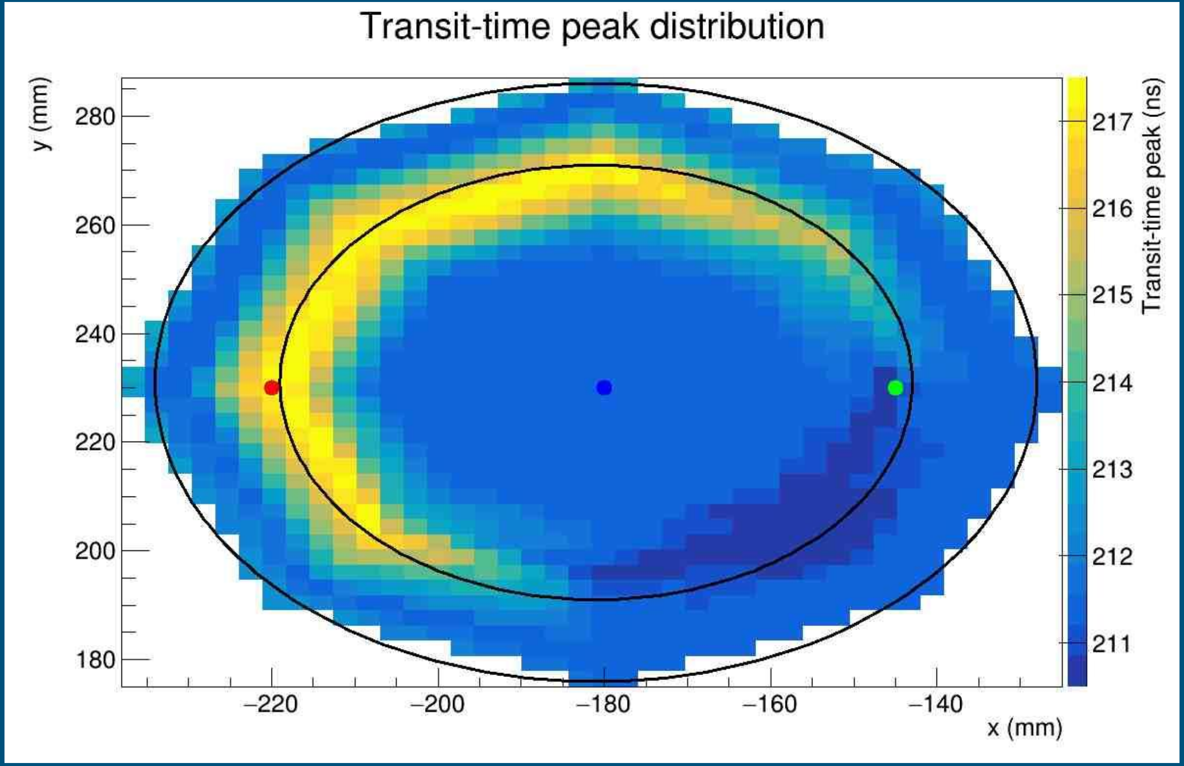
How does the peak position
position vary for different positions on the PMT?

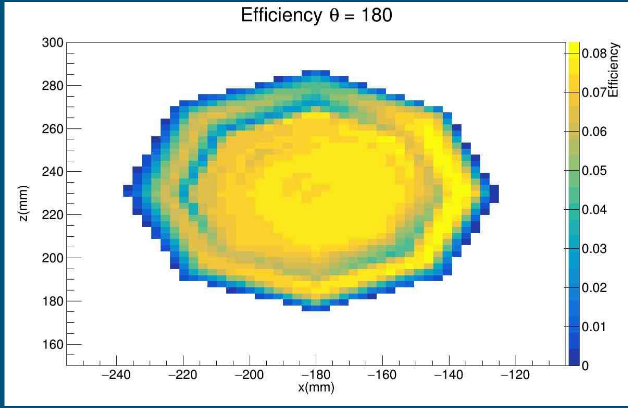
Gridscan - Transit-time peak (θ = 180)



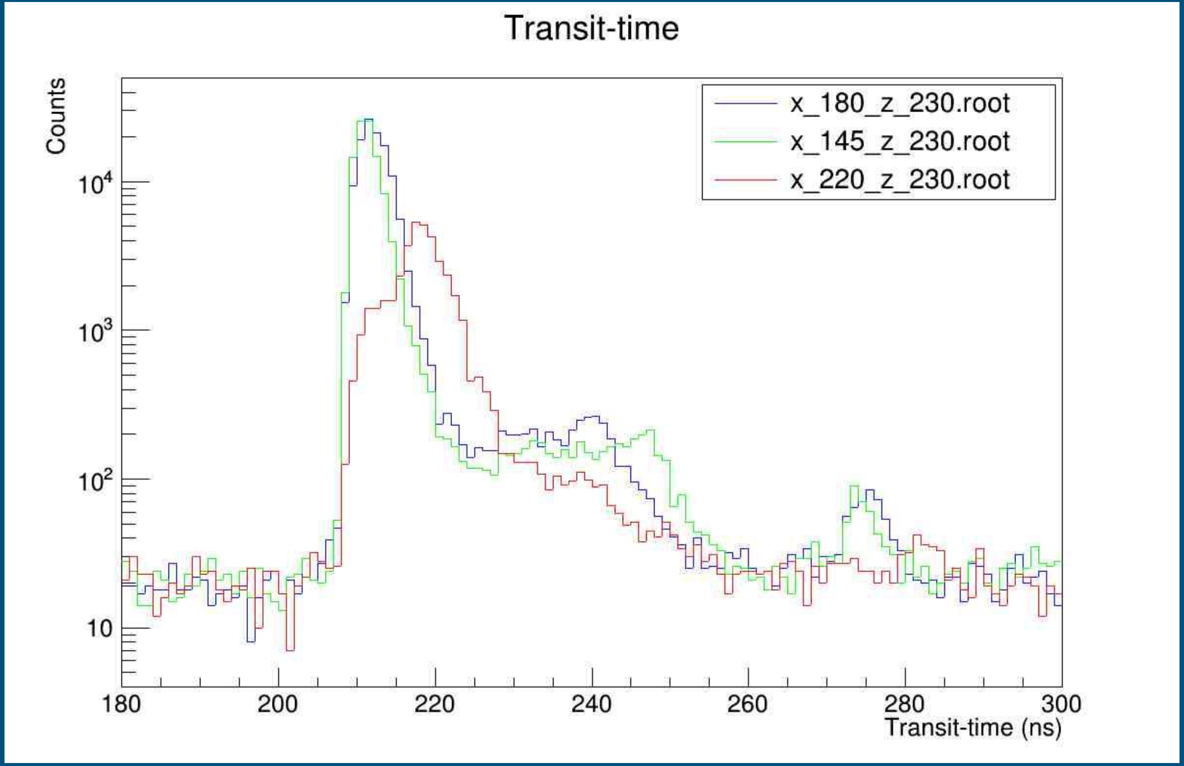


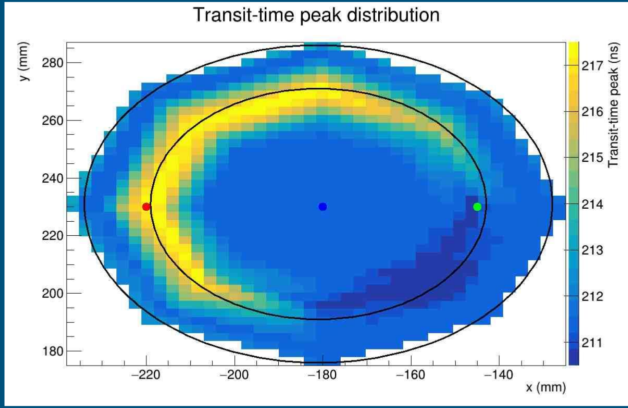
Gridscan - Transit-time peak (θ = 180)





Gridscan - Transit-time peak (θ = 180)

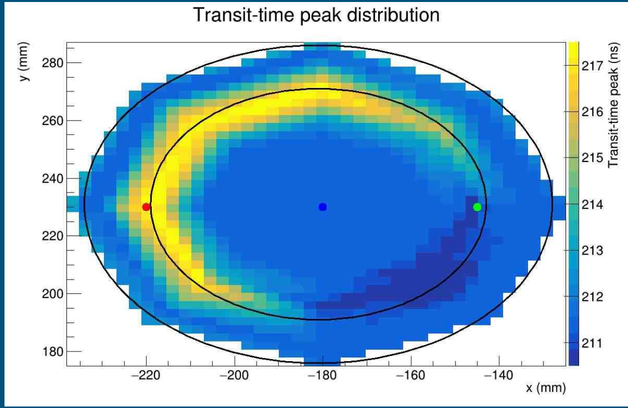


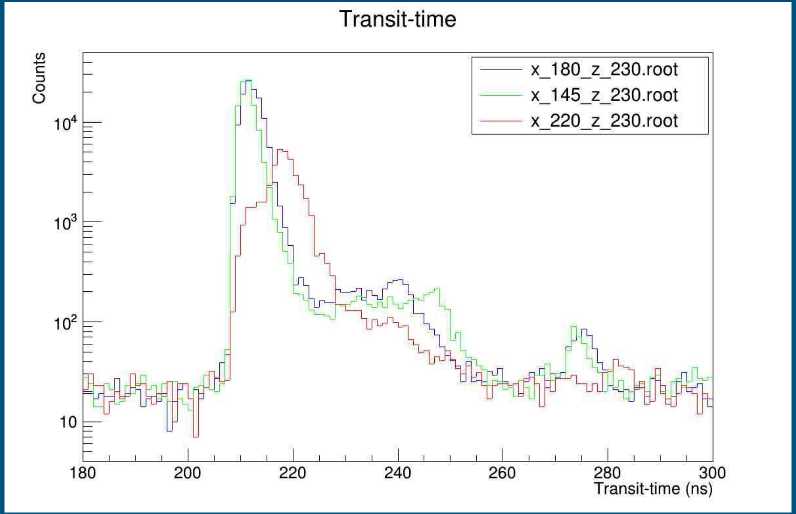


Gridscan - Transit-time peak (θ = 180)

Varying transit-time peaks (~ 6 ns)

- Varying optical paths for light hitting PMT on different spots

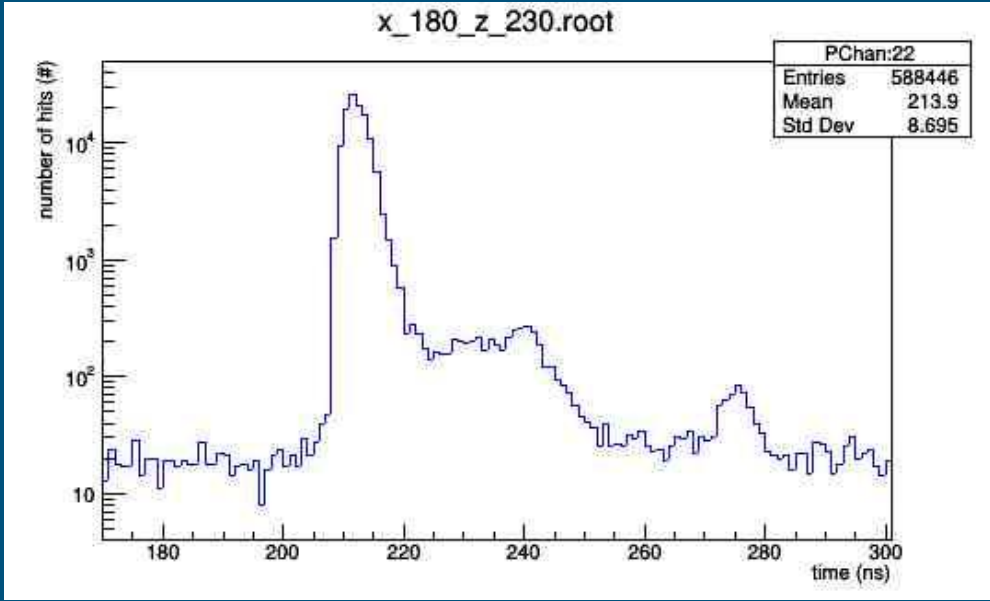




Gridscan - Transit time (θ = 180)

Normal transit time distribution:

- Peaks when most hits are counted

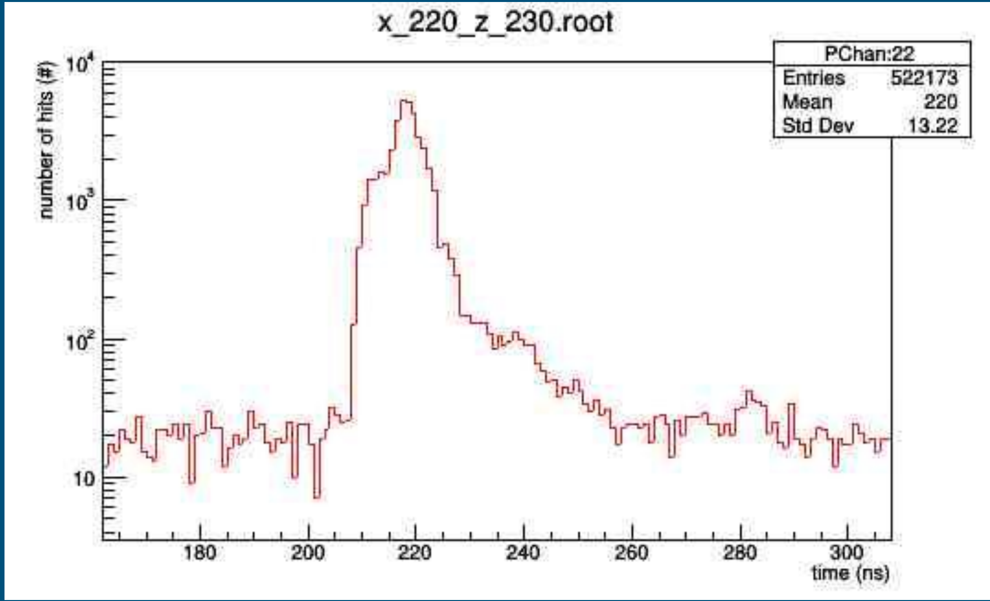


Gridscan - Transit time (θ = 180)

Normal transit time distribution:

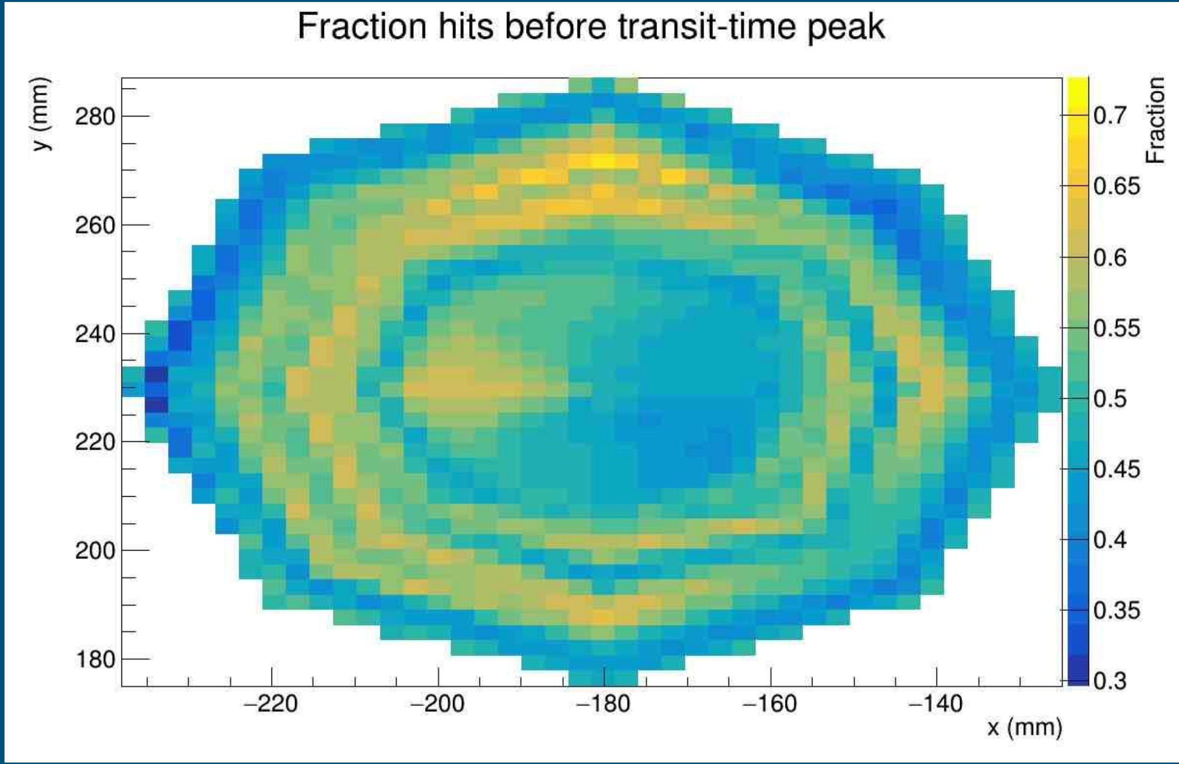
- Peaks when most hits are counted
- Sometimes there is a prepulse!

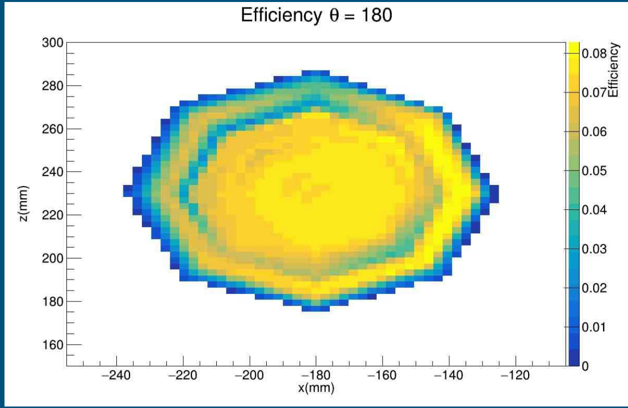
Where can we find this prepulse on the PMT?



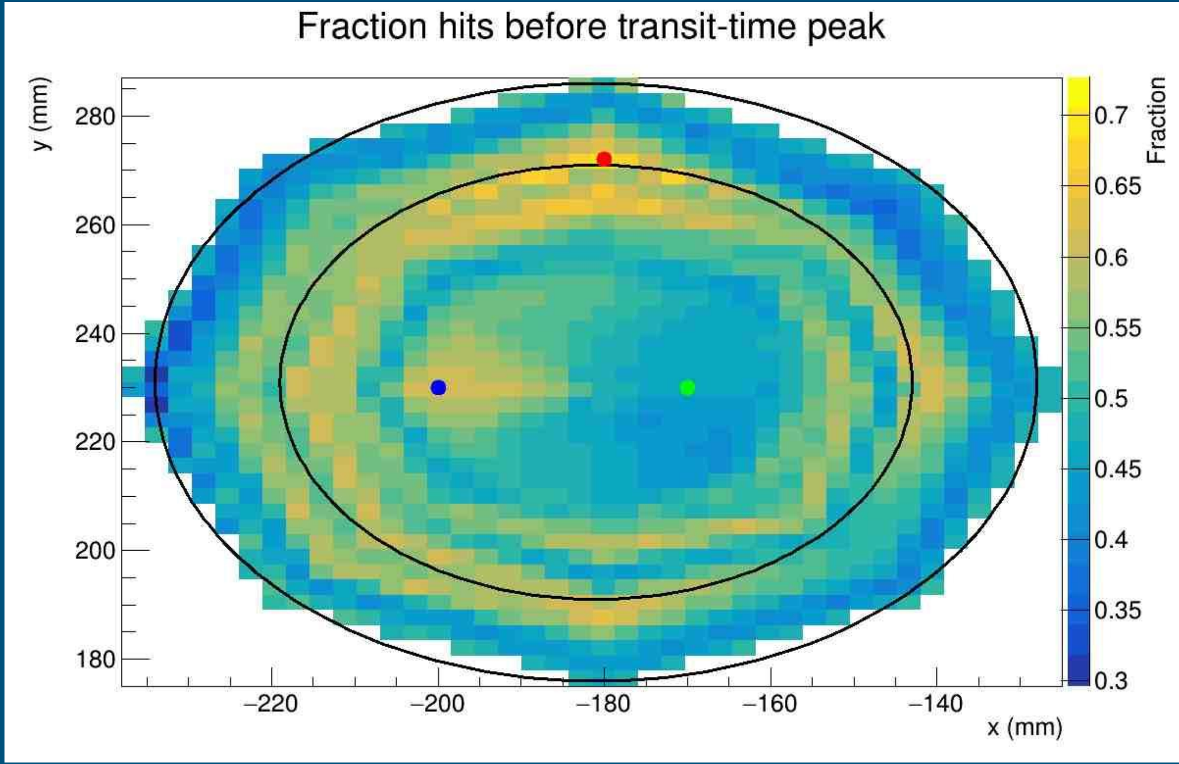
Integrate (transit-time peak - 10 ns, transit-time peak) and divide by (transit-time peak - 10 ns, transit-time peak + 10 ns)

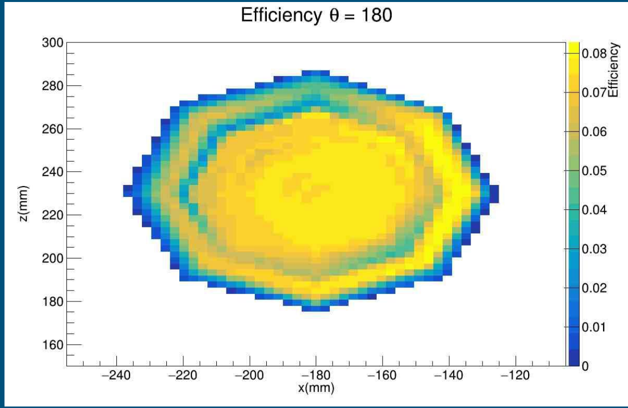
Gridscan - Prepulse fraction (θ = 180)



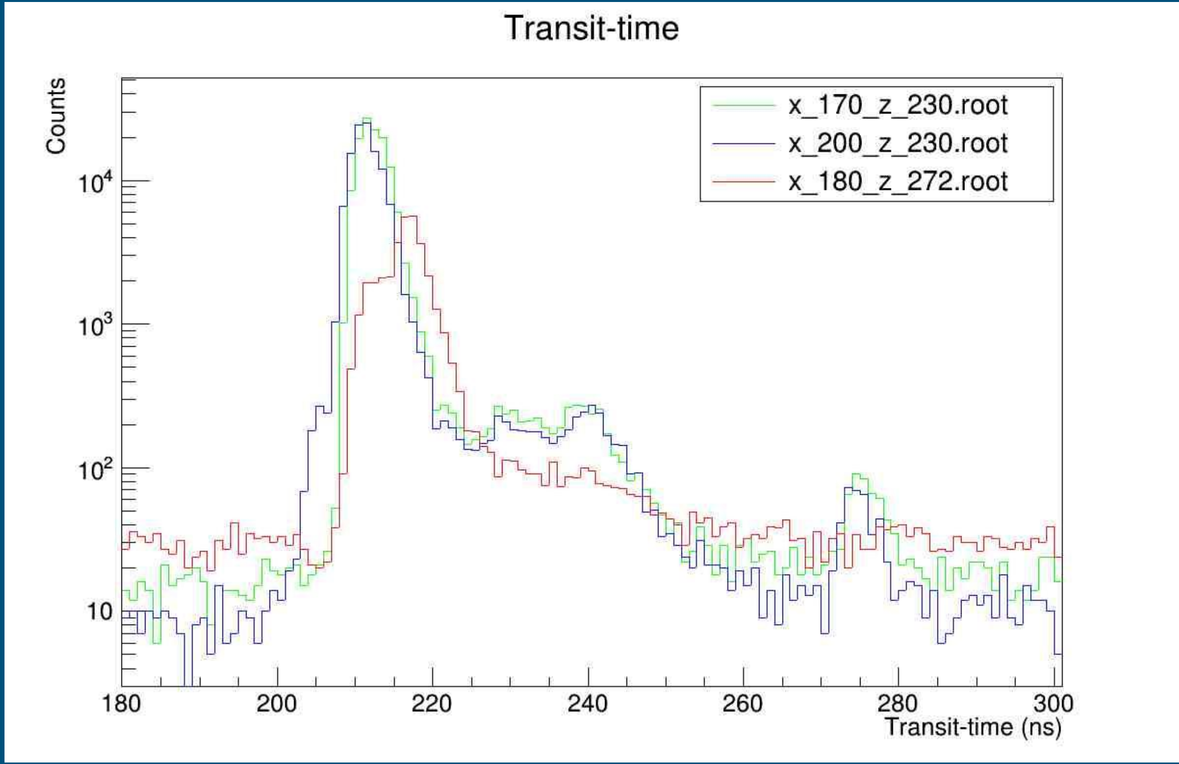


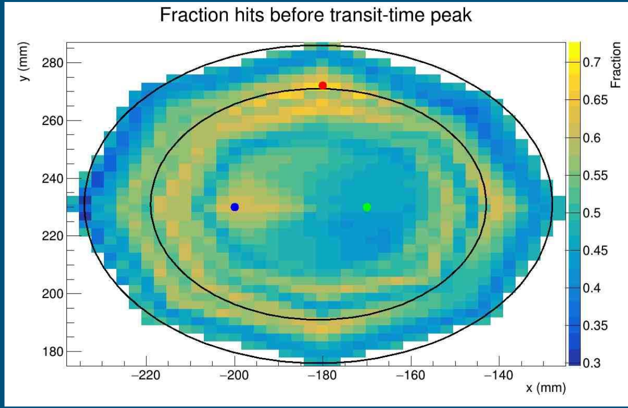
Gridscan - Prepulse fraction (θ = 180)





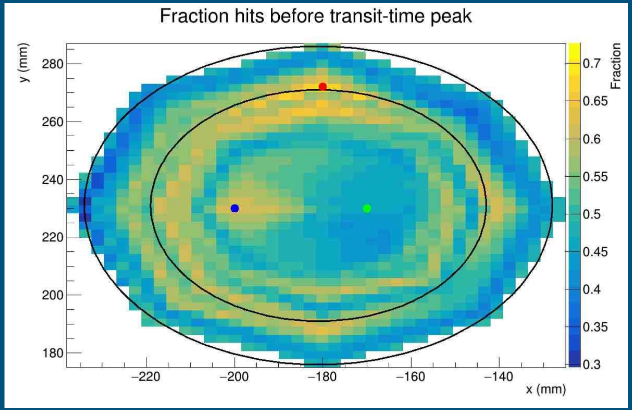
Gridscan - Prepulse fraction (θ = 180)

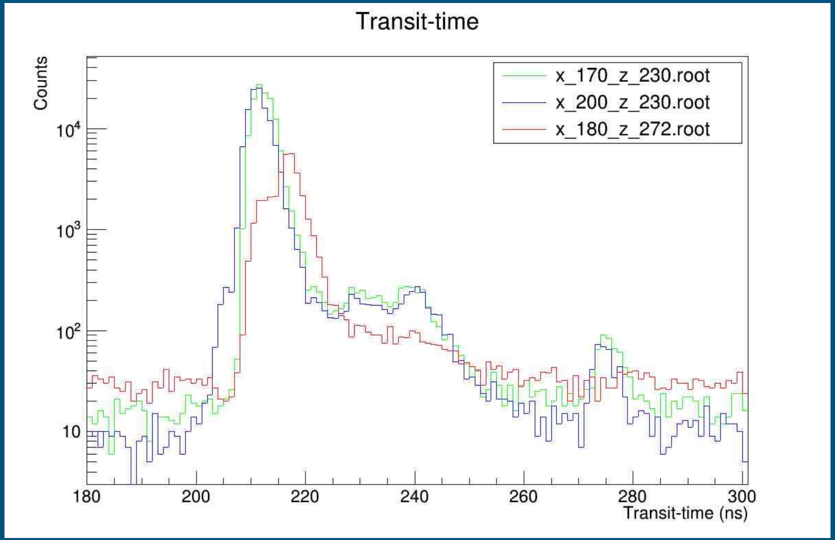




Gridscan - Prepulse fraction (θ = 180)

- Some positions have relatively more prepulses than others





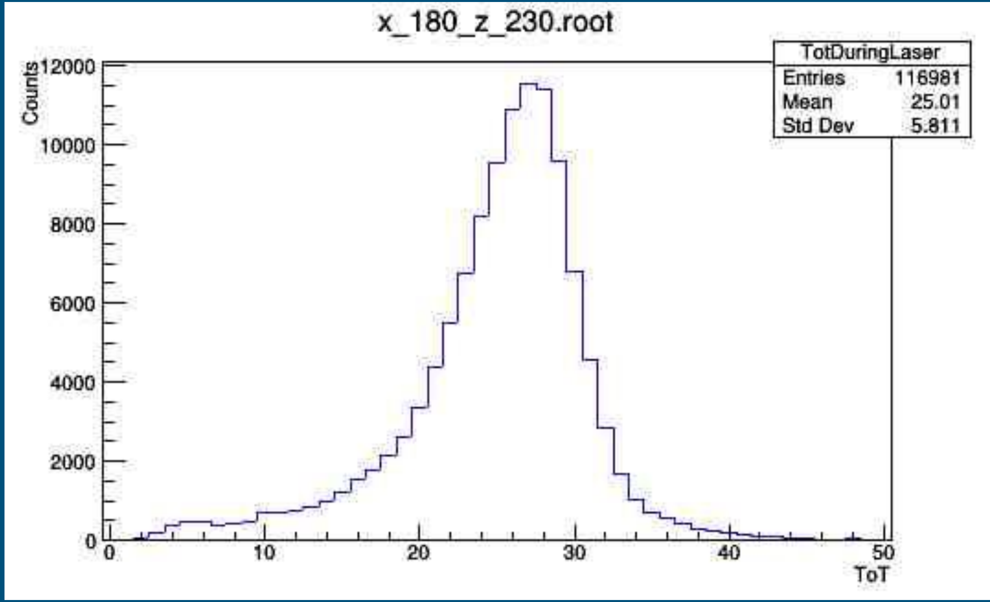
Gridscan - ToT (θ = 180)

Normal ToT distribution:

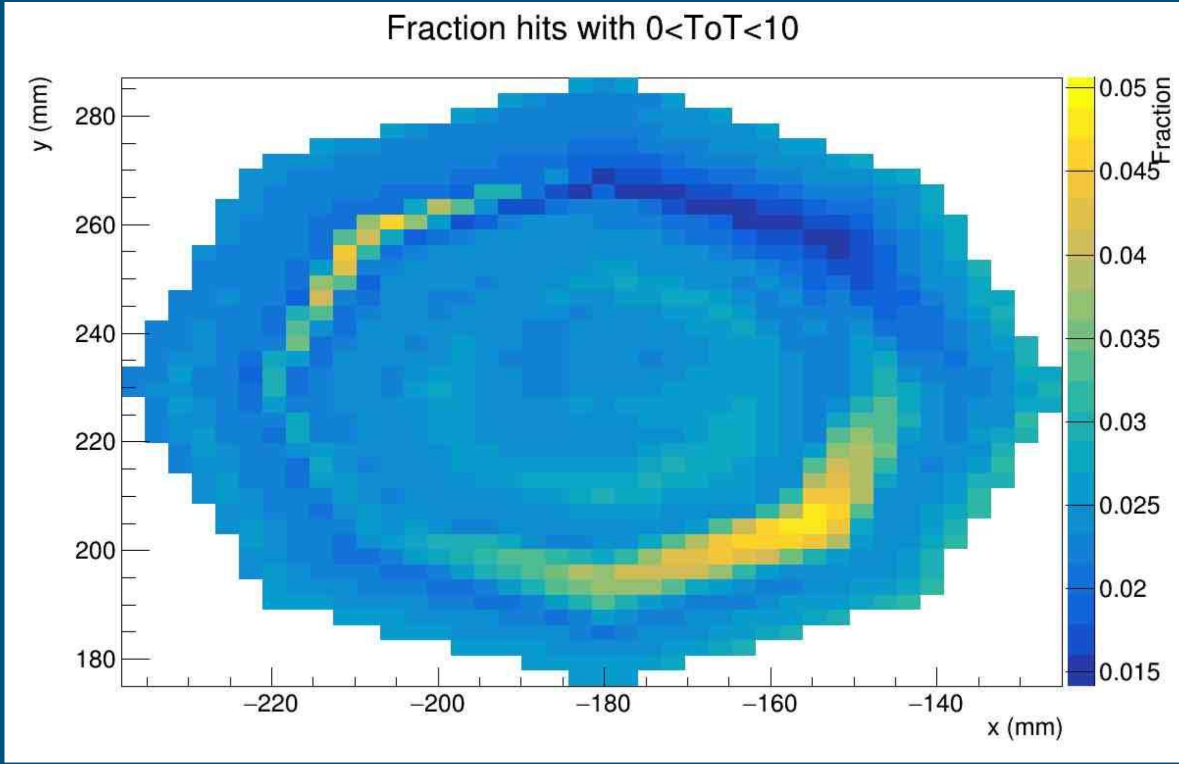
- Peaks around 26.4 ns
- Small peak around 5 ns

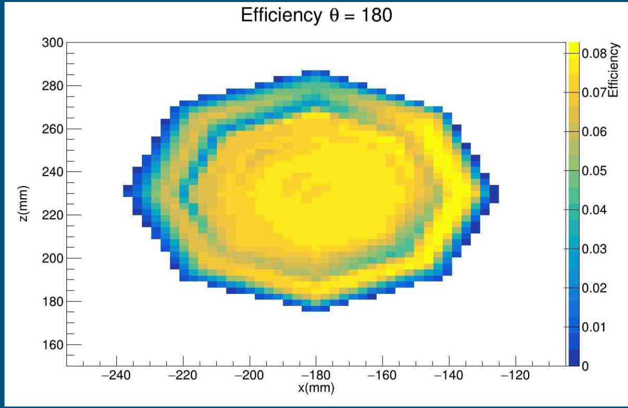
Where does the peak around 5 ns come from?

Integrate area 0<ToT<10 and divide by total to get percentage of hits with 0<ToT<10

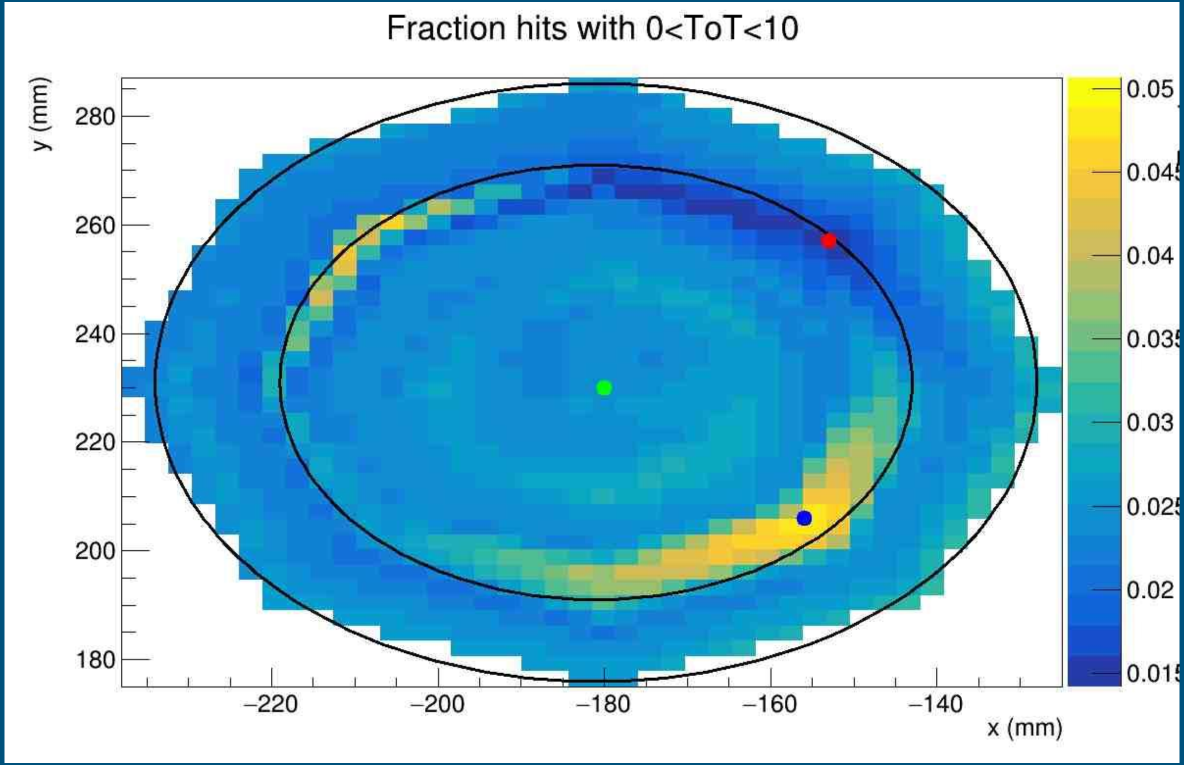


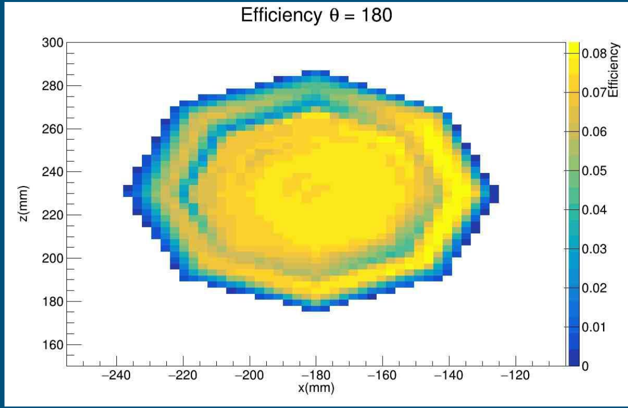
Gridscan - 0<ToT<10 (θ = 180)



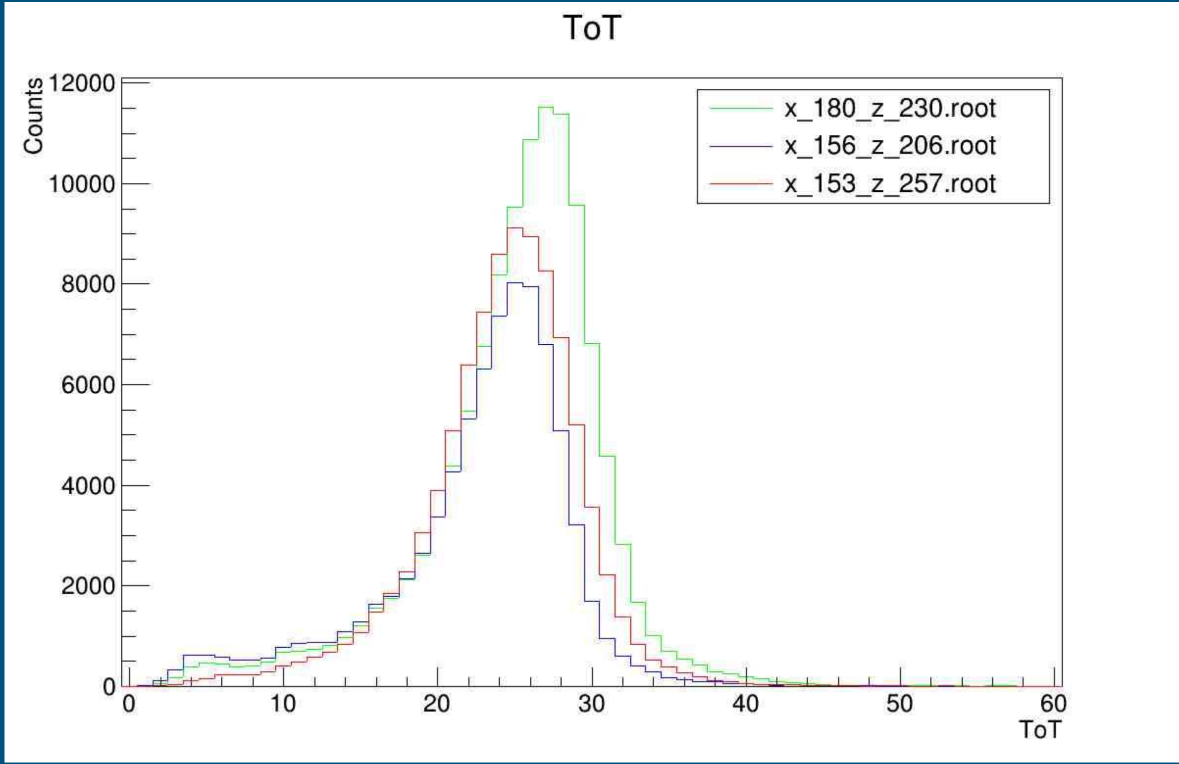


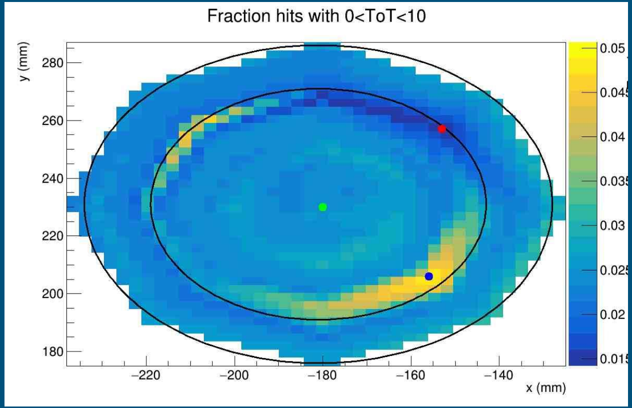
Gridscan - 0<ToT<10 (θ = 180)



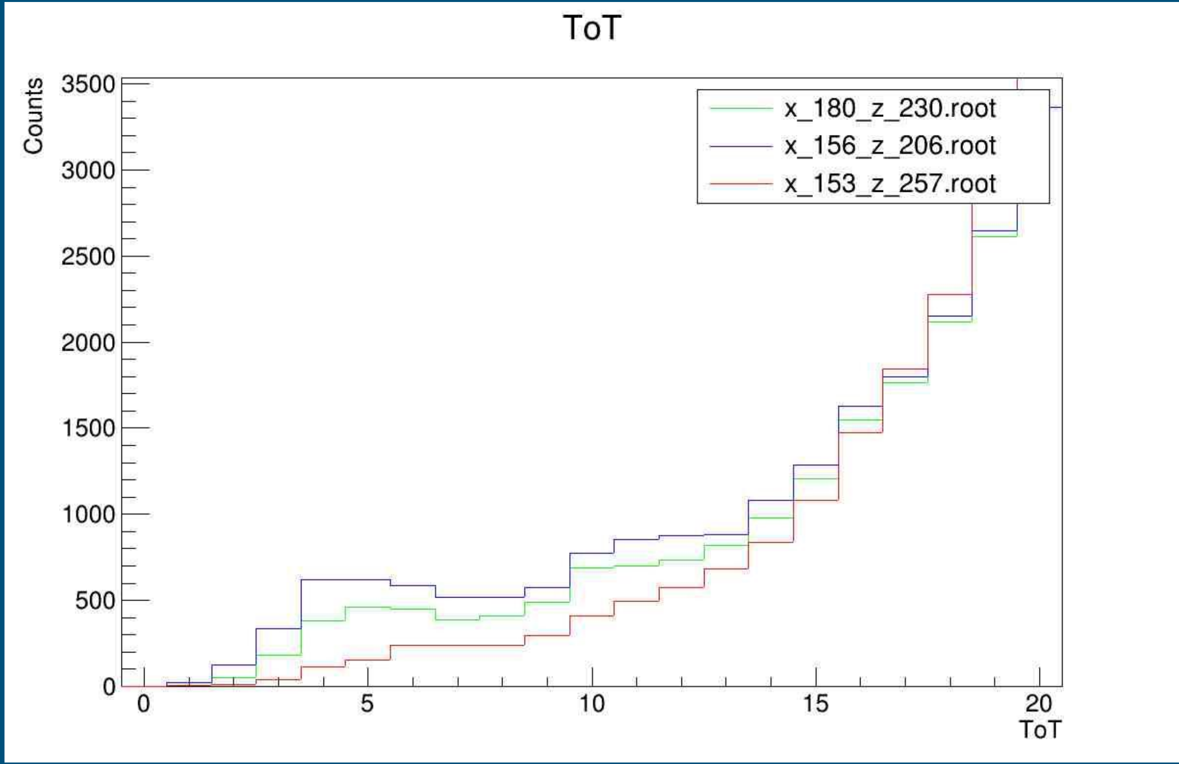


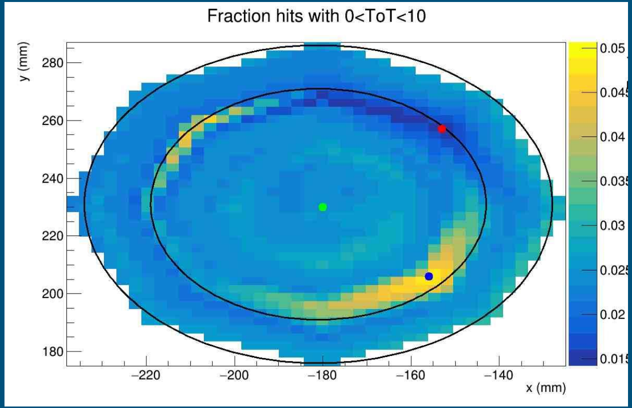
Gridscan - 0<ToT<10 (θ = 180)





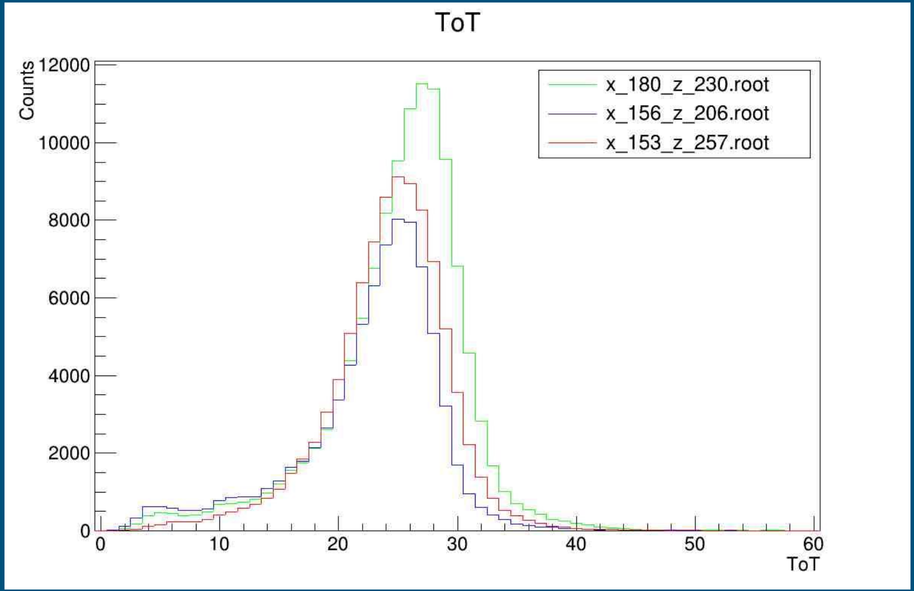
Gridscan - 0<ToT<10 (θ = 180)

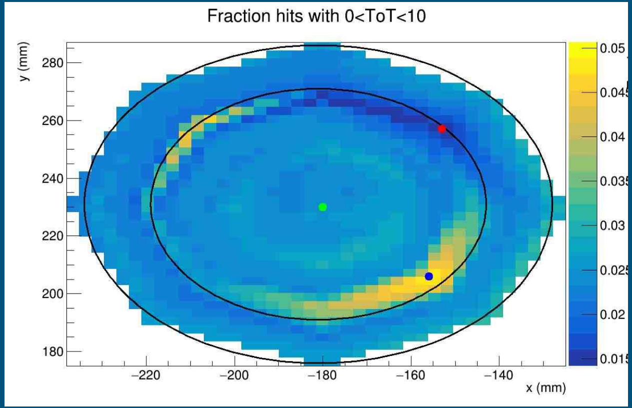




Gridscan - 0<ToT<10 (θ = 180)

- Number of relative hits with 0<ToT<10 vary over different spots on the PMT





Conclusions

Angular Acceptance

- Experimental results seem confirm simulations

Transit-time and ToT distributions vary for different locations on the PMT

- Hitting the PMT on different locations (reflector ring, edge, center) gives different paths for the light

Outlook

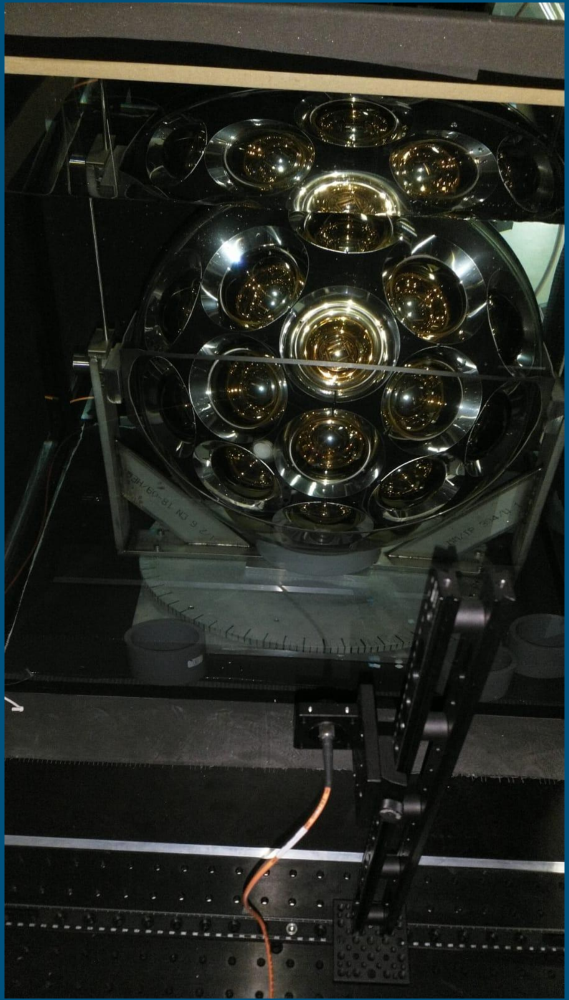
Transit-time and ToT distributions vary for different locations on the PMT

Now there is an experimental setup to measure and quantify this

- How should we do this?
- Can we incorporate these effects in our simulations?

Thank you for listening!

Are there any questions?



Backup

Laser properties

Collimator properties

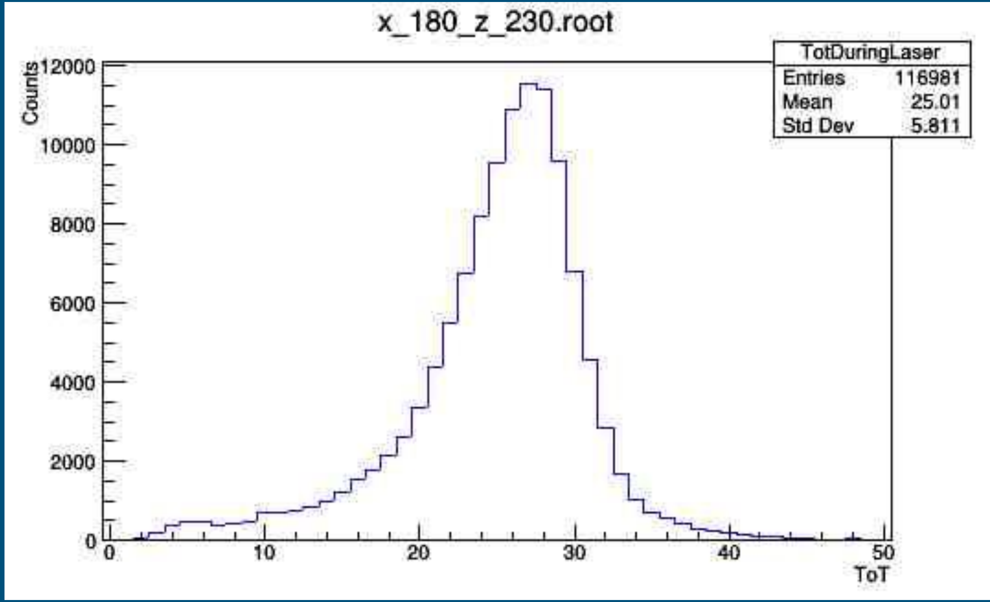
Finding the signal

Gridscan - ToT (θ = 180)

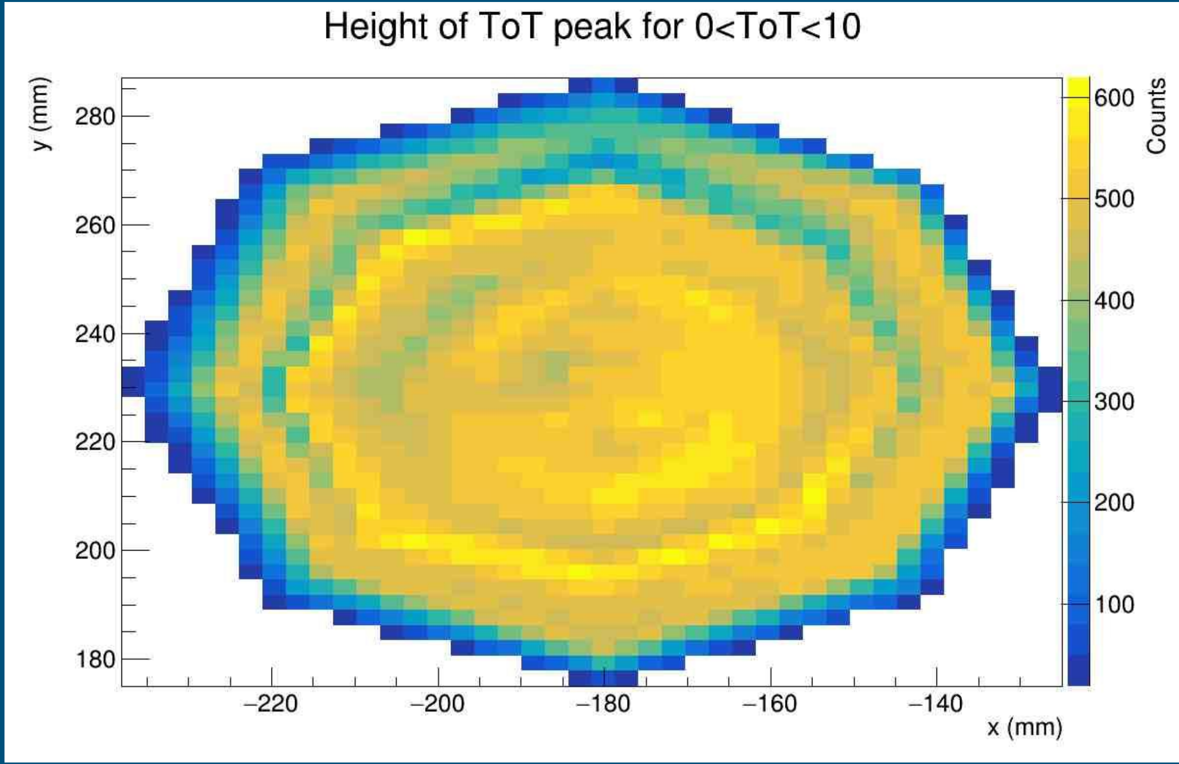
Normal ToT distribution:

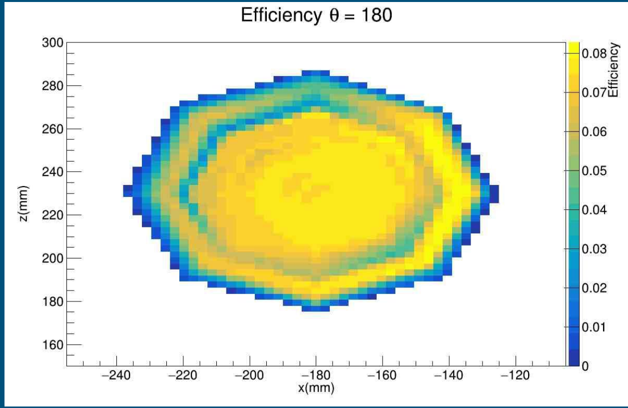
- Peaks around 26.4 ns
- Small peak around 5 ns

Where is the 5 ns peak highest?

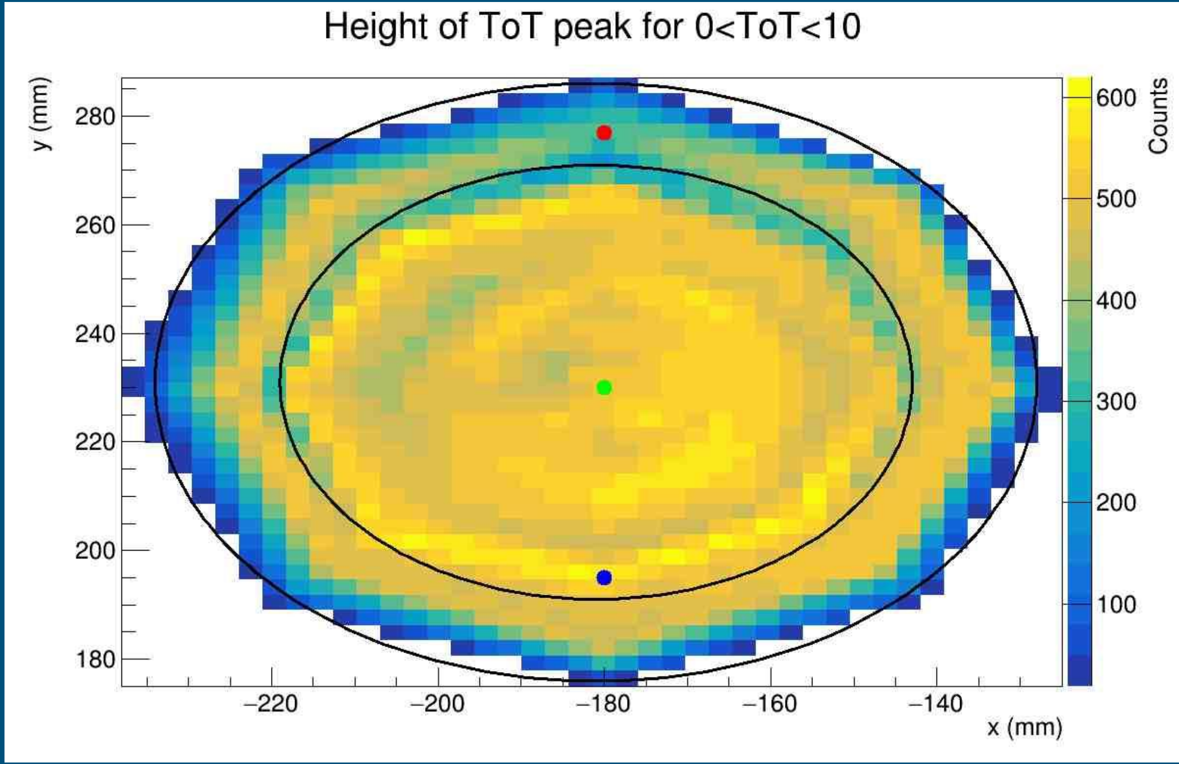


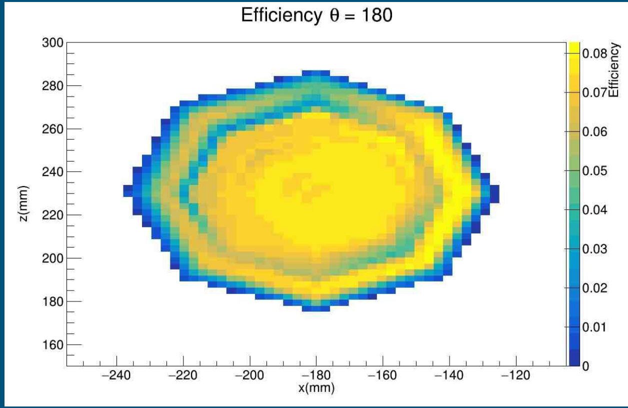
Gridscan - Peak ToT in 0<ToT<10 (θ = 180)



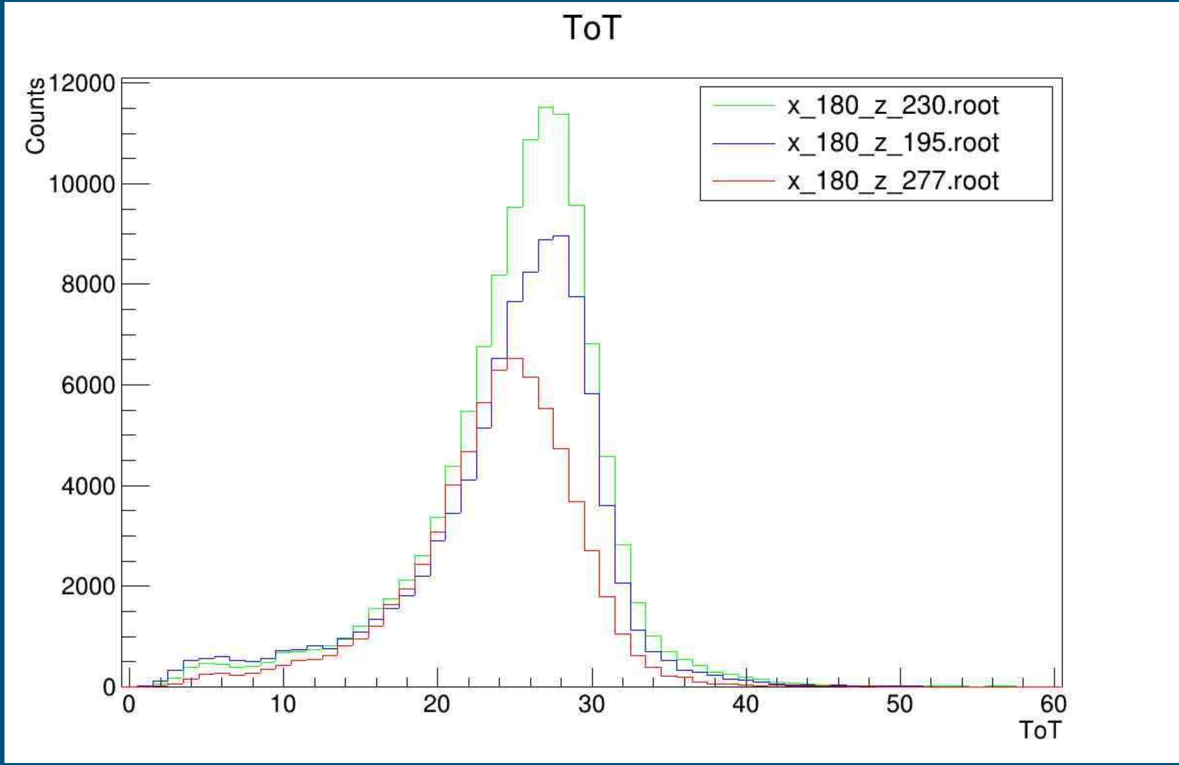


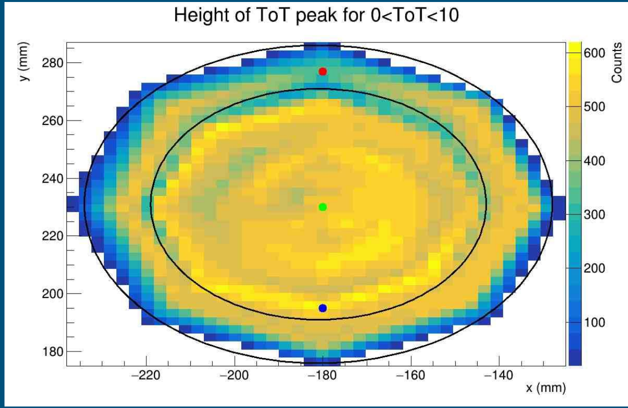
Gridscan - Peak ToT in 0<ToT<10 (θ = 180)



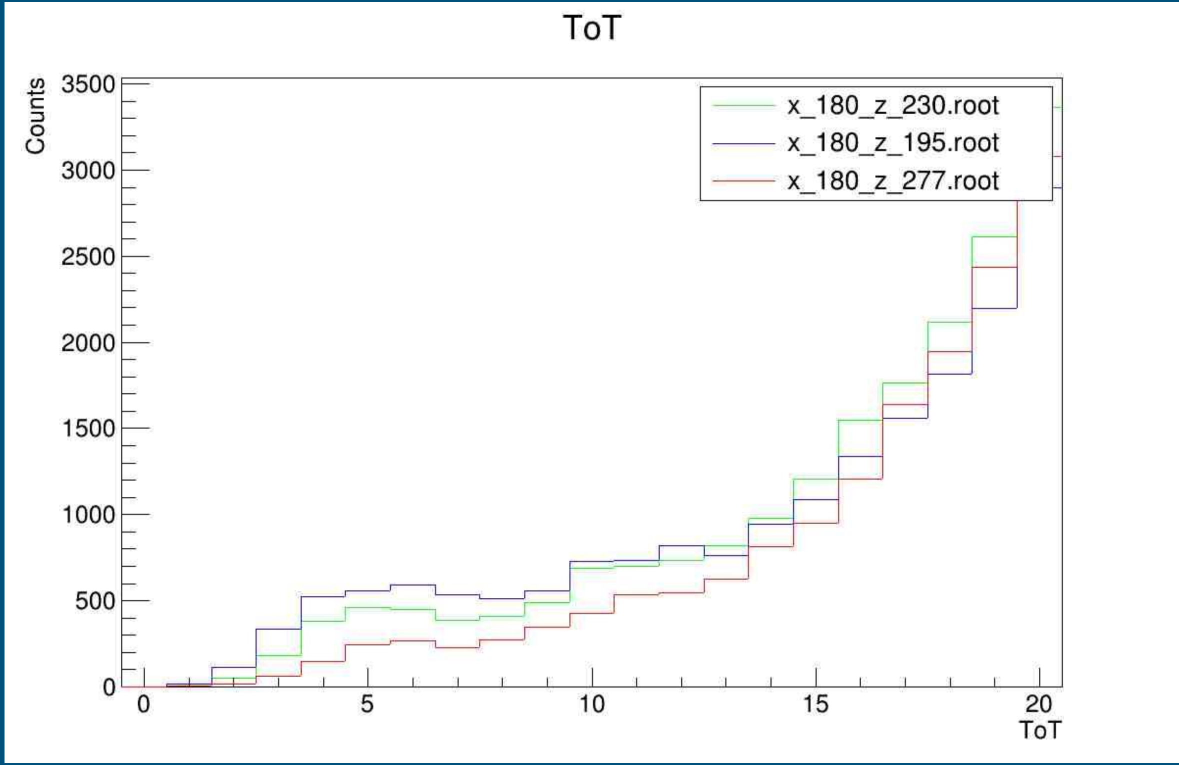


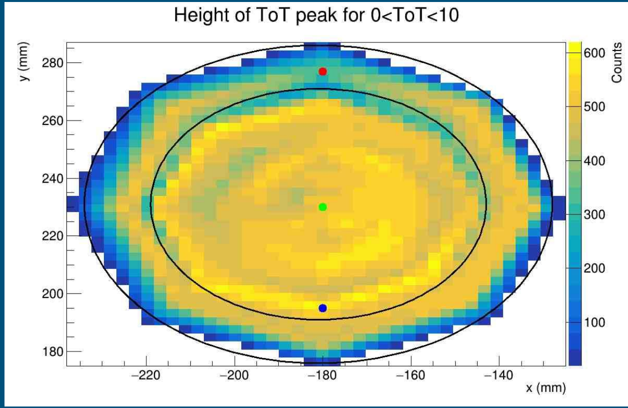
Gridscan - Peak ToT in 0<ToT<10 (θ = 180)





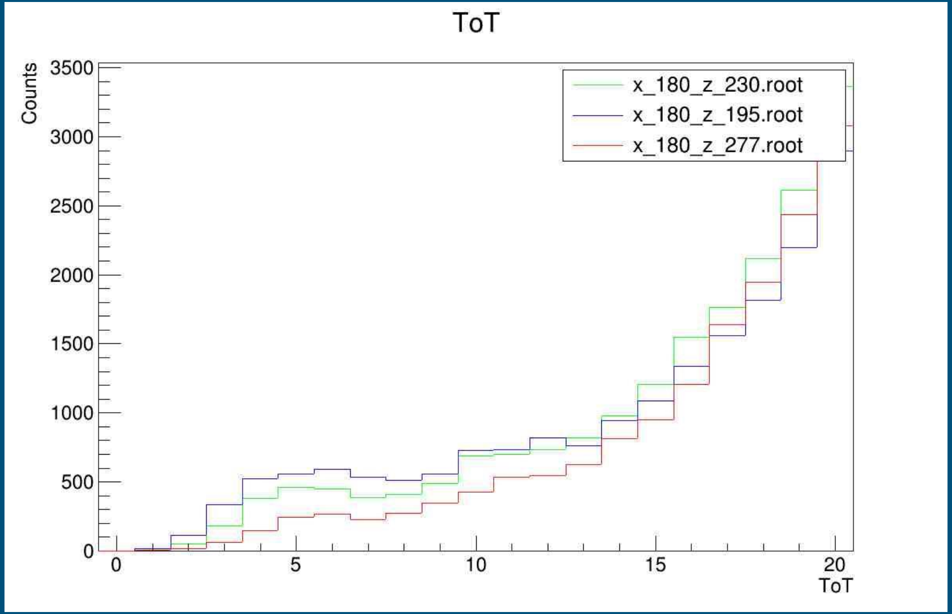
Gridscan - Peak ToT in 0<ToT<10 (θ = 180)

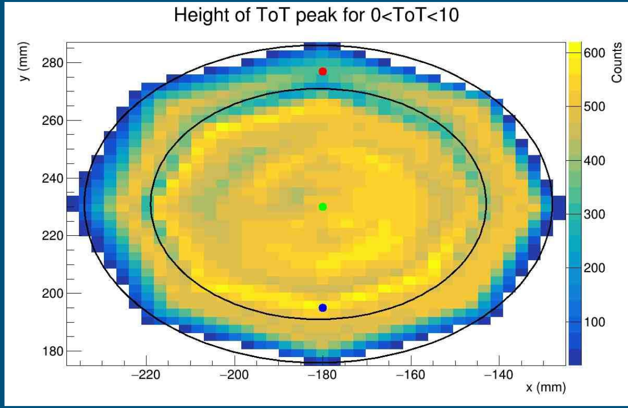




Gridscan - Peak ToT in 0<ToT<10 (θ = 180)

- Peak height in between 0<ToT<10 varies as well

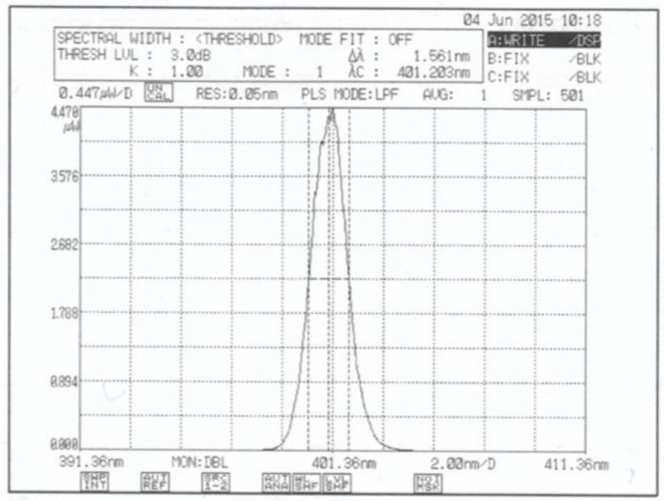




Laser properties

Alphalas Picosecond Diode Laser (Model?!)

- Wavelength ~ 401 nm
- Trigger frequency = 25 KHz
- Peak power ~ 530 mW
- Average power ~ 0.6 mu W
- Attenuated on driver until ~ 0.1 spe/pulse
  → ~ 2.5 KHz on DOM
- Pulse width ~ 50 picosecond



Spectrum in pulsed operating mode

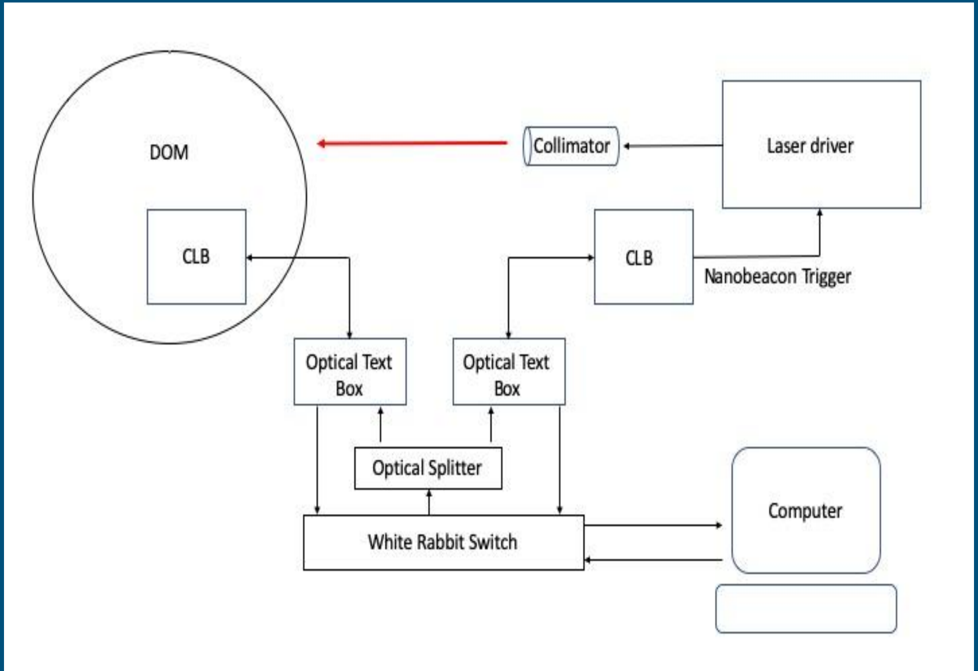
Collimator properties

https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=944&pn=F671FC-405

Finding the Signal

Picosecond pulsed laser triggered by the nanobeacon of a CLB

CLB and DOM connected to White Rabbit Switch (WRS) for time synchronization



Now we know when to expect our pulse!