

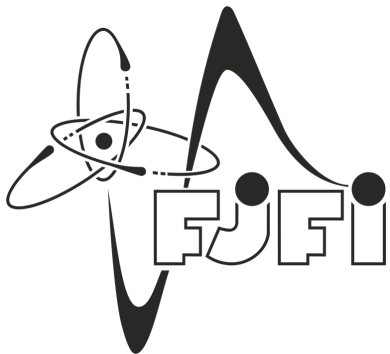
Time resolution measurement with Direct Photon Detector in EIC far-backward region

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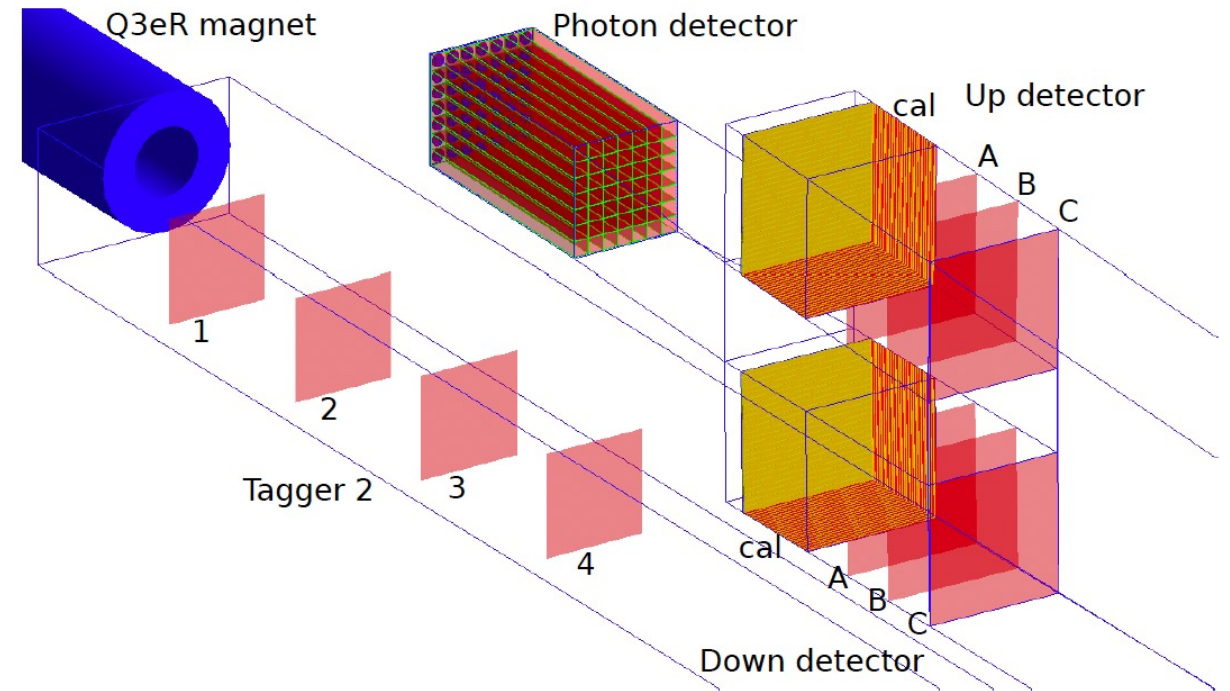
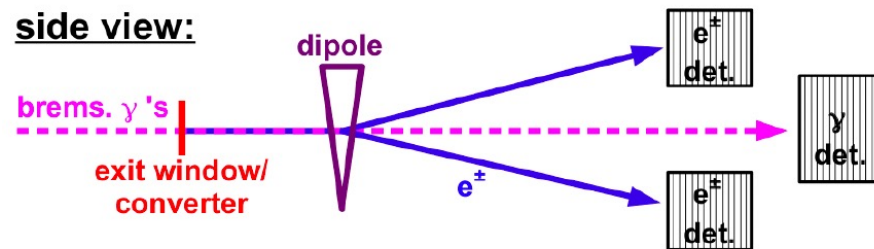


Luminosity monitor

Direct photon calorimeter:

Option 1: Quartz (SiO_2) fiber calorimeter (qCAL)

Option 2: PbWO_4 homogeneous calorimeter (PWO)

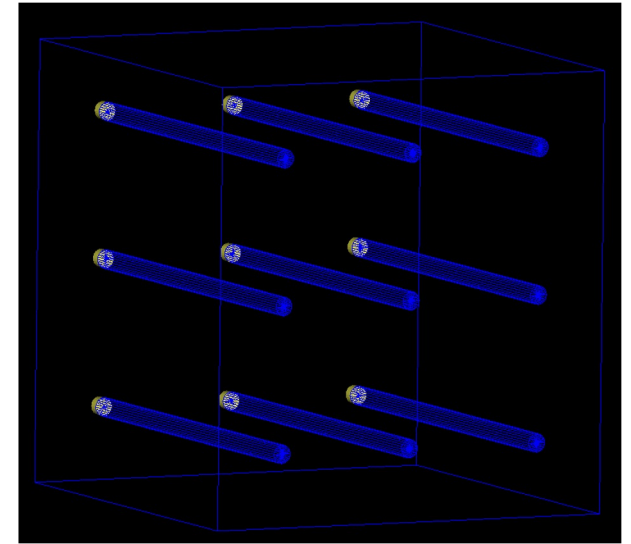


Previous work

qCal configuration

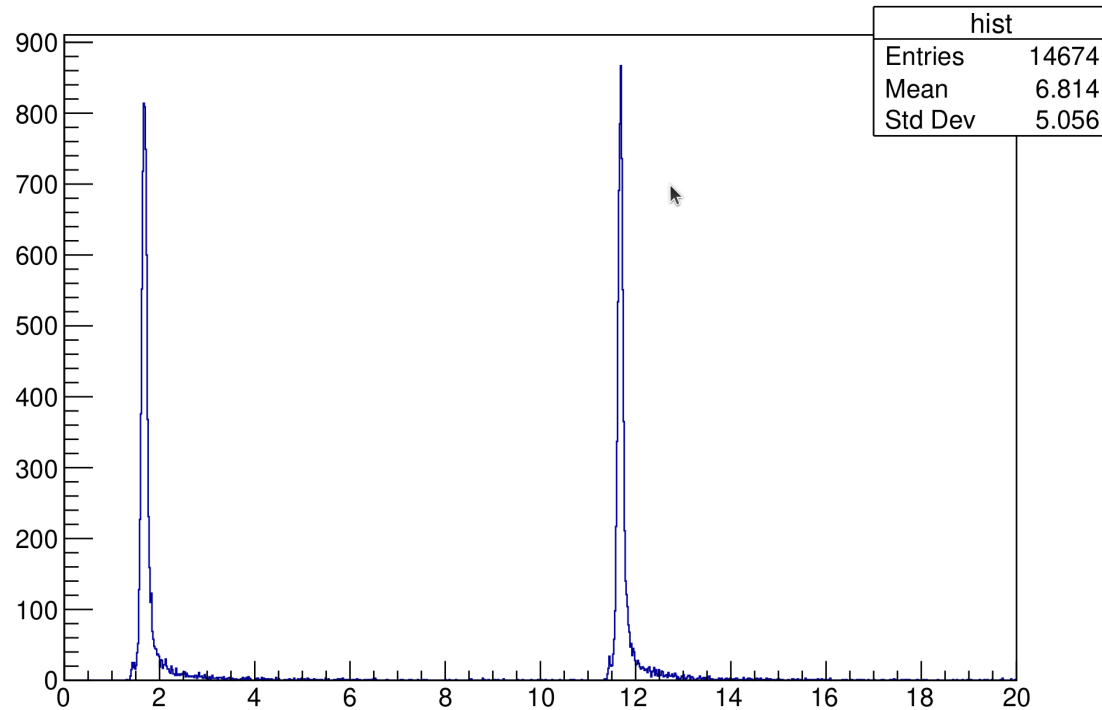
Detector construction

- Implementation of amorphous silica (SiO_2) infused calorimeter
- Quartz fiber with optical Cherenkov photons
- size-xy = 16 cm, z-length = 30 cm, fiber-length = 28 cm
- Fiber details: $r_{\text{core}} = 500 \mu\text{m}$, $r_{\text{clad}} = 540 \mu\text{m}$, and $dx = 4 \text{ mm}$
- Absorber material: Pb or W



Single cell with a few quartz fibers

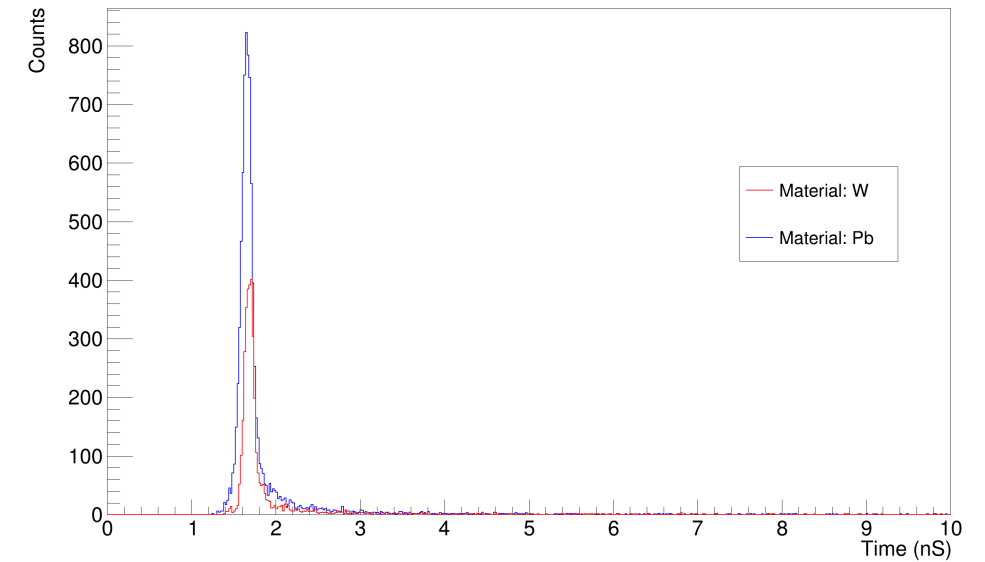
Light collection time



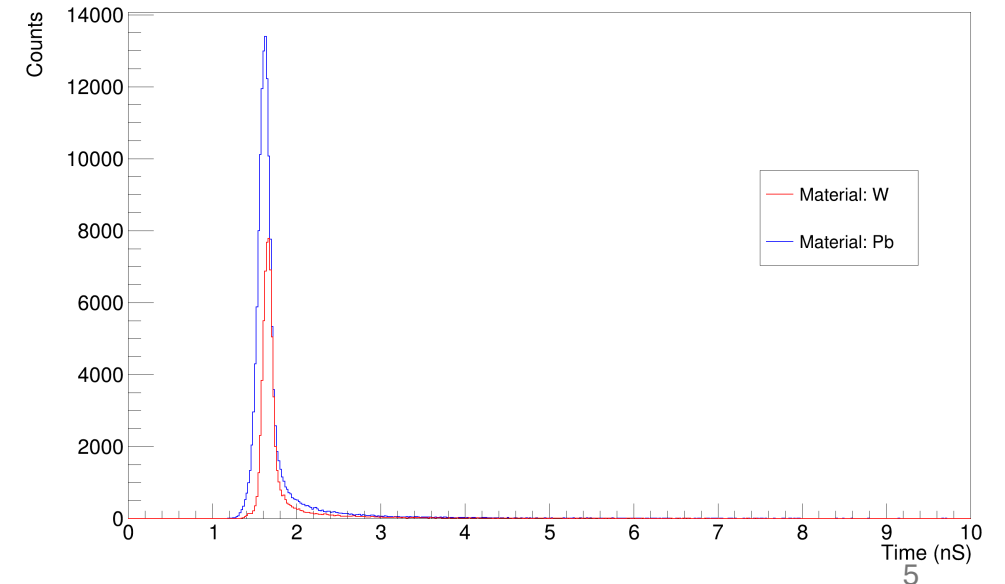
qCAL hit time

- Event statistics: 5000
- $E_\gamma = 1$ GeV
- Cherenkov light yield
- Time difference: 10 ns

Time measurement for qCal for 1 GeV gamma



Time measurement for qCal for 18 GeV gamma



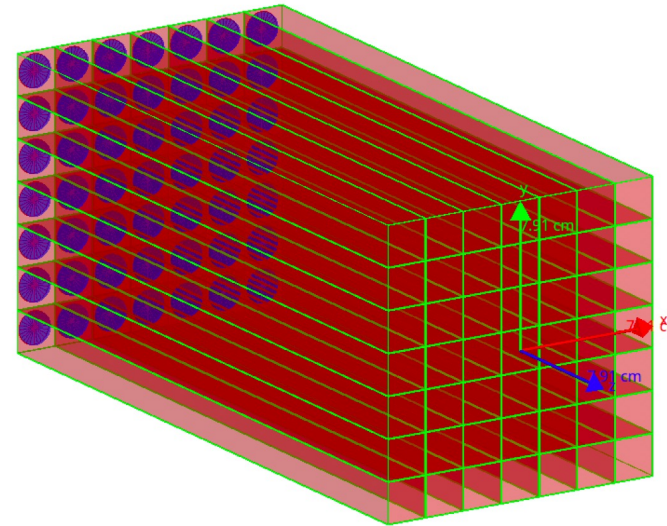
PWO configuration (i)

Detector construction

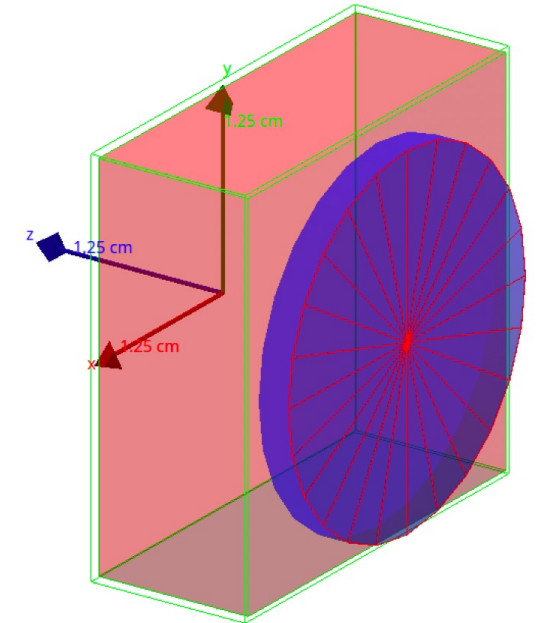
- PWO crystal (Red with green wrapping)
- Single cell: $22 * 22 * 350 \text{ mm}^3$
- Size-XY: $7 * 7$ module
- 2 mm thick BK7 glass (Blue)
- Photocathode (Red circles)

User definition:

- Fast time constant: 1.67 ns
- Slow time constant: 6.6 ns

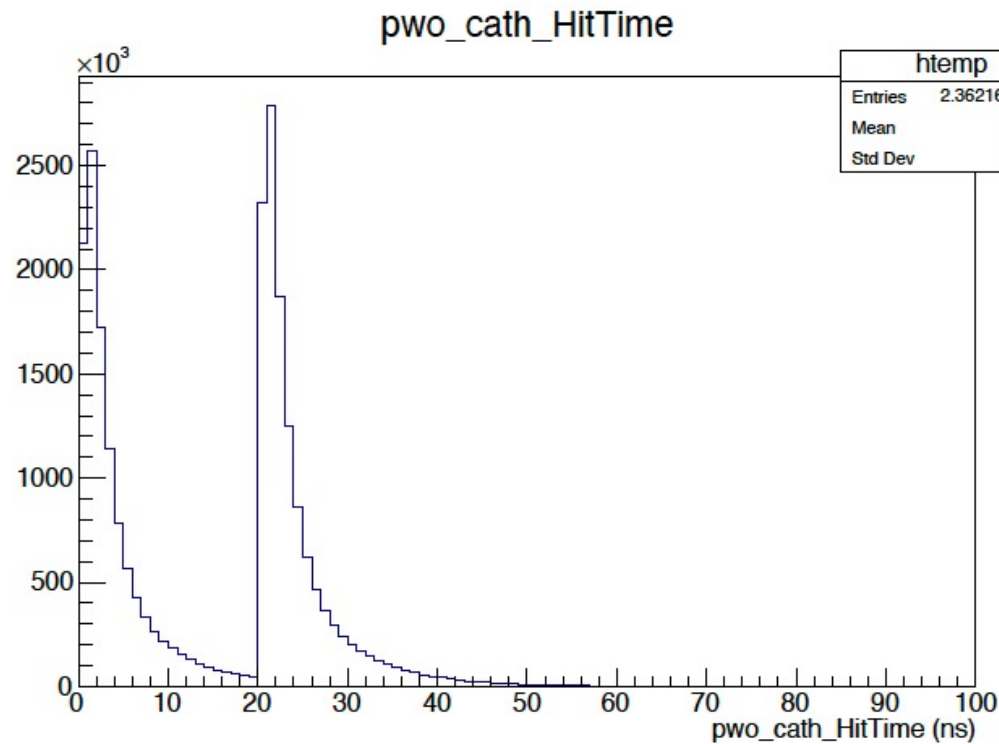


PWO calorimeter



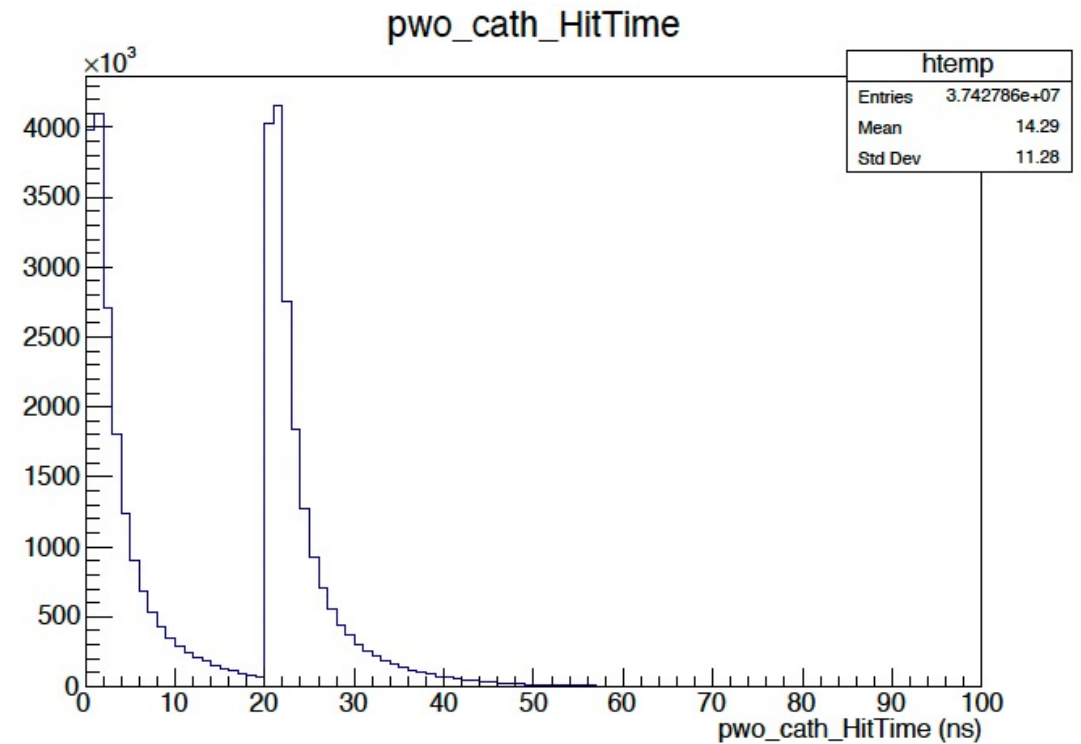
Single cell with PM

Light collection time



PWO hit time

- Event statistics: 1000
- $E_\gamma = 1$ GeV
- Scintillation light yield
- Time difference: 20 ns



PWO hit time

- Event statistics: 100
- $E_\gamma = 18$ GeV
- Scintillation light yield
- Time difference: 20 ns

Current status

PWO configuration (ii)

Detector construction

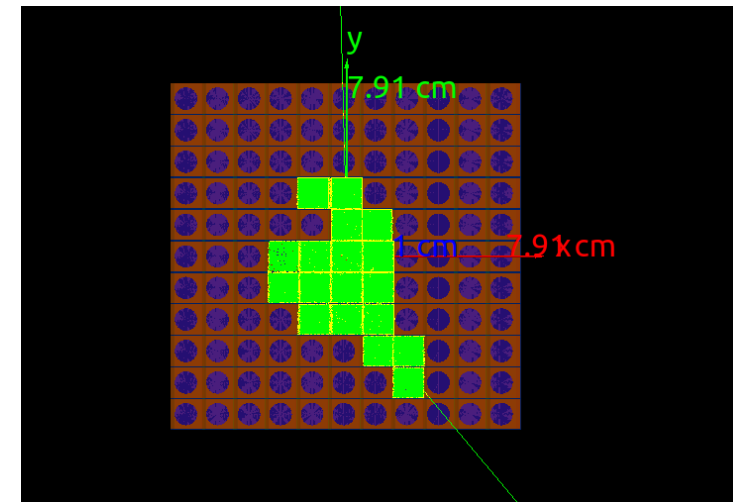
- PWO crystal
- Single cell: $12 * 12 * 300 \text{ mm}^3$
- Wrapping thickness: 0.3 mm
- Size-XY: $11 * 11$ module
- Photocathode-XY: $9 * 9 \text{ mm}$, Z: 2 mm

User definition:

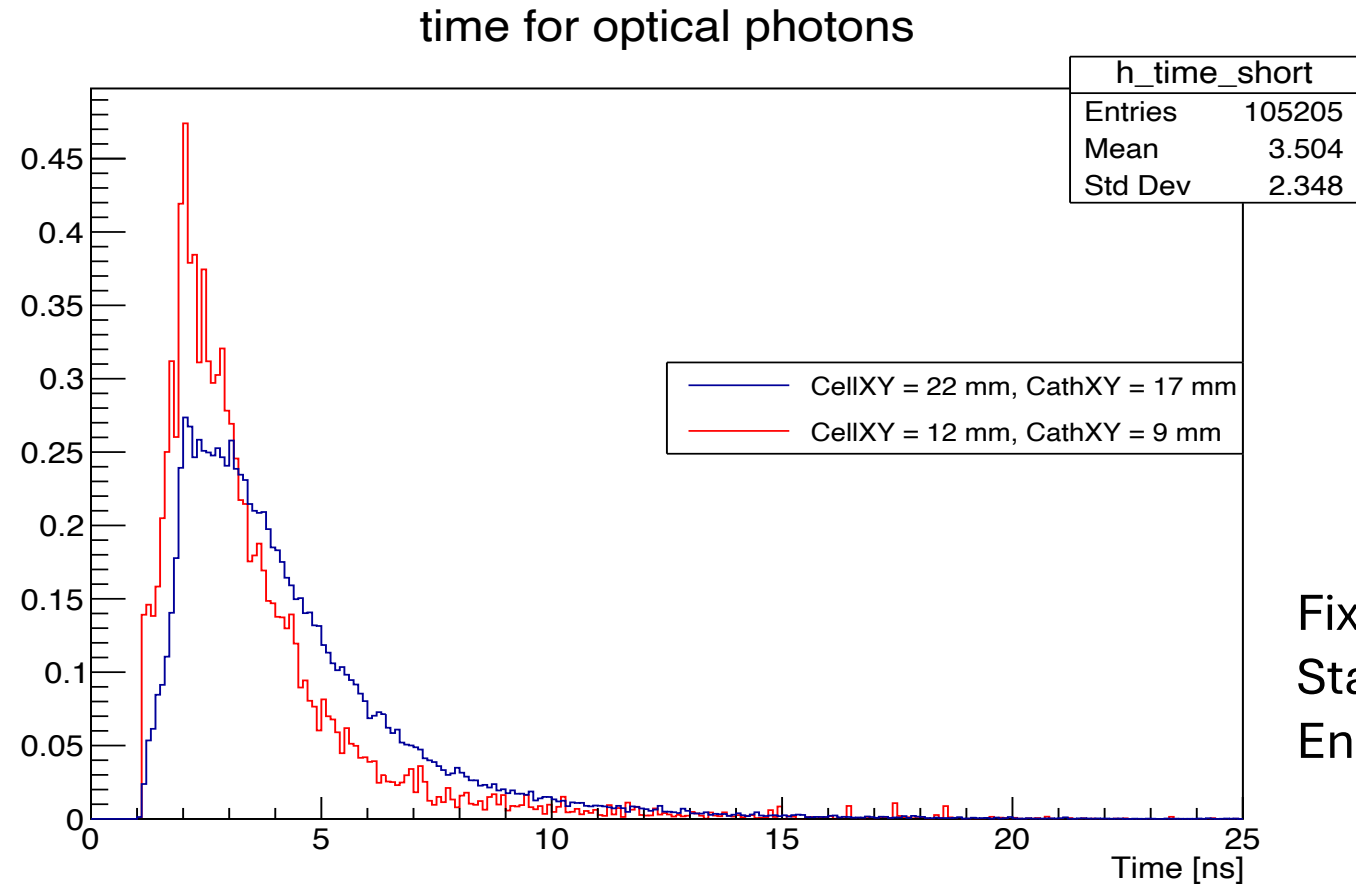
- Fast time constant: 0.64 ns
- Slow time constant: 3.2 ns

General particle source

- Number of particles: 2
- particle type: gamma
- Distance: 10 mm
- Angular distribution: iso
- Energy distribution: Mono
- Position distribution: Point
- Time difference: 10 ns
- Energy: 100 MeV (Figure)



Light collection time



Fixed length-z: 300 mm,
Statistics: 500 events,
Energy: 1 GeV

Checks on different XY-size

Light collection time

Checks on same energies in an event

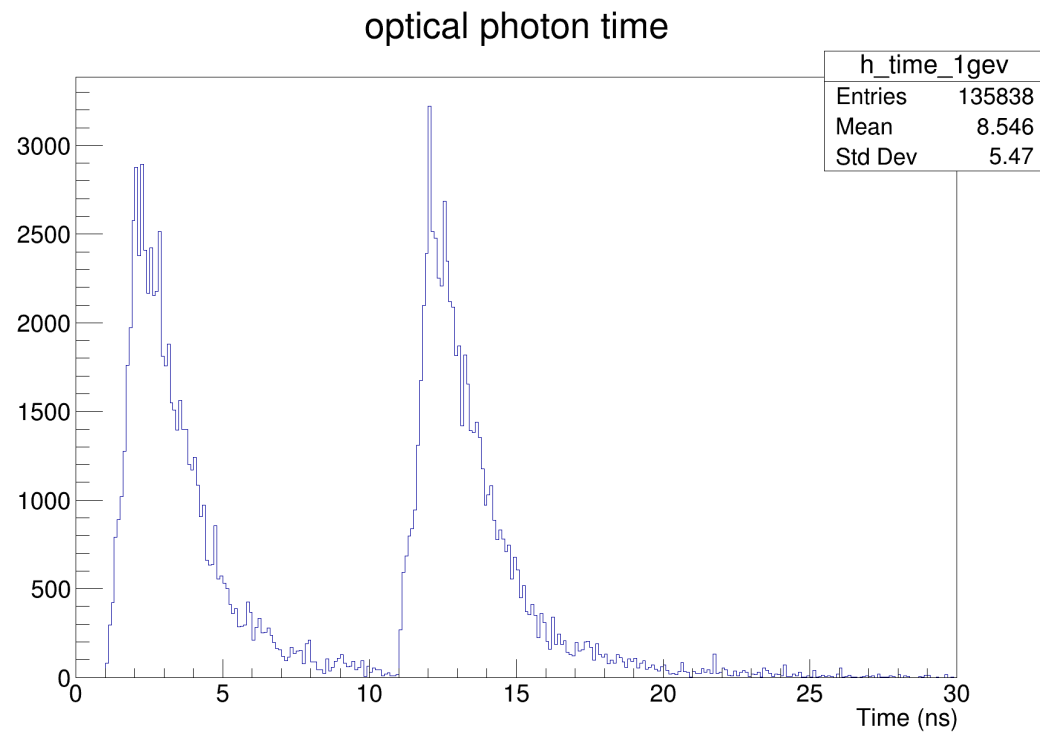


Fig.1: 1 GeV incident gamma

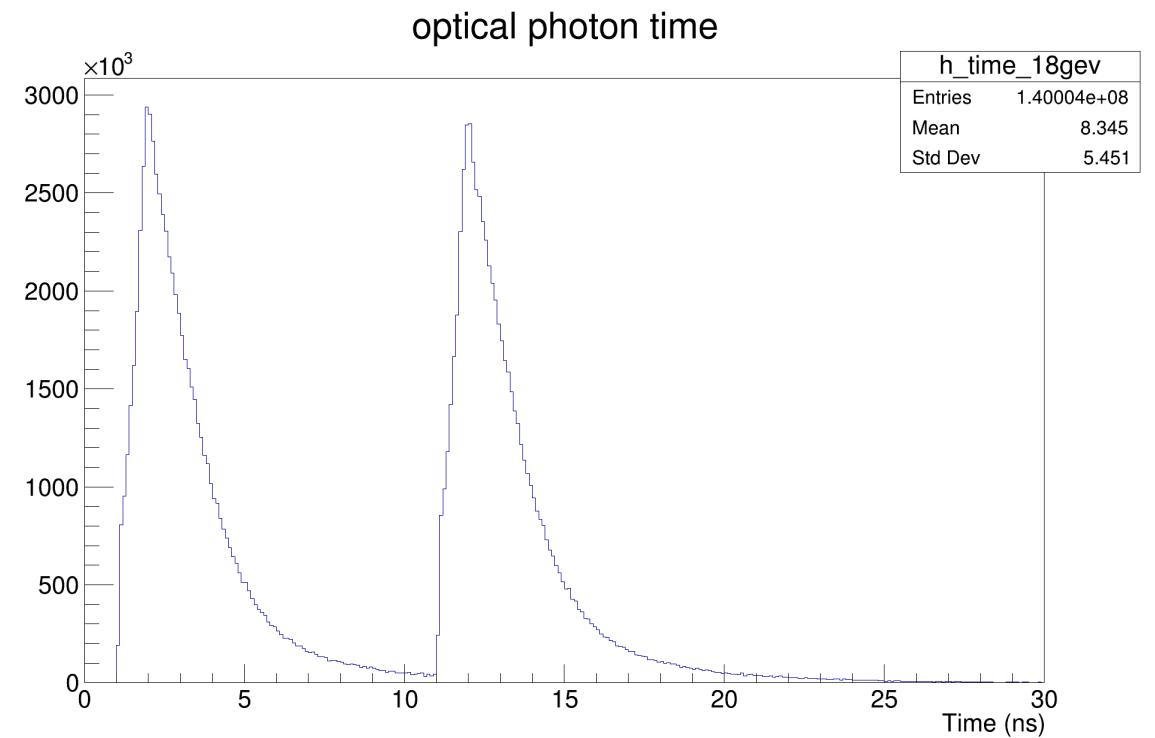


Fig.2: 18 GeV incident gamma

Light collection time

Checks on different energies in an event

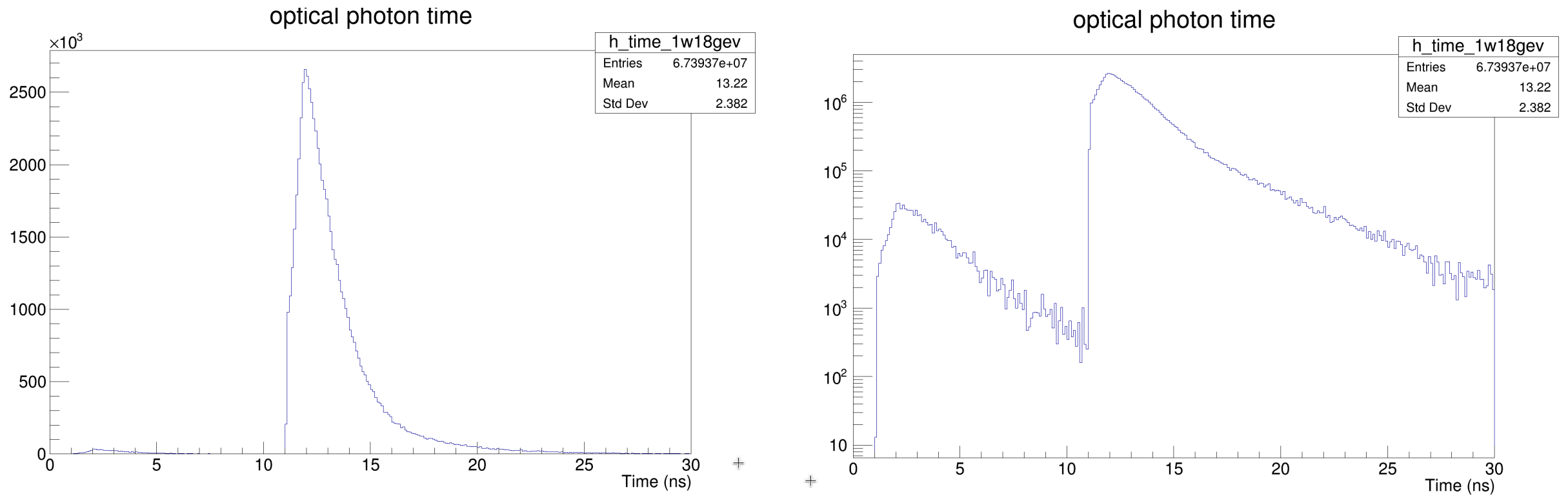


Fig 3: 1 GeV with 18 GeV incident gamma (log-scale right side)

Light collection time

Checks on different energies in an event

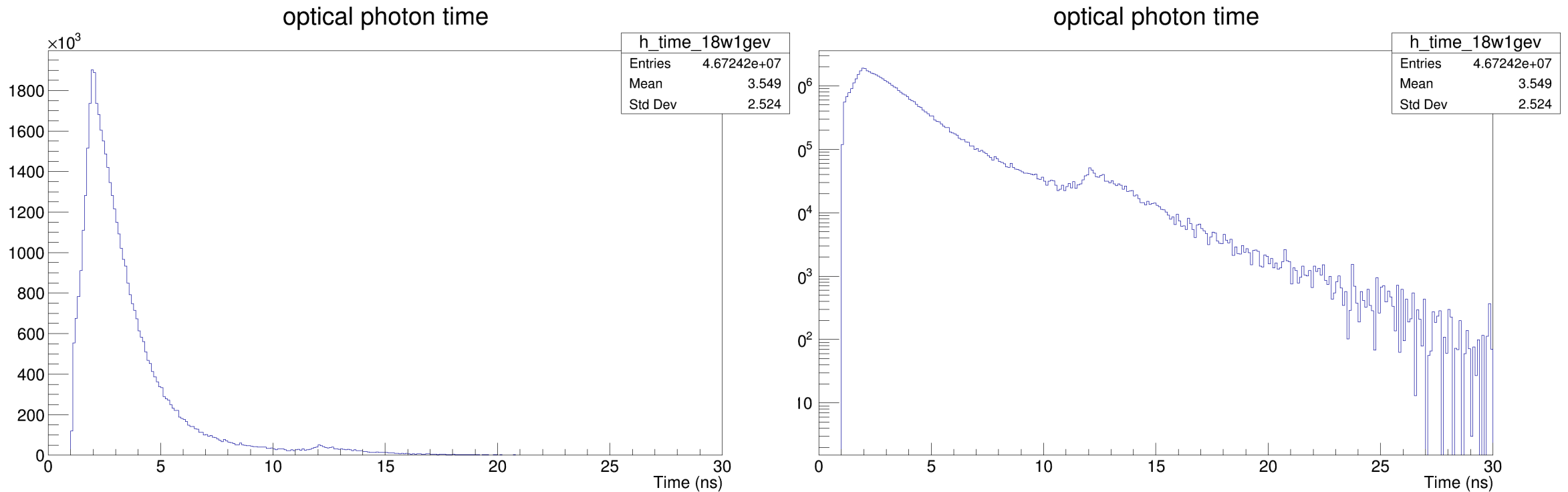


Fig 4: 18 GeV with 1 GeV incident gamma (log-scale right side)

References:

1. Korzhik et al, Ultrafast PWO scintillator for future high energy physics instrumentation
2. ALICE instrumentation, ALICE ZDC prototype with PWO calorimeter

Thank you