

Liquid Argon optical properties to be used in Geant4 and Opticks Simulations

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Abstract. In Geant4 and Opticks optical properties like e.g. the materials refractive index are inputs that have to be provided. In this paper we collect the optical properties relevant for liquid Argon TPC's.

1. Introduction

In Geant4 and Opticks optical properties like e.g. the materials refractive index are inputs that have to be provided. In this article we briefly describe the physical processes relevant to the production, transport and detection of optical photons in liquid Argon. We collect the values and parameterizations of optical properties relevant for liquid Argon TPC's. We provide scripts that plot this quantities and that convert this values into a gdmf description that can be directly used in the Geant4 Detector description.

2. Scintillation Properties of liquid Argon

Light yield few 10,000's of photons per MeV (depends on E field, particle type and purity)
(SCINTILLATIONYIELD: 50000/MeV when no electric field present)

Property	value
SCINTILLATIONYIELD	50000 photons/MeV (when no electric field present)
Wavelength of emission	128nm (FWHM= 10nm)
fast component (SCINTILLATIONTIMECONSTANT1) (SCINTILLATIONYIELD1)	6 ns 0.75
slow component (SCINTILLATIONTIMECONSTANT2) (SCINTILLATIONYIELD2)	1500 ns 0.25
(RESOLUTIONSCALE)	1

Table 1. Scintillation Properties of liquid Argon.

3. Cerenkov spectrum and Yield

4. Optical Properties of liquid Argon

4.1. Refraction Index of liquid Argon

Refraction Index: $n = 1.358 \pm 0.003$ at 128 nm (M. Babicz et al 2020 JINST 15 P09009) (compared to $n = 1.45 \pm 0.07$ (ArXiv:1502.04213)) Group velocity: $1/v_g = 7.46 \pm 0.08$ ns/m at 128 nm

4.2. Absorption length of liquid Argon

Argon is highly transparent to its own scintillation light. (ABSLENGTH) $\lambda 1.1$ m (ArXiv:1511.07725)

4.3. Rayleigh Scattering length of liquid Argon

Rayleigh scattering length (RAYLEIGH): 90 cm (M. Babicz et al 2020 JINST 15 P09009) 55 ± 5 cm (ArXiv:1502.04213)

4.4. quantum efficiency and absorption length of tetraphenyl butadiene thin films [7]

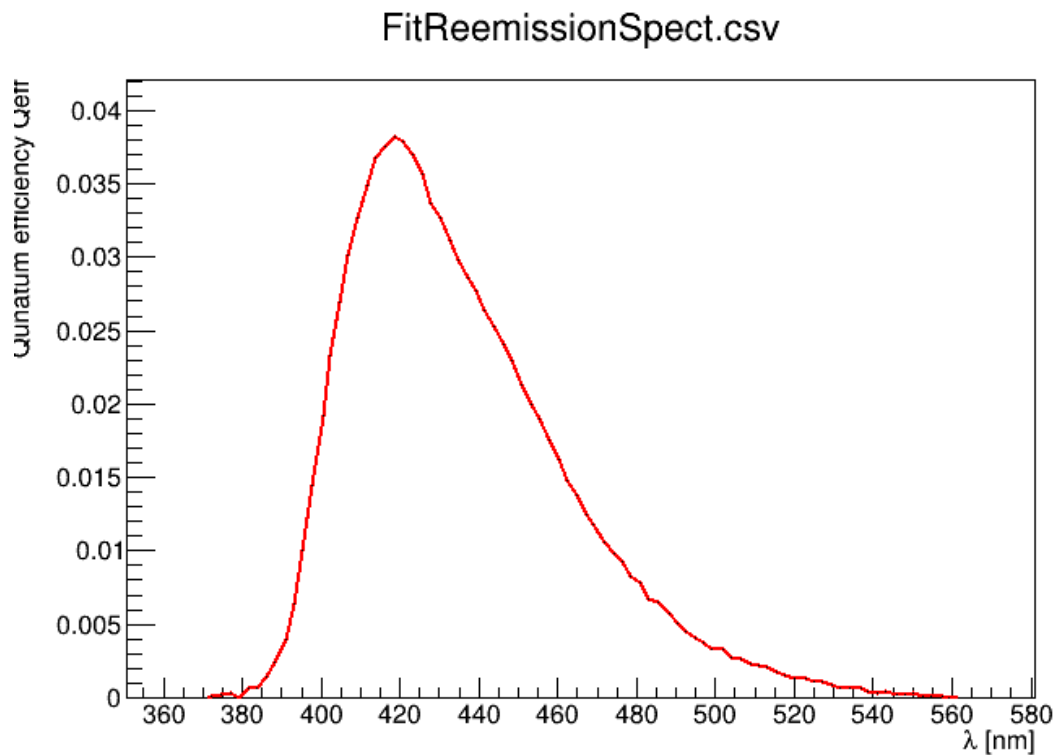


Figure 1. wave length spectrum.

5. Conclusions and Outlook

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