

OV Optical Simulation Validation Studies

Update: 25th March 2024

Re-simulated 5000, 10 MeV e⁻ in OV, with updated PDU placing.

Configurations:

- 1) PEN + Reflector* on SS vessel, on cryostat floor and walls (not ceiling) i.e. PENonGAr = 0
- 2) PEN + Reflector* on SS vessel, on cryostat floor and walls AND ceiling i.e. PENonGAr = 1
- 3) PEN + Lumirror on SS vessel, NO PEN or reflector on cryostat (EPSS) with UV reflectance 0%, 10%, and 20%.

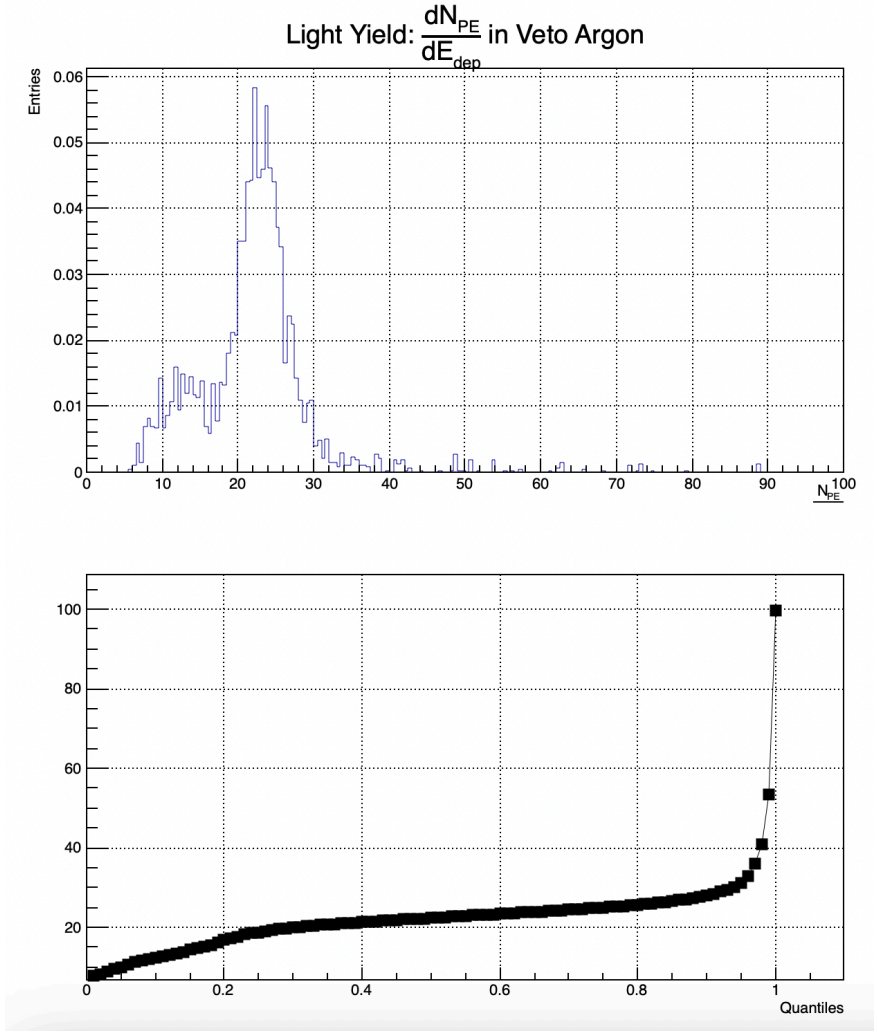
*Reflectors considered are: Lumirror; Tyvek; ESR.

LArVisAbs = 1km, LArUVAbs = 20m.

For cases where we have TPB on PDU, assume a 5 mm block of acrylic in front of PDU.

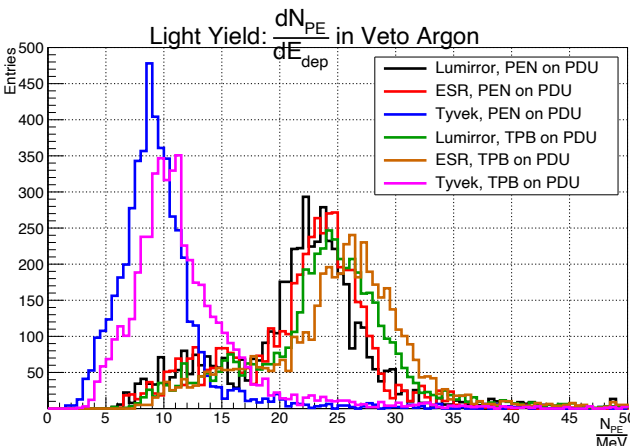
Calculated two different measures of LY:

- 1) Mean LY ± Standard Deviation (SD can be affected by statistics)
- 2) Median LY ± 1σ quantiles (Can get asymmetric error bars).



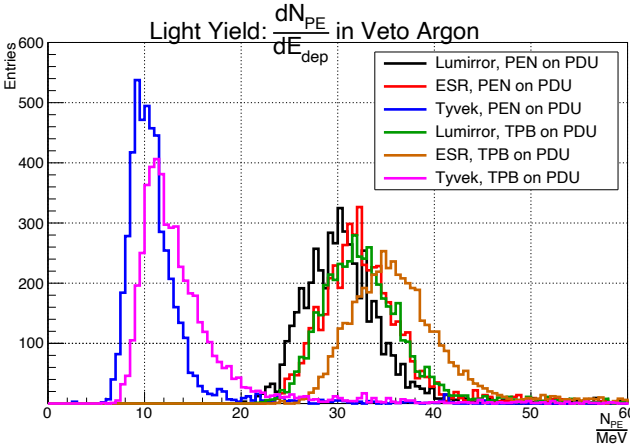
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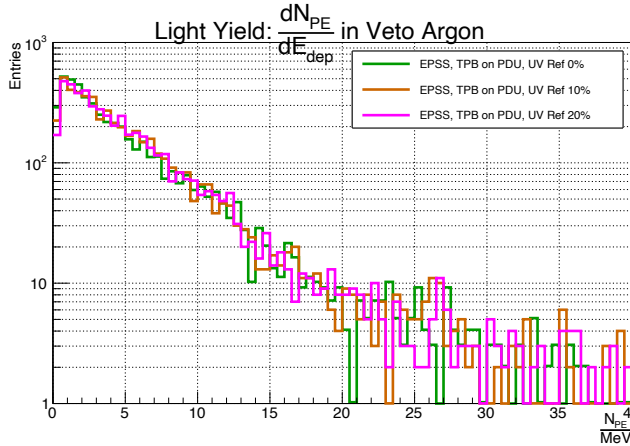
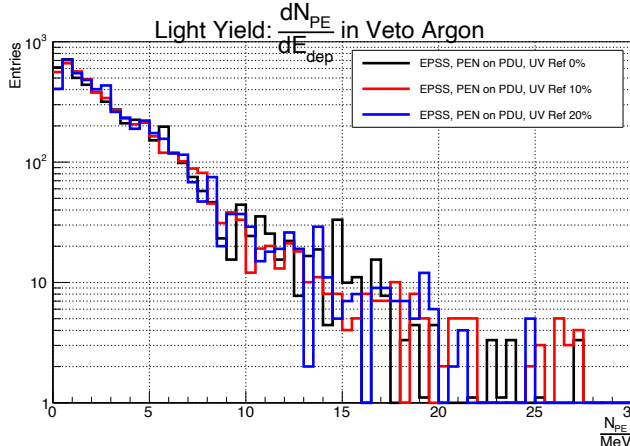


TL: PEN + reflector on SS, cryostat walls and floor but not ceiling.

BL: PEN + reflector on SS, cryostat walls and floor AND on ceiling.



TR [BR]: PEN + Lumirror on SS, NO PEN or reflector on cryostat (EPSS) with UV reflectance 0%, 10%, 20%, considering PEN on PDU [considering TPB on PDU].



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PEN + Reflector* on SS vessel, on cryostat floor and walls (not ceiling) i.e. PENonGAR = 0

Configuration	Mean LY ± Standard Deviation	Median LY ± 1σ quantiles
Lumirror, PEN on PDU	22.0 ± 7.85	22.4 ^{+4.1} _{-7.6}
Lumirror, TPB on PDU	24.8 ± 12.1	24.2 ^{+4.65} _{-7.01}
Tyvek, PEN on PDU	9.84 ± 6.05	9.08 ^{+2.75} _{-2.53}
Tyvek, TPB on PDU	12.5 ± 9.29	10.9 ^{+4.56} _{-2.86}
ESR, PEN on PDU	22.9 ± 9.25	23.1 ^{+3.80} _{-7.68}
ESR, TPB on PDU	26.1 ± 10.8	25.7 ^{+4.70} _{-7.57}

PEN + Reflector* on SS vessel, on cryostat floor and walls AND ceiling i.e. PENonGAR = 1

Configuration	Mean LY ± Standard Deviation	Median LY ± 1σ quantiles
Lumirror, PEN on PDU	31.0 ± 6.57	30.3 ^{+3.83} _{-3.61}
Lumirror, TPB on PDU	33.9 ± 10.0	32.4 ^{+4.49} _{-3.68}
Tyvek, PEN on PDU	11.4 ± 5.66	10.5 ^{+2.62} _{-1.74}
Tyvek, TPB on PDU	14.4 ± 7.93	12.5 ^{+4.40} _{-2.31}
ESR, PEN on PDU	33.4 ± 7.52	32.2 ^{+4.24} _{-3.51}
ESR, TPB on PDU	37.7 ± 11.2	35.8 ^{+5.21} _{-4.07}

ESR gives highest LY, closely followed by Lumirror. LY drops by ~50% when using Tyvek.

TPB on PDU gives higher LY than PEN (even with 5mm of acrylic in front of PDU).

PEN + Reflector also on ceiling gives substantial increase in LY compared to without, particularly for Lumirror and ESR cases.

For the most part, median LY comes out very close to mean LY.

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PEN + Lumirror on SS vessel, NO PEN or reflector on cryostat (EPSS) with UV reflectance 0%, 10%, 20%

Configuration	Mean LY \pm Standard Deviation	Median LY \pm 1 σ quantiles
UV Ref 0% PEN on PDU	3.41 \pm 3.77	2.31 ^{+3.62} _{-1.72}
UV Ref 0% TPB on PDU	5.63 \pm 11.3	3.17 ^{+5.83} _{-2.18}
UV Ref 10%, PEN on PDU	3.58 \pm 6.18	2.30 ^{+3.66} _{-1.63}
UV Ref 10% TPB on PDU	5.52 \pm 9.59	3.55 ^{+5.26} _{-2.48}
UV Ref 20%, PEN on PDU	3.50 \pm 3.77	2.46 ^{+3.49} _{-1.68}
UV Ref 20%, TPB on PDU	5.73 \pm 8.77	3.60 ^{+5.44} _{-2.45}

Substantial reduction in LY when no PEN or reflector on cryostat.

Very little change when consider EPSS with 0%, 10%, and 20% UV reflectance.