J-PARC E05 meeting

Toshiyuki Gogami

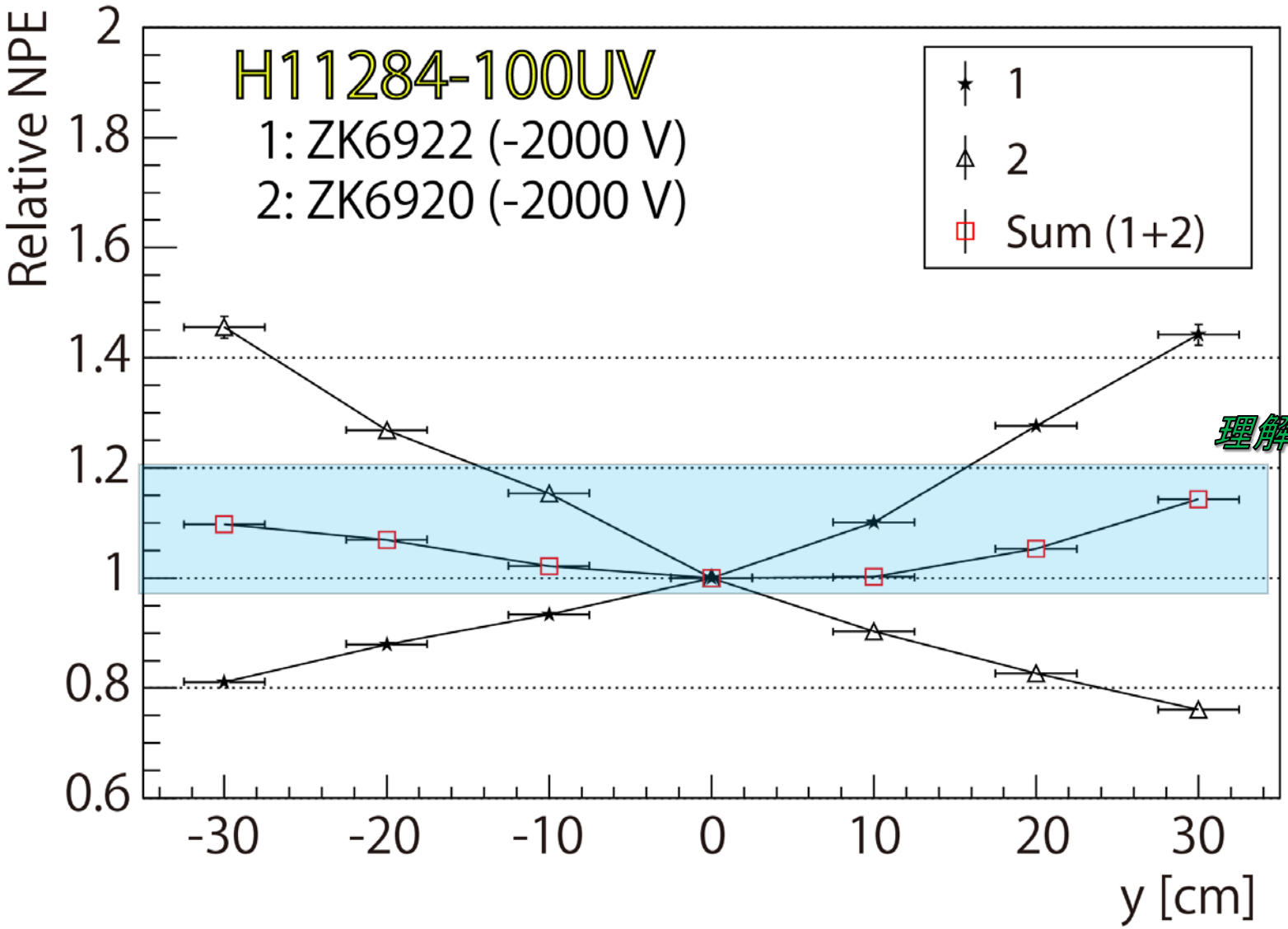
2015/7/3

NPE results of new prototype WC

PMT	Photocathode + Window	NPE
H11284-100UV	SBA + UVT	116 ± 6
H6522	BA + UVT	$78 \pm 0.3(stat.) \pm 4$
H1949-50	BA + BSG	$69 \pm 0.3(stat.) \pm 4$
H7195	BA + BSG	$84 \pm 0.3(stat.) \pm 5$
H7195UV	BA + UVT	$74 \pm 0.3(stat.) \pm 4$

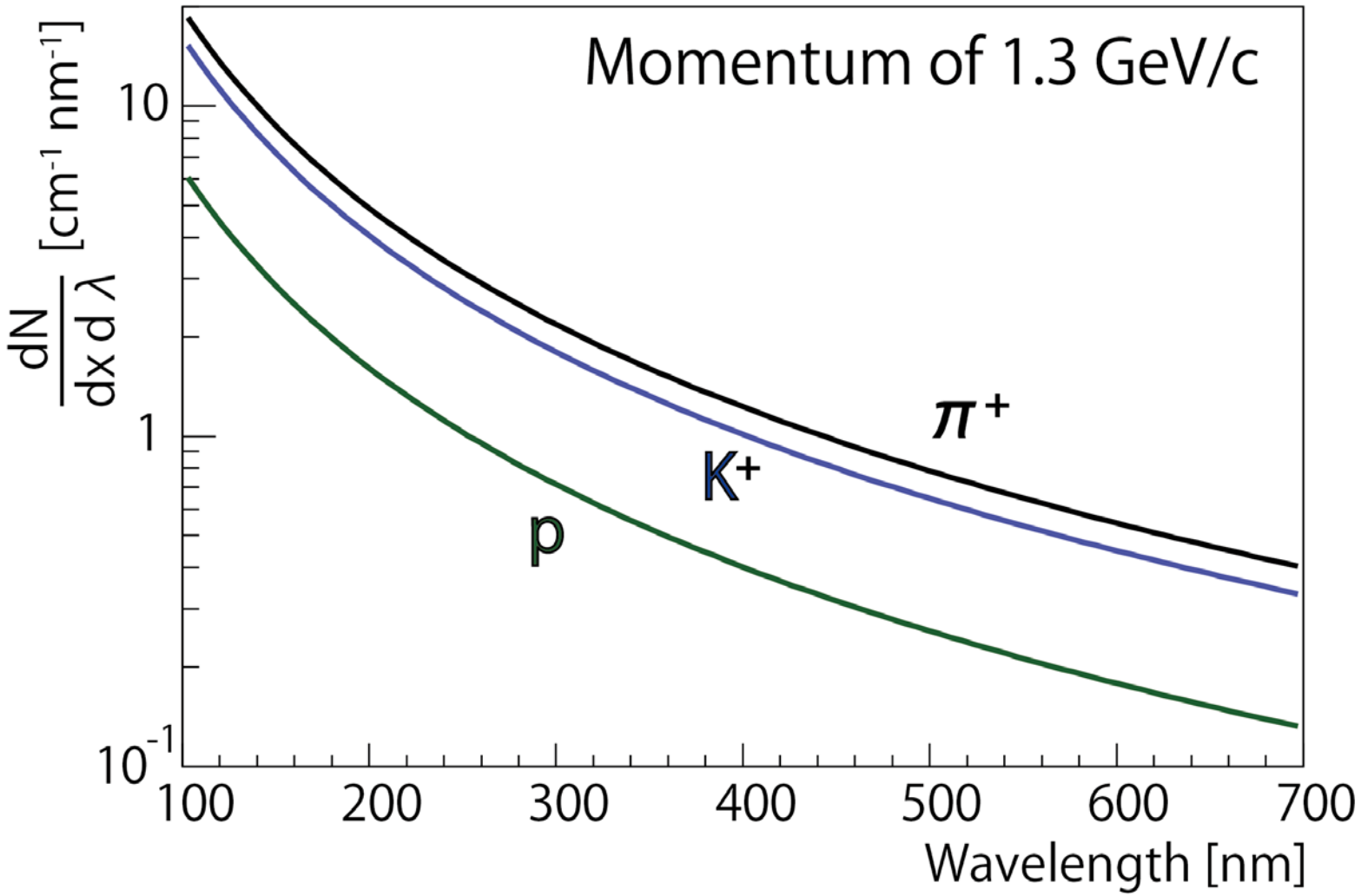
理解したい

A y-dependence of NPE



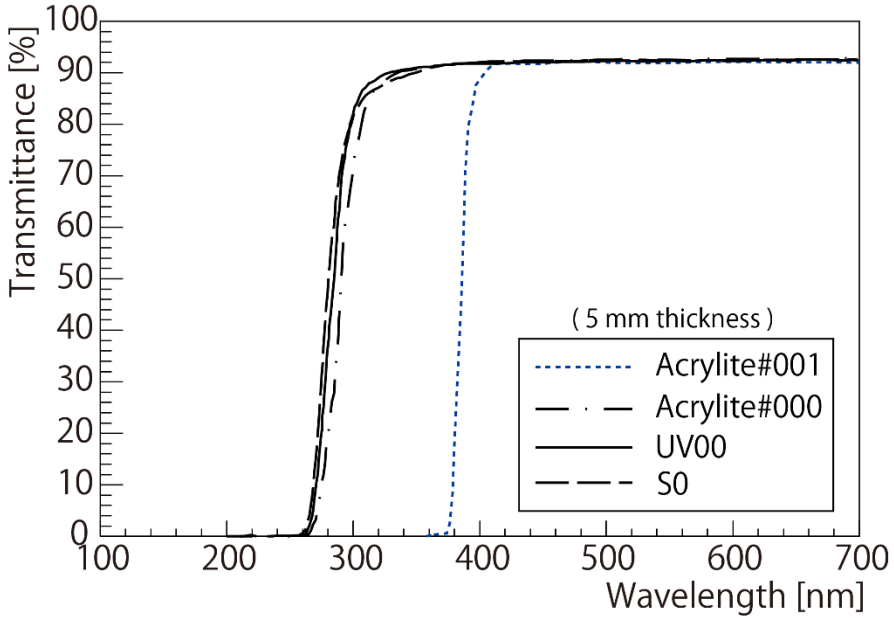
理解したい

Number of Cherenkov photons

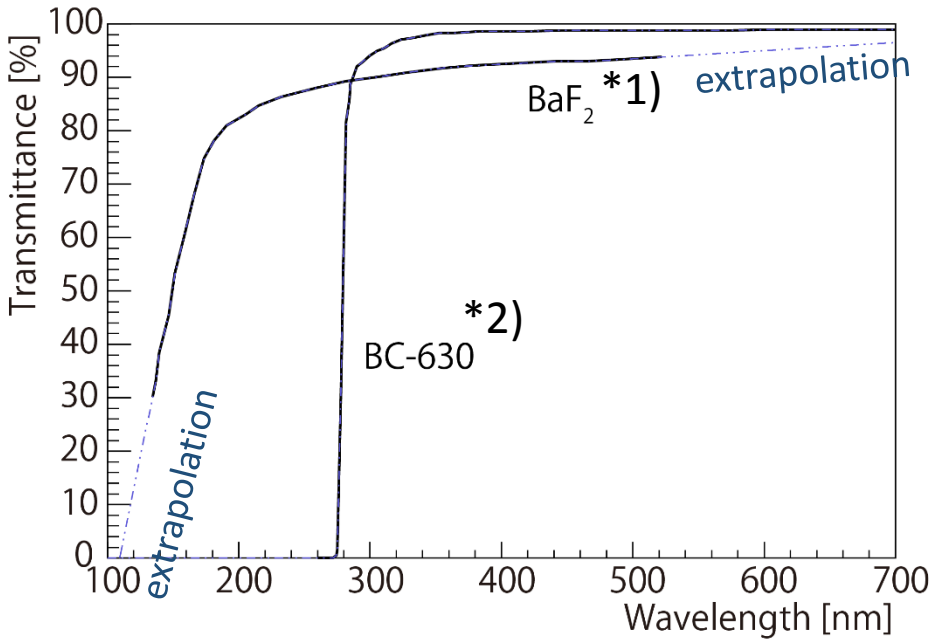


Ref. → PDG

Transmittance (1)

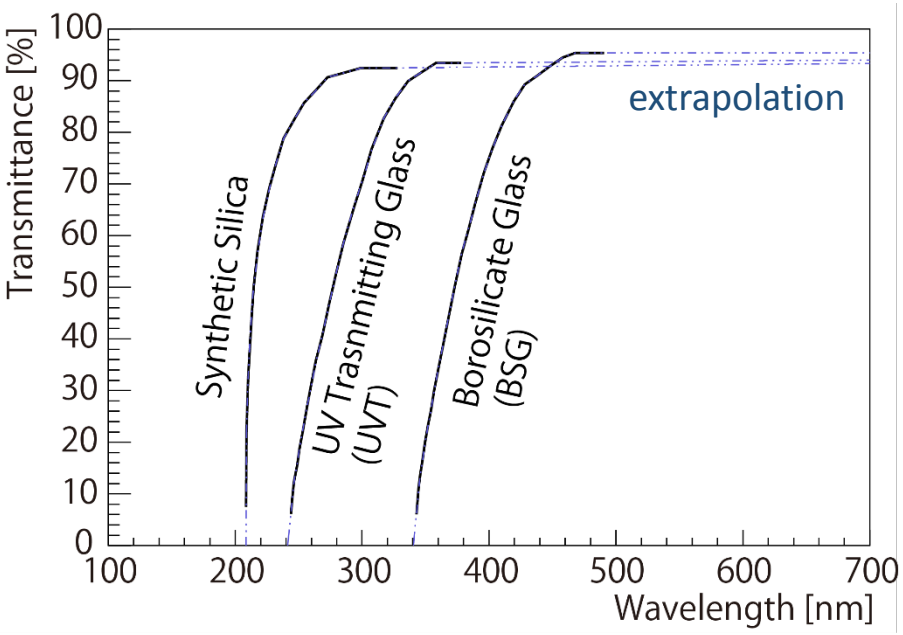


Measured at Kyoto Univ.

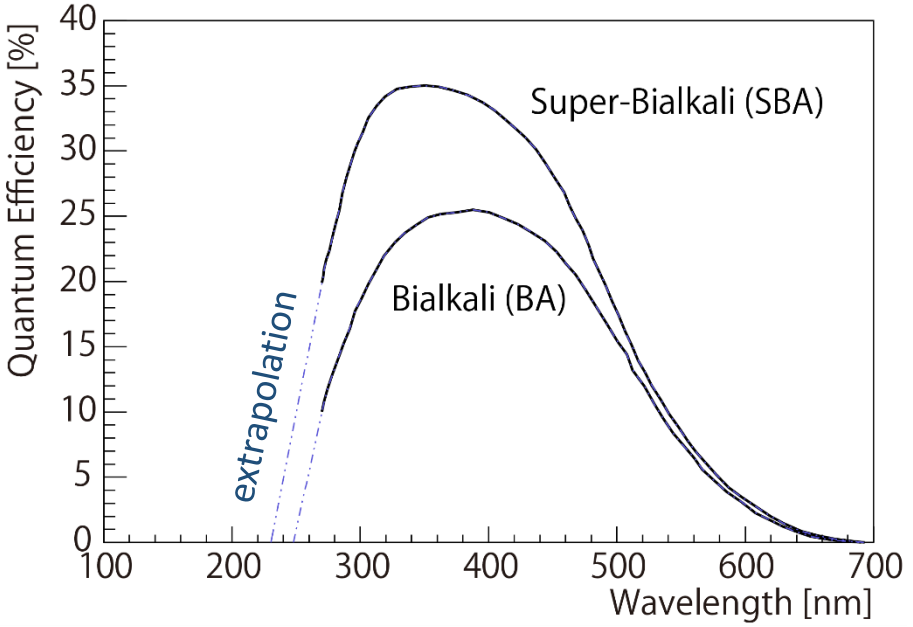


*1) http://www.oken.co.jp/web_oken/Baf2_jp.htm
*2) G.Finocchiaro et al., Proceedings of Technology and Instrumentation in Particle Physics 2014 (2014)

Transmittance (2) + QE of PMT

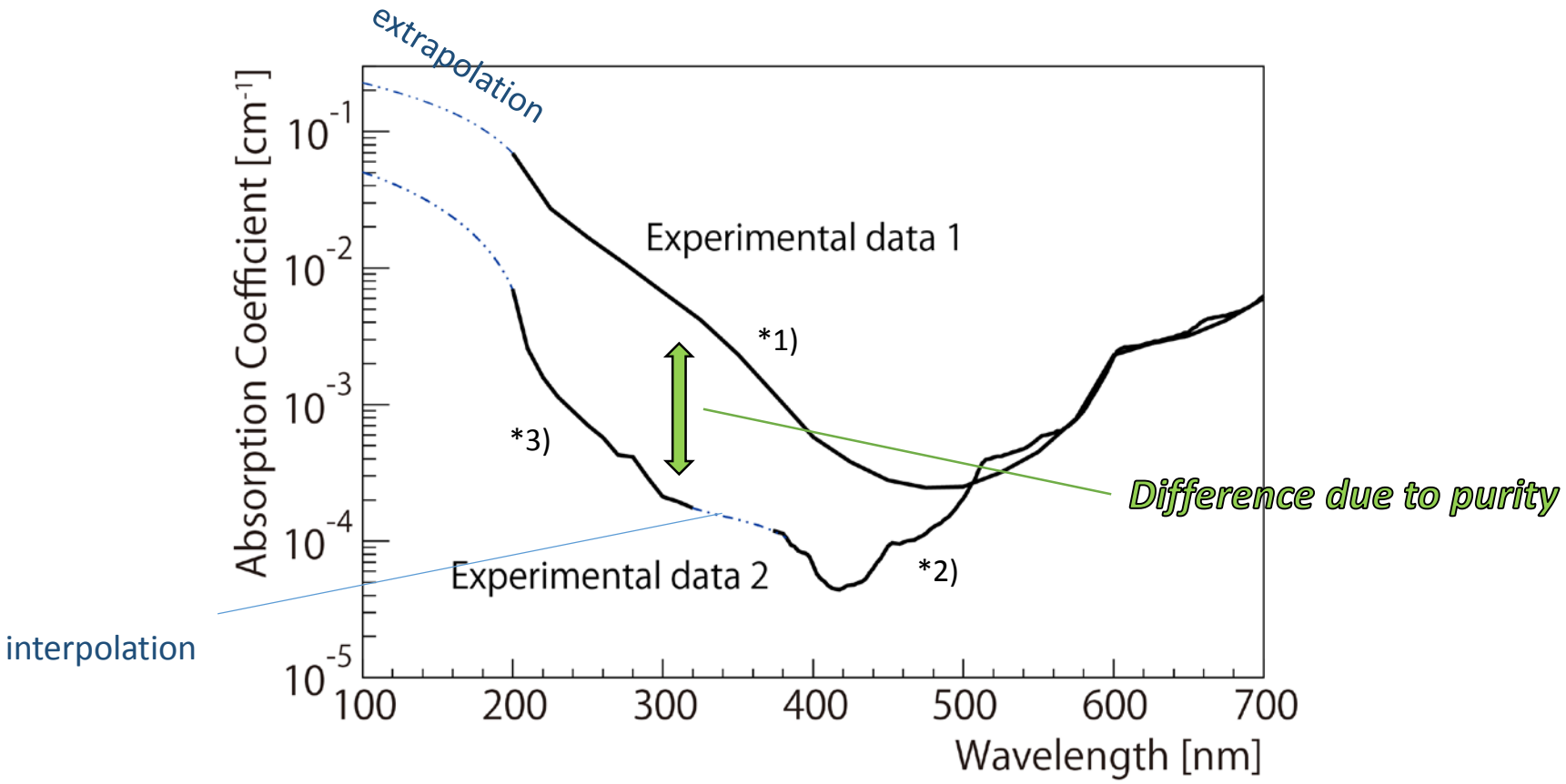


http://www.hamamatsu.com/resources/pdf/etd/PMT_handbook_v3aJ.pdf



http://www.hamamatsu.com/jp/ja/technology/innovation/photocathode/index.html

Absorption spectrum of water



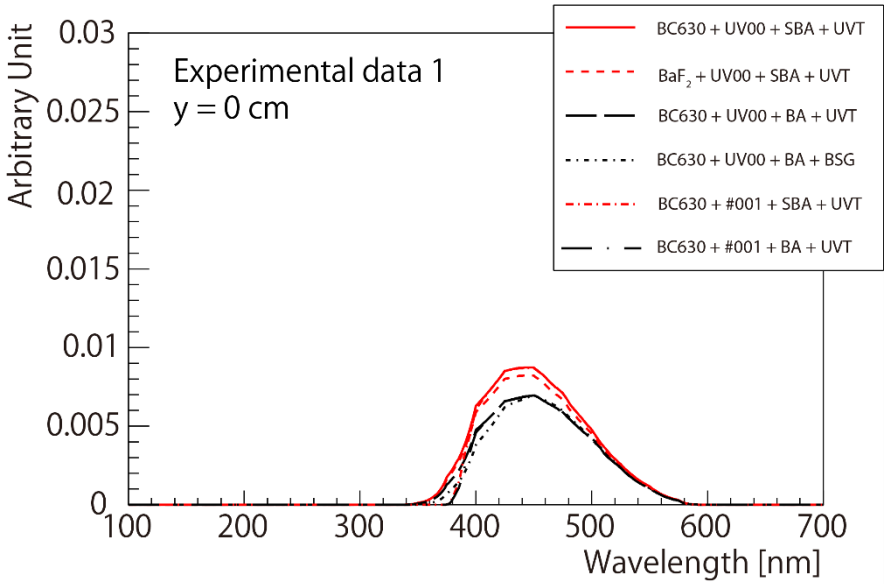
*1) G. M. Hale and M. R. Querry, Appl. Opt., 12, 555-563 (1973).

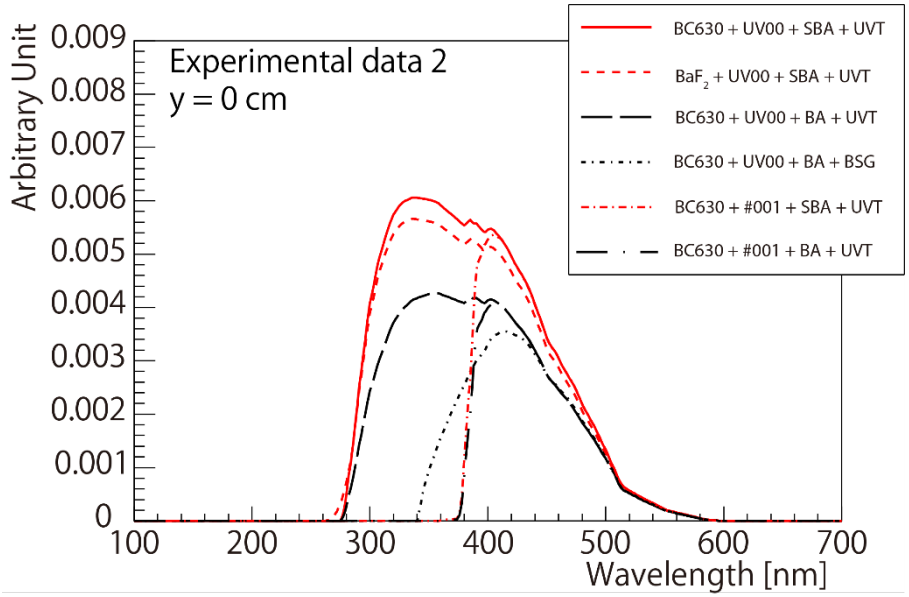
*2) R. M. Pope and E. S. Fry, Appl. Opt., 36, 8710-8723 (1997).

*3) T. I. Quickenden and J. A. Irvin, J. Chem. Phys., 72, 4416-4428 (1980).

Light intensity which relates to NPE as a function of the wavelength

Water absorption, transmittances of acrylic window and PMT window, and PMT Quantum efficiency were taken into account.
The reflectance of a Tyvek sheet was not considered here.



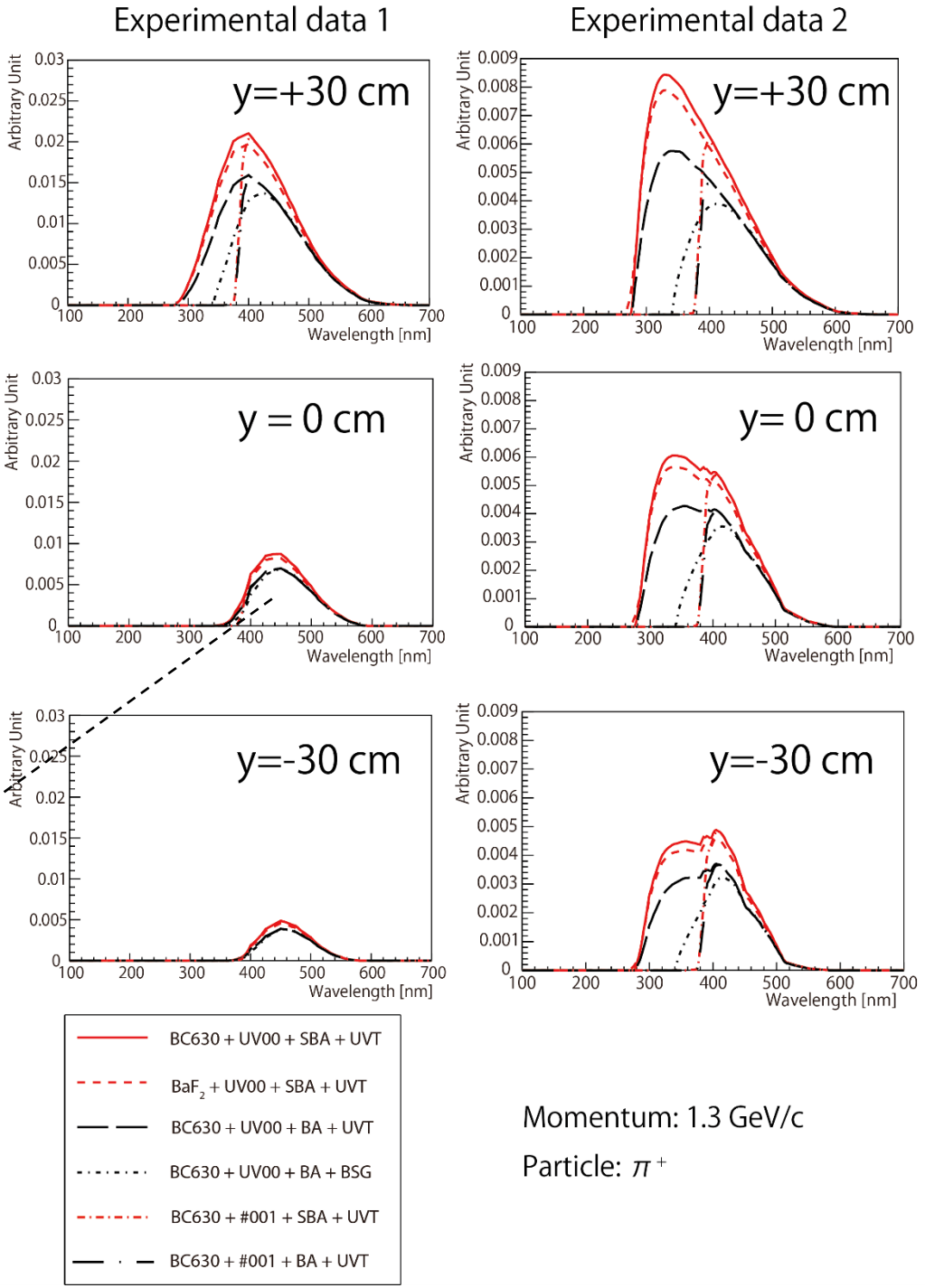


Assumption:

- ✓ Particle: 1.3 GeV/c π^+
- ✓ Cherenkov light path length: $35 \,/\, \cos\theta_C$ [cm] at y=0 cm.

y-dependence

Not only NPE itself but also the y-dependence changed depending on a configuration and water absorption spectrum (purity of water).



Compare these integrals with
a variety of configurations → Next page !

Momentum: 1.3 GeV/c

Particle: π^+

Relative NPE for a variety of configurations

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
① BC-630+UV00 +SBA+UVT	1	3.27	1.91	1.34	1.00	0.77	0.60	0.47
	[Sum]	[1.87]	[1.25]	[1.06]	[1.00]			
	2	1.35	1.21	1.10	1.00	0.91	0.84	0.77
	[Sum]	[1.06]	[1.02]	[1.01]	[1.00]			
② BaF_2+UV00 +SBA+UVT	1	3.07	1.79	1.26	0.95	0.73	0.57	0.45
		(3.23)	(1.88)	(1.33)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.05]	[1.00]			
	2	1.28	1.15	1.04	0.94	0.86	0.79	0.72
		(1.36)	(1.22)	(1.11)	(1.00)	(0.91)	(0.84)	(0.77)
	[Sum]	[1.07]	[1.03]	[1.01]	[1.00]			
③ BaF_2+S0 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.28	1.15	1.04	0.95	0.86	0.79	0.72
		(1.35)	(1.21)	(1.09)	(1.00)	(0.91)	(0.83)	(0.76)
	[Sum]	[1.06]	[1.02]	[1.00]	[1.00]			
④ BaF_2+#000 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
		[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.24	1.12	1.02	0.93	0.85	0.78	0.71
		(1.33)	(1.20)	(1.10)	(1.00)	(0.91)	(0.84)	(0.76)
	[Sum]	[1.05]	[1.02]	[1.01]	[1.00]			

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
⑤ BC-630+UV00 +BA+UVT	1	2.52	1.52	1.08	0.81	0.63	0.49	0.39
		(3.11)	(1.88)	(1.33)	(1.00)	(0.78)	(0.60)	(0.48)
	[Sum]	[1.94]	[1.24]	[1.06]	[1.00]			
	2	0.98	0.89	0.80	0.73	0.67	0.61	0.56
		(1.34)	(1.22)	(1.10)	(1.00)	(0.92)	(0.84)	(0.77)
	[Sum]	[1.06]	[1.03]	[1.01]	[1.00]			
⑥ BC-630+UV00 +BA+BSG	1	1.88	1.34	1.00	0.77	0.60	0.48	0.38
		(2.44)	(1.74)	(1.30)	(1.00)	(0.78)	(0.63)	(0.49)
	[Sum]	[1.46]	[1.19]	[1.04]	[1.00]			
	2	0.54	0.49	0.45	0.42	0.39	0.36	0.34
		(1.29)	(1.17)	(1.07)	(1.00)	(0.93)	(0.86)	(0.81)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑦ BC-630+#001 +SBA+UVT	1	2.17	1.62	1.24	0.96	0.75	0.59	0.47
		(2.26)	(1.69)	(1.29)	(1.00)	(0.78)	(0.61)	(0.49)
	[Sum]	[1.38]	[1.15]	[1.04]	[1.00]			
	2	0.60	0.54	0.50	0.47	0.44	0.41	0.39
		(1.28)	(1.15)	(1.06)	(1.00)	(0.94)	(0.87)	(0.83)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑧ BC-630+#001 +BA+UVT	1	1.75	1.31	1.00	0.78	0.61	0.48	0.38
		(2.24)	(1.68)	(1.28)	(1.00)	(0.78)	(0.61)	(0.48)
	[Sum]	[1.36]	[1.15]	[1.03]	[1.00]			
	2	0.48	0.44	0.40	0.37	0.35	0.32	0.30
		(1.30)	(1.19)	(1.08)	(1.00)	(0.95)	(0.86)	(0.81)
	[Sum]	[1.06]	[1.02]	[1.02]	[1.00]			

Relative NPE for a variety of configurations

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
① BC-630+UV00 +SBA+UVT	1	3.27	1.91	1.34	1.00	0.77	0.60	0.47
	[Sum]	[1.87]	[1.25]	[1.06]	[1.00]			
	2	1.35	1.21	1.10	1.00	0.91	0.84	0.77
	[Sum]	[1.06]	[1.02]	[1.01]	[1.00]			
② BaF_2+UV00 +SBA+UVT	1	3.07	1.79	1.26	0.95	0.73	0.57	0.45
		(3.23)	(1.88)	(1.33)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.05]	[1.00]			
	2	1.28	1.15	1.04				
		(1.36)	(1.22)	(1.11)				
	[Sum]	[1.07]	[1.03]	[1.01]				
③ BaF_2+S0 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.28	1.15	1.04	0.95	0.86	0.79	0.72
		(1.35)	(1.21)	(1.09)	(1.00)	(0.91)	(0.83)	(0.76)
	[Sum]	[1.06]	[1.02]	[1.00]	[1.00]			
④ BaF_2+#000 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
		[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.24	1.12	1.02	0.93	0.85	0.78	0.71
		(1.33)	(1.20)	(1.10)	(1.00)	(0.91)	(0.84)	(0.76)
	[Sum]	[1.05]	[1.02]	[1.01]	[1.00]			

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
⑤ BC-630+UV00 +BA+UVT	1	2.52	1.52	1.08	0.81	0.63	0.49	0.39
		(3.11)	(1.88)	(1.33)	(1.00)	(0.78)	(0.60)	(0.48)
	[Sum]	[1.94]	[1.24]	[1.06]	[1.00]			
	2	0.98	0.89	0.80	0.73	0.67	0.61	0.56
		(1.34)	(1.22)	(1.10)	(1.00)	(0.92)	(0.84)	(0.77)
	[Sum]	[1.06]	[1.03]	[1.01]	[1.00]			
⑥	1	1.88	1.34	1.00	0.77	0.60	0.48	0.38
								.49)
								.34
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			.81)
⑦ BC-630+#001 +SBA+UVT	1	2.17	1.62	1.24	0.96	0.75	0.59	0.47
		(2.26)	(1.69)	(1.29)	(1.00)	(0.78)	(0.61)	(0.49)
	[Sum]	[1.38]	[1.15]	[1.04]	[1.00]			
	2	0.60	0.54	0.50	0.47	0.44	0.41	0.39
		(1.28)	(1.15)	(1.06)	(1.00)	(0.94)	(0.87)	(0.83)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑧ BC-630+#001 +BA+UVT	1	1.75	1.31	1.00	0.78	0.61	0.48	0.38
		(2.24)	(1.68)	(1.28)	(1.00)	(0.78)	(0.61)	(0.48)
	[Sum]	[1.36]	[1.15]	[1.03]	[1.00]			
	2	0.48	0.44	0.40	0.37	0.35	0.32	0.30
		(1.30)	(1.19)	(1.08)	(1.00)	(0.95)	(0.86)	(0.81)
	[Sum]	[1.06]	[1.02]	[1.02]	[1.00]			

Exp.1, Exp.2それぞれのこの組み合わせで1に規格化
(Exp2の方がExp.1と比べて4倍絶対値が大きい)

Relative NPE for a variety of configurations

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
① BC-630+UV00 +SBA+UVT	1	3.27	1.91	1.34	1.00	0.77	0.60	0.47
	[Sum]	[1.87]	[1.25]	[1.06]	[1.00]			
	2	1.35	1.21	1.10	1.00	0.91		
	[Sum]	[1.06]	[1.02]	[1.01]	[1.00]			
② BaF_2+UV00 +SBA+UVT	1	3.07	1.79	1.26	0.95	0.73	0.57	0.45
		(3.23)	(1.88)	(1.33)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.05]	[1.00]			
	2	1.28	1.15	1.04	0.94	0.86	0.79	0.72
		(1.36)	(1.22)	(1.11)	(1.00)	(0.91)	(0.84)	(0.77)
	[Sum]	[1.07]	[1.03]	[1.01]	[1.00]			
③ BaF_2+S0 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.28	1.15	1.04	0.95	0.86	0.79	0.72
		(1.35)	(1.21)	(1.09)	(1.00)	(0.91)	(0.83)	(0.76)
	[Sum]	[1.06]	[1.02]	[1.00]	[1.00]			
④ BaF_2+#000 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
		[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.24	1.12	1.02	0.93	0.85	0.78	0.71
		(1.33)	(1.20)	(1.10)	(1.00)	(0.91)	(0.84)	(0.76)
	[Sum]	[1.05]	[1.02]	[1.01]	[1.00]			

①が一番良い

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
⑤ BC-630+UV00 +SBA+UVT	1	2.52	1.52	1.08	0.81	0.63	0.49	0.39
		(3.11)	(1.88)	(1.33)	(1.00)	(0.78)	(0.60)	(0.48)
	[Sum]	[1.94]	[1.24]	[1.06]	[1.00]			
	2	0.98	0.89	0.80	0.73	0.67	0.61	0.56
		(1.34)	(1.22)	(1.10)	(1.00)	(0.92)	(0.84)	(0.77)
	[Sum]	[1.06]	[1.03]	[1.01]	[1.00]			
⑥ BC-630+UV00 +BA+BSG	1	1.88	1.34	1.00	0.77	0.60	0.48	0.38
		(2.44)	(1.74)	(1.30)	(1.00)	(0.78)	(0.63)	(0.49)
	[Sum]	[1.46]	[1.19]	[1.04]	[1.00]			
	2	0.54	0.49	0.45	0.42	0.39	0.36	0.34
		(1.29)	(1.17)	(1.07)	(1.00)	(0.93)	(0.86)	(0.81)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑦ BC-630+#001 +SBA+UVT	1	2.17	1.62	1.24	0.96	0.75	0.59	0.47
		(2.26)	(1.69)	(1.29)	(1.00)	(0.78)	(0.61)	(0.49)
	[Sum]	[1.38]	[1.15]	[1.04]	[1.00]			
	2	0.60	0.54	0.50	0.47	0.44	0.41	0.39
		(1.28)	(1.15)	(1.06)	(1.00)	(0.94)	(0.87)	(0.83)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑧ BC-630+#001 +BA+UVT	1	1.75	1.31	1.00	0.78	0.61	0.48	0.38
		(2.24)	(1.68)	(1.28)	(1.00)	(0.78)	(0.61)	(0.48)
	[Sum]	[1.36]	[1.15]	[1.03]	[1.00]			
	2	0.48	0.44	0.40	0.37	0.35	0.32	0.30
		(1.30)	(1.19)	(1.08)	(1.00)	(0.95)	(0.86)	(0.81)
	[Sum]	[1.06]	[1.02]	[1.02]	[1.00]			

Relative NPE for a variety of configurations

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
① BC-630+UV00 +SBA+UVT	1	3.27	1.91	1.34	1.00	0.77	0.60	0.47
	[Sum]	[1.87]	[1.25]	[1.06]	[1.00]			
	2	1.35	1.21	1.10	1.00	0.91	0.84	0.77
	[Sum]	[1.06]	[1.02]	[1.01]	[1.00]			
② BaF_2+UV00 +SBA+UVT	1	3.07	1.79	1.26	0.95	0.73	0.57	0.45
		(3.23)	(1.88)	(1.33)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.05]	[1.00]			
	2	1.28	1.15	1.04	0.94	0.86	0.79	0.72
		(1.36)	(1.22)	(1.11)	(1.00)	(0.91)	(0.84)	(0.77)
	[Sum]	[1.07]	[1.03]	[1.01]	[1.00]			
③ BaF_2+S0 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.28	1.15	1.04				
		(1.35)	(1.21)	(1.09)				
	[Sum]	[1.06]	[1.02]	[1.00]				
④ BaF_2+#000 +SBA+UVT	1	3.07	1.80	1.27				
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.24	1.12	1.02	0.93	0.85	0.78	0.71
		(1.33)	(1.20)	(1.10)	(1.00)	(0.91)	(0.84)	(0.76)
	[Sum]	[1.05]	[1.02]	[1.01]	[1.00]			

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
⑤ BC-630+UV00 +BA+UVT	1	2.52	1.52	1.08	0.81	0.63	0.49	0.39
		(3.11)	(1.88)	(1.33)	(1.00)	(0.78)	(0.60)	(0.48)
	[Sum]	[1.94]	[1.24]	[1.06]	[1.00]			
	2	0.98	0.89	0.80	0.73	0.67	0.61	0.56
		(1.34)	(1.22)	(1.10)	(1.00)	(0.92)	(0.84)	(0.77)
	[Sum]	[1.06]	[1.03]	[1.01]	[1.00]			
⑥ BC-630+UV00 +BA+BSG	1	1.88	1.34	1.00	0.77	0.60	0.48	0.38
		(2.44)	(1.74)	(1.30)	(1.00)	(0.78)	(0.63)	(0.49)
	[Sum]	[1.46]	[1.19]	[1.04]	[1.00]			
	2	0.54	0.49	0.45	0.42	0.39	0.36	0.34
		(1.29)	(1.17)	(1.07)	(1.00)	(0.93)	(0.86)	(0.81)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑦ BC-630+#001 +SBA+UVT	1	2.17	1.62	1.24	0.96	0.75	0.59	0.47
		(2.26)	(1.69)	(1.29)	(1.00)	(0.78)	(0.61)	(0.49)
	[Sum]	[1.38]	[1.15]	[1.04]	[1.00]			
	2		0.54	0.50	0.47	0.44	0.41	0.39
			1.15)	(1.06)	(1.00)	(0.94)	(0.87)	(0.83)
	[Sum]		1.01]	[1.00]	[1.00]			
⑧ BC-630+#001 +BA+UVT	1	1.75	1.31	1.00	0.78	0.61	0.48	0.38
		(2.24)	(1.68)	(1.28)	(1.00)	(0.78)	(0.61)	(0.48)
	[Sum]	[1.36]	[1.15]	[1.03]	[1.00]			
	2	0.48	0.44	0.40	0.37	0.35	0.32	0.30
		(1.30)	(1.19)	(1.08)	(1.00)	(0.95)	(0.86)	(0.81)
	[Sum]	[1.06]	[1.02]	[1.02]	[1.00]			

y=0が1になるように規格化
→方読みの場合のy依存性をみる

Relative NPE for a variety of configurations

y-依存性:
Exp.2の方の実験値を使うと今回の測定とほどほどに合う

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
① BC-630+UV00 +SBA+UVT	1	3.27	1.91	1.34	1.00	0.77	0.60	0.47
	[Sum]	[1.87]	[1.25]	[1.06]	[1.00]			
	2	1.35	1.21	1.10	1.00	0.91	0.84	0.77
	[Sum]	[1.06]	[1.02]	[1.01]	[1.00]			
② BaF_2+UV00 +SBA+UVT	1	3.07	1.79	1.26	0.95	0.73	0.57	0.45
		(3.23)	(1.88)	(1.33)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.05]	[1.00]			
	2	1.28	1.15	1.04	0.94	0.86	0.79	0.72
		(1.36)	(1.22)	(1.11)	(1.00)	(0.91)	(0.84)	(0.77)
	[Sum]	[1.07]	[1.03]	[1.01]	[1.00]			
③ BaF_2+S0 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.28	1.15	1.04	0.95	0.86	0.79	0.72
		(1.35)	(1.21)	(1.09)	(1.00)	(0.91)	(0.83)	(0.76)
	[Sum]	[1.06]	[1.02]	[1.00]	[1.00]			
④ BaF_2+#000 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
		[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.24	1.12	1.02	0.93	0.85	0.78	0.71
		(1.33)	(1.20)	(1.10)	(1.00)	(0.91)	(0.84)	(0.76)
	[Sum]	[1.05]	[1.02]	[1.01]	[1.00]			

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
⑤ BC-630+UV00 +BA+UVT	1	2.52	1.52	1.08	0.81	0.63	0.49	0.39
		(3.11)	(1.88)	(1.33)	(1.00)	(0.78)	(0.60)	(0.48)
	[Sum]	[1.94]	[1.24]	[1.06]	[1.00]			
	2	0.98	0.89	0.80	0.73	0.67	0.61	0.56
		(1.34)	(1.22)	(1.10)	(1.00)	(0.92)	(0.84)	(0.77)
	[Sum]	[1.06]	[1.03]	[1.01]	[1.00]			
⑥ BC-630+UV00 +BA+BSG	1	1.88	1.34	1.00	0.77	0.60	0.48	0.38
		(2.44)	(1.74)	(1.30)	(1.00)	(0.78)	(0.63)	(0.49)
	[Sum]	[1.46]	[1.19]	[1.04]	[1.00]			
	2	0.54	0.49	0.45	0.42	0.39	0.36	0.34
		(1.29)	(1.17)	(1.07)	(1.00)	(0.93)	(0.86)	(0.81)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑦ BC-630+#001 +SBA+UVT	1	2.17	1.62	1.24	0.96	0.75	0.59	0.47
		(2.26)	(1.69)	(1.29)	(1.00)	(0.78)	(0.61)	(0.49)
	[Sum]	[1.38]	[1.15]	[1.04]	[1.00]			
	2	0.60	0.54	0.50	0.47	0.44	0.41	0.39
		(1.28)	(1.15)	(1.06)	(1.00)	(0.94)	(0.87)	(0.83)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑧ BC-630+#001 +BA+UVT	1	1.75	1.31	1.00	0.78	0.61	0.48	0.38
		(2.24)	(1.68)	(1.28)	(1.00)	(0.78)	(0.61)	(0.48)
	[Sum]	[1.36]	[1.15]	[1.03]	[1.00]			
	2	0.48	0.44	0.40	0.37	0.35	0.32	0.30
		(1.30)	(1.19)	(1.08)	(1.00)	(0.95)	(0.86)	(0.81)
	[Sum]	[1.06]	[1.02]	[1.02]	[1.00]			

Relative NPE for a variety of configurations

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
① BC-630+UV00 +SBA+UVT	1	3.27	1.91	1.34	1.00	0.77	0.60	0.47
	[Sum]	[1.87]	[1.25]	[1.06]	[1.00]			
	2	1.35	1.21	1.10	1.00	0.91	0.84	0.77
	[Sum]	[1.06]	[1.02]	[1.01]	[1.00]			
② BaF_2+UV00 +SBA+UVT	1	3.07	1.79	1.26	0.95	0.73	0.57	0.45
		(3.23)	(1.88)	(1.33)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.05]	[1.00]			
	2	1.28	1.15	1.04	0.94	0.86	0.79	0.72
		(1.36)	(1.22)	(1.11)	(1.00)	(0.91)	(0.84)	(0.77)
	[Sum]	[1.07]	[1.03]	[1.01]	[1.00]			
③ BaF_2+S0 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.28	1.15	1.04				
		(1.35)	(1.21)	(1.09)				
	[Sum]	[1.06]	[1.02]	[1.00]				
④ BaF_2+#000 +SBA+UVT	1	3.07	1.80	1.27				
		(3.23)	(1.89)	(1.34)				
	[Sum]	[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.24	1.12	1.02	0.93	0.85	0.78	0.71
		(1.33)	(1.20)	(1.10)	(1.00)	(0.91)	(0.84)	(0.76)
	[Sum]	[1.05]	[1.02]	[1.01]	[1.00]			

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
⑤ BC-630+UV00 +BA+UVT	1	2.52	1.52	1.08	0.81	0.63	0.49	0.39
		(3.11)	(1.88)	(1.33)	(1.00)	(0.78)	(0.60)	(0.48)
	[Sum]	[1.94]	[1.24]	[1.06]	[1.00]			
	2	0.98	0.89	0.80	0.73	0.67	0.61	0.56
		(1.34)	(1.22)	(1.10)	(1.00)	(0.92)	(0.84)	(0.77)
	[Sum]	[1.06]	[1.03]	[1.01]	[1.00]			
⑥ BC-630+UV00 +BA+BSG	1	1.88	1.34	1.00	0.77	0.60	0.48	0.38
		(2.44)	(1.74)	(1.30)	(1.00)	(0.78)	(0.63)	(0.49)
	[Sum]	[1.46]	[1.19]	[1.04]	[1.00]			
	2	0.54	0.49	0.45	0.42	0.39	0.36	0.34
		(1.29)	(1.17)	(1.07)	(1.00)	(0.93)	(0.86)	(0.81)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑦ BC-630+#001 +SBA+UVT	1	2.17	1.62	1.24	0.96	0.75	0.59	0.47
		(2.26)	(1.69)	(1.29)	(1.00)	(0.78)	(0.61)	(0.49)
	[Sum]	[1.38]	[1.15]	[1.04]	[1.00]			
	2				0.50	0.47	0.44	0.41	0.39
					(1.06)	(1.00)	(0.94)	(0.87)	(0.83)
	[Sum]				[1.00]	[1.00]			
	1				1.00	0.78	0.61	0.48	0.38
					(1.28)	(1.00)	(0.78)	(0.61)	(0.48)
+BA+UVT	[Sum]	[1.36]	[1.15]	[1.03]	[1.00]			
	2	0.48	0.44	0.40	0.37	0.35	0.32	0.30
		(1.30)	(1.19)	(1.08)	(1.00)	(0.95)	(0.86)	(0.81)
	[Sum]	[1.06]	[1.02]	[1.02]	[1.00]			

y=0で上下の和1になるように規格化
(PMTの性能が上下で同じと仮定)
→両読みの場合のy依存性をみる

Relative NPE for a variety of configurations

y-依存性(両読み):
Exp.2の方の実験値を使うと今回の測定とほどほどに合う

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
① BC-630+UV00 +SBA+UVT	1	3.27	1.91	1.34	1.00	0.77	0.60	0.47
	[Sum]	[1.87]	[1.25]	[1.06]	[1.00]			
	2	1.35	1.21	1.10	1.00	0.91	0.84	0.77
	[Sum]	[1.06]	[1.02]	[1.01]	[1.00]			
② BaF_2+UV00 +SBA+UVT	1	3.07	1.79	1.26	0.95	0.73	0.57	0.45
		(3.23)	(1.88)	(1.33)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.05]	[1.00]			
	2	1.28	1.15	1.04	0.94	0.86	0.79	0.72
		(1.36)	(1.22)	(1.11)	(1.00)	(0.91)	(0.84)	(0.77)
	[Sum]	[1.07]	[1.03]	[1.01]	[1.00]			
③ BaF_2+S0 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.28	1.15	1.04	0.95	0.86	0.79	0.72
		(1.35)	(1.21)	(1.09)	(1.00)	(0.91)	(0.83)	(0.76)
	[Sum]	[1.06]	[1.02]	[1.00]	[1.00]			
④ BaF_2+#000 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
		[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.24	1.12	1.02	0.93	0.85	0.78	0.71
		(1.33)	(1.20)	(1.10)	(1.00)	(0.91)	(0.84)	(0.76)
	[Sum]	[1.05]	[1.02]	[1.01]	[1.00]			

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
⑤ BC-630+UV00 +BA+UVT	1	2.52	1.52	1.08	0.81	0.63	0.49	0.39
		(3.11)	(1.88)	(1.33)	(1.00)	(0.78)	(0.60)	(0.48)
	[Sum]	[1.94]	[1.24]	[1.06]	[1.00]			
	2	0.98	0.89	0.80	0.73	0.67	0.61	0.56
		(1.34)	(1.22)	(1.10)	(1.00)	(0.92)	(0.84)	(0.77)
	[Sum]	[1.06]	[1.03]	[1.01]	[1.00]			
⑥ BC-630+UV00 +BA+BSG	1	1.88	1.34	1.00	0.77	0.60	0.48	0.38
		(2.44)	(1.74)	(1.30)	(1.00)	(0.78)	(0.63)	(0.49)
	[Sum]	[1.46]	[1.19]	[1.04]	[1.00]			
	2	0.54	0.49	0.45	0.42	0.39	0.36	0.34
		(1.29)	(1.17)	(1.07)	(1.00)	(0.93)	(0.86)	(0.81)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑦ BC-630+#001 +SBA+UVT	1	2.17	1.62	1.24	0.96	0.75	0.59	0.47
		(2.26)	(1.69)	(1.29)	(1.00)	(0.78)	(0.61)	(0.49)
	[Sum]	[1.38]	[1.15]	[1.04]	[1.00]			
	2	0.60	0.54	0.50	0.47	0.44	0.41	0.39
		(1.28)	(1.15)	(1.06)	(1.00)	(0.94)	(0.87)	(0.83)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑧ BC-630+#001 +BA+UVT	1	1.75	1.31	1.00	0.78	0.61	0.48	0.38
		(2.24)	(1.68)	(1.28)	(1.00)	(0.78)	(0.61)	(0.48)
	[Sum]	[1.36]	[1.15]	[1.03]	[1.00]			
	2	0.48	0.44	0.40	0.37	0.35	0.32	0.30
		(1.30)	(1.19)	(1.08)	(1.00)	(0.95)	(0.86)	(0.81)
	[Sum]	[1.06]	[1.02]	[1.02]	[1.00]			

Relative NPE for a variety of configurations

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
① BC-630+UV00 +SBA+UVT	1	3.27	1.91	1.34	1.00	0.77	0.60	0.47
	[Sum]	[1.87]	[1.25]	[1.06]	[1.00]			
	2	1.35	1.21	1.10	1.00	0.91	0.84	0.77
	[Sum]	[1.06]	[1.02]	[1.01]	[1.00]			
② BaF_2+UV00 +SBA+UVT	1	3.07	1.79	1.26	0.95	0.73	0.57	0.45
		(3.23)	(1.88)	(1.33)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.05]	[1.00]			
	2	1.28	1.15	1.04	0.94	0.86	0.79	0.72
		(1.36)	(1.22)	(1.11)	(1.00)	(0.91)	(0.84)	(0.77)
	[Sum]	[1.07]	[1.03]	[1.01]	[1.00]			
③ BaF_2+S0 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.28	1.15	1.04	0.95	0.86	0.79	0.72
		(1.35)	(1.21)	(1.09)	(1.00)	(0.91)	(0.83)	(0.76)
	[Sum]	[1.06]	[1.02]	[1.00]	[1.00]			
④ BaF_2+#000 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
		[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.24	1.12	1.02	0.93	0.85	0.78	0.71
		(1.33)	(1.20)	(1.10)	(1.00)	(0.91)	(0.84)	(0.76)
	[Sum]	[1.05]	[1.02]	[1.01]	[1.00]			

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
⑤ BC-630+UV00	1	2.52	1.52	1.08	0.81	0.63	0.49	0.39
		(3.11)	(1.88)	(1.33)	(1.00)	(0.78)	(0.60)	(0.48)
								6
								7)
BC-630+UV00 +BA+BSG		(2.44)	(1.74)	(1.30)	(1.00)	(0.78)	(0.63)	(0.49)
	[Sum]	[1.46]	[1.19]	[1.04]	[1.00]			
	2	0.54	0.49	0.45	0.42	0.39	0.36	0.34
		(1.29)	(1.17)	(1.07)	(1.00)	(0.93)	(0.86)	(0.81)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑦ BC-630+#001 +SBA+UVT	1	2.17	1.62	1.24	0.96	0.75	0.59	0.47
		(2.26)	(1.69)	(1.29)	(1.00)	(0.78)	(0.61)	(0.49)
	[Sum]	[1.38]	[1.15]	[1.04]	[1.00]			
	2	0.60	0.54	0.50	0.47	0.44	0.41	0.39
		(1.28)	(1.15)	(1.06)	(1.00)	(0.94)	(0.87)	(0.83)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑧ BC-630+#001 +BA+UVT	1	1.75	1.31	1.00	0.78	0.61	0.48	0.38
		(2.24)	(1.68)	(1.28)	(1.00)	(0.78)	(0.61)	(0.48)
	[Sum]	[1.36]	[1.15]	[1.03]	[1.00]			
	2	0.48	0.44	0.40	0.37	0.35	0.32	0.30
		(1.30)	(1.19)	(1.08)	(1.00)	(0.95)	(0.86)	(0.81)
	[Sum]	[1.06]	[1.02]	[1.02]	[1.00]			

UV透過窓(UV00)を使った
新箱が昔の箱(#001を使用)よりも
2倍NPEが高いというのと一致

Relative NPE for a variety of configurations

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
① BC-630+UV00 +SBA+UVT	1	3.27	1.91	1.34	1.00	0.77	0.60	0.47
	[Sum]	[1.87]	[1.25]	[1.06]	[1.00]			
	2	1.35	1.21	1.10	1.00	0.91	0.84	0.77
	[Sum]	[1.06]	[1.02]	[1.01]	[1.00]			
② BaF_2+UV00 +SBA+UVT	1	3.07	1.79	1.26	0.95	0.73	0.57	0.45
		(3.23)	(1.88)	(1.33)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.05]	[1.00]			
	2	1.28	1.15	1.04	0.94	0.86	0.79	0.72
		(1.36)	(1.22)	(1.11)	(1.00)	(0.91)	(0.84)	(0.77)
	[Sum]	[1.07]	[1.03]	[1.01]	[1.00]			
③ BaF_2+S0 +SBA+UVT	1	3.07	1.80	1.27	0.95	0.73	0.57	0.45
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
	[Sum]	[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.28	1.15					
		(1.35)	(1.21)	(				
	[Sum]	[1.06]	[1.02]	[				
④ BaF_2+#000 +SBA+UVT	1	3.07	1.80					
		(3.23)	(1.89)	(1.34)	(1.00)	(0.77)	(0.60)	(0.47)
		[1.85]	[1.24]	[1.06]	[1.00]			
	2	1.24	1.12	1.02	0.93	0.85	0.78	0.71
		(1.33)	(1.20)	(1.10)	(1.00)	(0.91)	(0.84)	(0.76)
	[Sum]	[1.05]	[1.02]	[1.01]	[1.00]			

Configuration	Water abso.	y [cm] +30	+20	+10	0	-10	-20	-30
⑤ BC-630+UV00 +BA+UVT	1	2.52	1.52	1.08	0.81	0.63	0.49	0.39
		(3.11)	(1.88)	(1.33)	(1.00)	(0.78)	(0.60)	(0.48)
	[Sum]	[1.94]	[1.24]	[1.06]	[1.00]			
	2	0.98	0.89	0.80	0.73	0.67	0.61	0.56
		(1.34)	(1.22)	(1.10)	(1.00)	(0.92)	(0.84)	(0.77)
	[Sum]	[1.06]	[1.03]	[1.01]	[1.00]			
⑥ BC-630+UV00 +BA+BSG	1	1.88	1.34	1.00	0.77	0.60	0.48	0.38
		(2.44)	(1.74)	(1.30)	(1.00)	(0.78)	(0.63)	(0.49)
	[Sum]	[1.46]	[1.19]	[1.04]	[1.00]			
	2	0.54	0.49	0.45	0.42	0.39	0.36	0.34
		(1.29)	(1.17)	(1.07)	(1.00)	(0.93)	(0.86)	(0.81)
	[Sum]	[1.05]	[1.01]	[1.00]	[1.00]			
⑦ BC-630+#001	1	2.17	1.62	1.24	0.96	0.75	0.59	0.47
		(2.26)	(1.69)	(1.29)	(1.00)	(0.78)	(0.61)	(0.49)
		[1.38]	[1.15]	[1.04]	[1.00]			
		0.60	0.54	0.50	0.47	0.44	0.41	0.39
		(1.28)	(1.15)	(1.06)	(1.00)	(0.94)	(0.87)	(0.83)
		[1.05]	[1.01]	[1.00]	[1.00]			
⑧ BC-630+#001 +BA+UVT	1	1.75	1.31	1.00	0.78	0.61	0.48	0.38
		(2.24)	(1.68)	(1.28)	(1.00)	(0.78)	(0.61)	(0.48)
	[Sum]	[1.36]	[1.15]	[1.03]	[1.00]			
	2	0.48	0.44	0.40	0.37	0.35	0.32	0.30
		(1.30)	(1.19)	(1.08)	(1.00)	(0.95)	(0.86)	(0.81)
	[Sum]	[1.06]	[1.02]	[1.02]	[1.00]			

Exp.1の方が
H7195 vs. H7195UVの違いを再現

まとめ

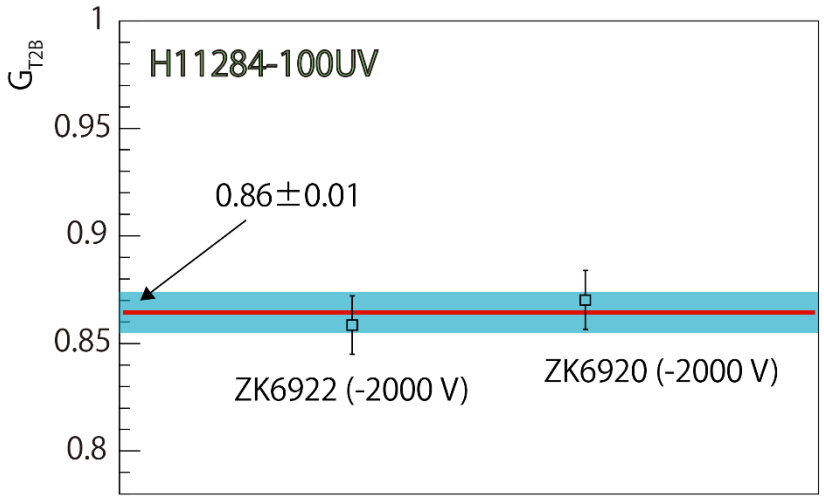
1. 水の純度とものの組み合わせによって挙動が変わる。

2. Exp.2でy依存性は理解できるが、
H7195とH7195UVのNPE違いはExp.1の方が再現しているように見える。

3. 水の純度的に(Exp.2寄りの)Exp.1とExp.2の間くらいか？

Backup

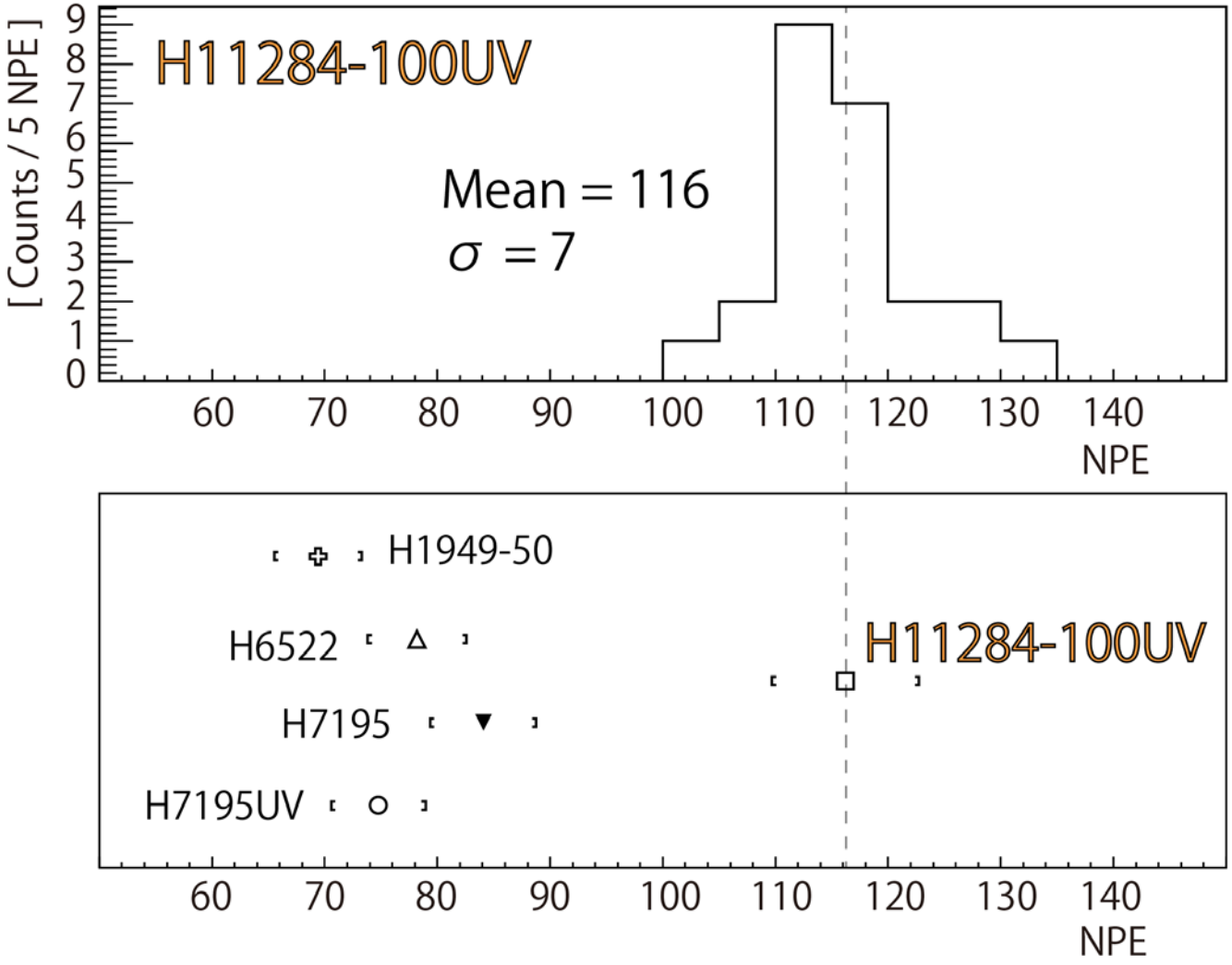
NPE results (ver. 2015/7/3)



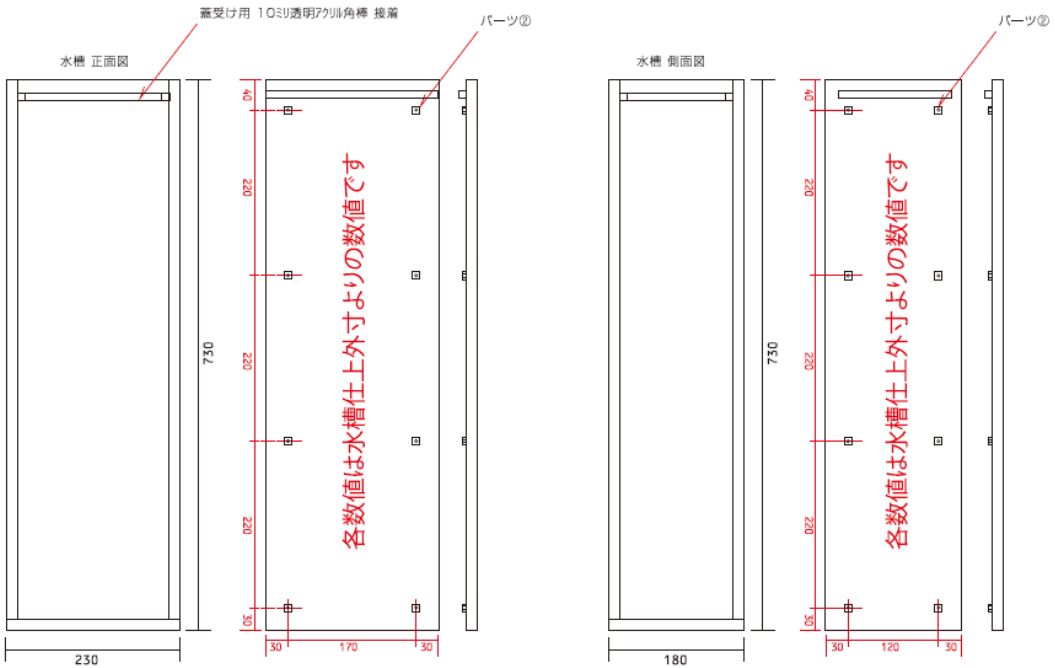
Bottom NPEs were multiplied by 1/0.86 to be compared with top ones.

Serial number	HV [V]	[ADC/NPE]	PMT position	NPE	Normalized NPE
ZK6920	-2000	19.08	BOTTOM	98.1 ± 0.3	114.1 ± 0.4
ZK6922	-2000	7.21	TOP	106.5 ± 0.3	106.5 ± 0.3
ZK6919	-2250	11.18	BOTTOM	104.8 ± 0.4	121.9 ± 0.4
ZK6925	-2250	7.04	TOP	113.0 ± 0.4	113.0 ± 0.4
ZK7295	-2000	6.31	BOTTOM	101.4 ± 1.0	117.9 ± 1.2
ZK7296	-2000	4.19	BOTTOM	102.1 ± 0.5	118.7 ± 0.5
ZK7298	-2000	9.97	BOTTOM	97.7 ± 0.7	113.6 ± 0.8
ZK7299	-2000	6.12	TOP	112.2 ± 0.6	112.2 ± 0.6
ZK7300	-2250	7.63	TOP	110.7 ± 0.6	110.7 ± 0.6
ZK7301	-2250	6.31	TOP	126.7 ± 0.4	126.7 ± 0.4
ZK7302	-2250	7.87	BOTTOM	102.5 ± 0.4	119.2 ± 0.4
ZK7303	-2250	4.20	BOTTOM	113.5 ± 0.4	131.9 ± 0.5
ZK7304	-2250	5.21	TOP	103.4 ± 0.6	103.4 ± 0.6
ZK7305	-2250	4.44	BOTTOM	109.4 ± 0.7	127.2 ± 0.8
ZK7306	-2250	3.80	TOP	117.1 ± 0.5	117.1 ± 0.5
ZK7307	-2250	13.50	TOP	124.7 ± 1.0	124.7 ± 1.0
ZK7308	-2250	11.82	TOP	115.8 ± 0.3	115.8 ± 0.3
ZK7309	-2250	7.71	BOTTOM	100.3 ± 0.7	116.7 ± 0.8
ZK7310	-2250	4.58	BOTTOM	98.7 ± 0.6	114.7 ± 0.7
ZK7311	-2000	10.88	BOTTOM	94.4 ± 0.5	109.8 ± 0.5
ZK7312	-2250	6.46	TOP	114.0 ± 0.5	114.0 ± 0.5
ZK7313	-2000	7.81	TOP	111.1 ± 0.4	111.1 ± 0.4
ZK7315	-2250	8.84	TOP	112.2 ± 0.4	112.2 ± 0.4
ZK7316	-2250	3.31	TOP	116.3 ± 0.5	116.3 ± 0.5

H11284-100UV performance comparing with others.



吉村様からの図面 → チェック

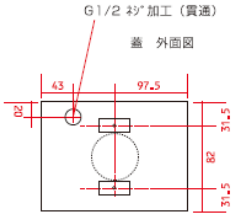


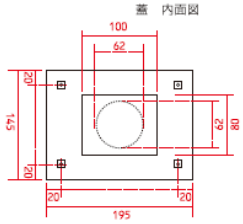
2015/02/24

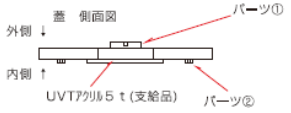
Aquarium 水槽工房

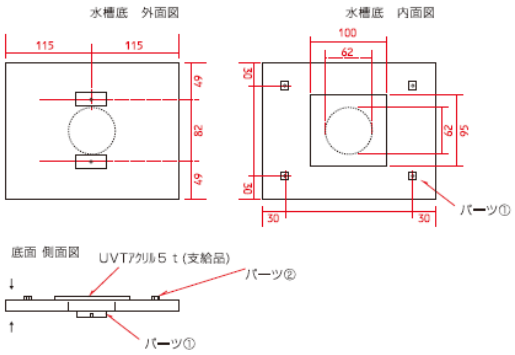
水槽本体 製作 12台

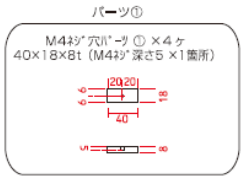
蓋　製作 12台











水槽本体
W230ミリ×D180ミリ×H730ミリ　枠15ミリ　底15ミリ
◆**全面**ホワイトキャスト板
底面窓つき（**支給ｱｸﾘﾙ板**）

水槽蓋
W195ミリ×D145ミリ　15ミリ厚
◆ホワイトキャスト板
天面窓つき（**支給ｱｸﾘﾙ板**）