

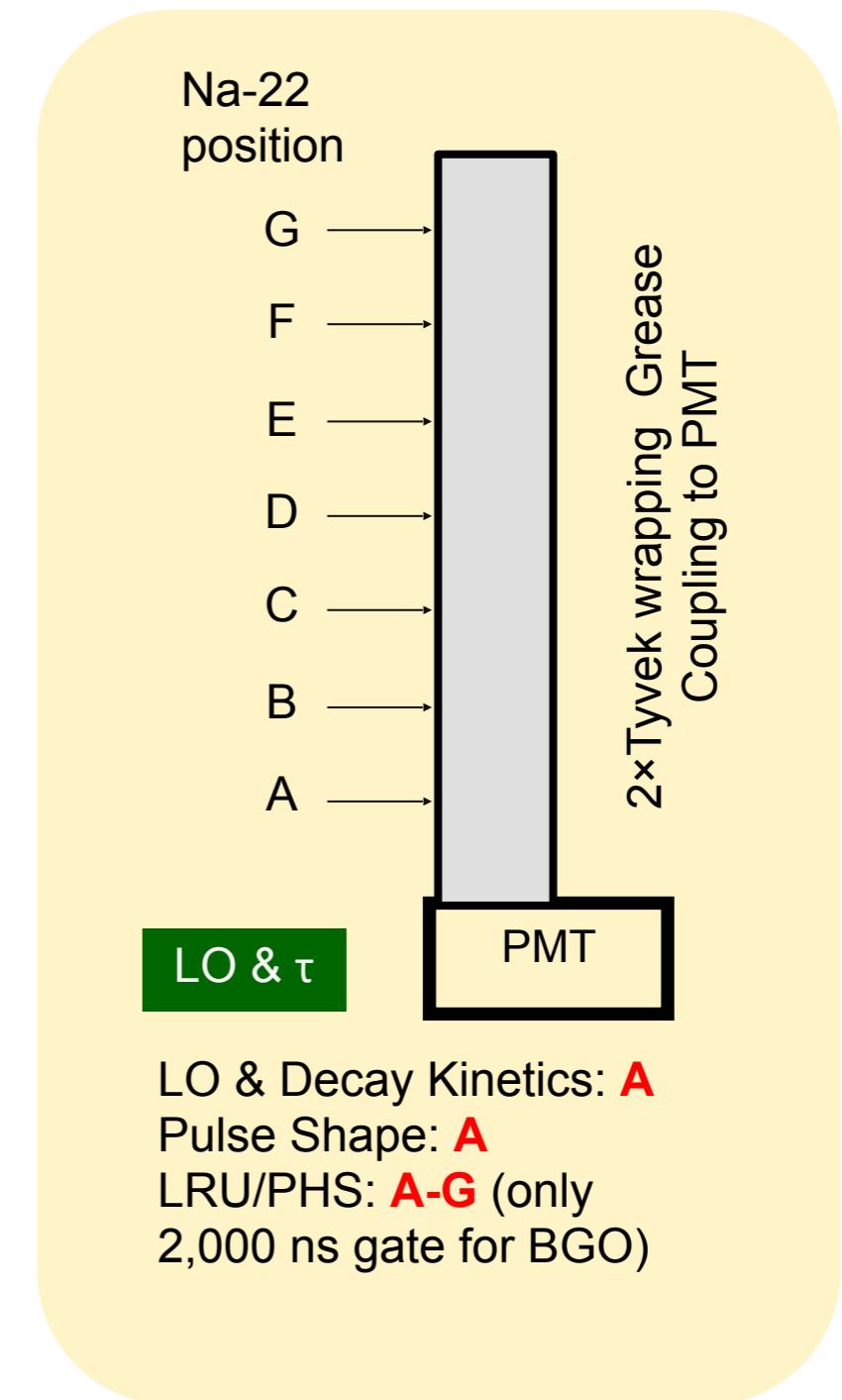
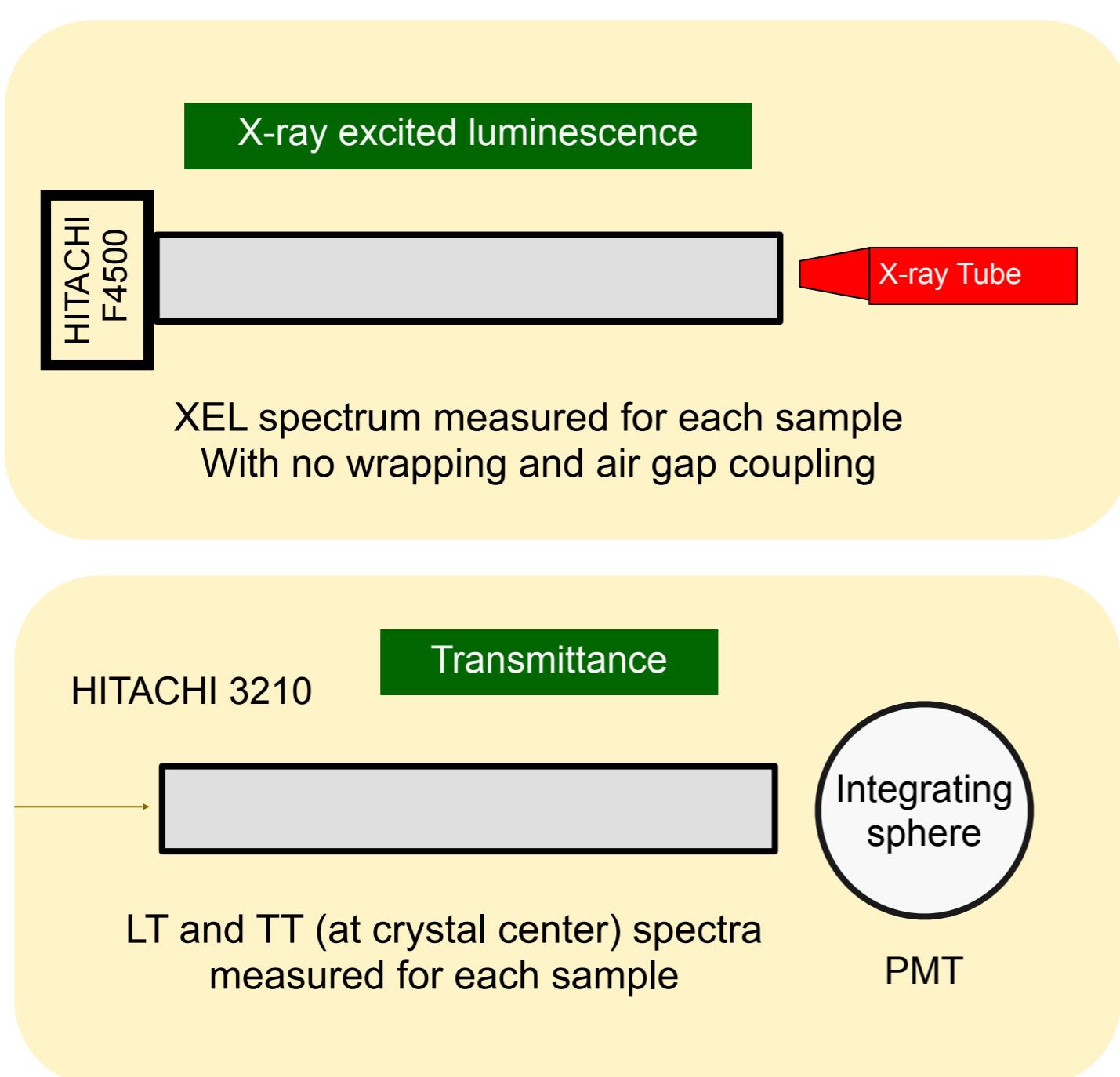


Crystal Characterization

Bhavya Singhal, Harvey Newman, Liyuan Zhang, Shin-Shan Eiko Yu
March 20th, 2025

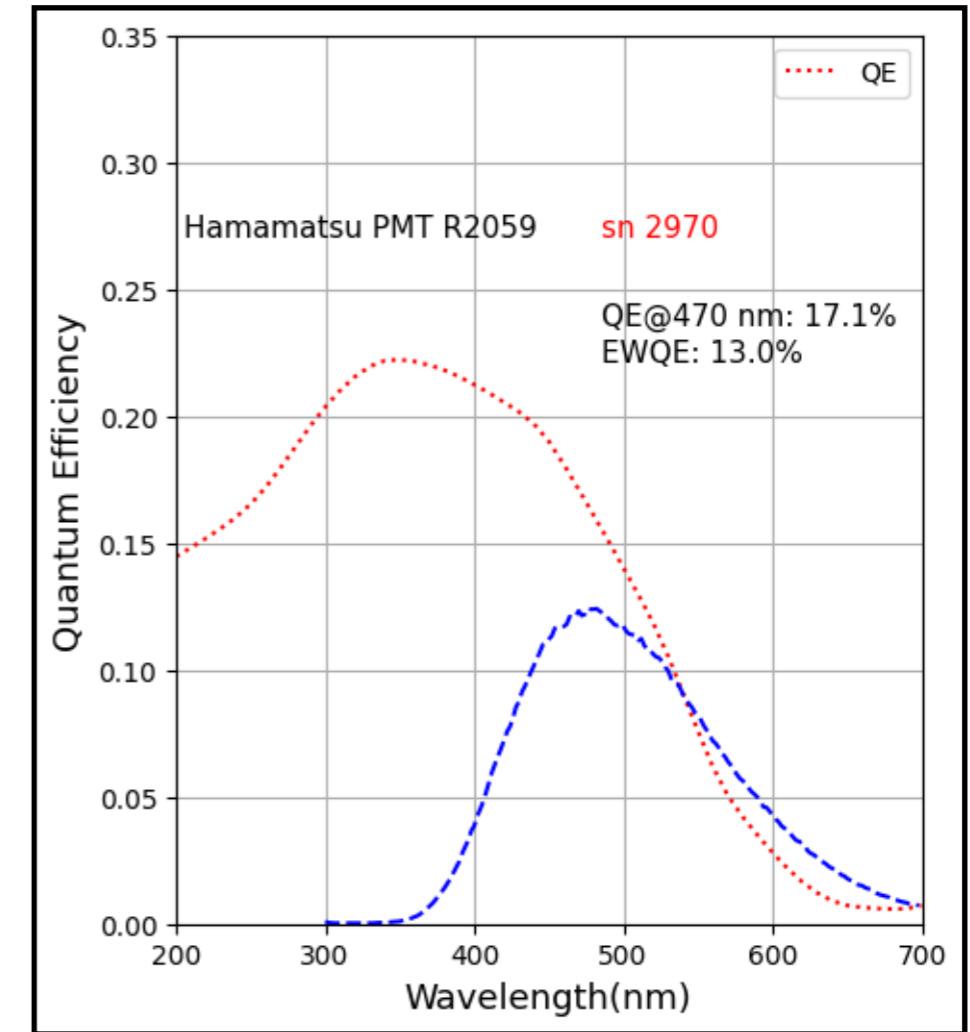
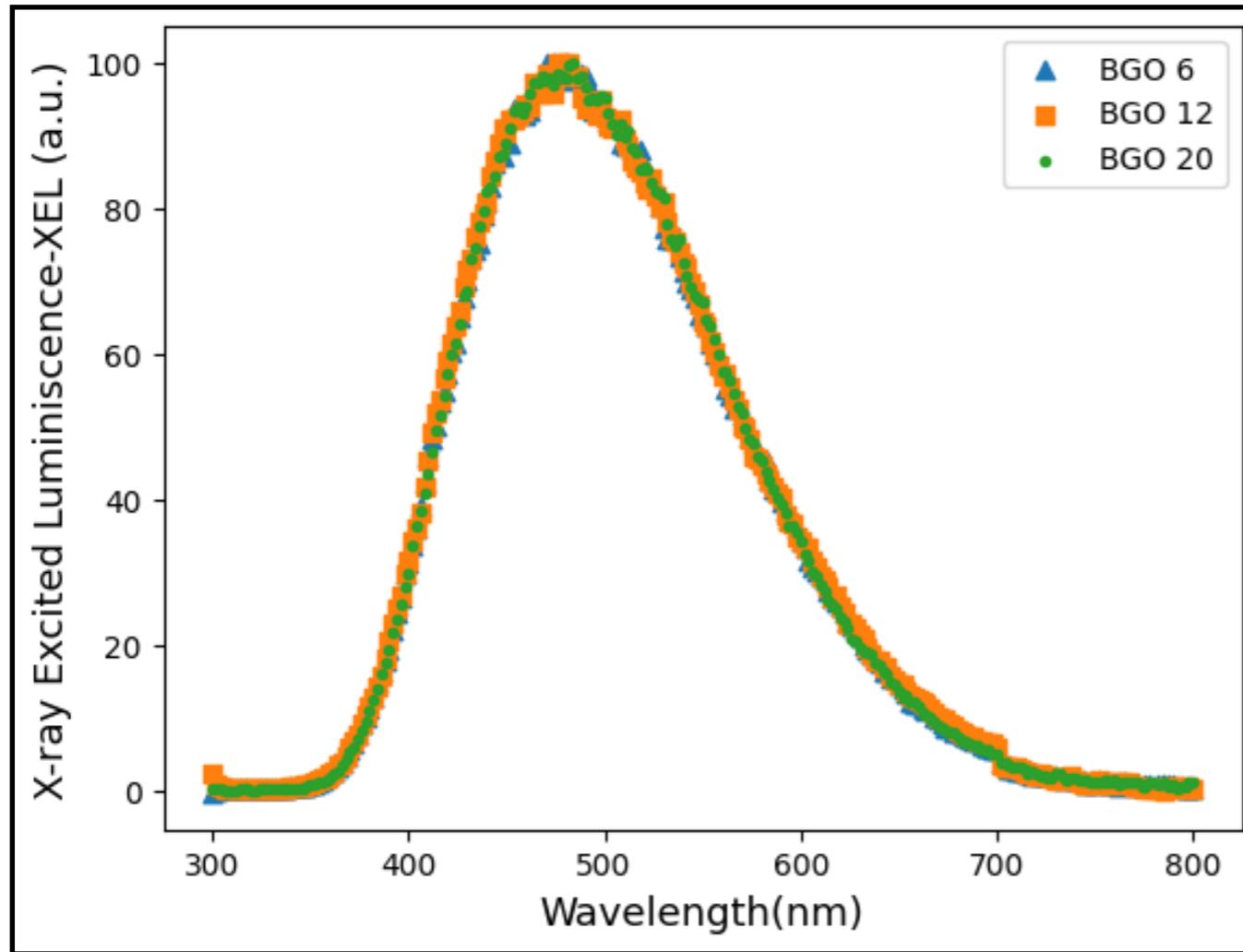
CalVision General Meeting

Measurement Setup

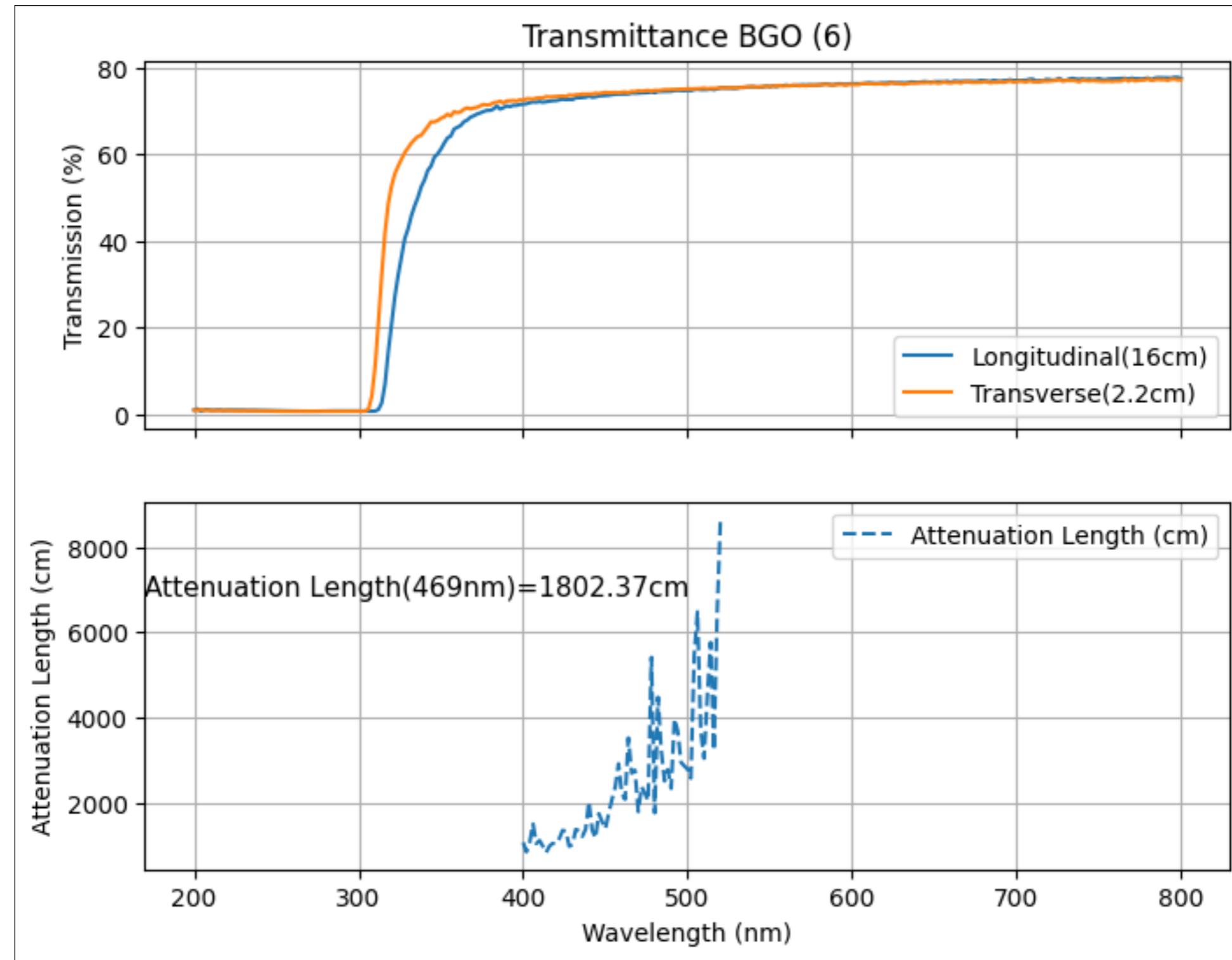


XEL and EWQE

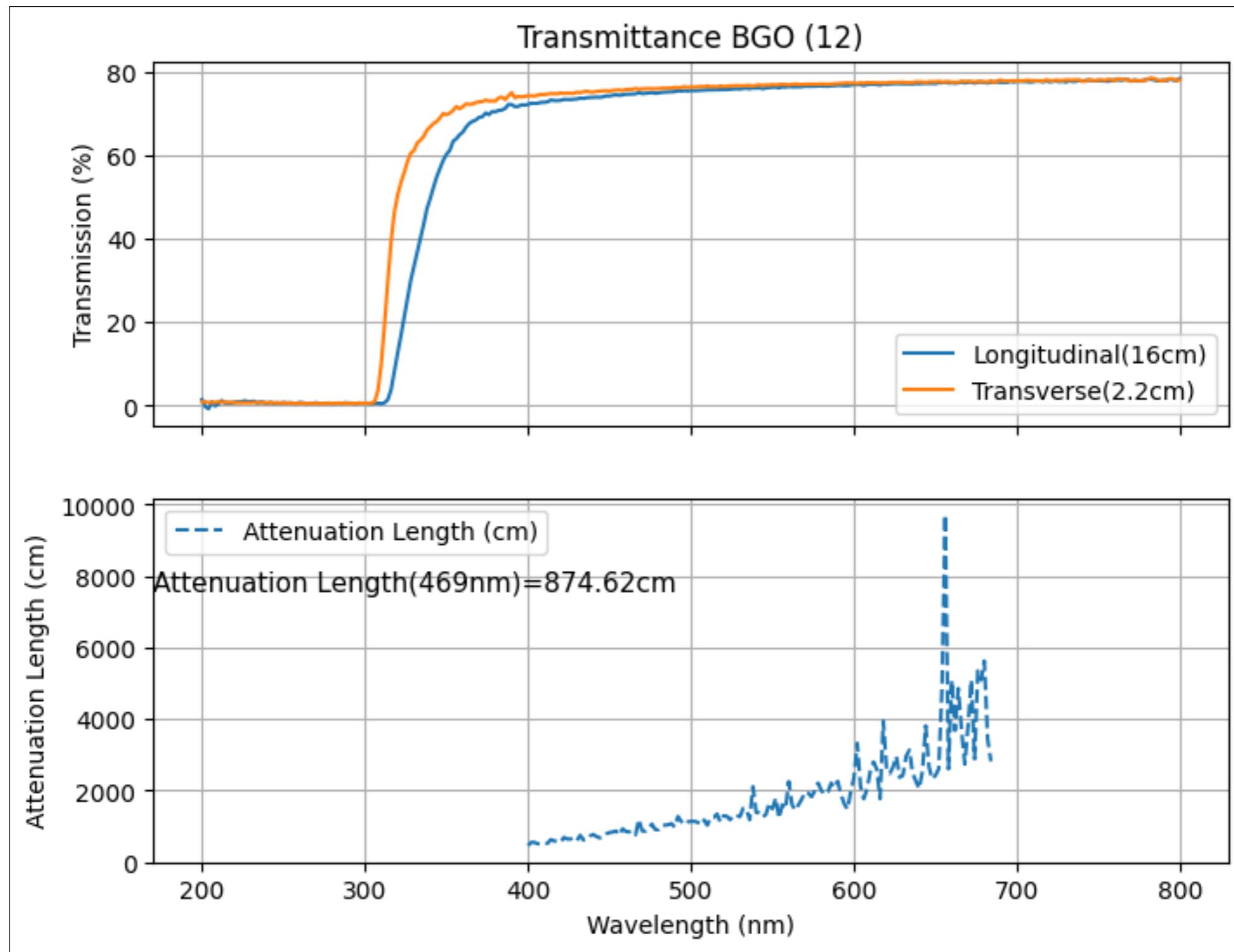
- The X-ray excited luminescence (XEL) was measured for 3 more BGO crystals, the emission spectra are consistent.
- The average of XEL spectra is used to calculate Emission Weighted Quantum Efficiency (EWQE) of the photo-detector (PMT R2059) in the light output measurement.



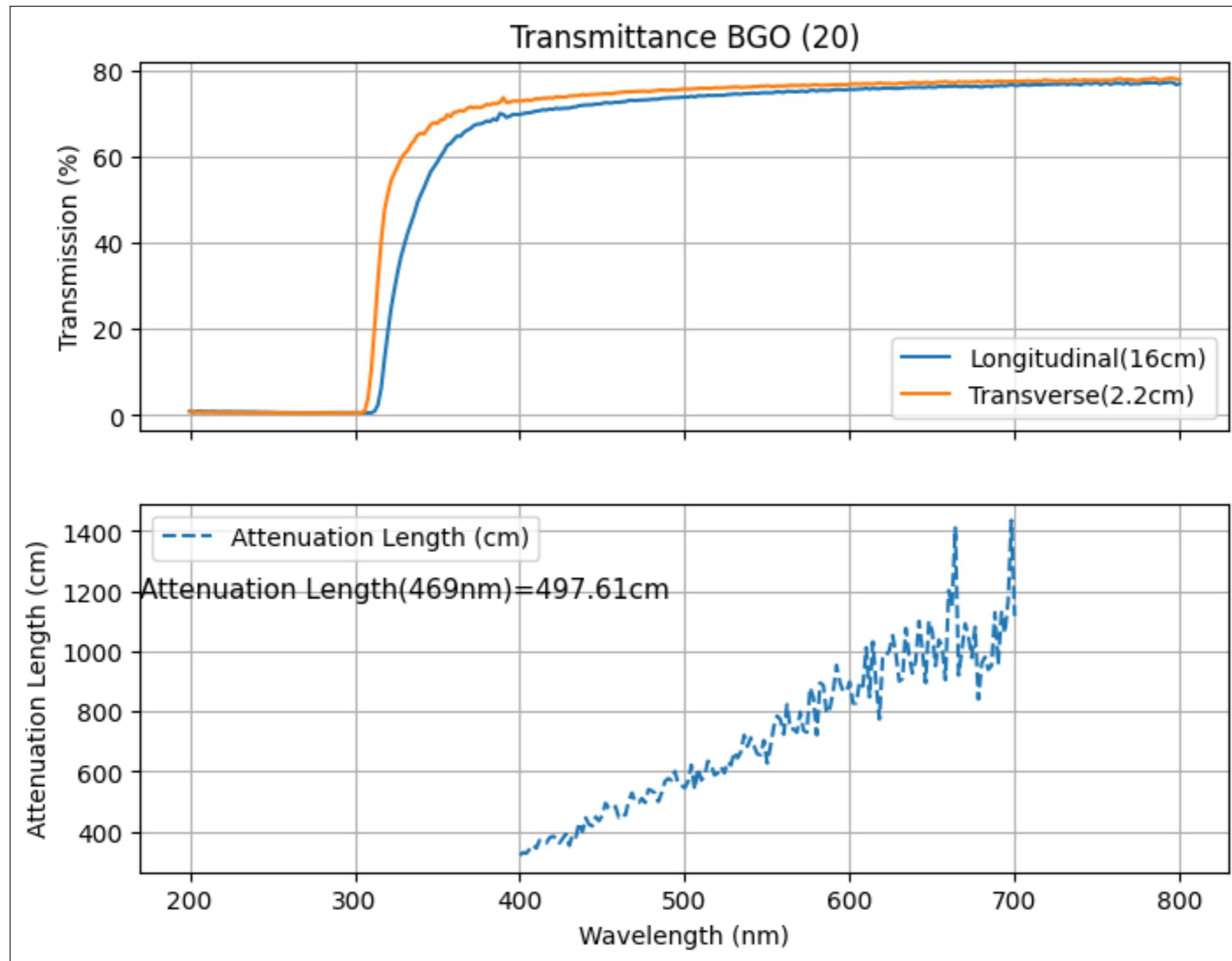
Transmission Spectra/Attenuation Length



Transmission Spectra/Attenuation Length

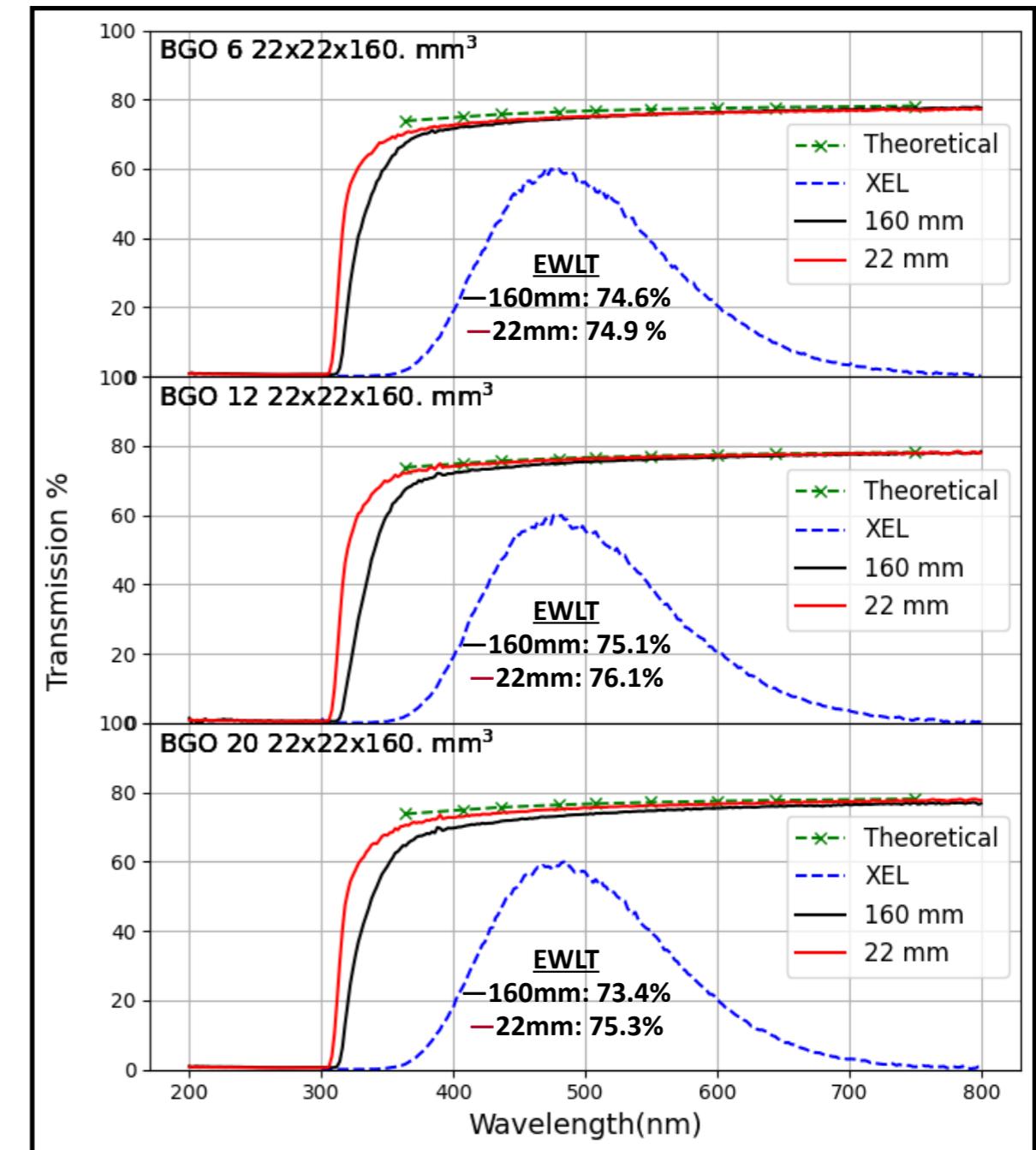
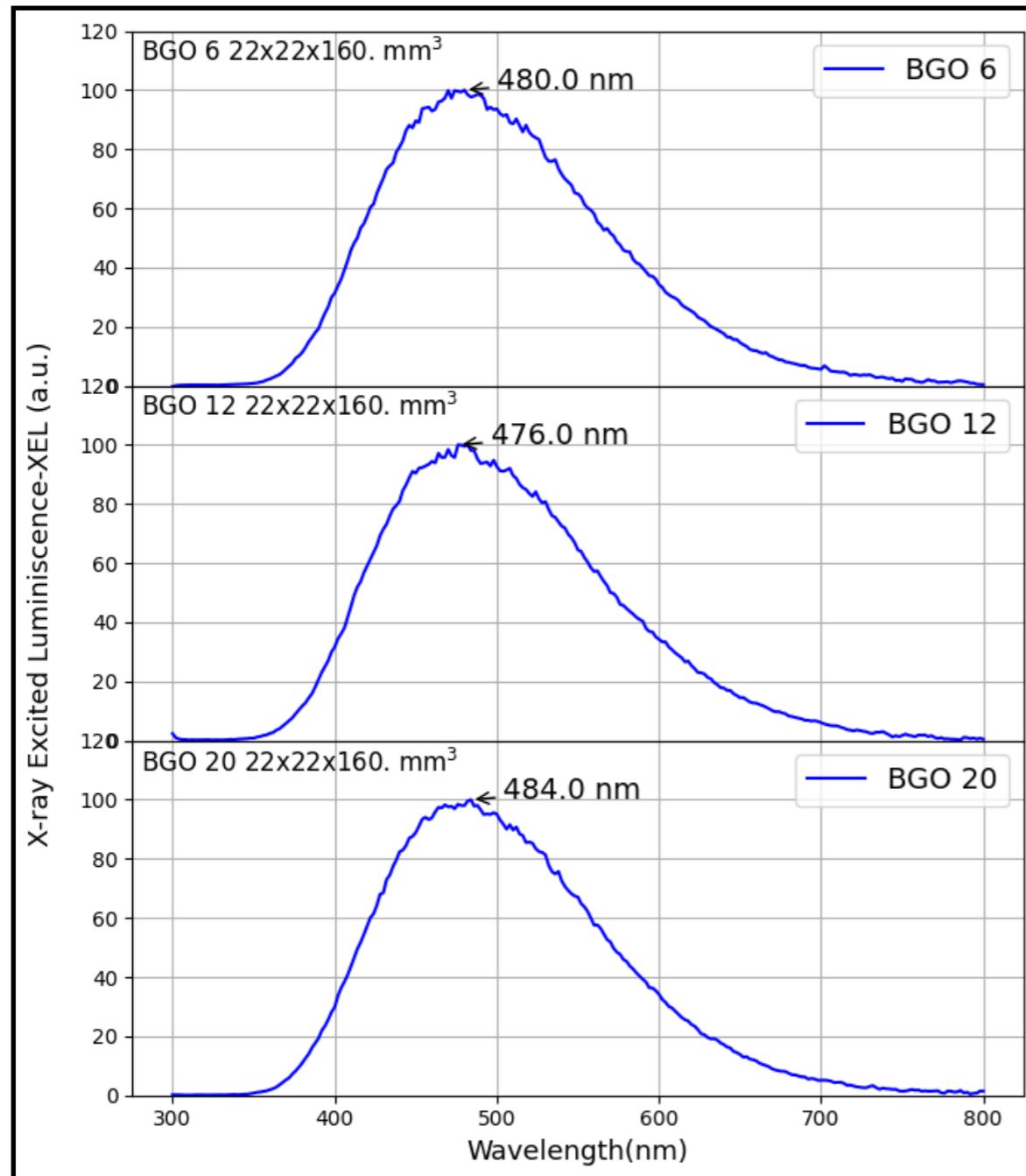


Transmission Spectra/Attenuation Length

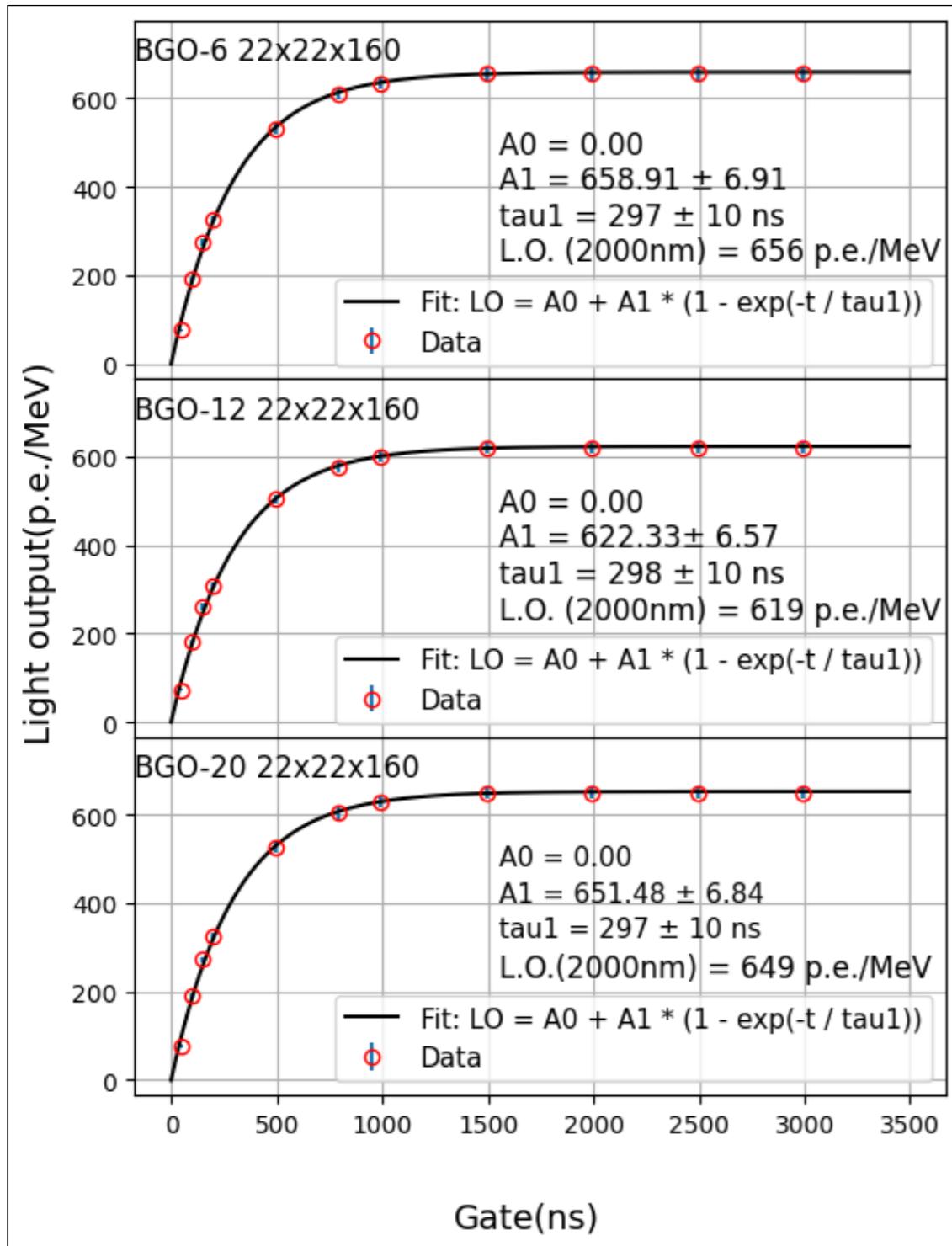


XEL, LT, TT Spectra and EWLT

- XEL Peaked at ~480nm
- Transverse Transmittance if measured at the centre of the crystal.

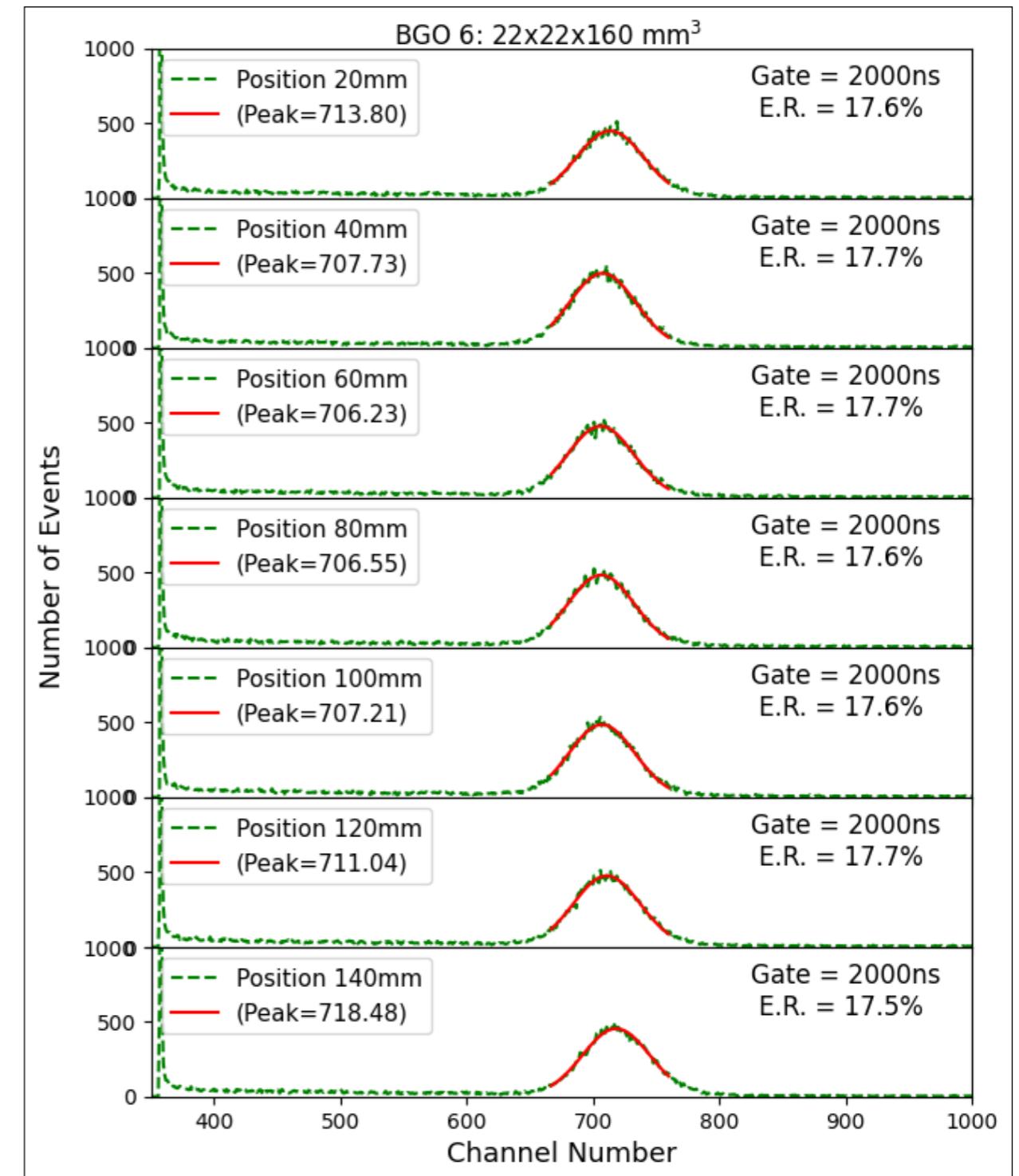
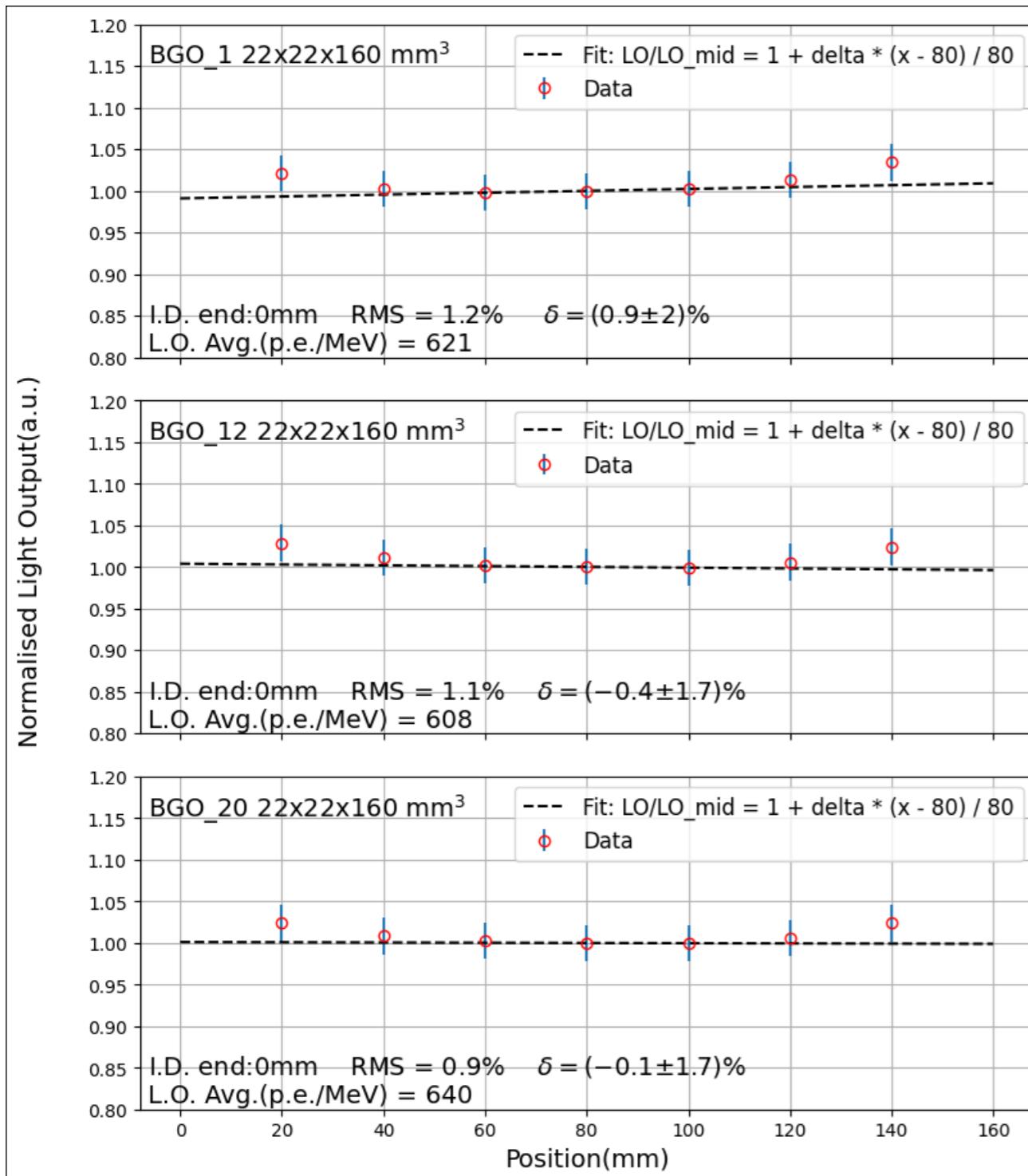


Decay Time Kinetics

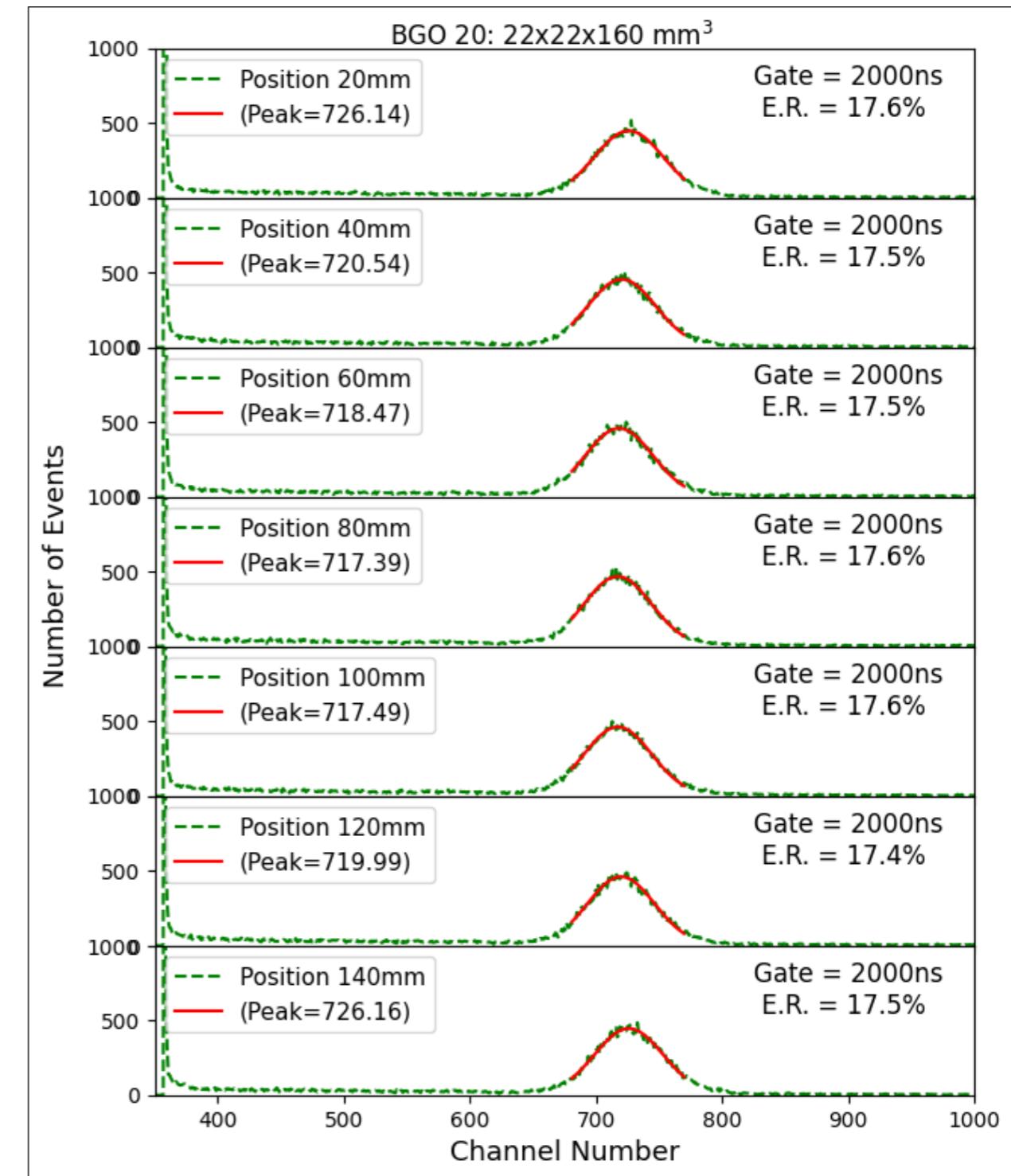
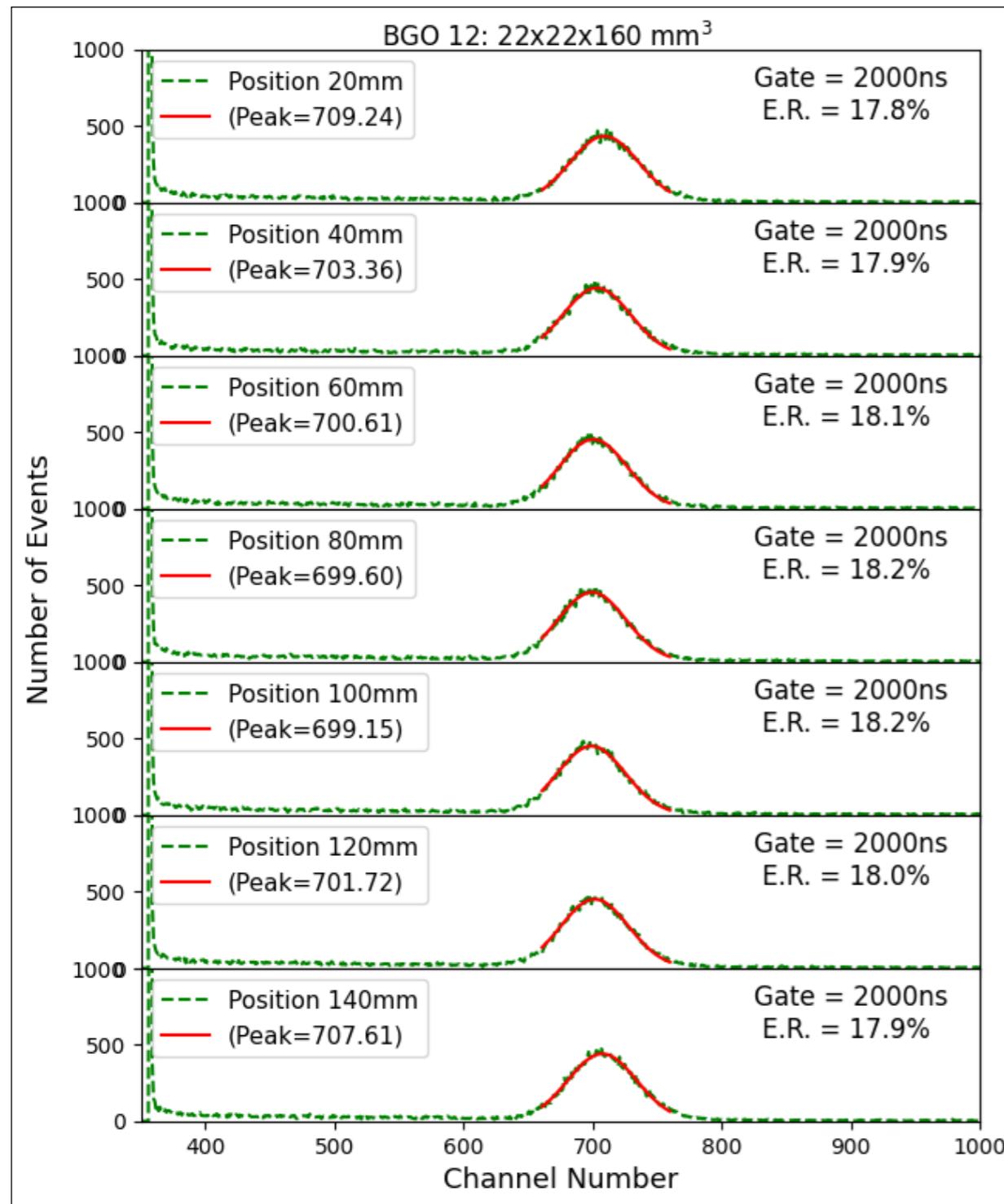


- o Decay Time for the three BGO crystals
 - 1. BGO 6: ~ 297 ns
 - 2. BGO 12: ~ 298 ns
 - 3. BGO 20: ~ 297 ns
- o Light Output for a 2000 ns Gate:
 - 1. BGO 6: 658 p.e./MeV
 - 2. BGO 12: 622 p.e./MeV
 - 3. BGO 20: 649 p.e./MeV

Light Response Uniformity(LRU)



Light Response Uniformity(LRU)



He-Ne Laser Scattering

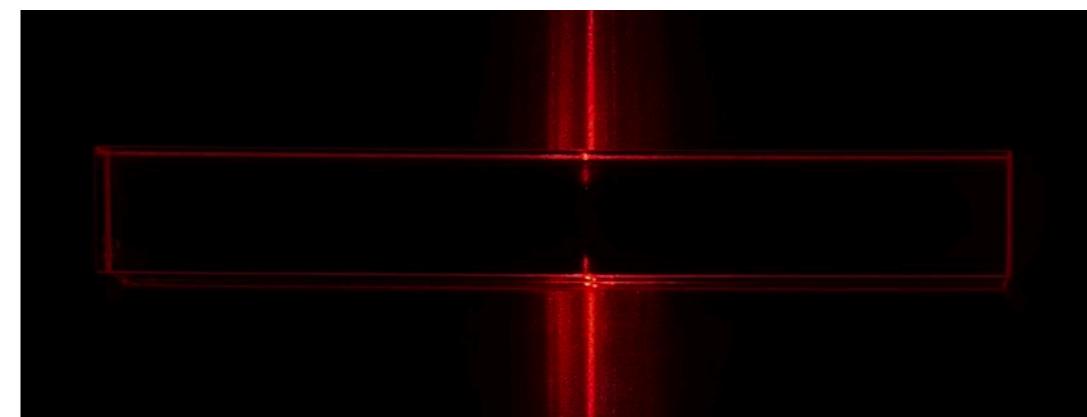
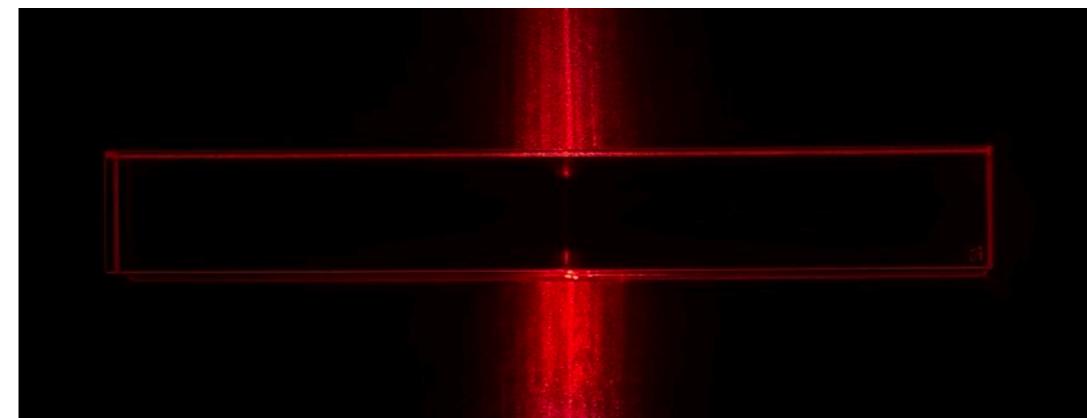
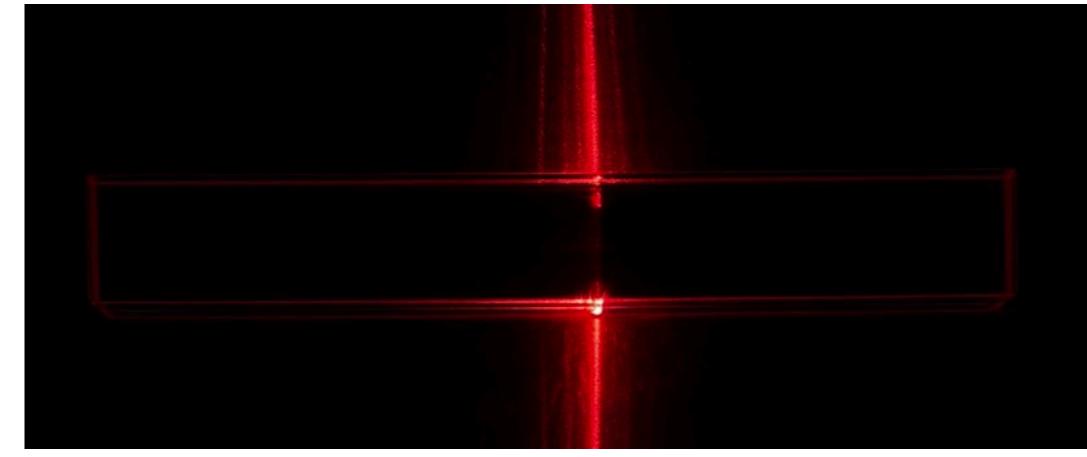
BGO 6



BGO12



BGO 20



Physical Dimensions

Vernier Caliper with 0.01 mm precision

BGO 6	Measurements(mm)			Average (mm)
Longitudinal	160.00	160.07	160.01	160.03
Transverse	22.03	22.07	22.08	22.06
BGO 12	Measurements(mm)			Average (mm)
Longitudinal	159.97	159.91	160.00	159.96
Transverse	22.07	22.10	22.04	22.07
BGO 20	Measurements(mm)			Average (mm)
Longitudinal	160.02	159.94	160.04	160.00
Transverse	22.06	22.09	22.05	22.07



Physical Dimensions

Vernier Caliper with 0.01 mm precision

BGO 1	Measurements(mm)			Average(mm)
Longitudinal	160.04	160.00	159.93	159.99
Transverse	22.06	22.05	22.06	22.06
BGO 7	Measurements(mm)			Average(mm)
Longitudinal	159.97	159.94	159.98	159.96
Transverse	22.09	22.09	22.08	22.09
BGO 14	Measurements(mm)			Average(mm)
Longitudinal	159.97	159.92	159.96	159.95
Transverse	22.08	22.09	22.07	22.08

Summary

BGO	EWLT(%)	Light Output (p.e./MeV)	Avg. Energy Resolution(%)	LRU(%)	Time Decay (ns)
BGO 6	74.9	658	17.6	1.2	297
BGO 12	76.1	622	18.0	1.1	298
BGO 20	75.3	649	17.5	0.9	297

Thank You!

Questions?

Backup Slides

Summary

Theoretical Transmittance

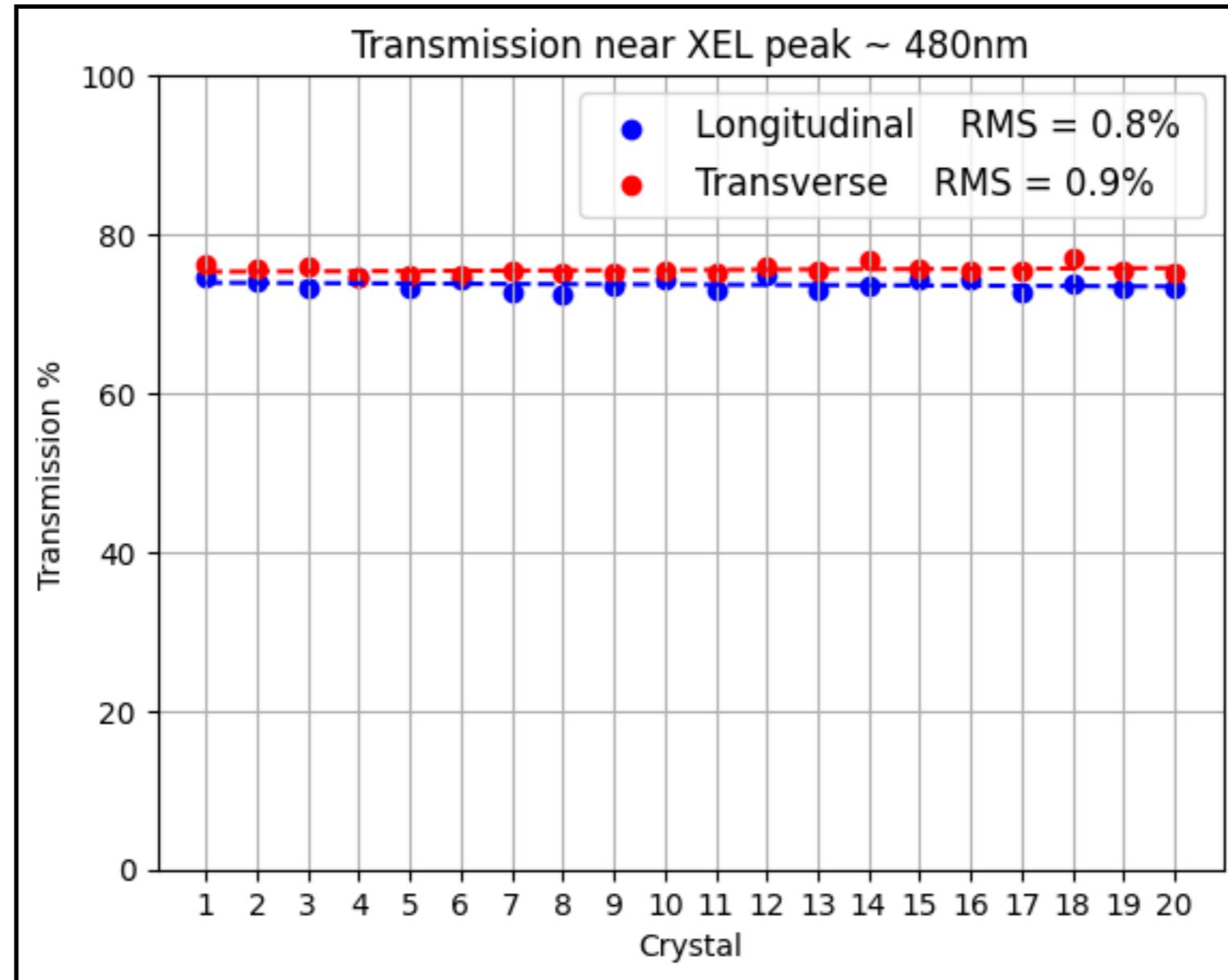
$$R = \frac{(n - n_{\text{air}})^2}{(n + n_{\text{air}})^2},$$

$$\begin{aligned} T_s &= (1 - R)^2 + R^2(1 - R)^2 + \dots \\ &= (1 - R)/(1 + R). \end{aligned}$$

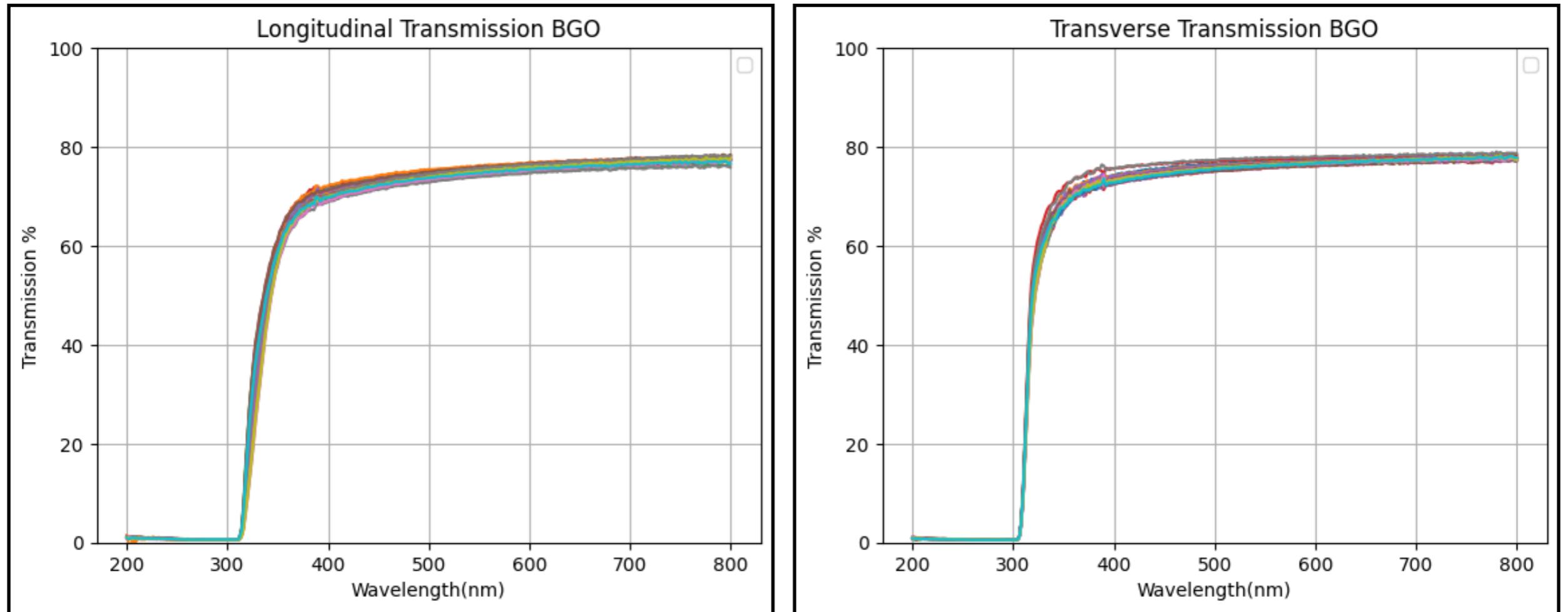
Loss of light at surfaces (Fresnel's Law)

Considering multiple bounces
between two end surfaces

Summary

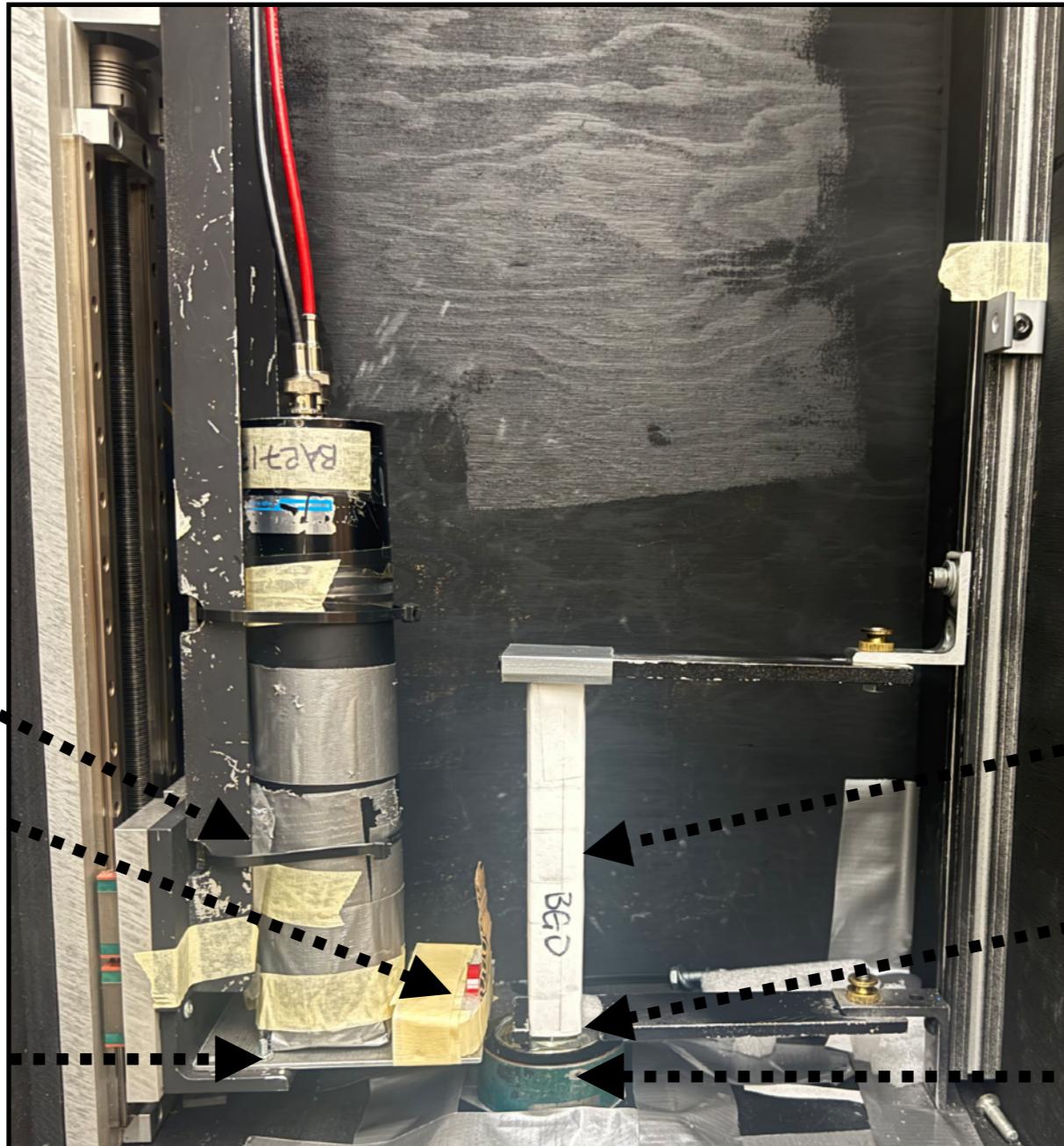


Summary



Setups

LRU/Time Decay



Control PMT

Radioactive Source
(Na-22)

Dynamic Platform
(for varying
position of source
along the length of
the crystal)

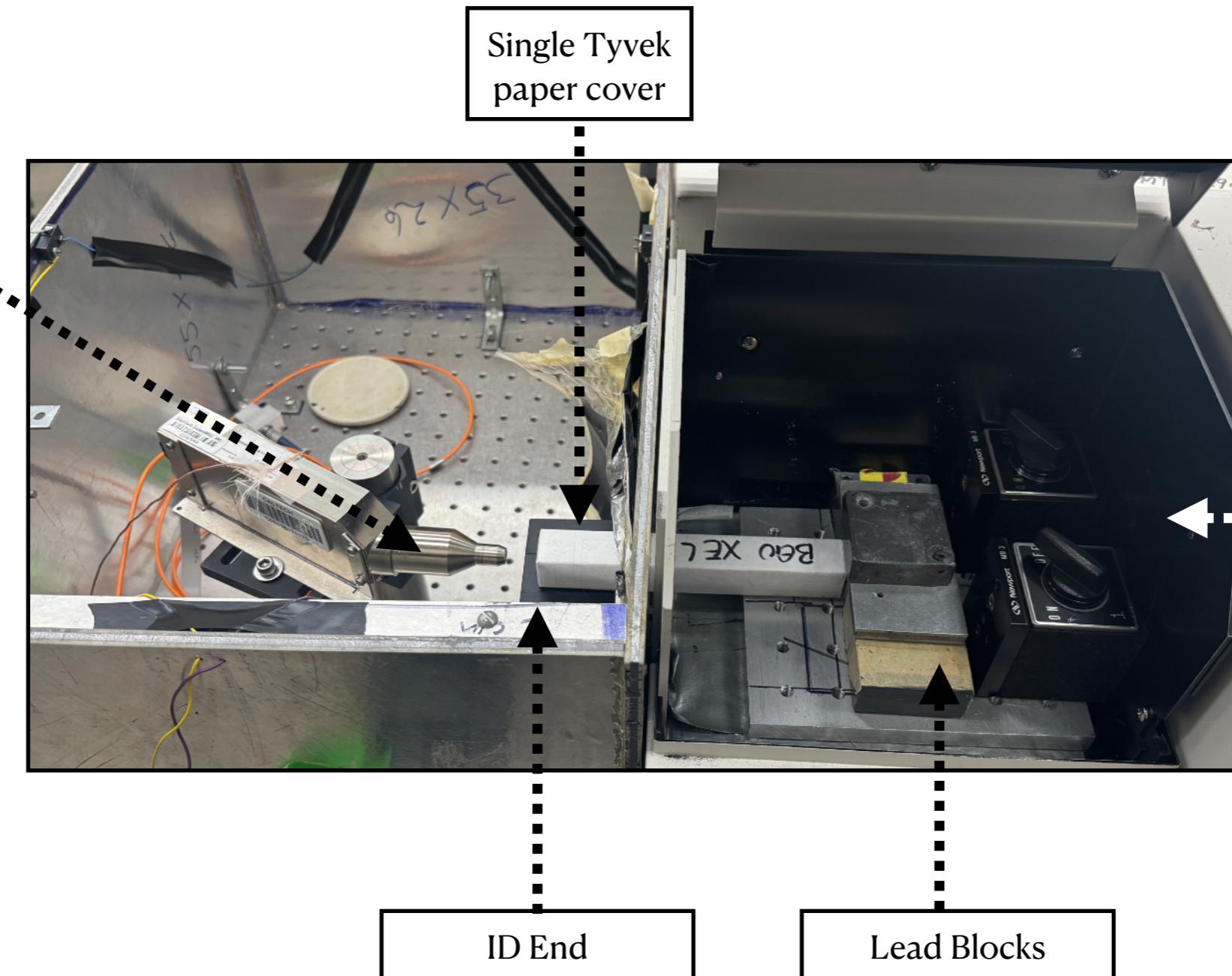
Double Tyvek
Wrapping

ID End (Coupled
with Silicon Grease)

Signal PMT
Hamamatsu R2059

Setups

XEL Measurements



Setups

Transmission Measurements

