Update on Simulation of Renyuan's Measurements

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Last week presentation:

"Out of the box" results for LO_1 in Setup 1

	3 mm / 5 mm	**1.5 mm / 5 mm**
simulation	1.00±0.01	1.00±0.01
measurement	1.06	1.16

"Out of the box" results for LO_2/LO_1 in [%]

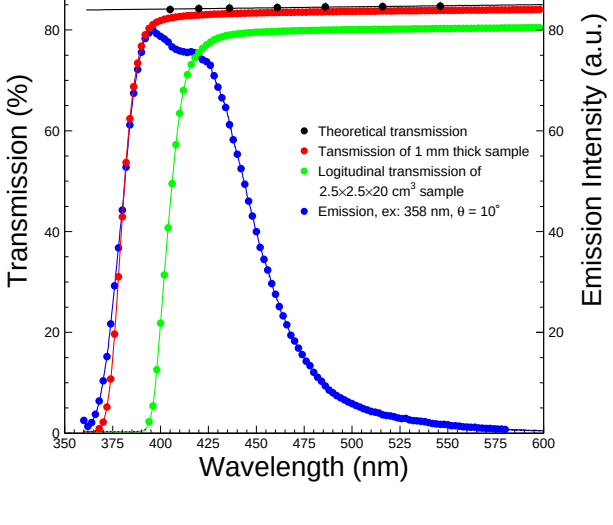
	5 mm	**3 mm**	**1.5 mm**
simulation	3.45±0.12	3.43±0.12	3.60±0.12
measurement	0.55	0.61	0.41

Modifications

1 Found records from NOνA R&D about absorption lenght of K27 dye for scintillation light: 0.4 mm and 0.2 mm for 150 ppm and 300 ppm respectively. Use L_{abs}=0.35 mm for Y11 (170 ppm)

2 Use overlapping absorption and emission spectra for LYSO

See Renyuan's HN post



Refractive index for LYSO

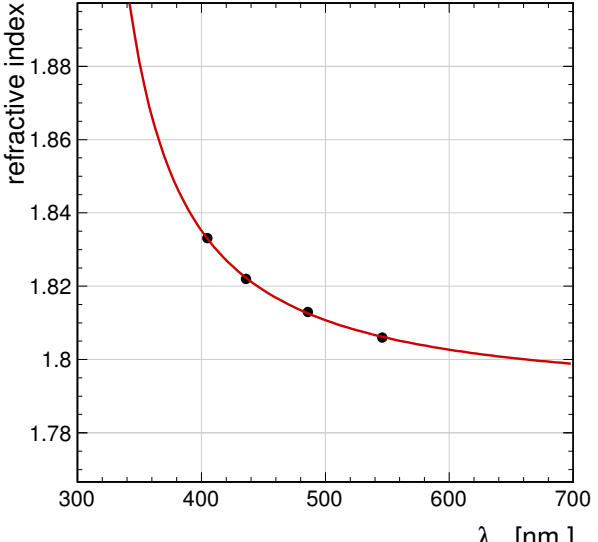
Black dots: Measurements from

Rihua Mao; Liyuan Zhang; Ren-Yuan Zhu, "Optical and scintillation properties of inorganic scintillators in high energy physics," Nuclear Science Symposium Conference Record, 2007. NSS '07. IEEE , vol.3, no., pp.2285,2291, Oct. 26 2007-Nov. 3 2007 doi:10.1109/NSSMIC.2007.4436602

Red line: Sellmeier Fit

$$n^2 = 1 + n_0^2 + \frac{n_1^2}{1 - \lambda_1^2/\lambda}$$

$$n_0 = 1.43923e+00$$
$$n_1 = 3.67622e-01$$
$$\lambda_1 = 2.95130e+02$$



Absorption Length from Transmittance Measurement

Transmittance

$$T = \frac{(1-R)^2 \cdot A}{(1-R\cdot A)(1+R\cdot A)}$$

where

$$R = \left(\frac{n_{\text{crystal}} - n_{\text{air}}}{n_{\text{crystal}} + n_{\text{air}}}\right)^2$$

$$A = e^{-D/L_{\text{abs}}}$$

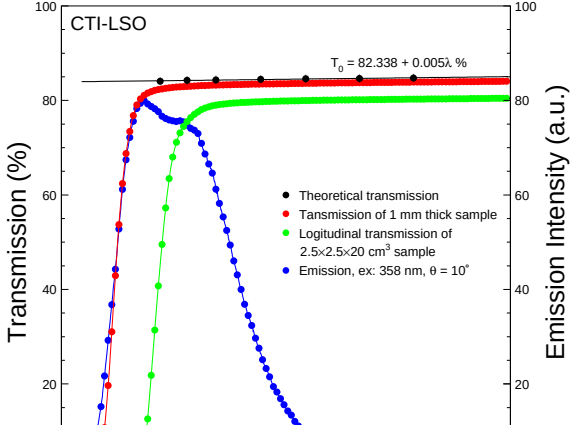
and D is the thickness of a crystal

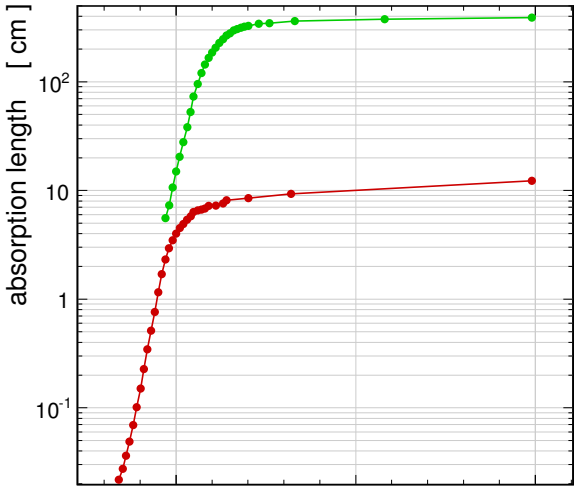
Solve numerically for $L_{\text{abs}}(\lambda)$ for each measurement of $T(\lambda)$

Absorption Length for LYSO with 20 cm and 1 mm thickness

Left plot: published measurements
Right plot: extracted L_{abs} for 20 cm (green) and 1 mm (red) samples

Use 1 mm results for simulations





Results

"Out of the box" results for LO_1 in Setup 1

	3 mm / 5 mm	**1.5 mm / 5 mm**
simulation	1.09±0.01	1.15±0.01
measurement	1.06	1.16

"Out of the box" results for LO_2/LO_1 in [%]

	5 mm	**3 mm**	**1.5 mm**
simulation	1.00±0.15	0.92±0.14	0.91±0.13
measurement	0.55	0.61	0.41