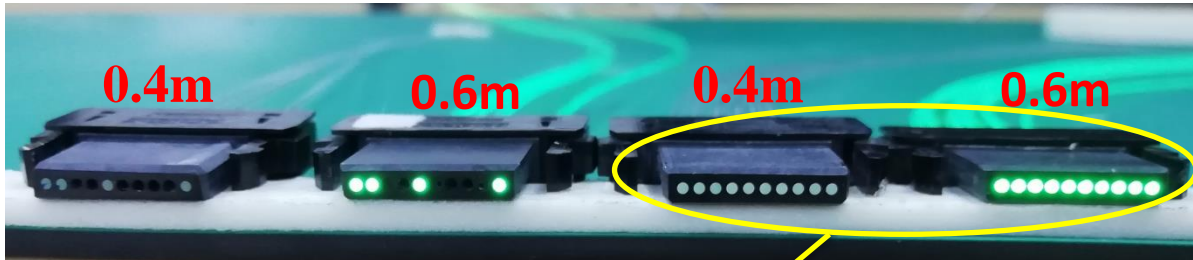


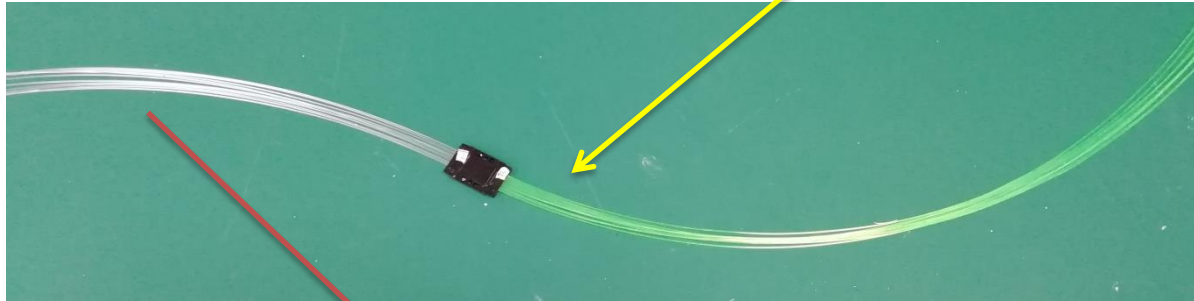
Fiber attenuation test

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Jun.13th, 2019

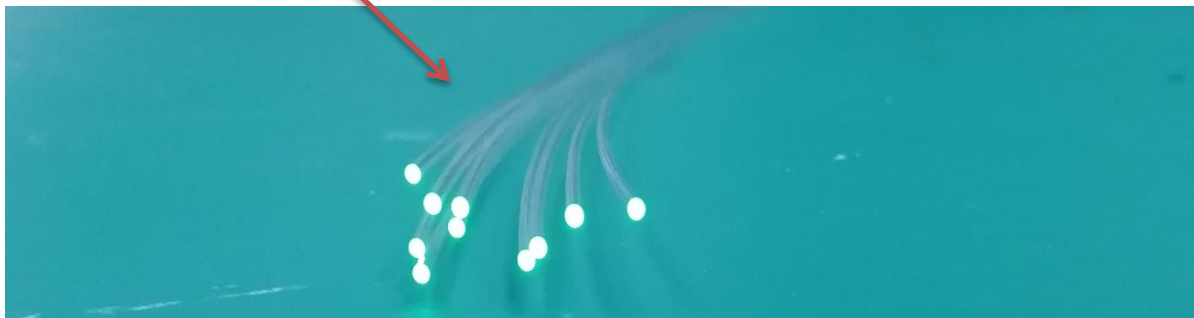
WLS fiber to white fiber



Fiber can stick firmly in holes (by the Nanjing Chunhui factory)

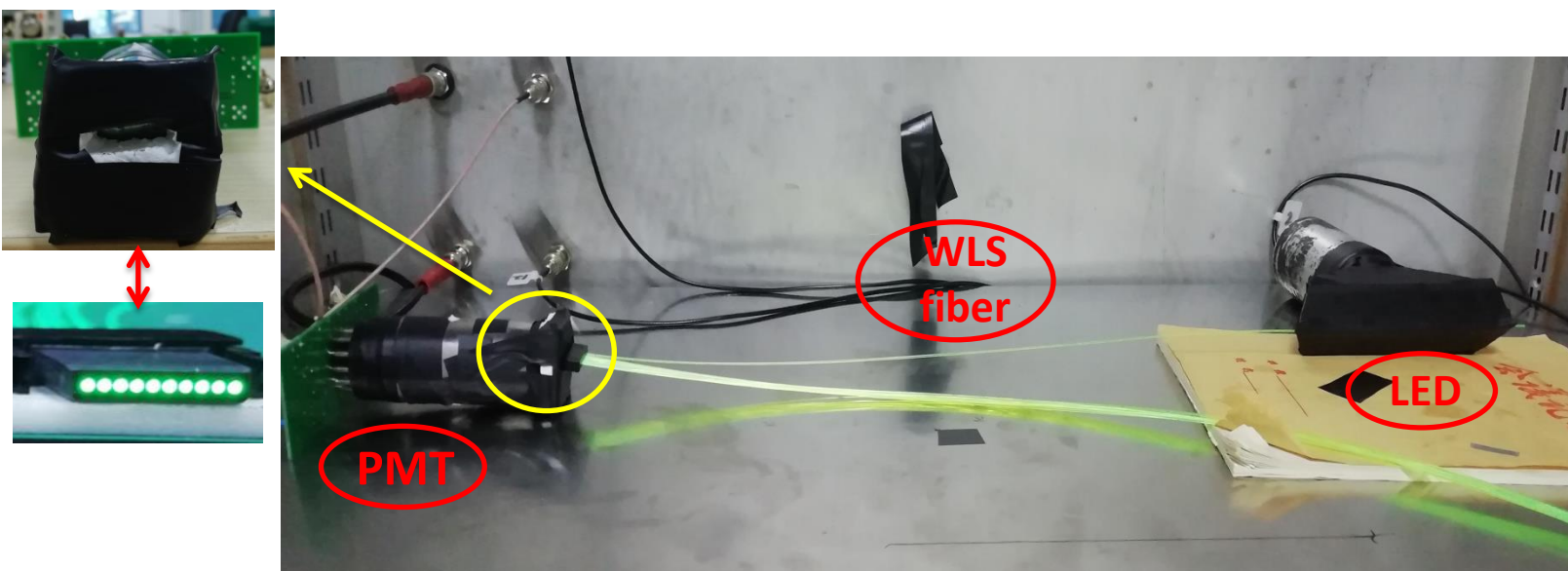


WLS fiber and clear fibers are coupled through connectors



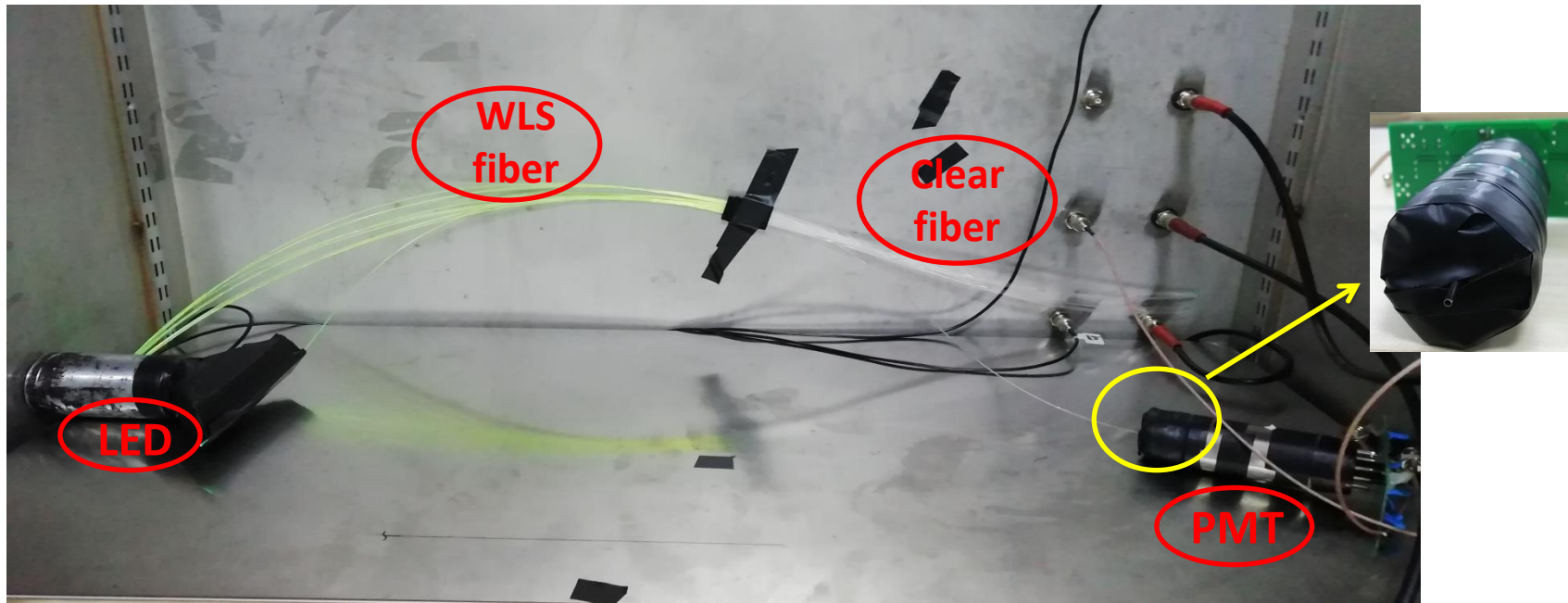
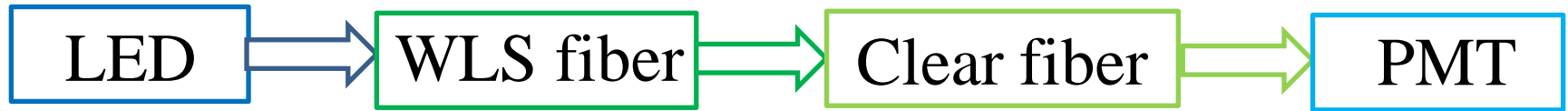
The coupled clear fiber emits green light

WLS fiber testing configuration





To fix the LED , then replace the WLS fiber , finally record the ADC channel count (which is proportional to the charge) of each WLS fiber .

WLS to clear fiber testing configuration

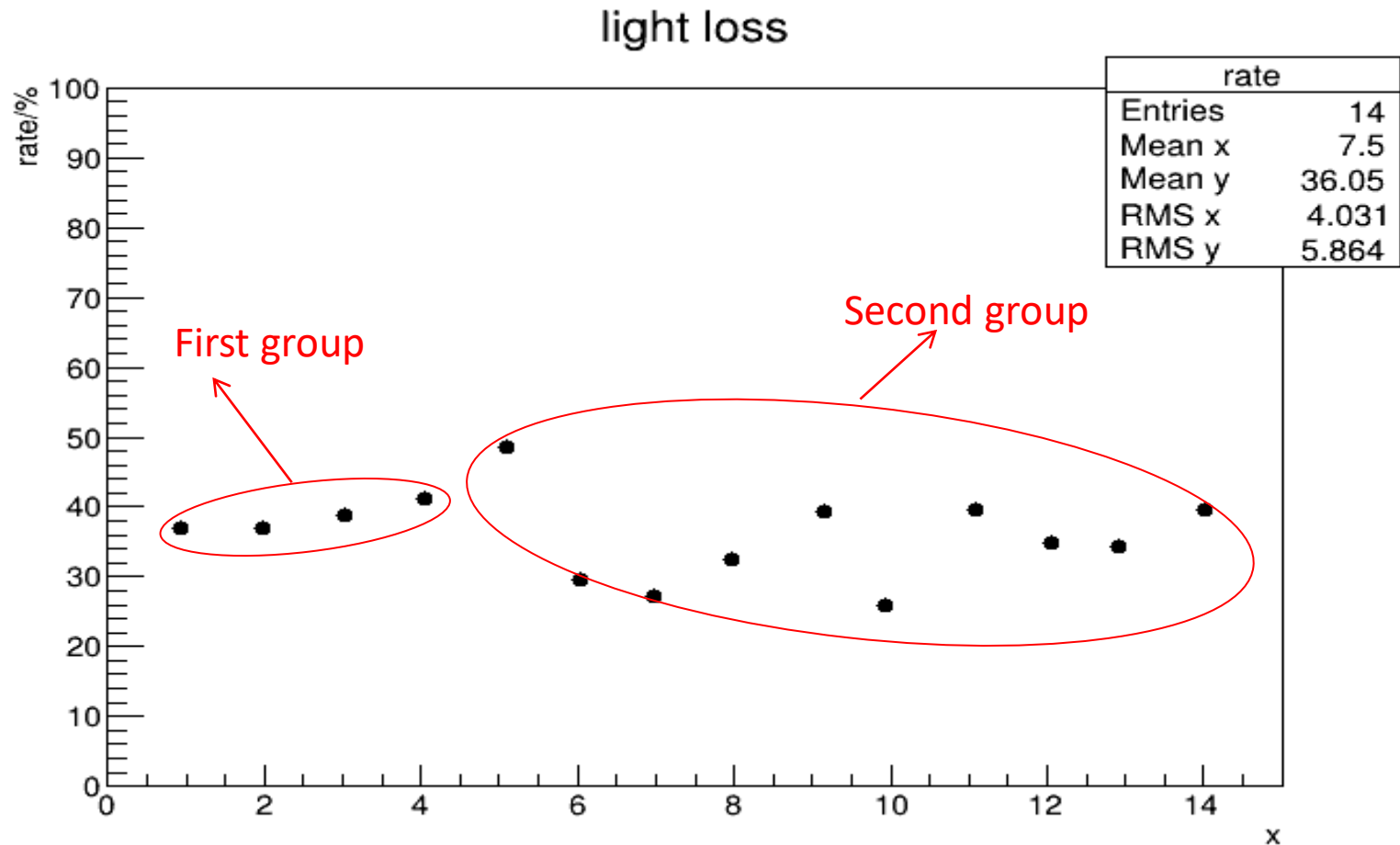


To fix the LED , then replace the WLS fiber and clear fiber ,finally record the ADC channel count.

Light loss

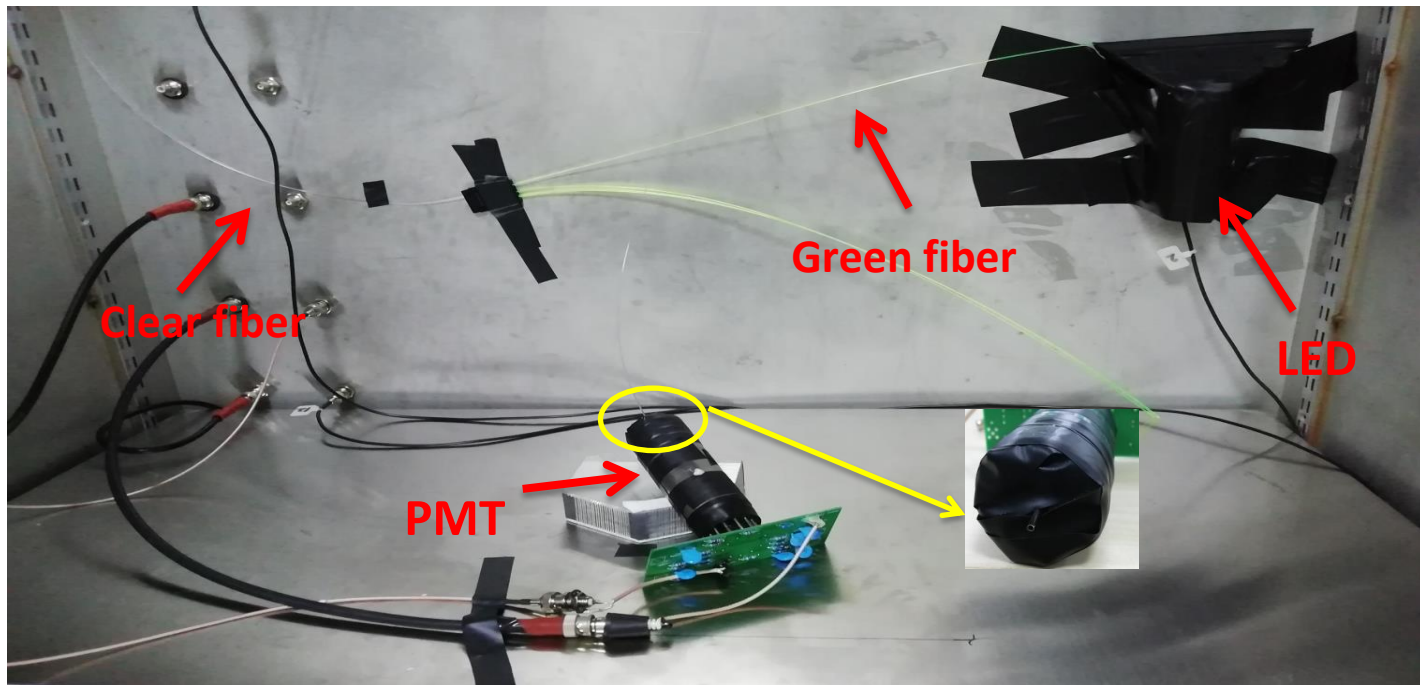
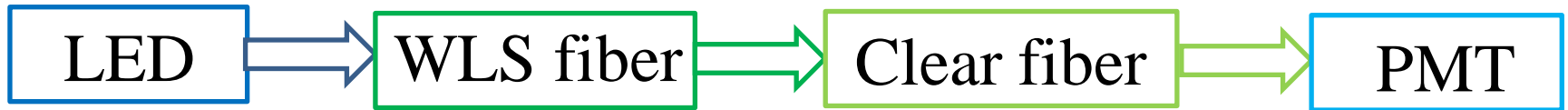
group	fiber	WLS fiber (ADC channel counts)	Clear fiber (ADC channel counts)	Light loss (WLS fiber-clear fiber/WLS fiber)
	1	464	294	36.6%
	2	488	304	37.7%
	3	490	299	38.9%
	4	510	299	41.3%
	1	635	328	48.3%
	2	502	353	29.6%
	3	481	350	27.2%
	4	504	342	32.1%
	5	648	393	39.3%
	6	514	383	25.4%
	7	667	401	39.8%
	8	531	346	34.8%
	9	449	296	34%
	10	539	325	39.7%

Light loss (distribution)



The light loss of WLS fiber to clear fiber is about 36%

Attenuation length of clear fiber



To fix the LED and WLS fiber , then replace the clear fiber of different length and record the ADC channel counts.

Result

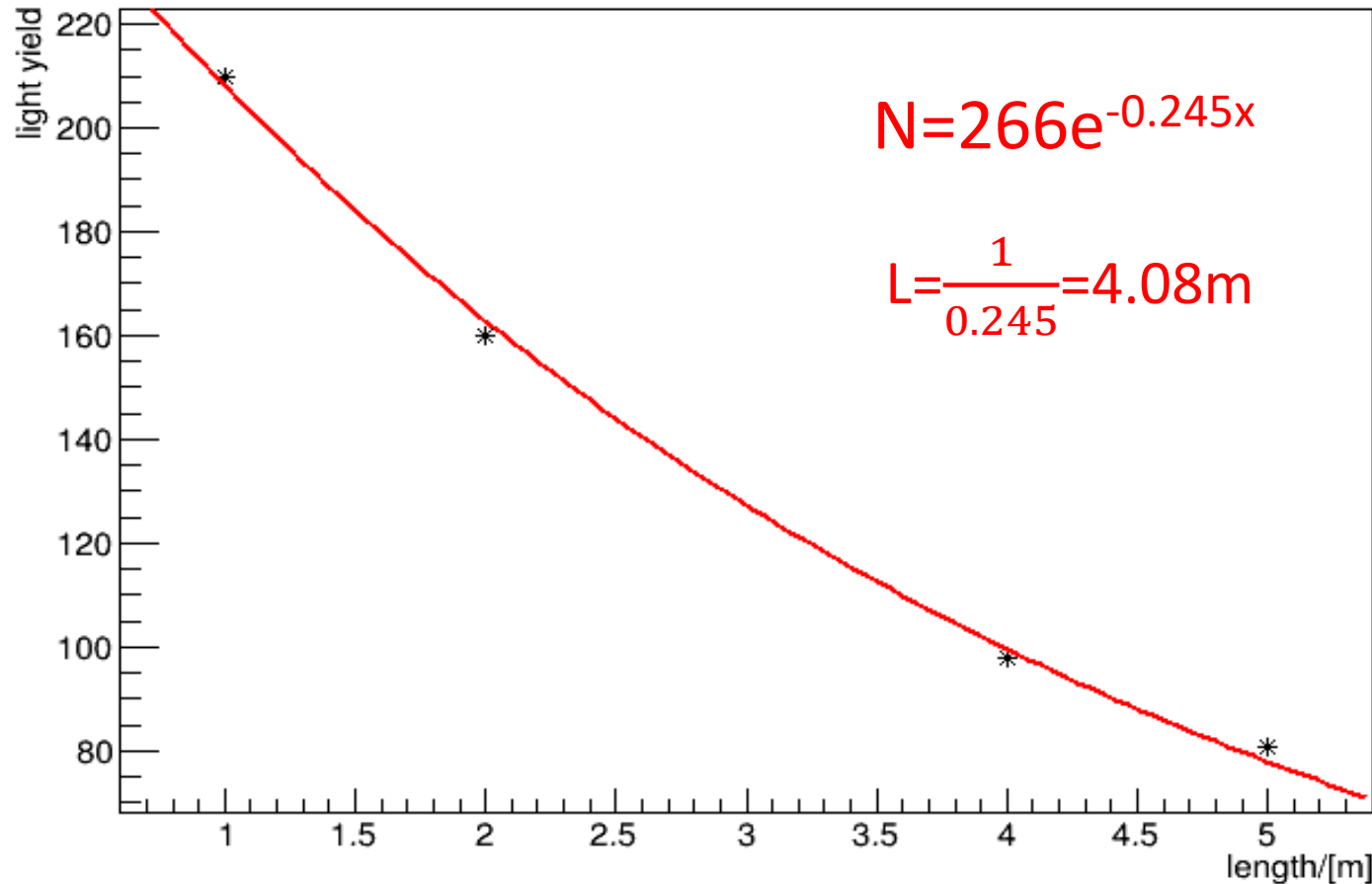
White fiber length[/m]	ADC channel counts
1	210
2	160
3	94
4	98
5	81

The result of 3m fiber isn't ideal .

The reason may be that the polishing quality of 3m fiber is worse than others .

Attenuation length

light decay



By using $N = N_0 e^{lx}$ and $L = \frac{1}{l}$, we can get the clear fiber attenuation length : $N = 266e^{-0.245x}$

and $L = \frac{1}{0.245} = 4.08\text{m}$

Conclusions

- The test result of light loss for different fiber is similar, the light attenuation loss of WLS fiber to clear fiber is about 36%.
- The attenuation length of the clear fiber is about 4 meters.
- Considering the 40cm clear fiber lead to 10% light loss in transport, we get final light loss from connector of this test is 29% $[1 - (1-36\%)/(1-10\%)]$.

Discussion

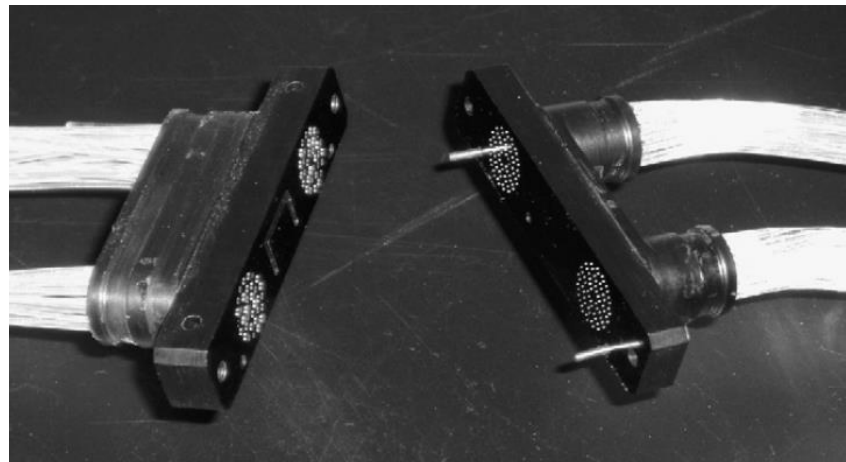
The compassion is mainly based on the paper “High efficiency plastic scintillator detector with wavelength-shifting fiber readout for the GLAST Large Area Telescope”(Space experiment)

<https://doi.org/10.1016/j.nima.2007.09.040>

1. Connector light loss

1mm diameter WLS fiber is mated to a larger 1.2mm diameter clear fiber for tolerance in fiber mating alignment with specially designed optical connector showed in picture below.

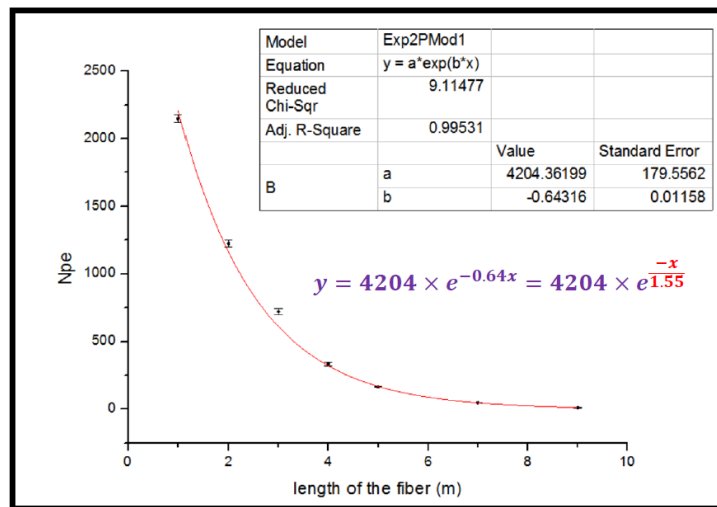
Paper shows it suffer 15%-20% light loss.



2. Attenuation length comparison in different experiment

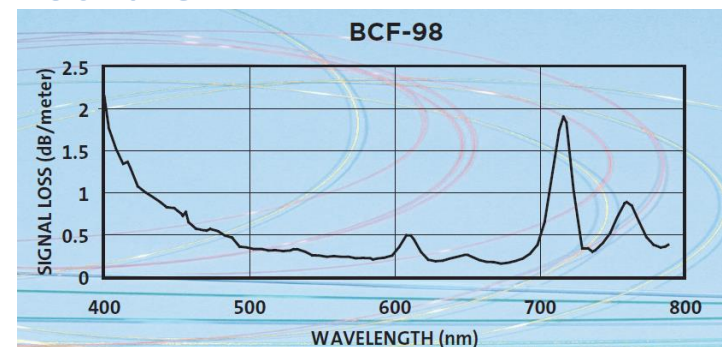
- 4m, SDU test
- 1.55m, THU test
- 8.68m, Saint Gobain brochure
- ~6m, GLAST Large Area Telescope paper

THU result plot



From the result, the attenuation length is 1.55m

Attenuation plot from Saint Gobain Brochure



$\text{dB} = 10 * \log N$, N is attenuation ratio.
 For clear fiber with 495 nm wavelength, the dB/m is 0.5, which equal to the $N = 1.122$.
 $(1.122)^x = e$, $x = 8.68\text{m}$.

Back up

Clear fiber attenuation test problem

Clear fiber	First testing	Second testing
1m	328	
2m	172	
3m	149	
4m	162	
5m	67	64
6m	34	35

The light yield is highly depended on the polishing quality.