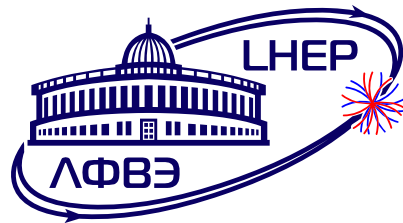


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# Comparative study of wavelength shifters for scintillation tile readout

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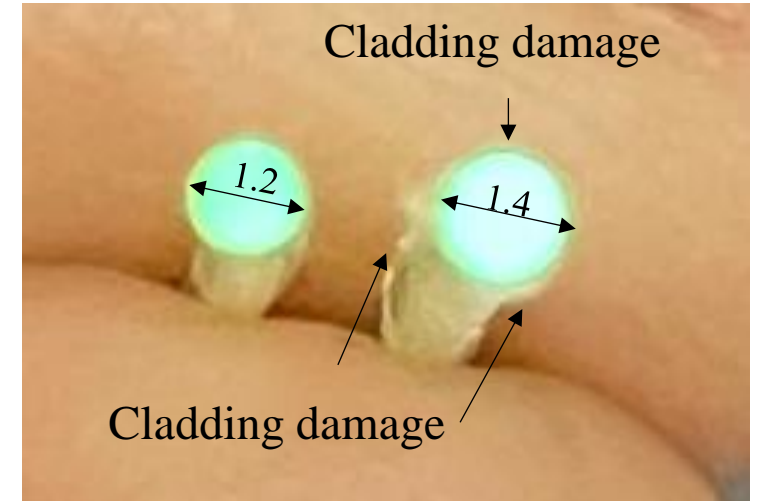
**Filipp Dubinin**  
on behalf of MEPhI group

Dubna, 5<sup>th</sup> November 2024

# Materials & equipment

## Single cladding shifters:

- ❖ Kurarai Y11,  $\text{\O}1\text{mm}$
- ❖ Gaint Gobain BCF-92,  $\text{\O}1\text{mm}$
- ❖ 1<sup>st</sup> Tver shifter,  $\text{\O}1.2\text{mm}$  – **mechanically weak cladding**
- ❖ 2<sup>nd</sup> Tver shifter,  $\text{\O}1.2\text{mm}$  – **weak cladding, core  $D=1.2..1.4\text{mm}$**



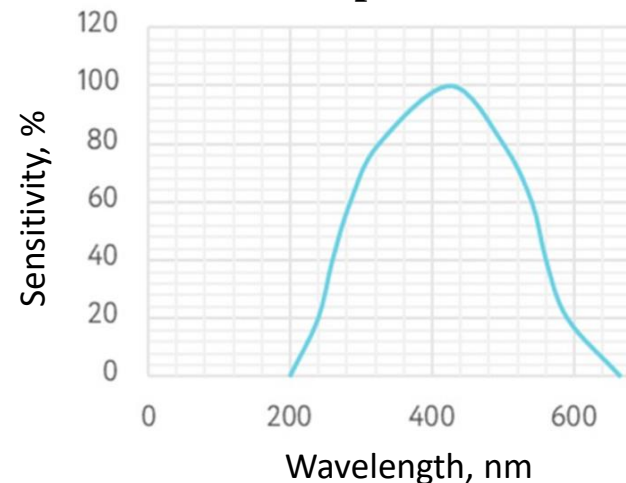
## LED in pulse mode

- $t_p = 20\text{ ns}$  (from pulse generator)
- LED wavelength = 400 nm

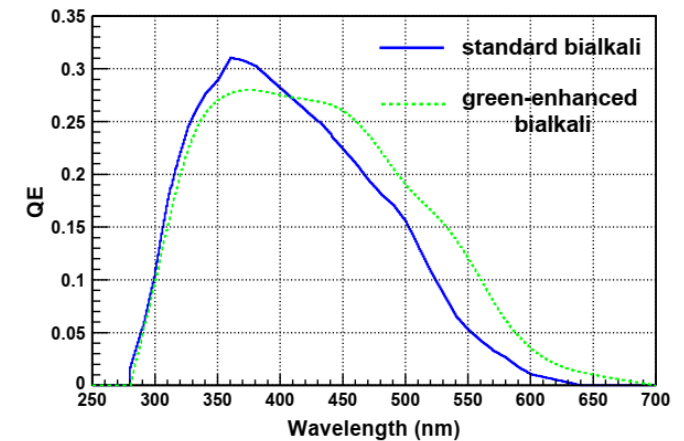
Photodetector – PMT-130 (1500V)

Pulse analyzer – Oscilloscope Lecroy 620Zi

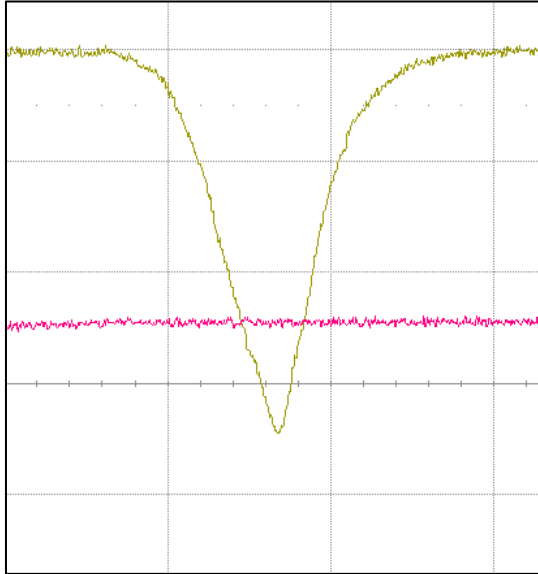
### Sb-K-Cs photocathode



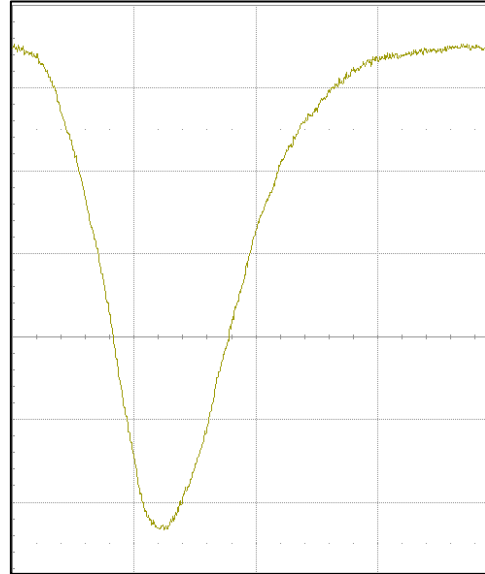
### Bialkali photocathode



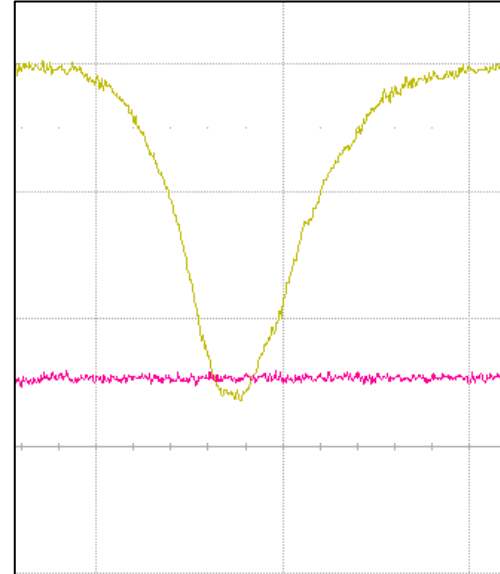
# Pulse shape (Generator pulse = 20 ns)



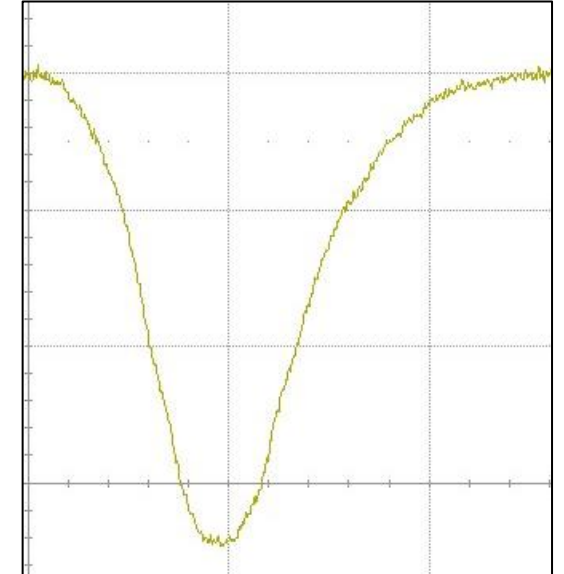
**Saint Gobain BCF-92**  
trailing edge = 12 ns



**Kurarai Y11**  
trailing edge = 24 ns



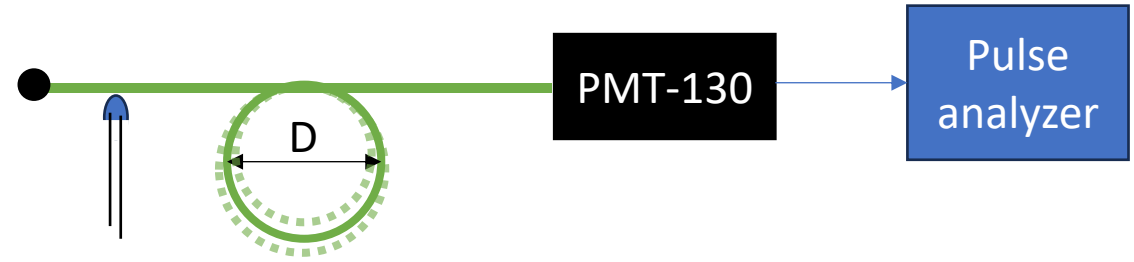
**1<sup>st</sup> Tver**  
trailing edge = 16 ns



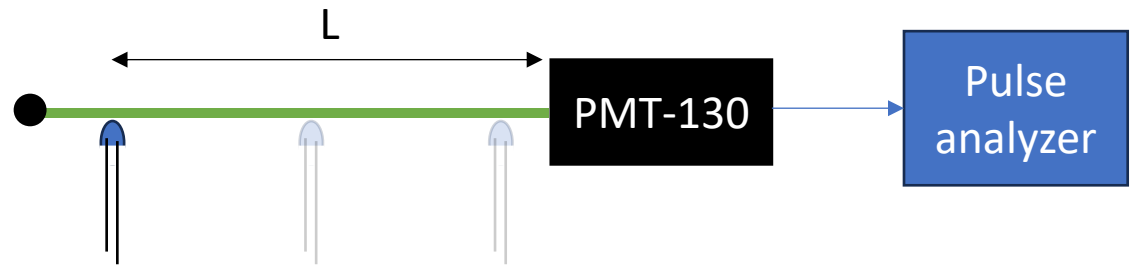
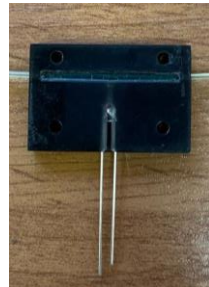
**2<sup>nd</sup> Tver**  
trailing edge = 20 ns

# Experimental setups

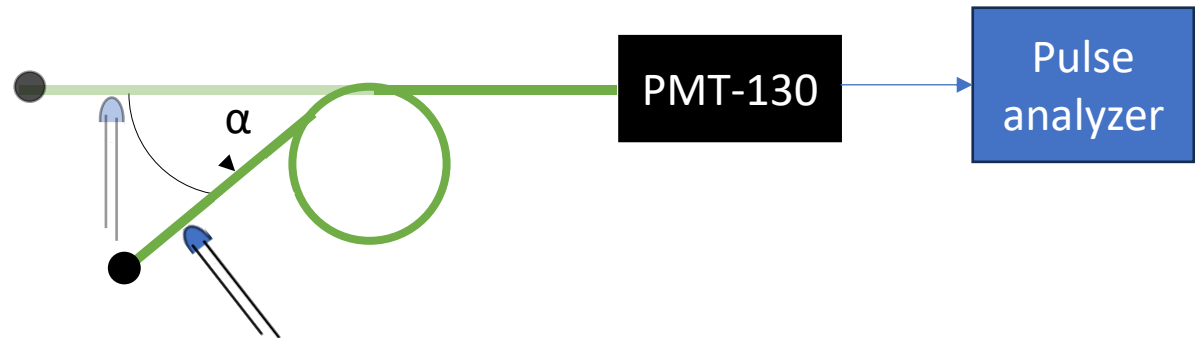
Bending loss measurement



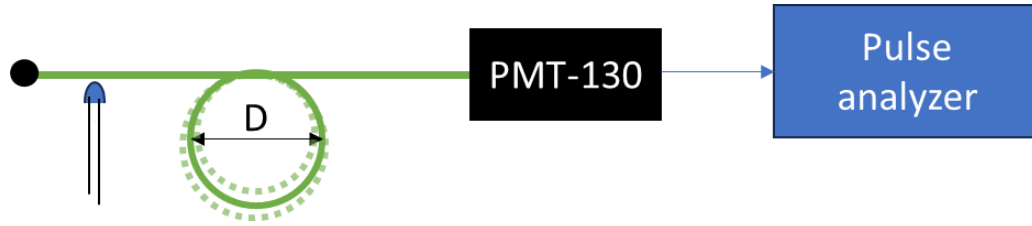
Relative light absorption & Light collection efficiency



Bending loss vs Arc length



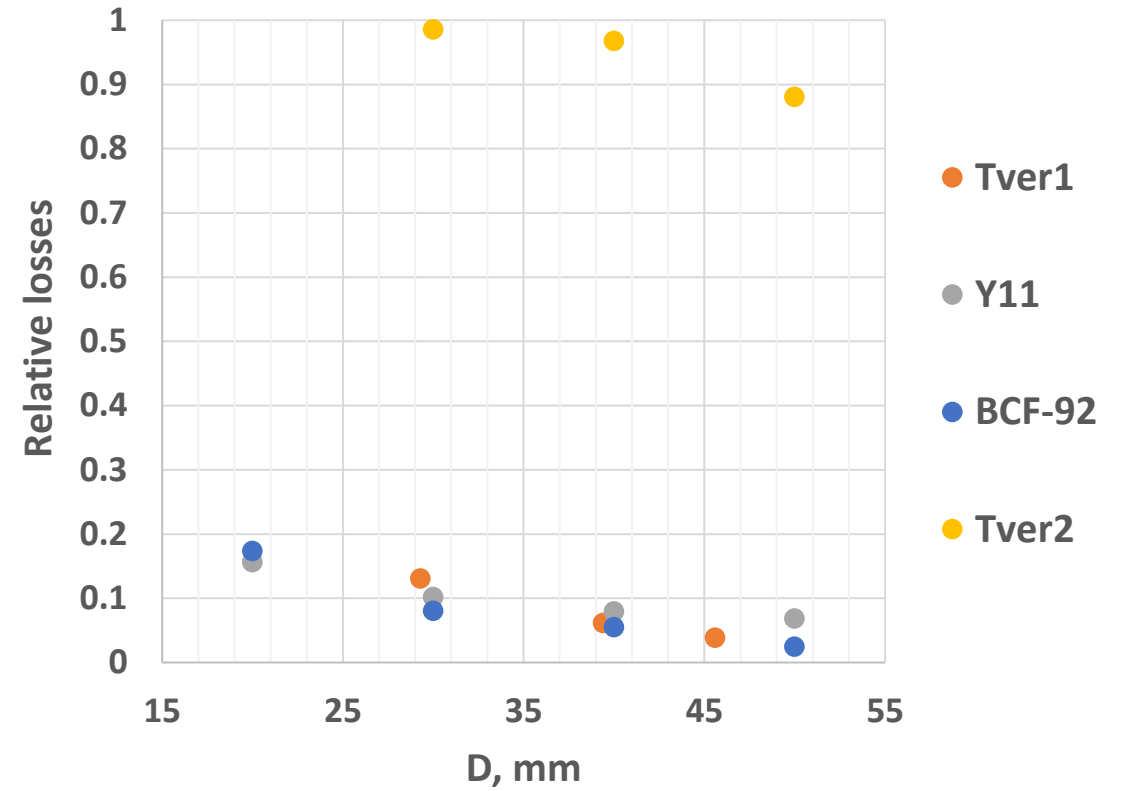
# Bending losses



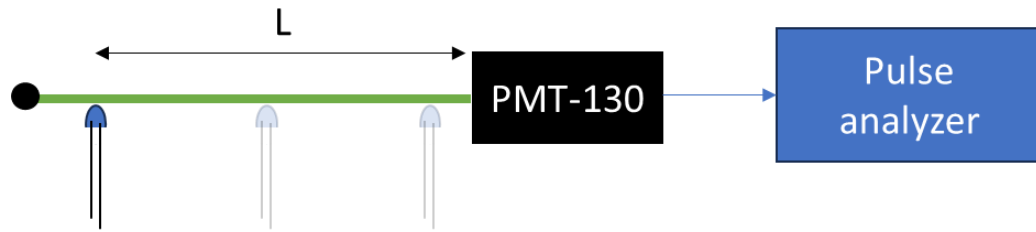
**Single loop**

**Fixed light path length**

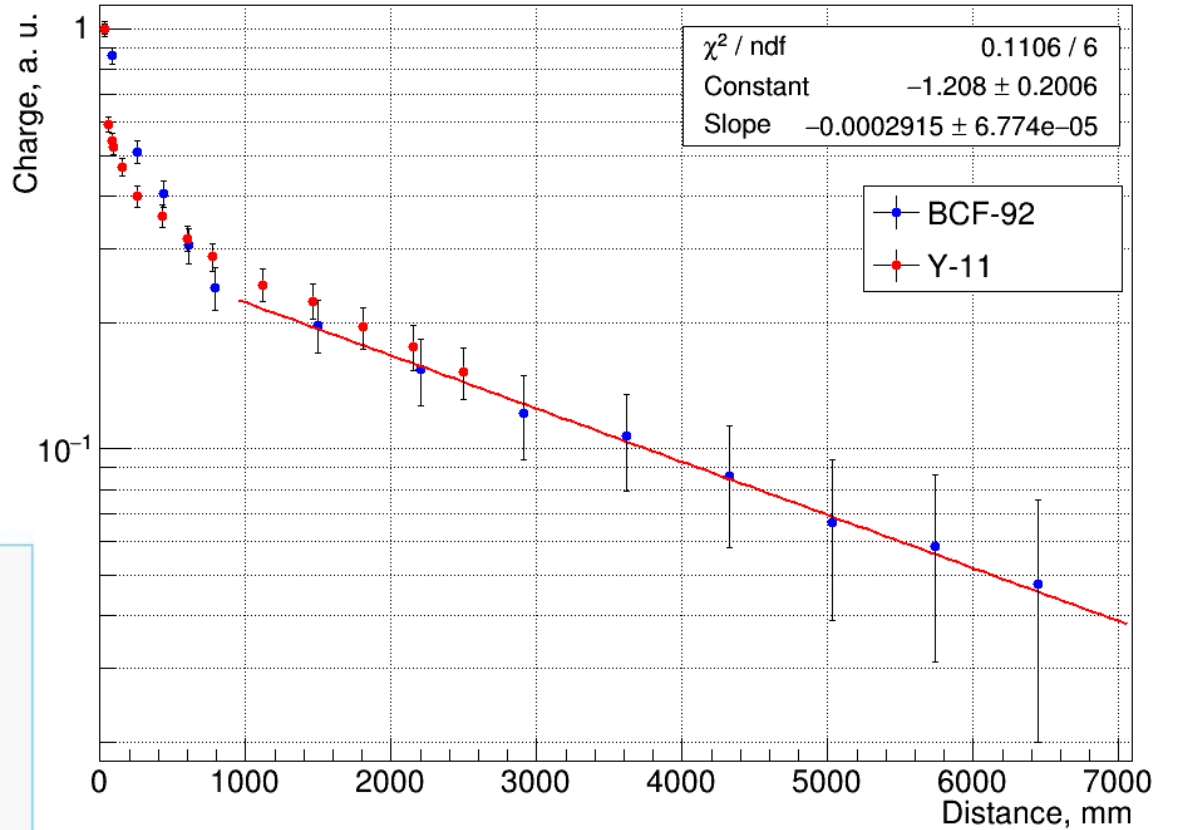
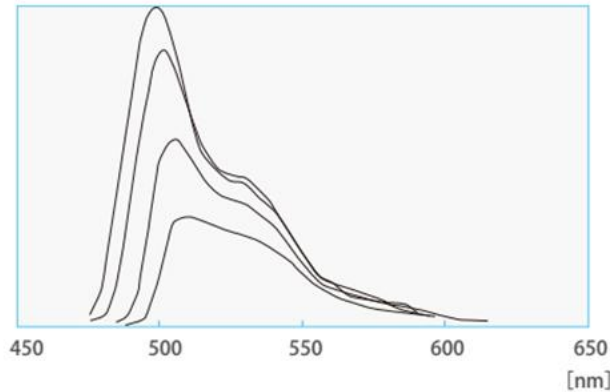
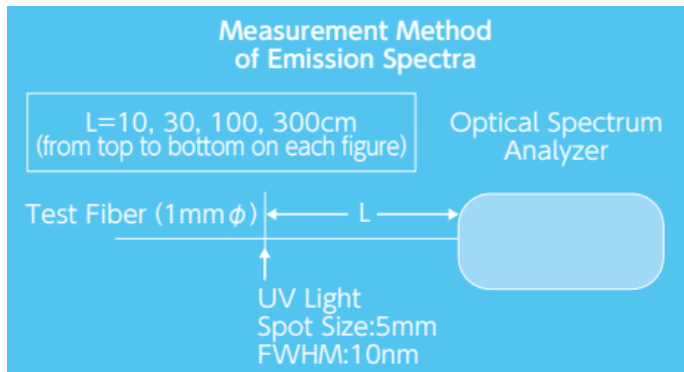
**30mm btw loop and PMT**



# Light transportation in WLS

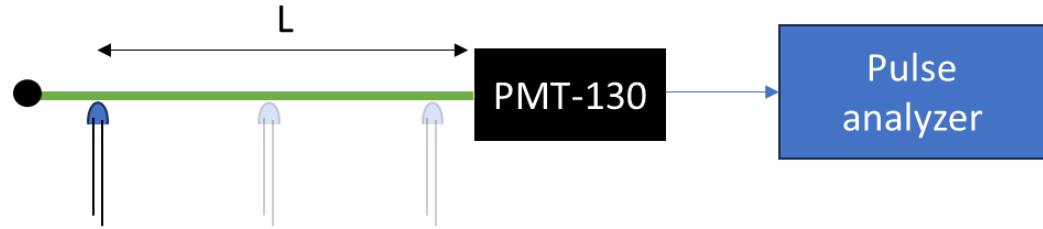


Kurarei datasheet:

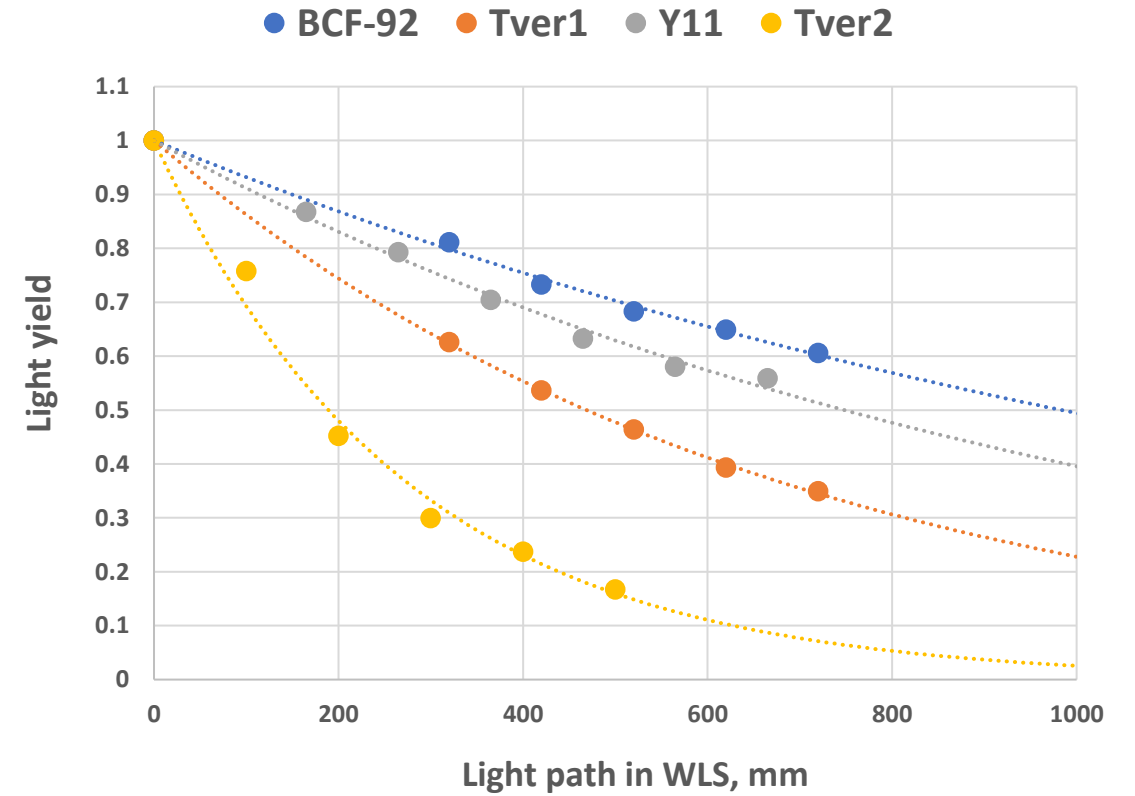
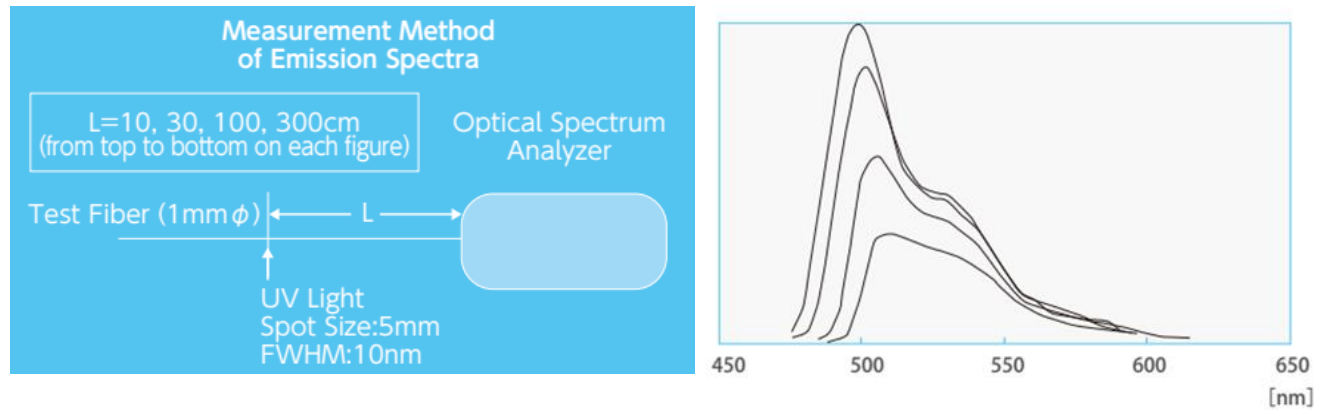


Attenuation length:  $\sim 3.5 \text{ m}$

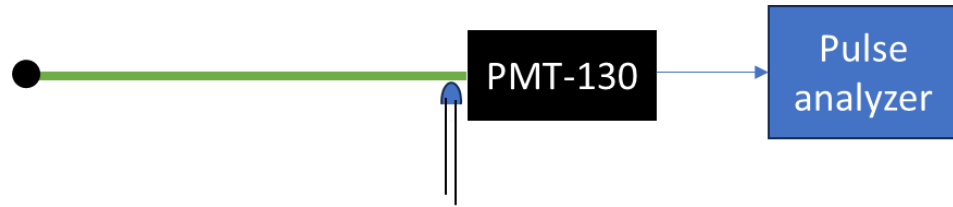
# Relative light absorption



Kurarai datasheet:



# Relative light yield



**Closest LED position**

**LED spot size:  $\varnothing$ 1.5mm**

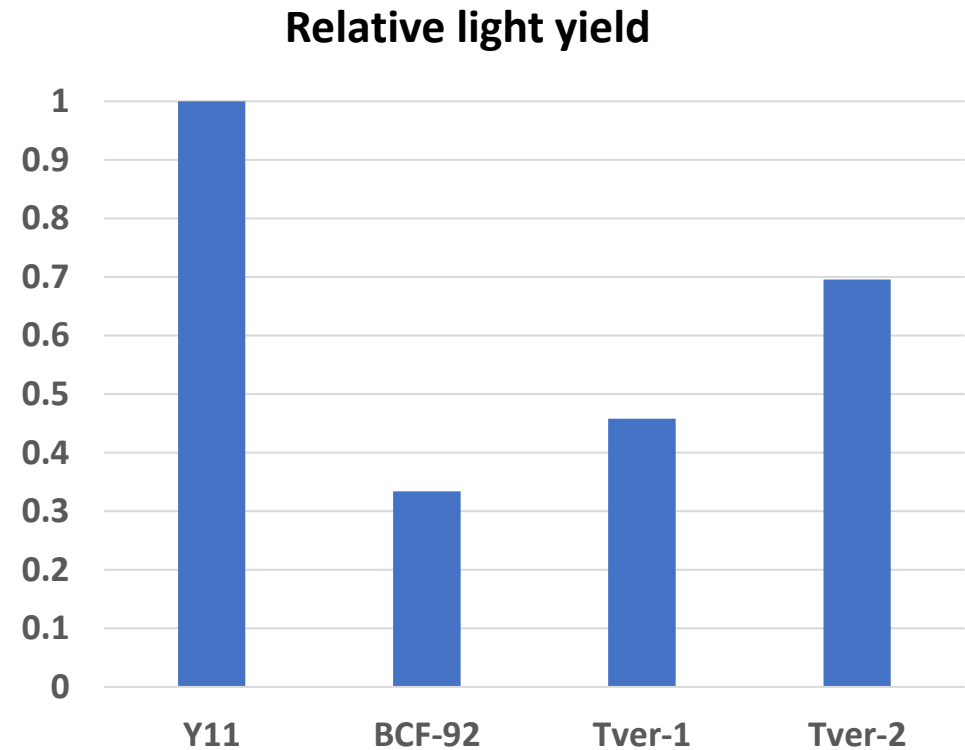
**Shifters diameter:**

Y11 -  $\varnothing$ 1mm

BCF-92 -  $\varnothing$ 1mm

Tver1 -  $\varnothing$ 1.2mm

Tver2 -  $\varnothing$ 1.2mm





# Dependence on the number of loops

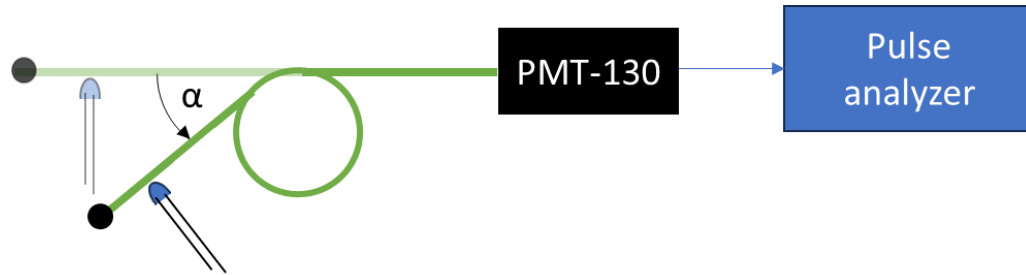
Influence of the number of loops on the light losses:

- Decrease of number of photoelectrons
- Increase of width of energy distribution → degradation of energy resolution

Sources of energy resolution degradation:

- Difference in light path in WLS
- Losses in bended WLS

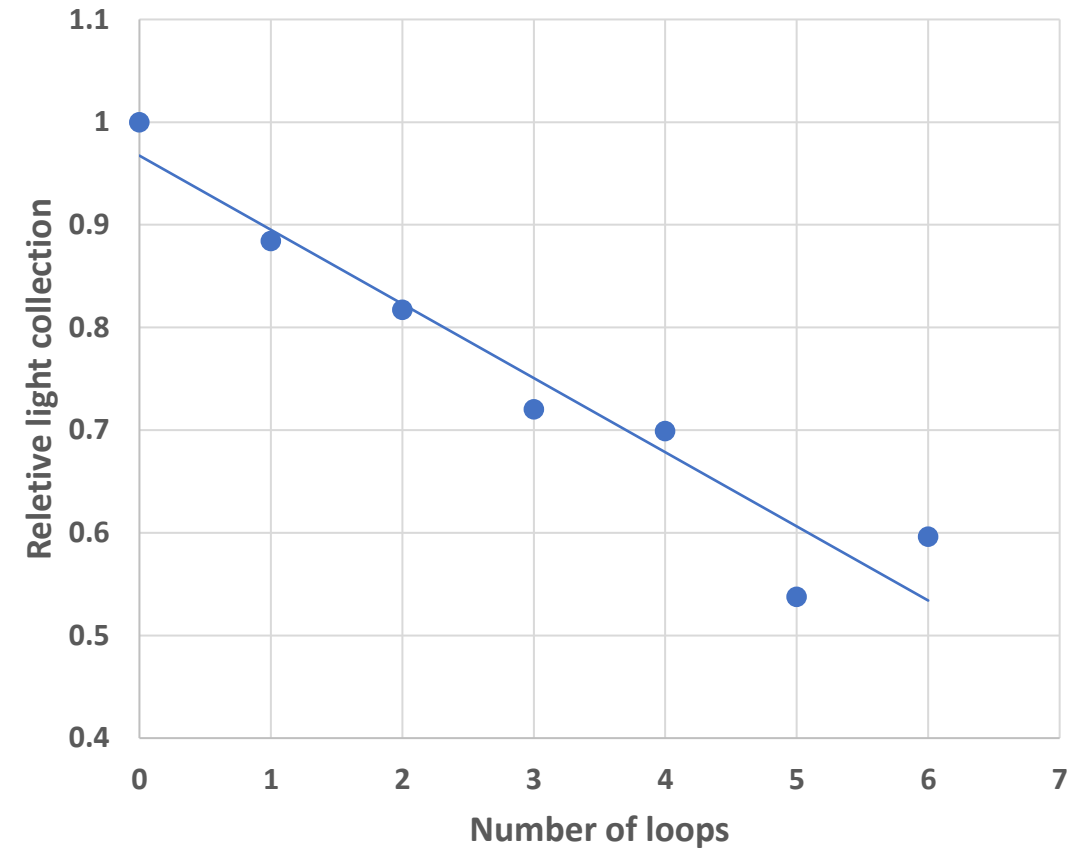
# Dependence on the number of loops



**WLS: Kyrarai Y11**

**D = 30mm**

**Base ~ 50cm**

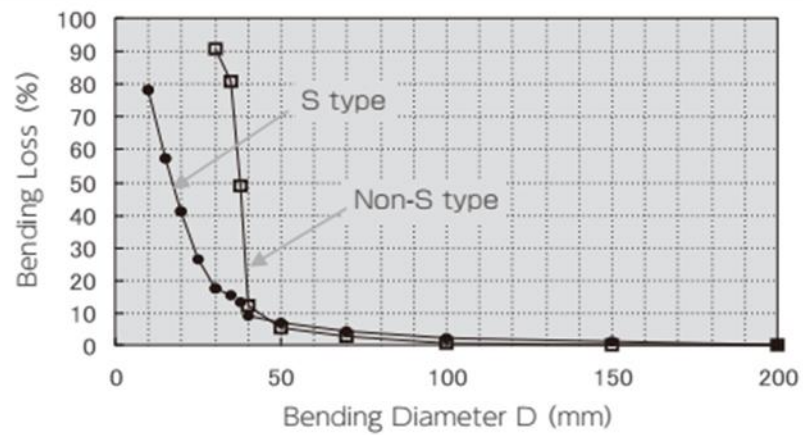


# Summary

	Y11, Ø1mm	BCF-92, Ø1mm	Tver1, Ø1.2mm	Tver2, Ø1.2mm
<b>Light yield</b>	1	0.33	0.45	0.69
<b>Bending loss @ D30mm, %</b>	10	8	12	99
<b>Light absorption @ 1m, %</b>	60%	50%	75%	95%
<b>Trailing edge, ns</b>	24	12	16	20

# Back-up

Multi-cladding Kurarai shifters:



Kurarai data:

