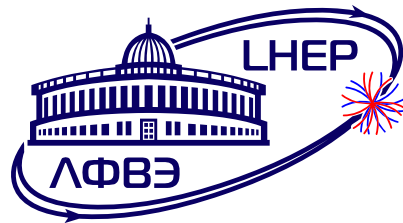
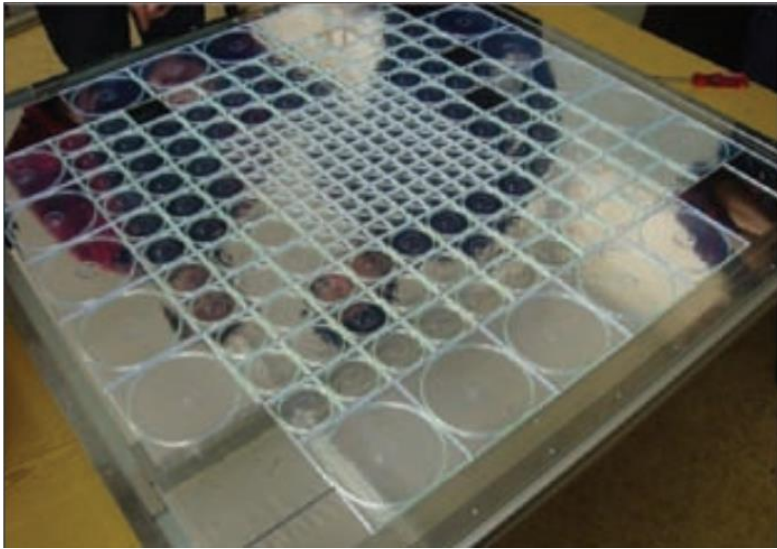

Comparative study of wavelength shifters for scintillation tile readout



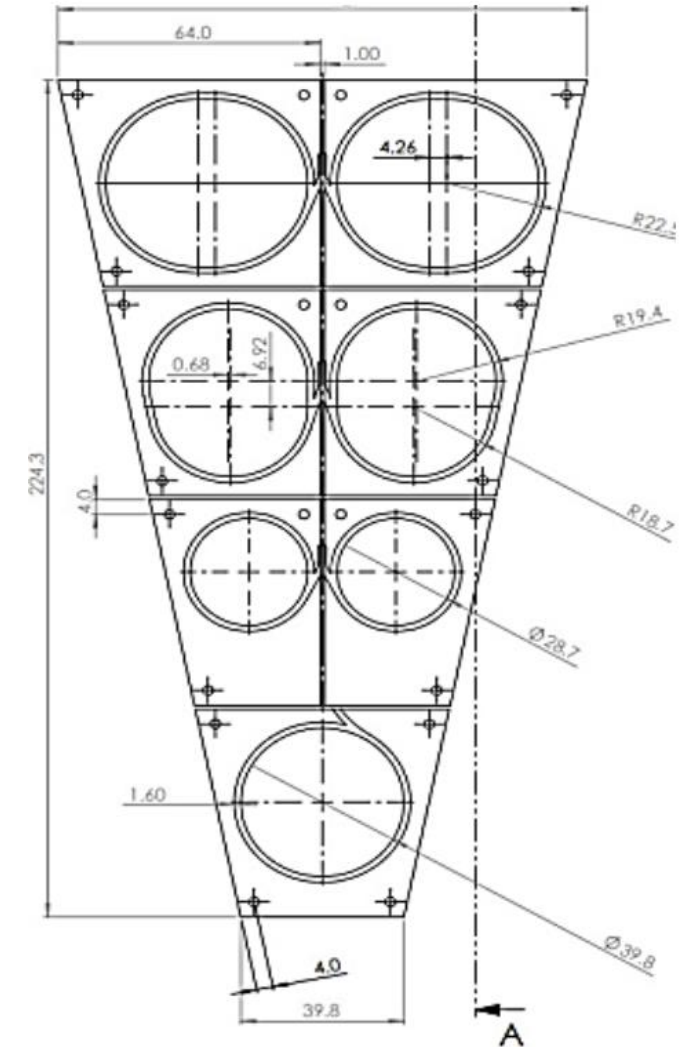
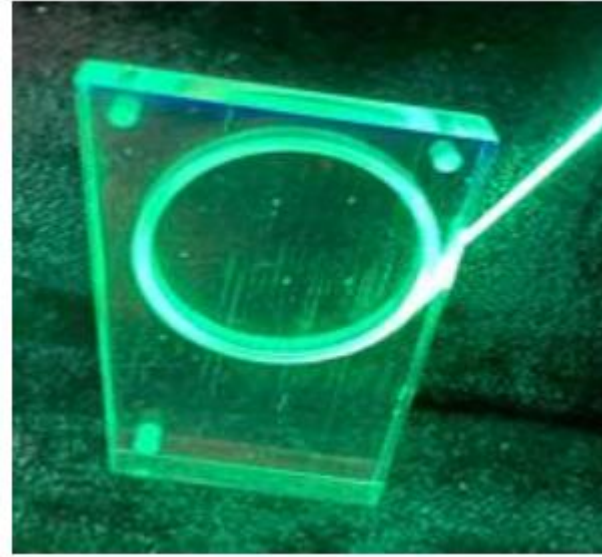
Filipp Dubinin
on behalf of MEPhI and JINR group

Moscow, 2024

Tile scintillators readout technic



* S. Klemin et al.



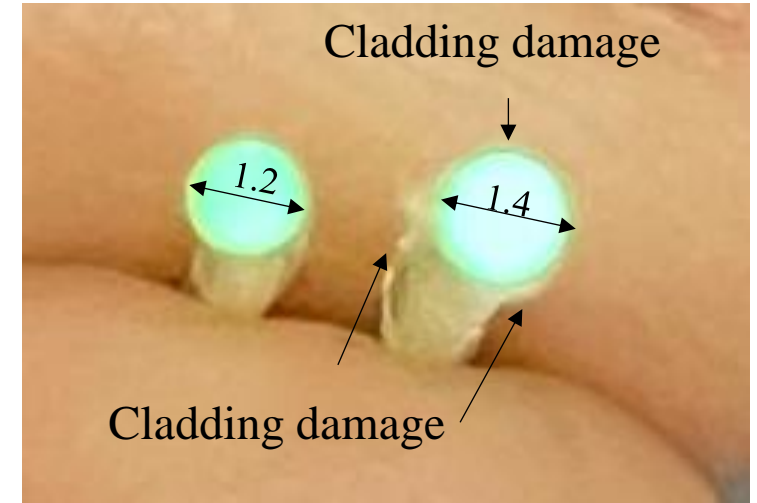
Tile scintillators with embedded wave length shifters (WLS)

- ❖ Homogeneous light collection
- ❖ Individual readout of each tile
- ❖ Small number of channels
- ❖ Coverage of wide area

Materials & equipment

Single cladding shifters:

- ❖ Kurarai Y11, Ø1mm
- ❖ Gaint Gobain BCF-92, Ø1mm
- ❖ 1st Tver shifter, Ø1.2mm – **mechanically weak cladding**
- ❖ 2nd Tver shifter, Ø1.2mm – **weak cladding, core D=1.2..1.4mm**



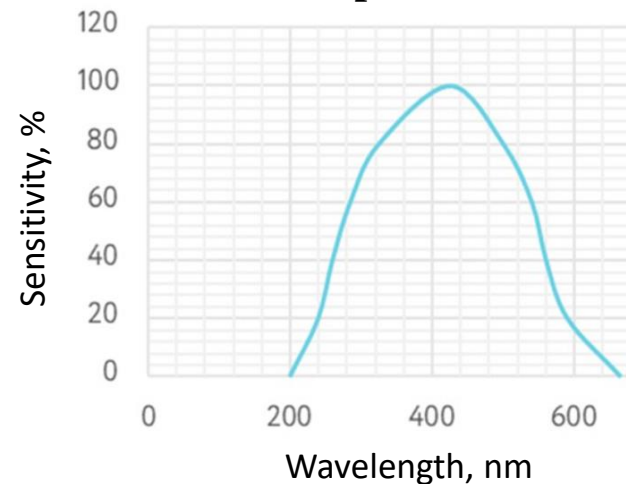
LED in pulse mode

- $t_p = 20$ ns (from pulse generator)
- LED wavelength = 400 nm

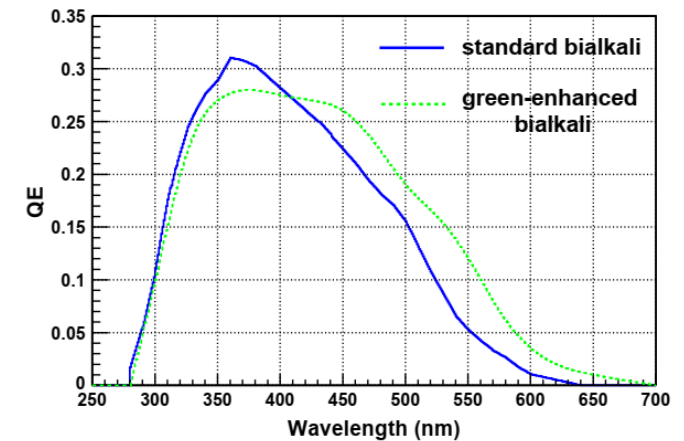
Photodetector – PMT-130 (1500V)

Pulse analyzer – Oscilloscope Lecroy 620Zi

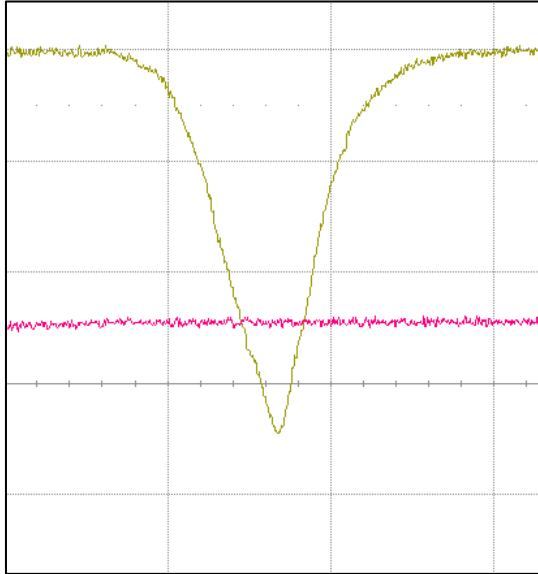
Sb-K-Cs photocathode



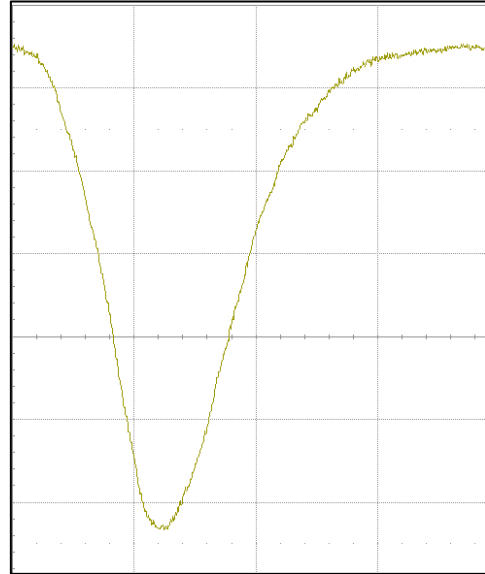
Bialkali photocathode



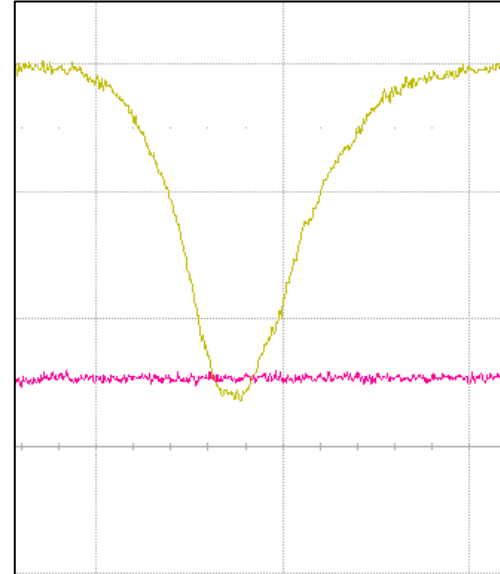
Pulse shape (Generator pulse = 20 ns)



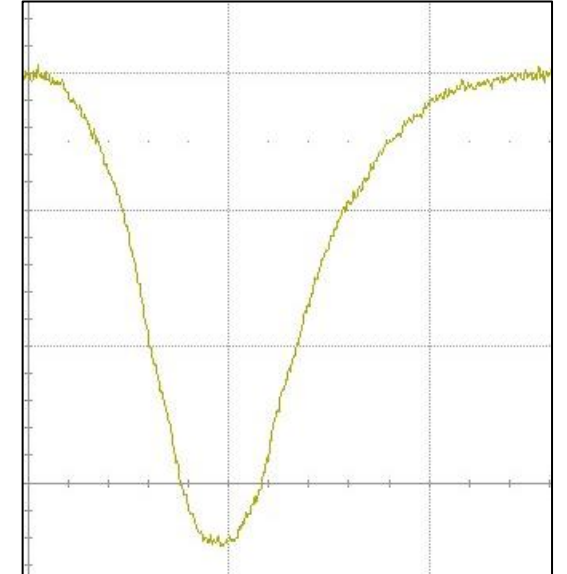
Saint Gobain BCF-92
trailing edge = 12 ns



Kurarai Y11
trailing edge = 24 ns



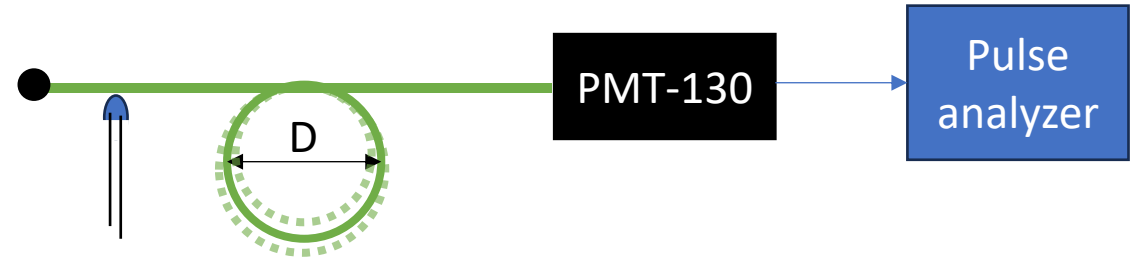
1st Tver
trailing edge = 16 ns



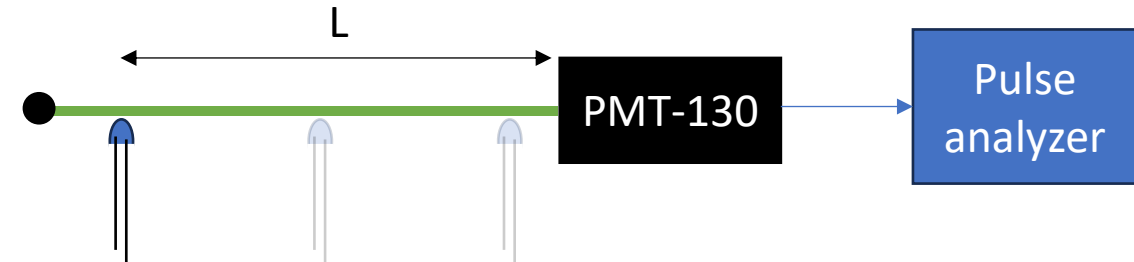
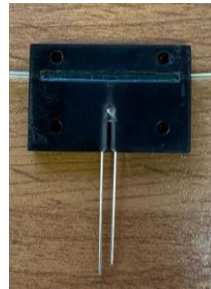
2nd Tver
trailing edge = 20 ns

Experimental setups

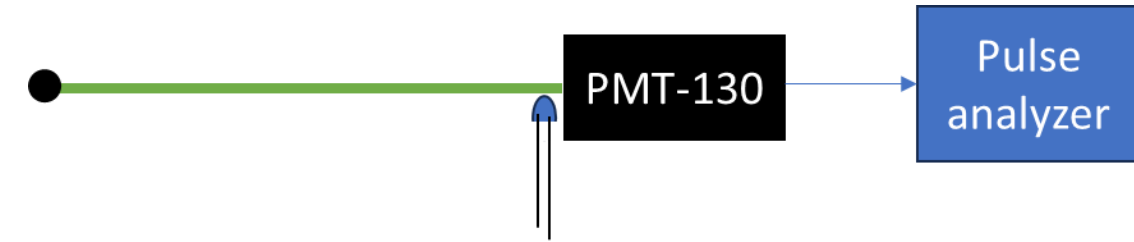
Bending loss measurement



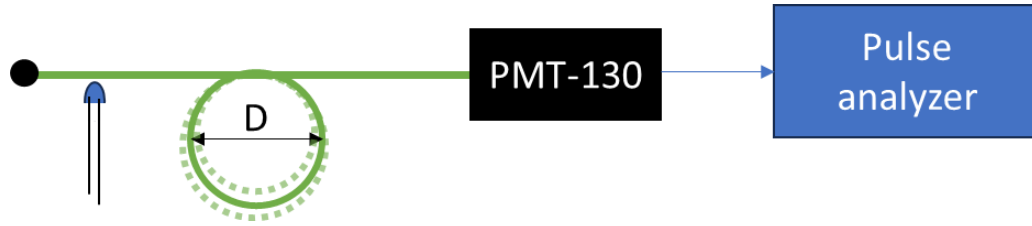
Relative light absorption



Light collection efficiency



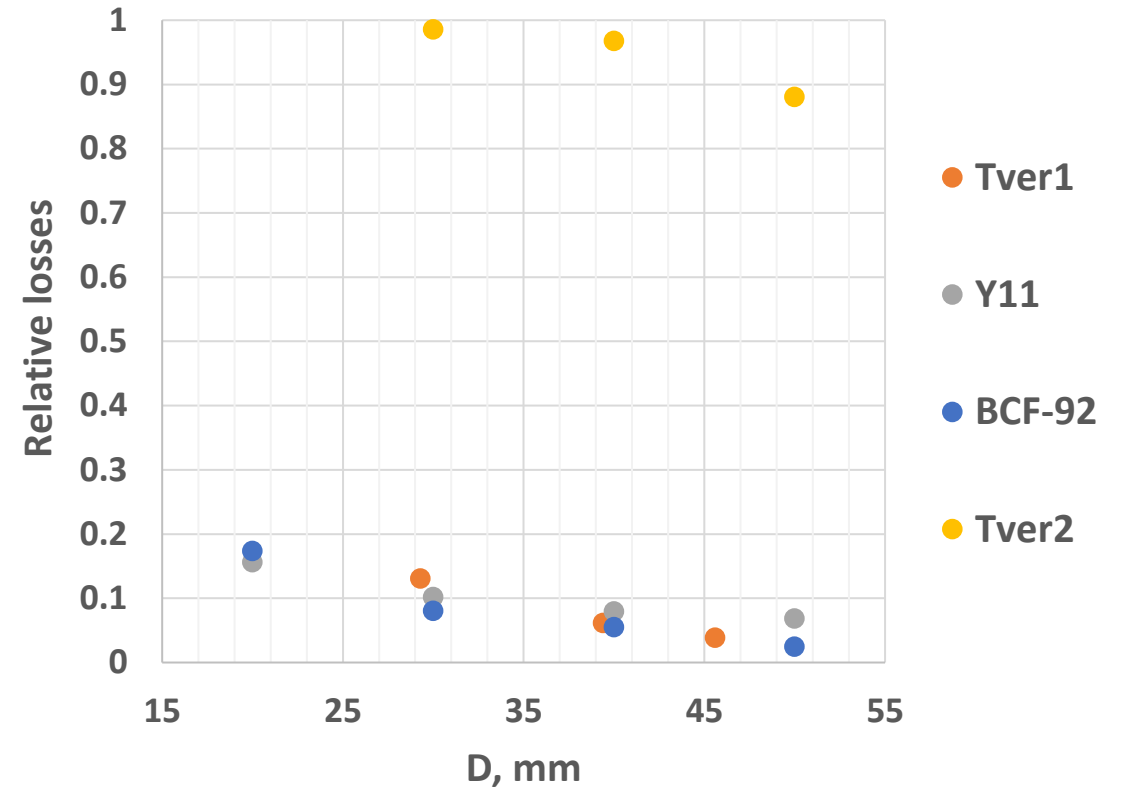
Bending losses



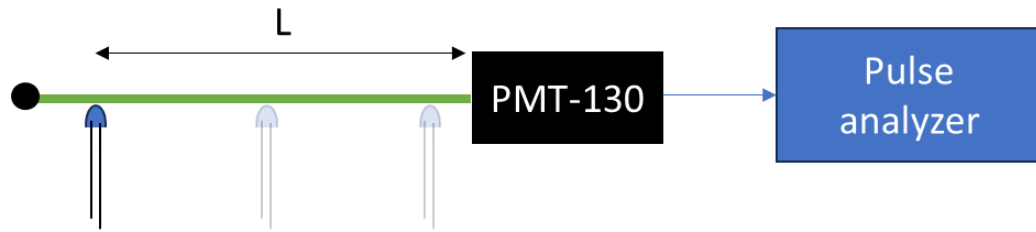
Single loop

Fixed light path length

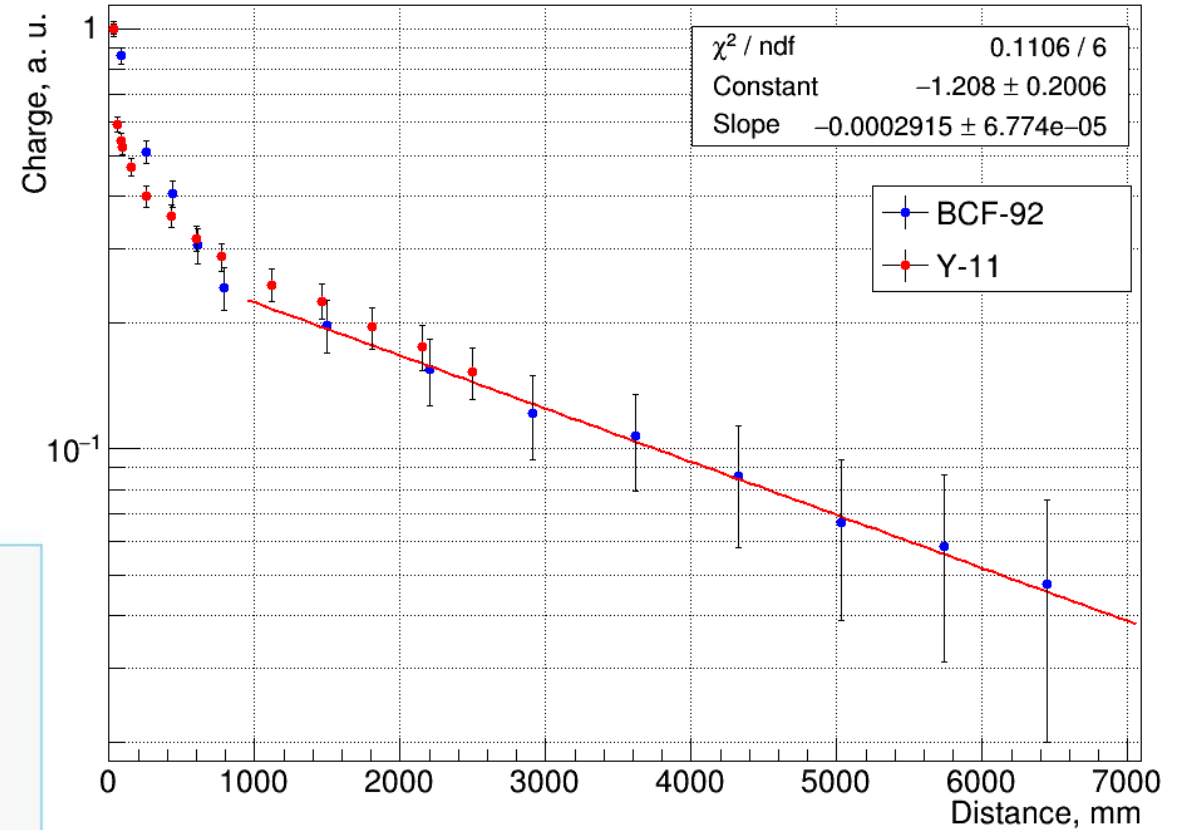
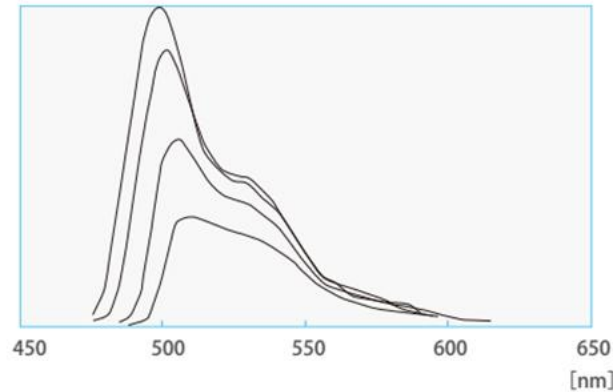
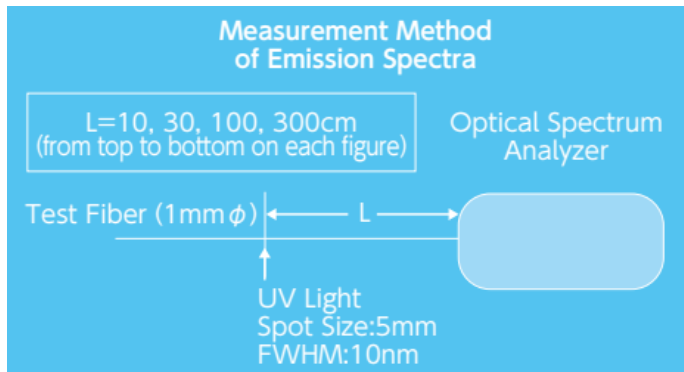
30mm btw loop and PMT



Light transportation in WLS

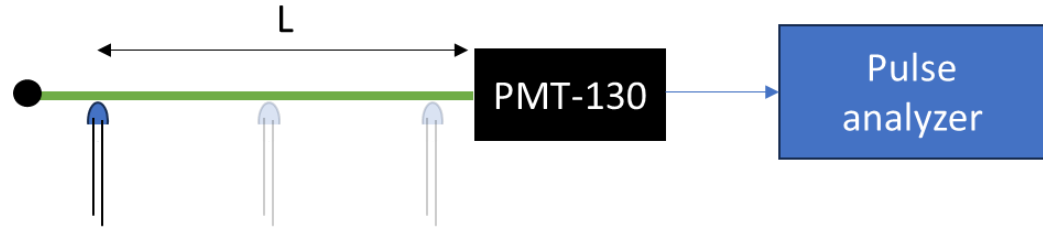


Kurarai datasheet:

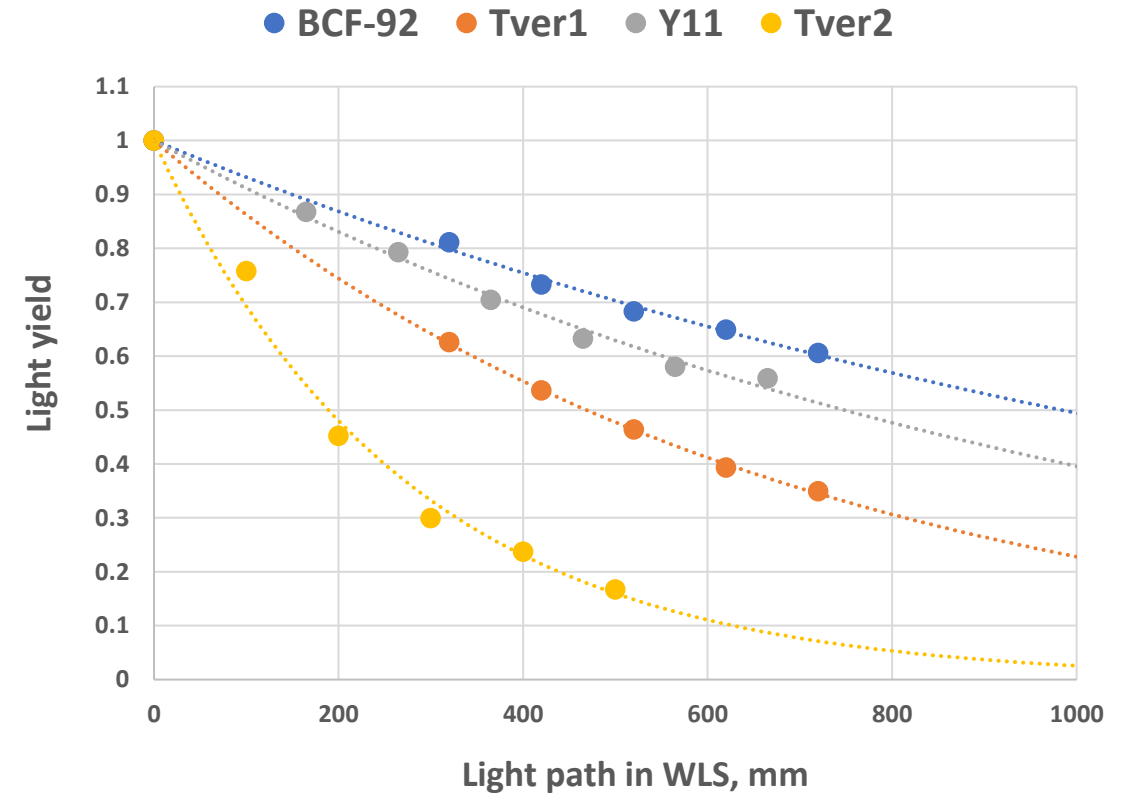
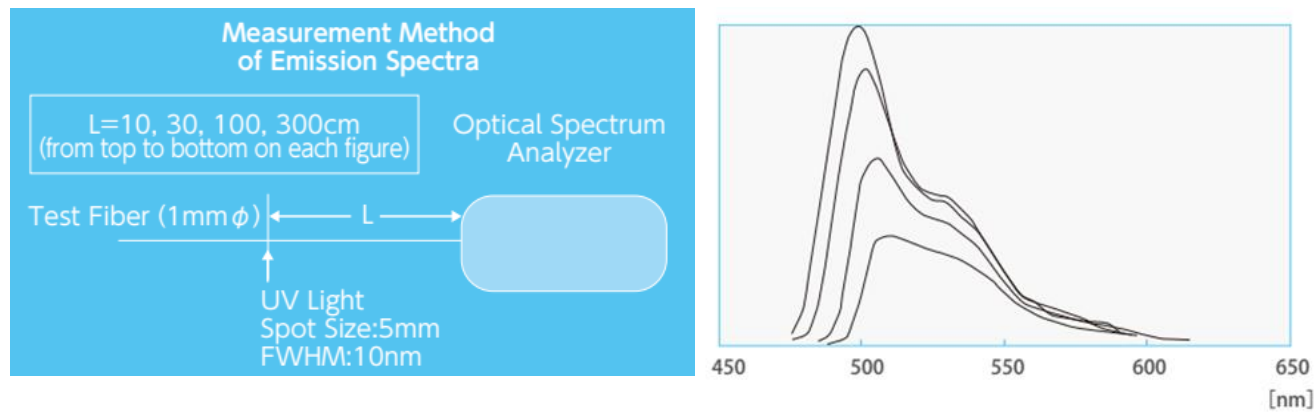


Attenuation length: $\sim 3.5 \text{ m}$

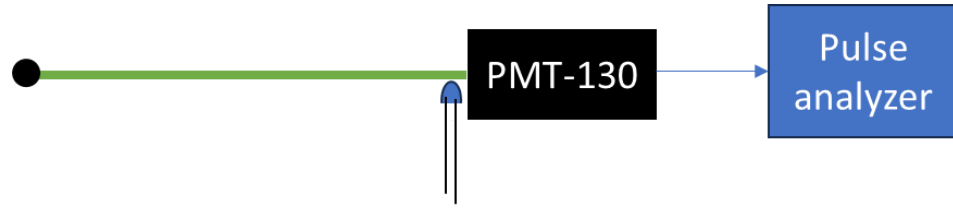
Relative light absorption



Kurarai datasheet:



Relative light yield



Closest LED position

LED spot size: \varnothing 1.5mm

Shifters diameter:

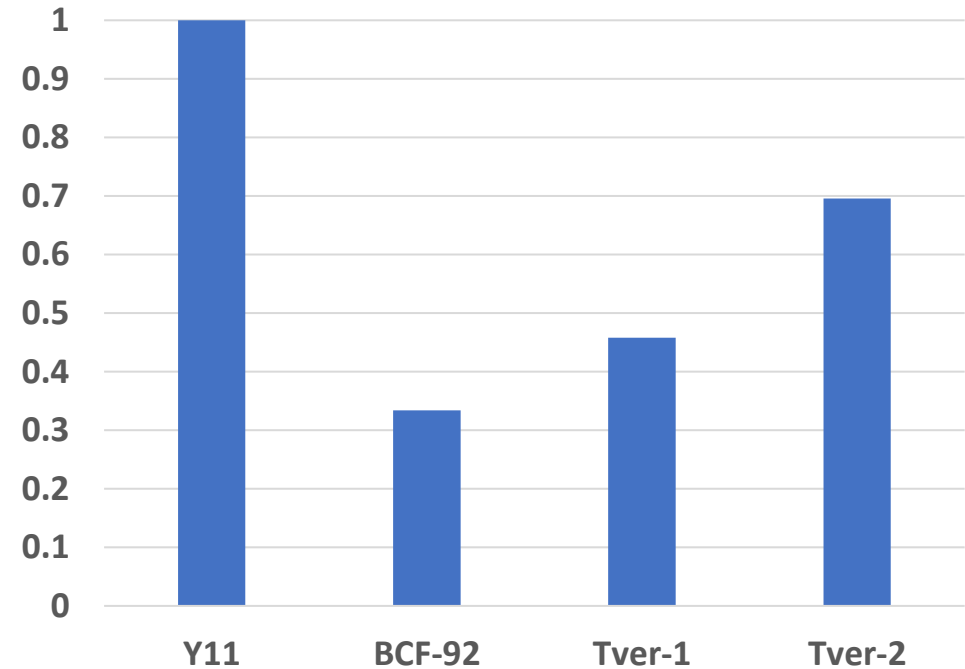
Y11 - \varnothing 1mm

BCF-92 - \varnothing 1mm

Tver1 - \varnothing 1.2mm

Tver2 - \varnothing 1.2mm

Relative light yield

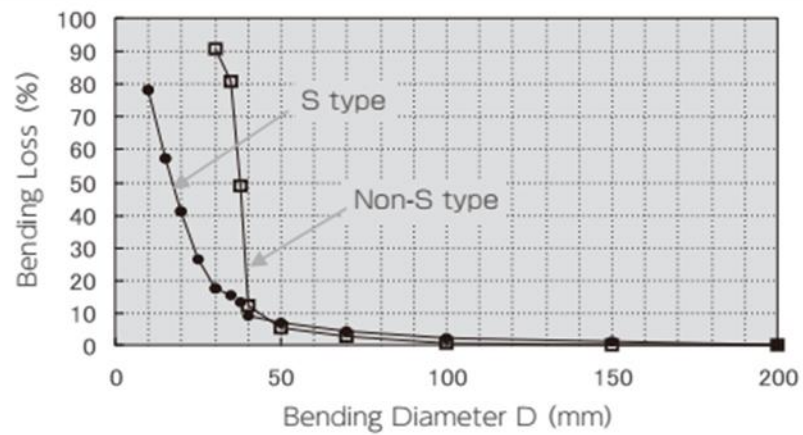


Summary

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

Back-up

Multi-cladding Kurarai shifters:



Kurarai data:

