SDC-92-275

SDC
SOLENOIDAL DETECTOR NOTES

BETTER RED THAN DEAD

June 8, 1992

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After irradiation, polystyrene based scintillators are known to be absorbing more of short-wavelength lights than long-wavelength lights, resulting decrease in light yield[1]. Therefore, a scintillator which emits longer wavelength light is expected to be more radiation hard than ones which emit shorter wavelength (see Figure 1 in ref[1]). As a test of candidate materials for endcap region in SDC calorimeter, 3 types of tile/fiber samples in different wavelength region were irradiated by ^{60}Co source in Phoenix Memorial Laboratory at University of Michigan. The light loss after damage and recovery were measured at FNAL.

1 Scintillating Tile and Waveshifting Fiber

The scintillating tiles used are 2.65 mm thick polystyrene-based scintillators from Kuraray Co. with a shape and size shown in figure 1. The edges of tiles were painted with BC600 reflected paint and wrapped with aluminum foil to increase light yields and to achieve better response uniformity and with marvel guard paper for protection of surface. A fiber, 1 mm in diameter and 120 cm long, was routed out through the key hole shape groove path and the ends were polished to get a consistant optical contact with the PMT. Optical coupling grease was also used during all the measurements.

The samples were Kuraray SCSN81, and SCSN81Y7(60ppm of Y7) scintillating tiles, and Kuraray 3HF+O2, and 3HF+R3 scintillating-shifter fibers and also Bicron BCF91 and BCF91A (green) waveshifting fibers as listed in table 1.

2 Evaluation of Light Yield

The ^{60}Co or ^{90}Sr induced current from a scintillating tile/fiber was measured with a pi-coammeter, Keithley 485 using a Hamamatsu R669 photomultiplier tube. The Quantum Efficiency of R669 as a function of wave length is shown in figure 2. Photomultiplier dark currents were measured and subtracted from the current readout. PMT gain variation was monitored by measuring a set of reference tiles (5 tiles with same materials as in set A but kept without irradiation). PMT gain stability during a measurement (usually over one hour) was estimated to be less than 1% by comparing the output currents of the reference tiles measured before and after the sample measurements. For each measurement, the light

Table 2: Relative light yield before and after 3 Mrad of irradiation.

set	relative light yield	3 days	7.5 months	fiber replaced
A	1.00	0.57	0.59	0.68
B	0.95	0.56	0.56	-
C	0.50	0.56	0.55	0.70
D	0.33	0.76	0.74	0.93

a green fiber). Although the relative light yield of the green tile with a red fiber is only 33% of the light yield of standard tile/fiber (blue/green) even with red sensitive photomultiplier, it is still worth investigating for the EM section of endcap region.[1]

Acknowledgement

We would like to thank Robert Blackburn in Phoenix Memorial Laboratory at University of Michigan for performing the ^{60}Co irradiation to the scintillator samples.

References

[1] A. Bross and A. Pla-Dalmau, "Radiation Induced Hidden Absorption Effects in Polystyrene Based Plastic Scintillator", FERMILAB-Pub-90/224

[2] K. Hara et al, "Radiation Hardness Study of Scintillating Tile/Fibers", SDC-92-00186

[1] We are repeating the same measurements but using waveshifting fibers (O2 and R3 fibers without 3HF) and more commonly available red sensitive PMT (Phillips XP2013B).

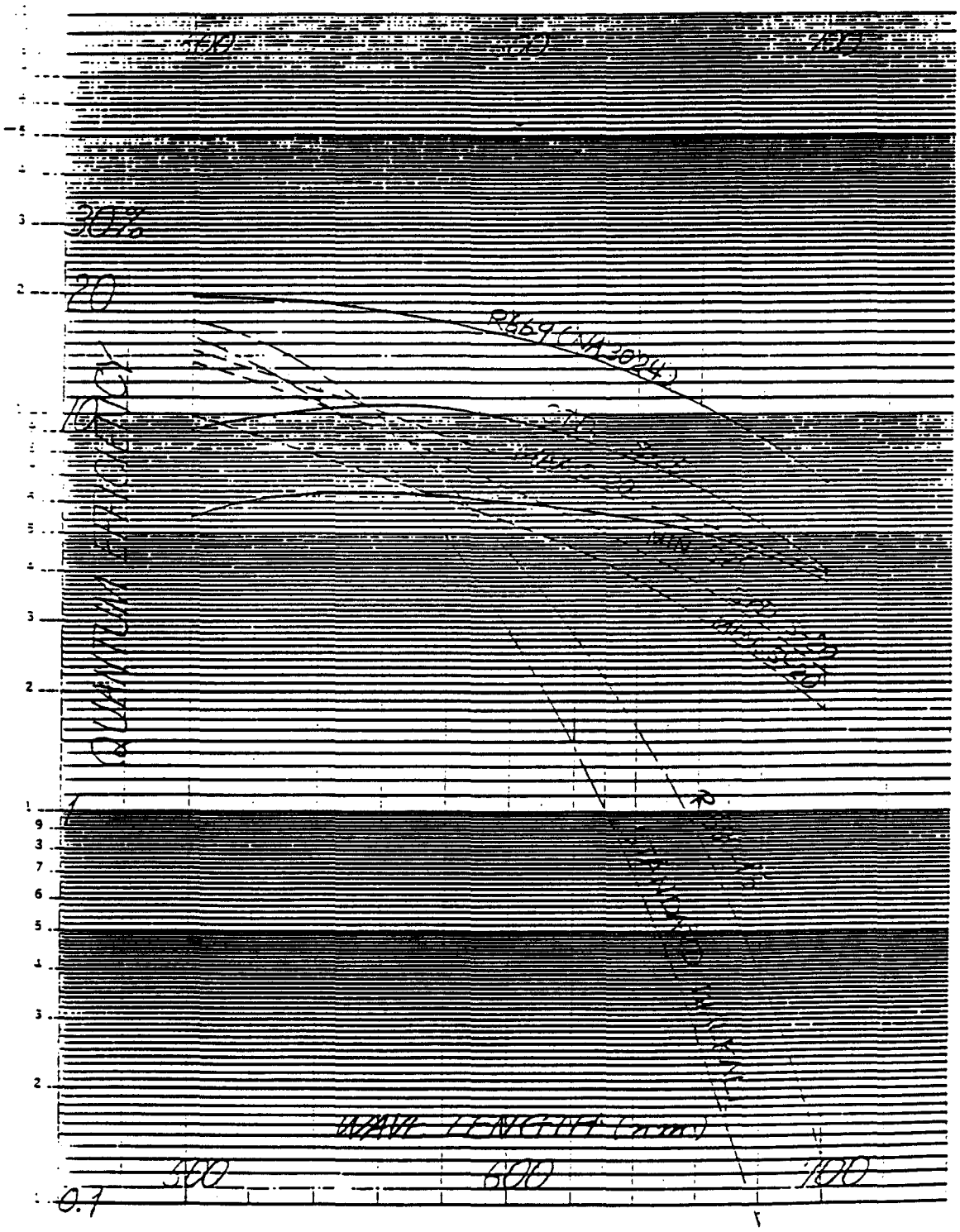

Figure 2: QE curve of R669 PMT