Internal Report No. 6

Temperature Variation of Photomultiplier Gain

M. Israel

(Summary of results observed by William Colglazier, January and February 1966. For complete data see notebook labeled "Colglazier P.M. Tests")

Summary

The temperature variation of the gain of EMI photomultipliers 62555/A, 9524B, and 9647 was measured in the range -10° C to $+40^{\circ}$ C. Gain variation near -1 percent per degree centigrade (i.e. lower gain at higher temperatures) were recorded for all three tubes.

Procedure

A NaI (Tℓ) scintillator crystal was attached directly to the photomultiplier face with an interface of optical grease. The photomultiplier output was attached to a charge sensitive (PM) amplifier whose output was fed into the RIDL pulse height analyzer. The gamma ray spectrum of Cs^{137} was recorded and the analyzer channel of the photopeak was taken as a measure of the gain.

The gain was measured with the NaI crystal and PM tube inside a temperature chamber. To insure thermal equilibrium, several spectra were recorded, at least a half-hour apart, while the chamber was held at constant temperature; when two successive spectra showed the same position for the photopeak this position was taken as the "gain" at that temperature. (e.g., when the 6255 was cooled from room temperature to 2° C, equilibrium was reached in three hours.)

Results are plotted in the accompanying figures. Note that the observed temperature coefficient for the NaI (Tℓ)-PM tube combination

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Results are plotted in the accompanying figures. Note that the observed temperature coefficient for the NaI (Tℓ)-PM tube combination

is approximately -1 percent/^{o}C. According to reference 1, the temperature coefficient of NaI (Tℓ) is -0.12 percent/^{o}C, so the observed temperature coefficient of -1 percent/^{o}C must be attributed primarily to the PM tube.

References

1. W. W. Managan, Recent Developments in Alkali Halide Scintillation Crystals, IRE NS-9 (3) 1 (June 62).

2. R. V. Smith, et al., Use of Scintillation Counters for Space Radiation Measurements, IRE NS-9 (3) 386 (June 62). (Temp. coef. -0.19 to -0.53 percent/^{o}C between 25^{o} C and 70^{o} C for various RCA tubes.)

3. R. E. Rohde, Gain vs. Temperature Effects in NaI Photomultiplier Scintillation Detectors Using 10 and 14 Stage Tubes, IEEE NS-12 (1), 16 (Feb. 65). (Various PM tubes - RCA, EMI, Amperex, 0^{o} C to 50^{o} C. Some show maximum gain near 21^{o} C, lower gain at lower and at higher temperature.)

WM COLLAZIER

GAIN vs TEMPERATURE

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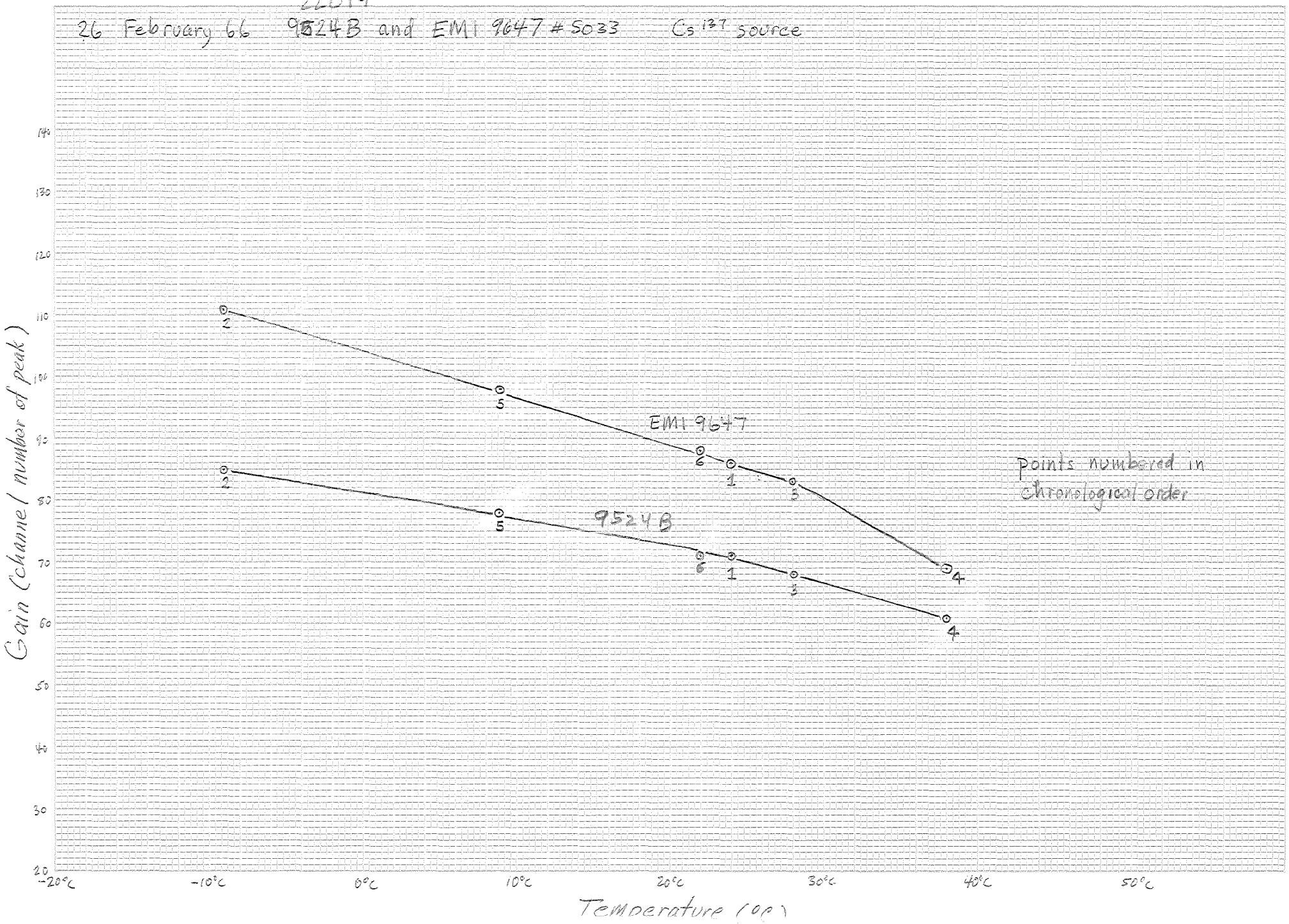
26 February 66 9524B and EMI 9647 # 5033 Cs^{137} source



Wm. Cole

GAIN vs TEMPERATURE

17 February 66 PM Tube NaI Crystal 6255SA S/N 12226 Cs^{137} Source
1000 v pos. high voltage coarse gain ⅛ Conv gain 8 PM Amp # 1

Voltage Calibration

40^{th} channel - 4.48 v
80^{th} channel - 8.07 v
60^{th} channel - 6.22 v