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TEMPERATURE STABILITY OF A STILBENE SPECTROMETER

by

James G. Dante

November 1966

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TEMPERATURE STABILITY OF A STILBENE SPECTROMETER

James G. Dante

Terminal Ballistics Laboratory

DASA NWER Subtask A2-11.052

ABERDEEN PROVING GROUND, MARYLAND

B A L L I S T I C R E S E A R C H L A B O R A T O R I E S

MEMORANDUM REPORT NO. 1808

JGDante/ss
Aberdeen Proving Ground, Md.
November 1966

TEMPERATURE STABILITY OF A STILBENE SPECTROMETER

ABSTRACT

A stilbene spectrometer will be used to measure neutron and gamma ray spectral distribution and intensity during Project HENRE at the Nevada Test Site. Daily temperature changes of from 30° to 40°F are expected. This report presents the results of an investigation of changes in the entire spectrometer system due to variations in temperature. Changes in time of output pulses and gain of the entire system were observed over a temperature range of 12° to 132°F.

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INTRODUCTION

The Ballistic Research Laboratories (BRL) are participating in Project HENRE^{1*}, a group of experiments which will be conducted at the Nevada Test Site. The BRL Task is to measure the neutron and gamma ray spectra inside and outside several shielding enclosures consisting of iron and water-filled cubes and spheres.

One of the instruments which will be used to measure these spectra is a stilbene scintillation spectrometer utilizing pulse shape discrimination. This spectrometer is described in detail in References 2 and 3.

Since the spectrometer will be used in the Nevada desert, temperature changes of about 30° to 40° Fahrenheit are expected during the course of a single day. Previous investigations have shown that stilbene crystals were affected by temperature changes and that a change in gain of approximately 0.25 percent per degree centigrade could be expected (Reference 4). This report, however, will present the investigation of the effects of temperature change on the entire detector assembly, consisting of the stilbene scintillator, the photomultiplier tube with its associated circuitry, and a preamplifier.

The experiment entailed observing the effects of temperature on the zero-crossover time of the output pulses and on the overall gain of the system. The difference in crossover time between the electron pulses due to gamma ray interactions and the proton pulses due to neutron interactions makes it possible to electronically discriminate between the two types of particles. If the zero-crossover times of these pulses shifts in time the possibility exists that some gamma rays might be counted as neutrons and that some neutrons might be counted as gamma rays. Changes in the gain of the spectrometer would effect the overall accuracy of energy determination and would also tend to distort the energy resolution.

* References may be found on page 25.

APPARATUS

The detector system was composed of several units. The detector head, a 1.5-inch diameter by 1.5-inch high stilbene crystal, was optically coupled to a 56 AVP photomultiplier tube. This was mounted in a 0.015 inch thick aluminum light-tight can. The bleeder circuit for the photomultiplier tube was of typical design allowing both anode and dynode outputs. The preamplifier was a BRL design (BRL 568) which had a gain of 0.1. The bleeder circuit and preamplifier were mounted in a single chassis and intimately connected with the detector head. Thus the entire detector system constituted of a single compact package³.

The preamplifier output was fed into the discrimination system where particle identification took place. The output of this system was then fed into a multichannel analyzer (RCL 512) where the data were stored and recorded.

An environmental chamber with a controlled range of -100° to $+350^{\circ}\text{F}$ detector system. The dimensions of the chamber were 13.75 inches x 10 inches x 10 inches.

PROCEDURES

The set up of the experiment is shown in Figure 1. A weak sodium-22 (Na-22) gamma ray source was placed directly on the stilbene crystal and the entire detector unit was put in the environmental chamber. The time spectrum produced by the Na-22 source was measured at various temperatures. The peak of the gaussian time distribution served as a measure of the zero-crossover time. A typical spectrum is shown in Figure 2. The pulse height distribution of the Na-22 source was measured at these same temperatures and a typical distribution is shown in Figure 3. The extrapolated end point of the distribution is a measure of the gain of the spectrometer.

The first set of measurements was begun at a temperature of 75°F . The temperature was increased to 130°F at a maximum rate of 3°F per minute because the stilbene crystal is susceptible to thermal shock.

FIGURE I. BLOCK DIAGRAM OF EXPERIMENTAL SETUP

FIGURE 2. TIME SPECTRUM FOR NA-22 USING STILBENE SPECTROMETER

FIGURE 3. ENERGY SPECTRUM FOR NA-22 USING STILBENE SPECTROMETER SHOWING EXTRAPOLATED END-POINTS

At a temperature of 80°F two measurements were made in order to determine the time for the spectrometer to reach temperature equilibrium. The first measurement was made 15 minutes after the temperature was reached and another was made 2.5 hours after 80°F had been reached. Figure 4 presents the time spectra while Figure 5 presents the pulse height distributions. A shift of only 0.5 channel was observed in both cases. This is within the stability of the multi-channel analyzer. It was concluded that a 15-minute waiting period was sufficient time for the detector assembly to attain temperature equilibrium. After the measurements at 130°F were performed the temperature was slowly brought down to 30°F , and then returned to 75°F .

The second set of measurements was also begun at 75°F but the temperature changes were reversed in direction. The temperature was slowly brought down to 12°F where the system was allowed to remain for 17.5 hours. The temperature was increased to 120°F and remained at this temperature for 41 hours then slowly returned to 75°F .

RESULTS AND CONCLUSIONS

Shifts in the time spectra were observed for both tests 1 and 2. These data are tabulated in Table 1 and plotted in Figures 6 and 7. The overall changes in the peaks of the time spectra were 2.5 channels for test number 1 (5.3 percent) and 3.5 channels for test number 2 (6.2 percent). This shift is within the width of the acceptance limits for each type of particle. Therefore, it is concluded that the effects of temperature changes on the time for zero-crossover of each type of particle is negligible.

The change in gain was observed for both energies of the Na-22 gamma-ray spectrum. The results of the measurements for test 1 are tabulated in Table 2 and are presented in Figures 8 and 9. The results for both energies are similar. The gain shifts or differences between 30°F and 100°F are fairly constant and are about 5 percent in both cases. This is probably due to the overall instability of the system

FIGURE 4. TIME SPECTRA FOR NA-22 USING STILBENE SPECTROMETER
SHOWING VARIATION DUE TO WARM UP PERIOD.

FIGURE 5. ENERGY SPECTRUM FOR NA-22 USING STILBENE SPECTROMETER SHOWING VARIATION DUE TO WARM-UP PERIOD

EFFECTS OF TEMPERATURE CHANGES ON THE CROSS-OVER TIME FOR STILBENE SPECTROMETER

TABLE NO. 1

TEST NO. 1.		TEST NO. 2.	
TEMPERATURE °F	PEAK CHANNEL	TEMPERATURE °F	PEAK CHANNEL
75	47.4	75	52.6
80	47.6	65	52.5
80	48.0	51	52.2
90	48.2	37	51.7
102	48.4	27	51.5
112	48.5	12	50.6
124	48.5	12	49.3
132	48.6	27	49.6
120	48.6	32	49.8
111	48.4	49	50.3
101	48.3	57	50.6
91	48.3	77	51.2
81	47.9	90	51.5
81	46.6	105	51.9
71	46.6	120	52.2
60	46.6	120	51.7
52	46.6	108	51.9
40	46.8	98	52.6
30	46.8	83	52.8
40	46.1	77	51.6
52	46.2		
60	46.6		
75	47.4		

FIGURE 6. TIME SPECTRA FOR NA-22 SHOWING VARIATION WITH TEMPERATURE
TEST NO. 1

FIGURE 7 TIME SPECTRA FOR NA-22 SHOWING VARIATION WITH TEMPERATURE
TEST NO. 2.

EFFECTS OF TEMPERATURE CHANGES ON THE GAIN OF THE STILBENE SPECTROMETER

TABLE NO.2TEST NO.1

TEMPERATURE	°F	END- POINT	
		0.511 MEV.	1.27 MEV.
75		32	99.1
80		31.9	98.2
80		32.3	98.2
90		32.0	98.0
102		31.8	96.5
112		31.0	95.2
124		30.2	92.3
132		29.0	90.0
120		28.9	90.3
111		29.7	91.4
101		30.5	93.6
91		30.5	94.2
81		30.7	94.6
81		30.7	96.4
71		30.6	96.6
60		31.2	97.3
52		31.9	97.9
40		32.0	98.4
30		32.0	98.0
40		31.0	96.8
52		31.0	97.5
60		31.1	97.1
75		31.1	97.6

TEST NO.2.

TEMPERATURE	°F	END-POINT	
		0.511 MEV.	1.27 MEV.
75		33.3	100
65		32.1	97.2
51		32.0	96.3
37		32.0	97.6
27		32.0	97.0
12		32.0	96.2
12		31.4	96.1
27		31.3	96.1
32		31.4	96.0
49		31.3	96.2
57		31.7	97.0
77		32.0	96.0
90		31.4	96.3
105		31.0	95.5
120		30.3	92.8
120		27.6	85.0
108		28.8	87.0
98		29.4	88.2
83		29.1	89.5
77		29.1	89.4

FIGURE 8. EFFECTS OF TEMPERATURE CHANGES ON THE GAIN OF STILBENE SPECTROMETER
0.511 MEV. ANNIHILATION PEAK OF NA-22 TEST NO. 1

FIGURE 9. EFFECTS OF TEMPERATURE CHANGES ON THE GAIN OF STILBENE SPECTROMETER
1.27 MEV GAMMA RAY PEAK OF NA-22 TEST NO.1.

rather than temperature changes since the differences are fairly constant over this temperature range. However, both sets of data indicate a temperature effect above 100°F which increases the gain spread to about 10 percent.

The results of test number 2 are tabulated in Table 2 and Figures 10 and 11. Note that the gain shifted approximately 9 percent when the detector assembly was held at 120°F for 41 hours. This indicates, as in test number 1, that at least a good portion of the gain changes are due to overall gain instability of the detector system and are not due to temperature changes. As in test 1 the effects due to temperature changes occur at approximately 100°F.

The overall results for both tests are tabulated in Table No. 3. These results are presented to show the shift in gain for temperatures above 100°F. Below 100°F, the shift in gain was due primarily to the instability of the system itself and was well within the $\pm$ one channel limits of the multi-channel analyzer. The mean extrapolated end point for each energy peak of the Na-22 gamma-ray source was determined for temperatures to 100°F; the percent variations for the temperatures above 100°F are then shown.

The conclusion that can be drawn from these data is that a gain shift of approximately 5 percent can be maintained if the detector assembly can be kept at a temperature of 100°F or below. For this field experiment a gain shift of this magnitude can be tolerated. Since part of the shift in gain is due to the instability of the spectrometer itself, a continuous monitoring of the system is required. By adjusting the high voltage on the photomultiplier tube before each measurement, the inherent gain stability of the system can be maintained at better than $\pm$ 5 percent.

JAMES G. DANTE

FIGURE 10. EFFECTS OF TEMPERATURE CHANGES ON THE GAIN OF STILBENE SPECTROMETER
0.511 MEV ANNIHILATION PEAK OF NA-22 TEST NO. 2

FIGURE II. EFFECTS OF TEMPERATURE CHANGES ON THE GAIN OF STILBENE SPECTROMETER
1.27 MEV. GAMMA RAY PEAK OF NA-22 TEST NO. 2

GAIN SHIFT AS A FUNCTION OF TEMPERATURE

TABLE NO. 3

TEST NO. 1	END-POINT FOR 0.511 MEV = 31.6	END-POINT FOR 1.27 MEV = 97.6
TEMPERATURE RANGE °F	% VARIATION	% VARIATION
30-100	0.6	0.1
30-110	1.3	2.2
30-120	3.5	4.4
30-132	8.2	7.8
30-120	8.5	7.5
30-110	5.7	6.1
30-100	3.5	4.0
TEST NO. 2.	END-POINT FOR 0.511 MEV = 31.7	END-POINT FOR 1.27 MEV = 96.5
TEMPERATURE RANGE °F	% VARIATION	% VARIATION
12-100	0.2	0.7
12-110	3.2	2.0
12-120	4.4	3.8
DELAY OF 41 HOURS		
12-120	12.9	11.9
12-110	10.1	10.2
12-100	7.6	8.8

REFERENCES

1. Editors, Haywood, F. F.; Provenzano, T. G.; and Auxier, J. A. Operations Plan - Operation HENRE. CEX 65.03, September 1965.
2. Devanney, J. A. Determination of the Neutron and Gamma Rays Response Junctions for a Stilbene Spectrometer. BRL Memorandum Report No. 1797, October 1966.
3. Konrad, F. Stilbene Spectrometer for Neutrons and Gamma Rays: Electronics and Related Performance. BRL Report 1335, September 1966.
4. Ball, W. P.; Booth, R. and McGreger, M. UCRL-4666, March 1956.

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It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. **KEY WORDS:** Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.