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X-325-71-399

PREPRINT

NASA TM X-65738

A MEASUREMENT OF THE FAST LUMINESCENT DECAY TIME OF P-15 PHOSPHOR

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SEPTEMBER 1971

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N72-11112

(NASA-TM-X-65738) A MEASUREMENT OF THE FAST LUMINESCENT DECAY TIME OF P-15 PHOSPHOR J.F. Sutton (NASA) Sep. 1971 6 p

CSCL 07B

Unclas
08692

G3/06

FACILITY

(NASA CR OR TMX OR AD NUMBER)

(CATEGORY)

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A MEASUREMENT OF THE FAST LUMINESCENT DECAY TIME OF P-15 PHOSPHOR

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A MEASUREMENT OF THE FAST LUMINESCENT DECAY TIME OF P-15 PHOSPHOR

During the development of a delayed coincidence apparatus for the study of atomic decays, the need arose for a bright, fast, and inexpensive light source with known decay characteristics. Previous measurements[1,2] indicated that electron-beam-excited P-15 phosphor exhibits, in addition to the long-lived green component, a single exponential luminescent decay component with a broad spectral maximum centered at 3900Å and a decay time of $\lesssim 3.5$ nsec., probably ~ 1 nsec. Accordingly, a sample of P-15 phosphor was obtained, courtesy of Sylvania Electric Products Inc., for use as a calibration light source.

The delayed coincidence apparatus[3] consisted of an electron gun, pulse generator, PMT, constant fraction timing discriminator, time-to-pulse-height converter, and a multi-channel analyzer (MCA). This system is believed to have a timing linearity of $\sim 2\%$ and a full scale calibration accuracy of $\sim 2\%$. The fast electron gun employed is a modified RCA 7587 tetrode Nuvistor mounted in a UHF connector. The radial beam was collected by a phosphor-coated cylinder fabricated from another UHF connector.

The phosphor-coated cylinder and electron gun assembly, located just inside a fused quartz window in the wall of a high vacuum chamber, was imaged via an f-3 lens onto the entrance slit of a monochromator which provided wavelength selection for an Amperex 56TUVP photomultiplier tube. The phosphor was excited by 1.2 nsec. F.W.H.M. pulses at a 1mHz rate. The short pulse duration was employed to preferentially excite the short lifetime components relative to the longer-lived components. The luminescent decay information accumulated in the digital memory of the MCA was stored on punched paper tape and then converted to punched cards for digital computer analysis.

The computer analysis[4] revealed that the raw MCA decay curve data could be very well described by a sum of three exponentials with decay times of ~ 88 nsec., ~ 6.5 nsec., and 1.04 nsec. $\pm\sim 2\%$. The fast decay time is in good agreement with the results obtained by Pendeleton[1] and by Kay[2]. The longest-lived component is thought to be due to residual CO known to be evolved by oxide-coated cathodes. The 6.52 nsec. component may derive from the same source. Its steady state amplitude (pulse duration $\rightarrow \infty$), however, was calculated to be $<10\%$ of that of the fast component. It could therefore be neglected for most system calibration work where a check of PMT transit time spread or an upper bound of system rise time is desired. Of course, a different apparatus configuration allowing for more rapid pumping of evolved gases could significantly reduce the magnitudes of the longer-lived components. Figure 1 is a graph of the MCA data and the three exponentials derived from the computer analysis of the data.

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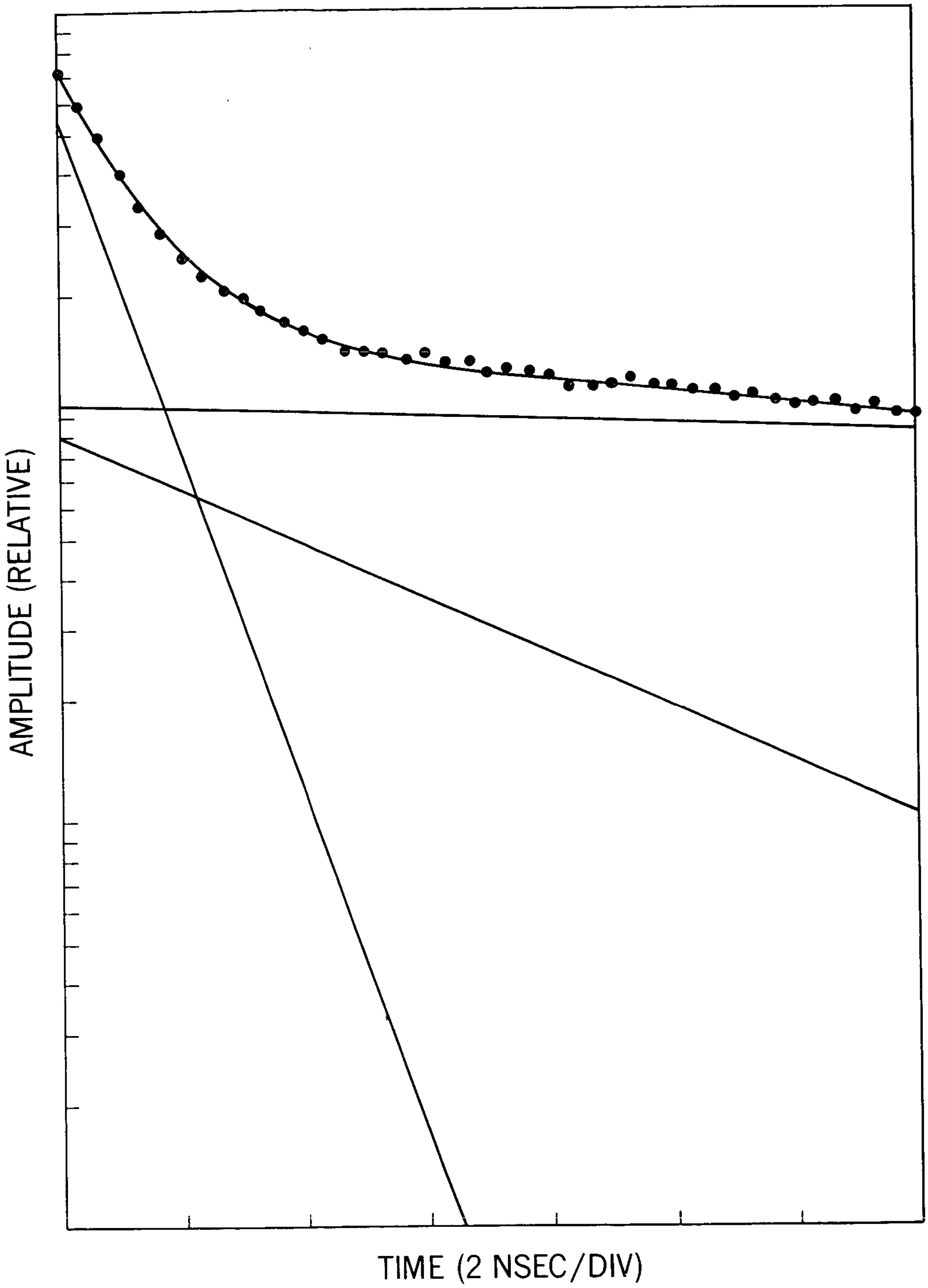

Figure 1. P-15 phosphor luminescent decay curve analysis. Dotted curve: data, solid curves: exponential fit to the data curve. Fast component decay time: 1.04 nsec. ± ~ 2%.