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MASTER

TITLE: NANOSECOND GATING PROPERTIES OF PROXIMITY FOCUSED MICROCHANNEL PLATE IMAGE INTENSIFIERS

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ABSTRACT

Nanosecond Gating Properties of Proximity Focused Microchannel Plate Image Intensifiers,* N.S.P. King, G.J. Yates, S.A. Jaramillo, and B.W. Noel, Los Alamos National Laboratory, P.O. Box 166[illegible], Los Alamos, New Mexico 87545, 505-667-3000; J.L. Detch Jr., and J.W. Ogle, EG&G Inc., Santa Barbara, California. A study has been carried out to characterize the optical gating properties of MCP image intensifiers. Emphasis is placed on parameters relevant to gating speed and correlations between the applied electrical and resultant optical gates.

This paper would be appropriate for the poster session.

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SUMMARY

Nanosecond Gating Properties of Proximity Focussed Microchannel Plate Image Intensifiers, N.S.P. King, G.J. Yates, S.A. Jaramillo, and B.W. Noel, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545, 505-667-3000; J.L. Detch Jr., and J.W. Ogle, EG&G Inc., Santa Barbara, California.

The gating properties of 18-mm-diam proximity-focussed microchannel plate (MCP) image intensifiers used for fast image shuttering have been studied in the nanosecond time regime. The system designed for this work, shown in Figure 1, uses a laser light pulse with an effective width of ~ 30 ps synchronized with an electrical gate pulse of 1.2 ns FWHM.

The intensifier is shuttered off by a reverse-bias voltage between the photocathode and the MCP input and is shuttered on by the forward-biasing gate pulse. The bias was varied while holding the gate amplitude constant at 80 volts. The integrated light intensity and the shutter speed were measured as functions of delay time between the gate pulse and the laser pulse.

The integrated light output as well as an intensity profile for a typical intensifier[1] are shown in Figures 2 and 3. The data in Fig. 2 show a delay of ~ 2 ns between the application of the electrical gate and the beginning of the optical gate. The total shutter time is inversely proportional to the reverse bias for a fixed gating pulse amplitude. Optical gate widths shown in Fig. 3 indicate that good correlation between the electrical and optical gate widths is a function of proper biasing. The line profiles clearly indicate a gain asymmetry throughout the gating sequence.

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[1] The image intensifiers evaluated during this study were obtained from ITT.

The samples taken at points A, B, C, D, E, F, and G of Fig. 2 are plotted in Fig. 3. The orientation is such that the single photocathode lead bringing in the gate pulse is on the left edge of the profiles. During turn-on (A, B, & C) the gating pulse propagates inward until the "hole" in the center is illuminated (D). The uniformity of the light source was verified by statically forward biasing the intensifier and measuring flat profiles (e.g. (H) of Fig. 3). Introducing the gate pulse at a single point apparently causes the non-uniformity.

A radial R-C transmission-line model for the intensifier has been developed in an attempt to understand the observed effects. The model predicts the pulse propagation behavior. The distributed R-C model can be approximated over a wide frequency range by a single lumped R-C equivalent circuit in which C is nearly constant at ~ pF and R decreases with frequency.

An rf impedance analyzer was used to measure the complex impedance of several intensifiers over the range from 3 to 500 MHz. Lead inductance and capacitance, respectively, cause a series resonance at ~ 115 MHz and a parallel resonance at ~ 410 MHz. Comparison of observed gating speeds and measured impedances of several intensifiers shows that turn-on time T is related to the RC product by $T \sim 2.76 \times 10^{13} (RC)^{2.24}$.

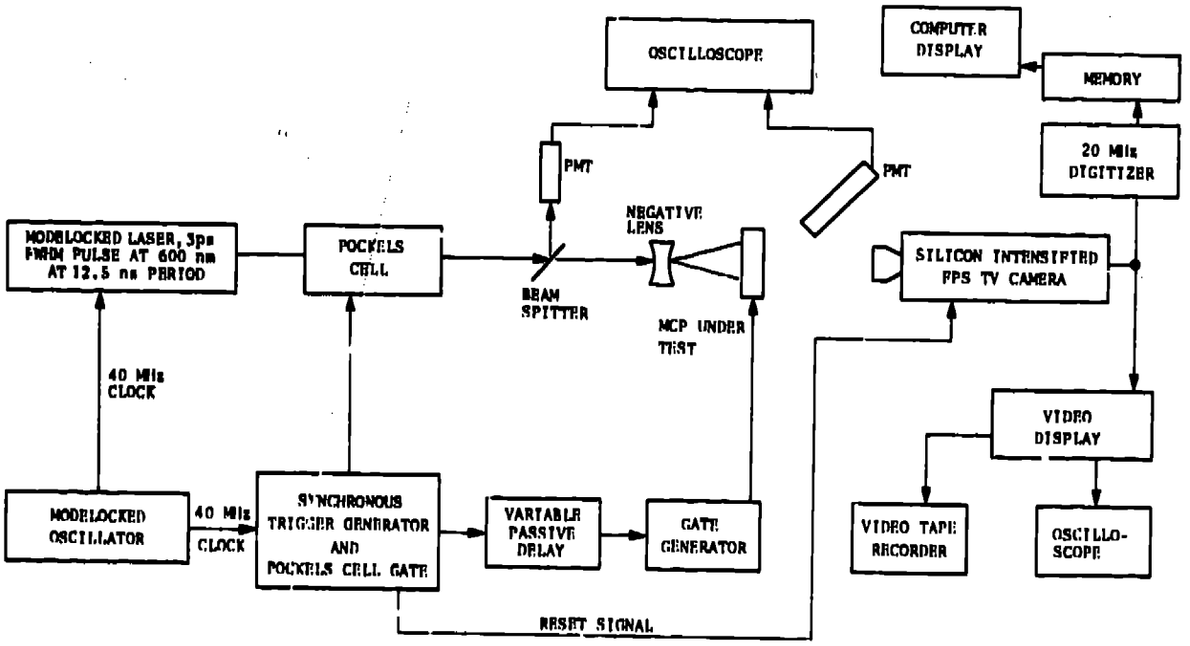

Figure 1. The characterization and measurement system.

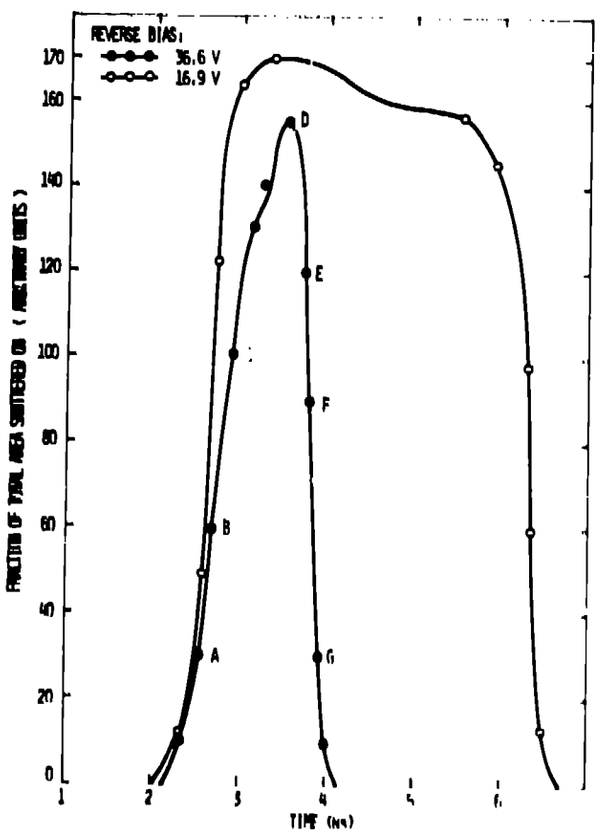

Figure 2. Optical gate width as a function of reverse bias between photocathode and MCP input.

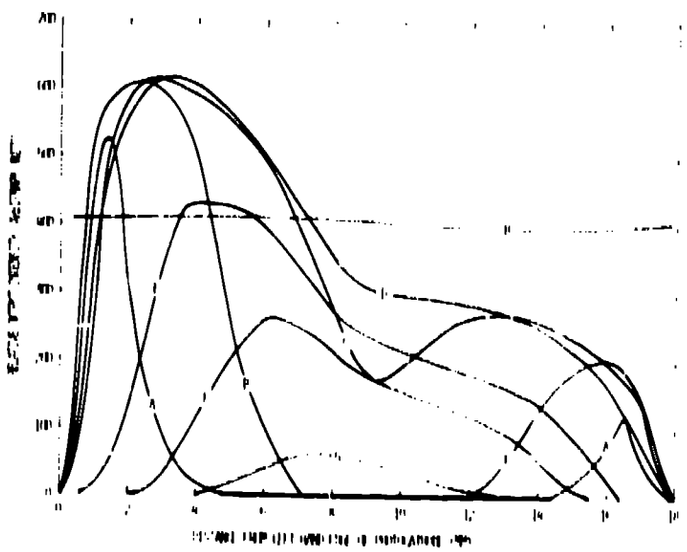

Figure 3. Intensity profiles of the output phosphor during turn-on and turn-off sequences, for uniformly illuminated photocathode.