XIX. GASEOUS ELECTRONICS*

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RESEARCH OBJECTIVES

Our general objectives are concerned with the study of atomic and molecular processes and with the transport of charged particles in weakly ionized collision-dominated plasmas. We are devoting our efforts to those problems in gaseous electronics that are relevant to the physics of gas lasers. In particular, we are looking into problems of striations, sound propagation, and mode locking.

G. Bekefi

A. TIME-DEPENDENT THRESHOLD CHARACTERISTICS OF A PULSED XENON LASER

We have been studying the characteristics of the laser output from pulsed Xenon and Argon discharges. We shall report here some preliminary measurements on a pulsed Xenon laser.

The laser tube has a 32-cm discharge length with a 2.2-mm bore. The current was pulsed at a repetition rate of ~10 Hz, by discharging a charged, 9 (constant z) section, delay line through the discharge tube. Peak currents of up to ~60 A, with a pulsewidth of ~20 μs were obtainable by this method. The laser cavity comprised two high-reflectivity (T ~ 0.2%) mirrors of radius of curvature 1.2 M, separated by ~1 M. The laser output was studied by using a Jarrell-Ash 0.5-m scanning spectrometer with a high-speed photomultiplier as a detector.

The detector output for the 4954 Å Xe line is illustrated in Fig. XIX-1. Here the upper trace illustrates the current pulse, and the lower trace illustrates the output of the detector. Notice that the laser pulse occurs 17 μs after the start of the current pulse. The voltage pulse (not shown) and the current pulse, however, start at the same time.

Upon increasing the current the laser pulse is observed to move toward earlier times. Figure XIX-2 illustrates this time delay τ (that is, the time between the start of the current pulse and the start of the laser pulse) as a function of peak

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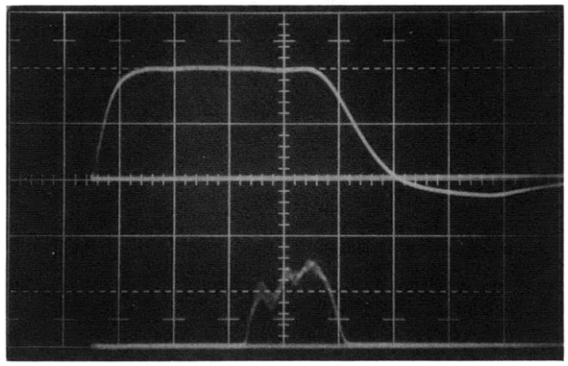

Fig. XIX-1. Upper trace: current pulse, 20 A/div. Lower trace: detector output, 0.2 V/div. Time is increasing toward the right, 5 μs/div, for the 4954 Å Xe laser line at a pressure of 25 μ.

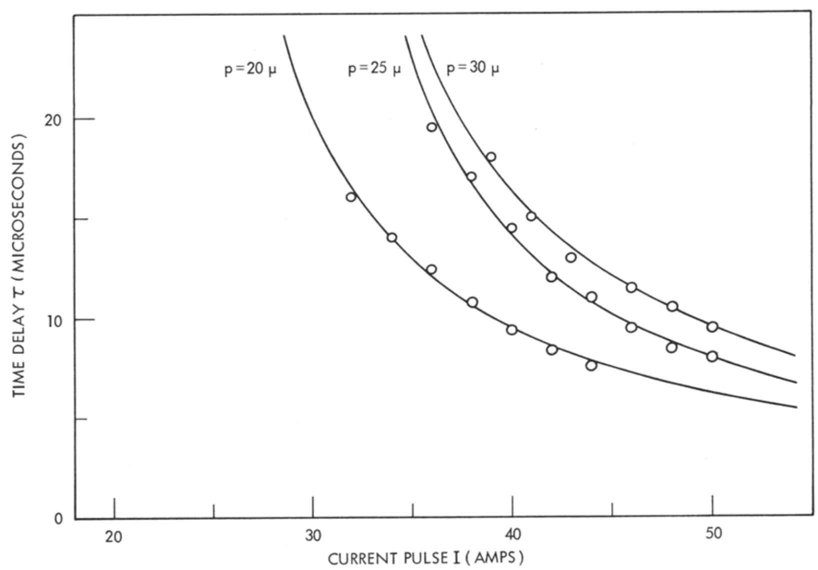

Fig. XIX-2. Time delay τ as a function of peak discharge current I for the 4954 Å Xe laser line at several pressures.

current I, for this spectral line at several pressures (open dots). The solid lines constitute a fit of the data to the relation

$$(I-I_o)\tau = \mathscr{C} \quad (1)$$

where I_o and $\mathscr{C}$ are constant for a given pressure. Similarly shaped curves were obtained for other Xe laser lines. Table XIX-1 illustrates the tabulated values of I_o

Table XIX-1. Values of I_o and G for Xe laser lines.

Wavelength (Å)	Classification	Pressure (μ)	I_o (A)	$\mathscr{C}$ (10^{-6} A-s)
4954	III ?	20	21	180
		25	27	183
		30	26	228
5007	III ?	20	31	186
		30	31	210
5259	II $7s\,^4P_{5/2} \rightarrow 6p\,^4D^o_{5/2}$	30	25	201

and $\mathscr{C}$ for the various Xe laser lines studied thus far.

Work is under way in an attempt to explain these results based on solutions to the time-dependent rate equations. The time-independent (or steady-state) solutions should predict the current asymptote I_o.

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