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PRELIMINARY TIME RESPONSE DATA FROM ITT MCP PMT

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The data presented in this paper represent very preliminary data obtained with an ITT image intensifier tube operated as a photomultiplier. Both L. Hocker of EGG/Santa Barbara and J. Madrid of EGG/Las Vegas collaborated in this effort.

Figure 1 lists the potential applications of our MCP PMT in plasma diagnostic experiments at LASL. The parameters we must emphasize for MCP PMT performance (high speed, high peak linear current, cost) are somewhat different from those emphasized by other speakers at this meeting (very high gain, magnetic field insensitivity, lifetime, cost).

Figure 2 shows the experimental setup at the EGG/ERDA electron accelerator at Santa Barbara, California. The Linac delivers 50 psec electron pulses with peak currents above 10A, repetition rates up to 360 pps, with energy from 30 MeV down to less than 1 MeV. The repetitive pulse is ideally suited to sampling techniques and to a "Computer-of-Average-Transients" (CAT) analyzer. Minimum usable pulse amplitudes are about 5 mV. Figure 3 shows the electron pulse measured on a fast Faraday cup as an indication of system time response. The observed FWHM of 103 psec includes contributions from the sampling head, Faraday cup, four feet of RG-214 cable, trigger jitter, and several connectors, as well as the actual electron pulse. When short lengths of precision air dielectric cable are used with the Faraday cup, a FWHM near 60 psec has been observed. It should be noted that the system trigger is derived from the RF driving the Linac, not from any detector output.

Figure 4 shows the geometries used in the Linac work. A Cerenkov radiator (lucite) was used to provide a 50 psec light flash to the detector. The best geometry, the "telescope" geometry, utilizes an F/1 curved mirror to collect and focus the light to a well shielded MCP PMT. The head-on geometry is less ideal. Backgrounds were subtracted in the "telescope" case with an opaque paper shutter following the lucite, and in the head-on case with a lead absorber in the primary beam. Beam normalization was done either with a 2 inch photodiode observing the same sample or with the NIBM (Non-Intercepting Beam Monitor).

Figure 5 shows an ITT drawing of the MCP PMT as supplied originally. The drawing is not completely accurate in that the tapered inner ground plane was omitted from the unit we received. The unit is a poor 50 ohm match and was intended to allow only a quick look at possible device performance. Figure 6 is the observed impulse response of this unit.

The observed FWHM was 485 psec with a 10%-90% risetime on the leading edge of 195 psec. With this geometry, careful linearity tests were not attempted, but peak currents above 2A were observed with no degradation in pulse shape.

A new housing has been constructed at EGG that is a better 50 ohm match based on TDR studies. It resembles the housing of Figure 5 (with the tapered ground plane included). Both inner and outer cone angles were calculated to yield a match to 50 ohms. This housing has been available for test for only a few days and is not yet well studied. Linearity studies were made on the unit. Pulse shape was constant over a range of currents. In Fig. 7 a pulse shape is shown for this housing. The FWHM is 580 psec and the 10%-90% risetime is 195 psec. The slower FWHM is thought to be due to a construction problem in the housing, which will be corrected shortly. A new ITT

housing will also be ready for tests very soon. In Fig. 8 a linearity curve is shown. Below 1A, the device appears to be linear. (The horizontal scale corresponds to NIBM Linac current up to about 10A; above that value the horizontal scale is normalized to the NIBM and does not represent actual Linac current.)

In Fig. 9 we list some of the related research tools that will complement the MCP PMT's. The fast plastics are discussed in several references (NIM 133 (1976) p. 175 and LASL report # LA-UR-76-1125).

Our group at LASL and EGG is very interested in development of MCP PMT's and will welcome opportunities to work with other researchers in both development and testing phases. As was evident at the Workshop, the capability of the EGG Linac, with its reproducible 50 psec Cerenkov light pulse, sampling scope and CAT system, offers perhaps the best method for characterization of PMT detectors over a wide range of pulse amplitudes.

APPLICATIONS

WEAPON DIAGNOSTICS

LASER PLASMA DIAGNOSTICS

DIAGNOSTIC DEVELOPMENT

FAST RADIATION-TO-LIGHT CONVERTERS
FIBER OPTIC PULSE DISPERSION

Fig. 1

Response of Plastic
Scintillators
T. J. C. C. C. C.

Fig. 2. Experimental Configuration

Fig. 4.

Fig. 5.

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Fig. 6.

Fig. 7.

MICROCHANNEL PLATE PHOTOMULTIPLIER LINEARITY

RELATED RESEARCH TOOLS

FAST RADIATION-TO-LIGHT CONVERTERS

INORGANIC PHOSPHORS (~ 300 PSEC FWHM)

NEW PLASTIC SCINTILLATORS (< 200 PSEC FWHM)

FAST OSCILLOSCOPES

E686 SCOPES - ~ 2 GHz

10 V/cm

LEP CRT TMC-4

~ 5 GHz

~ 0.1 V/cm

FIBER OPTIC CABLES - MULTIMODE

THEORETICAL PULSE DISPERSION - < 100 ps/km

AVAILABLE FIBERS: 1 GHz/km

Fig. 9.