Notes

BRIEF contributions in any field of instrumentation or technique within the scope of the Journal can be accorded earlier publication if submitted for this section. Contributions should in general not exceed 500 words.

Blanking Method for Continuous Channel Electron Multipliers*

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CONTINUOUS channel electron multipliers (Channeltrons) are easily adapted to a wide variety of experiments.[1,2] A disadvantage of these detectors, however, is that their gain depends on such parameters as count rate, change in count rate, and the total number of incident particles detected.[3–9]

One means of improving the gain characteristics of a Channeltron is to prevent unwanted particles incident on the Channeltron from being detected. This can be done with a simple blanking technique if the undesirable particles are bunched in time as they are in certain cyclic experiments.

One approach to blanking is to construct a detection system in which there are two detectors, one to provide initial detection at low gain and the second to provide a high gain for the output pulse. With such a configuration the coupling between the two detectors can be controlled.

The two detector scheme which we use is shown in Fig. 1(a). The first detector is a metal plate; the second is a Channeltron. When particles (with appropriate available energy) are incident on the metal plate, electrons are ejected. The collection of these electrons from the metal plate (held at −25 V) by the Channeltron (whose cone is held at +145 V) is controlled by the grid which is switched from −45 to +100 V for off and on conditions, respectively. Results are shown in Fig. 2. Display (a) shows the detector output with a steady beam of metastable helium atoms being sent into the detection chamber. Display (b) shows the detector output for the same beam conditions but with the voltage pulse of display (c) being applied to the grid.

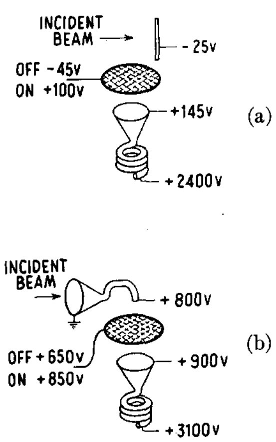

Fig. 1. The two detector blanking systems.

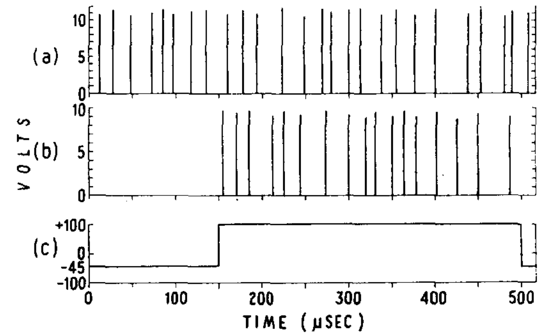

FIG. 2. Results for the two detector blanking system shown in Fig. 1(a). Display (a) is the detector output for an incident beam when the grid is held in the on position (+100 V); display (b) is the detector output when the voltage shown in display (c) is applied to the grid.

Before using the method described above, we used a piece of a broken Channeltron corresponding to about $\frac{1}{3}$ of a whole detector instead of the metal plate. The configuration and operating voltages are shown in Fig. 1(b). The system operated very much like the one described above. Disadvantages of this scheme are the shortage of Channeltron pieces and the fact that such pieces are subject to gain fatigue under conditions of very high incident flux. However, this scheme has the advantages of initial gain greater than 1 and a more complete shielding of the input to the second detector.

Since the gain of a Channeltron is strongly dependent on the high voltage applied to the detector, we examined the possibility of Channeltron blanking by reducing the gain of the Channeltron in a periodic manner through voltage switching. The results are shown in Fig. 3. Display (a) shows the detector output for normal high voltage conditions (2200 V); display (b) shows the detector output when the voltage in display (c) is applied to the detector. Note that after the return to normal voltage there is a deadtime of about 8 msec (the specific value of this deadtime interval shows some dependence upon the high voltage applied to the detector) followed by a rapid increase in gain. Such a deadtime will not permit high repetition rates in time-of-flight or other experiments.

The above technique assumes that a large signal level during that portion of the cycle where there is low detector gain (1700 V) does not adversely affect the Channeltron gain characteristics in the remainder of the cycle when the count rate is low and the voltage is at its normal value. However, we have observed such gain degradation. A

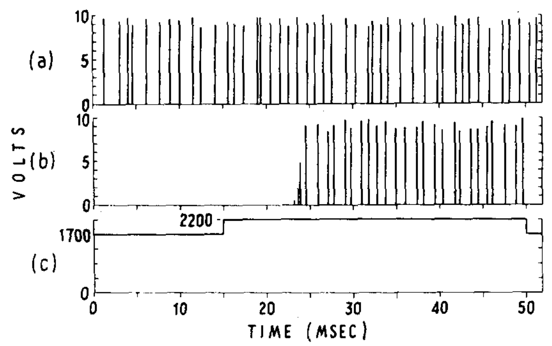

FIG. 3. Characteristics of a Channeltron during pulsation of the detector high voltage. Display (a) is the detector output for an incident beam of ions under normal voltage conditions; display (b) is the detector output when the voltage applied to the detector is that shown in display (c). The return to an apparent normal state takes about 8 msec after the full voltage is returned. Counting rate has been reduced in comparison with that shown in Fig. 2.

detector was placed in an intense beam (5×10^5 counts/sec) for several minutes with the detector supply at 1700 V; then the beam intensity was reduced to 3×10^2 counts/sec, the detector voltage was increased to 2200 V, and the Channeltron output was monitored as a function of time. The gain increased by a factor of 2 over a period of 3 min. No comparable gain variation was observed for an initial beam strength of 10^4 counts/sec.

We have also observed that the detector gain varies for periods of minutes after the application of the Channeltron voltage (from 0 to 2200 V) and that this variation very likely has some dependence on the intensity of the beam striking the Channeltron before any detector voltage is applied.

Comparison of the above blanking systems indicates that the two detector scheme overcomes both the dead-time and gain variation effect of the voltage pulsed scheme. However, there may be experiments with time scales and counting rates which would make the voltage pulsing scheme a feasible technique.

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Rejuvenation of Helium–Neon Lasers*

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WE have recently had cause to consider the origin of the characteristic loss of power output from helium–neon lasers as a result of aging. This deterioration is observed to occur independently of whether or not the laser is actually operated; typically, we find, a laser tube will suffer a loss of power by a factor of around 2 in a period of order 1–2 years. It is reasonable to assume that at least a part of the power degradation is due to irreversible effects such as contamination from electrode and wall sputtering, but in our case, the operating time was small, and we felt this effect was unlikely to be dominant. It is known that thin walled vessels of glass or quartz are particularly permeable to helium,[1] and a diminution of lasing efficiency of a helium–neon laser is to be expected as the helium escapes and the gas mixture departs from optimum. This gas loss is reversible and refilling may be accomplished in a very simple manner. We have immersed the complete laser, without any dismantling, in a helium atmosphere, at atmospheric pressure, inside a suitable container of thick Pyrex or metal. The laser is left there for one to several days. Upon removal, we have measured increases in output power of up to a factor of *six times* that of the prefilling value, powers which are as great as or greater than the manufacturer's specification. We have in this manner renewed three of our helium–neon lasers:

(a) A Spectra-Physics model 115, ≈ six years old, whose power output had fallen from 2 to 3 mW to 0.55 mW; after three days in the helium bath its power had risen to 3.0 mW.

(b) An Optics Technology model 195, ≈ one year old, whose output had fallen to 1.5 mW; after about 18 h in helium, the power was 5 mW. The manufacturer's specification is ≥ 2 mW.

(c) A Spectra-Physics model 130B, of uncertain history, whose power had fallen from the rated 1 to 0.4 mW. The power rose by nearly a factor of 2 in ≈20 h, then suffered a slow decrease, from 20 to 40 h, falling to around 0.5 mW; in this case the optimum helium pressure was exceeded.

These observations are consistent with calculations based on the known diffusion rates of helium through quartz and through Pyrex.[1] The filling pressure of normal laser tubes is ≈1 Torr helium to ≈0.1 Torr neon, and the tube is either quartz or Pyrex, usually having quartz laser beam exit faces. The diffusion rate of helium through Pyrex is about an order of magnitude slower than through quartz, and the resultant loss rate is dependent on the