With the redesigned system, a Tektronix 564 storage oscilloscope, a model-135 Moseley X–Y recorder, and Data Technology Corporation DT340 DVM's have been used simultaneously as output devices.

The system is extremely stable, with an observed signal drift of less than 1 part per 1000 during eight weeks of intermittent use. It is possible to calibrate the instrument with the DVM and to maintain the calibration for periods exceeding eight weeks. Mechanical calibration of the wavelength dials is eliminated, the DVM provides a more accurate and reproducible wavelength readout.

* This work was performed under the auspices of the United States Atomic Energy Commission.

[1] American Instrument Company (8030 Georgia Ave., Silver Spring, Maryland 20910), "Aminco–Bowman Spectrophotofluorometer Instrument Manual 768-H" (June 1968).

Detection of Metastable Atoms and Molecules with Continuous Channel Electron Multipliers*

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Beams of metastable molecules can be rapidly and efficiently detected by allowing them to strike the cathode of a windowless electron multiplier. In this note we report on the use of a continuous channel electron multiplier[1] (Bendix "Channeltron") in this application. Compared to other multipliers, the continuous channel multiplier has the advantages of lower noise, simpler circuitry, and far smaller size for a given cathode area.

We have detected thermal beams of metastable helium, hydrogen, neon, argon, krypton, xenon, and molecular nitrogen in our experiments. Although we have not measured the yield of Auger electrons per metastable incident on the multiplier cathode, we judge that the yield is comparable to that achieved[2] on the tungsten or platinum surfaces used in the conventional Auger detectors. The detection efficiency for a given metastable species seems to remain within 10% or so of an equilibrium value in spite of the frequent exposure of the multiplier to humid air and backstreaming pump vapors.

The usual background signal, or dark current, in the Channeltron multiplier is 0.1 counts/sec or less, so it is feasible to do experiments with beam signals as low as 1 count/sec. To maintain a low background count rate it is essential to keep uv radiation (as from bare filaments) and ions (as from vacuum gauge tubes) out of the multiplier. Windows in the vacuum system need not be covered during the experiments, however, since the multiplier does not respond to visible light.

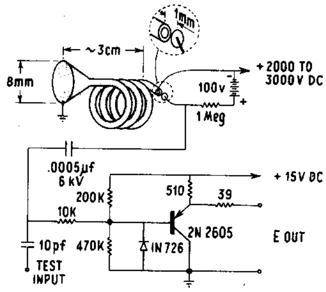

Fig. 1. The Channeltron output is picked up by a small metal button and fed to the input of an emitter follower which is mounted together with the multiplier inside the vacuum chamber. The circuit serves as an impedance transformer so that the signal pulses can be brought out through long, low impedance leads.

The arrangement shown in Fig. 1 is a simple, effective way to couple the output of the Channeltron to a remote pulse height analyzer.

Sometimes the Channeltrons will develop erratic gain or a very high noise level. This can come from mistreatment such as overloading due to high counting rates or from causes which are less obvious. We have usually found it possible to restore a multiplier to good operating condition by flushing it with acetone or ethyl alcohol and letting it rest on the shelf for a few days. In fact, one of our Channeltrons has been resuscitated in this manner after it had failed from a corona discharge that occurred when the system vacuum was lost with 2.5 kV still applied to the multiplier. A noisy or inoperative multiplier should not be discarded before a few of these "home remedies" have been tried.

The continuous channel multipliers are made of glass tubing which can be broken if too much strain is exerted by the mount; once the multiplier is in place, however, the assembly of multiplier plus amplifier on a single board is not overly delicate. It is useful to know that pieces of a broken Channeltron can sometimes still be used for electron multiplication, albeit with lower gain, if new electrical connections for the dc voltage are made to the resistive glass tube with conducting paint.

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[1] M. Kaminsky, *Atomic and Ionic Impact Phenomena on Metal Surfaces* (Academic Press Inc., New York, 1965), pp. 292 ff.

[2] G. W. Goodrich and W. C. Wiley, Rev. Sci. Instrum. **33**, 761 (1962); D. S. Evans, ibid. **36**, 375 (1965).