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High pressure, hydrogen, deuterium and methane filled ionization chamber counters have been used in this Laboratory. In each case there has been electron collection. This has been achieved by using a pure gas, and thoroughly cleaning and outgassing the counters before filling.

In order to take full advantage of the electron collection, it is important to minimize the contribution of the positive ions. This is achieved by suitable choice of counter geometry. We have employed cylindrical counters, 20 cms. long and 4 cms. diameter with an axial 1 mm. rod as collector, and spherical counters, 4 cms. diameter, with a 1 mm. rod with rounded end as collector. The latter

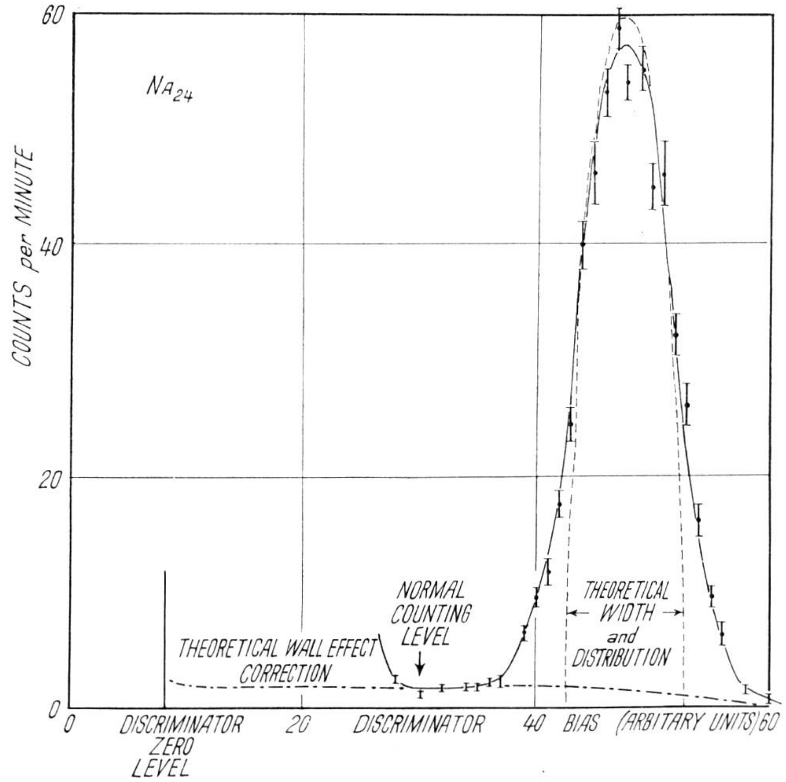

Fig. 1.
Pulse Height Distribution Photoprotons from Disintegration by Radiosodium.

type of counter lends itself particularly well to good definition (0.1 %) of the counting volume. With pure hydrogen and deuterium the positive ion mobility is also high, so that at no part of the counter does the pulse height vary by more than 15 % from the maximum with amplifier time constants of 1 μs. The electron mobility is not so high for hydrogen and deuterium as it is for methane; the maximum time taken for an electron to create a pulse (pulse delay time) is about 1 μs for methane at 35 atmospheres pressure, and 5 μs for hydrogen or deuterium at the same pressure. This is in rough agreement with the results of STAFFORD[4]).

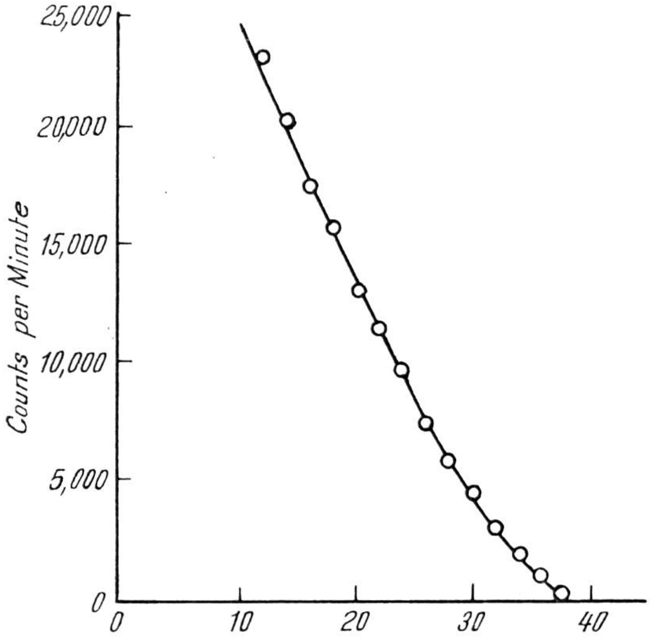

Fig. 2.
Bias Reading on Discriminator (Volts)
Pulse height distribution for methane chamber filled to 35 atmospheres using D + D neutrons.

The counters have been made with brass, copper, stainless steel and aluminium alloy with similar results; the high voltage and collector leads are brought through the pressure containing vessel by Kovar to glass seals. In some cases the pressure containing vessel acts as a guard ring and there is a high voltage cylinder or sphere inside, in other cases, two coaxial seals are used, with the join between them as a guard ring, and the pressure vessel is connected to the high voltage.

After assembly the counters are sealed by screwing together, and sealing the thread with soft solder (or in the case of the aluminium alloy counters, Cenco Sealstix); they are outgassed by pumping with a mercury diffusion pump for several hours, preferably with slight heating till the pressure does not rise when the pump is disconnected.

The filling gas is obtained in different ways. The pure hydrogen is obtained from a hydrogen liquefier, immediately after a charcoal cleaning stage (JONES, SIMON and LARSON, 1948); the deuterium is obtained by electrolysis of heavy water, and after recombination of any oxygen of a palladium catalyst and liquid air trap, is condensed onto charcoal immersed in liquid air. There is then a single stage of fractionation on charcoal at liquid air temperature, and the pure deuterium is obtained at pressure after removal of the liquid air. The methane is supplied to us from a multi-stage fractionating column by Messrs. KRONBERGER and London of A.E.R.E. HARWELL (BEGHIAN and HALBAN, 1949). In each case the gas is sufficiently pure to give electron collection up to 35 atmospheres — the highest pressure yet tried. At this pressure there is about 10% loss of pulse height due to recombination.

Fig. (1) shows the differential distribution of pulses from 280 kV protons, in a counters with well defined counting volume, filled with deuterium at 8 atmospheres pressure.

Fig. (2) shows the integral distribution of pulses from a larger neutron detector (filled to 35 atmospheres of methane) irradiated with 2.5 MeV neutrons.

The counters are used as hydrogen recoil neutron detectors, and as direct detectors of the photodisintegration of deuterium (WILSON, COLLIE and HALBAN, 1948, 1949).

References.

[1]) BEGHIAN and HALBAN, 1949, Proc. Phys. Soc. A, vol. LXII, p. 395.

[2]) JONES, SIMON and LARSEN, 1948, Research, vol. 1, p. 420.

[3]) WILSON, COLLIE and HALBAN, 1949, Nature, vol. 163, p. 245, 1948. Nature, vol. 162, p. 185.

[4]) STAFFORD, 1948, Nature, vol. 162, 771.