# A HIGH VOLTAGE NEUTRON SOURCE

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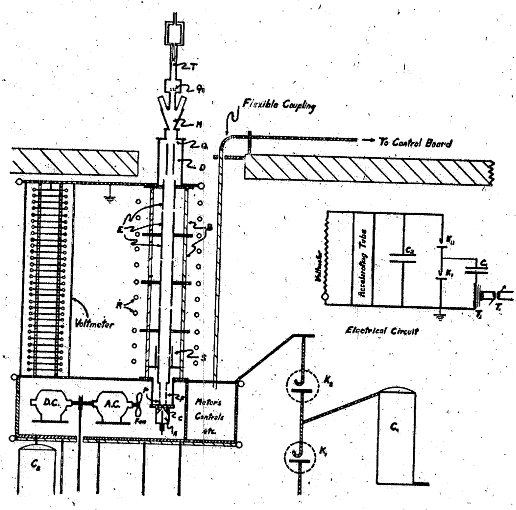
Of the several types of equipment which will give particles sufficient energy to penetrate the nucleus of any atom and thus provide information on its structure the most direct is a linear accelerator. The essential parts of this apparatus are a source of charged particles and a means of accelerating them through a difference of potential of several hundred kilovolts.

The details of the particular arrangement of the installation in the Physics Department of the University of Illinois are shown in Fig. 1. The ion source C, A at the lower end of the accelerating tube is a low voltage arc of the Zinn type.[1] The ions are extracted by a potential applied to the electrode P, focused by the electrode F and successively accelerated by the electrodes E. The total voltage across the tube is 250 kilovolts supplied by a voltage-doubler circuit, shown in the insert. The lower end of the tube is at high potential with respect to ground, and therefore all power for the ion source must be derived from the generators A. C., D. C. driven by an insulating belt. All equipment is remote-controlled from a room above that in which the high voltage equipment and tube are located.




One important provision of the apparatus is for securing modulated ion currents. This is accomplished by applying an oscillating potential to the deflecting plates, D, in the upper end of the tube, thus sweeping the beam across the target at the frequency of the potential applied to the deflection plates.

The chief application of this modulated ion beam is to secure neutrons of known velocity, using a beam of deuterons and a target T, of heavy water ice maintained by liquid air in the upper cylinder, each time the ion beam sweeps past the target a burst of neutrons will be ejected according to the reaction ${}_1H^2 + {}_1H^2 \rightarrow {}_2He^3 + {}_0n^1$. The ion current to the target triggers the sweep of a cathode-ray oscillograph whose vertical plates are connected to neutron recording equipment such that each neutron arriving at the recorder will produce a short voltage pulse on the oscillograph. The position of this pulse on the horizontal sweep or time scale thus records the time of arrival of the neutron at the recorder. Knowing the distance from the target to the recorder, the neutron velocity may be determined. This arrangement is the only satisfactory method so far devised for accurate measurement of neutron velocities.

From data on the neutron yield of the above reaction and the voltage and current available, the strength of the neutron source may be calculated. This is about $10^9$ neutrons per sec. which is equivalent to the number of neutrons obtained from approximately 40,000 milligrams of radium mixed with beryllium $[{}_4Be^9 + {}_2He^4 \rightarrow {}_6C^{12} + {}_0n^1]$.

Although the apparatus has been designed primarily as a neutron source, provision has been made for study of other nuclear reactions. The fan-shaped chamber, H, is located in a magnetic field which can be used to deflect the ion beam to either side tube in which different targets can be placed. At the same time, a magnetic analysis of the beam may be made.

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[1] *Zinn: Phys. Rev.* 52,655, (1937).