Energies of β-Particles from Uranium-X_2

THE end point energy of uranium-X_2 given in "Tables Annuelles de Constantes" is 1·66 Mev.[1] (from Wilson chamber measurements) in contradiction to the values found previously by absorption methods[2,3] and magnetic focusing[4].

At first sight, the Wilson chamber measurements might be considered more accurate than absorption methods, and an apparent end-point of 1·6 Mev. was obtained in this Laboratory from measurements of the curvature of β-ray tracks in a Wilson chamber (Fig. 1). However, when the energy spectrum of a very thin film of uranium-X_2 was measured with a magnetic spectrometer and coincidence counter[5], the spectrum given was as in Fig. 2, with an end point at 2·3 Mev., in agreement with the absorption and magnetic focusing values. The use of the spectrometer gives, of course, much greater accuracy than the other methods, and, incidentally, entails far less work than the Wilson chamber method.

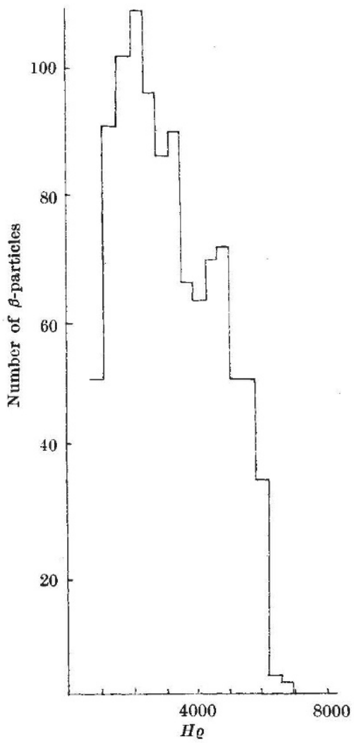
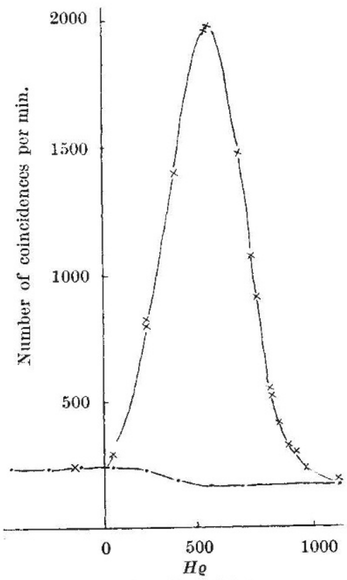


Fig. 1



— x — x, uranium-X_2 points; — · — ·, background with lead shutter over slit.

Fig. 2

In view of the discrepancy between the measurements obtained by this accurate method and those obtained by the Wilson chamber method, energy spectra derived from the latter should evidently be accepted with reserve.

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[1] "Tables Annuelles", **26**, 13 (1938).
[2] Sargent, *Proc. Roy. Soc.*, A, **139**, 659 (1932).
[3] Feather, *Proc. Camb. Phil. Soc.*, **34**, 115 (1938).
[4] Ward and Gray, *Canadian J. Research*, **15**, 42 (1937).
[5] Roaf, *J. Sci. Inst.*, **17**, 17 (1940).

Determination of h/e by the Method of Isochromats

IN recent years several determinations of h/e from the short wave-length limit of the continuous X-ray spectrum have been made. The results obtained from this method, however, disagree definitely with the value of h measured by other methods. According to Kirchner[1] the most accurate determinations of h/e by the method of isochromats give $h = 6{\cdot}614 \times 10^{-27}$ erg sec., provided $e = 4{\cdot}803 \times 10^{-10}$ E.S.U., $e/m = 1{\cdot}759 \times 10^{7}$ E.M.U./gm. and $R_\infty = 109{\cdot}737$ cm.$^{-1}$. This discrepancy has not yet been explained. Also the shape of the isochromats, especially in the vicinity of the short wave-length limit, causes a problem. Instead of running straight down to zero, thus giving a sharp radiation limit, the isochromats run asymptotically down to zero. This 'foot' of the curve indicates that some electrons hit the anticathode with a velocity which is greater than that corresponding to the voltage applied on the X-ray tube. Various hypotheses have been put forward to account for the existence of such electrons.

For some time back, I have been investigating the short wave-length limit in order to determine h/e. As a preliminary result of the investigation, it has been found that the phenomenon mentioned above seems to be a simple effect of the vacuum in the X-ray tube. Thus a pressure of 5×10^{-4} mm. of mercury in the tube gives isochromats of the usual shape, but if the pressure is diminished sufficiently, this shape will change. A pressure of $1{\cdot}5 \times 10^{-5}$ mm. of mercury gives an isochromat, which runs straight down to zero, thus giving a sharply marked short wave-length limit. Further, the isochromat is slightly displaced towards higher voltage, corresponding to a higher value of h/e. This influence of the pressure in the X-ray tube upon the shape of the isochromats may be explained as an effect of gas ions generated by the electron current in the tube. These ions release secondary electrons from the cathode, some of which have a velocity component directed towards the anticathode. Hence these electrons hit the anticathode with a correspondingly greater velocity.

In any event it seems necessary for an accurate determination of h/e to give greater attention to the vacuum than has been done in previous investigations.

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Jan. 12.

[1] Kirchner, F., *Ergebn. exakt. Naturwiss.*, **18**, 26 (1939).