and the Q_1 heads. The spacing between the R_2 and Q_1 heads is about 72 cm^{-1} and since the R_2 should turn at a greater distance from the origin than the Q_1 (since $B_2 > B_1$), it can be assumed that the electronic transition cannot be greater than 70 cm^{-1}.

We are making a rotational analysis of the bands from our third and fourth order plates. Where there is not too much overlapping, the lines are very well resolved and the various series of lines can easily be selected. A complete analysis of the rotational structure will be reported later.

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January 13, 1934.

The Constant in the Compton Equation

At a recent meeting of the Physical Society the writers[1] reported the results of an attempt to make a precision determination of the constant in the Compton equation specifying the wave-length modification of scattered x-rays. According to the simple Compton equation this constant should have the value h/mc. Birge's[2] most probable values of e, h, and e/m lead to the value 0.02415×10^{-8} cm for this constant. The mean experimental value in our investigation using tin $K\beta$ radiation and a graphite scattering block and assuming the simple Compton equation to apply was $(0.02380\pm0.00003)\times10^{-8}$ cm.

It seems to the writers that this discrepancy in values may, to a first approximation, be accounted for by the following simple theory expressible harmoniously with Compton's original corpuscular derivation. Assume that the interaction between the impinging quantum and the scattering electron extends over a time interval Δt and that the electron is held to an atom by a Coulomb binding force whose mean effective value is F during the interaction. If the scattering process is to result in modified radiation the electron must be removed from the atom during the interaction interval Δt. Let mv be the momentum of the electron *after escape* from the atom and let φ be the angle between that momentum and the momentum $F\Delta t$ acquired by the nucleus during the escape of the electron. Then the final momentum relations may be expressed by:

$$(F\Delta t)^2+(mv)^2+2mvF\Delta t\cos\varphi = (h\nu/c)^2+(h\nu'/c)^2-2(h\nu\cdot h\nu'/c^2)\cos\theta, \quad (1)$$

$$(mv)^2+2mvF\Delta t\cos\varphi=2(h\nu/c)^2(1-\cos\theta). \quad (2)$$

The energy relations may be expressed by:

$$mv^2/2+nFv\Delta t\cos\varphi=h\nu-h\nu'. \quad (3)$$

In this equation the relatively very small kinetic energy acquired by the nucleus has been neglected. The second term on the left-hand side represents the binding energy, E, of the scattering electron and n is a numerical term depending upon the manner of variation of v with respect to t.

From Eq. (2) we have:

$$2m(mv^2/2+Fv\Delta t\cos\varphi)=2(h\nu/c)^2(1-\cos\theta),$$

$$2m(mv^2/2+nFv\Delta t\cos\varphi) =2(h\nu/c)^2(1-\cos\theta)-(1-n)2mFv\Delta t\cos\varphi.$$

Substituting from Eq. (3) we obtain:

$$2m(h\nu-h\nu')=2(h\nu/c)^2(1-\cos\theta)-(1-n)2mFv\Delta t\cos\varphi,$$

$$\frac{\nu-\nu'}{\nu^2}=\frac{h}{mc^2}(1-\cos\theta)-\frac{Fv\Delta t\cos\varphi}{h\nu^2}(1-n),$$

$$\Delta\lambda=\frac{h}{mc}(1-\cos\theta)-\frac{\lambda^2}{hc}(nFv\Delta t\cos\varphi)\frac{1-n}{n},$$

$$\Delta\lambda=\frac{h}{mc}(1-\cos\theta)-\frac{\lambda^2}{hc}\cdot\frac{1-n}{n}\cdot E. \quad (4)$$

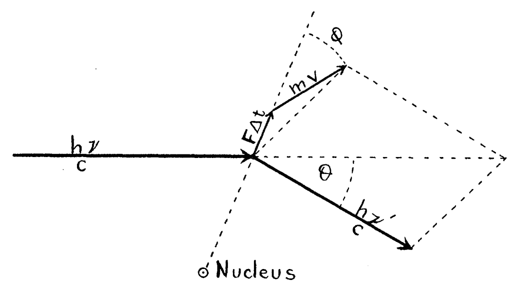

FIG. 1.

To test this equation we might *assume* a uniform acceleration of the scattering electron during expulsion, giving $n=\frac{1}{2}$. By taking E for carbon L as 19.9 volts[3] and by considering 90° scattering of Sn $K\beta$ Eq. (4) gives $\Delta\lambda=0.02415\times10^{-8}-0.00031\times10^{-8}=0.02384\times10^{-8}$ cm in good agreement with our experimental value of 0.02380 $\times10^{-8}$ cm.

Although the adoption of $\frac{1}{2}$ as the value of n is somewhat arbitrary, any value which could reasonably be assumed leads to a departure from the original Compton shift which is of the proper order of magnitude to agree with that which we have observed. We are proceeding to test Eq. (4) for other values of λ and E.

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January 13, 1934.

[1] Ross and Kirkpatrick, Bull. Am. Phys. Soc. **8**, No. 6 (1933).
[2] Birge, Phys. Rev. **40**, 319 (1932).
[3] I.C.T. **6**, 68.