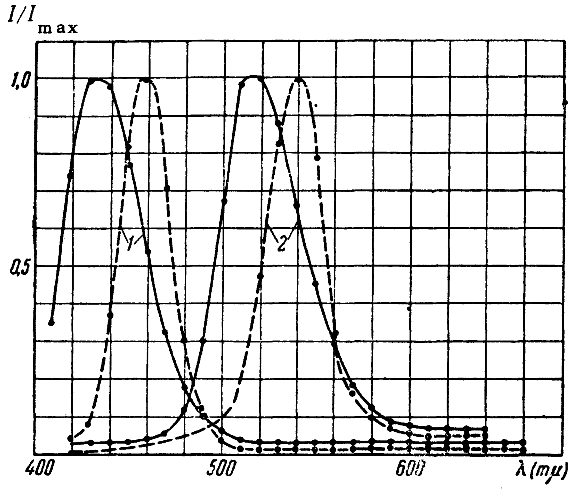

FIG. 2. *1.* Potassium; *2.* Barium. Continuous curves were obtained at $t = 20°$ C, curves shown in dashes were obtained at $t = -183°$ C.

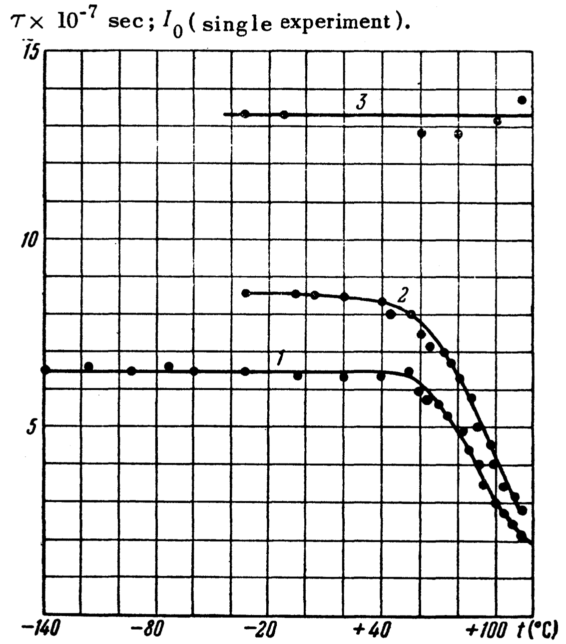

FIG. 3. $CaF_2(Eu^{++})$. *1.* τ; *2.* I_0; *3.* I_0/τ.

excitation, E, while the time necessary for relaxing and lighting does not depend on E. It can be seen from the above that in the case of all three substances we are dealing with a monomolecular process representing a relatively slow fluorescence.

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The Measurement of the Specific Charge of Conduction Electrons

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IN the development of the theory of metals and semiconductors there arises the problem of the experimental determination of the ratio e/m and the effective mass of conduction electrons.

As is well-known, Mandel'shtam and Papaleski[1] were the first to show the inertia for transport of charges in metals experimentally, but, because of the beginning of the war in 1914, they were not able to complete their work. In 1916-1926, Tolman and his co-workers proved conclusively, in a series of papers, that the transport of charges in metals was due to electrons. The value of e/m obtained in this work and the corresponding value for free electrons in a vacuum were, however, different from each other. This difference could be explained by inaccuracies in the theory.[2] Thus, assuming that the acceleration of the electron with respect to the conductor is equal to the acceleration of the conductor, with opposite sign, the value of e/m found in the later papers of this series can be interpreted as an overestimate of the electrons' acceleration. The sign of e/m obtained, in the first paper, by braking a rotating coil can be explained in terms of the disregard of capacitative currents and self-induction. Heat due entirely to electronic motion was also not taken into account. In what degree the various simplifications of the theory affected the result has not been established[3]. Planned extensions of the research have not occurred.

In future measurements of the ratio e/m of conduction electrons, we require both improvement in experimental techniques and the use of new methods, and also simpler and more accurate interpretation of the experiments. If the Coriolis effect is used as an inertial effect, we can evidently approach this goal closely. The fact is that the Coriolis forces act on the electrons in the rotating conductor in a fashion completely analogous to a Lorentz force. They can, therefore, equalize or balance it. Consequently, null methods are possible. In these, the electron will generally not be accelerated with respect to the conductor; the theory of such methods is extremely simple, since one proceeds only from the equality of the Coriolis and Lorentz forces. We note that all the effects caused by magnetic fields and explained by Lorentz forces must, because of the Coriolis force, also cause rotations. In particular, there must be a phenomenon of electron inertia induction, analogous to electromagnetic induction, acting on the rotation of a current bearing conductor. Such an effect would be similar to that of a magnetic field acting on current bearing conduction, to the Hall effect, and to others. Comparison or mutual compensation of some similar effects of rotation in a magnetic field will allow determination of e/m for conduction electrons.

As an example, we consider a generator, equipped with a special device permitting it to be driven in rotation about an axis parallel to the direction of the magnetic lines of force. Thus, the rotor of the generator performs two rotating motions about the mutually perpendicular axes. An electromotive force will then be generated in its windings even when the magnetic field is turned off. This emf will be called inertial, since it is generated by Coriolis forces. Let o be the angular velocity of rotation of this assembly, and let ω be the angular velocity of rotation of the rotor, which we shall consider to be at right angles to the frame of N turns of wire. Two sides of the frame (each of length l) are active; two others with length b connect them. The linear velocity of the leads will be $v = \omega b/2$, while the electrons experience the Coriolis force

$$2mvo \sin \omega t = m\omega o b \sin \omega t,$$

which corresponds to the voltage

$$(m/e)\, \omega o b \sin \omega t.$$

In order to find the electromotive force U_{inertia} that is produced in the rotor, it is necessary to multiply the last expression by $2l$ times the number of turns N; then, taking into account that $bl = S$, the area of the frame, we get

$$U_{\text{inertia}} = 2\,(m/e)\, N o \omega S \sin \omega t. \tag{1}$$

The centrifugal forces which act on the electron have the same direction in the opposite leads of each coil; their actions, therefore, are mutually compensated; therefore, they do not enter into the calculation for the computation of U_{inertia}.

The emf produced in the generator under the action of a magnetic field is determined by

$$U_{\text{mag}} = \frac{1}{c}\, NHS\omega \sin \omega t \tag{2}$$

(c = velocity of light, H = magnetic field strength). From Eqs. (1) and (2) we obtain

$$\frac{U_{\text{inertia}}}{U_{\text{mag}}} = \frac{2}{(e/cm)}\,\frac{o}{H}. \tag{3}$$

We can so choose the magnetic field that $U_{\text{mag}} = U_{\text{inertia}}$; the condition is

$$o = (e/2cm)\, H. \tag{4}$$

Equation (4) is the expression for the Larmor precession. As we know, the Larmor precession frequency is approximate, the degree of accuracy depending on how the centrifugal force compares with the Coriolis force. But, as is evident from our previous conclusion, Eq. (4) is exact in our case. This behavior is evidently connected with the absence of the effects of centrifugal force.

Upon obtaining equality for U_{inertia} and U_{mag}, we can determine e/mc from Eq. (4).

It is understood that a special generator must be prepared for experiments on the determination of e/m. The rotor must contain as large coils as possible, with very fine wire. The inductor can be replaced by a solenoid surrounding the assembly. The earth's magnetic field must be carefully removed. As a control, the rotor should be operated in each of its two rotations separately, for different positions of the rotor; elimination of the earth's field will be considered sufficient only when there exists no emf in the rotor in these preliminary experiments. The effect of a small residual field could be removed if the direction of rotation was changed in these experiments. The rotor resembles a precessing gyrocsope, the axes of precession being perpendicular to the axes of rotation. The leads from the frame can be connected to a copper commutator which rolls on a copper brush. Since the current is alternating, the effect of thermoelectric forces arising in the brushes can be eliminated.

Let the coil consist of $N = 10^4$ turns of copper wire of diameter 0.2 mm, the area of the loop S be 10^3 cm^2. Assume $o = \omega = 100$/sec and $e/m = 5 \times 10^{17}$ cgs units/gm. The amplitude of U_{inertia} is then 10^{-4} volt, the internal resistance of the rotor about 10^4 ohms. The large internal resistance makes insignificant the variable resistance at the moving contacts. The measurement can be obtained with the aid of a ballistic galvanometer and amplifier. With the estimated magnitudes above, this apparatus ought to give the value of e/m for conduction electrons with an error not exceeding 1%.

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The Radiation of a Rapidly Moving Electric Image of a Uniformly Moving Charge

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OF the wide class of problems on radiation effects accompanying the rapid passage of charges near conducting or dielectric surfaces of given arbitrary form, we consider the simplest concrete example: the calculation of the radiation caused by the change of the image of a charge with non-relativistic but sufficiently large velocity falling upon a conducting sphere of radius R. In the non-relativistic case we can employ certain formulas of electrostatics connected with the magnitude and coordinates of the inducing charge and the image charges: $x_1 x_0 = R^2$; $e_1 = -e_0 R/x_0 = -e_2$; $x_2 = 0$ (origin of coordinates measured from the center of the sphere, and the zero subscript denoting quantities relating to the inducing charge).

The dipole moment of the image charge is equal to the induced dipole moment of the sphere $p = e_1 x_1 = e_0 R^3 / x_0^2$, and has a second derivative with respect to time, different from zero even for $\dot{x}_0 = -\beta_0 c = \text{const}$. The total energy radiated for the change of dipole moment, due to the motion of the inducing change from infinity to the surface of the sphere, is

$$\Delta\mathcal{E} = \frac{2}{3c^3}\int \ddot{p}^2 dt = \frac{24}{7}\frac{e_0^2}{R}\beta_0^3.$$

Such energy of the first burst of radiation precedes the radiation of the transient decelerating source (concerning transient radiation for a plane boundary, see references 1 and 2). We compare the received radiation of the image with the radiation of a charge in complete braking in the electric field of a parallel plate condenser. For the path of charge parallel to the field

$$\delta\mathcal{E} = \frac{2}{3}\frac{e_0^3 E\beta_0}{m_0 c^2},$$

$$\frac{\Delta\mathcal{E}}{\delta\mathcal{E}} = \frac{36}{7}\frac{m_0 c^2\beta_0^2}{e_0 ER} = \frac{72}{7}\frac{\mathcal{E}_{\rm kin}}{e_0 ER};$$

for $eER = \mathcal{E}_{\rm kin}$; $\Delta\mathcal{E} \simeq 10\,\delta\mathcal{E}$.

It is evident that by suitable choice of the form (concave or convex) of the conducting surface, an accelerated or "super light" collapse of the field can be realized, redistributing the charge, even for a constant velocity of motion of the inducing charge (not exceeding that of light).

The employment of a bunch of charged particles as an inducing charge can increase the radiation effect by many orders of magnitude.[3] This justifies the interest in the study of the potentialities of transformation of the velocities and accelerations of image charges, and in the investigation of annihilation radiation associated with the uniting of the bunch with the induced charge.

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On the Problem of Rotational Levels and the Spectra of Heavy Nuclei. II

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IN the present communication, calculations concerning the relative intensities of α-particle groups from RdAc $\rightarrow$ AcX, based on the model of nuclear rotators[1], are presented, and are compared with experimental data[2,3]. The quantum-mechanical theory of α-decay, presented in