$$dW_{\gamma E0}(L\,\mathrm{III}) = 2.2\,\frac{2^{4\gamma-2}\,[\Gamma(\gamma_1+\gamma+1)]^2}{\Gamma(2\gamma_1+1)\,[\Gamma(2\gamma+2)]^3}\,W_{E0}(L\,\mathrm{I})\Big\{\Big[I_2^{\nu 0}+\frac{(\gamma+3)(\gamma+4)}{6}\,\xi^2\mathfrak{M}\Big]^2$$

$$+\frac{9}{32}\Big[\frac{(2\gamma+1)(\gamma+3)(\gamma+4)}{15}\Big]^2\xi^4\Big(\mathfrak{N}+\frac{5}{3}\,\mathfrak{M}\Big)^2\Big\}\,\delta(\Delta-\varepsilon_1-k-\varepsilon_f+1)\,\xi d\xi\, d\varepsilon_f,\quad \gamma_1=2\sqrt{1-\alpha^2},\quad \gamma=\sqrt{1-4\alpha^2},$$

where Δ is the nuclear transition energy and ϵ_1 is the binding energy of the L electron, equal to $(Ze^2)^2/8$.

If $\Delta \gg \alpha^2$ it is easy to estimate the lower limit of the total transition probability:

$$W_{\gamma E0}(L\,\mathrm{II}) \gtrsim W_{E0}(L\,\mathrm{I},\ \Delta)\,\frac{1}{137}\,1.2\,\frac{2^{4\gamma-2}}{[\Gamma(2\gamma+1)]^2}\,\frac{\alpha^2}{16}\,C,\quad W_{\gamma E0}(L\,\mathrm{III}) \gtrsim W_{E0}(L\,\mathrm{I},\ \Delta)\,\frac{1}{137}\,2.2\,\frac{2^{4\gamma-2}[\Gamma(\gamma_1+\gamma+1)]^2}{\Gamma(2\gamma_1+1)\,[\Gamma(2\gamma+2)]^3}\,\frac{\alpha^2}{16}\,C,$$

where the constant C is $\gtrsim 2$.

For the ratio of the two probabilities we obtain

$$W_{E0}(L\,\mathrm{II})\,/\,W_{\gamma E0}(L\,\mathrm{II}) \leqslant (1.37\cdot 10^3/C)\,2^{3-4\gamma}\,[\Gamma(2\gamma+1)]^2\,p_f^2\,(\varepsilon_f+1)^{-2}.$$

if $\Delta \sim \alpha^2$ the ratio of the probabilities can be on the order of unity, owing to the smallness of p_f.

The ratio $W_{E0}(L\mathrm{III})/W_{\gamma E0}(L\mathrm{III})$ does not exceed 10^{-4} to 10^{-5} for all values of Δ.

Also possible for the LIII electron is a $\gamma - E0$ conversion with a transition first into the state $j = 1/2$, $\ell = 1$ and emission of a M1 and E2 quantum. In this case, however, the probability $dW_{\gamma E0}$ is proportional to $W_{E0}(L\mathrm{II})$ and is considerably less than the probability $dW_{\gamma E0}$ of a process with emission of an E1 quantum.

[1] D. P. Grechukhin, J. Exptl. Theoret. Phys. (U.S.S.R.) 32, 103 (1957), Soviet Phys. JETP 5, 846 (1957).

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201

SIGN OF THE SPACE CHARGE ON THE AXIS OF A POSITIVE COLUMN IN A LONGITUDINAL MAGNETIC FIELD

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THE magnitude of the space charge in a positive column, together with the magnitude of the transverse electric field, depends for a given current not only on the temperatures and masses of the particles and on the pressure, but also on the superimposed external longitudinal magnetic fields.[1] To calculate the deviation from the quasi-neutrality on the discharge axis one can use a scheme analogous to that proposed by Ecker.[2] However, since direct measurements of the excess space charge is difficult, it is advantageous to change over to transverse gradients.

The ratio of the transverse gradients near the axis in a magnetic field and without the field is given by

$$E_r^H\,/\,E_r = Z^H\,(L_e^H - L_p^H)\,(D_e b_p + D_p b_e)\,/\,Z\,(D_e - D_p)\,(D_e^H b_p^H + L_p^H b_e^H), \tag{1}$$

where D_e, D_p, b_e, and b_p are the coefficients of diffusion and mobility of the electrons and ions without a magnetic field (while the index H denotes the presence of a magnetic field), and Z is the ionization coefficient.

Under conditions usually existing in the positive column of a gas discharge, the transverse field decreases in the presence of a longitudinal magnetic field. The character of the decrease depends on the degree of non-isothermal nature of T_e/T_p and on the masses of the atoms of the gas in which the discharge takes place. For light gases the transverse field does not change its sign, while in a discharge in heavy gases there exists such a magnetic field, for which the sign of the transverse gradient reverses.* In the case of light elements relation (1) can be represented as

$$E_r^H / E_r = (Z^H / Z)(1 + b_p^2 H^2 / c^2), \quad (1a)$$

and for fields less than 1,000 gauss it reduces to

$$E_r^H / E_r = Z^H / Z. \quad (1b)$$

To compare (1b) with experimental results we employed measurements of the longitudinal gradient in neon with and without a magnetic field. The ratio of the transverse fields obtained from the longitudinal gradients with the aid of formula (1b) gave a result that was in satisfactory agreement with the measurements of Bicerton and Engel.[1]†

In the case of heavy elements Eq. (1) becomes

$$E_r^H / E_r = (Z^H / Z)\,[1 - (D_p b_e^2 - D_e b_p^2)\,H^2 / (D_e - D_p)\,c^2], \quad (1c)$$

and the magnetic field at which the transverse gradient vanishes is determined by

$$H_0^2 = c^2 (D_e - D_p) / (D_p b_e^2 - D_e b_p^2). \quad (2)$$

In the case of discharge in mercury vapor at a pressure 10^{-2} mm mercury and $T_e/T_p = 10^2$ the value of the magnetic field determined by (2) is approximately 2,000 gauss; at larger fields the transverse gradient should reverse its sign.‡ However, experiments in which such a phenomenon would be observed are unknown to this author, and it is therefore impossible to compare the calculated and experimental results.

In conclusion I feel it my duty to thank Professor Ia. P. Terletskii and A. A. Zaitsev for advice in various problems touched upon in this work.

*When $T_e/T_p = 10^2$ and the free paths are gas-kinetic, the sign of the space charge cannot change for a gas of atomic weight less than 15.

†If the magnetic fields are large, the ratio (1a) tends to a constant value, as can be verified by using the equations from the Schottky theory.

‡The phenomenon can be studied at fields less than H_0. In this case the ratio of the gradients in a discharge in light gases should approach asymptotically a constant value, something that does not happen for heavy gases.

[1] R. J. Bicerton and A. Engel, Proc. Phys. Soc. 69B, 468 (1956).
[2] G. Ecker, Proc. Phys. Soc. 67B, 485 (1954).

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202

CONTRIBUTION TO THE THEORY OF STRIPPING AT HIGH ENERGIES

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SERBER[1] determined the cross section of the stripping reaction under the assumption that the nuclear radius R is considerably greater than the deuteron radius R_d. This, however, is a poor assumption even for the heaviest nuclei, where the ratio $p = R/R_d$ reaches approximately 5. It is therefore desir-