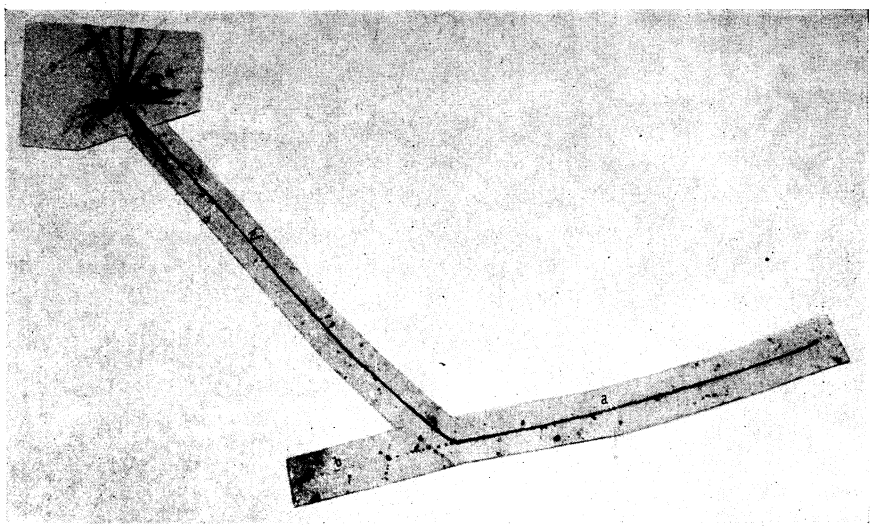

FIG. 2. Mesonic decay of a hyperfragment.

(A range $R = 0.8\mu$ is the largest range a particle can have without producing a visible track.)

The binding energy of the Λ^0 particle was determined for all possible decay schemes and those leading to positive binding energies were selected. This analysis leads to the following decay schemes of the hyperfragment:

$$_{\Lambda}F^{18,19,20} \rightarrow d(t) + p(d,t) + p + C, \quad (1)$$

$$_{\Lambda}Ne^{20,21} \rightarrow p(d,t) + p(d,t,He^3,He^4) + p + N(C) \quad (2)$$

with the following values for the binding energy: for decay scheme (1), $^{F}B_{\Lambda} = (18.9 \pm 16.3)$ Mev; for (2) $^{Ne}B_{\Lambda} = (21.8 \pm 17.7)$ Mev.

If a neutral particle participated in the decay the possibility is not excluded that the hyperfragment was actually lighter than F.

Case 2. A light hyperfragment is emitted from a star of type 21 + 8p. After travelling 276μ it decays into two particles (Fig. 2). The scattering of the hyperfragment indicates a decay at rest. From the number of gaps and of δ rays its charge was determined to be $Z = 2-3$.

Particle a has a range of 218μ and was identified to have a charge 1. Track b leaves the stack after traversing $(12{,}320 \pm 500)\ \mu$ in 13 emulsions.

A comparison of the track density with calibration curves showed that the track was due to a π meson with an energy of (32.8 ± 5.0) Mev.

A kinematical analysis yields the schemes

$$He^5_{\Lambda} \rightarrow p + \pi^- + He^4 + Q_1, \quad (3)$$

$$Li^{7,8}_{\Lambda} \rightarrow p + \pi^- + Li^{6,7} + Q_2, \quad (4)$$

with $Q_1 = Q_2 = (39.0 \pm 5.0)$ Mev.

Taking $Q_{\Lambda} = 36.9$ Mev[6] we obtain $B_{\Lambda} = (-2.1 \pm 5.0)$ Mev.

In conclusion the authors express their thanks to A. I. Alikhanian for his interest in the work and to V. M. Kharitonov for valuable comments.

[1] Fry, Scheps, and Swami, Phys. Rev. 99, 1561 (1955).

[2] Fry, Scheps, and Swami, Phys. Rev. 101, 1526 (1956).

[3] Freier, Anderson, and Naugle, Phys. Rev. 94, 677 (1954).

[4] M. Blau, Phys. Rev. 102, 495 (1956).

[5] B. Waldeskog, Arkiv f. Fys. 8, 369 (1954).

[6] Friedlander, Keete, and Menon, Nuovo cimento 2, 663 (1955).

Translated by M. Danos
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THE EFFECT OF COULOMB CORRELATIONS ON THE SPECTRUM OF ELECTRON-PLASMA OSCILLATIONS

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THE numerous articles on the collective oscillations of plasmas have thus far, to our knowledge, not clarified the role of Coulomb correlations. This problem can be approached in several ways. For example, a kinetic equation which takes the correlations into account can be used to derive the dispersion equation for small density oscillations. This dispersion equation would express the oscilla-

tory frequency $\omega(k)$ in terms of parameters that characterize a uniform spatial distribution (the ground state), the principal characteristic being the average energy of a single particle when all interactions (kinetic energy, exchange interaction, and Coulomb correlations) are taken into account.

The second possible method was considered in Ref. 1. Small deviations from uniform density are described by linearized time-dependent Hartree equations in hydrodynamical form, with the coefficients of the equations given in terms of the ground-state particle energy. In Ref. 1 the dispersion equation for weak excitations (long waves) is given as

$$\omega^2 = n_0 G(k) k^2/m + 2\bar{E}_0 k^2/m + O(k^4),$$

where $G(k)$ is a Fourier component of the interaction potential, $\bar{E}_0$ is the average energy per particle taking into account exchange and Coulomb correlations in the ground state, and n_0 is the average particle density.

For an electron gas we have

$$\bar{E}_0 = E_F + E_x + E_C,$$

where $E_F = 3P_0^2/10m$ is the Fermi kinetic energy, $E_X = -(3e^2/4\pi\hbar)P_0$ is the Coulomb exchange energy, and E_C is the Coulomb correlation energy. Wigner's calculations[2] give

$$E_C = -0.288/(r_s + 5.1\, r_B), \qquad r_s = (3/4\pi n_0)^{1/3},$$
$$r_B = e^2/m\hbar^2.$$

This expression for E_C is valid with 20% accuracy for both small and large densities. Transforming to the usual notation of the theory of electron-plasma oscillations, we obtain the following expression for the frequency of normal oscillations:

$$\omega^2 = \omega_0^2 + \left[1 - 0.47\xi^2 - \frac{0.065}{1+0.22\xi^2}\xi^4\right]\left(\frac{3P_0^2}{5m^2}\right)k^2 + O(k^4);$$

here we have ω_0 for the Langmuir frequency, and the dimensionless quantity $\xi = \hbar\omega_0/(P_0^2/2m)$. For metals $\xi \sim 1$, and exchange effects play a larger part than Coulomb correlations, whose contribution in the dispersion equation is about seven times smaller. For a very dense electron gas ($r_S/r_B \ll 1$) the correlation energy was recently calculated by Gell-Mann and Brueckner,[3] who obtained the following expression:

$$E_C = [0.0622 \ln(r_s/r_B) - 0.096](e^4 m/2\hbar^2).$$

Here the contribution of Coulomb correlations to the dispersion equation is still smaller. This can easily be understood, because in a dense gas the Fermi kinetic energy is proportional to $n_0^{2/3}$ and the energy associated with interactions is proportional to $n_0^{1/3}$. Therefore as the density increases the kinetic energy rises more rapidly than the Coulomb interaction energy.

[1] V. M. Eleonskii and P. S. Zyrianov, J. Exptl. Theoret. Phys. (U.S.S.R.) **33**, 289 (1957), Soviet Phys. JETP **6**, 225 (1958).

[2] E. Wigner, Phys. Rev. **46**, 1002 (1934).

[3] M. Gell-Mann and K. A. Brueckner, Phys. Rev. **106**, 364 (1957).

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FILM TRANSFER RATE IN HELIUM ISOTOPE MIXTURES

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As is well-known,[1,2] the effect of He^3 dissolved in He II upon the phenomenon of film transfer is to reduce the transfer rate.

It appeared of some interest to investigate this situation in more detail, for which purpose experiments were carried out with helium isotope mixtures of 1.5, 4.7, 7.0, and 9.6% He^3 content. The experiments were performed with the aid of an apparatus consisting of two reservoirs, communicating through the helium film, made of thin-walled capillary tubing (1.08 mm in diameter) and of different lengths,[1] so that as the helium isotope mixture was condensed into the system a difference in level was established, and film transfer from the higher level to the lower began to take place below the λ-point. Measurements of the rate of change in the height of the level in one of the reservoirs of the system, made with the aid of a cathetometer, permitted determination of the film transfer rate $R = v\delta$, where v is the velocity of the film and δ is its thickness. The temperature region investigated was immediately adjacent to the λ-point. This is due to the fact that at sufficiently low temperatures (where the transfer rate becomes large) a substantial difference in the concentrations of the mixtures in the two reservoirs of the system