circulation contained $10^8$ $Na^{24}$ atoms; thus, the number of radio-sodium atoms was only 1/1000 of that of the corpuscles of the rabbit and less than 1/10 of these atoms disintegrated in the circulation during the experiment.

Isotopes, radioactive and nonradioactive ones as well, are not strictly chemically identical and this may become a source of error in certain cases; furthermore, the problem of the permeability of the corpuscles to sodium is not yet finally settled for reasons the discussion of which would lead too far. The objection raised against the use of radioactive indicators in elucidating the above problem based on the possible effect of the radiation on the red cell walls seems to us, however, not to be justified.

G. HEVESY

Institute of Theoretical Physics,
Copenhagen, Denmark,
December 14, 1939.

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## Energy and Half-Life of $Be^{10}$

Recent precision determinations[1] of the maximum energy of the charged particles emitted in light nuclear reactions have led to the values 9.01474 and 10.01579 for the masses of $Be^9$ and $B^{10}$, respectively. On bombarding beryllium with 3.1-Mev deuterons a yield of protons of range 52.6 cm was found corresponding to an energy change of 4.52 Mev in the reaction

$$Be^9 + D \rightarrow Be^{10} + H.$$

This is in good agreement with Oliphant, Kempton and Rutherford[2] who found the value 4.59 Mev. The deduced mass for $Be^{10}$ is $10.0165 \pm 0.0001$. The energy difference between $Be^{10}$ and $B^{10}$ is therefore approximately 0.67 Mev.

The electrons from $Be^{10}$ were discovered by McMillan[3] who states in a brief report that their upper limit is about 0.3 Mev and half-life greater than 10 years. A beryllium probe which had been bombarded by deuterons for approximately 60 microampere hours after three weeks' aging showed a definite activity whose absorption curve indicates a range of $0.25 \pm 0.03$ g/cm$^2$ in aluminum which, by Feather's empirical formula corresponds to $0.75 \pm 0.07$ Mev for the upper limit, which agrees reasonably well with the masses given above. The half-life can be estimated roughly from the yield: It was found that $4 \times 10^6$ protons per microampere per minute were evolved in all directions so that the sample of $Be^{10}$ contained $1.4 \times 10^{10}$ radioactive atoms. The total number of electrons evolved is estimated to be 8 per second from which the decay constant can be deduced to be $5.7 \times 10^{-10}$ sec.$^{-1}$ giving a half-life of 380 years.

I wish to thank Dr. Gordon Brubaker for the amplifier used for detection and Mr. W. L. Davidson, Jr., for help in running the cyclotron.

ERNEST POLLARD

Sloane Physics Laboratory,
Yale University,
New Haven, Connecticut,
January 2, 1940.

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## On Bose-Einstein Fluids

It has been suggested by London[1] that the two liquid modifications of helium, below and above its transition temperature, might correspond qualitatively to the two phases predicted by Einstein[2] for an ideal gas which follows the laws of the Bose statistics. We should like to discuss here the properties of elasticity of such a Bose-Einstein (B-E), fluid as their experimental study might furnish supplementary information concerning the eventual quantum-statistical interpretation of the transition in liquid helium.

The average intensity of light scattered by a given volume of a fluid is, as well known, proportional to $\langle \Delta N^2 \rangle_{\mathrm{Av}}/N^2$ or $\langle \Delta V^2 \rangle_{\mathrm{Av}}/V^2$ i.e., to the relative mean square fluctuations of the total number $N$ of the particles of the fluid, or its volume $V$, around the equilibrium value at a given temperature $T$. Now, one may write

$$\langle \Delta N^2 \rangle_{\mathrm{Av}}/N^2 = \langle \Delta V^2 \rangle_{\mathrm{Av}}/V^2 = kT\chi_T/V,$$

where $k$ is Boltzmann's constant and $\chi_T$ is the isothermal compressibility of the fluid at temperature $T$. For an ideal B-E fluid $\chi_T$ tends to infinity when the temperature is decreased to the quantum-condensation temperature $T_0$ of the fluid. Consequently, if this condensation takes place in coordinate space, as the condensation of ordinary fluids, then a B-E ideal fluid scattering light should become opalescent when its temperature approaches $T_0$ from the high temperature side. If, however, the condensation takes place only in impulse space, the condensed particles do not separate themselves in space from the other particles of the fluid, the elementary scattering volumes of the fluid do not suffer any abnormal spatial change, and in spite of the anomalous isothermal compressibility predicted by the statistical thermodynamics of the fluid, no quantum opalescence should exist near $T_0$. The apparent ambiguity in the interpretation of the fluctuational properties of an ideal B-E fluid seems to indicate that the usual statistical thermodynamics of such a fluid does not give an adequate account of its quantum condensation.

In the case of a nonideal B-E fluid where the nonideal character is taken into account by an average potential energy $U$, independent of the coordinates of the particles, smeared over the whole volume of the fluid, the pressure is

$$p = p_{\mathrm{id}} - (\partial U/\partial V).$$

where $p_{\mathrm{id}}$ is the pressure of the ideal fluid and now $\chi_T$ becomes almost normal around $T_0$. This, incidentally, is the same as for the ideal fluid, as there is no apparent reason for $\partial U/\partial V$ having an anomalous behavior around $T_0$. The sudden vanishing of $\partial p_{\mathrm{id}}/\partial V$ near $T_0$ causes a slight jump in $\chi_T$ from $V^{-1}(-\partial p_{\mathrm{id}}/\partial V + \partial^2 U/\partial V^2)^{-1}$ at a temperature slightly higher than $T_0$ to $V^{-1}(\partial^2 U/\partial V^2)^{-1}$ at $T_0$, and in the case of condensation in coordinate space the scattering of light might be slightly abnormal around $T_0$. Again, following the mechanism of condensation in impulse space no such anomaly should exist.

The adiabatic compressibility of an ideal B-E fluid $\chi_{\mathrm{ad}}$ given by the quotient of $\chi_T$ and the ratio $c_p/c_v$ of the specific heats may be considered as normal around $T_0$, and it will be so *a fortiori* for a nonideal fluid. Apparently this