THE $Ne^{21}(n, \alpha)O^{18}$ *REACTION ON SLOW NEUTRONS*

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The nuclear reaction $Ne^{21}(n, \alpha)O^{18}$ has been detected in a neon-filled ionization chamber irradiated by thermal neutrons. The energy and effective cross section of the reaction have been measured.

CALCULATION based on the nuclear masses shows that neutrons can produce in neon isotopes only one exothermal reaction with emission of charged particles, namely $Ne^{21}(n, \alpha)O^{18}$ (the atomic masses used in the calculations were taken from the tables of [1,2]).

To observe this reaction we placed a spherical ionization chamber,[3] filled with pure neon to a pressure of 10 atm, in a beam of slow neutrons from the thermal column of the BR-5 reactor. A continuous discriminator was used to plot a blanking curve, differentiation of which yielded a pulse spectrum in the form of a peak with a "tail" stretching to the left. The reaction energy $Q = 0.696 \pm 0.019$ Mev, obtained from the peak position, coincides within the limits of experimental accuracy with the calculated value $Q = 0.704$ Mev.[4] No pulses of comparable amplitude were observed in control measurements with an argon filled chamber. This circumstance confirmed indirectly that the pulses registered in the main experiment were to due to the neon itself. The high cadmium ratio (> 100) measured with the neon-filled chamber indicates that the reaction noted is induced by thermal neutrons.

The effective cross section of the $Ne^{21}(n, \alpha)O^{18}$ reaction on thermal neutrons was measured by comparing it with the cross section of the $He^3(n, p)H^3$ reaction. For this purpose, two identical chambers, one with neon and the other with He^3, were placed successively at the same point in space and the ratio of the counting rates from the chambers was then determined. Since the helium chamber counted too many pulses per second in the direct neutron beam, all the measurements were made with scattered neutrons several meters away from the open damper of the thermal column. The ratio of the counting rates was found to be 13090 ± 208. Knowing the content of He^3 in the working mixture and of Ne^{21} in natural neon (0.257%), we could readily determine the cross section ratio: $\sigma_{Ne^{21}}/\sigma_{He^3} = 0.0177 \pm 0.0059$. The uncertainty in the result indicated here is the total experimental error, which reflects, in particular, the difference in the shape of the pulse spectra obtained from different chambers. Assuming now the cross section of the (n, p) reaction on He^3 for thermal neutrons to be 5400 ± 200 b,[5] we obtain finally $\sigma[Ne^{21}(n, \alpha)O^{18}] = 96 \pm 33$ b. The use of the value $\sigma_{He^3} = 5400$ b, obtained for a neutron velocity 2200 m/sec, is fully justified in this case, for it was established in physical tests on the BR-5 reactor that the spectrum of the neutrons leaving its thermal column is quite close to Maxwellian.

We note that the $Ne^{21}(n, \alpha)O^{18}$ reaction can be used for the spectrometry of fast neutrons along with the $He^3(n, p)H^3$ reaction. If the first of these reactions is used, pulses from the recoil nuclei will not interfere with the measurements up to a neutron energy ~ 4 Mev.

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