destroying process: ($He^3+He^4 \rightarrow Be^7$). It is probable that the concentration of He^3 is much lower.

It is interesting to notice from the diagram how the rate of energy losses is affected by different factors. Thus, for example, urca-process in Fe^{54} gives, at 10^9 °C, very large energy losses, in spite of the comparatively small abundance of this particular iron isotope. On the other hand, the abundant element N^{14} leads to a much smaller energy loss because the β-decay of C^{14} belongs to the transitions prohibited by the selection rule; if this transition were permitted, the energy loss through neutrino emission would be as high as 10^6 or even 10^7 erg/g sec. It is thus possible that, between as yet uninvestigated β-active elements, one might find one or two which will give very high energy losses even at 10^9 °C.

But, using only the tabulated nuclei, we find that energy losses as high as 10^{11} or 10^{12} erg/g sec. will take place at the temperature of 10^{10} °C. Such a temperature will be attained in the interior of a contracting star of 5 sun masses when its radius is reduced to one percent of its original value. It is quite possible that this stage of contraction corresponds to the beginning of the catastrophic collapse characterizing the processes of stellar explosion.

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The Absolute Cross Section for the Photo-Disintegration of Deuterium by 6.2-Mev Quanta

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THE photo-disintegration of deuterium is of special interest because of the relative simplicity of its theoretical treatment. We have been engaged in determining the absolute cross section of the photo-disintegration with the 6.2-Mev radiation produced when fluorine is bombarded with protons. An accurate measurement is made possible by the recent calibration of the yield from a thick target of crystalline calcium fluoride[1] as $8.9 \pm 0.5 \times 10^4$ quanta per microcoulomb of protons at 370 kev and $3.74 \pm 0.2 \times 10^6$ quanta per microcoulomb at 1050 kev.

A high pressure ionization chamber filled with deuterium gas was used to count visually the pulses due to the photo-protons. The chamber consisted of a high voltage electrode cylindrical in shape with a grid electrode along its axis, the whole being placed inside a steel pressure vessel with auxiliary pressure gages and valves. The volume of the chamber was about 36 cc.

Blank runs made with ordinary hydrogen in the ionization chamber gave null results, showing that neutrons produced in the magnetic deflection box of the accelerating tube by deuterium contamination in the beam were not present in sufficient numbers to make an appreciable background.

With deuterium in the chamber the pulse counting rate was observed to parallel closely the quantum yield curve, both with respect to varying the incident beam current at constant bombarding voltage, and to varying the bombarding voltage. In order to increase the heights of the pulses the stopping power of the gas in the ionization chamber was increased by the addition of about ten percent of argon. Check runs taken with hydrogen and argon showed that no photo-disintegrations occurred with the mixture.

Inasmuch as actual counting conditions required that the pulses exceed a certain minimum height to be detected, a fraction of the pulses was lost. These short pulses were those from disintegrations occurring near a wall of the ionization chamber with the proton heading into it. The apparent cross section, calculated assuming that no counts were lost, was measured at various pressures of the deuterium-argon mixture. The true cross section was then determined by extrapolating to infinite pressure (where the wall effect is obviously zero) the curve of the apparent cross section as a function of the reciprocal of the pressure.

Two such curves with different geometrical conditions and with different gas mixtures have been taken during January and February, 1941. In one the axis of the chamber was perpendicular to the line from the target, and in the second the axis of the chamber passed through the target. The extrapolation in the first case gave 11.3×10^{-28} cm² and in the second case 12.3×10^{-28} cm². The weighted average of these two results taking all known errors into account is then

$$11.6 \pm 1.5 \times 10^{-28} \text{ cm}^2.$$

In these curves the wall effect at the highest pressure amounted to about 20 percent. We are preparing to repeat these experiments under conditions in which the wall effect is considerably less. The ultimate accuracy with our present experimental arrangement can be expected to be about ten percent.

Our value is approximately equal to that of the Bethe-Peierls theory[2] for zero force range (12.6×10^{-28} cm²) and is therefore distinctly lower than any present theory[3] predicts when based on a reasonable value for the force range.

In preliminary experiments with the 17.5-Mev gamma-rays produced when lithium is bombarded with protons, no effect which is attributable to deuterium has yet been observed. The counting rate with the chamber filled with hydrogen has in fact exceeded several fold the expected rate from deuterium. This is not surprising since the γ-ray energy is in excess of the binding energy of the last proton or neutron of nearly every nucleus. A carbon-walled ionization chamber, however, shows good prospects of success in our latest trials.

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