JOLIOT

It ~~shall~~ should be possible to obtain the value of μ with great accuracy by the following method: let us have a sphere containing a homogeneous mixture of Uranium and water having n atoms of Hydrogen per atom of Uranium. This sphere of radius l is immersed in a large water tank and a photo neutron source is placed in the center of the sphere. The density ρ of the thermal neutrons is measured along a radius and the integrals of

$$I_{int} = \int_0^l r^2 \rho \, dr,$$

$$I_{ext} = \int_l^\infty r^2 \rho \, dr$$

are determined giving a measure of the number of slow neutrons which are present inside the sphere within the mixture and outside the sphere in the water. In another experiment the integral

$$I_0 = \int_0^\infty r^2 \rho \, dr$$

is determined for the same neutron source in pure water.

I find that one can derive from I_{int}, I_{ext} and I_0 the value of μ and that it is

$$\mu = \frac{1}{1-p} + \frac{n\,\sigma_c(H)}{\sigma_a(U)} \left\{ \frac{1}{1-p} - \frac{1}{s} \, \frac{1 - \left(I_{int}/I_0 \right)}{I_{ext}/I_0} \right\}$$

Where s is the density of the water inside the sphere in the mixture

This expression holds strictly if the radius of the sphere is sufficiently large to permit to neglect transition phenomena in the equilibrium of resonance neutrons and thermal neutrons near the surface of the sphere.

The values of $I_{int}/I_0 = 0.45$ $\quad I_{ext}/I_0 = 0.72$ for $n = 3$ and $s = 0.42$ gm/cc

Insert this

In a homogeneous mixture of Uranium and water the fraction p of the neutrons which are captured as resonance by Uranium and therefore never reach thermal energies depends upon n the number of Hydrogen atoms the Uranium atom contained in the mixture. One may hold for theoretic reasons which are generally known that if the value of p_1 is known for a given Hydrogen concentration $n_1 = n$. The value of p_2 for another Hydrogen concentration n_2 can be calculated from the equation

$$\frac{\log(1-p_1)}{\log(1-p_2)} = \frac{\sqrt{n_2}}{\sqrt{n_1}}$$

The value of p has been studied for values of $n > 30$ by Halban / Sandtch H. J. K. P.

~~From which~~ using those data one obtains from equation No. quoted by ... the value of

$$p = 0.5$$

A more accurate knowledge of the value of p might perhaps be obtained for low Hydrogen concentrations by the following method:

Let the B activity of an Iodine indicator activity by Cadmium filtered neutrons in the Uranium and water mixture and the activity of the same Cadmium Iodine indicator in pure water. Let further and be the corresponding B activities of an Iodine indicator covered both by Cadmium and an Iodine absorber. Let further , , and be the corresponding activities of an Indium indicator covered with Cadmium or Cadmium plus Indium in the Uranium and water mixture or in pure water.

We have then

here Insert

JOLIOT (continued)

can be taken from an experiment ~~of the type just described which~~ ~~was~~ ~~performed~~ reported by

H. J. K. P.

These authors ~~conclude from their experiment~~ performed an exp of the type just described They ~~which thus~~ conclude from their experiment that about 8 neutrons are generated in their arrangement by every primary neutron which causes a fission process in Uranium. They interpret this by stating that a considerable number of secondary and tertiary neutrons are created in that experiment which they choose to call a convergent chain reaction

using a ~~Used~~ dysprosium a s an indicator of the thermal neutron density

and ~~they report that the values in an experiment for which they had~~

~~n and s Putting these values into our formula and~~

using the above quoted values and ~~using in agreement with these authors~~ the value of p = 0.05 we have

$$\mu = 2.05 \text{ or } 2{\cdot}02$$

According to whether we attribute to $\frac{3\sigma_c(W)}{\sigma_a(U)}$ the value of 1/4 or 1/8.

The fact that μ is so very insensitive to a variation in the value of these absorbing cross-sections makes it possible to determine very accurately the value of μ by measuring accurately the value of p. This is now being done by a ~~new~~ method which has been devised for the purpose.