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Contract No. W-7405-Eng-48

SUMMARY OF THE RESEARCH PROGRESS MEETING

April 8, 1948

by, R. K. Wakerling

Berkeley, California

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Physics-General

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Some New Isotopes in the Rare Earth Region. H. Hicks.

The interpretation of the results of the bombardment of tantalum with 200 Mev deuterons from the 184-inch cyclotron has been virtually impossible because of the fact that properties of the light isotopes of the heavy rare earths hafnium, tungsten and rhenium were unknown. It was therefore decided to make a systematic study of these isotopes through a program of alpha and deuteron bombardments in the 60-inch cyclotron. So far bombardments have been made with alpha particles of energy 40 Mev and 20 Mev and deuterons of 20 Mev, using tantalum foil to reduce the energy of the beam.

In rare earth bombardments separation of individual elements was made using Nalcite columns. Samples were collected for fifteen minutes and then tested for activity by evaporation of an aliquot on a stainless steel tray. In order to prove conclusively the chemical identity of active fractions, macro amounts of rare earths on either side of the anticipated active elements were also added to the solution of bombarded material before transferring to the column, and eluted samples were checked spectrographically.

The 40 Mev alpha particle bombardment of terbium produced three holmium activities with half-lives of 20 minutes, 4.55 hours, and 50 days. The short-lived activity is formed in very high yield and probably is due to an (α, 3n) reaction in Tb.

The bombardments of holmium have been made with both 40 and 20 Mev alpha particles. In the lower energy the 7.7 hour isotope is in very low

yield and allocation to mass 166 seems reasonable. This isotope is the heaviest positron emitter yet characterized.

Deuteron bombardment of lutecium produces the well-known 3.75-hour and 6.9-day activities, and the observed radiation characteristics agree in general with published data.

The bombardment of lutecium with 40 Mev alpha particles produces isotopes of half lives 8 hours, 2.66 days and 16 days. At 20 Mev, not only is the 8-hour activity in very much reduced yield but the yields of the other isotopes are reversed compared to the 40 Mev bombardment.

The 40 Mev alpha bombardments of tantalum produce three activities of half lives approximately 11 hours, 64 hours, and 200 days. The 200-day activity has also been isolated from old tungsten exit strips from the 60-inch cyclotron.

It is planned to extend this work with deuteron bombardments of many of the elements which have only so far been bombarded with alpha particles.

Remarks on a New Alpha Series. A. Ghiorso.

A large number of alpha emitting isotopes have been observed following the bombardment of thorium with 60 Mev deuterons. Among these is a new decay series starting with Pa^{226} and which runs into the uranium series at RaE. The mass number was identified by observing the growth of Po^{210} from samples of separated protactinium. The Pa^{226} has a half-life of 38 minutes and decays by the emission of a 6.46 Mev alpha-particle. The half lives of the other members of the decay series cannot be longer than a few minutes since they appear at equilibrium several minutes after the separation of protactinium. It is also probable that there is little branching in the alpha decay at any point along the chain, since in all cases appreciable

orbital electron capture branching would lead to identifiable isotopes. None of these was observed. The probable members of the decay series and their alpha energies in Mev are Pa^{226} - 6.46, Ac^{222} - 6.64, Fr^{218} - 7.30, At^{214} - 8.00. The pairings of alpha energy and isotopic assignment as shown are reasonable assignments but are otherwise not proved.

Solid Counters. Dr. S. De Benedetti.

Dr. De Benedetti, who is a visitor from Clinton Laboratories, gave a brief summary of some of the work being done there on the use of anthracene and naphthalene scintillation counters. They have experienced much better results with anthracene than with naphthalene. For use in this work they have succeeded in producing some large anthracene crystals. These produce pulses in size from 3 to 5 times the size of pulses obtained from naphthalene. They also have the advantage that they can count with small background and without the use of refrigerants. A delayed coincidence counting arrangement for use with crystal counters was mentioned.

L. Wouters.

Naphthalene crystals have been replaced with anthracite in one of the experimental counters and some excellent results obtained. This work is continuing. An experiment was performed by L. Alvarez in which the light from naphthalene crystals was successfully transmitted through a 3-foot length of lucite rod 1" in diameter. Plans are also afoot to try a 1P128 photomultiplier tube with naphthalene crystals.

Biological Experiments with the Deuteron Bean of the 184-inch Cyclotron.

C. Tobias.

It should be possible with the 184-inch cyclotron to obtain quite

accurate bombardments of certain animal organs and to study the effect of such radiation. With the cyclotron one can measure the specific ionization and target area as well as the number of particles passing through the bombarded tissue. The experimental arrangement involves the use of two ionization chambers between which is placed the absorber, all this being followed by an evacuated Faraday cage. Thus far a number of runs have been made to calibrate the apparatus and a beam centering arrangement has been perfected. Bragg curves have been taken with aluminum and polystirene absorbers.

Mice have been placed in the beam in a position such that the 190 Mev deuterons pass lengthwise through the bodies of the animals. The range is much longer than the length of the body of the mouse, and the mean energy of the deuteron within the body was calculated to be about 170 Mev. The exposure required for the 50% LD is about 15 seconds. It appears from a comparison of these results with other data previously obtained with 90 Mev neutrons that the lethal effect of fast protons and deuterons is a function of the length of time of bombardment. Three experimental points obtained for 2 seconds, 2 hours and 24 hours indicate that the LD 50 varies approximately as the fourth root of the exposure time.

By the use of a slit or vane arrangement attempts will be made to irradiate particular animal organs, such as the adrenal gland, which is particularly sensitive to radiation.

Experiments are also under way for a study of the mechanism of sodium diffusion in connection with a study of ion exchange through cell walls. In the first phase of this work the distribution and mixing of sodium ions was studied by the tracer technique with and without X-radiation.

Definite effects due to sublethal amounts of X-rays have been demonstrated on the distribution of sodium ions. Sodium 24 was injected intravenously in rabbits and the radioactivity of the plasma was measured at frequent intervals. In unirradiated animals a constant Na level is reached within three hours after injection. This level is maintained almost constant for several hours. In irradiated rabbits (400 r of 200 kv X-rays) the sodium concentration in venous blood decreases over a period of several hours after irradiation. Results may be expressed terms of sodium space. In normal animals sodium space equals the volume of extracellular fluid. In irradiated animals the sodium space increased compared to the extracellular fluid by as much as 50 per cent in some cases. This result was shown in four of the six irradiated animals to date. The work is being continued.

Plans are also under way to study the effects of radiation on the chromosomes in the spores of certain plants.

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