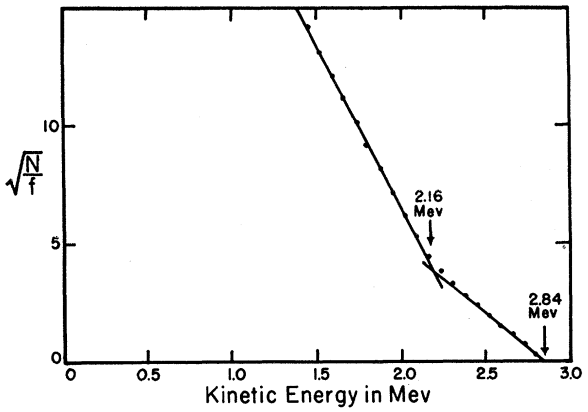

FIG. 2. Fermi plot of beta spectrum of 24-second Ag^{110}.

Brookhaven reactor for a period of approximately two seconds. The transit time from the pile to the spectrometer was approximately ten seconds. The decay rate of the activity indicated a half-life of 24±2 seconds thus insuring proper identification as Ag^{110}.

The Ag^{110} gamma spectrum is shown in Fig. 1 and a Fermi plot of the beta spectrum appears in Fig. 2. Energy calibrations were obtained from the 0.661-Mev gamma ray of Cs^{137} and its conversion line. Gamma rays of 0.66±0.02 Mev and 0.94±0.02 Mev are observed as well as weak, poorly resolved peaks at 0.72±0.02 Mev, 0.81±0.02 Mev, and 0.88±0.02 Mev. The beta spectrum consists of two groups with end points at 2.84±0.05 Mev and 2.16±0.05 Mev. These emissions may be arranged in the decay scheme shown in Fig. 3. The 0.37-Mev beta group was not observed. If present this group undoubtedly would have been masked by the higher-energy groups. This decay scheme meshes with the one given by Cork *et al.*[2] for the decay of the 270-day isomeric state of Ag^{110}.

The present experiment is similar to one performed by Goodrich[3] who found indications supporting the suggestion of Siegbahn[4] that a lower-energy beta transition may occur between the 24-second state and one of the higher Cd^{110} levels. The present experiment yields a beta-to-gamma intensity ratio of 200. Considering the two-second irradiation time and the 40-to-1 ratio of cross sections in favor of the excitation of the 24-second over the 270-day isomer, the 200-to-1 intensity ratio strongly supports the existence of a low-energy beta transition. The above data indicate an end point energy of approximately 0.37 Mev for the group.

The 13-second isomeric state of In^{116} was excited by irradiating finely powdered indium in the Brookhaven reactor for approximately two seconds. Identification was made on the basis of half-life as in the case described above. No gamma rays were detected. The end point of the single beta-ray group was determined to be 3.29±0.06 Mev. There appears to be no transition between the isomeric states of In^{116}. These results support the findings of Slätis *et al.*[5]

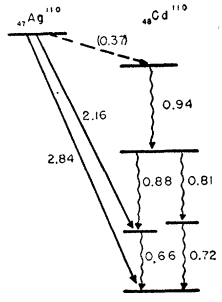

FIG. 3. Proposed decay scheme of 24-second isomeric state of Ag^{110}. Energies are in Mev.

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Half-Life and Beta Decay of the Long-Lived Niobium-94

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THE properties of the nuclide Nb^{94} have so far not been observed directly but have only been inferred from other experimental data owing to the difficulty of freeing even the purest niobium, element or compound, from impurities which become activated in the pile. From yield considerations, the most recent tentative assignment of the half-life to this beta-decaying nuclide[1] only indicates a lower limit of 5×10^4 years. Lately an efficient means of separating tantalum from niobium by solvent extraction was indicated,[2] based on the fact that tantalum and niobium have been found to extract into certain polar organic solvents. This enabled us to obtain the residual activity, due to Nb^{94}, of a niobium sample irradiated in the pile.

Spectroscopically pure metallic niobium as well as some niobium salts have been irradiated for 23 days with thermal neutrons in the nuclear reactor "JEEP." The short-lived 6.6-minute Nb^{94m} beta activity was confirmed. The bulk of the slow-decay activity is due to Ta^{182} beta and gamma radiations. Many ways have been tried to free efficiently the niobium metal from the tantalum impurity: anion exchange column, coprecipitation of Ta as potassium fluotantalate, and Ta/Nb solvent extraction using di-isopropyl ketone. Only the last one proved successful. In a Nb_2O_5 sample to which inactive tantalum was first added and then extracted successively four times, the residual activity was brought down to a stable value of 9.5 counts/min per mg Nb_2O_5 counted in a standard end-window Geiger tube assembly for a window-to-sample distance of 9 mm.

Absolute beta counting was carried out on this purified niobium pentoxide, resulting in a specific activity of 4.757×10^{-8} curies/g of irradiated niobium metal. From this value a half-life of 2.7×10^4 years was computed for the nuclide, the average value of the neutron flux during the 23-day irradiation being 1.5×10^{11} neutrons per cm^2 per sec. Considering the necessary approximations used, we estimate that the half-life of Nb^{94} is determined with an accuracy of ±15 percent of the indicated value.

From an aluminum absorption curve the energy of the residual Nb^{94} beta radiation was found to be 0.61 Mev.

The neutron irradiation and the measurement of the short-lived Nb^{94m} were carried out at the Joint Establishment for Nuclear Energy Research (JENER), Kjeller, Norway, the further research at the Institute of General Chemistry of the Polytechnic in Milan (Italy).

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