

THE NON EXISTENCE OF THE ^{92m}Nb ISOMER

H. E. BOSCH

Laboratorio de Radiaciones, Dinfia, Buenos Aires, Argentina

S. M. ABECASIS*

Dep Fís. Univ. Nac. La Plata, Argentina

E. ANSALDO, A. JECH and M. MARISCOTTI

F.C.E.N., Buenos Aires, Argentina

(Received 30 October 1963; in revised form 20 December 1963)

Abstract—A search for an isomer of ^{92}Nb from the $^{93}\text{Nb}(d, p2n)$ reaction was made. No evidence of either the already reported 13 hr activity or of a 2.35 MeV γ -ray was found. The possibility of the existence of the 2.35 MeV γ -ray as well as of the 13 hr activity in other chemically separated fractions formed in the same nuclear reaction is also ruled out.

SEVERAL authors⁽¹⁻⁸⁾ have searched for the 13 \pm 2 hr ^{92m}Nb isomer reported by JAMES⁽¹⁾ using the nuclear reactions (α, n) , $(\alpha, \alpha' n)$, $(n, 2n)$, (γ, n) on suitable targets but without success.

Up to the present, new experiments with (p, pn) reactions or similar ones which led to the activity reported by JAMES⁽¹⁾ have not been performed. Therefore the present authors have decided to study the reaction $^{93}\text{Nb}(d, p2n)$ in order to look for the 13 hr activity.

EXPERIMENTAL

(i) Chemical procedure

Twenty milligrams of spectroscopically pure powder niobium† were irradiated with 22 MeV deuterons, accelerated in the Philips synchrocyclotron of the Atomic Energy Commission, Argentina. The irradiated material was dissolved in conc. HF and some drops of conc. HNO_3 . Yttrium carrier was added and the YF_3 precipitate was separated by centrifugation. Copper and molybdenum carriers were added to the supernate and digestion with conc. HNO_3 was made. The niobium was precipitated as niobic acid in the usual way. The precipitate was dissolved by heating with conc. H_2SO_4 . Copper carrier was added to this solution and H_2S was bubbled till complete precipitation of the sulphide. In the solution obtained after filtration, digestion with conc. HNO_3 was repeated and niobium was reprecipitated.

The filtrate obtained after the first precipitation of the niobic acid was treated in a similar way as described in reference (9), to get the molybdenum fraction.

* Sponsored by the Comisión Especial de Física Atómica y Radioisótopos, Universidad Nacional de La Plata, La Plata, Argentina.

† Obtained from Johnson, Matthey and Co. Ltd., England.

⁽¹⁾ R. A. JAMES, *Phys. Rev.* **93**, 288 (1954).

⁽²⁾ E. SILVA, J. GOLDENBERG, P. R. SMITH and V. L. MARQUEZ, *Nuovo Cimento* **9**, 17 (1958).

⁽³⁾ M. E. BUNKER, B. J. DROPSKY, J. D. KNIGHT and J. W. STARNER, *Phys. Rev.* **127**, 844 (1962).

⁽⁴⁾ M. BOCCIOLINI, G. DI CAPORACCO, L. FOÁ and M. MANDÒ, *Nuovo Cimento* **16**, 780 (1960).

⁽⁵⁾ E. T. BRAMLITT and R. W. FINK, *J. Inorg. Nucl. Chem.* **24**, 1317 (1962).

⁽⁶⁾ E. T. BRAMLITT and R. W. FINK, *J. Inorg. Nucl. Chem.* **24**, 1321 (1962).

⁽⁷⁾ K. P. GOPINATHAN, *Proc. Indian Academy of Sciences* **56**, Sec. A, 141 (1962).

⁽⁸⁾ J. M. MATUSZECK JR. Thesis, Worcester, Mass., Clark Univ. (1962). (Unpublished)

⁽⁹⁾ S. M. ABECASIS, *Proc. Interam. Conf. Radiochemistry*, Montevideo, Uruguay (1963).

(ii) Equipment

The gamma-ray spectra have been measured with a 3-in. dia. \times 3-in. thick NaI(Tl) crystal coupled to a Du Mond 6292 photomultiplier (integral line assembly), in conjunction with a Nuclear Data 512-channel analyser.

RESULTS AND DISCUSSION

The γ -ray spectra from the niobium fraction have been examined at different source-to-crystal distances in order to investigate both interferences of solid angle

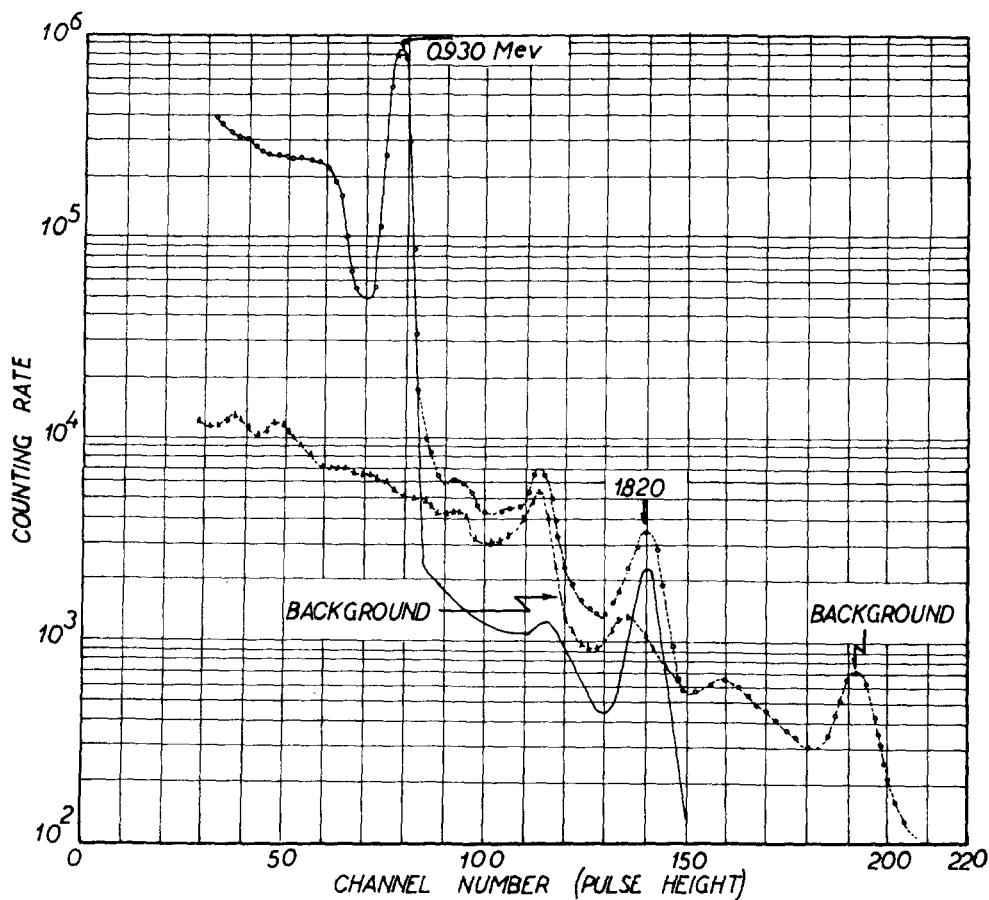


FIG. 1.— γ -ray spectrum from the niobium fraction taken at a source-to-crystal distance of 27 cm with a 3-in. dia. \times 3-in. thick NaI(Tl) crystal three hours after the end of bombardment. The corresponding room background is also shown at high energies. The solid line represents the remainder spectrum after background subtraction.

addition peaks and deformation of spectra due to high counting rates. A typical γ -ray spectrum of the chemical separated niobium fraction taken at a source to crystal distance of 27 cm is shown in Fig. 1. A 1.876 g/cm² beryllium absorber was used. The 0.930 MeV and 1.820 MeV γ -rays are those well known to be associated with the ⁹²Nb ground state. No evidence of a 2.35 MeV peak, with an upper limit of 10^{-6} with respect to the intensity of the 0.93 MeV γ -ray is found.

A γ -ray spectrum taken at 7 cm was followed during several days, in order to

look for the existence of the activity under consideration. The whole spectrum decayed with a 10.1 day half-life.

For the purpose of determining whether the 13 hr activity reported in the literature⁽¹⁾ belongs to the sample produced by irradiating ^{93}Nb with deuterons, or is due to a missubtracted background at high energies, the molybdenum fraction as well as the zirconium and yttrium fractions were analysed. Neither the 13 hr activity nor a 2.35 MeV γ -ray was found. In the yttrium fraction only the 3.1 hr activity characterized by γ -rays of 0.200 and 0.475 MeV energy was observed.⁽¹⁰⁾ This is the activity that BOCCIOLINI *et al.*⁽⁴⁾ have assigned to either the ^{92}Nb or ^{93}Nb isomer, and which is now definitely ascribed to the ^{90m}Y isomer.^(10,11)

⁽¹⁰⁾ S. M. ABECASIS, H. E. BOSCH, M. C. CARACOCHE, A. MOCOROA and H. VIGNAU, *Rev. de la Unión Matemática Argentina* **21**, 104 (1962).

⁽¹¹⁾ L. HASKIN and R. VANDENBOSCH, *Phys. Rev.* **123**, 184 (1961); R. L. HEATH, J. E. CLINE, C. N. REICH, E. L. YATES and E. H. TURK, *Ibid.* **123**, 903 (1961); W. S. LYON, J. S. ELDRIDGE and L. C. BATE, *Ibid.* **123**, 1747 (1961); J. M. FERGUSON, *Nucl. Phys.* **27**, 344 (1961); W. L. ALFORD, D. R. KOEHLER and L. E. MANDEVILLE, *Phys. Rev.* **123**, 1365 (1961).