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PROGRESS REPORT

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- March, 1971 -

PROGRESS ON THE STUDY OF THE THERMAL NEUTRON RADIATION CAPTURE REACTION

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One of the irradiation tubes at the RA-3 Reactor, has been used to extract a 5mm collimated neutron beam for studies of the (n, γ) reaction.

Gamma rays are detected with a Ge(Li) detector and NaI scintillator both in singles and coincidences, a target of Cr has been exposed to the beam and the γ-spectra analyzed with the purpose of determining the Ge(Li) detector efficiency in the high energy range.

Several target elements have been studied; Nd, Y, Ti and As, and branching ratios have been measured. In the particular case of Ti the experiment was carried out in an attempt to establish the existence of low lying excited states due to core excitations. The results of this investigation are being analyzed and will be published in the near future.

REACTOR PHYSICS DIVISION

1.- Activation resonance integral of Nd^{146}, Nd^{148}, Nd^{150}

The measurement of Nd^{146}, Nd^{148} and Nd^{150} activation resonance integral has been almost completed. Samples were prepared with natural neodymium and gold as a standard, activities were obtained by irradiating bare and cadmium covered samples for two hours in the internal reflector of the RA-1. The measurements were made in a Ge(Li) coaxial detector. Gamma rays of Pm^{149} (285 keV), Nd^{147} (532 keV), Pm^{151} (275 and 342 keV) and Au^{198}(412 keV) were measured.

Preliminary results agree with that of Alstad et al (J. Inorganic Nuclear Chem. 29 2155 (1967) and disagree with the resonance integral calculated from resonance parameters (JINR P3-3564 (1967)).

2.- Self-shielding of Zr^{96}

Due to the anomalous characteristics of Zr^{96} (Canadian Journal of Physics, 48, 2362 (1970) a careful determination of epithermal self-shielding of Zr^{96} was undertaken. Experimental determination has been completed and preliminary calculations show a good agreement, indirectly confirming resonance parameters of the 301 eV

3.- The activation resonance integral of Ge^{74} and Ge^{76}

The final analysis of the results for Ge^{74} and Ge^{76} has been completed and a paper has been prepared for publication. Self-shielding and infinite diluted resonance integral are consistently discrepant with the values calculated from resonance parameters (Maletzki et al. Atomn. Energ., French Translation, 24 (1968) 173).

4.- Instrumentation

A Hewlet-Packard computer (2116B) has been put "on line" with a Ge-Li spectrometer. A soft-ware has been developed to calculate on line the data reduction needed for our experimental work. An automatic sample changer is being built and will be added to our system.

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The IALE Programme for Nuclear Spectroscopy Studies of Short-Lived Nuclei

Progress Report 1970

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A set-up for nuclear spectroscopy studies of short-lived, fission-produced radioisotopes became operative at the Argentine AEC, in Buenos Aires, around the beginnig of 1969. The system is of the ISOL type, consisting in a continuous production and mass separation of the nuclei, followed by detection of the emitted radiation by means of solid-state detectors coupled to appropriate analysing devices.

A sample of uranyl stearate containing up to 20 g of 90% enriched uranium is exposed to a thermal neutron flux density of about 10^8 $n.cm^{-2}.s^{-1}$, produced by the (d,n) reaction on ^7Li through the use of a Cockcroft-Walton accelerator. The fission products are swept into the ion source of a double-focussing, Scandinavian-type, 90° mass separator of 1.5 m radius. Xe-I mixtures are used as sweeping gas. The activities are collected on fixed or moving collectors, according to the particular problem being studed. Two Ge(Li) detectors of nearly 35 cm^3, having about 2.2 and 3.0 keV resolution, and a Si(Li) electron detector with a resolution

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of 7.5 keV, have been used up to now. To a lesser extent NaI(Tl) detectors are also used for half-life determinations. Recently, a high resolution Si(Li) X-ray detector has been included as an additional facility. The pulses from the detectors are fed through conventional commercial electronics to a 2116B Hewlett-Packard computer provided with two ADC's and a 16K memory, operable as a 4096 channel pulse height analyser. A 512 -and a 1600- channel PHA are also in use.

From the very beginning, our aim was to install a transport line as short as possible between the uranium sample and the ion source of the mass separator in order to enhance the shorter half-lives, as well as to favour the collection of halogens. The overall performance of the set-up was satisfactorily tested by reproducing the gamma-ray spectra of ^{137} to ^{142}Xe previously reported by TRISTAN[1]. The neutron-reach Kr isotopes were also collected efficiently, including ^{93}Kr, which has a half-life as short as 1.2 s. Finally, the system proved capable of handling reasonable quantities of bromine and iodine activities.

The research programme started at the beginning of 1970 with an investigation of the decay of ^{134m,g}I to ^{134}Xe [2]. A 3.56 min isomeric state was definitely placed in ^{134}I (it had previously been proposed[9] from less decisive evidence). Conversion electron measurements established the E3 multipolarity of the 272.2 keV isomeric transition. The amount of β^--branching from the isomeric level was determined. Measurement of the internal conversion coefficients of 11 transitions belonging to the decay of ^{134g}I allowed the determination of the corresponding multipolarities and a subsequent reduction of the number of possible spins and parities proposed [3,4] for the ^{134}Xe level scheme.

A determination of conversion coefficients in several nuclei of the "heavy" ^{235}U-fission peak followed [5]. Altogether, about 35 of them were measured for transitions

which proceed in $^{133,\ 135,\ 136}Xe$, $^{135,\ 137,\ 139}Cs$ and ^{138}Ba. Based upon the published information regarding the corresponding level schemes, as well as on additional information we obtained, the multipolarities determined were used to assign parities and spins for the excited levels.

A study [5] was performed on the dynamics of the emanation in, and following removal of the gaseous fission products from, the uranium container. It included a discussion of the transport times along the tubing connecting the uranium container to the mass separator ion source and of the efficiency of the latter. The laws established were confirmed experimentally. They need to be taken into account when determining fission yields with ISOL-type systems.

Under progress is an investigation concerning the decay of 14 min ^{138}Xe. Nagahara et al.[6] proposed a level scheme for ^{138}Cs which includes a postulated-up to now undetected- 15.4 keV transition. We aim at clarifying the level scheme by thoroughly investigating the low-energy gamma-ray spectrum. Single gamma and conversion electron measurements have been performed. X-ray and coincidence measurements are planned for early 1971.

Two contradicting papers [7,8] have been published on the decay of 55 s ^{86}Br to ^{86}Kr. The discrepancies might be resolved by using a mass separator, which would avoid the perturbing prescence of ^{87}Br, which has almost the same half-life. Some exploratory runs have been performed and it is intended to begin more detailed measurements early in 1971.

As in earlier years, the programme enjoyed the continuous support of the efficient work of technitians A.Barroetaveña, J.Cava, R.D'Agostino, F.di Giacomo, A.Gorgoshidse, E.S.Menéndez, J.A.Purificato and A.Tersigni.

1) W.L.Talbert; private communication.

2) Submitted for publication in Phys.Rev.C.

3) W.G.Winn and D.G.Sarantites; Phys.Rev. 184 (1969) 1188.

4) E.Takekoshi et al.; Nucl.Phys. A133 (1969) 493.

5) Communicated at the 54th meeting of the Argentine Physical Society, 1970.

6) T.Nagahara et al.; J.Phys.Soc. Japan 26 (1969) 232.

7) E.T.Williams and C.D.Coryell; Phys.Rev. 144 (1966) 945.

8) A.Lundán; Z.Physik 236 (1970) 403.

9) H.Erten and C.D.Coryell; Chemistry Progress Report MIT-905-133, p.14 (1968).