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NUCLEAR DATA ACHIEVEMENTS IN ROMANIA WITHIN THE YEAR 1969

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The neutron nuclear data were obtained at the Institute of Atomic Physics (IAP) in Bucharest, by using as neutron sources, the 2 MW Research Reactor and the 120cm Cyclotron.

Thermal neutrons

Energy spectra of scattered neutrons and total cross sections of neutrons on some hydrogenous substances, were measured.

Cold neutrons scattering by methylic alcohol, cyclo - hexan and their mixture near the consolution point was studied /1/. A time of flight neutron spectrometer was used. In the spectra of inelastic scattered neutrons, the following peaks due to molecular rotations have been identified : at 5 meV, 8.7 meV, 21 meV and 31 meV for methyl alcohol and at 8.5 meV, 35 meV and 73 meV for cyclohexan. For the mixture near the consolution point (318.2°K), a peak of intensity is observed ; it is explained by rotation of molecular groupments.

The total cross section of 12.3 Å neutrons for methane adsorbed charcoal was measured in the temperature range from 80° to 300°K /2/. A neutron crystal spectrometer and a mechanical monochromator with a Bi filter were employed. Two discontinuities located at 135°K and 210°K are ascribed to phase transitions from hindered to free or quasifree motions in adsorbed system.

The neutron crystal spectrometer was used to measure the total cross sections for the following hydrogenous substances : ethyl-, propyl-, n-buthyl-, n-amyl-, sec-amyl-alcohol, pentan, ethyl- glycol and glycerol /3/. Such studies appear to be of interest to extend the group of organic moderators. The measurements were performed at room temperature in the neutron wave lengths range $\lambda = (3 \div 8)\mathring{A}$. From the dependence of the total cross section on the wave length one can obtain information on the molecular dynamics and chemical bond of hydrogen in these substances, which can be valuable in the description of the thermalization processes. For instance, it was observed the decreasing of the slope $\Delta\sigma/\Delta\lambda$ versus the number of hydrogen bonds (oxydril groups).

In this year the former direction concerning the thermal fission of ^{239}Pu /4/ was continued. The ^{239}Pu fission cross-section in the energy range (o.1-1o)meV was analysed in terms of an R-Matrix calculation /5/. The derivation of the multi-level expression for the cross-section was made in the approximation of a few resonance levels, taking into account the interference of a group of three resonances in the positive neutron energy range and a bound resonance placed in the negative energy range. The numerical calculations were carried-out on an Elliott-412o computer. A fairly good overall agreement was obtained.

In the next future, the following nuclear data studies with thermal neutrons are intended to be performed :

- the inelastic scattering of cold neutrons and the neutron angular distribution in Bi-Pb liquid mixture,

- the total cross section of 1o-25 Å neutrons for physisorbed organic molecular systems,
- the differential cross sections of thermal neutrons for dilute ferromagnetic alloys near the Curie point.

In cooperation with the Department of Physics of Bucharest University, the absolute fission cross section of ^{239}Pu at v = 22oo m/sec will be measured with a neutron chopper. This work is performed under contract with IAEA.

Also the energy dependence of the ^{239}Pu fission cross section in the thermal neutron range will be further investigated in order to increase the statistical accuracy.

We mention here also, a systematic of the neutron widths of the first resonances above the thermal energy, now in progress.

Fast neutrons

Fast neutron nuclear data are mainly obtained at the IAP Cyclotron. During 1969, the excitation function for the $^{243}Am(n,\gamma)^{244mf}$ reaction leading to the excitation of the o.6 ms fissioning isomer has been studied in the neutron energy range o.3 - 4 MeV /6/. The delayed fission fragments were registered by using mica detectors on a rotating disc placed before the target. The shape of the measured excitation function is similar to the analogue $^{241}Am(n,\gamma)^{242mf}Am$ reaction. The maximum value of the cross section equals $\sim$45 microbarns, and is shifted by about o.5 MeV towards higher energies as compared to $^{242mf}Am$.

In view of the possible use of photo-neutron cross sections in the calculations of the (n,γ) cross section, we mention here some works performed at the 25 MeV Betatron of IAP. The

$^{12}C(\gamma,n)^{11}C$ /7,8/, $^{19}F(\gamma,xn)$ /9/, $^{75}As(\gamma,xn)$ /1o/ and $^{59}Co(\gamma,n)$ /11/ cross sections were measured using the bremsstrahlung beam. The fine structure of the cross sections was observed.

In the future, the betatron group plans to measure the photofission cross section for elements with $A > 234$.

The isomer fission will be studied in U and Pu isotopes by means of neutron induced reactions. For measuring the isomer fission in the nanosecond range the natural modulation of the Cyclotron to pulse the fast neutron beam will be used. As a fission fragment detector a nitrogen-filled spark counter is now under operation, but a gaseous scintillation counter is intended for nearest future.

The cross sections for obtaining both the ground and isomeric states of ^{24}Na by $^{27}Al(n,\alpha)$ and $^{23}Na(n,\gamma)$ reactions will be measured at the cyclotron by using pulsed neutron beam in the 3-8 MeV energy range.

Based on the experience achieved in the calculation of charged particle cross sections, several groups at the cyclotron will begin some calculations of differential and total cross sections and excitation functions of (n,n), (n,n'), (n,γ), (n,p) and (n,α) reactions for various nuclei of interest in the fast reactor physics.

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