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IAEA NUCLEAR DATA SECTION, KÄRNTNER RING 11, A-1010 VIENNA

REACTOR CENTRUM NEDERLAND
and
FUNDAMENTEEL ONDERZOEK DER MATERIE
(F.O.M.-R.C.N. Nuclear Structure Group)

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In a newly established group, some dutch universities (Leiden, Groningen and Utrecht) combine efforts with the dutch reactor centre R.C.N., to study nuclear structure with the (n,γ) reaction at the high flux reactor (H.F.R.) in Petten.

These capture gamma-ray spectroscopy studies yield many spin assignments for bound levels. The three methods used (nuclear orientation, gamma-gamma angular correlation and gamma-ray circular polarization) will be briefly summarized in the following.

Nuclear Orientation (E.R. Reddingius, R. Kuiken, J.J. Bosman, H. Postma)

Current facility: Mono-energetic neutron beam, which is obtained by diffraction from crystals and which can be polarized.
A ^{3}He-^{4}He dilution refrigerator able to cool samples to 0.03 K for periods of several days uninterrupted.
Two Ge(Li) detectors of 6.4 and 40 cm^3 active volume of which the latter can be used as the central detector of a pair spectrometer.

Current research: Capture gamma-ray spectroscopy with polarized neutrons and polarized nuclei.

Recent publications:

J. Mellema and H. Postma, Investigation of nuclear level spins of ^{56}Mn by means of nuclear orientation.
Nuclear Physics 154 (1970) 385.

J. Mellema, E.R. Reddingius and H. Postma, A study of nuclear level spins of ^{142}Pr by means of nuclear orientation. (In print).

Gamma-gamma Angular Correlation (A.M.F. Op den Kamp, A.M.J. Spits, J. Akkermans, H.A.G.M. Ketelaars)

Current facility: Thermal neutron beam ($\approx 10^7$ cm^{-2} s^{-1}) obtained with a quartz-bismuth filter. Two 5"x5" NaI detectors, Ge(Li) detector of 23 cm^3 active volume, 16 window apparatus for coincidence studies.

Current research: Gamma-ga mma angular correlation on the $^{39}K(n,\gamma)$ reaction, capture gamma-ray spectroscopy on isotopes of Si and Cl.

Gamma-ray Circular Polarization (K. Abrahams, J. Kopecky, F. Stecher-Rasmussen)

Current facility: Neutron polarizing focussing mirror system giving a 90% polarized beam of flux density 3×10^7 cm^{-2} s^{-1}. Two cobalt-iron gamma-ray polarimeters. Two Ge(Li) detectors of 40 and 60 cm^3 active volume.

Current research: Circular polarization measurement and spectroscopy of the gamma radiation from the $^{50}Cr(n,\gamma)$, $^{52}Cr(n,\gamma)$ and the $^{54}Fe(n,\gamma)$ reaction.

Recent publications:

K. Abrahams, J. Kopecky and F. Stecher-Rasmussen, Negative energy resonances and potential capture in the $^{59}Co(n,\gamma)$ reaction. Physics Letters 32B (1970) 605.

Preprints:

F. Stecher-Rasmussen, K. Abrahams and J. Kopecky, A study of the $^{59}Co(n,\gamma)$ reaction.

F. Stecher-Rasmussen, K. Abrahams and J. Kopecky, Circular polarization of neutron capture γ rays from Al, Ar and Ca.

F. Stecher-Rasmussen, J. Kopecky, W. Ratynski and K. Abrahams, Circular polarization of neutron capture γ rays in Mn, Ni, Ga and W.

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Neutron-induced fission of aligned ^{233}U, ^{235}U and ^{237}Np

In a Dutch-English cooperation neutron-induced fission has been studied with the aid of aligned ^{233}U, ^{235}U and ^{237}Np nuclei. Orientation of these isotopes was achieved in thin layers of single crystals of rubidium uranyl nitrate and rubidium neptunyl nitrate. The main experiments were carried out at the 45 MeV linear electron accelerator at Harwell using samples of several crystals with total surface area in the order of 20 to 40 cm^2. Alignment was achieved with the aid of electric-quadrupole coupling cooling the samples to temperatures of 0.3 K or lower.

The first full scale experiments using ^{235}U were started in the beginning of 1969. Extensive measurements have been carried out on ^{233}U and ^{237}Np during part of 1969 and during 1970. The covered neutron-energy range was approximately 0.2 to 2000 eV. Resonances could be resolved below about 70 eV.

Experiments on the α-emission of ^{233}U and ^{237}Np and on fission of aligned ^{233}U and ^{235}U induced by thermal neutrons were carried out at the High Flux Reactor in Petten. In these measurements small single crystals were used as samples. These experiments gave important information about the quality of the samples and the characteristics of the alignment.

Fission experiments with aligned nuclei give information about the direction of fission-fragment emission with respect to the nuclear spin; or in other words about the projection, K, of the spin J of the compound nucleus on the deformation axis of the fissioning nucleus. It has been found that K is small for ^{234}U and ^{236}U. The interpretation is, that only channels with K=0 and 1 are fully open for these isotopes. For ^{238}Np it is found that K is equal to J for the group of subthreshold resonances between 20 and 50 eV. The fission channel for this group of resonances has likely $J^{\pi} = 2^+$ and K=2.

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Integral measurements of fission product cross sections (M. Bustraan)

The fast-thermal coupled facility STEK has come into operation in early 1970.

Integral measurements on a number of fission product samples and natural elements were performed in one core with a rather soft neutron spectrum. From the results obtained up to now it seems that in general in present evaluations the fission product cross sections are slightly overestimated. This is, however, a very preliminary conclusion for which more evidence has to be derived from many more measurements in cores with harder neutron spectra and by measurements on a great number of separated isotopes, which will take place in the coming years.