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SELF-CONSISTENT EVALUATION OF FISSILE NUCLEI RESONANCE CROSS SECTIONS

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Using the Adler formalism and the S-matrix unitary property, we obtained the resonance parameters of ^{239}Pu[1] and now of ^{235}U consistent between different external channels and with the experimental data available. The detailed energy structure of radiative capture and elastic scattering cross sections was described with the same precision usual for total and fission cross section measurements. Preliminary results for ^{235}U parameters are published [1] but a folliwing correction with precision of the level spins is necessary. The determination of an analogous consistent set for ^{235}U is in progress now.

We are in search of some best statistical sample (resonance parameter set in the case) in the unresolved resonance region in the scheme of Monte Carlo resonance cross sections modelling, which gives the same values of the energy averaged cross section functionals (e.g. average transmission in dependence of sample thickness). The cross sections calculated with this sample can be considered as recommended for unresolved resonance region. Using the scheme of conversion of R-matrix parameters into S-matrix ones, we can obtain a full evaluation of resonance cross sections in the resolved and unresolved resonance region in Adler formalism.

Reference: 1. N. Janeva, V. Kolesov, A. Lukyanov, S. Toshkov, Bul. Phus. J., 13(4), 1986, p. 335

NEUTRON PHYSICS AND FUSION REACTOR TECHNOLOGY

Numerical calculations for the TUD-Pb benchmark proposed by IAEA Advisory Group Meeting on Nuclear Data for Fusion Reactor Technology, calculated by ANISN, MCNP and MORSE transport codes and different cross section data have been carried out. TOF and PRS experimental spectra are higher than calculational ones. This conclusion is in contradiction with the results for activation and fission reaction rates which have lower values than calculated results.

Reference - Antonov S., G.Daskalov, K.Ilieva, J.Jordanova, K.Pavlova, I.Popova, IAEA Spec. Meeting on FENDL, 1989, Vienna

A benchmark experiment in a spherical geometry with a central 14 Mev neutron source for investigation of multiplier properties or a Fluorine-Lithium-Berilium mixture (FLiBe) have been performed. The neutron leakage spectrum has been measured in the energy range from 1 to 15 Mev. A comparison with three-dimensional code MORSE and one-dimensional code ANISN has been carried out. The experimental results are lower than the calculational ones. That means the multiplicatoion of the FLiBe assembly is smaller than the predicted one.

Reeferences: Antonov S., R.Radev, Bul.Yadernaja Energia, 30, 1989.

Radev R., O.Penchev, I.Penev, Bul.Yadernaja Energia, 31, 1990.

Antonov S., M.Drenska et al., XIX Int. Symp. on Nucl.Phys., Gaussig, November, 1989.

STATISTICAL MODELLING OF THE RESONANCE CROSS SECTIONS IN THE UNRESOLVED REGION

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The R-matrix formalism and the statistical distributions of resonance level parameters were used for constructing the practical scheme for neutron cross section energy structure modelling in the unresolved region with the aime to analyse the transmission experiments on a wide energy beam. In general, such a scheme has to be realized by Monte Carlo method for random sampling of resonance parameters. For non fissile nuclei (one channel case) the analytical method of the average cross section functional determination is in development [1]. The statistical function of cross section distribution one the same for all energy averaged physical cross section functionals has been found. The generalization of the method for a two-channel case is in progress. The results of the analytical aproach have to be used for testing the Monte Carlo calculations. The forthcoming application of the method developed is provided in analysis of the ^{238}U and ^{232}Th transmission experiments.

Reference: N. Janeva, A. Lukyanov, Mito Conf. on Nuclear Data, 1988, p. 635.

GAMMA-MULTIPLICITY IN THERMAL NEUTRON CAPTURE BY HAFNIUM

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The experimental set-up for measurement by the multiplicity spectrometry method has been situated at the horizontal channel of the research reactor IRT-2000 in Sofia [1]. Its main part is the 12-sectional scintillation detector "Romashka" ("Daisy") [2] with total volume of scintilation crystals 16.6 l. The neutron beam is formed by crystal filters and multi-slit collimator. Data acquisition and elaboration is performed by CAMAC electronic system based on mini-computer.

Gamma-multiplicity spectra in thermal neutron capture by hafnium isotopes have been measured. The monoisotopic hafnium oxide samples with thickness 0.5 $g.cm^{-2}$ were placed in aluminium containers in the central part of the detector. The unfolding procedure was applied for calculating the so-called physical multiplicity from the experimental data. The essential result of the average multiplicity $\bar{\nu}$ and its dispertion $\sqrt{\nu^2-(\bar{\nu})^2}$ are shown here in comparison of the exitation energy Uo and compound nucleus spin J^{π}.

target	Uo	J^{π}	ν	$\sqrt{\nu^2-(\bar{\nu})^2}$
^{177}Hf	7.623	$3^-,4^-$	3.9	0.9
^{179}Hf	7.383	$4^+,5^+$	4.0	0.9
^{176}Hf	6.383	$1/2^+$	3.8	0.7
^{178}Hf	6.098	$1/2^+$	3.5	0.7
^{180}Hf	5.693	$1/2^+$	3.3	0.9

From the cascade decay modelling in comparison with the experimental data the calculations have to be performed for obtaining the new information about radiative strength functions in large energy interval under the binding energy.

References: 1. Muradyan G. V., Sov. At. Energy, 1981, v50(6), p. 394
2. Adamchuk Yu. V., et al., ibid., 1985, v58(1), p. 61

MEASUREMENT OF NEUTRON DATA IN THE RESONANCE ENERGY BY GAMMA MULTIPLICTY METHOD

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A multiplicity detector of "Romashka" type has been used on the 500m flight path of the IBR-30 pulsed reactor at the Laboratory of Neutron Physics JINR (Dubna). The detector consists of 16 independent sections with total volume of 36 l NaI(Tl). The geometric efficiency of single-ray registration is 80%. This detector allows performance of neutron capture and fission cross section measurements and investigation of gamma-ray multiplicity and resonance absorption effects in the 20ev-200kev energy range.

This set-up was used to measure self-indication functions in the ^{238}U capture cross section[2]. The spectra were measured in dependence of the gamma-ray multiplicity, which permits to select the spectra with low background (e.g. third multiplicity). The transmissions were measured simultaneusly on the 1000m flight path with a battery of sixteen ^{3}He counters of SNM-type.

The experimental data have been analysed and resonance structure parameters have been obtained[3]. The average total and radiative cross sections in ABBN groups, self-schielding factors and resonance parameters have been evaluated on the base of experimental results.

The work is in progress and up to now we have only preliminary results about the analysis of the experimental data.

Similar investigations are now in progress with some samarium isotopes.

References:

1. G. P. Georgiev, Yu. V. Grigoriev et al., P3-88-555, JINR, Dubna, 1988
2. G. P. Georgiev, et al., P3-89-823, JINR, Dubna, 1989.
3. Yu. V. Grigoriev et al., FEI-2072, Obninsk, 1990.