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Average Values of ^{235}U Resonance Parameters up to 500 eV.*

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Introduction

An R-matrix analysis of ^{235}U neutron cross sections was recently completed.[1] The analysis was performed with the multilevel-multichannel Reich-Moore[2] computer code SAMMY[3] and extended the resolved resonance region up to 500 eV. Several high resolution measurements namely, transmission, fission and capture data as well as spin separated fission data were analyzed in a consistent manner and a very accurate parametrization up to 500 eV of these data were obtained. The aim of this paper is to present the results of average values of the resonance parameters.

Background

All ^{235}U evaluations prior to the new released ENDF/B-VI[4] were based on an evaluation performed in 1970 for the ENDF/B-III utilizing the single-level Breit-Wigner formalism in the energy range below 82 eV. In order to overcome the inadequacy of the single-level formalism in describing accurately the cross sections of fissile elements, it is a common procedure in the ENDF/B to introduce a smooth file containing the difference between the Breit-Wigner and the experimental cross sections. However, since this file is not constructed based on the reaction theory, it can lead to unexpected cross section values mainly when doppler broadening effects are calculated. Also, it is quite evident that the ENDF/B-III evaluation did not include the results of several high quality measurements as well as new techniques developed in the past 20 years. Therefore a new evaluation of the ^{235}U neutron cross sections based on a physically sound nuclear model is required.

Description of the Work

The Bayesian computer code SAMMY which accommodates the reduced Reich-Moore formalism appropriate to treat the neutron-nucleus reaction of fissile elements were used in the analysis. Consistent analysis of various high resolution data provided a set of 912 s-wave resonance parameters up to 500 eV. Each level, in the Reich-Moore formalism, are characterized by E_r, Γ_γ, Γ_n, Γ_{f1}, Γ_{f2} and J which are respectively energy level, capture width, neutron width, fission width channel one, fission width channel two and resonance spin state. Since all resonance levels were assumed to be s-wave, the possible values for J are 3 or 4. Of the 912 levels, 360 correspond to the spin state 3 and 552 to the spin state 4. Various set of experimental data available in the CSISRS[5] file and in the CINDA[6] index were examined to enter in the evaluation. Because of the high resolution and the easy access on the information on the data, experimental data from the Oak Ridge Linear Accelerator[7] received more weight. Spin separated fission data of Moore et al.[8] were the key tool in assigning a correct spin of the resonance.

Results and Conclusions

Average values of the ^{235}U resonance parameters for each spin state are presented in Table 1. The results are compared with that of Reynolds which is also an evaluation based on the Reich-Moore formalism up to 60 eV. From Table 1, we observe the Reynolds[9] evaluation yields larger values of the average level spacings and smaller average fission width values than the one obtained in this work. These discrepancies can be attributed to the smaller statistical samples used in Reynolds evaluation and to the fact that the use of high resolution data in our analysis has allowed us to detect more levels. The s-wave strength function defined as the ratio between the average reduced neutron width and the average level spacing is also given in Table 1 for both spin state.

In conclusion, the results of the analysis have provided a feasible and reliable set of resonance parameters which can accurately reproduce the cross sections and therefore of direct use in reactor calculations.

TABLE 1. Average value of observed ^{235}U resonance parameters compared with results of Reynolds

	Reynolds		This work	
	J=3	J=4	J=3	J=4
Level spacing	2.0	1.0	1.396±.003	.907±.002
Reduced neutron width(meV)	.12	.12	.124±.075	.092±.060
s-wave strength function (x10^4)	.62	1.2	.892±.067	1.013±.060
Fission width(meV)	187	178	256.2	225.8
Capture width(meV)	39.6	42.5	36	36

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