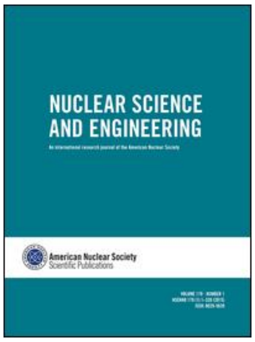

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Comment on a p-Wave Assignment to the 301-eV Neutron Resonance of Zirconium-96

M. D. Ricabarra, R. Turjanski & G. H. Ricabarra

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Letters to the Editor

Comment on a p-Wave Assignment to the 301-eV Neutron Resonance of Zirconium-96

Fulmer, Stricos, and Ruane[1] have arrived at the conclusion, suggested by us in a previous work,[2] that in order to explain the low thermal-neutron absorption cross section of ^{96}Zr, the 301-eV neutron resonance will be required to be a p-wave resonance. However, those authors have overlooked that this p-wave assignment is not consistent with nuclear systematics. As this fact may have been overlooked by other readers of our previous paper, it is worthwhile to explain this point in more detail.

If we calculate the probable value of a neutron width for a p-wave resonance at 301 eV, using the values of p neutron widths measured for ^{94}Zr by Bartolome et al.,[3] we obtain Γ_{n1} (301 eV) = 0.0014 eV. Thus the 301-eV resonance (Γ_n = 0.23 eV) is about 100 times wider than would be expected if it were a p-wave resonance.

This seems to be hardly possible from the point of view of current knowledge of experimental p-wave neutron widths and from a theoretical estimation. Only one clear example has been given in the literature which may support the p-wave assignment to the 301 eV resonance of ^{96}Zr. According to Harvey and Fuketa[4] the 62-eV neutron resonance of ^{124}Sn is a p-wave resonance 100 times stronger than expected. They suggested that the 62-eV resonance of ^{124}Sn is a $2p$-1h doorway p-state resonance, and found that its neutron width was comparable to those calculated by Shakin.[5]

However, an experimental value of I'/σ_0 (the ratio of the reduced resonance integral to the thermal-neutron cross section) obtained by us and reported at the Helsinki Conference,[6] showed that this ratio was in agreement with the ratio calculated assuming that the 62-eV resonance of ^{124}Sn is an s-wave resonance.

Another alternative explanation may be given to the anomalous thermal-neutron cross section of ^{96}Zr in terms of the theory of radiative capture of Lane and Lynn[7] in which there is a possibility of multilevel interference effects in the radiative channels. A similar anomaly in the thermal-neutron capture cross section has been shown to occur in very light elements but, unlike heavier nuclei, these nuclei have very few final states and partial anomalies due to interference effects in the radiative channels may appear in the total capture cross section. For a heavier element such as ^{96}Zr, however, it is difficult to understand how this destructive interference effect may depress the thermal cross section by a factor of 10. Further, no example has been found in the literature to support this explanation.

Finally, it is rather curious to see that a simple thermal-neutron activation cross section may present problems of interpretation by present knowledge of neutron physics. That ^{96}Zr may become a particular interesting element for a deeper analysis by nuclear physicists is suggested.

M. D. Ricabarra
R. Turjanski
G. H. Ricabarra

Comision Nacional de Energia Atomica
Libertador 8250
Buenos Aires, Argentina

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Comments on Transfer-Scattering Reactor Kinetics

In a recent paper, Dodds, Robinson, and Buhl[1] state that the transfer matrix formulation[2] of transport problems is difficult to apply to two-point transfer problems because of roundoff error. They conclude that a scattering matrix approach is more suitable for such problems.

I should like to point out that this difficulty was never present in the transfer matrix expressions for reflection and transmission matrices[2]. As the method is used today, the equations are so formulated that the roundoff error referred to never occurs, even for two-point transfer problems.[3] Gelbard[4] had made this observation independently. The reformulated equations in this new form are easy to apply[5-7] and lend themselves to a simple and useful physical interpretation.[8]

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