

Recommended Cross Sections of ^{168}Er and ^{170}Er Isotopes for (n,p), (n,2H) and (n, α) Reactions at 14.0 MeV

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ABSTRACT

The cross sections are reproduced in fine steps of incident neutron energy with 0.01MeV intervals with their corresponding errors. The recommended cross sections for available experimental data taken from EXFOR library have been calculated for all the considered neutron induced reactions for Er (Z=68; A=168-170) isotopes. The calculated results are analyzed and compared with the experimental data.

Keywords: EXFOR, Incident Neutron, 14MeV, Recommended Cross Section.

I. INTRODUCTION

The excitation functions in (n,p), (n,2H) and (n, α) reactions measured for Er (Z=68; A=168-170) with the aid of EXFOR library have been evaluated in the present work for the exact estimation of the cross sections among different authors. The systematic of such reactions, neutron induced reactions was discussed in Knopf K. and Waschowski W. (1997) [1], Wang T. et al. (2010) [2], Junhua L. et al. (2011) [3] Kadenko A.O. et al. (2013) [4] and Jean-Christophe S. and Michael F. (2014) [5]. The present work concerns the induced neutron cross section reactions. Recommended formulas for the evaluation of cross sections for these reactions were derived using EXFOR experimental data for different authors describing the emission or neutron capture in nuclear reactions. The parameters of formulas were fitted with minimum chi squared from the analysis of available experimental data.

II. RECOMMENDED CROSS SECTION

The available measured data from EXFOR library for the cross section of the above mentioned reactions measured for Er (Z=68; A=168-170) have been plotted, interpolated and recalculated in different fine steps and for different energy ranges of incident neutron by using Matlab-8.1 in order to calculate the recommended cross section for each mentioned reaction. This can be described in the following steps:

- 1- The interpolations for the nearest data for each energy interval as a function of cross sections and

their corresponding errors have been done using Matlab-8.1.

- 2- The sets of experimental cross sections data are collected for different authors and with different energy ranges. The cross sections with their corresponding errors for each value are re-arranged according to the energy interval 0.01MeV for available different energy range for each author.
- 3- The normalization for the statistical distribution of cross sections errors to the corresponding cross section values for each author has been done.
- 4- The interpolated values are calculated to obtain the recommended cross section which is based on the weighted average calculation according to the following expressions [6]:

$$\sigma_{w.a.} = \frac{\sum_{i=1}^n \frac{\sigma_i}{(\Delta\sigma_i)^2}}{\sum_{i=1}^n \frac{1}{(\Delta\sigma_i)^2}} \quad (1)$$

Where the standard deviation error is:

$$S.D. = \frac{1}{\sqrt{\sum_{i=1}^N \frac{1}{(\Delta\sigma_i)^2}}} \quad (2)$$

Where σ_i : is the cross section value. $\Delta\sigma_i$: is the corresponding error for each cross section value.

Figs. 1 to 3 illustrate the recommended cross sections for the above mentioned reactions as calculated in the

present work compared with EXFOR library. It is clear in the caption of each figure, the refry of authors name are arranged according to the year of measured data are listed with the present calculated recommended cross section. The results are in good agreement with the measured data.

III. RESULTS AND DISCUSSION

The behavior of the cross sections increasing exponentially for (n,p), (n,2H) and (n, α) reactions for fast incident neutron energy.

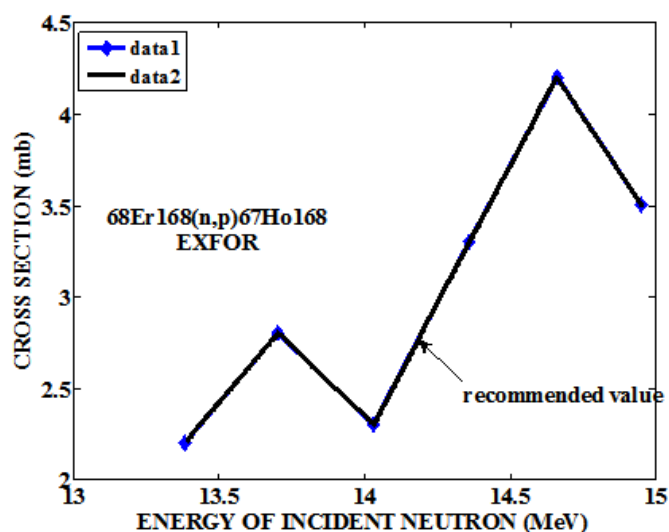


Figure 1. Recommended cross section compared with EXFOR Library versus the energy of incident neutron for 68Er168(n,p)67Ho168 reaction; Data 1: [7] Kasugai Y. et al.(1997). Data 2: present work (pw).

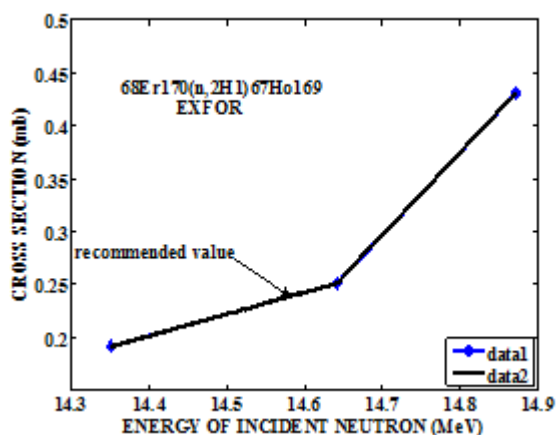


Figure 2. Recommended cross section compared with EXFOR Library versus the energy of incident neutron for 68Er170(n,2H1)67Ho169 reaction;

Data 1: [8] Sakane H. et al(2002). Data 2: present work (pw).

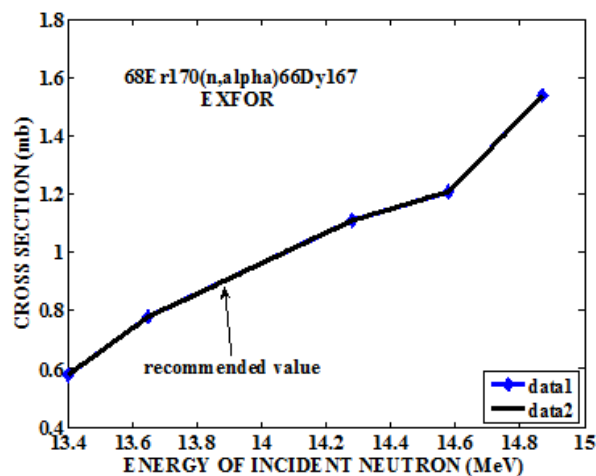


Figure 3. Recommended cross section compared with EXFOR Library versus the energy of incident neutron for 68Er170(n,alpha)66Dy167reaction; Data 1: [9] Sakane H. et al(2002). Data 2: present work (pw).

IV. CONCLUSION

A mathematical empirical formulae have been explored for (n,x) reactions, which seem to be a good prediction for the values of uncalculated cross sections.

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