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SIGMA CENTER

NEUTRON CROSS [illegible]

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ABSTRACT

The ability of the statistical model of nuclear reactions to interpret measured (n,2n) cross sections has been tested. Good agreement was observed for 22 nuclei having mass numbers greater than 30. The statistical model was then applied to all nuclei in this mass range to estimate both monoenergetic and fission spectrum averaged cross sections.

I. INTRODUCTION

One of the objectives of the Neutron Cross Section Evaluation Group is to obtain analytical models that are successful in fitting a wide range of experimental information. This model can then be used to predict cross sections for nuclei upon which measurements have not been performed. An understanding of (n,2n) cross sections is important in reactor applications because of the portion of fission neutrons that exceeds the (n,2n) threshold in all materials. This reaction can make a finite contribution to fast neutron multiplication and residual radioactivity throughout the reactor.

The model adopted here for exploring (n,2n) cross sections closely follows the hybrid theoretical and empirical procedure used by Barr, Browne, and Gilmore(1), with the following exceptions:

1. The model was extended to include (n,3n) reactions in order to fit the complete range of experimental data.

2. A realistic form of the level density parameter a was adopted. The amount of experimental information included here is more than double that included in the 1961 paper(1) and, therefore, provides a better test of the model's validity. In addition, the analytical form has been rewritten to provide a more rapid method of estimating unknown cross sections.

The objective here is to extend and modify the procedure of Reference 1 in order to generate energy dependent (n,2n) cross sections for nuclei. The resultant cross section is numerically integrated over the fission spectrum to obtain its weighted average.

Section II presents a "Discussion of (n,2n) Reactions." This is followed by the "Description of the Model" (Section III), a "Comparison of Calculated and Experimental Cross Sections" (Section IV), a discussion of "How to Use the Working Curves" (Section V), and finally a "Tabulation of Predicted Cross Sections" (Section VI). For those who simply wish to accept and use the conclusions drawn in this report, Sections III and IV may be omitted without loss of continuity.