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Reactor Physics Division

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SOME ELASTIC ANGULAR DISTRIBUTIONS:

A STATUS REPORT

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I. Introduction

This document was prepared in an effort to bridge the appreciable chronological gap existing between the completion of a set of experimental measurements and their formal publication. It is hoped that the differential elastic scattering cross sections contained herein will be of use to those doing applied work, particularly reactor design, and that these distributions will prove helpful in the evaluation of theoretical interpretations of elastic neutron scattering.

The selection of the material contained herein was subjectively based upon experimental completeness and applied and theoretical usefulness. All of this data is tentative, and subject to change without notice, until formal publication. Where such has occurred, that fact is specifically noted. In a real sense this document is a private communication rather than a formal publication.

II. Definition and Scope

The incident neutron energy domain considered here extends from 0.3 to 1.5 MeV. The elastic distributions were measured at $\sim$ 50 keV incident energy intervals. Each distribution contains ten or more individual measurements made at angles between 20 and 145 degrees. The experimental scattered neutron resolutions were tailored to the specific requirements of the individual measurements with particular attention to the resolution of the elastically and of the inelastically scattered components. A brief statement of the applicable resolutions is given preceding the tabulated cross sections of each element. The measurements were corrected for experimental perturbations including multiple scattering. All measured cross sections were normalized to the known differential elastic scattering cross section of carbon[1] and are given in the form:

$$\frac{d\sigma(el)}{d\Omega} = \frac{\sigma(el)}{4\pi} \left[1 + \sum_{i=1}^{n} \omega_i \, P_i \right] \qquad (1)$$

where P_i are associated legendre polynomials and the ω_i are derived from the experimental measurements. This separation of normalization and angular dependence is inherent to the experimental method.

This tabulation contains the differential elastic scattering cross sections of the following elements:

1.	Aℓ	11.	Ag	21.	W
2.	Cr	12.	Cd	22.	W^{184}
3.	Fe	13.	In	23.	Pt
4.	Co	14.	Sn	24.	Au
5.	Ni	15.	Sb	25.	Hg
6.	Cu	16.	I	26.	Tl
7.	Zn	17.	Sm	27.	Pb
8.	Zr	18.	Gd	28.	Bi
9.	Nb	19.	Yb	29.	Th
10.	Mo	20.	Ta	30.	U^{235}
				31.	U.

Less complete information is available for $\sim$ 20 additional elements and, in some cases, extensive determinations of the inelastic scattering cross sections have been completed. Finally, attention should be drawn to the feasibility of using theory to extrapolate and interpolate from the tabulated values.[2]

III. Tabulation Format

The differential cross sections given in these tables are in the form of Eq. (1), above. Each element is treated separately. A cover page proceeding the tabulation for the particular element contains a short statement dealing with resolution, resonance structure, inelastic content, and the termination of the series of Eq. (1) (the value of n in Eq. (1)). The format can treat expansions to and including the P_6 term but only P_4 and P_5 fits are given.

The first column of the tabular page is headed by EN (incident neutron energy in MeV). The next column, denoted by SEL, lists the respective total elastic scattering cross sections in barns. The next column, TEL, gives the elastic transport cross section defined by

$$\text{TEL} = \text{SEL}\left(1 - \frac{1}{3}\ \omega_1\right)$$

in barns. The remaining six columns refer to the ω_i coefficients of Eq. (1) and thus define the angular distribution. Each ω_i column defines two values for a given energy. The upper quantity is the value of the respective ω_i with the uncertainty given directly beneath. Thus,

$$\begin{bmatrix} \omega_i \\ .605 \\ .004 \end{bmatrix}$$

would be a value of $\omega_i = 0.605 \pm 0.004$. If both the value and error for any ω_i are identically zero, the expansion was terminated before reaching the respective value of the index "i." Thus an expansion to the P_4 term would, by definition, have ω_5 and ω_6 equal zero.

Throughout the tabulations all quantities are given in the Laboratory system.

IV. Uncertainties

The incident neutron energy is known to 5-8 keV. This uncertainty is usually smaller than the energy spread in the incident neutron beam. The uncertainty in the elastic cross section (SEL) is difficult to determine and may vary considerably from energy to energy and from element to element. However, a qualitative estimate of the error in SEL is $\sim$ 8%. The uncertainties in the ω_i values given in the tables were derived from the least square fit of Eq. (1) to the experimental measurements. As such, they are a measure of the "goodness" of the fit to the experimental data and are not necessarily representative of the actual uncertainties.

V. Machine Storage

The data contained in this tabulation is stored on standard "IBM" cards. The format is given on the following code sheet. The authors will entertain requests for such cards from a limited number of compilation centers.

VI. Acknowledgments

Certainly, the authors are not the only contributors to the information presented here. We are heavily indebted to members of the Applied Nuclear Physics Section, Reactor Physics Division, for major contributions to this work; in particular, to D. Reitmann,* J. A. M. deVilliers,* W. Vonach, and S. Buccino.

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* Now with the Atomic Energy Board, Pretoria, Republic of South Africa.