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REVIEW OF DIFFERENTIAL MEASUREMENTS AND
COMPILATIONS OF EXPERIMENTAL PHOTON DATA
IMPORTANT FOR APPLICATIONS FOR NEUTRON
ENERGIES BETWEEN THRESHOLD AND 13 MeV

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Review of Differential Measurements and Compilations of Experimental Photon Data Important for Applications for Neutron Energies Between Threshold and 13 MeV

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INTRODUCTION

At the 2d Research Coordination Meeting of the IAEA/NDS CRP on Measurement, Calculation and Evaluation of Photon Production Data [cite{IAEA96}], committee member S. P. Simakov [cite{simakov96}] reported on, "Status of Experimental and Evaluated Data for γ -ray Production at 14 MeV Neutron Incident Energy." The Committee, in session, on the basis of complementing the report on data at 14 MeV, provided for two actions: these were to provide similar reports on (a) for incident neutron energies from threshold to 13 MeV, and (b) for incident neutron energies above 14 MeV (excepting capture reaction gamma ray spectra).

Almost simultaneously a report was issued by Blokhin, et al., [cite{Blokhin96}] entitled, "Atlas of Energy-Angular Distributions of Gamma Rays Produced in Neutron Reactions." This document summarizes all data in the form of γ -ray spectral distributions (i.e. $d\sigma^2/dE d\omega$) available from the literature for the following elements: N, O, F, Na, Mg, Al, Si, P, S, Ca, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Se, Br, Rb, Sr, Y, Zr, Nb, Mo, Ag, In, Sn, Sb, I, Cs, Ba, La, Ce, Pr, Gd, Tb, Ho, Lu, Ta, W, Re, Os, Pr, Au, Tl, Pb, Bi, and U. Plotted data in this report include not only data for $(n,n'\gamma)$ and other $(n,x\gamma)$ reactions, but also for (n,γ) reactions. The citations of the data include EXFOR numbers so that the data can be retrieved from the data compilation centers.

DISCUSSION

The elements which have been underlined in the above list are given in the report as having data for incident neutron energies above threshold, some up to 3 MeV, others up to 13 MeV (or 20 MeV). (Those not underlined are primarily for $E_n \approx 14$ MeV.) Although the compilation does not include plots for all of the experimental data from a given experiment, there appears to be sufficient data for a user to make a judgment as to the utility of a given data set for a project. It appears, however, that most of the reviewing process has been accomplished in this report.

No attempt was made in the compilation by Blokhin, et al., [cite{Blokhin96}] to make comparisons of similar data from different laboratories. Presumably this task is left to the evaluators. One might, therefore, review comparisons of the measurements by reviewing different evaluations (for the same element) cognizant of the fact that different evaluations

In this figure, one will note discrepancies among the three evaluations for $E_n \sim 2$ and $E_n \sim 5$ MeV. A review of file 451 for the three evaluations gives an indication for these differences.

1. The BROND-2 evaluation relied on the data of Bondarenko and Petrov [cite{bondarenko84}].
2. The ENDF/B-VI evaluation involved variance-covariance (VC) analyses of data given in 14 experimental reports, but not including the Bondarenko paper cited above.
3. The JAERI-3.2 evaluation was based on the measurements of Morgan [cite{morgan78}], experimental data which were included in the ENDF/B-VI analysis.

CONCLUSIONS AND RECOMMENDATIONS

Evidently the different choices of evaluation methods produced differences for portions of the ${}^7\text{Li}(n,n'\gamma)$ evaluation; however, there appears to be quite good agreement for the main peak for $E_n \approx 4$ MeV as well as for $E_n > 7.5$ MeV. Although it might be assumed that the VC method of evaluation, although requiring more effort, might be the method of choice, it should be noted that the discrepancy for $E_n \approx 5$ MeV is due to the ENDF/B-VI; the other two evaluations agree for this E_n .

The standard criticisms apply. The VC method can be markedly affected by one or two experiments whose values are at a statistical variance from values derived by the method from the remaining sets of data. On the other hand, choosing a single experiment as the basis depends upon an assumption of quality which may not be warranted.

This paper does not presume to suggest that any method of evaluation (at least of those methods now used for the major evaluations) is superior to any other. What is recommended, however, is to give some consideration to the question of whether or not a workable set of rules can be promulgated for identifying experiments which should not be used by the evaluator.

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