INVESTIGATION OF THE INFLUENCE OF THE NEUTRON SPECTRUM IN DETERMINATIONS OF INTEGRAL NEUTRON CROSS-SECTION RATIOS*

by

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ABSTRACT

Ratio measurements are routinely employed in studies of neutron interaction processes in order to generate new differential cross-section data or to test existing differential cross-section information through examination of the corresponding response in integral neutron spectra. Interpretation of such data requires that careful attention be given to details of the neutron spectra involved in these measurements. Two specific tasks are undertaken in the present investigation: i) Using perturbation theory, a formula is derived which permits one to relate the ratio measured in a realistic quasi-monoenergetic spectrum to the desired pure monoenergetic ratio. This expression involves only the lowest-order moments of the neutron energy distribution and corresponding parameters which serve to characterize the energy dependence of the differential cross sections, quantities which can generally be estimated with reasonable precision from the uncorrected data or from auxiliary information. ii) Using covariance methods, a general formalism is developed for calculating the uncertainty of a measured integral cross-section ratio which involves an arbitrary neutron spectrum. This formalism is employed to further examine the conditions which influence the sensitivity of such measured ratios to details of the neutron spectra and to their uncertainties. Several numerical examples are presented in this report in order to illustrate these principles, and some general conclusions are drawn concerning the development and testing of neutron cross-section data by means of ratio experiments.

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