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INTERNATIONAL NUCLEAR DATA COMMITTEE

Report on Australian Activities May 1970-May 1971

1. FISSION PRODUCT EVALUATION

Re-evaluation of capture and total cross sections for all elements in the A.A.E.C. library is now complete. This data has been transmitted to the I.A.E.A. Nuclear Data Section and to the N.N.C.S.C. at Brookhaven, U.S.A.

Reactivity liftime studies have indicated that adequate accuracy can be achieved in thermal reactor system calculations with 41 nuclides represented explicitly and with the remainder lumped together as a pseudo fission product.

Studies of fast reactor systems are now in progress with the aim of reducing still further the number of fission products which require explicit representation in burn up calculations.

2. MULTILEVEL ANALYSIS OF CROSS SECTIONS

Cook (AAEC) is developing a new multilevel theory in which the cross section parameters, as proposed by Adler and Adler, are exact. The theory distinguishes between the contributions to the reaction matrix from the resonant compound nucleus processes and the essentially constant direct processes. Programmes have been written which fit cross sections to the Adler-Adler scheme and calculate reaction matrix parameters from Adler-Adler constants.

Cook's theory shows that the same equations and constants for the fission and capture cross sections are obtained regardless of the spin assignment. It has proved impossible to make spin assignments without accurate scattering cross section information. The main advantage of Cook's work lies in the ease with which analysis of fission and capture cross sections can be made.

3. FISSION PHYSICS

3.1 Musgrove has made trajectory calculations for the light particles emitted in spontaneous fission of ^{252}Cf. Initial dynamic variables were found which reproduced the measured energy spectra for ^{1}H, ^{2}H, ^{3}H and ^{6}He particles. It was also noted that the heavy fragment separation at scission increased as the mass of the third particle decreased. A naive interpretation might be that increased stretching of the neck progressively breaks down the structure of the third particle.

3.2 Boldeman has spent much time and effort in preparing his equipment for re-measurements of $\nu_p(E)$ for ^{235}U with energy resolution of better than $\pm$10 keV. This work should commence soon.

3.3 Measurements of the average total kinetic energy ($\bar{E}_k$) of ^{233}U with incident energy have been complimentary to his $\nu_p(En)$ data for ^{233}U.

4. CROSS SECTION DATA DISPLAY INFORMATION

A display programme for A.A.E.C.'s IBM360-50 computer and Calcomp 565 plotter enables data libraries and multigroup cross sections to be displayed. It is flexible and one such feature enables a superimposition of cross sections from different sources to be compared.

It is proposed to expand this work into a full interactive video display.

5. NEUTRON CAPTURE STUDIES

5.1 Resonance keV Neutron Capture

Resolved resonance spectra have been obtained from thin samples of Ti, Ni and Fe at a 1 metre flight path using a 20 x 15 cm shielded NaI detector. Partial capture yields for ^{48}Ti, ^{58}Ni and ^{56}Fe have been analysed to give $\sigma_0 \Gamma_{\gamma i}$ and sometimes $\Gamma_{\gamma i}$. This information has enabled partial capture cross sections to be established.

For Ti multiple scattering corrections were obtained by using two target thicknesses of 0.5 and 1.0 mm Ti. The yield for the fifth excited state of ^{49}Ti was analysed using a multi-level interference cross section. The ground state transition in ^{49}Ti confirms the presence of a d-wave resonance at 39 keV.

5.2 Average keV Capture in Zinc

Gamma ray transition strengths in ^{65}Zn and ^{67}Zn following neutron capture were analysed and the results compared with calculations based on resonance parameters and a statistical neutron capture mechanism. Estimates of p- and d-wave strength functions were obtained. Substantial deviations from the statistical behaviour of averaged transition strengths led to the conclusion that configuration effects are important in partial neutron capture cross sections.

5.3 Interpolations for Nuclear Level Spacings and Radiation Widths

Nuclear level densities obtained from the free gas model were used to interpolate unknown level spacings. The model's level density parameter was fitted semi empirically to give a good fit to measured level spacings. A formula was obtained for the total radiation width as a function of mass number, average level spacing and excitation energy. No correlation between radiation width and neutron strength function was observed. These parameters have been used to calculate the 30 keV capture cross sections which have been compared with measurements of Allen (1970) and calculations of Benzi and Reffo (1969).