September 1970 Brief 70-10357

AEC-NASA TECH BRIEF

Data from Various Sources Provide Standard Single-Level Resonance Parameters for ^{233}U

The problem:

To obtain Breit-Wigner resonance parameters for ^{233}U from experimental fission, capture, and total-cross-sectional data taken by different experimenters with different energy resolutions.

The solution:

A novel method of calculating parameters that allows for different sources of data. Parameters for 63 resonances in the neutron-energy range 0–62 eV were yielded by simultaneous fit to three sets of data.

How it's done:

An iterative least-squares analysis of experimental data converges to the set of Breit-Wigner resonance parameters that best reproduces these data, with allowances made for differences in sample temperature and experimental energy resolution among the sets of data used. In this case the data are weighed in inverse proportion to the cross-section value. This is a true simultaneous fit since the least-squares distances between calculated and experimental cross sections are considered for all three cross sections at once.

In summary, on the basis of published experimental data on the N + ^{233}U reaction, the low-energy fission, capture, and total cross sections have been fitted with a series of noninterfering Breit-Wigner resonances ("single-level fit"). Interference between resonant and potential scattering was taken into account; broadening of resonance peaks, due to thermal motion of the sample nuclei (Doppler broadening), and experimental resolution also were accounted for. The fit was made from 0.4 to 61.4 eV. All three cross sections were fitted simultaneously by use of a CDC-6600 computer and a fitting code. The following data were analyzed:

1. From the Brookhaven National Laboratory, Sigma Center Information Storage and Retrieval System data file, the results of recognized measurements of the total cross section of ^{233}U were selected. For this experiment the Oak Ridge fast chopper had been used, with a 45-m neutron-flight path; the data cover the energy range of interest. They are consistent with other measurements, and the experimental resolution is known at all energies.

2. The simultaneously measured capture and fission cross sections, obtained directly from the recognized experimenters at Oak Ridge National Laboratory, representing the first simultaneous measurement of these two cross sections for ^{233}U—one of the few measurements of its resonance capture cross section; they were normalized to the total cross sections selected at Brookhaven National Laboratory both in magnitude and in energy scale. Thus addition of a potential-scattering cross section of 12.5 barns to their capture and fission cross sections gives good agreement with the Brookhaven National Laboratory total cross section.

This analysis includes also resonant scattering and interference between resonant and potential scattering. Other new experimental data and evaluations also have been analyzed for provision of a new multigroup library on the ^{233}U-neutron cross sections, at energies from 0.001 eV to 10MeV, for GAM and TNS computer program reactor analysis calculations.

(continued overleaf)

Note:

Requests for further information may be directed to:
Technology Utilization Officer
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Washington, D.C. 20546
Reference: B70-10357

Patent status:

No patent action is contemplated by NASA.
Source: M. J. Schneider of
Westinghouse Astronuclear Laboratory
under contract to
AEC-NASA Space Nuclear Propulsion Office
(NUC-10229)