Computer Code Abstract

GANDY

1. Name of Code: GANDY.[1]
2. Computer: The GANDY code has been written for use on a UNIVAC 1108 computer, but it can be adapted for use on any computer with a FORTRAN-IV compiler.
3. Nature of Problem Solved: The GANDY code evaluates temperature-dependent effective neutron capture, fission, and scattering cross sections in the unresolved resonance region from average resonance parameters.
4. Method of Solution: Effective cross sections are evaluated at specified energies and temperatures using the narrow-resonance approximation and assuming isolated resonances. Resonance cross sections are treated on a statistical basis, using chi-squared distributions for the partial widths. The line shape functions, ψ and χ, are evaluated in a subroutine written by Naliboff which is based upon a method developed by Adler and Naliboff.[2] The statistical averaging is carried out using a quadrature scheme introduced in the RAPTURE code.[3]
5. Restrictions on Complexity of Problem: The code will handle as many temperatures as desired for a maximum of 100 energy points. Consideration is taken of neutron orbital angular momentum through d wave ($l = 2$).
6. Unusual Features: GANDY incorporates the following features, which distinguish the present treatment from earlier unresolved-resonance calculations:[3]

   a) computation of the unresolved-resonance scattering cross section as well as the capture and fission cross sections

   b) consideration of s-, p-, and d-wave ($l = 0$, 1, and 2) neutron orbital angular momenta

   c) consideration of arbitrary half-integer values of the target spin in addition to $I = 0$

   d) calculation of the fissile cross sections for chi-squared fission width distributions with one, two, three, or four degrees of freedom

   e) consideration of interference scattering.
7. Typical Running Time: The running time is very sensitive to the input options chosen. For a fissile nuclide with two spin states and $l = 0$, the statistical averaging performed, and interference scattering neglected, the running time is ~ 7 sec on the UNIVAC 1108 for one energy point. Nonfissile nuclides, which require statistical averaging only for the neutron width distribution, are an order of magnitude faster for the same degree of approximation. For reactor design calculations in which unresolved-resonance cross sections are evaluated at one-quarter lethargy intervals, the effective cross sections in the unresolved-resonance region for ^{238}U are evaluated by GANDY in ~ 10 sec.
8. Status: In use. Available from Argonne Code Center, Argonne, Illinois 60439.
9. Machine Requirements: The code requires 11 300 storage locations and the data storage requirement is ~ 15 800 locations. Two $I/0$ devices are required for reading and printing and one additional $I/0$ device is necessary if the program is loaded from tape.
10. Related and Auxiliary Programs: The GANDY code is a FORTRAN-IV extension of the RAPTURE code[3] and the unresolved-resonance treatment incorporated in the MC^2 program.[4] GANDY is incorporated into the GAND[5] portion of the Gulf General Atomic fast cross-section package, GAF/GAR/GAND.
11. *References:*

[1]S. C. COHEN and P. K. KOCH, "GANDY, A Computer Program for the Evaluation of Effective Cross Sections in the Unresolved Resonance Region," GA-8003, General Dynamics Corporation, General Atomic Division (May 1967).

[2]F. T. ADLER and Y. D. NALIBOFF, *J. Nucl. Energy, Parts A/B*, **14**, 209 (1961).

[3]J. H. FERZIGER, P. GREEBLER, M. D. KELLEY, and J. W. WALTON, "Resonance Integral Calculations for Evaluation of Doppler Coefficients; The RAPTURE Code," GEAP-3923, Atomic Power Equipment Department, General Electric Company (1962).

[4]B. J. TOPPEL, A. L. RAGO, and D. M. O'SHEA, "MC^2, A Code to Calculate Multigroup Cross Sections," ANL-7318, Argonne National Laboratory (1967).

[5]R. J. ARCHIBALD and D. R. MATHEWS, "The GAF/GAR/GAND Fast Reactor Cross Section Preparation System; Vol. II, GAND—A Computer Program for Preparing Input Data for the GAF/GAR Codes from an ENDF/B Format Nuclear Data File," GA-7542 (Vol. II), Gulf General Atomic, to be published.

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