Computer Code Abstract

EDISN

1. Name of Code: EDISN.

2. Computer for Which Program is Designed: The program can be run on either the IBM-360 or the IBM-1130.
   Programming Language: FORTRAN IV.

3. Nature of Physical Problem Solved: EDISN calculates the energy distribution of neutrons emerging from (n,n') and $(n,2n)$ reactions.

4. Method of Solution: Given a nucleus (N,Z) bombarded by a neutron of energy E, EDISN requires as input appropriate parameters specifying the level densities of (N,Z) and $(N-1,Z)$ and the binding energy of the last neutron in (N,Z). Employing the Weisskopf-Ewing[1] formula, with cross sections for compound-nucleus formation being determined by the continuum theory of nuclear reactions,[2] the code calculates the the energy spectra of the inelastically scattered "first" neutrons and the subsequently evaporated "second" neutrons.

5. Restrictions on the Complexity of the Problem: The code is applicable to situations in which the compound-nucleus reaction mechanism predominates and non-elastic processes other than (n,n') and $(n,2n)$ are negligible. In addition, it is required that the levels of the compound and residual nuclei be representable by continuous level densities.

6. Related and Auxiliary Programs: For the purpose of making the code self-contained, subroutines for calculating cross sections for compound-nucleus formation and nuclear level densities have been incorporated. The former calculation is based on the continuum theory, and the latter employs the familiar energy dependence of the level density as derived from the Fermi gas model. A more sophisticated treatment of these quantities would simply require the replacement of these routines by others that have a more detailed theoretical basis. For instance, the former subroutine could be replaced by one of several available programs for determining the compound-nucleus formation cross sections by the optical model.

7. Running Time: Running time increases rapidly as the number of increments used in the numerical integrations is raised. Typical times on the IBM-360 for 30 increments, which yield a high degree of accuracy, are ~3 min.

8. Unusual Features: Two approximations are usually made in spectral calculations of this sort. First, the cross section for compound-nucleus formation is assumed to be independent of energy. Second, the level density is expanded in a Taylor series with terms higher than the second being neglected. Together these approximations lead to a Maxwellian distribution for the inelastically scattered neutrons. Further commonly adopted simplifying assumptions result in a spectrum for the second neutrons which is a sum of two such Maxwellian terms. In the latter case, the approximations can introduce a significant error.[3] EDISN does not require these simplifications, although options are available for performing the approximate calculations if desired.

9. Status: The program has been put into production and is available through the Oak Ridge Radiation Shielding Information Center.

10. Machine Requirements: 8K of memory is adequate.

11. Operating System: For IBM-1130 use, it should be noted that EDISN was written under Version 1 Modification Level 7 of the 1130 Disk Monitor System.

12. Other Programming or Operating Information or Restrictions: Cards punched in EBCDIC.

13. *References:*

[1]D. H. EWING and V. F. WEISSKOPF, *Phys. Rev.*, **57**, 472, 935 (1940).

[2]J. M. BLATT and V. F. WEISSKOPF, *Theoretical Nuclear Physics*, pp. 345-358, John Wiley and Sons, New York and London (1952).

[3]R. SNOW and M. C. GEORGE, "A Computer Code for Calculating the Energy Distribution of Inelastically Scattered Neutrons," RL-SSL-200, Brown Engineering Company, Inc. (1968).

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