Computer Code Abstract

NMTC

A Nucleon-Meson Transport Code

1. Name of Code: NMTC[1]
2. Computers for Which Code is Designed: IBM 360/75 and IBM 360/91. Programming Language Used: FORTRAN IV, with two minor assembly language routines.
3. Nature of Code: NMTC computes the transport of nucleons below 3.5 GeV and muons and charged pions below 2.5 GeV. Monte Carlo methods are employed to provide a detailed description of the transport process. Virtually arbitrary geometries may be specified.

   The source-particle description is specified in a user-written subroutine and may be arbitrarily distributed in energy, direction, and space, provided the maximum energies mentioned above are not exceeded. Proton, neutron, π^+, π^-, μ^+, and μ^- sources are allowed.

   The code stores on magnetic tape a complete description of each "event" (nuclear interaction, geometry boundary crossing, pion decay, etc.) that occurs during the transport process. This information is then read and processed by user-written analysis programs to obtain results of interest for a particular problem.
4. Method of Solution: NMTC consists of two basic transport codes: NMT and a modified version of 05R.[2] NMT transports particles in the energy range from the source-particle energy down to a specified cutoff energy, which, for nucleons, is usually chosen between 15 and 50 MeV. Neutrons produced in NMT below the cutoff energy are transported via the 05R code.

   The description of nonelastic-collision products in NMT is obtained using the intranuclear-cascade-evaporation model. At each nonelastic collision, a calculation is performed using subprogram versions of Bertini's intranuclear-cascade program[3] and Guthrie's evaporation program[4] to determine the energy and direction of emitted cascade nucleons and pions and evaporated nucleons, deuterons, tritons, ^{3}He's, and alphas. Nonelastic collisions in 05R are treated using the evaporation model in conjunction with experimental cross sections. Experimental data are used for elastic-collision cross sections.

   Charged-pion and muon decay in flight and at rest are taken into account using known lifetimes. Negative-pion capture at rest is treated via the intranuclear-cascade-evaporation model.[5]
5. Restrictions on the Complexity of the Problem: Present dimensions restrict the number of different media to 15 or less and the number of nuclei types per medium to 11 or less.
6. Typical Running Time: Running time is extremely problem-dependent. A sample problem included with the code documentation requires approximately 10 min on the IBM 360/91 and approximately 3 times longer on the IBM 360/75.
7. Unusual Features of the Code: Differential cross sections for nucleon and pion production from nucleon-nucleus and pion-nucleus nonelastic collisions are not required as input since they are, in effect, computed in the course of the transport calculation using the intranuclear-cascade-evaporation model.
8. Related and Auxiliary Programs: XSECT, an 05R cross-section preparation code, and user-written analysis programs.
9. Status: In use. Several comparisons (e.g., Refs. 6 to 8) between results obtained with NMTC and experimental data have been made, and, in general, good agreement has been obtained.
10. Machine Requirements: A 565 K memory and 4 peripheral storage devices.
11. Operating System: IBM OS/360 with FORTRAN H compiler.
12. User Information: The code, documentation, and a sample problem can be obtained from the Radiation Shielding Information Center of the Oak Ridge National Laboratory.
13. *Acknowledgment:* This work was partially funded by National Aeronautics and Space Administration, Order No. H-38280A, under Union Carbide Corporation's contract with the U.S. Atomic Energy Commission.
14. *References:*

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September 24, 1970

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