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Neutron Ages Computed from Experimental Activation Data

The problem:

To devise a computer program for determining neutron ages from experimental activation data. The neutron or Fermi age is related to the mean-square distance traveled by a neutron from its point of generation to its point of thermalization.

The solution:

This program was written to reduce the time manually required to compute a neutron age and to provide a definite plan of procedural choices. It allows convenient comparison of several fitting and error-analysis procedures.

How it's done:

For the purpose of integration, the experimentally determined activation energy versus distance-squared curve is separated into two portions. The shape of curve I has not been analytically determined, whereas curve II is assumed to be exponential. The breakpoint or division between curves I and II may be determined by the program or by the experimenter. If the program option is selected, a difference method is used for calculation of the breakpoint.

After the breakpoint is determined, curve I is integrated in any of several ways that are left as options in the code. The first option available for the integration of curve I is the trapezoidal integration. This option should be used if many finely spaced points are to the left of the division point. The second option available is a least-squares polynomial curve fitted to the data. This option also allows the specification of the significance of the fit; that is, a certain confidence level for the polynomial fit may be inserted as program input. The third option available is an averaged parabolic fit. This option fits one parabola to the first three and another parabola to the last three of four successive points. The coefficients thus generated are averaged and the curve is integrated. A considerably better approximation to the integral is produced with this option than with the trapezoidal option, since curvature is allowed between points.

The exponential region of the curve (curve II) is fitted by a weighted least-squares exponential approximation. It is then integrated analytically from the division point to infinity. A fourth option allows the value of the index number of the breakpoint to be specified as part of the program input.

The remaining options of the code provide for error estimation of the various integration options.

Notes:

1. This program is written in FORTRAN IV language for use on the IBM 7094 computer.
2. Inquiries concerning this program may be directed to:

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Category 09

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