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A PROGRAM FOR THE EXTRACTION OF RADIATIVE LIFETIMES FROM EXPERIMENTAL BEAM-FOIL INTENSITY DECAY DATA

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PROGRAM SUMMARY

Title of program: HOMER

Catalogue number: AAED

Computer: IBM 360/67; *Installation*: University of Alberta

Operating system: Michigan Terminal System (MTS)

Programming language used: FORTRAN IV

High speed storage required: 16335 words

No. of bits in a word: 32

Overlay structure: None

No. of magnetic tapes required: None

Other peripherals used: Card reader, line printer, card punch

No. of cards in combined program and test deck: 2021

Keywords: Atomic, ion, life-time, excited state, beam-foil, decay curve, chi-square fit.

Nature of physical problem

The problem is to analyse experimental beam-foil intensity decay data into a sum of exponential terms, each with an amplitude and lifetime parameter. The most apt number of parameters and the optimum value of each is to be determined, together with estimates of standard deviation.

Method of solution

The minimum of chi-square is sought in an iterative procedure. Normal equations are obtained from a first order Taylor expansion of the multi-exponential fitting function, together with an auxiliary binomial expansion to first order. Non-convergence is impeded by two devices. A modified Marquardt method is built in as an option [1]. Initial estimates may be computed from the data. Rejection of extra-statistical data points may be allowed [2].

Restrictions on the complexity of the problem

The complexity of the fitting function is arbitrarily limited to, at most, a six-parameter fit in the form of a sum of three exponential terms. Provision is made for adjustment of the number of parameters during the computation so that a 6-, 5-, 4-, 3- or 2- parameter best fit may be obtained.

Typical running time

Typical running time is about 2 seconds on the IBM 360/67 with the G compiler for 25 data points and a six-parameter fitting function. This estimate does not include compilation of the program. It is recommended that a compiled version of the program be used in the interests of economy.

References

[1] N.R. Draper and H. Smith, *Applied regression analysis* (Wiley, New York, 1967) p. 272.

[2] E.M. Pugh and G.H. Winslow, *The analysis of physical measurements* (Addison-Wesley, Reading, Massachusetts, 1966) p. 108.

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