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QUANTUM MECHANICAL COUPLED CHANNELS CODE FOR COULOMB EXCITATION*

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PROGRAM SUMMARY

Title of program: AROSA-FOR-COULOMB-EXCITATION-I

Catalogue number: ABOY

Computer:	*Installation*:
PDP 1077	University of Pittsburgh, USA
UNIVAC 1108	Sandoz Co. Basel, Switzerland

Operating system: FORSE (32A)

Programming language used: Fortran IV

High speed storage required: 39K words.

No. of bits in a word: 36

Overlay structure: None

No. of magnetic tapes required: Optional in lieu of disc

Other peripherals used: Disc, card reader, line printer, card punch optional

No. of cards in combined program and test deck: 1686

CPC Library subprograms used:
Catalogue number: ABOZ; *Title*: AROSA-FOR-COULOMB-EXCITATION-II; *Ref in CPC*: 8 (1974) this paper.

Keywords: Nuclear, coupled channels, Coulomb-excitation, excitation amplitudes, excitation cross-sections, Schrödinger equation.

PROGRAM SUMMARY

Title of program: AROSA-FOR-COULOMB-EXCITATION-II

Catalogue number: ABOZ

Computer:	*Installation*:
PDP 1077	University of Pittsburgh, USA
UNIVAC 1108	Sandoz Co. Basel, Switzerland

Operating system: FORSE (32A)

Programming language used: Fortran IV

High speed storage required: 39K words.

No. of bits in a word: 36

Overlay structure: None

No. of magnetic tapes required: Optional in lieu of disc

Other peripherals used: Disc, card reader, line printer

No. of cards in combined program and test deck: 751

CPC Library subprograms used:
Catalogue number: ABOY; *Title*; AROSA-FOR-COULOMB-EXCITATION-I; *Ref. in CPC*: 8 (1974) this paper.

Keywords: Nuclear, coupled channels, Coulomb-excitation, excitation amplitudes, excitation cross-sections, Schrödinger equation.

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Nature of physical problem
AROSA calculates amplitudes and cross sections for Coulomb excitation of even even nuclei (g.s. spin and parity 0^+). Up to five excited states may be included in the calculation. All reduced E2 and E4 matrix elements between these states may be taken into account.

Method of solution
The set of radial second-order differential equations resulting from the Schrödinger equation is solved by outward integration from the vicinity of the origin. The integration method is based on the Taylor expansion whose coefficients are obtained from recursion relations. At larger distances a WKB procedure is employed. Convergence of the scattering amplitudes with the number of partial waves is improved by using a procedure which is related to the Padé approximation.

Restrictions on the complexity of the problem
The Sommerfeld parameter η must be smaller than 30, but methods are discussed for extrapolation of results to larger η values.

Typical running time
The running time is roughly proportional to the square of the number N of couplings which is given by $N = \Sigma_n (I_n + 1)$ where I_n is the spin of the nth state. A calculation involving three states with spins and parities 0^+, 2^+, 4^+ and all by selection rules permissible E2 and E4 matrix elements between them, requires on the PDP 1077 about 35 minutes.

Unusual features
Due to the long-range nature of the Coulomb force it is necessary to carry out the integration of the radial equations to large distances, and to assure convergence as a function of orbital angular momentum. The integration can be carried out to arguments $\rho = kr = 800$ and the convergence as a function of l is improved by the use of an iterative procedure related to the Padé approximation.

The program can be executed in two parts with part I supplying data on cards for part II. Alternatively, the two sections can be run consecutively with intermediate data stored on disc.