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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

BULLETIN OF THE DATA CENTRE OF THE LENINGRAD INSTITUTE OF NUCLEAR PHYSICS

Translated
by the
International Atomic Energy Agency

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WORKING PRINCIPLES OF THE DATA CENTRE OF THE LENINGRAD INSTITUTE OF NUCLEAR PHYSICS (LIYaF)

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Progress in modern science depends to a great extent on the organization of an information system, especially in view of the exponential growth of scientific research and the substantially increased interest in information concerning research and development in related fields of science. The traditional forms of information exchange have long ceased to satisfy the needs of modern science and technology. This has given rise to a large number of scientific information centres, one of whose main tasks is to achieve a more effective exchange of the growing volume of scientific information than is possible through the publication of journals and the use of postal services.

The idea of creating a world-wide information system is not new [1]. Many organizations, including the United Nations, are working on the problem. UNISIST, the main purpose of which is to organize a world-wide information system, is being developed under the auspices of the United Nations. The main conclusion reached by the experts engaged in creating such a system is that one should once and for all drop the concept of a single gigantic centre for storing and disseminating the entire scientific knowledge of mankind in favour of a flexible network based on voluntary co-operation between existing and future independent information services. The most rational approach is therefore considered to be the establishment of a network of interconnected information centres each specializing in the collection, storage and evaluation of data on some relatively narrow field of human activity.

Since the early 1960s there has indeed been a spontaneous growth in the number of scientific information centres concerned with the collection, storage and evaluation of data on particular physical and chemical properties of different substances, the work of these centres being based on the extensive use of electronic computers. At the end of 1971 there were about 50 such centres in the world, half of them in the United States [2]. They collect, classify and store data on a variety of subjects: nuclear and high-energy physics, the atomic and molecular properties of different substances, crystallography, spectrography, the properties of matter at high pressures and low temperatures, the properties of organic compounds, the properties of plasmas, oceanography, etc. Magnetic tape, discs and microfilm are used for storing the data or the bibliographic information. At present some 50 000-100 000 references are available at each of these centres, and the volume of information is growing on average by 3000-5000 references annually.

At the end of the 1960s there began to emerge a trend towards international co-operation between centres concerned with a particular subject, the aim being to increase the scope and speed of data collection. The collaboration between the Oak Ridge*/, Vienna (IAEA), Saclay and Obninsk neutron data centres is an example of successful international co-operation; it was initiated to meet the need for evaluated data for reactor construction, nuclear power engineering, industrial activation analysis, etc.

In recent years these four centres have felt the need also to collect non-neutron nuclear data - for example, data on the characteristics of the excited states of nuclei and on various distributions occurring in nuclear reactions. In this connection there have been many appeals for international co-operation in the collection, storage, evaluation and exchange of data on nuclear structure, nuclear reactions and elementary particles for use both in industry and in fundamental research.

The rapid development of reactors and accelerators, the advent of high-precision semiconductor detectors and proportional counters for recording charged particles, and the increasing use of computers and automated measuring systems in experimental work have produced a

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*/ Translator's note: The US neutron data center NNCSC is at Brookhaven, not Oak Ridge.

substantial growth in the amount of information which must be provided to users quickly and in its entirety. As a consequence, the scientific investigator has to deal with two increasing flows of information: the results of his own work and those obtained by other investigators. The best way of helping him to solve this problem is to free him of routine tasks connected with the handling of information. This means that one must automate and simplify as far as possible:

(a) The search for the data which he requires; and

(b) The processing of the results which he has obtained.

These two tasks underlie the activities of the Centre for Data on Nuclear Structure and Elementary Particles (Data Centre) of the Leningrad Institute of Nuclear Physics (LIYaF).

The Institute's basic activities - fundamental research in nuclear physics and elementary particle physics and the use of nuclear physics methods in solid state physics and radiobiology - have determined the Data Centre's principal objective:

> the creation and constant up-dating of an automated referral system on nuclear structure and elementary particles with fast access to data and to a set of computer programs for processing the data.

The word "data" covers three types of information:

1. "Raw" experimental results (spectra, distributions, tables graphs, etc.);
2. Actual papers (containing authors' evaluations);
3. Evaluated and reference data.

We discuss below the Data Centre's work as it relates to research in the field of nuclear structure.

Evaluated data are needed at literally all stages of research. The following categories of evaluated data are necessary for nuclear structure studies:

1. Fundamental physical constants (speed of light, electron mass and charge, etc.);

2. Characteristics of atoms (energies and intensities of X-ray transitions, coefficients of radiation absorption in matter, coefficients of internal electron and pair conversion, etc.);

3. Characteristics of nuclei (nuclear masses, transition energies, schemes of excited nuclear states, cross-sections for different reactions, etc.).

The data compiled by the Data Centre are made available to users through fast-access retrieval. In particular, an automated referral system for evaluated data on gamma transition energies and intensities in the decay of the nuclei formed in (n,γ) reactions has been extablished and is being kept up to date [3].

Special attention is devoted to the compilation of data on the decay schemes of radionuclides and on the structure of nuclear levels. At present, these data are concentrated mainly in the compilations of Dzhelepov and Peker [4] and of Lederer et al. [5] and in the "Nuclear Data Sheets" [6]; in all of these published evaluations, however, there is an average lag of several years. Clearly, this lag can be eliminated only through international collaboration in evaluating the properties of nuclear levels and putting the data into computer format. The Data Centre of the LIYaF, working in liaison with groups of Soviet evaluators, is compiling in its computer all existing data on the properties of excited nuclear states and is prepared to co-operate internationally in this field.

The data in the actual papers are of considerable interest for research and development; however, it is not at present possible to store all these data in a computer. Consequently, the Data Centre of the LIYaF is establishing a computerized library of keyword abstracts of actual papers in the field of nuclear physics. The Data Centre provides users with the possibility of automatic data retrieval on the basis both of individual retrospective inquiries and of a selective distribution of information.

The Data Centre's information retrieval system is based on the method of keyword abstracting adopted in "Nuclear Data" and "Nuclear Physics". The system of keywords has been in existence for a long time and fully meets the needs of scientific investigators.

The Data Centres of the LIYaF and the I.V. Kurchatov Institute of Atomic Energy [7] are together producing keyword abstracts of the material of all Soviet periodicals in which articles on nuclear structure and nuclear reactions are published and recording the data in an agreed format [8]. An obvious advantage of such regional abstracting is that the articles can be processed before publication, while they are in the editorial offices of the periodicals in which they are to appear. For example, the Data Centre had recorded on magnetic tape the abstracts of the papers presented at the 23rd Conference on Nuclear Spectroscopy and Nuclear Structure (Tbilisi, 1973) by the time the conference proceedings appeared [9].

It is felt at the Data Centre that such regional abstracting, if done within the framework of international co-operation involving information exchange on magnetic tape and the establishment of parallel complete libraries, will help to overcome the communication and language barriers which are at present hampering the rapid transmission of new information to users.

Besides the computer library of abstracts, the Data Centre has established and is maintaining compilations of published data on the lifetimes of excited nuclear states [10] and the results of studies of E0 transitions [11].

<u>"Raw" experimental data</u> are generally the material of greatest interest to scientific investigators concerned with the problem in question. The important point is that these data, which are needed by a relatively small group of investigators, must be as complete as possible and "raw" - that is to say, not distorted through processing or subjective evaluations by the authors. However, with the rapid increase in the volume of "raw" information resulting from experiments, there is a clear tendency to reduce the publication of such data owing to the limited space available in the periodicals.

The use of computer media removes the limitations associated with the volume of experimental information and makes effective data exchange possible. Difficulties do arise, however, in connection with the need for a single international exchange format. These difficulties are aggravated by the fact that, even when such a format exists, effective data exchange is possible only if investigators adopt it and use it widely.

The Data Centre of the LIYaF is working on the development of such a format and proposes to use it in recording as fully as possible on magnetic tape the results of work done at the Institute.

The processing of the "raw" results of experimental nuclear structure studies can be divided into three stages:

1. The processing of direct measurement results so as to derive the characteristics (energies, intensities, correlations, etc.) of the radiation types under consideration from measured radiation spectra and distributions;

2. The construction of schemes of excited nuclear states and the determination of their characteristics (energies and spins of the states, parities, transition probabilities, etc.);

3. Comparison of the characteristics so determined with predictions based on models.

A computer is used during these stages. Often, however, the processing programs do not match one another; moreover, the computer programmer frequently stands between the investigator and the computer, hampering the interaction of the investigator with the information which he has obtained.

The Data Centre of the LIYaF is working on the development of a system of matching programs which are simple to use in analysing experimental distributions, constructing nuclear level schemes on the basis of experimental results and comparing their characteristics with nuclear model predictions.

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ABSTRACTS IN KEYWORD FORM

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1. An abstract in keyword form is a short but complete description of the contents of a scientific paper (purpose of the work, procedure, results and conclusions). The use of keywords facilitates machine storage, retrieval and transmission to the user in response to a query which may also be in keyword form.

2. Ideally, an abstract in keyword form should be prepared by the author of the paper since he knows best what he wants to say. This procedure is also helpful to the author himself, since an abstract in keyword form is - virtually by definition - also a detailed summary of the scientific paper. Unfortunately, however, authors are not under any obligation to describe their papers in keyword abstracts - there is no-one really urging them to do so and no system of keywords has yet been widely adopted and publicized.

3. "Nuclear Physics" has been publishing keyword abstracts along with articles since 1964, and the same system underlies the computer library of abstracts established by the Nuclear Data Group at Oak Ridge. Some of these abstracts - those relating to papers containing data on the structure of nuclear levels - are published regularly in "Nuclear Data Sheets".

4. Aware of the need to establish a nuclear data library with fast access and of the fact that such a library can be established only on the basis of broad international co-operation, the Data Centre of the Leningrad Institute of Nuclear Physics [1] and the Centre for Data on Nuclear Structure and Nuclear Reactions of the I.V. Kurchatov Institute of Atomic Energy [2] - using the above-mentioned system of keywords - have started abstracting all Soviet scientific papers containing nuclear data.

Description of the system of keywords for preparing abstracts of papers containing nuclear data

Abstracts are prepared of papers containing information about the structure of nuclei obtained in investigations of radioactive decay and nuclear reactions and through the measurement of nuclear moments and also of theoretical papers relating to these questions. Essentially, the contents of the papers of interest are divided into four subject categories:

RADIOACTIVITY

NUCLEAR REACTIONS

NUCLEAR STRUCTURE

NUCLEAR MOMENTS

An abstract indicates the nuclei or reactions investigated, enumerates the measured nuclear characteristics and the nuclear characteristics obtained after processing of the measurement results, and specifies the experimental conditions. For example,

RADIOACTIVITY ^{62m}Co; measured $T_{1/2}$, E_{β}, $\beta\gamma$-coin, $\beta\gamma$-CP; deduced log ft, Q. ^{62}Ni deduced levels, J, π, ICC. Ge(Li) detector.

RADIOACTIVITY $^{186,188}Re$, ^{176m}Lu; calculated log ft, β-decay form factors.

RADIOACTIVITY, FISSION ^{252}Cf(SF); measured $T_{1/2}$, (fragment) (γ) - coin. $^{98,100,102}Zr$ deduced E_{γ}, I_{γ}.

A RADIOACTIVITY abstract must include every nucleus for which characteristics have been measured, calculated or deduced.

NUCLEAR REACTIONS $^{12,13}C$(d,d),(d,p), E = 0.4 - 0.85 MeV; measured σ (E;θ); deduced optical model parameters. $^{13,14}C$ levels deduced S. Enriched targets. DWBA analysis.

NUCLEAR REACTIONS ^{12}C(^{6}Li,^{6}Li), (^{6}Li, d), E = 13 MeV; calculated σ (θ).

NUCLEAR REACTIONS, FISSION ^{235}U(n,F), E = 1 - 1000 eV; measured σ(E), (fragment)(fragment)(E;θ).

A NUCLEAR REACTIONS abstract must include the target, the reaction and the energies of the incident particles for each reaction investigated. If the characteristics of the compound states or the product nuclei are obtained, each of these nuclei must be indicated.

NUCLEAR STRUCTURE $^{14,15}N$, $^{16,17,18}O$; calculated single-particle, binding energies. Hartree-Fock method, parity mixing.

NUCLEAR STRUCTURE $^{106,108,110}Cd$; calculated levels, J, π. Pairing and quadrupole interaction.

NUCLEAR MOMENTS ^{181}Ta; measured a,b,J; deduced μ, Q. Atomic beam magnetic resonance.

The nuclear moments of short-lived nuclear states are indicated in NUCLEAR REACTIONS or RADIOACTIVITY abstracts, depending on how the nuclei were obtained.

NUCLEAR REACTIONS $^{61}Ni(\gamma,\gamma)$, E = 67 keV; measured Mossbauer effect. ^{61}Ni level deduced μ, Q.

RADIOACTIVITY ^{227}Th; measured $\gamma\gamma(\theta$, H) in Ni, Co, Fe; deduced hyperfine fields. ^{223}Ra levels deduced g.

The keywords describing nuclear characteristics are either the full designations of the characteristics in English or abbreviations similar to those which are generally accepted. A list of abbreviations is given in Annex 1. Further verbs can be added to those used for indicating various operations ("measured", "deduced", "calculated") - for example, "analyzed" and "compiled".

Particular attention must be paid to the rules of punctuation when preparing an abstract since these rules determine the algorithm for automatic analysis of the text of the abstract:

- Keywords are separated by commas;
- The keywords and the verbs relating them to the subject (the nucleus or reaction) together form sentences which are separated by full stops (periods);
- Semicolons are placed before the verbs in sentences describing the decay or reaction being studied.

The Data Centre's method of writing keywords differs from the examples given above for technical reasons - the printing facilities at the Data Centre do not include either lower-case Latin letters or Greek symbols. Only capital Russian and Latin letters are used.

The abbreviated keyword equivalents used by the Data Centre are shown in Annex 1. In Annex 2 most of the foregoing examples of keyword abstracts are presented in the form adopted by the Data Centre.

System of descriptors used in the Data Centre's information retrieval system for the input and retrieval of abstracts

The grammar described above, which "Nuclear Physics" has been using for almost ten years, is convenient for the reading of abstracts. For retrieval purposes, however, there should be some simplification at the input stage, the texts of abstracts being reduced to retrievable data elements in the normal conjunctive-disjunctive (yes-no) form and without synonyms and homonyms. Accordingly, the texts of abstracts are processed before being fed into the system: verbs are omitted and keywords are replaced by descriptors linked by the logic elements AND (comma) and OR (full stop - period). In the derivation of descriptors from keywords, the subject categories vanish, but information about them is incorporated into the designations of the nuclei. If one is deducing the properties of the excited states of a particular nucleus, then the designation of that nucleus is preceded by the symbol L; other symbols and the corresponding subject categories are shown below:

Subject category	Symbol
RADIOACTIVITY	D
NUCLEAR REACTIONS	R
NUCLEAR REACTIONS, FISSION	F
NUCLEAR STRUCTURE	S
NUCLEAR MOMENTS	J

Descriptors should form a thesaurus which excludes synonyms and homonyms. However the work of compiling a thesaurus requires co-ordination of the efforts of all centres concerned with a particular subject. It might be mentioned in this connection that, in the automatic analysis of the text of an abstract, all the keywords in the text have so far been regarded as descriptors. Annex 2 contains, in addition to the texts of abstracts, the retrievable data elements resulting from the automatic analysis of such texts.

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Annex 1

a, b, c	A, B, C	electron-nucleus interaction constants
B(E2)	B(E2)	transition probability for E2 multipolarity
ce	CE	internal conversion electrons
coin	COIN	coincidences
CP	CP	circular polarization
delay	DELAY	delayed coincidences
E	E	energy
EC	EC	electron capture
g	GR	gyromagnetic ratio
HI	HI	heavy ions
I	I	intensity
IAS	IAS	isobaric analog state
ICC	ICC	internal conversion coefficient
J	J	total angular momentum
ℓ	L	orbital angular momentum
levels	LEVELS	energy of levels
Q	Q	total energy of reaction or disintegration
Q_E	QE	electric quadrupole moment
resonances	RESONANCES	energy of resonances
S	S	spectroscopic factor
SF	SF	spontaneous fission
(t)	(T)	time dependence
X	X	X-rays; unidentified reaction products
Γ	WIDTH	width
μ	MU	magnetic moment
π	PI	parity
ρ	RHO	density of nuclear charge
(θ)	(THETA)	angular dependence
σ	SIGMA	cross-section or yield
$\sigma(\theta)$	SIGMA(THETA)	angular distribution of differential cross-section or yield
$\sigma(E)$	SIGMA(E)	excitation function
$\sigma(E;E_p)$	SIGMA (E; EP)	spectrum of emitted protons for different incident particle energies
$\sigma(E_t,\theta)$	SIGMA(ET, THETA)	angular distribution of emitted tritons
B_n	BN	neutron binding energy

The letters A, B, G, N, P, D and T are used instead of α, β, γ, m, p, d and t for denoting particles and photons; for example, I_γ, E_β, $\gamma\gamma$-coin, $\alpha\gamma$-delay, $ce_\gamma(\vartheta)$, $(\alpha,p\gamma)$ becomes IG, EB, GG-COIN, AG-DELAY, CEG (THETA), (A,PG).

Annex 2

RADIOACTIVITY 62MCO; MEASURED T1/2,EB,BG-COIN,BG-CP; DEDUCED LOGFT,Q. 62NI DEDUCED LEVELS,J,PI,ICC. GE(LI) DETECTOR.

D62CO,T1/2,EB,BG-COIN,BG-CP,LOGFT,Q.L62NI,LEVELS,J,PI,ICC.GE(LI) DETECTOR.

RADIOACTIVITY 186,188RE,176M-LU; CALCULATED LOGFT,B-DECAY FORM FACTORS.

D186RE,D188RE,D176LU,LOGFT,B-DECAY FORM FACTORS.

RADIOACTIVITY,FISSION 252CF(SF); MEASURED T1/2,(FRAGMENT)(G)-COIN. 98,100,102ZR DEDUCED EG,IG.

D252CF,(SF),T1/2,(FRAGMENT)(G)-COIN.L98ZR,L100ZR,L102ZR,EG,IG.

NUCLEAR REACTIONS 12,13C(D,D),(D,P),E=0.4-0.85 MEV; MEASURED SIGMA(E;THETA); DEDUCED OPTICAL MODEL PARAMETERS. 13,14C LEVELS DEDUCED S. ENRICHED TARGETS, DWBA ANALYSIS.

R12C,R13C,(D,D),(D,P),SIGMA(E;THETA),OPTICAL MODEL PARAMETERS.L13C,L14C,S. ENRICHED TARGETS,DWBA ANALYSIS.

NUCLEAR REACTIONS 12C(6LI,6LI),(6LI,D),E=13 MEV; CALCULATED SIGMA(THETA).

R12C,(6LI,6LI),(6LI,D),SIGMA(THETA).

NUCLEAR REACTIONS,FISSION 235U(N,F),E=1-1000 EV; MEASURED SIGMA(E), (FRAGMENT)(FRAGMENT)(E;THETA).

F235U,(N,F),SIGMA(E),(FRAGMENT)(FRAGMENT)(E;THETA).

NUCLEAR STRUCTURE 14,15N,16,17,18O; CALCULATED SINGLE-PARTICLE,BINDING ENERGIES. HARTREE-FOCK METHOD,PARITY MIXING.

S14N,S15N,S16O,S17O,S18O,SINGLE-PARTICLE,BINDING ENERGIES.HARTREE-FOCK METHOD,PARITY MIXING.

NUCLEAR STRUCTURE 106,108,110CD; CALCULATED LEVELS,J,PI. PAIRING AND QUADRUPOLE INTERACTION.

S106CD,S108CD,S110CD,LEVELS,J,PI.PAIRING AND QUADRUPOLE INTERACTION.

NUCLEAR MOMENTS 181TA; MEASURED A,B,J; DEDUCED MU,Q. ATOMIC BEAM MAGNETIC RESONANCE.

J181TA,A,B,J,MU,Q.ATOMIC BEAM MAGNETIC RESONANCE.

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LIBRARY OF PROBLEM-ORIENTED PROGRAMS FOR SOLVING PROBLEMS IN ATOMIC AND NUCLEAR PHYSICS

Yu.I. Kharitonov

The Data Centre of the Leningrad Institute of Nuclear Physics is working on the establishment of a library of problem-oriented programs for solving different problems in atomic and nuclear physics. Such a library will considerably reduce the time and effort spent by the Institute's scientific staff in comparing experimental results with the predictions of different models and studying the possibilities of new models. Even the most diverse problems of atomic and nuclear physics involve many common elements; for example, the solution of Schrödinger's single-particle equation for a number of specific potentials, calculation of the matrix elements of different kinds of single-particle and two-particle operator, the diagonalization of matrices, and various transformation functions and coefficients. One of the Data Centre's principal tasks is therefore to identify such common elements and establish a library of corresponding computer programs, and for this purpose it is calling on the services of its own staff and co-operating widely with other scientific institutions, both in the Soviet Union and abroad.

Since the programs comprising the Data Centre's library are intended for users who may have no contact with the persons who have written them, they must possess a number of specific features. Above all, each program must describe the formulation of the problem, the method for solving it and its structure. The description must be short but sufficient for understanding the essence of the problem which is to be solved. In the description, all equations to be used must be written out exactly and all the quantities appearing in those equations must be explained. Such descriptions will be published in issues of this "Bulletin" together with notification that the corresponding programs are available in the Data Centre's library. If more detailed descriptions are needed in the case of certain programs, the Data Centre will arrange for their publication in special preprints. As a rule, the texts of programs will not be published but stored on punched cards in the Data Centre's library. To facilitate the use of a program, the corresponding text must contain an explanation of the purpose of individual logic elements, references to the relevant literature and to the numbers of formulas, etc. The results obtained with the programs should, if possible, be printed out in the form of easily readable tables and graphs.

ALGOL-60 and FORTRAN-IV have been adopted as the official algorithmic languages and the BESM-6 is the basic computer.

Each program to be included in the Data Centre's library is assigned a coded designation consisting of three letters and three numerical digits. The first two letters indicate the subject to which the problem relates and the third indicates the language in which the program is written; the three numerical digits simply make up the ordinal number of the program. At present, the subject breakdown is as follows:

1. AP (atomic physics) - problems relating to atomic physics;
2. NP (nuclear physics) - problems relating to nuclear physics;
3. QM (quantum mechanics) - problems relating to both atomic and nuclear physics and involving general considerations of quantum mechanics;
4. CT (calculational techniques) - purely mathematical methods most frequently used in physical calculations.

The third letter of the designations of programs written in ALGOL-60 is "A"; in the case of programs written in FORTRAN-IV it is "F". Thus, QMA003 denotes a program for solving a problem involving general considerations of quantum mechanics which is written in ALGOL-60 and has the ordinal number three.

At present, the Data Centre's library contains the following programs:

1. QMA001 and QMF001

These programs are for calculating Clebsch-Gordan coefficients with zero magnetic quantum numbers.

They enable one to calculate individual values of Clebsch-Gordan coefficients with zero magnetic quantum numbers provided that the algebraic sum of the angular momenta under consideration does not exceed 43. There is provision for printing out both the initial parameters and the results of calculations in the form of an easily readable table. The procedures involved in these programs can be used as ready input units when writing more complex programs containing such coefficients as component elements. The values obtained for these coefficients, the corresponding formulas and the program texts have been published in Leningrad Institute of Nuclear Physics (LIYaF) preprint LIYaF-73 (1973).

2. QMA002 and QMF002

These programs are for calculating Clebsch-Gordan coefficients of the general form.

They enable one to calculate individual Clebsch-Gordan coefficients for given values of the angular momenta which are being added, of the resulting angular momentum and of their projections provided that the algebraic sum of the three angular momenta under consideration does not exceed 43. There is provision for printing out both the initial parameters and the results of calculations in the form of an easily readable table. These programs can also be used for calculating Clebsch-Gordan coefficients with zero magnetic quantum numbers. The procedures involved in the programs can be used as ready input units when writing more complex programs containing Clebsch-Gordan coefficients of the general form as component elements. The values obtained for these coefficients, the corresponding formulas and the program texts have been published in preprint LIYaF-73 (1973).

3. QMA003 and QMF003

These programs are for calculating Racah coefficients.

They enable one to calculate values of individual Racah coefficients provided that the factorials n! encountered in the calculations are limited by the value n = 44. This limit fully meets the requirements of current spectroscopic calculations. There is provision for printing out both the initial parameters and the results of calculations. The procedures involved in the programs can be used in solving problems which contain Racah coefficients as component parts. The values obtained for these coefficients, the corresponding formulas, the program texts and examples of print-out with initial parameters and the results of calculations have been published in preprint LIYaF-76 (1973).

4. NPA001

This program is for calculating pair matrix elements for velocity-independent nuclear forces and the Coulomb interaction in a spherically symmetric oscillatory base (j-j coupling).

The program enables one to calculate the pair matrix elements of Wigner, singlet, tensor and Coulomb forces, the base being two-particle wave functions with a specific total angular momentum which are derived from the single-particle wave functions of a spherically symmetric harmonic oscillator on the basis of the j-j coupling scheme. The radial dependence of the forces can be in the form either of a δ-function or of a Gaussian well, there being in the latter case provision for changing the interaction radius. The program enables one to calculate pair matrix elements for any single-particle states within the limits of the shell model. In this variant of the program, the Pauli principle is not taken into account - that is to say, the program is used for calculating directly the matrix elements of the n-p interaction, while the matrix elements of the n-n and the p-p interaction are calculated only for equivalent particles. For particles of the same sort but at different levels, one must calculate the direct and the exchange matrix elements separately. A detailed description of the formulation of the problem, the corresponding formulas and the program text have been published in preprint LIYaF-47 (1973). There is provision for print-out of the initial data and the results of calculations in the form of the following table:

NON-SYMMETRIZED
PAIR MATRIX ELEMENTS OF WIGNER (W),
SINGLET (S), TENSOR (T) AND COULOMB
(C) FORCES IN A SPHERICAL OSCILLATORY BASE
FOR STATES WITH A TOTAL DETERMINED ANGULAR
MOMENTUM J WHICH ARE CONSTRUCTED ON THE BASIS OF
THE J-J COUPLING SCHEME

RADIAL DEPENDENCE OF NUCLEAR FORCES
IN THE FORM OF A GAUSSIAN WELL (X≠0) OR
IN THE FORM OF A DELTA POTENTIAL (X=0)

IN THE CALCULATIONS: X = 0.60
THE WIGNER FORCE PARAMETER VO = +1.00 MEV
THE SINGLET FORCE PARAMETER V1 = +1.00 MEV
THE TENSOR FORCE PARAMETER V2 = +1000 MEV
MASS NUMBER A+209

SINGLE-PARTICLE QUANTUM NUMBERS				TOTAL SPIN J	TYPE OF FORCES	MAT. EL-TS IN MEV
N1L1J1	N2L2J2	N3L3J3	N4L4J4			
0 5 4.5	0 7 7.5	0 5 4.5	0 5 5.5	3	W	-0.011283
					S	-0.000369
					T	+0.005548
					C	-0.015824

Here X is the ratio of the interaction radius to the oscillatory radius. When X=0, the following expression will be printed instead of "THE TENSOR FORCE PARAMETER ....":

"OSCILLATORY" RADIUS PO= FM

5. NPA002

This program is for calculating antisymmetric pair matrix elements for velocity-independent nuclear forces and the Coulomb interaction in a spherically symmetric oscillatory base (j-j coupling).

The program is a variant of program NPA001 in which the same pair matrix elements are calculated relative to antisymmetric wave functions. Accordingly, "NON-SYMMETRIZED" replaces "ANTISYMMETRIC" in the print-out of the initial data and the results of calculations.

6. NPF003

This program is for calculating pair matrix elements of central forces with single-particle wave functions in Saxon-Woods and harmonic oscillator potentials.

In the first part of the program, Schrödinger's single-particle equation with the Saxon-Woods potential is solved; in this equation, the spin-orbit interaction and the Coulomb potential are also taken into account. In the second part of the program, two-particle wave functions with a specific total angular momentum are constructed with the aid of the single-particle wave functions already obtained and the pair matrix elements of the central forces - that is to say, the matrix elements of the Wigner, spin-spin, singlet, triplet and Coulomb forces - are calculated. The radial dependence of the forces can be in the form of a Gaussian or a Yukawa well, for which there is provision for changing the range, and also in the form of a δ-function. There is also provision for taking into account the Pauli principle: in addition to the direct matrix element, the program calculates the exchange matrix element and the corresponding antisymmetric and symmetric matrix elements. For a given set of single-particle quantum numbers, the matrix elements of the central forces are calculated either for a given value of the total angular momentum J or for all its possible values. A detailed description of the program, the rules for using it and an example of print-out with the initial data and the results of calculations have been published in preprint LIYaF-69 (1973).

7. NPA003

This program is for calculating pair matrix elements of the n-p interaction involving central forces in deformed odd-odd nuclei.

The program enables one to calculate pair matrix elements for Wigner and spin-spin forces. Functions describing the motion of particles in a Nilsson potential are used as single-particle wave functions. The radial dependence of the forces can be in the form either of a Gaussian well, for which there is provision for changing the range, or of a δ-function. For the program to work, it is necessary to introduce as numerical material the coefficients of expansion of the single-particle wave function in a deformed potential with respect to the wave functions of a spherically symmetric harmonic oscillator. The initial data and the results of calculations are presented in tabular form.

UDK 002.6
681.142.2
539.14

ORGANIZATION OF THE INFORMATION SERVICE OF THE DATA CENTRE OF THE LENINGRAD INSTITUTE OF NUCLEAR PHYSICS

I.A. Kondurov, Yu.N. Petrov, Yu.F. Ryabov,
O.N. Sbitneva, I.M. Shesterneva

In accordance with the Data Centre's principal objective, "the creation and constant up-dating of an automated referral system on nuclear structure and elementary particles" [1], a system of computer programs for maintaining two nuclear data libraries and addressing inquiries to them has been established and put into operation.

I. Library of abstracts of scientific papers containing data on nuclear structure and nuclear reactions

The abstracts are prepared in keyword form [2]. It is assumed that completeness can be achieved only through the combined efforts of many centres. This implies certain requirements as regards the organization of the abstracts library - especially the organization of the information input. These requirements are connected primarily with the need to match different formats and with the input of information supplied on different carriers (punched cards, punched tape, magnetic tape).

Data input into the abstracts library involves two stages: reduction to the format of the information retrieval system (IRS) and input into IRS.

In the first stage (processing of the texts of abstracts), use is made of the facilities of the information-measurement centre [3] of the Institute's Neutron Research Laboratory, the following procedures being applied:

1. Input of text on punched tape and print-out for control purposes. The M-2 code (5-track tape) or the ASCII code (8 track tape) may be used for data punching;

2. Analysis of errors and their location on the punched tape;

3. Input and editing of the text - including correction of the errors found, the conversion of symbols which are not available in the M-2 code and which were replaced by others in the course of punching, setting of the line length (80 characters).

   The edited text is recorded on temporary-storage magnetic tape, a catalogue being compiled as a basis for output of the text in a given sequence;

4. Analysis of the text and input into IRS

   Analysis of the text consists in breaking it down by IRS-formated fields and in isolating the retrieval keywords (descriptors) in accordance with a list of synonyms. After analysis, the text is fed on punched cards into IRS, which is based on the Minsk-32 computer [4]. With IRS it is possible to retrieve and make available documents on the basis of the descriptors.

An example of an abstract after the control print-out can be seen at the top of Fig. 1. The numeric-alphabetic index at the beginning of the text consists of the year of publication, the first two letters of the surname of the first author (in Latin transcription) and a four-digit number equal to the number of the page in the reference or to the number of the publication (preprint, report) if the publication contains only one work.

In the lower part of Fig. 1, the same text has been broken down by IRS-formated fields, the meanings of which are clear. The IRS input number (ENTRY) is assigned automatically. With IRS, retrieval by ENTRY, AUTHORS, INDEX and KEYWORDS is possible on the basis of the descriptors.

The format for presenting the text of the abstract in keyword form, ABSTRACT, differs from the "Nuclear Data Sheets" format owing to the non-availability of lower-case Latin characters and of Greek symbols at the Data Centre. However, this fact should not hinder information exchange since there is a unique correspondence between the "Nuclear Data Sheets" method of writing keywords and the Data Centre's method [2].

The information retrieval system developed at the Institute is intended for accumulation, storage and retrospective retrieval and is designed for both bibliographic citation retrieval and fact retrieval.

The system is based on a controlled vocabulary between which basic preferential and hierarchical relationships have been established and permits retrieval on the basis of bibliographic data elements (authors, year of publication, source) and of descriptors (subject keywords). The descriptors of a query may be combined into any expression of Boolean algebra which includes the operations of conjunction, disjunction and negation. The system has an open descriptor dictionary to which additions can be made when new files are introduced. There is also the possibility of initial loading of the dictionary. If desired, the volume of the dictionary can be limited and its expansion thereby forbidden.

The presence of formated fields also makes it possible to specify such information elements as tables, graphs and diagrams in a compact form.

The system, operated with a Minsk-32 computer, consists of the following programs:

1. A program for control print-out of the input information;

2. A program for initial loading of catalogues and for adjustment;

3. A program for merging the existing file with new files;

4. A program for retrospective retrieval.

74AL0060! В.С.АЛЕКСАНДРОВ, Н.М.АНТОНЬЕВА, А.В.БАРКОВ, А.В.ЗОЛОТАВИН, Г.С.КАТЫХИН, В.М.МАКАРОВ, В.О.СЕРГЕЕВ - ПРОГРАММА И ТЕЗИСЫ ДОКЛАДОВ 24 СОВЕЩАНИЯ ПО ЯДЕРНОЙ СПЕКТРОСКОПИИ И СТРУКТУРЕ АТОМНОГО ЯДРА, ХАРЬКОВ, СТР.60 (1974)
СЛАБЫЕ БЕТА- И ГАММА-ПЕРЕХОДЫ В РАСПАДЕ (95M+95G)-NB
RADIOACTIVITY 95ZR; MEASURED IB; DEDUCED LOGFT. 95,95M-NB(FROM 95ZR DECAY); MEASURED EG,IG,ICE,EB,IB; DEDUCED LOGFT. 95MO DEDUCED TRANSITIONS, MAGNETIC SPECTROMETER,GE(LI) DETECTORS. CONF KHARKOV ABSTR 60

ENTRY
UA730001
INDEX
74AL0060
AUTHORS
В.С.АЛЕКСАНДРОВ, Н.М.АНТОНЬЕВА, А.В.БАРКОВ, А.В.ЗОЛОТАВИН, Г.С.КАТЫХИН, В.М.МАКАРОВ, В.О.СЕРГЕЕВ
SOURCE
ПРОГРАММА И ТЕЗИСЫ ДОКЛАДОВ 24 СОВЕЩАНИЯ ПО ЯДЕРНОЙ СПЕКТРОСКОПИИ И СТРУКТУРЕ АТОМНОГО ЯДРА, ХАРЬКОВ, СТР.60 (1974)
TITLE
СЛАБЫЕ БЕТА- И ГАММА-ПЕРЕХОДЫ В РАСПАДЕ (95M+95G)-NB
KEYWORDS
D95ZR,IB,LOGFT,D95NB,D95NB,EG,IG,ICE,EB,IB,LOGFT,L95MO,TRANSI,MAGNET SPECTR, GE(LI) DETECT,KHARKO
ABSTRACT
RADIOACTIVITY 95ZR: MEASURED IB: DEDUCED LOGFT. 95,95M-NB(FROM 95ZR DECAY): MEASURED EG,IG,ICE,EB,IB: DEDUCED LOGFT. 95MO DEDUCED TRANSITIONS, MAGNETIC SPECTROMETER,GE(LI) DETECTORS. CONF KHARKOV ABSTR 60

Fig. 1

Z 3 - 12
A 6 - 24
ПАРАМЕТР B(E2)

3	LI	6	2.180	B(E2)	5.5(-3)		KB	72OS1835
3	LI	7	0.4779	B(E2)	7.4(-4)	1	KB	72BA0193
9	F	19	0.197	B(E2)	5.2(-3)	+30-24	P4	73HA1396
9	F	19	1.554	B(E2)	3.55(-3)	+39-37	P4	73HA1396
10	NE	20	1.632	B(E2)	3.7(-2)	3	KB	72OL0201
10	NE	22	1.275	B(E2)	2.6(-2)	2	KB	72OL0201
12	MG	24	1.370	B(E2)	3.27(-2)	35	P4	72NA0001
12	MG	24	4.230	B(E2)	2.28(-3)	37	P4	72NA0001

72BA0193: A.BAMBERGER, G.JANSEN, B.POVH, D.SCHWALM, U.SMILANSKY - NUCL. PHYS., A194, 193 (1972)
72NA0001: A.NAKADA, Y.TORIZUKA - J.PHYS. SOC. JAP., 32, 1 (1972)
72OL0201: D.OLSEN, W.PHILLIPS, A.BARNETT - PHYS. LETT., 39B, 201 (1972)
72OS1835: R.OST, E.SPETH, K.PFEIFFER, K.BETHGE - PHYS. REV., C5, 1835 (1972)
73HA1396: P.L.HALLOWEL, W.BERTOZZI, J.HEISENBERG, S.KOWALSKI, X.MARUYAMA, C.SARGENT, W.TURCHINETZ, C.F WILLIAMSON, S.P.FIVOZINSKY, J.W.LIGHTBODY, JR., S.PENNER - PHYS. REV., C7, 1396 (1973)

Fig. 2

ЭНЕРГИЯ В КЭВ +100, - +2000,
ИЗОТОПЫ 152EU - 154EU
ПЕРИОД ПОЛУРАСП. +1,Н - +20,У
ИНТЕНСИВНОСТЬ +100, - +1000,

E	DE	ДОЧ	MAT	T 1/2		I(REL)	DI	I(ABS)	nI
121.7790	.0060	152SM	152EU	9.300	H	496.000	42.000	8.000	
123.1300	.0200	154GD	154EU	16.000	Y	1000.000	40.000	40.500	800
244,6800	.0200	152SM	152EU	12,700	Y	279,400	8,000	7,200	
248.0400	.0400	154GD	154EU	16.000	Y	173.000	16.000	6.590	130
344.2700	.0300	152GD	152EU	12.700	Y	1000.000	.	31.400	
344.2700	.0300	152GD	152EU	9.300	H	168.000	.	2.700	
443.9800	.0500	152SM	152EU	12.700	Y	105.000	4.000	3.300	
591.7400	.0500	154GD	154EU	16.000	Y	123.000	4.400	4.840	100
723.3000	.0400	154GD	154EU	16.000	Y	485.000	17.000	19.700	400
756.7700	.0300	154GD	154EU	16.000	Y	104.100	2.600	4.340	130
778,8700	,0500	152GD	152EU	12,700	Y	488,000	11,000	15,200	
841.6800	.0800	152SM	152EU	9.300	H	1000.000	40.000	13,000	
867.3300	.0500	152SM	152EU	12.700	Y	156.700	3.800	5.100	
873.1500	.0300	154GD	154EU	16.000	Y	291.300	6.100	11.500	200
963.3600	.0800	152SM	152EU	9.300	H	823.000	25.000	12.000	
964.0100	.0500	152SM	152EU	12.700	Y	540.000	14.000	17.300	
970.2700	.0700	152GD	152EU	9.300	H	425.000	28.000	.500	
996,2800	.0300	154GD	154EU	16.000	Y	254,600	7.700	10.300	200
1004,7600	,0400	154GD	154EU	16,000	Y	439.800	11,400	17,400	400
1085.8300	.0700	152SM	152EU	12,700	Y	395.000	12.000	10.000	
1112,0400	.0500	152SM	152EU	12.700	Y	506.000	14.000	16.400	
1274,4100	.0600	154GD	154EU	16.000	Y	875.000	35.000	35.500	700
1314,6500	.0700	152GD	152EU	12,700	Y	394.000	12.000		
1408,0200	.0500	152SM	152EU	12.700	Y	760.000	18.000	24.300	

Fig. 3

II. Library of systematized and evaluated characteristics of nuclei

This library at present comprises two automated indexes - one on the lifetimes of excited states of atomic nuclei and one on the energies and intensities of gamma transitions in the decay of radioactive nuclei occurring in (n,γ) reactions. The structure of the information in the two indexes is identical, so that the software is the same and also makes it possible to introduce any other indexes with a similar information structure.

Each index is a sequential file in which the rows of the table are arranged in the order determined by the columns. Handling programs make it possible to interchange, insert and extract rows without their order in the table being changed.

The indexes are referred to by teletype in a dialogue regime in which the system asks the user to specify which parameter ranges are required. The data in these ranges are printed pagewise by a fast printer. When necessary, it is possible to print out the bibliographic data on all the publications referred to in the selected rows.

Fig. 2 shows a request and an answer relating to the lifetimes of excited states of atomic nuclei. This index derives from the work of E.E. Berlovich, S.S. Vasilenko and Yu.N. Novikov published in book form in 1972 [5].

Fig. 3 shows a request and an answer relating to the energies and intensities of gamma transitions in the radioactive decay of nuclei occurring in (n,γ) reactions. This index was compiled by B.S. Dzhelepov and S.F. Koksharova [6].

The maximum search time, without printing time, is a few minutes. The indexes were created and are being used at the information-measurement centre of the Leningrad Institute of Nuclear Physics (LIYaF) [3].

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