

SOCIETA' ITALIANA DI FISICA

RENDICONTI
DELLA
SCUOLA INTERNAZIONALE DI FISICA
«ENRICO FERMI»
LXIX CORSO

*Elementary Modes
of Excitation in Nuclei*



~~475~~
~~69~~

~~04-53~~
~~388~~

8264516

04-53
P578.2
1976

ITALIAN PHYSICAL SOCIETY

PROCEEDINGS
OF THE
INTERNATIONAL SCHOOL OF PHYSICS
« ENRICO FERMI »

COURSE LXIX

edited by A. BOHR and R. A. BROGLIA

Directors of the Course

VARENNA ON LAKE COMO

VILLA MONASTERO

26th JULY - 7th AUGUST 1976

*Elementary Modes
of Excitation in Nuclei*



E8264516



NORTH-HOLLAND PUBLISHING COMPANY, AMSTERDAM - NEW YORK - OXFORD

Library of Congress Cataloging in Publication Data

Varenna, Italy. Scuola internazionale di fisica.

Elementary modes of excitation in nuclei.

(Proceedings of the International School of Physics
«Enrico Fermi»; course 69).

At head of title: Italian Physical Society.

Added t. p.: Modi elementari di eccitazione nei
nuclei.

Course held July 26-Aug. 7, 1976.

Bibliography: p.

1. Nuclear excitation-Congresses. I. Bohr, Aage.
- II. Broglia, R. A. III. Società italiana di fisica.
- V. Title: Modi elementari di eccitazione nei nuclei.
- IV. Title.

QC794.6.E9V37 1977 539.7'54 78-1402

ISBN 0-444-85153-4.

Copyright © 1977, by Società Italiana di Fisica

Proprietà Letteraria Riservata

Printed in Italy

8264516

SOCIETA' ITALIANA DI FISICA

RENDICONTI
DELLA
SCUOLA INTERNAZIONALE DI FISICA
«ENRICO FERMI»

LXIX Corso

a cura di A. BOHR e R. A. BROGLIA
Direttori del Corso

VARENNA SUL LAGO DI COMO
VILLA MONASTERO
26 LUGLIO - 7 AGOSTO 1976

*Modi elementari
di eccitazione nei nuclei*

1977



SOCIETÀ ITALIANA DI FISICA
BOLOGNA - ITALY

Preface.

In the study of nuclear dynamics, the concept of elementary modes of excitation occupies a central place. The elementary modes reveal themselves directly as the building blocks of the nuclear excitation spectra. The understanding of these modes and of their couplings also provides a basis for the exploration of the nucleus under the more extreme conditions that are now coming within reach of experimental study.

The subject is a vast one, and cannot be dealt with comprehensively within the framework of a course such as the present. The topics selected by the lecturers emphasize focal points of current development and at the same time illustrate general methods that have been developed for the analysis of nuclear dynamics.

The course has been an occasion to confront different approaches to the description of nuclear excitations on the background of the high precision and quality of the experimental information that has been accumulated during the last years. The problem of the proper interpretation of the evidence gave rise to lively discussions concerning the relation between the different approaches and their degree of validity. The discussions helped also to bring into perspective a variety of open problems and exciting new areas of research.

On behalf of all the participants to the course we would like to express our gratitude to the Italian Physical Society for making this course possible and for providing hospitality in the exquisite atmosphere of Villa Monastero.

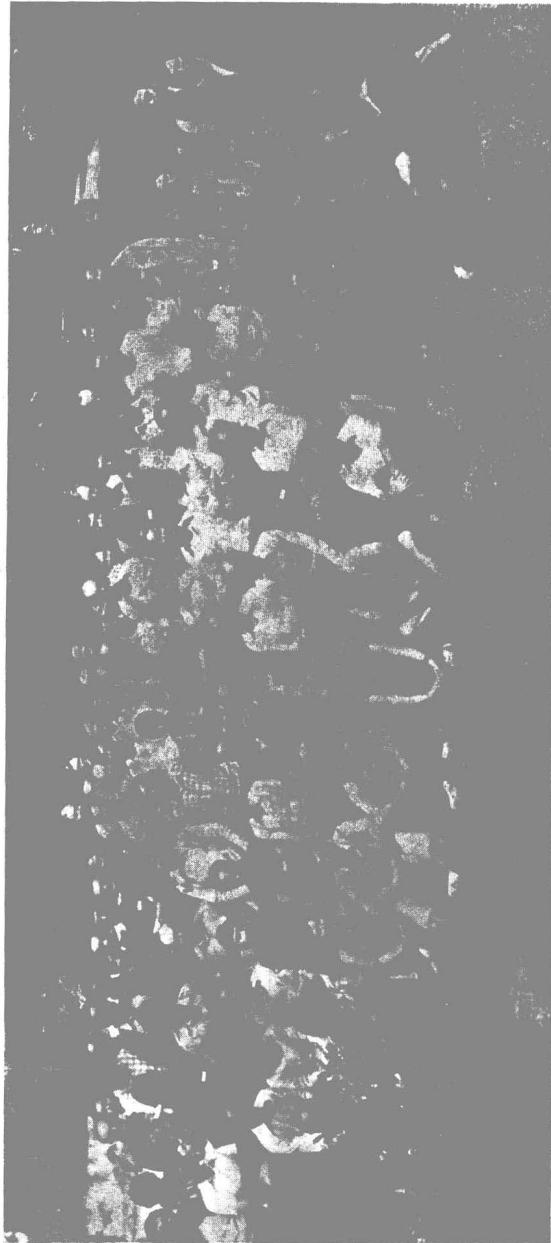
In the organization of the course it has been a great pleasure to work together with Prof. R. RICCI. At all stages of the preparation of the course and of the Proceedings the assistance of Drs. P. F. BORTIGNON and C. H. DASSO has been an invaluable help. We would also like to express our thanks for the very helpful contribution of Dr. A. COVELLO, who acted as scientific secretary of the course, and to pay tribute to the efficiency and devotion of the organizational staff headed by G. WOLZAK.

A. BOHR, R. A. BROGLIA

SOCIETA ITALIANA DI FISICA

SCUOLA INTERNAZIONALE DI FISICA « E. FERMI »

LXIX CORSO - VARENNA SUL LAGO DI COMO - VILLA MONASTERO - 26 Luglio - 9 Agosto 1976



PROCEEDINGS OF THE INTERNATIONAL SCHOOL OF PHYSICS

« ENRICO FERMI »

Course I

Questioni relative alla rivelazione delle particelle elementari, con particolare riguardo alla radiazione cosmica
edited by G. PUPPI

Course II

Questioni relative alla rivelazione delle particelle elementari, e alle loro interazioni con particolare riguardo alle particelle artificialmente prodotte ed accelerate
edited by G. PUPPI

Course III

Questioni di struttura nucleare e dei processi nucleari alle basse energie
edited by G. SALVETTI

Course IV

Proprietà magnetiche della materia
edited by L. GIULOTTO

Course V

Fisica dello stato solido
edited by F. FUMI

Course VI

Fisica del plasma e applicazioni astrofisiche
edited by G. RIGHINI

Course VII

Teoria della informazione
edited by E. R. CAIANIELLO

Course VIII

Problemi matematici della teoria quantistica delle particelle e dei campi
edited by A. BORSELLINO

Course IX

Fisica dei pioni
edited by B. TOUSCHEK

Course X

Thermodynamics of irreversible processes
edited by S. R. DE GROOT

Course XI

Weak Interactions
edited by L. A. RADICATI

Course XII

Solar Radioastronomy
edited by G. RIGHINI

Course XIII

Physics of Plasma: Experiments and Techniques
edited by H. ALFVÉN

Course XIV

Ergodic Theories
edited by P. CALDIROLA

Course XV

Nuclear Spectroscopy
edited by G. RACAH

Course XVI

Physicomathematical Aspects of Biology
edited by N. RASHEVSKY

Course XVII

Topics of Radiofrequency Spectroscopy
edited by A. GOZZINI

Course XVIII

Physics of Solids (Radiation Damage in Solids)
edited by D. S. BILLINGTON

Course XIX

Cosmic Rays, Solar Particles and Space Research
edited by B. PETERS

Course XX

Evidence for Gravitational Theories
edited by C. MØLLER

Course XXI

Liquid Helium
edited by G. CARERI

Course XXII

Semiconductors
edited by R. A. SMITH

Course XXIII

Nuclear Physics
edited by V. F. WEISSKOPF

Course XXIV
Space Exploration and the Solar System
edited by B. ROSSI

Course XXV
Advanced Plasma Theory
edited by M. N. ROSENBLUTH

Course XXVI
Selected Topics on Elementary Particle Physics
edited by M. CONVERSI

Course XXVII
Dispersion and Absorption of Sound by Molecular Processes
edited by D. SETTE

Course XXVIII
Star Evolution
edited by L. GRATTON

Course XXIX
Dispersion Relations and Their Connection with Causality
edited by E. P. WIGNER

Course XXX
Radiation Dosimetry
edited by F. W. SPIERS and G. W. REED

Course XXXI
Quantum Electronics and Coherent Light
edited by C. H. TOWNES and P. A. MILES

Course XXXII
Weak Interactions and High-Energy Neutrino Physics
edited by T. D. LEE

Course XXXIII
Strong Interactions
edited by L. W. ALVAREZ

Course XXXIV
The Optical Properties of Solids
edited by J. TAUC

Course XXXV
High-Energy Astrophysics
edited by L. GRATTON

Course XXXVI
Many-Body Description of Nuclear Structure and Reactions
edited by C. BLOCH

Course XXXVII
Theory of Magnetism in Transition Metals
edited by W. MARSHALL

Course XXXVIII
Interaction of High-Energy Particles with Nuclei
edited by T. E. O. ERICSON

Course XXXIX
Plasma Astrophysics
edited by P. A. STURROCK

Course XL
Nuclear Structure and Nuclear Reactions
edited by M. JEAN

Course XLI
Selected Topics in Particle Physics
edited by J. STEINBERGER

Course XLII
Quantum Optics
edited by R. J. GLAUBER

Course XLIII
Processing of Optical Data by Organisms and by Machines
edited by W. REICHARDT

Course XLIV
Molecular Beams and Reaction Kinetics
edited by CH. SCHLIER

Course XLV
Local Quantum Theory
edited by R. JOST

Course XLVI
Physics with Storage Rings
edited by B. TOUSCHEK

Course XLVII
General Relativity and Cosmology
edited by R. K. SACHS

Course XLVIII
Physics of High Energy Density
edited by P. CALDIROLA and H. KNOEPFEL

Course IL
Foundations of Quantum Mechanics
edited by B. D'ESPAGNAT

Course L
Mantle and Core in Planetary Physics
edited by J. COULOMB and M. CAPUTO

Course LI
Critical Phenomena
edited by M. S. GREEN

Course LII
Atomic Structure and Properties of Solids
edited by E. BURSTEIN

- Course LIII
Developments and Borderlines of Nuclear Physics
 edited by H. MORINAGA
- Course LIV
Developments in High-Energy Physics
 edited by R. R. GATTO
- Course LV
Lattice Dynamics and Intermolecular Forces
 edited by S. CALIFANO
- Course LVI
Experimental Gravitation
 edited by B. BERTOTTI
- Course LVII
Topics in the History of 20th Century Physics
 edited by C. WEINER
- Course LVIII
Dynamic Aspects of Surface Physics
 edited by F. O. GOODMAN
- Course LIX
Local Properties at Phase Transitions
 edited by K. A. MÜLLER
- Course LX
 O^ -Algebras and their Applications to Statistical Mechanics and Quantum Field Theory*
 edited by D. KASTLER
- Course LXI
Atomic Structure and Mechanical Properties of Metals
 edited by G. CAGLIOTI
- Course LXII
Nuclear Spectroscopy and Nuclear Reactions with Heavy Ions
 edited by H. FARAGGI and R. A. RICCI
- Course LXIII
New Directions in Physical Acoustics
 edited by D. SETTE
- Course LXIV
Nonlinear Spectroscopy
 edited by N. BLOEMBERGEN
- Course LXV
Physics and Astrophysics of Neutron Stars and Black Holes
 edited by R. GIACCONI and R. RUFFINI
- Course LXVI
Health and Medical Physics
 edited by J. BAARLI
- Course LXVII
Isolated Gravitating Systems in General Relativity
 edited by J. EHRLERS
- Course LXVIII
Metrology and Fundamental Constants
 edited by A. FERRO MILONE, P. GIACOMO and S. LESCHUTTA

内部交流

P 101/4

原子核中激发的基本模型

(英 2-3/7122)

A 00450

INDICE

A. BOHR and R. A. BROGLIA - Preface pag xii

Gruppo fotografico dei partecipanti al Corso fuori test

LECTURES

A. BOHR - Some aspects of rotational motion.

| | | |
|----------------------------------------------------------------------------------------|------|----|
| 1. Rotational degrees of freedom. Deformation and i symmetry | pag. | 3 |
| 2. General form of rotational matrix elements | » | 5 |
| 3. Cranking model | » | 10 |
| 4. Stability of highly spinning nuclei | » | 14 |
| 5. Nucleonic motion in rapidly rotating potentials. Rota tional alignment | » | 17 |
| 6. Rotation about symmetry axis | » | 23 |
| 7. Pairing in rotating potentials. Phase transition | » | 25 |

B. R. MOTTELSON - Elementary excitations in the nucleus. » 31

| | | |
|----------------------------------------------------------------------------------------------------------------------------|---|----|
| 1. Single-particle response function | » | 32 |
| 2. Interactions coupling particles and collective field | » | 39 |
| 3. Evaluation of effects of particle-field coupling in deter mining the properties of collective oscillations | » | 42 |
| 4. Some features of the spin-dependent modes | » | 47 |

D. R. BÉS and R. A. BROGLIA - Nuclear superfluidity and
field theory of elementary excitations.

| | | |
|---------------------------------------------------|---|----|
| Introduction | » | 55 |
| I Pairing modes of excitation in nuclei | » | 55 |
| 1. Pairing rotations | » | 55 |
| 1.1. The pairing interaction | » | 55 |

| | | | |
|--------|--------------------------------------------------------------------------------------|------|-----|
| 1'2. | Exact many-body solution of the pairing interaction | pag. | 57 |
| 1'3. | Empirical evidence on pairing bands | » | 58 |
| 1'4. | Collective interpretation of the pairing bands | » | 60 |
| 1'5. | The intrinsic wave function of a pairing rotational band. | » | 62 |
| 2. | Pairing vibrations | » | 67 |
| 2'1. | Two-level model | » | 67 |
| 2'2. | Collective treatment of pairing vibrations. Normal systems ($x < 1$) | » | 70 |
| 2'3. | Collective treatment of pairing vibrations. Superfluid systems ($x > 1$) | » | 72 |
| 2'4. | Pairing phase transitions | » | 76 |
| 3. | Applications. | » | 77 |
| 3'1. | Normal systems (Pb isotopes) | » | 77 |
| 3'2. | Superfluid systems (Sn isotopes) | » | 81 |
| 3'3. | Multipole pairing vibrations | » | 83 |
| 3'4. | Alternative description of ^{206}Pb | » | 86 |
| 3'5. | Pairing isomers | » | 86 |
| 3'6. | α -vibrations | » | 93 |
| 4. | Isospin structure of the pairing modes | » | 95 |
| 4'1. | Exact solutions and their collective interpretation | » | 96 |
| 4'2. | The harmonic model, level spectrum | » | 97 |
| 4'2.1. | States with only pair removal mode | » | 99 |
| 4'2.2. | States with one pair addition and several pair removal modes | » | 99 |
| 4'3. | Comparison with experiments | » | 100 |
| 4'3.1. | The « proton » pairing vibrational bands. | » | 101 |
| 4'3.2. | The « neutron » pairing vibrational bands | » | 104 |
| 4'3.3. | Neutron-proton states | » | 105 |
| II | Field theory of elementary excitations in nuclei | » | 107 |
| 5. | The concept of elementary modes of excitation | » | 107 |
| 6. | Nuclear field theory | » | 110 |
| 6'1. | Schematic model | » | 110 |
| 6'2. | Field-theoretical solutions | » | 111 |
| 7. | Spurious states | » | 117 |
| 8. | Applications. | » | 125 |
| | Résumé | » | 132 |

A. K. KERMAN – Time-dependent self-consistent field theory for heavy-ion reactions.

| | | | |
|----|-----------------------------------------------------|---|-----|
| 1. | Introduction | » | 135 |
| 2. | General remarks | » | 135 |
| 3. | A particular experiment | » | 138 |
| 4. | Phenomenology and microscopic description | » | 140 |

| | | |
|-------------------------------------------------------------------------------|------|-----|
| 5. Some microscopic calculations | pag. | 142 |
| 6. Characteristics of microscopic calculations | » | 151 |
| 7. The time-dependent variational principle and canonical variables | » | 155 |
| 8. Applications of the formalism | » | 160 |

F. S. STEPHENS - Nuclear structure at high angular momentum.

| | | |
|---------------------------------------------------------------------------|---|-----|
| 1. Transitional nuclei | » | 172 |
| 1'1. Rotational at high angular frequencies | » | 173 |
| 1'2. Effects of axial asymmetry | » | 184 |
| 1'3. Soft potentials | » | 189 |
| 1'4. Single-particle effects | » | 192 |
| 1'5. Conclusions | » | 193 |
| 2. Backbending | » | 194 |
| 2'1. The backbending phenomenon | » | 194 |
| 2'2. Pairing effects | » | 196 |
| 2'3. Shape changes | » | 197 |
| 2'4. Alignment effects | » | 199 |
| 2'5. Band mixing | » | 204 |
| 2'6. Calculations of backbending | » | 211 |
| 2'7. Conclusions | » | 211 |
| 3. Very high angular momentum | » | 212 |
| 3'1. Calculated behavior of nuclei at very high spins | » | 212 |
| 3'2. Experimental study of very-high-spin states | » | 217 |
| 3'3. Studies of ^{162}Yb at very high angular momentum | » | 222 |
| 3'4. Studies of ^{118}Te at very high angular momentum | » | 226 |
| 3'5. Conclusions | » | 230 |

I. HAMAMOTO - Rotational motion: particle - rotation coupling.

| | | |
|--------------------------------------------------------------------------------------------------------------|---|-----|
| 1. Introduction | » | 234 |
| 2. Analysis of data in terms of Coriolis coupling | » | 234 |
| 2'1. Decoupling parameter | » | 234 |
| 2'2. $E2$ matrix elements with $\Delta K = 1$ | » | 236 |
| 2'3. Additional evidence of the reduction of the Coriolis coupling | » | 240 |
| 3. Particle-rotation coupling resulting from rotationally induced pair field | » | 241 |
| 3'1. Derivation of an additional contribution to particle-rotation coupling and moments of inertia | » | 243 |
| 3'2. Estimate by using a deformed harmonic-oscillator model | » | 247 |
| 3'3. Numerical estimates and discussions | » | 249 |

I. HAMAMOTO – Particle-vibration coupling: octupole mode.

| | |
|------------------------------------------------------------------------------------------------------------------|----------|
| 1. Introduction | pag. 252 |
| 2. The properties of the octupole vibration itself | » 254 |
| 2'1. Consistency of the coupling strength | » 254 |
| 2'2. Wave function | » 255 |
| 2'3. Transition density | » 257 |
| 3. An example of the first-order effects: effective <i>E3</i> moments | » 259 |
| 4. A second-order effect; particle-phonon interaction | » 262 |
| 5. Anharmonic effects | » 266 |
| 5'1. Quadrupole moment of octupole phonon | » 266 |
| 5'2. The effect of the quadrupole moment on the energy splitting of the septuplet in ^{209}Bi | » 268 |

G. R. SATCHLER – The study of giant resonances in nuclei by inelastic scattering.

| | |
|----------------------------------------------------------------------------|-------|
| 1. Introduction | » 271 |
| 2. Experimental perspectives | » 272 |
| 3. Theoretical perspectives | » 277 |
| 3'1. Effects of shell structure on the spectrum | » 277 |
| 3'1.1. One-hole states and giant resonances in pick-up reactions | » 278 |
| 3'1.2. One-particle, one-hole states | » 279 |
| 3'2. Sum rules | » 281 |
| 3'3. Effective charges and «core polarization» | » 282 |
| 3'4. Selection rules and the distribution of excitation strength | » 283 |
| 3'5. Interactions for inelastic scattering | » 285 |
| 3'5.1. Electron scattering | » 285 |
| 3'5.2. Hadron scattering | » 285 |
| 3'6. Summary | » 287 |
| 4. Experimental evidence | » 288 |
| 4'1. Electron scattering | » 288 |
| 4'1.1. The isoscalar quadrupole | » 288 |
| 4'1.2. The isovector quadrupole | » 289 |
| 4'1.3. Higher multipoles | » 290 |
| 4'1.4. The monopole | » 290 |
| 4'1.5. Magnetic excitations | » 290 |
| 4'1.6. Structure in the GQ_0R | » 291 |
| 4'2. Inelastic scattering of hadrons | » 291 |
| 4'2.1. The isoscalar quadrupole | » 291 |
| 4'2.2. Excitation of the GDR | » 297 |

| | | |
|----------|----------------------------------------------------------|----------|
| 4'2.3. | Higher multipoles | pag. 298 |
| 4'2.4. | The monopole | » 299 |
| 4'2.5. | Structure in the GQ_0R | » 300 |
| 4'2.6. | $S=1$ type resonances | » 303 |
| 4'3. | Charge exchange reactions | » 303 |
| 4'4. | Summary | » 306 |
| 4'4.1. | The isoscalar quadrupole | » 306 |
| 4'4.2. | The isovector quadrupole | » 308 |
| 4'4.3. | The monopole | » 308 |
| 4'4.4. | Higher multipoles | » 309 |
| 4'4.5. | $S=1$ type resonances | » 309 |
| 4'4.6. | The GDR and analogue dipoles | » 309 |
| 5. | Models for inelastic scattering | » 309 |
| 5'1. | General considerations | » 310 |
| 5'2. | Collective or deformed potential models | » 312 |
| 5'2.1. | Isoscalar, $S=0$, excitations with $L \geq 2$ | » 313 |
| 5'2.2. | The monopole, breathing mode | » 316 |
| 5'2.3. | The GDR | » 319 |
| 5'2.3.1. | The GT model | » 320 |
| 5'2.3.2. | The JS model | » 321 |
| 5'2.3.3. | Coulomb excitation | » 322 |
| 5'2.3.4. | Applications | » 323 |
| 5'2.4. | Other modes | » 325 |
| 5'3. | Folded-potential models | » 325 |
| 5'4. | Microscopic calculations | » 327 |
| 5'4.1. | The effective interaction | » 329 |
| 5'4.2. | Transition potentials | » 331 |
| 5'4.3. | DWBA calculations | » 332 |
| 5'4.4. | Results | » 333 |
| 6. | More on sum rules and isospin | » 336 |
| 6'1. | Sum rule definitions and results | » 337 |
| 6'2. | Inelastic scattering | » 339 |
| 7. | Giant resonances as doorways | » 341 |
| 7'1. | Outline of theory | » 342 |
| 7'2. | Applications | » 345 |

I. TALMI - Pairing and seniority in finite nuclei.

| | | |
|----|-----------------------------------------------------------------|-------|
| 1. | Introduction. Effective interactions | » 352 |
| 2. | Identical nucleons in j^n configurations. Seniority | » 357 |
| 3. | Generalized seniority in semi-magic nuclei | » 366 |
| 4. | Valence protons and neutrons. Bosonlike excitations | » 374 |

B. H. WILDENTHAL — Realistic shell model calculations.

| | |
|---------------------------------------------------------------------------------------------------------------------------------|----------|
| Introduction | pag. 383 |
| 1. General comments, description of formalisms and specifications of shell model calculations to be discussed | » 386 |
| 1'1. | » 386 |
| 1'2. | » 389 |
| 1'2.1. | » 389 |
| 1'2.2. | » 390 |
| 1'2.3. | » 390 |
| 1'3. | » 391 |
| 1'4. | » 392 |
| 1'4.1. | » 393 |
| 1'4.2. | » 395 |
| 1'5. | » 395 |
| 1'6. | » 397 |
| 1'7. | » 401 |
| 2. Shell model and experimental energies of nuclear levels | » 402 |
| 2'1. | » 402 |
| 2'2.1. | » 403 |
| 2'2.2. | » 404 |
| 2'2.3. | » 406 |
| 2'2.4. | » 407 |
| 2'3. | » 408 |
| 2'4. | » 416 |
| 2'5. | » 425 |
| 3. Nucleon transfer processes and matrix elements | » 426 |
| 3'1. | » 426 |
| 3'2. | » 433 |
| 3'3. | » 437 |
| 4. Comparison of shell model predictions for electromagnetic and weak-interaction phenomena with experimental results | » 440 |
| 4'1. | » 440 |
| 4'2. Gamow-Teller beta-decay | » 442 |
| 4'2.1. | » 442 |
| 4'2.2. | » 443 |
| 4'2.3. | » 444 |
| 4'2.4. | » 446 |
| 4'3. Magnetic-dipole matrix elements | » 446 |
| 4'3.1. | » 446 |
| 4'3.2. | » 447 |
| 4'3.3. | » 450 |
| 4'4. Electric-quadrupole moments and transitions | » 453 |
| 5. Conclusions | » 459 |

SEMINARS

| | |
|---------------------------------------------------------------------------------------------------|----------|
| J. DUDEK - Study of the yrast states in the rare-earth oblate nuclei. | |
| 1. The total energy | pag. 465 |
| 2. The shell and pairing corrections | » 465 |
| 3. Results | » 466 |
| | |
| J. DUDEK - Gamma-vibrations in fast-rotating oblate nuclei. | |
| 1. Introduction | » 469 |
| 2. The dispersion relations | » 469 |
| 3. Results | » 470 |
| | |
| S. ÅBERG - Nuclei at very high angular momentum. | |
| 1. Introduction | » 473 |
| 2. Microscopic treatment at high angular momenta | » 473 |
| 2'1. Single-particle calculations | » 474 |
| 2'2. The Strutinsky smearing method applied to the rotating case | » 475 |
| 3. Results | » 479 |
| | |
| J. VERVIER - Band mixing in the nucleus ^{156}Dy | » 485 |
| | |
| D. PROETEL - Shape coexistence and shape isomerism in neutron-deficient mercury isotopes. | » 488 |
| | |
| P. PAUL - Experimental study of electric-multipole excitations in ^{16}O . | |
| 1. Introduction | » 495 |
| 2. The isovector character of the 1^- excitation | » 498 |
| 3. The isoscalar $E2$ mode | » 501 |
| 4. The isovector $E2$ mode in ^{16}O | » 504 |
| 5. The $E3$ multipole states | » 507 |

| | |
|----------------------------------------------------------------------------------------------------|----------|
| J. P. BLAIZOT - Microscopic theory of collective vibrations in nuclei. | |
| 1. Introduction | pag. 510 |
| 2. The method of calculation | » 511 |
| 3. The effective interactions. | » 512 |
| 4. The need for a large configuration space | » 512 |
| 5. The correlation between the single-particle spectrum and the transition probabilities | » 514 |
| 6. Comparison with experiment | » 515 |
| 7. The quadrupole resonance and the effective mass | » 515 |
| 8. The monopole resonance and the nuclear compressibility | » 516 |
| 9. Conclusion | » 517 |
| P. F. BORTIGNON - Nuclear field theory of two-phonon states. | » 519 |
| J. W. SMITS - Three-nucleon transfer applied to the (p, α) reaction. | |
| 1. Introduction | » 527 |
| 2. The semi-microscopic model of three-nucleon transfer | » 529 |
| 3. Experimental results and comparison with calculations | » 531 |
| 3'1. The $^{118}\text{Sn}(p, \alpha)^{115}\text{In}$ reaction | » 531 |
| 3'2. The $^{60}\text{Ni}(p, \alpha)^{57}\text{Co}$ reaction | » 534 |
| 4. Conclusion | » 536 |
| D. EVERE - Certain aspects of the $(^3\text{He}, n)$ reaction. | |
| 1. Introduction | » 538 |
| 2. Superfluid nuclei | » 538 |
| 3. Odd- A (f, p) shell nuclei | » 540 |
| 4. Remarks on the pairing vibrational model. | » 544 |