

INDICE

R. A. BROGLIA, C. H. DASSO and R. A. RICCI - Preface. pag. xv

A. GOBBI, U. LYNEN, A. OLMI, G. RUDOLF and H. SANN -
The Kr+Er collision.

1. Introduction	pag.	1
2. Experimental methods	»	3
3. General characteristics.	»	7
3'1. Trajectories	»	10
3'2. Positive and negative scattering angles.	»	11
3'3. Element distributions.	»	13
3'4. Mass equilibrium after capture	»	23
4. The dissipation of angular momentum	»	27
5. Search for pre-equilibrium decay of the fragments.	»	31
5.1. Neutron multiplicity	»	32
5'2. Projectile splitting at 12.1 MeV/u	»	35
6. Conclusions.	»	37

L. G. MORETTO - Experimental evidence for collective and
thermal features in heavy-ion reactions.

1. Introduction	»	41
2. An open list of « relevant » degrees of freedom	»	42
3. Characterization of the dynamical regimes	»	43
4. Damping of the relative motion and the energy thermalization	»	44
5. The neutron-to-proton ratio and the giant isovector resonances	»	51
6. The mass asymmetry mode and the charge or mass distributions	»	56
6'1. The deep inelastic component	»	56
6'2. The fusion-fission component	»	62

7. The relaxation of the rotational degrees of freedom	pag.	66
7'1. The equilibrium limit.	»	66
7'2. The relation between angular-momentum transfer and energy dissipation	»	67
7'3. Dependence of the γ -ray multiplicity upon mass asymmetry.	»	69
7'4. Results of a simple model of the dependence of the γ -ray multiplicities upon mass asymmetry and Q value	»	69
7'5. The second moments of the γ -ray multiplicities and their sources.	»	77
7'6. Alignment and polarization of the fragment angular momentum	»	80
L. G. MORETTO – Equilibrium statistical treatment of angular momenta associated with collective modes in fission and heavy-ion reactions.		
Introduction.	»	85
1. Angular-momentum fractionation along the mass asymmetry co-ordinate in compound-nucleus fission and in fusion-fission	»	86
2. Statistical coupling between orbital and intrinsic angular momenta and wiggling modes.	»	93
3. Thermal fluctuation of the angular-momentum projection on the disintegration axis: tilting	»	98
4. Twisting and bending modes excited in a zero-angular-momentum system	»	101
5. Coupling of twisting and bending modes to rigid rotation	»	102
6. A simple application to a typical heavy-ion reaction.	»	105
7. Conclusion	»	108
M. LEFORT – Charge-to-mass ratio and distribution of energy amongst the two fragments in dissipative collisions between heavy ions.	»	111
1. Experimental aspects of the study of the N/Z ratio. First evidence for a fast charge equilibrium in the composite system	»	112
2. Study of the charge width for fragments of fixed mass	»	120
2'1. Potential energy of the charge equilibration mode	»	120
2'2. Width of the charge distribution	»	123
3. The neutron excess collective degree and the dipole-giant-resonance excitation as a dissipative process	»	135
4. The kinetic-energy loss during the first stage of the collision due to the neutron excess equilibration.	»	136
5. Degree of thermalization of the dissipated energy. Sharing of excitation energy between the fragments.	»	140

H.-J. SPECHT – Fission phenomena in deep inelastic collisions.

1. Introduction	pag. 150
2. Experimental procedure	» 151
3. Results	» 153
3'1. The evidence for a sequential process	» 153
3'2. Angular-momentum transfer.	» 155
3'3. Angular-momentum orientation	» 168
3'4. Nuclei with $Z > 100$	» 175
4. Conclusions	» 182

F. S. STEPHENS – Gamma-rays from deep inelastic collisions.

1. Introduction	» 185
2. The gamma-rays from DIC	» 185
3. Information content of γ -ray spectra	» 188
4. Gamma-rays from DIC	» 189
4'1. Multiplicities.	» 189
4'2. Angular distributions	» 198
5. Conclusion	» 203

J. P. SCHIFFER – Nuclear structure and heavy-ion reactions.

1. Introduction	» 205
2. Some useful concepts from light-ion reactions	» 205
3. Heavy-ion reactions.	» 209

S. E. KOONIN – One-body nuclear dynamics.

1. Introduction	» 233
2. General considerations.	» 233
3. The wall formula	» 235
4. Classical linear response theory	» 238
5. Application to a slab of nuclear matter	» 242
6. Quantal linear response theory.	» 245
7. Application to a spherical nucleus	» 247
8. Application to heavy-ion collisions	» 252
9. Relation to TDHF calculations	» 253
10. Summary	» 259

J. RANDRUP – Multiple nucleon transfer in damped nuclear collisions.

1. Introduction	» 261
2. The model	» 262

3. Nearly degenerate limit	pag. 264
4. The dinucleus	» 266
5. Confrontation with experiment.	» 268
6. Concluding remarks	» 270
J. W. NEGELE – Introduction to functional integral methods for nuclear dynamics.	
1. Introduction	» 272
2. Functional integral representation of the evolution operator	» 275
2'1. The Hubbard-Stratonovich transformation	» 276
2'2. The stationary-phase approximation	» 279
3. The approximation of quantum eigenstates	» 281
3'1. The Fourier transform of the trace of the evolution operator.	» 282
3'2. Evaluation of the trace.	» 282
3'3. Time-independent solutions	» 288
3'4. The Hartree-Fock approximation	» 292
3'5. The loop expansion	» 296
3'6. Time-dependent solutions	» 303
4. Tunneling	» 311
4'1. Complex time	» 312
4'2. The bounce	» 315
5. Summary and conclusions	» 323
R. A. BROGLIA, C. H. DASSO and A. WINTHER – Coherent surface excitation model of heavy-ion reactions.	
1. The ingredients.	» 327
2. The degrees of freedom	» 329
3. The interaction.	» 336
4. The classical equations of motion	» 341
5. General features of the results.	» 347
6. Quantal treatment and fluctuations	» 351
7. Applications	» 362
H. A. WEIDENMÜLLER – Transport theory of heavy-ion col- lisions.	
1. Introduction	» 384
2. Collective and intrinsic degrees of freedom. Statistical as- sumptions	» 384
3. One-dimensional model. Statistical assumptions	» 386
4. Calculation of averages	» 388
5. Evaluation of the optical-model Green's function	» 390

6. Derivation of the transport equation. Discussion	pag. 393
7. The weak-coupling approximation: transport coefficients	» 396
8. The strong-coupling approximation: a modified Fokker-Planck equation with new transport coefficients	» 398
9. Summary	» 402

G. BERTSCH – Theories of heavy-ion collisions.

1. Introduction	» 404
2. Fusion	» 406
3. Angular distributions	» 408
4. Energy loss	» 410
5. Dispersions in energy and angle	» 411
6. Fragment mass distributions	» 414
7. Angular-momentum transfer	» 414
8. Massive transfer	» 416
9. Conclusion	» 416

A. LEJEUNE and C. MAHAUX – Single-particle field in nuclear matter.

1. Introduction	» 418
2. Definition and expansion of the field	» 419
2'1. Definitions	» 419
2'2. Approximation schemes	» 422
2'3. Effective masses	» 424
3. Nonlocality of the field	» 426
4. Energy dependence of the field	» 426
5. Effective mass	» 428
6. Physical consequences	» 430
6'1. Single-particle energies	» 430
6'2. Root-mean-square radius of valence orbits	» 432
6'3. Energies of giant resonances	» 433
6'4. Discussion	» 433
7. Imaginary part of the field	» 434
8. Conclusions	» 435

V. BERNARD and NGUYEN VAN GIAI – Single-particle and collective nuclear states in the Green's function method.

1. Introduction	» 437
2. Self-consistent RPA calculations in co-ordinate space	» 438
2'1. The method	» 438
2'2. Transition densities and strength distributions	» 440
2'3. Results for ²⁰⁸ Pb	» 442

3. Effects of the single particle-collective modes coupling on the single-particle properties	pag. 447
3'1. Calculation of the mass operator	» 447
3'2. Single-particle spectrum and effective mass	» 449
3'3. Results for ^{208}Pb	» 451
3'4. Concluding remarks	» 453
P. F. BORTIGNON – Strength function for single-particle states and for giant resonances.	» 455
W. M. ALBERICO – A study of the ground-state properties and of the excitation spectrum of the infinite nuclear matter.	
1. Introduction	» 463
2. Outlines of the formalism	» 464
3. Ground-state properties in the HF theory	» 465
4. Linear response of the infinite nuclear matter	» 468
4'1. Single-particle excitations in the HF theory	» 469
4'2. Collective response of the infinite nuclear matter	» 471
5. Ground-state properties in the G -matrix theory	» 473
6. Single-particle excitations in the BHF theory	» 474
J. RANDRUP – Nuclear proximity forces.	
1. Introduction	» 478
2. General treatment	» 479
2'1. Gap with gently paraboloidal width	» 480
2'2. Other gap or crevice geometries.	» 483
3. Specialization to nuclei	» 485
R. ÖMÜR AKYÜZ and AA. WINTHER – Nuclear surface-surface interaction in the folding model.	
1. Introduction	» 492
2. « Realistic » densities	» 492
3. Nucleon-nucleon and nucleon-nucleus forces	» 496
4. Surface-surface interaction	» 498
5. Discussion	» 502
Appendix A.	» 504

G. WOLSCHIN - Approaching equilibrium in heavy-ion collisions.

1. Introduction	pag. 508
2. Relative motion in a statistical treatment	» 512
2'1. Time scales	» 513
2'2. Fokker-Planck equation.	» 516
3. Classical model for the relative motion	» 521
3'1. Deflection function	» 521
3'2. Mean interaction time	» 525
4. Nucleon transport	» 528
4'1. Mass and element distributions	» 531
4'2. Charge drift retardation	» 535
5. Shape relaxation	» 538
6. Angular-momentum dissipation.	» 545
7. Multidifferential cross-sections	» 549
8. Structure effects	» 554
8'1. Nonlinear system.	» 556
8'2. Phase-transition analogy?	» 562
9. Conclusions.	» 566

H. ESBENSEN - Applications of Wigner transformations in heavy-ion reactions.

1. Introduction	» 572
2. The Wigner transformation	» 572
3. Dynamical approximation	» 576
4. Forced linear harmonic oscillators	» 577
5. Collective surface vibrations; diffuseness and renormalization	» 579
6. Semi-quantal cross-sections	» 581
7. An illustrative example	» 584
Appendix A. - Wigner-transformed oscillator states	» 586
Appendix B. - Relations between classical and quantal ex- pressions.	» 588
Appendix C. - Classical energy loss distribution	» 589

G. POLLAROLO and A. VITTURI - Excitation of giant resonances in inelastic α -particle scattering.

1. Introduction	» 592
2. Uncertainties in the standard analysis of the data in the region of the giant resonances	» 594
3. Analysis of the $\alpha + {}^{208}\text{Pb}$ inelastic data in the heavy-ion surface model	» 596

M. BALDO and O. CIVITARESE – Evaporation processes in heavy-ion collisions.

1. Introduction	pag. 604
2. Theory	» 605
3. The computational method	» 607
4. Evaporation process measurements	» 609
4'1. Mass and charge distributions of the residues.	» 609
4'2. Light-particle spectra and multiplicities	» 611
4'3. Particle angular distributions and correlations	» 613
4'4. Angular distributions of the residues.	» 617

F. E. BERTRAND – Giant multipole resonances. An experimental review. » 620

J. DE BOER, W. DÜNNWEBER, G. GRAW, W. HERING, C. LAUTERBACH, H. PUCHTA, CH. SCHANDERA, W. TRAUTMANN and U. LYNEN – Deep inelastic reactions and gamma-ray circular polarization.

1. Motivation	» 655
2. Deep inelastic reactions	» 657
2'1. Range of energies and scattering angles	» 657
2'2. Wilezyński plots	» 658
2'3. Angular momenta	» 659
2'4. Gamma-decay	» 660
3. Apparatus	» 663
3'1. Targets and chamber	» 663
3'2. Particle detectors	» 663
3'3. Polarimeters	» 663
3'4. Electronics	» 666
3'5. Double ratio.	» 666
4. Results	» 668
4'1. Particle spectra and circular polarization	» 668
4'2. List of parameters and averaged results	» 670
4'3. Interpretation	» 672
4'4. Connection to alignment measurements.	» 674
5. Summary	» 676

M. DAKOWSKI – Influence of the shell structure of the colliding nuclei on the energy and charge distributions in dissipative collisions. » 677

- H. TRICOIRE – Particle evaporation effects in deep inelastic collisions: an application to the $^{40}\text{Ca} + ^{40}\text{Ca}$ reaction at 400 MeV. pag. 691
- D. POČANIĆ and N. CINDRO – An orbiting-cluster description of resonances in heavy-ion reactions. » 699
- J. VERVIER – Average multipolarity of continuum gamma-ray transitions between high-spin states in compound-nucleus reactions.
1. Introduction » 704
 2. Angular-distribution, angular-correlation and linear-polarization experiments » 705
 3. Conversion electrons and X-ray experiments » 713
 4. Discussion » 718