

Contents

FOREWORD, <i>A. H. Compton</i>	xiii
1. WAVES AND PARTICLES	1
1.01 The Nuclear Radiations. 1.02 The Properties of Particles. 1.03 Properties of Waves. 1.04 The Quantum Nature of Wave Motions. 1.05 The Wave Nature of Particles. 1.06 The Uncertainty Principle. 1.07 The Dual Nature of Waves and Particles.	
2. ELECTROMAGNETIC WAVES	13
2.01 The Nature of an Electromagnetic Wave. 2.02 The Electromagnetic Spectrum. 2.03 The Quantum Nature of Electromagnetic Waves. 2.04 The Transmitting Medium. 2.05 The Einstein Explanation. 2.06 The Mass-Energy Law and Nuclear Reactions.	
3. PARTICLES IN MOTION	31
3.01 The Kinetic Theory of Gases. 3.02 The Atomic Nature of Electricity. 3.03 Electrical Units. 3.04 Electrical Conduction in Solids. 3.05 Electrolytic Conduction. 3.06 The Conduction of Electricity in Gases. 3.07 Electronics. 3.08 Forces on Moving Charges.	
4. ATOMIC STRUCTURE	50
4.01 The Rutherford Scattering Experiment. 4.02 The Rutherford Model. 4.03 The Electrical Nature of Matter. 4.04 The Simplest Atoms. 4.05 The Periodic System. 4.06 Atomic Spectra and Energy Levels. 4.07 The Bohr Atom. 4.08 Excitation and Ionization.	
5. X RAYS	68
5.01 X-Ray Production. 5.02 X-Ray Spectra. 5.03 Inner Electron Shells. 5.04 The Absorption of X Rays. 5.05 The Photoelectric Effect. 5.06 The Compton Effect. 5.07 Pair Production. 5.08 Other Properties of X Rays. 5.09 The Roentgen Unit.	

6. NATURAL RADIOACTIVITY	95
6.01 The Discovery of Natural Radioactivity. 6.02 Radiations Emitted by Radioactive Elements. 6.03 The Radioactive Decay Process. 6.04 The Curie Unit of Activity. 6.05 Radioactive Transformations. 6.06 The Uranium Series. 6.07 The Thorium, Actinium, and Neptunium Series. 6.08 Other Natural Radioelements. 6.09 Equilibrium in Radioactive Transformations.	
7. ISOTOPES AND NUCLEAR STRUCTURE . . .	127
7.01 Mass Spectroscopy. 7.02 The Relative Abundance of Isotopes. 7.03 The Neutron-Proton Plot of Stable Isotopes. 7.04 The Stability of Nuclei. 7.05 The Binding Energy Per Nucleon. 7.06 Nuclear Forces. 7.07 The Binding-Energy Equation. 7.08 A Nuclear Model.	
8. NUCLEAR RADIATIONS	155
I. ALPHA PARTICLES	
8.01 The Theory of Alpha Emission. 8.02 The Geiger-Nuttall Relation. 8.03 Alpha-Particle Spectra. 8.04 The Absorption of Alpha Particles.	
II. BETA PARTICLES	
8.05 The Beta-Particle Spectrum. 8.06 The Neutrino and the Beta-Decay Process. 8.07 Bragg Ionization. 8.08 Beta-Particle Absorption.	
III. GAMMA RAYS	
8.09 The Origin of Gamma Radiation. 8.10 Internal Conversion of Gamma Rays. 8.11 The Absorption of Gamma Rays.	
9. IONIZATION CHAMBER INSTRUMENTS . . .	189
9.01 Ionization in Gases. 9.02 The Wilson Cloud Chamber. 9.03 Ionization Currents. 9.04 Ionization Chamber. 9.05 Electroscopes. 9.06 Electrometers. 9.07 Ionization-Chamber Amplifier Instruments. 9.08 Ionization-Chamber Instruments in Practice.	

10.	GEIGER-MÜLLER COUNTERS	210
	10.01 Avalanche Ionization. 10.02 The Gas-Amplification Factor. 10.03 The Proportional Region. 10.04 The Geiger-Müller Region. 10.05 Quenching the Discharge. 10.06 Typical G-M Counter Construction. 10.07 G-M Counter Circuits. 10.08 Scaling Circuits. 10.09 Counting-Rate Meters. 10.10 Coincidence and Anticoincidence Circuits.	
11.	RADIATION MEASUREMENT TECHNIQUE	231
	11.01 Background Radiation. 11.02 Statistical Fluctuation. 11.03 Counter Resolving Time. 11.04 Self-Absorption. 11.05 Energy Measurements. 11.06 Decay-Curve Measurements. 11.07 Counting Geometry and Calibration. 11.08 Photographic Detection of Nuclear Radiations. 11.09 Portable Survey Instruments. 11.10 Special Methods.	
12.	ARTIFICIAL RADIOACTIVITY	252
	12.01 Nuclear Bombardment. 12.02 The First Induced Nuclear Reaction. 12.03 The Concept of Nuclear Cross Section. 12.04 Artificial Radioactivity. 12.05 Particle Acceleration. 12.06 Linear Accelerators. 12.07 The Cyclotron. 12.08 The Synchrocyclotron (F-M Cyclotron). 12.09 The Betatron. 12.10 The Synchrotron.	
13.	NUCLEAR REACTIONS	283
	13.01 The Theory of Nuclear Reactions. 13.02 Types of Nuclear Reactions. 13.03 Positron Emission and K-Electron Capture. 13.04 Nuclear Isomerism. 13.05 Photodisintegrations. 13.06 Proton-induced Reactions. 13.07 Deuteron-induced Reactions. 13.08 Triton-induced Reactions. 13.09 Alpha-Particle Reactions. 13.10 High-Energy Reactions. 13.11 The Cosmic Radiation.	
14.	THE NEUTRON	320
	14.01 The Discovery of the Neutron. 14.02 The Production of Neutrons. 14.03 Physical Properties of the Neutron. 14.04 The Slowing Down of Neutrons. 14.05 Resonance Capture. 14.06 Slow-Neutron Reactions. 14.07 Fast-Neutron Reactions. 14.08 The Transuranium Elements. 14.09 Energy Release from Nuclear Reactions.	

15. NUCLEAR FISSION	352
15.01 The Discovery of Nuclear Fission. 15.02 Types of Fission. 15.03 The Fission Energy. 15.04 The Energetics of Fission. 15.05 The Fission Mechanism. 15.06 Nuclear Radiations Emitted in Fission. 15.07 Delayed Neutrons. 15.08 The Decay of Fission Products. 15.09 Properties of Fission Products.	
16. THE NUCLEAR CHAIN REACTION	386
16.01 The Fissionable Materials. 16.02 The Concept of a Chain Reaction. 16.03 Fast Fission and the Atomic Bomb. 16.04 The Principles of a Nuclear Reactor. 16.05 Types of Reactors. 16.06 The Research Pile. 16.07 The Production Pile. 16.08 The Power Pile. 16.09 Application of Nuclear Power.	
17. RADIOACTIVE TRACER TECHNIQUES	411
17.01 Principles of the Tracer Method. 17.02 The Choice of the Tracer Isotope. 17.03 Specific Activity. 17.04 Target Materials. 17.05 The Problems of Chemical Syntheses. 17.06 Radiation Exposure of Test Animals. 17.07 Methods of Assay. 17.08 Localization Techniques. 17.09 General Remarks.	
18. HEALTH PHYSICS	431
18.01 The Health Physicist. 18.02 Absorption of Radiation by Body Tissue. 18.03 Radiation Dose Units. 18.04 Permissible External Radiation Exposure. 18.05 Internal Radiation Hazards. 18.06 Standards and Calibrations. 18.07 Photographic Film Monitoring. 18.08 Biological Effects of Radiation. 18.09 Safety Precautions and Techniques. 18.10 Disposal of Radioactive Wastes. 18.11 Comments on Radiation Protection.	
APPENDICES:	
1. List of General References	457
2. Physical Constants	458
3. Conversion of Units; Useful Data	459
4. Electron Velocity-Energy Data	461
5. Photon-Absorption Coefficients	462
6. Useful Radioisotopes	464
7. General Rules and Procedures Concerning Activity Hazards	469
8. Manufacturers of Radiation Instruments	477
INDEX	481