CONTENTS

Preface

1 I	NTRODUCTION	
1.1 1.2	Introduction	1 3
1.2	Experimental Aspects	8
1.3	Atomic Complex: Input and Exit Channels Symmetries	10
1.5	A One-Dimensional Illustration	12
1.6	Outline of Later Chapters	14
1.0	Problems	18
	References	20
	A PERTURBATION TREATMENTS PHOTOABSORPTION	
2 1	PHOTOABSORPTION	25
2 I	PHOTOABSORPTION Introduction	25 25
2 I 2.1 2.2	PHOTOABSORPTION Introduction Basic Theory	25
2.1 2.2 2.3	PHOTOABSORPTION Introduction Basic Theory Macroscopic Analysis	25 27
2.1 2.2 2.3 2.4	PHOTOABSORPTION Introduction Basic Theory Macroscopic Analysis General Properties of the Spectrum	25
2.1 2.2 2.3	PHOTOABSORPTION Introduction Basic Theory Macroscopic Analysis General Properties of the Spectrum Discrete Spectrum	25 27 31
2.1 2.2 2.3 2.4 2.5	PHOTOABSORPTION Introduction Basic Theory Macroscopic Analysis General Properties of the Spectrum Discrete Spectrum Partial Oscillator Strengths	25 27 31 33
2.1 2.2 2.3 2.4 2.5 2.6	PHOTOABSORPTION Introduction Basic Theory Macroscopic Analysis General Properties of the Spectrum Discrete Spectrum	25 27 31 33 35
2.1 2.2 2.3 2.4 2.5 2.6	PHOTOABSORPTION Introduction Basic Theory Macroscopic Analysis General Properties of the Spectrum Discrete Spectrum Partial Oscillator Strengths Specific Features	25 27 31 33 35 36

ix

VI	
V I	Contents

VI		Contents
10000	CHARGED-PARTICLE COLLISIONS N THE BORN APPROXIMATION	
3.1	Introduction	42
3.2	The Born Approximation	42
3.3	Construction of the Wave Function	44
3.4	Differential Cross Section	46
3.5	Momentum Transfer and Form Factors	46
3.6	Total Cross Section	51
3.7	Remarks on the Born Approximation	56
	Problems	56
	References	57
Part	B SINGLE-CHANNEL PHENOMENA	
4 E	LASTIC SCATTERING BY A SHORT-RANGE	
C	ENTRAL POTENTIAL	
4.1	Introduction	61
4.2	Partial Wave Expansion	61
4.3	Scattering Wave Functions	63
4.4	Time Delay	66
4.5	Collision Parameters and Matrices	68
4.6	Collision Cross Section	69
4.7	ACTIVITY STATE OF THE STATE OF	70 71
4.8 4.9	Phenomena at Near-Zero Energy Bound-State Levels	77
5.5.5	Levinson's Theorem	78
4.10		79
7.11	Problems	80
	References	80
	References	
5 II	NFLUENCE OF LONG-RANGE POTENTIALS	
5.1	Introduction	81
5.2		82
5.3		84
5.4	Parameters of Short-Range Interactions	89
5.5	Threshold Behavior: Resonances	92
5.6	Negative Energies: Spectrum of Bound-State Levels	93
5.7	Normalization of Wave Functions	96
5.8	The Phase Parameter $\beta(\epsilon)$ in (5.27)	100
5.9	Spin-Orbit Coupling and Relativistic Effects	101
5.10	Phase-Amplitude Treatments	102
5.11	Indentification of Irregular Wave Functions	107
	Problems	108
	References	109

Contents		vii
6 C	ALCULATION OF THE PHASE SHIFTS	
6.1	Introduction	111
6.2	Direct Integration	111
6.3 6.4	Configuration Mixing R-Matrix Treatment	114 122
6.5	Variational Approaches	125
6.6	Close-Coupling Equations	128
6.7	Reduction of Integrodifferential Equations to a Coupled	.20
	Differential System	132
6.8	Variational Principles for Scattering	133
6.9	Polarization Field	135
	Problems	136
	References	137
Part	C MULTICHANNEL PHENOMENA	
	IONRESONANT CONTINUA	
A	ND DISCRETE SPECTRA	
_		
7.1	Introduction	141
7.2 7.3	Two Degenerate Channels: Spin Exchange in $e + H$ Collisions Collision Parameters	144 152
7.3 7.4	Electron – Fluorine Interaction at Low Energy	157
7.5	Photoabsorption of H ₂	170
7.6	Semiempirical Analysis of $e + Ne^+$	181
7.7	Spin Polarization of Photoelectrons	185
7.8	Alternative Base Pairs in Multichannel Problems	186
7.9	Cross Sections in the Laboratory Frame	188
7.10	Angular Distribution of Collision Fragments	191
	Problems	196
	References	197
8 R	ESONANCES AND THE ELIMINATION	
100	OF CHANNELS	
8.1	Introduction	198
8.2	Resonances in Elastic Scattering	200
8.3	Resonances in the Two-Channel Photoabsorption of H ₂	203
8.4	Multichannel Treatment	214
8.5	Semiempirical Analysis of Multichannel Photoabsorption:	
	Argon and Other Spectra	220
8.6	Elimination of Open Channels	230
8.7	Fragmentation Channels in External Fields	237
	Problems References	246 247
	References	24 /

viii	Contents

9	CALCULATION OF INTERACTION PARAMETERS	
9.1 9.2 9.3 9.4	Alternative Parametrizations Methods of Calculation	248 249 259 278 298
Par	t D MULTIELECTRON EXCITATIONS	
10	DOUBLY EXCITED He AND H-	
10.1 10.2 10.3 10.4 10.5 10.6 10.7	Early Observations: Experimental and Theoretical Angular and Radial Correlations Analysis of the Schrödinger Equation Low Doubly Excited States High Excitations and Double Ionization	301 303 306 310 321 338 349 358
11	EXCITATIONS WITH A STRUCTURED CORE	
11.1 11.2 11.3 11.4 11.5		359 360 368 377 385 389
12	CONCLUSIONS AND PREVISIONS	
12.1	Discussion References	390 393
Glos: Inde:	sary of Symbols x	395 397