



## Contents

**CHAPTER 4. Experimental Techniques**

4.1	Introduction	.. .. .. .. .. .. .. .. ..	59
4.2	Absorption Spectrometry	.. .. .. .. .. .. .. .. ..	59
4.3	Photon Sources	.. .. .. .. .. .. .. .. ..	62
4.4	The Electron Synchrotron	.. .. .. .. .. .. .. .. ..	64
4.5	Detectors: (a) Photographic Plates	.. .. .. .. .. .. .. .. ..	67
4.6	Detectors: (b) Photomultipliers	.. .. .. .. .. .. .. .. ..	68
4.7	The Absorption Cell	.. .. .. .. .. .. .. .. ..	69
4.8	The Effective Absorption Path Length	.. .. .. .. .. .. .. .. ..	71
4.9	The Separation of Atomic and Molecular Absorption	.. .. .. .. .. .. .. .. ..	74
4.10	Thermochemical Data	.. .. .. .. .. .. .. .. ..	75
4.11	Photoionization Efficiencies	.. .. .. .. .. .. .. .. ..	76
4.12	Ionization Chambers	.. .. .. .. .. .. .. .. ..	77
4.13	Photon Flux Measurements	.. .. .. .. .. .. .. .. ..	79
4.14	Mass Spectrometer Measurements	.. .. .. .. .. .. .. .. ..	80
4.15	Excited Ionic States	.. .. .. .. .. .. .. .. ..	81
4.16	Retarding Potential Measurements	.. .. .. .. .. .. .. .. ..	81
4.17	Recombination Spectra	.. .. .. .. .. .. .. .. ..	83
4.18	Shock Tube Measurements	.. .. .. .. .. .. .. .. ..	87
4.19	Atomic and Molecular Beams	.. .. .. .. .. .. .. .. ..	92

**CHAPTER 5. The Effect of External Fields on the Ionization Process**

5.1	Introduction	.. .. .. .. .. .. .. .. ..	95
5.2	The Stark Effect	.. .. .. .. .. .. .. .. ..	95
5.3	Electric Field Ionization for Hydrogen	.. .. .. .. .. .. .. .. ..	96
5.4	Fields in an Electrical Discharge	.. .. .. .. .. .. .. .. ..	99
5.5	Electric Fields on Nonhydrogenic Atoms	.. .. .. .. .. .. .. .. ..	101
5.6	Foreign Gas Effects on the High-Series Members	.. .. .. .. .. .. .. .. ..	101
5.7	The Shape of the Absorption Curve near the Series Limit	.. .. .. .. .. .. .. .. ..	104
5.8	The Effect of the Foreign Gas on the Photoionization Continuum	.. .. .. .. .. .. .. .. ..	105

**CHAPTER 6. Photoionization Results for Atoms**

6.1	Atomic Hydrogen	.. .. .. .. .. .. .. .. ..	109
6.2	The Alkali Metals	.. .. .. .. .. .. .. .. ..	110
6.3	The Alkaline Earth Metals	.. .. .. .. .. .. .. .. ..	116
6.4	Zinc, Cadmium, and Mercury	.. .. .. .. .. .. .. .. ..	119
6.5	The $s^2p$ Configuration	.. .. .. .. .. .. .. .. ..	120
6.6	The Rare Gases	.. .. .. .. .. .. .. .. ..	122
6.7	Oxygen and Nitrogen Atoms	.. .. .. .. .. .. .. .. ..	127
6.8	Photoionization from Excited Atomic States	.. .. .. .. .. .. .. .. ..	130
6.9	The Other Atomic Systems	.. .. .. .. .. .. .. .. ..	131

**CHAPTER 7. Autoionization**

7.1	Introduction	.. .. .. .. .. .. .. .. ..	132
7.2	The Auger Effect	.. .. .. .. .. .. .. .. ..	133
7.3	Autoionization Lines in Atomic Arc Spectra	.. .. .. .. .. .. .. .. ..	134
7.4	Selection Rules	.. .. .. .. .. .. .. .. ..	136

7.5	Autoionization Lines in Absorption	.. .. .. .. ..	137
7.6	The Alkali Metals	.. .. .. .. ..	138
7.7	The Alkaline Earth Metals	.. .. .. .. ..	139
7.8	Zinc, Cadmium, and Mercury	.. .. .. .. ..	142
7.9	The $s^2p$ Configuration	.. .. .. .. ..	142
7.10	The Rare Gases	.. .. .. .. ..	144
7.11	Theoretical Considerations	.. .. .. .. ..	145
7.12	One Discrete State and One Continuum	.. .. .. .. ..	145
7.13	The Line Profile	.. .. .. .. ..	148
7.14	The General Case of More Than One Continuum	.. .. .. .. ..	149
7.15	The Rydberg Series Lines	.. .. .. .. ..	151
7.16	The Experimental Data	.. .. .. .. ..	152
7.17	Forbidden Autoionization Transitions	.. .. .. .. ..	155

**CHAPTER 8. Photoionization and Photodissociation Results for Molecules**

8.1	Photon-Molecular Interactions	.. .. .. .. ..	157
8.2	Preionization and Predissociation	.. .. .. .. ..	157
8.3	The Selection Rules	.. .. .. .. ..	158
8.4	The Observation of Predissociation	.. .. .. .. ..	160
8.5	Molecular Photoionization	.. .. .. .. ..	161
8.6	The Observation of Preionization	.. .. .. .. ..	161
8.7	Superexcited Molecular States	.. .. .. .. ..	162
8.8	Ionization Efficiency	.. .. .. .. ..	163
8.9	Experimental Cross-Sectional Values	.. .. .. .. ..	165
8.10	Hydrogen	.. .. .. .. ..	166
8.11	Oxygen	.. .. .. .. ..	167
8.12	Nitrogen	.. .. .. .. ..	173
8.13	Nitric Oxide	.. .. .. .. ..	178
8.14	Nitrous Oxide	.. .. .. .. ..	180
8.15	Carbon Monoxide	.. .. .. .. ..	182
8.16	Carbon Dioxide	.. .. .. .. ..	184
8.17	Water Vapor	.. .. .. .. ..	185
8.18	Ammonia	.. .. .. .. ..	186
8.19	Methane	.. .. .. .. ..	187
8.20	Hydrocarbons	.. .. .. .. ..	188
8.21	Ozone	.. .. .. .. ..	190
8.22	The Alkali Metals	.. .. .. .. ..	191

**CHAPTER 9. Photodetachment**

9.1	Negative Ions	.. .. .. .. ..	193
9.2	The Formation of Negative Atomic Ions	.. .. .. .. ..	193
9.3	The Negative Molecular Ions	.. .. .. .. ..	195
9.4	General Theoretical Considerations	.. .. .. .. ..	196
9.5	The Photodetachment Threshold	.. .. .. .. ..	197
9.6	The Photodetachment of $H^-$	.. .. .. .. ..	198
9.7	The Photodetachment of $O^-$	.. .. .. .. ..	200

9.8	The Photodetachment of C <sup>-</sup>	202
9.9	Photodetachment of Other Atomic Ions	203
9.10	The Photodetachment of OH <sup>-</sup>	203
9.11	The Photodetachment of O <sub>2</sub> <sup>-</sup>	204
9.12	Other Molecular Negative Ions	204
<b>CHAPTER 10. The Plasma State</b>		
10.1	Introduction	206
10.2	The Electrical Discharge	207
10.3	The Townsend Discharge	208
10.4	Townsend's Second Ionization Coefficient	209
10.5	The Development of the Townsend Discharge	210
10.6	The Condition for Low-Pressure Spark Breakdown	211
10.7	The Proportional Counter	212
10.8	The Geiger Counter	213
10.9	Photon Counters	214
10.10	The Discharge Streamer	218
10.11	The Nature of Streamers	219
10.12	The High-Temperature Shock Wave	224
10.13	The Establishment of Equilibrium Conditions	225
10.14	Radiative Recombination	226
10.15	Dielectronic Recombination	230
<b>CHAPTER 11. The Absorption of Solar Radiation by the Earth's Atmosphere</b>		
11.1	Introduction	233
11.2	The Absorption Cross Sections	234
11.3	The Solar Radiation	237
11.4	The Attenuation of Solar Radiation	239
11.5	Photoionization Rates	242
11.6	The Dissociation of Molecular Oxygen	243
<b>CHAPTER 12. Astrophysical Applications</b>		
12.1	Introduction	244
12.2	The Planetary Atmospheres	244
12.3	The Interplanetary Medium	245
12.4	The Sun	245
12.5	Stellar Interiors	247
12.6	The Stellar Interior Absorption Coefficient	250
12.7	The Calculation of the Opacity Coefficient	251
12.8	Stellar Atmospheres	253
12.9	The Planetary Nebulae	255
<b>REFERENCES</b>		
<b>AUTHOR INDEX</b>		
<b>SUBJECT INDEX</b>		