

## Contents

LIST OF CONTRIBUTORS . . . . .	v
PREFACE . . . . .	vii

### *Chapter 1*

#### **INTRODUCTION . . . . .**

RICHARD H. HUDDLESTONE

### *Chapter 2*

#### **BASIC MACROSCOPIC MEASUREMENTS**

STANLEY L. LEONARD

1 Electrical Measurements . . . . .	8
2 Photography . . . . .	27
3 Pressure and Momentum Measurements . . . . .	53
4 Other Macroscopic Techniques . . . . .	59
References . . . . .	64

### *Chapter 3*

#### **MAGNETIC PROBES**

R. H. LOVBERG

1 Introduction . . . . .	69
2 Components and Component Parameters . . . . .	71
3 Typical Magnetic Probe Experiments . . . . .	80
4 Perturbations of Plasma and Probe . . . . .	95
References . . . . .	112

### *Chapter 4*

#### **ELECTRIC PROBES**

FRANCIS F. CHEN

1 Introduction . . . . .	113
2 Sheath Formation . . . . .	117
3 Probe Theory in the Absence of Collisions and Magnetic Fields . . . . .	125

4	Probe Theory in the Presence of Collisions . . . . .	151
5	Probe Theory in the Presence of a Magnetic Field. . . . .	162
6	Floating Probes . . . . .	177
7	Time-Dependent Phenomena . . . . .	185
8	Experimental Considerations . . . . .	191
	References . . . . .	199

**Chapter 5****SPECTRAL INTENSITIES**

R. W. P. McWHIRTER

1	Introduction . . . . .	201
2	Plasma Models . . . . .	202
3	Diagnostic Methods . . . . .	241
	References . . . . .	261

**Chapter 6****LINE BROADENING**

W. L. WIESE

1	Introduction . . . . .	265
2	The Line-Broadening Mechanisms in Plasmas . . . . .	266
3	Availability of Stark-Broadening Data . . . . .	272
4	Comparison of the Recent Stark-Broadening Calculations with Experiment and Discussion of Their Accuracy. . . . .	279
5	Applications to Plasma Diagnostics . . . . .	299
6	Summary . . . . .	314
	References . . . . .	315

**Chapter 7****OPTICAL AND ULTRAVIOLET TECHNIQUES**

EUGENE B. TURNER

1	Introduction . . . . .	319
2	General Instrumentation Requirements . . . . .	320
3	Spectroscopic Instrumentation for the Visible and Near Ultraviolet . . . . .	322
4	Spectroscopic Instruments for the Vacuum Ultraviolet . . . . .	332
5	Detectors and Calibration Techniques . . . . .	338
	References . . . . .	358

**Chapter 8****X-RAY SPECTROSCOPY**

T. F. STRATTON

1	Introduction . . . . .	359
2	Diagnostic Techniques . . . . .	368
3	Formulas and Tables . . . . .	388
	References . . . . .	395

**Chapter 9****FAR-INFRARED TECHNIQUES**

M. F. KIMMITT, A. C. PRIOR, AND V. ROBERTS

1	Introduction . . . . .	399
2	Emission Properties of Plasmas in the Far Infrared . . . . .	400
3	Spectroscopic Instrumentation for the Far Infrared . . . . .	407
4	Emission Measurements on Plasmas . . . . .	420
	References . . . . .	429

**Chapter 10****OPTICAL INTERFEROMETRY**

RALPH A. ALPHER AND DONALD R. WHITE

1	Introduction . . . . .	431
2	Theory of Optical Refractivity of Plasmas . . . . .	433
3	Verification of Plasma Interferometry . . . . .	446
4	Experimental Procedures . . . . .	449
5	Applications . . . . .	465
	References . . . . .	473

**Chapter 11****MICROWAVE TECHNIQUES**

CHARLES B. WHARTON

1	Wave Interactions in a Cold, Uniform Plasma . . . . .	477
2	Wave Propagation in a Temperature Plasma . . . . .	487
3	Wave Propagation through Bounded Plasmas . . . . .	490
4	Space-Charged Waves in Plasma . . . . .	495
5	Plasmas Contained in Resonant Cavities . . . . .	499

6	Wave-Propagation Techniques and Experiments . . . . .	500
7	Microwave Radiation from a Plasma . . . . .	506
8	Radiation Experiments: Radiometers . . . . .	515
	References. . . . .	515

***Chapter 12******PARTICLE MEASUREMENTS***

J. E. OSHER

1	Introduction . . . . .	517
2	Direct Analysis of Plasma Particles . . . . .	519
3	Ion Measurements through Secondary Interactions . . . . .	561
4	Hard X-Ray Measurements . . . . .	582
5	Particle Beams as Diagnostic Tools . . . . .	589
	References. . . . .	596
	AUTHOR INDEX . . . . .	603
	SUBJECT INDEX . . . . .	615