

CONTENTS

I. ON THE VALIDITY OF KIRCHHOFF'S LAW OF HEAT RADIATION FOR A BODY IN A NONEQUILIBRIUM ENVIRONMENT

by H. P. BALTES (Zug, Switzerland)

1. INTRODUCTION	3
2. FUNDAMENTAL LAWS AND DEFINITIONS	4
2.1 Kirchhoff's law for a body in equilibrium environment	4
2.2 Einstein's concept of radiative energy exchange	6
2.3 Absorptivity and emissivity ambiguously defined	7
3. STIMULATED EMISSION TREATED AS NEGATIVE ABSORPTION	9
3.1 The concept of net absorption	9
3.2 Kirchhoff's law for a weakly absorbing freely radiating body	10
3.3 The transmission of a weakly absorbing hot body – re-interpretation of an experiment	13
3.4 Net absorption and spontaneous emission for freely radiating metals	15
4. STIMULATED EMISSION NOT CONSIDERED AS NEGATIVE ABSORPTION	17
4.1 Induced absorption and "total" emission for a freely radiating metal	17
4.2 The deviations from Kirchhoff's law predicted by Ashby and Shocken	18
4.3 Re-examination of the results of Ashby and Shocken	20
4.4 The proper thermodynamic definition of absorptivity and emissivity	21
5. SOME EXPERIMENTAL RESULTS	22
6. CONCLUSIONS	23
7. ACKNOWLEDGEMENTS	24
REFERENCES	24

II. THE CASE FOR AND AGAINST SEMICLASSICAL RADIATION THEORY

by L. MANDEL (Rochester, N.Y.)

1. INTRODUCTION	29
2. THE PHOTOELECTRIC EFFECT	30
3. RELATION BETWEEN SEMICLASSICAL THEORIES OF PHOTODETECTION AND Q.E.D.	39
4. SPONTANEOUS EMISSION OF LIGHT ACCORDING TO NEOCLASSICAL THEORY	43
5. RESONANCE FLUORESCENCE	50
6. FLUORESCENCE EFFECTS IN MULTI-LEVEL ATOMS	52
7. POLARIZATION CORRELATIONS IN AN ATOMIC CASCADE	54
8. MOMENTUM TRANSFER EXPERIMENTS	59

9. INTERFERENCE EXPERIMENTS	61
10. CONCLUSION	65
REFERENCES.	66

III. OBJECTIVE AND SUBJECTIVE SPHERICAL ABERRATION MEASUREMENTS OF THE HUMAN EYE

by W. M. ROSENBLUM and J. L. CHRISTENSEN (Birmingham, Alabama)

1. INTRODUCTION	71
2. THE ANATOMY OF THE OPTICAL ELEMENTS OF THE EYE	72
2.1 Cornea	72
2.2 Aqueous	76
2.3 Crystalline lens	76
3. THE BASIC CONCEPTS OF SPHERICAL ABERRATION	76
4. HISTORICAL INTRODUCTION TO THE MEASUREMENT OF THE SPHERICAL ABERRATION OF THE EYE	77
5. SUBJECTIVE ABERRATION MEASUREMENTS OF THE EYE	79
6. OBJECTIVE ABERRATION MEASUREMENTS OF THE EYE	86
7. CONCLUSIONS	89
REFERENCES.	90

IV. INTERFEROMETRIC TESTING OF SMOOTH SURFACES

by G. SCHULZ and J. SCHWIDER (Berlin)

1. INTRODUCTION	95
2. RELATIVE TESTING BY COMPARING TWO SURFACES	96
2.1 Determination of the deviation sums.	99
2.2 Determination of the deviation differences	105
2.3 The use of a null lens	106
2.4 Enhancement of sensitivity	108
2.5 The measurement of interference patterns.	115
3. ABSOLUTE TESTING BY COMPARING SEVERAL SURFACES	118
3.1 Testing flats	119
3.2 Testing spherical surfaces	126
3.3 Testing aspheric surfaces	131
3.4 Solutions applying uniformly to the whole surface	134
4. COMPARING A SURFACE WITH ITSELF	140
4.1 Shearing methods	141
4.2 Point reference methods	144
5. COMPARING A SURFACE WITH A HOLOGRAM	146
5.1 Comparing with a hologram produced by interference	146
5.2 Comparing the surface with a computer-generated hologram as master	150
6. SOME SYSTEMATIC SOURCES OF ERROR AND LIMITS OF MEASUREMENT	157
REFERENCES.	162
SUPPLEMENTARY NOTES ADDED IN PROOF	166

V. SELF FOCUSING OF LASER BEAMS IN PLASMAS AND SEMICONDUCTORS

by M. S. SODHA, A. K. GHATAK and V. K. TRIPATHI (New Delhi)

1. INTRODUCTION	171
2. PHENOMENOLOGICAL THEORY OF FIELD DEPENDENT DIELECTRIC CONSTANT	175
2.1 Effective dielectric constant	175
2.2 Pondermotive force	177
2.3 Heating of carriers by a Gaussian EM beam in slightly and fully ionized gases	178
2.4 Heating of carriers in parabolic and nonparabolic semiconductors	181
2.5 Redistribution of carriers and expressions for field dependent dielectric constant	185
2.5.1 Collisionless plasma (pondermotive mechanism)	190
2.5.2 Strongly ionized plasma ($R \ll 1$, thermal conduction predominant)	190
2.5.3 Slightly ionized plasma ($R \gg 1$, collisional loss predominant)	190
2.5.4 Germanium	191
2.5.5 n-type indium antimonide	192
2.5.6 Indium antimonide (both types of carriers)	193
2.6 Nonlinearity in the dielectric constant of a magnetoplasma	194
2.6.1 Nonlinear dielectric constant of a collisionless magnetoplasma: pondermotive mechanism	197
2.6.2 Nonlinear dielectric constant of a collisional magnetoplasma: $R \gg 1$	199
3. KINETIC THEORY OF FIELD DEPENDENT DIELECTRIC CONSTANT	203
3.1 Heating and redistribution of carriers by a Gaussian EM beam in a slightly ionized plasma and a parabolic semiconductor	203
3.2 Nonlinearity in the dielectric constant of a magnetoplasma	209
4. STEADY STATE SELF FOCUSING OF EM BEAMS IN PLASMA	213
4.1 Self focusing in a nonlinear isotropic medium	213
4.1.1 Collisionless plasma	217
4.1.2 Collisional plasma: collisional loss	220
4.1.3 Fully ionized plasma: conduction loss	223
4.1.4 Parabolic semiconductors (e.g. Ge)	225
4.1.5 Nonparabolic semiconductors (e.g. InSb)	227
4.2 Magnetoplasma	229
4.2.1 Collisionless magnetoplasma	232
4.2.2 Weakly ionized magnetoplasma: collisional loss	233
4.2.3 Strongly ionized magnetoplasma: thermal conduction loss	235
5. NONSTEADY STATE SELF FOCUSING	238
5.1 Linear part of current density	238
5.2 Nonlinear current density: no redistribution of carriers	239
5.3 Nonlinear current density: redistribution of carriers	240
5.4 Nonlinear propagation: self distortion of plane waves	242
5.5 Nonsteady self focusing	246
6. GROWTH OF INSTABILITY	249
6.1 Growth of instability in a plane wavefront	249
6.2 Growth of instability in a Gaussian beam	256
6.3 Growth of a Gaussian perturbation over a plane uniform wavefront	260
7. EXPERIMENTAL INVESTIGATIONS ON SELF FOCUSING	261
REFERENCES	262

VI. APLANATISM AND ISOPLANATISM

by W. T. WELFORD (London)

1. INTRODUCTION	269
2. THE ABBE SINE CONDITION	271
3. AXIAL ISOPLANATISM	273
3.1 The Staebble–Lihotzky condition	274
3.2 Conrady's theorem	275
3.3 Linear coma as an optical path aberration	277
3.4 Linear coma as ray aberration or wavefront aberration	277
3.5 Some different definitions of axial isoplanatism	279
3.6 Isoplanatism at varying magnification	282
4. ISOPLANATISM WITH NO AXIS OF SYMMETRY	283
4.1 The Smith optical cosine law	284
4.2 The most general isoplanatism theorem	285
4.3 Off-axis isoplanatism in a symmetrical optical system	287
5. ISOPLANATISM IN HOLOGRAPHY	289
REFERENCES	291
ADDENDUM	292
AUTHOR INDEX	293
SUBJECT INDEX	299
CUMULATIVE INDEX – VOLUMES I–XIII	304