

CONTENTS

AN INTRODUCTION TO THE ABSORPTION OF LASER LIGHT IN PLASMAS, R.A. Cairns

1. Introduction	1
2. Waves in a Plasma	2
3. Collisional Absorption	5
4. The Ponderomotive Force	6
5. Parametric Instabilities	8
6. Stimulated Brillouin Scattering	15
7. Raman Scattering and Two-Plasmon Decay	17
8. Resonant Absorption	18
9. Filamentation and Modulation Instabilities	22
10. Harmonic Generation	23
11. Magnetic Field Generation	24
12. Conclusion	25
References	26

NONLINEAR OPTICS AND WAVE PRESSURE IN LASER PLASMAS, P. Mulser

Introduction	29
1. Wave-Wave Interaction in the Homogeneous Plasma	30
1.1 Eigenmodes of the Plasma	30
1.2 Wave-Wave Coupling	36
1.3 The Matching Conditions	41
1.4 Three wave processes. Application of the general formalism	42
2. Wave Pressure and Coupling Mechanism	46
2.1 Wave Pressure	46
2.2 Parametric Instabilities Excited by Wave Pressure	50
2.3 Instabilities in the Inhomogeneous Plasma	52
References	54

THEORY AND SIMULATION OF ELECTROMAGNETIC WAVES IN LASER-PRODUCED PLASMAS,

T.J.M. Boyd

1. Introduction	55
2. Absorption and Scaling with Wavelength	57
3. Parametric Processes in Plasmas	60
4. Coupled Mode Equations Describing Stimulated Raman Scattering and Two-Plasmon Decay	63
4.1 Stimulated Raman Scattering	67
4.2 Two-Plasmon Decay	70
4.3 Instability Thresholds in Inhomogeneous Plasmas	72
5. Experimental Evidence for Raman and Two-Plasmon Instabilities	74
5.1 Plasmons	74
5.2 Hot Electrons	75
5.3 Photons at $\omega_0/2$	79
5.4 Photons at $3\omega_0/2$	80
6. Filamentation and Jet Formation	83
6.1 Filamentation	85
6.2 Jet Formation	87
7. Self-Generated Magnetic Fields	90
7.1 Macroscopic Fields	91
7.2 Microscopic Fields	98
7.3 Consequences of Macromagnetic Fields	100
References	102

THE PHYSICS OF LASER COMPRESSION OF PLASMAS, M.H. Key

1. Introduction	107
2. Thermal Conduction	107
3. Ablation Governed by Electron Thermal Conduction	110
4. Experimental Study of Mass Ablation Rate \dot{m} and Ablation Pressure P_a	113
5. Thermal Smoothing of Pressure Variations Due to Non-Uniform Irradiation	119
6. Rayleigh Taylor Instability	123
References	

THE DEVELOPMENT OF FLUID CODES FOR THE LASER COMPRESSION OF PLASMA,	
D.J. Nicholas	
1. Introduction	129
1.1 Laser Plasma Interaction-Absorption Processes	130
1.2 Electron Thermal Transport	132
2. Numerical Schemes	134
2.1 The Method of Finite Differences	134
2.2 Choice of Numerical Techniques	139
2.3 Timestep Restrictions	140
2.4 Problems Implicit in 2-D Codes	144
2.5 The Problem of Anisotropy	145
3. Hydrodynamic Simulation	147
3.1 The Fluid Equations in Conservative Form	147
3.2 The Fluid Equations in Reduced Form	149
3.3 Equations of the Hyperbolic Form	151
3.4 TRIFIC - a 1-D Eulerian Hydro-Code	152
3.5 MEDUSA - a 1-D Lagrangian Code	159
3.6 2D - Hydro-Codes	163
3.7 MHD	166
4. Numerical Simulation in Laser Plasmas	170
4.1 1-D Simulation with MEDUSA	170
4.2 2-D Simulation of Magnetic Fields with LASER B	173
4.3 2-D Thermal Smoothing Experiments with POLLUX	178
References	182
THEORY AND SIMULATION OF LASER PLASMA COUPLING, W.L. Kruer	
1. Introduction	185
2. The Raman Instability : Linear Theory	186
3. Nonlinear Features of Raman Scatter	191
4. Experiments on Raman Scatter	194
5. Wavelength Scaling of Laser Plasma Coupling :	
General Considerations	195
6. Wavelength Scaling of Inverse-Bremsstrahlung Absorption	196
7. Wavelength Scaling of Collective Effects	200
8. Summary	201
References	203

FAST ELECTRON INDUCED TRANSPORT PHENOMENA : EXPERIMENTAL OBSERVATIONS
AND RECENT PROGRESS IN UNDERSTANDING, R. Sigel

1. Introduction	205
2. Experimental Observations	206
3. Comparison with Recent Simulations	212
References	218

THE SPECTROSCOPY OF DENSE LASER GENERATED PLASMAS, D.D. Burgess

1. Introduction	219
2. Present Status of the Spectroscopy of Laser Plasmas	222
3. General Survey of High Density Effects on Atomic and Ionic Spectra	225
4. Pressure Broadening Processes in Dense Plasmas	233
4.1 Experimental Context	233
4.2 Existing Theoretical Approaches	234
4.3 A Hitchhiker's Guide to Line-Broadening in Dense Plasmas	238
5. Very Dense Plasmas	262
5.1 Thomas Fermi Type Models	262
5.2 Average Atom Model	263
5.3 Self-Consistent Schrödinger Equation Models	264
References	266

ION BEAM FUSION, T.D. Beynon

1. Introduction	271
2. Driver and Pellet Requirements	273
3. Ion Beam Requirements	274
4. Propagation and Focussing of an Intense Ion Beam	277
5. The Production of Intense Ion Beams	287
6. The Ion-Plasma Interaction	292
7. Ion Beam Fusion - Quo Vadis	300
References	302