

CONTENTS

CHAPTER 1	An Introduction to Spontaneously Generated Magnetic Fields and Transport of Laser Light in Plasmas	1
1.1	Introductory remarks	1
1.2	Preliminary survey for magnetic field generation: Theory and experiment	2
1.3	Self action effects in plasmas	5
1.4	Sources of magnetic field generation	6
1.5	Mechanisms of magnetic field generation in laser plasma interaction	7
	(A) $(\nabla T \times \nabla n)$ mechanism or thermo-electric effect	8
	(B) Dynamo mechanism	9
	(C) Magnetic moment field	9
	(D) Field from ponderomotive force	10
	(E) Effect of anisotropic electron pressure	10
1.6	Theory of magnetic moment field (Phenomenological)	11
1.7	Basic theory of magnetic moment generation related to inverse Faraday effect	11
1.8	Importance of magnetic field studies in laser plasmas	15
1.9	Contents of the present thesis	19

CHAPTER 2	An Analytical Study of Spontaneous Generation of Magnetic Fields in a Laser Produced Plasma	29
2.1	Introduction	29
2.2	Basic assumptions and equations	30
2.3	Perturbation scheme	32
2.4	Linearised field equations and solutions	33
2.5	Linear dispersion relation	36
2.6	Second order equations and solutions	37
2.7	Third order equations and solutions	41
2.8	Angular momentum and magnetization	45
2.9	A simple numerical example	47
2.10	Results and discussions	48
APPENDIX 2.A	Electrostatic wave and Landau damping	51
FIGURES		54
CHAPTER 3	A Mechanism for Simultaneous Generation of Magnetic Fields in a Laser Produced Plasma: Inclusion of Ion Motion	56
3.1	Introduction	56
3.2	Formulation of the problem	56
	(A)Basic assumptions	56
	(B)Basic equations	58
3.3	First order equations and solutions	59
3.4	Linear dispersion relations and preliminary analysis	62
3.5	Second order field equations and solutions	63
3.6	Third order field equations and solutions correct upto first order	66

3.7	Nonlinear angular momentum and magnetization	70
3.8	Graphical illustration of numerical results	73
3.9	Few important remarks	74
APPENDIX 3.A	First harmonic terms correct upto third order	77
FIGURES		80
CHAPTER 4	Spontaneous Faraday Rotation in a Laser Produced Plasma	89
4.1	Introduction	89
4.2	Formulation of the problem	91
	(I) Basic assumptions and relevant equations	91
	(II) A method using rotating complex coordinates	93
4.3	Linearized equations and solutions	95
4.4	Linear dispersion relation	99
4.5	Second order field equations and solutions	101
4.6	Derivation of nonlinear dispersion relation	104
CHAPTER 5	Effect of Self-Generated Magnetic Fields on Electron Heat flux in Laser Produced Plasmas	114
5.1	Introduction	114
5.2	Formulation of the problem	115
	(A) Basic assumptions	115
	(B) Basic equations	116
5.3	Results and discussions	117
FIGURES		119
BIBLIOGRAPHY		121
LIST OF PUBLICATIONS OF URMI SANYAL		137