

Contents

Prologue	1
1 Highlights to Plasma	6
1.1 Unveiling matter	6
1.2 Unveiling the atom	9
1.3 Unveiling the electron	14
1.4 Unveiling the nucleus	22
1.5 Unveiling a new state of matter	30
2 What is Plasma?	32
2.1 Introducing plasma	32
2.2 A visit to an exotic nightclub	36
2.3 A joint ping-pong game	39
2.4 The one-mile run	42
2.5 Shielding	46
2.6 Collisions	48
2.7 Swallowing and ejecting photons	51
2.8 The agents	54
2.9 Safekeeping	60
2.10 Plasma	62
3 The Solution to the Energy Problem	64
3.1 <i>Soylent Green</i>	64
3.2 Nuclear energy	68
3.3 Nuclear fusion energy	71
3.4 Conditions for nuclear fusion	81
3.5 Ignition temperature	85
3.6 Magnetic confinement—magnetic bottles	86

viii	CONTENTS		CONTENTS	ix
	3.7 Plasma diffusion	89	6.2 From the visual to the plasma universe	179
	3.8 Plasma instabilities	91	6.3 Plasma applications	182
	3.9 Plasma formation	93	6.4 Plasma reflections	191
	3.10 Plasma heating	93	6.5 Outlook	194
	3.11 The Tokamak	96		
	3.12 Magnetic mirrors	100	Epilogue	196
	3.13 Nuclear fusion reactors	103		
	3.14 Inertial confinement with lasers	105	Glossary	199
	3.15 Particle beam fusion	121		
	3.16 Advantages of nuclear fusion energy	123	Index	217
4	A Universe of Plasma	125		
	4.1 Plasma in the beginning	125		
	4.2 The Universe	130		
	4.3 The magnetosphere	137		
	4.4 Light from the stars	142		
	4.5 The star's interior	146		
	4.6 The solar exterior	149		
	4.7 A supernova explosion	153		
5	A Glimpse at the Plasma Historical Background	157		
	5.1 Plasma without realization	157		
	5.2 Realizing the fourth state of matter—plasma	158		
	5.3 The ionosphere—a plasma mirror for radio signals	161		
	5.4 Plasma in space	163		
	5.5 The Sun's 'secret' source of energy	165		
	5.6 Splitting the atom—fission	166		
	5.7 Fusion—the synthesis of light nuclei	167		
	5.8 Solving the energy problem for the generations ahead	169		
	5.9 Landmarks in the development of plasma physics	171		
	5.10 Science and scientists	175		
6	Plasma: Yesterday, Today and Tomorrow	176		
	6.1 The transition to the fusion era	176		