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In 1969, Chen went from Princeton to UCLA in California, where he organized an academic program in

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These notes are intended to provide a brief primer in plasma physics, introducing common definitions, basic properties, and typical processes found in plasmas.

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6 CHAPTER 1. INTRODUCTION

According to the definition of the Debye Length $D = (\frac{0kT}{e ne^2})^{1/2}$ (1.1)) $\log(D) = \frac{1}{2} \log(\frac{0}{e^2}) + \frac{1}{2} \log(kT/e)$

$\log(n)$ (1.2)) $\log(kT) = \log(n) + 2\log(D/7430)$ (kT in eV) (1.3)

Then we can draw the solid straight line in the Figure?? with the Debye length as parameter ranged from 10^{-1} to 10^7 . Points on a certain solid line,

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plasma's temperature and density.
An ideal plasma has many particles
per Debye sphere, i.e. $N_D n_e \gg 1$; (8) which is a prerequisite
for the collective behaviour
discussed earlier. An alternative
way of expressing this condition is
via the so-called plasma parameter
 $\Lambda = n_e \lambda_D^3$; (9)
which is essentially the reciprocal of
 N_D . Classical plasma theory is based
on the assumption that $\Lambda \gg 1$,

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Solutions and controlled fusion ...

As I've told several of them, Chen's book essentially "leads you by the hand"- going through particle motions, gyro-frequencies, adiabatic invariants etc., to magnetic mirror systems (including loss cone angles and Fermi accelerations applied to them) to plasma instabilities and MHD, whereas many others (even 'Plasma Physics' by Krall and Trivelpiece) tend to assume too much.

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Prof. Chen is a plasma physicist with a career extending over 48 years and encompassing both experiment and theory. He has

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In 1954, Chen worked at the Princeton Plasma Physics Laboratory (PPPL), where he worked initially with the Model B1 Stellarator, a device used to confine hot plasma with magnetic fields in order to sustain a controlled nuclear fusion reaction.

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This complete introduction to
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fusion by one of the pioneering
scientists in this expanding field
offers both a simple and intuitive
discussion of the basic concepts of
this subject and an insight into the
challenging problems of current

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Solutions research. In a wholly lucid manner the work covers single-particle motions, fluid equations for plasmas, wave motions, diffusion and resistivity, Landau damping, plasma instabilities and nonlinear problems. For students, this outstanding text offers a painless introduction to this important field; for teachers, a large collection of problems; and for researchers, a concise review of the fundamentals as well as original treatments of a number of topics never before explained so clearly. This revised edition contains new material on kinetic effects, including Bernstein waves and the plasma dispersion function, and on nonlinear wave equations and solitons. For the third edition, updates was made throughout each

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existing chapter, and two new chapters were added; Ch 9 on “ Special Plasmas ” and Ch 10 on Plasma Applications (including Atmospheric Plasmas).

TO THE SECOND EDITION In the nine years since this book was first written, rapid progress has been made scientifically in nuclear fusion, space physics, and nonlinear plasma theory. At the same time, the energy shortage on the one hand and the exploration of Jupiter and Saturn on the other have increased the national awareness of the important applications of plasma physics to energy production and to the understanding of our space environment. In magnetic confinement fusion, this period has

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seen the attainment 13 of a Lawson number nTE of 2×10^8 cm⁻³ sec in the Alcator tokamaks at MIT; neutral-beam heating of the PL T tokamak at Princeton to $KT_i = 6.5$ keV; increase of average β to 3%-5% in tokamaks at Oak Ridge and General Atomic; and the stabilization of mirror-confined plasmas at Livermore, together with injection of ion current to near field-reversal conditions in the 2XII β device. Invention of the tandem mirror has given magnetic confinement a new and exciting dimension. New ideas have emerged, such as the compact torus, surface-field devices, and the E β T mirror-torus hybrid, and some old ideas, such as the stellarator and the reversed-field pinch, have been revived.

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Radiofrequency heating has become a new star with its promise of dc current drive. Perhaps most importantly, great progress has been made in the understanding of the MHD behavior of toroidal plasmas: tearing modes, magnetic VII VIII islands, and disruptions.

This book grew out of lecture notes for an undergraduate course in plasma physics that has been offered for a number of years at UCLA. With the current increase in interest in controlled fusion and the wide spread use of plasma physics in space research and relativistic astrophysics, it makes sense for the study of plasmas to become a part of an undergraduate student's basic experience, along

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Solutions with subjects like thermodynamics or quantum mechanics. Although the primary purpose of this book was to fulfill a need for a text that seniors or juniors can really understand, I hope it can also serve as a painless way for scientists in other fields-solid state or laser physics, for instance to become acquainted with plasmas. Two guiding principles were followed: Do not leave algebraic steps as an exercise for the reader, and do not let the algebra obscure the physics. The extent to which these opposing aims could be met is largely due to the treatment of a plasma as two interpenetrating fluids. The two-fluid picture is both easier to understand and more accurate than the single-fluid approach, at least

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Solutions for low-density plasma phenomena.

Plasma processing of semiconductors is an interdisciplinary field requiring knowledge of both plasma physics and chemical engineering. The two authors are experts in each of these fields, and their collaboration results in the merging of these fields with a common terminology. Basic plasma concepts are introduced painlessly to those who have studied undergraduate electromagnetics but have had no previous exposure to plasmas. Unnecessarily detailed derivations are omitted; yet the reader is led to understand in some depth those

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Solutions, such as the structure of sheaths, that are important in the design and operation of plasma processing reactors. Physicists not accustomed to low-temperature plasmas are introduced to chemical kinetics, surface science, and molecular spectroscopy. The material has been condensed to suit a nine-week graduate course, but it is sufficient to bring the reader up to date on current problems such as copper interconnects, low-k and high-k dielectrics, and oxide damage. Students will appreciate the web-style layout with ample color illustrations opposite the text, with ample room for notes. This short book is ideal for new workers in the semiconductor industry who want to be brought up to speed

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Solutions with minimum effort. It is also suitable for Chemical Engineering students studying plasma processing of materials; Engineers, physicists, and technicians entering the semiconductor industry who want a quick overview of the use of plasmas in the industry.

Introducing basic principles of plasma physics and their applications to space, laboratory and astrophysical plasmas, this new edition provides updated material throughout. Topics covered include single-particle motions, kinetic theory, magnetohydrodynamics, small amplitude waves in hot and cold plasmas, and collisional effects. New additions include the

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ponderomotive force, tearing instabilities in resistive plasmas and the magnetorotational instability in accretion disks, charged particle acceleration by shocks, and a more in-depth look at nonlinear phenomena. A broad range of applications are explored: planetary magnetospheres and radiation belts, the confinement and stability of plasmas in fusion devices, the propagation of discontinuities and shock waves in the solar wind, and analysis of various types of plasma waves and instabilities that can occur in planetary magnetospheres and laboratory plasma devices. With step-by-step derivations and self-contained introductions to mathematical methods, this book is ideal as an advanced

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Undergraduate to graduate-level textbook, or as a reference for researchers.

There has been an increase in interest worldwide in fusion research over the last decade and a half due to the recognition that a large number of new, environmentally attractive, sustainable energy sources will be needed to meet ever increasing demand for electrical energy.

Based on a series of course notes from graduate courses in plasma physics and fusion energy at MIT, the text begins with an overview of world energy needs, current methods of energy generation, and the potential role that fusion may play in the future. It covers energy issues such as the production of

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Solution, power, power balance, the design of a simple fusion reactor and the basic plasma physics issues faced by the developers of fusion power. This book is suitable for graduate students and researchers working in applied physics and nuclear engineering. A large number of problems accumulated over two decades of teaching are included to aid understanding.

Recent books have raised the public consciousness about the dangers of global warming and climate change. This book is intended to convey the message that there is a solution. The solution is the rapid development of hydrogen fusion energy. This energy source is inexhaustible

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and, although achieving fusion energy is difficult, the progress made in the past two decades has been remarkable. The physics issues are now understood well enough that serious engineering can begin. The book starts with a summary of climate change and energy sources, trying to give a concise, clear, impartial picture of the facts, separate from conjecture and sensationalism. Controlled fusion -- the difficult problems and ingenious solutions -- is then explained using many new concepts. The bottom line -- what has yet to be done, how long it will take, and how much it will cost -- may surprise you. Francis F. Chen's career in plasma has extended over five decades. His textbook Introduction to Plasma

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Physics has been used worldwide continuously since 1974. He is the only physicist who has published significantly in both experiment and theory and on both magnetic fusion and laser fusion. As an outdoorsman and runner, he is deeply concerned about the environment. Currently he enjoys bird photography and is a member of the Audubon Society.

This rigorous explanation of plasmas is relevant to diverse plasma applications such as controlled fusion, astrophysical plasmas, solar physics, magnetospheric plasmas, and plasma thrusters. More thorough than previous texts, it exploits

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Solutions new powerful mathematical techniques to develop deeper insights into plasma behavior. After developing the basic plasma equations from first principles, the book explores single particle motion with particular attention to adiabatic invariance. The author then examines types of plasma waves and the issue of Landau damping. Magnetohydrodynamic equilibrium and stability are tackled with emphasis on the topological concepts of magnetic helicity and self-organization. Advanced topics follow, including magnetic reconnection, nonlinear waves, and the Fokker – Planck treatment of collisions. The book concludes by discussing unconventional plasmas such as non-neutral and dusty plasmas.

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Written for beginning graduate students and advanced undergraduates, this text emphasizes the fundamental principles that apply across many different contexts.

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