<<磁动力学导论>>

图书基本信息

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内容概要

magnetic fields influence many natural and man-made flows. they are routinely used in industry to heat, pump, stir and levitate liquid metals.there is the terrestrial magnetic field which is maintained by fluid motion in the earth's core, the solar magnetic field which generates sunspots and solar flares, and the galactic field which influences the formation of stars.this is an introductory text on magnetohydrodynamics (mhd) - the study of the interaction of magnetic fields and conducting fluids.

this book is intended to serve as an introductory text for advanced undergraduate and postgraduate students in physics, applied mathematics and engineering. the material in the text is heavily weighted towards incompressible flows and to terrestrial (as distinct from astrophysical) applications. the final sections of the text also contain an outline of the latest advances in the metallurgical applications of mhd and so are relevant to professional researchers in applied mathematics, engineering and metallurgy.

作者简介

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书籍目录

章节摘录

版权页：插图：are usually fairly straightforward. It pays, therefore, when confrontedwith a welter of mathematical detail, to follow the advice of Kelvinand keep asking the question: 'What is really going on？
 In line with this principle, we start, in 1.3, not with fully fledged MHD, but rather with a simple laboratory experiment. This consists ofa static magnetic field at right angles to a conducting rod which in turnslides along two conducting rails. Such an apparatus is commonly used inhigh schools to illustrate Faraday's law of induction. However, when thedynamics of the sliding rod are investigated we discover a lot more thanjust Faraday's law. In fact, this simple experiment illustrates many of thekey physical phenomena to be found in MHD. That is to say, a magneticfield, B, and a moving, conducting medium interact in such a way as torestrain the relative motion of the field and medium. We start our formal analysis in Chapters 2 and 3, where we set out thegoverning equations of MHD. These consist of the Navier-Stokes equation and a simplified version of Maxwelrs equations from which Gauss'slaw is omitted and displacement currents are neglected.In Chapter 4 we consider one half of the coupling between B and themedium. Specifically, we look at the influence of a prescribed fluid velocity, u, on the magnetic field without worrying about the origin of thevelocity field or the backreaction of the Lorentz force on the fluid. Ineffect, we take u to be prescribed, dispense with the Navier-Stokes equation, and focus on the r61e of u when using Maxwell's equations.We finally introduce dynamics in Chapters 5 and 6. We start, in Chapter 5, by considering weakly conducting or slowly moving fluidsin which the magnetic field greatly influences the motion of the conductorbut there is little back-reaction on the imposed magnetic field. This typifies much of liquid-metal MHD. Next, in Chapter 6, we consider highlyconducting, or rapidly moving, fluids in which the two-way coupling of Band u is strong. Here interest focuses on stability theory, which is important in plasma containment, and on dynamo theory, a phenomenon which is of considerable importance in geophysics. We end, in Chapter 7, with a discussion of MHD turbulence.

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