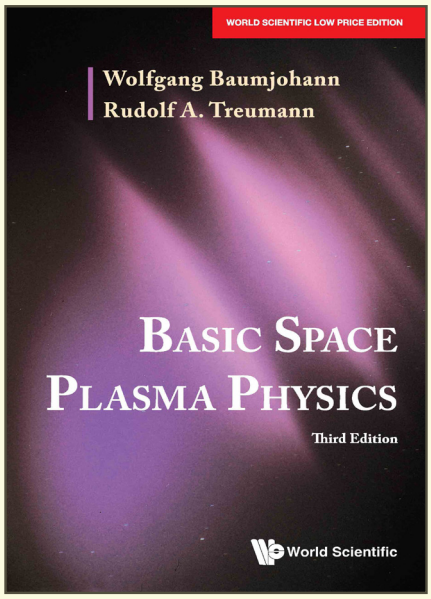
Basic Space Plasma Physics 3rd Edition



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ABOUT THE BOOK

This textbook describes Earth's plasma environment from single particle motion in electromagnetic fields, with applications to Earth's magnetosphere, up to plasma wave generation and wave-particle interaction. The origin and effects of collisions and conductivities are discussed in detail, as is the formation of the ionosphere, the origin of magnetospheric convection and magnetospheric dynamics in solar wind-magnetosphere coupling, the evolution of magnetospheric storms, auroral substorms, and auroral phenomena of various kinds.

The second half of the book presents the theoretical foundation of space plasma physics, from kinetic theory of plasma through the formation of moment equations and derivation of magnetohydrodynamic theory of plasmas. The validity of this theory is elucidated, and two-fluid theory is presented in more detail. This is followed by a brief analysis of fluid boundaries, with Earth's magnetopause and bow shock as examples. The main emphasis is on the presentation of fluid and kinetic wave theory, deriving the relevant wave modes in a high temperature space plasma. Plasma instability is the most important topic in all applications and is discussed separately, including a section on thermal fluctuations. These theories are applied to the most interesting problems in space plasma physics, collisionless reconnection and collisionless shock waves with references provided. The Appendix includes the most recent developments in the theory of statistical particle distributions in space plasma, the Kappa distribution, etc, also including a section on space plasma turbulence and emphasizing on new observational developments with a dimensional derivation of the Kolmogorov spectrum, which might be instructive for the student who may worry about its origin.

The book ends with a section on space climatology, space meteorology and space weather, a new application field in space plasma physics that is of vital interest when considering the possible hazards to civilization from space.

READERSHIP

Students, researchers and instructors focusing on space plasma, astronomy and astrophysics.

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