

Preface

The inner magnetosphere is an important region of space plasma because it is one of the “kitchens” for space weather effects. The scientific understanding of this region is important for predicting the interaction between space environmental conditions and human activities.

The inner magnetospheric plasma is a unique composition of different plasma particles and waves. It covers a huge plasma energy range with spatial and time variations of many orders of magnitude. In such a situation, the kinetic approach is the key element, and must be the starting point of a proper theoretical description of these inner magnetospheric plasma phenomena; a book dedicated to this particular area of research is required.

The kinetic theory of the inner magnetosphere has many different aspects and could not be described in one book. This particular book is based on my research and Space Plasma Physics and Advance Plasma Physics courses that I have delivered at different universities of the United States and Russia. The major topics in this book are: Kinetic Theory of Superthermal Electrons, Kinetic Foundation of the Hydrodynamic Description of Space Plasmas (including wave–particle interaction processes), and Kinetic Theory of the Terrestrial Ring Current.

The analytical solutions of simplified transport equations are the distinguishable features of this book. Approximate analytic solutions of transport phenomena are very useful because they help us gain physical insight into how the system responds to varying sources of mass, momentum, and energy and also to various external boundary conditions. They also provide us a convenient method to test the validity of complicated numerical models, a task that is usually tedious and time consuming.

This book provides a broad introduction to the theory of space plasma physics for students who intend to carry out independent research in upper atmospheric science and space physics. It is designed to provide a comprehensive description of the different kinds of transport equations for both plasma particles and waves with an emphasis on the applicability and limitations of each set of equations. It is hoped that this book will provide students and space researchers with an understanding of

how to determine the best approach to any upper atmospheric or space physics problem.

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George V. Khazanov

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Khazanov, G.V.

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