

## Earth's Proximal Space

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*Earth's Proximal Space: Plasma  
Electrodynamics and the Solar System*

by Chanchal Uberoi  
Universities Press (India) Ltd.  
3-5-819, Hyderguda  
Hyderabad 500 029  
2000, pp. 178, Price Rs 175

This is an excellent semi-popular book describing the near-space environment of the earth. Whereas there are numerous popular books written about the sun, stars, nebulae, black holes, galaxies and various aspects of astronomy and astrophysics, there has been a paucity of good popular books about space immediately surrounding our own planet. Thus the publication of this book is very timely. The advent of the space age and the advancement in the instrumentation techniques have helped mankind to see and understand the space near us. Over the past 4 decades, our knowledge about our space has increased tremendously and this book tries to convey the excitement of the new findings about our space environment with the help of beautiful pictures and diagrams.

The book describes in a lucid manner the structure of the atmosphere, its properties and its extent. The common belief held at the beginning of the century that the atmosphere extends to a few tens of km has undergone a drastic change. The earth's atmosphere extends up to the magnetopause, which acts

as a boundary between the earth and space. On the dayside this boundary is about 64,000 km, while on the night-side it could be much more. The entire atmosphere is contained in a cavity called the magnetosphere. The magnetosphere is formed by the interaction of the solar wind plasma (which is an ionized and highly conducting gas consisting mainly of electrons and protons) emitted from the sun with the geomagnetic field. The book gives an interesting account of how the solar wind was discovered and the history of the sun-earth plasma coupling. The most beautiful and attractive manifestation of this coupling is the brilliant auroral displays in high latitude regions in both the northern and southern hemispheres of the globe.

The earth's atmosphere occupies a volume of space some million times greater than the volume of the solid earth. In this huge system the charged particles of the plasma react strongly to the electric and magnetic fields. The book introduces the readers to the natural and man-made plasmas and various motions of the charged particles in the presence of magnetic and electric fields. The difficult concepts about magnetic reconnection, a process during which magnetic energy is released in the form of plasma kinetic energy involving change in magnetic field topology, and the dynamo theory that deals with the generation of magnetic field, are presented in a simple manner without recourse to mathematical equations. A mathematical supplement is provided for the benefit of those readers who may wish to know some of the mathematics that underlie the non-mathematical exposition. Some of the above concepts are necessary to understand how the

Reproduced from *Current Science*, Vol.80, No.9, p.1225, 2001.

mass, momentum and energy are transferred from the solar wind to the magnetosphere and the establishment of complex pattern of several current systems in the magnetosphere which dissipate this energy. Sub-storm is a phenomenon during which a huge amount of magnetic energy stored in the tail of the earth's magnetosphere is released in the form of plasma kinetic energy in an explosive manner.

The book clearly demonstrates that the earth's near-space environment is very much affected by the processes occurring in the sun. Eruptive processes like coronal mass ejections (CMEs) and solar flares occurring on the sun can distort the magnetosphere and cause geomagnetic storms. The level of geomagnetic activity is decided by the storm and sub-storm phenomena and both form an integral and crucial component of space weather. During geomagnetic storms and sub-storms, the magnetosphere is populated with intense fluxes of relativistic electrons and energetic protons, which can pose danger to the modern spacecrafts, astronauts, ground-to-satellite commercial and military telecommunication links and adversely affect the navigation services, exploration and can produce geomagnetically-induced harmful currents in long pipelines, power grids, etc. In view of this, space weather that relates essentially to the state of the sun, the solar wind and magnetosphere-ionosphere system, has gained great importance in many advanced countries like USA, Canada, Japan, France, Australia, Sweden, Taiwan and China, that have dedicated National Space Weather Programmes of their own.

The story of earth's proximal space does not end here; the reader is exposed to the magnetospheres of other planets, comets and heliosphere. In the eight chapters of this book, Uberoi has tried to explain in simple terms, without much technical jargon, the importance characteristics of solar wind, various regions of the magnetosphere and its current systems, magnetic pulsation and whistler waves, auroras, the impact of earth's near space on the technological systems and the flow of mass and energy from the sun to the earth and their subsequent coupling to the magnetosphere-ionosphere-thermosphere. Understanding of solar-terrestrial relationships has been an essential part of several international programmes like the International Solar Terrestrial Programme (ISTP), Geospace Environment Modelling (GEM), Solar Terrestrial Energy Programme (STEP), and presently the S-RAMP (STEP-Results, Applications and Modelling Phase), and NASA's Living with a Star Programme.

The book is written in a lucid style and it brings out the excitement of various interesting discoveries about our near-earth space. Readers with some knowledge of electrodynamics would be able to enjoy this book fully. The book has a lot to offer to science graduate students and teachers and even to the layman. The book could be a handy guide to the science managers and policy makers dealing with matters related to the near-earth space. The book is strongly recommended for college and institutional libraries dealing with some aspects of atmospheric and space sciences.

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