
Fundamental Astronomy



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Fundamental Astronomy

Fifth Edition
With 449 Illustrations
Including 34 Colour Plates
and 75 Exercises with Solutions

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Frontispiece: The Horsehead Nebula, officially called Barnard 33, in the constellation of Orion, is a dense dust cloud on the edge of a bright HII region. The photograph was taken with the 8.2 meter Kueyen telescope (VLT 2) at Paranal. (Photograph European Southern Observatory)

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Preface to the Fifth Edition

As the title suggests, this book is about fundamental things that one might expect to remain fairly the same. Yet astronomy has evolved enormously over the last few years, and only a few chapters of this book have been left unmodified.

Cosmology has especially changed very rapidly from speculations to an exact empirical science and this process was happening when we were working with the previous edition. Therefore it is understandable that many readers wanted us to expand the chapters on extragalactic and cosmological matters. We hope that the current edition is more in this direction. There are also many revisions and additions to the chapters on the Milky Way, galaxies, and cosmology.

While we were working on the new edition, the International Astronomical Union decided on a precise definition of a planet, which meant that the chapter on the solar system had to be completely restructured and partly rewritten.

Over the last decade, many new exoplanets have also been discovered and this is one reason for the increasing interest in a new branch of science – astrobiology, which now has its own new chapter.

In addition, several other chapters contain smaller revisions and many of the previous images have been replaced with newer ones.

Helsinki
December 2006

The Editors

Preface to the First Edition

The main purpose of this book is to serve as a university textbook for a first course in astronomy. However, we believe that the audience will also include many serious amateurs, who often find the popular texts too trivial. The lack of a good handbook for amateurs has become a problem lately, as more and more people are buying personal computers and need exact, but comprehensible, mathematical formalism for their programs. The reader of this book is assumed to have only a standard high-school knowledge of mathematics and physics (as they are taught in Finland); everything more advanced is usually derived step by step from simple basic principles. The mathematical background needed includes plane trigonometry, basic differential and integral calculus, and (only in the chapter dealing with celestial mechanics) some vector calculus. Some mathematical concepts the reader may not be familiar with are briefly explained in the appendices or can be understood by studying the numerous exercises and examples. However, most of the book can be read with very little knowledge of mathematics, and even if the reader skips the mathematically more involved sections, (s)he should get a good overview of the field of astronomy.

This book has evolved in the course of many years and through the work of several authors and editors. The first version consisted of lecture notes by one of the editors (Oja). These were later modified and augmented by the other editors and authors. Hannu Karttunen wrote the chapters on spherical astronomy and celestial mechanics; Vilppu Piirola added parts to the chapter on observational instruments, and Göran Sandell wrote the part about radio astronomy; chapters on magnitudes, radiation mechanisms and temperature were rewritten by

the editors; Markku Poutanen wrote the chapter on the solar system; Juhani Kyröläinen expanded the chapter on stellar spectra; Timo Rahunen rewrote most of the chapters on stellar structure and evolution; Ilkka Tuominen revised the chapter on the Sun; Kalevi Mattila wrote the chapter on interstellar matter; Tapio Markkanen wrote the chapters on star clusters and the Milky Way; Karl Johan Donner wrote the major part of the chapter on galaxies; Mauri Valtonen wrote parts of the galaxy chapter, and, in collaboration with Pekka Teerikorpi, the chapter on cosmology. Finally, the resulting, somewhat inhomogeneous, material was made consistent by the editors.

The English text was written by the editors, who translated parts of the original Finnish text, and rewrote other parts, updating the text and correcting errors found in the original edition. The parts of text set in smaller print are less important material that may still be of interest to the reader.

For the illustrations, we received help from Veikko Sinkkonen, Mirva Vuori and several observatories and individuals mentioned in the figure captions. In the practical work, we were assisted by Arja Kyröläinen and Merja Karsma. A part of the translation was read and corrected by Brian Skiff. We want to express our warmest thanks to all of them.

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Helsinki
June 1987

The Editors

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