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0521344026 - Introduction to Stellar Astrophysics: Basic Stellar Observations and Data, Volume 1

Erika Bohm-Vitense

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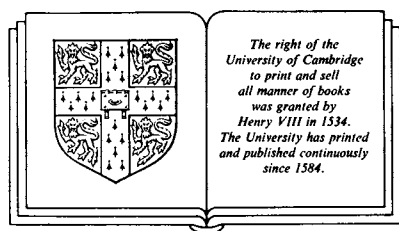
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Erika Böhm-Vitense

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Preface

The topic of this volume is stellar astronomy or more accurately stellar astrophysics. We call it astrophysics because all our knowledge about stars is based on the application of the laws of physics to the stars. We want to find out how big the stars are, how much mass they have, what material they are made of, how hot they are, how they evolve in time, and how they are distributed in space. The last question does not strictly belong to the field of stellar astrophysics but knowledge of stellar structure and evolution will provide a means by which to determine their distances. There are also important correlations, for instance, between the location and motion of the stars in our Galaxy and their physical properties.

In Volume 1, we shall be concerned mainly with finding out about the global properties of stars, such as brightnesses, colors, masses and radii. Brightnesses and colors can be measured directly for all stars, for masses and radii we have to study binaries. Parallax measurements can give us distances to nearby stars. We shall first discuss the majority of stars which we call normal stars. In the latter parts of this volume we shall also look at stars which seem to be different, the so-called ‘peculiar’ stars.

How can we get information, for instance, about the physical properties of the stars such as their temperatures, pressures, and chemical compositions? For most of the stars we have to get this information from that tiny little bit of light which we can receive. Only the sun gives us a lot of light to study, but even for this nearby star we get little more than just the light. For all the other stars it is only this tiny little dot of light that has to tell us all about the properties of the star from which it comes. It will be the topic of Volume 2 to study how we can do this.

In Volume 3 we will use theoretical considerations and the known laws of physics to derive the properties of stellar interiors, and discuss stellar evolution, as well as the origin of the chemical elements. We shall see which observations can tell us something about the structure of the insides of the stars.

The critical reader might wonder whether we are justified in applying the laws of physics, as we know them from our experiments on Earth, to the stars. How do we know whether the same laws apply to the stars? We really do not know. We can, however, try to understand the stellar observations, assuming that the same laws of physics hold. As long as we can do that and get sensible results, and if we can predict successfully the results of further observations we can feel that we are on the right track. Our space travel within the solar system so far has obeyed the laws of physics as we know them. Once we come to a point where we can see that the observations clearly contradict our earthly laws of physics we will have to make corrections. So far this has not been necessary, except that some refinements have been made. These refinements are, however, believed or proven to hold also in experiments on Earth, except that some effects are too small to be measurable in laboratory experiments. Our laboratories are too small to measure some effects such as the bending of a light beam in a gravitational field as predicted by the theory of general relativity. To measure these effects we need the largest laboratory which we can get, the universe.

The three volumes were written for students in their junior and senior years. They should be understandable by the educated layman with some basic knowledge of physics and mathematics.

I apologize for not giving all the references to the authors who have contributed to our present day knowledge of stars as described here. They would fill a large volume by themselves. I quote at the end only a few textbooks which also describe some of the observational results discussed here, and I list a number of reference books and tables which also give basic data about stars. I do list all the references from which figures and tables were used. Frequently these references are also textbooks or review articles which will lead the reader to a more detailed discussion than is possible in this short volume.

I am very much indebted to Dr G. Wallerstein for detecting several errors and weaknesses in the manuscript, and to Dr R. Schommer for a critical reading of the whole manuscript and for many helpful comments.

I am also very grateful for a JILA fellowship which permitted me to write most of this book. I acknowledge especially the help of the JILA secretaries with the typing of the manuscript.