

Preface

Rotation is often considered as a side effect in stellar evolution, a point not deserving more than a section at the end of a book. However, at each step from star formation to the final stages of evolution, rotation is present and in some cases even dominates the course of evolution, the timescales and the nucleosynthesis. This is in particular the case in star formation, where the initial angular momentum has to be reduced by a factor of 10^5 at least. Also during nuclear evolution the rotational instabilities drive internal mixing of the elements and rotation may enhance the mass loss rates. Recent works (see Chap. 29) even suggest that rotation is a dominant effect in the evolution and element synthesis of the first stars at zero and very low metallicities. Also, stellar rotation is an essential ingredient for the occurrence of gamma-ray bursts (GRBs). This is why here we thoroughly examine the basic mechanical and thermal effects of rotation during evolution, their influence on stellar winds, the effects of differential rotation and associated instabilities and the possible dynamos generated in rotating stars. Also, the observational signatures of rotational effects are numerous, first from spectroscopy and now also from interferometric observations, from chemical abundance determinations, from helioseismology and asteroseismology, etc.

To be useful at an introductory level, this book presents in a didactical way the basic concepts of stellar structure and evolution in chapters indicated by a star (★). These chapters form a basic course, while the other more specialized chapters form an advanced course. In general, I have given the step-by-step derivations of the analytical developments for the reader's comfort.

Three centuries ago, there were books covering all scientific domains, with even a touch of theology in addition. Then, science became more specialized. Half a century ago, there were still books, like the one by Pecker and Schatzman, able to present the whole astronomy at a specialized level. Nowadays, due to the explosion of scientific knowledge, it is becoming a considerable task to cover fields like stellar formation and evolution. Thus, despite the many subjects studied in this book, there are still many topics not treated here, in particular the properties of stellar remnants, which deserve full books (see for example [83] and [281]). The same applies to the evolution of binary stars, the fact they are not treated here does not mean that they have not a certain importance. Indeed, most effects studied here also find an application in binaries, however with a higher degree of complexity due to the interaction

with tidal mixing, tidal generation of gravity waves, transport of angular momentum and mass transfer.

As a consequence of the extraordinary vitality of astrophysics, the numerical models and observational results tend soon to become obsolete, being superseded by new results from more detailed computations and modern techniques. Therefore, I usually tried to emphasize the analytical results, which express the fundamental physics of the problem and fortunately are not aging in the same way. Numerical models, whenever presented, are given mainly for providing illustrations of the general properties. For specific applications, the last (and hopefully best) precise values are always recommended.

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Finally, I wish to the students in astrophysics and readers as much joy and fun in their attempts to discover and understand the processes which rule the stars as I have myself, whether it concerns astrophysics or all the other marvels of Nature.

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