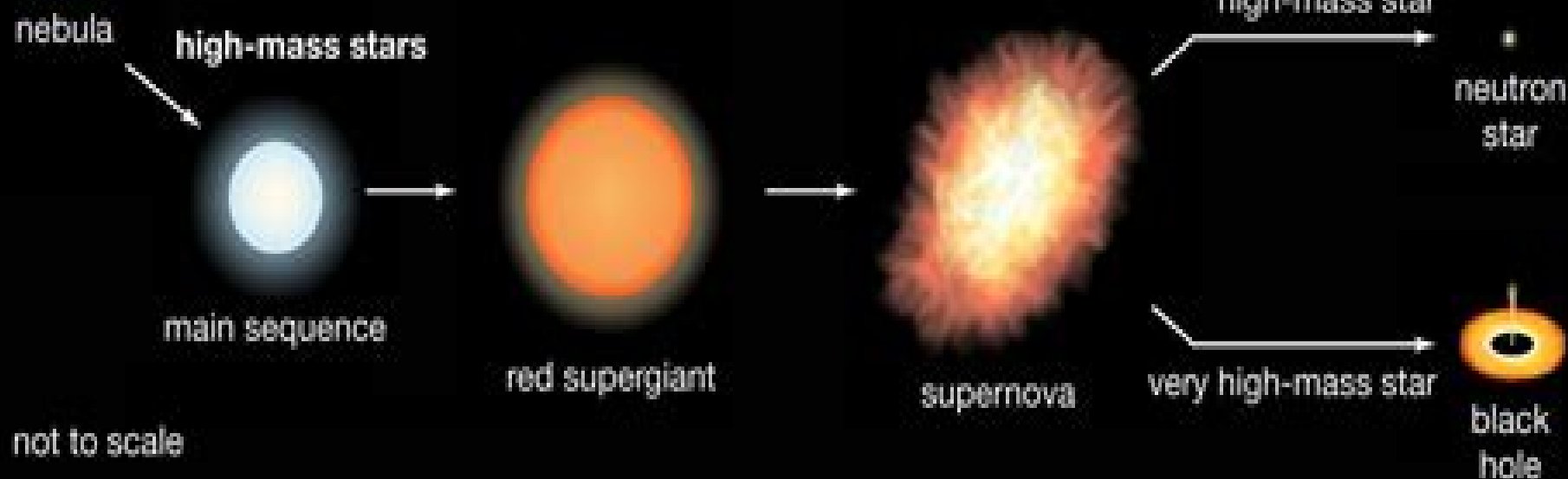


# Stellar evolution

low- and medium-mass stars  
(including the Sun)



high-mass stars



not to scale

# Stellar Structure And Evolution

**James MacDonald**



## **Stellar Structure And Evolution:**

Stellar Structure and Evolution Rudolf Kippenhahn, Alfred Weigert, Achim Weiss, 2012-10-31 This long awaited second edition of the classical textbook on Stellar Structure and Evolution by Kippenhahn and Weigert is a thoroughly revised version of the original text Taking into account modern observational constraints as well as additional physical effects such as mass loss and diffusion Achim Weiss and Rudolf Kippenhahn have succeeded in bringing the book up to the state of the art with respect to both the presentation of stellar physics and the presentation and interpretation of current sophisticated stellar models The well received and proven pedagogical approach of the first edition has been retained The book provides a comprehensive treatment of the physics of the stellar interior and the underlying fundamental processes and parameters The models developed to explain the stability dynamics and evolution of the stars are presented and great care is taken to detail the various stages in a star's life Just as the first edition which remained a standard work for more than 20 years after its first publication the second edition will be of lasting value not only for students but also for active researchers in astronomy and astrophysics

**Stellar Structure and Evolution** Onno Rudolf Pols, 2011 These lecture notes are intended for an advanced astrophysics course on Stellar Structure and Evolution given at Utrecht University NS AP434M Their goal is to provide an overview of the physics of stellar interiors and its application to the theory of stellar structure and evolution at a level appropriate for a third year Bachelor student or beginning Master student in astronomy Preface page iii

Stellar Interiors Carl J. Hansen, Steven D Kawaler, Virginia Trimble, 2004-02-26 The first edition of this text appeared in 1994 Shortly after the third printing our editor suggested that we attempt a second edition because new developments in stellar structure and evolution had made our original work outdated We the original authors CJH and SDK reluctantly agreed but with reservations due to the effort involved Our initial reluctance disappeared when we were able to convince cajole twist the arm of etc our new coauthor colleague Virginia Trimble to join us Welcome Virginia We i.e. all three of us hope that you agree that the present edition is a great improvement compared to the 1994 effort Our objectives in this edition are the same ones we set forth in 1994 What you will find is a text designed for our target audience the typical senior undergraduate or beginning graduate student in astronomy or astrophysics who wishes an overview of stellar structure and evolution with just enough detail to understand the general picture She or he can go on from there to more specialized texts or directly to the research literature depending on talent and interests To this end this text presents the basic physical principles without chasing all the interesting details For those of you familiar with the first edition you will find that some things have not been changed substantially For example Chapter 2 has been completely rewritten

**An Introduction to the Theory of Stellar Structure and Evolution** Dina Prialnik, 2000-07-24 Using fundamental physics the theory of stellar structure and evolution is able to predict how stars are born how their complex internal structure changes what nuclear fuel they burn and what their ultimate fate is a fading white dwarf or a cataclysmic explosion as a supernova

leaving behind a collapsed neutron star or black hole This lucid textbook provides students with a clear and pedagogical introduction to the theory of stellar structure and evolution It requires only basic physics and mathematics learnt in first and second year undergraduate studies and assumes no prior knowledge of astronomy The unique feature of this book is the emphasis throughout on the basic physical principles governing stellar evolution Exercises and their full solutions are included to help students test their understanding This textbook provides a stimulating introduction for undergraduates in astronomy physics planetary science and applied mathematics taking a course on the physics of stars     Structure and Evolution of Stars Martin Schwarzschild,2015-12-08 With the development of nuclear physics the theory of the stellar interior entered a new phase Many new investigations have been conducted and the results published in a variety of specialized media This book brings these results together in a single volume and summarizes the present status of the theory of stellar evolution Originally published in 1958 The Princeton Legacy Library uses the latest print on demand technology to again make available previously out of print books from the distinguished backlist of Princeton University Press These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905     *Stellar Structure and Evolution* Marc Pinsonneault,Barbara Ryden,2023-04-06 Stellar Structure and Evolution the second volume in the Ohio State Astrophysics Series takes advantage of our new era of stellar astrophysics in which modern techniques allow us to map the interiors of stars in unprecedented detail This textbook for upper level undergraduate and graduate students aims to develop a broad physical understanding of the fundamental principles that dictate stellar properties The study of stellar evolution focuses on the life cycle of stars how they are born how they live and how they die As elements ejected by one generation of stars are incorporated into the next generation stellar evolution is intertwined with the chemical evolution of our galaxy Focusing on key physical processes without going into encyclopedic depth the authors present stellar evolution in a contemporary context including phenomena such as pulsations mass loss binary interactions and rotation which contribute to our understanding of stars     *The Structure And Evolution Of Stars* J J Eldridge,Christopher Adam Tout,2018-12-06 Stars are the fundamental observable constituents of the Universe They are the first objects we see in the night sky they dominate the light produced in our own and other galaxies and nucleosynthesis in stars produces all the elements heavier than helium A knowledge of stars and their evolution is vital to understand other astrophysical objects from accreting black holes and galaxies to the Universe itself The structure of a star can be described mathematically by differential equations derived from the principles of hydrodynamics electromagnetic theory thermodynamics quantum mechanics atomic and nuclear physics The basic equations of a spherical star are derived in detail at an accessible level The topics discussed include modes of energy transport the equation of state the physics of the opacity sources and the nuclear reactions Attention is also given to

the virial theorem polytropic gas spheres and homology principles and the procedure for numerical solution of the equations is outlined This book tracks the evolution of stars from their main sequence evolution through the exhaustion of various nuclear fuels to the end points of evolution and also introduces the topic of interacting binary stars The aim is to take the reader from the essential underlying physical principles to the doors to current research on stellar interiors

*Introduction to Stellar Structure* Walter J. Maciel, 2015-09-16 This book provides a comprehensive overview of stellar structure evolution and basic stellar properties It includes integrated problems within the chapters with worked solutions In the first part of this book the author presents the basic properties of the stellar interior and describes them thoroughly along with deriving the main stellar structure equations of temperature density pressure and luminosity among others The process and application of solving these equations is explained as well as linking these results with actual observations The second part of the text describes what happens to a star over time and how to determine this by solving the same equations at different points during a star's lifetime The fate of various stars is quite different depending on their masses and this is described in the final parts of the book This text can be used for an upper level undergraduate course or an introductory graduate course on stellar physics

*Introduction to Stellar Astrophysics: Volume 3* Erika Böhm-Vitense, 1989 This book is the final one in a series of three texts which together provide a modern complete and authoritative account of our present knowledge of the stars It discusses the internal structure and the evolution of stars and is completely self contained There is an emphasis on the basic physics governing stellar structure and the basic ideas on which our understanding of stellar structure is based The book also provides a comprehensive discussion of stellar evolution Careful comparison is made between theory and observation and the author has thus provided a lucid and balanced introductory text for the student As for volumes 1 and 2 volume 3 is self contained and can be used as an independent textbook The author has not only taught but has also published many original papers in this subject Her clear and readable style should make this text a first choice for undergraduate and beginning graduate students taking courses in astronomy and particularly in stellar astrophysics

**Stellar Structure and Evolution** Rudolf Kippenhahn, Alfred Weigert, 1994-07-28 A complete and comprehensive treatment of the physics of the stellar interior and the underlying fundamental processes and parameters The text presents an overview of the models developed to explain the stability dynamics and evolution of the stars and great care is taken to detail the various stages in a star's life The authors have succeeded in producing a unique text based on their own pioneering work in stellar modeling Since its publication this textbook has come to be considered a classic by both readers and teachers in astrophysics This study edition is intended for students in astronomy and physics alike

*The Physics of Stars* A. C. Phillips, 2013-06-05 *The Physics of Stars* Second Edition is a concise introduction to the properties of stellar interiors and consequently the structure and evolution of stars Strongly emphasising the basic physics simple and uncomplicated theoretical models are used to illustrate clearly the connections between fundamental physics and stellar properties This text does not intend to be encyclopaedic rather it tends

to focus on the most interesting and important aspects of stellar structure evolution and nucleosynthesis In the Second Edition a new chapter on Helioseismology has been added along with a list of physical constants and extra student problems There is also new material on the Hertzsprung Russell diagram as well as a general updating of the entire text It includes numerous problems at the end of each chapter aimed at both testing and extending student's knowledge

*Stellar Structure and Evolution* Saurabh Vasishta, 2025-02-20 *Stellar Structure and Evolution* A Comprehensive Guide is an essential textbook crafted for undergraduate students and enthusiasts of astrophysics We take readers on an enlightening journey through the life cycles of stars from their formation in stellar nurseries to their spectacular ends as supernovae Blending theoretical knowledge with practical insights our guide covers hydrodynamics radiative transfer nuclear reactions and the broader implications of stellar evolution on the cosmos Designed to be both technically enriching and accessible this book encourages readers to delve into the mathematical foundations and observational techniques that reveal the mysteries of stars Real world examples and case studies are woven throughout to enhance understanding and application of the concepts With clear explanations and a focus on fostering a comprehensive grasp of the subject *Stellar Structure and Evolution* is an indispensable companion for anyone eager to explore the captivating world of stellar phenomena

**Introducing the Stars** Martin Beech, 2019-03-28 This textbook introduces the reader to the basic concepts and equations that describe stellar structure Various approximation techniques are used to solve equations and an intuitive rather than rigorous approach is employed to interpret the properties of the stars The book provides step by step instructions helpful exercises and relevant historical lessons to familiarize students with key concepts and mathematical theories Based upon a series of one semester 12 weeks elective undergraduate courses offered at the University of Regina this book is intended for students who are interested in seeing how basic calculus and introductory physics can be applied to the understanding of the stars from their formation to their death The text provides an intermediate stepping stone between lower level undergraduate classes and more specialized postgraduate texts on the subject of stellar structure

**Introduction to Stellar Astrophysics: Stellar structure and evolution** E. Böhm-Vitense, 1989 *Stars & Stellar evolution* Klaas de Boer, 2009-02-12T00:00:00+01:00 The diverse forms that stars assume in the course of their lives can all be derived from the initial conditions the mass and the original chemical composition In this textbook *Stars and Stellar Evolution* the basic concepts of stellar structure and the main roads of stellar evolution are described First the observable parameters are presented which are based on the radiation emerging from a stellar atmosphere Then the basic physics is described such as the physics of gases radiation transport and nuclear processes followed by essential aspects of modelling the structure of stars After a chapter on star formation the various steps in the evolution of stars are presented This leads us to brown dwarfs to the way a star changes into the red giant state and numerous other stages of evolution and ultimately to the stellar ashes such as white dwarfs supernovae and neutron stars Stellar winds stellar rotation and convection all influence the way a star evolves The evolution of binary stars is

included by using several canonical examples in which interactive processes lead to X ray binaries and supernovae of type Ia Finally the consequences of the study of stellar evolution are tied to observed mass and luminosity functions and to the overall evolution of matter in the universe The authors aim at reaching an understanding of stars and their evolution by both graduate students and astronomers who are not themselves investigating stars To that end numerous graphs and sketches among which the Hertzsprung Russell diagram is the dominant one help trace the ways of stellar evolution Ample references to specialised review articles as well as to relevant research papers are included

**Structure and Evolution of Single Stars** James MacDonald, 2015-12-01 Structure and Evolution of Single Stars An introduction is intended for upper level undergraduates and beginning graduates with a background in physics Following a brief overview of the background observational material the basic equations describing the structure and evolution of single stars are derived The relevant physical processes which include the equation of state opacity nuclear reactions and neutrino losses are then reviewed Subsequent chapters describe the evolution of low mass stars from formation to the final white dwarf phase The final chapter deals with the evolution of massive stars

The Life of Stars Giora Shaviv, 2009-10-03 It is the stars The stars above us govern our conditions William Shakespeare King Lear A Few Words about What Why and How The structure of the stars in general and the Sun in particular has been the subject of extensive scientific research and debate for over a century The discovery of quantum theory during the latter half of the nineteenth century provided much of the theoretical background needed to understand the making of the stars and how they live off their energy source Progress in the theory of stellar structure was made through extensive discussions and controversies between the giants of the field as well as brilliant discoveries by astronomers In this book we shall carefully expose the building of the theory of stellar structure and evolution and explain how our understanding of the stars has emerged from this background of incessant debate About hundred years were required for astrophysics to answer the crucial questions What is the energy source of the stars How are the stars made How do they evolve and eventually die The answers to these questions have profound implications for astrophysics physics and biology and the question of how we ourselves come to be here While we already possess many of the answers the theory of stellar structure is far from being complete and there are many open questions for example concerning the mechanisms which trigger giant supernova explosions Many internal hydrodynamic processes remain a mystery Yet some global pictures can indeed be outlined and this is what we shall attempt to do here

Stellar Evolution Amos Harpaz, 1993-06-15 This book addresses the fascinating subject of astrophysics from its theoretical basis to predominant research conducted in the field today An accomplished researcher in the field and a well known expositor the author strikes a balance that allows the serious reader to appreciate the current issues without previous knowledge of the subject Astronomy and Astrophysics The Equations of Stellar Structure The Gas Characteristics The Structure of a Star Computation of Stellar Evolution Evolutionary Track Binary Systems Star Formation Rotation of Stars Supernova Close Binary Systems Special

Topics The Galaxy      **The Stars** Roger John Tayler, 1994-06-23 This text examines how knowledge of many branches of physics can help provide an understanding of the structure and evolution of stars Topics covered include observational properties of stars equations that govern their structure and recent theoretical work on stellar evolution      **Stellar Structure and Evolution** Mark A. Stull, 1967



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