1. Record Nr. UNINA9910746286503321

Autore	Benhar Omar
Titolo	Structure and dynamics of compact stars / / Omar Benhar
Pubbl/distr/stampa	Cham, Switzerland : , : Springer International Publishing AG, , [2023] ©2023
ISBN	3-031-35628-4
Edizione	[First edition.]
Descrizione fisica	1 online resource (xi, 169 pages) : illustrations (some color)
Collana	Lecture Notes in Physics Series
Disciplina	523.887
Soggetti	Compact objects (Astronomy)
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Intro -- Preface -- Contents -- Acronyms -- Physical and Astronomical Constants -- Part I White Dwarfs -- 1 The Prototype Compact Star -- 1.1 Discovery of White Dwarfs -- 1.2 Formation of White Dwarfs -- 1.3 Properties of the Degenerate Fermi Gas -- 1.3.1 Energy Density -- 1.3.2 Pressure -- 1.3.3 Relativistic Regime -- 1.4 Significance of the Equation of State -- 1.5 Equation of State of White Dwarf Matter -- 1.6 Equilibrium of White Dwarfs and Chandrasekhar Limit -- Part II Neutron Stars -- 2 Neutron Star Structure -- 2.1 Discovery of Neutron Stars -- 2.2 Overview of Neutron Star Composition -- 2.2.1 Outer Crust -- Inverse -decay -- Neutronisation -- 2.2.2 Inner Crust -- Superfluidity and Superconductivity -- 3 The Neutron Star Core -- 3.1 Preamble -- 3.2 Constraints on the Nuclear Matter EOS -- 3.3 Microscopic Models of the Nuclear Matter EOS -- 3.3.1 Empirical Information on Nuclear Forces -- 3.3.2 The Nucleon-Nucleon Interaction -- 3.3.3 Irreducible Three-Nucleon Interactions -- 3.3.4 Non Relativistic Nuclear Many-Body Theory -- The Nuclear Many-Body Problem -- 3.3.5 Nuclear Matter Theory -- G-Matrix Perturbation Theory -- CBF Perturbation Theory -- The Equation of State of Akmal Pandharipande and Ravenhall -- 3.3.6 Relativistic Approaches -- The Relativistic Nuclear Hamiltonian -- 3.3.7 The - Model -- 3.4 The Equation of State of Charge-Neutral -Stable Matter -- Appendix 1: Speed of Sound in Matter and Causality -- Appendix 2: Derivation of Yukawa's OPE Potential -- The Two-Nucleon System -- The Two-Nucleon Interaction -- 4 Exotic Forms of Matter -- 4.1 Stability of Strange Baryonic Matter -- 4.1.1

Hyperon Interactions -- 4.2 Deconfinement and Quark Matter -- 4.2.1 The MIT Bag Model -- 4.2.2 The Equation of State of Quark Matter -- 4.3 The Nuclear Matter-Quark Matter Phase Transition -- 4.3.1 Coexisting Phases vs Mixed Phase.
4.3.2 Stability of the Mixed Phase -- 4.3.3 Strange Stars -- Appendix: Partition Function of Fermion Systems -- 5 Neutrino Emission from Neutron Stars -- 5.1 Direct Urca Process -- 5.1.1 Threshold of the Direct Urca Process -- 5.2 Modified Urca Processes -- 5.2.1 Neutron Branch -- 5.2.2 Proton Branch -- 5.3 Neutrino Bremsstrahlung in Nucleon-Nucleon Collisions -- Appendix 1: Neutron -Decay Rate -- Appendix 2: Rate of the Direct Urca Process -- Calculation of A -- Calculation of I -- 6 Neutron Star Structure and Dynamics -- 6.1 Hydrostatic Equilibrium -- 6.2 Cooling -- 6.3 Tidal Deformation in Coalescing Binary Systems -- 6.4 Neutron Star Oscillations -- Part III Multimessenger Neutron Star Astronomy -- 7 Observational Constraints on Theoretical Models -- 7.1 The Golden Age of Neutron Stars -- 7.2 Measurements of Mass and Radius -- 7.3 Measurements of the Tidal Deformability -- 7.4 Measurements of Neutron Star Cooling -- 7.5 Towards Multimessenger Astronomy -- References -- Index.

Sommario/riassunto

This book aims at providing an accessible, and yet comprehensive and self-contained discussion of compact stars. After a pedagogical introduction to the physics of white dwarfs, the bulk of the book is devoted to the analysis of the structure and dynamics of neutron stars. A great deal of emphasis is placed on the dynamical models underlying the description of neutron star matter at microscopic level. The analysis of these models is inherently cross-disciplinary - from nuclear and particle physics to astrophysics and condensed matter physics and the relevant concepts are introduced following a didactic approach, drawing largely on the historical development of the field. The impact of the latest experimental data, such as gravitational waves emissions, and the potential of future observational developments in the new era of multimessenger astronomy are extensively discussed. This volume is intended to provide PhD students in physics and astrophysics with solid foundations for their future research career. It is also a useful tool for the broader audience of more advanced readers, working in the fields of nuclear and particle physics as well as gravitational physics.