COMPACT STELLAR X-RAY SOURCES

X-ray astronomy provides the main window onto astrophysical compact objects such as black holes, neutron stars and white dwarfs. In the past ten years new observational opportunities have led to an explosion of knowledge in this field. In sixteen chapters, written by leading experts, this book provides a comprehensive overview of the observations and astrophysics of X-ray emitting stellar-mass compact objects.

Topics discussed in depth include the various phenomena exhibited by compact objects in binary systems such as X-ray bursts, relativistic jets and quasi-periodic oscillations, as well as gamma-ray burst sources, super-soft and ultra-luminous sources, isolated neutron stars, magnetars and the enigmatic fast transients. The populations of X-ray sources in globular clusters and in external galaxies are discussed in detail. This is an invaluable reference for both graduate students and active researchers.

WALTER LEWIN is Professor of Physics at MIT. A native of The Netherlands, Professor Lewin received his Ph.D. in Physics from the University of Delft (1965). In 1966, he went to MIT as a postdoctoral associate in the Department of Physics and was invited to join the faculty as Assistant Professor later that same year. He was promoted to Associate Professor of Physics in 1968 and to full Professor in 1974. Professor Lewin's honors and awards include the NASA Award for Exceptional Scientific Achievement (1978), twice recipient of the Alexander von Humboldt Award (1984 and 1991), a Guggenheim Fellowship (1984), MIT's Science Council Prize for Excellence in Undergraduate Teaching (1984), the W. Buechner Teaching Prize of the MIT Department of Physics (1988) and the Everett Moore Baker Memorial award for excellence in undergraduate teaching (2003). In 1997, he was the recipient of a NASA Group Achievement Award for the Discovery of the Bursting Pulsar. He is a corresponding member of the Royal Netherlands Academy of Arts and Sciences (elected 1993) and Fellow of the American Physical Society.

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Preface

Extra-solar X-ray astronomy began with the historical paper in *Physical Review Letters* by Giacconi, Gursky, Paolini, and Rossi (1962). Now, more than four decades later, X-ray astronomy is central to many aspects of astronomy. In 2002, Riccardo Giacconi was awarded the Nobel Prize in Physics "for pioneering contributions to astrophysics, which have led to the discovery of cosmic X-ray sources". In the decade since the publication of *X-ray Binaries* – the predecessor of the present book – the study of compact stellar X-ray sources has received enormous impetus from observations with the BeppoSAX, Rossi X-ray Timing Explorer (RXTE), Chandra, and XMM-Newton X-ray observatories. In addition, many exciting new results on these X-ray sources have also been produced in the radio, infrared, optical and ultraviolet bands. Highlights include the discovery in low-mass X-ray binaries of millisecond X-ray pulsations, confirming the connection with the millisecond radio pulsars. Millisecond and sub-millisecond quasi-periodic oscillations (QPO) were discovered that are thought to provide a direct view of regions of strong-field gravity near neutron stars and black holes. The discovery of X-ray, optical and radio afterglows of gamma-ray bursts (GRB) firmly established their long-suspected cosmological distances. Super-luminal motion of radio jets was discovered in accreting black-hole binaries. Dozens of ultra-luminous X-ray sources (ULX) have been detected in many galaxies. Their origin is still not clear; some may be accreting intermediate-mass (i.e., of order 10^3 $M_\odot$) black holes (IMBH). Great progress was also made in our understanding of the soft gamma-ray repeaters (SGR) and anomalous X-ray pulsars (AXP). We now know that they are "magnetars", neutron stars with magnetic dipole fields of enormous strength ($10^{14}-10^{15}$ G). This book is a comprehensive and up-to-date survey on compact stellar X-ray sources written by leading experts in the field. It covers in detail the recent developments in X-ray and multi-wavelength observations, and the theory behind them.