

Preface

Black holes are thought to be the final product of the complete gravitational collapse of massive bodies. In the framework of standard physics, the spacetime metric around astrophysical black holes should be well approximated by the Kerr solution. However, macroscopic deviations from standard predictions may be expected from a number of scenarios beyond Einstein's theory of general relativity. Astrophysical black holes are thus an ideal laboratory for testing strong gravity.

The main aim of this book is to discuss the electromagnetic techniques to study the strong gravity region around astrophysical black holes. For completeness, gravitational wave methods will be also reviewed, but only very briefly and without the necessary details to start working on the corresponding line of research. This book has not the ambition to be a complete manual on this research field. Hopefully, it may be a good starting point. The reader should be already familiar with the theory of general relativity (at a more advanced level than that one can learn in an introductory course in an undergraduate program), while it is not required a background in astronomy/astrophysics.

Chapters 1–5 provide a general introduction on some basic concepts. Some topics are not necessary to understand the rest of the book (in particular some topics in Chap. 2), and in such a case they are briefly reviewed without many details, but they may be useful to get a complete overview of current knowledge on black holes. Chapters 6–11 are the core of the book. Chapters 6–10 discuss the main techniques to test astrophysical black holes with electromagnetic radiation. Chapter 11 briefly reviews the approaches available with gravitational waves. Chapters 12–14 summarize the state of the art of tests of the Kerr black hole hypothesis. Appendices A–F provide more details on some particular calculations, briefly discuss some related topics not covered in Chaps. 1–14, or summarize some useful formulas. The Glossary at the end of the book can be useful to learn/recall some quite common terms.

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