

Preface

This volume aims at providing a pedagogical review on recent developments and applications of black hole physics in the context of high energy physics and cosmology. The contributions are based on lectures delivered at the school “Theoretical Frontiers in Black Holes and Cosmology”, held at the “International Institute of Physics” (IIP) in Natal, Brazil, in June 2015. The lectures give a panoramic view of mainstream research lines sharing black hole solutions to gravity and supergravity as common denominator. Starting with accessible and introductory concepts, the newcomer to the field will be brought to a level suitable to face cutting-edge research in the various topics considered in this book.

The only prerequisite for the reader is a working knowledge in field theory and group theory, and the knowledge of general relativity and supersymmetry is desirable. The primary audience is intended to be postgraduate students but the well-established techniques presented in this volume forms a useful review for any scientist working in the field. The selection of authors has been based on worldwide recognized contributions on geometric approaches to fundamental problems in the field of black hole physics.

The book is organized as follows: Chapter “[Three Lectures on the FGK Formalism and Beyond](#)” introduces the key role of dualities and the attractor mechanism in the context of singular solutions in ungauged supergravities. These concepts are further developed in Chap. “[Introductory Lectures on Extended Supergravities and Gaugings](#)”, which is a review of the present methods to build up a gauged supergravity. A basic knowledge on how to gauge a supergravity is the necessary ingredient for Chap. “[Supersymmetric Black Holes and Attractors in Gauged Supergravity](#)” that deals with the construction of black hole solutions in a gauged supergravity. The relevance of these solutions is due to applications to gauge/gravity duality, where black hole backgrounds in the bulk are used to model finite temperature condensed matter systems on the boundary. In this framework, the asymptotical AdS space, generated by the gauging procedure, provides the right symmetries to describe a conformal system on the boundary. These first three contributions are intended to be a primer for the community of scientists working in

the field of gauge/gravity duality that want to embed more complicated bulk backgrounds in the holographic settings. In Chap. “[Lectures on Holographic Renormalization](#)”, we selected the holographic renormalization among the many topics in gauge/gravity duality, due to the strong overlapping with techniques used to find the scalar flows for black holes backgrounds in supergravity. Chapter “[Nonsingular Black Holes in Palatini Extensions of General Relativity](#)” introduces the reader to a different formulation of gravity based on metric-affine spaces. This approach allows to remove the singularity of general relativity giving rise to a wormhole structure. Finally, Chap. “[Inflation: Observations and Attractors](#)” is an introduction to inflation both from theoretical and experimental points of view, aimed at describing the role of cosmological attractors for inflationary model building.

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