# Preface

Controlling the behaviour of the solutions to Einstein's field equations on large scales is still the most important technical task in classical general relativity. The long standing problem of 'cosmic censorship' will not be resolved without a sufficiently general and deep understanding of the solutions. The unexpected emergence of the Bartnik-McKinnon solutions and Choptuik's disclosure of critical collapse phenomena show us that Einstein's theory still has surprises in store.

The last two discoveries also demonstrate clearly the important role of numerical techniques in the analysis of specific solutions and in the study of the manifold of solutions. The interplay of analytical with numerical methods is bound to become the most important strategy in exploring the content of the theory.

Moreover, since various projected gravitational wave antennae will soon become operational, templates with gravitational waves forms will urgently be needed for analysing the recorded data. This makes the interaction between analytical and numerical techniques a most exciting and important project, because it may help open new vistas of our universe. The fact that the calculation of the form of gravitational waves generated by astrophysical processes turned out so much more difficult than expected hints at a lack of insight into the analytical basis of the theory or at an insufficient exploitation of the present analytical knowledge.

Any general analysis of asymptotically flat space-times in the large needs to take into account the causal and the underlying null cone or conformal structure of the field. These structures should thus also be critical in the semi-global or global numerical calculation of space-times. Not surprisingly, the two numerical techniques presently used to perform such calculations, the characteristic method and the method based on the conformal field equations, employ basic features of the conformal structure in the definition of their procedures.

The analytical and the numerical methods both offer possibilities not accessible to the other one, and each of them asks questions and poses problems likely to initiate interesting research with the other method. For researchers in the fields to get an insight into the potential and the problems of the other field, we therefore organized a workshop on analytical, geometrical, and numerical studies which make explicit use of conformal or related structures. This book contains extended versions of the contributions to this workshop.

Following the suggestion of the publisher we tried to avoid the traditional style of proceedings and aimed at a book which will help a newcomer find access to the field, which offers new results to the experienced researcher, and which provides a comprehensive source of references. In particular, one of us (H.F.) wrote an extensive introductory chapter in which he tries to introduce the newcomer to the field and to provide a general perspective by pointing our the relations to the other studies represented here.

Because this perspective may be clouded by the author's ignorance and personal taste, however, we do urge the reader to understand these references as an encouragement to carefully study those articles themselves. The intricate net of relations between the different parts of the work discussed in this book will then become evident. A complete picture of the present situation can only be obtained by trying to understand the full scope of those articles and the specific views of their author's. Were different opinions occur the reader is invited to search for solutions of the corresponding open problems.

While we have tried to maintain to some extent the division of this area of research into the three subfields indicated in the title of this book, it is clear that the assignment of a single article to any of these subfields is not sharply defined. This fact should be seen as a virtue since it was the expressed purpose of the workshop to have researchers in different areas interact with each other and see how they can profit by viewing their subject from different perspectives.

There remains the pleasant task to thank the speakers and the participants for helping create an inspiring atmosphere at the workshop and the contributors of these proceedings for helping create a picture of the present situation of the field which illustrates its richness and its potential.

We also thank the Deutsche Forschungsgemeinschaft and the 'Unibund' of the University of Tübingen for their financial support. It is a pleasure to thank Prof. Hanns Ruder for his support and Heike and Bettina Fricke for their help in administrative matters during and after the workshop. Finally, we acknowledge help from T. Müller, A. King and M. King during the preparation of this book.

Tübingen and Golm,
June 2002

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