Ammon, Martin; **Erdmenger, Johanna**
Gauge/gravity duality. Foundations and applications. (English) ⎡Zbl 1327.81001⎤
Cambridge: Cambridge University Press (ISBN 978-1-107-01034-5/hbk; 978-0-511-84637-3/ebook). xiii, 533 p. (2015).

This comprehensive textbook is unique in that it provides not only a thorough introduction to gauge/gravity duality – with the celebrated AdS/CFT correspondence as its most prominent example –, but gives also a survey of its most important applications that have arisen up to about 2012. In principle the book is self- contained, which is not an easy task even for a volume of 500+ pages given that its subject involves all major disciplines of physics – not only quantum field theory and general relativity, but also thermodynamics, hydrodynamics and condensed matter physics. Therefore the first of the three parts of the book, entitled Prerequisites, consists of chapters on elements of field theory, elements of gravity, symmetries in quantum field theory, and an introduction to superstring theory. As the presentation is rather concise, the sections on further reading concluding each chapter will be helpful especially to graduate students and researchers from neighbouring areas. Similarly helpful will be the exercises interwoven in the text. Both further readings and exercises are also contained in all other chapters of the book. The subjects of Grassmann numbers and Lie algebras and superalgebras are delegated to two Appendices after the main text. There is also an index at the end of the book.

Part II, which has the same title as the book, introduces the AdS/CFT correspondence and various generalizations thereof, in particular to non-conformal field theories and the finite-temperature case (which is obtained by considering a black hole in Anti-de Sitter space), as well as the important notion of holographic renormalisation group flows. It contains also material on a more advanced level that is not a prerequisite for Part III and may therefore be skipped on first reading. Part III is devoted to applications and starts with a chapter on linear response theory and hydrodynamics. Their implementation in gauge/gravity duality provides the tools for calculating transport coefficients, the most famous example being the shear viscosity to entropy ratio as its theoretical prediction matches the experimental results obtained for the quark-gluon plasma (showing it to be the "most perfect" liquid). Although an exact dual of QCD is not known, various aspects of this fundamental theory of the strong interactions can be reproduced by gauge/gravity duality as discussed in subsequent chapters. The final chapter deals with subjects relevant to condensed matter physics such as quantum phase transitons, holographic superconductors and entanglement entropy. Of particular interest for future applications is the extension of the duality to nonrelativistic systems using the concepts of Schrödinger and Lifshitz spacetime.

All in all one cannot be but impressed by the accomplishment achieved by the authors in writing this book as well as by the accomplishments of the research area they describe. Surely gauge/gravity duality constitutes a decisive progress in the understanding of strongly coupled systems encountered in many different areas of physics.

Reviewer: Helmut Rumpf (Wien)

MSC:

81-01	Introductory exposition (textbooks, tutorial papers, etc.) pertaining to quantum theory	Cited in **1** Review
81T13	Yang-Mills and other gauge theories in quantum field theory	Cited in **62** Documents
81T30	String and superstring theories; other extended objects (e.g., branes) in quantum field theory	
81T40	Two-dimensional field theories, conformal field theories, etc. in quantum mechanics	
81T60	Supersymmetric field theories in quantum mechanics	
83E30	String and superstring theories in gravitational theory	
83E50	Supergravity	
82D15	Statistical mechanics of liquids	
82D50	Statistical mechanics of superfluids	
82D55	Statistical mechanics of superconductors	
81V17	Gravitational interaction in quantum theory	

Keywords:

Full Text: DOI