Preface

This book is a pedagogical introduction to supergravity. Supergravity is a gravitational field theory that includes supersymmetry (symmetry between bosons and fermions) and is a generalization of Einstein's general relativity. Supergravity provides a low energy effective theory of superstring theory, which has attracted much attention as a candidate for the unified theory of fundamental particles, and it is a useful tool for studying nonperturbative properties of superstring theory such as D-branes and string duality.

This work considers classical supergravities in four and higher dimensional spacetime with their applications to superstring theory in mind. More concretely, it discusses classical Lagrangians (or field equations) and symmetry properties of supergravities. Besides local symmetries, supergravities often have global non-compact symmetries, which play a crucial role in their applications to superstring theory. One of the main features of this book is its detailed discussions of these non-compact symmetries.

The aim of the book is twofold. One is to explain the basic ideas of supergravity to those who are not familiar with it. Toward that end, the discussions are made both pedagogical and concrete by stating equations explicitly. The other is to collect relevant formulae in one place so as to be useful for applications to string theory. They include the lists of possible types of spinors in each dimension, field contents of supergravities, and global symmetries of supergravities.

Most of the discussions are restricted to pure supergravities without matter couplings. An exception is a coupling to the super Yang–Mills multiplet in ten dimensions. Supergravities in lower than four dimensions are not considered. There are many other issues on supergravity which are not discussed in this book. For those issues, consult the references given at the end of Sect. 1.1.

The plan of the book is as follows. In Chap. 1, we first explain a role of supergravity in superstring theory briefly, and then review the formulations of the gravitational field and other fields coupled to it. In Chap. 2, we discuss supergravities in four dimensions in details. Much of the properties of supergravities in higher dimensions already appear in four dimensions. In Chap. 3, we discuss superalgebras and supermultiplets in general dimensions and give the lists of possible types of supergravities and their field contents. In Chap. 4, we consider global non-compact symmetries in supergravities, which are useful in understanding the structure of scalar fields. The non-compact symmetry in

supergravities is sometimes realized as a duality symmetry of vector or antisymmetric tensor fields, which is a generalizations of the electric–magnetic duality in Maxwell's equations. In Chap. 5, we consider supergravities in higher dimensions. In particular, the Lagrangians (or field equations) and the symmetry properties of supergravities in 11 and 10 dimensions are discussed in details. In Chap. 6, we consider dimensional reductions of supergravities in eleven and ten dimensions to lower dimensions in order to understand the origins of the global non-compact symmetries. Finally, in Chap. 7, we consider gauged supergravities, which have minimal couplings to vector gauge fields, and massive supergravities similar to them. Notation and conventions used in this book are summarized in Appendix A. Formulae of gamma matrices and spinors in general dimensions are collected in Appendix B.

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