GAUGE GRAVITATION THEORY

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PREFACE

Gauge theory is generally recognized to provide us with the adequate picture of the fundamental interactions. The gauge approach to the gravitation interaction establishes two main features of gravity as a physical field.

Gravitation phenomena are described by two geometric fields. These are an Einstein (tetrad or metric) gravitational field and a Lorentz connection. A Lorentz connection plays the role of a gauge gravitational potential induced by a gauge potential of fermion fields.

An Einstein gravitational field is a Higgs field which accompanies the spontaneous breaking of world symmetries. This spontaneous breaking takes place because of the coexistence of the Dirac fermion matter with exact Lorentz symmetries and the world geometric arena. Moreover, in contrast with Higgs fields of the Grand Unification models, Einstein gravitational field is a macroscopic Higgs field due to the peculiarity of gauge world transformations.

This book concerns only the gauge theory of the classical gravity. In the algebraic quantum theory, Higgs fields characterize nonequivalent Gaussian states on the algebras of quantum fields. They are "fictitious" fields describing collective phenomena. These fields fail to be quantized in the framework of the conventional quantum field theory. The Higgs nature of gravity therefore may open the door to many unexpected quantum effects.

Our formulation of gauge theory uses the machinery of modern differential geometry. Preliminary and Chapter 1 of this book are intended as an introduction to the jet bundle formalism and to the geometric theory of classical fields. In this book, we consider those aspects of gauge theory which explain local phenomena, although the theory itself is formulated in global terms.