



Canonical Quantum Gravity: Fundamentals and Recent Developments

By Francesco Cianfrani, Orchidea Maria Lecian, Matteo Lulli, Giovanni Montani

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This book aims to present a pedagogical and self-consistent treatment of the canonical approach to Quantum Gravity, starting from its original formulation to the most recent developments in the field.

We start with a rapid and original introduction to the formalism and concepts on which General Relativity has been built up, giving all the information necessary in the later analysis. The Lagrangian approach to the Einsteinian Theory is then presented in some detail, underlining the parallelism with non-Abelian gauge theories. Then the basic concepts of the canonical approach to Quantum Mechanics are provided, focusing on all those formulations which are relevant for the Canonical Quantum Gravity problem. The Hamiltonian formulation of General Relativity and its constrained structure is then analyzed by comparing different formulations and the resulting quantum dynamics, described by the Wheeler DeWitt equation, is fully discussed in order to outline its merits and limits. Then, the reformulation of the Canonical Quantum Gravity in terms of the Ashtekar Barbero Immirzi variable is faced, by a detailed and complete discussion of the resulting Loop Quantum Gravity Theory. Finally, we provide a consistent picture of canonical Quantum Cosmology, by facing the main features of the Wheeler De Witt equation for the homogeneous Bianchi models and then by a detailed treatment of Loop Quantum Cosmology, including very recent developments.

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