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Quantum gravity is among the most fascinating problems in physics. It modifies our understanding of time, space and matter. The recent development of the loop approach has allowed us to explore domains ranging from black hole thermodynamics to the early universe.

This book provides readers with a simple introduction to loop quantum gravity, centered on its covariant approach. It focuses on the physical and conceptual aspects of the problem and includes the background material needed to enter this lively domain of research, making it ideal for researchers and graduate students.

Topics covered include quanta of space gauge theory, classical and quantum physics without time, tetrad formalism, Holst action, lattice gauge theory, Regge calculus, ADM and Ashtekar variables, Ponzano–Regge and Turaev–Viro amplitudes, kinematics and dynamics of 4d Lorentzian quantum gravity, spectrum of area and volume, coherent states, classical limit, matter couplings, graviton propagator, spinfoam cosmology and black hole thermodynamics.

Carlo Rovelli is Professor of Physics at Aix-Marseille Université, where he directs the gravity research group. He is one of the founders of loop quantum gravity.

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