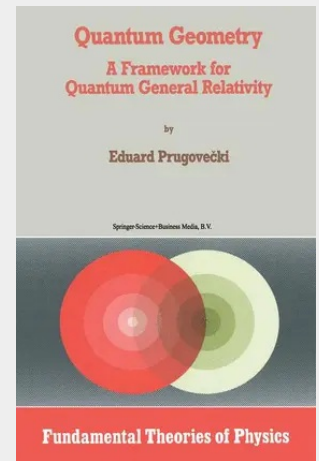


Quantum Geometry

A Framework for Quantum General Relativity

The present monograph provides a systematic and basically self-contained introduction to a mathematical framework capable of incorporating those fundamental physical premises of general relativity and quantum mechanics which are not mutually inconsistent, and which can be therefore retained in the unification of these two fundamental areas of twentieth century physics. Thus, its underlying thesis is that the equivalence principle of classical general relativity remains true at the quantum level, where it has to be reconciled, however, with the uncertainty principle. As will be discussed in the first as well as in the last chapter, conventional methods based on classical geometries and on single Hilbert space frameworks for quantum mechanics have failed to achieve such a reconciliation. On the other hand, foundational arguments suggest that new types of geometries should be introduced. The geometries proposed and studied in this monograph are referred to as quantum geometries, since basic quantum principles are incorporated into their structure from the outset. The mathematical tools used in constructing these quantum geometries are drawn from functional analysis and fibre bundle theory, and in particular from Hilbert space theory, group representation theory, and modern formulations of differential geometry. The developed physical concepts have their roots in nonrelativistic and relativistic quantum mechanics in Hilbert space, in classical general relativity and in quantum field theory for massive and gauge fields.

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