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Which mathematics for quantum gravity ?

Since (at least) Plato, the world is described with mathematics and their « unreasonable effectiveness » appeared more and more clearly in the recent developments of physics. One of the challenge of present physics is to build a theory of quantum gravity. This search is very active but we do not know in which extent the mathematical tools used for gravity (mainly Riemannian Geometry), dynamics (symplectic geometry) and quantum physics (algebra, group theory...) may remain relevant for this task. On the other hand, mathematics have exhibited correspondences, dualities and various links between these distinct branches, and physicists have proposed different reformulations of a given theory in different frameworks.

I will review some of the various mathematical tools involved in these formulations of gravity, quantum physics and Loop quantum gravity. I will insist on their relations and correspondences, and present the possible benefits that new mathematical approaches (in particular category theory) can bring.