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Unweaving the fabric of the Universe

Our conventional understanding of space-time, as well as our notion of geometry, break down when we discuss the very early Universe. In the description of the extreme physical conditions near the Big Bang, the interplay between physics and mathematics becomes more necessary than ever.

The main challenge is the construction of a theory of quantum gravity, the long-sought unification of Einstein's general relativity with quantum mechanics. Such a theory is supposed to describe the evolution of the very early Universe.

Of course, theoretical models have to be tested against the various experimental and observational results coming from high energy physics and astrophysics, leading to a remarkable interplay between gravity, particle physics and cosmology.

Among the various quantum gravity proposals are those inspired from string theory, loop quantum gravity and noncommutative geometry, which I will briefly discuss.