

.....I offer the following scenario of how the present revolution in physics will end.

- Some version of string theory will remain the right description at the level of approximation at which there are quantum objects moving against a classical spacetime background. But the fundamental theory will look nothing like any of the existing string theories.
- Some version of the holographic principle will turn out to be right, and it will be one of the foundational principles of the new theory. But it will not be the strong version of the principle I discussed in Chapter 12.
- The basic structure of loop quantum gravity will provide the template for the fundamental theory. Quantum states and processes will be expressed in diagrammatic form, like the spin networks. There will be no notion of a continuous geometry of space or spacetime, except as an approximation. Geometrical quantities, including areas and volumes, will turn out to be quantized, and to have minimum values.
- A few of the other approaches to quantum gravity will turn out to play significant roles in the final synthesis. Among them will be Roger Penrose's twistor theory and Alain Connes's non-commutative geometry. These will turn out to give essential insights into the nature of the quantum geometry of spacetime.
- The present formulation of quantum theory will turn out to be not fundamental. The present quantum theory will first give way to a relational quantum theory of the kind I discussed in Chapter 3, which will be formulated in the language of topos theory. But after a while this will be reformulated as a theory about the flow of information among events. The final theory will be non-local or, better, extra-local, as space itself will come to be seen only as an appropriate description for certain kinds of universe, in the same way that thermodynamic quantities such as heat and temperature are meaningful only as averaged descriptions of systems containing many atoms. The idea of 'states' will have no place in the final theory, which will be framed around the idea of processes and the information conveyed between them and modified within them.
- Causality will be a necessary component of the fundamental theory. That theory will describe the quantum universe in terms of discrete events and their causal relations. The notion of causality will survive at a level in which space will no longer be a meaningful concept.
- The final theory will not be able to predict unique values for the masses of the elementary particles. The theory will allow a set of possible values for these and other quantities in fundamental physics. But there will be a rational, nonanthropic and falsifiable explanation for the values of the parameters we observe.
- We shall have the basic framework of the quantum theory of gravity by 2010, 2015 at the outside. The last step will be the discovery of how to reformulate Newton's principle of inertia in the language of a quantum spacetime. It will take many more years to work out all the consequences, but the basic framework will be so compelling and natural as to remain fixed, once it is discovered.
- Within ten years of having the theory new kinds of experiment will be invented which will be able to test it. And the quantum theory of gravity will make predictions about the early universe which will be tested by observations of radiation from the big bang, including the cosmic microwave background radiation and gravitational radiation.
- By the end of the twenty-first century, the quantum theory of gravity will be taught to high-school students all around the world.