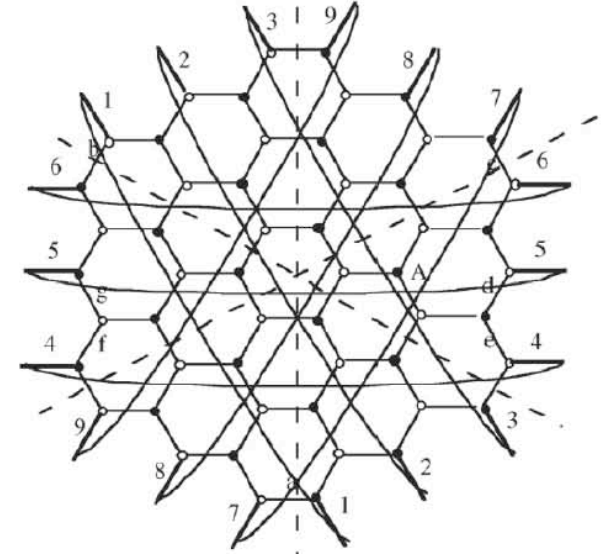
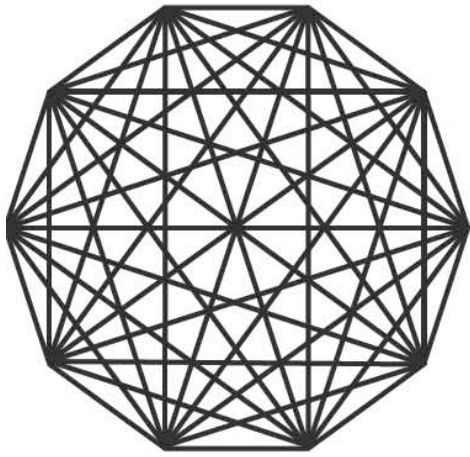


# Spacetime Puzzles in a Quantum World



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Our understanding of the physical world at the most fundamental level is based on two theories: quantum theory and general relativity. They are impressively successful but only when each is considered on its own. In situations where both play a role, we are reduced to puzzles and absurdity. Hence the search for a quantum theory of gravity, the currently missing theory that will work sensibly in exactly these situations.

To the great frustration of researchers in this field, candidate quantum theories of gravity tend to produce more puzzles instead of answers. We shall take a tour of some of the problems, focusing on the role of spacetime and causality.

Finally, we shall see how one can create a spacetime from a world with no notion of "here" and "there".



Fotini Markopoulou is faculty at the Perimeter Institute for Theoretical Physics, Waterloo, Ontario, Canada and Adjunct Professor of Physics at the University of Waterloo. Her research spans quantum gravity, quantum cosmology, discrete structure of space(time), and quantum computing. Born in Athens, Greece in 1971, she received her Ph.D. in theoretical physics from Imperial College, London, and has held postdoctoral positions at Pennsylvania State University, Imperial College, and the Albert Einstein/Max Planck Institute for Gravitational Physics, Berlin.

Markopoulou was recognized for a new formulation of quantum cosmology in which quantum theory is applied to a system that contains its own observers, such as the whole universe. For this work she was awarded first prize at the Young Researchers Competition in honor of J.A. Wheeler. She has also explored the role of causality in the quantum theory of gravity and developed methods to study the relationship between the quantum and classical theories of gravity.

Her work often involves introducing to quantum gravity ideas and methods from other fields. She has used the abstract mathematical methods of category theory to develop a new mathematical expression of causality. In her recent work, she is investigating how to represent the universe as a giant quantum computer.