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Dr. Elena Caceres

University of Texas at Austin

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Holography, quantum information and the nature of spacetime

Einstein's theory of general relativity is a bedrock of modern science. However, general relativity is not enough to describe the interior of black holes or the earliest stages of our universe. In both cases microscopic physics becomes relevant and we need a *quantum theory of gravity*. The formulation of such a theory is one of the fundamental problems in theoretical physics. The holographic principle, or holography for short, is a significant advance in this direction. The idea of an emergent spacetime, the geometrization of quantum field theory concepts and the relation of quantum gravity with quantum information are some of the ways in which holography has dramatically changed our understanding of theoretical physics and in particular of quantum gravity. The Anti de Sitter/ Conformal Field Theory (AdS/CFT) correspondence is a realization of the holographic principle. In the past, it has been extensively used as a tool to better understand strongly coupled theories. Currently, research on foundational questions in AdS/CFT offer fascinating glimpses into the nature of spacetime.
In this talk I will review these ideas and illustrate them with results on holographic entanglement entropy and a recently found scenario leading to traversable wormholes.

Department Contact Information
Veronica.Castellanos@utsa.edu
http://physics.utsa.edu