Classical and Quantum Picture of the Interior of Two-Dimensional Black Holes

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ABSTRACT

A quantum-mechanical description of black holes would represent the final step in our understanding of the nature of space-time. However, any progress towards that end is usually foiled by persistent space-time singularities that exist at the center of black holes. From the four-dimensional point of view, black holes seem to resist quantization. Under highly symmetric conditions, all higher-dimensional black holes are two-dimensional. Unlike their higher-dimensional counterparts, two dimensional black holes may not resist quantization. A non-trivial description of gravity in two dimensions is not possible using Einstein's theory of gravity alone. However, we may still arrive at a consistent description of gravity by introducing a scalar field known as the dilaton. In this thesis, we study both the classical and quantum aspects of the interior of two-dimensional black holes using a generalized dilaton-gravity theory. Classically, we will find that the interior of most two-dimensional black holes is not much different from that of four-dimensional black holes. But by introducing quantized matter into the theory, the fluctuations in space-time will give a different picture of the structure of interior of black holes. Using a low-energy effective field theory, we will show that it is indeed possible to identify quantum modes in the interior of black holes and perform quantum-mechanical calculations near the singularity.