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Semiclassical $S$-matrix and black hole entropy in dilaton gravity. (English) [Zbl 1454.83081]

Summary: We use complex semiclassical method to compute scattering amplitudes of a point particle in dilaton gravity with a boundary. This model has nonzero minimal black hole mass $M_{cr}$. We find that at energies below $M_{cr}$ the particle trivially scatters off the boundary with unit probability. At higher energies the scattering amplitude is exponentially suppressed. The corresponding semiclassical solution is interpreted as formation of an intermediate black hole decaying into the final-state particle. Relating the suppression of the scattering probability to the number of the intermediate black hole states, we find an expression for the black hole entropy consistent with thermodynamics. In addition, we fix the constant part of the entropy which is left free by the thermodynamic arguments. We rederive this result by modifying the standard Euclidean entropy calculation.

MSC:
83C80 Analogues of general relativity in lower dimensions
83C57 Black holes
83D05 Relativistic gravitational theories other than Einstein’s, including asymmetric field theories
83C45 Quantization of the gravitational field
81U20 $S$-matrix theory, etc. in quantum theory
81P17 Quantum entropies

Keywords:
black holes; 2D gravity; models of quantum gravity

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