

Black holes are among the most intriguing objects in the Universe. When isolated and stationary, they are described by the simple Kerr(-Newman) metric. However, astrophysical black holes are seldom isolated; in fact, we can only know of them through their interaction with the environment. Consequently, the actual gravitational field differs from the Kerr(-Newman) ideal. This thesis investigates the influence of the environment on the gravitational field of black holes. In the stationary (or static) and axially symmetric setting, we derive several analytical models describing a black hole surrounded by a disc or ring. The static problem is solved exactly, yielding the metric in closed form in some cases. Besides the basic physical properties of the results, we analyze the scalar-field quasinormal modes in such a deformed black-hole geometry. Our findings indicate a universal behaviour of the QNM response, which may help in distinguishing the environmental effects from those of modified theories of gravity. In the stationary case, we employ perturbation theory in the tetrad formalism. By introducing the Debye potential, we find the electromagnetic field of a ring source on the rotating black-hole background. We conclude with a discussion of similar treatment of gravitational perturbations.