Absorption of planar massless scalar waves by charged rotating black holes

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The existence of black holes has been intensively debated along many decades. Although a lot of indirect evidences that black holes are present in nature have been collected, e.g., Cygnus X-1, a stronger evidence of their existence was still demanded. Recently, it has been reported the detection of gravitational waves, what is remarkable, not only as a confirmation of one of the most important predictions of General Relativity, but also because the gravitational waves detected by LIGO Scientific Collaboration are claimed to have been produced by the merger of a binary black hole system. One way to investigate the nature of black holes is observing how they absorb and scatter particles and waves in their surroundings. Many works have been done in order to determine the absorption and scattering cross sections of black holes, considering different sorts of black hole solutions, particles, and waves as well. However, the absorption and scattering of scalar waves by Kerr-Newman black holes has not been investigated yet. We consider the case of a massless scalar plane wave impinging upon a rotating and charged black hole, computing the absorption cross section numerically. In the low-frequency limit we consider the general result obtained by Higuchi and for the high-frequency limit we consider the eikonal approach, using the geodesic equation to obtain the high-frequency absorption cross section. We show numerical results for different choices of the plane wave incidence angle, the rotation parameter and the electric charge of the black hole.