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Are eikonal quasinormal modes linked to the unstable circular null geodesics?

Abstract

In Phys. Rev. D 79, 064016 (2009) it was claimed that quasinormal modes which any stationary, spherically symmetric and asymptotically flat black hole emits in the eikonal regime are determined by the parameters of the circular null geodesic: the real and imaginary parts of the quasinormal mode are multiples of the frequency and instability timescale of the circular null geodesics respectively. We shall consider asymptotically flat black hole in the Einstein-Lovelock theory, find analytical expressions for gravitational quasinormal modes in the eikonal regime and analyze the null geodesics. Comparison of the both phenomena shows that the expected link between the null geodesics and quasinormal modes is violated in the Einstein-Lovelock theory. Nevertheless, the correspondence exists for a number of other cases and here we formulate its actual limits.