Gravitational radiation from a particle in circular orbit around a Schwarzschild black hole in a semiclassical framework

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Black holes (BHs) are important objects in General Relativity (GR). Their strong gravity regime provides a rich setting for the study of physical phenomena. Several aspects of the geometric structure of a BH, such as the presence of an event horizon, give rise to very interesting physical aspects, among which we can mention Hawking radiation, BH thermodynamics, frame-dragging effect, and many others. Despite the complexity related to these aspects, isolated BHs are rather simple objects, in the sense that they can be described by a small set of parameters: their mass, charge and angular momentum. Radiation settings in BH spacetimes are of particular importance, especially because the radiation observed can serve as a probe to the strong gravity regime and horizon physics. Both gravitational radiation and BHs are expected to play a central role in the quantum theory of gravity. Moreover, the recent observations of gravitational radiation from BH binaries indicate that other radiation settings are not experimentally out of reach. In this work, we analyze the gravitational radiation emitted by a test particle in stable and unstable circular orbits around a Schwarzschild BH. This simple model can be regarded as a first approximation to more complicated settings such as the radiation emitted due to accretion of matter by the BH. We compute the emitted power by using a semiclassical approach, i.e. we consider the gravitational perturbations as a quantized field in the background of a Schwarzschild spacetime.