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Quantization of gravitational perturbations in Schwarzschild spacetime

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Quantum field theory in curved spacetimes (QFTCS) considers quantum fields propagating in a background spacetime. Although being an effective theory, it can give satisfactory results in many cases of interest, particularly in some phenomena with energy well below Planck's scale. In QFTCS, gravity itself is not fully quantized, but we can consider gravitational perturbations as the quantum field that propagates in the background spacetime. For this, we apply perturbation theory to general relativity (GR) by considering approximate solutions (gravitational perturbations) that slightly deviate from an exact solution of Einstein's equation. Retaining terms only up to first order in the perturbation, we establish a linear theory for gravity. Upon quantization of these gravitational perturbations, we obtain a linear theory for a tensorial field of spin 2: the graviton. Black holes (BHs) are among the most important predictions of GR. These astrophysical objects are believed to be in the center of nearly all galaxies (including our own galaxy). Isolated BHs are rather simple objects, but their strong gravity provides a rich structure for several phenomena. Moreover, BHs play a major role in powerful astrophysical processes and galaxy formation. The way these objects interact with gravitational perturbation is an important subject of study. In this work, we consider quantum gravitational perturbations in the background spacetime of an spherically symmetric uncharged BH, the Schwarzschild spacetime. We use a gauge-invariant formalism to describe the perturbations at the classical level. By fixing the gauge, we can quantize the perturbations by using an algebraic approach.